

Series II

# WORKSHOP MANUAL

FOR PETROL  
AND DIESEL  
MODELS

---

88

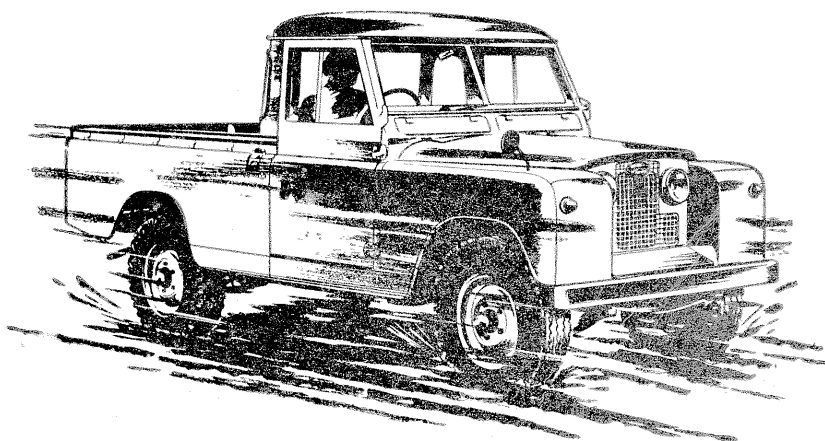
---

and

---

109

---



THE ROVER CO. LTD . SOLIHULL . WARWICKSHIRE . ENGLAND

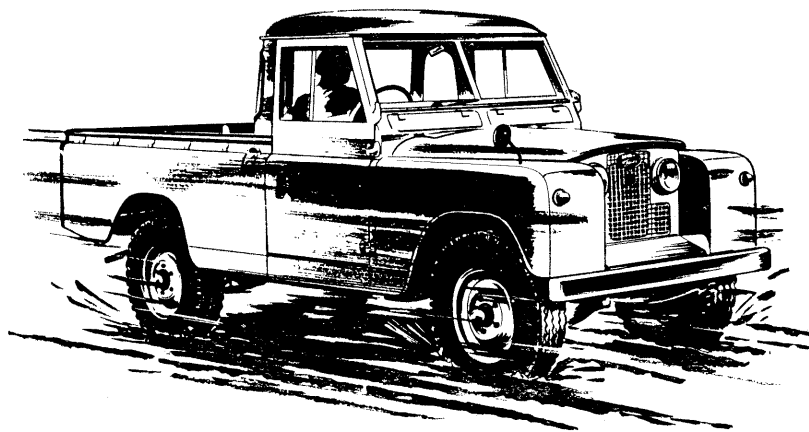
PART No. 4220



Series II

# WORKSHOP MANUAL

FOR PETROL  
AND DIESEL  
MODELS



---

88

---

and

---

109

---

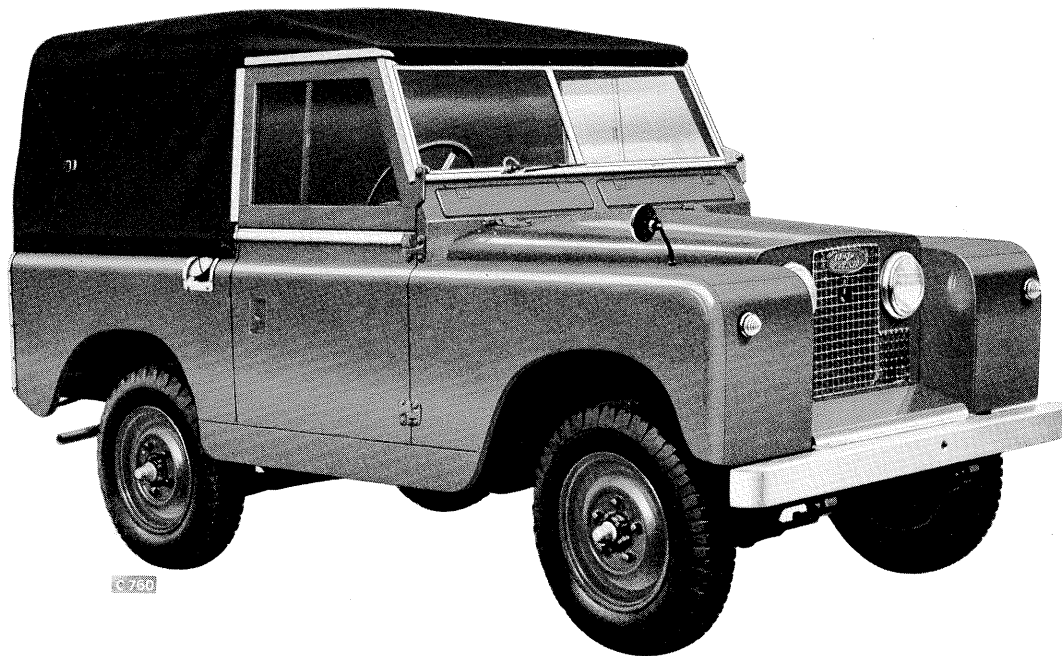
*By Appointment to  
Her Majesty  
Queen Elizabeth II*



*Manufacturers  
of  
Land-Rovers*

THE ROVER CO. LTD . SOLIHULL . WARWICKSHIRE . ENGLAND





Land-Rover Series II 88 model



Land-Rover Series II 109 model

## COMMENCING VEHICLE NUMBERS

### PETROL MODELS

	88 All models	109 basic	109 Station Wagon
Basic Vehicle Home	141800001 onwards	151800001 onwards	161900001 onwards
Basic Vehicle L.H.D. Export	144800001 onwards	154800001 onwards	164900001 onwards
Basic Vehicle R.H.D. Export	142800001 onwards	152800001 onwards	162900001 onwards
C.K.D. L.H.D. Export	145800001 onwards	155800001 onwards	165900001 onwards
C.K.D. R.H.D. Export	143800001 onwards	153800001 onwards	163900001 onwards

### DIESEL MODELS

	88 All models	109 basic	109 Station Wagon
Basic Vehicle Home	146800001 onwards	156800001 onwards	166900001 onwards
Basic Vehicle L.H.D. Export	149800001 onwards	159800001 onwards	169900001 onwards
Basic Vehicle R.H.D. Export	147800001 onwards	157800001 onwards	167900001 onwards
C.K.D. L.H.D. Export	150800001 onwards	160800001 onwards	170900001 onwards
C.K.D. R.H.D. Export	148800001 onwards	158800001 onwards	168900001 onwards

*Please note that all prices and specifications are subject to alteration without notice*

## THE ROVER COMPANY LTD.

SOLIHULL, WARWICKSHIRE, ENGLAND

SERVICE AND SPARES DEPT.:  
SOLIHULL, WARWICKSHIRE  
ENGLAND

Telephone: SHEldon 4242      Telegrams: Rovrepair, Solihull, England  
Telex: 33-156

LONDON SERVICE STATION:  
SEAGRAVE ROAD, FULHAM  
LONDON S.W.6 ENGLAND

Telephone: FULham 1221      Telegrams: Rovrepair, Wesphone,  
London, England

PART No. 4220

**2nd Edition**

DECEMBER, 1958

Revised February 1961



# Introduction

This Workshop Manual is designed to assist those responsible for the maintenance and overhaul of the Land-Rover.

The subject matter is sectionised as detailed in the index on the next page, and the pages are numbered within those sections. At the beginning of each section will be found a sub-index for that section.

## NOMENCLATURE

As this manual covers both right- and left-hand drive models, reference is made throughout the text to the "left-hand" and "right-hand" sides of the vehicle, rather than to the "near-side" and "off-side". The "left-hand" side is that to the left hand when the vehicle is viewed from the rear; similarly, "left-hand drive" models are those having the driving controls on the left-hand side, again when the vehicle is viewed from the rear.

## CAPACITIES

All capacities are quoted in Imperial and Metric measure; to ascertain the U.S. equivalent, multiply the Imperial figure by 1.2.

## MEASUREMENTS

All measurements are given in Imperial measure; the Metric equivalent is added where possible, but in certain cases, such as cylinder rebore sizes, this is of course not practicable, and the Imperial figure must be used.

## VEHICLE SERIAL NUMBERS

The vehicle serial number will be found on the transfer box instruction plate on the dash panel over the gearbox cover. It is the same as the chassis number, which is stamped on the right-hand front spring shackle bracket.

Note that this re-issue incorporates all Workshop Manual information appertaining to Land-Rovers circulated by means of combined Rover Service News Letters numbered up to 117 and Land-Rover Service News Letters numbered up to 8.

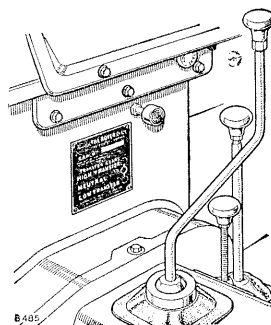


Fig. 1.  
Vehicle serial number

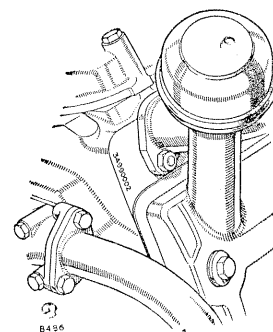


Fig. 2.  
Engine serial number  
2 litre

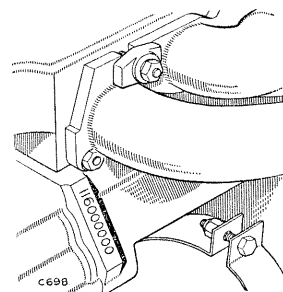


Fig. 3.  
Engine serial number  
2½ litre and Diesel

The full vehicle serial number must be quoted in all correspondence; the registration number of the vehicle is of no use whatever to us.

The engine serial number, which need not be quoted in correspondence unless specifically asked for, is stamped on the left-hand side of the cylinder block at the front.

Other units bear serial numbers as detailed below, but they should not be quoted unless specifically requested:—

Gearbox number: Right-hand side of gearbox casing.

Rear axle: On top of axle casing on left-hand side.

Front axle: On top of axle casing on left-hand side.

# Index to Sections

See section title pages for detailed operation indexes

Section	Title	Pages
A	ENGINE 2 litre petrol ..... 2 $\frac{1}{4}$ litre petrol ..... 2 litre diesel .....	A-1 to A-18 A-19 to A-36 A-37 to A-57
AO	LUBRICATION SYSTEM .....	AO-1 to AO-8
A2	VIBRATION DAMPER .....	A2-1 to A2-2
B	CLUTCH .....	B-1 to B-14
C	GEARBOX .....	C-1 to C-27
D	PROPELLER SHAFTS .....	D-1 to D-4
E	REAR AXLE .....	E-1 to E-5
F	FRONT AXLE .....	F-1 to F-17
G	STEERING AND LINKAGE....	G-1 to G-9
H	BRAKE SYSTEM .....	H-1 to H-17
J	SUSPENSION .....	J-1 to J-4
K	CHASSIS .....	K-1 to K-3
L	COOLING SYSTEM....	L-1 to L-8
M	FUEL SYSTEM .....	M-1 to M-31
N	EXHAUST SYSTEM .....	N-1 to N-2
P	ELECTRICAL SYSTEM .....	P-1 to P-24
Q	INSTRUMENTS AND CONTROLS .....	Q-1 to Q-10
R	BODY .....	R-1 to R-14
S	WHEELS AND TYRES .....	S-1 to S-4
T	EXTRA EQUIPMENT .....	T-1 to T-52
V	RECLAMATION SCHEMES .....	V-1 to V-2

# Detailed Index

Component	Section	Component	Section
Air cleaner	M	Brake, transmission	H
Air cleaner support	K	Brakes, foot	H
Accelerator pedal and linkage	Q	Brush gear dynamo	P
Accelerator pedal housing	Q	Brush gear starter motor	P
Accelerator pump carburetter	M	Bump rubber, road spring	J
Accelerator shaft	Q	Bumper, front	K
Adaptor, distributor, 2½ litre	A	Cab	R
Adaptor, external oil filter	A	Cable clips	P
Adaptor, power-take-off	T	Cable, fuel tank	P
Adjuster, timing chain	A	Cable harness, dash	P
Alternator	T	Cable harness, frame	P
Ammeter	Q	Cable harness, headlamp	P
Anchor plate, brake, foot	H	Cable harness, main	P
Anchor plate, brake, hand	H	Cable, speedometer	Q
Approved lubricants	AO	Cables, high tension	P
Apron, front	R	Camshaft	A
Arm, drop	G	Camshaft bearing	A
Arms, steering	F	Camshaft chain	A
Attachments, towing	T	Camshaft chain adjuster	A
Axle casing oil seal	F	Capacity, cooling system	L
Axle, front	F	Capacity, lubrication system	AO
Axle, rear	E	Capstan winch, front	T
Axle shaft, rear	E	Carburetter	M
Axles, stub	F	Carrier, battery	K
		Carrier, spare wheel (on bonnet)	T
Back leakage, fuel	M	Casing, gearbox	C
Back light, cab	R	Catch, bonnet	R
Back rest, rear seat	T	Centre cover panel	R
Back rest, seat	R	Centre power take-off	T
Balance weight, road wheel	S	Chaff guard	L
Batteries	P	Chain, tailboard	R
Battery and air cleaner support	K	Chain, timing	A
Bearings, camshaft	A	Change speed lever, main	C
Bearings, centre propeller shaft, 109	D	Change speed lever, transfer	C
Bearings, connecting rod	A	Chassis frame	K
Bearings, gearbox	C	Check strap, rear spring	J
Bearings, main	A	Cleaner, air	M
Bearings, steering column thrust	G	Clutch cylinder, master	B
Bearings, swivel pin	F	Clutch cylinder, slave	B
Bearings, transfer box	C	Clutch unit	B
Bearings, valve rockers	A	Clutch linkage	B
Belt, fan	A & L	Clutch pedal unit	B
Bell housing	C	Clutch plate	B
Board, tail	R	Clutch operating levers	B
Body, rear	R	Clutch withdrawal mechanism	B
Body mounting	R	Coil, ignition	P
Body repairs	R	Connecting rods	A
Body sides	R	Control box, voltage	P
Bonnet	R	Control, mixture	Q
Bonnet carrier for spare wheel	T	Control tube, steering	G
Bonnet catch	R	Control quadrant, engine governor	T
Brake cylinder, master	H	Control quadrant, engine speed, 2½ litre	T
Brake cylinder, wheel	H	Control quadrant, engine speed, Diesel	Q
Brake drum, foot	H	Cooler, oil	T
Brake drum, hand	H	Cooling system	L
Brake, hand	H	Cover, gearbox	R
Brake lever, hand	H	Cover plate, universal joint	T
Brake pedal	H	Cover plate, wing valance	R
Brake pipes	H	Crankcase sump	A
Brake shoe, foot	H	Crankshaft	A
Brake shoe, hand	H	Cushion, seat	R
Brake supply tank	H		

Component	Section	Component	Section
Cushion, seat, rear	T	Flashing indicators	T
Cut-off control	Q	Floor, front	R
Cylinder block	A	Flywheel	A & B
Cylinder, brake, master	H	Flywheel reclamation	V
Cylinder, brake, wheel	H	Foot pedal	H
Cylinder, clutch, master	B	Frame alignment	K
Cylinder, clutch, slave	B	Frame harness	P
Cylinder head	A	Front axle	F
Cylinder liners	A	Front axle half shaft	F
		Front bumper	K
Damper, vibration	A2	Front capstan winch, mechanical	T
Dampers, hydraulic	J	Front exhaust pipe	N
Dash panel	R	Front hub	F
Data, axles	E & F	Front hydraulic winch	T
Data, brakes	H	Front output shaft	C
Data, clutch	B	Front shock absorber	J
Data, coolant system	L	Front wing	R
Data, electrical	P	Fuel, gauge, instrument panel	Q
Data, engine	A	Fuel level unit	P
Data, extras	T	Fuel pump, 2 litre petrol	M
Data, fuel	M	Fuel pump, 2½ litre petrol and diesel	M
Data, gearbox	C	Fuel tank	M
Data, lubrication	AO	Fuse box	P
Data, steering	G		
Data, suspension	J	Gauge unit, fuel tank	P
Decarbonising	A	Gearbox	C
Differential, front	F	Gearbox bearings	C
Differential pinion oil seal	F	Gearbox cover	R
Differential, rear	E	Gearbox units, power take-off	T
Dip switch	P	Gear change levers	C
Distributor	P	Gears, main gearbox	C
Distributor housing	A	Gears, rear power take-off	T
Door	R	Gears, transfer box	C
Door hinges	R	Glass, hard top, cab	R
Door locks	R	Glass, windscreen	R
Doors and fittings	R	Governor, engine	T
Drag link	G	Grille, radiator	R
Drawbar, rear	K	Grommet, bell housing	C
Driven plate, clutch	B	Gudgeon pins	A
Driving shaft, front axle	F		
Drop arm	G	Half shaft	F
Drum, foot brake	H	Hand brake	H
Drum, hand brake	H	Hand throttle	T
Dynamo	P	Hard top	R
		Harness, dash	P
Engine	A	Harness, frame	P
Engine governor	T	Harness, main	P
Engine support, front	A	Headlamps	P
Engine support, rear	C	Heater plugs	P
Exhaust manifold	A	Heater unit	T
Exhaust pipe, front	N	Hinge, bonnet	R
Exhaust rocker shaft	A	Hinge, door	R
Exhaust silencer	N	Hinge, locker lids	R
Exhaust valves	A	Hinge, ventilator	R
Extra equipment	T	Hood, full length	T
		Hood socket	T
Fan	L	Hood stick	T
Fan belt	A & L	Hood, three-quarter length	T
Fan driving pulley	A	Horn	P
Fastener, windscreen	R	Horn button	P
Filler cap, petrol	M	Hot spot	A
Filter, fuel pump	M	Housing, accelerator pedal	Q
Filter, injection pump	M	Housing, clutch withdrawal	B
Filter, oil external	AO	Housing, distributor	A
Filter, oil internal	AO	Housing, front output	C
Filters, fuel oil	M	Housing, rear mainshaft bearing	C
Fire fighting equipment	T		

<i>Component</i>	<i>Section</i>	<i>Component</i>	<i>Section</i>
Housing, universal joint ....	F	Oil seal, pinion housing ....	F
Housings, swivel pin ....	F	Oil seal, swivel pin housing ....	F
Hub, front ....	F	Operating levers, clutch ....	B
Hydraulic dampers ....	J	Output shaft, front ....	C
Ignition switch ....	Q	Paint, touch-up process ..	R
Ignition timing ....	A	Panel light switch ....	Q
Indicators, flashing ....	T	Panel lights ....	Q
Inlet manifold ....	A	Pedal, accelerator ....	Q
Inlet rocker shaft ....	A	Pedal, brake ....	H
Inlet valves ....	A	Pedal, clutch ....	B
Injection nozzle....	M	Petrol level gauge ....	Q
Injection pump ....	M	Petrol pipes ....	M
Inner tubes ....	S	Petrol pump ....	M
Instruments ....	Q	Petrol sediment bowl ....	M
Lamp, head ....	P	Petrol tank ....	M
Lamp, number plate ....	P	Petrol tank level unit ....	P
Lamp, rear ....	P	Pins, gudgeon ....	A
Lamp, side ....	P	Pins, shackle ....	J
Lamp, stop ....	P	Pins, swivel ....	F
Lamp switch ....	Q	Pipes, brake ....	H
Layshaft ....	C	Pistons ....	A
Level gauge, fuel ....	Q	Plate clutch drive, starter....	P
Level unit, fuel tank ....	M	Plate, toe ....	R
Lever, change speed, main ....	C	Plate, tow ....	T
Lever, change speed, transfer ....	C	Plug, heater, Diesel ....	M
Lever, hand brake ....	H	Plug, hot, Diesel ....	A
Lever, steering relay ....	G	Plugs, sparking ....	A
Levers, steering....	F	Power take-off, centre ....	T
Light, warning, instrument panel ....	Q	Power take-off, gearbox units ....	T
Liners, cylinder....	A	Power take-off, rear ....	T
Link, drag ....	G	Power take-off, rear pulley ....	T
Linkage, accelerator ....	Q	Priming fuel system ....	M
Linkage, clutch ....	B	Propeller, shaft, front ....	D
Linkage, hand brake ....	H	Propeller shaft joint cover plates ....	T
Linkage, steering ....	G	Propeller shaft, power take-off ....	D & T
Lock, door ....	R	Propeller shaft, rear ....	D
Lock stop, steering ....	F	Pulley, power take-off ....	T
Longitudinal tube, steering ....	G	Pump, accelerator ....	M
Lubricants, recommended ....	AO	Pump, fuel ....	M
Lubricating system ....	AO	Pump, oil ....	A
Main bearings ....	A	Pump, water ....	L
Main gear change lever ....	C	Radiator ....	L
Mainshaft bearing housing, rear ....	C	Radiator grille panel ....	R
Mainshaft, gearbox ....	C	Rear axle ....	E
Manifold, exhaust ....	A	Rear axle shaft ....	E
Manifold, inlet ....	A	Rear body ....	R
Master cylinder, brake ....	H	Rear capstan winch ....	T
Master cylinder, clutch ....	B	Rear drawbar ....	K
Mixture control ....	Q	Rear drive pulley ....	T
Mixture control thermostat switch ....	P	Rear lid, hard top ....	R
Mounting, body ....	R	Rear number plate lamp ....	P
Mountings, engine ....	A & C	Rear power take-off ....	T
Nozzle, cleaning ....	M	Rear seats ....	T
Nozzle, flushing....	M	Reboring, petrol models ...	A
Nozzle, injection ....	M	Recommended lubricants....	AO
Nozzle, testing ....	M	Relay unit, steering ....	G
Number plate lamp ....	P	Relief valve, oil ....	A
Oil cooler ....	T	Resistance, heater plugs ....	P
Oil filter, external ....	A	Reverse stop, gearbox ....	C
Oil filter, internal ....	A	Rings, piston ....	A
Oil pressure gauge ....	T	Riveting body panels ....	R
Oil pressure release valve....	A	Road spring, front ....	J
Oil pump ....	A & AO	Road spring, rear ....	J
Oil seal, axle casing ....	F	Road wheels ....	S
		Rocker shafts ....	A



Component	Section	Component	Section
Rod, connecting	A	Switch, panel lights	Q
Rod, hand brake	H	Switch, starter	P
Rod, track	G	Switch, stop lamp	P
Roof, hard top	R	Swivel pin housings	F
Roof, tropical	R	Swivel pins	F
Rubber grommet, electrical	P	Synchronising clutch	C
Seat base	R	Tailboard	R
Seat cushions	R	Tailboard chain	R
Seats, rear	T	Tail lamps	P
Seats, standard vehicle	R	Tank, clutch and brake supply	B & H
Sediment bowl, fuel	M	Tank, fuel	M
Selector, four-wheel drive	C	Tappet adjustment	A
Selector, power take-off	T	Thermostat	L
Selector shaft, gear	C	Throttle control, hand	T
Shackle pins	J	Thrust bearings, crankshaft	A
Shaft, brake lever	H	Timing	A
Shaft, front axle	F	Timing chain tensioner	A
Shaft, gearbox selector	C	Toe plates	R
Shaft, output, front	C	Towing jaws	T
Shaft, propeller, front	D	Tow plates	T
Shaft, propeller, power take-off	D	Track rod	G
Shaft, propeller, rear	D	Transfer box	C
Shaft, rear axle	E	Transfer shaft housing	C
Shafts, rocker	A	Transmission brake	H
Shock absorber, front	J	Tropical roof panel, hard top and cab	R
Shock absorber, rear	J	Tyre pressures	S
Shoe, foot brake	H	Tyres	S
Shoe, hand brake	H	Units, power take-off	T
Side lamps	P	Universal joint cover plates	T
Side screen	R	Universal joint, front half shaft	F
Silencer, exhaust	N	Universal joint housing	F
Sleeve, clutch withdrawal	B	Valve guides	A
Solenoid, starter motor	P	Valve rocker shafts	A
Spare wheel carrier (on bonnet)	T	Valve seats, exhaust	A
Sparkling plugs	A	Valve timing	A
Speedometer	Q	Valves	A
Speedometer cable	Q	Valves, fuel pump, 2 litre petrol	M
Speedometer drive	Q	Valves, fuel pump, 2½ litre petrol and diesel	M
Spray for, Diesel nozzle	M	Vehicle heater	T
Spring, road, front	J	Ventilator, windscreen	R
Spring, road, rear	J	Vertical drive shaft gear	A
Starter drive	P	Vibration damper	A2
Starter motor	P	Voltage regulator	P
Starter switch	P	Warning lights, instrument panel	Q
Steering column thrust bearing	G	Water pump	L
Steering drag link	G	Water temperature gauge	T
Steering longitudinal tube	G	Wheel alignment	G
Steering relay unit	G	Wheel brakes	H
Steering track rod	G	Wheel cylinder, brake	H
Steering unit	G	Wheel, steering	G
Steering wheel	G	Wheel support, spare (on bonnet)	T
Stop lamp switch	P	Wheels, road	S
Stop lamps	P	Winch, capstan, front	T
Stub axles	F	Window glass, hard top	R
Stub shaft	F	Windscreen	R
Sump, crankcase	A	Windscreen fastener	R
Sump filter	A	Windscreen ventilator	R
Supply tank, brake and clutch	B & H	Windscreen wiper	P
Support, air cleaner	K	Windstone horn	P
Support, engine front	A	Wing, front	R
Support, engine rear	C	Wing valance cover plate	R
Support, spare wheel	T	Wiring diagram, flashers and trailers	T
Switch, dip	P	Wiring diagram, general	P
Switch, direction indicator	T	Withdrawal mechanism, clutch	B
Switch, ignition	Q		
Switch, lamps	Q		

# Section A—ENGINE—2 LITRE—PETROL

## INDEX TO OPERATIONS WITH ENGINE REMOVED

	Page		Page
Camshaft and bearings, to remove and refit	.... A-4 and 10	Data	.... A-17, 18 and 19
Camshaft chainwheels, to remove and refit	.... A-3 and 10	Defect location	.... A-16
Connecting rods, bearing and pistons, to remove and refit....	.... A-4 and 6	Engine removal and replacement	.... A-2 and 13
Crankshaft, bearings and seals, to remove and refit	.... A-4 and 8	Engine to overhaul, complete	.... A-2 to 13
Cylinder head and rocker shaft, to remove and refit....	.... A-3 and 12	Ignition timing	.... A-13
		Reboring and fitting cylinder liners	.... A-6
		Tappet adjustment	.... A-13
		Timing valves	.... A-10
		Timing ignition	.... A-13

THE INDEX TO OPERATIONS WITH ENGINE IN THE CHASSIS IS ON PAGE 14

## LIST OF ILLUSTRATIONS

Fig.	Page	Fig.	Page
A-1 Distributor housing location bolt	.... A-2	A-17 Checking crankshaft end-float	.... A-8
A-2 Oil pressure relief valve	.... A-3	A-18 Guide in position on cylinder block (oil seals)	.... A-8
A-3 Timing chain and tensioner	.... A-3	A-19 Crankshaft two-piece oil seal	.... A-9
A-4 Clip for timing chain tensioner	.... A-3	A-19a Crankshaft three-piece oil seal	.... A-9
A-5 Removing camshaft chainwheel	.... A-4	A-20 Checking flywheel run-out....	.... A-10
A-6 Exhaust rocker shaft location bolts	.... A-4	A-21 Camshaft bearing location bolts	.... A-10
A-7 Camshaft bearing location bolts	.... A-4	A-22 Exhaust valve fully open position	.... A-11
A-8 Fitting exhaust valve guide	.... A-5	A-23 Timing chain and tensioner	.... A-11
A-9 Protection plate	.... A-5	A-24 Oil pressure relief valve	.... A-12
A-10 Fitting exhaust valve seat	.... A-5	A-25 Drilling oil feed holes, inlet rockers	.... A-12
A-11 Fitting cylinder liner	.... A-6	A-26 Tightening cylinder head bolts	.... A-12
A-12 Reboring, jig block	.... A-6	A-27 Tappet adjustment	.... A-13
A-13 Checking piston clearance	.... A-6	A-28 Removing gudgeon pin	.... A-14
A-14 Checking piston ring gap	.... A-7	A-29 Fitting gudgeon pin	.... A-14
A-15 Checking big-end bearing nip	.... A-7	A-30 Flywheel housing drain plug	.... A-15
A-16 Checking main bearing nip	.... A-8		

## ENGINE REMOVAL AND DISMANTLING PROCEDURE

### Removing engine

### Operation A/2

1. If fitted, remove the spare wheel from bonnet panel.
2. Remove the bonnet panel.
3. Disconnect the battery leads.
4. Disconnect the air intake pipe from the carburetter and remove air cleaner.
5. Drain the coolant from system (one tap at bottom L.H. side of radiator and one tap at L.H. side of cylinder block).
6. Disconnect the side lamp leads at snap connectors at each side of the grille panel assembly and the front lamp harness from the junction box at R.H. side of scuttle, then pull the wiring clear to front of engine.
7. Detach the top hose at radiator header tank and the bottom hose from water pump inlet.
8. Remove the fan blades.
9. Remove the bolts securing the front apron and remove. Remove the bolts securing the grille panel to the front cross member and front wings.
10. Lift the radiator, grille panel and headlamps assembly upward, then forward to clear the vehicle.
11. Disconnect the exhaust pipe from exhaust manifold.
12. Disconnect the heater pipes (if fitted) at the engine side of scuttle.
13. Disconnect the petrol pipe at carburetter.
14. Disconnect the throttle return spring, throttle linkage (at a ball joint) and the cold start control cable at carburetter and clamp. If fitted, disconnect the hand speed control cable.
15. Disconnect:  
Dynamo wiring; ignition coil leads; starter lead from switch; oil pressure switch wire; mixture control switch wire (at rear of cylinder head).
16. Secure a sling to the engine and with suitable lifting tackle just take the strain.
17. Disconnect the clutch slave cylinder hose at bracket mounted on scuttle.
18. Remove the front floor and gearbox cover.
19. Support the gearbox assembly with a jack or packing blocks.
20. Remove the three nuts and washers securing the clutch slave cylinder bracket to the flywheel housing and pull the complete assembly as far back as possible.
21. Remove the remaining nuts and washers securing the gearbox to the flywheel housing.
22. Remove the bolts from engine front support brackets and allow the engine to move forward and thus clear the gearbox input shaft. Ensure

that the speedometer cable and all wires, etc., are clear, then hoist the engine gently from the vehicle.

23. Drain the oil and remove sump.
24. Bolt the engine to a suitable stand, securing by the sump fixing studs.

## DISMANTLING ENGINE

### Externals

### Operation A/4

1. Disconnect the accelerator linkage (at a ball joint), distributor vacuum pipe and remove carburetter. Detach sparking plug covers and leads, remove locating screw and withdraw the distributor. Remove sparking plugs.  
See Section M for overhaul of carburetter, and Section P for overhaul of distributor.
2. Remove the exhaust manifold.
3. If fitted, disconnect the heater pipe and flow control tap from cylinder head.
4. Remove the inlet and exhaust rocker covers.
5. Remove the dynamo and starter motor.  
See Section P for overhaul of dynamo and starter.
6. Disconnect the oil feed pipe—gallery to cylinder head.
7. Remove the dipstick and tube.
8. Remove the external full flow oil filter complete.  
See Section AO for details of oil filter.
9. Remove the starter dog, using spanner Part No. 263055 and withdraw the vibration damper complete.  
See Section A-2 for overhaul of vibration damper.
10. Remove the clutch, flywheel and housing.  
See Section B for overhaul of clutch and flywheel.

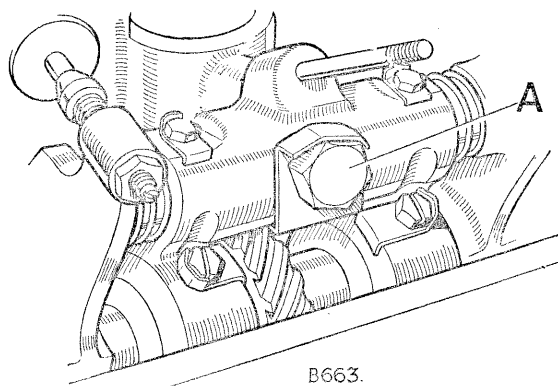


Fig. A-1—Distributor housing location bolt

A—Distributor housing location bolt

**Oil pump drive shaft, to remove****Operation A/6**

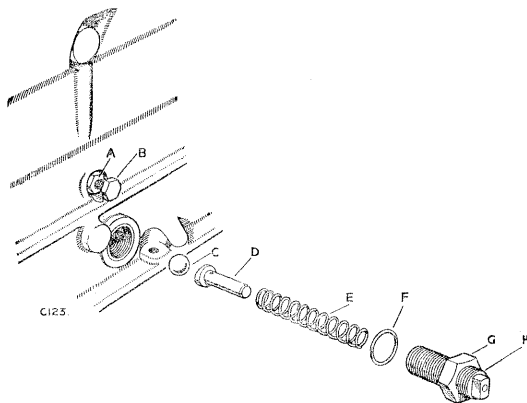
1. Remove the hollow bolt locating the distributor housing. Withdraw the distributor housing, and remove oil pump drive shaft. Fig. A-1.

**Oil pump, to remove****Operation A/8**

1. Slacken the locknut securing oil pressure adjusting screw, then remove screw, washer, spring, plunger and ball (which may remain in the pump and can be removed when the pump complete is withdrawn).

2. Remove the pump locating screw and withdraw the pump.

*Note:* See Section AO for overhaul of oil pump and drive shaft.



**Fig. A-2—Oil pressure relief valve**

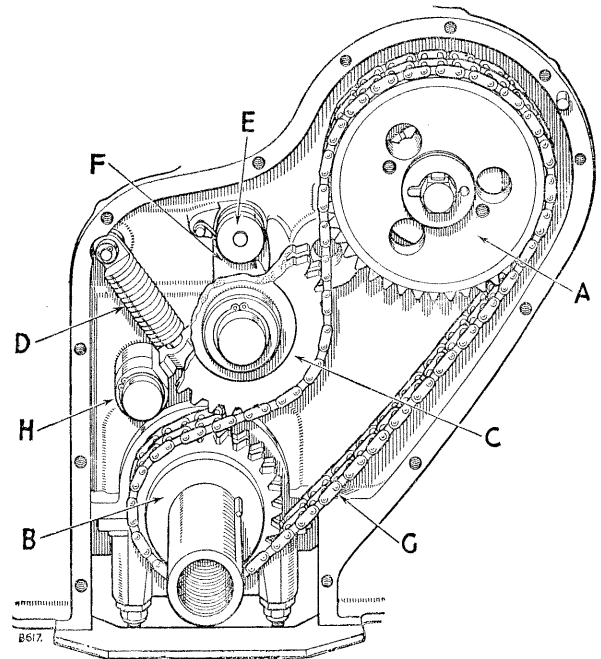
- |                           |                                |
|---------------------------|--------------------------------|
| A—Locknut                 | E—Spring                       |
| B—Locating screw—oil pump | F—Washer                       |
| C—Ball                    | G—Locknut                      |
| D—Plunger                 | H—Adjusting screw—oil pressure |

**Cylinder head and inlet rocker shaft, to remove****Operation A/10**

1. Loosen the nuts securing the rocker shaft.
2. Remove the rocker shaft complete with all components.  
The  $\frac{3}{8}$  in. (spanner size) nuts have  $\frac{7}{16}$  in. threads.
3. Withdraw the push rods and insert them in a piece of cardboard pre-pierced and numbered 1 to 4.
4. Loosen the securing bolts evenly and lift the cylinder head clear complete with manifold.

**Water pump, to remove****Operation A/12**

1. Remove the copper tube and rubber joint ring from either the bottom face of the thermostat housing or the top face of the water pump casing.
2. Remove the water pump complete with joint washer and inlet pipe; as the pump casing is spigoted in the block, it will be necessary to oscillate it slightly as it is removed.  
See Section L for overhaul of water pump.

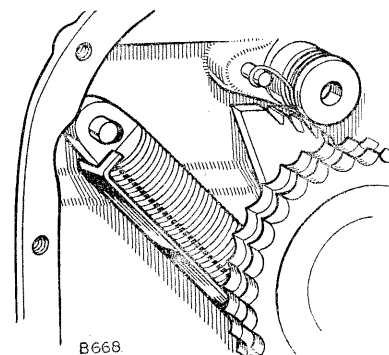


**Fig. A-3—Timing chain and tensioner**

- |                         |                               |
|-------------------------|-------------------------------|
| A—Camshaft chainwheel   | E—Pawl                        |
| B—Crankshaft chainwheel | F—Ratchet                     |
| C—Jockey pulley         | G—Timing chain (driving side) |
| D—Hydraulic tensioner   | H—Jockey pulley arm           |

**Front cover, chain tensioner and chainwheels To remove****Operation A/14**

1. Remove the securing bolts and remove the front cover.
2. Remove the crankshaft oil thrower.
3. Release the pawl from the ratchet, compress the tensioner spring by lifting the jockey pulley arm as far as possible, and fit clip, Part No. 262748, over the tensioner.



**Fig. A-4—  
Clip for timing  
chain tensioner**

4. Remove the jockey pulley; remove the driving chain.
5. Withdraw the jockey pulley arm and tensioner.
6. Carefully remove the special clip and part the tensioner spring, piston, cylinder and, if necessary, extract the ball and the two retaining springs from the cylinder.

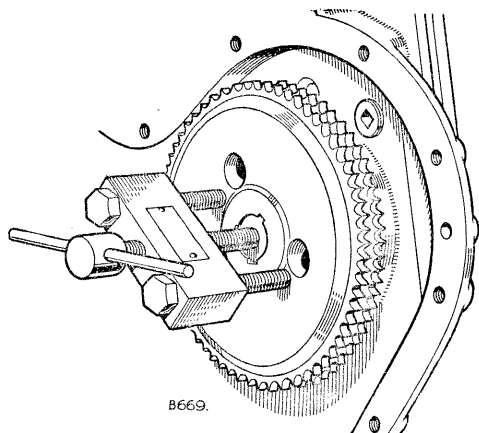


Fig. A-5—Removing camshaft chainwheel

7. If necessary, extract the pawl pivot pin ( $\frac{5}{16}$  in. B.S.F. tapped hole); remove the pawl and pawl spring.
8. Remove the camshaft chainwheel, using extractor, Part No. 262750 or 507231.
9. If necessary, remove the crankshaft chainwheel, using a claw extractor.
10. Examine all parts of tensioner mechanism and renew as necessary.

#### Exhaust rocker shafts, to remove Operation A/16

1. Remove the plug and fibre washer from the cylinder block.

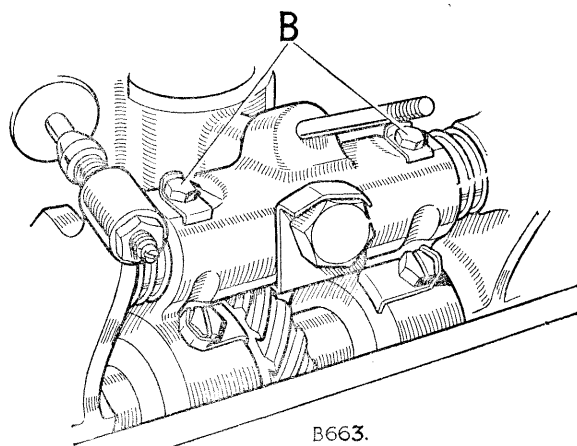


Fig. A-6—Exhaust rocker shaft location bolts  
B—Exhaust rocker shaft location bolts

2. Remove the location bolts ; two for the rocker shafts and withdraw the shafts, using extractor, Part No. 262749.

Lay out the components in order:—

Spring; R.H. rocker; washer; R.H. cam follower; washer; L.H. rocker; spring. Same order applies to both rocker shafts.

#### Camshaft and bearings, to remove Operation A/18

1. Remove the camshaft thrust plate.
  2. Remove the bolt and lock washers locating each of the three front bearings.
  3. Withdraw the camshaft until the third bearing is clear of No. 2 bearing housing; split the bearings and lay aside. Remove the camshaft and front bearing.
- Split the front bearing and remove.

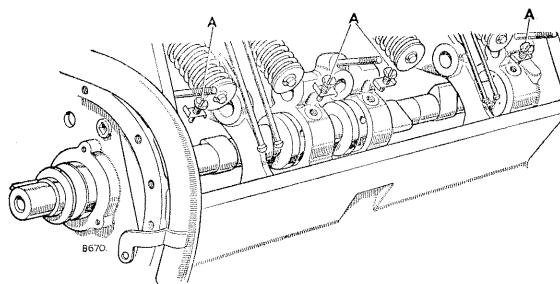


Fig. A-7—Camshaft bearing location bolts  
A—Location bolts

4. If necessary, remove the bolt and lock washer from the rear bearing. Remove the rear camshaft cover.
5. Remove the rear bearing; preserve all bearings in their respective pairs.

#### Exhaust valves, to remove      Operation A/20

1. Slacken the tappet adjusting screws right back.
2. Set each rocker on the back of its cam, and using a valve spring compressing tool, Part No. 276102, remove the valve assemblies. The valves should be inserted in a piece of cardboard pre-pierced and numbered 1 to 4. Retain the springs in pairs; they are selected to ensure an interference fit.

#### Crankshaft, pistons and connecting rods, to remove      Operation A/22

1. Remove the connecting rod caps.
2. Remove the main bearing caps and shells. The lower half of the rear main oil seal may be removed complete with rear main bearing cap.
3. Lift out the crankshaft and remaining bearing halves. The bearing halves must be preserved in pairs. Ensure that the thrust washers are retained in original housings if used again.
4. Withdraw the pistons and connecting rods, and replace the caps on their original connecting rods.

#### Cylinder block checks      Operation A/24

Check that the main bearing caps have not been filed, in the following manner.

Assemble the caps without bearing shells to the crankcase, ensuring that they are correctly located by means of the dowels. Tighten both securing bolts for each cap, then slacken one bolt of each pair right off. There should be no clearance at the joint face.

If there is a clearance at the joint face this indicates that the main bearing caps have been filed, and the cylinder block is scrap.

## ENGINE ASSEMBLY

### Exhaust valve guides, to renew Operation A/26

1. Remove the guide with a drift, Part No. 263051.
2. Pull in the new guide, using tool Part No. 262753, and ream to .3448 in.—.0005 (8,757 mm—0,012).

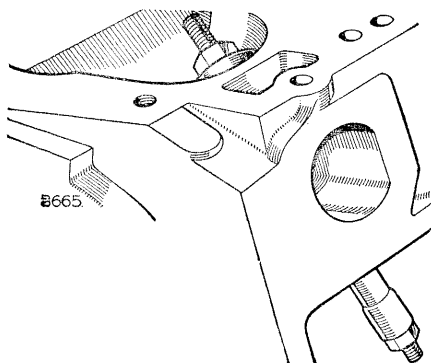


Fig. A-8—Fitting exhaust valve guide

### Valve seats, to renew Operation A/28

1. Grind the insert away until only a thin sliver remains, then, with the area suitably masked to avoid injury from flying fragments, gently tap the insert with a centre punch and remove the broken parts.
2. Remove the valve guide by means of a piloted drift, Part No. 263051.

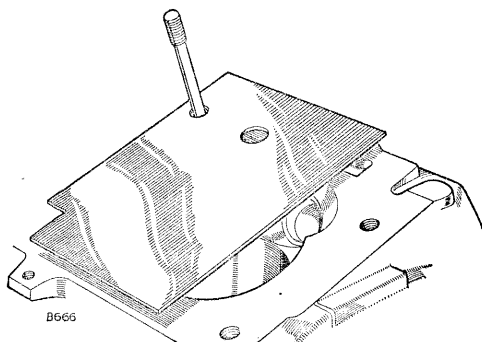


Fig. A-9—Protection plate

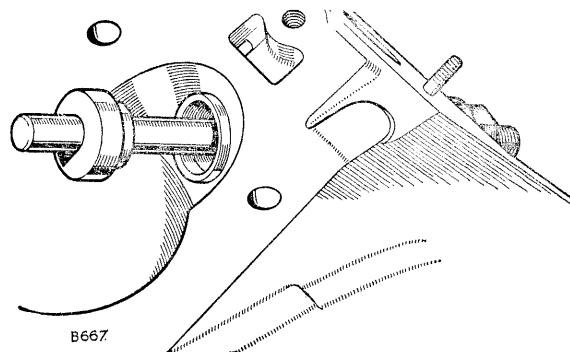


Fig. A-10—Fitting exhaust valve seat

3. Clean the seat recess and pull the new insert into position, using tool Part No. 262752. It is not necessary to heat the block or freeze the insert, but light taps on the tool may be required to ensure that the insert enters smoothly.
4. Pull in the new guide, using tool Part No. 262753, and ream to .3448 in.—.0005 in. (8,757 mm—0,012 mm).

### Exhaust valves, to refit Operation A/30

1. Grind the seats to  $45^\circ + \frac{1}{4}$ , using 'Vibro-centric' equipment.
2. Face the valves to  $45^\circ - \frac{1}{4}$  and lap into their respective seats.
3. Wash each valve, seat, port and guide in paraffin.
4. Locate each valve into their respective guides and, using compressor Part No. 276102, fit the spring assemblies, caps and split cones.

### Cylinder liner fitting Operation A/32

If the cylinder block has already been bored out to maximum size, cylinder liners may be fitted.

Fitting conforms to standard practice; note the following points:—

Machine the cylinder block bores to 3.245 in. + .001 (82,42 mm + 0,025). This gives an interference fit of .003 to .004 in. (0,07 to 0,10 mm)

Prior to pressing in the liner, allowance must be made for twist up to  $\frac{3}{16}$  in. (5 mm) clockwise. To facilitate re-alignment should the liner not be positioned correctly at the first attempt, scribe lines down the sides of the liner from the two peaks and make corresponding marks on the cylinder block.

Press in the liner, using press block Part No. 262864, until the top edge is level with the bottom of the exhaust valve pocket. Blend to the shape of the cylinder block.

Bore to suit the selected pistons.

Liners can only be bored out to suit standard or .010 in. (0,25 mm) oversize pistons.

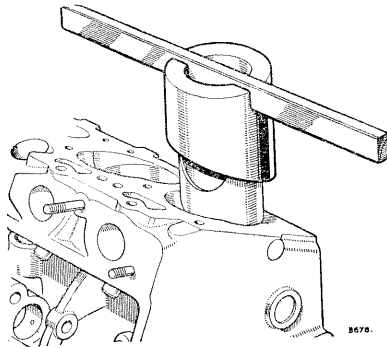


Fig. A-11—Fitting cylinder liner

**Reboring****Operation A/34**

1. Reboring conforms to normal practice. It is necessary to employ a jig block, Part No. 261287, to enable standard equipment to be used.

The cylinder block may be rebored up to .040 in. (1,00 mm) oversize.

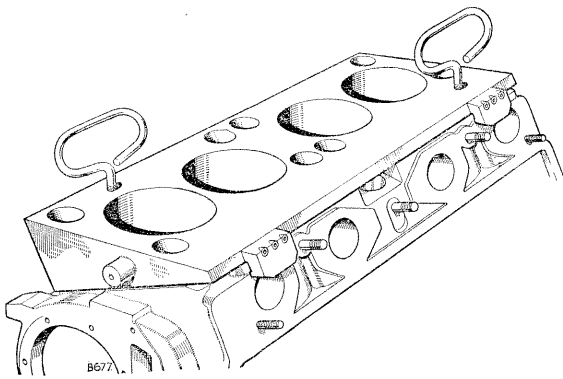


Fig. A-12—Reboring jig block

2. If the cylinder block has already been bored out to the maximum size, cylinder liners may be fitted.

The cylinder block must be thoroughly cleaned at this stage.

**Pistons to cylinder****Operation A/36**

When fitting pistons, standard or oversize, the cylinder bore clearance should be in accordance with the dimensions laid down in the data section. When reboring, the block must be honed to suit the selected pistons.

When an engine fitted with standard size pistons is dismantled, it will be noted that the pistons are marked with a grade letter on the crown, and a corresponding letter is stamped on the crankcase sump face, adjacent to the relative bore. If the original pistons are being refitted, they must be returned to their original bores. Where the pistons are being replaced, normal piston clearance must be checked as detailed below.

**Four-ring piston**

On early models a four-ring piston is used, consisting of two compression rings, one stepped scraper ring and one H-section scraper ring.

**Piston clearance in bore, four-ring type**

In order to obtain the correct piston clearance with a new piston in a new or worn bore, insert a long .0015 in. (0,038 mm) feeler gauge down the thrust side of the cylinder, that is the left-hand side of the cylinder looking at the engine from the front. Insert the piston upside down in the cylinder bore with the gudgeon pin in line with the centre line of the engine. Push the piston down the cylinder until the piston skirt reaches its tightest point, where the feeler gauge should require a 10 lb. (4,6 kg) pull to withdraw it.

It may be necessary to check the clearance of several pistons in the bore before the correct one is selected.

The above method of checking the piston clearance ensures that the piston has the correct clearance in its working position.

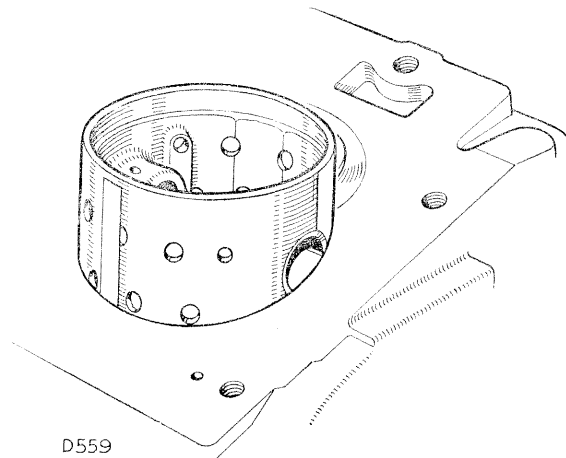


Fig. A-13—Checking piston clearance

**Three-ring piston**

On late models a three-ring piston is used, consisting of two compression rings, and one H-section scraper ring.

**Piston clearance in bore, three-ring type**

In order to obtain the correct piston clearance with a new piston in a new or worn bore, insert a long .0025 in. (0,063 mm) feeler gauge down the thrust side of the cylinder, that is the left-hand side of the cylinder looking at the engine from the front. Insert the piston upside down in the cylinder bore with the gudgeon pin in line with the centre line of the engine. Push the piston down the cylinder until the piston skirt reaches its tightest point where the feeler gauge should require a 10 lb. (4,6 kg) pull to withdraw it.

It may be necessary to check the clearance of several pistons in the bore before the correct one is selected.

The above method of checking the piston clearance ensures that the piston has the correct clearance in its working position.

#### Piston ring fitting

1. Check gap and side clearance. To check gap, support the ring in the cylinder bore with an old piston. See Data Section.
2. Stepped scraper rings, where used, must be fitted with the larger diameter at the top.
3. Compression rings are marked "T" or "Top" on one face.

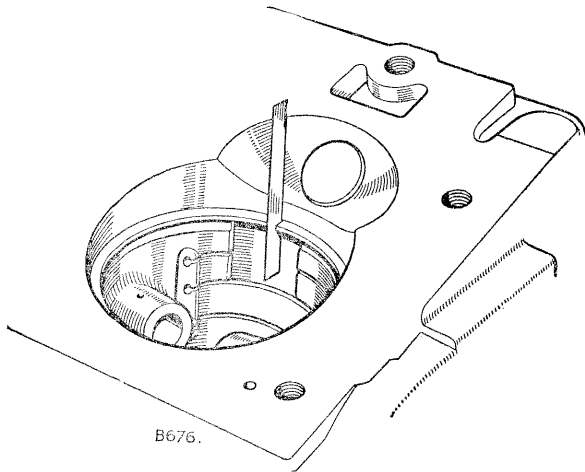


Fig. A-14—Checking piston ring gap

#### Connecting rod checks Operation A/38

Check that the connecting rods and caps have not been filed, in the following manner:

1. Select the correct cap for each connecting rod, as denoted by the number stamped near the joint faces. This number also indicates the crankpin to which it must be fitted.
2. Assemble the connecting rods, less shell bearings, with corresponding numbers together.
3. Tighten the securing nuts, then slacken one of them right off and check that there is no clearance at the joint face.

If there is a clearance at the joint face, this indicates that the connecting rods or caps have been filed, and the assemblies must be scrapped.

#### Connecting rod bearing nip Operation A/40

Check the bearing nip in the following manner.

1. Fit the bearing shells and tighten both securing nuts—slacken one nut as before and check the nip with a feeler gauge; this should be .002 to .004 in. (0,05 to 0,10 mm).

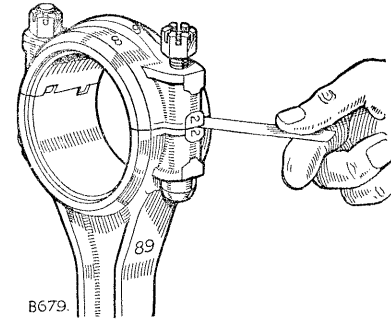


Fig. A-15—Checking big-end bearing nip

2. The nip can be corrected by selective assembly of bearing shells; these are available in slightly varying thicknesses.
3. Assemble the big-end of each connecting rod to its respective crankpin, then check for correct end-float, by inserting a feeler gauge between the end face of the rod and the crankpin shoulder. End-float should be .009 to .013 in. (0,23 to 0,33 mm).
4. Remove the connecting rods from the crankshaft, ensuring that the bearing shells are kept with the rods to which they were fitted.

#### Gudgeon pin, bush and piston

##### Operation A/42

1. The oil hole in gudgeon pin bush is pre-drilled and care must be taken to ensure that the oil holes of bush and connecting rod will align when the bush is pressed into position. The gudgeon pin bushes should be a .001 to .002 in. (0,02 to 0,05 mm) interference fit in connecting rods. Ream the bush when fitted to connecting rod to allow a .0003 to .0005 in. (0,007 to 0,012 mm) gudgeon pin clearance. Ensure that correct alignment is maintained while reamering.

This fit is selected to give the smallest possible clearance consistent with a smooth revolving action.

2. When cold and dry, the gudgeon pin should be an *easy sliding* fit in the connecting rod and should have a *slight interference* fit in both piston bores, i.e. so that it can be pressed in by hand but will not fall out under its own weight.

It is of particular importance that gudgeon pins are not fitted tighter than this in the three-ring type of piston, otherwise piston seizure may result.

3. Fit each connecting rod to a suitable test rig and check for twist and mal-alignment.
4. Fit the pistons to their respective connecting rods and insert the pistons into the bores, using a suitable piston ring clamp.
5. Ensure that the oil spray hole in the connecting rod is towards the right-hand side of the engine, opposite side to the camshaft.



### Crankshaft, main bearing and seals, to refit Operation A/44

Check the main bearing nip in the following manner.

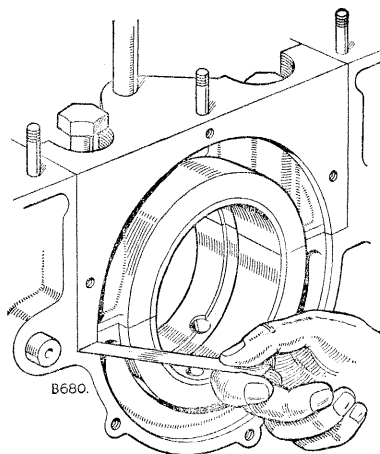


Fig. A-16—Checking main bearing nip

1. Remove the bearing caps and fit the bearing shells, locating by means of the tags. Tighten the caps down and slacken off one bolt of each pair. Check the bearing nip, as illustrated in Fig. A-16, ensuring that the clearance does not exceed .004 to .006 in. (0,10 to 0,15 mm). The nip can be corrected by selective assembly of bearing shells; these are available in slightly varying thicknesses.
2. When the bearing nip has been checked, remove the caps and bearing shell bottom halves. Position a standard-size thrust bearing at each side of centre bearing shell—top half, and fit the crankshaft.
3. Refit the bearing shell bottom halves and bearing caps. Tighten the securing bolts evenly and check each bearing in turn for correct clearance. The crankshaft should resist rotation when a feeler paper, .0025 in. (0,06 mm) thick, is placed between any one bearing shell and crankshaft journal, and turn freely by hand when the feeler paper is removed. Adjust by selective assembly of bearing shells.

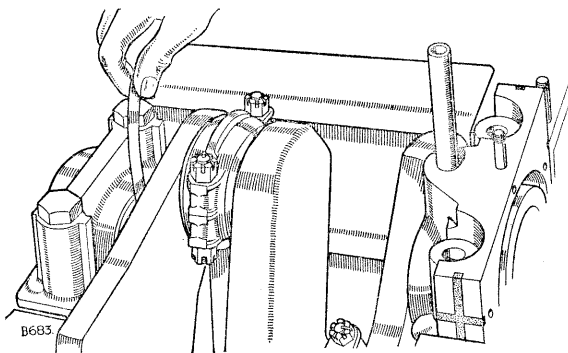


Fig. A-17—Checking crankshaft end-float

4. Check the crankshaft end-float with a feeler gauge (Fig. A-17); adjust at centre bearing by selective assembly of thrust washers to give .002 to .006 in. (0,05 to 0,15 mm) end-float.

If the crankshaft end-float reading obtained is not within the limits, fit suitable oversize thrust bearings. The variation of thrust bearing thickness at each side must not exceed .003 in. (0,07 mm) to ensure that the crankshaft remains centralised.

5. Remove the bearing caps, bottom half shells and crankshaft.
6. To the rear main bearing cap fit neoprene seals in recess at each side.

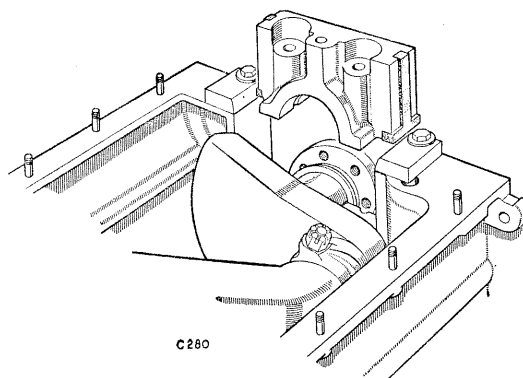


Fig. A-18—Guide in position on cylinder block

### Fitting crankshaft oil seal (two- or three-piece)

7. **Preparatory work.** This preparatory work is essential when fitting the seal to a new crankshaft and desirable when fitting to a crankshaft which has been in service.

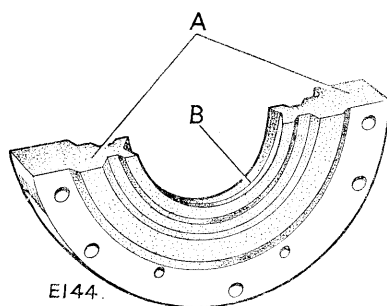
To ensure efficient lubrication during the initial running-in period of the oil seal, the crankshaft oil seal journal must be treated with a mixture of molybdenum disulphide and Butyl acetate as detailed below:

- (a) **Thoroughly stir** the mixture immediately prior to use.
- (b) Degrease the crankshaft oil seal journal.
- (c) Paint mixture evenly on to the surface of the oil seal journal with a fine brush; alternatively, if a quantity of crankshafts are being done, it can be sprayed on with a gravity feed spray gun, using 40 lb./sq.in. (2,8 kg/cm<sup>2</sup>) air-line pressure. This solution, which **must be dry** before the seal is fitted, takes approximately 10 minutes to dry, and the surface must not be scratched after treatment. On crankshafts which have been previously run the solution will take 15 minutes to dry thoroughly. A warm air stream may be used to reduce these times if necessary.

**Procedure—two-piece seals**

8. Bolt the cylinder block half of the oil seal firmly on to the block by the three bolts. With five-bolt fixing seals leave the two bolts adjacent to the split line loose.
9. Bolt the other half of the oil seal to the rear main bearing cap in the same manner. Refit the crankshaft, first lubricating the journals, bearing shells and thrust bearings.
10. The groove in each half of the oil seal is to be half filled with Silicone MS4 Compound, ensuring no grease reaches the split line face.
11. Apply 'Heldite' jointing compound to both split line joint faces on each half of the seal. **This instruction does not apply to the three-piece type oil seal.**

The compound should be spread thinly over the surface, ensuring it reaches across the sealing lips, but must not be allowed to get on to the lips themselves. See Fig. A-19. This compound must be allowed to become tacky before assembly.



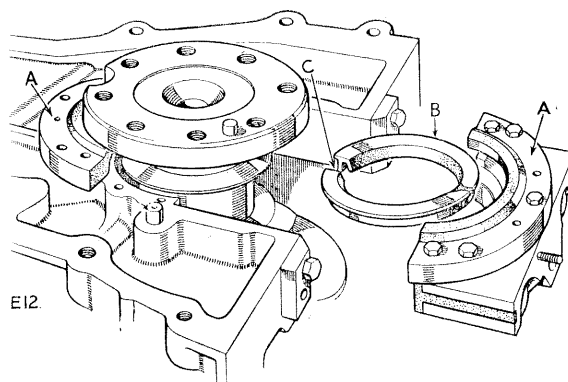
**Fig. A-19—Rear crankshaft oil seals—2-piece type**

A—Apply 'Heldite' jointing compound at this face  
B—Fill groove with Silicone MS4 Compound

12. Fit rear main bearing cap and tighten to the required torque.
13. Where applicable, tighten the four bolts adjacent to the split line.
14. Rotate the crankshaft through a small arc to prevent the jointing compound from adhering to the crankshaft.
15. Fitment of the rear main bearing cap with side seals in position, will be facilitated by using a lead tool (Part No. 270304) fitted to the sump studs adjacent to rear bearing cap aperture.
16. It will be found advantageous to cut a very slight lead on to the bottom edges of the side seals, as this will prevent them from folding under the cap during fitment, thus causing an oil leak due to the cap not seating properly. Smear seals with Silicone MS4 Compound when fitting.

**Procedure—three-piece oil seals**

17. Apply Silicone Grease MS4 liberally to both sides of the split oil seal rubbing face.
18. Open the split oil seal sufficiently to allow it to be fitted over the crankshaft oil seal journal. The rubber ribs on the inside of the seal should be facing the crankshaft thrust collar. The split line on the seal should be pointing towards the top of the cylinder block. The oil seal must not be repeatedly fitted and removed from the crankshaft, as this can damage the sealing lip.
19. Slide the split oil seal along the journal until it is nearly touching the crankshaft flange.
20. Fit one half of oil seal housing on to the crankcase dowels. The split oil seal should be compressed to assist assembly.
21. Bolt the housing firmly on to the crankcase, tightening all five bolts fully.
22. Bolt the other half of the oil seal housing firmly on to the main bearing cap, tightening all five bolts fully.
23. Fit the main bearing cap with the seal housing, bearing shell half and packing for main bearing cap to the crankcase. Smear side seals with Silicone Grease MS4 and use special tool Part No. 270304 to assist assembly. Do not fully tighten at this stage.



**Fig. A-19A—Fitting retainer halves and oil seal (3-piece type)**

A—Retainer halves      B—Split oil seal  
C—Split line of seal towards top of engine

24. Using two screwdrivers, slide the split oil seal along the shaft until its flange is flush with both the top and bottom oil seal housing halves. It is essential that care is taken to ensure that there is no buckling of the split oil seal or misalignment of the split joint.
25. Pull the main bearing cap down to the correct torque, that is 65 lb/ft. (9 mkg), ensuring that the split oil seal does not move.

Note that the split oil seal must be renewed whenever a crankshaft is removed and replaced for any reason.

### Piston and connecting rod, to refit to crankshaft **Operation A/46**

1. Turn the crankshaft until the crank journals relative to numbers 1 and 4 cylinders are at B.D.C. Squirt oil on to the journal, refit appropriate bearings to cap and connecting rod, pull the rod down to the journal and fit cap, ensuring that the oil hole in the connecting rod is on the opposite side to the camshaft. Tighten the nuts to 40 lb/ft (5,5 mKg) and then turn on to the next split pin hole. Fit split pin.

### Flywheel housing and flywheel, to refit **Operation A/48**

1. Ensure that the rear main bearing oil seal is in good condition, then secure the flywheel housing to cylinder block. See note regarding drain plug at end of section.
2. Fit the flywheel and tighten the securing bolts to 70 lb/ft (9,8 mKg).

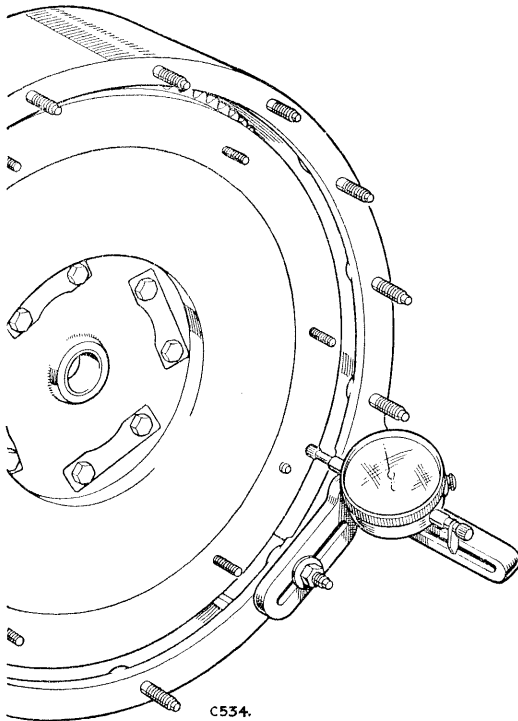


Fig. A-20—Checking run-out on flywheel face

3. Check the run-out on the flywheel face as illustrated by Fig. A-20. The run-out must not exceed .005 in. (0,12 mm) at outer edge of face.

For overhaul of flywheel and clutch see Section B-2.

### Camshaft and bearings, to replace **Operation A/50**

The bearings must be fitted dry and must be a hand push fit in the cylinder blocks; they must always be renewed in paired halves and the numbers stamped on one of the end faces of each of the bearing halves must be adjacent.

The rear bearing is provided with four lateral holes.

1. Checking bearing clearance on camshaft; if new bearings are fitted, make sure that they can be dismantled and assembled without difficulty.
2. Insert the camshaft partly into the cylinder block, assemble the bearings on to the shaft with the locating holes in line with the holes in the housing, and push the shaft into position.
3. Line up the locating holes in the bearings and housings, and before replacing the set bolts, squirt oil down the holes to lubricate the bearings until oil pressure is built up. Replace set bolts. See Fig. A-21.
4. Fit the camshaft thrust plate and chainwheel. The camshaft should have .003 in. (0,07 mm) to .005 in. (0,12 mm) end-float, measured with a dial gauge.

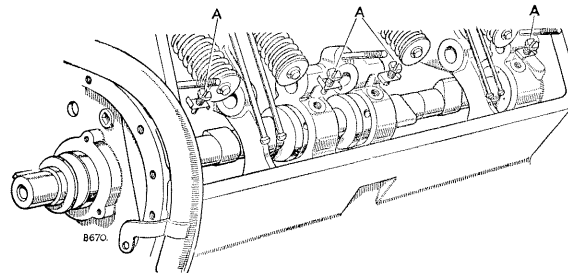


Fig. A-21—Camshaft bearing location bolts

A—Location bolts

### Exhaust rockers, to rebush and refit **Operation A/52**

When fitting a replacement rocker or cam-follower, it is essential that the component be fitted with the special protective coating of grease still adhering.

1. Fit new bushes in the rockers and followers as necessary and drill through the  $\frac{1}{16}$  in. (1,58 mm) oil feed hole. The bush must be a *light drive fit* in the rocker or follower and a *sliding fit* on the shaft. Ream in position to .593 in. +.001 (15,081 mm + 0,025).
2. Ensure that the "F" stamped on one end of each shaft is towards the front of the engine. Replace the rockers in their original order.
3. Ensure that, with both shafts in position, the oil feed holes in the rocker shafts are facing towards the cylinder block. Replace the shaft location bolts and lock in position.
4. Fit the plug and fibre washer to the cylinder block.

### Chainwheels, timing chain, adjuster and valve timing **Operation A/54**

1. Fit the crankshaft chainwheel on to shaft and key.

2. Turn the crankshaft in direction of rotation until the E.P. mark on the flywheel is in line with the timing pointer.
3. Replace the camshaft chainwheel and key (do not secure at this stage), rotate the camshaft and set No. 1 exhaust tappet at .010 in. (0,254 mm).
4. If removed, refit the pawl pivot pin, pawl and spring.
5. Fit dial test indicator and bracket, Part No. 262751, so that the "fully open" position of No. 1 exhaust valve can be ascertained in the following manner:—
6. Turn the camshaft in direction of rotation until the lobe of cam has nearly opened the valve fully, then stop rotation and mark the chainwheel and timing case to record the position.

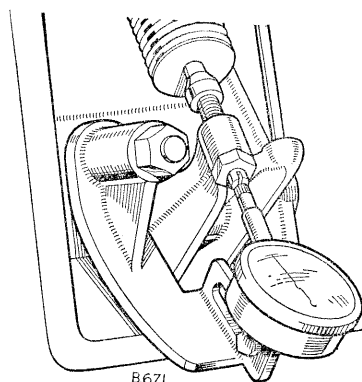


Fig. A-22—Checking exhaust valve fully open position

7. Note the reading on dial test indicator, then continue to turn the chainwheel slowly in direction of rotation until the needle has again reached the same position.
8. Mark the chainwheel at a point opposite to the mark on timing case and make a third mark on the chainwheel, exactly between those made previously.
9. Turn the camshaft **against** direction of rotation until the third mark is in line with that on timing casing, whereon the valve should be fully open.
10. Fit the timing chain with "no slack" on the driving side. It may be necessary to remove and re-position the camshaft chainwheel to obtain this "no slack" condition on the driving side when the flywheel and camshaft are correctly positioned. The camshaft chainwheel is provided with three irregularly spaced key-ways to facilitate accurate timing.
11. Fit the jockey pulley arm to its locating spindle.
12. Assemble the hydraulic tensioner, compress and retain the spring with clip, Part No. 262748, and fit complete assembly to its locating spindle. Position the ball-end in its seat on the pulley arm, holding the ratchet pawl clear, and push arm upwards to the extent of its travel. Remove the special clip and fit jockey wheel.

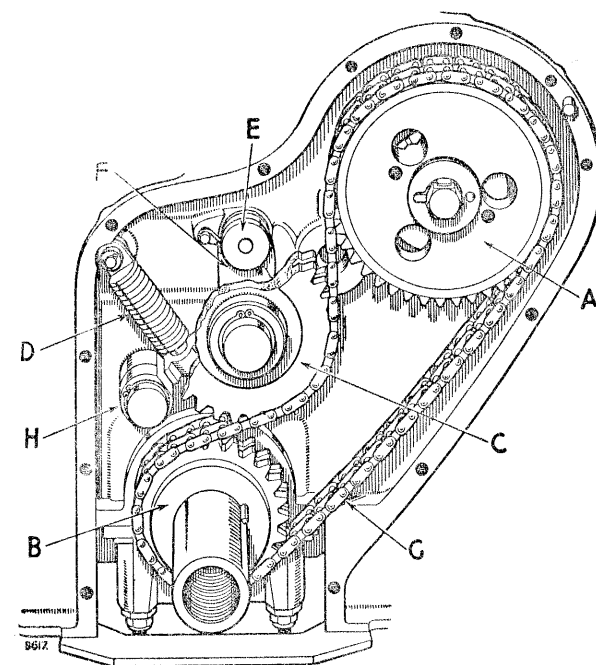


Fig. A-23—Timing chain and tensioner

- |                         |                               |
|-------------------------|-------------------------------|
| A—Camshaft chainwheel   | E—Pawl                        |
| B—Crankshaft chainwheel | F—Ratchet                     |
| C—Jockey pulley         | G—Timing chain (driving side) |
| D—Hydraulic tensioner   | H—Jockey pulley arm           |

#### Water pump, front cover and vibration damper, to replace Operation A/56

1. Fit a new seal into the front cover, using a suitable sealing compound.
2. Fit new joint washer, smear with light grease and secure cover to cylinder block.
3. Fit a new joint washer to the water pump and secure to cylinder block complete with copper tube and rubber ring in recess on top of pump.
4. Refit the damper to crankshaft, securing with locking washer and starter dog.
5. Tighten the starter dog, using spanner, Part No. 263055.

For details of water pump overhaul, see Section L.

For details of vibration damper overhaul, see Section A-2.

**Oil pump, to refit****Operation A/58**

See Section AO for overhaul of oil pump.

1. With the gauze oil strainer secured in position, offer the pump up to the engine.
2. Fit the pump locating screw and locknut.
3. Fit the relief valve assembly. Do not tighten the locknut at this stage.

See Section AO for details of oil pressure adjustment.

The starter motor, dynamo, external oil filter and oil sump may be refitted at this stage, if convenient.

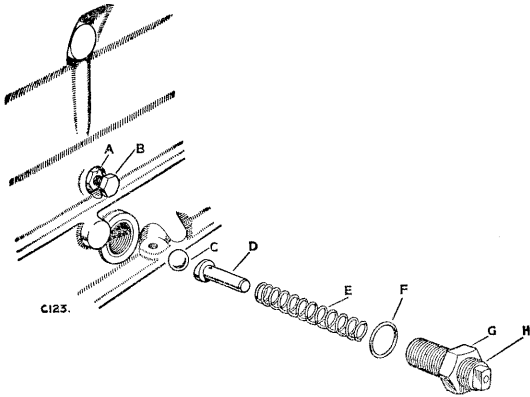


Fig. A-24—Oil pressure relief valve

- |                           |                                |
|---------------------------|--------------------------------|
| A—Locknut                 | E—Spring                       |
| B—Locating screw—oil pump | F—Washer                       |
| C—Ball                    | G—Locknut                      |
| D—Plunger                 | H—Adjusting screw—oil pressure |

## CYLINDER HEAD TO OVERHAUL AND REFIT

**Rocker shaft, to overhaul****Operation A/60**

1. Fit new bushes in the rockers as necessary. The bush must be a *light drive fit* in the rocker and a *sliding fit* on the shaft. Press a new bush in with its shoulder on the same side as the rocker pad; drill through the oil feed holes— $\frac{1}{16}$  in. (2,77 mm) to the push-rod and  $\frac{1}{16}$  in. (1,58 mm) in the top of the rocker. Ream in position to .005 in. + .001 (12,7 mm + 0,025).

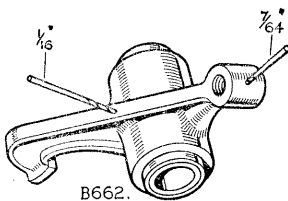


Fig. A-25—  
Drilling oil feed holes

2. Fit the component parts to the rocker shafts in the following order:
3. Rear bracket (located by set screw); spring; R.H. rocker; bracket; L.H. rocker; two brackets; spring; R.H. rocker; bracket; L.H. rocker; spring; front bracket.

**Inlet valves, to remove****Operation A/62**

1. If necessary remove the inlet manifold, thermostat housing and cylinder head end plate.
2. Using a valve spring compressing tool, Part No. 276102, remove the valve assemblies.
3. The valves should be inserted in a piece of cardboard, pre-pierced and numbered 1 to 4.
4. Retain the springs in pairs; they are selected to ensure an interference fit.

**Inlet valve guides, to renew Operation A/64**

1. Remove the guide with a drift, Part No. 263051.
2. Press in the new guide, and ream to .3448 in.—.0005 (8,757 mm—0,012).

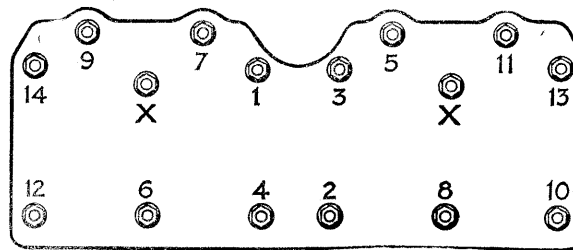
The valve seat must be ground in the event of a new guide being fitted.

**Inlet valves, to reface and refit Operation A/66**

1. Cut the valve seats (in cylinder head) to  $30^\circ \pm \frac{1}{4}$  only when necessary; normally they require cutting only at every second or third decarbonising operation.
2. Face the valves to  $30^\circ \pm \frac{1}{4}$  and lap into their respective seats.
3. Wash each valve, seat, port and guide in paraffin.
4. Fit a new 'O' ring seal to each guide.
5. Locate each valve into their respective guides and, using compressor Part No. 276102, fit the spring assemblies, caps and split cones.

**Cylinder head and rocker shaft, to replace****Operation A/68**

1. If removed, replace the inlet manifold thermostat housing and cylinder head end plate. See Section L for checking of thermostat.
2. Smear the joint face of cylinder block and cylinder head gasket with engine oil, then fit the gasket and cylinder head to cylinder block. Ensure that the copper tube and rubber ring are fitted to the top of the water pump before fitting the cylinder head.



B652

Fig. A-26—

Order of tightening cylinder head bolts. Those marked X also secure the rocker shaft

3. Locate head and gasket with the securing bolts, fitting all bolts except those which also secure the rocker shaft pedestals, but do not tighten at this stage.
4. Insert the push-rods into their original position, through cylinder head and locate in the cam-followers.
5. Fit the rocker shaft to the cylinder head. When in position, the oil feed holes in the rocker shaft must face the push-rods. Tighten all the bolts down in the manner illustrated by Fig. A-26:  $\frac{7}{16}$  in. bolts to 55 lb/ft (7,5 mKg);  $\frac{3}{8}$  in. bolts to 35 lb/ft (4,5 mKg).

**Tappet adjustment****Operation A/70**

The exhaust tappets may be set with the engine cold.

The inlet tappets should be set with the engine at running temperature.

1. Set the valve receiving attention fully open by engaging the starting handle and turning the engine, then rotate the engine one complete revolution, to bring the tappet on the back of the cam.

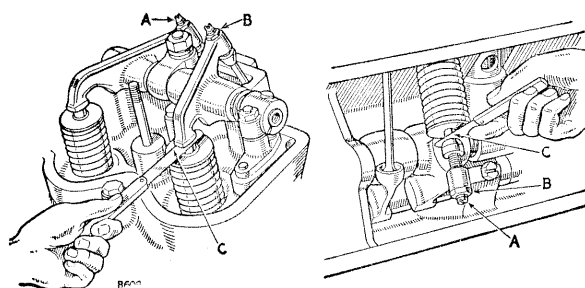


Fig. A-27—Tappet adjustment

A—Tappet adjusting screw      B—Locknut  
C—Feeler gauge

2. Slacken the tappet locknut and using a feeler gauge, rotate the adjusting screw to give the correct clearance .010 in. (0,25 mm) inlet and .012 in. (0,30 mm) exhaust, bearing down on the screw to take up all the clearance at the push-rod ends.

Tighten the locknut.

3. Repeat for the remaining tappets.

**Distributor and ignition timing****Operation A/72**

1. Rotate the engine in running direction until the F.A. 10° mark on the flywheel is in line with the pointer, with both valves on No. 1 cylinder closed.
2. Fit the oil pump drive shaft so that when fully engaged in oil pump, the broad segment of driving spigot will be nearest to No. 3 exhaust port. The crankshaft may have to be rotated slightly to allow engagement of driving shaft in oil pump, and when this is necessary, item 1 must be repeated.
3. Secure the distributor housing in position with the hollow oil feed bolt, then fit distributor drive shaft.

4. Locate a cork washer in recess in top of distributor housing.
5. Check the distributor contact breaker clearance and adjust if necessary, .014 to .016 in. (0,35 to 0,40 mm). Set the octane selector so that the fourth line from the L.H. side of the calibrated slide is against the face of distributor body casting.
6. Rotate the distributor spindle until the rotor is at the firing point for No. 1 cylinder. The broad side of the driving spigot should be towards No. 3 exhaust port and vacuum unit facing forward when the distributor is located.
7. Mount distributor and secure to distributor housing.
8. Slacken the pinch bolt at the base of the distributor body; rotate the distributor bodily in the opposite direction to the arrow on the rotor arm, until the contact breaker points are just opening with the fibre cam follower on the leading side of the cam; retighten the pinch bolt.

**Checking with 12 volt timing lamp**

- (a) Connect a lead between the distributor L.T. terminal and the centre pole of the bulb; earth the bulb body.

**Externals****Operation A/74**

1. Fit the oil filter complete and joint washer.
2. Fit the exhaust rocker cover and joint washer.
3. Fit the oil feed pipe, gallery to cylinder head.
4. Fit the dynamo and starter motor; adjust the dynamo belt tension to allow the belt to move  $\frac{1}{8}$  to  $\frac{3}{8}$  in. (12 to 19 mm) when pressed by thumb between the crankshaft and water pump pulleys.
5. If removed, refit heater pipes, etc., to cylinder head.
6. Fit the inlet rocker cover and joint washer.
7. Fit the sparking plugs, covers and rubber sealing rings, and connect plug leads to distributor.
8. Fit the carburetter, and connect vacuum pipe between carburetter and distributor, connect fuel feed pipe from pump. Connect the accelerator linkage to the carburetter.
9. Fit the oil sump, noting rubber seal, packing strip and three distance pieces at rear.
10. Fit the dipstick and tube.

**Engine, to refit****Operation A/76**

1. Reverse removal procedure—fit new mounting rubbers if necessary. Refill with lubricating oil, 10 imperial pints (5,5 litres), and coolant, 17 imperial pints (9,75 litres).
2. See Section M for details of carburetter adjustments.
3. See Section AO for details of oil pressure adjustment.
4. Check for oil and coolant leaks—rectify as necessary.

## OVERHAULS TO ENGINE IN CHASSIS

Decarbonise and grind in the valves: carry out the following operations:

Page	Operation	Items
A-2	A/2	1 to 5
A-2	A/4	1, 3 and 4
A-3	A/10	All
A-4	A/20	All
A-5	A/30	All
A-12	A/62 to A/70	All
A-13	A/72 to A/76	As necessary

Timing chain, tensioner, or front cover oil seal to renew: carry out the following operations:

Page	Operation	Items
A-2	A/2	1 to 10
A-3	A/14	All
A-10	A/54	All
A-11	A/56	As necessary

Camshaft bearings, exhaust rockers and shafts, to renew: carry out the following operations:

Page	Operation	Item
A-2	A/2	1 to 10
A-2	A/4	4, 6 and 9
A-3	A/6	All
A-3	A/14	All
A-4	A/16 and A/18	All
A-9	A/50 to A/54	All
A-10	A/56	As necessary
A-13	A/70 and A/72	All
A-13	A/74 and A/76	As necessary

Reboring, renewing pistons, rings, little ends, or big-end bearings: carry out the following operations:

Page	Operation	Items
A-2	A/2	1 to 5 and 23
A-2	A/4	1, 3 and 4
A-3	A/10	All

In order to remove the pistons and connecting rods with the engine in the chassis, it is necessary to carry out the following instructions:

#### Pistons and connecting rods, to remove Operation A/78

1. Remove the connecting rod caps, bearings and bolts.
2. Push each connecting rod up and turn, in order to engage the slots at the bottom of the cylinder bore. Remove the circlips; withdraw the gudgeon pin, using extractor, Part No. 278668; remove the piston.
3. Lower each connecting rod, turning the crankshaft as necessary to effect withdrawal.

4. Remove the piston rings.

5. Mark all components in sets.

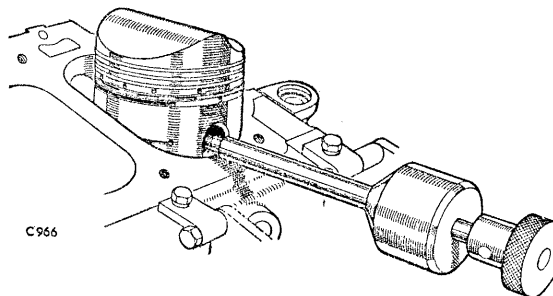


Fig. A-28—Removing gudgeon pin

When the pistons and connecting rods are removed continue with the following operations:

Page	Operation	Items
A-6	A/34 to A/40	As necessary
A-7	A/42	1 to 3

In order to refit the pistons and connecting rods with the engine in the chassis it is necessary to carry out the following instructions:

#### Pistons to connecting rods, to refit

##### Operation A/80

1. Enter the connecting rod, without bolts, up into the cylinder bore and engage in the cylinder block slots.
2. Enter the skirt of the piston into the top of the bore, with the flat top of the piston in line with the oil hole in the connecting rod.
3. Fit the gudgeon pin, using thimble Part No. 272103, to align piston and connecting rod. Lock the pin in position with circlips.

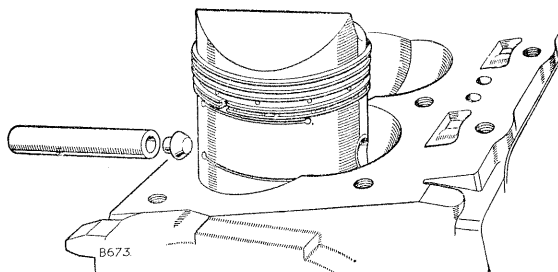


Fig. A-29—Fitting gudgeon pin

#### Piston and connecting rod to cylinder block and crankshaft Operation A/82

1. The connecting rod bolts are a tight fit in the rod and must be tapped into place with a 'Z'-shaped bar.

2. Turn the crankshaft until the crank journals relative to numbers 1 and 4 cylinders are at B.D.C. Squirt oil on to the journal, refit appropriate bearings to cap and connecting rod, pull the rod down to the journal and fit cap, ensuring that the oil hole in the connecting rod is on the opposite side to the camshaft. Tighten the nuts to 40 lb/ft. (5,5 mKg) and fit split pin.

When the pistons and connecting rods have been refitted, continue with the following operations for replacement of the cylinder head.

Page	Operation	Items
A-12	A/68 to A/70	All
A-13	A/72 to A/76	As necessary

**Inlet rocker shaft to overhaul: carry out the following operations:**

Page	Operation	Items
A-3	A/10	As necessary
A-12	A/60	All
A-12	A/68	As necessary
A-13	A/70	All

Oil pump and filters	....	Section A-O
Water pump and thermostat		Section L
Vibration damper	....	Section A-2
Flywheel and clutch	....	Section B
Starter, dynamo, distributor		Section P
Carburetter	....	Section M

#### Flywheel housing drain plug

The drain plug should not be fitted to the housing, unless the vehicle is expected to operate under very muddy conditions, or to wade. The plug should be screwed into the stowage bracket fitted to later models, or stored in the tool locker.

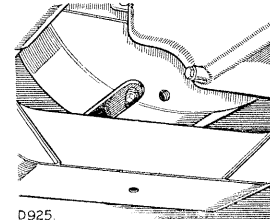


Fig. A-30—Flywheel housing drain plug and stowage bracket



## DEFECT LOCATION

(Symptom, Cause and Remedy)

## A—ENGINE FAILS TO START

1. Incorrect starting procedure—*See Instruction Manual.*
2. Starter motor speed too low—*Check battery and connections.*
3. Faulty ignition system—*Section P.*
4. Water or dirt in fuel system—*Section M.*
5. Carburettor flooding—*Section M.*
6. Defective fuel pump—*Section M.*
7. Defective starter motor—*Section P.*
8. Starter pinion jammed in flywheel—*Rotate starter shaft with spanner to free pinion.*
9. Starter pinion not engaging—*Clean drive sleeve and pinion with paraffin.*

## B—ENGINE STALLS

1. Low idling speed—*Section M.*
2. Faulty sparking plugs—*Rectify.*
3. Faulty coil or condenser—*Renew.*
4. Faulty distributor points—*Rectify or renew. Section P.*
5. Incorrect tappet clearance—*Adjust.*
6. Incorrect mixture—*Adjust carburettor. Section M.*
7. Foreign matter in fuel system—*Section M.*

## C—LACK OF POWER

1. Poor compression—*If the compression is appreciably less than the correct figure, (Page A-16) the piston rings or valves are faulty. Low pressure in adjoining cylinders indicates a faulty cylinder head gasket.*
2. Badly seating valves—*Rectify or renew.*
3. Faulty exhaust silencer—*Renew.*
4. Incorrect ignition timing—*Rectify.*
5. Leaks or restrictions in fuel system—*Section M.*
6. Faulty sparking plugs—*Rectify.*
7. Clutch slip—*Section B.*
8. Excessive carbon deposit—*Decarbonise.*
9. Brakes binding—*Section H.*
10. Faulty coil, condenser or battery—*Section P.*

## D—ENGINE RUNS ERRATICALLY

1. Faulty electrical connections—*Rectify.*
2. Defective sparking plugs—*Rectify.*
3. Low battery charge—*Recharge battery. Section P.*
4. Defective distributor—*Rectify.*
5. Foreign matter in fuel system—*Section M.*
6. Faulty fuel pump—*Section M.*
7. Sticking valves—*Rectify or renew.*
8. Incorrect tappet clearance—*Adjust.*
9. Defective valve springs—*Renew.*
10. Incorrect ignition timing—*Rectify.*
11. Worn valve guides or valves—*Renew.*
12. Faulty cylinder head gasket—*Renew.*
13. Damaged exhaust system—*Rectify or renew.*

## E—ENGINE STARTS, BUT STOPS IMMEDIATELY

1. Faulty electrical connections—*Rectify low tension circuit.*
2. Foreign matter in fuel system—*Section M.*
3. Faulty fuel pump—*Section M.*
4. Low fuel level in tank—*Replenish.*

## F—ENGINE FAILS TO IDLE

1. Incorrect carburettor setting—*Section M.*
2. Faulty fuel pump—*Section M.*
3. See defect D, 7-12.
4. See defect D, 1-4.

## G—ENGINE MISFIRES ON ACCELERATION

1. Distributor points incorrectly set—*Rectify. Section P.*
2. Faulty coil or condenser—*Renew.*
3. Faulty sparking plug—*Rectify.*
4. Faulty carburettor—*Section M.*

## H—ENGINE KNOCKS

1. Ignition timing advanced—*Adjust.*
2. Excessive carbon deposit—*Decarbonise.*
3. Incorrect carburettor setting—*Section M.*
4. Unsuitable fuel—*Adjust octane selector.*
5. Worn pistons or bearings—*Renew.*
6. Distributor advance mechanism faulty—*Rectify. Section P.*
7. Defective sparking plugs—*Rectify or renew.*
8. Incorrect tappet clearance—*Adjust.*
9. Incorrect valve timing—*Adjust.*

## J—ENGINE BACKFIRES

1. Ignition defect—*Section P.*
2. Carburettor defect—*Section M.*
3. Incorrect valve timing—*Adjust.*
4. Incorrect tappet clearance—*Adjust.*
5. Sticking valve—*Rectify.*
6. Weak valve springs—*Renew.*
7. Badly seating valves—*Rectify or renew.*
8. Excessively worn valve stems and guides—*Renew.*
9. Loose timing chain—*Rectify tensioner.*
10. Excessive carbon deposit—*Decarbonise.*

## K—BURNED VALVES

1. Insufficient tappet clearance—*Adjust.*
2. Sticking valves—*Rectify.*
3. Weak valve springs—*Renew.*
4. Excessive deposit on valve seats—*Re-cut.*
5. Distorted valves—*Renew.*

## L—NOISY VALVE MECHANISM

1. Excessive tappet clearance—*Adjust.*
2. Sticking valves—*Rectify.*
3. Weak valve springs—*Renew.*
4. Faulty valve mechanism—*Renew worn parts.*

## M—MAIN BEARING RATTLE

1. Low oil pressure—*See defect N.*
2. Excessive bearing clearance—*Renew bearings; grind crankshaft.*
3. Burnt-out bearings—*Renew.*
4. Loose bearing caps—*Tighten.*

## N—LOW OIL PRESSURE

1. Thin or diluted oil—*Refill with correct oil.*
2. Low oil level—*Replenish.*
3. Choked pump intake filter—*Clean*
4. Faulty release valve—*Rectify.*
5. Excessive bearing clearance—*Rectify.*
6. Excessive camshaft bearing clearance—*Rectify.*
7. Loose or restricted oil line—*Rectify.*

## GENERAL DATA

Capacity (piston displacement)	1,997 cc (121.9 cu. in.)	Maximum torque	101 lb/ft (14 mKg) at 1,500 R.P.M.
Number of cylinders	4	Firing order	1—3—4—2
Bore	77,8 mm (3.063 in.)	Piston speed at 4,500 R.P.M.	3,110 ft/min. 15.75 m/sec.
Stroke	105 mm (4.134 in.)	Compression pressure (at starter motor cranking speed, i.e., 300 R.P.M. with engine hot)	125 lb/sq. in. 8,8 Kg/cm <sup>2</sup>
Compression ratio	6.9-1		
B.H.P.	52 at 4,000 R.P.M.		
B.M.E.P.	125 lb/sq.in. (8,8 Kg/cm <sup>2</sup> ) at 1,500 R.P.M.		

## DETAIL DATA

## Camshaft

Journal diameter	.874 in.—.0005 (22,2—0,001 mm)
Clearance in bearing	.001 to .002 in. (0,02 to 0,05 mm)
End-float	.003 to .005 in. (0,07 to 0,12 mm)

## Camshaft bearings

Type	Split Mazak die castings
Internal diameter	.876 in.—.001 (22,2—0,001 mm)

## Connecting rods

Bearing fit on crankpin	.001 to .0025 in. (0,02 to 0,06 mm)
Bearing nip	.002 to .004 in. (0,05 to 0,10 mm)
End-float at big-end	.009 to .013 in. (0,23 to 0,33 mm)
Gudgeon pin bush fit in small end	.001 to .002 in. (0,02 to 0,05 mm) interference
Gudgeon pin bush—Internal diameter—reamed in position	.8755 in.—.0005 (22,187 mm—0,012)
Fit of gudgeon pin in bush	.0003 to .0005 in. (0,007 to 0,012 mm) clearance

## Crankshaft

Journal diameter	2.005 in. (50,80 mm)
Crankpin diameter	1.875 in. (47,52 mm)
End-float	.002 to .006 (0,05 to 0,15 mm)

## Regrind sizes:

Undersize	Journal dia.	Crankpin dia.
.010 in.	1.990 in. (50,55 mm)	1.865 in. (47,37 mm)
.020 in.	1.980 in. (50,29 mm)	1.855 in. (47,12 mm)
.030 in.	1.970 in. (50,04 mm)	1.845 in. (46,87 mm)
.040 in.	1.960 in. (49,79 mm)	1.835 in. (46,62 mm)

## Flywheel

Number of teeth	97
Thickness at pressure face	1.093 in.—.016 (22,76—0,4 mm)
Maximum permissible run-out on flywheel face	.005 in. (0,12 mm)
Maximum refacing depth	.030 in. (0,75 mm)
Minimum thickness after grinding	1.063 in. (27 mm)
Markings:	
T.D.C.	When opposite pointer, No. 1 piston is at top dead centre
E.P.	When opposite pointer, No. 1 exhaust valve should be fully open. 114° before T.D.C.
F.A.10°	When opposite pointer, with both valves closed, indicates firing point of No. 1 cylinder.
Primary pinion bush	
Fit in flywheel	.001 to .003 in. (0,02 to 0,07 mm) interference
Internal diameter—reamed in position	.878 in. (22,3 mm)
Fit of shaft in bush	.003 to .004 in. (0,07 to 0,10 mm) clearance

## Gudgeon pin

Fit in piston (selective assembly)	Zero to .0003 in. (zero to 0,007 mm) interference
Fit in connecting rod bush (selective assembly)	.0003 to .0005 in. (0,007 to 0,012 mm) clearance

## Main bearings

Clearance on crankshaft journal	.001 to .002 in. (0,025 to 0,05 mm)
Bearing nip	.004 to .006 in. (0,10 to 0,15 mm)

Oil pump assembly See Section AO

### Pistons (Four-ring type)

Type	Light alloy, tin plated
Clearance in bore, measured at bottom of skirt at right angles to gudgeon pin	.0012 to .0017 in. (0,030 to 0,043 mm)
Clearance in bore, measured at top of skirt at right angles to gudgeon pin	.0022 to .0027 in. (0,055 to 0,068 mm)
Gudgeon pin bore	.8747 in. +.0002 (22,21 mm—0,005)

### Piston rings (Four-ring type)

Compression (2)	Taper periphery
Gap in bore	.015 to .020 in. (0,38 to 0,50 mm)
Clearance in groove	.0005 to .002 in. (0,012 to 0,05 mm)

### Scraper ring (upper) Early models only

Type	Stepped
Gap in bore	.012 to .017 in. (0,3 to 0,4 mm)
Clearance in groove	.0005 to .002 in. (0,012 to 0,05 mm)

### Scraper ring (lower)

Type	Slotted, H section
Gap in bore	.012 to .017 in. (0,3 to 0,4 mm)
Clearance in groove	.0005 to .002 in. (0,012 to 0,05 mm)

### Pistons (Three-ring type)

Type	Light alloy, tin plated
Clearance in bore, measured at bottom of skirt at right angles to gudgeon pin	.002 to .0025 in. (0,05 to 0,063 mm)
Clearance in bore, measured at top of skirt at right angles to gudgeon pin	.0030 to .0035 in. (0,076 to 0,089 mm)
Gudgeon pin bore	.8747 in. +.0002 (22,21 mm + 0,005)

### Piston rings (Three-ring type)

Compression (2)	Taper periphery
Gap in bore	.015 to .020 in. (0,37 to 0,50 mm)

Clearance in groove	.0018 to .0038 in. (0,045 to 0,096 mm)
---------------------	--

### Scraper (1)

Type	Slotted, H section
Gap in bore	.012 to .017 in. (0,30 to 0,43 mm)
Clearance in groove	.002 to .004 in. (0,050 to 0,10 mm)

### Rocker gear

Rockers and cam followers:		Inlet	Exhaust
Reamed bore		.500 in. + .001 (12,7 mm + 0,025)	.593 in. + .001 (15,08 mm + 0,025)
Clearance on shaft		.001 to .002 in. (0,025 to 0,050 mm)	.001 to .003 in. (0,025 to 0,075 mm)

### Tappet clearance

Exhaust, engine cold	.012 in. (0,30 mm)
Inlet, engine at running temperature	.010 in. (0,25 mm)

### Timing chain tensioner

#### Driving chain

Type	Endless roller, pre-stretched
Diameter of rollers	$\frac{1}{4}$ in. (6,35 mm)

#### Chain tensioner spring

Free length	4.200 in. (106,68 mm)
Length in position	1.937 in. (49,2 mm)
Load in position	$15\frac{1}{2}$ lb $\pm$ $\frac{1}{2}$ (7 Kg $\pm$ $\frac{1}{4}$ )

#### Hydraulic chain tensioner

Inlet valve lifts at	4 to 12 lb/sq.in. (0,30 to 0,80 Kg/cm <sup>2</sup> )
----------------------	--

### Thrust bearings, crankshaft

Type	Semi-circular, steel backed, tin plated
Thickness	.093 in.—.002 (2,36 mm — 0,05)
Oversizes	.0025 in., .005 in., .0075 in. and .010 in.

### Torque loadings

Connecting rod bolts	40 lb/ft. (5,5 mKg)
Cylinder head bolts:	
7/16 in. B.S.F.	55 lb/ft. (7,5 mKg)
3/8 in. B.S.F.	35 lb/ft. (4,5 mKg)
Main bearing bolts	80 lb/ft. (11 mKg)
Flywheel securing bolts	70 lb/ft. (9,7 mKg)

**Valves**

Inlet valve	
Diameter (stem) ....	.343 in.—.001 (8,71—0,025 mm)
Face angle ....	30°— $\frac{1}{4}$
Exhaust valve	
Diameter ....	.343 in.—.001 (8,71—0,025 mm)
Face angle ....	45°— $\frac{1}{4}$
Valve seat—inlet	
Type ....	Integral
Angle ....	30°+ $\frac{1}{4}$
Valve seat—exhaust	
Type ....	Removable insert
Angle ....	45°+ $\frac{1}{4}$
Fit in cylinder block	.005 in. to .007 in. (0,12 to 0,17 mm) interference
Fit of inlet and exhaust valves in guides ....	.002 to .003 in. (0,05 to 0,08 mm) clearance
Valve guides	
Length—inlet ....	1.968 in.—.016 (49,9—0,4 mm)
Length—exhaust ....	2.250 in.—.016 (57,15—0,4 mm)
Reamed bore ....	.3448 in.+0.0005 (8,757 mm+0,012)

**Valve springs**

Free length, inner ....	1.817 in. (46,0 mm)
Free length, outer ....	1.845 in. (46,8 mm)

Compressed length, inner ....	1.469 in. (36,3 mm)
Compressed length, outer ....	1.625 in. (41,2 mm)
Pressure, valve closed, inner ....	10 lb.± $\frac{1}{2}$ (4,5 kg± $\frac{1}{4}$ )
Pressure, valve closed, outer ....	32.8 lb.±1 (14,8 kg± $\frac{1}{2}$ )
Pressure, valve open, inner ....	17.9 lb.±1 (8,1 kg± $\frac{1}{2}$ )
Pressure, valve open, outer ....	74.0 lb.±1 (33,5 kg± $\frac{1}{2}$ )

**Valve timing**

Inlet opens....	9° B.T.D.C.
closes....	45° A.B.D.C.
peak ....	83° B.B.D.C.
Exhaust opens ....	42° B.B.D.C.
closes ....	16° A.T.D.C.
peak ....	66° A.B.D.C.

**Vibration damper**

Fit of bush in flywheel	.002 to .004 in. (0,05 to 0,10 mm) interference
Clearance of bush or driving flange ....	.005 to .007 in. (0,12 to 0,17 mm)
Run-out on front face	.005 in. (0,12 mm) maximum
Permissible out-of-balance ....	3 grams



# Section A — ENGINE — 2½ LITRE — PETROL

## INDEX TO OPERATIONS WITH ENGINE REMOVED

	Page		Page
Camshaft and bearings, to remove and refit ....	A-24, 25 and 29	Data ....	A-38—40
Camshaft chainwheels, to remove and refit ....	A-24—32	Defect location ....	A-37
Connecting rods, bearings and pistons, to remove and refit ....	A-24—29	Engine removal and replacement ....	A-22—35
Crankshaft, bearings and seals, to remove and refit ....	A-24—27	Engine to overhaul, complete ....	A-22—35
Cylinder head and rocker shaft, to remove and refit ....	A-23—32	Ignition timing ....	A-34
		Reboring and fitting cylinder liners ....	A-24
		Tappet adjustment ....	A-34
		Valves, timing ....	A-32—33

THE INDEX TO OPERATIONS WITH ENGINE IN THE CHASSIS IS ON PAGE A-36

## LIST OF ILLUSTRATIONS

Fig.	Page	Fig.	Page
A-31 Removing tappet roller guides ....	A-23	A-46 Checking camshaft end-float ....	A-30
A-32 Tappet guide and roller ....	A-23	A-47 Tappet guide and roller ....	A-30
A-33 Removing vertical drive shaft gear ....	A-24	A-48 Checking run-out on flywheel face ....	A-30
A-34 Checking piston clearance ....	A-25	A-49 Compressing valve springs ....	A-31
A-35 Checking piston ring gap ....	A-25	A-50 Fitting valve guides ....	A-31
A-36 Checking ring clearance in groove ....	A-25	A-51 Order of tightening cylinder head bolts ....	A-32
A-37 Outer camshaft bearing removal ....	A-25	A-52 Timing pointer ....	A-32
A-38 Inner camshaft bearing removal ....	A-26	A-53 Checking exhaust valve "fully open" position ....	A-32
A-39 Fitting camshaft front bearings ....	A-26	A-54 Timing diagram ....	A-33
A-40 Reaming camshaft bearings ....	A-27	A-55 Timing gear arrangement ....	A-33
A-41 Checking main bearing nip ....	A-27	A-56 Distributor, adaptor and driving gear ....	A-34
A-42 Checking crankshaft end-float ....	A-27	A-57 Adjusting tappets ....	A-34
A-43 Crankshaft rear oil seal ....	A-28	A-58 Hot-spot adjustment ....	A-35
A-44 Fitting rear bearing cap and seal assembly ....	A-28	A-59 Flywheel housing drain plug ....	A-36
A-45 Checking big-end bearing nip ....	A-29		

## ENGINE REMOVAL AND DISMANTLING PROCEDURE

### Removing engine

### Operation A/82

1. If fitted, remove the spare wheel from bonnet panel.
2. Remove the bonnet panel.
3. Disconnect the battery leads. If fitted, remove the exhaust heat shield.
4. Disconnect the air intake pipe from the carburettor and remove air cleaner.
5. Drain the coolant from system (one tap at bottom L.H. side of radiator and one tap at L.H. side of cylinder block).
6. Disconnect the side lamp leads at snap connectors at each side of the grille panel assembly and the front lamp harness from the junction box at R.H. side of scuttle, then pull the wiring clear to front of engine.
7. Detach the top hose at radiator header tank and the bottom hose from water pump inlet.
8. Remove the fan blades.
9. Remove the bolts securing the front apron and remove. Remove the bolts securing the grille panel to the front cross member and front wings.
10. Lift the radiator, grille panel and headlamps assembly upward, then forward to clear the vehicle.
11. Disconnect the exhaust pipe from exhaust manifold.
12. Disconnect the heater pipes (if fitted) at the engine side of scuttle.
13. Disconnect the inlet petrol pipe at pump.
14. Disconnect the throttle return spring, throttle linkage (at a ball joint) and the cold start control cable at carburettor and clamp. If fitted, disconnect the hand speed control rod (at a ball joint).
15. Disconnect: Dynamo wiring; ignition coil leads; starter lead from switch; oil pressure switch wire; thermostat switch wire (at L.H. front of engine).
16. Fit the engine sling to the support brackets at front and rear of cylinder head and with suitable lifting tackle just take the strain.
17. Disconnect the clutch slave cylinder hose at bracket mounted on scuttle.
18. Remove the front floor and gearbox cover.
19. Support the gearbox assembly with a jack or packing blocks.
20. Remove the three nuts and washers securing the clutch slave cylinder bracket to the flywheel housing and pull the complete assembly as far back as possible.
21. Remove the remaining nuts and washers securing the gearbox to the flywheel housing.
22. Remove the bolts from engine front support brackets and allow the engine to move forward and thus clear the gearbox input shaft. Ensure that the speedometer cable and all wires, etc., are clear, then hoist the engine gently from the vehicle.
23. Drain the oil from sump and remove.
24. Bolt the engine to a suitable stand, securing by the sump fixing studs.

## DISMANTLING ENGINE

### Externals

### Operation A/84

1. Disconnect the accelerator linkage (at a ball joint), distributor vacuum pipe and petrol pipe. Remove carburettor.
2. Detach sparking plug covers and leads, remove locating screw and withdraw the distributor. Remove sparking plugs. Disconnect and remove petrol pipe from pump.  
See Section M for overhaul of carburettor and Section P for overhaul of distributor.
3. If fitted, remove the heater pipes and flow control tap.
4. Remove the dynamo, fan belt and starter motor.  
See Section P for overhaul of dynamo and starter motor.
5. The rearmost tappet chamber cover and fuel pump may be removed as one unit; the foremost tappet chamber cover and oil filler pipe may also be removed together, complete with baffle plate (late models).  
See Section M for overhaul of fuel pump.
6. Remove the external full-flow oil filter complete with oil pressure warning switch.  
See Section AO for details of oil filter.
7. Disconnect the oil feed pipe—gallery to cylinder head, and the hose, thermostat to water pump casing.
8. Remove the rocker cover, dipstick, and dipstick tube.

### Clutch and flywheel, to remove

### Operation A/86

1. Mark the cover plate and flywheel, so that on reassembly the plate may be fitted in the same relative position, to retain the original balance of the unit.

2. Remove the clutch, flywheel and housing.  
See Section B for overhaul of clutch and flywheel.

#### Oil pump, to remove **Operation A/88**

1. Remove the securing bolts and withdraw the pump assembly.
2. Withdraw the driving shaft from the pump upper casing.

See Section AO for overhaul of oil pump.

#### Water pump, to remove **Operation A/90**

1. Remove the water pump assembly and pulley.  
See Section L for overhaul of water pump.

#### Fan driving pulley, to remove **Operation A/92**

1. Remove the starting dog pulley nut with special tool, Part No. 507234, then withdraw pulley.

#### Rocker shaft and cylinder head, to remove **Operation A/94**

1. Remove the rocker shaft cover, unscrew the bolts securing the rocker shaft support brackets, and lift the rocker shaft assembly complete from the cylinder head.
2. Ensure the component parts of the rocker shafts remain in their correct relative positions.
3. Withdraw the push rods and insert them in a piece of cardboard pre-pierced and numbered 1 to 8.
4. Loosen the securing bolts evenly and lift the cylinder head clear, complete with manifolds and thermostat.

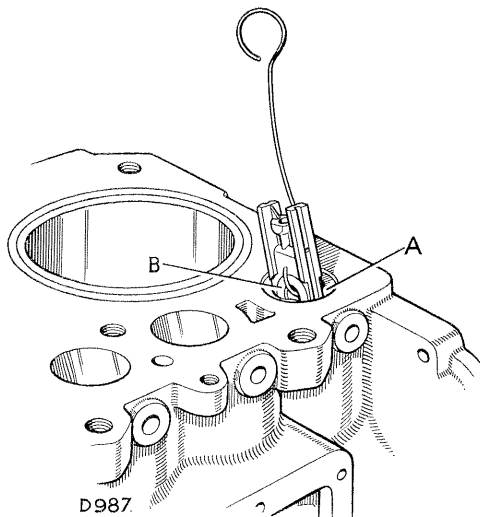


Fig. A-31—Removing tappet and roller  
A—Tappet guide B—Roller

#### Tappet assembly, to remove **Operation A/96**

1. Remove the tappet locating bolts from the R.H. side of the cylinder block.
2. Hook out the roller and brass tappet slide with a piece of wire, ensuring the tappet guide does not move. If the guide moves this may allow the roller to fall down into the camshaft chamber.  
The tappet assemblies are marked to ensure correct refitment as follows:

##### Roller

The front of the roller is indicated by a chamfer on its inside diameter.

##### Brass tappet slide

The tappet is clearly marked "Front".

##### Guide

The guide can only be fitted one way due to the bolt location hole. See Fig. A-32.

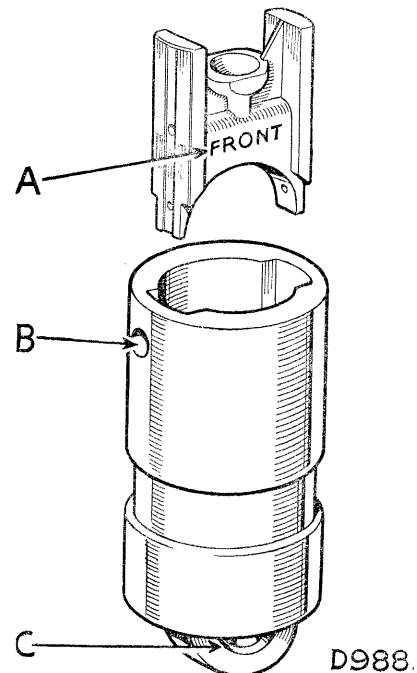


Fig. A-32—Tappet guide and roller

A—Brass tappet slide marked "Front"  
B—Tappet guide bolt location hole  
C—Roller with chamfer to front.

#### Vertical drive shaft gear, to remove **Operation A/98**

1. Remove the aluminium adaptor plate, then remove the distributor drive shaft from the vertical drive shaft. Remove the locating grub screw from the external filter adaptor joint face. Lift the drive shaft gear and external bush assembly clear, with a pair of snipe-nosed pliers. The split bush may be removed by tapping to release the dowels. Do not remove the aluminium plug in the gear unless absolutely necessary. A new plug must be fitted if the old one has been removed.



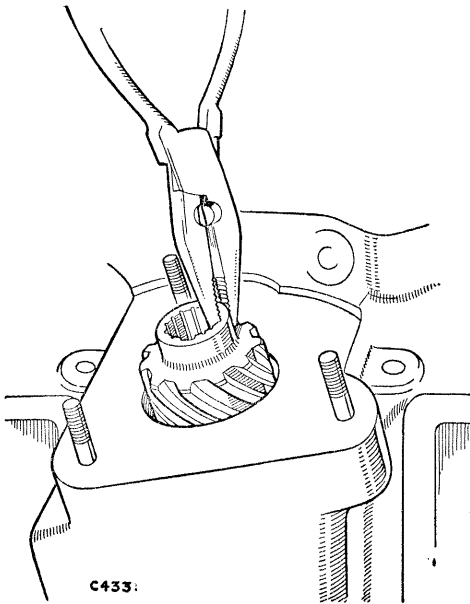


Fig. A-33—Removing the vertical drive shaft gear

**Front cover, chain tensioner and chainwheels, to remove** **Operation A/100**

1. Remove the front cover.
2. Remove the ratchet securing bolt and withdraw the ratchet and spring. Compress the chain tensioner spring, unscrew the lower fixing bolts and remove the chain tensioner assembly.
3. Lift off the timing chain and remove the chainwheels.

**Camshaft, to remove** **Operation A/102**

1. Remove the camshaft front thrust plate, then withdraw the camshaft.

**Pistons and connecting rods, to remove** **Operation A/104**

1. Turn the crankshaft until the pistons of numbers 1 and 4 cylinders are at B.D.C. Remove the big-end bolt securing nuts of numbers 1 and 4 connecting rods, then withdraw the piston and connecting rod assemblies from the top of cylinder block.
2. Repeat for numbers 2 and 3 assemblies.
3. Remove pistons from connecting rods and ensure that the component parts are retained in their correct relative positions.

**Crankshaft, main bearings and rear bearing seal, to remove** **Operation A/106**

1. Remove the main bearing caps, lift the crankshaft clear and place in a suitable stand.
2. Retain the shell bearings in pairs adjacent to the journal from which they were removed.
3. The rear bearing seal halves may be removed from the cylinder block and bearing cap.

**Cylinder block checks** **Operation A/108**

Check that the main bearing caps have not been filed, in the following manner.

1. Assemble the caps without bearing shells to the crankcase, ensuring that they are correctly located by means of the dowels. Tighten both securing bolts for each cap, then slacken one bolt of each pair right off. There should be no clearance at the joint face.

If there is a clearance, this indicates that the main bearing caps have been filed, and the cylinder block must be replaced.

**ENGINE ASSEMBLY**

**Reboring** **Operation A/110**

1. Reboring conforms to normal practice. The cylinder block may be rebored up to .040 in. (1,00 mm) oversize.
2. If the cylinder block is already bored out to maximum oversize, cylinder liners may be fitted. Cylinder liners can only be bored out to take standard size pistons.

**Cylinder liners** **Operation A/112**

1. Fitting cylinder liners conforms to normal practice.
2. Machine the cylinder block bores to 3.683 in. + .001 (93,54 mm + 0,025). This gives an interference fit of .003 to .004 in. (0,07 to 0,10 mm).
3. Press the liners into the cylinder block, Cylinder liners can only be bored out to standard size, that is 3.562 in. (90,47 mm).

**Checking piston fit in bore** **Operation A/114**

1. Graded pistons of standard size are available for replacement purposes. This does not apply to oversize pistons. The grade letter which is stamped on the piston crown represents a difference in diameter of .0002 in. (0,0051 mm) as shown below.

- 'Z' Nominal to minus .0002 in. (0,005 mm)
- 'A' Nominal to plus .0002 in. (0,005 mm)
- 'B' .0002 in. (0,005 mm) to .0004 in. (0,01 mm) above nominal
- 'C' .0004 in. (0,01 mm) to .0006 in. (0,015 mm) above nominal
- 'D' .0006 in. (0,015 mm) to .0008 in. (0,02 mm) above nominal

When fitting standard pistons in a comparatively new engine, a graded piston, corresponding to the piston removed, should be fitted. However, a check must be made to ensure that the clearance falls within the limits laid down. For example:

If the car has done little mileage and there is no appreciable bore wear, a graded piston of the same size as that taken out should be used; however, if a certain amount of bore wear is apparent it may be necessary to fit a piston two or three

grades larger than the one removed. In the case of a top-limit piston fitted as original equipment it may be necessary to rebore to the first oversize to obtain the correct piston fit.

The grade size of any particular bore is also stamped on the cylinder block at the sump joint face, using the same letters as stamped on the piston crown.

2. In order to obtain the correct piston clearance with a new piston in a new or worn bore, insert a long .0025 in. (0,063 mm) feeler gauge down the thrust side of the cylinder, that is the left-hand side of the cylinder looking at the engine from the front. Insert the piston upside down in the cylinder bore with the gudgeon pin in line with the centre line of the engine. Push the piston down the cylinder until the piston skirt reaches its tightest point in the bore, where the feeler gauge should require a 10 lb. pull to withdraw it.

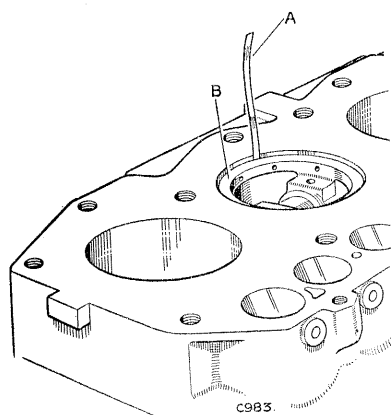


Fig. A-34—Checking piston clearance  
A—Feeler gauge B—Piston

It may be necessary to check the clearance of several pistons in the bore before the correct one is selected.

This method of checking the piston clearance ensures that the piston has the correct clearance in its working position.

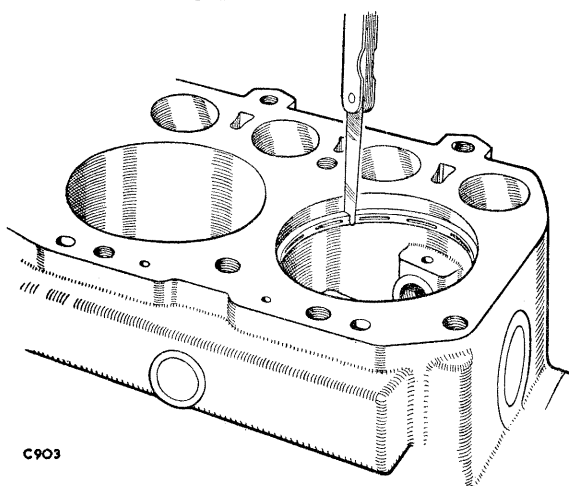


Fig. A-35—Checking piston ring gap

### Piston ring fitting

### Operation A/116

1. Check the piston ring gaps in the cylinder bores, using an old piston as illustrated in Fig. A-35, to keep the rings square in the bore.
2. The two compression rings are of the tapered periphery type, and must be fitted with the side marked "T" uppermost; the oil scraper ring has a square friction edge and may be fitted either way. Fit the piston rings and check the clearance in the oil groove. Clearance should not exceed .0005 to .002 in. (0,012 to 0,05 mm).

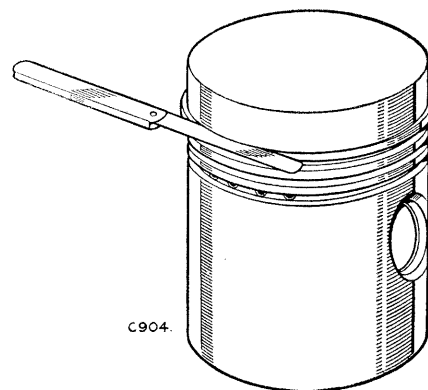


Fig. A-36—Checking ring clearance in groove

### Camshaft bearings, to renew

### Operation A/118

When new camshaft bearings are to be fitted, the front and front intermediate bearings must be removed and new ones fitted **before** removing the rear bearings.

1. Unscrew the 3½ in. (88 mm) long stud from the joint face at front of cylinder block.

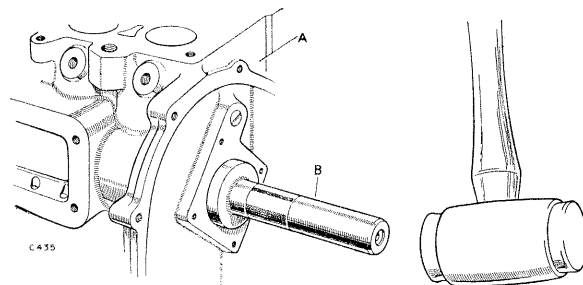


Fig. A-37—Outer camshaft bearing removal  
A—Cylinder block B—Drift

2. Drift the front camshaft bearing into the foremost tappet chamber, using tool Part No. 274388, then withdraw the bearing from the chamber aperture.
3. The front intermediate bearing is removed by drifting it into the distributor drive chamber, using the same tool, but it must be collapsed before withdrawing from the drive aperture as illustrated in Fig. A-38.

Fit new front and front intermediate bearings, **before** removing the rear bearings with drift.

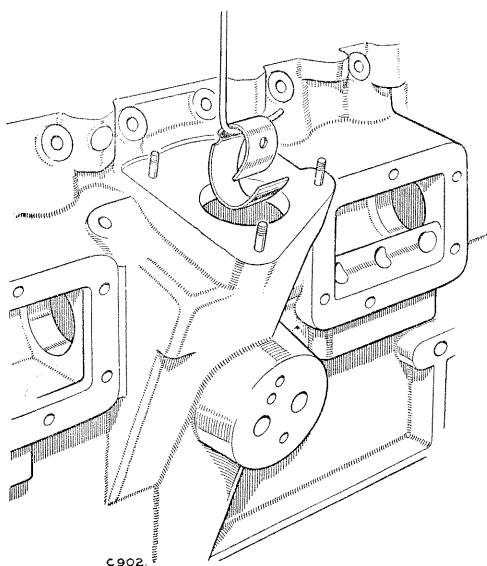


Fig. A-38—Inner camshaft bearing removal

4. Fit a guide tool, Part No. 274385, into the two old rearmost bearings with the part of flange marked "TOP" uppermost, then insert three end cover set bolts loosely for location purposes. Position a new bearing on to the handle end of bearing fitting bar, Part No. 274382, and locate by means of the peg and semi-circular cut-out, then slide a spacer, Part No. 274383, on to the fitting bar and engage the locating shoulder.

5. Place a new bearing on spigot, Part No. 274384, and position it inside the foremost tappet chamber with the bearing nearest the front intermediate housing.

Insert the bearing fitting bar into the front bearing housing and feed the spigot on to the bar; withdraw the spigot handle. Turn the spigot to engage the locating shoulder in the spacer, then press the fitting bar inward, turning as necessary to engage the bar slot with the peg in guide tube.

6. When the fitting bar has been pressed in as far as possible by hand, ensure that all locating points are properly engaged, then drive the bearings into position with a hide-faced hammer.

Remove the bearing fitting tools and check the oil holes for alignment. Remove the two rearmost bearings as illustrated in Figs. A-37 and A-38.

7. Fit new camshaft rear bearings in the same manner as for front bearing fitment, but remove the spacer from fitting bar and use guide tool, Part No. 274386, instead of the guide tube used when fitting front bearings.

8. Locate a guide plug, Part No. 274394, in the front new camshaft bearing and locate, using the end plate screws. Do not tighten these screws until the reamer, Part No. 274389, is put into position and the guide collar immediately in front of the cutter is entered into the rearmost bearing, which is first to be cut. This precaution is to ensure correct alignment of the reamer. Before commencing the reamering operation it is necessary to turn the engine block to a vertical position, i.e. front end facing downwards, in order that the weight of the reamer will assist in the cutting operation. As each bearing is cut the reamer should be held steady by the operator whilst an assistant, using a high-pressure air line, blows away the white metal cuttings, before allowing the reamer to enter the next bearing.

9. After the rearmost and the two intermediate bearings have been cut, remove the guide plug Part No. 274394, before cutting the foremost bearing. Remove the reamer handle and carefully remove the reamer, turning it in the same direction as for cutting. Care must be taken to prevent the reamer damaging the foremost bearing as the reamer is removed.

No lubricant is necessary for the reamering operation, best results are obtained when the bearings are cut dry.

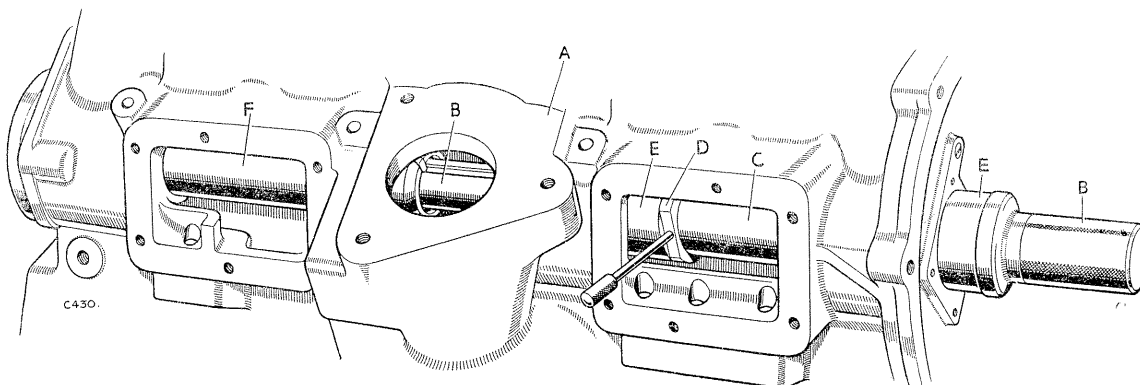


Fig. A-39—Fitting camshaft front bearings

- |                       |                |
|-----------------------|----------------|
| A—Cylinder block      | D—Spigot       |
| B—Bearing fitting bar | E—New bearings |
| C—Spacer              | F—Guide tube   |

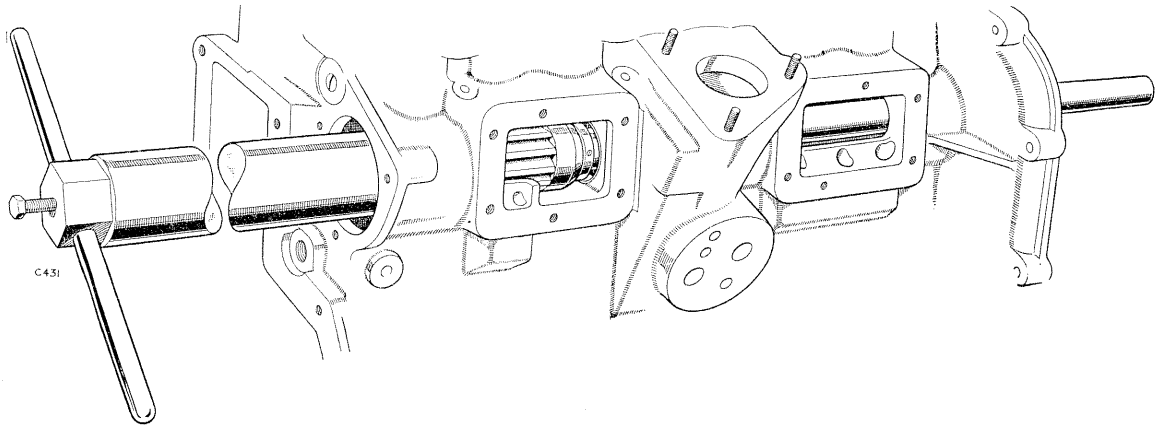


Fig. A-40—Reaming camshaft bearings  
(Engine must be in vertical position)

Remove the plugs from the ends of oil gallery passage and clean the gallery and oil feed passages to camshaft and crankshaft bearings, using compressed air. Refit the plugs and lock in position.

10. The cylinder block must be thoroughly cleaned at this stage.

#### Crankshaft main bearings and seals

##### Operation A/120

Check the main bearing nip in the following manner.

1. Remove the bearing caps and fit the bearing shells, locating by means of the tags. Tighten the caps down and slacken off one bolt of each pair. Check the bearing nip, as illustrated in Fig. A-41, ensuring that the clearance does not exceed .004 to .006 in. (0,10 to 0,15 mm). The nip can be corrected by selective assembly of bearing shells; these are available in slightly varying thicknesses.

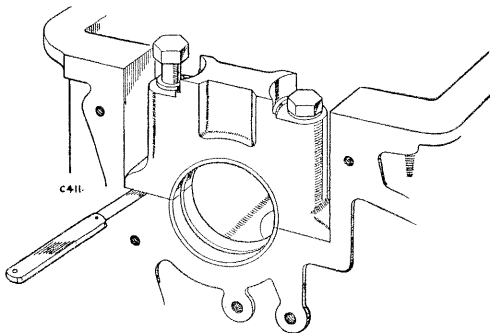


Fig. A-41—Checking main bearing nip

2. When the bearing nip has been checked, remove the caps and bearing shell bottom halves. Position a standard size thrust bearing at each side of centre bearing shell—top half, and fit the crankshaft.

3. Refit the bearing shell bottom halves and bearing caps. Tighten the securing bolts evenly and check each bearing in turn for correct clearance. The crankshaft should resist rotation when a feeler paper, .0025 in. (0,06 mm) thick, is placed between any one bearing shell and crankshaft journal, and turn freely by hand when the feeler paper is removed. Adjust by selective assembly of bearing shells.

4. Mount a dial test indicator, then check and note the crankshaft end-float reading which should be .002 to .006 in. (0,050 to 0,15 mm).

If the crankshaft end-float reading obtained is not within the limits, fit suitable oversize thrust bearings. The variation of thrust bearing thickness at each side must not exceed .003 in. (0,07 mm) to ensure that the crankshaft remains centralised.

5. Remove the bearing caps, bottom half shells and crankshaft.

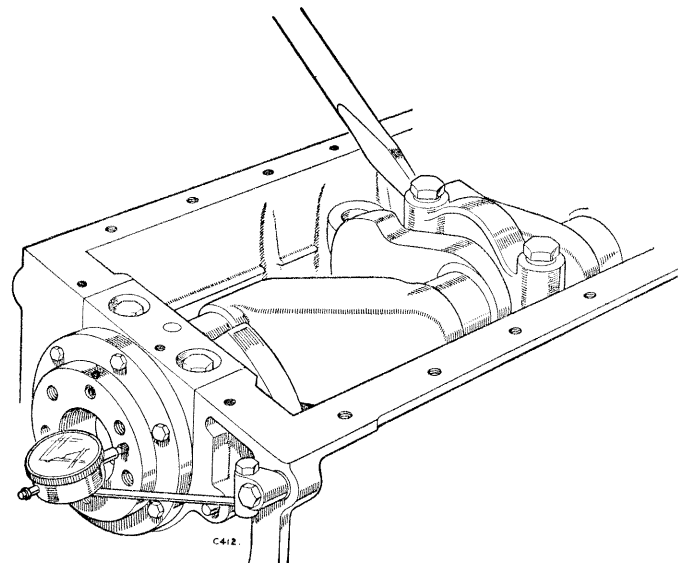


Fig. A-42—Checking crankshaft end-float

6. To the rear main bearing cap fit neoprene seals in recess at each side.

#### Fitting two-piece oil seal

7. **Preparatory work.** This preparatory work is essential when fitting the seal to a new crankshaft and desirable when fitting to a crankshaft which has been in service.

To ensure efficient lubrication during the initial running-in period of the oil seal, the crankshaft oil seal journal must be treated with a mixture of molybdenum disulphide and Butyl acetate as detailed below:

- (a) **Thoroughly stir** the mixture immediately prior to use.
- (b) Degrease the crankshaft oil seal journal.
- (c) Paint mixture evenly on to the surface of the oil seal journal with a fine brush; alternatively, if a quantity of crankshafts are being done, it can be sprayed on with a gravity feed spray gun, using 40 lb./sq.in. (2,8 kg/cm<sup>2</sup>) air-line pressure. This solution, which **must be dry** before the seal is fitted, takes approximately 10 minutes to dry, and the surface must not be scratched after treatment. On crankshafts which have been previously run the solution will take 15 minutes to dry thoroughly. A warm air stream may be used to reduce these times if necessary.

#### Procedure

8. Bolt the cylinder block half of the oil seal firmly on to the block by the three bolts. With five-bolt fixing seals leave the two bolts adjacent to the split line loose.
- Bolt the other half of the oil seal to the rear main bearing cap in the same manner.
9. Refit the crankshaft, first lubricating the journals, bearing shells and thrust bearings.
10. The groove in each half of the oil seal is to be half filled with Silicone MS4 Compound, ensuring no grease reaches the split line face.

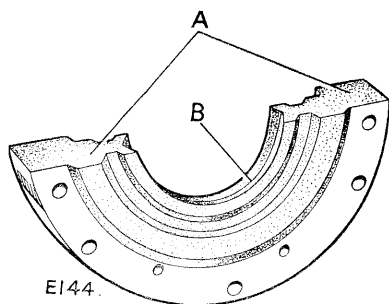


Fig. A-43—Rear crankshaft oil seals

A—Apply 'Heldite' jointing compound at this face.  
B—Fill groove with Silicone MS4 Compound

11. Apply 'Heldite' jointing compound to both split line joint faces on each half of the seal. **This instruction does not apply to the three-piece type oil seal.**

The compound should be spread thinly over the surface, ensuring it reaches across the sealing lips, but must not be allowed to get on to the lips themselves. See Fig. A-43. This compound must be allowed to become tacky before assembly.

12. Fit rear main bearing cap and tighten to the required torque.
13. Where applicable, tighten the four bolts adjacent to the split line.
14. Rotate crankshaft through a small arc to prevent the jointing compound from adhering to the crankshaft.
15. Fitment of the rear main bearing cap, with side seals in position, will be facilitated by using a lead tool (Part No. 270304) fitted to the sump studs adjacent to rear bearing cap aperture. See Fig. A-44.
16. It will be found advantageous to cut a very slight lead on to the bottom edges of side seals as this will prevent them from folding under the cap during fitment, thus causing an oil leak due to the cap not seating properly. Lubricate seals with Silicone MS4 Compound.

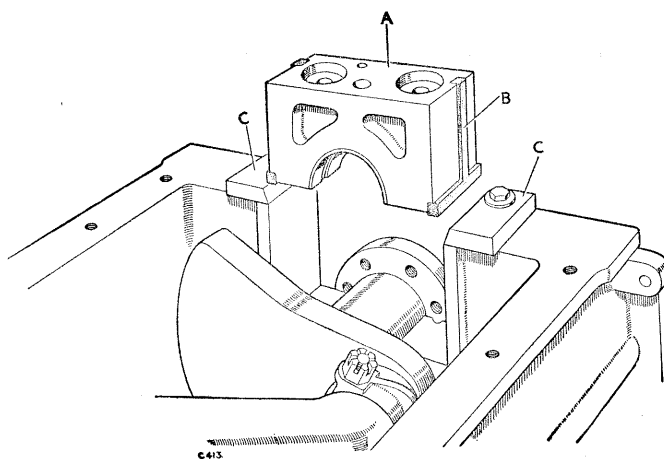


Fig. A-44—Fitting rear bearing cap and seal assembly

A—Bearing cap B—Seal C—Lead tool

#### Connecting rod checks Operation A/122

1. Check that the connecting rods and caps have not been filed as follows:
2. Select the correct cap for each connecting rod, as denoted by the number stamped near the joint faces. This number also indicates the crankpin to which it must be fitted.
3. Assemble the connecting rods, less shell bearings, with corresponding numbers together.

4. Tighten the securing bolts, then slacken one of them right off and check that there is no clearance at the joint face.

If there is a clearance, this indicates that the connecting rods or caps have been filed, and the assemblies must be replaced.

#### Connecting rod bearing nip Operation A/124

1. Check the bearing nip as follows:—
2. Fit the bearing shells and tighten both securing bolts—slacken one bolt as before and check the nip with a feeler gauge; this should be .002 to .004 in. (0,05 to 0,10 mm).
3. The nip can be corrected by selective assembly of the bearing shells; these are available in slightly varying thickness. Do **not** file the rod or cap.
4. Assemble the big-end of each connecting rod to its respective crankpin, then check for correct clearance.

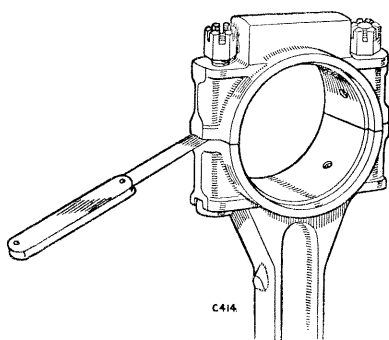


Fig. A-45—Checking big-end bearing nip

5. The connecting rod should resist rotation when a .0025 in. (0,063 mm) shim paper is fitted between the crankpin and one-half of big-end bearing shell, then move freely by hand when the shim paper is removed. Adjust by selective assembly of bearing shells.
6. Bearing clearance should be .001 to .0025 in. (0,025 to 0,063 mm).
7. Check the connecting rod end-float on crankpin by inserting a feeler gauge between the end face of rod and the crankpin shoulder. End-float should be .007 to .011 in. (0,17 to 0,27 mm).
8. Remove the connecting rods from crankshaft, ensuring that the bearing shells are kept with the rods to which they were fitted.

#### Connecting rods and pistons, to refit

##### Operation A/126

1. The oil hole in gudgeon pin bush is pre-drilled and care must be taken to ensure that the oil holes of bush and connecting rod will align when the bush is pressed into position. The gudgeon pin bushes should be a .001 to .002 in.

(0,025 to 0,050 mm) interference fit in connecting rods. Ream the bush when fitted to connecting rod to allow a .0003 to .0005 in. (0,007 to 0,012 mm) gudgeon pin clearance. Ensure that correct alignment is maintained while reamering.

This fit is selected to give the smallest possible clearance consistent with a smooth revolving action.

2. Fit each connecting rod to a suitable test rig and check for twist and mal-alignment.
3. The gudgeon pin, when cold and dry, should be an easy sliding fit in the connecting rod.

The gudgeon pin should be fitted to the piston with the piston warmed to 120°-140°F, and should be an easy hand fit.

If the piston is not warmed to within this range, the pin may "pick up" on the piston bores, and will rattle when the engine is at normal running temperature.

4. Fit the connecting rods to the pistons with the oil spray hole of the rod facing the same side of the cylinder block as the camshaft.
5. Turn the crankshaft until the crankpins relative to numbers 1 and 4 cylinders are at B.D.C. Insert the connecting rods and pistons for these cylinders from the top of cylinder block, with the oil spray hole in connecting rod towards the right-hand side of engine—towards the camshaft. Secure the big-ends to crankpins, using new bolts and nuts; tightening nuts to 35 lb/ft (4 mkg), for machined threads and 25 lb/ft (3,5 mkg) for bolts with rolled threads (identified by a drill point at the nut end).
6. Repeat Item 5 for numbers 2 and 3 cylinders.

#### Camshaft, to refit

##### Operation A/128

When replacing camshafts it should be noted that 2½ litre petrol engine camshafts are marked "petrol" between No. 1 and No. 2 cam lobes. This is to differentiate between diesel and petrol camshafts, which look similar in all respects except for the positioning of the cam lobes.

1. Insert the camshaft—keyed end to extend at front of engine.
2. Fit the front thrust plate and secure the camshaft chainwheel but do not bend up the locking tab for securing bolt at this stage.

Check the camshaft end-float with a dial test indicator as illustrated by Fig. A-46 and ensure that the reading is within .0025 to .0055 in. (0,063 to 0,139 mm).

Adjust by selective assembly of the front thrust plate.

3. Refit the camshaft rear end cover.

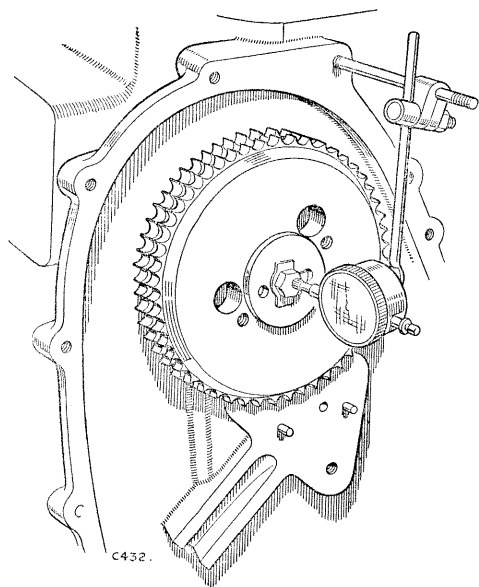


Fig. A-16—Checking camshaft end-float

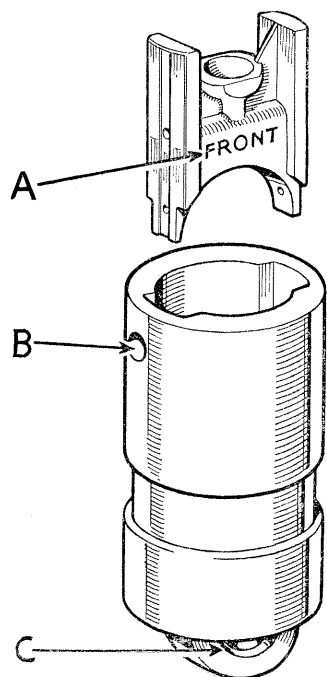
**Tappet assembly, to replace Operation A/130**

1. Before fitting the tappet assembly into the block, thoroughly clean all parts and check that the tappet will move freely in the tappet guide when held in the hand and shaken up and down.

2. Fit tappet guides into the cylinder block, ensuring that the locating hole lines up with the hole in the cylinder block.

The tappet guides must not be too tight in the block or they may be damaged by insertion of the locating screw in cases when they are not properly aligned.

3. Gently insert the roller into the guide. Do not drop the roller, as it is easily damaged.

Fig. A-47—  
Tappet guide and roller

- A—Brass tappet slide marked "Front"  
B—Tappet guide bolt location hole  
C—Roller with chamfer to the front

4. Fit tappet into the guide and locate on to the roller. The tappet is marked "Front" and must be facing the front of the guide.
5. Fit the tappet locating screws and washers; the locating screws must be screwed up with the fingers and then tightened; if they are not free, remove and investigate reason.
6. Lock the locating screws in pairs, using 20 s.w.g. iron wire.

**Flywheel housing, flywheel and clutch, to replace Operation A/132**

1. Ensure that the rear main bearing oil seal is in good condition, then secure the flywheel housing to cylinder block. See note regarding drain plug at end of section.

2. Fit the flywheel and tighten the securing bolts to 50 lb/ft (7 mkg) torque.

3. Check the run-out on flywheel face as illustrated in Fig. A-48. The run-out on flywheel face must not exceed .002 in. (0.050 mm).

4. Ensure that the clutch disc splines are clean, and will slide on every one of the primary shaft splines.

5. Fit the clutch assembly to the flywheel, using an old primary shaft to ensure that the clutch disc is central with the flywheel bush.

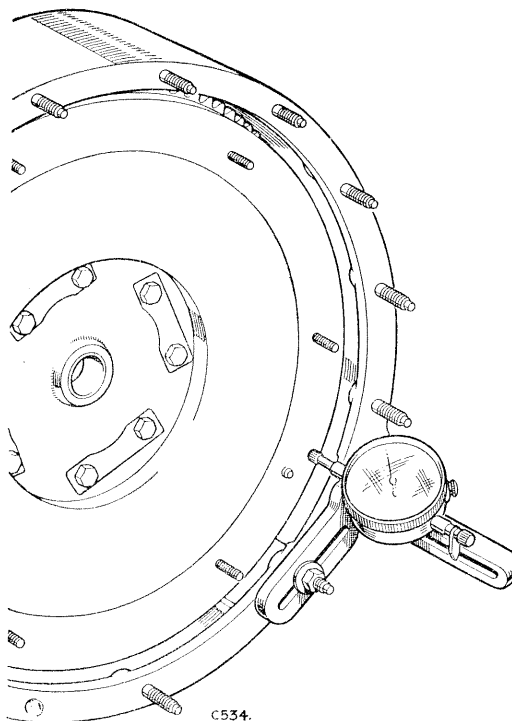


Fig. A-48—Checking run-out on flywheel face

**Cylinder head, valves and rocker shaft, to overhaul Operation A/134**

1. If necessary remove the inlet and exhaust manifold assembly and thermostat.

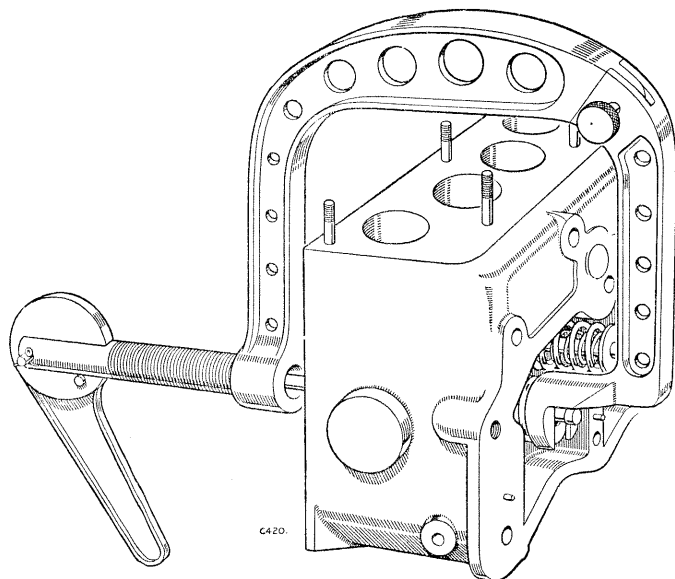


Fig. A-49—Compressing valve springs

2. Using a valve spring compressing tool, Part No. 276102, remove the valve assemblies.
3. If necessary drift the valve guides from the cylinder head, using tool Part No. 274401 (exhaust) and 274400 (inlet).
4. Pull the new inlet and exhaust valve guides into position, using tool Part No. 274406.

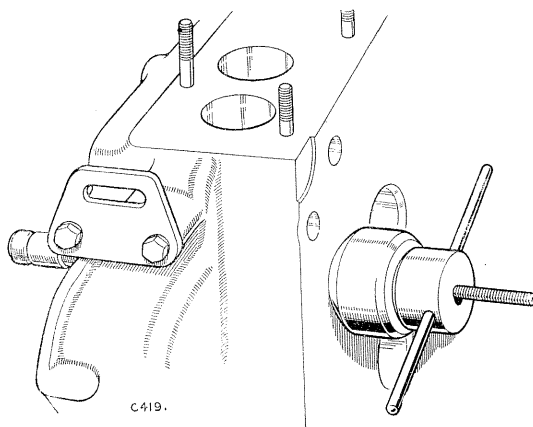


Fig. A-50—Fitting valve guides

#### Valve seats, to renovate      Operation A/135

1. It is necessary to remove the very hard crust of carbon from the valve seats with a piece of emery cloth before attempting to reface them as personal injury can be caused by flying fragments of hard carbon.
2. Reface the valve seats, using Standard Workshop Vibro-Centric equipment. Always ensure that the cutting angle is correct and dress the stone before use.

When cutting the valve seats do not use excessive weight on the tool as this will cause the cutter to judder and thus ruin the seating.

Seat angle, inlet	....	30°
Seat angle, exhaust	....	45°

3. Using a little grinding paste, lap the new or reground valves into the seatings.
4. When lapping is completed, thoroughly wash the cylinder head and valves in paraffin, to remove all traces of grinding paste. Retain the valves in their original order.
5. Fit a new rubber seal into each valve guide, noting that the larger diameter seals must be fitted to the exhaust valve guides.
6. Lubricate the valve stem and fit the valves, springs, cups and split cotters, ensuring that the components are retained in their original sets and positions.

**A new valve seal must be fitted whenever a valve is removed.**

The valve springs have an interference fit of .005 in. If the inner spring will slide through the outer spring both must be renewed.

7. Refit the manifolds to the cylinder head, using a new gasket. Tighten all securing nuts evenly, to ensure alignment of the gasket faces.
8. Test the thermostat before refitting to cylinder head, by immersing in hot water. Expansion should commence between 164°F and 173°F and be complete at 193°F.

Insert the thermostat with rubber "O" ring in the housing in cylinder head and fit the joint washer and cover.

#### Rocker shaft, to overhaul      Operation A/136

1. If necessary, press new bushes into the rockers. The oil holes in the rocker bushes are pre-drilled and care must be taken to ensure that the oil holes of bush and rocker will align when pressed into position.
2. Reamer the bush to .530 in. +.001 (13,4 mm + 0,02) to obtain the correct clearance. The reamer and rocker assembly must be held in such a manner as to ensure the correct alignment of the reamed hole.
3. Align the rocker shafts, with the bored ends together, and slide a support bracket on to each shaft. The locating hole in each bracket must be positioned immediately above the chamfered



hole in shaft, 4.75 in. (120,65 mm) from the plugged end, and then secured with a locating screw and spring washer.

4. Assemble the remaining components with the plugged end of the shafts in the end brackets and the bored end of both shafts located in the centre bracket.

#### Cylinder head and rocker shaft, to replace Operation A/138

1. Smear the joint face of cylinder block and cylinder head gasket with engine oil, then fit the gasket and cylinder head assembly to cylinder block.
2. Locate head and gasket with the securing bolts, fitting all bolts **except** those which also secure the rocker shaft pedestals, but do not tighten at this stage.
3. Insert the push-rods into their original positions, through cylinder head and locate in the tappets.
4. Slacken off all tappet adjusting screws and offer the rocker assembly to cylinder head. Fit the bracket securing bolts, but do not tighten.
5. Tighten down the cylinder head bolts in the order indicated by Fig. A-51. The  $\frac{1}{2}$  in. U.N.F. bolts, including those that also secure the rocker brackets, must be pulled down to 65 lb/ft (8,9 mkg) whilst the  $\frac{5}{16}$  in. U.N.F. bolts securing the rocker brackets only are pulled down to 12 lb/ft (1,66 mkg).

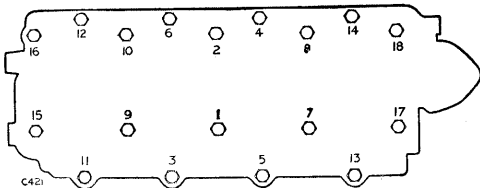


Fig. A-51—Order of tightening cylinder head bolts

#### Chainwheels, timing chain, adjuster and valve timing Operation A/140

1. The screwed plug and ball may be removed from the piston if necessary and the piston pressed from its housing if unduly worn.
2. The tensioner cylinder and bush must be renewed complete if the bush is unduly worn.
3. The bushes in idler wheel and ratchet arm should also be removed if worn beyond reasonable limits.
4. If removed, fit the crankshaft chainwheel on to shaft and key.

5. Turn the crankshaft in direction of rotation until the E.P. mark on flywheel is in line with the timing pointer.

6. Rotate the camshaft until the dwell of the cam serving the exhaust valve for No. 1 cylinder is nearest the tappet and set the tappet clearance to .010 in. (0,25 mm).

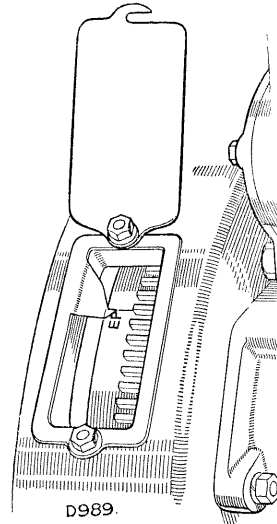


Fig. A-52—Timing pointer

7. Fit a dial test indicator so that the “fully open” position of the valve can be ascertained in the following manner:—
8. Turn the camshaft in direction of rotation until the lobe of cam has nearly opened the valve fully, then stop rotation and mark the chainwheel and timing casing to record the position.
9. Note the reading on dial test indicator, then continue to turn the chainwheel slowly in direction of rotation until the needle has again reached the same position.

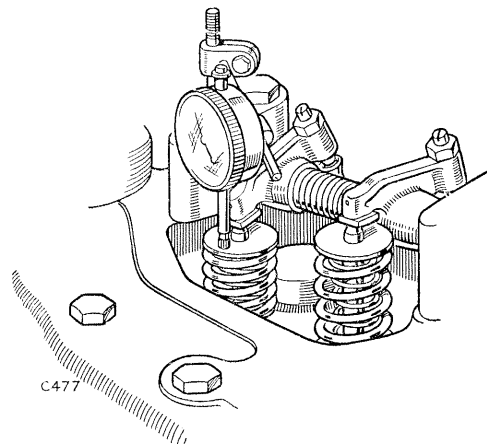


Fig. A-53—  
Checking exhaust valve “fully open” position

10. Mark the chainwheel at a point opposite to the mark on timing casing and make a third mark on the chainwheel, exactly between those made previously.
11. Turn the camshaft **against** direction of rotation until the third mark is in line with that on timing casing, whereon the valve should be fully open.
12. Fit the timing chain with "no slack" on the driving side. It may be necessary to remove and re-position the camshaft chainwheel to obtain this "no slack" condition on the driving side when the flywheel and camshaft are correctly positioned.
13. Fit new bushes to the chain tensioner components as necessary; ensure that the fits and clearances are in accordance with those laid down in the Data Section. Position the ball in chain tensioner piston and secure with the retaining clip. Fit the compression spring over piston, locate the cylinder assembly, compress the spring and retain in compressed position. Place the idler wheel on bearing arm and offer the assembly to the cylinder block, locating by means of the dowels. Screw the stepped bolt with ratchet and spring in position into cylinder block, then finally secure with two set bolts. Remove the spring compressing clip and allow the idler wheel to take up the chain slack.

16. Lock the set bolt securing camshaft chainwheel when timing has been set satisfactorily.

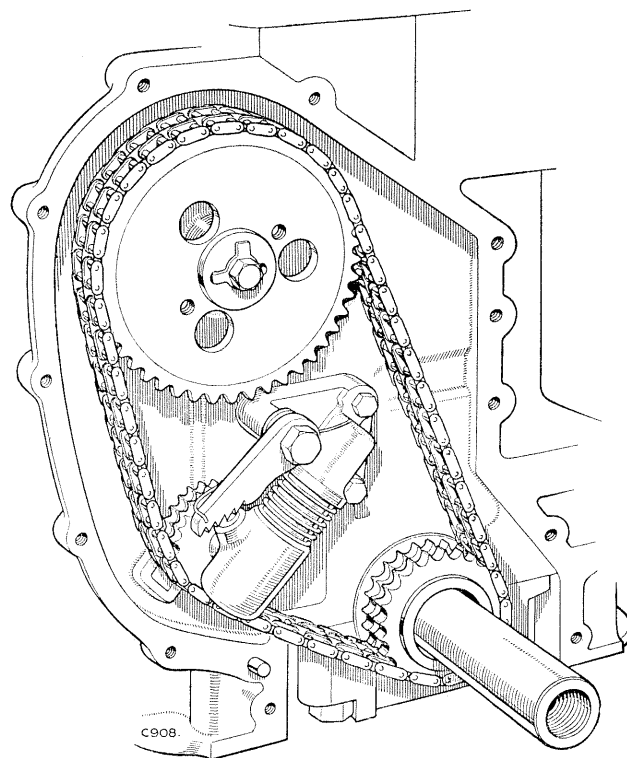


Fig. A-55—Timing gear arrangement

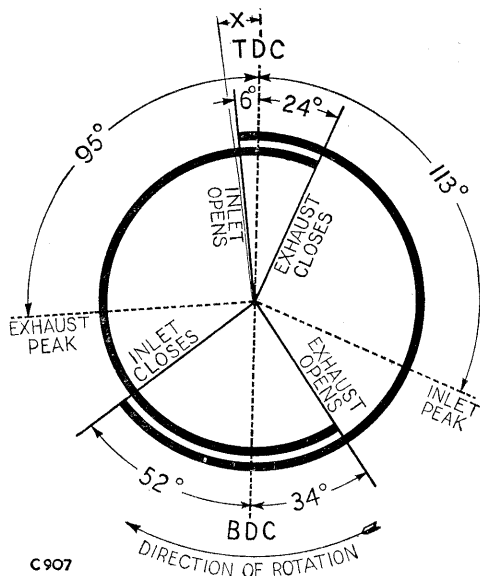


Fig. A-51—Timing diagram

14. Turn the flywheel **against** direction of rotation approx. 90°, then slowly in direction of rotation, checking that the exhaust valve reaches the "fully open" position, as indicated by the dial test indicator, exactly when the "E.P." mark on flywheel is in line with the pointer on flywheel housing.
15. Adjust if necessary by means of the six irregularly spaced keyways in the timing chainwheel. This arrangement allows a variation of 2° between each position.

#### Front cover, to replace Operation A/142

1. Examine the crankshaft oil seal and replace if necessary, using a little sealing compound on the outside of the seal.
2. Position new joint washers and fit the front cover.

#### Fan driving pulley, to replace Operation A/144

1. Examine the hub of the pulley for excessive wear, and if necessary fit a replacement.
2. Locate the pulley on the crankshaft and key, then secure with the locking washer and starting dog.

#### Vertical drive shaft gear, to assemble Operation A/146

1. Fit the circlip to groove dividing the upper and lower internal splining and enter the tapered splined plug in the end furthest from gear teeth, small end first.
2. Drift the plug into the gear until it abuts on the circlip.
3. Lubricate the split bush and fit it to the gear with the reduced diameter nearest the teeth.

### Ignition timing and vertical drive gear, to replace Operation A/148

1. Rotate the crankshaft in direction of rotation until the 3° mark on the flywheel, using regular fuels, or 6° mark, using premium fuels, is in line with the pointer on the flywheel housing and both valves of number 1 cylinder are closed.
2. Locate the vertical drive shaft so that with the short distributor drive shaft entered into the splines, the narrow segment of the distributor drive shaft is toward the R.H. side of the vehicle and the slot pointing toward number 1 cylinder. Lock the driving gear assembly in position with a grub screw.
3. Locate and secure the aluminium adaptor plate.
4. Locate a cork washer in the recess in top of adaptor plate.
5. Check the distributor contact breaker gap and adjust to .012 to .014 in. (0,35 to 0,40 mm). Set the octane selector so that the fourth line from L.H. side of the calibrated slide is against the face of the distributor body casting.
6. Rotate the distributor spindle in direction of arrow on rotor arm until the rotor is at the firing point for number 1 cylinder. With the vacuum unit facing rearward, the narrow segment of the distributor shaft should be toward the R.H. side of the vehicle and the slot pointing toward number 1 cylinder.
7. Mount the distributor and secure to distributor adaptor plate.

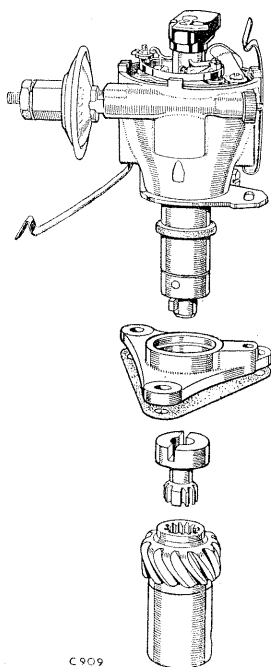


Fig. A-56—Distributor, adaptor and driving gear

8. Slacken the pinch bolt in base of distributor body and rotate the distributor in opposite direction to arrow on rotor arm until the contactor breaker points are just opening with the cam follower on the leading side of the cam. Re-tighten the pinch bolt.
9. Connect one lead of a 12 volt test lamp to the distributor L.T. terminal and the other one to a good earth on engine. Switch ignition 'on' and turn the crankshaft two revolutions in direction of rotation. The bulb should light as the pointer on flywheel housing comes into line with the predetermined mark on flywheel. See item 1.
10. Adjust as required by slackening the pinch bolt and turning the distributor bodily, or for fine adjustment, by means of the vernier screw.

### Oil pump

### Operation A/150

See Section AO for overhaul of oil pump.

1. Insert the longer splined end of driving shaft into the pump and locate in the driving gear.
2. With the inlet port rearward, and the splined upper end of driving shaft aligned to the vertical drive gear, offer the pump to engine and secure in position.

No provision is made for oil pressure adjustment.

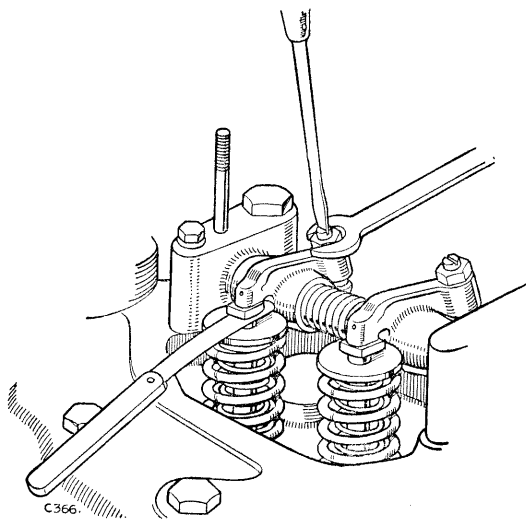


Fig. A-57—Adjusting tappets

### Tappet adjustment

### Operation A/152

1. Turn the crankshaft in direction of rotation until number 8 valve (counting from front end of engine) is fully open. In this position the tappet for number 1 valve is on the dwell of its cam and the tappet clearance may be set with a .010 in. (0,25 mm) feeler inserted between the rocker and valve stem. Recheck the clearance after tightening the locknut.

The tappets should be set in the following order:

- Set No. 1 tappet with No. 8 valve fully open.
- Set No. 3 tappet with No. 6 valve fully open.
- Set No. 5 tappet with No. 4 valve fully open.
- Set No. 2 tappet with No. 7 valve fully open.
- Set No. 8 tappet with No. 1 valve fully open.
- Set No. 6 tappet with No. 3 valve fully open.
- Set No. 4 tappet with No. 5 valve fully open.
- Set No. 7 tappet with No. 2 valve fully open.

#### Water pump fitment to front cover

##### Operation A/154

1. Renew the joint washer, then locate and secure the pump to front cover.

#### Externals

##### Operation A/156

1. Fit the oil filter assembly and joint washer.
2. Secure the breather pipe and oil filler assembly, complete with baffle plate, where fitted, and joint washers over the forward tappet chamber aperture and steady bracket, to top of cylinder block.
3. Mount and secure the petrol pump and cover plate assembly over the rear tappet chamber aperture.
4. Fit the starter motor and dynamo.
5. Fit the dynamo driving belt and adjust the tension to allow the belt to move  $\frac{3}{16}$ — $\frac{1}{4}$  in. (4—6 mm) when pressed by thumb between the crankshaft and water pump pulleys.
6. Connect the oil feed pipe and pressure gauge assembly between cylinder head and cylinder block rear end.
7. Secure the coolant pipe to thermostat and water pump casings.
8. Position the joint washer and fit the rocker and valve gear cover.
9. Fit the oil sump.
10. Fit the exhaust and inlet manifold assemblies.
11. Fit the sparking plugs and connect leads between plugs and distributor.
12. Fit the carburettor and connect the vacuum pipe between carburettor and distributor.  
Fit petrol pipe between pump and carburettor.

#### Thermostatically controlled hot spot

The hot spot, located in the centre of the exhaust manifold, see Fig. A-58, is accurately adjusted before the vehicle leaves the factory and should not require any further attention, but if after a very long period of service, it becomes necessary to alter the setting, the operation should be carried out as detailed below:—

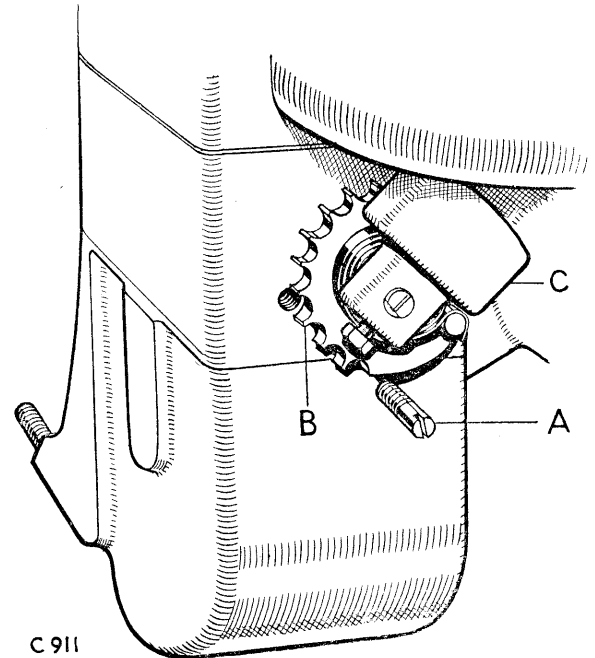


Fig. A-58—Hot spot adjustment

A—Set screw B—Adjustment plate C—Balance weight

#### To adjust

##### Operation A/158

1. Remove the retaining set screw 'A' and turn the serrated adjustment plate 'B', in an anti-clockwise direction until the balance weight 'C' is just supported.
2. Replace the retaining set screw, selecting the appropriate serration, and tighten.

#### Engine—to refit

##### Operation A/160

1. Reverse the removal procedure—fit new mounting rubbers if necessary.  
Refill with lubricating oil, 11 Imperial pints, 13 U.S. pints (6,0 litres) and coolant, 17½ Imperial pints, 20½ U.S. pints (9,75 litres).
2. See Section M for details of carburettor setting.
3. Check for oil and coolant leaks—rectify as necessary.

## OVERHAULS TO ENGINE IN CHASSIS

Decarbonise and grind in valves, carry out the following operations:

Page	Operation	Items
A-22	A/82	1 to 5
A-22	A/84	As necessary
A-23	A/94	All
A-30 and 32	A/134 and A/138	All
A-34	A/148	As necessary
A-34	A/152	All
A-35	A/156 and A/158	As necessary

Timing chain, tensioner or front cover oil seal, to renew, carry out the following operations:

Page	Operation	Items
A-22	A/82	1 to 10
A-23	A/90 and A/92	All
A-24	A/100	All
A-32	A/140 to A/144	All
A-34	A/148	As necessary
A-34	A/152 to A/160	As necessary

Camshaft or roller tappets, to renew, carry out the following operations:

Page	Operation	Items
A-22	A/82	1 to 10
A-22	A/84	As necessary
A-23	A/90 to A/102	All

**CAMSHAFT BEARINGS CANNOT BE RENEWED WHILST THE ENGINE IS IN THE CHASSIS**

Page	Operation	Items
A-29	A/128 and A/130	All
A-32	A/138 to A/148	All
A-34	A/152 and A/154	All
A-35	A/154 to A/160	As necessary

Reboring, renewing pistons, rings, little-ends or big-end bearings, carry out the following operations:

Page	Operation	Items
A-22	A/82	1 to 5
A-22	A/84	As necessary
A-23	A/88	All
A-23	A/94	All
A-24	A/104	All
A-24	A/112 to A/116	All
A-28	A/122 to A/126	All
A-32	A/138	All
A-34	A/150	All
A-34	A/152	All
A-35	A/156 to A/160	As necessary

Rocker shaft, to overhaul, carry out the following operations:

Page	Operation	Items
A-23	A/94	1
A-31	A/136	All
A-32	A/138	As necessary
A-34	A/152	All

Oil pump and filters .... Section AO

Water pump and thermostat Section L

Flywheel and clutch .... Section B

Starter, dynamo and distributor Section P

Carburettor and petrol pump Section M

### Flywheel housing drain plug

The drain plug should not be fitted to the housing, unless the vehicle is expected to operate under very muddy conditions, or to wade. The plug should be screwed into the stowage bracket fitted to later models, or stored in the tool locker.

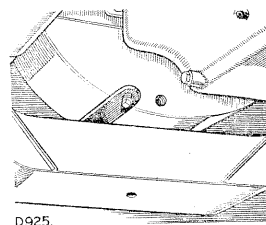


Fig. A-59—Flywheel housing drain plug and stowage bracket

## DEFECT LOCATION

## (Symptom, Cause and Remedy)

## A—ENGINE FAILS TO START

1. Incorrect starting procedure—*See Instruction Manual.*
2. Starter motor speed too low—*Check battery and connections.*
3. Faulty ignition system—*Section P.*
4. Water or dirt in fuel system—*Rectify. Section M.*
5. Carburetter flooding—*Section M.*
6. Defective fuel pump—*Section M.*
7. Defective starter motor—*Section P.*
8. Starter pinion jammed in flywheel—*Rotate starter shaft with spanner to free pinion.*
9. Starter pinion not engaging—*Clean drive sleeve and pinion with paraffin.*

## B—ENGINE STALLS

1. Low idling speed—*Section M.*
2. Faulty sparking plugs—*Rectify.*
3. Faulty coil or condenser—*Renew.*
4. Faulty distributor points—*Rectify or renew. Section P.*
5. Incorrect tappet clearance—*Adjust.*
6. Incorrect mixture—*Adjust carburetter. Section M.*
7. Foreign matter in fuel system—*Rectify. Section M.*

## C—LACK OF POWER

1. Poor compression—*If the compression is appreciably less than the correct figure, (Page A-34) the piston rings or valves are faulty. Decarbonise and grind in valves.*
2. Badly seating valves—*Rectify or renew.*
3. Faulty exhaust silencer—*Renew. Section N.*
4. Incorrect ignition timing—*Rectify. Section P.*
5. Leaks or restrictions in fuel system—*Section M.*
6. Faulty sparking plugs—*Rectify.*
7. Clutch slip—*Section B.*
8. Excessive carbon deposit—*Decarbonise.*
9. Brakes binding—*Section H.*
10. Faulty coil, condenser or battery—*Section P.*

## D—ENGINE RUNS ERRATICALLY

1. Faulty electrical connections—*Rectify.*
2. Defective sparking plugs—*Rectify.*
3. Low battery charge—*Recharge battery. Section P.*
4. Defective distributor—*Rectify. Section P.*
5. Foreign matter in fuel system—*Section M.*
6. Faulty fuel pump—*Section M.*
7. Sticking valves—*Rectify or renew.*
8. Incorrect tappet clearance—*Adjust.*
9. Defective valve springs—*Renew.*
10. Incorrect ignition timing—*Rectify.*
11. Worn valve guides or valves—*Renew.*
12. Faulty cylinder head gasket—*Renew.*
13. Damaged exhaust system—*Rectify or renew.*

## E—ENGINE STARTS, BUT STOPS IMMEDIATELY

1. Faulty electrical connections—*Rectify low tension circuit.*
2. Foreign matter in fuel system—*Section M.*
3. Faulty fuel pump—*Section M.*
4. Low fuel level in tank—*Replenish.*

## F—ENGINE FAILS TO IDLE

1. Incorrect carburetter setting—*Section M.*
2. Faulty fuel pump—*Section M.*
3. See defect D, 7-12.
4. See defect D, 1-4.

## G—ENGINE MISFIRES ON ACCELERATION

1. Distributor points incorrectly set—*Rectify. Section P.*
2. Faulty coil or condenser—*Renew.*
3. Faulty sparking plugs—*Rectify.*
4. Faulty carburetter—*Section M.*

## H—ENGINE KNOCKS

1. Ignition timing advanced—*Adjust.*
2. Excessive carbon deposit—*Decarbonise.*
3. Incorrect carburetter setting—*Section M.*
4. Unsuitable fuel—*Adjust octane selector.*
5. Worn pistons or bearings—*Renew.*
6. Distributor advance mechanism faulty—*Rectify. Section P.*
7. Defective sparking plugs—*Rectify or renew.*
8. Incorrect tappet clearance—*Adjust.*
9. Incorrect valve timing—*Adjust.*

## J—ENGINE BACKFIRES

1. Ignition defect—*Section P.*
2. Carburetter defect—*Section M.*
3. Incorrect valve timing—*Adjust.*
4. Incorrect tappet clearance—*Adjust.*
5. Sticking valve—*Rectify.*
6. Weak valve springs—*Renew.*
7. Badly seating valves—*Rectify or renew.*
8. Excessively worn valve stems and guides—*Renew.*
9. Loose timing chain—*Rectify tensioner.*
10. Excessive carbon deposit—*Decarbonise.*

## K—BURNED VALVES

1. Insufficient tappet clearance—*Adjust.*
2. Sticking valves—*Rectify.*
3. Weak valve springs—*Renew.*
4. Excessive deposit on valve seats—*Re-cut.*
5. Distorted valves—*Renew.*

## L—NOISY VALVE MECHANISM

1. Excessive tappet clearance—*Adjust.*
2. Sticking valves—*Rectify.*
3. Weak valve springs—*Renew.*
4. Faulty valve mechanism—*Renew worn parts.*

## M—MAIN BEARING RATTLE

1. Low oil pressure—*See N.*
2. Excessive bearing clearance—*Renew bearings; grind crankshaft.*
3. Burnt-out bearings—*Renew.*
4. Loose bearing caps—*Tighten.*

## N—LOW OIL PRESSURE

1. Thin or diluted oil—*Refill with correct oil.*
2. Low oil level—*Replenish.*
3. Choked pump intake filter—*Clean.*
4. Faulty release valve—*Rectify.*
5. Excessive bearing clearance—*Rectify.*
6. Excessive camshaft bearing clearance—*Rectify.*
7. Loose or restricted oil line—*Rectify.*

## GENERAL DATA

Capacity (piston displacement) .....	2,286 cc. (140 cu.in.)
Number of cylinders .....	4
Bore .....	3.562 in. (90,47 mm)
Stroke .....	3.5 in. (88,8 mm)
Compression ratio .....	7 : 1
B.H.P. at 4,250 R.P.M. ....	77
B.M.E.P. ....	134 lb./sq. in. (9,421 Kg/cm <sup>2</sup> ) at 2,500 R.P.M.

Maximum torque .....	124 lb./ft. (17 mKg) at 2,500 R.P.M.
Firing order .....	1 . 3 . 4 . 2
Piston speed at 4,280 R.P.M. ....	2,500 ft./min. (12,6 m/sec.)
Compression pressure (at starter motor cranking speed, with engine hot) .....	145 lb./sq.in. (10,2 Kg./cm <sup>2</sup> )

## DETAIL DATA

## Camshaft

Journal diameter	.... 1.842 in.—.001 (26,70 mm—.002)	.030 in. (0,762 mm)	2.470 in. (62,738 mm)	2.095 in. (53,213 mm)
Clearance in bearing	.... .001 to .002 in. (0,02 to 0,05 mm)	.040 in. (1,016 mm)	2.460 in. (62,484 mm)	2.085 in. (52,959 mm)
End-float	.... .0025 to .0055 in. (0,06 to 0,14 mm)			
Cam lift—inlet	.... .257 in. (6,53 mm)			
Cam lift—exhaust	.... .257 in. (6,53 mm)			

## Camshaft bearings

Type	.... Split, steel backed, white metal lined
Internal diameter (line-reamed in position)	1.843 in.+.0005 (46,8 mm+0,012)

## Connecting rods

Bearing fit on crankpin	.001 to .0025 in. (0,025 to 0,063 mm)
Bearing nip	.... .002 to .004 in. (0,05 to 0,10 mm)
End-float at big-end	.... .007 to .011 in. (0,177 to 0,280 mm)
Gudgeon pin bush, fit in small-end	.... .001 to .002 in. (0,02 to 0,05 mm)
Gudgeon pin bush internal diameter—reamed in position	1.000 in.+.0005 (25,4 mm+0,012)
Fit of gudgeon pin in bush	.... .0003 to .0005 in. (0,007 mm to 0,012 clearance)

## Crankshaft

Journal diameter	.... 2.5 in.—.001 (63,5 mm—0,025)	
Crankpin diameter	.... 2.126 in.—.001 (53,9 mm—0,025)	
End-float (controlled by thrust washers at centre bearing)	.... .002 to .006 in. (0,05 to 0,15 mm)	
Regrind sizes		
Undersize	Journal dia.	Crankpin dia.
.010 in. (0,254 mm)	2.490 in. (63,246 mm)	2.115 in. (53,721 mm)
.020 in. (0,508 mm)	2.480 in. (62,992 mm)	2.105 in. (53,467 mm)

## Flywheel

Number of teeth	.... 97
Thickness at pressure face	.... 1.515—.015 in. (38,5—0,39 mm)
Maximum permissible run-out on flywheel face	.... .002 in. (0,05 mm)
Primary pinion bush Fit in flywheel	.... .001 to .003 in. (0,02 to 0,08 mm)
Internal diameter—reamed in position	.875 in.+.002 (23,2 mm+0,05)
Fit of shaft in bush	.001 to .003 in. (0,025 to 0,076 mm)
Maximum refacing depth	.... .030 in. (0,76 mm)
Minimum thickness after grinding	.... 1.485 in. (37,7 mm)

## Markings

T.D.C.	.... When opposite pointer, No. 1 piston is at top dead centre
E.P.	.... When opposite pointer, No. 1 exhaust valve should be fully open.
3° (Regular fuels)	.... When opposite pointer, indicates firing point of
6° (Premium fuels)	.... No. 1 cylinder when both valves are closed.

## Gudgeon pin

Fit in piston	.... Zero to .0002 in. (0,005 mm) interference
Fit in connecting rod bush	.... .0003 to .0005 in. (0,0076 to 0,013 mm) clearance

## Main bearings

Clearances on crankshaft journal	.... .001 to .0025 in. (0,02 to 0,06 mm)
Bearing nip	.... .004 to .006 in. (0,10 to 0,15 mm)

Oil pump assembly.... See Section AO.

**Pistons**

Type	.....	Light alloy, tin plated, flat top
Clearance in bore, measured at bottom of skirt at right angles to gudgeon pin	.....	.0023 to .0028 in. (0,058 to 0,071 mm)
Clearance in bore, measured at top of skirt at right angles to gudgeon pin	.....	.0035 to .004 in. (0,89 to 0,10 mm)
Fit of gudgeon pin in piston	.....	Zero to .0002 in. (0,005 mm) interference
Gudgeon pin bore	.....	.9998 in+.002 (25,37 mm +0,05)

**Piston rings**

Compression (2)		
Type	.....	Taper periphery
Gap in bore	.....	.015 to .020 in. (0,38 to 0,50 mm)
Clearance in groove	.....	.0005 to .002 in. (0,012 to 0,05 mm)
Scraper		
Type	.....	Slotted, square friction edge
Gap in bore	.....	.015 to .020 in. (0,38 to 0,50 mm)
Clearance in groove	.....	.0005 to .002 in. (0,012 to 0,05 mm)

**Rocker gear**

Bush internal diameter, reamed in position	.....	.53 in+.001 (13,4 mm + 0,02)
Shaft clearance in rocker bush	.....	.001 to .002 in. (0,02 to 0,05 mm)

Tappet clearance	.....	.010 in. (0,25 mm) hot or cold
------------------	-------	--------------------------------

**Timing chain tensioner**

Fit of bush in cylinder	.....	.003 to .005 in. (0,07 to 0,12 mm) interference
Fit of bush in idler wheel	.....	.001 to .003 in. (0,02 to 0,07 mm) interference
Fit of idler wheel on steel shaft	.....	.001 to .003 in. (0,02 to 0,07 mm) clearance
Fit of piston in cylinder bush	.....	.0005 to .001 in. (0,001 to 0,02 mm) clearance

**Thrust bearings, crankshaft**

Type	.....	Semi-circular, steel back, tin plated on friction surface
Standard size, total thickness	.....	.093 in.—.002 (2,362 mm —0,05)
Oversizes	.....	.0025 in. (0,06 mm) .005 in. (0,12 mm) .0075 in. (0,18 mm) .010 in. (0,25 mm)

**Torque loadings**

Connecting rod bolts ( $\frac{3}{8}$ in. U.N.F.)	.....	35 lb/ft (4,84 Kg/m) for bolts with machined threads and 25 lb/ft (3,5 Kg/m) for bolts with rolled threads (identified by a drill point at the nut end)
--	-------	---

Cylinder head bolts, special	.....	65 lb/ft (8,98 Kg/m)
Main bearing bolts ( $\frac{9}{16}$ in. U.N.F.)	.....	85 lb/ft (11,75 Kg/m)
Rocker shaft support bracket bolts ( $\frac{5}{16}$ in. U.N.F.)	.....	12 to 13 lb/ft (1,66 to 1,80 Kg/m)
Flywheel securing bolts	.....	50 lb/ft (6,91 Kg/m)

**Valves**

Inlet valve		
Diameter (stem)	.....	.312 in.—.001 (7,93 mm—0,02) or .311 in.—.0005 (7,91 mm—0,01) later type
Face angle	.....	30°— $\frac{1}{4}$
Exhaust valve		
Diameter (stem)	.....	.343 in.—.001 (8,73 mm—0,02) or .342 in.—.0005 (8,70 mm—0,01) later type
Face angle	.....	45°— $\frac{1}{4}$
Fit of inlet and exhaust valves in guide	.....	.001 to .003 in. (0,02 to 0,07 mm)

**Valve seat**

Seat angle—inlet	.....	30°
Seat angle—exhaust	.....	45°

**Valve guides**

Inlet guide bore size, after fitting	.....	.3125 in+.0015 (7,93 mm+0,04)
Exhaust guide bore size, after fitting	.....	.3435 in+.0015 (8,73 mm+0,04)



**Valve springs—inlet**

## Inner

Length—free .... 1.61 in. (40,89 mm)

Length under 17.5 lb

(7,9 kg) load .... 1.38 in. (35,1 mm)

## Outer

Length—free .... 1.76 in. (44,9 mm)

Length under 46 lb.

(21 kg) load .... 1.50 in. (38,3 mm)

**Valve springs—exhaust**

## Inner

Length—free .... 1.61 in. (40,89 mm)

Length under 18.5 lb

(8,3 kg) load .... 1.37 in. (34,8 mm)

## Outer

Length—free .... 1.76 in. (44,9 mm)

Length under 48 lb

(21,76 kg) load .... 1.49 in. (38 mm)

**Valve timing**

Inlet opens .... 6° B.T.D.C.

Inlet closes .... 52° A.B.D.C.

Inlet peak .... 113°

Exhaust opens .... 34° B.B.D.C.

Exhaust closes .... 24° A.T.D.C.

Exhaust peak .... 95°

**Vertical drive shaft gear**

Backlash .... .006 to .010 in. (0,15 to 0,25 mm)

Internal diameter of  
bush .... 1.00 in. +.001 (25,4 mm +0,02)

Fit of gear in bush .... .001 to .003 in. (0,02 to 0,07 mm) clearance

# Section A—ENGINE—2 LITRE—DIESEL

## INDEX TO OPERATIONS WITH ENGINE REMOVED

	Page		Page
Camshaft and bearings, to remove and refit	A-44, 45—49	Data	A-60—62
Camshaft chainwheels, to remove and refit	A-44—53	Defect location	A-59
Connecting rods, bearings and pistons, to remove and refit	A-44—48	Engine removal and replacement	A-42—57
Crankshaft, bearings and seals, to remove and refit	A-44—46	Engine, to overhaul, complete	A-42—57
Cylinder head and rocker shaft, to remove and refit	A-43—53	Hot plugs, to renew	A-52
		Injection pump timing	A-55
		Injector shrouds, to remove and refit	A-52
		Liners, to remove and refit	A-44—48
		Tappet adjustment	A-56
		Valve timing	A-53

THE INDEX TO OPERATIONS WITH ENGINE IN THE CHASSIS IS ON PAGE A-53

## LIST OF ILLUSTRATIONS

Fig.	Page	Fig.	Page
A-61 Removing tappet and roller	A-43	A-80 Compressing valve springs	A-51
A-62 Tappet guide and roller	A-43	A-81 Fitting valve guides	A-51
A-63 Removing vertical drive shaft gear	A-44	A-82 Valve seat cutting tool	A-51
A-64 Outer camshaft bearing removal	A-44	A-83 Push-rod tube removal	A-52
A-65 Inner camshaft bearing removal	A-45	A-84 Correct position of push-rod tubes in relation to hot plugs	A-52
A-66 Fitting camshaft bearings	A-45	A-85 Fitting push-rod tubes	A-52
A-67 Reamering camshaft bearings	A-46	A-86 Order of tightening cylinder head bolts	A-53
A-68 Checking main bearing nip	A-46	A-87 Timing pointer	A-53
A-69 Checking crankshaft end-float	A-47	A-88 Checking exhaust valve "fully-open" position	A-54
A-70 Rear crankshaft oil seal	A-47	A-89 Timing gear arrangement	A-54
A-71 Fitting rear bearing cap and seal assembly	A-47	A-90 Timing diagram	A-54
A-72 Checking cylinder liner extension	A-48	A-91 Driving gear in correct timing position	A-55
A-73 Checking piston clearance	A-48	A-92 Injection pump timing marks correctly aligned	A-55
A-74 Checking piston ring gap	A-48	A-93 Adjusting tappets	A-56
A-75 Checking ring clearance in groove	A-49	A-94 Position of injection nozzle washers	A-56
A-76 Checking big-end bearing nip	A-49	A-95 Flywheel housing drain plug	A-58
A-77 Checking camshaft end-float	A-50		
A-78 Tappet guide and roller	A-50		
A-79 Checking run-out on flywheel face	A-50		

## ENGINE REMOVAL AND DISMANTLING PROCEDURE

The information in this Section, covering the dismantling and assembly of the engine, is also applicable to the Series I Diesel models.

### Removing engine Operation A/162

1. If fitted remove the spare wheel from bonnet.
2. Disconnect the bonnet support stay and remove the bonnet.
3. Disconnect the hose from inlet manifold, unscrew the securing wing nut and lift the air cleaner and hose clear.
4. Disconnect the battery leads and remove the L.H. battery.
5. Drain the coolant from system (one tap at bottom L.H. side of radiator and one tap at L.H. side of cylinder block).
6. Disconnect the side lamp leads at each side of the grille panel assembly and the front lamp harness from the junction box at R.H. side of scuttle, then pull the wiring clear to front of engine.
7. Detach the top hose at radiator header tank and the bottom hose from water pump inlet.
8. Remove the fan blades.
9. Remove bolts securing the front apron. Remove the bolts securing the grille panel to front cross-member and front wings.
10. Lift the radiator, grille panel and headlamps assembly upward, then forward to clear the vehicle. Remove the L.H. battery support.
11. Loosen the bolts securing the intermediate to front exhaust pipe and disconnect the exhaust pipe from exhaust manifold.
12. Disconnect the heater pipes (if fitted) at the engine side of bulkhead.
13. Disconnect the wiring from starter motor, dynamo, oil pressure warning switch and glow-plug lead at resistance on **bulkhead**.
14. Disconnect the fuel inlet and outlet pipes from fuel lift pump and injection pump, then disconnect the three pipes joined at scuttle, lower R.H. side.
15. Remove the accelerator control rod, then the cut-off control cable from the steady bracket on engine and from the lever on injection pump.
16. Fit the engine sling to the support brackets at front and rear of cylinder head and with suitable lifting tackle just take the strain.
17. Disconnect the clutch slave cylinder hose at bracket mounted on dash.
18. Remove the front floor and gearbox cover.
19. Support the gearbox assembly with a jack or packing blocks.

20. Remove the clutch slave cylinder bracket from the flywheel housing and pull back the complete assembly as far as possible.
21. Remove the remaining nuts and washers securing the gearbox to the flywheel housing.
22. Remove the bolts from engine front support brackets, allow the engine to move forward and thus clear the gearbox input shaft. Ensure that the speedometer cable, etc., and all wires are clear, then hoist the engine gently from the vehicle.
23. Drain engine oil and remove the sump.
24. Bolt the engine to a suitable stand, securing by the sump fixing studs.

## DISMANTLING ENGINE

### Externals Operation A/164

1. Disconnect the fuel spill gallery pipe from injectors and remove the fuel feed pipes— injection pump to injectors.
2. Remove the securing straps, then withdraw the injectors and seating washers. Make sure the small steel washer is also removed from out of the orifice in the cylinder head.
3. Release the accelerator pull-off spring and remove the injection pump; disconnect the wiring, then remove heater plugs carefully to avoid damage to element.
4. All items of injection equipment should be stored in dustproof containers or submerged in clean Diesel fuel.  
See Section M for details of all fuel injection equipment.
5. If necessary remove the inlet and exhaust manifolds, then the starter, fan belt and dynamo.  
See Section P for overhaul of starter and dynamo.
6. Disconnect the heater pipes and water tap from cylinder head if fitted. Remove the fuel filter from mounting bracket at R.H. front of engine.
7. The rearmost tappet chamber cover and fuel lift pump may be removed as one unit; the foremost tappet chamber cover and oil filler pipe may also be removed together.  
See Section M for details and overhaul of fuel filters and lift pump.
8. Remove the external full-flow oil filter complete with oil pressure warning switch.  
See Section AO for details of oil filter.
9. Disconnect the oil feed pipe—gallery to cylinder head.  
Remove the rocker cover, dipstick and dipstick tube.

**Clutch and flywheel, to remove****Operation A/166**

1. Mark the cover plate and flywheel, so that on reassembly the plate may be fitted in the same relative position, to retain the original balance of the unit.
2. Remove the clutch, flywheel and housing.

See Section B for overhaul of clutch and flywheel.

**Oil pump, to remove****Operation A/168**

1. Remove the securing bolts and withdraw the pump assembly.
2. Withdraw the driving shaft from the pump upper casing.

See Section AO for overhaul of oil pump.

**Water pump, to remove****Operation A/170**

1. Remove the water pump assembly and pulley.

See Section L for overhaul of water pump.

**Vibration damper, to remove****Operation A/172**

1. Remove the starting dog nut with special tool. No. 507234, and tab washer, then withdraw the vibration damper assembly from crankshaft.

See Section A2 for overhaul of vibration damper.

**Rocker shaft and cylinder head, to remove****Operation A/174**

1. Remove the rocker shaft cover, unscrew the bolts securing the rocker shaft support brackets, and lift the rocker shaft assembly complete from the cylinder head.
2. Ensure the component parts of the rocker shafts remain in their correct relative positions.
3. Withdraw the push-rods and insert them in a piece of cardboard pre-pierced and numbered 1 to 8.
4. Loosen the securing bolts evenly and lift the cylinder head clear, complete with manifolds and thermostat.

**Tappet assembly, to remove Operation A/176**

1. Remove the tappet locating bolts from the right-hand side of the cylinder block.
2. Hook out the roller and brass tappet slide with a piece of wire, ensuring the tappet guide does not move. If the guide moves this may allow the roller to fall down into the camshaft chamber.

The tappet assemblies are marked to ensure correct refitment.

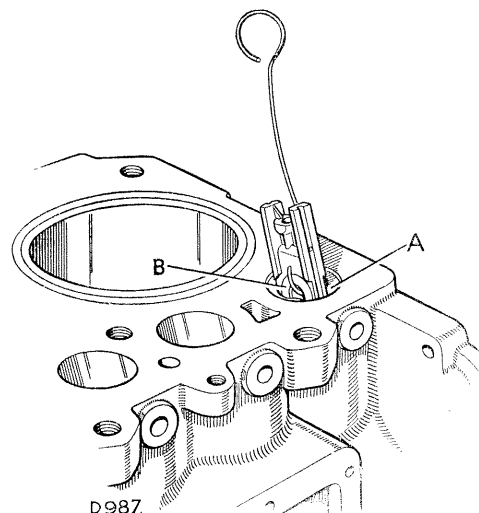


Fig. A-61—Removing tappet and roller

A—Tappet guide

B—Roller

**Roller**

The front of the roller is indicated by a chamfer on its inside diameter.

**Brass tappet**

The tappet is clearly marked "FRONT".

**Guide**

The guide can only be fitted one way due to the bolt locating hole. See Fig. A-62.

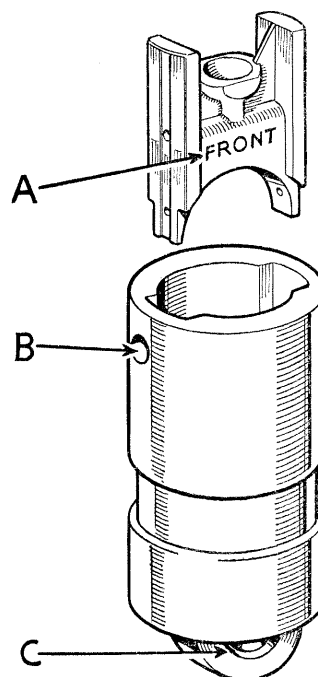


Fig. A-62—

Tappet guide and roller

A—Brass tappet slide marked "Front"

B—Tappet guide bolt location hole

C—Roller with chamfer to the front

**Vertical drive shaft gear, to remove****Operation A/178**

1. Remove the locating screw from the external filter adaptor joint face.

2. Lift the drive shaft gear and external bush assembly clear with a pair of snipe-nosed pliers.
3. The split bush may be removed by tapping to release the dowels. Do not remove the aluminium plug in the gear unless absolutely necessary. A new plug must be fitted if the old one has been removed.

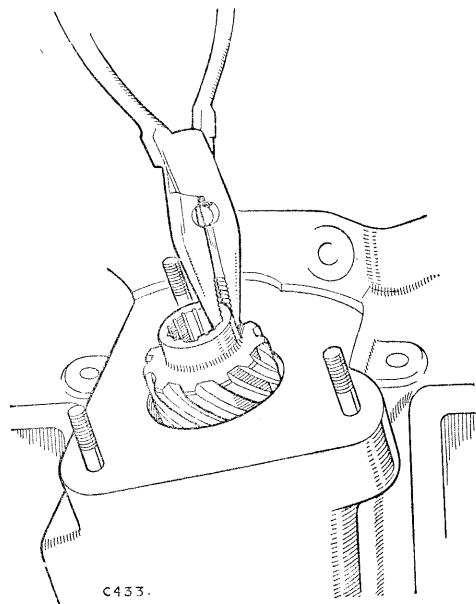


Fig. A-63—Removing the vertical drive shaft gear

#### Front cover, chain tensioner and chainwheels, to remove Operation A/180

1. Remove the front cover.
2. Remove the ratchet securing bolt and withdraw the ratchet and spring. Compress the chain tensioner spring and unscrew the lower fixing bolts and remove the chain tensioner assembly.
3. Lift off the timing chain and remove the chainwheels.

#### Camshaft removal Operation A/182

1. Remove the camshaft front thrust plate, then withdraw the camshaft.

#### Pistons and connecting rods, to remove Operation A/184

1. Turn the crankshaft until the pistons of numbers 1 and 4 cylinders are at B.D.C. Remove the big-end bolt securing nuts of numbers 1 and 4 connecting rods, then withdraw the piston and connecting rod assemblies from the top of cylinder block.

Repeat for numbers 2 and 3 assemblies.

#### Cylinder liners, to remove Operation A/186

1. Mark the top of the liners and the cylinder block to ensure correct refitment; the liners may be withdrawn by hand and the sealing rings removed from the crankcase end of cylinder block bores.

Ensure that the component parts are retained in their correct relative positions.

#### Crankshaft, main bearings and seals, to remove Operation A/188

Crankshafts removed from Diesel engines and considered unserviceable because of wear on the journals, must not under any circumstances be reconditioned.

It is most important, therefore, that when a Diesel crankshaft becomes unserviceable it should be scrapped out, and damaged to ensure that it cannot be subsequently reconditioned. A new crankshaft of the latest type must be fitted.

1. Remove the main bearing caps, lift the crankshaft clear and place in a suitable stand.

Retain the shell bearings in pairs adjacent to the journal from which they were removed.

2. The rear bearing seal halves may be removed from the cylinder block and bearing cap.

#### Cylinder block checks Operation A/190

1. Check that the main bearing caps have not been filed, in the following manner.
2. Assemble the caps without bearing shells to the crankcase, ensuring that they are correctly located by means of the dowels. Tighten both securing bolts for each cap, then slacken one bolt of each pair right off. There should be no clearance at the joint face.

If the main bearing caps have been filed, the cylinder block is scrap.

### ENGINE ASSEMBLY

#### Camshaft bearing, to renew Operation A/192

When new camshaft bearings are to be fitted, the front and front intermediate bearings must be removed and new ones fitted **before** removing the rear bearings.

1. Unscrew the  $3\frac{1}{2}$  in. (88,9 mm) long stud from the joint face at front of cylinder block.

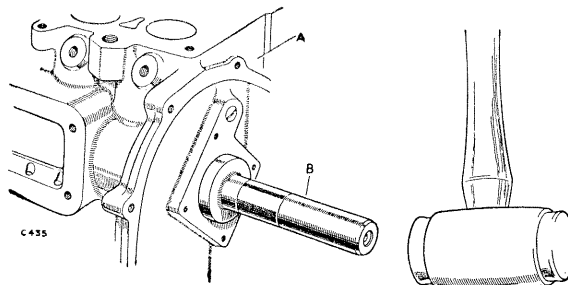


Fig. A-64—Outer camshaft bearing removal

A—Cylinder block

B—Drift

2. Drift the front camshaft bearing into the foremost tappet chamber, using tool, Part No. 274388, then withdraw the bearing from the chamber aperture. Fig. A-64.
3. The front intermediate bearing is removed by drifting it into the fuel injection pump drive chamber, using the same tool, but it must be collapsed before withdrawing from the drive aperture as illustrated in Fig. A-65.

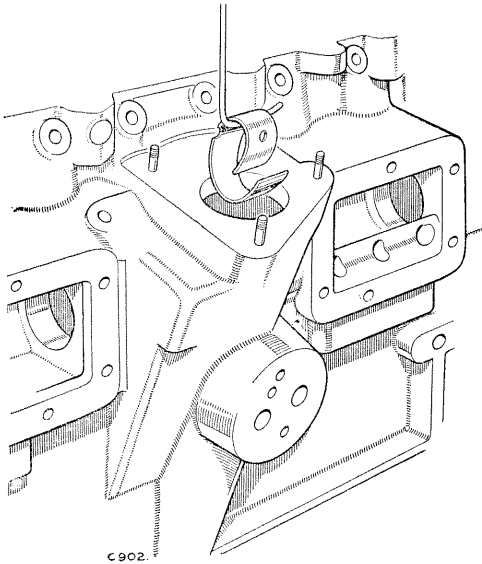


Fig. A-65—Inner camshaft bearing removal

4. Fit a guide tool, Part No. 274385, into the two old rearmost bearings with the part of flange marked "TOP" uppermost, then insert three end cover set bolts loosely for location purposes. Position a new bearing on to the handle end of bearing fitting bar, Part No. 274382, and locate by means of the peg and semi-circular cut-out, then slide a spacer, Part No. 274383, on to the fitting bar and engage the locating shoulder.

5. Place a new bearing on spigot, Part No. 274384, and position it inside the foremost tappet chamber with the bearing nearest the front intermediate housing.
6. Insert the bearing fitting bar into the front bearing housing and feed the spigot on to the bar; withdraw the spigot handle. Turn the spigot to engage the locating shoulder in the spacer, then press the fitting bar inward, turning as necessary to engage the bar slot with the peg in guide tube.
7. When the fitting bar has been pressed in as far as possible by hand, ensure that all locating points are properly engaged, then drive the bearings into position with a hide-faced hammer. Remove the bearing fitting tools and check the oil holes for alignment. Remove the two rearmost bearings.
8. Fit new camshaft rear bearings in the same manner as for front bearing fitment, but remove the spacer from fitting bar and use guide tool, Part No. 274386, instead of the guide tube used when fitting front bearings.
9. Locate a guide plug, Part No. 274394, in the front new camshaft bearing and locate, using the end-plate screws. Do not tighten these screws until the reamer, Part No. 274389, is put into position and the guide collar immediately in front of the cutter is entered into the rearmost bearing, which is first to be cut. This precaution is to ensure correct alignment of the reamer. Before commencing the reamering operation it is necessary to turn the engine block to a vertical position, front end facing downwards, in order that the weight of the reamer will assist in the cutting operation. As each bearing is cut the reamer should be held steady by the operator whilst an assistant, using a high pressure air line, blows away the white metal cuttings, before allowing the reamer to enter the next bearing.
10. After the rearmost and the two intermediate bearings have been cut, remove the guide plug, Part No. 274394, before cutting the foremost

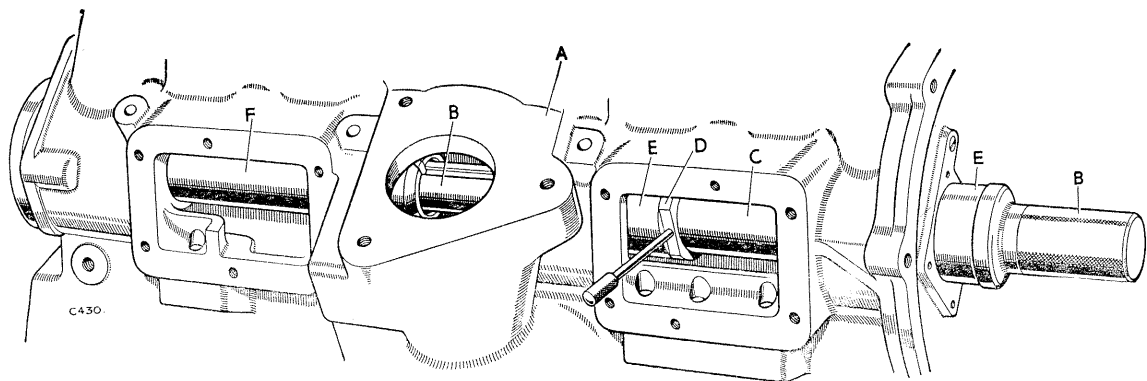


Fig. A-66—Fitting camshaft front bearings

- |                       |          |                |
|-----------------------|----------|----------------|
| A—Cylinder block      | C—Spacer | E—New bearings |
| B—Bearing fitting bar | D—Spigot | F—Guide tube   |

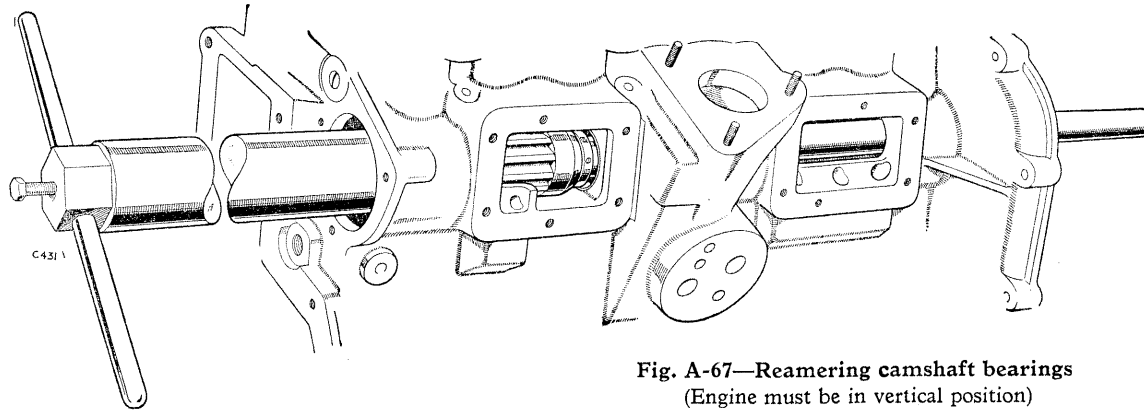


Fig. A-67—Reamering camshaft bearings  
(Engine must be in vertical position)

bearing. Remove the reamer handle and carefully remove the reamer, turning it in the same direction as for cutting. Care must be taken to prevent the reamer damaging the foremost bearing as the reamer is removed.

No lubricant is necessary for the reamering operation, best results are obtained when the bearings are cut dry.

11. Remove the plugs from the ends of oil gallery passage and clean the gallery and oil feed passages to camshaft and crankshaft bearings, using compressed air. Refit the plugs and lock in position.

**The cylinder block must be thoroughly cleaned at this stage with special attention to the liner seal grooves.**

### Crankshaft main bearings and seals

#### Operation A/194

Crankshafts removed from Diesel engines and considered unserviceable because of wear on the journals, must not under any circumstances be reconditioned.

It is most important, therefore, that when a Diesel crankshaft becomes unserviceable it should be scrapped out, and damaged to ensure that it cannot be subsequently reconditioned. A new crankshaft of the latest type must be fitted.

1. Remove the bearing caps and fit the bearing shells, locating by means of the tags. Tighten the caps down and slacken off one bolt of each pair. Check the bearing nip, as illustrated in Fig. A-68, ensuring that the clearance does not exceed .004 to .006 in. (0,10 to 0,15 mm). The nip can be corrected by selective assembly of bearing shells; these are available in slightly varying thicknesses.
2. When the bearing nip has been checked, remove the caps and bearing shell bottom halves. Position a standard size thrust bearing at each side of centre bearing shell—top half, and fit the crankshaft.

3. Refit the bearing shell bottom halves and bearing caps. Tighten the securing bolts evenly and check each bearing in turn for correct clearance. The crankshaft should resist rotation when a feeler paper, .0025 in. (0,06 mm) thick, is placed between any one bearing shell and crankshaft journal, and turn freely by hand when the feeler paper is removed. Adjust by selective assembly of bearing shells.

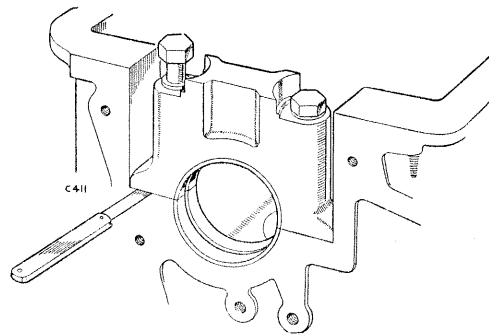


Fig. A-68—Checking main bearing nip

4. Mount a dial test indicator, then check and note the crankshaft end-float reading which should be .002 to .006 in. (0,050 to 0,15 mm).
5. If the crankshaft end-float reading obtained is not within the limits, fit suitable oversize thrust bearings. The variation of thrust bearing thickness at each side must not exceed .003 in. (0,07 mm) to ensure that the crankshaft remains centralised.
6. Remove the bearing caps, bottom half shells and crankshaft.
7. To the rear main bearing cap fit neoprene seals in recess at each side.

### Fitting two-piece oil seal

8. **Preparatory work.** This preparatory work is essential when fitting the seal to a new crankshaft and desirable when fitting to a crankshaft which has been in service.

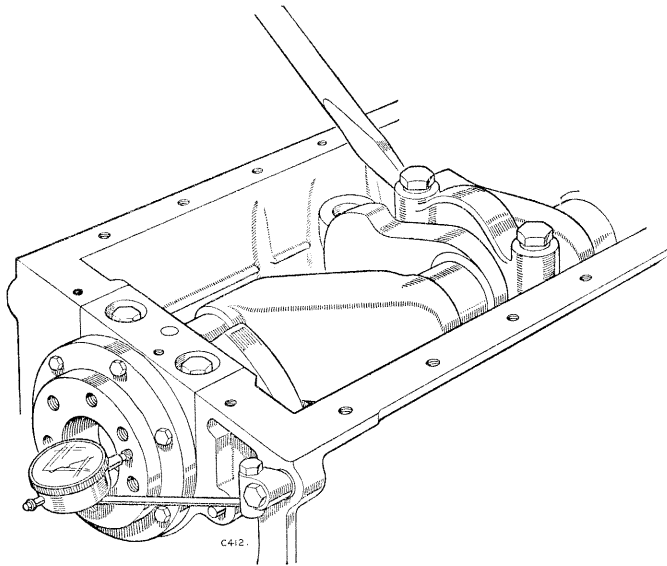


Fig. A-69—Checking crankshaft end-float

To ensure efficient lubrication during the initial running-in period of the oil seal, the crankshaft oil seal journal must be treated with a mixture of molybdenum disulphide and Butyl acetate as detailed below:

- (a) **Thoroughly stir** the mixture immediately prior to use.
- (b) Degrease the crankshaft oil seal journal.
- (c) Paint mixture evenly on to the surface of the oil seal journal with a fine brush; alternatively, if a quantity of crankshafts are being done, it can be sprayed on with a gravity feed spray gun using 40 lb/sq.in. (2,8 kg/cm<sup>2</sup>) air-line pressure. This solution, which **must be dry** before the seal is fitted, takes approximately 10 minutes to dry, and the surface must not be scratched after treatment. On crankshafts which have been previously run the solution will take 15 minutes to dry thoroughly. A warm air stream may be used to reduce these times if necessary.

#### Procedure

9. Bolt the cylinder block half of the oil seal firmly on to the block by the three bolts. With five-bolt fixing seals leave the two bolts adjacent to the split line loose.  
Bolt the other half of the oil seal to the rear main bearing cap in the same manner.
10. Refit the crankshaft, first lubricating the journals, bearing shells and thrust bearings.
11. The groove in each half of the oil seal is to be half filled with Silicone MS4 Compound, ensuring no grease reaches the split line face.
12. Apply 'Heldite' jointing compound to both split line joint faces on each half of the seal. **This**

**instruction does not apply to the three-piece type oil seal.**

The compound should be spread thinly over the surface, ensuring it reaches across the sealing lips, but must not be allowed to get on to the lips themselves. See Fig. A-70. This compound must be allowed to become tacky before assembly.

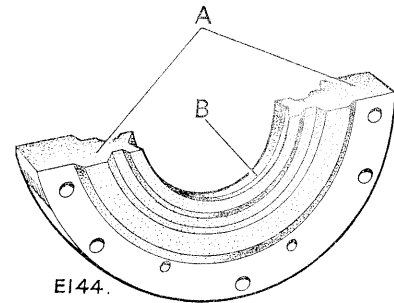
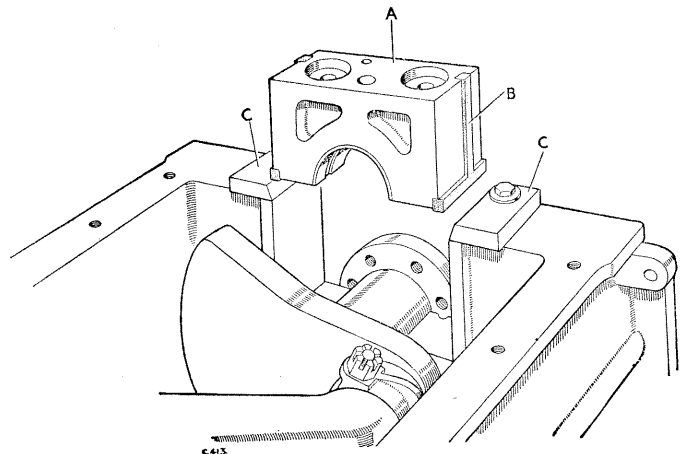


Fig. A-70—Rear crankshaft oil seals

A—Apply 'Heldite' jointing compound at this face  
B—Fill groove with Silicone MS4 Compound

13. Fit rear main bearing cap and tighten to the required torque.
14. Where applicable, tighten the four bolts adjacent to the split line.
15. Rotate crankshaft through a small arc to prevent the jointing compound from adhering to the crankshaft.
16. Fitment of the rear main bearing cap, with side seals in position, will be facilitated by using a lead tool (Part No. 270304) fitted to the sump studs adjacent to rear bearing cap aperture. See Fig. A-71.
17. It will be found advantageous to cut a very slight lead on to the bottom edges of side seals as this will prevent them from folding under the cap during fitment, thus causing an oil leak due to the cap not seating properly. Lubricate seals with Silicone MS4 Compound.

Fig. A-71—Fitting rear bearing cap and seal assembly  
A—Bearing cap B—Seal C—Lead tool



## Cylinder liners and seals, to refit

## Operation A/196

1. Smear the sealing ring grooves at the crankcase end of cylinder block bores, and the liner sealing rings, with Silicone MS4 Compound, then fit a ring to the upper and lower grooves of each bore.

A small hole is drilled through the cylinder block into the middle groove to provide evidence of coolant leakage past the top sealing ring.

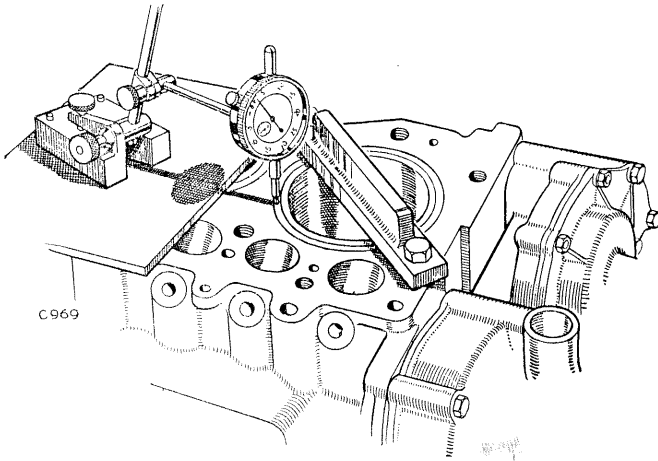


Fig. A-72—Checking cylinder liner extension

2. Press the liners into their respective bores by hand and align the marks made whilst dismantling.
3. Clamp each liner in turn in the manner illustrated and tighten the securing bolts to 65 lb/ft (8,9 mKg) torque. Mount a dial test indicator and check that the outer edge of the cylinder liner is from .002 to .004 in. (0,050 to 0,10 mm) above the cylinder head joint face. See Fig. A-72. Adjust if necessary by removing liner and adding a suitable shim washer under the flange. Clamp and re-check liner as described above. Shim washers are available .002 in. (0,50 mm) and .004 in. (0,10 mm) thick.

## Pistons and rings, to refit Operation A/198

1. When fitting pistons, the clearance in liner bore should be in accordance with the dimensions laid down in the Data Section. In the absence of suitably accurate measuring instruments, a long feeler, .004 in. (0,1016 mm) thick, may be inserted in the thrust side of the liner bore, as illustrated in Fig. A-73, and the piston located crown downward and the gudgeon pin in line with the centre line of cylinder block. The piston should become a tight fit when the bottom of skirt enters the bore.
2. Check the piston ring gaps in the liner bores, using an old piston as illustrated in Fig. A-74, to keep the rings square in the bore.

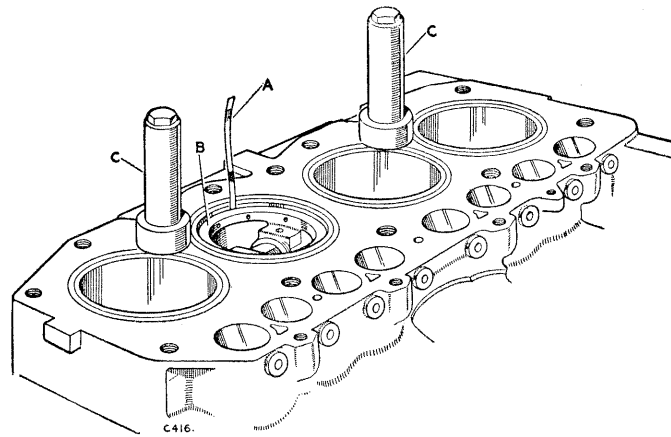


Fig. A-73—Checking piston clearance

A—Feeler gauge B—Piston C—Liner retainer

3. The second and third compression rings are bevel edged and **must** be fitted with the side marked "T" uppermost; the top chromium plated compression and the oil scraper ring has a square friction edge and may be fitted either way. Fit the piston rings and check the clearance in ring groove. See Data Section.

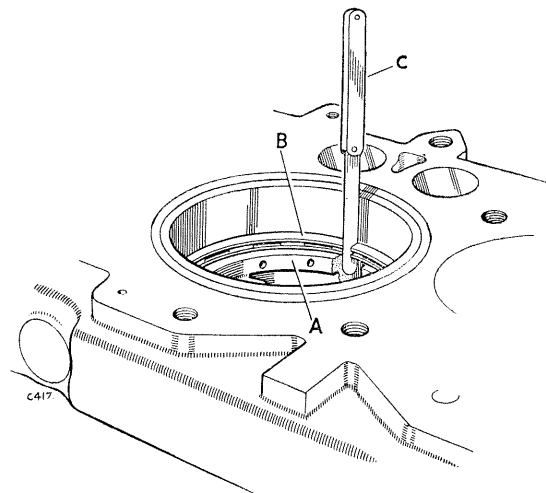


Fig. A-74—Checking piston ring gap

A—Scrap piston B—Piston ring C—Feeler gauge

It will be seen that provision is made for the fitment of two oil scraper rings. The second groove is for service purposes only.

## Connecting rod checks Operation A/200

1. Check that the connecting rods and caps have not been filed, in the following manner.
2. Select the correct cap for each connecting rod, as denoted by the number stamped near the joint faces. This number also indicates the crankpin to which it must be fitted.

Assemble the connecting rods, less shell bearings, with corresponding numbers together.

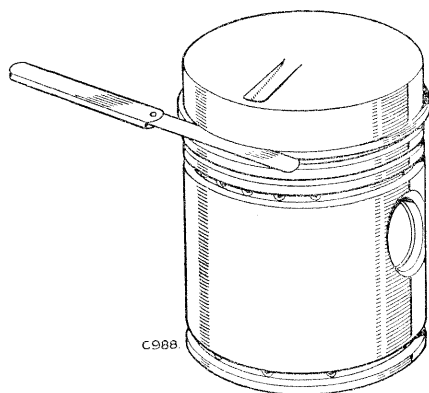


Fig. A-75—Checking ring clearance in groove

3. Tighten the securing bolts, then slacken one of them right off and check that there is no clearance at the joint face.

If the connecting rods or caps have been filed the assemblies must be scrapped.

#### Connecting rod bearing nip Operation A/202

1. Check the bearing nip in the following manner.
2. Fit the bearing shells and tighten both securing bolts—slacken one bolt as before and check the nip with a feeler gauge; this should be .002 to .004 in. (0,050 to 0,10 mm).

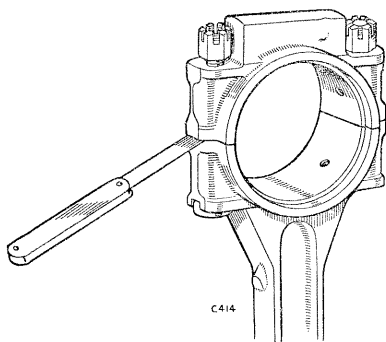


Fig. A-76—Checking the big-end bearing nip

3. The nip can be corrected by selective assembly of the bearing shells; these are available in slightly varying thickness. **Do not file the rod or cap.**
4. Fit liner retainers (Part No. 274411) to joint face of cylinder block, then rotate assembly in the stand to bring crankshaft uppermost.
5. Assemble the big-end of each connecting rod to its respective crankpin, then check for correct clearance.

The connecting rod should resist rotation when a .0025 in. (0,0635 mm) shim paper is fitted between the crankpin and one-half of big-end bearing shell, then move freely by hand when the shim paper is removed. Adjust by selective assembly of bearing shells.

Bearing clearance should be .001 to .0025 in. (0,025 to 0,063 mm).

6. Check the connecting rod end-float on crankpin by inserting a feeler gauge between the end face of rod and the crankpin shoulder. End-float should be .007 to .011 in. (0,177 to 0,2792 mm).
7. Remove the connecting rods from crankshaft, ensuring that the bearing shells are kept with the rods to which they were fitted.

#### Gudgeon pin, bush and piston fitting

##### Operation A/204

1. The oil hole in gudgeon pin bush is pre-drilled and care must be taken to ensure that the oil holes of bush and connecting rod will align when the bush is pressed into position. The gudgeon pin bushes should be a .001 to .002 in. (0,025 to 0,050 mm) interference fit in connecting rods. Ream the bush when fitted to connecting rod to allow a .0003 to .0005 in. (0,0076 to 0,0127 mm) gudgeon pin clearance. Ensure that correct alignment is maintained while reamering.

This fit is selected to give the smallest possible clearance consistent with a smooth revolving action.

2. Fit each connecting rod to a suitable test rig and check for twist and mal-alignment.
3. The gudgeon pin, when cold and dry, should be a slight **interference** fit in both bores of the piston—see Data. It must be fitted by hand pressure but must **not** be able to fall out of either bore under its own weight.

Lubricate the gudgeon pin when the correct size has been selected for a particular piston, but do not fit and remove the pin from piston unnecessarily thereafter, or the slight interference fit may be lost.

4. Fit the connecting rod to the piston with the oil spray hole of rod on the same side as the swirl-inducing recess in piston crown. Lock the gudgeon pin in position with circlips.
5. Turn the crankshaft until the crankpins relative to numbers 1 and 4 cylinders are at B.D.C. Insert the connecting rods and pistons for these cylinders from the top of cylinder block, with the oil spray hole in connecting rod and turbulence recess in piston towards the R.H. side of engine—toward the camshaft. Secure the big-ends to crankpins, tightening the securing nuts to 35 lb/ft (4,338 Kg/m).
6. Repeat Item 1 for numbers 2 and 3 cylinders. Lock the securing nuts with split pins.

#### Camshaft, to replace

##### Operation A/206

When replacing camshafts it should be noted that 2 litre Diesel engine camshafts are marked "DIESEL" between No. 1 and No. 2 cam lobes.

This is to differentiate between Diesel and petrol camshafts, which look similar in all respects except for the positioning of the cam lobes.

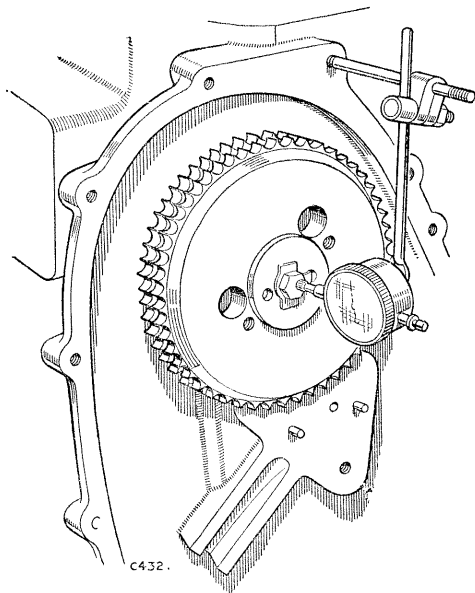


Fig. A-77—Checking camshaft end-float

1. Insert the camshaft—keyed end to extend at front of engine.
2. Fit the front thrust plate and secure the camshaft chainwheel but do not bend up the locking tab for securing bolt at this stage.

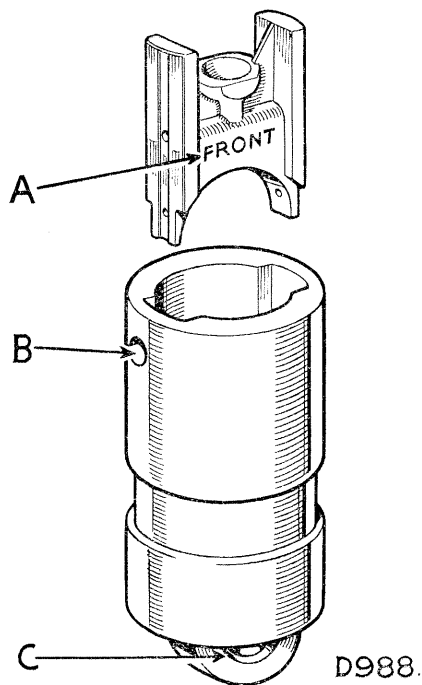


Fig. A-78—Tappet guide and roller

- A—Brass tappet slide marked "front"  
 B—Tappet guide bolt location hole  
 C—Roller with chamfer to the front

Check the camshaft end-float with a dial test indicator as illustrated by Fig. A-77 and ensure that the reading is within .0025 to .0055 in. (0,063 to 0,139 mm).

Adjust by selective assembly of the front thrust plate.

### Tappet assembly and fitment

#### Operation A/208

1. Before fitting the tappet assembly into the block, thoroughly clean all parts and check that the tappet will move freely in the tappet guide when held in the hand and shaken up and down.
2. Fit tappet guides into the cylinder block, ensuring that the locating hole lines up with the hole in the cylinder block.  
 The tappet guides must not be too tight in the block or they may be damaged by insertion of the locating screw in cases when they are not properly aligned.
3. Gently insert the roller into the guide. Do not drop the roller, as it is easily damaged.
4. Fit tappet into the guide and locate on to the roller. The tappet is marked "Front" and must be facing the front of the guide.
5. Fit the tappet locating screws and washers; the locating screws must be screwed up with the fingers and then tightened; if they are not free, remove and investigate reason.
6. Lock the locating screws in pairs, using 20 s.w.g. iron wire.

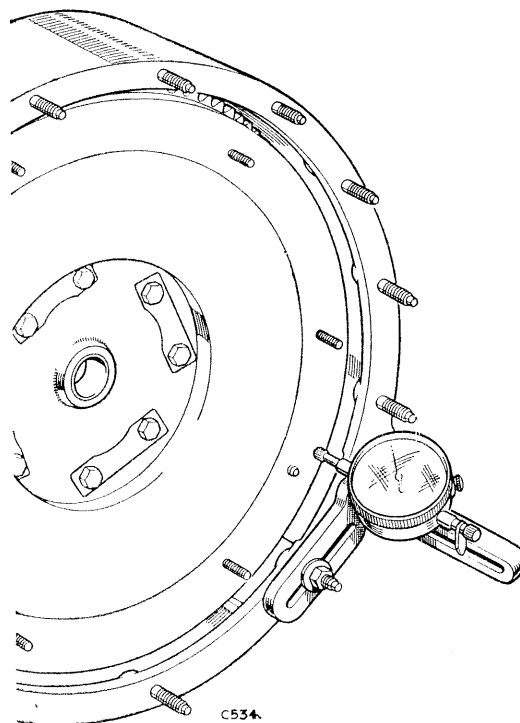


Fig. A-79—Checking run-out on flywheel face

**Flywheel housing, flywheel and clutch****Operation A/210**

1. Ensure that the oil seal is in good condition, then secure the flywheel housing to cylinder block. See note regarding drain plug at end of section.
2. Fit the flywheel and tighten the securing bolts to 50 lb/ft (6,912 Kg/m) torque.
3. Check the run-out on flywheel face as illustrated by Fig. A-79. The run-out on flywheel face must not exceed .002 in. (0,050 mm).
4. Ensure that the clutch disc splines are clean, and will slide on every one of the primary shaft splines.
5. Fit the clutch assembly to the flywheel, using an old primary shaft to ensure that the clutch disc is central with the flywheel bush.

**Cylinder head overhaul**

If necessary remove the inlet manifold, exhaust manifold and thermostat.

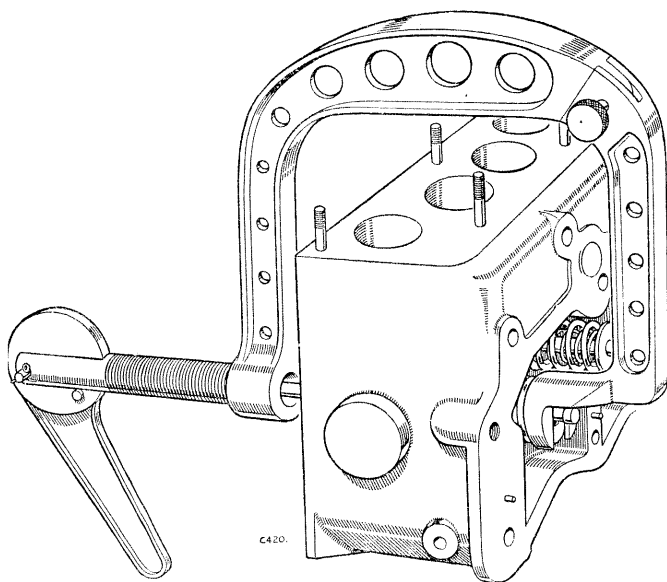


Fig. A-80—Compressing valve springs

**Valves, to overhaul****Operation A/212**

1. Using a valve spring compressing tool, Part No. 276102, remove the valve assemblies.
2. Drift the valve guides from the cylinder head, using tools Part No. 274401 (exhaust) and 274400 (inlet). Remove and scrap the seals.
3. Pull the inlet and exhaust valve guides into position, using tool Part No. 274406.

**Valve seats**

4. It is necessary to remove the very hard crust of carbon from the valve seats with a piece of emery cloth before attempting to re-face them with the special tools recommended.

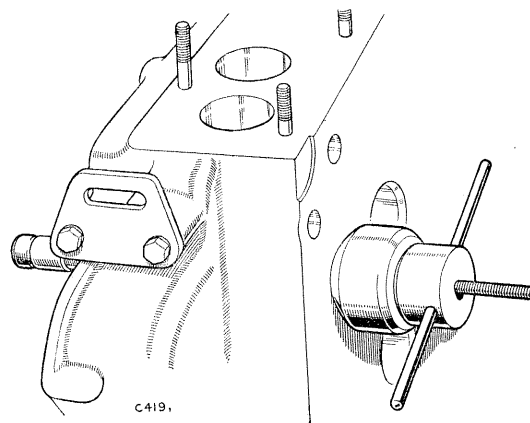


Fig. A-81—Fitting valve guides

5. Reface the inlet valve seats using special tool No. 274413 and special tool No. 274414 for the exhaust valve seats. See Fig. A-82.

When cutting the valve seats, do not use excessive weight on the tool, as this will cause the cutter to judder and thus ruin the seating.

Seat angle, inlet: 45°

Seat angle, exhaust: 45°

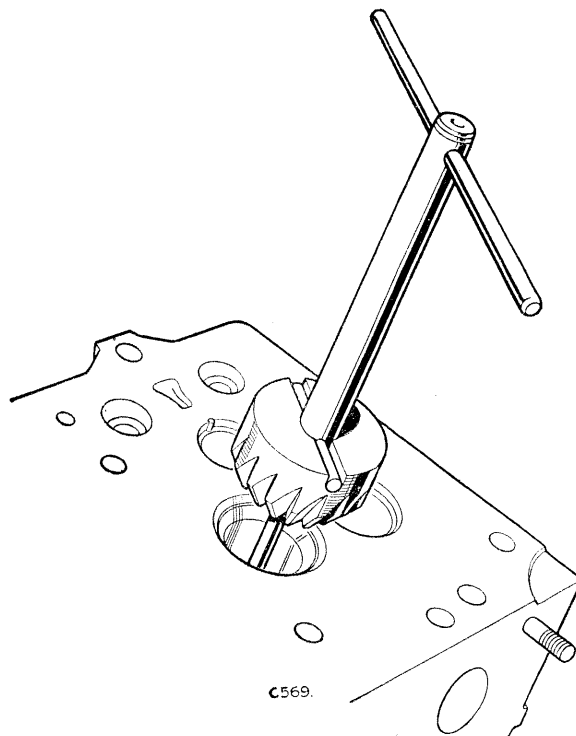


Fig. A-82—Valve seat cutting tool

6. Using a little grinding paste, lap the new or re-ground valves into the seatings.
7. When lapping is completed, remove each valve in turn and fit a new rubber seal into the valve guide. Clean off all traces of grinding paste, lubricate the valve stem.

Fit the valves, springs, cups and split cotters, ensuring that the components are retained in their original sets and positions.

A new valve seal *must* be fitted whenever a valve is removed.

The valve springs have an interference fit of .005 in. (0,01 mm). If the inner spring will slide through the outer spring, both are scrap.

### Push-rod tubes

### Operation A/214

1. The push-rod tubes may also be removed if necessary by drifting them out, using tool Part No. 274399.

When the tubes are removed they are scrap, and new ones must be fitted.

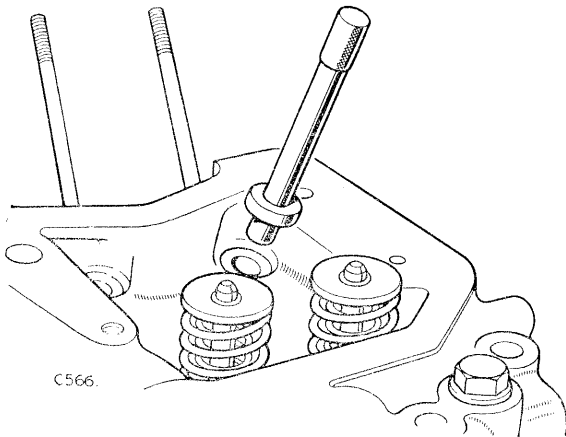


Fig. A-83—Removing push-rod tubes

2. If the push-rod tubes were removed, new tubes complete with new sealing rings, smeared with Silicone M.S.4 Compound, should be pulled into position, using tool Part No. 274402. Ensure that the chamfers on tube and in cylinder head are in full contact and that the "flat" of tube is at right angles to a line drawn between the centre of push-rod tube and centre of hot plug, as illustrated by Fig. A-84.

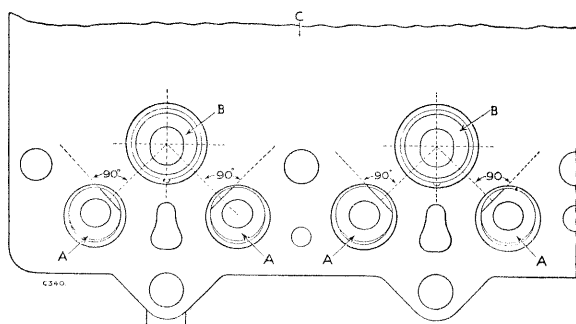


Fig. A-84—Correct position of push-rod tubes in relation to hot plugs

A—Push-rod tubes      B—Hot plug  
C—Cylinder head inverted

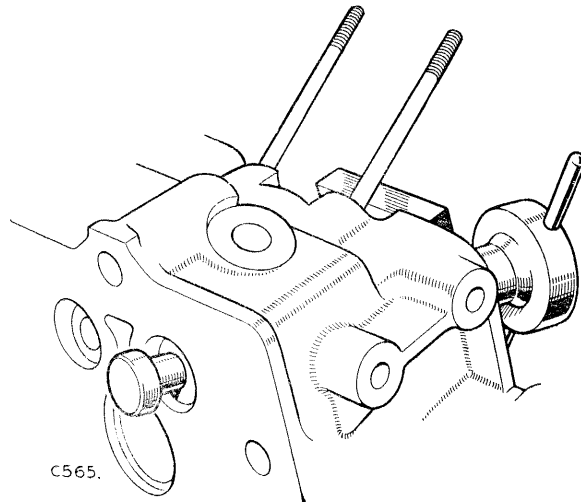


Fig. A-85—Fitting push-rod tubes

### Hot plugs and injector shroud, to renew

### Operation A/216

In order to renew the injector shrouds it is necessary to remove the hot plugs.

1. If necessary, remove the hot plugs by inserting a copper drift through the injector shroud aperture, then tap evenly and gently around the inside of hot plug. Avoid using a heavy hammer if possible and thus minimise the possibility of damage.
2. If necessary, remove the injector shrouds, using suitably shaped drift.
3. Thoroughly clean out the combustion chamber. The hole in the side of the injector shroud is for manufacturing purposes only, but at the same time can be used as a guide when refitting the shroud.
4. Smear a little oil on the shroud and insert into the cylinder head with the hole pointing towards the centre of the cylinder head, and drift into position, using tool No. 274399.
5. The hot plugs must now be replaced by tapping gently into position with a hide-faced hammer. When fitted they must be checked with a clock gauge to ensure that they do not protrude above the level of the cylinder head face more than .002 in. (0,050 mm) and are not recessed below the level of the cylinder head face more than .001 in. (0,025 mm).

If the hot plugs are loose in the cylinder head they may be retained with a little grease.

6. The fitment of wooden plugs in the injector nozzle apertures will be found advantageous at this stage, to prevent entry of dirt into the combustion chamber.
7. Refit the inlet and exhaust manifolds to the cylinder head, using a new gasket.

8. Test the thermostat before fitment to cylinder head, by immersing in hot water. Expansion should commence between 164°F and 173°F and be complete at 193°F.

Insert the thermostat with rubber "O" ring in the housing in cylinder head and fit the joint washer and cover.

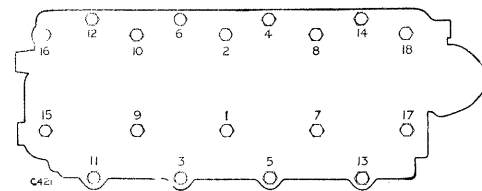


Fig. A-86—Order of tightening cylinder head bolts

#### Rocker shaft, to overhaul Operation A/218

1. Remove locating set bolts from the intermediate support brackets. Remove the component parts from the rocker shafts but retain the items in their correct relative positions.
2. If necessary, press new bushes into the rockers. The oil holes in the rocker bushes are pre-drilled and care must be taken to ensure that the oil holes of bush and rocker will align when pressed into position.
3. Reamer the bush to .530 in +.001 (13,4 mm + 0,02) to obtain the correct clearance. The reamer and rocker assembly must be held in such a manner as to ensure the correct alignment of the reamed hole.
4. Align the rocker shafts, with the bored ends together, and slide a support bracket on to each shaft. The locating hole in each bracket must be positioned immediately above the chamfered hole in shaft, 4,75 in. (120,65 mm) from the plugged end, and then secured with a locating screw and spring washer.
5. Assemble the remaining components with the plugged ends of the shafts in the end brackets and the bored ends of both shafts located in the centre bracket.

#### Cylinder head and rocker shaft, to refit Operation A/220

1. Smear the joint face of cylinder block and cylinder head gasket with engine oil, then fit the gasket and cylinder head assembly to cylinder block, using the two studs to facilitate alignment.
2. Locate head and gasket with the securing bolts, fitting all bolts **except** those which also secure the rocker shaft pedestals, but do not tighten at this stage.
3. Insert the push-rods into their original positions, through cylinder head and locate in the tappets.
4. Slacken off all tappet adjusting screws and offer the rocker assembly to cylinder head. Fit the bracket securing bolts, but do not tighten.
5. Tighten down the cylinder head bolts in the order indicated by Fig. A-86. The  $\frac{1}{2}$  in. U.N.F. bolts, including those that also secure the rocker brackets, must be pulled down to 75 lb/ft (10,3 Kg/m) whilst the  $\frac{5}{16}$  in. U.N.F. bolts securing the rocker brackets only are pulled down to 12 lb/ft (1,66 Kg/m).

#### Chainwheels, timing chain, adjuster and valve timing Operation A/222

1. The screwed plug and ball may be removed from the piston if necessary and the piston pressed from its housing if unduly worn.
2. The tensioner cylinder and bush must be renewed complete if the bush is unduly worn.
3. The bushes in idler wheel and ratchet arm should also be removed if worn beyond reasonable limits.
4. Fit the crankshaft chainwheel on to shaft and key.
5. Turn the crankshaft in direction of rotation until the E.P. mark on flywheel is in line with the timing pointer.
6. Fit a dial test indicator so that the "fully open" position of the valve can be ascertained in the following manner:—

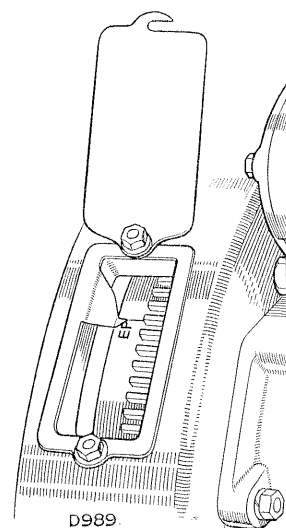


Fig. A-87—Timing pointer

7. Turn the camshaft in direction of rotation until the lobe of cam has nearly opened the valve fully, then stop rotation and mark the chainwheel and timing casing to record the position.
8. Note the reading on dial test indicator, then continue to turn the chainwheel slowly in direction of rotation until the needle has again reached the same position.

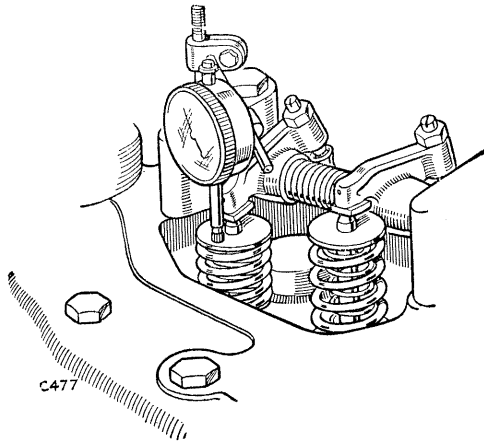


Fig. A-88—Checking exhaust valve "fully open" position

9. Mark the chainwheel at a point opposite to the mark on timing casing and make a third mark on the chainwheel, exactly between those made previously.
10. Turn the camshaft **against** direction of rotation until the third mark is in line with that on timing casing, whereon the valve should be fully open.
11. Fit the timing chain with "**no slack**" on the driving side. It may be necessary to remove and re-position the camshaft chainwheel to obtain this "no slack" condition on the driving side when the flywheel and camshaft are correctly positioned.

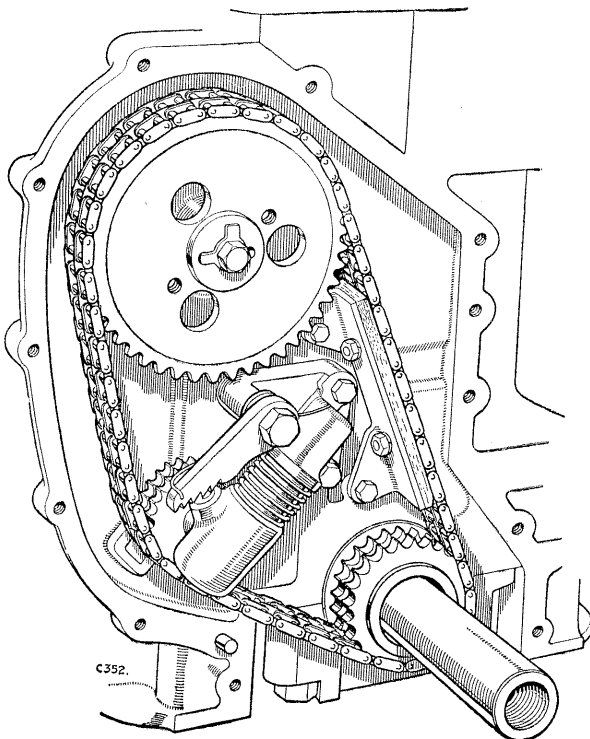


Fig. A-89—Timing gear arrangement

12. Fit new bushes to the chain tensioner components as necessary; ensure that the fits and clearances are in accordance with those laid down in the Data Section. Position the ball in chain tensioner piston and secure with the retaining clip. Fit the compression spring over piston, locate the cylinder assembly, compress the spring and retain in compressed position.

Place the idler wheel on bearing arm and offer the assembly to the cylinder block, locating by means of the dowels. Screw the stepped bolt with ratchet and spring in position into cylinder block, then finally secure with two set bolts. Remove the spring compressing clip and allow the idler wheel to take up the chain slack.

13. Turn the flywheel **against** direction of rotation approx.  $90^\circ$  then slowly **in** direction of rotation, checking that the exhaust valve reaches the "fully open" position, as indicated by the dial test indicator, exactly when the "E.P." mark on flywheel is in line with the pointer on flywheel housing.
14. Adjust if necessary by means of the six irregularly spaced keyways in the timing chainwheel. This arrangement allows a variation of  $2^\circ$  between each position.
15. Lock the set bolt securing camshaft chainwheel when timing has been set satisfactorily.

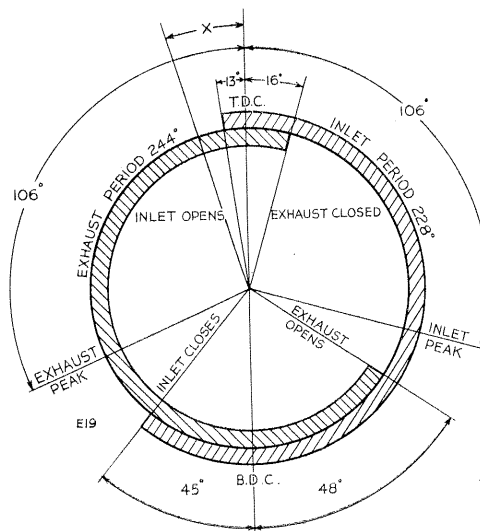


Fig. A-90—Timing diagram  
X—Injection point is  $17^\circ$

#### Front cover to cylinder block

##### Operation A/224

1. Examine the crankshaft oil seal and replace if necessary, using a little sealing on the outside of the seal.
2. Position new joint washers and fit the front cover.

**Vibration damper, to refit Operation A/226**

1. Locate the vibration damper on crankshaft and key, then secure with the starting dog and tab washer.

*Note:* For overhaul of vibration damper see Section A2.

**Vertical drive shaft gear assembly****Operation A/228**

1. Fit the circlip to groove dividing the upper and lower internal splining and enter the tapered splined plug in the end furthest from gear teeth, small end first.
2. Drift the plug into the gear until it abuts on the circlip.
3. Lubricate the split bush and fit it to the gear with the reduced diameter nearest the teeth.

**Injection pump timing Operation A/230**

The line against which the timing figure is stamped on the flywheel, as detailed below, when set opposite the pointer, indicates the position at which injection starts.

88 Diesel, up to engine number 146900522

109 Diesel, up to engine number 156900285

Set the pointer exactly between the 16° and 18° markings, that is the 17° position.

88 Diesel, from engine number 146900523 onwards

109 Diesel from engine number 156900286 onwards

Set the pointer in line with the 16° mark.

It is possible, however, that engines numbered in the range up to 146900522 and 156900285 have been modified. These are easily identified by a splash of red paint on the cylinder head. The injection pump timing for these engines is 16°.

The injection pump timing must be carried out with the utmost precision, therefore the following procedure must be executed methodically.

1. Turn the crankshaft in the direction of rotation until both valves of number 1 cylinder are closed and the piston is ascending the bore on the compression stroke, continue to turn the crankshaft slowly until the appropriate timing mark is visible through the timing aperture in the flywheel housing. Carefully align the timing mark with the pointer. If the flywheel is inadvertently turned too far and the timing mark goes past the pointer the operation must be repeated from item 1.

Ensure that a correct line of vision is taken when lining up the timing marks. An incorrect line of vision can result in the timing being 1° to 2° out.

2. Insert the driving gear assembly for injection and oil pumps complete with split bushes, then mesh with camshaft gear so that when fully engaged, the master spline is approx. 20° from the centre line of engine (measured from front end) and the locating holes are correctly aligned. Lock the driving gear assembly in position with a grub screw.
3. Remove the inspection cover from the injection pump and rotate the spindle in direction of rotation until the line marked "A" on driving plate aligns with the mark on the timing ring.
4. Offer the pump to the engine and engage in the splined drive shaft. With a small mirror observe the markings through inspection aperture in injection pump and make any final necessary adjustment by turning the pump body to align the timing ring with the "A" mark.

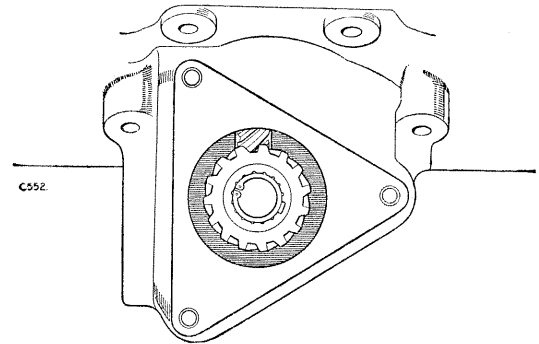


Fig. A-91—Driving gear in correct timing position

As the final adjustment is made to the timing by turning the pump body, this action in itself is sufficient to cause a slight error in the timing, due to the backlash in the pump drive skew gear. It is therefore essential that the pump drive plate and thus the skew drive gear is held back against the driving side of the teeth whilst final adjustment is made and the pump secured.

5. Re-check the timing by turning the crankshaft in the direction of rotation until both valves of number 1 cylinder are closed and the piston is ascending the bore on the compression stroke, continue to turn the crankshaft slowly.

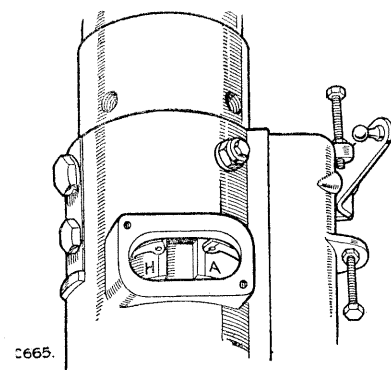


Fig. A-92—Injection pump timing marks correctly aligned



6. With a small mirror observe that the timing mark "A" on the pump drive plate aligns with the mark on the timing ring. When the "A" mark is exactly in line with the mark on the timing ring, the appropriate flywheel timing mark should be exactly in line with the flywheel housing pointer. In this way any slight timing error is magnified by the 2:1 ratio of the camshaft to crankshaft. An error of a given width on the pump marking will be 12 times that width if transferred to the flywheel.

If the flywheel is inadvertently turned too far and the timing mark on the pump drive plate goes past the mark on the timing ring, the operation must be repeated from item 6.

#### Tappet adjustment

#### Operation A/232

1. Turn the crankshaft in direction of rotation until number 8 valve (counting from front end of engine) is fully open. In this position the tappet for number 1 valve is on the dwell of its cam and the tappet clearance may be set with a .010 in. (0,25 mm) feeler inserted between the rocker and valve stem. Re-check the clearance after tightening the locknut.

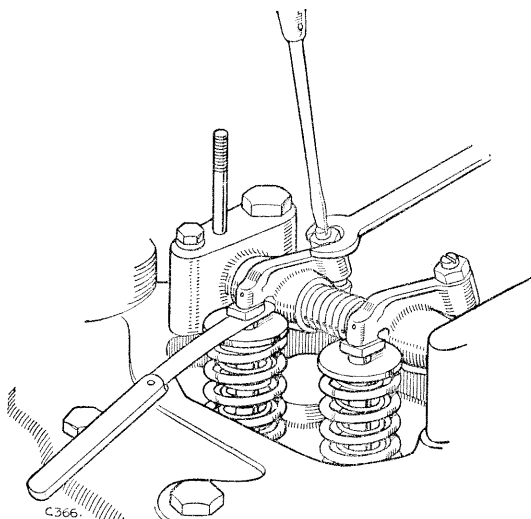


Fig. A-93—Adjusting tappets

The tappets should be set in the following order:

- Set No. 1 tappet with No. 8 valve fully open.
- Set No. 3 tappet with No. 6 valve fully open.
- Set No. 5 tappet with No. 4 valve fully open.
- Set No. 2 tappet with No. 7 valve fully open.
- Set No. 8 tappet with No. 1 valve fully open.
- Set No. 6 tappet with No. 3 valve fully open.
- Set No. 4 tappet with No. 5 valve fully open.
- Set No. 7 tappet with No. 2 valve fully open.

#### Oil pump

#### Operation A/234

See Section AO for overhaul of oil pump.

1. Insert the longer splined end of driving shaft into the pump and locate in the driving gear.

2. With the inlet port rearward, and the splined upper end of driving shaft aligned to the vertical drive gear, offer the pump to engine and secure in position.

No provision is made for oil pressure adjustment.

#### Water pump, to replace

#### Operation A/236

1. See Section L for overhaul of water pump.
2. Renew the joint washer, then locate and secure the pump to front cover.

#### Externals

#### Operation A/238

1. Fit the lubricating oil filter assembly and joint washer.
2. Secure the breather pipe and oil filler assembly over the forward tappet chamber aperture, and steady bracket to top of cylinder block.
3. Mount and secure the fuel lift pump and cover plate assembly over the rear tappet chamber aperture.
4. Mount and secure the fuel oil filter assembly.
5. Fit the starter motor.
6. Fit the dynamo driving belt and adjust the tension to allow the belt to move  $\frac{3}{16}$  to  $\frac{1}{4}$  in. (4 to 6 mm) when pressed by thumb between the camshaft and water pump pulleys.
7. Connect the oil feed pipe and pressure gauge assembly between cylinder head and cylinder block rear end.
8. Secure the coolant pipe to thermostat and water pump casings.
9. Position the joint washer and fit the rocker and valve gear cover.

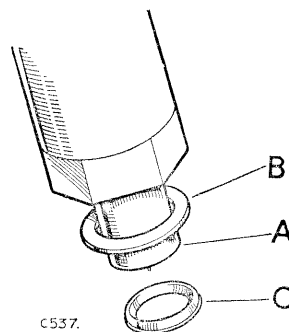


Fig. A-94—Position of injection nozzle washers

A—Nozzle B—Copper washer C—Steel washer

10. Fit the oil sump.
11. Smear new injector copper joint washers with grease and fit one to each injector. Insert a new corrugated sealing washer into each injector nozzle recess in cylinder head, with the raised portion upward, then locate the injector nozzles; do **not** tighten the clamping straps fully at this stage.

*Note:* Ensure that the bottom steel washer (corrugated) is replaced correctly, when refitting injectors. See Fig. A-94.

*Note:* For injector assembly and check, see Section M.

12. Connect the injector pipes to the injector pump. Turn the injectors to align with the pipes and connect.

Do not overtighten the clamping strap.

13. Fit the heater plugs to cylinder head and tighten to 25 lb/ft (3,4 Kg/m).

#### Engine, to refit

#### Operation A/240

1. Reverse removal procedure—fit new mounting rubbers if necessary. Refill with lubricating oil, 11 Imperial pints, 13 U.S. pints (6 litres). If necessary add extra oil for filter, capacity 3½ Imperial pints, 3½ U.S. pints (1,75 litres) and coolant, 17 Imperial pints, 20½ U.S. pints (9,75 litres).

2. See Section M, Fuel Section, for method of priming injection pump, then Section Q for resetting controls and slow-running adjustment procedure.

3. Check for oil and water leaks—rectify as necessary.

At all times when the Diesel engine is running, it is necessary to ensure that the oil bath air cleaner is fastened securely in the vertical position.

If adjustments are made with the engine running and the oil bath cleaner balanced on top of the engine, it is possible, should the cleaner tip to one side, for oil to be drawn into the intake manifold and hence into the engine, where it will act as a fuel and cause the engine to overspeed out of control and serious damage may result.

Should it be necessary to run the engine with the air cleaner out of the normal position, the rubber hose should be disconnected from the inlet manifold and the whole oil bath removed from the vehicle.

## OVERHAULS TO ENGINE IN CHASSIS

Decarbonise and grind in valves, carry out the following operations:

Page	Operation	Items
A-42	A/162	1 to 5
A-42	A/164	1, 2, 4 and 9
A-43	A/174	All
A-51	A/212	All
A-53	A/220	All
A-56	A/232	All
A-56	A/238 and A/240	As necessary

Hot plugs, injector shrouds and push-rod tubes to renew, carry out the following operations:

Page	Operation	Items
A-42	A/162	1 to 5
A-42	A/164	1, 2, 4 and 9
A-43	A/174	All
A-52	A/214	All
A-52	A/216	All
A-53	A/220	All
A-56	A/232	All
A-56	A/238 and A/240	As necessary

Camshaft or roller tappets, to renew, carry out the following operations:

Page	Operation	Items
A-42	A/162	1 to 12
A-42	A/164	1, 2, 3 and 9
A-43	A/170 to A/184	All
A-49	A/206 and A/208	All
A-55	A/228 to A/232	All
A-56	A/236	All
A-56	A/238 and A/240	As necessary

Renewing pistons, liners, little-end or big-end bearings, carry out the following operations:

Page	Operation	Items
A-42	A/162	1 to 5
A-42	A/164	1, 2, 4 and 9
A-43	A/174	All
A-44	A/184 and A/186	All
A-48	A/196 to A/204	All
A-53	A/220	All
A-56	A/232	All
A-56	A/238 and A/240	As necessary

Rocker shaft to overhaul, carry out the following operations:

Page	Operation	Items
A-43	A/174	1 to 3
A-53	A/218	All
A-53	A/220	As necessary
A-56	A/232	All

Oil pump and filters .... Section AO

Water pump and thermostat Section L

Flywheel and clutch .... Section B

Starter, dynamo .... Section P

Injection pump and filters .... Section M

Vibration damper .... Section A-2

### Flywheel housing drain plug

The drain plug should not be fitted to the housing, unless the vehicle is expected to operate under very muddy conditions, or to wade. The plug should be screwed into the stowage bracket fitted to later models, or stored in the tool locker.

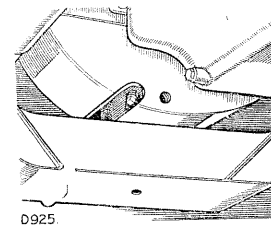


Fig. A-95—Flywheel housing drain plug and stowage bracket

## DEFECT LOCATION

(Symptom, Cause and Remedy)

### A—ENGINE FAILS TO START

1. Incorrect starting procedure—*See Instruction Manual.*
2. Starter motor unserviceable—*Section P.*
3. Batteries in low state of charge—*Remove and charge.*
4. Heater plug circuit broken—*Section P.*
5. Foreign matter in fuel system—*Section M.*
6. Supply of fuel to injection nozzles restricted—*Section M.*
7. Insufficient compression—*Check tappet clearance, cylinder head for tightness, cylinder head gasket, valve seats, valve springs, pistons, piston rings and liners for wear.*
8. Injection nozzles setting incorrect—*Reset. Section M.*
9. Injection nozzle auxiliary spray hole blocked—*Clean. Section M.*

### B—ENGINE STALLS

1. Slow-running incorrectly adjusted—*See Section Q.*
2. Incorrect tappet clearance—*Adjust.*
3. Injection nozzle setting incorrect—*Reset. Section M.*
4. Injection nozzle auxiliary spray hole blocked—*Clean. Section M.*
5. Insufficient compression—*See item 7 of "A" above.*

### C—REDUCED POWER AND ROUGH RUNNING

1. Broken valve spring—*Renew.*
2. Incorrect tappet clearance—*Reset.*
3. Burnt valve—*Renew, reset tappet clearance and tighten injection nozzles.*
4. Broken piston rings—*Renew damaged parts as necessary.*
5. Compression uneven—*See Item 7 of "A" above.*
6. Injection nozzles burnt—nozzle valve seating badly—*Service. Section M.*
7. Incorrectly timed injection pump—*Check and adjust.*

8. Fuel supply restricted—*Clean filters. Section M.*
9. Injection nozzles improperly tightened—*Check sealing washer and re-tighten.*
10. Fuel pumps not delivering properly—*Section M.*

### D—ENGINE OVERHEATING

1. Defective coolant system—*See "Defect Location". Section L.*
2. Defective lubrication system—*See "Defect Location". Section AO.*
3. Defective injection nozzles—*See "Defect Location". Section M.*
4. Incorrect injection pump timing—*Check and adjust.*
5. Restricted fuel supply—*Section M.*

### E—LOW OIL PRESSURE

1. Defective lubrication system—*See "Defect Location". Section AO.*

### F—BLACK SMOKE ISSUES FROM EXHAUST

1. Defective fuel injection nozzle—*Section M.*
2. Injection pump incorrectly timed—*Check and adjust.*

### G—WHITE VAPOUR ISSUES FROM EXHAUST

1. Coolant leaking into combustion chamber—*Ascertain cause.*  
*Note:—Do not confuse with the issue of vapour immediately after starting and caused by condensation in the exhaust pipe.*

## GENERAL DATA

Capacity (piston displacement) ....	2,052 cc (125 cu.in.)	B.M.E.P. ....	105 lb/sq.in. (7,382 Kg/cm <sup>2</sup> ) at 2,000 R.P.M.
Number of cylinders ....	4	Maximum torque ....	87 lb/ft (12,00 Kg/m) at 2,000 R.P.M.
Bore ....	3.375 in. (85,725 mm)	Firing order ....	1 - 3 - 4 - 2
Stroke ....	3.5 in. (88,9 mm)	Piston speed at 3,500 R.P.M. ....	2,040 ft./min.
Compression ratio ....	22.5 to 1		
B.H.P. ....	52 at 3,500 R.P.M.		

## DETAIL DATA

## Camshaft

Journal diameter ....	1.842 in.—.001 (26,70 mm—0,02)
Clearance in bearing ....	.001 to .002 in. (0,02 to 0,05 mm)
End-float ....	.0025 to .0055 in. (0,06 to 0,14 mm)
Cam lift—inlet ....	.262 in. (6,65 mm)
Cam lift—exhaust ....	.279 in. (7,10 mm)

## Camshaft bearings

Type ....	Split—steel backed, white metal lined
Internal diameter (line reamed in position) ....	1.843 in.+.0005 (46,812 mm+0,012)

## Connecting rods

Bearing fit on crankpin ....	.001 to .0025 in. (0,02 to 0,06 mm) clearance
Bearing nip ....	.002 to .004 in. (0,05 to 0,10 mm)
End-float at big-end ....	.007 to .011 in. (0,177 to 0,280 mm)
Gudgeon pin bush fit in small end ....	.001 to .002 in. (0,02 to 0,05 mm) interference
Gudgeon pin bush internal diameter—reamed in position ....	1.1875 in.+.0005 (31,87 mm+0,012)
Fit of gudgeon pin in bush ....	.0003 to .0005 in. (0,007 mm to 0,012) clearance

## Crankshaft (do not regrind)

Journal diameter ....	2.5 in.—.001 (63,5 mm—0,021)
Crankpin diameter ....	2.126 in.—.001 (54 mm—0,02)
End-float (controlled by thrust washers at centre bearing) ....	.002 to .006 in. (0,05 to 0,15 mm)

## Flywheel

Number of teeth ....	100
Thickness at pressure face ....	1.375 in.—.015 (85,725 mm—0,39)
Maximum permissible run-out on flywheel face ....	.002 in. (0,05 mm)
Maximum refacing depth ....	.030 in. (0,76 mm)
Minimum thickness after grinding ....	1.345 in. (33,15 mm)

## Markings

T.D.C. ....	When opposite pointer, No. 1 piston is at top dead centre
E.P. ....	When opposite pointer, No. 1 exhaust valve should be fully open
88 Diesel, up to engine No. 146900522	
109 Diesel, up to engine No. 156900285	Set the pointer exactly between the 16° and 18° markings, that is, the 17° mark.
88 Diesel, from engine No. 146900523 onwards	
109 Diesel, from engine No. 156900286 onwards	Set the pointer in line with the 16° mark.
....	When opposite pointer, with both valves closed, indicates start of injection

## Primary pinion bush

Fit in flywheel ....	.001 to .003 in. (0,02 to 0,083 mm) interference
Internal diameter—reamed in position ....	.875 in.+.002 (22,23 mm+0,051)
Fit of shaft in bush ....	.001 to .0035 in. (0,02 to 0,08 mm) clearance

**Gudgeon pin**

Fit in piston	....	Zero to .0002 in. (0,005 mm) interference
Fit in connecting rod bush	....	.0003 to .0005 in. (0,075 to 0,127 mm) clearance

**Injection pump**

Type	....	Distributor, self-governing
Injection takes place	....	16°, 17° or 18° B.T.D.C. See Flywheel markings.
Injector		
Type	....	C.A.V. Pintaux
Size	....	BDNO/SP6209

**Liners**

Internal diameter	....	3.375 in. +.001 (85,725 mm +0,02)
Fit in cylinder block		
Top—upper	....	.005 to .015 in. (0,13 to 0,38 mm) clearance
Top—lower	....	.001 to .003 in. (0,02 to 0,08 mm) clearance
Bottom	....	.001 to .003 in. (0,02 to 0,08 mm) clearance

**Main bearings**

Clearance on crankshaft journal	....	.001 to .0025 in. (0,02 to 0,06 mm)
Bearing nip	....	.004 to .006 in. (0,10 to 0,15 mm)

**Push-rod tubes**

Fit in cylinder head	....	.0005 to .002 in. (0,01 to 0,051 mm) interference on large diameter.
		Full contact fit at chamfered edges of tube and cylinder head

**Oil pump assembly**

See Section AO.

**Pistons**

Type	....	Light alloy, with swirl-inducing recess in crown
Clearance in liner bore, measured at bottom of skirt at right angles to gudgeon pin	....	.004 to .005 in. (0,10 to 0,12 mm)

**Fit of gudgeon pin in piston**

....	....	Zero to .0002 in. (0,005 mm) interference
------	------	---

Gudgeon pin bore	....	1.187 in. +.002 (47,57 mm +0,05)
------------------	------	----------------------------------

**Piston rings****Compression No. 1**

Type	....	Square friction edge—chromium plated
Gap in liner bore	....	.010 to .015 in. (0,25 to 0,38 mm)
Clearance in groove	....	.0025 to .0035 in. (0,063 to 0,089 mm)

**Compression—Nos. 2 and 3**

Type	....	Bevelled friction edge. Marked 'T' on upper side.
Gap in liner bore	....	.010 to .015 in. (0,25 to 0,38 mm)
Clearance in groove	....	.0025 to .0035 in. (0,063 to 0,089 mm)

**Scraper No. 4**

Type	....	Slotted, square friction edge, double landed
Gap in liner bore	....	.010 to .015 in. (0,25 to 0,38 mm)
Clearance in groove	....	.0025 to .0035 in. (0,063 to 0,089 mm)

**Rocker gear**

Bush internal diameter (reamed in position)	....	.530 +.001 in. (13,4 +0,02 mm)
Shaft clearance in rocker bush	....	.001 to .002 in. (0,02 to 0,04 mm)
Tappet clearance	....	.010 in. (0,25 mm) hot or cold

**Timing chain tensioner**

Fit of bush in cylinder	....	.003 to .005 in. (0,07 to 0,12 mm) interference
Fit of bush in idler wheel	....	.001 to .003 in. (0,02 to 0,07 mm) interference
Fit of idler wheel on stub shaft	....	.001 to .003 in. (0,02 to 0,07 mm) clearance
Fit of piston in cylinder bush	....	.0005 to .001 in. (0,01 to 0,02 mm) clearance

**Thrust bearings, crankshaft**

Type	.....	Semi-circular, steel back, tin plated on friction surface
Standard size, total thickness....	.....	.093 in.—.002 (2,362 mm—0,05)
Oversizes	.....	.0025 in. (0,06 mm) .005 in. (0,12 mm) .0075 in. (0,18 mm) .010 in. (0,25 mm)

**Torque loadings**

Connecting rod bolts	35 lb/ft (4,84 Kg/m)
Cylinder head ( $\frac{1}{2}$ in. U.N.F.)	..... 75 lb/ft (10,3 Kg/m)
Main bearing bolts ( $\frac{9}{16}$ in. U.N.F.)	..... 85 lb/ft (11,75 Kg/m)
Rocker shaft support bracket bolts ( $\frac{1}{16}$ in. U.N.F.)	..... 12 to 13 lb/ft (1,66 to 1,80 Kg/m)
Flywheel securing bolts	50 lb/ft (6,91 Kg/m)

**Valves**

Inlet valve	
Diameter (stem)	..... .312 in.—.001 (7,93 mm— 0,02) or .311 in.—.0005 (7,91 mm—0,01) later type
Face angle	..... $45^\circ - \frac{1}{4}$
Exhaust valve	
Diameter (stem)	..... .343 in.—.001 (8,73 mm— 0,02) or .342 in.—.0005 (8,70 mm—0,01) later type
Face angle	..... $45^\circ - \frac{1}{4}$
Fit of inlet and exhaust valves in guides	..... .0005 to .003 in. (0,01 to 0,07 mm) clearance
Valve seat	
Seat angle (inlet and exhaust)	..... $45^\circ + \frac{1}{4}$

**Valve springs—inlet**

Inner	
Length—free	..... 1.61 in. (40,89 mm)
Length under 17.5 lb. (7,9 Kgs) load	1.383 in. (35,12 mm)
Outer	
Length—free	..... 1.768 in. (44,90 mm)
Length under 46 lb. (21 Kgs) load	..... 1.508 in. (38,30 mm)

**Valve springs—exhaust**

Inner	
Length—free	..... 1.61 in. (40,9 mm)
Length under 18.5 lb. (8,37 Kgs) load	1.372 in. (34,8 mm)
Outer	
Length—free	..... 1.768 in. (44,9 mm)
Length under 48 lb. (21,76 Kgs) load	1.497 in. (38,0 mm)

**Valve timing**

Inlet opens....	..... $13^\circ$ B.T.D.C.
Inlet closes....	..... $45^\circ$ A.B.D.C.
Inlet peak	..... $106^\circ$ A.T.D.C.
Exhaust opens	..... $48^\circ$ B.B.D.C.
Exhaust closes	..... $16^\circ$ A.T.D.C.
Exhaust peak	..... $106^\circ$ B.T.D.C.

**Vertical drive shaft gear**

Backlash	..... .006 to .010 in. (0,1524 to 0,254 mm)
Internal diameter of bush	..... 1.00 in. +.001 (25,4 mm + 0,02)
Fit of gear in bush	..... .001 to .003 in. (0,02 to 0,07 mm) clearance

**Vibration damper**

Fit of bushes in fly- wheel and back plate	.002 to .004 in. (0,05 to 0,10 mm)
Internal diameter of bushes (reamed in position)....	..... 1.917 in. +.001 (47,70 mm + 0,02)
Fit of bushes on driv- ing flange	..... .001 to .003 in. (0,02 to 0,07 mm) clearance
Maximum permissible run-out of flywheel	.005 in. (0,12 mm)

# SECTION AO — ENGINE LUBRICATION

## INDEX

	Page		Page
Data, all models	AO-8	Recommended lubricants:	
Defect location, all models	AO-8	2 litre Petrol	AO-3
Filter, external, 2 litre Petrol	AO-7	2½ litre Petrol	AO-3
Filter, external, 2½ litre Petrol, 2 litre Diesel	AO-7	2 litre Diesel	AO-3
Oil pump, 2 litre Petrol	AO-1	Relief valve adjustment, 2 litre Petrol	AO-5
Oil pump, 2½ litre Petrol, 2 litre Diesel	AO-5		

## LIST OF ILLUSTRATIONS

Fig.		Page	Fig.		Page
AO-1	Oil pressure relief valve, 2 litre Petrol	AO-1	AO-7	Oil pump ball valve lapping tool	AO-5
AO-2	Distributor housing location bolt	AO-1	AO-8	Exploded view of oil pump and driving gear, 2½ litre Petrol, 2 litre Diesel	AO-6
AO-3	Exploded view of oil pump and driving gear, 2 litre Petrol	AO-2	AO-9	Engine oil filters, 2½ litre Petrol, 2 litre Diesel	AO-7
AO-4	Checking clearance of oil pump gears, 2 litre Petrol	AO-4	AO-10	Engine oil filters, 2 litre Petrol	AO-7
AO-5	Oil pump ball valve lapping tool	AO-4			
AO-6	Checking clearance of oil pump gears, 2½ litre Petrol, 2 litre Diesel	AO-5			

### Oil pump, 2 litre Petrol

#### To remove Operation AO/2

1. Drain the oil and remove sump.
2. Slacken the locknut securing oil pressure adjusting screw, then remove screw, washer spring, plunger and ball (which may remain in the pump and can be removed when the pump complete is withdrawn).
3. Remove the pump locating screw.
4. Withdraw the pump, leaving the drive shaft in position.
5. If necessary, withdraw the oil pump drive shaft.

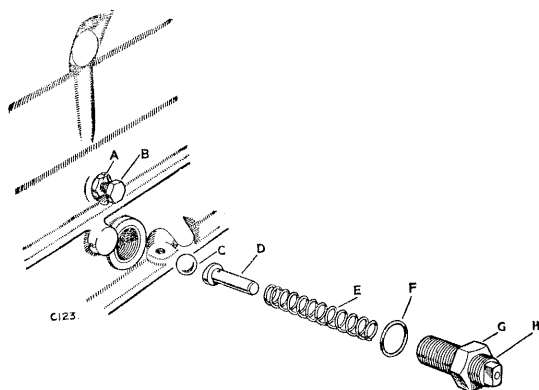


Fig. AO-1—Oil pressure relief valve

- |                           |                                |
|---------------------------|--------------------------------|
| A—Locknut                 | E—Spring                       |
| B—Locating screw—oil pump | F—Washer                       |
| C—Ball                    | G—Locknut                      |
| D—Plunger                 | H—Adjusting screw—oil pressure |

### Pump drive shaft and distributor housing Operation AO/4

1. Detach sparking plug covers and leads, remove distributor locating screw and withdraw the distributor.

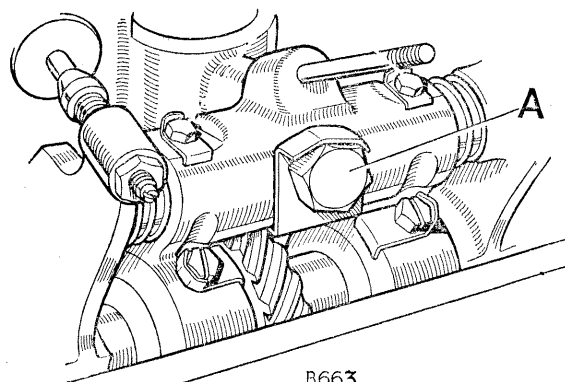


Fig. AO-2—Distributor housing location bolt  
A—Location bolt

2. Remove the hollow bolt for the distributor housing. Withdraw the distributor housing, and remove oil pump drive shaft.
3. Remove the oil pump cover and lift out the gears.
4. Remove the idler gear spindle. If necessary, press out the idler gear bush and drive out the bush in the pump body.
5. Clean parts, examine for wear and renew as necessary.
6. If removed, press a new bush into the body and ream in position to .5625 in. + .001 (14,28 mm + 0,025), ensuring correct alignment with the bore at the bottom end of the pump body. The bush should be a *light drive fit* in the pump body.



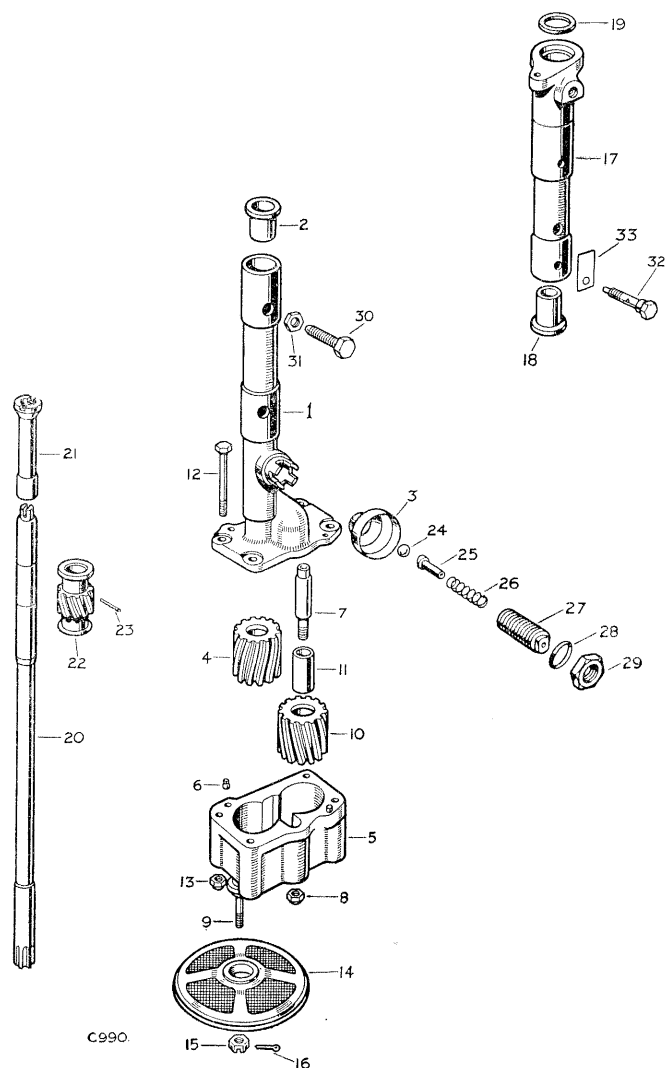


Fig. AO-3—Exploded view of oil pump and driving gear, 2 litre Petrol

- |   |  |
|---|--|
| 1 Oil pump body assembly                              | 18 Bush for drive shaft                        |
| 2 Bush for drive shaft                                | 19 Cork washer for housing                     |
| 3 Oil pump shield                                     | 20 Oil pump drive shaft                        |
| 4 Oil pump gear, driver                               | 21 Drive shaft for distributor                 |
| 5 Oil pump cover assembly                             | 22 Oil pump driving gear                       |
| 6 Dowel locating body                                 | 23 Taper pin, fixing gear to shaft             |
| 7 Spindle for idler wheel                             | 24 Steel ball                                  |
| 8 Self-locking nut ( $\frac{3}{8}$ " ) fixing spindle | 25 Plunger                                     |
| 9 Stud for oil strainer                               | 26 Spring                                      |
| 10 Oil pump gear idler assembly                       | 27 Adjusting screw                             |
| 11 Bush for idler gear                                | 28 Washer                                      |
| 12-13 Fixings—cover to body                           | 29 Locknut                                     |
| 14 Oil strainer for pump                              |  |
| 15-16 Fixings—oil strainer to pump                    |  |
| 17 Distributor housing assembly                       |  |
|   | 30-31 Fixings—oil pump to cylinder block       |
|   | 32 Oil feed bolt, locating distributor housing |
|   | 33 Locker for bolt                             |

For oil pressure  
release valve

## RECOMMENDED LUBRICANTS

These recommendations apply to temperate climates where operational temperatures may vary between approximately 10°F (-12°C) and 90°F (32°C).

Information on recommended lubricants for use under extreme Winter or Tropical conditions can be obtained from The Rover Co. Ltd. Technical Service Department.

2 LITRE AND 2 $\frac{1}{4}$ LITRE PETROL ENGINES								
COMPONENTS	S.A.E.	B.P.	DUCKHAM'S	ESSO	MOBIL	REGENT	SHELL	WAKEFIELD
PETROL ENGINE, AIR CLEANER AND GOVERNOR	20W	Energol SAE 20W	Duckham's NOL 20	Esso Extra Motor Oil 20W/30	Mobiloil Arctic	Advanced Havoline 20/20W	Shell X-100 SAE 20/20W	Castrolite
2 LITRE DIESEL ENGINE								
DIESEL ENGINE, AIR CLEANER AND GOVERNOR	20W	Energol Diesel D20W	NOL Diesel Engine Oil 20	Essolube H.D. 20	Mobiloil Arctic	R.P.M. Delo Special 20	Rotella 20/20W	Castrol CR 20
ALL MODELS								
GEARBOX, DIFFERENTIALS AND SWIVEL PIN HOUSINGS, STEERING BOX, STEERING RELAY (SEALED), REAR POWER TAKE-OFF, PULLEY UNIT, CAPSTAN WINCH AND HYDRAULIC WINCH GEARBOX	90EP	Energol E.P. SAE 90	Duckham's Hypoid 90	Esso Gear Oil GP 90	Mobilube GX 90	Universal Thuban 20	Spirax 90 EP	Castol Hypoy
HYDRAULIC WINCH SUPPLY TANK	—	—	—	Teresso 43	D.T.E. Light	—	Tellus 27	Hyspin 70
LUBRICATION NIPPLES	—	Energol L2	LB 10 Grease	Esso Multi-purpose Grease H	Mobilgrease MP	Marfak Multi-purpose 2	Retinax A	Castrol LM

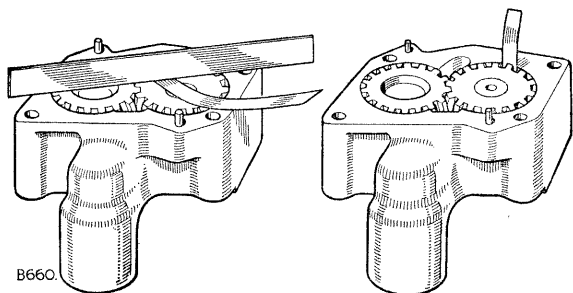


Fig. AO-4—Checking clearance of oil pump gears

7. If removed, press a new bush in the idler gear. Drill the  $\frac{1}{8}$  in. (3,17 mm) oilway and ream in position to .500 in.  $\pm$  .001 (12,7 mm  $\pm$  0,025).
8. Check the radial clearance (.001 to .004 in., 0,02 to 0,10 mm), backlash (.008 to .012 in., 0,20 to 0,30 mm) and end-float (.003 to .005 in., 0,075 to 0,13 mm steel gear, and .004 to .006 in., 0,10 to 0,15 mm aluminium gear) of the gears; renew parts as necessary. If incorrect, oil flow would be insufficient.
9. To renovate the pressure relief valve seating it is necessary to make a lapping tool.
10. Solder a new ball bearing (Part No. 01035) on to the end of a suitable length of tubing, as shown in Fig. AO-5.

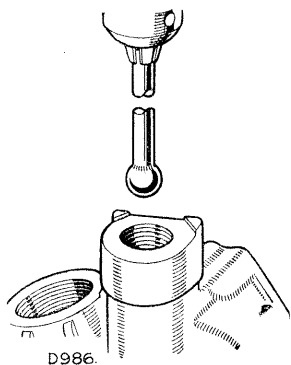


Fig. AO-5—Oil pump ball valve lapping tool

11. The lapping tool may be installed in a drilling machine or hand brace and the ball seating refaced, using coarse grinding paste. The tool may then be removed and used to "hand lap" the ball seating with fine grinding paste to a good finish.
12. Complete the assembly ensuring that the gears do not bind.

#### Oil pump drive shaft and distributor housing

13. Examine the pump drive shaft and gear for excessive wear and renew as necessary.  
Ensure that the new gear is fitted in the same position on the shaft as the old one.

14. If necessary press a new bush into the distributor housing and ream to .572 in.
15. If necessary the pump may be tested before refitting, as follows.
16. Install the pump drive shaft in a hand drilling brace.
17. Submerge the pump gear housing in a container of oil, insert the driving shaft into the pump and rotate the shaft for a few minutes.
18. Refit pump, pressure valve, and oil sump.  
Fill the engine with 10 Imperial pints (5,5 litres) of the correct grade oil.

#### Distributor and ignition timing

##### Operation AO/6

1. Rotate the engine in running direction until the F.A. 10° mark on the flywheel is in line with the pointer, with both valves on No. 1 cylinder closed.
2. Fit the oil pump drive shaft so that when fully engaged in oil pump, the broad segment of driving spigot will be nearest to No. 3 exhaust port. The crankshaft may have to be rotated slightly to allow engagement of driving shaft in oil pump, and when this is necessary, item 1 must be repeated.
3. Secure the distributor housing in position with the hollow oil feed bolt, then fit distributor drive shaft and side cover.
4. Locate a cork washer in recess in top of distributor housing.
5. Check the distributor contact breaker clearance and adjust if necessary, .014 to .016 in. (0,35 to 0,40 mm). Set the octane selector so that the fourth line from the left-hand side of the calibrated slide is against the face of distributor body casting.
6. Rotate the distributor spindle until the rotor is at the firing point for No. 1 cylinder. The broad side of the driving spigot should be towards No. 3 exhaust port and vacuum unit facing forward when the distributor is located.
7. Mount distributor and secure to distributor housing.
8. Slacken the pinch bolt at the base of the distributor body; rotate the distributor bodily in the opposite direction to the arrow on the rotor arm, until the contact breaker points are just opening with the fibre cam follower on the leading side of the cam; retighten the pinch bolt.

#### Checking with 12 volt timing lamp

- (a) Connect a lead between the distributor L.T. terminal and the centre pole of the bulb; earth the bulb body.
- (b) Rotate the distributor; the bulb will glow exactly when the points begin to open.

- Adjust as required by slackening the pinch bolt and turning the distributor bodily, or for fine adjustments, by means of the vernier screw.

#### Oil pressure relief valve, 2 litre Petrol models To adjust Operation AO/8

- Fit a slave oil pressure gauge in place of the warning light switch, run the engine and ensure that there is at least 20 lb./sq.in. (1,4 kg/cm<sup>2</sup>) oil pressure.
- Warm the engine to running temperature and adjust the pressure by means of the valve to 55-65 lb./sq.in. (3,8-4,5 Kg/cm<sup>2</sup>) at 30 m.p.h. (50 k.p.h.) in top gear. Tighten the screw to increase pressure and vice versa. If necessary, renew the release valve spring.
- Refit the warning light switch and lead.

#### Oil pump, 2½ litre Petrol—2 litre Diesel To remove Operation AO/10

- Drain the oil and remove sump.
- Remove the securing bolts and withdraw pump assembly.
- Withdraw the driving shaft from pump upper casing.

#### To overhaul and refit Operation AO/12

There are two types of oil pump fitted to both 2½ litre Petrol and 2 litre Diesel models. The early type pumps are fitted with spur type gears. The driving gear being made of steel, the idler cast iron. The late type pumps are fitted with skew gears, the driving gear being made of steel, the idler aluminium, with a pressed-in brass bush.

- Unscrew the securing nut and remove filter gauze assembly.
- Remove the bolts securing the upper casing to lower body, tap them gently apart and withdraw the gears. The idler gear spindle may be removed if necessary.
- Unscrew the relief valve plug and remove the spring, plunger and ball.
- Clean parts, examine for wear and renew as necessary.
- Check the radial clearance and end-float of the gears as shown in Fig AO-6.

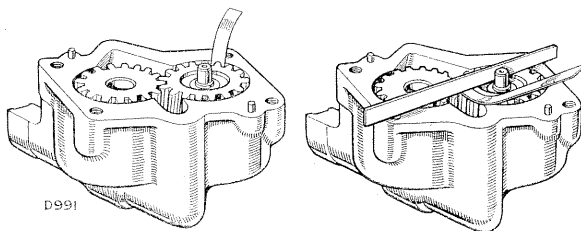


Fig. AO-6—Checking clearance of oil pump gears

#### Clearances, early type pump

End-float of gears	.... .002 to .005 in. (0,025 to 0,12 mm)
Radial clearance of gears	.... .0005 to .002 in. (0,012 to 0,050 mm)
Backlash of gears	.... .004 to .008 in. (0,10 to 0,20 mm)

#### Clearances, late type pump

End-float, steel gear	.... .002 in (0,05 mm)
End-float, aluminium gear	.... .003 in. (0,07 mm)
Radial clearance of gears	.... .001 to .003 in. (0,02 to 0,07 mm)
Backlash of gears	.... .006 to .012 in. (0,15 to 0,28 mm)

If necessary the idler gear bush may be renewed on late type pumps only. Press the new bush into the gear, drill the lubrication hole .125 in. (3,175 mm) and ream the bush to .5 in. (12,7 mm).

- To renovate the pressure relief valve seating it is necessary to make a lapping tool.
- Solder a new ball bearing (Part No. 3748) on to the end of a suitable length of tubing, as shown in Fig. AO-7.
- The lapping tool may be installed in a drilling machine or hand brace and the ball seating refaced, using coarse grinding paste. The tool may then be removed and used to "hand lap" the ball seating with fine grinding paste to a good finish.
- Smear the joint faces of pump body and cover lightly with suitable jointing compound, then bolt together.
- Insert the relief valve ball, plunger and spring. Secure with plug and washer.  
No provision is made for oil pressure adjustment.
- Fit a tab locking washer and seal to the filter gauze and nut assembly. Screw the unit into the pump inlet ports and position the filter square with sump bottom; lock in position.
- If necessary the pump may be tested before refitting, as follows.

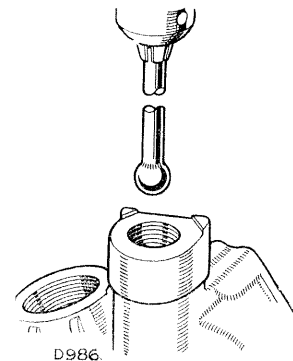


Fig. AO-7—Oil pump ball valve lapping tool

14. Install the pump drive shaft in a hand drilling brace.
15. Submerge the pump gear housing in a container of oil, insert the driving shaft into the pump and rotate the shaft for a few minutes.
16. Insert the longer splined end of driving shaft into the pump and locate in the driving gear.
17. With the inlet port rearward, and the splined upper end of driving shaft aligned to the drive

gear, offer the pump to engine and secure in position.

18. Refit the crankcase sump and refill with oil—11 Imperial pints, 13 U.S. pints (6 litres)—to the "high" mark on dipstick, run the engine and check for oil leaks at the sump joint face, then add more oil as necessary. Figure for capacity includes 2 pints (1 litre) for filter.

The above figures do not include filter capacity, which is  $3\frac{1}{2}$  Imperial pints, 3 U.S. pints (1,75 litres).

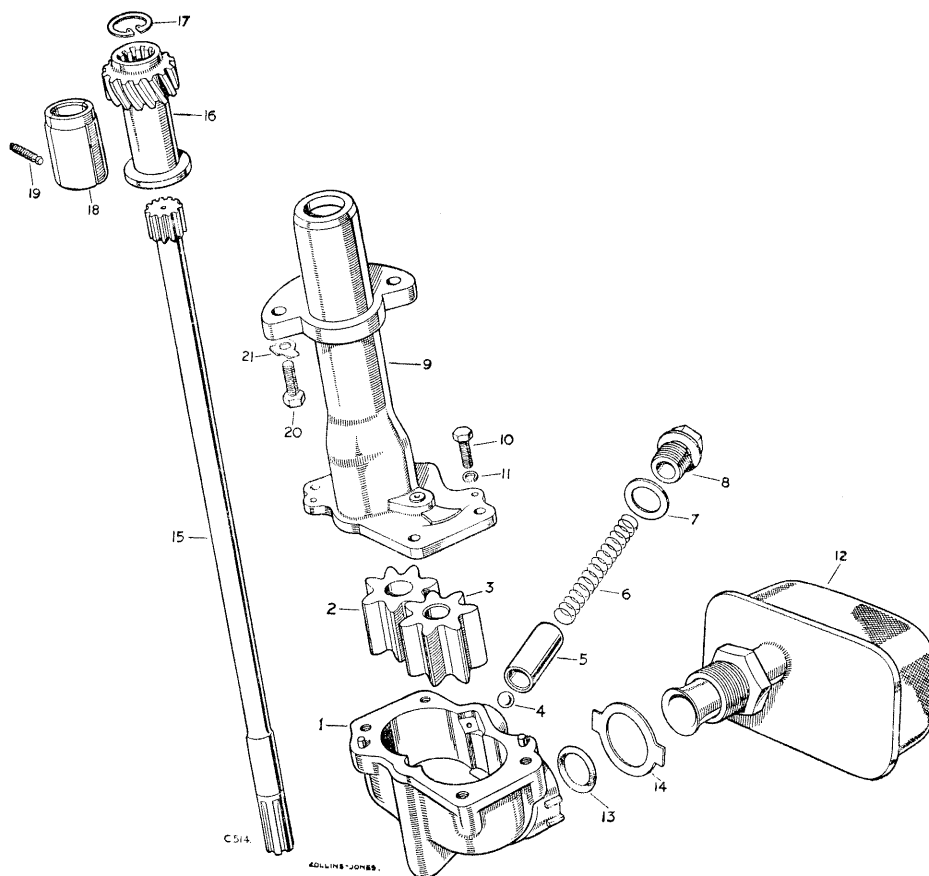


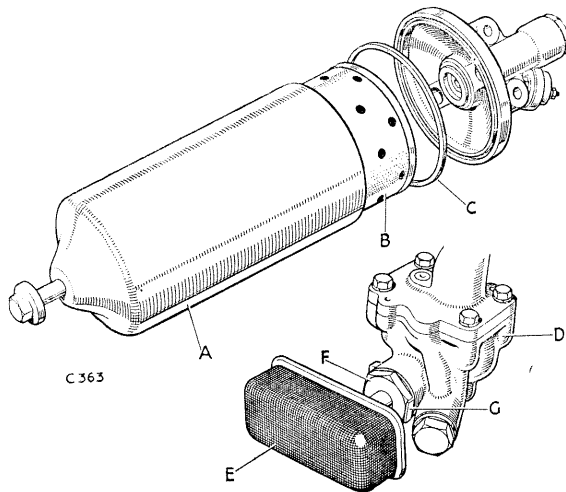
Fig. AO-8—Exploded view of oil pump and driving gear,  $2\frac{1}{2}$  litre Petrol, 2 litre Diesel

- |                         |                           |
|-------------------------|---------------------------|
| 1 Lower casing          | 11 Spring washer for bolt |
| 2 Driving gear          | 12 Filter gauze assembly  |
| 3 Driven gear           | 13 Oil seal               |
| 4 Relief valve ball     | 14 Tab washer             |
| 5 Relief valve plunger  | 15 Driving shaft          |
| 6 Relief valve spring   | 16 Driving shaft gear     |
| 7 Washer                | 17 Circlip                |
| 8 Plug                  | 18 Bush—drive shaft gear  |
| 9 Upper casing          | 19 Locating screw         |
| 10 Set bolt for casings | 20 Securing bolt          |
|                         | 21 Locking washer         |

**External oil filter, Petrol and Diesel models**  
**Element, to renew**                      **Operation AO/14**

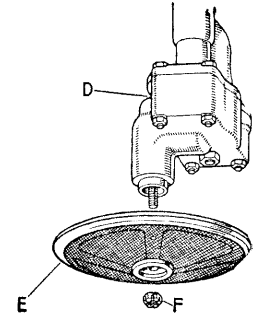
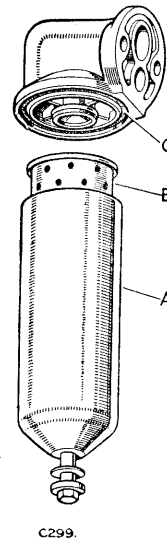
1. Position a suitable drip-tray beneath the filter, then unscrew the bolt at base of the filter container. Withdraw the container complete with the element, which must be discarded.

If necessary, the filter may be removed complete from the cylinder block.



**Fig. AO-9—Engine oil filters, 2½ litre Petrol, 2 litre Diesel**

A—Container    D—Oil pump    F—Nut for filter gauze  
 B—Element    E—Filter gauze    G—Locker for nut  
 C—Gasket



**Fig. AO-10—Engine oil filters, 2 litre Petrol**

A—Container    D—Oil pump  
 B—Element    E—Filter gauze  
 C—Gasket      F—Castellated nut

2. Wash the container thoroughly in petrol, fit a new element, sealing rings, then replace the container.
3. Fill sump with clean oil to the "high" mark on dipstick, run the engine and check for oil leaks and then add more oil as necessary.

## DEFECT LOCATION

(Symptom, Cause and Remedy)

**A—WARNING LIGHT REMAINS "ON"—ENGINE RUNNING**

1. Low oil pressure—*See item B.*
2. Oil pressure switch unserviceable—*Renew.*
3. Electrical fault—*Check circuit.*

**B—LOW OIL PRESSURE**

Ascertained by gauge fitted in place of switch and with sump oil level correct.

1. Dirty gauze filter on pump—*Remove sump, remove filter gauze and clean in petrol with a stiff brush. Refill with clean oil.*
2. Pump body joints loose—*Tighten.*
3. Foreign matter on pump ball valve seat—*Remove and clean.*

4. Relief valve plunger sticking—*Remove and ascertain cause.*
5. Weak relief valve spring—*Renew.*
6. Incorrectly adjusted relief valve (2 litre Petrol only)—*Adjust to 55 to 65 lb/sq. in. (3,8 to 4,5 Kg/cm<sup>2</sup>)*
7. Gears excessively worn—*Renew.*
8. Excessively worn bearings—main, connecting rod big-end, camshaft, etc.—*Ascertain which bearings and rectify.*

**C—WARNING LIGHT FAILS TO GLOW**

When engine is stopped and ignition (petrol engines) or auxiliary services (Diesel) switch is "on".

1. Bulb filament broken—*Renew bulb. Section Q.*
2. Oil pressure switch unserviceable—*Renew.*
3. Electrical fault—*Check circuit.*

## DATA

**Oil pump—2 litre Petrol**

Type	....	....	Gear
Drive	....	....	Skew gear from camshaft
End-float of gears:			
Steel gear	....	.003 to .005 in. (0,075 to 0,13 mm)	
Aluminium gear	....	.004 to .006 in. (0,10 to 0,15 mm)	
Radial clearance of gears	....	.001 to .004 in. (0,02 to 0,10 mm)	
Backlash of gears	....	.008 to .012 in. (0,20 to 0,30 mm)	

**Oil pressure, engine warm**

At 2,000 R.P.M.	....	55 to 65 lb./sq.in. (3,8 to 4,6 Kg/cm <sup>2</sup> )
-----------------	------	--

**Oil pressure relief valve**

Type	....	....	Adjustable
Relief valve spring:			
Free length	....	3.050 in. (77,47 mm)	
Compressed length at 13 lb. (5,89 Kg) load	....	1.990 in. (50,54 mm)	

**Oil pump, early type—2½ litre Petrol, 2 litre Diesel**

Type	....	....	Spur gear
Drive	....	....	Splined shaft from camshaft skew gear
End-float of gears	....	.002 to .005 in. (0,025 to 0,12 mm)	

Radial clearance of gears	....	.0005 to .002 in. (0,012 to 0,050 mm)
Backlash of gears	....	.004 to .008 in. (0,10 to 0,20 mm)

**Oil pump, late type—2½ litre Petrol, 2 litre Diesel**

Type	....	....	Skew gear
Drive	....	....	Splined shaft from camshaft skew gear
End-float of gears:			
Steel gear	....	.002 in. (0,05 mm)	
Aluminium gear	....	.003 in. (0,07 mm)	
Radial clearance of gears	....	.001 to .003 in. (0,02 to 0,07 mm)	
Backlash of gears	....	.006 to .012 in. (0,14 to 0,28 mm)	

**Oil pressure, engine warm**

At 2,000 R.P.M.	....	55 to 65 lb./sq.in. (3,8 to 4,6 Kg/cm <sup>2</sup> )
-----------------	------	--

**Oil pressure relief valve**

Type	....	....	Non-adjustable
Relief valve spring:			
Free length	....	2.840 in. (52,93 mm)	
Compressed length at 10 lb. load (4,53 Kg.)	....	2.45 in. (61,23 mm)	

# Section A2—VIBRATION DAMPER

## 2 LITRE PETROL and 2 LITRE DIESEL

### INDEX

	Page
Radiator, to remove ....	A2-1
Vibration damper, to overhaul ....	A2-1
Radiator, to refit ....	A2-2
Data ....	A2-2

### LIST OF ILLUSTRATIONS

Fig.	Page
A2-1 Checking vibration damper run-out	A2-1
A2-2 Sectioned view of vibration damper	A2-2
A2-3 Balancing vibration damper	A2-2

In order that the vibration damper may be removed it is necessary to remove the radiator.

#### Radiator, to remove Operation A2/2

1. Drain off the coolant. Diesel models only: Disconnect the lead coupling the two batteries.
2. Disconnect the top and bottom hoses from the radiator.
3. Disconnect the side lamp leads at snap connectors at each side of the grille panel assembly and the front lamp harness from the junction box at right-hand side of scuttle, then pull the wiring clear to front of engine.
4. Remove the radiator grille and chaff guard (if fitted) from the grille panel complete with the name plate.
5. Remove the fan blades.
6. Remove the bolts securing the front apron and remove panel. Remove the bolts securing the grille panel to the front cross-member and front wings.
7. Lift the radiator, grille panel and headlamps assembly upward, then forward to clear the vehicle.
8. Remove the rubber buffers from beneath the grille panel.
9. Slacken the dynamo and remove the fan belt.

#### Vibration damper, to overhaul

##### Operation A2/4

1. Remove the starting nut and tab washer, then withdraw the vibration damper assembly from crankshaft.
2. Unscrew the set bolts securing the backplate to flywheel, withdraw the backplate, rubber discs and shims.
3. If necessary renew the bushes in flywheel and backplate with an interference fit of .002 in. (0,05 mm) to .004 in. (0,10 mm).
4. Bolt the flywheel and backplate together, and reamer the bushes (ensuring that the bore is axially concentric) to allow a clearance fit on driving flange of .001 to .003 in. (0,02 to 0,07 mm).
5. Remove the securing bolts and withdraw the backplate from flywheel.

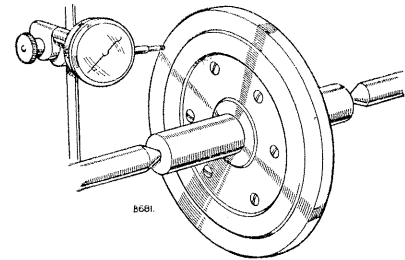


Fig. A2-1—Checking vibration damper run-out

6. Fit a rubber disc to each side of the driving flange, mount the flywheel, shims and backplate, with the arrows on backplate and flange aligned, then fit the set bolts and locking



tabs. With the bolts fully tightened, it should be just possible to turn the flywheel by hand whilst the driving flange is locked stationary. Add or remove shims to ensure this condition.

7. Mount the unit on a suitable mandrel and rotate between centres. Check the run-out with a dial test indicator and adjust to within .005 in. (0,127 mm) by means of the securing bolts.

Finally bend up the locking tabs to secure the set bolts, on the 2½ litre petrol, and Diesel models. On 2 litre Petrol models the screws should be staked with a centre punch.

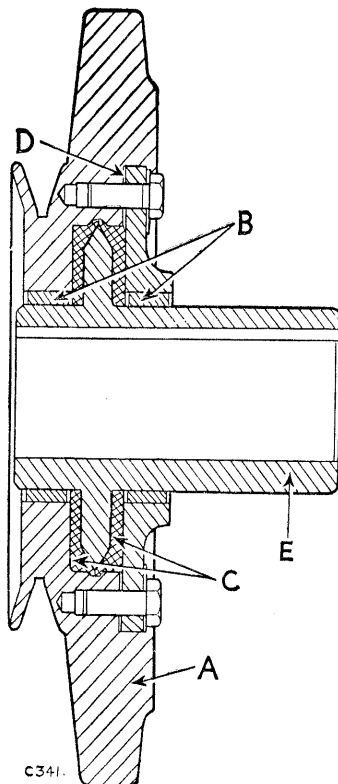


Fig. A2-2—Sectioned view of vibration damper

A—Flywheel and pulley      D—Shims  
B—Bushes                      E—Driving flange  
C—Rubber discs

8. Balance statically, using putty or similar material. Weigh the putty and drill balancing hole in the flywheel. A hole  $\frac{3}{8}$  in. (9,5 mm) dia. x  $\frac{1}{4}$  in. (6 mm) deep represents 1½ grams.

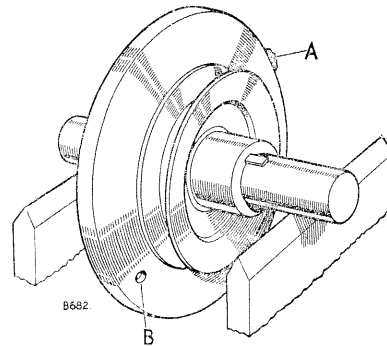


Fig. A2-3—Balancing vibration damper

A—Putty      B—Balancing hole

9. Locate the vibration damper on crankshaft and key, then secure with the starting dog and tab washer.
10. Fit the dynamo driving belt and adjust the tension to allow the belt to move  $\frac{5}{16}$  to  $\frac{7}{16}$  in. (8 to 11 mm) when pressed by thumb between the camshaft and water pump pulleys.

#### Radiator, to refit

#### Operation A2/6

1. Reverse the removal procedure, replacing the rubber buffers, if necessary, and connecting the wiring in accordance with the appropriate wiring diagram—Section P.

The total capacity of the cooling system is: 2½ litre petrol models, 17½ Imperial pints (10 litres); 2 litre petrol and Diesel models, 17 Imperial pints (9,5 litres).

*Note:* Use soft water wherever possible; if the local water supply is hard, clean rain or distilled water should be used.

2. Run the engine until working temperature is reached and top the water level as necessary.

#### DATA—ALL MODELS

##### Vibration damper

Fit of bush in flywheel .002 to .004 in. (0,05 to 0,10 mm) interference

Clearance of bush or driving flange .... .005 to .007 in. (0,12 to 0,17 mm)

Run-out on front face .005 in. (0,12 mm) maximum

Permissible out - of - balance .... 3 grams

# Section B — CLUTCH UNIT — ALL MODELS

## INDEX

	Page		Page
Adjustments in the vehicle		Stripping ....	B-4
Bleeding the clutch system ....	B-8	Assembling ....	B-4
Master cylinder ....	B-9	Data ....	B-13
Pedal ....	B-9	Defect location ....	B-12
Clutch master cylinder		Driven plate	
Removal ....	B-8	Re-lining ....	B-5
Stripping ....	B-8	Fluid reservoir	
Assembling ....	B-8	Removal ....	B-7
Fitment ....	B-8	Fitment ....	B-8
Clutch operating levers		Flywheel	
Adjustments....	B-4	Remove and overhaul ....	B-2
Clutch pedal		Fitment ....	B-2
Removal ....	B-7	Gearbox and transfer box	
Fitment ....	B-8	Removal ....	B-1
Clutch slave cylinder and bracket		Fitment ....	B-7
Removal ....	B-8	Withdrawal mechanism	
Stripping ....	B-8	Removal ....	B-6
Assembling ....	B-8	Stripping ....	B-6
Fitment ....	B-8	Overhaul ....	B-6
Clutch unit		Assembling ....	B-7
Removal ....	B-2	Fitment ....	B-7
Fitment ....	B-6		

## LIST OF ILLUSTRATIONS

Fig.	Page	Fig.	Page
B-1 Checking run-out on flywheel face ....	B-2	B-8 Gearbox unit mounting bolts and pads	B-7
B-2 Layout of clutch unit ....	B-3	B-9 Brake and clutch fluid reservoir ....	B-7
B-3 Setting operating levers ....	B-5	B-10 Bleed nipple, clutch slave cylinder ....	B-8
B-4 Driven plate ....	B-5	B-11 Clutch adjustment ....	B-9
B-5 Cross-section of clutch unit ....	B-6	B-12 Clutch linkage setting ....	B-9
B-6 Cross-section of withdrawal mechanism	B-6	B-13 Layout of clutch master cylinder, slave cylinder and pedal unit ....	B-10
B-7 Setting withdrawal shaft ....	B-7		

### Gearbox and transfer box assembly, to remove Operation B/2

1. Remove the hood, hard top or cab, for convenience in working.
2. Remove the front wheel drive control knob, locknut and spring; remove the knob and locknut from the transfer gear change lever.
3. Remove the floor board assembly and gearbox cover. Section R.
4. Remove the seat box complete. Section R.
5. **L.H.D. models only.** Remove the hand brake lever and linkage. Section H.
6. **R.H.D. models only.** Remove the hand brake rod and the expander rod from the relay lever.
7. Disconnect the front axle propeller shaft, rear axle propeller shaft and rear power take-off propeller shaft (if fitted) at the gearbox end.
8. Disconnect the clutch operating hose at the slave cylinder, remove the split pin and withdraw

the pin fixing the connecting tube to the clutch cross and operating shafts, then remove the nuts and washers securing the bracket to the bell housing and remove the bracket complete with slave cylinder.

9. Disconnect the speedometer cable at the gearbox and withdraw the cable clear of the gearbox. Disconnect the earth lead at the transfer box.
10. Remove the remaining nuts and plain washers fixing the bell housing to flywheel housing, then remove the gearbox unit bearer bolts, top bearer rubbers, washers, shims and distance tubes.
11. Place a suitable sling around the gearbox unit, raise it approximately 1 inch (25 mm).
12. Place a jack under the rear end of the engine; this prevents any strain being taken on the primary pinion shaft.
13. Withdraw the gearbox unit and remove it from the vehicle.

**Clutch unit, to remove      Operation B/4**

1. Mark the cover plate and flywheel, so that on reassembly the plate may be fitted in the same relative position, to retain the original balance of the unit.
2. Release the self-locking nuts securing the clutch unit to the flywheel, until the spring pressure is relieved; remove the clutch unit and drive plate.

The release lever adjustment nuts are correctly set and locked when the clutch is assembled, and should not be altered unless the clutch has been dismantled and new parts fitted. Interference with this adjustment would throw the pressure plate out of position and result in clutch judder.

**Flywheel, to remove and overhaul      Operation B/6**

If the flywheel is excessively worn it must be renewed or refaced.

**Flywheel data****2 litre Petrol**

Number of teeth	.... 97
Thickness at pressure face	1.093 in. (28 mm)
Maximum permissible run-out on flywheel face	.... .002 in. (0,05 mm)
Maximum refacing depth	.030 in. (0,75 mm)
Minimum thickness after grinding	.... 1.063 in. (27 mm)
Primary pinion bush:	
Fit in flywheel	.... .001 to .003 in. (0,02 to 0,07 mm) interference
Internal diameter—reamed in position	.878 in. (22 mm)
Fit of shaft in bush	.... .003 to .004 in. (0,07 to 0,10 mm) clearance

**2 litre Diesel**

Number of teeth	.... 100
Thickness at pressure face	.... 1.375 in. (35 mm)
Maximum permissible run-out on flywheel face	.... .002 in. (0,05 mm)
Maximum refacing depth	.030 in. (0,75 mm)
Minimum thickness after grinding	.... 1.345 in. (34 mm)
Primary pinion bush:	
Fit in flywheel	.... .001 to .003 in. (0,02 to 0,07 mm) interference
Internal diameter—reamed in position	.875 in. (22,2 mm)
Fit of shaft in bush	.... .001 to .003 in. (0,02 to 0,07 mm) clearance

**2½ litre Petrol**

Number of teeth	.... 97
Thickness at pressure face	1.515 in. (38 mm)
Maximum permissible run-out on flywheel face	.... .002 in. (0,05 mm)
Primary pinion bush:	
Fit in flywheel	.... .001 to .003 in. (0,02 to 0,07 mm)
Internal diameter—reamed in position	.875 in. (22,2 mm)
Fit of shaft in bush	.... .001 to .003 in. (0,02 to 0,07 mm) clearance
Maximum refacing depth	.030 in. (0,75 mm)
Minimum thickness after grinding	.... 1.485 in. (37,5 mm)

2. After refacing, a new primary pinion bush may be fitted and reamed to size.

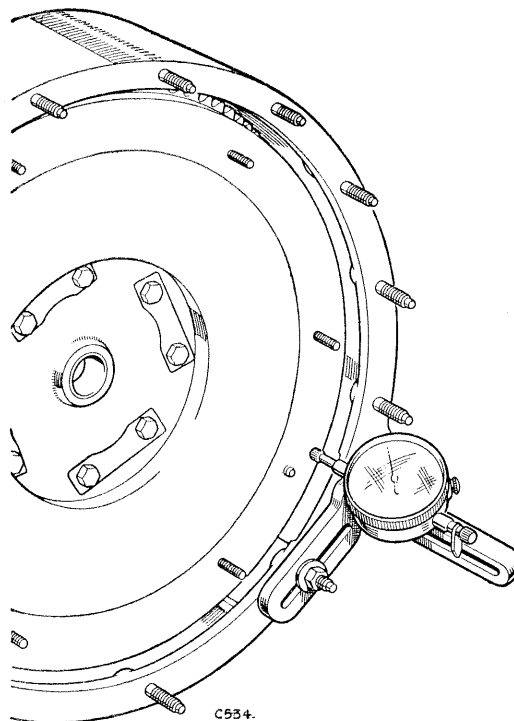


Fig. B-1—Checking run-out on flywheel face

**Flywheel, to replace      Operation B/8**

1. Fit the flywheel and tighten the securing bolts to 50 lb./ft. (7 Kgs/m) torque.
2. Check the run-out on flywheel face as illustrated by Fig. B-1. The run-out on flywheel face must not exceed .002 in. (0,05 mm).

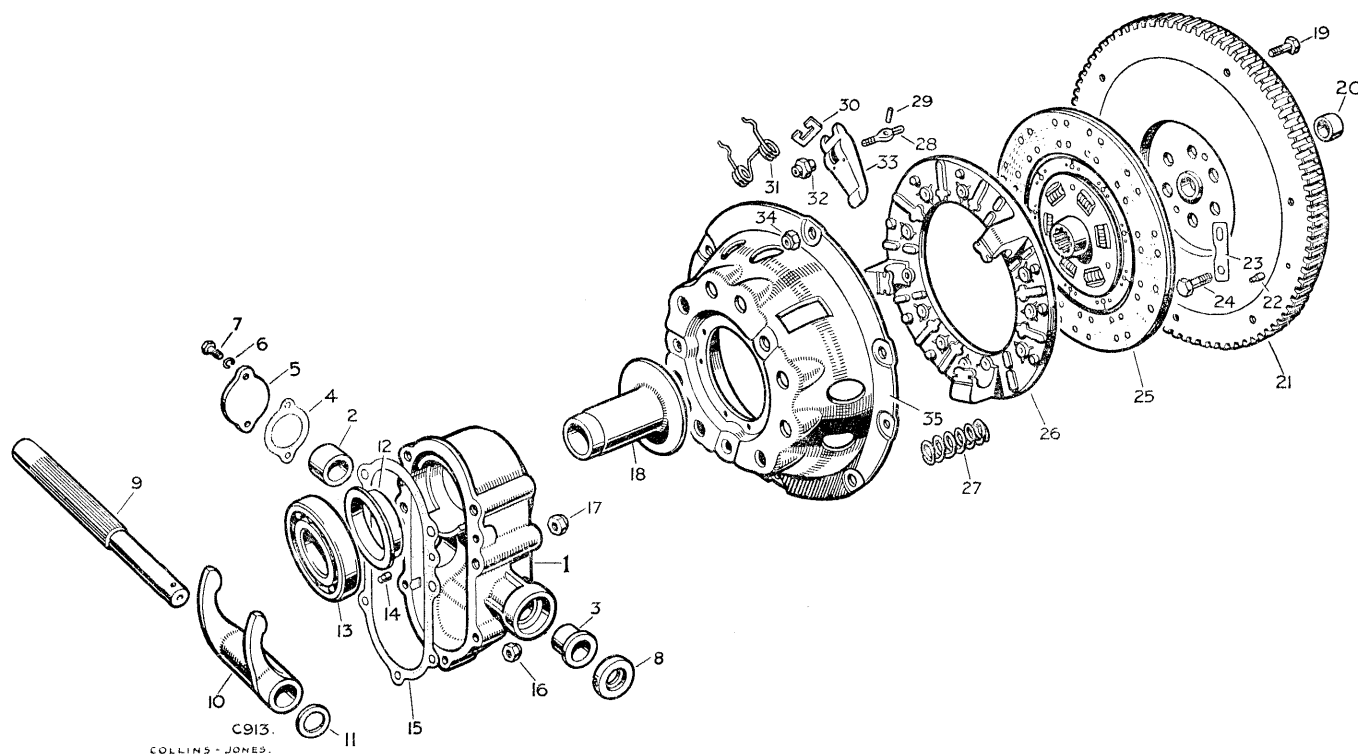


Fig. B-2—Layout of clutch unit

- |       |                                     |    |                                    |
|-------|-------------------------------------|----|------------------------------------|
| 1     | Withdrawal housing                  | 20 | Bush for primary pinion            |
| 2     | Bush, large                         | 21 | Flywheel                           |
| 3     | Bush, small                         | 22 | Dowel locating clutch unit         |
| 4     | Joint washer                        | 23 | Locker                             |
| 5     | Cover plate                         | 24 | Special bolt                       |
| 6-7   | Fixings for cover plate             | 25 | Clutch driven plate                |
| 8     | Oil seal                            | 26 | Clutch pressure plate              |
| 9     | Cross-shaft for fork                | 27 | Clutch thrust spring               |
| 10    | Operating fork for clutch           | 28 | Eyebolt                            |
| 11    | Thrust washer for cross-shaft       | 29 | Fulcrum pin for lever              |
| 12    | Bush for sleeve                     | 30 | Strut                              |
| 13    | Thrust bearing                      | 31 | Anti-rattle spring                 |
| 14    | Dowel                               | 32 | Adjustment nut                     |
| 15    | Joint washer for housing            | 33 | Release lever                      |
| 16-17 | Fixings for withdrawal race housing | 34 | Nut fixing clutch unit to flywheel |
| 18    | Withdrawal sleeve                   | 35 | Clutch cover plate                 |
| 19    | Fitting bolt fixing clutch          |    |                                    |

**Clutch, to strip****Operation B/10**

1. Suitably mark the cover plate, pressure plate plugs and release levers, so that they may be assembled in the same relative position, in order to retain the original balance.
2. Place the cover assembly under a press with the pressure plate resting on wooden blocks, so arranged that the cover can move downwards when pressure is applied. Place a block of wood across the top of the cover, resting on the spring bosses.
3. Press the cover downwards and remove the release lever adjusting nuts; slowly release the pressure to prevent the clutch springs from flying out.
4. Lift off the cover.
5. Remove each release lever by holding the lever and eyebolt between fingers and thumb, so that the inner end of the lever and the threaded end of the eyebolt are as near together as possible, keeping the release lever pin in position in the lever. Lift the strut over the ridge on the lever and remove the eyebolt from the pressure plate.
6. Examine the pressure plate for signs of scoring or burning, and regrind. The limit being .010 in. (0,25 mm) undersize. The minimum thickness is 1.531 in. (39 mm). The thickness of the plate is measured from the pressure face to the underside of the operating lugs. Discard the plate if it still shows signs of wear when ground to this dimension. Serious shortening of the effective life of the clutch unit will result if the limit for regrinding is exceeded.

The thickness of the pressure plate must always be measured from the underside of the same operating lug and the amount skimmed off the plate stamped on the side of the lug in question.

**Clutch, to assemble****Operation B/12**

1. Clean all the components and lay them out for inspection.
2. Renew all parts which show damage or appreciable wear.
3. A very slight smear of high melting-point grease should be applied to the following parts during assembly:  
Release lever pins, contact faces of struts, eyebolt seats in cover, drive lug sides on the pressure plate and the plain end of the eyebolts.
4. Check the clutch springs in accordance with the data given and renew as necessary.
5. Assemble the release lever eyebolt and lever pin; holding the threaded end of the eyebolt and the inner end of the lever as close together as possible. With the other hand, insert the

strut in the slots in the pressure plate lug and insert the plain end of the eyebolt in the hole in the pressure plate. Move the strut upwards into the slots in the pressure plate lug and over the ridge on the short end of the lever, and drop it into the groove formed in the latter. Fit the other two release levers in a similar manner.

6. Place the pressure plate on the wooden blocks under the press and arrange the thrust springs in a vertical position on the plate, seating them on the bosses provided. Lay the cover over the assembled parts, ensuring that the anti-rattle springs are in position and that the tops of the thrust springs are directly under the seats in the cover. Also ensure that the machined portions of the pressure plate lugs are under the slots in the cover and that the parts marked before dismantling are in their correct relative positions.
7. Place the block of wood across the cover, resting it on the spring bosses, and compress the cover, guiding the eyebolts and pressure plate lugs through the holes in the cover.
8. Screw the adjusting nuts on the eyebolts and operate the clutch a few times by means of the press, to ensure that the working parts have settled into their correct positions.
9. Adjust the operating levers.

**Clutch operating levers, to adjust****Operation B/14**

This adjustment must be carried out before the clutch is refitted to the engine, and will always be necessary after complete stripping of the unit, or if any new parts have been fitted.

1. The setting of the clutch release levers is checked, using  $\frac{3}{8}$  in. (9,5 mm) distance pieces in place of the driven plate. The levers must be adjusted to a dimension of 1.655 in. (42 mm) from the flywheel face, with a maximum of .010 in. (0,25 mm) difference in height between the three levers. (Fig. B-3).
2. Place the flywheel on a surface plate and set the scribe to 1.655 in. (42 mm) from the flywheel face, using gauge Part No. 262754.
3. Place the three distance pieces on the flywheel in place of the driven plate.
4. Fit the cover assembly to the flywheel by tightening all six securing nuts a turn at a time by diagonal selection, until the unit is fully secured.
5. Check the height of each operating lever and adjust as necessary, by turning the adjustment nut until the top of the lever is exactly level with the scribe. Adjust the two other levers in a similar manner.
6. Secure the adjusting nuts by staking.

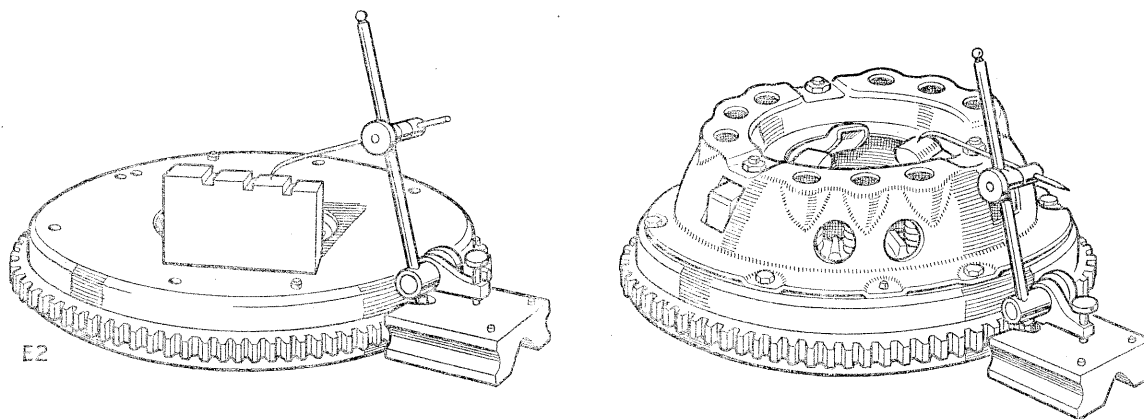


Fig. B-3—Setting the operating levers

7. Slacken the securing nuts a turn at a time by diagonal selection, and remove the clutch unit from the flywheel.
8. Remove the distance pieces.

**Driven plate, to re-line****Operation B/16**

The driven plate, if appreciably worn, must be renewed or re-lined.

1. Drill out the retaining rivets, using a  $\frac{5}{32}$  in. (4 mm) drill inserted through the clearance hole in the opposite lining; each rivet attaches one facing only. The rivets must not be punched out, as serious deformation of the plate would thereby result.
2. Thoroughly examine the segments for cracks; renew as necessary.

3. Place one facing in position with the countersunk holes coinciding with the ones located on the crown or longer side of each segment.
4. Insert the rivets with their heads in the countersunk holes of the facing and roll the shanks over securely against the segments. If a rolling tool is not available, a blunt-ended centre punch will prove satisfactory.
5. Secure the second facing on the opposite side of the plate in a similar manner, matching the countersunk holes with the remaining holes in the segments. The rivet heads should always face outwards.
6. Mount the plate on a suitable mandrel between centres and check for run-out as near the edge as possible; if the error is more than .010 in. (0,25 mm), press over the high spots until the plate is true within this figure.

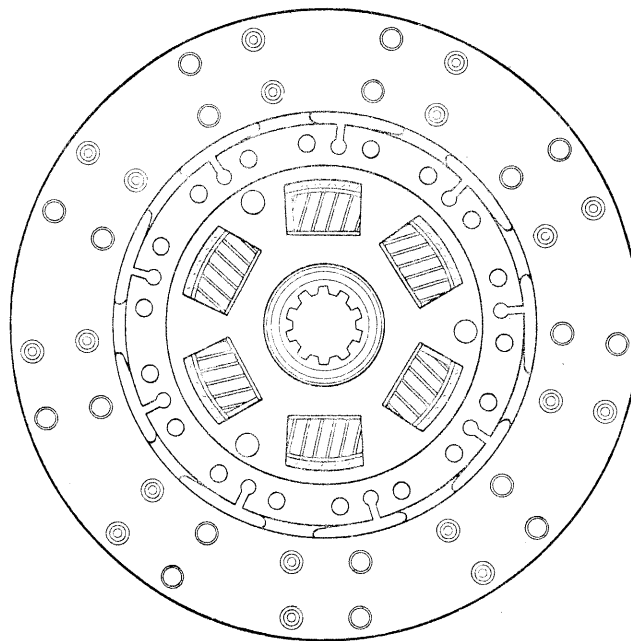


Fig. B-4—Driven plate

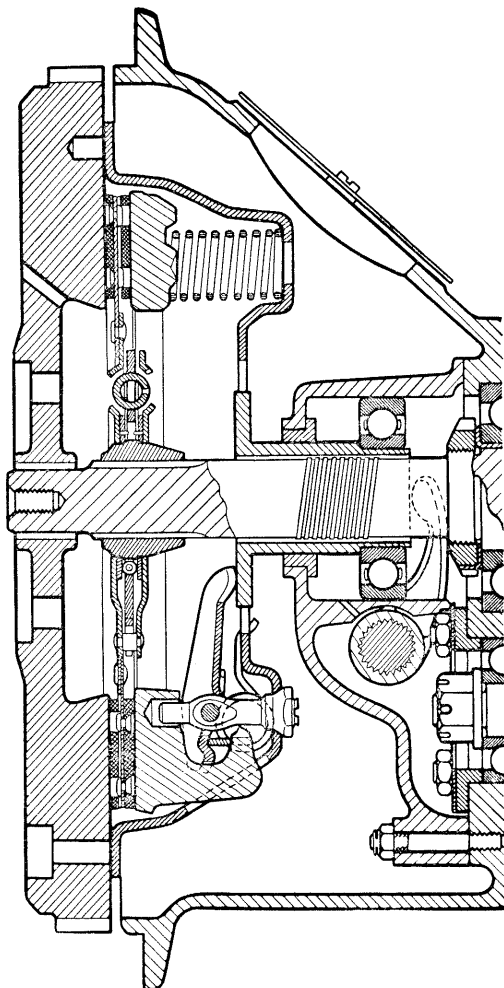


Fig. B-5—Cross-section of the clutch unit

**Clutch, to replace****Operation B/18**

Ensure that the driven plate will slide on every spline on the primary shaft before refitting.

1. Place the driven plate in position on the flywheel with the longer end of the central boss away from the engine.
2. Centralise the plate by means of a slave primary pinion.
3. Fit the clutch unit with the identification marking adjacent to that on the flywheel; pull down the securing nuts a turn at a time by diagonal selection to prevent distortion of the unit.
4. Remove the centralising shaft.

**Withdrawal mechanism****To remove****Operation B/20**

1. Remove the grommets from the bell housing.
2. Remove the clutch withdrawal unit from the bell housing.

**To strip****Operation B/22**

1. Remove the cross-shaft cover plate.
2. Drive out the cross-shaft from right to left, thus releasing the withdrawal fork, a thrust washer and a thrust spring.
3. If necessary, remove the oil seal from the withdrawal housing.
4. If necessary, press off the grommet centre from the housing.
5. Remove the bearing from the withdrawal sleeve and remove the sleeve from the front of the housing.

**To overhaul****Operation B/24**

1. If necessary, renew the two small flanged oilite bushes in the right-hand cross-shaft bore of the housing. The bushes must be a light drive fit in the housing bore. Renew the cross-shaft if badly worn.
2. If necessary, renew the large oilite bush in the left-hand cross-shaft bore of the housing. The bush must be a drive fit in the housing bore; press the bush in flush with the outer face of the housing.

3. If necessary, renew the oilite withdrawal sleeve bush in the housing. The bush must be a drive fit in the housing. The bush should be a sliding fit on the sleeve. Renew the sleeve if a greater clearance than this is obtained in a new bush.

Ensure that the oil scroll machined on the primary pinion is not damaged; a faulty scroll may result in oil reaching the driven plate, thus causing clutch slip.

4. Renew the thrust bearing if badly worn or damaged. The bearing must be a light drive fit on the sleeve; renew the parts as necessary.

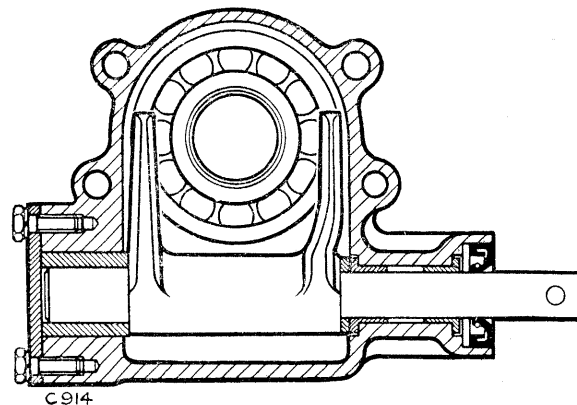


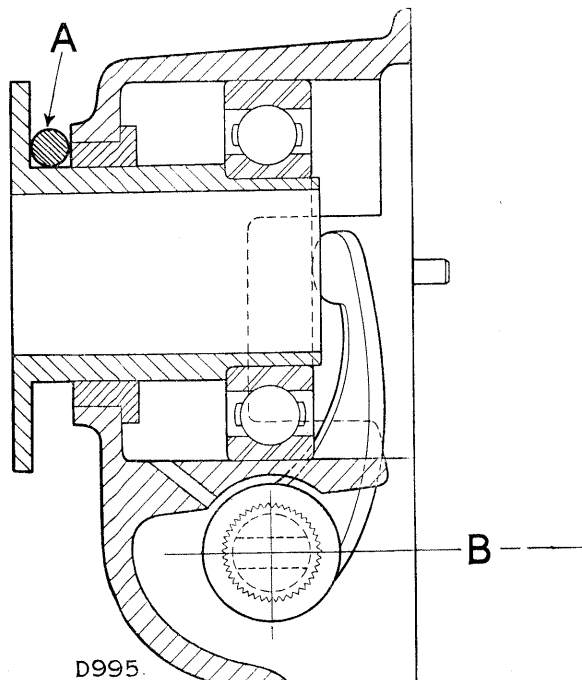
Fig. B-6—Cross-section of withdrawal mechanism

**To assemble****Operation B/26**

1. Replace the withdrawal sleeve in the housing; fit the thrust bearing.
  2. Fit the oil seal in the cross-shaft bore, with its knife edge inwards.
  3. Place a  $\frac{7}{16}$  in. (11 mm) round-section bar between the withdrawal sleeve and the housing. See Fig. B-7.
- This will give the required position of the withdrawal fork when the cross-shaft is inserted.
4. Place the withdrawal fork, thrust washer and thrust spring in position in the housing.
  5. Ensure the withdrawal fork is in contact with the bearing, and the  $\frac{7}{16}$  in. (11 mm) round-section bar is still trapped between the withdrawal sleeve and housing, then insert the cross-shaft, with linkage connecting drilling in the horizontal position. See Fig. B-7.
  6. Refit the cover plate and joint washer.

**To refit****Operation B/28**

1. Refit the withdrawal unit (together with a joint washer).
2. Replace the open grommet over the operating end of the cross-shaft and attach it to the centre and bell housing with a suitable adhesive.

**Fig. B-7—Setting withdrawal shaft**

A— $\frac{7}{16}$  in. (11 mm) setting bar  
 B—Connecting drilling in horizontal position

**Gearbox and transfer box, to replace**  
**Operation B/30**

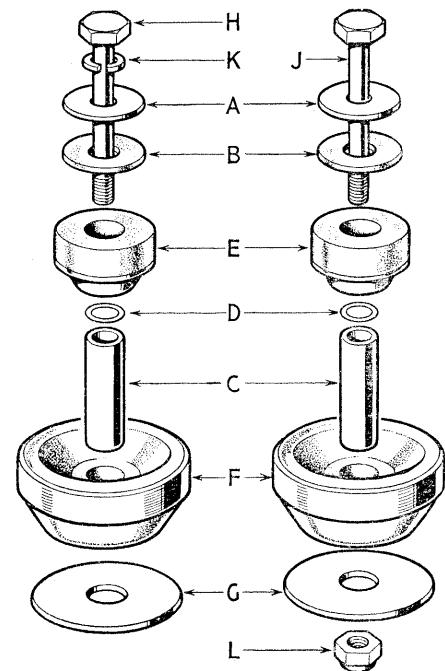
1. Reverse the removal procedure.

2. **2 litre Petrol models only.** The nip on the gearbox unit mounting rubber pad is adjusted by the addition or removal of shims on the top of the central distance tube.

The correct setting is with the top shim approximately  $\frac{1}{16}$  in. (1,5 mm) below the top face of the upper rubber pad.

**All models.** The rear mounting brackets are adjustable laterally, to facilitate alignment with the mounting rubbers.

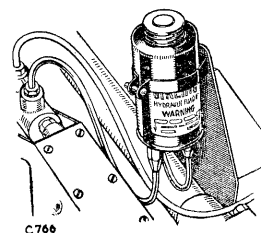
3. If necessary, refill the main gearbox,  $2\frac{1}{2}$  pints (1,5 litres) and transfer box,  $4\frac{1}{2}$  pints (2,5 litres) with oil.
4. If necessary bleed the clutch system, and adjust the pedal movement as necessary.

**Fig. B-8—Gearbox unit mounting bolts and pads.****2 litre Petrol models only**

- |                        |                        |
|------------------------|------------------------|
| A—Plain washer (upper) | G—Plain washer (lower) |
| B—Rubber washer        | H—Front bolt           |
| C—Distance tube        | J—Rear bolt            |
| D—Shim                 | K—Spring washer        |
| E—Top rubber           | L—Self-locking nut     |
| F—Bottom rubber        |                        |

**Clutch pedal linkage to overhaul and**  
**fluid reservoir to remove**      **Operation B/32**

1. Remove bonnet. (Remove spare wheel if fitted.)

**Fig. B-9—**  
**Brake and clutch**  
**fluid reservoir**



2. Disconnect the brake and clutch outlet pipe.
3. Remove the securing nut and spring washer and withdraw assembly, complete with clamp.  
If necessary, the pedal bracket, complete with master cylinder and pedal, can be removed as one assembly.
4. Remove cover plate and gasket from pedal bracket.
5. Disconnect input and output unions from clutch master cylinder.
6. Remove retaining nut from plunger, and push plunger up into master cylinder.
7. Using a suitable punch, drift out pin from the pedal shaft.
8. Remove pedal shaft.
9. Remove spring, pedal to anchor bracket (inside vehicle) and withdraw pedal.

#### Clutch master cylinder

To remove Operation B/34

##### L.H.D. models

1. Remove the securing bolts (inside vehicle) and remove pedal bracket, complete with master cylinder.
2. Remove the self-locking nuts, plain washers and bolts, and withdraw the master cylinder.

##### R.H.D. models

3. Remove the nut, securing plunger to trunnion, then remove the self-locking nuts, plain washers and bolts, and withdraw the master cylinder.

#### Clutch slave cylinder and bracket

To remove—cylinder only Operation B/36

1. Remove floor boards.
  2. Disconnect jump hose at slave cylinder.
- 2 litre Petrol**
3. Remove securing bolts.
  4. Withdraw slave cylinder, leaving push-rod in position.
- 2½ litre Petrol, Diesel models**
5. Remove the clevis pin, securing the slave cylinder push-rod to the clutch shaft operating lever. Remove the return spring.
  6. Remove the cotter fixing the clutch shaft and operating lever to the cross-shaft connecting tube.
  7. Remove the securing bolts and split the spherical bearing housing, then pull the clutch shaft and operating lever out from the connecting tube. Rotate the shaft to withdraw the slave cylinder push-rod.
  8. Remove the securing bolts and withdraw the slave cylinder, from underneath the bracket.

9. If necessary remove the three nuts and plain washers securing the bracket to the flywheel housing and withdraw the bracket.

#### Clutch master cylinder and slave cylinder

To strip

Operation B/36

1. Remove the locknut and rubber cover from the piston push-rod; remove the circlip and withdraw the push-rod and retaining washer.
2. Apply a low air pressure to the intake orifice in order to expel the piston assembly from the cylinder.

To assemble

Operation B/40

1. Clean all the component parts in Girling Crimson brake fluid.
2. Carefully inspect the seals and rubber dust cover; renew as necessary; smear the seals with Wakefield No. 3 rubber grease.
3. Assemble the unit by reversing the dismantling procedure.

#### Clutch pedal linkage, cylinders and

fluid reservoir, to refit

Operation B/42

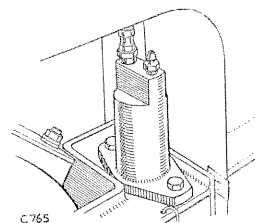
1. Reverse the removal procedure, renewing gaskets and any worn parts as necessary.

#### Bleeding the clutch system Operation B/44

If the level of fluid in the supply tank is allowed to fall too low, or if any section of the clutch pipe line has been disconnected, the clutch will not operate smoothly and may give place to judder and harshness.

1. Attach a length of rubber tubing to the bleed screw and place the lower end of the tube in a glass jar containing a small amount of fluid.
2. Slacken the bleed screw and pump the clutch pedal, pausing at each end of each stroke, until the fluid issuing from the tube shows no signs of air bubbles when the tube is held below the surface of the fluid in the jar.
3. Holding the tube under the fluid surface, tighten the bleed screw.

Fig. B-10—  
Bleed screw for clutch  
slave cylinder



The fluid in the reservoir must be replenished throughout the operation to prevent another air lock being formed.

Note particularly that the fluid reservoir for the clutch is the small central tube in the combined reservoir, and that the level is correct when the fluid is just above the top of the inner reservoir. Use only Girling Crimson brake fluid.

#### Clutch linkage adjustment pedal position, to adjust Operation B/46

The lock-stop bolt located in the pedal bracket back plate, should not be disturbed, but in the event of this being absolutely necessary, it must be reset as follows:—See Fig. B-12.

1. Support the pedal pad 6 in. (152 mm) from the toe-board, and screw in bolt A until it touches the pedal shaft stop plate. Tighten the locknut.

#### Master cylinder free play, to adjust Operation B/48 See Fig. B-12

1. Check the free play B in the master cylinder push-rod D which should be  $\frac{1}{16}$  in. (1,5 mm) at the push-rod and is felt as approximately  $\frac{5}{16}$  in. (8 mm) at the pedal pad; if it is less than the given figure:
2. Slacken off locknut C and rotate the push-rod D with the fingers, until the correct movement has been attained.

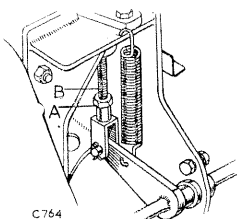


Fig. B-11—  
Clutch adjustment

A—Locknut  
B—Push-rod

#### Pedal free play, to adjust Operation B/50

1. Slacken the push-rod locknut, at the slave cylinder. See Fig. B-11.
2. Adjust the push-rod by rotating until the total free movement at the pedal is  $1\frac{1}{2}$  in. (38 mm).

The total free play is felt in two stages:

- (a) Light movement of approximately  $\frac{5}{16}$  in. (8 mm), which takes up the master cylinder free play against the pedal return spring.
  - (b) Slightly heavier movement which should be approximately  $1\frac{3}{16}$  in. (30 mm) which takes up the slave cylinder free play through the hydraulic system and against the slave cylinder return spring.
3. Secure with the locknut.

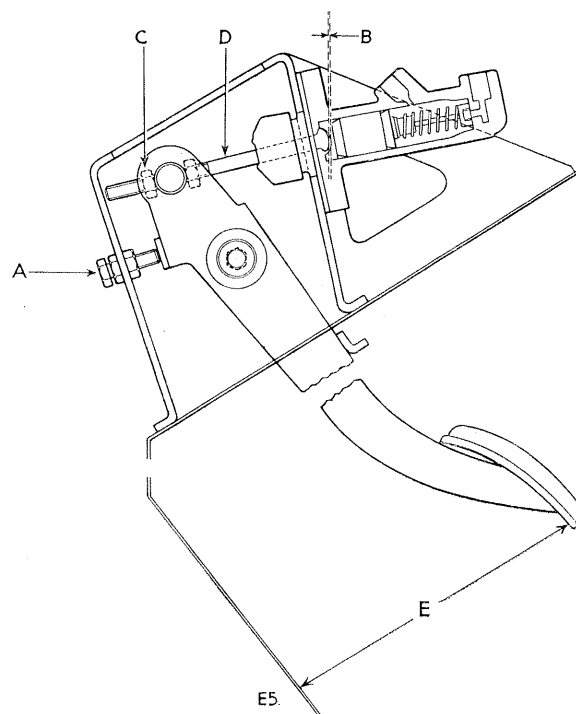


Fig. B-12—Clutch linkage setting

A—Pedal position setting bolt  
B—Free play master cylinder push-rod  $\frac{1}{16}$  in. (1,5 mm)  
C—Master cylinder push-rod locknuts  
D—Master cylinder push-rod.  
E—6 in. (152 mm) from pedal pad to toe-board.

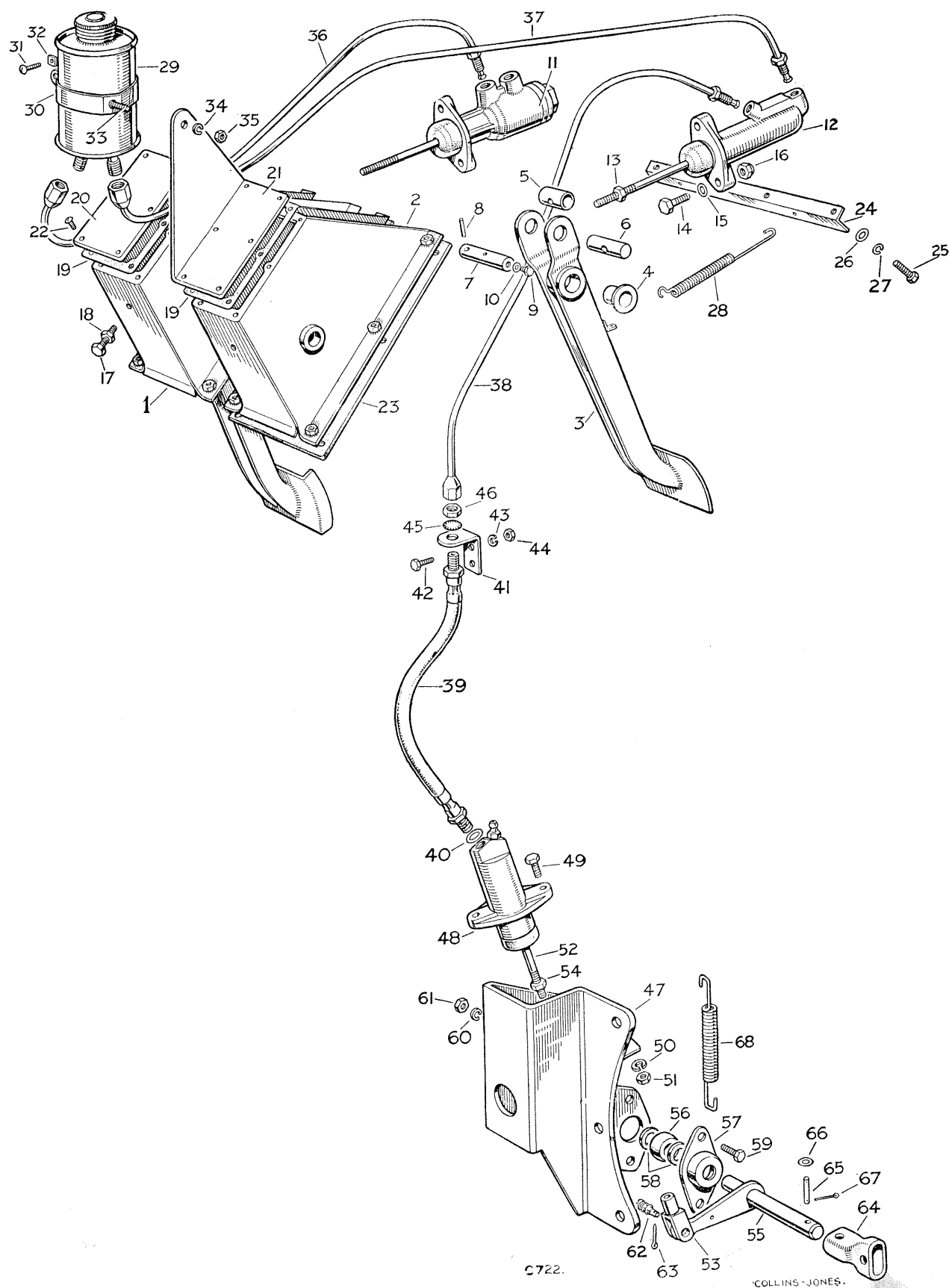


Fig. B-13—Layout of clutch master cylinder, slave cylinder and pedal unit

## Key to Fig. B-13

- |   |  |
|---|--|
| 1 Pedal and bracket assembly                          | 36 Pipe, reservoir to brake master cylinder  |
| 2 Clutch pedal bracket                                | 37 Pipe, reservoir to clutch master cylinder |
| 3 Clutch pedal  | 38 Pipe, clutch master cylinder to hose      |
| 4 Bush for pedal                                      | 39 Hose, pipe to clutch slave cylinder       |
| 5 Pedal trunnion distance piece                       | 40 Gasket for hose at slave cylinder         |
| 6 Pedal trunnion                                      | 41 Hose mounting bracket                     |
| 7 Pedal shaft   | 42 Bolt                                      |
| 8 Pin, locating pedal shaft                           | 43 Spring washer                             |
| 9 Oil plug  | 44 Nut                                       |
| 10 Joint washer for oil plug                          | 45 Shakeproof washer                         |
| 11 Brake master cylinder                              | 46 Special nut                               |
| 12 Clutch master cylinder                             | 47 Clutch slave cylinder support bracket     |
| 13 Nut for master cylinder push-rod                   | 48 Clutch slave cylinder                     |
| 14 Bolt   | 49 Bolt                                      |
| 15 Plain washer                                       | 50 Spring washer                             |
| 16 Self-locking nut                                   | 51 Nut                                       |
| 17 Bolt   | 52 Clutch slave cylinder push-rod            |
| 18 Nut  | 53 Push-rod clevis                           |
| 19 Pedal bracket top cover gasket                     | 54 Push-rod locknut                          |
| 20 Pedal bracket top cover                            | 55 Clutch shaft and operating lever          |
| 21 Pedal bracket top cover and reservoir tank support | 56 Spherical bearing                         |
| 22 Drive screw, fixing top cover to bracket           | 57 Spherical bearing housing                 |
| 23 Pedal bracket gasket                               | 58 Felt ring for spherical bearing           |
| 24 Pedal return spring anchor bracket                 | 59 Bolt                                      |
| 25 Bolt   | 60 Spring washer                             |
| 26 Plain washer                                       | 61 Nut                                       |
| 27 Spring washer                                      | 62 Clevis pin, lever to fork end             |
| 28 Clutch pedal return spring                         | 63 Split pin for clevis pin                  |
| 29 Combined brake and clutch reservoir                | 64 Clutch cross-shaft connecting tube        |
| 30 Clip for reservoir                                 | 65 Pin                                       |
| 31 Screw  | 66 Plain washer                              |
| 32 Nut  | 67 Split pin                                 |
| 33 Bolt   | 68 Return spring for clutch operating lever  |
| 34 Spring washer                                      |  |
| 35 Nut  |  |
- } Fixing master cylinder to pedal bracket  
 } Fixing bracket to dash  
 } Fixing hose to bracket  
 } Fixing slave cylinder to support bracket  
 } Fixing pedal bracket and anchor to dash  
 } Fixing spherical bearing to support bracket  
 } Fixing reservoir clip to mounting bracket  
 } Fixing tube to clutch cross and operating shafts

## DEFECT LOCATION

(Symptom, Cause and Remedy)

## A—GRABBING CLUTCH

1. Incorrect release lever adjustment—*Adjust.*
2. Oil on the clutch lining—*Renew.*
3. Worn clutch plates or flywheel—*Renew.*
4. Clutch plate hub sticking on the pinion shaft—*Free off the clutch plate and check for wear and distortion. Check the pinion shaft for wear.*
5. Worn or binding operating levers—*Wear on levers usually indicates a binding withdrawal race thrust bearing. Free off bearing and renew levers.*
6. Worn or glazed linings—*Renew.*
7. Broken or weak pressure springs—*Renew.*
8. Sticking clutch pedal—*Free off the pedal and check for damaged or bent parts. Check the return spring.*
9. Damaged or deteriorated engine mountings, or engine loose in chassis frame—*Re-tighten or renew.*

## B—SLIPPING CLUTCH

1. Slipping the clutch in order to overcome poor engine response—*This must never be done—ensure that the engine is in good condition and completely free from carburation flat spots, which may only be noticed under load conditions.*
2. Weak or broken pressure springs—*Renew.*
3. Worn clutch linings—*Renew and check plates for scoring.*
4. Incorrect clutch adjustment—*Adjust.*
5. Oil on the linings—*Renew. Rectify the oil leak. Note—The drain plug must only be used for operating in heavy mud, or when the vehicle is wading. At all other times the plug should be removed.*
6. Warped clutch plate—*Renew.*
7. Scored or damaged pressure plate—*Skim or renew.*
8. Binding withdrawal lever—*Free off the lever and check for wear. Examine the clutch linings, plates and springs for wear or damage and the flywheel for scoring. Renew as found necessary.*
9. Binding clutch pedal mechanism—*Rectify or renew.*
10. Insufficient free movement on the clutch pedal—*Adjust.*
11. Riding clutch—*In the hands of the operator.*
12. Fractured clutch plate—*See Item C (6).*

## C—DRAGGING OR SPINNING CLUTCH

1. Oil on the clutch linings—*Renew; if necessary rectify oil leak.*  
*Note.—The drain plug must only be used for operating in heavy mud, or when the vehicle is wading. At all other times the plug should be removed.*
2. Incorrect lever adjustment—*Examine and adjust.*
3. Incorrect pedal adjustment—*Adjust.*
4. Incorrect master cylinder push-rod free movement—*Adjust.*
5. Dust or other foreign matter in the clutch—*Clean and renew.*
6. Bent clutch plate—*Ascertain reason for damage, check the remainder of the clutch and renew the plate. A plate may be distorted due to the weight of the gearbox being allowed to hang on the clutch plate during erection. When fitting a new plate, take the weight of the gearbox with a jack or by other suitable means.*
7. Clutch plate hub binding on the pinion shaft—*Rectify or renew.*
8. Primary pinion bush binding—*Rectify.*
9. Clutch withdrawal sleeve sticking—*Rectify and examine all mating surfaces for scoring and wear.*

10. Warped clutch pressure plate and clutch cover—*Renew.*
11. Clutch facings too thick—*Renew.*
12. Broken clutch linings—*Renew. Examine the pressure plate, clutch cover, etc., for distortion and damage.*
13. Insufficient fluid—*Replenish tank.*
14. Air in hydraulic system—*Bleed system. Operation B/2.*

## D—RATTLING CLUTCH

1. Weak or broken operating lever return spring—*Renew.*
2. Damaged pressure plate—*Ascertain the reason for the damage and rectify. Recondition or renew.*
3. Broken pedal return spring—*Renew.*
4. Pinion shaft or clutch plate splines worn—*Renew.*
5. Worn primary pinion bush—*Renew.*
6. Unequal contact of operating levers—*Adjust.*
7. Incorrect free play in pedal lever—*Adjust.*
8. Damaged clutch plate, loose or broken springs; warped clutch plate—*Renew.*
9. Worn parts in the withdrawal mechanism—*Renew.*
10. Excessive backlash in the transmission—*Rectify.*
11. Normal wear in clutch—*Renew.*

## E—SQUEAKING CLUTCH

1. Primary pinion bush binding—*Rectify and renew.*
2. Primary pinion bush turning in the flywheel—*Renew.*

## F—VIBRATING CLUTCH OR CLUTCH JUDDER

1. Incorrect clutch balance—*Renew.*
2. Clutch pressure plate incorrectly fitted—*Refit.*
3. Loose engine mountings—*Tighten.*
4. Worn propeller shaft universal joints—*Rectify.*
5. Loose flywheel—*Tighten. Check run-out on flywheel.*
6. Oil or other foreign matter on the clutch lining—*Renew. Note—The drain plug must only be used for operating in heavy mud, or when the vehicle is wading. At all other times the plug should be removed.*
7. Contact area of friction faces not evenly distributed—*Rectify or renew.*
8. Bent splined shaft or buckled driven plate—*Renew and check for damage.*
9. Pressure plate out of parallel with flywheel face—*Rectify.*

## G—STIFF CLUTCH OPERATION

1. Dry or damaged linkage parts—*Lubricate and renew, if necessary.*
2. Clutch pedal spindle dry—*Lubricate.*

## H—CLUTCH TICKS OR KNOCKS

1. Clutch plate hub splines worn—*Rectify and renew.*
2. Worn primary pinion bush—*Renew.*

## J—FRACTURED CLUTCH PLATE

1. See Item C (6)—*Rectify and renew.*

## K—EXCESSIVE LINING WEAR

Produced by overloading or by slipping clutch—*See B item 1. For maximum payloads and drawbar pull, see Instruction Book.*

## DATA

**Clutch:**

Type	Single dry plate, spring drive, self-centralising
Operation	Hydraulic

**Thrust race:**

Type	Ball bearing
------	--------------

**Thrust springs:**

Number off	9
Free length (2 litre Petrol)	2.680 in. (68 mm)
Free length (2½ litre Petrol)	2.680 in. (68 mm)
Free length (Diesel)	2.688 in. (68,5 mm)
Working length	1.688 in. (43 mm)
Load at working length (2 litre Petrol)	120-130 lb. (54-59 kg)
Load at working length (2½ litre Petrol, 2 litre Diesel)	135-145 lb. (61-65 kg)
Identification (2 litre Petrol)	Cream paint
Identification (2½ litre Petrol)	Yellow and light green paint
Identification (2 litre Diesel)	Yellow paint

**Pressure plate:**

Re-grinding limit	.010 in. (0,25 mm) under-size
Minimum thickness	1.531 in. (39 mm)

**Operating levers:**

Height from flywheel face using ⅜ in. (9,5 mm) distance piece in place of the driven plate	1.655 in. (42 mm)
--	-------------------

**Driven plate:**

Diameter	9 in. (230 mm)
Thickness of plate, new	.330 in. (8,5 mm)
Maximum permissible wear	.120 in. (3 mm)
Identification (2 litre Petrol)	Red and violet springs
Identification (2½ litre Petrol), springs	3 off—Buff and light green 3 off—White and light green
Identification (2 litre Diesel), springs	3 off—Buff and light green 3 off—Light grey and violet

**Withdrawal mechanism:**

Clearance of flanged bushes on cross-shaft	.001 to .003 in. (0,02 to 0,07 mm)
Clearance of L.H. bush on cross-shaft	.002 to .004 in. (0,05 to 0,10 mm)
Clearance of bush on withdrawal sleeve	.003 to .007 in. (0,07 to 0,18 mm)

**Clutch pedal unit:**

Pedal free movement	¾ in. (20 mm) measured at pedal pad
Fit of bush on pedal shaft	.001 to .003 in. (0,02 to 0,07 mm) clearance
Bush reamed bore	.750 in. (20 mm)

**Master cylinder:**

Type	Girling c.v.
Bore	¾ in. (19 mm)
Stroke	1⅜ in. (35 mm)
Push-rod free movement	⅛ in. (1,5 mm)

**Slave cylinder:**

Type	Girling
Bore	⅞ in. (22 mm)

**2 litre Petrol****Flywheel**

Number of teeth	97
Thickness at pressure face	1.093 in. (28 mm)
Maximum permissible run-out on flywheel face	.002 in. (0,05 mm)
Maximum refacing depth	.030 in. (0,75 mm)
Minimum thickness after grinding	1.063 in. (27 mm)

**Markings:**

T.D.C.	When opposite pointer, No. 1 piston is at top dead centre
E.P.	When opposite pointer, No. 1 exhaust valve should be fully open. 114° before T.D.C.
F.A.10°	When opposite pointer, indicates firing point of No. 1 cylinder.

Primary pinion bush	
Fit in flywheel	.... .001 to .003 in. (0,02 to 0,07 mm) interference
Internal diameter—reamed in position	.875 in. (22 mm)
Fit of shaft in bush	.001 to .003 in. (0,02 to 0,07 mm) clearance
Flywheel bolt tightening torque	.... 50 lb./ft. (7 kgs/m)

**2½ litre Petrol****Flywheel**

Number of teeth	.... 97
Thickness at pressure face	.... 1.515 in. (38 mm)
Maximum permissible run-out on flywheel face	.... .002 in. (0,05 mm)
Primary pinion bush:	
Fit in flywheel	.... .001 to .003 in. (0,02 to 0,08 mm)
Internal diameter—reamed in position	.875 in. (22,2 mm)
Fit of shaft in bush	.001 to .003 in. (0,025 to 0,075 mm)
Maximum refacing depth	.... .030 in. (0,75 mm)
Minimum thickness after grinding	.... 1.485 in. (37,5 mm)
Markings:	
T.D.C.	.... When opposite pointer, No. 1 piston is at top dead centre
E.P.	.... When opposite pointer, No. 1 exhaust valve should be fully open.
F.A. 3° for Regular fuels	
F.A. 6° for Premium fuels	.... When opposite pointer, indicates firing point of No. 1 cylinder.
Flywheel bolt tightening torque	.... 50 lb./ft. (7 kgs/m)

**2 litre Diesel****Flywheel**

Number of teeth	.... 100
Thickness at pressure face	.... 1.375 in. (35 mm)
Maximum permissible run-out on flywheel face	.... .002 in. (0,05 mm)
Maximum refacing depth	.... .030 in. (0,75 mm)
Minimum thickness after grinding	.... 1.345 in. (34 mm)
Markings:	
T.D.C.	.... When opposite pointer, No. 1 piston is at top dead centre
E.P.	.... When opposite pointer, No. 1 exhaust valve should be fully open
16° and 18° marks	
See below.	When opposite pointer, with both valves closed, indicates start of injection
88 Diesel, up to engine No. 146900522	
109 Diesel, up to engine No. 156900285	
Set the pointer exactly between the 16° and 18° marking, i.e. the 17° mark;	
88 Diesel, from engine No. 146900523	
109 Diesel, from engine No. 156900286	
Set the pointer in line with the 16° mark	
Primary pinion bush:	
Fit in flywheel	.... .001 to .003 in. (0,02 to 0,07 mm) interference
Internal diameter—reamed in position	.875 in. (22,2 mm)
Fit of shaft in bush	.001 to .003 in. (0,02 to 0,07 mm) clearance
Flywheel bolt tightening torque	.... 50 lb./ft. (7 kgs/m)

# Section C

## GEARBOX UNIT — ALL MODELS

### INDEX

	Page		Page
Defect location .....	C-25	Stripping .....	C-13
Detail data .....	C-27	Dismantling .....	C-13
Front output shaft housing assembly		Assembling .....	C-15
Removal .....	C-21	Fitment .....	C-17
Stripping .....	C-21	Main gear change lever	
Assembling .....	C-22	Overhaul .....	C-24
Fitment .....	C-23	Reverse stop	
Gearbox and transfer box assembly		Adjustment .....	C-24
Removal .....	C-13	Transfer box	
Fitment .....	C-13	Removal .....	C-17
General data .....	C-26	Stripping .....	C-18
Main gearbox		Assembling .....	C-19
Removal .....	C-13	Fitment .....	C-20

### LIST OF ILLUSTRATIONS

Fig.		Page	Fig.		Page
C-1	Layout of the gearbox unit: casings....	C-2	C-13	Fitting synchronising clutch assembly	C-16
C-2	Layout of the gearbox unit: shafts and gears .....	C-4	C-14	Tightening transfer drive gear securing nut .....	C-16
C-3	Layout of the gearbox unit: front output shaft housing and controls....	C-6	C-15	Adjusting 2nd speed gear stop bolt .....	C-17
C-4	Layout of the gearbox unit: main gear change lever and selectors .....	C-8	C-16	Removing intermediate gear shaft .....	C-18
C-5	Cross-section of gearbox unit: elevation	C-10	C-17	Fitting transfer box output shaft protection cap .....	C-18
C-6	Cross-section of gearbox unit: plan....	C-11	C-18	Removing transfer box output shaft front bearing outer race .....	C-18
C-7	Cross-section of gearbox unit: controls	C-12	C-19	Removing transfer box output shaft front bearing inner race .....	C-19
C-8	Gearbox unit mounting rubbers .....	C-13	C-20	Adjusting transfer box output shaft end-float .....	C-20
C-9	Removing the transfer drive gear securing nut .....	C-14	C-21	Adjusting reverse gear stop bolt .....	C-20
C-10	Removing layshaft rear bearing outer race .....	C-14	C-22	Setting the link pin .....	C-22
C-11	Checking mainshaft gear end-float .....	C-15	C-23	Setting transfer and dog clutch selector shaft .....	C-23
C-12	Measuring mainshaft bush end-float	C-15	C-24	Cross-section of reverse stop	C-23
			C-25	Adjusting reverse stop .....	C-24



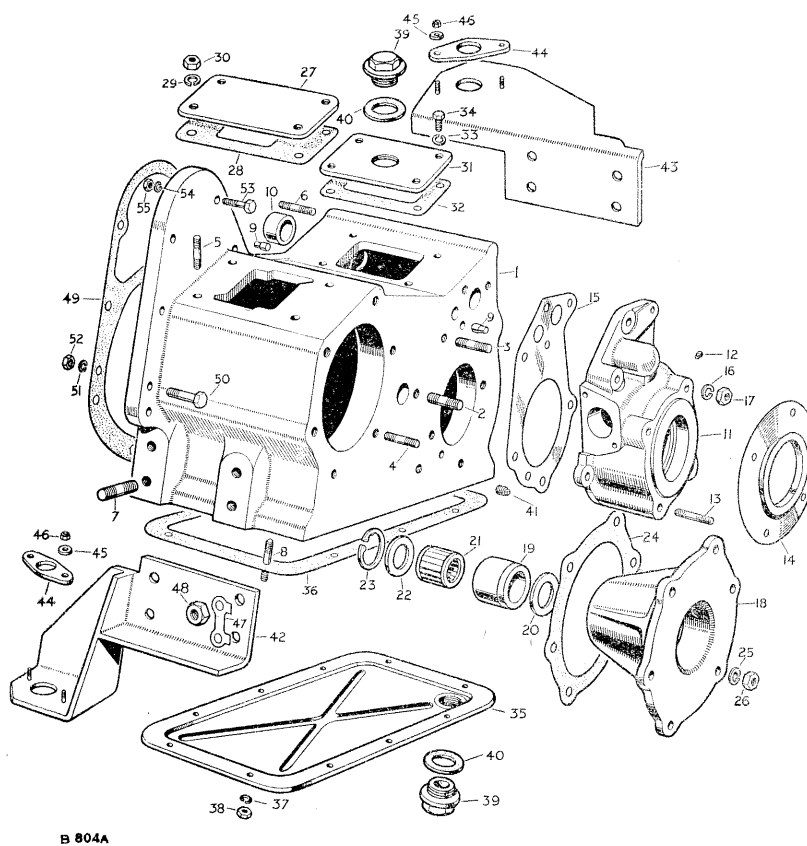
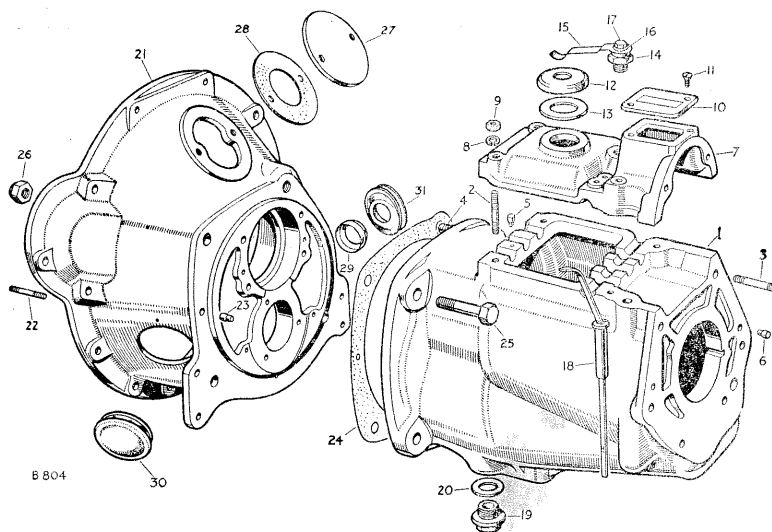


Fig. C-1—Layout of the gearbox unit casings

## Key to Fig. C-1

- |  |  |
|--|--|
| 1 Gearbox casing assembly                  | 16-17 Fixings for spring                 |
| 2 Stud for top cover and gear change plate | 18 Oil level dipstick                    |
| 3 Stud, short, for transfer casing         | 19 Drain plug for gearbox                |
| 4 Stud for bell housing                    | 20 Washer for plug                       |
| 5 Dowel locating top cover                 | 21 Bell housing assembly                 |
| 6 Dowel locating transfer casing           | 22 Stud for withdrawal race housing      |
| 7 Top cover for gearbox                    | 23 Dowel locating gearbox                |
| 8-9 Fixings for top cover                  | 24 Joint washer, bell housing to gearbox |
| 10 Inspection cover plate for selectors    | 25-26 Fixings for gearbox casing         |
| 11 Set screw fixing cover plate            | 27 Top cover for bell housing            |
| 12 Oil filler cap                          | 28 Rubber seal for top cover             |
| 13 Joint washer for cap                    | 29 Centre for dust cover                 |
| 14 Plug for retaining spring               | 30 Grommet for bell housing hole         |
| 15 Retaining spring for cap                | 31 Grommet for bell housing shaft        |
- 
- |   |  |
|---|--|
| 1 Transfer box casing assembly              | 25-26 Fixings for housing                |
| 2 Stud for intermediate shaft               | 27 Cover plate for P.T.O. selector       |
| 3 Stud for speedometer housing, short       | 28 Joint washer for cover plate          |
| 4 Stud for mainshaft housing                | 29-30 Fixings for cover plate            |
| 5 Stud for top cover plate                  | 31 Cover plate for transfer gear change  |
| 6 Stud, short, for transfer shaft housing   | 32 Joint washer for cover plate          |
| 7 Stud for engine mounting                  | 33-34 Fixings for plate                  |
| 8 Stud for bottom cover                     | 35 Cover plate, bottom, for transfer box |
| 9 Dowel locating speedometer housing        | 36 Joint washer for bottom cover         |
| 10 Bush for shaft guide                     | 37-38 Fixings for cover                  |
| 11 Housing assembly for speedometer pinion  | 39 Plug, top and bottom                  |
| 12 Insert for pinion                        | 40 Joint washer for plug                 |
| 13 Stud for transmission brake              | 41 Oil level plug                        |
| 14 Mudshield for housing                    | 42 Rear mounting foot L.H.               |
| 15 Shim for speedometer pinion housing      | 43 Rear mounting foot R.H.               |
| 16-17 Fixings for housing                   | 44 Adjuster for mounting foot            |
| 18 Housing assembly, rear mainshaft bearing | 45 Plain washer } For                    |
| 19 Bush for housing                         | 46 Self-locking nut } adjuster           |
| 20 Retaining plate, inner                   | 47-48 Fixings for feet                   |
| 21 Bearing for mainshaft                    | 49 Joint washer, transfer box to gearbox |
| 22 Retaining plate, outer                   | 50-52 Fixings for transfer box           |
| 23 Circlip fixing bearing                   | 53-55 Fixings for transfer box           |
| 24 Joint washer for bearing housing         |  |

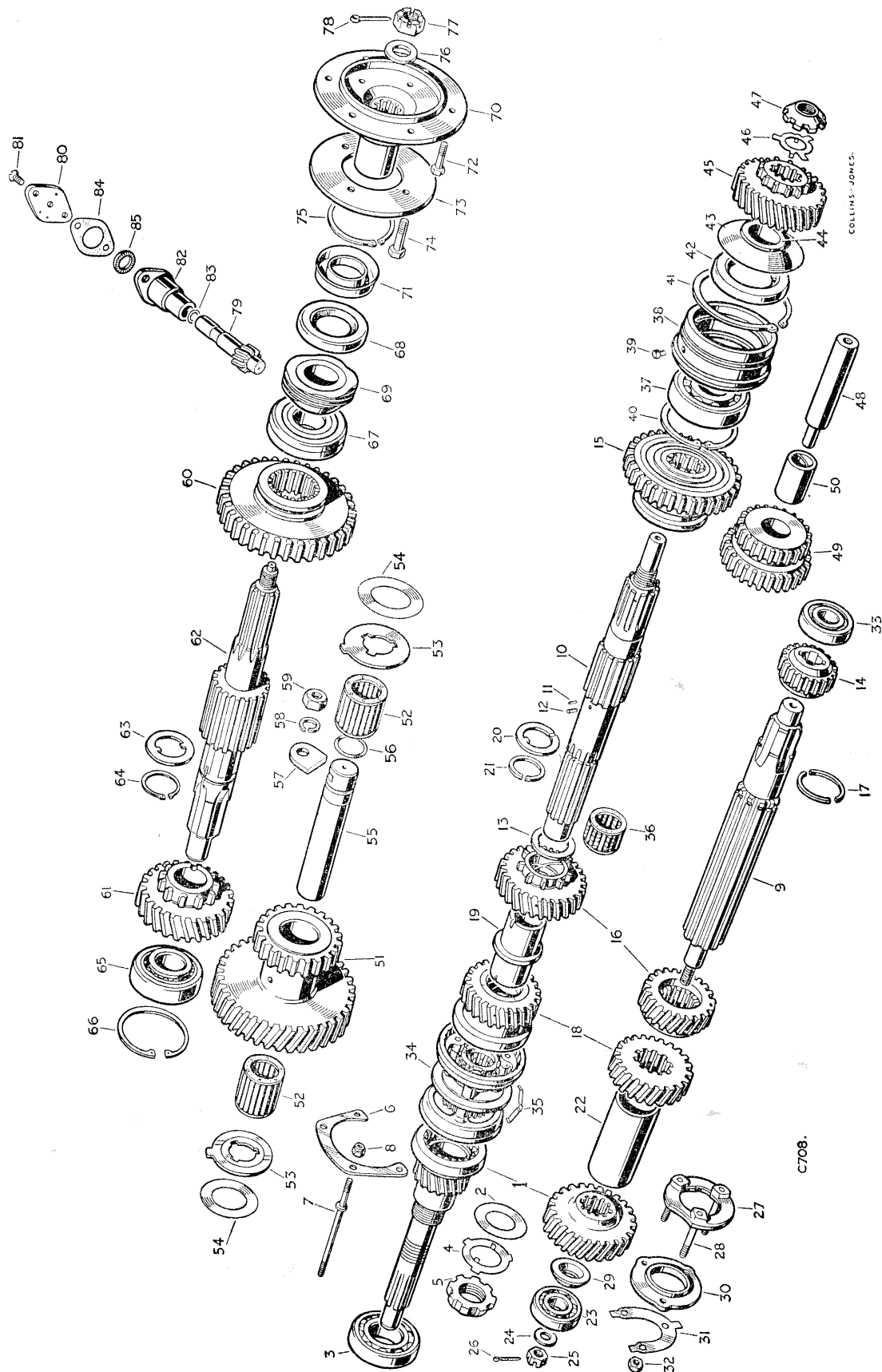


Fig. C-2—Layout of the gearbox units: shafts and gears

Key to Fig. C-2

1	Primary pinion and constant gear	44	Distance piece, rear of mainshaft
2	Shield for primary pinion	45	Mainshaft gear for transfer box
3	Ball bearing for primary pinion	46-47	Fixings for gear
4-5	Fixings for bearing	48	Shaft for reverse gear
6-8	Fixings for bearing	49	Reverse wheel assembly
9	Layshaft	50	Bush for reverse wheel
10	Mainshaft	51	Gear, intermediate
11	Peg for 2nd gear thrust washer	52	Roller bearing for intermediate gear
12	Peg for mainshaft distance sleeve	53	Thrust washer for intermediate gear
13	Thrust washer for 2nd speed gear	54	Shim for intermediate gear
14	1st speed layshaft gear	55	Shaft for intermediate gear
15	1st speed mainshaft gear	56	Sealing ring for intermediate gear
16	2nd speed layshaft and mainshaft gear	57	Retaining plate for shaft
17	Split ring for 2nd speed layshaft gear	58-59	Fixings for plate
18	3rd speed layshaft and mainshaft gear	60	Low gear wheel
19	Distance sleeve for mainshaft	61	High gear wheel
20	Thrust washer for 3rd speed mainshaft gear	62	Output shaft, rear drive
21	Spring ring fixing 2nd and 3rd mainshaft gears	63	Thrust washer for high gear wheel
22	Sleeve for layshaft	64	Circlip fixing washer to shaft
23	Bearing for layshaft, front	65	Bearing for output shaft, front
24-26	Fixings for bearing to layshaft	66	Circlip fixing bearing to case
27	Bearing plate assembly for layshaft	67	Bearing for output shaft, rear
28	Stud for bearing cap	68	Oil seal for output shaft
29	Distance piece for layshaft	69	Speedometer worm complete
30	Retaining plate for layshaft front bearing	70	Flange for output shaft, rear drive
31-32	Fixings for cap and bearing	71	Mudshield for flange
33	Bearing for layshaft, rear	72	Fitting bolt for brake drum
34	Synchronising clutch	73	Retaining flange for brake drum bolts
35	Detent spring for clutch	74	Fitting bolt for propeller shaft
36	Roller bearing for mainshaft	75	Circlip retaining bolts and flange
37	Ball bearing for mainshaft	76-78	Fixings for flange
38	Housing for mainshaft bearing, rear	79	Speedometer pinion
39	Peg, housing to casing	80	Retaining plate for pinion
40	Circlip, bearing to housing	81	Screw fixing plate to housing
41	Circlip, housing to casing	82	Sleeve for pinion
42	Oil seal for rear of mainshaft	83	Sealing ring for sleeve
43	Oil thrower for mainshaft	84	Joint washer for sleeve
		85	Oil seal for pinion

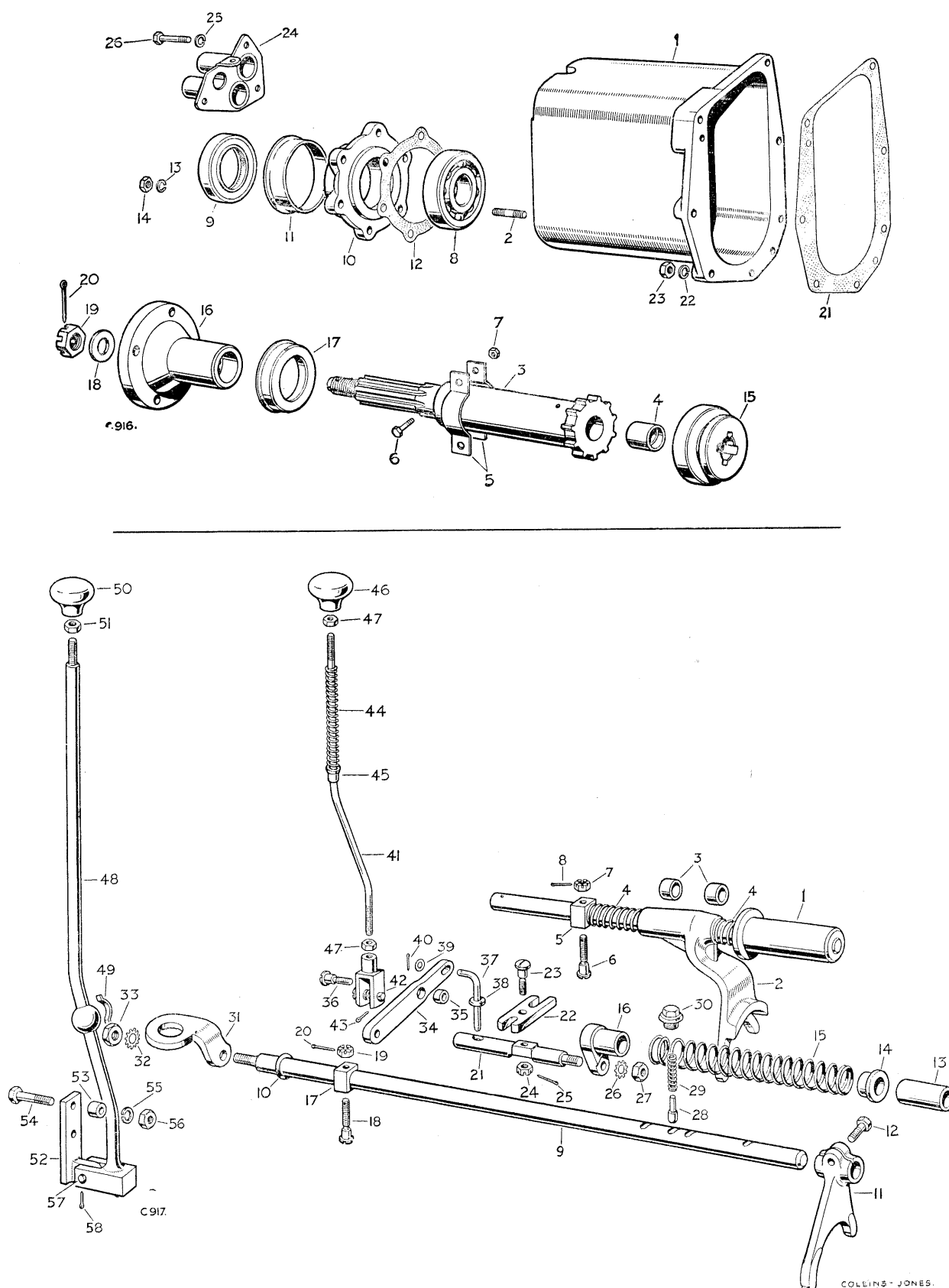


Fig. C-3—Layout of the gearbox unit: front wheel drive, transfer gear controls and front output shaft and housing

## Key to Fig. C-3

- |                                  |   |
|----------------------------------|---|
| 1 Output shaft housing assembly  | 12 Joint washer for retainer            |
| 2 Stud for oil seal retainer     | 13-14 Fixings for retainer              |
| 3 Front output shaft assembly    | 15 Locking dog, four wheel drive        |
| 4 Bush for shaft                 | 16 Flange for transfer shaft            |
| 5 Oil thrower for output shaft   | 17 Mudshield for flange                 |
| 6-7 Fixings for oil thrower      | 18-20 Fixings for flange                |
| 8 Bearing for front output shaft | 21 Joint washer for transfer housing    |
| 9 Oil seal for shaft             | 22-23 Fixings for housing               |
| 10 Retainer for oil seal         | 24 Dust cover plate for selector shafts |
| 11 Mudshield for retainer        | 25-26 Fixings for dust cover            |
- 
- |  |   |
|--|---|
| 1 Selector shaft, four wheel drive             | 31 Link for selector shaft                    |
| 2 Selector fork complete, four wheel drive     | 32-33 Fixings for link                        |
| 3 Bush for selector fork                       | 34 Lever assembly, four wheel drive           |
| 4 Spring for selector fork                     | 35 Bush for lever                             |
| 5 Block for selector shaft                     | 36 Special bolt, lever to housing             |
| 6-8 Fixings for block                          | 37 Locking pin, four wheel drive lever        |
| 9 Selector shaft, transfer gear change         | 38 Sealing ring, four wheel drive locking pin |
| 10 Sealing ring for transfer gear change shaft | 39-40 Fixings for locking pin                 |
| 11 Selector fork, transfer gear change         | 41 Selector rod, four wheel drive             |
| 12 Set bolt fixing fork                        | 42 Clevis complete for rod                    |
| 13 Distance tube for transfer selector shaft   | 43 Split pin for clevis                       |
| 14 Locating bush for selector shaft spring     | 44 Spring for selector rod                    |
| 15 Spring for gear change selector shaft       | 45 Special bush for spring                    |
| 16 Connector, gear change to pivot shaft       | 46 Control knob for rod                       |
| 17 Block for selector shaft                    | 47 Locknut for knob and clevis                |
| 18-20 Fixings for block                        | 48 Transfer gear change lever complete        |
| 21 Pivot shaft for selector shafts             | 49 Spring for transfer gear change lever      |
| 22 Coupling, selector shafts to pivot          | 50 Knob for gear change lever                 |
| 23-25 Fixings for coupling                     | 51 Locknut for knob                           |
| 26-27 Fixings for pivot shaft                  | 52 Bracket for gear change lever              |
| 28 Plunger for transfer selector shaft         | 53 Distance piece for bracket                 |
| 29 Spring for plunger                          | 54-56 Fixings for bracket                     |
| 30 Plug  | 57-58 Fixings for gear lever                  |

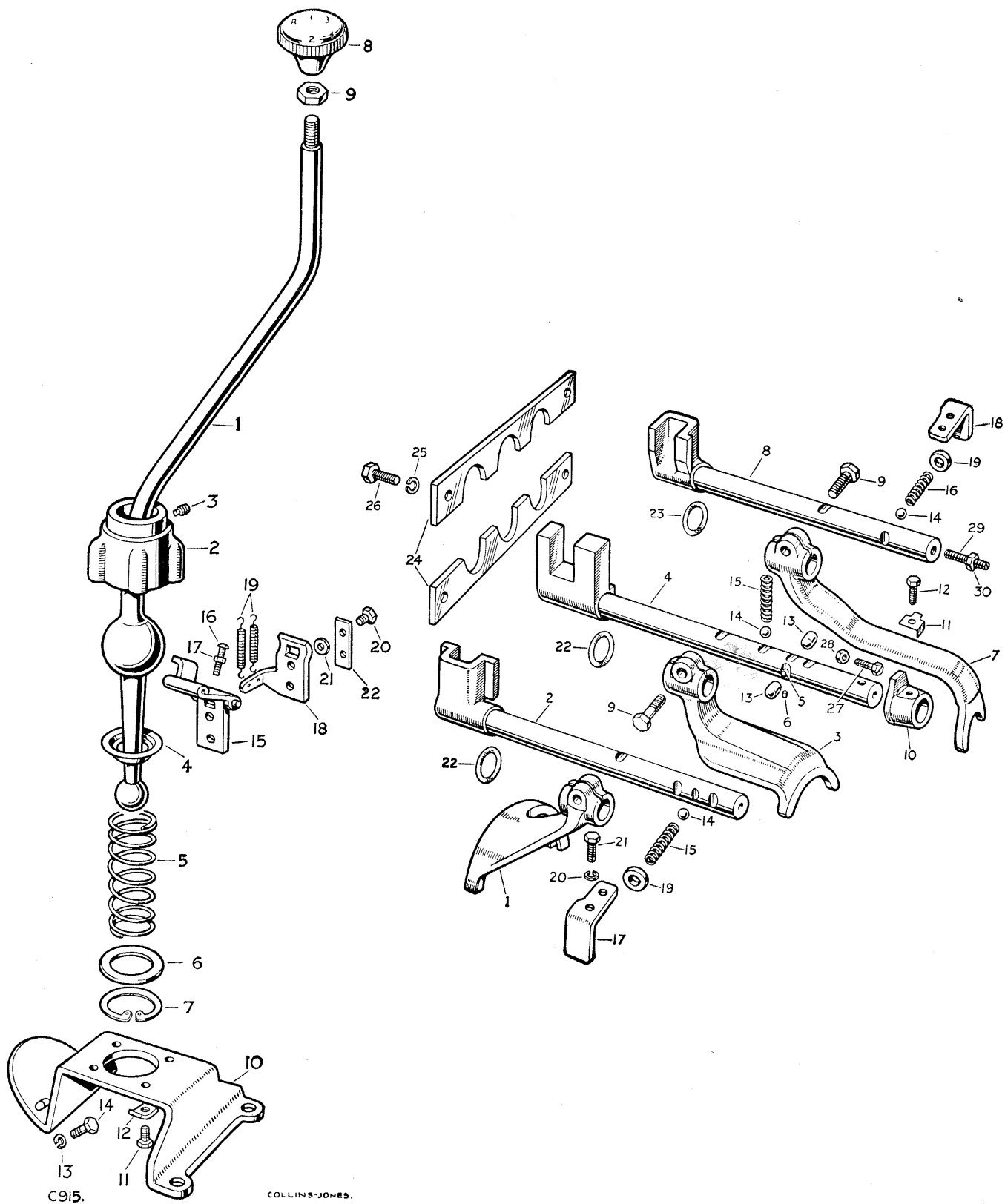


Fig. C-4—Layout of the gearbox unit: main gear change lever and selectors

## Key to Fig. C-4

- |   |  |
|---|--|
| <ul style="list-style-type: none"> <li>1 Gear change lever</li> <li>2 Housing for lever</li> <li>3 Locating pin for lever ball</li> <li>4 Spherical seat for gear lever</li> <li>5 Retaining spring for lever</li> <li>6 Retaining plate for spring</li> <li>7 Circlip fixing retaining plate</li> <li>8 Knob for lever</li> <li>9 Locknut for knob</li> <li>10 Mounting plate for gear change</li> <li>11-12 Fixings for housing</li> <li>13-14 Fixings for mounting plate</li> <li>15 Reverse stop hinge complete</li> <li>16 Adjusting screw } For hinge</li> <li>17 Locknut }</li> <li>18 Bracket for reverse stop spring</li> <li>19 Spring for reverse stop</li> <li>20-22 Fixings for hinge and bracket</li> </ul> | <ul style="list-style-type: none"> <li>1 Selector fork, 3rd and 4th speed</li> <li>2 Shaft for fork, 3rd and 4th speed</li> <li>3 Selector fork, 1st and 2nd speed</li> <li>4 Shaft assembly for fork, 1st and 2nd speed</li> <li>5 Interlocking pin</li> <li>6 Peg fixing interlocking pin</li> <li>7 Selector fork, reverse</li> <li>8 Shaft for fork, reverse</li> <li>9 Set bolt fixing forks to shafts</li> <li>10 Stop for 2nd speed</li> <li>11-12 Fixings for stop</li> <li>13 Interlocking plunger</li> <li>14 Steel ball for selectors</li> <li>15 Selector spring, forward</li> <li>16 Selector spring, reverse</li> <li>17 Retaining plate L.H. } For selector</li> <li>18 Retaining plate R.H. } springs, side</li> <li>19 Rubber grommet }</li> <li>20-21 Fixings for retaining plates</li> <li>22 Seal for selector shafts</li> <li>23 Cork seal for reverse shaft</li> <li>24 Retaining plate for sealing ring</li> <li>25-26 Fixings for retaining plate</li> <li>27 Set bolt } In cover for</li> <li>28 Locknut } 2nd gear stop</li> <li>29 Adjustable stop for reverse selector shaft</li> <li>30 Locknut for stop</li> </ul> |
|---|--|



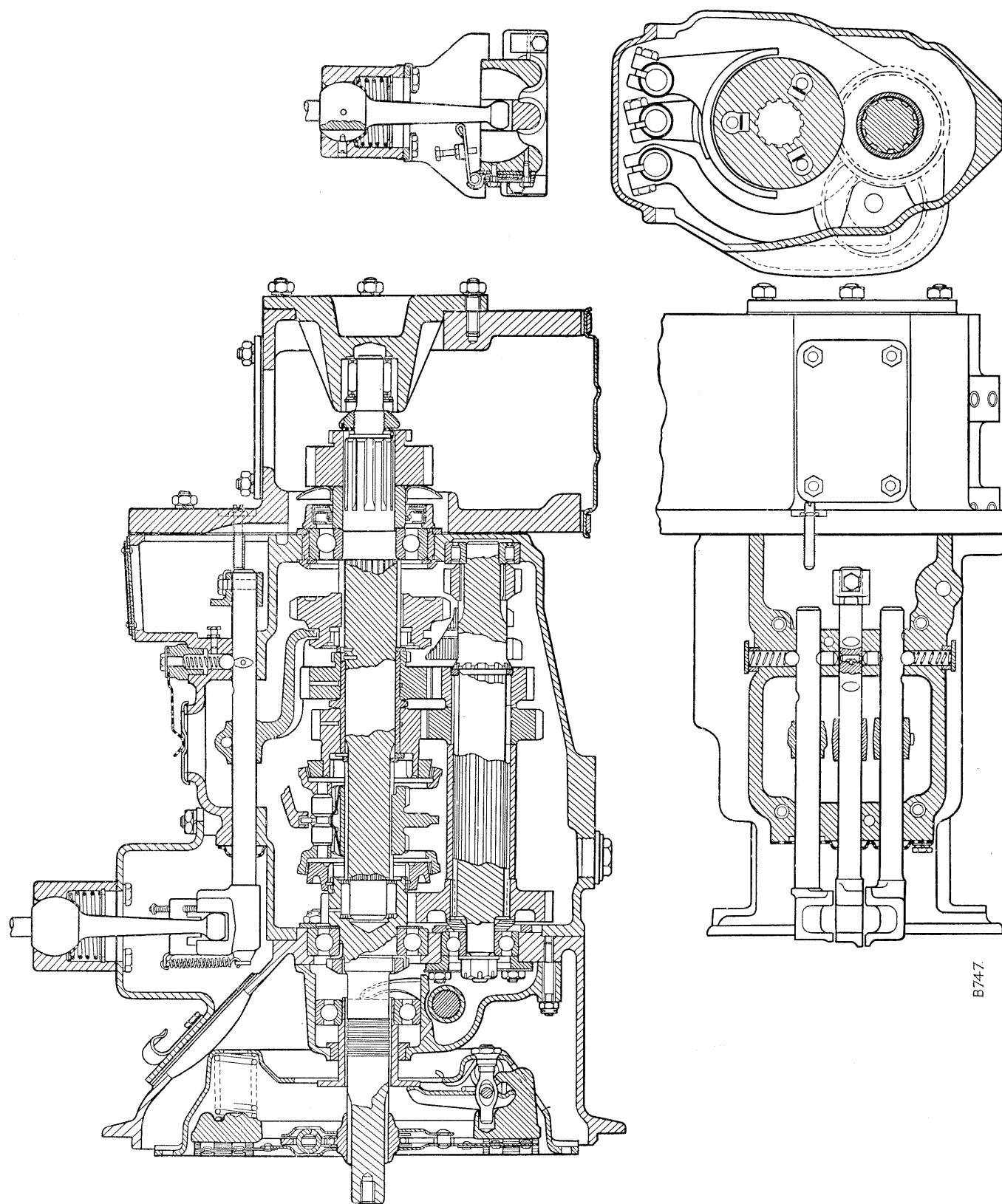


Fig. C-5—Cross-section of gearbox unit: elevation

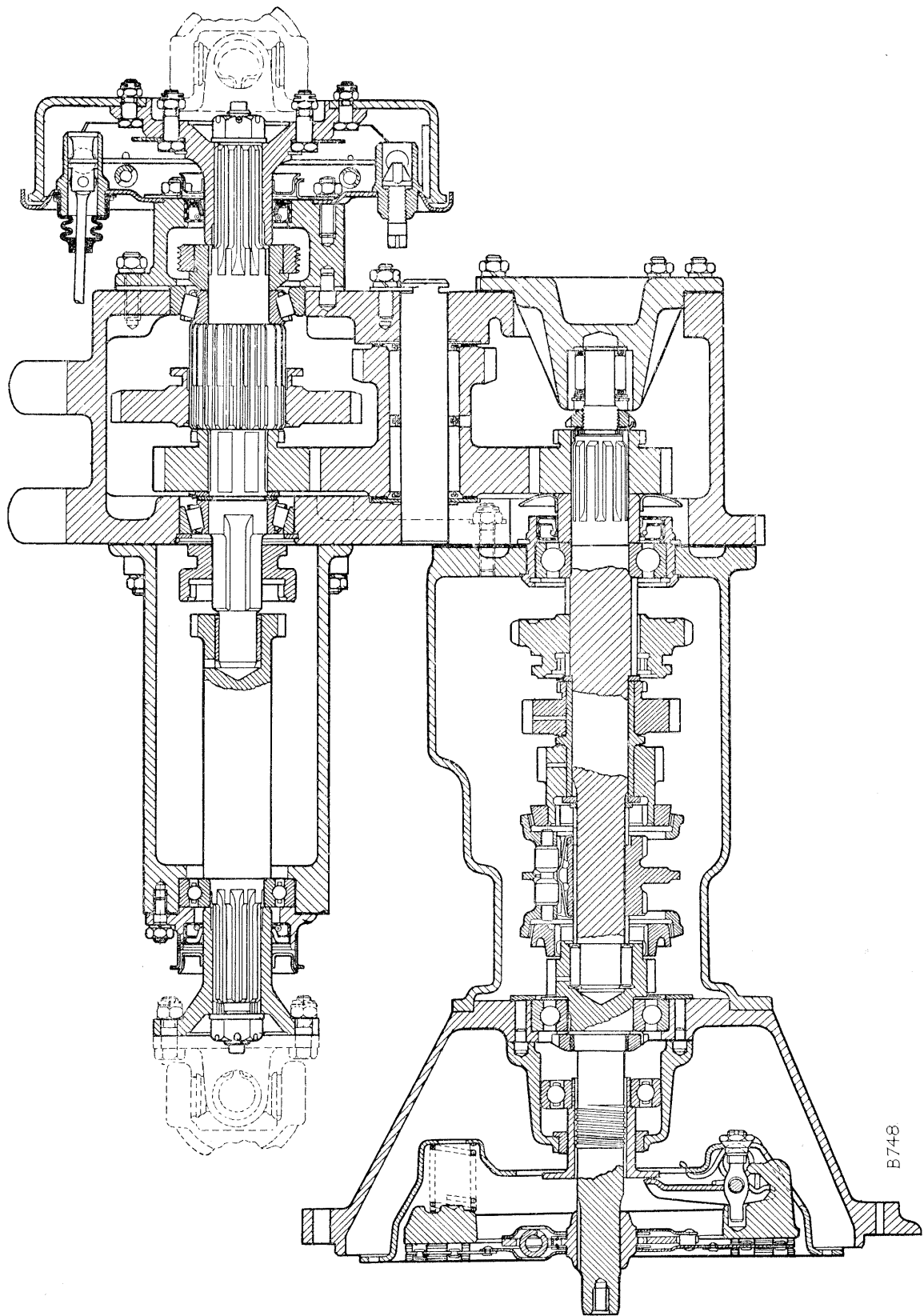


Fig. C-6—Cross-section of gearbox unit: plan

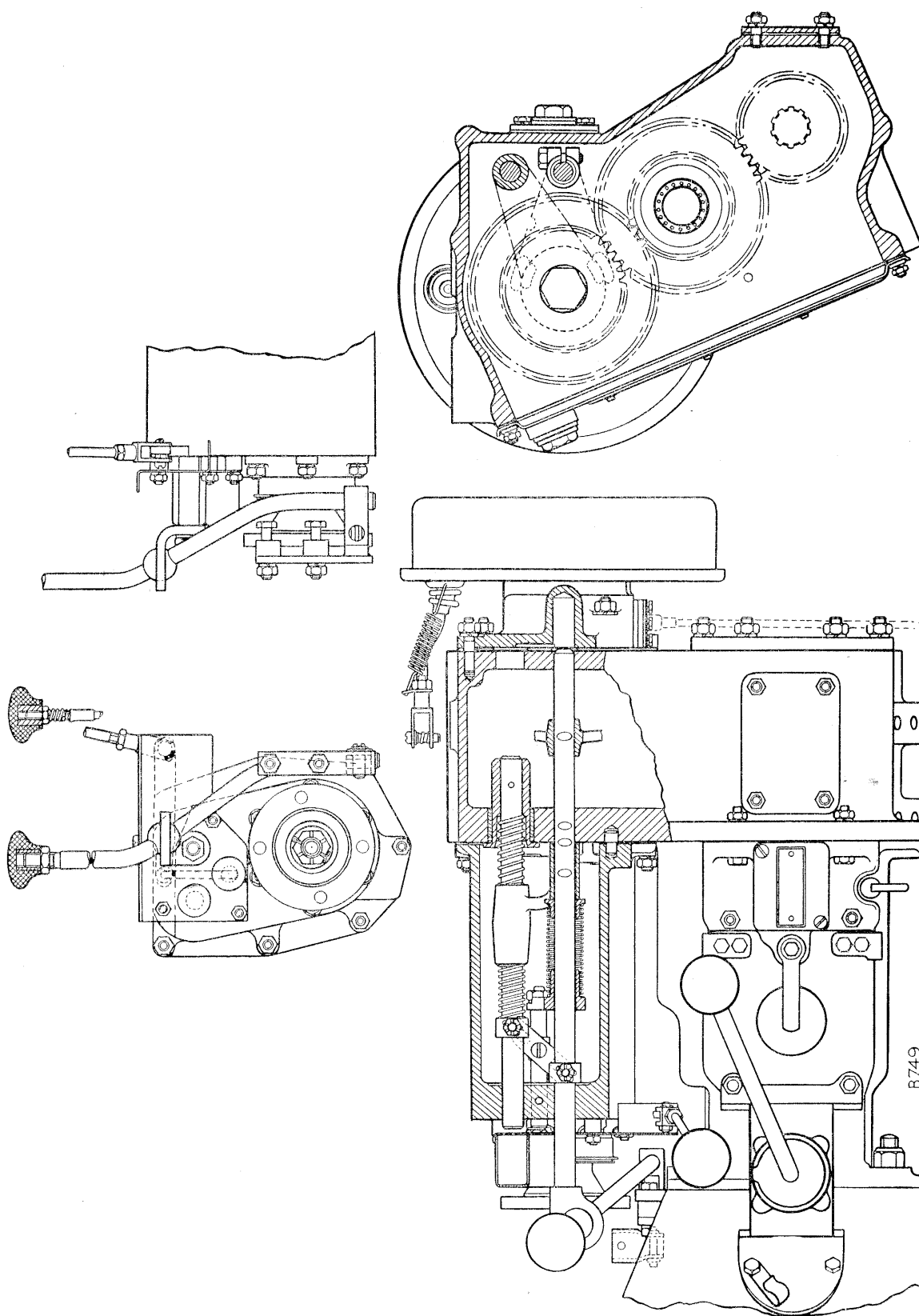


Fig. C-7—Cross-section of gearbox unit: controls

### Gearbox and transfer box assembly

#### To remove Operation C/2

1. Remove the hood, hard top or cab, for convenience in working.
2. Remove the front wheel drive control knob, locknut and spring; remove the knob and locknut from the transfer gear change lever.
3. Remove the floor board assembly and gearbox cover. Section R.
4. Remove the seat box complete. Section R.
5. **L.H.D. models only.** Remove the hand brake lever and linkage. Section H.
6. **R.H.D. models only.** Remove the hand brake rod and the expander rod from the relay lever.
7. Disconnect the front axle propeller shaft, rear axle propeller shaft and rear power take-off propeller shaft (if fitted), at the gearbox end.
8. Disconnect the clutch operating hose at the slave cylinder, remove the split pin and withdraw the pin fixing the connecting tube to the clutch cross and operating shafts, then remove the nuts and washers securing the bracket to the bell housing and remove the bracket complete with slave cylinder.
9. Disconnect the speedometer cable at the gearbox and withdraw the cable clear of the gearbox. Disconnect the earth lead at the transfer box.
10. Remove the remaining nuts and plain washers fixing the bell housing to flywheel housing, then remove the gearbox unit bearer bolts, top bearer rubbers, washers, shims and distance tubes.
11. Place a suitable sling around the gearbox unit, raise it approximately 1 inch.
12. Place a jack under the rear end of the engine; this prevents any strain being taken on the primary pinion shaft.
13. Withdraw the gearbox unit and remove it from the vehicle.

#### To refit Operation C/4

1. Reverse the removal procedure.

#### 2 LITRE PETROL ONLY

2. The nip on the gearbox unit mounting rubber pads is adjusted by the addition or removal of shims on the top of the central distance tube. The correct setting is with the top shim approximately 1/16 in. (1,5 mm) below the top face of the upper rubber pad.

#### ALL MODELS

*Note:* The rear mounting brackets are adjustable laterally, to facilitate alignment with the mounting rubbers.

3. If necessary, refill the main gearbox, 2½ pints (1,5 litres) and transfer box, 4½ pints (2,5 litres) with oil.
4. Adjust the transmission brake. Section H.
5. Adjust the four-wheel drive control rod. Operation C/28.
6. Bleed the clutch system, and adjust the pedal movement as necessary. Section B.

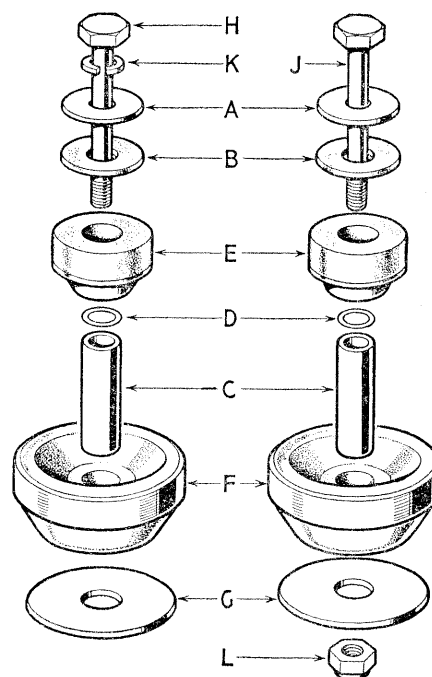


Fig. C-8—Gearbox unit mounting bolts and pads—  
2 litre petrol only

- |                        |                        |
|------------------------|------------------------|
| A—Plain washer (upper) | G—Plain washer (lower) |
| B—Rubber washer        | H—Front bolt           |
| C—Distance tube        | J—Rear bolt            |
| D—Shim                 | K—Spring washer        |
| E—Top rubber           | L—Self-locking nut     |
| F—Bottom rubber        |                        |

### Main gearbox

#### To remove Operation C/6

1. For removal procedure, see Operation C/2.

#### To strip Operation C/8

1. Mount the gearbox on a suitable stand.
2. Drain off the gearbox and transfer box oil.
3. Remove the main gear change lever assembly, then the reverse stop hinge. Operation C/30.
4. Remove the transfer box and front output shaft housing complete. Operation C/14.

#### Dismantle the main gearbox as follows:

5. Disconnect the connecting tube from the clutch cross-shaft.
6. Remove the dust-proofing grommets from the bell housing apertures.
7. Remove and strip the clutch withdrawal unit from the bell housing, Section B.
8. Remove the oil filler cap and joint washer from the gearbox top cover.
9. Remove the filler cap retaining clip.
10. Remove the plug retaining the 1st/2nd speed selector spring in the top cover and withdraw spring.

*Note:* To prevent the selector ball falling into the gearbox, with the top cover removed, pack the hole with grease.

11. Remove the retaining plates for the side selector springs, the rubber grommets and the 3rd/4th and reverse selector springs.
12. Remove the selector cover plate from the gearbox top cover.
13. Remove the two selector shaft end cover securing set bolts.
14. Remove the gearbox top cover, together with the upper selector end cover. Remove the two selector balls and locking plunger from the gearbox and the 1st/2nd speed selector ball from the top cover. Remove the 2nd gear stop from the top cover.
15. Select 1st gear (centre selector to rear); remove the reverse gear selector by lifting and turning the selector shaft one quarter of a turn to the left. Move the 1st/2nd speed selector to the neutral position and remove it; remove the 3rd/4th selector. Remove the lower selector end cover.
16. Withdraw the reverse selector fork and the rubber sealing ring from the shaft.
17. Remove the 2nd speed stop from the end of the 1st/2nd selector shaft. Withdraw the selector fork and the rubber sealing ring from the shaft.
18. Withdraw the 3rd/4th selector fork and the rubber sealing ring from the shaft.
19. Remove the castle nut from the front of the layshaft. (To lock the shaft for nut removal, select top and 2nd speeds simultaneously.)
22. Remove the layshaft front bearing retaining plate.
23. Remove the layshaft bearing plate; press out the layshaft front bearing, remove the pinion bearing retaining plate. Press out the primary pinion and bearing from the bell housing. Remove the nut securing the primary pinion bearing; press the bearing and shield off the pinion shaft. (The nut has a left-hand thread.)
24. Remove the synchronising clutch unit from the mainshaft and then withdraw the layshaft complete from the gearbox and strip it as follows:
25. Remove the distance sleeve. Remove the 3rd and 2nd speed gears. Remove the split ring retaining the 2nd speed gear. Press off the rear bearing and 1st speed gear.
26. Drive out the mainshaft complete from the rear and strip it as follows:
27. Remove the 1st speed gear. Prise out the spring ring inside the 3rd speed gear cone and discard it; remove the 3rd speed gear thrust washer and gear. Remove the distance sleeve and 2nd speed gear. Remove the peg locating the distance sleeve and withdraw the located 2nd speed gear thrust washer.
28. Remove the circlip retaining the mainshaft rear bearing housing to the rear face of the gearbox casing. Tap out the peg-located bearing housing complete from the rear. Remove the oil seal from the housing. Remove the circlip retaining the bearing in the housing and press out the bearing.
29. Drive out the reverse gear shaft from inside the gearbox; the gearbox casing must be warmed to facilitate this operation. Remove the reverse gear and, if necessary, press out the bush from the gear.
30. To remove the outer race of the layshaft rear bearing from the gearbox casing, proceed as follows:

Make a plunger (preferably from hardwood) about 12 in. (300 mm) long and approximately  $1\frac{11}{16}$  in. (43,50 mm) in diameter, i.e. to just fit

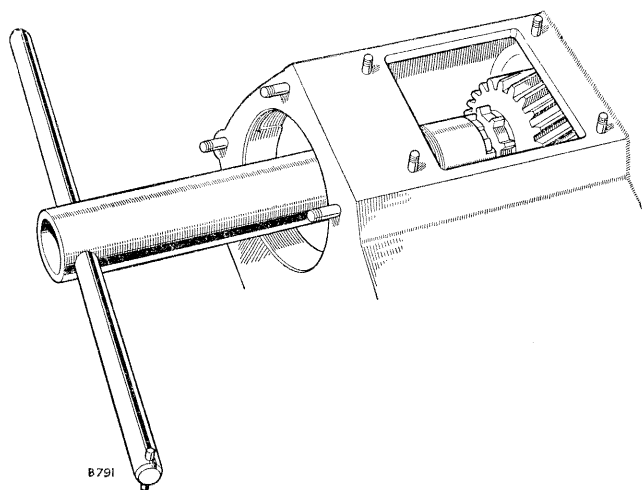


Fig. C-9—

Removing the transfer drive gear securing nut

20. Remove the nut at the rear of the mainshaft retaining the transfer drive gear. Withdraw the gear and distance piece and oil flinger from the mainshaft.
21. Remove the bell housing complete with joint washer, tapping the layshaft out of the front bearing, so that it remains in the gearbox. Remove the needle roller bearing from the front end of the mainshaft. Remove the constant gear and conical distance piece from the bell housing.

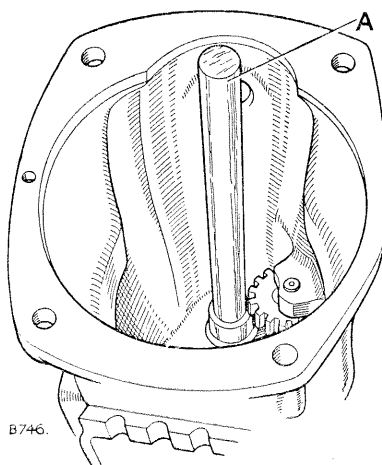


Fig. C-10—  
Removing lay-  
shaft rear bearing  
outer race  
A—Plunger

into the outer race. Stand the gearbox casing on end and fill the race housing with thick oil, insert the plunger and tap it down sharply. In most cases the oil will force the outer ring upwards out of the casing; if necessary, the gearbox casing may be warmed to facilitate removal of the race.

### To assemble

### Operation C/10

1. Wash all the component parts thoroughly and lay them out for inspection. Renew all lock-washers, split pins and spring rings.
2. Check all the bearings for wear and damage, and renew them as necessary.
3. Check all the gears for damage marks and rectify or renew them as necessary. The constant, second and third speed gears are only supplied in mated pairs; all other gears may be replaced singly.
4. Examine the casing for signs of damage or cracks and renew it as necessary. A casing may also be scrap as a result of excessive wear in a bearing bore; such wear will be obvious during the course of assembly.
5. Press the layshaft rear bearing outer race into the gearbox casing with the lipped edge to the rear. It must be a *drive fit*. It may be necessary to warm the casing to assist in this operation.
6. If necessary, renew the reverse gear bush, bell out its extremities and ream it in position to .812 in. (20 mm). The bush should be a *press fit* in the gear. Place the reverse gear (with the smaller wheel to the rear) in position in the gearbox and drive the shaft through the gearbox casing and the gear. It will be necessary to warm the casing to assist in this operation. The shaft must be a *drive fit* in the casing.
7. Press the mainshaft rear bearing into the bearing housing until it abuts the flange in the housing bore; the bearing must be a *press fit* in the housing. Secure the bearing with a circlip.
8. Smear the outer diameter of the oil seal with jointing compound and press it into the other end of the housing, with the knife edge inwards.
9. Fit the location peg in the bearing housing and push the complete housing into the gearbox casing from the inside, until the housing flange abuts the casing. The housing must be a *push fit* in the casing; secure the housing with a circlip.

### Mainshaft

10. If removed, replace the rear thrust washer. Do not fit the large bush locating peg at this stage.
11. Slide on the mainshaft bush with the large locating slot to the rear, together with the second speed gear, synchromesh cone to the rear.
12. Place the third speed gear on the bush with the gear wheel against the shoulder, and secure with the second thrust washer and the old spring ring.

13. While pressing the third speed gear hard against the bush shoulder, the end-float of the second speed gear, measured between the gear and the bush shoulder, should be .004 to .007 in.

The third speed gear end-float should be the same, measured with the second speed gear pressed hard against the bush shoulder.

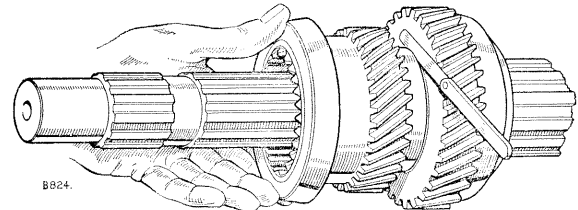


Fig. C-11—Measuring mainshaft gear end-float

14. If the end-float of either gear is insufficient, a new mainshaft bush must be fitted; if excessive, it may be reduced by rubbing down the end face of the bush.
15. Remove the spring ring, take off the thrust washer, bush and gears, and replace the bush and washer, securing with the old spring ring.
16. An end-float of .001 to .008 in. for the mainshaft bush is allowed, but this should be kept as low as possible by the use of the thrust washers, which are supplied in four thicknesses—.125 in., .128 in., .130 in. and .135 in.

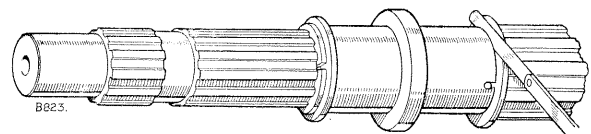


Fig. C-12—Measuring mainshaft bush end-float

17. When the end-floats are correct, fit the rear thrust washer and the bush locating peg. Assemble the bush and gears and slide on the front thrust washer with its groove in line with the small slot in the bush.
18. Secure the assembly with a *new* spring ring.
19. Slide the first speed mainshaft gear over the mainshaft splines with its internally splined flange to the front; check that the internal splines mesh easily with the second speed gear at all positions of a complete revolution.
20. Insert the mainshaft complete into the gearbox casing and tap the rear end of the shaft home into its bearing; the shaft must be a *drive fit* in the bearing.
21. Assemble the layshaft as follows:  
Slide the first speed layshaft gear over the splines on the rear of the layshaft with the chamfered end of the teeth to the front and fit the rear bearing inner race on to the shaft. The bearing must be a *tap fit* on the shaft.

Fit the split ring retaining the 2nd speed gear and slide the gear on to the shaft, with its flange to the front, over the split ring; ensure that the ring beds well into its groove and does not foul or tilt the gear. Slide the 3rd speed gear on to the shaft with its flange to the front, followed by the distance tube, constant gear and conical distance piece. Press the layshaft front bearing on to the end of the layshaft and lock up the whole assembly tightly by means of the plain washer and castle nut. Ensure that the layshaft assembly is locked up tightly and that the gears are not tilted by excessive run-out, either on their faces or those of the distance sleeve.

22. Should the gears have any end-float, this condition must be rectified by fitting a new distance tube.
23. Remove the castle nut, plain washer, bearing, conical distance piece and constant gear from the end of the shaft and fit the rest of the assembly in the gearbox casing, engaging the constant mesh gears.

Assemble the primary shaft as follows:

24. Press the primary pinion bearing on to the pinion shaft until it abuts the shoulder. The bearing must be a *light press fit* on the shaft. Secure the bearing by means of the lockwasher and locknut.

Assemble the bell housing as follows:

25. Press the primary shaft and bearing into the bell housing. The bearing must be a *press fit* in the housing. It may be necessary to warm the bell housing to assist in this operation.
26. Fit the pinion bearing retaining plate.
27. Press the layshaft front bearing into the bell housing until it is flush with the rear face of the housing. The bearing must be a *press fit* in the housing; it may be necessary to warm the bell housing to assist in this operation. Fit the layshaft bearing plate.
28. Check and renew the synchronising clutch unit detent spring, if necessary. Fit the synchronising clutch assembly over the mainshaft splines, with the recessed portion towards the 3rd speed gear (Fig. C-13).
29. Place the needle roller bearing over the front of the mainshaft and place the conical distance piece and constant gear in position in mesh with the primary pinion on the rear face of the bell housing. Offer the bell housing and joint

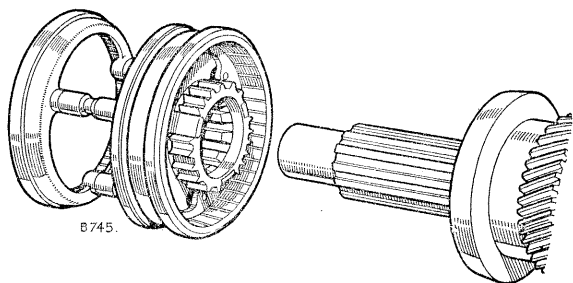


Fig. C-13—Fitting synchronising clutch assembly

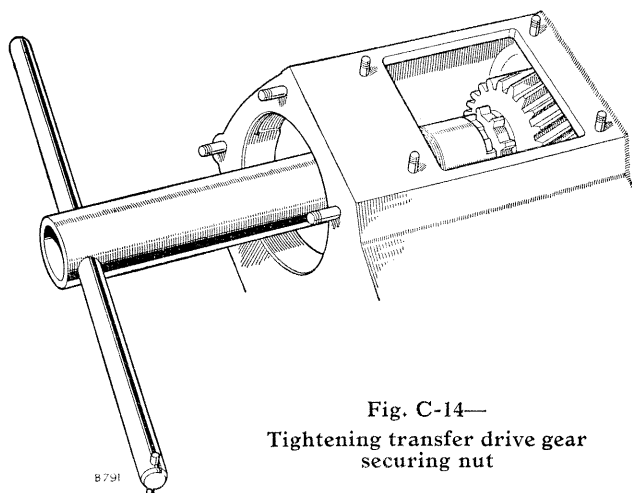


Fig. C-14—  
Tightening transfer drive gear  
securing nut

washer to the gearbox casing, locating the dowel and entering the housing lip into the casing; the front end of the layshaft is a *sliding fit* in the bearing inner member. Secure the housing to the gearbox casing.

Special fitting bolts are used for securing and locating the gearbox to bell housing.

These bolts are accurately machined and **must not** be replaced by standard bolts.

30. With the bell housing secured, and the layshaft front bearing retaining plate fitted but not tightened, ensure that a minimum layshaft movement of .005 in. (0,13 mm) is present, to ensure adequate bearing clearance. If the layshaft bearings are binding, remove the bell housing and retaining plate and fit a thinner conical distance washer from the range available, i.e., .312 in. (8 mm), .332 in. (8,5 mm) and .352 in. (9 mm).

Refit the bell housing and retaining plate over the layshaft front bearing and secure. Lock the layshaft by selecting top and second simultaneously, and tighten the layshaft securing nut to 75 lb/ft (10 kg/m), if necessary tightening to the next split pin hole. This will draw the layshaft forward, so allowing a minimum of .005 in. (0,13 mm) clearance for the end bearing.

31. Examine the distance piece for the rear end of the mainshaft, this acts also as a track for the oil seal and must be rectified or renewed if damaged in any way on its outer diameter. Place the distance piece and oil flinger over the shaft and fit the transfer drive gear with its splined flange to the rear; secure the gear with the tab washer, shim and nut using special spanner Part No. 263056 (Fig. C-14).

Assemble the main selectors as follows:

32. Fit the rubber sealing ring and 3rd/4th selector fork to the selector shaft; fit the rubber sealing ring and 1st/2nd selector fork to the selector shaft and fit the 2nd speed stop to the end of the shaft. Fit the rubber sealing ring and reverse selector fork to the selector shaft.

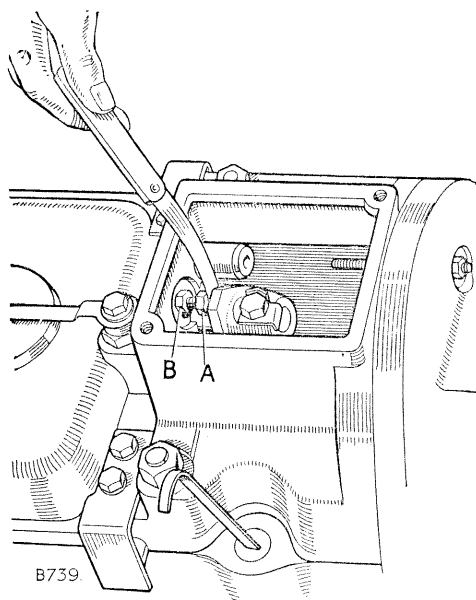


Fig. C-15—Adjusting 2nd speed gear bolt  
A—Stop bolt B—Locknut

33. Place the lower selector end cover in position on the gearbox. Fit the 3rd/4th and 1st/2nd selectors; move the 1st/2nd selector to the 1st speed position (to the rear) and fit the reverse gear selector; move the 1st/2nd speed selector to the neutral position.
34. Fit the locking plungers between the selector shafts.
35. Fit the gearbox top cover. Fit the upper selector end cover and secure both halves.  
*Note:* The gearbox casing and top cover are machined together and must not be renewed separately.
36. Replace the reverse and 3rd/4th speed selector balls and springs (the reverse spring is the stronger of the two); fit the rubber grommets and retaining plates.
37. Replace the 1st/2nd speed selector ball and spring in the top cover and fit the filler cap spring plug and spring.
38. Ensure that the operation of the selector mechanism is correct.
39. Fit the set bolt and locknut (acting as a 2nd speed stop) in the top cover. Select 2nd gear and adjust the stop bolt so that there is .002 in. (0,05 mm) clearance between the bolt head and the stop on the selector shaft; tighten the locknut (Fig. C-15). The reverse stop bolt cannot be adjusted until the transfer box has been fitted. Operation C/20.
40. Assemble the clutch withdrawal unit. Section B.
41. Fit the clutch withdrawal unit to the bell housing.
42. Fit the dust-proofing grommets.

43. Fit the connecting tube to the clutch cross-shaft.
44. Refit the transfer box and front output shaft housing complete. Operation C/20.
45. Refit main gear change lever. Operation C/30.
46. Fit and adjust reverse stop hinge. Operation C/32.

#### To refit

#### Operation C/12

1. Replace the complete gearbox and transfer box assembly in the vehicle. Operation C/4.

#### Transfer box

#### To remove

#### Operation C/14

1. Drain off the transfer box oil.
2. Remove the floor board assembly and gearbox cover. Section R.
3. Remove seat box. Section R.
4. Disconnect the front propeller shaft at the output shaft housing end.
5. Disconnect the rear propeller shaft and rear power take-off propeller shaft (if fitted) at the gearbox end.
6. **R.H.D. models.** Disconnect the hand brake expander rod from the relay lever.
7. **L.H.D. models.** Disconnect the hand brake rods from the relay lever. Remove the hand brake cross-shaft. Section H.
8. Disconnect the speedometer cable.
9. Remove the transfer box output shaft driving flange complete with brake drum.
10. Remove the brake back plate and shield from the speedometer drive housing.
11. Remove the transfer box bottom cover and joint washer.
12. Remove the nut and spring washer securing the intermediate gear shaft retaining plate; extract the retaining plate stud and remove the plate.
13. Remove the mainshaft rear bearing housing—or, if fitted, the power take-off drive unit assembly (Section T) and joint washer, and extract the intermediate gear shaft, complete with rubber seal, using special extractor Part No. 262772.
14. Remove the intermediate gear cluster through the base of the casing, complete with a needle roller bearing at each end of its bore. Remove the bearings from the gear. Remove also the thrust washer and if fitted, a shim.
15. Disconnect the earth lead at the transfer box.



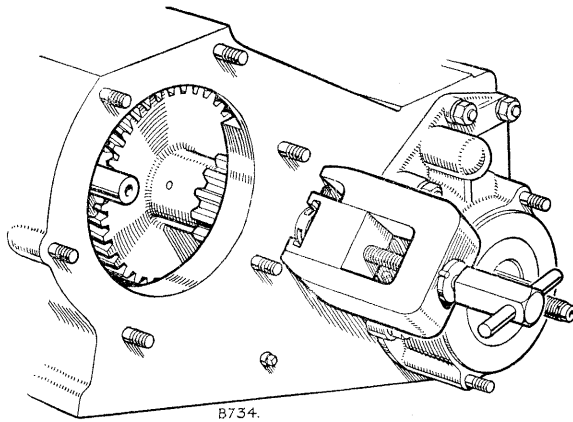


Fig. C-16—Removing intermediate gear shaft

16. Disconnect the two gearbox unit bearer bolts, the top plain washers, rubber washers, shims, if fitted, top rubbers and distance tubes.
17. Remove the transfer lever from the bracket fixed to the bell housing.
18. Position a jack under the gearbox and raise it sufficiently to enable withdrawal of transfer box and front output shaft housing unit.
19. Detach the transfer casing from the main gearbox, noting that the three self-locking securing nuts are located inside the transfer casing. Remove the transfer casing and front output shaft housing unit complete from the vehicle.

**To strip****Operation C/16**

1. Remove the speedometer drive pinion unit. Withdraw the pinion from the sleeve. If necessary, remove the oil seal from the pinion sleeve. Remove rubber 'O' ring.
2. Remove the speedometer drive housing complete with shims, which should be preserved. If necessary, remove the front output shaft oil seal from the housing.
3. Withdraw the speedometer drive worm from the transfer box output shaft; this is a sliding fit on the shaft.
4. Remove the front output shaft housing complete with output shaft, front wheel drive dog clutch, dog clutch selector shaft and fork and the joint washer.
5. Remove the top cover plate from the transfer box.
6. Remove the transfer gear selector fork and shaft.
7. Remove the circlip retaining the front bearing outer race in the transfer casing.
8. Drive out the transfer box output shaft rear bearing outer race from the transfer casing.

*Note:* Protect the transfer casing output shaft bearing bores with pads of rag to prevent damage during the following operations.

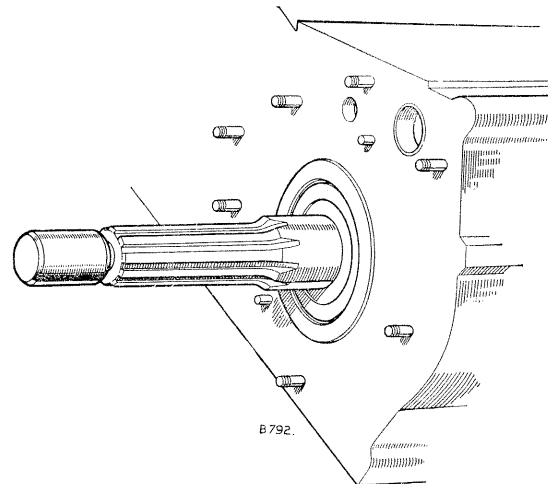


Fig. C-17—Fitting transfer box output shaft protection cap

9. Fit the protection cap (Part No. 243241) over the threaded portion of the transfer box output shaft and tap the shaft forward as far as possible to drive the front bearing outer race from the casing. Slide the shaft to the rear and insert an appropriate packing piece (Fig. C-18), between the front bearing rollers and the outer race; this packing piece may be fashioned from a scrap bearing outer race, the outer diameter of which should be ground to give free movement in the transfer box, and a portion cut away so that it may be fitted over the shaft. Tap the shaft forward again, when the bearing outer race should be driven clear of the casing.

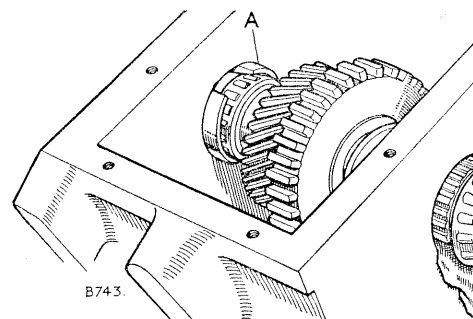


Fig. C-18—Removing transfer box output shaft front bearing outer race

A—Packing piece

10. Part the front bearing inner race from the circlip retaining the high speed gear thrust washer by means of a mild steel chisel (Fig. C-19), then drive the front bearing inner race from the output shaft by means of brass drift.
11. Remove the circlip and thrust washer from the output shaft in front of the high speed gear, and push the output shaft through the gears clear of the casing; the high and low speed gears can then be withdrawn through the bottom of the casing.

12. If required, remove the rear bearing inner race from the output shaft by means of a suitable extractor.

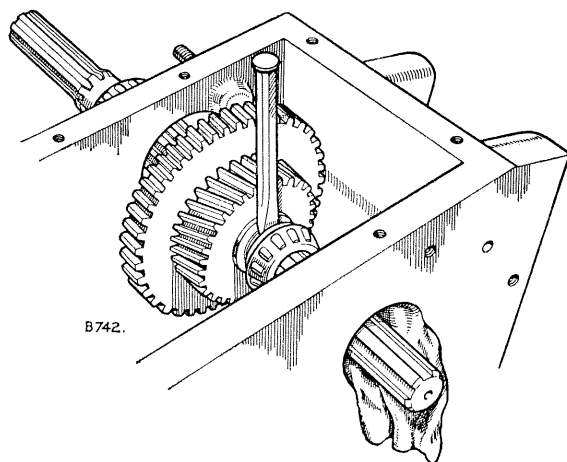


Fig. C-19—Removing transfer box output shaft front bearing inner race

13. Remove the top cover plate or the power take-off selector assembly (Section T) and joint washer from the transfer casing.
14. Remove the mainshaft rear bearing assembly or the power take-off drive unit assembly and dog clutch (Section T) and joint washer from the rear of the transfer casing.
15. Remove the circlip securing the bearing in the mainshaft housing and withdraw the retaining plate and needle roller bearing. If necessary, remove the hardened steel bush from the housing, when the second plate can be withdrawn.
16. If necessary, remove the engine support brackets from the transfer casing.
17. If necessary, remove the dog clutch selector shaft bush from the transfer casing. If necessary, remove the reverse gear stop bolt and locknut from the transfer casing.
18. If necessary, remove the driving flange complete from the brake drum.
19. If necessary, remove the dust shield, circlip, bolts and retaining plate from the flange.

#### To assemble

#### Operation C/18

1. If necessary, renew the oilite bush in the transfer casing which carries the dog clutch selector shaft. The bush is made to an *interference fit* in the casing, and must be reamed to 1.148 in. (29,17 mm) after fitting.
2. Fit the two output shaft gears on the shaft and check that they mesh easily at every point of a complete revolution.
3. Remove the two gears from the shaft and place them in position in the transfer casing; the smaller (high-speed gear) should be fitted at the

front with its engaging teeth to the rear and the large (low-speed gear) at the rear with its selector flange to the rear.

4. Insert the output shaft through the casing and gears from the rear, engaging the splines in the low-speed gear.
5. Fit the located thrust washer in front of the high-speed gear and secure it with a circlip.
6. Fit the inner members of the two output shaft bearings to the shaft (smaller bearing at the front). The bearings must be a *light press fit* on the shaft.
7. Fit the front bearing outer race and secure it with a circlip. The bearing must be a *drive fit* in the transfer casing.
8. Fit the rear bearing outer race to the transfer casing. The bearing must be a *drive fit* in the casing.
9. Place the protection cap (Part No. 243241) on the threaded portion of transfer box output shaft (Fig. C-17) and drive the shaft until the front bearing is hard against the circlip. Lightly tap the rear bearing outer race until all the end-float of the output shaft has been taken up.
10. Ensure that the high speed gear has .004 to .008 in. (0,10 to 0,20 mm) end-float on the shaft, by checking with feeler gauges between the two gears. The end-float can be increased if necessary, by grinding the located thrust washer.
11. The end-float of the transfer box output shaft must be adjusted to zero by means of shims between the transfer casing and speedometer drive housing. (Fitted at a later stage.)
12. Engage the transfer gear selector fork with the groove in the low speed gear, with the threaded end of the pinch bolt hole to the left-hand side.
13. Slide the selector shaft through the transfer casing and fork and secure the fork.
14. If necessary, renew the transfer box output shaft oil seal in the speedometer drive housing, with the knife edge inwards. The outer diameter of the seal should be smeared with jointing compound and the housing warmed before assembly.
15. If necessary, renew the oil seal in the speedometer drive pinion sleeve; the seal should be fitted with the knife edge inwards. Fit the pinion in the sleeve and fit the assembly to the drive housing, with the "flat" on the sleeve to the bottom. The pinion should be a *sliding fit* in the sleeve. Check that the drive functions correctly. Replace rubber 'O' ring.
16. Slide the speedometer drive worm over the transfer box output shaft with its conical end inwards and fit the dowel-located speedometer drive housing to the transfer casing, complete with suitable shims for adjustment of the transfer box output shaft bearing end-float. The

shims, which are available .003 in. (0,08 mm), .005 in. (0,13 mm), .010 in. (0,25 mm) and .015 in. (0,38 mm) thick, should be selected so that the face of the rear bearing lies .002 in. (0,05 mm) below the face of the outer shim, Fig. C-20. Secure the drive housing to the transfer casing. Drive the output shaft towards the rear and ensure that it turns quite freely, but that no end-float is present; check also that the high speed gear end-float is retained.

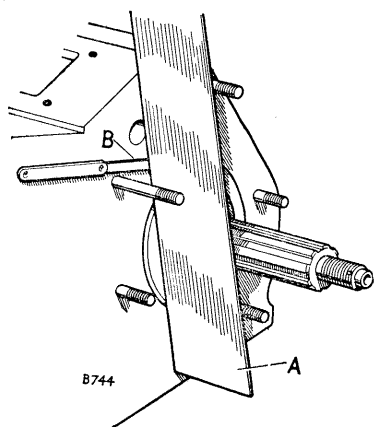


Fig. C-20—

Adjusting  
transfer box  
output shaft  
end-float

A—Straight-edge  
B—Feeler gauge

17. Place the two intermediate shaft thrust washers in the transfer casing and retain them with a film of grease; the washers should be fitted with their bronze faces inwards and located in the casing by means of the tabs.
18. Fit the two needle roller bearings in the intermediate cluster gear and offer the gear into position, meshing it with the mainshaft and output shaft gears, i.e., with the larger wheel to the front.
19. Fit the intermediate shaft, from the rear through the casing, thrust washers and gear, tapping it lightly home when the register engages. The shaft must be a *light tap fit* in the casing.
20. Ensure that the gear has .004 in. to .008 in. (0,10 to 0,20 mm) end-float in the casing; if incorrect, the float can be adjusted by grinding the thrust washers or fitting a shim (.010 in. thick) behind one washer. When the end-float is correct, withdraw the shaft and remove the gear cluster from the casing complete with needle rollers and thrust washers.
21. Examine the outer diameter of the rear axle drive flange for damage which may have caused failure of the transfer box output shaft oil seal and rectify or renew the flange as necessary.
22. If removed, insert the six fitting brake drum securing bolts in the outer flange holes and fit the retaining plate over the flange. Fit the four propeller shaft securing bolts in the inner holes and secure them with a circlip.
23. Fit the dust excluder over the outer diameter of the rear axle drive flange, with the open end towards the flange.

24. Replace the front output shaft housing assembly. Operation C/24.
25. Fit the retaining plate and hardened steel bush in the main shaft bearing housing; fit the needle roller bearing and second retaining plate and secure with a circlip.
26. Fit the complete bearing housing (or power take-off drive unit—see Section T) to the transfer casing, together with a joint washer.
27. Fit the top cover plate (or power take-off selector assembly—see Section T) to the transfer casing, together with a joint washer.
28. Fit the gearbox unit support brackets to the transfer casing.

#### To refit

#### Operation C/20

1. Fit the complete transfer casing and joint washer to the main gearbox, locating it with two dowels. **NOTE**—Three self-locking nuts inside the transfer casing.
2. Replace the intermediate shaft retaining plate stud in the transfer casing.
3. Fit the intermediate shaft and cluster gear. Operation C/18—(17) and (18).
4. Fit the intermediate shaft together with the retaining plate in its deepest slot through the casing, thrust washers and gear, tapping it lightly home when the register engages.  
A rubber seal is fitted to the intermediate gear shaft. This seal must be examined for wear and signs of deterioration. Renew if necessary, before refitment.
5. Fit the transfer casing bottom cover, together with a joint washer and drain plug.
6. Fit the complete transmission brake (Section H) and shield, to the speedometer drive housing, with the expander rod on the right-hand side.

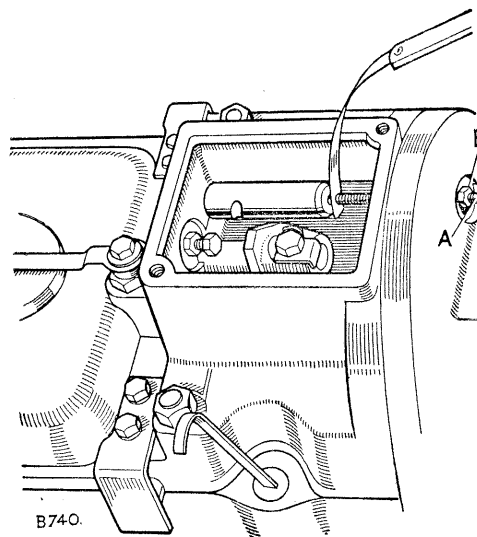


Fig. C-21—Adjusting reverse gear stopbolt

A—Stop bolt B—Locknut

7. Slide the complete drive flange over the front output shaft and secure.
8. Ensure that the drive flange abuts the speedometer drive worm and gives a positive drive to the pinion.
9. Fit the transmission brake drum. Adjust the brake—Section H.
10. Select reverse gear in the main gearbox, and adjust the stop bolt in the transfer casing so that there is .002 in. (0,05 mm) clearance between the selector shaft and bolt.
11. Replace the oil level dipstick and refill with oil. Fit the main gearbox selector cover plate.
12. Complete the assembly by reversing the removal procedure
13. Adjust the gearbox unit mounting rubbers. Operation C/4.
14. Adjust the front wheel drive rod. Operation C/24.

#### Front output shaft housing assembly

##### To remove Operation C/22

1. Drain off the transfer box oil.
2. Remove floor board assembly and gearbox cover. Section R.
3. Remove seat box central panel.
4. Remove front propeller shaft. Section D.
5. Remove the hand-brake expander rod from the relay lever.
6. Remove the slave cylinder bracket assembly. Operation C/2.
7. Remove the gearbox mounting securing nuts, plain washers, rubber washers, shims (if fitted) and top rubbers.
8. Remove the transfer control link from the selector shaft; remove the transfer lever.
9. Remove the dust cover from the front of the output shaft housing.
10. Remove the front wheel drive control lever assembly. Remove the locking peg from the lever. Disconnect the operating rod from the lever (spring-loaded clevis). If necessary, press out the bush from the lever.
11. Place a jack under the gearbox and raise it as much as possible and remove the front output shaft housing complete with output shaft, front wheel drive dog clutch, the dog clutch selector shaft and fork and a joint washer. Withdraw

the dog clutch selector shaft and dog clutch from the rear of the housing. Remove the top cover plate from the transfer box, hold in low transfer and slide the output shaft housing downwards and to the rear, and remove from under the vehicle. Leave the transfer selector shaft and link in position protruding from the transfer box.

##### To strip

##### Operation C/24

1. Remove the block from the transfer selector shaft.
2. Slide the following parts from the transfer selector shaft:—  
Link, link pin and connector assembly, spring, spring locating bush, and distance tube.
3. Detach the link from the link pin.  
*Note:* The connector should not be removed from the link pin unless absolutely necessary, as difficulty will be experienced in effecting correct alignment on reassembly.
4. Carefully remove the front axle drive flange complete with mudshield, avoiding damage to the oil seal.
5. Remove the output shaft from the output shaft housing.
6. Remove the block from the dog clutch selector shaft.
7. Slide the two springs and selector fork from the dog clutch selector shaft.
8. If necessary, remove the two bushes from the selector fork boss.
9. If necessary, remove the spigot bush from the rear end of the front output shaft.
10. Remove the oil seal retainer complete with oil seal, joint washer and mudshield.
11. If necessary, remove the oil seal from the retainer.
12. If necessary, remove the mudshield from the oil seal retainer.
13. If necessary, withdraw the output shaft front bearing from the front output shaft housing.
14. Remove the rubber seals in front output shaft housing for transfer gear change shaft and four-wheel drive locking pin.

##### To assemble

##### Operation C/26

1. If necessary, replace the front output shaft front bearing in the front output shaft housing. The bearing must be a *push fit* on the shaft and a *light drive fit* in the housing. Renew the shaft, bearing and housing as necessary.

Examine the rubber seals for transfer gear change shaft and four-wheel drive locking pin, for signs of wear or deterioration. Renew seals if necessary and replace in respective bores.

2. If removed, fit a new oil seal in the retainer with its knife edge inwards. The external diameter of the oil seal must be smeared with jointing compound and the retainer warmed before assembly.
3. If removed, replace the mudshield on the oil seal retainer.
4. If removed, replace the spigot bush in the rear end of the front output shaft, pressing it in flush with the face of the shaft.  
The bush must be reamed in position to  $.8755 + .0005$  (22,2 mm + 0,013), and should be a *sliding fit* on the transfer box output shaft.
5. If removed, renew the two oilite bushes in the dog clutch selector fork boss, pressing them flush with the end faces of the boss. They must be reamed in position to  $.6255 \text{ in.} + .0005$  (15,887 mm + 0,012) and should be a *sliding fit* on the selector shaft.
6. Check the two dog clutch selector springs and renew as necessary. Free length should be 2.75 in. (69,8 mm).
7. Check the transfer selector shaft spring and renew as necessary. Free length should be 7.156 in. (181,76 mm).
8. Replace the oil seal retainer on the front output shaft housing.
9. Fit the two springs and selector fork (crank to the rear) over the dog clutch selector shaft.
10. Replace the block on the selector shaft.
11. If the connector has been detached from the link pin, replace it with the hole for the locking peg vertical and the cutaway on the link pin underneath; ensure that the connector is square with the pin and secure *lightly* with the nut and shakeproof washer.
12. Secure the link to the link pin by means of the special screw, castle nut and split pin. The threaded end of the screw must be downwards and the shorter end of the link towards the transfer selector, with the longer arm of the jaw at the opposite end to the rear.
13. Replace the transfer shaft selector spring and plunger and secure with the plug and joint washer.
14. Slide the following parts on to the transfer selector shaft:—

Distance tube, spring locating bush with its smaller diameter to the front, and spring. Compress the spring and fit the link and connector assembly until the block is over the hole in the shaft. Fit the special screw from the bottom, through the coupling jaw, block and

selector shaft and secure with the castle nut and split pin.

15. If they have been separated, the position of the connector and link pin should now be adjusted as follows:—
16. (a) The most efficient method of carrying out this operation is to use a dummy front output shaft housing with a large aperture in the side through which the connector securing nut can be tightened. Place the

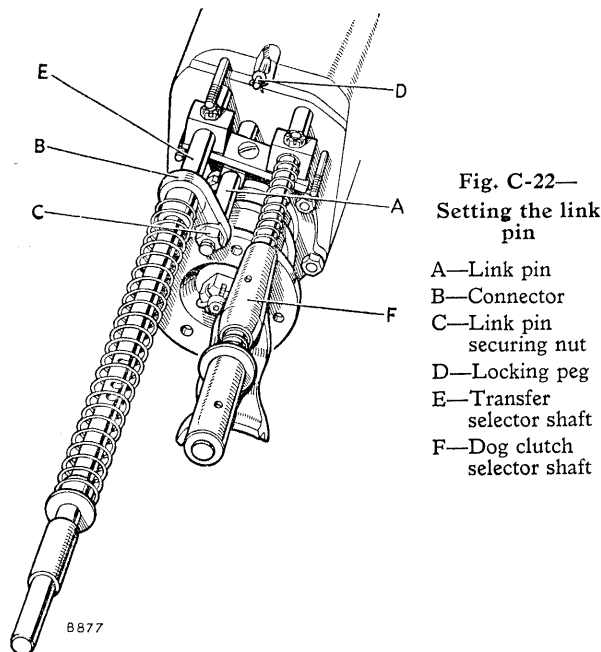


Fig. C-22—  
Setting the link  
pin

A—Link pin  
B—Connector  
C—Link pin  
securing nut  
D—Locking peg  
E—Transfer  
selector shaft  
F—Dog clutch  
selector shaft

dummy housing over the selector shafts and locate the link pin by means of the locking peg. Tighten the connector securing nut, withdraw the peg, and remove the housing.

- (b) If a dummy housing is not available, the actual output shaft housing can be used to align the selectors by sliding it over the shafts back to front. Proceed as follows:—  
Remove the pinch bolt securing the selector fork to the transfer selector shaft and withdraw the shaft. Engage the transfer selector shaft, link pin and dog clutch selector shaft into the front face of the front output shaft housing ensuring that the link engages the pivot screws of the transfer and dog clutch selector shafts. Locate the link pin in the housing by means of locking peg and tighten the connector nut.

Remove the locking peg and withdraw the shafts and link pin from the housing. Slide the transfer selector shaft through the transfer casing and fork, and secure the fork.

17. Fit the output shaft in its housing. Examine the outer diameter of the front axle drive flange for damage which may have caused failure of the original oil seal; rectify or renew as necessary. Fit the flange and dust shield to the front output shaft.

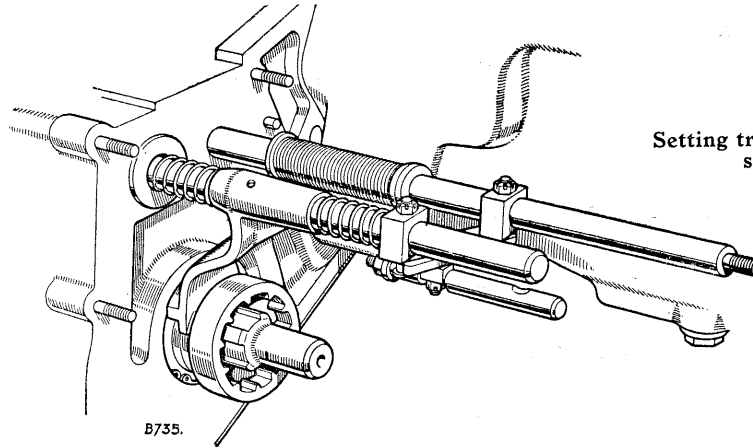


Fig. C-23—  
Setting transfer and dog clutch  
selector shafts

### To refit

### Operation C/28

1. Fit the front output shaft housing joint washer.
2. Engage the dog clutch selector fork with the groove in the locking dog.
3. Engage the selector shaft into the bush in the transfer box, and at the same time slide the dog clutch over the splines on the transfer box output shaft, ensuring that the link engages the screw correctly.
4. Select low transfer (through the aperture in the transfer box). Place the housing over the selector shafts (from under) and secure to the transfer casing, picking up the earth lead under one of the nuts.
5. If necessary, renew the bush in the front wheel drive control. Connect the operating rod and locking peg to the lever.
6. Replace the control lever assembly.
7. The joint faces of dust cover shield and front output shaft housing should be smeared with Bostik sealing before refitment. Secure cover using three set bolts.
8. Replace the transfer lever. Secure the lever to the selector shaft by means of the control link.
9. Reconnect hand brake expander rod to the relay lever.
10. Replace the transfer gear change cover plate.
11. Refill the transfer box with oil of the correct grade.
12. Complete the assembly by reversing the sequence of removal operations.
13. Adjust the gearbox unit mounting rubbers. Operation C/4.
14. Adjust the front wheel drive rod to ensure sufficient extraction and replacement of the locking peg; proceed as follows:—
  - (a) Depress the four-wheel drive control rod.
  - (b) Screw down the knob locknut until the compressed spring length is  $2\frac{5}{16}$  in.— $\frac{1}{16}$  (58 mm—1).
  - (c) Fit knob and tighten locknut.

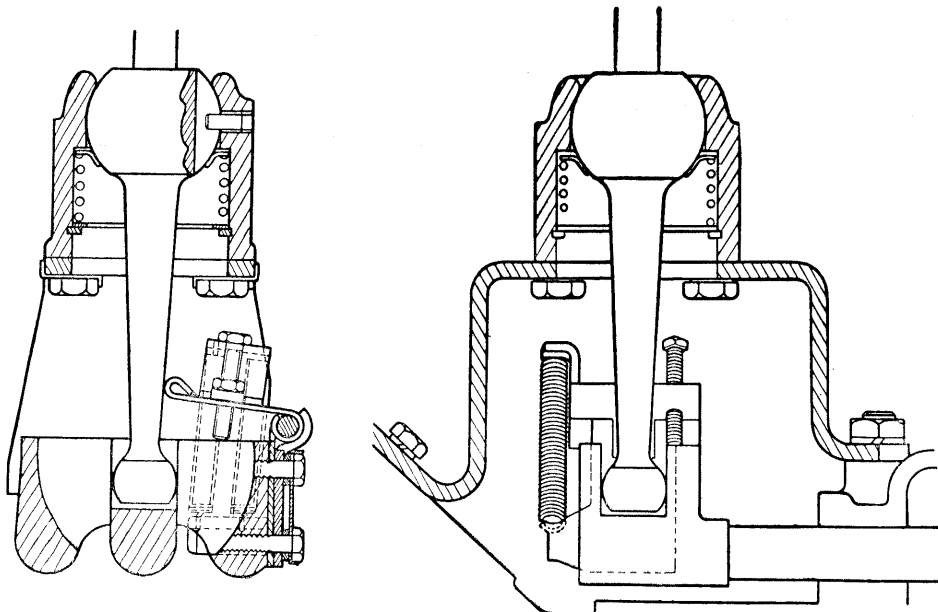


Fig. C-24—  
Cross-section  
of reverse  
stop

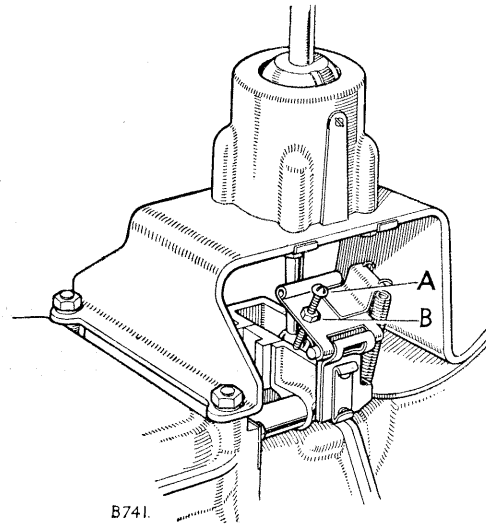
**Main gear change lever****To overhaul****Operation C/30**

1. Remove front wheel drive control knob, locknut and spring; remove the knob and locknut from the transfer gear change lever.
2. Remove the floor board assembly and gearbox cover—Section R.
3. Remove the gear change mounting plate and gear change lever complete.
4. Remove the gear change lever housing from the mounting plate.
5. Remove the circlip from the lever housing and draw out the spring retaining washer, spring and spherical seat; withdraw the gear lever from the housing. If necessary, remove the lever ball locating pin from the housing.
6. Detach the two springs from the reverse stop hinge. Remove the reverse stop hinge (complete with adjusting screw and locknut) and the spring bracket from the reverse selector.
7. Renew the worn components.
8. Replace the lever ball locating pin in the housing (if removed on stripping) and secure it by staking.
9. Fit the gear change lever in the housing; replace the spherical seat, spring and retaining washer and secure the whole with a circlip.
10. Fit the housing to the mounting plate with the locating pin on the right-hand side.
11. Fit the reverse stop hinge and spring bracket to the reverse selector and secure them by means of two plain washers, one lockplate and two set bolts (the plain washers should be fitted under the lockplate). Replace the two reverse stop springs.
12. Fit the mounting plate to the gearbox unit.
13. Adjust the reverse stop. Operation C/32.
14. Replace the floor board assembly and gearbox cover—Section R.

15. Replace the front wheel drive control knob, locknut and spring; replace the locknut and knob on the transfer gear change lever.

**Reverse stop****To adjust****Operation C/32**

1. The screw and locknut on the reverse stop hinge should be adjusted so that:—
  - (a) The hinge rides easily up the gear lever when reverse gear is selected, and
  - (b) Appreciable resistance is felt on moving the gear lever to the reverse position.
2. This adjustment should be carried out on any gearbox removed for attention, before the gearbox cover is fitted.
3. It can be carried out at any time after: selecting reverse gear and sliding the access panel up the front wheel drive control rod.



**Fig. C-25—Adjusting reverse stop**  
 A—Adjusting screw      B—Locknut

## DEFECT LOCATION

## (Symptom, Cause and Remedy)

## A—GEARBOX NOISY IN NEUTRAL

1. Primary pinion bearing worn—*Renew*.
2. Constant mesh gears incorrectly matched or badly worn—*Renew*.
3. Layshaft bearing worn—*Renew*.
4. Insufficient oil in gearbox or incorrect grade of oil—*Replenish*.

## B—GEARBOX NOISY IN GEAR

1. Worn speedometer gear—*Renew*. See Section Q.
2. If the gearbox is noisy in all gears except top, the constant mesh gears may be worn or incorrectly paired or the layshaft bearings may be worn—*Renew the constant mesh gears or the layshaft bearings*.
3. Noise in either the 1st, 2nd or 3rd speed gear only, due to wear—*Renew the gear or pair of gears*.
4. Noise in all gears in all probability denotes worn primary or mainshaft bearings—*Renew bearings and check gear teeth for wear*.

## C—OIL LEAKS FROM THE GEARBOX

1. Lubricant level too high—*Correct level*.
2. Damaged, incorrectly fitted or missing joint washers—*Renew*.
3. Damaged or incorrectly fitted oil seals—*Renew*.
4. Drain or level plugs loose or threads damaged—*Rectify*.
5. Cracked or broken gearbox housing—*Renew*.

## D—DIFFICULTY IN ENGAGING GEARS

1. Incorrect adjustment of the gear change mechanism—*Adjust*.
2. Failure to release the clutch completely—*In the hands of the operator*.
3. Clutch spinning or sticking on the pinion shaft—*Section B*.

## E—DIFFICULTY IN DISENGAGING GEARS

1. Incorrect adjustment of the gear change mechanism—*Adjust*.
2. Failure to release the clutch completely—*In the hands of the operator*.
3. Distorted or damaged mainshaft splines—*Renew*.

## F—DIFFICULTY IN ENGAGING REVERSE

1. Bush loose in gear—*Replace*.
2. Faulty stop setting on selector forks—*Adjust*.

## G—GEAR LEVER GOING INTO REVERSE TOO EASILY AND NOT INTO FIRST

1. Stop requires setting on selector shafts—*Adjust*.

## H—TRANSFER OF OIL FROM TRANSFER BOX TO GEARBOX, TO CLUTCH

1. Faulty oil seal, gearbox to transfer box—*Fit new seal and sleeve*.

## J—JUMPING OUT OF HIGH TRANSFER

1. Selector spring too weak—*Renew*.

## K—JUMPING OUT OF LOW TRANSFER

1. Transfer selector fork assembled wrongly on shaft—*Assemble fork with set towards rear of vehicle*.
2. Too much end-float on intermediate gear—*Adjust*.
3. Selector spring too weak—*Renew*.

## L—NOISY TRANSFER BOX

1. Too much end-float on intermediate gear—*Adjust*.
2. End-float on output shaft—*Adjust*.
3. Worn bearings—*Renew*.

## M—CANNOT ENGAGE FOUR-WHEEL DRIVE

1. Maladjustment of return spring for yellow knob—*Adjust*.
2. Shafts sticking in bores of casing—*Rectify*.



## GENERAL DATA

## Main gearbox

Type	.... Four speed and reverse
Oil capacity	.... 2½ pints (1,5 litres)
Early models:	
Dipstick position	.... L.H. rear of casing
Late models:	
Oil level plug	.... L.H. side of casing

## Gear ratios:

Top	.... 1 to 1
Third	.... 1.377 to 1
Second	.... 2.043 to 1
First	.... 2.996 to 1
Reverse	.... 2.547 to 1

## Transfer gearbox:

Type	.... Two-speed gear in main gearbox output, in unit with main gearbox
Oil capacity	.... 4½ pints (2,5 litres)

## Gear ratios:

High	.... 1.148 to 1
Low	.... 2.888 to 1

## Overall gear ratios:

Main gearbox	Transfer box	
	High ratio	Low ratio
Top gear	5.396	13.578
Third gear	7.435	18.707
Second gear	11.026	27.742
First gear	16.171	40.688
Reverse gear	13.745	34.585

## Front axle drive:

Type	.... Dog clutch in transfer box
To engage	.... Depress yellow knob on gearbox cover
To dis-engage	.... Automatic by selecting low transfer, then reverting to high transfer. Automatically engaged on selection of low transfer

## Speedometer drive:

Ratio	.... 5 to 11
Position	.... At rear of transfer box

## Transmission brake:

Type	.... Mechanical. (See Section H.) On transfer box output shaft
------	--

## DETAIL DATA

**Main gearbox:**

## Reverse gear bush—

Reamed bore .... .812 in. + .001 (20 mm  
+ 0,025 mm)

## Mainshaft bush—

Fit in gears .... .0015 to .002 in. (0,0375  
to 0,051 mm) clearance

Fit on shaft .... .005 to .002 in. (0,0125 to  
0,051 mm) clearance

End-float .... .001 to .008 in. (0,025 to  
0,20 mm)

2nd and 3rd speed  
gears—

End-float on distance  
sleeve .... .004 to .007 in. (0,10 to  
0,177 mm)

Synchronising clutch—  
load

.... 15-20 lb. (6,5-9 kg)

## 2nd gear stop—

Adjustment .... .002 in. (0,05 mm) clear-  
ance

## Reverse gear stop—

Adjustment .... .002 in. (0,05 mm) clear-  
ance

**Transfer gearbox:**Dog clutch selector  
shaft bush—

Reamed bore .... 1.148 in. — .001 (29,17  
mm — 0,025)

Output shaft front and  
rear bearings—

End-float .... Zero

## High-speed gear—

End-float .... .004 to .008 in. (0,10 to  
0,20 mm) (after adjust-  
ing output shaft end-  
float)

## Intermediate gear—

End-float .... .004 to .008 in. (0,10 to  
0,20 mm)

**Front output shaft housing assembly:**Transfer selector shaft,  
spring—

Free length .... 7.156 in. (181,76 mm)

Length in position 3.875 in. (98,43 mm)

Load in position .... 24 lb. (10,89 kg)

Dog clutch selector  
springs—

Free length .... 2.75 in. (69,8 mm)

Solid length .... .64 in. (16,2 mm)

Maximum load .... 13 lb. (5,9 kg)



# Section D—PROPELLER SHAFTS—ALL MODELS

## INDEX

	Page		Page
Centre bearing assembly		Propeller shaft	
Stripping ....	D-3	Removal ....	D-1
Assembling ....	D-3	Stripping ....	D-1
Defect location ....	D-4	Assembling ....	D-2
General data ....	D-4	Fitment ....	D-3

## LIST OF ILLUSTRATIONS

Fig.		Page	Fig.		Page
D-1	Construction of propeller shaft	D-1	D-4	Removing the splined sleeve or shaft....	D-2
D-2	Removing a yoke bearing, Stage 1	D-2	D-5	Removing the flange yoke ....	D-2
D-3	Removing a yoke bearing, Stage 2	D-2	D-6	Rubber grommet in position on shaft	D-3

### Propeller shaft (front and rear axle drives)

Wear on the thrust faces of the bearings can be located by testing the lift in the joint, either by hand or with the aid of a length of wood suitably pivoted.

Any circumferential movement of the shaft relative to the flange yokes indicates wear in the roller bearings or the splined joint.

Lubricant may seep from the bearings after a lengthy period of service, owing to failure of the bearing seals.

If a leak is severe, or is neglected, failure of the needle roller bearings may result.

If any of these defects are apparent, the complete shaft should be removed from the vehicle and rectified as described.

### To remove Operation D/2

1. Disconnect the propeller shaft from the differential input flange.
2. Disconnect the propeller shaft from the transfer box output flange.

3. Withdraw the propeller shaft complete.

### Propeller shaft (rear power take-off drive)

#### To remove Operation D/4

See Section T.

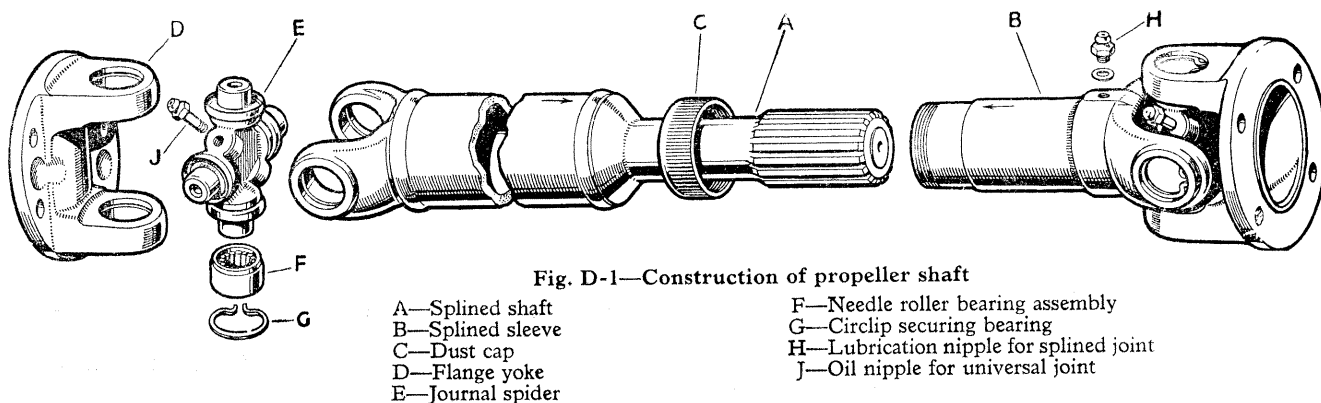
#### To strip Operation D/6

1. If fitted, unscrew the two hose clips and slide the rubber grommet up the shaft.
2. Unscrew the dust cap and withdraw the sliding joint from the splined shaft.

Dismantle each universal joint as follows:

3. Clean the enamel and dirt from the four circlips and the tops of the bearing races.
4. Remove the circlips.
5. Hold the joint in the left hand with one of the splined sleeve (or shaft) yoke lugs uppermost and tap the radius of the yoke lightly with a soft-nosed hammer.

The top bearing should then begin to emerge from the yoke. (Fig. D-2.)



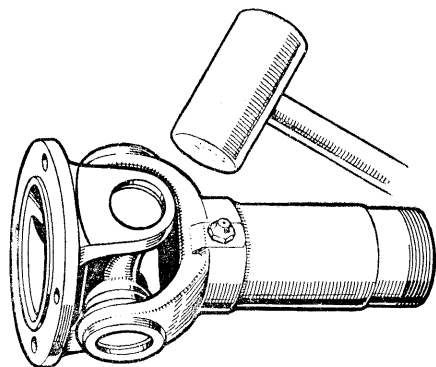


Fig. D-2—Removing a yoke bearing. Stage 1

6. Turn the joint over and withdraw the bearing. (Fig. D-3.)

Always remove a bearing downwards, to avoid dropping the needle rollers. It may be necessary to tap the bearing race from the inside with a small drift; in such cases, care should be taken to prevent damage to the bearing race.

7. Repeat these operations for the opposite bearing.

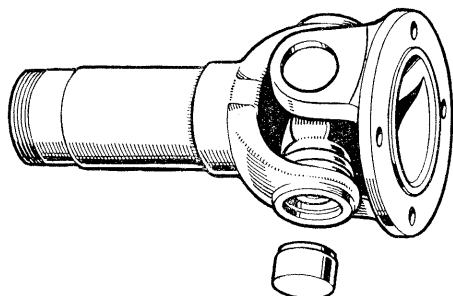


Fig. D-3—Removing a yoke bearing. Stage 2

8. The splined sleeve (or shaft) yoke can now be removed. (Fig. D-4.)
9. Rest the flange yoke on a short piece of tubing of suitable diameter (slightly larger than the bearing race) and drive out the two remaining bearings, using a brass drift. (Fig. D-5.)
10. Wash all the parts and lay them out for inspection.

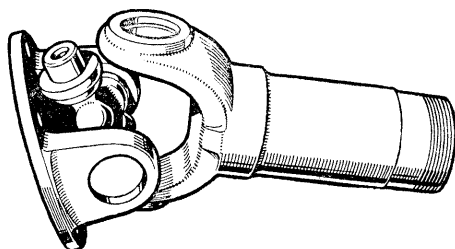
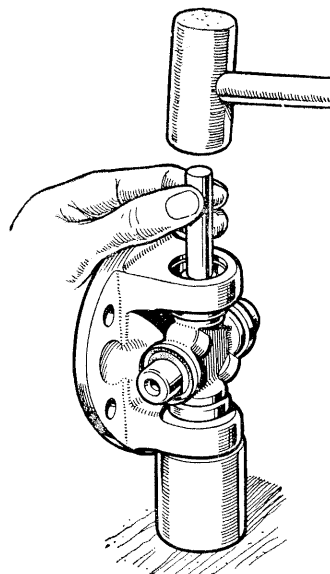


Fig. D-4—Removing the splined sleeve or shaft

Fig. D-5—  
Removing the  
flange yoke

#### To assemble

#### Operation D/8

The parts most likely to show signs of wear after long use are the bearing races and the spider journals. Should looseness in the fit of these parts, load markings or distortion be observed, they must be renewed complete, as oversize journals or bearing races are not supplied. Replacement journal assemblies comprise a spider complete with cork oil seals and four bearings.

The other parts likely to show signs of wear are the splined sleeve yoke and splined shaft. A total of .004 in. (0,1 mm) circumferential movement, measured on the outside diameter of the splines, should not be exceeded. If wear beyond this limit has taken place, a new propeller shaft complete must be fitted.

1. Assemble the needle rollers in the bearing races, if necessary using a smear of vaseline to retain them in place. About half fill the races with a recommended grease.
2. Insert the journal in the flange yoke holes and, using a brass drift slightly smaller in diameter than the hole in the yoke, lightly tap the first bearing into position.

It is essential that the bearing races be a *light drive fit* in the yoke trunnions. In the event of wear taking place in any of the eight yoke cross holes, rendering them oval, a new propeller shaft complete must be fitted.

3. Repeat the operation for the other three bearings comprising the universal joint, and assemble the other joint similarly.
4. Replace the circlips and ensure that they are firmly located in their grooves. If the joint appears to bind, tap the ears slightly with a soft-nosed hammer.

2. Insert the bolts securing the front and rear propeller shafts together, in the rear flange, before fitting the flange on the splined shaft.
3. The centre ball bearing must be a *light drive fit* on the shaft; if a new bearing is loose on the shaft, the complete shaft must be renewed.
4. The centre ball bearing must be a *press fit* in the housing; if a new bearing is loose in the housing, the complete housing must be renewed.

Propeller shaft (front and rear axle drives)  
To refit Operation D/14

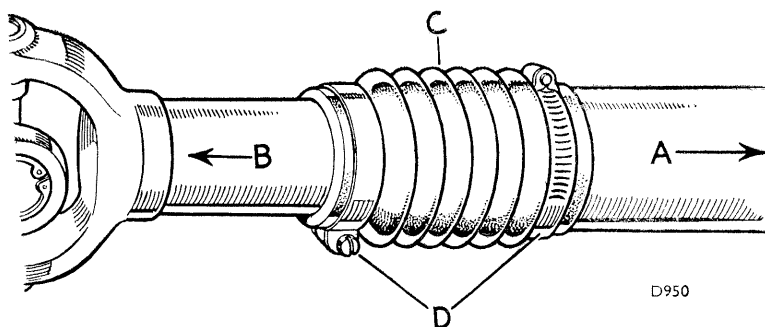
### Operation D/10

1. Wipe the faces of the transfer box and differential flanges clean.
2. Replace the propeller shaft and ensure that the register engages and that the joint faces bed down correctly all round.
3. Secure the propeller shaft, **sleeve end**, to the transfer box output flange. Tighten the nuts evenly.
4. Secure the propeller shaft to the differential input flange (with the nuts behind the input flange). Tighten the nuts evenly.

## Operation D/12

- Propeller shaft (rear power take-off drive)  
To refit Operation D/16

1. See Section T.



A—To output shaft housing.  
B—To front axle.  
C—Rubber grommet.  
D—Hose clips at 180° to each other.

## DEFECT LOCATION

(Symptom, Cause and Remedy)

## A—VIBRATING PROPELLER SHAFT

1. Worn needle roller bearings—
2. Balance marks out of alignment—*Check alignment of balance marks on the splined sleeve yoke and shaft.*
3. Worn splines—*Renew.*
4. Shaft out of balance—*Tighten the securing nuts; renew the shaft if still out of balance.*

## B—UNIVERSAL JOINTS NOISY

1. Lack of lubrication—*Lubricate or renew bearings.*
2. Securing nuts loose—*Tighten.*
3. Worn bearings or worn spline—*Renew.*

## GENERAL DATA

## 88 in.

Type: Hardy Spicer needle bearing

Tubular shaft—

diameter ..... 2 in. (50,8 mm)

wall thickness .....  $\frac{3}{32}$  in. (2,4 mm)

Overall length (face to face in neutral position)—

Front axle drive ..... 23.812 in. (654 mm)

Rear axle drive ..... 21.812 in. (554 mm)

Lubricant ..... Grease

## 109 in.

Type: Hardy Spicer needle bearing

Tubular shaft—

diameter ..... 2 in. (50,8 mm)

wall thickness .....  $\frac{3}{32}$  in. (2,4 mm)

Overall length (face to face in neutral position)—

Front axle drive ..... 23.812 in. (654 mm)

Rear axle drive ..... 42.812 in. (1,087 mm)

Lubricant ..... Grease

# Section E — REAR AXLE — ALL MODELS

## INDEX

	Page		Page
Axle complete		Differential pinion seal	
Removal	E-4	Renewal	E-4
Fitment	E-5	General data	E-5
Detail data	E-5	Rear hub assembly	
Differential assembly		Adjustment	E-1
Removal	E-4	Removal	E-1
Stripping, examination and assembling	E-4	Stripping	E-2
Fitment	E-4	Assembling	E-2

## LIST OF ILLUSTRATIONS

Fig.	Page
E-1 Checking hub end-float	E-1
E-2 Cross-section of rear hub	E-2
E-3 Layout of rear axle	E-3

Data, details and illustrations concerning the differential assembly will be found in Section F.

### Rear hub assembly

#### To adjust

#### Operation E/2

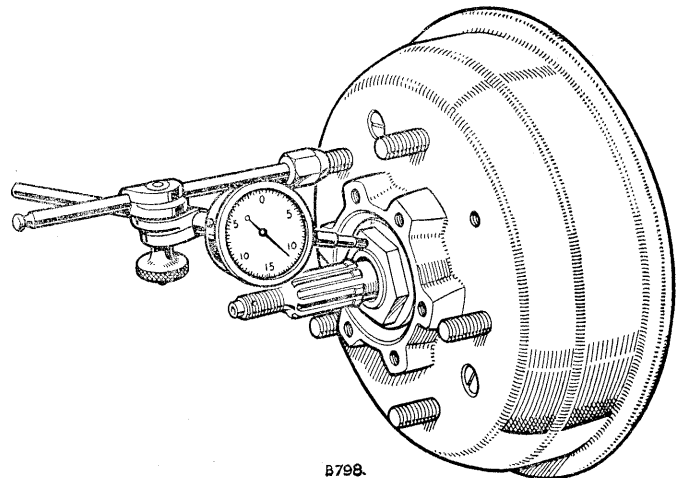
1. Adjust the end-float of the hub bearing by adjusting the inner hub nut by hand until it can be felt that the end-float has been taken up, and at the same time revolving the hub slowly to allow the rollers to settle down in their bearings. Tighten the locknut and check the end-float by means of a dial test indicator mounted on to one of the wheel studs (see Fig. E-1). Take the reading by pushing the hub as far as possible towards the axle centre, note the indicator reading, pull the hub outwards and again take the indicator reading, the total hub movement so measured should be .004 in. to .006 in. (0,10 mm to 0,15 mm). When the correct end-float has been obtained, bend over two tabs of the locking washer. As a safeguard, the end-float should be checked once more after locking the nuts.

#### To remove

#### Operation E/4

1. Jack up the rear of the vehicle under the chassis frame.
2. Drain off the rear axle oil.
3. Remove the road wheel and brake drum.

4. Depress the brake pedal fully, and wedge it in that position, detach the brake pipes at the wheel brake unit.
5. Remove the brake components. (Section H).
6. Withdraw the shaft and hub assembly, complete with anchor plate, from the flange, by removing the six securing bolts, spring washers and nuts.



B798.

Fig. E-1—Checking hub end-float



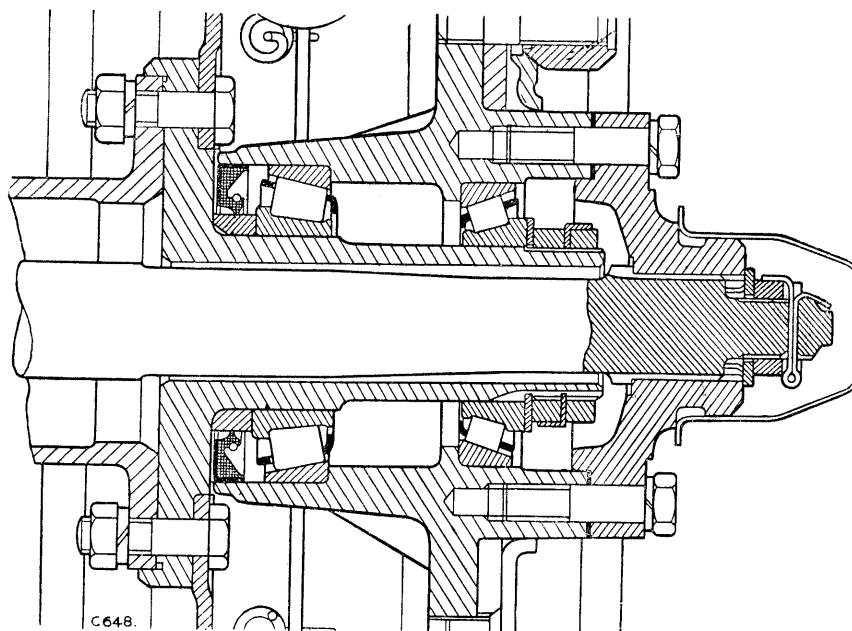


Fig. E-2—Cross-section of rear hub

**To strip****Operation E/6**

1. Remove the hub cap (*press fit*) on the driving member.
2. Remove the driving member and joint washer from the axle shaft and the hub. Remove oil seal.
3. Prise up the locking tabs and remove the locknut, lock washer and adjusting nut from the rear bearing sleeve, remove the thrust key.
4. Remove the hub complete with the inner and outer roller bearings and oil seal. Remove brake anchor plate. Withdraw the oil seal and bearings from the hub if necessary.

**To assemble hub****Operation E/8**

1. Before assembling the hub, examine the outside diameter of the inner bearing distance piece, on which the oil seal runs, for signs of damage or roughness. Renew as necessary. The distance piece should be a *press fit* on the rear hub bearing sleeve. Any clearance between these two parts will allow oil to leak past on to the brake linings.
2. Examine the two hub bearings and renew them as necessary. Both bearings should be an *easy fit* on the rear hub bearing sleeve and a *press fit* in the hub. If new bearings are slack in the hub, the hub itself should be renewed.
3. Lightly smear the bearings with grease and press them into the hub. Do not disturb the coating of oil, which is present on new bearings.

4. Examine the oil seal and renew as necessary; press the seal into the hub with the knife edge towards the inner bearing until the oil seal face is flush with the rear face of the hub. If the seal is pressed too far in, the element will fail to register on the rear hub bearing sleeve distance piece, so allowing oil to leak past and on to the brake linings.

**To assemble complete unit    Operation E/10**

1. Bolt the rear hub bearing sleeve to the axle casing.
2. Place brake anchor plate into position and then slide the complete hub on to the rear hub bearing sleeve.
3. Fit the thrust key washer, adjusting nut, lock washer and locknut. Adjust the hub end-float, Operation E/2.
4. Slide the axle shaft through the rear hub bearing sleeve until it locates in the splines of the differential unit. Place a joint washer on to the driving member, then slide the member on to the spline at the end of the axle shaft, securing it to the hub with the six set bolts and washers.
5. Replace oil seal and secure the axle shaft to the driving member by using the slotted nut, plain washer and split pin. Take care not to over-tighten. Tap the hub cap into place.
6. Fill the hub with one-third of a pint (0,190 litres) of oil, through the oil filler plug in the driving member, using a dispenser with a pipe extension, so that the oil is discharged adjacent to the outer bearing. Replace the filler plug and joint washer.

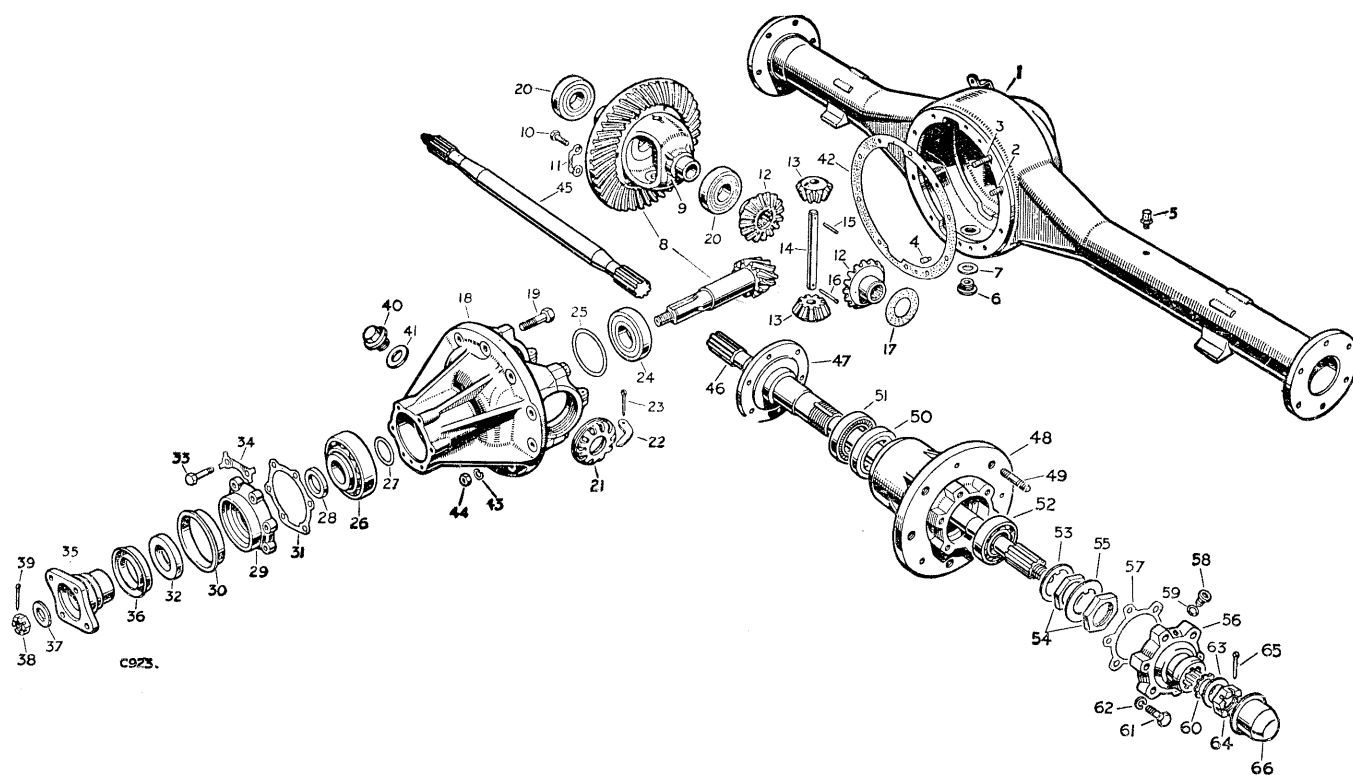


Fig. E-3—Layout of rear axle

- |       |  |       |                                      |
|-------|--|-------|--------------------------------------|
| 1     | Rear axle casing                         | 31    | Joint washer for retainer            |
| 2-3   | Bolts fixing differential                | 32    | Oil seal for pinion                  |
| 4     | Dowel locating differential              | 33-34 | Fixings for retainer                 |
| 5     | Breather                                 | 35    | Driving flange                       |
| 6-7   | Oil drain plug                           | 36    | Dust shield for driving flange       |
| 8     | Crownwheel and bevel pinion              | 37-39 | Fixings for driving flange           |
| 9     | Differential casing                      | 40-41 | Oil filler plug and washer           |
| 10-11 | Fixings for crownwheel                   | 42    | Joint washer for differential        |
| 12    | Differential wheel                       | 43-44 | Fixings for differential             |
| 13    | Differential pinion                      | 45    | Axle shaft, R.H.                     |
| 14    | Spindle for pinions                      | 46    | Axle shaft, L.H.                     |
| 15-16 | Fixings for spindle                      | 47    | Rear hub bearing sleeve              |
| 17    | Thrust washer for differential           | 48    | Rear hub assembly                    |
| 18    | Bevel pinion housing                     | 49    | Stud for road wheel                  |
| 19    | Bolt fixing bearing cap                  | 50    | Hub bearing, inner                   |
| 20    | Roller bearings for differential         | 51    | Oil seal for inner bearing           |
| 21    | Serrated nut                             | 52    | Hub bearing, outer                   |
| 22    | Lock tab                                 | 53-55 | Fixings—for hub bearing              |
| 23    | Split pin                                | 56    | Driving member for rear hub          |
| 24    | Bearing for bevel pinion, pinion end     | 57    | Joint washer for driving member      |
| 25    | Shims for bearing adjustment, pinion end | 58    | Filler plug for hub driving member   |
| 26    | Bearing for bevel pinion, flange end     | 59    | Joint washer for filler plug         |
| 27    | Shims for bearing adjustment, flange end | 60    | Oil seal for rear axle shaft         |
| 28    | Washer for bearing                       | 61-62 | Fixings—driving member to rear hub   |
| 29    | Retainer for oil seal                    | 63-65 | Fixings—axle shaft to driving member |
| 30    | Mudshield for retainer                   | 66    | Hub cap, rear                        |

7. Refill the rear axle with 3 pints (1,75 litres) of oil.
8. Replace brake components and reconnect the brake pipes, bleed and adjust the brakes (Section H).

#### Differential pinion oil seal

#### To renew Operation E/12

Proceed as detailed under Section F, Operation F/2.

#### Differential assembly

#### To remove Operation E/14

1. Jack up the rear of the vehicle.
2. Drain off the axle oil.
3. Remove the road wheels and brake drums.
4. Depress the brake pedal and wedge it in that position; detach the brake pipes at the wheel brake units.
5. Remove the wheel brake components. Section H.
6. Withdraw the shafts complete with driving member about 6 in. (150 mm) from the axle casing.
7. Disconnect the propeller shaft at the differential input flange.
8. Remove the differential assembly from the axle casing.

*Note:*—If any difficulty is anticipated when adjusting the differential, it is recommended that the unit be replaced by a new assembly (obtainable from our Spares Department) and the old one returned for reconditioning.

#### To strip, examine and assemble

#### Operation E/16

Proceed as detailed under Section F, Operations F/6, F/8 and F/10. For data see "Data", Section F.

#### To refit Operation E/18

1. Fit the differential assembly in the axle casing.
2. Connect the propeller shaft to the input flange.
3. Push the axle shafts into the splines of the differential, and secure in position.
4. Replace the wheel brake components. Section H.

5. Replace the brake drums and road wheels.
6. Connect the brake pipes to the wheel brake units and bleed the brake system. Section H.
7. Lower the vehicle to the ground.
8. Refill the axle with oil, 3 pints (1,75 litres).

#### Axle complete

#### To remove, Method I Operation E/20

1. Jack up the rear of the vehicle.
2. Remove both road wheels.
3. Depress the brake pedal and wedge it in that position. Disconnect the flexible brake pipe at the Tee-piece on the differential casing.
4. Disconnect the propeller shaft at the differential input flange. Disconnect one extremity of each check strap.
5. Remove the axle U-bolts.
6. Remove the self-locking nuts from the rear shackle pins. Slacken the shackle pins at the front end of the springs. Place a jack under the axle casing, raise the axle slightly and withdraw the shackle pins to allow the rear ends of the springs to rest on the ground.
7. Lower and remove the jack and axle complete towards the rear.

#### To remove, Method II Operation E/22

An alternative method for removal eliminates removal of the shackle pins; proceed as follows:—

1. Jack up the rear of the vehicle.
2. Drain off the axle oil.
3. Remove the road wheels and brake drums.
4. Depress the brake pedal and wedge it in that position; detach the brake pipes at the wheel brake units.
5. Remove the wheel brake components. Section H.
6. Withdraw the shaft and hub assemblies complete from the axle casing.
7. Disconnect the flexible brake pipe at the Tee-piece on the differential casing.
8. Disconnect the propeller shaft at the differential input flange.
9. Remove the differential assembly from the axle casing.

10. Remove the axle U-bolts and allow the road spring bottom plates to hang on the shock absorbers.
11. Remove the axle casing by manoeuvring it past the road springs and check straps.

**To refit**

**Operation E/24**

1. Replace the axle assembly by reversing the removal procedure (Method I or II).
2. Bleed the brake system. Section H.
3. Refill the differential with oil, 3 pints (1,75 litres) and lower the vehicle off the jacking stands.

**GENERAL DATA**

Type:	....	.... Fully floating
Oil capacity	....	3 pints (1,75 litres)
Hub bearing lubrication	1/3rd pint	(0,190 litres)
Final drive	....	Spiral bevel
Ratio	....	4.7 to 1

**DETAIL DATA**

**Rear hub assembly:**

Rear hub end-float .... 0.004 to .006 in. (0,10 to 0,16 mm)

Clearance of hub bearing in rear hub bearing sleeve .... .0002 to .0013 in. (0,005 to 0,033 mm)

Fit of hub bearing in hub .... .001 to .003 in. (0,025 to 0,075 mm) interference



## Section F – FRONT AXLE – ALL MODELS

### INDEX

	Page		Page
Axle casing oil seal		Half shaft	
Renewal ....	F-9	Removal ....	F-13
Axle complete		Stripping ....	F-13
Removal ....	F-15	Assembling ....	F-14
Fitment ....	F-15	Fitment ....	F-14
Defect location ....	F-16	Lock stop	
Detail data ....	F-17	Adjustment ....	F-15
Differential assembly		Stub axle	
Removal ....	F-5	Renewal ....	F-10
Stripping ....	F-5	Stub shaft	
Examination ....	F-5	Renewal ....	F-10
Assembling ....	F-6	Swivel pins	
Fitment ....	F-8	Renewal ....	F-11
Differential pinion oil seal		Swivel pins and bearings	
Renewal ....	F-1	Stripping ....	F-12
Front hub		Assembling ....	F-12
Adjustment ....	F-9	Swivel pin bearing housing	
Stripping ....	F-9	Renewal ....	F-15
Assembling ....	F-9	Swivel pin housing oil seal	
General data ....	F-17	Renewal ....	F-10
		Universal joint	
		Renewal ....	F-11

### LIST OF ILLUSTRATIONS

Fig.	Page	Fig.	Page
F-1 Layout of front axle and differential	F-2	F-14 Removing a yoke bearing (Stage 1) ....	F-11
F-2 Cross-section of axle (differential) ....	F-4	F-15 Removing a yoke bearing (Stage 2) ....	F-11
F-3 Cross-section of axle (universal joint and hub) ....	F-4	F-16 Removing the stub shaft ....	F-11
F-4 Pressing out pinion end bearing outer race ....	F-5	F-17 Replacing a yoke bearing ....	F-11
F-5 Pressing pinion end bearing outer member into pinion casing ....	F-6	F-18 Setting top swivel pin ....	F-12
F-6 Measuring pinion bearing pre-load ....	F-6	F-19 Cross-section of universal joint housing assembly ....	F-12
F-7 Pinion setting ....	F-7	F-20 Cone bearing setting ....	F-13
F-8 Bevel pinion adjustment shims ....	F-7	F-21 Checking swivel pin housing resistance to rotation ....	F-13
F-9 Adjusting crownwheel backlash ....	F-8	F-22 Stripping half shaft ....	F-14
F-10 Fitting crownwheel lockers ....	F-8	F-23 Assembling half shaft ....	F-14
F-11 Checking crownwheel backlash ....	F-8	F-24 Hub removal tool and adaptor kit ....	F-14
F-12 Checking hub end-float ....	F-9	F-25 Extractor used as a ram to drive collar on to axle shaft ....	F-14
F-13 Cross-section of hub ....	F-10	F-26 Adjusting lock stop bolt ....	F-15

#### Differential pinion oil seal

##### To renew

##### Operation F/2

1. Jack up the front of the vehicle and support the chassis frame on jacking stands.
2. Drain off the oil from the differential.
3. Disconnect the propeller shaft from the differential input flange.
4. Remove the differential pinion driving flange.
5. Remove the oil seal retainer and seal together with a joint washer. Care should be taken not

to dislodge the bearings and flange end bearing washer during this operation.

6. Remove the oil seal from the retainer and fit the new seal with the lip towards the axle casing. The retainer must be warmed and the outer diameter of the new oil seal, smeared with jointing compound before assembly.
7. Replace a new joint washer and the oil seal retainer.
8. Examine the input flange outer diameter for roughness or damage which may have caused failure of the original seal and rectify or replace as necessary.



Fig. F-1—Layout of front axle

Key to Fig. F-1

1	Axle casing complete	52	Housing for swivel pin bearing
2-3	Fixings—differential housing to axle casing	53	Distance piece for bearing
4	Dowel, locating housing	54	Bearing for half shaft
5	Oil seal, in casing	55	Retaining collar for bearing
6	Breather	56	Joint washer for housing
7	Oil filler plug	57-58	Fixings—housing to front axle casing
8-9	Drain plug and joint washer	59	Housing assembly for swivel pin
10	Crownwheel and bevel pinion	60	Special stud for steering lever and bracket
11	Differential casing	61	Stud for steering lever
12	Set bolt	62-63	Drain plug and joint washer
13	Locker (double type)	64	Swivel pin and steering lever
14	Differential wheel	65	Cone seat for swivel pin, top
15	Differential pinion	66	Cone bearing for swivel pin, top
16	Spindle for pinion	67	Spring for cone bearing
17	Plain pin } For	68	Bearing for swivel pin, bottom
18	Split pin } spindle	69	Swivel pin and bracket
19	Thrust washer	70	Shim, for swivel pin bearing
20	Bevel pinion housing	71-74	Fixings—swivel pin to swivel pin housings
21	Special bolt, fixing bearing cap	75	Oil seal for swivel pin bearing housing
22	Taper roller bearing for differential	76	Retainer for oil seal
23-24	Bearing adjustment	77-81	Fixings—retainer and lock stop plate to swivel pin housing
25	Split pin, fixing lock tab	82	Oil filler plug for swivel pin housing
26	Bearing for bevel pinion, pinion end	83	Stub axle assembly
27	Shim, bearing adjustment, pinion end	84	Bush for driving shaft
28	Bearing for bevel pinion, flange end	85	Distance piece for inner bearing
29	Shim, bearing adjustment, flange end	86-87	Fixings—stub axle to swivel pin housing
30	Washer for pinion bearing	88	Front hub assembly
31	Retainer for oil seal	89	Stud for road wheel
32	Mudshield for retainer	90	Bearing for front hub, inner
33	Joint washer for oil seal retainer	91	Oil seal for inner bearing
34	Oil seal for pinion	92	Bearing for front hub
35-36	Fixings—oil seal retainer	93	Keywasher } Fixing
37	Driving flange	94	Locker } front hub
39	Mudshield for driving flange	95	Special nut } bearing
40-42	Fixings for flange	96	Driving member for front hub
43-44	Oil filler plug and joint washer	97	Joint washer for driving member
45	Joint washer, differential to axle casing	98-99	Fixings—driving member to front hub
46-47	Fixings—differential to axle casing	100	Plain washer } Fixing
48	Half shaft	101	Slotted nut } driving member
49	Stub shaft	102	Split pin } to
50	Journal assembly	103	Hub cap, front } driving shaft
51	Circlip for journal		

555.1212  
689.4431  
406

Key K B Seal



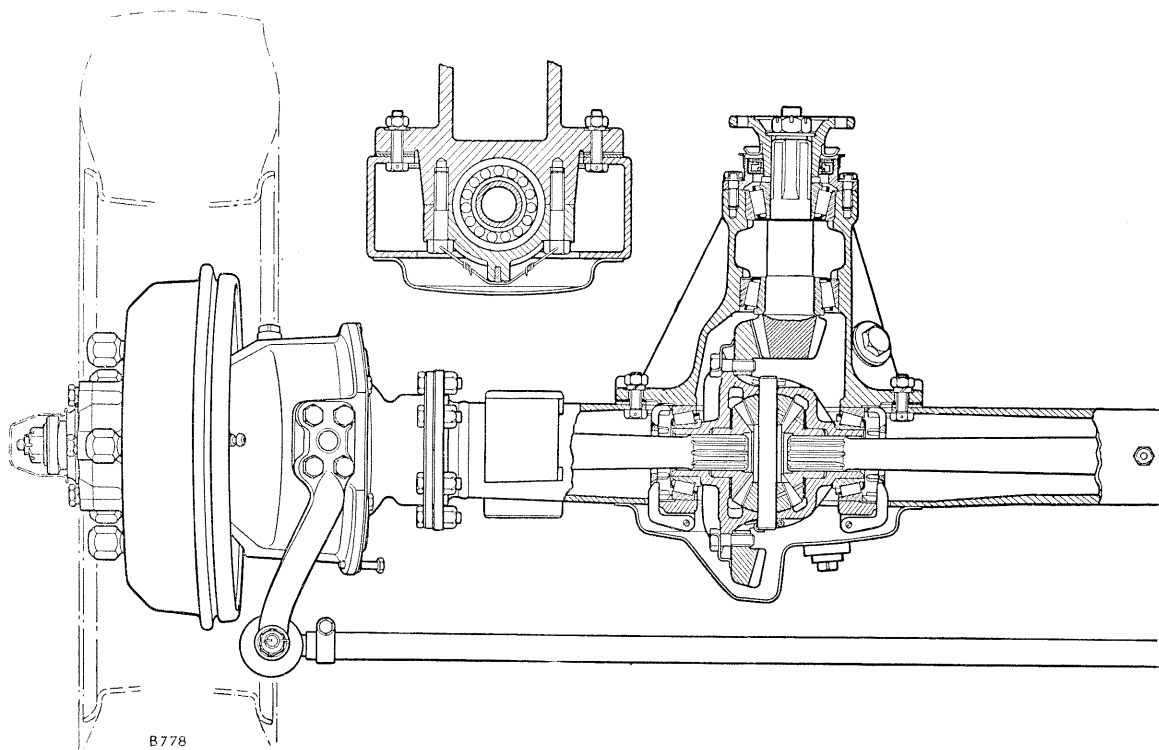


Fig. F-2—Cross-section of axle (differential)

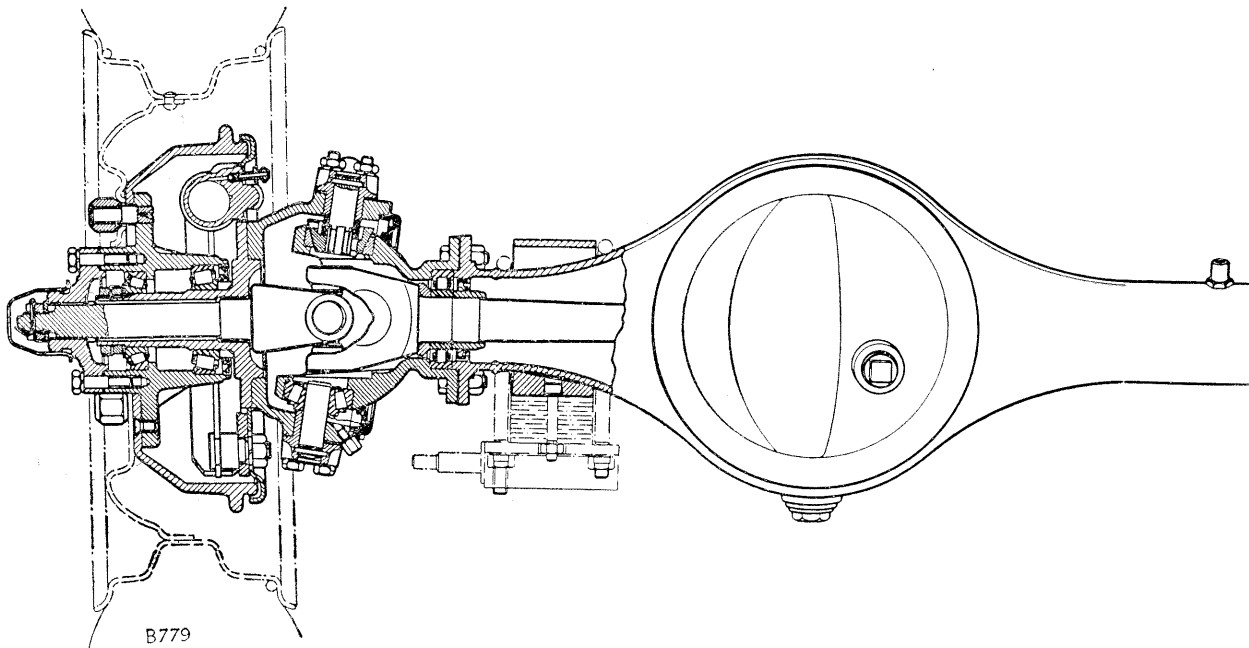


Fig. F-3—Cross-section of axle (universal joint and hub)

9. Refit the flange. Tighten the castle nut to 85 lb./ft. (11,75 mKg) on a torque spanner. Fit the split pin.
10. Reconnect the propeller shaft.
11. Lower the vehicle from the jacking stands and refill the differential with oil, 3 pints (1,75 litres).

### Differential assembly

#### To remove Operation F/4

1. Jack up the front of the vehicle and place jacking stands under the chassis frame.
2. Remove the road wheels.
3. Drain off the axle and universal joint housing oil; (drain and filler plugs to be removed).
4. Depress the brake pedal and wedge it in that position; detach the flexible brake pipes at the wheel brake units.
5. Disconnect the drag link and track rod from the steering arm.
6. Withdraw each universal joint housing assembly from the axle casing, taking care not to damage the axle casing oil seals.
7. Disconnect the propeller shaft at the differential input flange.
8. Remove the differential assembly.

*Note:*—If any difficulty is anticipated when adjusting the differential it is recommended that the unit be replaced by a new assembly (obtainable from our Spares Department) and the old one returned for reconditioning.

#### To strip Operation F/6

1. Remove the differential bearing caps.
2. Remove the serrated nuts.
3. Remove the differential complete with races.
4. Remove the crownwheel from the differential case.
5. Remove the split pin and tap out the differential wheel spindle.
6. Remove the two differential wheels.
7. Remove the two differential pinions, together with the fibre thrust washer fitted between each wheel and the differential casing.
8. Draw off the two differential thrust bearings.
9. Remove the differential pinion input flange.
10. Remove the oil seal retainer and washer from the pinion housing.
11. Withdraw the pinion, remove the flange end bearing washer and the flange end bearing inner member.

12. Remove the shims for flange end bearing adjustment and press off the inner member of the pinion end bearing.
13. Press out both bearing outer members and remove the pinion bearing shims. Use the special extractor Part No. 262757 to remove the pinion end bearing outer race.
14. Press out the oil seal from the retainer.

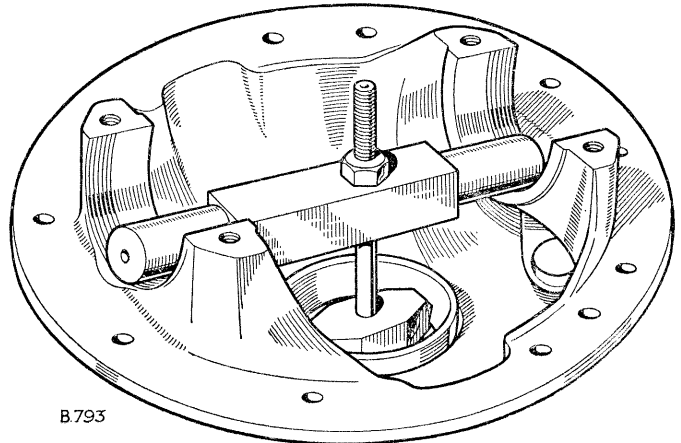


Fig. F-4—Pressing out pinion end bearing outer race

#### To examine Operation F/8

Wash all the component parts and renew them as necessary.

The more important examination details are listed below:—

1. **Flange end pinion bearing.** This bearing is of single row taper roller pattern; it should be renewed if it does not roll smoothly or if excessively worn. The pinion housing should be checked and renewed if worn in the bore. The bearing should be a *light press fit* in the housing and a *light push fit* on the pinion shaft.
2. **Pinion end pinion bearing.** This bearing should also be renewed if it does not run smoothly, or if excessively worn. It should be a *drive fit* on the bevel pinion shaft and a *light press fit* in the pinion housing.
3. **Differential thrust bearings.** These taper roller bearings must be renewed if any doubt exists about their condition. They should be a *light press fit* on the differential casing spigots.
4. **Pinion oil seal.** Renew as necessary. The retainer must be warmed and the outer diameter of the seal smeared with jointing compound before assembly. The lip of the seal must be set towards the axle casing.
5. **Crownwheel and pinion.** The crownwheel and pinion are lapped and supplied in pairs with corresponding engraved markings on each component. It is absolutely essential that they are retained and fitted in pairs, otherwise it will be impossible to obtain the correct tooth bearing on assembly. Should any imperfections such as

cracks or roughness be found on the teeth of either component, they must be discarded and a new factory-mated pair fitted.

If new pinion bearings are loose on the pinion shaft (see above), both the crownwheel and pinion must be renewed.

6. **Pinion housing.** The pinion housing is supplied complete with differential caps and securing bolts; the caps are not available as separate items and must always be retained with the correct pinion housing.

If a new pinion bearing outer member is loose in the pinion housing, the housing must be renewed complete.

7. **Differential casing.** If new differential thrust bearings are loose on the differential casing spigots, the casing must be renewed.

A larger amount of wear is permissible on the remaining differential components, but parts whose serviceability is in doubt should be renewed.

#### To assemble

#### Operation F/10

1. Press the outer member of the pinion end bearing into the pinion casing together with the shims removed on stripping (at least .020 in. (0,50 mm) should be used), using press block (Part No. 262758). Press the outer member of the flange end bearing into the pinion casing.
2. Press the inner member of the pinion end bearing on to the pinion shaft.
3. Fit the pinion shaft into the pinion case together with the shims removed on stripping (at least .020 in. (0,50 mm) should be used).

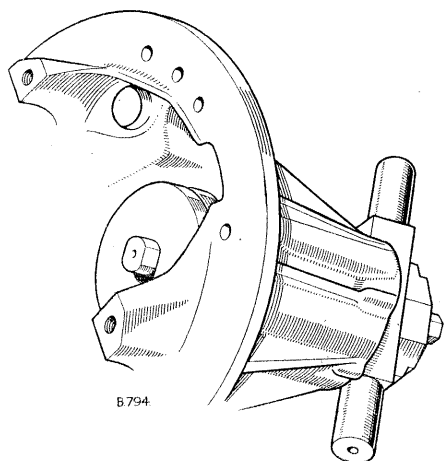


Fig. F-5—Pressing pinion end bearing outer member into pinion casing

4. Fit the flange end bearing inner member into position on the pinion shaft.
5. Fit the flange end bearing washer and the driving flange on to the pinion shaft and retain with the nut and plain washer. The nut should be tightened to 85 lb./ft. (11,75 mKg) on a torque spanner.
6. The loading on the bearings should be sufficient to give a reading of 6 to 10 in./lb. (0,07 to 0,11 mKg) when rotating the shaft. If the loading is incorrect, then the assembly must be dismantled sufficiently to allow shims to be either placed or removed from the front of the flange end bearing until the correct value is obtained. The required number of shims can only be found by trial and error. When the correct poundage is obtained, note the thickness of each shim used. The shims are available .003 in. (0,076 mm), .005 in. (0,127 mm), .010 in. (0,254 mm) and .020 in. (0,50 mm) thick.

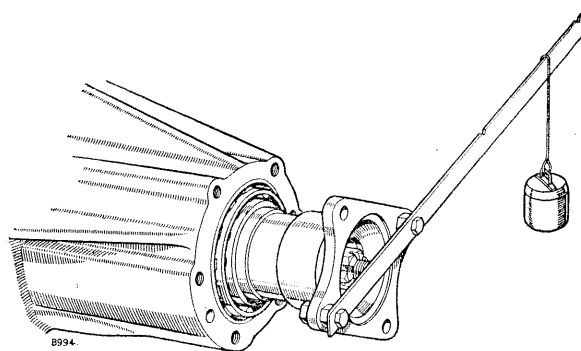


Fig. F-6—Measuring pinion bearing pre-load

#### Set the pinion as follows:

7. Check the dimension from the axis of the crownwheel to the pinion face, using special gauge, Part No. 262761 (Fig. F-7). This dimension should be 3.00 to 3.002 in. (76,2 mm to 76,7 mm).
8. Measure the clearance between the bar and end face of the pinion with a set of feeler gauges. Adjust the position of the pinion, as necessary, by placing shims of the same value behind the pinion end bearing; these shims are available .003 in. (0,076 mm), .005 in. (0,127 mm) and .020 in. (0,50 mm) thick.
9. Note the total thickness of the shims added to those already placed behind the pinion end bearing, and add a similar amount in front of the flange end bearing in addition to those already fitted to load the bearings.

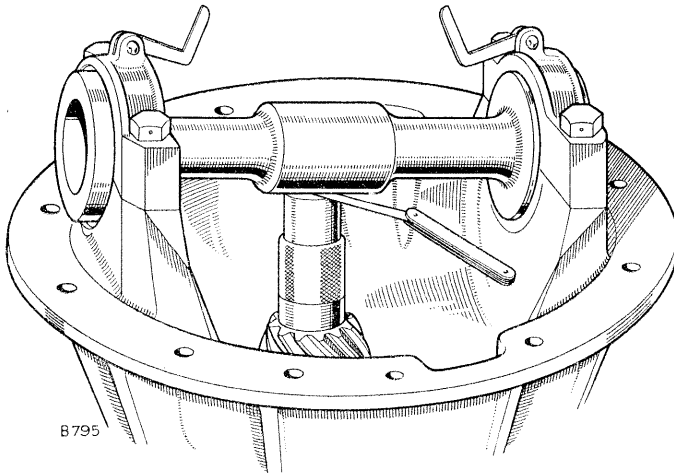


Fig. F-7—Pinion setting

10. Smear the pinion oil seal with Molytone 'C' Compound, then place the oil seal retainer and joint washer in position on the pinion shaft, but do not fit the retainer fixing bolts at this stage.
11. Recheck the torque on the pinion shaft and adjust as necessary.
12. Position the oil seal retainer and joint washer (oil hole at the bottom) and secure to the pinion housing.
13. Replace the two differential wheels, together with the fibre thrust washers, which are supplied .040 in. (1,015 mm), .045 in. (1,142 mm) and .050 in. (1,270 mm) thick; they should be selected to give minimum but definite backlash between the differential wheels and pinions.

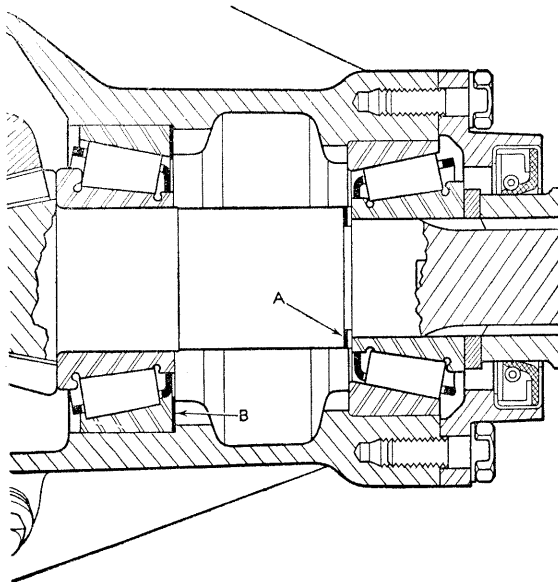


Fig. F-8—Bevel pinion adjustment shims

A—Shims adjusting bearing preload  
B—Shims adjusting pinion position

14. Replace the two differential pinions.
  15. Replace the differential wheel spindle and secure with a split pin.
  16. Fit the crownwheel to the differential with eight standard bolts, .375 in. (9,5 mm) dia., and two special bolts, .390 in. (10 mm) dia., and five double lockers.
  17. The special bolts can be fitted in any hole in the differential casing; selective fitting to line up with the crownwheel holes may be necessary, but they must be as nearly diametrically opposite each other as possible. Tighten the bolts evenly by diagonal selection.
- The double lockers must be fitted as shown in Fig. F-10.
18. Press on the inner members of the two differential thrust bearings.
  19. Place the differential in the housing, together with the thrust bearing outer races and serrated locking nuts. Replace the bearing caps ensuring that the markings coincide and secure each with two set bolts, which must not be tightened at this stage.
  20. Tighten the locking nut on the crownwheel side of the differential casing as much as possible; slacken the locking nut, then tighten once more until it just rests against the bearing. Proceed in a similar manner for the other locking nut; this ensures that all end-float has been taken up and that the bearings are not pre-loaded at this stage. The special spanner, Part No. 262759 (Fig. F-9) will facilitate this operation.
  21. Slacken the locking nut on the crownwheel side of the differential casing by two serrations and tighten the opposite locking nut by the same amount. This should ensure an initial backlash of .008-.010 in. (0,20-0,25 mm) on the crownwheel.
  22. Check the backlash on the crownwheel by using a dial test indicator mounted on the crownwheel teeth. The indicator should be mounted so that the indicator plunger can be brought to bear on the securing flange of the pinion housing.

Hold the pinion shaft securely and rotate the crownwheel through its available backlash; the total movement indicated should be .008 in. to .010 in. (0,20 to 0,25 mm) at the tightest position.

Adjust the backlash as necessary by turning the serrated locking nuts retaining the differential thrust bearings, both in the same direction; as no tolerance is permitted and as one serration on the adjusting nut alters the backlash by approximately .005 in. (0,12 mm), it may be necessary to effect a re-location of the locking tabs to obtain the correct figure at the tightest point.

When the pinion and backlash are adjusted to these requirements the tooth bearing should also be correct.

23. Tighten both locking nuts by half a serration, so putting the necessary .005 in. (0,12 mm) preload on the bearings.

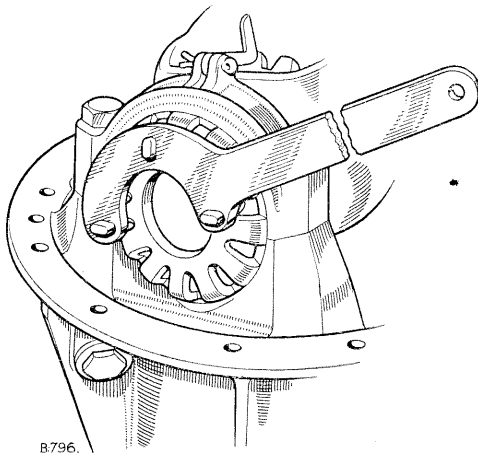


Fig. F-9—Adjusting crownwheel backlash

24. Lock the serrated nuts with the locking tabs; tighten the set bolts securing the thrust bearing caps, and lock the tabs and bolts with locking wire. Split pin the castle nut securing the driving flange.

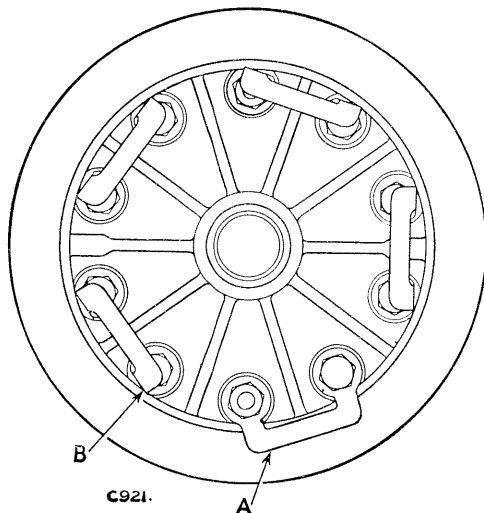


Fig. F-10—Fitting crownwheel double lockers

A—Lockers before bending  
B—Locker bent in position

#### To refit

#### Operation F/12

1. Secure the differential assembly, together with joint washer, to the axle casing.
2. Connect the propeller shaft to the differential input flange (nuts behind the input flange).
3. If necessary, renew the oil seals in the ends of the axle casing by prising out the oil seal from the end of the axle casing. The new oil seal must be fitted with the knife edge inwards. For further details see Operation F/14.
4. Place the joint washer on the axle casing joint face.
5. Replace the universal joint housing assemblies, taking care not to damage the axle casing oil seals.
6. Replace the drag link and track rod. If the ball joints have been disturbed, the lengths of the drag link and track rod must be adjusted. Section G.

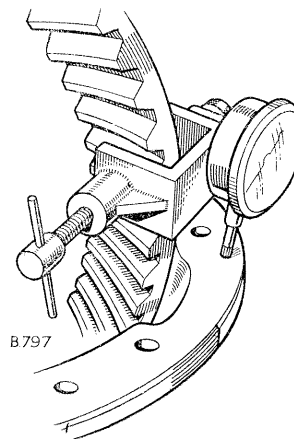


Fig. F-11—  
Checking crownwheel  
backlash

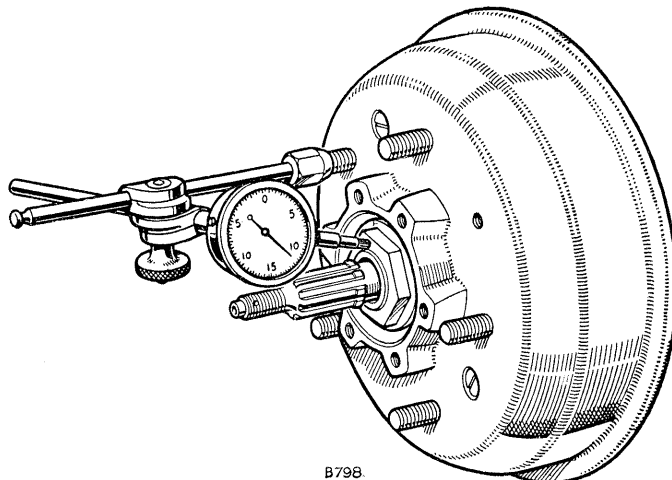
7. Connect the flexible brake pipes to the wheel brake units and bleed the brake system. Section H.
8. Replace the road wheels.
9. Lower the vehicle to the ground.
10. Replace the axle and universal joint housing drain plugs and refill with oil, 3 pints (1,75 litres) in the axle and 1 pint (0,5 litre) in each universal joint housing.

**Axle casing oil seal****To renew****Operation F/14**

1. Remove the universal joint housing assembly from the axle casing. Operation F/4.
2. Prise out the oil seal from the end of the axle casing and fit the new seal, with the knife edge inwards.
3. Examine the retaining collar on the half shaft, on which the oil seal runs, for signs of damage or roughness which may have caused failure of the original seal; renew as necessary. Operations F/38 and F/40.
4. Replace the universal joint housing assembly by reversing the stripping procedure, taking care not to damage the seal.
5. Bleed the brake system. Section H.
6. Refill the axle and the universal joint housings with oil, 1 pint (0,5 litre).

**Front hub****To adjust****Operation F/16**

1. Jack up the front of the vehicle and remove the road wheel.
2. Remove the driving member and joint washer from the stub shaft and hub. Operation F/18.
3. Mount a dial test indicator on one of the road wheel studs using the bracket, illustrated at Fig. F-12. The total hub movement should be .004-.006 in. (0,10-0,15 mm).
4. Should the end-float prove to be correct, re-assemble by reversing the stripping procedure.
5. If the end-float is not correct, prise up the locking tabs and unscrew the outer locknut.



B798

**Fig. F-12—Checking hub end-float**

6. Adjust the end-float of the hub bearing by adjusting the inner hub nut, by hand, until it can be felt that the end-float has been taken up, and at the same time revolving the hub slowly to allow the rollers to settle down in their bearings. Tighten the locknut and check the end-float by means of a dial test indicator mounted on to one of the wheel studs (see Fig. F-12). Take the reading by pushing the hub as far as possible towards the axle centre, note the indicator reading, pull the hub outwards and again take the indicator reading. The total hub movement so measured should be .004 to .006 in. (0,10 to 0,15 mm). When the correct end-float has been obtained, bend over two tabs of the locking washer. As a safeguard, the end-float should be checked once more after locking the nuts.
7. Replace the driving member and joint washer and complete the assembly by reversing the stripping procedure, taking care not to over-tighten the nut securing the driving shaft to the driving member.
8. Check oil level in universal joint housing.

**To strip****Operation F/18**

1. Jack up the front of the vehicle and remove the road wheel and brake drum.
2. Drain off the oil from the universal joint housing (remove both drain and filler plugs).
3. Remove the hub cap (*press fit* on the driving member).
4. Place a drip tray below the hub and remove the driving member and joint washer from the stub shaft and the hub.
5. Prise up the locking tabs and remove the locknut, lock washer and adjusting nut from the stub axle. Remove the thrust key washer.
6. Remove the hub complete with the inner and outer roller bearings and oil seal. Withdraw the oil seal and bearings from the hub, if necessary.

**To assemble****Operation F/20**

1. Before assembling the hub, examine the outside diameter of the inner bearing distance piece, on which the oil seal runs, for signs of damage or roughness. Renew as necessary. The distance piece should be a *press fit* on the stub axle. Any clearance between these two parts will allow oil to leak past on to the brake linings.
2. Examine the two hub bearings and renew them as necessary. Both bearings should be an *easy fit* on the stub axle and a *press fit* in the hub. If new bearings are slack in the hub, the hub itself should be renewed.
3. Lightly smear the bearings with grease and press them into the hub. Do not disturb the coating of oil, which is present on new bearings.
4. Examine the oil seal and renew as necessary; smear the operating surfaces with a suitable

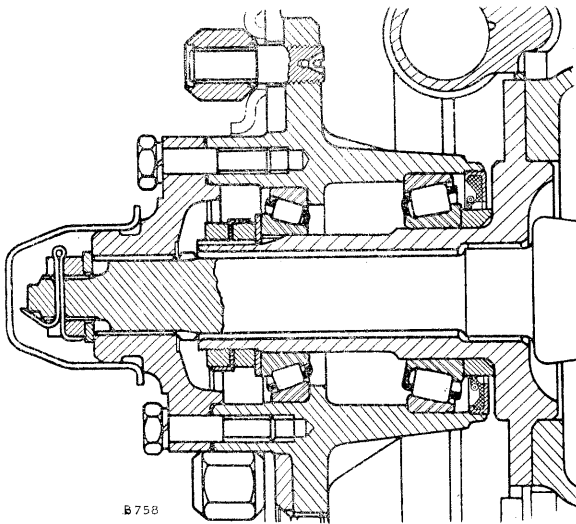


Fig. F-13—Cross-section of hub

jointing compound and press the seal into the hub with the knife edge towards the inner bearing until the oil seal face is flush with the rear face of the hub. If the seal is pressed too far in, the element will fail to register on the stub axle distance piece, so allowing oil to leak past and on to the brake linings.

5. Replace the complete hub on the stub axle, fit the thrust key washer adjusting nut, lock washer and locknut. Adjust the hub end-float and complete the assembly. Operation F/16.

#### Stub axle

##### To renew Operation F/22

1. Remove the front hub components. Operation F/18.
2. Remove the brake anchor plate and stub axle from the swivel pin housing; swing the anchor plate back to rest on the road spring, thus obviating bleeding the brakes on reassembly.
3. Remove the stub axle and discard if unserviceable.
4. If the original stub axle is to be replaced, examine the stub shaft bush at the inner end of the axle. The clearance of the shaft in the bush should be .020 to .028 in. (0,50 to 0,70 mm). Renew the bush if necessary and ream to 1.250 in. (31,75 mm). The road wheel studs are peened over and the peening should be filed away before withdrawing a faulty stud.
5. Ensure that the joint faces of the stub axle and swivel pin housing are clean and replace the stub axle with the keyway to the top.
6. Ensure that the joint face of the brake anchor plate is clean and secure it and the stub axle to the housing. Use only the correct lock plates with the securing bolts; spring or shakeproof washers will allow the passage of oil from the housing.
7. Complete the assembly. Operation F/20.

#### Universal joint housing assembly

*Note:* The half shaft, universal joint and stub shaft assembly can be withdrawn without disturbing the universal joint housing assembly.

#### Swivel pin housing oil seal

##### To renew Operation F/24

1. Jack up the front of the vehicle and remove the road wheel.
2. Depress the brake pedal and wedge it in that position; detach the flexible brake pipe at the wheel brake unit.
3. Drain off the axle and universal joint housing oil.
4. Disconnect the track rod and drag link (if applicable), from the steering arm.
5. Remove the universal joint housing assembly from the axle casing, taking care not to damage the axle casing oil seal.
6. Remove the swivel pin housing oil seal retainer, complete with seal. Discard the seal.
7. Examine the surface of the swivel pin bearing housing for signs of corrosion or damage, and renew if necessary. Operation F/44.
8. Pack the new oil seal with heavy grease and replace the retainer and the seal with the knife edge towards the swivel pins; ensure that the seal "wipes" the surface of the swivel pin bearing housing over its full range of travel. If not, adjust the position of the oil seal by slackening off the retainer bolts and resetting the seal as necessary.

For further details see Operation F/34.

9. Set the adjustable lock stop bolt so that the head of the bolt protrudes  $\frac{1}{8}$  in. (12,7 mm) from face of oil seal retainer. See Fig. F-26.
10. Complete the assembly by reversing the stripping procedure.
11. Bleed the brake system. Section H.
12. Refill the universal joint housing and axle with oil, 3 pints (1,75 litres) in the axle and 1 pint (0,5 litre) in each universal joint housing.

#### Stub shaft

##### To renew Operation F/26

1. Withdraw the stub shaft, universal joint and half shaft assembly. Operation F/36.
2. Disconnect the stub shaft from the spider journals. Operation F/28. Discard the shaft.
3. Connect the new stub shaft to the spider journals, Operation F/28, and complete the assembly, Operation F/42.

### Universal joint

#### To renew

#### Operation F/28

1. Withdraw the stub shaft, universal joint and half shaft assembly. Operation F/36.
2. Dismantle the universal joint as follows:—
3. Remove the circlip.

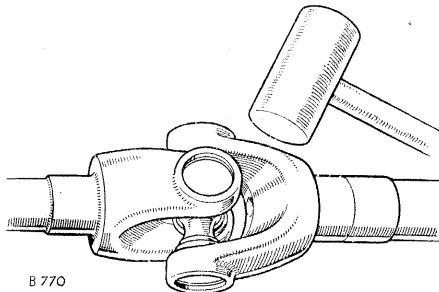


Fig. F-14—Removing a yoke bearing. Stage 1

4. With one of the stub shaft yoke lugs uppermost tap the radius of the yoke lightly with a soft-nosed hammer.

The top bearing should then begin to emerge from the yoke.

5. Turn the joint over and withdraw the bearing.

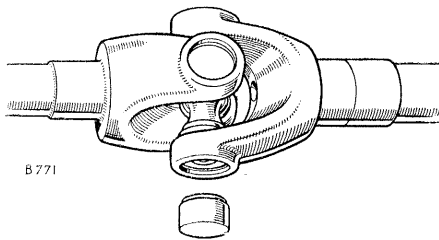


Fig. F-15—Removing a yoke bearing. Stage 2

Always remove a bearing downwards, to avoid dropping the needle rollers.

6. Repeat these operations for the opposite bearing.
7. Part the stub shaft from the spider journals.
8. Repeat Items 4 to 7 for the half shaft bearings.

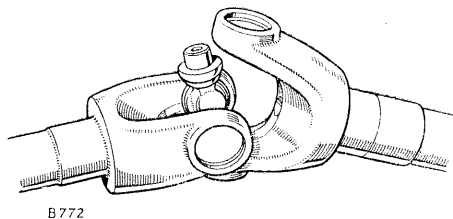


Fig. F-16—Removing the stub shaft

9. Wash all parts and renew as necessary.
10. The parts most likely to show signs of wear after long usage are the bearing races and the spider journals. Should looseness in the fit of these

parts, load markings or distortion be observed, they must be renewed complete, as oversize journals or bearing races are not supplied separately.

The bearing races should be a *light drive fit* in the yoke trunnions.

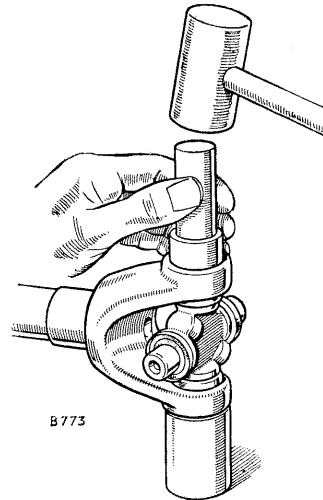


Fig. F-17—  
Replacing a yoke bearing

In the event of wear taking place in any of the four yoke cross holes, rendering them oval, a new stub shaft or half shaft must be fitted.

11. Assemble the needle rollers in the bearing races, if necessary using a smear of vaseline to retain them in place.
12. Insert the journal in the stub shaft yoke holes, and using a brass drift slightly smaller in diameter than the hole in the yoke, lightly tap the first bearing into position.
13. Repeat the operations for the other three bearings.
14. Replace the circlips and ensure that they are firmly located in their grooves. If the joint appears to bind, tap the ears slightly with a soft-nosed hammer.
15. Complete the assembly. Operation F/42.

### Swivel pins

#### To renew

#### Operation F/30

1. Remove the swivel pins. Operation F/32.
2. Thoroughly clean the boss of the steering lever or bracket with paraffin and a wire brush.
3. Drill out the grooved pin by means of a 1/8 in. (3,17 mm) drill.
4. Place the steering lever or bracket upon a solid base, i.e., between the jaws of a vice, and drive out the swivel pin from the lever or bracket boss by means of a brass drift.
5. **Top swivel pin only.** Fit the new pin, by positioning its splines in relation to the track rod



lever as shown at Fig. F-18, that is with a splined groove placed in line with the longitudinal axis of the track rod lever. This is very important as it ensures that the cone is located correctly.

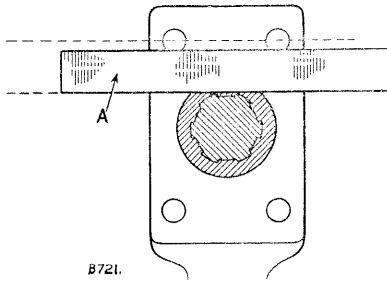


Fig. F-18—  
Setting the top  
swivel pin  
A—Straight edge

6. Press the pin squarely into the lever or bracket.
7. Drill the lever or bracket boss and swivel pin with a 5/32 in. (3,96 mm) drill and insert a 5/32 in. grooved pin.
8. Examine the cone bearing and cone seat for wear and roughness and renew as necessary. Operation F/34.
9. Examine the bottom taper roller race for wear and renew as necessary. Operation F/34.
10. Reassemble the universal joint housing assembly. Operation F/34.

#### Swivel pins and bearings

##### To strip Operation F/32

1. Remove the front hub components. Operation F/18.
2. Remove the brake anchor plate and stub axle from the swivel pin housing and swing the anchor plate back to rest on the road spring, thus obviating bleeding the brakes on re-assembly.
3. Disconnect the track rod and drag link (if applicable) from the steering arm.
4. Withdraw the stub shaft complete with universal joint and half shaft, taking care not to damage the oil seal in the end of the casing.  
Remove the universal joint housing assembly complete with joint washer, half shaft roller outer member and race from the axle casing. Remove the half shaft roller race outer member and race from the swivel pin bearing housing.
5. Remove the swivel pin housing oil seal retainer complete with seal.
6. Remove the swivel pin and steering lever assembly from the top of the swivel pin housing together with the shims, which should be preserved. Remove the cone bearing spring.
7. Remove the swivel pin and bracket assembly from the bottom of the swivel pin housing together with the shims which should be preserved.

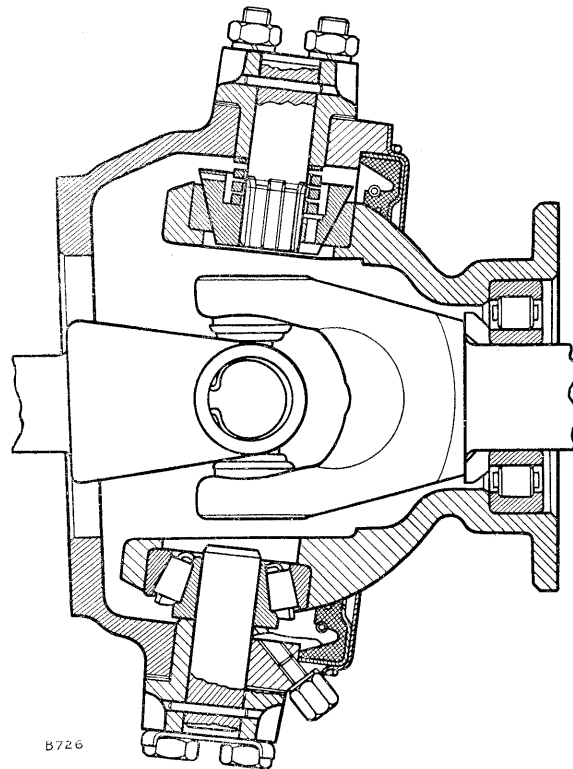


Fig. F-19—  
Cross-section of universal joint housing assembly

8. Part the swivel pin and swivel pin bearing housings and remove the roller race inner member and the cone bearing.
9. Drive out the race outer member and the cone seat from the swivel pin bearing housing.

##### To assemble Operation F/34

1. Examine the bottom taper roller race and swivel pin for wear and renew as necessary. The bearing should be a *light press fit* in the housing and a *light push fit* on the swivel pin. If a new bearing race is slack in the housing, the housing must be renewed; if it is slack on the swivel pin, the swivel pin assembly must be renewed. Operation F/30.
2. Examine the upper cone seat and swivel pin for wear and roughness and rectify as necessary. The cone seat should be a *light press fit* in the housing; if a new cone seat is slack in the housing, the housing must be renewed.
3. Examine the cone bearing for wear or roughness and rectify or renew as necessary.
4. Check the cone spring: free length 1.150 in. (2,92 mm) and renew as necessary.
5. Examine the surface of the swivel pin bearing housing for signs of corrosion or damage, and renew it if necessary.
6. Press the roller race outer member and cone seat squarely into the swivel pin housing as far as possible.

7. If necessary, renew the axle casing oil seal, by prising out the seal from the end of the axle casing. The new seal must be fitted with the knife edge inwards. For further details see Operation F/14.
8. Place the swivel pin housing oil seal and retainer over the axle casing flange, and fit the joint washer in position on the joint face of the flange.
9. Fit the half shaft roller race outer member and race in the swivel pin bearing housing and fit the housing to the axle casing flange.

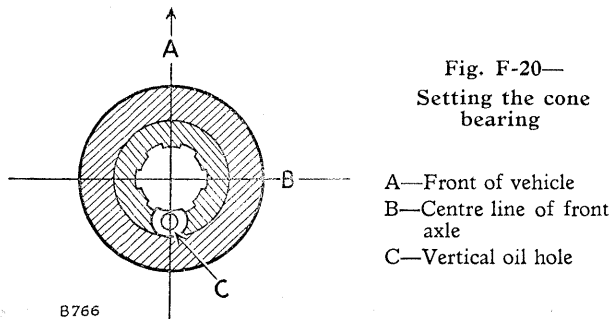


Fig. F-20—  
Setting the cone bearing

A—Front of vehicle  
B—Centre line of front axle  
C—Vertical oil hole

10. Insert the cone bearing after smearing with oil, with the vertical oil hole in the bearing towards the rear of the vehicle (Fig. F-20).
11. Insert the race inner member, and holding it in position, offer the swivel pin housing to the bearing housing.
12. Replace the swivel pin and bracket assembly at the bottom of the swivel pin housing, together with the shims removed on stripping, to the value of .040 in. (1,0 mm), and tighten down. Sharply tap the assembly to ensure positive seating and again check the tightness of the securing nuts.
13. Insert the cone spring in the top bearing.

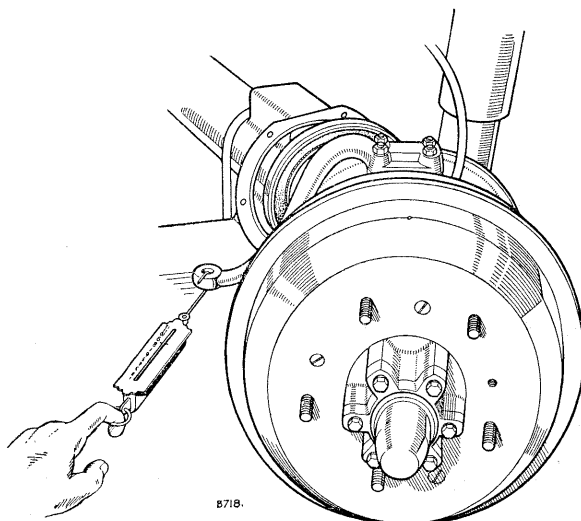


Fig. F-21—Checking swivel pin housing resistance to rotation

14. Fit the swivel pin and steering lever assembly at the top of the swivel pin housing, fitting the shims removed on stripping to the value of .040 in. (1,0 mm).

Note that the double steering lever is fitted to the L.H. assembly on R.H.D. models and to the R.H. assembly on L.H.D. vehicles.

15. Pull down the top swivel pin securing nuts in rotation until tight, then check the resistance to rotation of the steering lever.
16. Using a suitable spring balance as shown at Fig. F-21, add or subtract shims at the top only until a figure of 14-16 lb. (6,25-7,25 kg) is obtained.
17. Pack the swivel pin housing oil seal with heavy grease, and fit the seal and its retainer to the swivel pin housing.

Check that the oil seal wipes the full surface of the bearing housing and adjust the position, if necessary, by slackening off the retainer bolts and resetting the seal.

18. Check that there is a .050 in. (1,2 mm) clearance between the stub and half shaft yoke lugs and the swivel pin end faces. If the clearance is insufficient, increase the chamfer on the radius of the yokes.
19. Set the lock stop bolts, so that the head of the bolt protrudes  $\frac{1}{8}$  in. (12,7 mm) from face of oil seal retainer. See Fig. F-26.
20. Replace the half shaft, universal joint and stub shaft assembly, taking care not to damage the oil seal in the end of the casing.
21. Replace the stub axle and brake anchor plate. Operation F/22.
22. Reconnect the track rod and drag link (if applicable).
23. Replace the front hub components. Operation F/20.
24. Refill the universal joint housing with oil, 1 pint (0,5 litres).

#### Half shaft

##### To remove Operation F/36

1. Remove the front hub components. Operation F/26.
2. Remove the stub axle. Operation F/22.
3. Withdraw the stub shaft, universal joint and half shaft assembly from the universal joint housing assembly.

Note: There are two methods of stripping and assembling the half shafts.

##### Method A—Using hydraulic press

##### To strip Operation F/38

1. Stand the half shaft on its splined end and press down squarely on the conical distance piece, using press blocks, A, D, J and K (Part No. 245178) (Fig. F-22).

2. Remove the collar together with the roller race inner member and the conical distance piece. Discard the retaining collar.

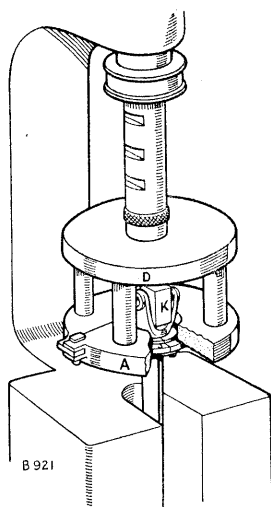


Fig. F-22—  
Stripping the half shaft

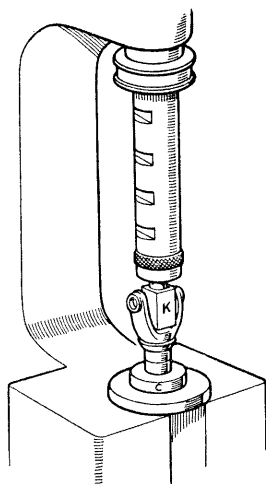


Fig. F-23—  
Assembling the half shaft

#### Method A—Using hydraulic press

##### To assemble

1. Examine the bearing for excessive wear. The bearing is a *light press fit* on the shaft and a *light push fit* in the housing. Examine the external surface of the swivel pin bearing housing for signs of corrosion or damage. Renew the bearing or housing as necessary.
2. Fit the conical distance piece over the half shaft with the internal chamfer to the radius on the shaft.
3. Place the roller race inner member and a new retaining collar over the half shaft with the chamfer towards the splined end; stand the shaft on end and press the race inner member and collar on to the shaft until the race inner member abuts the conical distance piece. The necessary press blocks C and K, Part No. 245178, are illustrated at Fig. F-23.
4. Connect the half shaft to the spider journals. Operation F/28.

#### Method B—Using extractor

##### To strip

##### Operation F/40

1. Clamp the extractor firmly in the vice.
2. Position the appropriate adaptor on the end of the axle shaft and insert into the extractor.
3. Secure the shaft to the extractor, using adaptor No. 5.
4. The shaft may now be forced out of the collar by screwing in the ram.

#### Method B—Using extractor

##### To assemble

1. Examine the bearing for excessive wear. The bearing is a *light press fit* on the shaft.

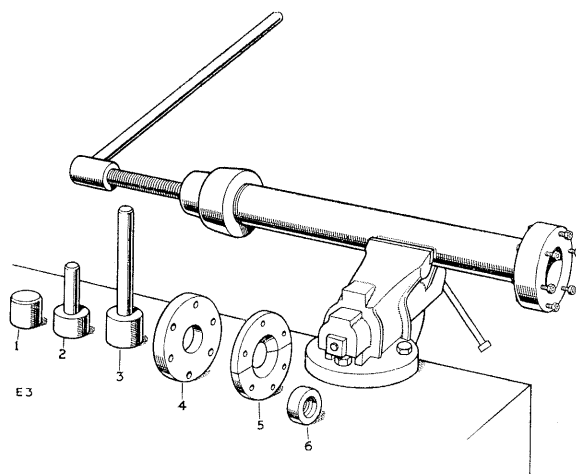


Fig. F-24—Hub removal tool and adaptor kit  
(Part No. 275870)

2. Fit the conical distance piece over the half shaft with the internal chamfer to the radius on the shaft.
3. Place the roller race inner member and a new retaining collar over the half shaft with the chamfer towards the splined end; stand the shaft on end on a block of hard wood.
4. Bolt adaptor No. 4 to the tool with the recess towards the collar.
5. The weight of the extractor is such that it may now be used as a ram to drive the collar on to the shaft.

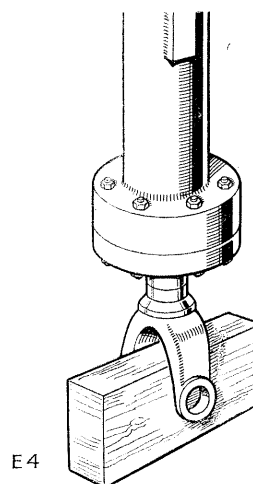


Fig. F-25—Extractor used as a ram to drive collar  
on to axle shaft

##### To refit

##### Operation F/42

1. If necessary, renew the axle casing oil seal, by prising out the seal from the end of the axle casing. The new seal must be fitted with the knife edge inwards. For further details see Operation F/14.

2. Replace the half shaft, universal joint and stub shaft assembly, taking care not to damage the axle casing oil seal.
3. Check that there is a .050 in. (1,27 mm) clearance between the stub and half shaft yoke lugs and the swivel pin end faces. If the clearance is insufficient, increase the chamfer on the radius of the yokes.
4. Replace the stub axle and brake anchor plate. Operation F/22.
5. Complete the assembly. Operation F/20.

#### Swivel pin bearing housing

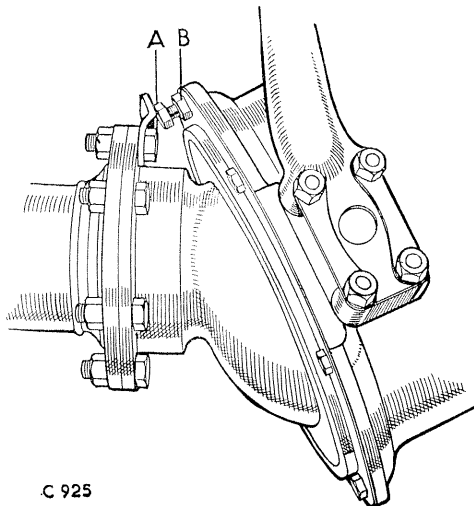
##### To renew Operation F/44

1. Remove and strip the universal joint housing assembly. Operation F/32.
2. Discard the housing.
3. Reassemble the universal joint housing and complete the assembly. Operation F/34.

#### Lock stop

##### To adjust Operation F/46

1. Slacken the stop bolt locknut(s).



C 925

Fig. F-26—Adjusting lock stop bolt

A—Lock stop bolt

B—Locknut

Distance between head of bolt and oil seal retainer  
 $\frac{1}{2}$  in. (12,7 mm)

2. Adjust the stop bolt so that the distance from the head of the bolt to the face of the oil seal retainer is correct.
3. Tighten the locknut.

#### Axle complete

##### To remove, method 1 Operation F/48

1. Jack up the front of the vehicle and place jacking stands under the chassis side member.
2. Remove both road wheels.

3. Depress the brake pedal and wedge it in that position; disconnect the flexible brake pipes at the wheel brake units.
4. Disconnect the drag link from the lower relay lever.
5. Disconnect the propeller shaft at the differential input flange.
6. Support the axle on a jack placed under the centre of the casing.
7. Remove the axle U-bolts; slacken the shock absorber fixing nuts and swing the spring bottom plates to the rear to allow full downwards movement of the springs.
8. Slacken the shackle pins at the rear end of the springs. Remove the self-locking nuts from the front shackle pins, and withdraw the shackle pins.
9. Remove the jack with the complete axle towards the front.

##### To remove, method 2 Operation F/50

An alternative method for removal eliminates removal of the shackle pins; proceed as follows:—

1. Jack up the front of the vehicle and place jacking stands under the chassis side members.
2. Remove the road wheels.
3. Drain off the universal joint housing and the axle oil.
4. Depress the brake pedal and wedge it in that position; detach the flexible brake pipes at the wheel brake units.
5. Disconnect the drag link and track rod from the steering arms and lower relay lever.
6. Withdraw each half shaft complete with joint washer, universal joint housing, hub and brake gear from the axle casing, taking care not to damage the axle casing oil seal.
7. Disconnect the propeller shaft at the differential input flange.
8. Remove the differential assembly. Operation F/4.
9. Remove the U-bolts and allow the road spring bottom plates to hang on the shock absorbers.
10. Remove the axle casing by manoeuvring it past the road springs.

##### To refit Operation F/52

1. Replace the axle assembly by reversing the removal procedure (Method 1 or 2).
2. Bleed the brake system. Section H.
3. Lower the vehicle off the jacking stands and refill the differential (3 pints, 1,75 litres) and universal joint housing (1 pint, 0,5 litres) with oil.

## DEFECT LOCATION

(Symptom, Cause and Remedy)

## A—VEHICLE PULLS TO ONE SIDE

1. Incorrect camber—*Check for worn bushes, settled road springs or damage to front axle unit.*
2. Incorrect or unequal castor and swivel pin inclination—*Check front wheel alignment. Check for damage to front axle unit and settled road springs.*
3. Uneven tyre pressures or worn tyres—*Renew tyres if necessary and check pressures. Section S.*
4. Dragging brake—*Adjust. Section H.*
5. Swivel pin tight—*Rectify or renew.*
6. Tight or dry front wheel bearings—*Inspect the wheel bearings for damage; adjust and check oil level.*
7. Incorrect toe-in on front wheels—*Adjust.*

## B—VEHICLE WANDERS

1. Incorrect castor—*Check for worn bushes and damage to front suspension and axle unit; check for settled road springs.*
2. Incorrect toe-in—*Adjust.*
3. Worn swivel pins and bearings—*Renew.*
4. Worn front wheel bearings—*Renew.*
5. Tight steering assembly—*Adjust. Section G.*
6. Bent or broken frame—*Examine frame for damage. Section K.*
7. Loose axle "U" bolts—*Tighten.*
8. Unequal tyre pressures—*Section S.*
9. Unequal tyre wear—*Section S.*

## C—WHEEL SHIMMY

1. Excessive castor—*Check for worn bushes and damage to the front axle or suspension; check for settled road springs.*
2. Worn ball joints—*Renew.*
3. Insufficient damping at relay unit—*Section G.*
4. Worn or loose front wheel bearings—*Adjust or renew.*
5. Steering column loose on dash—*Section G.*
6. Out-of-balance wheels—*Check, balance. Section S.*

7. Worn swivel pins and bearings—*Renew.*
8. Eccentric wheels and tyres—*Rectify or renew.*
9. Under-inflation of front tyres—*Section S.*
10. Unequal inflation—*Section S.*
11. Loose engine mountings—*Rectify or renew.*
12. Worn universal joint—*Renew. Section D.*
13. Faulty hydraulic dampers—*Renew.*
14. Insufficient damping at swivel pins—*Adjust.*

## D—EXCESSIVE TYRE WEAR

1. Incorrect camber—*Check for worn bushes, settled road springs or damage to front axle unit.*
2. Incorrect toe-in—*Adjust.*
3. Incorrect tyre inflation—*Section S.*
4. Fast cornering—*In the hands of the operator.*
5. Wheel wobble—*Renew wheel and tyre assembly as necessary.*
6. Worn swivel pins—*Renew.*
7. Harsh or unequal brakes—*Section H.*
8. Sustained high speed driving—*In the hands of the operator.*
9. Failure to rotate tyres—*Change position of tyres, including spare—Section S.*

## E—FRONT END NOISY

1. Looseness in front suspension—*Retighten and check all mountings for wear; renew as necessary. Check the front wheel alignment.*
2. Front hydraulic damper noisy—*Check damper mounting bushes for wear. If the damper itself is noisy, renew. Section J.*
3. Worn bushes—*Renew.*

## F—OIL LEAKS

1. Loose drain plug—*Tighten.*
2. Worn oil seals—*Replace.*
3. Damaged joint washer—*Replace.*

## GENERAL DATA

Type:	..... Fully floating	Differential oil capacity	3 Imperial pints (1,75 litres)
Final drive	..... Spiral bevel		
Angularity of universal joint on full lock	..... 26°	Universal joint housing oil capacity	..... 1 Imperial pint (0,5 litre)

## DETAIL DATA

Swivel pin setting:	..... Resistance of 14-16 lb. (6,25-7,25 kg) at steering lever eye	Differential pinion input flange: tightening torque	..... 85 lb./ft. (11,75 mKg)
Clearance between stub and half shaft yoke lugs and swivel pin end faces.....	..... .050 in. (1,27 mm)	Crownwheel fixing bolts, tightening torque	..... Standard .375 in. (9,5 mm) bolts 35 lb./ft. Special .390 in. (10 mm) bolts 45 lb./ft.
Cone spring:		Pinion thrust bearing pre-load	..... Adjust to give a torque of 6 to 10 in./lb. (0,069 to 0,115 mKg) on the pinion shaft
Number of working coils	..... Three	Crownwheel bearing pre-load	..... .005 in. (0,13 mm)
Free length	..... 1.150 in. $\pm$ .010 (29,2 mm $\pm$ 0,25)	Distance from crownwheel axis to pinion face	..... 3.000 to 3.002 in.
Length in position	..... .687 in. (17,4 mm)		
Rate	..... 660 lb/in. (7,5 mKg)		
Fit of retaining collar on shaft	..... .001 in. (0,025 mm) interference (selective assembly)		
Differential assembly:		Front hub and stub axle assembly:	
Pinion teeth	..... 10	Front hub end-float	..... .004 to .006 in. (0,10 to 0,15 mm)
Crownwheel teeth	..... 47	Clearance between stub shaft and stub axle bush	..... .020 to .028 in. (0,50 to 0,70 mm)
Ratio	..... 4.7 to 1	Stub axle bush bore	..... 1.250 in. + .004 (31,75 mm + 0,10)
Backlash: crownwheel to pinion.....	..... .008 to .010 in. (0,20 to 0,25 mm) at the tightest point		
Backlash: differential wheels to differential pinions	..... Minimum but definite backlash		



# Section G

## STEERING UNIT AND LINKAGE — ALL MODELS

### INDEX

	Page		Page
Ball joints .....	G-8	Assembling .....	G-6
Defect location .....	G-10	Fitment .....	G-8
Detail data .....	G-10		
Drag link .....		Steering unit .....	
Renewal .....	G-8	Removal .....	G-1
Drop arm .....		Fitment .....	G-3
Removal .....	G-1	Dismantling .....	G-1
Fitment .....	G-3	Assembling .....	G-2
General data .....	G-10		
Longitudinal steering arm .....		Steering wheel .....	
Removal .....	G-8	Removal .....	G-1
Replacement .....	G-8	Fitment .....	G-3
Steering kick or wheel wobble .....	G-9		
Steering relay unit .....		Track rod .....	
Removal .....	G-3	Renewal .....	G-8
Stripping .....	G-6		
		Wheel alignment .....	G-8

### LIST OF ILLUSTRATIONS

Fig.		Page	Fig.		Page
G-1	Sectional view of steering column, top	G-2	G-5	Relay unit .....	G-6
G-2	Relative position of cam, bearings and main nut .....	G-2	G-6	Compressing steering relay spring .....	G-6
G-3	Sectioned view of rocker shaft and steering box .....	G-3	G-7	Assembling steering relay shaft assembly .....	G-7
G-4	Layout of steering column and linkage .....	G-4	G-8	Compressing steering relay spring .....	G-7
			G-9	Replacing steering relay shaft and bushes in housing .....	G-8

#### Steering unit

##### To remove

##### Operation G/2

1. Unscrew the clamp bolt and withdraw the steering wheel.
2. Disconnect the clamp securing the horn switch and support bracket to the steering outer column, then remove the assembly complete with leads.
3. Remove the spare wheel if mounted on bonnet, disconnect the support and lift the bonnet clear.
4. R.H.D. models only—Remove the air cleaner.
5. Remove the name plate and withdraw the radiator grille.
6. Loosen the bolt securing the upper relay lever to the relay unit and prise the lever clear.
7. Turn the road wheels to allow the longitudinal steering arm to move fully forward, then slacken the clamping bolt nearest the drop arm and unscrew the longitudinal arm complete with relay lever.
8.  $2\frac{1}{4}$  Litre Petrol R.H.D.: disconnect the accelerator control linkage.
9. Remove the bolts securing the steering support bracket to chassis side-member, scuttle and wing valance.

10. The support clip, rubber strip, support brackets and seal must now be removed from the dash.

11. Withdraw the steering unit complete with support plate, drop arm and ball joint from under the front wing.
12. Remove the securing screw and extract the drop arm, using special tool (Part No. 262776).
13. Unscrew the castellated nut and remove the ball joint from drop arm by tapping the side adjacent to taper smartly with a hammer.

#### Steering unit—to dismantle      Operation G/4

1. Remove the side cover and drain off the oil.
2. Lift off the main nut, roller, and withdraw the rocker shaft.
3. With the outer column held in a vice, unscrew the nuts holding the steering box and tap the inner column at the steering wheel end with a hide-faced hammer to partially remove the box.
4. Withdraw the box and inner column complete. The dust cover at the top of steering column will be freed by this last operation and care must be taken to ensure that this or balls from the steering box are not inadvertently lost.



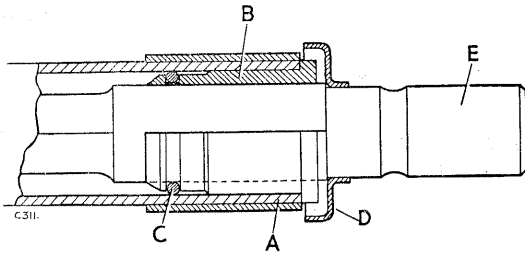


Fig. G-1—Sectioned view of steering column top

A—Column outer tube      C—Seal  
B—Tufnol bush              D—Dust cover  
E—Inner shaft

5. Make provision for catching the balls, and with a hide-faced hammer, gently tap the box away from the inner column sufficiently to remove the outer ball race.

The main nut should be positioned approximately midway on the cam during this operation.

6. Turn the inner column to unscrew the main nut assembly and withdraw the column completely from the steering box. Remove the main nut assembly.

7. Remove the end cover, shims, ball race and any balls that may have dropped into the steering box.
8. The ball transfer tube may be removed from the main nut.
9. If oil leakage and bearing wear is excessive, remove the retaining washer, oil seal and press out the bush from steering box.
10. Remove the bush and seal from top of outer of column, if excessively worn.

#### Steering unit, to assemble      Operation G/6

1. Press the Tufnol bush with oil seal into the top outer steering column tube.
2. If removed fit the rocker shaft bush to the steering box.
3. Locate the rocker shaft seal and retaining washer.
4. Grease a suitable shim and two paper washers each side of the shim, to the flange on the outer column, then mount the outer column in a vertical position in a vice (Tufnol bush downwards).

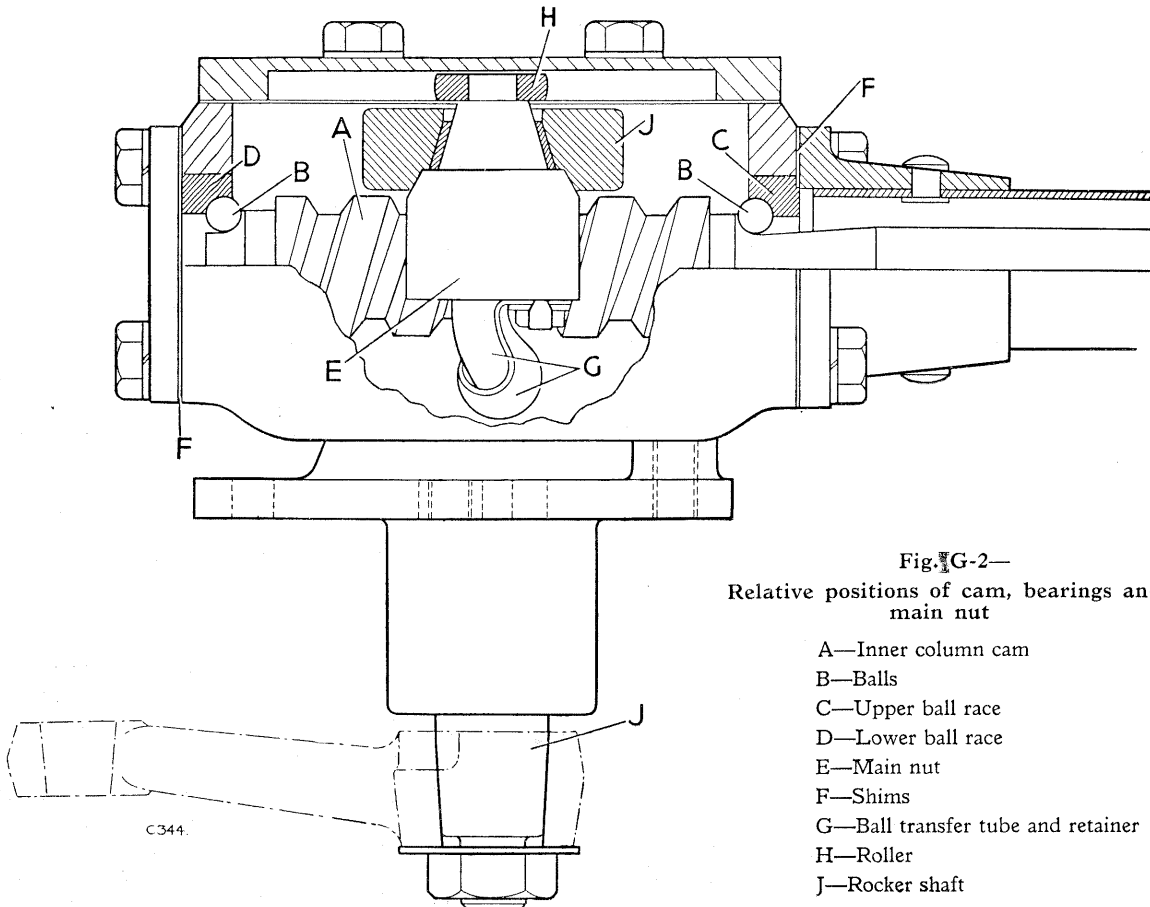


Fig. G-2—  
Relative positions of cam, bearings and main nut

A—Inner column cam  
B—Balls  
C—Upper ball race  
D—Lower ball race  
E—Main nut  
F—Shims  
G—Ball transfer tube and retainer  
H—Roller  
J—Rocker shaft

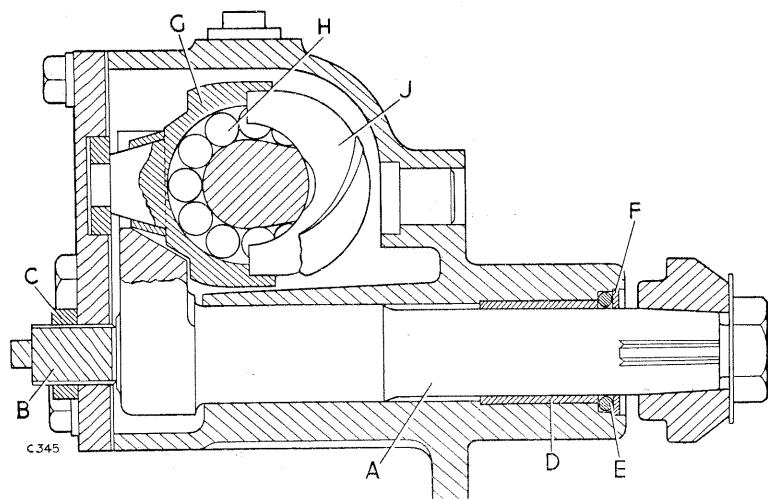
5. Place one of the ball races less ball bearings over the inner column and slide the inner column into the outer column and Tufnol bush, ensuring it is free to rotate. Lift the inner column a little, grease the ball race and load with ten ball bearings, ensuring that none fall down the inside of the outer column.
6. Assemble the main nut, replacing balls as necessary and retain them in position with grease. Locate the assembly in steering box and lower on to the cam end of the inner column.
7. Carefully rotate the inner column, ensuring that the ball bearings in the main nut are not dislodged, and the steering box is up the correct way. (Filler plug towards the outer column.)
8. Grease the lower ball race and load with ten ball bearings, carefully insert the race into the steering box and locate on the inner column, ensuring that none of the ball bearings are dislodged.
9. Locate the shims, joint washer and end cover, then carefully tighten. The column may now be positioned horizontally.  
The inner shaft should have **no** end-float, but to ensure that the bearings are not over-stressed, sufficient shims must first be fitted to allow an end-float reading and then shims equivalent in thickness to this reading, be removed.
10. Replace the rocker shaft, roller, joint washer and cover, ensuring that the roller is correctly located in the cover slot.
11. With the main nut at mid-position on cam, tighten the adjusting screw on side cover by hand until resistance is felt as it contacts the rocker shaft; tighten a further tenth of a turn and lock the adjusting screw.
12. Refit the dust cover to top end of steering column.

**Steering unit, to refit****Operation G/8**

1. Refit the support plate to chassis side-member, scuttle and wing valance.
2. Mount the steering unit less drop arm, then secure at dash and, using internal type shake-proof washers, support plate. Refit the horn switch and bracket assembly.
3. Turn the inner steering column lock to lock and select the intermediate position.
4. Replace the steering wheel with one series of spokes pointing forward and secure.
5. Screw the ball joint into the longitudinal arm and lock in the original position.
6. Fit the longitudinal arm complete with upper relay lever to the drop arm and insert the assembly along the top of chassis side-member. Connect the upper relay lever to relay unit.
7. With the front wheels positioned "straight ahead" and the steering wheel in the **intermediate** position, fit the drop arm to the rocker shaft. The longitudinal arm may require adjusting slightly to align the splines of drop arm and steering rocker shaft.
8. Check the steering, lock to lock, for correct functioning. Adjust if necessary by altering the length of the longitudinal arm.

**Steering relay unit****To remove****Operation G/10**

1. **R.H.D. models:** Remove the air cleaner and battery.
2. **Diesel models L.H.D.:** Remove battery on left-hand side.
3. Remove the bolts securing the radiator grille panel to the front wings.



- A—Rocker shaft
- B—Adjusting screw—rocker shaft
- C—Locknut
- D—Rocker shaft bush
- E—Rocker shaft seal
- F—Seal retainer
- G—Main nut
- H—Main nut balls
- J—Transfer tube

**Fig. G-3—Sectioned view of rocker shaft and steering box**

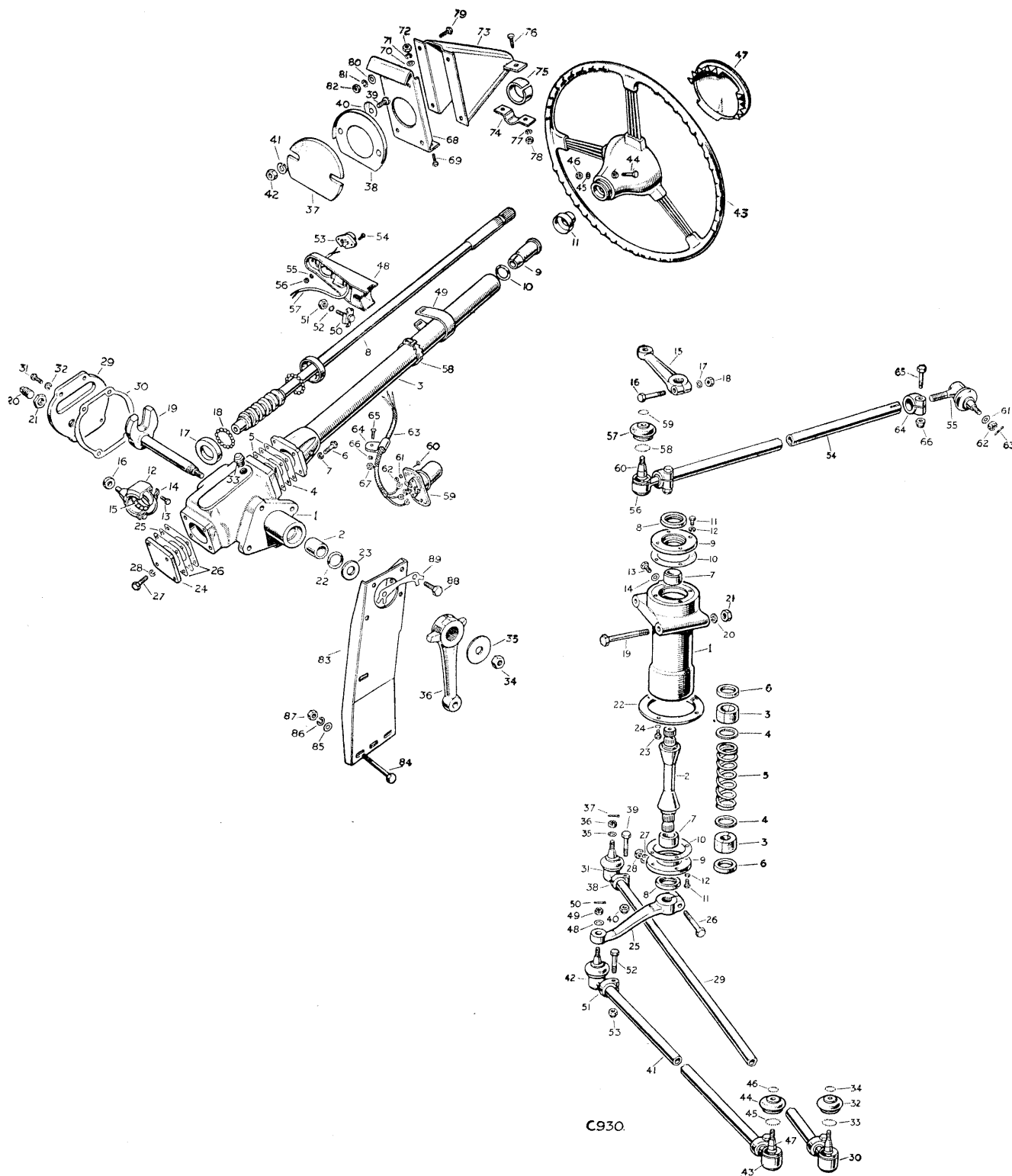


Fig. G-4—Layout of steering column and linkage

## Key to Fig. G-4

## Steering unit, wheel and drop arm

- |       |                                   |       |   |
|-------|-----------------------------------|-------|---|
| 1     | Steering box assembly             | 36    | Steering drop arm                               |
| 2     | Bush for rocker shaft             | 37    | Rubber seal for steering column                 |
| 3     | Outer column                      | 38    | Cover for steering column seal                  |
| 4     | Joint washer, steel               | 39-42 | Fixings—cover and seal to dash                  |
| 5     | Joint washer, paper               | 43    | Steering wheel                                  |
| 6-7   | Fixings—for outer column          | 44-46 | Fixings—for steering wheel                      |
| 8     | Inner column                      | 47    | Steering wheel centre cover                     |
| 9     | Bush for inner column             | 48    | Horn push bracket                               |
| 10    | Spring ring for inner column bush | 49    | Clip for horn push bracket                      |
| 11    | Dust shield for inner column      | 50    | Yoke assembly for push bracket                  |
| 12    | Main nut assembly                 | 51-52 | Fixings—for horn push bracket                   |
| 13-14 | Fixings—for retainer              | 53    | Horn push                                       |
| 15    | Steel ball for main nut           | 54-56 | Fixings—horn push to bracket                    |
| 16    | Roller for main nut               | 57    | Lead, horn push to junction box                 |
| 17    | Adjustable ball race              | 58    | Cable cleat on steering column                  |
| 18    | Steel balls for adjustable race   | 59    | Dip switch                                      |
| 19    | Rocker shaft                      | 60-62 | Fixings—for dip switch                          |
| 20    | Adjuster screw for rocker shaft   | 63    | Lead, dip switch to junction box                |
| 21    | Locknut for adjuster screw        | 64    | Clip fixing dip switch lead to floor            |
| 22    | Oil seal for rocker shaft         | 65-67 | Fixings—for clip                                |
| 23    | Washer for rocker shaft oil seal  | 68    | Support bracket on dash                         |
| 24    | End plate                         | 69-72 | Fixings—support bracket to dash                 |
| 25    | Joint washer, steel               | 73    | Support bracket for steering column             |
| 26    | Joint washer, paper               | 74    | Clip for steering column                        |
| 27-28 | Fixings—for end plate             | 75    | Rubber strip for clip                           |
| 29    | Side cover plate                  | 76-78 | Fixings—clip to support bracket                 |
| 30    | Joint washer for side cover plate | 79-82 | Fixings—support bracket to dash bracket         |
| 31-32 | Fixings—for side cover plate      | 83    | Support bracket—steering box on chassis         |
| 33    | Oil filler plug                   | 84-87 | Fixings—bracket to chassis frame                |
| 34-35 | Fixings—for drop arm              | 88-89 | Fixings—steering box to chassis support bracket |

## Relay unit and steering arms

- |       |                                 |       |   |
|-------|---------------------------------|-------|---|
| 1     | Housing for relay shaft         | 34    | Spring ring and retainer, cover to ball |
| 2     | Shaft for steering relay levers | 35-37 | Fixings for ball joints                 |
| 3     | Split bush for housing          | 38    | Clip for ball joint                     |
| 4     | Washer for spring               | 39-40 | Fixings for ball joint clips            |
| 5     | Spring for bushes               | 41    | Steering drag link assembly             |
| 6     | Thrust washer for shaft         | 42    | Ball joint assembly R.H. thread         |
| 7     | Distance piece for shaft        | 43    | Ball joint assembly L.H. thread         |
| 8     | Oil seal for shaft              | 44    | Rubber cover for ball joint             |
| 9     | Retainer for oil seal           | 45    | Spring ring, cover to body              |
| 10    | Joint washer for retainer       | 46    | Spring ring } Cover                     |
| 11-12 | Fixings for retainer            | 47    | Retainer } to ball                      |
| 13    | Plug for oil hole               | 48-50 | Fixings for ball joints                 |
| 14    | Joint washer for plug           | 51    | Clip for ball joint                     |
| 15    | Relay lever, upper              | 52-53 | Fixings for ball joint clips            |
| 16-18 | Fixings for lever               | 54    | Longitudinal steering tube assembly     |
| 19-21 | Fixings for housing             | 55    | Ball joint assembly R.H. thread         |
| 22    | Flange plate for relay mounting | 56    | Ball joint assembly L.H. thread         |
| 23-24 | Fixings for flange plate        | 57    | Rubber cover for ball joint             |
| 25    | Relay lever, lower              | 58    | Spring ring, cover to body              |
| 26-28 | Fixings for lever               | 59    | Spring ring } Cover                     |
| 29    | Steering track rod assembly     | 60    | Retainer } to ball                      |
| 30    | Ball joint assembly R.H. thread | 61-63 | Fixings for ball joints to levers       |
| 31    | Ball joint assembly L.H. thread | 64    | Clip for ball joint                     |
| 32    | Rubber cover for ball joint     | 65-66 | Fixings for ball joint clips            |
| 33    | Spring ring, cover to body      |       |   |

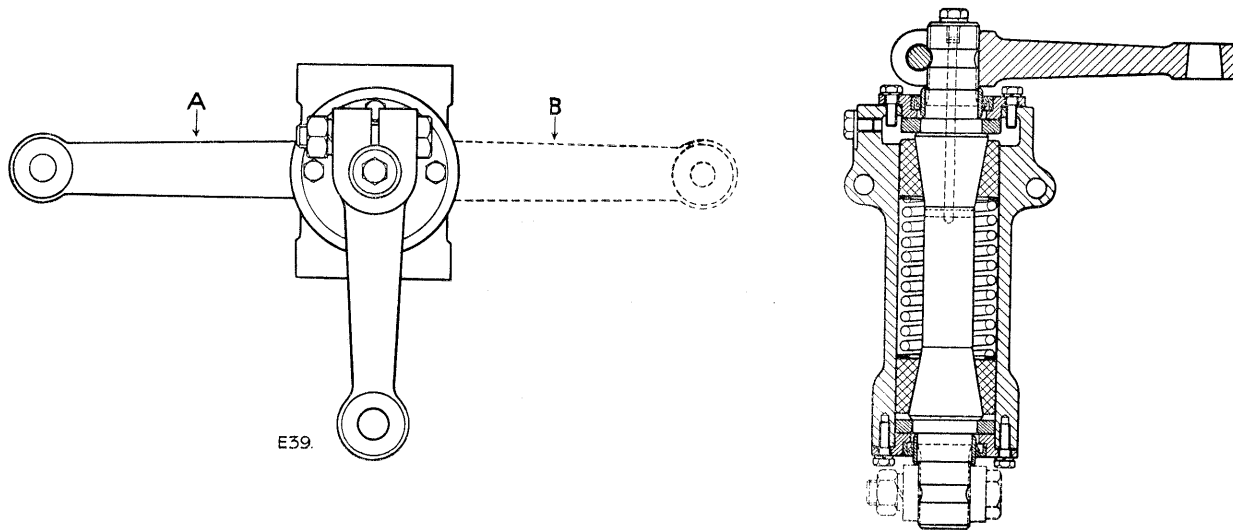


Fig. G-5—Relay unit

A—Lower relay lever, L.H.D. vehicles

B—Lower relay lever, R.H.D. vehicles

4. Remove the bolts securing the grille panel to the chassis frame; remove the front apron panel; when the bolts are clear, the rubber packing pieces between the panel and frame may also be withdrawn. It will now be possible to move the radiator assembly slightly to assist in the removal of the relay unit, but care must be taken to prevent damage to the coolant hoses.
5. Raise the upper relay lever slightly to allow the ball joint pin to clear the lever; disconnect the longitudinal tube ball joint from the upper relay lever.
6. Detach the lower relay lever from the relay unit shaft.
7. Remove the relay unit upwards, tapping gently with a hide-faced hammer, if necessary. The flange plate can be left in position on the underside of the chassis cross-member.

**To strip****Operation G/12**

1. Remove the upper relay lever.
2. Drain off as much oil as possible by removing the oil filler and bleed plugs.
3. Remove the bottom plate complete with oil seal and joint washer.
4. Remove the brass thrust washer.
5. Cover the bottom end of the shaft by tying a sock to the relay body and carefully tap out the shaft, spring and Tufnol bush into the sock. The spring is compressed to over 100 lb. in position, and will cause serious damage if care is not exercised. If possible retain the split bushes in mated pairs.
6. Remove the bottom end plate and brass thrust washer.

**To assemble****Operation G/14**

1. Examine the oil seals in the end caps and renew them if damaged. Examine the distance pieces on the shaft (which form tracks for the oil seals) for damage which may have caused failures of the seals; renew them as necessary.
2. Renew the split Tufnol bushes if worn or damaged.
3. Check the spring in accordance with given data. Renew the spring if necessary.
4. Fit the top end plate and joint washer to the housing.

There are two methods of assembling the relay unit.

**Method A**

1. Fit one split bush to the taper on the shaft and secure tightly with a suitable 2 in. hose clip (Part No. 50320).

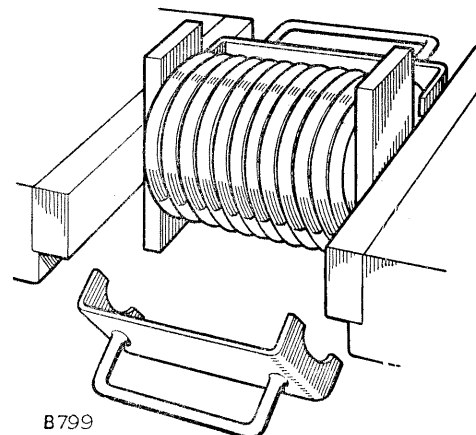


Fig. G-6—

Method of compressing steering relay spring

2. Hold a suitable bar (Part No. 262768) over each end of the spring and compress it to a length of 3 in. (75 mm) in a vice, with the bars central and vertical. Place a suitable clip (Part No. 262769) over each side of the spring, as shown at Fig. G-6. Release the vice and remove the spring and clips complete.
3. Slide a washer over the shaft and fit the spring to the shaft so that it abuts the washer and bush.
4. Slide a second washer over the shaft and fit the second split bush to the shaft, securing it with a hose clip as for the first one (Fig. G-7).

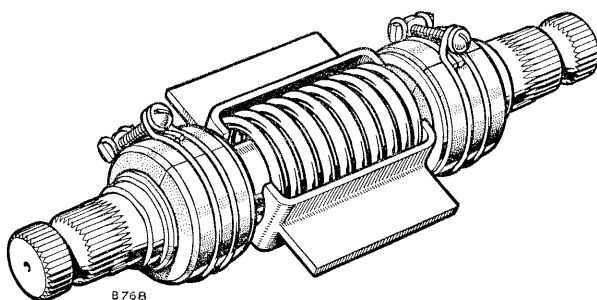


Fig. G-7—Assembling steering relay shaft assembly

5. Remove the clips retaining the spring, slide the lower brass thrust washer over the top end of the shaft and carefully enter the assembly, top end first, into the housing; push the shaft into the housing, up towards the bleed plug end, so leaving the first hose clip free. Remove the clip and push the shaft home; release the second hose clip. See Fig. G-9.
6. Fit a thrust washer to the bottom end of the shaft and fit the end cap and joint washer.
7. Fit the upper relay lever.
8. Fill the housing with oil, and fit the filler and bleed plugs and joint washers.
9. If the assembly is in order, it should need a force of at least 12 lb. (5,5 kg) to turn the relay lever and shaft, using a spring balance in the relay lever boss.

#### Method B

1. Examine all parts and renew as necessary.
2. Fit the top end plate and joint washer to the housing.
3. Fit one split bush to the taper on the bottom end of the shaft, and secure tightly with a suitable 2 in. hose clip (Part No. 50323).
4. Place a steel washer on to the shaft, next to the inner side of the Tufnol bush.
5. Place the spring over the shaft and insert the special tool (Part No. 510309) through the coils of the spring and right through the lubrication cross-drilling in the shaft. See Fig. G-8.

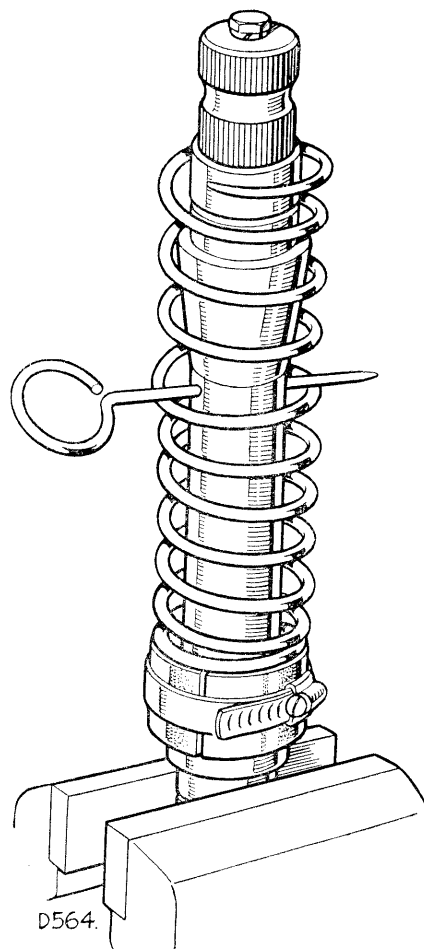


Fig. G-8—Compressing steering relay spring

6. The spring can now be wound down the tool until the steel washer and the split Tufnol bush can be secured to the taper on the other end of the shaft with a hose clip.
7. Remove the special tool (Part No. 510309).
8. Place a brass thrust washer on the top end of the shaft, lubricate the shaft and insert into the housing.
9. With a plastic hammer gently tap the shaft into the housing until the first hose clip slides off the Tufnol bush, remove the clip completely from the shaft. See Fig. G-9.
10. Continue to tap the shaft into the housing until the second clip is freed and the shaft abuts the top end cover.
11. Fit the bleed and filler plugs, fill the unit with oil, replace the bottom end thrust washer, joint washer, end cover and tighten the retaining bolts.
12. Fit the upper relay lever.
13. If the unit is in order, it should require a force of at least 12 lb. (5,5 kg) to turn the relay shaft, using a spring balance in the relay lever boss.

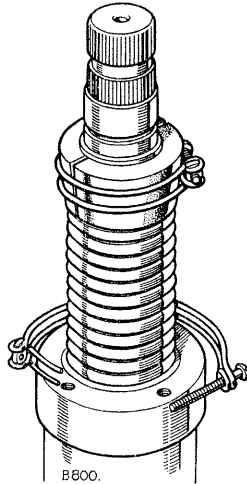


Fig. G-9—  
Replacing  
steering relay  
shaft and  
bushes in  
housing

#### Steering relay, to refit Operation G-15

1. Reverse removal procedure. The lower relay lever must be fitted as illustrated at Fig. G-5.

#### Longitudinal steering arm

##### To remove Operation G/16

1. Remove spare wheel, if mounted on bonnet; disconnect the support and lift the bonnet clear.
2. **R.H.D. models:** Remove air cleaner and battery.
3. **Diesel models L.H.D.:** Remove battery on left-hand side.
4. Remove the radiator grille, loosen the clamping bolt securing the upper relay lever and prise the lever off the relay unit.
5. Turn the steering wheel to allow the longitudinal steering arm to move fully forward, loosen the clamping bolt nearest to drop arm and unscrew the longitudinal arm complete with relay lever. Withdraw the assembly from the front of vehicle.
6. Unscrew the castellated nut securing the ball joint to the drop arm, then with a solid metallic object on one side of the drop arm adjacent to the taper, tap the other side with a hammer to loosen the ball joint.
7. Turn the steering wheel to move the drop arm rearwards and remove the ball joint.

##### Drag link or track rod, to remove

##### Operation G/18

Disconnect the track rod ball joints from the steering levers by tapping smartly around the eye of tapered pin.

##### Ball joints, to check

##### Operation G/19

The steering ball joints have been designed in such a way as to retain the initial filling of grease for the normal life of the ball joint; however, this applies only if the rubber boot remains in position

on the joint. The rubber boots should be checked every 3,000 miles (5,000 km) to ensure that they have not become dislodged or the joint damaged. Should any of the rubber boots be dislodged, proceed as follows—

- (a) Remove the ball end from the drop arm lever by tapping smartly around the eye of the pin.

If necessary unscrew the ball joints from the steering rods, noting that there is one left-hand and one right-hand threaded ball joint to each steering rod.

- (b) Remove the rubber boot.
- (c) Thoroughly clean all parts.
- (d) Place the castle nut upside down on the pin and screw on a few threads, then place the ball joint under a press or between the jaws of a vice and carefully force the pin and ball down against the spring. In this position the interior of the ball joint can be cleaned and lubricated.
- (e) Apply grease around the taper, and fill the rubber boot.
- (f) Reassemble, using new rubbers and spring rings as required.

#### Steering linkage, to replace Operation G/20

- (g) When refitting steering linkage and ball joints to the steering arms, ensure that the ball joints are aligned with each other, in order to allow full unrestricted movement of the steering linkage.

#### Wheel alignment

##### To check and adjust

##### Operation G/22

1. No adjustment is provided for castor, camber or swivel pin inclination.
2. The toe-in is adjustable; proceed as follows:
3. Set the vehicle on level ground with the road wheels in the straight-ahead position, and push it forward a short distance.
4. Measure the toe-in with the aid of a tracking stick or suitable proprietary equipment; it should be  $\frac{3}{64}$  in. to  $\frac{3}{32}$  in. (1,2 mm to 2,4 mm).
5. If correction is required to the toe-in, slacken the clips securing the ball joints to the track rod and turn the rod to decrease or increase its effective length as necessary, until the toe-in is correct.
6. Tighten the ball joint clips.

**Steering kick or wheel wobble****Operation G/24**

In many cases the swivel cone bearing springs are being fitted in an attempt to cure steering wheel kick, but replacement is actually seldom required and will by itself not normally cure such a complaint.

A certain amount of kick is experienced over rough surfaces, but where this is excessive or if actual wheel wobble should be reported the following checks must be carried out.

Only after these checks have failed to reveal the cause, should the cone bearing springs be examined.

**Checks:**

- (i) Ensure that the bolts securing the steering box to its mounting bracket, and the bolts securing the bracket to the frame, are tight. Also ensure that the stiffener bracket is fitted.
- (ii) Check the steering box adjustment.
- (iii) Check for tightness the nuts securing drop arm to rocker shaft and nuts securing ball joints to track rods and steering arms.
- (iv) Check the ball joints for excessive wear and renew as necessary.
- (v) Check the relay top and bottom lever clamp bolt for tightness and check for wear on lever and shaft splines. Rectify any play in the relay unit.
- (vi) The through bolts securing relay to chassis must be checked for tightness, also the four bolts at the bottom plate of the relay. Check the bolt flanges for cracking and check the fit of the bottom of the relay in the spigot.
- (vii) The nuts and studs securing the steering arms must be checked, and ensure that the one special "fitting" stud on each side is a tight fit and that it positively locates the arm.
- (viii) Check shock absorber action, replace if weak. Examine the rubber bushes and replace as necessary. Check shackle pins and bushes for wear and tighten the spring 'U' bolts. Ensure that the spring location bolt has not sheared and that its seating hole is not elongated.
- (ix) Check all the spring leaves, either side of the centre bolt, for breakage.
- (x) Check the front wheel alignment.
- (xi) Check the road wheels for out-of-balance and rectify as necessary.
- (xii) Check the swivel pin poundage figure. Check for cone and spline wear.
- (xiii) Check for badly or unevenly worn tyres. Similar tread pattern tyres should be fitted. Check the pressures. (Normal road condition —25 lb/sq.in. (1,7 kg/cm<sup>2</sup>) all round.)
- (xiv) While the vehicle is on ramp or pit, it is a good plan to examine the chassis members and axle casing for accident damage.



## DEFECT LOCATION

(Symptom, Cause and Remedy)

**A—EXCESSIVE LOOSENESS OR BACKLASH IN THE STEERING**

1. Steering rocker shaft incorrectly adjusted or badly worn—*Adjust or renew.*
2. Steering linkage loose or worn—*Rectify or renew.*
3. Swivel pins and bearings loose or worn—*Section F.*
4. Loose or worn front wheel bearings—*Section F.*
5. Steering box securing bolts loose—*Tighten, and ensure that the unit is secured to the mounting bracket with internal type shakeproof washers.*

**B—TIGHT STEERING**

1. Low or unequal tyre pressures—*Section S.*
2. Steering box oil level low—*Replenish.*
3. Steering rocker shaft adjusted too tightly—*Adjust.*

**C—RATTLE IN STEERING COLUMN**

1. Steering rocker shaft incorrectly adjusted or badly worn—*Adjust or renew.*

**D—VEHICLE PULLS TO ONE SIDE**

1. Section F.

**E—VEHICLE WANDERS**

1. Section F.

**F—WHEEL SHIMMY**

1. Section F.

## GENERAL DATA

Type ..... Re-circulating ball  
 Ratio: Straight ahead 15.6 : 1  
 Full lock .... 23.8 : 1

Inner column end-float ..... Nil  
 Rocker shaft end-float ..... Nil  
 Number of turns of steering wheel from lock to lock.... 3.3

## DETAIL DATA

**Relay shaft clearances**

in bushes ..... .003 to .0045 (0,08 to 0,12 mm)

**Longitudinal steering tube****Ball joints**

Type ..... Non-adjustable; 7/16 in. B.S.F. thread

Tightening torque.... 30 lb./ft. (4 kg/m)

**Steering relay unit****Bushes**

Type ..... Tufnol cones

**Spring**

Number of working coils ..... 10  
 Free length ..... 7 $\frac{1}{4}$  in. (184 mm)  
 Fitted length ..... 3 in. (72 mm)  
 Load at fitted length 104 lb. (47 kg)

**Wheel alignment**

Wheel camber ..... 1 $\frac{1}{2}$ °  
 Wheel castor ..... 3°  
 Swivel pin inclination 7°  
 Toe-in ..... 3/64 in. to 3/32 in. (1,2 mm to 2,4 mm)

# Section H — BRAKE SYSTEM — ALL MODELS

## INDEX

	Page		Page
Brake flexible pipe		Hand brake lever and linkage	
Removal	H-6	Stripping	H-11
Fitment	H-6	Assembling	H-11
Brake master cylinder		Rear wheel brake unit, 11" brakes, 109 models	
Removal	H-4	Adjustment	H-10
Stripping	H-4	Stripping	H-10
Assembling	H-4	Assembling	H-10
Fitment to bracket	H-6	Transmission brake shoes	
Fitment of pedal bracket complete	H-6	Re-lining	H-15
Brake pedal		Transmission brake unit	
Removal	H-4	Stripping	H-11
Fitment	H-4	Assembling	H-14
Data	H-17	Wheel brake unit, front and rear, 10" brakes,	
Defect location	H-16	88 models	
Front wheel brake unit, 11" brakes, 109 models		Adjustment	H-6
Adjustment	H-7	Stripping	H-7
Stripping	H-7	Assembling	H-7
Assembling	H-10	Wheel brake shoes	
Fluid reservoir		Re-lining	H-11
Removal	H-4	Wheel brake system	
Fitment	H-4	Bleeding	H-1

## LIST OF ILLUSTRATIONS

Fig.		Page	Fig.		Page
H-1	Layout of master cylinder and pedal unit	H-2	H-10	Plungers correctly paired	H-10
H-2	Layout of pipe lines	H-3	H-11	Plungers correctly located	H-10
H-3	Brake and clutch fluid reservoir	H-4	H-12	Plungers incorrectly located	H-10
H-4	Cross-section of brake master cylinder	H-4	H-13	Transmission brake unit	H-11
H-5	Layout of wheel brake unit, 10"	H-5	H-14	Left and right hand plungers	H-11
H-6	Attachment of flexible brake hoses	H-6	H-15	Layout of transmission brake, early type	H-12
H-7	Wheel brake unit—front and rear, 10" brakes—88 models	H-6	H-16	Layout of transmission brake, late type	H-13
H-8	Layout of front wheel brake unit, 11" brakes—109 models	H-8	H-17		H-14
H-9	Layout of rear wheel brake unit, 11" brakes—109 models	H-9	H-18	Selection and fitting of adjuster plungers	H-14
			H-19		H-15

### Wheel brake system

#### To bleed

#### Operation H/2

If the level of the fluid in the supply tank is allowed to fall too low, or if any section of the pipe line has been disconnected, the brakes will feel "spongy" due to air having been absorbed into the system. It is necessary to remove the air-lock, bleeding the system at the wheel cylinders. Bleeding must always be carried out at all four wheels, irrespective of which portion of the pipe line is affected, starting with the wheel cylinder farthest from the master cylinder.

1. Remove the rubber dust cover and attach a length of rubber tubing to the bleed screw and place the lower end of the tube in a glass jar, containing a small amount of fluid.

2. Slacken the bleed screw and pump the brake pedal, pausing at each end of each stroke, until the fluid issuing from the tube shows no sign of air bubbles when the tube is held below the surface of the fluid in the jar.
3. Holding the tube under the fluid surface, tighten the bleed screw.
4. The fluid in the reservoir must be replenished throughout the operation to prevent another air lock being formed.  
Never use fluid that has just been bled from the system for topping up the reservoir, as it may have become aerated.
5. In the event of a master cylinder being changed, the system may be bled from the bleed screw located on the engine side of the scuttle.

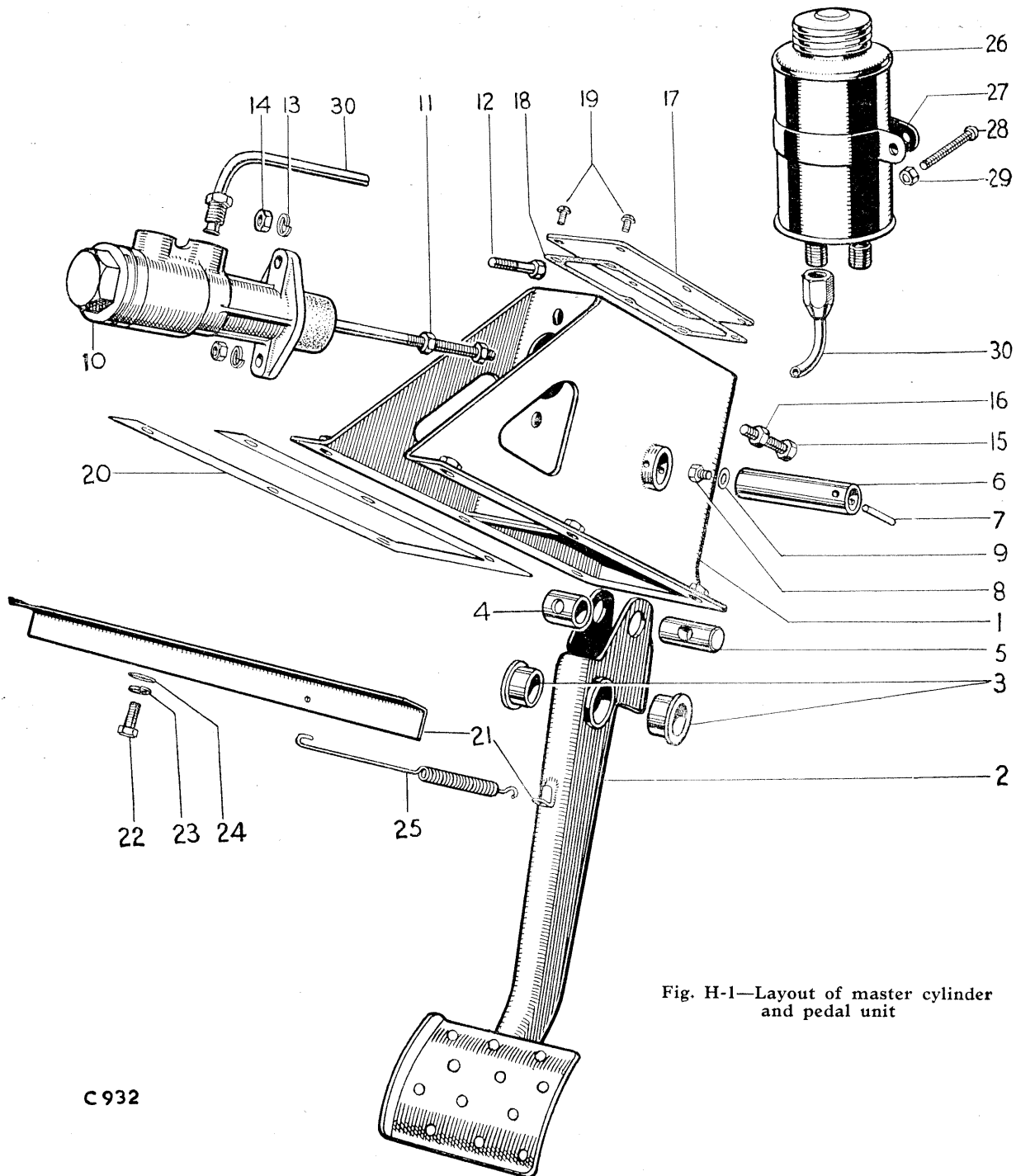


Fig. H-1—Layout of master cylinder and pedal unit

C 932

- |       |  |       |  |
|-------|--|-------|--|
| 1     | Brake pedal bracket                      | 17    | Pedal bracket top cover                        |
| 2     | Brake pedal                              | 18    | Gasket   |
| 3     | Bushes                                   | 19    | Fixings—top cover to pedal bracket             |
| 4     | Distance piece                           | 20    | Pedal bracket gasket                           |
| 5     | Pedal trunnion                           | 21    | Pedal return spring anchors                    |
| 6     | Pedal shaft                              | 22-24 | Fixings—anchor plate and pedal bracket to dash |
| 7     | Pedal shaft locating pin                 | 25    | Pedal return spring                            |
| 8     | Oil plug                                 | 26    | Brake and clutch fluid reservoir               |
| 9     | Joint washer                             | 27    | Reservoir retaining clip                       |
| 10    | Brake master cylinder                    | 28-29 | Fixings—clip to reservoir                      |
| 11    | Nut for master cylinder push rod         | 30    | Pipe complete—reservoir to master cylinder     |
| 12-14 | Fixings—master cylinder to pedal bracket |       |  |
| 15-16 | Bracket pedal stop                       |       |  |

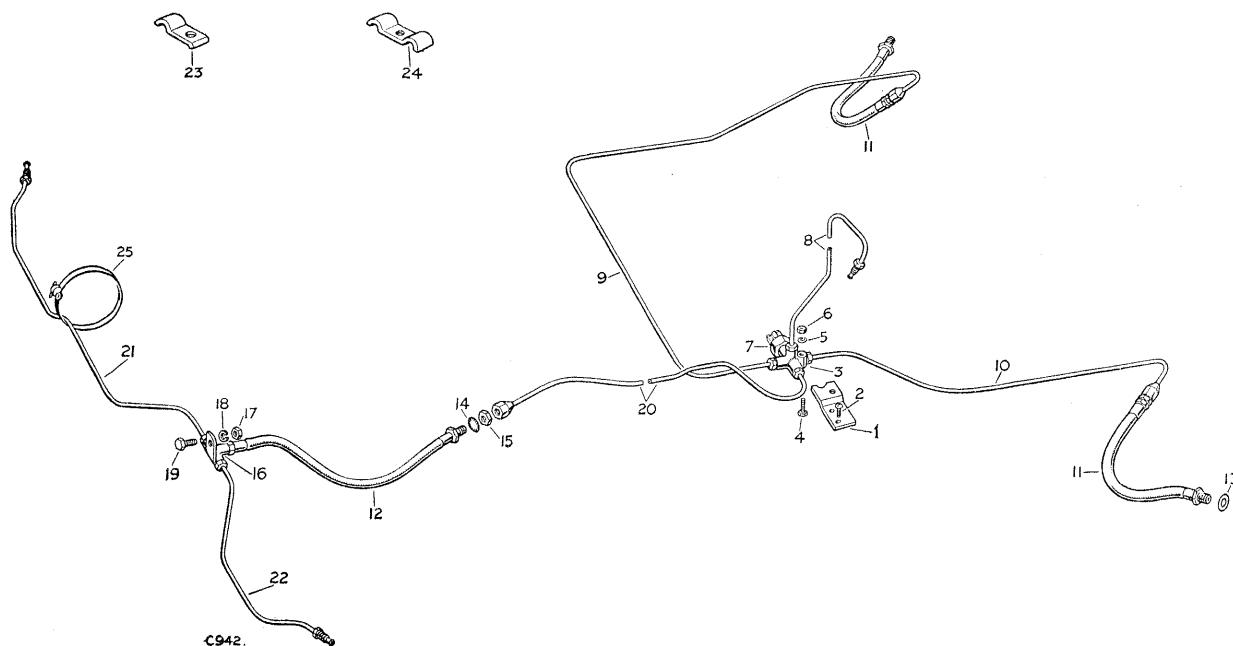


Fig. H-2—Layout of pipe lines

- |     |  |       |                                      |
|-----|--|-------|--------------------------------------|
| 1   | Bracket, for 5-way piece                   | 13    | Joint washer for hoses               |
| 2   | Drive screw, fixing bracket                | 14-15 | Fixings—hose to bracket              |
| 3   | 5-way piece for brake pipes                | 16    | "T" piece on rear axle               |
| 4-6 | Fixings—5-way piece                        | 17-19 | Fixing—"T" piece                     |
| 7   | Stop lamp switch                           | 20    | Brake pipe to rear hose              |
| 8   | Brake pipe, master cylinder to 3-way piece | 21    | Brake pipe, L.H. rear to "T" piece   |
| 9   | Brake pipe, 5-way to L.H. front            | 22    | Brake pipe R.H. rear to "T" piece    |
| 10  | Brake pipe, 5-way to R.H. front            | 23    | Clip, brake pipes to chassis frame   |
| 11  | Hose complete for front wheels             | 24    | Clip, brake and clutch pipes to dash |
| 12  | Hose complete to rear axle                 | 25    | Clip on rear axle for L.H. pipe      |

All normal bleeding operations **must** be carried out at the wheel cylinders. Note particularly that the fluid reservoir for the brakes is the outer container of the combined reservoir and that the level is correct when the fluid is just above the top of the inner reservoir. Use only Girling Crimson brake fluid.

#### Fluid reservoir

##### To remove Operation H/4

1. Disconnect the brake and clutch outlet pipes.
2. Remove the securing nut and spring washer and withdraw assembly complete with clamp.

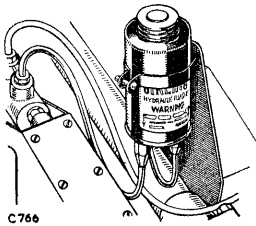


Fig. H-3—  
Brake and clutch  
fluid reservoir

##### To refit Operation H/6

1. Reverse the removal procedure.
2. Bleed the system.

#### Brake pedal

##### To remove Operation H/8

1. Remove bonnet. (Remove spare wheel if fitted.)
2. Remove securing nut and pull fluid reservoir away from cover plate.
3. Remove cover plate and gasket from brake pedal bracket.
4. Disconnect input and output unions from brake master cylinder.
5. Remove retaining nut from plunger, and push plunger up into master cylinder.
6. Using a suitable punch, drift out pin, from the pedal shaft.
7. Remove pedal shaft.

8. Remove spring, pedal to anchor bracket (inside vehicle) and withdraw pedal.

##### To refit Operation H/10

1. Reverse removal procedure, renewing cover plate gasket if necessary.
2. Bleed system. Operation H/2.

#### Brake master cylinder

##### To remove Operation H/12

1. Remove the securing bolts (inside vehicle) and remove pedal bracket, complete with master cylinder, and pedal.
2. Remove the nut securing the plunger to the trunnion, then remove the securing self-locking nuts, plain washers and bolts, and withdraw the master cylinder.

##### To strip Operation H/14

1. Remove the locknut and rubber cover from the piston push rod; remove the circlip and withdraw the push rod and retaining washer.
2. Apply a low air pressure to the intake orifice in order to expel the piston assembly from the cylinder.

##### To assemble Operation H/16

1. Clean all the component parts in Girling Crimson brake fluid.
2. Carefully inspect the seals and rubber dust cover; renew as necessary; smear the seals with Wakefield No. 3 rubber grease.
3. Assemble the unit by reversing the dismantling procedure.

The lock stop bolt, located in the pedal bracket back plate, should not be disturbed, but in the event of this being absolutely necessary, it must be reset as follows:—

With the master cylinder removed, support the pedal pad 6 in. (15 cm) from the toe-board, and screw in the bolt until it touches the pedal shaft stop plate. Tighten the locknut.

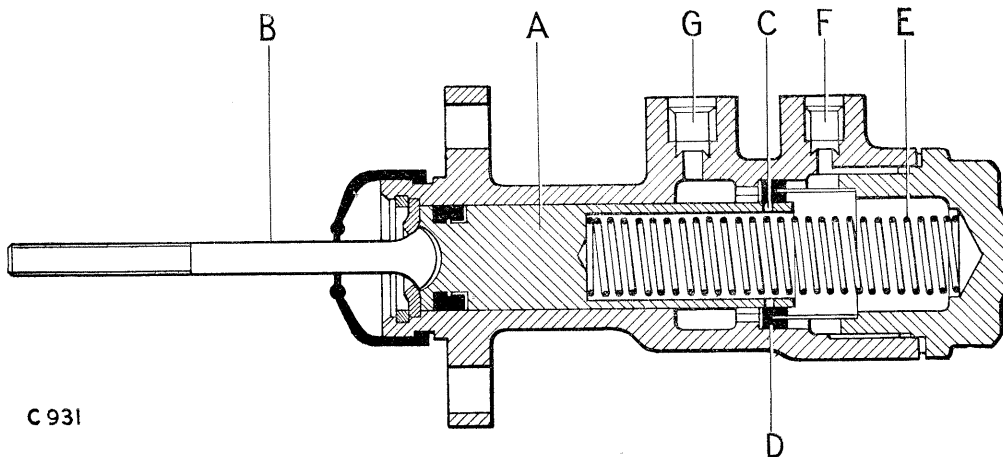


Fig. H-4  
Cross-section of brake  
master cylinder

- A—Piston
- B—Push rod
- C—Inlet ports
- D—Recuperating seal
- E—Piston spring
- F—Outlet to wheel  
cylinders
- G—Inlet from reservoir

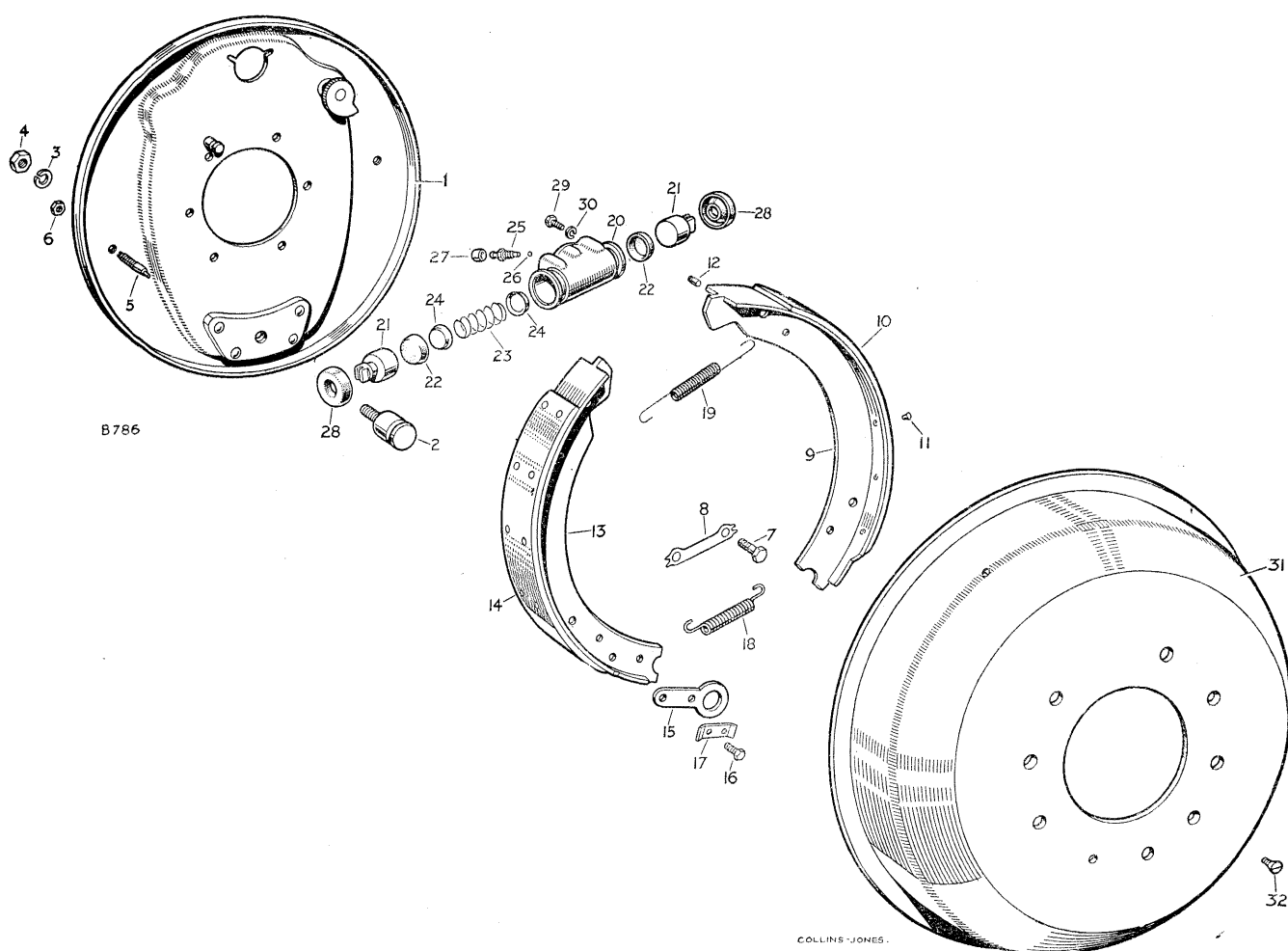


Fig. H-5—Layout of wheel brake unit—front and rear (10" brakes)

- |     |                                   |       |                                       |
|-----|-----------------------------------|-------|---------------------------------------|
| 1   | Brake anchor plate assembly, R.H. | 17    | Locking plate for bolt                |
| 2   | Anchor pin for brake shoe         | 18    | Pull-off spring for brake shoe        |
| 3   | Spring washer                     | 19    | Pull-off spring for leading shoe      |
| 4   | Special nut                       | 20    | Wheel cylinder only R.H. front        |
| 5   | Shoe steady post                  | 21    | Piston for cylinder, front            |
| 6   | Locknut for steady post           | 22    | Rubber cup for piston, front          |
| 7-8 | Fixings for front anchor plate    | 23    | Spring for piston, front              |
| 9   | Brake shoe assembly R.H., leading | 24    | Washer for spring, front              |
| 10  | Lining for brake shoe             | 25    | Bleed screw                           |
| 11  | Rivet fixing lining               | 26    | Steel ball for bleed screw            |
| 12  | Spring post for brake shoe        | 27    | Rubber dust cap for bleed screw       |
| 13  | Brake shoe assembly, trailing     | 28    | Rubber boot for wheel cylinder, front |
| 14  | Lining for brake shoe             | 29-30 | Fixings for wheel cylinder            |
| 15  | Anchor for brake shoe             | 31    | Brake drum                            |
| 16  | Special set screw fixing anchor   | 32    | Set screw fixing brake drum           |

**To refit, master cylinder to bracket****Operation H/18**

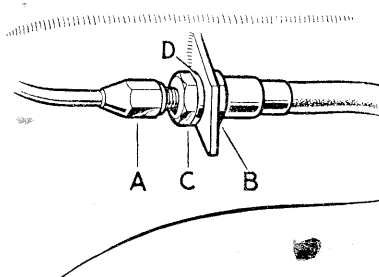
1. Reverse the removal procedure, renewing gaskets as necessary.
2. Bleed system. Operation H/2.

**To refit, pedal bracket complete****Operation H/20**

1. Reverse the removal procedure, renewing gaskets as necessary.
2. Refill the fluid reservoir.
3. Bleed the system. Operation H/2.
4. Check for leaks and rectify as necessary.
5. Check the free play in the push rod, which should be 1/16 in. (1,5 mm) if it is less than the given figure:—
6. Slacken off the locknut and rotate the push rod, with the fingers, until the correct movement has been attained.
7. Tighten the locknut and recheck the free play.

**Brake flexible pipe****To remove** **Operation H/22**

1. Hold the brake pedal down to prevent loss of fluid from the supply tank.
2. Unscrew the pipe nut (A) clear of the hose adaptor.
3. Hold the adaptor nut (B) with a spanner and remove the bulkhead nut (C) and shakeproof washer (D).



**Fig. H-6—**  
Attachment of  
flexible  
brake hoses

A—Pipe nut  
B—Adaptor nut  
C—Bulkhead nut  
D—Shakeproof washer

4. Withdraw the hose from the chassis bracket and disconnect from the banjo on the wheel cylinder.

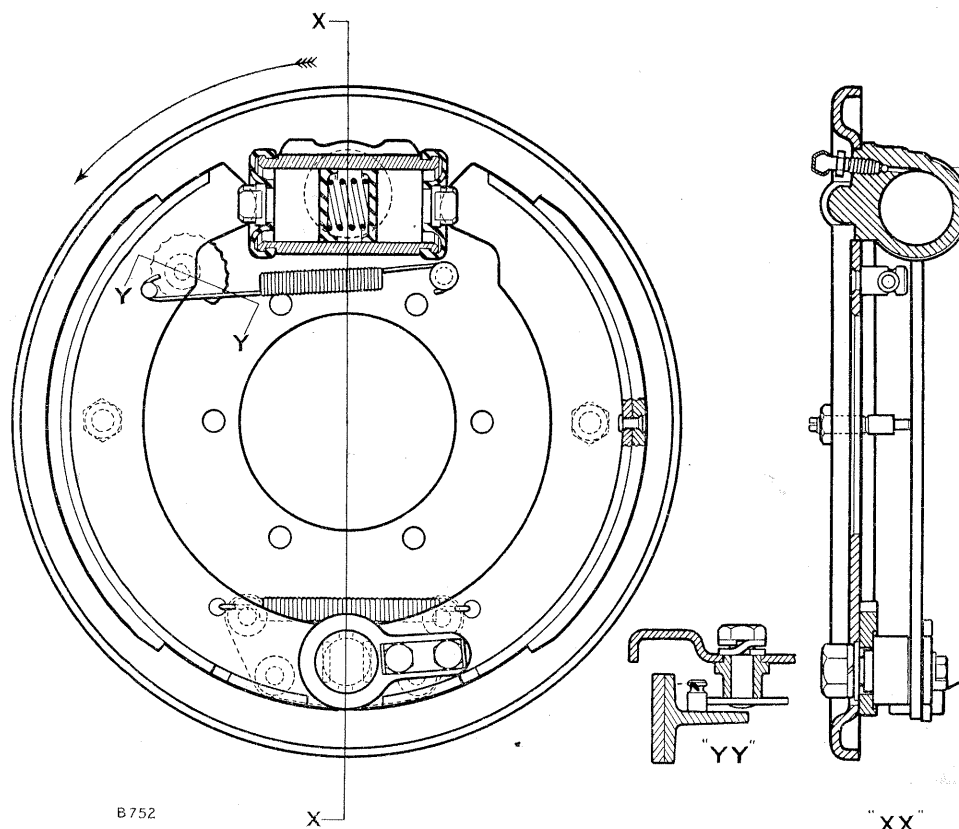
**To refit****Operation H/24**

1. Reverse the removal procedure.
2. Bleed the brake system. Operation H/2.

Whenever any section of the pressure pipe system has been removed, a careful check should be made on replacement to ensure that all the connections and joint washers are in good condition. A faulty connection will admit air into the system, so causing poor and "spongy" braking.

**Wheel brake unit, front and rear 10" brakes—88 models****To adjust****Operation H/26**

Jack up each wheel in turn. On the back face of the brake anchor plate will be found a hexagon adjustment bolt, which operates a snail cam bearing on the leading shoe. Only one of these is fitted to each wheel brake unit, thereby providing single-point



**Fig. H-7—Wheel brake unit—front and rear 10" brakes—88 models**

adjustment. Spin the wheel and rotate the adjuster bolt until the brake shoe contacts the drum, then ease the adjuster until the wheel again rotates freely. Repeat for the other three wheels.

**To strip****Operation H/28**

1. Jack up the vehicle.
2. Remove the road wheel and brake drum.
3. Turn back the adjuster cam to release the tension of the leading shoe pull-off spring and remove the spring.
4. Remove the trailing shoe anchor plate.
5. Remove the brake shoes together from the pivot end first; part them by disconnecting the bias reducing spring. If the wheel cylinder is not to be removed, e.g., when relining the shoes, it is well to slip the special clip Part No. 242526 over the cylinder pistons to prevent loss of fluid and admission of air to the system.
6. In cases where the unit is to be completely dismantled, the front flexible hose to wheel cylinder must be disconnected at the support bracket on frame before unscrewing from wheel cylinder, to avoid twisting and damaging of hose. The securing nut for rear wheel cylinder pipe may be unscrewed directly.
7. Depress the brake pedal to its fullest extent and wedge in that position, so preventing leakage of fluid from the supply tank; it is also advantageous to secure the loose end of the flexible hose as high as possible to reduce loss of fluid from the pipeline to a minimum.
8. Remove the wheel cylinder and detach the rubber dust covers, pistons, piston cups and spring; remove the bleed nipple cover, nipple and ball.
9. Remove the brake anchor plate after first removing the hub components. Sections E and F.

**To assemble****Operation H/30**

1. Clean and replace the anchor plate.
2. Clean all the wheel cylinder components, using Girling Crimson Brake Fluid, and assemble wet.
3. Replace the bleed ball and nipple.
4. Examine the piston cups for damage or distortion and renew as necessary, replace the piston spring, cups and pistons.
5. Examine the rubber dust covers; renew if damaged.
6. Refit the wheel cylinder to the anchor plate.
7. Reconnect the bias reducing spring, renewing it if necessary; the brake shoes should be fitted together at the wheel cylinder end first (Fig. H-7).
8. Reconnect the leading shoe pull-off spring, renewing it if necessary; replace it with its longest extremity hooked over the post on the shoe web.
9. Replace the trailing shoe anchor plate.

10. Examine the brake drum for scoring, ovality, and skim if required, standard diameter 10 in. (254 mm). Reclamation limit .030 in. (0.75 mm) oversize on diameter.

11. Replace the brake drum and set the leading shoe adjuster. See Instruction Manual.

12. Early 88 models. If the brake shoe steady posts have been disturbed, they should be reset as follows:—

Screw the posts, where fitted, well back, clear of the shoes. Apply the brakes lightly and turn the drum by hand to centralise the shoes; continue depressing the pedal until the shoes are hard on the drum. Screw in the steady posts, where fitted, until they just contact the shoe webs and secure by means of the locknuts.

Later models (88) are fitted with anchor plates embodying a pressed projection in place of the shoe steady posts.

13. Replace the road wheel.
14. Lower the vehicle from the jack.
15. If air has entered the system during the re-lining operation, or if the unit has been completely stripped, the brake system must now be bled. Operation H/2.

**Front wheel brake unit, 11" brakes—109 models****To adjust****Operation H/32**

Each shoe is independently set by means of an adjuster operating through a serrated snail cam.

1. With the front wheels jacked up, ensure that the wheels rotate freely; slacken off the adjusters if necessary by turning anti-clockwise.
2. Turn the adjuster for each shoe clockwise until the shoe just brushes the brake drum, then slacken off two serrations.

**To strip****Operation H/34**

1. Slacken wheel nuts slightly and jack up the vehicle.
2. Unscrew the wheel nuts completely and remove road wheel.
3. Turn adjuster cams at rear of brake anchor plate (anti-clockwise) to increase clearance between linings and brake drum and facilitate removal of brake drum.
4. Remove the three countersunk head screws retaining brake drum and withdraw brake drum.
5. Release brake shoes and pull-off springs by levering the trailing edge of each shoe away from the wheel cylinders.

If the wheel cylinders are not to be removed, e.g., when relining brake shoes, a clip must be used to hold the pistons in position and prevent loss of fluid and admission of air to the system.

6. Release bleed nipple on bottom wheel cylinder, then depress brake pedal to fullest extent and wedge in this position, thereby preventing leakage of fluid from supply tank.



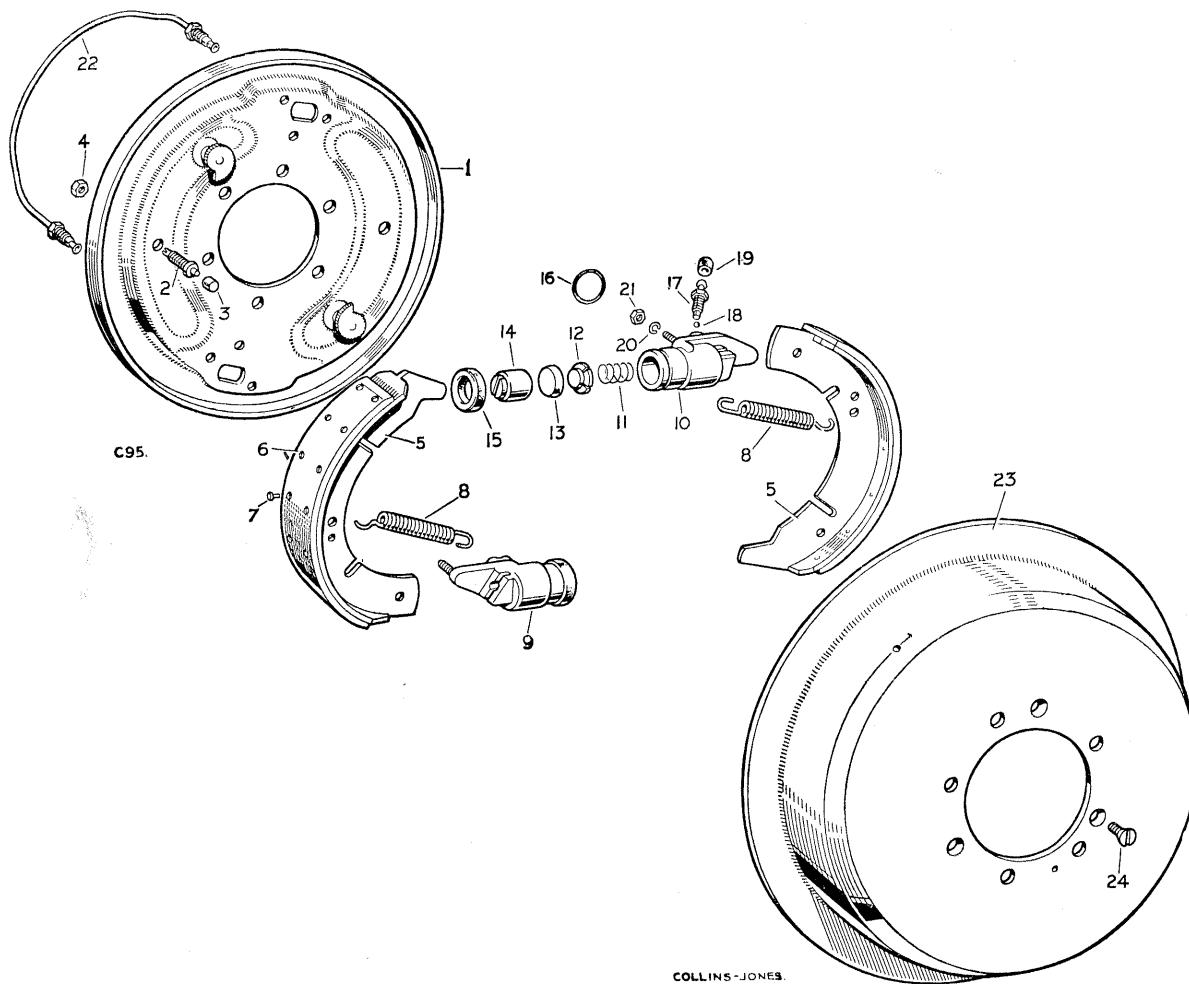


Fig. H-8—Layout of front wheel brake unit, 11" brakes—109 models

- |                                    |  |
|------------------------------------|--|
| 1 Brake anchor plate assembly—L.H. | 16 Sealing ring for cylinder               |
| 2 Steady post for brake shoe       | 17 Bleed screw                             |
| 3 Bush for steady post             | 18 Steel ball for bleed screw              |
| 4 Special nut—fixing steady post   | 19 Rubber dust cap for bleed screw         |
| 5 Brake shoe assembly—L.H.         | 20 Spring washer } Securing wheel cylinder |
| 6 Lining for brake shoe            | 21 Nut }                                   |
| 7 Rivet securing lining            | 22 Connecting pipe for wheel cylinders     |
| 8 Pull-off spring                  | 23 Brake drum                              |
| 9 Wheel cylinder assembly—L.H.     | 24 Set screw fixing brake drum             |
| 10 Wheel cylinder—L.H.             |  |
| 11 Spring                          |  |
| 12 Air excluder                    |  |
| 13 Seal                            |  |
| 14 Piston                          |  |
| 15 Rubber boot                     |  |
- } Part of wheel cylinder assembly

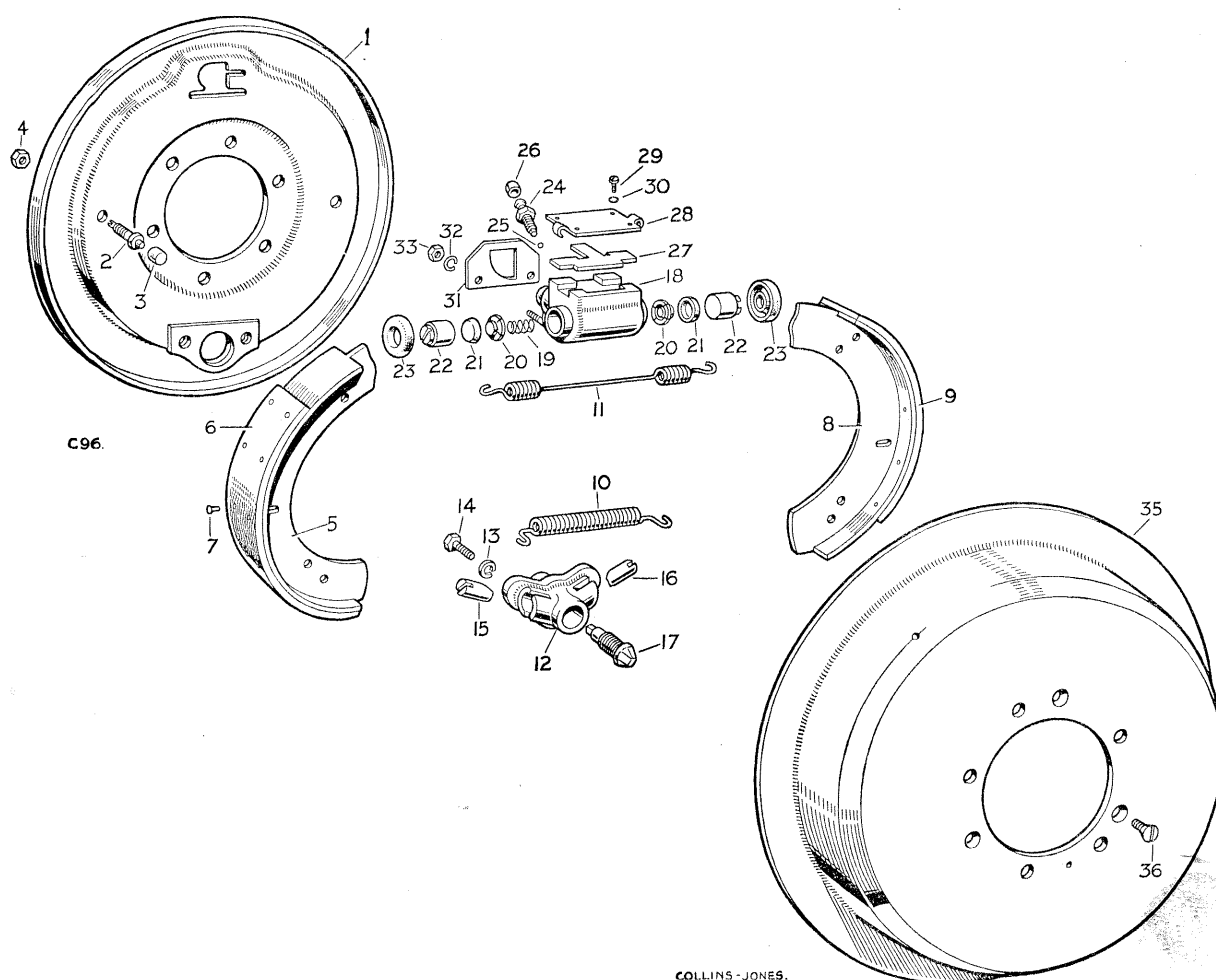


Fig. H-9—Layout of rear wheel brake unit, 11" brakes—109 models

- |    |                                |    |   |   |
|----|--------------------------------|----|---|---|
| 1  | Brake anchor plate—L.H.        | 18 | Wheel cylinder—L.H.                     | } Part of wheel cylinder assembly         |
| 2  | Steady post for brake shoe     | 19 | Spring                                  |   |
| 3  | Bush for steady post           | 20 | Air excluder                            |   |
| 4  | Special nut—fixing steady post | 21 | Seal                                    |   |
| 5  | Shoe assembly—leading          | 22 | Piston                                  |   |
| 6  | Lining for leading shoe        | 23 | Seal                                    |   |
| 7  | Rivet securing linings         | 24 | Bleed screw                             |   |
| 8  | Shoe assembly—trailing         | 25 | Ball for bleed screw                    |   |
| 9  | Lining for trailing shoe       | 26 | Rubber dust cap for bleed screw         |   |
| 10 | Pull-off spring—adjuster end   | 27 | Abutment plate                          | } For wheel cylinder                      |
| 11 | Pull-off spring—cylinder end   | 28 | Dust cover plate                        |   |
| 12 | Adjuster housing               | 29 | Set screw                               | } Securing abutment and dust cover plates |
| 13 | Spring washer                  | 30 | Spring washer                           |   |
| 14 | Set bolt                       | 31 | Dust cover plate for brake anchor plate |   |
| 15 | Plunger—L.H.                   | 32 | Spring washer                           | } Securing wheel cylinder                 |
| 16 | Plunger—R.H.                   | 33 | Nut                                     |   |
| 17 | Cone for adjuster              | 35 | Brake drum                              |   |
|    |                                | 36 | Retaining screw                         |   |

7. Disconnect union nut of brake fluid supply pipe from flexible pipe, and remove locknut securing flexible pipe to support bracket on chassis, forward of shock absorber.
8. Disconnect flexible pipe and connecting pipe from wheel cylinders.
9. Unscrew securing nuts, then remove wheel cylinders from anchor plate and detach the rubber dust covers, pistons, seals, air excluders and springs.
10. Remove the brake anchor plate and steady posts if necessary.

**To assemble****Operation H/36**

Clean and examine all parts and renew as necessary. If the brake linings have been renewed, the ends must be backed off. Reverse the sequence of stripping operations excepting for bleed nipple which should be fitted to wheel cylinder before assembly to anchor plate. Finally bleed each wheel cylinder in accordance with Operation H/2.

If the brake shoe steady posts have been disturbed, reset as instructed in Item 12 of Operation H/30.

**Rear wheel brake unit, 11" brakes—109 models****To adjust****Operation H/38**

The rear brake shoes are adjusted by means of a single adjuster assembly fitted at the lower side of the brake anchor plate which allows the shoes to expand or contract equally.

1. With the rear wheels jacked up ensure that they rotate freely; slacken the adjuster if necessary, by turning anti-clockwise.
2. Apply the foot brake to ensure that the shoes are bedded in and turn the adjuster clockwise until the linings brush the brake drum, then slacken adjuster off (anti-clockwise) two clicks.

**To strip****Operation H/40**

1. Slacken wheel nuts slightly and jack up the vehicle.
2. Unscrew the wheel nuts completely and remove road wheel.
3. Turn adjusters at lower end of anchor plate anti-clockwise to increase clearance between linings and brake drum and thereby facilitate removal of brake drum.
4. Remove the three countersunk head securing screws and withdraw brake drum.
5. Release the brake shoes and pull-off springs by levering the shoes away from the wheel cylinder. If the wheel cylinders are not to be removed, e.g., when relining brake shoes, a clip must be used to hold the pistons in position and prevent loss of fluid and admission of air to the system.
6. Disconnect the fluid pipes from wheel cylinders and depress brake pedal to the fullest extent, then wedge in this position, thereby preventing leakage of brake fluid from supply tank.

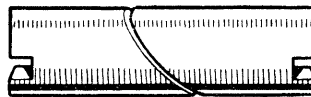
7. Remove the securing nuts and withdraw the wheel cylinders from anchor plates, then detach the rubber dust covers, pistons, seals, air excluders and springs.
8. Remove the securing bolts and withdraw the adjuster assemblies complete with cover plates. Withdraw the plungers and unscrew the adjuster cones.
9. Unscrew the steady posts, with fibre bushes and locknuts.
10. Remove the anchor plates if necessary (see Section E).

**To assemble****Operation H/42**

Clean and examine all parts and renew as necessary, then reverse the sequence of stripping operations.

*The following points should be observed:—*

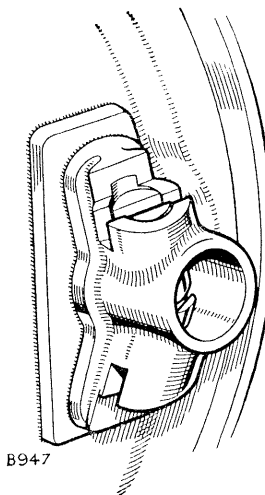
1. Lubricate the cone and adjuster plungers with graphite grease.



B946.

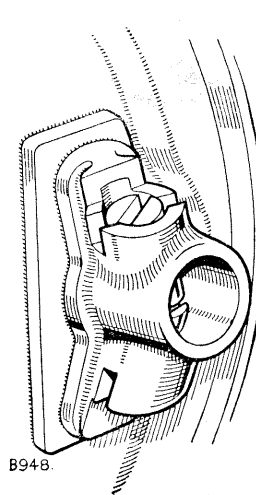
Fig. H-10—  
Plungers  
correctly paired

2. Ensure that the plungers are fitted in pairs. This can be checked by placing them end to end; in this position the slots should be parallel to each other.
3. Check that the plungers are fitted to the correct bore in adjuster housing. When the plungers are fitted correctly and forced down on the flats of the adjusting cone, the slot for brake shoe web will be in line with the slots in adjuster housing and the angle of the plunger slot will coincide with the angle of brake shoe web.



B947

Fig. H-11—



B948.

Fig. H-12—

Plungers correctly located Plungers incorrectly located

4. Leave the wheel cylinder fixing nuts one turn slack so that the cylinder is free to float on the anchor plate.

5. If new linings have been fitted the ends must be backed off. The trailing shoe has the shorter lining and care must be taken to ensure it is not fitted in the leading position.
6. Finally bleed the wheel cylinders and if the brake shoe steady posts have been disturbed, reset as instructed in Item 12 of Operation H/30.

#### Wheel brake shoes

##### To re-line Operation H/44

1. Remove the old linings from the shoes by shearing the rivets.
2. Re-line both shoes in the normal way, with the correct linings, and "back-off" both ends of each lining. Uneven braking is liable to occur if mixed sets of linings are employed.

#### Hand brake lever and linkage

##### To strip (R.H.D. models) Operation H/46

1. Remove the centre inspection panel from the seat box.
2. Disconnect the transmission brake expander rod and vertical adjuster rod from the bell-crank lever.
3. Remove the hand brake assembly complete from the vehicle, withdrawing the lever grip carefully through the rubber draught excluder in the front of the seat box.
4. Remove the adjuster rod from the adjuster pin; remove the adjuster pin, thus releasing the brake catch and locating plate.
5. Remove the locating plate.
6. Remove the lever from the ratchet plate.
7. Remove the brake catch from the plunger rod and unscrew the plunger, plunger rod and spring from the brake lever.
8. Remove the bell-crank and spindle complete from the chassis.
9. Remove the bell crank lever from the spindle.
10. If necessary, press the bush out of the lever.

##### To strip (L.H.D. models) Operation H/48

1. Remove the centre panel from seat box.
2. Disconnect the transmission brake expander rod and vertical adjuster rod from the bell crank lever.
3. Remove the hand brake and cross-shaft complete.
4. Remove the split housing from the cross-shaft support brackets, remove the felt dust seals and self-lubricating bushes supporting the hand brake cross-shaft.

5. Strip the unit. Operation H/46.
6. Remove the bell crank lever. Operation H/46.

##### To assemble Operation H/50

1. Reverse the sequence of operations detailed for stripping.
2. Renew the bell crank lever bush and spindle if required.
3. L.H.D. models. The bushes should be greased prior to assembly and new felt seals fitted as required.
4. Set the adjuster rod by means of the locknuts at the adjuster pin, so that the hand brake lever has two ratchet clicks free movement in the "off" position.

#### Transmission brake unit

##### To strip Operation H/52

1. Remove the centre inspection panel from the seat box.
2. Drain the transfer box.
3. Disconnect the brake expander rod from the bell crank lever.
4. Disconnect the rear propeller shaft from the transfer box output shaft.
5. Withdraw the brake drum and rear drive output flange. Remove the brake drum from the flange, if necessary.

If access is only required to the brake shoes, e.g., for re-lining, the propeller shaft may be left in position; the brake drum may then be detached from the output flange and pushed back over the propeller shaft.

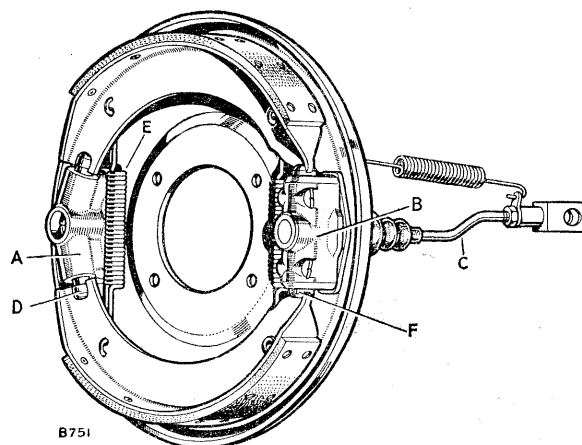


Fig. H-13—Transmission brake unit, early type

- |                 |                    |
|-----------------|--------------------|
| A—Adjuster unit | D—Adjuster plunger |
| B—Expander unit | E—Pull-off spring  |
| C—Expander rod  | F—Expander plunger |



L.H. Plunger

Fig. H-14  
Early type

R.H. Plunger

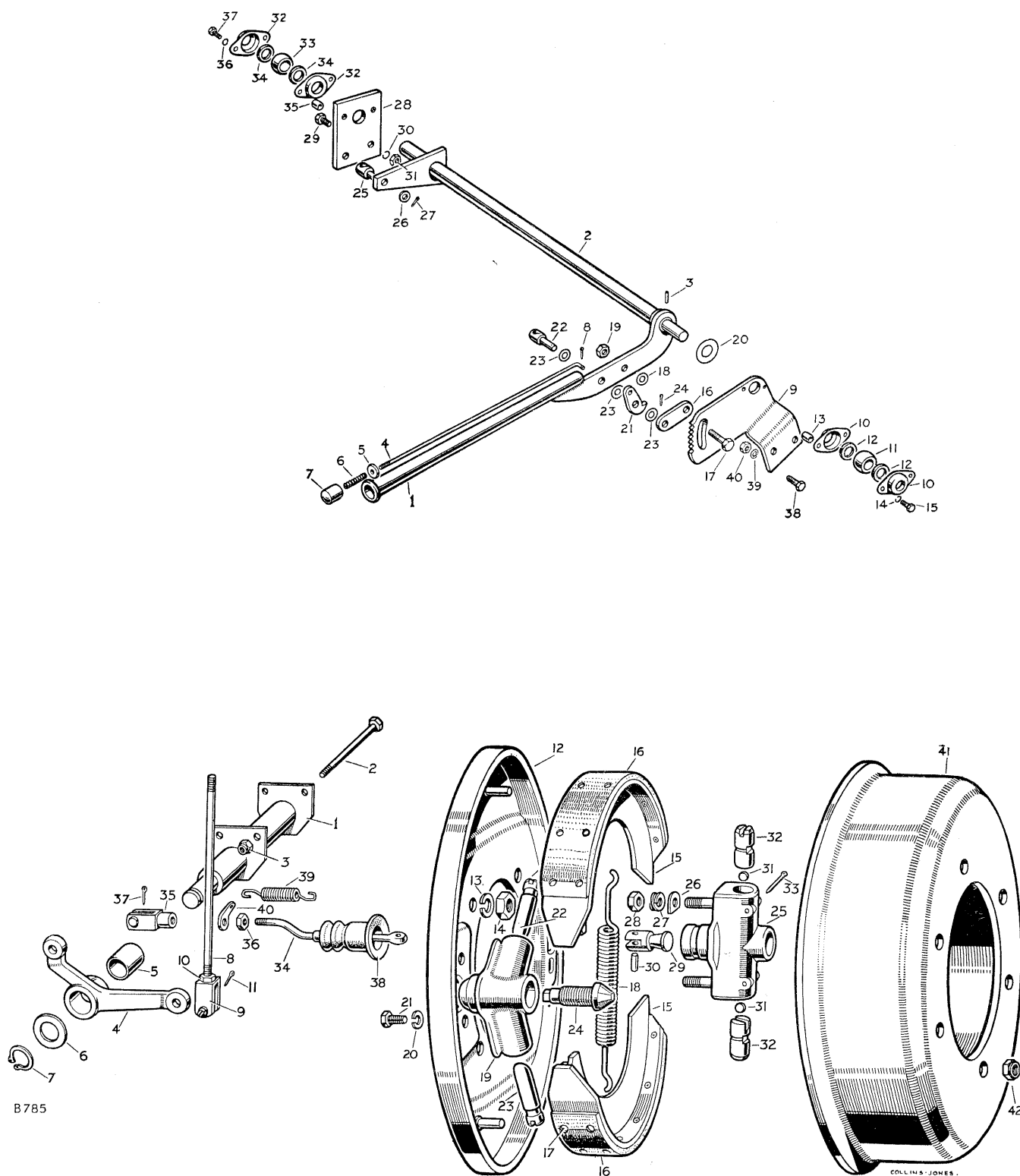


Fig. H-15—Layout of transmission brake, early type

Key to Fig. H-15

- |                                       |   |
|---------------------------------------|---|
| 1 Hand brake lever                    | 17-19 Fixings for locating plate and lever      |
| 2 Cross-shaft for hand brake          | 20 Plain washer between lever and ratchet       |
| 3 Pin fixing lever to shaft           | 21 Brake catch                                  |
| 4 Plunger rod                         | 22-24 Fixings for catch to lever                |
| 5 Washer for plunger spring           | 25 Pin for hand brake adjuster rod              |
| 6 Spring for plunger rod              | 26-27 Fixings for pin                           |
| 7 Plunger                             | 28 Support plate for hand brake bearing housing |
| 8 Split pin fixing rod to catch       | 29-31 Fixings for support plate                 |
| 9 Ratchet for hand brake              | 32 Housing for cross-shaft bearing              |
| 10 Housing for cross-shaft bearing    | 33 Spherical bearing for cross-shaft            |
| 11 Spherical bearing for cross-shaft  | 34 Felt ring for bearing                        |
| 12 Felt ring for bearing              | 35-37 Fixings for housing and bearing           |
| 13-15 Fixings for bearing and housing | 38-40 Fixings for hand brake lever              |
| 16 Locating plate                     |   |

- |   |                                       |
|---|---------------------------------------|
| 1 Spindle for hand brake relay lever                        | 23 Plunger L.H.                       |
| 2-3 Fixings for spindle                                     | 24 Adjuster cone                      |
| 4 Relay lever assembly for hand brake                       | 25 Expander housing                   |
| 5 Bush for relay lever                                      | 26-28 Fixings for expander housing    |
| 6-7 Fixings for lever                                       | 29 Expander cone                      |
| 8 Brake rod, relay to hand brake lever                      | 30 Pin fixing cone to brake rod       |
| 9-11 Fixings for brake rod to relay and hand<br>brake lever | 31 Roller for expander                |
| 12 Anchor plate, transmission brake                         | 32 Plunger for expander               |
| 13-14 Fixings for anchor plate                              | 33 Split pin fixing plunger           |
| 15 Brake shoe assembly                                      | 34 Brake rod, expander to relay lever |
| 16 Lining for shoe  | 35-37 Fixings for brake rod           |
| 17 Rivet for lining   | 38 Dust cover for brake rod           |
| 18 Pull-off spring for brake shoe                           | 39 Return spring for brake rod        |
| 19 Adjuster housing   | 40 Anchor for spring                  |
| 20-21 Fixings for adjuster housing                          | 41 Brake drum                         |
| 22 Plunger R.H.   | 42 Self-locking nut fixing brake drum |

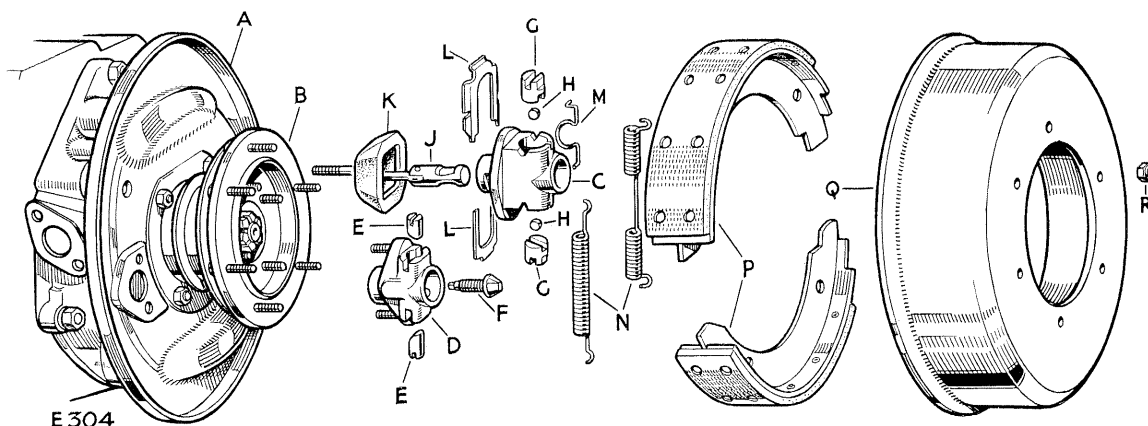


Fig. H-16—Layout of transmission brake, late type

- |                      |                            |  |
|----------------------|----------------------------|--|
| A—Anchor plate       | G—Expander plungers        | M—Spring clip retaining expander parts |
| B—Hub flange         | H—Expander rollers         | N—Pull-off springs                     |
| C—Expander housing   | J—Expander operating lever | P—Brake shoes                          |
| D—Adjuster housing   | K—Rubber dust cover        | Q—Brake drum                           |
| E—Adjusting plungers | L—Expander securing clip   | R—Self-locking securing nut            |
| F—Adjusting cone     |                            |  |

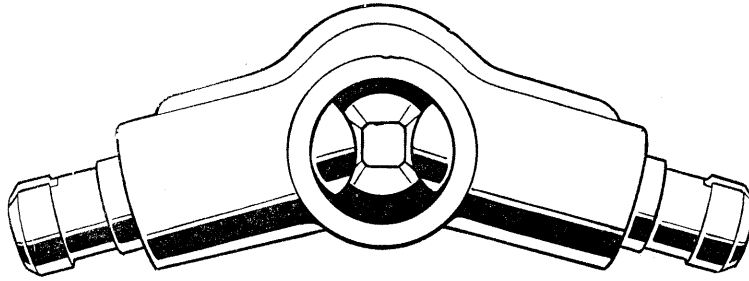


Fig. H-17—Plungers in correct bores, early type

6. Remove the brake shoes together with the pull-off springs, separate the shoes by detaching the springs.
7. Remove the anchor plate complete with adjuster and expander housings from the speedometer drive housing.
8. **Early type.** Remove the clevis, return spring, spring anchor and rubber dust cover from the expander rod and remove the expander housing complete. If necessary, remove the split pins from the expander housing, thus releasing the plungers, steel balls and expander cone; detach the expander rod from the cone.
9. **Late type.** Withdraw the rubber dust excluder and remove the clip securing the expander housing to the anchor plate. Withdraw the expander assembly. If necessary remove the spring clip and withdraw the plungers, steel rollers and operating rod.
10. Remove the adjuster housing, pull out the plungers and unscrew the adjuster cone from the housing.

**To assemble****Operation H/54**

1. Clean the brake anchor plate.
2. Replace the adjuster housing, leaving the securing bolts slack at this stage; screw in the adjuster cone, leaving it in the fully "off" position.
3. Grease the adjuster plungers and replace them in the housings.

It is essential that the adjuster plungers be replaced in the correct bores of the housing. They are handed, due to the fact that in addition to the adjustment flats being at an angle of  $30^\circ$  when viewed vertically, they are also inclined at

an angle of  $15^\circ$  to the plunger axes, owing to the housing bores being similarly inclined. When dismantled the plungers are not readily distinguished, and care must be taken to ensure that handed pairs are fitted.

A quick method of selecting pairs is shown at Fig. H-14. The plungers should be placed end to end with the flats mated exactly, when a correct pair will show the brake shoe slots parallel with each other. If the slots are not in line, both plungers are of the same hand, but this test gives no indication as to which hand, right or left.

Having made certain that a correct pair has been chosen, it will still be necessary to make sure that they are fitted in the proper bores, as in Fig. H-17, i.e., with the flats of the adjuster cone and plungers face to face; the slots in the ends of the plungers must be in line and vertical (parallel with the anchor plate). In this case, four distinct "clicks" will be felt for each revolution of the adjuster cone.

When assembled wrongly, the brake shoes will force the plunger slots into a vertical position, throwing the plunger flat off the flat of the adjuster cone, pushing the plunger approximately  $1/16$  in. (1.5 mm) out of the housing and so upsetting the centralisation of the shoes.

It is possible to erect the units incorrectly in three ways:

- (a) R.H. plunger in L.H. bore and L.H. plunger in R.H. bore (Fig. H-18).

In this case it is likely that no "click" will be felt when adjusting the brake.

- (b) Two L.H. plungers in the housing.
- (c) Two R.H. plungers in the housing (Fig. H-19).

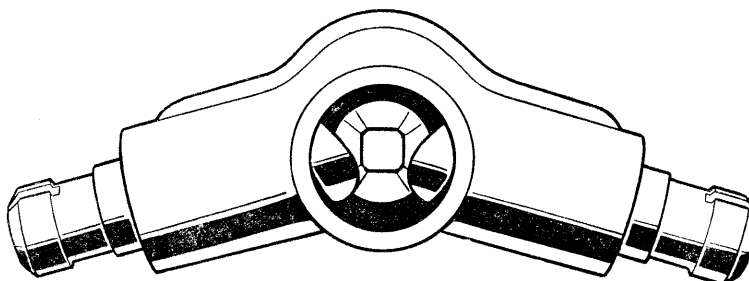


Fig. H-18—Correct pair of plungers in incorrect bores, early type

In both these cases the correct plunger will "click" on adjustment, thus giving the erroneous impression that the assembly is in order.

**Early type, items 4, 5 and 6**

4. Grease and replace the expander plungers, steel rollers and expander cone in the housing and locate with split pins.
5. Reconnect the expander rod to the cone and fit the complete housing to the brake anchor plate, leaving the Simmonds securing nuts one turn slack. Ensure that the housing is free to float on the anchor plate.
6. Replace the rubber dust cover, spring anchor plate, return spring and clevis on the expander rod.

**Late type, items 7 and 8**

7. Grease and replace the plungers, steel rollers and operating rod in the expander housing.
8. Refit the housing to the anchor plate with the spring clip fitted as illustrated. Refit the rubber dust excluder and ensure that the housing retaining clip is positively fitted under the lip formed in the dust excluder.
9. Mount the complete anchor plate on the speedometer drive housing.
10. Refit the brake shoes and pull-off springs together; **Early type**—the half-round slots in the shoe webs should be fitted to the adjuster housing. **Late type**—the fully lined ends of the shoes should be fitted to the adjuster housing plungers.

11. Clean and replace the brake drum and rear drive output flange.
12. Reconnect the propeller shaft to the transfer box output shaft.
13. Reconnect the expander rod to the hand brake bell-crank lever.
14. To ensure correct clearance between the brake shoes and drum, turn the adjuster cone until the brake shoes are locked tightly against the drum; tighten the set bolts securing the adjuster housing (these were left slack on assembly) and slacken off the cone two clicks; give the brake a firm application to ensure that the shoes have centralised at the expander end. The brake drum should now be free to rotate.
15. Set the hand brake linkage at the vertical adjuster rod, so that the hand brake has one or two clicks free movement in the "off" position.
16. Refill the transfer box with oil,  $4\frac{1}{2}$  pints (2,5 litres).
17. Replace the seat box centre inspection panel.

**Transmission brake shoes**

**To re-line**

**Operation H/56**

1. Remove the old linings from the shoes by shearing the rivets.
2. Re-line both shoes in the normal way with the correct linings, and "back-off" both ends of each lining.

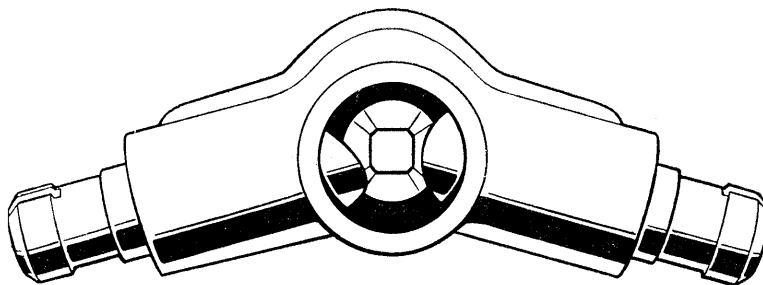


Fig. H-19—Two R.H. plungers in the housing, early type



## DEFECT LOCATION

(Symptom, Cause and Remedy)

## A—SPONGY PEDAL ACTION

1. Air in system—*Bleed the brake system.*
2. Swollen rubber components due to incorrect brake fluid—*Renew the affected parts, drain the system and refill with Girling Crimson Brake Fluid.*
3. Incorrect adjustment of brake shoes—*Adjust.*

## B—CHATTERING BRAKES

1. Incorrect adjustment of brake shoes—*Adjust.*
2. Loose front wheel bearings—*Section F.*
3. Hard spots on brake drum—*Renew linings as necessary and fit a new brake drum.*
4. Distorted brake drum—*Renew linings as necessary and fit a new brake drum.*

## C—LOSS OF PEDAL PRESSURE

1. Leak in master cylinder—*Renew.*
2. Leak in wheel cylinder—*Renew.*
3. Leak in brake pipes—*Renew.*

## D—HARD BRAKE PEDAL

1. Incorrect lining—*Renew.*
2. Restriction in master cylinder—*Rectify.*
3. Incorrect shoe adjustment—*Adjust.*

## E—BINDING BRAKE PEDAL

1. Worn or tight pedal shaft—*Rectify, renewing any excessively worn parts. Lubricate.*
2. Loose master cylinder mounting bolts—*Tighten.*

## F—BRAKE PEDAL FAILS TO RETURN

1. Weak pedal return spring—*Renew.*
2. Loose master cylinder mounting bolts—*Tighten.*
3. Sticking pedal shaft—*Free the pedal shaft, renewing any excessively worn part. Lubricate.*

## G—POOR BRAKES

1. Water-soaked linings—*Dry the brake linings by applying the brakes lightly whilst driving.*
2. Incorrect linings—*Renew.*
3. Glazed linings—*Renew.*
4. Incorrect shoe adjustment—*Adjust.*
5. Incorrect master cylinder adjustment—*Adjust.*

## H—GRABBING BRAKES

1. Grease, oil or brake fluid soaked linings—*Replace and rectify leaks.*
2. Scored or cracked drums—*Recondition or replace.*
3. Incorrect shoe adjustment—*Adjust.*
4. Incorrect linings—*Renew.*
5. Hard spots on drums—*Renew.*

## J—SIDE PULL

1. Grease, oil or fluid soaked linings—*Renew and rectify leaks.*
2. Incorrect shoe adjustment—*Adjust.*
3. Loose wheel cylinders—*Tighten.*
4. Clogged or crimped brake hose—*Clear the hose with air pressure or renew.*
5. Excessive wear in drum or scored drum—*Recondition or renew.*
6. Mixed linings—*Replace.*
7. Incorrect tyre pressures—*Section S.*
8. Water and mud in brakes—*Clean the brake assemblies, examine drums for scoring, and linings for wear. Renew as necessary.*

## K—SQUEALING BRAKES

1. Incorrect linings—*Renew.*
2. Distorted brake drum—*Renew.*
3. Bent brake anchor plate—*Renew.*
4. Sprung or bent brake shoes—*Renew.*
5. Foreign bodies embedded in brake linings—*Recondition or renew.*
6. Dust or road dirt in the drums—*Clean thoroughly. If necessary, renew the linings and recondition or renew the drums.*
7. Where applicable. Shoes binding on the steady posts—*Adjust.*
8. Loose wheel cylinders—*Tighten. Check the brake linings and renew as necessary.*

## L—BRAKES OVERHEATING

1. Brake shoes continuously in contact with drum—*Adjust.*
2. High spots on brake drums—*Recondition or renew.*
3. Defective master cylinder or swollen rubber components—*Renew.*
4. Dust or road dirt in the drums—*Clean thoroughly. If necessary, renew the linings and recondition or renew the drums.*
5. Incorrect master cylinder adjustment—*Adjust.*

## M—FADING BRAKES

1. Incorrect linings—*Renew.*
2. Poor lining contact—*Adjust.*
3. Excessive heat—*Renew linings.*

## N—BRAKE DRAGS

1. Incorrect brake adjustment—*Adjust.*
2. Distorted rubber boots—*Renew.*
3. Seized brake shoe—*Free the brake shoe from its anchor and smear the point of seizure lightly with grease.*
4. Weak brake shoe pull-off springs—*Renew.*
5. Loose front wheel bearings—*Section F.*
6. Restriction or obstruction in brake pipe—*Clear the pipe.*
7. Distorted brake drum—*Renew.*

## P—ALL BRAKES DRAG

1. Incorrect adjustment of brakes—*Adjust.*
2. Incorrect master cylinder adjustment—*Adjust.*
3. Rubber cylinder boots swollen—*Renew.*
4. Restriction in master cylinder—*Remove, clean or recondition.*
5. Linings too thick—*Check.*
6. Weak pull-off springs—*Renew.*

## Q—BRAKE LOCKS

1. Oil or brake fluid soaked linings—*Replace; rectify leaks.*
2. Torn or loose lining—*Renew and check the shoe for distortion.*
3. Loose wheel cylinders—*Tighten. Check the brake linings and renew as necessary.*
4. Swollen rubber components—*Renew.*

## R—PEDAL GOES TO FLOOR BOARD

1. Linings badly worn—*Re-line.*
2. Pedal incorrectly set—*Adjust.*

## DATA

**Brakes:**

Type .... Girling  
 Operation .... Hydraulic

**Foot pedal:**

Fit of bush on pedal  
 shaft .... .001 to .003 in. (0,02 to  
 0,07 mm)  
 Bush reamed bore ....  $\frac{3}{4}$  in. + .001 in. (19 mm  
 + 0,02)

**Wheel brake unit, front and rear (10 in. brakes):**

Lining:  
 Length ....  $8\frac{1}{2}$  in. (215 mm)  
 Width ....  $1\frac{1}{2}$  in. (38 mm)  
 Thickness ....  $\frac{3}{16}$  in. (4,75 mm)

**Brake drum:**

Standard diameter .... 10 in. + .004 (254 mm +  
 0,1)  
 Reclamation limit .... .030 in. (0,75 mm) over-  
 size on diameter

**Wheel brake unit, front (11 in. brakes):**

Lining:  
 Length .... 10.45 in. (265 mm)  
 Width ....  $2\frac{1}{4}$  in. (57 mm)  
 Thickness ....  $\frac{3}{16}$  in. (4,75 mm)

**Wheel brake unit, rear (11 in. brakes):**

Lining:  
 Length .... 8.6 in. (218 mm)  
 Width ....  $2\frac{1}{4}$  in. (57 mm)  
 Thickness ....  $\frac{3}{16}$  in. (4,75 mm)

**Brake drum:**

Standard diameter .... 11 in. + .004 (279,4 mm  
 + 0,10)  
 Reclamation limit .... .030 in. (0,75 mm) over-  
 size on diameter

**Transmission brake:**

Lining:  
 Length .... 7.70 in. (195 mm)  
 Width ....  $1\frac{3}{4}$  in. (44,5 mm)  
 Thickness ....  $\frac{3}{16}$  in. (4,75 mm)

**Brake drum:**

Standard diameter .... 9 in. + .004 (228,6 mm  
 + 0,1)  
 Reclamation limit .... 0.30 in. (0,75 mm) over-  
 size on diameter

**Master cylinder:**

Type (88 models) .... Girling CB  
 Bore ....  $\frac{3}{4}$  in. (19 mm)  
 Stroke ....  $1\frac{1}{2}$  in. (38 mm)  
 Type (109 models) .... Girling CB  
 Bore .... 1 in. (25 mm)  
 Stroke ....  $1\frac{1}{2}$  in. (38 mm)  
 Pushrod free move-  
 ment ....  $\frac{1}{16}$  in. (1,5 mm)



# Section J — SUSPENSION — ALL MODELS

## INDEX

	Page		Page
Bump rubber		Rear axle check strap	
Renewal ....	J-3	Renewal ....	J-3
Data ....	J-4		
Front spring		Rear spring	
Removal ....	J-1	Removal ....	J-2
Fitment ....	J-1	Fitment ....	J-2
Hydraulic damper		Overhaul ....	J-2
Renewal ....	J-2		

## LIST OF ILLUSTRATIONS

Fig.	Page
J-1 Road spring ....	J-1

### Front springs

The driver side and passenger side front springs are not interchangeable, the free camber of the driver's side spring being greater to compensate for the extra weight (driver, etc.) carried on that side of the vehicle.

#### To remove

#### Operation J/2

1. Jack up the vehicle and support it on four jacking stands.
2. Remove the front wheel.
3. Support the front axle with a jack.
4. Remove the four nuts and two lock plates securing the spring to the axle. Allow the spring bottom plate to hang on the hydraulic damper boss.
5. Remove the self-locking nut from the shackle pin in each spring eye.
6. Remove the shackle pin from the front end of the spring.
7. Remove the shackle pin from the rear end of the spring; the pin is threaded into the inner shackle plate.

8. Remove the road spring complete.

9. Remove the self-locking nut from the shackle pin securing the shackle plates to the chassis. Unscrew the pin from the inner shackle plate and remove it together with the two plates.

#### To refit

#### Operation J/4

1. If necessary, remove the shackle bushes from the chassis frame, with the aid of either a tubular drift or a suitable extractor; fit new bushes, which must be a *drive fit*.
2. If necessary, renew the rubber bushes in the spring eyes in a similar way.
3. Replace the spring by reversing the removal procedure, but do not fully tighten the shackle pins and locking nuts at this stage.
4. Lower the vehicle to the ground and move vehicle bodily backward and forward to settle the springs. Tighten the shackle pins and locking nuts.

If the shackle pins and locking nuts are tightened prior to lowering the vehicle to the ground, premature failure of the bushes will occur.

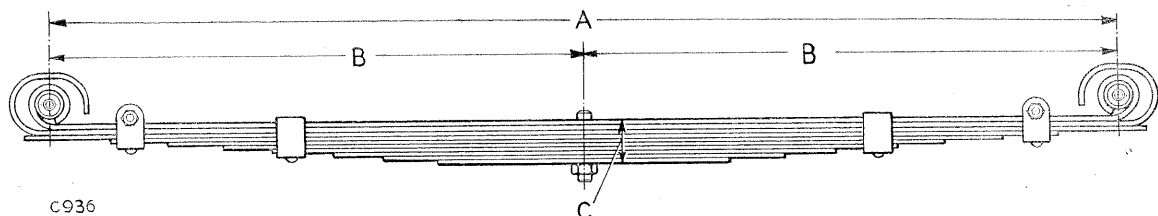


Fig. J-1—Road spring

A—All models, Front 36.250 in. (925,5 mm)  
Rear 48 in. (1,22 m)  
B—All models, Front 18.125 in. (460 mm)  
Rear 24 in. (610 mm)

C—88 models, Front 1.45 in. (37 mm)  
Rear 2.125 in. (54 mm)  
109 models, Front 1.88 in. (48 mm)  
Rear 2.09 in. (53 mm)

### Rear springs

The driver side and passenger side rear springs are not interchangeable, the free camber of the driver's side spring being greater to compensate for the extra weight (driver, etc.) carried on that side of the vehicle.

#### To remove

#### Operation J/6

1. Jack up the vehicle and support it on four jacking stands
2. Remove the rear wheel.
3. Support the rear axle with a jack.
4. Remove the four nuts and two lockplates securing the spring to the axle. Allow the spring bottom plate to hang on the hydraulic damper boss; the brake pipe protection plate will remain in position, clipped to the pipe.
5. Remove the self-locking nut from the shackle pin in each spring eye.
6. Remove the shackle pin from the rear end of the spring, the pin is threaded into the inner shackle plate.
7. Remove the shackle pin from the front end of the spring.
8. Remove the road spring complete.
9. Remove the self-locking nut from the shackle pin securing the shackle plates to the chassis frame. Unscrew the pin from the inner shackle plate and remove it, together with the two plates.

#### To refit

#### Operation J/8

1. If necessary, remove the shackle bush from the chassis frame bracket with the aid of a tubular drift or suitable extractor; fit a new bush, which must be a *drive fit*.
2. If necessary, renew the bushes in the spring eyes in a similar way.
3. Replace the spring by reversing the removal procedure, but do not fully tighten the shackle pins and locking nuts at this stage.
4. Lower the vehicle to the ground and move vehicle bodily backward and forward to settle the springs. Tighten the shackle pins and locking nuts.

If the shackle pins and locking nuts are tightened prior to lowering the vehicle to the ground, premature failure of the bushes will occur.

#### To overhaul

#### Operation J/10

1. Remove the four leaf clips; except for the inner clips on the front springs which are bent over the top leaf, all the clips are secured by bolts and nuts.
2. Remove the spring bushes, using a tubular drift.

3. Remove the centre bolt and nut to release the spring leaves.
4. Clean (or preferably degrease) the leaves; carefully examine them for signs of failure cracks. Only the main and second leaves are supplied as replacement, so that should any other leaf be faulty, the complete spring must be renewed.
5. The recambering of road springs is not advised, but if no alternative is possible, the spring should be reset, if necessary, either to a new spring or to the data set out on Page J-4.
6. Grease each leaf with graphite grease and reassemble the spring by fitting the centre bolt and leaf clips; fit the spring bushes, which must be a drive fit.

### Hydraulic dampers

#### To renew

#### Operation J/12

If it is suspected that a shock absorber is not functioning satisfactorily it should be removed and placed vertically in a vice, the lower eye being secured between the jaws of the vice. It should then be extended and compressed, when a uniform resistance throughout the stroke should be noted, in both directions. Should erratic or weak resistance be found, the shock absorber should be replaced.

The resistance felt when extending the shock absorber is very much greater than that encountered when compressing it.

No attempt must be made to strip or adjust the hydraulic dampers; if any trouble is experienced, a new damper must always be fitted and the original part returned for replacement.

1. Withdraw the hydraulic damper complete with four tapered rubber bushes and the retaining washers. Note that the top fixing is by self-locking nut and that the lower fixing is by split pin, except for the 109, where self-locking nuts and cup washers are used.
2. Renew the retaining washers as necessary.
3. Renew the rubber mounting bushes as necessary.
4. Fit the new damper with its outer sleeve uppermost.

Note that when the securing nut is fully tightened the compressed overall length of the two rubber bushes in the damper lug must be  $1\frac{5}{16}$  in. (33 mm) for all upper and 109 lower, fixings; where split pins are used, the correct nip on the rubber bushes is pre-determined by the position of the split pin hole.

5. If the rubber bushes are not correctly nipped or if they are not tightened with the vehicle lowered on to level ground, premature failure of the bushes will occur.

**Bump rubber****To renew****Operation J/14**

1. Remove the bump rubber secured to the underside of the chassis member.
2. Fit the new bump rubber and secure with the two bolts and self-locking nuts.

**Rear axle check strap****To renew****Operation J/16**

1. Remove the fabric check strap, complete with two clamping plates.
2. Fit the new check strap by reversing the removal procedure; take care that the strap is fitted to the rear of the brake pipe protection plate.

## DATA

## Road Springs

## Driver

## Passenger

## 88—Petrol—Front

Number of leaves	....	....	10	10
Width of leaves	....	....	2½ in. (63,5 mm)	2½ in. (63,5 mm)
Static load (vehicle unladen)	....	....	610 lb. (277 Kg.)	508 lb. (230 Kg.)
Camber under static load	....	....	2½ in. (63,5 mm)	2½ in. (63,5 mm)
Free camber	....	....	6.70 in. (170 mm)	6 in. (152 mm)

## 88—Diesel—Front

Number of leaves	....	....	11	11
Width of leaves	....	....	2½ in. (63,5 mm)	2½ in. (63,5 mm)
Static load (vehicle unladen)	....	....	750 lb. (340 Kg.)	750 lb. (340 Kg.)
Camber under static load	....	....	2¾ in. (70 mm)	2¼ in. (57 mm)
Free camber	....	....	5⅝ in. (143 mm)	5¾ in. (130 mm)

## 109—Petrol—Front

Number of leaves	....	....	11	11
Width of leaves	....	....	2½ in. (63,5 mm)	2½ in. (63,5 mm)
Static load (vehicle unladen)	....	....	750 lb. (340 Kg.)	750 lb. (340 Kg.)
Camber under static load	....	....	2¾ in. (69,85 mm)	2¼ in. (57 mm)
Free camber	....	....	5⅝ in. (142,9 mm)	5¾ in. (130 mm)

## 109—Diesel—Front

Number of leaves	....	....	11	11
Width of leaves	....	....	2½ in. (63,5 mm)	2½ in. (63,5 mm)
Static load (vehicle unladen)	....	....	750 lb. (340 Kg.)	750 lb. (340 Kg.)
Camber under static load	....	....	3¼ in. (82,5 mm)	2¾ in. (70 mm)
Free camber	....	....	6⅛ in. (155,5 mm)	5⅝ in. (143 mm)

## 88—Petrol—Rear

Number of leaves	....	....	11	11
Width of leaves	....	....	2½ in. (63,5 mm)	2½ in. (63,5 mm)
Static load (vehicle unladen)	....	....	440 lb. (200 Kg.)	330 lb. (150 Kg.)
Camber under static load	....	....	4 in. (102 mm)	4 in. (102 mm)
Free camber	....	....	6.7 in. (170 mm)	6 in. (152 mm)

## 88—Diesel—Rear

Number of leaves	....	....	11	11
Width of leaves	....	....	2½ in. (63,5 mm)	2½ in. (63,5 mm)
Static load (vehicle unladen)	....	....	440 lb. (200 Kg.)	330 lb. (150 Kg.)
Camber under static load	....	....	4 in. (102 mm)	4 in. (102 mm)
Free camber	....	....	6.7 in. (170 mm)	6 in. (152,4 mm)

## 109—Petrol—Rear

Number of leaves	....	....	10	10
Width of leaves	....	....	2½ in. (63,5 mm)	2½ in. (63,5 mm)
Static load (vehicle unladen)	....	....	1020 lb. (463 Kg.)	860 lb. (390 Kg.)
Camber under static load	....	....	2 in. (50 mm)	2 in. (50 mm)
Free camber	....	....	9¼ in. (235 mm)	8.2 in. (208 mm)

## 109—Diesel—Rear

Number of leaves	....	....	10	10
Width of leaves	....	....	2½ in. (63,5 mm)	2½ in. (63,5 mm)
Static load (vehicle unladen)	....	....	1020 lb. (463 Kg.)	860 lb. (390 Kg.)
Camber under static load	....	....	2 in. (50 mm)	2 in. (50 mm)
Free camber	....	....	9¼ in. (235 mm)	8.2 in. (208 mm)

## Hydraulic dampers

Type	....	....	....	Telescopic, double acting
Mounting	....	....	....	Rubber bushes

# Section K — CHASSIS — ALL MODELS

## INDEX

	Page		Page
Battery and air cleaner support		Frame alignment	
Removal ....	K-1	Check ....	K-1
Replacement ....	K-1	Front bumper ....	K-1

## LIST OF ILLUSTRATIONS

Fig.	Page	Fig.	Page
K-1 Chassis frame diagonal measurements	K-1	K-3 Chassis frame dimensions—109	K-3
K-2 Chassis frame dimensions—88	K-2		

### Frame alignment

#### To check

#### Operation K/2

Figs. K-2 and K-3 show the various dimensions that should be used as a guide in checking frame alignment. Fig. K-1 illustrates the diagonal measurements which may be taken to check the frame for "squareness". Extreme care must be taken when checking for malalignment.

When the body is removed, the frame may easily be checked against the measurements in Figs. K-1 and K-2. If the body is in position, measurements may be taken with the aid of a plumb-bob and chalk as follows:—

1. Place the vehicle on a level floor.
2. Hold the plumb line against one of the measuring points, with the bob slightly above the floor; mark the floor directly beneath the bob.
3. Repeat for other measuring points.
4. Move the vehicle away and measure between the chalk marks.

Care should be taken when measuring diagonals, that exactly corresponding points are used on each side of the frame.

### Front bumper

The channel-section front bumper is bolted to the chassis side members, so that it may be removed to facilitate repair after accidental damage.

### Battery and air cleaner support

#### To remove

#### Operation K/4

1. Remove the air cleaner. Section M.
2. Disconnect the battery leads, remove the securing cover and lift the battery clear. Note that there are two batteries and two supports on Diesel vehicles.
3. Remove the battery and air cleaner support from the chassis frame (this action releases the earth leads).

#### To replace

#### Operation K/6

1. Reverse the removal procedure.

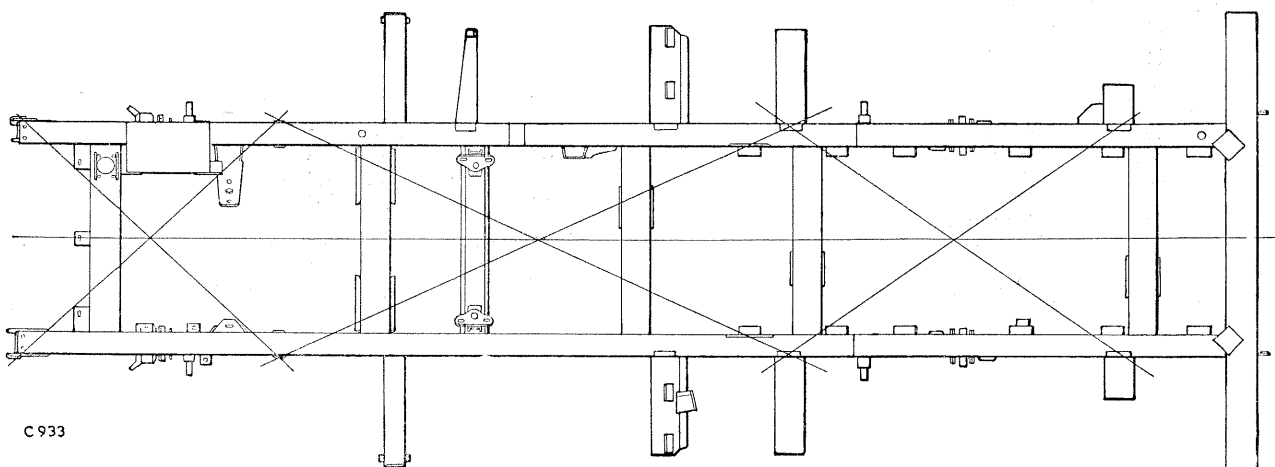


Fig. K-1—Chassis frame diagonal measurements



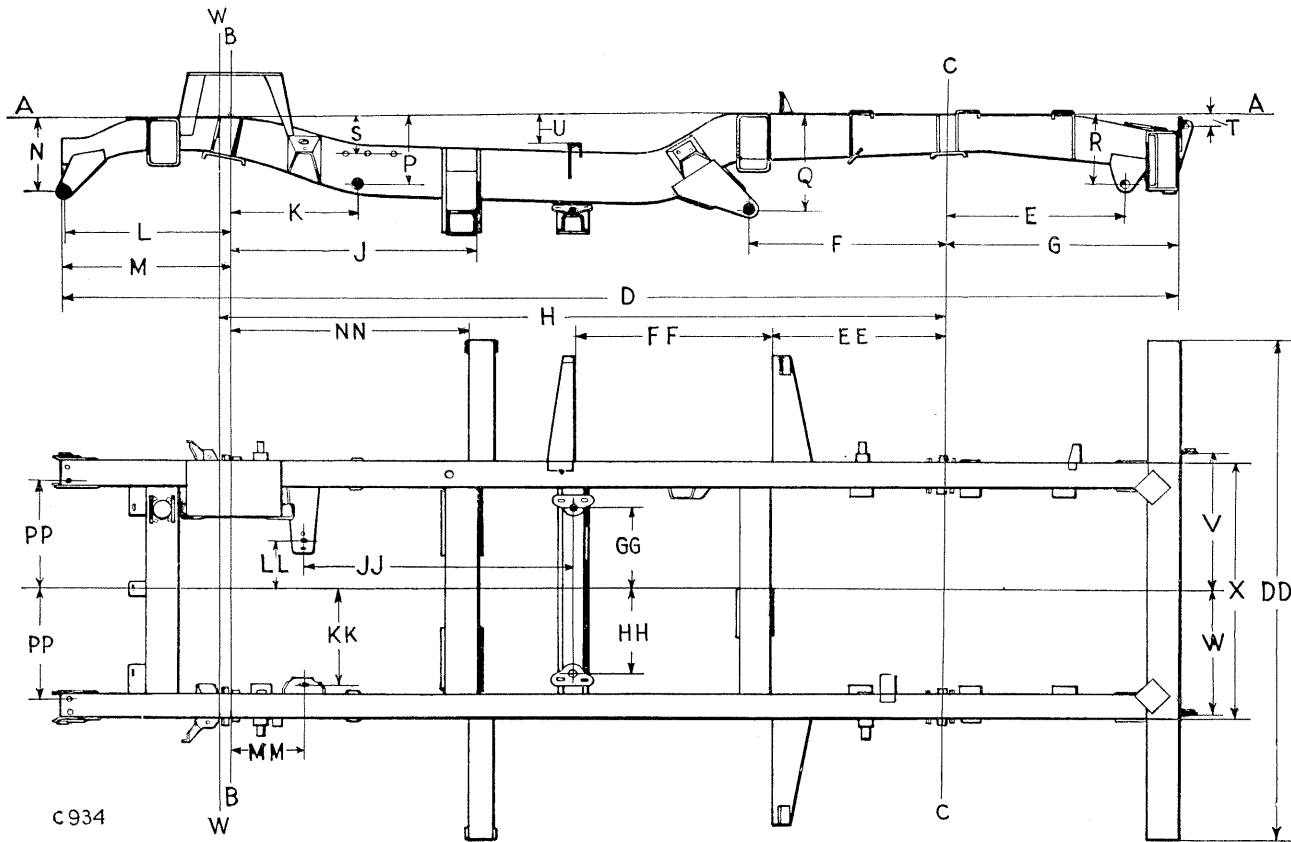


Fig. K-2—Chassis frame dimensions—88

AA—Datum line  
 BB—Centre line of front axle  
 CC—Centre line of rear axle  
 D— $134\frac{31}{32}$  in. (3,42 m)  
 E— $21\frac{1}{4}$  in. (540 mm)  
 F—24 in. (610 mm)  
 G— $28\frac{3}{4}$  in. (713 mm)  
 H—38 in. (2,235 m)  
 J— $29\frac{1}{4}$  in. (743 mm)  
 K— $14\frac{3}{8}$  in. (375 mm)  
 L—20 in. (508 mm)  
 M— $20\frac{37}{64}$  in. (523 mm)  
 N—9 in. (229 mm)  
 P— $8\frac{3}{8}$  in. (213 mm)  
 Q— $11\frac{7}{16}$  in. (297 mm)  
 R— $7\frac{13}{16}$  in. (182 mm)  
 S— $4\frac{3}{4}$  in. (121 mm)

T— $1\frac{3}{32}$  in. (29 mm)  
 U— $3\frac{1}{2}$  in. (83 mm)  
 V—17 in. (432 mm)  
 W— $15\frac{1}{2}$  in. (387 mm)  
 X—31 in. (787 mm)  
 DD— $60\frac{1}{2}$  in. (1,53 m)  
 EE— $21\frac{1}{4}$  in. (540 mm)  
 FF— $23\frac{3}{4}$  in. (603 mm)  
 GG— $10\frac{1}{8}$  in.  $\pm \frac{1}{32}$  in. (257 mm  $\pm 0,8$ )  
 HH—10 in.  $\pm \frac{1}{32}$  in. (254 mm  $\pm 0,8$ )  
 JJ— $32\frac{7}{8}$  in.  $\pm \frac{1}{32}$  in. (835 mm  $\pm 0,8$ )  
 KK— $11\frac{9}{16}$  in. (294 mm)  
 LL— $6\frac{9}{16}$  in. (167 mm)  
 MM—8 in. (203 mm)  
 NN— $28\frac{1}{2}$  in. (718 mm)  
 PP— $13\frac{1}{16}$  in.  $\pm \frac{1}{32}$  (332 mm  $\pm 0,5$ )

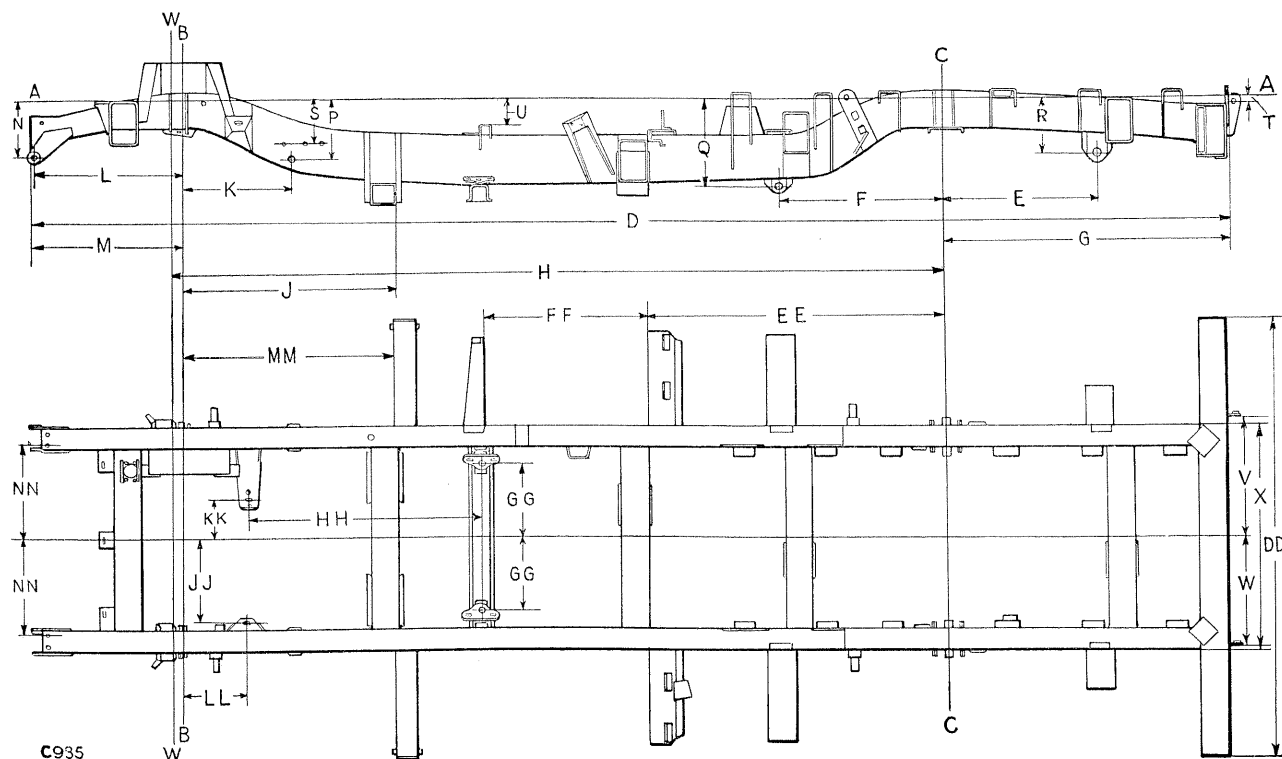


Fig. K-3—Chassis frame dimensions—109

AA—Datum line	S—4 $\frac{3}{4}$ in.	(121 mm)
BB—Centre line of front axle	T—1 $\frac{5}{32}$ in.	(29 mm)
CC—Centre line of rear axle	U—3 $\frac{1}{4}$ in.	(83 mm)
D—166 $\frac{9}{16}$ in.	V—17 in.	(432 mm)
E—21 $\frac{1}{4}$ in.	W—15 $\frac{1}{4}$ in.	(387 mm)
F—24 in.	X—31 in.	(787 mm)
G—39 $\frac{3}{8}$ in.	DD—60 $\frac{1}{2}$ in.	(1,53 m)
H—109 in.	EE—42 $\frac{1}{4}$ in.	(1,07 m)
J—29 $\frac{1}{4}$ in.	FF—23 $\frac{3}{8}$ in.	(603 mm)
K—14 $\frac{3}{8}$ in.	GG—10 $\frac{3}{8}$ in. $\pm$ $\frac{1}{32}$ in.	(257 mm $\pm$ 0,8)
L—20 in.	HH—32 $\frac{3}{4}$ in. $\pm$ $\frac{3}{32}$ in.	(835 mm $\pm$ 0,8)
M—20 $\frac{3}{4}$ in.	JJ—11 $\frac{1}{16}$ in. $\pm$ $\frac{1}{32}$ in.	(294 mm $\pm$ 0,8)
N—9 in.	KK—6 $\frac{9}{16}$ in.	(167 mm)
P—8 $\frac{3}{8}$ in.	LL—8 in.	(203 mm)
Q—11 $\frac{11}{16}$ in.	MM—28 $\frac{1}{4}$ in.	(718 mm)
R—8 $\frac{1}{16}$ in.	NN—13 $\frac{1}{16}$ in. $\pm$ $\frac{1}{64}$	(332 mm $\pm$ 0,50)



# Section L—COOLING SYSTEM—ALL MODELS

## INDEX

	Page		Page
Cleaning radiator, externally	L-6	Thermostat, 2½ litre Petrol and 2 litre Diesel	
Data	L-8	Renewal	L-4
Defect location	L-8	Visual inspection, cooling system	L-4
Draining the cooling system	L-6	Water pump, 2 litre Petrol	
Frost precautions	L-6	Removal	L-1
Radiator		Stripping	L-1
Removal	L-7	Assembling	L-2
Fitment	L-7	Fitment	L-2
Tests and adjustments		Water pump, 2½ litre Petrol and 2 litre Diesel	
Fan belt	L-5	Removal	L-2
Thermostat	L-4	Stripping	L-2
Thermostat, 2 litre Petrol		Assembling	L-2
Renewal	L-4	Fitment	L-4

## LIST OF ILLUSTRATIONS

Fig.	Page	Fig.	Page
L-1 Cross-section of water pump, 2 litre Petrol	L-2	L-4 Layout of pump, thermostat and fan, 2½ litre Petrol, 2 litre Diesel	L-5
L-2 Layout of pump, thermostat and fan, 2 litre Petrol	L-3	L-5 Radiator drain taps	L-6
L-3 Cross-section of water pump, 2½ litre Petrol, 2 litre Diesel	L-4	L-6 Radiator filler cap	L-6
		L-7 Layout of radiator and grille panel	L-7

### Water pump, 2 litre Petrol

#### To remove Operation L/2

The following procedure for removing the water pump will be modified if an engine governor or heater unit is fitted. See Section T for details of these items of extra equipment.

1. Partially drain off the coolant.
2. Slacken the dynamo mounting bolts and adjusting link bolts and push the dynamo inwards.
3. Slacken the lower clip on the top hose and the clip securing the inlet manifold hose to the inlet elbow on the thermostat housing.
4. Remove the thermostat housing from the cylinder head complete with thermostat, outlet pipe, inlet elbow and joint washer.
5. Remove the copper tube and rubber joint ring from either the bottom face of the thermostat housing or the top face of the water pump casing.
6. Remove the fan blade, pulley and distance piece.

7. Slacken the clip securing the bottom hose to the water pump inlet pipe and remove the bolt securing the pipe to the front cover.

8. Remove the water pump complete with joint washer and inlet pipe; as the pump casing is spigoted in the block, it will be necessary to oscillate it slightly as it is removed.

9. Remove the inlet pipe from the water pump.

10. The water pump may now be overhauled, or exchanged for a Service Pump Assembly, obtainable from our Parts Department.

#### To strip Operation L/4

1. Remove the bearing location bolt, place the pump in a vice and drift out the impeller, bearing and spindle as an assembly from the pump body and from hub.
2. Cut through the seal and remove from spindle, insert the spindle into the water pump body, so that the impeller is in the position of the fan pulley. The spindle and bearing may now be drifted out of the impeller.

**To assemble****Operation L/6**

1. Examine the spindle and bearing assembly; it need not be renewed if the bearing is satisfactory and the spindle is free from excessive corrosion. Clean any corroded portion of the spindle and paint with chlorinated rubber primer to prevent further action. (Part No. 261483 for half-pint tin.) As an alternative, good quality aluminium paint or other anti-corrosive paint can be used in place of a rubber primer.
2. Insert a few drops of thick oil in the location hole in the bearing.
3. Press the spindle and bearing assembly into the front of the pump body with the longer end of the spindle leading. Locate it with the set bolt and spring washer.
4. The fan pulley hub must be pressed on to the spindle to a set dimension between the front face of the pulley hub and the mounting face of the water pump casing. This dimension must be: 4.140 in. (105 mm).  
Care must be taken to set the hub to the correct dimension. When pressing on the hub, the spindle must be supported, to prevent pressure falling on the location set bolt.
5. Fit the carbon ring and seal into the bore of the pump body with the carbon ring to the rear, and fit the rubber water deflector washer.
6. Press the impeller on to the spindle until there is .020 in. (0.5 mm) clearance between the vanes and the pump body face (check with a feeler gauge). The impeller must be a *press fit* on the spindle. If the impeller is loose on the spindle, replace either part as necessary.
7. Refit the inlet pipe to the water pump.

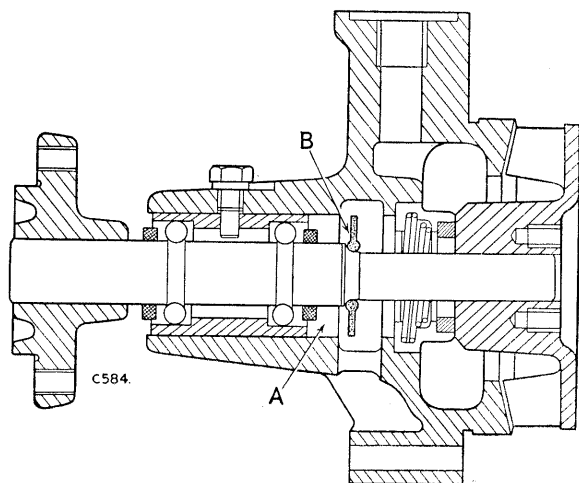


Fig. L-1—Cross-section of water pump,  
2 litre Petrol

A—Through bore housing  
B—Water deflector washer

**To refit****Operation L/8**

To refit the water pump to the engine, reverse the removal procedure, noting the following points:—

1. Renew both joint washers.
2. When fitting the fan pulley, first engage the fan belt in the pulley groove.
3. On completion, run the engine and check and rectify any leaks.

**Water pump, 2½ litre Petrol, 2 litre Diesel****To remove****Operation L/10**

1. Partially drain off coolant.
2. Slacken the dynamo mounting bolts and adjusting link bolts and push the dynamo inwards.
3. Disconnect the hoses from pump.
4. Remove the fan blade, pulley and distance piece.
5. Remove the water pump complete with joint washer.
6. The water pump may now be overhauled, or exchanged for a Service Pump Assembly, obtainable from our Parts Department.

**To strip****Operation L/12**

1. Remove the bearing location bolt, place the pump in a vice and drift out the impeller, bearing and spindle as an assembly from the pump body and from hub.
2. Cut through the seal and remove from spindle, insert the spindle into the water pump body, so that the impeller is in the position of the fan pulley. The spindle and bearing may now be drifted out of the impeller.

**To assemble****Operation L/14**

1. Examine the spindle and bearing assembly; it need not be renewed if the bearing is satisfactory and the spindle is free from excessive corrosion. Clean any corroded portion of the spindle and paint with chlorinated rubber primer to prevent further action. (Part No. 261483 for half-pint tin.) As an alternative, good quality aluminium paint or other anti-corrosive paint can be used in place of a rubber primer. A stainless steel deflector washer is fitted on later models.
2. Insert a few drops of thick oil in the location hole in the bearing.
3. Press the spindle and bearing assembly into the front of the pump body with the longer end of the spindle leading. Locate it with the set bolt and spring washer.
4. The fan pulley hub must be pressed on to the spindle to a set dimension between the front face of the pulley hub and the mounting face of the water pump casing. This dimension must be: 3.453 in. (86.5 mm). Care must be taken to set the hub to the correct dimensions. When pressing on the hub, the spindle must be supported, to prevent pressure falling on the location set bolt.

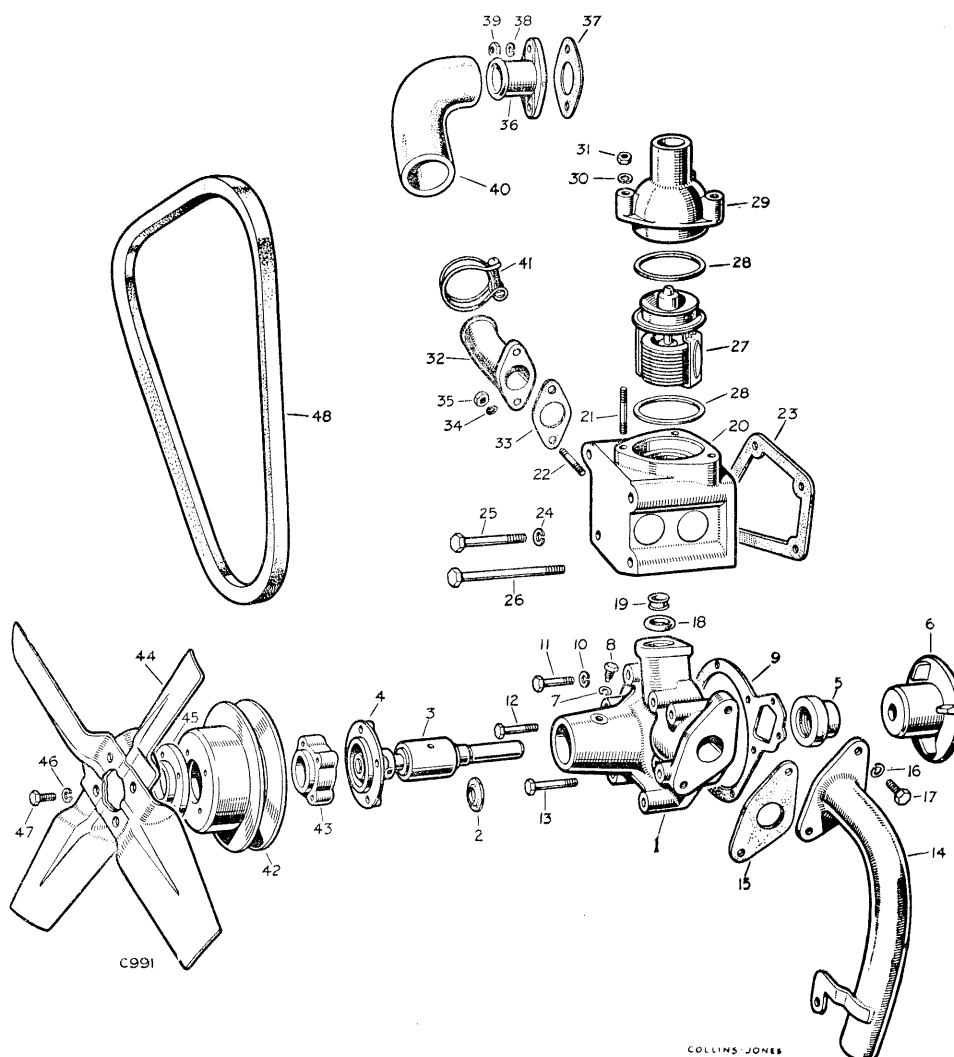


Fig. L-2—Layout of water pump, thermostat and fan, 2 litre Petrol

- |       |                                     |       |   |
|-------|-------------------------------------|-------|---|
| 1     | Water pump casing                   | 24-26 | Fixings for thermostat housing            |
| 2     | Water deflector washer              | 27    | Thermostat                                |
| 3     | Pump spindle and bearing            | 28    | Fibre washer for thermostat               |
| 4     | Hub for fan                         | 29    | Water outlet pipe, thermostat to radiator |
| 5     | Carbon ring and seal unit           | 30-31 | Fixings for outlet pipe                   |
| 6     | Impeller for pump                   | 32    | Water inlet elbow to thermostat           |
| 7     | Spring washer                       | 33    | Joint washer for inlet elbow              |
| 8     | Set bolt                            | 34-35 | Fixings for elbow                         |
| 9     | Joint washer for water pump         | 36    | Water outlet pipe from manifold           |
| 10-13 | Fixings for water pump              | 37    | Joint washer for outlet pipe              |
| 14    | Inlet pipe for water pump           | 38-39 | Fixings for water outlet pipe             |
| 15    | Joint washer for inlet pipe         | 40    | Rubber hose                               |
| 16-17 | Fixings for pipe                    | 41    | Clip for hose                             |
| 18    | Rubber joint ring                   | 42    | Fan pulley                                |
| 19    | Copper tube                         | 43    | Distance piece for fan pulley             |
| 20    | Thermostat housing assembly         | 44    | Fan blade                                 |
| 21    | Stud for outlet pipe                | 45    | Reinforcing plate for fan blade           |
| 22    | Stud for inlet pipe                 | 46-47 | Fixings for fan blade and pulley          |
| 23    | Joint washer for thermostat housing | 48    | Fan and dynamo belt                       |

5. Fit the carbon ring and seal into the bore of the pump body with the carbon ring to the rear.
6. Press the impeller on to the spindle until there is .020 in. (0,5 mm) clearance between the vanes and the pump body face (check with a feeler gauge). The impeller must be a *press fit* on the spindle. If the impeller is loose on the spindle, replace either part as necessary.
7. Refit the inlet pipe to the water pump.

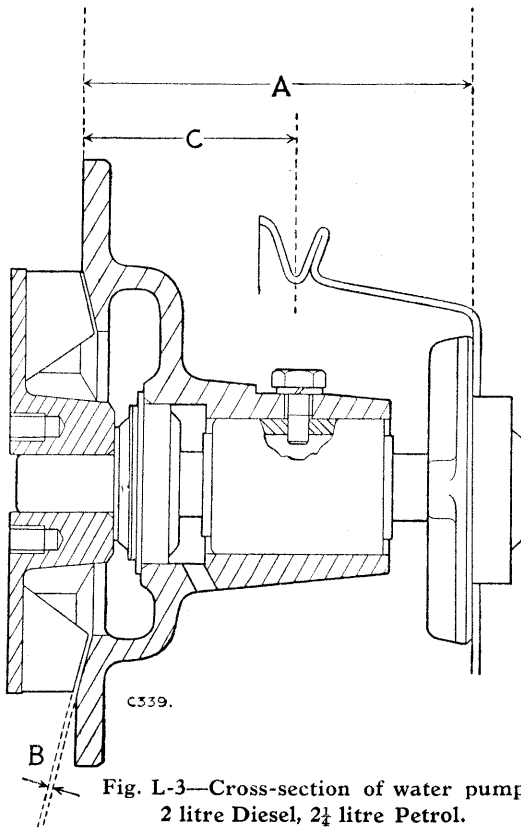


Fig. L-3—Cross-section of water pump,  
2 litre Diesel, 2 1/4 litre Petrol.  
A—3.453 in. (86,5 mm). B—.020 in. (0,5 mm).  
C—1.875 in. (48 mm).

#### To refit

#### Operation L/16

To refit the water pump to the engine, reverse the removal procedure, noting the following points:—

1. Renew joint washer.
2. When fitting the fan pulley, first engage the fan belt in the pulley groove.
3. On completion, run the engine and check and rectify any leaks.

#### Thermostat, 2 litre Petrol

If the thermostat becomes faulty in operation, overcooling or overheating of the engine will usually result. To check the thermostat, remove it from its housing and run the engine; if the overheating or overcooling is eliminated, the unit is faulty and must be renewed. Further tests may be made by immersing the thermostat in hot water, whereon

expansion of the bellow should commence between 162°F. and 171°F. and be completed at 191°F.

#### To renew

#### Operation L/18

1. Partially drain off the coolant and remove the top hose.
2. Remove the water outlet pipe from the top of the thermostat housing.
3. Lift out the thermostat from the housing, together with a fibre joint washer, above and below its flange.
4. Fit the new thermostat, together with two new joint washers.
5. Replace the water outlet pipe and top hose.
6. Refill the coolant system to the bottom of the radiator filler neck and check for leaks.

#### Thermostat, 2 1/4 litre Petrol, 2 litre Diesel

If the thermostat becomes faulty in operation, overcooling or overheating of the engine will usually result. To check the thermostat, remove it from its housing and run the engine; if the coolant temperature remains unchanged, the unit is faulty and should be renewed.

Further tests may be made by immersing the thermostat in hot water, whereon expansion of the bellows should commence between 164° F. and 173° F. and be complete at 193° F.

#### To renew

#### Operation L/20

1. Partially drain off the coolant, disconnect the top and by-pass hoses from the thermostat cover—also the heater hose if fitted—and remove the cover.
2. Lift out the thermostat from its housing and fit the new one.
3. Replace the top cover and re-connect the hoses.
4. Refill the coolant system to the bottom of filler neck and check for leaks.

#### Visual inspection, cooling system

It is a good plan to inspect the cooling system at the same time as the engine oil level is checked; such care would largely prevent the possibility of a sudden and costly delay due to coolant loss and consequent engine damage. Attention should be paid to the following points:—

1. Water level in radiator— $\frac{3}{4}$  to 1 in. (19 to 25 mm) below the bottom of the filler neck.
2. Condition of all hoses—freedom from cracks and hose clips tight.
3. Any water leaks.
4. Check that the drain taps are fully closed.

## Tests and adjustments

## Fan belt

The fan belt is of the "V" type, drive is on the sides of the belt and it is not therefore necessary to adjust it tightly and so put an excessive load on the water pump and dynamo bearings; the tension is correct when the belt can be depressed  $\frac{5}{16}$  to  $\frac{7}{16}$  in. (8 to 11 mm)—2½ litre Petrol, 2 litre Diesel, and  $\frac{1}{2}$  to  $\frac{3}{4}$  in. (12 to 19 mm)—2 litre Petrol, by thumb

pressure between the fan and crankshaft pulleys. The procedure for adjustment is as follows:—

Slacken the dynamo pivot bolts and the bolt securing the dynamo to the adjusting link. Move the dynamo outwards until the tension is correct and re-tighten the bolts.

## Thermostat

See page L-4 of this section.

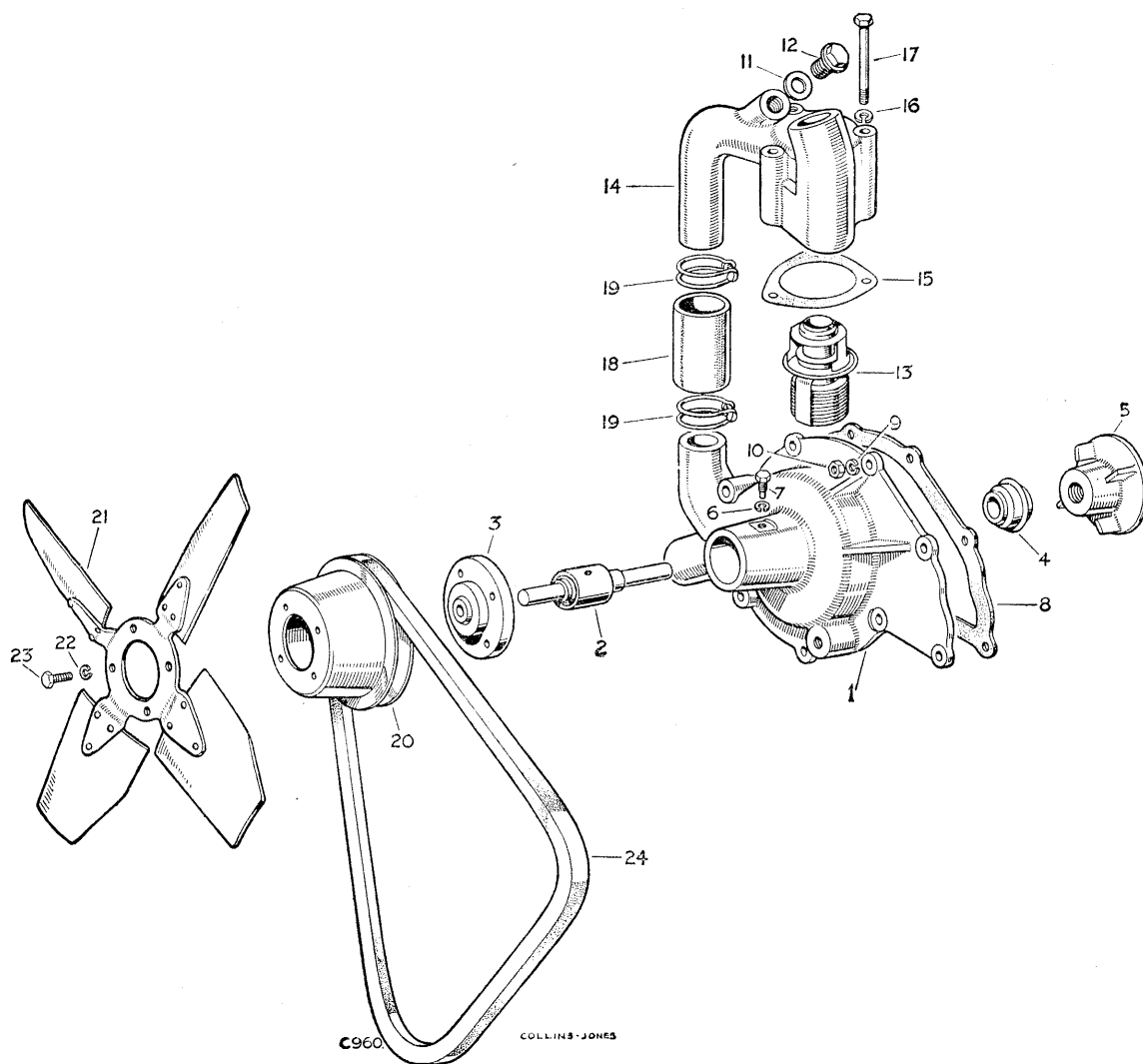


Fig. L-4—Layout of pump, thermostat and fan, 2½ litre Petrol and 2 litre Diesel

- |    |                              |    |                        |
|----|------------------------------|----|------------------------|
| 1  | Water pump casing            | 13 | Thermostat             |
| 2  | Spindle and bearing assembly | 14 | Outlet pipes and cover |
| 3  | Pulley hub                   | 15 | Joint washer for cover |
| 4  | Seal                         | 16 | Spring washer          |
| 5  | Impeller                     | 17 | Set bolt               |
| 6  | Spring washer                | 18 | By-pass hose           |
| 7  | Set bolt                     | 19 | Clip                   |
| 8  | Joint washer                 | 20 | Pulley                 |
| 9  | Spring washer                | 21 | Fan blades             |
| 10 | Nut                          | 22 | Spring washer          |
| 11 | Joint washer for plug        | 23 | Set bolt               |
| 12 | Plug                         | 24 | Driving belt           |
- } Locating spindle and bearing  
 } For casing  
 } For heater return in water outlet pipe  
 } For fan blades



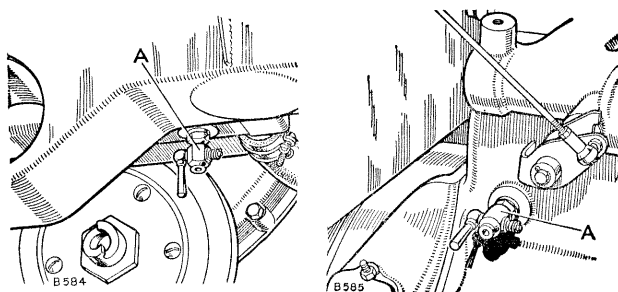
**Draining the cooling system**

The cooling system should be drained and flushed out at least twice each year in the following manner:—

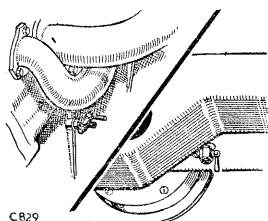
1. Remove the radiator filler cap.
2. Open the water drain taps at the bottom of the radiator and on the left-hand side of the cylinder block.
3. When the water flow has ceased, insert a piece of wire in each tap to make sure that a blockage has not been caused by rust or scale.
4. Place a hose in the radiator filler neck and fill the system; adjust the flow of water to equal that draining from the taps.
5. Run the engine for a short time to ensure thorough cleaning of the whole system.
6. Stop the engine, remove the hose and close the taps. Refill the system with clean water to the bottom of the filler neck and replace the filler cap.

The total capacity of the cooling system is: 2 litre Petrol, 2 litre Diesel—17 Imperial pints (9,5 litres) and 2½ litre Petrol—17½ Imperial pints (10,0 litres).

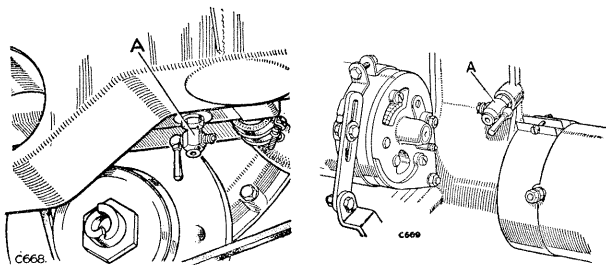
Use soft water wherever possible; if the local water supply is hard, clean rain or distilled water should be used.



A—Drain taps—2 litre Petrol



Drain taps—2½ litre Petrol



A—Drain taps—2 litre Diesel

Fig. L-5—Radiator drain taps

7. Run the engine until working temperature is reached and top the water level as necessary.

**Cleaning radiator, externally**

In the event of the cooling gills of the radiator becoming blocked with dirt, straw, etc., they should be cleaned by means of compressed air or water pressure applied from the rear, so forcing the foreign matter out through the front of the radiator. Never use a metal implement for this purpose or serious damage may result to the radiator core.

**Frost precautions**

In cold weather, when the temperature may drop to or below freezing point, precautions must be taken to prevent freezing of the water in the cooling system.

A thermostat is fitted in the system and it is therefore possible for the radiator block to freeze in cold weather even though the engine running temperature is quite high; for this reason the use of an anti-freeze mixture is essential.

Only high quality inhibited glycol-based solutions should be used.

When the temperature is between 32°F and 0°F (0°C and minus 17°C) use one part of anti-freeze to four parts of water.

Proceed as follows:—

1. Ensure that the cooling system is leak-proof; anti-freeze solutions are far more "searching" at joints than water.
2. Drain and flush the system. See "Draining the cooling system".
3. Mix the solution to the required strength in a separate container and refill the system.
4. Run the engine to ensure good circulation of the mixture.

If the vehicle is to be stored in cold weather, unless it is kept in a well-heated garage or anti-freeze solution has been used, the cooling system must be completely drained.

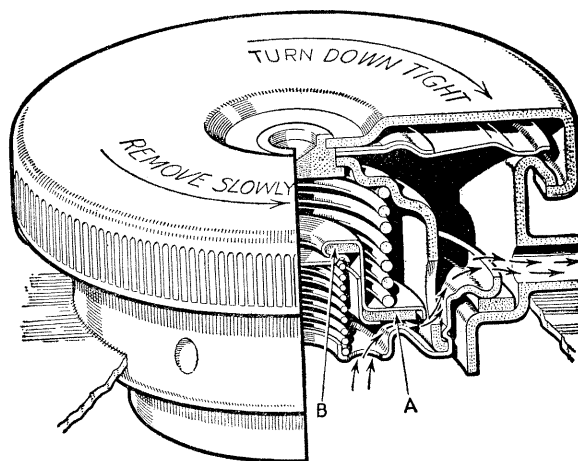


Fig. L-6—Radiator filler cap

A—Pressure relief valve (steam escape)  
B—Depression relief valve

### To remove Radiator Operation L/22

1. Drain off the coolant. Diesel only : Disconnect the lead coupling the two batteries.
2. Disconnect the top and bottom hoses from the radiator.
3. Disconnect the side lamp leads at snap connectors at each side of the grille panel assembly and the front lamp harness from the junction box at R.H. side of scuttle, then pull the wiring clear to front of engine.
4. Remove the radiator grille and chaff guard (if fitted) from the grille panel complete with the name plate.
5. Remove the fan blades.
6. Remove the bolts securing the front apron and remove panel. Remove the bolts securing the

grille panel to the front cross member and front wings.

7. Lift the radiator, grille panel and headlamps assembly upward, then forward to clear the vehicle.
8. Remove the rubber buffers from beneath the grille panel.
9. Remove the radiator block from the grille panel.
10. Remove the drain tap and joint washer from the bottom of the radiator block.
11. Remove the filler cap, complete with the joint washer, retainer and chain.

### To refit Operation L/24

1. Reverse the removal procedure, replacing the rubber buffers, if necessary, and connecting the wiring in accordance with the appropriate wiring diagram—Section P.

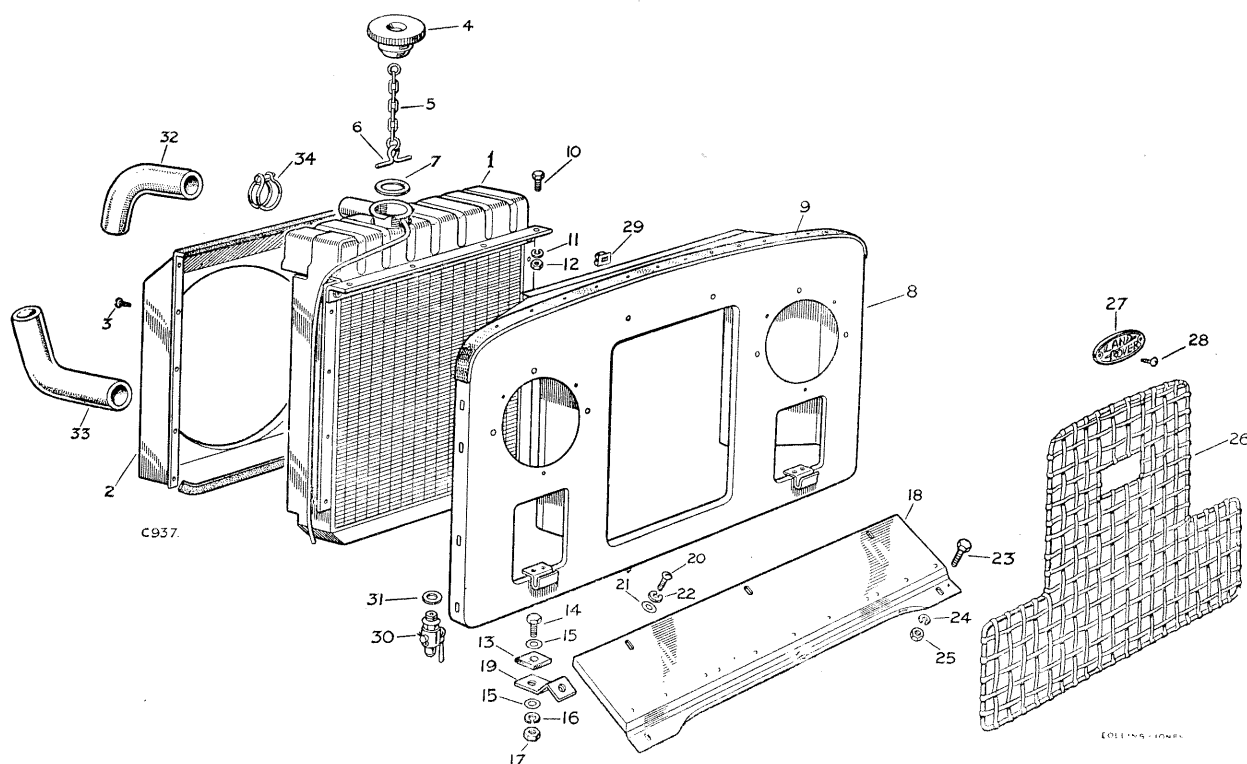


Fig. L-7—Layout of radiator and grille panel

- |  |   |
|--|---|
| 1 Radiator block assembly                      | 19 Securing bracket                             |
| 2 Cowl for fan                                 | 20-22 Fixings for apron panel—securing brackets |
| 3 Drive screw for cowl                         | 23-25 Fixings for apron panel—chassis frame     |
| 4 Filler cap for radiator                      | 26 Grille for radiator                          |
| 5 Chain for filler cap                         | 27 "Land-Rover" name plate                      |
| 6 Retainer for chain                           | 28-29 Fixings for grille and name plate         |
| 7 Joint washer for filler cap                  | 30 Drain tap for radiator                       |
| 8 Radiator grille panel assembly               | 31 Joint washer for drain tap                   |
| 9 Bonnet rest strip                            | 32 Hose for radiator, top                       |
| 10-12 Fixings for radiator block               | 33 Hose for radiator, bottom                    |
| 13-17 Fixings for grille panel and front apron | 34 Clip for radiator hoses                      |
| 18 Front apron panel                           |   |

## DEFECT LOCATION

(Symptom, Cause and Remedy)

**A—EXTERNAL LEAKAGE**

1. Loose hose clips—*Tighten.*
2. Defective rubber hose—*Renew.*
3. Damaged radiator seams—*Rectify.*
4. Excessive wear in the water pump—*Renew.*
5. Loose core plugs—*Renew.*
6. Damaged gaskets—*Renew.*
7. Leak at the heater connections or plugs—*Rectify.*
8. Leak at the water temperature gauge plug—*Tighten.*
9. Diesel only—leak from either of the four small holes in L.H. side of cylinder block—*Fit new sealing rings to liner Section A.*

**B—INTERNAL LEAKAGE**

1. Defective cylinder head gasket—*Renew, check engine oil for contamination and refill as necessary.*
2. Cracked cylinder bore or liner—*Renew cylinder block (or Diesel) liner.*
3. Loose cylinder head bolts—*Tighten. Check engine oil for contamination and refill as necessary.*

**C—WATER LOSS**

1. Overfilling—*See Instruction Manual for filling instructions.*
2. Boiling—*Ascertain the cause of engine overheating and correct as necessary.*
3. Internal or external leakage—*See items A and B.*
4. Restricted radiator or inoperative thermostat—*Flush radiator and renew the thermostat as necessary.*

**D—POOR CIRCULATION**

1. Restriction in system—*Check hoses for crimps, and flush the radiator.*
2. Insufficient coolant—*Replenish.*
3. Inoperative water pump—*Renew.*
4. Loose fan belt—*Adjust.*
5. Inoperative thermostat—*Renew.*

**E—CORROSION**

1. Excessive impurity in the water—*Use only soft, clean water (rainwater is satisfactory).*
2. Infrequent flushing and draining of system—*The cooling system should be drained and flushed thoroughly at least twice a year.*
3. Incorrect anti-freeze mixtures—*Certain anti-freeze solutions have a corrosive effect on parts of the cooling system. Only good glycol-base solutions should be used.*

**F—OVERHEATING**

1. Poor circulation—*See item D.*
2. Dirty oil and sludge in engine—*Flush and refill.*
3. Radiator fins choked with chaff, mud, etc.—*Use air pressure from the engine side of the radiator and clean out passages thoroughly.*
4. Incorrect injection pump or ignition timing—*Section A.*
5. Incorrect valve timing—*Section A.*
6. Low oil level—*Replenish.*
7. Tight engine—*New engines are very tight during the "running-in" period and moderate speeds should be maintained for the first 1,000 miles (1,500 km).*
8. Choked or damaged exhaust pipe or silencer—*Rectify or renew.*
9. Dragging brakes—*Check cause. Section H.*
10. Overloading vehicle—*In the hands of the operator.*
11. Driving in heavy sand or mud—*In the hands of the operator.*
12. Engine labouring on grades—*In the hands of the operator.*
13. Low gear work—*In the hands of the operator.*
14. Excessive engine idling—*In the hands of the operator.*

**G—OVERCOOLING**

1. Defective thermostat—*Renew.*

**DATA****Capacity of cooling system—**

2 litre Petrol, 2 litre Diesel	....	....	17 Imperial pints (9,5 litres)
--------------------------------	------	------	--------------------------------

**Capacity of cooling system—**

2½ litre Petrol	....	17½ Imperial pints (10,0 litres)
-----------------	------	----------------------------------

**Radiator**

Filler cap pressure valve opens at:

2 litre Petrol models	4 lb/sq.in. (3 Kg/cm²)
2½ litre Petrol (early models) and Diesel models	.... 10 lb/sq.in. (0,7 Kg/cm²)
2½ litre Petrol (late models)	.... 9 lb/sq.in. (0,6 kg/cm²) identified by figure '9'
<b>Not interchangeable with 10 lb/sq.in. (0,7 kg/cm²) type</b>	

Filler cap vacuum valve opens at .... 1 lb/sq.in. (0,07 Kg/cm²)

**Thermostat**

Type	....	....	Bellows
Opening temperature—			
2 litre Petrol	Commences at	....	162° to 171°F (72°-77°C)
	Fully open at	....	191°F (88°C)
Opening temperature—			
2½ litre Petrol, 2 litre Diesel	Commences at	....	164° to 173°F (73°-78°C)
	Fully open at	....	193°F (89,4°C)

**Water pump**

Type	....	....	Centrifugal impeller
Dimensions between front face of pulley and mounting face of pump body			
2 litre Petrol	....	4.140 in. (105 mm)	
2½ litre Petrol and 2 litre Diesel	....	3.453 in. (86,5 mm)	

Clearance between impeller vanes and pump body .... 0.20 in. (0,5 mm)

# Section M—FUEL SYSTEM—ALL MODELS

## INDEX

	Page		Page
Accelerator pump		Fuel pipe: tank to sediment bowl	
Renewal	M-7	Renewal	M-12
Accelerator pump membrane		Fuel pump—2 litre Petrol	
Renewal	M-8	Removal	M-14
Accelerator pump operating rod		Fitment	M-14
Adjustment	M-7	Stripping	M-14
Additional filter		Assembling	M-14
Renewal	M-25	Fuel pump—2½ litre Petrol and Diesel	
Air cleaner		Testing on vehicle	M-17
Removal	M-9	Removal	M-17
Fitment	M-9	Overhaul	M-17
Carburettor		Testing without special equipment	M-18
Removal	M-7	Fitment	M-19
Fitment	M-7	Fuel pump filter and sediment bowl	
Carburettor jets and controls		Removal and cleaning	M-19
Fault location	M-7	Fitment	M-19
Contact breaker	M-14	Fuel return pipe—Renewal	M-12
Data	M-34	Fuel system—Diesel	M-20
Defect location	M-33	Injection pump	
Filler pipe and fuel tank		Removal	M-26
Removal	M-9	Fitment and timing	M-26
Fitment	M-9	Injection pump filter	
Filters	M-21, M-24	Removal and cleaning	M-26
Fuel injection nozzle		Fitment	M-26
Checking on vehicle	M-28	Magnet assembly	M-15
Testing on vehicle	M-28	Main filter	
Bench testing	M-28	Removal	M-21
Dismantling and cleaning	M-30	Fitment	M-21
Back leakage	M-31	Removal—filter in position	M-21
Pressure setting	M-31	Priming the fuel system	M-25
Seat tightness	M-32	Sediment bowl	
Spray form	M-32	Removal and fitment	M-12
Fuel inlet hose		Speed jet membrane—Renewal	M-8
Renewal	M-9	Valve cage	M-14

## LIST OF ILLUSTRATIONS

Fig.	Page	Fig.	Page
M-1	Layout of carburettor, 2 litre Petrol	M-23	Diagram of fuel system, Diesel models
M-2	Layout of carburettor, 2½ litre Petrol	M-24	Sectioned view of main fuel filter
M-3	Carburettor jets and controls, 2 litre Petrol	M-25	Paper element filter, twin system
M-4	Carburettor jets and controls, 2½ litre Petrol	M-26	Layout of fuel injection system, late models
M-5	Setting accelerator pump operating rod, 2 litre Petrol	M-27	Layout of twin filters
M-6	Setting accelerator pump operating rod, 2½ litre Petrol	M-28	Priming the fuel system
M-7	Layout of accelerator pump membrane assembly, 2 litre Petrol	M-29	Air vent on filter
M-8	Layout of accelerator pump membrane assembly, 2½ litre Petrol	M-30	Injection pump filter
M-9	Layout of speed jet membrane assembly	M-31	Injection pump timing marks correctly aligned
M-10	Air cleaner	M-32	Extension shaft, revolution counter
M-11	Layout of fuel system	M-33	Pump control screws
M-12	Fuel sediment bowl	M-34	Pump screws adjusted and sealed
M-13	Exploded view of fuel pump, 2 Litre Petrol	M-35	Testing nozzle assemblies on vehicle
M-14	Layout of valve cage	M-36	Exploded view of injection nozzle and holder assembly
M-15	Contact breaker	M-37	Injection nozzle setting outfit
M-16	Feed terminal assembly	M-38	Clearing nozzle body oil feed passages
M-17	Armature impact washer	M-39	Scraping nozzle body annular recess
M-18	Armature adjustment	M-40	Removing carbon from valve seat
M-19	Holding armature in position	M-41	Cleaning Pintaux nozzle hole
M-20	Sectioned view of fuel pump	M-42	Removing carbon from nozzle valve cone
M-21	Exploded view of fuel pump	M-43	Cleaning auxiliary spray hole
M-22	Removing sediment bowl	M-44	Flushing nozzle body
		M-45	Injection nozzle lapped faces
		M-46	Sectioned view of adaptor
		M-47	Nozzle spray form development

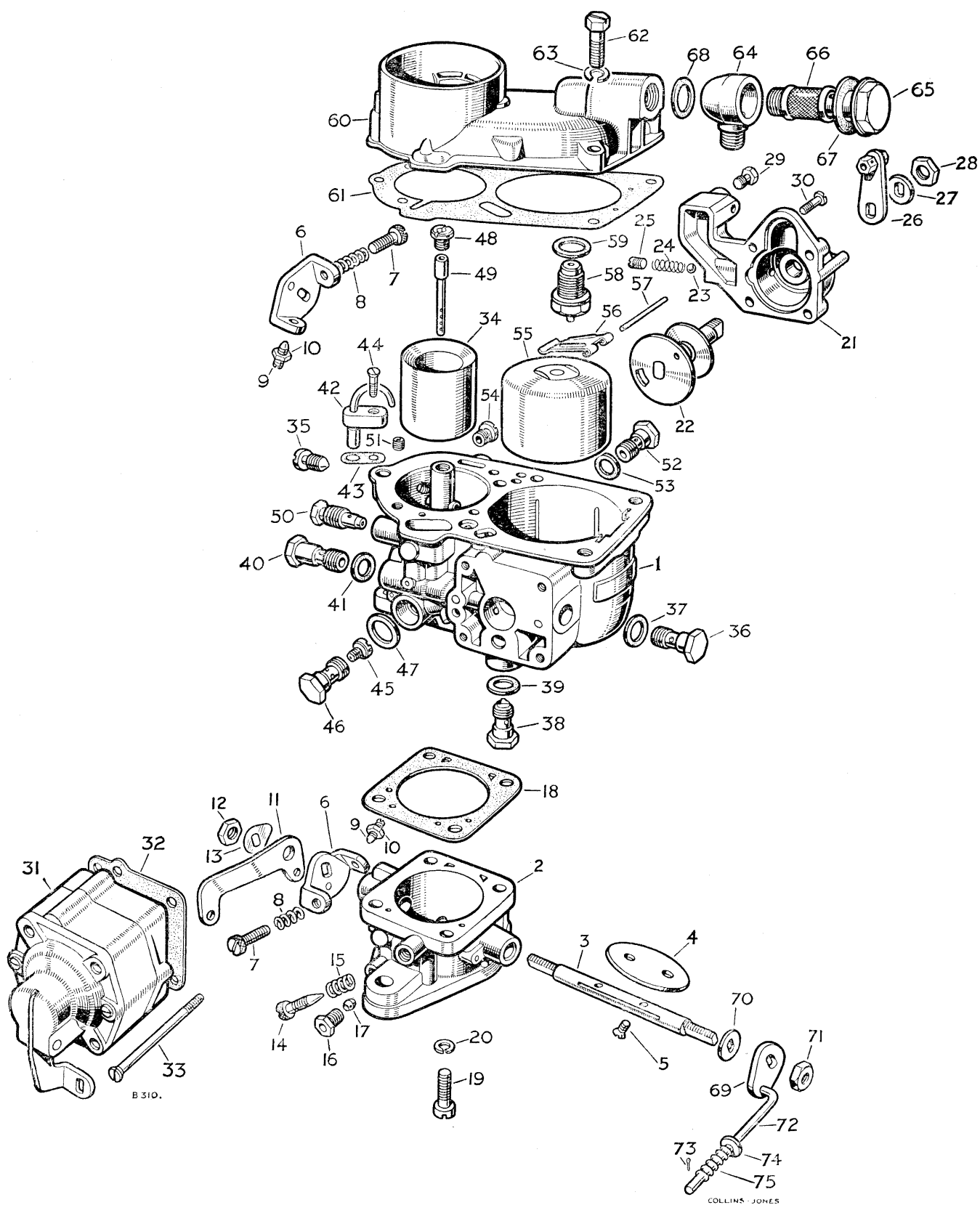


Fig. M-1—Layout of carburettor, 2 litre Petrol

## Key to Fig. M-1

- |       |                                     |    |                                  |
|-------|-------------------------------------|----|----------------------------------|
| 1     | Carburettor body                    | 39 | Fibre washer for valve           |
| 2     | Throttle chamber                    | 40 | Jet (75) accelerator pump        |
| 3     | Spindle for throttle                | 41 | Fibre washer for jet             |
| 4     | Butterfly for throttle              | 42 | Pump injector                    |
| 5     | Special screw fixing butterfly      | 43 | Joint washer for pump injector   |
| 6     | Plate, throttle abutment            | 44 | Special screw fixing injector    |
| 7     | Special screw                       | 45 | Main jet (115)                   |
| 8     | Spring                              | 46 | Bolt, main jet carrier           |
|       | } For slow running adjustment       | 47 | Fibre washer for bolt            |
| 9     | Special screw                       | 48 | Correction jet (170)             |
| 10    | Locknut                             | 49 | Emulsion tube                    |
|       | } For throttle stop                 | 50 | Pilot jet (55)                   |
| 11    | Throttle lever                      | 51 | Jet air bleed (1.5)              |
| 12    | Nut fixing throttle lever           | 52 | Starter jet, petrol (135)        |
| 13    | Lockwasher for nut                  | 53 | Fibre washer for jet             |
| 14    | Special screw                       | 54 | Starter jet, air (5.5)           |
| 15    | Spring                              | 55 | Float                            |
|       | } For mixture control               | 56 | Toggle for float                 |
| 16    | Screwed union                       | 57 | Spindle for toggle               |
| 17    | Olive                               | 58 | Needle valve complete            |
|       | } For suction pipe                  | 59 | Fibre washer for valve           |
| 18    | Joint washer for throttle chamber   | 60 | Top cover for carburettor        |
| 19-20 | Fixings for chamber                 | 61 | Joint washer for top cover       |
| 21    | Starter body                        | 62 | Special screw fixing top cover   |
| 22    | Starter valve complete              | 63 | Spring washer for screw          |
| 23    | Ball                                | 64 | Banjo union                      |
| 24    | Spring                              | 65 | Special bolt for union           |
|       | } For starter valve                 | 66 | Filter gauze for union           |
| 25    | Plug retaining starter valve spring | 67 | Fibre washer, large              |
| 26    | Lever for starter                   | 68 | Fibre washer, small              |
| 27    | Special washer for lever            |    | } For union                      |
| 28    | Nut fixing starter lever            | 69 | Lever for accelerator pump rod   |
| 29    | Special bolt fixing starter cable   | 70 | Special washer for lever         |
| 30    | Special screw fixing starter body   | 71 | Nut fixing lever to spindle      |
| 31    | Accelerator pump complete           | 72 | Control rod for accelerator pump |
| 32    | Joint washer for pump               | 73 | Split pin                        |
| 33    | Special screw fixing pump           | 74 | Plain washer                     |
| 34    | Choke tube (25)                     | 75 | Spring                           |
| 35    | Special screw fixing choke tube     |    | } For control rod                |
| 36    | Jet economy (50)                    |    |                                  |
| 37    | Fibre washer for jet                |    |                                  |
| 38    | Non-return valve                    |    |                                  |

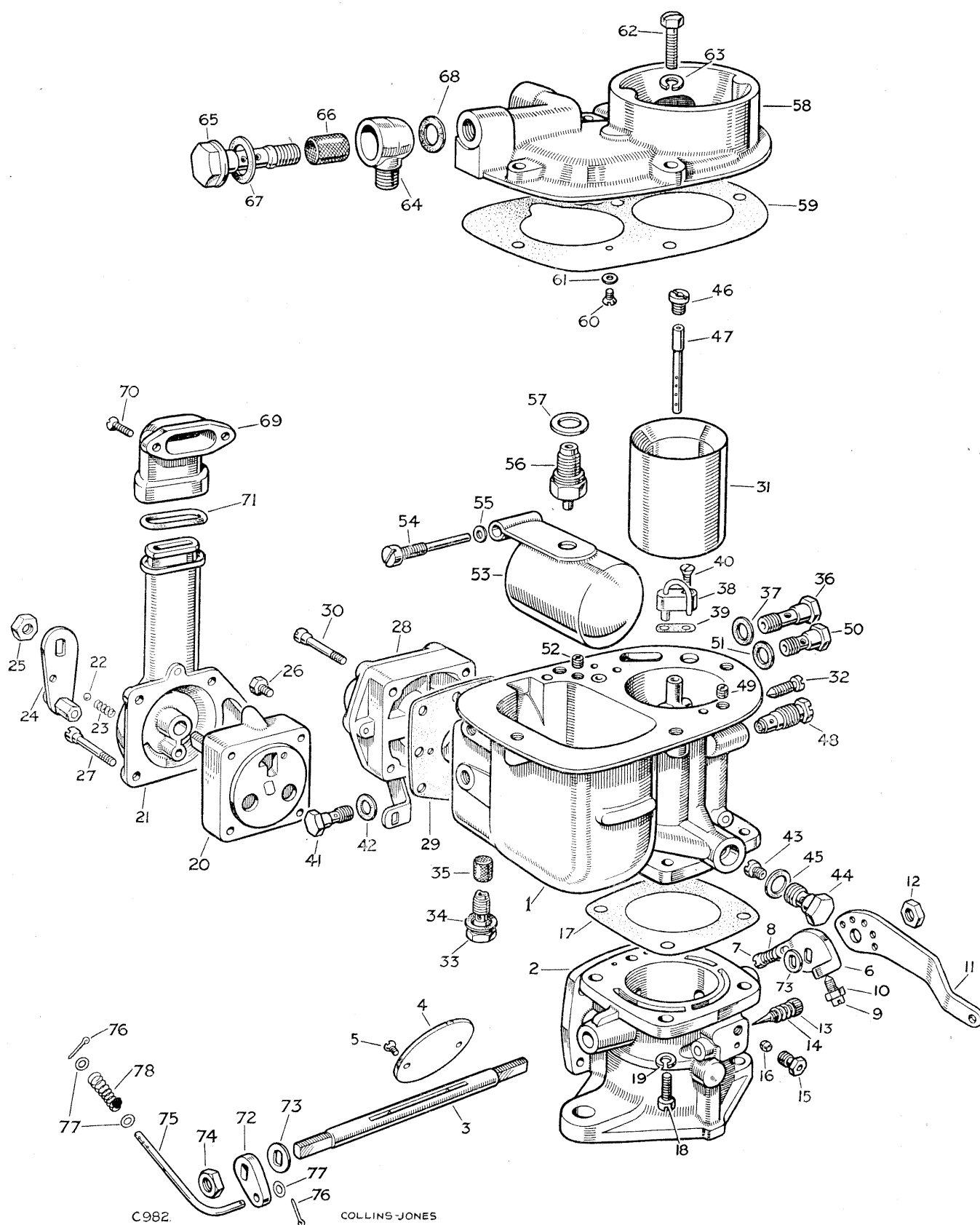


Fig. M-2—Layout of carburettor, 2½ litre Petrol

Key to Fig. M-2

- |       |                                    |       |   |
|-------|------------------------------------|-------|---|
| 1     | Carburetter body                   | 40    | Special screw fixing injector                 |
| 2     | Throttle chamber                   | 41    | Economy jet (blank)                           |
| 3     | Spindle for throttle               | 42    | Joint washer for blank jet                    |
| 4     | Butterfly for throttle             | 43    | Main jet (125)                                |
| 5     | Special screw fixing butterfly     | 44    | Main jet carrier                              |
| 6     | Plate, throttle abutment           | 45    | Fibre washer for carrier                      |
| 7     | Special screw                      | 46    | Correction jet (185)                          |
| 8     | Spring                             | 47    | Emulsion tube                                 |
| 9     | Special screw                      | 48    | Pilot jet (50)                                |
| 10    | Locknut                            | 49    | Jet air bleed (1.5)                           |
| 11    | Throttle lever                     | 50    | Starter jet, petrol (145)                     |
| 12    | Nut fixing throttle lever          | 51    | Fibre washer for jet                          |
| 13    | Special screw                      | 52    | Economy jet (100)                             |
| 14    | Spring                             | 53    | Float   |
| 15    | Screwed union                      | 54    | Spindle for float                             |
| 16    | Olive                              | 55    | Copper washer for spindle                     |
| 17    | Joint washer for throttle chamber  | 56    | Needle valve complete                         |
| 18-19 | Fixing chamber to carburetter body | 57    | Fibre washer for valve                        |
| 20    | Starter body and valve             | 58    | Top cover for carburetter                     |
| 21    | Cover for starter                  | 59    | Joint washer for top cover                    |
| 22    | Ball                               | 60-61 | Fixings—joint washer to top cover             |
| 23    | Spring                             | 62-63 | Fixings—top cover to body                     |
| 24    | Lever for starter                  | 64    | Banjo union                                   |
| 25    | Nut fixing starter lever           | 65    | Special bolt for union                        |
| 26    | Special bolt fixing starter cable  | 66    | Filter gauze for union                        |
| 27    | Special screw fixing starter body  | 67    | Fibre washer, large                           |
| 28    | Accelerator pump complete          | 68    | Fibre washer, small                           |
| 29    | Joint washer for pump              | 69    | Elbow for top cover                           |
| 30    | Special screw fixing pump          | 70    | Screw fixing elbow to top cover               |
| 31    | Choke tube (28)                    | 71    | Rubber sealing washer, elbow to starter cover |
| 32    | Special screw fixing choke tube    | 72    | Lever for accelerator pump rod                |
| 33    | Non-return valve                   | 73    | Special washer for lever                      |
| 34    | Fibre washer for valve             | 74    | Nut fixing lever to spindle                   |
| 35    | Filter gauze for non-return valve  | 75    | Control rod for accelerator pump              |
| 36    | Jet, accelerator pump (65)         | 76    | Split pin                                     |
| 37    | Fibre washer for jet               | 77    | Plain washer                                  |
| 38    | Pump injector                      | 78    | Spring  |
| 39    | Joint washer for pump injector     |       |   |



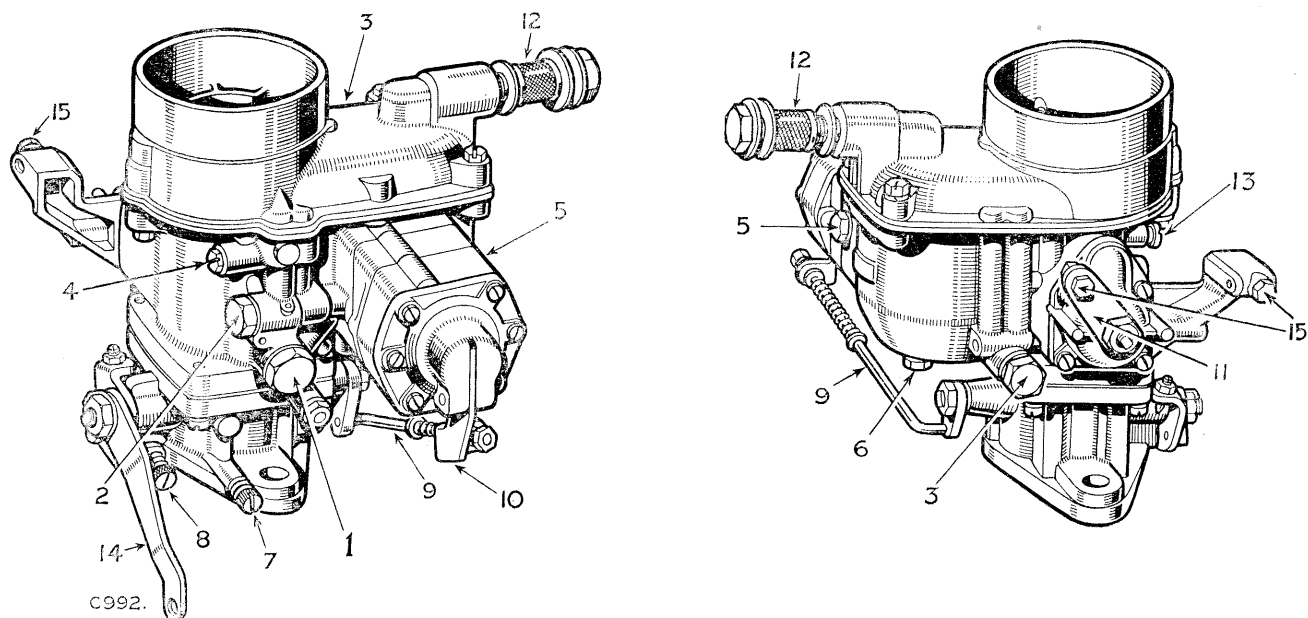


Fig. M-3—Carburettor jets and controls, 2 litre Petrol

- 1 Main jet
- 2 Accelerator pump jet
- 3 Starter jet, petrol
- 4 Pilot jet
- 5 Economy jet (blank on 2½ litre)
- 6 Non-return valve
- 7 Mixture control
- 8 Slow running adjustment

- 9 Pump operating rod
- 10 Pump operating lever
- 11 Lever for starter
- 12 Banjo union
- 13 Special screw fixing choke tube
- 14 Throttle lever
- 15 Cold start cable clamping bolts

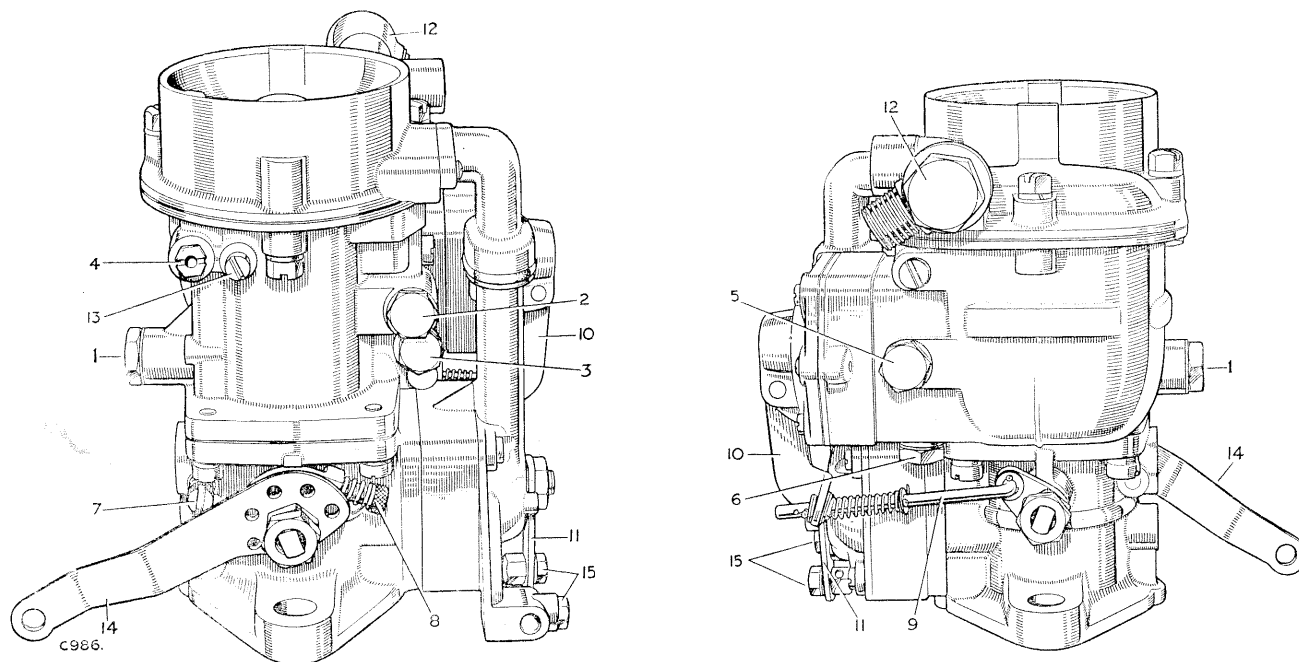


Fig. M-4—Carburettor jets and controls, 2½ litre Petrol

### Carburettor—Petrol models

#### To remove

#### Operation M/2

1. Disconnect the air cleaner connection from the carburettor intake orifice.
2. Remove the air cleaner.
3. Disconnect the feed pipe from the carburettor inlet banjo.
4. Disconnect the distributor suction pipe from the carburettor and pull pipe clear.
5. Disconnect the accelerator connecting rod from the carburettor throttle lever, at a ball joint.
6. Release the cold start control cable from the cold start lever on the carburettor.
7. Remove the carburettor from the inlet manifold, together with two joint washers and a packing washer.

#### To refit

#### Operation M/4

1. Reverse the removal procedure.
2. Renew the joint washers and packing washer.
3. Check the operation of the cold start control (2 Litre Petrol—three positions on the cold start lever, 2½ Litre Petrol—ensure that maximum travel—both ways—is easily obtained).

### Carburettor jets and controls

#### Fault location

#### Operation M/6

1. If acceleration is bad, make sure that the speed jet is not choked (such a condition, however, will seriously affect the general performance).
2. Failure of the accelerator pump membrane will be shown by weak mixture and spitting in the carburettor on rapid acceleration.  
It can be checked by pumping the throttle with the engine running and vehicle stationary, and noting the petrol delivery from the injector tube; if the delivery is small, renew the accelerator pump membrane. Operation M/12.
3. **2 Litre Petrol:** Failure of the speed jet membrane will cause a rich mixture at all times, particularly at small throttle openings, and result in excessive fuel consumption. To rectify, renew the speed jet membrane. Operation M/14.
4. At all times when accelerator pump trouble is suspected, the non-return ball valves in the pump system should be inspected for correct seating. The valves are positioned as follows: one valve in the petrol inlet to pump, the second in the injector tube, and, 2 Litre Petrol only, a third in the pump assembly outlet, visible when the pump is removed from the carburettor.

### To overhaul

#### Accelerator pump

#### To renew

#### Operation M/8

1. Disconnect the operating rod from the pump lever and remove the four set screws at the corners of the pump body and lift off the pump complete. Do not remove the other two set screws in the centre of the body.
2. Fit the new accelerator pump, entering the rod into the pump operating lever at the same time.
3. Adjust the pump operating rod. Operation M/10.

#### Accelerator pump operating rod

#### To adjust

#### Operation M/10

1. Remove the split pin behind the spring and allow the spring to move back along the rod.
2. Slacken the slow running screw right off.

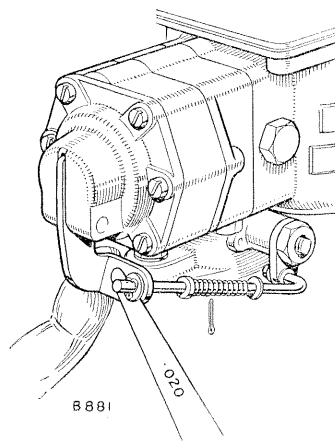


Fig. M-5—  
Setting accelerator  
pump operating rod  
2 litre Petrol

3. With the throttle fully closed and the operating lever just about to operate the pump diaphragm, add washer/s on the end of the rod up to the nearest split pin hole, ensuring that there remains .20 in. (0,5 mm) clearance between the lever and the first washer when the outer split pin is fitted.

This clearance ensures that there is no lost movement of the lever travel.

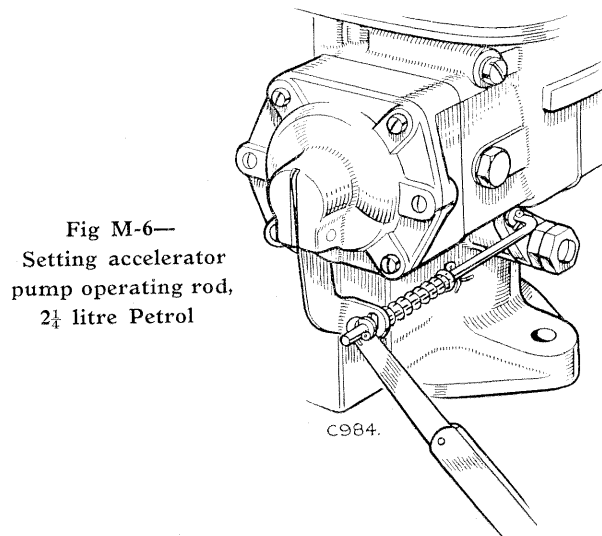


Fig M-6—  
Setting accelerator  
pump operating rod,  
2½ litre Petrol

4. Compress the spring and replace the inner split pin.
5. Check that the spring is not coilbound when the throttle is fully open.

### Accelerator pump membrane

To renew

Operation M/12

1. Remove the outer split pin and washer(s) securing the operating rod to the pump lever (the washer(s) should be preserved).
2. Remove the four set screws at the corners of the pump body and lift off pump complete.

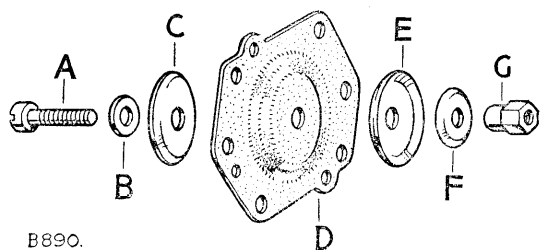


Fig. M-7—Layout of accelerator pump membrane assembly, 2 litre Petrol

A—Operating rod  
B—Fibre washer  
C—Dished washer  
D—Membrane  
E—Dished washer  
F—Distance washer  
G—Securing nut

3. Remove the two set screws in the centre of the body and part the pump end cover, together with the membrane assembly, from the pump body; remove the spring from the recess in the pump body.
4. Part the membrane from the outer cover and remove the operating rod from its centre. Discard the membrane.
5. Fit the operating rod to the new membrane (Figs M-7 and M-8) taking care not to twist the membrane when tightening the securing nut.

Secure the nut by staking.

6. Clean the pump body and end cover joint faces.
7. Replace the spring in the recess of the pump body. Place the end cover together with the membrane assembly in position on the pump body and insert the two set screws, which must not be tightened at this stage.

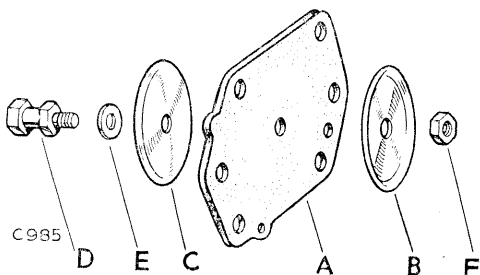


Fig. M-8—Layout of accelerator pump membrane assembly, 2 1/2 litre Petrol

A—Membrane  
B—Dished washer  
C—Dished washer  
D—Operating rod  
E—Fibre washer  
F—Securing nut

8. Depress the pump membrane by means of the operating lever and tighten the two screws fully.
9. Refit the accelerator pump unit to the carburetter, entering the rod into the pump operating lever at the same time; renew the neoprene joint washer if necessary.
10. Adjust the pump operating rod. Operation M/10.

### Speed jet membrane—2 litre Petrol only

To renew

Operation M/14

1. Remove the outer split pin and washer(s) securing the operating rod to the pump lever (the washer(s) should be preserved).
2. Remove the four screws at the corners of the pump body and lift off the pump complete.
3. Remove the two set screws in the centre of the body and separate the two halves of the pump body; remove the speed membrane assembly and the spring.
4. Remove the pump shaft from the centre of the membrane and discard the membrane.
5. Fit the pump shaft to the new membrane so that the small hole for the air duct tube (E) is on the left of the securing nut (G) (Fig. M-9). Care must be taken not to twist the membrane when tightening the securing nut. Secure the nut by staking.

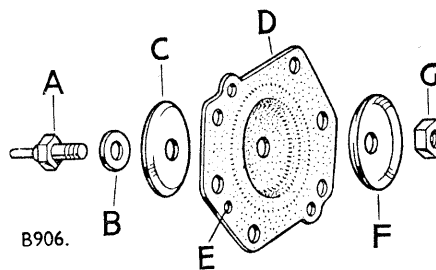


Fig. M-9—Layout of speed jet membrane assembly

A—Pump shaft  
B—Fibre washer  
C—Dished washer  
D—Membrane  
E—Air duct tube hole  
F—Dished washer  
G—Securing nut

6. Clean the joint faces of the two halves of the pump body.
7. Place the membrane assembly in position on the inner half of the pump body, locating it by means of the small air duct tube.
8. With the spring in its recess, place the outer half of the pump body in position on the inner half and secure with two set screws.
9. Refit the accelerator pump unit to the carburetter, entering the rod into the pump operating lever at the same time; renew the joint washer if necessary.
10. If necessary, adjust the pump operating rod, Operation M/10.

### Air cleaner—all models

The air cleaner must be removed and cleaned at frequent intervals if an excessive rate of engine wear is to be avoided; the actual intervals will depend solely on operating conditions.

Under clean road conditions in a temperate climate, the oil bath need only be cleaned and refilled when engine oil changes are due, but when the vehicle is operated in a dust-laden atmosphere, desert, sub-tropical or tropical conditions—cleaning may be necessary twice daily.

#### To remove

#### Operation M/16

1. Disconnect the air intake pipe from cleaner.

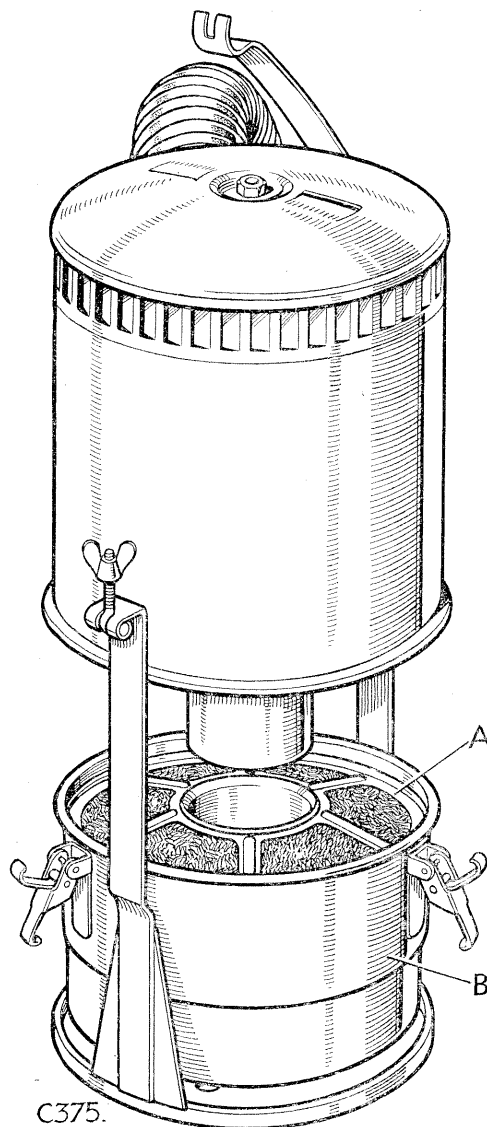


Fig. M-10—Air Cleaner

A—Oil level B—Oil level mesh

2. Release the clamping strap securing air cleaner and lift the assembly clear.
3. Detach the oil bowl by releasing the three securing clips.
4. Remove the gauze from oil bowl and wash all parts thoroughly in petrol or paraffin.
5. Drain off surplus petrol or paraffin, then refill the oil bowl to the level mark.
6. Refit the unit.

#### To refit

#### Operation M/18

1. Reverse the removal procedure.

### Fuel tank—all models

#### To remove

#### Operation M/20

1. Disconnect the battery.  
Diesel models: disconnect the positive lead of R.H. battery.
2. Remove the R.H. seat cushion and squab.
3. Detach the fuel feed pipe and—Diesel—spill back pipe—from the unions on the top of the tank.
4. Disconnect the wire from the level gauge unit.
5. Disconnect, at the tank end, the fuel inlet hose and air pipe.
6. Drain the tank, then remove the tank from below.

#### To refit

#### Operation M/22

1. Reverse removal procedure, connecting wiring in accordance with the wiring diagram.

### Fuel inlet hoses

#### To renew

#### Operation M/24

1. Remove the R.H. seat squab.
2. Loosen the clips securing the hoses to metal pipes.
3. Remove the hoses.
4. Fit new hoses and tighten clips.
5. Refit the seat squab.

### Filler pipe assembly

#### To renew

#### Operation M/26

1. Remove the securing nuts and bolts and remove cover panel.
2. Tilt seat squab forward and slacken upper hose clips.

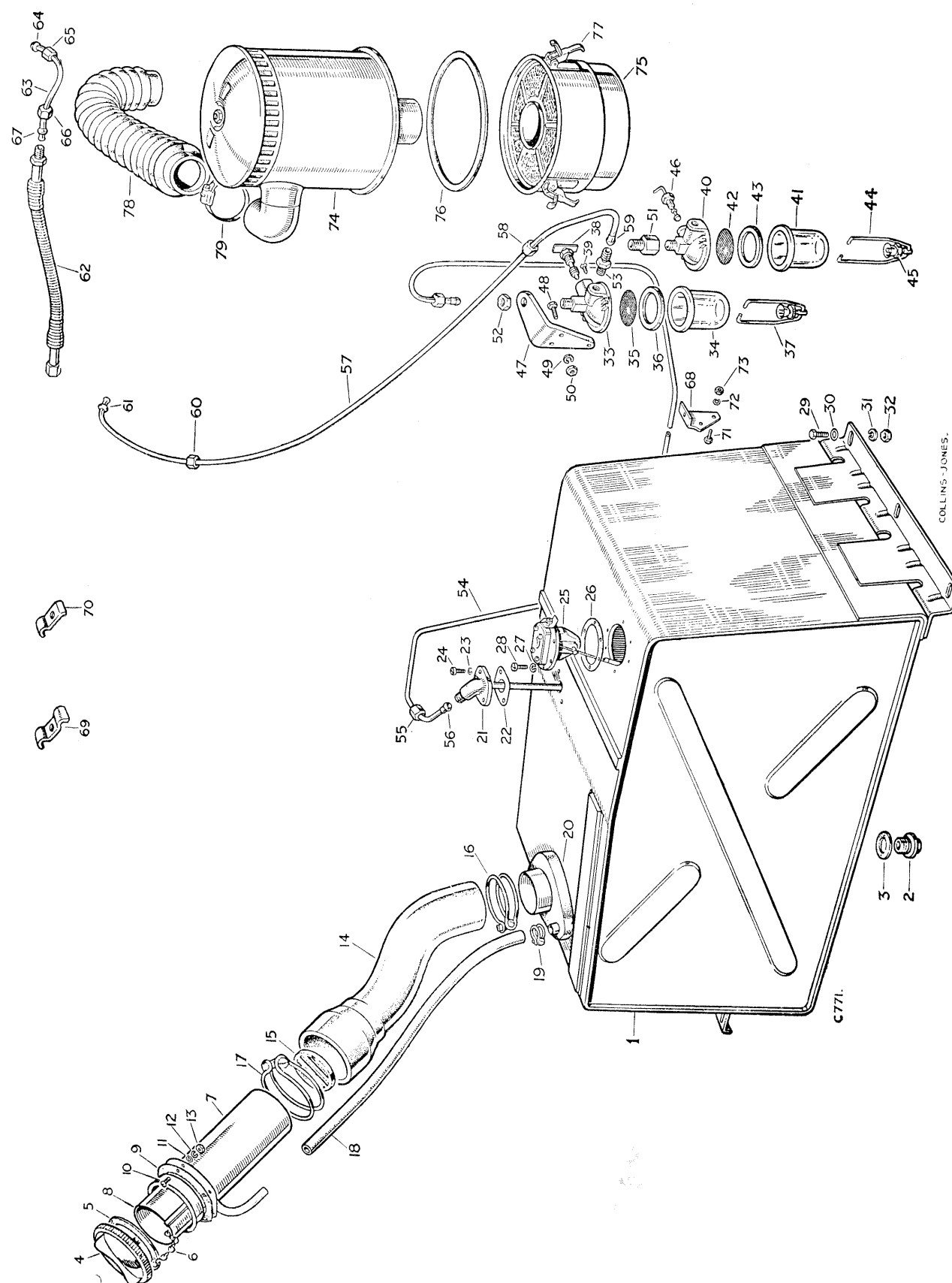


Fig. M-11—Layout of fuel system

Key to Fig. M-11

1	Fuel tank	40	Sediment bowl body
2	Drain plug, for tank	41	Bowl
3	Joint washer	42	Gauze for bowl
4	Filler cap	43	Joint washer
5	Joint washer	44	Retainer for bowl
6	Chain for filler cap	45	Screw cap for retainer
7	Filler tube	46	Tap and gland
8	Extension tube for filler	47	Bracket for sediment bowl
9	Grommet for fuel tank filler	48-50	Fixings—bracket to dash
10-13	Fixings—filler to body side	51	Inlet adaptor for sediment bowl
14	Hose, tank to filler tube	52	Nut, fixing adaptor and bowl to bracket
15	Anti-theft grid	53	Outlet union for sediment bowl
16-17	Fixings—clips	54	Petrol pipe, tank to bowl
18	Breather hose	55-56	Fixings—pipe to tank and bowl
19	Clip	57	Petrol pipe, bowl to pump
20	Rubber seal for filler pipe	58-61	Fixings, pipe to bowl and pump
21	Outlet elbow for tank	62	Flexible petrol pipe
22	Joint washer for elbow	63	Petrol pipe, flex to carburetter
23-24	Fixings—elbow to tank	64-67	Fixings, pipe to flex and carburetter
25	Gauge unit	68	Fuel pipe retaining bracket
26	Gasket	69	Clip for fuel pipes—Diesel models
27-28	Fixings—gauge unit to tank	70	Clip for fuel pipes—Petrol models
29-32	Fixings—fuel tank to chassis	71-73	Fixings—clip and bracket to chassis cross-member
33	Sediment bowl body	74	Air cleaner
34	Bowl	75	Oil container
35	Gauze for bowl	76	Washer for container
36	Joint washer	77	Toggle
37	Retainer for bowl	78	Connection, air cleaner to carburetter
38	Tap and gland	79	Clip fixing connections
39	Special screw for tap		

Alternative types

Alternative types

3. Remove the securing nuts and bolts and withdraw filler assembly.
4. Fit new assembly, carefully entering it into the two rubber hoses.
5. Replace the securing bolts, nuts and washers and tighten.
6. Tighten hose clips, then replace the cover panel.

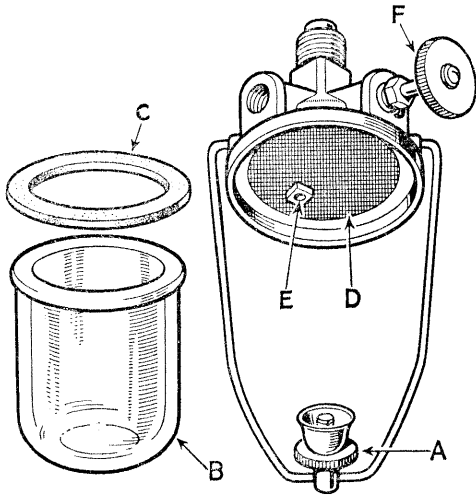


Fig. M-12—Fuel sediment bowl

- |                |                |
|----------------|----------------|
| A—Thumbscrew   | D—Filter gauze |
| B—Glass bowl   | E—Fuel inlet   |
| C—Joint washer | F—Shut-off tap |

#### Fuel pipe: tank to sediment bowl

To renew

Operation M/28

1. Disconnect the union nuts securing the pipe to the fuel tank outlet elbow and sediment bowl.
2. Remove the clips and withdraw the pipe from below the vehicle.
3. Replace the pipe by reversing the removal procedure.

#### Fuel return pipe—Diesel models

To renew

Operation M/30

1. Remove the union nuts securing the flexible pipe to the fuel tank and leak-off pipe.
2. Remove the clips and withdraw the pipe from below the vehicle.

#### Sediment bowl, 2 litre Petrol

To remove and refit

Operation M/32

1. Disconnect the inlet and outlet pipes at the sediment bowl union.
2. Remove the sediment bowl complete from the dash bracket.
3. If necessary, remove the bracket from the dash.
4. Refit by reversing the removal procedure.

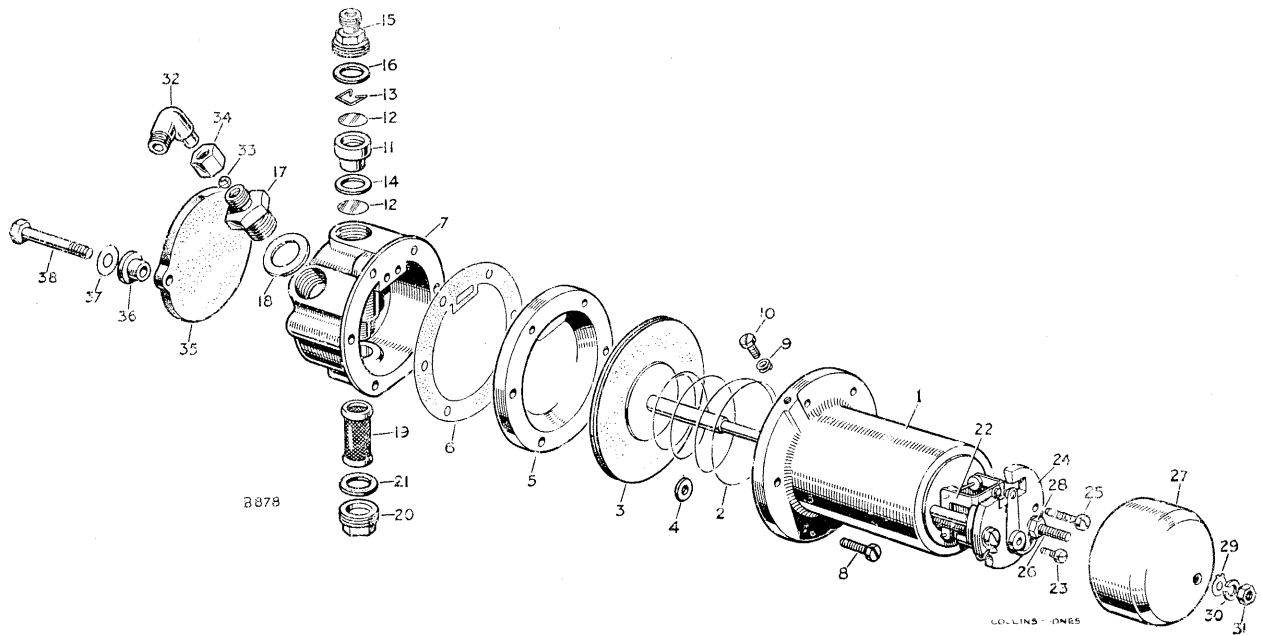


Fig. M-13—Exploded view of fuel pump, 2 litre Petrol

- |    |                                   |       |                                  |
|----|-----------------------------------|-------|----------------------------------|
| 1  | Coil complete                     | 18    | Washer for inlet union           |
| 2  | Spring for armature               | 19    | Filter                           |
| 3  | Diaphragm complete                | 20    | Plug for filter                  |
| 4  | Roller for diaphragm              | 21    | Washer for filter plug           |
| 5  | Plate body                        | 22    | Contact set complete             |
| 6  | Joint washer for plate body       | 23    | Special screw for contact blade  |
| 7  | Body                              | 24    | Moulding for end plate           |
| 8  | Screw fixing coil housing to body | 25    | Screw fixing moulding            |
| 9  | Special spring washer             | 26    | Terminal screw                   |
| 10 | Special nut                       | 27    | Cover for end plate              |
| 11 | Valve cage                        | 28    | Terminal nut                     |
| 12 | Disc for valve                    | 29    | Tag for terminal                 |
| 13 | Spring clip retaining valve disc  | 30    | Spring washer                    |
| 14 | Washer for valve cage             | 31    | Nut                              |
| 15 | Outlet union                      | 32    | Elbow for pump                   |
| 16 | Washer for outlet union           | 33-34 | Fixings for elbow                |
| 17 | Inlet union                       | 35-38 | Fixings for electric petrol pump |



**Fuel pump—2 litre Petrol****To remove** **Operation M/34**

1. Disconnect the battery.
2. Detach the inlet and outlet pipes from the elbows on the fuel pump.
3. Disconnect the feed and earth wires from the pump terminals.
4. Remove the pump.

**To refit** **Operation M/36**

Reverse the removal procedure.

**To strip** **Operation M/38**

**Under no circumstances should any attempt be made to move the core of the magnet.**

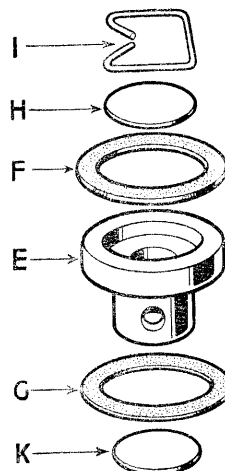
1. Remove the cast iron body from the aluminium body.
2. Unscrew the armature from the inner rocker and remove it complete with rollers, spring and impact washer.
3. If necessary, remove the impact washer (Fig. M-17) from the recess of the armature.
4. Remove the contact blade.
5. Disconnect the earth connection (held under one of the pedestal securing screws).
6. Withdraw the outer and inner rocker hinge pin and remove the rocker assembly complete from under the pedestal.
7. Separate the two halves of the aluminium body.
8. Remove the inlet union from the rear portion of the aluminium body.
9. Remove the outlet union and withdraw the thick fibre washer, the valve cage complete with delivery valve and retaining clip, the thin fibre washer and the suction valve.
10. Remove the filter plug, fibre washer and filter.

**To assemble** **Operation M/40**

1. Carefully clean all the component parts, renewing the diaphragm, contact breaker assembly and valves assembly as necessary.

**Valve cage** (See Fig. M-14)

2. The delivery valve (H) and suction valve (K) should both be fitted with the smooth side downwards.
3. Care should be taken that the valve retaining clip (I) in the valve cage (E) is located correctly in its groove.



**Fig. M-14—**  
**Layout of valve cage**

E—Valve cage  
F—Thick fibre washer  
G—Thin hard fibre washer  
H—Delivery valve  
I—Valve retaining clip  
K—Suction valve

4. The thin fibre washer (G) should be fitted under the valve cage and the thick washer (F) above the cage.
5. Thick fibre washers are also fitted under the inlet union and the gauze filter.

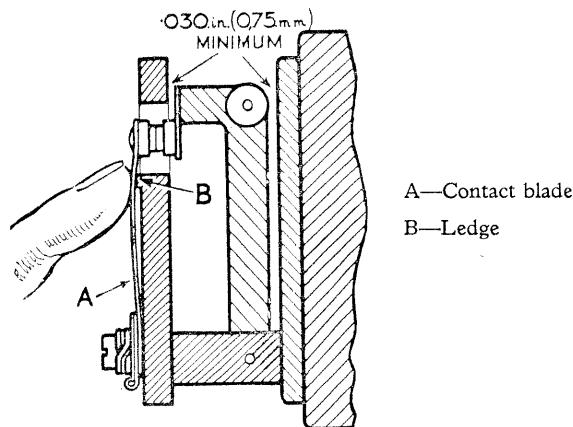
**Contact breaker** (See Fig. M-15)

6. The contact breaker should be assembled on its pedestal in such a way that the rockers are free in their mountings, without appreciable side play.

Any excessive side play on the outer rocker would permit the points to get out of line while excessive tightness would make the contact breaker sluggish in operation.

To obtain the correct freedom, it may be necessary to square the outer rocker with a pair of thin nosed pliers. The rocker hinge pin is case-hardened and must not be replaced by ordinary wire.

The contact blade (A) should be fitted next to the bakelite pedestal, that is, underneath the tags. It should rest against the ledge (B) on the pedestal when the points are apart. The points should just make contact when the rocker is in its midway position.



**Fig. M-15—Contact breaker**

7. Check the position by holding the blade in contact with the pedestal, being careful not to press on the overhanging portion (Fig. M-15); then ensure that a .30 in. (0,75 mm) feeler just slides between the white rollers and the cast iron body of the pump. If necessary the tip of the blade may be set in order to obtain the correct clearance.
8. The spring washer on the 2 B.A. screw to which the earth connection is made should be fitted between the tag and the pedestal, and the brass tag next to the head of the screw.
9. All four connections, that is, the two ends of the earthing tag and the two ends of the coil, should be soldered.

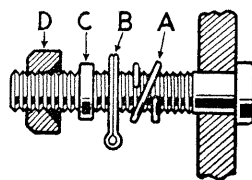


Fig. M-16—Feed terminal assembly

10. In the case of the feed terminal screw, which holds the bakelite cover in position, the correct order for assembly is spring washer (Fig. M-16, A) next to the bakelite pedestal, then the tag (B) lead washer (C) and countersunk nut (D). Under no circumstances should this assembly be shortened by leaving out the spring washer, or in any other way, as this would probably result in distortion or breakage of the pedestal when the nut holding the cover in position is tightened.

### Magnet assembly

11. Fit the armature return spring with its large diameter towards the coil. The spring must not be stretched or the action of the pump will be affected.
12. Swing the contact blade on the pedestal to one side.

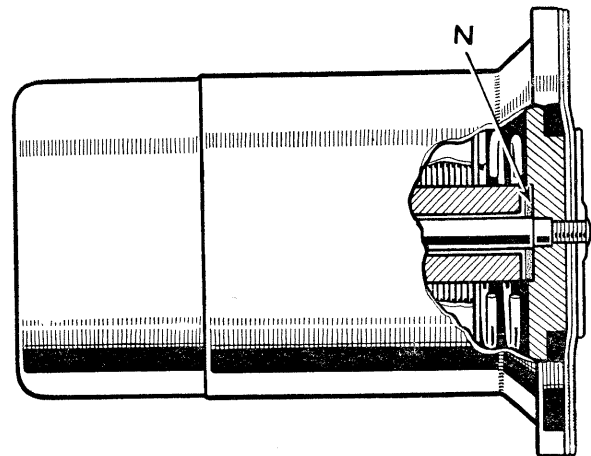


Fig. M-17—Armature impact washer

N—Impact washer

13. Fit the impact washer (N) in the recess of the armature.
14. Screw the armature into position.
15. Fit the eleven guide rollers in position round the armature.
16. Hold the magnet assembly in the left hand in an approximately horizontal position. Push the armature in firmly but steadily, with the thumb of the right hand (Fig. M-18).

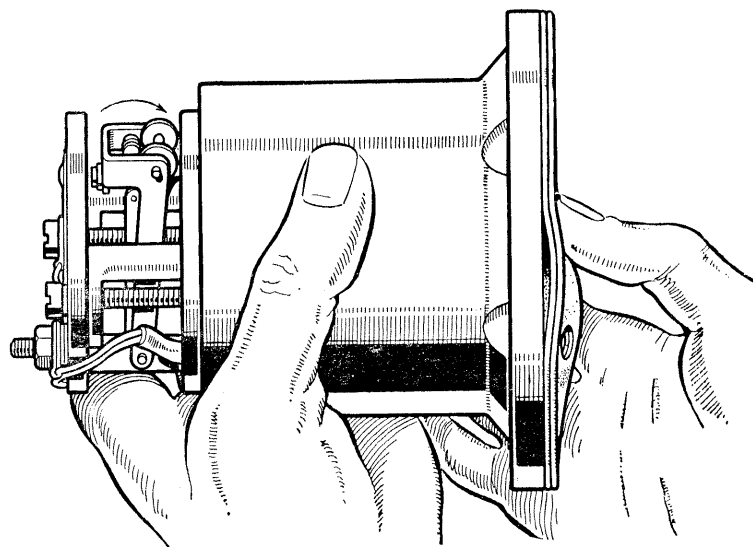


Fig. M-18—Armature adjustment

17. If the contact breaker throws over, the armature should be screwed in further until it ceases to do so. It should then be unscrewed one-sixth of a turn at a time until a position is found at which the contact breaker just throws over, care being taken to avoid jerking the armature. The armature should then be unscrewed for two-thirds of a turn, i.e. four holes; the setting is then correct.

**Do not forget that this setting must be carried out with the points out of contact.**

When a new diaphragm is fitted, it is possible that considerable pressure will be required to push the armature right home. If there is any doubt about the point at which the contact breaker throws over, come back one-sixth of a turn.

18. Place the cast iron body in position on the aluminium body, with the drain hole in the cast iron member at the bottom in line with the filter plug in the aluminium body. Ensure that all the rollers are in their correct position. If one of the rollers falls out of position, it will get trapped between the two parts and cut a hole in the diaphragm.

19. Make sure that the cast iron body seats properly on the aluminium body, and insert the six screws. These screws must not be tightened up at this stage, as it is absolutely necessary to first stretch the diaphragm to its outermost position.

This is best effected by using a special forked wedge to keep the armature in its extreme position (Fig. M-19); the wedge is inserted between the white rollers of the outer rocker and pressed in under the tips of the inner rocker,

until it lifts the trunnion in the centre of the inner rocker as far as it will go. Tighten the retaining screws fully, and remove the wedge.

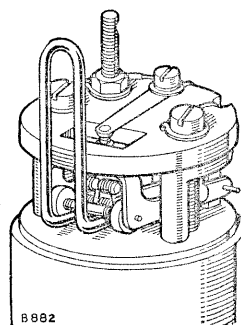


Fig. M-19—  
Use of forked wedge to  
keep the armature in  
position

If a wedge is not available, the diaphragm may be stretched by holding the points in contact, by inserting a matchstick under one of the white fibre rollers and passing a current through the pump; this will excite the magnet, actuate the armature, and so stretch the diaphragm.

20. Test the fuel pump. It is best to use a cut-away cover while testing the pump, as this prevents the hinge pin from falling out, and, at the same time, makes it possible to observe the action of the contact breaker. The pump should be mounted three feet above the supply tank for testing; either paraffin or petrol may be used. When switched on, the pump should prime itself promptly, and fluid should flow from the outlet union. If the pump output is restricted, the pump should slow down gradually, and if completely cut-off it should stop for at least 15 seconds.

## Fuel pump 2½ litre Petrol and Diesel

### Testing fuel pump on vehicle

Ensure that there is sufficient fuel in the tank, then disconnect the fuel inlet pipe from the carburetter, or (Diesel) from the filter mounted on the front R.H. side of the engine. Turn the engine over by hand, with sparking plugs or (Diesel) injection nozzles, removed if necessary; there should be a well-defined spurt of fuel from the disconnected pipe every second revolution of the starting handle.

It should be noted that Diesel engine pumps are of the high pressure type, while those fitted to 2½ litre engines are low pressure. Therefore they are not interchangeable. 2½ litre pumps are identified by a splash of green paint on the cover.

### To remove

### Operation M/42

1. Disconnect the inlet and outlet pipes, remove the securing nuts and withdraw the pump complete.

### To overhaul

### Operation M/44

1. Unscrew the nut at base of sediment bowl, move the retainer aside and withdraw the bowl, cork sealing gasket and gauze filter disc. Care must be taken to avoid damage to the filter disc.

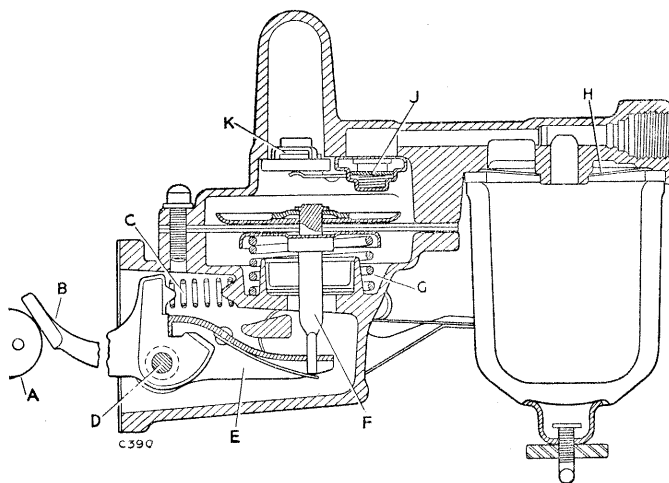


Fig. M-20—Sectioned view of fuel pump

- |                        |                      |
|------------------------|----------------------|
| A—Cam                  | F—Diaphragm pull rod |
| B—Rocker arm           | G—Diaphragm spring   |
| C—Return spring        | H—Gauze filter disc  |
| D—Rocker arm pivot pin | J—Inlet valve        |
| E—Operating link       | K—Outlet valve       |

2. Mark the upper and lower halves of pump casing to ensure correct alignment on re-assembly and **note the position of diaphragm tab**. Remove the six screws securing the casings and, with the thumb pressing the diaphragm tab against the lower casing, lift the upper half clear.
3. Ease the diaphragm flexible material from the lower body joint face and holding the metal part of the diaphragm with the fingers, turn it 90° in either direction, whereon the diaphragm spring will push the diaphragm clear.

4. Remove the circlips (on late models the pivot pin is secured by two retainers), then drift the rocker arm pivot pin from the lower casing and withdraw the rocker arm, operating link, return spring and plain washers.

5. It is extremely unlikely that the hand priming mechanism will ever require replacement, but the hand lever, cork washers and hand rocker may be removed by filing the hexagon each side of the operating lever and springing the lever clear. Withdraw the cork washers and hand rocker.

*Note:* If removed, the hand operating mechanism must be replaced by new parts.

6. If necessary the oil seal and retainer may be removed by filing away the spread of metal caused by the four peening marks and then drift from below.
7. Remove the retaining plate and withdraw the valves and valve gasket from the upper casing.
8. Clean all parts thoroughly in paraffin. (Diesel only, clean as above, then immediately before assembly, in Shell Fusus 'A' oil.)
9. Examine all parts for wear and replace as necessary. Observe the following points:
  - (a) All gaskets to be renewed.
  - (b) Sediment bowl filter disc must be free of damage and fit tightly round the inlet neck of the upper casing.
  - (c) Renew the diaphragm assembly if any sign of hardening, cracking or porosity is present.
  - (d) Only very slight wear should be tolerated at the rocker arm contact face, pivot pin, link and pull-rod slots.
  - (e) Springs should be renewed, but ensure that the correct type are used.
  - (f) Valves to be tested for air tightness by suction.

### Early models

10. Assembly of the components is a reversal of dismantling procedure, but the location of the rocker arm, washers and operating link on a piece of .240 in. (6.1 mm) diameter rod inserted in place of the pivot pin and then driven out by the pin will facilitate this part of the operation. Replace circlips.

### Late models

If rocker arm pin and related parts have been detached from pump body, re-assemble rocker arm, link and spacing washers on to pin, and refit to body, after replacing return spring. Tap the retainers into their grooves, then holding the retainers firmly against the rocker pin, peen over the ends of the grooves to ensure that they cannot work loose.

Always use replacement retainers, as these are slightly shorter than the original to allow for satisfactory fixing in the body.

- 1 Upper casing
- 2 Securing screws
- 3 Spring washer
- 4 Valve gasket
- 5 Valves
- 6 Retainer for valves
- 7 Screw securing retainers
- 8 Gauze filter disc
- 9 Cork sealing gasket
- 10 Sediment bowl
- 11 Bowl retainer
- 12 Diaphragm assembly
- 13 Diaphragm spring
- 14 Oil seal retainer
- 15 Sealing washers
- 16 Lower casing
- 17 Hand priming lever
- 18 Return spring for hand lever
- 19 Hand rocker
- 20 Cork washers
- 21 Rocker arm pivot pin
- 22 Operating link
- 23 Plain washers
- 24 Rocker arm
- 25 Return spring
- 26 Joint washer

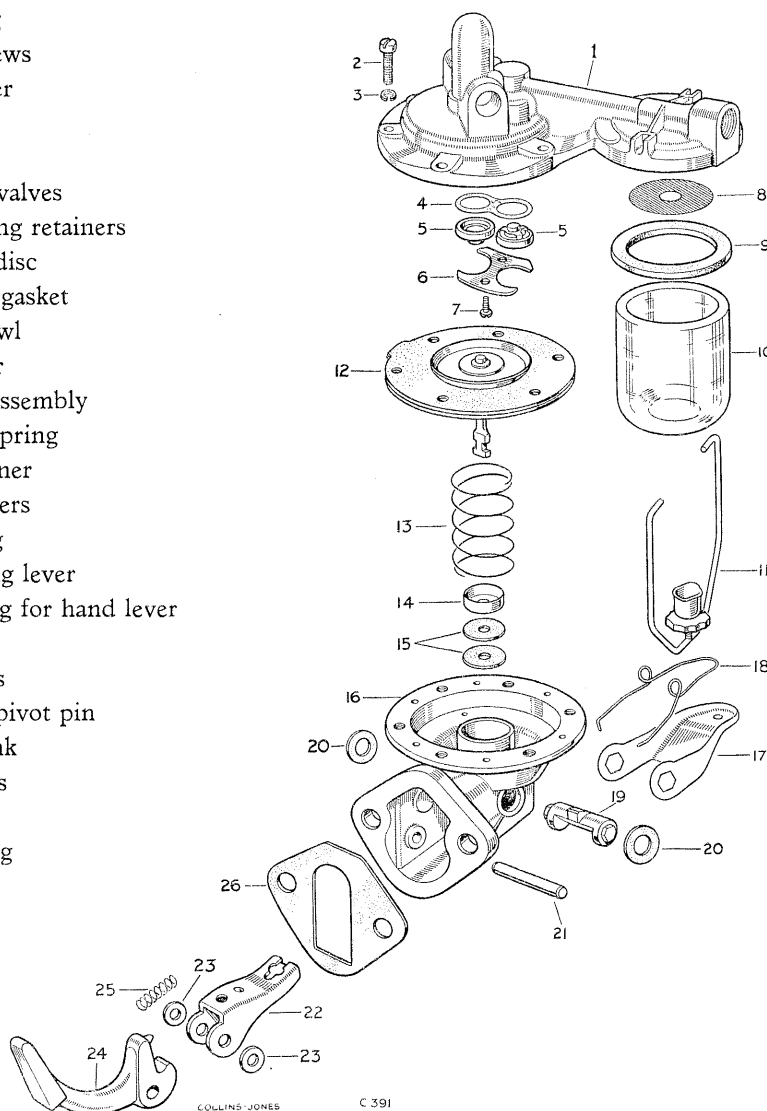


Fig. M-21—Exploded view of fuel pump

11. To refit the diaphragm assembly, hold the pump lower casing with the return spring in position and the rocker arm held outwards. Position the diaphragm over the spring with the flattened end of pull rod in line with the slot in operating link and the large tab on diaphragm 90° from original fitted position. Press the diaphragm assembly downward to engage the operating link slot and turn it 90° to the position noted whilst dismantling.
12. Push the rocker arm towards the pump until the diaphragm is level with the joint face, then place the upper casing assembly in position, aligning the marks made before dismantling. Fit the six securing screws and spring washers but tighten the screws just sufficiently for the heads to contact the spring washers. The rocker arm must now be pushed inward to the fullest extent before the screws are finally tightened.

The diaphragm outer edges should be approximately flush with the outer edges of the pump joint faces when fitted.

Any appreciable protrusion of the diaphragm beyond the joint face edges, indicates improper fitment and necessitates the release of the six securing screws and refitment in accordance with item 12.

#### Fuel pump—to test without special equipment Operation M/46

1. Immerse the pump in a bath of paraffin, or (Diesel) fuel oil or Shell Fusus 'A' oil, and operate the rocker arm several times to flush.
2. Hold the pump clear of the bath and continue to operate the rocker arm until the pump is empty, then place a finger over the inlet port ('in') and work the rocker arm several times

more. A distinct suction sound should be heard when the finger is removed from the inlet port, denoting that a reasonable degree of suction has been developed.

3. Place a finger over the outlet port and again operate the rocker arm. Air pressure should be felt for two or three seconds after rocker movement has ceased. Build up the air pressure in the pump again, and with the finger held firmly over the outlet, submerge the pump completely in the paraffin or oil bath, then observe the joint face edges for signs of air leakage.

#### To replace Operation M/48

1. Reverse the removal procedure.

#### Fuel pump filter and sediment bowl

#### To remove and clean Operation M/50

1. Unscrew the nut at base of sediment bowl, move the retainer aside and withdraw the bowl, cork sealing gasket and gauze filter disc. Care must be taken to prevent damage to the filter disc.
2. Clean the bowl and filter disc in petrol or (Diesel) fuel oil, directing a compressed air jet on the gauze to remove any obstinate particles.
3. Examine the cork gasket for filter bowl and renew if signs of deterioration are evident.

#### To replace

#### Operation M/52

1. Reverse the removal procedure ensuring that the gauze filter disc fits tightly round the inlet neck and is quite undamaged in any way.

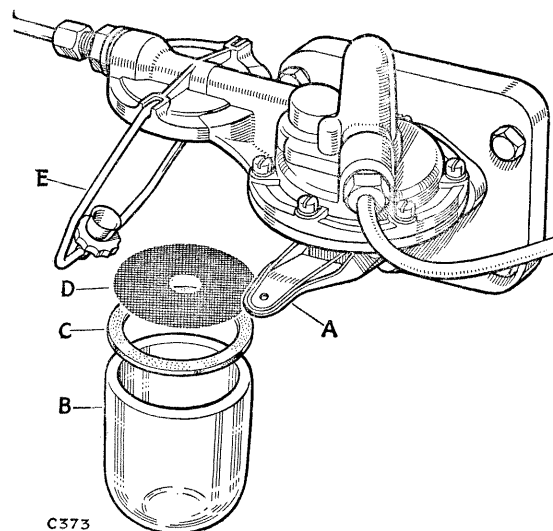


Fig. M-22—Removing sediment bowl

- |                      |                              |
|----------------------|------------------------------|
| A—Hand priming lever | D—Filter gauze               |
| B—Sediment bowl      | E—Retainer for sediment bowl |
| C—Cork gasket        |                              |

### Fuel system—Diesel models

Details of fuel lift pump will be found on Pages M-17 to M-19.

If the injection pump is drained by disconnecting the drain pipe or by running the vehicle until all the fuel has been used, the injection pump **must** be primed before attempting to restart the engine. To minimise the possibility of inadvertently running out of fuel, a blue fuel level warning light is fitted to the instrument panel which glows when only two gallons of fuel remain in the tank and remains "on" until more fuel is added. This device is in addition to the usual fuel contents gauge.

Clean fuel is essential for the efficient operation of the fuel injection pump and injection nozzle assemblies, and for this reason four filters in all are fitted in the system. The first one is fitted in the fuel tank and requires no attention; the second—a sediment bowl and filter disc—is part of the fuel lift pump; the third is a large self-contained unit mounted on the R.H. front side of the engine on early models, and on the bulkhead on later vehicles and lastly a small tubular gauze filter is fitted in the injection pump head.

An additional filter is fitted to all export Diesel Land-Rovers. This filter is dealt with in Operation M/62.

### Filters

Wear of injection pump, injection nozzle parts and the subsequent loss of power and efficiency is primarily due to the presence of dirt in the fuel.

Filters are situated in the Rover system in a manner calculated to minimise the possibility of foreign matter reaching the injection pump or injection nozzles, but the element in the main filter must be renewed, the sediment bowl and filter gauze on lift pump and the filter gauze in injection pump cleaned, at appropriate intervals. These intervals vary and are dependent on operating conditions, but reference to the Owner's Instruction Manual will provide a guide.

Complete sludging up of the main filter element in an unreasonably short operating period is usually due to an excessive quantity of wax in the fuel. Attention should be paid to the method of storage (where bulk storage is used) and the advice of supplier requested. Never draw fuel from the **lowest** point of a storage tank or barrel for refuelling purposes; the lowest point should only be used for draining off sludge and other impurities which accumulate at the bottom end.

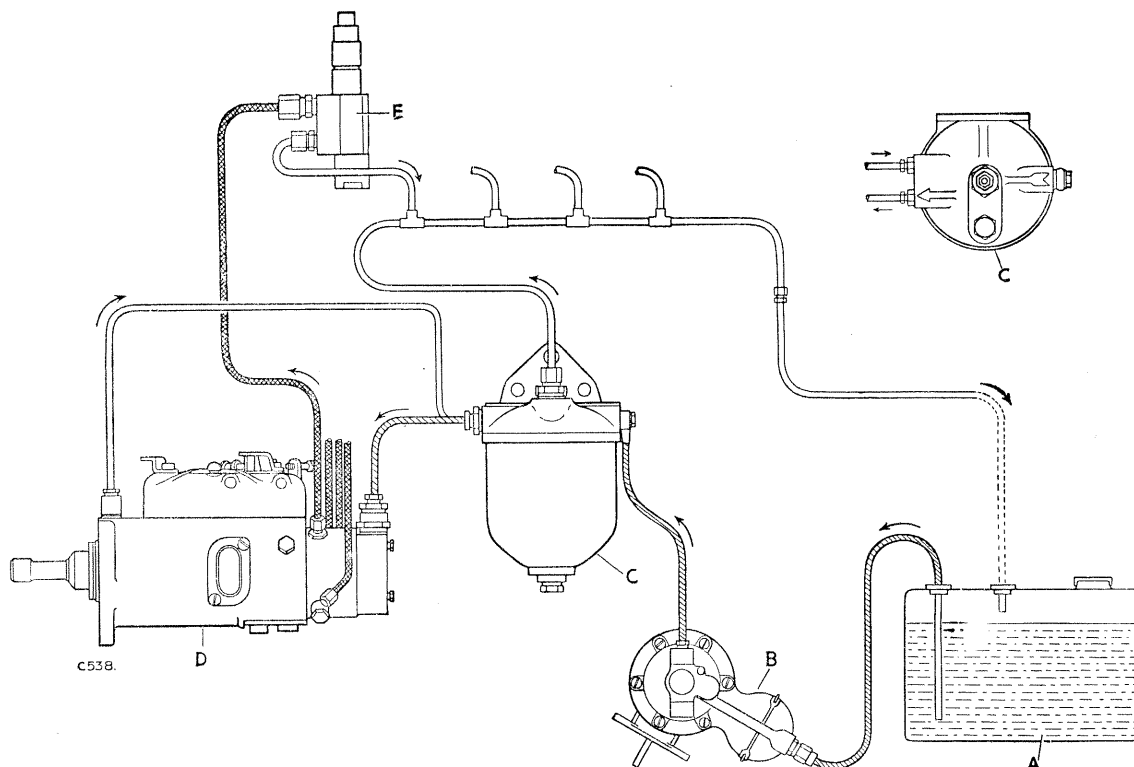


Fig. M-23—Diagram of fuel system

- A—Fuel tank
- B—Fuel pump
- C—Main filter
- D—Injection pump

- E—Injection nozzle
- ~~~~~—Low pressure delivery
- XXXXXX—High pressure delivery
- =====—Excess fuel spill back

**Main filter, early type, engine mounted****To remove** **Operation M/54**

1. Slacken the drain plug at the base of filter container and allow fuel to flow into a suitable receptacle.
2. Disconnect the fuel inlet, outlet and bleed back pipes.
3. Remove the securing bolts and lift the assembly clear.

A non-return valve is incorporated in the excess fuel spill back pipe. It can be removed by disconnecting the union at the top of the filter, and withdrawing the valve complete with holder.

**To refit** **Operation M/56**

1. Reverse the removal procedure and prime as in Operation M/64.

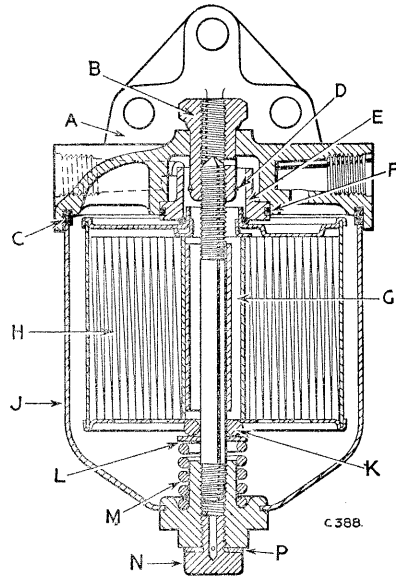


Fig. M-24—Sectioned view of main fuel filter, early type

A—Housing cover	H—Element
B—Cap nut	J—Container
C—Oil seal	K—Seal
D—Circlip	L—Plain washer
E—Sealing ring	M—Spring
F—Oil seal	N—Drain plug
G—Location sleeve	P—Washer

**To remove element—filter in position on vehicle, early type** **Operation M/58**

1. Slacken the plug at base of filter container and allow the fuel to flow into a suitable receptacle.
2. Disconnect the bleed back pipe from the top of filter unit.
3. Unscrew the centre cap nut at top of filter whilst supporting the container.
4. Withdraw the container complete with small sealing ring at top of element and remove the large sealing ring from the underside of filter cover.

5. Discard the filter element, then wash the container thoroughly in fuel oil. Clean the holes in drain plug and boss with a wire. Great care should be taken to ensure that the centre spindle above lower sealing ring is absolutely clean.
6. Renew the lower sealing ring if its serviceability is in any way doubtful—a new top sealing ring is supplied with each element and should always be used.
7. Examine the large sealing gasket for container and replace if necessary.
8. Fit the new element, top sealing rings, and refit container.
9. Reconnect pipes, tighten drain plug and prime. Operation M/64.

**Main filters, late type**

The latest type installation can be identified by the black nylon fuel pipes and the fact that the main fuel filter is no longer attached directly to the engine, but is fitted to the dash. The design of the later filter uses the outer casing of the filter element as an extension of the element holder, thus making it impossible to run the vehicle without a filter element in the system.

**To renew** **Operation M/60**

1. Support element holder and unscrew the special bolt on the top of the filter; the element holder can now be removed.
2. Remove and discard the used element.
3. Wash the element holder in petrol or fuel oil.
4. If necessary, renew both the large rubber washer and the small rubber washer in the filter top, also renew the large rubber washer in the element holder.
5. Push the element on to the filter top spigot, with the perforated holes in the element to the top.
6. Fit the element holder to the bottom of the element and secure with the special bolt.
7. Prime the system as in Operation M/64 or 66 and check for leaks.

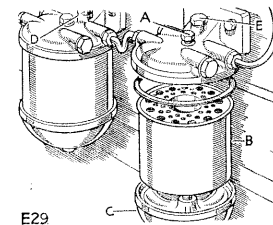


Fig. M-25—Paper element filter, twin system illustrated

A—Element retaining bolt	D—Bleed pipe
B—Element	E—Air vent screw
C—Element holder	



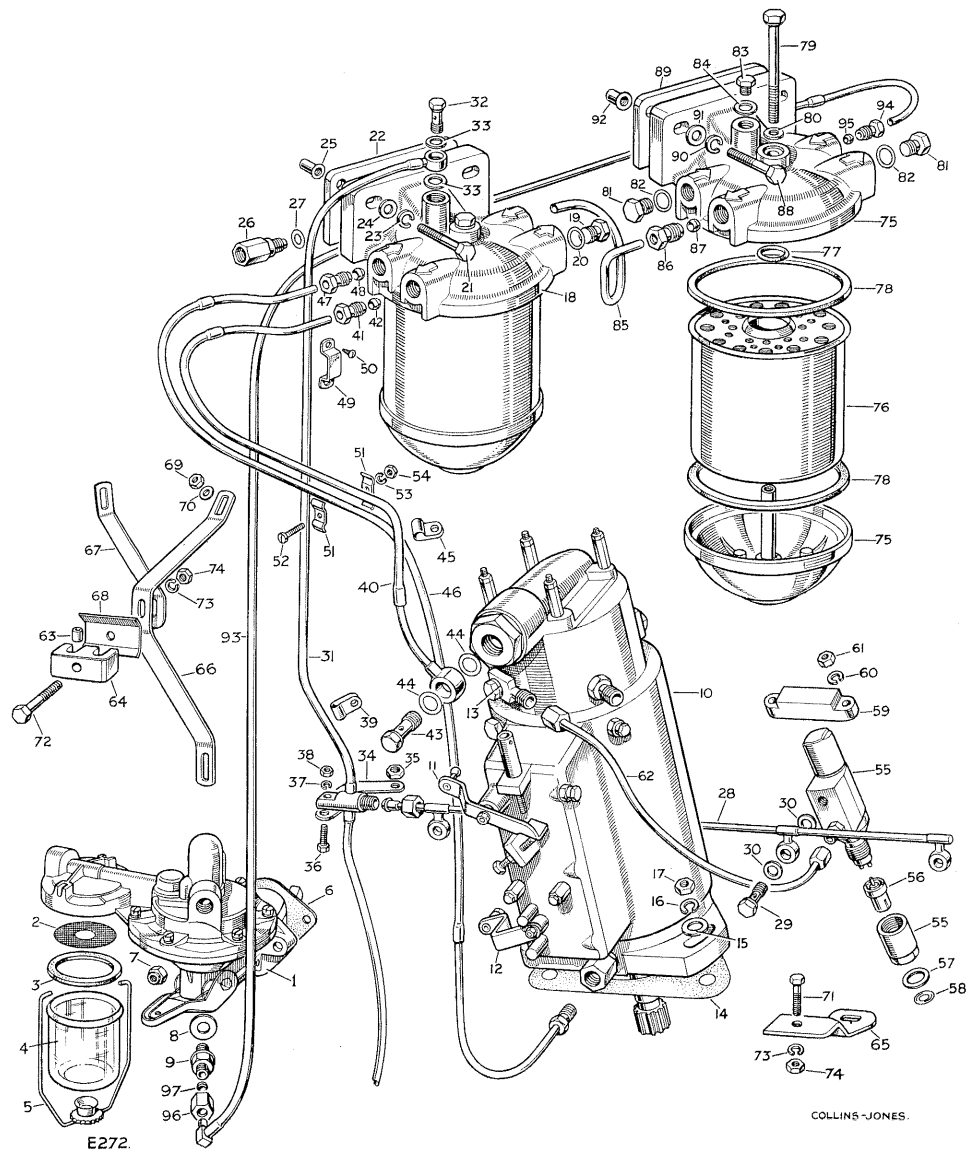


Fig. M-26—General layout of fuel injection system, late models  
Twin filters illustrated

## Key to Fig. M-26

- |       |  |  |                         |  |
|-------|--|--|-------------------------|--|
| 1     | Fuel pump, mechanical  |  |                         |  |
| 2     | Filter for sediment bowl   |  |                         |  |
| 3     | Washer for sediment bowl   |  |                         |  |
| 4     | Sediment bowl  |  |                         |  |
| 5     | Retainer   |  |                         |  |
| 6     | Joint washer   |  |                         |  |
| 7     | Self-locking nut   |  |                         |  |
| 8     | Joint washer   | } For mechanical pump inlet and outlet                   |                         |  |
| 9     | Union  |  |                         |  |
| 10    | Distributor pump   |  |                         |  |
| 11    | Accelerator control lever  | } For distributor pump                                   |                         |  |
| 12    | Stop lever   |  |                         |  |
| 13    | Joint washer for injection pipe, distributor pump end              |  |                         |  |
| 14    | Joint washer   |  |                         |  |
| 15-17 | Fixings—distributor pump to cylinder block                         |  |                         |  |
| 18    | Fuel filter  |  |                         |  |
| 19    | Plug for filter  |  |                         |  |
| 20    | Joint washer   |  |                         |  |
| 21-25 | Fixings—filter to dash   |  |                         |  |
| 26    | Non-return valve for filter  |  |                         |  |
| 27    | Joint washer   |  |                         |  |
| 28    | Leak-off pipe  |  |                         |  |
| 29    | Banjo bolt   | } Fixings—leak-off pipe to injector                      |                         |  |
| 30    | Washer   |  |                         |  |
| 31    | Fuel pipe, spill return to tank                                    |  |                         |  |
| 32    | Banjo bolt   | } Fixing spill return pipe to filter                     |                         |  |
| 33    | Joint washer   |  |                         |  |
| 34    | Bracket for leak-off pipe  |  |                         |  |
| 35    | Locknut fixing bracket to injector stud                            |  |                         |  |
| 36-38 | Fixings—spill return pipe to bracket on injector stud              |  |                         |  |
| 39    | Clip   |  |                         |  |
| 40    | Fuel pipe, filter to distributor pump                              |  |                         |  |
| 41    | Nut  | } Fixing pipe to filter                                  |                         |  |
| 42    | Olive  |  |                         |  |
| 43    | Banjo bolt   | } Fixing pipe to distributor pump                        |                         |  |
| 44    | Joint washer   |  |                         |  |
| 45    | Clip, fixing pipe to distributor pump                              |  |                         |  |
| 46    | Fuel pipe, distributor pump return to filter                       |  |                         |  |
| 47    | Nut  | } Fixing pipe to non-return valve at filter              |                         |  |
| 48    | Olive  |  |                         |  |
| 49    | Clip   |  |                         |  |
| 50    | Drive screw  | } Fixing distributor pump feed and return pipes together |                         |  |
| 51    | Double pipe clip   |  |                         |  |
| 52-54 | Fixings—pipes and clips  |  |                         |  |
| 55    | Injector   |  |                         |  |
| 56    | Nozzle   |  |                         |  |
| 57    | Joint washer, copper   | } For injector   |                         |  |
| 58    | Joint washer, steel  |  |                         |  |
| 59    | Clamping strip for injector  |  |                         |  |
| 60-61 | Fixings—injector to cylinder head                                  |  |                         |  |
| 62    | Injector pipe to No. 2 cylinder                                    |  |                         |  |
| 63    | Damper for injector pipe   |  |                         |  |
| 64    | Shroud   |  |                         |  |
| 65    | Bracket  | } For shroud   |                         |  |
| 66    | Support strap  |  |                         |  |
| 67    | Steady strap   |  |                         |  |
| 68    | Backplate  |  |                         |  |
| 69-70 | Fixings—straps to injector studs                                   |  |                         |  |
| 71-74 | Fixings—shroud and dampers to backplate, strap and support bracket |  |                         |  |
| 75    | Fuel filter  | } Additional fuel filter                                 |                         |  |
| 76    | Element  |  |                         |  |
| 77    | Seal, small  |  | } For element           |  |
| 78    | Seal, large  |  |                         |  |
| 79    | Special centre bolt for filter                                     |  |                         |  |
| 80    | Washer for centre bolt   |  |                         |  |
| 81    | Plug for fuel filter   |  |                         |  |
| 82    | Joint washer   |  |                         |  |
| 83    | Plug for fuel filter, top, leak-off                                |  |                         |  |
| 84    | Joint washer for leak-off plug                                     |  |                         |  |
| 85    | Transfer pipe, extra filter to basic filter                        |  |                         |  |
| 86    | Nut  |  | } Fixing pipe to filter |  |
| 87    | Olive  |  |                         |  |
| 88-92 | Fixings—filter to dash   |  |                         |  |
| 93    | Fuel pipe, pump to filters   |  |                         |  |
| 94    | Nut  | } Fixing pipe to filter                                  |                         |  |
| 95    | Olive  |  |                         |  |
| 96    | Nut  | } Fixing pipe to pump                                    |                         |  |
| 97    | Olive  |  |                         |  |

### Additional filter

All Export Diesel models are fitted with an additional C.A.V. paper element type fuel filter mounted on the engine side of the dash, in the pipe line between the fuel tank and the mechanical fuel pump. See Fig. M-25.

### Early models

This means that the bowl on the additional filter becomes the water trap, therefore when two C.A.V. filters are fitted, the sediment bowl on the mechanical fuel pump and second fuel filter ('F') mounted at the front right hand side of the engine will only need cleaning and the element changed, every 24,000 miles (40,000 km).

The bowl of the filter mounted on the dash should be emptied and cleaned every 3,000 miles (5,000 km) and the paper element replaced every 6,000 miles (10,000 km).

If the amount of dirt and water collected when cleaning the bowl at 3,000 miles (5,000 km) appears excessive the element should also be changed; it will also indicate that more frequent checking of the filter bowl is required.

### Late models—filters on dash

Where one filter is fitted, the paper element must be renewed every 12,000 miles (20,000 km) or as found necessary according to the cleanliness of the fuel used.

When two filters are fitted, the paper element in the first one, which is fed direct from the fuel pump, must be renewed every 12,000 miles (20,000 km). The paper element in the second fuel filter which feeds straight to the distributor pump, must have the paper element renewed every 36,000 miles (60,000 km); in both cases more frequent changes may be necessary according to the cleanliness of the fuel used.

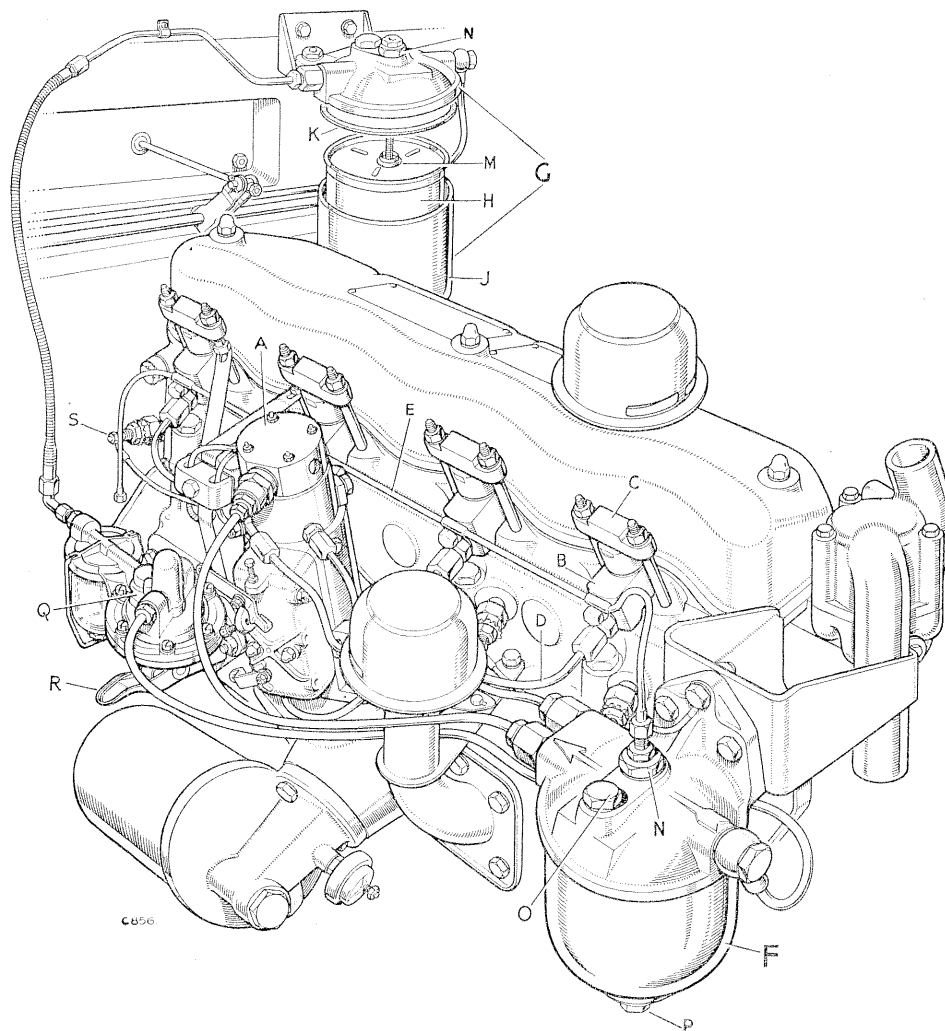


Fig. M-27—Layout of twin filters, early models

- |                         |                       |                        |
|-------------------------|-----------------------|------------------------|
| A—Distributor pump      | G—Fuel filter at dash | O—Air vent plug        |
| B—Injector              | H—Element             | P—Drain plug           |
| C—Clamp bar             | J—Container           | Q—Mechanical fuel pump |
| D—Feed pipes            | K—Large washer        | R—Hand priming lever   |
| E—Spill pipes           | M—Small washer        | S—Heater plug          |
| F—Fuel filter at engine | N—Retainer nut        |                        |

### To renew additional filter element, early type Operation M/62

1. Unscrew the special bolt on the top of the filter, until the element holder can be removed.
2. Remove and discard the used element and the rubber washer.
3. Wash the container in petrol or fuel oil.
4. Renew the large rubber washer in the filter top, place a new element in the container, with the perforated holes to the bottom. Renew the small rubber washer on the top of the element.
5. Fit the container complete with element to the filter top and tighten the special bolt.
6. Prime the system. Operation M/64.

### Priming the fuel system, early type filter Operation M/64

A—When the filter bowl has been cleaned or the paper element changed on **either or both** fuel filters, the system must be primed as follows:—

1. Do not attempt to start the engine hoping to draw the fuel through in this way, otherwise the full priming procedure will be necessary.
2. Slacken the air vent screw on the top of the engine filter.
3. Operate the hand priming lever in the mechanical pump until fuel free from bubbles emerges.
4. Tighten the bleed screw.
5. Operate the hand priming lever once or twice to clear the last bubbles of air into the filter bleed pipe.
6. Start the engine in the normal way and check for leaks.

B—When fuel system has been completely emptied proceed as follows:—

7. Carry out operations above 1 to 5 inclusive.

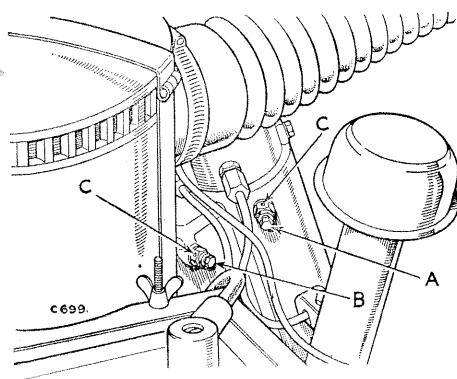


Fig. M-28—Priming the fuel system

A—Air vent screw on distributor body  
B—Air vent screw on distributor control cover  
C—Fuel orifice

8. Release air vent screw (A) on distributor pump. See Fig. M-28.

9. Operate the fuel pump hand priming lever until fuel free of air emerges. See hand lever, Fig. M-27.

10. Retighten the air vent screw.

11. To ensure that all air is exhausted from the pump it may also be necessary to slacken air vent screw 'B' in the distributor control cover and repeat items 9 and 10.

12. Start engine in normal way and check for leaks.

C—When distributor pump only has been drained it is only necessary to carry out operations 8 to 12 inclusive.

Ensure that fuel pump lever is on the bottom of the operating cam when priming the fuel system, otherwise maximum movement of the priming lever will not be obtained.

It should not be necessary to remove additional filter, but if removed, note that it is secured to the dash by three bolts and rivnuts.

### Priming the fuel system, late type filter (Single or twin filter system) Operation M/66

When the filter bowl has been cleaned or the paper element changed on either or both fuel filters, the system must be primed as follows:

1. Do not attempt to start the engine hoping to draw the fuel through in this way, otherwise the full priming procedure will be necessary.
2. Slacken the bleed pipe or air vent screw as the case may be, on the top of the filter which has had the replacement element fitted.
3. Operate the hand priming lever on the mechanical pump, until fuel free from bubbles emerges.
4. Tighten the bleed pipe or air vent screw.
5. Operate the hand priming lever once or twice to clear the last bubbles of air into the filter bleed pipe.
6. Start engine in normal way and check for leaks.

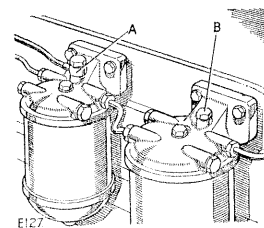


Fig. M-29—Air vent on filter, Diesel models. Twin filter system illustrated

A—Bleed pipe      B—Air vent screw

### Injection pump filter

#### To remove and clean Operation M/68

1. Remove the pipe filter to injection pump.
2. Unscrew the pipe connection from injection pump head and withdraw the filter.
3. Wash the filter in fuel oil and direct an air jet on to it.

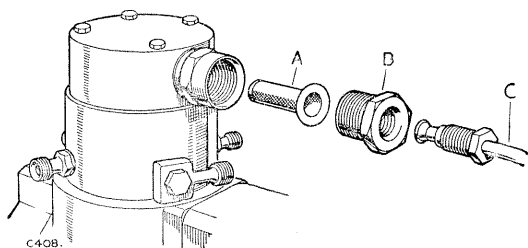


Fig. M-30—Injection pump filter

A—Filter      B—Connection      C—Inlet pipe

#### To refit Operation M/70

1. Replace the filter and pipe connection and reconnect the feed pipe at main filter end. Operate the lift pump by hand and couple the pipe to injection pump head whilst fuel flows from the pipe.

### Injection pump

#### To remove Operation M/72

1. Remove the air cleaner and flexible air intake pipe.
2. The fuel pipes, injection pump to injection nozzle, filter to injection pump and drain from injection pump should now be removed.
3. Disconnect the accelerator and cut-off controls.
4. Remove the securing nuts and washers then withdraw the pump.
5. Blank off all openings with special caps or adhesive tape if caps are not available.

#### To refit Operation M/74

##### Timing

1. The line against which the timing figure is stamped on the flywheel, as detailed below, when set opposite the pointer, indicates the position at which injection started.

88 Diesel, up to engine number 146900522

109 Diesel, up to engine number 156900285

Set the pointer exactly between the 16° and 18° markings, i.e., the 17° position.

88 Diesel, from engine number 146900523 onwards

109 Diesel from engine number 156900286 onwards

Set the pointer in line with the 16° mark.

It is possible, however, that engines numbered in the range up to 146900522 and 156900285 have been modified. These are easily identified by a splash of red paint on the cylinder head. The injection pump timing for these engines is 16°.

2. The injection pump timing must be carried out with the utmost precision, therefore the following procedure must be executed methodically.

Turn the crankshaft in the direction of rotation until both valves of number 1 cylinder are closed and the piston is ascending the bore on the compression stroke, continue to turn the crankshaft slowly until the appropriate timing mark is visible through the timing aperture in the flywheel housing. Carefully align the timing mark with the pointer. If the flywheel is inadvertently turned too far and the timing mark goes past the pointer the operation must be repeated.

Ensure that a correct line of vision is taken when lining up the timing marks. An incorrect line of vision can result in the timing being 1° to 2° out.

3. Remove the inspection cover from the injection pump and rotate the spindle in direction of rotation until the line marked "A" on driving plate aligns with the mark on the timing ring.
4. Offer the pump to the engine and engage in the splined drive shaft. With a small mirror observe the markings through inspection aperture in injection pump and make any final necessary adjustment by turning the pump body to align the timing ring with the "A" mark.

As the final adjustment is made to the timing by turning the pump body, this action in itself is sufficient to cause a slight error in the timing, due to the backlash in the pump drive skew gear. It is therefore essential that the pump drive plate and thus the skew drive gear is held back against the driving side of the teeth whilst final adjustment is made and the pump secured.

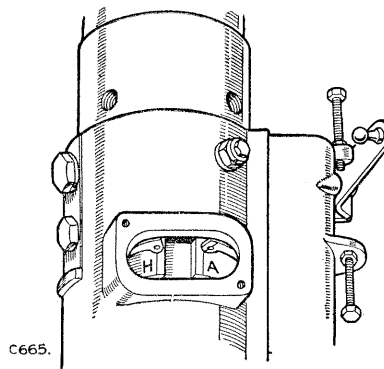


Fig. M-31—

Injection pump timing marks correctly aligned

5. Re-check the timing by turning the crankshaft in the direction of rotation until both valves of number 1 cylinder are closed and the piston is ascending the bore on the compression stroke, continue to turn the crankshaft slowly. With a small mirror observe that the timing mark "A" on the pump drive plate aligns with the mark on the timing ring. When the "A" mark is exactly in line with the mark on the timing ring, the appropriate flywheel timing mark should be exactly in line with the flywheel housing pointer. In this way any slight timing error is magnified by the 2 : 1 ratio of the camshaft to crankshaft. An error of a given width on the pump marking will be 12 times that width if transferred to the flywheel.

If the flywheel is inadvertently turned too far and the timing mark on the pump drive plate goes past the mark on the timing ring, the operation must be repeated.

6. Reconnect the pipes and controls; check the cut-off and throttle controls for full movement. Prime the system in accordance with Operation M/56, then refit the air cleaner and rubber connection.
7. Run the engine and adjust the slow-running control if necessary. Turn the stop screw inward to increase idling speed and outward to decrease.

The upper maximum power output stop screw setting is sealed at the works and must not be altered.

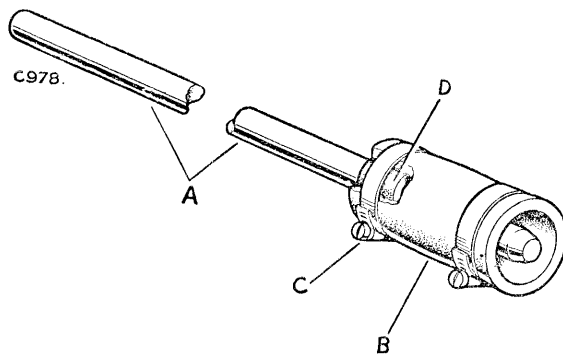


Fig. M-32—Extension shaft for revolution counter

- A—Starting handle. 26 in. (660 mm) long x .687 in. (17 mm) diameter  
 B—Rubber hose. 3 in. (75 mm) long x 1½ in. (32 mm) internal diameter  
 C—Hose clips, to suit external diameter of rubber hose  
 D—Rubber packing between hose and starting handle

8. When a new or reconditioned distributor pump is to be fitted, it will be found that the slow-running control screw is wired to the distributor pump and that the maximum output control screw is not sealed.

It is necessary, therefore, after the distributor pump has been assembled to the engine, first to fit the slow-running control screw and then adjust both screws as detailed below.

Finally the maximum output control screw should be wired up and sealed as shown at Fig. M-34.

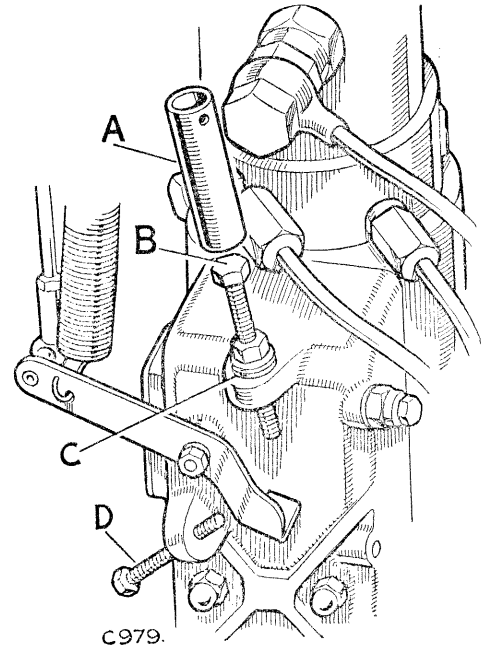


Fig. M-33—Distributor pump control screws

- A—Screw collar  
 B—Maximum output control screw  
 C—Screw retainer for collar  
 D—Slow running control screw

The slow-running engine speed should be set at 590 r.p.m.  $\pm$  20 r.p.m.

The maximum engine speed should be set at 3,650 r.p.m.  $\pm$  20 r.p.m.

Note that the maximum engine speed corresponds to 55 m.p.h. (84 k.p.h.) in top gear, 41 m.p.h. (66 k.p.h.) in third gear and 28 m.p.h. (45 k.p.h.) in second gear.

The engine speeds should be checked with a revolution counter from the starting dog. To do this some form of extension shaft is required; a starting handle cut down with driving pin removed and modified as shown at Fig. M-32 is one method of doing this.

9. To adjust the maximum output control screw, proceed as follows:—
  - (a) Fit extension shaft to starting dog by sliding the rubber hose over the dog, tighten by means of the hose clip.
  - (b) Check engine speed with revolution counter.
  - (c) Remove adjusting screw collar. See Fig. M-33.
  - (d) Slacken adjusting screw locknut; screw down to decrease engine speed and up to increase.

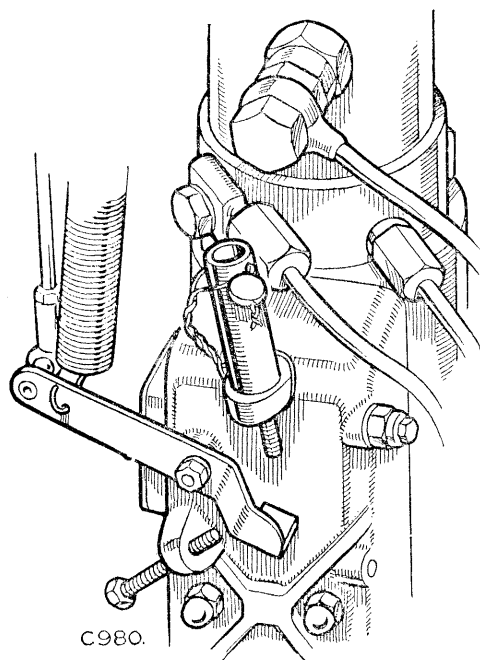


Fig. M-31—Control screws adjusted and sealed

- (e) When maximum engine speed of 3,650 r.p.m.  $\pm$  20 has been obtained, tighten locknut, replace adjusting screw collar, wire and seal screw collar as shown at Fig. M-34.

To adjust the slow running control screw, proceed as follows:—

- (a) Check engine speed with revolution counter.
- (b) Slacken adjusting screw locknut and screw inwards to increase speed and outwards to decrease.
- (c) When a slow-running speed of 590 r.p.m.  $\pm$  20 has been obtained, tighten locknut.
- (d) Remove extension shaft.

### Fuel injection nozzles

#### Checking nozzle assemblies on vehicle

##### Operation M/76

When an injection nozzle is considered to be the cause of irregular running and loss of power, a quick check may be made by loosening the fuel feed pipe union nut on each nozzle in turn, whilst the engine is idling and again at approximately 1,000 R.P.M.

If the injection nozzle assembly being checked has been operating properly, there will be a distinct reduction in R.P.M. accompanied by obvious roughness, but a faulty injection nozzle may make little or no difference to the engine note when its fuel feed pipe is loosened.

#### Testing nozzle assemblies on vehicle

##### Operation M/78

1. Remove the fuel spill gallery pipe complete, from the injection nozzles, then disconnect the fuel feed pipe (injection pump to nozzle) from the nozzle to be tested and from the injection pump.

2. Release the clamping strap and withdraw the suspected injection nozzle assembly; reconnect the pipe and nozzle assembly to the injection pump in a position whereby fuel ejection may be observed.
3. Loosen the union nuts securing the remaining fuel pipes to injection nozzles.
4. Whilst the starter turns the engine over, observe the manner in which fuel issues from the nozzle and compare the spray form with section "A" of Fig. M-47.

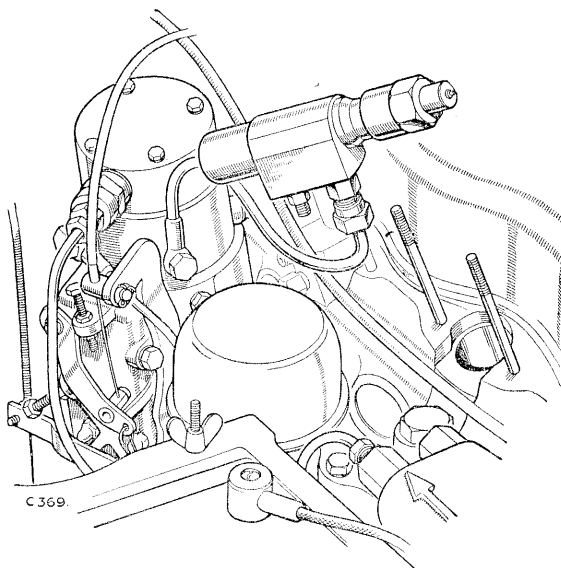


Fig. M-35—Testing nozzle assemblies on vehicle

Very little fuel should issue from the main spray hole with the engine turning over at starter speed but a fine spray comparable to that illustrated in section "A" should be ejected from the auxiliary spray hole. If the ejected fuel is more in the form of a liquid jet or issues from the main pintle hole, then the nozzle and holder assembly should be removed for overhaul (Operation M/80) and a replacement unit fitted.

#### Bench testing of injection nozzle and holder assembly

To check a nozzle assembly and ensure that it is functioning correctly, a setting outfit as illustrated in Fig. M-37 is essential. A bench covered with linoleum or non-ferrous sheet metal is most suitable for mounting the outfit; such a surface facilitates the cleanliness essential when checking nozzle parts. Between the bench and setting outfit, a tray, also of non-ferrous metal, should be positioned to prevent spilt fuel spreading. Small containers may be attached to the bench to isolate the component parts of each assembly; these parts are carefully mated by the manufacturers and must **not** be interchanged. Lastly, a small bath with cover, containing Shell Fusus "A" oil for washing components, should be kept conveniently near.

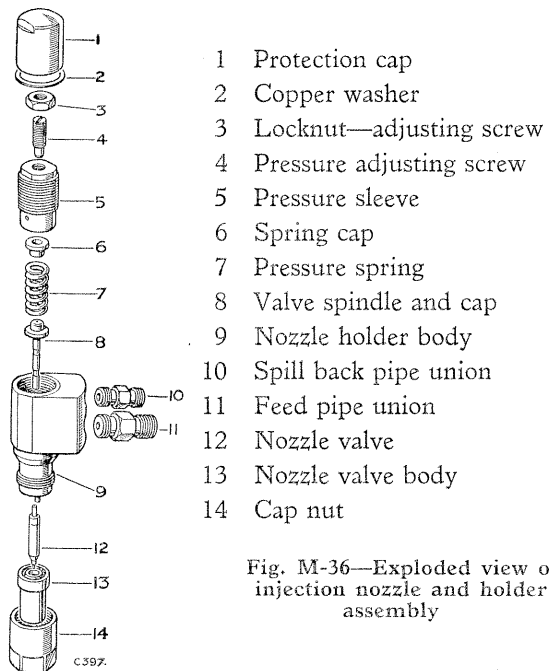


Fig. M-36—Exploded view of injection nozzle and holder assembly

The efficient operation of the injection nozzle assembly is dependent on four main conditions, as follows:—

- (a) The nozzle valve must open at 135 Ats.
- (b) The rate of back leakage must be within 150 to 100 Ats.
- (c) Seat tightness must be sufficient to prevent leakage.
- (d) Spray form must compare favourably with the illustrations Fig. M-47.

Pressure setting, back leakage and seat tightness tests may be made by coupling the injection nozzle and holder assembly direct to the pressure feed pipe on setting outfit, but an adaptor must be fitted between the pipe and injection nozzle and holder assembly when testing spray form. This adaptor, described in Operation M/82, increases the pressure of fuel to the injection nozzle and holder assembly sufficiently for the main and auxiliary spray form to be determined.

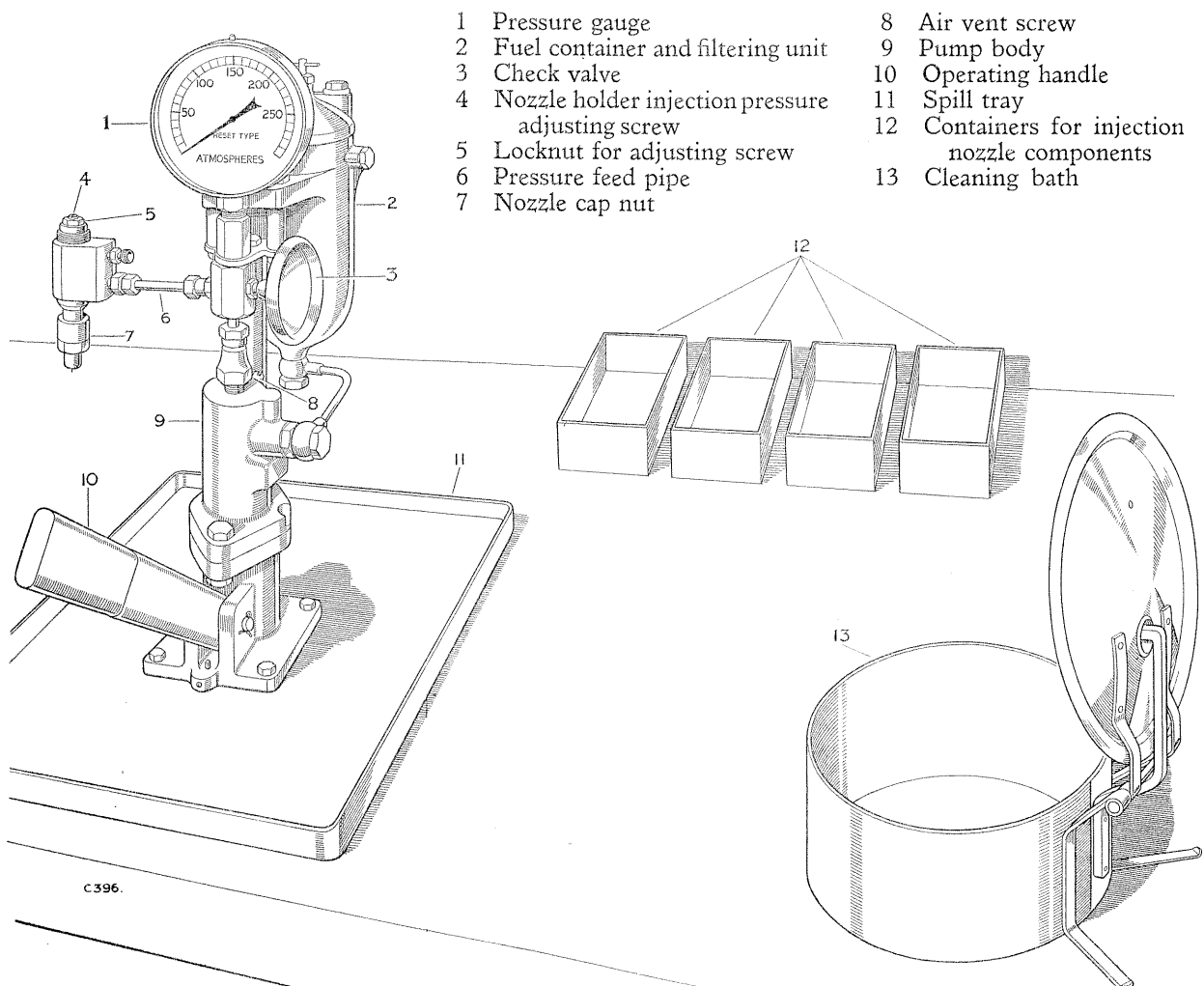


Fig. M-37—Injection nozzle setting outfit



## Dismantling and cleaning Operation M/80

A cleaning kit (Part No. 271484) is essential for removing carbon from the component parts of the injection nozzle and holder assembly. The use of special spanners (set Part No. 271482) is recommended.

1. Remove the nozzle holder protection cap and copper washer, unscrew the locknut, pressure adjusting screw and pressure sleeve, then withdraw the spring cap, spring and valve spindle. Unscrew the pipe unions and remove the copper washers.

2. Unscrew the cap nut, then remove the nozzle valve and body.

3. Soak the component parts of the assembly in Shell Fusus "A" oil to loosen carbon deposits but do **not** allow parts of any one assembly to be interchanged with those of another.

4. Brush away all external carbon deposits from component parts with a brass wire brush (Part No. ET.068) and replace them in the oil bath.

Particular care must be exercised when cleaning the pintle and seat of nozzle valve to avoid scratching or scoring, which may result in spray distortion.

5. Clean the three oil feed passages in the nozzle body with a wire or drill of  $\frac{1}{16}$  in. diameter. Remove the carbon from the annular recess with tool Part No. ET.071 and from the valve seat, using tool Part No. ET.070, with a rotary motion.

6. Select the appropriate size probe from the pocket of cleaning kit and secure it in the pintle hole cleaner (Part No. ET.069). Insert the probe into the bore of nozzle valve body and allow the end to extend through the main fuel outlet, then turn in a rotary manner to remove carbon.

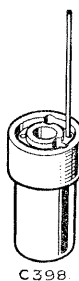


Fig. M-38—Cleaning nozzle body oil feed passages



Fig. M-39—Scraping nozzle body annular recess

7. Carbon may be removed from the nozzle valve cone by inserting the valve into tool Part No. ET.072 and then rotating it alternatively in a clockwise then anti-clockwise manner whilst pressing the valve inward.

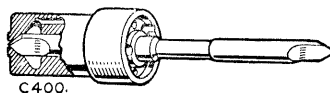


Fig. M-40—Removing carbon from valve seat

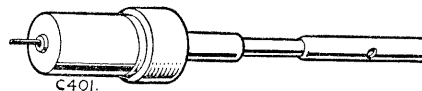


Fig. M-41—Cleaning Pintaux nozzle hole

If the nozzle is blued or the seating has a dull circumferential ring indicating pitting or wear, the nozzle body and valve should be returned to a C.A.V. Service Agent and replacement parts fitted. See "Defect Location".

Do **not** attempt to lap the nozzle valve to body. This process requires special equipment and training.

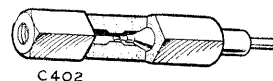


Fig. M-42—  
Removing carbon from nozzle valve cone

8. Clean the auxiliary spray hole using tool Part No. ET.120 fitted with probing wire (.008 in. (0,20 mm) diameter). Allow  $\frac{1}{16}$  in. (2,0 mm) only to extend from the chuck and thus minimise the possibility of the wire bending or breaking while probing. Great care must be taken to prevent breakage of the wire in the hole.
9. With flushing tool ET.427 secured to the nozzle testing outfit, fit the nozzle body (spray holes uppermost) to the flushing tool and pump test oil through vigorously. This flushing process is necessary for the removal of any tiny carbon particles which may have become lodged in the body after scraping and probing.

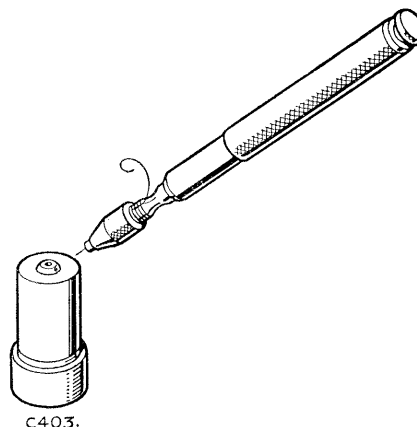


Fig. M-43—Cleaning auxiliary spray hole

10. Examine the pressure faces of nozzle body and nozzle holder to ascertain their freedom from scoring and scratches. These surfaces must be perfectly smooth. Fit the nozzle to nozzle body and check for freedom of movement.

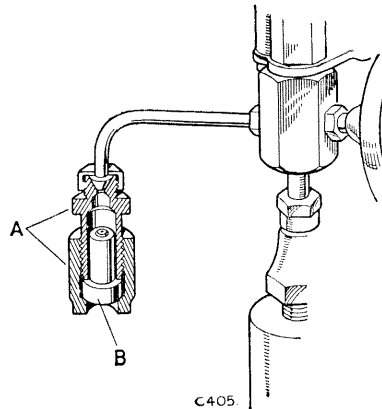


Fig. M-44—Flushing nozzle body  
A—Flushing tool B—Nozzle body

11. Immerse the nozzle body and valve in the oil bath and assemble whilst submerged. Wash the remaining components thoroughly and reverse dismantling procedure.
12. Seat injection nozzle assembly in accordance with Operation M/82.

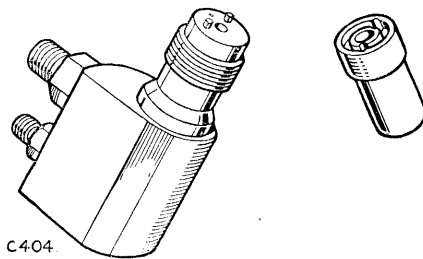


Fig. M-45—  
Injection nozzle assembly lapped pressure faces

To test (Fig. M-34)

#### Operation M/82

**WARNING:** The injection nozzle must **not** be allowed to point towards the operator when spraying and the hands must **never** be allowed to contact the spray, which has great penetrating force.

1. Remove the cap from oil container (2) and fill with  $1\frac{1}{2}$  pints (0,8 litre) of Shell Fusus 'A' oil.
2. Air vent the system by removing the vent screw (8), allow oil to flow freely for a few seconds and replace the screw whilst the flow continues. Operate the pump handle until oil flows from pipe (6).

3. Connect the injector and holder assembly to the pressure feed pipe with the nozzle pointing downwards. The length and bore of this pipe is important and replacement pipes must be approximately 75 mm (2.8 in.) between the union nuts and of 3 mm (.118 in.) bore.
4. Close the check valve (3) to keep the pressure gauge out of circuit and smartly operate the hand lever (10) several times to expel all air from the system.

#### Back leakage

5. Open the check valve (3), move the operating handle slowly downward and note the highest pressure at which the gauge needle "flicks". This "flick" indicates the opening of the needle valve and should occur for this test at 160 to 170 atmospheres. Adjustment is made by removing the cap nut from the nozzle holder, loosening locknut (5) and turning the adjusting screw (4) clockwise to increase and anti-clockwise to decrease the opening pressure.
6. Raise the pressure in the system to just less than valve opening pressure, release the operating lever and time the pressure drop from 150-100 atmospheres. This should be not less than 5 seconds for the original nozzle and not less than 7 seconds, if a new one is to be fitted, and not more than 36 seconds for either.
7. Check externally the top and bottom of nozzle cap nut (7) and pressure pipe union nuts for signs of oil leakage. If leakage occurs at the nozzle cap nut, remove the nut and examine the pressure faces of nozzle holders and nozzle body for presence of foreign matter or surface scoring, before tightening further.

A leakproof nozzle assembly with an excessive rate of pressure drop, indicates a worn nozzle valve; the nozzle valve and nozzle body should be renewed.

#### Pressure setting

8. The selected **operational** opening pressure of the nozzle valve is 135 atmospheres. Readjust to this setting in the manner described in item 5.

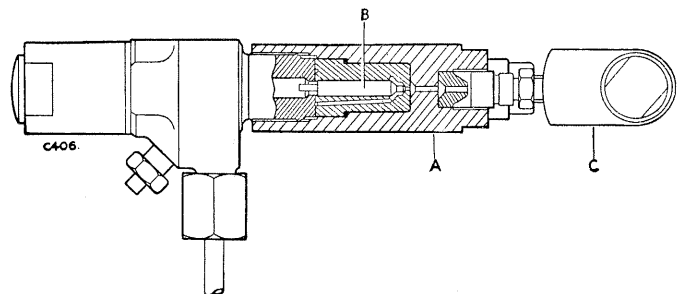


Fig. M-46—Sectioned view of adaptor (C.A.V.-E.T. 872)

A—Modified cap nut B—Nozzle valve (less pintle)  
C—Nozzle under test

**Seat tightness**

9. Wipe the bottom face of the injection nozzle dry and raise the pressure in the system to 125 atmospheres. A slight dampness on the bottom face is permissible, but blob formation or dripping indicates a badly seating valve in which case the assembly should be dismantled for further examination.

**Spray form**

10. Fuel delivery to the injection nozzle assembly when testing **spray form**, must be characteristically similar to fuel delivery under normal operating conditions and to effect these conditions an adaptor (CAV Y7044872) must be fitted between the injection nozzle assembly and the pressure pipe.

The adaptor differs mainly in the cap nut and nozzle valve, from the ordinary type of injection nozzle and holder assembly as fitted to the engine; the nozzle valve has no pintle and the cap nut is extended, bored and threaded, to receive nozzles for testing.

11. Connect the adaptor assembly to the pressure pipe and adjust the opening pressure of the nozzle valve to 220 atmospheres. (See items 4 and 5.) Screw the injection nozzle and holder assembly to be tested, into the adaptor and with the check valve closed, operate the handle smartly to expel air from the system.

The auxiliary spray form may be tested at 60 strokes per minute and the main spray at 140. Spray development from starting to running speeds is illustrated in Fig. M-47; this illustration should be referred to and compared with the spray form of nozzles under test.

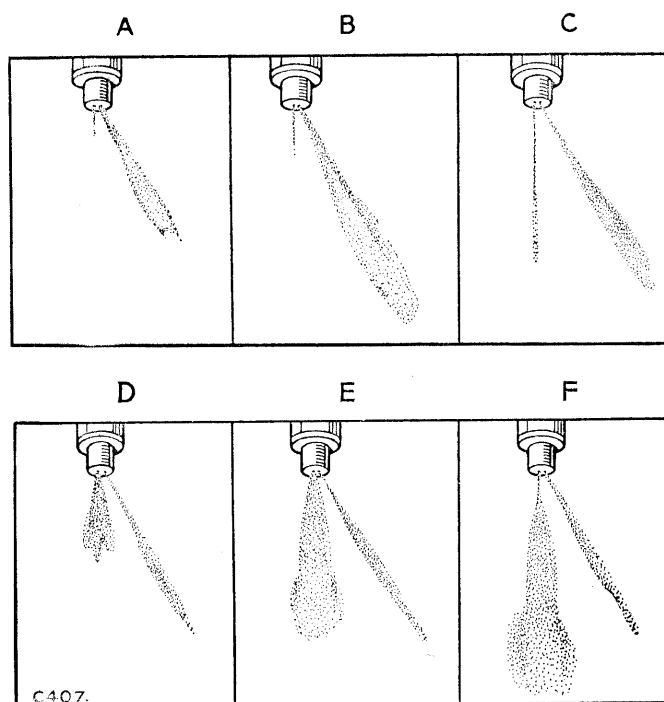


Fig. M-47—Injection nozzle spray form development  
—starting to running conditions

## DEFECT LOCATION

(Symptom, Cause and Remedy)

### PETROL ENGINES

#### A—NO PETROL SUPPLY TO CARBURETTER

1. Blocked pump or bowl filter—*Clean.*
2. Stoppage in pipe lines—*Clear.*
3. Sticking needle valve—*Replace.*
4. Pump inoperative—*See item B for 2 litre; see item F for 2½ litre.*

#### B—INOPERATIVE FUEL PUMP (ELECTRIC)

1. Broken wiring or poor connections—*Rectify.*
2. Dirty contact points—*Clean.*
3. Foreign matter in pump—*Overhaul.*
4. Faulty pump—*Renew.*

#### C—ELECTRIC FUEL PUMP NOISY

1. Air leak between pump and tank—*Rectify.*
2. Dirt under pump valves—*Clean.*

#### D—LACK OF ENGINE POWER

1. Badly adjusted carburetter—*Adjust.*
2. Blocked jets—*Clear.*
3. Needle valve sticking—*Replace.*
4. Blocked filters or pipes—*Clean.*
5. Pump inoperative—*See items B or F.*
6. Engine fault—*See Section A.*
7. Accelerator linkage stiff—*Lubricate.*
8. Water in petrol—*Drain and clear system.*

#### E—HEAVY PETROL CONSUMPTION

1. Badly adjusted or worn carburetter—*Adjust or replace.*
2. Float chamber flooding—*Replace needle valve.*
3. Petrol leaks—*Rectify.*
4. Wrong main jet—*Check and rectify as necessary.*

### DIESEL ENGINES

#### LIFT PUMP

#### F—INOPERATIVE FUEL PUMP (MECHANICAL)

1. Fuel tank empty—*Refuel.*
2. Cork sealing gasket for sediment bowl hardened or cracked—*Renew.*
3. Sediment bowl loosely fitted—*Tighten.*
4. Filter disc clogged—*Remove and clean.*
5. Diaphragm cracked or porous—*Renew. Operation M/40.*
6. Screws securing upper and lower casings loose—*Re-set diaphragm and tighten in accordance with Operation M/40.*
7. Rocker arm excessively worn—*Renew.*
8. Springs fatigued—*Renew.*
9. Valve seating gasket or valves damaged—*Renew.*
10. Dirt on valve or valve seats—*Clean and refit.*
11. Valve retainer screws loose—*Tighten.*
12. Pipe union—tank to pump—loose—*Tighten.*

#### G—FUEL LEAKING FROM BASE OF PUMP

1. Diaphragm porous or cracked—*Renew.*

### INJECTION NOZZLES

#### A—NOZZLE BLUEING

1. Nozzle holder not tightened properly—*Renew nozzle body and valve—tighten fully.*
2. Inefficient cooling—*Check cooling system—renew nozzle body and valve.*
3. Small corrugated sealing washer not fitted or damaged—*Renew nozzle and valve, fit new washer.*

#### B—EXCESSIVE LEAK-BACK

1. Cap nut loose—*Tighten.*
2. Pressure seats scored—*Renew nozzle and holder assembly.*
3. Nozzle valve worn—*Renew nozzle and holder assembly.*

#### C—VALVE LIFTING PRESSURE TOO HIGH

1. Compression screw incorrectly adjusted—*Re-adjust.*
2. Nozzle valve sticking—*Renew nozzle valve and nozzle body.*

#### D—VALVE LIFTING PRESSURE TOO LOW

1. Compression screw incorrectly adjusted—*Re-adjust.*
2. Spring fatigued or broken—*Renew.*

#### E—SPRAY FORM DISTORTED

1. Carbon on valve seat—*Remove.*
2. Nozzle tip distorted—*Renew nozzle valve and nozzle body.*
3. Spray holes distorted—*Renew nozzle valve and nozzle body.*
4. Injection holes partially blocked with carbon—*Remove deposit.*

#### F—NOZZLE DRIP

1. Valve seat scored—*Renew nozzle valve and nozzle body.*
2. Spring pressure incorrectly adjusted—*Re-adjust.*
3. Carbon deposit on valve or seating—*Remove.*
4. Nozzle valve sticking—*Clean and re-check, renew nozzle valve and body if trouble is not corrected.*

### MAIN FILTER

#### A—LEAKAGE AT CONTAINER JOINT

1. Gasket unserviceable—*Renew.*
2. Container loose—*Tighten.*

#### B—FUEL PUMPED TO FILTER AT NORMAL PRESSURE BUT EMERGES AT MUCH REDUCED RATE

1. Element waxed up—*Renew element.*
2. Foreign body lodged in inlet connection—*Remove and examine.*

### INJECTION PUMP

#### A—INJECTION PUMP DEFECTIVE

1. For any reason—*Return to CAV Agent—fit a replacement unit.*

## DATA—ALL MODELS

Air cleaner	....	....	A.C. Centrifugal—oil bath
Capacity	....	....	1.5 Imperial pints (0.85 litres)

## Carburetter

Make	.....	Solex	Solex
Type	.....	—	PA10-5
Details	.....	2 litre Petrol	2½ litre Petrol
Choke size	.....	25	28
Main jet	.....	115	125
Correction jet	.....	170	185
Pilot jet	.....	55	50
Pump jet	.....	75	65
Economy jet	.....	50	Blank
Air bleed jet	.....	1.5	1.5
Starter air jet	.....	5.5	—
Starter petrol jet	.....	135	145

Economy system		
Petrol jet	.... —	100
Petrol level	.... $\frac{5}{8}$ in. $\pm \frac{1}{8}$	(16 mm $\pm 3$ ) below float chamber joint face

Exceptions to standard settings to suit various altitudes, 2 litre Petrol only:

3,000 to 6,000 ft. (918,4 to 1837 m)

Main jet	....	110
Air bleed jet....		2.0

6,000 to 10,000 ft. (1837 to 3061 m)

Main jet	....	107.5
Air bleed jet	....	2.0

10,000 to 14,000 ft. (3061 to 4286 m)

Choke size	....	26
Main jet	....	107,5
Correction jet	....	180
Air bleed jet	....	2.0

Exception to standard settings to suit tropical conditions:

Main jet .... 110

Carburettor settings which may be advantageous for high altitudes, 2 $\frac{1}{4}$  litre Petrol only

Main jet (120)	5,000 to 7,000 ft. (1.524 to 2.134 m)
----------------	--

Main jet (117.5)	7,000 to 9,000 ft. (2.134 to 2.740 m)
------------------	--

Main jet (115)	} 9,000 to 12,000 ft. (2.740 to 3.655 m)
Pilot jet (45)	

Main jet (112.5)	} 12,000 to 14,000 ft. (3.655 to 4.268 m)
Pilot jet (45)	

## Filters

Petrol models	....	Sediment bowl, full flow
Diesel models, main....		C.A.V. Replaceable element, full flow

## Fuel pump

2 litre Petrol	....	S.U. Electric
2¼ litre Petrol, Diesel		A.C. Mechanical
		(Not interchangeable)
Pressure, 2¼ litre		
Petrol	....	1½ to 2½ lb/sq.in. (0,10 to 0,17 Kg/cm²)
Pressure, Diesel	....	5 to 8 lb/sq.in. (0,3 to 0,5 Kg/cm²)

## Fuel tank

Capacity, except	109		
Station Wagon	....	10 Imperial gallons (45	litres). No reserve
Capacity, 109	Station		
Wagon....	....	16 Imperial gallons (73	litres). No reserve

### Injection pump, Diesel models

Type ..... C.A.V. Mechanically governed distributor

## Injection nozzle assemblies

Nozzle size	....	B.D.N.O./SP6209
Opening pressure of nozzle valve	....	135 Ats.
Back leakage rate, 150 to 100 Ats.:		
New nozzle	....	7 seconds
Original nozzle	....	5 seconds

# Section N — EXHAUST SYSTEM — ALL MODELS

## INDEX

	Page		Page
Exhaust silencer		Fitment	N-1
Removal	N-1	Intermediate exhaust pipe	
Fitment	N-1	Removal	N-1
Front exhaust pipe		Fitment	N-1
Removal	N-1		

## LIST OF ILLUSTRATIONS

Fig.	Page
N-1 Layout of exhaust system	N-2

### Front exhaust pipe

#### To remove Operation N/2

1. Remove securing bolts at front exhaust pipe and intermediate pipe joint.
2. Remove nuts and spring washers securing pipe at exhaust manifold.
3. Withdraw the exhaust pipe and joint washer.

#### To refit Operation N/4

1. Reverse the removal procedure.

### Intermediate exhaust pipe

#### To remove Operation N/6

1. Remove securing bolts at front exhaust pipe and silencer.
2. Remove supporting clamp and withdraw intermediate exhaust pipe.

#### To refit Operation N/8

1. Reverse the removal procedure, leaving the supporting clamps loose until the pipe has been secured firmly to front exhaust pipe and silencer.

### Exhaust silencer (R.H.D. models only)

#### To remove Operation N/10

1. Remove the bolts securing intermediate pipe to silencer and release support saddle from silencer tail pipe, keeping silencer supported by hand.
2. Withdraw silencer assembly.

#### To refit Operation N/12

1. Reverse removal procedure, ensuring that the bolts securing intermediate pipe to silencer are fully tightened before finally clamping the tail pipe support.

### Exhaust silencer (L.H.D. models only)

#### To remove Operation N/14

1. Remove bolts securing intermediate pipe to silencer.
2. Keeping the silencer supported, release the supporting strap for silencer right-hand side and saddle clamp on tail pipe, then withdraw silencer assembly.

#### To refit Operation N/16

1. Fit the silencer in position and loosely support by means of supporting strap and saddle clamp.
2. Secure the intermediate pipe to silencer.
3. Finally tighten bolts securing support strap and saddle clamp.

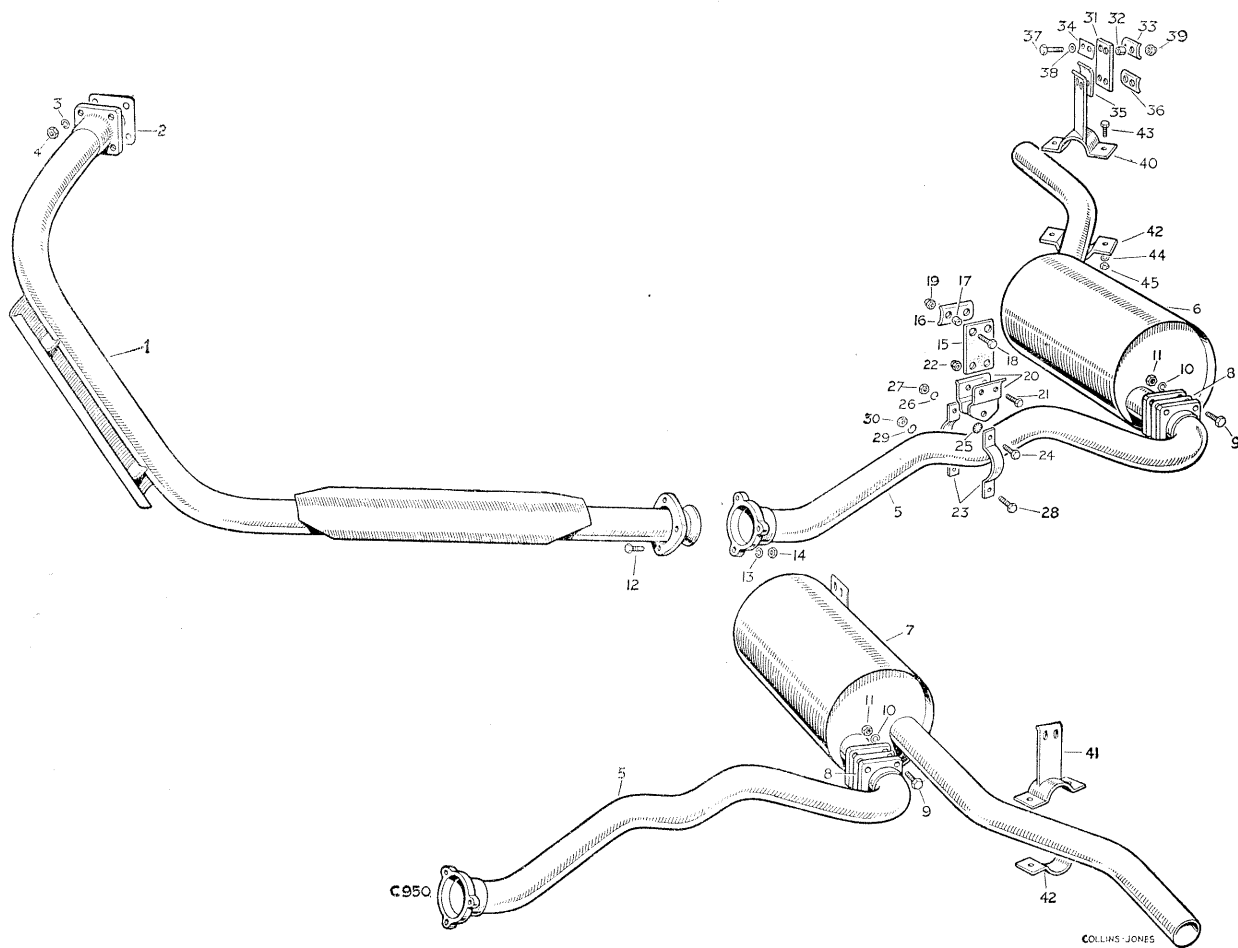


Fig. N-1—Layout of exhaust system

- |    |                                 |   |  |
|----|---------------------------------|---|--|
| 1  | Front exhaust pipe              |   |  |
| 2  | Joint washer for exhaust pipe   |   |  |
| 3  | Spring washer                   | } Exhaust pipe to manifold                                    |  |
| 4  | Nut                             |   |  |
| 5  | Intermediate exhaust pipe       |   |  |
| 6  | Silencer complete—R.H.D.        |   |  |
| 7  | Silencer complete—L.H.D.        |   |  |
| 8  | Joint washer                    | } Intermediate pipe to silencer                               |  |
| 9  | Bolt                            |   |  |
| 10 | Spring washer                   | } Front pipe to intermediate pipe                             |  |
| 11 | Nut                             |   |  |
| 12 | Bolt                            |   |  |
| 13 | Spring washer                   | } Flexible mounting to chassis frame                          |  |
| 14 | Nut                             |   |  |
| 15 | Flexible mounting               |   |  |
| 16 | Clamp plate                     | } Flexible mounting to chassis frame                          |  |
| 17 | Distance piece                  |   |  |
| 18 | Bolt                            |   |  |
| 19 | Self-locking nut                | } Plate to flexible mounting                                  |  |
| 20 | Plate for flexible mounting     |   |  |
| 21 | Bolt                            | } Plate to flexible mounting                                  |  |
| 22 | Self-locking nut                |   |  |
| 23 | Pipe clamp                      |   |  |
| 24 | Bolt                            | } Pipe clamp to flexible mounting                             |  |
| 25 | Shakeproof washer               |   |  |
| 26 | Spring washer                   |   |  |
| 27 | Nut                             | } Pipe clamp to exhaust pipe                                  |  |
| 28 | Bolt                            |   |  |
| 29 | Spring washer                   |   |  |
| 30 | Nut                             | } Flexible mounting for tail pipe                             |  |
| 31 | Flexible mounting for tail pipe |   |  |
| 32 | Distance piece                  | } Fixing flexible mounting to chassis frame and clamp bracket |  |
| 33 | Upper clamp plate               |   |  |
| 34 | Upper packing plate             |   |  |
| 35 | Lower packing plate             |   |  |
| 36 | Lower clamp plate               |   |  |
| 37 | Bolt                            |   |  |
| 38 | Plain washer                    |   |  |
| 39 | Self-locking nut                |   |  |
| 40 | Pipe clamp bracket—R.H.D.       |   |  |
| 41 | Pipe clamp bracket—L.H.D.       |   |  |
| 42 | Clamp bracket saddle            | } Fixing exhaust pipe to clamp bracket                        |  |
| 43 | Bolt                            |   |  |
| 44 | Spring washer                   |   |  |
| 45 | Nut                             |   |  |

# Section P

## ELECTRICAL EQUIPMENT — ALL MODELS

### INDEX

	Page		Page
Batteries		Coil	
Removal ....	P-3	Removal ....	P-20
Fitment ....	P-3	Fitment ....	P-20
Current voltage regulator—Diesel models		Mixture control thermostat switch—	
Fault locating on charging circuit ....	P-14	Petrol models	
Regulator adjustments ....	P-15	Renewal ....	P-22
Electrical setting of voltage regulator ....	P-15	Number plate illumination lamp	
Electrical setting of current regulator on vehicle ....	P-15	Removal ....	P-19
Electrical setting of cut-out relay ....	P-16	Fitment ....	P-19
Cleaning contacts ....	P-16	Resistance—heater plugs	
Mechanical setting of air gaps ....	P-16	Removal ....	P-21
Voltage and current regulator ....	P-16	Fitment ....	P-21
Setting of cut-out relay air gap ....	P-16	Side lamp	
Removal ....	P-17	Removal ....	P-19
Fitment ....	P-17	Fitment ....	P-19
Data ....	P-24	Starter and heater plug switch—Diesel models	
Defect location ....	P-23	Removal ....	P-22
Dipswitch		Fitment ....	P-22
Removal ....	P-20	Starter drive	
Fitment ....	P-20	Stripping ....	P-11
Dynamo		Assembling ....	P-11
Removal ....	P-13	Testing of solenoid ....	P-12
Fitment ....	P-13	Closing coil ....	P-12
Stripping ....	P-13	Hold-on coil ....	P-12
Overhauling ....	P-13	Starter motor	
Brushes ....	P-13	Removal ....	P-3
Commutator ....	P-13	Fitment ....	P-3
Assembling ....	P-13	Dismantling ....	P-3
Checking ....	P-14	Overhauling	
Fuel gauge tank unit		Brushes ....	P-3
Renewal ....	P-22	Commutator ....	P-11
Fuse and junction boxes		Armature ....	P-11
Removal ....	P-22	Assembling ....	P-11
Fitment ....	P-22	Starter switch	
Heater plugs—Diesel models		Removal ....	P-13
Fault location on heater plug circuit ....	P-20	Fitment ....	P-13
Removal, cleaning and inspection ....	P-21	Stop and tail lamp	
Headlamps		Removal ....	P-19
Removal ....	P-17	Fitment ....	P-19
Fitment and adjustment ....	P-17	Stop lamp switch	
Adjustment, using setting board ....	P-17	Renewal ....	P-20
Horn		Voltage regulator—Petrol models	
Adjustment ....	P-19	Removal ....	P-14
Horn button		Fitment ....	P-14
Removal ....	P-19	Checking ....	P-14
Fitment ....	P-19	Windscreen wiper motor	
Ignition—Petrol models		Removal ....	P-22
Distributor		Fitment ....	P-22
Removal ....	P-20		
Fitment ....	P-20		



## LIST OF ILLUSTRATIONS

Fig.		Page	Fig.		Page
P-1	Checking starter brushes .....	P-3	P-12	Charging circuit .....	P-14
P-2	Wiring diagram—2 litre Petrol .....	P-4	P-13	Current voltage regulator .....	P-15
P-3	Wiring diagram—2½ litre Petrol .....	P-6	P-14	Short-circuiting regulator contacts .....	P-15
P-4	Wiring diagram—2 litre Diesel .....	P-8	P-15	Voltage and current regulators .....	P-16
P-5	Exploded view of starter motor—Petrol models .....	P-10	P-16	Cut-out relay .....	P-16
P-6	Sectioned view of starter motor—Diesel models .....	P-10	P-17	Headlamp .....	P-17
P-7	Testing brush spring tension .....	P-11	P-18	Headlamp beam setting board .....	P-17
P-8	Setting pinion movement .....	P-11	P-19	Layout of lamps .....	P-18
P-9	Layout of starter drive—Petrol models .....	P-11	P-20	Side and tail lamps .....	P-19
P-10	Exploded view of starter drive—Diesel models .....	P-12	P-21	Number plate lamp .....	P-19
P-11	Undercutting commutator insulators .....	P-13	P-22	Horn adjustment—Lucas .....	P-20
			P-23	Horn adjustment—Clear Hooters .....	P-20
			P-24	Checking heater plug circuit .....	P-21
			P-25	Testing heater plug circuit .....	P-21

### Batteries

Two batteries fitted to Diesel models—see Data section.

#### To remove

#### Operation P/2

1. Disconnect the leads, remove the securing frame and lift battery clear (when removing one battery only—Diesel models—always remove the inter-connecting battery lead completely from both batteries).

#### To refit

#### Operation P/4

1. Reverse removal procedure, taking care to smear the battery terminals with petroleum jelly.

The drive screws securing the battery leads are manufactured from a special non-corrosive metal and must never be replaced with ordinary drive screws, which may cause serious corrosion of the battery terminals.

### Starter motor

#### To remove

#### Operation P/6

1. **Petrol models**—disconnect the positive lead from the battery.

**Diesel models**—disconnect the negative L.H. battery lead from the battery and the leads from the starter solenoid.

2. **2½ litre Petrol, Diesel models**—remove the inlet and exhaust manifolds, and the dipstick and tube.
3. **Petrol models**—disconnect the cable from starter.
4. Remove the securing bolts and withdraw starter.

#### To refit

#### Operation P/8

1. Reverse the removal procedure.
2. Check the operation of the starter motor.

#### To dismantle

#### Operation P/10

1. Remove the cover band, hold back the brush springs and lift the brushes from their holders.

#### Petrol models

2. Remove the starter drive, by withdrawing split pin from retaining nut on end of driving shaft and unscrewing the nut.
3. Remove the driving-end bracket, by unscrewing the two through bolts.
4. Withdraw the armature from the starter yoke.

#### Diesel models

5. Disconnect the copper link between the lower solenoid terminal and the starter motor casing.

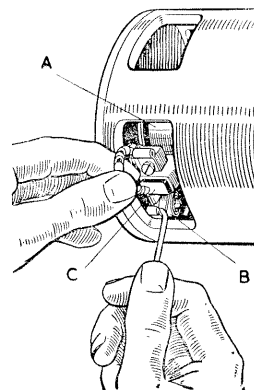
6. Remove the solenoid securing bolts. Withdraw the solenoid from the drive-end bracket casting, carefully making sure that the solenoid plunger is free from the starter drive engagement lever.
7. Unscrew and withdraw the two through bolts from the commutator end bracket, and remove bracket from the starter motor yoke.
8. Remove the rubber seal from the drive-end bracket.
9. Remove the nut securing the eccentric pin, on which the drive engagement lever pivots, and withdraw pin.
10. Split the armature and intermediate bracket assembly from the drive-end bracket.
11. Slide the drive assembly and engagement lever off the shaft, first removing the washer from the end of the armature shaft extension.
12. Slide the intermediate bracket and brake assembly off the shaft, first removing the retaining ring from the armature shaft extension.

#### To overhaul

#### Operation P/12

#### Brushes

1. Check that the brushes move freely in their holders by holding back the brush spring and pulling gently on the flexible connectors. Any tendency to stick should be corrected by cleaning with a petrol-moistened cloth, or in extreme cases by the **light** use of a smooth file. If a brush is damaged or worn so that it does not make good contact on the commutator, all the brushes must be renewed.

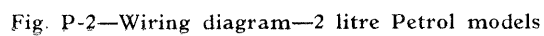


**Fig. P-1—**  
**Checking brushes**

A—Commutator  
B—Brush spring  
C—Brush

2. Check the tension of the brush springs with a spring balance. The correct tension is 30 to 40 ozs. (850 to 1,134 grammes) and new springs must be fitted if the tension is low.
3. The flexible connectors are soldered to terminal tags; two are connected to brush boxes, and two are connected to the free ends of the field coils. These flexible connectors must be removed by unsoldering, and the flexible connectors of the new brushes secured in their places by soldering.

The new brushes being pre-formed, "bedding" to the commutator is unnecessary.




### Wiring diagrams

**NOTE:** On vehicles to the North American specification, the connections at the lighting switch are such that the sidelamps are extinguished when the headlamps are in use.

### Key to cable colours

B—Black      N—Brown      R—Red      W—White  
 G—Green      P—Purple      U—Blue      Y—Yellow  
 RN—Red with brown, and so on.

### Key to Fig. P-2

- |  |   |
|--|---|
| 1 Rear number plate light                | 21 Fuse box (35 amp. fuse)  |
| 2 Stop tail lamps                        | 22 Mixture control switch (at control)  |
| 3 Snap connectors for number plate light | 23 Mixture control thermostat switch (at cylinder head)   |
| 4 Ammeter                                | 24 Petrol pump  |
| 5 Fuel level gauge                       | 25 Starter  |
| 6 Headlamp main beam warning light       | 26 Starter solenoid switch  |
| 7 Dynamo warning light                   | 27 Dynamo   |
| 8 Panel lights                           | 28 Horn   |
| 9 Panel light switch                     | 29 Horn push  |
| 10 Speedometer                           | 30 Headlamp dipper switch   |
| 11 Ignition and lighting switch          | 31 Junction box   |
| 12 Mixture control warning light         | 32 12-volt battery (positive earth)   |
| 13 Oil pressure warning light            | 33 Ignition coil  |
| 14 Oil pressure switch                   | 34 Distributor  |
| 15 Windscreen wiper plug and socket      | 35 Headlamps  |
| 16 Windscreen wiper                      | 36 Main beam  |
| 17 Fuel tank level unit                  | 37 Dip beam   |
| 18 Stop lamp switch                      | 38 Side lamps   |
| 19 Inspection lamp sockets               | 39 Snap connectors shown thus  |
| 20 Voltage control box                   |   |

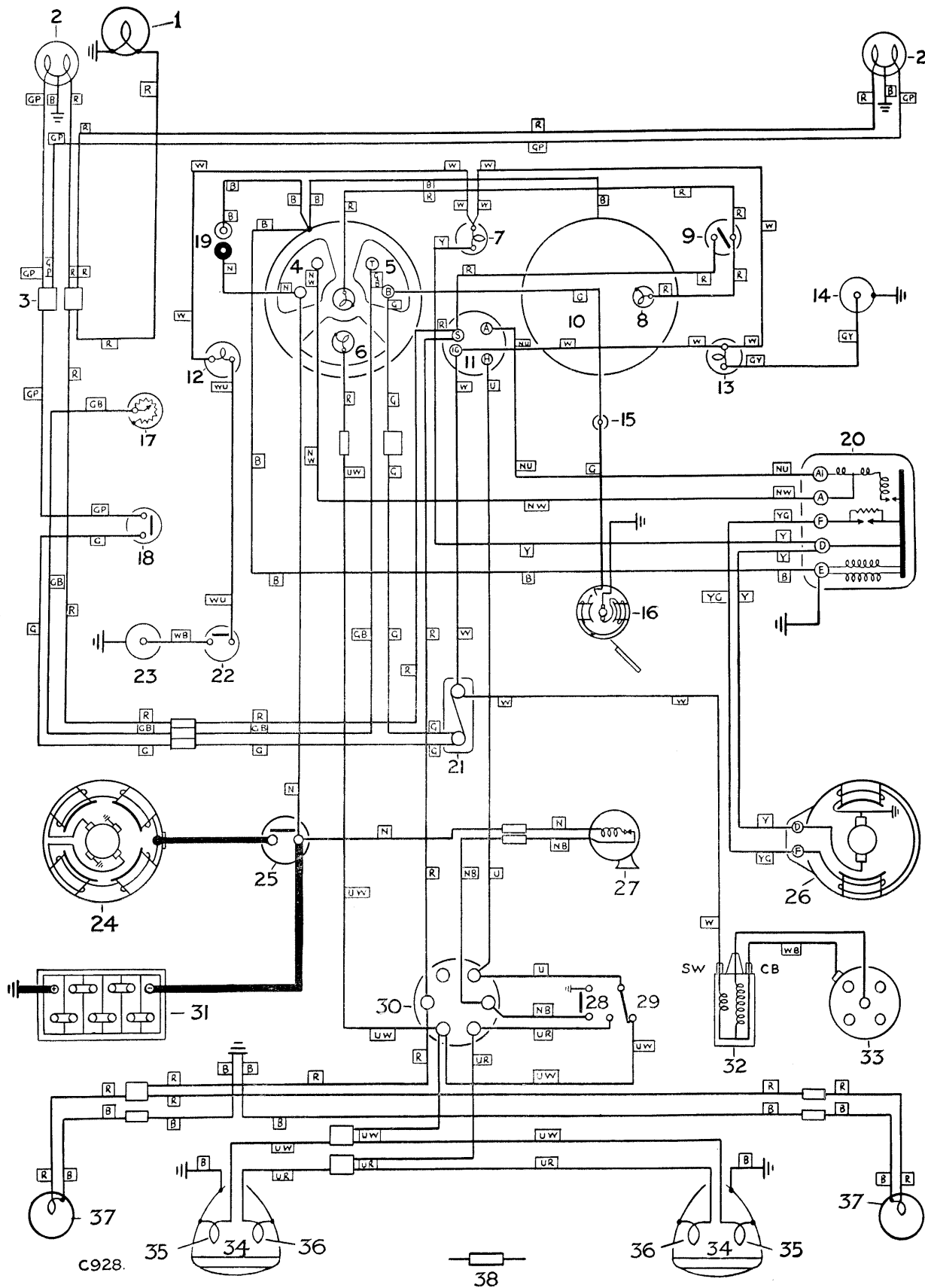


Fig. P-3—Wiring diagram—2 1/4 litre Petrol models


**Wiring diagrams**

**NOTE:** On vehicles to the North American specification, the connections at the lighting switch are such that the sidelamps are extinguished when the headlamps are in use.

**Key to cable colours**

B—Black    N—Brown    R—Red    W—White  
 G—Green    P—Purple    U—Blue    Y—Yellow  
 RN—Red with brown, and so on.

**Key to Fig. P-3**

- |  |   |
|--|---|
| 1 Rear plate illumination lamp           | 20 Voltage control box  |
| 2 Stop, tail lamps                       | 21 Fuse box (35 amp. fuse)  |
| 3 Snap connectors for number plate light | 22 Mixture control switch (at control)  |
| 4 Ammeter                                | 23 Mixture control thermostat switch (at cylinder head)   |
| 5 Fuel level gauge                       | 24 Starter  |
| 6 Headlamp beam warning light            | 25 Starter solenoid switch  |
| 7 Dynamo warning light                   | 26 Dynamo   |
| 8 Panel lights                           | 27 Horn   |
| 9 Panel light switch                     | 28 Horn push  |
| 10 Speedometer                           | 29 Headlamp dipper switch   |
| 11 Ignition and lighting switch          | 30 Junction box   |
| 12 Mixture control warning light         | 31 12-volt battery (positive earth)   |
| 13 Oil pressure warning light            | 32 Ignition coil  |
| 14 Oil pressure switch                   | 33 Distributor  |
| 15 Windscreen wiper plug and socket      | 34 Headlamps  |
| 16 Windscreen wiper                      | 35 Main beam  |
| 17 Fuel tank level unit                  | 36 Dip beam   |
| 18 Stop lamp switch                      | 37 Side lamps   |
| 19 Inspection lamp sockets               | 38 Snap connectors shown thus  |

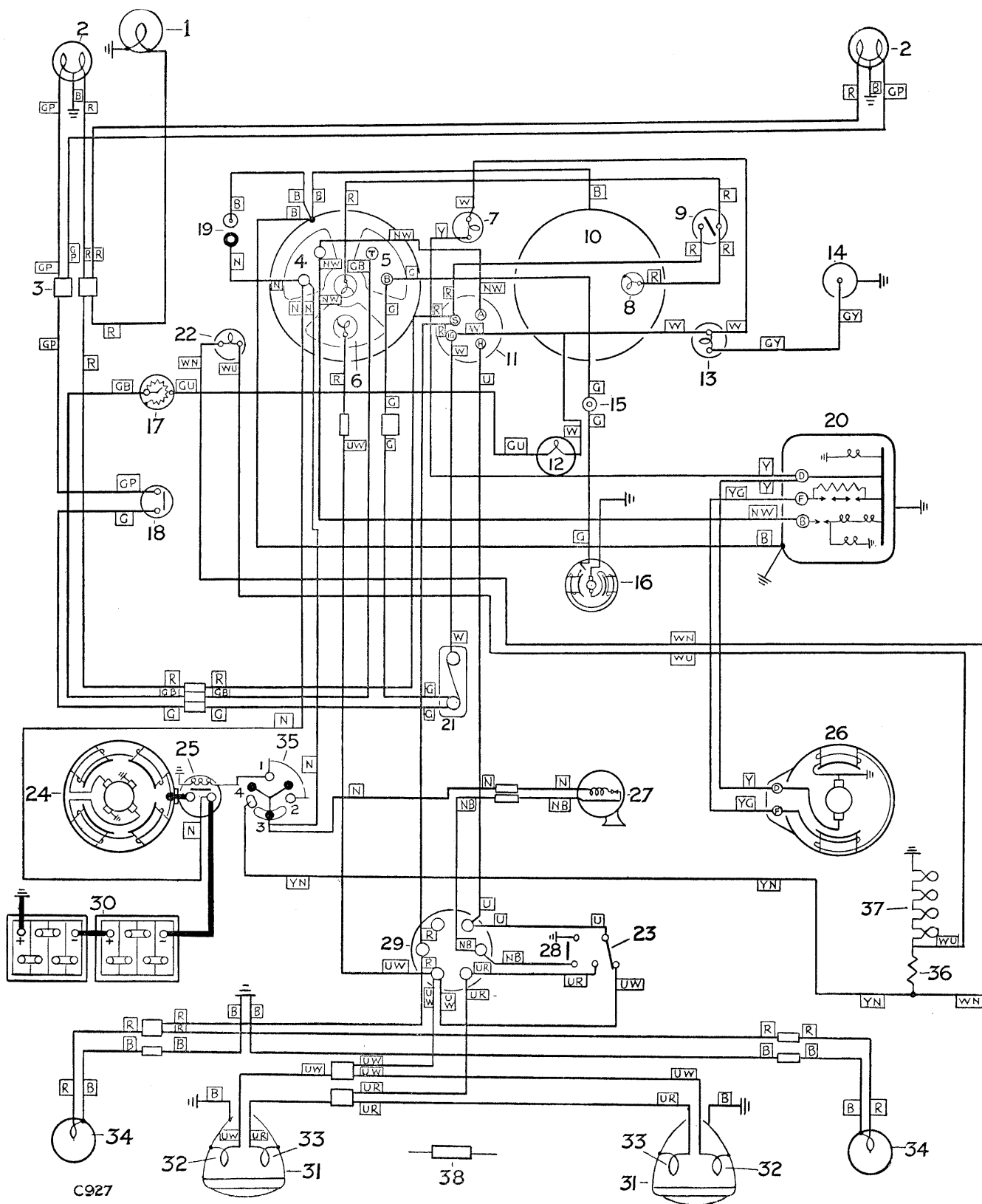


Fig. P-4—Wiring diagram—2 litre Diesel

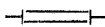
### Wiring diagrams

**NOTE:** On vehicles to the North American specification, the connections at the lighting switch are such that the sidelamps are extinguished when the headlamps are in use.

### Key to cable colours

B—Black    N—Brown    R—Red    W—White  
 G—Green    P—Purple    U—Blue    Y—Yellow  
 RN—Red with brown, and so on.

### Key to Fig. P-4

- |  |   |
|--|---|
| 1 Rear number plate light                  | 20 Current control box  |
| 2 Stop tail lamps                          | 21 Fuse box (35 amp. fuse)  |
| 3 Snap connectors for number plate light   | 22 Heater plug warning light  |
| 4 Ammeter                                  | 23 Headlamp dipper switch   |
| 5 Fuel level gauge                         | 24 Starter  |
| 6 Headlamp main beam warning light         | 25 Starter solenoid switch  |
| 7 Dynamo warning light                     | 26 Dynamo   |
| 8 Panel lights                             | 27 Horn   |
| 9 Panel light switch                       | 28 Horn push  |
| 10 Speedometer                             | 29 Junction box   |
| 11 Electrical services and lighting switch | 30 6-volt batteries (positive earth)  |
| 12 Fuel level warning light                | 31 Headlamps  |
| 13 Oil pressure warning light              | 32 Main beam  |
| 14 Oil pressure switch                     | 33 Dip beam   |
| 15 Windscreen wiper plug and socket        | 34 Side lamps   |
| 16 Windscreen wiper                        | 35 Starter and heater plug switch   |
| 17 Fuel tank level unit                    | 36 Resistance for heater plug   |
| 18 Stop lamp switch                        | 37 Heater plugs   |
| 19 Inspection lamp sockets                 | 38 Snap connectors shown thus  |



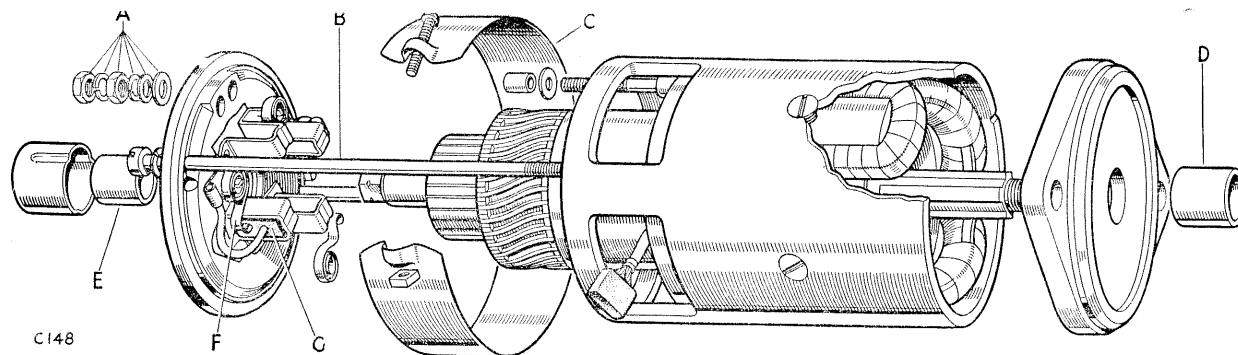


Fig. P-5—Exploded view of starter motor—Petrol models

- |                            |                |                |         |
|----------------------------|----------------|----------------|---------|
| A—Terminal nuts and washer | C—Cover band   | E—Bearing bush | G—Brush |
| B—Through bolt             | D—Bearing bush | F—Brush spring |         |

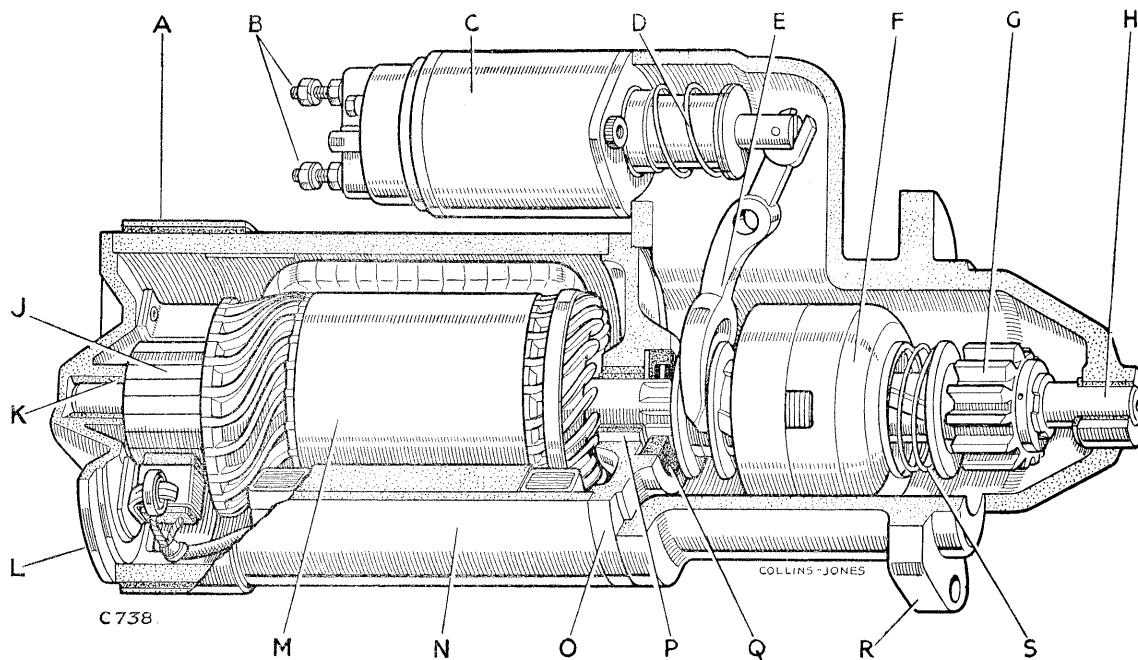


Fig. P-6—Sectioned view of starter motor—Diesel models

- |                          |                          |                          |
|--------------------------|--------------------------|--------------------------|
| A—Commutator cover band  | G—Driving pinion         | N—Yoke                   |
| B—Solenoid terminals     | H—Porous bronze bush     | O—Intermediate bracket   |
| C—Solenoid               | J—Commutator             | P—Impregnated brass bush |
| D—Solenoid return spring | K—Porous bronze bush     | Q—Brake ring             |
| E—Engagement lever       | L—Commutator end bracket | R—Drive-end bracket      |
| F—Clutch assembly        | M—Armature               | S—Cushion spring         |

### Commutator

4. Clean the commutator with a petrol-moistened cloth. If necessary, rotate the armature and, using fine glass-cloth, remove pits and burned spots from commutator; remove abrasive dust with a dry air blast. If the commutator is badly worn, mount in a lathe, and, using a very sharp tool, take a light cut, taking care not to remove any more metal than necessary. The insulators between the commutator segments **must not** be undercut.

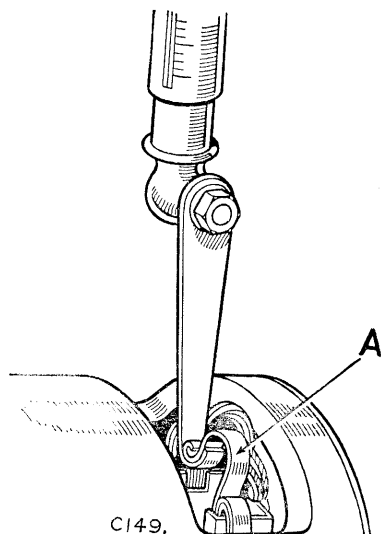


Fig. P-7—Testing brush spring tension  
A—Brush spring

### Armature

5. If the armature is damaged, i.e. "lifted" conductors, or distorted shaft, it must be replaced. Never attempt to machine the armature core, or true a distorted armature shaft.

### To assemble

#### Operation P/14

1. Reverse the removal procedure.

### Diesel models

2. To facilitate fitting the solenoid to the drive-end bracket, ease the drive assembly forward along the armature shaft.
3. Before tightening the eccentric pivot pin securing nut, set the pinion movement as detailed below. After re-assembly of the starter motor, connect the small centre terminal on the solenoid to a six-volt supply, using a switch. Connect the other side of the battery to a solenoid fixing stud. Close the switch, thus throwing the drive assembly forward into the engaged position, and measure the distance between the pinion and the washer on the armature shaft extension.
4. This measurement should be made with the pinion pressed lightly towards the armature to take up any slack in the engagement linkage. This setting should be 0.20 in.-0.30 in. (0,5-0,7 mm).

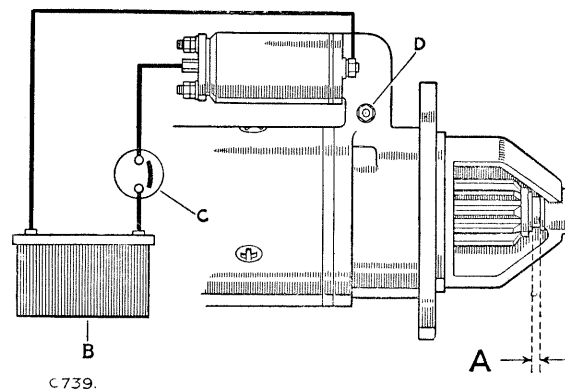


Fig. P-8—Setting pinion movement, when solenoid is energised

A—0.20 in.-0.30 in. (0,5-0,7 mm) C—Switch

B—6-volt battery

D—Eccentric pivot pin

To adjust the setting, slacken the eccentric pivot securing nut and turn the pin until the correct setting is obtained.

The adjustment arc is 180° and the head of the arrow, as marked on pivot pin, should be set only between the arrows on the arc described on the drive-end bracket casting.

After setting, tighten the securing nut, in order to hold the pin in position.

### Starter drive—Petrol models

#### To strip

#### Operation P/16

1. Withdraw split pin from nut on end of driving shaft and unscrew nut.
2. Remove main spring, washer, pinion and sleeve assembly, collar, push-off spring and spring restraining sleeve.

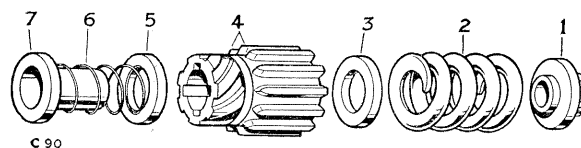


Fig. P-9—Layout of starter drive—Petrol models

1 Shaft nut

2 Main spring

3 Washer

4 Screwed sleeve and pinion

5 Collar

6 Pinion restraining spring

7 Spring retaining sleeve

#### To assemble

#### Operation P/18

1. Examine parts for excessive wear and replace as necessary. Assemble by reversing the removal procedure.

### Starter drive—Diesel models

#### To strip

#### Operation P/20

1. Remove the drive assembly from the armature shaft.
2. Remove the lock ring from the driving sleeve.

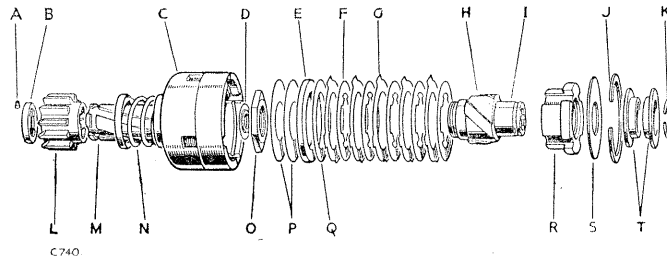


Fig. P-10—Exploded view of starter drive assembly, Diesel models

A—Rivet	K—Lock ring
B—Pinion retaining ring	L—Pinion
C—Barrel unit	M—Helical splined sleeve
D—Thrust washer	N—Cushion spring
E—Backing ring	O—Ring nut
F—Clutch inner plate	P—Pressure plates
G—Clutch outer plate	Q—Shim
H—Helical splines	R—Moving member
I—Driving sleeve	S—Retaining washer
J—Circlip	T—Engagement bush

- Lift the two halves of the engagement bush off the driving sleeve.
- Using a suitable circlip extractor, remove the clutch retaining circlip from the barrel unit and withdraw the driving sleeve and clutch unit.
- The clutch assembly can now be dismantled by removing all the parts from the driving sleeve—excepting the two pressure plates which are held in position by the ring nut. To remove the ring nut, slide the driving sleeve on to the splined armature shaft and, using soft metal jaw plates, clamp the armature in a vice, file away the peened rims and remove ring nut. This locknut should only be removed if absolutely necessary. If removed, fit a new nut and peen the rim over the notch in the driving sleeve.
- To remove the pinion from the helically splined sleeve, knock out the pinion retaining ring securing rivet. The retaining ring, pinion, cushion spring with cup washers and sleeve can now be separated.

#### To assemble

#### Operation P/22

- Reverse the stripping procedure.  
The correct cushion spring tension is 11 lb. (5 Kg.) measured with the spring compressed to  $\frac{3}{8}$  in. (22 mm) length and 16 lb. (7 Kg.) with the spring compressed to  $\frac{1}{2}$  in. (12 mm) length.
- Check the slipping torque of the clutch as follows; fit the drive assembly on the splined armature shaft and clamp the armature between soft metal jaw plates in a vice.

Apply an anti-clockwise torque to the pinion with a suitable "torque wrench" fastened to the pinion teeth. The clutch should slip between 800-950 lb./in. (142 to 169 Kg/cm).

If the clutch slips at too low a torque figure, dismantle again, and add shims one at a time until the correct figure is obtained.

If the clutch does not slip between the torque limits given, again remove the circlip—dismantle and remove shims one at a time until the torque test gives correct figures.

- The assembled clutch unit and lever mechanism must be capable of being pushed to the full extent of the set travel. The assembly must move along the armature shaft extension smoothly and freely, but without slackness.
- Before fitting the drive assembly to the armature shaft, lightly smear the shaft and pack the space between the indented bearings inside the pinion sleeve, with a bentonite-based grease.

#### Solenoid (Diesel models)—to test

The solenoid is composed of two coils, namely, a closing coil, by-passed when the plunger is fully home, and a hold-on coil to retain the plunger in the fully home position.

To test individually, remove existing connections and with the use of a 4-volt DC supply (constant voltage), proceed as below:

#### Closing coil

Connect the supply between the solenoid terminal marked 'S T A' and the smaller centre terminal. This should cause a current of 14.8 amps. to 17.4 amps. to pass.

#### Hold-on coil

Connect the supply between the solenoid body and the small centre terminal. This should cause a current of 4.5-5.6 amps. to pass.

These tests should not be carried out while the solenoid is hot. Do not attempt to repair a faulty solenoid, it should always be replaced.

**Starter switch—Petrol models****To remove** **Operation P/24**

1. Disconnect the battery.
2. Disconnect the three leads from the switch.
3. Screw off the switch knob and the locking nut from the switch spindle.
4. Remove the switch from the dash panel.

**To refit** **Operation P/26**

Reverse the removal procedure, connecting the wires in accordance with the appropriate wiring diagram.

**Starter switch—Diesel models**

See Operation P/108.

**Dynamo****To remove** **Operation P/28**

1. Disconnect the positive lead from the battery.

**Diesel only:** completely detach the lead connecting both batteries, disconnect the negative lead from the L.H. battery and remove L.H. battery.

**2 litre Petrol:** remove the air cleaner.

2. Disconnect the leads from dynamo.
3. Remove the bolts securing the dynamo to adjusting and anchor brackets.
4. Remove the belt from pulley and withdraw dynamo.

**To refit** **Operation P/30**

1. Reverse the removal procedure.
2. Adjust the driving belt tension—2 litre Petrol:  $\frac{1}{2}$  to  $\frac{3}{4}$  in. (12-19 mm); and 2½ litre Petrol, 2 litre Diesel:  $\frac{5}{16}$  to  $\frac{7}{16}$  in. (8-11 mm).

**To strip** **Operation P/32**

1. Take off the driving pulley.
2. Unscrew and withdraw the two through bolts.
3. The commutator end bracket can now be withdrawn from the dynamo yoke. Do not lose the fibre thrust washer.
4. The driving end bracket together with the armature can now be lifted out of the yoke.

**To overhaul** **Operation P/34****Brushes**

1. Lift the brushes up into the brush boxes and secure them there by positioning the brush spring at the side of the brush.
2. Fit the commutator end bracket over the commutator and release the brushes.
3. Check that the brushes move freely in their holders by holding back the brush spring and

pulling gently on the flexible connectors. Any tendency to stick should be corrected by cleaning with a petrol-moistened cloth, or in extreme cases by the **light** use of a smooth file. If a brush is damaged or worn so that it does not make good contact on the commutator, all the brushes must be renewed.

4. Check the tension of the brush springs with a spring balance. The correct tension is 22 to 25 oz. (624 to 709 grammes). In service it is permissible for this value to fall to 15 oz. (425 grammes). New springs must be fitted if the tension is low.
5. The new brushes being pre-formed, "bedding" to the commutator is unnecessary.

**Commutator**

6. Clean the commutator with a petrol-moistened cloth. If necessary, rotate the armature and, using fine glass-cloth, remove pits and burned spots from the commutator; remove abrasive dust with a dry air blast. If the commutator is badly worn, mount in a lathe, and, using a very sharp tool take a light cut, taking care not to remove any more metal than necessary. Undercut the insulators between the segments to a depth of  $\frac{1}{32}$  in. (0.7 mm) with a hacksaw blade ground to the thickness of the insulator.

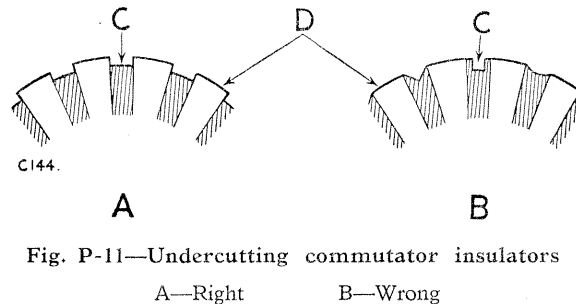


Fig. P-11—Undercutting commutator insulators

A—Right B—Wrong

**To assemble** **Operation P/36**

1. Lift the brushes up into the brush boxes and secure them in that position by positioning the brush spring at the side of the brush.
2. Fit the commutator end bracket on the armature shaft until the brush boxes are partly over the commutator. Place a thin screwdriver on top of each brush in turn and press the brush down on the commutator. The brush springs should then position themselves on top of the brushes.
3. Fit the commutator end bracket to the yoke so that the projection on the bracket locates in the yoke.
4. Refit the two through bolts.
5. Inject a few drops of any high quality medium viscosity (SAE 30) engine oil into the hole marked "Oil" at the end of the commutator bearing housing.

**To check****Operation P/38**

1. Check the driving belt tension, ensure that it is neither too tight nor too loose; Operation P/30. Adjust if necessary by slackening the pivot and adjusting link bolts, then move the dynamo outwards from the engine to tighten belt or inwards to loosen. Re-tighten the securing bolts.
2. Disconnect the cables from terminals of dynamo and connect the two terminals with a short length of wire.
3. Start the engine and run at normal idling speed. Clip the negative lead of a moving coil voltmeter, calibrated 0-20 volts, to one dynamo terminal and the other lead to a good earthing point on the yoke.
4. Gradually increase the engine speed; the voltmeter reading should rise rapidly and without fluctuation. Do not allow the voltmeter reading to reach 20 volts nor race the engine in an attempt to increase the voltage output. An engine speed of 1,000 r.p.m. should not be exceeded.
5. If there is no reading, check the brush gear as described in Operation P/8. A low reading of approximately  $\frac{1}{2}$ -1 volt indicates a possibly faulty field winding. Readings of 4 to 5 volts are probably attributable to faulty armature windings.

If a radio suppression capacitor is fitted between the output terminal and earth, disconnect this capacitor and re-test the dynamo before dismantling. If a reading is now given on the voltmeter, the capacitor is defective and must be replaced.

6. The dynamo being found serviceable, remove the link connecting the terminals and fit them to the respective connections. Ensure that the larger terminal is connected to control box terminal marked "D" and the smaller dynamo terminal to the control box terminal marked "F".

**Voltage regulator—Petrol engines****To remove****Operation P/40**

1. Disconnect the battery.
2. Disconnect all wires from the control box.
3. Remove the control box complete from the mounting plate.

**To refit****Operation P/42**

1. Reverse the removal procedure, connecting the wiring in accordance with the appropriate wiring diagram.

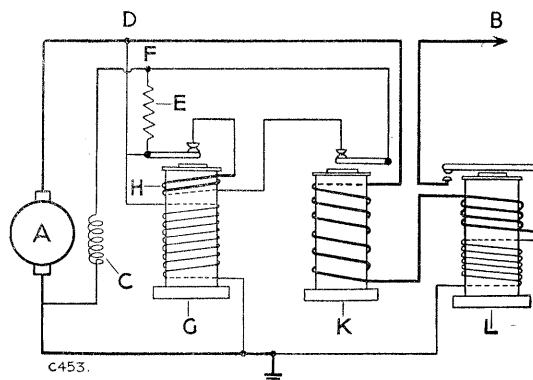
**To check****Operation P/44**

1. Place a piece of paper between the cut-out contacts and connect a moving-coil voltmeter to the "D" terminal on the regulator and to a good earth (not the one on the regulator box). Start the engine and increase R.P.M. until the voltage remains constant, i.e. the regulator is controlling; the voltmeter reading should be 15.8 to 16.4 volts. If the regulating voltage is not correct, the vehicle should be examined by a qualified electrician. Should the regulator be reading correctly at the commencement of this test, the earth lead of the voltmeter should be transferred to the "E" connection on the regulator box; the reading should be the same as that obtained with the previous earth. If there is any difference, i.e. the "E" connection on the regulator gives a lower reading, it will indicate a bad earth on the regulator box.

**Current voltage regulator—Diesel models****Locating faults on charging circuit**

Ensure that the dynamo is functioning correctly (Page P-14) and that the batteries are in order, then proceed as follows:—

- (a) Ensure that the wiring between battery and control box is in order by disconnecting the wire from control box terminal B and connecting the end of the wire removed to the negative terminal of a voltmeter. Connect the positive voltmeter terminal to an earthing point on the chassis. If a voltmeter reading is observed, the wiring is in order and the control box must be examined.
- (b) If there is no reading, examine the wiring between battery and control box for defective cables or loose connections.
- (c) Re-connect the wire to terminal B.

**Fig. P-12—The charging circuit**

- |                            |                           |
|----------------------------|---------------------------|
| A—Armature                 | F—Terminal on control box |
| B—Terminal on control box— | G—Voltage regulator       |
| to ammeter and battery     | H—Bucking coil            |
| C—Field windings           | K—Current regulator       |
| D—Terminal on control box  | L—Cut-out relay           |
| E—Resistor                 |                           |

### Regulator adjustments

The regulators are carefully set during manufacture to suit the normal requirements of standard equipment and, in general, further adjustments should not be necessary. However, if the battery does not keep in a charged condition, or if the dynamo output does not fall when the battery is fully charged, it may be advisable to check the settings and re-adjust if necessary.

Before disturbing any settings, it is important to check that a fault in the charging system is not due to a slipping dynamo belt or to a defective battery.

### Electrical setting of voltage regulator

#### Operation P/46

1. Disconnect control box terminal B. Connect a first-grade moving coil 0-20 voltmeter between terminal D and earth.

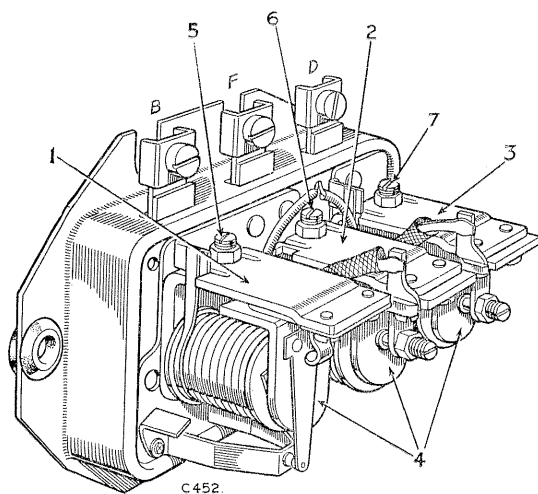


Fig. P-13—Current voltage regulator

- |                           |                           |
|---------------------------|---------------------------|
| 1 Cut-out                 | 6 Current adjusting screw |
| 2 Current regulator       | 7 Voltage adjusting screw |
| 3 Voltage regulator       | B—Terminal                |
| 4 Armature                | F—Terminal                |
| 5 Cut-out adjusting screw | D—Terminal                |
2. Slowly increase the speed of the engine until the voltmeter needle flicks and steadies. This should occur at a reading between 14.2 and 14.8 volts. If it does not, stop the engine and remove the control box cover.
  3. Slacken the adjustment screw locking nut (see Fig. P-14) and turn the screw in a clockwise direction to raise the voltage setting, or anti-clockwise to lower the setting. Turn the screw a fraction of a turn only at a time and re-tighten the locknut.
  4. Repeat this open-circuit voltage test until the correct setting is obtained.

Re-make the original connections.

When the dynamo is run at a high speed on open circuit, it builds up a high voltage. Therefore, when adjusting the regulator, do not run the

engine up to more than half throttle or a false voltmeter reading will be obtained. The adjustment should be completed within 30 seconds, otherwise heating of the regulator winding may cause an inaccurate setting to be made.

### Electrical setting of current regulator on vehicle

#### Operation P/48

1. When setting the current regulator on the vehicle, the dynamo must be made to develop its maximum rated output, whatever the state of charge of the battery might be at the time of setting. The voltage regulator must therefore be rendered inoperative. To do this, the voltage regulator contacts should be short-circuited with a clip large enough to bridge the outer armature assembly securing screw and the insulated fixed contact bracket, as shown in Fig. P-14.

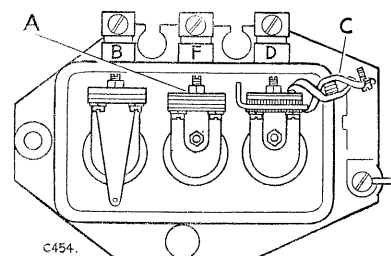


Fig. P-14—Short-circuiting voltage regulator contacts

- |                                     |            |
|-------------------------------------|------------|
| A—Current regulator adjusting screw | D—Terminal |
| B—Terminal                          | F—Terminal |
| C—Clip—short-circuiting             |            |

2. Disconnect the cable from control box terminal B and connect a first-grade moving coil 0-40 ammeter between this cable and terminal B. Switch on all lamps and accessories. This will prevent the voltage of the system rising when the engine is started.

There are two types of dynamo and current voltage regulator fitted to Diesel models.

Early Diesel models:

Dynamo type C45.PV5, maximum output 22 amp.

Current voltage regulator type RB3.

Late Diesel models:

Dynamo type C45.PV6, maximum output 25 amp.

Current voltage regulator type RB310.

The latest type dynamo can be used on earlier models, but the latest type current voltage regulator must not be used with the C45.PV5 dynamo, otherwise there is a danger of burning out the dynamo.

3. With the dynamo running at approximately 4,000 r.p.m., the ammeter needle should be steady and indicate a current of 22 amp with a type C45.PV5 dynamo or 25 amp with a type C45.PV6 dynamo. If it does not, the unit must be adjusted in a manner similar to that described for the voltage regulator.

Re-make the original connections.

### Electrical setting of cut-out relay

#### Operation P/50

1. Connect a first-grade moving coil 0-20 volt-meter between control box terminal D and earth. Switch on the headlamps and slowly increase the engine speed from zero. Closure of the contacts, indicated by a slight drop in the voltmeter reading, should occur between 12.7 and 13.3 volts. If it does not, the unit must be adjusted in a manner similar to that described for the voltage regulator.

When setting the cut-in voltage at a test bench, a suitable load resistor passing about 6 amperes should be connected between control box terminal B and earth. This will cause the voltmeter needle to flicker at the instant of contact closure.

2. Disconnect the cable from control box terminal B. Connect a first-grade moving coil 0-20 volt-meter between this terminal and earth. Run the engine up to speed and then slowly decelerate, noting the instant when the voltmeter reading drops to zero. This should occur between 9.5 and 10.5 volts. If it does not, adjust by carefully bowing the legs of the fixed contact post. Repeat the test and, if necessary, re-adjust until the armature releases at the voltage specified.

3. Slacken the voltage (or current) adjustment screw locking nut and unscrew the adjustment screw until it is well clear of the armature tension spring.
4. Using a 0.015 in. thick flat steel gauge, wide enough to cover completely the core face, insert the gauge between the underside of the armature and the copper disc. Take care not to turn up or damage the edge of this disc.
5. Press the armature squarely down against the gauge and re-tighten the two armature assembly securing screws.
6. With the gauge still in position, screw in the fixed contact adjustment screw until it just touches the armature moving contact. Re-tighten the locking nut.
7. Carry out the electrical settings, Operation P/48 or 50 as applicable.

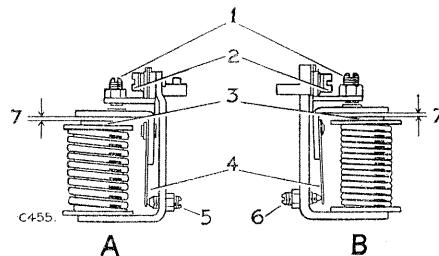


Fig. P-15—Voltage and current regulators

- |                                     |                             |
|-------------------------------------|-----------------------------|
| A—Voltage regulator                 | B—Current regulator         |
| 1—Fixed contact adjustment screws   | 4—Armature tension springs  |
| 2—Armature assembly securing screws | 5—Voltage adjustment screws |
| 3—Cores                             | 6—Current adjustment screws |
| 7—.015 in. (0.40 mm)                |                             |

### Cleaning contacts

#### Operation P/52

When cleaning the voltage or current regulator contacts, use fine carborundum stone or silicon carbide paper, followed by methylated spirits (denatured alcohol).

When cleaning the cut-out contacts, use a strip of fine glass paper—never carborundum stone or emery cloth.

### Mechanical setting of air gaps—Voltage and current regulators

#### Operation P/54

All air-gap settings are accurately adjusted before the units leave the factory, and should require no further attention. If, however, an armature is removed for any reason, care must be taken to obtain the correct air-gap settings on re-assembly.

1. Slacken the two armature assembly securing screws so that the armature is loosely attached to the regulator frame.
2. Slacken the fixed contact locking nut and unscrew the fixed contact adjustment screw until it is well clear of the armature moving contact.

### Setting cut-out relay air gap Operation P/56

1. Slacken the two armature assembly securing screws so that the armature is loosely attached to the cut-out frame.
2. Slacken the adjustment screw locking nut and unscrew the adjustment screw until it is well clear of the armature tension spring.
3. Press the armature squarely down against the copper-sprayed core face and re-tighten the two armature assembly securing screws. No gauge is necessary.

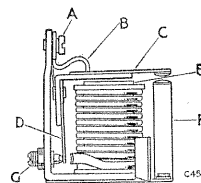


Fig. P-16—Cut-out relay

- |                                    |                           |
|------------------------------------|---------------------------|
| A—Armature assembly securing screw | D—Armature tension spring |
| B—Armature back stop               | E—Core                    |
| C—Contact blade                    | F—Fixed contact post      |
|                                    | G—Adjustment screw        |

- Press the armature down against the core face and adjust the armature back stop so that a .018 in. (0,5 mm) gap is obtained between the tip of the back stop and the contact blade.
- Insert a .010 in. (0,25 mm) thick flat steel gauge between the underside of the armature and the copper-sprayed core face. The gauge should be inserted from the side of the core nearest the fixed contact post. The leading edge of the gauge should not be inserted beyond the centre line of the core face. Press the armature down against the gauge and check the cut-out contacts. These should be just touching. If necessary adjust the height of the fixed contact by carefully bowing the legs of the fixed contact post.
- Reset the cut-in voltage (Operation P/50) and lock the adjustment screw.

**To remove****Operation P/58**

- Disconnect the positive lead of R.H. battery and the leads to regulator box.
- Remove the securing bolts and withdraw the regulator unit.

**To refit****Operation P/60**

- Reverse removal procedure, connecting wiring in accordance with the appropriate wiring diagram.

**Headlamp****To remove****Operation P/62**

- Disconnect the leads at the snap connectors and remove them from supporting clips.

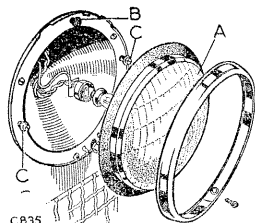


Fig. P-17—Headlamp

A—Lens                      B—Vertical adjustment screw  
C—Horizontal adjustment screw

- Remove the securing screw from the lower side of rim and ease the rim off from the bottom.
- Withdraw the dust-excluding rubber.
- Press the light unit against the compression springs of the adjusting screws and turn anti-clockwise to release.
- Release the bulb contact housing and remove the bulb.
- Remove the securing screws and withdraw the lamp body complete with leads and rubber gasket.

**To refit and adjust****Operation P/64**

- Reverse the removal procedure.
- Adjustment in a vertical plane is effected by turning the spring loaded screw at the top of the lamp body.
- Adjustment on a horizontal plane is made by means of a screw at each side of the lamp body.

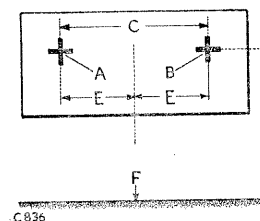


Fig. P-18—Headlamp beam setting board

A—Concentrated area of light—L.H. headlamp  
B—Concentrated area of light—R.H. headlamp  
C—21 3/8 in. (543 mm)  
D—37 1/2 in. (952 mm)—88 models  
—39 1/2 in. (1002 mm)—109 models  
E—10 1/8 in. (271 mm)  
F—Ground level

**To adjust, using beam setting board****Operation P/66**

- Mark on a board the dimensions given in Fig. P-19 and position the vehicle unladen, on level ground.

**Bulbs**

Position	Make and Type	Voltage	Wattage
Headlamps—R.H.D. models	Lucas No. 414	12	50/40 Double filament (dip to left)
Headlamps—L.H.D. models (except Europe)	Lucas No. 415	12	50/40 Double filament (dip to right)
Headlamps—L.H.D. models (Europe except France)	Lucas No. 410	12	45/40 Double filament (duplo) (vertical dip)
Headlamps—France	Lucas No. 411	12	45/40 Double
Headlamps—North America	Sealed beam unit	12	—
Side lamp	Lucas No. 207	12	6
Stop, tail lamp	Lucas No. 380	12	21/6 Double filament
Rear number plate lamp	Lucas No. 222	12	6
Instrument panel lights	Lucas No. 987	12	2.2 M.E.S.
Warning lights	Lucas No. 987	12	2.2 M.E.S.
Flasher equipment (where fitted)	Lucas No. 382	12	21



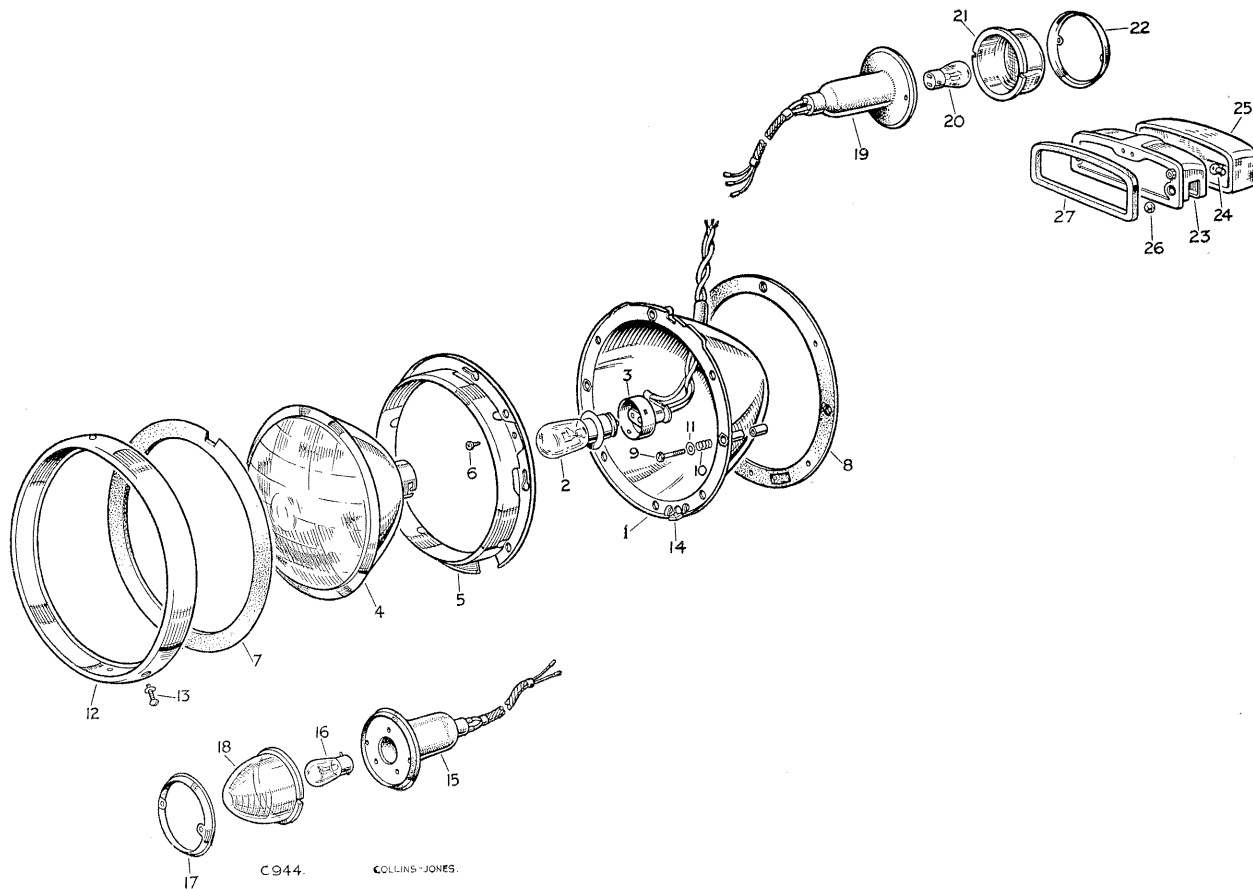


Fig. P-19—Layout of lamps

- |    |                                  |    |                            |
|----|----------------------------------|----|----------------------------|
| 1  | Body for headlamp                | 15 | Side lamp body             |
| 2  | Bulb for headlamp                | 16 | Bulb for side lamp         |
| 3  | Adaptor for bulb, double contact | 17 | Bezel                      |
| 4  | Light unit                       | 18 | Lens                       |
| 5  | Rim complete for light unit      | 19 | Stop tail lamp body        |
| 6  | Special screw for light unit rim | 20 | Bulb for stop tail lamp    |
| 7  | Rubber gasket for headlamp rim   | 21 | Glass                      |
| 8  | Gasket for body                  | 22 | Bezel                      |
| 9  | Special screw                    | 23 | Number plate lamp          |
| 10 | Spring for screw                 | 24 | Bulb for number plate lamp |
| 11 | Cup washer for screw             | 25 | Glass                      |
| 12 | Rim for headlamp, chrome         | 26 | Rubber grommet             |
| 13 | Screw                            | 27 | Rubber gasket              |
| 14 | Spire nut                        |    |                            |
- } Light unit adjustment
- } Retaining rim

2. Place the board 12 ft. (365 cm) in front of the headlamps, ensuring that it is at right angles to the vehicle centre line and that the centre line on board is in the same plane as vehicle centre line.
3. Adjust the beam by turning the adjusting screws indicated in Fig. P-18 until the area of concentrated light corresponds with the marks on beam setting board.

### Side lamp

#### To remove Operation P/68

1. Disconnect the leads at the snap connectors, alongside the radiator cowl.
2. Withdraw the rim and lens by removing the securing screws.
3. If required, remove the bulb.
4. Remove the lamp from the wing, by removing the retaining screws, spring washers and nuts.

#### To refit Operation P/70

1. Reverse the removal procedure, connecting the wiring in accordance with the wiring diagram.

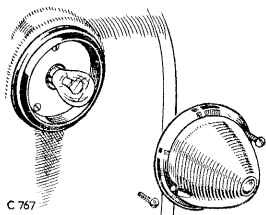


Fig. P-20—Side and tail lamp replacement

### Stop and tail lamp

#### To remove Operation P/72

1. Disconnect the tail lamp harness at the snap connectors located beneath the wheel box, adjacent to the chassis frame side member.
2. Remove the screws, washers and nuts, and withdraw the rear lamp cover plate (inside vehicle).
3. Withdraw the tail lamp harness through the rubber grommet in the wheel box.
4. Withdraw the rim and glass by removing the securing screws. If required, remove the bulb.
5. Remove the lamp and harness complete by removing the securing screws.

#### To refit Operation P/74

1. Reverse the removal procedure, connecting the harness in accordance with the wiring diagram.

### Number plate illumination lamp

#### To remove Operation P/76

1. Disconnect the leads at the snap connectors located beneath the wheel box, adjacent to the chassis frame side member.

2. Remove the screws, washers and nuts and withdraw the rear lamp cover plate (inside vehicle).
3. Withdraw the leads—through the wheel box grommet.
4. Remove the securing screw and withdraw lamp cover. If required remove the bulb.
5. Withdraw the lamp by removing the securing nuts (inside vehicle).

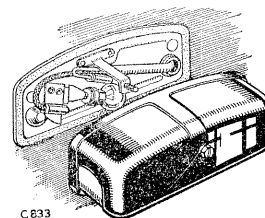


Fig. P-21—Number plate lamp

#### To refit Operation P/78

1. Reverse removal procedure, connecting the wiring in accordance with the wiring diagram.

### Horn button

#### To remove Operation P/80

##### Bracket mounted type

1. Remove the securing screws and withdraw the horn button and leads.
2. Disconnect the leads if necessary.

##### Centre type

3. Gently prise out the centre complete from the steering wheel. Disconnect the lead at the snap connector on the centre.
4. Remove the horn button from the centre if necessary.

#### To refit Operation P/82

1. Reverse the removal procedure.

### Horn

The horn is adjusted on initial assembly and should not require attention for some considerable time.

Ascertain that horn failure or faulty note is not due to some outside source, such as a discharged battery, loose connections or loose horn mounting, before carrying out any adjustment.

### Adjustment of horn

#### Operation P/84

##### Lucas

1. Disconnect the leads at the snap connectors adjacent to the horn, then remove the securing bolts and withdraw the unit.

2. Remove the dome and dome securing clip, clean the points and adjust them until they are almost touching, then turn the adjusting screw **half** a turn to increase the gap.
3. If adjustment of the horn does not produce satisfactory results, the horn should be returned to the makers.

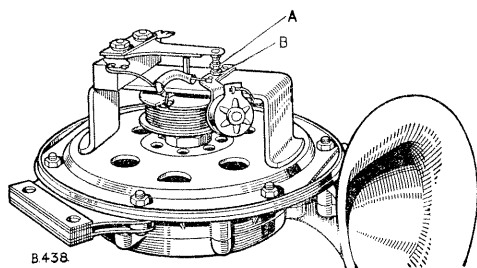


Fig. P-22—Horn adjustment. Lucas  
A—Adjustable contact B—Locknut

#### Clear Hooters

4. Remove the horn—Item 1, Operation P/84, then remove the dome and dome clip.
5. Connect the horn leads to a 12-volt battery and adjust nut (A) until maximum volume is obtained, then lock in position with nut (B). See Fig. P-23
6. Adjust the air gap between armature (C) and the magnet core face (D) to .045 to .050 in. (1,0 to 1,25 mm) by slackening nut (E) and turn the armature (C) clockwise or anti-clockwise until the recommended distance is obtained, then tighten nut (E). The current consumption with horn correctly adjusted is 9 amperes.

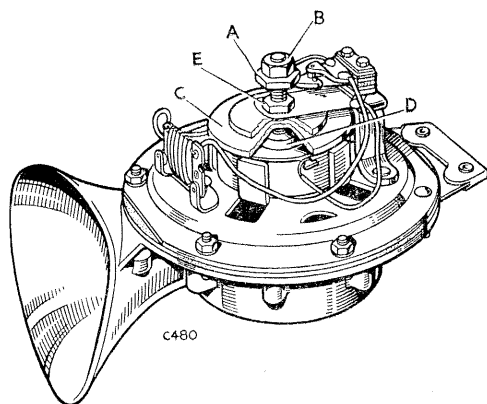


Fig. P-23—Horn adjustment. Clear Hooters  
A—Adjusting nut C—Armature  
B—Locknut D—Magnet core  
E—Locknut—armature

#### Dipswitch

- To remove** **Operation P/86**
1. Disconnect the dipswitch leads at junction box.
  2. Remove the securing screws and withdraw the switch from toe board.

#### To refit

#### Operation P/88

1. Reverse removal procedure, connecting leads in accordance with the wiring diagram.

#### Ignition—Petrol models

##### Distributor

#### To remove

#### Operation P/90

1. Pull off the sparking plug covers and detach the plug leads; disconnect the vacuum pipe, L.T. and H.T. leads.
2. Remove the set bolt securing the distributor clamp to the distributor mounting plate.
3. Remove the distributor complete with clamp.

#### To refit

#### Operation P/92

1. Reverse the removal procedure; set the contact breaker gap to .014 to .016 in. (0,35 to 0,40 mm). The driving spigot on the distributor drive shaft is offset, so eliminating any possibility of mistiming the engine on replacement.

##### Coil

#### To remove

#### Operation P/94

1. With the ignition switched off, disconnect the high and low tension leads from the coil.
2. Remove the coil from the dash panel.

#### To refit

#### Operation P/96

1. Reverse the removal procedure.

#### Stop lamp switch

#### To renew

#### Operation P/98

The hydraulic switch is located on the brake pipe five-way piece, at the front R.H. chassis side member.

1. Disconnect the leads, unscrew switch and remove.
2. Replace by reversing the removal procedure, connecting wires in accordance with the wiring diagram. Minimise loss of brake fluid by fitting new switch immediately.
3. Bleed the brake system—Section H.

#### Heater plugs—Diesel models

The heater plugs do not require any maintenance. However, if at any time when the heater plugs are in use, the warning light glows very brightly, a short circuit in the system is indicated. No light will indicate an open circuit.

Great care must be taken not to twist the centre terminal when removing heater plug leads.

#### Fault location on heater plug circuit

#### Operation P/100

- (a) Examine the fuse at terminal A3 and replace if "blown".

- (b) Failure of the warning light bulb will not affect the heater plug circuit, but the bulb should be replaced when conveniently possible—Section Q.
- (c) Connect one lead of the test lamp to the earth lead terminal on No. 1 heater plug and the other lead to the L.H. battery negative terminal, whereon the bulb should light. If the bulb remains unlit, a corroded, loose, or disconnected heater plug earth lead is indicated.

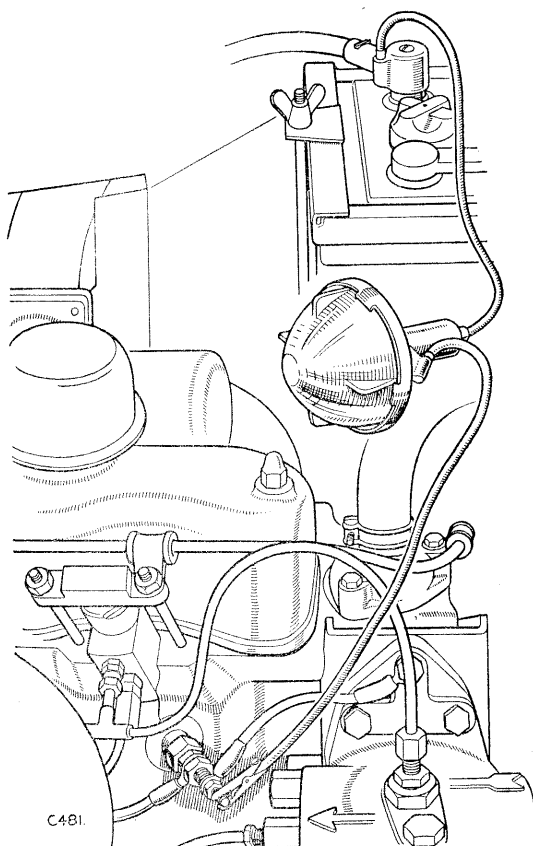


Fig. P-24—Checking heater plug circuit

Move the test lamp lead from the earth terminal on No. 1 heater plug, to the terminal also on No. 1 plug, to which the inter-connecting lead is attached. If the plug is serviceable the bulb will light but a broken heater plug filament will be indicated by the lamp remaining unlit.

Check the remaining plugs in the same manner until the fault is located.

If the heater plugs are found serviceable check each terminal of the resistance unit in the same way.

#### Removal, cleaning and inspection of heater plugs. Operation P/102

The shape of the heater plug element and its position in relation to the plug body is important and care must therefore be taken when fitting, removing or cleaning the plug, to avoid distortion or damage to the element.

1. Disconnect the leads from plugs, using two spanners at each terminal to prevent the central rod or insulating tube twisting.
2. Remove carbon from base of heater plug to avoid possible short circuiting of the element. Do **not** sandblast.
3. Examine the element for signs of fracture or severe heat attack and the seating for scores. Plugs with fractured elements must be replaced. Where scoring of the seating is sufficient to allow gas leakage or erosion of the element such that a fracture is likely to occur, then a replacement plug must be fitted.
4. Test the plug internal circuit for continuity, by connecting it **and** a 12 volt side-lamp bulb in circuit, to a 12 volt battery.

The inclusion of a bulb in circuit is **essential**.

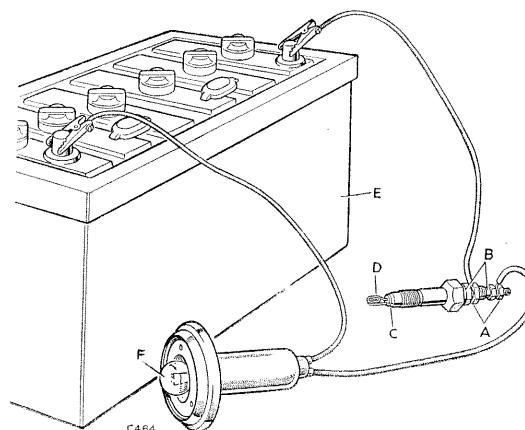


Fig. P-25—Testing heater plug circuit

A—Terminal nuts  
B—Insulation  
C—Seating  
D—Element  
E—12 volt battery  
F—Bulb (12 v.)

5. Ensure that the terminal nuts and threads are clean and that the thread at base of plug is free of carbon, then refit the plugs and tighten.

Make sure the shakeproof washers are fitted under the terminal in order to maintain good electrical contact.

Refit the heater plugs and tighten to 25 lb/ft. (3,4 kg/m).

Replace the leads in accordance with the wiring diagram and tighten the terminals, using two spanners to each terminal.

#### Resistance—heater plugs

##### To remove Operation P/104

1. Disconnect the leads from resistance.
2. Remove the securing screws and withdraw the unit.

##### To refit Operation P/106

1. Reverse removal procedure.

**Starter and heater plug switch—Diesel models****To remove** **Operation P/108**

1. Disconnect the positive lead from the right-hand battery.
2. Disconnect the leads from the back of the starter switch.
3. Remove the large securing nut from fascia side of panel.
4. Withdraw switch.

**To refit** **Operation P/110**

1. Reverse removal procedure, connecting leads in accordance with the appropriate wiring diagram.

**Fuel gauge tank unit**

No adjustment or repair is permissible to the fuel contents gauge tank unit. If the gauge reads wrongly or—Diesel models—the fuel level warning light does not glow when two or less gallons only remain in the tank, the lead(s) at the tank unit should be checked for security. If the fault is not corrected by tightening the terminal(s), remove and test the warning light and check the tank unit by substitution.

**To renew** **Operation P/112**

1. Disconnect the battery.  
Diesel—disconnect the positive lead from R.H. battery.
2. Remove the special bolts, bracket to squab, and remove squab.
3. Remove seat cushion, remove securing screws and lift cover plate clear.
4. Remove remaining fixing bolts and lift off extension panel complete with squab mounting bracket.
5. Remove lead(s) and securing screws from tank gauge unit and withdraw unit from tank.
6. Fit the new unit and cork washer; complete the assembly by reversing the removal procedure, connecting lead(s) in accordance with the appropriate wiring diagram.

**Fuse and junction boxes****To remove** **Operation P/114**

1. Disconnect the battery.  
Diesel—Disconnect the positive lead from the R.H. battery.

2. Remove the cover and disconnect the leads.
3. Remove the securing screws and withdraw the unit.

**To refit** **Operation P/116**

1. Reverse removal procedure and reconnect the leads in accordance with wiring diagram.

**Windscreen wiper motor****To remove** **Operation P/118**

1. Slacken the wiper arm fixing nut and tap sharply to release the clamp collet, then remove the wiper arm and blade.
2. With the key in lamp switch turned "off", disconnect the leads from wiper motor.
3. Remove the securing nuts, washers, grommets, wiper blade stop, rubber mounting block and brass bushes, then withdraw the motor.

**To refit** **Operation P/120**

1. Reverse removal procedure, but do not lock the wiper arm blade until the sweep is correctly adjusted.

**Mixture control thermostat switch—Petrol engines****To renew** **Operation P/122**

1. Disconnect the wire from the thermostat switch.
2. Remove the switch from the cylinder head (2 litre Petrol—located in the rear cover plate; 2½ litre Petrol—located in the cylinder head, front L.H.).
3. Check the switch: Contact is made at 51-54°C (124-129°F); contact is broken at 47-53°C (117-127°F).
4. Fit the new switch by reversing the removal procedure.

Renewal of the second switch in the mixture control warning light circuit (at the manual control) is dealt with in Section Q.

## DEFECT LOCATION

### (Symptom, Cause and Remedy)

**A—BATTERY DISCHARGED**

1. Battery unserviceable—*Renew.*
2. Battery leads corroded or loose—*Clean and tighten.*
3. Voltage or current voltage regulator faulty—*Rectify or renew.*
4. Dynamo faulty—*Rectify.*

**B—DYNAMO NOT CHARGING OR CHARGING AT REDUCED RATE**

1. Slipping fan belt—*Tighten.*
2. Dynamo loose on mounting—*Tighten.*
3. Continuity of circuit broken—*See Pages P-14 to P-15 inclusive.*
4. Brushes excessively worn—*Renew.*
5. Commutator burnt or worn unevenly—*Skim the surface in lathe.*
6. Commutator glazed—*Clean with fine glass paper.*
7. Voltage or current voltage regulator faulty—*Rectify or renew.*
8. Dynamo internal circuit faulty—*Dismantle and check.*

**C—LAMPS DIM WHEN ENGINE REVOLUTIONS ARE LOW**

1. Faulty earth—*Check earthing points of lamps affected.*
2. Battery in a low state of charge—*See Symptom A.*

**D—BULBS FAIL FREQUENTLY**

1. Battery in a low state of charge—*See Symptom A.*
2. Voltage or current voltage regulator faulty—*Rectify or renew.*
3. Loose connections—*Tighten.*
4. Wrong type of bulb used—*See bulb chart.*

**E—HORN FAILURE**

1. Loose connections—*Tighten.*
2. Burnt or loose contact points—*Clean and adjust. See Page P-19.*

**F—INSTRUMENT PANEL LIGHTS FAIL—See Section Q.****Ga—STARTER FAILS TO OPERATE—PETROL MODELS**

1. Stiff engine, indicated by inability to turn by hand—*Locate and remedy.*  
If the engine can be turned by hand, the trouble may be due to:—
2. Battery discharged—*Start by hand. Charging the battery either by a long period of daylight running, or from independent electrical supply.*
3. Broken or loose connection in starter circuit—*Check and tighten all battery, starter and starter switch connections and check the cables connecting these units for damage.*
4. Greasy, charred or glazed commutator—*Clean.*
5. Brushes worn, not fitted correctly or wrong type—*Renew.*
6. Brushes sticking in holders or incorrectly tensioned—*Rectify.*
7. Starter pinion jammed in mesh with flywheel—*Rotate the squared end of the starter shaft with a spanner to free the pinion.*

**Gb—STARTER FAILS TO OPERATE—DIESEL MODELS**

1. Batteries discharged—*Re-charge.*
2. Starter/heater switch unserviceable—*Renew.*
3. Wiring at starter/heater switch loose—*Tighten.*
4. Solenoid unserviceable—*Renew.*
5. Wiring at solenoid loose—*Tighten.*
6. Brushes unduly worn—*Renew.*
7. Brush springs fatigued—*Renew.*
8. Commutator greasy or dirty—*Clean with petrol-moistened cloth.*
9. Commutator burnt or worn unevenly—*Remove armature, and skim.*
10. Fault in internal circuit—*Dismantle and check.*
11. Starter solenoid badly earthed—*Clean and tighten connections.*

**H—STARTER OPERATES BUT ENGINE IS NOT CRANKED**

1. Petrol models: Starter drive pinion not engaging with the flywheel, due to dirt on the screwed sleeve—*Clean.*  
Diesel models: Plate clutch pinion faulty—*Remove starter and dismantle to ascertain cause.*

**J—STARTER PINION WILL NOT DISENGAGE FROM FLYWHEEL**

1. Petrol models: Starter pinion jammed in mesh with the flywheel—*Rotate squared end of starter shaft with a spanner until pinion flies off. On no account run the engine or serious damage to the starter will result.*  
Diesel models: Return spring in starter broken—*Dismantle starter and renew.*

**K—ENGINE WILL NOT FIRE—PETROL MODELS**

1. The starter will not turn the engine due to a discharged battery—*Start the engine by hand. The battery should be recharged by running the car for a long period during daylight or from an independent electrical supply.*
2. Sparking plugs faulty, dirty or incorrect plug gaps—*Rectify or renew.*
3. Defective coil or distributor—*Remove the lead from the centre distributor terminal and hold it approximately  $\frac{1}{4}$  in. from some metal part of the engine while the engine is being turned over. If the sparks jump the gap regularly, the coil and distributor are functioning correctly. Renew a defective coil or distributor.*
4. A fault in the low tension wiring is indicated by no ammeter reading when the engine is turned slowly with the ignition on, or no spark occurs between the contacts when separated quickly with the fingers with the ignition on—*Examine all the ignition cables and check that the battery terminals are secure and not corroded.*
5. Dirty or pitted contacts—*Clean.*
6. Contact breaker out of adjustment—*Adjust.*
7. Controls not set correctly or trouble other than ignition—*See Instruction Manual "STARTING PROCEDURE".*

**M—ENGINE MISFIRES—PETROL MODELS**

1. See items (2), (5) and (6) under "Engine will not fire", and refer to Section A.

**N—ENGINE FAILS TO START FROM COLD—DIESEL MODELS**

1. Heater plug circuit broken—*See Operation P/100.*

**P—IGNITION AND MIXTURE DEFECTS—PETROL MODELS—DEFECTIVE DISTRIBUTOR**

1. Contact breaker gap incorrect or points burned and pitted—*Clean and adjust.*
2. Distributor cap cracked—*Renew.*
3. Condenser failure—*Renew.*
4. Weak or broken contact breaker spring—*Renew.*
5. Excessive wear in distributor shaft bushes, etc.—*Renew.*
6. Rotor arm pitted or burned—*Clean or renew.*

**Q—MIXTURE CONTROL WARNING LIGHT FAILS TO APPEAR WHEN ENGINE REACHES RUNNING TEMPERATURE**

1. Mixture control already pushed in—*In the hands of the operator.*

2. Broken connection in warning light circuit—*Rectify.*
3. Faulty thermostat switch (at cylinder head)—*Renew.*
4. Faulty manual switch (at mixture control)—*Renew. Section Q.*
5. Broken operating mechanism at manual switch—*Rectify.*

**R—MIXTURE CONTROL WARNING LIGHT REMAINS ON WITH ENGINE AT RUNNING TEMPERATURE**

1. Mixture control out—*Push control right in.*
2. Faulty manual switch—*Renew. Section Q.*
3. Broken operating mechanism at manual switch—*Rectify.*

**DATA****Batteries**

<b>Petrol models</b>	.... Single 12 volt, positive earth
Capacity	.... 51 A.H.
<b>Diesel models</b>	.... Two 6 volt, series connected, positive earth
Capacity	.... 120 A.H.

**Starter motor****Petrol models**

Nominal voltage	.... 12
Starting shaft end-float	.... Zero

**Diesel models**

Nominal voltage	.... 12
Starting shaft end-float	.... Zero
Lock torque	.... 32.5 lb./ft. (4,50 mKg)
Torque at 1,000 r.p.m.	.... 15 lb./ft. (2 mKg)

**Starter motor drive**

<b>Petrol models</b>	.... Spring-loaded pinion and sleeve
<b>Diesel models</b>	.... Multi-plate clutch
Slip load....	.... 800 to 950 lb./in. (142 to 169 Kg/cm)

**Dynamo****Petrol models**

Maximum output	.... 19 amps.
----------------	---------------

**Diesel models**

Type	.... C45.PV5
Maximum output	.... 22 amps

**Late Diesel models**

Type	.... C45.PV6
Maximum output	.... 25 amps

**Control box**

<b>Petrol models</b>	.... Compensated voltage control
----------------------	----------------------------------

**Control box****Early Diesel models** Compensated current voltage control

Voltage regulator—open circuit setting	20°C (68°F) at
2,000 r.p.m.	.... 14.2 to 14.8 volts
Current regulator—Contact opening	amperage
	.... 19
Cut-in voltage	.... 12.7 to 13.3 volts

**Control box****Late Diesel models** Compensated voltage control

Voltage regulator—open circuit setting	20°C (68°F) at
2,050 r.p.m.	.... 14.9 to 15.5 volts
Current regulator—Contact opening	amperage
	.... 19
Cut-in voltage	.... 12.7 to 13.3 volts
Drop-off voltage	.... 9.5 to 11.0 volts

**Distributor**

Contact breaker gap	.... .014 to .016 in. (0,35 to 0,40 mm)
Distributor rotation	.... Clockwise, at drive end
Advance mechanism	.... Centrifugal/vacuum

**Fuse**

	.... Protects the horn and windscreen wiper
Amperage	.... 35

**Heater plugs**

Type	.... K.L.G. coil element—1.7 volts 36/40 amps.
------	--

**Stop lamp switch**

Type	.... Hydraulic
------	----------------

**Mixture control****thermostat switch**

Contact made at	.... 51-54°C (124-129°F)
Contact broken at	.... 47-53°C (117-127°F)

# Section Q

## INSTRUMENTS AND CONTROLS—ALL MODELS

### INDEX

	Page		Page
Accelerator controls		Instruments and switches	
Removal ....	Q-5	Removal ....	Q-1
Fitment ....	Q-5	Fitment ....	Q-4
Cut-off control—Diesel models		Mixture control	
Removal ....	Q-10	To remove ....	Q-5
Fitment ....	Q-10	To replace ....	Q-10
Defect location ....	Q-10	Speedometer drive	
Hand-throttle control		To overhaul ....	Q-4
Removal ....	Q-5	Speedometer drive cable	
Fitment ....	Q-5	Removal ....	Q-4
		Replacement ....	Q-4

### LIST OF ILLUSTRATIONS

Fig.	Page	Fig.	Page
Q-1 Layout of instruments and controls, Petrol models ....	Q-2	Q-4 Correct position of speedometer drive cable ....	Q-4
Q-2 Layout of instruments and controls, Diesel models ....	Q-2	Q-5 Accelerator restrictor linkage ....	Q-5
Q-3 Exploded view of instrument panel ....	Q-3	Q-6 Accelerator controls, Petrol models ....	Q-6
		Q-7 Accelerator and hand speed controls, Diesel models ....	Q-8

#### Instruments and switches

##### To remove Operation Q/2

1. Disconnect the battery.  
**Diesel**—disconnect the positive lead of R.H. battery.
2. Remove the panel from the dash.
3. Disconnect the speedometer drive cable.
4. Remove the panel light bulb and holder from the speedometer. If necessary, unscrew the bulb from its holder.
5. Remove the speedometer retaining bracket (this action will also release an earth wire) and withdraw the speedometer.
6. Disconnect the wiring from the panel light switch.
7. Unscrew the knob and securing nut from the switch and remove the panel light switch from the panel.
8. Disconnect the wires from the mixture or heater plug warning light.
9. Compress the retaining spring, remove the circlip and withdraw the mixture or heater plug warning light. If necessary, unscrew the bezel from the warning light bakelite holder and withdraw the bulb.
10. Disconnect the wires from the dynamo warning light.
11. Compress the retaining spring, remove the circlip and withdraw the dynamo warning light. If necessary, unscrew the bezel from the warning light bakelite holder and withdraw the bulb.
12. **Diesel**—disconnect the wires from the fuel level warning light, unscrew the lens from the front of instrument panel and withdraw the unit. The bulb may be removed if necessary by easing the smaller diameter of the lamp body from the larger section.  
**Diesel**—fuel level warning lamp bulb replacement can only be effected by removing the instrument panel.
13. Disconnect the wires from the ignition or auxiliary services and lamp switch.
14. Release the retaining clip and withdraw the ignition or auxiliary services and lamp switch complete.
15. Withdraw the headlamp main beam warning light bulb and holder from the multiple gauge unit. If necessary, unscrew the bulb from its holder.
16. Disconnect the wiring to the ammeter and fuel gauge and withdraw the multiple gauge illumination bulb and holder. If necessary, unscrew the bulb from its holder.
17. Remove the multiple gauge from the panel (this action will also release two earthing wires). The sections of the gauge can be removed separately.
18. Disconnect the wires from the two inspection lamp sockets and withdraw the sockets.
19. Disconnect the wires from the oil pressure warning light.
20. Compress the retaining spring, remove the circlip and withdraw the oil pressure warning light. If necessary, unscrew the bulb from its holder.



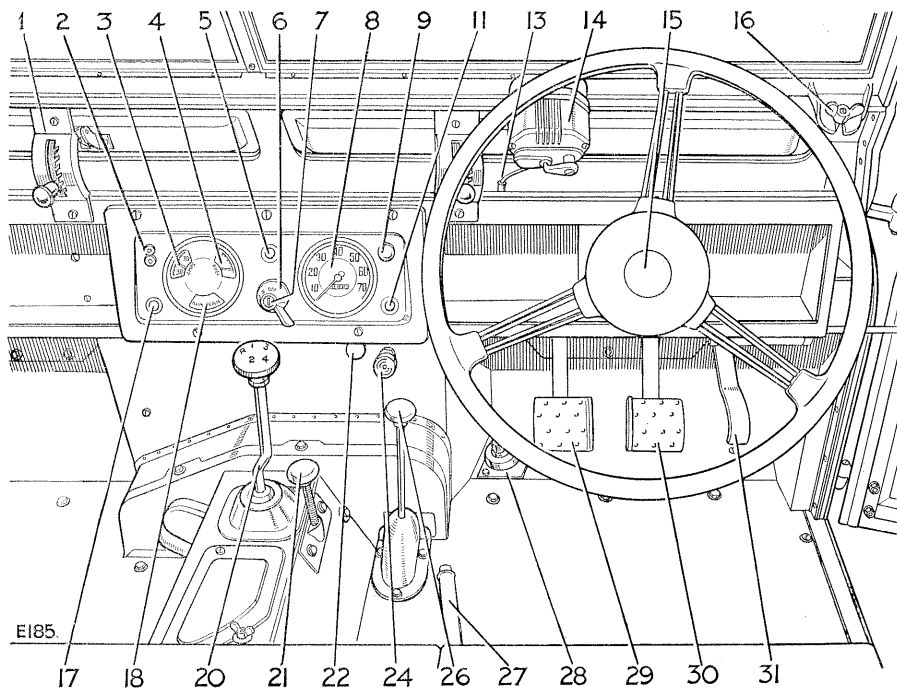


Fig. Q-1—Layout of instruments and controls—Petrol models

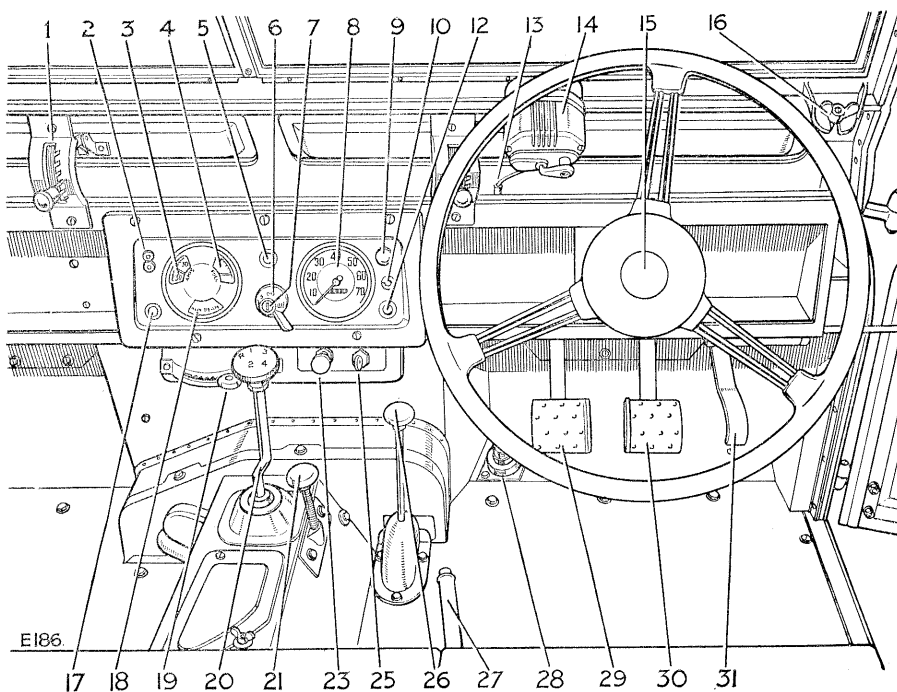


Fig. Q-2—Layout of instruments and controls, Diesel models

## Key to instruments and controls

- |  |  |   |
|--|--|---|
| 1 Windscreen ventilator                  | 11 Cold start control warning light (Petrol) | 21 Front wheel drive control                    |
| 2 Lead lamp socket                       | 12 Heater plug warning light (Diesel)        | 22 Cold start control (Petrol)                  |
| 3 Ammeter                                | 13 Wiper lead plug                           | 23 Engine stop control (Diesel)                 |
| 4 Fuel level gauge                       | 14 Windscreen wiper                          | 24 Starter switch (Petrol)                      |
| 5 Oil pressure warning light             | 15 Horn button                               | 25 Switch for starter and heater plugs (Diesel) |
| 6 Lamp switch                            | 16 Wingnut securing windscreen               | 26 Transfer box lever                           |
| 7 Electrical services or ignition switch | 17 Charging warning light                    | 27 Hand brake                                   |
| 8 Speedometer                            | 18 Headlamp warning light                    | 28 Headlamp dipper switch                       |
| 9 Instrument panel light switch          | 19 Engine hand speed control (Diesel)        | 29 Clutch pedal                                 |
| 10 Fuel tank warning light (Diesel)      | 20 Main gear change lever                    | 30 Brake pedal                                  |
|  |  | 31 Accelerator pedal                            |

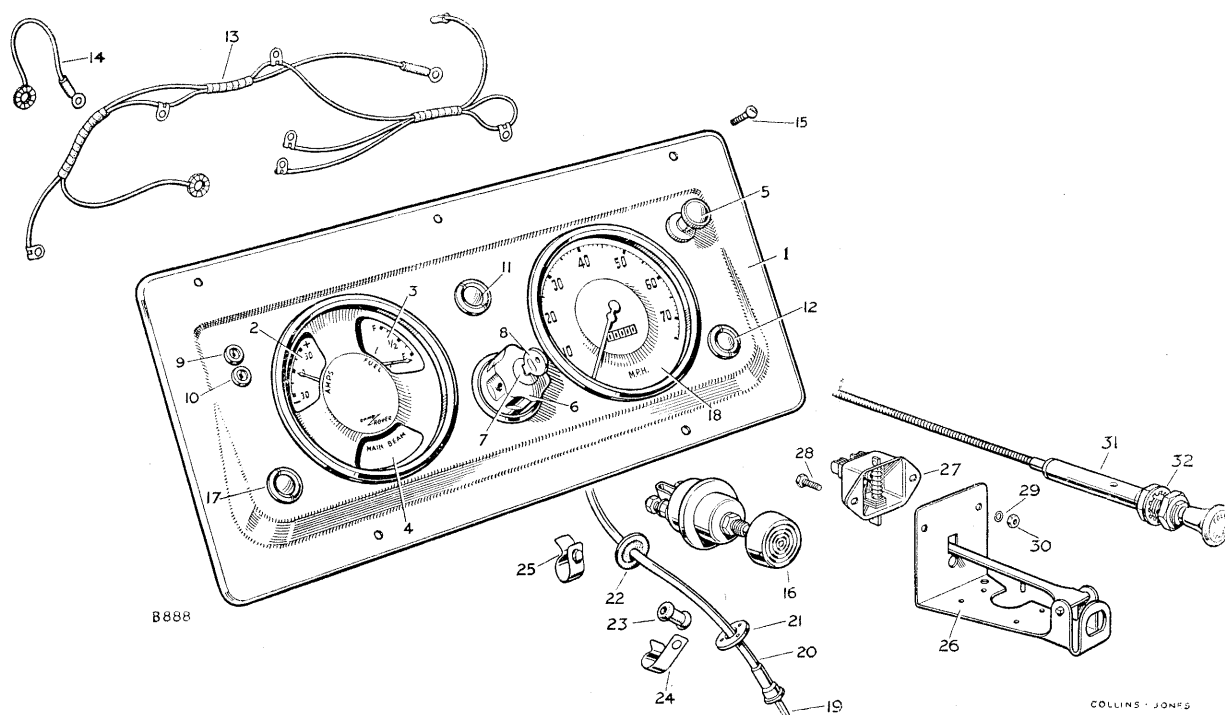


Fig. Q-3—Exploded view of instrument panel

- |   |                                     |
|---|-------------------------------------|
| 1 Instrument panel                                | 15 Fixings for instrument panel     |
| 2 Ammeter   | 16 Starter switch—Petrol models     |
| 3 Fuel gauge                                      | 17 Warning light, oil               |
| 4 Warning light for headlamp beam                 | 18 Speedometer                      |
| 5 Switch for panel lights                         | 19 Cable, inner                     |
| 6 Switch for lamps                                | 20 Cable, outer                     |
| 7 Barrel lock for ignition or electrical services | 21 Retaining plate for cable        |
| 8 Key for lock                                    | 22 Rubber grommet, in dash          |
| 9 Socket for inspection lamp, black               | 23 Rubber grommet, on cable         |
| 10 Socket for inspection lamp, red                | 24 Clip                             |
| 11 Warning light, dynamo                          | 25 Clip                             |
| 12 Warning light, mixture or heater plugs         | 26 Bracket for mixture control      |
| 13 Panel harness                                  | 27 Switch for mixture warning light |
| 14 Lead, ammeter to inspection socket             | 28-30 Fixings for switch            |
|   | 31 Mixture control complete         |
|   | 32 Shakeproof washer for control    |
- } For speedometer cable  
 } For speedometer cable  
 } Petrol models

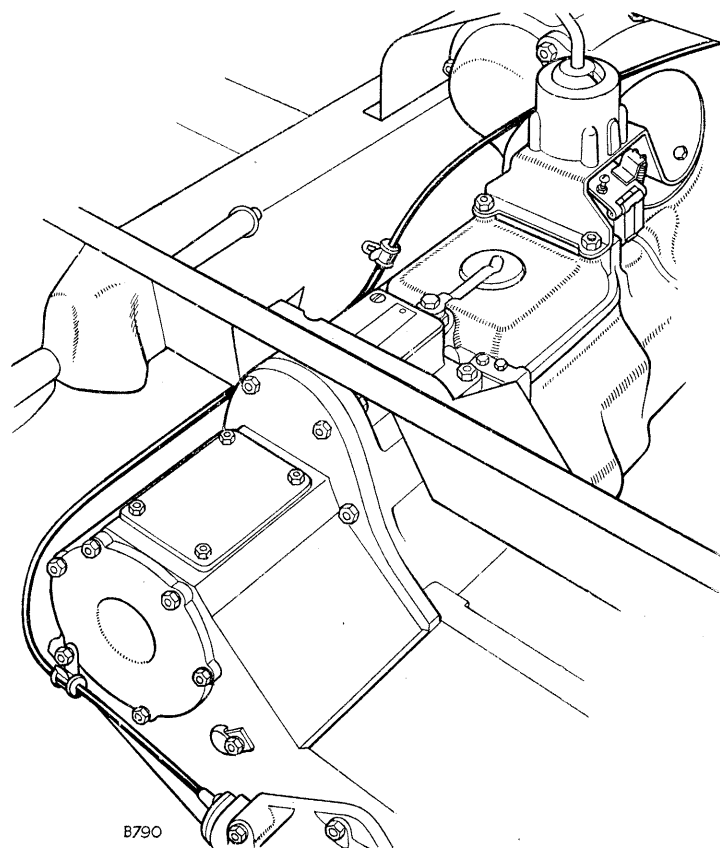


Fig. Q-4—Correct position of speedometer drive cable

**To refit****Operation Q/4**

Reverse the removal procedure, connecting the wiring in accordance with the appropriate wiring diagram, Section P. Replacement bulbs are listed in Section P.

*Note:* Care should be taken when re-connecting the lamp switch wiring on North American vehicles, as it is so arranged that the sidelamps are extinguished when the headlamps are switched on.

**Speedometer drive cable****To remove****Operation Q/6**

1. Disconnect the battery.  
**Diesel**—disconnect the positive lead of R.H. battery.
2. Withdraw the instrument panel clear of the dash.
3. Disconnect the speedometer drive from the speedometer head.
4. Free the cable by withdrawing the end from the dash and pushing the three rubber grommets from the securing clips on the flywheel housing, chassis side member and transfer casing.

5. Disconnect the speedometer cable at the gearbox end. (If necessary, remove the centre seat panel).

6. Withdraw the inner cable from the outer casing.

**To replace****Operation Q/8**

1. Thoroughly clean the inner cable and smear suitable grease over its entire length.
2. Insert the cable in the outer casing.
3. Replace the speedometer drive by reversing the removal procedure, care being taken to avoid acute curves. The inner shaft end must be located in the square or slot of the speedometer pinion before the drive is secured to the housing.
4. If the clips holding the securing grommet have been moved, the drive should be correctly positioned before these clips are tightened.

**Speedometer drive****To overhaul****Operation Q-9**

1. Remove the centre inspection panel from the seat box.
2. Drain the transfer box.

3. Disconnect the brake expander rod from the bell crank lever.
4. Disconnect the rear propeller shaft from the transfer box output shaft.
5. Remove the securing nut, withdraw the brake drum and rear drive output flange. Remove the brake drum from the flange, if necessary.
6. Disconnect the speedometer cable.
7. Remove the speedometer drive housing complete with brake assembly and shims, which should be preserved. If necessary, remove the front output shaft oil seal from the housing.
8. Remove the speedometer drive pinion unit. Withdraw the pinion from the sleeve. If necessary, remove the oil seal from the pinion sleeve. Remove rubber 'O' ring.
9. Withdraw the speedometer drive worm from the transfer box output shaft; this is a *sliding fit* on the shaft, and is clamped securely in position by the rear drive output flange nut.
10. If necessary, renew the oil seal in the speedometer drive pinion sleeve; the seal should be fitted with the knife edge inwards. Fit the pinion in the sleeve and fit the assembly to the drive housing, with the "flat" on the sleeve to the bottom. The pinion should be a *sliding fit* in the sleeve. Check that the drive functions correctly. Replace rubber 'O' ring.
11. Slide the speedometer drive worm over the transfer box output shaft with its conical end inwards and fit the dowel-located speedometer drive housing to the transfer casing, complete with shims and brake assembly.
12. Ensure that the drive flange abuts the speedometer drive worm and the securing nut fully tightened and split pinned.
13. Fit the transmission brake drum. Adjust the brake—Section H.

#### Accelerator controls

To remove—see Figs. Q-4-5 and 6.

#### Operation Q/10

1. Remove the throttle return springs.
2. Detach the control rods from the shaft levers.
3. Loosen the clamping bolt, securing lever on accelerator pedal shaft, then withdraw the lever.
4. Remove the accelerator shaft and pedal stop housing.
5. Detach the pedal shaft support bracket from the toe-box and remove the shaft and pedal complete.

On L.H.D. models, the accelerator pedal, pedal shaft and distance piece may be withdrawn without removing the support bracket.

6. Remove the cross-shaft, bracket(s) and distance washers.

7. If necessary, remove the two levers from the cross-shaft.

#### 88—2½ litre petrol only.

8. Remove the accelerator restrictor, if fitted.

On late 88 2½ litre petrol models an accelerator restrictor is fitted which allows the pedal to be pressed down for three-quarters of its travel with normal pressure, thereafter requiring greater pressure to obtain full throttle.

This device gives a considerable improvement in fuel consumption, and may be fitted to early 88 2½ litre petrol models if necessary.

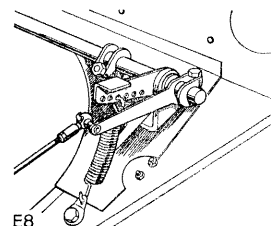


Fig. Q-5—Accelerator restrictor

#### To refit

#### Operation Q/12

1. Reverse the removal procedure. If disturbed, adjust the lengths of the control rods as necessary.

#### Hand throttle control—Diesel models

To remove—see Fig. Q-7

#### Operation Q/14

1. Disconnect the control rod, quadrant to cross-shaft, at the quadrant ball joint, inside vehicle.
2. Remove the securing bolts, quadrant to scuttle.
3. Remove instrument panel and remove securing bolts, quadrant upper bracket to dash bottom centre panel.
4. Withdraw complete unit.

#### To refit

#### Operation Q/16

1. Reverse removal procedure.
2. Check for correct functioning and set the hand speed lever as necessary by adjusting the operational lengths of the control rod, quadrant to cross-shaft.

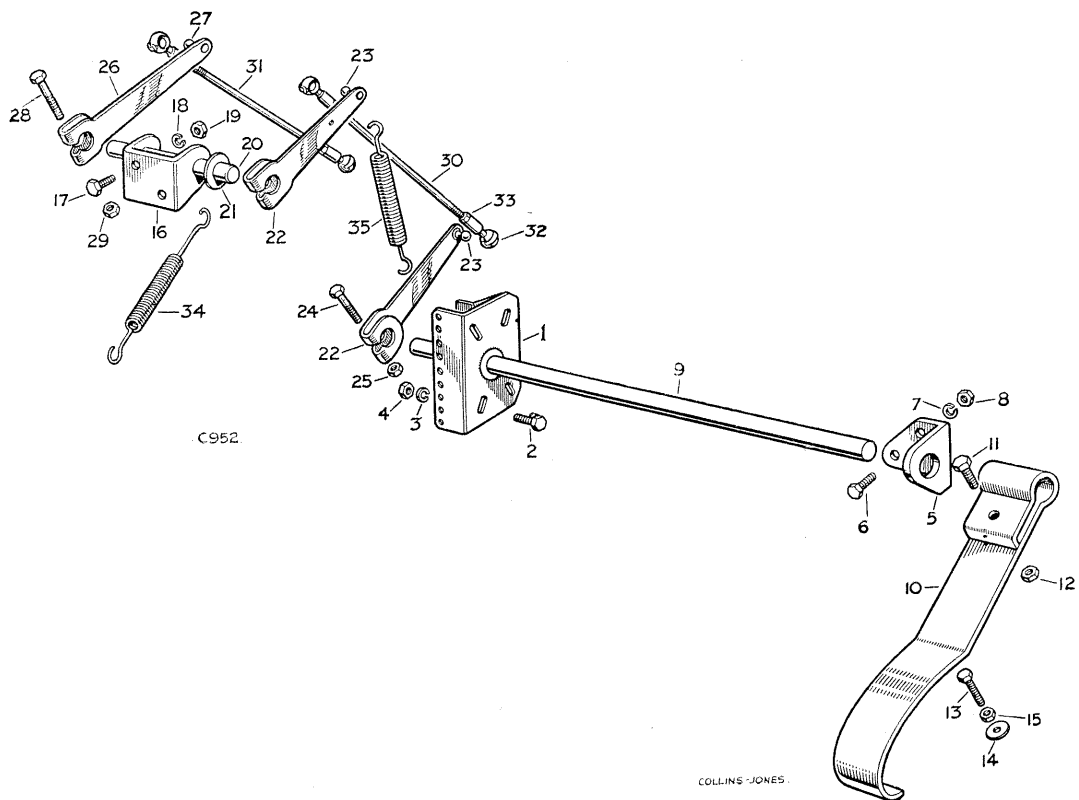
#### Mixture control—Petrol models

To remove

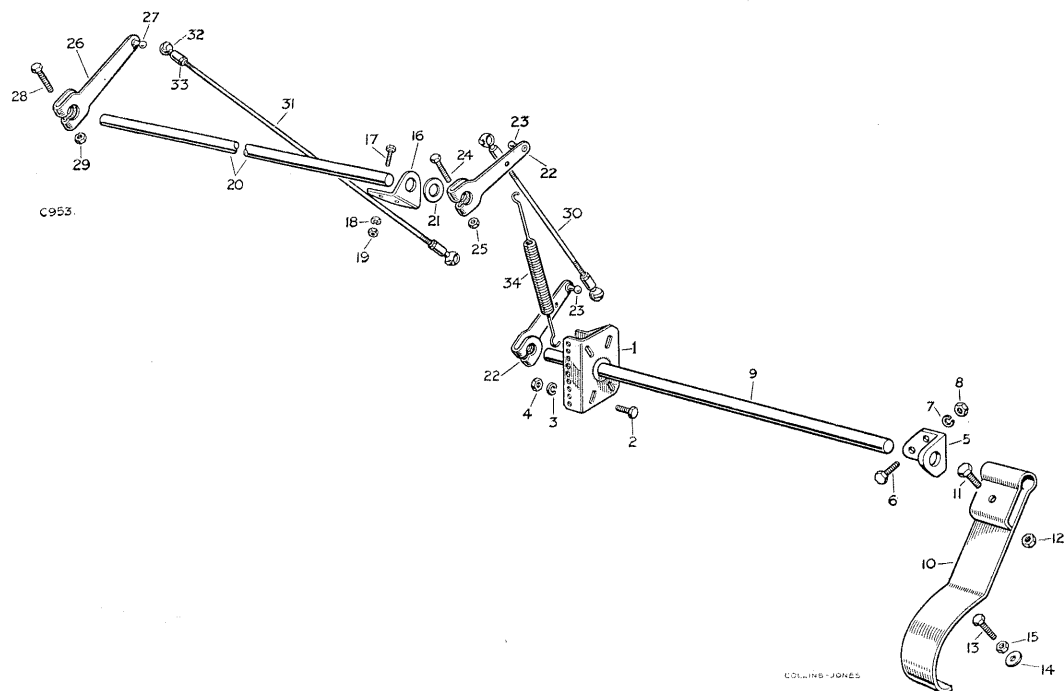
#### Operation Q/18

A plunger switch is incorporated in the mixture control; it is wired in series with a bi-metal thermostat switch at the rear of the cylinder head and the amber warning light on the instrument panel.

1. Disconnect the battery.



2 litre Petrol



2 1/4 litre Petrol

Fig. Q-6—Accelerator controls—Petrol models

## Key to Fig. Q-6

- |  |  |
|--|--|
| 1 Accelerator shaft and pedal stop housing | 23 Lever ball end  |
| 2-4 Fixings—housing and pedal stop to dash | 24-25 Fixings—levers and stop clip to shaft—<br>2 litre; levers to shaft— $2\frac{1}{4}$ litre |
| 5 Accelerator pedal shaft bracket          | 26 Cross shaft lever assembly  |
| 6-8 Fixings—bracket to dash                | 27 Lever ball end  |
| 9 Accelerator pedal shaft                  | 28-29 Fixings—lever to cross shaft   |
| 10 Accelerator pedal                       | 30 Control rod, pedal shaft to cross shaft   |
| 11-12 Fixings—pedal to shaft               | 31 Control rod, cross shaft to engine  |
| 13-15 Pedal stop, in floor                 | 32 Ball joint socket for rods  |
| 16 Accelerator cross shaft bracket         | 33 Locknut for socket  |
| 17-19 Fixings—bracket to dash              | 34 Return spring for throttle—2 litre<br>Return spring for pedal— $2\frac{1}{4}$ litre         |
| 20 Accelerator cross shaft                 | 35 Return spring for pedal—2 litre   |
| 21 Lever distance washer                   |  |
| 22 Accelerator lever assembly              |  |

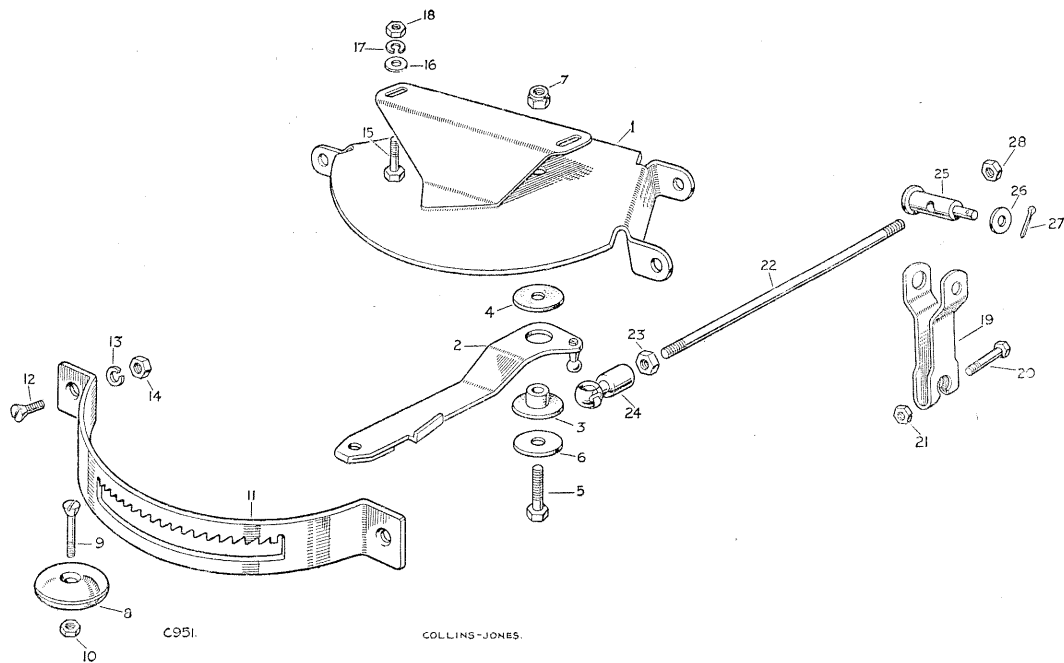
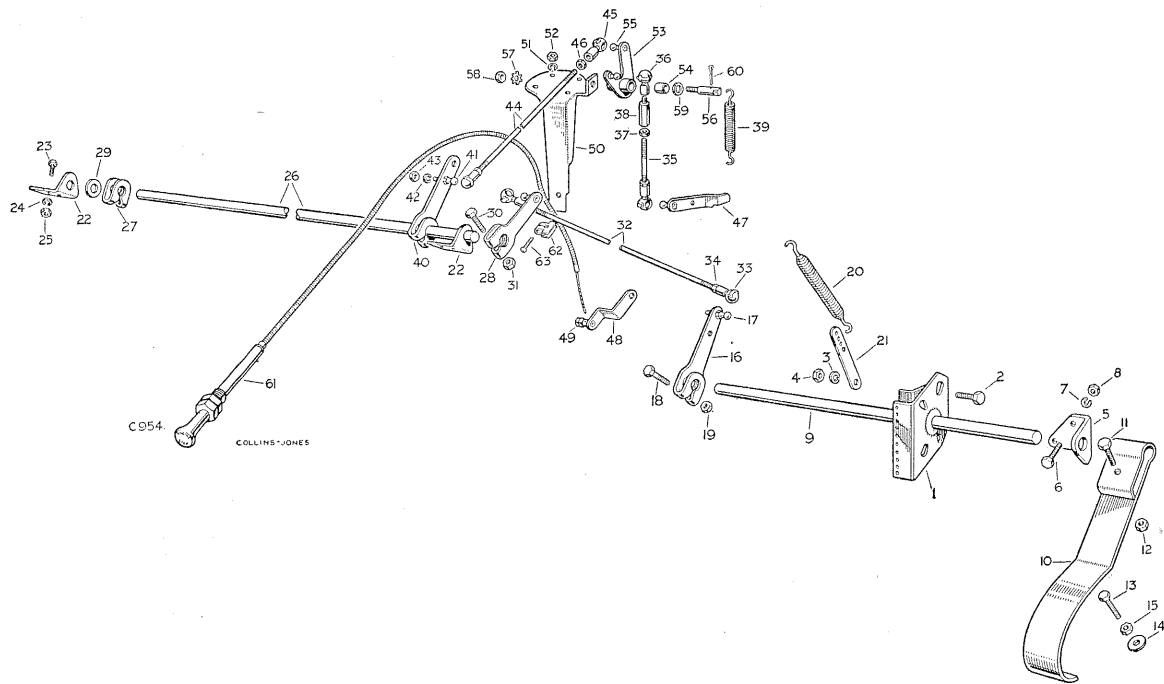


Fig. Q-7—Accelerator and hand speed controls—Diesel models

## Key to Fig. Q-7

- |   |   |
|---|---|
| 1 Accelerator shaft and pedal stop housing        | 35 Control rod, bell crank to accelerator lever                 |
| 2-4 Fixings—housing and pedal stop to dash        | 36-38 Ball socket, nut and adjusting nut—bell crank control rod |
| 5 Accelerator pedal shaft bracket                 | 39 Distributor levers return spring                             |
| 6-8 Fixings—bracket to dash                       | 40 Lever cross shaft to engine                                  |
| 9 Accelerator pedal shaft                         | 41-43 Fixings—ball end to accelerator lever                     |
| 10 Accelerator pedal                              | 44 Control rod, cross shaft to bell crank                       |
| 11-12 Fixings—pedal to shaft                      | 45-46 Ball joint and locknut for control rod                    |
| 13-15 Pedal stop, in floor                        | 47 Distributor pump accelerator control lever                   |
| 16 Accelerator lever assembly, pedal shaft        | 48 Distributor stop lever                                       |
| 17 Lever ball end                                 | 49 Stop lever swivel clamp                                      |
| 18-19 Fixings—lever to shaft                      | 50 Distributor pump bell crank bracket                          |
| 20 Pedal return spring                            | 51-52 Fixings—bracket to distributor pump                       |
| 21 Return spring anchor                           | 53 Distributor pump bell crank                                  |
| 22 Accelerator cross shaft bracket                | 54 Bell crank bush  |
| 23-25 Fixings—bracket to dash                     | 55 Bell crank ball end  |
| 26 Accelerator cross shaft                        | 56 Bell crank pin   |
| 27 Cross shaft stop clip                          | 57-58 Fixings—pin to bell crank bracket                         |
| 28 Accelerator lever assembly, cross shaft        | 59-60 Fixings—bell crank lever to pin                           |
| 29 Cross shaft distance washer                    | 61 "Engine stop" control  |
| 30-31 Fixings—levers and stop clip to cross shaft | 62-63 Fixings—control outer cable to pump abutment bracket      |
| 32 Control rod, pedal shaft to cross shaft        |   |
| 33-34 Ball joint socket and locknut—for rod       |   |

- |   |  |
|---|--|
| 1 Housing for governor control quadrant | 15-18 Fixings—control to dash                            |
| 2 Control lever and ball end            | 19 Hand engine speed control operating lever             |
| 3 Lever bush                            | 20-21 Fixings—operating lever to accelerator cross shaft |
| 4 Lever washer                          | 22 Control rod for engine speed control                  |
| 5-7 Fixings—control lever to housing    | 23 Nut } For   |
| 8 Lever knob                            | 24 Ball socket } control rod                             |
| 9-10 Fixings—knob to lever              | 25-27 Fixings—engine speed control rod                   |
| 11 Quadrant plate                       | 28 Nut—fixing control rod to joint pin                   |
| 12-14 Fixings—quadrant plate to housing |  |



2. Disconnect the wiring from the mixture control warning light switch.
3. Disconnect the operating wire from the lever at the carburetter.
4. Withdraw the inner wire and knob from the driver's side of the dash. See Fig. Q-2.
5. Loosen the screw holding the outer cable at the carburetter.
6. Remove the cold start control outer cable, bracket and switch from the dash by removing the securing nut on the driver's side of the dash.
7. If necessary, remove the warning light switch from the bracket.
8. If necessary, remove the control outer cable from the bracket by unscrewing the cable through the securing locknut.

**To refit****Operation Q/20**

Reverse the removal procedure, taking care that the carburetter cold start lever is fully closed when

the control knob is pushed right in, and that, on 2 litre models, the three positions of the control knob are definite. 2½ litre models have a progressive cold start action.

*Note:* For further details of the mixture control warning light system, see Section P.

**Cut-off control—Diesel models****To remove****Operation Q/22**

1. Disconnect the control cable from the injection pump cut-off lever and outer cable support.
2. Unscrew the securing nut from the engine side of scuttle and withdraw the cut-off control cable complete.

**To refit****Operation Q/24**

1. Secure the control to the scuttle and the outer cable to the clamping clip on injection pump; locate the inner cable in the cut-off lever clamping screw, then, pressing the lever firmly downward, tighten the clamping screw.

**DEFECT LOCATION****(Symptom, Cause and Remedy)****A—SPEEDOMETER NEEDLE ERRATIC**

1. Rear drive output flange and speedometer drive securing nut loose—*See Operation Q-9.*
2. Speedometer cable damaged or position of cable incorrect—*See Operation Q-8.*
3. Faulty speedometer head—*Renew.*

# Section R

## BODY — ALL MODELS

### INDEX

	Page		Page
Bonnet		Hard top	
Removal	R-3	Removal	R-10
Fitment	R-3	Rear lid	R-10
Cab		Roof panel	R-10
Removal	R-9	Side panels	R-10
Fitment	R-9	Fitment	R-10
Cab back lights		Hard top tropical roof	
Sliding light		Removal	R-11
Renewal	R-9	Fitment	R-11
Quarter light		Hard top window glass	
Renewal	R-9	Renewal	R-10
Cab tropical roof		Radiator grille panel	
Removal	R-10	Removal	R-3
Fitment	R-10	Fitment	R-4
Dash panel		Rear body	
Removal	R-7	Removal	R-11
Renewal	R-7	Fitment	R-11
Fitment	R-8	Seat base	
Door lock		Removal	R-8
Renewal	R-5	Fitment	R-9
Front door		Adjustment	R-8
Removal	R-5	Sidescreeen windows	
Hinge		Sliding window	
Removal	R-5	Renewal	R-5
Front floor		Fixed window	
Removal	R-5	Renewal	R-5
Fitment	R-5	Tailboard	
Front wings		Removal and fitment	R-11
Removal	R-4	Ventilator lid	
Fitment	R-5	Removal	R-7
General body repairs		Fitment	R-7
Riveting	R-1	Windscreen	
Paint touching-up process for body panels	R-3	Removal	R-5
Preparatory work	R-3	Fitment	R-7
Colour	R-3	Windscreen glass	
Polishing	R-3	Renewal	R-7

### LIST OF ILLUSTRATIONS

Fig.	Page	Fig.	Page
R-1	Layout of seat base, seats, front floor, wings and bonnet	R-6	Fitting filler strip in window weather strip
R-2	Layout of tailboard, doors and side-screens	R-7	Layout of cab and tropical roof
R-3	Layout of dash panel, windscreen and ventilators	R-8	Layout of hard top and tropical roof—fixed windows
R-4	Fitting corner plate for seat cushion	R-9	Layout of hard top with sliding windows
R-5	Drilling rubber block	R-10	Layout of rear body unit—88 models
		R-11	Layout of rear body unit—109 models

#### General body repairs

With the exception of the dash panel, which is steel, the body panels are constructed throughout from Birmabright, with steel cappings and corner brackets; all steel parts are galvanised.

#### Riveting

Three types of rivet are used on the body:—

1. Aluminium pop or "blind" rivets are used only on box sections or where it is difficult or impossible to use any other type because of limited working

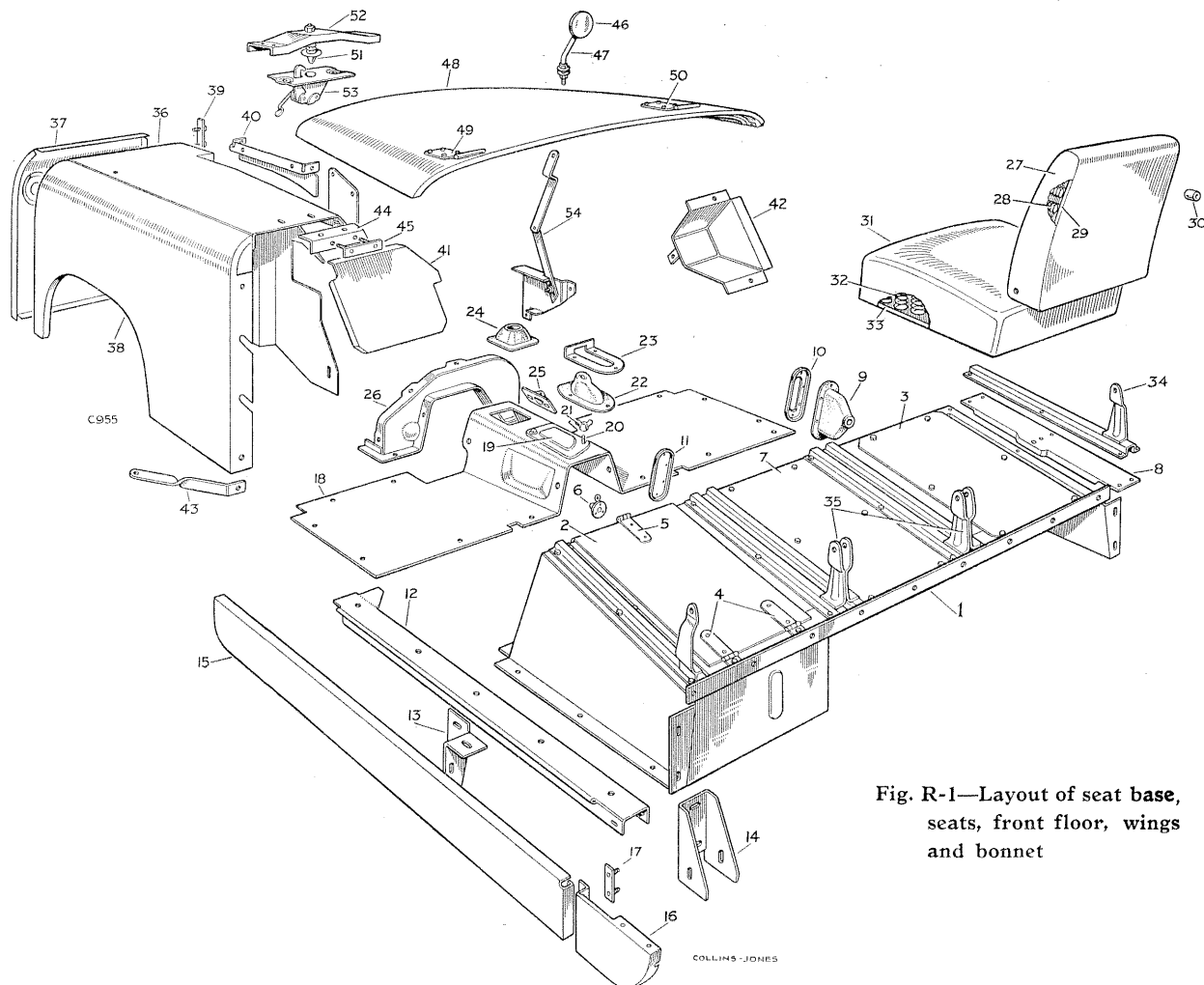


Fig. R-1—Layout of seat base, seats, front floor, wings and bonnet

- |    |   |       |                                       |
|----|---|-------|---------------------------------------|
| 1  | Seat base and floor assembly                | 28    | Squab spring case                     |
| 2  | Tool locker lid                             | 29    | Squab frame                           |
| 3  | Fuel tank cover panel                       | 30    | Buffer, for seat back rest on bracket |
| 4  | Lid hinge                                   | 31    | Seat cushion                          |
| 5  | Locker lid hasp                             | 32    | Cushion spring case                   |
| 6  | Locker lid turnbuckle                       | 33    | Cushion frame                         |
| 7  | Centre cover panel                          | 34    | Cushion support, outer                |
| 8  | Extension panel, at seat base ends          | 35    | Seat support, centre                  |
| 9  | Handbrake rubber cover                      | 36    | Front wing                            |
| 10 | Retainer for rubber cover                   | 37    | Front panel and registration plate    |
| 11 | Handbrake slot cover plate                  | 38    | Front wing outer panel                |
| 12 | Sill channel L.H. front                     | 39    | Fixing plate, wings to grille panel   |
| 13 | Sill channel securing bracket               | 40    | Wing valance bottom panel             |
| 14 | Sill channel mounting bracket, to rear body | 41    | Mudshield, front wing                 |
| 15 | Front sill panel                            | 42    | Steering unit cover box               |
| 16 | Rear sill panel                             | 43    | Front wing stay                       |
| 17 | Fixing plate for sill panels                | 44    | Bracket, for rear of wing             |
| 18 | Front floor complete                        | 45    | Fixing plate—brackets to dash         |
| 19 | Inspection cover, for front floor           | 46    | Mirror                                |
| 20 | Stud plate for inspection cover wing nut    | 47    | Arm for mirror                        |
| 21 | Wing nut, fixing inspection cover           | 48    | Bonnet top panel                      |
| 22 | Transfer gear lever seal                    | 49-50 | Bonnet hinges                         |
| 23 | Transfer lever seal retainer                | 51    | Bonnet catch striker pin              |
| 24 | Gear lever rubber seal                      | 52    | Bonnet striker bracket                |
| 25 | Operating rod cover plate                   | 53    | Bonnet control                        |
| 26 | Gearbox cover complete                      | 54    | Bonnet prop rod                       |
| 27 | Seat squab                                  |       |                                       |

space; these rivets are "snapped-up" from one side only. The setting is controlled by the breaking of a headed steel mandrel which passes through the tubular rivet; the mandrel break occurs only when the thicknesses being riveted have been pulled together tightly and the rivet head on the blind side fully formed. The mandrels are either of the break stem or break head type, the latter being used in positions where the mandrel head is free to fall away after the rivet head is set. Where it is required to retain the broken-off portion of the mandrel within the headed-up part of the rivet, as for example in box sections (where a loose mandrel head would rattle) or for sealing the rivet with filler or stopper, the break stem type is used. Either a mechanical or pneumatic hand tool can be used for fixing pop rivets.

2. Bifurcated or "split" rivets are used for securing rubber and canvas together or to metal. The rivet is passed through the materials to be joined, a boss cap is placed over the tongues of the rivet, and these tongues then spread with a suitable drift.
3. Various sizes and lengths of round head rivets are used, and for these a suitably indented dolly is needed for the rivet head, while the tail of the rivet is peened over with a hammer, operated manually, electrically, or by compressed air.

#### Paint touching-up process for body panels

Body panels are finished in stoving synthetic enamel and a special technique, detailed below, must be followed when touching up the paint finish after repair work.

#### Preparatory work

Thoroughly clean the damaged portion; all traces of wax polish, etc., should be removed with a suitable solvent such as White Spirit.

The surrounding edges of the paint film must be correctly feather edged, using a wooden block and suitable paper.

#### Colour

- (a) Small damaged areas—  
Prepare the correct colour finish by thinning to 40 parts finish to 60 parts thinner by volume.  
Apply a built-up coat by spray and allow to air dry for four to six hours.
- (b) Large damaged areas (complete wings or panels)—  
Prepare the correct colour finish by thinning 50/50 with thinner.  
Apply one or two full spray coats; allow 15 to 30 minutes between coats and four to six hours (or preferably overnight) after the final application.  
Half-hour air drying colour finish and thinners are obtainable from our Spares Department.

#### Polishing

After the recommended drying period, lightly polish with any good smooth polishing compound and finally clear, if necessary, with any good quality wax polish.

#### Notes

1. When spraying in small areas and in order to minimise dry spray, it is recommended that the air pressure for spraying be reduced to 30-40 lb/sq.in. (2,1-2,8 kg/cm<sup>2</sup>).
2. When touching up stoved synthetic finishes, no advantage is to be gained by mist-coating the patch. Instead, the edges of the patch should be faded out during application and any resultant dry spray removed during polishing with any good polishing compound.
3. It is not always easy to blend a patch or touch-up; to do so successfully and lose the edges requires practice by a skilled operator. In cases where the damage is on a conspicuous part of the vehicle, it is recommended that the operator sprays out the entire damaged part, e.g., door panel, wing, etc.
4. In certain instances, the materials listed are available locally. We can furnish additional information in this respect on demand, providing the serial numbers of vehicles concerned are quoted.

#### Bonnet

##### To remove Operation R/2

1. If fitted, remove spare wheel and lift bonnet.
2. Remove the split pin and washer and disconnect the bonnet prop rod.
3. Lift the bonnet to its highest position and slide out from hinges.
4. As necessary, remove the bonnet strike pin and bracket by removing the securing bolts and washers; remove the pin from the bracket; remove the hinges by removing the bolts, washers and nuts; if fitted, remove the spare wheel carrier, Section T.

##### To refit Operation R/4

Reverse the removal procedure.

#### Radiator grille panel

##### To remove Operation R/6

1. Disconnect the battery.  
Diesel—disconnect the lead coupling both batteries.
2. Disconnect the side lamp leads at snap connectors at each side of the grille panel assembly and the front lamp harness from the junction box at R.H. side of scuttle, then pull the wiring clear to front of engine.
3. Remove the grille and name-plate; if fitted, remove the chaff guard.
4. Remove the securing bolts and lift the front apron clear.
5. Remove the bolts securing the grille panel to the front cross member.
6. Remove the bolts securing the grille panel to the wings and radiator block.

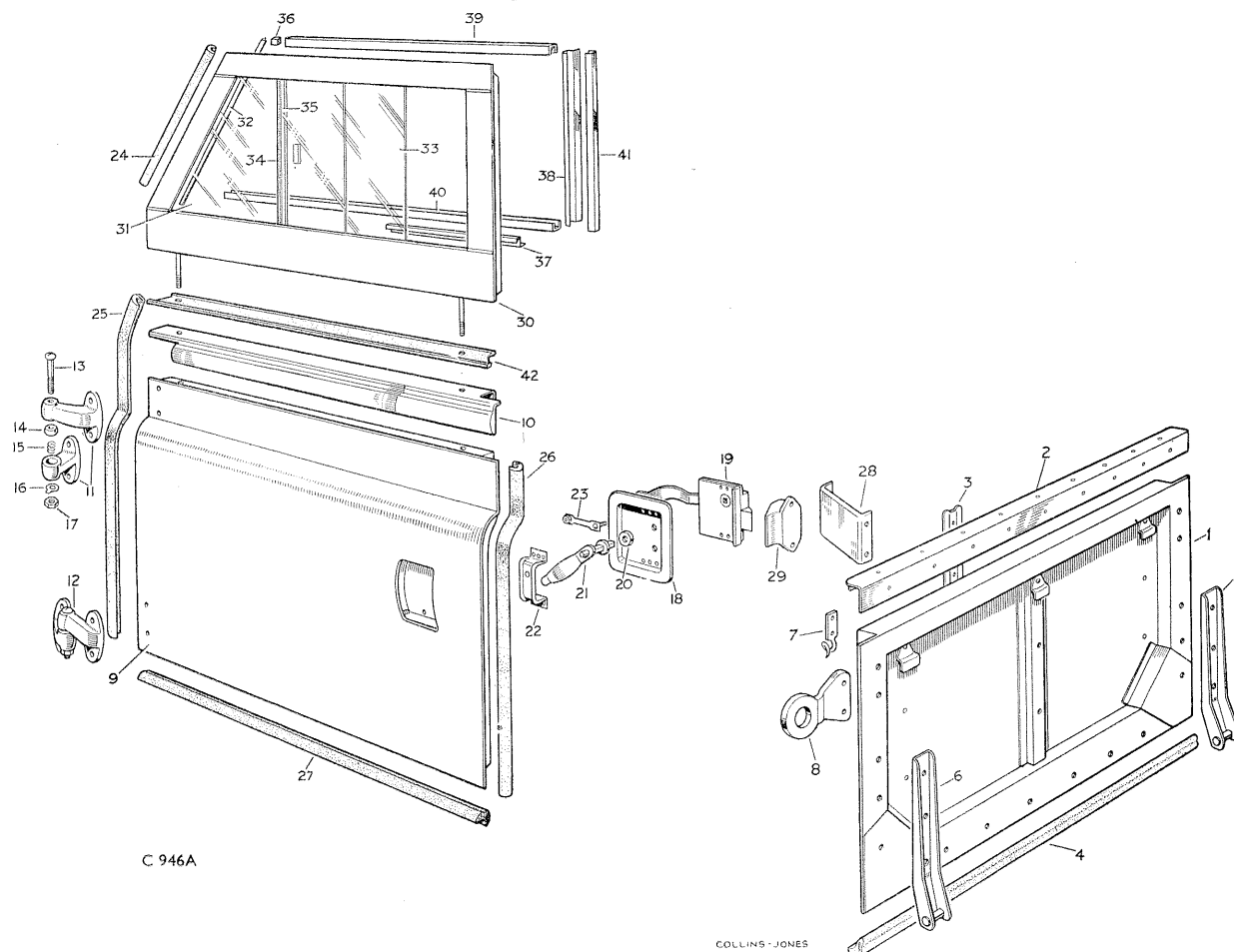
7. Lift off the grille panel complete with headlamps and wiring.
8. If necessary, remove the headlamp and harness, Section P; remove the bonnet control by removing the securing set bolts and spring washers.

**To refit****Operation R/8**

1. Reverse the removal procedure, connecting the wiring in accordance with the wiring diagram.

**Front wings****To remove****Operation R/10**

1. Remove the bonnet. Operation R/2.
2. Disconnect the side lamp harness at the snap connectors in the engine compartment.
3. Remove the securing bolts and lift the mudshield (see Fig. R-1) out from under the wing. Driver's side: remove the steering box mudshield.

**Fig. R-2—Layout of tailboard, doors and side screens**

- |  |  |
|--|--|
| 1 Tailboard assembly                         | 24 Seal for door, front upper                      |
| 2 Tailboard top capping                      | 25 Seal for door, front lower, dash                |
| 3 Tailboard tread plate                      | 26 Seal for door, rear lower                       |
| 4 Tailboard sealing rubber, bottom           | 27 Seal for door, bottom, sill                     |
| 5 Tailboard hinge, R.H.                      | 28 Support bracket at door striker                 |
| 6 Tailboard hinge, L.H.                      | 29 Door lock striking plate                        |
| 7 Tailboard chain hook                       | 30 Side screen assembly                            |
| 8 Tailboard locking plate                    | 31 Front fixed window                              |
| 9 Front door assembly                        | 32 Window retainer                                 |
| 10 Door top capping                          | 33 Rear sliding window                             |
| 11 Hinge complete, upper                     | 34 Sealing rubber for front edge of sliding window |
| 12 Hinge complete, lower                     | 35 Sealing rubber channel                          |
| 13-17 Fixings for door hinge                 | 36 Buffer for sliding window, at top               |
| 18 Door lock mounting plate                  | 37-38 Filler strip for windows                     |
| 19 Door lock                                 | 39 Top channel                                     |
| 20 Washer, handle to cover                   | 40 Bottom channel                                  |
| 21 Handle                                    | 41 Rear channel                                    |
| 22 Door handle bracket                       | 42 Sidescreen sealing strip                        |
| 23 Captive plate, door lock mounting to door |  |

4. Using a box spanner, remove the bolts securing the wing to the scuttle pillar.
5. Remove the bolts securing the wing stay and the wing to the sill panel.
6. Remove the bolts securing the wing to the rear wing upper mounting bracket.
7. Remove the bolt securing the wing to the steering column support plate.
8. Remove the bolts securing the wing to the grille panel (on R.H. wings, this action also releases the bonnet prop bracket).

**To refit** **Operation R/12**

1. Reverse the removal procedure.

**Sidescreen windows**

**Sliding window**

**To renew** **Operation R/14**

1. Move the sliding window to allow access to the screws securing glass run channel—top and bottom—then remove the screws from inside channel.
2. Withdraw the top run channel and sliding window.
3. Renew the bottom run channel if necessary.
4. Fit new parts as necessary and assemble by reversing the removal procedure.

**Fixed window**

**To renew** **Operation R/16**

1. See Operation R/14, items 1-3 inclusive.
2. Remove the screws securing front retainer and ease the fixed glass clear of frame.
3. Apply new Prestik sealing strip to window frame, renewing parts as necessary and assemble by reversing the removal procedure.

Two-piece door only—if necessary, the complete assembly can be removed by removing the nuts, plain washers and spring washers securing the assembly to the door.

**Front door**

(Two-piece and full length)

**To remove** **Operation R/18**

1. Remove the bolts, washers and nuts securing the hinges to the door.
2. Remove the door.

**To refit** **Operation R/20**

1. Reverse the removal procedure, renewing sealing rubbers as necessary.

**Hinge**

**To remove** **Operation R/22**

1. The hinges may be stripped by prising back the lock washer tab and removing the special nut and bolt. Care must be taken to ensure that the cone and spring are not lost.

**To refit** **Operation R/24**

1. Fit a new lock washer and assemble by reversing the removal procedure.

Adjust by increasing or lessening the load on the spring by tightening or slackening the special nut, and bend lock tab over to secure assembly.

**Door lock**

**To renew** **Operation R/26**

1. Remove the door lock from the door.
2. If required, remove the striking plate from its support bracket.
3. Renew the lock and plate as necessary and refit by reversing Items 1 and 2.
4. Adjust the position of the striking plate as necessary, so that the door draught excluders are slightly compressed.

**Front floor**

**To remove** **Operation R/28**

1. Remove the transfer lever knob and dust excluder.
2. Remove the four wheel drive lever knob, spring and ferrule.
3. Remove the floor board securing bolts and lift off the front floor complete.
4. If necessary, remove the gearbox cover from the dash panel.

**To refit** **Operation R/30**

1. Reverse the removal procedure.
2. Adjust the four wheel drive lever. Section C.

**Windscreen**

**To remove** **Operation R/32**

1. Remove the doors and sidescreens complete. Operation R/18.
2. Remove the hard top or cab, Operation R/60 or R/48; if a soft hood is fitted, release the front straps from the support stays at the top of the windscreen and disconnect the top drain channels from the windscreens.
3. Remove the windscreen wiper positive lead plug from the socket on the dash panel.
4. Slacken the wing nuts at the bottom corners of the windscreen.
5. Remove the windscreen pivot bolts and remove the windscreen complete.

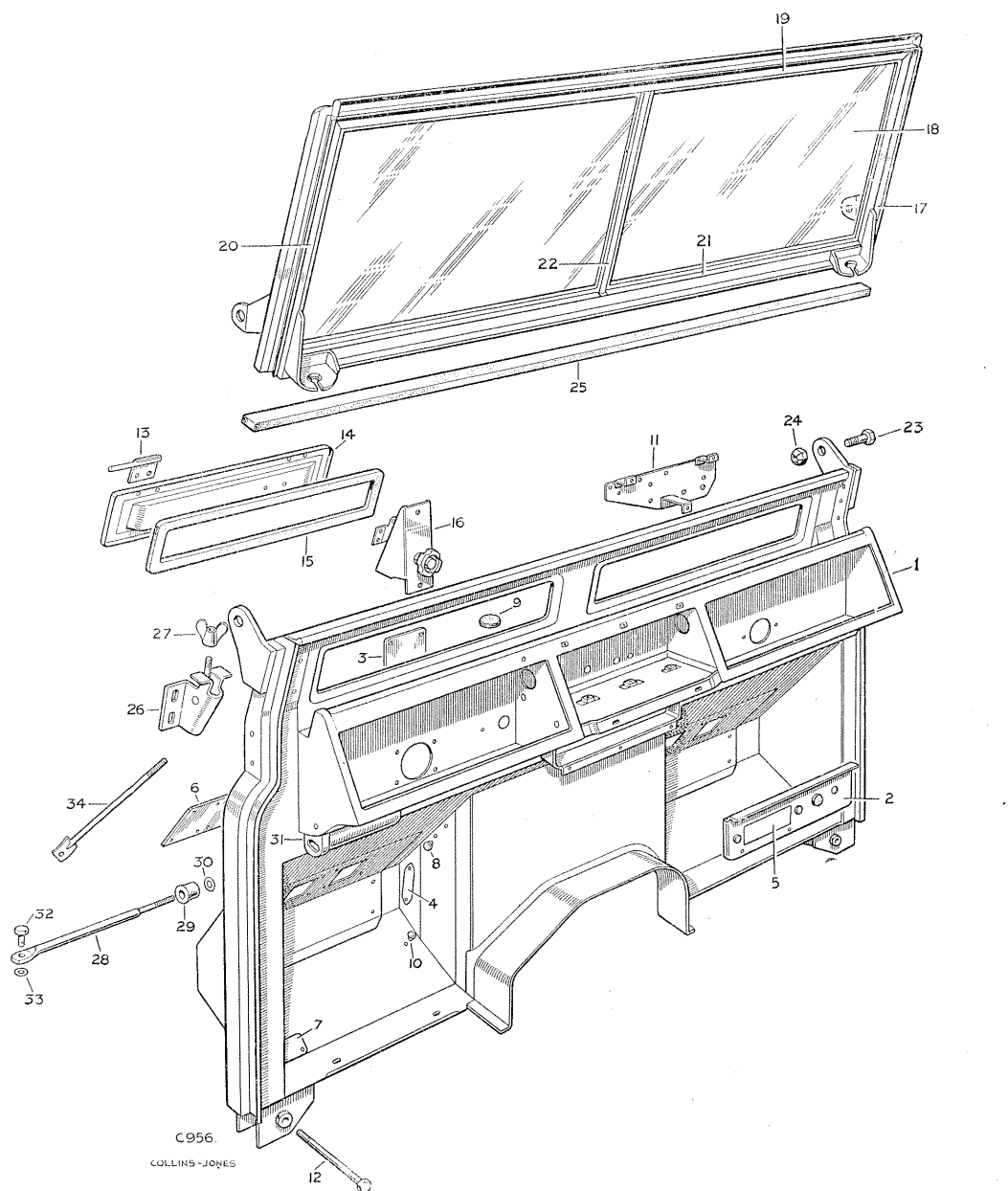


Fig. R-3—Layout of dash panel, windscreen and ventilators

- |  |   |
|--|---|
| 1 Dash complete  | 16 Ventilator control mechanism complete    |
| 2 Panel for controls   | 17 Windscreen complete assembly             |
| 3 Cover panel for steering cut-out                           | 18 Glass for windscreen                     |
| 4 Cover plate for accelerator pedal hole                     | 19 Retainer for windscreen glass, top       |
| 5 Cover panel for governor cut-out in dash—<br>Petrol models | 20 Retainer for windscreen glass, side      |
| 6 Cover plate for pedal holes                                | 21 Retainer for windscreen glass, bottom    |
| 7 Cover plate for dipswitch hole                             | 22 Cover for centre strip                   |
| 8 Rubber plug, redundant accelerator holes                   | 23-24 Fixings for windscreen to dash        |
| 9 Rubber grommet for demister holes                          | 25 Rubber sealing strip for windscreen      |
| 10 Rubber plug, redundant accelerator stop<br>holes          | 26 Fastener for windscreen, R.H.            |
| 11 Mounting plate for pump                                   | 27 Wing nut for fastener                    |
| 12 Tie bolt  | 28 Check strap rod                          |
| 13 Ventilator hinge  | 29 Check strap buffer                       |
| 14 Ventilator lid for dash                                   | 30 Fixings—buffer to rod                    |
| 15 Sealing rubber for ventilator lids                        | 31 Check strap mounting bracket             |
|  | 32-33 Fixings—check strap rod to front door |
|  | 34 Tie rod                                  |

**To refit** **Operation R/34**

1. Reverse the removal procedure, renewing the windscreen sealing strip if necessary.

**Windscreen glass****To renew** **Operation R/36**

1. If necessary, remove the windscreen wiper blade; disconnect the wiper motor earth wire and remove the wiper motor from the windscreen.
2. Withdraw the drive screws securing the retainers round the glass and prise away the retainers; remove the glass or glasses as necessary. Apply "Prestik" strip  $\frac{1}{2}$  in. (12 mm) wide, round the outside on both faces of the new glass and fit the glass by reversing the stripping procedure.

**Ventilator lid****To remove** **Operation R/38**

1. Remove the securing screws and remove one of the ventilator hinges.
2. Remove the securing bolts and disconnect the ventilator panel from the operating control.
3. Withdraw the ventilator. The same procedure applies to either ventilator.
4. If necessary, remove remaining hinges.
5. If necessary, remove the ventilator control.

**To refit** **Operation R/40**

1. Reverse the removal procedure, renewing sealing rubbers as necessary.

**Dash panel****To remove** **Operation R/42**

1. Remove the front floor, gearbox cover, doors, windscreen, bonnet and wings, Operations R/28, R/18, R/32, R/2 and R/10.
2. Disconnect the battery.  
**Diesel models**—disconnect the lead coupling both batteries.
3. **Petrol models**—disconnect the starter motor lead from the terminal on the switch.  
**Diesel models**—disconnect the starter/heater plug switch leads from the switch.
4. **Petrol models**—disconnect the high tension wire and the distributor wire from the coil.
5. Disconnect the oil warning light wire from the oil pressure switch.
6. **Petrol models**—disconnect the mixture warning light wire from the switch on the cylinder head.
7. Remove the pipe complete, three-way piece, on dash panel to five-way piece on chassis frame.

8. Disconnect the clutch jump hose at the bracket on dash.

9. **2 litre Petrol**—disconnect the petrol pipe (pump to carburetter) at the pump. Disconnect the petrol pipe (tank to sediment bowl) at the bowl.

10. Disconnect the accelerator linkage by disconnecting the control rod, at the carburetter, or injection pump.

11. **2 litre Petrol**—if fitted, disconnect the engine governor operating rod at the quadrant.

12. **Diesel models, or if fitted, 2½ litre Petrol**—disconnect the engine hand speed control rod at the cross-shaft by removing the retaining nut and locknut.

13. If fitted, disconnect the heater water pipe hoses, disconnect the leads and remove the heater unit complete.

14. Disconnect the dynamo leads.

15. **2 litre Petrol**—if fitted, disconnect the hand throttle wire from the bracket on the cylinder head and the hand throttle lever.

16. Disconnect the speedometer drive from the transfer box; release the cable from the clips on the transfer box, the chassis and the flywheel housing.

17. **R.H.D. models**—remove the drop arm from the steering rocker shaft, using extractor, Part No. 262776.

18. Disconnect the headlamp and horn wires at the junction box on the dash.

19. Part the frame and dash section of the main harness at the snap connectors.

20. **Diesel L.H.D.**—disconnect the additional filter pipes at the filter.

21. Remove the bolt securing the steering box support bracket to the chassis; remove the two tie bolts, plain washer and nuts fixing the dash to the chassis; remove the nuts and bolts securing the extremities of the sill panels to the dash. Lift off the dash panel complete.

**L.H.D. models:** remove the steering column and box complete, Operation G/2, Section G.

**To renew** **Operation R/44**

1. Remove the dash panel. Operation R/42.
2. Lift off the junction box and disconnect the wiring; remove the junction box from the dash.

3. Remove the clutch and brake pedal assemblies, master cylinders, pipes, return springs, fluid reservoir and three-way piece. Sections B and H.

**R.H.D. models**

4. Disconnect the clamp securing the horn button bracket to the steering outer column, then remove assembly complete with leads.



5. Unscrew the clamp bolt and withdraw the steering wheel.
6. Remove the steering column clip and rubber strip; remove the steering column support bracket; remove the steering column rubber seal.
7. Remove the bolts and nuts securing the steering column to its support bracket and withdraw it from the dash.
8. **All models**—remove the steering column support brackets and tie rod from the dash.
9. **2 litre Petrol**—disconnect and remove the petrol pipe (pump to sediment bowl). Disconnect the wiring from the petrol pump, voltage control box and the fuse box; remove the mounting plate complete with pump, voltage control box and the fuse box.
10. **2½ litre Petrol—Diesel models**. Disconnect the wiring from the control box and the fuse box; remove the mounting plate complete with control box and fuse box.
11. **Petrol models**—disconnect the wiring from the mixture control warning light switch and remove the bracket, switch and mixture control. Section Q.
12. **Diesel models**—disconnect the wires and remove the heater plug resistance.
13. **2 litre Petrol**—if fitted, remove the hand throttle control; if fitted, remove the engine governor control quadrant assembly.
14. **Diesel models**—remove the engine hand speed control. Section Q.
15. **Petrol models**—disconnect the wiring from the coil and remove the coil from the dash; after disconnecting the cables from the starter switch, screw off the starter knob and locknut. Withdraw the switch from the dash.
16. **Diesel models**—disconnect the leads and remove the starter/heater plug switch by removing the large securing nut from fascia side of panel.
17. Remove accelerator linkage, Section Q; detach the clutch jump hose bracket from the dash.
18. **R.H.D. models**—detach the pedal shaft bracket from the dash panel complete with shafts and pedals.  
**L.H.D. models**—withdraw the pedal shafts complete with pedals and distance pieces.
19. **Diesel L.H.D.**—remove the additional filter from the dash panel.
20. Disconnect the speedometer drive from the speedometer head and withdraw it from the dash; disconnect all the wiring from the instruments and controls on the instrument panel, Section Q, and remove the main harness.
21. Remove the dip switch, complete with leads.
22. Remove the windscreen sealing strip. Remove the windscreen fastener catches from the dash panel.
23. Remove the transfer lever instruction plates; remove the rocker shaft access plate.
24. Remove the governor cut-out panel and the pedal hole covers.
25. Remove the ventilators and operating controls. Operation R/38.
26. Remove the harness clip.
27. Remove all remaining rubber grommets and plugs; remove the steering column blanking plate and refit it on the new dash panel.
28. Transfer all the dash fittings to the new panel by reversing the removal procedure, referring to appropriate sections and connecting the wiring in accordance with the appropriate wiring diagram. Section P.

**To refit****Operation R/46**

1. Reverse the removal procedure.
2. Connect the wiring in accordance with the appropriate wiring diagram.
3. Adjust the accelerator, mixture or cut-off control and throttle linkage by reference to appropriate sections.
4. Set the road wheels straight ahead and the steering wheel in the midway position between full lock in each direction before securing the drop arm to the steering box rocker shaft.
5. Bleed the clutch and brake systems. Sections B and H.

**Seat base****To remove****Operation R/48**

1. Lift out the seat cushions, withdraw securing bolts and remove the seat squabs.
2. Remove front floor. Operation R/28.
3. Remove the bolts securing the seat base to the back rest and to the sill panels.
4. Lift off the seat base, manoeuvring the hand lever grip carefully through the rubber draught excluder in the front of the seat base.
5. As necessary: remove the set bolts and lift off the locker lid and hinges; remove the set bolts and lift off the fuel tank cover, the centre cover panel and the extension panels; shear the rivets and remove locker lid hasp and remove the turn-buckle by removing the securing nuts and screws.

Note that an adjustment for driver's seat cushion inclination on 88 models can be provided, as follows:

1. Cut two triangular corner plates, using 16 s.w.g. (1,6 mm) steel, as illustrated.
2. Drill four .204 in. (5 mm) diameter holes (drill No. 6) and one ¾ in. (8,5 mm) diameter hole as shown at Fig. R-4.

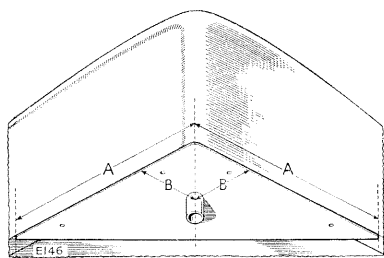


Fig. R-4—Fitting corner plate to bottom front corners of seat cushion

A—5 in. (127 mm) B—1½ in. (38 mm)

3. Insert a clevis pin or bolt  $\frac{5}{16}$  in. x  $\frac{11}{16}$  in. (8 mm x 17 mm) in the centre hole and weld it in position.
4. Using the plate as a template, drill four .204 in. dia. (5 mm) holes (drill No. 6) in the seat cushion frame at both front corners.
5. Fix one plate to each front corner of the cushion and secure with pop rivets or drive screws.
6. Obtain a suitable block of black rubber and drill three holes  $\frac{9}{32}$  in. (7,0 mm) diameter and  $\frac{3}{4}$  in. (19 mm) deep as shown.

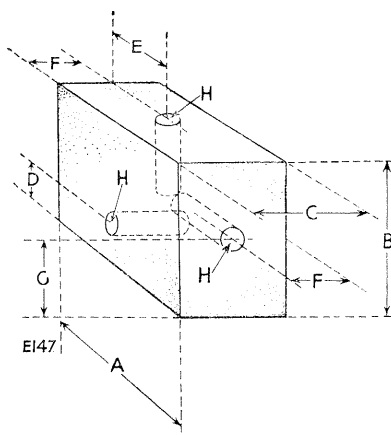


Fig. R-5—Drilling rubber block

A—2½ in. (54 mm) E—1  $\frac{1}{8}$  in. (27 mm)  
 B—1  $\frac{1}{8}$  in. (41 mm) F— $\frac{9}{16}$  in. (14 mm)  
 C—1  $\frac{1}{8}$  in. (28,5 mm) G— $\frac{13}{16}$  in. (21 mm)  
 D— $\frac{9}{16}$  in. (14 mm) H—Alternative adjustment holes

7. Push rubber blocks over the pin on the corner plates, using one of the three holes to give the required inclination of the seat cushion.

#### To refit Operation R/50

1. Reverse the removal procedure.

#### Cab

#### To remove Operation R/52

1. Remove the nuts and bolts securing the cab at the windscreen and the nuts securing the cab at the hood sockets.

88 models: remove the bolts, nuts and washers securing the cab to the cab mounting rail, at the rear body.

109 models: remove the set bolts and washers securing the cab to the cab mounting brackets, at the rear body.

2. Lift off the cab complete, then remove the roof panel and sealing rubber from the rear panel.
3. Remove the draught excluders and retaining strips from the top of the front door apertures.
4. Remove the rear upper front door seals and the draught pads from the front edge of the side panels.
5. If necessary, remove the rear bottom sealing strip from the back rest panel capping.
6. If necessary, remove the sealing rubber from the front edge of the roof.
7. If necessary, remove all mounting brackets.

#### To refit

#### Operation R/54

1. Reverse the removal procedure.
2. Renew the back and quarter lights as necessary, Operations R/56 and R/58.

#### Cab back lights

#### Sliding light

#### To renew

#### Operation R/56

1. Withdraw the drive screws securing the bottom channel to the cab rear panel (the drive screws are inside the channel).
2. Remove the "Phillips" screw, distance piece (two on R.H. light), special washers and tapped plate securing the catch to the back light.
3. Remove the bottom run channel and sliding back light.
4. If necessary, remove the top run channel.
5. If necessary, remove the catches from the back lights.
6. Renew the rubber sealing strips, fittings and sliding lights as necessary. Refit by reversing the removal procedure.

#### Quarter light

#### To renew

#### Operation R/58

1. Prise out the rubber filler strip from the glass weather strip; push the glass and weather strip from the panel aperture.
2. Square off one end of the rubber weather strip, and, starting at the bottom centre, fit the narrow groove of the strip to the panel aperture with the locking groove to the weather side.

3. Force the strip well into the aperture corners, and, allowing about one inch (25 mm) overlap, square off the other end of the moulding. Compress the moulding around its length until the ends can be joined. (This overlap is important, as otherwise a gap will appear between the moulding ends when the glass is fitted).
4. Fit the glass into the moulding, using a flat piece of metal to pull the lip over the glass.
5. Square off one end of the filler strip, and, starting opposite the joint in the moulding, insert the filler strip in the groove in the weather strip by means of the special tool, Part No. 262771. Allowing about  $\frac{1}{4}$ " (6 mm) overlap, square off the end of the filler strip, and force the overlap into the weather strip groove.

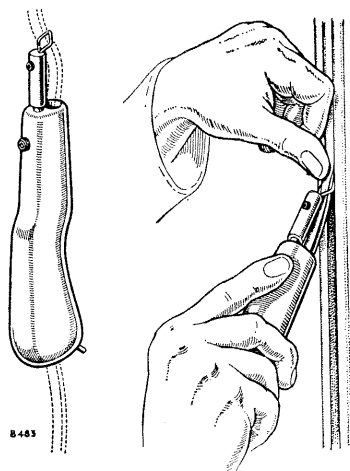


Fig. R-6—  
Fitting filler strip in  
window weather  
strip

### Cab tropical roof

#### To remove Operation R/60

1. Remove the screws, spring and plain washers, nuts, distance pieces and rubber washers securing each side of the panel to the roof.
2. Remove the screws, spring, plain and rubber washers and nuts securing the tropical panel stiffeners to the cab roof both at the front and at the back, then lift off the tropical roof panel.

#### To refit Operation R/62

1. Reverse the removal procedure.

### Hard top

#### To remove Operation R/64

1. Remove the nuts, bolts and washers securing the hard top to the windscreen.
2. Remove the set bolts securing the hard top to the front mounting bracket.
3. Remove the nuts, bolts and washers securing the hard top to the centre mounting bracket.
4. Remove the nuts and washers securing the hard top to the rear hood sockets.

5. Remove the nuts, bolts and washers securing the rear mounting brackets to the body. Lift off the hard top complete.

### Rear lid

#### Early type

6. Remove the rear lid by removing the nuts, bolts and washers securing the stays to the side panels, withdraw the split pins and remove the hinge pins. Lift off lid.
7. Remove stays and hinge leaves by removing the securing bolts and washers; if necessary, remove glass, Operation R/58; to remove the lid lock, remove the inner handle by depressing the spring-loaded boss and push out the locking pin.

#### Late type

8. Remove the rear lid by withdrawing the hinge pins. If necessary remove the split pins securing the stays and remove.
9. If necessary, remove the stay support mounting brackets from the side panels. To remove the lid lock, remove the inner handle by depressing the spring-loaded boss and push out the locking pin.
10. Remove the handle, boss, cap and spring. Withdraw the screws, spring and plain washers and nuts securing the lock to the lid panel; remove the bolts and plain washers securing the bolt guides to the lid panel; remove the outer handle and lift off the lock complete.
11. If necessary, remove the lock bolt sockets from the side panels by removing the securing nuts and bolts. If necessary, remove the rubber seal and retainer from the lower edge of the lid.

### Roof panel

8. Remove the roof panel by removing the nuts, bolts and washers securing it to the side panels. If necessary, remove the rubber seal.

### Side panels

9. If necessary, remove the glasses. Operation R/58.
10. If necessary, remove the seals and retaining strips.

#### To refit Operation R/66

1. Reverse the removal procedure.
2. If removed, replace or renew the seals and retaining strips.
3. If removed, replace or renew the glasses. Operation R/58.
4. On assembly of the door handle, it will be necessary to adjust the position of the bolts by slackening the locking nuts, to obtain adequate entry into the sockets.

### Hard top window glass

#### To renew Operation R/68

As some difficulty may be experienced in carrying out this operation, it will be found advantageous,

3. If necessary, remove the tailboard hinges and the chain hooks.

4. Refit by reversing items 1 to 3.

## Rear body

## Operation R/70

## Operation R/76

1. Remove the hood and hood sticks or the hard top.
2. Remove the spare wheel if fitted in the rear body.
3. **88 models:** remove the seat cushions.
4. **109 models:** tilt forward the squabs.
5. Disconnect the fuel filler and breather hoses.
6. Remove the bolts, washers and nuts securing the rear body to the seat base.
7. Remove the bolts securing the sill channel mounting bracket to the seat base and rear body.
8. Detach the nuts and bolts securing the rear sill panel to the body.
9. **88 models:** detach the wing stays from the chassis members.
10. Remove the nuts and bolts securing the body to the rear cross-member mounting brackets.
11. Remove the rear body complete.
12. If necessary, remove all serviceable parts for fitment to new body.

## Operation R/72

1. Reverse the removal procedure.

## To remove and refit

## Operation R/74

- To refit

Operation R/78

1. Reverse the removal procedure.

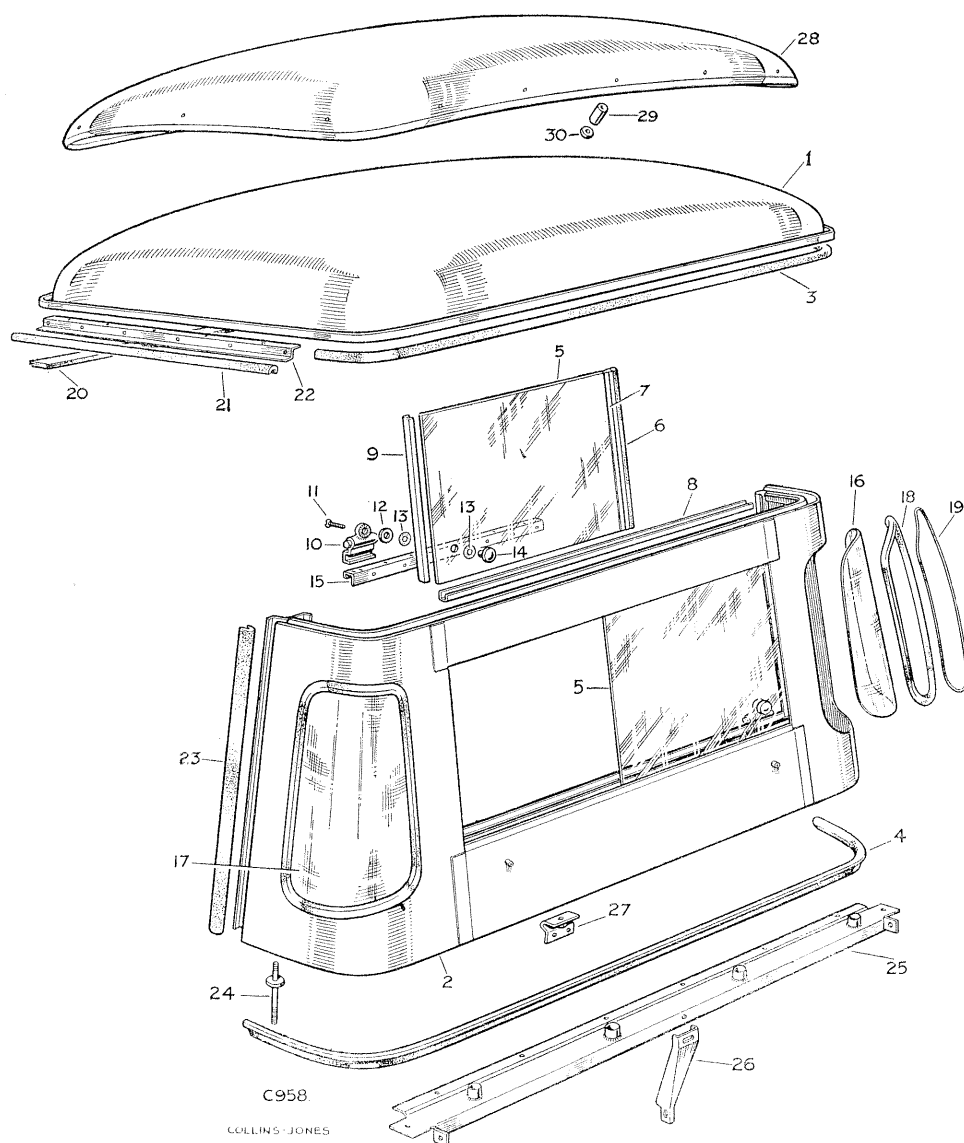


Fig. R-7—Layout of cab and tropical roof

- |       |                                      |    |                                    |  |
|-------|--------------------------------------|----|------------------------------------|--|
| 1     | Cab roof                             | 18 | Weather strip                      | } For quarter light                      |
| 2     | Cab rear panel assembly              | 19 | Sealing strip                      |  |
| 3     | Rubber seal, roof to back panel, top | 20 | Sealing rubber, windscreen to roof |  |
| 4     | Rubber seal back panel to rear body  | 21 | Sealing rubber, door top           |  |
| 5     | Sliding back light                   | 22 | Retainer for seal                  |  |
| 6     | Sealing rubber for back light        | 23 | Sealing rubber, door side          |  |
| 7     | Channel for rubber                   | 24 | Mounting stud                      |  |
| 8     | Channel, top and bottom              | 25 | Mounting rail for cab              | } For back light                         |
| 9     | Channel, sides                       | 26 | Mounting rail support bracket      |  |
| 10    | Back light catch                     | 27 | Cab mounting distance piece        |  |
| 11-14 | Fixings for catches                  | 28 | Cab tropical roof panel            |  |
| 15    | Runner for sliding back light catch  | 29 | Distance piece                     | } Fixing tropical roof panel to cab roof |
| 16    | Cab quarter light, R.H.              | 30 | Rubber                             |  |
| 17    | Cab quarter light, L.H.              |    |                                    |  |

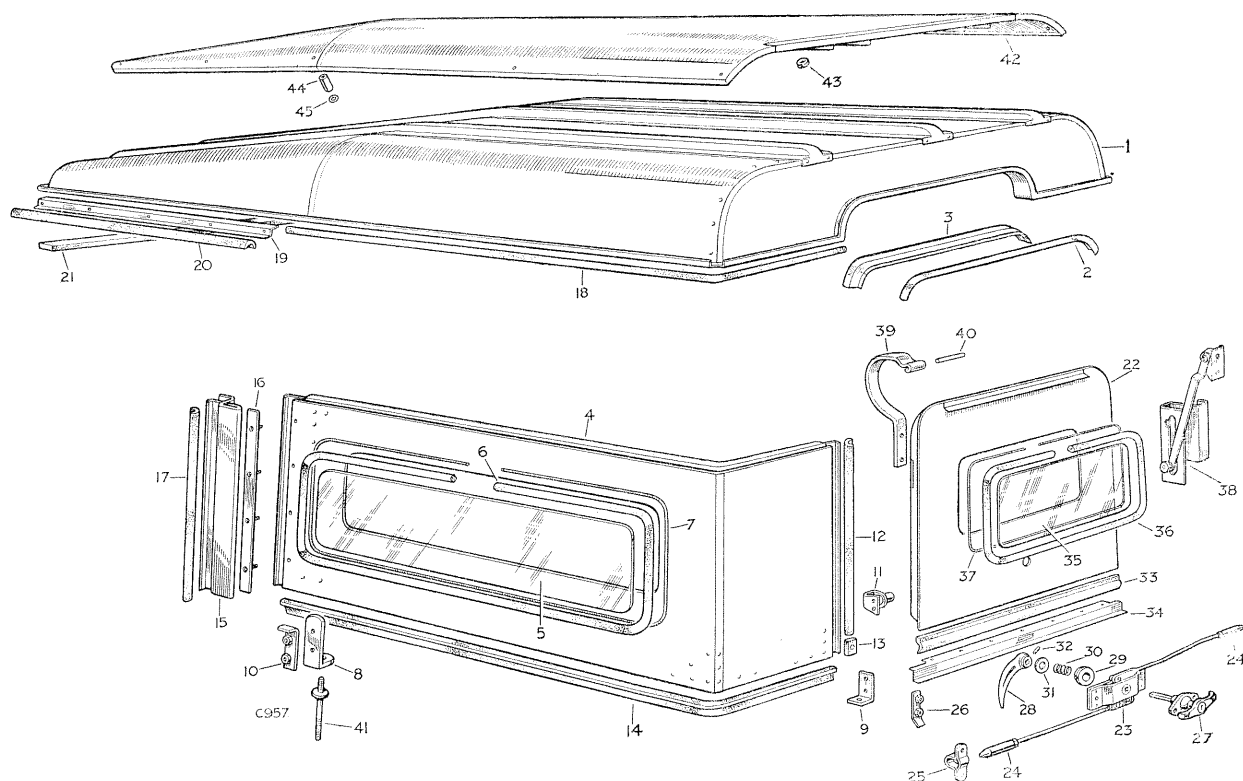


Fig. R-8—Layout of hard top and tropical roof, fixed windows, showing early type lid

- |   |                                   |
|---|-----------------------------------|
| 1 Cab roof assembly                         | 22 Rear lid assembly              |
| 2 Rubber seal for roof                      | 23 Rear lid lock                  |
| 3 Seal retainer                             | 24 Lock bolt end                  |
| 4 Side panel assembly                       | 25 Rear lid lock guide            |
| 5 Glass for side window                     | 26 Nut plate                      |
| 6 Weather strip for glass                   | 27 Handle for rear lid, outer     |
| 7 Filler strip for weather strip            | 28 Handle for rear lid, inner     |
| 8 Front mounting bracket                    | 29-32 Fixing for handles          |
| 9 Rear mounting bracket                     | 33 Rear lid rubber seal, bottom   |
| 10 Nut plate                                | 34 Bottom seal retainer           |
| 11 Rear lid lock bolt socket                | 35 Rear lid glass                 |
| 12 Rubber seal for rear lid                 | 36 Back light weather strip       |
| 13 Rubber buffer for rear lid               | 37 Filler strip for weather strip |
| 14 Rubber sealing strip, lower edge to body | 38 Stay for rear lid              |
| 15 Front door rear seal capping             | 39 Hinge leaf for rear lid        |
| 16 Stud plate                               | 40 Pin for rear lid hinge         |
| 17 Seal for front door, upper, side         | 41 Mounting stud                  |
| 18 Rubber seal, roof to side                | 42 Tropical roof panel assembly   |
| 19 Door top seal retainer                   | 43 Rubber washer                  |
| 20 Door top sealing rubber                  | 44 Distance piece                 |
| 21 Sealing rubber, windscreen to roof       | 45 Rubber washer                  |

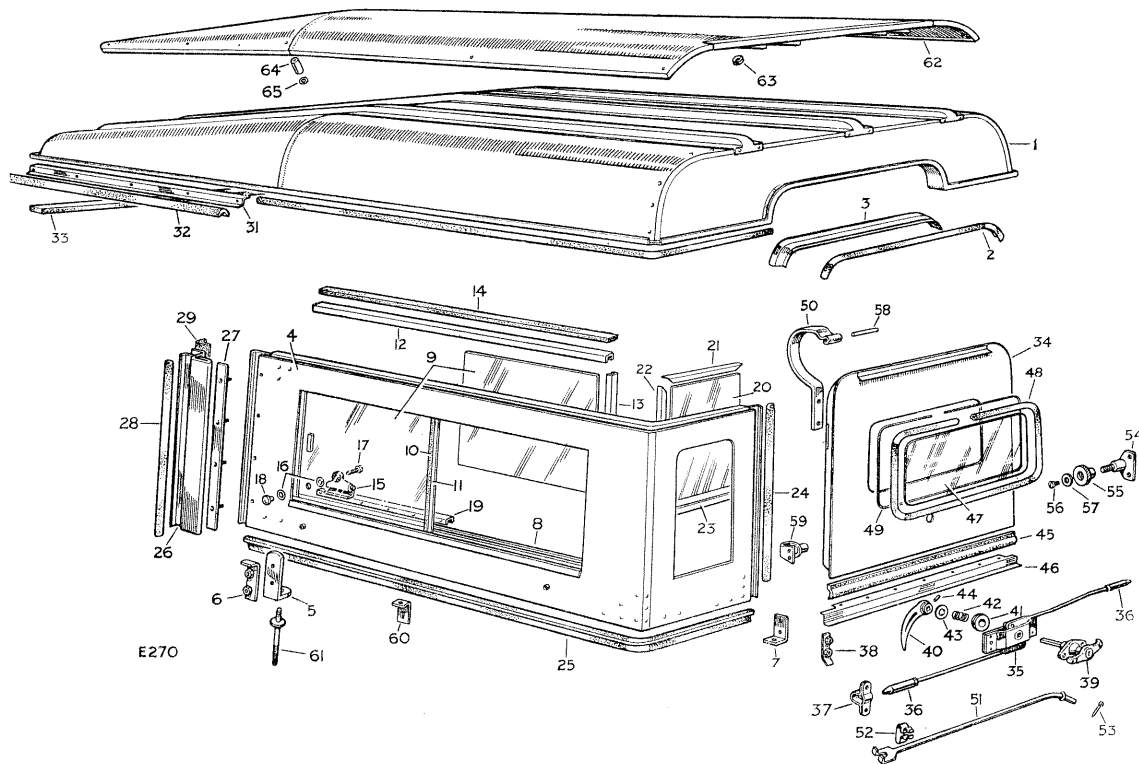


Fig. R-9—Layout of hard top with sliding windows, showing late type lid

- |  |   |
|--|---|
| 1 Cab roof assembly                            | 34 Rear lid assembly                                      |
| 2 Rubber seal for roof, rear                   | 35 Lock complete for rear lid                             |
| 3 Seal retainer for roof, rear                 | 36 Bolt end for lock                                      |
| 4 Side panel assembly, L.H.                    | 37 Guide for rear lid lock                                |
| 5 Mounting bracket front                       | 38 Nut plate  |
| 6 Nut plate—fixing mounting bracket to body    | 39 Handle for rear lid, outer, locking                    |
| 7 Support bracket at tail board                | 40 Handle for rear lid, inner                             |
| 8 Drain channel complete for side windows      | 41 Boss   |
| 9 Glass for side window, sliding               | 42 Coil spring  |
| 10 Sealing rubber for sliding light            | 43 Cup for coil spring                                    |
| 11 Channel for sliding light rubber            | 44 Locking pin  |
| 12 Channel for sliding light, top              | 45 Rubber seal for rear lid, bottom                       |
| 13 Channel for sliding light, sides            | 46 Retainer for bottom seal                               |
| 14 Packing strip for top channel               | 47 Glass for rear lid                                     |
| 15 Catch for sliding glass, front              | 48 Weather strip for back light                           |
| 16 Washer for catch                            | 49 Seal strip for weather strip                           |
| 17 Screw fixing front catch                    | 50 Hinge leaf for rear lid                                |
| 18 Cupped plate for catch                      | 51 Stay for rear lid, R.H.                                |
| 19 Runner for sliding catch                    | 52 Spring clip for rear lid stay                          |
| 20 Glass for rear end window                   | 53 Split pin fixing rear lid stay to support              |
| 21 Retainer for rear end glass upper L.H.      | 54 Mounting bracket for stay support                      |
| 22 Retainer for rear end glass inner and outer | 55 Locking nut for mounting bracket                       |
| 23 Retainer for rear end glass lower L.H.      | 56 Screw  |
| 24 Rubber seal for rear lid, side              | 57 Plain washer   |
| 25 Rubber sealing strip, lower edge to body    | 58 Pin for rear lid hinge                                 |
| 26 Capping for front door rear seal, L.H.      | 59 Socket for rear lid lock bolt, L.H.                    |
| 27 Stud plate—fixing cappings to side panel    | 60 Support bracket, centre, body side                     |
| 28 Seal for front door, upper, side            | 61 Mounting stud—fixing hard top to body                  |
| 29 Rubber seal at door pillar top and bottom   | 62 Tropical roof panel                                    |
| 30 Rubber seal, roof to side                   | 63 Rubber washer—fixing panel to roof at end of stiffener |
| 31 Seal retainer for door top, L.H.            | 64 Distance piece   |
| 32 Sealing rubber for door top                 | 65 Rubber washer  |
| 33 Sealing rubber, windscreen to roof          |   |

} Fixing handle

} Retaining

} locking nut

} Fixing roof to panel at sides

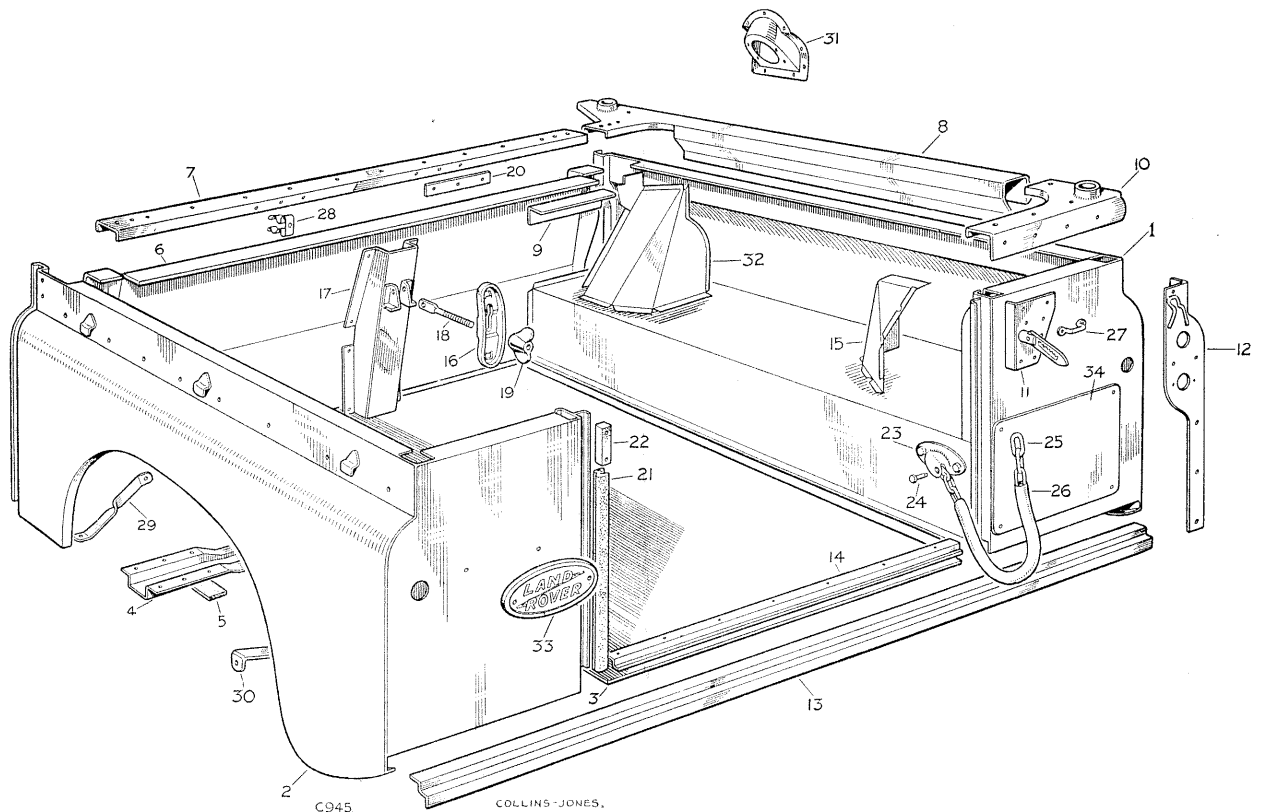


Fig. R-10—Layout of rear body unit—88

- |  |   |
|--|---|
| 1 Side and wheelarch complete R.H.     | 18 Spare wheel clamp tie bar              |
| 2 Side and wheelarch complete L.H.     | 19 Wing nut, fixing spare wheel clamp     |
| 3 Rear floor complete                  | 20 Spare wheel rubbing strip              |
| 4 Rear floor cross-member and pads     | 21 Tailboard sealing rubber               |
| 5 Rear floor cross-member mounting pad | 22 Tailboard rubber buffer                |
| 6 Rear body front panel                | 23 Tailboard chain bracket                |
| 7 Body front panel capping             | 24 Pin, fixing tailboard chain to bracket |
| 8 Body top side capping                | 25 Tailboard chain                        |
| 9 Corner strengthening angle           | 26 Sleeve for chain                       |
| 10 Hood socket complete, rear corner   | 27 Hood strap staple                      |
| 11 Corner bracket and tailboard cotter | 28 Starting handle and jack handle clip   |
| 12 Rear protection angle               | 29 Rear wing stay, front                  |
| 13 Rear mounting angle                 | 30 Rear wing stay, rear                   |
| 14 Protecting strip at rear of floor   | 31 Fuel filler cowl                       |
| 15 Cover panel for rear lamps          | 32 Fuel filler cover plate                |
| 16 Spare wheel clamp                   | 33 'Land-Rover' name plate                |
| 17 Clamp reinforcement bracket         | 34 Registration plate                     |



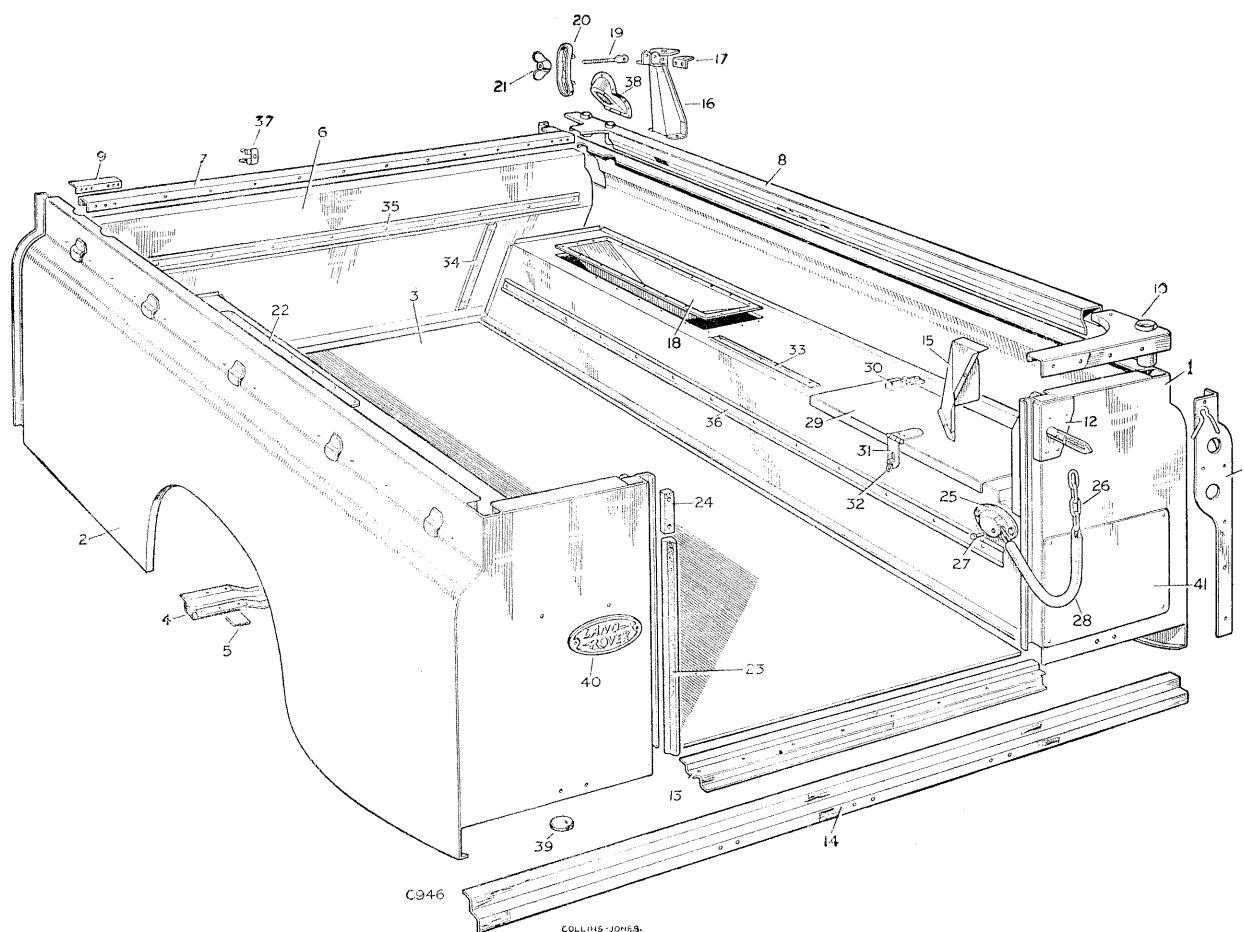


Fig. R-11—Layout of rear body unit—109

- |  |   |
|--|---|
| 1 Side and wheelarch complete R.H.           | 22 Cover plate  |
| 2 Side and wheelarch complete L.H.           | 23 Tailboard sealing rubber                           |
| 3 Rear floor complete                        | 24 Tailboard rubber buffer                            |
| 4 Rear floor cross-member and pads           | 25 Tailboard chain bracket                            |
| 5 Rear floor cross-member mounting pad       | 26 Tailboard chain                                    |
| 6 Rear body front panel                      | 27 Clevis pin, fixing chain to bracket                |
| 7 Rear body front panel capping              | 28 Sleeve for chain                                   |
| 8 Body top side capping                      | 29 Wheelarch box locker lid                           |
| 9 Corner strengthening angle                 | 30 Locker lid hinge                                   |
| 10 Hood socket complete, rear corner         | 31 Locker lid hasp                                    |
| 11 Rear protection angle                     | 32 Locker lid turnbuckle                              |
| 12 Corner bracket and tailboard cotter       | 33 Tread plate, wheelarch box top                     |
| 13 Protecting strip at rear of floor         | 34 Tread plate, vertical, front panel                 |
| 14 Rear mounting angle                       | 35 Tread plate, horizontal, front panel               |
| 15 Rear lamp cover panel                     | 36 Tread plate for rear floor and wheelarch box sides |
| 16 Spare wheel mounting strengthening member | 37 Starting handle and jack handle clip               |
| 17 Nut plate                                 | 38 Fuel filler cover plate                            |
| 18 Spare wheel housing                       | 39 Rubber grommet, wheelarch, locker access hole      |
| 19 Spare wheel clamp tie bar                 | 40 'Land-Rover' nameplate                             |
| 20 Spare wheel clamp                         | 41 Registration plate                                 |
| 21 Wing nut, fixing spare wheel clamp        |   |

# Section S – WHEELS AND TYRES – ALL MODELS

## INDEX

	Page		Page
Changing tyre positions ....	S-2	Divided wheels	
Defect location ....	S-4	Removal ....	S-3
Factors affecting tyre life ....	S-2	Fitment ....	S-3
Tyres		Tyre pressures....	S-1
Well base rims		Tyre treads ....	S-2
Fitment ....	S-2	Wheel and tyre ....	S-3

## LIST OF ILLUSTRATIONS

Fig.	Page
S-1 Changing wheel positions ....	S-2
S-2 Divided wheel ....	S-2
S-3 Tightening sequence ....	S-3

## Tyre pressures

Maximum tyre life and performance will only be obtained if the tyres are maintained at the correct pressures.  
See chart below:

		Normal				Emergency soft			
		Load under 550 lb. (250 kg)		Load over 550 lb. (250 kg)		Load under 550 lb. (250 kg)		Load over 550 lb. (250 kg)	
		Front	Rear	Front	Rear	Front	Rear	Front	Rear
<b>88 models</b>									
Avon or Dunlop	lb/sq.in.	25	25	25	30	15	15	15	20
6.00 x 16.00	kg/cm <sup>2</sup>	1,7	1,7	1,7	2,1	1,0	1,0	1,0	1,4
Avon or Dunlop	lb/sq.in.	25	25	25	30	15	15	15	20
7.00 x 16.00	kg/cm <sup>2</sup>	1,7	1,7	1,7	2,1	1,0	1,0	1,0	1,4
Avon or Dunlop	lb/sq.in.	25	25	25	30	15	15	15	20
7.50 x 16.00	kg/cm <sup>2</sup>	1,7	1,7	1,7	2,1	1,0	1,0	1,0	1,4
Michelin XY	lb/sq.in.	15	15	15	22	10	10	10	16
7.50 x 16.00	kg/cm <sup>2</sup>	1,0	1,0	1,0	1,5	0,7	0,7	0,7	1,1
<b>109 models</b>									
Avon or Dunlop	lb/sq.in.	25	25	25	36	12	12	15	24
7.50 x 16.00	kg/cm <sup>2</sup>	1,7	1,7	1,7	2,5	0,8	0,8	1,0	1,6
Michelin XY	lb/sq.in.	20	20	20	35	15	15	15	28
7.50 x 16.00	kg/cm <sup>2</sup>	1,4	1,4	1,4	2,4	1,0	1,0	1,0	1,9

Pressures should be checked and adjusted monthly, paying attention to the following points:

1. Whenever possible, check the tyres cold, as the pressure is about 2 lb. (0,1 Kg) higher at running temperature.
2. Always replace the valve caps, as they form a positive seal on the valves.
3. Any unusual pressure loss (in excess of 1 to 3 lb. (0,05 to 0,20 kg) per month) should be investigated and corrected.
4. Always check the spare wheel, so that it is ready for use at any time.
5. At the same time, remove embedded flints, etc., from the tyre treads with the aid of a penknife or similar tool. Clean off any oil or grease on the tyres, using petrol sparingly.

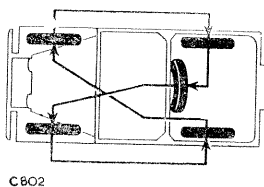
### Tyre treads

When cross-country tyres are used, they must be fitted with the V in the tread pattern pointing forwards at the top of the wheel, to ensure maximum grip and efficient tread cleaning when operating on soft ground. For this reason it may be found necessary to reverse the spare tyre on its wheel (dependent on which side it is to be fitted) when putting it into service.

### Changing tyre positions

In the interests of tyre mileage and even wear, it is recommended that the wheels are changed round every 3,000 miles (5.000 Km) as follows:

Spare to left-hand front; left-hand front to left-hand rear; left-hand rear to right-hand front; right-hand front to right-hand rear and right-hand rear to spare.



C802

Fig. S-1—Changing wheel positions

### Factors affecting tyre life

1. Incorrect tyre pressures.
2. High average speeds.
3. Harsh acceleration.
4. Frequent hard braking.
5. Warm, dry climatic conditions.
6. Poor road surfaces.
7. Impact fractures caused by striking a kerb or loose brick, etc.
8. Incorrect front wheel alignment. Alignment should be checked periodically.

### Tyre and inner tube repairs

Minor tyre injuries such as from nails, require no attention other than removal of the object, but more severe tread or wall cuts require vulcanised repairs.

Avoid the use of gaiters or liners except as a temporary expedient. As "Butyl" synthetic tubes are used, all repairs must be vulcanised.

### Tyres

#### Well base rims (Standard on all models)

##### To remove

##### Operation S/2

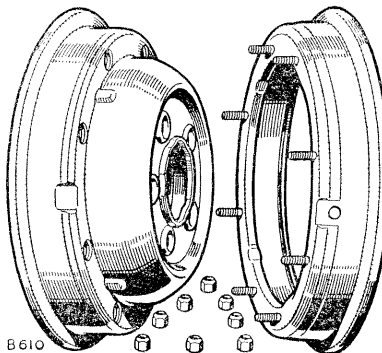
1. Remove the valve cap and core (extractor provided in tool kit) and deflate the tyre.
2. Press each bead in turn off its seating. Insert a lever at the valve position and, while pulling on this lever, press the bead into the well, diametrically opposite the valve.
3. Insert a second lever close to the first and prise the bead over the wheel rim. Continue round the bead in small steps until it is completely off the rim.
4. Remove the inner tube and pull the second bead over the rim.

##### To refit

##### Operation S/4

1. Place the cover over the wheel and press the lower bead over the rim edge into the well.
2. Inflate the inner tube until it is just rounded out, dust with French chalk, and insert it in the cover, with the white spots near the cover bead coinciding with the black spots on the tube.
3. Press the upper bead into the well diametrically opposite the valve and lever the bead over the rim edge.
4. Push the valve inwards to ensure that the tube is not trapped under the bead, pull it back and inflate the tyre.
5. Check the concentricity of the fitting line on the cover and the top of the wheel flange. Deflate the tube completely and re-inflate to the correct pressure, to relieve any strains in the tube.

#### Divided wheels (fitted as optional equipment on 88 models)



B610

Fig. S-2—  
Divided wheel

**To remove****Operation S/6**

Do not touch the nuts securing the two halves of the wheel together before the tyre is deflated or serious personal injury may result.

1. Remove the valve cap and core to deflate the tyre.
2. Press each bead in turn away from the flange, using levers and working round the tyre in small steps. Two or three circuits of the tyre may be necessary to free the beads completely.
3. Slacken and remove the clamping nuts. Remove the upper half of the wheel. Push the valve through the lower half of the wheel and remove the cover and tube.

**To refit****Operation S/8**

1. Thoroughly examine the cover for nails, flints, etc., and ensure that no loose objects have been left inside. Clean the wheel rim flanges and seatings.
2. Inflate the innertube until it is just rounded out, dust with French chalk and insert it in the cover with the white spots near the cover bead coinciding with the black spots on the tube.
3. Fit the protection flap, starting at the valve position. Make sure that the edges of the flap

are not turned over inside the cover and that it lies centrally between the beads. See that the flap fits closely against the tube round the valve.

4. Lay the studded half of the wheel on the floor or bench with the studs pointing upwards. Fit the cover over the wheel and thread the valve through the hole, making sure that it points downwards.
5. Fit the other half of the wheel and tighten the clamping nuts lightly. Finally tighten the nuts in the sequence illustrated. Check that the valve is free and inflate the tyre to the recommended pressure.

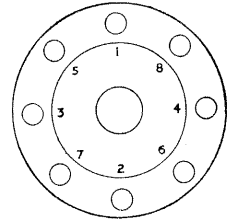


Fig. S-3—  
Tightening sequence

**Wheel and tyre****To balance****Operation S/10**

Wheel and tyre units are accurately balanced on initial assembly with the aid of small weights secured to the inner side of the wheel slot flanges by means of set bolts. In the interests of smooth riding and even tyre wear, it is advantageous to check the balance whenever a tyre is refitted, on suitable proprietary equipment.

### DEFECT LOCATION

(Symptom, Cause and Remedy)

#### A—EXCESSIVE WEAR ON FRONT TYRES

1. Tyres under-inflated—Refer to "Recommended Tyre Pressures".
2. Tyre positions not changed regularly—Change every 3,000 miles (5,000 Km)
3. Incorrect toe-in—Section G.
4. Harsh or unnecessary use of brakes—In the hands of the operator.
5. Incorrectly adjusted brakes—Section H.
6. Eccentric brake drum—Section H.
7. Front wheels or tyres out of balance—Rebalance the wheel assembly.

#### B—RATTLES FROM FRONT WHEELS

1. Loose wheel bearings—Adjust and examine for damage. Section F.
2. Broken wheel bearings—Renew. Section F.
3. Brake shoes or anchor plate loose—Check and retighten. Section H.

#### C—SQUEAKS FROM FRONT WHEELS

1. Wheel stud nuts loose—Examine studs for damage and tighten.
2. Lack of lubrication to front wheel bearings—See Section F.
3. Front wheel bearings adjusted too tightly—Adjust and examine for damage.
4. Damaged front wheel bearings—Renew. Section F.

#### D—OTHER NOISES FROM THE FRONT WHEELS

1. Variation in tread surface due to patch or damage—Renew outer cover.
2. Type or condition of tyre tread giving a noise similar to gear growl—Renew with tyres of the recommended type.
3. Under-inflated tyres also giving a noise similar to gear growl—Inflate to the pressures recommended.
4. Foreign body embedded in tyre—Extract the embedded matter and repair the tyre as necessary.
5. Wear in differential—Section F.

#### E—OVERHEATING OF FRONT WHEEL BEARINGS

1. Insufficient lubricant—See Section F.
2. Use of a poor quality or incorrect grade of lubricant—Replenish.
3. Front wheel bearings adjusted too tightly—The end-float in the front hub bearings must be correct. Adjust and examine for damage. Section F.
4. Damaged front wheel bearings—Renew. Section F.
5. Heat transfer from brake drums due to dragging brakes—Adjust. Section H.
6. Excessive use of the brakes—In the hands of the operator.
7. Foreign matter in the bearings—Clean and renew bearings.

#### F—EXCESSIVE WEAR ON REAR TYRES

1. Under-inflated tyres—Refer to "Recommended Tyre Pressures".
2. Rear wheels out of alignment—Check that the rear spring centre dowel is not sheared. Check for a broken rear spring main leaf. Check for a damaged chassis frame. Rectify.
3. Rear wheel run-out or wobble—Check for loose wheel nuts. Check for a damaged wheel or incorrectly fitted tyres. Rectify.
4. Harsh and unnecessary use of brakes or high speed driving—In the hands of the operator.
5. Wheels or tyres out of balance—Rectify.

#### G—REAR WHEEL NOISE

1. Wheel hub nuts or drum studs loose—Rectify.
2. Interference of brake drum with brake shoes—Check the shoes for damage or warping and rectify. Check the brake drum for scoring. Rectify or renew.
3. Brake back plate loose—Rectify. Check shoes and drum for damage.
4. Type or condition of tyre tread—Renew with suitable tyres.
5. Wear in the differential—Section E.

# Section T — EXTRA EQUIPMENT — ALL MODELS

## INDEX

	Page		Page
Alternator 12v. A.C.		Hand throttle—2 litre Petrol	
Fitment ....	T-60	Fitment ....	T-41
Service ....	T-63	Heater unit and demister tubes	
Centre power take-off		Unit fitment—2 litre Petrol ....	T-50
Fitment ....	T-3	Unit fitment—2½ litre Petrol, Diesel ....	T-52
Overhauling		Demister fitment ....	T-52
Selector unit ....	T-5	Locking door handles—all models	
Drive unit ....	T-6	Fitment ....	T-65
Data ....	T-79	Oil cooler—all models	
Defect location ....	T-79	Fitment ....	T-42
Engine governor—Petrol models only		Oil temperature gauge	
Fitment ....	T-11, 15	Removal ....	T-76
Setting governor control linkage	T-14, 17	Fitment ....	T-76
Checking engine speed with governor		Pump	
in position ....	T-14, 17	Removal ....	T-76
Points to check if governor surges	T-14, 17	Dismantling ....	T-76
Removal ....	T-15	Checking component parts for wear	T-78
Extra windscreen wiper—all models		Assembling ....	T-78
Fitment ....	T-66	Power take-off gears	
Fire fighting equipment—Petrol models only		To transpose ....	T-9
To pump from first aid tank ....	T-69	Propeller shaft joint cover plates	
To pump from static water supply ....	T-70	Fitment ....	T-54
To pump from a hydrant or gravity feed		Rear drive pulley—all models	
supply ....	T-70	Fitment ....	T-9
To temporarily stop output ....	T-72	Overhauling ....	T-9
To stop pumping ....	T-72	Rear seats—all models	
Frost precautions ....	T-72	Fitment ....	T-65
Periodic checks ....	T-72	Rear power take-off	
First aid hose reel		Fitment ....	T-6
Removal ....	T-76	Overhauling ....	T-8
Fitment ....	T-76	Reel support and first aid tank	
Flashing indicators—all models		Removal ....	T-76
Fitment ....	T-55	Fitment ....	T-76
Service ....	T-57	Spare wheel carrier on bonnet, all models	
Front capstan winch—all models, mechanical		Fitment ....	T-66
Fitment ....	T-18	Three-quarter length hood—all models	
Overhauling ....	T-19	Fitment ....	T-67
Front winch, hydraulic, all models		Towing attachments—all models	
Fitment ....	T-22	Fitment ....	T-67
Overhauling ....	T-29	Trailer plug and socket	
Full length hood—all models		Fitment ....	T-57
Fitment ....	T-67	Vacuum or pressure gauge	
Governor control cable, inner		Removal ....	T-76
Removal ....	T-73	Fitment ....	T-76
Fitment ....	T-73	Ventilator flyscreens	
Hand speed control—2½ litre Petrol		Fitment ....	T-69
Fitment ....	T-41	Water temperature and oil pressure gauge—	
		all models	
		Fitment ....	T-48

## LIST OF ILLUSTRATIONS

Fig.		Page	Fig.		Page
T-1	Installation of centre power take-off, early type selector .....	T-3	T-39	Checking worm wheel position .....	T-33
T-2	Cutting and drilling inspection panel, early type .....	T-3	T-40	Winch gearbox .....	T-34
T-3	Drilling the heel board, late type selector .....	T-3	T-41	Hydraulic motor .....	T-34
T-4	Layout of gearbox drive unit and centre pulley .....	T-4	T-42	Assembly sleeve .....	T-35
T-5	Installation of centre power take-off unit, late type selector .....	T-5	T-43	Tank and pipes .....	T-36
T-6	Cross-section of gearbox drive unit and centre pulley .....	T-5	T-44	Pump in position .....	T-37
T-7	Rear power take-off propeller shaft centre bearing assembly.....	T-6	T-45	Hydraulic pump .....	T-37
T-8	Layout of rear power take-off unit .....	T-7	T-46	Assembly sleeve .....	T-38
T-9	Rear power take-off and drive pulley .....	T-7	T-47	Control valve in position .....	T-38
T-10	Cross-section of rear power take-off .....	T-8	T-48	Control valve .....	T-39
T-11	Cross-section of rear pulley unit .....	T-10	T-49	Relief and unloader valve .....	T-39
T-12	Layout of rear pulley unit.....	T-11	T-50	Supply tank .....	T-40
T-13	Installation of engine governor .....	T-12	T-51	Tank fitting .....	T-40
T-14	Layout of engine governor—2 litre Petrol .....	T-13	T-52	Layout of hand throttle—2 litre Petrol .....	T-41
T-15	Layout of engine governor—2½ litre Petrol .....	T-16	T-53	Layout of engine hand speed control .....	T-42
T-16	Rivnut ready for fitting .....	T-18	T-54	Layout of oil cooler—2 litre Petrol .....	T-43
T-17	Rivnut fittings .....	T-18	T-55	Location and drilling of tapping plates .....	T-44
T-18	Layout of front capstan winch .....	T-20	T-56	Additional drillings in grille panels .....	T-44
T-18A	Drilling heel board for selector unit.....	T-23	T-57	Layout of oil cooler—2½ litre Petrol and Diesel models .....	T-45
T-19	Control valve adaptors and unions .....	T-23	T-58	Installation of oil cooler—2 litre Petrol .....	T-46
T-20	Reservoir fixing holes—88 models .....	T-24	T-59	Installation of oil cooler—2½ litre Petrol and Diesel models .....	T-47
T-21	Drilling hole in L.H. rear wheel arch box .....	T-24	T-60	Water temperature and oil pressure gauge—2 litre Petrol .....	T-48
T-22	Position of hole in L.H. body side panel .....	T-24	T-61	Water temperature and oil pressure gauge—2½ litre Petrol and Diesel models .....	T-49
T-23	Reservoir fixing holes—109 models.....	T-25	T-62	Layout of heater unit—2 litre Petrol .....	T-51
T-24	Drilling hole in L.H. rear wheel arch .....	T-25	T-63	Layout of heater unit—2½ litre Petrol and Diesel models .....	T-53
T-25	Position of hole in L.H. rear wheel arch .....	T-25	T-64	Propeller shaft joint cover plates .....	T-54
T-26	Layout of pipes and clips—88 models .....	T-25	T-65	Cover plates in position .....	T-54
T-27	Layout of pipes and clips—109 models .....	T-26	T-66	Position of flasher mounting brackets .....	T-55
T-28	Pipe fitting sequence .....	T-26	T-67	Flasher wiring diagram, late type .....	T-57
T-29	Pipe clip positions .....	T-27	T-68	Additional drillings in front wings .....	T-57
T-30	Layout of hydraulic winch equipment .....	T-29	T-69	Flasher and trailer plug wiring diagrams .....	T-58
T-31	Winch gearbox .....	T-30	T-70	Alternator layout .....	T-60
T-32	Winch on tubular stand .....	T-30	T-71	Charging circuit .....	T-61
T-33	Layout of hydraulic winch .....	T-31	T-72	Harness connections .....	T-62
T-34	Worm shaft fitting .....	T-32	T-73	Alternator charging circuit .....	T-64
T-35	Checking worm shaft end-float .....	T-32	T-74	Bonnet panel carrier dimensions .....	T-66
T-36	Brake drum assembly .....	T-33	T-75	Towing attachments .....	T-68
T-37	Drum shaft bearing and oil seal .....	T-33	T-76	Flow chart, fire tender .....	T-70
T-38	Worm wheel, key and drum shaft .....	T-33	T-77	Pump and controls .....	T-71
			T-78	Arrangement of governor control .....	T-73
			T-79	Exploded view of pump .....	T-74
			T-80	Sectioned view of pump .....	T-77

## Centre power take-off

To fit

Operation T/2

## Early type selector

1. Remove the centre inspection panel from the seat box.
2. Remove the top cover plate complete with joint washer from the transfer casing.
3. Remove the mainshaft rear bearing housing assembly and joint washer from the rear of the transfer casing.

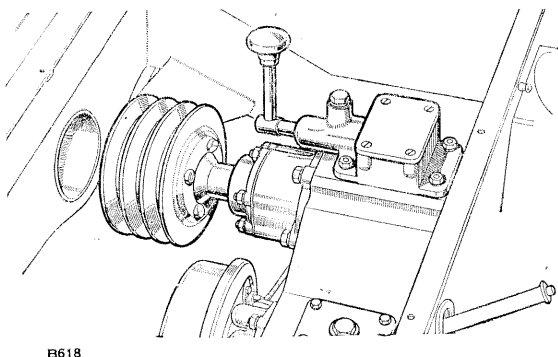


Fig. T-1—Installation of centre power take-off unit, early type

4. Fit the power take-off drive unit assembly and joint washer to the rear of the transfer casing with the oil drain hole in the housing at the bottom.

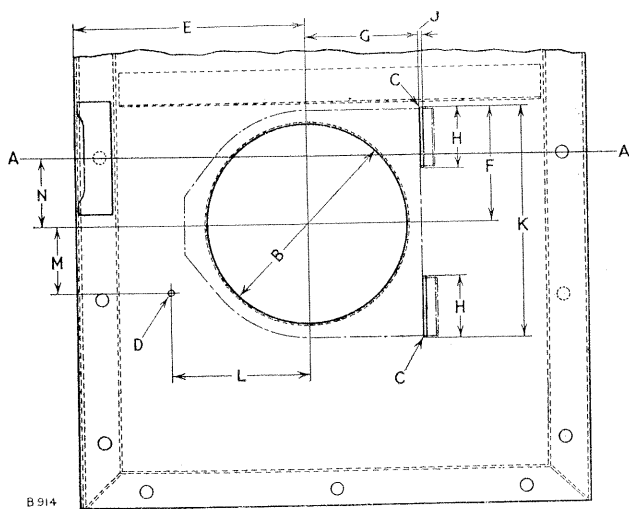


Fig. T-2—Cutting and drilling seat box centre inspection panel, early type

- |                                  |                                  |
|----------------------------------|----------------------------------|
| AA—Centre line of body.          | G—4 in. (101 mm).                |
| B—7 in. (177 mm).                | H—2 $\frac{1}{16}$ in. (52 mm).  |
| C—Two slots as shown.            | J— $\frac{1}{8}$ in. (3 mm).     |
| D—One hole .204 in. (5 mm).      | K—8 $\frac{1}{16}$ in. (205 mm). |
| E—7 $\frac{1}{16}$ in. (201 mm). | L—4 $\frac{3}{8}$ in. (120 mm).  |
| F—4 $\frac{1}{32}$ in. (104 mm). | M—2 $\frac{1}{4}$ in. (57 mm).   |
|                                  | N—2 $\frac{1}{2}$ in. (63 mm).   |

5. Fit the power take-off selector assembly and joint washer to the top face of the transfer casing; ensure that the selector fork engages with the dog clutch on the drive shaft.

6. Mark out and cut one hole 7 in. (177 mm) diameter and two slots  $\frac{1}{8}$  in. (3 mm) wide and 2  $\frac{1}{16}$  in. (52 mm) long, and drill one hole .204 in. (5 mm) diameter in the panel as illustrated in Fig. T-2.

7. Rivet the cover retaining clip to the panel by means of the rivet and the plain washer, which should be placed between the clip and the panel. Engage the tongues of the cover in the slots cut in the panel.

8. Replace the seat box inspection panel.

## Late type selector

9. Remove the centre seat panel and the seat retaining bollard.
10. Mark off the heel board as illustrated and drill a  $\frac{3}{4}$  in. (19 mm) dia. hole. Fit a grommet to the hole, then replace the bollard.

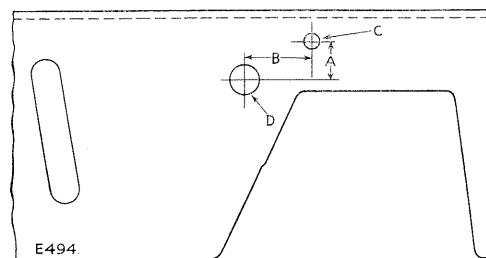


Fig. T-3—Drilling the heel board, late type selector

- |   |
|---|
| A—1.187 in. (30 mm)                         |
| B—1.968 in. (50 mm)                         |
| C—Hole for seat strap retaining bolt        |
| D— $\frac{3}{4}$ in. (19 mm) diameter hole. |

11. Remove the mainshaft rear bearing housing assembly and the joint washer from the rear of the transfer box casing. Remove the top cover plate and joint washer complete from the transfer box casing.
12. Remove the bearing housing fixing stud from the L.H. side top corner on the transfer box casing.
13. Fit the power take-off assembly and joint washer to the rear of the transfer casing with the oil drain hole in the housing at the bottom.
14. Secure the power take-off unit in position, using the new stud supplied in place of the one removed at item 12.
15. Fit the selector unit and joint washer to the top face of the transfer box casing, and ensure that the selector fork engages the dog.
16. Attach the link rod to the operating lever before fitting to the selector unit, using a clevis pin, spring and split pin. If fitted, remove the knob and locknut from the link rod.
17. Pass the link rod and lever through the grommeted hole in the heel board and attach the lever to the selector shaft on the selector unit, and to the stud on the transfer box casing. Use a locknut on the stud. Refit the knob, and secure with a locknut to the link rod.



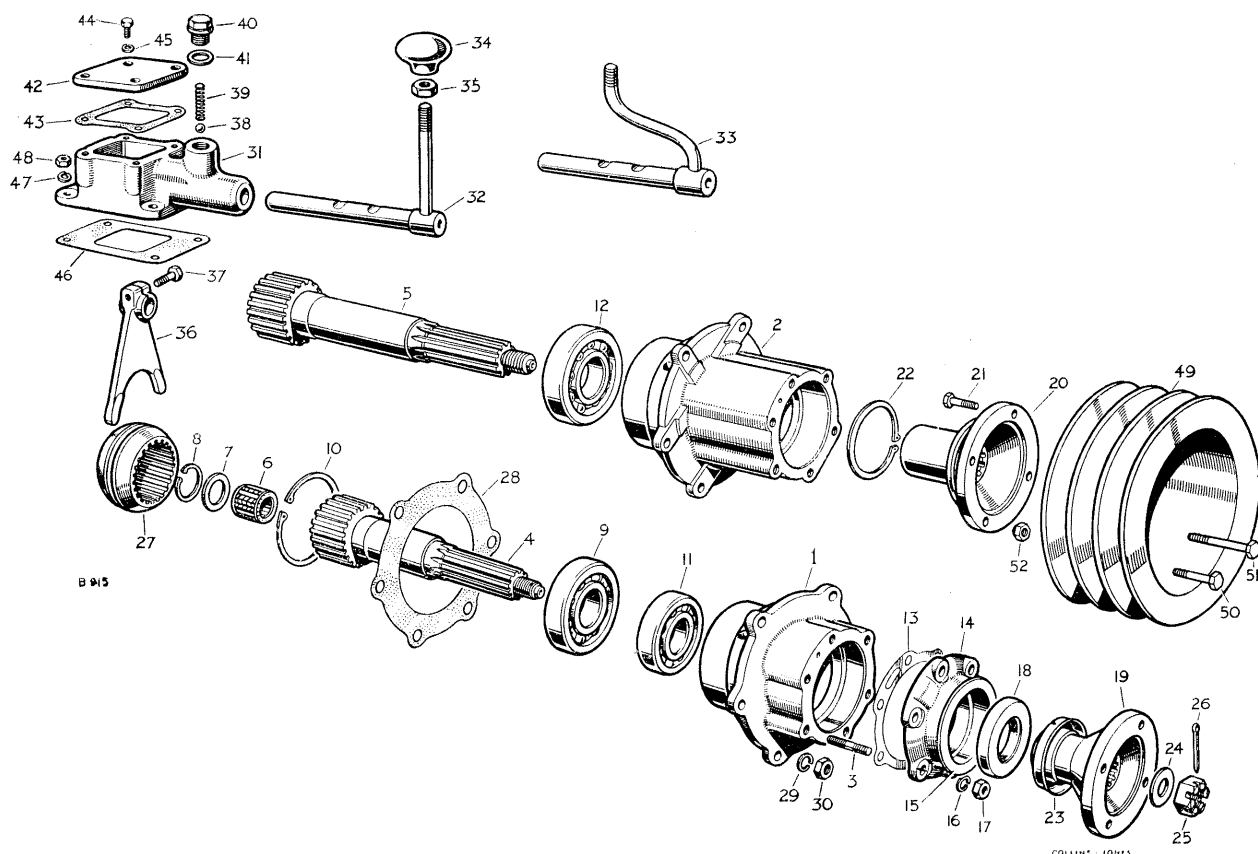


Fig. T-4—Layout of gearbox drive unit and centre pulley (early type illustrated)

- |       |   |       |  |
|-------|---|-------|--|
| 1     | Housing assembly for drive bearing              | 24-26 | Fixings for flange                             |
| 2     | Housing assembly for drive bearing (heavy duty) | 27    | Dog clutch for P.T.O. shaft                    |
| 3     | Stud for oil seal housing                       | 28    | Joint washer for housing                       |
| 4     | Shaft for P.T.O. drive                          | 29-30 | Fixings for housing                            |
| 5     | Shaft for P.T.O. drive (heavy duty)             | 31    | Housing for P.T.O. selector                    |
| 6     | Bearing for gearbox mainshaft                   | 32    | Selector shaft and rod for P.T.O.              |
| 7     | Retaining plate for bearing                     | 33    | Selector shaft for rod and P.T.O. (heavy duty) |
| 8     | Circlip fixing retaining plate                  | 34    | Knob for rod                                   |
| 9     | Bearing for drive shaft, front                  | 35    | Locknut for knob                               |
| 10    | Circlip, bearing to housing                     | 36    | Fork for selector shaft                        |
| 11    | Bearing for drive shaft, rear                   | 37    | Set bolt fixing fork to shaft                  |
| 12    | Bearing for drive shaft, rear (heavy duty)      | 38    | Steel ball                                     |
| 13    | Shim for bearing                                | 39    | Spring   |
| 14    | Housing for oil seal                            | 40    | Plug for spring                                |
| 15    | Mudshield for housing                           | 41    | Joint washer for plug                          |
| 16-17 | Fixings for oil seal housing                    | 42    | Cover plate for housing                        |
| 18    | Oil seal for drive shaft                        | 43    | Joint washer for plate                         |
| 19    | Flange for P.T.O. drive shaft                   | 44-45 | Fixings for plate                              |
| 20    | Flange for P.T.O. drive shaft                   | 46    | Joint washer for housing                       |
| 21    | Bolt for flange                                 | 47-48 | Fixings for housing                            |
| 22    | Circlip retaining bolts                         | 49    | Pulley for centre power take-off               |
| 23    | Mudshield for flange                            | 50-52 | Fixings for pulley                             |

18. Check for free movement of the control and lock the locknut on the stud about which the operating lever pivots. Replace the seat panel.

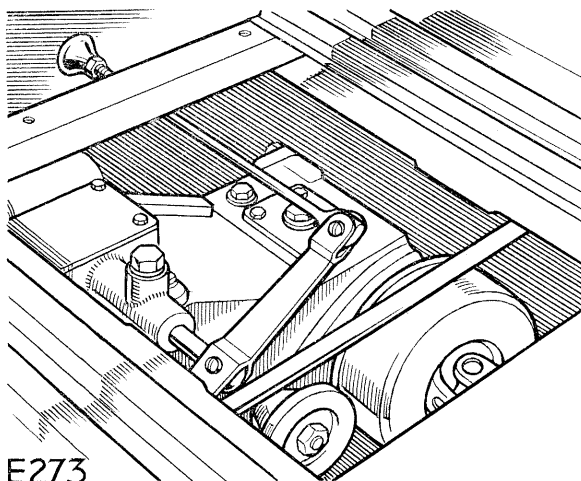


Fig. T-5—Installation of centre power take-off unit, late type selector

## 2 litre petrol models

The centre power take-off must only be used in conjunction with an engine governor. Operation T/16.

### To overhaul

### Operation T/4

1. Remove the centre inspection panel from the seat box.
2. Slacken the adjustment and remove the driving belts; identify the belts so that they may be replaced in their original grooves.
3. Withdraw the driving pulley from the drive shaft flange.
4. Remove the selector assembly complete with a joint washer from the top of the transfer casing.
5. Remove the drive unit complete with a joint washer and dog clutch from the rear face of the transfer casing.

Strip the units as follows:—

### Selector unit

6. Remove the brass plug and joint washer from the top of the selector housing and lift out the selector spring and ball.

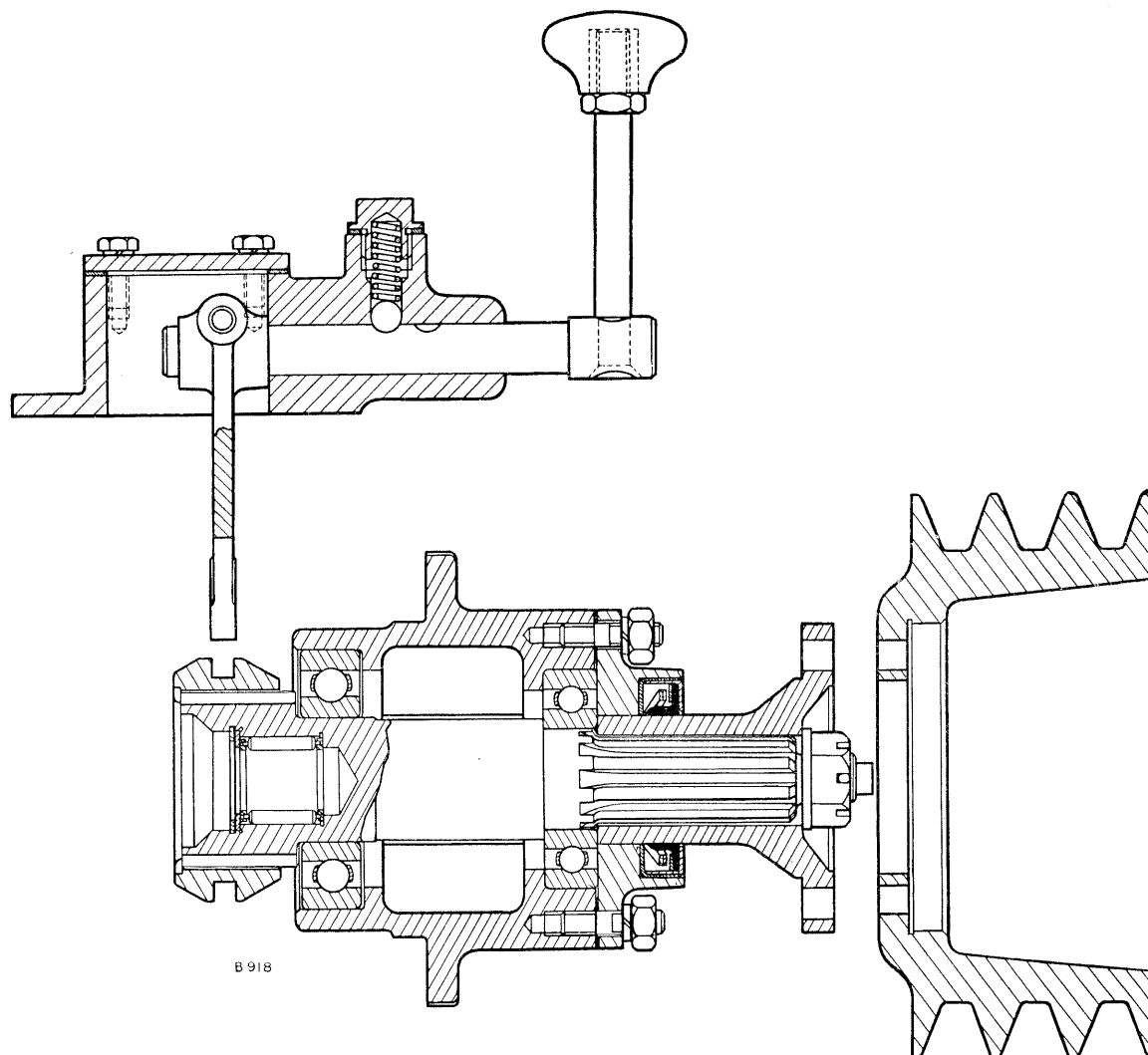


Fig. T-6—Cross-section of gearbox drive unit and centre pulley, (early type illustrated)

7. Remove the housing cover plate and joint washer.
8. Withdraw the shaft and selector fork from the housing.
9. If necessary, remove the knob and locknut from the selector shaft.

#### Drive unit

10. Slide the dog clutch off the power take-off shaft.
11. Grip the gearbox end of the shaft in a soft-jawed vice; remove the driving flange.
12. Remove the oil seal housing from the drive housing together with shims (if fitted) which should be preserved. Drift out the oil seal from the housing.
13. Remove the unit from the vice. Remove the circlip retaining the drive shaft front bearing; place the protection cap (Part No. 243241) on the threaded portion of the shaft and drive out the shaft from the housing. Drift the rear bearing from the housing.
14. Remove the internal circlip from the bore of the shaft and lift out the plain retaining washer and the gearbox mainshaft bearing.
15. Renew any worn parts and reassemble by reversing the stripping procedure, paying particular attention to the following points:—

#### Selector unit

16. Assemble by reversing the stripping procedure.

#### Drive unit

17. The front (large) ball bearing must be a *light drive fit* on the shaft and in the housing.
18. The rear ball bearing must be a *light drive fit* on the shaft and in the housing.
19. The oil seal must be replaced with its knife edge inwards and with the plain face flush with the lower edge of the chamfer in the seal retainer. When fitting the retainer to the drive housing, the oil drain slot in the retainer must be in line with the drain hole in the housing.
20. The end-float of the shaft must be adjusted to nil on assembly by means of shims between the oil seal retainer and drive housing; these shims are available .003 in. and .005 in. (0.07 mm and 0.12 mm) thick.
21. The dog clutch must be fitted with its recessed end towards the gearbox.
22. Refit the drive unit. Operation T/2.

#### Rear power take-off

##### To fit

##### Operation T/6

1. If not already fitted, install the power take-off drive and selector units on the transfer casing. Operation T/2.
2. **88 models:** Secure the propeller shaft to the input flange of the rear take-off unit with the sliding joint at the front.

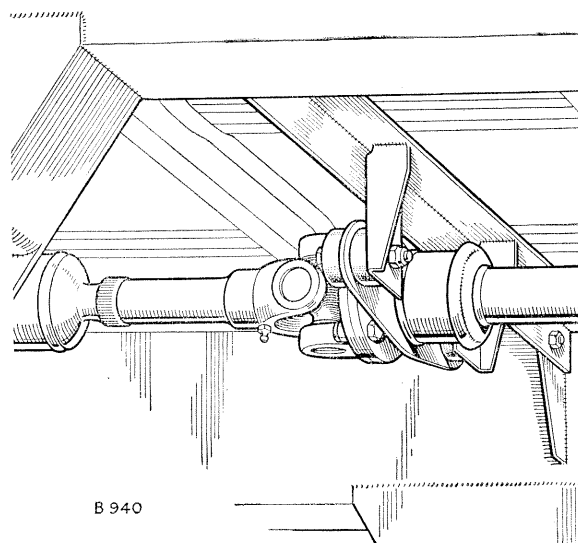


Fig. T-7—  
Rear power take-off propeller shaft centre bearing  
assembly—109 models only

Pass the sliding joint end of the propeller shaft forwards through the holes provided in the rear and centre chassis cross-members. Secure the power take-off unit to the rear cross-member, with the fixings provided.

Secure the front end of the propeller shaft to the flanged drive shaft on the gearbox.

If a centre power take-off pulley is also fitted, four bolts  $1\frac{3}{8}$  in. (43 mm) long must be used to secure the propeller shaft.

3. **109 models only.** Secure the cross-member intermediate bearing support to the brackets welded to the chassis side members, using the bolts, spring washers and nuts provided. (Fig. T-7.)

Pass the universal joint end of the front propeller shaft forward through the hole provided in the centre chassis cross-member, and secure the front end of the shaft to the flanged drive shaft on the gearbox.

Secure the centre bearing housing to the cross-member intermediate bearing support by means of the rubber bushes, bolts, nuts, plain and spring washers provided.

When tightened, the rubber bushes on the centre bearing housing are compressed to a length of  $1\frac{1}{2}$  in. (38 mm); the bearing housing flange must be adjusted by means of shims which are supplied .048 in. thick, so that it lies centrally in the rubber bushes.

Secure the rear end of the rear propeller shaft to the input flange of the rear take-off unit, with the sliding joint at the front.

Pass the sliding joint end of the propeller shaft forward through the holes provided in the rear and No. 5 (front bumper is No. 1 cross-member) cross-members and secure the power take-off unit to the rear cross-member with the fixings provided.

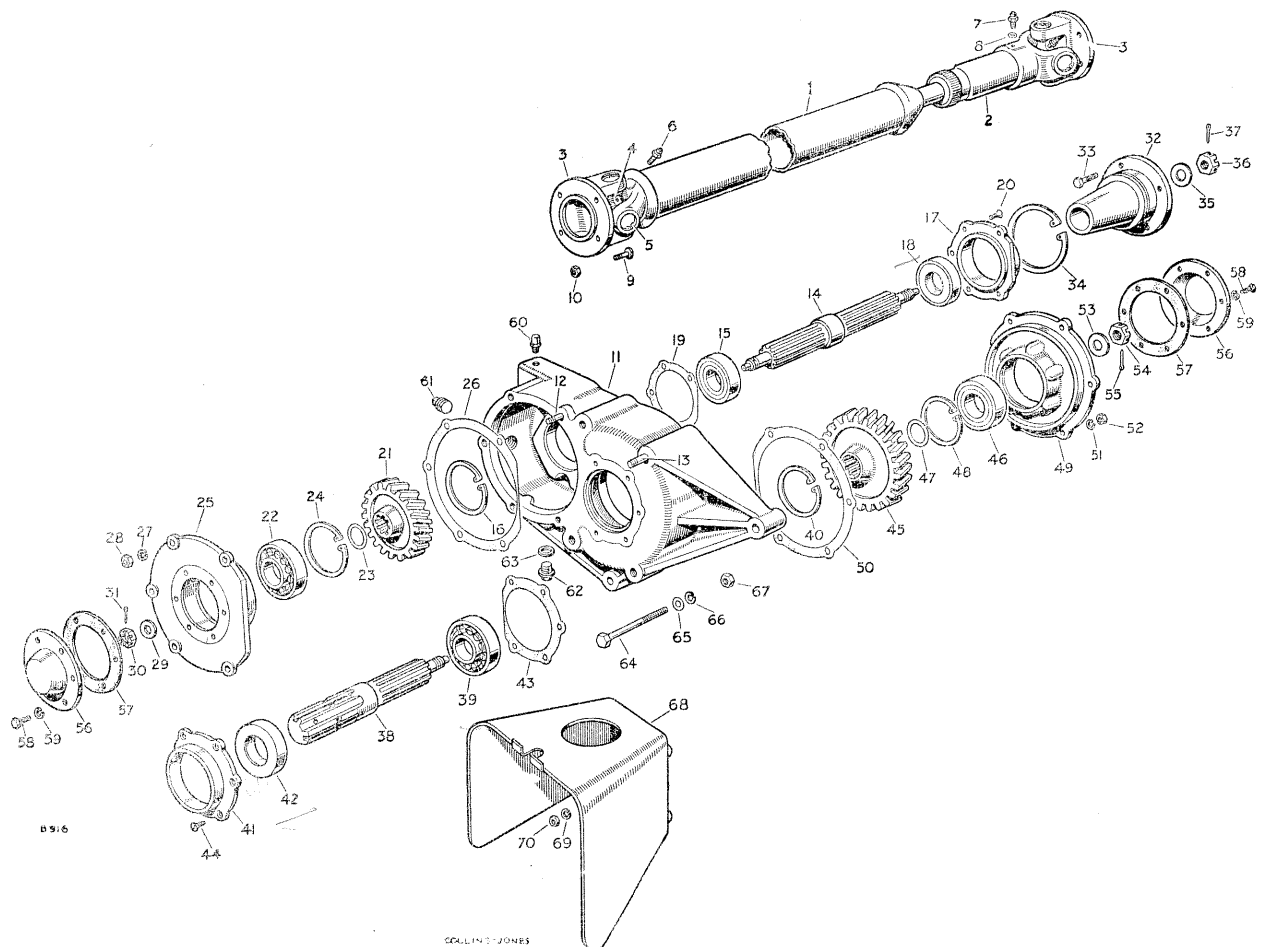


Fig. T-8—Layout of rear power take-off unit

- |       |  |       |  |
|-------|--|-------|--|
| 1     | Propeller shaft, P.T.O. drive                        | 33    | Special bolts for propeller shaft      |
| 2     | Splined end  | 34    | Circlip retaining bolts to flange      |
| 3     | Flange   | 35-37 | Fixings for flange                     |
| 4     | Journal complete for propeller shaft                 | 38    | Output shaft for P.T.O. 6-spline       |
| 5     | Circlip for journal                                  | 39    | Bearing for output shaft, rear         |
| 6     | Grease nipple for journal                            | 40    | Circlip for bearing                    |
| 7     | Grease nipple for propeller shaft, .250" (6 mm) dia. | 41    | Retainer for oil seal                  |
| 8     | Washer for nipple                                    | 42    | Oil seal                               |
| 9-10  | Fixings for propeller shaft                          | 43    | Joint washer for retainer              |
| 11    | Housing assembly for P.T.O.                          | 44    | Screw fixing retainer                  |
| 12    | Stud for bearing housing                             | 45    | Gear wheel, 24 teeth                   |
| 13    | Stud for pulley housing or guard                     | 46    | Bearing for output shaft, front        |
| 14    | Input shaft for P.T.O.                               | 47    | Shim, for front output shaft bearing   |
| 15    | Bearing for input shaft, front                       | 48    | Circlip, bearing to housing            |
| 16    | Circlip, bearing to housing                          | 49    | Housing for output shaft front bearing |
| 17    | Retainer for oil seal                                | 50    | Joint washer for bearing housing       |
| 18    | Oil seal   | 51-52 | Fixings for bearing housing            |
| 19    | Joint washer for retainer                            | 53-55 | Fixings for front bearing              |
| 20    | Screw fixing retainer                                | 56    | Cover plate for bearings               |
| 21    | Gear wheel, 20 teeth                                 | 57    | Joint washer for cover plate           |
| 22    | Bearing for input shaft, rear                        | 58-59 | Fixings for cover                      |
| 23    | Shim for rear input shaft bearing                    | 60    | Breather for casing                    |
| 24    | Circlip, bearing to housing                          | 61    | Filler plug                            |
| 25    | Housing for rear input shaft bearing                 | 62    | Drain plug for casing                  |
| 26    | Joint washer for rear bearing housing                | 63    | Fibre washer for plug                  |
| 27-28 | Fixings for bearing housing                          | 64-67 | Fixings for P.T.O. assembly            |
| 29-31 | Fixings for rear bearing                             | 68    | Guard for P.T.O. spline                |
| 32    | Flange for P.T.O. input shaft                        | 69-70 | Fixings for guard                      |

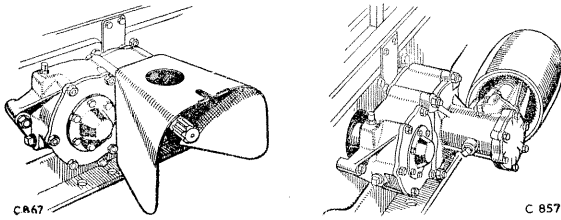


Fig. T-9—Rear power take-off and rear drive pulley

Secure the front end of the rear propeller shaft to the front shaft flange.

4. Fill the unit with oil, 1 pint (0,5 litre).

#### To overhaul

#### Operation T/8

1. **88 models only.** Disconnect the front end of the propeller shaft from the flanged drive shaft on the gearbox.
2. **109 models only.** Disconnect the rear propeller shaft from the front shaft.
3. Remove the unit complete with propeller shaft from the rear chassis cross-member.
4. **109 models only.** Remove the front propeller shaft complete with centre bearing assembly.
5. Disconnect the propeller shaft from the input flange. To overhaul the propeller shafts see Section D.
6. Remove the output shaft guard.
7. Drain off the oil from the take-off and secure it in a vice by means of the input flange.
8. Remove the input shaft rear bearing cover plate and joint washer.
9. Remove the breather.
10. Remove the split pin, castle nut and plain washer securing the input shaft rear bearing; remove the bearing inner race and shims, which should be preserved.
11. Remove the input shaft rear bearing housing complete with circlip and outer race and a joint washer. If necessary, remove the circlip and drift the race from the housing.
12. Withdraw the 20-tooth gear and front inner race from the input shaft.
13. Lift off the complete unit from the input shaft and set aside.
14. Remove the external circlip retaining the propeller shaft bolts in the input flange and remove the bolts. Remove the split pin, castle nut and plain washer securing the flange to the shaft and drift the flange from the shaft.
15. Secure the complete unit in a soft-jawed vice by means of the output shaft.
16. Remove the input shaft oil seal retainer complete with oil seal and joint washer. Drift the seal from the retainer.

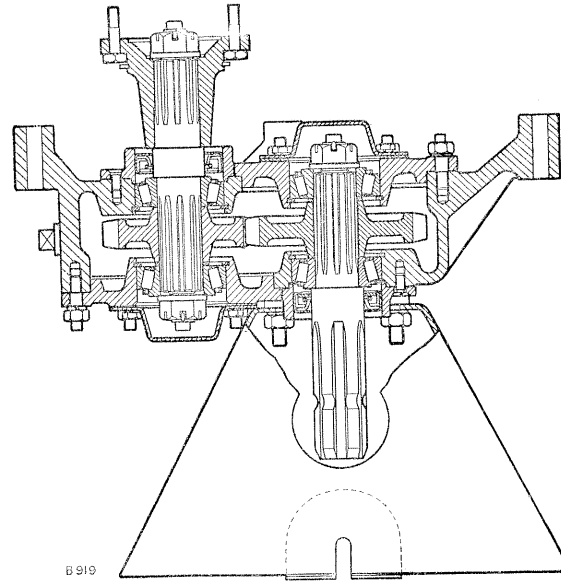


Fig. T-10—Cross-section of rear power take-off unit

17. Remove the output shaft front bearing cover plate and joint washer.
18. Remove the split pin, castle nut and plain washer securing the output shaft front bearing; remove the bearing inner race and shims, which should be preserved.
19. Remove the output shaft front bearing housing complete with circlip and outer race and a joint washer. If necessary, remove the circlip and drift the race from the housing.
20. Withdraw the 24-tooth gear and rear inner race from the output shaft.
21. Lift off the power take-off housing, leaving the output shaft in the vice.
22. Remove the output shaft oil seal retainer complete with oil seal and joint washer. Drift the seal from the retainer.
23. To remove the bearing outer races remaining in the housing, remove the two internal circlips, heat the housing in water and tap out the races.
24. Wash all the component parts thoroughly and lay them out for inspection. Renew all joint washers and split pins.
25. Check all the bearings for wear and damage and renew them as necessary.
26. Check the gears for damage marks and rectify or renew as necessary; the gears must only be replaced as a pair.
27. Examine the housings for signs of damage or cracks and renew them as necessary. A housing may also be scrap as a result of excessive wear in a bearing bore; such wear will be obvious during the course of assembly.

28. Assemble the unit by reversing the stripping procedure, paying particular attention to the following points:—
29. The two bearing outer races must be a *warm tap fit* in the take-off housing.
30. The other bearing outer races must be a *light drive fit* in the bearing housings.
31. The bearing inner races must all be an *easy tap fit* on the input and output shafts.
32. The backlash between the gears must be .008 in. to .012 in. (0,20 to 0,30 mm).
33. The recess in the splined bore in each gear must be fitted adjacent to the centre flange on each shaft. The input shaft gear must be fitted on the longer end of the shaft.
34. Each oil seal must be pressed into its retainer until the plain face is approximately  $\frac{5}{16}$  in. (8 mm) below the outer face of the retainer.
35. When replacing the shafts, a piece of shim steel or stiff paper should be wrapped round the shaft splines, to prevent damage to the oil seals.
36. Adjust the bearings in the following manner:—
  - (a) When both shafts are in position with the castle retaining nuts pulled up tightly, tap both ends of each shaft to settle the bearings.
  - (b) Rotate each shaft in turn; it should turn quite freely, but no end-float must be present. Adjustment to achieve this condition is provided by the shims adjacent to the bearing inner race which are available .005 in., .010 in. and .020 in. (0,12 mm., 0,25 mm and 0,50 mm) thick. To reduce the end-float, shims must be removed; if the bearings have too much interference, suitable shims must be added to bring the setting correct.

#### Power take-off gears

##### To transpose

##### Operation T/10

1. Remove the rear pulley unit (if fitted).
2. Drain off the oil from the take-off unit.
3. Remove the take-off unit from the chassis frame.
4. Remove the input shaft cover plate.
5. Remove the split pin, castle nut and plain washer from the end of the input shaft.
6. Remove the input shaft bearing housing complete with bearing.
7. Remove and preserve the shims from the input shaft and withdraw the 20-tooth gear.
8. Withdraw the 24-tooth gear from the output shaft in a similar manner.
9. Transpose the gears and reassemble the unit by reversing the stripping procedure.
10. It is most important that the two sets of shims removed be replaced on their original shafts.
11. Refill the unit with oil, 1 pint (0,5 litre).

#### Rear drive pulley

##### To fit

##### Operation T/12

1. Remove the output shaft guard from the rear power take-off casing.
2. Offer the pulley unit to the power take-off by entering the splined output shaft into the pulley sleeve and secure it by means of the nuts and spring washers.
3. Fill the unit with oil,  $\frac{3}{4}$  pint (0,5 litre).
4. It is most important to ensure alignment of the driving belt in the centre of the pulley and also to obtain the correct tension of the belt; the belt tension is correct when the hand brake will hold the vehicle and the two sides of the belt cannot be compressed completely together by hand at a point midway between the vehicle and the driven machine.

##### To overhaul

##### Operation T/14

1. Remove the pulley unit from the rear drive unit.
2. Drain off the oil from the pulley unit.
3. Remove the pulley from the bevel pinion shaft.
4. Remove the pinion shaft housing from the drive housing complete with shims, which should be preserved.
5. Tap the pinion shaft from the housing, complete with one inner race, distance tube and shims, which should be preserved; the second inner race can only be withdrawn after the oil seal is removed. Slide the shims, distance tube and inner race off the pinion shaft.
6. Warm the housing in hot water, drift out the oil seal, remove the second inner race and drift out the outer races.
7. Remove the bevel wheel bearing end plate from the drive housing, complete with the bearing outer race and shims, which should be preserved.  
If desired, the outer race can be removed from the end plate by heating the plate in hot water.
8. Remove the drive shaft and bevel wheel complete with the bearing inner races from the housing.
9. Remove the set bolt and spring washer securing the bevel wheel retaining plate, lift off the plate and cork washer and slide off the bevel wheel complete with an inner race and shims which should be preserved. Drift the inner race from the bevel wheel.
10. Drift the second inner race from the drive shaft and remove the retaining circlip.
11. Warm the drive housing in hot water and drift out the oil seal and outer race.
12. Wash all the component parts thoroughly and lay them out for inspection.

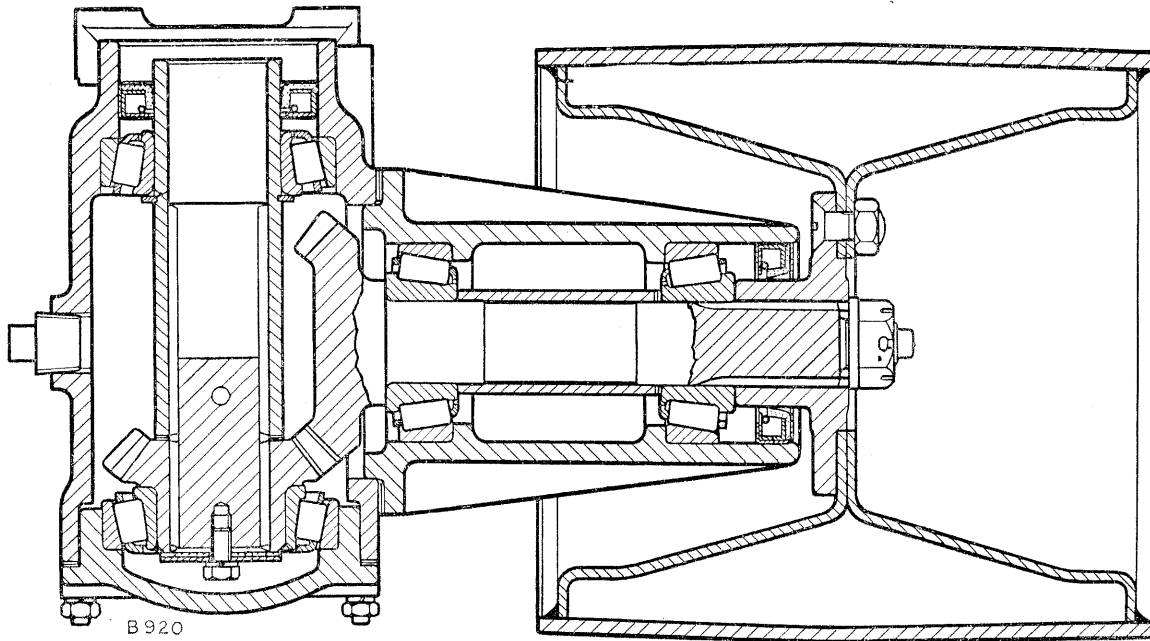


Fig T-11—Cross-section of rear pulley unit

13. Check all the bearings for wear and damage and renew them as necessary.
14. Check the gears for damage marks and rectify or renew them as necessary; the gears must only be renewed as a pair.
15. Examine the housings for signs of damage or cracks and renew them as necessary. A housing may also be scrap as a result of excessive wear in a bearing bore; such wear will be obvious during the course of assembly.
16. Assemble the unit by reversing the stripping procedure, paying particular attention to the following points:—
17. The two drive shaft bearing outer races must be a *warm tap fit* in the drive housing and end plate. The two inner races must be a *light drive fit* on the drive shaft and bevel wheel.
18. The pinion shaft bearing outer races must be a *warm tap fit* in the pinion housing. The inner races must be an *easy tap fit* on the pinion shaft.
19. The drive housing, end cover and pinion housing should be warmed to facilitate fitting the bearing outer races.
20. The small shims (available .005 in., .010 in. and .020 in. (0,12 mm, 0,25 mm and 0,50 mm) thick) behind the bevel wheel, provide adjustment for alignment of the bevel wheel and pinion teeth; the original shims should be correct if the original gears, etc., are replaced.
21. The drive housing oil seal must be fitted with its sealing lip inwards.
22. The drive shaft must be able to turn quite freely, no end-float must be present. Adjustment to achieve this condition is provided by the shims under the end cover, which are available .005 in., .010 in. and .020 in. (0,12 mm, 0,25 mm and 0,50 mm) thick. To reduce the end-float, shims must be removed.
23. The pinion housing oil seal must be fitted just below the housing end face with its sealing lip inwards.
24. Adjust the pinion shaft bearings as follows:—
  - (a) With the pulley fitted and the pinion shaft retaining nut pulled up tightly, tap both ends of the shaft to settle the bearings.
  - (b) Rotate the shaft; it should turn quite freely, but no end-float must be present. Adjustment to achieve this condition is provided by the shims on the shaft between the distance tube and outer bearing, which are available .005 in., .010 in. and .020 in. (0,12 mm, 0,25 mm and 0,50 mm) thick. To reduce the end-float, shims must be removed.
25. The shims between the pinion and drive housings, available .005 in., .010 in. and .020 in. (0,12 mm, 0,25 mm and 0,50 mm) thick, are provided for adjustment of the backlash between the bevel wheel and pinion. There must be definite backlash at all positions of a complete revolution, but this must not exceed .004 in. (0,10 mm) at any point. Excessive backlash can be corrected by removing suitable shims.

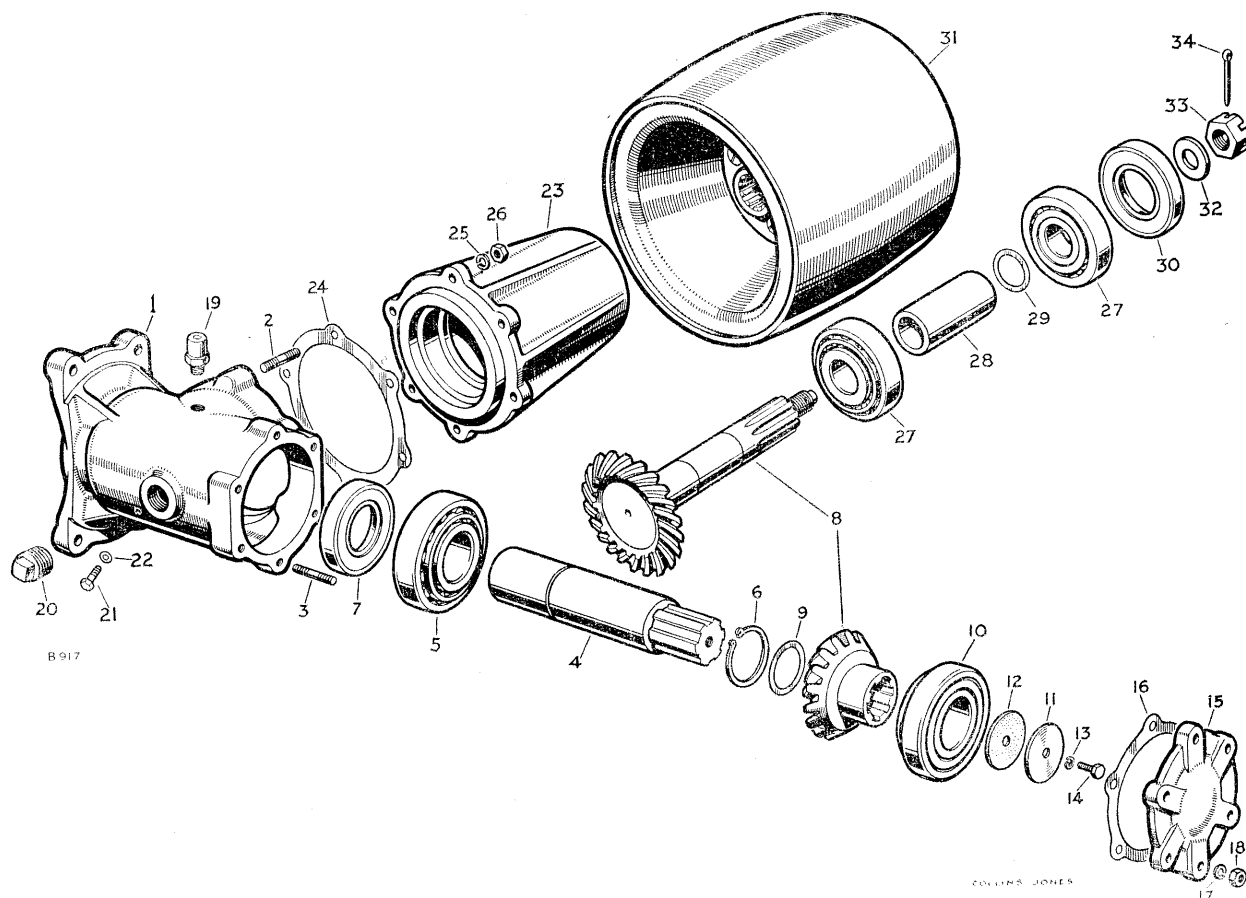


Fig. T-12—Layout of rear pulley unit

- |       |                                    |       |                                      |
|-------|------------------------------------|-------|--------------------------------------|
| 1     | Housing assembly for P.T.O. pinion | 17-18 | Fixings for bearing end plate        |
| 2     | Stud for pulley drive housing      | 19    | Breather for housing                 |
| 3     | Stud for end plate                 | 20    | Filler plug for housing              |
| 4     | Pinion driving sleeve, 6-spline    | 21    | Plug for oil level                   |
| 5     | Bearing for sleeve                 | 22    | Washer for plug                      |
| 6     | Circlip, bearing to sleeve         | 23    | Housing for pulley drive pinion      |
| 7     | Oil seal for driving sleeve        | 24    | Shim for pulley drive pinion housing |
| 8     | Spiral bevel wheel and pinion      | 25-26 | Fixings for pulley drive             |
| 9     | Shim                               | 27    | Bearings for pinion                  |
| 10    | Bearing for bevel wheel            | 28    | Distance tube for bearings           |
| 11    | Retaining plate for bevel wheel    | 29    | Shim for bevel pinion bearings       |
| 12    | Cork washer for retaining plate    | 30    | Oil seal for bevel pinion bearings   |
| 13-14 | Fixings for plate                  | 31    | Pulley                               |
| 15    | End plate for bevel wheel bearing  | 32-34 | Fixings for pulley                   |
| 16    | Shim for bevel wheel end plate     |       |                                      |

**Engine governor—2 litre Petrol****To fit****Operation T/16**

1. Disconnect the bonnet prop rod from the bonnet.
2. Remove the bonnet.
3. Fit the governor bracket support on top of the dynamo support bracket, using the bolt already securing the dynamo bracket. Turn the support to the rear and leave the bolt slack.
4. Fit the governor to the bracket (three bolts and spring washers).
5. Slacken the dynamo adjusting bolt to relieve the tension on the fan belt.
6. Remove the original fan pulley and distance piece from the hub of the water pump spindle, and fit the new double groove pulley and distance piece.
7. Remove the three set bolts securing the thermostat housing and in their places fit the three studs using the existing spring washers.



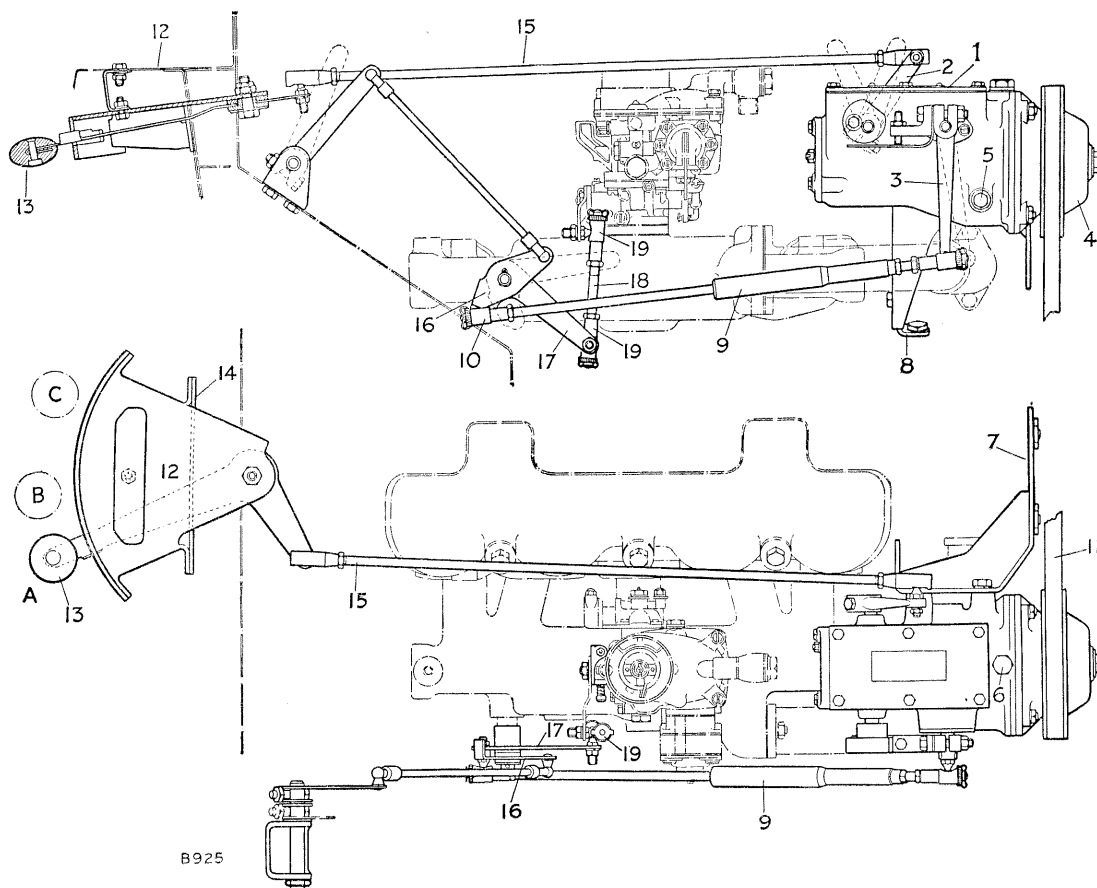


Fig. T-13—Installation of engine governor—2 litre Petrol

A—Inoperative position

B—1,500 R.P.M.

C—3,000 R.P.M.

- |                                  |                                   |
|----------------------------------|-----------------------------------|
| 1 Engine governor                | 11 Drive belt                     |
| 2 Loading lever                  | 12 Control quadrant               |
| 3 Throttle control lever         | 13 Operating lever                |
| 4 Governor pulley                | 14 Draught excluder               |
| 5 Oil level plug                 | 15 Governor operating rod         |
| 6 Oil filler plug                | 16 Relay lever                    |
| 7 Bracket for governor           | 17 Carburettor bell crank         |
| 8 Support for bracket            | 18 Rod, bell crank to carburettor |
| 9 Collapsible control rod        | 19 Adjustable ball joint for rod  |
| 10 Adjustable ball joint for rod |                                   |

8. Readjust the fan belt tension.
9. Place the governor driving belt over the fan pulley and round the governor pulley. Fit the mounting bracket and governor to the extension studs on the front of the thermostat housing, securing the bracket with the three special nuts and shakeproof washers, leaving the nuts slack.
10. Secure the mounting bracket to the support with one bolt, spring washer and nut, leaving the nut slack.
11. Carefully bend the distributor vacuum pipe to clear the governor and bracket.
12. Hold the governor out to tension the belt, (it should be possible to depress the belt  $\frac{1}{2}$  in. (12,5 mm) by thumb pressure midway between the pulleys) and tighten the nuts and bolts holding the governor mounting bracket and support.
13. Check the oil level in the governor, by removing the filler plug at the top front and the level plug at the R.H. side. Replenish as necessary with engine oil through the filler hole until the level is to the bottom of the level plug hole. Replace both plugs.
14. Remove and discard the throttle return spring between the bell crank lever and the anchor on the petrol filter bracket.
15. Remove the cover plate on the dash panel immediately below the instrument panel.

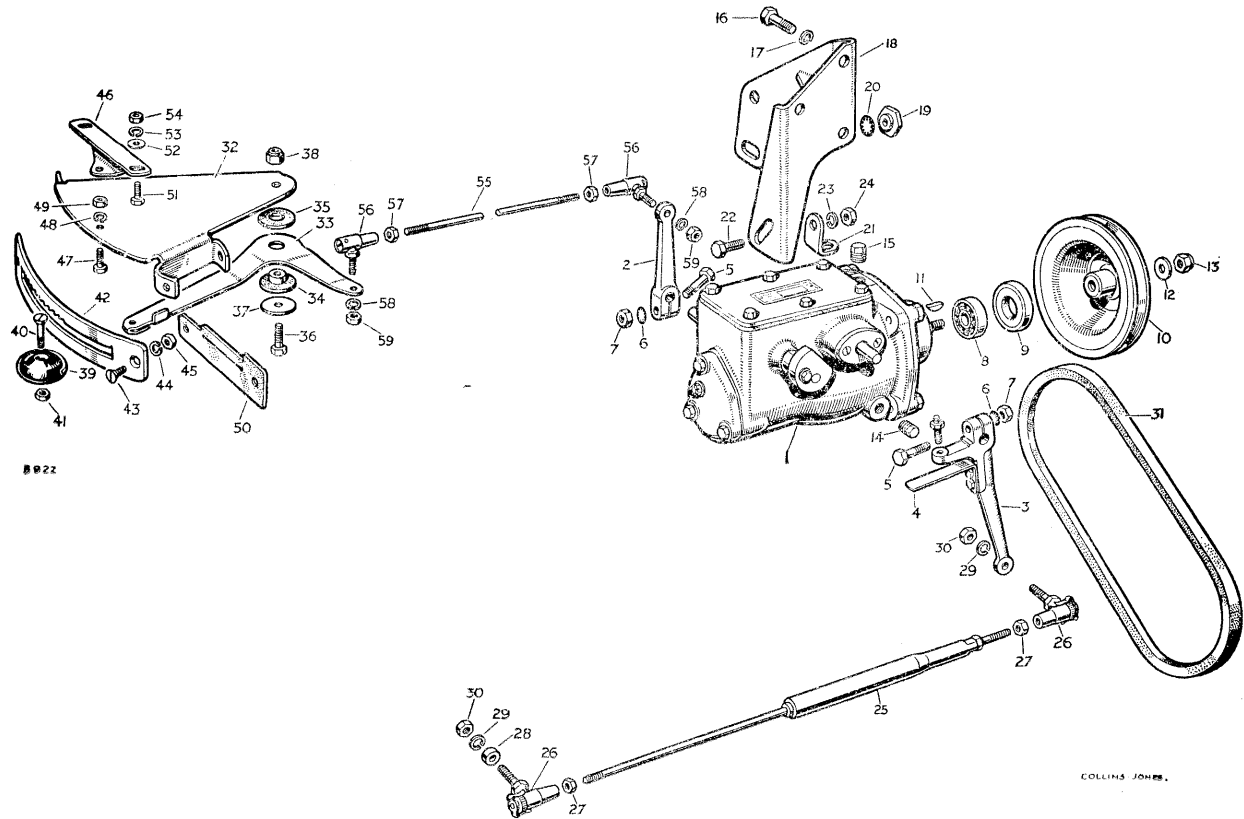


Fig. T-14—Layout of engine governor—2 litre Petrol

- |       |                                     |       |                                       |
|-------|-------------------------------------|-------|---------------------------------------|
| 1     | Engine governor complete            | 28    | Distance piece, bell crank lever end  |
| 2     | Lever, governor to quadrant         | 29-30 | Fixings for rod                       |
| 3     | Lever, grommet to bell crank        | 31    | Belt for governor drive               |
| 4     | Spring blade for bell crank         | 32    | Housing for governor control quadrant |
| 5-7   | Fixings for levers                  | 33    | Lever for control                     |
| 8     | Bearing, large } For engine         | 34    | Bush for lever                        |
|       | Bearing, small } governor           | 35    | Washer for lever                      |
| 9     | Oil seal for pulley end             | 36-38 | Fixings for control lever to housing  |
| 10    | Pulley for governor                 | 39    | Knob for lever                        |
| 11    | Woodruff key for pulley             | 40-41 | Fixings for knob                      |
| 12-13 | Fixings for pulley                  | 42    | Quadrant plate                        |
| 14    | Level plug for governor             | 43-45 | Fixings for quadrant plate            |
| 15    | Filler plug for governor            | 46    | Support for governor control          |
| 16-17 | Fixings for governor                | 47-49 | Fixings for support                   |
| 18    | Bracket for governor                | 50    | Rubber draught excluder               |
| 19-20 | Fixings for bracket                 | 51-54 | Fixings for control                   |
| 21    | Support for bracket                 | 55    | Operating rod, quadrant to governor   |
| 22-24 | Fixings for support                 | 56    | Ball joint for rod                    |
| 25    | Control rod, governor to bell crank | 57    | Locknut for ball joint on rod         |
| 26    | Ball joint complete for rod         | 58-59 | Fixings for operating rod             |
| 27    | Locknut for ball joint              |       |                                       |

16. Insert the governor control quadrant in the rectangular hole uncovered, and bolt it to the dash, using the fixings originally securing the cover plate and with the rubber draught excluder between the quadrant housing and the dash.

Leave the nuts slack at this stage.

17. Remove the instrument panel complete, without disconnecting the instruments.
18. Secure the quadrant bracket to the underside of the instrument box. Tighten the nuts securing the quadrant to the dash and then the nuts fixing the bracket to the instrument box.
19. Replace the instrument panel.
20. Fit a ball joint to each end of the governor operating rod and attach the rod to the control quadrant lever, using a spring washer and nut. Loosen the governor throttle control (R.H.) lever on its shaft and place the quadrant lever in the inoperative (extreme R.H.) notch. Push the governor loading (L.H.) lever forward until a marked resistance is felt, indicating that the internal mechanism is against the stop in the rear end cover. With the loading lever in this position, adjust the length of rod and connect it to the loading lever, using a spring washer and nut. Tighten the ball joint locknuts.
21. Fit the collapsible control rod between the bell crank lever and the governor throttle control (R.H.) lever; secure it at the governor end, and at the bell crank end with two spring washers, nuts and one distance piece to be fitted between rod and bell crank.
- Before fitting, ensure that there is no free play in the collapsible control rod.
22. Check that the carburettor throttle is fully open when the accelerator pedal is fully depressed. If this is not so, the throttle lever on the dash cross-shaft should be adjusted as necessary.
- The Amal adjustable ball joints on the linkage should be adjusted as follows:—

- (a) Tighten the ratchet screw at the head of the joint until the ball is held solidly in its cup.
- (b) Unscrew the ratchet one or two clicks until the ball is free.

#### Setting the governor control linkage

23. Place the quadrant control lever in its highest speed position, i.e., in the extreme L.H. notch.
24. Hold the carburettor throttle fully open and tighten the governor throttle control (R.H.) lever on its shaft.
25. With the engine running, move the quadrant control lever to the first operating notch, i.e., the 1,500 R.P.M. position; with the lever in this position, check the anti-surge stop clearance. The stop clearance should be .020 in. to .025 in. (0.5 mm to 0.6 mm) measured between the spring leaf attached to the throttle control lever

and the cam on the loading lever shaft. Adjust the clearance as necessary by means of the set screw and locknut in the bracket attached to the throttle control lever.

26. Return the quadrant lever to the inoperative position.

With the linkage set in this way, the governor should control the speed of the engine between 1,500 R.P.M. with the quadrant lever in the first operating notch, and 3,000 R.P.M. in the extreme L.H. notch.

Whenever any part of the governor linkage is disturbed for any reason, the complete linkage must be reset.

#### Checking the engine speed with the governor in position

27. It is possible to check the governed speed of the engine with the governor in operation, by measuring the rear power take-off speed with a revolution counter.

The relationship between the engine speed and the rear power take-off speed is shown in the following tables:—

##### (a) Rear power take-off pulley:—

Governor position	Engine speed	Pulley Speed	
		5:6 Power take-off ratio	6:5 Power take-off ratio
1	1500	1070	1540
4	1950	1390	2000
8	2550	1820	2630
11	3000	2145	3100

##### (b) Rear power take-off drive shaft:—

Governor position	Engine speed	Drive shaft speed	
		5:6 Power take-off ratio	6:5 Power take-off ratio
1	1500	1250	1800
4	1950	1625	2350
8	2550	2125	3050
11	3000	2500	3600

#### Points to be checked if the governor surges

28. Ensure that there is negligible backlash in the linkage between the governor and carburettor. Such backlash must not exceed .010 in. (0.25 mm).
29. Ensure that there is no drag at any point in the linkage and that the throttle moves freely.
30. Ensure that all the carburettor jets are clean.

31. Check and correct as necessary, the tension in the fan and governor belts. If it is necessary to retension the governor belt, it may also be necessary to reset the linkage in the manner described.
32. Fit the new spring to the accelerator pump actuating rod.
33. If the governor still surges after attentions 28-32, it can be rectified by inserting 2 B.A. washers behind the spring on the accelerator pump actuating rod. Washers to the thickness of  $\frac{1}{8}$  in. (3 mm) should be inserted initially and additions of one washer at a time then made until the surge is eliminated:—
  - (a) Remove the nut securing the pump lever to the carburettor throttle spindle.
  - (b) Slide the lever off the spindle and unscrew it from the pump actuating rod, counting the number of turns of the lever to unscrew.
  - (c) Remove the split pin holding the spring abutment washer.
  - (d) Thread the new washers up the pump rod, screw the lever on the pump actuating rod, giving the same number of turns as when removed, and reassemble on the carburettor.

On no account must the split pin be removed from the end of the pump rod, as this is set to give the correct pump action.

Only just enough washers to rectify the surge should be incorporated, as their addition preloads the governor linkage.

In any case, no further washers should be inserted after the point when the spring is compressed to  $\frac{1}{2}$  in. (12,5 mm) length with the throttle fully open.
34. Replace the bonnet and reconnect the bonnet prop rod to the bonnet.

#### To remove Operation T/18

1. Disconnect the operating rod at the governor end by removing the nut and spring washer.
2. Disconnect the control rod at the governor end by detaching the adjustable ball joint.
3. Remove the governor unit complete with mounting bracket and support.

#### Engine governor—2½ litre Petrol

#### To fit Operation T/20

1. Disconnect the bonnet prop and remove the bonnet.
2. Drain the radiator, then disconnect the top and bottom hoses. If fitted, disconnect the oil cooler.
3. Disconnect the headlamps from the harness.
4. Remove the grille panel complete with radiator and cowl. See Section L.
5. Remove the forward engine lifting bracket and remove the two L.H. front cylinder head bolts and fit the two special bolts provided.
6. Fit the governor mounting bracket to the cylinder head bolts and to the front of the cylinder head, using the fixings provided.
7. Fit the engine governor to the bracket and leave the bolts slack.
8. Slacken the dynamo adjusting bolts to relieve the tension on the fan belt, remove the four fan fixing bolts, then remove fan and fan belt.
9. Remove the original fan pulley from the water pump and fit the new double pulley supplied.
10. Remove and discard the dynamo pulley and replace with the double pulley supplied.
11. Remove the crankshaft pulley and replace with the double pulley supplied. Secure with the starter dog, using a new lockwasher.
12. Assemble the jockey pulley, shaft, bearing and circlip, then fix to the adjusting plate with a nut and spring washer.
13. Fit the adjusting plate and the jockey pulley assembly to the support plate, using the nuts, bolts and washers provided.
14. Fit the above assembly to the front cover.
15. Fit the fan driving belt supplied to the inner groove on the fan pulley and inner groove on the crankshaft pulley and around the jockey pulley; adjust the tension by moving the jockey pulley.
16. Fit the governor driving belt over the governor pulley and inner groove of dynamo pulley; do not adjust at this stage.
17. Replace the original fan belt, if in good condition, on the outer grooves of the dynamo, fan and crankshaft pulleys; adjust the tension by moving the dynamo.
18. Adjust the governor driving belt tension by raising the governor on the support bracket, then fit the eight-bladed fan provided to the fan pulley, using four set bolts. Remove the bracket, supporting the carburettor bell crank spindle, from the wing fitting.
19. Replace the two front studs securing the exhaust manifold to the inlet manifold with the two larger studs provided. Fit the bell crank bracket provided to these studs. Screw the bell crank spindle into this bracket, using a shakeproof washer.
20. Attach the governor control rod assembly to the angle of the bell crank lever, using a ball joint, distance piece, nuts and spring washer.
21. Attach the other end of the governor control rod to the ball joint on the governor (throttle control) lever held by a nut and spring washer. Ensure, before fitting, that there is no free play in this collapsible control rod.

22. Remove the original carburettor lever and fit the new lever provided and connect up to the bell crank lever, using the original rod. Connect up the original control rod from the accelerator cross-shaft lever.
23. Remove the cover plate on the dash panel immediately below the instrument panel, remove the instrument panel and fit the new plate provided.
24. Insert the governor control quadrant into the rectangular hole uncovered and bolt it to the dash, using the fixings originally securing the cover plate and with the rubber draught excluder between the quadrant housing and the dash. Leave the nuts slack.
25. Withdraw the instrument panel as far as possible and secure the quadrant bracket to the underside of the instrument box, using the fixings provided.

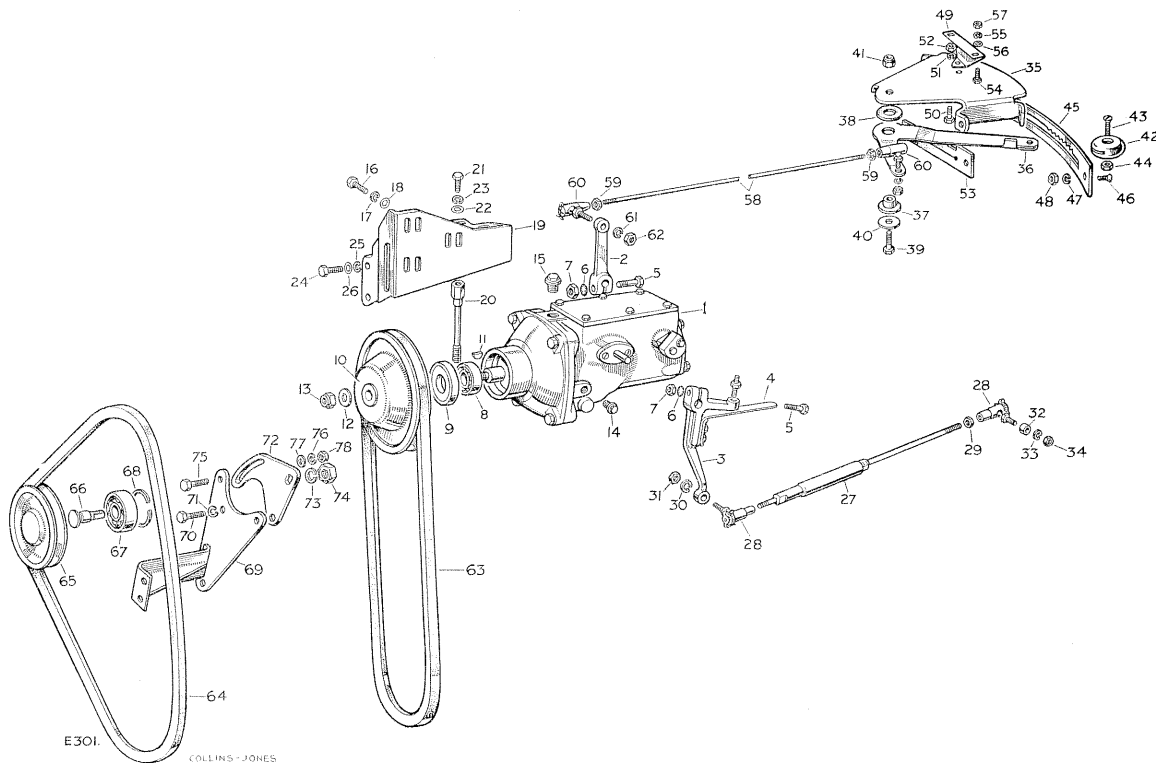


Fig. T-15—Layout of engine governor—2½ litre Petrol

- |  |  |
|--|--|
| 1 Engine governor                          | 37 Bush for lever                                  |
| 2 Lever, governor to quadrant              | 38 Washer  |
| 3 Lever, governor to bell crank            | 39-41 Fixings—lever to housing                     |
| 4 Spring blade for bell crank              | 42 Knob for lever                                  |
| 5-7 Fixings—lever to governor              | 43-44 Screw and nut, for knob                      |
| 8 Bearing for engine governor              | 45 Quadrant plate                                  |
| 9 Oil seal, pulley end                     | 46-48 Fixings—quadrant plate to housing            |
| 10 Pulley for governor                     | 49 Support for governor control                    |
| 11 Woodruff key for pulley                 | 50-52 Fixings—support to housing                   |
| 12-13 Fixings for pulley                   | 53 Rubber draught excluder                         |
| 14 Level plug                              | 54-57 Fixings—governor control to dash             |
| 15 Filler plug                             | 58 Operating rod                                   |
| 16-18 Fixings—governor to bracket          | 59-60 Locknut and ball joint for operating rod     |
| 19 Governor bracket                        | 61-62 Fixings—operating rod to control lever       |
| 20 Special bolt for mounting bracket       | 63 Belt for engine governor                        |
| 21-23 Fixings—bracket to set bolt          | 64 Fan belt  |
| 24-26 Fixings—bracket to cylinder head     | 65 Jockey pulley                                   |
| 27 Control rod, governor to bell crank     | 66-68 Shaft, bearing and circlip for jockey pulley |
| 28-29 Ball end and locknut for control rod | 69 Support plate for jockey pulley                 |
| 30-31 Fixings—control rod to governor      | 70-71 Fixings—support plate to front cover         |
| 32-34 Fixings—rod to bell crank lever      | 72 Belt adjusting plate                            |
| 35 Housing for governor control quadrant   | 73-74 Fixings—jockey pulley shaft to plate         |
| 36 Control lever                           | 75-78 Fixings—adjusting plate to support plate     |

26. Tighten the nuts securing the quadrant to the dash and then the nuts fixing the bracket to the instrument box. Replace the instrument panel.
27. Fit a ball joint and locknut to each end of the governor operating rod and attach the rod to the quadrant control lever, using the nuts and spring washers provided. Loosen the governor throttle control lever on its shaft and place the quadrant in the inoperative position. Push the governor loading lever forward until a marked resistance is felt, indicating that the internal mechanism is against the stop in the rear of the cover. With the loading lever in this position, adjust the length of the rod and connect it to the loading lever, using a spring washer and nut. Tighten the ball joint locknuts.
28. As further settings will require the engine running, replace the grille panel assembly and connect the radiator hoses. Connect the head lamp to the harness and refill the radiator.
29. Check the oil level in the governor and adjust as necessary, using the recommended oil. The L.H. front plug is the level guide.
30. Before proceeding with further settings of the control linkages, ensure that the carburetter throttle is fully open when the accelerator pedal is fully depressed. Adjust as necessary.

#### Fitting the tie-rod

31. Fit the bracket provided to the L.H. rear flange of the bell housing, using the nuts, bolts and washers provided.
32. Fit a locknut, nut, top washer, sleeve and rubber bush to the engine tie-rod; insert the rod through the bracket fitted to the bell housing, from the rear.
33. Complete the fixing to the bracket on the bell housing with a further rubber bush, top washer (dished side inwards), nut and locknut. The nuts should only be finger-tight at this stage.
34. Attach the rear bracket to the tie-rod in a similar manner and hook the bracket over the frame cross-member. With the vehicle on level ground and the handbrake off, position the rear bracket so that the tie-rod is parallel to the ground and in line with the longitudinal axis of the vehicle.
35. Using the hole in the bracket as a template, drill a  $\frac{3}{16}$  in. hole (19 mm) through the cross-member and secure the bracket with a nut, bolt and spring washer.
36. Adjust the tie-rod so that there is no strain on it with the vehicle on flat ground and the handbrake off; tighten the locknut.

#### Setting the governor control linkages

37. Place the quadrant control lever in its highest speed position.

38. Hold the carburetter throttle fully open and tighten the governor throttle control lever on its shaft.
39. With the engine running, move the quadrant control lever to the first operating notch, i.e. the 1500 r.p.m. position; with the lever in this position check the anti-surge stop clearance. The clearance should be .008 in. to .010 in. (0,20 to 0,25 mm) measured between the spring leaf attached to the throttle control lever and the cam on the loading lever shaft. Adjust the clearance as necessary by means of the set screw and locknut in the bracket attached to the throttle control lever.
40. Return the quadrant lever to the inoperative position.

With the linkage set in this way, the governor should control the speed of the engine between 1,500 r.p.m. with the quadrant lever in the first operating notch and 3,000 r.p.m. in the last.

#### Checking the engine speed with the governor in position

41. It is possible to check the governor speed of the engine with the governor in operation either by checking directly off the front of the engine crankshaft, with a suitable adaptor, or by measuring the rear power take-off speed with a revolution counter.
42. The relationship between engine speed and rear power take-off is shown in the following tables:

##### (a) Rear power take-off pulley:—

Governor position	Engine speed	Pulley speed	
		5: 6 power take-off ratio	6: 5 power take-off ratio
1	1500	1070	1540
4	1950	1390	2000
8	2550	1820	2630
11	3000	2145	3100

##### (b) Rear power take-off drive shaft—

Governor position	Engine speed	Drive shaft speed	
		5: 6 power take-off ratio	6: 5 power take-off ratio
1	1500	1250	1800
4	1950	1625	2350
8	2550	2125	3050
11	3000	2500	3600

#### Points to be checked if the governor surges

43. Ensure that there is negligible backlash in the linkage between the governor and carburetter. Such backlash must not exceed .010 ins. (0,25 mm).

44. Ensure that there is no drag at any point in the linkage and that the throttle moves freely. Ensure that all carburetter jets are clear. Check and correct as necessary the tension in the fan and governor belts; re-tension as necessary and re-set the linkage as necessary. Replace the bonnet prop and bonnet.

#### Front capstan winch—mechanical—all models

A hand throttle must be fitted and used in conjunction with the front capstan winch, on Petrol models.

New heavy duty front springs must be fitted to 2 litre Petrol models. See Section J for removal and refitting procedure.

#### To fit

#### Operation T/22

1. Remove and discard the front apron panel. Remove the grille panel and radiator complete (Section L).
2. Remove the four set bolts and spring washers and withdraw the fan.
3. Mark off a point on the front face of chassis second cross-member  $3\frac{9}{32}$  in. (83,3 mm) from the top face and mid-way between the side-members.

Use a pilot drill first, then drill the front face only of the cross-member to  $\frac{7}{8}$  in. (10,318 mm).

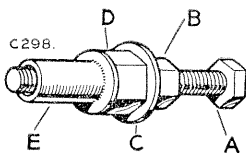


Fig. T-16—Rivnut ready for fitting

A—Set bolt  
B— $\frac{5}{16}$  in. U.N.F. nut  
C—Plain washer  
D—Distance piece  
E—Rivnut

4. Fit a nut and plain washer to a  $\frac{5}{16}$  in. U.N.F. set bolt having a threaded length not less than  $1\frac{1}{2}$  in. (38 mm). Drill or file the thread clear, of a  $\frac{3}{8}$  in. U.N.F. nut, and slide it on to the set bolt, then screw on a Rivnut. Adjust so that  $\frac{1}{8}$  in. (3 mm) of the set bolt extends beyond the Rivnut and then lock the assembly. Insert the Rivnut into the hole in second cross-member and then, keeping the set bolt and distance nut stationary, turn the  $\frac{5}{16}$  in. U.N.F. nut clockwise  $2\frac{1}{4}$  turns. Remove set bolt, nut, plain washer and distance nut.
5. Assemble the winch support plate temporarily to the cross-member, securing with a set bolt and spring washer.

Using the support plate as a template, mark off and drill the other four holes as in item 3, and five  $\frac{5}{16}$  in. (8 mm) clearance holes in the front bumper.

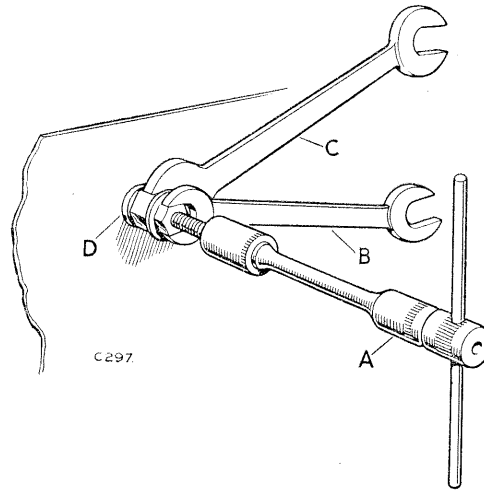


Fig. T-17—Rivnut fitting

A— $\frac{5}{16}$  in. U.N.F. spanner  
B— $\frac{5}{16}$  in. U.N.F. spanner  
C— $\frac{3}{8}$  in. U.N.F. spanner  
D—Rivnut

6. Remove the winch support plate and front bumper. Fit the other four Rivnuts to second cross-member.
7. **2 litre Petrol models:** Relieve the fan belt tension.
8. Prise up the tabs on the starting dog lock washer and remove the dog and washer.
9. **2 litre Petrol models:** Using a suitable extractor, withdraw the vibration damper from the crankshaft. Withdraw the six screws from the damper and remove retaining plate, shims, rubber disc and remove the existing driving flange. Reassemble the damper, using the new driving flange; it will be necessary to true the damper between centres by adjusting the six fixing screws. (Section A.)
- 2½ litre Petrol, Diesel models:** Fit new driving plate, complete with special plug and shakeproof washer.
10. Secure the two shaft plate brackets to the engine front cover, replacing the original four bolts or studs with the four new bolts or studs.
11. **2 litre Petrol models:** Replace the vibration damper, securing it to the crankshaft by means of the winch driving plate, locking washer and special set bolt. Readjust the fan belt tension.
12. Secure the shaft housing to the shaft support plate by means of two spring washers and two nuts. Grease the driving shaft and insert it in the housing, sliding the driving flange on to its spline. Insert the control shaft in the housing and secure the selector fork to the control shaft and in the groove of the flange by means of a spring washer and nut. Push the steel ball into the hole, holding it in position by the spring and the plug. Fit the grease nipple in the shaft housing.

13. Bolt the housing and support plate to the brackets.
14. Slide two rubber dust covers on to the propeller shaft and fit a spring and plunger into each end of the shaft; insert one end of the shaft into the driving shaft held in the shaft housing; slide the dust cover over the joint.
15. Bolt the winch support plate to the front bumper.
16. Fit the winch to the support plate. Offer the winch, plate and bumper into position; engage the propeller shaft with the universal joint sleeve on the winch; secure the winch and plate to the cross-member. Secure the bumper to the chassis. Slide the second dust cover over the propeller shaft joint.
17. Slide the eyebolt on to the control rod and fit the locknut and clevis to the end of the rod.
18. Pass the rod through the hole in the cross-member and secure it to the support plate with a spring washer and nut on the eyebolt; fit the spring, plain washer, locknut and knob on the rod.
19. Fit the clevis to the control shaft in the shaft housing and adjust it so that the driving flange is engaged and disengaged fully, when the rod is moved in its slot to the "drive" and "free" positions, located by the selector ball.
20. Mount the rope guide brackets and guide bar on the support plate. Making sure that the bar turns freely, drill four holes through the brackets into the front face of the bumper; secure the brackets to the bumper.
21. Fill the unit with oil, to the mark on the dipstick, using an S.A.E. 90 oil.
22. Turn the unit (by means of the short starting handle supplied) until the hole in the side of the bollard exposes a grease nipple provided for lubrication of the bollard shaft and apply grease, using a suitable gun.
23. Grease all moving parts and apply grease, by means of a gun, to the nipples provided on the rope guide brackets and the drive shaft housing.
24. Replace the fan blade.
25. Replace the grille panel and radiator. Section L.  
It may be necessary to tighten the starting dog on the front of the winch shaft and secure it by means of the lock washer.
2. Remove the nuts, spring and plain washers securing the support plate to the chassis cross-member, and the bolts, plain washers and self-locking nuts securing the front bumper to the chassis; remove the bumper, support plate, rope guide and winch complete, at the same time disengaging the propeller shaft from the universal joint sleeve on the winch. The spring and plunger in the propeller shaft will be freed at this stage and care should be taken that these are not lost.
3. Remove the winch from the support plate.
4. Slide the rear dust cover along the propeller shaft and withdraw the propeller shaft from the sleeve of the driving shaft, care being taken that the second spring and plunger are not lost.
5. Extract the driving shaft from the shaft housing and remove the driving flange from engagement with the selector fork.
6. Disconnect the control rod clevis from the control shaft and remove the drive shaft support plate, housing and control shaft complete from the brackets.
7. Remove the selector fork from the control shaft; remove the plug, spring and ball from the drive shaft housing and withdraw the control shaft; remove the shaft housing from the plate.
8. Remove the radiator and grille panel assembly—Section L.
9. **2 litre Petrol models:** Remove the driving plate from the crankshaft vibration damper; remove the vibration damper (Section A).
10. Remove the two support plate brackets.
11. **2½ litre Petrol, Diesel models:** Remove the driving plate from the fan driving pulley or vibration damper.
12. If necessary, remove the two rope guide brackets and rope guide from the front bumper and support plate.  
If necessary, remove the bushes from the brackets.
13. Remove the drain plug and filler plug and drain off the oil.
14. Drive out the Mills pin securing the universal joint sleeve to the rear of the worm shaft and remove the sleeve.
15. Unscrew the dog from the front of the worm shaft; slide off the lock washer.
16. Remove the oil seal retainer, oil seal and joint washer from the casing. If necessary, remove the oil seal from the retainer.
17. Turning the shaft to disengage the worm from the worm wheel, drive the worm shaft, ball bearing and distance piece from the casing. Drift the bearing and distance piece from the shaft.

**To overhaul****Operation T/24**

1. Remove the control knob and locknut, plain washer and spring from the control rod; remove the nut and spring washer securing the control rod eyebolt to the support plate and drop the control rod, slide back the dust cover from the front universal joint on the winch propeller shaft.



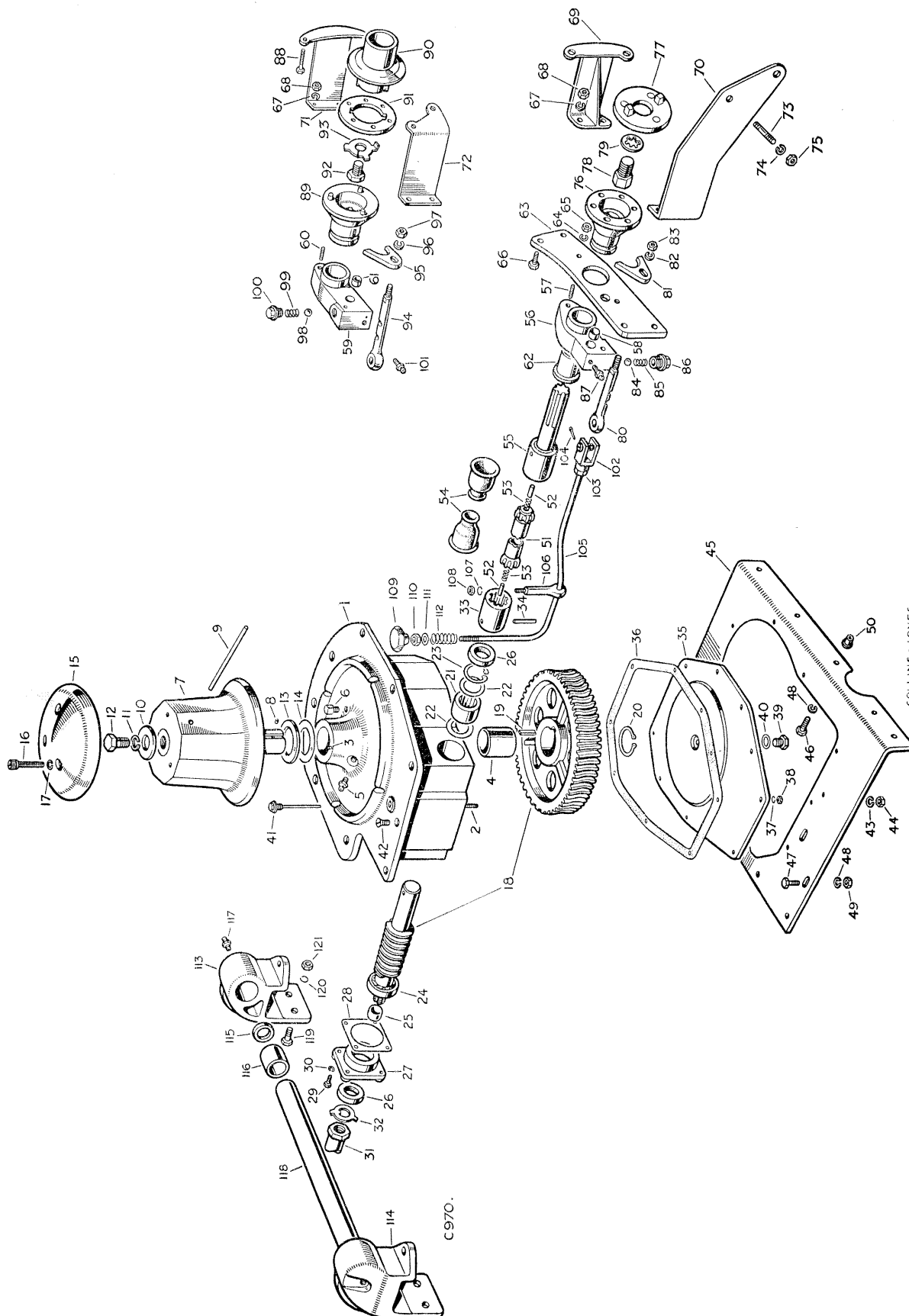


Fig. T-18—Layout of front capstan winch, mechanical

Key to Fig. T-18

1	Casing assembly for front winch	46-49	Fixings for support plate	88	Set bolt fixing bracket to front cover	2 litre Petrol models
2	Stud for bottom cover	50	Rivnut	89	Driving flange for front winch	
3	Dowel for thrust washer	51	Propeller shaft for front winch	90	Driving flange for fan pulley	
4	Bush for bollard shaft	52	Plunger spring	91	Winch driving plate	
5	Grease point for shaft	53	Plunger	92-93	Fixings for driving flange and plate	
6	Breather cup for housing	54	Dust cover			
7	Bollard and shaft assembly	55	Driving shaft for front winch	94	Control shaft for driving flange	
8	Dowel for shaft	56	Winch shaft housing assembly	95	Selector fork for control shaft	
9	Pin for bollard	57	Stud for support plate	96-97	Fixings for fork	
10-12	Fixings for bollard	58	Bush for control shaft	98	Steel ball	
13	Thrust washer			99	Spring	
14	Shim	59	Winch shaft housing assembly	100	Plug for spring	
15	Cap for bollard	60	Stud for support plate	101	Grease point for control shaft	
16-17	Fixings for cap	61	Bush for control shaft	102-104	Clevis, locknut and split pin	
18	Worm wheel and worm complete	62	Bush for winch driving shaft	105	Control rod for winch	
19	Special key to worm wheel	63	Support plate for winch shaft	106	Eye bolt for winch control rod	
20	Circlip fixing worm wheel	64-65	Fixings for housing	107-108	Fixings for eye bolt	
21	Roller bearing for worm	66-68	Fixings for support	109	Knob for control rod	
22	Washer for bearing	69	Bracket for winch shaft support	110	Locknut for knob	
23	Circlip fixing bearing to casing		plate R.H.	111	Plain washer for spring	
24	Ball bearing for worm shaft	70	Bracket for winch shaft support	112	Spring for control rod	
25	Distance piece for worm shaft		plate L.H.	113	Rope guide bracket assembly R.H.	
26	Oil seal for worm shaft	71	Bracket for winch shaft support	114	Rope guide bracket assembly L.H.	
27	Retainer for oil seal		plate R.H.	115	Thrust washer	
28	Joint washer for oil seal retainer	72	Bracket for winch shaft support	116	Bush for guide bar	
29-30	Fixings for oil seal retainer		plate L.H.	117	Grease point for bush	
31	Starting dog	73-75	Fixings—bracket to front cover	118	Guide bar for winch rope	
32	Lock washer for starting dog	76	Driving flange for front winch	119-121	Fixings for rope guide	
33	Universal joint sleeve	77	Winch driving plate			
34	Special pin fixing sleeve to worm	78-79	Fixings for driving plate			
35	Bottom cover for winch casing	80	Control shaft for driving flange			
36	Joint washer for bottom cover	81	Control shaft for control shaft			
37-38	Fixings for bottom cover	82-83	Selector fork for control shaft			
39	Drain plug for front winch	84	Fixings for fork			
40	Joint washer for drain plug	85	Steel ball			
41	Filler plug and dipstick		Spring			
42-44	Fixings for front winch	86	Plug for spring			
45	Support plate for front winch	87	Grease point for control shaft			

18. Remove the bottom cover and joint washer from the casing.
19. Withdraw the three Allen screws and spring washers and lift off the bollard cap.
20. Remove the set bolt, spring washer and plain washer from the end of the bollard shaft; drift out the safety pin securing the bollard to the shaft and remove the bollard.
21. Remove the thrust washers and shims, which should be preserved and withdraw the worm wheel and shaft from the casing.
22. Remove the circlip securing the worm wheel and press the shaft from the wheel; if necessary, remove the peg and key from the shaft.
23. If necessary, press the two bollard shaft bushes from the casing; remove the worm shaft oil seal from the casing; remove the roller retaining circlip, a distance washer, the roller bearing, and a further washer; remove the grease nipple, the breather cup and the thrust washer peg, leaving the bare casing.
24. Wash all the component parts thoroughly and lay them out for inspection.
25. Check all the bearings for wear and damage and renew them as necessary.
26. Check the gears for damage marks and rectify or renew them as necessary; the gears must only be renewed as a pair.
27. Examine the casing for signs of damage or cracks and renew as necessary. The casing may also be scrap as a result of excessive wear in a bearing bore; such wear will be obvious during the course of assembly.
28. The bollard and shaft are only supplied as an assembly.
29. Assemble the unit by reversing the stripping procedure, paying particular attention to the following points:—
30. The roller bearing must be a *push fit* in the casing and on the worm shaft. The ball bearing must be a *light press fit* in the casing and on the worm shaft.  
Renew the bearings, casing or shaft as necessary.
31. If necessary, renew the bollard shaft bushes, which must be a *press fit* in the casing and a *sliding fit* on the bollard shaft. They must be reamed to 1.312 in. (33,4 mm).  
The upper bearing must stand  $\frac{1}{8}$  in. (3 mm) proud of the top face of the casing.
32. The bollard shaft must be well greased on assembly.
33. The worm shaft oil seals must be replaced with their knife edges inwards.
34. The worm shaft must be able to turn quite freely, but no end-float must be present.
35. The shims between the bollard thrust washer and the casing, available .005 in. thick, are provided for adjustment of the bollard shaft end-float, which must be set on assembly to .003 in. to .005 in. (0,07 to 0,12 mm).
36. If necessary, renew the bushes in the rope guide brackets.  
The old bushes may be removed by screwing a suitable size tap into the bearing and then extract; a thrust washer is fitted behind each bush.  
The new bushes must be a *light press fit* in the brackets. The guide bar must be able to rotate freely in the bushes, which must be reamed in position to 1.390 in. (35,3 mm).
37. If necessary, renew the drive shaft bush in the shaft housing. The bush must be a *press fit* in the housing. After fitting, ream the bush to .750 in. (19 mm) and drill the lubrication hole through the nipple side of the bush. The drive shaft must be a *sliding fit* in the bush.
38. If necessary, renew the two control shaft bushes in the housing, the bush on the studded side of the housing should stand  $\frac{3}{32}$  in. (2 mm) proud of the housing face.
39. Complete the assembly and installation. Fill the winch with oil.  $3\frac{1}{2}$  pints (2,0 litres). Apply grease at the nipples on the rope guide, bollard shaft and drive shaft housing. Smear all moving parts liberally with grease.

#### Hydraulic front winch

##### To fit

##### Operation T/26

1. Remove and discard the front valance and mounting clips.
2. Remove the radiator grille.
3. If the winch rear mounting bracket is not already attached to the winch, fit this mounting bracket loosely to the winch rear connecting tube with the U bolts supplied.
4. Remove the two large thimble protection covers from the R.H. and L.H. sides of the winch hydraulic motor inlet and outlet ports.
5. Fit to the L.H. side hydraulic motor port a right-angled elbow, with the elbow outlet facing forward. Secure with an 'O' ring, a set bolt and a spring washer.
6. Fit an adaptor to the right-angle elbow, using a bonded seal.
7. Fit to the R.H. side hydraulic motor port the high pressure hose connection, using an 'O' ring, a set bolt and a spring washer.
8. Ensure that the bumper is level and is not damaged. Replace or rectify if necessary.

9. Offer the winch assembly into position between No. 1 and No. 2 cross-members and insert a half-inch (13,0 mm) block of wood between the top of the worm shaft housing and grille tunnel—to ensure adequate grille clearance when refitted.
10. Ensure that the half-round cut-away in the winch rear mounting bracket is flush with the large hole in No. 2 cross-member and that the right-angle elbow fitted to the hydraulic motor maintains a clearance of  $\frac{1}{8}$  to  $\frac{1}{4}$  in. (3,0 to 6,0 mm) between chassis frame side member.
11. Using the winch mounting bracket as a template, mark off the accessible fixing holes in No. 2 cross-member.
12. Remove the winch and front bumper and drill the marked-off holes  $\frac{3}{16}$  in. (10,0 mm) dia. in in No. 2 cross-member and fit the rivnuts, using a special rivnut tool. Reference to Operation T/22 will show an alternative method. Care must be taken not to overtighten when fitting rivnuts.
13. Remove the mounting bracket from the winch connecting tube and temporarily fit the mounting bracket to the rivnuts on No. 2 cross-member. Mark off the remaining fixings in the cross-member and complete the rivnut fitting.
14. Finally, fit the mounting bracket to the cross-member, using the ten  $\frac{5}{16}$  U.N.F. x  $1\frac{1}{4}$  in. (32 mm) long bolts and spring washers supplied.
15. Replace the front bumper, leaving the fixing bolts loose, and temporarily secure the winch in position with the U bolts to the mounting bracket.
16. Line up the front bumper and tighten the bumper fixing bolts. Mark off the winch forward fixing holes in the bumper.
17. Remove the winch and drill the fixing holes in the bumper  $\frac{3}{16}$  in. (10,0 mm) dia. holes.
18. Replace the winch in position together with the roller rope snubber frame and secure the winch to the mounting bracket with the U bolts and to the front bumper, using the four  $\frac{3}{8}$  U.N.F. x  $1\frac{3}{4}$  in. (44 mm) long bolts, plain washers, spring washers and nuts supplied.
19. Position the guide frame on to the winch rear connecting tube with the two short U bolts supplied, and against the front face of the bumper.
20. With the rope snubber frame central to the cable drum, maintain a  $\frac{3}{8}$  in. (10,0 mm) clearance between frame and cable drum flanges. Using the three holes in the snubber frame as a template, drill the  $\frac{3}{16}$  in. (10,0 mm) dia. fixing holes in the front bumper. Secure in position with the bolts  $\frac{3}{8}$  U.N.F. x 1 in. long (25,4 mm), plain washers, spring washers and nuts supplied. Tighten the U bolts.
21. Replace the radiator grille.

### Installing the pump, control valve and P.T.O. selector units assembly

22. Remove the centre seat inspection panel and the centre seat strap retaining bollard.
23. Mark off and prepare the positions for fitting the hydraulic control valve and the selector lever operating the P.T.O. selector unit as illustrated at Fig. T-18A.

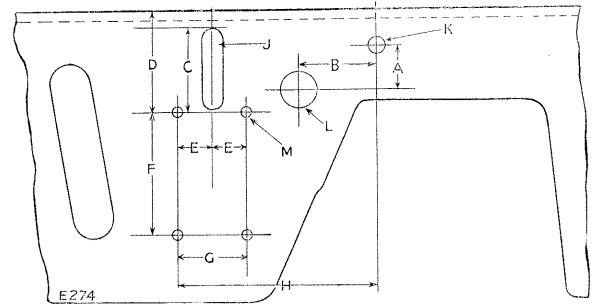


Fig. T-18A—Drilling heel board for selector unit

- A—1.187 in. (30 mm)
- B—1.968 in. (50 mm)
- C—2.250 in. (57 mm)
- D—2.750 in. (69 mm)
- E—Equal
- F—3.00 in. (76 mm)
- G—1.500 in. (38 mm)
- H—4.968 in. (126 mm)
- J—Slot  $\frac{1}{2}$  in. (12,5 mm) wide
- K—Hole for seat strap retaining bolt
- L— $\frac{3}{8}$  in. (19 mm) diameter hole
- M—Four holes,  $\frac{3}{8}$  in. (9,5 mm) diameter

24. Fit a grommet to the  $\frac{3}{4}$  in. (19,0 mm) dia. hole and replace the seat strap bollard.
25. Before fitting the hydraulic control valve to the heel board, fit a brass union and washer and adaptors complete with bonded seals to the control valve. Temporarily cover unions and adaptors for protection against damage and dirt. See Fig. T-19 for fitting adaptors and the brass union.

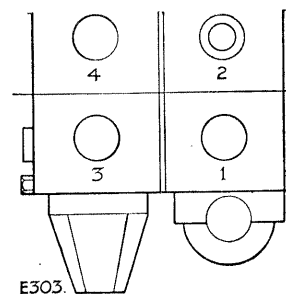


Fig. T-19—Rear view of control valve showing positions of adaptors and union

- 1—Steel adaptor and seal
- 2—Brass union and washer
- 3—Steel adaptor and seal
- 4—Steel adaptor and seal

E303.

26. Remove the control valve knob to facilitate fitting the control valve to the heel board. Secure control valve in position, using a mounting plate, to the outside of the heel board panel, using the four set bolts  $\frac{5}{16}$  U.N.F. x  $\frac{5}{8}$  in. (16 mm) long supplied. Replace the control knob and check for free movement of the control lever.
27. Remove the top cover plate and joint washer from the transfer box casing.
28. Remove the main shaft rear bearing housing assembly and joint washer from the rear of the transfer box casing.

29. Remove one bearing housing fixing stud from the L.H. side top corner on the transfer box casing and replace with the longer stud supplied.
30. Fit the assembled P.T.O. unit with the hydraulic pump to the transfer box casing, with the port marked Inlet to the R.H. side and the tapped holes in the pump flange uppermost. Secure in position to the studs on the transfer box casing, using the spring washers and nuts already removed.
31. Fit the P.T.O. selector unit and joint washer to the top face of the transfer box casing, ensuring that the selector fork engages the dog. Secure in position, using the spring washers and nuts already removed. The selector control rod to be fitted to the heel board after the installation of the control valve.

#### Installing the oil reservoir—88 models

32. Mark off and drill three holes  $\frac{11}{32}$  in. (9,0 mm) dia. in the underside of the rear cross-member, as illustrated.

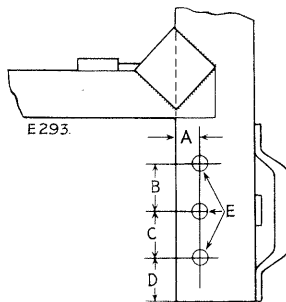


Fig. T-20—Drilling holes in rear cross-member for Reservoir—88 models

- A— $1\frac{1}{4}$  in. (32,0 mm)      C— $2\frac{5}{8}$  in. (67,0 mm)  
 B— $2\frac{5}{8}$  in. (67,0 mm)      D— $2\frac{1}{2}$  in. (63,5 mm)  
 E—Three holes  $\frac{11}{32}$  in. (9,0 mm) dia.

33. Cut a 6 in. (152 mm) dia. hole in the left-hand wheel arch box as illustrated. Mark off a 7 in. (178 mm) dia. circle parallel to the 6 in. (152 mm) dia. hole just cut.

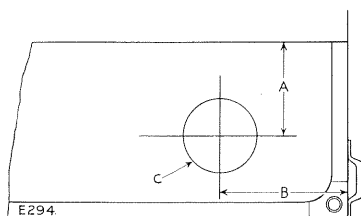


Fig. T-21—Position of hole in L.H. rear wheel arch box—88 models

- A—7 in. (178 mm)      B—9 in. (229 mm)  
 C—6 in. (152 mm) dia. hole.

34. Using the cover plate as a template, position the three holes in the plate centrally with the 7 in. (178 mm) diameter circle and drill  $\frac{7}{16}$  in. (10,0 mm) dia. holes in the seat panel.

35. Position the three spire nuts supplied to the three holes in the seat panel and fit the protection strip supplied to the tank access hole, using a suitable adhesive. Secure the cover plate in position after the tank has been fitted, using the three Acme bolts and plain washers provided.
36. Jack up the vehicle and remove the L.H. road wheel and wing stay.
37. Attach the tank lower mounting bracket loosely to the holes in the rear cross-member, using the three bolts  $\frac{1}{4}$  U.N.F. x  $\frac{3}{8}$  in. (9,5 mm) long, plain washers, spring washers and nuts provided.
38. Attach the tank loosely to the mounting bracket, using the two bolts  $\frac{1}{4}$  U.N.F. x  $\frac{5}{8}$  in. (16 mm) long provided. Position the tank so that the pipe connections in the tank side face the gap between chassis frame and body floor, to provide for pipe fitting.
39. Using the fixing holes in the upper split flange as a template, drill a  $\frac{7}{16}$  in. (7,0) dia. hole in the seat panel and secure in position, using two  $\frac{1}{4}$  U.N.F. x  $\frac{5}{8}$  in. (16 mm) long bolts provided. Tighten all the tank fixings.
40. Cut out a 4 in. (102,0 mm) dia. hole in the L.H. side rear wing, central and opposite to the oil reservoir filter plug, and fit the protection strip provided with a suitable adhesive. See Fig. T-22.

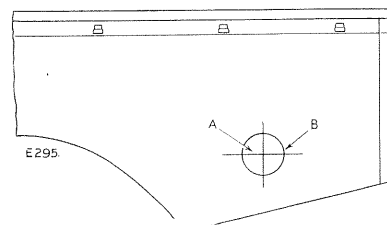


Fig. T-22—Position of hole in L.H. body side panel—88 models

- A—One 4 in. (102,0 mm) dia. hole central to oil filter plug.  
 B—Protection strip at this edge.

41. Fit the rear wing stay provided to one of the bottom tank fixing bolts and the original wing stay fitted to the wing. Replace the road wheel.

#### Installing the oil reservoir—109 models

42. Mark off and drill  $\frac{7}{16}$  in. (7,0 mm) dia. hole in the underside of the rear cross-member as illustrated.
43. Cut out the aperture 15 x 12 in. (381 x 305 mm) in the L.H. side wheel arch locker box base, as shown at Fig. T-24.
44. Attach the tank lower mounting bracket loosely to the holes in the rear cross-member, using the two bolts  $\frac{1}{4}$  U.N.F. x  $\frac{3}{4}$  in. (19 mm) long supplied.

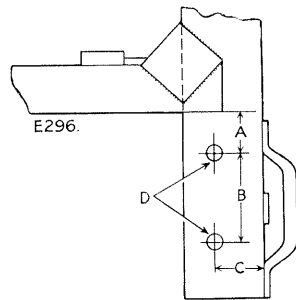


Fig. T-23—Position of holes on underside of rear cross-member, 109 models

- A—4 $\frac{3}{4}$  in. (121 mm)      C—2 $\frac{1}{2}$  in. (64 mm)  
 B—7 $\frac{1}{2}$  in. (191 mm)      D—Two holes  $\frac{17}{32}$  in. (7,0 mm) dia.

45. Attach the tank loosely to the lower mounting bracket, using the bolts  $\frac{1}{4}$  U.N.F. x  $\frac{3}{4}$  in. (19 mm) long supplied. Position the tank so that the pipe connections in the tank side face the gap between chassis frame and body floor to allow for pipe fitting.

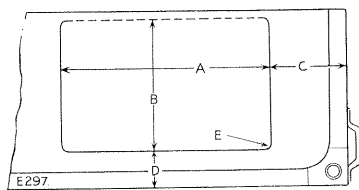


Fig. T-24—Position of cut-out in L.H. side wheel arch locker base—109 models

- A—15 in. (381 mm)      C—3 $\frac{1}{2}$  in. (89 mm)  
 B—12 in. (304 mm).      D—1 $\frac{1}{2}$  in. (38 mm)  
 E— $\frac{1}{4}$  in. (6,0 mm) radius

46. Using the tank top mounting bracket as a template, position tank and top mounting bracket squarely in the locker base aperture and mark off position for fixing top mounting bracket to wheel arch seat. Drill three  $\frac{7}{8}$  in. (7,0 mm) dia. holes, and secure mounting bracket in position, using the three bolts  $\frac{1}{4}$  U.N.F. x  $\frac{3}{4}$  in. (19 mm) long provided.

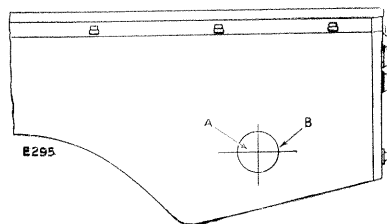


Fig. T-25—Position of hole in L.H. body side panel—109 models

- A—One 4 in. (102 mm) diameter hole central to the oil filler plug  
 B—Dash protection strip around this edge.

47. Mark off and drill  $\frac{7}{8}$  in. (7,0 mm) dia. holes for the tank fixing positions to the top mounting bracket and secure tank to the mounting bracket, using the fixings provided. Tighten all tank fixings.

48. Cut out a 4 in. (102 mm) diameter hole in the L.H. side rear wing, central and opposite the oil reservoir filter plug, and secure the protection strip provided with a suitable adhesive.

### Installation of hydraulic pipes and clip fitting—88 models (and 109 models forward of the hydraulic pump)

Use a suitable ramp to facilitate pipe and clip installation.

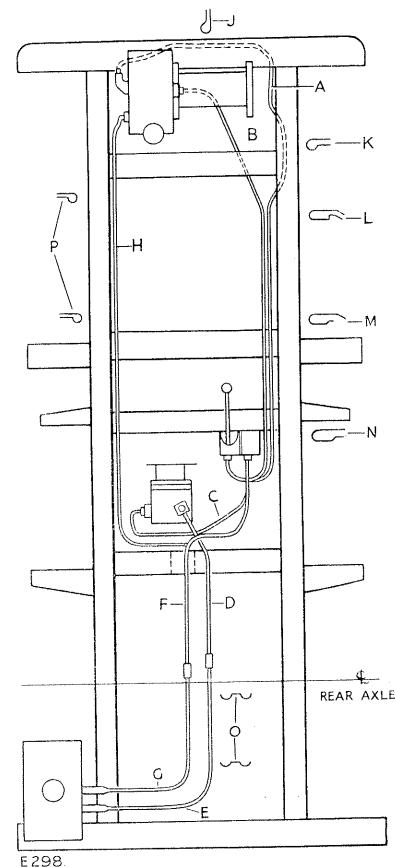


Fig. T-26—Layout of pipes and clips, 88 models

- A—Pipe, upper on control valve  
 B—Pipe, lower on control valve  
 C—Pipe, lower on control valve  
 D—Pipe, suction  
 E—Pipe, suction  
 F—Pipe, upper on control valve  
 G—Pipe, return reservoir  
 H—Pipe, exhaust  
 I—Clip, front bumper (single)  
 J—Clip, R.H. chassis side member (single)  
 K—Clip, R.H. chassis side member (double)  
 L—Clip, R.H. chassis side member (double)  
 M—Clip, R.H. chassis side member (double)  
 N—Clip, R.H. rear engine mounting (double)  
 O—Clip, suction and return pipes to body floor stiffeners  
 P—Clip, motor exhaust

49. Connect the flexible pipe loosely to the L.H. side pipe connection on the winch hydraulic motor and secure the pipe inside the front bumper, using the clip provided.
50. Feed the pipe beneath the battery carrier and over the R.H. side front engine mounting. Secure the pipe to the chassis frame side member, adjacent to the cross-member, with a clip provided.
51. Connect the flexible pipe loosely to the R.H. side pipe connection on the winch hydraulic motor and secure the pipe to the cross-member adjacent to the relay damper fixing.

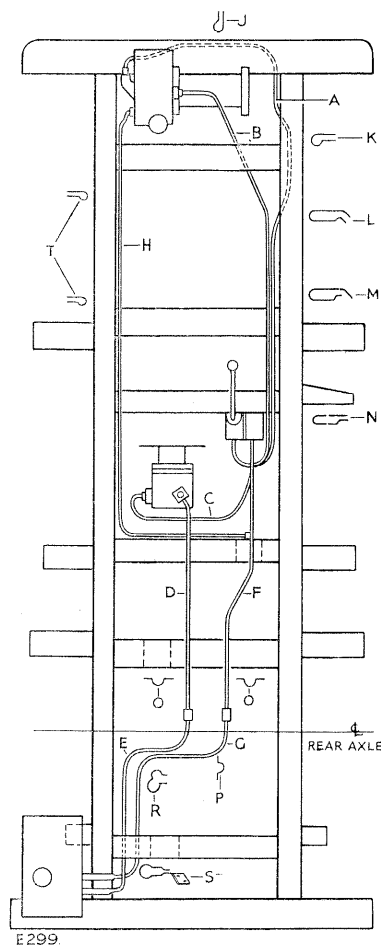


Fig. T-27—Layout of pipes and clips, 109 models

- A—Pipe, upper, on control valve
- B—Pipe, lower, on control valve
- C—Pipe, lower, on control valve
- D—Pipe, suction
- E—Pipe, suction
- F—Pipe, upper, on control valve
- G—Pipe, return reservoir
- H—Pipe, exhaust
- J—Clip, front bumper (single)
- K—Clip, R.H. chassis side member (single)
- L—Clip, R.H. chassis side member (double)
- M—Clip, R.H. chassis side member (double)
- N—Clip, R.H. rear engine mounting (double)
- O—Clip, chassis cross member
- P—Clip, return pipe to body
- R—Clip, suction and return pipes together
- S—Clip, suction return pipe to rear cross-member
- T—Clip, motor exhaust pipe to chassis frame

52. Secure both pipes from the hydraulic motor to the R.H. top shock absorber fixing bolt, using a double clip, fitted uppermost.
53. Secure both pipes from the hydraulic motor to the centre bolt on the steering mounting bracket, using a double clip provided.
54. Secure both pipes from the hydraulic motor to the R.H. rear engine mounting, using a double clip provided.
55. Fit the suction hose connections to each end of the suction pipe, using hose clips, then connect the pipe complete to the suction connection on the tank, using a hose clip.
56. Fit the return hose connections to each end of the return pipe, using hose clips, then connect the pipe complete to the return connections on the tank, using a hose clip.
57. Remove the protection cup from the hydraulic pump inlet port, marked 'Inlet' and fix the suction elbow to the pump, using an "O" ring. Secure the elbow to the pump, using the set bolts provided.
58. Fit the suction pipe connection to the suction elbow on the hydraulic pump, using a hose clip.
59. Fit the suction pipe between the hose connection on the hydraulic pump and the hose connection on the suction pipe from the tank. Use hose clips.
60. Remove the protection cup from the hydraulic pump outlet port marked 'Outlet' and fit the delivery connection to the pump, using an "O" ring. Secure the connection to the pump, using the fixings provided.

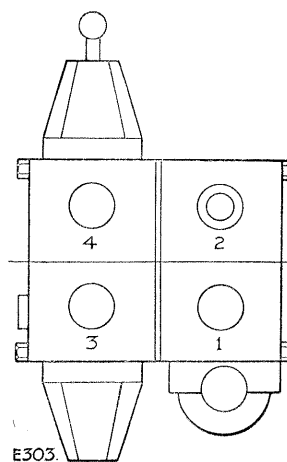


Fig. T-28—Rear view of control valve, showing sequence of pipe fitting

- 1—Flexible pipe from pump, to be fitted first
- 2—Return pipe to tank, to be fitted second
- 3—Flexible pipe from front winch, R.H. side connection, fitted third
- 4—Flexible pipe from front winch, L.H. side connection, fitted last

61. Connect the flexible pipe by the right-angle connection to the delivery connection on the hydraulic pump.
62. Fit the return pipe to the hose connection on the tank return pipe, using a hose clip.
63. Connect the four hydraulic pipes to the control valve on the heel board as shown at Fig. T-28.
64. Secure the rear suction and return pipes to the body floor stiffeners above the rear axle and silencer, using the double clips provided as templates.
65. Remove protection cap from the L.H. side winch hydraulic motor and fit the banjo connection to the exhaust port.
66. Fit the coupling to the short connecting pipe on the return pipe, using the olive provided.
67. Anneal the copper exhaust pipe if necessary to facilitate bending when fitting, and feed pipe from the left-hand side front of the vehicle over the rear engine mounting.
68. Bend the copper pipe in as large a radius as possible and connect the end of the pipe to the coupling fitted on the return pipe to the tank, using the olive provided.
69. Slide the retaining clip on to the exhaust pipe and secure the clips to the chassis side member at approximately 12 in. (305 mm) apart from No. 2 cross-member by drilling a  $\frac{1}{8}$  in. (3 mm) dia. hole and using drive screws.
70. Connect the copper pipe to the banjo connection on the winch motor, using the olive provided.
71. Before fitting the P.T.O. control, attach the link rod to the lever, using a clevis pin and spring, and split pin. Remove the knob and locknut.
72. Pass the link rod attached to the lever through the heel board grommet and fit the lever to the selector shaft on the selector unit and stud fitted to transfer box casing. Secure with a clevis pin and spring and split pin. Replace the knob and locknut.
73. Check free movement of the control and lock the locknut on the stud fitted to the transfer box casing.
74. Fit the winch hydraulic motor protection shield to the front bumper, central to the motor position, using the protection shield fixing holes as a template. Drill the bumper  $\frac{11}{32}$  in. (9 mm) diameter and secure the protection shield inside the bumper, using the fixings provided.
75. Fit the tank protection panel to the body wheel arch, seat panel and wing edge. Using the protection panel fixing holes as a template, drill a  $\frac{3}{16}$  in. (5 mm) diameter hole and secure in position with the pop rivets provided. Fit centre seat panel after test.

### Installation of hydraulic pipes and clip fixing—109 models—rear

76. On the L.H. underside of the chassis cross-member, adjacent to the tank connections, mark off and drill  $\frac{1}{8}$  inch (3 mm) holes for fixing the clip as illustrated.

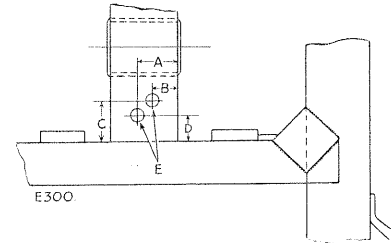


Fig. T-29—Position of clip on underside of chassis cross-member

- |   |                               |
|---|-------------------------------|
| A— $2\frac{1}{8}$ in. (54 mm)                                   | C— $\frac{3}{8}$ in. (79 mm)  |
| B— $1\frac{1}{8}$ in. (45 mm)                                   | D— $2\frac{1}{8}$ in. (67 mm) |
| E—Two holes $.120$ in. (3 mm) on underside chassis cross-member |                               |

77. Fit the hose connections to each end of the suction pipe, using the hose clips provided, and connect the suction pipe by the hose connections to the suction connection on the tank, using the hose clip provided.
78. Fit the hose connections to each end of the return pipe, using the hose clip provided.
79. Carry out operations 57 and 58 as detailed for 88 models.
80. Fit the suction pipe between the hose connection on the hydraulic pump and the hose connection on the suction pipe from the tank, using the hose clips provided.
81. Carry out operations 60 and 61 as detailed for 88 models.
82. Fit the return pipe to the hose connections on the tank return pipe, using the hose clips provided.
83. Connect the four hydraulic pipes to the control valve on the heel board in the sequence illustrated at Fig. T-28.
84. Secure the suction and return pipes to the drilled holes in the chassis frame cross-member, using the clips, drive screws and bolts provided.
85. Secure the return pipe from the control valve to the centre stiffener on the body floor, using the clip and drive screws provided.
86. Secure the suction and return pipes together with a clip, using the fixings provided.
87. Secure the suction and return pipes to the chassis cross-member, with a clip securing the return pipe and a clip securing the suction pipe, using the drive screws as provided. Use the clips as templates.



88. Carry out operations 65 to 74 as detailed for 88 models.
89. Fit the tank protection panel to the body wheel arch and seat panel; using the protection panel as a template, drill five  $\frac{7}{16}$  in. (7 mm) dia. holes in the body and secure in position, using the fixings provided. Fit the centre seat panel after test.

### Test after installation

#### Important

The oil reservoir and front winch gearbox must be filled with the recommended oils before any tests are carried out.

Fill the oil reservoir at rear of vehicle by removing the filler cap, leaving the filler gauze in position, with  $4\frac{1}{2}$  gallons (20,0 litres) of the correct grade of oil as follows:—

Fill winch gearbox by removing the filler plug and breather and level plug on the L.H. side gearbox casing cover plate, with 2 pints (1,0 litre) of the correct grade of oil as follows. Replace filler and level plugs.

### Recommended lubricants

	COMPONENTS		
	Hydraulic winch supply tank	Hydraulic winch gearbox	Lubrication nipples
Capacities	$4\frac{1}{2}$ gallons (20,0 litres)	2 pints (1,0 litre)	—
S.A.E. ....	—	90 E.P.	—
B.P. ....	—	Energol E.P. S.A.E. 90	Energol L.2
Duckham's	—	Duckham's Hypoid 90	Duckham's L.B. 10 Grease
Esso ....	Terresso 43 or Essolube HD 10/W	Esso Gear Oil G.P. 90	Esso Multi-purpose Grease H
Mobil ....	D.T.E. Light	Mobilube GX90	Mobilgrease M.P.
Shell ....	Tellus 27	Spirax 90 E.P.	Retinax A
Wakefield ....	Hyspin 70 or Castrolite	Castrol Hypoy	Castrol L.M.

1. Apply grease to all grease nipples on the winch rope snubber rollers and inspect run of pipes to ensure pipes are not fouling moving parts, engine, gearbox, steering and spring shackles.
2. With the winch driving dog uncoupled, select neutral position on transfer gear change lever and apply hand brake.
3. Run the engine at tick-over speed, engage 3rd gear and pull out P.T.O. operating lever on the heel board.

The hydraulic control valve lever should be in the central position. With controls in this position the hydraulic system is operating in the neutral circuit, tank to pump, pump to control valve, control valve to tank.

4. Run the assembly light for three minutes by moving the control valve lever upwards and run the assembly in the reverse direction for one minute by moving the control valve lever downwards. Check for oil leaks.
5. Fit the winch cable ( $\frac{3}{8}$  in. dia. x 100 ft. (9,5 mm dia. x 35 m.) long) to the winch drum flange, through the hole provided, far enough to facilitate bending the end of the cable at right angles with pliers. Secure the end of the cable to the drum with the cleat provided.
6. Engage the winch driving dog, and with an assistant offering resistance to the cable by using protective gloves, wind the cable on to the top of the drum by operating the control valve lever upwards to pay-in cable.
7. Pay out the cable by operating the control valve lever downwards and anchor the cable hook to a suitable solid fixture. Secure the vehicle with ground anchors or sprags under wheels.
8. Run up to speed in 3rd gear for five minutes so that the drum is stalled. Check all pipes and points for leaks. The safety valve in the pressure line of the hydraulics will prevent damage to both winch and vehicle.

### Instructions for using hydraulic winch

1. Vehicle should be positioned in line with the object to be recovered, or in the case of self-recovery the end of the cable should be anchored in line with the vehicle.
2. The transfer box lever should be placed in the neutral position.
3. Engage 3rd gear in the main gearbox and pull out the power take-off lever protruding through the heel board. The hydraulic pump will then be driving when the clutch is released.

The engine should be run at approximately 2,000 r.p.m., which will result in the pump being driven around 1,500 r.p.m. In practice the engine can be controlled during self-recovery by the accelerator pedal, but for some applications the hand throttle can be used.

4. The hydraulic control lever protruding from the heel board, which should be in the central position, can now be moved downwards to "Pay-out" or upwards for "Pay-in" the cable and held in position.

### The following points should be noted:

- (a) The control knob on the left-hand side of the winch unit (viewed from the front) is for the engagement of the cable drum to the driving shaft. When disengaged for a rapid run-out of the cable, two inbuilt brake pads prevent over-run of the drum, which would otherwise cause the cable to spring into loose coils.

- (b) When rewinding the slack cable after a winching operation it is necessary to apply some resistance to the cable to obtain a neat and even lay on the drum (*i.e.* an assistant holding the end of the cable against the pull of the drum).
- (c) If the overload safety valve operates during a winching operation (indicating that the maximum pull has been exceeded), the control valve can be moved to the "Pay-out position" and then re-engaged to "Pull-in position".
- (d) When recovery or self-recovery operations take place on a very steep slope, the maximum pull is sometimes exceeded due to the angle of the cable when the vehicle has reached the apex of the hill. If the safety valve operates it will sometimes be found that a restart is not possible. In these circumstances the vehicle should be lowered a certain amount in the "Pay-out position", and a further attempt made after the tension in the cable has been reduced.
- (e) Ground anchors, sprags under the wheels, other vehicles, trees, etc., can be used for securing the vehicle when it is used for general winching or for securing the end of the cable when self-recovery is necessary. The safety valve in the pressure line of the hydraulics will prevent damage to both the winch and the vehicle.

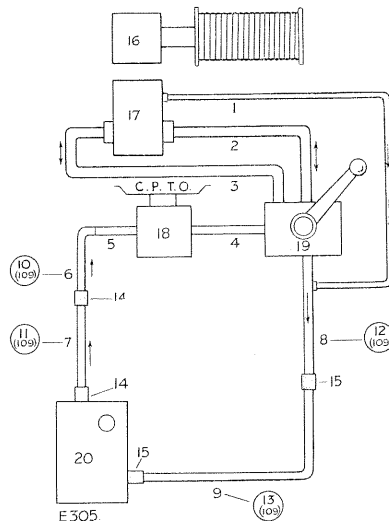


Fig. T-30—Diagrammatic layout of hydraulic winch equipment—88 and 109 models

- 1—Pipe, motor exhaust—88 and 109
- 2—Pipe, flexible, valve to motor—88 and 109
- 3—Pipe, flexible, valve to motor—88 and 109
- 4—Pipe, flexible, pump to valve—88 and 109
- 5—Pipe, pump suction—88 and 109
- 6—Pipe, suction pump end—88
- 7—Pipe, suction tank end—88
- 8—Pipe, return control end—88
- 9—Pipe, return tank—88
- 10—Pipe, suction pump end—109
- 11—Pipe, suction tank end—109
- 12—Pipe, return control end—109
- 13—Pipe, return tank—109
- 14—Hose connection—88 and 109
- 15—Hose connection—88 and 109
- 16—Front winch
- 17—Motor
- 18—Pump
- 19—Control valve
- 20—Oil reservoir

- (f) The power take-off lever should be pushed in after winching operations are completed, to prevent the pump being driven unnecessarily when travelling along the road.

#### Hydraulic winch, to service

##### Winch, to remove Operation T/28

1. Remove the cable by unwinding the drum and slackening the cable retaining cleat on the outside of the right-hand drum flange.
2. Disconnect the copper exhaust pipe and the two flexible pipes from the winch motor.
3. Disconnect the clip securing the copper pipe from the winch mounting flange.
4. Remove the bolts securing the roller guide frame to the front cross-member (bumper bar).
5. Remove the bolts securing the winch support brackets to the front bumper.
6. Remove the two outer U bolts securing the winch rear connecting tube to the mounting bracket.
7. Lift off winch complete. Remove the hydraulic motor if necessary.

##### Winch, to refit Operation T/30

1. If removed, refit the hydraulic motor.
2. Refit the roller guide frame, complete with winch, loosely to the rear connecting tube.
3. Refit the bolts securing the winch support brackets to the front bumper.
4. Refit the bolts securing the roller guide frame to the front bumper.
5. Refit the clip for copper pipe to the winch mounting flange.
6. Reconnect the copper exhaust pipe and the two flexible pipes to the winch motor.
7. Refill the winch with the correct oil; then test and wind on cable. Check for leaks under normal load conditions.

##### Roller guide frame, to remove and refit

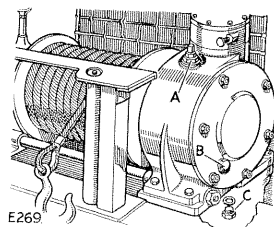
##### Operation T/32

1. Remove the front winch complete.
2. Remove the bolts securing the roller guide frame to the rear connecting tube.
3. To refit, reverse the removal procedure, but do not fully tighten the roller guide frame U bolts until the winch is secured.

Note that there must always be a minimum of  $\frac{3}{8}$  in. (9,5 mm) clearance between the cable drum flanges and the guide frame.

**Hydraulic winch, to strip      Operation T/34**

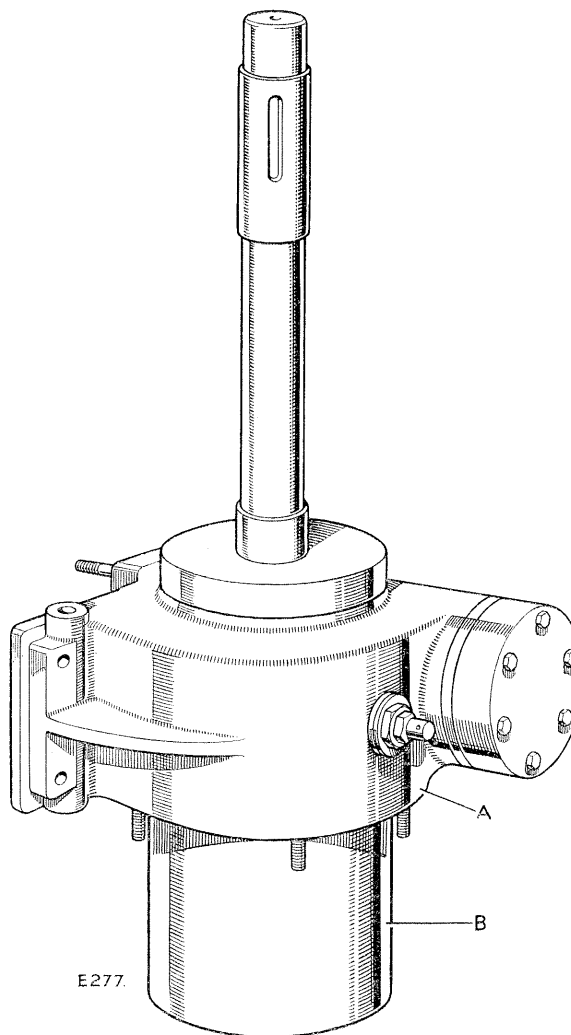
1. Remove the winch drain plug and allow the oil to flow into a suitable receptacle. Do not use this oil again.

**Fig. T-31—Hydraulic front winch gearbox**

A—Filler plug      B—Level plug      C—Drain plug

2. Remove the nuts securing the left-hand side support bracket to the front and rear connecting tubes, and remove the bracket complete with the shaft bearing and dog clutch selector lever. If necessary, remove the bearing and selector lever.
3. Remove the two slotted screwed plugs from the right-hand side of the winch drum flange. Withdraw the springs and braking pads.
4. Withdraw the dog clutch and the two keys from the shaft. Remove the winch drum and thrust ring.
5. Remove the securing nut and washers and withdraw the hydraulic motor complete with gasket, from the gearbox casing.
6. Remove the securing nuts and lift off the end plate and gasket from the casing.
7. Support the worm wheel on a suitable tubular stand. If a stand is not to hand, a strong deep tin of suitable diameter will suffice. Using a copper-headed mallet drift out the main shaft from the worm wheel, support bearing and friction disc. Retain the brass shims, if fitted, and worm wheel key.
8. Slacken the brake band plunger, then remove the set bolts and washers securing the brake drum cover and brake band to the gearbox casing. Remove the joint washer.
9. Withdraw the brake drum from the worm shaft. Remove the locating key.
10. Remove the bearing retaining cap from the worm shaft housing, complete with joint washer and brass shims.
11. Gently tap the worm shaft, complete with bearing races, out from the gearbox casing.

12. Remove the shaft bearing and oil seal from the gearbox casing. If necessary remove the outer shaft bearing from the cover plate.
13. If necessary, remove the front and rear connecting tubes from the gearbox casing.

**Fig. T-32—Winch on tubular stand**

A—Winch      B—Tubular stand

**Hydraulic winch, to assemble****Operation T/36**

1. Clean all parts thoroughly in paraffin. Carefully inspect the bearing races, and renew if showing signs of wear. Examine the worm shaft and worm wheel; renew as an assembly if badly worn or if damaged.
2. Slide the two distance pieces on to the worm shaft, one either side of the gear, with the chamfered recesses facing inward.

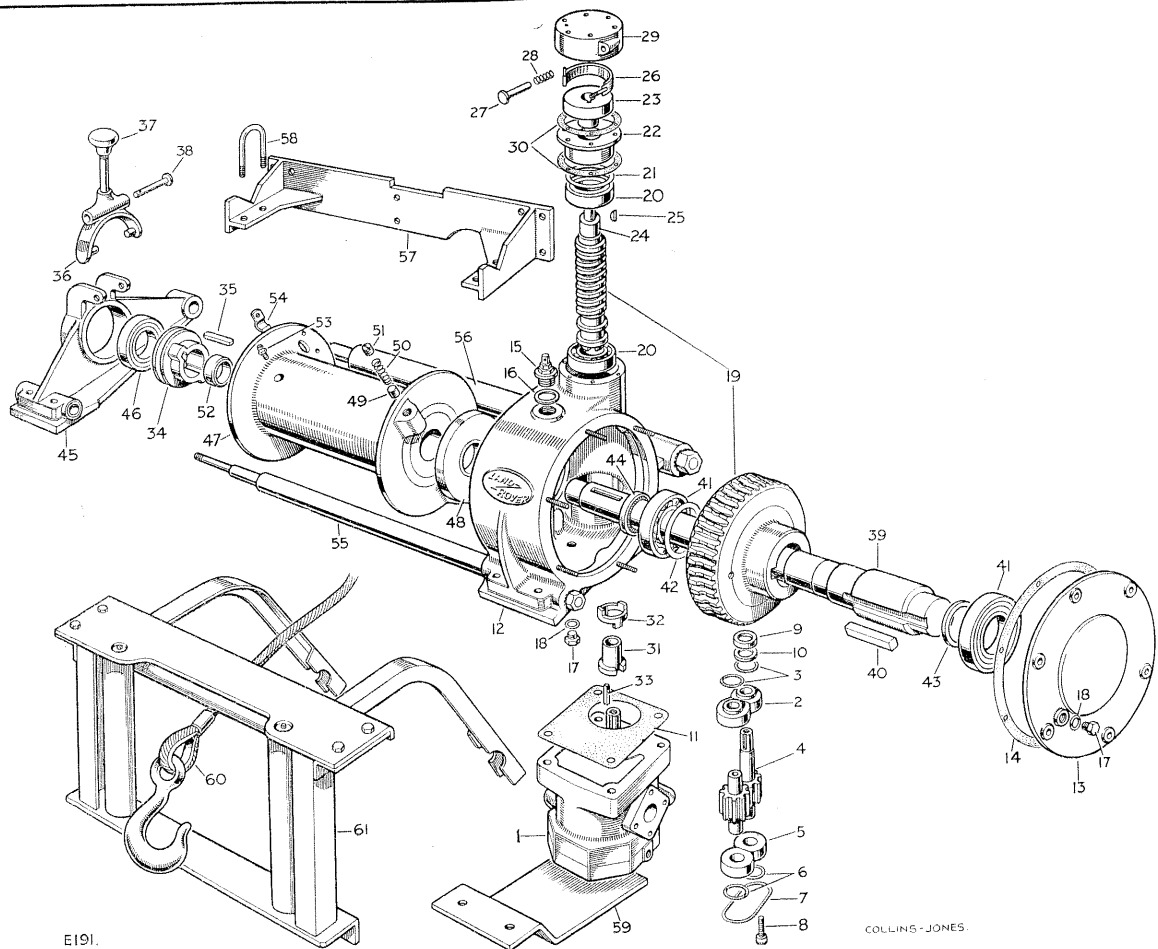


Fig. T-33—Layout of hydraulic winch

- |   |  |                                       |
|---|--|---------------------------------------|
| 1 Hydraulic motor                             | 31 Coupling sleeve                         | } Connecting motor unit to worm shaft |
| 2 Bushes, 'B' for gear shaft                  | 32 Coupling dog                            |                                       |
| 3 'O' rings                                   | 33 Key                                     |                                       |
| 4 Gears and shafts                            | 34 Dog clutch                              |                                       |
| 5 Bush 'A' for gear shafts                    | 35 Key                                     |                                       |
| 6 Sealing ring for 'A' bushes                 | 36 Selector lever                          |                                       |
| 7 'O' ring for housing                        | 37 Knob                                    |                                       |
| 8 Special screw fixing body cover and body    | 38 Retaining pin                           |                                       |
| 9 Shaft oil seal                              | 39 Worm and drum shaft                     |                                       |
| 10 Oil seal baffle                            | 40 Key fixing worm to shaft                |                                       |
| 11 Joint washer                               | 41 Bearing for shaft worm end              |                                       |
| 12 Gearbox casing                             | 42 Shims                                   |                                       |
| 13 End plate for casing                       | 43 Distance wing for shaft, worm end       |                                       |
| 14 Joint washer                               | 44 Oil seal for shaft, worm end            |                                       |
| 15 Oil filler plug                            | 45 Support bracket for worm and drum shaft |                                       |
| 16 Joint washer                               | 46 Bearing for worm and drum shaft         |                                       |
| 17 Oil level and drain plug                   | 47 Cable drum                              |                                       |
| 18 Joint washer                               | 48 Friction disc                           |                                       |
| 19 Worm wheel, worm shaft and distance pieces | 49 Pad                                     | } For friction disc                   |
| 20 Bearing for worm shaft                     | 50 Spring                                  |                                       |
| 21 Shims                                      | 51 Retaining plug                          |                                       |
| 22 Retaining cap                              | 52 Thrust spring                           |                                       |
| 23 Brake drum                                 | 53 Grease point                            |                                       |
| 24 Distance piece                             | 54 Pleat                                   |                                       |
| 25 Key  | 55 Connecting tube, front                  |                                       |
| 26 Brake band                                 | 56 Connecting tube, rear                   |                                       |
| 27 Plunger                                    | 57 Rear mounting bracket                   |                                       |
| 28 Spring                                     | 58 U bolt                                  |                                       |
| 29 Brake drum cover                           | 59 Protection shield                       |                                       |
| 30 Joint washer                               | 60 Winch cable                             |                                       |
|   | 61 Guide frame for cable                   |                                       |

3. Fit one of the worm shaft bearings on to the shaft, at the keyway end, and position the other shaft bearing into the winch casing at the hydraulic pump end, ensuring that it is squarely located. Note carefully that these are thrust bearings, and that they must be fitted the correct way round, or excessive worm shaft backlash will be present. See Fig. T-34, item D, upper and lower, for correct fitting.

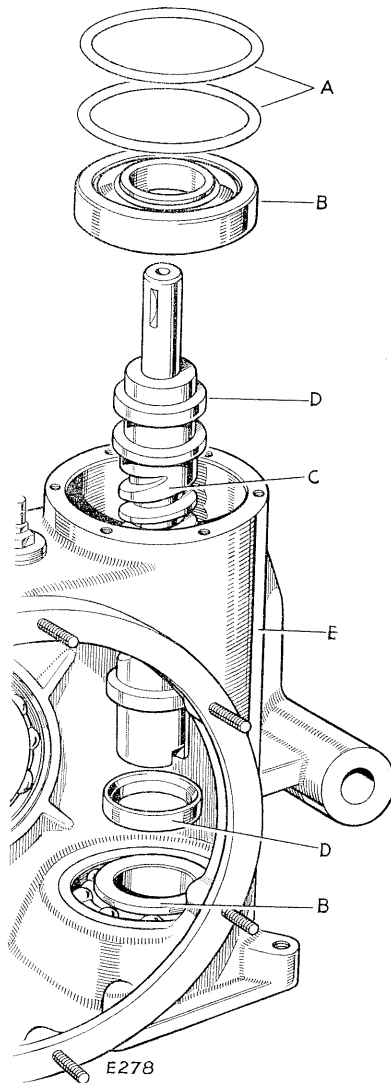


Fig. T-34—Worm shaft fitting

A—Shims  
B—Bearing  
C—Worm shaft  
D—Collars  
E—Casing

4. Enter the worm shaft complete with bearing into the lower bearing located in the gearbox casing. Holding the shaft absolutely central, gently tap the bearings and shaft fully home.
5. Temporarily fit the bearing retaining cap and brake drum cover and check the worm shaft end-float as illustrated. Obtain the correct end-float of .002 in. (0,05 mm) by fitting shims between the retaining cap and upper shaft bearing.

Brass shims are available .002 in., .005 in. and .010 in. (0,05 mm, 0,12 mm and 0,25 mm) thick. When the correct end-float has been obtained, remove the brake drum cover and retaining cap.

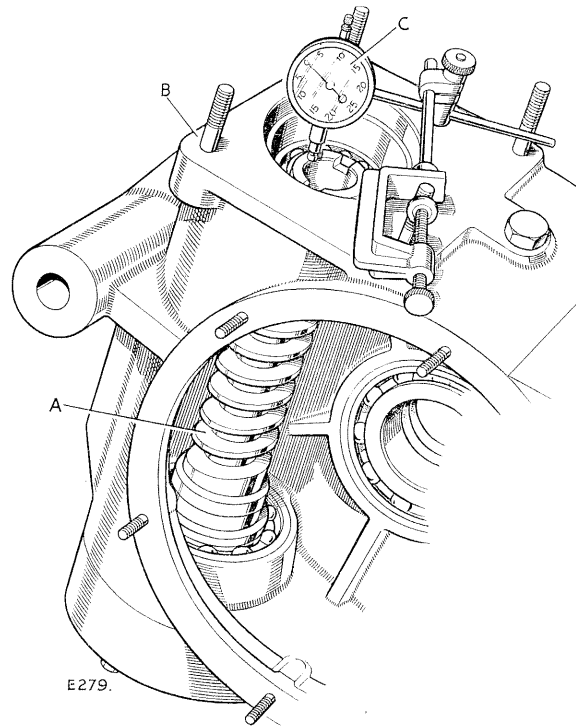


Fig. T-35—Checking worm shaft end-float

A—Wormshaft B—Casing C—Clock gauge

6. Slide the brake drum distance piece over the shaft, with the chamfered recess facing inwards. Fit the key.
7. Position the bearing retaining cap and a new joint washer on the winch gearbox casing. Fit the brake drum to the shaft and key.
8. Fit the brake band to the brake drum cover, allowing the peg to enter the locating hole, and the adjustment screw to enter the operating plunger hole. Fit the plunger and return spring but do not screw in at this stage.
9. Fit the brake drum cover, complete with brake band and a new joint washer. The brake band must also be located in the small hole in the bearing retaining cap and the whole assembly must be positioned so that the operating plunger faces forward. Secure with the set bolts and washers.
10. Fit the oil seal and drum shaft bearing to the winch gearbox casing.
11. Fit the worm wheel to the winch drum shaft and key and ensure a smooth sliding fit. Mark the key and remove the worm wheel and key from the shaft.

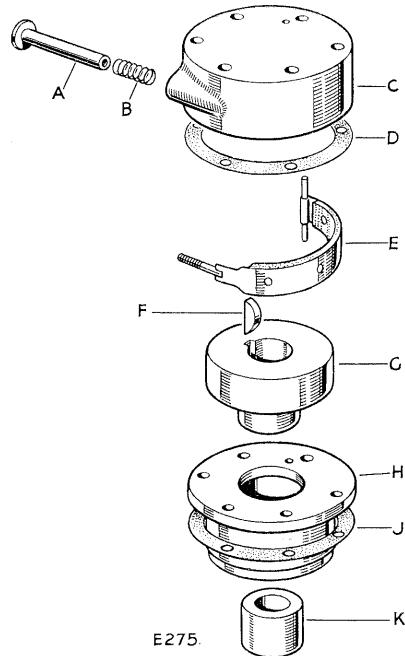


Fig. T-36—Brake drum assembly

- |                |                  |
|----------------|------------------|
| A—Plunger      | F—Key            |
| B—Spring       | G—Brake drum     |
| C—Drum cover   | H—Retaining cap  |
| D—Joint washer | J—Joint washer   |
| E—Brake band   | K—Distance piece |

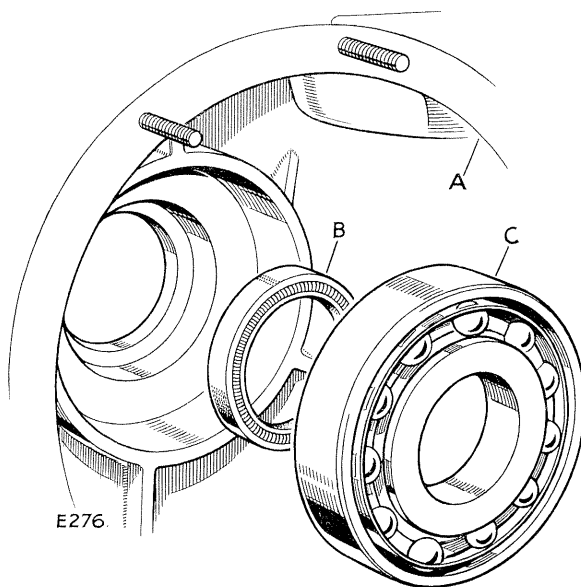


Fig. T-37—Drum shaft bearing and oil seal

- |          |            |           |
|----------|------------|-----------|
| A—Casing | B—Oil seal | C—Bearing |
|----------|------------|-----------|

12. Place the worm wheel into the gearbox casing in mesh with the worm shaft.
13. Temporarily fit the drum drive shaft less key to the worm wheel and bearing in the gearbox casing.

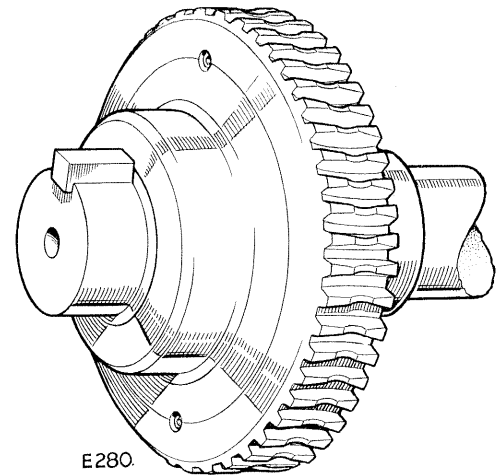


Fig. T-38—Worm wheel, key and drum shaft

14. Fit the distance ring to the shaft and measure the clearance between the ring and worm wheel. Remove the drum shaft, then fit shims to this value between the worm wheel and the shaft bearing located in the gearbox casing. Shims are available .002 in., .005 in. and .010 in. (0,05 mm, 0,12 mm and 0,25 mm) thick.
15. Refit the drum shaft to the worm wheel and casing and tap home the securing key. Ensure that the key is below the surface of the worm wheel.

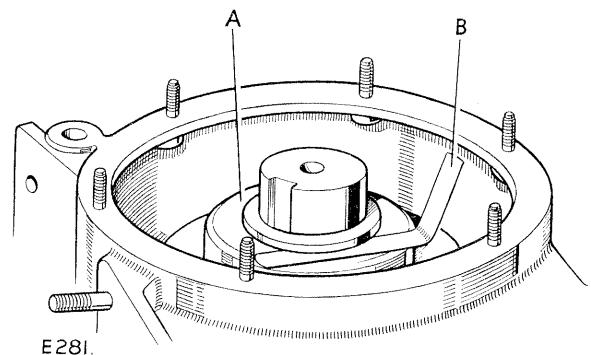


Fig. T-39—Checking worm wheel position

- |              |                |
|--------------|----------------|
| A—Worm wheel | B—Feeler gauge |
|--------------|----------------|

16. Fit the distance ring, with the chamfered side facing inward, and thrust bearing to the winch drum shaft.
17. Fit the end cover plate complete with gasket to the gearbox casing and drum shaft bearing, with the oil level plug adjacent to the front connecting tube.
18. Fit the friction disc to the winch drum shaft with the slight boss towards the gearbox casing. Ensure that the disc is driven right home on to the shaft shoulder.
19. Fit the cable drum to the shaft with the dog clutch slots facing outwards.

exercised to ensure that the seal counterbore housing is not scored.

20. Fit the thrust ring on to the drive shaft and tap fully home into the drum. The chamfer should face towards the drum. Fit the two keys to the drive shaft and ensure that the dog clutch slides freely on the shaft.
21. If removed, fit the clutch bearing into the end support bracket and fit the dog clutch operating lever.
22. Fit the end support bracket with the bearing facing the shaft to the front and rear connecting tube and winch drum shaft. Secure in position.
23. Fit the friction pads, springs and screwed plugs to the winch drum. Screw in until tight, then slacken back one complete turn.
24. Fit the key and coupling sleeve to the hydraulic pump and secure in position with plain washer, spring washer and set bolt.

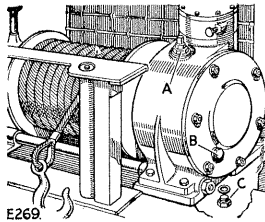


Fig. T-40—Hydraulic front winch gearbox

A—Filler plug      B—Level plug      C—Drain plug

25. Fit the coupling dog to the pump sleeve, then fit the hydraulic pump to the worm shaft, with the exhaust outlet pipe facing outward, using a new joint washer.
26. Refill the winch casing with the recommended oil up to the level plug and refit the oil filler plug. Capacity 2 pints (1,0 litre).

#### Hydraulic motor, to strip      Operation T/38

1. Remove the special screws securing the end cover to the body.
2. Withdraw the end cover and the two small and one large sealing rings.
3. Press the drive shaft into the body so that a finger-hold on the first pair of bushes marked 'C' can be obtained.
4. Remove the bushes and slide off the drive shaft and gear; remove the driven gear, the second pair of bushes marked 'A' and the two small sealing rings.

A drift must not be used when extracting bushes. Should they be tight, tap the body on a wooden block to dislodge them.

To facilitate assembly, the parts should be laid out in the same order as they were withdrawn, in order to maintain mating shafts and bushes in the same relative position. Mark the bushes 'I' for idler and 'D' for drive respectively.

5. If necessary drift the shaft seal and baffle washer out from inside the case; care should be

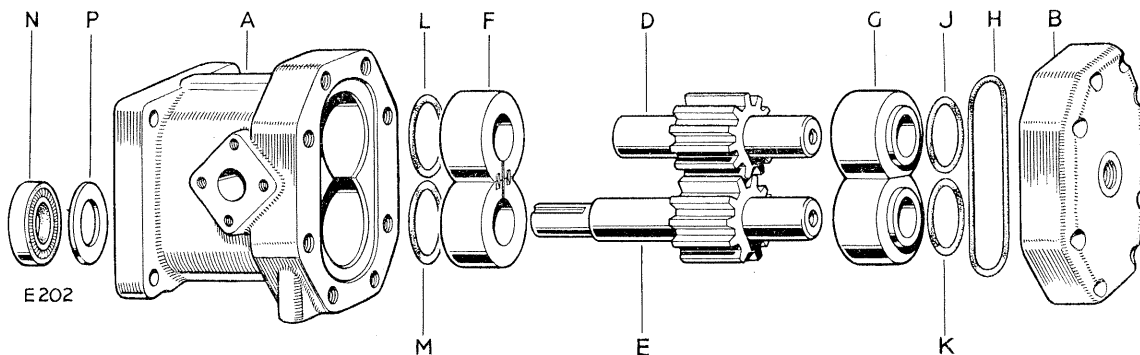


Fig. T-41—Hydraulic motor

A—Body  
B—Cover plate  
D—Drive shaft and gear  
E—Driven gear

F—Bushes 'A'  
G—Bushes 'C'  
H—'O' ring  
J—Support ring  
K—Support ring

L—'O' ring  
M—'O' ring  
N—Shaft seal  
P—Baffle washer

**Hydraulic motor, to assemble****Operation T/40**

Before assembling the motor, carefully inspect the various components. New bushes should be fitted if the original ones show signs of wear or scoring. If a new body is necessary new bushes must be fitted to ensure maximum efficiency. New sealing rings must always be fitted, and gear shafts should be renewed if not in good condition. Measure the shafts with a micrometer, and if the diameter is less than 0.75 in. (19 mm) dia., it should be replaced.

1. Wash all parts thoroughly in a bath of petrol or thinners and blow out passage ways with an air line.
2. If removed fit a new shaft seal as follows: place the baffle washer and new seal, with the sealing lip facing inwards, in the body counterbore and press in flush with the spigot on the motor body.
3. Place new rubber sealing rings on the forward pair of bushes marked 'A', retaining them with a smear of Silicone MS4 grease, and slide the bushes into location in the body bore. The bushes must be kept square both to the bore and to each other during insertion, otherwise possible damage will occur. Lightly oiled bores will facilitate fitting.
4. Check that the rubber sealing rings have not slipped during assembly and that they are located between the bushes and the bottom of the bores. Ensure that the recess in the bush faces are not staggered.
5. Fit the drive shaft to the body, using assembly sleeve, Part No. 515743.

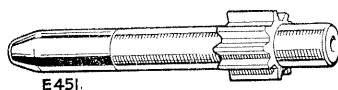


Fig. T-42—Assembly sleeve for drive shaft

6. Fit the driven gear to the pump body. If the original gears and shafts are being used, check that the driven gear takes up its 'bedded' position by mating the teeth contact marks with those on the drive gear.
7. Lubricate the rear pair of bushes, marked 'C', and insert into the housing.
8. Mount the new rubber sealing rings in position on the bushes, and place a new large rubber sealing ring in the housing.
9. Fit the end cover and secure with the eight special screws, tightening down evenly. Lock by centre punching the cover around the heads.

10. Pour a small quantity of oil in the ports, and turn the pump over by hand. If it has been correctly assembled it should rotate smoothly by hand from a radius of 4 in. (102 mm). Undue stiffness must be investigated and remedied.
11. A pump that has been assembled with new gears, bushes or body must be carefully run in. This should be effected for a period of at least thirty minutes, starting at 500 r.p.m., and zero pressures, gradually increasing speed and pressure to full working requirements. It should be ensured that there is no undue rise in temperature during this process, or extended running-in at reduced pressure may be necessary.

**Hydraulic pump and P.T.O. assembly, to remove**

**Operation T/42**

1. Remove the seat centre panel.
2. Remove the three clevis pins and withdraw the selector lever and linkage.
3. Remove the four bolts securing the selector unit to the gearbox housing.
4. Remove the hose connecting the suction pipe to the pump.
5. Disconnect the flexible pressure pipes between selector valve and pump.
6. Remove the twin pipe clips from the pump flange.
7. Remove the four nuts securing the pump to the rear of the transfer box, noting that the left-hand upper stud is longer and includes the clevis pin fixing for the selector lever.
8. Withdraw the pump and power take-off complete.
9. If necessary, remove the pump and composite coupling from the P.T.O. assembly.

**Hydraulic pump and P.T.O., to refit****Operation T/44**

1. If removed, refit the pump and composite coupling to the P.T.O. assembly, using a new joint washer.
2. Offer up the pump and power take-off assembly with the port marked 'Inlet' to the right-hand side. The two tapped holes on the top of the pump body should be uppermost. Secure the pump to the gearbox casing.
3. Fit the power take-off selector unit complete with a new gasket and ensure that it will enter the dog clutch.
4. Reconnect the flexible hoses to the pump in accordance with the diagram at Fig. T/43.
5. Refit the twin hose clips to the pump flange.





- 80 Flexible pipe, control valve to  
motor, 101½ in. long
- 81 Elbow for flexible pipe
- 82 'O' ring
- 83 Adaptor
- 84 Special seal
- 85 Adaptor
- 86 Special seal
- 87 Flexible pipe, pump to control  
valve, 26 in. long
- 88 Connection for pipe, pump to  
control valve
- 89 'O' ring—connection to pump
- 90 Adaptor
- 91 Special seal
- 92 Flexible pipe, pump to tank, pump  
end
- 93 Elbow on pump for flexible pipe
- 94 'O' ring—fixing elbow to pump
- 95 Pipe, steel, front
- 96 Pipe, steel, rear
- 97 Rubber connection, front to rear  
pipe and rear pipe to tank
- 98 Hose clip
- 99 Pipe, steel, front
- 100 Pipe, steel, rear
- 101 Adaptor on control valve for tank pipe
- 102 Joint washer for adaptor
- 103 Rubber connection, front to rear  
pipe and rear pipe to tank
- 104 Hose clip
- 105 Oil exhaust pipe for motor
- 106 Banjo complete
- 107 Union for exhaust pipe at rear
- 108 Clip
- 109 Clip
- 110 Clip
- 111 Clip
- 112 Clip
- 113 Clip
- 114 Clip
- 115 Clip

- 1 Selector housing
  - 2 Selector shaft
  - 3 Selector fork
  - 4 Ball
  - 5 Spring
  - 6 Plug for spring
  - 7 Joint washer
  - 8 Cover plate for selector housing
  - 9 Joint washer, top cover plate
  - 10 Joint washer
  - 11 Stud for selector pivot
  - 12 Pivot for selector lever
  - 13 Operating lever for shaft
  - 14 Clevis complete—fixing lever and  
pivot to selector shaft
  - 15 Rod for operating lever
  - 16 Clevis complete—fixing rod to  
operating lever
  - 17 Grommet for rod
  - 18 Knob
  - 19 Hydraulic pump for power take-off  
unit
  - 20 Bush 'A' for gear shafts
  - 21 'O' ring for 'A' bushes
  - 22 Gears and shafts
  - 23 Bush 'C' for gear shafts
  - 24 Sealing ring for 'C' bushes
  - 25 Support ring for 'C' bushes
  - 26 Special dowel for body and bush
  - 27 'O' ring for housing
  - 28 'O' ring, body ports
  - 29 Special screw fixing body cover to  
body
  - 30 Oil seal for shaft
  - 31 Throttle for oil seal
  - 32 Adaptor for hydraulic pump
  - 33 Joint washer
  - 34 Drive shaft
  - 35 Distance piece
  - 36 Ball bearing
  - 37 Circlip
  - 38 Circlip
  - 39 Roller bearing
  - 40 Retaining ring
  - 41 Circlip
- } For selector  
control  
mechanism
- } For power  
take-off unit
- } Fixing roller  
bearing to shaft

6. Refit the control levers and linkage, adjust by means of the lower clevis, to ensure that the dog clutch makes full engagement and that the control knob does not foul the heelboard.
7. Test and check for correct operation and leaks, under normal load conditions.
8. Replace the seat box cover panel.

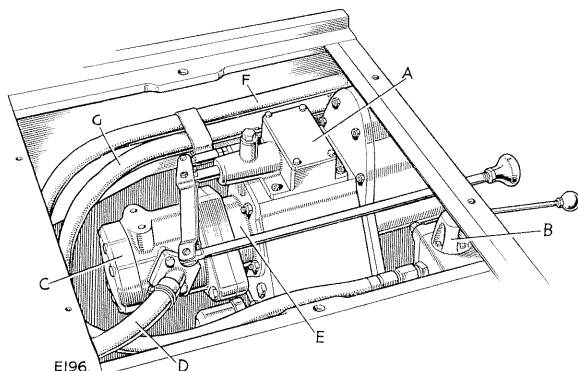


Fig. T-44—Pump in position

- |                        |   |
|------------------------|---|
| A—Power take-off       | E—Pump adaptor                                  |
| B—Control valve        | F—Hose winch motor to control valve, L.H. side  |
| C—Pump                 |   |
| D—Suction pipe to tank | G—Hose, winch motor to control valve, R.H. side |

#### Hydraulic pump, to strip      Operation T/46

1. Remove the set bolt and withdraw the coupling from the pump driving shaft.
2. Remove the key.
3. Remove the eight special screws securing the end cover to the body.
4. Withdraw the end cover and the two small and one large sealing rings.

5. Press the drive shaft into the body so that a finger, hold on the first pair of bushes marked 'C' can be obtained.
6. Remove the bushes and slide off the drive shaft and gear; remove the driven gear, the second pair of bushes marked 'A' and the two small sealing rings.

A drift must not be used when extracting bushes. Should they be tight, tap the body on a wooden block to dislodge them.

To facilitate assembly the parts should be laid out in the same order as they were withdrawn, in order to maintain mating shafts and bushes in the same relative position. Mark the bushes 'I' for idler and 'D' for drive respectively.

If necessary drift the shaft seal and baffle washer out from inside the case; care should be exercised to ensure that the seal counterbore housing is not scored.

#### Hydraulic pump, to assemble

##### Operation T/48

Before assembling the motor, carefully inspect the various components. New bushes should be fitted if the original ones show signs of wear or scoring. If a new body is necessary new bushes must be fitted to ensure maximum efficiency. New sealing rings must always be fitted, and gear shafts should be renewed if not in good condition. Measure the shafts with a micrometer, and if the diameter is less than 0.75 in. (19 mm) dia. it should be replaced.

1. Wash all parts thoroughly in a bath of petrol or thinners and blow out passage ways with an air line.
2. If removed fit a new shaft seal as follows: place the baffle washer and new seal, with the sealing lip facing inwards, in the body counterbore and press in flush with the spigot on the motor body.

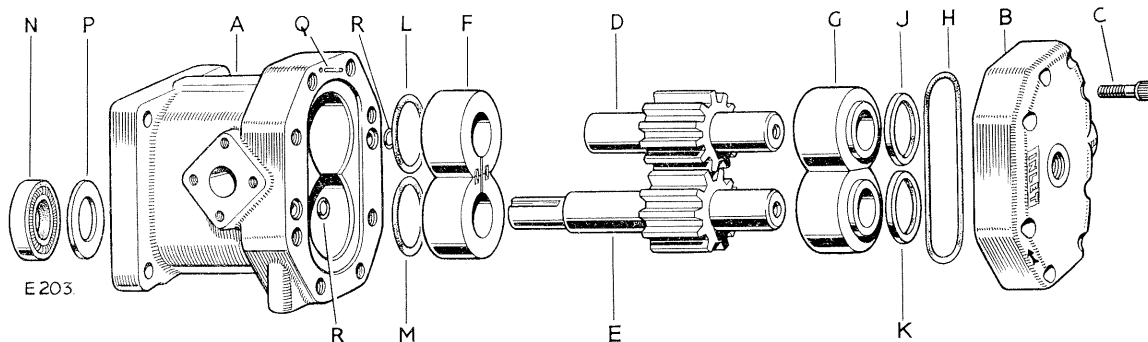


Fig. T-45—Hydraulic pump

- |                        |                |
|------------------------|----------------|
| A—Body                 |                |
| B—Cover plate          |                |
| C—Special bolts        |                |
| D—Drive shaft and gear | } Matched pair |
| E—Driven gear          |                |

- |                |
|----------------|
| F—Bushes 'A'   |
| G—Bushes 'C'   |
| H—'O' ring     |
| J—Support ring |
| K—Support ring |
| L—'O' ring     |

- |                 |
|-----------------|
| M—'O' ring      |
| N—Shaft seal    |
| P—Baffle washer |
| Q—Dowel         |
| R—'O' ring      |

3. Place new rubber sealing rings on the forward pair of bushes marked 'A', retaining them with a smear of Silicone MS4 and slide the bushes into location in the body bore. The bushes must be kept square both to the bore and to each other during insertion, otherwise possible damage will occur. Lightly oiled bores will facilitate fitting.
4. Check that the rubber sealing rings have not slipped during assembly and that they are located between the bushes and the bottom of the bores. Ensure that the recess in the bush faces are not staggered.
5. Fit the drive shaft to the body, using assembly sleeve, Part No. 515743; lubricate the sleeve before use.



Fig. T-46—Assembly sleeve for drive shaft

6. Fit the driven gear to the pump body. If the original gears and shafts are being used, check that the driven gear takes up its "bedded" position by mating the tooth contact marks with those on the drive gear.
7. Lubricate the rear pair of bushes, marked 'C', and insert into the housing.
8. Mount the new rubber sealing rings in position on the bushes, and place a new large rubber sealing ring in the housing.
9. Fit the end cover and secure with the eight special screws, tightening down evenly. Lock by centre punching the cover around the heads.
10. Pour a small quantity of oil in the ports, and turn the pump over by hand. If it has been correctly assembled it should rotate smoothly by hand from a radius of 4 in. (102 mm). Undue stiffness must be investigated and remedied.
11. Refit the coupling and key, and secure with a set bolt and plain and spring washers.
12. A pump that has been assembled with new gears, bushes or body must be carefully run in. This should be effected for a period of at least thirty minutes, starting at 500 r.p.m. and zero pressures, gradually increasing speed and pressure to full working requirements. It should be ensured that there is no undue rise in temperature during this process, or extended running-in at reduced pressure may be necessary.

#### Power take-off, to strip      Operation T/50

1. Remove the pump and composite coupling. Withdraw the dog clutch.

2. Remove the large circlip securing the shaft and bearing to the P.T.O. housing.
3. Remove the circlip and withdraw the ball race and distance piece.
4. Remove the retaining ring and circlip and withdraw the needle roller race from the splined shaft.

#### Power take-off, to assemble

##### Operation T/52

1. Fit the needle roller race into the splined drive shaft and secure with the retaining ring and circlip.
2. Fit the driving shaft ball race and distance piece on to the shaft and secure with a circlip.
3. Fit the shaft, complete with bearings, into the P.T.O. housing and secure with the large circlip.
4. Refit the pump and composite coupling, using a new joint washer.
5. Fit the dog clutch to the splined shaft, with the internal recess facing the vehicle gearbox.

#### Control valve, to remove

##### Operation T/54

1. Remove seat centre panel.
2. Remove the power take-off control rod, to gain access to the hoses and pipes.
3. Disconnect the three flexible hoses and the steel tank-return pipe.
4. Remove the knob and locknut, from control valve rod.
5. Remove the four set bolts and mounting plate.
6. Withdraw the control valve complete.

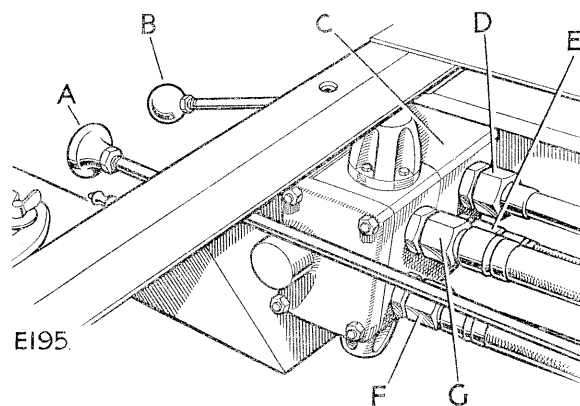


Fig. T-47—Control valve in position

- |                             |                                      |
|-----------------------------|--------------------------------------|
| A—Power take-off lever      | E—Hose, pump to control valve        |
| B—Control valve lever       | F—Hose, valve to winch motor         |
| C—Control valve             | G—Hose, control valve to winch motor |
| D—Steel pipe, valve to tank |                                      |

**Control valve, to refit      Operation T/56**

1. Offer up the control valve and secure in position with the mounting plate and four set bolts.
2. Check that the operating lever moves freely.
3. Refit the three flexible hoses and the steel tank-return pipe in accordance with the diagram given at Fig. T/47.
4. Refit the locknut and knob to control valve rod.
5. Fit the power take-off control rod.
6. Test and check for fluid leaks under normal load conditions.

**Control valve, to strip      Operation T/58**

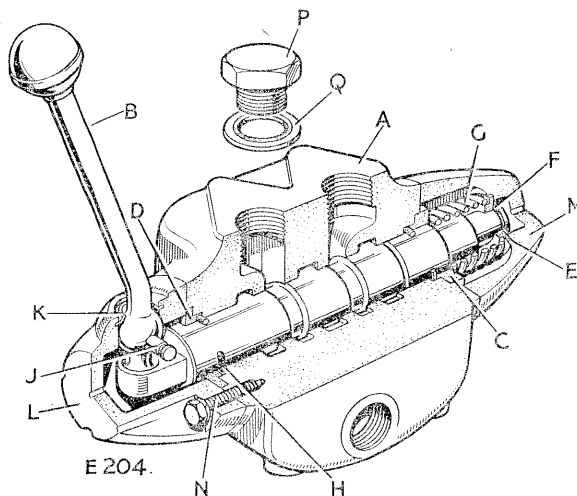
1. Remove the four tie-bolts and separate the side plate and unloader valve.

**Control valve, items 2-4**

2. Remove the hand lever and end cap, also cap at other end of body.
3. Extract the locating peg and tap out the lever pin. Draw the hand lever shank down through the wiper washer and then extract the wiper washer. Remove the other end cap.
4. Remove the piston, followed by the gland washers and rubber sealing rings.

**Unloader valve, items 5-8**

5. Remove the end cap from the unloader valve body and the seal from the end cap spigot.
6. Extract the spring and unloader piston from the body.

**Fig. T-48—Control valve**

- |                     |                      |
|---------------------|----------------------|
| A—Body              | J—Lever pin          |
| B—Hand lever        | K—Wiper washer       |
| C—Gland washer      | L—Hand lever end cap |
| D—Gland washer      | M—End cap            |
| E—Retaining washer  | N—Securing bolt      |
| F—Retaining ring    | P—Blanking plug      |
| G—Return spring     | Q—Bonded seal        |
| H—'O' ring (piston) |                      |

7. Unscrew and remove the cap nut and locknut from the adjusting screw and, using a screw-driver, remove the adjusting screw.
8. The spring and valve can now be extracted.

**Control valve, to assemble      Operation T/60**

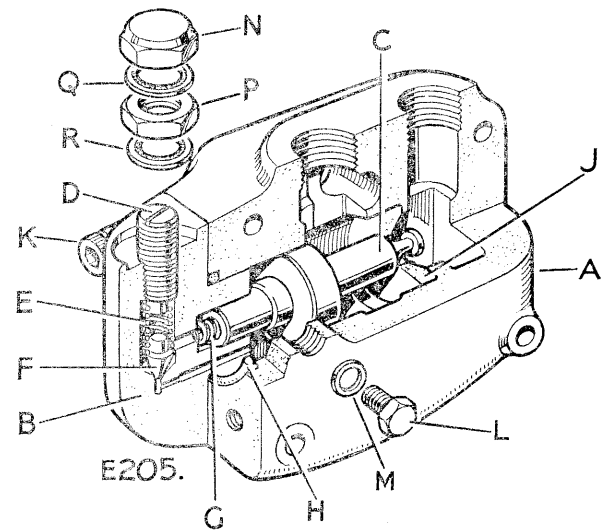
Examine all bores, spools and pistons for scoring, cracks, indentation, high spots, corrosion, etc., and renew as necessary.

Examine all valves and seatings for pitting, scoring, etc. Ensure that a thin, bright, unbroken line is apparent on both the valve and the seating.

Examine all seals for deterioration, cuts or signs of deformation.

Renew as necessary.

1. Fit the return spring and retaining washer to the piston and secure with a new circlip.
2. Insert the piston into the valve body, ensuring that the eye end protrudes from the 'control' side of the body.

**Fig. T-49—Relief and unloader valve**

- |                   |                    |
|-------------------|--------------------|
| A—Body            | J—Valve seat       |
| B—End cap         | K—Retaining screws |
| C—Unloader piston | L—Blanking plug    |
| D—Adjusting screw | M—Bonded seal      |
| E—Valve spring    | N—Cap nut          |
| F—Relief valve    | P—Locknut          |
| G—Piston spring   | Q—Locknut          |
| H—'O' ring        | R—Bonded seal      |

3. Carefully insert the two rubber sealing rings into their housings between the piston and the body.
4. Place the gland washers in position, at each end of the piston.
5. Fit the end cap, which should be packed with Silicone MS4 grease.

6. Slide the hand lever through the hole in the other end cap and carefully fit the wiper washer in the housing. Pack the cap with Silicone MS4 grease.
7. Align the hand lever with the end cap bores and enter the lever pin, locating it by means of the locating peg.
8. Place the hand lever ball in the eye of the piston and then locate and secure the end cap.

#### Unloader valve, items 9-13

9. Insert the piston into the bore in the unloader body and follow this with the spring.
10. Smear the rubber sealing ring with Silicone MS4 grease and position it on the end cap spigot.
11. Offer up the end cap to the unloader body and secure it in position.
12. Insert the relief valve and valve spring into the end cap bore and then temporarily assemble the adjusting screw, bonded seal, locknut, bonded seal, cap nut, in that order.
13. After smearing the face seal (rubber 'O' rings) with Silicone MS4 grease, locate them in their respective recesses in the valve body and in the side plate. Align the side plate, control valve and unloader/relief valve, then insert the four tie-bolts and secure the assembly.

#### Setting relief valve pressure Operation T/62

1. Connect the valve in circuit, then remove the pressure port plug from the unloader valve and substitute a suitable pressure gauge.

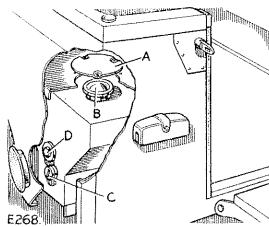


Fig. T-50—Supply tank

A—Cover plate  
B—Filler cap  
C—Drain plug  
D—Oil filter

2. Remove the cap nut, locknut and bonded seals, from the unloader valve.
3. Set the hand lever to the normal operating position and, using a screwdriver, turn the adjusting screw until the gauge indicates a pressure of 1000 lb/sq.in. (70 kg/sq.cm).
4. Fit the locknut, cap nut and bonded seals—lock in position.

5. Remove the pressure guage and refit the plug.

#### Tank, to remove

#### Operation T/64

1. Drain the oil from the tank into a suitable receptacle.
2. 88 models—Drill out the pop rivets and remove the protection plate.
3. 109 models—Remove the nuts and bolts and remove the protection plate.
4. Slacken the clips securing the suction and return pipes to the under-side of the vehicle body, then slacken the two hose clips at the tank, and manoeuvre the two pipes away.
5. Remove the cover plate from the wheel-arch seat base.
6. Remove the four bolts securing the tank to the seat base.
7. Remove the two nuts and bolts securing the tank to the bracket on the rear cross-member.

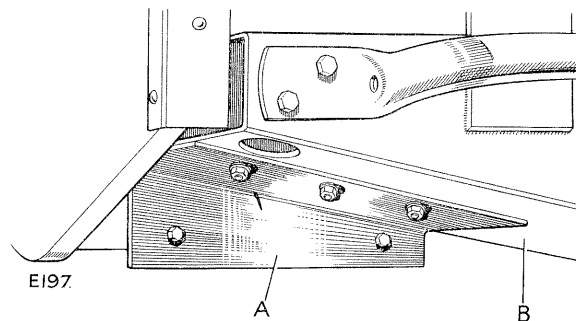


Fig. T-51—Tank fitting

A—Mounting bracket B—Rear cross-member

#### Tank, to refit

#### Operation T/66

1. Offer up the tank and loosely secure to the mounting brackets and seat box panel.
2. Ensure that the tank is positioned so that the outlet pipes face the gap between the body floor and chassis side member.
3. Tighten the tank fixings.
4. Connect the hoses to the tank pipes and tighten all the securing clips.
5. Refill the tank with the filler neck gauze in position, with  $4\frac{1}{2}$  gallons (20 litres) of the recommended oil.
6. Test and check for leaks under normal load conditions.
7. Replace the top cover and the protection panel (rivets on 88 models—nuts and bolts on 109 models).

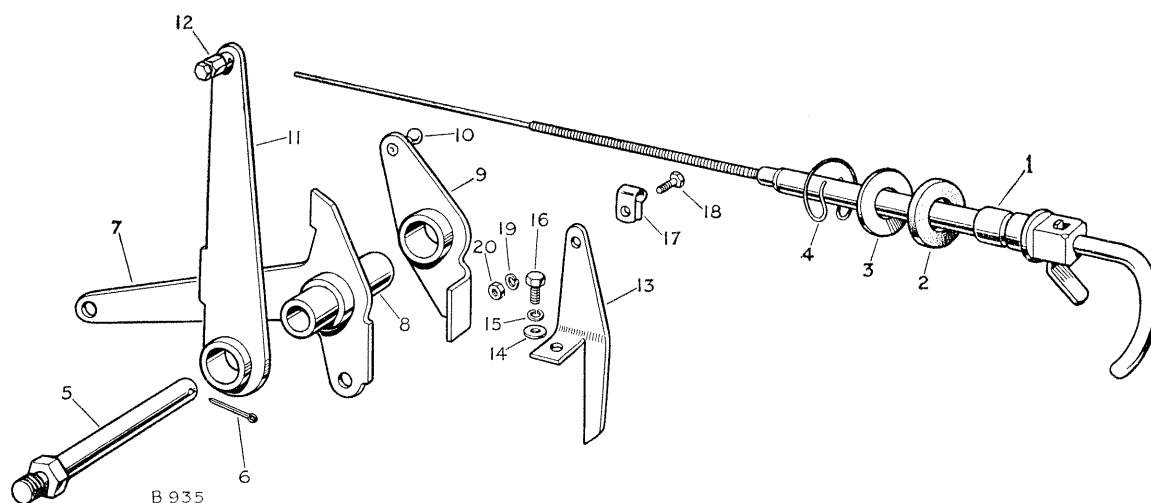
**Hand throttle—2 litre Petrol****To fit****Operation T/68**

1. Remove the air cleaner and connecting tube.
2. Disconnect the control rod between the accelerator relay lever and the carburettor relay lever, the rod between the carburettor lever and the bell crank lever, and the return spring from the bell crank lever.
3. Remove the bell crank lever and the relay lever from the bell crank spindle, unscrew the spindle from the inlet manifold, and replace with the new spindle.
4. Secure the abutment bracket to the tapped hole in the top rear face of the inlet manifold, using a set bolt, spring washer and plain washer.
5. Remove the ball pin from the original bell crank lever and fit it in the same position on the new bell crank lever.
6. Fit the hand throttle lever, the new bell crank lever, and the new relay lever to the spindle, using the original plain washer and split pin.
7. Replace the control rod between the carburettor lever and the bell crank lever, and connect the return spring to the bell crank lever.
8. Drill a  $\frac{13}{32}$  in. (15 mm) dia. hole in the control panel  $1\frac{1}{16}$  in. (30 mm) from the right-hand edge of the panel and  $1\frac{3}{8}$  in. (9 mm) from the bottom.

9. Place the hand throttle control in the hole drilled in the panel and secure with the fixings provided.
10. Secure the control outer casing to the abutment bracket with a clip, screw, spring washer and nut.
11. Connect the control inner cable to the hand throttle lever, using the fixings provided. Position the abutment bracket so that the control cable lies in smooth curves.
12. Connect the control rod between the accelerator relay lever and the carburettor relay lever. Adjust the control rods until there is  $\frac{1}{16}$  in. (1.58 mm) clearance between the hand throttle lever and the bell crank lever, and between the bell crank lever and the relay lever.
13. Test the operation of the control and replace the air cleaner.

**Engine hand speed control—2½ litre Petrol****To assemble quadrant control.****Operation T/70**

1. Fit lever for hand speed control to lever housing with large washer above lever and the bush beneath. Secure with bolt, plain washer from beneath and self-locking nut above.
2. Attach quadrant plate to front of housing with ratchet teeth to top, secure with countersunk screw, plain washers, spring washers and nuts.
3. Fit knob to lever with 2 B.A. screws and nuts.

**Fig. T-52—Layout of hand throttle—2 litre Petrol**

- |       |                                    |  |
|-------|------------------------------------|--|
| 1-4   | Hand throttle control              |  |
| 5-6   | Spindle for bell crank             |  |
| 7-8   | Bell crank lever                   |  |
| 9-10  | Relay lever                        |  |
| 11-12 | Hand throttle lever                |  |
| 13    | Abutment bracket for hand throttle |  |
| 14    | Plain washer                       | } Fixing abutment bracket                        |
| 15    | Spring washer                      |  |
| 16    | Set bolt                           |  |
| 17    | Cable clip                         | } Fixing hand throttle cable to abutment bracket |
| 18    | Screw                              |  |
| 19    | Spring washer                      |  |
| 20    | Nut                                |  |

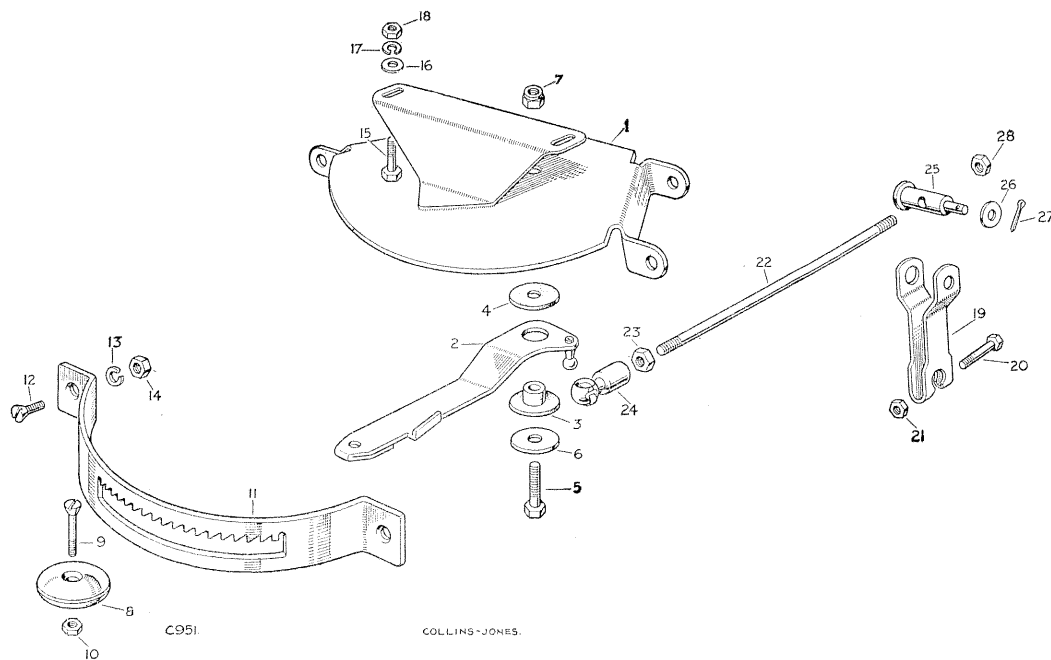
**To fit quadrant assembly to vehicle.**

4. Insert rubber grommet in cover panel.
5. Remove original cover panel from dash, (mounted beneath instrument panel), and replace with new panel, grommet to right-hand side, also position quadrant assembly and affix both with 2 bolts, spring washers and nuts.
6. Screw 2 B.A. locknut and ball socket on to control rod. Push control rod through grommet on dash and secure ball joint socket to ball end on hand speed control lever.
7. Disconnect battery feed lead.
8. Remove the 6 2 B.A. screws holding the instrument panel and pull panel forward.
9. Fit the two upper bolts, plain washers, spring washers and nuts securing the control housing to the dash panel.
10. Replace instrument panel, and reconnect battery lead.
11. Remove bracket supporting accelerator relay cross-shaft, and relay lever to engine.
12. Slide lever for quadrant control rod along cross-shaft until it aligns with control rod.

13. Replace relay lever to engine and cross-shaft supporting bracket.
14. Fit relay lever securing pinch bolt and nut.
15. Push joint pin through eye in relay lever, fit plain washer and split pin to joint pin.
16. The control rod should now be fitted through the hole in the joint pin and the adjusting and locking nut fitted to the control rod.
17. With the quadrant lever in the fully off position, lock the relay lever to the cross-shaft, and adjust the length of the control rod, until there is a small clearance between the adjusting nut and the joint pin.
18. Check the operation of the hand throttle. It is important to ensure that the throttle is allowed to return to the fully closed position when the quadrant lever is in the off position.

**Oil cooler—all models****To fit****Operation T/72**

1. Disconnect the bonnet prop rod from the bonnet by removing the split pin, plain and spring washers, then remove the bonnet.

**Fig. T-53—Layout of engine hand speed control—2 1/4 Litre Petrol**

- |   |   |
|---|---|
| 1 Control quadrant housing              | 15-18 Fixings—control to dash                             |
| 2 Lever and ball end for control        | 19 Operating lever, for hand engine speed control         |
| 3 Bush for lever                        | 20-21 Fixings—operating lever to accelerator cross-shaft  |
| 4 Washer for lever                      | 22 Control rod, for engine speed control                  |
| 5-7 Fixings—control lever to housing    | 23-24 Nut and ball socket, for control rod                |
| 8 Knob for lever                        | 25-27 Joint pin and fixings, for engine speed control rod |
| 9-10 Fixings—knob to lever              | 28 Nut, fixing control rod to joint pin                   |
| 11 Quadrant plate                       |   |
| 12-14 Fixings—quadrant plate to housing |   |

2. Drain the oil from the sump into a suitable receptacle.
3. Remove the dipstick, then remove the sump.
4. **2½ litre Petrol and Diesel models:** Remove the oil relief plug from the pump, then fit new plug complete with joint washer; fit the new crankcase sump complete with drain plug and replace the dipstick.
5. **2 litre Petrol models**
  - (a) Slacken the locknut securing the oil pressure relief valve, then screw out the valve, complete with spring, plunger and ball. Discard the screw and spring. Remove the locating screw and withdraw pump, leaving the pump driving shaft in position in the distributor shaft housing.
  - (b) Dismantle the pump and fit the new gears (Section A). Fit the new pump cover with the new bolts and split pins. Fit a new split split pin fixing the oil strainer.
- (c) Fit the reassembled pump to the engine, using the original locating screw. Replace the oil pressure relief valve, using the new adjusting screw and spring.
- (d) Fit the new crankcase sump complete with drain plug and replace the dipstick.
6. Secure the flexible oil pipe to the sump by means of the banjo centre and two joint washers. Do not fully tighten.
7. Remove the air cleaner body, oil reservoir and flexible pipe.
8. Remove the battery or batteries and carrier top/s.
9. Drain the coolant from the radiator.
10. Remove the front apron, radiator, and grille panel complete with headlamps. (Section L.)

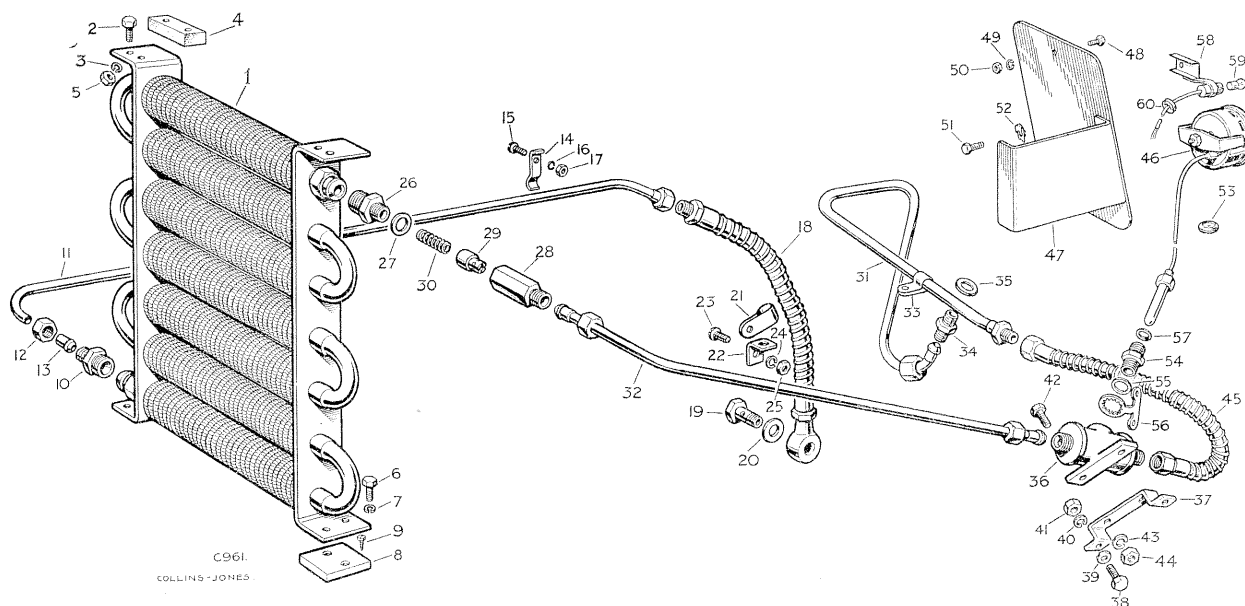
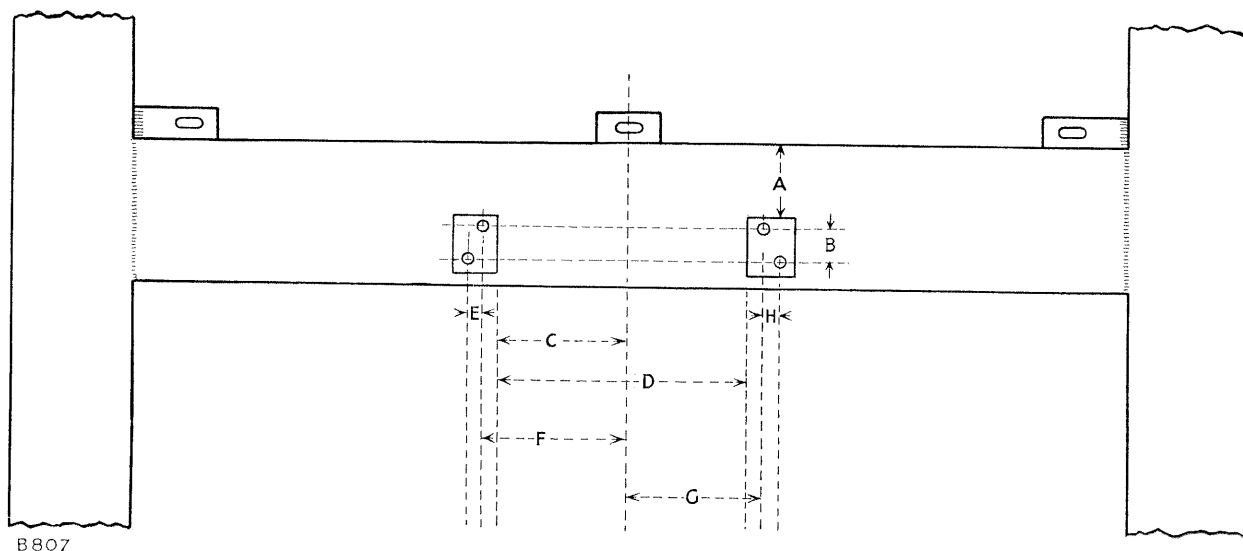


Fig. T-54—Layout of oil cooler—2 litre Petrol

- |       |                                      |                         |
|-------|--------------------------------------|-------------------------|
| 1     | Oil cooler                           |                         |
| 2-5   | Fixings—oil cooler to radiator       |                         |
| 6-7   | Fixings—oil cooler to frame          |                         |
| 8     | Tapping plate for oil cooler         |                         |
| 9     | Drive screw fixing plate to frame    |                         |
| 10    | Oil return pipe union                |                         |
| 11    | Oil return pipe                      |                         |
| 12-13 | Union fixings—for return pipe        |                         |
| 14    | Oil return pipe clip                 |                         |
| 15-17 | Fixings—for clip                     |                         |
| 18    | Flexible oil pipe, return to sump    |                         |
| 19-20 | Fixings—flexible pipe to sump        |                         |
| 21    | Flexible pipe clip                   |                         |
| 22    | Clip bracket                         |                         |
| 23-25 | Fixings—for clip                     |                         |
| 26    | Oil union                            | } For oil relief valve  |
| 27    | Joint washer for union               |                         |
| 28    | Body                                 | } For oil relief valve  |
| 29    | Plunger                              |                         |
| 30    | Spring for plunger                   |                         |
| 31    | Oil pipe, union to flexible pipe     |                         |
| 32    | Oil pipe to relief valve             |                         |
| 33    | Clip for pipe—union to flexible pipe |                         |
| 34    | Union for oil pipe                   | } On oil filter adaptor |
| 35    | Joint washer for union               |                         |
| 36    | Thermometer pocket complete          |                         |
| 37-41 | Not required                         |                         |
| 42-44 | Fixings—pocket to wing valance       |                         |
| 45    | Flexible pipe—pump to pocket         |                         |
| 46    | Oil temperature gauge                |                         |
| 47    | Mounting bracket for gauge           |                         |
| 48-52 | Fixings—mounting bracket to dash     |                         |
| 53    | Grommet for pipe in dash             |                         |





B807

Fig. T-55—Location and drilling of tapping plates

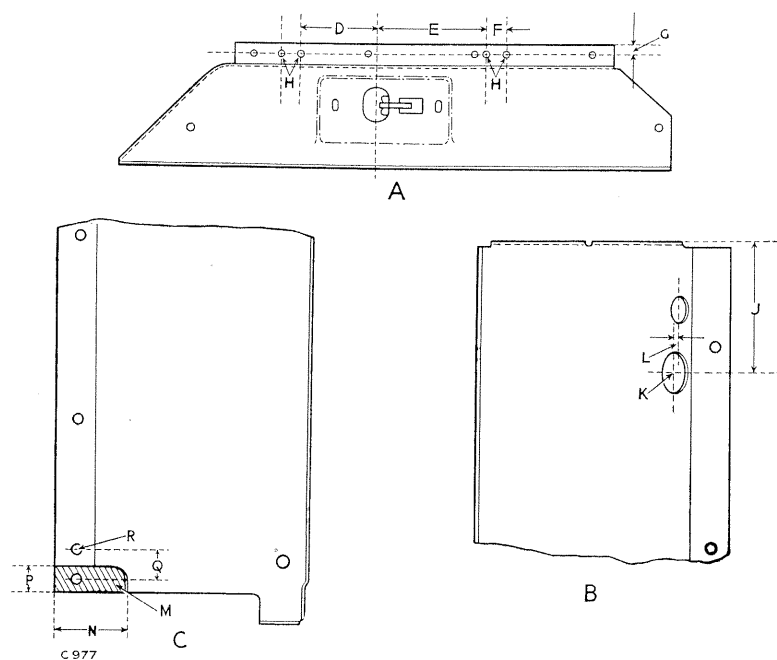
A— $1\frac{11}{16}$  in. (49 mm)C— $4\frac{7}{8}$  in. (124 mm)E— $\frac{1}{2}$  in. (12,5 mm)G— $4\frac{3}{8}$  in. (111 mm)B— $1\frac{1}{4}$  in. (31,5 mm)D— $8\frac{1}{4}$  in. (209,5 mm)F— $5\frac{7}{8}$  in. (149 mm)H— $\frac{1}{2}$  in. (12,5 mm)

Fig. T-56—Details of additional drillings in grille panels

A—Top panel

B—L.H. side panel

C—R.H. side panel

D— $3\frac{11}{16}$  in. (100 mm)E— $5\frac{7}{16}$  in. (138 mm)F— $\frac{11}{16}$  in. (24 mm)G— $\frac{9}{16}$  in. (14 mm)H—Four new holes  $\frac{9}{32}$  in. (7 mm) dia.J— $3\frac{1}{4}$  in. (82,5 mm)K—One new hole  $1\frac{1}{8}$  in. (29 mm) dia.L— $\frac{1}{8}$  in. (3 mm)

M—Shaded area represents section to be cut away

N— $1\frac{3}{4}$  in. (44 mm)P— $\frac{5}{8}$  in. (16 mm)Q— $\frac{1}{2}$  in. (12,5 mm)R—One new hole  $\frac{9}{32}$  in. (7 mm) dia.

11. Ease the tension on the fan belt. Remove and discard the fan and (2 litre Petrol) distance piece, and (2½ litre Petrol and Diesel models) fan belt, pulley and set bolts, but retain the spring washers.
12. Drive screw the two tapping plates to the chassis front cross-member, as illustrated in Fig. T-19.
13. Drill and tap the four holes in the tapping plates to ¼" U.N.F.
14. Remove and discard the inner left-hand nut and bolt, securing the grille panel assembly to the top of the radiator, then detach earth clip from the bolt in the top panel, and re-tighten the bolt.
15. Mark out and drill the L.H. side panel as shown in Fig. T-57.
16. Remove the lower securing nut and bolt, then mark out and cut away the section of the R.H. side panel indicated in Fig. T-57. Drill a hole above the cut-out, through the panel and radiator bracket, and refit securing nut and bolt.
17. **2 litre Petrol:** Remove and discard the fan cowl and replace with the new one.
18. **2 litre Petrol:** Remove and discard the radiator cap, and replace with the new one.
19. **2½ litre Petrol and Diesel models:**
  - (a) Remove the starter dog and withdraw the fan driving pulley or (Diesel) damper assembly. Replace with the new double pulley assembly and secure to the crankshaft with the starter dog and a new lock washer.

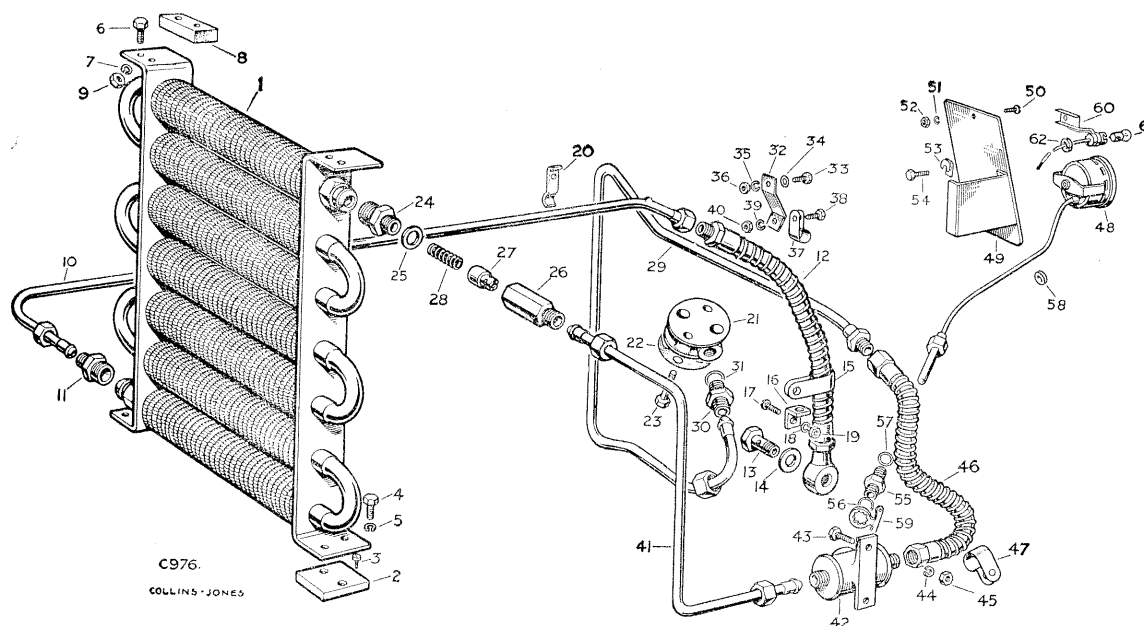
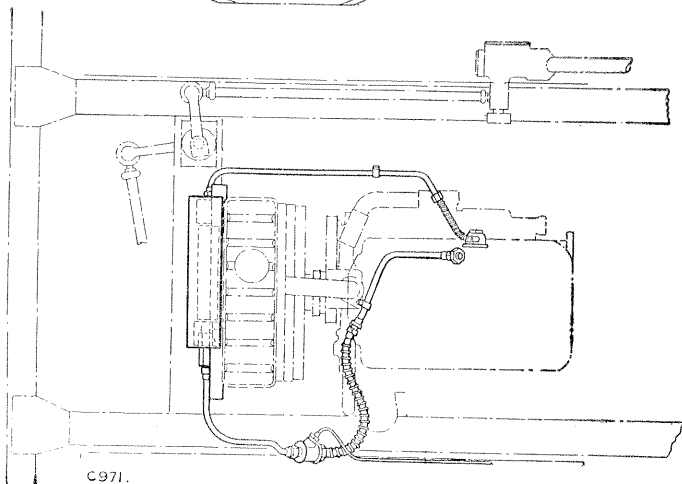
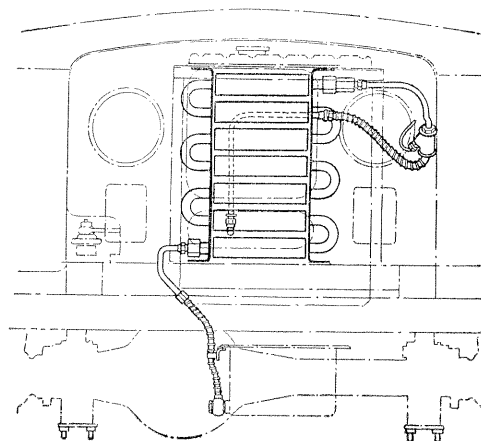
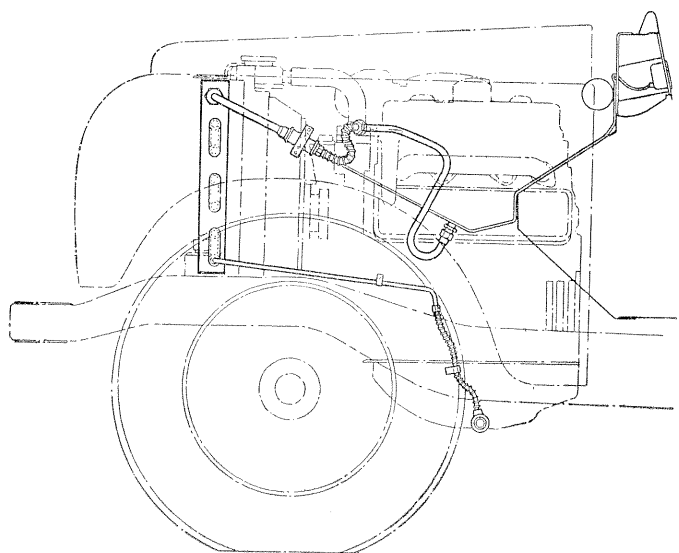


Fig. T-57—Layout of oil cooler—2½ litre Petrol, Diesel models

- |   |   |
|---|---|
| 1 Oil cooler                                    | 26 Body   |
| 2 Tapping plate                                 | 27 Plunger  |
| 3 Drive screw—plate to frame                    | 28 Spring for plunger                                 |
| 4-5 Fixings—cooler to chassis frame             | 29 Oil pipe, union to flexible pipe                   |
| 6-9 Fixings—cooler to radiator and grille panel | 30 Union for oil pipe                                 |
| 10 Oil return pipe                              | 31 Joint washer for union                             |
| 11 Union for return pipe                        | 32 Bracket for clip                                   |
| 12 Flexible oil pipe, return to sump            | 33-36 Fixings—bracket to front engine lifting bracket |
| 13-14 Fixings—flexible pipe to sump             | 37 Clip for union to flexible oil pipe                |
| 15 Clip, for flexible oil pipe                  | 38-40 Fixings—clip to bracket                         |
| 16 Bracket for clip                             | 41 Oil pipe to relief valve                           |
| 17-19 Fixings—return pipe clip to bracket       | 42 Thermometer pocket complete                        |
| 20 Clip for oil return pipe                     | 43-45 Fixings—thermometer pocket to valance           |
| 21 Adaptor for engine oil filter                | 46 Flexible oil pipe, pump to pocket                  |
| 22 Joint washer for adaptor                     | 47 Clip fixing flexible pipe to L.H. battery support  |
| 23 Bolt, fixing adaptor                         |   |
| 24-25 Oil union and joint washer                |   |

- (b) Remove the dynamo, and withdraw the pulley; fit the new double pulley and refit the dynamo.
20. Fit the oil cooler to the tapping plates, using the four set bolts and washers provided, then fit the oil relief valve to the top union in the oil cooler.
  21. Replace the radiator and grille panel assembly, securing with the original nuts and bolts. Do not fully tighten.
  22. **2 litre Petrol:** Fit the new fan to the pulley and refit the belt.
  - 2½ litre Petrol and Diesel models:** Fit the new fan to the new double pulley, ensuring that the holes are in correct alignment, and fit two new belts.
  23. Mark out and drill the radiator grille panel top, as shown in Fig. T-57.
  24. Secure the oil cooler to the radiator and grille panel assembly, using the four holes drilled in the top panel and secure with the nuts, bolts, washers and distance pieces supplied.
  25. Drill a further  $\frac{9}{32}$  in. (7 mm) dia. hole in a suitable position in the grille top panel, and using the sherardised nut and bolt supplied, fit the earth clip.
  26. Tighten all nuts and bolts.
  27. Fit the union to the oil cooler lower R.H. side and fit the right-angled end of the oil return pipe to the union and secure the other end of the flexible pipe already fitted to the sump. Figs. T-59 and T-60. Secure the non-flexible pipe to the battery carrier (R.H. on Diesel), using a clip, screw, nut and spring washer.
  28. Tighten the banjo bolt securing the flexible pipe to sump and secure the pipe to a convenient sump securing stud, using a bracket, clip, screw, nut and spring washer—Figs. T-55 and T-58.
  29. Fit the oil pipe relief valve to the thermometer pocket, but do not fully tighten the union; connect the pipe to the foremost end of the thermometer bulb pocket—see Figs. T-55 and T-58. Secure the flexible oil pipe to the pocket.



C971.

Fig. T-58—Installation of oil cooler—2 litre Petrol

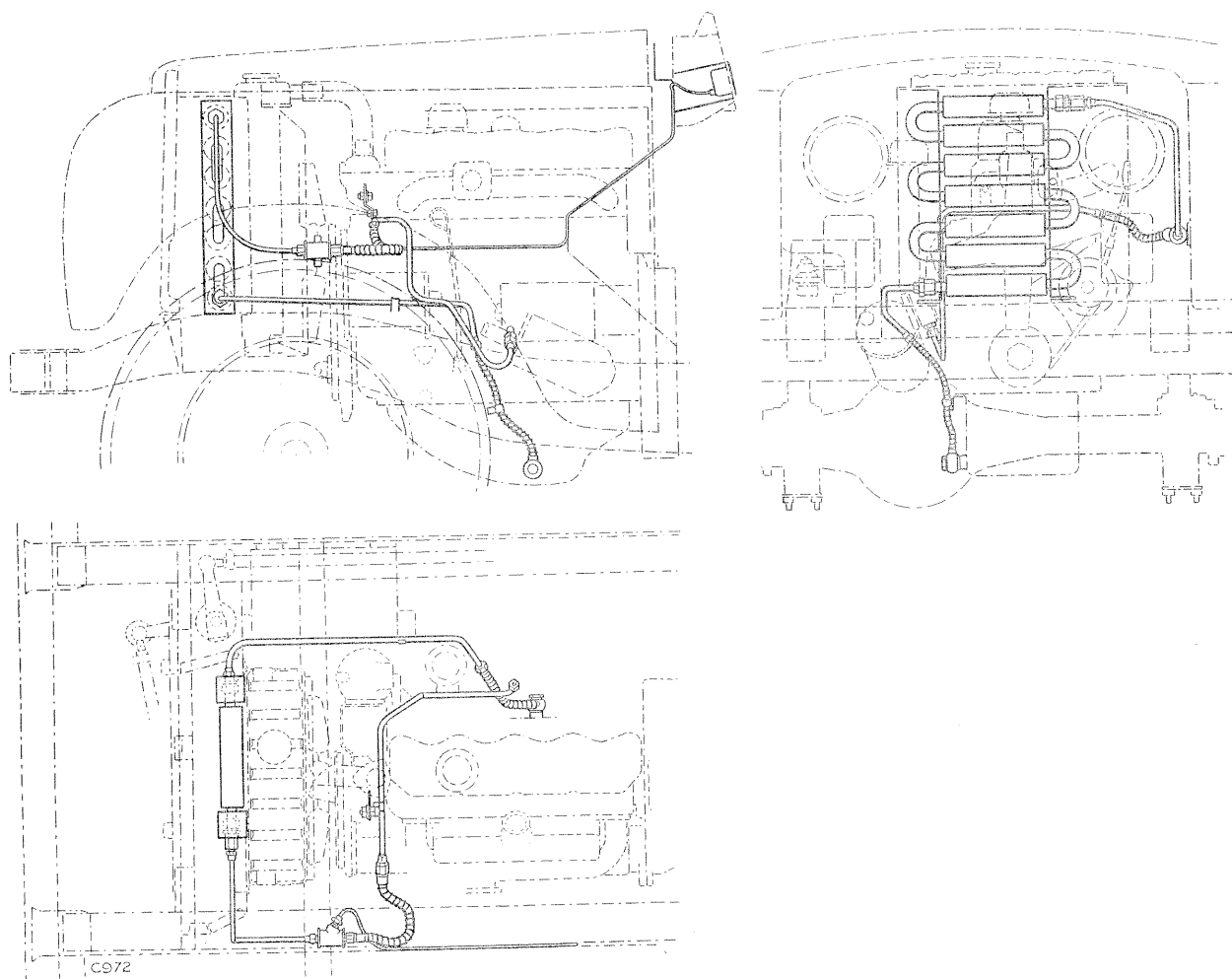


Fig. T-59—Installation of oil cooler—2½ litre Petrol, Diesel models

30. Fit the oil pipe, flexible pipe to oil filter adaptor and 2 litre Petrol models: secure it with a clip to the thermostat housing stud, or 2½ litre Petrol and Diesel models: fit a bracket to the engine lifting bracket, then secure the pipe to the bracket with a clip—See Figs. T-55 and T-58.
31. Using the thermometer pocket as a guide, drill two holes  $\frac{11}{32}$  in. (5 mm.) dia. in the L.H. wing valance, or—Diesel models: L.H. battery valance, and secure the pocket, using two bolts, nuts and spring washers.
32. **2 litre Petrol models:** Remove plug from oil filter adaptor and fit a union and joint washer. Fit the pipe, connecting flexible pipe to adaptor, to the union, and connect the other end to the flexible pipe.
33. **2½ litre Petrol and Diesel models:** Remove the engine oil filter and fit the adaptor and joint washer between it and cylinder block, and secure with the new bolts and original spring washers; fit the union and joint washer. Fit the pipe, connecting flexible pipe to adaptor, to the union and connect the other end to the flexible pipe.
34. Mark a centre at the rear of the left-hand glove box, positioned horizontally in line with, and 2 in. (50 mm) to the right of the top hole blanked off by a nut and bolt; cut a 1 in. (25 mm) dia. hole at this centre, then remove the blanking-off bolt.
35. Fit the oil temperature gauge to the bracket, using the existing attachments and fitting the bulb and holder to the inner fixing stud on the gauge.
36. Drill a  $\frac{7}{32}$  in. (5,5 mm) dia. hole in the glove box stiffener, and a  $\frac{1}{4}$  in. (6,3 mm) dia. hole in the bottom glove box stiffener, using the gauge mounting bracket as a guide, and secure bracket to stiffeners, using the fixings provided.
37. Pass a rubber grommet over the thermometer bulb and tubing and fit to the hole in the glove box.
38. Lead the capillary tubing conveniently over the toe box to the thermometer pocket, then fit the bulb and joint washer to the pocket.
39. Connect the lead from the bulb holder to the junction with the petrol gauge light. Check and tighten all nuts, bolts and unions, etc.

40. Replace the battery and terminals.
41. Replace the air cleaner assembly.
42. Refill the cooling system, and then the engine oil sump to the "H" mark on the dipstick.
43. **2 litre Petrol.**
  - (a) Remove the oil pressure warning light switch at the L.H. rear of the cylinder block and in its place fit a slave oil pressure gauge.
  - (b) Start the engine and when normal running temperature has been reached, adjust the oil pressure by means of the oil pressure relief valve on the cylinder block, to 75-80 lb/sq.in. (5,3-5,6 kg/cm<sup>2</sup>) at 2,500 r.p.m.
  - (c) Remove the slave gauge and replace the warning light switch.
44. Run the engine and check for oil and coolant leaks, then refit bonnet.

#### Engine tie-rod (Diesel models only)

45. Fit the bell housing bracket to the left-hand rear flange of the bell housing with the nuts, bolts and washers provided.
46. To the engine tie-rod, fit a locknut, nut, cup washer, sleeve and a rubber bush and insert the rod through the bell-housing bracket, from the rear.

47. Complete the fixing to the bell-housing bracket with a further rubber bush, cup washer (dished side inwards), nut and locknut. The nuts should only be finger tight.
48. Attach the rear bracket to the tie-rod in a similar manner, and hook the bracket over the frame cross-member.
49. With the vehicle on level ground and the handbrake off, position the rear bracket so that the tie-rod is parallel to the ground, and in line with the longitudinal axis of the vehicle.
50. Using the hole in the bracket as a template, drill a  $\frac{3}{8}$  in. (10 mm) dia. hole through the cross-member and secure the bracket to it with the fixings provided.
51. Adjust the tie-rod so that with the vehicle on level ground, and the handbrake off, there is no strain. Tighten the locknuts.

#### Water temperature and oil pressure gauge— all models

##### To fit

##### Operation T/74

1. Disconnect the bonnet prop rod from the bonnet by removing the split pin, plain and spring washers, then remove the bonnet.

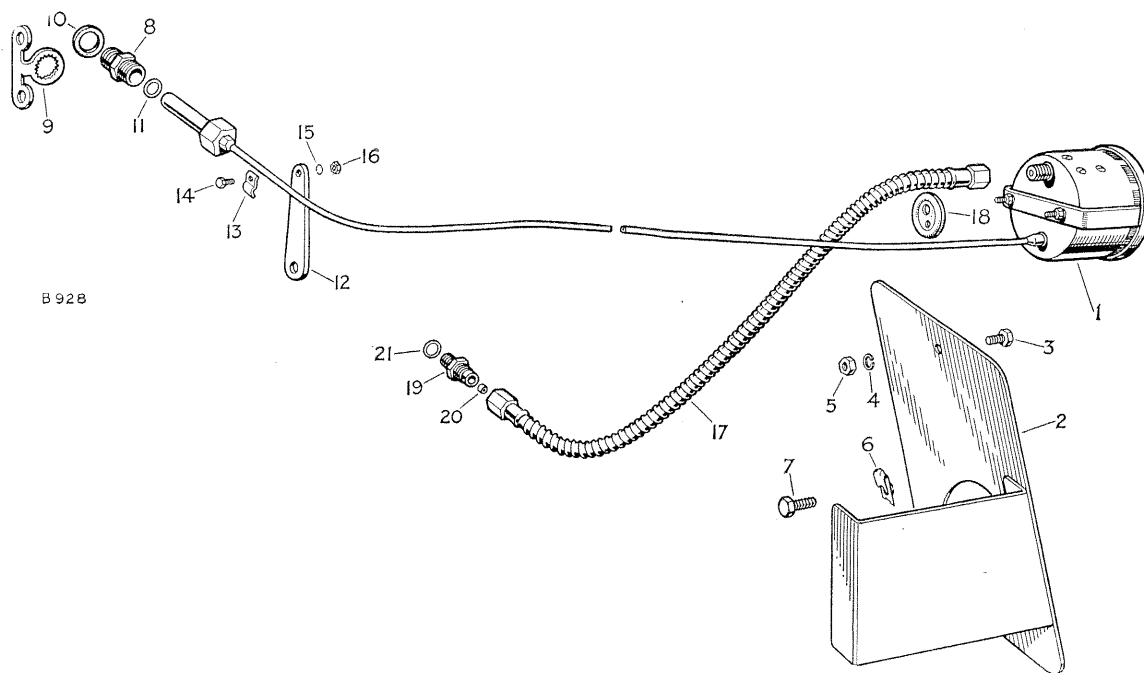


Fig. T-60—Water temperature and oil pressure gauge—2 litre Petrol

- |  |                              |
|--|------------------------------|
| 1 Water temperature and oil pressure gauge | 13 Thermometer pipe clip     |
| 2 Mounting bracket for gauge               | 14-16 Fixings for clips      |
| 3-7 Fixings—mounting bracket to dash       | 17 Oil pipe for gauge        |
| 8 Union for thermometer bulb               | 18 Grommet for pipe, in dash |
| 9 Locker for union                         | 19 Union for oil pipe        |
| 10 Washer for union                        | 20 Meter valve               |
| 11 Washer for thermometer bulb             | 21 Washer for union          |
| 12 Thermometer pipe support bracket        |                              |

2. Drain the coolant from the radiator into a suitable receptacle.
3. Mark and cut out a 1 in. (25 mm) hole in the L.H. glove box, approximately 3 in. (75 mm) from the base and 2 in. (50 mm) from R.H. side of glove box.
4. Fit the combined water temperature and oil pressure gauge to the gauge-mounting bracket using the existing attachments, and fitting the bulb and holder to the inner fixing stud on the gauge. Attach the bulb holder lead to the panel light switch.
5. Fit the oil pipe to the union on the gauge.
6. Pass the oil pipe and bulb pipe of the gauge through the 1 in. (25 mm) dia. hole cut in the panel, and fit the bracket to the panel, using the lower ventilator control mounting hole and fixings to secure the top of the gauge bracket.
7. Secure the bracket stiffener to the glove box, using a bolt, washer and nut, after removing the rubber plug from the rear of the glove box.
8. Drill a  $\frac{7}{32}$  in. (5.5 mm) dia. hole in the glove box stiffener, using the existing hole in the gauge-mounting bracket as a guide, and secure bracket to stiffener with a nut, screw and spring washer.
9. Pass a rubber grommet over the thermometer bulb and tubing and fit to the hole in the glove box.
10. **2 litre Petrol**
  - (a) If fitted, remove the governor (Operation T/18) and remove the thermostat housing. Strip the old housing, discard and fit parts to new housing.
  - (b) Fit the plug and washer to the larger tapped hole in the new thermostat housing and fit the union and washer to the other hole. Fit the locker over the union, and tighten the

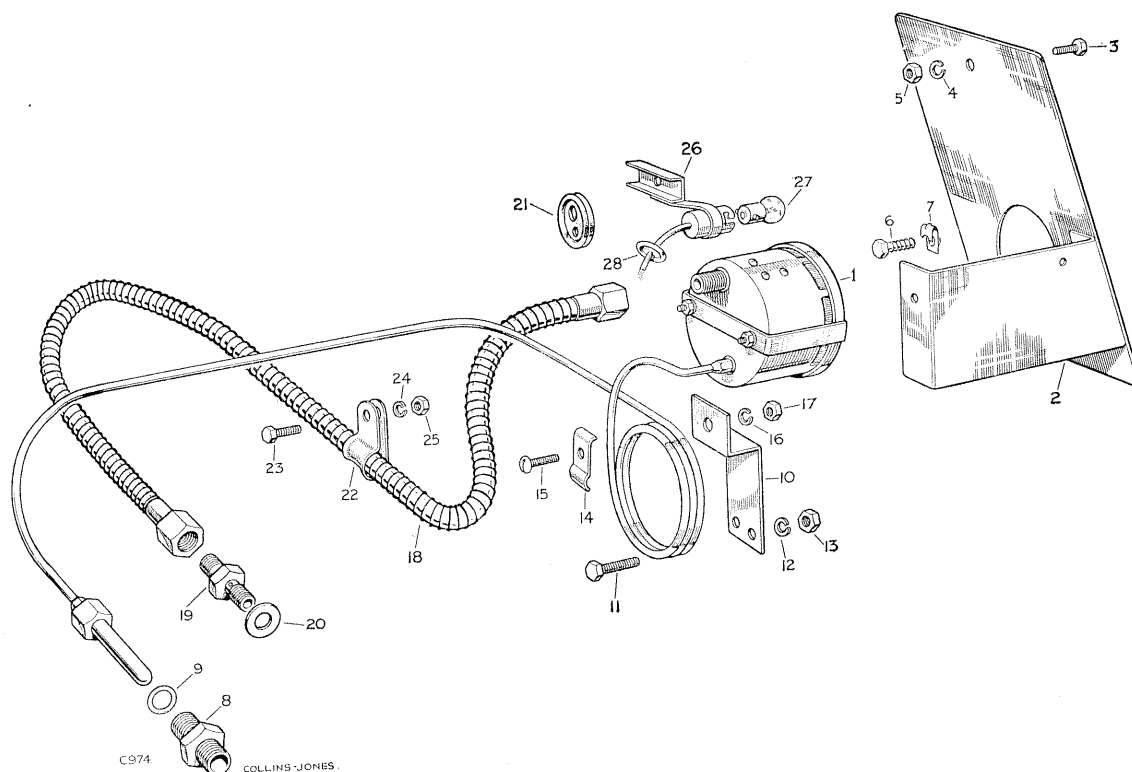


Fig. T-61—Water temperature and oil pressure gauge—2½ litre Petrol and Diesel models

- |       |  |       |                              |
|-------|--|-------|------------------------------|
| 1     | Water temperature and oil pressure gauge | 18    | Oil pipe for gauge           |
| 2     | Mounting bracket for gauge               | 19    | Union for oil pipe           |
| 3-7   | Fixings—mounting bracket to dash         | 20    | Joint washer for union       |
| 8     | Union for thermometer bulb               | 21    | Grommet for oil pipe in dash |
| 9     | Joint washer for gauge bulb              | 22    | Clip for pipe                |
| 10    | Support bracket for pipe clip            | 23-25 | Fixings—clip to dash         |
| 11-13 | Fixings—bracket to dash                  | 26    | Panel light adaptor          |
| 14    | Clip for thermometer pipe                | 27    | Bulb                         |
| 15-17 | Fixings—pipe clip to support bracket     | 28    | Grommet for lead             |

union until the holes in the locker are in line with the holes in the right-hand side of the housing.

- (c) Fit the new thermostat housing complete to the engine and secure with the existing bolts and spring washers, ensuring that the rubber seal is in position between the water pump and the housing.
- (d) Refit the governor (if fitted).
- (e) Form the thermometer pipe to pass to the left of the coil, down over the toe box and along the wing valance to the thermostat housing. Coil the excess thermometer pipe neatly, adjacent to the bulb and to the L.H. wing valance, tape both coils at the top, then fit the bulb to the union, using the joint washer provided.
- (f) Fit the bracket under a convenient bolt on the engine front cover, fit a clip over the pipe and secure it to the bracket.
- (g) Secure the pipe to the L.H. wing valance and toe box, using the two existing holes in the wing valance, opposite the two front manifold flanges, and to three other suitable points, using the remaining clips, screws, spring washers and nuts.

#### 11. 2½ litre Petrol

- (a) Remove the plug from the R.H. front of the cylinder head, discard, then replace with a union and joint washer.
- (b) Drill two  $\frac{7}{32}$  in. (5,5 mm) holes in dash for mounting thermometer pipe clip bracket. The holes to be 6 in. and  $7\frac{7}{8}$  in. (152 and 200 mm) from R.H. side of L.H. toe box, and in a position to be approximately level with the top of the cylinder head.
- (c) Secure the bracket to the engine side of the dash, using two nuts, screws and spring washers. Coil the thermometer pipe neatly into approximately a 3 in. (76,2 mm) coil, tape at the top; and clip to the bracket.
- (d) Lead the thermometer pipe along the R.H. side of vehicle, clip it at three points to the carburettor feed pipe, using the existing rubber cleats, and fit the bulb to the union using the joint washer provided.

#### 12. Diesel models

- (a) Remove the plug from the L.H. rear of the cylinder head, discard, then replace with a union and joint washer.
- (b) See item 11 (b and c).
- (c) Lead the thermometer pipe along the L.H. side of the vehicle and fit the bulb to the union, using the joint washer provided.

#### 13. 2 litre Petrol

- (a) Disconnect the feed wire from the oil pressure switch at the L.H. rear of the cylinder block and carefully cover the wire with insulating tape. Remove and discard the switch, then replace with a union and joint washer.

- (b) Clip the flexible oil pipe to the dash panel at a convenient point and connect the oil pipe to the union.

#### 14. 2½ litre Petrol and Diesel models

- (a) Remove the banjo bolt fixing the valve gear feed pipe at the R.H. rear of the cylinder block, discard and replace with a union and joint washer.
  - (b) Clip the flexible oil pipe to an existing hole in the dash panel, located approximately  $7\frac{1}{2}$  in. (190 mm) down and 4 in. (101 mm) to left of the thermometer pipe clip bracket previously secured to the dash.
  - (c) Lead the oil pipe along the dash panel and clip again to the panel about  $2\frac{1}{2}$  in. (63 mm) to the right of the vehicle centre line. Secure the pipe to the R.H. toe box side panel, using the remaining clip and fixings, and connect the oil pipe to the union.
15. Refill the cooling system.
  16. Start the engine and check for leaks (both coolant and oil).
  17. Refit the bonnet.

#### Heater unit and demister tubes

Unit fitment	Operation T/76
--------------	----------------

##### 2 litre Petrol

1. Disconnect the bonnet prop rod from the bonnet.
2. Remove the bonnet.
3. Drain off the coolant.
4. Disconnect the bottom water hose at the inlet pipe to the pump end. Remove the inlet pipe from the pump and discard the pipe.
5. Fit the new inlet pipe to the pump with the joint washer and secure it using the existing bolts, spring washers and clip.
6. Fit the reducing union and joint washer to the pipe.
7. Disconnect the top water hose from the thermostat housing and disconnect the water hose to the inlet elbow.
8. Remove the thermostat housing from the cylinder head. Completely strip and discard the housing.
9. Fit the parts removed from the old housing to the new thermostat housing.
10. Fit the plug and joint washer to the smaller tapped hole in the housing and to the large tapped hole fit the water supply valve and joint washer.
11. Fit the thermostat housing complete to the cylinder head, ensuring that the rubber seal is in place on the top of the water pump, and secure using the existing set bolts and spring washers.

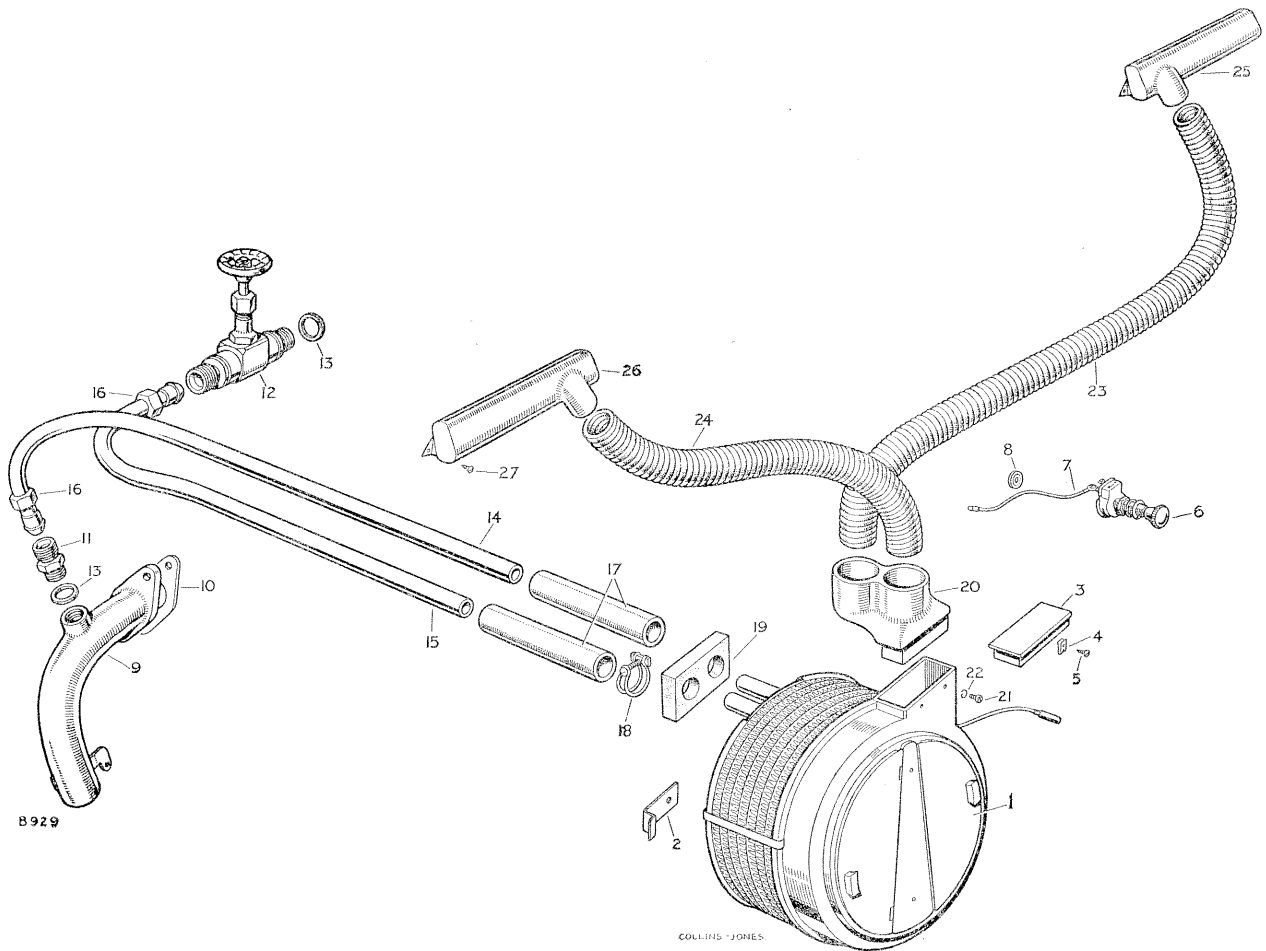


Fig. T-62—Layout of heater unit—2 litre Petrol

- |       |  |                                     |
|-------|--|-------------------------------------|
| 1     | Heater                                       |                                     |
| 2     | Bracket for heater                           |                                     |
| 3     | Blanking cap                                 |                                     |
| 4     | Spire nut                                    | } Fixing<br>blanking cap            |
| 5     | Acme bolt                                    |                                     |
|       |  |                                     |
| 6     | Switch for heater                            |                                     |
| 7     | Feed wire for heater                         |                                     |
| 8     | Grommet for heater leads                     |                                     |
| 9     | Inlet pipe for water pump                    |                                     |
| 10    | Joint washer for pipe                        |                                     |
| 11    | Reducing union for pipe                      |                                     |
| 12    | Valve for water supply                       |                                     |
| 13    | Joint washer for valve and union             |                                     |
|       |  | } Not required<br>with<br>demisters |
| 14    | Water outlet pipe                            |                                     |
| 15    | Water inlet pipe                             |                                     |
| 16    | Union nut for heater pipe to valve and union |                                     |
| 17    | Hose for water pipes                         |                                     |
| 18    | Clip for hose                                |                                     |
| 19    | Rubber seal for pipes                        |                                     |
| 20    | Junction box for demister tubes              |                                     |
| 21-22 | Fixings: junction box to heater              |                                     |
| 23    | Tube for demister, R.H.                      |                                     |
| 24    | Tube for demister, L.H.                      |                                     |
| 25    | Nozzle for demister, R.H.                    |                                     |
| 26    | Nozzle for demister, L.H.                    |                                     |
| 27    | Drive screw fixing nozzle                    |                                     |



12. Remove the rubber plugs, one from the front face of the control panel and the other from the L.H. side of the control panel box.
13. Fit to the heater switch the feed wire and also a suitable length of wire to connect the heater switch to the terminal with the single green wire in the fuse box.
14. Remove the knob from the switch and fit the switch to the face of the control panel using the existing hole. Refit the knob.
15. Remove the two large, and three small rubber plugs from the dash centre panel.
16. Fit the rubber seal to the heater over the water pipes.
17. Fit the rubber hoses to the water pipes and secure.
18. Remove the nuts, spring washers and plain washers from the three studs on the heater and fit to the studs the three brackets. Fit the heater to the dash and secure using the existing nuts, spring washers and plain washers.  
Before fully tightening the nuts ensure that the mounting brackets are lying radially outwards from the studs.
19. Connect the feed wire to the snap connectors on the heater lead.
20. Fit the two union nuts, one to the water inlet pipe and one to the water outlet pipe.
21. Fit the remaining two clips, one to each hose on the heater and fit the inlet and outlet pipes to the hoses. Secure the pipes to the water supply valve and the reducing union. Secure the pipes to the hoses using the two clips.
22. Fit the two spire nuts to the blanking cap and fit the blanking cap to the heater, securing by means of the two acme screws.  
This operation is eliminated if demisters are to be fitted.
23. Refill the cooling system.
24. Open the water supply valve and check the functioning of the heater.
6. Part the lead connected to the heater at the snap connector and connect the eyeletted end to one terminal of the rheostat switch. Connect the eyeletted end of the lead with bared opposite end, to the switch second terminal. Remove the control knob from switch and fit to hole in R.H. side of control panel, then lock in position. Replace knob.
7. Fit a rubber grommet to the hole in L.H. side of control box and pass both leads from the rheostat switch through the grommet.
8. Remove the two large and three small rubber plugs from the L.H. side of the scuttle centre panel.
9. Fit the sponge rubber seal over the heater pipes, then remove the nuts, plain and spring washers from the securing studs—leave the earth lead terminal on the lower stud.
10. Position a steady bracket to each mounting stud and offer the unit to the scuttle. Fit the nuts, spring and plain washers, but before tightening ensure that the steady brackets are extending radially outward.
11. Reconnect the heater to switch lead, at the snap connector, and connect the lead from switch with bared end to the terminal with the single green wire or—Diesel, unused terminal on fuse box. Switch the ignition or electrical services “on” and operate the rheostat switch to check that the heater motor works—switch off.
12. Fit the “Z” shaped hose to the control valve and heater inner pipe, then secure. The “L” shaped hoses should now be fitted to the water outlet pipe, then the hose and pipe assembly connected to the heater and water pump adaptor.
13. Fit the support clip for water outlet pipe and secure it loosely to the manifold securing stud. Adjust the hoses and pipe as necessary and secure.
14. Refill the coolant system, open the water valve and check the functioning of heater.

#### 2½ Litre Petrol, Diesel models

1. Disconnect the bonnet prop and remove the bonnet complete.
2. Drain off the coolant.
3. Unscrew the plug from L.H. side of water outlet pipe and fit the union for hose with a copper sealing washer interposed.
4. Remove the plug from rear L.H. corner of cylinder head top and fit the flow control valve and copper joint washer.
5. Remove the rubber plug from R.H. side of control box panel face and another from L.H. side of control box.

#### To fit demisters

#### Operation T/78

1. Remove the blanking cap (if fitted) from the heater and fit the junction box for demister tubes.
2. Remove the rubber plugs from the top of both glove boxes.
3. **Petrol models:** Disconnect the battery.  
**Diesel models:** Disconnect the positive lead of R.H. battery.
4. Remove the securing screws and withdraw the instrument panel complete with controls and wiring.
5. Pass the R.H. demister tube through the hole in R.H. glove box top, through the hole in R.H. side of instrument box, over the wiring, on through the hole in instrument box, L.H. side, and fit the tube to one pipe of the demister junction box.

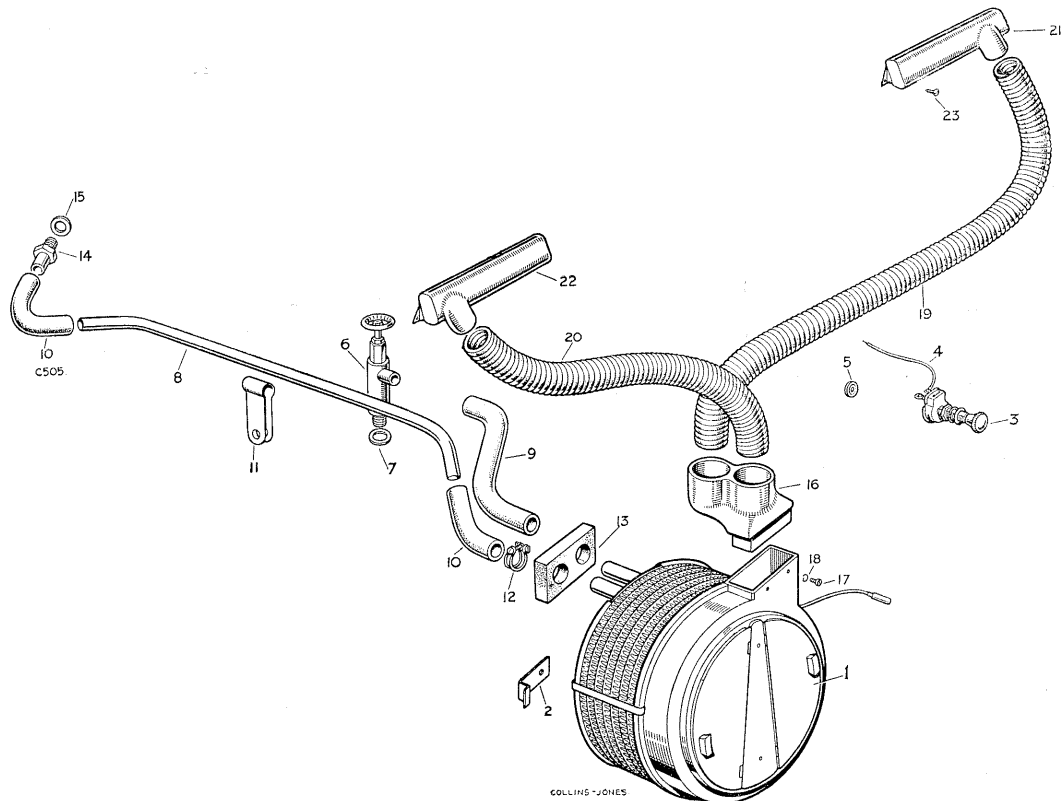


Fig. T-63—Layout of heater unit—2½ litre Petrol and Diesel models

- |                                    |                                       |
|------------------------------------|---------------------------------------|
| 1 Heater                           | 12 Clip for hose                      |
| 2 Bracket for heater               | 13 Rubber seal for pipes              |
| 3 Switch for heater                | 14 Union outlet pipe to pump          |
| 4 Feed wire for heater             | 15 Washer                             |
| 5 Grommet for heater leads         | 16 Junction box for demister tubes    |
| 6 Valve for water supply           | 17-18 Fixings: junction box to heater |
| 7 Joint washer for valve and union | 19 Tube for demister, R.H.            |
| 8 Water outlet pipe                | 20 Tube for demister, L.H.            |
| 9 Water inlet pipe                 | 21 Nozzle for demister, R.H.          |
| 10 Hose for water outlet pipe      | 22 Nozzle for demister, L.H.          |
| 11 Clip for hose pipe              | 23 Drive screw fixing nozzle          |

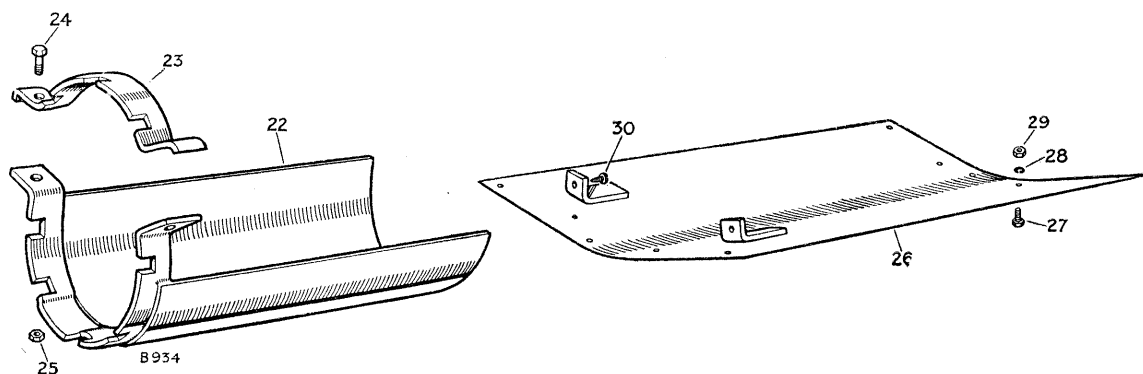


Fig. T-64—

Layout of propeller shaft joint cover plates

22	Cover plate for joint at differential housings	27	Bolt	} Fixing shield
23	Top strap for cover plate	28	Spring washer	
24-25	Fixings for cover plates	29	Nut	
26	Shield for joint at transfer box	30	Drive screws	

- Insert the L.H. demister tube into the hole in L.H. glove box top, pass it through the L.H. side of instrument panel and through the hole in L.H. bottom of instrument box. Fit the tube to the other pipe on the demister junction box.
- Fit the demister nozzles to their respective tubes and using the holes in the nozzles as pilots, drill  $\frac{7}{8}$  in. (2,5 mm) dia. holes in windscreen frame, then secure the nozzle with drive screws.
- Refit the instrument panel and battery lead, then test heater and demister for correct functioning.
- Refit the bonnet and prop rod.

#### Propeller shaft joint cover plates

To fit Operation T/80

- Protect the rear shaft rear joint by placing a cover plate under the rear axle differential housing, with the slots in the retaining strap located in the stiffening webs of the housing; retain it with a strap over the housing and secure by means of two bolts and nuts.

- Protect the front shafts front joint in a similar manner.

Protect the front shaft rear joint by means of a plate which should be secured under the transfer box, between No. 3 and No. 4 chassis cross-members (front bumper is No. 1 member) as follows:—

- Position the plate centrally beneath the front shaft rear joint, with the two right angle brackets abutting the rear of No. 3 cross-member.
- Bend the plate to the contour of the cross-members and drill three  $\frac{9}{16}$  in. (3,5 mm) dia. holes in the front member, and three in the rear member using the plate as a template, the holes should be the three outermost at each end of the plate.
- Secure the plate in position with six drive screws; disregard the two right angle brackets which are not used when fitting the plate with the gearbox and transfer box unit in position.

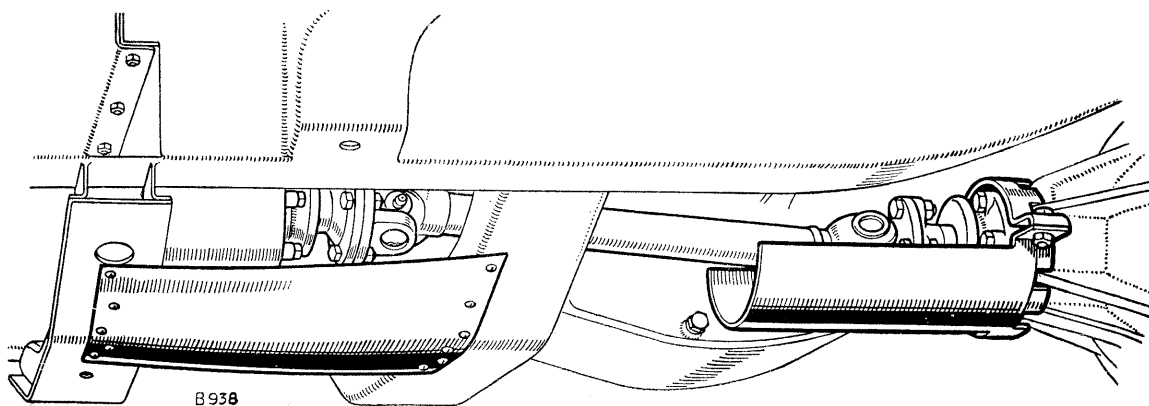


Fig. T-65—

Propeller shaft joint cover plates in position

6. The rear shaft front bearing is effectively screened by the transmission brake unit.

**Flashing indicators, early type—All models**  
**To fit Operation T/82**

1. Remove the five screws and lower the instrument panel, drill one hole .189 in. (4.5 mm) dia. (No. 12 drill) in accordance with the dimensions in Fig. T-67 for mounting the flasher unit.
2. Drill one hole  $\frac{3}{4}$  in. (18 mm) dia. in the dash, as shown in Fig. T-67.
3. Make the connections from the end of the flasher harness to the flasher switch and warning light, as indicated in the wiring diagram. The green lead connected to the X terminal on the flasher unit should be plugged into the spare hole in the petrol gauge snap connector.

4. Mount the flasher unit to the dash, behind the instrument panel, using a drive screw and refit the instrument panel.

5. Fit the switch and warning light to the mounting bracket.

6. Secure the bracket to the upper glove box stiffener channel, by using the lower ventilator control fixings. Using the existing hole in the bracket as a guide, drill a  $\frac{9}{32}$  in. (7 mm) dia. hole in the lower stiffener channel and secure bracket with a screw, washers and nut.

The flasher switch and warning light mounting bracket is fitted to the R.H. side of the instrument panel on R.H.D. models and on the L.H. side on L.H.D. models.

L.H.D. models fitted with oil pressure and/or water temperature gauge have the mounting bracket fitted between the steering column and

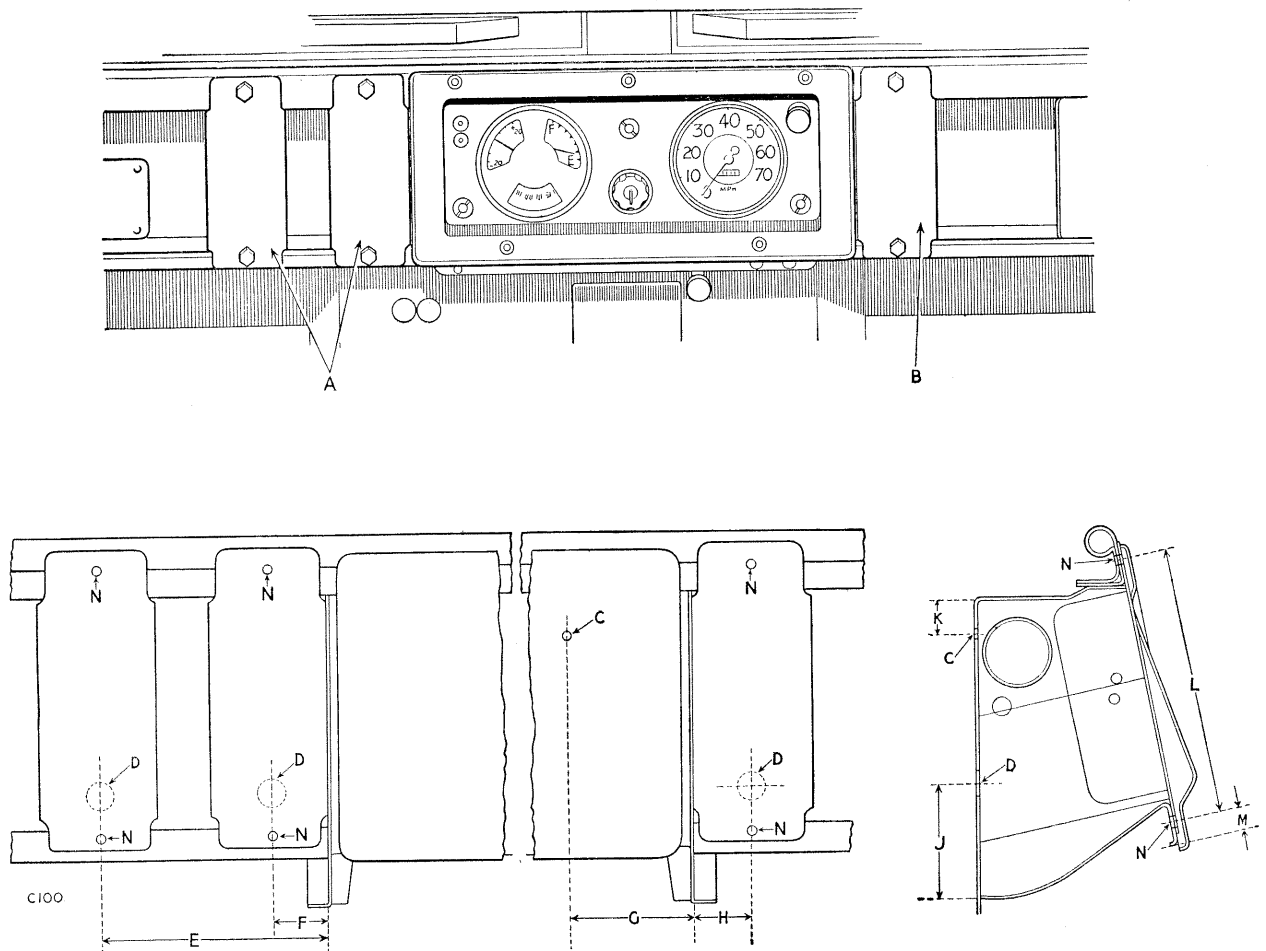


Fig. T-66—Position of flasher mounting bracket, early models

A—Alternative position of bracket on L.H.D. models.  
B—Position of bracket on R.H.D. models  
C—Hole in dash for flasher unit mounting .189 in. dia. (5 mm)  
D—Hole in dash for flasher harness  $\frac{3}{4}$  in. dia. (19 mm)  
E— $5\frac{5}{16}$  in. (135 mm)  
F— $1\frac{1}{16}$  in. (33 mm)

G—3 in. (76 mm)  
H— $1\frac{1}{16}$  in. (33 mm)  
J— $2\frac{1}{2}$  in. (63 mm)  
K— $\frac{3}{4}$  in. (19 mm)  
L— $6\frac{1}{2}$  in. (158 mm)  
M— $\frac{1}{16}$  in. (11 mm)  
N—Hole in glove box stiffener  $\frac{9}{32}$  in. dia. (7 mm)

the gauge panel, which means that the ventilator control fixing cannot be used and a further  $\frac{3}{8}$  in. (7 mm) hole must be drilled as shown in Fig. T-67.

7. Fit a rubber grommet to the  $\frac{3}{8}$  in. (19 mm) dia. hole in the dash and feed the harness through. Clip the harness to the dash panel.
8. Feed the flasher harness for the rear lamps through the side member, the harness emerging at the rear of the member with the rear light harness.  
It will be found that the best method of feeding the lead through the chassis member is to disconnect the wires of the frame harness at the rear of the vehicle, then attach a length of soft iron wire to the leads and withdraw leads and wire back through the side member. Attach the flasher harness to the iron wire and pull wire and harness back through the chassis.
9. Cut out two holes  $1\frac{7}{16}$  in. (36 mm) dia. in the rear body panel to take rear flasher lamps. The cappings are pre-drilled to the correct size.
10. Connect the harness to the lamps and fit the lamp to the body. Connect the earth terminal to the rear cross-member.
11. Drill the wings as shown in Fig. T-31.
12. Move the side lamps to the inner hole.
13. Pass the harness through the wing valances and connect to flasher lamps.
14. Fit the lamps to the wings in the position vacated by the side lamps.
15. Check flasher system for correct operation.

#### Flashing indicators, late type—All models

To fit

Operation T/84

1. Remove the five screws and lower the instrument panel, drill one hole .189 in. (4.5 mm) dia. (No. 12 drill) in accordance with the dimensions in Fig. T/67 ('C') for mounting the flasher unit.
2. With the steering wheel spokes vertical, offer the flasher switch to the steering column boss near the top of the steering column dust shield. Secure the flasher switch to the column. Do not fully tighten.
3. Adjust the flasher switch until it lies midway between the steering wheel spokes and tighten the fixings with the rubber operating ring slightly pre-loaded. Check the operation of the switch.
4. Run the harness down the column and into the instrument panel box through the hole in the side of the panel box. Use a rubber grommet. Secure the leads to the column, using the cleat provided. Secure the harness in the instrument panel box to the horn lead clip.
5. Secure the lead—black with red, to the terminal P on the flasher unit and the flasher switch lead—green with brown to terminal L and secure the flasher unit to the dash. The short green lead supplied should be connected to terminal B on the flasher unit, the other lead to be plugged into the spare hole in the petrol gauge snap connector. The black with white lead from the flasher switch should be drive-screwed into the dash.
6. Remove the two rear lamp cover plates from inside the vehicle.
7. Cut out two holes  $1\frac{7}{16}$  in. (36 mm) dia. in the rear body panel to take the rear flasher lamps. The cappings are pre-drilled to the correct size.
8. Drill the front wings as shown in Fig. T/69.
9. Move the side lamps to the inner holes.
10. Disconnect the rear light connections from the main feed harness where it emerges from the chassis side member grommeted hole.
11. Remove the grommet from the chassis side member and secure a length of strong string to the main harness. Withdraw the harness through the side member to the front of the vehicle.
12. Attach the new flasher harness to the main harness and pull the pair through the side member to the rear. Replace the grommets.
13. Reconnect the rear lights to the main harness and make the connections between rear flasher lamps and flasher harness and secure the flasher lamps to the rear body panels.  
Replace the two-way earth clip on the frame with the four-way provided and make the lamp earth connections.
14. Connect the short twin cable flasher harness to the flasher switch harness in the instrument panel box, using snap connectors and ensuring that the colours are correctly matched.
15. Run the short harness through the grommeted hole carrying the vehicle main harness in the dash, and connect to the rear flasher harness and to the front flasher lamp harness, using snap connectors and ensuring that the colours are correctly matched. See the wiring diagram. Replace the two-way earth snap connectors on the side lamp harness with the four-way provided, and earth the flashers and side lamps.
16. Connect the front harness to the front flasher lamps. Green with red to the L.H. front flasher and green with white to the R.H. front flasher.
17. Secure the lead between harness and L.H. rear flasher lamp to the number plate harness, using the clip provided.
18. Check flasher system for correct operation. Ensure that the self-cancelling switch returns correctly. Adjust as necessary.
19. Replace rear lamp cover plates.

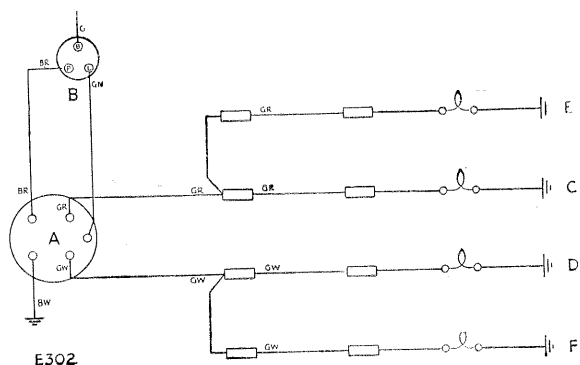


Fig. T-67—Flasher wiring diagram—late type

A—Switch and pilot light  
B—Flasher unit  
C—L.H. front flasher  
D—R.H. front flasher  
E—L.H. rear flasher  
F—R.H. rear flasher

Colour code:

B—Black G—Green N—Brown R—Red W—White

**Flashing indicator, late type, to service****Operation T/86****To replace warning bulb**

1. Remove the nuts and bolts securing the indicator switch to the column.
2. Remove the two cover retaining bolts from the switch and unscrew the long chromed bolt until the cover can be removed.
3. Withdraw the long bolt, which also acts as a pivot for the operating lever, and gently remove the operating lever.
4. Replace the bulb and complete the operation by reversing the dismantling and removal procedure.

**To remove flasher switch**

1. Remove the fixings and withdraw the instrument panel as far as possible.
2. Remove the flasher unit and disconnect the leads—black with red, and green with brown.
3. Disconnect the remaining flasher leads—green with brown and green with white at the snap connectors, and the lead—black with white drive-screwed to the bulkhead.
4. Remove the nuts and bolts securing the indicator switch to the column, and withdraw complete with harness.
5. To refit, reverse the removal procedure with reference to the appropriate wiring diagram.

**Trailer plug and socket****To fit****Operation T/88**

Appropriate cable colours in parenthesis. See wiring diagram.

1. Using the dummy socket bracket as a template, mark off two mounting holes on rear cross-member,  $1\frac{5}{8}$  in. (41 mm) from inner face of

step mounting bracket to centre of socket aperture and 1 in. (25 mm) down from the bottom of the cross-member.

2. Drill two holes,  $\frac{11}{16}$  in. (5 mm) and secure bracket to cross-member, using self-tapping screws.
3. Mark a point,  $1\frac{3}{4}$  in. (44 mm) from the centre of the rear plug socket, towards the outer edge of cross-member,  $1\frac{1}{4}$  in. (32 mm) from bottom edge, and drill a  $\frac{11}{16}$  in. (12 mm) hole.
4. Fit a rubber grommet to the hole, then fit dummy socket to bracket, and thread flasher plug lead through grommet.
5. Fit the trailer socket and leads to rear cross-member.

**Fitting vehicle flasher plug (items 6-12 inclusive)**

6. Remove R.H. rear wheel and disconnect flasher and rear light wires from snap connectors under wheelarch.
7. Fit double snap connectors to main tail lamp lead from harness (red) and reconnect rear lamp wire.
8. Connect the stop and tail light wires from the lamps (green and purple) to the flasher plug wire (yellow) with a snap connector.
9. Connect the R.H. flasher wire (white and green) to the flasher plug wire (buff) with a snap connector.
10. Connect the L.H. flasher wire (red and green) to the flasher plug wire (purple) with a snap connector.
11. Connect the flasher plug earth wire (blue) to the existing earth wire on the rear cross-member, using an earth bridge lead.

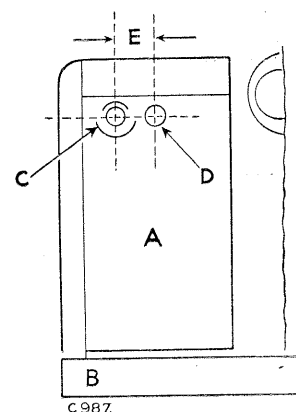


Fig. T-68—

Additional drillings in front wings

A—Wing  
B—Bumper  
C—Existing side light position  
D—One new hole,  $1\frac{7}{16}$  in. (36 mm) dia.  
E— $3\frac{1}{4}$  in. (82 mm)



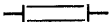
Fig. T-69—Flasher (early type) and trailer plug wiring diagrams

**Key to Fig. T-69**

A—Wiring diagram for flashers only.

B—Wiring diagram, using trailer and flashers. On this diagram, flashers are disconnected and trailer plug is in use, giving flashers on trailer.

C—Wiring diagram, using flashers and trailer socket. On this diagram, the rear flashers are shown connected via the trailer socket, and vehicle flasher plug; the plug must be in this position when the trailer is not in use.

- |                             |  |
|-----------------------------|--|
| 1 Rear flasher lamp L.H.    | 10 Stop and tail lamp  |
| 2 Rear flasher lamp R.H.    | 11 Number plate illumination lamp  |
| 3 Front flasher lamp L.H.   | 12 Vehicle flasher plug in dummy trailer socket  |
| 4 Front flasher lamp R.H.   | 13 Trailer socket  |
| 5 Self-cancelling switch    | 14 Trailer plug  |
| 6 Warning light             | 15 Vehicle flasher plug  |
| 7 Flasher unit              | 16 Dummy trailer socket  |
| 8 Trailer flasher lamp L.H. | 17 Wiring as diagram "A" from this point   |
| 9 Trailer flasher lamp R.H. | 18 Snap connectors shown thus:  |

**KEY TO CABLE COLOURS**

B—Black  
G—Green

N—Brown  
P—Purple  
RN—Red with Brown and so on

R—Red  
U—Blue

W—White  
Y—Yellow



12. The flasher plug wire (white) is for the rear lamps. Leave disconnected as the lamps are coupled direct from the main harness.

#### Trailer socket wiring (items 13-19 inclusive)

13. Connect trailer socket wire (red) to main loom wire (red) with a two-way snap connector.
14. Connect L.H. and R.H. tail lamp wires (red) to connectors (13).
15. Using tail lamp bridge lead, connect snap connectors (14) together.
16. Connect the trailer socket wire (green and purple) to the main loom wire (green and purple) with a snap connector.
17. Connect the R.H. flasher trailer socket wire (white and green) to main loom wire (white and green) with a snap connector.
18. Connect the L.H. flasher trailer socket wire (red and green) to the main loom wire (red and green) with a snap connector.
19. The trailer socket wire (black) goes to earth on rear cross-member with the main loom earth connection, using the earth bridge lead.

#### Fitting trailer plug and lead (items 20 and 21)

20. Pass the trailer plug wires through the retaining clip along the draw bar.
21. Connect the rear lamps, stop lamp and flashers to the terminals. See wiring diagram.

#### To use trailer plugs

22. Trailer not in use: remove trailer plug and fit flasher plug into trailer socket at rear cross-member.
23. Trailer in use: fit trailer plug from draw bar to trailer socket on rear cross-member and fit flasher plug into dummy socket.

#### 12 volt A.C. generator—2½ litre Petrol models

##### To fit Operation T/90

1. Remove the bonnet and disconnect the battery lead.
2. Remove the flexible connection between the air cleaner and carburettor and remove the cleaner complete.
3. Remove and discard the dynamo and the fan belt.
4. Slacken the four set bolts securing the fan and pulley to the water pump and, removing the securing bolt, remove the dynamo adjusting link.
5. Remove the lifting bracket from the front of the cylinder head and discard.
6. Remove the dynamo anchor bracket from the cylinder block and discard.

7. With the engine cold, remove one at a time the two most forward cylinder head bolts adjacent to the thermometer switch on the left-hand side of the engine and replace with the special set bolts ( $\frac{1}{2}$  in. U.N.F. x  $4\frac{9}{16}$  in long). Pull the bolts down to 65 lb/ft. (9 Kg/m).
8. Fit the generator mounting bracket to the top holes in the special bolts, but do not tighten fully at this stage.
9. Fit the packing piece to the cylinder head, together with the generator front mounting bracket and secure in position with a set bolt and spring washers.

#### Idler wheel body on pulley assembly

10. Press the small bearing on to the idler spindle and fit the complete assembly into the idler wheel body.

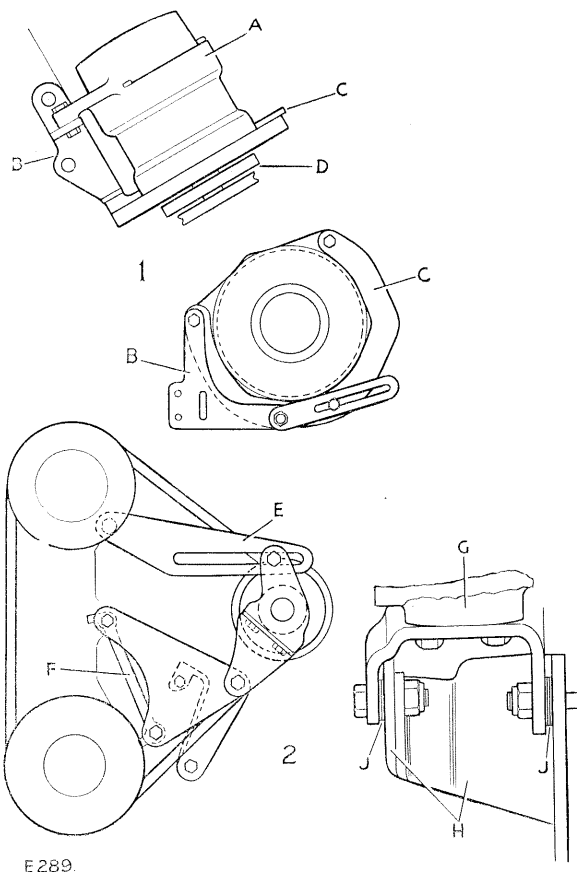


Fig. T-70—Diagrammatic layout of components

#### 1—Alternator mountings

- A—Alternator
- B—Mounting brackets
- C—Yoke
- D—Fan

#### 2—Idler body mounting and adjusting link

- E—Adjusting link
- F—Locking plate
- G—Idler body bracket
- H—Anchor brackets, front and rear

11. Half fill the idler body with front hub grease and fit the larger bearing with the bearing seal outwards on to the spindle and into the idler body. Care must be exercised to avoid damage to the bearing seal.
12. Secure the bearings and spindle with a circlip.
13. *Important:* Before fitting the double grooved pulley. Fit the adjusting link to the idler wheel body at the adjusting slot and see that the link is set away from the idler body.
14. Press the double grooved pulley on to the spindle with the larger diameter pulley towards the idler body and retain in position with a circlip.
15. Fit the plug and joint washer to the idler body.
16. Fit the short set bolt and joint washer to the lubrication hole in the idler body.
17. Assemble loosely to the idler body, the mounting bracket, with the joggle towards the pulley.
18. To the fixing hole in the joggle side of the idler body bracket, locate the pivot bolt complete with the two shim washers. First assemble the front anchor bracket on to the bolt with the bracket set away from the pulley, then assemble the rear anchor bracket on to the bolt. Secure the three brackets together with self-locking nuts.
19. Remove the crankshaft starting dog and withdraw the fan pulley sufficiently to remove the front cover securing bolt and the securing bolt immediately above.
20. Fit a long bolt ( $3\frac{3}{4}$  in. (95 mm)) into the original dynamo bracket top fixing hole in the engine cylinder block.
21. Fit the assembled idler pulley and fixing bracket to the front cover and secure the rear anchor bracket in position with two set bolts and spring washers to the original dynamo anchor bracket fixing holes in the cylinder block.
22. Secure the front anchor bracket to the front cover with set bolts, and secure with a locking plate.
23. Insert three shims between the idler body mounting bracket and rear anchor bracket; locate bracket and shims in position with the bolt fitted at item 20. Secure to the engine block with a self-locking nut.
24. Fit the adjusting link attached to the idler body, to the front cover behind the top fan pulley, using the set bolt and spring washer removed from the dynamo fixings.
25. Re-tighten the four set bolts securing the fan and fan pulley.
26. Re-tighten the lower fan pulley with the starting dog nut. Use a new lock washer.
27. Fit the fan to the generator with the fan blades inclined inwards, together with the drive pulley. Secure in position, using a spacing washer if necessary.
28. To the generator attach the yoke behind the generator body flange, using a special set bolt ( $\frac{5}{16}$  in. A.N.F.—18 T.P.I.) and plain and spring washers.
29. Mount the generator complete with yoke to the mounting bracket previously fitted to the engine. Secure with bolts and spring washers and nuts.
30. Fit the adjusting link (removed with the dynamo fittings) to the front mounting bracket on the engine and to the centre hole in the yoke by the adjusting slot in the link.
31. Position the alternator driving belt between generator pulley and the large diameter pulley on the idler wheel.
32. Ensure that the driving belt between the generator pulley and idler wheel pulley is in line by adjusting the idler body on its mounting bracket. Tighten the set bolts, securing body to bracket.
33. Adjust the driving belt tension to allow the belt to move  $\frac{1}{4}$  in. to  $\frac{3}{8}$  in. (6 to 9 mm) when pressed by thumb between the pulleys. Secure the adjusting link.
34. Position the fan belt between top and lower pulleys on the engine and the small diameter pulley on the idler wheel.
35. Ensure that the fan belt is in line with the pulleys and finally tighten the top mounting bracket.
36. Adjust the fan belt tension to allow the belt to move  $\frac{1}{4}$  in. to  $\frac{3}{8}$  in. (6 to 9 mm) when pressed by thumb between the pulleys. Secure the adjusting link and check all fixing bolts.

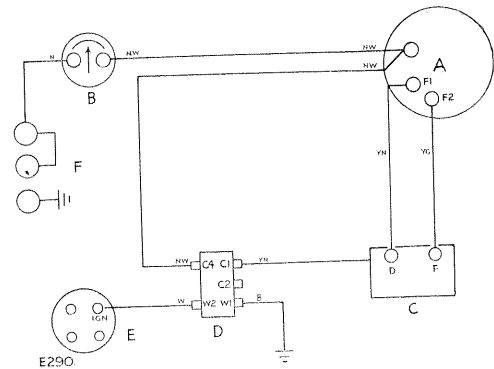


Fig. T-71—Alternator charging circuit

A—Alternator	D—Relay
B—Ammeter	E—Ignition and lighting switch
C—Regulator box	F—Terminals

### Installation of new dash harness

1. Disconnect the leads from the horn and remove the clip securing all the wires to the bulkhead.
2. Disconnect the wires from the control box.
3. Remove the wires from the fuse box and junction box.

4. Disconnect the wires from the three-way snap connector, connecting dash harness to chassis harness.
5. Disconnect wiring from starter switch, oil switch, thermometer switch and choke warning light switch.
6. Disconnect the coil feed wires and remove control box earth connection.
7. Remove the control box.
8. Remove the instrument panel, and disconnect the speedometer cable.
9. Disconnect the dash harness wires from the instrument and at the snap connectors.
10. Remove the clip securing the harness to the bulkhead and withdraw the harness complete, withdrawing instrument panel wires and the grommet.
11. Enlarge the grommet hole in the bulkhead, situated behind the instrument panel, to 1 in. (25,4 mm) dia., to take the extra thickness of harness cable.
12. Fit the new regulator to the existing holes in the mounting bracket already secured to the scuttle. Note that if an auxiliary fuse box is fitted to the mounting bracket, remove and refit adjacent to the mounting bracket.
13. Fit the relay to the centre of the bulkhead, beneath the bonnet water rail.

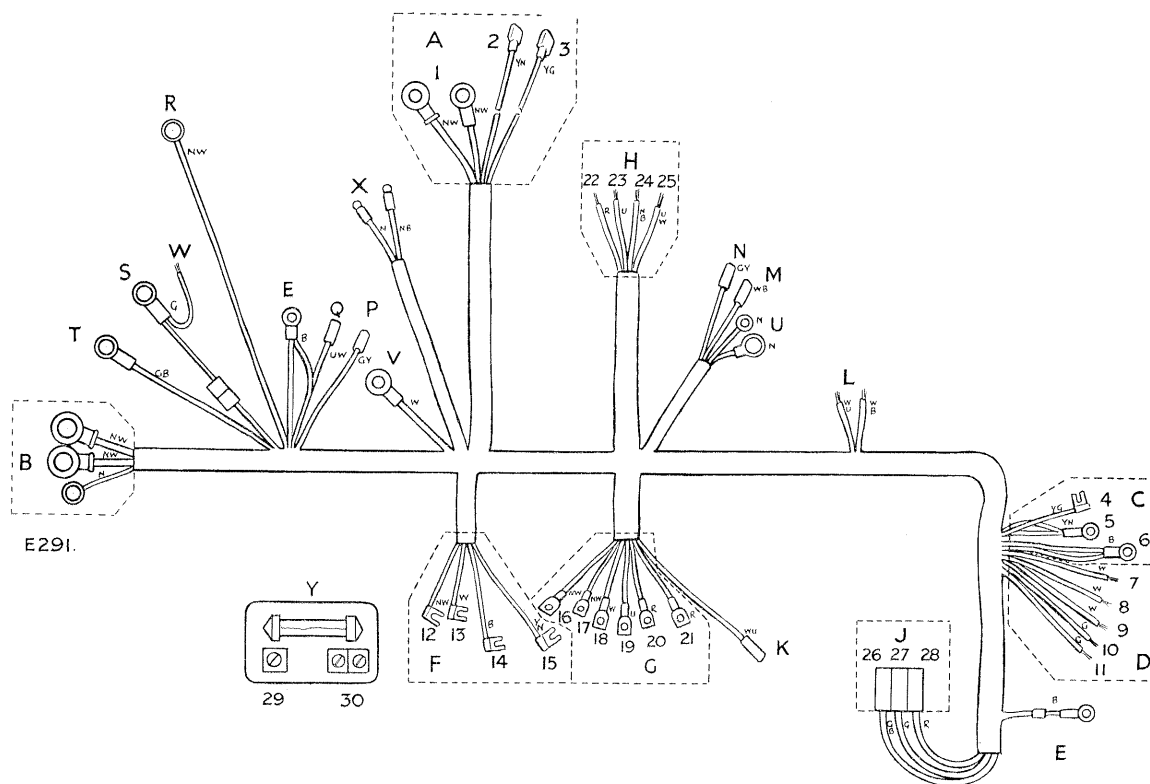



Fig. T-72—Dash harness connections

- |   |   |  |
|---|---|--|
| <p>A—Alternator</p> <p>1 Feed</p> <p>2 To 'red' on alternator</p> <p>3 To 'black' on alternator</p> <p>B—Ammeter</p> <p>C—Regulator</p> <p>4 'F'</p> <p>5 'D'</p> <p>6 Earth</p> <p>D—Fuse box</p> <p>7 'A3'</p> <p>8 'A3'</p> <p>9 'A3'</p> <p>10 'A4'</p> <p>11 'A5'</p> <p>E—Earth</p> | <p>F—Relay</p> <p>12 'C4'</p> <p>13 'W2'</p> <p>14 'W1'</p> <p>15 'C1'</p> <p>G—Ignition and lighting switch</p> <p>16 'A' feed</p> <p>17 'A'</p> <p>18 'Ignition'</p> <p>19 'H'</p> <p>20 'S'</p> <p>21 'S'</p> <p>H—Junction box</p> <p>22 Tail</p> <p>23 Head</p> <p>24 Horn</p> <p>25 Main beam warning light</p> <p>J—Frame junction</p> <p>26 Tail</p> <p>27 Stop light switch</p> <p>28 Petrol tank unit</p> | <p>K—Choke warning light</p> <p>L—Choke warning light switch</p> <p>M—Thermo-switch</p> <p>N—Oil pressure switch</p> <p>P—Oil warning light</p> <p>Q—Main beam warning light</p> <p>R—Inspection socket</p> <p>S—Petrol gauge 'B'</p> <p>T—Petrol gauge 'T'</p> <p>U—Starter switch</p> <p>V—Ignition coil</p> <p>W—Windscreen wiper</p> <p>X—Horn</p> <p>Y—Fuse box details</p> <p>29 White wire</p> <p>30  Green wire</p> |
|---|---|--|

14. Fit the new harness connections for the instruments and ammeter to the enlarged hole in the bulkhead and into the instrument panel box. Feed the ammeter wires through the demister tube hole on the left-hand side of the tunnel aperture. If demister tubes are fitted enlarge the hole and grommet as necessary.
15. Connect the lead to the generator in accordance with the wiring diagram.
16. Fix a suitable clip and rubber grommet to one of the securing screws on the generator cover plate and secure the cable to the clip.
17. Secure the cable from the generator along the left-hand side wing valance folded edge with the clips and screws supplied.
18. Connect the horn wires to the horn and secure the leads to the scuttle.
19. Connect wires to the relay mounted on the scuttle, in accordance with the wiring diagram and fit the rubber cover.
20. Connect the wires to the regulator box in accordance with the wiring diagram.
21. Connect the three earth terminals on the harness to the lower fixing bolt securing the regulator to mounting bracket.
22. Connect the leads to the ignition fuse box and the junction box in accordance with the wiring diagram.
23. Connect the leads to the starter switch, oil warning light switch, ignition and lighting switch, choke warning light switch and ignition coil, in accordance with the wiring diagram.
24. Connect the harness wires to the three-way connector on the chassis frame harness in accordance with the wiring diagram and secure to the scuttle with a clip.
25. Secure the harness to the bulkhead as necessary.
26. Remove the ammeter from the multiple instrument and fit the blanking plate supplied in its place.
27. Remove charging warning light complete with leads and fit the plug supplied in its place.
28. Connect the wires of the new harness to the instruments and snap connectors in accordance with the wiring diagram.
29. Reconnect speedometer cable and refit the instrument panel.
30. Paint the ammeter mounting bracket the colour of the vehicle and fit the new ammeter.
31. Connect the leads to the ammeter in accordance with the wiring diagram.
32. Fit the mounting bracket and ammeter to the dash below the windscreen ventilator control and secure the top of the mounting bracket to the ventilator control fixing bolt.

33. Secure the rear of the mounting bracket to the glove box panel, using the fixings provided.
34. Use the mounting bracket as a template and drill a  $\frac{3}{16}$  in. (4.7 mm) dia. hole in the grabrail and secure with the fixings provided.
35. Connect the battery leads and refit the oil bath air cleaner and the flexible pipe between cleaner and carburetter.
36. Test as follows:—  
     Check operation of generator fittings;  
     Check head, side and tail lights.

### Servicing the alternator and ancillary equipment

**General maintenance** (points to check when the vehicle receives a major overhaul).

#### Lubrication

Pre-packed bearings, requiring no attention between major overhauls.

#### Brush gear

Excessive wear is unlikely as the brushes run on the smooth unbroken surface of the slip rings.

If for any reason excessive wear has taken place, the brushes should be replaced if worn to less than 0.400 in. (10 mm).

Brush spring tension (new brush) should be  $7\frac{1}{2}$  oz. (213 grammes).

In service it is permissible for this value to fall to 4 oz. (113 grammes) (fully worn brush).

When changing brushes, the slip rings should be cleaned with a piece of smooth glass-paper. *Under no circumstances should emery cloth or other similar abrasives be used.*

#### Control box

Periodically check that the control box open circuit setting is within the specified limits. See under 'Testing the control box' on the following page.

#### Rectifiers

Inspect the alternator diode rectifiers and if necessary carefully wipe off any dirt or oil, which may have accumulated.

#### Fault diagnosis and service testing

Fault finding should always be carried out in a systematic manner. It is only necessary to carry out tests on the alternator rectified output (D.C.) side, as any faults in the A.C. section will be obvious by their effect on the D.C. output.

#### Equipment required

1. A good quality moving coil D.C. ammeter, capable of accurate readings up to at least 75 amps.
2. A good quality moving coil D.C. voltmeter, scale 0-20 volts.

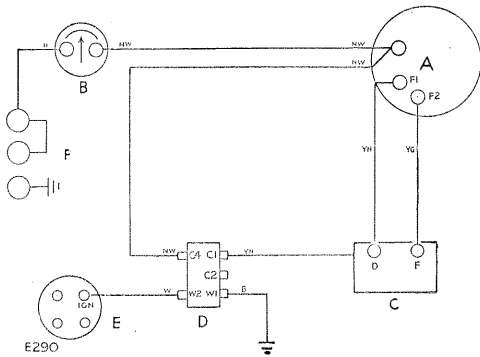


Fig. T-73—Alternator charging circuit

- |                 |                             |
|-----------------|-----------------------------|
| A—Alternator    | D—Relay                     |
| B—Ammeter       | E—Ignition and light switch |
| C—Regulator box | F—Terminals                 |

### Testing the alternator current output

1. Check the driving belt tension. The correct tension is when the driving belt can be depressed by the thumb  $\frac{1}{4}$  to  $\frac{3}{8}$  in. (6-9 mm), between pulleys.
2. Disconnect the battery earth lead.
3. Disconnect both cables from alternator output terminal 'G'.
4. Connect a D.C. ammeter between the alternator main terminal 'G' and the two cables previously disconnected from this terminal.
5. Disconnect the brown-with-green cable from the control box terminal marked 'F' and temporarily connect it to earth (vehicle chassis).
6. Reconnect battery earth lead—switch on the ignition, start the engine and slowly open the throttle until alternator speed is approximately 2,500 r.p.m. At this point the reading at the ammeter should be in excess of 45 amps., with the alternator at ambient temperature.

### Conclusions

1. If satisfactory, a reading in excess of 45 amps. should be obtained at 2,500 alternator r.p.m., with the alternator at ambient temperature.
2. A low reading at 2,500 r.p.m. will indicate either a faulty alternator, bad earths or poor circuit wiring connections. If after checking the latter a low reading is still given, a replacement alternator is required.
3. A zero reading can be the result of a faulty alternator, faulty field isolating relay, or its associated circuit. If the relay fails to close it will prevent the rotor field circuit from being completed across contacts 'C1' and 'C4'.

The alternator will not generate if the contacts fail to close when the ignition is switched on.

### Testing the relay

1. With the D.C. ammeter connected as for the alternator test, connect a bridging lead between terminals 'C1' and 'C4' and again check alternator output.

### Conclusions

1. If with the ignition switched on the alternator now charges with the bridging lead across 'C1' and 'C4', it indicates a faulty relay and the usual checks for continuity of relay windings, faulty wiring and earth connections, should be carried out.

If fault still not eliminated, replace the relay unit.

### Testing the control box

If after testing the alternator and relay the alternator proves to be capable of supplying its full output, and provided the control box earth is satisfactory, and previous checks on the wiring have been carried out, the fault lies in the control unit itself and a replacement unit should be fitted. Apart from re-setting, if necessary, the open-circuit voltage, no other adjustment should be attempted.

### Checking and adjusting the open-circuit voltage

1. Disconnect battery earth lead.
2. Disconnect the battery (brown with white) cable from the alternator terminal 'G' leaving the smaller (brown with white) cable, which connects to the relay contact 'C1' in position. Care being taken not to short-circuit the battery lead to earth.
3. Connect a D.C. voltmeter between the main 'G' terminal of the alternator and earth.
4. Reconnect battery earth lead.
5. Switch on the ignition and start the engine.
6. Raise the engine speed momentarily to half-throttle or more to achieve self-excitation, then slowly reduce the alternator speed to approximately 3,000 r.p.m. At this point the open-circuit voltage at 20°C (68°F) should be 14.9-15.3 v. Temperature correction factor is 0.1 volt. **Add** this to standard setting for every 10°C (18°F) below 20°C. Conversely **subtract** for every 10°C above 20°C.
7. If necessary adjust the setting by removing the regulator cover and altering the setting screw as required. **Clockwise to increase** the voltage, or **anti-clockwise to decrease** the voltage, whilst maintaining an alternator speed of approximately 3,000 r.p.m. Make the adjustments as quickly as possible.
8. Increase the alternator speed to 4,500 r.p.m. when the open-circuit voltage must not exceed 15.8 v.
9. Switch off engine and remove battery earth lead, replace cover and reconnect the main (brown with white) cable to the alternator terminal 'G'.
10. Reconnect battery earth lead.

### Conclusions:

1. If the regulator setting is unstable, particularly at the maximum speed of 4,500 r.p.m., the unit should be replaced.

**Fault diagnosis procedure****Charging faults****'Flat' battery or low state of charge**

1. Check battery condition.
2. Check driving belt tension.
3. Test alternator, relay and control box as necessary.  
Check to make certain that the field isolating relay opens when the ignition is switched off, otherwise the battery will be continually discharging through rotor field.

**Battery overcharged**

1. Test control box.
2. Check battery condition.

**Alternator not charging or charging intermittently**

1. Check driving belt tension.
2. Test alternator, relay and control box, as necessary.

**Service notes**

1. Due to the stresses imposed on the driving belt by the alternator it is absolutely essential to check periodically that there is no slackness in the driving belt and that the pulleys are in good condition.
2. Bad earths or loose wiring connections, particularly those associated with the regulator, will cause low alternator output.
3. Failure of the isolating relay contacts to open when the ignition is switched off will result in partial or complete discharge of the battery, depending on the length of time the fault exists.
4. The control box is polarised to suit a specific earth polarity. Earthing the wrong battery terminal will damage the regulator and the rectifiers in the alternator.

**Rear seats—all models****To fit****Operation T/92**

1. Ensure that the support angles on the seat frame assembly are set and fitted in their correct positions, as below. For 88 models use the upper pair of holes and 109 models use the lower pair of holes. Leave the bolts loose until the seat frame assembly is in position.

**88 models**

2. Place each rear seat frame in position on the wheelarch box, ensuring that the support angles engage with the existing slots on the underside of the body cappings.

3. Drill two  $\frac{1}{4}$  in. (6 mm) dia. holes in the wheelarch box, using the frames as a guide, and secure each seat frame to the wheelarch box by means of bolts, plain and spring washer and nuts. Tighten the support angle bolts.
4. Secure backrest panels to the seat back frames with bolts, spring washers and nuts.
5. Place each seat cushion in position and attach to the seat frame with the tapes provided.

**109 models**

It is possible to fit either one or two seat assemblies to each wheelarch box. The following items are for fitting two assemblies to each wheelarch box. Note also that when four seats are fitted it is necessary to remove the spare wheel, and blank the wheel well with a cover plate. A cover plate and a special dished bonnet to take the spare wheel are available.

6. Remove the spare wheel from the well and remove all the clamping attachments from the body capping.
7. Fit the two rubber buffers to the back of each seat frame, in the existing holes in the frame, just above the support angle, using two screws, packing washers, plain washers and nuts.
8. Repeat items 2-5 inclusive, noting that four packing washers must be fitted between the seat frame and the wheelarch box before securing with the two bolts, spring and plain washers and nuts.

**Locking door handles—all models****To fit****Operation T/94**

1. Remove both door handles complete with locks and mounting plates.

**R.H. door lock (locking)**

2. Withdraw the key from the door lock and remove the locking plate, loosely secured by a pin; remove the lock securing nut.
3. Fit the lock to the new door handle with the key slot serrations facing downwards (unlocked) and the plain washer between the lock and bracket.
4. Replace the lock securing nut, but do not fully tighten.
5. Refit the locking plate so that the hooked part is uppermost.
6. Fit the pin to the locking plate, check the operation of the lock, and peen over the end of the pin.
7. Screw the slotted nut back to the locking plate.
8. Remove the exterior handle support bracket from the original door lock, transfer the rubber washer from the old handle to the new, and discard the old handle.

9. With the catch in the unlocked position, fit the handle to the door lock, securing with the support bracket and original fittings. The screw heads must be to the door interior.
10. Fit the handle and lock complete to the R.H. door, using the original fixings, then tighten the slotted nut securing the catch lock, using a special 'C' spanner, Part No. 248877.
11. Open out the centre inner hole at the rear of the mounting plate to  $\frac{3}{16}$  in. (4.5 mm).
12. Secure the pillar in the drilled hole, using a plain washer, spring washer and nut.
13. Check the operation of the lock.

#### L.H. door lock (with catch)

14. Remove the top front screw, securing the lock to the mounting plate.
15. Secure the catch to the vacant hole, using a screw, plain washer and nut.
16. Ensure that the catch moves freely, and prevents the door handle from being lifted when in the lowered position.

#### Window locks

17. With the side screws shut, position the brackets of the catch assembly on the bottom rail, so that the screws are just clear of the rear of the sliding windows.
18. Drill two  $\frac{11}{16}$  in. (5 mm) holes through each bracket into the bottom rail and secure each bracket with the two pop rivets provided.

#### Extra windscreen wipers—all models

##### To fit

##### Operation T/96

1. Remove the blanking piece and washer from the passenger's side windscreen after withdrawing the two screws, spring washers and nuts.
2. Fit the new windscreen wiper motor to the windscreen, with the escutcheon and seal on the outside, using the fixings provided.
3. Remove the rubber plug and fit the plug socket in the hole in the glove box top.
4. Withdraw the five screws and lower the instrument panel.
5. Connect the feed lead to the two-way connector in the green lead to the fuel gauge terminal 'B'.
6. Replace the rubber plug in the instrument box side with a grommet; pass the feed lead through the grommet and, with a cap placed on the lead, connect it to the plug socket.
7. Clip the feed lead to the rear of the glove box, using a clip.
8. Cut the feed lead with plug at a point 4 in. from the terminal end and bare the wire at the ends.

9. Connect the section of the lead with the plug between the wiper motor and the plug socket and the other portion with the terminal to a drive screw on the windscreen rail to act as an earth.
10. Fit the wiper arm to the motor, and the blade to the arm.
11. Adjust the blade position and test the wiper operation.
12. Replace the instrument panel.

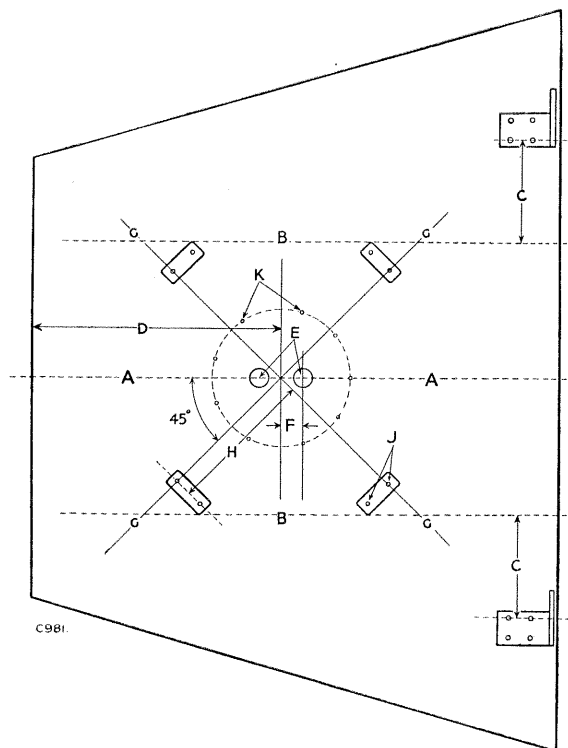


Fig. T-74—Bonnet panel carrier dimensions

- A—Centre line
- B—Guide lines
- C— $7\frac{1}{2}$  in. (190 mm)
- D— $18\frac{1}{2}$  in. (460 mm)
- E—2 new holes,  $1\frac{1}{2}$  in. (38 mm) dia.
- F— $1\frac{11}{16}$  in. (42 mm)
- G—Diagonals
- H— $11\frac{1}{8}$  in. (282 mm)
- J—Eight new holes  $\frac{5}{16}$  in. (5.5 mm) dia.
- K—Nine new holes—No. 6 drill .204 in. (5 mm) dia.

#### Spare wheel carrier on bonnet—all models

The following items are for fitting a spare wheel carrier to the existing bonnet on 88 models. A special dished bonnet, which must be fitted to 109 models, is available, which only requires the support plate fitting.

The clamps are reversible to accommodate 6 in. or 7 in. tyres.

**To fit****Operation T/98**

1. Mark a centre line, with a pencil, along the bonnet from front to rear.
2. **88 models:** Mark a guide line on each side of this line,  $7\frac{1}{2}$  in. (190 mm) from each inner hinge fixing. See Fig. T-33.
3. Mark and centre pop the centre line at  $18\frac{1}{8}$  in. (460 mm) from the front edge of the bonnet, and using this as a centre, mark off a point either side at  $1\frac{11}{16}$  in. (42 mm) and cut two  $1\frac{1}{2}$  in. (38 mm) dia. holes.
4. **88 models:** Mark out from the centre pop, four diagonal lines,  $45^\circ$  to the centre line, as shown in Fig. T-33, then mark each line at  $11\frac{1}{8}$  in. (282 mm) and drill a  $\frac{7}{32}$  in. (5,5 mm) dia. hole.
5. Fit two bolts and clamps to the support plate, then secure a split pin to each bolt.
6. Locate the spare wheel support, complete with clamp to bonnet, ensuring that the two bolts are over the centres of the two  $1\frac{1}{2}$  in. (38 mm) dia. holes.
7. Using the support plate as a template, drill nine .204 in. (5 mm) dia. holes (No. 6 drill) and rivet assembly to bonnet.
8. **88 models:**
  - (a) Position the four rubber support blocks on the diagonal lines, and secure with a screw, large plain washer, small plain washer, spring washer and nut to the hole previously drilled. Do not fully tighten.
  - (b) With the outer lower edge against the guide line, and using the hole in the block as a guide, drill four more  $\frac{7}{32}$  in. (5,5 mm) holes. Secure to bonnet, and tighten.

**Towing attachments—all models****To fit****Operation T/100**

1. All towing attachments can easily be fitted, using the nuts, bolts, spring and plain washers provided.

**Full length hood—all models**

The soft hood completely encloses the vehicle and can be opened at the rear to facilitate loading. It is available with plain sides or, for Export territories only, with side windows.

**To fit****Operation T/102**

1. Fit the two hood sticks in the sockets at the corners of the rear body and secure with clamp arms, bolts, washers and nuts.
2. Secure the tie tube between the sticks by means of self-locking nuts.
3. Fit the intermediate hood stick between the tie tube, securing it with locknuts.

On 109 models the intermediate hood stick is full length and should be secured to the body side cappings, using four bolts and two nut plates.

4. Secure the top drain channels to the front hood stick, using bolts, plain washers and self-locking nuts. Fit the adjustment plate between the top drain channel and the windscreen top rail.
5. If not already fitted, secure the door rear drain channels to the front hood stick with bolts, plain washers and self-locking nuts.
6. Secure the two rope hooks (one L.H., one R.H. —the hook towards the door jamb) to the body sides,  $\frac{1}{4}$  in. (6 mm) from the door jamb, with the top of the rope hook touching the capping, using the 2 B.A. nuts, screws and washers provided.
7. Secure the two staples to the tailboard cotter brackets by removing the second pair of rivets down on each bracket. Fix the staples to the brackets with the  $\frac{3}{4}$  in. (19 mm) long 2 B.A. screws, nuts and washers provided.
8. Place the hood over the sticks and secure it to the windscreen top rail.
9. Secure the front support straps to the staples on the windscreen top rail.
10. Secure the rear hood straps to the staples on the body and the side curtain straps to the front hood stick.
11. Pass the side ropes round the hooks at the front corner of the body, secure under the side hooks, and together with the rear ropes, to the hooks at the rear of the body.
12. Push the rear curtain side flaps through the side pockets and secure.

**Three-quarter length hood—all models**

The soft hood encloses the vehicle rear body, behind the cab, and can be opened at the rear to facilitate loading. It is available with plain sides or, for Export territories only, with side windows.

**To fit****Operation T/104**

1. Position the drain channels against the cab rear panel so that with the lower edge resting on the rear body front capping, each drain channel protrudes approximately  $\frac{1}{8}$  in. (3 mm) out from the body side capping. The drain channels are shaped to go round the hood stick.
2. Using the drain channels as templates, drill six holes  $\frac{7}{16}$  in. (7 mm) dia. and secure the channels to the cab rear panel, using the fixings provided.
3. Position the hood mounting frame centrally against the cab rear panel and resting on the drain channels.



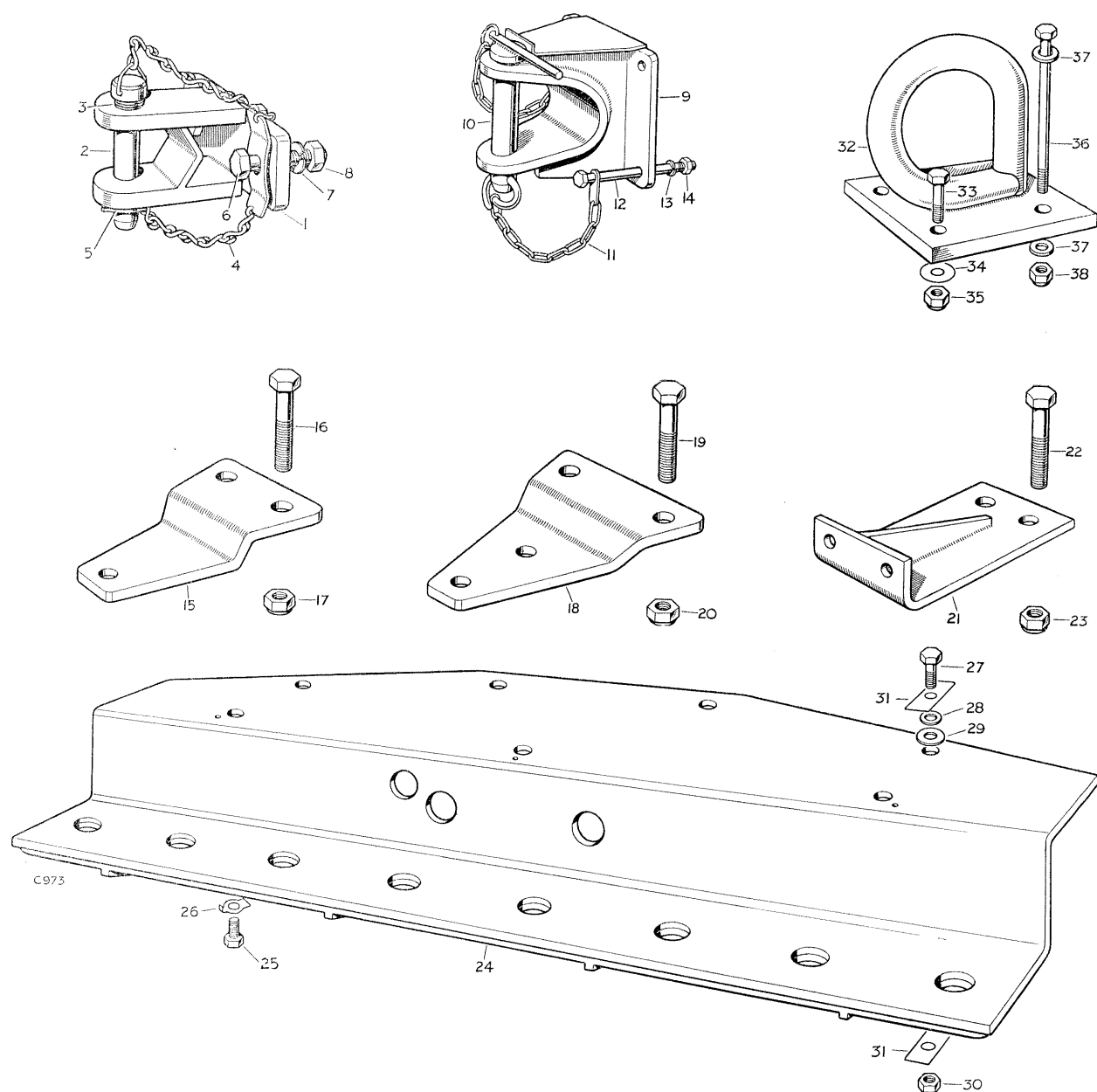


Fig. T-75—Towing attachments

- |  |                      |   |   |
|--|----------------------|---|---|
| 1 Towing jaw assembly                    | } Standard equipment | 18 Rear tow plate                               | } For use with combine harvester only         |
| 2 Pintle pin for jaw                     |                      | 19-20 Fixings—tow plate to rear draw bar        |   |
| 3 Spring for pin                         |                      | 21 Anchor plate for towing jaw                  | } Only required when power take-off is fitted |
| 4 Retaining chain for pin                |                      | 22-23 Fixings—tow plate to rear draw plate      |   |
| 5 Spring clip for chain                  |                      | 24 Rear tow plate                               |   |
| 6-8 Fixings—jaw to chassis frame         |                      | 25-31 Fixings—towing plate to rear cross-member |   |
| 9 Towing jaw                             |                      | 32 Lifting and towing ring                      |   |
| 10 Towing jaw pin                        |                      | 33-35 Fixings—towing ring to front bumper       |   |
| 11 Chain for towing jaw pin              |                      | 36-38 Fixings—towing ring and bumper to frame   |   |
| 12-14 Fixings—jaw to chassis             |                      |   |   |
| 15 Rear tow plate                        |                      |   |   |
| 16-17 Fixings—tow plate to rear draw bar |                      |   |   |

4. Using the mounting frame as a template, drill twelve holes  $\frac{11}{16}$  in. (7 mm) dia. and secure the frame to the cab rear panel, using the fixings provided.
5. Fit the rear hood sticks in the sockets at the rear corner of the body and secure with clamp arms, bolts, washers and nuts.
6. Fit the front hood sticks in the sockets in the front corners of the body and secure with bolt plates, spring washers and nuts.
7. Secure the tie tubes between the sticks, using self-locking nuts.
8. Fit the intermediate hood stick between the tie tubes, securing it with self-locking nuts and, 109 models, securing the hood stick flanges to the pre-drilled holes in the body side cappings, using the fixings provided.
9. Mark a centre 9 in. (229 mm) from the door jamb and 2 in. (50 mm) down from the top of the rear body capping, and using the front rope hooks as templates, drill four holes and fix the rope hooks to the body sides, using the 2 B.A. nuts, screws and washers provided.  
Two rope hooks, one L.H., one R.H.,—the hook should be towards the door jamb.
10. Secure the two staples to the tailboard cotter brackets by removing the second pair of rivets down on each bracket. Fix the staples to the bracket with the  $\frac{3}{4}$  in. (19 mm) long 2 B.A. screws, nuts and washers provided.
11. Place the hood over the sticks and secure to the mounting frame. The hood retaining strips should be inserted in the top and side channels of the mounting frame. Peg the upper retaining strip into the side strip.
12. Fit the lower ends of the two side retaining strips to the staples on the mounting frame and secure with the short straps.
13. Fasten the two straps over the intermediate hood stick, secure the ropes to the rope brackets on the body sides and, together with the rear ropes, to the hooks at the rear of the body.
14. Secure the rear curtain straps to the two staples fitted to the rear of the body.
15. Push the rear curtain side flaps through the side pockets and secure.

#### Ventilator flyscreens

To fit

Operation T/106

1. The flyscreens may be fitted, an inner and an outer to each ventilator orifice, by using the screens as templates and drilling twenty  $\frac{1}{4}$  in. (2 mm) dia. holes and then fixing in position over each orifice using the drive screws provided.

### FIRE FIGHTING EQUIPMENT

The pump, mounted at the rear of vehicle, is a two-stage, self-priming, high-pressure impeller type. A single shaft, supported on a plain bearing at the rearmost end and a ball bearing at the driving end, carries three impellers. The first impeller, furthest from the driving end of pump, withdraws air from the suction pipe, causing the necessary depression and thus inducing a flow of water to the pump. The two main impellers maintain and pressurise the water flow.

An engine speed governor and oil cooler are used in conjunction with the pump; drive is taken from the rear of the gearbox transfer casing by propeller shaft.

To prime the pump (Fig. T-77)

Operation T/108

1. Select the "Priming" position with lever (1) and remove wing cap (2); pour water into the filler neck until it flows from the exhaust pipe (3), then replace the wing cap.

To engage the pump drive (Fig. T-77)

Operation T/110

1. Start the engine with the transfer gear lever in neutral position; depress the clutch, select top gear with main gear lever and move the "power

take-off" selector (early models, beneath centre seat box; late models, knob on heelboard) forward, then release the clutch pedal. Control engine r.p.m. by means of the governor control lever (8).

To pump from first-aid tank (Fig. T-77)

Operation T/112

1. Fit a blanking cap (4) to suction port and ensure that main delivery valves (5) are closed.
2. Open first-aid suction control valve (6) and pressure control valve (7) and select "Working" position with lever (1).
3. Start the engine and engage the drive.
4. Increase engine r.p.m. to suit output requirements.
5. To decrease the flow from delivery hoses reduce the engine r.p.m.

To fill first-aid tank from a hydrant (Fig. T-77)

Operation T/114

1. Connect the suction hose to the hydrant.
2. Open first-aid suction control valve (6) and ensure that delivery valves are closed.

3. Open hydrant valve.
4. When first-aid tank is full, shut off the hydrant.  
The pump is not under power during this operation.

**To pump from a static water supply (Fig. T-77)**  
**Operation T/116**

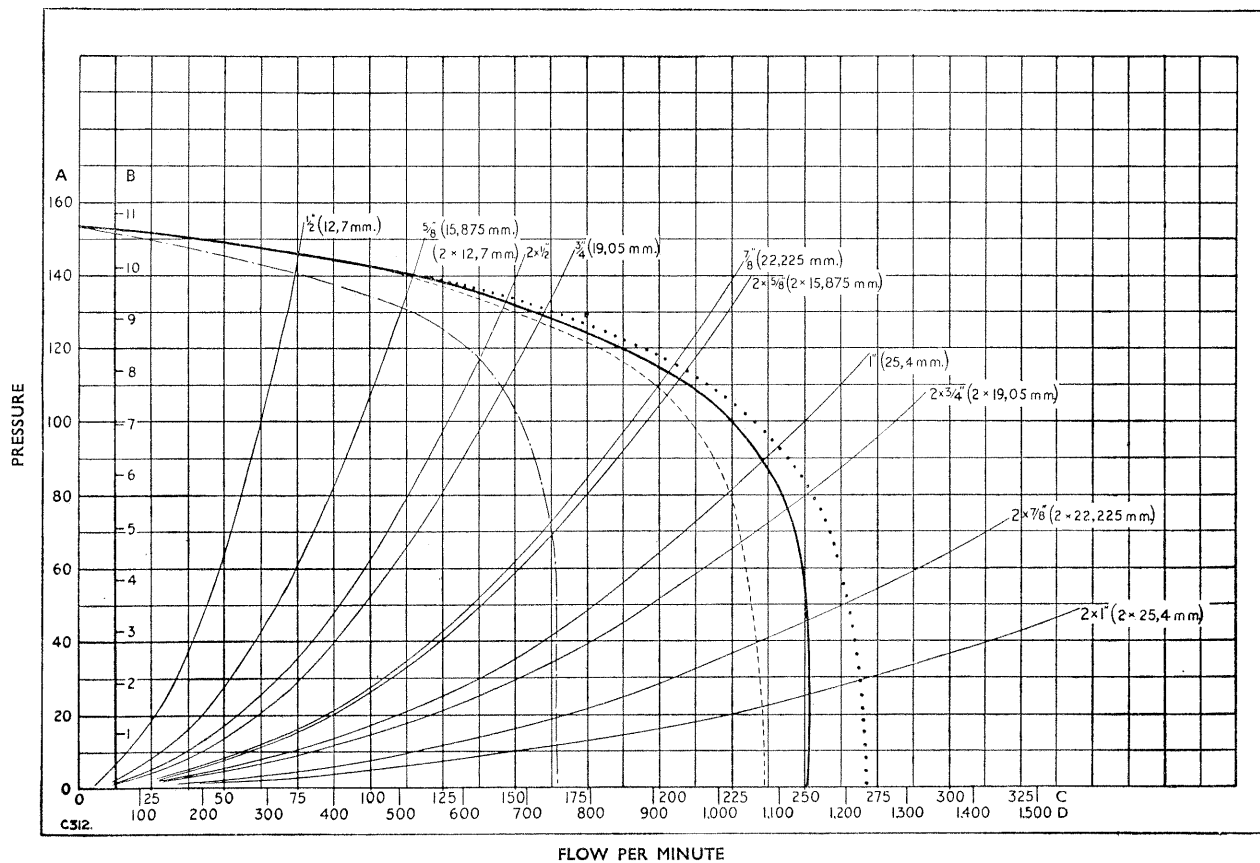
1. Prime pump.
2. Connect the suction and main delivery hoses; ensure that a strainer is fitted to the suction hose to prevent impurities entering the pump.
3. Close the delivery valves.
4. With lever (1) at "Priming" start the engine and engage the drive.
5. Move the governor control quadrant to the fully open position. The vacuum gauge (9) should indicate an increasing depression, and when water flows from exhaust pipe (3), the delivery

valves must be slowly opened. When the pressure gauge (10) indicates rising pressure, move the lever (1) into "Working" position.

6. To decrease the flow from delivery hoses, reduce the engine r.p.m.

**To pump from a hydrant or gravity feed supply (Fig. T-77)**  
**Operation T/118**

1. Connect the suction and delivery hoses and open the delivery valves.
2. Select "Working" position with lever (1).
3. Open the valve of tank or hydrant.
4. Start the engine and engage the pump drive.
5. Increase the engine r.p.m. to suit delivery requirements.
6. To decrease flow from delivery hoses, reduce the engine r.p.m.



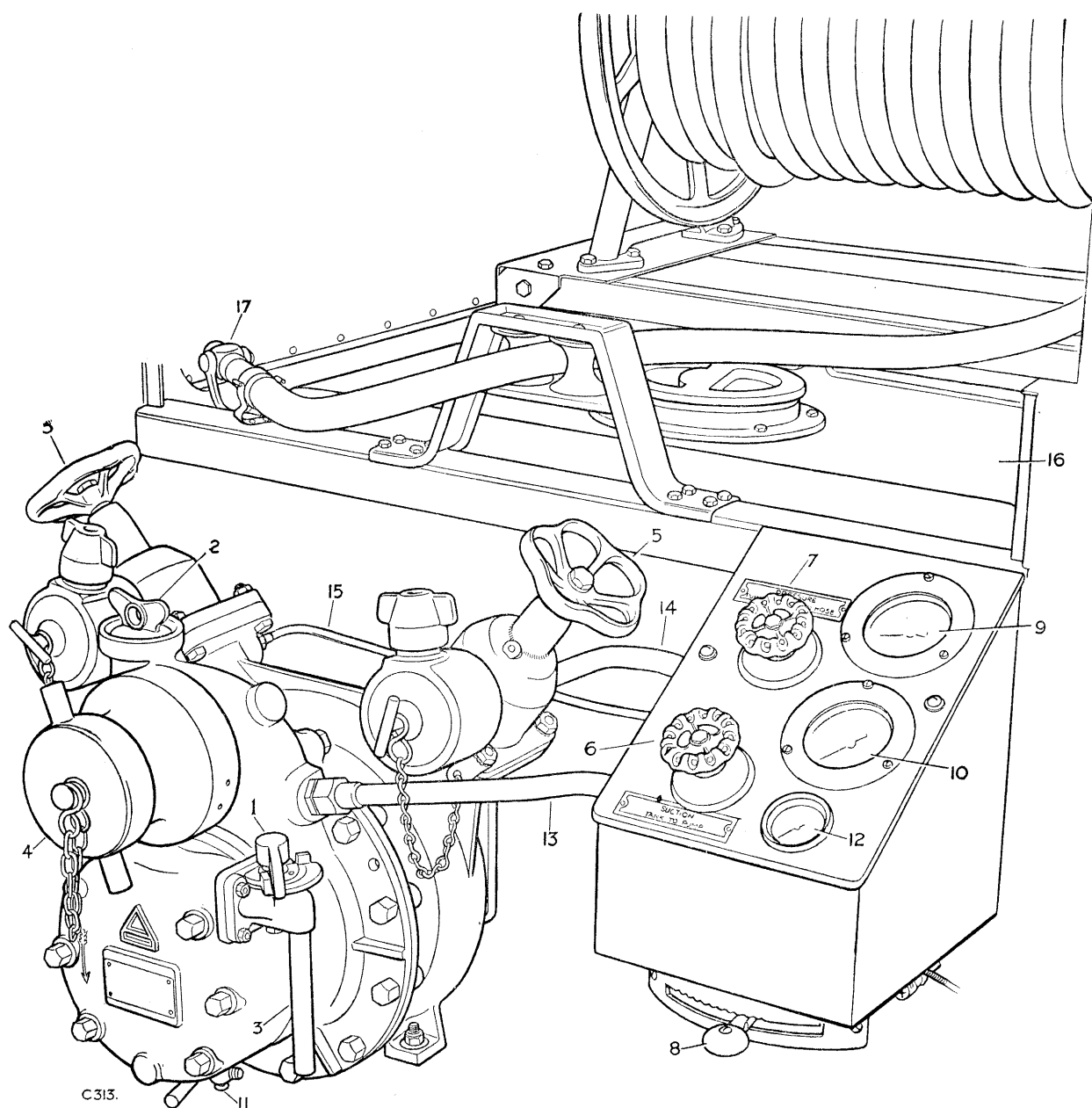


Fig. T-77—Pump and controls

- |                                    |                            |
|------------------------------------|----------------------------|
| 1 Priming lever                    | 10 Pressure gauge          |
| 2 Filler cap                       | 11 Drain cock              |
| 3 Exhaust pipe                     | 12 Oil temperature gauge   |
| 4 Blanking cap                     | 13 First-aid suction pipe  |
| 5 Main delivery valves             | 14 First-aid delivery pipe |
| 6 First-aid suction control valve  | 15 Pressure gauge pipe     |
| 7 First-aid pressure control valve | 16 First-aid tank          |
| 8 Governor control lever           | 17 First-aid hose nozzle   |
| 9 Vacuum and pressure gauge        |                            |

When the pump is working for a prolonged period it is desirable from time to time to close the delivery valve, reduce the engine r.p.m. and select the "Priming" position with lever (1), so changing the water in the priming pump and avoiding overheating.

#### To temporarily stop output (Fig. T-77)

##### Operation T/120

1. Move governor control lever to extreme right-hand side to allow engine to idle, and close delivery valves.

Periodically select "Priming" position with lever (1) in order to allow the water in pump to be changed and thereby avoid overheating.

#### To stop pumping

##### Operation T/122

1. Close the valve of supply tank or hydrant, reduce engine speed and close delivery valves.
2. Disengage the drive to pump and disconnect the delivery and suction hoses.

#### Precautions to be taken when pumping

(Fig. T-77)

##### Operation T/124

A strainer in a wicker basket should be used on the end of the suction hose when the supply is being taken from open water. Care should be taken to ensure that as the water level falls the suction hose is kept far enough below the surface to ensure no air is drawn in. Suction hose joints must be screwed up tightly to avoid reduced delivery, and if necessary the hose must be secured to prevent kinking.

Rate of flow and pressure of the pump must be regulated by varying engine speed and **not** by partially closing the valves.

Should the suction hose be leaking and air is drawn in, the lever (1) should be left in the "Priming" position so that any air is passed through the exhaust pipe together with water from the priming pump. In this case a hose may be connected to the exhaust pipe to carry excess water away.

#### Frost precautions

##### Operation T/126

1. Under cold weather conditions, where freezing may occur, the drain cocks must be opened when pumping is concluded. Complete drainage will be ensured if the pump is kept running for a few minutes after the suction hose is disconnected and whilst the cocks are open.
2. To ensure that the pump will be ready for instant use, prime with "anti-freeze mixture" instead of water alone.

#### Periodic checks

##### Operation T/128

After every operation ....

.... Remove and clean filter in priming funnel.

After every operation and every seven days inoperative ....

Ensure that the priming pump casing is full.

See Frost Precautions.

After pumping water containing impurities (lake, canal, sea water, etc.) ....

Thoroughly scavenge the pump with clean fresh water.

Every ten hours running and every fourteen days inoperative

Top up the filler pipes, protruding from the pump mounting ring, with engine oil. At the same time check the effectiveness of the mechanical seal by removing the oil drain plug from underneath the driving flange end of the pump. An undue proportion of water flowing out with the oil indicates a damaged seal, which should be replaced.

Every 1,000 hours running ....

(a) Remove the pump, driving flange and end cover. Syringe the ball bearing with petrol and re-pack one-third full with good quality non-acid grease.

(b) Apply a suitable oil to the pump driving propeller shaft nipples, one on each universal joint and one on the sliding sleeve.

At convenient intervals (dry suction test) ....

Ensure that the priming casing is full of water; close all valves and blank off the suction port. With lever (1) at "Priming" run the engine for **not** more than two minutes with the control quadrant lever fully open and note the depression registered by the vacuum gauge. The gauge should soon show 24-28½ inches of mercury if the system is air tight. Move the exhaust lever to "Working" position and stop the engine.

The vacuum gauge should record a drop of not more than three inches of mercury per minute if the pump is air tight.

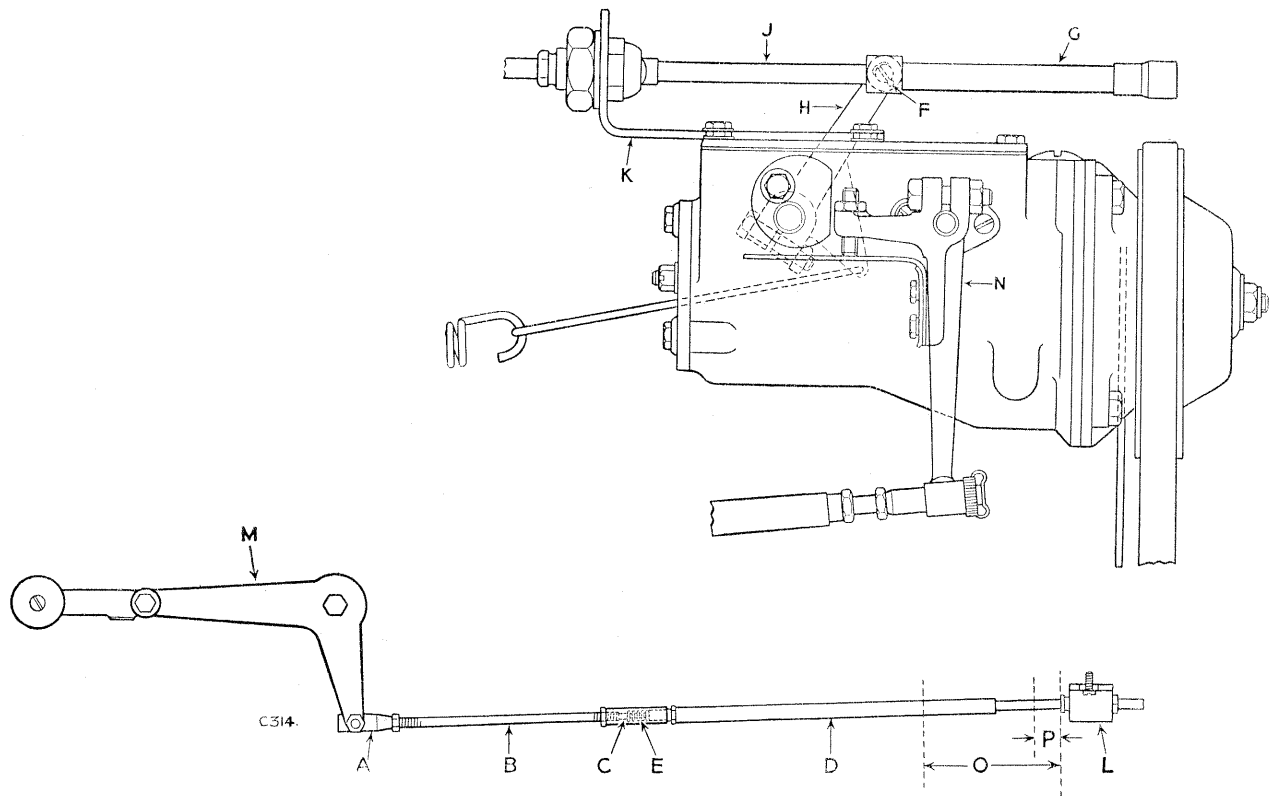


Fig. T-78—Arrangement of governor control (2 litre)

A—Ball joint  
 B—Adjusting rod  
 C—Body  
 D—Tube and plug assembly  
 E—Locking spring  
 F—Split pin  
 G—Inner cable and slider assembly  
 H—Governor arm  
 J—Swivel assembly  
 K—Support bracket for swivel assembly

L—Swivel coupling  
 M—Control quadrant lever  
 N—Governor arm (R.H.)  
 O—Control fully open  
     2 litre,  $3\frac{1}{8}$  in. (78 mm)  
      $2\frac{1}{4}$  litre,  $2\frac{1}{2}$  in. (63,5 mm)  
 P—Control inoperative  
     2 litre,  $\frac{1}{2}$  in. (12,5 mm)  
      $2\frac{1}{4}$  litre,  $\frac{3}{4}$  in. (19 mm)

#### Governor control cable—inner, to remove (see Fig. T-78)

#### Operation T/130

1. Disconnect the ball joint at control quadrant and remove it from the rod.
2. Unscrew the adjusting rod and body from tube and plug assembly.
3. Remove the locking spring from inner cable.
4. Withdraw the tube and plug assembly.
5. Take out the split pin securing the inner cable and slider assembly to the governor arm (L.H.) and withdraw the assembly from the swivel.
6. Grease the new cable assembly and feed it into the swivel assembly attached to support bracket on governor. Turn the cable occasionally to overcome any slight resistance which may be felt.
7. When fully inserted, the trunnion of the inner cable assembly should be attached to the governor arm again with a plain washer and split pin.
8. Press the governor arm fully forward. Pass the tube and plug assembly over the inner cable extending from the outer tube, until it is  $\frac{1}{2}$  in. (12,5 mm), 2 litre;  $\frac{3}{4}$  in. (19 mm),  $2\frac{1}{4}$  litre, from the shoulder of swivel coupling on chassis side member.
9. Screw the locking spring over the inner cable until it is  $\frac{1}{16}$  in. (1,5 mm) from the end of tube and plug assembly, and cut the surplus inner cable off with a small hack-saw. Ensure that the governor arm is extended fully forward before finally cutting the cable.
10. Screw the body tightly on to tube and plug assembly, position control quadrant in the fully closed position, screw the adjusting rod with ball joints and locknuts into body and adjust to fit quadrant. Open and close the quadrant lever fully and check for correct adjustment.

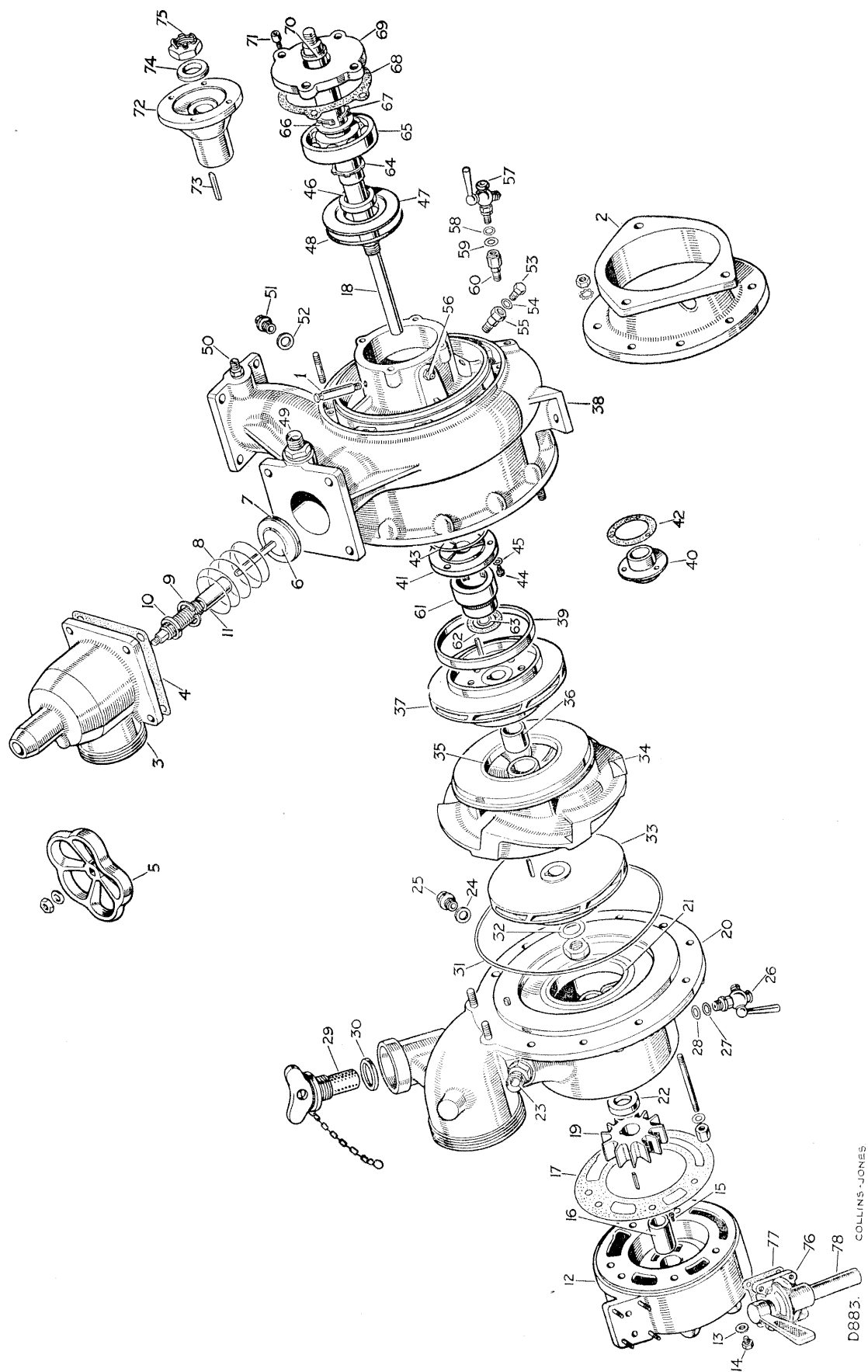


Fig. T-79—Exploded view of pump

Key to Fig. T-79

Plate Ref.	Description	Part No.	Plate Ref.	Description	Part No.	Plate Ref.	Description	Part No.
1	Oil filler tube	271751	30	Washer for cap	271776	58	Fibre washer	271773
2	Mounting ring	271752	31	Rubber 'O' ring	271777	59	Copper washer	218961
3	Delivery valve	271754	32	Locking washer	275385	60	Extension for drain cock	514562†
4	Joint washer for valve	271755	33	Suction impeller	267618	61	Mechanical seal	504062
5	Control wheel	271756	34	Diffuser ring	271778	62	Fibre washer	271790
6	Spindle and seal assembly	271757	35	Wearing ring	267621	63	Rubber 'O' ring	271791
7	Rubber seal	271758	36	Distance piece	271779	64	Circlip	271793
8	Spring	271759	37	Suction and pressure impeller	267619	65	Ball bearing	267616
9	Circlip	271760	38	Main casing	271780*	66	Distance piece	271794
10	Seal	271761		Main casing	514574†	67	Circlip	271793
11	Spindle body	271762	39	Wearing ring	267622	68	Joint washer	271796
12	Priming casing	267623	40	Stationary sealing ring	271781*	69	Bearing cover	271797
13	Washer } For priming	271770	41	Stationary sealing ring	514575†	70	Seal	271798
14	Plug } casing	271771	42	Joint washer	514560*	71	Screw for cover	271799
15	Grub screw, securing bush	271763	43	Sealing ring	514561†	72	Driving flange	271800
16	Bush for shaft	271764	44	Screw } For sealing	271782	73	Key for flange	271801
17	Gasket for priming casing	271765	45	Washer } ring	271783	74	Washer } For	271802
18	Shaft with washers and keys	267615	46	Seal	271784	75	Nut } flange	271803
19	Priming impeller	267620	47	Cover for rear seal	514563†	76	Priming cock	271804
20	Suction casing	271766	48	Sealing ring	514561†	77	Joint washer for cock	271805
21	Wearing ring	271767	49	Union for delivery pipe, first aid	240041	78	Exhaust pipe	271806
22	Seal (in suction casing) for shaft	271768	50	Union for pressure gauge pipe	3075			
23	Suction pipe union, first aid	240041	51	Plug	271771			
24	Washer } For suction	271771	52	Washer for plug	271770			
25	Plug } casing	271770	53	Plug, oil drain	271771†			
26	Drain cock	271772	54	Joint washer	271770†			
27	Fibre washer	271773	55	Extension tube	514564†			
28	Copper washer	213961	56	Grease nipple	271789			
29	Cap and filter assembly	271775	57	Drain cock	271772			

\*—Up to pump A745059

†—From pump A745060 onwards



**First-aid hose reel, to remove****Operation T/132**

1. Unscrew the nozzle from end of hose and withdraw the hose from fairleads.
2. Remove the union securing the delivery pipe to reel centre shaft.
3. Unscrew the breather pipe from first-aid tank.
4. Remove the bolts securing the supporting feet and lift the hose and reel assembly clear.

**First-aid hose reel, to fit      Operation T/134**

1. Reverse removal procedure.

**Reel support and first-aid tank, to remove****Operation T/136**

1. Remove the first-aid hose reel.
2. Disconnect the pressure pipe "reel to control cock" at the cock, and withdraw.
3. Disconnect the suction pipe "tank to control cock" at the tank and cock, then withdraw.
4. Unscrew the two bolts from the first-aid tank steady straps and move the tank centrally in the rear body.
5. Remove the bolts securing the reel support to the wheel arch box sides, then lift the support clear and remove the tank.

**Reel support and first-aid tank, to refit****Operation T/138**

1. Reverse removal procedure.

**Vacuum or pressure gauge, to remove****Operation T/140**

1. Disconnect the pipe from rear of gauge.
2. Remove the screws securing bezel to the instrument panel and withdraw the gauge.

In some cases it may be necessary to raise the instrument panel slightly, to gain access to the rear of instruments with a spanner. To raise the panel remove the control wheels and rubber grommets, withdraw the screws securing panel and instruction plates.

**Oil temperature gauge, to remove****Operation T/142**

1. Disconnect the ball joint at the control quadrant and remove the bolts securing quadrant to support bracket; lower quadrant.
2. Unscrew the knurled nut securing the oil temperature gauge to instrument panel.
3. Disconnect the capillary tubing from the oil pipe union on L.H. front wing valance and release the supporting clips from chassis side and cross-member.

4. Withdraw the gauge and capillary tubing, ensuring that the tubing is not bent unnecessarily nor twisted.

**Oil temperature gauge, to refit****Operation T/144**

1. Reverse removal procedure, again taking great care to bend the tubing only where necessary; do not twist it.

**Pump, to remove****Operation T/146**

1. Drain the pump and then remove the rearmost water drain plug or tap.
2. Disconnect from pump the first-aid delivery and suction pipes and also the pressure gauge pipe.
3. Remove the bolts securing the driving propeller shaft to the power take-off driving flange at rear of gearbox.
4. Ensure that the pump is suitably supported (with a sling, etc.), then remove the three bolts securing pump to rear cross-member and the two bolts to support plate.
5. Withdraw the pump and propeller shaft complete and lower. Unscrew the foremost drain tap as soon as possible to avoid damage, then disconnect the propeller shaft.

**Pump, to dismantle (see Fig. T-79)****Operation T/148**

1. Unscrew the lubricating pipes (1) and oil drain plug and extension (53, 55). Drain off oil. Remove the nuts and washers securing mounting ring (2) and withdraw the ring.
2. Remove the delivery valve securing bolts and withdraw the valve assemblies (3). Take out the spindle and seal assembly (6) and (7) and spring (8). A peg spanner will be required to unscrew the lower plate of the spindle and seal assembly if a new disc type rubber seal (7) is required.
3. The discharge valves may be dismantled completely by unscrewing the nuts securing control wheel (5), withdrawing the wheels, pressing the spindle body (11) downwards and extracting the body. Circlip (9) and spindle seal (10) may now be removed from the discharge valve casting.
4. Unscrew the cap nuts and gently tap the priming pump cover (12) off with a hide-faced hammer. Carefully remove the gasket (17). If necessary remove the grub screw (15) and extract the bush (16).
5. Slide the priming pump impeller (19) from the shaft (18) and take out the impeller key.
6. Remove the cap nuts and withdraw the suction casing (20) with sealing 'O' ring. If necessary withdraw the shaft seal (22).

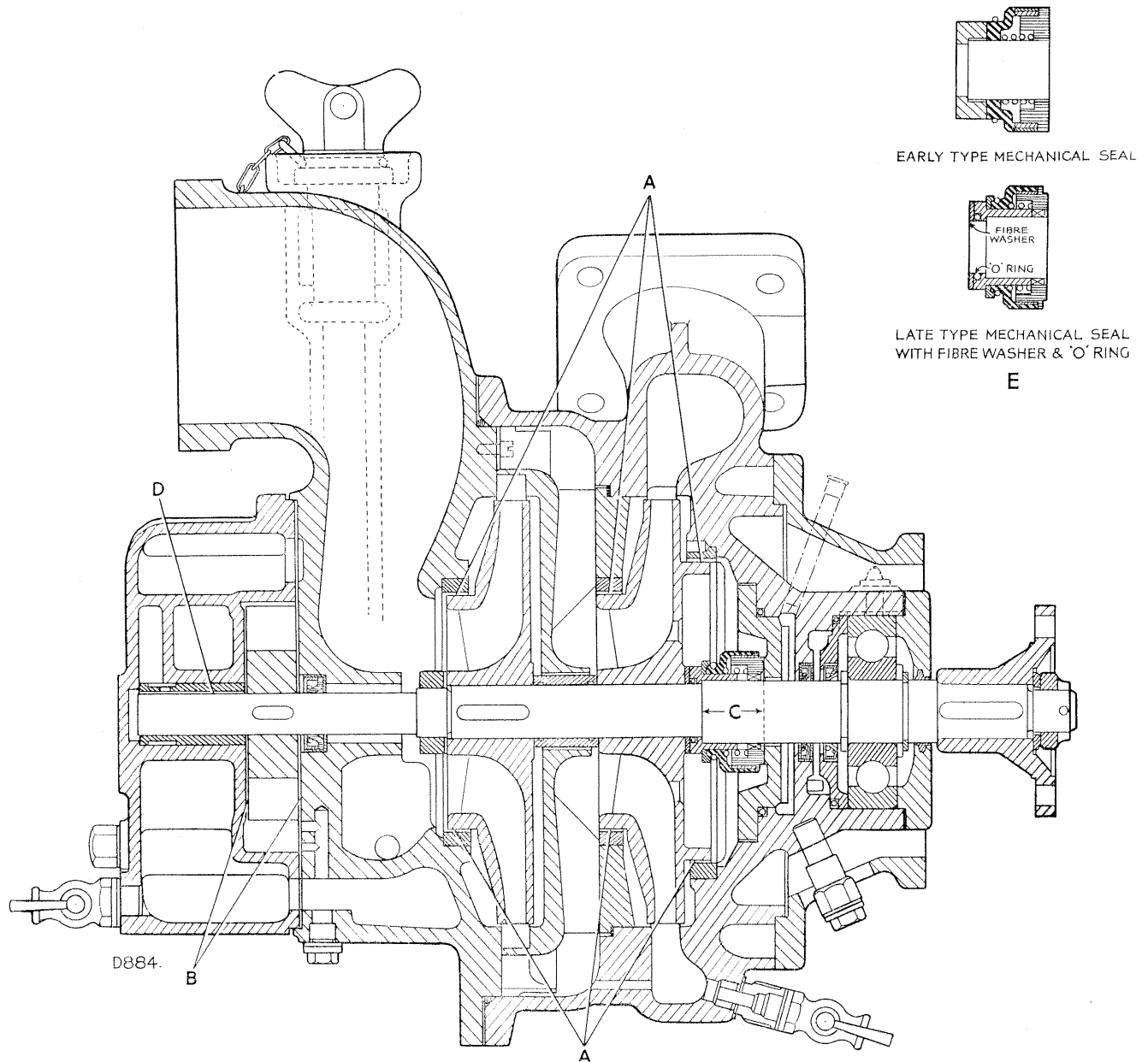


Fig. T-80—Sectioned view of pump, Serial No. A745060 onwards

A—Wearing ring clearance 0,25 mm (.010 in.)

B—Impeller total end-float 0,2 mm (.008 in.)

C—28 mm  $\pm$  0,3 (1.102 in.  $\pm$  .012)

7. Tap the locking washer (32) down and unscrew the impeller nut. Withdraw the suction impeller (33) and remove the key from the shaft.

A metal strip, bent hook shape, will facilitate the removal of impeller.

8. Using the hooks if necessary, draw the diffuser (34) from housing and shaft. Remove distance piece (36), pressure impeller (37) and pressure impeller key.

9. Remove the split pin, washer and nut (L.H. thread) securing the driving flange (72), then withdraw the flange and key.

The shaft should be positioned vertically between two pieces of wood and clamped in a vice when unscrewing the flange nut. *Do not* grip the shaft between metal jaw protectors or allow it to be held in the horizontal position. The weight of the main casing (38) plus the torque exerted by the operator on the flange nut, whilst the shaft is held horizontally, might cause distortion.

10. Using an "Allen" key, unscrew the socket-headed bolts (71) securing bearing cover (69).
11. Tap the shaft on the impeller side of main casing (38) with a hide-faced hammer to remove it

complete with bearing cover and ball bearing (65). The fibre washer (62), 'O' ring (63) and mechanical seal (61) may be withdrawn as the shaft is taken from the casing.

12. Remove the bearing cover, securing circlips, spacer and ball bearing from the shaft.
13. The seal (70) in bearing cover, seals (46) and stationary sealing ring (40 or 41), joint washer or sealing ring (42 or 43) and seal cover (47), if fitted, may now be removed if necessary, from the main casing.
14. Remove the priming cock and exhaust pipe assembly (76) from the priming pump cover.

#### Checking pump component parts for wear (Fig. T-80) Operation T/150

1. Check the bush in priming pump cover for excessive wear, see data section. If necessary remove the bush as instructed in Item 4 of the dismantling procedure, and fit a new one. Wear at this point must not be allowed to become excessive, since a corresponding amount of wear will take place in other components mounted on the shaft.
2. Note the end-float of priming pump impeller. Any increase on 0,2 mm (.008 in.) will result in reduced suction capacity. To check the end-float, place the impeller in position in priming casing with an already compressed gasket in place. Lay a straight-edge over the gasket and impeller and check the clearance with a feeler gauge.
3. Examine shaft seal in suction casing and renew if necessary.
4. Check the internal diameter of wearing rings, and the external diameter of shoulders on suction and pressure impellers. An axial clearance of 0,25 mm (.010 in.) is normal. A clearance in excess of 0,5 mm (.020 in.) will necessitate the regrinding of impeller shoulders and the fitment of suitably oversize wearing rings.
5. The fibre washer and 'O' ring seal (see Fig. T-79) must be replaced if any sign of deterioration exists.

6. If the mechanical seal has worn unduly and is to be renewed, the stationary sealing ring must also be replaced.

Ensure that the dimension from friction face of the stationary seal and the shoulder of shaft when in position is 28 mm  $\pm$  0,3 (1.102 in  $\pm$  .012).

On pumps prior to Serial No. A745060 if the early type mechanical seal having a large distance piece and no fibre washer or 'O' ring is fitted, it may be replaced by the latest type complete with fibre washer and 'O' ring. When fitting the latest type mechanical seal the original seal distance piece as well as the seal should be discarded (see 'E', Fig. T-80).

7. When a new stationary sealing ring is fitted it must be secured in the main casing by the three fixing screws and then accurately turned and lapped in position.
8. Check the seals in pressure casing and bearing cover and replace if necessary. If a felt ring type of seal is fitted in the bearing cover, the new or old one must be soaked in engine oil before replacement.
9. The ball bearing should be renewed if its serviceability is in any way doubtful.
10. Thoroughly clean the exhaust cock and check for correct functioning.

#### Pump, to assemble Operation T/152

1. Reverse the dismantling procedure and note that the mechanical seal should be tapped on to the shaft (after ensuring that the seal splines are correlated), using a piece of tubing and a hide-faced hammer.

When the mechanical seal is against the shaft shoulder, the end of the shaft key-way for pressure impeller will be 4 mm (.196 in.) from the face of the mechanical seal.

2. Use grease throughout assembly and top up with oil, using the filler tube at driving end, when assembly is complete.
3. After fitting pump to the vehicle, a dry suction check should be made as instructed on Page T-72.

**DEFECT LOCATION, FIRE FIGHTING EQUIPMENT****(Symptom, Cause and Remedy)**

**A—PUMP NOT DELIVERING. HIGH VACUUM READING WITH LITTLE OR NO AIR ESCAPING FROM EXHAUST PIPE.**

1. Strainer or suction pipe completely blocked—*Remove and clear.*

**B—PUMP NOT DELIVERING. VACUUM READING LOWER THAN CORRESPONDING STATIC SUCTION LIFT. AIR CONTINUALLY ESCAPING FROM EXHAUST PIPE.**

1. Badly leaking hose—*Rectify.*
2. Leaking delivery valve—*Rectify.*
3. Leaking mechanical seal—*Rectify.*

**C—PRESSURE INDICATED BY GAUGE BUT LITTLE OR NO DELIVERY FROM HOSE.**

1. Obstruction in suction hose—*Clear.*
2. Foreign matter in pump or at intake due to damaged strainer—*Dismantle, clean and rectify.*
3. Pressure gauge unserviceable—*Renew.*
4. Higher suction lift due to water level at supply failing—*Set pump at lower level if possible.*

**D—VACUUM FALLS AFTER PROLONGED RUNNING WITH CLOSED VALVES.**

1. Water in priming pump overheated—*Drain off hot water by opening drain cock in priming casing. Refill and re-prime pump.*

**E—NO VACUUM INDICATED. AIR CONTINUALLY ESCAPING FROM EXHAUST PIPE.**

1. Delivery valve open—*Close.*
2. Drain cock in main casing open—*Close and prime.*

**F—NO VACUUM INDICATED. NO AIR ESCAPING FROM EXHAUST PIPE.**

1. Priming pump contains too little or no water—*Refill and re-prime pump.*
2. Filler strainer choked—*Clean.*
3. "Priming" lever in "Working" position—*Re-set to "Priming" position.*

**G—WATER EMERGES FROM OIL FILLER TUBE OR AT DRIVING FLANGE.**

1. Worn mechanical seal or scored stationary seal—*Dismantle pump and replace.*

**DATA****Fire fighting equipment****General**

Capacity of first-aid water tank	40 gal. (182 litres) approx.
Length of first aid hose	120 ft. (40 metres)
Maximum permissible nozzle size when both delivery ports are in use	One $\frac{7}{8}$ in. (22 mm) and a 1 in. (25 mm)
Delivery port	$2\frac{1}{2}$ in. B.S.P. thread
Suction port	$4\frac{1}{2}$ in. B.S.P. thread
Delivery port adaptor	Suitable for standard British instantaneous $2\frac{1}{2}$ in. hose coupling
Suction port adaptor	Screwed to B.S.S. 336/1954 for 3 in. (76 mm) hose
Maximum self-priming suction lift	26 ft. (8 metres)

**Pump**

Type	Two-stage impeller, self-priming, high-pressure
Drive	Propeller shaft from gearbox at engine speed
Maximum R.P.M. (governed)	3,000
Threads	Metric
Priming pump impeller end-float	0,2 mm (.008 in.)
Face of stationary seal to shoulder on shaft	28 mm $\pm$ 0,3 (1.102 in $\pm$ .012)
Radial clearance between wearing rings and impeller shoulders	0,25 mm (.010 in.)

**Alternator**

Type	2 A.C.
Rotation	Clock or anti-clockwise
Output	52-57 amps (hot)

**Centre power take-off**

Drive shaft end-float	.003 to .005 in. (0,07 to 0,12 mm)
-----------------------	------------------------------------

**Rear power take-off**

Backlash between gears	.008 to .012 in. (0,20 to 0,30 mm)
Input and output shaft end-float	Zero

**Rear drive pulley**

Drive shaft end-float	Zero
Pinion shaft end-float	Zero
Backlash: bevel wheel to pinion	.004 in. (0,10 mm)

**Front capstan winch, mechanical**

Bollard shaft bushes	
Bush bore	1.311 in. + .002 (33,31 mm + 0,050)
Bollard shaft end-float	.003 to .005 in. (0,07 to 0,12 mm)
Reamed bore	1.390 in. + .004 (35 mm + 0,10)
Drive shaft housing bush	
Reamed bore	.750 in. + .002 (19 mm + 0,05)

**Front winch, hydraulic**

Operation	Hydraulic oil
Relief valve setting	1000 lb/sq.in. (70 kg/cm <sup>2</sup> )



## Section V— RECLAMATION SCHEMES—ALL MODELS

### Flywheel

#### A. Wear or scoring on the flywheel pressure face

1. Remove the clutch bolts and dowels from the flywheel.
2. Machine the *whole* pressure face, not merely inside the bolts and dowels, until the score marks are removed.

The maximum amount of metal which may be removed from the flywheel face is .030 in. (0,76 mm). If the face is not satisfactory after machining to these limits, the flywheel must be scrapped.

Minimum thickness after refacing is as follows:

2 Litre Petrol:	1.063 in. (27 mm)
2½ Litre Petrol:	1.485 in. (37,5 mm)
2 Litre Diesel:	1.345 in. (33 mm)

#### B. Starter ring excessively worn or damaged Petrol models

1. Remove the scrap starter ring by securing the flywheel in a vice fitted with jaw protectors, then drill a  $\frac{3}{16}$  in. (4 mm) dia. hole axially between the root of any one tooth and the inner diameter of the starter ring  $\frac{11}{16}$  in. (10 mm) deep. Care must be taken to prevent the drill entering the flywheel.
2. The operator should then stand in the position indicated by Fig. V-1, place a chisel immediately above the drilled hole, and strike it sharply.

**Important Note:** The starter ring will normally split harmlessly but on remote occasions rings have been known to fly asunder when split; it is therefore important that the operator should be in the position indicated and as an additional precaution, a cloth may be laid over the upper part of the starter ring.

3. Heat the starter ring uniformly to between 220°C and 225°C but do not exceed the higher temperature.
4. With the flywheel placed on a suitably flat surface, position the ring on to the flywheel with the square edge of the teeth against the flange.

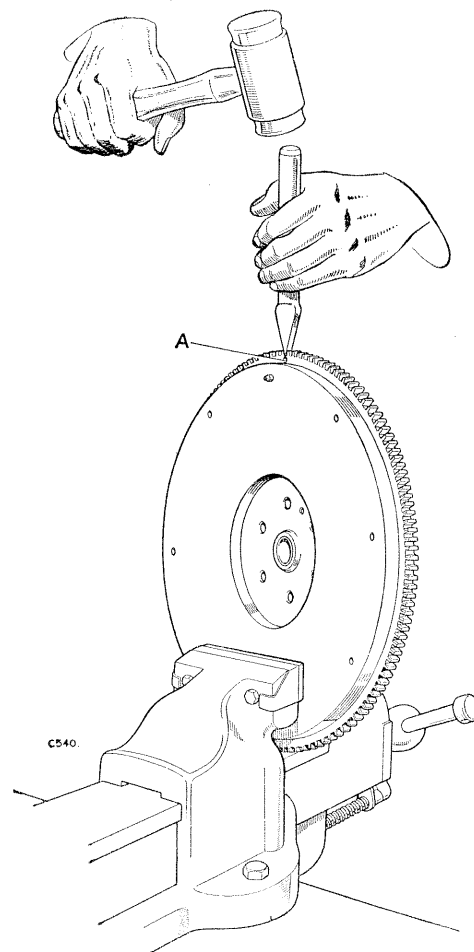


Fig. V-1—Removing an unserviceable starter ring

A—Drilled hole

There should be a clearance of  $\frac{1}{16}$  to  $\frac{1}{8}$  in. (1,5 to 3 mm) between the inner diameter of ring and flywheel if the temperature is correct. Press the starter ring firmly against the flange until the ring contracts sufficiently to grip the flywheel.

5. Allow the flywheel assembly to cool gradually; do not hasten cooling in any way and thereby avoid the setting up of internal stresses in the ring which may cause fracture or failure in some respect.

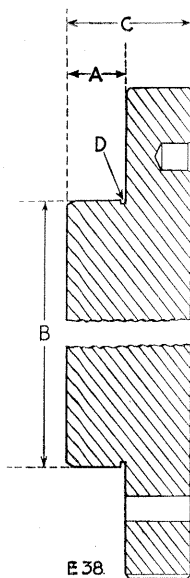


Fig. V-2—Machining flywheel for ring gear (Diesel models)

- A—Depth of spigot—.625 in. (15,81 mm)  
 B—Spigot diameter—9.624 in. (244,44 mm)  
 C—Minimum thickness after refacing—1.33 in. (33,8 mm)  
 D—Undercut—.062 in. wide x .031 in. (1,58 x ,79 mm) undercut.

### Diesel models

1. Remove the clutch bolts, dowels and primary pinion bush.
2. Machine the flywheel teeth off flush and turn the gear ring spigot to the dimensions shown in the illustration (Fig. V-2).
3. Fit the ring gear to the flywheel, using the original clutch cover fixing bolts. (These bolts should be a tight fit in the flywheel, and must be replaced if in poor condition.)
4. Replace the dowel and renew the primary pinion bush if necessary.

### Clutch pressure plate

When worn or scored, a maximum of .010 in. (0,25 mm) may be machined off the face of the clutch pressure plate.

### Brake drums

If scored or worn, .030 in. (0,75 mm) may be machined off the brake drums.





Tony Chambers  
936-6352.



PRINTED IN ENGLAND BY  
JOSEPH WONES LIMITED  
WEST BROMWICH, STAFFS

7245