

Length 180 = 15 ft
Height 77 = 6.5
Width 72 = 6 ft
Pounds 3660
3075

U.S. Oil Will Sainte Claire Special
Mobil Oil. B
SERVICE HANDBOOK

Heavy Body Oil — FOR THE —

WILLS SAINTE CLAIRE

32 X 4 1/2 U.S. Cans \$ 40.

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WILLS SAINTE CLAIRE, INC.
Marquette, Michigan

SERVICE HANDBOOK

— FOR THE —

WILLS SAINTE CLAIRE



INSTITUTE



WILLS SAINTE CLAIRE, INC.

Marysville, Michigan

INTRODUCTION

This Service Handbook for Wills Sainte Claire Cars is issued with a view to placing in the hands of every owner and prospective owner of a Wills Sainte Claire car, and service mechanics everywhere, the more important facts pertaining to the car and its operation, and the maintenance and adjustment of its parts.

The Wills Sainte Claire is not complicated. On the contrary, it is free from many motor car features which increase the necessity for service and at the same time render the performance of such service difficult and costly.

Wills Sainte Claire was the first motor car to use broached, interchangeable crankshaft and connecting rod bearings, bearings finished like a piece of fine jewelry, held to unbelievably close limits in manufacture, and capable of being installed by any mechanic, anywhere, without scraping or fitting.

Overhead valves, operated by overhead camshafts, eliminate most of the moving, wearing parts generally employed in valve-in-head construction, which become noisy in operation and require frequent adjustment or replacement. The Wills' design gives a silent, efficient, long-lived operation, and if tappet adjustment is required, the tappets are easily accessible.

The Service Handbook is a digest of the best information obtainable regarding the Wills Sainte Claire car. It is based on experience in shop and field, and careful observance of the instructions and suggestions here presented will enable the owner to enjoy a greater measure of satisfaction in the perfect performance and longer life of his Wills Sainte Claire.

WILLS SAINTE CLAIRE, INCORPORATED.

SERVICE HAND BOOK

for the

WILLS SAINTE CLAIRE

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LUBRICATION

Lubricant is the life-blood of the motor car.

Systematic attention to the oiling and greasing of the automobile means thousands of miles added to its performance. Irregular attention and the use of incorrect lubricants inevitably lead to trouble, expense and actual discomfort.

Plenty of good oil in the engine is essential, since virtually every part of the motor is oiled by the pressure circulating system. The amount and QUALITY of the oil in the engine should be tested every two hundred miles, by means of the oil depth gauge (Fig. 1) which shows the level of oil in the sump. This level should never be allowed to fall below the middle ring nor rise above the top one. Such a gauge cannot get out of order and enables the user to test the oil by observing the drip, (whether thick or thin), noting the color and by rubbing a drop or two on the fingers.

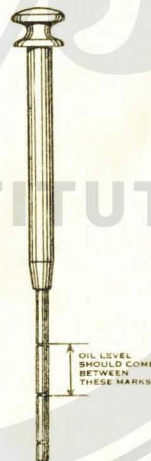


Fig. 1

The following specifications of lubricants should be observed:

Type "A": A light oil, such as is used for typewriters, sewing machines, electric motors, etc. (100 viscosity at 100° F.)

Type "B": HIGH GRADE heavy or extra heavy oil. The products of most well known refineries will meet the requirements. Suitable for year-round use in most climates. In extremely cold weather, starting will be made easier by mixing it with a lighter grade motor oil.

Type "C": A heavy transmission oil is preferable to most of the so-called transmission greases. In climates of extremely low temperatures, dilute Type "C" lubricant with 15% to 20% of motor oil to aid in shifting gears.

Type "D": No. 4 Dark Fiber Grease. For use with compressor gun where Alemite fittings are provided.

Type "E": Graphited, heavy cylinder oil. For lubrication between SPRING LEAVES ONLY. UNDER NO CIRCUMSTANCES IS IT TO BE USED ELSEWHERE, as it causes rapid wear of parts, especially gears and bearings.

LUBRICATING THE ENGINE

Seven quarts of type "B" lubricant, put into the engine through the oil filler (No. 2, Fig. 2) should bring the oil level just to the top ring on the rod gauge. The engine should not be running and the gauge should be wiped clean with a cloth before taking the reading. The oil pressure is regulated by the oil relief valve (No. 4, Fig. 2).

It is advisable to change the oil every 500 miles; otherwise, serious damage to the engine may result. Use the drain plug at the bottom of the oil sump.

Never flush out the engine with kerosene, as it dilutes the new oil.

Other parts of the car which require regular lubrication are as follows:

EVERY 200 MILES:

Spring Bolts, type "D" grease. Alemite.

King Pins, type "D" grease. Alemite.

Clutch Throwout. Keep cup on right side of clutch

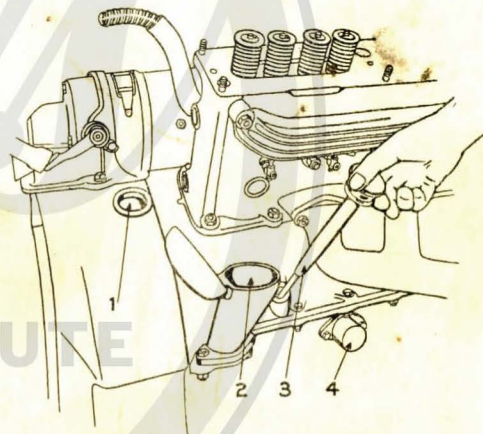


Fig. 2—Lubricating the Engine.

housing filled with type "D" grease and give one full turn of compression screw.

Rear Axle Spring Seats, type "D". Alemite. Not used on Hotchkiss axle.

EVERY 500 MILES:

Motor-Generator: Type "A" (four drops) in cups at either end. Type "D" through Alemite fitting at rear.

Distributor: Four drops of type "A" in small oil cup at right side.

EVERY 1000 MILES:

Distributor: Vaseline on surface of breaker cam. Clean inside of the distributor head, apply vaseline and remove thoroughly with a cloth.

Ring Type Universal Joint: Use type "C" lubricant. Never use hard grease or cup grease. Bring one oil plug directly above the other, REMOVE BOTH PLUGS and add lubricant through the lower hole until it runs out at the top.

Spicer Universal Joint: Use type "C" lubricant, applied through the grease plug hole. The joint should not be more than one-third full.

Rear Wheel Bearings: Type "D" lubricant. Alemite.

EVERY 2000 MILES:

Rear Axle Gears and Bearings: Type "C" lubricant through filler hole in housing cover. Keep oil level at height of filler hole. Drain, flush and refill every 5000 miles.

Steering Gear: Type "C" lubricant through filler plug hole. Check this condition every 2000 miles. To overcome creaks and groans in the steering gear, mix 60% powdered carbonate of lead with 40% of 600-W by weight and fill the housing. White lead paste will not give satisfactory results.

Transmission: Add Type "C" lubricant every 2000 miles through filler hole on left side of the case. Keep oil level even with the filler hole. Drain, flush and refill every 5000 miles.

Tie Rod and Drag Link: Type "D" lubricant through Alemite fittings. On cars not having Alemite fittings in the socket plugs, remove the plugs and steering arm balls, packing sockets with the lubricant.

Pedals: Type "D" lubricant. Alemite.

Brake Tubes: Type "D", through Alemite fittings. Not applicable to cars equipped with Lockheed Hydraulic brakes.

Brake Operating Parts: A few drops of type "B" lubricant to all brake pins, clevises, nuts and adjusting screws.

Spring Leaves: Once each season, separate the spring leaves and insert a sufficient quantity of type "E" lubricant.

TIRES

Tires should be inspected frequently for proper air pressure.

Small cuts or bruises in the tread or sidewall should be attended to without delay. Failure to do so permits sand and moisture to penetrate into the fabric, definitely shortening the life of the tire.

HEADLIGHTS

The Wills Sainte Claire headlight includes a specially designed tilting device which deflects the light rays in such a way as to remove the glare from the eyes of an approaching driver.

A special Mangin mirror (No. 6, Fig. 15) mounted on two pivots, is operated by an electro-magnet (No. 7, Fig. 15).

The magnet is controlled by a switch lever located at the top of the steering column. When the mirror is tilted upward, powerful rays of light are thrown far ahead to illuminate the road; tilting the mirror downward concentrates the light beams close to the car, giving a dimming effect without dangerously darkening the roadway. The control is so placed that the driver need not remove his attention from the steering wheel.

See Page 45 for instructions for adjusting the headlights.

THE BACKING LIGHT

Combined in the same housing with the red tail light is the backing-up light, a distinguishing mark of the Wills Sainte Claire.

This light is operated automatically by a switch located in the top-cover of the transmission. As the gears are shifted into position for backing up, the light circuit is closed and a flood of white light is thrown behind the car. This removes the danger of backing the car into a dark place, and also serves as a warning to persons in the rear that the car is about to be backed.

THE COOLING SYSTEM

The cooling system is the Thermo-Siphon type and, including the condenser, has a capacity of seven and one-half gallons.

The overflow pipe from the radiator leads to the condenser tank, located under the splashers on the left side of the frame. Steam or vapor rising from the radiator

passes through this pipe to the condenser, where it is cooled and becomes a part of the liquid.

When the engine is stopped for some time and the liquid in the radiator cools, it occupies less space than the same amount of heated liquid. This shrinkage creates a vacuum, and the atmospheric pressure, entering at the vent opening of the condenser tank, forces the liquid back through the pipe into the radiator, refilling it. This device safeguards the cooling system by insuring a full volume of liquid in the radiator at all times, and promotes economy in the winter months by reducing the loss of alcohol through evaporation.

A spout for filling the condenser tank is located under the floor board, the tank may also be filled through the overflow pipe when the radiator is being filled. In the winter months, the condenser tank must be filled with the same anti-freezing solution that is used in the radiator.

TO INSURE THE OPERATION OF THE CONDENSER, EVERY PART OF THE COOLING SYSTEM MUST BE AIR TIGHT.

Drain and flush the cooling system once a month. Drain plugs are located in the lower radiator connections, one on each side. These can be unscrewed to allow the free passage of liquid but cannot be removed entirely. Drain the condenser tank by removing the drain plug in the bottom.

In cold weather the safest anti-freezing solution is denatured alcohol—not wood alcohol—in the following proportions:

Alcohol	Water	Freezes at
25%	75%	Zero
30%	70%	5 below
40%	60%	20 below

It is important that the proper proportion be maintained as long as there is any expectation of freezing weather.

IMPORTANT

WARMING UP THE ENGINE

Warming up the engine is one of the simplest operations in handling any motor car. It is also one of the most important because, if improperly done, far-reaching injury to the mechanism is almost certain to result.

When preparing to start the engine, make sure the gears are in neutral. Set the throttle lever at one-quarter of the way open and place the spark lever about midway of its travel.

Pull the choke control button and the manifold heater control button clear out. Turn the ignition switch on and listen for the clicking that indicates the starting motor is turning over.

Depress the starter button. As soon as the engine begins to fire, push the choke part way in and close the throttle. After a few minutes of running, the choke control button should be pushed in gradually until the choke valve is completely open. If the engine still misses or "pops" occasionally, pull the choke button part way out and return it immediately.

When the motor is warm, press the manifold heater control button clear in. Failure to do so creates excessive heat and back pressure in the left hand cylinders, reducing engine efficiency and aiding rapid accumulation of carbon.

Racing the engine is bad practice at any time, but racing it just after starting may lead to an expensive

repair bill. If the car has stood for any length of time, most of the oil has drained into the crankcase and time must be allowed for it to reach the several parts of the engine. Scored pistons and cylinders, burned out bearings or seized camshaft bearings are the logical consequences of racing a newly started engine, especially a new engine which has not been properly broken in.

Do not drive over twenty-five miles an hour for the first mile or two after starting and not over thirty miles an hour until the engine, transmission and rear axle have become warm and thoroughly lubricated. Then the car will be capable of performing creditably under all conditions. Until the car has run at least 2500 miles the instructions given on the windshield sticker and in the book on Care and Operation should be followed.

USE THE CHOKE FOR STARTING ONLY. When driving on the road, be sure the choke button is all the way in. Excessive use of the choke causes liquid gasoline to enter the cylinders, whence it finds its way into the crankcase and, by diluting the oil, paves the way for serious trouble.

CARE OF THE BODY FINISH

The motor car manufacturer buys the finest materials obtainable for finishing the bodies of his cars. He employs expert craftsmen to apply them. Every effort is made to produce a beautiful, durable luster on your automobile.

Once the car leaves the factory, the maker can have no control over the care that will be given to the finish. That is strictly up to the buyer. It is easy to preserve the luster of an automobile, but wrong methods of washing and caring for the finish will quickly ruin it.

If you do not wash your own car, patronize a place that is properly equipped and intelligently manned. The results of carelessness on the wash rack are often blamed on the manufacturer of the car.

If you wash your own car, provide proper equipment. Have one fine wool sponge and a chamois leather for the hood and body and another of each for the wheels and under parts. A large pail, a soft wool duster and a few yards of soft cheese cloth complete the necessary items.

Remove all grease, oil and tar before washing. To do this, soak a piece of soft flannel or cheese cloth in water and squeeze fairly dry. Apply a little olive oil or sweet oil and rub the greasy area gently in straight lines, and finish by polishing lightly with a soft dry cloth. NEVER USE GASOLINE ON VARNISHED SURFACES, NOR TRY TO REMOVE OIL OR GREASE WITH A DRY CLOTH.

The hood often becomes dull and faded while the body retains its luster. This is due to washing the car just after a run while the hood is still warm.

The effect of washing a warm hood serves as a warning against washing any part of the car while it is warm. A car should never be washed in the glare of a hot sun, or just after a run on a hot day. Give the body time to cool and do the washing under cover or in the shade.

Use a hose without a nozzle and shower the whole car. When the mud and dust have softened, use the hose and a sponge together, rubbing gently in straight lines. Follow the sponging by another shower, to remove any mud or grit that may remain, and dry the surface with the chamois, keeping it clean and well squeezed out.

The use of soaps, cleaning compounds and polishes on the body, hood and fenders is not recommended.

SERVICE OPERATIONS

VALVE TIMING:

A practical method of timing Wills Sainte Claire Camshafts and valves:

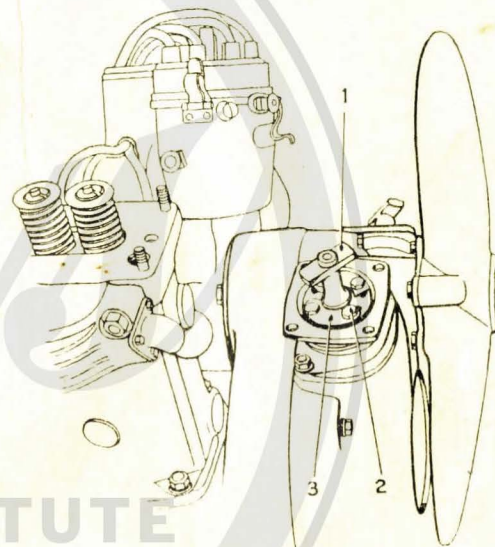


Fig. 3 - Right Coupling Position

- A. When the camshaft drive gear and pinion have not been unmeshed:
1. Assembling the camshaft housing (R H) to the cylinder block.

- a. Crank the motor until the flywheel timing mark I. O. 1 (Intake Opening No. 1) is at the center of the flywheel inspection opening.
 - b. Set the camshaft so the point of No. 1 intake cam (second cam from the front) points toward the upper edge of the opening on the left side. The slot in the upper camshaft drive shaft should then point toward the fan as the housing is placed in position. This agrees with the position of the upper cross-arm of the adjusting coupling when the flywheel is set at I. O. 1. (See No. 1, Fig. 3.)
 - c. Place the camshaft housing in position and tighten the nuts which hold it to the cylinder block. Install the valve followers.
2. Timing the Camshaft (R H).
- a. Obtain a tappet clearance of 12 thousandths at No. 1 intake tappet. Be sure it is obtained on the heel, or smallest diameter of the cam.
 - b. Crank motor ahead carefully until a snug (not tight) six thousandths clearance is obtained at No. 1 intake tappet.
 - c. Loosen the cap screws (No. 2) in the adjustment coupling and back up the flywheel

until T C 1 (top center No. 1) timing mark appears in the center of the inspection hole. Then turn motor ahead until the I O 1 mark is again at the center of the hole. The last movement takes up backlash if any is present in the front end gears.

- d. With the feeler, make sure that the six thousandths clearance still obtains at No. 1 intake. If so, tighten the cap screws in the adjusting coupling.
- e. Check the timing by inserting the six thousandths feeler between the cam and the valve follower of No. 1 intake. Crank the motor ahead almost two full turns and when the snug feel is obtained, note the position of the I O 1 flywheel mark. If it is just at the center line of the inspection hole, the camshaft is in time. If it is above center, the timing is late; if it is below center, the valve timing is early. When the timing is correct, tighten the cap screws, and turn up the ends of the locking plates (No. 3).

B. When the camshaft drive gear and pinion have been unmeshed, set the camshaft as described in Par. 1-b above. Then mesh the pinion with the camshaft gear in such a way that the drive shaft slot will be in the proper position, that is, pointing toward the fan when the camshaft housing has been set in place.

C. When the camshaft drive gear and pinion have not unmeshed:

1. Assembling the Camshaft housing (L H) to the cylinder block.

a. Set the Camshaft so No. 5 intake cam (second cam from the front) points toward the upper edge of the inspection opening (to the left). The slot in the camshaft drive shaft should then be almost in line with the camshaft itself, to correspond with the position of the coupling upper cross arm on the left side when the I O 5 (intake opening No. 5) timing mark is at the center of the flywheel inspection hole.

b. Assemble the camshaft housing to the cylinder block as outlined in Paragraph A-1 above, substituting the figure 5 for the figure 1, wherever the latter appears.

D. Timing the camshaft (L H). Proceed as outlined for the right-hand camshaft, substituting the figure 5 for figure 1 in every case.

E. When the gear and pinion (L H) have been unmeshed, set the camshaft so No. 5 intake cam points as indicated in Par. C-1-a above. Then mesh the pinion with the gear in such a way that the drive shaft slot points almost straight front and rear, as shown in No. 1, Fig. 4.

NOTE—The above directions apply to all engines with the firing order shown in Fig. 5.

The distributor cover will show the firing order. One is 1-8-3-6-4-5-2-7, while another arrangement is 1-5-2-6-4-8-3-7. The above timing instructions will apply to the first named firing order by substituting the number 8 for

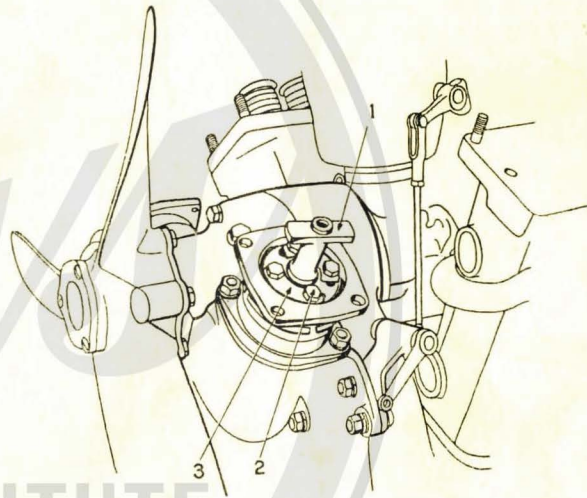


Fig. 4—Left Coupling Position

the number 5 wherever the latter appears. No. 8 intake cam is the second cam FROM THE REAR on the lefthand camshaft.

The numbering of the cylinders is as shown in the cut, Fig. 5.

ADJUSTING TAPPETS:

The engine should be at room temperature.

From front to rear the valves are in the following order: Exhaust, intake, intake, exhaust, exhaust, intake, intake, exhaust. Beginning at the front end, adjust the intakes first, one at a time, then adjust the exhaust tappets.

Remove the inspection covers, open the engine relief cocks and crank the motor until the heel of the cam (opposite the point or toe) is next to the valve follower of the tappet to be adjusted. Insert a feeler of the proper thickness, as shown on the rear inspection covers, between the

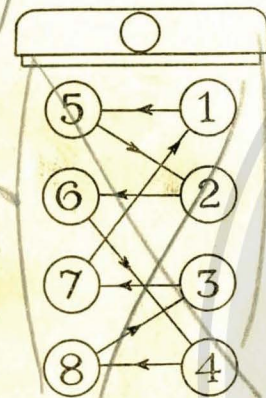


Fig. 5—Firing Order

valve follower and the cam, and adjust the tappet to the proper clearance.

Never try to adjust a tappet screw without first releasing the lock nut. The screw may be broken; the threads will almost certainly be stripped, rendering permanent adjustment impossible without replacing the tappet screw and possibly the valve followers.

When the feeler passes snugly between the surfaces but without buckling, set the lock nut up tightly and re-check the clearance with the same feeler.

SPARK TIMING:

Remove the distributor cover, head and rotor. Note the condition of each as it is removed, as clues to ignition trouble may be evident here.

Disconnect the vertical control rod and place a small screw driver under the distributor lever to hold it in the full retard position.

Open all relief cocks except No. 1, and ascertain the compression stroke by cranking the engine until a resistance is felt. Continue to crank slowly ahead until the E C 1 (Exhaust Closing No. 1) mark appears exactly at the center of the flywheel inspection hole.

Remove both low tension wires from the distributor terminals, and connect one wire of a small test lamp to the right hand terminal. Attach the other wire to the battery cable terminal on the generator. (If dry cells are used, attach the second wire to them and run another wire from the cells to any part of the engine or frame.)



Fig. 6—Delco Wrench

Examine both distributor points to see if re-touching is needed. After cleaning, adjust both sets of breaker points to 20 thousandths of an inch gap, using the gauge attached to the Delco wrench (Fig. 6) as an indicator.

Loosen the lock screw in the distributor cam (No. 1, Fig. 13) and turn the cam until the large flat surface faces the right hand terminal to which the wire is attached.

The test lamp will now be lighted.

Now turn the cam clockwise until the light just goes out, then turn back carefully to a point where the lamp just lights again. Tighten the set screw in the cam and check the setting by cranking the motor two full turns (or until the test light goes out the fourth time). If the E C 1 mark is in the center of the opening, the ignition is in time. If the mark is above center, the timing is late; if it is below center, the timing is early. The first

condition will cause overheating of the motor. The second condition will be apt to cause a "spark knock."

Having made the setting on No. 1 cylinder correctly, change the test-lamp wire from the right to the left terminal and rotate the crankshaft 60 degrees, until the E C 5 mark comes to the center of the inspection hole. The test lamp will go out at this point if the left hand points have been given the proper gap. The timing must agree for both sides of the engine.

VALVE GRINDING:

With proper attention to lubrication and the correct use of the choke, the average Wills Sainte Claire engine will not require valve grinding and carbon cleaning for thousands and thousands of miles. The design of the Wills Sainte Claire cylinder promotes the most efficient cooling at the valve seats, and this tends to lengthen the periods between valve grinding.

Not all the following operations are strictly a part of the valve-grinding job. They are listed here because their observance means a better job and a greater period between grindings. The instructions are purposely given in detail so that every step will be clearly understood:

1. Place protecting covers over the fenders, cowl and running boards, and disconnect one battery terminal, placing a piece of cardboard between the battery and the cable end.
2. Remove the hood, replacing the hinge screw in the radiator.
3. Drain radiator, saving anti-freezing solution if any is used. Disconnect upper hose connections, pushing same back on intake manifold pipes. Note the condition of the hose.

4. Turn off gasoline at vacuum tank cock and disconnect gas line.
5. Remove bolts joining radiator tie rods to radiator tie rod eyes.
6. Remove the four acorn nuts holding intake manifold to cylinder.
7. Remove the bolts holding hot spot tubes to manifold. (In engines where intake manifold heaters are not used, reference to such parts may be disregarded.)
8. Disconnect gas line at carburetor and remove the intake manifold and carburetor as a unit.
9. Crank motor until I O 1 (Intake Opening No. 1) timing mark appears in the exact center of the flywheel inspection opening (No. 1, Fig. 2). Make sure that No. 1 cylinder is on the compression stroke at this time.
10. Remove camshaft inspection covers and valve follower covers. Remove nuts connecting camshaft adjustment sleeves to camshaft housings.
11. Remove both camshaft housings.
12. Disconnect heater clamps from the exhaust pipes, both sides, and remove the heater tube assemblies. (On some cylinders, the heater tubes are removed intact with the cylinder blocks.)
13. Disconnect exhaust pipes from manifolds.
14. Disconnect water inlet manifolds from cylinders.
15. Disconnect the long distributor control rod at the front bracket.

16. Remove nut and lock washer holding ignition assembly to generator, and free the rear end of the assembly slightly.
17. Remove the cylinders. Be sure the relief cocks are open, otherwise the suction within the cylinders will make their removal difficult.
18. Remove the valves. The following method can be used anywhere. Procure four blocks, $8\frac{3}{4}" \times 2\frac{1}{2}" \times 1"$, and place a block in each cylinder. When the cylinder is turned upright on the bench, the blocks serve to hold the valves while the springs and locks are being removed. With a suitable fixture press down on the valve spring seat to relieve the pressure, and remove the lock collars.
19. Inspect the valves for warpage, pits, cracks, etc. Clean and polish and, if necessary to remove pits, reface the valves.
20. Remove carbon from combustion chambers and tops of cylinders. A screw driver, 14-inch or longer serves for this purpose. Be careful to avoid scratching cylinder walls or making nicks in the valve seats.
21. Remove the loose carbon, using air if possible. Wash the cylinder and note condition of the valve seats. If burned or pitted they should be re-seated.
22. Grind the valves. The best seat is about $\frac{1}{16}"$ wide, in the center of the valve face.
23. Wash valves and cylinders after grinding to remove all grinding compound.

24. Replace valves in the same cylinder in which they were ground, using the blocks as explained in Par. 18.
 25. While the cylinders are off the engine, loosen the dust cover on the front end of the generator and slide it forward. Remove one of the cap screws holding the generator drive shaft to the generator clutch and inject type "D" lubricant into the clutch through the opening.
 26. Clean pistons, noting condition of piston walls and rings, and the fit of connecting rod bearings.
 27. Drain engine oil sump, removing oil sump and screen. In replacing cylinder blocks, clamps are used on the lower piston rings, and these must be removed from below after the cylinder is in place.
 28. Replace the cylinders. Note that the front and rear crankcase dowels are in place, and thoroughly oil the surfaces of all pistons and cylinder walls. Install new cylinder to crankcase gaskets. If no ring clamps are at hand, cut four strips of soft tin, 10" by $1\frac{3}{4}"$ and tie one firmly around each lower ring. Crank the engine until the tops of the end pistons are just even with the wrist pin holes of the center pistons. Block the wheels, put the car in gear and set the emergency brake.
 29. Grasp the cylinder block by the ends and start it carefully over the center pistons; the front and rear pistons will enter without difficulty. Remove the clamps from below at once.
- (CAUTION—Never force a cylinder block downward. If all preparations are right, it will slip into place easily.

Failure to do so indicates that something is wrong, and forcing will only lead to trouble. If necessary remove the block and try again.

Never allow the weight of a cylinder block to rest on the pistons, either in removal or assembly. The piston walls are extremely light, and even a slight abnormal strain may put them out of round, if it does not result in actual breakage. Cylinder blocks should be removed and installed in a straight line, and not by excessive rocking, tipping or pushing.)

30. Replace the lock washers and nuts holding the cylinders in place.
31. Replace the camshaft housings. (See instructions, page 13.)
32. Connect water inlet manifolds to cylinders.
33. Install heater tubes, hook up exhaust pipes and heater tube clamps.
34. Clean carburetor and install carburetor and intake manifold assembly.
35. Connect gas line at carburetor and vacuum tank.
36. Connect radiator tie rods and replace hose connections.
37. Replace washer and nut holding ignition assembly to generator.
38. Connect long distributor control rod.
39. Check valve timing (See page 14) and adjust tappets (See page 18.)
40. Connect battery terminal at battery and replace battery box cover.
41. Clean and adjust distributor points and adjust timing (See page 18.)

42. Clean spark plugs and adjust gaps (See page 43.)
43. Replace oil sump and screen, and put seven quarts of fresh oil in engine.
44. Fill radiator and condenser tank with water or anti-freezing solution.
45. The engine can now be started. It should be run slowly and allowed to idle with retarded spark and closed throttle for ten to fifteen minutes before any attempt is made to adjust the carburetor.

It is advisable to use all new gaskets in reassembling any part of the engine. The additional cost is slight and provides perfect insurance against oil leaks which are unsightly if not actually dangerous.

It is advisable, when valve grinding is required, to have the work performed in a Wills Sainte Claire service station.

CONNECTING ROD BEARINGS:

The connecting rod bearings used in Wills Sainte Claire engines are broached to an exact size and no scraping or fitting is required in installing them. The standard bearings are interchangeable, and undersize bearings can be obtained for motors of extremely high mileage, where some wear is apparent on the crank pins.

INSTALLING CONNECTING ROD BEARINGS:

Remove the oil sump and screen, and determine which bearing or bearings are giving trouble. Crank the motor so the bearing to be changed comes to the lowest point, and remove the caps from both the forked and plain rods.

In taking off the connecting rod caps, note that the caps and rods are numbered to assist in reassembling. The numbers always go on the left side.

When the bearing is removed, note the small "O" on one end of each half. The same end may also bear markings to indicate an oversize or undersize. These markings should always face the front of the engine when the bearing is installed.

If the babbitted surface of the bearing has melted and run, some of the metal will certainly have found its way into the crankshaft oil lead. If allowed to remain, it will plug the oil lead and another burned bearing will result.

To remove the babbitt, remove the Welch plug nearest the bearing, clean the oil lead and replace a new plug to seal the oil lead.

Examine the crank pin for signs of scoring. If none appear, install a new connecting rod bearing. Attach the forked rod first, making sure that the dowels of the rod are located properly in the dowel holes of the bearing; otherwise the caps will not fit. When the forked rod is properly connected, connect the plain rod. BE SURE TO REPLACE ALL COTTER PINS.

Replace the oil sump and screen.

CAUTION—Under no circumstances are bearing caps to be filed, in an effort to adjust the rods. The extremely close limits to which all parts of the Wills Sainte Claire engine are held makes it impossible to do so without leading to serious trouble.

SERVICING THE RING TYPE UNIVERSAL JOINT:

Completely dis-assemble the joint, having marked both halves of it to aid in re-assembling. Remove the

small pin, press out the trunnion pin and remove the plain half of the housing from the flanged yoke.

Hold a steel scale or other accurate straight-edge across the faces of each half of the housing, to determine if any of the ground faces are low. Any that are low should be brought to the proper level by resting the housing on an anvil or other solid fixture and tapping lightly with a hammer.

When the faces are as nearly level as possible, prepare a small portion of grinding compound on a surface plate—a foot square piece of heavy glass will do—and proceed to rub the ground faces of the housing until a perfectly smooth, accurate surface is obtained. Rub just enough to insure an accurate face.

Re-assemble the plain half of the housing to the flanged yoke and replace the trunnion pin, taking care to line up the hole in the pin with the hole in the yoke, so the retaining pin can be installed. Put the trunnion bearings in place in the plain half, and start the nuts. Use new cork washers to insure an oil tight joint.

When assembling the joint, half to half, apply a light coat of shellac to the ground faces to aid in perfecting the oil seal. Then draw up the trunnion bearing nuts, BOTH SIDES, on two trunnion bearings opposite each other first, and afterward on the two bearings remaining. Since the trunnion bearing is not a through bolt but has shoulders inside the housing, it is important that the nuts on both the front and rear sides be drawn tight. Then turn up the lock plates.

SERVICING THE SPICER UNIVERSAL JOINT:

To disassemble the Spicer joint, loosen the clamp screw in the locking ring, and relieve the tension of the retaining spring. This will allow the outer casing and packing to move away from the inner casing or housing,

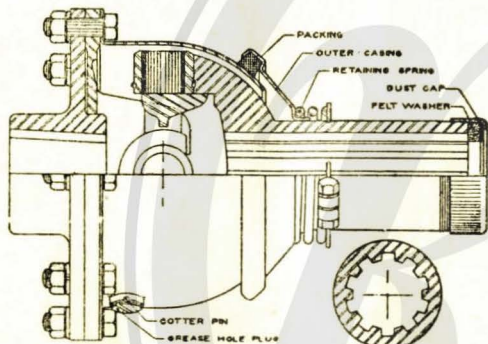


Fig. 7—Spicer Universal Joint

and when the latter is removed, the journal, bushings and flanges are exposed.

The trunnion bushings are held in place in the yokes by bushing rings. When these rings are removed, the bushings come out easily.

A grease plug hole is provided in the inner casing, through which lubricant is supplied to the joint.

In assembling the Spicer joint, care should be taken to see that the bolt holes in the flange and the inside casing are matched up in such a way as to bring the grease

hole opposite an open space in the joint and not opposite one of the lugs, as the latter condition would prevent the introduction of lubricant through the hole.

The use of the retaining spring gives just the right pressure on the outer casing when the lock ring is tightened in place, and no adjustment is required.

To remove the forward universal joint from the propeller shaft, unscrew the dust cap from the splined yoke, noting the felt washer. The propeller shaft can then be withdrawn. In reassembling be sure the dust cap is run up tight.

BRAKES

ADJUSTING THE MECHANICAL BRAKES:

Do not attempt to adjust the mechanical brakes by adjusting the pull rods. The factory setting on these rods will take care of all conditions of wear on the linings.

FOOT BRAKES:

Remove the rear wheel. Remove the cotter pin which locks the adjusting screw at the rear of the assembly. Turn this screw clockwise, moving the band toward the drum, until a clearance of $\frac{1}{8}$ " is obtained. This is equivalent to fifteen thousandths with the feeler. Then replace the cotter pin in the adjusting screw.

To adjust the lower half of the band, loosen the lock nut and turn the adjusting nut up or down until $\frac{1}{8}$ " clearance prevails all the way around. Tighten the lock nut securely against the adjusting nut.

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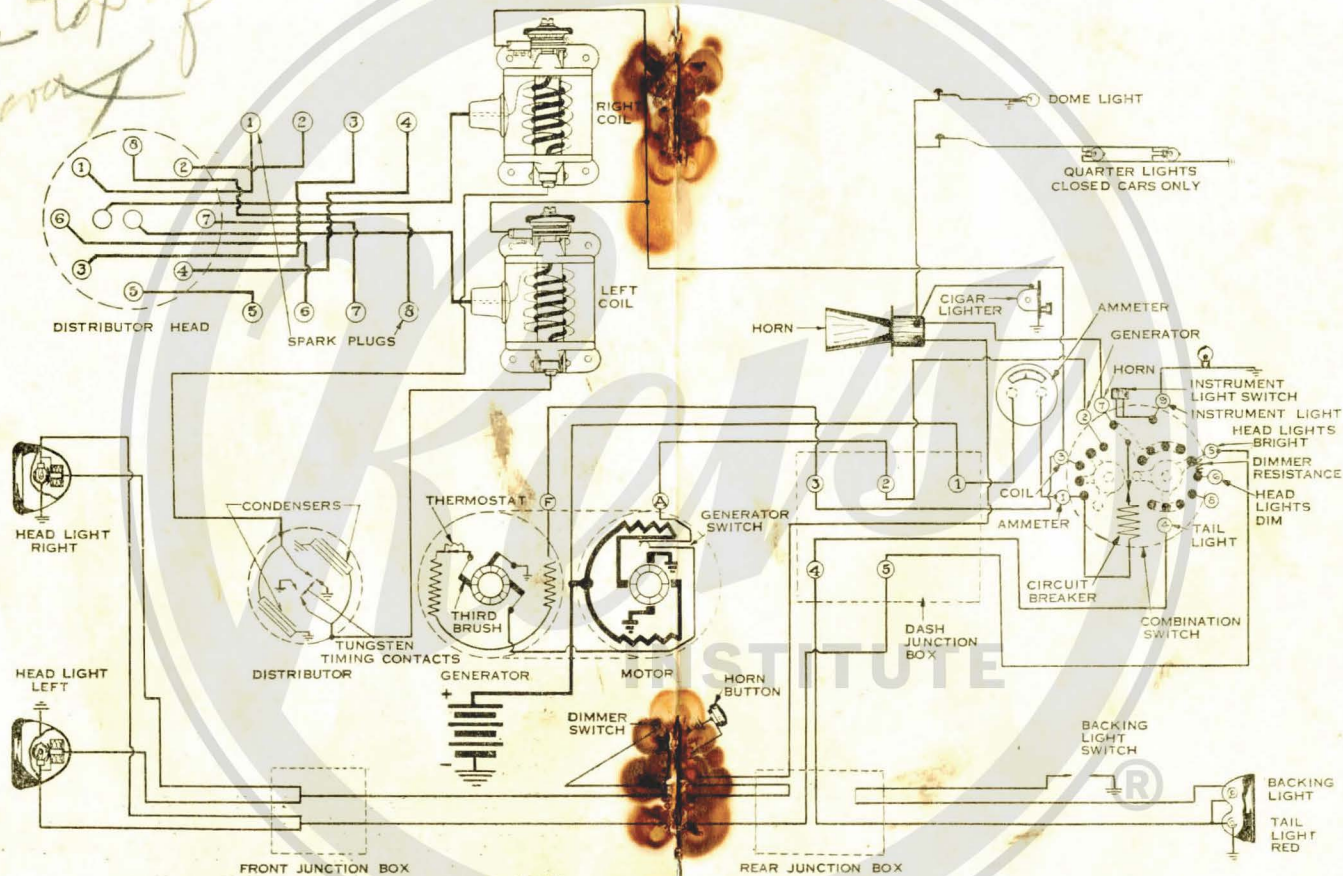


Fig. 8—Electrical System on B-68 Model. For A-68, See Book on Care and Operation

Next proceed to adjust the upper half of the band. Turn the square adjusting nut up or down until the proper clearance ($\frac{1}{8}$ ") is obtained all the way around the top half. The adjusting nut locks itself on the lock rib when the groove on the lower side of the nut is in the proper position.

The emergency (internal) brakes should be adjusted by a Wills Sainte Claire dealer.

FOUR-WHEEL HYDRAULIC BRAKES:

The Lockheed four-wheel hydraulic brake system on Wills Sainte Claire cars consists of a pressure—or master—cylinder mounted on the transmission case below the foot brake pedal; copper tubes leading from the master cylinder to the frame and then along the channels to union fittings at either end where a connection is formed with flexible hose. These in turn, lead to the wheel cylinders (Fig. 9) mounted firmly on each axle.

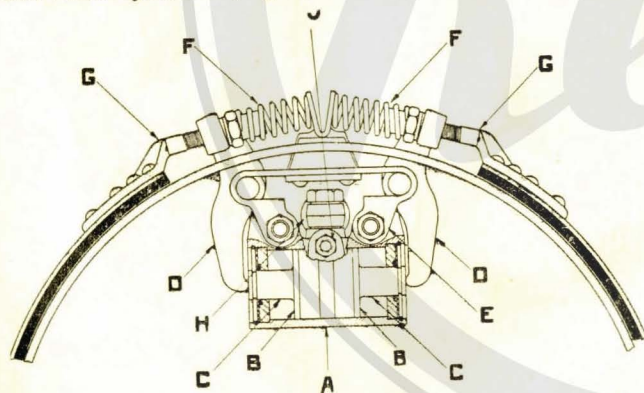


Fig. 9—Sectional View of Wheel Cylinder.

In each wheel cylinder are two opposed pistons (B) whose stems are in contact with the brake actuating levers (D). These levers are pivoted in the center and the outer ends of the levers are connected to the brake bands (G). Coiled springs (F) on the brake bands act to return the opposed pistons to their normal position when the braking pressure is removed.

OPERATION:

Depressing the foot brake pedal moves the master cylinder piston backward, forcing the liquid through the copper tubes and hose connections into the wheel cylinders. The opposed pistons are forced outward against the brake band levers, and the bands are contracted around the brake drums.

Since pressure applied to any portion of a fluid enclosed in a vessel is transmitted undiminished EQUALLY to all parts, hydraulic brakes are self-equalizing, and a given pressure applied at the master cylinder will exert a like pressure at each of the bands. When the foot pressure is released, the springs on the brake bands force the wheel cylinder pistons toward each other, expelling the liquid back into the copper tubes and thence to the master cylinder.

THE LIQUID:

Use equal parts of No. 5, or No. 6, COMPLETELY DENATURED alcohol and medicinal castor oil. This mixture is immune to freezing except at extremely low temperatures, in which case increase the proportion of alcohol. High temperatures have no effect on the liquid.

RESERVE SUPPLY OF LIQUID:

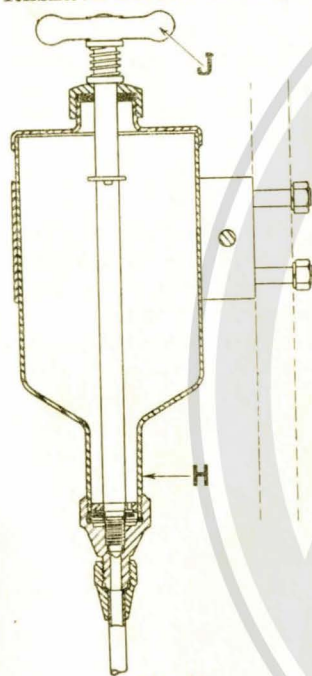


Fig. 10
Reserve Supply Tank.

ADJUSTMENT OF HYDRAULIC BRAKES:

The absence of the numerous working parts used with mechanical brakes eliminates the troubles due to improper operation of such parts and simplifies the adjustment of hydraulic brakes.

A small tank (Fig. 10) mounted on the dash serves as a reserve supply tank for the master cylinder and in the event of a loss of liquid, which will prevent the working of the brakes, the supply is obtained from this tank.

Unscrew the plunger (J) and pump enough liquid into the master cylinder to restore a normal pressure. Allow the pump plunger to rest at the top of its stroke for a few seconds after pumping. Then screw it back into place using only the hands. Be sure to screw the plunger down before using the brakes.

The occasions when it will be necessary to draw on the reserve supply will be rare, usually only in cases where some part of the line is broken.

The only adjustment to the bands is made by means of the anchor pin on each band and the adjusting nuts on the band ends. The clearance between the band lining and the drum should not be less than 25 thousandths of an inch.

BLEEDING THE LINES:

This is the operation by which air is expelled from the system and a full column of liquid is insured.

Jack up the car and remove a wheel. Turn the hub drum until the hole in it is opposite the wheel cylinder.

Remove the cap and plunger from the reserve supply tank (Fig. 10) and fill the tank with brake fluid.

Screw bleeder hose nipple into end of bleeder screw (J, Fig. 9) and pass the free end of the hose through the tubular bleeder wrench, afterward engaging the wrench on the hexagonal head of the bleeder screw. Place the free end of the bleeder hose in a clean container (such as a pint milk bottle).

With the wrench open the bleeder screw $\frac{3}{4}$ of a turn, permitting the fluid to flow into the container provided. Allow the flow to continue until it is free from air bubbles. This condition will be reached when about one-half pint has passed.

Tighten the bleeder screw and then immediately reopen same and permit a very small additional volume to flow. Again tighten the screw and remove wrench and bleeder hose.

Proceed in like manner for the other three wheels being especially careful to prevent any of the fluid getting on the brake bands.

After completing the bleeding operation, refill the reserve supply tank and replace the plunger and cap.

Then give several strokes to the plunger to make certain that the system is full of liquid. Screw down the plunger, using only the hands, making certain that the valve is firmly seated before attempting to use the brakes.

THE TRANSMISSION BRAKE:

Mounted on the rear end of the transmission is the transmission brake, consisting of two brake shoes hinged to a horizontal shaft below in such a way that when the upper ends of the shoes are drawn together, they grip the cast iron drum incorporated into the propeller shaft and universal joint assembly.

The transmission brake is operated by means of the hand brake lever. A short rod with an adjustable end makes the connection between the lever and a bell crank; and a simple combination of linkage serves to actuate the brake.

The only adjustment to be made on the transmission brake is made by the nuts on the brake adjusting bolt, directly under the floor board. It should be such that the braking effect just becomes noticeable as the hand lever reaches the fifth notch on the sector. Two more notches will serve to lock the brake.

TO REMOVE THE TRANSMISSION BRAKE:

Disconnect the rear universal joint and drop the propeller shaft. Unscrew the splined yoke cap from the forward universal joint and withdraw the propeller shaft.

Remove the two nuts from the brake adjusting bolt, allowing the shoes to become free. Remove the nuts holding the universal joint studs to the companion flange and withdraw the universal joint and brake drum.

Remove the clevis pin holding the short rod to the hand brake lever and by turning the bell crank slightly to the right, slip it from the shaft. Remove the two cap screws which hold the adjusting bolt bracket to the transmission top cover. Remove the four nuts which hold the countershaft rear bearing retainer to the transmission case, and the complete brake assembly can be removed.

A dummy cover should be provided to prevent the transmission lubricant leaking out while the countershaft retainer is off, unless it is desired to replace the oil at assembly.

ADJUSTING THE PEDALS:

Clutch Pedal: The clearance between the clutch pedal and the toe board should always be between $\frac{3}{4}$ " and $1\frac{1}{4}$ ". Too little clearance will prevent proper engagement of the clutch and wear out the discs. Too great clearance prevents the proper release of the clutch.

To adjust the clutch pedal clearance, loosen the lock nut (No. 2, Fig. 11) and turn the adjusting screw in or out until the proper clearance is obtained.

Brake Pedal: Maintain a clearance of $\frac{3}{4}$ " between the brake pedal and the toe board. This adjustment is made by loosening the lock nut (No. 3, Fig. 11), and turning the adjusting screw (No. 4) in or out until proper clearance is obtained.

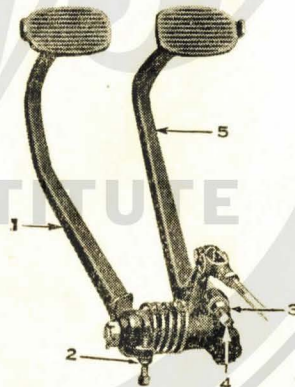


Fig. 11 - Pedals
(No. 4) in or out until proper clearance is obtained.

CHANGING WHEELS:

All Wills Sainte Claire cars are equipped with steel disc wheels of a special design, and each wheel is held to the hub by six nuts, marked R or L for the right and left sides respectively.

To remove the wheel, jack up the car and remove the six nuts with the brace wrench supplied with the tool kit. Lift the wheel from the studs.

A pilot bar is supplied for replacing the wheel. Insert the bar through the lowest hole of the wheel and engage the cut-away end of the bar with the lowest stud on the hub. Lift up on the outer end of the bar, guiding the wheel with the free hand, and it will slip easily into place.

Replace the wheel nuts, drawing up first on two nuts opposite one another and making sure they center properly in the wheel holes. Then draw up all other wheel nuts.

To remove the tire, use the rim ring tool supplied with the tool kit and, having started the locking ring, remove it by working gradually around the rim. When the lock ring has been removed, the tire will come off without trouble.

LINING UP THE FRONT WHEELS:

Unequal or unusual wear on front tires is usually due to the wheels being out of line. Correctly adjusted wheels show a slight "toe in" toward the front—a tram gauge will show about $\frac{3}{16}$ " less distance between the rims in front of the axle than behind it.

Jack up the front axle until the wheels turn free. If no tram gauge is at hand, one can be constructed from a few pieces of board, as shown in Fig. 12.

Set the left wheel exactly parallel to the frame. Then place the wooden gauge in front of the wheels and while



Fig. 12 —Gauge for Front Wheel Alignment

holding a pencil as shown in the illustration, turn the wheel. The pencil will make a mark on the tire tread. Having marked both tires in this manner, place the gauge behind the wheels and note the position of the pencil marks with reference to the mark on the gauge.

The pencil marks should be about $\frac{3}{16}$ " farther apart than they were on the front side. If the distance is greater or less, make the necessary adjustment on the tie rod and check again.

ADJUSTING THE TIE ROD:

Adjustable Socket Type: Loosen the lock nut at the left hand socket, and remove the steering ball from the

arm. Adjust the socket until the wheels are properly aligned, and with the ball replaced in the steering arm.

Integral Socket Type: Remove end plug and ball seat from one end of the tie rod. Drop the tie rod off the steering ball and remove inner ball and spring. Remove or add shims until proper alignment is obtained. It may be necessary to add or remove shims from the opposite end of the tie rod.

ADJUSTING THE STEERING GEAR (WORM AND GEAR TYPE)

Before attempting an adjustment, learn whether the play is in the steering post or steering arm. This can be done by working the steering wheel back and forth, while placing a finger on the lower edge of the wheel hub; also place a finger on the frame bracket and outer flange of the steering arm. With no perceptible looseness at these points, the play is probably between the gear and the worm.

When checking looseness in the steering gear, always check the tie rod and drag link also. A feeling of looseness in driving is often traceable to parts between the steering gear proper and the front wheels.

STEERING POST END PLAY:

Loosen the clamp bolt in the instrument board bracket and the three cap screws in the steering gear housing upper cover, unlocking the worm gear adjusting ring.

Turn the upper cover and column assembly clockwise until the end play is taken up. Do not make this adjustment too tight as an excessive thrust will be placed on the ball bearings.

Tighten the screws in the upper cover and tighten the clamp bolt in the instrument board bracket.

STEERING ARM END PLAY:

Loosen the three cap screws in the worm gear thrust ring cover (back side of the steering gear housing) unlocking the thrust ring. Turn the cover clockwise to remove end play, but do not get the adjustment too tight, as excessive pressure on the worm gear thrust washer will result.

Tighten the cap screws in the cover, locking the adjusting ring.

NOTE—In disassembling the steering gear, note the number of shims between the eccentric flange and the housing. Replace the same number in rebuilding.

ADJUSTMENT BETWEEN WORM AND GEAR:

Jack up the front axle until the wheels are free and turn steering wheel almost to extreme right or left, thus bringing the least worn parts of the worm and gear in contact.

Loosen the frame bracket screw and remove the four through bolts and the cap screw that hold the flanged sleeve to the housing. Turn the flanged sleeve until there is about $\frac{1}{2}$ " free movement at the rim of the steering wheel, making sure there is no binding at any point.

Replace the cap screw and bolts and tighten the frame bracket clamp screw.

In cases of extreme wear at the contact point of the worm and gear when the wheels are straight ahead, possibly neither of the above adjustments will remove the play. Provision has been made to correct such cases as follows:

Mark the position of some point on the steering wheel. Remove the steering arm and gear assembly. Remove the gear and reassemble it to the arm, using one of the other keyways provided for this purpose.

Turn the steering wheel at least a quarter turn, so the point noted on the rim assumes a different position, and replace the arm and gear assembly. Then adjust the flange as outlined above. This method brings entirely new points in contact on both worm and gear when the wheels are straight ahead.

THE LAVINE STEERING GEAR:

The Lavine steering gear is known as a "split nut" type.

Inside the housing, the steering arm terminates in an oval plate, on which are two substantial dowels. Fitted to each dowel is a small square block which enters a recess in the sliding block.

The sliding blocks are concave on the inside to receive the steering post and reversible threads on the blocks correspond with the reversible worm on the steering post.

The post rests on a thrust bearing at its lower end, and the only adjustment is made by tightening or loosening the adjusting nut at the lower end of the housing.

As the steering post is turned, the reversible threads cause one block to slide upward and the other to slide downward. This motion, transmitted to the steering arm plate, through the dowels, causes it to oscillate, turning the steering arm and consequently the bell crank, thus controlling the position of the front wheels through the drag link and tie rod.

ELECTRICAL ADJUSTMENTS

SPARK PLUG GAPS:

Irregular firing, especially at low engine speeds, is often due to non-uniform gaps at the spark plug points. The gaps should be inspected frequently and maintained at 25 thousandths. A feeler of the proper thickness is attached to the distributor wrench. A worn dime gives approximately the right gap.

ADJUSTMENT OF DISTRIBUTOR POINTS:

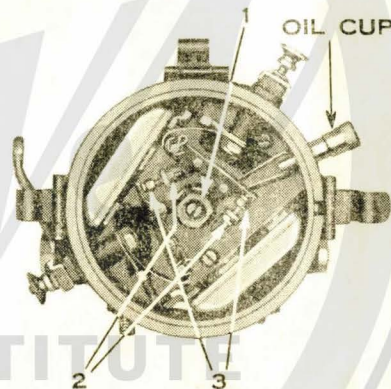


Fig. 13—Distributor

distributor cam. (No. 1, Fig. 13.)

Loosen the lock nut. (No. 2.)

Turn adjusting screw (No. 3) until the feeler gauge marked "Distributor" attached to the distributor wrench, will just pass between the points. Then, holding the adjusting screw in this position, tighten the lock nut.

Ignition on Wills Sainte Claire motors is separate for each side of the engine, hence there are two sets of breaker points. Proper engine performance requires that the gap for each set of breaker points be identical.

First, see that the breaker arm makes contact with the high point of the

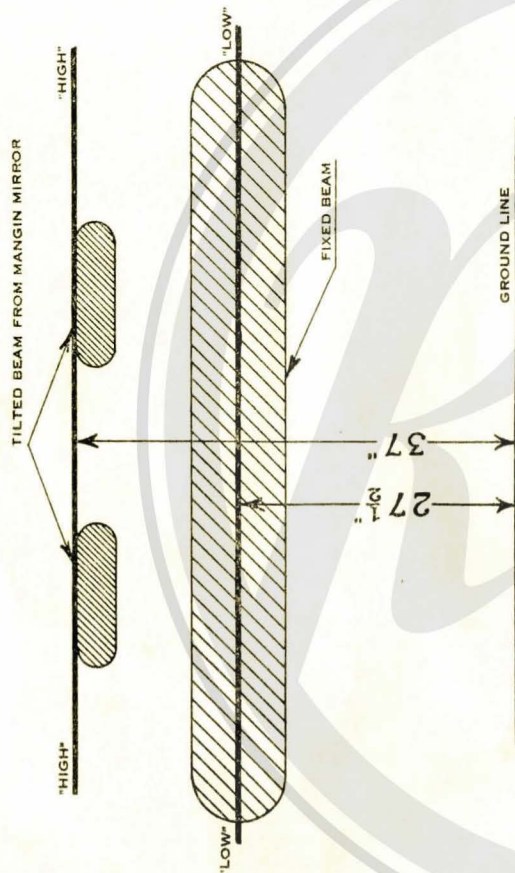


Fig. 14—Headlight Screen

TIMING THE DISTRIBUTOR:

See Spark Timing, page 18.

ADJUSTING THE GENERATOR CHARGING RATE:

The generator should be set so that the ammeter on the instrument board registers 10 to 12 points "charge" with all lights off, at an approximate speed of thirty miles an hour. A higher rate may burn out lamps; a lower rate may allow the battery to run down, if much night driving is done. In no case should the ammeter read over 16.

Loosen the clamp nut at the right side of the front end housing. Remove the forward cover band and note the lever in the left side of the generator.

To increase the rate, move the third brush by means of the lever, in the direction opposite to which the armature rotates, upward or to the right. To lower the charging rate, move the lever downward or to the left.

ADJUSTING THE HEADLIGHTS:

Provide a portable screen. Wall board makes a good screen. Paint a horizontal black line on the screen 27½" from the floor; paint another line at 37" from the floor. These lines must be parallel to each other and to the floor. (Note Fig. 14). Lacking a screen, the lines can be placed on a blank wall which is clean and fairly smooth.

ADJUSTMENT OF LAMPS ON CROSS TUBE:

Do not remove the headlamp covers.

Loosen the clamp nuts slightly and set the lamp front parallel with each other by holding a straight edge across both at the same time. The beam of light from the tilting mirror should be in the high position.

Set the lamp fronts vertically by causing the center of the lower beam of light from the large reflector to register exactly on the lower line on the screen, which must be ten feet from the car and exactly level with it.

When the lamps are properly set, tighten the cross-tube clamp nuts.

ADJUSTING THE TILTING MIRROR:

Having adjusted the lamp position as above, remove the covers.

Turn on the lights and try tilting the mirrors by working the dimmer switch on the steering column. Failure to tilt may be due to the battery being too low, in which case it will be necessary to operate on generator current. To do this start the engine and run it at a speed sufficient to show 8 points charge on the ammeter with all lights off.

Turn lights on and try tilting as before. If they now fail to tilt, remove the screws which hold the large re-

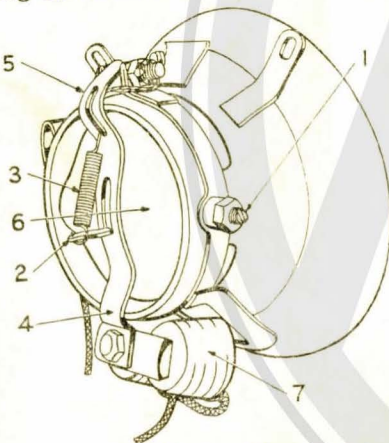


Fig. 15—Mirror Adjustment

flector in place, being careful not to injure nor soil the silvered surface of the reflector.

Support the assembly in one hand, and loosen the

lock nut and back off one of the pivot screws (No. 1, Fig. 15) to relieve any binding which may retard the tilting action. Tighten the lock nut at once, and replace the reflector in the lamp, taking up tightly on the screws.

Try tilting again. If the downward tilt is slow, remove the reflector assembly and, with pliers, carefully bend down slightly, the tongue (No. 2) projecting from the mirror support, to which a coiled spring (No. 3) is attached. This increases the tension on the return spring. Do not make this tension too strong if working with a fully charged battery, as the magnets will be unable to overcome the spring tension when the battery is weaker.

An image of the lamp filament will appear on the screen in the form of a horizontal coiled spring. This image is projected from the Mangin mirror. If the image appears blurred, try turning the bulb half over in the socket. If the image is still blurred, remove the reflector unit and return to the lamp manufacturer for adjustment.

UNDER NO CIRCUMSTANCES MUST THE MIRROR SUPPORT CLAMP SEAL BE BROKEN.

Note on the screen, a constant spot of light, independent of the mirror image. This is thrown from the large reflector and the center of this spot should be directly on the low position line.

If, in operating the magnets, the images of the mirror fail to check with the positions shown on the sketch, (Fig. 14) remove the large reflector assembly and with long-nose pliers, bend the lower end of the strap projecting from the mirror support to correct the "high" position. (No. 4, Fig. 15). Bend the upper end (No. 5, Fig. 15) of the strap to correct error in the low position. Do not place any strain on the delicate pivot screws.

ADJUSTING THE REBOUND CONTROLLER:



Fig. 16—Rebound Controller

which cars leave the factory. After the first thousand miles running, it may be desirable to set seven stars in front and eight in rear.

THE REAR AXLE

Wills Sainte Claire cars are built with three types of rear axles. They are classified as Torque Tube, Torque Arm and Hotchkiss Drive.

THE TORQUE TUBE AXLE:

This type of axle is distinguished by the torque tube which is fastened firmly to the rear axle housing and encloses the propeller shaft, pinion carrier assembly and the speedometer drive gear and pinion.

On each controller is a cap screw with indicator arrow attached. Turning the screw clockwise stiffens the adjustment; counter-clockwise loosens it.

When the present adjustment is unknown, loosen the cap screw with a wrench until it can be turned with the fingers grasping the arrow.

Still grasping the arrow, turn the screw clockwise as far as possible, with the fingers. Then apply the wrench and continue turning clockwise to the sixth star for front controllers and to the seventh star for rear ones. This is the setting with

The propeller shaft connects with the pinion shaft by a splined coupling. This coupling is keyed to the propeller shaft and slides on the pinion shaft, thus compensating for the varying distance between the transmission and rear axle due to inequalities of the road.

The front end of the propeller shaft is tapered to receive the universal joint, which is held in place by a castellated nut and cotter pin. The flanged yoke of the universal joint is attached to the transmission flange.

Torque tube axles are furnished in two gear ratios, 49-10 and 49-11.

THE TORQUE ARM AXLE:

This type of axle has a torque arm whose rear end is attached to the rear axle housing by a pin. The front end of the torque arm is supported by a specially designed shaft and bracket, connection being made through a ball joint. Springs above and below the ball joint hold the torque arm secure and eliminate rattles. Their tension is regulated by the nut on the lower end of the shaft.

Torque Arm axles use two universal joints, one at each end of the propeller tube. A splined connection between the propeller tube and the front universal joint makes the tube self-adjusting to road conditions.

Torque Arm axles have gear ratios of 49-10 and 54-11 which are equivalent, and 49-11 and 53-12 which are also equivalent. Ring gears and pinions of the Torque Arm axle are not interchangeable with those of the torque tube type.

THE HOTCHKISS DRIVE:

The Hotchkiss drive axle has no torque tube or torque arm, but transmits the driving force through the rear

springs to the frame. Used in conjunction with the Lockheed Hydraulic brake, all brake shafts, operating levers, etc., are eliminated from the rear axle assembly.

The spring seats on the Hotchkiss type axle are rigid instead of being free to rock.

The Hotchkiss Type rear axle is not interchangeable with either the torque tube or torque arm types, although the differential and pinion assemblies used in the torque arm axle are interchangeable.

Rear wheel bearings and axle shafts of the Hotchkiss type axle are not interchangeable with either of the other types, since the Hotchkiss axle uses a double roller bearing in each wheel.

THE CLUTCH

The clutch in Wills Sainte Claire cars may be either the multiple disc or single plate type. The two types are not interchangeable.

THE MULTIPLE DISC CLUTCH:

As the name indicates, the multiple disc clutch consists of six driving discs, faced with woven asbestos and the same number of driven discs which are plain. These discs are assembled alternately on the driven drum and are held in contact by the action of a heavy spring inside the clutch sliding sleeve. The driving discs have teeth on the outer edge to engage with the flywheel drum, and the driven discs have teeth on their inner edge to fit the teeth on the driven drum.

Depressing the clutch pedal causes the throwout yoke to draw the throwout assembly and pressure plate backward, allowing the discs to spread apart. The driving discs, being engaged with the flywheel drum, continue to revolve, but the absence of contact between

them and the driven or plain discs permits the latter to stop. When the pressure is removed from the clutch pedal, the pressure plate forces the discs into contact, transmitting the driving impulse from the engine to the transmission.

There is no adjustment on the multiple disc clutch, other than the pedal adjustment described on Page 37.

THE SINGLE-PLATE CLUTCH:

The single plate clutch consists of a single driving disc 12 inches in diameter, with a woven asbestos facing, which is held in contact with the face of the flywheel by a pressure plate. The pressure plate is held tightly against the driving disc by twelve springs which in turn are kept under compression by the backing plate, fastened to the rim of the flywheel by capscrews.

The center of the driving disc is splined to receive the splined end of the transmission intermediate shaft. This shaft is supported at its front end by a Hyatt roller bearing in the end of the crankshaft, and when the driving disc is pressed against the flywheel the splines transmit the turning action to the intermediate shaft.

On the rear portion of the intermediate shaft is the sliding throwout sleeve, with a flange at the rear and a ball bearing at the front end. When the clutch pedal is depressed, the throwout yoke engages with the rear flange of the sleeve pushing it backward. As the sleeve slides back, the ball bearing comes in contact with the clutch release fingers, mounted on the pressure plate studs, and as their inner ends are drawn backward, the contact between the pressure plate and the driving disc is broken, allowing the latter to stop.

When the foot pressure is removed from the clutch

pedal, the twelve springs force the pressure forward against the driving disc, restoring its contact with the flywheel.

ADJUSTING THE SINGLE-PLATE CLUTCH:

The only adjustment on the single plate clutch consists in establishing a uniform setting of the release fingers against the ball bearing on the clutch throwout sliding sleeve.

The clutch pedal should be correctly adjusted (See Page 37). Remove the clutch inspection cover and slide the sleeve forward with the hand until the rear flange is touching the throwout yoke which should be straight up and down.

The clearance between the fingers and the sleeve ball bearing should now be about three to five thousandths of an inch—just enough to insure complete engagement of the pressure plate, disc and flywheel. The adjustment is made with the self-locking nuts which hold the fingers to the pressure plate studs.

The clearance of all three fingers must be the same, otherwise the pressure plate will not be released equally on all sides and the efficiency of the clutch will be affected.

THE ZENITH CARBURETOR:

The Zenith carburetor used on the Wills Sainte Claire is a double throat type, and fuel is drawn through fixed jets. The only adjustment on the Zenith carburetor is by means of the knurled nuts which control the mixture going through the idling jets. These are located on the front side of the carburetor, just above the bowl. Turning the nuts to the right decreases the richness of the mixture; turning them to the left increases the richness.

THE HOLLEY CARBURETOR:

The Holley carburetor is a single throat type. Its use requires a different type of intake manifold, hence it is not interchangeable with the Zenith carburetor.

The idling adjusting screw is located in a horizontal position at the right side of the carburetor column, and the richness of the mixture is regulated by turning the screw in or out.

The high speed adjusting screw is in a vertical position at the left side of the mixing chamber. The best average adjustment will be obtained by turning the adjusting screw all the way down and then opening it three full turns. This setting will serve for all temperatures and all speeds, although in individual cases an opening of two and three-quarter turns may prove satisfactory and will increase the economy.

To clean the Holley carburetor, remove the large strainer nut at the bottom of the bowl. In it will be found a coiled spring which holds the strainer in place. After cleaning the strainer, replace the spring and nut.

THE MANIFOLD HEATER

The intake manifold is heated by exhaust gases from the exhaust manifold.

A section through the intake manifold would show three passages. The inner one carries the gas mixture to the cylinders; the outer one contains water and is part of the cooling system. Between them, surrounding the gas passage, is a passage through which the exhaust gases travel when the heater valve is closed.

By this arrangement, the gas intake passage becomes superheated as soon as the engine is started, and aids

easy starting in cold weather without excessive use of the choke.

Directions for the use of the heater are given on page 10.

MULTIPLE TUBE MANIFOLD HEATER:

One type of manifold heater consists of eight steel tubes, four on each side, which are attached to the exhaust pipes by clamps. The pipes pass through openings in the cylinder blocks, into a header which leads to the manifold.

A butterfly valve, located in the left hand exhaust pipe and controlled by a rod from the instrument board, serves to divert the exhaust gases from their normal passage through the left exhaust pipe, and sends them through the heater tubes to the manifold. They pass through the manifold and down through the right hand heater tubes into the exhaust pipe and thence to the muffler.

TWO-TUBE MANIFOLD HEATER:

Wills Sainte Claire engines are also equipped with two-tube manifold heaters. The tubes are connected to the forward ends of the exhaust manifold and lead around the front end of the cylinder block below the spark plugs and up to a connection with the intake manifold. It is not necessary to detach the heater tubes when removing the cylinder assembly.

The butterfly valve is located in the left hand exhaust manifold and is operated by means of a lever and a rod leading to the control button on the instrument board. The length of the control rod should be regulated so that the valve will be entirely open when the control button is pushed all the way in. The lever is about 15° in front of center when the valve is clear open.

THE SINGLE MUFFLER:

When a single muffler is used, it is located on the right side. The left hand exhaust pipe extends diagonally across the car to a "Y" connection on the front end of the muffler. The double and single muffler installations are not interchangeable.

ORDERING PARTS, TOOLS AND ACCESSORIES

Wills Sainte Claire dealers should be consulted about adjustments, replacements and repairs. All dealers have a supply of parts in stock, but if he should not have the part desired, same can be obtained promptly from the factory.

When ordering parts, be sure to state car and motor number for which the parts are required.

The car owner should consult with his dealer whenever it becomes necessary to replace any accessory part, such as tires, electrical units, speedometers, closed body parts, etc. Practically all such parts are serviced by the respective manufacturers, a list being given below:

Part	Manufacturer or Service
Alemite Gun and Fittings	Bassick Mfg. Co., 361 W. Superior St., Chicago.
Battery	Willard Storage Battery Co., Cleveland, Ohio.
Body Parts (Closed Cars)	
(A-68)	Fisher Body Corp., Service Div., Detroit, Mich.
Body Parts (B-68) as follows: except Hardware:	
Roadster	Babcock Body Co., Watertown, N. Y.

Part	Manufacturer or Service
Sedan, 7-passenger	Babcock Body Co., Watertown, N. Y.
Sedan, 5-passenger	Witham Body Co., Amesbury, Mass.
Brougham, 4-door	Lang Body Company, Cleveland, Ohio.
Coupe	Baker, R. & L. Co., Cleveland, O.
Coil, Ignition	United Motors Service, Branches in all principal cities.
Distributor	United Motors Service, Inc.
Gasoline Gauge (Tank)	National Gauge & Equipment Co., LaCrosse, Wis.
Gasoline Gauge (Dash)	King-Seeley Corp., 311 Maynard St., Ann Arbor, Mich.
Horn (A-E)	A-E Laboratories, Inc., Brooklyn, N. Y.
Motor Generator	United Motors Service, Inc.
Rebound Controllers	American Bosch Magneto Corp., Springfield, Mass.
Spark Plugs and Gaskets	Champion Spark Plug Co., Toledo, Ohio.
Speedometer	Waltham Watch Co., Waltham, Mass.
Tires	Tire Manufacturer (Name on Tires).
Vacuum Tank	Stewart-Warner Speedometer Corp., Chicago, Ill.
Special Service Tools	Miller Tool & Mfg. Co., Detroit, Mich.
Bumpers	Biflex Products Corp., Waukegan, Ill.

GENERAL DATA

The following information may be useful in applying for a car license or for the purpose of shipping a car:

Engine	A-68 121" Wheelbase	B-68 127" Wheelbase
Number of Cylinders	8	8
Bore	3 1/4 in.	3 1/4 in.
Stroke	4 in.	4 in.
Piston Displacement	265 cu. in.	265 cu. in.
Horse Power (N. A. C. C. Rating)	33 plus	33 plus
Car—Shipping Weights:		
Chassis	2220 lbs.	2330 lbs.
Roadster	3240 lbs.	3500 lbs.
Phaeton (5-passengers)	3320 lbs.	
Phaeton (4-passenger)		3500 lbs.
Phaeton (7-passenger)		3500 lbs.
Brougham	3500 lbs.	3700 lbs.
Coupe	3460 lbs.	3650 lbs.
Sedan (5-passenger)	3630 lbs.	3700 lbs.
Sedan (7-passenger)	3670 lbs.	3750 lbs.
Imperial Sedan	3670 lbs.	
Town Car	3600 lbs.	3700 lbs.
Limousine	3650 lbs.	
Overall Heights:		
Roadster	70 in.	70 in.
Phaeton (5-passenger)	77 1/2 in.	
Phaeton (4-passenger)		75 3/4 in.
Phaeton (7-passenger)		76 1/4 in.
Coupe	74 in.	73 1/4 in.
Brougham	74 in.	73 1/4 in.
Sedan	74 in.	75 in.
Imperial Sedan	74 in.	
Town Car	74 in.	74 in.
Limousine	74 in.	
Wheel Base	121 in.	127 in.
Overall Length	14 ft.	15 ft.
Tread (Standard)	56 in.	56 in.
Overall Width	67 in.	69 in.
Tires (Cord)	32 x 4 1/2 in.	32 x 4 1/2 in.
Tires (Balloon)	32 x 6 in.	32 x 6 in.

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