Repair Manual

Showing Short Cuts
and Methods for
Repairing and Upkeep

Durant and Star Cars
FOUR CYLINDER MODELS

JANUARY, 1929

DURANT MOTORS, Inc.
BROADWAY AT 57th STREET
NEW YORK CITY

DURANT MOTOR CO. of NEW JERSEY
Elizabeth, N. J.

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Lansing, Michigan

DURANT MOTOR CO. of CANADA, LTD.
Toronto (Leaside), Ontario

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WARRANTY

WE warrant each new DURANT and STAR motor vehicle so by us to be free from defects in material under normal use and service, our obligation under this warranty being limited to making good at our factory any part or parts thereof which shall with ninety (90) days after delivery of such vehicle to the original purchaser be returned to us, transportation charges prepaid, and which our examination shall disclose to our satisfaction to have been thus defective, this warranty being expressly in lieu of all other warranties expressed or implied and of all other obligations or liabilities on our part.

This warranty shall not apply to any vehicle which shall have been repaired or altered outside of our factory in any way, so as in our judgment, to affect its stability or reliability, nor which has been subject to misuse, negligence or accident.

We make no warranty whatever in respect to tires, rims, ignition apparatus, horns or other signaling devices, starting devices, generators, batteries, speedometers or other trade accessories, inasmuch as they are usually warranted separately by their respective manufacturers.

We do not make any guarantee against, and we assume no responsibility for, any defect in metal or other material, or in any part, device, or trade accessory that cannot be discovered by ordinary factory inspection.

It is understood and agreed that our Standard Warranty as shown above is null and void on any DURANT or STAR model where parts not sold by us are used in replacements or otherwise.

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The following is a list of unit manufactures supplying Durant and Star units who have established many service stations throughout the United States:

Ammeter
W. G. Nagel Electric Co., Toledo, Ohio

Battery
U. S. Light & Heat Corporation, Niagara Falls, N.Y.

Carburetor
Tillotson Manufacturing Co., Toledo, Ohio

Circuit Breaker
Electric Auto-Lite Co., Toledo, Ohio

Coil
Electric Auto-Lite Co., Toledo, Ohio

Generator
Electric Auto-Lite Co., Toledo, Ohio

Horn
Schwarze Electric Co., Adrian, Mich.
E. & A. Laboratories, Inc., Brooklyn, N. Y.

Distributor
Electric Auto-Lite Co., Toledo, Ohio

Lighting and Ignition Switch
Briggs & Stratton Co., Milwaukee, Wis.
Clum Mfg. Co., Milwaukee, Wis.

Oil Pressure Guage
W. G. Nagel Electric Co., Toledo, Ohio

Rims
Hayes Wheel Co., Jackson, Mich.
Bimel Spoke and Auto Wheel Co., Portland, Ind.

Speedometer
Stuart-Warner Speedometer Corp., Chicago, Ill.

Starting Motor
Electric Auto-Lite Co., Toledo, Ohio

Starting Switch
Electric Auto-Lite Co., Toledo, Ohio

Tires
Fisk Rubber Co., Chicopee Falls, Mass.

PREFACE

We have attempted in this Repair Manual to deliver a clear and concise message, which will enable any mechanic to make the necessary repairs and adjustments on DURANT and STAR cars.

With a thorough understanding of the working parts, and their relation one to the other, this service can be delivered with a minimum of delay.

For a mechanic to perform carefully and intelligently the duties required in a Service Station, it is necessary the he understand the construction and the various functions which component parts perform, in order to deliver to the owner the satisfactory "service" to which he is entitled.

In trying to diagnose the various ailments common to an automobile, we have illustrated different parts of the car and have described the easiest and simplest methods to be used in the making repairs, adjustments or tests. The various operations performed in disassembling or assembling a car are graphically illustrated.

It has been made simple, with technical terms explained, for the benefit of the mechanics who are without previous experience.

We are providing service facilities in every part of the world.

At our Factories we maintain a service organization which is at your disposal at all times, and on which we will be glad to give you any information you may desire.

Figure 1 shows the controls of the DURANT and STAR car.

The throttle and spark levers (cars equipped with full automatic spark control are without hand spark hand lever) are located on the steering column

In addition to the throttle lever at steering wheel a foot accelerator is located on the toe board just to the right of the brake pedal.

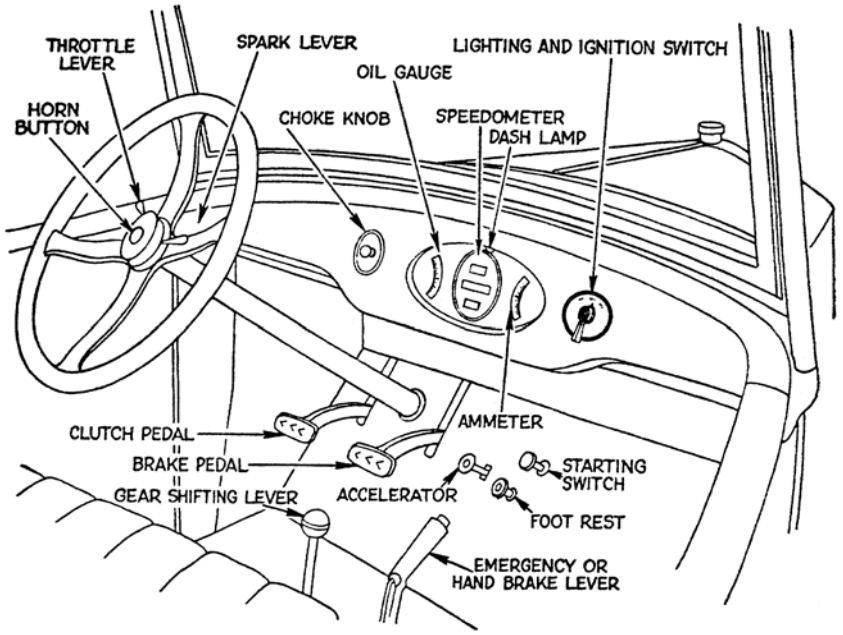

Fig. 1—Front Compartment and Controls

The lighting and ignition switch, oil gauge, speedometer and ammeter are located on the instrument board, where the oil gauge and ammeter can be watched by the driver to see that the oil and electric current are working satisfactorily.

The carburetor choke control is located at the left side of steering column on instrument board.

The horn button is located at the center of steering wheel.

The starting switch is located on the toe board, at the right of accelerator pedal and foot brake.

The gear shift is what is known as a standard shift; that is, three speeds forward and one reverse.

The emergency or hand brake lever is located at right of the gear shift lever.

The clutch and brake pedals are located below the steering column, the brake being on the right side and the clutch on the left.

COOLING SYSTEM

The cooling system used is a large cellular type radiator, and a water pump of the centrifugal type which is attached to right side of motor directly behind the generator, and is driven by the generator, which is connected to the water pump shaft by a rubber hose which is securely clamped to the shafts by two screws, one through each shaft.

As the circulating pump is connected to the lower radiator outlet, the water drawn through the radiator before being delivered to the water jacket surrounding the cylinder walls, which insures a proper circulation of cool water at all times regardless of engine speed. See Fig. **2**.

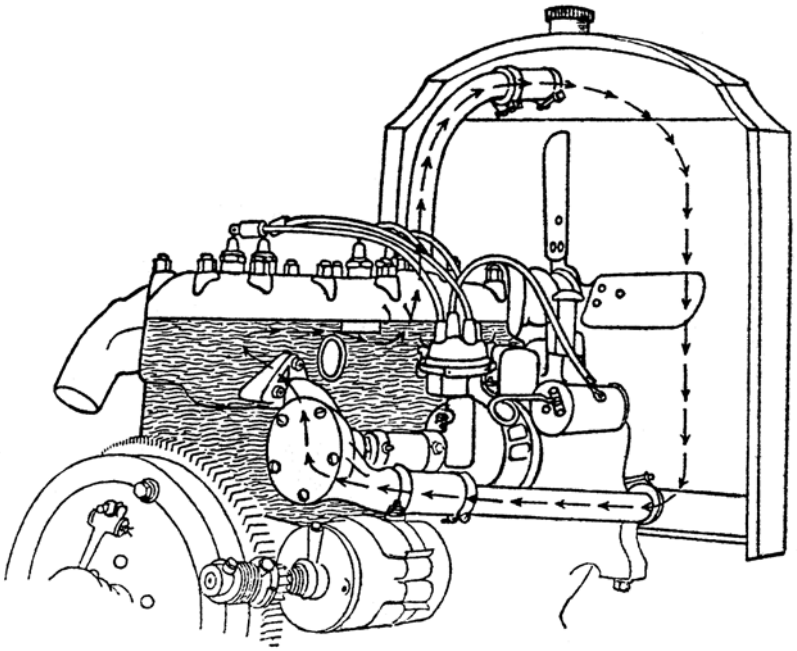

Fig. 2—Cooling System

Should water leak through the stuffing box on the end of the pump, tighten the nut. If this does not stop the leak, unscrew the stuffing box nut, install new packing or wrap around the shaft ordinary candle wicking that has been saturated with tallow or graphite grease and tighten the nut again.

Keep the cellular openings clean. Never allow mud to remain in them as it cuts down the radiation and prevents proper cooling. The entire circulating system should be thoroughly flushed out occasionally. This can be done in ordinary cases by disconnecting both the upper and lower hose connections and allowing fresh water to enter the enter the filler neck and flow down through the radiator and out the lower hose. The motor water jackets can be flushed out in the same way.

When hard water has been used, a scale or deposit will be formed which unless removed, will obstruct the circulation, causing unnecessary heating and frequent refilling. In this case a good way to clean out the scale is to dissolve a half pound of lye in about five gallons of water. Strain the liquid through a cloth and pour in the radiator. Run the motor for about five minutes, then draw off the solution through the radiator drain cock.

Fill the radiator with fresh water and run the motor again for several minutes; then drain off and refill with fresh water.

Never Use A More Powerful Chemical

Once a week it is a good plan to open the radiator drain cock and let all the water and accumulated dirt run out. If the water is very dirty, flush the radiator with fresh water.

Never—and be sure about this—put cold water into the radiator while the motor is hot. By "hot" we mean any temperature which is uncomfortable to the hand when held against the cylinder head.

When a motor gets "hot", the cylinder walls and especially the cylinder head around the exhaust ports are thoroughly heated up. The danger of cracking these parts cannot be overestimated; so make it a point, should you stop for water after the motor has been running for some time, to test the temperature of the motor by raising the heed and placing your hand on the cylinder head. If you can hold it there with comfort, water can be placed in the radiator; if not, wait until you can. It will only take a few minutes for the motor to cool off, and the repair bill saved will more than offset the slight loss of time and inconvenience.

Leaks in any system subject to vibration are likely to occur. It is not a good plan to put corn meal, bran or other substances in a radiator to stop a leak. It clogs up the tubes, thereby decreasing the cooling efficiency. Make a permanent repair with solder.

Winter Driving

As soon as the temperature begins to approach the freezing point, an anti-freezing solution should be placed in the radiator. Wood alcohol of denatured alcohol is best for that purpose.

The following table may be used in estimating the quantity of comercial alcohol required for different temperatures.

30° F. Above……..½ qts.	Zero…….2¾ qts.
20° F. Above……1½ qts.	10° F. Below…….....4 qts.
10° F. Above…….2 qts.	20° F. Below……...4½ qts.

50° F. Below……..5¼ qts.

Capacity cooling system—8 quarts.

Since alcohol evaporates more quickly than water, it is well when filling the radiator to make up the loss by adding a s solution of equal parts of alcohol and water.

The use of powerful chemicals, while sometimes cheaper in first cost, is very likely to cause damage later, costing more in repair bills that the amount saved, as they attack the metal and rubber hose connections.

If the radiator should freeze, do not try to thaw it by starting the motor, but thaw it by placing in a warm place.

It is a good plan, when making a stop in cold weather, to cover the radiator and hood with a blanket or other covering. This helps hold the heat, and in the way gives considerable protection for the prob-ability of freezing, besides making the motor start easier.

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CHAPTER I

A DETAILED DESCRIPTION OF THE THINGS MOST LIKELY TO CAUSE DIFFICULTY AND HOW TO DIAGNOSE THEM

HOW THE MOTOR OPERATES

The DURANT and START motors are of the "L" head, poppet valve type. All models have four cylinders on which the firing sequence is 1-3-4-2.

All DURANT and STAR motors are "four cycle," which means there are four complete strokes of the piston or two complete revolutions of the flywheel to one complete firing sequence.

1. As the piston starts downward in the first stroke of the cycle, the intake valve is opened. The motion of the piston creates a vacuum in the cylinder and draws a charge of gas from the carburetor through the valve opening.

2. When the piston reaches the bottom of its stroke and starts upward on the second stroke of the cycle, the intake valve closes and the piston compresses the gas that is drawn into the space at the top of the cylinder.

3. As the piston reaches the end of its upward stroke, the compressed gas is ignited by an electric spark which occurs at the points of the spark plug and the resulting explosion pushes the piston downward, turning the crankshaft on the third cycle or power stroke.

4. On the upward stroke of the piston, the exhaust valve is opened and the piston forces the burned gas out through the exhaust pipe, leaving the cylinder empty and ready for the beginning of a new intake stroke.

MOTOR FAILS TO START

If for any reason the motor does not start immediately under its own power, remove your foot from the starting button at once. One of the following things may be causing the trouble:

Ignition switch may not be turned on.

The storage battery may be partially discharged and when the starting motor is in operation, not enough electric current is flowing to the coil to produce a spark sufficient to ignite the gas. (See Pages 102 to 105.)

The coil may be burned out. (See Page 90.)

The contact points in the distributor may not be opening or the points may be burned so badly as to form a poor contact.

The primary wire from coil to distributor, coil to switch or to battery, may be loose or broken, making poor contact.

Spark plugs points fouled with oil or carbon.

Secondary wire from coil to distributor cover disconnected at coil or distributor.

Gasoline supply exhausted.

Shut-off cock in gasoline feed line may be closed.

Filter screen in bottom of carburetor may be clogged with sediment so that gasoline cannot enter float chamber.

Filter screen at top of vacuum tank may be clogged with sediment to stop flow of gasoline.

Gasoline line may be clogged with dirt; or if is cold weather, an accumulation of water n the line may have frozen.

The carburetor choke wire may not be pulled up far enough, providing the motor is cold, to make the mixture rich enough to ignite, or the choke valve may have been closed too tight, causing the mixture to be so rich with gasoline that it will not ignite.

WATER IN GASOLINE SYSTEM

If there is water in the gasoline, it will not mix; but being heavier than gasoline, will find its way to the bottom or lowest point in the carburetor. In cold weather it may freeze. By pouring hot water or applying hot cloths to the supply pipe and carburetor this can be loosened up. If poured on, be careful that none enters the carburetor.

MOTOR MISSES AT HIGH SPEED ONLY

There is insufficient gasoline flowing to carburetor, due to obstruction in gasoline line or filter screen, or the shut-off cock may be only partly open.

A valve may be sticking slightly and does not seat properly.

There may be a loose electrical connection.

The spark plug points do not have the proper gap. The point should be separated .025 of an inch

MOTOR MISSES AT ALL SPEEDS

First determine which of the cylinders are not firing. This can be accomplished by placing a screw driver (with wood or rubber handle) from the terminal end of the spark plug to the cylinder head. (See Fig. 73.) If a change in the running of the motor is noticed, it is not the correct cylinder. Test each cylinder separately until one is found that by "short-circuiting" the spark plug with the screwdriver makes no difference in the running of the motor. The following reasons may be causing the motor to misfire:

Spark plugs may be fouled or may have broken porcelain. If the plugs are fouled, wash with gasoline. If the plugs have a broken porcelain, a new plug is the only remedy.

One or more valves are sticking. In this event, with an oil can filled with equal portions of cylinder oil and kerosene, squirt around the valve stem of valves that are sticking. In some instances it will be necessary to remove the valve and polish stem. (See Page 31, Fig. 13.)

Valves may need grinding. (See Page 30, Fig. 12.)

One of the ignition wires may be loose. Examine and make sure that all electrical connections are tight.

The contact points in the breaker box may be badly worn or need cleaning. (See Page 101 Fig. 75.)

Valve spring may be weak and not allowing the valve to properly close. (See Page 29, Fig. 11.)

The valve tappet may be adjusted too tight not allowing the valve to close, or the valve adjustment may be loose, not allowing the valve to open.

A valve spring may be broken.

Filter screen in carburetor clogged and gasoline not flowing to carburetor properly. (See Page 85.)

The spark plug gaps are not adjusted properly. The gaps should be about .025 of an inch.

The carburetor may be flooding, causing the mixture to be too rich. The is usually caused by the needle valve not seating properly. To correct, remove float chamber cover, rotate valve slowly with fingers and tap lightly on top of valve. This will cause a new seat to be formed and will also remove any obstruction or roughness that there may be on the needle valve seat.

MOTOR MISSES AT LOW SPEED ONLY

Compression is weak due to leaky piston rings or valves not seating.

There may be a leaky gasket where the carburetor is attached to the intake manifold or where the manifold attaches to the cylinder block, permitting air to enter, weakening the mixture. To detect the leak, take an oil can filled with gasoline and squirt around where the connections are made. If any gasoline enters the opening, the speed of the motor will immediately increase, thereby indicating a leak.

The regulator screw which regulates the flow of gasoline at low speed only may not be adjusted properly. Set the throttle for low speed running and turn the screw in and out to obtain the best low speed running adjustment.

The spark lever (cars equipped with manual control may be advanced too far. When running at low motor speeds, the spark lever should be retarded.

When running at low motor speed the generator does not deliver electric current to the storage battery, as the circuit breaker makes an “open” circuit in the line and ignition current is then supplied from the storage battery. If the battery is in a badly discharged condition, it ofttimes happens that insufficient current is being supplied for ignition purposes.

There may be one or more weak exhaust springs and, with the throttle practically closed, the vacuum created the cylinders by the piston on the suction stroke will open the exhaust valve, drawing in burned gases and weakening the mixture so it will not burn.

MOTOR STOPS SUDDENLY

If the motor stops suddenly, without any further explosions:

Examine gasoline supply.

Examine carburetor to see if gasoline is running into the float chamber.

If motor has been running along evenly and begins to miss with considerable backfiring through the carburetor and finally stop, it is usually an indication the gasoline supply is exhausted. When the gasoline gets below a certain point in the carburetor, an insufficient supply is furnished to the cylinders, which produces a slow-burning mixture with the resultant backfiring.

Examine the switch, and, at any point on the reverse side of the instrument board where wires are attached, at the storage batter, igniter and on the coil, for loose connection, as a wire may have become detached.

The switch may be burned out, or the key does not produce a contact.

Test the coil (See Page 90) to determine whether it is burned out, and, in fact, make a thorough examination of the entire ignition system.

Test the wires at the distributor (See Page 100) to determine whether electricity is getting through the ignition switch.

If it is found that the electrical connections are all tight and that there is electricity in the wires, examine the distributor, as the cam which operates the distributor may have become loosened and the contact points are not opening. If this is found to be the case (See Pages 96 to 98) for retiming distributor.

MOTOR SPITS AND BACKFIRES

This is usually an indication of carburetion faults, although the backfiring through the exhaust pipe or muffler may be due to defective ignition. If for any reason the igniter or ignition apparatus fails to operate for a few revolutions of the motor, there is a considerable amount of unburned gas forced from the cylinders into the exhaust pipe and muffler; the when the gas is ignited in the cylinders the flame which is emitted through the exhaust valve ignites the gas in the muffler, causing an explosion.

Backfiring and spitting through the carburetor is often due to a weakened mixture, which is slow-burning, and as there is still a certain amount of flame in the cylinder when the intake valve opens to receive the new charge of gas, the result is that the gas in the intake pipe is ignited. The cause is usually a low gasoline supply or a clogged gasoline system, or there may be small air leaks in the intake manifold or at the connections which allow air to enter, making the mixture too lean.

Carbon Deposits on top of the piston or on the sides of the combustion chamber becoming heated to a degree of incandescence will sometimes ignite the incoming charge of gas, causing a backfire through the carburetor.

On of the intake valves may be sticking and not getting to its seat in time. It should be removed and the stem polished. (See Page 31.)

STARTING MOTOR DOES NOT OPERATE

This is not an infrequent source of difficulty and may be caused by any one of the following:

Exhausted storage battery, due to excessive use of the starting motor or lights and is the direct result of failure of the part of the owner in not observing the rules set forth for the care of his battery. (See Page 103.)

Broken or loose wires either at the battery, starting switch or starting motor. Examine all connections and wires carefully.

Starter cables may be loose at the battery posts or have become corroded and are not making a good contact. Remove and thoroughly clean, then cover with vaseline or petroleum jelly.

The cable leading from the negative post of the battery to the starting switch or from the starting switch to the starting motor may be loose at the terminal post.

Starting switch making poor contact, having broken blades or sticking. Remove the switch and make necessary repairs.

Starting motor may be "short-circuited" or may have shifted out of line. (See Page 95.)

MOTOR OVERHEATS

The following causes will usually lead to a hot motor:

Low water supply in the radiator. It is necessary to have full tank of water as it to have plenty of gasoline or oil. Make it a rule to regularly inspect and fill the radiator.

Radiator tubes stopped with lime deposits. The radiator should be thoroughly cleaned. (See Page 7.)

Fan belt too loose, or broken, causing fan to stop rotating. (See Page 46 on adjustment and replacement.)

Oil not circulating through the motor properly, or it may be diluted with gasoline to such an extent that the friction-reducing qualities are affected.

Late or retarded spark. This is usually apparent by a marked loss in power. A late spark produces a slow-burning charge which causes an increased amount of heat due to the piston having started downward on the power stroke, reducing the density of the compressed gas before it is ignited. (See Pages 96 to 98 covering retiming distributor.)

Gasoline mixture too rich.

MOTOR LACKS POWER AND IS SLUGGISH

This is very apparent when ascending a slight grade or in attempting to accelerate the motor suddenly, and ay be caused by the following:

Carbonized Valves

As the motive power is obtained by burning or exploding a highly compressed gas mixture, it follows that a certain amount of carbon will be deposited on the valve seats, piston head and combustion chamber. Small particles of burnt carbon will lodge under a valve, especially the exhaust, holding it open. As this exposes the valve seats to the heat generated b the explosion, small pits or burnt spots will in time cause the surface to be so roughened as to prevent tile proper seating of the valves. This will cause a leakage of gases, resulting in loss of power and uneven running of the motor. When this occurs, grinding the valves is the only remedy.

To determine which valve needs attention, turn the motor over slowly by hand and note whether the same degree of resistance is met with in each cylinder. The ones offering the least resistance are those whose valves leak. Grinding the valves is the only remedy. (See Page 30, Fig. 12.)

Worn or Broken Piston Rings

It is always advisable to grind the valves first and in that way remove the most likely cause of trouble. With the cylinder head off an approximate examination of the rings be made. as follows: Turn the motor

over by hand so as to bring successive pistons to the top of their strokes. Then rock the fly wheel back and forth, holding your fingers on the top of the piston. If the rings are worn in the grooves, you can feel them move.

Piston rings seldom wear enough on their outside diameters to require replacement. However, they will wear on the sides where they fit into the grooves, therefore when they become loose enough to feel the movement as described above they should be replaced. (See Page 37.)

Replacing the piston rings will not always overcome the "blowing by" of gases if the cylinder walls are worn out of round. An examination should be made to determine whether this condition exists, as the new piston rings will only touch the high spots in the cylinder, leaving a space between the rings and the cylinder walls. In this event, the only remedy is to hone or regrind the cylinders or replace the cylinder block.

Valves Adjusted Too Close

Valve tappets set up too tight, causing the valves to hold open. With the motor hot, test the tappet clearance (Pages 26-27) and adjust accordingly.

Late Ignition

If the piston starts downward on the power stroke before the spark crosses the gap of the spark plug, the compression is reduced and a portion of the effect of the expansion or explosion of the gases on top of the piston is lost. The ignition timing should be checked very carefully to see that the electric current is being delivered to the spark plug at the proper time. (See Pages 96 to 98.)

Badly burned spark plug electrodes, which increase the resistance of the plugs, resulting in a weak spark. Replacing the plug is the only remedy.

MOTOR POUNDS OR KNOCKS

When a peculiar pound or knock, unusual to the regular motor sounds, is heard, it should be investigated to determine as nearly as possible its location and seriousness.

Go about the task of locating the source of trouble carefully—don't jump at conclusions, and, above all, do not operate the car until you are satisfied that no harm will result pending later repairs.

Nearly all motor noises can be definitely located. Some, however, can only be Approximated. These noises are usually the result of :

An Accumulation of Carbon Deposits on Piston Heads, Valves and Combustion Chamber

A motor which is badly carbonized will pound when the power is applied suddenly or when ascending a slight grade. Retarding the spark will reduce the noise; however, the motor will be sluggish, heat readily and labor on the slightest pull.

Carbon will deposit in the combustion chamber of any internal combustion engine, so do not be alarmed. However, at the first opportunity the cylinder head should be taken off (Fig. 5), the carbon removed, and the valves reground (Fig. 12).

Loose or Worn Bearings

A bearing knock or thump can be detected in two ways: First, by accelerating the motor quickly, at which time a rattling and clashing sound will be produced; and, second, by starting the car with the brakes set, which will cause the motor to pull against resistance. By holding one end of a screwdriver or rod to the ear and placing the other end at different points on the motor. the particular spot where the noise is loudest can be determined (Fig. 3).

If the sound is loudest at the top of the motor, short circuit the plug.

(Fig. 73) on that cylinder. If the noise disappears you have located the cylinder in which the trouble lies.

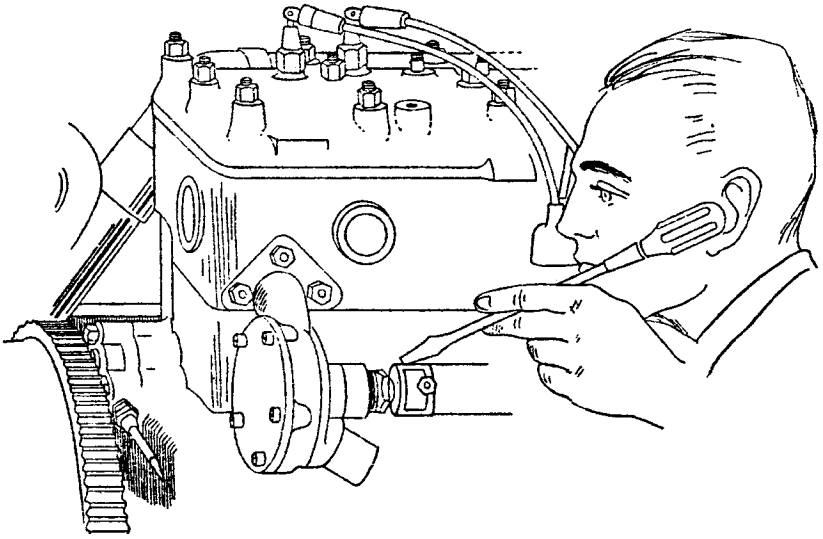

Fig. 3—Locating Motor Knock

The next step is to determine: First, whether it is due to a worn piston pin; second, to a worn or loose piston.

Worn piston pins cannot always be located by short-circuiting the spark plug, but by holding open an exhaust valve, thereby reducing the vacuum in the combustion clamber on the suction stroke of the piston, the knock will usually disappear, indicating the cylinder in which the trouble lies.

If the motor is cold, run enough to thoroughly heat up the pistons and cylinder walls-as a cold motor will always be noisy and is likely to deceive the inexperienced mechanic.

If the noise is produced by a loose piston, retarding the spark will lessen it; however, the best test is to operate the car at a speed of ten to twelve miles per hour, either on a slight grade or by having the brakes partly set. Under these conditions a knock produced by a loose piston usually develops, and by short-circuiting the spark plugs, the cylinders containing worn or loose pistons can usually be located.

To replace piston or piston pins, remove the oil pan (Fig. 16) and proceed as instructed on Pages 35 to 43.

If the noise appears to come from the lower part of the motor, determine whether it is in the main crankshaft bearings or connecting rod bearings. By holding the screwdriver or rod opposite the main bearings and putting the motor on a "pull," the location can usually be determined with accuracy.

Remove the lower crankcase and tighten the bearings as instructed on Pages 43 to 44.

Worn or improperly adjusted valve tappets.

This is easily detected and adjustment or replacement made as per instruction (pages 27 to 29).

Loose flywheel bolts. This sometimes is a very difficult noise to locate, as the sound is transmitted to all parts of the motor and gives the impression of loose main bearings. If tightening the bearings does not remove the noise, examine the flywheel bolts.

Worn camshaft bearings or loose timing sprocket keys.

Lack of Oil or Water

Insufficient oil circulating through the motor or a low supply of water will cause the motor to over heat and knock. Examine the oil pump and circulating pipes.

CLUTCH

The releasing and engaging of the clutch will in time produce the following conditions:

Clutch Grabs

If the clutch takes hold too quickly, causing the car to start with a jerk, (when the clutch is engaged slowly), the adjusting fingers should be adjusted evenly so that same pressure is on each one, or the disc which holds the friction plates may be sprung. Remove and straighten.

Clutch Slips

If clutch slips the adjusting fingers may not be adjusted property to give enough pressure on the single plate disc. To increase pressure, loosen the three castled nuts on the clutch fingers; or, perhaps, the clutch pedal is striking the toe board.

Weak Clutch Springs

This seldom occurs, as the action of the springs is very light. However, if none of the above conditions are the source of trouble, renewing the springs will usually correct the difficulty.

TRANSMISSION

The transmission is of the selective type, having three (3) speeds forward and one reverse. It is composed of a countershaft on which are keyed three gears and a main or splined shaft, on which two gears slide, which, by a lengthwise movement, can be made to engage the gears on the countershaft.

The most frequent source of annoyance is having the gears jump out of engagement. This is usually produced by one or more of the following causes:

First: Gears not meshed deep enough, causing the load to be carried on a part of the teeth only. In making the gear shifts always be sure, before engaging the clutch, that the gearshift lever has been moved as far forward or backward as it will go without straining. If this is not done, the edges of the teeth will become beveled, and in time it will be possible to keep the, gears- engaged.

Second: Bent gearshift forks. (See Pages 56 to 57.)

Third: Loose or worm sliding gears.

Fourth: Loose main drive gear bearing or worn, main drive gear bushing.

If transmission becomes noisy or grinds when the motor is running idle with the clutch engaged, it may be due to the transmission being out of alignment with the motor.

REAR AXLE NOISES

These can be subdivided into two classes:

First: A normal and natural steady hum which is always present when gears are used, whether in an axle or otherwise. This should not be confused, neither should the motorist become alarmed, if the noise continues steady and uniform.

Second: Lumpy, jerky noises usually produced by wear. Although occasionally one or more teeth may become broken. There is no absolute method of diagnosis except to disassemble the axle and examine and try the fit of each working part,

A rear axle is divided into three component parts:

(a) A propeller shaft, which is the connecting shaft between the transmission and the axle proper (Fig 51).

(b) A differential, whose function is to permit one wheel to travel. faster than the other, or independent of the other, such as turning corners, etc.

(c) The main or driving shafts to which the rear wheels are attached.

Each of the above are properly supported on bearings mounted in suitable housings. By following the description covering the disassembly and assembly of the different units on Pages 63 to 67 the proper repair of the axle should not be a difficult task.

The following will give a general idea of the probable source of difficulty.

REAR WHEELS WILL NOT ROTATE

(a) Remove the, hub caps and note if axle shafts revolve. Occasionally the key holding the wheel hub to the axle shaft shears off.

(b) Remove the cover on the transmission and note if the spline shaft revolves; if it does, the trouble may be looked for at the following places:

First—Universal joint, key sheared on drive pinion.

Second—Broken axle shafts.

Third—Rivets sheared holding ring gear to differential case.

Fourth—Broken universal joint or propeller shaft.

Grinding Noises When Turning Corners

This is an indication that the differential thrust bearings are out of adjustment. Replacement or proper fitting is the only remedy.

AXLE “BUCKS" OR "CLASHES" WHEN COASTING

May be due to one or all of the following:
First: Worn or improperly adjusted pinion shaft thrust bearing.
Second: Worn drive gear or pinion.
Third: Worn universal joint. (See Page 63.)
Fourth: Loose rear axle shaft wheel key.
Fifth: Worn bushing in the transmission drive gear.
Sixth: Loose rivets holding drive gear to differential gear case.
Seventh: Worn differential spider pins.

BRAKES

Brakes are the "safety factors" of an automobile, and, yet is safe to say that the average motorist seldom give them any thought until they have become so worn as to be ineffective.

Brakes "Howl" or "Squeak" When Applied

This is due to the brake linings becoming worn so that the heads of thee rivets holding the linings to the bands or shoes strike the drum, or the surface of the lining has become glazed. If the rivets protrude, remove the bands or shoes and sink the rivet heads below the lining. If the linings are too thin, renew them.

Car Skids, or One Wheel Locks When Applying Brakes

The brakes are not adjusted evenly; that is, those on one wheel grip before those on another. For proper adjustments, see Pages 67 to 74.

Brakes Will Not Hold on a Hill

This indicates that the lining is not bearing evenly and is gripping on portion of the lining only. (See Pages 67 to 74.)

CAR STEERS HARD

This is usually caused by any one of the following:
Steering gear needs lubrication.
Steering knuckle king pins need lubrication. This is one of the most common causes.

Front tires not properly inflated.

Wheels not in proper alignment. To properly grip the road, the wheels, should "toe in" at the front that is the distance between the center of the tires should be not greater than ⅛" shorter at the front than at the rear of the wheels, when measured at the height of the hubs. (See Page 59, Fig. 46.)

The bolts holding the steering gear to the frame may have become loose.

FRONT TIRES WEAR UNEVENLY

This is due entirely to the front wheels not being properly lined up. (See Page 59 for front wheel alignment.)

CHAPTER II

PRACTICAL METHODS FOR THE REPAIR AND MAINTENANCE OF DURANT AND STAR CARS

TO REMOVE MOTOR FROM CAR

Disconnect all parts which connect the motor to the body, frame or radiator.

Remove universal joint between clutch and transmission.

By installing a motor hook, as shown in Fig. 4, fastened in No. 3 spark plug hole, and with the aid of a chain hoist, it can be removed very easily.

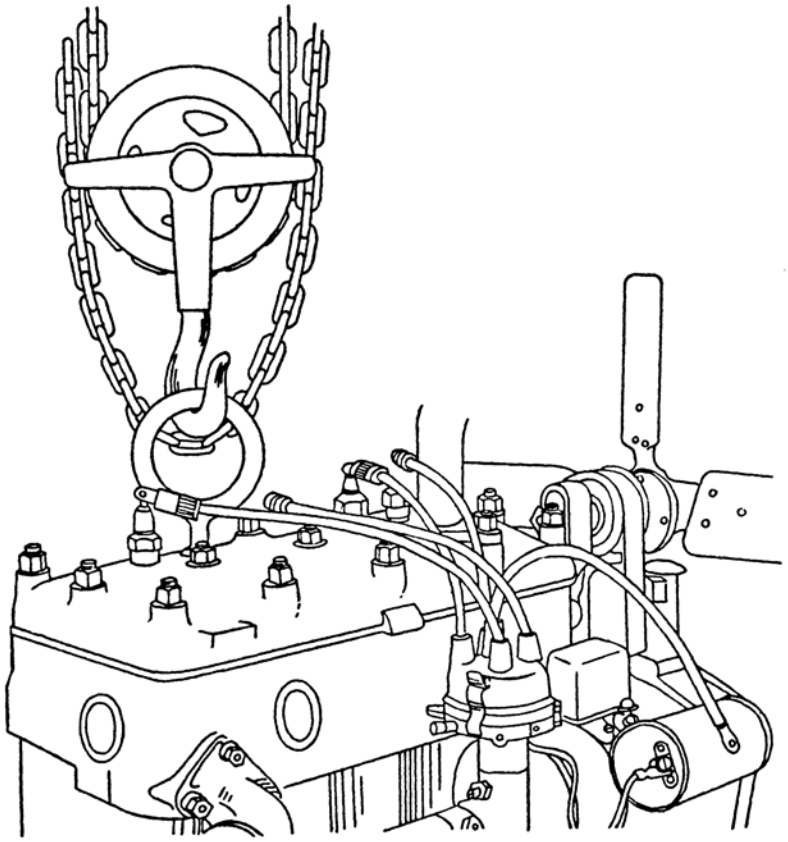

Fig. 4—Removing Motor from Car

CYLINDER HEAD

The cylinder head, a separate casting, can be removed by disconnecting radiator hose, spark plug wires, and fifteen (15) 7/16' hexagon nuts. (See Fig. No. 5.)

The old cylinder head gasket may be considered in good condition, and may be reinstalled if the copper lining 'is free from marks of depressions, and the surface is smooth and unbroken.

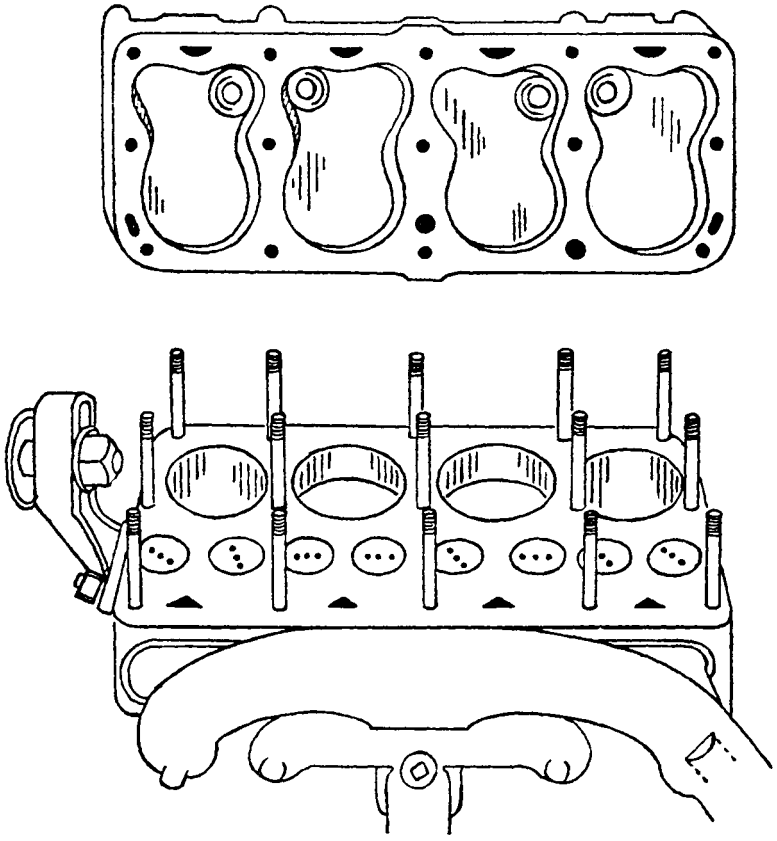

Fig. 5—Cylinder Head Removed

Shellac should never be used on a gasket when installing a cylinder head. The gasket is held in place by fifteen (15) studs projecting from the cylinder block.

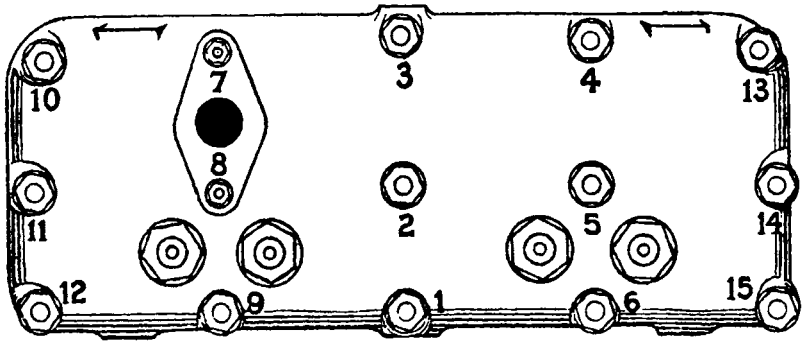

Fig. 6—Cylinder Head Bolt Tightening Diagram

When the gasket is in position on the cylinder block, put the head in place; then the upper water connections Screw each of the fifteen 7/16" hexagon nuts until they just touch the cylinder head. Then tighten each one evenly, a little at a time, until all are tight.

The best results may be obtained by tightening the bolts in the order specified on the cylinder head bolt tightening diagram, as shown in Fig, 6.

After the motor been warmed up under its own power, tighten each nut again.

VALVE TAPPETS

Four valve tappets are installed in each of two guide gates and are held in position by pin and spring plungers between each tappet.

These can be removed as an assembly, as shown in Fig. 7 by removing two (2) 3/8”-16 x 1-9/16” hexagon head cap screws which screw into bosses on cylinder.

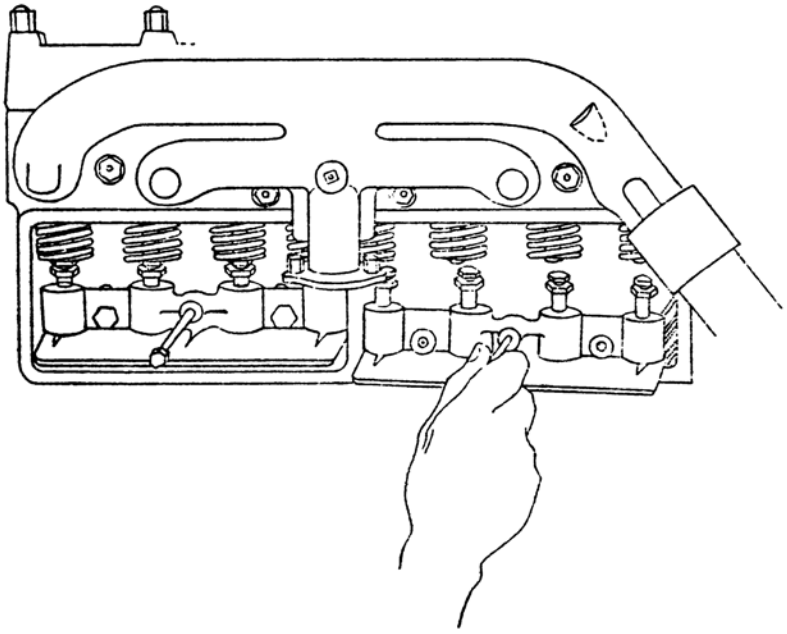

Fig. 7—Removing Valve Tappet Guide

Caution:—Do not use longer cap screw than specified above, as a longer screw will extend into the cylinder and cause damage to the piston.

Adjusting Valve Tappets

To adjust valve tappet, crank the motor by hand until the valve tappet being tested has reached its lowest point of travel, then measure the

space between the tappet adjusting screw and the valve stem; there should be .008 of an inch clearance or back lash with hot motor.

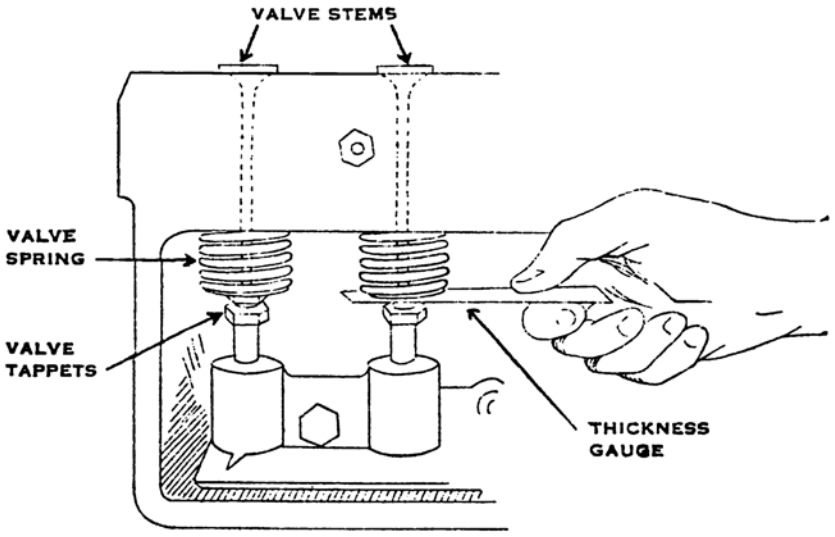

Fig. 8—Determining Proper Valve Clearance

Clearance can be determined by feeler stock or thickness gauge, as shown in Figure 8; but if same is not available, an ordinary sheet of writing paper can be used which will measure approximately .005 of an inch. If adjustment is required, loosen the lock nut with a 9/16" flat wrench, and turn adjusting screw with an 11/16" flat wrench until proper adjustment is made, after which the lock nut should be tightened.

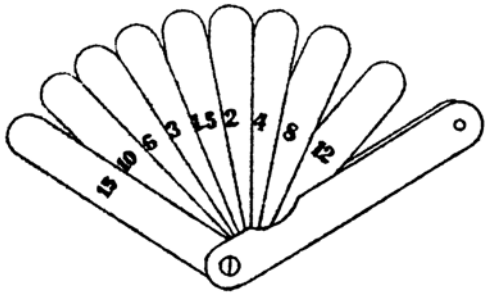

Fig. 9—Standard Thickness Gauge

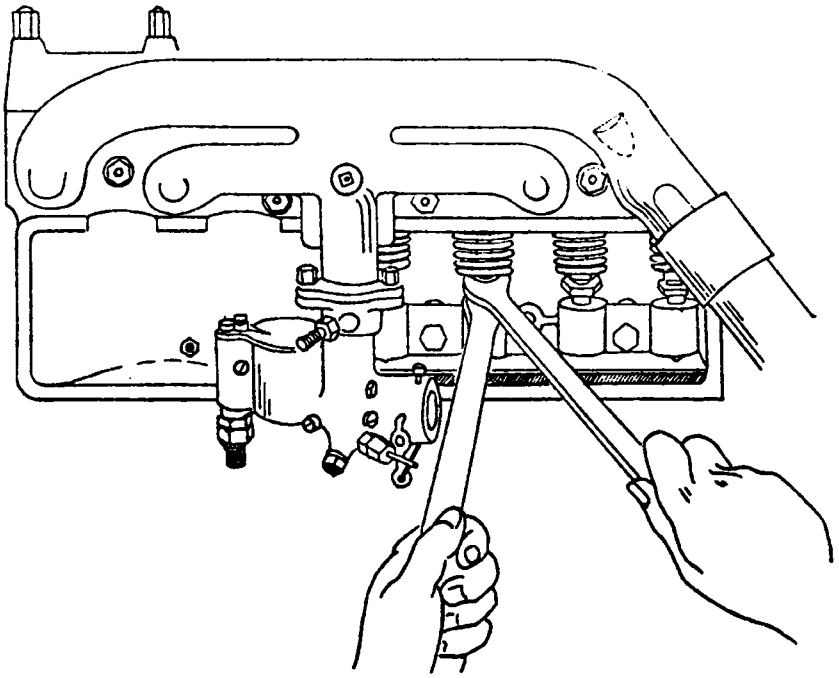

Fig. 10—Adjusting Valve Tappet

NOTE: By welding an eight or nine-inch handle on standard 11/16" and 9/16" flat wrenches, it will allow you to make adjustments more easily as shown in Fig. 10.

REMOVING VALVE SPRINGS

After the cylinder head and valve tappet assemblies have been removed, compress valve springs, and remove lock pin.

TESTING TENSION OF VALVE SPRINGS

Insert a screwdriver or some other suitable tool between the coiIs of the valve spring while the motor is running.

Twist or turn the screwdriver, thus increasing the spring's tension, as shown in Fig. 11.

If the motor picks up and runs properly, replace the spring with a new one.

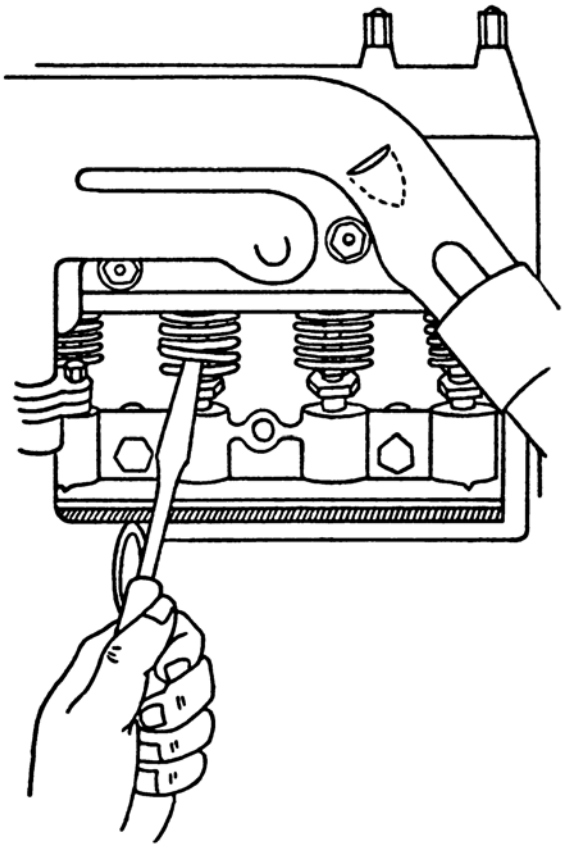

Fig. 11—Testing Tension of Valve Spring

The spring's tension can be increased for a short time by removing the spring and stretching.

GRINDING VALVES

Place a light coil spring, 1¾" long, around the valve stem.

Smear a thin coat of grinding compound on the bevel edge of the valve head, insert the valve in its original position and with a brace and screwdriver bit or with a vacuum cap valve grinding tool, rotate the valve back and forth a quarter of a turn, using enough pressure to overcome the resistance of the small spring. (NOTE: When a vacuum cup valve grinding tool is used, no spring is necessary around the valve stern.)

Do not turn the valve through a complete circle, as it will cause the compound to cut ridges on the surfaces.

Quite often valve seats are badly burnt or pitted and should be reseated by a special resealing tool before attempting to grind in valve.

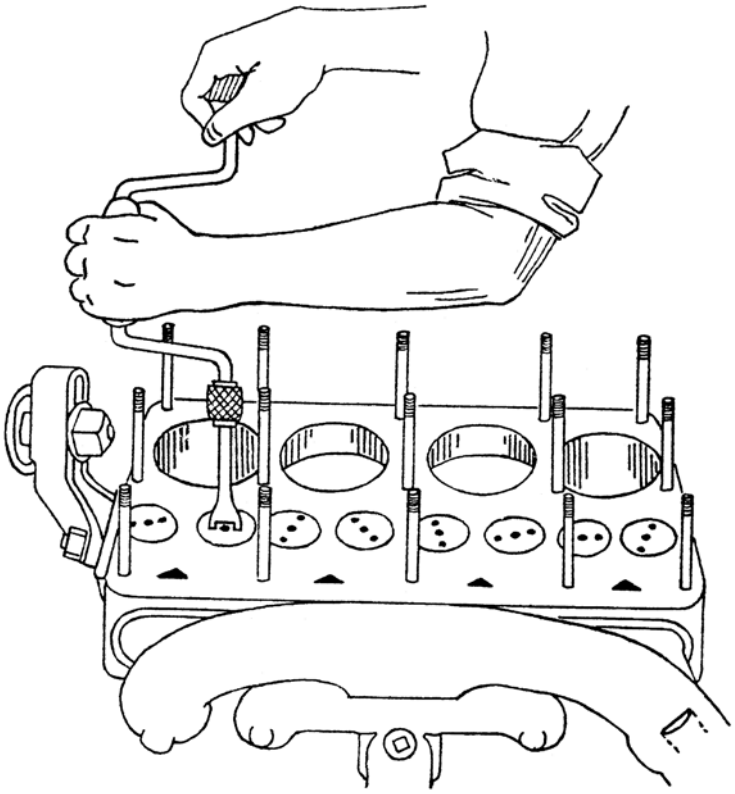

Fig. 12—Grinding Valves

After rotating the valve a few moments, release the pressure on the brace. This will cause the coil spring to act, lifting the valve slightly before again resealing. For further grinding turn valve one-quarter revolution, and repeat operation until the valve seats in block are polished, and show no dark spots. To test for perfect contact, mark lines with a lead pencil, about ¼" apart on the bevel edge of the valve and reseat the valve. Give the valve one-half turn to the right and one-half turn to the left using a little extra pressure on the brace.

If all marks are removed, the grinding is perfect. If one line or part of one line remains untouched, this indicates an uneven spot, and the valve must be reground until it seats properly,

POLISHING VALVE STEMS

Remove all particles of carbon and grit.

Hold the valve head in wooden blocks clamped in the jaws of a vise as shown in Fig. 13. Wrap a narrow emery cloth around the valve stem and pull the ends back and forth, at the same time causing it to slide up and down the stem.

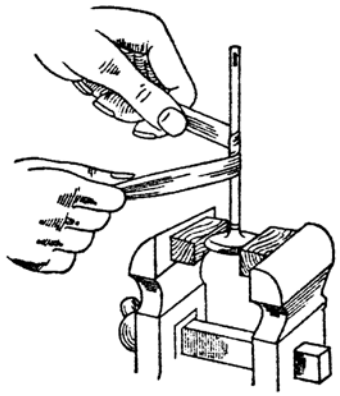

Fig. 13—Polishing Valve Stem

After the grinding or polishing operation, be sure all compounds are thoroughly washed out with gasoline.

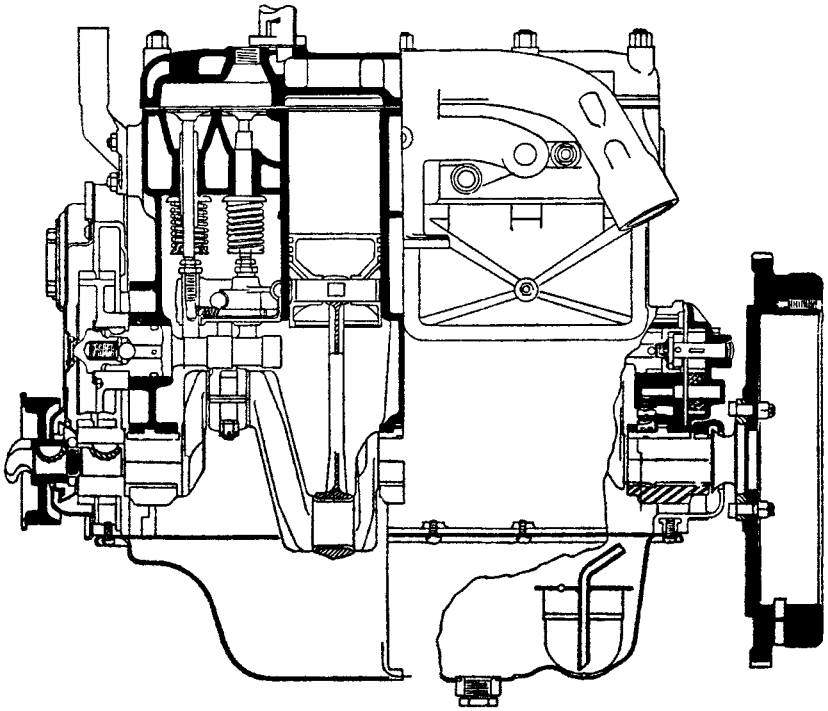

Fig. 14—Side View of Motor

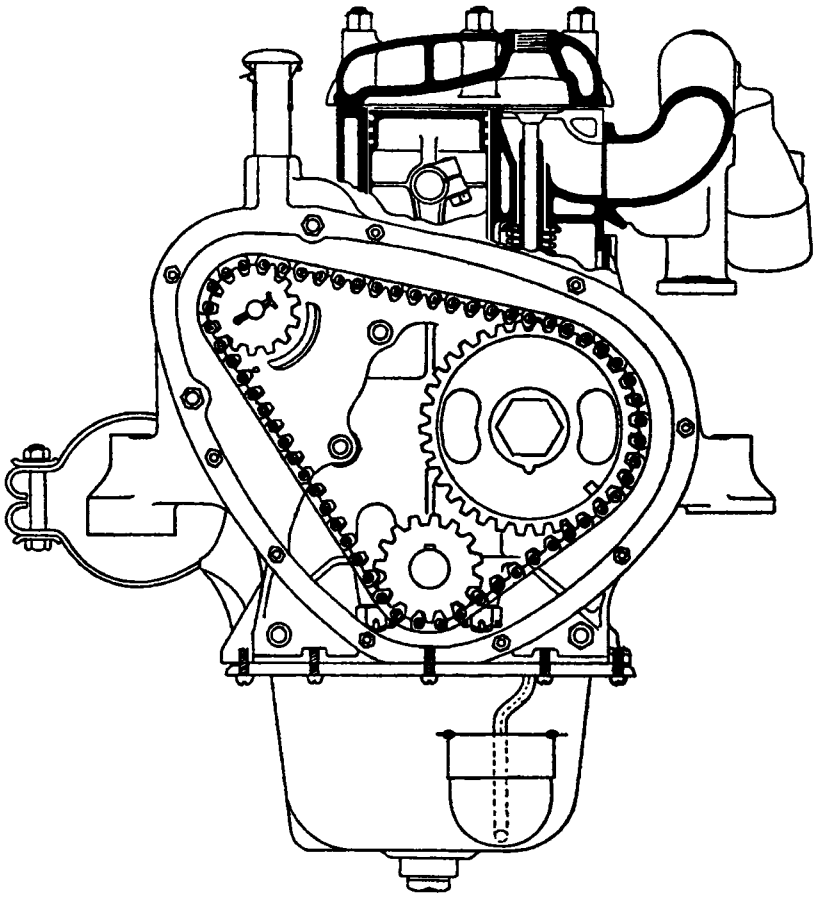

Fig. 15—Front View of Motor

REMOVING CONNECTING RODS AND PISTONS (3⅛" Bore Motor)

After oil pan is removed, the connecting rod bearing caps can be removed, disconnecting the connecting rod from the crankshaft.

Turn motor over by hand with starting crank until connecting rod journal is horizontal, which will allow the connecting rod and piston to be pulled out.

If the cylinder head is off, the connecting rod and piston can be removed from the top.

Figure 16 shows connecting rod and piston being removed from bottom of cylinder.

To remove connecting rods and pistons from the 3⅜" bore motor it is necessary to remove cylinder head and oil pan and take rods and pistons out from

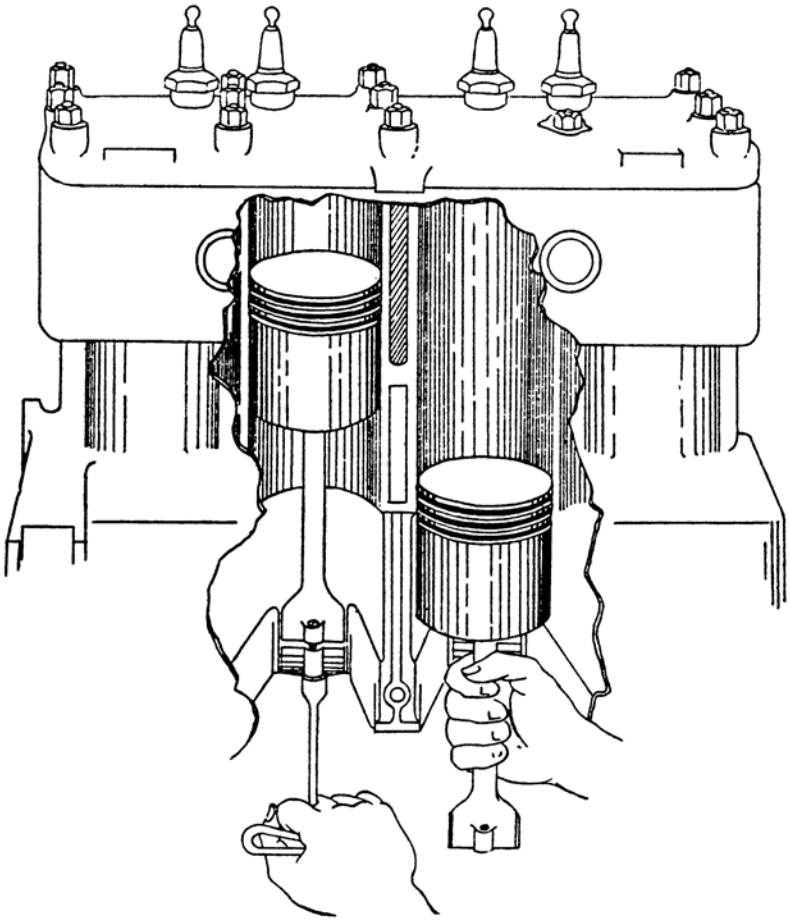

Fig. 16—Removing Connecting Rods and Pistons from 3⅛" Bore Motor

PISTONS

The piston is made of cast iron or light weight metal, with three rings above the piston pin.

Fitting new pistons is often resorted to when in reality the difficulty is due to improperly fitted or worn piston rings, carbonized pistons, or improperly seated valves.

With a motor having carbon removed from piston heads, valves properly seated and piston rings fitted properly, there is little need to consider replacing piston until after the cylinder wall has become worn to a considerable extent.

Do not confuse carbon knocks with piston slaps.

Remember that in a cold motor, there is usually a slight metallic click-ing which will disappear as soon as the motor heats up.

There is always a slight shoulder above and below the piston ring, travel in a worn cylinder bore. These shoulders must be removed before a new piston can be properly fitted.

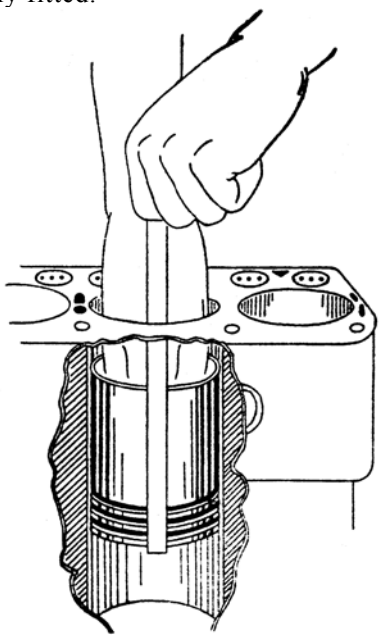

Fig. 17—Fitting Piston

Where motors have been in service an unusually long time, the cylinder bores will wear unevenly: that is. will be out of round and somewhat tapered.

To determine the condition of the cylinder, as to size and taper use a piston and feeler stock of sufficient thickness to fill up the space between the cylinder wall and the piston.

Insert the piston and feeler at the top of the cylinder, as shown in Fig. 17. If the piston binds at the bottom of the cylinder, and is free at the top, you will know that the cylinder is tapered. It should be honed or reground.

To determine if the cylinder walls are out of round, insert piston with feeler gauge into cylinder bore, noting the clearance.

Remove piston and turn one-quarter turn with the feeler gauge in same position of the piston and again insert in the cylinder.

If the clearance is not the same, the cylinder is out of round, and should be reground or honed.

After honing or regrinding a cylinder bore, oversized pistons must be used. We stock at our factories, .003, .005, .010, .015, and .020 oversized cast iron, and lightweight, solid skirt pistons. We can also furnish oversized lightweight, pistons .023, .025, .030, and .035 oversize.

A standard cast iron piston measures $\frac{3.124}{3.122}$ and is stamped on the top of the piston, 3.122, A standard lightweight, solid skirt piston measures $\frac{3.123}{3.121}$ and is stamped on the top of piston 3.121. A standard lightweight piston for the 3⅜" bore motor measures $\frac{3.375}{3.373}$ The letter "S" is also painted on the top.

Oversized pistons are stamped with the full decimal measurements of the piston. To determine the amount of oversize, deduct the known standard given above from the stenciled figures.

On new pistons the amount of oversize is also painted on the piston, thus: 3+, 5+, etc.

Pistons—both cast iron and lightweight—for the 3⅛" bore motor should be fitted loose on a .003" feeler and tight on a .004" feeler and tight on a .015" feeler for the 3⅜" bore motor.

To determine the correct clearance between piston and cylinder wall, secure three narrow strips of feeler stock, .0015", .003" and .004" thick and ½" wide, and long enough to reach the full length of the bore.

First insert the feeler stock of the proper thickness between piston and cylinder wall, make sure the feeler lays at side of piston between the piston pin bosses. Piston should be pushed well into the cylinder bore and considerable resistance should be felt in removing the feeler stock.

Pistons with slot in skirt must be installed with slot side of piston toward the valve side.

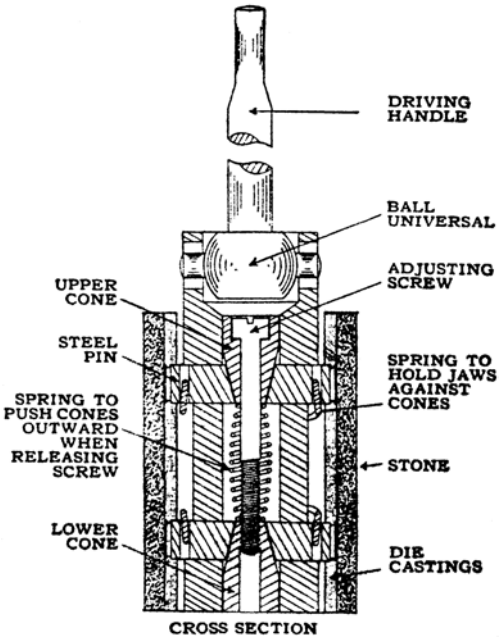

Fig. 18—Cylinder Hone

Next insert piston in cylinder bore using the low limit thickness of feeler for the type piston being fitted and with piston pushed well into bore, it should be a free fit, or to remove feeler, only a slight drag should be felt.

By using the two thickness of feelers, it gives for the proper fit, a loose and tight piston, which is correct.

Pistons should not be fitted to closer limits than specified, as some room for expansion must be provided.

Caution: Powdered emery, glass or other abrasive should never be used to grind in an oversized piston, as the compound works into the pores of the cylinder wall, and no amount of washing or brushing will remove it. Therefore, it is an active abrasive, making an early renewal of the piston and cylinder necessary.

If a hone is not available, there are machine shops in almost every locality that are equipped to regrind or rebore cylinders.

Figure 18 shows the hone which is recommended for refinishing bores in DURANT and STAR motor blocks.

The operation of the hone is as follows:

The hone is placed in the cylinder and adjusting screw tightened until the stones are up against the cylinder wall. The driving handle is put into the drill chuck and ball end of driver in end of hone; then, with an oil can see that plenty of kerosene is put on the honing stones and cylinder wall. Drill is started and, as hone revolves it is moved slowly up and down far enough to let the ends of the stones protrude about half an inch through block. As soon as the hone begins to free itself, the driver handle is removed and adjusting screw tightened, it being necessary to keep hone adjusted tightly and working until the finish; then move up and down very slowly f or about five times and stop at top of stroke. Loosen adjusting screw one-half a turn and remove hone.

PISTON RINGS

The purpose of the piston ring is to fill up the space between the cylinder wall and the piston, so as to prevent leakage of gases.

As these gases are under pressure, it is necessary that the rings not only fit snugly around the cylinder wall, but in the grooves of the pistons as well; otherwise the gas and oil work behind the rings.

Remove the piston rings over the top of the piston. It will be found easier to remove the top ring first, then the center, and lastly the bottom.

A piston vise as shown in Fig. 20, the jaws of which are lined with babbitt, will not mar or distort the finest piston. Indispensable in ring or piston-pin fitting operations.

Caution: Be careful in handling a piston with light walls as they, may be easily sprung, causing the piston to be out of round.

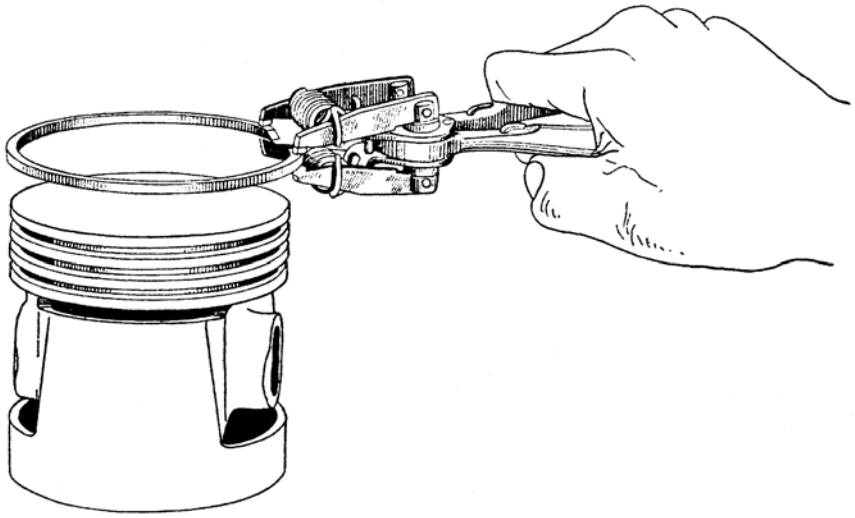

Fig. 19—Removing Piston Rings

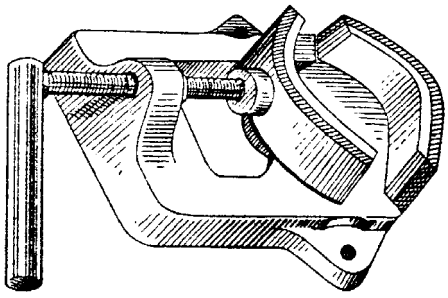

Fig. 20—Piston Vise

Removing Piston Rings

To remove the piston ring use piston ring expander (See Fig. 19). If this tool is not available, then raise one end of ring and insert a knife blade or hacksaw blade back of it and guide it around the piston with one hand using the other hand to help force it out of groove.

Fitting Piston Rings

To properly fit new piston rings, proceed as follows:

Slide the piston into the cylinder bore (top up). Insert the ring into the bore and press it down until it rests snugly against the piston at all points, It may be necessary to file the beveled edges of the ring to do this, as all rings when new are oversize; however, use care not to remove more metal than is necessary to make the ring rest squarely on the piston head. (See Fig. 21.)

With the aid of a narrow strip of feeler stock, .003' thick, slip it between the two edges of the split in the ring. If the space between the

split is less than this, remove the ring and with a very fine file dress the edge until the proper clearance is obtained.

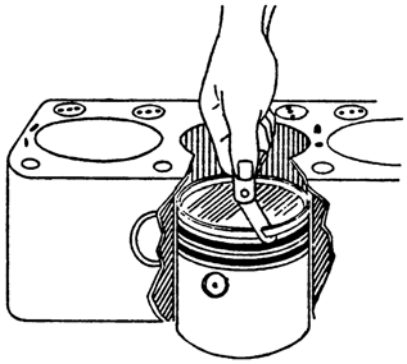

Fig. 21—Testing Split in Piston Ring for Clearance

Care should be exercised not to round the edges of the rings. Fit each ring separately.

Figure 22 shows a piston ring filing gauge. By inserting the piston ring in the recessed groove, the beveled edges can be filed without danger of rounding the edges.

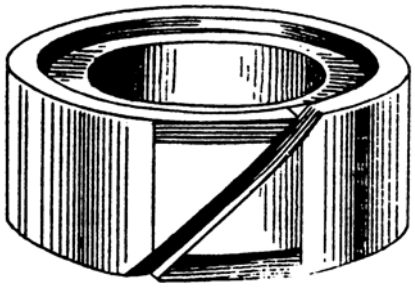

Fig. 22—Piston Ring Filing Gauge

With a scraping tool, carefully remove all particles of carbon from the faces of the ring grooves in the piston.

Slip the back side of the ring into the groove, and roll it entirely around the groove. If the ring is the proper thickness, you should feel it drag slightly in the groove. The ring clearance in groove should be from .001”' to .0015”. If it is too loose, try another ring.

If too thick, fasten the ring to a flat board; then lay a sheet of very fine emery cloth on a flat surface. Lay the board,, ring down, on the emery cloth, and with the hand resting lightly on the board, slide it across the emery. Be careful to put pressure on the board evenly, so as to remove an equal amount of metal from the entire surface of the ring. (See Fig. 23.)

Remove the ring from the board and try the fit, repeating the grinding operation if necessary.

In fitting rings back in the grooves again, use piston ring expander so as not to break or distort also be very careful not to injure the edges of the-ring, as these must not be broken in any way; otherwise trouble will result.

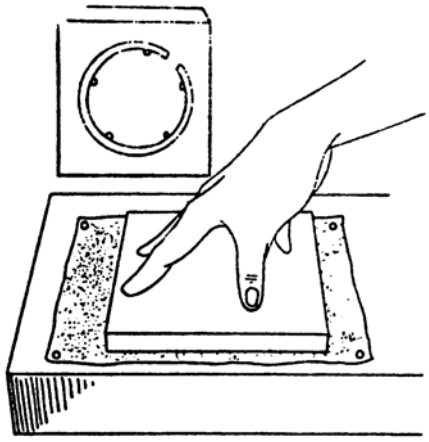

Fig. 23—Grinding Piston Rings

In slipping the pistons and connecting rods back into the cylinders, use extreme care. Take your time and do not force the rings into the bore.

The splits in the three rings should not be in a vertical line, as the gases could leak by more easily. Therefore stagger the splits so that they will be equally distant around the circumference of the piston.

FITTING PISTON PINS
3⅛" Bore Motor

Fitting piston pins is a very important operation, both because the holes through each boss must be exactly parallel and smooth, and also because it is difficult to hold a piston firmly without distorting it.

The best method we know of is to clamp the piston in a special vise (See Fig. 20) which has the babbitt-lined jaws.

If no fixture of this kind is available, the piston can be clamped between wooden blocks or copper jaws in an ordinary vise. Place the open end of the piston against one jaw and the head against the other. Use just enough pressure to hold the piston firmly.

We have designed for the DURANT and STAR motors an adjustable, piloted reamer for the reaming operation. Figure 24 shows this reamer just finishing one side and entering the other. Two taper plugs pilots hold the reamer bar firmly and in proper line.

Do not crowd the reamer, either in cutting speed or depth of cut. It is very important that the holes be perfectly smooth and polished.

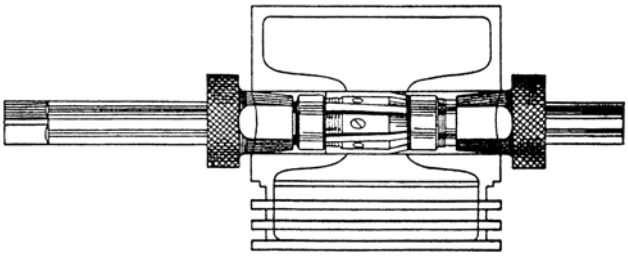

Fig. 24—Piston Pin Hole Reamer

In fitting the pin it should slide through both. bosses with slight drag, equal approximately to thumb pressure,

We carry in stock .003", .005", .010", .015" and .020" oversized pins for the 3d" bore motor,

3⅜" Bore Motor

The assembly of the lightweight piston in the 3⅜" bore motor is different from the ordinary type and construction. The piston pin holes in piston bosses are burnished to a polished bearing surface and finished three ten thousands smaller than the finished piston pin. The dif-ference in size allows a shrink fit of pin in the piston. Connecting rod is bronze bushed and the finish size in the bushing is held to a regular running fit of from .0002" and .0005" clearance.

Piston pins are retained from moving endwise in piston by a retaining or lock ring.

Piston is heated in hot oil or boiling water to expand piston pin hole and allow pin to enter. As soon as the motor warms up, the piston will expand and the pin will be free to rotate both in the piston and con-necting rod, thus doubling the bearing area.

After the motor has been in service for some time, the pin will seat itself in the piston bosses and be free to rotate when cold.

This is a highly satisfactory development, and pins should not be exchanged for this reason. The following instructions are intended only for the fitting of new pins:

First Operation

In removing piston pin from piston, take out the small wire retaining ring from groove in piston pin hole at end of piston pin. Use the point of a small screw driver or knife blade, insert under end of ring, lifting it from the small groove. Make sure ring is replaced in groove when piston pin is again replaced in piston.

Second Operation

Immerse piston and pin in heated oil or boiling water for approxi-mately one minute.

Third Operation

After piston with pin has been heated to the correct temperature, hold piston in hand with glove or cloth and with finger or some small blunt tool, push pin out of piston pin boss. Do not attempt to drive pin out. If it cannot be removed easily, reheat piston. In replacing piston pin, the same heating process is necessary to expand piston pin hole so pin can easily be fitted into place. Pin must also be heated otherwise a cool pin would cause hole in piston to contract before the installation was made. Pin must be removed or replaced quickly after parts have been heated.

We furnish piston pins. 003" and .005" oversize for the 3d" bore motor.

CONNECTING ROD BEARINGS

The connecting rod babbitt bearings are die cast into the connecting rod.

When a bearing is scored or burnt, either from lack of lubrication or from having them set up too tight and not properly worked in, refitting the bearing is the only remedy.

A scored bearing is one having the surface slightly roughened, but where the babbitt metal has not been burnt or run. A bearing of this kind can usually be refitted.

A burnt bearing is one having the surface badly roughened or where the babbitt has melted and started to run. This bearing cannot be used and a new rod with bearing should be fitted.

Connecting rods which are not otherwise damaged, can be exchanged at factory for rebabbitted rods for the cost of the babbitting only.

Fitting of Connecting Rod Bearings

The fitting of the connecting rod bearings is one of the most important repair operations that can be performed on a motor.

Misalignment produces knocks, causes vibration and excessive wear of cylinder walls.

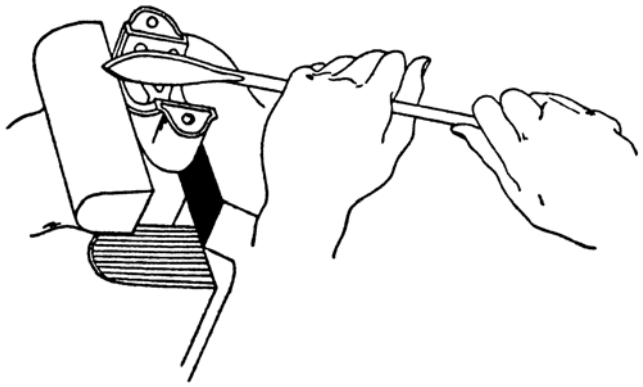

Fig. 25—Scraping Bearing

Connecting rods come with the crank pin bearings finished to size so reaming is unnecessary and they only require a little sizing or hand fit ting for a perfect surface bearing-. This being accomplished by spreading a very thin coat of Prussian blue on the crankshaft to which rod is to be fitted.

Install the connecting rod on the crankshaft or arbor of the same diameter with the piston end hanging downward, as shown in Figure 26.

Draw the nuts tight so that the bearing is snug on the shaft. Swing the rod back and forth several times and then examine the bearing for blue spots.

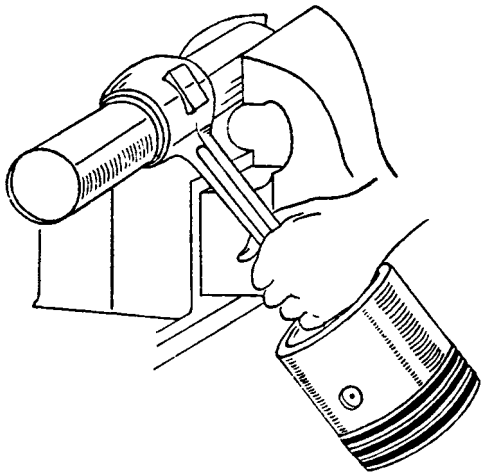

Fig. 26—Fitting Connecting Rod to an Arbor

The blue spots, or as they are termed high spots, indicate that the bearing and the crankshaft rub at these points only.

It is then necessary to remove the high spots on the bearing with a scraper, as shown in Fig. 25.

Repeat operation until all high spots are removed, and the bearing surface is smooth, and touches the crankshaft at all points.

The tension of the rod on the shaft should be snug enough so that when the piston and rod are moved to a horizontal position they will of their own weight move to a vertical position with a slight drag.

All burrs and other obstructions must be removed from the oil holes.

When the bearing has been fitted to the shaft, lubricate it thoroughly.

After the bearing has been properly fitted, the connecting rod must be tested for alignment, which can be done in the connecting rod aligning fixture, as shown in Fig. 27.

Fasten the piston pin in the upper end of the rod and slip the 1½" bushing in the lower bearing. Pass the plug through the holes in the Fixture and through the 1½" bushing.

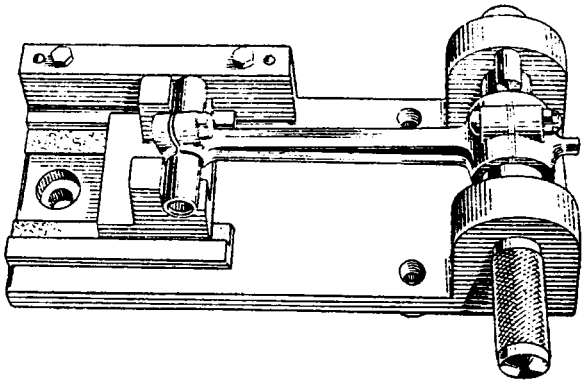

Fig. 27—Connecting Rod Aligning Fixture

Let the piston pin rest on the squared portion of test slide and test from both surfaces, using paper shims as "feelers" or a feeler gauge. Bend the rod until piston pin bears equally in both planes.

With the piston assembled, test the straightness by placing the piston against the straightedge, using feelers as before.

CRANKSHAFT AND MAIN BEARING

Tightening Loose Main Bearings

To tighten the main bearings, care should be exercised in removing an equal number of metal shims from each side of the bearing cap.

The number and thickness of shims to be removed will depend upon how loose the bearings are.

If it is found there are no shims between the main bearing caps and the crankcase, the bearing cap should be removed, locked in a vise and with a mill file remove enough metal from the face of the bearing cap to allow the proper tension. (See Fig. 28.)

Considerable care should be exercised not to get the bearings too tight, as there is danger of scoring or burning them.

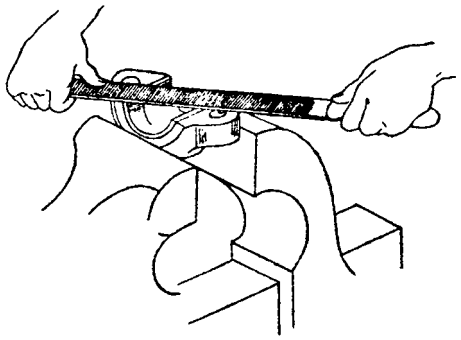

Fig. 28—Filing Bearing Caps

If more than one bearing is loose, each bearing should be tightened separately, and when the proper adjustment has been secured, loosen the nuts sufficient to take the pressure of the bearing from the crankshaft. Then proceed to the next bearing in the same manner.

After bearings have been properly fitted, the motor should be allowed to run idle under its own power for some time, which will have a tendency to work in the bearings properly.

Use plenty of lubrication during this process, as bearings which are set up too snug will heat readily at first. Therefore, the danger of scoring or burning is very great until the bearings have time to work in.

Care must be exercised in driving car for approximately one hundred miles after bearings have been tightened.

Fitting Crankshaft Main Bearing.

The upper half of the crankshaft bearings are loose in the crank-case. The lower half being die-cast in bearing caps.

If line reaming fixture is not available, the bearings can be scraped.

This can be accomplished by putting a thin coat of Prussian blue on the bearing surface of the crankshaft.

Place the crankshaft in 'its normal position in the case, and rock back and forth. Remove crankshaft and scrape the blue spots from the bearings. (See Fig. 29.)

It is necessary to repeat this operation several times to obtain the desired results.

The upper bearings must be scraped in first. After the desired bearing is obtained, the bearing caps can then be fitted. The bearing caps must be fitted to the crankshaft in the same manner as the upper bearings,

After the bearing surfaces form to those of the crankshaft, lubricate the bearings well and adjust each separately to get the proper tension.

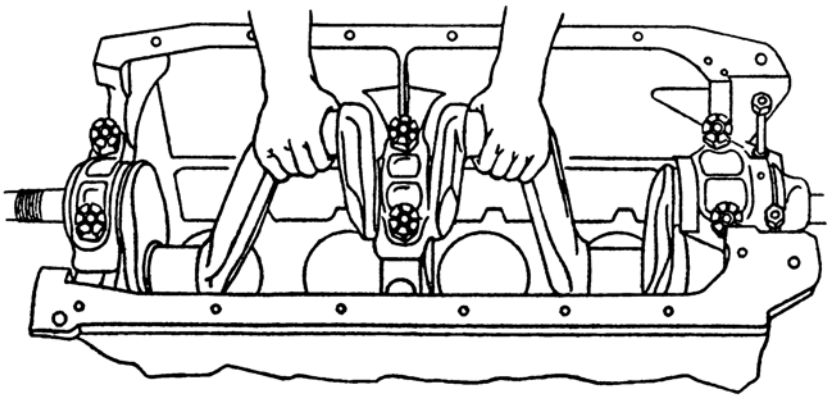

Fig. 29—Fitting Main Bearings

End Play In Crankshaft

The end play in a crankshaft 'is governed by the front crankshaft bearing.

A clearance of .006' should be allowed between the crankshaft and the bearing.

Too much end play will often cause a pound or knock when the motor is running idle.

To remove end play it is only necessary to take out shims back of

crankshaft sprocket and pressing sprocket farther back on shaft until proper clearance is obtained between crankshaft and front main bearing,

Sprung Crankshaft

A sprung crankshaft will cause the bearings to loosen quickly and if the motor has been run for some time with loosened bearings, the shaft should be tested to see if it 'I true before attempting to refit the bearings.

A test can be made by placing the crankshaft in the case as shown in Fig. 29 by first smearing the babbitt bearings with a thin coat of Prussian blue; then revolve the crankshaft and note whether the blue shows completely around all the main bearings.

If it is sprung to any extent, it will also pivot on the center main bearing in a certain position.

Another method of testing a crankshaft is to place it between centers in a lathe or straightening press as shown in Fig. 30, and by using a dial indicator, the exact amount it is out of true can be determined.

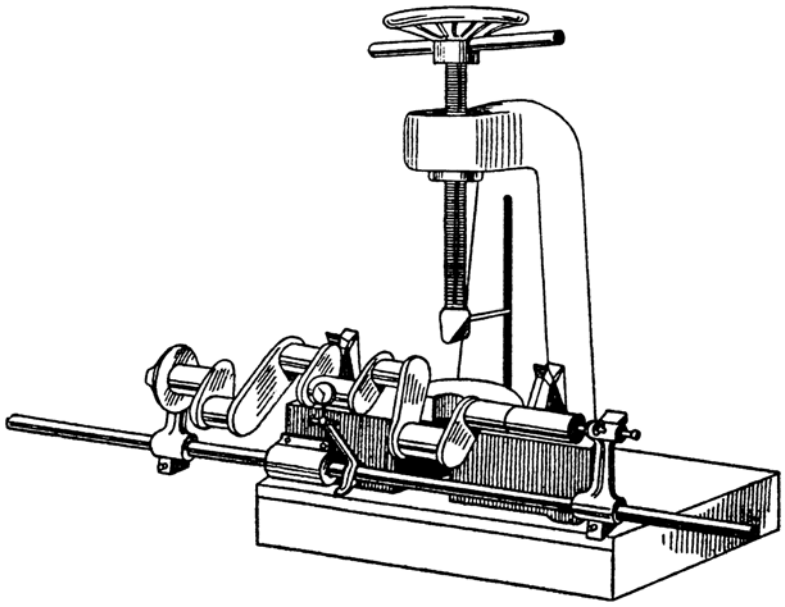

Fig. 30—Straightening Arbor Press

A crankshaft can be straightened in an arbor or straightening press by supporting the two end bearings with blocks and applying the pressure on the center main bearings.

Out-of-round Crankshaft Bearings

To determine whether main or connecting rod bearings are out of round, tighten each bearing cap separately and give the crankshaft a complete turn. If the bearing is out of round, the shaft will invariably turn free at one point and bind at another. Or measurements can be taken of the shaft bearings with a pair of outside micrometers.

If bearings are out of round, they should be reground or turned in a lathe and polished, unless badly worn then the best remedy would be a new shaft.

FAN

The fan is 16" in diameter and has four blades. It is adjustable for belt wear or stretch, being mounted to a slotted bracket and held in place to bracket with a Y8" nut and a lock washer which is fastened to the forward end of cylinder casting. Fan is driven by a 1" woven belt from pulley on end of crankshaft. It is very easily adjusted and right tension can be secured on the fan belt by either moving the fan assembly up or down. (See Fig. 31.)

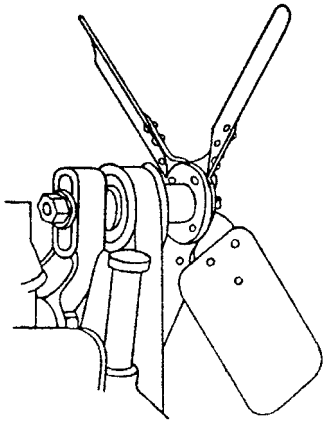

Fig. 31—Fan Adjustment

To Install Fan Belt

Pass belt between radiator and over the fan blades.

Loosen the jam nut, which will allow the fan assembly to be lowered.

Loop belt over fan pulley, which is driven by the crankshaft.

Insert the starting crank and turn motor over -while holding loose end of fan belt tightly against the fan pulley until is completely in the groove.

Adjust fan belt to right tension by moving fan assembly upward and tighten jam nut

Removing Fan Drive Pulley

Figure 32 shows the method of removing fan drive pulley. The shaft passes through the starting crank hole and the pins on the shaft engage in starting jaws,

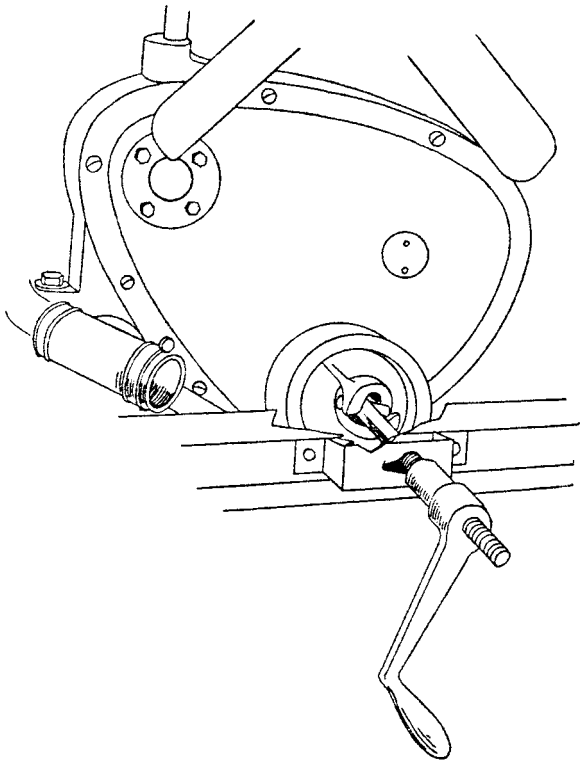

Fig. 32—Removing Fan Drive Pulley

If this puller is not available a starting crank can be used by engaging same in the starting jaws and tapping the handle of starting crank firmly with a hammer.

This pulley can be removed without removing radiator.

CHAIN CASE

The chain case is bolted to the front of the crank case and houses the timing chain also supports the generator.

TIMING CHAIN

The timing chain in the front end of the motor runs over three sprockets, viz, crankshaft sprocket, camshaft sprocket and Generator shaft sprocket. (See Fig. 33.) It is properly adjusted when the car is shipped from the factory. However, owing to slight wear or "running

in" of the three sprockets and the natural stretch which will develop in any silent chain, it is necessary to again adjust this chain to the proper tension after it has seen approximately 800 to 1,000 miles of service.

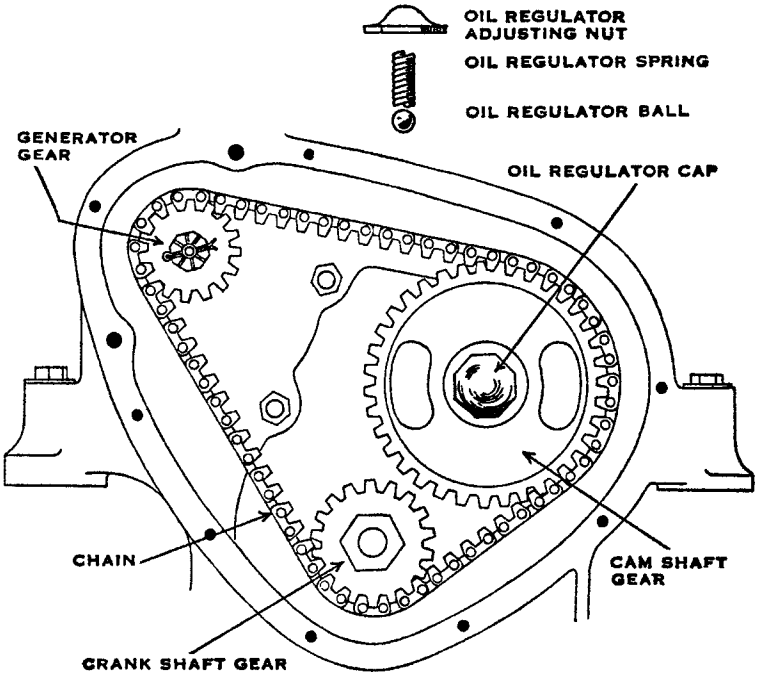

Fig. 33—Timing Sprockets and Chain

Adjusting Chain

We have provided for the adjustment of this chain by the simple method of either shifting the generator in towards the motor, or out from the motor. It is unnecessary to remove the timing chain case cover. Moving generator outward tightens the chain.

The generator housing is assembled to the crankcase with two cap screws; one at the bottom, which might be termed a pivot screw, and one at the top. By loosening both cap screws the generator can be rotated in or out. (See Fig. 66.)

The proper adjustment of the timing chain may be made as follows: With the motor not running, loosen the two nuts and shift the position of the generator out from the motor to a point where the chain is drawn up snug, tighten securely; then start the motor. The timing chain will give off a slight hum, indicating that the chain is too tight, Again loosen the nuts and shift the position of the generator towards ' the motor 4 t where the timing chain hum disappears, to a point Again tighten securely and you will then have the correct adjustment on the timing chain. Unless some abnormal condition in the motor or front end develops, no further adjustment should be required for 2,000 to 3,000 miles.

The necessity for adjusting the chain will occur when there is a slight tapping or rattle in the front end.

Caution: In any case when it becomes necessary for you to install a timing chain, be sure that it is assembled so that the chain will run in the direction of the arrows stamped on the chain.

Do not let the chain too tight when adjusted, for if you do it is more than likely that immediately upon starting the motor the chain will break. Do not use a crow-bar or pry in b hind the generator to throw it out from the motor. This is an abnormal way of making this adjustment and is not necessary.

When it is impossible to make further adjustment on the chain by shifting the position of the generator, then the chain should be shortened

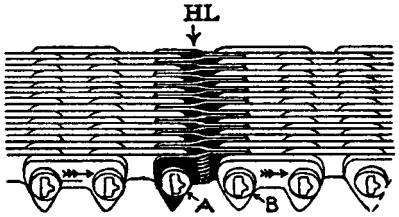

Fig. 34—Chain Showing Hunting Link

by removing the "hunting link." (See Fig. 34.) After removing the "hunting link" the chain may be reassembled on the sprockets and adjustments made as before.

How to Determine the Condition of a Chain

The condition of a Morse chain is best determined when on the sprockets. That is, if the looseness of a chain can be taken up by the adjustment or by removing a link and adjusting. it is still in service-able condition, Testing for slackness (or come and go) of a chain by removing pins at some point and laying chain out flat is the wrong method of determining the true condition of a Morse chain.

Morse chain has a two-part joint consisting of a rocker pin which rolls or rocks on a seat pin. To permit this rocking action, clearance of about .010 of an 'Inch is allowed at each point, (See Fig. 35.). Therefore in a new chain having 63 links, there would be 63 times .010 of an inch, equaling .630 of an inch or approximately ⅝ of an inch slackness (come and go). If a worn chain shows a total come and go of 1 ⅝” when laid

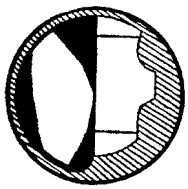

Fig. 35—Rocker Pin and Seat Pin of Chain

out flat, it is obvious that the additional slackness over what is built into a new chain is 1". Only half of this increased slackness (½") represents the lengthening of the chain due to wear. The other ½" of slack-ness will be apparent when it is seen that the worn chain will compress ½" shorter than it is possible with a new chain. Remember that the chain runs under tension when on the sprockets and not compressed. Comparing a new and worn chain when both are fully extended will clearly show that the added length due to wear 'is only a small portion of the total slackness.

How to Shorten

In practically all chains a row of thin "hunting links" (sometimes called half, offset or master links) will be found, which can b removed by taking out pins A and B. (See Fig. 36.) The ends can then be dove-tailed together and repinned. Always use the old rocker pins and new seat pins,

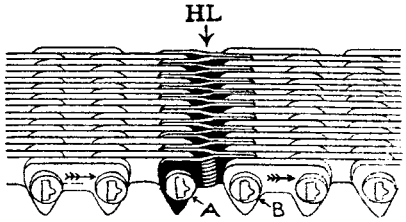

Fig. 36—To Remove Hunting Link

Inserting Pins Into Links

The seat and rocker pins must be inserted as shown. The pointed 'de of the rocker pin bears on the flat side of the seat pin. The pointed side of the rocker pin and the ribbed side of the seat pin are placed toward the direction in which the arrows fly, which is the direction the chain travels. (See Figs. No. 37-38.) Do not place the rocker pin in backward; that is, with the flat side against the seat pin. This will result 'in noise and possible destruction of the chain.

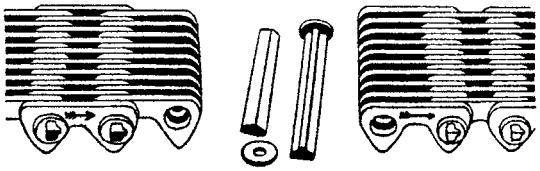

Fig. 37—Rocker Pin and Seat Pin Removed

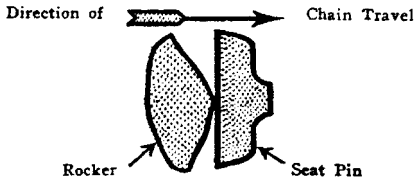

Fig. 38—To Install Rocker Pin and Seat Pin

REMOVING CAMSHAFT SPROCKET

Remove acorn nut, which also acts as an oil relief body and thrust nut for camshaft.

Remove the spring and check ball on end of camshaft. Camshaft sprocket can then be pulled off.

REMOVING CRANKSHAFT SPROCKET

Remove lock nut and oil ring. Sprocket can then be pulled off by hand.

REMOVING GENERATOR SPROCKET

Remove lock nut and sprocket can be pulled off by hand.

The timing sprockets mentioned above are lip-fitted to their respective shafts and should not cause any difficulty in removing by hand.

TIMING MOTOR

Should the camshaft be removed, or if when the chain is removed, the position of the camshaft is changed, retime the motor as follows: (See Fig. 39.)

With the chain off, rotate the motor until No. 1 piston is at its highest point, that is, top dead-center.

Rotate the camshaft until the No. 1 exhaust valve (the one next to the radiator) closes.

The valve must be closed, but the valve lifter should still be in contact with the valve stem.

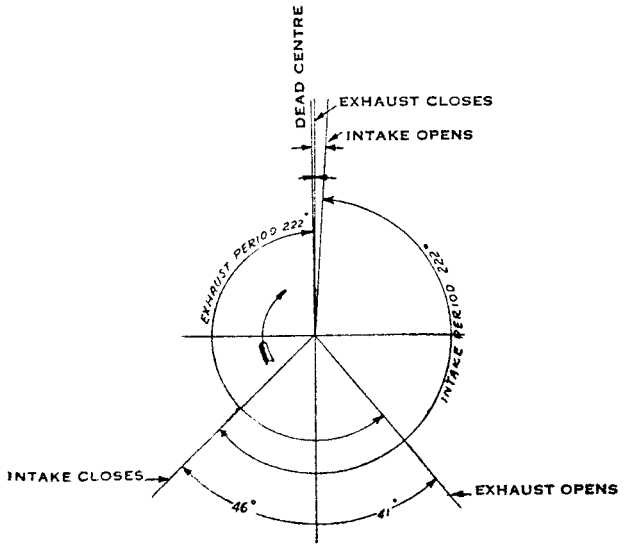

Fig. 39—Valve Timing Diagram

The motor is then timed and the chain can be installed.

Use care in placing the chain on the sprockets so as not to change the position of these sprockets. In line with the chain travel and between the generator sprocket and camshaft sprocket, and between the crank-shaft sprocket and the camshaft sprocket, the number of chain links is plainly marked on the chain case casting.

On the generator sprocket-at the proper position from the keyway and at the base of the teeth-the figure "O" is stamped. Counting from this point to a similar mark on the crankshaft sprocket the number of links should correspond to the number of links as marked on the timing chain case. Also as between the crankshaft sprocket and the camshaft sprocket there should be a definite number of links as marked on the timing gear' case, these counts being taken from similar marks on the two gears.

The crankshaft gear has two naughts stamped on it. The count is always taken from the naught nearest to the gear for which the count is being taken.

it is very important that these counts be correct; otherwise there is danger of mis-timing and crowding the chain, causing breakage and serious damage.

OIL PUMP

The oil pump is located at the rear end of motor block, and is driven direct by the camshaft.

It is a gear type and should not cause the slightest trouble. -However, as a safeguard and to avoid accidents, a registering dial is mounted on the instrument board so that the action of the pump may be observed. Should this dial for any reason show that the pump has stopped working, the car should be stopped at once, and the source of trouble located and remedied. -

The pressure of this pump works direct against the spring and ball check located in the front end of camshaft. To increase pressure on gauge, it is necessary to increase spring tension.

After the car has been in service for a long time, the small gears may be worn to a point where they will not function, in which case replacement of gears is the only remedy. Also the drive bar which drives the gears may become worn and also need replacement. When repairs have been made on the motor and necessitates the removal of the ol 'I pump or oil pump feed lines, it is well to prime the pump with cylinder oil by priming into the line which runs from the motor to the oil gauge on the dash.

Get into the habit of noting the action of the registering dial regularly —not in the expectation of trouble, but to avoid its possibility.

The oil suction line leading from the oil pump to the oil pan is surrounded at its lower end b a fine-meshed screen strainer. Occasionally lint and dirt may clog the screen and interfere with proper suction. Therefore - it is very important when working o -n the motor, to make sure that no lint is allowed to collect either on the inside of the motor or 'in the oil an.

Caution: Whenever the motor is drained of oil and fresh oil is installed and the motor started,, always see that the oil gauge on the instrument board is working. If no pressure is registered, it will be necessary to prime the oil pump, which can be accomplished by removing the oil pressure line at the point where it enters the motor and put in sufficient oil to start pump working.

THE CLUTCH

The clutch is of special design, known as single plate dry disc type.

A large steel disc is riveted to a splined clutch shaft. The outer edge of the disc is deflected 'into equal spaces in both directions and segments of hard asbestos fibre are riveted to each side.

The clutch disc fits into the recessed portion of the flywheel and one side of the fibre discs rests against the face of the flywheel.

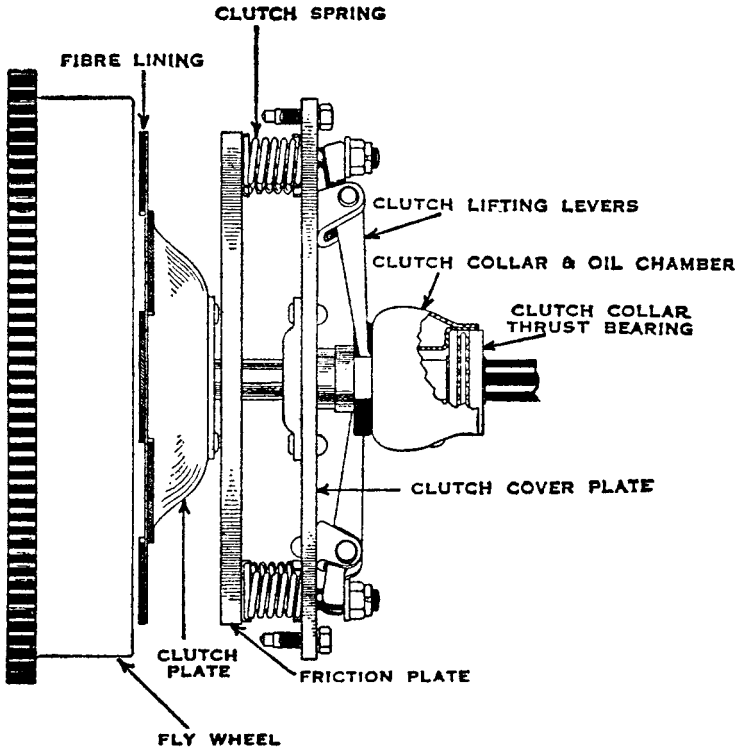

Fig. 40—Clutch

A clutch friction plate rests against the outer segments, to which is attached three studs, One end of each stud is securely fastened to the friction plate, the other ends pass through the clutch cover plate.

Each stud is centered between two heavy coil springs, interposed between the friction and cover plate the tension of which is controlled by castled nuts on the free-ends of each stud.

Mounted on the clutch cover plate are three levers, hinged at their upper ends to brackets attached to the cover plate.

These levers, called clutch lifting levers, are forked at one end so as to engage under the heads of the castled nuts on the studs. The free end rests in slots on the clutch throwout collar.

The clutch throwout collar consists of a hollow pressed steel bowl in the end of which is mounted a ball thrust bearing. The hollow collar is provided with a screw plug which can be removed and the cavity filled with lubricating oil.

Two pressure fingers mounted on a transverse tube, to which is attached the clutch foot pedal, press against the clutch thrust bearing.

The clutch cover plate is bolted directly to the flywheel, becoming a part of it and carrying with it the clutch friction plate and lifting levers.

The clutch springs cause the friction plate to bear heavily against the clutch disc, which in turn is forced against the face of the flywheel, thus holding the clutch disc firmly between.

Pressing down on the clutch pedal causes the pressure fingers to move the clutch collar in the direction of the flywheel. This movement operates the three lifting levers, causing them to lift the studs; and as the

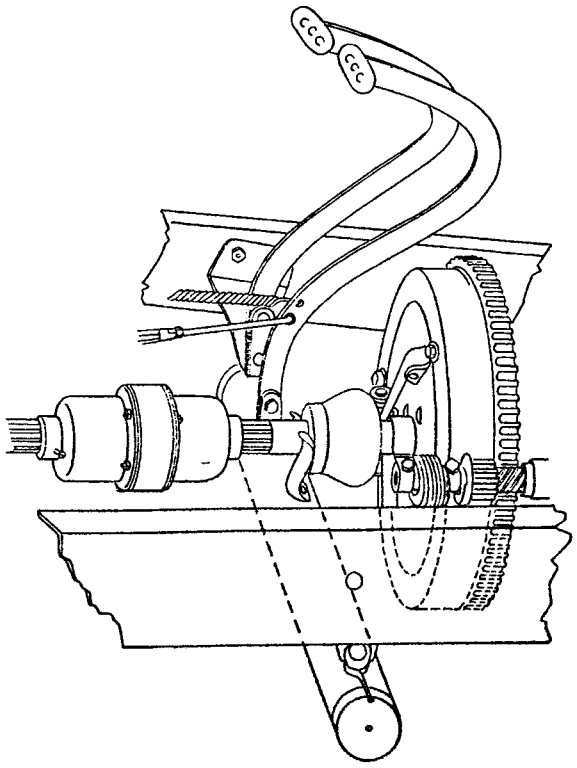

Fig. 41—Clutch Throwout Control and Universal joint

clutch cover plate is bolted to the flywheel in a fixed position, this action is carried through to the friction plate, causing it to move away from the clutch disc, releasing the pressure and disengaging the clutch.

As the leverage ratios are high the actual pressure on the clutch pedal is very slight, making the act of disengaging the clutch both easy and comfortable.

The Clutch Throwout Bearing

The clutch throwout bearing is housed in the rear end of the oil chamber, and should not cause any trouble if properly lubricated: The pipe plug located in the oil chamber should be removed and lubricating oil inserted once a week.

Removing Clutch

Remove the universal joint which connects the clutch and the transmission; then drop one end of the throwout shaft to allow the throwout fork to clear the thrust bearing. Then remove the three bolts which hold the clutch to flywheel and the entire assembly can be easily removed.

The Clutch Grabs

If he clutch takes hold too quickly, causing the car to start with a jerk when the clutch is engaged slowly, the lifting levers should be equalized.

To Adjust Lifting Levers

When the clutch is in neutral position the distance between the throwout collar and the clutch cover should be 1⅛". To equalize lifting levers, either tighten or loosen the castle nut holding the levers so each has equal pressure on the throwout collar.

When Clutch Slips

It is necessary to increase the clutch spring tension on the friction plate by backing off the three (3) castle nuts on the ends of the studs. These should be backed off an equal amount on each nut so as to retain an even pressure.

Weak Clutch Springs

This seldom occurs, as the action on the springs is very light. However, if adjustments cannot be made as stated above, renewal of clutch springs will usually remedy the difficulties encountered.

We carry in stock clutch discs and shafts completely assembled; also friction segments. Neither of these will need replacement for several thousand miles.

REMOVING FLYWHEEL

To remove the flywheel, it is necessary first to remove the clutch assembly complete, as described on this page.

Then remove the six (6) nuts holding the flywheel to the crankshaft.

The flywheel can then be removed by applying a few light blows with soft hammer, either babbitt or rawhide.

The holes for the flywheel bolts are staggered so that the flywheel can only be installed in the same position as when removed

TRANSMISSION

The transmission is of the selective type, having three speeds forward and one reverse.

The gear speed ratios are as follows:

Reverse:	4.3 to 1
Low:	3.32 to I
Intermediate:	1.77 to 1
High:	Direct

The gear shift is standard.

The transmission assembly is attached to the frame cross member by two ⅜" cap screws. The rear end is hung on the two (2) brake cross rods by a bracket and ½" cap screws, making a secure mounting and one very accessible.

The transmission control lever is the usual type, operating on a universal ball joint in transmission cover.

The most frequent difficulty encountered in a transmission is having the gears jump out of mesh. This is usually produced by one or more of the following causes.

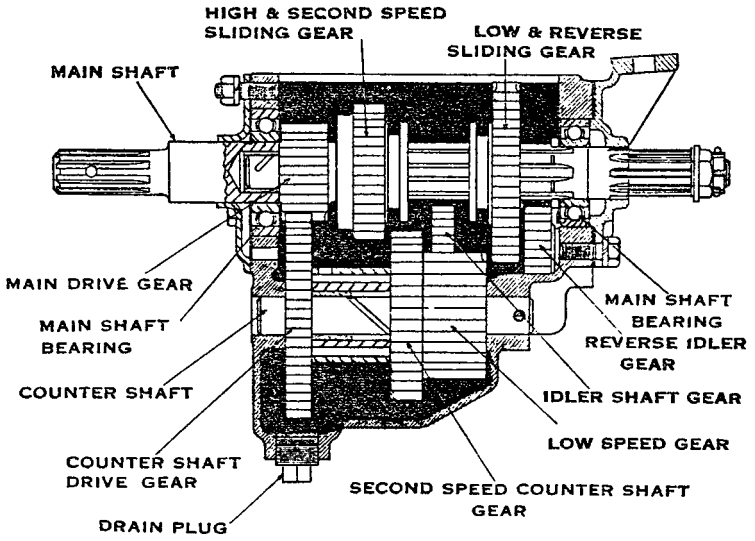

Fig. 42—Transmission

First: Gears Not Meshed Properly

Gears not meshed deep enough, causing a load to be carried on a part of the teeth only. In making the gear shifts, always be sure before engaging the clutch that the gear shift lever has been moved as far forward or backward as it will go without straining. If this is not done, the edges of the teeth will become beveled, and in time it will be impossible to keep the gears engaged:

Second: Bent Gear Shift Forks

The shifting forks may be bent which does not allow the gear to come fully in mesh with the companion gear. To determine this, place the shifting lever in the position of the speed desired; then remove the cap screws which hold transmission cover in place and raise the cover. You

can then readily determine from the position of the sliding gears, its relation to the companion gear. (See Fig. No. 43.) (Shows Fork location.)

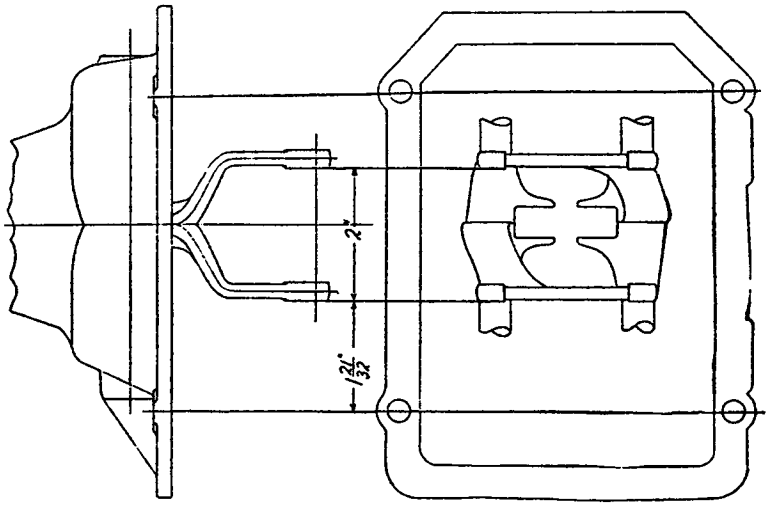

Fig. 43—Location of Shifter Forks

Third: Loose or Worn Sliding Gears

Occasionally the sliding gear will become loose on the spline shaft, allowing the gears to canter or cock on the shaft. This condition is brought about by excessive wear produced by lack of proper lubrication, and is best detected by having the gears jump out of mesh when passing over rough spots or when coasting. Loose main bearings and end play in spline shaft will also cause this condition.

A drain plug is provided in the bottom of the case for cleaning, and we recommend that the old oil be drained, and transmission cleaned, and refilled with new oil every three months.

The oil capacity of the transmission is one quart.

Misalignment of Transmission

To determine if the transmission is out of alignment, remove the universal joint between the clutch and the transmission.

For a perfect alignment, the transmission shaft and the clutch shaft should be in line with each other. If they are not, remove the two rear motor support bolts and raise or lower the motor to bring these two shafts in alignment. (See Fig. 44.)

All bolts which hold the transmission and motor in place must be kept tight at all times to prevent disalignment.

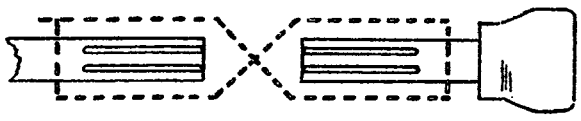

Fig. 44—Alignment of Motor and Transmission

To Remove Transmission Assembly

Remove gear shift lever by removing two (2) machine screws holding gear shift lever to transmission cover.

The universal joint and propeller shaft at the transmission end should then be removed.

Remove three (3) bolts holding forward end of transmission to frame cross member.

Remove bolt at rear end of transmission which holds transmission to the cross brake rods.

The transmission can then be removed, in an assembly.

FRONT WHEEL ADJUSTMENT

The front wheels are equipped with inner and outer tapered roller bearings, adjustable by castled nut on end of steering knuckle. Care

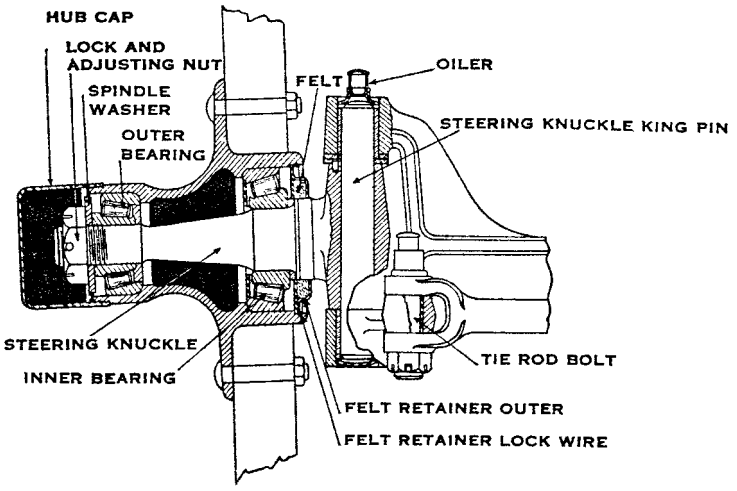

Fig. 45—Front Wheel Bearings

should be exercised when tightening this nut, to see that the proper adjustment is made that will allow the wheel to turn very freely and yet eliminate any loose play.

Three Things Are Absolutely Necessary to the Proper Working of Wheel Bearings:

First: Regular and careful lubrication.

Second: Removal of wheels and thorough cleaning of all working parts every three months.

Third: Inspection and adjustment to compensate for wear when needed.

Front Wheel Alignment

The front wheels should “toe in” slightly, as this will make driving easier and eliminate excessive wear on tires.

To get proper alignment, measure the distance between the felloe bands (at the height of the hub) at the front of wheels, and the distance between the felloe bands at the rear of wheels. (See Fig. 46.)

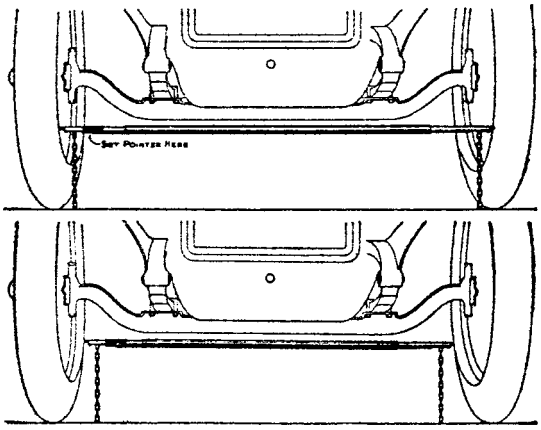

Fig. 46—Front W heel Aligning Gauge

For proper alignment, the rear distance should read not to exceed ⅛" greater than the front distance.

If adjustment is required, remove the tie rod bolt on left side, lengthen or shorten the tie rod by turning on or off the adjusting yoke bolt and measure.

Continue until dimension of not greater than ⅛" is obtained.

Tighten clamp screw.

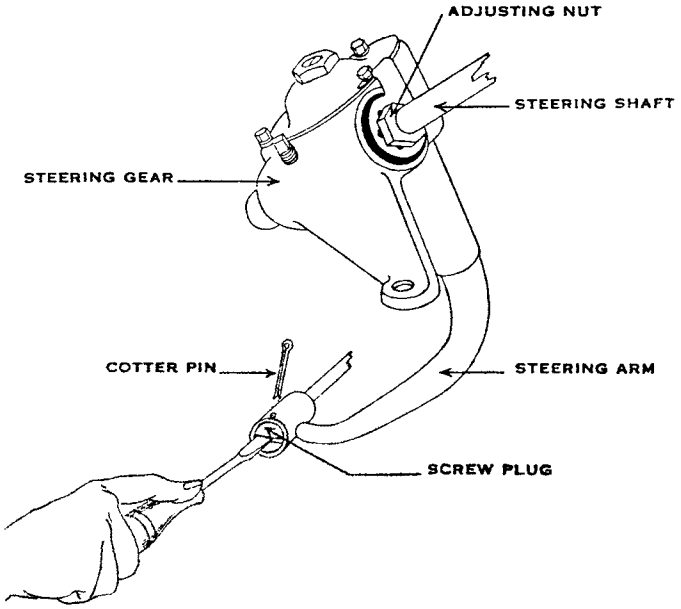

Fig. 47—Taking Lost Motion from Steering Connecting Rod (Cross Rod Type)

TAKING LOST MOTION FROM STEERING CONNECTING ROD

Figures 47 and 49 shows the adjustment of the drag link after the lost motion is removed, be sure to lock the plug with a cotter pin.

ADJUSTMENT OF STEERING GEAR (Cross Rod Type)

Raise the front end of the car until the front wheels clear the ground. You can then determine by taking hold of the wheel which part of the steering mechanism needs adjustment.

If there is lost motion within the steering gear, first loosen the clamp bolt on top of gear case; next release the locking plate and then tighten the adjusting nut until all looseness disappears.

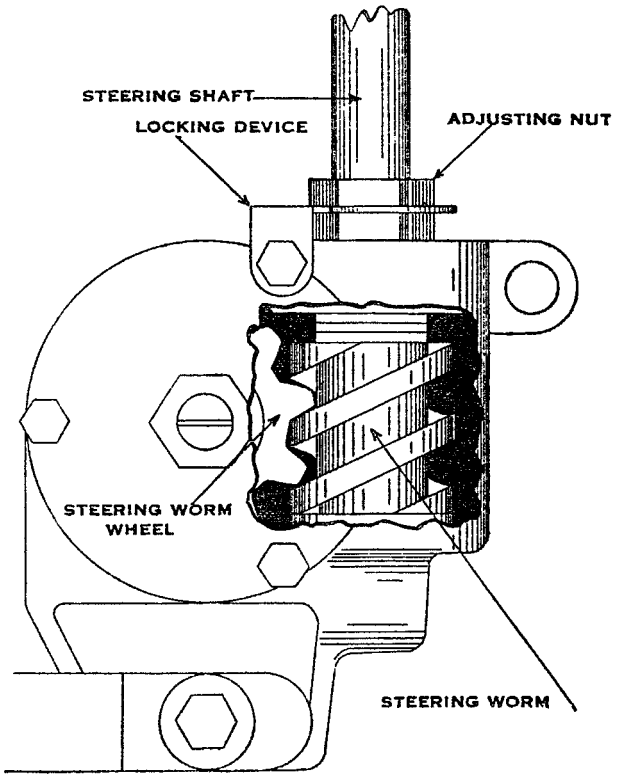

Fig. 48—Steering Gear (Cross Rod Type)

ADJUSTMENT OF STEERING GEAR (Fore and Aft Type)

Adjustment for End Play in Thrust Bearings

This is controlled by the steering gear worm adjusting nut, (See Fig. 50) located at the upper end of the steering gear housing. Tightening this nut eliminates end play in the thrust hearings, but in tightening care must be taken not to exert any undue pressure on the thrust bearings.

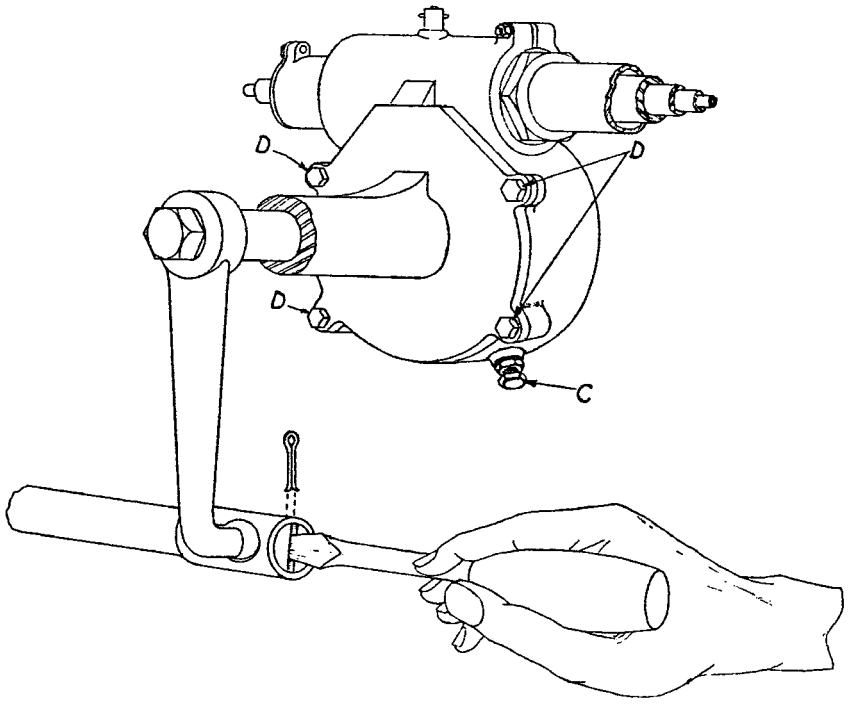

Fig. 49—Taking Lost Motion from Steering Connecting Rod (Fore and Aft Type)

This can be checked by the ease with which the steering wheel can be turned.

Adjustment for End Play in the Pitman Arm

This is controlled by the worm gear thrust screw (See Fig. 50) and locking nut located on the inner side of the steering gear housing next to the cylinder block. The tightening of this thrust screw removes end play from the Pitman arm. Care must also be exercised in tightening this thrust screw so as to avoid a binding action in the main tube, which will occur if the adjustment is made too tight.

Adjustment for Wear or Looseness Between Worm and Worm Wheel

This is controlled by the steering gear worm wheel adjusting screw. (See Fig. 50.) This adjusting screw is located on the lower portion of the housing, and a hole is cut in the engine underpan to make Ibis adjusting screw accessible from underneath the car. This screw fits into a shoulder- on the inner portion of the housing around the worm, and tightening the screw presses the housing upwards, thus bringing the worm into closer mesh with the worm wheel. Before making this adjustment it is necessary to slacken off the tour nuts on the car) screws holding the cover to the housing.

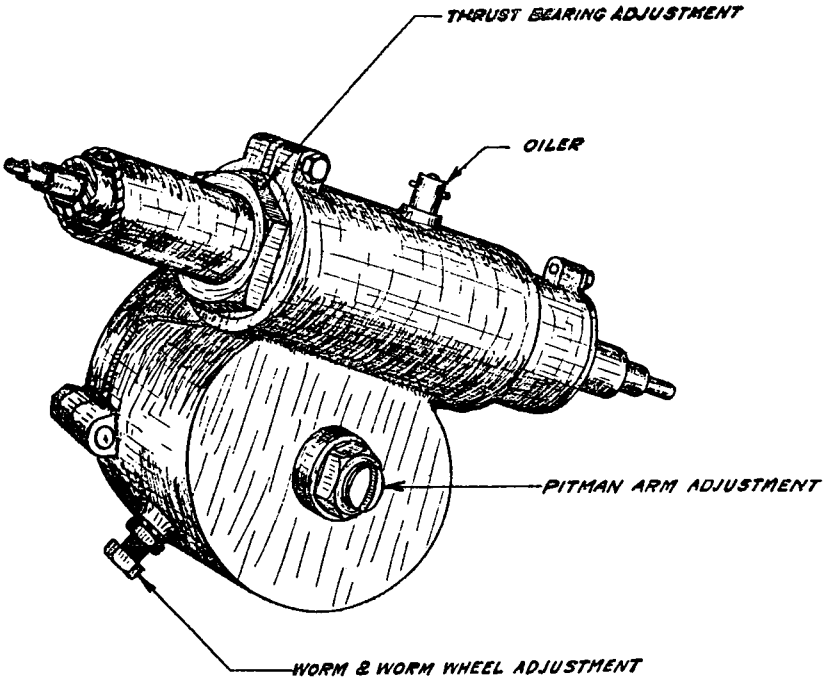

Fig. 50—Steering Gear

SPRING BREAKAGE

Nearly all spring plate breakage is caused by loose clips or bolts, or to a bind or twist in the spring caused by misalignment or improperly applied bolts.

If the car is used every day the clips holding the spring to the axle should be tightened once a month.

The spring leaves should be lubricated regularly, using cylinder oil mixed with graphite or with one of several graphite solutions on the market.

Spring shackle bolts should be drawn up tight until all side play is removed; then the nut should be backed off one-quarter turn.

All shackle bolts are supplied with lubricators. Caution your customers to lubricate these parts regularly.

PROPELLER SHAFT AND UNIVERSAL JOINTS

The propeller shaft and universal joints connect the rear end of the transmission and the drive pinion shaft of the rear axle. The function of this is to transmit power from the transmission to the rear axle, in addition to allowing the rear axle to rise and fall with the road irregularities.

The universal joints are completely enclosed and dust-proof, and are provided with a pipe plug for lubrication, and should be filled with Spicer Universal Joint Grease or No. 672 Dixon's graphite every thirty (30) days.

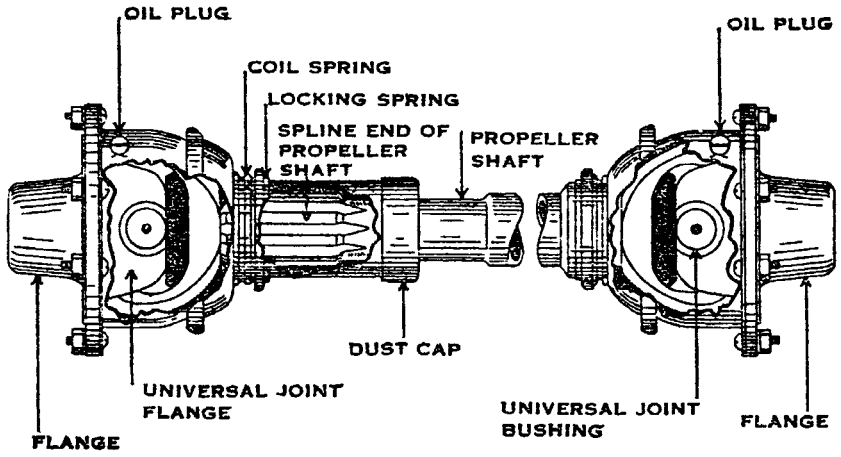

Fig. 51—Propeller Shaft and Universal Joints

To Remove Front Universal Joint and Propeller Shaft

To remove the front universal joint, unscrew dust cap, allowing same to slide down propeller shaft towards rear axle.

Then remove the locking spring and the six (6) bolts holding the universal joint housing to the flange, and allow same to slip down on propeller shaft towards rear axle.

Grease should then be removed, and the universal joint pin bushings removed, which will allow the universal joint cross to be released from the flange.

To Remove Upper Universal Joint flange

First, remove the tapered pin which holds to the transmission splint shaft. With the aid of a puller or a few slight blows of soft hammer this can be very easily removed.

To Remove the, Rear Universal Joint

Unscrew the dust cap, and remove locking spring and the universal joint housing from the universal joint flange, allowing these parts to slip upward on the propeller shaft.

Remove grease and the universal joint cross pin bushings, allowing the propeller shaft to be removed from the flange.

To Remove Lower Universal Joint Flange

Remove cotter pin, and the drive pinion shaft lock nut, and with the aid of a gear puller the flange can be removed. This flange is keyed to the drive pinion shaft. Never drive off as this may ruin bearings on pinion shaft.

To Install Propeller Shaft

The flange of the rear universal joint is key-wayed on the tapered end of the drive pinion shaft, and is held in position by the drive pinion shaft castled nut, locked with cotter pin.

One-half of the universal joint cross can then be attached to the flange by the installation of the universal joint cross bushings.

The universal joint housing can then be attached to the flange by six (6) bolts, nuts and lock washers.

The lock spring and dust cap can then be installed.

The front universal joint flange is placed on the spline shaft of the transmission and is held in place by a tapered pin.

The front end of the propeller shaft is equipped with a longer yoke than the rear end. Into this spline yoke slides the splined end of the propeller shaft be sure that the "arrow marks" on spline shaft and yokes are assembled in straight line. This end is also provided with a pipe plug for lubrication, and should be filled with Spicer Universal Joint Grease or No. 672 Dixon's graphite every thirty (30) days.

REAR AXLE

The rear axles used on DURANT and STAR Cars are known as the semi-floating type, in which the revolving parts are mounted on heavy-duty tapered roller and ball bearings.

The driving gears are spiral bevel of heavy tooth section capable of withstanding any reasonable load. The drive pinion gear and shaft are forged integral of special alloy steel.

Adjustment of Bearings

The gears and shafts of an axle seldom wear out under thousands of miles of use if they are kept in proper alignment and mesh.

Most rear axle troubles come from failure to keep these parts in proper adjustment.

As the loads carried by the bearings are both radial and thrust, they are subjected to continual changes in stresses; therefore, it is to be expected that some wear will take place and that from time to time they must be adjusted to eliminate play.

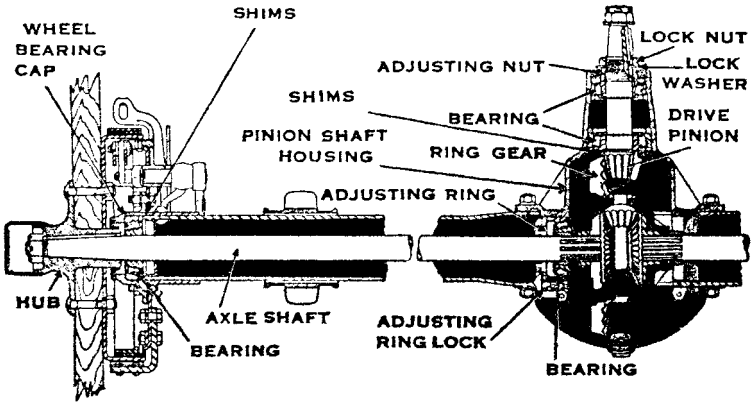

Fig. 52—Rear Axle (Solid Type Housing)

Every axle should be examined at the end of each 2500 miles and bearings adjusted. In a rear axle the change in direction of thrust is very rapid, due to side sway of the car and contour of road surfaces; therefore, if the bearings become loosened, there is a constant hammer-

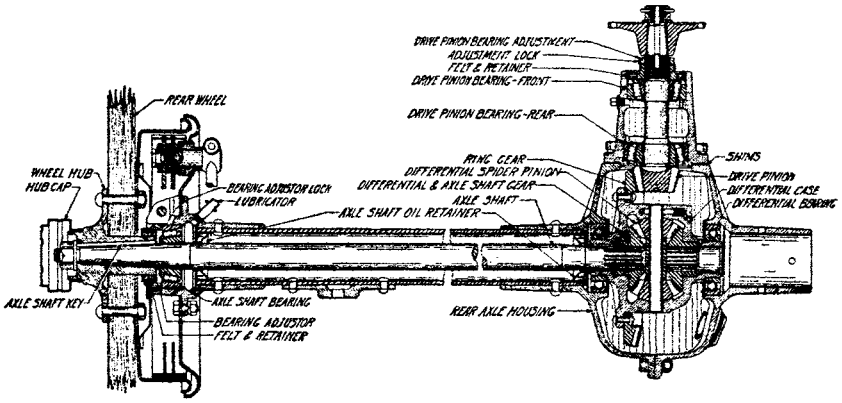

Fig 52A—Rear Axle (Split Type Housing

ing action set up in the bearing which will crack the races or split the rollers or balls.

The axle having the solid type housing has a large cover plate which when removed allows adjustment of differential bearings and ring gear.

Adjusting Drive Gears (Split Type- Housing)

The axle having a split type housing carries the entire differential thrust on tapered roller bearings at the outer ends of axle housing.

To remove the axle shaft end play, or to adjust ring gear into pinion, remove, wheels and tighten up bearing adjusting nuts.

To adjust for proper back lash of ring gear in pinion, which should be .008” to .012”, wheels must be removed first. Next, back off the right hand adjusting nut enough so that the left hand nut can be turned up far enough to force the ring gear in the pinion tight. Next screw up the right hand adjusting nut until it is tight, then back off the left hand nut three notches and again bring up the right hand nut until it is tight. Then lock both adjusting nuts in place.

The adjusting nut has sixteen threads per inch. One complete turn of the nut would be 1/16” or .0625”. Adjusting nut has fifteen notches or approximately .004” adjustment per notch. By backing off the nut as advised two notches, it gives .008 back lash which is required.

Removing Pinion (Split Typo Housing)

To remove the pinion gear it is necessary to disconnect the propeller shaft lower universal joint and then the pinion shaft housing assembly.

Remove nut on end of pinion, joint flange and pull pinion out through the large end of housing.

In reassembling pull joint flange up snug. The bearings should be just loose enough to turn freely.

Adjusting Drive Gears (Solid Type Housing)

The tooth bearing of drive gears is very important and extreme care should be taken whenever adjustment is made.

First, make sure that the pinion bearings are properly adjusted.

Second, spread a thin coat of flat paint on both the working and back faces of the ring gear teeth.

Third, move the differential assembly over until the back lash between pinion and ring gear is between .008" and .012". Lock the differential adjusting bearings securely.

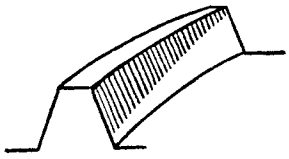

Fig. 53—Proper Tooth Bearing

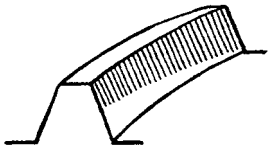

Fig. 54—Improper Tooth Bearing

Fourth, set the brakes and revolve the gears—first in a forward direction; then in a reverse direction.

Fig. 53 shows the proper tooth bearing under load.

Never allow gears to run as shown in Fig. 54.

The moment the load comes onto the gear, a pinching action is set up which will break the ends of the teeth. Fig. 54 shows pinion raised out of ring gear too far; or the kind of tooth bearing when the bearing gives out back of pinion.

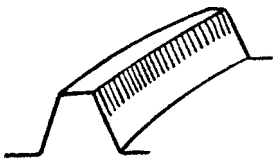

Fig. 55—Not Meshed Deep Enough

Figure 53 shows a gear where the entire load is carried on a part of the teeth. Usually the gear soon wears out. The effect is the same as upsetting pinion bearing spacer, causing pinion to float endwise.

For a properly set gear the marks on the reverse side should be approximately the same as on the drive side with a toe bearing back approximately ⅝" starting from small end of tooth.

Removing Pinion (Solid Type Housing)

To remove the pinion gear it is necessary to disconnect the propeller shaft lower universal joint and remove the pinion shaft housing assembly. Remove the joint flange, pinion bearing lock nut, lock washer and adjusting nut.

In reassembly of pinion be sure to draw the adjusting nut up snug. The bearings should be just loose enough to turn freely.

The outer wheel bearings can be adjusted by removing the rear wheels and the wheel bearing cap.

Between the wheel bearing cap and the axle flange are shims which can be changed to suit.

We carry .010" shims in stock.

BRAKES

The brakes on a motor car are very important. Extreme care should be used to keep them in good condition and properly adjusted.

Nearly every fatality or smash-up is caused by inability to stop quickly, so every service station should make it their business to see that customer's brakes are in good repair.

In some cities brake inspections are being made by the police and heavy penalties are imposed for bad brakes.

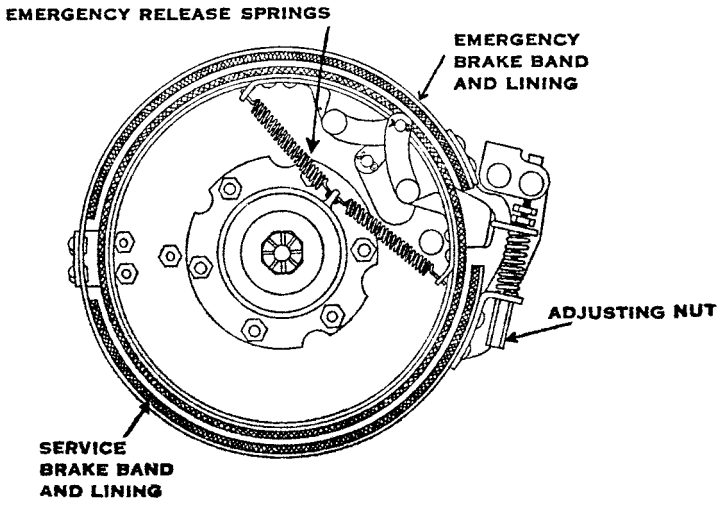

Fig. 56—Two Wheel Band Type Brake (Solid Type Housing—l0" Brakes)

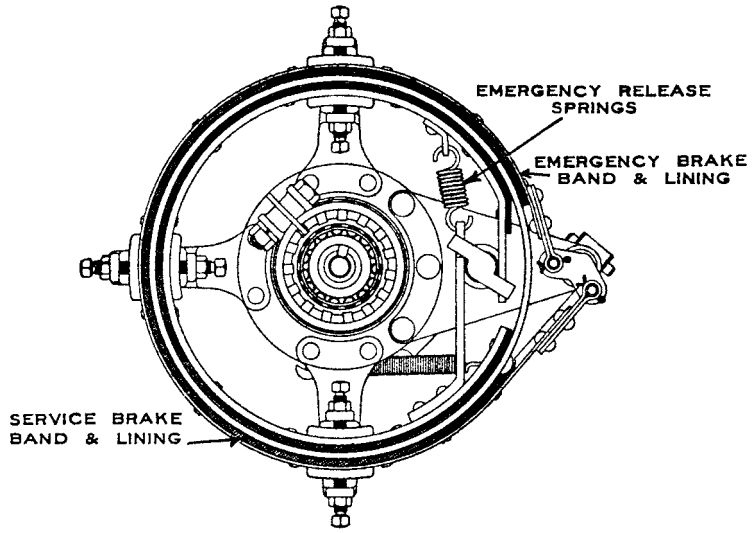

Fig. 56A—Two Wheel Band Type Brake (Split Type Housing—10" Brakes)

Two Wheel Band Type Brakes

The two wheel band type brakes are the conventional external contract--ing and internal expanding, against a heavy brake drum mounted on the rear wheels.

They are lined with a good quality brake lining and under normal conditions will not require replacement for several thousand miles.

Equalized Brakes (Two Wheel Band Type Brake)

Both brakes when applied should have the same pressure on the brake

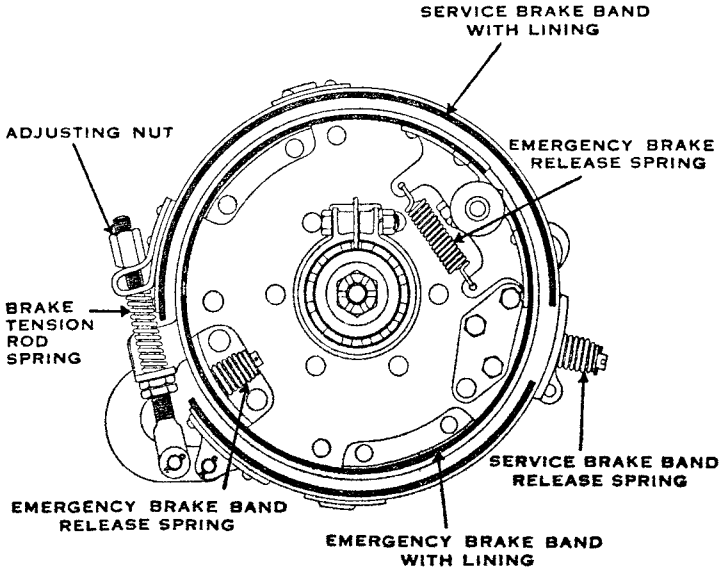

Fig. 56B—Two Wheel Band Type Brakes (Split Type Housing—11" Brakes).

drums. If one band grips tighter than the other, a bad skid is sure to result, particularly if the road surface is wet or slippery.

After the brakes have been adjusted for clearance, have some one apply the brakes separately; grasp the rear wheels and see if one wheel turns more freely than the other. Be sure that the one applying the brakes holds the pressure on the pedal or lever at the same point for both wheels.

The car should be jacked up for all brake adjustments.

If one brake is looser than the other, shorten the rod on that brake, which runs from the brake operating lever to the rocker shaft amidship of the car, by screwing up on the yoke ends.

The point to bear in mind in any brake adjustment is that the bands must not touch the brake drum when released and at the same time be close enough so that when fully applied they will stop the rotation of the wheels.

Occasionally a band gets out of round; that is, it touches the drum at one spot only. When this occurs, remove the band and form it to the brake drum.

In applying new linings, be sure to set the rivet heads up snug and see that they are well below the surface of the lining.

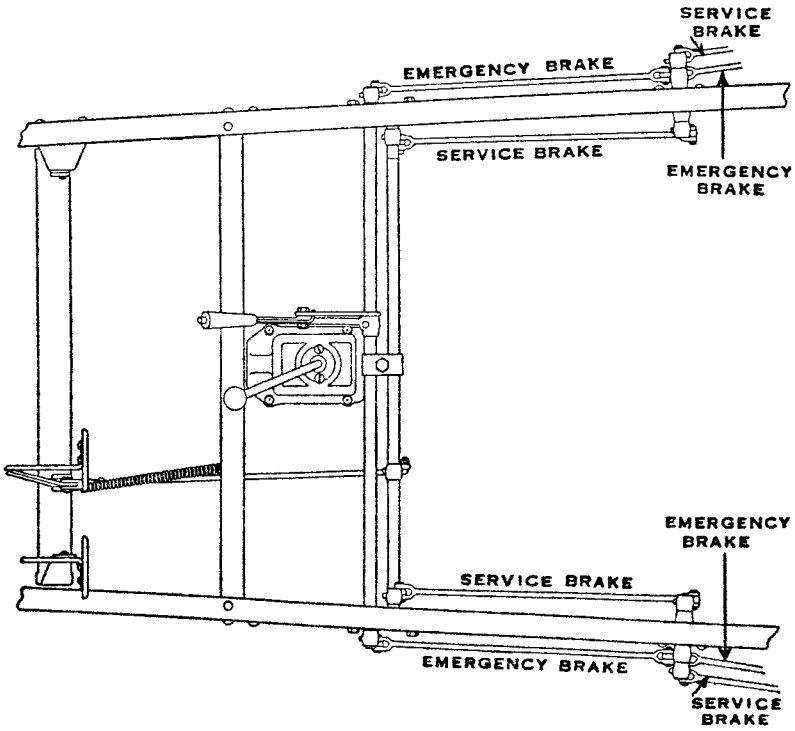

Fig. 57—Brake Controls (Two Wheel Band Type Brakes)

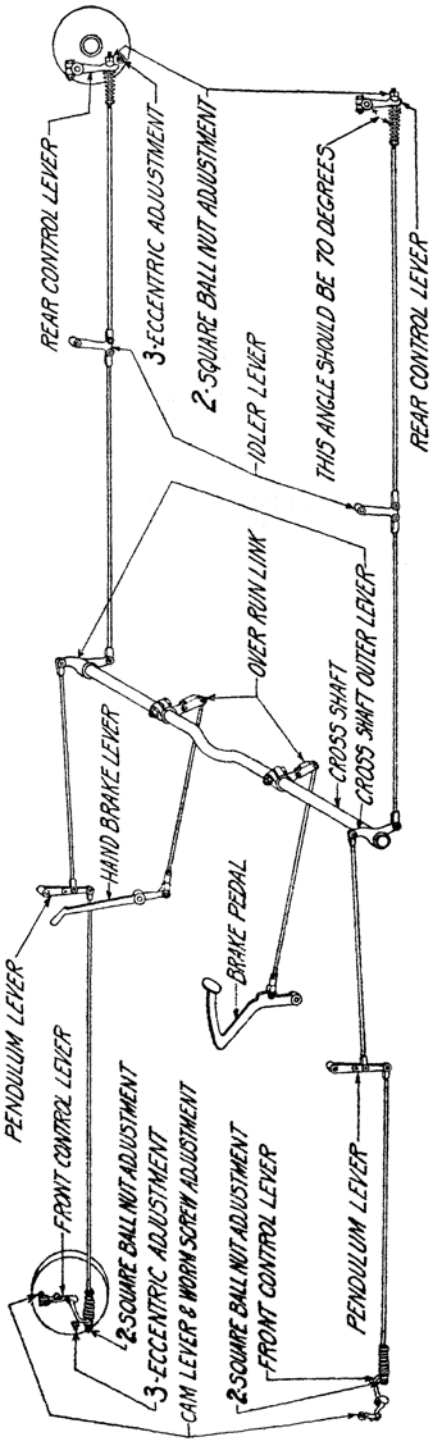

Fig. 58 —Brake Control (Bendix Four Wheel)

Squeaking brakes are caused by rivet heads rubbing on the brake drum.

The foot brake pedal is connected to the rocker shaft by a rod in which is placed a turn buckle. By screwing up on the turn buckle (which can be reached by lifting tile floor board) the foot brake can be tightened; however, be sure to equalize both brakes afterwards.

The real purpose of the turn buckle is that the foot brake pedal may be adjusted for height in relation to the position of the operating levers on the rocker shaft and axle.

When the foot brake is fully released, these levers should incline backwards from a vertical position about one-half inch. If they incline forward, it is likely .that part of the foot pressure ~viil be absorbed in an attempt to straighten the levers, as the arc of travel will be in a straight line with the pull rods.

With the brakes fully released and operating levers inclined properly, the service or foot brake bands can be adjusted for clearance by screwing in or out on the adjusting nut attached to each brake band.

Be sure to equalize the brakes afterward and adjust foot pedal for height.

If the brake band linings have worn to such an extent that tins cannot be done and at the same time keep all the conditions mentioned above normal—replace the linings.

BRAKES

Four Wheel Mechanical Brakes

The DURANT car is equipped with the Bendix Mechanical Four Wheel Brakes which are accepted as the safest and simplest braking system of present day engineering. All working parts at the four wheels are mounted on a heavy steel plate that fits over the 11” brake drum, thus protecting these parts from water, dirt and slush which insures peak efficiency of operation when the brakes are most needed.

Pressing down on the foot brake pedal or pulling back on the hand brake lever (See Fig. 58) operates in unison all four brakes.

Both the foot brake pedal and hand brake lever are connected by separate pull rods, to the cross-shaft located just back of the center cross-member of the frame. Mounted on both outer ends of cross-shaft are double levers, known as over-running links to which are attached two pull rods that operate the shoe controls of the front and rear brakes. (See Fig. 58)

All four brakes must be adjusted exactly alike to insure efficient operation and should be adjusted as follows:

FOUR WHEEL BRAKE ADJUSTMENT FOR WEAR FRONT WHEELS

A. Turn square ball nuts until center line of ball on lever is ¼” to 5/16” back of center line of steering king pin with brakes released.

B. Loosen lock nut on worm screw adjustment (1) and turn slot to right until brake shoes are free.

C. Loosen eccentric lock nut (3) at front wheels, and turn eccentric in same direction in which wheel revolves when car moves forward, until brake is tight against drum, then back off gradually until wheel is just free. Hold eccentric and tighten lock nut.

D. Turn worm screw (1) to left until brake binds, then back off until wheel is just free. Tighten lock nut.

FOUR WHEEL BRAKE ADJUSTMENT FOR WEAR, REAR WHEELS

A. Loosen eccentric lock nut (3) at rear wheels, and turn eccentric in same direction in which wheel revolves when car moves forward, until brake is tight against drum, then back off gradually until wheel is just free. Hold eccentric and tighten lock nut.

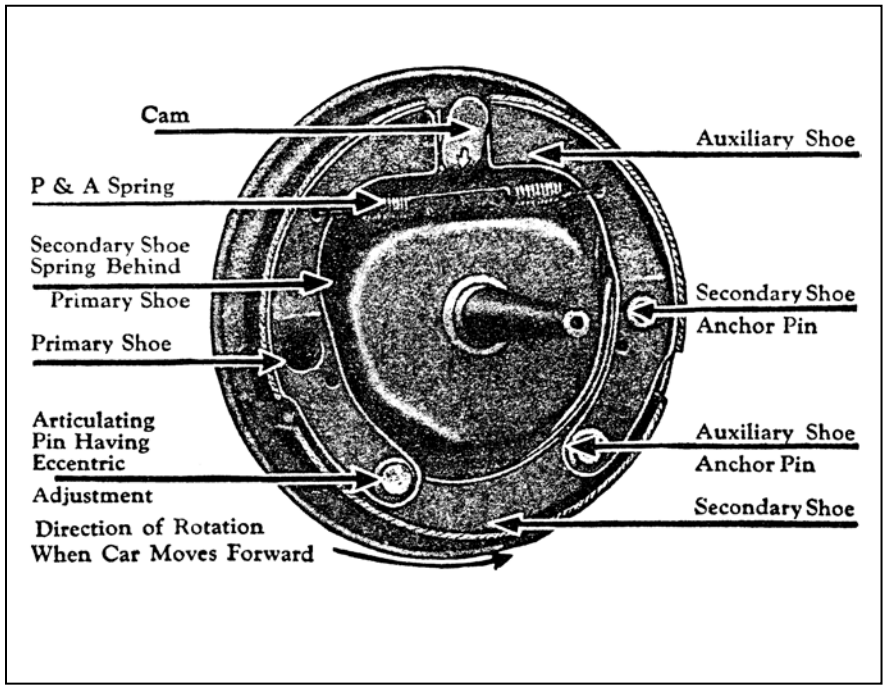

Fig. 59—Brake Shoe Assembly

B. Angle of control levers with brake rods should be 70 degrees with the brakes released, otherwise reset as follows: Loosen pinch bolt and slide lever off serrations. Slack off square ball nut (2) to end of thread on rod. Apply brake with Stillson wrench on camshaft and slip control lever on serrations. If brake is too tight move lever back one serration.

Tighten pinch bolt. Control levers should have approximately the same angle with the rod on both brakes. (Fig 58)

EQUALIZING FOUR WHEEL BRAKES

D. Equalize all four wheels as follows: Push pedal down with block or jack within 3" of floor board or until the tightest wheel can just be turned by hand. Slack off tight wheels a turn at a time at the square ball nut (2) on all four wheels, until all four are the same, remembering that a change in the rear brake mar affect the front brake on the same side and vice versa. (See Fig. 58).

E. Remove block from pedal and try all four wheels for drag. There should be no drag if previous operations were properly done. If necessary, slack off the same number of turns on all four wheels.

MAJOR ADJUSTMENTS FOUR WHEEL BRAKES

Anchor pins should he adjusted only, (a) When fitting newly lined

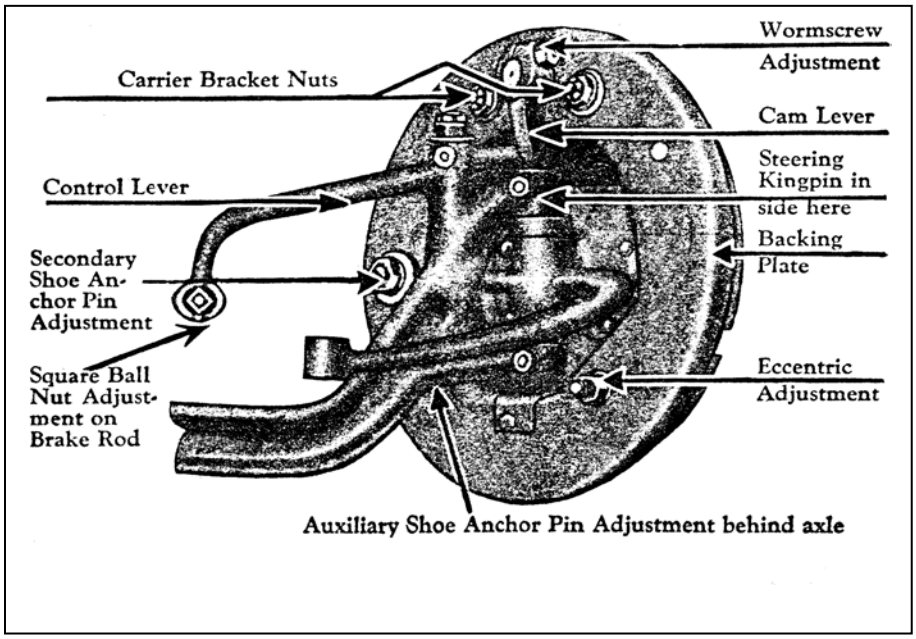

Fig. 60—Lever Control Assembly

shoes,. (b) When anchor pin nuts are found loose, (c) When other adjustments fail to give satisfactory results. (See Fig. 58.)

To adjust anchors: Jack up all four wheels. Turn eccentric adjustment (3) away from articulating pin and leave loose. Slacken tight anchor pin nuts free of lock washers. Tap both anchors out against drum. Hold brake on tight by 100 pound load on the end of an 8-in. Stillson wrench on control shaft, or equivalent monkey wrench on con-

trol lever. Tap anchor pins on end and try to turn wheel forward with brake applied. Still holding brake on, tighten both nuts as tight as possible. with a 16-in, wrench. Release brake, then adjust eccentric and make other adjustments as in Adjustment for wear."

Where the brake drums are slotted so that feeler gauges may be inserted between the shoe lining and the brake drums the adjustments may be checked as follows

Remove covers on slots. Check toe and heel of auxiliary shoe and toe and heel of secondary shoe with feelers. Both ends of the shoe should be alike within 0.002-in. If not to these limits repeat anchor adjustment or loosen improperly set anchor one turn and tap until correct clearance is obtained. Then tighten firmly. Replace covers on slots.

REMOVING THE FOUR WHEEL BRAKE SHOES

To remove Bendix Brake shoes, detach the return springs, indicated in Fig. 59. Take off the nut or cotter pin from the secondary shoe anchor pin. Spread the primary and auxiliary shoes to clear the cam, drop shoes sufficiently to allow disengagement of articulating pin and eccentric and slip all three shoes off tog-ether.

It will be noted that the auxiliary shoe anchor pin has no nut and is the same diameter as the hole in the shoe. This enables the shoe to be slid off the end of the pin.

In removing the shoe it is not necessary to detach the anchor pin assembly.

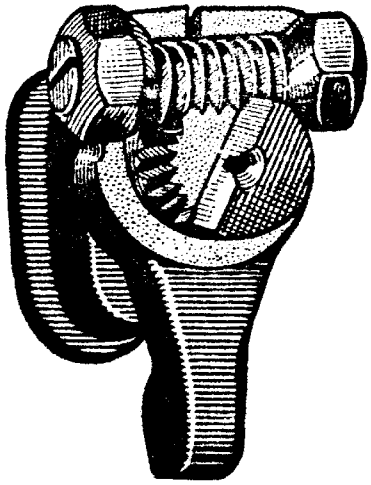

Fig. 61—Cam Wormscrew Adjustment

CHAPTER III

CARBURETION AND ELECTRICAL SYSTEM

VACUUM TANK (Lever Type)

As the gasoline tank is mounted on the rear of the car, some distance from the carburetor, it is necessary to provide a means of drawing the fuel from the tank into the carburetor.

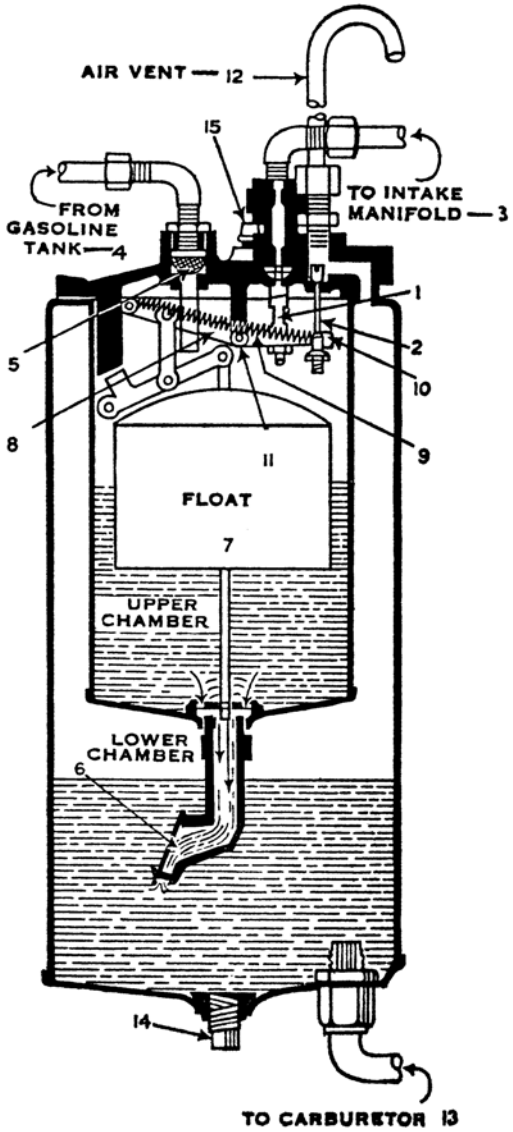

Fig. 62—Vacuum Tank (Lever Type)

This is accomplished by the use of a vacuum tank mounted under the hood, the construction of which is illustrated in Figs 62 and 63.

Every motor draws its supply of gasoline through the carburetor by reason of the pumping action of the pistons which, on their downward or suction stroke, create a partial vacuum in the intake pipe. It is this

same pumping action which draws gasoline from the main supply tank into the vacuum tank.

The vacuum tank is composed of two chambers. The upper or smaller one is the filling chamber, and the lower one the emptying chamber. To the upper chamber is connected a copper pipe, 3, which is attached to the intake pipe at the center of the two branches. Gasoline enters this chamber from the main supply tank through the connection 4, at the base of which a small wire strainer, 5, is placed to catch any dirt or lint which may have gotten into the main tank. At the base of this chamber is placed a flapper valve, 6, which, when closed, prevents the gasoline from running into the lower chamber.

The suction of the pistons on the intake stroke exhausts the air in the upper chamber, creating a vacuum, and this vacuum closes the valve, 6. As the main supply tank is open to atmospheric pressure (through the vent hole in the filler cap), the vacuum created in the upper chamber will cause the gasoline to flow from the main tank through the supply line and into the chamber through the connection, 4. Mounted inside of ft this chamber is a metal float, 7, and as the gasoline rises in the chamber the lever, 8, moves upward until when the proper quantity has been obtained the direction of pull on the springs, 9, is reversed, which causes the lever, 13, to move upward. This action closes the valve, 1, thus shutting off the suction from the motor, and opens the valve, 2, which allows air to flow into the chamber through the vent pipe, 12.

The admission of outside air destroys the vacuum in the chamber, which automatically releases the suction on the valve, 6, and at the same time stops the flow of gasoline through the pipe, 4. The weight of the gasoline in the upper chamber then causes the valve, 6, to open, allowing the gasoline to flow into the lower chamber, from whence it flows by gravity to the carburetor through the connection, 13.

As the level of the gasoline in the upper chamber drops, the float, 7, moves downward, causing the lever, 8, to move at its free end in the same direction. The levers 8 and 10 are pivoted on the pin, 11, and connected together at their free ends by springs, 9; therefore, when the free end of lever, 8, has dropped below the center line of the pivot, 11, the direction of pull on the springs, 9, will reverse, and the lever, 10, will move downward at its free end. This action opens the valve, 1, thus permitting the motor suction to create a vacuum in the upper chamber and start the flow of gasoline, through the connection, 4, and at the same time closes the valve, 2, shutting off the admission of outside air. The process of filling the upper chamber is then repeated.

As all lint and dirt cannot be kept out of the system, it is necessary to drain the lower chamber every three months, and to do this a drain plug, 14, is placed at the lowest point in the tank.

The manufacturers of the vacuum tank maintain a complete service repair organization in all principal cities, and we recommend that should trouble be encountered with this system you consult one of their experts or write the factory direct. .

Should this be impossible, the following instructions supplied by the manufacturers, if carefully followed, should give relief:

Care and Repair of Vacuum System

Before proceeding to repair the vacuum tank, make absolutely sure that the trouble is not due to some other cause.

Vent Tube Overflows (Lever Type)

The air vent, 12, allows an atmospheric condition to be maintained in the lower chamber, and also serves to prevent an overflow of gasoline in descending steep grades. If once in a long while a small amount of gasoline escapes no harm will be done, and no adjustment is needed.

However, if the vent tube regularly overflows, the air hole in main gasoline tank filler cap may be too small, or may be stopped up. Tithe hole is too small, or if there is no hole at all, the system will not work. Enlarge hole to ⅛" diameter, or clean it out.

Failure to Feed Gasoline to Carburetor (Lever Type)

Remember that this condition may be due to other causes than the vacuum system. Do not blame the vacuum system until you are sure that the fault does not lie elsewhere. After flooding the carburetor, or "tickling the carburetor," as it is commonly called, if gasoline runs out of the carburetor float chamber you may be sure that the vacuum is performing its work of feeding the gasoline to carburetor.

Another test is to take out the inner vacuum tank, leaving only the outer shell. If you fill this shell with gasoline and the motor still refuses to run properly, then the fault clearly lies elsewhere, and not with the vacuum system—because you must certainly get gasoline feed from this open, elevated tank of gasoline, unless there is stoppage in the connection line to carburetor.

To Remove Top (Lever Type)

In removing top of tank, after taking out screws, run the blade of a knife carefully around top, between cover and body of tank, so as to separate gasket without damaging it. Gasket is shellaced to make an air-tight joint.

If Faulty Feed Is Traced to Vacuum System, One of the following Conditions May Be the Cause: (Lever Type)

(A.) The float, which should he air-tight, may have developed a leak, thus filling up float with gasoline and making it too heavy to rise sufficiently to close vacuum valve. This allows gasoline to he drawn into manifold, which in turn will choke down the motor.

Proper operation depends upon the float being air-tight.

To Repair Float (Lever Type)

Remove top of tank (to which float is attached) as above directed. Dip the float into a pan of hot water, in order to find out definitely where the leak is. Bubbles will be seen at point where leak occurs. Mark this spot.

Next, punch two holes, one in the top and the other in the bottom of the float, to permit discharge of the gasoline. Then solder up these holes and the leak. Test the float by dipping in hot water. if no bubbles are seen, the float is air-tight.

In soldering float, be careful not to use more solder than required. Any unnecessary amount of solder will make the float too heavy.

In taking out float and repairing it, take care not to bend the float guide rod. If you bend the rod, it will strike against guide and retard float, producing the same effect as a leaky float, and allowing gasoline to enter manifold. Also note whether surface of rod is perfectly smooth, so that it cannot be retarded by guide.

To overcome the condition of a leaky float temporarily until you can reach a garage, remove plug 15 at the top. In some cases the suction ii.. of the motor is sufficient to draw gasoline into tank even with this plug open, but not enough to continue to be drawn into manifold. If, however, you are not able to do this, close up plug, 15, with engine running. This will fill tank. After running engine until tank is full, remove plug, 15, until gasoline gives out. Repeat the same operations until a repair station or garage is reached, where the leaky float can be remedied.

(B.) The flapper valve, 6, may be out of commission.

A small particle of dirt getting under the flapper valve might prevent it from seating absolutely air-tight, and. thereby render the tank inoperative.

In order to determine whether or not the flapper valve is not function--ing, first plug up air vent; then detach tubing from bottom of tank to carburetor. Start motor and apply finger to this opening. If suction is felt continuously, then it is evident that there is a leak in the connection between the tank and the main gasoline supply, or else the flapper valve is being held off its seat and is letting air into the tank instead of drawing gasoline.

In many cases this troublesome condition of the flapper valve can be remedied by merely tapping the side of the tank, thus shaking loose the particle of dirt or lint which has clogged the valve. If this does not prove effective, remove tank cover, as described on previous page. Then lift out the inner tank. The flapper valve will be found screwed into the bottom of this inner tank.

(C.) Manifold connection, 3, may be loose, allowing air to be drawn into manifold.

(D.) Tubing may have become stopped up in lengths 4 or 3.

(E.) Gasoline strainer, 5, is a screen located in the line from gasoline tank. This screen collects all foreign substances that might get in the rear tank and he carried through to the carburetor, and clog it. If tank fails to ‘work it may be that this screen is clogged, preventing gasoline from getting into tank. Screen may be easily cleaned by unfastening connection at elbow. This cleaning should be done every three weeks. If tank should ever fail to operate, examine strainer first.

VACUUM TANK (Leverless Type)
GENERAL DESCRIPTION

The Stewart-Warner Tank has two separate chambers—the inner or vacuum chamber M and the outer or reserve chamber N (see Figure 62). The inner chamber has four openings:

1. The fuel inlet A, which is connected to the main supply tank. (The fuel passes through the screen S.)
2. The vacuum opening F, which is connected to the intake manifold.
3. The atmospheric opening C.
4. The flapper valve G.

The outer or reserve chamber has two openings:

1 At the top the opening to the atmosphere at all times through vent tube K.
2. Outlet E, which is connected to the carburetor float bowl.

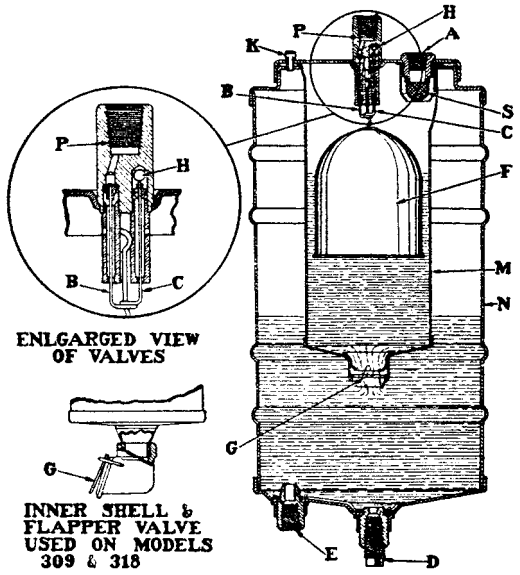

Fig. 63—Vacuum Tank (Leverless Type)

Except the inner shell bottom, which is brass, the outer and inner shell and top are made of terne plate, which is sheet steel coated with lead by a special process. All rear gasoline tanks are also made of this.

The float F is made of brass and nickel-plated. The float stem is made of bronze. The stem extends to the bottom of the float to which it is attached. This prevents the float from being bent in at the top from jars and putting the stem out of line with the vertical axis of the float.

The bends in the float stem cause the valves to be opened and closed as the float reaches the bottom or top of its travel. The valve stern eyes cannot pass these bends, except when the float is held far to one side. This cannot occur after it is assembled in the tank. The float stem, between these bends, moves freely through the valve stem eyes.

The valve stems are spring steel, brass plated, but the valves are brass.

The "flapper" valve is flat glazed bakelite. This seats against a ring embossed in the brass bottom of the inner shell. This ring-shaped valve seat is lapped to form an air-tight seat for the bakelite valve.

How It Operates

The pumping action of the pistons in the motor creates a suction or vacuum in the intake manifold. By connecting the Stewart-Warner Tank to the intake manifold, air is withdrawn from the inner chamber thus reducing the pressure below that of the atmosphere. The fuel in the main supply tank being under atmospheric pressure is forced into the inner chamber (this action is commonly called suction) from where it flows to the outer chamber, as explained later. As the Stewart-Warner Tank is always installed at a point higher than the carburetor the fuel flow3 by gravity to the carburetor.

As float F raises the lower bend its stem lifts and closes the vacuum valve B. When the float starts to go down Valve B is held closed by vacuum in the manifold. For this reason the manifold vacuum must be great enough under all conditions to operate this tank properly.

When the vacuum chamber M is nearly or entirely empty, the float is down, the atmospheric valve C is closed and the vacuum valve B is open. The suction of the intake manifold is applied to the inner chamber M through the open vacuum valve B. This reduces the pressure in the inner chamber M below that of the atmosphere. This closes flapper valve C, as outer chamber N is at atmospheric pressure. Fuel from the main supply tank which is at atmospheric pressure is therefore forced into inner chamber M through fuel inlet and screen S.

As inner chamber M fills with fuel float F rises. As float reaches the top of its stroke it closes vacuum valve B and opens atmospheric valve C, allowing atmospheric pressure to he established in chamber M.

As the pressure in both chambers is now equal the fuel flows by gravity through flapper valve C into outer or reserve chamber N, allowing the float F to drop gradually.

As the float F reaches the bottom of its stroke it opens vacuum valve B and closes atmospheric valve C. The intake manifold vacuum again lowers the pressure in inner chamber M, fuel is forced into inner chamber and the operation is repeated.

This operation is continued at a rapid rate until the fuel level in chamber N comes to a balance with the fuel level in chamber M and operated thereafter as the carburetor demands the fuel.

As the gravity chamber N is always open through vent tube K, a perfect, even flow of fuel to the carburetor is maintained by gravity.

Instructions For Disassembling

It is not necessary to remove the tank from the car to repair it.

1. Disconnect the fuel line U and vacuum line J connections.
2. Remove the four screws from the top.
3. Lift the cover with the float attached.
4. Lift out the inner shell, if required.

Trouble Indications

Except in one respect, that of a check valve not seating properly on back pressure from the manifold, the various possible troubles in this tank will be indicated in the same way as similar troubles are indicated with the lever type tank.

Failure to Draw Fuel

1. Air leak in vacuum line or fittings. Air leak in the supply line or fittings from the supply tank to the vacuum tank. This may be caused by loose or broken fittings at the vacuum tank, supply tank or manifold or by split, broken or worn tube. It will be most likely to prevent operation on open throttle, but will not cause total failure unless the leak is very had. To repair, replace broken tube or fittings or tighten loose fittings.

2. Plugging of supply tank vent (usually in the filler cap). This may also cause some gasoline to he forced out of the vacuum tank, due to expansion of the gas in the supply tank creating a pressure.

3. Restriction in supply tube U. Any restriction will limit the flow of fuel. Restriction may be caused by dirt clogging the screen 5, at the vacuum tank or the entrance to the tube at the supply tank, especially when a valve or screen of any kind is used. It may also he caused by a sharp bend in the tube or dirt clogged in the tube at bends, etc.

Over-rich Mixture or “flooding” Engine

1. Float leak. A leak in the float will cause it to fill partly, fail to open promptly, or at all, the atmospheric valve and close the vacuum valve. This will cause gasoline to fill the inner chamber and he drawn through the vacuum valve into the manifold, resulting in an over-rich H mixture or flooding the engine, especially on idling. To repair, see “Instructions for Disassembling.” Punch a very small pin hole in the float and empty it of fuel. Solder the leak and the pin hole, then test by immersing it in a pan of hot water. If no bubbles are seen, the float is air tight.

2. The vent tube K may have become clogged. This can easily he determined by tile use of a test tool which can he purchased of Stewart-Warner Speedometer Corporation which they list under No. T-46026.

3. The atmospheric valve C may not seat properly because of some foreign matter having lodged on the seat. If this leaks much air a sufficient degree of vacuum cannot he built up in the inner chamber to draw H gasoline to it. To test the seating of this valve, the test tool T-46026 should he used placing it over the lower part of the intake manifold and then hold entire assembly with the upper half of the intake mani-- fold pointing upward, and in this position seal the vacuum connection with the finger and then suck on the stem of the test tool. If air can be drawn through, invert the entire assembly and endeavor to blow out the matter preventing the valve from seating properly. In this position (upside down) the vacuum valve will he closed so any air going through must go through the atmospheric valve and out the vent at the side. Also by turning the valve stem while pulling it against its seat try to grind off the dirt or whatever is preventing it from seating.

If the valve cannot he made to seat properly, replace the defective top assembly with a good one. If these are in such condition as to be reusable as new after being repaired they should be returned to the factory or your distributor for repair and base your charges on the cost for repairs.

4. Vacuum valve dirty or will not seat properly. When the vacuum valve B does not seat properly there will be a continuous flow of air coming through the atmospheric valve and out the vacuum valve into the manifold. After the inner chamber is filled gasoline will be drawn into the manifold through valve B and cause the engine to be flooded and finally stop.

This valve can easily be tested by holding the entire cover assembly in a vertical position and pull out the valve stem and blow into the vacuum nipple. Push the valve stern in and suck. A properly seated valve will not allow air to be drawn through it thus into the mouth. Pull out the stem and continue to suck. Air should pass through the valve when the valve stern is pulled outward. When you find the valve defective and cannot make it scat properly by pushing it upward and turning it, replace the defective assembly.

Fuel Won't flow to Carburetor or Only Slowly

1. Clogged vent to inner shell in center top nipple or clogged vent tube K. Under such directions fuel could flow only as air comes up through the carburetor line to replace it.

2. Sticking Flapper valve. This is sometimes due to an insoluable gum getting on the valve seat. At other times a green paste, formed by the action of acid on the brass bottom, may get on the valve seat and cause it to stick closed. The source of this gum is not known and it has been found in quantities too small for analysis. This and the paste may be tl1e result of some soldering flux not removed from the supply tank or vacuum tank before use.

We have occasionally seen tanks having in them a substance like varnish, hut in too small a quantity for analysis. The source of this has not been determined.

Check this valve in the following manner: Remove the inner shell, and place open end over your mouth and attempt to breathe through it. A defective flapper will allow air to leak into the shell. Clean the valve seat and flapper, but if this does not help, replace the inner shell and flapper assembly with a new one. This must not be construed as authorizing a charge for a new shell.

It will he found more difficult than is apparent to remove the old flapper without damaging the shell bottom beyond repair or to put on a new flapper so it will not leak around the rivet or the seat. For this reason no tools are supplied for this repair and the complete inner shell and flapper valve should be returned to the factory for repair if the shell is not rusty and it can• be repaired for resale as new by merely putting on a new flapper and relapping the seat

CARBURETOR

The Tillotson Carburetor is especially designed for the DURANT and STAR engine. It is a plain tube carburetor with air-feed main nozzle, accelerating well, and a by-pass for idling.

The upper cross-holes in main nozzle feed air above the level of gasoline and thin out the mixture at ordinary speeds to give maximum economy. The lower cross holes fill the accelerating well, and empty it when throttle is opened quickly.

The needle valve regulates the flow of fuel to main nozzle. The approximate setting is two and one-fourth turns open. To adjust, open throttle one-third, retard spark, adjust needle valve until engine runs smoothly, then cut off one-eighth to one-fourth turn, which should give you best performance.

The by-pass needle regulates the air for idling; the approximate setting is one-fourth to one-half turn open. The position of butterfly to give required speed is determined by a stop screw, which should be adjusted at the same time as the by-pass needle. When desired speed is secured, lock the screw by binder screw.

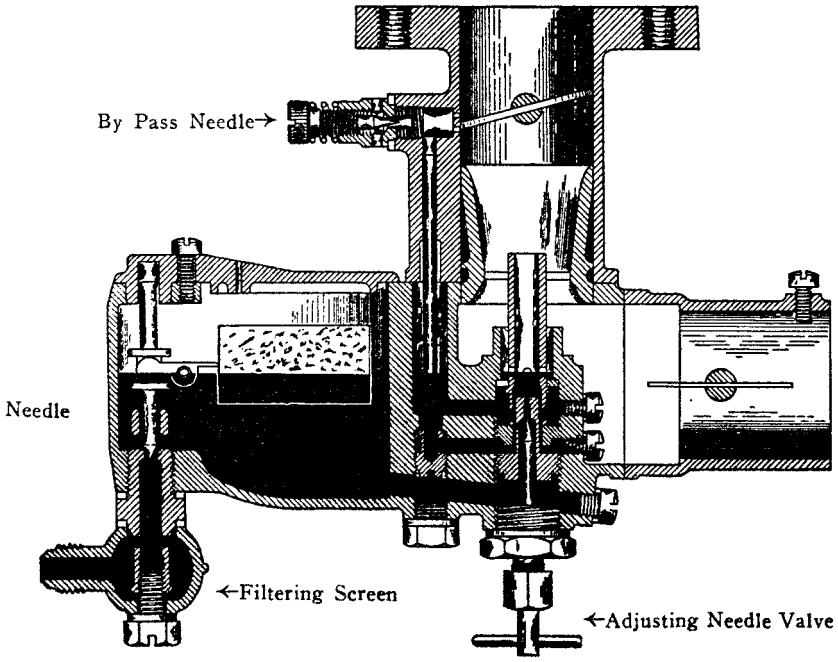

Fig. 64—Carburetor

Before adjusting carburetor, spark plugs, ignition system and valves should be in good order; gasoline line and strainers free and clean, and engine well warmed up.

A large proportion of carburetor trouble is due to water or dirt in gasoline stopping up the screen and nozzles.

This instrument has been designed and adjusted for use with gasoline fuel; when using other fuels, secure instructions from Tillotson Mfg. Co., or authorized service stations.

The carburetor has been carefully tested and properly adjusted with the motor at the factory, and no further adjustments should be necessary. Too often attempts are made to adjust the carburetor when something else is causing the motor to run unevenly.

The carburetor is equipped with a filtering screen or strainer at the point where the gasoline enters the carburetor. Dirt or water may be causing the motor to misfire and sputter; and in this event, the bowl to which the gasoline line is connected should be removed and thoroughly cleaned.

If dirt should pass the screen or strainer, it may lodge so that the needle valve will not have a good seating. In this event, it would cause a leaky carburetor, and the needle valve should be reseated.

Remove the cover over the float chamber bowl and with a light hammer or other suitable tool, tap lightly on the end of the needle valve. The needle valve seat is made of brass and this action will cause a new seat to be formed.

A slight drip from the carburetor is sometimes due to the gasoline level being too high. The lever for this carburetor is 13/16" from the top of the float chamber to the surface of the gasoline. The level can be changed by bending the float lever arms.

In nearly every case of difficulties encountered with a carburetor, you will find that dirt in the carburetor or passages between the gasoline tank and carburetor, is a contributing cause.

To Clean Carburetor

Disassemble the carburetor completely and examine each part.

Clean all parts thoroughly in gasoline using a stiff brush to remove caked dirt and blow out the small drilled passages which may become clogged with chips or dirt.

Inspect carefully for defects in fibre washers or leaks due to sand holes in body castings.

If due care is exercised, further difficulties can generally he traced to insufficient fuel feed, faulty ignition or poor compression.

ELECTRICAL SYSTEM

The system used is known as the two-unit system; that is, with a separate generator and starting motor, each performing its function independently of the other.

The system, as a whole, comprises three principal units:

The generator, which produces an electric current and delivers it to the storage battery.

The storage battery, which receives and accumulates the current thus generated, and delivers it to the distributor, lighting system or the starting motor when needed.

The starting motor receives the current from the storage battery and cranks the automobile motor whenever it is to be set in motion.

In addition, there are four auxiliary systems for the regulation and control of the different units, as follows:

A circuit breaker, whose function is to "break" the charging circuit when the automobile engine is standing still or when the speed drops below the point where the generator will produce a charging voltage.

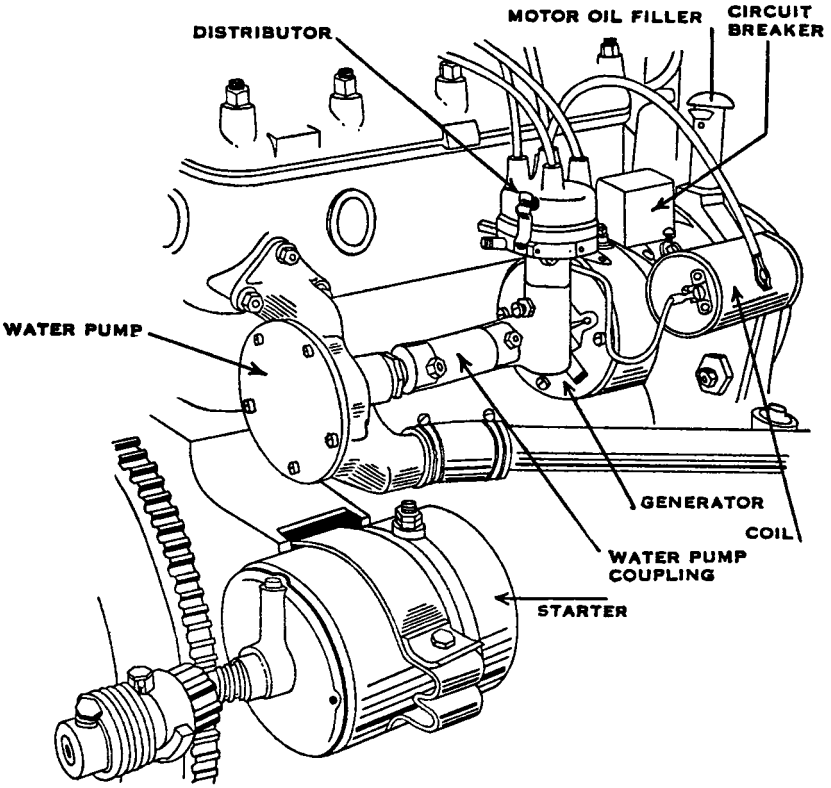

Fig. 65—Right-hand Side of Motor

An ammeter, which registers on a dial the charging or discharging rate of current floating through the system. When the car is at rest and no lights burning, the indicating needle or pointer should stand at "zero."

When the lights are turned "on" the pointer will move to the right, and indicate the amount of discharge or current flowing from the storage battery. With the automobile motor running at a fair speed, and no lights burning, the pointer will move to the left of zero, and indicate the amount of current flowing into the storage battery, or "charging rate." Should the pointer indicate "discharge" when the car is at rest and no lights burning, the system is not working properly and should be investigated to determine the cause of the trouble as quickly as possible.

A starting switch, the function of which is to make the necessary electrical connection from the storage battery to the starting motor when the automobile motor is to be set in motion. This switch is self-contained in an insulated steel box and requires no attention.

An ignition and lighting switch, by which the ignition and lighting systems are controlled.

Figure 65 illustrates the relative position of the generator and igniter sets for the DURANT and STAR cars. The units are mounted on the

right side of the motor. The generator is driven by a chain connecting with the crankshaft and camshaft gears housed in the chain case at the forward part of the motor. The ignition coil is mounted on the side of the generator and the distributor is driven by the generator armature shaft.

THE GENERATOR

The construction of the generator is of the utmost simplicity, and beyond a few drops of oil every week, requires no attention. The machine is enclosed in a dust and moisture proof shell which effectually protects it from oil and dirt.

The voltage output is controlled by a third brush, which increases or decreases the field strength in proportion to the motor speed, thus doing away with mechanical governors and clutches, which are liable to get out of adjustment.

The generator begins to produce a charging current of sufficient voltage at a car speed of about ten miles per hour. At twenty-five miles per hour the generator is producing nearly its maximum output, or about fifteen amperes.

Care of the Generator

The generator should be examined occasionally to see that all connections are tight and that there is no undue wear on the moving parts. The commutator end of the generator can be reached by removing the steel band around the commutator head.

If the commutator should be found blackened or rough, it may be smoothed down with No. 00 sandpaper, while the generator is running. Never use emery cloth for this purpose.

After smoothing down the commutator, examine it carefully and remove all particles of metal which may bridge across from one copper segment to another. Blow out every particle of carbon dust which may be accumulated in the generator case.

See that there is just enough spring tension on the carbon brushes to insure good contact on the commutator. Too much tension will cause heating and unnecessary wear to brushes and commutator segments.

See that the brushes are making even contact with the commutator. When they become worn to such an extent as to need replacement, new ones should be installed.

Locating Generator Troubles

The Generator is provided with a field fuse to protect it from serious damage should a loose connection or broken wire occur in the charging circuit. This is located in the right hand tipper quarter of the commutator end plate looking at the unit from the commutator end and is easily accessible by removing the head band assembly. The fuse is of a 5 ampere capacity and should never be replaced by a fuse substitute or one of higher rating.

After checking all the connections in Fig 67, examine the field fuse for being “Blown” or “Open”. A blown fuse will show no wire in the glass which will also have a smoky appearance, while an open fuse will generally have loose metal end ferrules.

If the ammeter shows no charge at fair motor speed, go carefully over each connection. Make sure that every wire is intact and is securely fastened to its respective terminal. In nearly every case of suspected generator trouble, it will be found outside of the generator itself.

If trouble is traced directly to the generator do not remove it immediately, but by removing the flat band around the rear end examine the brushes, brush connections and commutator segments. There are a number of insulating discs on the brush rigging; also on terminal posts. Make sure that none of these are broken or misplaced and that whenever used the terminals or screws are not touching some grounded portion of the generator housing.

If you are sure these are in good condition, first mark the exact position of the brush holder plate; then remove the generator, then the armature.

The brushes are set at the exact neutral point of the magnetic field. This varies on each generator, so it is very important not to change this in any way.

Testing Field Coils

Disconnect the coil leads; attach one end to the positive battery terminal. Connect a six-volt lamp in series with a wire attached to the negative battery terminal. Make and break the connection by touching the other coil lead. If the coil circuit is intact, the lamp will light. If it is open (broken) the lamp will not burn.

Sometimes the insulation on one of the coil wires breaks, causing the bare wire to come in contact with the field pieces, causing a ground. To determine this, attach the negative battery wire (still in series with the lamp) directly to the generator case; then bring the free end of the coil wire into contact with the generator case. Make and break the contact. If a ground exists, the lamp will light.

Do not attempt to repair a broken or grounded coil, as it will be much cheaper to install a new one.

Before removing the pole pieces to take off the coils, mark each one plainly so they can be put back in exactly the same condition and position. The polarity will be changed unless this is done.

Note which direction the coil is wound; that is, right or left handed. In putting on new coils, be sure to have the winding run in the same direction.

If the coils are on backwards, it will change the polarity and the machine will not generate.

Testing Armature

The armature is more difficult to test, requiring special test apparatus, such as a Growler, or bar-to-bar test.

There are three conditions that would cause an armature to fail.

First: Shorted commutator segment.

Second: Broken armature coil.

Third: Shorted armature coil.

The first case can be determined by a careful examination of the slots between each segment. Each segment is separated from its neighbor by a thin mica insulating strip.

With a tool the exact width of the space between the segments, scrape the mica down so that it is somewhat below the top of each segment.

Examine the connections of each coil wire to its respective segment to make sure that no solder is shorting one coil with another.

If there is no short circuit between segments or coils at commutator, then either one of the second or third causes mentioned above is the reason for the failure.

It is much cheaper to replace the armature with a new one than it is to attempt to repair it.

It is essential for the proper working of a generator that the bearings supporting the armature be tight; therefore, when they become loosened from wear, replace them.

Adjusting Generator Third Brush

When DURANT and STAR cars leave the factory, the third brush is set for average driving needs. In congested centers where the driving speeds is continually low, it may he necessary to increase the voltage output at comparatively low speeds. To do this, remove the flat band which surrounds the generator at the rear end. The tower brush (when facing the motor) is the third brush. By loosening the lock nut, this brush may be moved up or down slightly. Moving the brush upwards increases the voltage.

It is best not to change the regular setting unless you are sure that it is necessary for that particular car and its operating conditions.

To Remove Generator

Remove the generator sprocket plate from the chain case cover which will allow the cotter pin and castled nut to be removed which holds the sprocket to the generator shaft.

Next remove the two cap screws holding generator to chain case: disconnect water pump held by three (3) bolts.

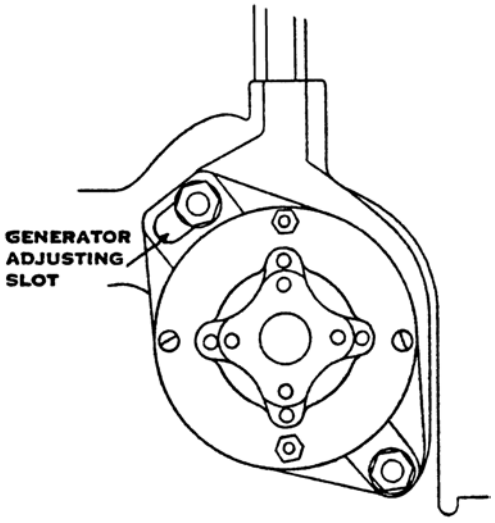

Fig. 66—Adjustment of Chain by Moving Generator

Due to the boss on generator where Slot for adjusting is located, it may strike the motor block if pulled straight back; but when taken off in an assembly unit, and by moving the generator slightly at the same time pulling off the generator gear, which is a slip fit on generator shaft, it can be easily removed.

Ignition Coil

In order to determine if the coil is operating properly, secure a piece of wire, and, holding one end to the frame of the car, motor casting, or other metallic "ground," bring the other end to within one-quarter inch from the point where the high tension wire (running from the coil to the central terminal of the igniter) leads from the coil.

Turn the engine over by hand with the switch turned on.

If a spark occurs at this point and not at the distributor, the trouble is in the high-tension wire which leads from the coil to the igniter.

If no spark occurs at either point, the distributor in proper shape and the primary circuit intact, it is evident that the coil should be replaced.

Primary Circuit

When testing the primary circuit, there are practically only two things to be taken into consideration; namely, the condition of the contact points in the breaker box and the wiring.

When tracing the primary circuit, first see if the fuse on the back of the instrument board has "blown"; then trace all wiring, following the diagram shown in this book. (Figs. 67 and 68.)

Lighting and Ignition Switch

In order to test switch and determine if current flows through it:

Remove the white wire from the terminal on coil. (Figs. 67 and 68)

Attach a wire to the negative terminal on the storage battery and bring its free end around so that it can be brought in contact with the free end of the wire which was removed from the coil.

Then turn on the ignition switch and make and break the circuit with the two wires by touching their free ends together.

If no spark occurs, bring the free end of the wire attached to the negative terminal of the battery up to the switch and make and break the circuit by touching the screw on the back of the switch marked "Bat."

If a spark is given off, then the wire from the switch to the coil is broken or faulty and should be replaced. If no spark is given off, there is doubtless an open circuit in the interior.

WIRING DIAGRAMS

Wiring diagrams for DURANT and STAR models are shown in Figures 67 and 68

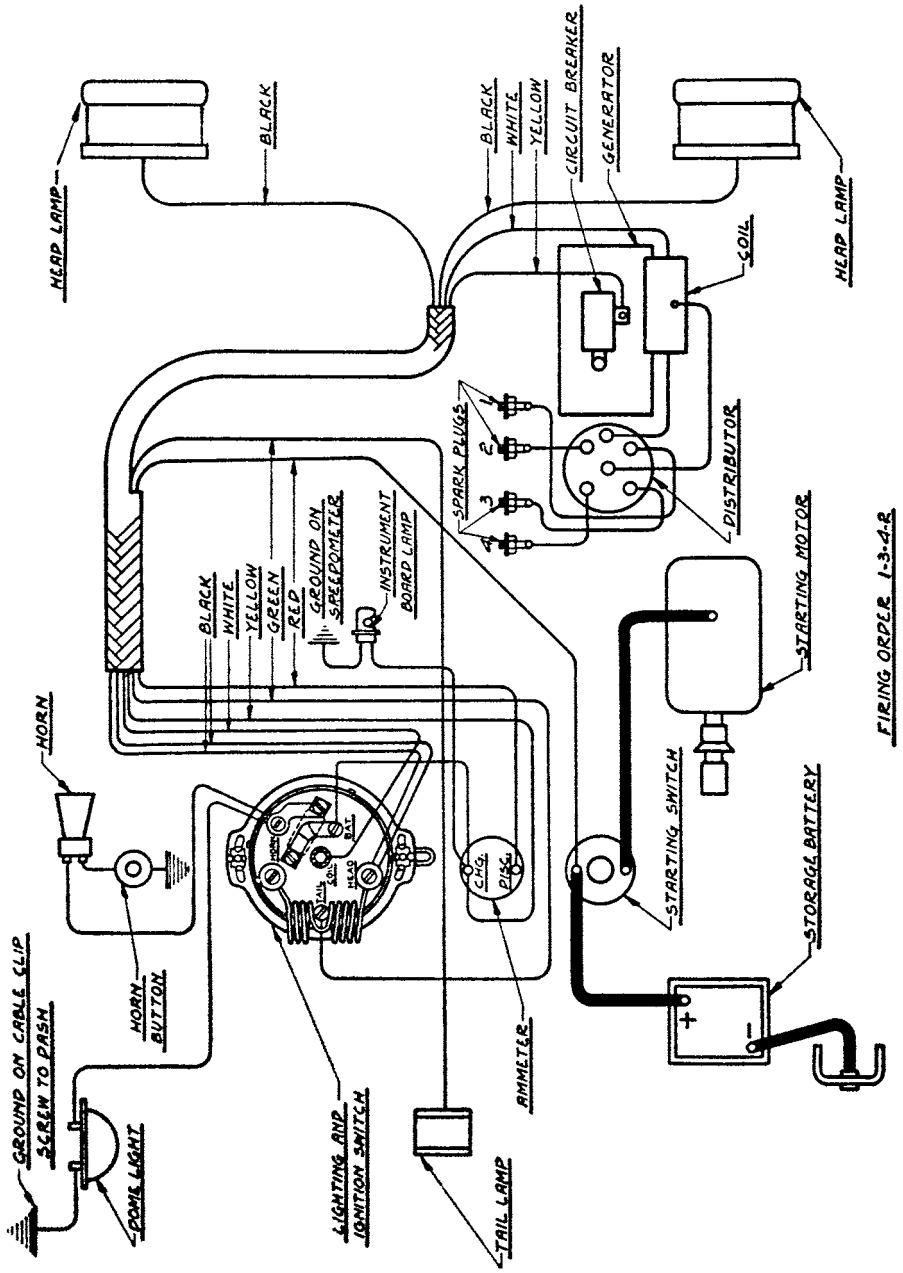

Fig. 67—Wiring Diagram—Durant and Star Passenger Car

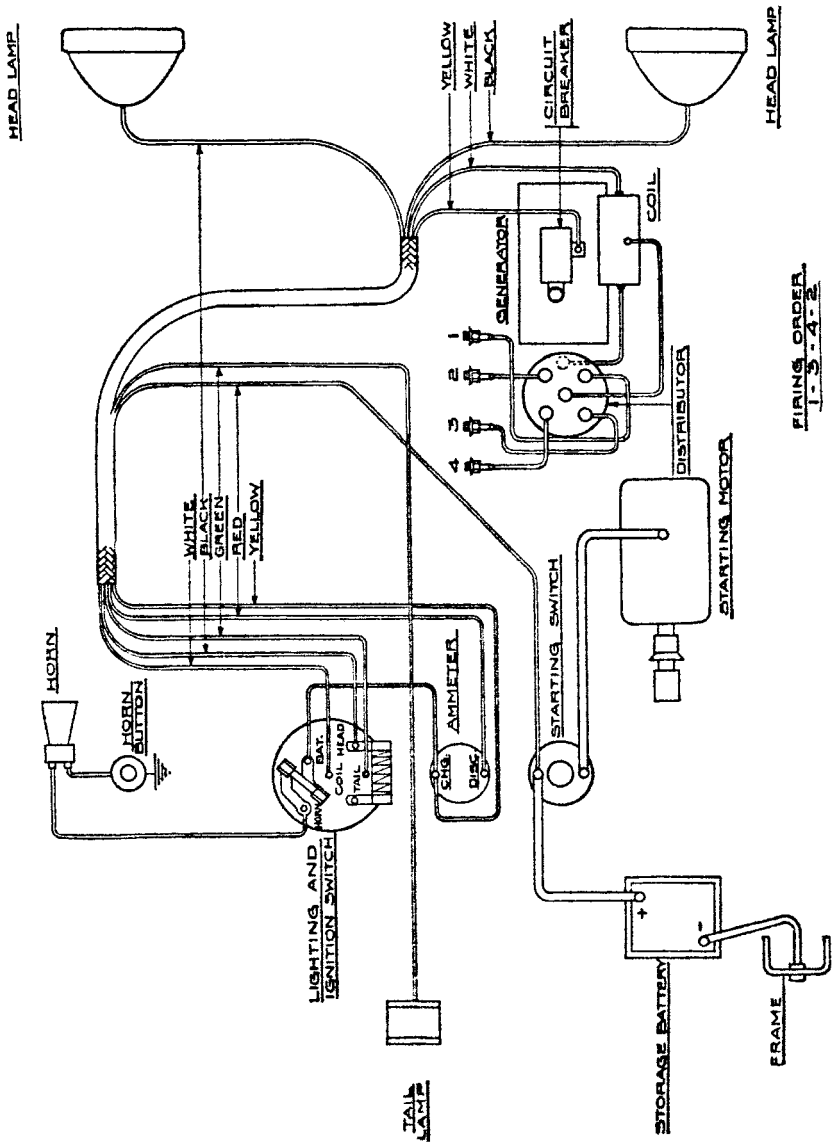

Fig. 68—Wiring Diagram (Durant and Star Commercial)

CIRCUIT BREAKER

The circuit breaker is entirely automatic and requires no lubrication or attention. If the circuit breaker is removed, the car must not be operated until a short piece of copper wire is connected between the two terminal posts on the generator.

Figure 69 illustrates the circuit breaker.

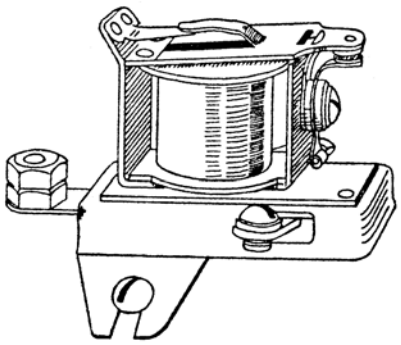

Fig. 69—Circuit Breaker

Minor repairs, such as removing the burrs and pits from the contact points, which have become burned through constant use, may be done by securing a nail file. This file, being perfectly flat, may, without any injurious effect be placed between the contact points, and, with the movable points held lightly against the file, pull the file out. It may be necessary to repeat this operation several times in order to secure a perfectly flat and clean contact surface.

Do not move the file back and forth between the points, as this motion has a tendency to round off the edges, causing them to have a convex surface rather than a flat surface. If the points burn off entirely or if the contact spring breaks, reinstalling new parts is the only remedy. If the coil burns out on account of the excessive flow of current through it, the only remedy is to install a new circuit breaker.

It is seldom that the coil in a circuit breaker burns out. Usually a loose outside connection is the real reason why the contact points will not closest proper car speeds..

Do not condemn the circuit breaker until you are sure all outside connections are tight and that the generator is actually functioning.

The generator should cut in or start showing a charge on the ammeter between 8 and 10 miles per hour, (car speed), 15 miles per hour should show from 8 to 10 amperes, from 15 to 20 miles per hour 14 to 15 amperes, and generator should start cutting back approximately 30 miles per hour.

Due to the very resistant condition that comes through the wiring harness, circuit breaker and other parts of electrical equipment, the factory endeavors to adjust and set the generator so it will show a consistent output on every car as noted above.

If results are not obtained, as noted above, the generator third brush should be adjusted.

STARTING MOTOR

The starting motor like the generator requires little attention beyond regular oiling. (Generators equipped with graphite bearings are self-lubricating and should not he lubricated.)

It is attached to the motor base in a saddle which securely locks it in place. A dowel between the motor base and starting motor frame locates it in relation to the flywheel.

In replacing the starting motor, be sure this dowel is in its proper place and that the clamping bands are tight and square with the motor.

To the end of the armature shaft is mounted a pinion which automatically engages the toothed edge of the flywheel when the motor armature is rotated rapidly, as in starting. The armature shaft of the starting motor has an extension or sleeve provided with square threads. The pinion is also threaded and, in addition, carries an eccentric weight, which holds the pinion in the position shown in Fig. 70, with the weight underneath. Because of the weight, the pinion is too heavy to turn on the threaded extension, and because the pinion does not turn, it must move along the screw sleeve.

After the pinion has moved along the threaded sleeve, it engages the teeth on the flywheel and keeps on moving along until it reaches a stop at the end of the threaded sleeve. The pinion and the flywheel gear are then fully meshed. Fitted over the end of the armature shaft is a second sleeve, held securely to the shaft by a clamping bolt. A heavy coiled spring connects the outer sleeve with the threaded sleeve. After the pinion has reached the stop, it now must turn with the threaded sleeve; but since it is engaged with the flywheel gear, the shock of starting the engine would be very great were it not that the armature shaft is connected to the threaded sleeve through the coiled spring. Instead of picking up the load immediately, this spring keeps coiling until the torque of the starting motor overcomes the resistance of the spring and starts to revolve the flywheel.

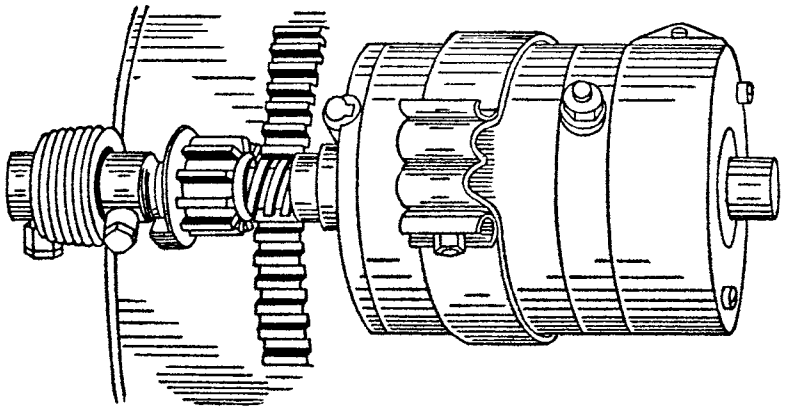

Fig. 70—Starting Motor

As soon as the gasoline engine starts under its own power, the flywheel revolves at a much higher speed than it did when the starting motor was cranking the engine. This increases the speed of the pinion, but because it is running faster than the threaded sleeve, it will be thrown out of mesh with the flywheel gear.

Should the operator of the car, through error, not immediately remove his foot from the starting butt on, the unbalanced weight of the pinion causes it to twist on the threaded sleeve and clutch the threads, preventing it from again meshing with the flywheel gear. This demeshing movement and clutching action is entirely automatic.

The coiled spring should be examined occasionally to see that it is clamped tightly and that no distortion has taken place. Should this occur, replace the spring, as this must he in good working order to prevent damage to the teeth on the flywheel gear.

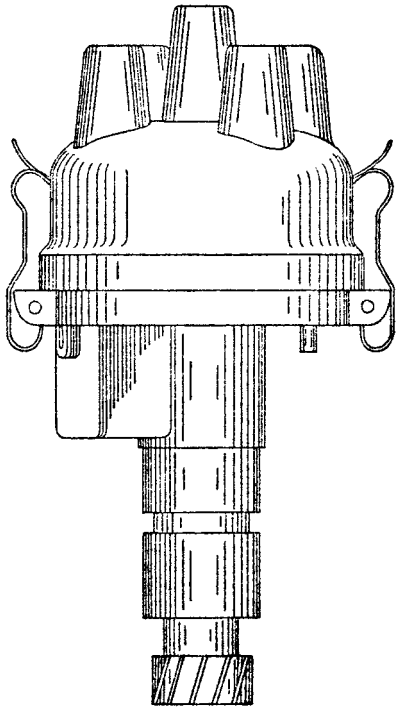

Fig. 71—Distributor

While the coiled spring absorbs much of the starting torque, the vibration of the car, coupled with the shock of starting, may cause the clamping bolts, holding the starting motor to the motor, to loosen and possibly shift the starting motor slightly, throwing the pinion out of proper alignment with the flywheel gear.

Whenever, when starting the engine, the pinion goes into mesh with a “bang,” accompanied with considerable noise while cranking, take your car to a garage and have the bolts examined and the starting motor

lined up properly. By turning the threaded sleeve with the fingers, the pinion can be moved into mesh with the flywheel gear, and any dis-alignment observed and corrected.

When resetting the motor, be sure there is between .017" and .020" clearance or back lash between the pinion and flywheel teeth.

In general, the instructions given for the care of the generator will apply as well to the starting motor. The brushes and commutator are easily accessible for examination by removing the sheet metal cover on the commutator end of the machine.

Removing Distributor

Should it become necessary to remove the distributor assembly, loosen the lock screw on the side of the distributor shaft housing, and same can be easily removed.

In replacing, care should be taken to see that the shoulder on the machine end of the distributor comes in contact with the generator support, and the lock screw fits firmly into the slot in the distributor shaft.

Retiming Distributor (Full Manual Spark Control)

Remove the valve cover and with the starting crank turn the motor over by hand until the intake valve on No. 1 cylinder begins •to open. This is the second valve from the radiator.

Continue to turn until the valve is entirely closed and there is clearance between the valve stem and valve lifter. On the rim of the flywheel is a heavy stamped line. Continue to turn the motor slowly until this line is exactly on top and in a direct line with the center of the crank shaft.

This is called the top dead center position of the compression stroke.

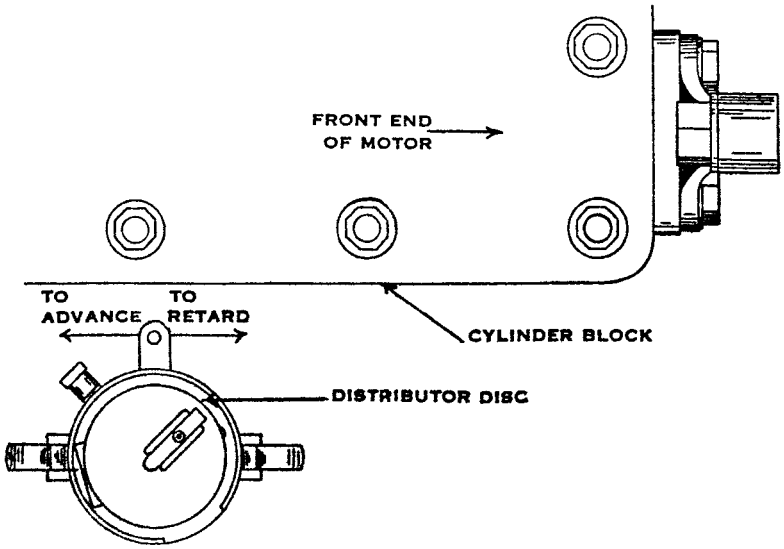

Fig. 72—Timing of Distributor (Full Manual Spark Control)

Remove the distributor cap (do not remove the disc) and set the distributor assembly into the generator housing so that the metal contact on the top of the disc inclines forward 45°, as shown in Fig 72.

Before installing the distributor, see that the spark lever on the distributor housing is moved forward as far as it will go. That is, the distributor must be in a retarded position.

Should any of the wires be removed from the distributor, their proper position can be determined by reference to the wiring diagram on Pages 91 and 92.

Retiming Distributor (Full Automatic Control)

This distributor is equipped with a full automatic spark control device which automatically times the ignition according to the speed of the engine. This renders a hand spark advance unnecessary. The initial setting at the factory is correct and should not be altered unless these parts have been removed or disturbed.

To check the timing when necessary, proceed as follows: First, remove the spark plugs from all cylinders except No. 1 cylinder (No. 1 cylinder is the one nearest the radiator) crank the engine by hand until the piston in No. 1 cylinder starts up on the compression stroke which will be when resistance is offered, then remove the spark plug in No. 1 cylinder and continue to crank the engine slowly until the fourth tooth on the flywheel ahead of the top dead center markings on the rim of the flywheel is exactly at the top and in the center of the cylinder bore or in a direct line with the center of the crankshaft.

Next, loosen the distributor cap nut before entirely removing make sure the position of the distributor arm is pointing directly to the spark plug wire leading from the top of the distributor cap to the spark plug of No. 1 cylinder. If it is not in this position, loosen vertical clamp bolt on the retainer bracket and lift the entire distributor tip Just far enough so the gears at the lower end of distributor shaft are out of mesh and then turn the distributor arm only, until it is pointing directly to the No. 1 spark plug wire. In this position the distributor cam should be just touching the breaker arm to cause the contact points to start separating or opening. To adjust if necessary loosen the clamp screw on the outside of the distributor just beneath the housing and turn the entire distributor slightly in the proper direction. Turning the distributor to the right or clock—wise retards the ignition: turning to the left or anti-clockwise advances the ignition.

After the proper adjustment is made, tighten the clamp screw, replace the distributor cap, spark plugs, etc., and the ignition timing should be correct.

IGNITION TIMING
SEMI-MANUAL SPARK CONTROL

The distributor is equipped with a semi-automatic spark control device which mechanically controls the advancing and retarding of the spark. The initial setting at die factory is correct and should not he altered unless the parts have been removed or disturbed.

To check the timing when necessary. proceed as follows: first, remove the spark plugs from all the cylinders except No. 1 cylinder (No. 1 cylinder is the one nearest to the radiator). Crank the engine by hand until the piston in No. 1 cylinder starts up on the compression stroke, which will be when resistance is offered; then remove the spark plug in No. 1 cylinder and continue to crank the engine slowly until the fourth tooth ahead of the dead center line on the flywheel lines up with the pointer located on the right hand side of the bell housing, which encloses the flywheel.

Next, advance the spark lever on the steering wheel to its full limit (See Fig. 1) then loosen the springs holding the distributor cap in place but before entirely removing the cap, make sure the position of the distributor arm is pointing directly to the spark plug wire leading from the top of the distributor cap to the spark plug in No. 1 cylinder. If it is not in this position, loosen vertical clamp bolt on the retainer bracket and lift the entire distributor up just far enough so the gears at the lower end of distributor shaft are out of mesh and then turn the distributor arm only, until it is pointing directly to the No. 1 spark plug wire. In this position the distributor cam should be just touching the breaker arm to cause the contact points to start separating or opening. To adjust, if necessary, loosen the clamp screw on the outside of the distributor just beneath the housing and turn the entire distributor slightly in the proper direction. Turning the distributor to the right or clockwise retards the ignition; turning to the left or anti-clockwise advances the ignition.

After the proper adjustment is made, tighten the clamp screw, replace the distributor cap. spark plugs, etc., and the ignition timing should be correct.

LOCATING ELECTRICAL TROUBLES

When the electric system gives trouble, do not jump at conclusions. Only when you have made sure that the wiring is in perfect condition, all terminals tight and connected up according to the wiring diagrams (Figs. 67-68), should trouble be looked for in the electrical instrument themselves.

A short circuit occurs when any two wires of opposite polarity come in contact at exposed places or with any metallic conductor. This will discharge the storage battery in a very short time; therefore, the greatest care should be taken to see that all connections remain tight and that the insulation of all wires is not broken or cut.

To prevent a short circuit from damaging the lights, a fuse is inserted on back of the instrument board. When this “blows,” it can be easily replaced; however, before doing so, be sure everything else in the wiring system is in good order. If the ammeter hand shows a discharge when the lights are turned off and engine idle, disconnect the positive (+) wire from the battery, and if the hand goes back to zero it shows that there is a leak or short circuit, which should be remedied at once. If the hand does not go back to zero, the needle is bent.

After satisfying yourself that the wiring is in good working order, test each of the electrical instruments.

Examine the generator brushes; see that they work freely and that the commutator is clean. Examine the circuit breaker; see that the points make contact; if not, close them with your fingers. If the ammeter registers "charge" with the engine running at fair speed, remove the circuit breaker and repair as instructed.

Examine the ammeter. With the lights turned on and engine idle, the ammeter hand should register "discharge." If it stands at zero, remove the ammeter and return to the manufactures for repair.

Examine the storage battery. See that the solution in each cell covers the plates, and add distilled water if it does not. See that the top of the battery is clean and terminals tight. In case of leakage of the electrolyte in one or more cells, take your battery to the nearest battery service station for examination and replacements.

It should be remembered that the efficiency of any storage battery decreases with a drop in temperature, and for that reason the starting motor and lights should be used sparingly in cold weather and the engine run for several minutes at good speed after each start.

Misfiring

Figure 73 shows the proper method to locate the particular cylinder which misfires.

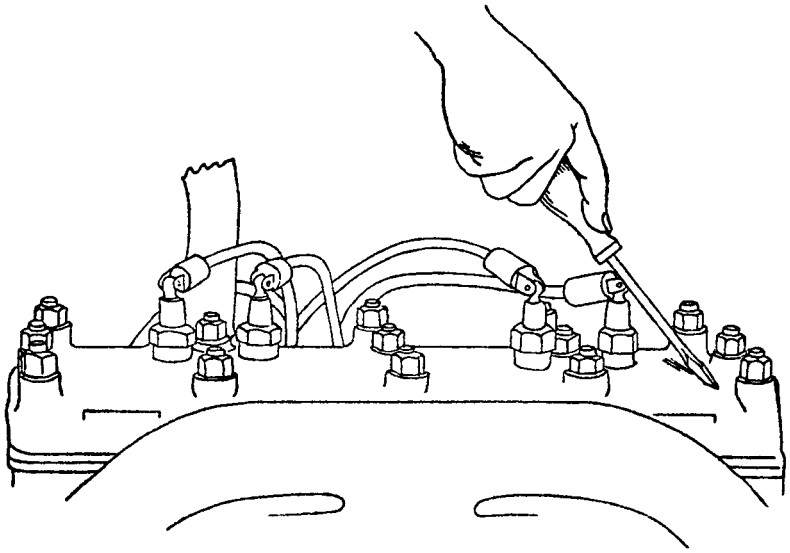

Fig. 73—Short-Circuiting Spark Plug

With the motor running, hold a wooden-handled screwdriver so that the metal edge touches the spark plug terminal and then comes in contact with the cylinder head.

If a change in the running of the motor is noticed, that particular cylinder is running properly. If no change, however, is noticed, either the spark plug or the spark plug wire is at fault.

Remove the spark plug, and, if it is fouled with carbon, clean with gasoline and a brush.

If the porcelain insulation of the spark plug is broken, a complete new plug must be installed.

Trouble may also be caused by the spark plug points being too far apart. The proper spark gap is .027", or slightly less than 1/32".

The spark gap may be changed by exerting a slight pressure upon the two points and carefully forcing them closer together; or may be increased by inserting the blade of a knife, which will separate the points the desired distance.

The sparking points or electrodes may have become burned to such an extent as to increase the resistance of the electric current. If this is true, the best remedy is to renew the plug.

Another method of determining the working qualities of the spark plug is to interchange the plugs which you know are good with those which appear to be poor, and by the process of elimination weed out the inferior plugs.

The trouble may be with the spark plug wire. Disconnect it from the spark plug and hold the end about 34" from the plug. If no spark jumps across the gap with the motor running, examine the terminals and insulation. Frequently the stranded copper wires break, which will cause an open circuit and which is very difficult to discover.

If no exterior damage can be found, procure another piece of wire, fasten one end to the igniter cap and hold the other end near the spark plug. With the motor running, if a spark jumps across the gap, a new spark plug wire should be installed.

Distributor

If trouble is suspected with the distributor, see if a spark is delivered to the plugs. Failing to get a spark at the plugs, disconnect the high tension wire (running from the central terminal of the distributor to the coil) from the coil (Fig. 74), and hold it within 54" from the point from which it was removed.

Turn the motor over by hand with the ignition switch "turned on." If no spark occurs at this point, first examine the wire to see that it is in good condition and that it is properly secured to the distributor cap.

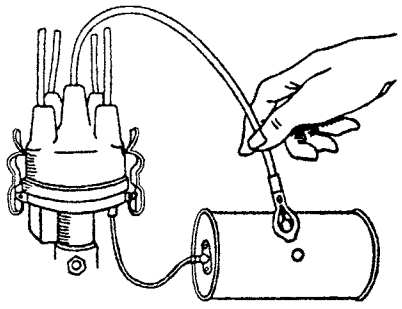

Fig. 74—Testing Distributor

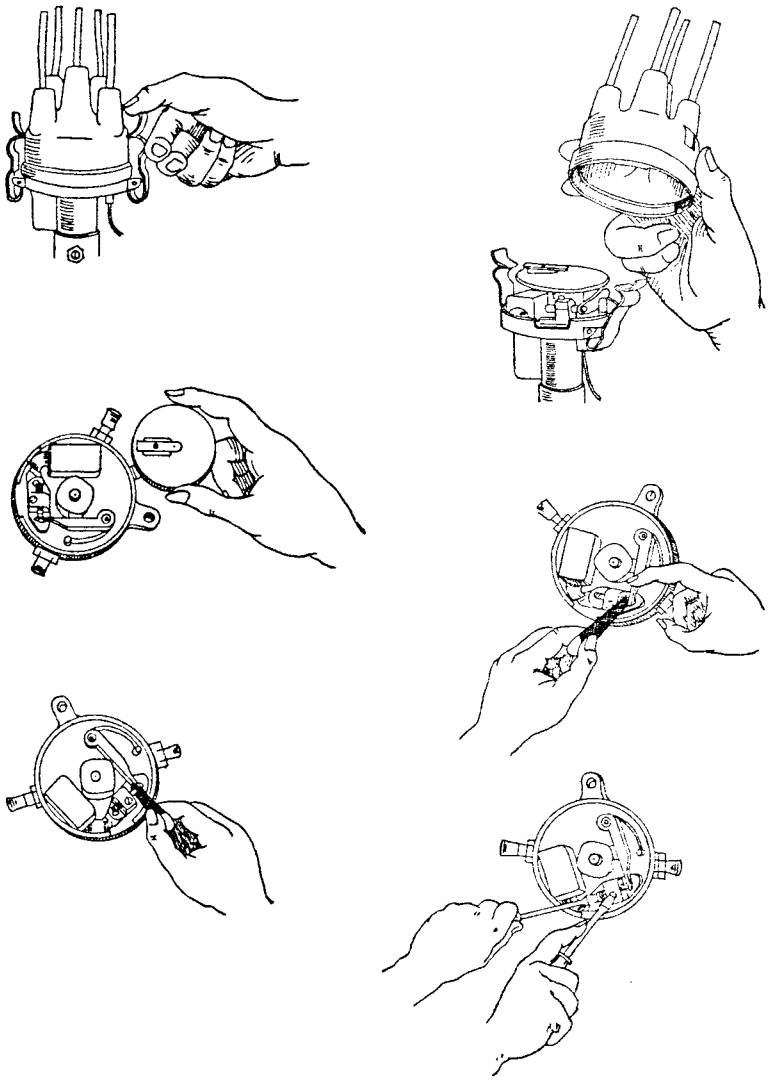

Fig. 75—Distributor, Showing Head Removed; How to File and Adjust Contact Points

After satisfying yourself that this is the proper shape, take the distributor cap off the distributor and examine the small spring on the distributor disc (Fig. 75). See that this is not broken and that it is making good contact with the high-tension terminal. If this part of the assembly is in good condition, some ground exists in the breaker box.

Examine the primary wire; see that the insulation is good and that it is properly fastened to the distributor. Occasionally oil or grease will

get into the breaker box and form a connection between the case and the insulated contact point. Wipe out thoroughly.

Contact Points

The contact points will require little attention or refiling, even though they may be very rough and irregular. When they become so badly burned as to cause missing, they should be "trued" so that their contact surfaces are exactly parallel. The best way to do this is to secure a thin Swiss jewelers, or nail file, insert the blade between the contact points, then press them together firmly with the fingers (Fig. 75), at the same time withdrawing the file. Repeat this operation two or three times, then adjust the contact points so that when the cam holds them open the space between is .020".

Caution: The contact points are made from thin discs of tungsten welded to alloy buttons, so care must be taken to remove only enough metal (when trueing points) to get parallel surfaces. When the tungsten has been removed by reason of frequent refiling, a new adjustable screw and contact arm should be secured.

STORAGE BATTERY

The storage battery is the heart of the electric system. It is a reservoir into which the electrical energy made by the generator is stored for ignition, lighting and cranking the motor.

A storage battery is an electro-chemical device entirely different from the mechanical parts of the car. Its life depends on the care which it receives and the kind of service demanded from it.

A battery possesses three compartments or cells. Within each cell are two elements, one positive (+), and the other negative (-). Each element consists of a number of plates called "grids," the openings of which are filled with a lead paste. Each group of plates is connected together and separated from the opposite group by wooden separators between each plate.

The liquid in which these plates are immersed is called electrolyte, and is composed of diluted sulphuric acid.

The passage of current from the generator through the positive and negative elements of the battery arouses a definite chemical action, separating the lead paste into its several component parts. When the battery is fully charged, this composition is soft or spongy.

The chemical action of a battery while undergoing a charge emits a fine spray, called "gassing," composed principally of water. Therefore it is absolutely essential that distilled water he added every two weeks.

At the top of each cell is a vent hole or opening accessible by unscrewing the vent cover. These vents are for the purpose of inspection, adding water, and reading the specific gravity of the electrolyte.

Immediately upon receipt of a battery or a new automobile the battery should he inspected. This requires but a few minutes, and may prevent trouble. All vent covers should be removed, and the level of the solution in each cell ascertained.

The battery plates should he well covered with solution; if not, add distilled water.

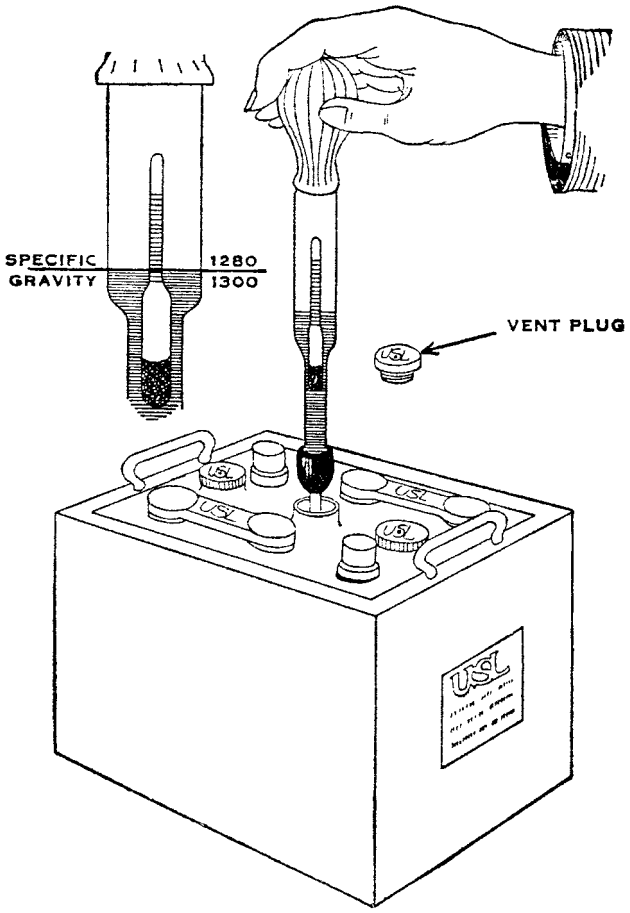

Fig.76—Storage Battery

Filling one cell does not fill all, so examine each one and fill as required. If inconvenient to obtain distilled water, use melted artificial ice or rain water that has been caught in a wooden tub (not metal). Under no circumstances use ordinary water. Do not store water for batteries in metallic vessels—use glass. Remember that if the battery plates are exposed (not covered by the liquid), they become hardened and the battery capacity is greatly reduced.

Never add acid, except to replace spilled solution. In that case, one part of chemically pure sulphuric acid and three parts of pure distilled water by volume.

Proper Battery Care

Keep all cells filled with distilled water to a level ½" above the top of the plates. Never fill above this level.

Keep the battery and the battery compartment clean and dry.

Keep the terminals clean and tight and well covered with vaseline to prevent corrosion.

Never allow the battery to become heated in service above 100° F. Watch the battery for heating one or more times every day in warm weather. If the top connectors feel more than blood-warm to the touch, burn all the lamps while driving, until you can consult a U. S. L. Service Station, which will prescribe what is necessary. If the temperature reaches 120°' F., the battery may be ruined.

In order to prevent freezing in cold weather, test the battery frequently and see that the gravity is kept up to at least 1.275. A discharged battery will freeze at a little below the freezing point.

When filling, if one cell takes considerably more water than the others, this indicates a leaky jar and the battery should be taken or sent to a U. S. L. Service Station. Unless repaired immediately, the battery may be ruined.

If you lay up your car, the battery should be removed and placed in storage with a U. S. L. Service Station, who will issue a receipt for it.

A battery will slowly discharge when standing idle. Serious injury will result if it is not kept charged, and it is not practical to do this by running the engine when the car is not in use.

U. S. L. SERVICE POLICY

U. S. Light & Heat Corporation guarantees batteries of its manufacture to be free from defects in material or workmanship and insures the service of such batteries under the following service and adjustment policies:

Initial Test

The purchaser of a new car should immediately drive his car to the nearest U. S. L. Service Station for initial test. This test, which covers complete inspection of the battery and its relation to the electrical system, will be made without cost to the owner.

90-Day Free Service Period

During the first ninety days of service, if repairs to the battery are necessary, such repairs till be made by any U. S. L. Service Station without cost to the owner, unless it is apparent that such repairs are made necessary by neglect or abuse. It is, of course, understood that the owner will be expected to pay for any necessary recharging.

The battery should be inspected and distilled water added, if required, at least twice monthly in summer and monthly in winter. The owner may inspect and fill his battery, if desired, in accordance with the instructions in his car instruction book or the U. S. L. battery instruction book, or this service may be performed by the U. S. L. Service Station.

Fifteen Months' Guaranteed Adjustment Plan

After the expiration of the ninety-day free service period, but within fifteen months of the date indicated in code on the number plate of the

battery, the owner will, in case of battery failure, have the option of paying for necessary repairs or of obtaining at any U. S. L. Service Station a new U. S. L. battery in exchange at a price, f. o. b. factory, equal to one-fifteenth of the list price for every month of the fifteen months guaranteed adjustment period which has elapsed.

U. S. Light & Heat Corporation,

Niagara Falls, N. Y.

CHAPTER IV

GENERAL LUBRICATION

MOTOR LUBRICATION

The purpose of lubrication is to prevent any two pieces of metal that are working against the other from touching. This is accomplished by having a film of oil between these two metals. Upon this film of oil depends entirely the life of the bearings, cylinder walls, pistons, and, in fact, all working parts of the car. Care of the lubricating system will often eliminate a great many repairs.

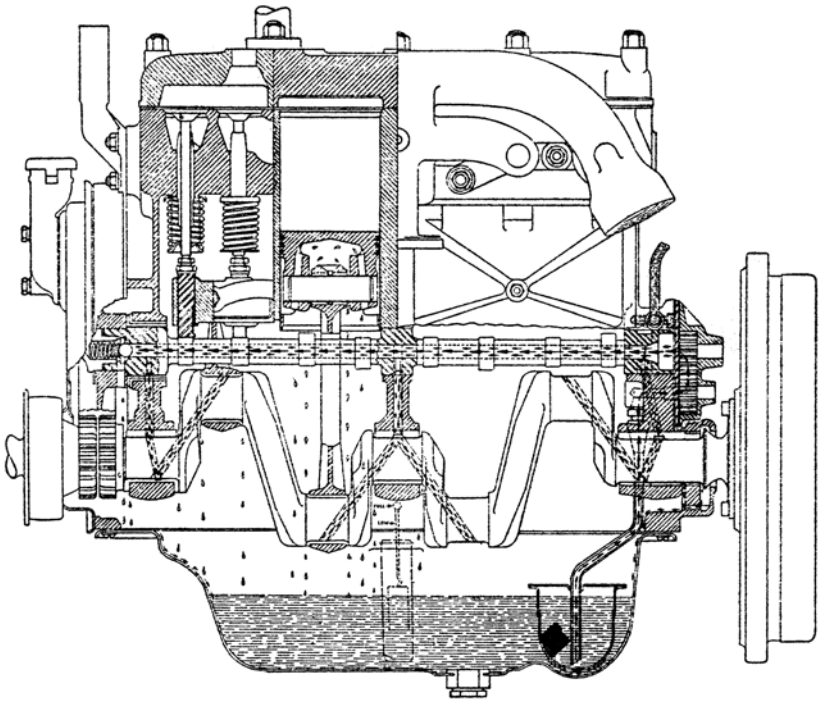

Fig. 77—Motor Oiling System

The oil system used in the DURANT and STAR motor is known as the forced feed system. The oil is carried in the reservoir, or oil basin, located at the bottom of the motor, and the oil drawn from this reservoir by a pump located at the rear end of the camshaft. It is then forced through the camshaft, which is hollow, to the three camshaft. hearings. An oil regulator is located at front end of camshaft.

To increase oil pressure, it will be necessary to remove the oil pressure nut, spring, and ball, and by either stretching the spring or putting a shim in the oil pressure nut, which is a dome-shaped nut, more tension can be given the spring, which will increase the oil pressure.

Oil is forced from the camshaft hearings to the crankshaft bearings and to connecting rod bearings through a drilled crankshaft.

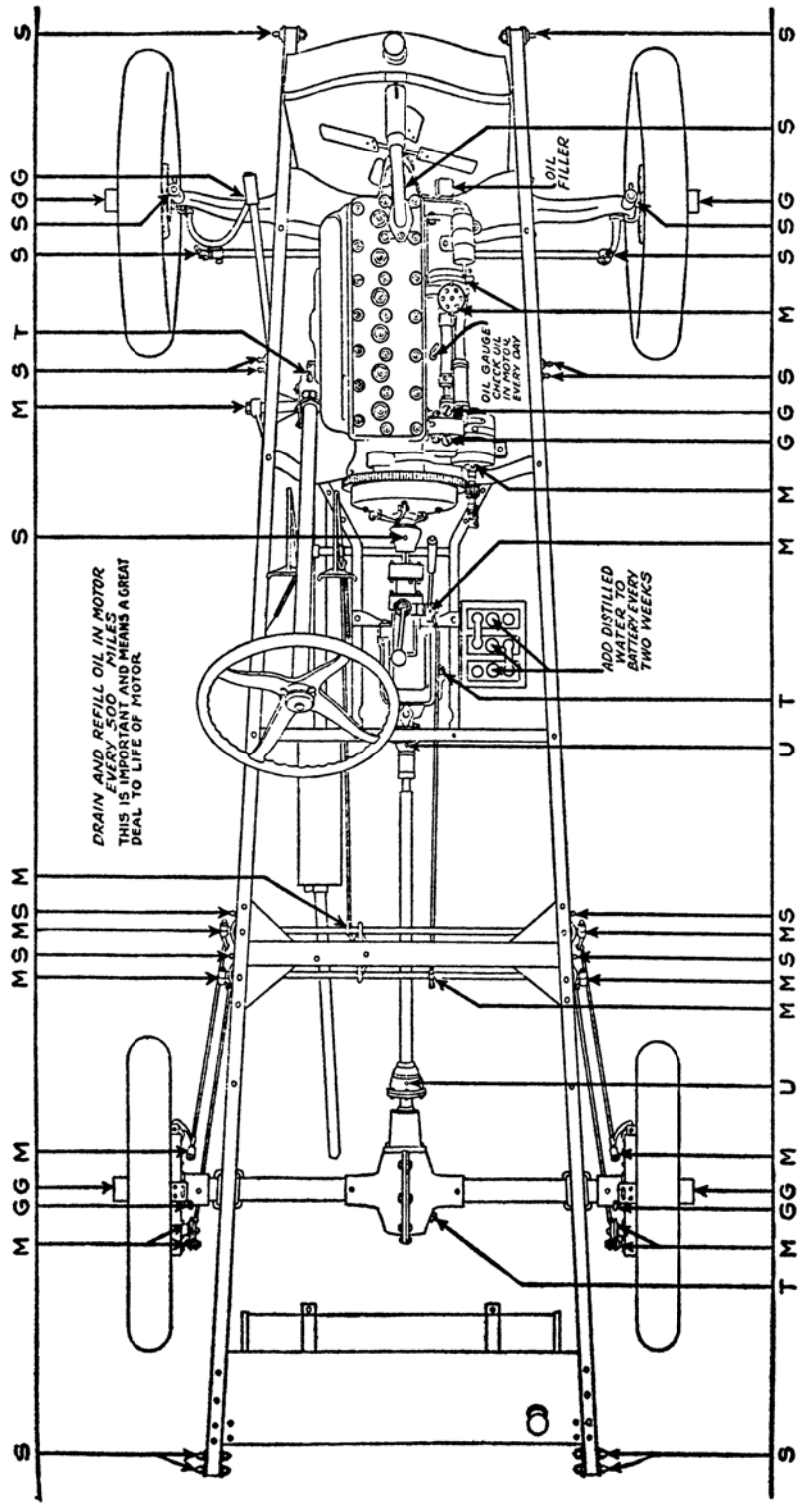

Fig. 78—Lubrication Chart (Two Wheel Brakes)

M—Lubricate every 500 miles with Motor Oil
S—Lubricate every 500 miles with 600-W Steam Cylinder Oil
G—Lubricate every 1000 miles with Grease
T—Lubricate every 2500 miles with 600-W Steam Cylinder Oil
U—Lubricate every 2500 miles with Spicer Universal Joint Grease or Dixon's No. 672 Graphite Grease

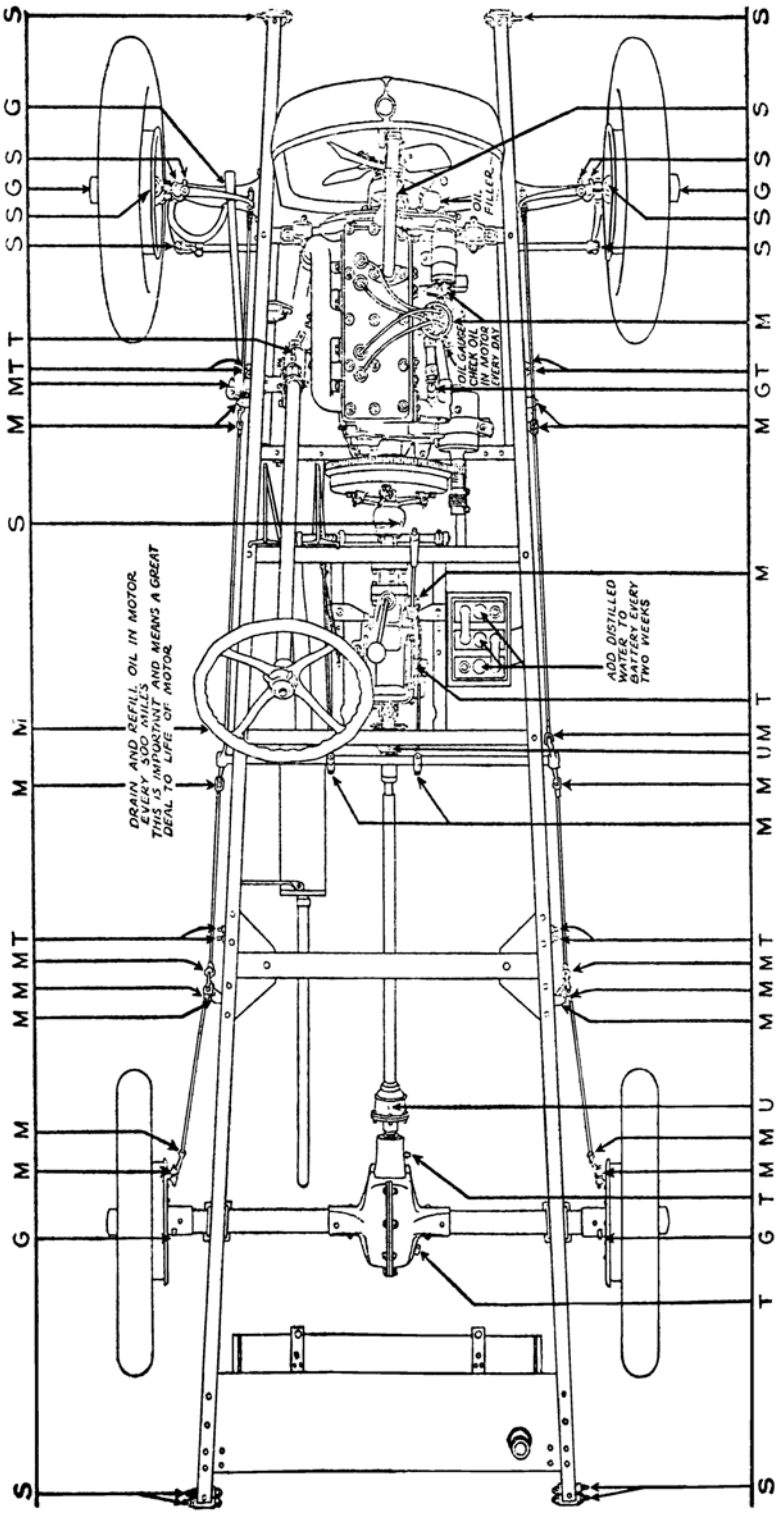

Fig. 78—Lubrication Chart (Four Wheel Brakes)

M—Lubricate every 500 miles with Motor Oil
S—Lubricate every 500 miles with 600-W Steam Cylinder Oil
G—Lubricate every 1000 miles with Grease
T—Lubricate every 2500 miles with 600-W Steam Cylinder Oil
U—Lubricate every 2500 miles with Spicer Universal Joint Grease or Dixon's No. 672 Graphite Grease

The capacity of the oil reservoir is four quarts.

Midway of the cylinder block in a recessed place you will find a small rod or plunger. This is the motor oil gauge, and when the proper amount of oil is in the motor, the rod will extend to the high step cast in the recess.

When oil in motor is drained, and fresh oil installed, always see that oil pressure is shown on the oil gauge mounted on the instrument board.

If no pressure is shown, it is necessary to prime the oil pump by disconnecting the oil pressure pipe at the motor end and injecting sufficient oil to start the pump working.

The old motor oil should be removed at the end of each 500 miles and fresh oil put in. It is impossible to prevent oil dilution and the above is the only way to insure proper lubrication.

Transmission Lubrication

The transmission should be inspected for oil at least once every month.

Hard grease or cup grease should not be used either in the transmission or rear axle, as gears will have a tendency to cut a channel or path through grease of this nature, and lubrication will not be provided for the working parts.

An oil of the consistency of the 600-W should be used.

On the right side of the transmission is a pipe plug which can be removed to allow filling of transmission. This also acts as an oil level, and oil should be supplied to bring same up to this point.

Every 2500 miles the oil in the transmission should be drained by removing plug provided for this purpose, and the housing cleaned with gasoline, and new oil provided.

In the winter months an equal amount of motor oil should be mixed with 600-W oil. Heavy oils become stiff from cold and it is necessary to thin them to secure proper lubrication.

Clutch Release Bearing Lubrication

The clutch release bearing is mounted in an oil chamber, which operates the three (3) clutch throw-out arms. Chamber is provided with a pipe plug which can be removed and oil injected.

This should be lubricated every 500 miles.

6007W oil is recommended for summer use and a lighter oil for the winter. Chamber holds 11/2 ounces of oil to the shaft hole level.

Rear Axle

The rear axle is equipped with a pipe plug installed in the rear axle housing, which also acts as an oil level.

Hard grease or cup grease should not be used in the rear axle as the gears will have a tendency to cut a channel or path in the grease, and the working parts will not receive sufficient lubrication.

600-W oil is recommended for the rear axle.

In the winter mouths an equal amount of motor oil should he mixed with 600-W oil. Heavy oils become stiff from cold and it is necessary to thin them to secure proper lubrication.

Every 2500 miles the oil in the rear axle should be drained and fresh oil put in.

Rear Wheel Bearings

The rear wheel bearings are lubricated by Alemite fittings located at lower rear side of rear axle housing into which cup grease should be installed every 1000 miles.

Universal Joint

The universal joints at the transmission and rear axle end are equipped with pipe plugs which can he removed, and the universal joints lubricated.

The lubrication of these two joints should he done every 2500 miles.

Spicer Universal Joint Grease or Dixon's Na. 672 Graphite Grease is recommended for these universal joints.

The front universal, between the clutch and transmission, on the Model "M", "M-2" and M-4" requires no lubrication.

Front Wheel Bearing Lubrication

The front wheel bearings can he lubricated by filling the huh caps with cup grease and replacing.

The front wheels should he lubricated once every month.

Oil connections are on all spring shackles, steering cross rod bolts, tie rod bolts and should be oiled weekly.

Figures 78 and 79 show DURANT and STAR car lubrication charts.

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