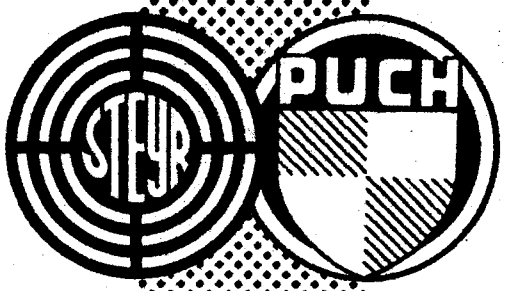

REPAIR INSTRUCTIONS

STEYR-PUCH „HAFLINGER"

FOUR WHEEL DRIVE LIGHT CROSS-COUNTRY VEHICLE

STEYR-DAIMLER-PUCH AKTIENGESELLSCHAFT
Austria

F O R E W O R D

We attach considerable importance to a precise knowledge of the car as well as to a rapid and expert execution of repair work. This has been our main object in producing the present repair instructions intended for all workshops engaged in repairing our cross-country vehicle.

You will also find in this book the technical data, mounting clearances and wear limits. A list at the end of the book contains a description of all special tools needed and shows how to use them.

STEYR-DAIMLER-PUCH
Aktiengesellschaft
Graz Works

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Group 0 : TECHNICAL DATA

Engine

Type	Horizontally opposed flat twin, four stroke engine, air-cooled
Bore	3.149" (80 mm)
Stroke	2.519" (64 mm)
Cubic capacity	39.223 cu.in. (643 cc.)
Compression ratio	7.2 : 1 (8 : 1) (6.5 : 1)
Max. output	26.5 BHP SAE (24 BHP DIN) at 4500 RPM
Max. torque	28.932 ft. - lbs. (4 mkg) at 2500 RPM
Engine governor	limits max. revolutions to 4500 RPM
Ignition timing	4^{0} 30' before TDC i.e. .2756" (7 mm) before TDC measured at the double fanbelt drive pulley
Valves	Overhead type
Valve clearance	Intake .006" (0.15 mm) Exhaust .006" (0.15 mm) To be adjusted when engine cold
Lubrication	Forced feed type lubrication (gear pump with oil cooler and full-flow micro oil filter)
Oil capacity	3 pts. 10 fl.oz. (Imp.) (2 litres)
Petrol supply	Mechanical petrol pump
Carburettor	Weber 32 ICS, special cross-country downdraught carburettor
Settings:	Choke tube 27 Main jet 135 Air correction jet 240 Pilot jet 50
Air cleaner	Oil bath air cleaner
Electrical equipment	Coil ignition, operating voltage 12 V, DC Dyna-starter, Bosch 12 V / 240 W Voltage regulator, Bosch Starter selenoid, Bosch Battery 12 V / 42 Amp.h. Ignition coil, Bosch Spark plugs, Bosch W 225 T 1 or equivalent Bosch distributor with centrifugal advance mechanism
Engine position	At the rear of the vehicle. Flange mounted on the gearbox-rear axle assy.

Clutch

Type	Single dry plate

Gearbox-axle drive assy.

Gearbox	Four forward speeds and optionally one crawler gear (all 5 forward speeds with positive synchromesh), one reverse speed

Speedometer drive:	Worm driven off the front axle drive bevel pinion
Gear shift:	By floor-mounted lever
Axle drive:	By means of crown wheel and bevel pinion, the differential bevel gears and the axle shafts to the spur gears within the wheel hubs
Type:	Gearbox with rear axle drive assy. in one housing

Transmission ratios:

Crown wheel-pinion: . . . . . 4.22 (38 : 9)

Spur gear drive: . . . . . 2,72 [38 : 14) optional 3.0 (39 : 13) or 2.38 (38 : 16)

Gearbox: (Crawler gear 7.55) Overall transmission ratio with spur gear ratio 38 : 14: (86.5)

1st gear	3.73	42.7
2nd gear	2.18	25
3rd gear	1.21	13.9
4th gear	0.71 (0.68)	8.15 (7.75)
reverse gear	3.55	40.6

Front axle drive

Drive operated by means of crownwheel and spiral bevel pinion over bevel differential gears, axle shafts and homokinetic universal joints (Rzeppa universal joint) to spur gears placed within the wheelhubs. The front axle drive operated by a jointless propeller shaft from the rear drive. The propeller shaft runs within the "backbone" chassis tube which unites the two axle drive assy's. The front wheel drive may be engaged or disengaged whilst in motion by actuating a hand lever.

Differential lock

Both axle drive units are equipped with differential locks which may be engaged individually whilst in motion.

Wheel suspension (fully floating suspension)

Independent suspension of all the four wheels by means of forked tubular steel swinging arms protecting the axle shafts housed within them.

Springing

Front and rear wheels suspended upon coil springs and additional hollow rubber springs of progressive effect.

Spring travel at wheels: 7.874" (200 mm) max.

Shock absorbers

Double acting hydraulic telescopic shock absorbers (front and rear).

Brakes

Foot brake:	Hydraulic four-wheel brake. Generously finned light in alloy brake drums with integrally cast in castiron liners Brake drum dia. 8.4645" (215 mm) Total brake lining surface 101.99 sq.in (658sq.cm)
Hand brake	Mechanical, operating upon rear wheels only

Steering assembly

ZF-Gemmer type steering assembly arranged as duplicated steering with divided track rods.

Steering wheel revolutions 3

Min. turning-circle dia. . . . . 6.5 m

Chassis

The chassis, consists of a central "backbone" tube with the front axle assy. and the gearbox-rear axle assy. flanged to it and the four fully-floating swinging arms. Both the front and rear axle assy's carry steel cross members supporting the road springs and the bodywork (platform).

Road wheels and tyres

Disc wheels with rims 3.50 x 12, with cross-country tyres 145 - 12 or universal grip tyres 165 - 12

Tyre pressure front and rear: 20 - 24 lbs. / sq.in. (1.4 - 1.6 atm.) for tyres 145 - 12

14 - 22 lbs. / sq.in. (1.0 - 1.5 atm.) for tyres 165 - 12

Body

Level platform made of heavily reinforced and corrugated sheet steel incorporating longitudinal and cross members with all edges designed as box sections. The platform front end carries the cowl supporting the headlamps, the instrument panel and steering column bracket. The two front seats are adjustable forwards and backwards. The steering gear case and pedal bearings are fixed at the floor of the front foot pan. Tool box, petrol tank, battery compartment, spare wheel and the two boxes to accomodate the two collapsible rear seats are situated under the platform. A carrier to hold a 4 gal. jerry-can is also fitted.

The engine compartment is provided with two hinged covers, one at the rear end of the platform and one below the tailboard.

The platform is mounted on the "backbone" chassis on four rubber mountings (silent blocs).

The windscreen, complete with wipers may be folded down forwards.

The vehicle may be equipped with a small canvas cab and doors for the front seats only or optionally with large canvas cab and four doors.

Specifications

Wheelbase	59.055" (1500 mm)	
Track - front	44.488" (1130 mm)	
Track - rear	44.488" (1130 mm)	
Overall length without bumpers	111.417" (2830 mm)	
Overall length with bumpers	117.519" (2985 mm)	or 118.897" (3020 mm)
Max. width	53.149" (1350 mm)	
Height of platform (laden)	27.559" (700 mm)	
Max. height (laden, above steering wheel)	51.181" (1300 mm)	
Max. height with canvas cab (unladen)	68.503" (1740 mm)	
Kerb-weight approx.	1345 lbs. (610 kg)	
Total weight (G.V.W.)	2480 lbs. (1125 kg)	

Specifications cont'd

Ground clearance under gearbox-rear axle assy.	(laden)	9.251" (235 mm)
Fording depth		15.748" (400 mm)
Loading area behind front seats:	length	61.629" (1540 mm)
	width	50.196" (1275 mm)
	surface 21 sq. ft. (1.96 sq. meters)	

Capacities

Petrol tank	7 mp. gal. (32 litres)
Sump	3 pts. 10 fl.oz. (2 litres) motor oil
Air cleaner	10.6 fl.oz. (0.3 litre) motor oil
Gearbox with rear axle	3pts. 10 fl.oz. (2 litres) gear oil
Front axle	1 pt. 15 fl.oz. (1 litre) gear oil
Backbone tube	17.6 fl.oz. (0.5 litre) gear oil
Wheel drive casings	8.8 fl.oz. (0.25 litre) gear oil each
Steering gear	7 fl.oz. (0.2 litre) gear oil
Brake system	8.8 fl.oz (0.25 litre) brake fluid

Fuel-consumption

On road	31.6 mp. gal. (9 litres) per 100 km level road fuel consumption
Cross-country	approx. 6 - 9 pts. (3.5 - 5 litres) per hour

Road performances

Top speed (at 4500 RPM), 40 mph. (64 kmh.); or 36.25 (37.5) mph (58 (60) kmh.); or 32.5 mph. (52 kmh.) depending upon spurgear ratio.

Min. cruising speed in crawler gear (at 2000 RPM 1.56 mph. (2.5 kmh.)

Max. hill-climbing ability on dry, non-skidding soil 50%; 58%; 65% depending upon spurgear ratio

Group 2 : Engine

All indications as there are: Front and rear, l.h.s. (left hand side) and r.h.s. (right hand side) always are given viewing the vehicle from rear to front. The handling of the special tools mentioned in the text is given in group .

I. Removing the engine

1.) Open the engine compartment rear door and remove. Release catch to open upper engine compartment lid.

2.) Disconnect positive battery cable. The battery is situated in a box at the l.h.s. of the vehicle.

3.) Drain petrol tank.

4.) Remove skid plate or tubular underguard from under the engine.

5.) Take off the exhaust silencer: Slacken the clip and push it away; undo the two silencer fixing screws.

6.) On models equipped with tropical oil cooling system, detach the intermediate deflector tube at the blower hood. Slacken off the three hose clips of the air intake pipe ("S" - shape) and remove same.

7.) Disconnect the petrol pipe from the fuel pump. Remove air cleaner complete with connection to carburettor.

8.) Remove blower hood (cowl), detach throttle control rod and choke cable from carburettor.

9.) Disconnect both the groundstraps at the dyna-starter and pull through the l.h.s. cylinder fairing. Detach the ignition coil cables. Then disconnect the three cables (30 h, DF, D+) at the dyna-starter and pull through the r.h.s. front cylinder fairing underneath the intake manifold. Disconnect the oil pressure switch at the soft rubber plug.

10.) Unscrew and remove the lower box section cross member of the engine compartment.

11.) Undo the drain plug for the clutch (bell) housing.

Remove the engine: Undo the two upper and the two lower engine fixing nuts, jack up the engine, pull out backwards and lower down.

II. Stripping the engine

It is recommended to take the engine down in the following sequence:

1.) Drain motoroil from crankcase and oil cleandr. Detach governor control rod and remove deflector plate from oil cooler.

2.) Undo the special nut for the double fan belt pulley (insert a tommy bar into the blower fan wheel). The special nut is tightened with a torque wrench reading of 73.30 ft.-lbs. (10 mkg.). Remove dyna.starter complete with blower fan housing.

3.) Detach intake manifold complete with carburettor and detach exhaust manifold.

4.) Remove rocker over with gasket and oilbackflow tube with rubber seal.

5.) Disconnect H.T. - leads.

6.) Remove sheet steel fairings of the air cooling system:

a) two side covers

b) two covers of the front cover plate

c) the front cover plate

d) front deflector plate l.h.s. cylinder

e) rear deflector plate

6.) Remove sheet steel fairings of the air cooling system: cont'd:

f) front deflector plate r.h.s. cylinder

g) rear deflector plate

7.) Undo the cylinder head nuts and loosen cylinder heads

8.) Partly unscrew tappet adjusting screws, after moving the rockers sideways withdraw the push rods and remove the cylinder heads.

9.) Pull off the cylinder.

10.) Detach pistons from connecting rods.

11.) Remove oil filler pipe complete with breather cap and detach the petrol hose at the fuel pump.

12.) Remove the petrol pump from the crank case.

13.) Detach the governor Vee - belt by removing the governor pulley.

14.) Remove clutch pressure plate and clutch plate .

15.) Undo the retaining bolt for the double Vee crankshaft pulley. The retaining bolt is tightened with a torque wrench reading of 86.79 ft. - lbs. (12 mkg.). For undoing use flywheel holder part no. 501.1.1001.5 - W 4

16.) Take off the oil cleaner and remove governor with its bracket.

17.) Remove the distributor.

18.) Undo the special belt for the flywheel. The special bolt is tightened with a torque wrench reading of 231.45 ft. - lbs. (32 mkg.). For undoing use flywheel holder part no 501.1.1001.5 - W 4 and pull off using the flywheel puller part no 501.1.5531.2.

19.) Take off the oil cooler. Note: When reassembling use new rubber seals.

20.) Undo the retaining bolts of the front camshaft bearing .

21.) Remove the oil pump cover and take out both the pump gears.

22.) After slackening off of the crankcase bolts pull out the oil pump housing.

23.) On models with an oil strainer fitted at the bottom of the crankcase remove same first. Then remove the oil pump intake pipe. On older models remove the oil intake pipe complete with oil strainer.

24.) Pull out both the machined barrel bolts from the crankcase, all crankcase bolts and split crankcase.

25.) Remove the camshaft.

26.) Remove the crankshaft

27.) Remove cam follower shafts, one of which carrying the fuel pump actuating lever.

Reassembling is done in the reverse sequence, particular attention must be paid to the following items:

III. Cylinder head and valve - operating mechanism

a) Dismantling and stripping

1.) Strip engine up to and including para 11 / 8

2.) Clamp cylinder head into the device part no. 505.1.55.021.0

3.) Press out rocker shafts, remove rockers, thrust washers and springs

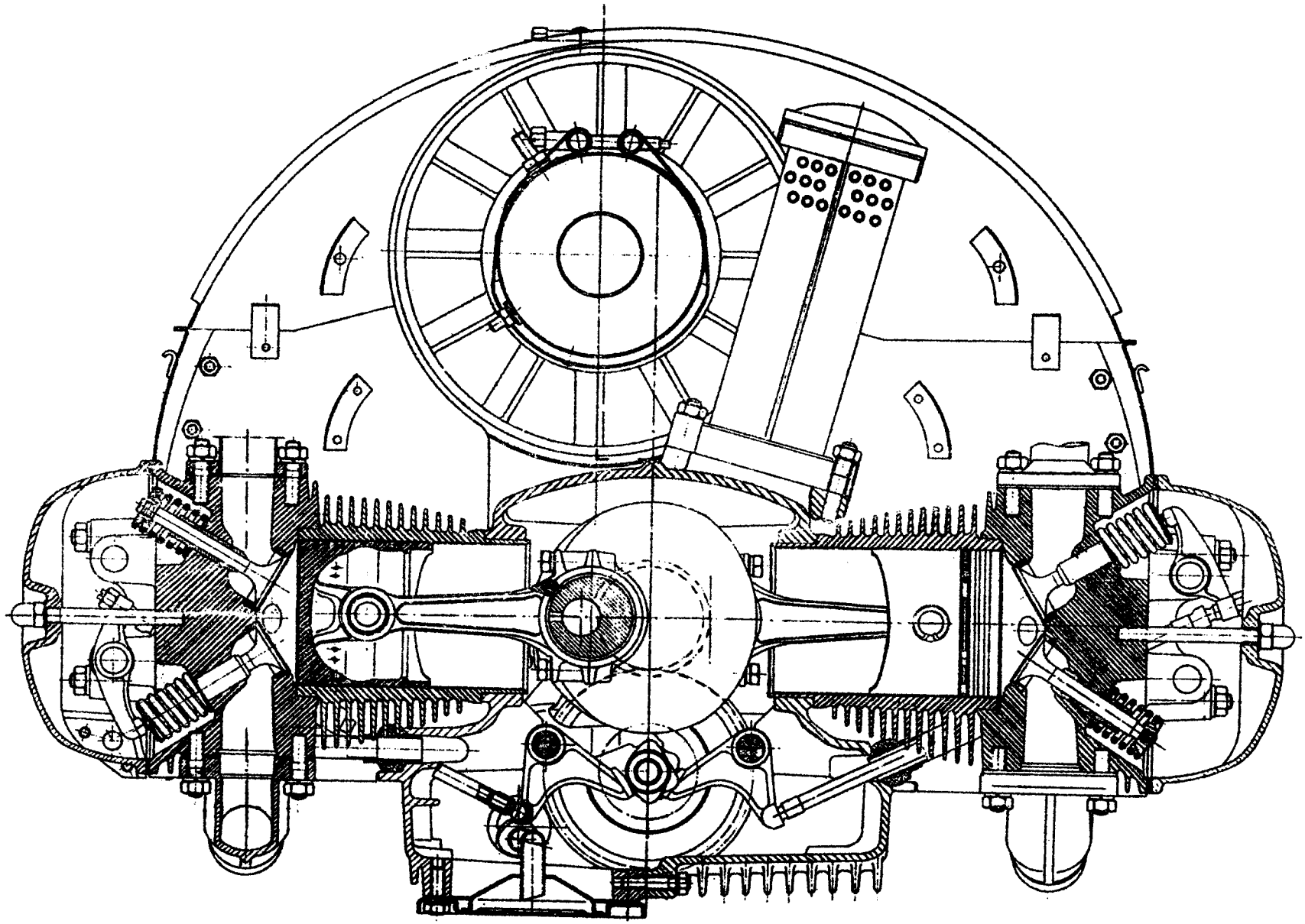


Fig. 2/I: Motor engine moteur

4.) Compress valve springs with lifter, and remove valve cotters.

5.) Withdraw the valves from their guides. If the valve stem shows burrs at the cotter grooves (after extended service), remove them carefully with a smooth file before withdrawing the valves from the guides.

b) Examination

1.) Inspect valve guides. The clearance between valve stem and valve guide, when new, is .00137" - .0022" (0.035 - 0.056 mm) for intake and exhaust valve. Wear limit : .00393" (0.1 mm)

2.) Inspect valves.

a) For burned valve stem. If necessary, regrind according to the description given under fig. 2 / II and fig. 2 / III the first number being the group number, the second the number of the illustration.

The measures for fig. 2 / II being:

For intake valve:	For exhaust valve:
A = 1.372" - 1.382" (34.85 - 35.10 mm)	A = 1.254" - 1.263" (31.85 - 32.10 mm)
B = 3.346" - 3.37" (85.00 - 85.60 mm)	B = 3.287" - 3.311" (83.50 - 84.10 mm)
C = .3134" - .3138" (7.96 - 7.97 mm)	C = . 3685 - .3688" (9.36 - 9.37 mm)
b = .0531" - .0649" (1.35" - 1.65 mm)	b = .0531" - .0649" (1.35 - 1.65 mm)

The measures for fig. 2 / III being:

For intake valve	For exhaust valve
A = 1.372" - 1.382" (34.85 - 35.10 mm)	A = 1.254" - 1.263" (31.85 - 32.10 mm)
B = 3.354" - 3.37" (85.20 - 85.60 mm)	B = 3.287" - 3.311" (83.50 - 84.10 mm)
C = .3134" - .3138" (7,96 - 7.97 mm)	C = .3685" - .3688" (9.36 - 9.37 mm)
b = .0531" - .0649" (1.35 - 1.65 mm)	b = .0531" - .0649" (1.35 - 1.65 mm)

2

b) For wear (hard chromium layer on stem damaged). In the event of the hard chromium layer being worn through, fit a new valve.

c) For eccentricity. Max. out of true .000787" (0.02 mm). See fig. 2 / IV.

3.) Inspect valve seat for wear pitting. When reseating the valves, keep the following things in mind: In cutting or grinding the 45° seat be careful to cut / grind the seat concentrically and without chatter marks; mill off only as little as possible in order to permit repeated refacing. After milling the 45° surface, reduce the seats to the dimensions indicated in fig. 2 / V, by means of two 15° and 75° cutters or grinding stones.

The middle of the face diameter of the valve should not be less than the middle diameter of the 45° surface of the valve seat.

Width of valve seats "A" Intake valve .03149" - .03937" (0.8 - 1.0 mm)

Exhaust valve .03937" - .04724" (1.0 - 1.2 mm)

c) Assembling

Assembling is done in the reverse sequence paying close attention to the following items:

1.) The valve springs have been coiled progressively. The closer coils should be facing to the cylinder head, when the springs are fitted.

2.) Fit the cylinder head without gasket or gasket cement.

3.) Always renew the rubber seals of the push rod cover tubes and of the oil backflow pipes (the latter are from rocker cover to crankcase) when reinstalling.

4.) Tighten the cylinder head nuts diagonally with a torque wrench reading of 18 - 21.7 ft. - lbs. (2.5 - 3 mkg).

5.) The tappet clearance is .006" (0.15 mm) for both intake and exhaust valves when the engine is cold.
When adjusting the tappet clearance, first put the opposite cylinder into overlap position, (both valves open) and then adjust valve clearance.
On models with inspection doors on the l.h.s. and r.h.s. engine compartment sides, open the inspection doors to simplify the adjusting of the tappet clearance when the engine is mounted.

6.) If the valve seat inserts or the valve guides in the respective cylinder heads are beyond permissible wear limits, those cylinder heads may be sent to the factory for reconditioning.

7.) There are two types of valves. The valves differ in the number of cotter grooves in the valve stems. The older type valve stem has one groove, whereas the self rotating type valve stem has three grooves.
Note: Do not interchange spring retainers and valve cotters.

IV. Cylinder

A.) Dismantling

1.) Strip the engine up to including para II / 8

2.) Turn crankshaft to TDC position, then pull off cylinder.

3.) Mark the cylinders to prevent interchanging.

B.) Examination

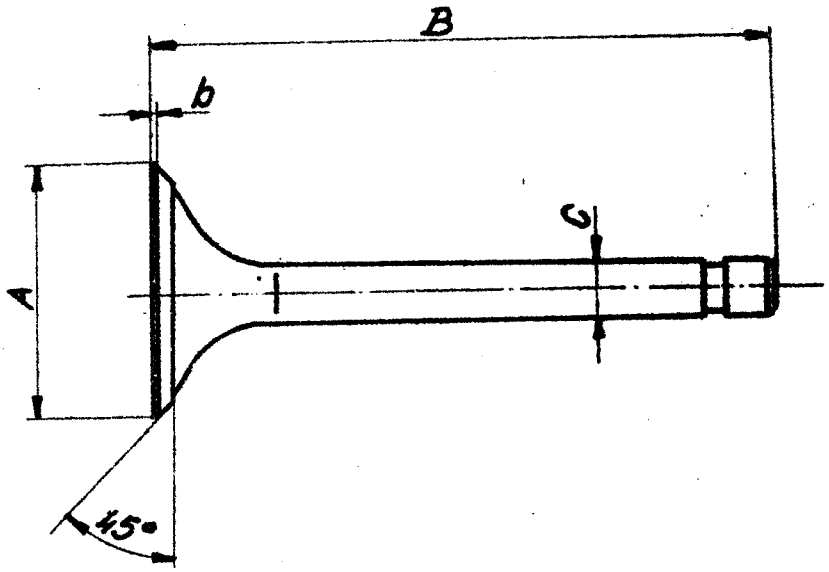
1.) Inspect cylinder bore for cracks and scores.

2.) Measure cylinder.

a) the cylinder-piston clearance of a new engine is .001377" (0.035 - 0.045 mm) for dia. 2.755 " (70 mm) cylinders and .001574" - .001968" (0.04 - 0.05 mm) for dia. 3.149" (80 mm) cylinders.
Wear limit: .006" (0.15 mm) max.
Max. ovality when new .0006" (0.015 mm), wear limit .006" (0.15 mm) max.
Determin the actual cylinder-piston clearance by gauging cylinder and piston. Also see illustration 2 / VI and 2 / VII.

Fig. 2/II

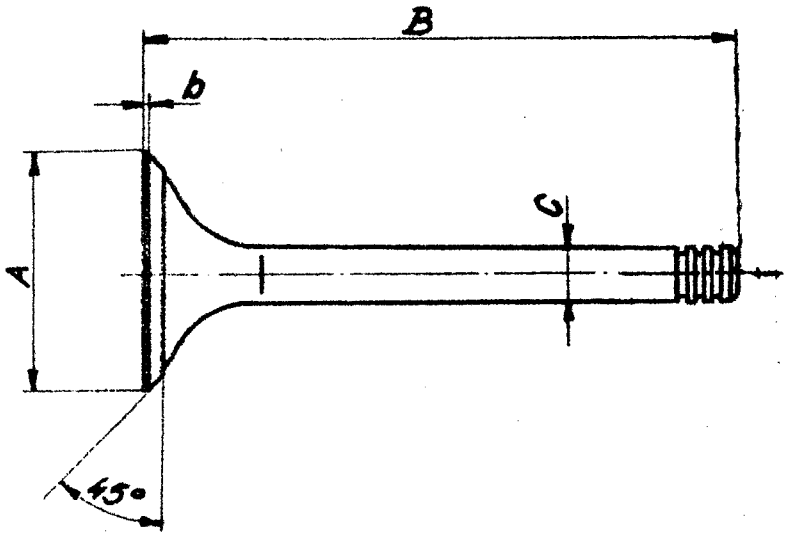
Erklärungszeichnung zum Nachschleifen der Ventile
Commentary drawing for regrinding the valves
Esquisse explicative pour remouler les soupapes



Einlaßventil
intake valve
soupape d'admission
A=34,85-35,1 C=7,96-7,97
B=85,00-85,6 b=1,35-1,65

Auslaßventil
exhaust valve
soupape d'émission
A=31,85-32,1 C=9,36-9,37
B=83,5-84,1 b=1,35-1,65

Fig. 2/III



Einlaßventil
intake valve
soupape d'admission
A=34,85-35,1 C=7,96-7,97
B=85,2 -85,6 b=1,35-1,65

Auslaßventil
exhaust valve
soupape d'émission
A=31,85-32,1 C=9,36-9,37
B=83,5-84,1 b=1,35-1,65

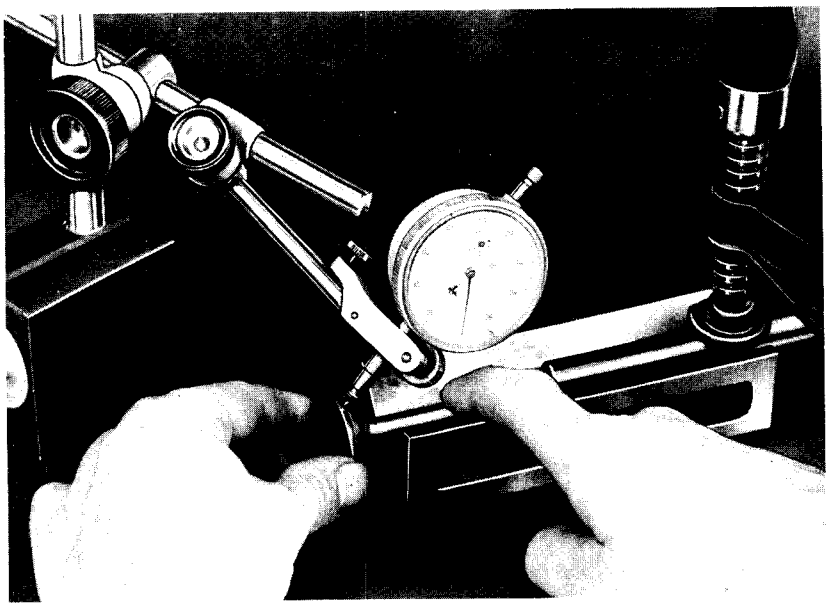
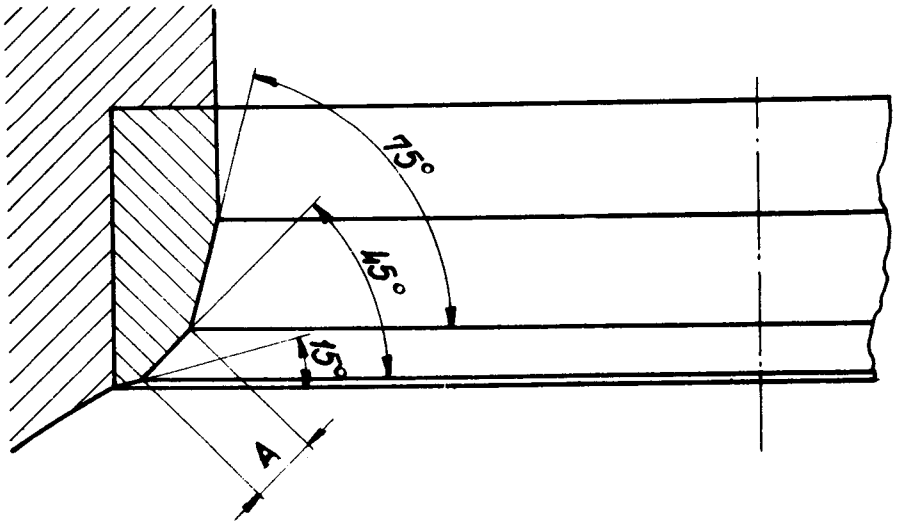


Fig. 2/IV

Fig. 2/V

Erklärungszeichnung zum Nachfräsen der Ventilsitze
Commentary drawing for remilling the valve seats
Esquisse explicative pour refraiser les soupapes



b) Gauge cylinder wear: Example

cylinder gauging point	parallel to gudgeon pin	under 90° to gudgeon pin
about 5" (12 mm) from top edge	3.15038" (80.020 mm)	3.15137" (80.045 mm) (largest diameter)
half way down	3.14999" (80.010 mm)	3.15057" (80.025 mm)
.25 - .5" (6 - 12 mm) from bottom edge	3.1496" (80.000 mm) smallest diameter	3. 14979" (80.005 mm)

Cylinder wear: 3.15137" largest dia.

\- 3.14960" smallest dia.

Actual cylinder wear .00177" (0.045 mm)

Gauge piston wear: Example

c) Gauge piston wear: Example

Measure stamped on piston : 79.96 mm = 3.14803"

Gauging as described under "PISTON" gives 33.14556"

Actual piston wear .00237" (0.06 mm)

d) Total wear: Example

Cylinder wear (re. b)	.00177"	(0.045 mm)
Piston wear (re. c)	.00237"	(0.060 mm)
Total wear	.00414"	(0.105 mm)

In this case a repair is not necessary as the total wear does not exceed .005905" (0.15 mm) provided there is no excessive oil consumption.

3.) Check cylinder length. For series production compression ratios of 7.2 : 1 (8 : 1), the length of the cylinder is 3.937008 + .003937" (100.0 + 0.1 mm)

C) Installing

Installing is done in the reverse sequence paying attention to the following items:

1.) The cylinders are classified in two tolerance groups:

Group I. Standard cylinder dia.	3.14960 - 3.14996"	(80.000 - 80.009 mm)
Low expansion piston, skirt dia.	3.14783 ± .000181"	(79.955 ± 0.005 mm)
Group II. Standard cylinder dia.	3.14996 - 3.15045"	(80.009 - 80.019 mm)
Low expansion piston, skirt dia.	3.14822 ± .000181"	(79.965 ± 0.005 mm)

2.) Lubricate the piston and cylinder bores well.

3.) The bottom end of the cylinder bore is well chamfered to facilitate the installation of the piston rings

4.) The piston ring gaps must be placed under an angle of approx. 120^{0}.

5.) The contact surfaces of both cylinder flange and crankcase must be absolutely clean, as any foreign bodies are bound to cause leakage and deterioration of cylinder flange and crankcase. Cylinder and cylinder-head are fitted without gaskets.

When fitting new cylinders and pistons, carefully watch the clearances which must be correct. Excessive play of the new parts might entail piston slap.

6.) Chamfer upper edge of cylinder bore slightly by scraper (see fig. 2 / VII).

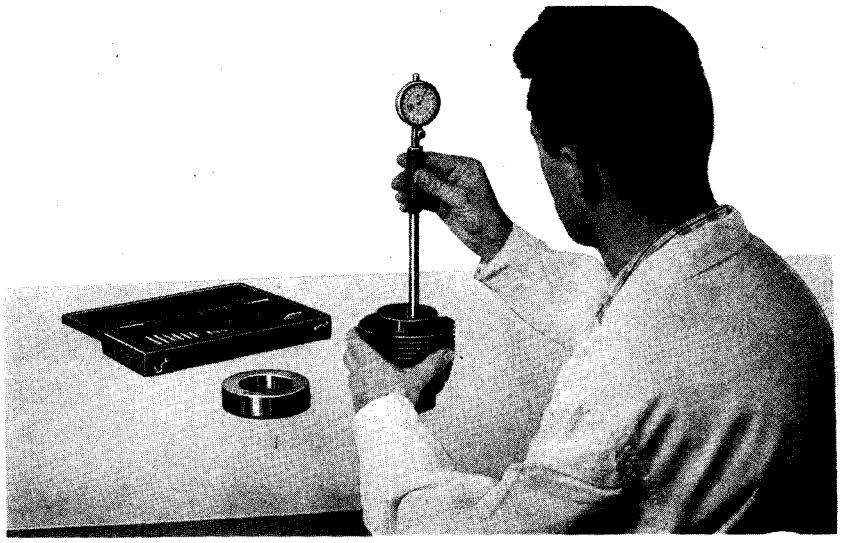
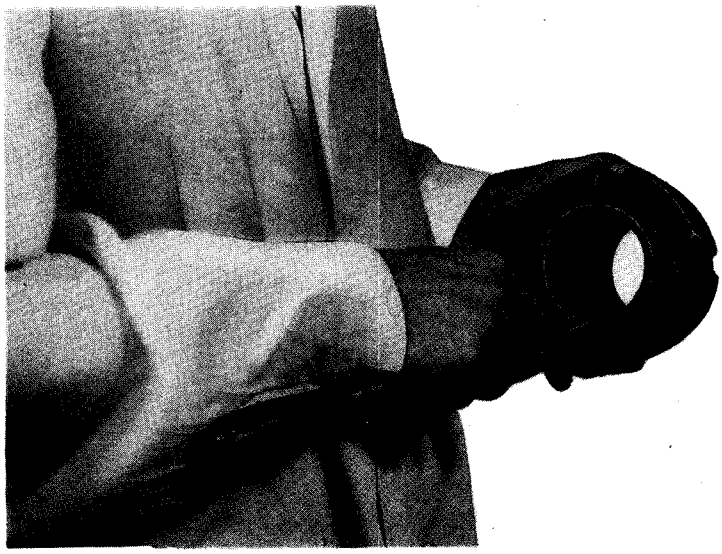


Fig. 2/VI

Fig. 2/VII



V. Piston

a) Dismantling and stripping

1.) Strip the engine up to and including Para II / 9.

2.) Remove gudgeon pin circlips with a suitable pair of pliers.

3.) Push out the gudgeon pin carefully in order not to bend the connecting rod. If you find difficulty in getting the gudgeon pin out, push it back and remove any oil deposits or burrs in the bosses. Do not interchange the gudgeon pins. After taking them out, place them back in their respective pistons.

4.) When removing pistons and / or piston rings, do not interchange them. Each piston ring must be reinstalled into the same groove and in the same position as originally.

Note: Piston rings always must be installed with their lettering facing towards the piston crown ("Top" rings).

5.) Worn out piston rings remove by means of piston ring pliers, also in case of heavy carbon deposits.

6.) Clean away oil deposits from piston crown and piston ring grooves. We recommend the removal of carbon deposits from grooves by using a piece of an equal-sized piston ring. Never apply emery cloth upon pistons!

b) Examination

1.) Measuring the pistons

The gauging of the diameter is carried out at right angles to the gudgeon pin axis some .5" (12 mm) from the lower end of the piston skirt (largest diameter of the piston). For measurements and wear limits refer to the chapter " Cylinder ".

2.) Groove clearance of piston rings:

	Play when new	Wear limit
1st ring	.00177" - .00303" (0.045 - 0.077 mm)	.006" (0.15 mm)
2nd ring	.00137" - .00244" (0.035 - 0.062 mm)	.006" (0.15 mm)
Oil scraper ring	.001" - .002" (.025 - .052 mm)	.004" (0.10 mm)

3.) Check piston ring gap. Insert the rings approx 1/4" into the lower part of the cylinder and use a piston to line up. Gap of new rings: .012" - .018" (0.30 - 0.45 mm) wear limit .040" (1.0 mm).

4.) Piston ring side clearance: When pressed into the groove, the circumference of the ring should be .012" (0.3 mm) under the circumference of the ring land.

5.) Check gudgeon pin play. The gudgeon pin used is of the full-floating type and may be pushed in without effort (engine cold), the play when new being .00004" - .000275" (.001 - .007 mm).

Pistons and gudgeon pins are marked with white or black colour;

White -	gudgeon pin boss bore dia.	.787442" - .78756" (20.001 - 20.004 mm)
	gudgeon pin dia.	.787282" - .787402" (19.997 - 20.000 mm)
Black -	gudgeon pin boss bore dia.	.787321" - .787442" (19.998 - 20.001 mm)
	gudgeon pin dia.	.787164" - .787282" (19.994 - 19.997 mm)

c) Assembling

Is done in the reverse sequence. Pay attention to the following items:

1.) When installing new piston rings, or re-fitting old ones take care that the "Top" mark or the lettering stamped upon the compression rings and oil control rings are pointing to the piston crown.

2.) As mentioned above, old piston rings must be re-installed in the same position as before.

3.) The rings must move freely in their grooves.

4.) The circlips must snap into their grooves and fit under tension.

5.) Autothermatic pistons must not be coupled with non-autothermatic pistons! (difference in weight).

Never pair pistons with displaced gudgeon pins, with pistons with centre gudgeon pin.

When re-fitting a piston with displaced gudgeon pin, take care that the pin displacement (narrow side of the piston) points to the thrust side of the cylinder i.e. : l.h.s. cylinder downwards

r.h.s. cylinder upwards

VI. Ignition distributor

The distributor is installed by turning the crankshaft clockwise until the valves of the r.h.s cylinder are in overlap position. At the same time, the TDC mark on the double - Vee pulley must be in the TDC position (i.e. corresponding to the mark on the blower housing). After the marks on the distributor finger and on the distributor casing have been arranged so as to coincide, the distributor is inserted into the crankcase together with the driving pinion previously fitted. Take care that the distributor finger does not move when the pinions mesh. In order to facilitate the adjustment of the ignition setting as well as of the distributor lubrication, install the distributor so, that the oil filler plug points backwards.

If necessary to replace the distributor drive pinion, it only can be replaced together with a matched bronze driving worm gear for the crankshaft. The distributor drive pinion should always be fitted with a new grooved dowel and a new Bosch fibre washer as well as the necessary shims to eliminate excessive end float.

Before checking the ignition timing, inspect the contact beeaker gap and the condition of the contact points. The breaker gap is adjusted after slackening the fixing screw of the contact carrier and turning the eccentric screw or inserting a screw driver into the notch of the contact carrier. The contact breaker gap should be set to .016" (0.4 mm), which corresponds to a closing angle of $57^{0} - 63^{0}$ gauged at the distributor shaft. If dirty or burnt, clean the breaker points with a contact file, replace if necessary.

The distributor cam lubrication pad should be greased with H.M.P. grease, but not excessively.

Ignition timing is carried out as follows:

Remove the l.h.s spark plug, connect the H.T. -lead, earth the plug. Switch on ignition. Turn the crankshaft slowly clockwise until a spark is produced at the spark plug, i.e. until the contact breaker points commence opening. At this very moment the mark on the double - Vee pulley on engines 500 D, 500 DL must be .236" - .393" (6 - 10 mm) and on engines 700 C, 700 AP / APT / APL and ST 600, .236" - .275" (6 - 7 mm) before the TDC mark upon the blower housing.

Also at this moment the mark of the distributor finger (with the distributor cap removed) must correspond to the mark on the distributor base. Ignition timing also can be adjusted by using a test lamp. The lamp is wired between terminal 1 (condenser cable connection) and earth and lights as soon as the breaker points commence opening (the ignition, of course, must be switched on).

VII. Camshaft

a) Dismantling

1.) Strip engine up to and including Para II / 25

b) Examination

1.) Inspect rivetting of camshaft wheel. (It is not permissible to re-rivet the helical gear).

2.) Inspect wear of camshaft gear wheel: If worn replace only together with a matched timing gear fitted upon the crankshaft. Check backlash with the help of the measuring device 50.1.55.047.0, which should be .0004" - .0012" (0.01 - 0.03 mm). For the engines from August onwards the play between oil pump housing and engine crankcase has been modified so that in case of excessive backlash of the camshaft gear wheels, the oil pump may be pushed towards the crankshaft (using the special tool part number 501.1.55.053.2) (ill. 2 / IX). After this correcting measure the backlash must be checked again. As the gear wheels are shaped after rivetting, camshafts with damaged gear wheels must be sent to the factory together with their respective driving gear wheels in order to be replaced.

3.) Check wear of camshaft:

a) Check cam face (uneven)

b) Check transversal wear of cams.

c) Check height of cams

Cam shaft no. 501.1.0501.0 used in the engines 500 D, 500 DL, 500 DH, 700 AP / APL / APT and ST 600:

Cam height .2015" (5.12 mm) wear limit .0047" (0.12 mm)

Camshaft no. 503.1.05.001.0 (sports model camshaft) (of older design) :

Cam height .2283" (5.8 mm) wear limit .0047" (0.12 mm)

Camshaft 504.1.05.001.0 used in the engines of the 700 C model and the sports models:

Cam height .2362" (6.00 mm) wear limit .0047" (0.12 mm).

The camshaft is measured between two prisms by means of a dial gauge. See fig. 2 / X

Camshafts not worn beyond wear limit, may be sent to the factory for regrinding.

c) Assembling

1.) When installing the camshaft, watch the setting of the engine timing.

The marking upon the helical gear mounted upon the camshaft must be exactly opposite to the mark upon the crankshaft helical gear.

The timing can be measured at a .03937" (1 mm) valve clearance and should be as follows:

Intake opens 3° before T.D.C. Exhaust opens 41° before B.D.C.
Intake closes 41° after B.D.C. Exhaust closes 3° after T.D.C.

2.) The camshaft end float is adjusted by means of shims installed in the camshaft bearings after assembling the two crankcase halves. The end float should be .008" (0.2 mm).

3.) The cam followers must be parallel to the respective cams. If necessary they must be aligned by means of the special tool no. 501.1.55.038.

VIII. Crankshaft:

b) Dismantling

1.) Strip the engine up to and including Para II / 26.

2.) Clamp crankshaft between adequate wooden or aluminium vice jaws after having pulled off the main bearing.

3.) Remove the double - Vee pulley locating key.

4.) Pull from the crankshaft, one by one, oil seal, auxiliary bearing (aluminium alloy), distributor driving gear, spacer, camshaft timing gear, by using the puller no. 501.1.5520.2.

5.) Also pull off the second crankshaft main bearing (ternary alloy). Remove locating keys.

6.) Take off connecting rods and bearing shells (see chapter "Connecting rod")

7.) Remove welsh plugs from crankshaft and clean oil passages (always use new plugs, and fix them well).

b) Examination:

1.) Inspect crankshaft journals and connecting rod journals for ovality and wear.

2.) Check bearing clearances.

a) Install bearing crankcase. Assemble and bolt together both crankcase halves. For measuring purposes, tighten only the four M nuts with a torque wrench reading of 28.932 ft. lbs. (4 mkg).

b) Gauge the bearing bores.

Bearing clearances: Max. permissible ovality for the journals .0006" (0.015 mm)

Crankshaft main bearings

For crankshaft with dia. 1.771" (45 mm) journals .0026" - .0036" (0.066 - 0.092 mm)

For crankshaft with dia. 1.929" (49 mm) journals .0033" - .004" (0.086 - 0.102 mm)

Auxiliary bearing	Big end bearing
.0023" - .0036" (0.060 - 0.092 mm)	.0014" - .0038" (0.037 - 0.083 mm)

3.) Check crankshaft for eccentricity .008" (0.02 mm). See fig. 2 / XI.

4.) Inspect crankshafts for cracks.

5.) Check end float .0067" - .014" (0.17 - 0.29 mm). Use special device no. 501.1.55.051.0.

6.) The special flywheel fixing bolt is tightened with a torque wrench reading of 231.45 ft. lbs. (32 mkg)

7.) The double Vee - pulley fixing bolt is tightened with a torque wrench reading of 86.79 ft. lbs. (12 mkg)

c) Reconditioning of crankshaft:

Flame hardened crankshaft

After regrinding the crankshafts, the hardening of the journals must be checked and must have 58 - 62 RC. If necessary the journals must be rehardened.

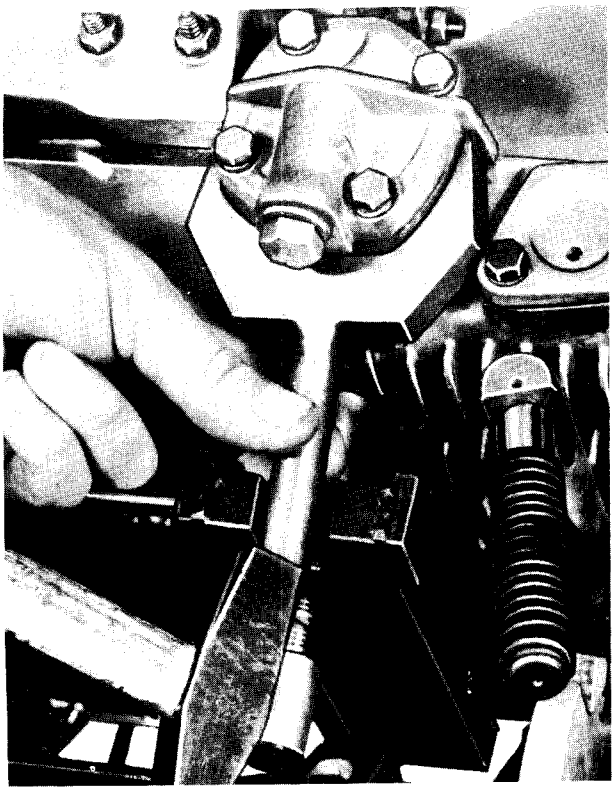


Fig. 2/IX

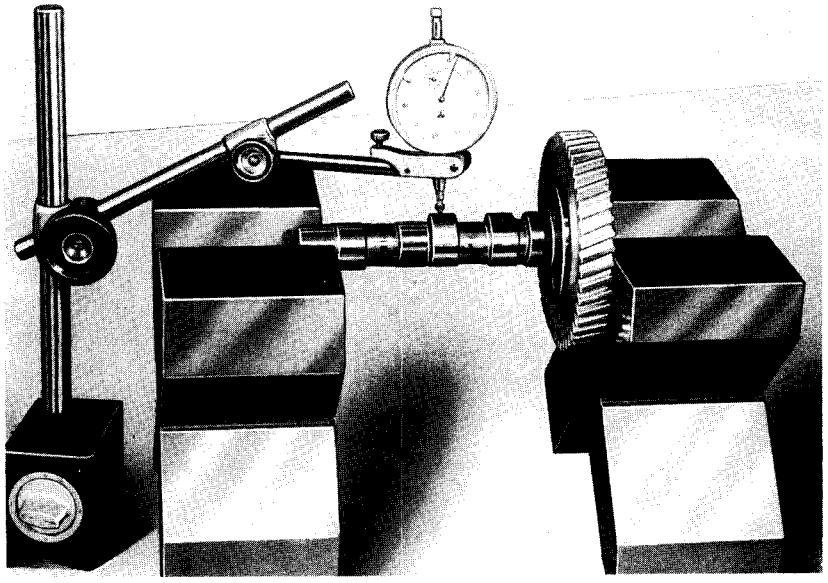


Fig. 2/X

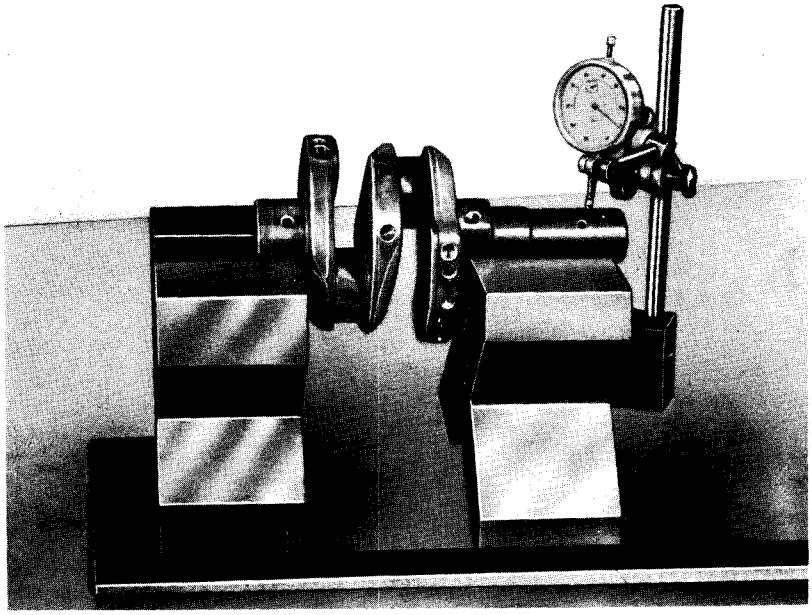


Fig. 2/XI

Fig. 2/XII

Flame hardened crankshaft cont'd

We therefore suggest to send worn out crankshafts to the manufacturers for reconditioning.

Nitrated crankshaft

From engine no. 511.4406 of the model 500 D and from engine no. 515.2784 of the moden 500 D1 onwards the crankshafts have been modified. These crankshafts differ from the older ones by larger main bearing journals and the hardening by nitration. After regrinding, these crankshafts must be re-nitrated. Therefore it will be necessary to return them to the manufacturers for reconditioning.

The part number of the new crankshaft is 501.1.02.031.2.

d) Assembling and installing

Assembling is done in the reverse sequence noting the following points:

1.) We wish to point out that crankshafts of the older design, i.e. with smaller main bearing journals were temporarily built in nitrated finish and have the part no. 501.4.0201.2. For better distinction, all those nitrated crankshafts have been marked with an "N" on one of the crank webs. This circumstance must receive special attention for repair operations.

Crankshafts of older design part no. 501.1.0201.2 or part no. 501.4.0201.2 may be assembled exclusively with the crankcase part no. 501.1.0101.0. New type crankshafts part no. 501.1.02.031.2 only may be assembled with the crankcases part no. 501.2.01.001.0 or part no 700.1.01.010.0

2.) Install the camshaft timing gear, together with short locating key. The main bearing must be pushed upon the crankshaft journal so that the off centre hole for the locating dowel is nearer to the crank web.

3.) Do not alter or modify any bearings.

4.) Care must be taken that the locating dowels engage properly in the holes of the bearings.

5.) Assemble the two crankcase halves and push in the two machined barrel bolts. Then tighten slightly the two nuts (M 10) of the one half and two nuts on the other half. Then tighten all four of them at 28.932 ft. - lbs. (4 mkg). The other bolts of the crankcase may be tightened without torque wrench.

6.) After bolting up the two crankcase halves, gauge the end float of the crankshaft with the flywheel fitted. In the event of the end float being insufficient, insert one or more paper gaskets between flywheel and crankshaft.

For fitting the crankshaft oil seals into the crank case, use the pressing device part. no. 501.1.5522 and 501.15523.

IX. Connecting rod

a) Removal

After loosening the connecting rod bolts, take off the connecting rod halvessand bearing shells. Mark the shells of each of the connecting rods in order to prevent interchanging when re-assembling. Care must be taken that the shells are refitted in their original position. The oil hole of the bearing shell must correspond to the oil spray hole of the conrod.

b) Examination

1.) Weigh the connecting rod (only when fitting new ones). The difference of weight between the two connecting rods must not exceed 5 grammes.

2.) Check wear and gudgeon pin clearance of the small end bush. Max. permissible clearance .002" (0.05 mm). With a newly fitted small end bush, the gudgeon pin must move in the bush upon gentle pressure of the finger at 68^0 F (20^0 C).

3.) Check connecting rod for alignment of the gudgeon pin. Control device part no. 501.1.55.049.1.

c) Installing

Is done in the reverse sequence to that of stripping. Pay attention to the following items:

1.) New connecting rods with squirt holes

From engine no. 511.4443 of the model 500 D, from engine no. 515.3183 of the model 500 DL, and from engine no. 535.0033 of the Haflinger model, the connecting rods have oil squirt holes drilled. These connecting rods must be fitted so that the holes point to the thrust side of the cylinders i.e. at the r.h.s. cylinder upwards, and at the l.h.s. cylinder downwards. When fitting, take care that the hole of the bearing shell is aligned with the hole in the connecting rod. The diameter of the hole in the shell is .138" (3.5 mm).

For these connecting rods the crankshafts have been adequately modified. Instead of two oil holes in each big end journal, only one hole is provided. Do not modify old big end journals with a view to changing over to the new type lubrication. It is equally important not to use drilled conrods together with the old type crankshafts, as this would entail a considerable loss of oil pressure owing to the two oil holes provided in each big end journal. The part number of this conrod is 5012.03.001.0 and as mentioned above, should be used exclusively for crankshafts with one oil drilling only. However it may be used for crankshafts with two oil holes on each big end journal provided that big end bearing shells without oil squirt holes are mounted. But since only big end bearing shells with oil holes are available, the shell with the squirt hole must be mounted in the lower half of the conrod so that the other shell covers the squirt hole of the conrod.

Please note that the old type crankshafts with two oil holes in each big end journal and the latest type crankshaft with one each oil hole have the same part number. As spare part, only crankshafts of the latest type are available, but may be used in conjunction with conrods without oil squirt hole.

2.) In case of worn out small end bushes, never fit oversize gudgeon pins. After pressing in the small end bush, drill an oil hole of dia. 1.8" (3 mm). The gudgeon pins are clasified into two tolerance groups.

Black indicates an outer diameter of .787164"- .787282" (19.994 - 19.997 mm)

White indicates an outer diameter of .787282"- .787404" (19.997 - 20.000 mm)

The small end bushes therefore must be finebored to an inner diameter of

.788110" - .788228" (20.014 - 20.017 mm) for black resp. to

.787953" - .788071" (20.018 - 20.021 mm) for white gudgeon pins.

3.) When refitting used big end bearing shells, observe the marking (See : "Removal" para IX / a).

4.) The connecting rod fixing bolts must be tightened with a torque wrench reading of 21.669 ft. lbs. (3 mkg). They are locked by punching the collar into the notch provided in the connecting rod (staking). Use a smooth edged-tool for this operation.

5.) When tightening the conrod fixing bolts, particular care must be taken that the top and bottom halves of the connecting rods are correctly aligned. We recommend to insert two feeler gauges .006" - .010" (0.15 - 0.25 mm) corresponding to the axial play between conrod and crankweb when tightening (see fig. 2 / XII).
This is important as the diameter of the fixing bolts is smaller than the diameter of the holes in the conrod. Therefore the lower conrod halves do not align automatically. After tightening the fixing bolts at 21.699 ft. lbs. (3 mkg) the connecting rod should turn under its own weight. Do not alter or modify bearings.

X. Clutch

a) When fitting the clutch actuating shaft and lever assy note the following:
Push the withdrawal race complete with fork back into the bellhousing until the contact surface of the graphite ring lies 1.732" - 1.751" (44 - 44.5 mm) deeper than the flange of the gearbox / bellhousing. Then insert the clutch actuating shaft into the splines of the clutch withdrawal fork so that the clutch actuating lever is parallel to the rear axle and secure in this position.

b) The clutch pressure plate is adjusted by the manufacturers and further adjustment is usually not necessary. If however, after re-facing the pressure plate or if clutch take- up is irregular, re-adjusting of the clutch mehcanism proves necessary, proceed as follows:
The height of the withdrawal ring is to be adjusted by means of the two adjusting screws with slotted nuts (when re-adjusting always use new nuts), so that the contact surface of this ring is .551" (14 mm) from the upper side of the base plate and .669" (17 mm) from the lower side of the base plate (contact surface of the clutch bas plate upon the flywheel). The adjusting nuts must be tightened uniformly so that the max. out of true of the clutch withdrawal ring does not exceed .008 " (0.2 mm). Check by means of tool part no. 501.1.55.051.0. (see fig. 2/XIII).

c) When installing the clutch, use the dummy shaft part no. 501.1.5524. The max. permissible out of true of the clutch plate is .02" (0.5 mm). If necessary, check between centre points. Adjust by means of adequate setting forks.

d) Do not interchange clutch thrust plates assy of models 700 C, 700 AP / APL / APT, 650 T and 500 DH with those of models 500 D and 500 DL. The appearance of both types is identical but the clutch thrust plate assy for models 700, 650 T and 500 DH is equipped with 6 thrust springs painted red: The part number for the above models is 700.1.16.301.0.
The clutch for models 700, 650 T and 500 DH have "TEXTAR" liners.
The part number for the clutch thrust plate assy for models 500 D and 500 DL is 501.2.15.301.0.

e) New type clutch for models 700 APT.

The difference between the above described type and the new type is as follows:

The new type clutch is reinforced i.e. has harder springs and is designed for better heat dissipation.

The clutch springs are insulated by means of porcelain spring supports.

The flywheel clutch assy is higher by .59" (15 mm).

Clutch plate

Thickness of the clutch plate with liners .342" (_.7 mm) and under pressure .335" (_.5 mm)-

Max. wear of the total lining thickmess .06" (1.5 mm)

Max. out of true .02" (0.5 mm)

Max. out of balance 5 cmg.

Clutch assembly

In case the contact surface of the clutch pressure plate becomes scored or uneven, it must be surface-ground. In case more than .02" (0.5 mm) have been taken off by reconditioning, ground steel washers of corresponding thickness must be inserted underneath the spring supports.

The height of the withdrawal ring above the upper side of the base plate is .866" (22 mm), gauged with a new thrust plate and a new clutch plate. For adjusting the withdrawal ring proceed as outlined under X / b .

Max. out of true of the withdrawal ring: .016" (0.4 mm).

Travel of the withdrawal ring: 1275" (7 mm) gauged on its face.

Colour marking of the clutch springs: red.

Number of clutch springs: 9

Exterior diameter of the clutch springs 1" (25.4 mm).

Diameter of spring wire: .138" (3.5 mm).

Length of the clutch springs: 1.653" (42 mm).

Dead travel at the clutch pedal: .787" (30 mm).

Gap between withdrawal race and withdrawal ring: .078" (2 mm).

Max. out of balance of the clutch assy is 15 cmg.

The out of balance is indicated by colour markings:

0 - 5 cmg. no colour marking

5 - 15 cmg. white colour marking at the point of the max. out of balance.

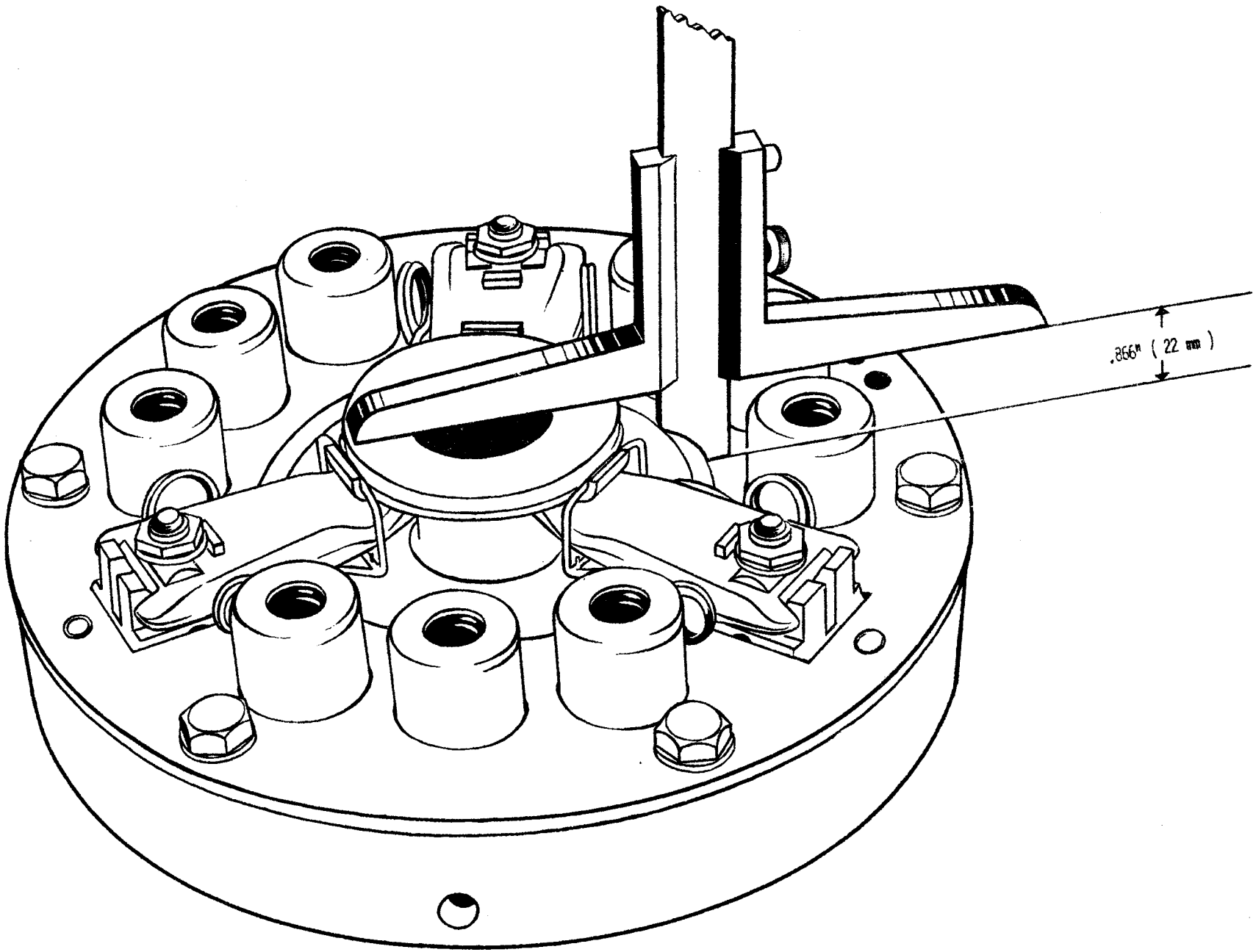
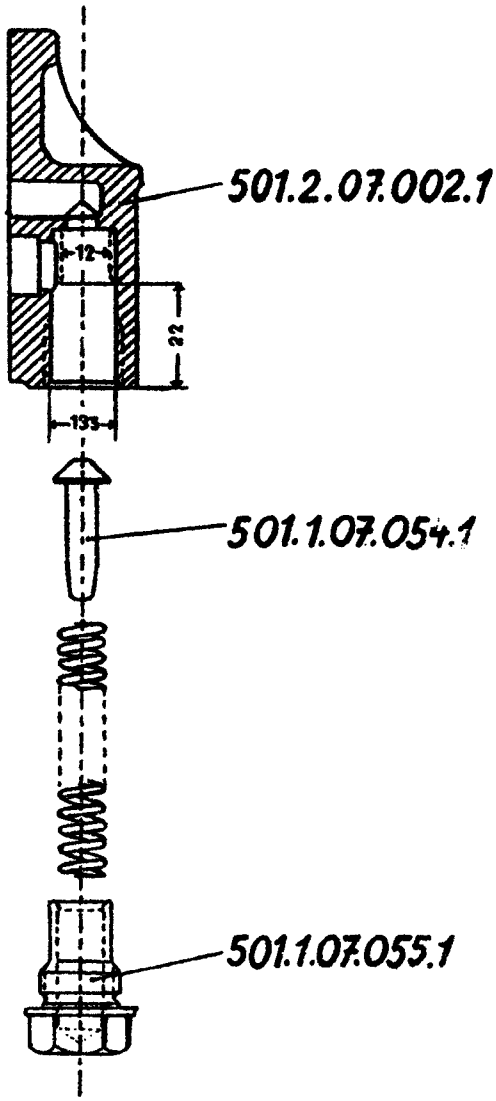


Fig. 2 / XIII

Fig. 2/XIII



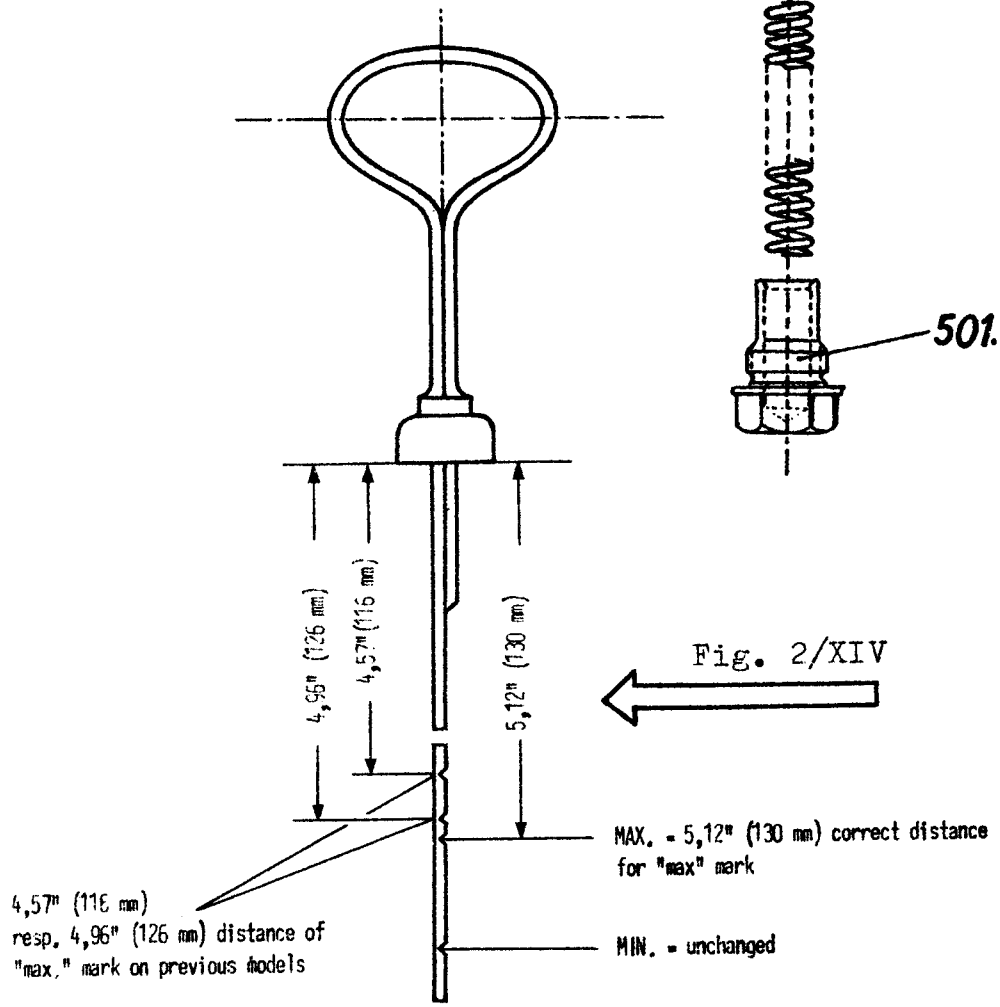


Fig. 2/XIV

XI. Lubrication

1.) After stripping the engine, clean all oilways of the crankcase and the crankshaft from oil sludge which might have accumalated there. When cleaning the crankshaft, it is not sufficient to flush the oilways with petrol or kerosene; remove the welsh plugs of the crankshaft and clean all the cavities thoroughly. When assembling, new plugs have to be pressed into the crankshaft.

2.) Oil filter

As the life of an engine primarily depends upom the good function of the oil filter, its fitting, and especially the assembly of the various by-pass valves has to be done with great care.

Type I

The first engines fitted with the oil-filter housing no. 501.1.0721.2 (without partition wall). The corresponding cover had the part no. 501.1.0735.2. As by-pass valve, a ball-valve was fitted in the tube of the filter cover. For this by-pass valve, a 3/8" ball part no. 22753 with a spring part no. 501.1.0748 (wire gauge .047" (1.2 mm)) was used.

When checking this type of by-pass valven take special care that the initial tension of the valve spring is correct. The depth of the dia. .413" (10.5 mm) hole in the tube is 1.83" (46.5 mm). Only with this depth the pre-tension is correct and guarantees that at a pressure difference of 10.5 lbs / sq.in. (0.7 atm.) before and after the filter, the oil reaches the bearings via the by-pass valve.

This type is no longer supplied. Therefore in case of damage to oilfilter cover or housing, a complete cover and housing of the later type must be ordered.

Type II

This type is characterized by a reservoir in the oil filter housing. The part number 501.0721.2 has remained the same. The oil filter cover has been modified too, and has now the part no. 501.2.07.035.2. The by-pass valve works on the same principal as in type I, but the valve spring part no. 1.07.094.1 (Wire gauge .027"(0.7 mm), length 2.44" (62 mm)) and the ball part no. 900.6119 / dia. .354" (9 mm) have been modified.

Type III

Larger micro filter. Note:

The by-pass valve for this type of filter is no longer a ball valve, but is a mushroom type valve, the same as used for the oil pump. For mushroom valve part no. 501.1.07.054 with the valve spring part no. 501.2.07.094.1.

The length of this spring is 1.77" + .039" (45 + 1.0 mm) when unloaded, that means, that the spring must not be shorter than 1.77" (45 mm). The by-pass valve opens at a pressure difference of about 11.75 lbs. / sq.in. (0.8 atm.) before and after the filter.

Whenever the filter is removed or replaced, check the tightness of the by-pass valve simply by inspecting the valve seat. If necessary, reseat the mushroom valve with a few gentle taps using tool no. 501.1.55.052.1. A leaking valve seat causes increased engine wear, as in this case unfiltered oil reaches the lubricating points. The micro oil filter cartridge part no. 501.1.07.058.1 must be replaced at least every second oil

3.) Oil cooler

When fitting the oil cooler, always use new and genuine rubber seals. Fit oil cooler to the crankcase squarly and evenly by uniformly tightening the fixing nuts in order to avoid a straining of the oil cooler.

4.) Oil pump and oil pressure control valve

a) When installing the oil pump, ensure that the pump gears are not touching the pump cover; on the ether hand their end float must not be excessive either (end float pump pf gears .0016" - .0027" (0.04 - 0.07 mm). When installing the oil pump, crank the engine in order to ensure that the oil pump drive fits well into the slot of the camshaft.

b) When replacing single components, do not interchange parts of different types. Up to date two types have been used, differing only by width of the pump gears. For Mark I .472" (12 mm) and Mark II .59" (15 mm).

Mark I			Mark II		
Pump gear width	.472" (12 mm)		Pump gear width	.59" (15mm)	
Pump housing	501.1.0701		Pump housing	501.1.0796.1	
Driving pump gear	501.1.0703		Driving pump gear	501.1.07.098.1	
Driven pump gear	501.1.0704		Driven pump gear	501.1.07.097.1	
Spindle 501.1.0705	dia.	.472" (12 mm)	Spindle 501.1.07.099	dia.	.472" (12 mm)
	length	.905" (23 mm)		length	1.023" (26 mm)

c) There are also two types of oil pressure control valves (see fig. 2/XIV)

Mark I with barrel comprises of:		Mark II with mushroom valve comprisesof:	
Pump cover	501.1.0701.2	Pump cover	501.2.07.002.1
Barrel valve	501.1.0749	Mushroom valve	501.1.07.054.1
Screw plug	501.1.0708	Screw plug	501.1.07.055.1
Coil spring	501.1.0748	Coil spring	501.1.0748

Mark I pump cover, barrel valve and screw plug are no longer manufactured but a modification of the mark II pump cover is possible, This modification consists of boring out the hole for the barrel valve to a depth of .866" (22 mm) with a dia. of .531" (13 mm) drill. Then cut the valve seat using the face cutter part no. 501.1.55.045.0 and seat the mushroom valve by gently tapping using the tool part no. 501.1.55.052. This modification permits the use of Mark II mushroom valve 501.1.07.054 and Mark II screw plug 501.1.07.055.1 The oil pressure should be gauged at an oil temperature of about 176 - 194° F (80 - 90° C) with the engine at operating temperature.

Mark I oil pump and Mark I pressure control valve:

The idling pressure should be 14.5 - 36.7 lbs. / sq.in. (1 - 2.5 atm.)

The max. pressure at 4500 RPM should be 42.7 - 64 lbs. / sq.in. (3 - 4.5 atm.)

Mark I oil pump and Mark II pressure control valve:

The idling pressure should be 14.5 - 36.7 lbs. / sq.in. (1 - 2.5 atm.)

The max. pressure at 4500 RPM should be 56.9 - 71.1 lbs. / sq.in. (4 - 5 atm.)

Mark II oil pump

The idling pressure should be 21.3 - 42.7 lbs. / sq.in (1.5 - 3 atm.)

The max. pressure at 4500 RPM should be 56.9 - 78.2 lbs. / sq.in. (4 - 5.5 atm.)

Insufficient oil pressure: Causes and their remedy

A) Mark I oil pump with Mark II oil pressure control valve

a) Pressure fluctuating

Cause:

Partly seized barrel valve, movement impaired

Remedy:

Polish barrel valve, turn off the diameter above the groove by about .004" - .008" (0.1 - 0.2 mm), then polish it also. Ream the bore of the oil pump cover with a dia. 12 H 9 reamer.

To obtain a close seat, tap the barrel valve gently into the pump cover, using a soft drift.

b) Oil pressure insufficient at low engine speed, but normal at full throttle

Cause:

Barrel valve leaking at its seat

Remedy:

Remove the barrel valve. Clean the oil pump cover by using the face cutter 501.1.55.045.0 and tap the barrel valve into the pump cover as above.

c) Required oil pressure reached when engine cold, but insufficient at operating temperature, pressure fluctuations occur, In this case, the barrel valve may be leaking as well. Mostly however, a defective oil pump will be the cause, e.g. excessive end float of the pump gear or, a driven pump gear installed with the more chamfered teeth pointing towards the pump cover (instead of the other way round) or, a driven pump gear excessively chamfered on both sides. Oil strainer leaking e.g. at the intake elbow or at the fixing flange.

d) Insufficient oil pressure when cornering

Cause:

Too little oil in sump, or oil pump output insufficient (see above) or oil strainer too far from the bottom of the crankcase.

Remedy:

Top up to correct oil level. Bend oil intake elbow into position.

e) Oil pressure drops at very high cruising speed and with very hot engine, but returns to normal when speed is reduced.

Cause:

Too much oil in sump- Oil foams through being whirled up by the crankshaft, and the oil pump not only takes in oil, but also air bubbles, thus reducing the oil pressure.

Remedy:

Drain oil to correct level. Note: For checking the oil level just insert the dip stick, do not screw it home.

Check the max. mark of the dipstick according to fig. 2/XIV, amend if necessary. For engines built up to 1959 (116 mm of max. mark) resp. built up to 1962 (126 mm max. mark) a larger filling capacity of oil has been provided. The filling capacity has been reduced, and according to it the dipsticks have been altered (130 mm max. mark), dipsticks with 116 mm resp. 126 mm marks have to be dressed subsequently.

f) Excessive oil pressure, up to 213 lbs./sq. in. (15 atm.) thus damaging the oil cooler and oil pressure switch.

Cause:

Seized barrel valve stuck in closed position

g) No oil pressure at all, neither at idling speed nor at high speed.

Cause:

Remedy for f) and g):

Replace the complete pump cover assy.

B) Mark I and Mark II oil pump with Mark II oil pressure control valve. Except for seizing, the same defects as for the mark II valve may occur. Moreover, this system is highly susceptible to dirt causing leakage, as the actual working stroke of the valve does not exceed .016" (0.4 mm). Chips which may be getting caught on the valve seat may therefore considerably reduce the oil pressure. To obviate dirt being caught on the valve seat a very narrow seat has been provided in the pump cover. Refacing or hammering will widen this seat thus defeating this object. In all cases where the above mentioned operations of reseating or hammering in of the valve or after a long period of service the valve seat has widened beyond permissible limits, it must be reseated by using the face cutter for the oil pressure control valve part no. 501.1.55.045.0 in order to restore the sharp edge. After refacing the seat the valve must be hammered in, using the special tool part no. 501.1.55.052.1.

XII. Governor

The engines of the models 700 AP / APL / APT and the stationary engine ST 600 are fitted with a Vee-belt driven centrifugal-type governor, that governs the crankshaft speed to 4500 RPM on models 700 AP / APT and adjustable to 3200 and 4500 RPM on models 700 APL and to 3200 on model ST 600.

This governor has been set to a maximum crankshaft speed of 4500 RPM. When checking the governor always make sure that the above crankshaft speed is not exceeded. If no revolution counter is at your disposal, you may provisionally check with speedometer readings.

At 4500 RPM the max. roadspeed of the vehicle should be:

With a spur ratio of:	3.0	2.71	2.38
1st gear	6.2 mph. (10 kmh.)	6.8 mph. (11 kmh.)	6.8 mph. (12.5 kmh.)
2nd gear	10.5 mph. (17 kmh.)	11.8 mph. (19 kmh.)	13.6 mph. (21.0 kmh.)
3rd gear	18.6 mph. (30 kmh.)	21.4 mph. (34 kmh.)	23.3 mph. (37.5 kmh.)
4th gear	32.3 mph. (52 kmh.)	36.0 mph. (58 kmh.) resp. (37.3 mph. (60 kmh.))	39.8 mph. (64.0 kmh.)

The free movement of the governor linkage and especially the shafts is essential for troublefree operations of the governor. Additional adjustment is possible at the ball joint of the linkage whereby the closing angle of the butterfly throttle may be varied.

The initial of the governor is as follows:
With the governor in neutral position the governor lever should be in vertical position, if necessary reset it on the splines of the governor shaft. Take care that the governor lever does not touch the oil filler pipe.
Adjust the stop screw of the throttle spindle so that the governor lever lifts slightly so as to release the actuating plunger of the governor (Dead travel at the governor lever in height of the ball joint approx. .04" (1 mm)).
Now set the governor linkage travel as follows:
Remove the connection airfilter to carburettor, open the carburettor throttle to full bore so that the governor throttle (butterfly valve) can be seen through the carburettor. Pull at the governor lever so that the governor throttle closes and insert inbetween the bore of the intake manifold and the butterfly valve a length of wire Dia .040" (10 mm) (Fig. 2 / XIX) so that the governor throttle cannot close completely but leaving an annular gap.
Mark on the governor control rod this position enabling you to see exactly when the governor throttle is closed to gap of .040" (1 mm) during operation. Start the engine and rev up. At 4500 RPM the governor throttle must close to the before mentioned gap. In case this gap should be less it is possible that the butterfly valve gets stuck causing fluctuating running of the engine as it will open all of a sudden when the crankshaft speed has dropped considerably. This gap may be adjusted by turning the ball joint (Fig. 2 / XVI).
To achieve correct governing the tension of the governor linkage return spring must be adjusted as well.
The length of the spring should be 1.574" - 1.653" (40 - 42 mm) gauged from the first to the last coil when mounted (Fig. 2 / XX). For adjusting slacken off the locknut of the spring fixing stud at the blower fairing.
After adjusting the governor linkage etc., check the max. crankshaft speed by means of a revolution counter. If there is none at hand , proceed as follows: Check the hubgear ratio. To facilitate this job numbers are stamped on the wheel flange (hub).
A'13' indicates that the hubgear ratio is 3.0 with a max. roadspeed of 32.5 mph. (52 kmh.)
A'14' indicates that the hubgear ratio is 2.71 with a max. roadspeed of 36.25 mph. (58 kmh.) at 4500 RPM
A'16' indicates that the hubgear ratio is 2.38 with a max. roadspeed of 40 mph. (64 kmh.) at 4500 RPM.

With the hubgear ratio known drive the vehicle flat out on a level road and check whether the max. engine revs are obtained or not. It is essential to execute this test only with warm engine or after driving some 3 miles (5 km) and at temperatures well above freezing point. It is also advisable to check the speedometer reading against a stopwatch in order to compensate misreadings. In case the vehicle cannot reach its max. roadspeed or exceeds same considerably, the governor itself must be readjusted. For this job remove the centrifugal governor complete with its mounting flange and drive pulley after undoing both the hexagon fixing nuts.
Speed regulation is done by uniformly turning the two self-locking nuts, thus modifying the initial tension of the governor springs. (See fig. 2 / XV).

By clockwise turning of the nuts, the speed will be increased whereas by anticlockwise turning of the nuts it will be reduced. Uniform adjustment of the two nuts is important, to prevent unbalance and excessive wear of the governor mechanism. By turning the adjusting nuts by 1/2 turn the roadspeed in topgear will change by:

93 mph. (1.5 kmh.) with a hubgear ratio of 3.0

1.25 mph. (2 kmh.) with a hubgear ratio of 2.71

1.56 mph. (2.5 kmh.) with a hubgear ratio of 2.38

a) Governor upon test bench:

1. Governor weigths begin to open at 2580 RPM governor speed
2. Weights end their movement at 3100 RPM governor speed
3. Between the revs given above the plunger travel is about .196" (5 mm).
4. Turning the adjusting nuts by about 1/2 a turn moves the working range of the governor by about 100 RPM.

b) Governor mounted in the vehicle:

Due to the load of the return spring the flyweight of the governor will be opened fully at 3600 RPM governor speed. This corresponds to a crankshaft speed of about 4500 RPM. As there is a transmission ratio 1.2 : 1 governor to crankshaft. It is essential that the governor is adjusted such that the vehicle reaches its max. roadspeed, specified for its hubgear ratio, as otherwise the engine life will be shortened.

In case it is impossible to adjust the governor linkage so that the engine speed is controlled properly (engine speed is fluctuating) it is an indication that there is excessive play in the governor linkage.

Check the following components:

a) Governor push rod

b) Governor lever upon the splined shaft

c) Ball joint

d) Light alloy bearing on the intake manifold

e) Clearance of the grooved dowel in the slot of the governor throttle spindle.

f) Play of the butterfly shaft in the intake manifold

When assembling or replacing the various components be careful not to interchange with parts belonging to governors of different types.

On engines for cross-country trucks 700 AP / APT the governor part no. 700.1.14.013.0 is used in conjunction with the governor pulley part no. 700.1.14.004.1, the drive pulley (upon the crankshaft) part no. 700.1.02.002.1 with an outer dia of 2.086" (53 mm) and a Vee-belt 8 X 450 part no. 900.4408.

Note:

After adjusting of the governor, do not forget to replenish the oil in the governor housing.

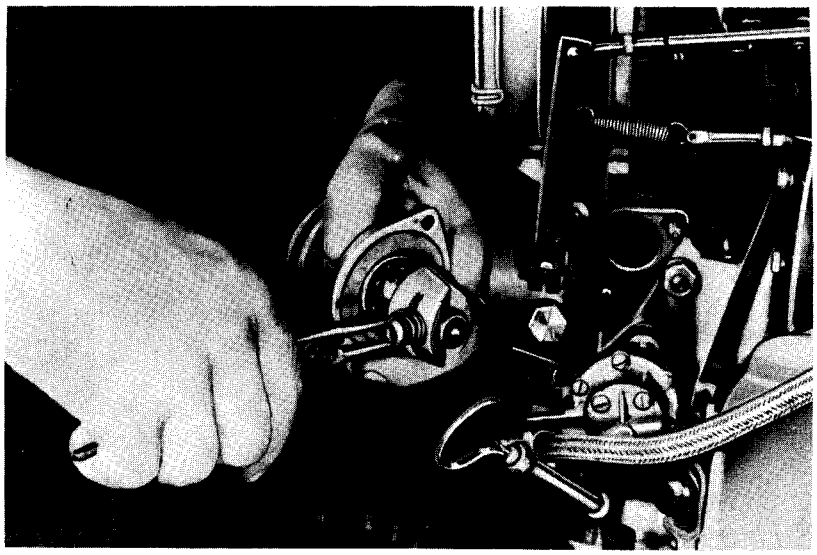


Fig. 2/XV

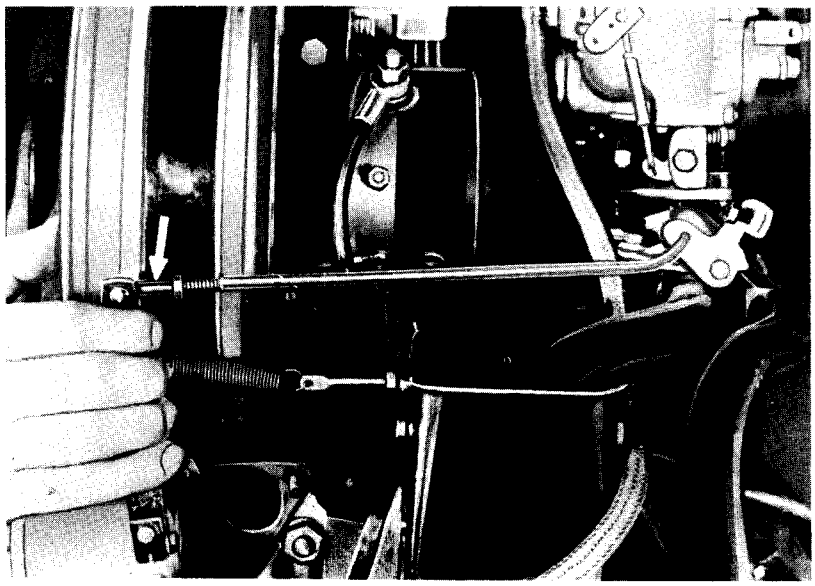
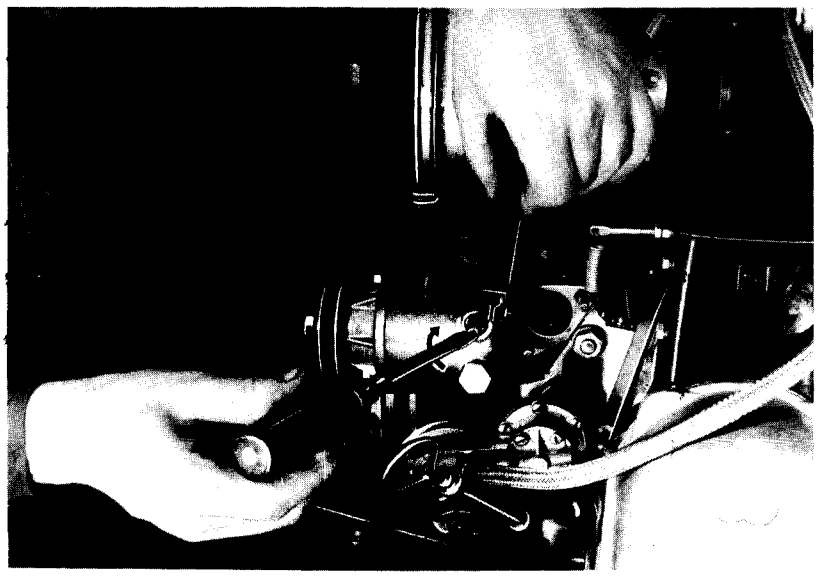


Fig. 2/XVI



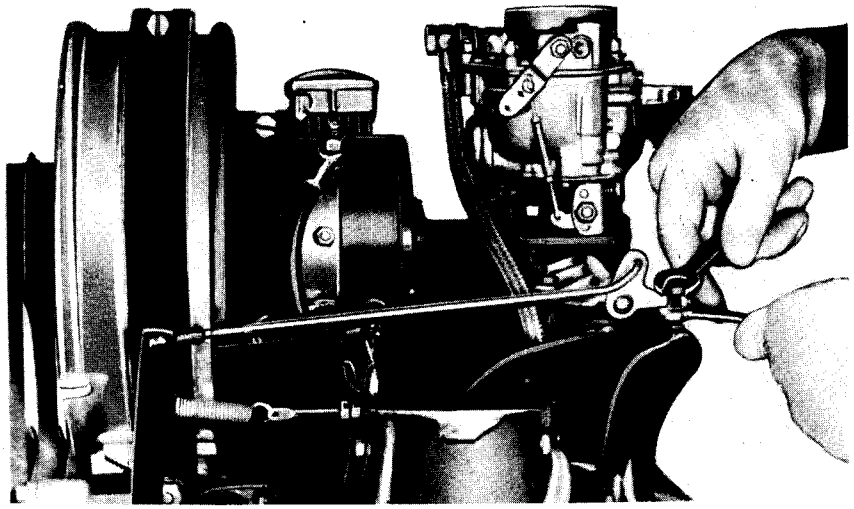


Fig. 2/XVIII

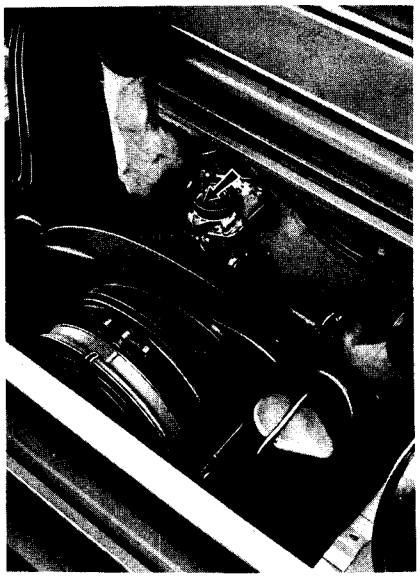
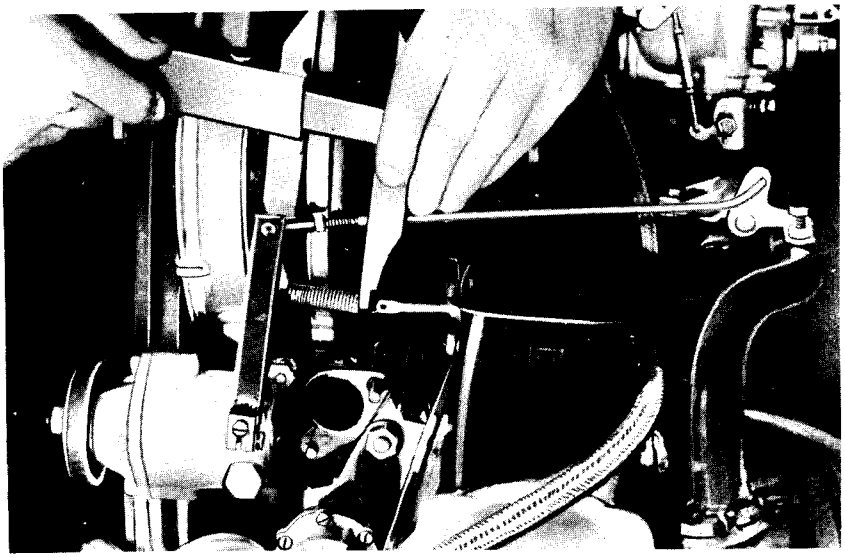


Fig. 2/XIX



2.) Governor for model 700 APL

This type of governor differs from the one described above by its two-speed switch, which permits two speed ranges, the first corresponding to the usual road use at 4500 REM and the other for stationary operation at 3000 RPM. Instead of the return spring another spring is fitted upon the governor itself. For the first (low) range this spring has an initial tension of 1.187" (30 mm) adjustable by regulating the adjusting sleave. For the second (high) range, the initial tension is increased by .531" (13.5 mm). As drive-pulley (crankshaft) the part no. 600.1.02.001.0 with an outer dia of 3.346" (85 mm) is used. The transmission ratio is 1.3 : 1. The Vee-belt 8 X 500 has the part no. 900.4409. Setting and adjusting of the centrifugal weights are the same as for models 700 AP / APT.

3.) For governing the stationary engine ST 600 the centrifugal governor is adjusted so that the flyweights commence to open at 3660 RPM and are entirely opened at 3900 RPM governor speed. The part number of this governor is 690.1.14. 005.0. The plunger travel is 1.196" (5 mm).

The governor drive is the same as for the models 700 APL. The return spring is adjusted to about 1.968" - 2" (50 - 51 mm).

XIII. Fuel system

A. Weber Carburettor type 32 ICS used on models 500 DL, 700 AP / APL / APT and 700 C.

1.) General remarks

The Weber carburettor type 32 ICS is a special cross-country downdraught carburettor, The devided float chamber with two floats ensures correct fuel supply under all conditions e.g. or transversing steep inclines.

The carburettor has a central air intake and is of a waterproof and dustproof design. The bore of the light alloy diecast carburettor body is 1.22" (32 mm).

2.) Structure

The carburettor consists of two main components.

Carburettor cover (see fig. 2 / XXI).

The cover carries the fuel connection, the fuel strainer with water seperator, the float assembly with shock-obsorbing float needle and the choke butterfly with poppet valve. The carburettor cover is designed for central air intake i.e. all air is drawn through the air cleaner, which ensures dustfree air also for the ventilation of the bowl and the idling air bleed.

Carburettor body (See fig. 2 / XXI)

The body houses the throttle butterfly, the throttle spindle with its abutment plate and the slow running adjustment screw (volume control screw).

Attached to the throttle spindle are the throttle lever, the return spring, the throttle- and choke connecting rod and return spring, and the accelerator pump actuating lever.

Besides the parts mentioned, the carburettor body houses the accelerator pump with actuating rod and spring, pump inlet valve with backflow bore and pump injector assy.: the main jet system consisting of main jet, emulsion tube and air correcting jet, atomizer and choke tube (venturi), the idling system consisting of pilot jet, idling air bleed, volume control screw, slow running outlet and by-pass bores.

3.) Operation

Again the carburettor may be regarded as consisting of two systems:
First the slow running system which has to prepare the air / fuel emulsion for idling and for the transfer and second the main jet system with accelerator pump which supplies fuel for the range from the transfer to full throttle. There is no seperate starting system as the closing of the choke butterfly will cause sufficient depression in the choke tube to operate the mainjet system.

Function of the slow running system (fig. a)

The idling mixture is controlled by:
The fuel drawn from the emulsion well (8) passes through the canal (16) to the pilot jet (14). An emulsion isformed with air drawn through the calibrated air bleed (13) and via canal (15) and the idling orifice (18) adjustable by the volume control screw (17),this emulsion enters the mixing chamber underneath the butterfly (19). In the first stage of the transfer additional emulsion is drawn through the by-pass holes (20).

a) The pilot jet for metering the fuel supply

b) The pilot air bleed for metering the air for the production of the slow running emulsion

c) The volume control screw for the control of the slow running emulsion rate

d) The air stream entering through the butterfly gap

Slow running

The slow running system also constitutes in its operation an auxiliary carburettor. The fuel required for idling, which is drawn from the main jet system is metered by the pilot jet and mixed with air admitted through the calibrated pilot air bleed. This slow running emulsion is led downwards by a channel to three small holes at and downstream the throttle butterfly. It is possible to vary the cross - sectional area of the lowermost of these three holes by means of the volume control screws. When the throttle butterfly is closed, the idling emulsion is drawn into the inlet mainifold through this orifice. The two upper holes, which are termed by - pass holes, have a different function. Idling emulsion is also drawn through the hole located in the throttle aperture, as it is in an area of very high depression. The other by - pass hole, which is situated slightly above the throttle butterfly in the closed position, comes into action only when the butterfly is slightly open. These two holes serve to improve the transfer from the idling to the main jet system. Incoming air admitted through the throttle aperture forms the idling mixture with the idling emulsion.
The idling mixture may be weakened or enriched by means of the control screw. Turning the screw in a clockwise direction (= reduction of cross sectional area) weakens the idling mixture; anti - clockwise rotation (increase in cross sectional area) provides a richer idling mixture.

2.) Governor for model 700 APL

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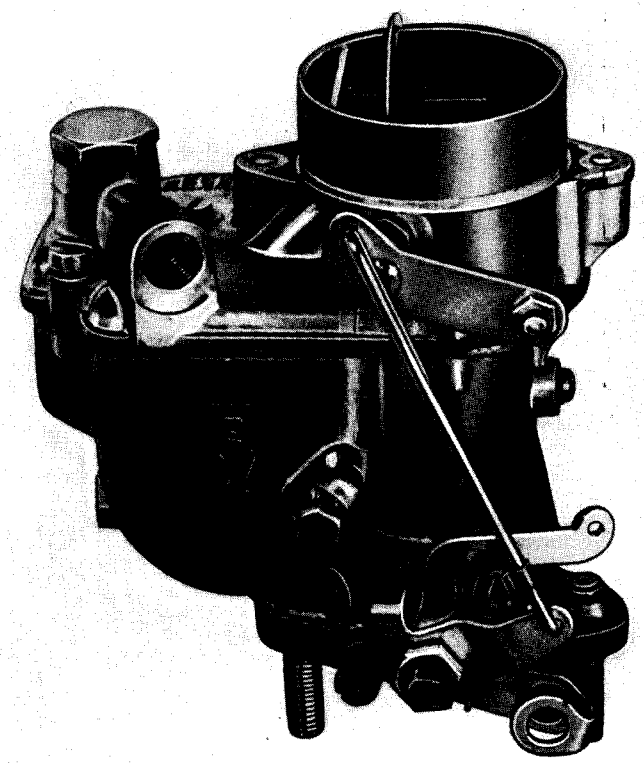


Fig. 2/XXI
Weber 32 ICS

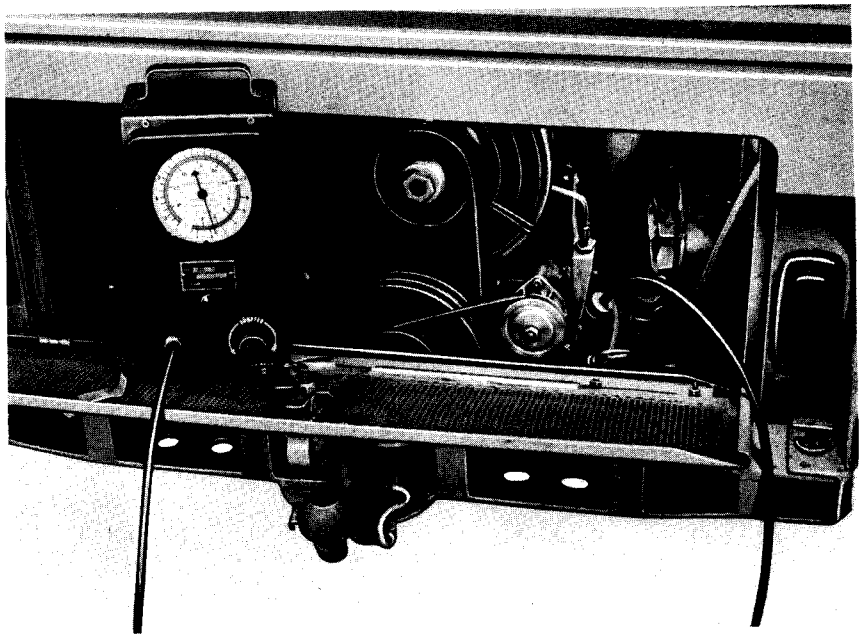


Fig. 2/XXXVIII

The idling speed of the engine may be controlled by means of the screw which is fitted to an abutment plate attached to the throttle spindle. Movement of this screw alters the closed position of the throttle butterfly by moving the abutment plate, and brings about an increase or a reduction in the annular space between the wall of the carburettor and the throttle butterfly. By rotating this screw clockwise (increasing the annular space) the idling speed is increased and anti - clockwise rotation (reduction of annular space) reduces it.

Adjustment of the slow running system

Before adjusting the idling speed it will be useful to check condition and setting of the spark plug electrodes.

For correct adjustment of the idling speed, proceed as follows:

a) Bring engine to operating temperature; stop engine .

b) Close gently the volume control screw then open by one full turn .

c) Start the engine .

d) Set the throttle stop screw (on the abutment plate) so that the engine runs at slightly raised idling speed. (Approx. 1000 RPM)

e) Adjust the volume control screw, to the greatest possible engine speed.

f) Unscrew the throttle stop screw so that the correct idling speed is attained (about 700 RPM).

g) Repeat the procedure as under e) and f).

If, through this adjustment, the engine speed has again increased beyond idling speed, reset the throttle stop screw and readjust once more the volume control screw.

If after the adjustment thus carried out progression (transfer) is unsatisfactory, and if the reason for this is the accelerator pump, carry out the following test:

Increase the idling speed by means of the throttle stop screw, then screw or unscrew the volume control screw

If by screwing in of the volume control screw the engine speed will increase, it is an idication that the progression mixture is too rich, hence adjust the slow running mixture till it is as lean as possible. If, on the contrary, engine speed will increase by unscrewing the volume control screw, it indicates that the progression mixture is too lean, render the slow running mixture a bit richer.

Note:

These adjustments are very sensitive.

Never screw in the volume control screw completely! If an adjustment proves impossible, a differently calibrated pilot jet must be fitted.

A second test for slow running is provided by turning in the volume control screw completely after having set the idling system. In this case the engine should peter out.

If, however by complete screwing in of the volume control screw, the engine does not stall as outlined above, or smoothest running is obtained, this indicates that either the idling speed has been adjusted too high, or that the progression outlets (by - pass holes) in the carburettor have not been drilled in the right position.

(This of course requires a new carburettor.)

Function of the normal running system (fig. b)

The fuel enters the bowl (5) through the needle valve (2) where the float (4) controls the position of the needle (3) in order to keep the fuel level constant. From the bowl (5) the fuel is drawn via the canal (7) to the emulsion tube well (8). Mixed with bleed air from the emulsion tube (9) entering through the air correcting jet (1) the fuel is entering the mixing zone, which consists of the choke tube (10) and the auxiliary venturi (11), through the efflux hole (12).

Carburation is normally carried out in the mixing chamber by the main jet system. On top of the choke tube is an auxiliary venturi with an efflux hole connected through a calibrated drilling with the emulsion tube well. In the well the emulsion tube is held in position, by means of the air correction jet. The main jet itself is screwed into the main jet carrier at the bottom of the float chamber.

During normal operation, the fuel / air mixture is determined as follows:

a) Main jet, which meters the petrol quantity .

b) Air correction jet which, together with the emulsion tube, regulates the air bleed.

c) The auxiliary venturi calibrating the fuel flow from the emulsion well.

d) The choke tube regulating the main air.

From the float chamber, the fuel is passing through the main jet carrier and the main jet to the emulsion tube well which is filled up to fuel level. Upon opening of the butterfly, a depression is caused in the intake manifold, which attains its maximum in the choke tube.

Under the influence of this depression fuel is drawn through the efflux hole of the auxiliary venturi.

When the depression increases, correctional air passing through the air correcting jet and progressively passing through more and more holes of the emulsion tube, forms an emulsion with the fuel metered by the main jet.

The fuel / air mixture is thus weakened (leaned out) and its correct composition for all engine speeds is assured.

Once the petrol level in the well has dropped to the extent that all bleed holes are open the calibration of the air correction jet comes into action (the cross - section of all bleed holes being greater than that of the air correction jet) ; thus the mixture for the max. engine speed is provided.

Series production vehicles are tuned for economy; therefore mostly the main jet is one size smaller than would be needed to obtain the max. output. As the air correction jet becomes operative only after all the bleed holes are open, it is obvious that it influences the fuel / air ratio only in the upper speed range. A smaller air correction jet will allow a richer mixture at high engine speeds, whereas a bigger one will provide a leaner mixture.

Replacement of the main jet by a bigger one will enrich the mixture more or less equally throughout the normal operation range. A smaller main jet will result in a corresponding leaner mixture. The slow running system and the normal running system must be adjusted so that the normal running system (main jet system) comes into action before the slow running system has finished working!

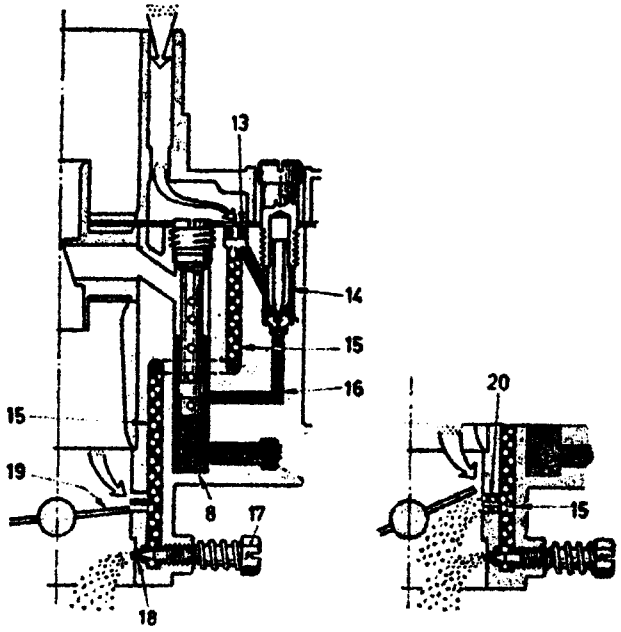


Fig. a

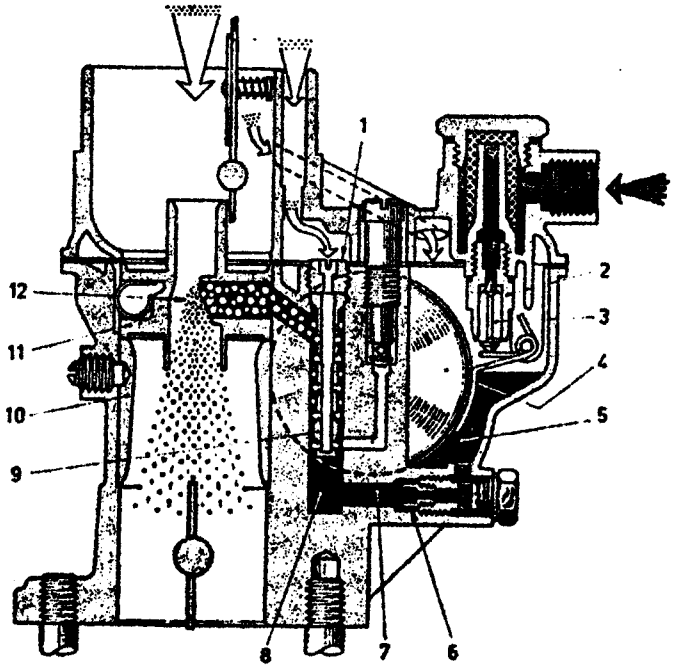


Fig. b

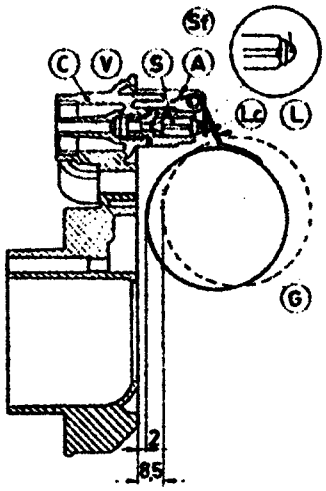


Fig. d

Weber 32 ICS

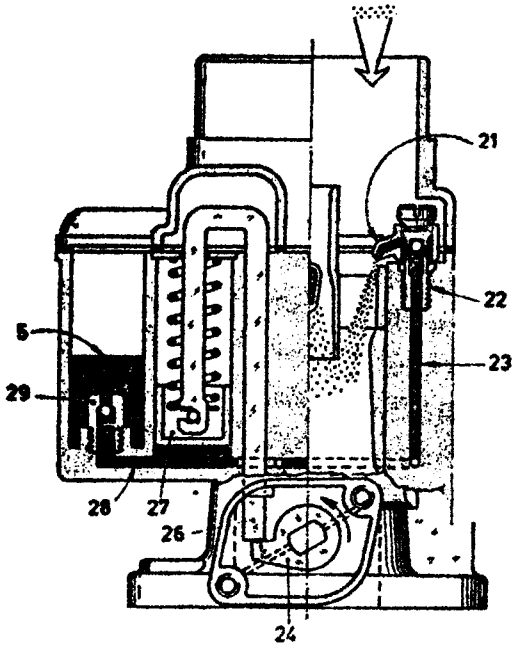


Fig. c

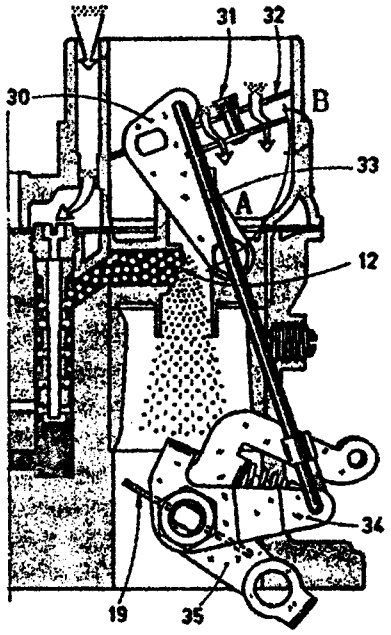


Fig. e

The point where the main jet system commences to operate can be adjusted by modifying the efflux tube, the auxiliary venturi and the choke tube. Besides that, the size of the air correction jet influences to some extent the commencement of the main jet system.

Main jets, are correction jets and venturis are tuned one to another so that inspite of a satisfactory engine output the consumption of petrol remains within reasonable limits. A resetting might however prove necessary if a very different type of fuel is to be used. In general, this adjustment should not be altered.

For replacing jets, we give the following data:

Bigger main jet = increased performance, higher consumption

Smaller main jet = reduced performance, reduced consumption

Larger air correction jet = reduced consumption, reduced peak performance

Smaller air correction jet = increased peak performance, increased consumption.

Accelerator pump (fig. c)

When closing the throttle the pump plunger (27) is lifted by means of the pump control rod (26) and the pump actuating lever (24). The fuel is drawn from the bowl (5) via the pump suction valve (29) and the canal (28). By opening of the throttle the pump control rod (26) is released and the plunger (27) is pressed via the canal (23) and the pump pressure valve (22) to the pump jet (21) and injected into the mixing chamber. The pump suction valve (29) can be equipped with a calibrated backflow bore through which a part of the accelerator fuel is brought back into the bowl.

The carburettor accelerator pump is a piston type pump. A chamber adjacent to the float chamber forms the pump barrel, in which the pump plunger operates. The pump plunger is attached to the pump control rod with the plunger spring. When the butterfly is closed, the pump plunger goes up and draws fuel through the suction valve into the pump barrel; this is the intake stroke of the pump (which depends upon the length of the pump control rod). A short control rod entails a short stroke whereas a long one entails a long stroke, with the injected quantity varying correspondingly. When the throttle is opened, the pump control rod is released and the plunger spring pushes the plunger down. This is the working stroke of the pump.

With invariable pump jet (injection tube) the pressure of the accelerator pump resp. the duration of injection is controlled by the thrust of the plunger spring. During the working stroke of the pump, after passing through pump release valve and pump jet the fuel is injected into the space above the auxiliary venturi. This is the part with the lowest depression, so that, under normal driving conditions, there is no petrol drawn via the pump jet.

Only at full load or at high engine speed additional fuel will be drawn via the pump jet. As obstruction or partial choking of the pump injection nozzle may result in leaning of the mixture in the upper range, thus causing reduction of engine performance as well as overheating, always clean this nozzle, when inspecting the carburettor.

In order to be able to check the quantity of injected fuel and the duration of injection with unvarying stroke and plunger spring, the pump intake valve has been fitted with a calibrated backflow hole, which renders it possible for a part of the drawn fuel to flow back into the float chamber (bowl).

The fuel injected by the accelerator pump when accelerating, facilitates the transfer from the slow running system to the main jet system, rendering possible a more rapid acceleration of the vehicle. The pump has been adjusted by the manufacturers and should not be altered. Only under abnormal conditions i.e. high altitude or extremely low temperatures, it is necessary to fit a suction valve with a smaller (for richer mixture) or larger (for leaner mixture) backflow hole.

Checking the fuel level (adjusting the float) (fig. d)

When adjusting the fuel level check the following items:

The float needle valve (V) for tight fit.

Maintain the carburettor cover (C) in a vertical position so that the torque (Lc) of the float (G) just touches the spring ball (Sf) at the lower end of the valve needle (S).

Whilst the carburettor cover (C) is kept vertically the distance between the face of the carburettor cover and the float drum (G) must be .0787" (2 mm) gauged without gasket. For adjusting this distance bend, if necessary, the tongue (Lc). After adjusting of the fuel level check the working stroke of the float.

With fully swung out float the distance between the face of the carburettor cover (C) and the float drum (G) must be .335" (8,5 mm) if necessary adjust by bending the tongue (A).

Both the float drums must be parallel to the carburettor cover if not bend the bracket (L) into position.

Further check the tongue (Lc) for grooves which might prevent free movement of the ball of the needle (Sf).

When reinstalling the carburettor cover assy. make sure that both the float drums do not touch the bowl.

When cleaning the carburettor take special care, that the calibrated fuel; mixture - and air orifices are not cleaned with metal instruments. The settings of the Weber carburettor type 32 ICS for the Models Haflinger 700 AP / APL / APT are as follows:

Diameter	32 mm
Choke tube	27 mm
Main jet	135 (125 for the tropics)
Air correction jet	240
Emulsion tube	F 18
Pilot jet	50
Idling air bleed	1.75
Auxiliary venturi	4.5
Accelerator pump jet	60
Spring for choke poppet valve	160 gr at 7 mm
Float needle valve	1.50
Weight of float	25 gr
Float adjustment (gap between face of carburettor, cover and float drum)	2 mm

Ventilation for bowl (float chamber)	2 each Dia 8 mm
Ventilation for air correction jet	4,3 mm
By - pass bores	1 dia. 2 mm
	1 dia. 1,65 mm

B: Pallas Zenith carburettor type 32 NDIX

1.) Description

The Pallas Zenith carburettor type 32 NDIX is a cross-country twin-choke downdraught carburettor with a bore of 2 X 32 mm. It consists of three main parts:

a) Throttle body assy.

b) Float chamber (bowl), carburettor body

c) Carburettor cover assy.

The cast iron throttle body assy. is flange mounted upon the intake manifold. It bears the common throttle spindle for both the butterflies. The throttle spindle carries on one end the throttle lever and on the other end the abutment plate together with the accelerator pump actuating lever. The throttle lever regulates the position of the throttle valve and thus the quantity of fuel / air mixture fed to the engine. The abutment plate supports the idling adjusting screw (throttle stop). Besides, the throttle body contains the two slow running mixture control screws (volume control screws).

The float chamber assy is a light alloy diecasting and contains the two mixing chambers and the twin float - chamber. It comprises all components necessary for preparing the fuel / air mixture, the float assy. the accelerator pump, and the starting device.

Float chamber assy. and throttle body assy. are tightly screwed upon each other (gasket inserted). They must not be seperated for routine mainterance works.

The carburettor cover as well, is a light alloy diecasting. It is fixed with a gasket upon the float chamber and may be removed after undoing five fixing screws (note : the gasket is secured upon the carburettor cover by means of two rivets and therefore must be removed together with the carburettor cover). If the gasket sticks to the carburettor body it must be relieved cautiously in order to prevent damage. The carburettor cover carries the fuel connection; the float needle valve and starter emulsion tube. It has been designed so that both float chamber ventilation and bleeding air, for the starting device are drawn through the centre air intake i.e. through the air cleaner. This arrangement ensures that any possible entering of dust or dirt into the interior of the carburettor is largely avoided.

2.) Operation

Starting:

The starting device constitutes a complete auxiliary carburettor exclusively for starting and for operating the engine when cold. The starting device provides a fuel and air mixture, the starting emulsion. The fuel enters the well from the float chamber via the starter jet, in which the starter emulsion tube projects. The well is connected by a passage to the starter mixing chamber.

From the starter mixing chamber . a tunnellike canal supplies the emulsion to the throttle part and enters the manifold under the butterfly valves. A rotary slide valve is fitted in the starting emulsion mixing chamber permitting an infinitely variable starting emulsion. With the choke control pulled out completely the rotary slide valve is in the positions as shown in fig. 2 / XXVII allowing a full flow of the starter fuel and through the calibrated bore enters the starter air, forming the starter emulsion. This emulsion is drawn through the vertical canal into the carburettor mixing chamber where it will form the starting mixture with the air entering through the annular gap of the throttle butterfly. This starting mixture is so rich that starting of the engine even at very low temperatures is possible. As soon as the fuel of the starter well is consumed, the second stage commences (see fig. 2 / XXVII).

Fuel drawn through the starter jet is mixed with bleed air entering through the starter emulsion tube such leaning out the fuel in the starter well and ensuring a further smooth running of the engine whilst warming up.

At very low winter temperatures, it is possible that the fuel level in the starter well drops before the engine is sufficiently warmed up, causing the engine to peter out.

This phenomenon where the engine starts at once, but peters out after a few seconds, necessitates waiting until the well will be filled up again - after a few seconds - then the engine may be restarted. After repeating this procedure two or three times, the engine should be warm enough to run even with a slightly too lean mixture. With the further warming up still leaner mixture is required. Therefore the starter rotary valve must be set to warming up position (fig. 2 / XXIX), thus leaning the starter mixture owing to the reduction of the cross section of the entry for air and fuel into the starter mixing chamber.

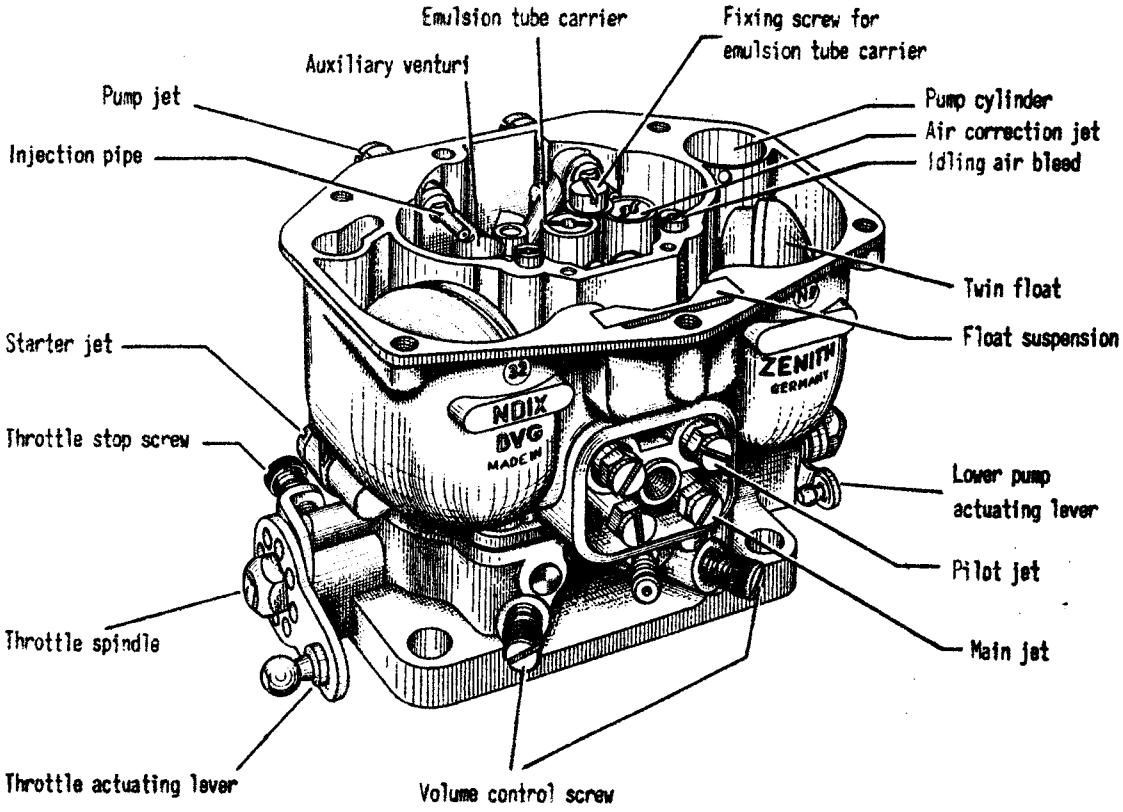
The adjustment of the cross section renders it possible that the engine may be operated for some time and even the vehicle may be driven. This position approx. corresponds to the middle position of the choke control. As by adjusting the starter rotary valve, additional air is added to the emulsion , the starting device works progressively with infinite variation. To each position of the starter rotary valve corresponds a different starter mixture.

Slow running:

Both carburettor induction bores are provided with one each slow running system, which again form an auxiliary carburettor. The slow running system, is equal to the one of the Weber carburettor type 32 ICS. Also see ill. 2 / XXX and 2 / XXXI.

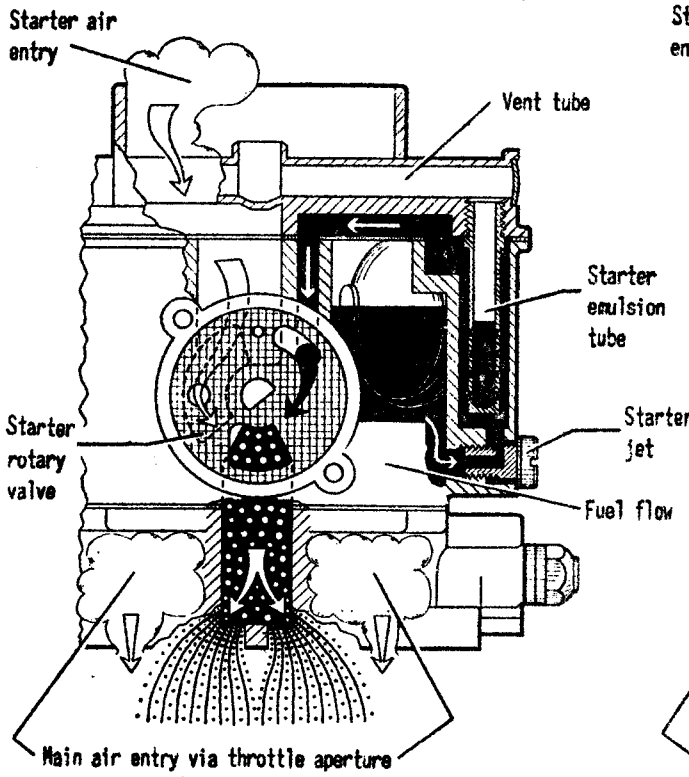
Main jet system:

The formation of the fuel / air mixture for normal operation is carried out by the main jet system. In each one of the mixing chambers a choke tube and an auxiliary venturi, which is united with the emulsion tube carrier, are installed. The two emulsion tube carriers are bolted to the carburettor body. Each emulsion tube carrier contains an emulsion tube held in position by the air correction jet screwed upon it. The two main jets together with two pilot jets are situated in a chamber under a cover of the side of the carburettor body. This cover is provided with a gasket as this chamber is filled with the fuel from the bowl. The working of the system is more or less the same as the one for the Weber carburettor type 32 ICS (fig. 2 / XXXII).



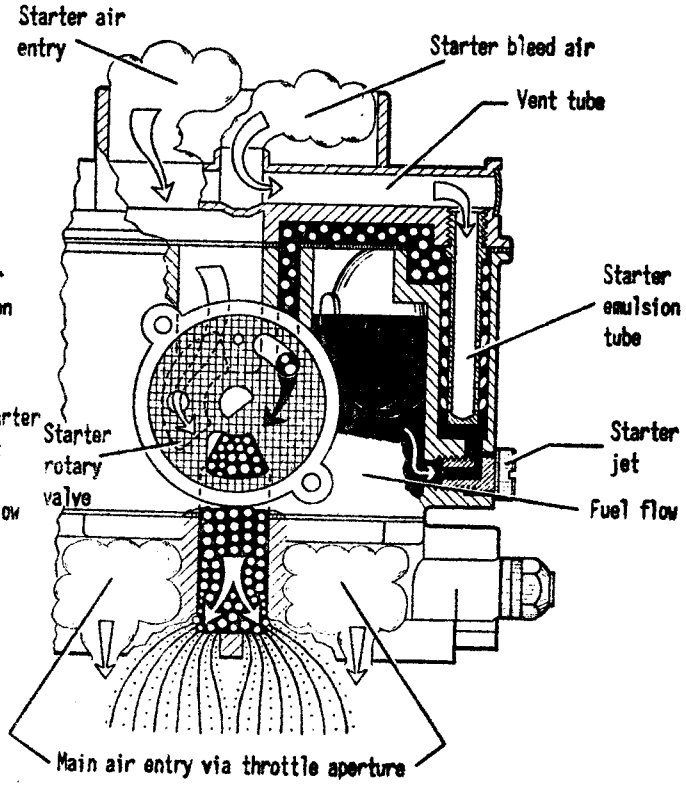
Zenith carburettor, type 32 NDIX , cover removed

Fig. 2 / XXVI



Starter device, starting from cold I stage

Fig. 2 / XXVII



Starter device, starting from cold II stage

Fig. 2 / XXVIII

Accelerator pump

The accelerator pump, a piston type pump, is attached to the pump shaft supported in the carburettor cover. The connection between throttle spindle and pump shaft is effected by an adjustable linkage consisting of the upper and the lower pump actuating lever and the pump actuating rod (Fig. 2 / XXXIII).
As scon as the butterflies are closed, the pump plunger is pulled upwards, drawing fuel via the pump suction valve into the pump cylinder (intake stroke of the pump). Upon opening of the butterflies, the pump plunger is forced downwards (pressure stroke of the pump). Fuel is pressed to the two pump jets injecting it into the mixing chambers through the two injection pipes . The pump plunger is fitted with a damping device which becomes effective, on sudden operation of the pump. In this case the pressure of the plunger is taken up by a spring, which on turn will actuate the plunger in confirmity with the fuel flow. The quantity of the fuel injected depends upon the length of the pump stroke. An alteration of the pump jets entails a different injection period as the calibration of these jets determines the quantity of fuel passing through.

Part load control

When using a carburettor for one or two cylinders generally the mixture ratio used for full load operation is too lean for part load operation, contrary to fast running, 4.6 or 8 cyl. engines.
In this case the accelerator pump has the additional task of controlling the part load operation in such a way that the mixture is enriched at part load operation, but leaned out under full load operation. This kind of part load control requires a " weak " pump as this type pump closes under full load, thus leaning the fuel / air mixture.
Under part load additonal fuel is drawn via the injection pipe of the accelerator pump, the pump jets, pump pressure valve and pump suction valve. (The main fuel supply is drawn via the main jet system).
In its lowest position, the pump plunger presses against a rubber ring on top of the pump pressure valve, thus closing the additional fuel supply. Before this closing of the pump pressure valve, additional fuel may be drawn into the mixing chambers, the quantity depending upon the depression in the mixing chambers, as the efflux holes of the injection pipes are situated at the part of greatest depression (unside the auxiliary venturi). This system of part load control commences to operate at relatively low engine speed.
The accelerator pump is adjusted such, that at a certain position of the butterfly this supply will be closed. This so called closing point of the pump (or beginning of the leaning out) must be adjusted very carefully according to the instructions as otherwise at high engine speed, additional enriching of the mixture might occur, causing excessive fuel consumption. On the other hand too early closing of the pump will cause a bad transfer.

3.) Handling and adjusting of the carburettor

Starting

For the operation of the starting device, we give the following instruction:
When starting from cold, pull out the choke knob to its fullest extent. Switch on ignition and press the starter button without depressing the accelerator pedal. When the engine has started, push back the choke control half way. In this position the vehicle may be driven already.

After reaching operating temperatures push the choke knob right home. Failure to do so increases fuel consumption and engine wear. For starting an engine not quite cold, pull out the choke control halfway only. For starting a hot engine, press down the accelerator pedal and do not use the choke at all. If the hot engine does not start, press down the accelerator pedal fully and start. Under normal circumstances altering of the starter jet sizes is not necessary.

Slow running

Slow running is adjusted in the same way as for the Weber carburettor type 32 ICS. Take care that both the volume control screws are adjusted simultaneously.

It sometimes happens that the two butterflies are not perfectly parallel, which prevents correct slow running adjustment. In this case block one end of the throttle spindle and turn the other until both the flaps are parallel to each other, i.e. both open at the same time the by - pass holes.

Accelerator pump

For correct adjustment the pump actuating rod must be engaged into the outermost hole, of the upper pump actuating lever. Then the pump will deliver the correct injection quantity which is 0.4 ccm ± 0.1ccm per stroke, provided the closing point of the pump has been adjusted correctly (see fig. 2 / XXXIV).

. Part load control

The part load control (pump closing point) is adjusted by modifying the length of the pump actuating rod (see figs. 2 / XXXIII and 2 / XXXIV).

Proceed as follows:

Remove the carburettor and drain the bowl. When opening the throttle, an instant increase of resistance will be noticeable. At this very moment the pump plunger has closed the pump pressure valve. Further opening of the throttle only will compress the pump plunger actuating spring.

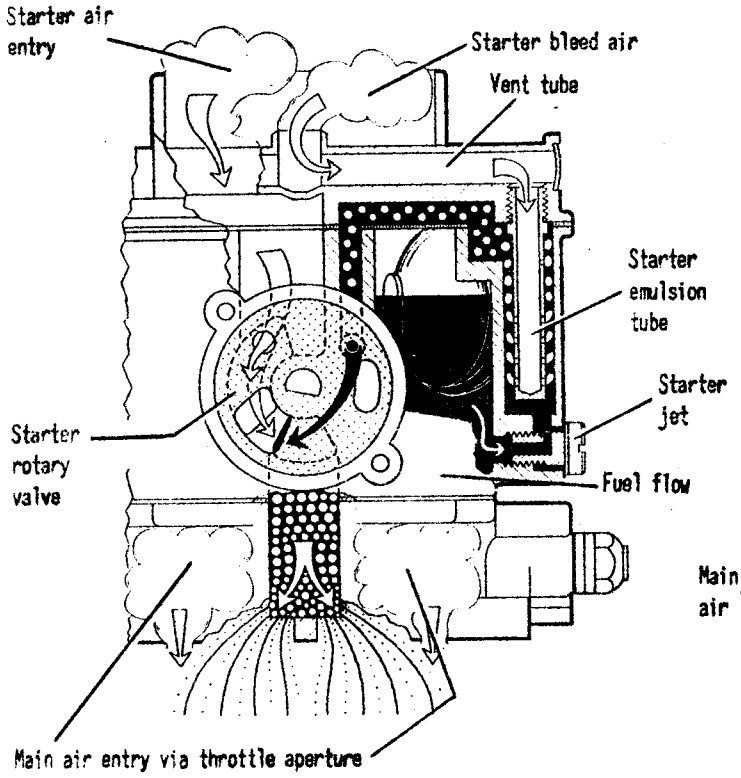
This is the socalled closing point and must be at a throttle position of 17^{0} i.e. the annular gap between carburettor bore and butterfly must be.063" ± 0.004" (1.6 mm ± 0.1 mm). By turning the turnbuckle of the pump actuating rod, the rod may be shortened or lengthened i.e. the gap becomes wider or narrower. We would like to point out once more, that correct adjusting is of great importance. In case of excessive fuel consumption with correctly adjusted closing point, the rubber seal of the pump pressure valve should be checked.

Normal running

The same applies as for the Weber carburettor type 32 ICS.

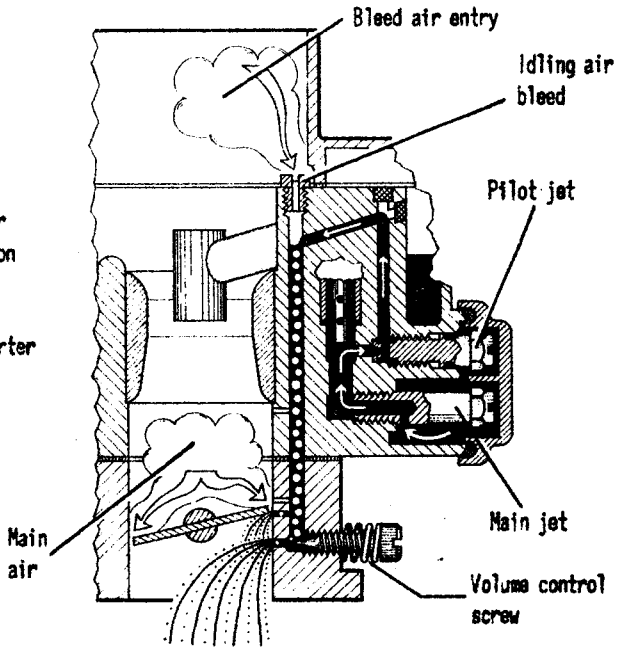
. Fuel level

For checking the fuel level, detach the fuel pipe, unscrew the five fixing bolts of the carburettor cover and remove same. Take care of the gasket (see Para I). The fuel level is gauged by means of a depth gauge from the edge of the bowl downwards and should be .6811" ± .02" (17.3 mm ± 0.5 mm). (See fig. 2 / XXXV).



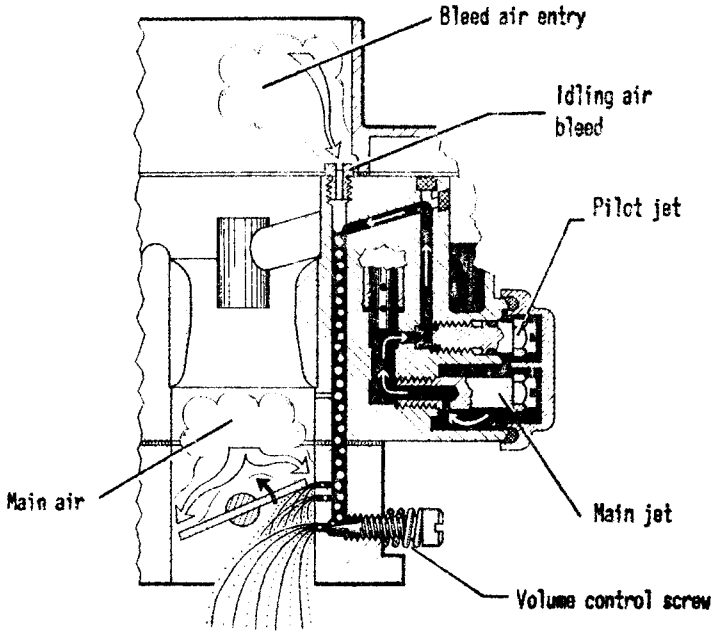
Starter device, warming up

Fig. 2 / XXIX



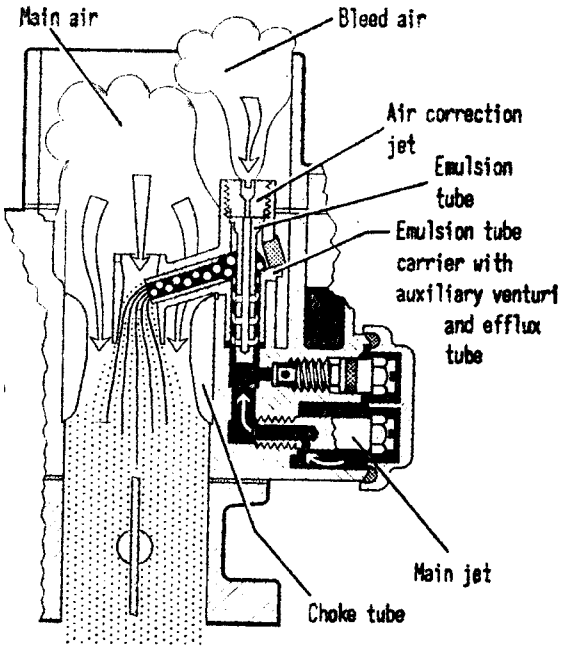
Slow running system, idling

Fig. 2 / XXX



Slow running system, progression

Fig. 2 / XXXI



Main jet system, full load

Fig. 2 / XXXII

A few final remarks:

The bolts for fixing the carburettor upon the intake manifold must be tightened crosswise.

When fitting the accelerator control linkage, avoid any play or tension on the throttle lever.

Make sure that both the throttle butterflies open and close completely. When tightening the nuts on the end of the throttle. spindle, take care the spindle does not twist, as otherwise simultaneous opening and closing of the butterflies would no longer be assured.

When fitting the control cable, avoid sharp bends. Before fixing the cable to the choke control lever, pull out the choke knob approx. 1/8" (3 mm).

Removing of the carburettor from the intake manifold is only necessary if the pump closing point must be adjusted, or the butterfly assy. and the carburettor body must be taken apart.

When reassembling, defective gaskets must be replaced. Check all connections for leakage. Clean the carburettor occasionally.

Removed jets should be flushed with petrol and cleaned with compressed air. Never clean calibrated orifices with metal tools. Never ream out jets! If adjusting of sizes becomes necessary, take genuine jets of the desired size.

Ensure that all screws, bolts and particularly the carburettor flange nuts are perfectly tight!

When unscrewing the pump jets, apply a few drops of brake fluid onto the rubber gasket to avoid damage.

The choke control should be lubricated with a few drops of oil from time to time.

The oil bath air cleaner and on models fitted with the tropical air intake also the centrifugal type air cleaner should be cleaned according to the "Owners handbook".

Adjustment for the models 700 / AP / APL / APT

Diameter	2 x 32
Carturettor cover with inside air bleed	
Choke tube	2 x 22
Main jet	2 x 110 (for tropical regions and altitudes up to 6500 ft (2000 m) (2 x 105)
Correction jet	2 x 240
Emulsion tube	2 x 6 S
Pilot jet	2 x 45
Idling air bleed	2 x 80
By - pass system no. 32	lower by - pass hole Dia 0.9 mm
Pump	Type " Lean "
Pump closing point	17^{0} (i.e. .063" ± .004" (1.6 mm ± 0.1 mm) butterfly gap)
Pump jet	40
Injection quantity	0.4 ± 0.1 ccm
Injection pipe ending in the auxiliary venturi	Outlet Dia 2 mm calibrated to 0.6 mm
Starter jet	190

Float needle valve	1.75
Fuel level with float at 5.8 ft (1.8 m) column of water	1.73 ± 1 mm (.6811" ± .02")

Pump actuating rod engaged in the outermost hole of the upper pump actuating lever

C. Fuel pump: Types Weber PM 16, 20, 24 and Solex PK 11280

The fuel pump types PM 16, 20 and 24 are similair in working and differ solely in their structure, the sealing of the flange of the PM 16 type pump being done by an O - ring, whereas this sealing is carried out by an oilseal for the pumps PM 20 and 24. In case of trouble check the diaphragm and the dise valves and springs. It will be useful to check also the pump pressure by means of a pressure gauge. The pressure should correspond to 3.28 - 4.92 ft (1 - 1.5 m) column of water.

Maintenance and inspedtion of the fuel pump PK 11280 is the same. When however, replacing the diaphragm, adjust the plunger so that the full pump stroke is attained without the diphragm being excessively strained. The pressure should correspond to 4.27 - 5.9 ft. (1.3 1.8 m) column of water.

The fuel pumps are mounted to the crankcase with an insulating washer. With insulating washers and gaskets and with the bell-crank lever at its lowest position, the pump plunger should have an initial tension of .02" (0.5mm).

XIV. General hints for the engine

A. Fitting instructions

1. When removing the engine it is very useful to support the engine by means of a hydraulic jack and pull it backwards, after having undone all connections. In case there is no jack available, put the rear skid plate (resp. tubular under guard on tropic models) upside down underneath the engine. This serves as a sort of platform onto which the engine can be lowered and pulled backwards.

2. When reassembling the engines, take care to use the right nut into the right place.

There are five kinds of M8 nuts:

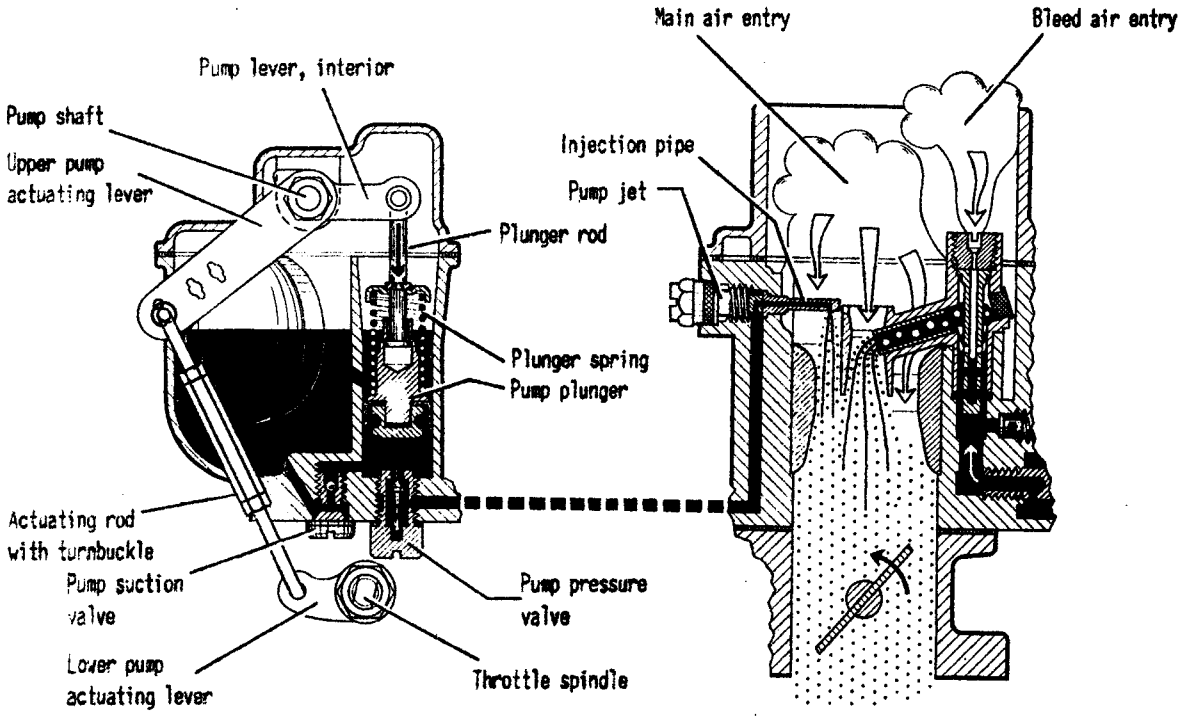
M8 x 1	for fixing the carburettor onto the intake manifold
M8 (for 12 mm wrench)	for fixing the intake manifold onto the cylinder heads
M8 (brass)	for fixing the exhaust manifold
M8 (hardened, black coloured)	for fixing the cylinder heads
M8 (normal)	for all other parts

3. After adjusting the speed-governor check the oil level. For topping up, SAE 30 motor oil should be used. The filler plug also indicates the oil level.

B. Failures and their cause.

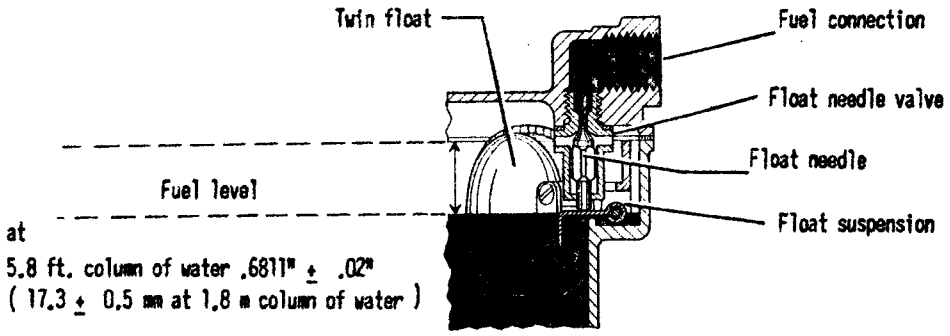
1. Starting and carburettor troubles

Engine won't start	Possible cause:
	a) Vee - belt insufficiently tended and slipping
	b) Battery discharged or loose cable connections



Accelerator pump

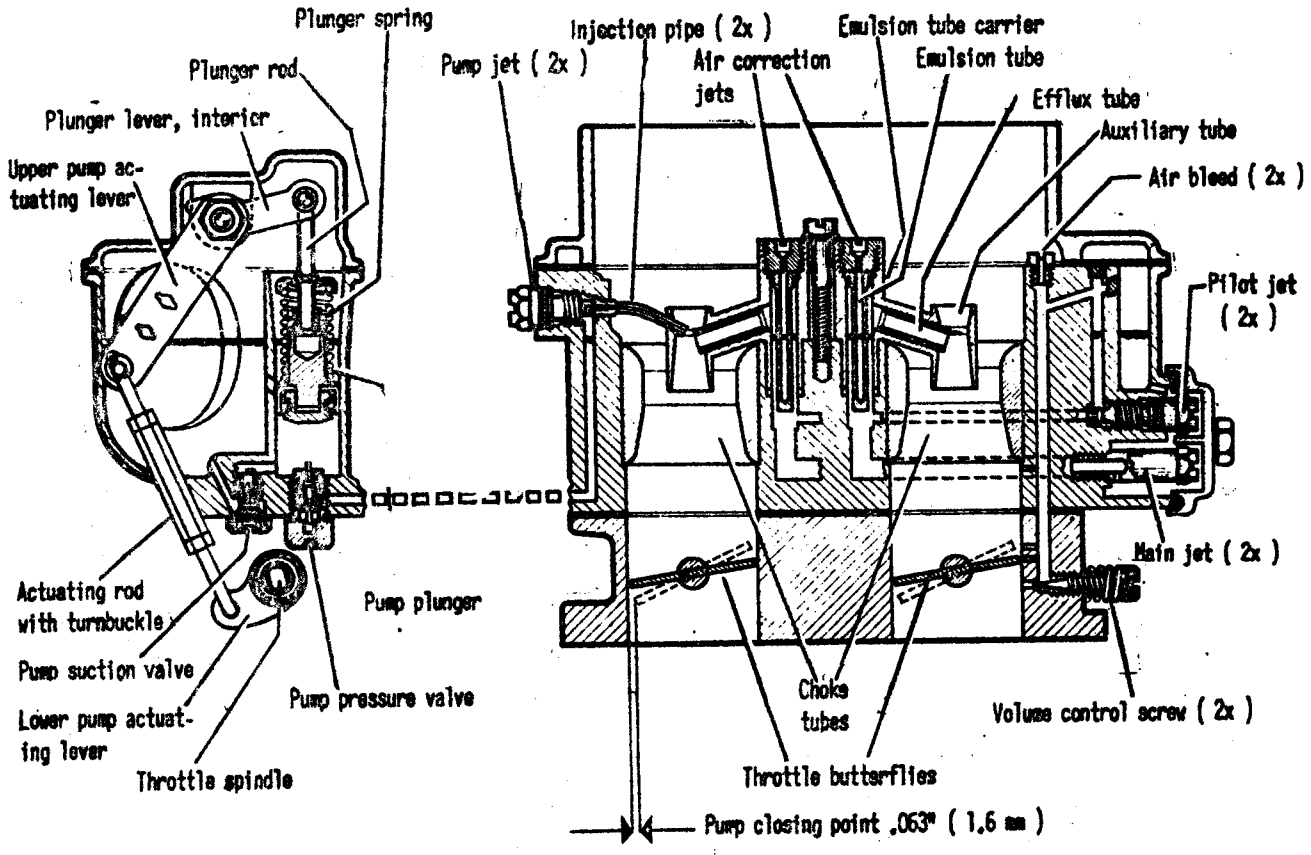
Fig. 2 / XXXIII

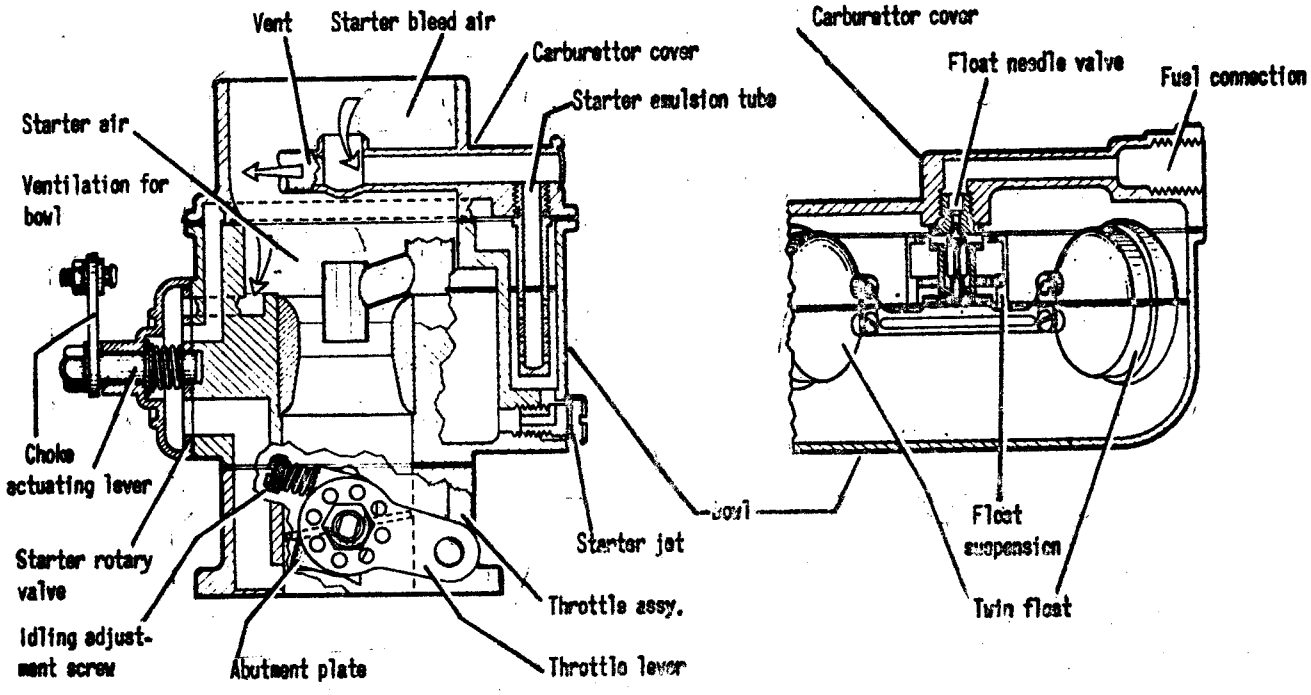


Float assy.

Fig. 2 / XXXV.

Pallas Zenith carburettor, type 32 NDIX





Starter device

Float assy.

Fig. 2 / XXXIV

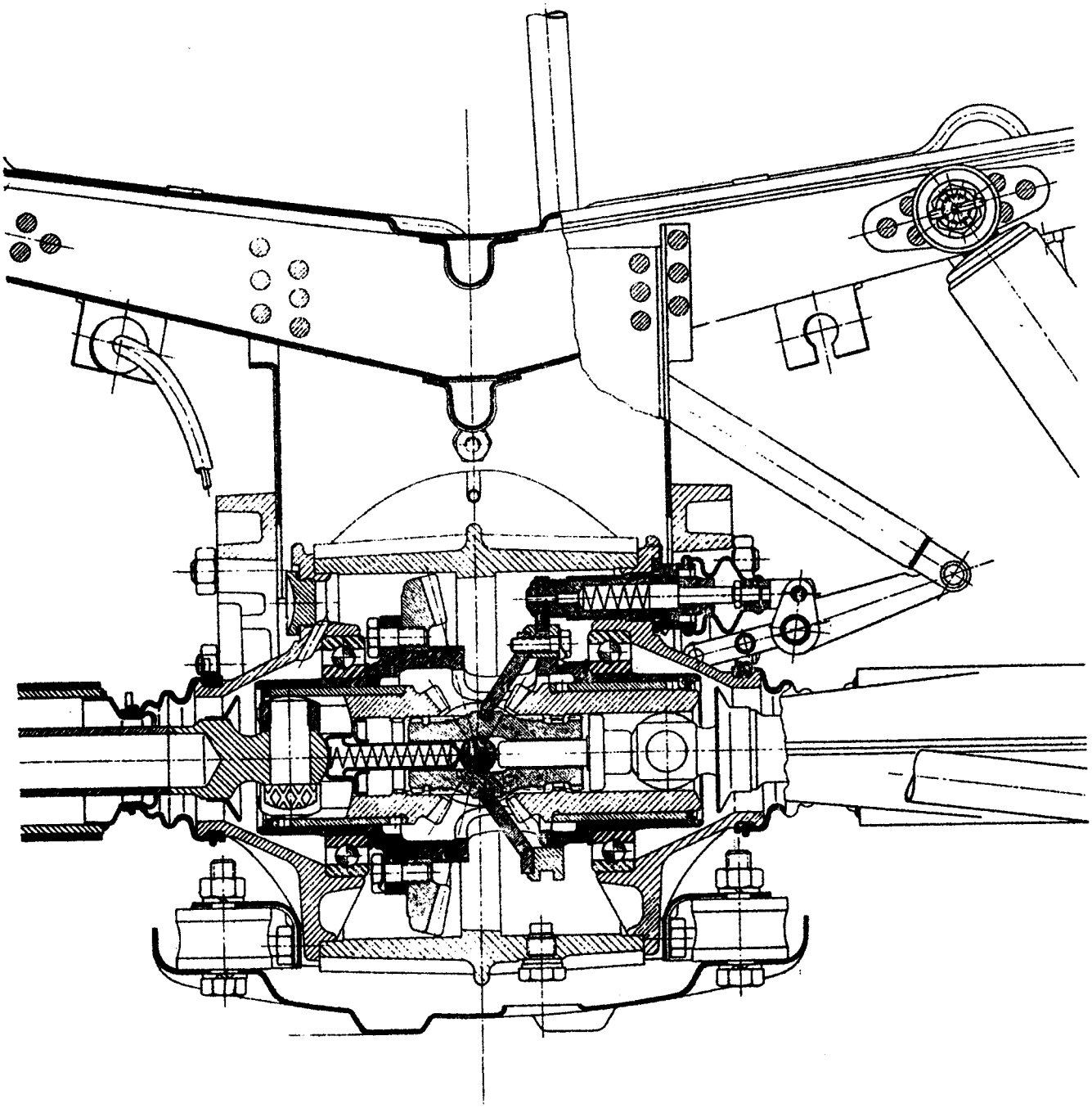


Fig. 4/V

Ausgleichgetriebe der Vorderachse
Front axle differential
Différentiel de l'essieu avant

	c) Starter solenoid faulty
	d) Ignition: faulty coil, loose cables, dirty distributor, incorrectly adjusted ignition timing
	e) Tappet clearance incorrect
	f) Carburettor: Choke butterfly doesn't close properly. Spring for poppet valve out of order
Fluctuating slow running (idling)	a) Pilot jet or idling air bleed blocked
	b) Canal for idling emulsion or by -pass holes blocked
	c) Fuel level incorrectly adjusted or float needle valve defective.
	d) Volume control screw damaged or excessive play of the throttle spindle
	e) Connection carburettor to intake manifold or intake manifold to cylinderhead, leaking
Too fast idling (beyond 800 RPM)	a) Volume control screw incorrectly adjusted
	b) Throttle stop screw (on the abutment plate) incorrectly adjusted
	c) Choke butterfly jammed
Bowl flooding	a) Float needle valve leaking
	b) Gasket for carburettor cover defective
Bad transfer	a) By - pass holes blocked
	b) Injection pipes loose or clogged up
	c) Injection quantity incorrectly adjusted
	d) Back flow jet leaking (loose) or wrong size
Excessive fuel consumption	a) Float needle valve leaking or gasket for float needle valve defedtive
	b) Fuel level too high
	c) Fuel pump delivery pressure excessive
	d) Pilot jet or main jet loose or emulsion tube clogged up
	e) Choke butterfly does not open completely
	f) Pump jet too large, backflow jet too small
	g) Speed governor incorrectly adjusted

2. Lubrication system.

No oil pressure

In case the oil pressure control light does not extinguish immediately after starting, the engine must be stopped at once. A possible cause might be a faulty pressure control switch. A shorted control switch cable will cause lighting up of the control light, as the oil pressure control switch is an earthing switch.

Check the oil level

The oil level must be inbetween " minimum" and "maximum". Take care that the oil level is not above the max. mark. As the crankwebs would be dipping into the oil causing oil foam, this in turn will cause air entering into the oil passages, the oil pressure will drop.

Having checked the oil level a pressure gauge may be connected at the oil filter drain plug. The max. oil pressure should be 64 - 78 lbs.sq.in (4.5 - 5.5 atm). For idling the oil pressure should be 21 - 43 sq.in. (1.5 - 3 atm).

In case there is no oil pressure at all, the oil passages are not leaking, the crankshaft bearings are in good condition and the oil cooler is tight as well, remove the oil pump and check the pump gears and the pump casing. In case there is not sufficient oil pressure at idling speed, but correct at full speed, this indicates that the mushroom valve is leaking. Clean the valve seat, ream it with the special face cutter and hammer in the valve seat with the special tool. At this stage take care not to hammer too much as too much a wide valve will cause early failure of the valve.

The fullflow micro airfilter is equipped with a by -pass valve which opens when the filter cartridge is clogged up, resp. at a pressure of approx. 11.5 lbs.sq.in. (0.3 atm).

Also see Para XI Lubrication.

Group 4 : Chassis

1. Seperating body from chassis

On later models with inspection doors at the engine compartment it is possible to seperate the body from the chassis, without prior removing of the engine. However, all cable connections and carburettor controls must be disconnected. On older models the engine must be removed first as outlined under group 2 / 1.

a) Detach rear axle connections from body.

1.) Disconnect the handbrake cable: Slacken the turnbuckle in the centre cable tunnel (after slackening off the locknut), uncouple the cable ends from the exterior handbrake levers on the hubgear casings. Undo the two bowden cable retaining clips at the gearbox, or at the drag links, or at the platform, depending upon the model.

2.) Disengage the gearshift rod: Engage first gear. Pull off the rubber boot from the upper selector casing and push it forwards. Undo the bolts of the connecting flange resp. on previous models the cotter. Seperate the gearshift rod from the universal joint by engaging the second gear.

b) Detach front axle connections from body.

1.) Remove the skid plate from under the front final drive casing.

2.) Disconnect the clutch cable at the turnbuckle, first taking off the side cover from the steering support. Undo the speedometer drive flex at the front final drive assy by unscrewing the union nut and removing from the cross member-retaining clip.

3.) Detach the handlever for the front differential lock at its clevis pin and turn anticlockwise by 90^{0}. Also detach the handlever for the rear differential lock at its clevis pin and pull upwards. On models with power take-off, disconnect also this handlever.

4.) Engage the front wheel drive and disconnect the handlever at its clevis pin by removing the BZ-washer.

5.) Disconnect brake hose for master cylinder at the 4-way junction, but only after having sealed the lid of the brake fluid reservoir with a piece of cellophane (plastic) in order to prevent draining of the brake fluid.

6.) Disconnect the steering linkage at the drop arm by undoing the castle nut and removing the steering drag link.

7.) Remove the rubber hose from the clutch conduit. Disconnect the clutch control cable at the clutch withdrawal lever (bellhousing).

c) Removing the body.

1.) Take off both front seats. Unscrew the four body fixing bolts at the two cross members front and rear and lift off the platform.

2.) Remove the 4 wheels.

II. Disconnecting front and rear axle assy.

a) Disconnect front axle assy.

1.) Drain the final drive casing, compress the coil springs, one at a time by means of the special tool part no. 700.1.55.040.2. Apply the tools diametrically opposite each other (fig. 4 / I). Remove the shock absorbers, axle check straps and drag links. Drop the swinging axle slightly, or lift the final drive casing (fig. 4 / II) and remove the springs. After removal of the springs, replace the shock absorbers temporarily. Compress the road springs on an arbor press and remove the special tools (fig. 4 / III) for further use.

2.) Disconnect the rear brake tubing at the 4-way connection and twist it to allow its passing under the cross member; Unscrew the shackle for the clutch cable conduit at the bracket on the cross member carrier. Detach the rear differential lock control rod at the lever assy on the front cross member. Undo the retaining hat-nuts at the backbone tube flange and pull off the front axle assy. Before undoing the hat-nuts remove the rubber mountings for the skid plate. On models with power take-off, the spindle for the actuating lever should be removed for easier accessibility of the hat-nuts. Knock off the intermediate housing by means of a mallet.

3.) Disconnect the speedometer drive box assy at the front final drive. Remove the lower four-wheel drive actuating lever from its splined shaft. Pull off the intermediate housing with the spiral bevel pinion from the fixing studs.

4.) Undo six each retaining bolts resp. nuts of the cross member carriers and remove the cross member complete with carriers after detaching the front differential-lock toggle lever at the shift rod clevis pin and disconnecting the brake hoses at the 4-way connection.

5.) Disconnect the differential-lock, push back the rubber boot and by unscrewing the special hollow screw, remove the plunger assy.

5a.) Remove the wheels in case they are still on.

b) Disconnect rear axle assy.

1.) Drain gearbox / final drive casing (2 drain plugs). Remove the coil springs, as outlined under a / 1.

2.) Remove the rear crossmember from the transmission / final drive casing as outlined under a / 4 after disconnecting the brake tubing at the Tee-connection and the swinging axles.

3.) Disconnect the differential-lock plunger assy as outlined under a / 5.

4.) Remove the backbone tube with propellor shaft; after disconnecting the rear differential-lock control rod at the gearbox swivel pin. On models with power take-off also remove the control rod. Remove the propellor shaft muff coupling.

Remove the wheels in case they are still on.

Fig. 4/I

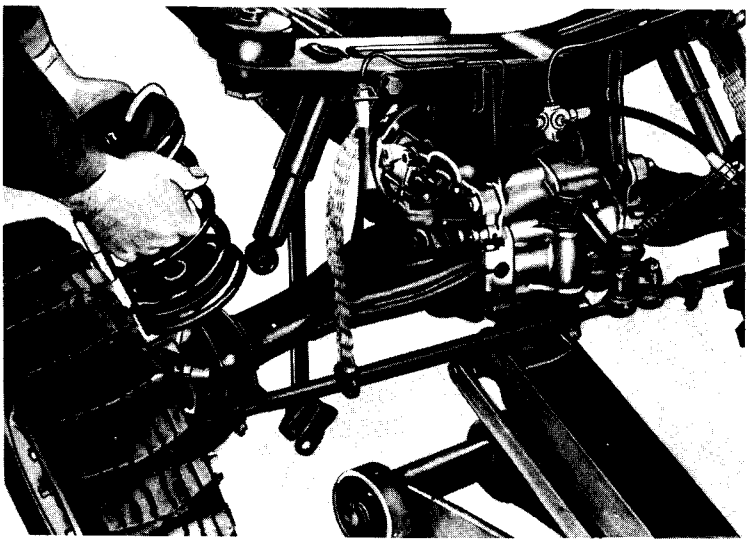
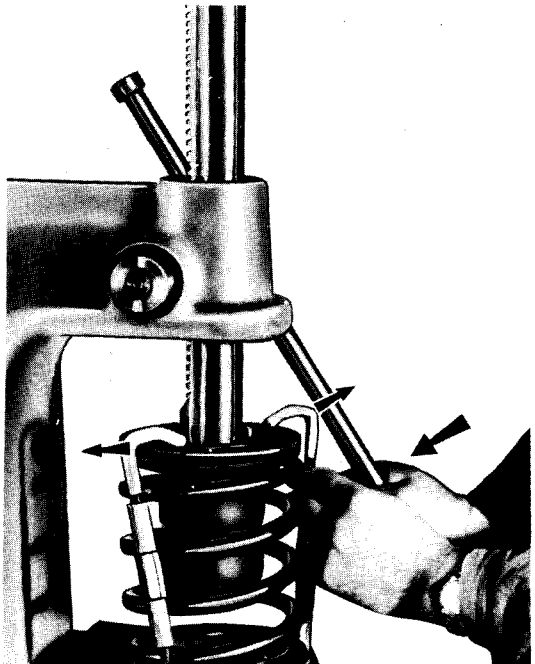


Fig. 4/II



III. Stripping and reassembling the front axle assy.

a) Pull off the swinging axles from the front final drive casing.

1.) Detach the track rods by removing the steering levers from the hubgear casings. Then undo the lower cup-bearing (complete with ball upper cup bearing and shim), by unscrewing the castle nuts. Take off the castle nut of the lower swivel pin, remove the cotter of the upper swivel pin.

Pull out both swivel pins, the upper by means of a M 7 bolt and the lower one by means of a M 10 bolt.

Then remove the hubgear assy complete with the Rzeppa-constant velocity joint. The Rzeppa-joint is splined to the half-shaft.

2.) Remove the steering linkage by taking off the relay lever from the front final drive casing (remove the cotter).

3.) Remove the r.h.s. swinging axle, after undoing the fixing nuts of the front differential side cover, by tapping it with a plastic hammer.

Remove the differential adjusting shim, and mark it.

4.) Remove the l.h.s. swinging axle with differential casing assy as outlined under para 3.

Note: It is necessary to remove the drain plug prior to pulling out of the differential casing assy as otherwise the magneto of the plug will be damaged.

5.) The swinging axles are hinged to the side covers by means of threaded bushes and fulcrum pins.

After a short period of service, a certain clearance between bushes and fulcrum pins may be noticed. However, this remains more or less constant and increases only after a very long running period. For elimination of the play, replace only the threaded fulcrum pins by the next oversize.

The following fulcrum pins are available for repair purposes:

Threaded fulcrum pin	501.1.3212.2/00	standard dia. 16.4 mm (1.6456")	no colour mark
Threaded "	501.1.3212.2/05	I oversize by 0.05 mm (.002")	red dot
Threaded "	501.1.3212 2/10	II oversize by 0.10 mm (.004")	green dot
Threaded "	501.1.3212.2/15	III oversize by 0.15 mm (.006")	2 green dots

Note: When ordering, please quote the size required by adding the oversize behind the part no. e.g. 501.1.3212.2/05. There is no need to replace the threaded bushes when replacing a fulcrum pin, except when a bush came loose in its boss of the swinging arm. For this purpose an oversize bush part no. 501.1.34.067.1 with a larger outside dia. should be used. However, before installing an oversize bush, the boss of the swinging axle must be machined to size.

b) Stripping and reassembling the hubgear assys.

Stripping the hubgear casings:

1.) Undo the inboard nuts of the hubgear casing, disconnect the brake tubing at their banjos (on rear axles also the exterior handbrake lever) and split the hubgear casing.

2.) Take out split pin resp. locking pin of the castle nut, for wheel flange resp. half-shaft and undo the castle nuts.

Note: The rear half-shafts have left hand thread at the l.h.s. and right hand thread at the r.h.s.

3.) Remove the washer, knock out the wheel flange and remove the various components in the following order:

Inner race of tapered roller bearing and thrust washer

Larger spur gear with the raised shoulder pointing towards the wheel flange

Chamfered washer, with the chamfer towards the wheel flange

Inner race of the outer tapered roller bearing

Inner race for oil, with the recess pointing towards the wheel flange

Assembling is done in the reverse sequence

Reassembling the hubgear assys.

1.) Adjusting the wheel bearings

Should adjustment of the wheel bearings be necessary, it is carried out before the final assembly of the hubgear assy. Assemble the hubgear casing without the small driving pinion on the constant velocity joint (resp. half-shaft). Then remove the rectangular bearing adjusting cover on the swivel assy (resp. the swinging axle on the rear axle), insert a thrust washer (gauge the size provisionally by Vernier gauge) and replace the cover. Turn the wheel flange. If it moves freely (no initial tenison), take thrust washer which is by .004" (0.1 mm) thicker and repeat this procedure using thicker thrust washers until the wheel flange no longer can be turned. Then remove this thrust washer and install one which is by .004" (0.1 mm) thinner (gauge with a micrometer fig. 4 / VII), and which allows the wheel flange to be turned at a torque of .5 - .65 ft. lbs. (0.07 - 0.09 mkg). If no torque wrench is available insert a bar horizontally between the wheel studs and fasten a weight of 2.2 lbs. (1 kg) some 2.75 - 3.5" (7 - 9 cm) from the axis centre; the weigth must just remain in suspense. The thrust washers are available in sizes ranging from .3858 - .4527" (9.8 - 11.5 mm) gauged by .004 (0.1 mm).

2.) The small pinion is fitted with the raised shoulder pointing towards the ball race onto the constant velocity joint (resp. half-shaft).

3.) When boxing up the hubgear assy always use new gaskets. The rollers of the small roller bearing must be well greased so that the rollers do not project and hinder the fitting of the inner race.

4.) As there are various hubgear ratios, always take care that the reduction ratio is the same on all four wheels.

c) Removing and installing the front spiral bevel pinion.

1.) Push the muff coupling inside and extract split pin from castle nut.

2.) Fasten the intermediate casing on the special tool part no. 700.1.55.043.0

3.) Support the pinion at the speedometer worm gear and press out (special tool part no. 700.1.66.043.0 and arbor press).

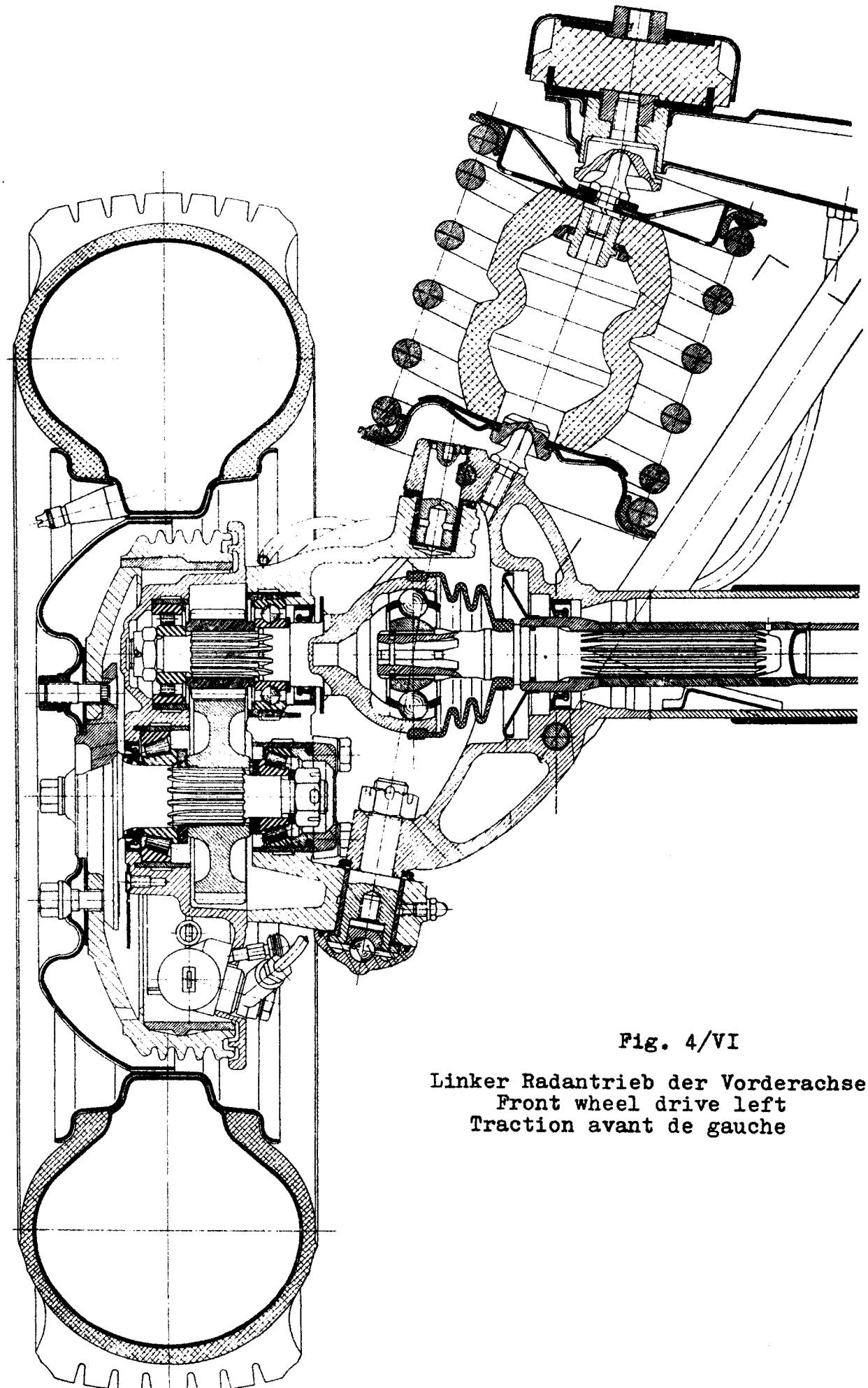


Fig. 4/VI

Linker Radantrieb der Vorderachse
Front wheel drive left
Traction avant de gauche

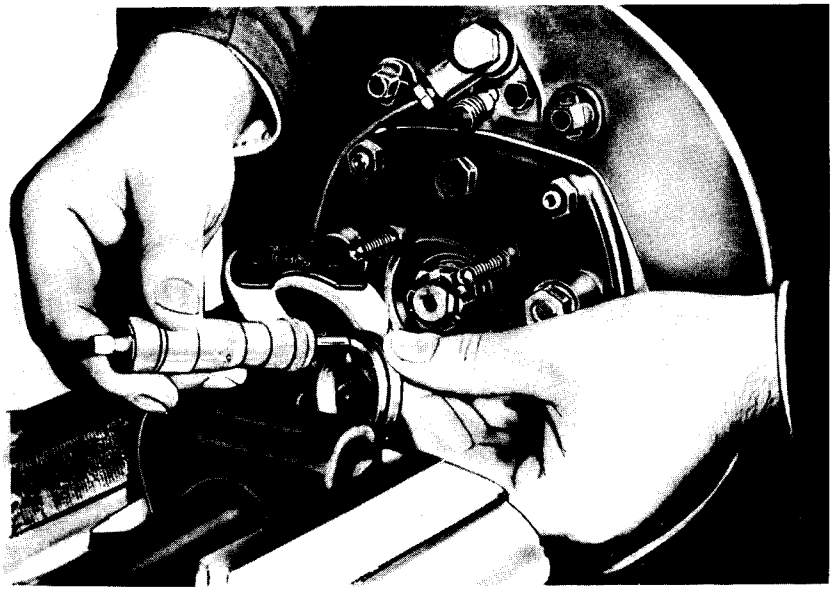


Fig. 4/VII

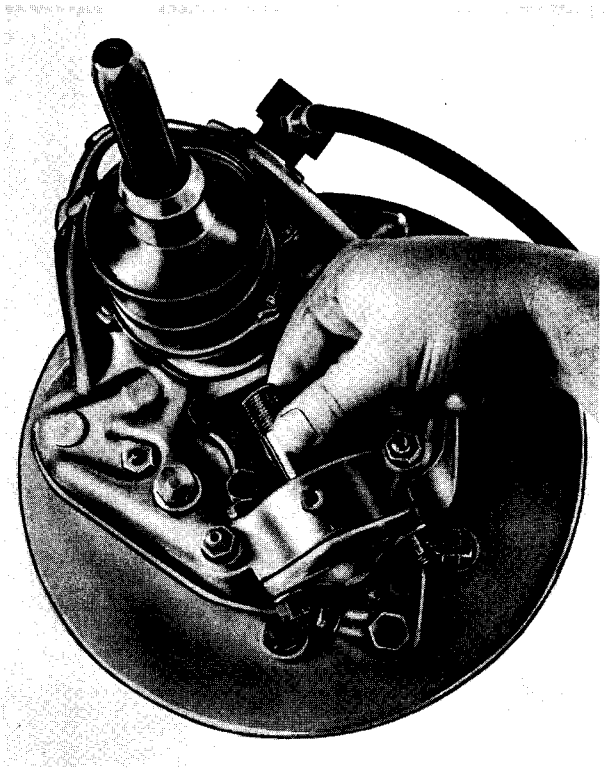


Fig.4/VIII

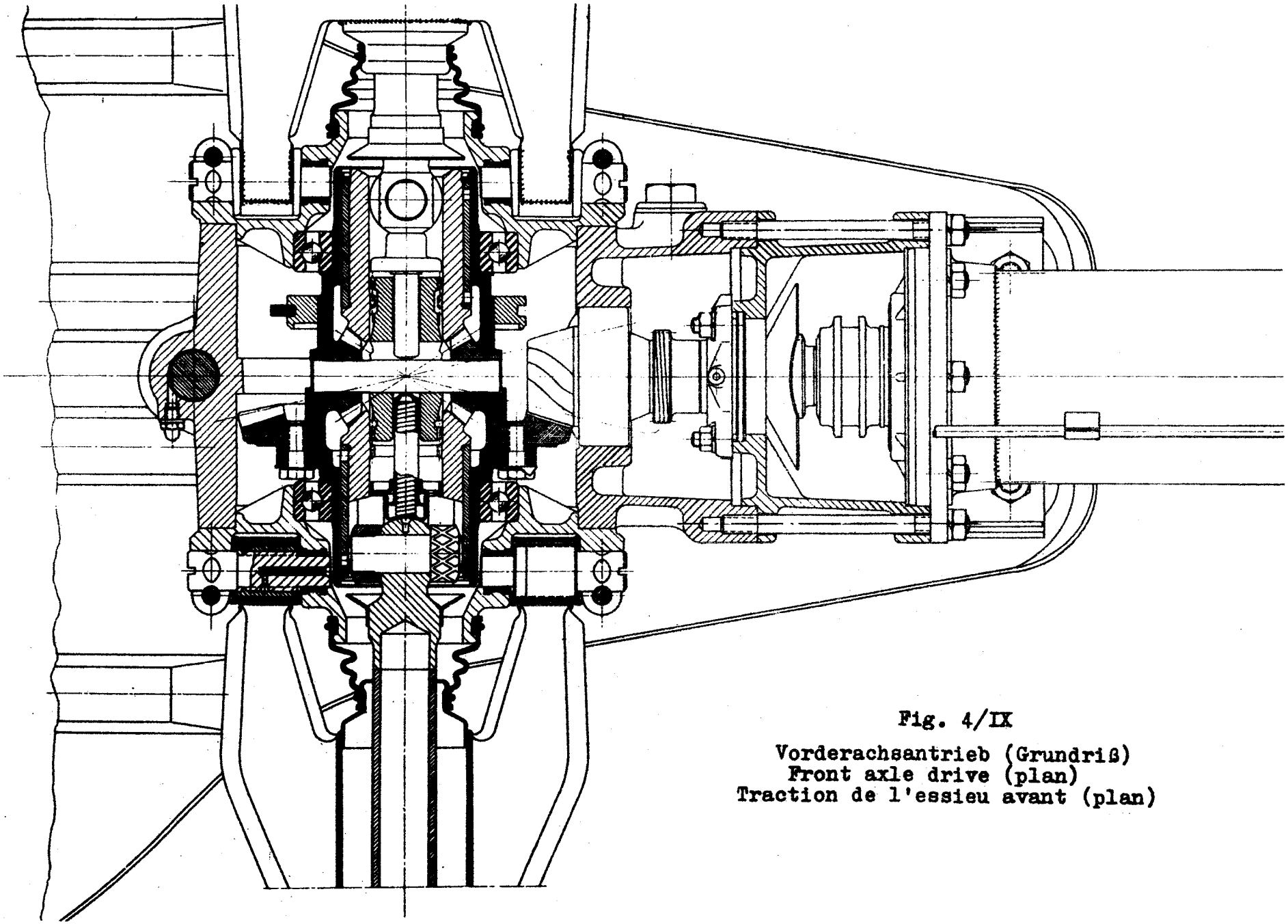


Fig. 4/IX

Vorderachsantrieb (Grundriß)
Front axle drive (plan)
Traction de l'essieu avant (plan)

Installing front spiral bevel pinion:

1.) After pressing in and locking of the inner race of the pinion bearing slide on the speedometer worm gear and adjusting washer of previously determined size (see chapter "Adjusting crown wheel and pinion") and insert the pinion assy into the doublerow ball race without pressing in.

2.) Insert the oil thrower, the washer with the recess pointing inwards, the splined hub for the muff coupling (the external teeth of which are shaped wedge-like and the narrow side of the teeth must face towards the pinion), the muff coupling (also engaging the selector fork) into the intermediate casing. Now press in the pinion assy (prop up at the splined hub). Check the pinion backlash, if necessary press out again to change the adjusting washer (see chapter "Adjusting crown wheel and pinion ").

Selector fork for engaging the front wheel drive. The selector fork must be fitted upon its shaft such that the fulcrum blocks do not press when the front wheel drive is engaged, i.e. they must rest loosely in the muff coupling (check with feeler gauge).

d) Installing and adjusting the swivel assy. (steering knuckles)

1.) Insert the lower swivel pin into the swivel assy and insert a shim upper cup bearing ball, and lower cup bearing. Press down the lower cup bearing by hand and in case the swivel pin should have endfloat, insert a thicker shim or in case inbetween lower cup bearing and swivel assy there should be some play, gauge by feeler gauge and use an accordingly thinner shim. With mounted lower cup bearing, the swivel pin should have no noticeable endfloat and should turn by hand.

Shims are available in the sizes from .11 - .15" (2.8 - 3.9 mm) graduated by .004" (0.1 mm).

2.) Introduce the splined end of the constant velocity joint into the half-shaft, make sure that the double oil seal of the swinging axle has been filled with grease. The hubgear / swivel assy is thus brought into mounting position; fit top and bottom rubber washers with metal covers.

3.) Insert the upper swivel pin with O - ring and secure by means of the cotter.

4.) Insert the lower swivel pin and tighten with castle nut (24 mm box socket wrench). Install the lower cup bearing only after having tightened the castle nut of the swivel pin.

e) Assembling the front axle assy.

Do not interchange the hubgear assys (steering levers must point forwards).

Note: The differential lock selector fork (with the coil spring into its shaft) must be installed into the final drive casing, together with the differential assy and the l.h.s. swinging axle. Ensure that both the spring loaded plungers are in the differential casing. Before fitting the r.h.s. swinging axle, install the half-shaft with the fulcrum squares, then install the swinging axle assy with side cover. Line up the differential lock selectorfork then press on the cover. Install the crossmember together with its carriers.

Fitting the steering linkage:

1.) First fit the steering levers on the hubgear casings.

2.) Then fit the relay lever with its shaft on the final drive casing (top and bottom rubber washers and special washers) and tighten the cotter. There should be no endfloat at all.

IV. Stripping and reassembling the rear axle assy.

a) Removing the swinging axles from the final drive casing:

1.) Undo the retaining nuts of the l.h.s differential side cover and knock off (mallet) the l.h.s. swinging axle assy. Take off and mark the differential adjusting shim.

2.) Undo the retaining nuts of the r.h.s differential cover and knock off the swinging axle complete with the differential casing assy.

Note: It is necessary to remove the drain plug prior to pulling out the differential casing assy as otherwise the magneto of the plug will be damaged.

3.) Refer to III / a / 5 fulcrum springs

4.) Refer to III / b

b) Removing and installing the brake shoes

Removing the brake shoes:

1.) Remove the handbrake spindle (rear brake only). On older models this spindle carries also the return spring, spring cup and plastic bushes.

2.) Remove both the retaining springs (use wire loop) at the brake shoes.

3.) Withdraw the brake shoes (whereby the pull-off spring must be overun)

Fitting the brake shoes:

1.) In case the special bolt with the retaining plates and the abutment pins have been removed, refit them now. Assemble the brake shoes with the pull - off spring (for the rear brake complete with brake intermediate lever, return spring, spring cup, and BZ circlip) (on older models the return spring is fitted onto the hand brake spindle). Insert the brake shoes into the cylinders. Remove the dust covers to ensure a correct fitting of the brake shoe-notches in the cylinder plungers. (The pressure of the pull - off spring must be overun)

2.) Attach the retaining springs first at hubgear casing, then at the brake shoes by means of a wire loop.

3.) Install the handbrake spindle and complete with exterior handbrake lever, in case the exterior return spring has been removed install with special washers and nuts prior to fitting the exterior hand brake lever.

4.) On older models install return spring, cup and circlip upon the handbrake spindle and slide on plastic bush. Insert the handbrake spindle while stretching the return spring so that it may engage at both ends (or be fixed by shackle).

5.) On both types the inner actuating lever must engage properly with the intermediate lever.

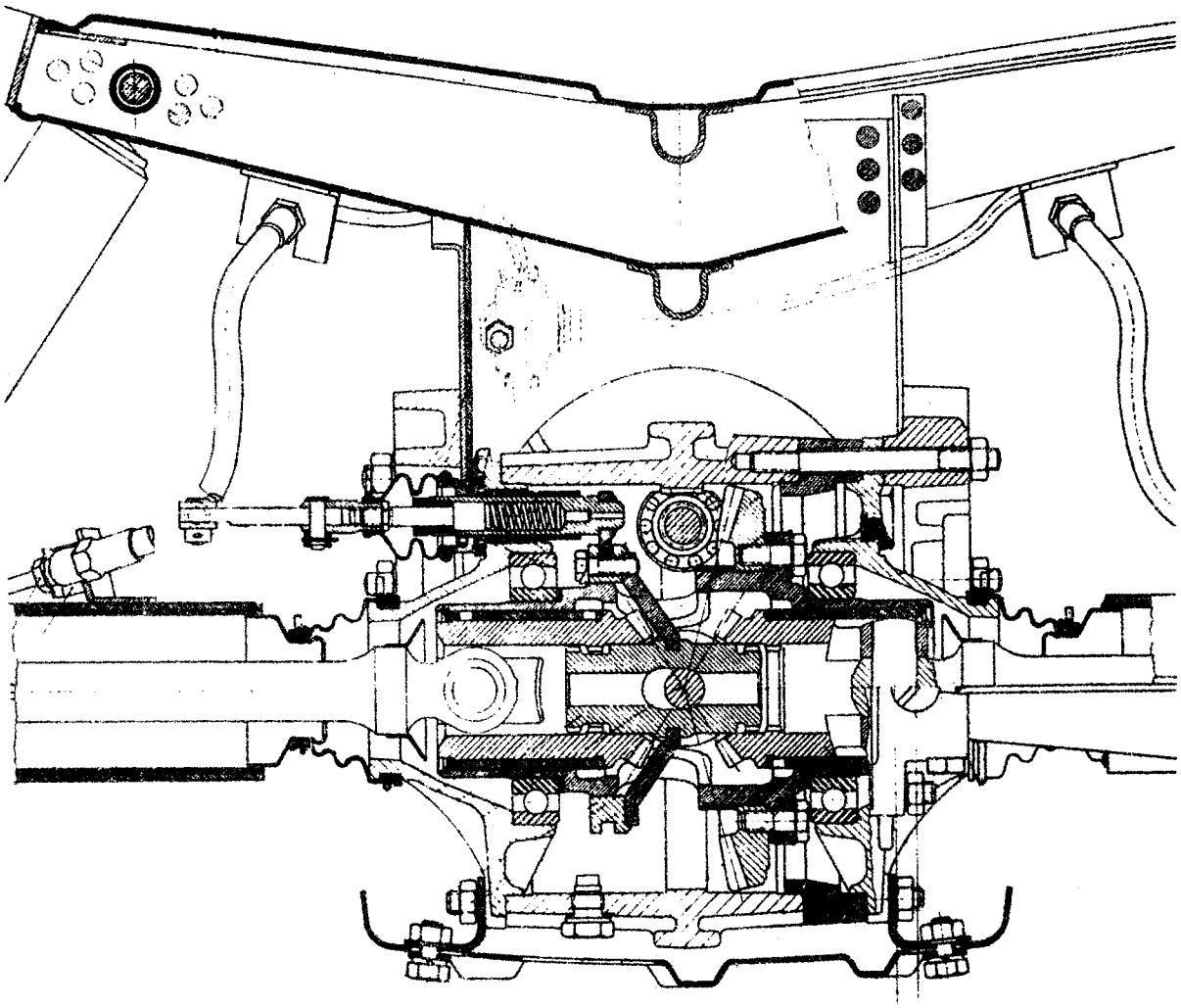


Fig. 4/X

Ausgleichgetriebe der Hinterachse
Rear axle differential
Différentiel de l'essieu arrière

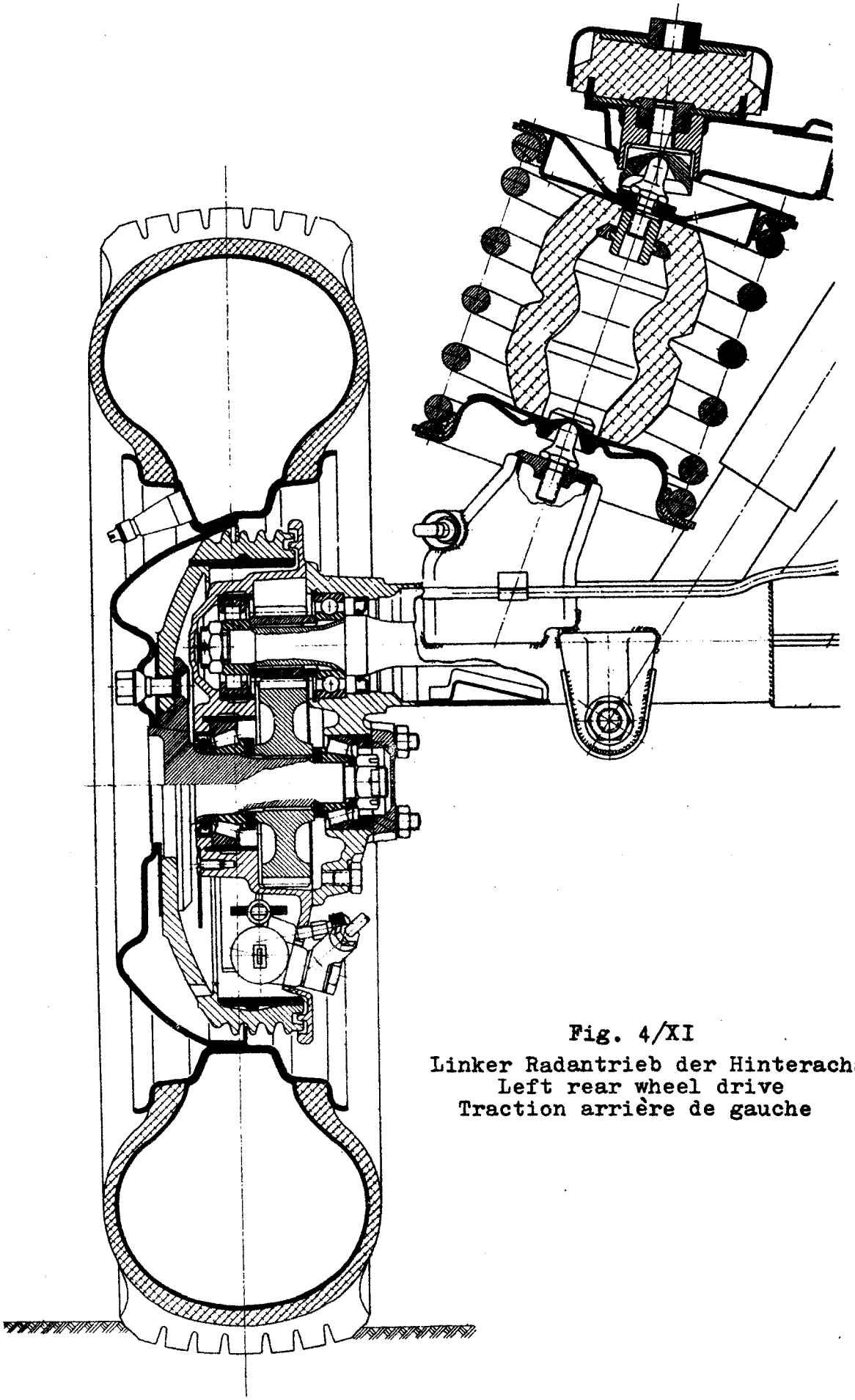


Fig. 4/XI
Linker Radantrieb der Hinterachse
Left rear wheel drive
Traction arrière de gauche

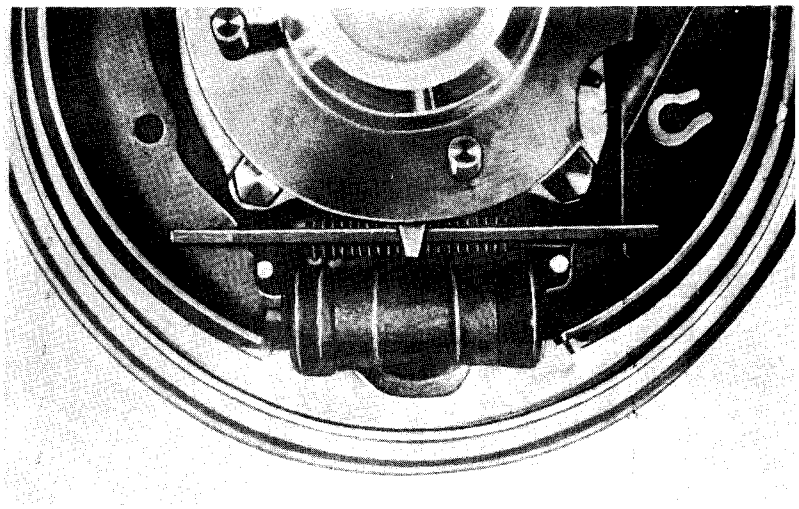


Fig. 4/XII

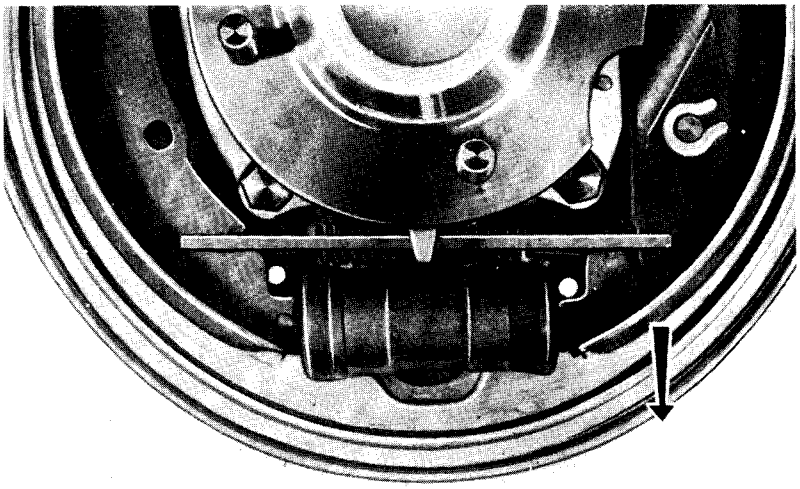
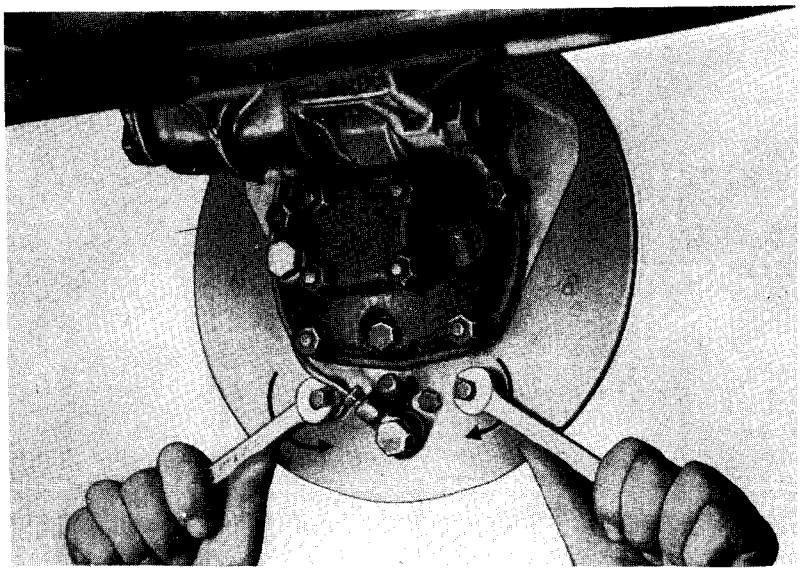


Fig. 4/XIII



c) Assembling the rear axle:

1.) Install r.h.s differential side cover complete with swinging axle assy and differential assy and differential lock selector fork in the final drive casing. Tighten the retaining nuts on models with skid plate in place of the tubular underguard, fit also the skid plate mounting brackets.

2.) The l.h.s differential side cover only can be fitted if the hubgear assy has been stripped:
Unscrew the castle nut on the half-shaft (l.h. thread) while locking the pinion at the same time with the special tool 700.1.55.037.2. Insert the half-shaft with the fulcrum squares onto the pot-type differential gear. Then slide over the swinging axle assy, then line up the differential lock selector and bolt up the differential side cover. Assemble the differential lock mechanism before fitting the crossmember with its carriers.
When replacing the oil seal in the differential lock bush, slide a new oil seal upon the special tool part no. 700.1.21.000.5 W 50. Screw the special tool into the selector spindle and install the oil seal, remove the special tool and reassemble the selector mechanism.

d) Brake adjustment:

When fitting the brake shoes, pay special attention to the position of the eccentrics. The eccentrics have to be adjusted so that they touch the brake shoes laterally (see fig. 4 / XII) and not at the notches (see fig. 4 / XIII) where the the r.h.s. eccentrics have been adjusted wrongly. When adjusting the eccentrics, the two eccentrics must be adjusted by means of their square selflocking heads and as shown on fig. 4 / XIV. The position of the eccentrics is important as the self-centering shoes when pressed down, are prevented from taking up the correct position during braking.
If brakes are inefficient, first check the adjustment of the brake shoes, then the lining of the brake shoes which should indicate full contact.
If you possess a braking deceleration-meter you may check the efficiency of the brakes. With the vehicle fully laden, a deceleration of 5 to 6 m / sec^2. must be reached at a pressure of 80 kg upon the brake pedal.

V. "Backbone" tube

a) Stripping the backbone tube:

1.) Drain oil out of the backbone. (On models with oil filler plug, drain there).

2.) Remove bearing flanges
Remove circlip and spacer on both sides of the propeller shaft. Remove bearing flange by means of an extractor and knock out the propeller shaft releasing the centre bearing of the propeller shaft and remove.

3.) Whenreassembling, take care that the propeller shaft is mounted in the short-splines facing to the gearbox.

4.) Always knock the propeller shaft towards its stop, i.e. the circlip of the propeller shaft must jam the spacer on the gearbox side, whereas on the front end the spacer should have an axial play of at least .04" (1 mm). If the play is considerably greater, use one thicker of two thinner spacers.

5.) The oil holes of the bearing flanges (front and rear) must always point upwards.

b) Flanging the axle assys.

Front axle assy with cross member:

1) Mount the intermediate casing with bevel pinion, insert the bearing flange locking ring (fig. 4 / XV / 3) into the intermediate casing .Push on the backbone assy while introducing the propeller shaft into the muff coupling (fig. 4 / XV / 1) (position : front wheel drive engaged) and bolt on.

With the backbone fixing nuts are also fastened: Underneath : mounting bracket for the front skid plate

On top : the mounting bracket for the power take-off linkage (if any)

When boxing up the backbone tube and the front axle assy, the brake tubing must be pushed under the cross member (fig. 4 / XV / 2).

2) Compress the road springs on an arbor press and fit the spring compressors part no. 700.1.55.040.2. Install the road springs and fit the drag links, the shock absorbers and the check straps, then open the spring compressors to release the spring.

The steering stops must point to the steering levers on the swivel / hubgear assy.

Connect the brake tubing at the 4-way junction.

Rear axle assy with cross member

3) First place the washer and then the flinger wheel (fig. 4 / XVI / 1) on the splined hub of the mainshaft / pinion, on models with crawler gear onto the synchronizer sleeve for the crawler gear.

Install the locking ring for the backbone bearing flange.

Box up the rear axle / transmission assy and the backbone tube.

When bolting up also fasten: Bracket for clutch conduit

Mounting bracket for skid plate.

4) Install the road springs, shock absorbers and check straps.

Connect handbrake cables and differential lock linkage.

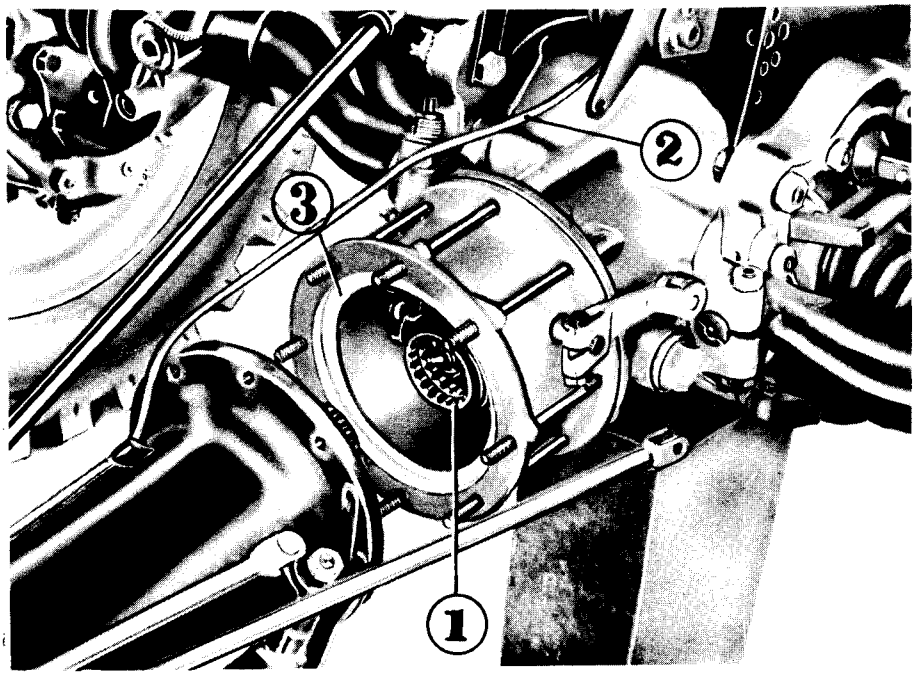


Fig. 4/XV

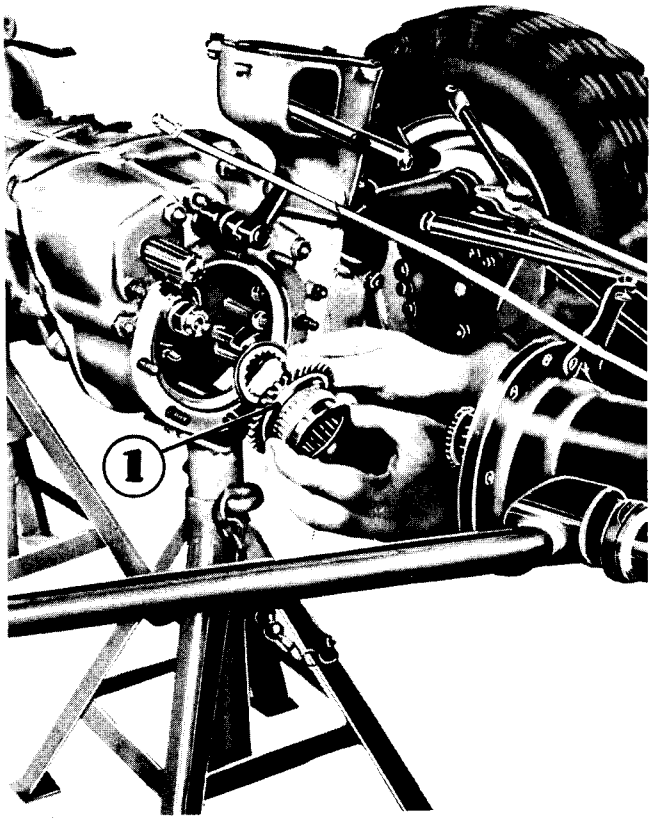


Fig. 4/XVI

VI. Steering assembly

The toe-in on Haflingers is adjusted to zero (2 persons on the front seats).

1.) Steering assembly play:

If after long operation steering backlash is noticed (dead travel of the steering wheel), the steering gear has to be adjusted. Slacken off the locknut of the adjusting screw, located on the front side of the steering box, screw in the adjusting screw by means of a screwdriver to eliminate the backlash and lock again. Check the steering from lock to lock for ease.

2.) Checking the toe-in:

Roll the vehicle straight ahead on level ground (workshop floor) with 2 persons on the front seats.

Gauge the rear-most distance of the front wheel rims (in heigth of the axle).

Push the vehicle forwards until the gauging points are in the fore-most position . (A hypothetical line drawn between the rear-most and the fore-most gauging point must pass through the centre of the axle).

Gauge the distance of this fore-most point which should be equal to the rear one, i.e. zero toe-in.

VII. General hints for the chassis

a) Fitting instructions:

1.) Remove the battery compartment for easier connecting or disconnecting of the gearshift rod. (This applies not for models with welded platform body). On models with crawler gear exact adjusting of the gearshift rod is very important, as adjusting by .004" (0.1 mm) is already of great effect.

2.) When removing the platform always lift it upwards and then sidewards, never to the front or rear. The removed platform always should be put on racks and not direct on the ground as the front clutch conduit would be damaged.

3.) Do not remove the drag links at the backbone tube but always at the swinging axles. In case they must be removed note the shims in order to reinstall correctly.

4.) For easier removing of the front axle assy from the backbone tube, two threads have been provided in the mounting flange. With two bolts, the front axle assy easily can be pressed off.

5.) It is advisable to detach the clutch conduit before removing of the axle assy.

6.) Before mounting of the platform we suggest to excecute the following operations:

Engage the front wheel drive for easier accessibility of the clevis pin.

Pull out (but do not remove) both the front wheel drive actuating hand lever and the rear differential lock hand lever.

The front differential lock hand lever should be turnded by 90^{0} anticlockwise.

Pull back the clutch cable so far that the threaded end can not be damaged.

Put the steering drag link on top of the clutch conduit.

7.) In case the screw holes of the platform mounting rubber cushions do not correspond with the holes in the platform, line up by means of a tommy bar (it will snap in).

8.) Connecting of the handbrake cable after mounting of the platform:

First engage at the exterior handbrake levers then press forwards and screw on the turnbuckle in the centre tunnel (2 men required).

b) Brake troubles

Failure	Cause	Remedy
There is nor resistance felt when the brake pedal is depressed, it feels soft and spongy.	a) Air entering into the brake system	a) Bleed the system
	b) Too little brake fluid in the reservoir	b) Top up with brake fluid and bleed the system
Even with bled system the brake pedal may be depressed without effect.	a) Residual pressure check valve (master cylinder) faulty	a) Replace residual pressure check valve
	b) Valve seat for residual pressure check vale leaking	b) Clean valve seat of residual pressure check valve, if necessary replace master cylinder
	c) Leaking tubing	c) Make tubing leak-proof resp.replace it
	d) Damaged cups in master cylinder resp.wheel cylinders	d) Replace damaged cups
Brakes are heating up during driving resp. do not pull off	a) By-pass of the master cylindera) blocked	Clean by-pass
	b) Insufficient play between piston and rod of the master cylinder	b) Adjust dead travel of the brake pedal
	c) Pull-off spring for brake shoes broken or too weak	c) Replace pull-off spring
	d) Handbrake jammed	d) Repair handbrake system
	e) Wheel cylinder rusty,pistonse seized	Clean wheel cylinder and lubricate with brake cylinder grease, In case the cylinder is heavily scored, replace
	f) Rubber parts swollen due to incorrect brake fluid	f) Drain the whole system, dismantle and clean. All rubber components, including the brake hoses must be replaced, Fill the system with genuine Ate-Lockheed brake fluid
Bad braking effect even at high pedal pressure. Brakes are dragging.	a) Brake linings greasy or oily	a) Replace oil seal for wheel flange and replace brake shoes
	a) Bad contact of the brake linings	a) Touch up brake linings
	b) Dia.of brake shoes too large on one of the wheels	b) Touch up brake linings

	c) Brake drums differ in dia.	c) Bring brake drums to same dia., if necessary replace
	d) Brake drums oval or scored	d) Turn the brake drum if necessary replace or exchange the drums with each other
	e) Brake linings greasy or oily	e) Replace oil seal for wheel flange, replace brake shoes
	f) Brake shoes jammed in abutment joint	f) Match up brake shoes to abutment
	g) Piston of wheel cylinder partly seized	g) Check piston if necessary replace
	h) Water entered the brake drum	h) Repeated braking to dry the linings
Squealing brakes	a) Bad contact or burned linings	a) Touching up resp., replacing of brake shoes
	b) Abrasion in the drums	b) Clean with compressed air
Rattling brakes	a) Oval brake drums or burned brake linings	a) Check ovalidity of drums with dial clock. The ovalidity may not exceed .002" (0.05 mm) if necessary turn brake drums or replace
	b) Expanded pull-off springs	b) Replace pull-off springs
	c) Bad contact of brake linings	c) Touch up brake linings
	d) Faulty wheel suspension	d) Check and rectify wheel suspension
	e) Rims out of true	e) True up rims if necessary replace
Brake fluid reservoir drains	a) Brake system leaking	a) Check the system for leaks by screwing brake pedal under pressure
	b) Master cylinder leaking	b) Check master cylinder and replace cups
	c) Wheel cylinders leaking	c) Check wheel cylinders. If necessary replace cups.

Note:

Take special care that the eccentrics are correctly adjusted also see para "Adjusting the brakes" and fig. 4 /XII, XIII, XIV. For longer mileage we recommend to remove the brake drums and wash with water after driving through mud. Faulty dust covers on the wheel cylinders cause excessive wear of cups. When installing brake shoes make sure they fit well in their abutment.

Group 6 : Gearbox and differential assy.

I. Stripping the gear selector mechanism:

1.) Remove lid for upper selector casing. Unscrew lower lever cover for selector casing and undo the opposite plug of the intermediate flange.

2.) Remove cotter for lower selector finger (the finger must be in neutral position). Knock out the cotter using a brass drift.

3.) Remove selector rails for upper selector finger complete with spacers. Pull out the selector shaft assy with selector lever, upper finger and universal joint. Remove lower selector finger and interlocking finger.

4.) Unscrew the retaining nuts for the selector casing (on models with crawler gear, the crawler gear casing) and pull off.

4a.) On models with crawler gear:

Pull off the crawler gear synchromesh complete with selector fork and muff coupling for propeller shaft.

Lock the double gear wheel by means of a tommy bar supporting it on the intermediate flange, bend open the tabwasher on the layshaft, undo the retaining nut and remove the pinion.

Undo retaining nut and tabwasher of the intermediate shaft and pull off the overload clutch by means of the camshaft gear puller part no. 501.1.5520.2.

Undo the screws for the retaining plate. The two upper screws are accessible through the double gear wheel, and pull off the upper intermediate shaft with double gear wheel and ball. Pull out the intermediate shaft for the overload clutch complete with ball race.

5.) Undo the retaining nuts of the intermediate flange, knock out the locating dowel, remove the oil drain plug and pull out the intermediate flange with gear cluster.

II. Dismantling gear cluster.

Pressing out mainshaft complete with pinion and layshaft from the intermediate flange and dismantling the gear cluster.

1.) Disconnect clutch shaft at the splined connecting sleeve (att.: clutch and layshaft are secured in the connecting sleeve by means of spring-loaded balls.

2.) Engage the first gear by shifting the synchronizer clutch gear, hold the first gear wheel in a vice using light alloy vice jaws, undo the castle nut after removing the split pin and remove washer and splined hub for propeller shaft. On 4-speed models also undo the retaining nut for the layshaft and remove the spacer or power take-off gear.

3.) Remove the retaining flange for the doublerow ball race (on models with 4-speed transmission also the retaining plate for the layshaft bearing) and slacken off the gear selector forks. Undo the grub screws with interlocking balls and springs. Now the shift rods may be extracted and the interlocking balls removed. Remove the locating plate for the reverse shaft and remove reverse shaft, reverse idler gear and spacer

4.) Insert the two special halfwashers of the tool part no. 700.1.55.043.0 inbetween the 3rd / 4 th synchronizer clutch sleeve in such a way that the 3rd / 4th clutch sleeve will engage into the slot of the tool. Support the intermediate flange across the open end of the special tool by means of the distance piece provided and press out (arbor press) mainshaft and layshaft simultaneously using the special cross piece for the shafts.

Note: Four balls and springs will jump out of the synchronizer hub (which contains four springs and six balls) during this operation.

The above method only permits a pressing out of the gear cluster without damaging the doublerow ball bearing of the intermediate flange.

Dismantling the mainshaft / pinion cluster:

Each of the four gear wheels is supported by needle bearings. On either side of the gear wheels are thrust washers, of which the chamfered side i.e. the side with lubrication grooves, is facing towards the gears. (Inbetween the second and third gear wheel is only one thrust washer with the chamfer facing towards the second gear wheel).

1.) Remove the thrust washer (acts also as shim for adjusting the bevel pinion position) remove the helical top gear wheel complete with needle cage and second thrust washer.

2.) Remove the 3rd / 4th gear synchronizer assy complete with blocking rings. Mark the sides in order not to interchange the synchronizer components.

3.) Remove the flat cotter and the thrust washer of the third helical gear wheel after turning the thrust washer in order to align same with the splines. Remove third gear wheel complete with needle cage and inner race and the second thrust washer of the third gear wheel. In case the locating peg has not a tight fit remove same, otherwise leave it in its place.

4.) Remove second helical gear wheel complete with needle cage and thrust washer of the second helical gear wheel.

5.) Remove the 1st / 2nd gear synchronizer assy complete with blocking rings

6.) If the first gear wheel is to be removed, the retaining circlip must be taken off with a pair of special pliers. Remove then the first gear wheel complete with the split needle cage.

7.) In case the inner race for the pinion needle bearing must be replaced, the retaining ring must be removed first from the pinion.

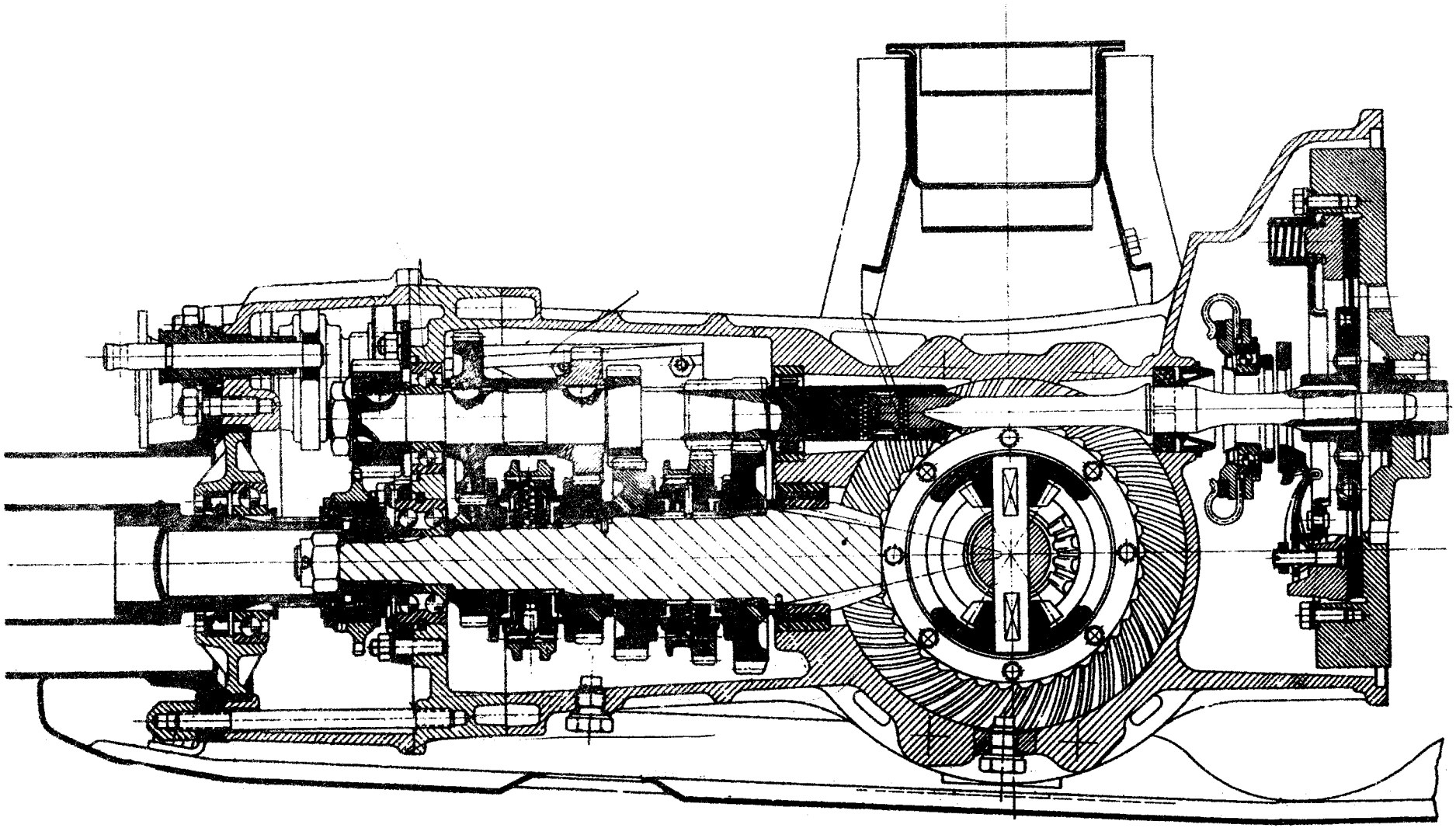


Fig. 6/I : Getriebe - Gear - Engrenage de transmission

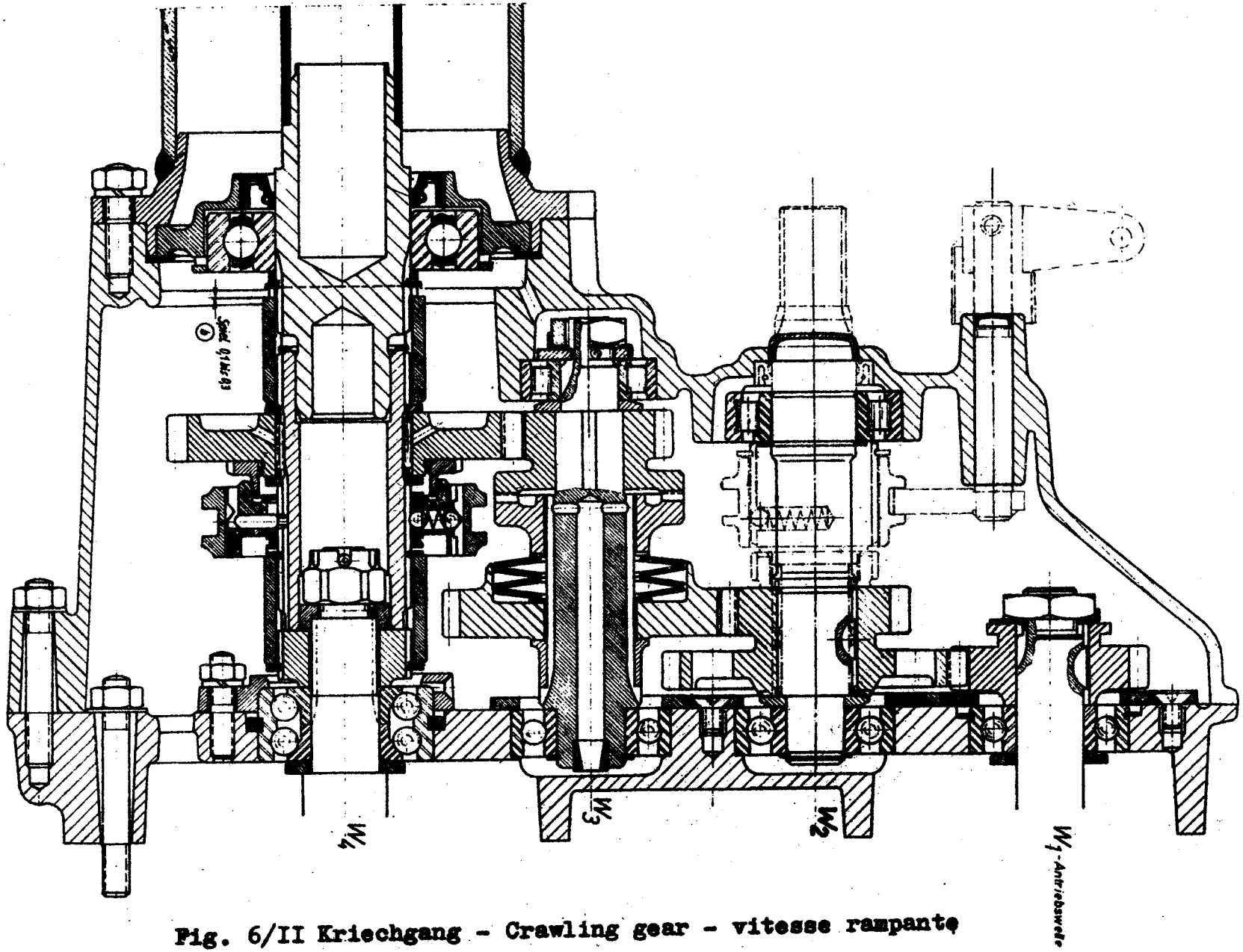


Fig. 6/II Kriechgang - Crawling gear - vitesse rampante

III. Checks:

Intermediate flange

1.) Check all bearing seats for wear.

2.) Check the doublerow ball race of the mainshaft for wear.

If worn out replace the doublerow ball race. When installing the retaining flange of the doublerow ball race make sure that there is a minimum tension of .0012" (0.03 mm).

3.) Check the ball race of the layshaft for wear.

4.) Check the shiftrod guides for wear and the shiftrods as well (interlocking ball area).

5.) The locking balls: a) Check interlocking balls for wear

b) Ball springs: The open length of which must be .59" (15 mm).

When under a pressure of 14 - 19 lbs. (6.4 - 8.6 kg) the length must be .512" (13 mm).

The pressure necessary to overcome the load of the interlocking balls must not be more than max. 33 lbs (15 kg).

To be checked in case of gear selecting difficulties.

Gearbox final drive casing:

1.) Check all bearing seats for wear.

2.) In case of any breakage it is necessary to check all bearing seats with mounted intermediate flange for alignment.

3.) Check the casting for damage and cracks (also see "Adjustment of crown wheel and pinion").

On the clutch and layshaft the following checks must be done:

1.) Checking clutch shaft for wear:

a) Check the bearing journal for the needle bearing in the flywheel retaining bolt for wear. Max. play .004" (0.1 mm).

b) Check the splines for the clutch disc for wear, max. play .004" (0.1 mm). Amend roughness of the splines if necessary.

c) Check the contact surface for the oil seal and the oil seal itself for wear.

2.) Checking layshaft for wear:

a) Check the bearing surfaces for the ballraces and the 3rd and 4th gear wheel for the correct snug fit.

b) Check all gear wheels for wear or damage. In case of wear the layshaft and each worn out gear wheel may be replaced seperately.

Note: When replacing a gear wheel for 3rd or 4th speed also the mainshaft gear wheels must be replaced, as these gears are available only in matched sets.

Checking the mainshaft:

1.) Check the mainshaft and especially the pinion for wear and damage. If it is necessary to replace the pinion it only can be done in conjunction with the crown wheel (also see para. "Adjusting crown wheel and pinion").

2.) Check needle bearings for wear, if necessary replace.

3.) Check all gear wheels for wear and damage. Third and fourth speed gear wheels are available in matched sets only.

4.) Check all synchromesh components for wear.

The blocking rings must be pressed onto the synchronizer by hand. Gauge the gap inbetween the face of the blocking rings and the face of the clutch-teeth of the gear wheel (feeler gauge).

For the first and second gear the gap must be at least .02" (0.5 mm) and for the third and top gear at least .03" (0.75 mm). Should the gap be less than before mentioned, the blocking ring and possibly the gear wheel must be replaced.

5.) Check the play of the gear selector forks in the 3rd / 4 th synchronizer clutch sleeve and in the 1st / 2nd synchronizer clutch gear and the reverse gear max. play .03" (0.75 mm).

Checking the reverse shaft:

1.) Check reverse shaft for wear.

2.) Check double gear wheel for wear and damage.

3.) Check the bronze bush of the double gear wheel and radial play, max play .004" (0.1 mm). If there are seizing scores or excessive play the bush must be replaced. After pressing in the bush, the bush is secured by caulking. Drill oil passages and ream the bush to a size of .787402" + .0000787" (20 mm H7).

IV. Reassembling gear cluster.

Assembling the mainshaft bevel pinion cluster (also see III. "Checks").

Preliminary work:

a) Assembling synchromesh components for the 1st and 2nd gear.

1.) The blocking rings are secured in the synchronizer hubs by circlips. The blocking rings must move freely within their fixed limits.

2.) Insert the two coil springs, length .394" (10 mm,) into the pocket holes of the synchronizer hub, then two balls as well.

3.) Slide the synchronizer clutch gear onto the synchronizer hub. There is only one position where both those components are corresponding. This is when the flatened teeth of the synchronizer clutch gear (fig. 6 / III / 2) are exactly opposite the notches of the synchronizer hub (fig. 6 / IV / 1). At the same time the ball holes (fig. 6 / IV / 2) must point to the only chamfered teeth (fig. 6 / III / 1) located halfway inbetween the flatened teeth. For easier assembling the synchronizer hub and the synchronizer clutch gear are marked.

4.) Insert from inside of the splined bore of the synchronizer hub one ball in each of lateral holes, then a coil spring, length .24" (6 mm) and another ball.

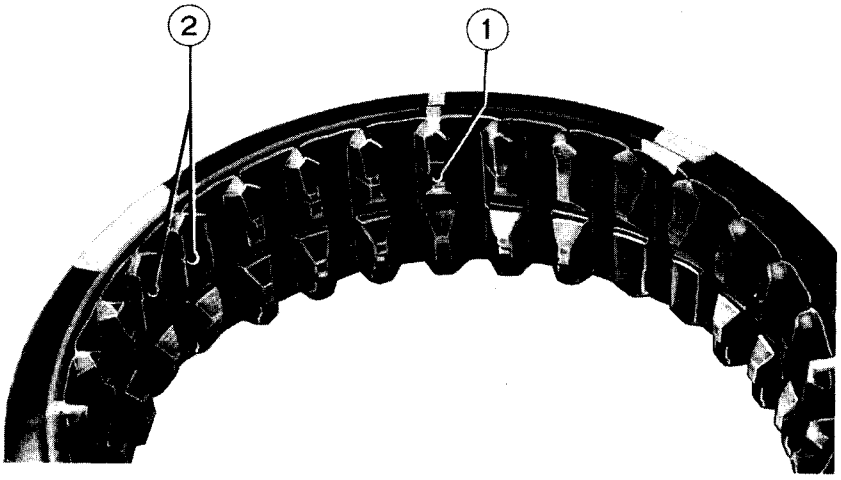


Fig. 6/III

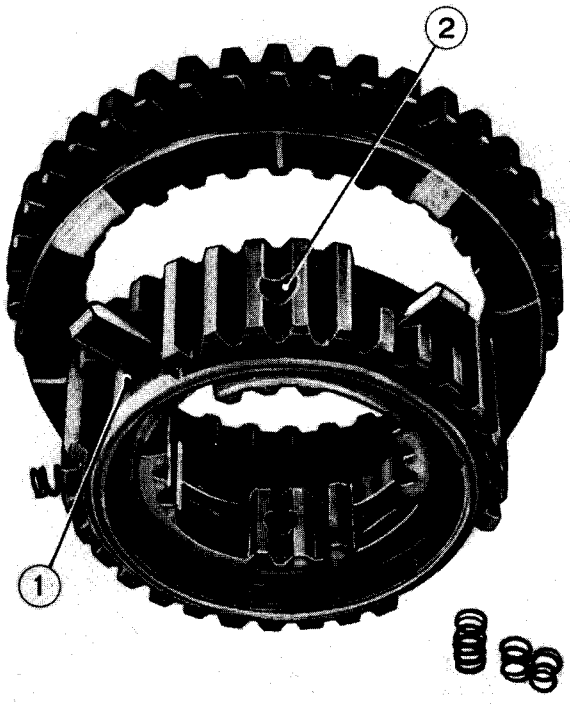


Fig. 6/IV

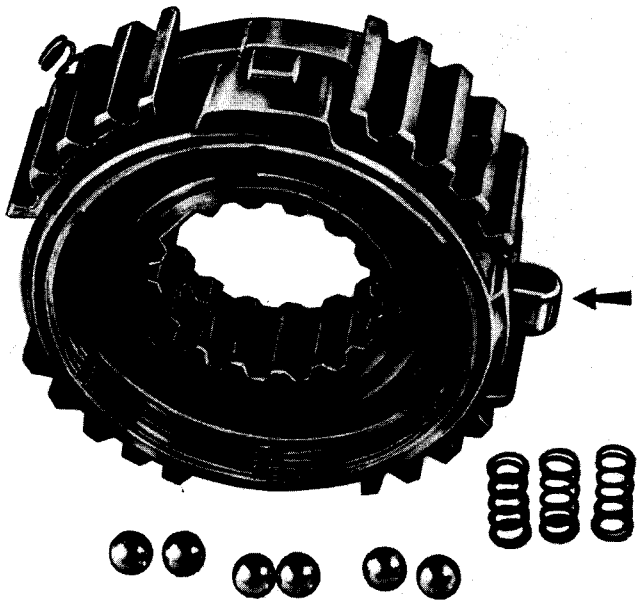


Fig. 6/V

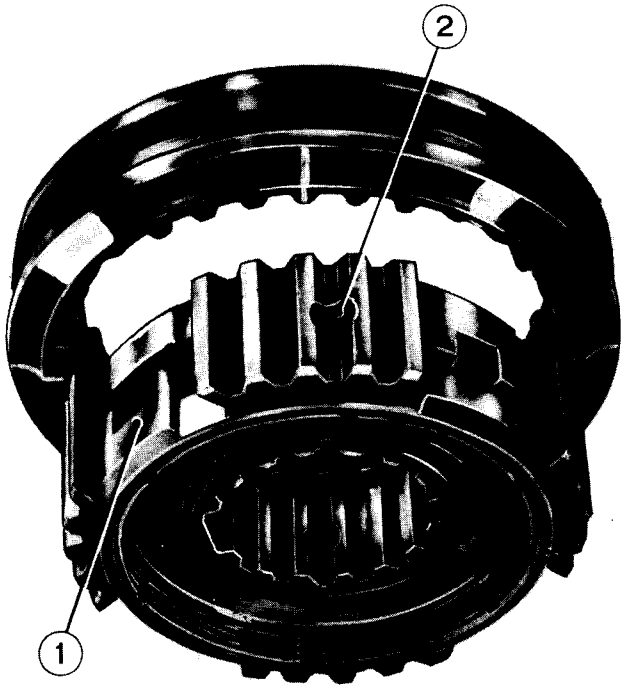


Fig. 6/VI

For easier assembling it is advisable to close the holes with HMP grease.

5.) Insert now from the inside of the splined bore the 4 flat locking keys. The rounded end of the locking keys must face towards the mainshaft / pinion.

b) Assembling synchromesh components for the third and top gear:

1.) The blocking rings are secured in the synchronizer hub by circlips. The blocking rings must move freely within their fixed limits.

2.) Insert two of the coil springs, length .43" (11 mm) and two balls into the pocket holes of the synchronizer hub (again use some HMP grease).

3.) Insert now the 4 square locking keys into the slots of the blocking rings. The locking keys must be inserted such that the rounded end, pointing towards the mainshaft, lines up with the grooves in the mainshaft. Also see fig. 6 / V.

4.) The correct position of the synchronizer hub and the synchronizer clutch sleeve is only then, when the shoulders of the blocking rings (fig. 6 / VI / 1), which carry the locking keys are exactly opposite the flatened teeth (fig. 6 / III / 2) of the synchronizer clutch sleeve and on the same side.
Furthermore the ball holes (fig. 6 / VI / 2) must come opposite the only chamfered teeth (fig 6 / III / 1).

5.) Now insert into each of the remaining lateral holes a ball, a coil-spring (length .43" (11 mm) and another ball each (again use some HMP grease). For easier assembling the synchronizer hub and the synchronizer clutch sleeve are marked.

c) Assembling of the mainshaft gear cluster:

1.) If not yet mounted, press the inner race of the pinion needle bearing. Press in the peg with its round end ahead and install circlip and locking ring. Then mount the split needle cage for the first gear wheel and slide on the first gear wheel and secure same with the circlip.
(Note : The chamfered side of the split needle cage must face the pinion).

2.) Slide on the synchronizer assy for 1st and 2nd gear such, that the toothed side is facing towards the first gear wheel and the locking keys are engaged into their resp. grooves on the splines of the mainshaft.

3.) Put on the thrust washer with the 4 interior teeth, the side with the lubricating grooves must be facing the second gear wheel. Press down this thrust washer by hand and check if the first gear whell spins freely. There should be an endfloat of .004 - .028" (0.1 - 0.7 mm). Make sure that the blocking ring does not brake the first gear wheel.

4.) Put on the needle cage for the second gear wheel such, that the chamfered side of the needle cage is facing towards the pinion, and slide the second gear wheel onto the mainshaft. The synchronizer cone of the second gear wheel must face towards the pinion.

5.) Insert the peg, with the rounded end ahead, into the mainshaft, slide on the thrust washer with the slot for the peg. The chamfered side of the thrust washer must face towards the second gear wheel, firmly press down this thrust washer by hand and check if the second gear wheel is spinning freely, endfloat .004 - .026 " (0.2 - 0.65 mm), and if the blocking ring does not brake the gear wheel.

6.) Slide on the inner race for the 3rd gear needle bearing with the slot ahead.

7.) Slide on the needle cage and the third gear wheel.

8.) Put on the thrust washer with internal teeth, the side with the lubricating grooves must face towards the third gear wheel. After sliding on the thrust washer, turn the thrust washer into a position, that the locating plate may be inserted.

9.) Slide on the preassembled synchronizer clutch sleeve for 3rd and top gear.
The keyway of the splined synchronizer hub must of course correspond with the locating plate of the mainshaft.

10.) Put on the thrust washer with internal teeth onto the splines of the mainshaft, the lubricating grooves of this thrust washer must face towards the top gear wheel. Firmly press on this thrust washer and check if the third gear wheel spins freely, play .004 - .016" (0.1 - 0.4 mm) and if the blocking ring does not brake the gear wheel.

11.) Slide on the needle cage for the top gear wheel and the top gear-wheel.

12.) Put on the thrust washer (adjusting shim for the pinion adjustment) with the chamfered side towards the top gear wheel. Press down this thrust washer firmly and check if the top gear wheel spins freely, play .004 .004 - .016" (0.1 - 0.4 mm) and if the blockingsring does not brake the gear wheel.

Assembling of the intermediate flange and adjusting the selector forks:

1.) First run over the special tool part no. 700.1.55.043.0 to its side, that both the cut-aways are facing upwards then remove both the sliding side pieces. Insert now the mainshaft-cluster and the layshaft complete with the calculated shims (the same size shim (thrust washer) as used for the pinion also must be used for the layshaft. Also see "Adjusting crown wheel and pinion") into the special tool with the pinion downwards. Put the intermediate flange complete with ball races onto the shafts.

2.) Set the special driver for the mainshaft and layshaft bearings onto the inner races. Carefully press now the intermediate flange onto both the shafts (use an arbor press). The intermediate flange is in its correct position, when it is flush on the special tool.

3.) Remove gear cluster complete with intermediate flange from the special tool and insert the intermediate flange assy into the jig part no. 700.1.55.041.2.
Push the reserve shaft through the intermediate flange and slide on the reverse gear (the teeth of which must face towards the pinion) and spacer. Push reserve shaft right home and insert the locking plate.
Mount the retaining flanges for mainshaft and layshaft bearing. On models with crawler gear only the retaining flange for the mainshaft bearing.
Note: There must be an initial tension of .0012" (0.03 mm) when mounting the retaining flange for the double row bearing.
Engage two gears in order to lock the gear cluster. Fit splined hub onto the mainshaft and on models with 4-speed transmission also spacer or power take-off gear or layshaft. On models with 4-speed transmission tighten both the nuts for mainshaft and layshaft. On models with crawler gear only the nut on the mainshaft.

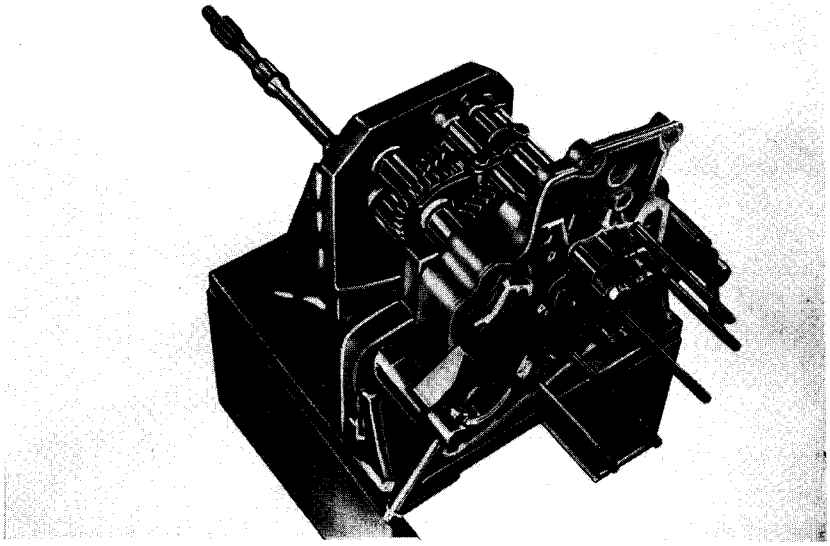


Fig. 6/VII

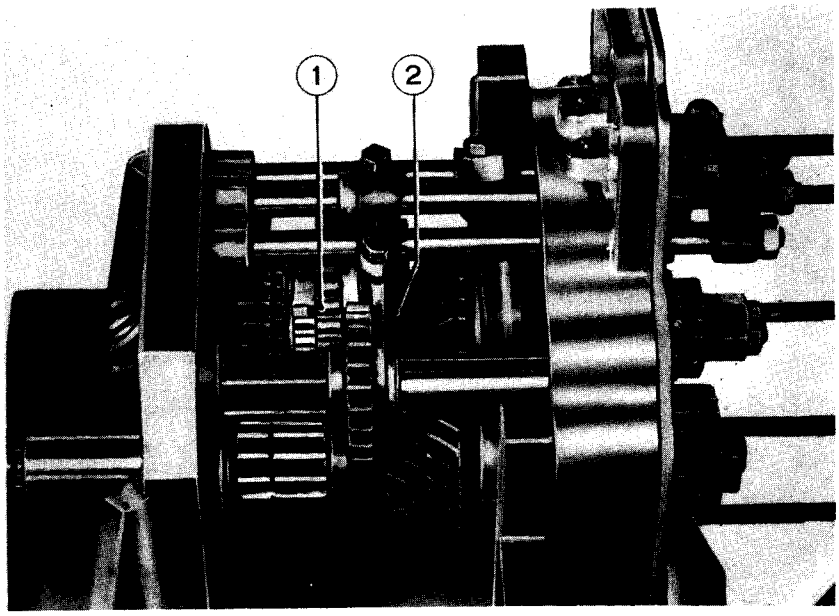
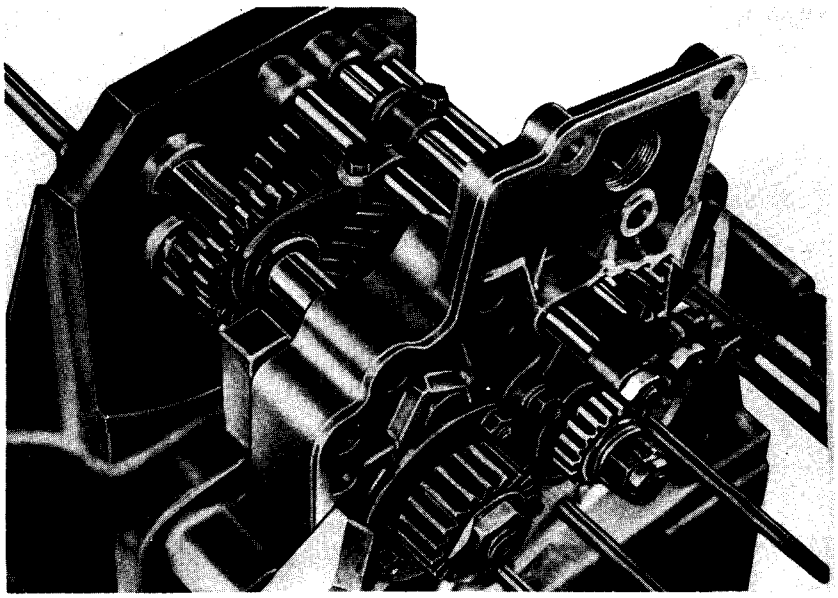


Fig. 6/VIII



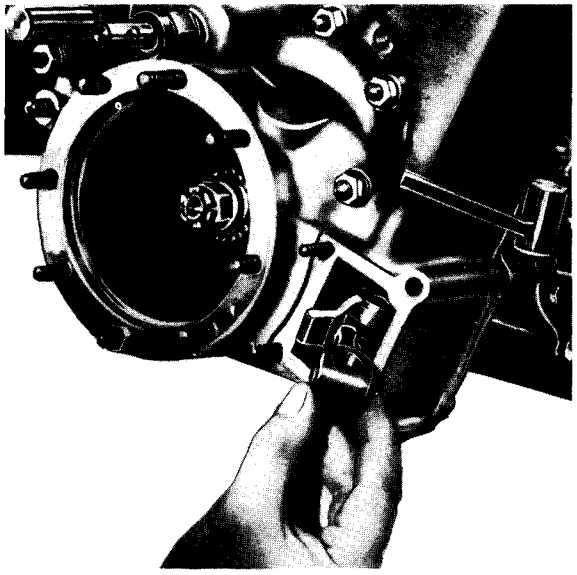


Fig. 6/X

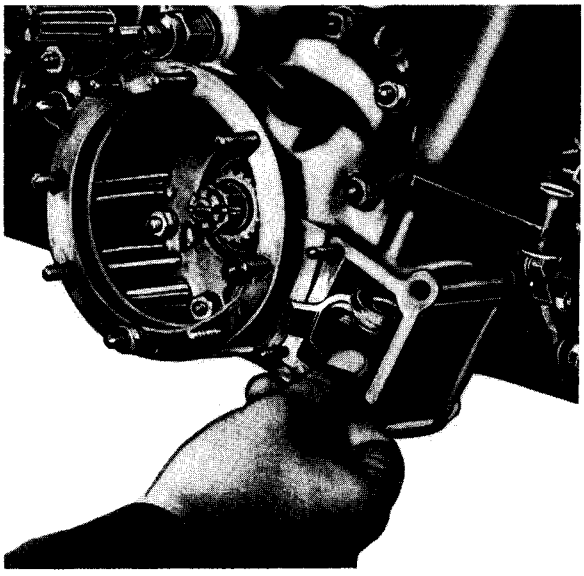


Fig. 6/XI

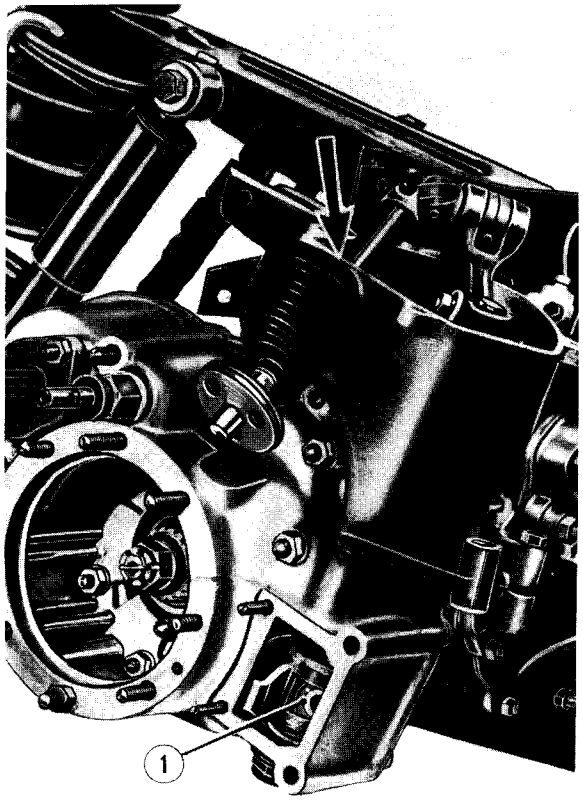


Fig. 6/XII

Both the nuts are tightened with a torque wrench reading of 101.26 ft. lbs (14 mkg).

Note: Do not forget to put underneath the nuts the tabwashers and the hardened shims.

4.) Push now the three shiftrods into their guides in the intermediate flange (approx. half inch), insert the three interlocking balls and springs and screw them down a few turns by means of the grub screws which must be dipped into gasket cement first.

Note: The springs must face with their narrower end towards the balls.

5.) Install now the gear selector fork for the 3rd and top gear (the selector fork for the 3rd and top gear is symetrical in relation to the fork clamp) into the 3rd / 4 th synchronizer clutch sleeve, and push the lower shift rod into the selector fork. Do not adjust or tighten the selector fork.

Install now the selector fork for the 1st and 2nd gear into the 1st / 2nd gear synchronizer clutch gear (the selector fork for the 1st and 2nd gear is assymetric in relation to the fork clamp). Push the centre shift rod into the selector fork. Make sure that the selector fork for the 1st and 2nd gear is not touching the reverse gear. If necessary grind off the edge of the selector fork for sufficient clearance. Do not adjust or tighten the selector fork for the 1st and 2nd gear.

At last push in the shift rod for the reverse gear and insert the reverse gear selector fork. Again do not tighten the selector fork.

6.) Push the shift rods right up to their neutral position and tighten the grub screws for the interlocking balls. Screw them right home and slack them off by 1/2 turns. Secure this grub by caulking.

7.) Adjust now the gear selecting forks such, that they are in their correct position in the grooves of the synchronizer clutch sleeves, and tighten their fixing bolts with a torque wrench reading of 6.5 ft. lbs. (0.9 mkg). Make sure that the shift rods are in their neutral position and the interlocking balls are engaged properly in the shift rods. The gear selector forks are correctly adjusted when by engaged gear the synchronizer clutch slides still have some play at the selector forks, i.e. they are not pressing.

When the second gear is engaged the reverse gear (idler) must under no circumstance touch, neither the synchronizer clutch gear (fig. 6 / VIII / 1) nor the second gear wheel (fig. 6 / VIII / 2).

8.) Push all gears into their neutral position and check wether the slots in the gear shift rods are aligned (fig. 6 / IX). On models with crawler gear also ensure that there is sufficient space for the crawler gear selector shift rod.

9.) Remove the so far assembled and adjusted gear cluster assy from the adjusting jig and complete the layshaft with the clutch shaft, by means of the splined connecting sleeve, the two springs and the two balls.

10, Install the assy into the gearbox casing. Coat the sealing surfaces of the intermediate flange with gasket cement and line up reverse shaft and shift rods, then tighten the retaining nuts.

V. Fitting the crawler gear (only on models with crawler gear)

1.) Press in lower intermediate shaft with bearing.

2.) Press in upper intermediate shaft with keyed double gear wheel, with the retaining plate, and pressed on and secured ball race. Tighten retaining plate.

3.) Fit the crawler gear pinion and tighten with a torque wrench reading of 101.26 ft.lbs. (14 mkg). Lock the layshaft by engaging two gears.

4.) Mount the components of the lower intermediate shaft in the following order:

Spacer, gear wheel with recess for the disc springs, adjusting shim, cup springs (two and two symetrically facing each other), overload clutch, (consisting of dog hub and dog gear) thrust washer and roller bearing. Put on locking plate, tab washer and tighten the nut.

5.) Check the overload clutch adjustment:

Engage two gears in order to lock the crawler gear wheels. Put the special socket part no. 700.1.55.046.1 onto the dog gear of the lower intermediate shaft and check the adjustment of the overload clutch by means of a torque wrench. The overload clutch should start slipping at a torque wrench reading of 144.6 + 14.5 ft.lbs. (20 + 2 mkg). If necessary adjust by means of different shims for the dise springs.

6.) Fit the crawler gear synchronizer assy complete with splined hub, selector fork and shaft. Install locking ball spring and grub screw into the intermediate flange. Apply gasket cement and push on the crawler gear casing (on models with 4-speed transmission the selector casing) with the upper selector casing, and tighten.

VI. Fitting the gear selector mechanism.

1.) Push the interlocking finger through the opening in the selector casing (crawler gear casing) (fig. 6 / XI) install the lower selector finger (fig. 6 / X) into the interlocking finger, so that the partially milled side (fig. 6 / XII / 1) points forward. (driving direction). Insert the selector shaft assy from above (fig. 6 / XII). At the same time, make the universal joint come out of the opening (arrow).

2.) Introduce the cotter through the plug hole of the intermediate flange, turn the selector shaft till the cotter fits in well and tighten the nut.

3.) Mount the cover for the selector casing and the plug for the intermediate flange.

4.) Install the selector rails in the upper selector casing. First put on one rail with the chamfer pointing towards the selector shaft, then add the spacers (if required shims as well) and enage the upper selector finger. Put on the top rail (chamfer towards selector shaft) and bolt up. Grease the selector mechanism and check for easy operation and fit the lid for the upper selector casing.

VII. Adjusting the crown wheel and pinion (differential)

A. Adjusting the pinion (rear axle)

1.) Press the mainshaft pinion complete with thrust washer for the top gear wheel into the intermediate flange (use the special tool part no. 700.1.55.043.0) and tighten the hexagon nut with a torque wrench reading of 65 ft. lbs. (9 mkg).

2.) For gauging and calculating the correct thrust washer (shim) for the pinion (mainshaft) a sliding gauge (depthgauge) with a metric dial is essential.

If there is no sliding gauge with metric dial available, the obtained measures in inches must be converted into millimeters.

a) Measure the length of the pinion (mainshaft) i.e. from the face of the pinion down the sealing surface of the intermediate flange.

b) Add to this measure (which of course must be in mm) 54,90 mm.

c) Take note of the tolerance, which is written on the face of the pinion.

d) Add to, or deduct the above measure (a + b) the tolerance of the pinion, depending upon the tolerance being positive or negative.

e) The so obtained figure which is the actual length of the pinion from the point of intersection (crown wheel and pinion axis) down to the sealing surface of the intermediate flange, now must be compared with the actual depth of the gearbox final drive casing.

f) The theoretical depth of the gearbox final drive casing is from the point of intersection of the crown wheel and pinion axis to the sealing surface of gearbox and intermediate flange. This depth is 211 mm.

In order to obtain the actual measure the tolerance, which is stamped onto the gearbox casing above the r.h.s. oil filler plug must be noted.

Is this tolerance a figure larger than 50, this tolerance must be added to 210 mm.

Is this tolerance a figure less than 50, this tolerance must be added to 211 mm.

The so obtained figure is the actual depth of the gearbox final drive casing.

g) The difference between the actual length of the pinion (mainshaft) and the actual depth of the gearbox final drive casing is the amount which must be added to, or deducted from (depending upon being positive or negative) to the thickness of the thrust washer being used for gauging.

Remove the pinion (mainshaft) from the intermediate flange, gauge (micrometer) the thickness of the thurst washer used and add to, or deduct from the obtained measure the above difference. The now obtained figure is the thickness of the thrust washer, which must be used for correct pinion adjustment.

As the thrust washers are avai lable only in sizes from 2,7 - 3,8 mm graded in 0,1 mm, the obtained thickness of the thrust washer must be rounded off to the next full tenth of a millimeter. Never round up.

For example: The calculated thickness of the thrust washer is 13,16 mm, then the thrust washer to be used must be 3,10 mm.

3.) In case the gauging device complete with dial gauge part no. 501.2100.5 - L 3 is available, it is not necessary, to use the before mentioned method (para 2 a - f) for adjusting the pinion position.

Proceed as follows:

a) Press the pinion (mainshaft) with any of the available thrust washers into the intermediate flange and tighten with a torque wrench reading of 65 ft. lbs. (9 mkg).

b) Bolt the intermediate flange with at least 4 nuts onto the gearbox casing, using some spacers on the long studs.

c) Adjust the dial clock of the gauging device part no. 501.1.2100.5 - L 3 to the tolerance of the pinion i.e.:
Adjust the dial clock by means of the master gauge to a reading of 3.00 mm.
Turn now the dial of the dial clock by the same amount as the tolerance written upon the face of the pinion anticlockwise, if the tolerance is a positive one; and clockwise if the tolerance is a negative one.

d) The so adjusted gauging device is now inserted into the final drive casing and the position of the pinion gauged on its face. A clockwise deflexion of the dial gauge from the measure 3.00 indicates by what amount the thrust washer must be chosen thinner (an anticlockwise deflexion indicates the amount by what the thrust washer must be thicker).

Note: As the thrust washers only are available from 2.7 - 3.8 mm graded in 0.1 mm, the dial clock reading always must be rounded off to the next full tenth, e.g. the anticlockwise deflexion from the measure 3.00 is 0.39, then only 0.30 mm must be added to the thickness of the existing thrust washer in order to obtain the correct one. In case the deflexion is 0.39 clockwise, then 0.40 mm must be deducted from the thickness of the existing thrust washer.

If the pinion adjustment with the correct thrust washer is checked, an anticlockwise deflexion of up to 0.09 mm may be existing i.e. if the anticlockwise deflexion of the dial clock from the measure 3.00 is 0.09 only, nothing must be added to the existing thrust washer

4.) Remove now the intermediate flange and the pinion from the gearbox final drive casing and dismantle same in order to assemble the fear cluster and intermediate flange. Re. IV "Reassembling gear cluster ".

Note: Do not caulk the tabwasher of the mainshaft retaining nut until the tooth flank play and the tooth contact of the crown wheel and pinion have been checked.

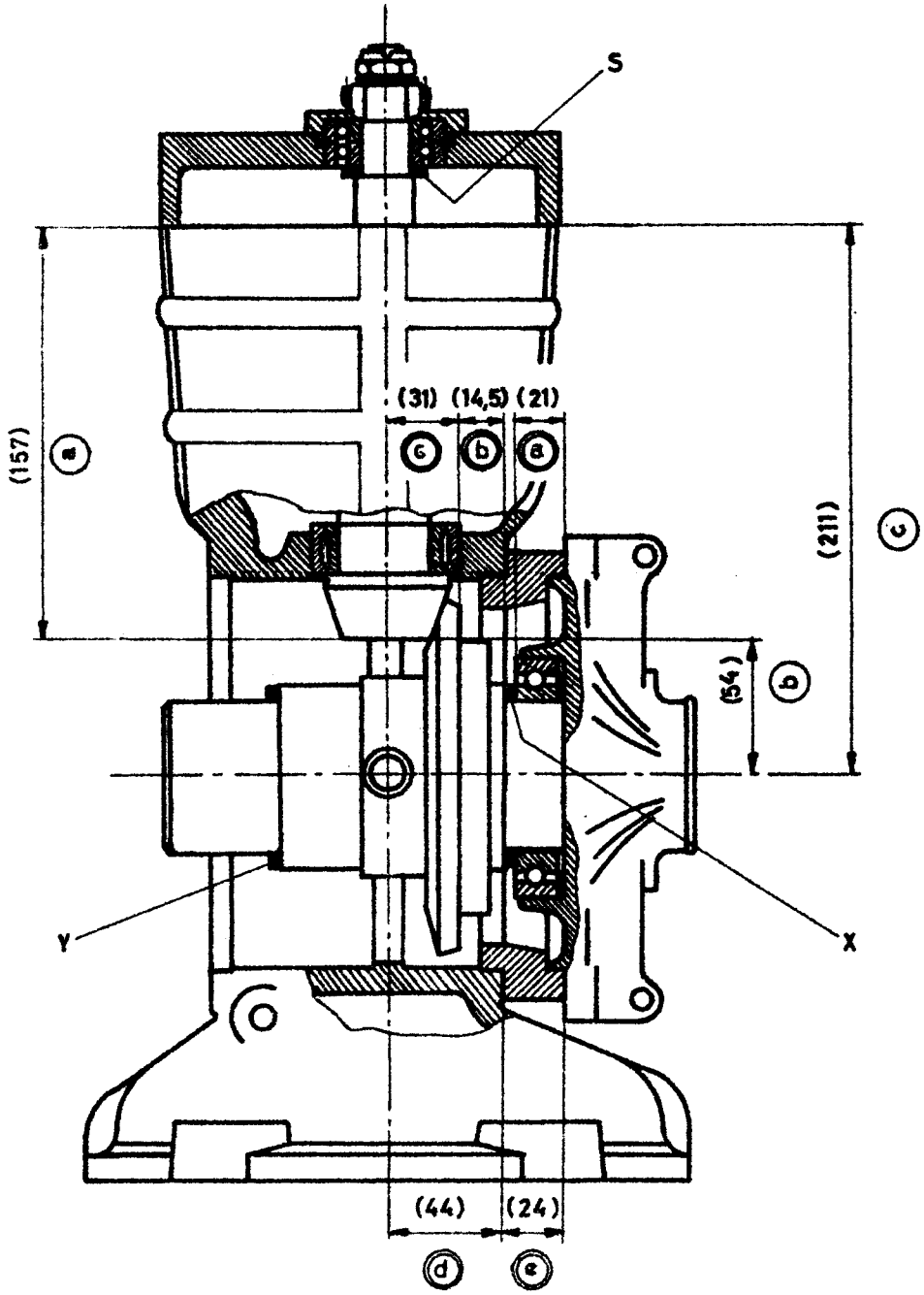
Example A (Re. method para. 2 a - f).

Pinion

Length of pinion (face of pinion to sealing surface of intermediate flange)	156.50 mm
add	54.00 "
	210.50 mm
Tolerance of pinion (written upon its face) + 20 (positive, therefore add)	0.20 "
Acotual length of the piston	210.70 mm

Fig. 6/XIII

Erklärung zur Triebling- und Tellerradeinstellung der Hinterachse
Comment for adjustment of rear axle bevel gear and differential drive wheel
Dessin pour le réglage du pignon conique et roue du différentiel de l'essieu arrière



○ Nennmaße zur Trieblingeinstellung
Rated figures for adjustment of bevel gear
Cote nominale pour le réglage du pignon conique

◎ Nennmaße zur Tellerradeinstellung
Rated figures for adjustment of differential drive wheel
Cote nominale pour le réglage de la roue du différentiel

Gearbox final drive casing

Theoretical depth	211.00 mm
Tolerance stamped on r.h.s. 19 (less than 50, therefore add to 211.00)	0.19 "
Actual depth of the casing	211.19 mm

The difference between casing	211.19 mm
and pinion is	210.70 "
	0.49 mm

0.49 is the amount by which the required shim (thrust washer, top gear bearing side) must be chosen thicker.
Round off as outlined under para. VI / 2 / g.

Existing shim (thrust washer)	2.90 mm
To be added	0.40 "
Actually to be used thrust washer	3.30 mm

If for example the actual depth of the casing should be	210.80 mm
And the actual length of the pinion should be	210.90 "
The difference between casing and pinion would be	- 0.10 mm

As this figure is a negative one, it must of course be deducted from the existing thrust washer:

Existing thrust washer	2.90 mm
To be deducted	- 0.10 "
Actually to be used thrust washer	2.80 mm

Example B (Re. method para. 3 a - d).
The tolerance of the pinion is + 0.20.
Adjust the dial clock on the master gauge to a reading of 3.00.
Now turn the dial by 0.20 anticlockwise.
Insert the gauging device into the final drive casing and read the deflexion which for example should be 0.49 anticlockwise. Again round off and therefore 0.40 must be added to the existing washer.

A control with the gauging device part no. 501.1.2100.5 - L 3 will read in both cases (A and B) 0.09 anticlockwise deflexion.

8. Adjusting the front drive pinion.

1.) Press the pinion with assy of the thrust washers (7 mm standard size) into the intermediate casing and tighten the hexagon nut with a torque wrench reading of 65 ft. lns. (9 mkg).

2.) For gauging and calculating the correct thrust washer (shim) for the pinion a sliding gauge (depthgauge) with a metric dial is essential.

If there is no sliding gauge with metric dial available the obtained measures in inches must be converted into millimeters.

a) Measure the length of the pinion i.e. from the face of the pinion down to sealing surface of the intermediate casing.

b) Add to this measure (which of course must be in millimeters) 54.00 mm.

c) Take note of the tolerance which is written on the face of the pinion.

d) Add to, or deduct from the above measure (para. b) the tolerance of the pinion, depending upon the tolerance being positive or negative.

e) The so obtained figure, which is the actual length of the pinion from the point of intersection (crown wheel and pinion axis) down to the sealing surface of the intermediate casing, now must be compared with the actual depth of the front final drive casing.

f) The theoretical depth of the front final drive casing is from the point of intersection of the crown wheel and pinion axis to the sealing surface of the intermediate casing. This length is 155 mm. In order to obtain the actual measure the tolerance, which is stamped onto the front final drive casing next to the speedometer drive assy, must be noted.

Is this tolerance a figure larger thon 50, this tolerance must be added to 154 mm.

Is this tolerance a figure less than 50, this tolerance must be added to 155 mm.

The so obtained figure ist the depth of the front final drive casing.

g) The difference between the actual length of the pinion and the actual depth of the front final drive casing amount which must be added, to, or deducted from (depending upon being positive or negative) to the thickness of the thrust washer being used for gauging.

Remove the pinion from the intermediate casing, gauge (micrometer) the thickness of the thrust washer used and add to, or deduct from the obtained measure the above difference. The now obtained figure is the thickness off the thrust washer which must be used for correct pinion adjustment.

As the thrust washers are only available in sizes from 6,3 - 7,5 mm graded in 0.1 mm, the obtained thickness of the thrust washer must be rounded off tb the next full tenth of a millimeter. Never round up.

For example: The calculated thickness of the thrust washer is 7,16 mm, then the thrust washer to be used must be 7,10 mm.

3.) In case the gauging device complete with dial gauge part no. 501.1.2100.5 - L 3 is available, it is not necessary to use the before mentioned method (para. 2 a - f) for adjusting the pinion position.

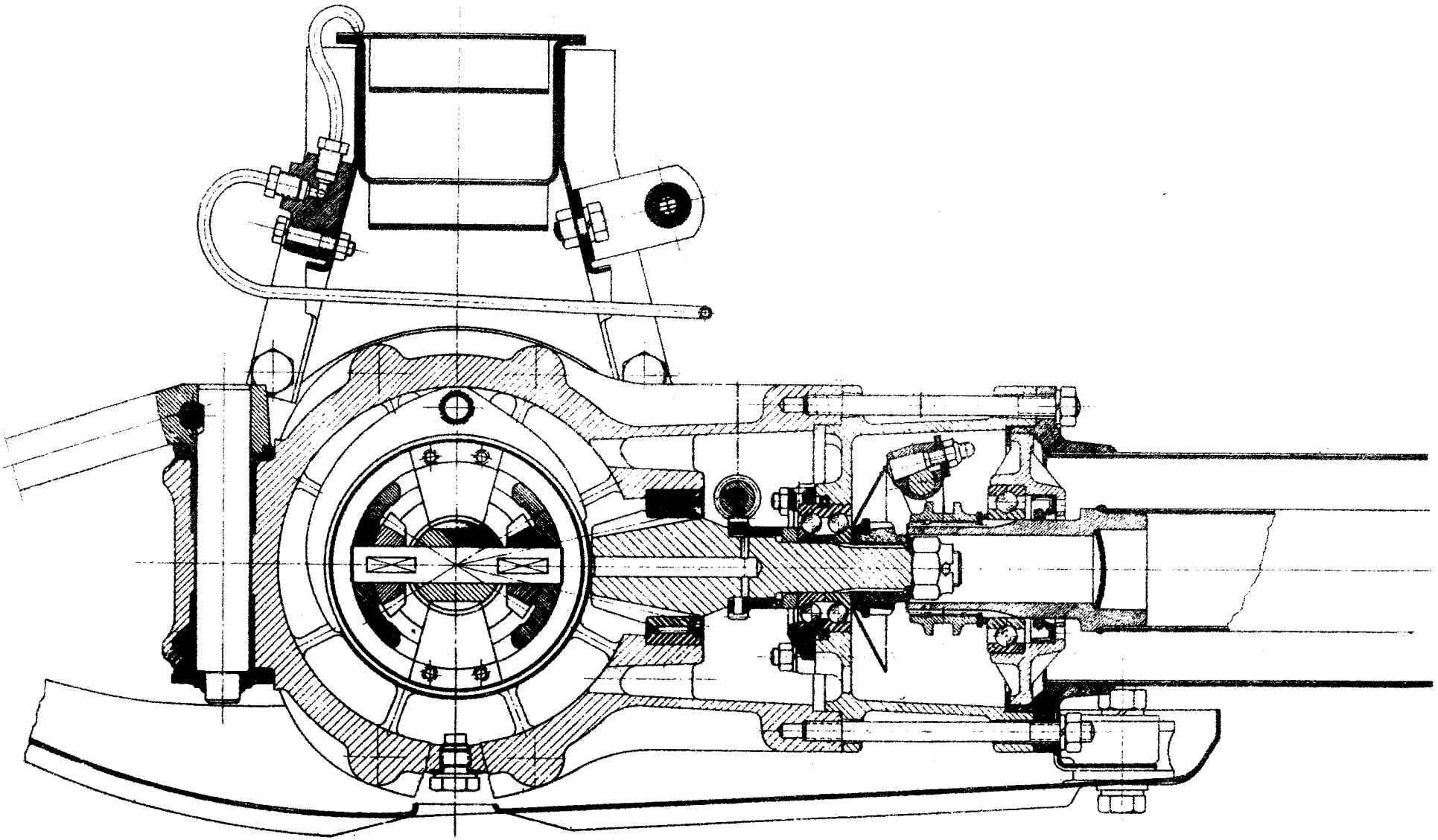


Fig. 6/XIV: Vorderachsantrieb (Aufriß) Front axle drive (elevation)
Traction de l'essieu avant (élévation)

Proceed as follows:

a) Press a pinion with any of the available thrust washers into the intermediate casing and tighten with a torque wrench reading of 65 ft. lbs. (9 mkg).

b) Bolt the intermediate casing with at least four nuts onto the front final drive casing using some spacers on the long studs.

c) Adjust the dial clock of the gauging device part no. 501.1.2100.5 - L 3 to the tolerance of the pinion i.e. Adjust the dial clock by means of the master gauge to a reading of 3.00 mm.
Turn now the dial of the dial clock by the same amount as the tolerance written upon the face of the pinion anticlockwise if the tolerance is a positive one, and clockwise if the tolerance is a negative one.

d) The so adjusted gauging device is now inserted into the front final drive casing and the position of the pinion gauged on its face. A clockwise deflexion of the dial gauge from the measure 3.00 indicates by what amount the thrust washer must be chosen thinner (an anticlockwise deflexion indicates the amount by what the thrust washer must be thicker).

Note: As the thrust washers only are available from 2.7 - 3.8 mm graded in 0.1 mm, the dial clock reading always must be rounded off to the next full tenth, e.g. the anticlockwise deflexion from the measure 3.00 is 0.39, then only 0.30 mm must be added to the thickness of the existing thrust washer in order to obtain the correct one. In case, the deflexion is 0.39 clockwise then 0.40 mm must be deducted from the thickness of the existing thrust washer.

If the pinion adjustment with the correct thrust washer is checked an anticlockwise deflexion of up to 0.09 mm may be existing i.e. if the anticlockwise deflexion of the dial clock from the measure 3.00 is 0.09 only, nothing must be added to the existing thrust washer.

4.) Remove now the intermediate casing and the pinion from the front final drive casing and dismantle same in order to mount the correct thrust washer.

Note: Do not caulk the tabwasher of the pinion retaining nut until the tooth flank play and the tooth contact of the crown wheel and pinion have been checked.

Example A (re. method para. 2 a - f)

Pinion

Length of pinion (face of pinion to sealing surface of intermediate casing)	100.50 mm
Add	54.00 "
	154.50 mm
Tolerance of pinion (written upon its face) + 0.20 (positive therefore add)	0.20 "
Actual length of the pinion	154.70 mm

Final drive casing

Theoretical depth	155.00 mm
Tolerance stamped next to the speedometer drive 19	
(less than 50, therefore add to 154.00)	0.19 "
Actual depth of front final drive casing	155.19 mm
	155.19 mm
	154.70 "
The difference between casing and pinion is	0.49 mm

0.49 is the amount by which the required shim (thrust washer) must be chosen thicker. Round off as cutlined under para. VII / 2 / g.

Existing shim (thrust washer)	6.90 mm
To be added	0.40 "
Actually to be used thrust washer	7.30 mm

If f.e. the actual depth of the casing should be	154.80 mm
And the actual length of the pinion should be	154.90 "
The difference between casing and pinion would be	- 0.10 mm

As this figure is a negative one it must of course be deducted from the existing thrust washer:

Existing washer	6.90 mm
To be added	- 0.10 "
Actually to be used thrust washer	6.80 mm

Example B (re. method para. 3 a - d)

The tolerance of the pinion is + 0.20 mm.

Adjust the dial clock on the master gauge to a reading of 3.00.

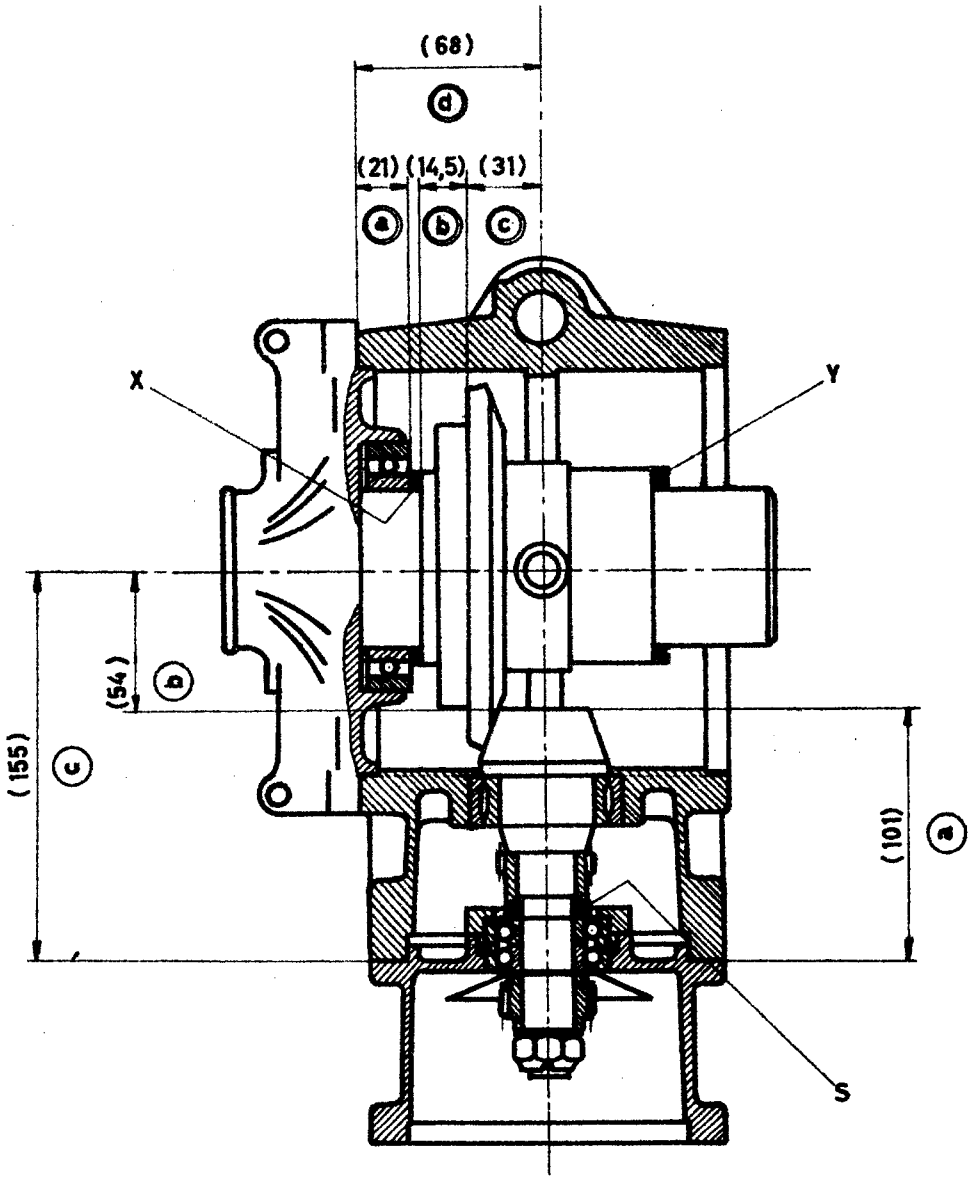
Now turn the dial by 0.20 anticlockwise.

Insert the gauging into the front final drive casing and read the deflexion, which in this case should be 0.49 anticlockwise. Again round off and therefore 0.40 must be added to the existing washer.

A control with the gauging device part no. 501.1.2100.5 - L 3 will read in both cases (A and B) 0.09 anticlockwise deflexion.

Fig. 6/XV

Erklärung zur Triebling- und Tellerradeinstellung der Vorderachse
Comment for adjustment of front axle bevel gear and differential drive wheel
Esquisse pour le réglage du pignon conique et roue du différentiel de l'essieu avant



○ Nennmaße zur Trieblingeinstellung
Rated figures for adjustment of bevel gear
Cote nominale pour le réglage du pignon conique

◎ Nennmaße zur Tellerradeinstellung
Rated figures for adjustment of differential drive wheel
Cote nominale pour le réglage de la roue du différentiel

C. Adjusting the crown wheel position:

After pulling off the final drive side cover assy (final drive side cover complete with swinging axle), mark the differential assy adjusting shim, for correct reassembling.

However, if components of the differential must be replaced, new shims for adjusting the differential bearing (which also acts as crown wheel positioning shims) must be calculated. For calculating the thickness of these shims proceed as follows:

1.) Measure the distance from the sealing surface of the r.h.s. side cover to the face of the pressed in differential ball race.

In case a new final drive side cover assy (side cover complete with pressed in ball race) is to be used, it is not necessary to obtain the above measure, as the assembly already has been gauged at the works. The tolerance of this assy is stamped on the outside of the side cover.

In case the tolerance is a figure larger than 50, it must be added to 20.00 mm, in case the tolerance is a figure less than 50, it must be added to 21.00 mm.

If by installing a new crown wheel (always replace the complete set) either the final drive side cover or the differential ball race will be reused, do not take any notice of the stamped on tolerance of the side cover, but measure the distance as outlined above.

2.) Take note of the distance flange for crown wheel to flange for ball race of the differential casing. The tolerance of which is stamped onto the differential casing. The stamped on tolerance always must be added to 14.00 mm, which is the theoretical measure. Add this measure to the above one of the side cover. (a)

3.) Add now the theoretical height of the crown wheel, which is 31.00 mm, and add or deduct the tolerance of the crown wheel, depending upon being positive or negative.

4.) Gauging the depth of the final drive casing. The theoretical measure is 44.00 mm and the tolerance is stamped onto the gearbox final drive casing above the differential itself.

Tolerances larger than 50 must be added to 43.00 mm

Tolerances less than 50 must be added to 44.00 mm.

5.) The height of the intermediate ring is 24 mm. The tolerance is stamped onto the circumference of the ring and figures larger than 50 must be added to 23.00 mm

figures less than 50 must be added to 24.00 mm

6.) The difference between the actual depth of the final drive casing, including intermediate ring, and the actual height of the differential casing (point of intersection of the crown wheel and pinion to the sealing surface of the final drive side cover) is the thickness of the actually to be used shim washer for the correct positioning of the crown wheel.

Example:

Crown wheel

1.) Distance sealing surface of side cover to face of differential ball race	21.05 mm
2.) Stamped onto the differential casing , 45 (to be added to 14.00)	14.45 mm
3.) The tolerance of the crown wheel is - 0.10 (negative, therefore to be deducted from 31.00)	30.90 mm
Actual height of the crown wheel assy	66.40 mm

Final drive casing

4.) Tolerance of the final drive casing (stamped on top of the casing) 29, (less than 50, therefore to be added to 44.00	44.29 mm
5.) Tolerance of the intermediate ring 10 (less than 50, therefore to be added to 24.00)	24.10 mm
Actual depth of casing, incl. ring	68.39 mm
The difference of final drive casing	68.39 mm
and crown wheel assy	66.40 mm
is	1.99 mm

This figure is the thickness of the required shim.

As the shims only are available graded in 0.1 mm the obtained measure always must be rounded off to the next full tenth (also see VII / A "Adjusting the pinion").

Therefore in this case a shim of 1.90 mm is to be used.

D. Calculating the counter shim for the l.h.s differential ball race:

1.) Put the before calculated shim for positioning the crown wheel (re. B a - e) onto the r.h.s of the differential casing and press the differential casing assy into the r.h.s side cover assy (final drive side cover with swinging axle). Install now the side cover assy into the final drive casing. Apply some gasket cement and tighten.

2.) Measure the distance from the sealing surface of the final drive casing to the l.h.s bearing flange of the differential casing (fig. 6 / XVI).

Measure the distance from the sealing surface of the l.h.s final drive side cover to the face of the pressed in differential ball race (fig. 6 / XVII). Deduct from the difference of both these measures 0.05 mm. The so obtained figure is the correct thickness of the counter shim (l.h.s differential bearing adjusting shim).

Put the above calculated shim onto the l.h.s bearing flange of the differential casing

3.) The endfloat of the differential gears in the differential casing should be .004" - 0.1" (0.1 - 0.26 mm).

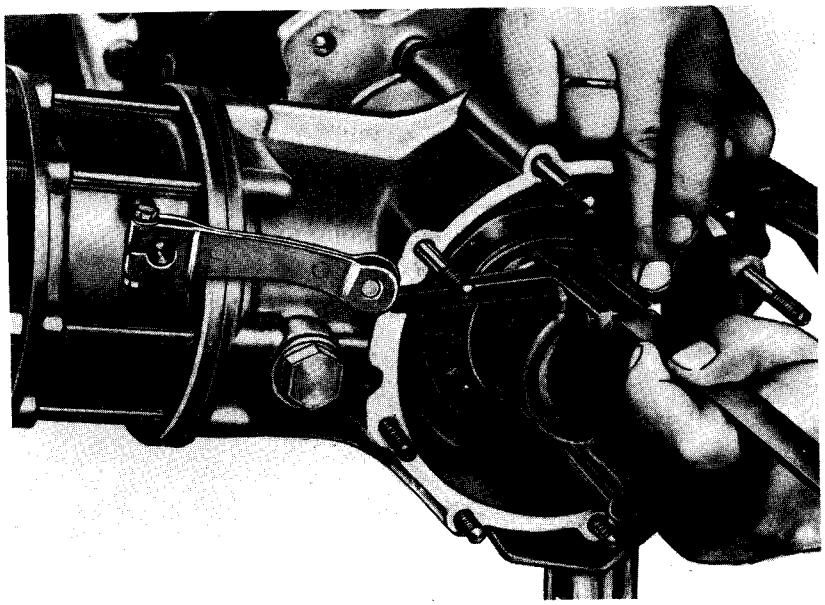
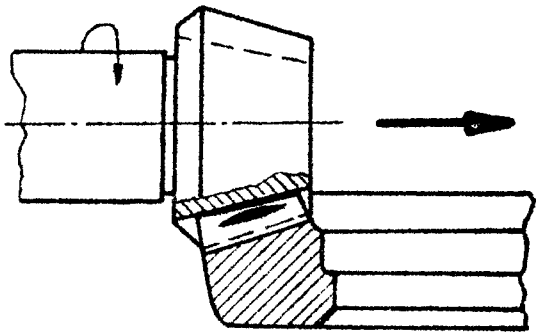


Fig. 6/XVI

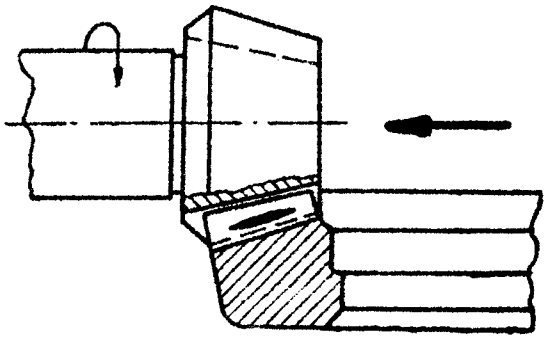
Fig. 6/XVII

Fig. 6/XVIII

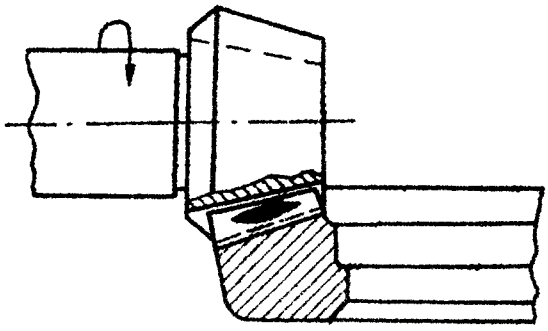
Erklärungszeichnung zur Prüfung des Tragbildes
Commentary drawing for determining the pitch point of mating gears
Esquisse pour determiner le point de contact des roues dentées



Tragbild liegt am Kopf der Zahnflanke
Pitch point too high
Point de contact trop haut



Tragbild liegt am Fuß der Zahnflanke
Pitch point too low
Point de contact trop bas



Einwandfreies Tragbild
Pitch point correct
Point de contact exact

E. Checking the tooth flank play (backlash) of crown wheel and pinion:

1.) The flank play must be inbetween .006" - .012" (0.15 - 0.30 mm).

2.) The flank play is automatically adjusted by means of the r.h.s differential bearing adjusting shim as calculated under B.

3.) After assembling of the final drive assy and bolting up of the side covers fasten with the mainshaft (pinion) castle nut (retaining doublerow ball race) a finger with a length of 3.937" (100 mm).

4.) If this check results in an either too big or too little tooth flank play, check under all circumstances once more the pinion and the crown wheel adjustment (shims). In case there was no mistake in adjusting the crown wheel and pinion, and the tooth flank play is still out of tolerance, the r.h.s differential bearing adjusting shim must be corrected.

Installing a thicker shim results in less, installing a thinner one in more backlash.

5.) After having checked the backlash, paint the crown wheel with red lead or prussian blue and turn the differential several times so that the pinion will make an impression on the teeth of the crown wheel.

F. Checking the tooth contact:

1.) Diagnosis: Narrow impression on the face of the tooth.

Correction: Pinion must be brought closer to crown wheel axis, therefore use a slightly thicker thrust washer on the pinion (mainshaft).

Recheck tooth flank play (backlash), if necessary readjust crown wheel position.

2.) Diagnosis: Narrow impression on the flank of the tooth.

Correction: Move pinion away from the crown wheel axis, therefore install a slightly thinner thrust washer on the pinion (mainshaft).

Recheck tooth flank play (backlash) if necessary correct crown wheel position.

3.) A "spot-on" adjustment of the crown wheel and pinion with backlash within tolerance, will show an elliptically shaped impression across the face and flank of the tooth.

G. Adjusting the crown wheel position (front axle):

This method is similar to the one applied for the rear axle with the following exceptions.

1.) The adjusting shim for the crown wheel is installed on the l.h.s and the counter shim on the r.h.s.

2.) There is no intermediate ring (B / 5). The depth of the front final drive casing is 68 mm (also see B / 4). Tolerances larger than 50 are to be added to 67 mm.

Tolerances less than 50 are to be added to 68 mm.

Group 8 : Electrical equipment on Steyr - Puch motor cars.

I. Battery:

a) Structure:

The battery box consists of acid-proof insulating material and is devided into six cells. Each cell contains a set of negative and positive plates made of lead grids filled in with chemically active substance and separated from each other by insulating plates (separators). The electrolyte is constituted by diluted sulphuric acid. Each cell is closed by a cover which seals the cell tight and acid-proof. The filler holes are closed by cell plugs which at the same time serve as air vents. As the positive plates under onesided strain would bend, negative plates are arranged at the ends of each set of plates. This obviously means that every set contains one more negative than positive plates. Contact rails and terminals are lead plated or entirely made of lead as this metal is not attacked by sulphuric acid.

b) Operation:

The battery is a galvanic cell in which the chemical conversion occurring when discharging may be reversed by supplying electric energy (charging).

During discharging, sulphuric acid is split up. Upon the positive plates, whose active substance consists of lead sponge, lead sulphate is formed. Concurrently water is formed and the specific gravity decreases. When charging water is split up, sulphuric acid is formed and the lead peroxide as well as the lead sponge are regenerated, the specific gravity of the acid increases. Hence the concentration in a reliable guide to the charging condition. It can be determined by a hydrometer, provided the battery has received correct maintenance.

The following values will be obtained, provided that acid of specific gravity has been used originally:

The acid of a well charged battery has a specific gravity of 1.285.

The acid of a half-charged battery has a specific gravity of 1.20.

The acid of a discharged battery has a specific gravity of 1.12.

c) Preparing new batteries for operation

The batteries supplied on Steyr-Puch motor cars drycharged to approx. 80%. In emergency cases these batteries may be put into operation without prior charging, after being filled with the proper acid.

However, we recommend to charge the drycharged batteries as stipulated below:

1.) Unscrew cell plugs, remove cardboard washers and plastic ribbons if fitted.

2.) Fill all cells with chemically pure sulphuric acid of a specific g avity of 1.285 at 68^{0} F (20^{0} C) i.e. 32^{0} Baumé (for the tropics with a specific gravity of 1.23, i.e. 27^{0} Baumé) up to .2" (5 mm) above the upper edge of the separators. Do not use metal funnels.

3.) Let the battery stand for a period of 5 to 6 hours during which the acid level will drop as the plates will absorb acid. After that top up to the former level.

4.) Connect the positive terminal (+) of the battery to the positve terminal of a D.C. charging unit and the negative terminal (-) of the battery to the negative terminal of the D.C. charging unit.

5.) Switch on the battery charger and charge at a rate of 2.4 - 2.6 Amp. for initial charging. For normal charging at 3.4 - 4.0 Amp. Do not use under any circumstances a boost charging unit. During charging do not screw on the cell plugs.

6.) Occasionally measure the acid (electrolyte) temperature. Max. permissible temperature 104^{0} F (40^{0} C). If this temperature is exceeded, reduce the charging amperage and extend correspcodingly the charging period.

7.) Charge for about 10 hours, but continue charging till all the cells gas uniformly and till at three successive checks carried out at intervals of one hour the specific gravity of the acid and the voltage of each of the cells have been equal. Then the specific gravity must be 1.285 and the voltage 2.6 - 2.7 V per cell. This measurement is done by switched on charging current.

8.) Two hours after terminated charging, check the acid level, top up if necessary. Apply battery grease upon metal parts.

9.) When installing first connect the positive lead, then the earth strap.

Note: The circuit on Steyr - Puch cars has negative earth. Therefore the earth strap always must be connected to the negative (-) terminal of the battery.

d) Maintenance:

1.) Keep the battery clean and dry. Pay particular attention to cable connections. Grease metal parts, especially the underside of terminal slamps. Ensure that the air vents of the cell plugs are open.

2.) Inspect the acid level weekly, if necessary top up. Top up with distilled water to replace evaporated liquid. If acid has been spilled, top up with acid of the same specific gravity.

3.) Determine charging condition by measuring the specific gravity. Recharge if necessary.

e) Laying up the battery:

1.) Incase of intermittent use, or laying up of the battery, recharge every 6 to 8 weeks but only till all the cells gas uniformly. By no means overcharge. Check acid level.

2.) Never leave an acid filled battery uncharged. Keep acid filled and charged batteries in a cool place.

3.) Sulphated batteries must be charged for 40 hours at 1/4 of the normal charging rate, then charged at full rate.

f) Troubles:	Cause:	Remedy
Battery sulphated	1) Short circuit in the cable system	1) Inspect cable system, rectify
	2) Short circuit between the plates, chemically active substance fallen out or damaged separators.	2) Have battery repaired by specialist.
	3) Constant under-charging	3) Increase generator output (cutout adjustment), inspect connections.

	4) Excessive self discharging caused by contaminated acid.	4) Drain the battery and fill with sulphuric acid of the correct specific gravity.
Positive plates are too soon exhausted.	1) Constant overcharging.	1) Check cutout adjustment. Replace battery or have it repaired.
Voltage at terminal too low.	1) Terminal connections oxidized.	1) Clean terminals and connections, apply battery grease.

II. Dyna-starter: Bosch LA / EJ 160 / 12 / 3000 + 1.0 R (1 / 5).

For Steyr - Puch motor cars Bosch dyna-starters are used in which dynamo and starter motor are united to a single unit.

a) Test data:

N max. = 240 W

J max. = 20 A

N max. = 10000 RPM

0 Watt = 2800 RPM

Cutting-in speed = 2900 to 3000 RPM

Nominal speed = 3000 to 3200 RPM

Starter current = 300 A

Battery voltage = 9 V

Torque = 1.8 mkg.

The short circuiting measurements of the starter is carried out with blocked flywheel upon a test bench at a temperature of 68^{0} F (20^{0} C) and half-charged battery. Starter current and battery voltage are to be measured 2 sec. after switching on.

When connecting dyna-starter and cutout make sure that all cables are connected to their respective terminals. Therefore the DF - terminals have a fixing nut resp. fixing screw that cannot be removed. The respective cables have open-end cable sockets, whereas for D+ and D- normal round cable sockets are used.

The gauge (cross section) for cables to be used must be:

Terminal 30 h: min. 0.38 sq.in. (25 sq. mm)

Terminal 30 / 51: min. 0.38 sq.in. (25 sq. mm) and .006 sq.in. (4 sq. mm)

Terminal DF: min. .0016 sq.in. (1 sq. mm)

Terminal 50: min. .0016 sq.in. (1 sq. mm)

Terminal D+ / 61: min. .006 sq.in. (4 sq. mm) and .0016 sq.in. (1 sq. mm).

b) Structure:

The main components of the dyna-starter are:

The pole casing with 4 pole shoes

The starter field coils

The dynamo introduction winding

The armature with armature winding and commutator

The carbon brushes and brush holders

The end covers.

c) Working:

The dyna-starter is one of the most important items of the elctrical equipment.

1.) As starter motor it has to overcome engine compression, piston and bearing frictions etc. The appropriate motor to be employed is an electromotor through the induction winding (starter field coil) of which the full starter current flows, thus attaining a considerable torque. Such a motor is called a compound motor, as when working as starter motor field coils and armature are connected in series, while when operating as dynamo field coils and armature are connected in parallel.

Once the engine is started, the starter field coil is switched off.

2.) As dynamo it is driven by the engine and has to supply current to the various electrical components of the vehicle and to charge the battery. This task, however must be fullfilled under very special conditions, as the engine speed being subject to considerable fluctuations, particularly during town-driving or driving mountainous areas the dynamorspeed will vary accordingly. Voltage and amperage are depending upon dynamo speed, thus also the output of the dynamo. In order to render the dynamo capable of meeting these varying requirements it must be fitted with a regulating device. Therefore the dynamo is always coupled with a so-called cutout switch (voltage regualtor) situated somewhere apart from the dynamo.

The basic working principle of the dynamo consists of the following:

An armature is rotating in a magnetic field, the armature carrying copper windings in the slots of its core. With the armature revolving these windings cut the lines of magnetic force of the magnetic field between the poles of the machine, thus creating electromotive force in the armature windings. Thus, provided there is a closed circuit, there is a flow of current which the carbon brushes take from the commutator segments and feed to battery and consumers via connecting cables. The dynamo is designed as a D.C. shunt machine.

Its armature and induction winding are connected in parallel. The current needed for induction of the magnetic field is generated by the machine itself and is branched off from the armature current.

At the beginning of the starting process there is only a weak magnetic field between the pole shoes, which is created by the residual magnetism left in any piece of soft iron (pole shoes) once magnetized. When the lines of magnetic force of the field are cut by the revolving armature windings, a low voltage will be produced during the initial revolutions and induction current, though not very strong at first, will reinforce the already existing magnetic field.

Thus the electromotive force created in the armature windings increases with increasing speed. This process is repeated till the machine is fully inducted.

For the regulation of the dynamo see the chapter on the voltage regulator cutout switch.

d) Dynamo maintenance:

1.) Vee - belt tension.

The Vee - belt servesto transmit the power from the starter motor to the crankshaft and then to drive the dynamo. Therefore their correct tension is important. You should be able to depress them by about .4 - .8" (10 - 20 mm).

Note: When adjusting Vee - belts make sure that always both Vee - belts are tightened equally i.e. there must be the same number of spacer shims inbetween both the pulley halves. On previous models there have been used 12 spacer shims, six for each Vee - belt. When removing spacer shims from the pulley halves the removed ones must be added underneath the special nut. On recent models the intermediate half of the pulley has been reinforced so that only 6 spacer shims are required.

2.) When executing repair work on the electrical equipment there is always the danger of causing short - circuits. We therefore suggest to disconnect the groundstrap (earth strap) from the battery.

3.) Carbon brushes:

Every 7500 - 9500 miles (12.000 - 15.000 km) inspect the condition of the carbon brushes which must be perfect. They must move freely in the brush holders. Carbon brushes holders must be absolutely free from dust, oil or grease. If these parts are dirty or if they jam, thus no longer rest upon the commutator under the correct pressure, clean them with a clean, petrol-soaked cloth and let them dry afterwards. Also clean the brush holder by compressed air. If a carbon brush is worn to the extent that the spring or the lead soldered upon the brush threatens to make contact against the brush holder it must be replaced.

Use genuine Bosch carbon brushes for replacement, only they ensure sufficient durability, correct resistance and right size.

4.) Commutator:

The state of the commutator surface is highly important for the perfect wotking of the dynamo. The surface should be uniformly smooth and should have a greyish aspect; moreover it must be free from dust, oil and grease. The commutator must run absolutely true, as otherwise the brushes would have bad contact, thus impairing a trouble free supply of electricity. Clean dirty commutators with a clean, petrol soaked cloth, let them dry afterwards. Commutators that have become worn (max. out of true: .012" (0.03 mm) or scored are to be skimmed off by turning in a lathe (do not turn off more than necessary), then saw out (undercut) the insulationsbetween the individual terminals of the commutator. Before refitting the armature, smooth the commutator surface by using very fine glass paper (never use emery cloth) and clean the commutator by compressed air.

5.) Lubrication :

The dynamo is fitted with ball bearings which need not to be lubricated especially as the special grease contained in them will last to the next dynamo repair. Strip the dynamo every 15.000 miles (24.000 km), wash the old grease out with petrol and put in new Bosch special grease.

e) Trouble elimination:

In case of troubles occurring in the generating equipment note that the cause must not always be looked for in the dynamo or the cutout switch, but may also be with the battery or the wires. For troubles that may occur we give the following list of possible causes and their remedies.

Cause:	Remedy:
a) Battery is not charged or not charged sufficiently:	
1.) Brushes do not rest properly upon the commutator, are jammed in their guides, are worn out or oil-covered or dirty.	1.) Check brushes, clean or replace them.
2.) Commutator dirty or contaminated by lubricating oil.	2.) Clean commutator.
3.) Commutator worn out	3.) Skim commutator by turning, undercut segments.
4.) The lead 30 / 51 between battery and regulator or ground strap from battery or dynamo losse or damaged.	4.) Repair or replace leads or straps, tighten connections.
5.) Battery defective	5.) Have battery repaired in a specialist workshop
6.) Interruption, grounded or short-circuited winding in dynamo.	6.) Check dynamo, have it repaired in a specialist workshop.
7.) Cutout adjustment too low, regulator cutout defective.	7,) Adjust voltage regulator cutout switch or replace if defective.
8.) Vee - belt too loose.	8.) Adjust Vee - belt tension.
b) Charging control lamp does not light with switched on ignition and stationary engine.	
1.) Charging control lamp burnt out	1.) Replace lamp.
2.) Battery discharged.	2.) Charge battery.
3.) Battery defective.	3.) Replace battery or have it repaired.
4.) Cables 61.30 or 31 disconnected or defective.	4.) Repair cables, tighten connections.
5.) Cutout switch defective.	5.) Replace cutout switch.
c) Charging control lamp does not extinguish at increased revolutions.	
1.) Cable 61 grounded	1.) Repair or replace cable.
	2.) Replace cutout relay or replace fuse by a copper wire dia, .026" (0.65 mm). Install a groundwire dia .0337 sq.in. (2.5 sq.mm) from dynamo to regulator support.

III. Voltage regulator and cutout switch:

Bosch-voltage regulators type RS / ZD / 160 / 12 / A 3 united with the starter selenoid or RS / TBA 160 / 12 / 1 with a seperate starter selenoid type SSM / 120 L / 47 Z are used.

For models with full interference suppression Bosch-voltage regulators type RS / UAM / 160 / 12 / 1 or RS / TBA 160 / 12 / 1 (tropical equipment) with separate starter selenoid type SSM / 120 L / 47 Z are used.

The Bosch -voltage regulator is a combined unit where voltage regulator, cutout switch and starter selenoid are housed under the same cover.

The voltage regulator is a socalled 2-contact switch and works after the system of progressive control, reducing the voltage with increasing load. Therefore a discharged battery will be charged with high voltage current, whereas a well charged battery will be charged with low voltage current. This prevents overloading of the battery.

a) Starter selenoid:

1.) Structure

The starter selenoid consists of:

The U-shaped bracket.

The magnetic core.

The induction winding.

The contact carrier with contacts.

2.) Working

By pressing the starter button the induction winding upon the magnetic core is set under tension, which renders the iron core magnetic; the contact carrier is attracted and closes the contacts. Over the thus closed contacts, current flows from the battery through the starter field coils, the armature winding and via earth strap and body back to the battery, turning the engine in operating direction. After releasing the starter button the circuit in the winding of the starter selenoid is interrupted and the spring-loaded contact carrier opens the contacts, thus switching off the starter winding.

b) Voltage regulator-cutout switch:

Cutout

1.) Structure

Important parts:

The selenoid bracket, the selenoid core, the regulator contact carrier, the cutout contact carrier, the cutout contacts and the regulator contacts.

The selenoid core carries the voltage coil, which consists of many windings of thin wire and the current coil which consits of a few windings of thick wire. Regulator carrier and cutout carrier are suspended upon leaf springs which act against the attractive power of the selenoid core.

2.) Function of the cutout switch:

With the engine turning slowly (or stationary) the dynamo must be automatically disconnected from the battery as in this case the dynamo voltage is lower than the battery voltage and the battery would be discharged via the dynamo.

With the engine speed increasing, the cutout contact carrier automatically connects the dynamo in parallel with the battery. Hence the dynamo takes charge of supplying current to the consumers and of charging the battery.

3.) Working :

The cutout contacts close as soon as the engine has reached sufficient speed, the cutting-in speed. Through the effect of the voltage coil the contact carrier of the cutout is attracted and the dynamo is connected in parallel with the battery.

The voltage of the dynamo being in this case slightly higher than that of the battery current flows from the dynamo to the battery. The battery is charged.

This current that now flows through the current coil is an additional warrant that the cutout contacts remain firmly closed as long as the engine speed is sufficiently high.

The cutout contacts open as soon as the engine speed decreases to the extent that the dynamo voltage is lower than that of the battery and that the "return current" becomes effective enough for the current coil to push off the cutout contact carrier.

The charging control lamp is connected with the cutout contacts. It is connected in series with the ignition switch and connected to the terminal 61 of the voltage regulator. It lights as long as the ignition is switched on and the dynamo is stationary or has a lower voltage than that of the battery i.e. as long as the cutout contacts are open. Because of the fall in voltage between battery and dynamo a current flows from the positive terminal of the battery via the charging lamp to the positive brush. The lighting of the lamp indicates that the ignition is switched on but that the dynamo is not yet working. The lamp will extinguish as soon as the dynamo voltage reaches the battery voltage and the cutout contacts close. Then the lamp is short-circuited. Th~~e~~ The extinguishing of the lamp indicates that the dynamo is working and that it is connected to the electric system. This however does not always mean that the dynamo is charging. (See fig. 8 / 1).

c) Voltage regulator :

1.) <u>Working</u>

During the first stage of regulating the outer fixed regulator contact and the outer contact of the contact carrier are opening and closing in rapid succession some 50 - 200 times per second. At the moments these contacts are open a resistance is connected in series with the induction winding which will lower the voltage of the dynamo. Due to the high frequency the voltage is maintained at a constant value.

With further increasing revolutions of the dynamo the contact carrier will be further attracted by the voltage selenoid so that the inner fixed contact and the inner contact of the contact carrier are commencing to operate. When these contacts are closed, the induction winding of the dynamo is short-circuited. Again the opening and the closing of these contacts occur in rapid succession, thus maintaining the voltage within the permissible range.

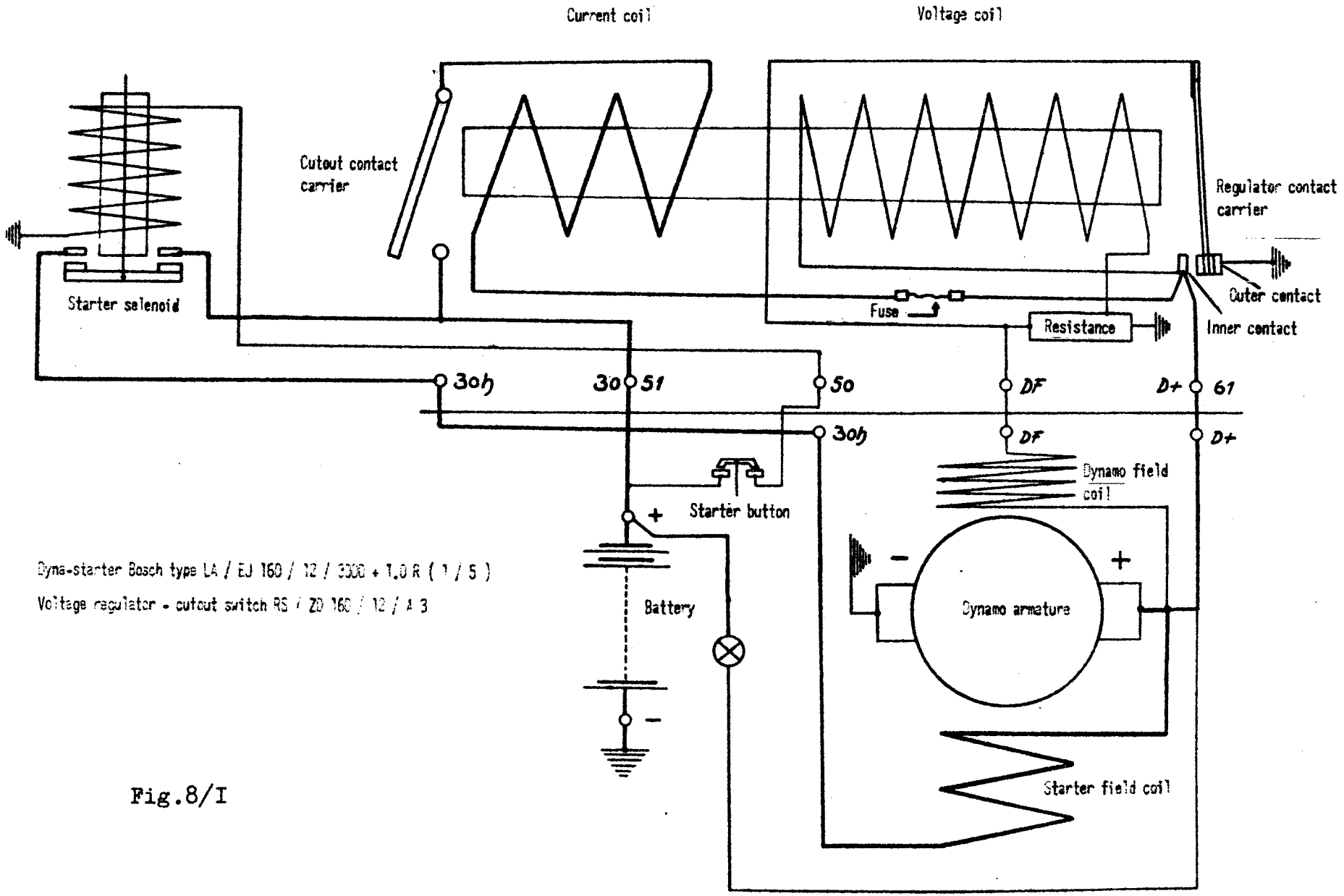

Current coil
Voltage coil
Cutout contact carrier
Regulator contact carrier
Starter solenoid
Fuse
Resistance
Outer contact
Inner contact
30h
30
51
50
DF
D+
61
Starter button
Dynamo field coil
Battery
Dynamo armature
Starter field coil
Dyna-starter Bosch type LA / EJ 160 / 12 / 3300 + 1,0 R (1 / 5)
Voltage regulator - cutout switch RS / ZD 160 / 12 / A 3

Fig.8/I

The current coil through which the entire dynamo current flows, lowers the output voltage slightly with increasing load thus protecting the dynamo against overloading. This type regulator has an inclined characteristic curve.

d) Maintenance:

The voltage regulator cutout switch requires no maintenance. Regulators, the contacts of which do not longer meet the requirements must be replaced.

e) Adjustment of the idling voltage and of the return current:

Do not open the sealed regulator box during the period of guarantee as Bosch refuses all claims for compensation in such a case.

1.) Checking idling voltage:

For checking the idling voltage a D.C. revolving coil voltmeter with a range of 20 V is required.

Proceed as follows:

a) Disconnect the lead 30 / 51 at the positive terminal of the battery.

b) Connect the positive terminal of the voltmeter to the terminal 30 / 51 (B + / 30) of the voltage regulator. Earth the negative terminal of the voltmeter.

c) Reconnect the lead 30 / 51 to the positive terminal of the battery, start the engine, adjust a slightly increased idling speed and disconnect the lead 30 / 51 at the positive terminal of the battery.

d) Increase slowly the engine speed until the voltmeter reaches its max. deflexion and note the idling voltage.

Idling voltage for Bosch or Bären - batteries : 14.5 - 15.1 Volt.

In case the voltmeter reads a voltage of 14.5 - 14.7 Volt, a readjusting of the idling voltage is not necessary.

e) Increase the engine speed to 4 000 RPM. At this speed the above indicated voltage should not change by more than $\pm$ 0.1 Volt.

f) During the above operations the cover for the regulator must be fitted and the engine must have operating temperature.

2.) Readjusting idling voltage:

a) If adjustment becomes necessary remove the regulator cover. Bend the fixing bracket of the regulator contact carrier slightly inwards in order to obtain a higher idling voltage (fig. 8 / 11) and slightly outwards for lower idling voltage. This operation is carried out by means of the regulator adjusting tool (fig. 8 / 11).

The engine must be at operating temperature.

Note: When reinstalling the cover for the regulator the adjusted idling voltage will automatically diminish by approx. 0.1 - 0.2 V.

b) In order to prevent short-circuiting when reinstalling the regulator cover switch off the engine (do not disconnect the positive lead of the battery). Recheck idling voltage.

3.) Checking the return current:

For checking the return current an Amperemeter with charge and discharge indication and a range of 15 - 0 - 15 is required.

Proceed as follows:

a) Disconnect the positive lead at the positive terminal of the battery and connect to this cable the negative terminal of the Ammeter. The positive terminal of the ammeter is connected to the positive terminal of the battery.

b) Before starting the engine short-circuit the Ammeter i.e. reconnect the lead 30 / 51 as otherwise the Ammeter would be damaged by the starter current. After starting the engine disconnect the lead 30 / 51.

c) Increase engine speed until a positive reading of the ammeter is indicated (charging), then switch off the engine. The engine speed will decrease and the finger of the Ammeter will return to zero, pass zero and indicate discharging before it will return to zero. The discharging current indicated is the socalled return current and should be between 4 - 9 Amperes. In case the ammeter indicated a 5 Amp. return current it is an indication that the cutout switch disconnected the dynamo from the battery at 5 AMP.

4.) Adjusting the return current:

Before adjusting the return current check the charging condition of the battery by means of a Hydrometer. The battery must be at least half charged. In case the above check has been carried out with an insufficiently charged battery, check once more the return current with a fully charged battery.

Should the return current be less than 4 Amp. or more than 9 Amp. the battery is exposed to additional and unnecessary strain, therefore readjust the cutout switch.

a) Remove the regulator cover and disconnect the Ammeter at one terminal and bend the fixing bracket of the cutout contact carrier slightly inwards to obtain a lower return current (Fig. 8 / 11.) and slightly outwards for higher return current.

b) Reconnect the Ammeter and check the return current as outlined under Para 3 "Checking the return current". After the return current has been adjusted correctly close the cover of the regulator (stationary engine) and connect the lead 30 / 51 at the positive terminal of the battery.

5.) Residual charging current:

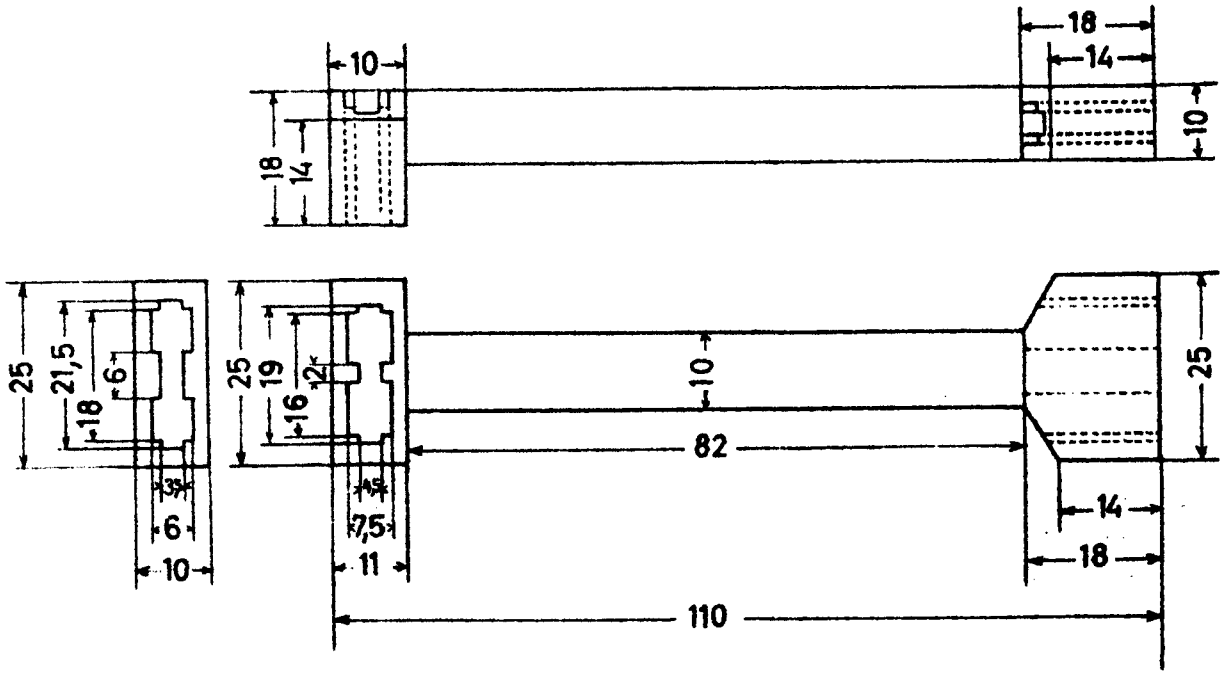
With fully charged battery and an acid temperature of 86° F (20° C) and day driving the charging current should be 0.8 - 1.0 Amp. In case the battery should not be fully charged the charging current will be correspondingly higher.

IV. Ignition:

a) Ignition coil

The case of the ignition coil contains an iron core carrying the primary winding (low voltage) and the secondary winding (high voltage). At every ignition point the contact breaker interrupts the primary current, the magnetic field collapses and creates a high tension in the secondary winding. This high tension will be transmitted to the spark plug electrodes by means of the distributor.

Voltage regulator adjusting tool



All measures are quoted in mm

Voltage regulator Bosch RS/ZD 160/12 A3

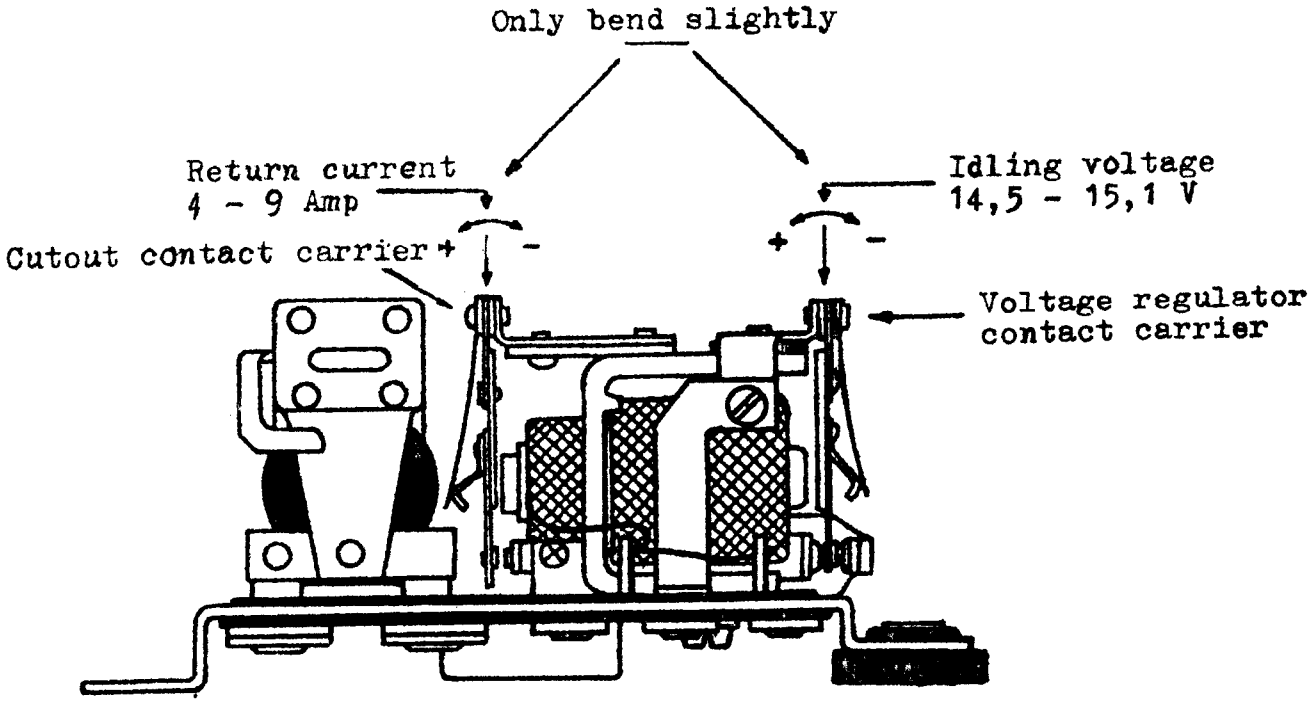


Fig. 8/II

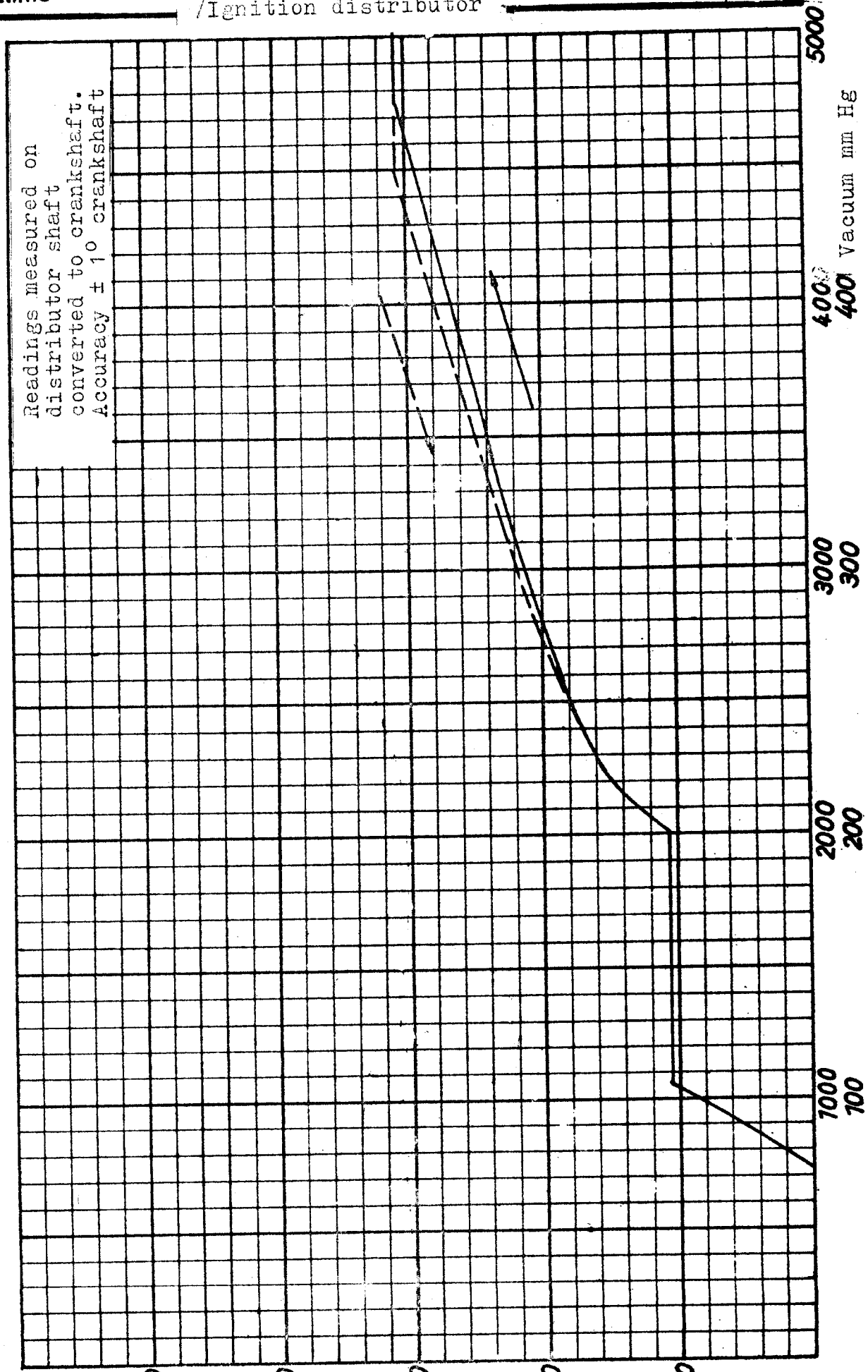
BOSCH
EZU
Verstellinie

VJU 2 BR... nach ZV2/3733
Zündverteiler E 12/54
für Steyr-Daimler-Puch

Schaublatt
EZU 1363
Bl.2

/Ignition distributor

Änderung	durch



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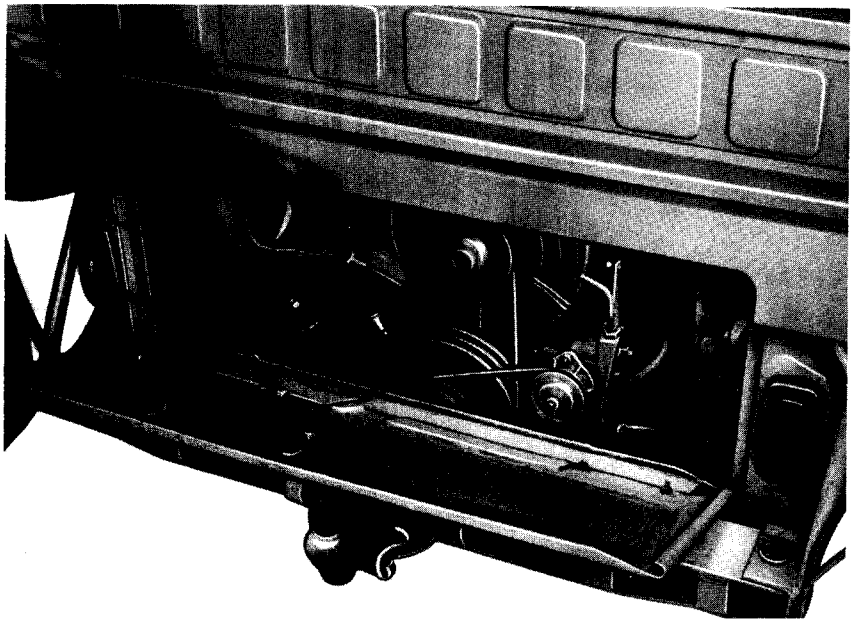


Fig. 8/IV

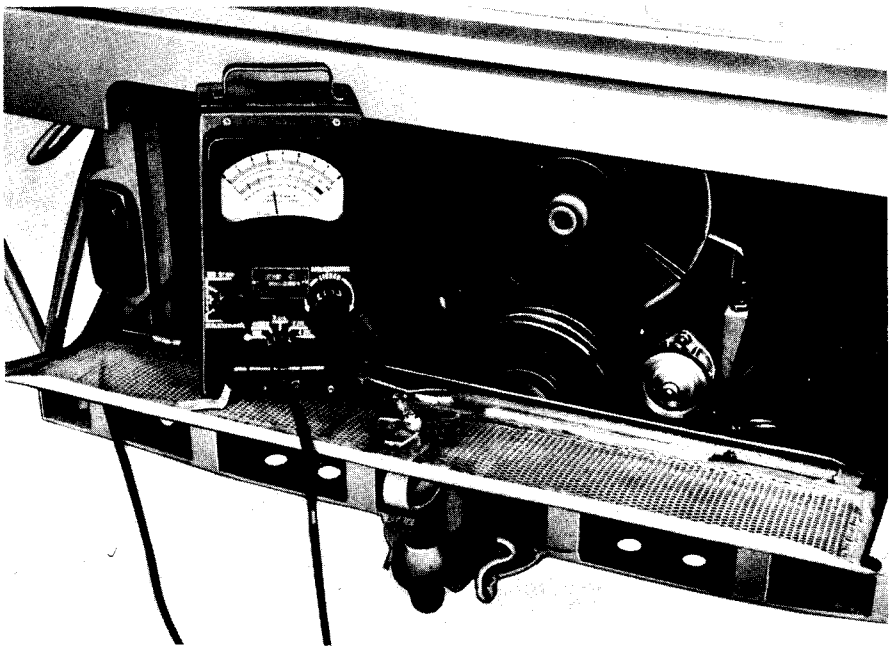


Fig. 8/V

b) Condenser:

Two strips of aluminium foil and insulating paper inbetween are coiled up and set into a box. The condenser is connected in parallel to the contact breaker, prevents the forming of sparks and contacts and also prolongs the life of the breaker contacts causes quicker collapsing of the magnetic field, which in turn will increase the tension of the secondary winding.

c) Checking the ignition coils and the condenser:

When checking ignition coils or condensers by means of usual checking devices make sure that the components are checked at operating temperatures.

d) Ignition:

The maximum engine output is obtained when the max. combustion pressure occurs immediately after the piston has passed top dead center (t.d.c.). As the fuel / air mixture takes some time until it is fully inflamed i.e. has reached its max. combustion pressure, the ignition must take place at a certain position of the piston before t.d.c. The ignition advance gauged at the double Vee - belt pulley should be .236 - .275 in. (6 - 7 mm) before t.d.c.

The advance must increase with increasing engine speed.

e) Centrifugal advance mechanism:

The centrifugal advance mechanism of the distributor has the task to adjust automatically, following a specific curve, the ignition timing required for the various engine speeds. Thus the engine operates at any crankshaft speed with its corresponding max. output. The max. advance of the distributor is 32^{0} (1.77" (45 mm)) gauged at the double Vee - belt pulley (fig. 8 / III). The centrifugal advance may be checked by means of a power timing light (fig. 8 / IV).

f) Closing angle:

A correct closing angle of the contact breaker points is most important for a troublefree working of the ignition system. The closing angle is the angle during which the breaker points are closed. With increasing the number of revolutions the closing periods become shorter and shorter so that the current of the primary winding cannot reach its maximum. If the closing angle in its initial setting is too small it might cause misfiring at high revolutions. If on the other hand, the closing angle is too large it entails excessive current in the primary winding, the ignition coil becomes too hot and the breaker contacts will be destroyed.

The closing angle on Steyr - Puch motor cars is $57 - 63^{0}$. The closing angle is checked by means of a distributor tester and may be adjusted by altering the contact breaker gap (fig. 8 / V). Gauge the closingngle at idling speed, then increase engine revolutions to approx. 4000 RPM and note the closing angle once more. At this speed the closing angle may be smaller by a max. of 3^{0} than at idling speed. Is the difference more than 3^{0}, the distributor is mechanically worn out. A more or less correct closing angle is obtained with new breakerscontacts and a gap of 0.15" (0.4 mm).

V. Adjusting the head lights:

Place the vehicle loaded with four persons at a distance of 16.4 ft. (5 m) in front of a vertical wall and switch on both the head lights. The centre of the beams must be at the same height as the centre of the head lights. With dipped head lights the line between light and shade on the wall must be 2" (5 cm) lower than the centres of the head light beams. Adjusting is done by turning the retaining nuts of the headlight assys.

VI. Wiring diagram:

Repair work on the wiring system always should be carried out in conjunction with the wiring diagram.

Conversion table for wiring diagrams:

schwarz	=	black
blau	=	blue
weiß	=	white
braun	=	brown
rot	=	red
grün	=	green
lila	=	lilac
grau	=	grey
gelb	=	yellow
orange	=	orange

Wiring diagram

I. Standard model

1 Headlamp l.h.s.

2 Headlamp r.h.s.

3 Trafficator, front l.h.s.

4 Trafficator, front r.h.s.

5 Trafficator l.h.s.

6 Trafficator r.h.s.

7 Windscreen wiper

8 Electric horn

9 Horn button

10 Speedometer illumination

11 Headlamp control light

12 Trafficator control light

13 Oil pressure warning light

14 Charging control light

15 Switch for windscreen wiper

16 Fuse box

17 Trafficator switch

18 Trafficator relay

19 Ignition light switch

20 Dipper switch

21 Brake light switch

22 Starter switch

23 Battery

24 Voltage regulator

25 Dyna-starter

26 Oil pressure control switch

27 Ignition coil

28 Distributor

29 Combined tail brake trafficator light l.h.s.

30 Combined tail brake trafficator light r.h.s.

31 Number plate lamp

32 Reading lamp

Wiring diagram

II. Model with camouflage equipment.

1 Headlamp l.h.s.
2 Headlamp r.h.s.
3 Camouflage light
4 Trafficator, front l.h.s.
5 Trafficator, front r.h.s.
6 Trafficator, l.h.s.
7 Trafficator, r.h.s.
8 Windscreen wiper
9 Electric horn
10 Horn button
11 Speedometer illumination
12 Headlamp control light
13 Traffictor control light
14 Oil pressure warning light
15 Charging control light
16 Switch for windscreen wiper
17 Fuse box
18 Trafficator switch
19 Trafficator relay
20 Ignition light camouflage switch
21 Plug
22 Dipper switch
23 Brake light switch
24 Starter switch
25 Battery
26 Voltage regulator
27 Dyna-starter
28 Oil pressure control switch
29 Ignition coil
30 Distributor
31 Combined tail brake trafficator light l.h.s.
32 Combined tail brake traficator light r.h.s.
33 Number plate lamp
34 Camouflage tail light
35 Night march device
36 Camouflage brake light
37 Reading lamp
38 Spark plugs
39 Starter selenoid
40 Fuse 25 A

Wiring diagram

III. Model with tropical equipment

1 Headlamp l.h.s.

2 Headlamp r.h.s.

3 Trafficator, front l.h.s.

4 Trafficator, front r.h.s.

7 Windscreen wiper

8 Electric horn

9 Horn button

10 Speedometer illumination

11 Headlamp control light

12 Trafficator control light

13 Oil pressure warning light

14 Charging control light

15 Switch for windscreen wiper

16 Fuse box

17 Trafficator switch

18 Trafficator relay

19 Ignition light switch

20 Dipper switch

21 Brake light switch

22 Starter switch

23 Battery

24 Voltage regulator

25 Dyna-starter

26 Oil pressure control switch

27 Ignition coil

28 Distributor

29 Combined tail brake trafficator light l.h.s.

30 Combined tail brake trafficator light r.h.s.

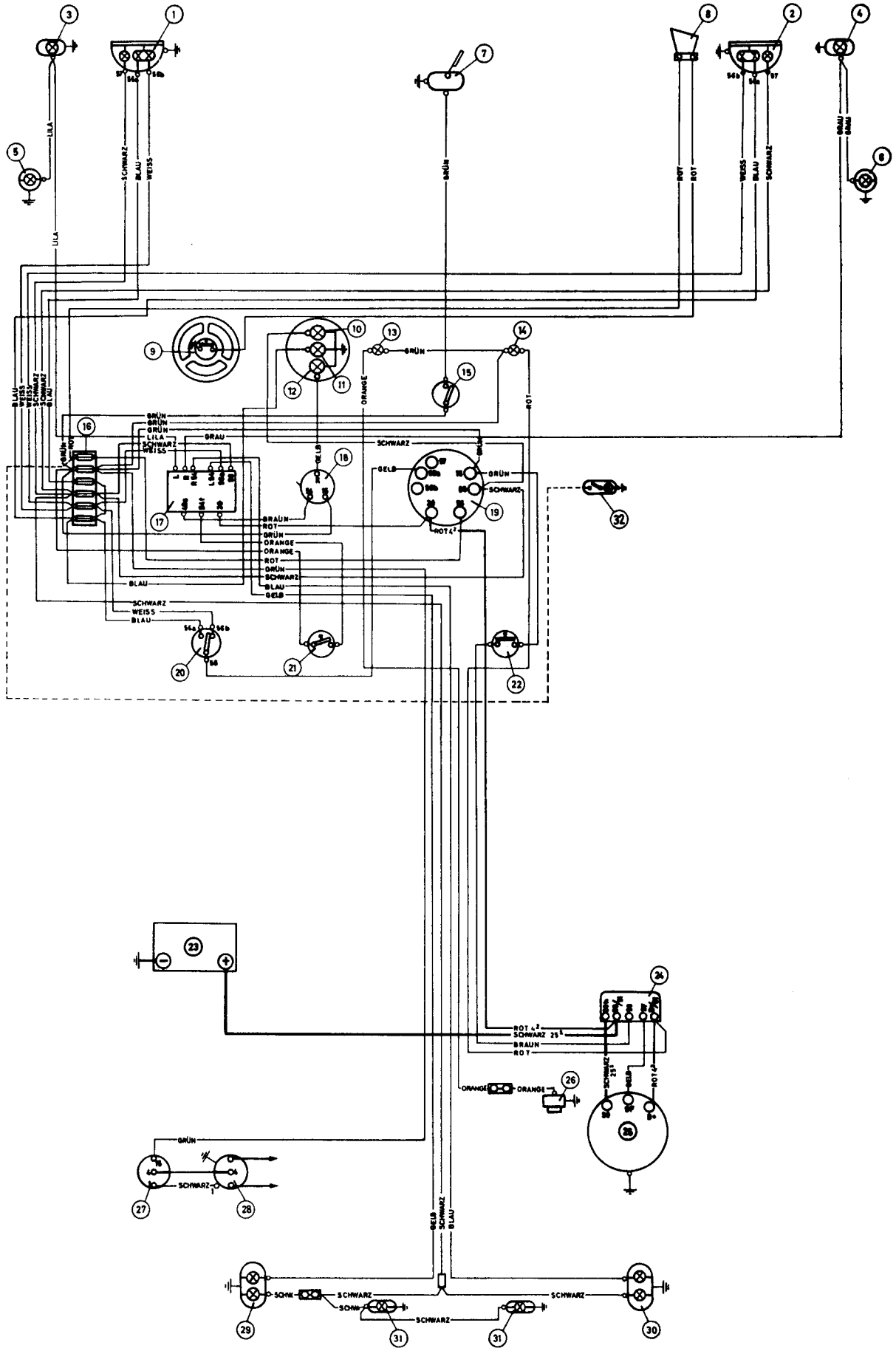
31 Number plate lamp

33 Fuse 25 A

34 Starter selenoid

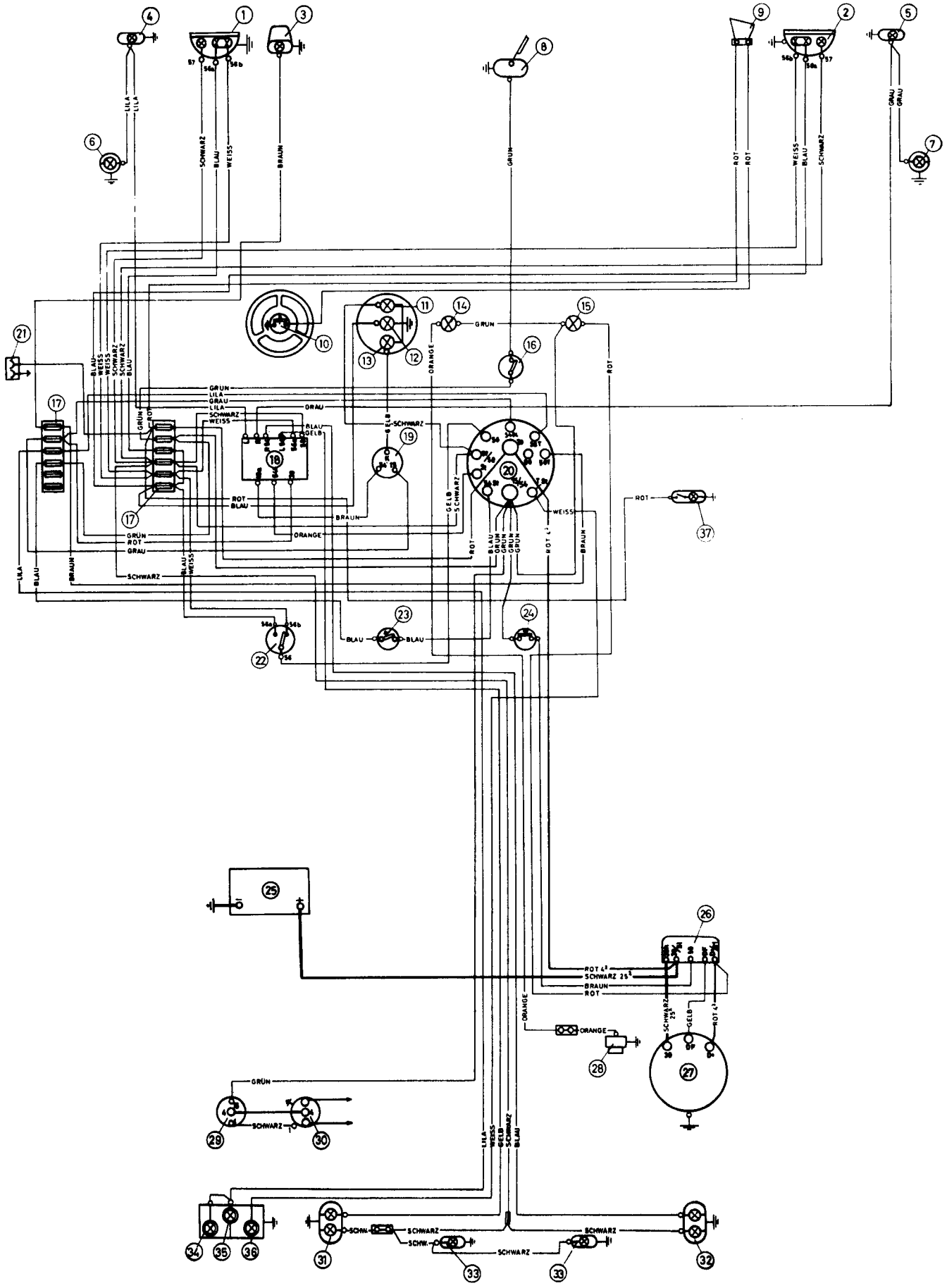
W I R I N G D I A G R A M

I. STANDARD MODELS



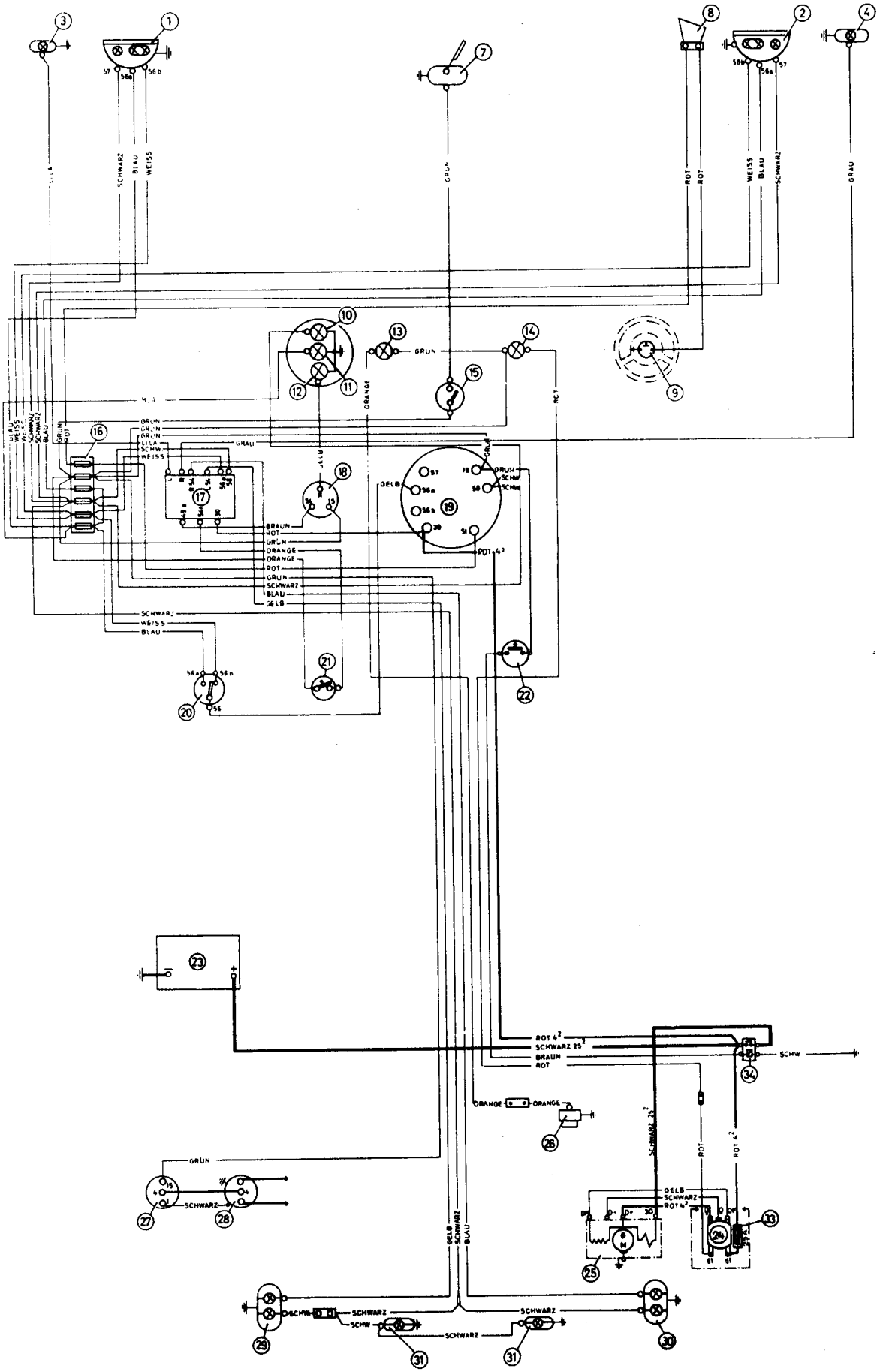
WIRING DIAGRAM

II. MODELS WITH CAMOUFLAGE EQUIPMENT



W I R I N G D I A G R A M

III. MODELS WITH TROPICAL EQUIPMENT



Group 10 : Special tools

I. List of tools

Engine:

1	Flywheel holder with box wrench	501.1.1001.5 - W 4
1	Puller for camshaft timing gear	501.1.5520.2
1	Driver for camshaft timing gear	501.1.5533
1	Valve-lifter for removing and installing split cones	501.1.55.021.0
1	Driver for oil seal, flywheel side	501.1.5522
1	Driver for oil seal, pulley side	501.1.5523
1	Dummy shaft for clutch plate	501.1.5524
1	Tappet clearance adjusting wrench	501.1.55.034.1
1	Aligning fork for cam follower	501.1.55.038.1
1	Flywheel puller	501.1.5531.2
1	Connecting rod aligner	501.1.55.049.1
1	Device with dial clock for checking clutch withdrawal ring and flywheel for end float and out of true	501.1.55.051.0
1	Face cutter for mushroom valve	501.1.55.055.0
1	Device for checking backlash of camshaft timing gear	501.1.55.047.0
1	Hammering - in tool for mushroom valve	501.1.55.052.1
1	Fork for adjusting oil pump casing	501.1.55.053.1

Gearbox and chassis

1	Driver and guide for oil seal, clutch shaft	700.1.21.000.5 W 42
1	Driver and guide for oil seal, differential lock	700.1.21.000.5 W 50
1	Locker for pinion, hub gear, 14 teeth	700.1.55.037.2
1	Driver for oil seal, propeller shaft	700.1.55.038.2
1	Compressors for road springs	700.1.55.040.2
1	Jig for adjusting selector forks	700.1.55.041.2
1	Gauging device for adjusting crown wheel and pinion	501.1.2100. 5 L 3
1	Puller for outer race, pinion bearing	700.1.55.039.2
1	Device for pressing in and out gear cluster and front drive pinion	700.1.55.043.0
1	Device for checking alignment of front swinging axles	700.1.41.155.2 L 14

1	Device for checking alignment of rear swinging axles	700.1.34.176.1 L 4
1	Face cutter for final drive side cover	501.1.55.048.0

Assembly trestles

1	Engine assembly trestle	501.1.1001.5 W 1
1	Front axle assembly trestle	700.1.21.000.5 W 19
1	Rear axle assembly trestle	501.1.2100.5 W 4

II. Application of special tools

Engine

Flywheel holder with box wrench, part no. 501.1.1001.5 - W 4.

is used for locking the flywheel when undoing or tightening the flywheel retaining bolt.

The bracket of the flywheel holder is inserted into the two upper fixing holes of the engine mounting flange and bolted onto the flywheel. At the same time the special box wrench is fixed so that undoing and tightening of the retaining bolt is an easy and safe job.

Puller for camshaft timing gear, part no. 501.1.5520.2,

is used for pulling off the timing gear from the crankshaft. The mushroom type plug must be inserted into the screw hole of the crankshaft, the puller is slid behind the timing gear from the side and all components of the crankshaft are pulled off.

Note: The locating key for the double Vee-belt pulley must be removed first.

Driver for camshaft timing gear, part no. 501.1.5533 ,

for mounting of the camshaft timing gear. Insert the key in the crankshaft, slide on the timing gear with the chamfer pointing towards the crankweb, line up with the key and press on with the driver.

Valve lifter for removing and installing split cones part no. 501.1.55.021.0,

fasten the bracket into a benchvice and fasten the cylinder head by means of the wing-nuts. Mount the lifter either on the exhaust flange - or intake flange studs, compress the valve springs and remove or insert the split cones.

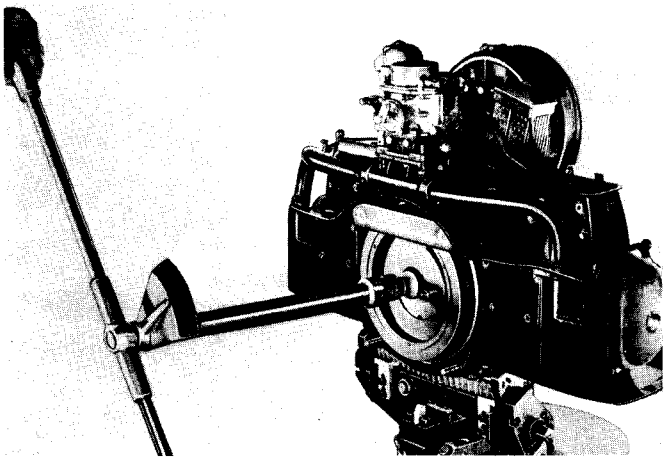
Driver for oil seal, flywheel side, part no. 501.1.5522,

Apply some gasket cement on the circumference of the oil seal and install by means of the driver.

Note: The sealing edge of the oil seal must be greased prior to installing.

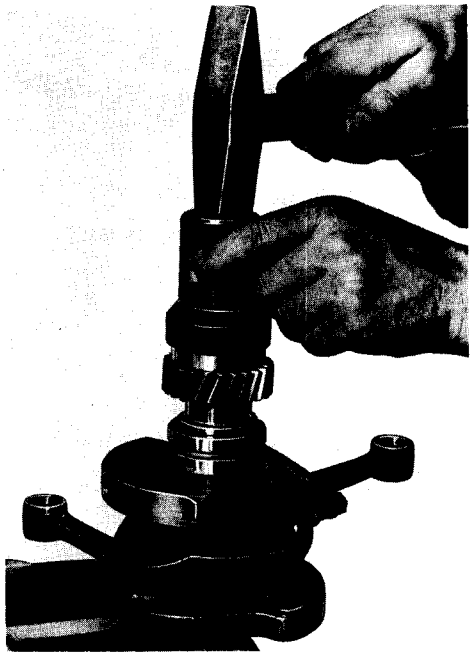
Driver for oil seal pulley side part no. 501.1.5523 ,

proceed as above.

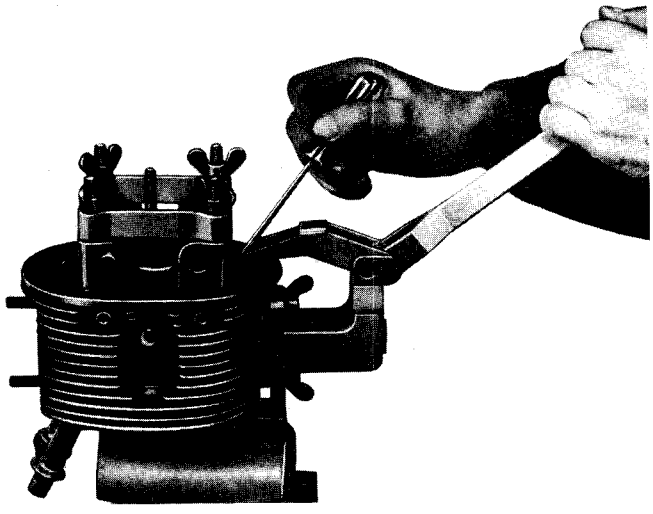


Pos. 501.1.1001.5-W4

Pos. 501.1.5520.2



Pos. 501.1.5533



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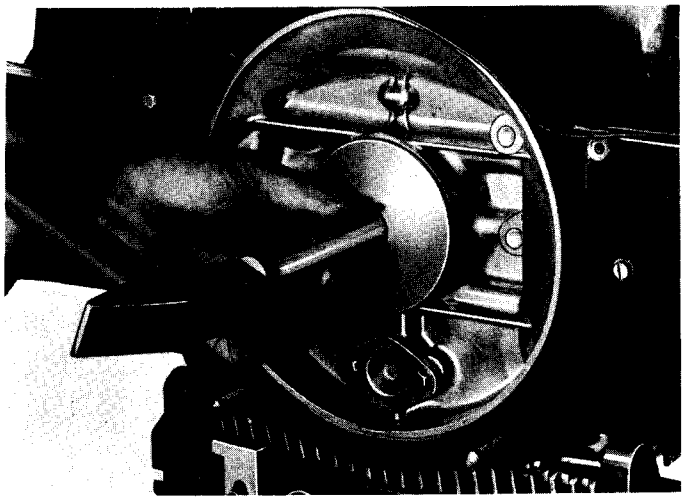

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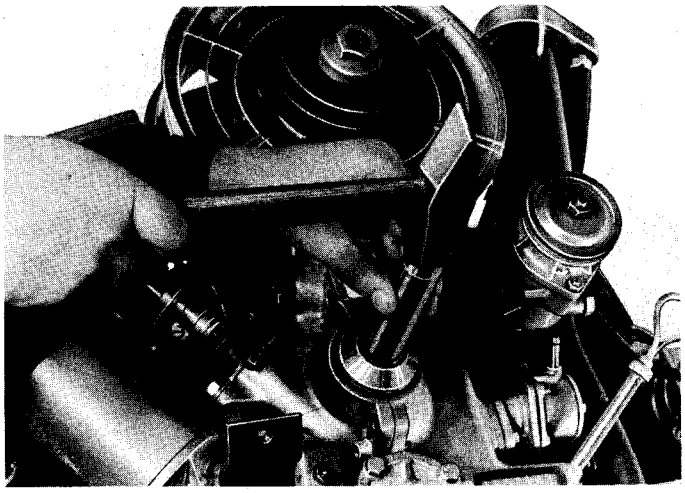

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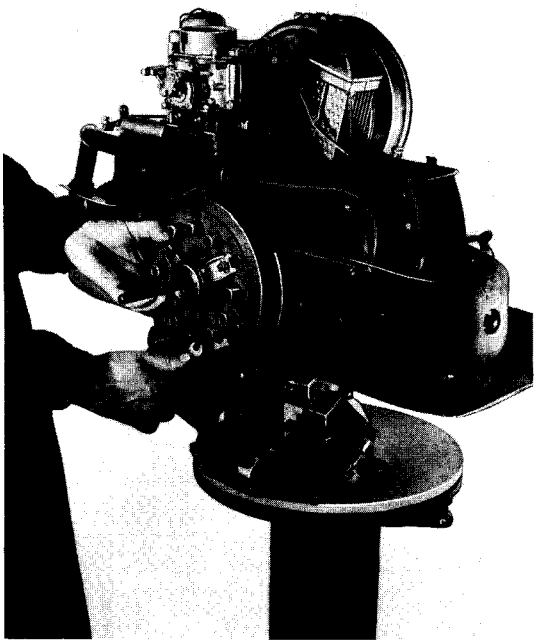
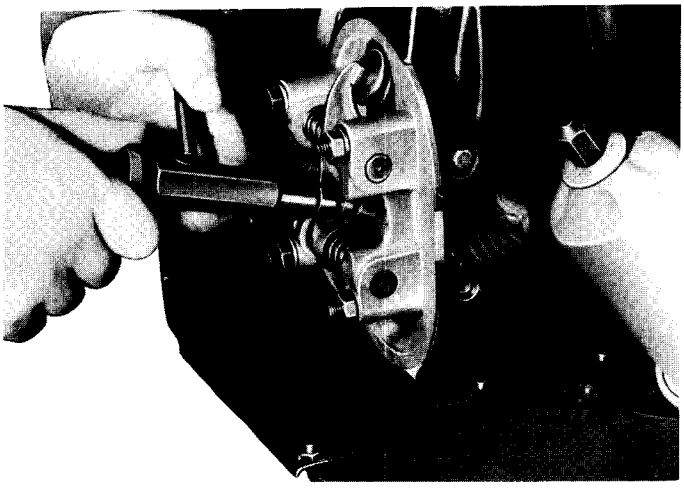




Pos. 501.1.55.034.1

Dummy shaft for clutch plate part no. 501.1.5524 ,

Insert the dummy shaft into the auxiliary bearing of the flywheel retaining bolt, slide on the clutch plate and install the clutch assy.

Tappet clearance adjusting wrench , part no. 501.1.55.034.1 ,

after slackening of the tappet locknut. The tappet clearance is adjusted by means of the built in screwdriver. After the adjusting, the screw is also kept in position by the screwdriver for locking the nut.

Aligning fork for cam follower, part no. 501.1.55.038.1 ,

After installing of the cam followers into the crankcase halves, the camshaft complete with its bearing is inserted into the resp.crankcase halves and the contact of the cam followers, on each cam checked. (Cam and cam follower must be absolutely parallel). If necessary bend the cam followers by means of the aligning fork.

Flywheel puller, part no. 501.1.5531.2 ,

After undoing the flywheel retaining bolt remove the flywheel holder, fasten the flywheel puller by means of the two bolts and pull off.

Connecting rod aligner, part no. 501.1.55.049.i ,

Insert the device in place of the cylinder before installing the piston. Fit the gudgeon pin and check the parallelity of the gudgeon pin to the face of the device. If necessary bend the connecting rod by means of adjusting forks.

Note: The gauging device, as well as the crankcase must be absolutely clean.

Device with dial clock for chedking clutch withdrawal ring for out of true and flywheel for end float and out of true, part no. 501.1.55.051.0 ,

Fasten the bracket onto the lower engine fixing studs and adjust the dial gauge onto the withdrawal ring. By turning of the flywheel, the out of true of the withdrawal ring can be gauged. Through axial movement of the crankshaft, the end float can be determined.

Face cutter and hammering-in tool for mushroom valve, part nos. 501.1.55.055.0 and 501.55.052.1.

If the valve seat of the oil pressure control valve (mushroom valve) has become too wide or defective, the valve seat is cut to a sharp edge by means of the face cutter. After inserting the mushroom valve into the hammering-in tool, insert the tool into the oil pump cover and tap gently forming the valve seat.

Device for checking backlash of camshaft timing gear, part no. 501.1.55.047.1 ,

Remove the oil strainer elbow on older type engines, on later models remove the oil strainer at the bottom of the crankcase and the oil pump intake elbow. Mount the device instead and adjust the "puppi-tast" onto the tooth flank of the timing gear.

Slacken off all tappet adjusting screws in order to have no pressure on the camshaft. Rock the camshaft timing gear by means of a soft pin inserted through the oil drain hole and note the backlash.

Fork for adjusting oil pump casing, part no. 501.1.55.053.1 ,

In case of excessive backlash of the timing gears, slightly slacken off the oil pump fixing screws and move the oil pump towards the crankshaft by means of the adjusting fork (hammer gently). Tighten the oil pump and make sure to check the backlash once more by means of the device 501.1.55.047.0.

Gearbox and chassis:

Driver and guide for oil seal, clutch shaft, part no. 700.1.21.000.5 - W 42 ,

Slide the guide onto the splines of the clutch shaft, lubricate the oil seal at the sealing edge and also on the circumference. Slide onto the guide and press in by means of the driver.

Guide and driver for oil seal, differential lock part no. 700.1.21.000.5 - W 50 ,

Screw the guide into the shaft of the differential lock shift fork, lubricate the oil seal, apply some gasket cement on the circumference and press in by means of the driver.

Locker for pinion, hubgear, part no. 700.1.55.037.2 ,

to lock the pinion when undoing or tightening the pinion retaining nuts on the half shafts.

Driver for oil seal propeller shaft, part no 700.1.55.038.2 ,

for pressing in of the oil seal into the bearing flange of the backbone tube.

Compressors for road springs, part no. 700.1.55.040.2 ,

for compressing the road spring for removing and installing. Always use a pair of compressors diametrally opposite each other.

Note : Release the spring slowly because of their considerable pressure.

Jig for adjusting selector forks, part no 700.1.55.041.2 ,

Clamp complete gear cluster with intermediate flange into the jig and adjust the selector forks as outlined.

Gauging device for adjusting crown wheel and pinion, part no 501.1.2100.5 - L 3 ,

For gauging the position of the pinion adjust the dial clock on the master gauge and insert into the final drive casing. For detailed instructions see under "Adjusting crown wheel and pinion".

Puller for outer race, pinion bearing part no. 700.1.55.039.2 ,

After removing of the retaining plate insert the puller into the needle bearing (from the final drive casing) put the cross piece across the gearbox and pull out the bearing by means of the spindle.

Device for pressing in and out gear cluster and front drive pinion, part no. 700.1.55.043.0 ,

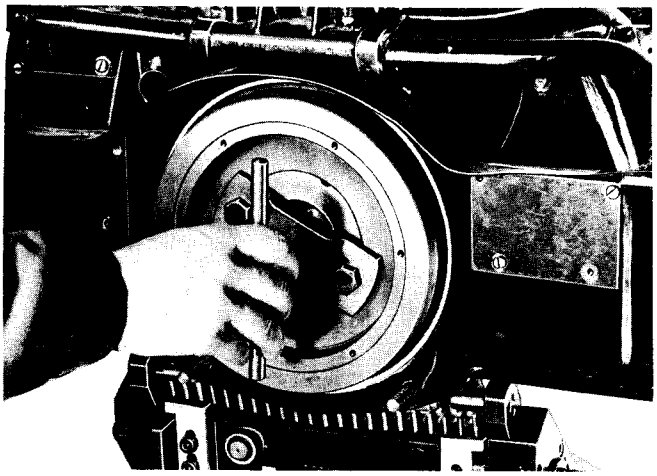
a) This device has a wide range of application and consists of the following parts:

A table shaped support with two removable supporting plates.

A locking ring for the drive pinion with three locking notches.

Special twintube driver for pressing the gear cluster and layshaft into the intermediate flange.

A special split washer to insert between the fourth speed gear wheel and the 3rd - 4th synchronizer assy when pressing out the gear cluster.



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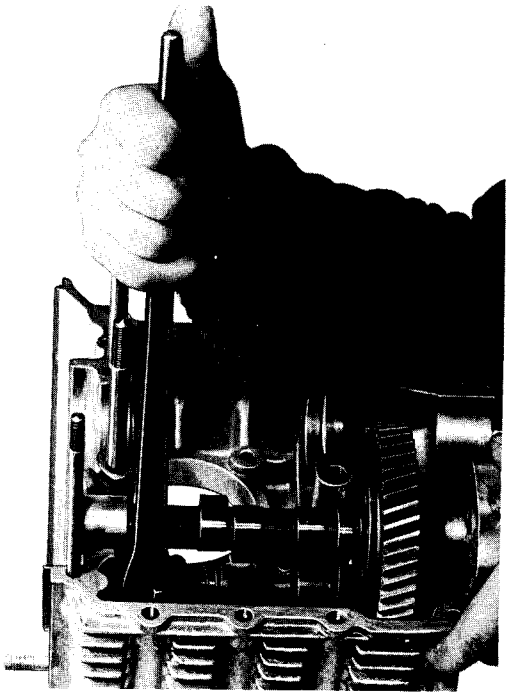

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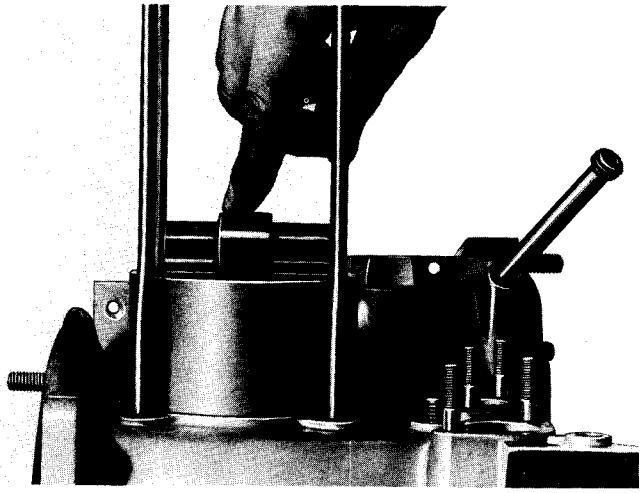

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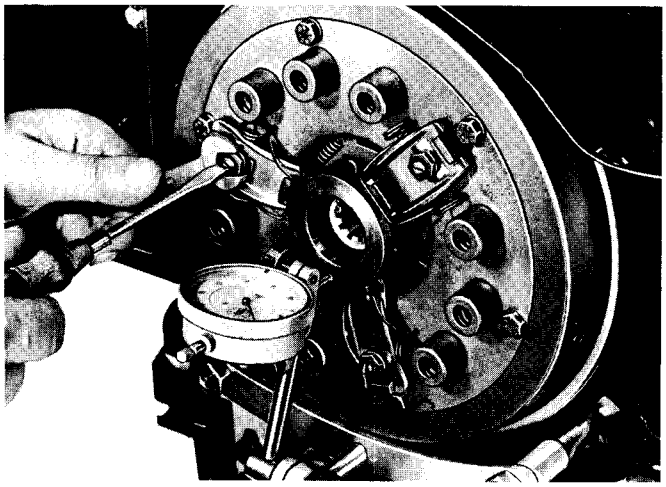

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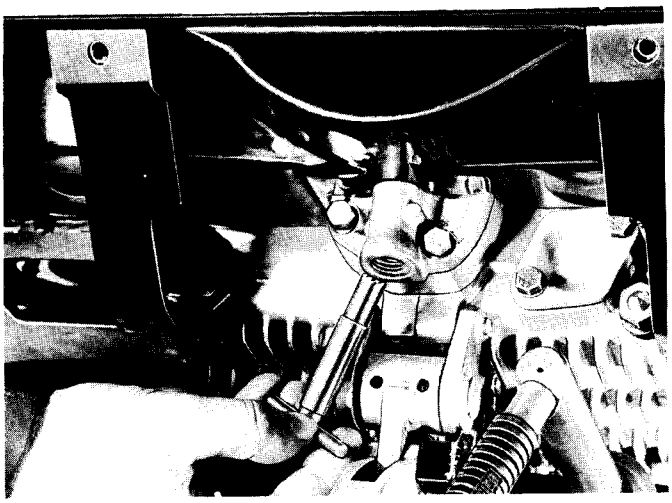

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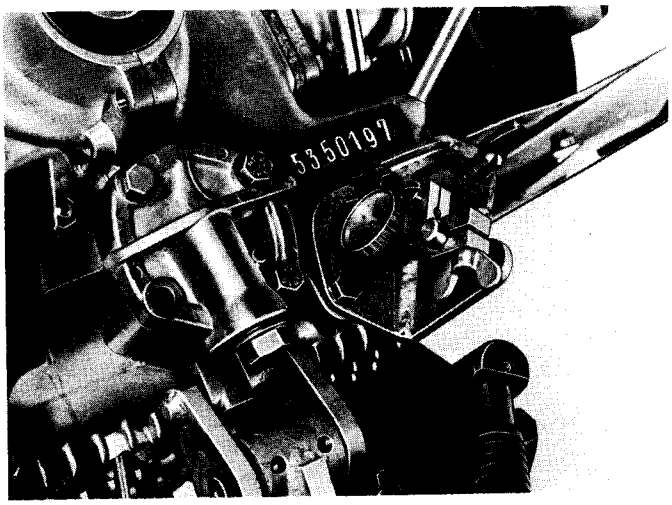
Pos. 501.1.55.053.1



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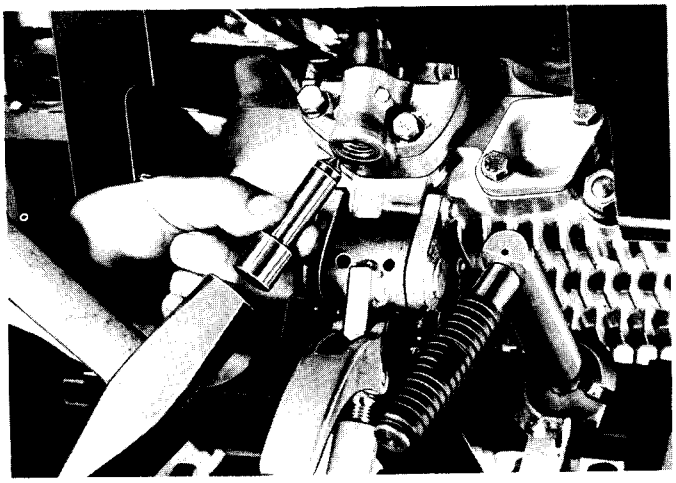

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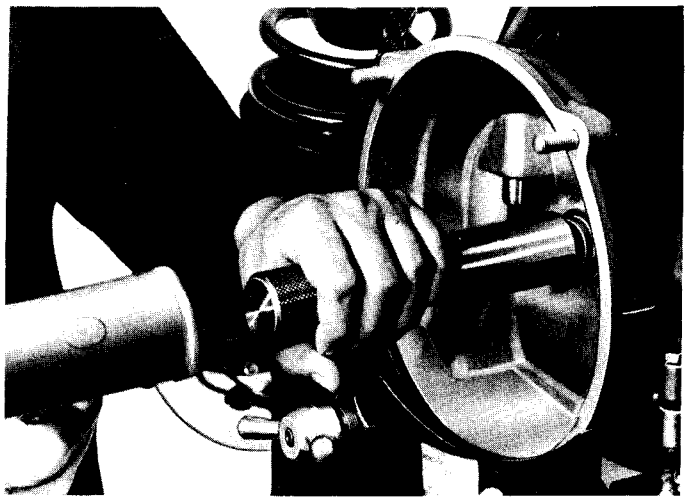

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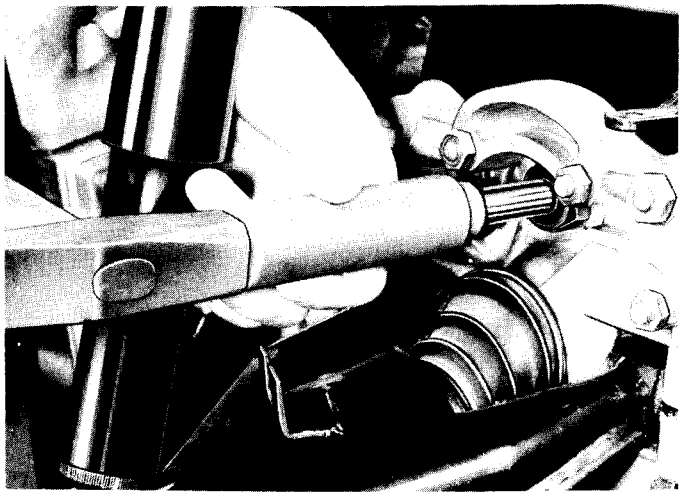

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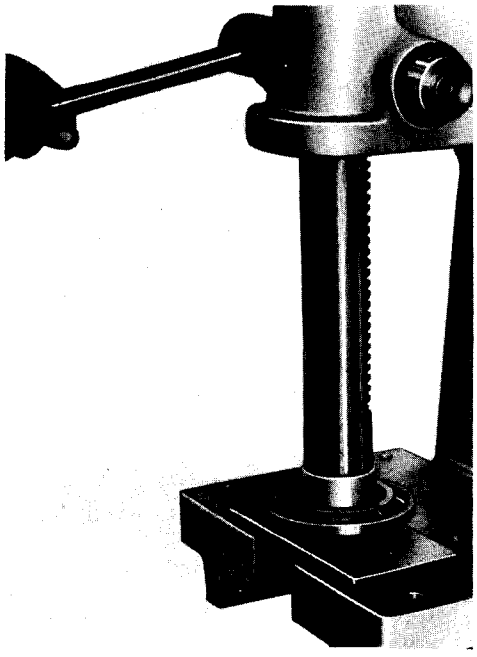

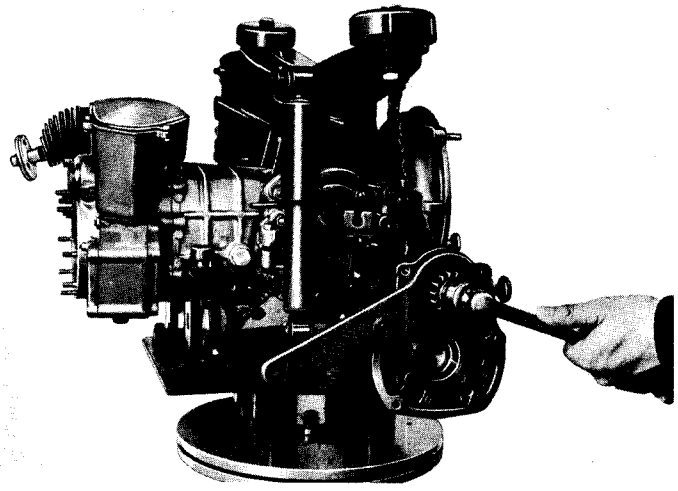

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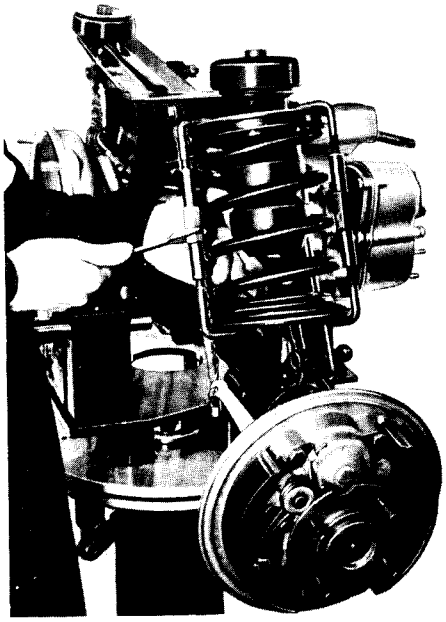

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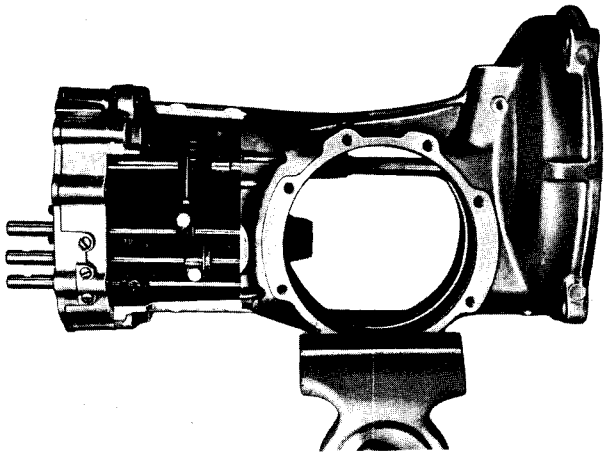

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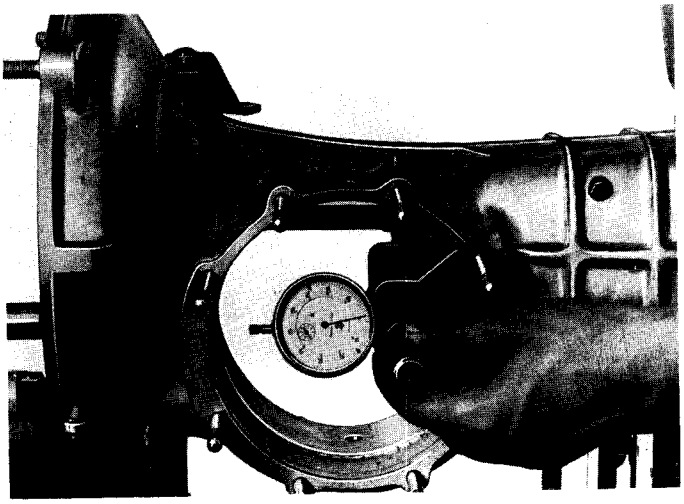

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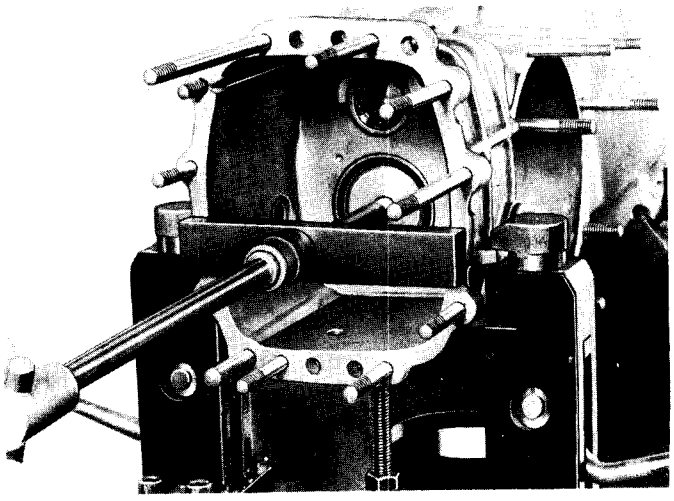

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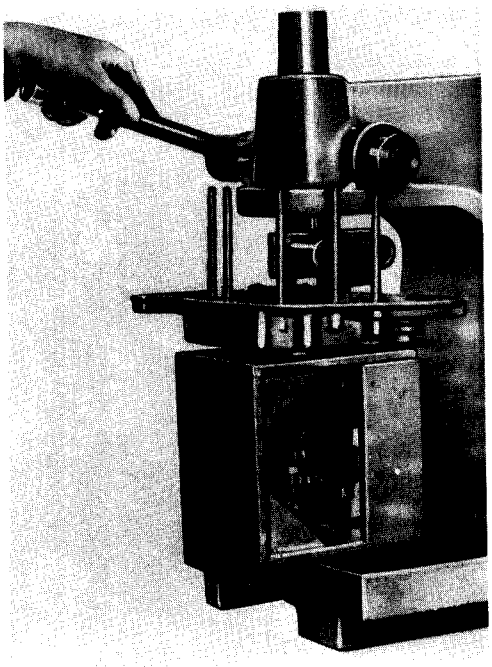

Pos.700.1.55.043.0
Fig. 1

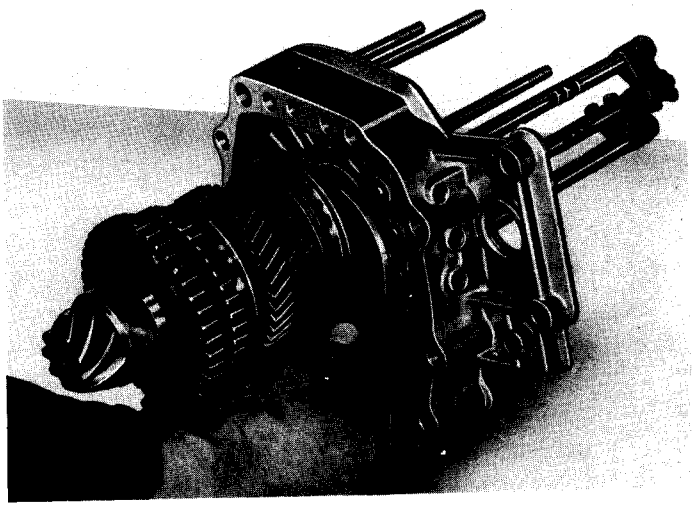

Fig. 1a

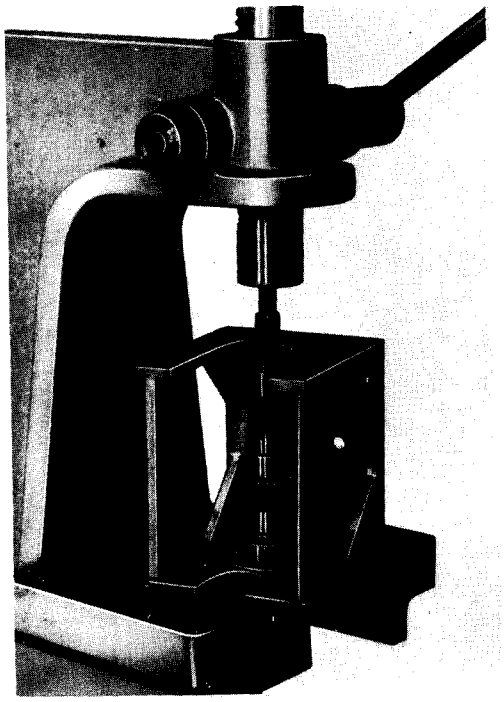

Fig. 2

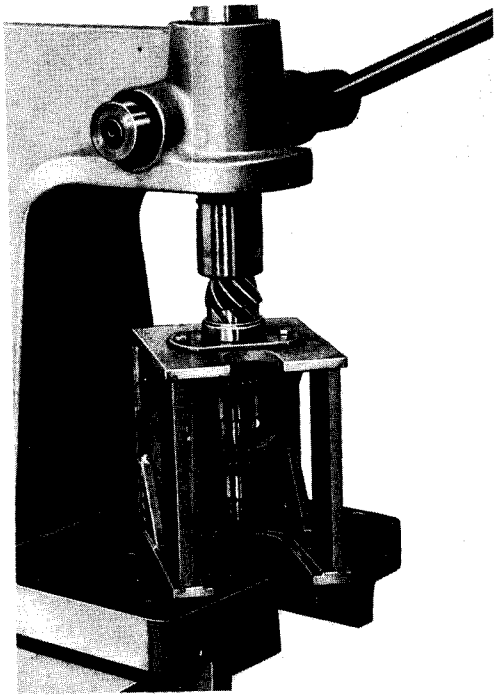

Fig. 2a

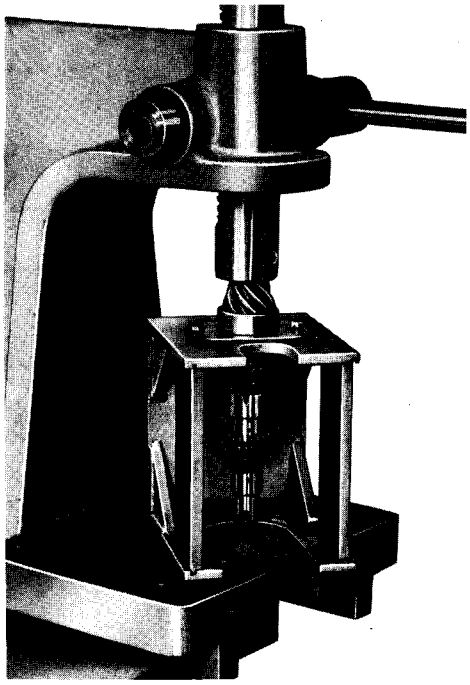

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Fig. 3

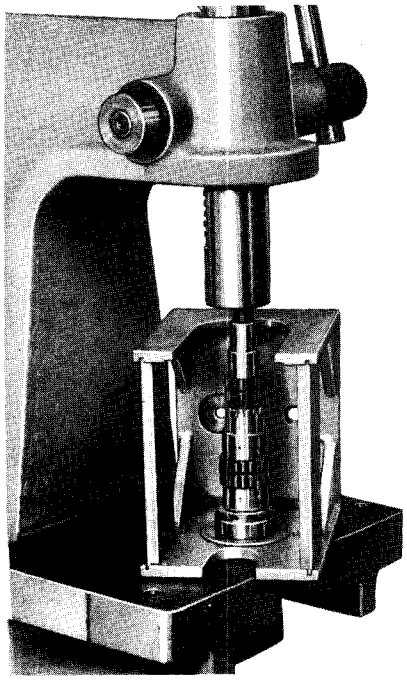


Fig. 3a

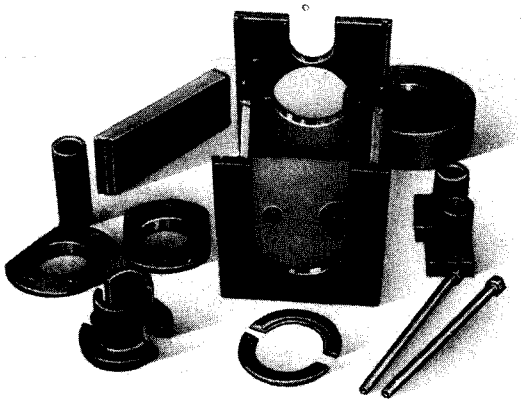


Fig. 4

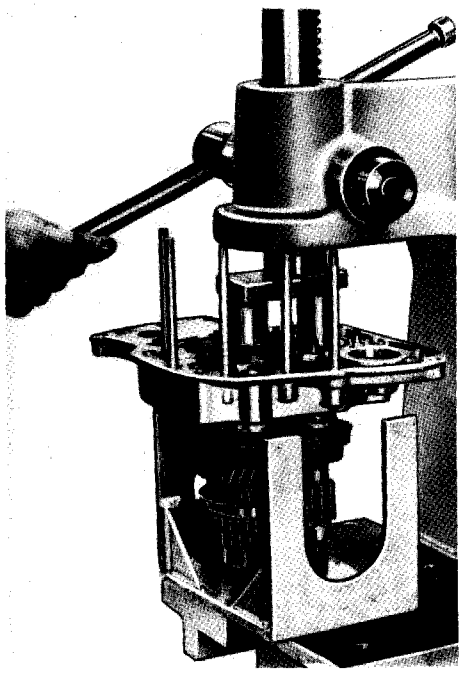
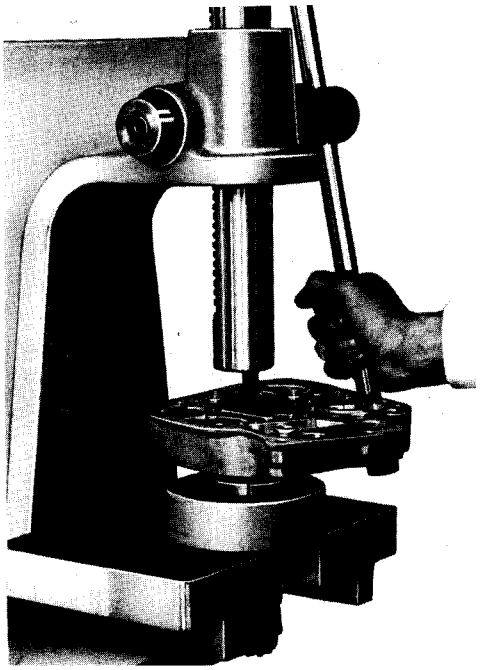


Fig. 5



Pos. 700.1.55.043.0
Fig. 6

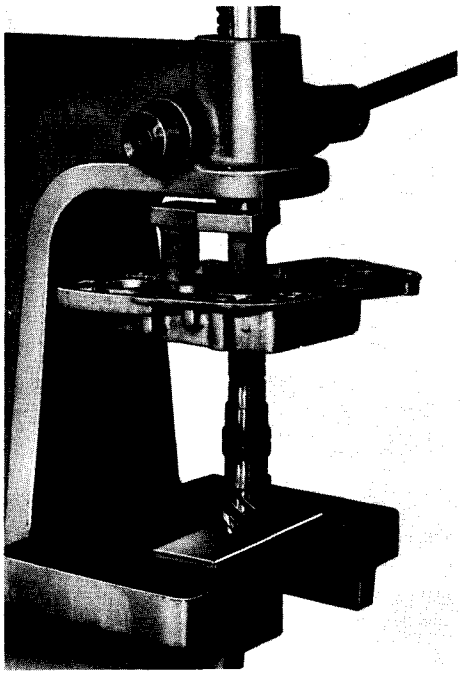


Fig. 6a

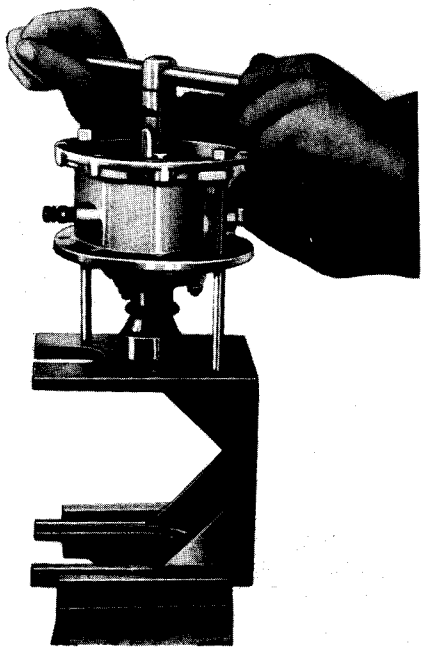


Fig. 7

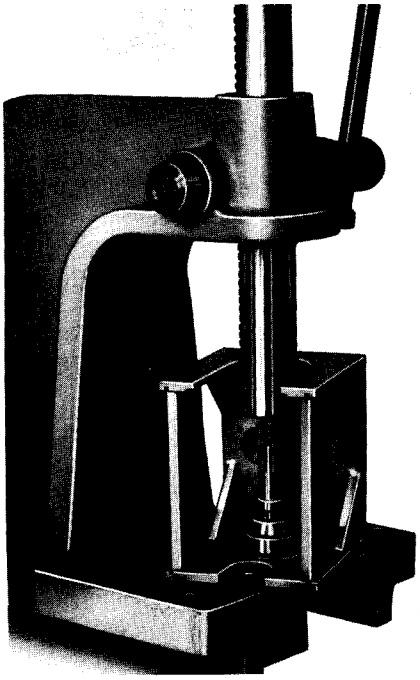
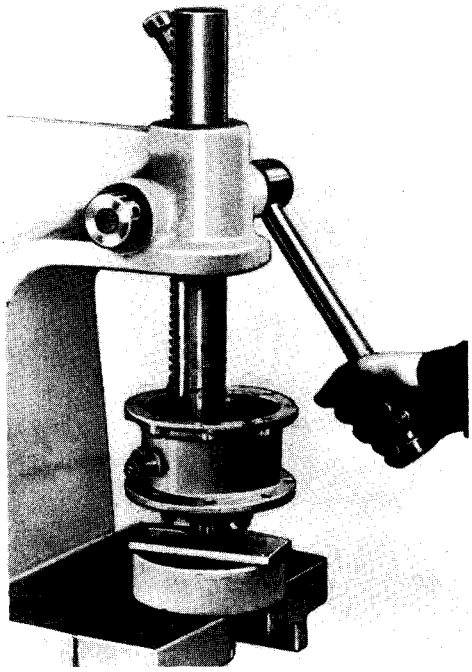
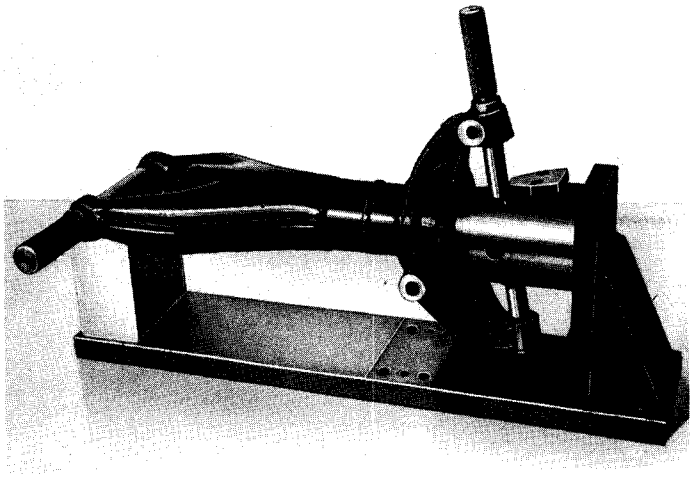


Fig. 8



Pos. 700.1.55.043.0
Fig. 9



Pos. 700.1.41.155.2 - L 14

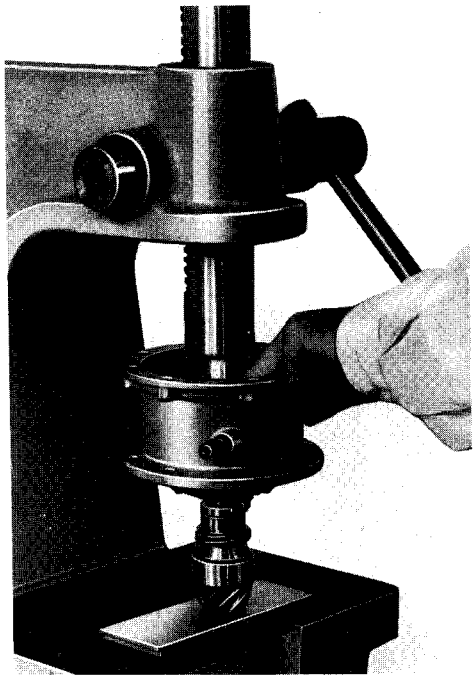
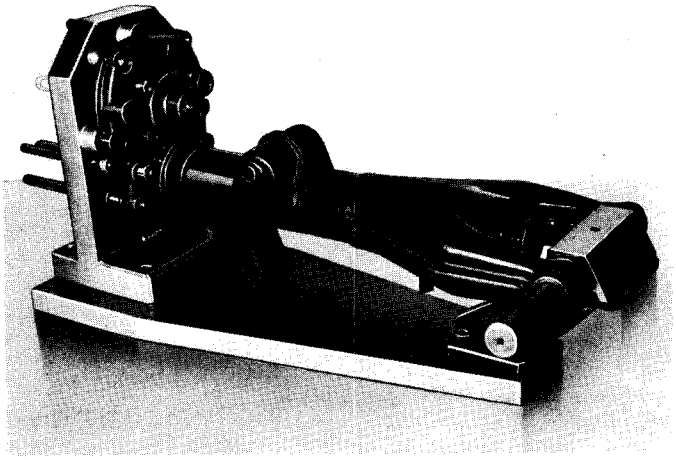


Fig. 9 a



Pos. 700.1.34.176.1 - L 4

Tubular driver for pressing in the mainshaft - pinion (with all four gear wheels removed) into the intermediate flange and for pressing in the front drive pinion as well.

A split tubular support for pressing the mainshaft - pinion out of the intermediate flange. (With all four gear wheels removed)

Two bolts for fixing the intermediate casing onto the special tool in order to lock or to undo the pinion retaining nut.

An U - shaped plate for pressing out of the front drive pinion.

A wing - shaped spacer for supporting the intermediate flange during pressing out of the gear cluster.

b) Application:

1.) Pressing the gear cluster and layshaft out of the intermediate flange:

Insert the special split washer inbetween the fourth gear wheel and the 3rd - 4th synchronizer assy (fig. 1a) and insert the intermediate flange assy into the slot of the table shaped support such that the synchronizer clutch sleeve will engage in the slot. Support the intermediate flange by means of the wing - shaped spacer across the slot and press out by means of the special driver using an arbor press (fig. 1).

2.) Pressing in and out of the inner race of the pinion needle bearing:

Remove the circlip and support the inner race by means of the three notches of the locking ring (fig. 2 and 2a).

3.) Pressing in of the gear cluster and layshaft into the intermediate flange:

Remove both the supporting plates, of the table shaped support and turn it upside down, such that the open end is upside. Put the main cluster with the pinion downwards into the opening provided for the pinion, and the layshaft into the hole provided for it (fig. 4 , arrows).

Install the intermediate flange and press it on by means of the special twintube driver (fig. 5).

4.) Pressing in and out of the pinion for pinion adjustment. For this purpose use the tubular driver and the split tubular support (fig. 6 and 6a).

5.) Undoing and tightening of the retaining nut of the front drive pinion:

For this purpose fasten the intermediate casing onto the table shaped support by means of the two long bolts (fig. 7).

6.) Pressing in and out of the front drive pinion. For pressing out the U - shaped plate is put behind the speedometer worm gear. Support the U - shaped plate on the press and press out (fig. 9).

For pressing in, use the special tubular driver (fig. 9a). For pressing out of the inner race of the pinion, see fig. 8.

Device for checking alignment of rear swinging axle, part no. 700.1.41.155.2 - L 14 ,

For checking the front half axle for alignment, put it onto the device and insert the vertical gauging spindle and then the horizontal one, the latter must lie flat and parallel on its support.

Device for checking alignment of rear swinging axle, part no. 700.1.34.167.1 - L 4 ,

For checking the rear half axle for alignment put it onto the device and insert the gauging spindle. This must be parallel to its support, after that put on the control block, the mark of which must correspond with the marking of the spindle support.

Face cutter for final drive side cover, part no. 501.1.55.048.0 ,

Due to excessive tightening of the fulcrum pins, it is possible that the side covers will be distorted. In case such side covers are installed on the final drive casing, they might damage the differential bearings. Therefore prior to installing of the side cover - swinging axle assy the side cover should be checked and if necessary its sealing surfacesurfaced, by means of the special face cutter. Only cut off the absolute minimum as otherwise the crown wheel pinion adjustment would no longer be correct.

Assembly trestles:

Engine assembly trestle, part no. 501.1001.5 - W 1 ,

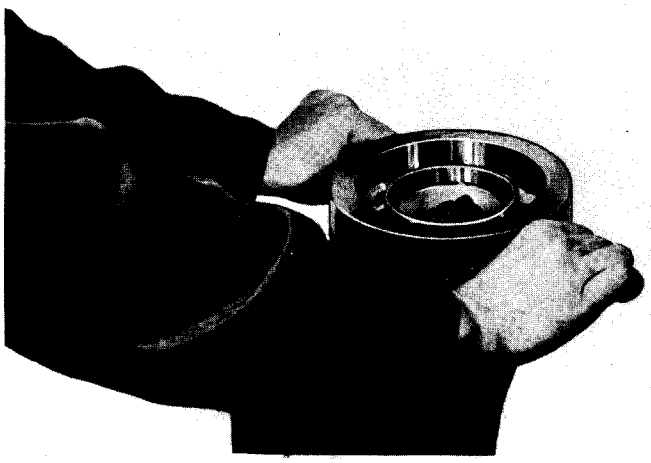
for supporting the engine assy for efficient repair work. The engine is supported on the l.h.s. and r.h.s. at the cooling fins (flywheel side) and strapped down on the pulley side by means of a toggle engaging in the hole of one of the crankcase bolts. The engine may be turned and tilted by means of this device.

Front axle assembly trestle, part no. 700.1.21.000.5 - W 19 ,

for supporting the front axle assy during repair work. The front axle assy may be turned by means of this device.

Rear axle assembly trestle, part no. 501.1.2100.5 - W 4 ,

for supporting the rear axle assy during repair work. The rear axle assy may be turned by means of this device.



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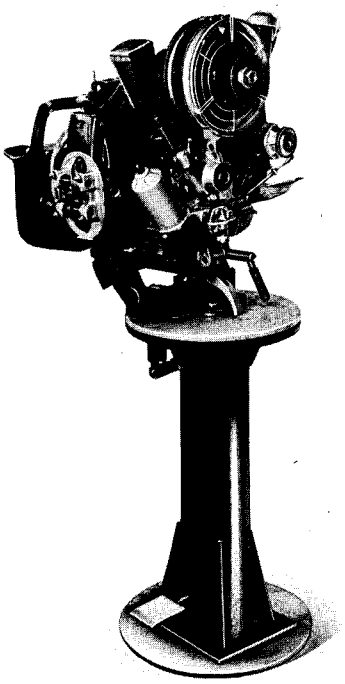
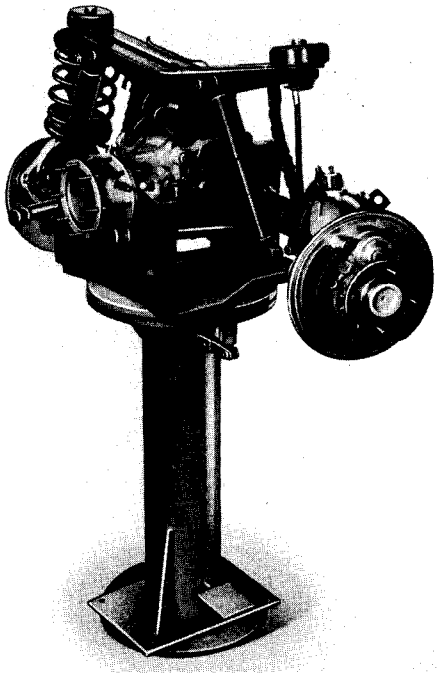
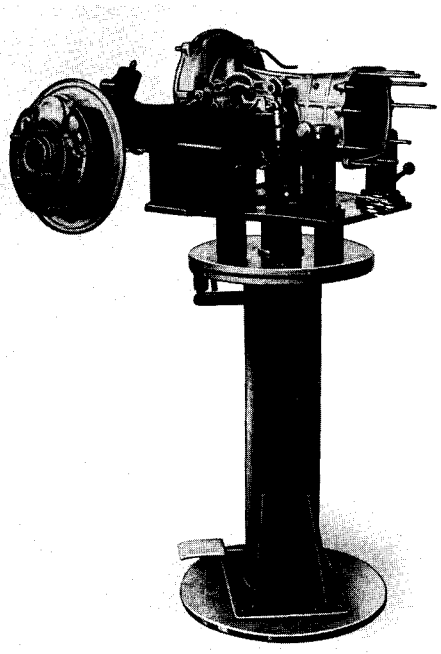


Pos. 501.1.1001.5-W1



Pos. 700.1.21.000.5-W19



Pos. 501.1.2100.5-W4

Group 12 : Tolerances and Wear Limits

General hints

The applied conception of wear limit is to be understood in such way that parts should not be reinstalled any more in case they approach or reach the stated measure. In order to ascertain the wear limit of the piston and cylinder, the oil consumption of the engine in question has to be taken into consideration.

1 Engine

1/0 Cylinder, piston and crankcase	Newly fitted	Wear limit
1/01 cylinder ovality	0,00019" - 0,0059"	0,001968"
1/02 piston - cylinder - clearance (bore - dia. 80)	0,00157" - 0,00196"	0,04724"
1/03 weight - difference of pistons	max. 5 grammes	
1/04 gudgeon pin - clearance of pistons	0,00004" - 0,00028"	0,00039"
1/05 crankshaft - main bearing - bores dia. of crankcase	2,16535" - 2,16609"	
1/1 Piston rings		
1/11 top - piston ring	0,00157" - 0,00276"	0,05906"
1/12 middle - piston ring	0,00118" - 0,00236"	0,05906"
1/13 oil scraper	0,00078" - 0,001968"	0,00393"
1/14 clearance at the piston ring gap	0,00118" - 0,00177"	0,03937"
1/15 piston ring side clearance (when pressed into the groove, the circumference of the ring should be 0,0118" under the circumference of the ring band)	0,00118"	
1/2 Connecting rod		
1/21 gudgeon pin play of the small end bush	max. 0,00196"	
1/22 deviation of the right - angled position	max. 0,00157"	
1/23 the difference of weight between the two connecting rods	max. 77,15 gr	
1/3 Crankshaft		
1/31 crankshaft with dia.1,929" main bearing +)	0,00339" - 0,00402	0,00709"
1/32 auxiliary bearing +)	0,00236" - 0,00362	0,00787"

+)The bearing-clearancees quoted are correct if the crankcase halves are bolt together with a torque wrench reading of 28,932 ft.lbs.(4 mkg).

	Newly fitted	Wear limit
1/33 big end bearing radial	0,00146" - 0,00327"	0,00551"
1/34 big end bearing axial	0,00591" - 0,00984"	0,02362"
1/35 crankshaft end clearance	0,00669" - 0,01142"	0,02362"
1/36 permissible eccentricity for journals		0,00188"
1,37 permissible ovality for journals	max. 0,00059"	0,00118"
1,38 permissible ovality for connecting rod journal	max. 0,00059"	0,00118"
1/4 Flywheel		
1/41 flywheel side clearance	max. 0 01181"	
1/42 flywheel height clearance	max. 0,01575"	
1/43 flywheel unbalance	max. 0,770 gr	
1/5 Camshaft		
1/51 eccentricity for camshaft	max. 0.00039"	
1/52 camshaft axial clearance	max. 0,00787"	
1/53 cam height 0,2362"	0,0047"	
1/54 tooth flank clearance (camshaft - camshaft timing gear)	0,00039" - 0,00157"	
1/55 camshaft bearing play	0,00157" - 0 00323"	0,00433"
1/6 Valves		
1/61 length for valve spring length stressed with a pressure of 103,635 lbs. ± 5 %	0,98425"	
1,62 clearance between valve guide and intake valve	0,00138" - 0,00220"	0,00394"
1/63 clearance between valve guide and exhaust valve	0,00138" - 0,00220"	0,00394"
1/64 valve stem - valve seat play	max. 0,00079"	
1/65 valve - face width intake	0,03150"- 0,03937"	
1/66 valve - face width exhaust	0,03937" - 0 04724"	
1/67 valve - face obliquity	45°	
1/68 valve - stem diameter for intake valve	0,31339" - 0,31378"	
1/69 valve - stem diameter for exhaust valve	0,36850" - 0,36890"	
1/7 Rockers, cam followers and lever for fuel pump		
1/71 clearance rocker - axle for rods	0,00150" - 0,00264"	0,00394"
1/72 clearance camfollower - axle for camfollower	0,00150" - 0,00264"	0,00394"

	Newly fitted	Wear limit
1/73 valve clearance intake - exhaust	0,00591" - 0,00787"	
1/74 clearance for fuel pump lever	0,00150" - 0,00264"	0,00394"
1/8 Compression pressure	92,456 psi - 113,792 psi	71,120 psi
1/9 Oil pump		
1/91 axial play for pump gears	0,00157" - 0,00276"	0,00394"
1/92 t oth flank clearance	max. 0,00047"	
1/93 clearance for oil pump housing - gears	0,00315" - 0,00315"	0,00787"
1/94 oil pressure at mashroom valve - idling speed	21,336 psi - 42,272 psi	21,336 psi
oil pressure for mashroom valve at 4500 RPM	64,008 psi - 78,232 psi	
oil pressure difference from 3500 to 5000 RPM	max. 14,224 psi	
spring for pressure release valve in normal state +)	1,92913" - 0,03937"	
1/95 oil pressure control switch opens at	11,3792 psi - 17,0688 psi	
1/96 spring for bypass valve in normal state ++)	1,77165" - 0,03937"	
2 Clutch		
2/1 Clutch - plate		
2/11 side clearance for clutch plate	max. 0,01969"	
2/2 Clutch pressure - plate		
2/21 pressure plate eccentricity		0,00394"
2/22 withdrawal race eccentricity	max. 0,00787"	
2/23 total unbalance for clutch	max. 2,31 gr	
2/24 clutch spring (red) normal length	1,41732"	
2/25 clutch spring 44,10 lbs $\pm$ 5 % load by pressure 0,98425"	blockheight 0,72835"	
2/26 adjustment of the clutch measured from clutchplate to withdrawal race	0,55118"-- 0,57087"	
2/27 dead travel at the clutch pedal	0,59055" - 0,78740"	

+) The 0,55118" pre-tension is adaquate to a pressure of 7,497 lbs.

++) Pre-tension of 0,3937" is adaquate to a pressure of 1,6758 lbs.

	Newly fitted	Wear limit
3 Gearbox		
3/1 Crown wheel - bevel pinion		
3/11 crown wheel - bevel pinion tooth flank clearance	0,00591" - 0,01181"	
3/12 mounting in bearings of the gear wheel at pinion:		
radial clearance:		
1st gear	0,00071" - 0,00193"	0,00315"
2nd gear	0,00071" - 0,00193"	0,00315"
3rd gear	0,00071" - 0,00193"	0,00315"
4th gear	0,00055" - 0,00157"	0,00276"
3/13 mounting in bearings of the gear wheels at pinion:		
axial clearance:		
1st gear	0,00394" - 0,02827"	0,03150"
2nd gear	0,00394" - 0,03335"	0,03543"
3rd gear	0,00287" - 0,01890"	0,02362"
4th gear	0,00394" - 0,01339"	0,02165"
3/2 Differential assembly		
3/21 differential assembly axial play	0,00197"	
3/22 differential wheels axial clearance	0,00394" - 0,01181"	
3/23 sliding joint play	0,00787" - 0,00244"	0,00984"
3/24 spherical seat of small diff.wheels inside diff.casing	2,71653" dia.	2,72440" dia.
3/3 Synchronization		
3/31 length of the synchr.springs:		
blocking ring 1st - 2nd gear		
throughbore	2 each 0,21654"	
sackbore	2 each 0,46063"	
3/32 length of synchr.springs:		
blocking ring 3rd - 4th gear	4 each 0,46063"	
3/33 length of synchr.springs:		
blocking ring crawler gear		
through bore	2 each 0,21654"	
sack bore	2 each 0,46063"	

	Newly fitted	Wear limit
3/4 Locking springs		
length of all 4 springs	0,82677"	
3/5 Selector forks		
3/51 selector fork - selector ring - clearance		
1st - 2nd gear axial	0,00709" - 0,01850"	0,03543"
3/52 selector fork - selectorrring - clearance		
3rd - 4th gear axial	0,00709" - 0,01850"	0,03543"
3/53 selector fork - selector ring - clearance		
reverse gear axial	0,01063" - 0,01654"	0,03150"
3/54 selector fork - selector ring - clearance		
crawler gear axial	0,00709" - 0,01850"	0,03543"
3/6 Layshaft		
3/61 clutch shaft - play for needle bearing of fixing screw for flywheel	0,00079" - 0,00118"	0,00236"
3/62 reverse shaft - reverse gear wheel play	0,00315" - 0,00480"	0,00669"
3/7 Crawler gear		
3/71 crawler gear wheel and synchr.gear		
radial play	0,00071" - 0,00193"	0,03150"
axial play	0,00787" - 0,02047"	0,02362"
4 Backbone tube		
4/1 bearing clearance for propeller shaft radial	0,00197" - 0,00472"	
4/2 bearing clearance for propeller shaft axial	0,03937"	
4/3 propeller shaft out of true	max. 0,01575"	
5 Axles		
5/1 Threaded stud - threaded bush		
5/11 flank clearance	0,00079" - 0,00315"	0,00394"
6 Front axle		

6/1 for the differential gear of the front axle the same data are available as quoted by 3/11, 3/21, 3/22, 3/23

	Newly fitted	Wear limit
6/2 Axle arm		
6/21 upper swivel pin - bronze bush clearance	0 - 0,00177"	0,01575"
6/22 bronze bush - lower swivel pin clearance	0 - 0,00205"	0,01575"
6/23 axle arm axial clearance	0,00197" - 0,00591"	0,01969"
7 Steering assembly		
7/1 steering shaft - bushing clearance	0,00469" - 0,00650"	0,03543"
7/2 steering play - measured at steering wheel circumference		2,36220"
7/3 axle for relay lever clearance	0,00035" - 0,00394"	
8 Brakes		
8/1 Brake shoes		
8/11 thickness of lining	0,15748"	0,05906"
8/2 Brake drum		
8/21 brake drums - inner diameter	8,46455" - 8,47597"	8,52361"
8/22 brake drums - taper	max. 0,00394"	
8/23 brake drums - height clearance	max. 0,00984"	
8/24 brake drums - side clearance	max. 0,00984"	
9 Springs		
9/1 length of front spring	8,97636"	
length of rear spring	8,97636"	
9/2 front spring pre-tensioned to 6,22046" is adequate to a pressure of 617,4 lbs. $\pm$ 7 %		
9/3 rear spring pre-tensioned to 6,22046" is adequate to a pressure of 765,135 lbs $\pm$ 7 %		
9/4 diameter of the spring bar		
front	0,55118"	
rear	0.59055"	