

*for Economical Transportation*



# INSTRUCTIONS

FOR THE OPERATION  
AND CARE OF

**CHEVROLET  
MOTOR CARS**

FOUR NINETY  
*and*  
SUPERIOR  
MODELS

*Issued January 1, 1923*

<sup>4</sup> <sup>5</sup> <sup>56</sup>  
**CHEVROLET MOTOR CO.**

Division of General Motors Corporation  
DETROIT, MICHIGAN

*for Economical Transportation*



## DIRECTIONS FOR ORDERING PARTS

When ordering parts be sure to give the model, year produced and car number for which parts are desired.

The model and car number on Model Four-Ninety will be found on the name plate attached to the dash under the instrument board.

The model and car number on Superior models will be found on the name plate attached to the front seat frame visible when the left front door is open.

If in doubt as to the name of the part needed, send the broken part to your dealer or the factory or nearest Distributing branch, attention of Parts and Service Department by **PREPAID EXPRESS**. Write your name and address plainly on the package so that it can be identified upon arrival. Write a letter the same day shipment goes forward, stating the purpose for which it is returned, **REGARDLESS OF ANY PREVIOUS CORRESPONDENCE**.

In ordering from factory or nearest Distributing branch, attention of Parts and Service Department, if possible always send cash with order because we cannot open accounts except with our regularly appointed dealers, who maintain a deposit sufficient to cover their accounts. **ORDERS NOT ACCOMPANIED BY CASH WILL BE SENT C. O. D.**

In ordering parts by telegram, be sure the message is **PREPAID**. **COLLECT MESSAGES WILL NOT BE ACCEPTED** by this company. Always confirm the telegram by a regular order, marked "confirmation of telegram," through the mail.

All Chevrolet dealers carry a stock of such parts as are needed most frequently; therefore, delays can be avoided by ordering from your nearest dealer or from the Factory or Branch listed below which is nearest to you.

## FACTORIES AND BRANCHES

### FACTORIES

Flint, Mich.  
St. Louis, Mo.

Janesville, Wis.

Tarrytown, N. Y.  
Oakland, Cal.

### BRANCHES

Cincinnati, Ohio  
Minneapolis, Minn.  
Kansas City, Mo.  
Fort Worth, Texas  
Denver, Colo.

Atlanta, Ga.  
Chicago, Ill.  
Buffalo, N. Y.  
Pittsburgh, Pa.  
Baltimore, Md.

### WHOLESALE OFFICES

Philadelphia, Pa.  
Des Moines, Ia.  
Los Angeles, Cal.

Charlotte, N. C.  
Memphis, Tenn.  
Portland, Ore.

**Important Notice. SEND PARTS ORDERS to Factory or Branch. Wholesale Offices do not carry a Parts Stock.**

## STANDARD WARRANTY

Approved as to Form by National Automobile Chamber of  
Commerce, Inc.

We warrant each new motor vehicle manufactured by us to be free from defects in material and workmanship 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 within ninety (90) days after delivery of such vehicle to the original purchaser be returned to us with 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, and we neither assume nor authorize any other person to assume for us any other liability in connection with the sale of our vehicles.

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

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, nor which has been subjected 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.

CHEVROLET MOTOR COMPANY.

### IMPORTANT NOTICE

It is understood and agreed that our Standard Warranty is null and void on any Chevrolet Model where parts not made or sold by us are used in any replacements or otherwise.

## MISCELLANEOUS DATA

The following information may be useful in securing license and insurance.

### **Serial Number:—**

The Serial Number on Superior Model will be found stamped on a small metal plate located on the left side of the front seat frame visible when the left front door is open.

The Serial Number on the Model Four-Ninety will be found on a small metal plate attached to the dash under the instrument board.

### **Motor Number:—**

The Motor Number is stamped on the smooth rim of flywheel back of the starter teeth.

### **Wheel Base:—**

The wheel base is 103 inches.

### **Tread:—**

The tread is standard, 56 inches.

### **Wheels and Tires:—**

All cars are equipped with 30 x 3½" wheels and tires. The closed cars use a straight side cord and the open cars a clincher fabric tire.

### **Engine:—**

Number of cylinders, 4; bore, 3½"; stroke, 4"; horsepower (N. A. C. C. formula), 21.7.

### **Shipping Weight—Superior:—**

Touring, 1800 lbs.; Roadster, 1700 lbs.; Sedan, 2100 lbs.; Utility Coupe, 1900 lbs.; Sedanette, 2100 lbs.; Light Delivery, 1800 lbs.

### **Shipping Weight—Four-Ninety:—**

Touring, 1810 lbs.; Roadster, 1710 lbs.; Sedan, 2100 lbs.; Utility Coupe, 1955 lbs.; 4-pass. Coupe, 2050 lbs.; Light Delivery, 1859 lbs.

The following is a list of manufacturers supplying accessories for Chevrolet Cars, and as under the terms of our warranty these are guaranteed separately by the manufacturers, any questions as to the repair or replacement of the units may be taken up with them or their nearest service station.

**Battery:—**

Willard Storage Battery Co., Cleveland, Ohio, or authorized service stations.

Electric Storage Battery Co., Philadelphia, Pa., or authorized Exide Service Stations.

**Carburetor:—**

Zenith Carburetor Co., Detroit, Mich., or authorized service stations.

Holley Carburetor Co., Detroit, Mich., or authorized service stations.

**Circuit Breaker:—**

Electric Auto-Lite Co., Toledo, Ohio, or authorized service stations.

**Coil:—**

Remy Electric Co., Anderson, Ind., or any branch of United Motors Service, Inc.

**Generator:—**

Remy Electric Co., Anderson, Ind., or any branch of United Motors Service, Inc.

Electric Auto-Lite Co., Toledo, Ohio, or authorized service stations.

**Starting Motor and Starting Switch:—**

Electric Auto-Lite Co., Toledo, Ohio, or authorized service stations.

Remy Electric Co., Anderson, Ind., or any branch of United Motors Service, Inc.

**Distributor:—**

Remy Electric Co., Anderson, Ind., or any branch of United Motors Service, Inc.

**Rims:—**

Jaxon Steel Products Co., Jackson, Mich., or any branch of United Motors Service, Inc.

**Speedometer:—**

Stewart-Warner Corporation, Chicago, Ill., or authorized service stations.

**Tires:—**

Goodyear Tire & Rubber Co., Akron, Ohio.

Goodrich Rubber Co., Akron, Ohio.



(15)

**HOW TO SECURE PROMPT CHEVROLET SERVICE**

- ★ INDICATES THE LOCATION OF CHEVROLET FACTORIES OR DISTRIBUTING BRANCHES WHERE A COMPLETE STOCK OF PARTS FOR ALL CHEVROLET CARS IS CARRIED. EACH FACTORY OR BRANCH CONTROLS THE SURROUNDING TERRITORY.
  - INDICATES WHOLESALE OFFICES. NO PARTS STOCK CARRIED AT THESE OFFICES.
- EACH FACTORY OR BRANCH IS PREPARED TO MAKE PROMPT SHIPMENT TO ANY POINT WITHIN ITS TERRITORY. WHEN ORDERING PARTS OR CORRESPONDING REGARDING OUR CARS, PLEASE ADDRESS FACTORY OR BRANCH CONTROLLING TERRITORY IN WHICH YOU RESIDE.





## WHAT TO DO UPON RECEIVING THE CAR

Chevrolet Four-Ninety and Superior cars are shipped from the factory properly adjusted, with lubricant in all parts needing lubrication. The fuel system is drained. Our dealers inspect the car to insure themselves that it is in perfect running order for delivery to the purchaser. However, when putting a new car or one that has been in storage into service, the owner should satisfy himself that the cooling system is filled with clean water, the fuel tank with a good grade gasoline and that the motor oil reservoir contains a sufficient amount of cylinder oil.

On the left side of the oil reservoir are two pet cocks. (Fig. 1.) Open the upper pet cock by turning the valve handle so that its face is parallel with the outlet and then pour a good grade of cylinder oil into the oil filler pipe until the oil begins to drip from the upper pet cock. Do not put more oil into the reservoir than is required, as the level of oil is predetermined to give best results and any over-filling will simply mean increased consumption, smoking and carbonization. The lower of the two pet cocks is for draining off old oil. Occasionally mud or dirt will stop up the openings in the pet cocks, so to avoid over-filling open the valve and insert a wire into the opening to clean it.

See that the tires are inflated properly (air pressure should be

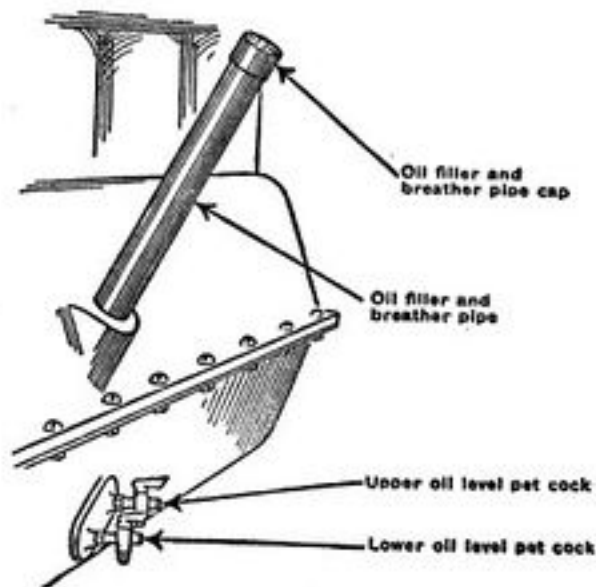


Fig. 1—Oil gauge and filler pipe.

about twenty pounds per inch of tire diameter), remove the caps on all grease cups and see that they are full. Raise the hood and examine the wiring—see that the terminals are tight upon the spark plugs, that no dirt or water covers the coil or ignition system, in short, see that all parts of the motor are clean and free from surplus oil or dirt. Make it your business thereafter, during the life of the car, to keep it in this condition and you will be sure of securing the maximum of service from it.

## MOTOR

### HOW THE MOTOR OPERATES

The power of the motor is produced by burning or exploding charges of gas in the cylinders above the pistons, the resulting pressure forcing the pistons down.

The pistons are connected with the crank shaft by means of connecting rods and as they move up and down, turn the crank shaft around in a clockwise direction, viewed from front of the car. At the rear end of the crank shaft is a heavy fly wheel in which the clutch engages and transmits the power to the rear wheels through the transmission or gear set.

In the four cycle motor, of which the Chevrolet is an example, it takes four strokes of the piston or two complete revolutions of the crank shaft for each explosion or working stroke in any one cylinder.

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

When the piston has reached 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 in the top of the cylinder.

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 or expansion pushes the piston downward turning the crank shaft on the third or working stroke.

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

### STARTING THE MOTOR

These few details attended to, you are ready to start the motor.

Before you can do so, however—in fact, before you can start the motor at any time—you must make certain of three things.

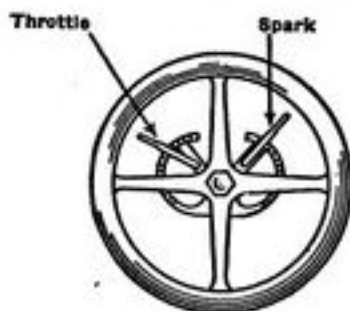


Fig. 2—Position of spark and throttle levers when starting motor.

First, that the gear shifting lever is in neutral position, that is, it should be free to move from right to left.

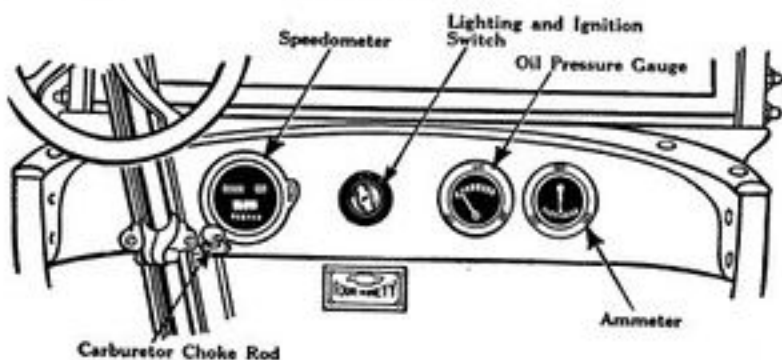


Fig. 3—Instrument Board

Second, that the spark and throttle levers are in the proper positions for starting. (Fig. 2)

Third, that the ignition switch is turned on. (Fig. 3.) To do so, insert key, press it forward slightly until it will turn, then give it one-quarter turn to right or left.

Be absolutely sure that the spark lever is properly retarded, as shown. Failure to observe this may cause serious damage to the starting equipment and subject you to unnecessary trouble and expense.

**WE WILL NOT BE RESPONSIBLE FOR SUCH DAMAGE, SO OBSERVE THIS POINT WITHOUT FAIL.**

After being absolutely sure that all THREE RULES given above have been carefully observed, start the motor.

Located on the floor boards (Fig. 4) within reach of the right foot is the starting button. Press this down as far as it will go and hold it until the motor starts under its own power. REMOVE YOUR FOOT THE MOMENT THE MOTOR STARTS. Serious damage can be done to the starting motor unless this is watched very carefully.

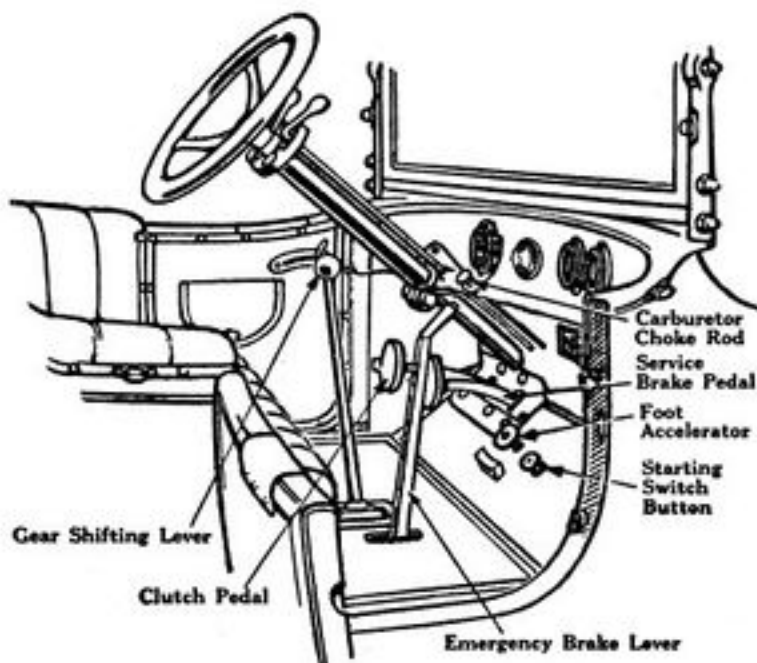


Fig. 4—Controlling Device.

Never hold the starting button down for any length of time without stopping to examine the position of the levers, switch, etc., as failure to start is generally an indication that something is wrong and a prompt investigation should be made.

Owing to the difference in specific gravity of gasoline obtainable in various localities, and also to difference in atmospheric conditions, it is sometimes necessary to feed the motor a fuel mixture rich in gasoline and poor in air. This is particularly true in cold weather when the motor has become thoroughly chilled. This is done conveniently by means of the carburetor adjusting rod located on the instrument board (Fig. 3). In very cold weather it may be necessary to pull this rod all the way out. As the motor warms up, the rod may be pushed inward again until, when the engine is running smoothly, being warmed up to the temperature of best efficiency, the rod should again be returned to its original position. The carburetor, before leaving the factory, has been adjusted so that the motor

will run at its best efficiency with the least gasoline consumption, therefore always see that as soon as the motor warms up to the proper temperature the rod is returned to its original position as quickly as possible.

A mixture which is "rich" in gasoline heats up the motor, causing lubrication troubles, with the consequent danger of "scoring," besides being wasteful of fuel.

#### MOTOR STARTED

It is not a good thing to let the motor "race" idle (run at considerable speed). Therefore, you should now "retard" the THROTTLE LEVER, thereby cutting down the gas supply. AT THE SAME TIME ADVANCE THE SPARK LEVER until both have the position indicated in Fig. 5.

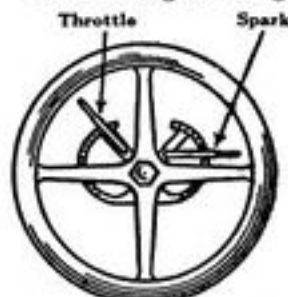


Fig. 5—Position of spark and throttle levers when motor is running idle.

It is best to retard the throttle lever until the motor turns very slowly, just fast enough to maintain its operation.

For the novice it is well to try the motor-controlling devices with the car standing still—advancing and retarding the spark, opening and closing the throttle. In this way a fair idea may be gained of the effect of these controlling devices on the action of the motor.

When the car is being operated at a speed greater than fifteen (15) miles an hour, the spark lever should be advanced to the fullest extent. This brings the spark in the cylinder at the proper time to ignite the charge when it will be most effective. This places the spark in the cylinders a trifle in advance of the time when the piston reaches the top of the compression stroke, but it is necessary, as there is a certain lapse of time after the spark crosses the point of the plug before the gas is fully ignited. The full amount of the pressure is then brought to bear on the piston as it is ready to start on the downward or power stroke. By operating the spark in the retarded position, when the car is traveling along at some speed, the motor runs hot as the late explosion develops considerably more heat.

When the motor is laboring in sandy roads or on a hill at low speed, the spark lever should be retarded just enough to prevent the motor from having an ignition knock. This knock is brought about by the explosion or expansion taking place in the top of the cylinder before the piston has reached the top of the

compression stroke. The motor will develop its maximum power when the spark lever is operated in such a manner so as to ignite the gas at the moment the piston is ready to go downward on the power stroke.

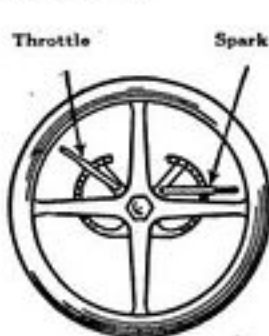


Fig. 6 — Position of spark and throttle levers—car in motion.

The accelerator pedal is located to the right of the service brake pedal. Pressing down upon this pedal causes the motor to be speeded up or "accelerated." When pressure is released a spring returns it to its normal position. The hand throttle lever and the accelerator pedal are interconnected. Advancing or retarding the hand throttle lever will move the accelerator pedal down or up, but pressing the accelerator pedal down will not actuate the hand throttle lever. It is possible, therefore, to set the hand throttle lever for any desired minimum speed so that when pressure is removed from the accelerator pedal the motor will not stop, but will drop to the minimum speed which you have selected. This arrangement gives greater freedom to the operator's hands, especially when it is necessary to shut off power when going around bad spots in the road, approaching turns or in passing other vehicles.

The hand throttle is used in starting the motor and in touring as an occasional relief to rest the foot at times when the car is run considerable distances without material changes in its speed.

#### PUTTING THE CAR IN MOTION

When you are seated behind the steering wheel in the car, you have at your right hand a vertical lever moving in a ball and socket called the GEAR SHIFTING LEVER (Fig. 4). This lever controls the various speeds of the car.

The motor is still idling along slowly and the gear shifting lever is still in the neutral position (vertical and free to move to right or left).

You are now going to set the car in motion on the first or low speed.

First, ADVANCE THE SPARK AND THROTTLE LEVERS to the position indicated in Fig. 6. The motor speed will be increased.

Second, PUSH DOWN ON THE CLUTCH PEDAL, the one under your left foot (Fig. 4).

Third, move the gear shifting lever from the neutral position into first or low-speed position by moving it first to the left as far as it will go, and then backwards as shown in Fig. 7.

#### ACCELERATOR

The accelerator pedal is located to the right of the service brake pedal. Pressing down upon this pedal causes the motor to be speeded up or "accelerated." When pressure is released a spring returns it to its normal position. The hand throttle lever and the accelerator pedal are interconnected. Advancing or retarding the hand throttle lever will move the accelerator pedal down or up, but pressing the accelerator pedal down will not actuate the hand throttle lever. It is possible, therefore, to set the hand throttle lever for any

desired minimum speed so that when pressure is removed from the accelerator pedal the motor will not stop, but will drop to the minimum speed which you have selected. This arrangement gives greater freedom to the operator's hands, especially when it is necessary to shut off power when going around bad spots in the road, approaching turns or in passing other vehicles.

The hand throttle is used in starting the motor and in touring as an occasional relief to rest the foot at times when the car is run considerable distances without material changes in its speed.

In moving the gear-shifting lever be sure to avoid the left-hand front or reverse position.

While you have been moving the gear-shifting lever you have kept the clutch pedal pressed down with the left foot.

Now let it come up, not suddenly, but gradually and smoothly, little by little, until the car moves slowly ahead. A little practice will soon show the proper clutch manipulation.

Remember, letting the clutch in suddenly is not only unpleasant to the occupants of the car, but **VERY INJURIOUS** to the entire mechanism.

Since you are in first or low speed your motor will run comparatively fast, but your car will travel slowly. Do not permit your motor to "race" at this stage.

Be in no hurry to change into a higher speed, but let the car gain some momentum. If you are a novice run along for some distance on the first speed to get the "feel" and to gain the confidence of handling.

After the car has gained sufficient momentum, prepare for changing to second speed.

Speed the car up just a little by opening the throttle.

Release the clutch by depressing the clutch pedal, the one under your **LEFT** foot, and while the car retains its slightly increased speed, and while you **KEEP THE CLUTCH RELEASED**, move the gear-shifting lever forward to neutral, thence to the right and right-front position. (Fig. 6A).

Now, let the clutch pedal come back easily as before, and at the same time advance the spark and throttle levers slightly.

Allow the car to gain some speed (do not permit the motor to race), then prepare for changing to high or third speed.

Release the clutch as before and, while the clutch pedal is depressed, pull the gear-shifting lever straight back into the right-rear position as indicated in Fig. 6A. At the same time advance both the spark and throttle levers a little.

When you have become accustomed to changing gears, try using the accelerator pedal to "accelerate" the motor after making shifts from second to high or high to second. You will find it less awkward, besides giving greater freedom of the hands.

It is possible to move the gear shifting lever from any one position to another, only be careful:

**To keep the clutch released while moving the gear shifting lever.**

**To avoid the left front or reverse position while the car is moving.**

**To avoid "clashing" when engaging the gears.**

When the gears clash press down a little more upon the clutch pedal and wait a moment before trying again. Remember, clashing the gears burrs up the edges of the teeth, injuring them and, in time, making gear changes exceeding hard, besides necessitating

an early renewal of the gears.

Be deliberate: It is well to pause a moment or two after disengaging the gears before moving into the next speed. The fundamental requirements in every case are that the gears to be meshed shall be revolving at as nearly the same speed as possible. By waiting a moment, time is given for this to take place.

In changing to a higher gear, slow down the motor while the gears are disengaged. When changing to a lower speed, speed up the motor while the gears are disengaged.

#### STOPPING THE CAR

When you have decided that you want to make a stop, release the clutch and at the same time retard the throttle lever, or remove your foot from the accelerator pedal. Allow the car to coast for a moment or two on its own momentum, then gradually press downward on the service brake pedal, the one under your right foot, until the car comes to a stop.

By applying the pressure on the brakes gradually, and by permitting the car to coast for a distance on its own momentum, you can gauge your stop to a nicety and come to a stop exactly at the desired spot.

You must keep the clutch pedal depressed while the car is coming to rest, and **NEVER UNDER ANY CIRCUMSTANCES, TAKE PRESSURE OFF THE CLUTCH PEDAL** until after you have moved the gear shifting lever from the high speed position into the **NEUTRAL** position.

When the gear shifting lever is in neutral the transmission gears remain out of engagement, and although the pressure on the clutch pedal be now removed, the car will remain motionless although the motor continues to run.

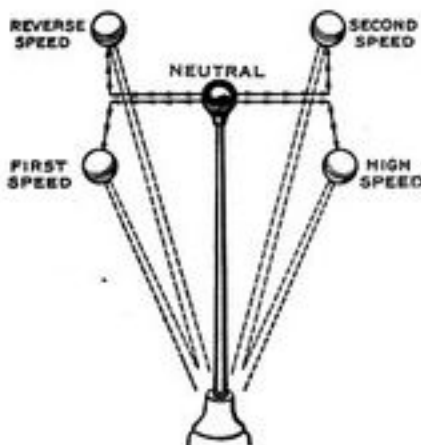


Fig. 6A—Gear shifting Lever positions.



If the stop is to be of some duration, always, before leaving the car, set the emergency brake (Figure 4) by pulling the emergency brake lever straight back towards you as far as it will go. Be sure that the pawl attached to the lever engages the tooth segment, otherwise the brake will not hold. To release the brake pull the lever towards you slightly. This causes the pawl to disengage more easily from the toothed segment then the lever can be pushed forward into its original position. Be sure the lever has been pushed forward as far as it will go, otherwise your brake may partially "set," using up power besides wearing out the brake linings.

To stop the motor turn the ignition key to the right or left one-quarter turn and remove it from the switch.

It is also good practice to turn the steering gear so that the wheels "turn in" toward the curb or side of the road. Should the brake, for any reason, be released, this will prevent the car from starting on a "wild plunge," should your stop be on a down grade.

#### REVERSING OR BACKING THE CAR

Always bring your car to a "dead" stop before attempting to back up. Failure to observe this may result in serious damage to the transmission and cause unnecessary expense. With the car at rest and the gear shifting lever in neutral release the clutch by depressing the clutch pedal and move the gear shifting lever forward into the left forward position (Fig. 6A). Now let the clutch pedal come back easily and at the same time accelerate the motor speed by opening the throttle slightly.

Remember that in moving backward the same movement of the steering wheel will cause you to turn to the right or left as it would were you going forward.

Proceed cautiously—more accidents occur when backing up than when going forward, as you cannot see clearly, so take your time, look around and make sure that you have your car under such control that a stop can be made instantly.

#### MAKING AN EMERGENCY STOP

There are times when the ability to bring the car quickly to a stop is of the greatest importance. When this occurs, release the clutch by pressing the pedal under your left foot and at the same time **PRESS DOWN HARD** on the service brake pedal, the one under your right foot. If this braking action is not sufficient to bring the car to a stop in the required time, "set" the emergency brake by pulling the emergency brake lever (Fig. 4) towards you as far as it will go. By applying both the service and emergency brakes you apply braking effect in opposite directions, which will have immediate results.

As soon as possible retard the throttle to prevent the motor "racing."

If a full stop is not desired, merely a temporary slackening of the speed, **RELEASE THE BRAKES FIRST, THEN LET THE CLUTCH PEDAL COME UP.**

If the speed of the car has been decreased to any great extent, it is advisable to shift into a lower gear. Never allow the motor to pick up a slowly moving car on high gear. The strain placed upon it is very great, and the likelihood of "stalling" the motor easily offsets the small effort necessary to change speeds.

Be considerate: the manufacturers have placed three forward speeds at your disposal, each ratio of which is designed for certain loads and conditions. Don't overload the motor; the next lower gear, while a little slower, is in the end an insurance for longer life and more efficiency.

#### **BRAKING EFFECTS**

When the brakes are applied suddenly and with full force to the wheels of a car going at a considerable speed, the braking action will be so powerful as to immediately stop the rotation of the driving wheels. But the car will not come to an immediate standstill, its momentum will carry it forward, and the locked rear wheels will slide over the ground with most destructive effect on the tires.

The best method of using the brakes is that which applies pressure on them so gradually that the forward movement of the car and the rotation of the wheels come to a stop **TOGETHER.**

Avoid spectacular stops; they are not only unnecessary, but there may also come a time when the brakes will fail. The inevitable result will be a bad smash up with its consequent danger to others.

The careful driver shuts his power off before he reaches the stopping point, and permits the car to carry him along on its momentum, bringing it, with a gradual application of the brakes, to a halt at the exact spot.

Never apply the service brake without first closing the throttle or disengaging the clutch if the car is moving at considerable speed as the braking effect would be destroyed, besides it is injurious to the mechanism. The motor can be used, however, in assisting to hold back the car when going down steep grades by leaving the clutch engaged and the transmission gears in first or second speed, as the resistance offered by the compression in the motor makes it unnecessary to apply brakes so hard that they might become overheated.

When operating the car in this manner, keep the throttle closed but do not turn off the ignition switch as a certain amount of

unburned gas would accumulate in the exhaust pipe and muffler and there is danger of bursting the muffler when the ignition switch is turned on.

### STEERING

Steering is not a difficult task. Perfection comes from confidence, as well as from knowledge. Within a short time the novice will have learned just how much of a movement on the steering wheel is required to turn a corner, pass other vehicles or obstructions.

Turning the steering wheel to the left will cause the front wheels to turn in the same direction and the car will travel to the left. Turning the steering wheel to the right causes the car to travel to the right. This applies when backing up as well as when going forward.

Proceed cautiously, preferably on a road that is little frequented and wide enough to give plenty of room for your first attempt at automobile driving.

Don't forget that after turning a corner the front wheels should be "straightened" up, otherwise you will run off the road.

### A FEW HINTS ON DRIVING

Never drive your car at high speed over any road, much less a rough or slippery one. The slight gain in time saved will not offset the liability of an accident nor the pounding and racking to which the car is subjected. Usually the time saved is unimportant when figured in dollars and cents. The resulting repair bills, which in time are sure to follow, are never unimportant.

It has been demonstrated that the motorist who drives his car at average speeds of from twenty-five to thirty-five miles per hour over all sorts of roads pays much more per mile for gasoline, oil and tires than the one who is more conservative and averages from eighteen to twenty miles per hour.

In addition, a car which is driven at high speeds all the time is in the repair shop at frequent intervals, which adds to the cost per mile of operation.

It is not a question of how many miles are covered in a given time that counts, but the number of miles of useful travel that can be obtained at the least cost for fuel, oil, tires and repairs.

In times of emergency when to stop suddenly is absolutely necessary, remember the speed at which you are traveling combined with the road surface may spell safety or disaster for you, the occupants and your car. One cannot always observe closely road surfaces when traveling at high speed; the necessity of watching the road far ahead prevents. So, avoid excessive speed is a rule to be observed.

### RULES OF THE ROAD

Road and traffic laws vary in different localities. It is, therefore, impossible to set down a complete list of rules which may be followed in all parts of the country. The following are some of the rules which are practically universal in all parts of the United States.

In meeting a vehicle going in an opposite direction **PASS TO THE RIGHT.**

In passing a vehicle going in the same direction **PASS TO THE LEFT.**

Always stop with the right side of the car next to the curb. If it is necessary to turn around to do this, it should be done.

Never turn around or turn off onto another road without making absolutely sure that there are no other vehicles behind you.

Never enter upon street car tracks without making sure that no car is directly behind you—**NO MATTER HOW SURE YOU FEEL, LOOK AND SEE.**

Do not cross street car or steam railroad tracks without making sure that it is absolutely safe to do so.

In crowded traffic do not apply the brakes suddenly unless it is absolutely necessary. It may be that the vehicle following cannot stop as quickly as you can. If this is the case, a collision is sure to result.

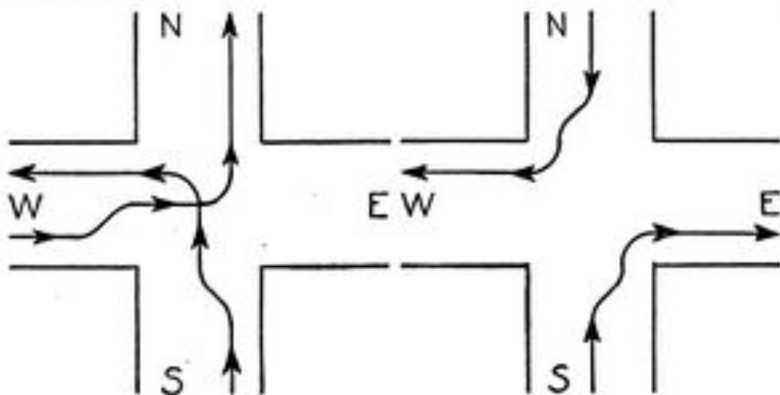


Fig. 7—Traffic diagram.

On wet asphalt streets or slippery roads do not apply the brakes suddenly unless absolutely necessary. If the brakes are applied suddenly under these conditions a bad skid is sure to result.

When you have reached a point that you intend to turn or stop, always make your intention known in advance to the **DRIVER** following.

If you are driving north and wish to turn west, or if going east and intend turning north (Fig. 7): First, pull over so that you are traveling in the center of the road **SOME DISTANCE FROM THE CROSSING**, and, second, before you begin to turn **HOLD YOUR ARM OUT IN A HORIZONTAL POSITION** so that the driver in your rear may be aware of your intention to turn. He can then pass to your right with plenty of room, and without danger of collision.

If you are driving north and wish to turn east, or if going south and intend turning west (Fig. 7): First, pull over near the curb or side of the road **SOME DISTANCE FROM THE CROSSING**, and, second, indicate your intention to the driver in your rear **BEFORE YOU BEGIN TO MAKE THE TURN**.

When you intend stopping, or, in crowded traffic, slow up, **ALWAYS** make your intention known to the driver in your rear by **HOLDING YOUR ARM** out from the side of the car in a horizontal position.

More rear-end collisions occur by neglecting to notify the driver following, that you intend stopping, or turning, than there are through carelessness on the part of the rear driver. Remember, the driver following cannot read your mind—all he can see is the rear of your car and the roadway between—he cannot see the road ahead of you, and is therefore dependent on you to prevent a collision and damage to both cars.

#### **KEEP THE MOTOR CLEAN**

Too much stress cannot be laid upon the necessity of keeping the motor clean. The dust drawn through the radiator openings as the car travels ahead contains grit, which, when wet with oil, forms a cutting compound that wears and scratches, leaving an irregular surface. This in time is sure to give trouble, so make it a rule to regularly clean all working parts. The slight inconvenience to yourself will be more than offset by the saving in repair bills later on.

#### **SUMMARY**

In order that you may get the maximum of enjoyment and comfort out of your car, you must be as considerate and thoughtful about it as you would of a fine horse that is as fine and costly as your car.

Therefore:

Do not race the motor unnecessarily.

Be warned by every abnormal noise; if a squeak, locate it and lubricate the part. If it is some other noise, locate the loose parts that cause it and tighten the bolts.

Don't tinker. Half the ability to make an adjustment or repair is the ability to discover its necessity.

Some motorists are said to have "luck" with their cars. There never seems to be any trouble, everything is trim and neat, the motor always starts when wanted and runs as long as is needed without any of the exasperating breakdowns on the road with which the unfortunate one thinks himself cursed through the carelessness of the manufacturer. With all adjustments carefully made when needed, every bearing and working part well lubricated, the whole car will work very satisfactorily and will continue to do so with only a very small fraction of the attention that would be absolutely necessary for the care of a horse.

By neglecting details you will save yourself some time and inconvenience in getting on your way; but the day of reckoning is sure to come. What you have saved may be spent in expensive roadside repairs.

## DETECTING TROUBLE

### MOTOR WILL NOT 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:

The ignition switch has not been turned on.

Gasoline supply exhausted.

Shut-off cock under gasoline tank closed (Touring car and Roadster with tank under seat). When opened the valve handle should point at right angles to bottom of tank. When closed it should point downward.

If vacuum system is used, vacuum tank may be empty due to connections on top of tank or suction line to intake manifold becoming loosened or the shut-off cock under the vacuum tank may be closed.

Filter or screen in bottom of carburetor may be clogged with sediment so gasoline cannot enter float chamber (See instructions, Page 57 on carburetors, regarding the cleaning of this screen).

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

The carburetor choke rod may not be pulled out 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. (See instructions, Page 10, covering the operation of the choke rod).

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.

The coil may be burned out.

The contact points in the distributor may not be opening or the points may be burned so badly as to remain open. (See Page 63 on adjustment of contact points).

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

Spark plugs may be fouled with oil or carbon.

Secondary wire from coil to distributor cover disconnected at coil.

#### WATER IN GASOLINE SYSTEM

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

#### MOTOR MISSES AT HIGH SPEED ONLY

There is insufficient gasoline flowing to carburetor due to obstruction in gasoline line or filter screen.

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

There may be a loose electrical connection.

The spark plug points may not be spaced properly. About  $\frac{1}{16}$  of an inch is the proper gap.

The springs on the contact arm in the distributor may be weak.

#### MOTOR MISSES AT ALL SPEEDS

Porcelain in the spark plug may be broken, allowing the spark to jump from the electrode in the center of the porcelain to the shell of the plug before entering the combustion chamber.

One or more spark plugs may be fouled. Thoroughly clean the sparking points and porcelain with cloth dipped in gasoline.

A valve may be sticking. Remove and thoroughly polish the stems. (See Page 38.)

Compression may be poor due to pitted or warped valves. (See Page 37.)

A valve spring may be broken.

Push rods may be adjusted too tight. (See Page 33.)

Valves may not be seating. (See Page 37.)

Adjustment for the push rods may have become loosened and valve is not opening.

Filter screen in carburetor clogged and gasoline not flowing to carburetor properly. (See Page 59.)

One of the ignition wires may be loose and due to vibration makes and breaks the contact.

Contact points in distributor are not opening and closing properly.

Contact points may need cleaning or filing. (See Page 63.)

The carburetor may be flooding causing the mixture to be too rich. This is usually caused by the needle valve not seating properly. To correct, remove needle valve cap, rotate valve slowly with fingers and tap lightly on top of the valve with a light hammer. 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 head, permitting air to enter, weakening the mixture. To detect the leak, take a squirt 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 or out to obtain the best low speed running adjustment.

The spark lever 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 oftentimes 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 in 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 the switch, and at any point on the reverse side of the instrument board where wires are attached, the storage battery, distributor and on the coil for loose connections, as a wire might have become detached.

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

Test the coil (See Page 28) 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 27) 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 Page 63 for retiming distributor.

Examine gasoline supply.

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

#### 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 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, then 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 which collects on top of the pistons and in the combustion chamber will sometimes become heated until it is incandescent and will ignite the incoming gas prematurely.

One of the intake valves may be sticking and not getting to its seat in time. It should be removed and the stem polished.

#### MOTOR LACKS POWER AND IS SLUGGISH

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

First—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 seat to the heat generated by the explosion, small pits or burnt spots will in time cause the surface to be so roughened as to prevent the 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 valves need 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.

Second—Worn or broken piston rings.

This is sometimes difficult to determine in advance, especially if the valves are badly carbonized and need grinding. By removing the cap from the breather tube (Fig. 1) and holding the ear to the opening you can sometimes hear the gas "blowing" by the rings. Inasmuch as the cylinder head must be removed to make replacement of rings or pistons, it is advisable to examine carefully the valves before going further. Should the rings or pistons be worn, they should be replaced.

Third—Valve push rods set up too tight, causing the valves to hold open. With the motor hot, test the valve clearance (Page 34) and adjust accordingly.

Fourth—Late or sluggish ignition.

This is not a common occurrence and is best detected by an almost entire lack of power; also, the motor will heat readily causing the water in the radiator to boil. Where it is very late, the motor will pound and knock on the slightest pull. Check up the timing of the ignition. (Page 63).

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

#### MOTOR GETS HOT

The following causes will usually lead to a hot motor:

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

Second—Radiator tubes stopped with lime deposit. The radiator should be thoroughly flushed and cleaned. (See Page 30).

Third—Fan belt too loose, or broken, causing fan to stop rotating. (See Page 32 on adjustment.)

Fourth—Late or retarded spark. This is usually apparent by a marked loss in power, and can best be detected in that manner.

Fifth—Carburetor choke rod may be partially pulled out causing the mixture from the carburetor to be too rich. This point should be watched very closely and as soon as the motor gets warm after starting, the carburetor choke button should be pushed forward as far as it will go.

Sixth—Examine brakes and see that they are not dragging. Sometimes the emergency brake lever is left partially set.

Seventh—The igniter may have become loosened, resulting in a retarded spark.

### 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 your 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:

**FIRST—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, the carbon removed, and the valves reground (Fig. 18).

**SECOND—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, rod or piece of wood 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.

If it is found that the bearings have become loosened, they should be adjusted by a reliable mechanic.

Sometimes an ignition knock is mistaken for a loose bearing. Ignition knocks usually occur when the car is being operated on grades or in sandy roads with the spark fully advanced or when accelerating the motor after the car has been running at a low speed. By retarding the spark slightly, a knock or pound of this kind can be overcome. The spark should be advanced as soon as the car begins to reach its normal speed again and the going becomes easier.

Do not confuse body noises with motor knocks.

### WEAK VALVE SPRINGS

As the valve springs are subjected to considerable heat, it follows that in time their "temper" will be affected.

By inserting a screw driver or other suitable tool between the coils of the spring (Fig. 8) and turning it (while the motor is running) the tension of the spring can be increased. If the motor picks up and runs properly, replace the spring. If you have no new

spring at hand, remove the old one and stretch it about an inch. As soon as possible, however, a new spring should be secured and installed to insure a permanent repair.

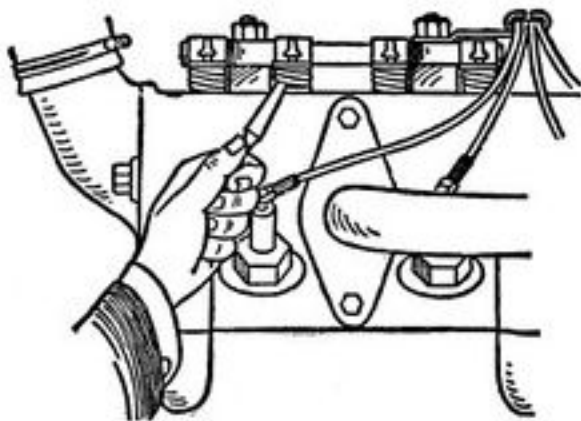


Fig. 8—Testing tension of valve springs.

#### DEFECTIVE IGNITION

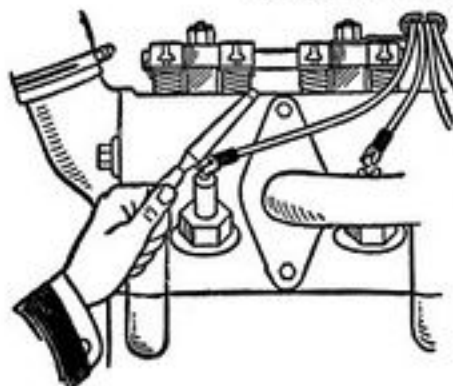


Fig. 9—Short circuiting spark plugs.

First of all, ascertain whether the trouble is in the distributor the wiring, or the spark plugs. In most cases it will be found in the external wiring or plugs when one cylinder continually mis-fires.

To determine the location of the trouble, go about the task systematically—do not jump from one thing to another but satisfy yourself that

each part examined is working in its proper position.

When the engine misfires, locate the particular cylinder at fault as follows: With a screw driver (having a wooden handle) touch the top of the terminal end of the spark plug and at the same time allowing the screw driver to come in contact with the cylinder head (Fig. 9). If a change in the motor running is noticed, that cylinder is working properly. Try each spark plug until one is found where "short-circuiting" the plug causes no change in the motor running. You have then located the particular cylinder that is missing.

### SPARK PLUGS

The faults generally occurring in the spark plugs are as follows:

- (1). Fouled or sooted plugs. These may be very easily cleaned with a brush dipped in gasoline.
- (2). Broken insulation or porcelain. A close examination of the plug will determine if this is the cause of the trouble. Replacing the plug is the only remedy.
- (3). Too wide gaps between the sparking points. The best width of spark gap is 0.020 inch, or slightly less than 1/32 inch. Larger or smaller gaps are detrimental to the ignition.
- (4). The sparking points or electrodes have become burned to such an extent as to increase their resistance. Replacement of the plug is the best remedy.

If, after satisfying yourself that none of the things listed above is the cause of the trouble, find a cylinder that you know is working and put the assumed bad plug in that one and the good plug in the bad cylinder. If the trouble goes with the plug you are sure it is the plug; if not, look elsewhere.

### SPARK PLUG WIRES

To determine if the spark-plug wire is at fault disconnect it from the spark plug and hold the end about one-quarter inch from the plug. If no spark jumps across the gap with the motor running, examine the terminals and insulation. Sometimes the copper wires break but do not damage the insulation. If no exterior damage can be found replace the wire on the plug, and with motor running, slip the wire out of the socket on the distributor cap and hold it about one-quarter inch away from the brass ring on the socket. If a spark is given off, you are sure the wire is at fault, and should replace it with a new one. If no spark is obtained, remove the distributor cap and examine the terminal point protruding from the inside of the cap. If it is found burned or blackened on the point thoroughly clean and polish.

### TESTING DISTRIBUTOR

If trouble is suspected with the distributor, first see if electric current is being delivered to the distributor by the primary wire from the switch and battery. If the distributor is functioning properly, the primary current will pass through the breaker arm and contact points direct from the coil when the contact points are closed. To determine whether there is any trouble at this point, disconnect at the coil the primary wire which leads from the distributor to the coil, and with the contact points closed and with the ignition switch turned on, strike the terminal end of the wire against the terminal on the coil.

If there is a spark, the current is flowing properly. If no spark is obtained, make the following examination:

Examine the spring on the distributor arm. See that this is not broken and that it is making a good contact with the high tension terminal in the center of the distributor cap.

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 distributor and form a connection between the case and the insulated contact point. Wipe out thoroughly.

There may be a "ground" in the distributor due to defective insulation between the supports of the contact points and the distributor housing.

Examine the contact points to see that they are opening and closing properly.

#### TESTING COIL

In order to determine if the coil is operating properly, secure a piece of wire, attach one end to the frame of car or 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 coil to the central terminal on the distributor) leads from the coil and crank the motor by hand with the switch on. If a spark occurs at this point the coil is operating properly.

If no spark occurs and the primary circuit from the battery to the coil is intact, it is evident that the coil should be replaced or repaired.

There are times, however, when it is possible to obtain a spark in a test of this kind when the coil will not operate properly at higher speeds. If ignition trouble occurs and it is impossible to locate the trouble at other points, the coil should be taken to some repair station where a test can be made of the coil when it is operating under practically the same conditions as it is in the car when the trouble occurs.

#### TEST OF 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 distributor and the wiring.

#### TESTING IGNITION SWITCH

In order to test switch and determine if current flows through it, remove the wire from the terminal marked "Bat" on coil. 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 C. 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 of the switch.

#### STARTING MOTOR DOES NOT OPERATE

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

First—Exhausted storage battery due to excessive use of the starting motor or lights and is the direct result of failure on the part of the owner in not observing the rules set forth for the care of his battery. (See Page 69).

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

Third—Corroded terminals causing poor contact. Remove and thoroughly clean, then cover with vaseline or petroleum jelly.

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

Fifth—Starting motor may be "short-circuited" or may have shifted out of line.

#### COOLING SYSTEM

The cooling system consists of a large cellular type radiator and a belt driven centrifugal pump. As the circulating pump is connected to the lower radiator outlet the water is drawn through the radiator before being delivered to the water jackets surrounding the cylinder walls, which insures a proper circulation of cool water at all times, regardless of engine speed. (Fig. 10).

The circulating pump is readily accessible by removing the bolts holding it to the cylinder jacket. Should water leak through the stuffing box on the end of the pump shaft, tighten the nut. If this does not stop the leak, unscrew the stuffing box nut and wrap around the shaft ordinary candle wicking that has been saturated with tallow or graphite grease and tighten the nut again.

The radiator at all times should be kept full, or trouble is sure to follow. It is a good plan to form the habit of inspecting and filling the radiator before the car is taken from the garage. On long tours, especially when you have been traveling over hilly roads or those with a loose top surface, examine the water supply quite frequently. Consider, always, that the proper amount of water is as important as your supply of gasoline and oil. It is well to examine the water supply every time a stop is made for oil or gasoline.

Always use clear water. If rain water can be had, use it, as less scale or deposit will result.

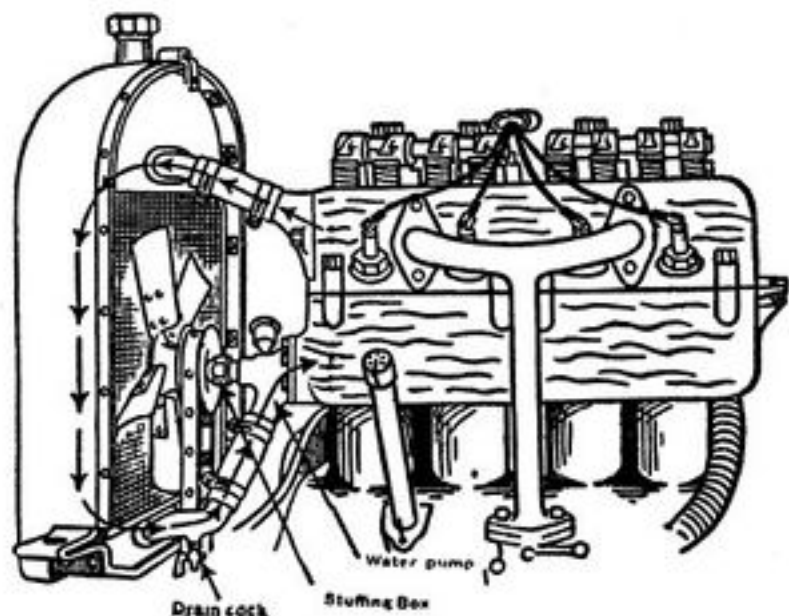


Fig. 10—Sketch showing cooling system.

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 filler neck and flow down through the radiator and out the lower hose. The motor water jackets can be flushed out 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 put 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 the solution 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 ports 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 hood 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 subjected to vibration are likely to occur, so don't be alarmed if you find your radiator has "sprung" a leak. As soon as possible it should be soldered, as a leaky radiator is not only a source of some annoyance by reason of frequent refilling, but a seam, once opened up, is likely to get larger, resulting in sudden loss of water with disastrous results.

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 radiating efficiency. Make a permanent repair at the first opportunity.

#### 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 or denatured alcohol is best for that purpose.

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

(Wood Alcohol)	(Denatured Alcohol)
10 Per Cent 18° F. Above	10 Per Cent 24° F. Above
20 " " 5° F. "	20 " " 16° F. "
30 " " 9° F. Below	30 " " 7° F. "
40 " " 23° F. "	40 " " 2° F. Below
50 " " 36° F. "	50 " " 8° F. "

Since alcohol evaporates more quickly than the water, it is well when filling the radiator to make up the loss by adding a 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 than the amount saved, as they attack the metal system and rubber hose connections.

If the radiator should freeze, do not try to thaw it out 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 that way gives considerable protection from the liability of freezing, besides making the motor start easier.

## FAN BELT

The fan belt is a composition of rubber and fabric formed into a V-shape endless belt.

With this type greater belt surface is gained, permitting it to run much looser than would be the case with a flat belt. This not only means that the belt will work better and give longer service, but relieves the fan bearings of considerable strain.

The purpose of a fan belt is to revolve the fan at engine speeds without undue slipping. Therefore, the belt should be just tight enough to do this. A tight belt soon stretches, damaging the fibre and necessitating early renewal.

When the belt becomes so loose that it requires tightening, loosen the jamb nut holding the set screw (a) and unscrew until its end disengages the slot in the fan hub. The forward half of the fan pulley flange (b) screws on the hub of the rear flange (c). Screwing the forward flange (b) onto the hub decreases the distance between the beveled edges of the two flanges, causing the fan belt to "ride" higher on the pulley, which tightens the belt.

The position of the belt before and after tightening is illustrated by sketches I and II.

After tightening the belt, BE SURE TO LOCK THE FLANGE "B" WITH THE SET SCREW "A." See that the screw engages the slot in the hub, after which TIGHTEN THE JAMB NUT.

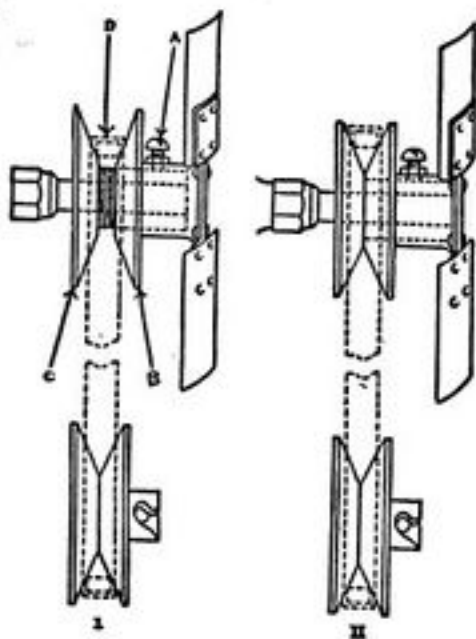


Fig. 11—Fan Belt Adjustment

### VALVES AND VALVE SETTING

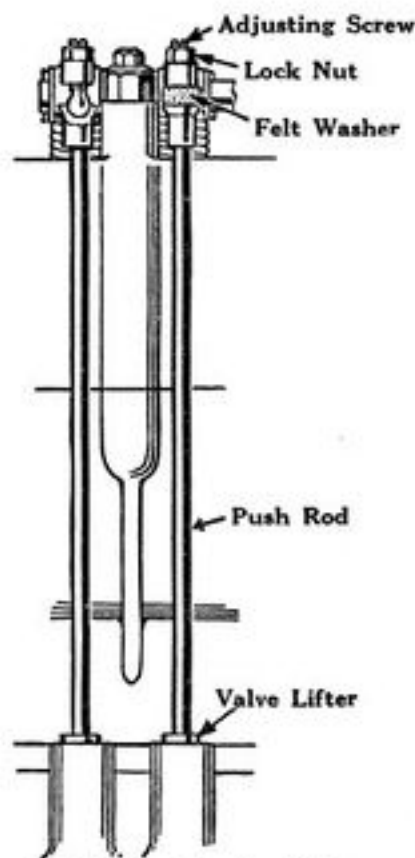


Fig. 12—Adjusting Valves.

The valve mechanism used on Chevrolet cars is recognized as the highest type of engineering practice, not only from the standpoint of greatest efficiency, but of simplicity as well, allowing, as it does, absolute freedom in making adjustments and renewals.

To keep the valves in a state of continued efficiency, it is only necessary to give attention to a few simple rules.

Keep all rocker arms, push rods and valve lifters clean and free from dirt.

Adjust when needed, the clearance between ends of valve stems and rocker arms. (Fig. 13.)

Remove all pits and carbon deposits from valve seats when loss of compression or poor running indicates the necessity.

Too much stress cannot be laid upon the necessity of keeping the motor clean. The dust drawn through the radiator openings as the car travels

ahead contains grit which, when wet with oil, forms a cutting compound that wears and scratches, leaving an irregular surface. This in time is sure to give trouble, so make it a rule to regularly clean all working parts. The slight inconvenience to yourself will be more than offset by the saving in repair bills later on.

### HOW TO ADJUST VALVE CLEARANCE

The continual action of the push rod, opening and closing the valves, will in time produce wear which must be taken up.

To determine proper valve clearance, crank the motor by hand,

turning the motor until the valve lifter has reached its lowest position.

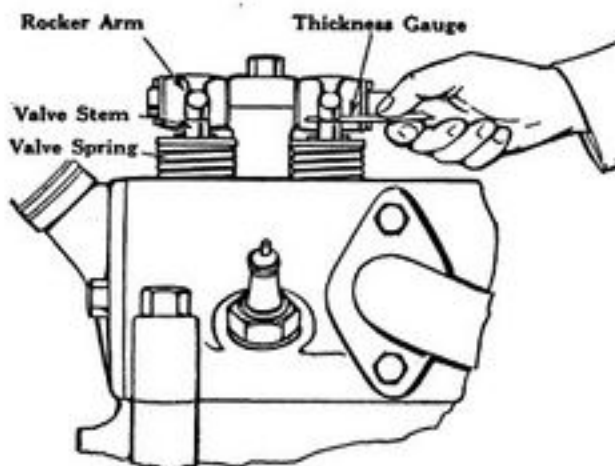


Fig. 13—Determining proper valve clearance

The space between the rocker arm and the valve stem (Fig. 13) should be about .008 of an inch on the intake valves and about .010 of an inch on the exhaust valves when the valves are seated. The adjustment should be made when the motor is hot so that the valve stems and push rods will be expanded to the limit. If the space is greater than this, loosen the lock nut on the rocker arm adjusting screw (Fig. 12) and turn the screw slightly with a screw driver until the proper clearance is obtained, then tighten the lock nut so that the adjustment will not come loose.

Fig. 14 shows one of the valve lifters removed for inspection or replacement.

**Caution:** The necessity for valve adjustment will show itself first by excessive clicking of valve lifters, and second by poor running of motor. It is not necessary to make alterations under any other conditions.

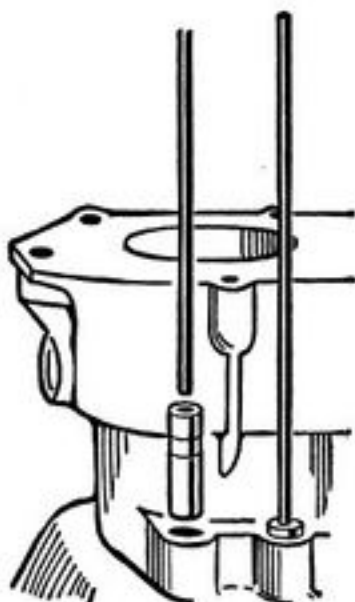


Fig. 14—Push rod and valve lifter removed.

In time the ends of the valve lifters where they come in contact with the cams will become worn to such an extent as to require replacement.

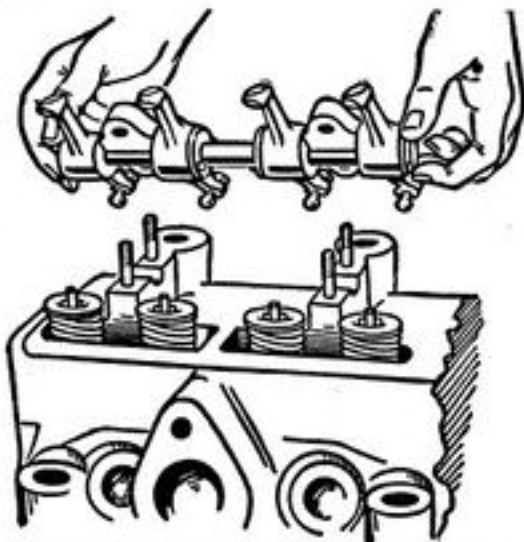


Fig. 15—Rocker arms and shaft removed.

### GRINDING VALVES

To determine which valve needs attention, turn the motor over slowly by hand until the number one intake valve closes (the second valve from the radiator). The piston in number one cylinder is then traveling upward on the compression stroke. Then note the amount of compression or resistance offered.

Keep turning motor. The next cylinder to compress will be number two, then number four, then number three.

The ones offering the least resistance, or compression, are those valves which leak and need grinding (Note: Except piston rings leaking—see page 34).

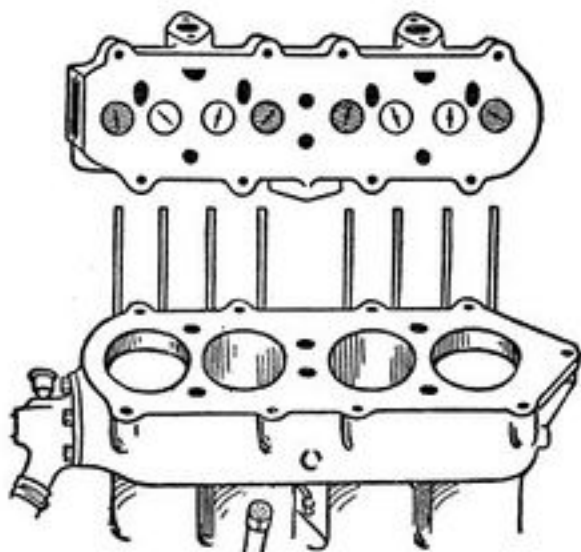


Fig. 16—Cylinder head removed.

The grinding of a valve is not a difficult operation when undertaken with patience. First, it is necessary to remove the cylinder head as follows:

Disconnect intake manifold from cylinder head.

Disconnect the upper radiator hose connections and remove rocker arms and shafts (Fig. 15) then each of the bolts holding the cylinder head to the cylinder casting and lift the head off. (Fig. 16.)

To remove the valves, proceed as follows: With a screwdriver and your fingers press down upon the valve spring cap until

the spring has been compressed enough to admit pulling out the valve spring cap pin (Fig. 17).

Remove each valve separately, using care not to mix them in any way, as they must go back in the order in which they were removed.



Fig. 17—Removing valve springs.

With a brace and a screwdriver of good size rotate the valve back and forth, using only a light pressure on the seat (Fig. 18). DO NOT TURN THE VALVE THROUGH A COMPLETE CIRCLE, as this will cause the compound to cut ridges on the surfaces. After rotating the valve a few moments release the pressure on the brace. This will cause the coil spring to act, lifting the valve off its seat. Turn valve slightly before again reseating for further grinding. Continue this method until the entire contact surfaces on both valve head and valve seat show no dark spots. After the valves have become apparently properly ground, test the seats for unevenness, as follows: With a pencil mark lines on the beveled edge of the valve head about  $\frac{1}{4}$  inch apart, and reseat the valve. Give it

Scrape off all carbon deposits from the combustion chamber and valve ports. Do not leave any projections of carbon, as they will heat up and cause pre-ignition.

At the same time remove the carbon deposits from each piston head. Scrape clean, but use care not to scratch the surfaces, as this will provide a "pocket" to catch carbon more easily. Brush out all the particles of carbon, and finally wash with clean kerosene.

Secure a light coil spring and place it around the valve stem before replacing it for grinding. Use a good grade of grinding material, the best being none too good if a satisfactory job is to be done. Smear the compound thinly on the beveled edge of the valve head.



Fig. 18—Grinding valves.

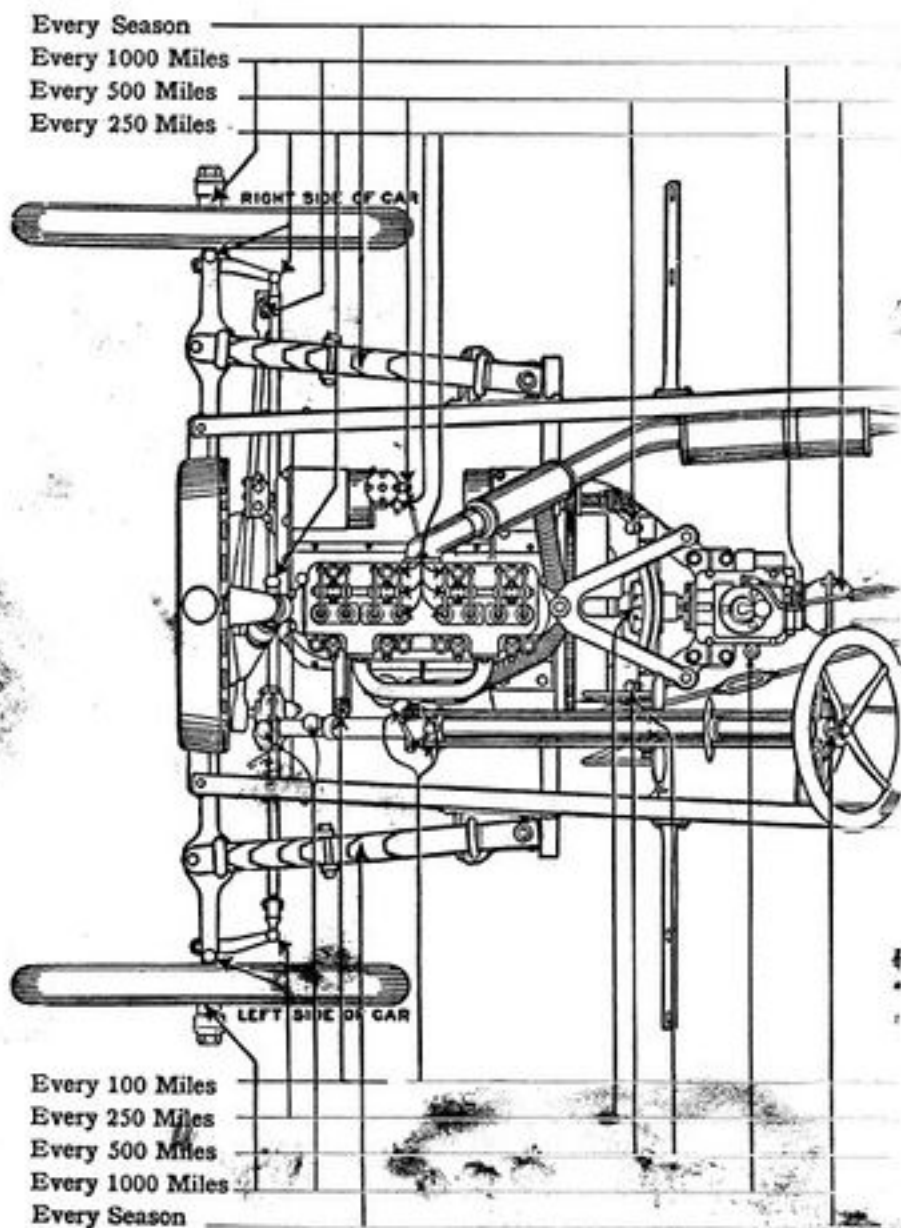
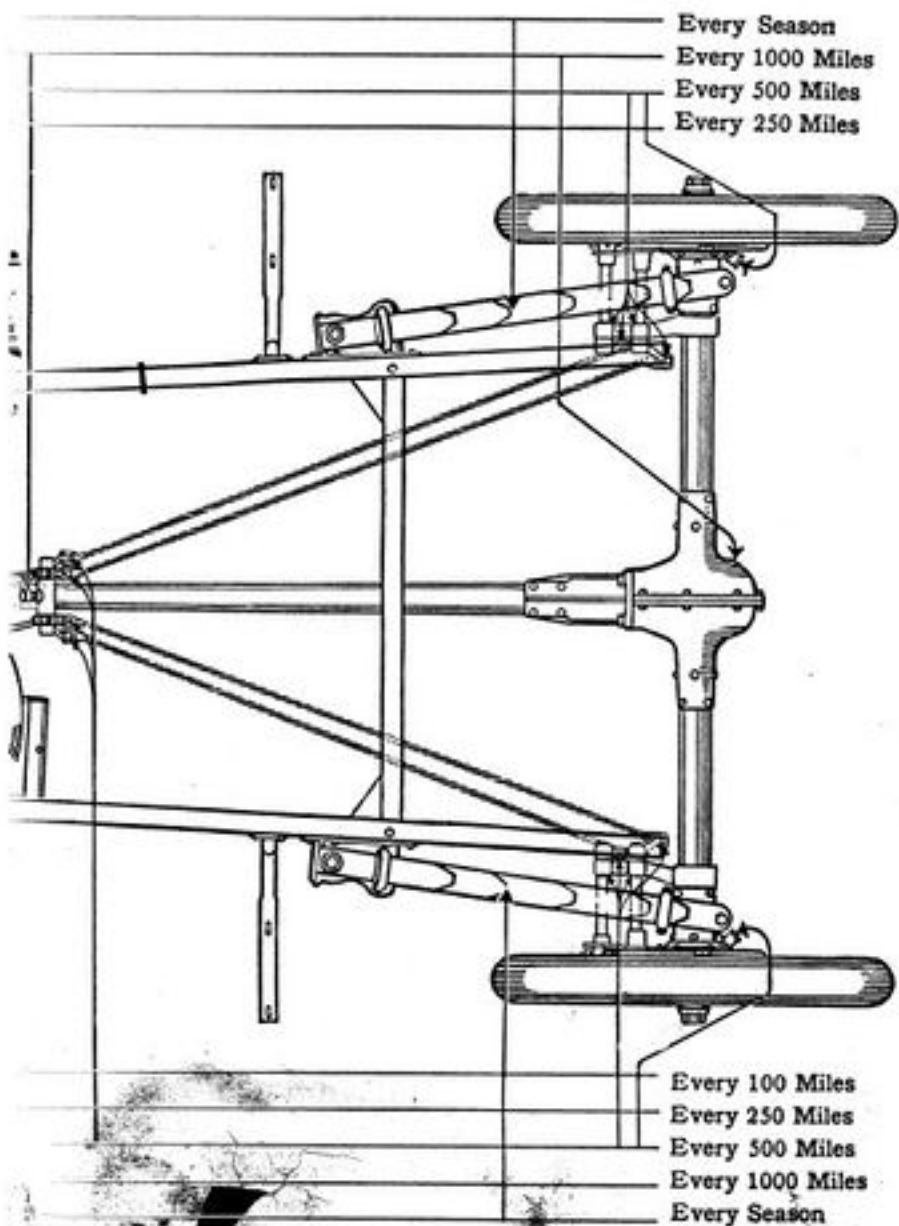


Fig. 1. Lubr





ation chart.

a one-half turn to the right and then to the left, using a little extra pressure on the brace. If the valve has been ground accurately, each one of the pencil marks will be wiped away; but on the other hand, if one line, or a part of one, remains untouched, there is an uneven spot, and the valve must be reground until it seats accurately.

The secret of good valve grinding comes only with experience; however, if care is taken to properly rotate the valve back and forth with a reciprocating motion, and at the same time turning the valve so that at the end of several such movements the valve has been turned through a complete circle, a good job will result.

Never grind a valve more than is required to secure a good accurate seat. Excessive grinding will lower the valve seat so that in time the valve head will fall below the top edge of the seat and cause trouble. When this occurs the only remedy is to have an expert reset the valves with proper tools and replace the worn valve heads with new ones.

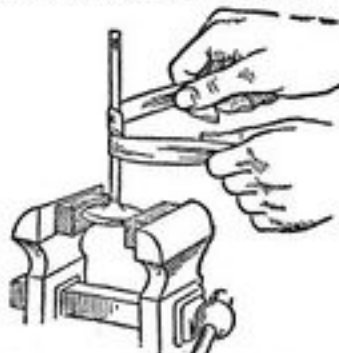


Fig. 20 Polishing Valve Stems

After having secured a good finish and accurate seat, remove with clean cotton waste EVERY ATOM of grinding compound from the valve head, valve seat, combustion chamber and intake passages. Wash with gasoline or kerosene and then flush the valve guides. BE SURE ABOUT THIS, as it requires only a small particle of abrasive to cause trouble.

While you have the valve out, examine the stem, removing every particle of carbon and grit. Do not use a file for this purpose, but a fine grade of emery cloth. A good way to do this without the liability of getting the valve stem out of round is to clamp the valve head between wooden blocks or copper jaws (Fig. 20), then a strip of emery cloth about  $\frac{1}{4}$  inch wide wrap it around the stem one and one-half turns. Grasp the free ends of the cloth and pull back and forth, at the same time causing it to slide up and down the stem.

Before replacing the cylinder head examine carefully the copper asbestos gasket. If any weak spots appear, it is better to replace the gasket than to try to use the old one, as much depends upon a good fitting gasket. In replacing the cylinder head bolts, run each one down until the head just touches the boss on the cylinder head, then—and be sure about this—TIGHTEN EACH ONE EVENLY A LITTLE AT A TIME UNTIL FINALLY ALL ARE TIGHT. No one bolt should be drawn down tight until all are set snug.

### MOTOR LUBRICATION

The oiling system used on Chevrolet cars is known as the constant-level splash system. The oil is carried in a reservoir located at the bottom of the crank case and is filled through a filler tube on the left side of the motor, just back of the fan.

Two pet cocks located on the side of the oil reservoir (Fig. 1) indicate the level of oil. When full, oil will begin dripping out of the upper pet cock when the valve is open.

Oil is drawn from the oil reservoir by a geared pump located on the timing gear cover and is then "fed" into a basin having four troughs or depressions into which the spoons or splashers on the ends of the connecting rods dip.

The rapid "splashing" of these spoons keeps the main bearings, connecting rods, piston pins and cylinder walls bathed in oil, from whence it drains back into the reservoir, to be used over again.

Once every 1000 miles the oil reservoir should be drained by removing the drain plug. This removes all "old" or "burned" oil and prevents clogging of oil holes and pockets. Fill to the proper level with a medium oil.

Fresh oil is cheaper than repair bills, so observe this point regularly.

Use light cylinder oil to lubricate the rocker arms and push-rod felts. Keep the felts saturated with oil. Grease the fan every time you oil the rocker arms.

### OIL PUMP

Upon the oil pump depends the successful lubrication of the motor. The pump used on Chevrolet Cars has been simply designed

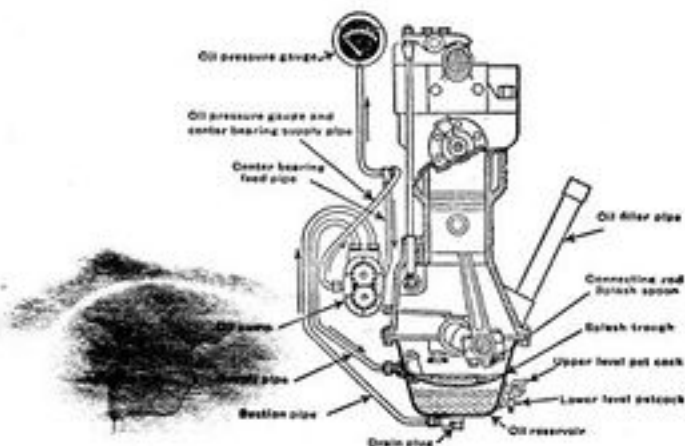


Fig. 21—Sectional view of engine lubricating system.

to give a constant, even supply of oil with a minimum of parts and a consequent lessening of pump troubles. Under normal conditions you will not experience the slightest trouble, and will need to give no thought to this important part; however, as a safeguard, and to avoid accidents, a registering dial is mounted upon the instrument board (Fig. 3) so that the motorist may observe the action of the pump.

Should this dial for any reason show that the pump has stopped working the car should be stopped at once and the source of the trouble located and remedied. Usually this will be found to be due to air leaks in the suction pipe (Fig. 21), and can, in most cases, be corrected by tightening the connections at the upper and lower ends. Occasionally dirt and unburned carbon will form as a sediment and be drawn into the suction and feed pipes, obstructing them, in which case they should be taken off and blown out.

Get into the habit of noting the action of the registering dial regularly—not in the expectation of trouble, but to avoid its possibility and resulting large repair bill. Frequently, as you drive along, look at the dial—it only takes a second, and requires no special effort. Failure to make proper observations may cost you in time and money several times this amount.

#### OIL GAUGE

The needle or hand of the oil gauge is actuated by the pressure of oil against a column of air in the tube from the oil pump to the gauge. This instrument is self-contained and will require no attention in itself. Should the dial indicate that the pump has stopped working, disconnect the SUPPLY PIPE (Fig. 21) at the pump. If the pump is working, oil will be discharged, and the trouble is in the air line or dial. Examine the air line, especially the connections, and see that they are tight. If tightening the connections does not remedy the trouble, take a squirt can full of oil and, with motor running slowly, squirt oil along the entire length of the air line. If the tubing has split, bubbles will appear at the leak. If the air line is in good condition then it is evident that the gauge is at fault and it should be returned to the makers for repair.

#### GENERAL LUBRICATION

The chart on lubrication (Fig. 19) shows where and when to lubricate the different units of a Chevrolet Car. The thing to bear uppermost in mind is that oil and grease are much cheaper than repair bills and that a slight inconvenience to yourself is necessary, if you are to secure the maximum of useful service from your car.

Don't wait until you hear a "squeak" before oiling. A "squeak" means a rusted or dry bearing, and when once in that condition trouble soon follows.

The compact construction of a Chevrolet makes necessary the placing of oil holes and grease cups under the floor boards of the car. Don't, because it might cause you a little extra trouble, forget to remove them and lubricate as directed.

We guarantee that, when adjusted and lubricated, following the instructions contained in this booklet, your car will give you a maximum of service at a minimum of upkeep cost.

For those who wish we have prepared an enlarged cut of the oiling chart which can be tacked on the garage wall for handy reference. Write us for this chart.

### CLUTCH

The clutch used is the conventional cone engaging with a beveled edge of the fly wheel. The "face" of the cone is covered with a leather band firmly riveted to it. To prevent "grabbing" expanders are placed under the clutch leather so as to present slightly raised points of contact. If the clutch takes hold too quickly and

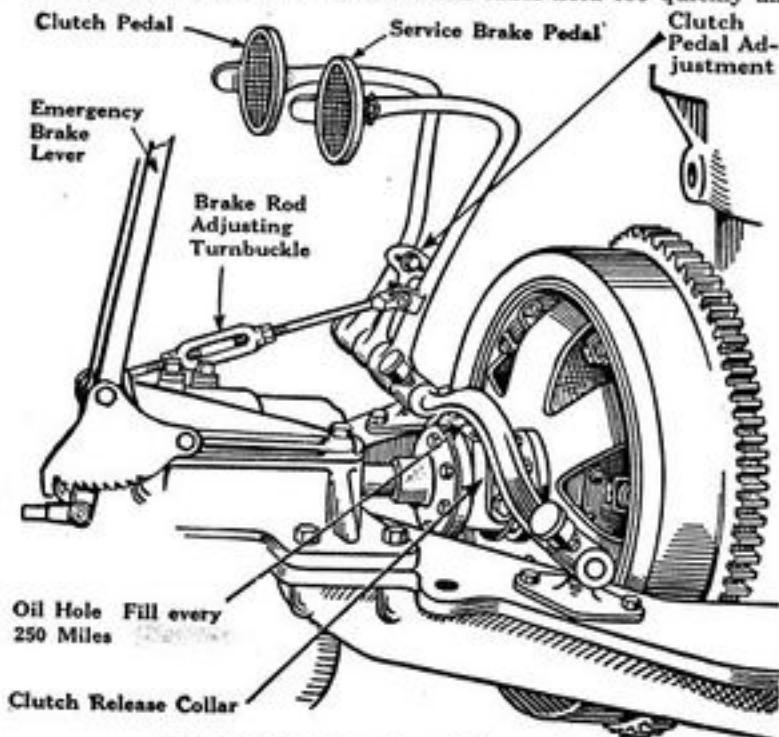


Fig. 22—Clutch and operating mechanism.

causes the car to start with a jerk, it is an indication that the clutch leather expanders need adjusting. To do this, turn each of the expander nuts to the right, until they lightly touch the clips, and

then give them a half turn to the left. This unscrewing a half turn allows the expander to act properly under the clutch leather.

The clutch leather will in time "dry" out, resulting in "grabbing," or slipping. Once a month rub a little neat's-foot oil on the leather to soften it. Should the clutch leather become greasy, apply a little Fuller's earth to it. DO NOT USE SAND OR OTHER GRITTY SUBSTANCES to make a slipping clutch hold. If you do you simply are inviting a large repair bill.

Should the clutch leather become worn because of continued slipping, it should be replaced. We carry in stock clutch bands ready for installation and recommend ordering from us or your nearest dealer when this becomes necessary.

As the clutch leather wears, the clutch will set deeper in the fly wheel, bringing the clutch pedal more closely to the floor board. There should always be sufficient clearance between the pedal and the board to permit the clutch to seat properly. If not, it will slip. An adjustment is provided on the shank of the pedal (See Fig. 22) to compensate for the wear of the leather.

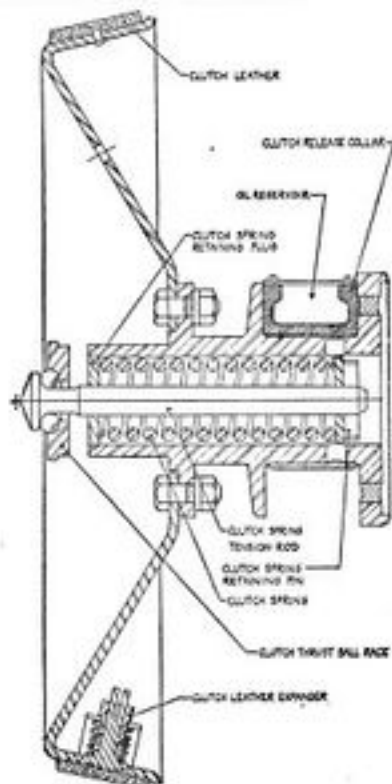


Fig. 24—Sectional view of clutch and release collar.

### LUBRICATING CLUTCH COLLAR

The clutch collar consists of a hollow bronze casting. In its friction surfaces wood plugs are inserted extending into an oil receptacle formed by the hollow casting; through these plugs the oil exudes (or sweats) and lubricates the friction surfaces.

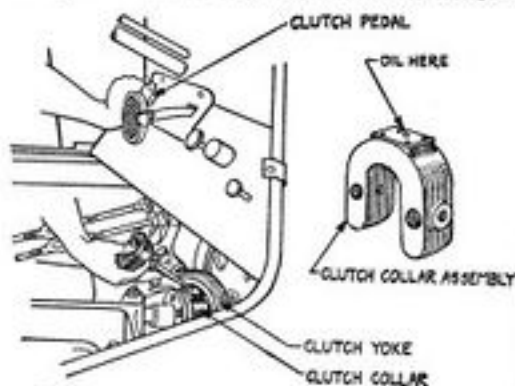


Fig. 25—Lubricating Clutch Collar.

It will be found easier to push down on the CLUTCH PEDAL with the left hand, while sitting on the left door sill, and using the right hand with the oil can to inject the oil into the CLUTCH COLLAR.

THE CLUTCH COLLAR SHOULD BE OILED REGULARLY EVERY 250 MILES with cylinder or machine oil.

### TRANSMISSION

The transmission is of the selective type, having three speeds forward and one reverse. Stripped of technicalities, it is composed of a countershaft on which are keyed three gears and a main or splined shaft on which slide two gears, which by a lengthwise movement can be made to engage the gears on the countershaft (Fig. 26).

The fundamental requirement is in every case to first engage the gears so that the entire tooth "face" of the sliding gears mesh with those on the countershaft and second, to properly lubricate all working parts. Proper engagement can be had by being sure when shifting gears that the gear-shift lever travels as far forward or backward as it will go without straining before re-engaging the clutch.

To lubricate the transmission, fill every 1000 miles with No. 600W or steam cylinder oil, not grease, so that the oil level stands at the elbow filler on the left side of the case.

Once every 2000 miles it is a good plan to wash out the transmission with kerosene to remove any chips of metal knocked off the gears, or other foreign substances. To do this, remove the

drain plug at the bottom of the transmission case and allow the oil to drain off, after which flush out thoroughly and refill with oil.

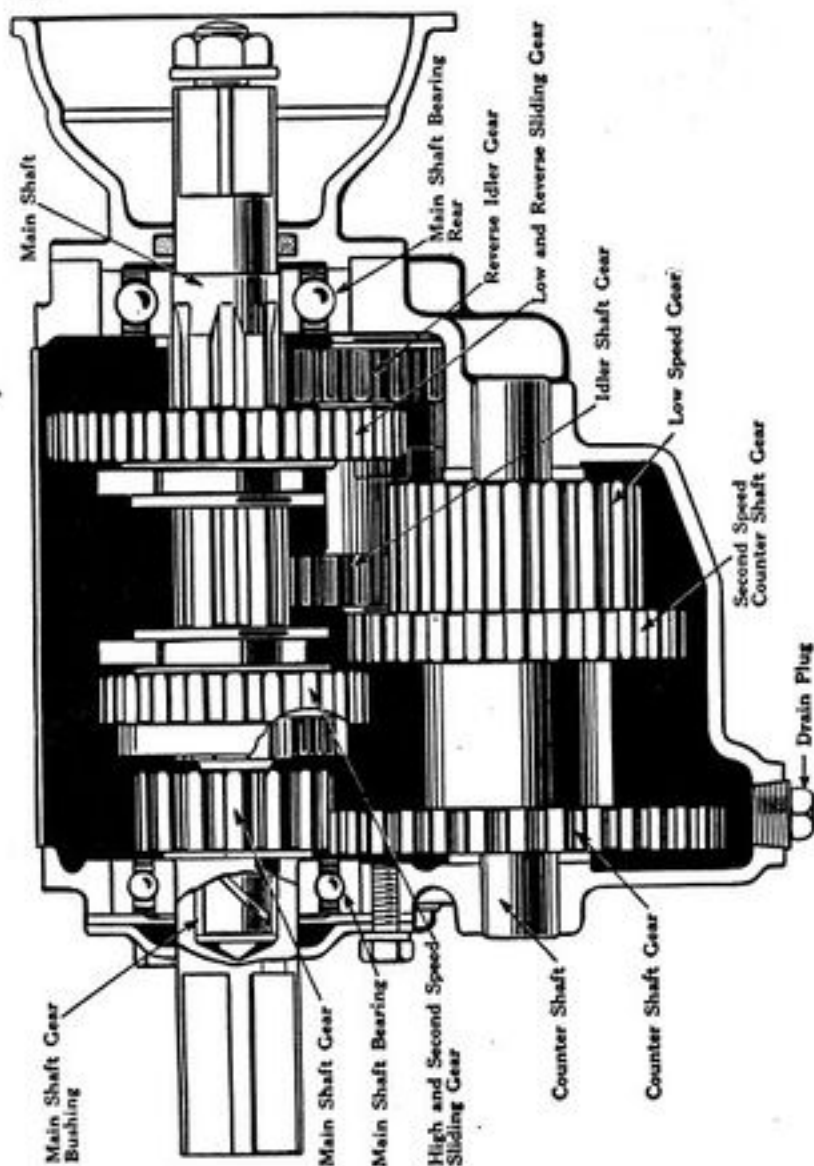
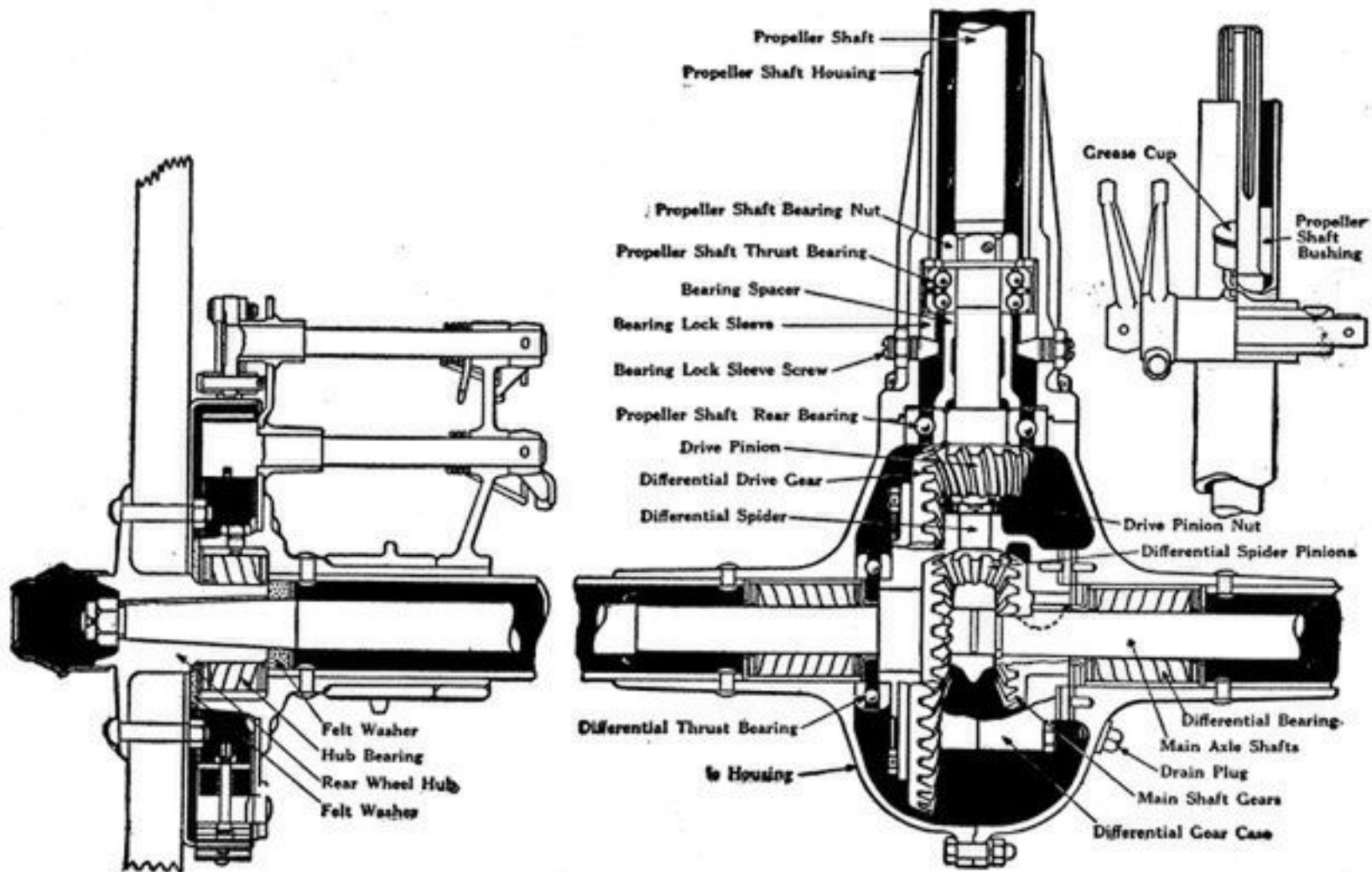


Fig. 26—Sectional View of Transmission.



Fig. 27—Sectional View of Rear Axle.



### REAR AXLE

The rear axle used on Chevrolet Cars is the floating type, in which the load is carried by the axle housings instead of the main axle shafts, their only function being to rotate the rear or driving wheels. The manner of supporting the load between the hub and the axle housing is a patented device controlled only by this company.

A glance at the illustration (Fig. 27) shows the construction, the different units being so marked as to show their relation to each other. That you may be familiar with its general construction we will describe briefly the different units.

The driving torque is transmitted from the motor crankshaft through the clutch and transmission to the propeller shaft.

On the end of this shaft is mounted a bevel pinion called the **DRIVE PINION**, with spiral cut teeth, which meshes with a large ring gear called the **DIFFERENTIAL DRIVE GEAR**. This in turn is securely bolted to a housing called the **DIFFERENTIAL GEAR CASE**.

Inside the differential gear case are mounted five gears. Two of these, called the **DIFFERENTIAL MAIN SHAFT GEARS**, are fastened to the ends of the axle shafts. The other three gears, called **DIFFERENTIAL PINIONS**, are mounted on the **DIFFERENTIAL SPIDER**, and mesh with the two **Differential Main Shaft Gears**.

The function of a **DIFFERENTIAL** is to permit one rear wheel of the car to travel faster than the other, or independent of the other when required. If such a device were not used, turning corners would be difficult, as without it both wheels would have to move at the same speed, whereas a turn demands that one wheel travel faster than the other.

When the car is traveling over uneven road surfaces, turning corners, or on the side of the roadway, considerable end play or "thrust" is transmitted to the differential. To prevent injury, and to reduce the power loss due to friction, a suitable bearing, called a **DIFFERENTIAL THRUST BEARING**, is used, composed of hardened-steel balls mounted between steel washers.

The weight of the differential and the driving torque is carried by two roller bearings on either side and bearing on the main axle shafts.

The propeller shaft is housed inside the **PROPELLER SHAFT HOUSING** and is supported at its lower end by a ball bearing which is mounted on the hub of the pinion gear. A ball bearing called the **PROPELLER SHAFT THRUST BEARING** absorbs the end play of the shaft and driving thrust.

One end of the Propeller Shaft Housing is flanged and bolted to the axle housings. The opposite end is supported by a **BALL AND SOCKET JOINT**, inside of which works a **UNIVERSAL JOINT** connecting the propeller shaft with the main or splined transmission shaft.

### REAR AXLE NOISES

In some axles there is a slight and steady hum which is usually present when gears are used, whether in an axle or otherwise. This noise should not be confused, neither should the motorist become alarmed if it continues steady and uniform.

If a loud noise develops, there is no absolute method of diagnosis except to have the axle disassembled and an examination made of it by a reliable mechanic.

### LUBRICATION

An oil of the consistency of 600W or steam cylinder oil should be used to lubricate the differential, and an examination should be made about every one thousand miles. By removing the oil plug on the right hand side of the differential housing, the amount of oil in the housing can be determined. The housing should be filled until the oil is level with the lower edge of this hole.

### REAR WHEEL BEARINGS

Large roller bearings carry the car load and are mounted on special one-piece drop-forged hubs, hardened and ground. The method of mounting is covered by patents controlled by this company, and insures to the owner a minimum of power loss and upkeep cost. Suitable felt washers are provided to prevent oil leaking from the differential, and can easily be renewed by removing the wheels.

### BRAKES

As will be shown by reference to illustration (Fig. 28), the service brake is the outside or external band, and the emergency the inside, or internal band. One, the service, contracts on the outside of the brake drum, and the other, the emergency, expands against the inside of the drum.

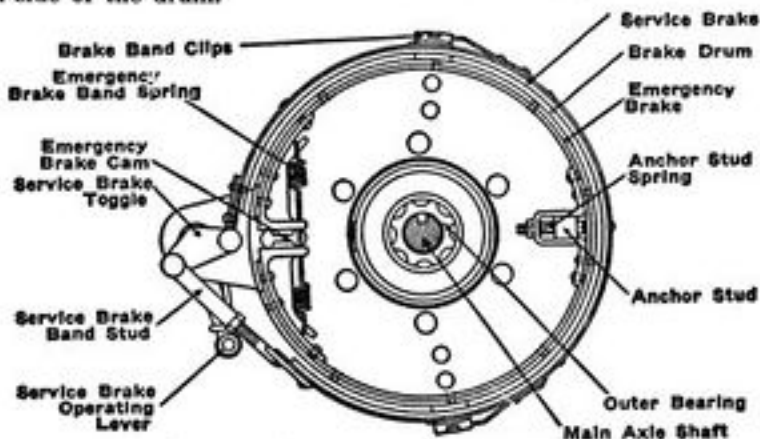


Fig. 28—Chevrolet brake mechanism

## ADJUSTING BRAKES

No part of an automobile is more neglected by the average user than the brakes. They are of the utmost importance, however, and there should be no disregard for the precautions necessary to insure their dependable condition at all times.

When the brake pedal is pressed downward as far as it will go without stopping the forward movement of the car, shorten the rod between the pedal and the brake shaft on the propeller shaft housing by turning the turn buckle E (Fig. 29) to the right. When the hand brake lever is pulled back as far as it will go without stopping the forward movement of the car, shorten the rod between the hand lever and the brake shaft on the propeller shaft housing by the turning of the turn buckle F (Fig. 29) to the right. When these adjustments are being made, a jack should be placed under the rear axle and the rear wheels raised from the ground so that they can be turned from time to time to see that the brakes are not dragging.

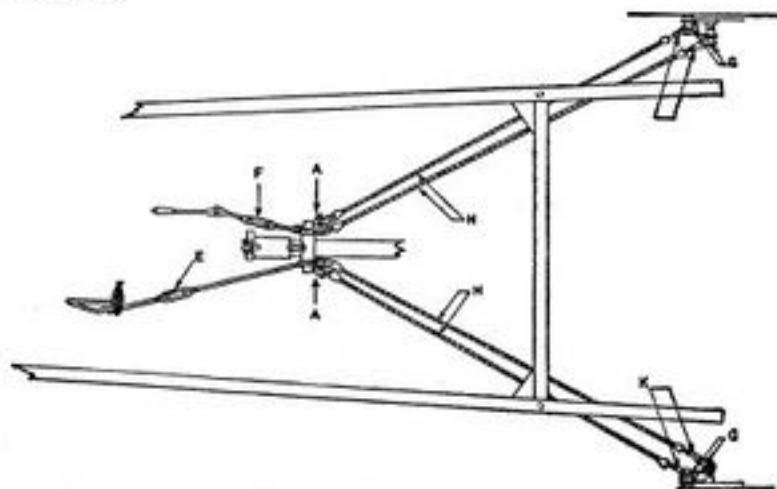


Fig. 29 Adjusting Brakes

After making this adjustment note the position of levers "A," (Fig. 29) (with the brakes released) which are attached to the brake shaft on the propeller shaft housing. To give proper pull on the brake cables these levers should point downward and about one inch to the rear of a vertical position.

If these levers stand in a vertical or forward from vertical position with the brakes released, unscrew the turn buckle E or F and remove the yoke pins G from the brake pin levers and shorten the brake cables H by turning the yoke nuts K to the right until the levers A assume their proper position.

Caution—Be sure to turn each of the yoke ends an equal number of turns, otherwise one brake will take hold before the other.

The turn buckle E or F can then be adjusted so as to bring the cables H tight.

Should one brake "grab," that is, take hold too quickly, remove the yoke pin G on that brake and lengthen the cable H by unscrewing slightly the yoke nut K.

After considerable use, the brake bands will become worn to such an extent that it will be necessary to replace them. When the service brake operating lever or the emergency brake operating lever (Fig. 29) stands in a vertical or forward of vertical position with the brake applied, it indicates that the brake linings have become worn to the point where they should be replaced.

### STEERING GEAR

The steering mechanism used on Chevrolet cars has been designed to give the greatest ease of handling with the least amount of wear and consequent adjustment. No part of the car is so vital, therefore it is absolutely essential that it be well lubricated and any looseness immediately corrected. Go over all the connections regularly and tighten any bolts or nuts which are loose, supplying grease and oil where needed, as this is the only safe insurance against a costly accident.

The steering gear on the Superior Model is the worm and worm wheel type, in which the worm on the steering gear shaft meshes with a worm wheel to which the crank arm is attached.

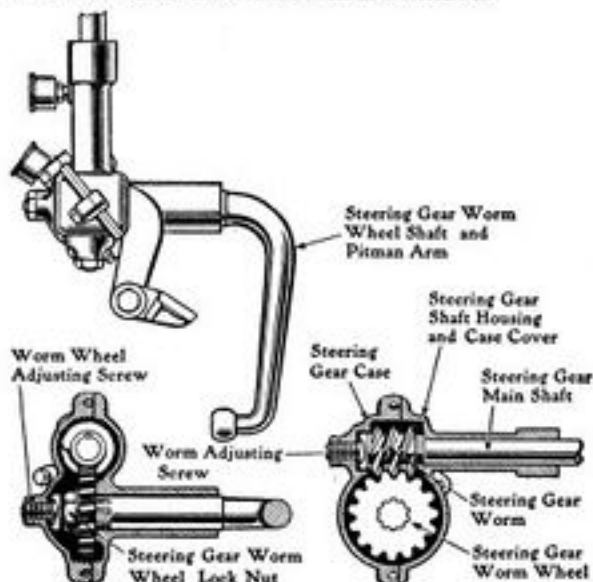


Fig. 30—Steering gear (worm and worm wheel—Superior)

To take up end play in the worm shaft loosen the worm adjusting screw lock nut (Fig. 30) and screw down the worm adjusting screw until all play is removed without binding the steering gear. Be sure to tighten the worm adjusting screw lock nut after securing the proper adjustment. To adjust end play in the worm wheel tighten the worm wheel adjusting screw.

The steering gear on the "Four-Ninety" Model is the gear and sector type in which the gear on the main shaft meshes with reduction gears that actuate the sector gear to which the pitman arm is attached. (Fig. 31.)

600W or steam cylinder oil should be put into the gear case every 250 miles. This is quite important, as your safety depends upon a well-lubricated gear.

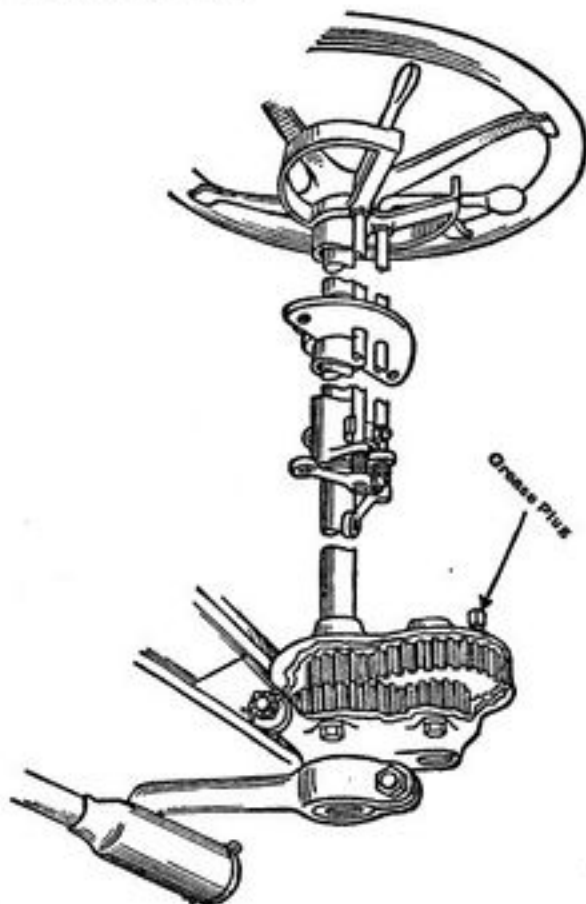


Fig. 31—Steering gear (gear and sector—Four-Ninety)

Every 500 miles the ball and socket connection on the steering connecting rod (connection between steering crank arm and front axle) should be packed with grease and any looseness in the connections can be removed by tightening the screws in the end of the steering rod tube. Be sure to replace the cotter pin after making this adjustment.

### FRONT WHEEL BEARINGS

The front wheels run on tapered roller bearings (Model "Four-Ninety") and New Departure ball bearings (Superior Model) which are lubricated through a grease plug on the hub flange and by filling the hub caps with soft cup grease. In mounting the front wheels, care should be exercised to thoroughly saturate the cone and roller assembly with this grease and also fill the space between the inner cone and dust enclosure with grease. The best lubricant for front

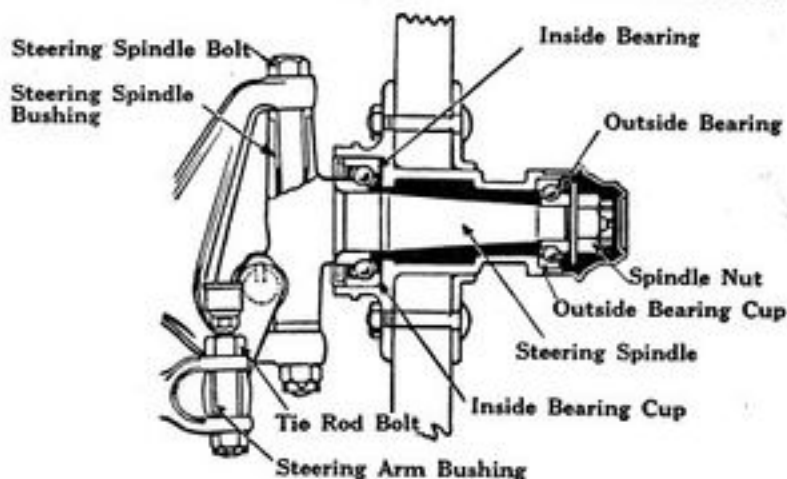


Fig. 32—Front wheel bearings. (Ball type).

wheel bearings is a straight mineral grease which does not contain any free acid or acid forming compounds and which is also entirely free of graphite, asbestos fibre or other foreign matter.

There are two bearings to each front wheel (Fig. 32) and these are held in adjustment by the spindle nut which is fastened with a cotter pin and also by a safety washer which is interposed between the spindle nut and the cone to the outer bearing.

The bearings should be adjusted by drawing the spindle nut up tightly, revolve the wheel a few times to insure that all parts are operating satisfactorily, at the same time tapping the safety washer lightly to insure a proper contact with the outer bearing. The wheel will now revolve somewhat stiffly. Turn the wheel until the valve stem is at the top, unscrew the spindle nut until the weight

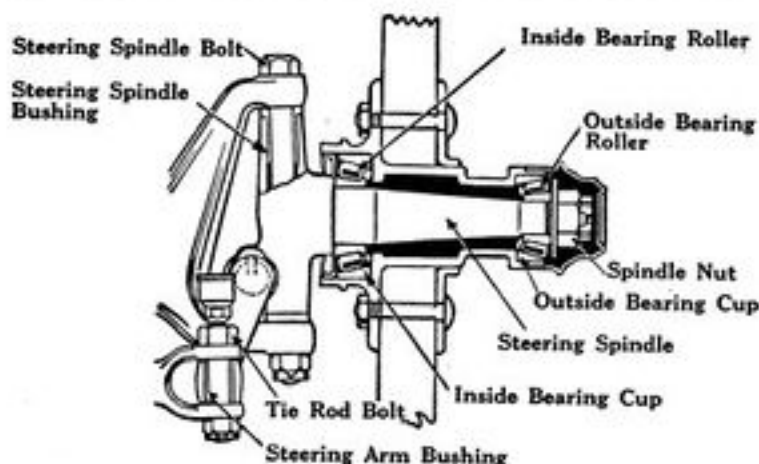


Fig. 33—Front wheel bearings. (Roller type).

of the valve stem causes the wheel to rotate, then insert and spread the cotter key. When adjusting wheel bearings, it is sometimes advisable to insert a chisel or a small bar between the axle and the steering knuckle to insure that any play in the steering spindle bolt is not confused with play in the bearings.

### FRONT WHEEL ALIGNMENT

To make steering easy it is required that the front wheels should "toe" in; that is, the distance between the inside faces of the wheel felloes, measured at the height of the wheel hubs, should be  $\frac{3}{8}$  in. more at the rear than at the front. This causes the wheels to grip the road better, and allows the car to hold its course without undue action on the steering mechanism.

As the car passes over uneven road surfaces the front wheels are subjected to considerable strain; therefore, about once every 2,500 miles their alignment should be checked to make sure that none of the connecting links have changed adjustment, otherwise there is the possibility that the front tires may become unduly worn, necessitating early renewal.

To adjust the front wheels: 1, fasten securely one end of a stout cord around either right or left REAR WHEEL HUB. (Sketch 1, Fig. 35.)

2. Pass the cord between the SPOKE, toward the REAR and around the tire, across the face of the wheel at the height of the HUB. (Sketch 1, Fig. 34.)

3. Pass the cord completely around the FRONT of the car across the faces of each of the WHEELS at the height of the HUB, and tie the end around the tire at the point (D), (Fig. 34).



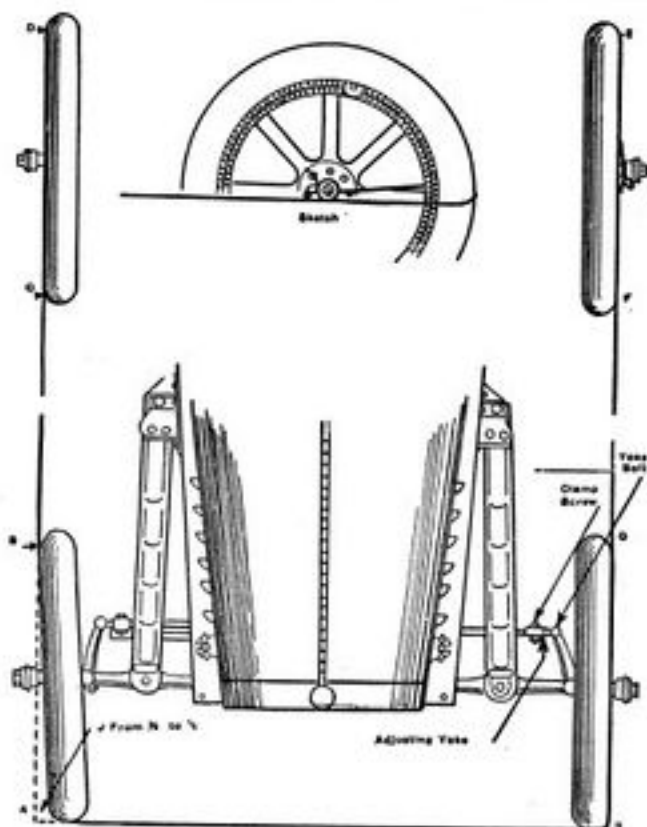


Fig. 34—Front wheel alignment.

4. Turn the STEERING WHEEL so that the RIGHT FRONT WHEEL is in line with the RIGHT REAR WHEEL. The cord MUST touch the wheels at the points B, C, D, E, F, G, H.

5. The total amount the two FRONT WHEELS "toe in" may then be determined by drawing the cord at (A) in a straight line, retaining the point of contact at (B). The dimension (J) measured from the cord to the tire should be  $\frac{3}{8}$  to  $\frac{1}{2}$  in.

#### IF ADJUSTMENT IS REQUIRED

1. Remove the TIE ROD YOKE BOLT on the left side.
2. Loosen the ADJUSTING YOKE CLAMP SCREW.
3. Lengthen or shorten the TIE ROD by turning on or off the ADJUSTING YOKE.
4. Insert YOKE BOLT and measure (J).
5. Continue until the correct dimension  $\frac{3}{8}$  to  $\frac{1}{2}$  in. is obtained.
6. Tighten CLAMP SCREW.

7. The amount each FRONT WHEEL "toes in" will be  $\frac{3}{16}$  to  $\frac{1}{4}$  in.

The lubrication of the SPINDLE BOLTS and TIE ROD BOLTS is very important, so make it your business to follow the instructions contained on the oiling chart regularly.

### SPRINGS

It is of the utmost importance that regular attention be given to the springs on your car if you are to realize their fullest riding qualities. Even the best designed spring will become squeaky as soon as moisture enters between the leaves and causes rust. The fullest action and resiliency of the springs obtain only when the different leaves are free to slide on each other. A spring which is "rusted up" cannot do this, causing unequal strains to be placed on each leaf, especially the larger or main one. It follows, therefore, that to lubricate the springs as soon as they begin to squeak is the surest way to secure easy riding and prevent spring breakage.

The best way to lubricate the springs is to place a jack under the frame or body and raise the car (not the wheels) until the spring leaves separate far enough so that graphite grease can be spread between them.

Once a week examine the clamping bolts and spring clips holding both front and rear springs to the axles and SEE THAT THEY ARE ABSOLUTELY TIGHT. No matter how "tight" they were drawn up at last examination, the action of the spring will cause them to "stretch" or loosen up. Nearly all spring breakage can be traced to loose spring clips and bolts, so observe this rule carefully.

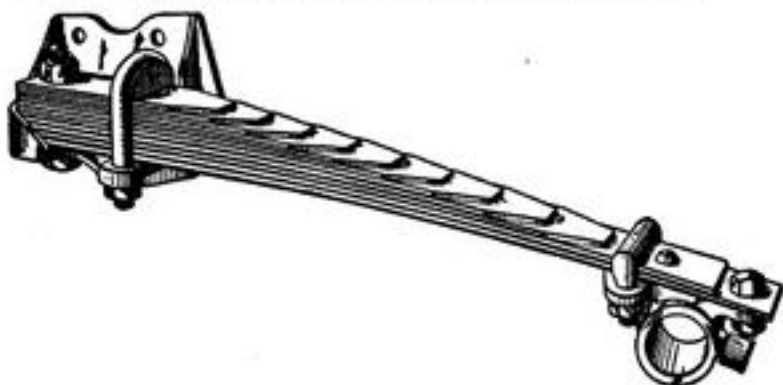


Fig. 35—Keep spring clips tight

### CARBURETOR

The Zenith Carburetor was used on all "Four-Ninety" Models. On the Superior Models both the Zenith and Holley Carburetors are used.

They have been carefully tested and adjusted to the motor before leaving the factory. No adjustments should be made as it has been found by experience that those made at the factory are proper for all changes in gravity and atmospheric conditions when the motor has been heated to a proper temperature. Too often adjustments to the carburetor are made when in reality something else is causing uneven running or the motor has not thoroughly warmed up. It is well to remember that any changes in carburetor's action will come gradually and not suddenly. Therefore if your car was operating properly when run last, you may depend upon it that some other part of the motor is at fault and the trouble should be located and corrected before attempting alterations to the carburetor.

#### CARBURETING PRINCIPLE (ZENITH)

On each suction stroke of the piston a partial vacuum is created which causes a fine spray of gasoline to flow from the carburetor jets. This spray is picked up by the air which is also drawn through the fixed air intake (Fig. 36), and as it passes through the choke or "venturi" a rotative action is produced (by the special shape of the choke) which breaks up the fine particles of gasoline, and thoroughly mixing with the air, passes into the cylinder through the intake pipe in the form of a carbureted gas.

The gasoline from the tank passes through the gasoline inlet, filter screen and needle valve into the float chamber, raising the float as the volume increases. Passing through the center of the float is a rod or needle valve having a pointed end. This rod is attached to fulcrums which are actuated by the float so that as it raises the needle valve moves downward and the conical end engages and closes the needle-valve seat, thus shutting off the gasoline flow when the proper volume has been obtained.

All gasoline, before being placed in the tank, should be strained through chamois to remove water and dirt; however, in spite of care a certain amount of dirt or lint will get into the system and interfere with the best working of the carburetor. To remove as much as possible the liability of dirt getting into the instrument itself, a wire-gauze strainer is inserted between the gasoline inlet pipe and the float chamber.

Once every 2000 miles the filter plug should be removed. This allows the gasoline inlet connection to slide off the boss on the end of the carburetor. Surrounding this boss is the filter screen or strainer. Remove and clean thoroughly. In replacing, care should be taken not to damage it, as this must be in perfect condition or trouble will result.

If carburetor float chamber overflows, the trouble will usually be traced to the needle valve seat, and is sometimes caused by either dirt collecting on the seat or some imperfection which permits the gasoline to flow past the point of the valve. Trouble of this sort can usually be eliminated by removing the needle valve cap, rotating

the needle valve, at the same time tapping the top of the valve with a light hammer. This causes the valve to form a new seat or push aside any obstructions which may be under it.

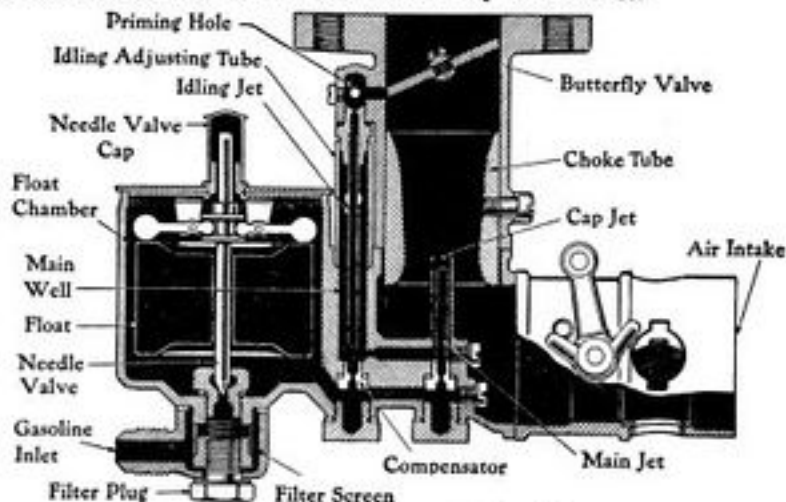


Fig. 36—Carburetor. (Zenith)

#### CARBURETOR (HOLLY)

The adjustments on the Holly carburetor are so locked that they cannot change of themselves; faulty operation is usually caused by dirt or water interfering with the proper flow of fuel through the carburetor. To the extreme left of the float chamber bowl is the fuel entrance and the strainer body which is connected to the vacuum tank. Before the gasoline enters the float chamber, it must pass

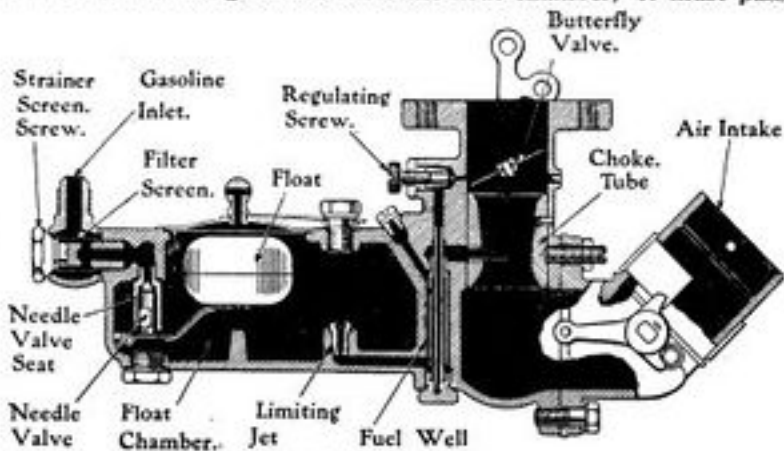


Fig. 37—Carburetor. (Holly.)

through a filter screen. This screen may be easily removed by unscrewing the strainer screen screw.

To properly clean the screen, it should be washed in a bowl of gasoline. This should be done at least every 2,000 miles.

#### **Throttle and Idle Adjustments**

The idling adjustment is controlled by the regulating screw with a knurled head—turning clockwise gives less fuel, turning counter-clockwise gives more fuel for idle.

#### **Throttle Adjusting Screw**

The throttle adjusting screw prevents the complete closing of the throttle valve. When idling, if the throttle valve is allowed to shut off too far, the motor speed will be too slow and similarly, if the valve is opened too far, the speed will be much too fast. The size of the opening of the valve is controlled by the adjusting screw. This screw is clearly shown in the cut and is located on the engine side of the carburetor. If this throttle adjusting screw turns too tightly, first loosen the lock screw, making sure to tighten the lock screw after the proper adjustment is secured. Turning the adjusting screw counter-clockwise reduces the idling speed of the engine and turning the screw clockwise will increase the idling speed of the engine.

#### **Main or Running Adjustment**

All the fuel passing to the main nozzle and also to the idling nozzle is metered by the limiting jet, which is a fixed adjustment. If dirt collects over this jet the float must be removed in order to take this jet out for cleaning.

In very warm climates or in hot summer months, it may be necessary to open the cool air vent in the air intake sleeve on the carburetor, as the excessive heat drawn through the intake does not form a perfect mixture. It also adds to the heat of the motor.

#### **GASOLINE TANK**

Gasoline should be carefully strained before being placed in the tank to remove the sediment which will eventually clog the filter screen in the carburetor.

Vibration will in time cause a loosening of the gasoline pipe connections, causing leaks. Remedy these as soon as they appear, as they are dangerous and also wasteful of fuel.

In order that the gasoline will flow properly to the carburetor, there is a small hole in the top of the filler cap on the tank so that air can enter as the quantity of gasoline in the tank is decreased. It is essential that this hole be kept open.

#### **VACUUM TANK (STEWART)**

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.

This is accomplished by the use of a vacuum tank mounted under the hood, the construction of which is illustrated in Fig. 38.

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.

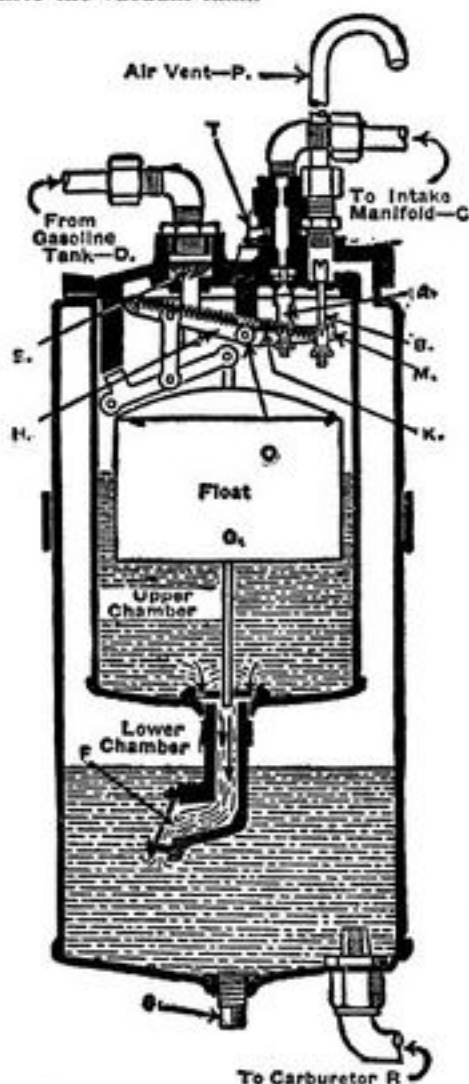


Fig. 38—Vacuum tank. (Stewart).

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 C, 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 D, at the base of which a small wire strainer E 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 F, 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 F. 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 D. Mounted inside of this chamber is a metal float G, and as the gasoline rises in the chamber the lever H moves upward until when the proper quantity has been obtained the direction of pull on the springs K is reversed, which causes the lever M to move upward. This action closes the valve A, thus shutting off the suction from the motor, and opens the valve B, which allows air to flow into the chamber through the vent pipe P.

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

### FUEL SYSTEM (G. G.)

The principle on which the "G. G." Fuel System operates is as follows: The rotation of the motor creates, by means of a small pipe connected to the intake manifold, a partial vacuum within the inner chamber, which is communicated through the vacuum feed to the gasoline tank in the rear of car. This causes the fuel to be forced by suction into the inner chamber of the vacuum system. When the gas reaches the level, the valve is automatically closed by action of the float, thus the "Suction" of the motor, having been temporarily eliminated, normal or atmospheric pressure is established within the inner chamber, by means of air entering through the small permanent vent, which is located between the screen, and the outlet to the manifold.

The weight of the gasoline now opens the lower valve, whereby the gasoline flows rapidly from the inner into the outer chamber of storage reservoir, which is independent of any suction of the motor, and functions simply as a storage tank supplying gasoline by gravity to the carburetor.

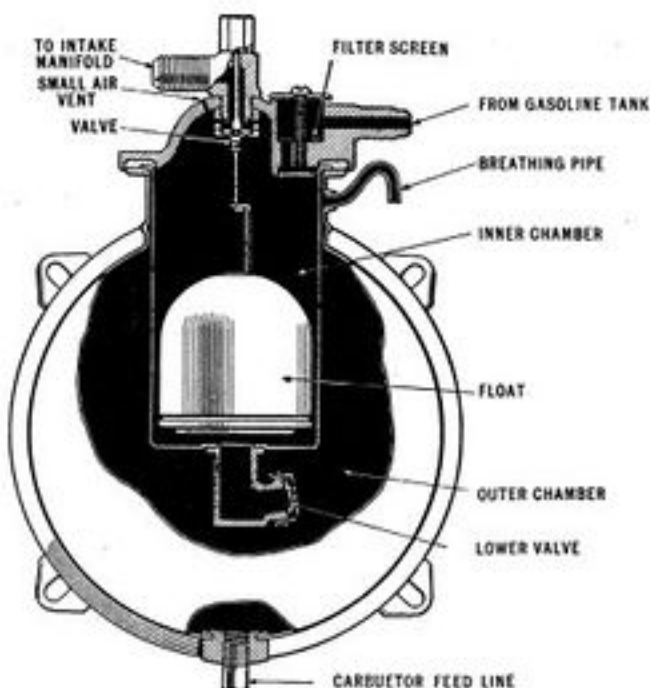


Fig. 39—Fuel System.

#### IGNITION

The engine derives its power from the explosion and expansion of compressed gas in the engine cylinders, the expansion driving down the pistons, which produces power.

These charges of gas are ignited by an electric spark made in the engine cylinder, the electric current being produced by a battery and a generator, the battery furnishing the current when the motor is running slowly.

When the generator speed increases beyond a certain point, the circuit breaker (Fig. 45) closes the generator circuit and the generator charges the battery and furnishes current for the ignition. This current is called the primary current, which ranges from six to eight volts and is distributed at regular intervals by the breaker arm contacts in the distributor to the coil, through the primary wire, where it is transformed to a high tension or secondary current which flows to the distributor through the high tension wire and from the distributor to the spark plugs.

The ignition equipment used on Chevrolet Cars is designed to give an even hot spark at all times regardless of engine speed. It is therefore possible to run your car at slow speeds with an even flow of power, also to accelerate the motor without stalling.



Care should be taken to see that all terminals are tight and that the instrument is kept clean.

#### 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 or jeweler's file, insert the blade between the contact points, then press them together firmly with the fingers (Fig. 41), 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 fully open the space between is  $1/32$  inch.

**CAUTION**—The contact points are made from thin discs of tungsten, so care must be taken to remove only enough metal (when truing points) to get parallel surfaces. When the tungsten has been removed by reason of frequent refiling, a new adjustable point and contact arm can be secured by writing us or the maker of the instrument.

#### RETIMING DISTRIBUTOR

Should it become necessary to remove the distributor assembly, loosen the two clamping bolts through the split collar on the gen-

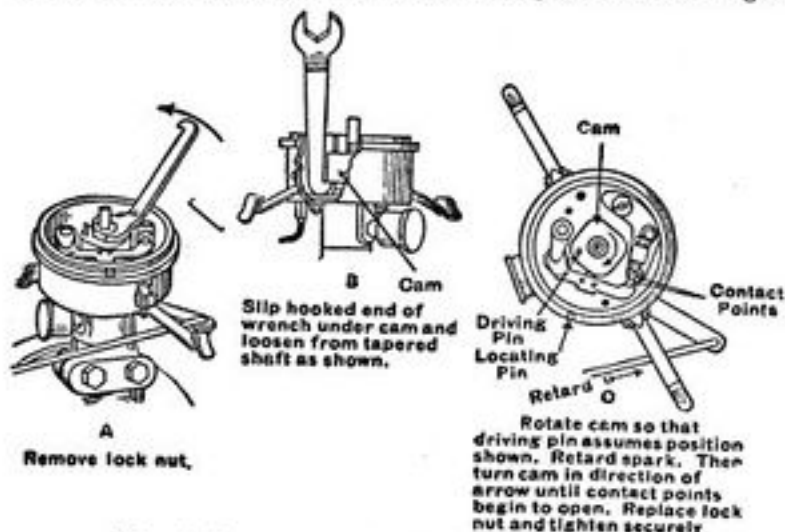
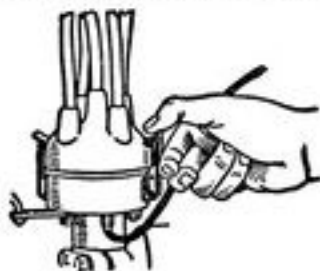


Fig. 40—Disassembling Distributor to clean points.

erator housing and lift the entire assembly. In replacing care should be taken to see that the shoulder on the machined end of the distributor housing comes in contact with the generator housing, otherwise the gears will not be in proper engagement.

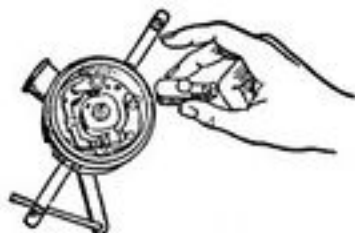
The clamping bolts can then be tightened securely and the advance rod connected. Remove the distributor cover and distributor arm, as in Fig. 40, then remove the lock nut holding the igniter cam to the shaft and pry upward to loosen it from the shaft (the igniter shaft is tapered and the cam is held to this taper by friction so that it should not require a great effort to loosen it).



**Fig. A.**  
Unclasp spring hinges  
on the sides of igniter



**Fig. B.**  
Remove distributor  
case and wires



**Fig. C.**  
Remove distributor arm



**Fig. D.**  
Open arm and insert file  
between contact points



**Fig. E.**  
Close contacts and square  
points by moving file up  
and down three or four times



**Fig. F.**  
Adjusting contact points

**Fig. 41—Disassembling Distributor to clean points.**

Insert the starting crank and turn until the intake valve on No. 1 cylinder begins to open—remove the spark plug on that cylinder and insert a screw driver or rod (Fig. 42)—continue to turn

the motor until the piston has traveled downward and again returned to its uppermost position. By holding the screw driver or rod firmly the position of the piston at which no further upward movement takes place can be readily determined. The piston is then on "top dead center" of the compression stroke and the gases have been compressed ready for firing.

Next turn the cam on the igniter shaft so that the driving pin assumes the position shown in Sketch C, Fig. 40. Retard spark, then turn the cam in the direction of the arrow until the two contact points begin to open—by the term "begin to open" we mean that point at which the two contact surfaces no longer touch each other.

The lock nut can then be slipped on the shaft and securely tightened against the cam; however, in doing this use care not to disturb the position of the cam. The distributor arm and cap can now be put in place and the car operated.

The sequence of firing is 1-2-4-3, the No. 1 wire being the one immediately above the small slot on the edge of the distributor case.

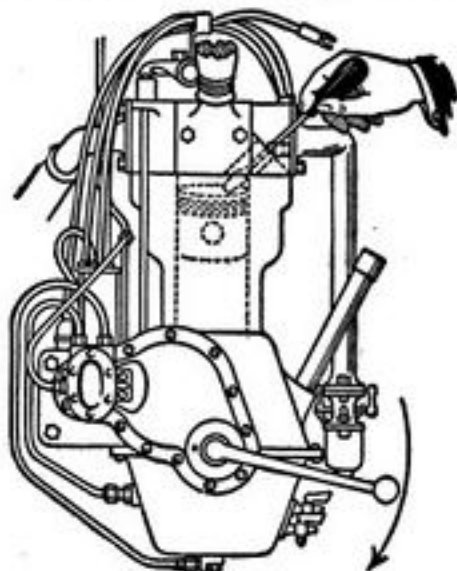


Fig. 42—Locating "Top Center" position of piston.

This slot fits over the locating pin on the rim of the igniter body. The rotation of the igniter is called "clock wise," that is, it turns in the same direction as the hands of a clock, therefore in the same direction will come the No. 2 wire, then No. 4, and lastly No. 3.

Remember that for every revolution of the motor the igniter shaft is revolving at the same speed, therefore it is necessary to

turn down the grease cup one-quarter turn every day to insure proper lubrication at this important point.

Keep the top of the distributor clean—examine the wires occasionally to see that they are in good condition and that no oil or grease is allowed to remain on them; in short, make it your business to see that the entire ignition assembly is kept in a clean and healthy condition and you will have no cause to fear exasperating break-downs or delays on the road.

### **ELECTRIC STARTING AND LIGHTING SYSTEM**

The system used on Chevrolet Cars is known as the two-unit type; 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 GOVERNOR, 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 igniter and lighting system or the starting motor when needed.

The STARTING MOTOR, which receives 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.

AN AMMETER, which registers on a dial the charging or discharging rate of current flowing 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 you should consult a competent electrician as quickly as possible.

A STARTING SWITCH, whose function 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.

### THE GENERATOR

The construction of the generator is of the utmost simplicity, and beyond a few drops of oil every 500 miles requires no attention. The machine is inclosed in a dust and moisture proof shell which effectually protects it from oil and dirt. The generator is driven by a gear meshing with the camshaft gear housed in the gear case at the forward end of the automobile motor.

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*. (Fig. 43 and 44).

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

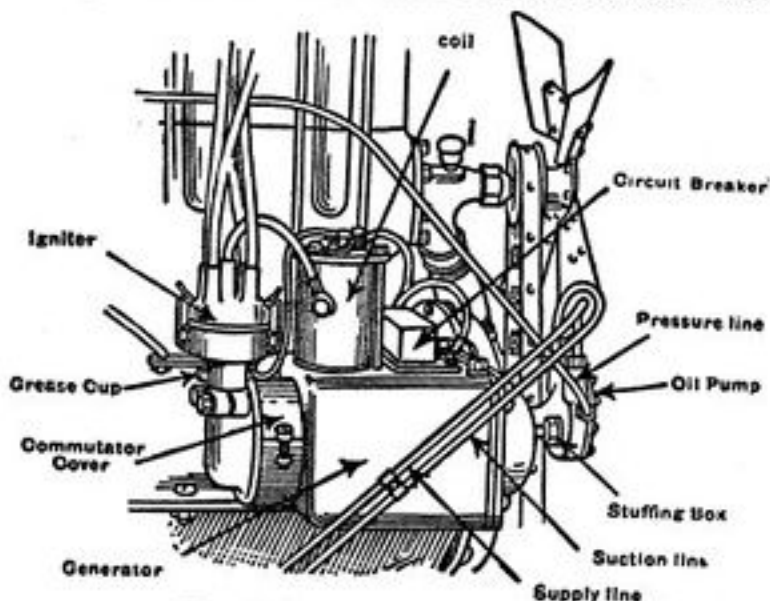


Fig. 43—Generator and Ignition Set  
(Square Type)

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 have 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.

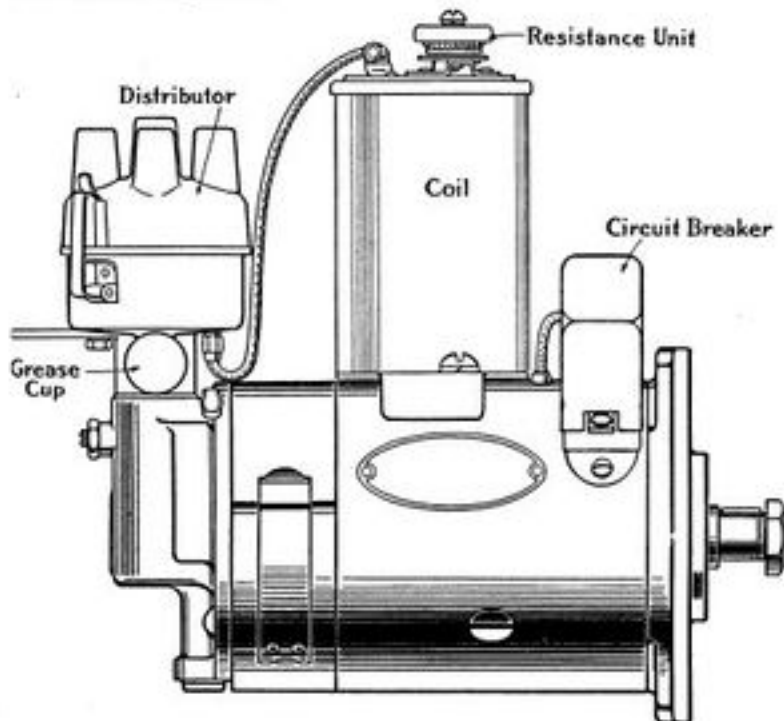


Fig. 44—Generator and Ignition Set  
(Round Type)

See that the brushes are making even contact with the commutator. When they become worn to such an extent as to need replacement order new ones from your dealer or direct from the factory. **DO NOT USE CHEAP CARBON BRUSHES OR SUBSTITUTES.**

The brush holders must be entirely insulated from the generator case. Should any of the insulating plates or bushings become torn or broken they must be replaced with new ones.

Should it be necessary to operate the car with the generator to ammeter primary wire disconnected at the generator, **BE SURE TO CONNECT A SHORT PIECE OF COPPER WIRE BETWEEN THE TERMINAL**

POSTS OF THE GENERATOR. Remove this when again connecting up the battery

In case of any trouble with the generator winding or serious damage to an important part, the machine should be returned to the manufacturer for adjustment and repairs.

Once every 500 miles lubricate the bearings with a few drops of good machine oil through the oilers provided. Do not use too much oil, as only enough to soften the grease in the bearings is necessary. DO NOT, UNDER ANY CIRCUMSTANCES, GET OIL OR GREASE ON THE COMMUTATOR OR BRUSHES.

### CIRCUIT BREAKER

The circuit breaker is entirely automatic and requires no lubrication or attention. If for any reason the instrument should fail to

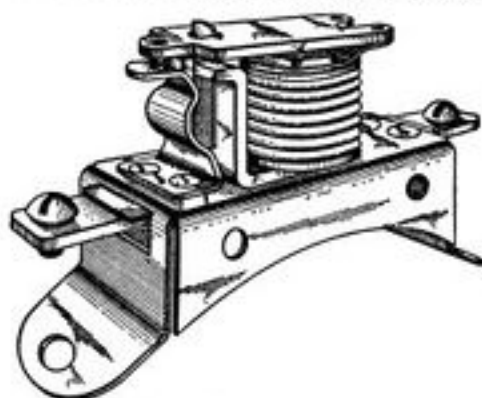


Fig. 45—Circuit breaker cover removed

operate properly, it should be returned to the manufacturer for adjustment. 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.

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 very fine jeweler's 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 or return the old one to the nearest Auto Line Service Station for repairs.

### 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.

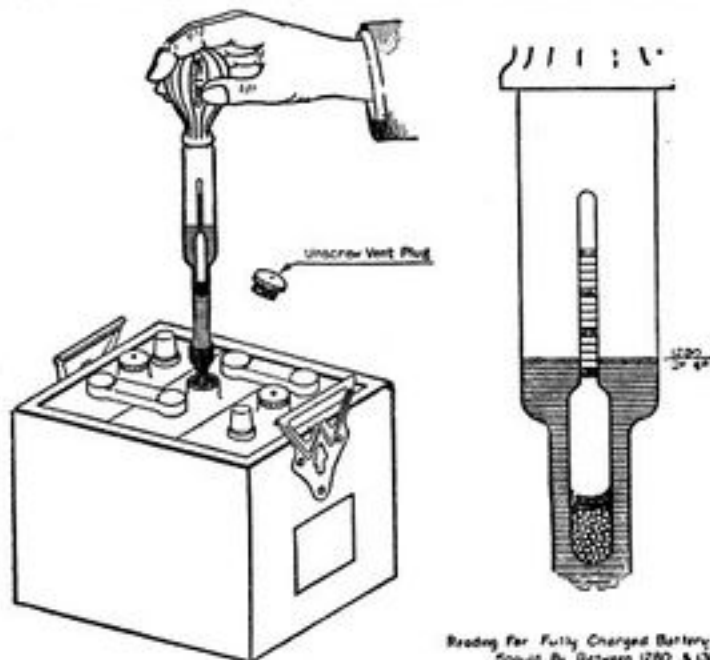
A Storage Battery is an electro-chemical apparatus entirely different from the mechanical parts of the car. Its life depends on the care which it receives and the kind of service demanded from it.

### PROPER BATTERY CARE

1. When a new car is purchased, the owner should go to the nearest Authorized Battery Service Station of the battery manufacturers immediately and have the battery registered in order to take advantage of their 90-day insurance policy. Also ask for a Service Card on which the registration date will be written.

If you buy a battery to replace the one you now have, it will be registered when sold.

2. If your car is not new, call at an Authorized Service Station and get a Consulting Service Card which will entitle you, without charge, to testing and filling service twice a month. At the same



Reading for Fully Charged Battery  
Should Be Between 1280 & 1308

time you will be given advice which will help you to get the best possible service from your battery.



3. Test all cells with a hydrometer on the first and fifteenth of every month. If any cells are below 1.275 on two successive testing dates, take the battery to an Authorized Battery Service Station and have it fully charged. In taking these readings, care should be exercised to return the electrolyte from the hydrometer syringe to the same battery cell from which it was taken.

4. Keep all cells filled with distilled water to a level  $\frac{1}{2}$  in. above the top of the plates. Never fill ABOVE this level.

5. Keep the battery and the battery compartment clean and dry.

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

7. 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 an Authorized Battery Service Station, which will prescribe what is necessary. If the temperature reaches 120° F., the battery may be ruined.

8. In order to prevent freezing in cold weather, test your 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.

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

10. If you lay up your car, the battery should be removed and placed in storage with an Authorized Battery 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.

#### AMMETER

The ammeter is self-contained, and requires no attention, except that the accuracy of its reading should be checked up occasionally to make certain that no short circuit has bent the pointer or otherwise injured its internal parts. To test for accuracy, remove the wires from the ammeter terminals or the positive (+) wire from the storage battery. The ammeter pointer should now stand at "zero," and any difference between where it actually stands and "zero" is the degree of error, and should be allowed for when observing ammeter readings.

When for any cause it is necessary to remove the ammeter and operate the car without it, the two wires which were attached to the ammeter terminals should be firmly fastened together and the bare spots covered with electrician's tape.

## STARTING MOTOR

The starting motor is mounted on the rear motor supporting arm, having a pinion, which automatically engages the toothed edge of the fly wheel 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. 46 and 47, with the weight underneath. Because of the weight, the pinion is too heavy to turn

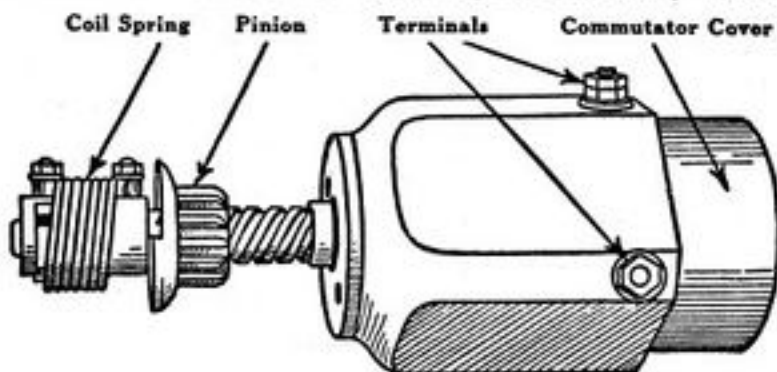


Fig. 46—Starting motor.  
(Square Type)

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 fly wheel and keeps on moving along until it reaches a stop at the end of the threaded sleeve. The pinion and the fly wheel 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 service, but since it is engaged with the fly wheel 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 fly wheel.

As soon as the gasoline engine starts under its own power, the fly wheel 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 screwed on the threads of the sleeve like a nut on a bolt until it has been screwed out of mesh with the fly wheel gear. Should the operator of the car, through error, not immediately re-

move his foot from the starting button, 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 fly wheel gear. This demeshing movement and clutching action is entirely automatic.

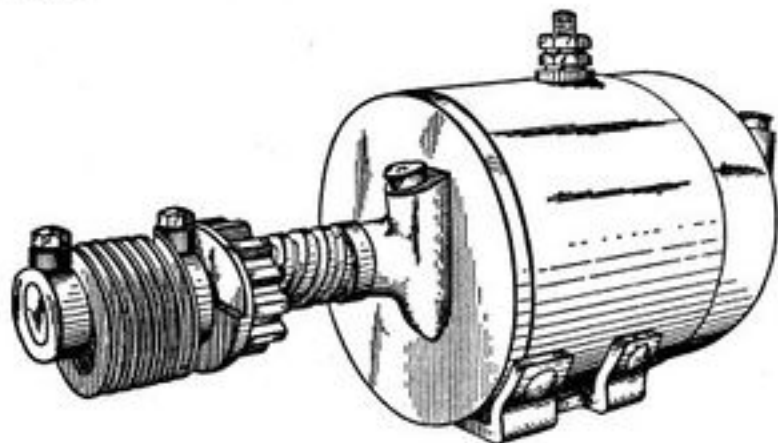


Fig. 47—Starting Motor (Round Type)

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 be in good working order to prevent damage to the teeth on the fly wheel gear.

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 support, to loosen and possibly shift the starting motor slightly, throwing the pinion out of proper alignment with the fly wheel 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 fly wheel gear, and any disalignment observed and corrected.

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.

#### LOCATING 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 diagram (Fig. 44), should trouble be looked for in the electrical instruments themselves.

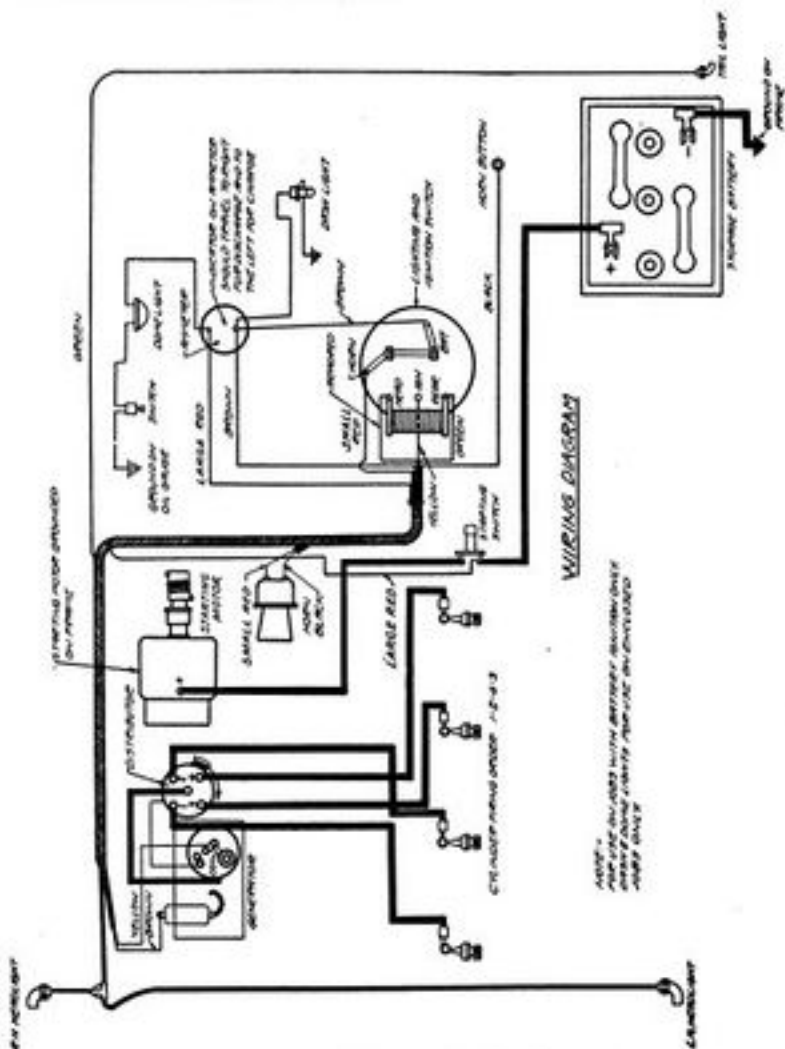


Fig. 48—Wiring diagram.

#### SHORT CIRCUITS

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 CON-**

NECTIONS 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 the rear of the lighting switch. 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 battery, and if the hand goes back to zero it shows that there is a leak or a short circuit, which should be remedied at once. If the hand does not go back to zero, the needle is bent. (See care of ammeter.)

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 send to the makers for repairs 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 manufacturers as instructed.

You may operate your car while the ammeter is being repaired by connecting the two ends of the wires removed from the ammeter. Be sure to thoroughly cover the connection with electrician's tape.

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 service station maintained by the battery manufacturers 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.

#### WINTER STORAGE OF CARS

When it is found necessary to store the car during the winter months, the water should be thoroughly drained from the radiator and motor, after which the engine should be run under its own power until it becomes thoroughly heated. Do not run the motor too fast, but keep it going long enough to evaporate every particle of water that may be "pocketed" to prevent the water freezing and possibly bursting the water jackets.

It is desirable to remove the tires and place them in a room

where they are not subjected to extreme temperature changes. The casings should be thoroughly cleaned to remove all oil which may have adhered to them. After removing the tires, thoroughly clean the inside of the wheel rims and apply a coat of enamel to prevent rust, which is very injurious to the fabric of the tire.

If the tires are not removed, jack up the car so that the wheels clear the floor at least two inches, and let the air out of the tubes.

UNDER NO CIRCUMSTANCES should the car be stored in a barn or other building in which horses or cattle are kept at the same time. The ammonia fumes given off will quickly discolor the paint and enamel. Select a building having a good roof, and preferably a wooden floor raised several inches from the ground.

All bright metal parts should be thoroughly coated with slab oil, vaseline, cosmic or gun grease to prevent rusting.

#### CARE OF TOPS

The top of the car should be thoroughly cleaned and all dust brushed out. Never attempt to clean the top or curtains with gasoline or kerosene—use a good brush or broom.

If possible the top should be kept open, which will keep it well stretched and smooth. If this cannot be done, use care in folding it—see that the folds are straight and that none of the fabric is pinched between the bows or supports.

Do not fold the top until it is thoroughly dry, because any moisture remaining in the fabric will likely cause mildew, resulting in an unsightly and leaky top.

#### CARE OF CLOTH UPHOLSTERY

To clean the cloth upholstery on Sedan Bodies, use warm water and Ivory Soap only. Gasoline has a tendency to spread the grease and leave a discolored spot.

After cleaning, wipe dry with a clean cloth.

#### TREATMENT OF BATTERIES IN STORAGE

If the car is to be placed in storage for any length of time without the battery being removed, it should be thoroughly charged. The hydrometer should show that the gravity of the electrolyte in each cell is up to 1.280.

Tests should be made at intervals of two weeks, and if necessary the engine should be run until the hydrometer shows the reading given above. This is especially essential in freezing weather, as a battery in a discharged condition will freeze and considerable damage might result.

The proper method of handling a storage battery, if the car is to be placed in storage either in winter or summer, is to remove the battery from the car and take it to a Service Station where for a nominal sum it can be either placed in dry storage or kept on a tickler charge which will insure it against any damage resulting from standing in a discharged condition and the owner will derive the best results when the car is again placed in operation.

## DIRECTIONS FOR ORDERING PARTS

When ordering parts be sure to give the model, year produced and car number for which parts are desired.

The model and car number on the model "Four-Ninety" will be found on the name plate attached to the dash under the instrument board.

The model and car number on Superior model will be found on the name place attached to the front seat frame visible when the left front door is open.

If in doubt as to the name of the part needed, send the broken part to your dealer or the factory or nearest Distributing branch, indicated by \* on page 5, attention of Parts and Service Department by PREPAID EXPRESS. Write your name and address plainly on the package so that it can be identified upon arrival. Write a letter the same day shipment goes forward, stating the purpose for which it is returned, REGARDLESS OF ANY PREVIOUS CORRESPONDENCE.

In ordering from the factory or nearest Distributing branch, attention of Parts and Service Department, if possible always send cash with order because we cannot open accounts except with our regularly appointed dealers, who maintain a deposit sufficient to cover their accounts. ORDERS NOT ACCOMPANIED BY CASH WILL BE SENT C. O. D.

In ordering parts by telegram, be sure the message is PREPAID. COLLECT MESSAGES WILL NOT BE ACCEPTED by this company. Always confirm the telegram by a regular order, marked "confirmation of telegram," through the mail.

All Chevrolet dealers carry a stock of such parts as are needed most frequently; therefore, delays can be avoided by ordering from your nearest dealer.

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