Suggestions for Operation and Care of the

MOTOR CHANDLER CARS

New Series Model

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Identification Sheet

TO THE OWNER:

Please fill in and detach this sheet, mailing it to the Chandler Motor Car Co., Cleveland, Ohio.

The serial number will be found stamped on the brass plate attached to the front motor arm.

Keep a record of this serial number. It is important whenever corresponding with the dealer or the factory that you mention the serial number of your car. It enables us to identify the car equally as well as though we were looking at it.

Serial Number.....

Date of delivery to you.....

Owner's Name.....

Address.....

City.....

State.....

Car purchased from.....

CHANDLER GUARANTEE

We guarantee Chandler Motor Cars for ninety days from date of delivery to the original purchaser—this guarantee being limited to the replacement or repair at our factory of such parts of the car as shall, under normal use and service be judged by us to have been defective in material or workmanship.

This guarantee is limited to the shipment to the purchaser or dealer, without charge, except for transportation, of the part or parts repaired or intended to replace the part or parts claimed to have been defective, which parts, upon the return to us at our factory for inspection, transportation prepaid, we shall have determined were defective.

This guarantee does not apply to repairs or replacement made necessary by accident, carelessness, negligence or abuse. It does not include adjustments, tuning up, general overhauling or replacement of parts worn out in service.

Our liability under this guarantee shall cease if the car to which it applies is altered or repaired outside of our factory or the shops of our authorized dealers.

We make no guarantee in respect to tires, rims, magnetos, lamps, starters or other accessories not manufactured by us other than the guarantees given by the manufacturers of these appliances. Claims as to these should be made to the manufacturers direct.

The purchaser understands and agrees that no other guarantee of the car is made or authorized to be made by the company other than therein above set forth.

Introductory

The suggestions contained within the following pages, if carefully followed out, will aid the owner materially in obtaining first class service from his car at all times.

Familiarize yourself with the oiling charts and the necessity for proper lubrication from time to time. Lubrication is one of the most important points in the daily upkeep of a car, and should not be neglected.

Learn to drive and control the car properly. Do not attempt to change mechanical adjustments, unless conditions are such that a change will prove beneficial, and unless one is thoroughly familiar with the proper adjustments it should not be attempted.

As an owner you will serve your own best interest by keeping your car in as good condition as when it left the factory. A little care and attention of the right kind at frequent intervals will pay big dividends in pleasure and comfort, insuring long life to your car.

A new car should be handled with good judgment during its first thousand miles. Drive the car carefully. Do not attempt excessive speed. Change the motor oil at the end of the first five hundred miles. Proper handling and care during the first thousand miles of driving is very important.

ORDERING PARTS

Chandler distributors are conveniently located in practically every state in the Union. They aim to have on hand at all times a complete line of parts, therefore all Chandler owners are requested to place all orders for parts required for repairs with the nearest Chandler distributor. In the event they should be temporarily unable to supply a certain part, they will immediately place the order with the factory for shipment to them or to the customer.

Orders for parts should not be made a part of any letter covering several other subjects.

Always state clearly what part or parts are wanted, whether they are used on the right or left hand side of the car and whether for front or rear. This information applies particularly to fenders, wheels, doors, mud splashers, running boards, etc.

Give shipping directions and method of forwarding. In the event that information is neglected, the distributors will undoubtedly use their own judgment, making the shipment via freight, express or parcel post.

ALWAYS MENTION SERIAL NUMBER OF CAR FOR WHICH PARTS ARE INTENDED. IT IS ABSOLUTELY NECESSARY THAT THE DISTRIBUTORS HAVE THIS INFORMATION BEFORE FILLING THE ORDER.

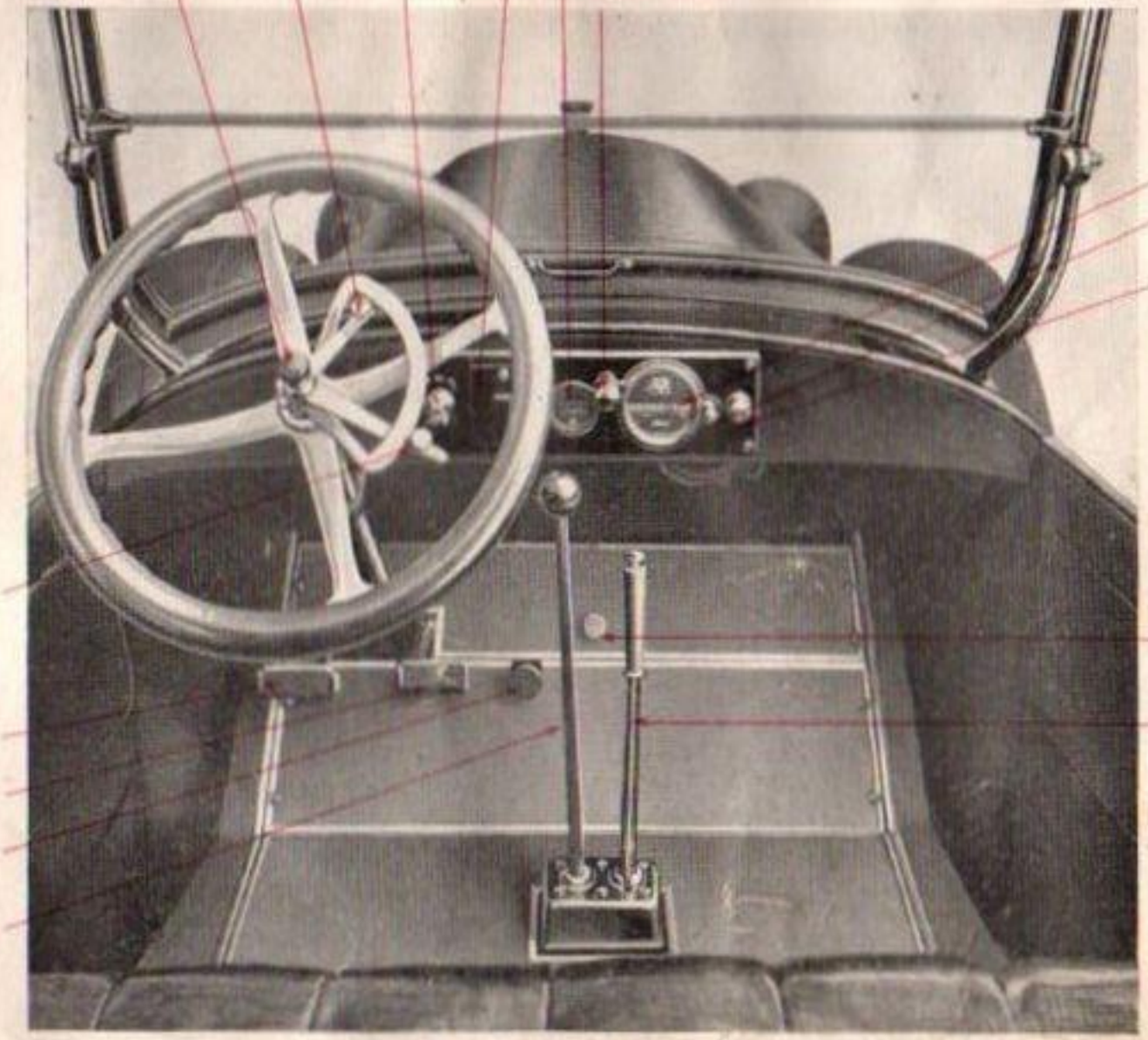
The serial number will be found stamped on a brass plate attached to the right hand front motor arm.

WARNING

Make it a point to change the motor oil frequently. This should be done at least once in every five hundred miles both winter and summer.

The extra expense involved through more frequent changing of the oil will be more than repaid through added life to the bearing surfaces in the various parts of the motor.

Do not neglect this point.



DRIVING COMPARTMENT

PREPARATION

Before attempting to drive the car, make sure it is ready for the road. See that there is gasoline in the tank and that the radiator is filled to the level of the overflow pipe with clean water. SEE THAT SUFFICIENT OIL IS CONTAINED WITHIN THE MOTOR AS INDICATED BY THE OIL LEVEL INDICATOR AT THE LEFT OF THE MOTOR, AND THAT THE STORAGE BATTERY IS PROPERLY CONNECTED. See that the gasoline shut-off cock between the vacuum tank and the carburetor is fully open.

If the car has been standing idle for several days it may be necessary to prime the vacuum tank by removing the pipe plug in the cover and introducing a pint or so of gasoline. Be sure to screw the plug in tight after replacing it, otherwise the vacuum tank might refuse to operate.

HOW TO START MOTOR

See photograph on page 9.

See that the gear shift lever is in neutral or cross over position.

Close the magneto switch circuit by inserting the key and turning to the right. This is a small key which is removable and locks both the ignition and lighting systems.

Advance spark lever to a point about one inch from the top of the quadrant.

Advance the throttle lever about one inch from the bottom of the quadrant.

Pull out the choker, enriching mixture furnished by the carburetor.

Press down firmly on the starter pedal, connecting the motor with the engine, allowing the starting motor to crank the engine until it picks up under its own power, when the pedal should be immediately released. At the same time the choker or the carburetor dash control, as it is sometimes called, should be pushed in three or four notches and allowed to remain during the first few minutes of driving until the motor warms up sufficiently so that it will operate with the choker or dash control fully closed or pushed down. Close the throttle lever on steering wheel until the motor runs slowly and evenly.

NEVER ALLOW THE MOTOR TO RUN FOR ANY LENGTH OF TIME WITH THE CHOKER PULLED CLEAR OUT. THIS GIVES AN EXCESSIVELY RICH MIXTURE AND ALSO CONSUMES AN ABNORMAL AMOUNT OF GASOLINE.

In the event the motor is warm from previous running it should start within a few seconds. In winter the motor may not start as readily as in warm weather. Do not, however, allow the starting motor to crank the engine indefinitely.

If the car has stood for any length of time, for instance during the winter season, and is being placed in commission for summer driving, watch the oil indicator closely to see that it indicates the passage of oil when the motor is started. If it does not it might be well to remove the oil pump and see that all parts of it are in good order. Before reassembling the pump see that it is thoroughly saturated with oil. If the car has stood idle for several months all of the oil in the pump may have gradually drained, leaving it dry.

While the starting motor is cranking the engine it is a good plan to release the clutch by pressing down the clutch pedal, which is the pedal on the left. Hold the clutch out while the starting motor is cranking the engine. This practice is not so important during warm weather as it is during the winter and fall, when the oil in the transmission will congeal around the gears. If the clutch is engaged the starting motor cranking the engine will also have to drive the countershaft gears in the transmission, and since considerable electrical energy is required when cranking the engine with the starting motor it would be a good plan to release the clutch, making it unnecessary for the starting motor to drive the transmission countershaft gears, which would be the case were the clutch left engaged.

In colder weather, when the car has stood long enough for the oil within the transmission compartment to congeal, quite a little effort is required to break the body of oil that will adhere to the countershaft gears.

After the engine is running under its own power, the clutch may then be engaged.

DO NOT PRESS THE STARTER BUTTON WHILE THE MOTOR IS RUNNING.

SHIFTING GEARS

(See Illustration Page 9)

First Speed

Release the clutch by pressing down with the left foot. Pull the shifting lever toward the left and back into first speed. Relieve the pressure with the left foot, allowing the clutch to come in gently. Increase the speed of the motor slightly as the clutch is let in, either with the use of the foot accelerator or the throttle lever on the steering wheel. (For a beginner it may prove more practical for a short time, until one gets accustomed to the car, to use the throttle lever on the steering wheel, leaving the right foot on the brake pedal for emergencies.)

Second Speed

Open the throttle sufficiently so that the car speed will increase to about five miles an hour. Then close the throttle, at the same time release the clutch by pressing down with the left foot, then move the gear shift lever forward into neutral position and to the right as far as it will go and forward into second speed. (When shifting from first into second speed be careful not to carry the shifting lever too far forward into reverse.)

Engage the clutch gently, and at the same time open the throttle, allowing the car to pick up to a speed of about ten miles an hour, when the shift may be made into third speed.

Third Speed

Close the throttle; at the same time release the clutch and pull the shifting lever straight back into third or high speed. Let the clutch in gently, accelerating the motor slightly at the same time.

Reverse

Whenever necessary to reverse the direction of the car bring the car to a dead stop. Proceed the same as when engaging the other speeds; that is, close the throttle, press down on the clutch pedal, bring the shifting lever to the left as far as it will go and straight ahead into reverse, letting the clutch in gently, slightly accelerating the motor at the same time.

Before engaging first speed again bring the car to a full stop.

That is quite necessary, relieving the mechanism of the unnecessary strain which would result if the gears were shifted either into first or reverse speed with the car moving in the opposite direction.

Never change gears without first releasing the clutch, thereby disconnecting the motor from the transmission. If the

gears do not mesh readily on the first attempt, do not try to force them, but try it over again, bringing the car to a full stop if necessary.

Always allow the clutch to come in gently after shifting gears. Practice changing gears until the art is thoroughly learned. As you become familiar with the car you will be able to accelerate the motor to the proper relative car speed so there will be no jerking, jarring motion or clashing of the gears.

Use of the Brakes

One of the most important things in the operation of a car is to know how to stop and control it. As you become familiar with its operation you will find, in nearly all cases, the speed of the car may be controlled by the throttle.

When the throttle is open it automatically increases the engine speed; that in turn increases the car speed. When the throttle is closed the tendency is for the motor to slow down to a certain prearranged speed, equal to from three to five miles an hour in car speed. With the clutch engaged, however, the momentum of the car continues to carry it forward, at the same time driving the motor at a higher rate of speed than the throttle opening calls for, and under those conditions the motor acts as a brake, gradually slowing the car down to a speed of from three to five miles, depending on the throttle opening.

When preparing to stop, pick out the place where you intend to bring the car to a standstill, close the throttle and allow the car to coast under its own momentum. When you reach the point where you wish to slow down preparatory to stopping the car altogether, press down on the clutch pedal and apply the foot brake gradually, until the car comes to a standstill.

After bringing the car to a full stop, move the shifting lever to neutral position, relieve pressure on the clutch pedal, shut off the ignition and set the emergency brake.

On wet and slippery pavements it is more than ever necessary to keep the car under perfect control, since sudden applications of the brakes may lock the wheels and allow the car to skid.

A car which is skidding may be controlled by turning the front wheels in the same direction, for instance, if the skid is toward the right, turn the front wheels sharply to the right. Release the brakes if they have been applied and leave the clutch engaged.

When driving on a slippery road avoid getting into tight places where a sudden stop may be required. Do not press out the clutch when the brake is first applied, but apply the brake gently, slowing down the car, leaving the clutch engaged and the gears in mesh, since the motor will keep the rear

wheels turning and serve to keep the car steady. Before the car reaches a speed slower than the relative speed at which the motor would drive it, release the clutch.

If the car is left standing on a grade set the emergency brake and, as an added precaution, move the shifting lever into one of the speeds. For instance, if the car is on a grade facing uphill, shift into first or second speed, or if the car is left on a grade facing downhill, place the lever in reverse. Always remove the ignition switch key when the car is left standing, especially if the gears are in mesh.

As an extra precaution, turn the front wheels in toward the curb, so that, should anyone tamper with the car and release the emergency brake, the compression in the cylinders and the fact that one of the wheels is set against the curb will serve to hold the car.

Shifting from a Higher to a Lower Speed

Shifting from a higher to a lower speed is more difficult than shifting from a lower to a higher speed.

When traveling on a level road never shift from a higher to a lower speed until the car is traveling very slowly. Release the clutch, apply the brake gently, when you will find a shift from third to second or from second to first can be made quite easily without noise. When ascending a hill in third speed, if the motor begins to labor, making it necessary to shift to second speed, release the clutch, make the shift quickly from third to second or from second to first, as the case may be, before the car loses its momentum altogether.

When shifting to a lower speed while ascending a hill, close the throttle at the same time the shift is made, immediately opening it again sufficiently to pick up the car as the clutch is engaged.

Driving

Until you become thoroughly familiar with the control of the car and how to steer do not attempt fast driving. Watch the road ahead and slow the car down before attempting to turn corners. Slow down when approaching street intersections, railroad crossings and danger signs in the roadway. Practice steering until you become thoroughly familiar with the motion of the car, when you can then give your undivided attention to the road ahead. Usually the car is driven in high gear under all conditions, but occasionally when encountering a steep hill or a stretch of sandy or muddy road, which the car may not negotiate as well in high as it would in lower speed, and since the transmission is provided with lower speeds for such occasions when they arise, you should use second speed, or even first, so as not to throw an unnecessary strain on the motor and other mechanism of the car.

Oil Sight Feed

When the motor is first started, watch the oil sight feed, see that it denotes oil is passing through the oiling system. Should the hand not indicate pressure at any time while driving or when first starting, increase the oil pressure by speeding the motor slightly, since, with the motor turning over slowly, pressure sufficiently to show on the gauge may not develop.

Failure of the oil gauge to register should be investigated. **Do not drive the car or allow the motor to run if the gauge does not indicate passage of oil. Stop the motor and inspect the oil level in the motor.** If the oil is low, refill to the proper level. If the oil level is at the proper point, examine the connections between the instrument board gauge and oil line for air leaks.

If the oil within the motor is very thin the gauge may not register until the motor attains a higher rate of speed. In that case the old oil should be drawn off and a new supply placed in the oil pan.

In winter, especially in cold climates, the oil will congeal if the car is kept in a cold garage or allowed to stand out on the street during the day or night for any length of time. When that occurs at low temperatures the oil will not circulate and the car should not be driven. If necessary, have the car taken into a warm place and allowed to remain there until the oil becomes liquid and will flow.

Practically all automobile cylinder oils will congeal if exposed to zero temperature, and under the circumstances the driver or owner must realize that proper lubrication of the motor cannot take place if the oil is exposed to a lower temperature.

Under any circumstances, if the gauge does not indicate the passage of oil, do not run the motor until an investigation has been made. If necessary, remove the oil pump, which you will find is bolted to the side of the crank case, just back of the carburetor. See that all the working parts of the pump are in good order, and before reassembling, see to it that all parts of the pump are thoroughly saturated in oil.

Racing the Motor

Do not race the motor unnecessarily when first starting, especially when cold. Allow the motor to run slowly for a few minutes until the action of the pump distributes fresh oil to the bearings. Oil congeals in cold weather but thins rapidly after the motor is started. Racing the motor is injurious and not needed at any time.

Washing the Car

Whenever the car gets very dirty or muddy it should be thoroughly washed with plenty of clean water.

When mud has settled on the body, do not attempt to rub it off, but soak it off with water, using a slow stream from a hose without nozzle or metal fitting of any kind. If an attempt is made to remove mud which is settled on the body before it is thoroughly water soaked it will scratch the finish.

A forcible stream of water against the varnished surface will drive grit and particles of mud into the varnish, breaking down the finish, and is sometimes responsible for rapid deterioration of the finish.

Mud and clay may leave spots on the finish if the mud has been allowed to collect without proper washing.

Never use water colder than 40 degrees or warmer than 60 degrees.

Never wash the hood while it is hot. The effect is the same as washing it with hot water, and the lustre will soon disappear.

Only a soft natural wool sponge should be used for washing the body and hood and same should be kept perfectly free from dirt and grit by washing it frequently. Do not rub the finish but go over it several times lightly with the sponge, using plenty of water until perfectly clean.

After the mud has been soaked loose, it may be necessary to use soap. Very often a car can be successfully washed without the use of soap, and since a great many soaps are injurious to varnish, it would be better not to use it except where absolutely necessary, using only cold water instead. Use nothing other than a pure linseed oil soap.

The running board covers may best be cleaned with soap and water.

For removing dirt and grease from the chassis and underneath the fenders, use plenty of soap suds and rinse with running water.

Descending Hills

When preparing to descend a long, steep hill with which you are not familiar, it is well as a precaution to shift into a lower speed, close the throttle and allow the car to drive down the hill under its own power. You will find the car will not travel much faster than the motor will drive it, unless in the event the hill is extremely steep, in which case the brakes should be used in connection with the motor.

Spark Lever

Under ordinary conditions the spark lever should be carried near the top of the quadrant on the steering wheel, unless the car commences to slow down climbing a steep hill or through hard going in mud and sand, relieve the spark by pulling the lever down about half way, or even more. If the motor is laboring with the spark advanced it will commence to pound, the result of what is known as a spark knock.

The Top

Before preparing to fold down the top see that the curtains are folded neatly in the pockets provided at the rear of the top.

Open the bow socket holders so they will receive the top when folded back. Release catches holding top to windshield, raise top until nearly vertical, pull down on the front bow sockets, causing them to give where hinged, allowing the top to fold down. See that the material is compactly folded between the bows before clamping down the bow holders, and then apply the top slip cover, putting it on carefully without jerking. The top slip cover is a snug fit, in order to preserve a neat appearance when applied to the top, and after putting on one or two times can be handled very easily.

When raising the top, first remove the top slip cover, unfasten the bow holders, and, standing in the center of the car, grasp the front bow in the center and pull the top up toward the front of the car. As the top comes up pull down on the front bow, at the same time pressing up on the center bow. When straightened out it can be drawn into position and attached to the wind-shield.

Do not jerk the top in order to close or open it when putting up or down. Jerking will not help, and may result in injury to the bows or bow sockets.

After one or two attempts at putting the top up or down, you will find it works very easily.

Do not fold up the curtains or put down the top while it is wet; allow both the curtains and the top to dry out.

The roadster tops are provided with curtain pockets. When not in use the curtains should be folded neatly and carried under the rear seat cushion.

COLD WEATHER PROCEDURE

Storing Car

With the advance of cold weather extra precaution will have to be taken in connecton with proper care of the car.

Drain Radiator

If the car is "laid up" during the extreme cold weather the water should be drained from the cooling system. Water from the radiator and cylinder jackets may be drained by opening the pet cock in the radiator outlet at the lower left hand corner of the radiator.

Drain Carburetor

Since the carburetor is hot water jacketed, the water that may remain in the carburetor jacket should be drained by opening the pet cock on the side of the carburetor.

Storage Battery

The battery should be taken out of the car and removed

to a warm place and, while not in use, should be recharged occasionally and kept filled with distilled water to the proper level.

If you are located near a Willard Storage Battery Service Station, or any other electrical company making a practice of caring for batteries, it would be well to place the battery in their charge while the car is not in use. By so doing you will be sure of having the battery in good condition when you place your car in commission.

A battery gradually deteriorates, especially when not in use, and if allowed to remain in the car for any length of time without proper care will require considerable rebuilding before it can be placed in service again. In addition, a run-down battery will freeze very easily.

Consult the booklet, "Care of the Battery," which is furnished with each and every car, or write the factory for name and location of nearest Willard Storage Battery Station.

Drain both the vacuum tank and carburetor by opening the pet cocks.

Block up the car so the weight will be removed from the tires and cover the car to protect it from dust.

Clean and wash the car thoroughly before storing. See that all bearing surfaces are properly lubricated with fresh oil and grease. It would also be well to cover the nickeled parts with vaseline, preserving their finish against dampness.

WINTER DRIVING

Freezing Solution

During freezing weather, and to guard against unexpected drops in temperature, an anti-freezing solution should be used in the cooling system.

Wood or denatured alcohol mixed with the water contained within the cooling system will probably answer the purpose as an anti-freezing solution equally as well as any other solution. The following table will indicate the proper solution for your climate:

10% solution will freeze at 22° above zero
specific gravity 987

20% solution will freeze at 10° above zero
specific gravity 975

25% solution will freeze at 4° above zero
specific gravity 968

32% solution will freeze at 3° below zero
specific gravity 959

40% solution will freeze at 12° below zero
specific gravity 948

50% solution will freeze at 25° below zero
specific gravity 935

60% solution will freeze at 38° below zero
specific gravity 923

Specific gravity can be measured with the aid of a standard hydrometer, though the hydrometer used for testing the battery does not have sufficient range.

FREEZING SOLUTION

Keep the cooling system supplied with a proper anti-freezing solution as required.

If the anti-freezing solution is not kept at the proper strength the water in the cooling system is liable to freeze, and if an attempt is made to start the motor it may result in damage to the water pump coupling.

Since the smallest volume of water is in the water pump, it will congeal before the water in the cylinders and radiator is affected. Therefore be careful to keep the anti-freezing solution at proper strength. If the starting motor is used while the water in the pump is partially frozen it may break the water pump coupling disc.

STARTING

Heretofore it has been rather difficult to start the motor in low temperatures, more especially if the car is kept in a cold garage over night or allowed to remain outside during the day. When preparing to start, pull out the choker as far as it will go, and ordinarily the motor will start within a few seconds. If it does not, investigate and make sure that the choker is fully open and that the cam on the choker arm comes in contact with the plunger, which it should do with the choker in a fully opened position. When the plunger is depressed it opens a duct between the float chamber and mixing chamber. The suction of the pistons will draw gasoline into the combustion chamber, much in the same manner as though a primer were used. When the motor starts under its own power, push the choker in one or two notches. If the motor stops when the choker is pushed in, leave it fully open for a few seconds, or until the motor will run with the choker pushed down about two notches or a sufficient distance to release the plunger above mentioned.

Flooding Carburetor

Remove the small brass cap over the center of the float chamber; the top of the needle valve projects through the cover; pull it up several times and hold it for an instant. Press down lightly several times on the auxiliary air valve, that will serve to syphon gasoline into that compartment of the carburetor, then make use of the starting motor, and invariably the motor will start after a few turns.

Priming Cylinders

Should the motor fail to start, introduce a small quantity of gasoline through the pet cocks on top of the motor. Be sure to close them afterwards. Only use a small quantity of gaso-

line for that purpose, not any more than the cup on top of the pet cock will hold when full. If an excessive amount is poured in through the pet cocks it will thin the lubricant in the cylinder walls and might result in the pistons seizing.

Should all other means fail in obtaining results, and you believe the cold temperature is the real cause, as it undoubtedly will be, you will find by filling the radiator and cooling system with warm water the motor can be started almost immediately.

If water in the gasoline lines has frozen, approximately one-half pint of gasoline may be poured into the vacuum tank, after removal of the small pipe plug in the top of it. That will probably be sufficient gasoline to drive the car a short distance to a warm garage, where it may be allowed to stand until the lines have thawed.

During cold weather the cylinder oil within the motor will congeal and not flow freely when the motor is started. Be careful when starting the motor in extreme low temperatures to see that the oil indicator denotes passage of oil through the oiling system. If the gauge fails to register, do not drive the car with the oil in that condition.

Cover Radiator

It is also a good plan to cover the lower part of the radiator, shutting off some of the cold air, causing the water to attain and hold a higher temperature, resulting in greater efficiency. If cardboard is used, be careful in fastening not to injure the radiator.

A radiator and hood cover, designed to cover the hood and radiator, is a good thing for use in cold weather.

Since the cooling system is designed to prevent overheating of the motor in the warmest weather, it naturally follows the engine will be overcooled in winter weather, unless the radiator is partially covered.

Shifting Gears

In extreme cold climates some difficulty may be experienced shifting gears when first starting the car, due to the lubricant congealing within the transmission case. With the approach of cold weather it might be well to drain the lubricant contained within the transmission and differential housing, substituting a lubricant of lighter body, which may be used during the winter months, changing to heavier lubricant with the approach of warm weather.

Care of the Battery

The battery used is commonly known as a wet battery, 6-volt.

A storage battery begins to deteriorate as soon as put into use, and you should familiarize yourself with the instructions for proper care of the battery as contained in the booklet entitled "Care of the Battery," furnished with each and every car. Also refer to paragraph under Storage Battery, Page 18.

Battery Inspection

At least once every week in warm weather an examination should be made to determine whether or not additional water is required to fill the battery to the proper level, and the same inspection should be made at least once every two weeks during cold weather.

Test the battery occasionally with a hydrometer syringe; a battery in good condition will show a test of from 1.275 to 1.300.

First indication of the battery's weakness is made known through sluggish action of the starting motor, dim lights or a low sounding horn. If a test of the battery shows the density of the solution is less than 1.175 it should be charged from an outside source, or, if that is not practical, the lights, horn and starting mechanism should be used sparingly until the generator has an opportunity to build up the battery.

The Willard Storage Battery Company are the manufacturers of the batteries used in our cars, and have service stations located in all the principal cities. You should acquaint yourself with the location of the nearest service station, so that you may know where to go to have a battery recharged or inspected when occasion requires.

It is a common practice for owners to neglect the storage battery, and one never realizes its importance until it suddenly goes "dead" at the wrong time.

The storage battery is not in any way connected with the ignition system, the ignition for the motor being furnished entirely by a Bosch Magneto.

Starting Mechanism

A starting motor equipped with Bendix drive is used for the purpose of cranking the motor.

When the starting pedal is depressed current from the storage battery causes the shaft on which the drive gear is mounted to revolve, bringing the driving gear into mesh with the flywheel, in which position it will crank the motor until the starting pedal is released. The starting pedal or button should be released immediately, as the motor picks up under its own power, allowing the starting motor drive pinion to slip out of mesh with the flywheel.

Aside from proper oiling at stated intervals, the starting motor requires no attention, and should difficulty be experienced, consult the nearest Westinghouse service station or consult the booklet of instructions issued by the Westinghouse Electric and Manufacturing Company of Pittsburgh, Pa.

Reasonable care should be exercised when the motor is running to guard against any possibility of mistaking the starting pedal for the accelerator.

Should the starting pedal be depressed with the motor running it is liable to result in injury to the starting mechanism, the teeth on the flywheel and starting motor drive pinion.

Lighting System

Current for the lights is furnished from the storage battery and controlled by the lighting switch on the instrument board.

If the lights burn dimly, the horn is weak and the starting motor does not seem to turn the motor over as fast as ordinarily, it will usually indicate a weak battery, and the battery should be tested and inspected by a competent battery repair man, preferably by the Willard Storage Battery Service Station.

Be sure that all wiring connections are tight. See that battery ground wire is not loose. See that wires leading to terminals on starting motor and generator are tight.

Lamps Do Not Light—The tail lamp is in series with both the small and large head lamp bulbs. Failure of either one of them to burn when the switch is set at the proper point, might mean a loose connection in the lamp itself or a loose ground within the lamp.

See that the wiring connections to the lamps themselves are in proper position and not loose.

One of the fuses may have been burned; try another fuse in that circuit.

The nickeled head lamp retaining ring furnishes the ground connection for the head lamp bulbs. See that it has not loosened. Press it firmly into position. If that has no effect, and the lamps still fail to burn, the bulbs themselves may be burned out or broken.

Headlamp Connections—If the headlamps connections are removed for any cause, be careful to see that they are installed again in the same position. Examination will show the connections carry a large wire and a small wire, the large wire furnishing current for the larger bulbs and the smaller wire for the dimmer bulb. If replaced in the lamp in opposite position it will result in one dimmer and one large bulb lighting at the same time.

Lamps Flicker; Bulbs Burn Out—If the light flickers when traveling over rough road it will indicate a loose connection. If the bulb in any one socket seems to burn out oftener than the others it may indicate a short circuit. Perhaps a strand of the wire may be touching against the metal conduit.

Lamps Burn Very Brightly or Go Out Suddenly—A loose connection, particularly a ground connection, making intermittent contact, will cause the lamps to burn very brightly as the speed of the motor is increased, and in some cases when the motor is stopped the lights will go out altogether. This does not happen very often, and will only do so when a wiring connection has become disconnected. If the battery is weak the lamps will brighten and grow dim as the motor speed is correspondingly increased or diminished.

Bulbs—The bulbs used in the lighting system are all of

the 6-volt type, Ediswan base and single contact. Their sizes are as follows:

Large headlamp	bulb	18 candle power
Small headlamp	bulb	4 candle power
Dash lamp	bulb	4 candle power
Tail lamp	bulb	2 candle power

It must be borne in mind that if the car is driven nearly altogether at night, when lights are used, that a car speed of approximately fifteen miles an hour is necessary in order for the generator to balance the light load. Under those conditions if the car is used almost exclusively after dark, when lights are required, the battery will run down more quickly than though the car is used during the day time without any load on the battery, giving the generator a chance to restore the current or energy which has been withdrawn.

Generator

The generator, which supplies current to the storage battery, is located on the crankcase at the right hand front corner of the motor and requires no attention other than oiling at stated intervals.

The purpose of the generator is to supply current for the storage battery.

The charging rate of the generator should be checked occasionally, in order to determine that it is working properly.

This should be undertaken only by someone who is thoroughly familiar with the operation of the generator and it is preferable to have this done by a Westinghouse service station.

Any repairs or adjustments to be made on the generator should be undertaken only by someone who is thoroughly competent.

GASOLINE SYSTEM

Vacuum Gasoline Feed

Gasoline is carried in the main supply tank, located at the rear of the chassis, from which point it is fed to the carburetor through the Stewart Warner Vacuum tank suspended from the dash underneath the hood.

That system is extremely simple and reliable, requiring very little attention aside from the fact that the fuel tank at the rear of the chassis should be kept supplied with gasoline and the vent hole in the gasoline tank kept free and open for the passage of air which is required for the proper working of the vacuum gasoline feed.

A card of instructions, issued by the Stewart Warner Speedometer Corp., distributors of the Stewart Warner Vacuum Feed tank, is included with the tool equipment of each car. You should study this card and familiarize yourself with its contents. Aside from cleaning the strainer contained within the top of the vacuum tank at stated intervals, the tank requires very little attention.

The strainer above mentioned collects the foreign substance passing through with the gasoline.

Occasionally the pet cock on the bottom of the tank should be opened to allow water to drain out should any accumulate in the bottom of the tank.

Should any difficulty be encountered communicate with the nearest Service Station conducted by the Stewart Warner Corporation.

Should you feel the vacuum tank is not supplying gasoline it can be readily determined by flooding the carburetor. If the carburetor will flood it will indicate gasoline is in the vacuum tank. If the carburetor does not flood close the throttle and crank the motor for a few seconds with the starting motor, which will serve to draw gasoline from the rear tank into the vacuum tank if the system is working properly. In the event it is not, examine the vent hole in the gasoline tank cap, see that it is free and open and then make an examination of the strainer located in the top of the vacuum tank to determine if it is open for the passage of gasoline. See that rear tank is not empty.

Should anything ever interfere with the proper working of the vacuum tank, so that it does not supply gasoline properly, the vacuum tank may be filled and the car driven to the nearest point where help may be obtained.

The vacuum tank may be filled through the opening left after removal of the small pipe plug, located in the top of the vacuum tank.

IGNITION SYSTEM

Current for the ignition system is furnished by a Bosch Magneto. The battery has no connections with the ignition system, supplying current for the lights, horn and starter only.

The Bosch Magneto requires practically no attention other than oiling and cleaning at stated intervals.

Lubrication of Magneto—Oil should be used sparingly, especially at the rear oiler, located over the distributor, since an excessive amount of oil at this point will get onto the contact points, gum them up, and interfere with proper ignition.

Cleaning Magneto Contact Points—The distributor is clamped to the rear of the magneto by two clamps, one on either side, they are easily removed so that the six points near the outer edge of the distributor may be cleaned with fine emery. Very often rubbing them with a soft cloth will serve equally well. The contact point in the center of the distributor block should also be given attention at the same time.

The Platinum points located in the breaker box, at the rear of the magneto, should have attention once or twice during the season. They will probably need to be cleaned and prop-

SCHEDULE OF LUBRICATION AND INSPECTION

Once Every Day

Water Level—Inspect level of water in radiator, refilling as necessary.

Oil Level—Inspect oil level as indicated by indicator on left-hand side of the motor, refilling as required. (The oil sight feed indicator located on the dash shows when oil is passing through the oiling system but does not indicate the amount of oil contained within the oil pan.)

Once Each Week, or at the End of 250 Miles:

Grease Cups

Turn down all grease cups on the steering gear, rear axle and brake connections underneath the car. Consult the oiling chart on page 29 for their location.

Do not neglect the grease cups. See that they are turned down at least once every week, unless in the event the car is used for touring purposes, in which case they should be turned down oftener. A few minutes spent in turning down the grease cups at the end of each day's run will serve to keep the parts properly lubricated and will prevent annoying squeaks and wear.

While the car is being used for touring see that the spring clip nuts are tightened at least once in every two hundred and fifty miles.

Place a few drops of oil on the brake connections underneath the car, particularly on the yoke ends and pins at the ends of the brake rods. This latter point is important. If oiled regularly they will work freely and give better service, whereas if neglected, will work hard through the formation of rust and mud, and wear through quickly.

The four grease cups on the brake rocker shafts, leading into the brake drums, should be given attention regularly each week. Since the shafts are inside of one another they will seize if the matter of greasing them is not given the attention it deserves, resulting in the brake shoes dragging on the drums.

Oil clutch thrust bearing. Use cylinder oil. The clutch thrust bearing oiler cup is located just ahead of the gear shift lever housing, and projects through the large floor board.

Add distilled water to battery as required.

Oil Cups

Fill the small oil cups on the spring shackle bolts, tie rod bolts and front axle king bolts. Consult oiling chart on Page for their location.

Only a few drops are required, but do not neglect filling them at the end of every two hundred and fifty miles. If this is neglected the spring shackle bolts will soon become rusty,

causing the spring action to be interfered with and making the car ride very hard.

This also applies to the steering gear parts, which if neglected will soon cause the steering gear to operate very hard.

Every Two Weeks, or at the End of 500 Miles:

DRAIN MOTOR OIL FROM CRANKCASE — REFILL WITH TWO GALLONS OF FRESH OIL—DO NOT NEGLECT THIS. (See warning on page 8.)

Test battery and add distilled water as required.

Place a small quantity of oil in the oilers provided on the generator, starting motor and magneto.

Oil the rocker tube assembly bolts to the rear of the crankcase to which the accelerator pedal is connected.

A few drops of oil around the ends of the springs will serve to lubricate the bearing surfaces between the edge of the spring and shackle and may sometimes be the means of stopping an annoying squeak.

Oil clutch and brake pedal shaft. (Do not put oil in clutch compartment.)

Tighten nuts on spring clips holding springs in position on axles. That is most important and will prolong the life of the springs. Practically all spring breakages can be traced to loose spring clips.

Every Four Weeks, or at the End of 1,000 Miles

Inspect the level of oil contained within the transmission compartment. Refill with heavy lubricating oil to proper point, bringing lubricant up to secondary shaft. Do not use more than required.

An excessive amount of oil within the transmission compartment will probably work its way into the clutch compartment, therefore, do not use more than required.

Do not use grease within the transmission compartment, use only a good grade of heavy gear oil.

Remove oblong plate over fan oil compartment and add fresh oil as necessary. Carry the oil level in the fan compartment one-half inch underneath the shaft. If the oil is carried at a greater height it is liable to work out through the fan shaft and be blown over the engine and through the hood onto the fenders.

See that the king bolt at the rear end of the torque arm is tight. See that the small locking bolts at rear end of the torque arm are tight.

Repack boots at either end of steering drag link.

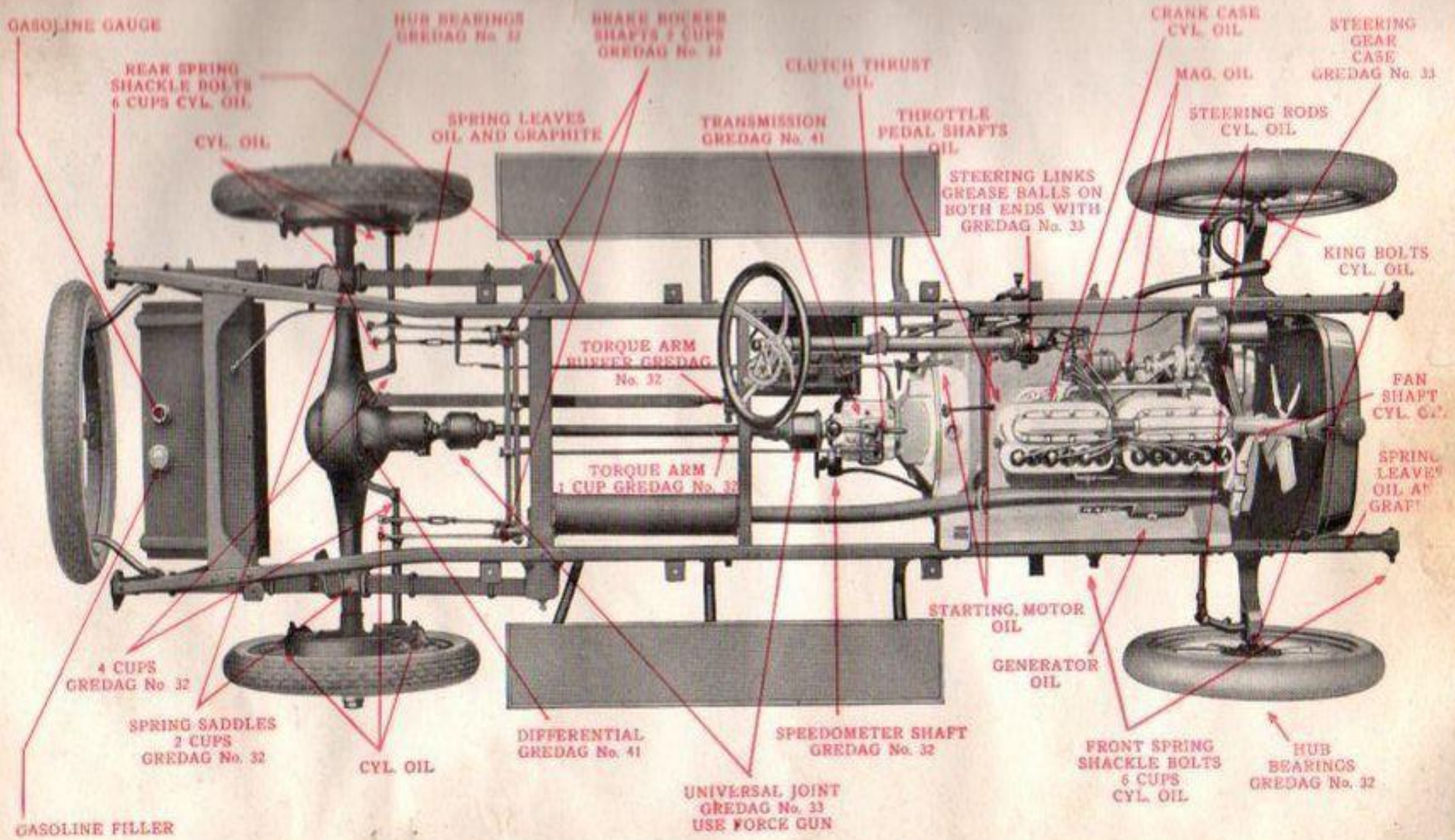
Repack the universal joints with Gredag or heavy grease, using a force gun.

Drain and flush radiator.

Tighten nuts and bolts on fenders and mud splashers.

Inspect and tighten nuts on spring shackle bolts.

Tighten adjusting nut in bottom of torque arm buffer.


GASOLINE GAUGE
REAR SPRING SHACKLE BOLTS 6 CUPS CYL. OIL
HUB BEARINGS GREDAG No. 32
BRAKE ROCKER SHAFTS 2 CUPS GREDAG No. 33
CLUTCH THRUST OIL
CRANK CASE CYL. OIL
MAG. OIL
STEERING GEAR CASE GREDAG No. 33
CYL. OIL
SPRING LEAVES OIL AND GRAPHITE
TRANSMISSION GREDAG No. 41
THROTTLE PEDAL SHAFTS OIL
STEERING RODS CYL. OIL
STEERING LINKS GREASE BALLS ON BOTH ENDS WITH GREDAG No. 33
KING BOLTS CYL. OIL
TORQUE ARM BUFFER GREDAG No. 32
TORQUE ARM 1 CUP GREDAG No. 32
FAN SHAFT CYL. OIL
SPRING LEAVES OIL AND GRAPHITE
STARTING MOTOR OIL
GENERATOR OIL
4 CUPS GREDAG No. 32
SPRING SADDLES 2 CUPS GREDAG No. 32
CYL. OIL
DIFFERENTIAL GREDAG No. 41
SPEEDOMETER SHAFT GREDAG No. 32
FRONT SPRING SHACKLE BOLTS 6 CUPS CYL. OIL
HUB BEARINGS GREDAG No. 32
UNIVERSAL JOINT GREDAG No. 33 USE FORCE GUN
GASOLINE FILLER

Tighten nuts in end of steering drag link, in each case remove locking cotter pin, reinstalling when adjustment is made.

Every Eight Weeks, or at the End of 2,000 Miles:

Drain transmission compartment and refill with correct amount. Requires three pints when empty. Do not use more.

Drain differential compartment and refill with sufficient lubricant (heavy gear oil), being level even with overflow plug in rear cap, requiring about three quarts when empty.

When refilling rear axle be careful not to use an excessive amount of oil. If filled higher than the proper level the excessive amount will work out around the drive shafts onto the wheels and brakes.

Do not use grease in differential compartment, use only a good grade of heavy gear oil.

Every Twelve Weeks, or at the End of 3,000 Miles:

Remove the wheels, clean bearings and repack with a fresh grade of good cup grease.

Once Each Season:

Graphite the spring leaves, thereby keeping the springs in good condition, preventing formation of rust between the leaves, resulting in stiff spring action, hard riding and annoying squeaks.

GENERAL DESCRIPTION

Various assemblies in the car may be roughly divided into three classes as follows.

Motor
Transmission
Running gear

Motor

When the motor is started it develops power which is transmitted through the clutch, transmission and propeller shaft to the rear axle, propelling the car forward or in reverse direction as desired.

The gasoline vapor compressed and exploded by a spark at proper intervals furnishes the energy.

In explanation, as the piston starts on its downward stroke the inlet valve opens for an interval until the piston reaches a predetermined point in its travel, when the valve closes. The piston when it reaches lower center reverses its direction. When it reaches the proper point in its upward travel a spark, furnished to the spark plug, jumps across the gap, igniting the charge and driving the piston down on its next stroke known as a power stroke. As the piston reaches lower center it again reverses its direction and as it starts on

its upper travel the exhaust valve opens, allowing the burned gases to escape into the exhaust manifold and from there into the muffler.

It will be seen then that four strokes of one piston are required to complete each operation. The same thing occurring in each one of the six cylinders, according to the firing order 1-5-3-6-2-4, meaning that when the explosion occurs in No. 1 cylinder the other cylinders fire in rotation, No. 1 being followed by No. 5, then No. 3, then No. 6, then No. 2, then No. 4.

The opening and closing of the exhaust and inlet valves is governed by the camshaft which travels at a speed equal to one-half crankshaft speed.

The spark for ignition of the gases within the cylinder occurs when the contact points within the magneto come into relation with one another. The magneto is driven by the crankshaft and travels at a speed equal to one and one-half times crankshaft speed.

In the Chandler Light Six Motor the power impulses of each piston are so regulated they overlap one another, insuring an even flow of power under all conditions, whether throttled down to a walk or at speed.

The camshaft and magneto shaft are connected directly with the crankshaft by silent chains, the chains being mounted at the front of the motor within the chain compartment.

The connecting rods, to which the pistons are attached at their upper end and which in turn are attached to the crankshaft at the lower end, convert the up and down motion of the pistons into the revolving action of the crankshaft.

A flywheel at the rear of the crankshaft balances the separate impulses of the motor, insuring an even flow of power to the driving mechanism.

Clutch

The clutch serves as a connection between the motor and transmission. When no weight is applied to the clutch pedal the clutch is in driving position and may be disconnected from the motor, for the purpose of shifting gears by depressing the clutch pedal, separating the driving members, and bringing into operation a brake on the clutch shaft, stopping the shaft momentarily while the gears are changed.

Transmission

The transmission proper is contained within the housing bolted to the rear of the motor base, the bell shaped part of the housing containing the clutch, the balance consisting of the transmission.

With the gear shift lever in neutral position none of the gears are in driving position, consequently the car cannot be started until the gears are placed in mesh.

The gears contained within the case are mounted on two

shafts, one above the other. The reverse idler pinion mounted on a separate shaft; the main driving gear integral with the main clutch shaft.

Change of speed is obtained with the aid of the shifting lever. The two gears mounted on the upper shaft are splined, moving forward or back, one serving for second and third speed, the other for first and reverse.

Both shafts are mounted on ball bearings, the spline shaft being connected at its rear end with the universal and propeller shaft assembly, the front end riding free within a roller bearing.

With the motor in operation the main clutch gear is constantly turning (except when the clutch is released), and in turn drives the countershaft to which first, second and reverse countershaft gears are keyed.

When engagement is made for any one speed, the sliding gear on the upper shaft moves into mesh, and, as the clutch is engaged, the countershaft gear in turn drives the gear on the main spline shaft, transmitting power to the rear axle.

Since the gears are in constant use whenever the car is in motion, frequent inspection as regards proper lubrication should not be neglected.

The gears are made of nickel steel, especially heat treated, and will last indefinitely, provided they are not abused through neglect of lubrication or improper shifting of gears.

To reverse the car, reverse sliding gear is brought into mesh with the reverse idler, which being in constant mesh with the reverse countershaft gear drives the car in that direction.

There are no adjustments provided for or necessary in the transmission unit. The owner or driver should endeavor to always shift gears properly so they will not clash, and should see to it that the transmission compartment is properly supplied with the correct lubricant. Grease should not be used in the transmission compartment. A heavy grade of good gear oil, same as used in the differential compartment, should be used.

Continual clashing of the gears, when changing from one speed to the other, will in time break down the corners of the gear teeth, resulting in rapid wear.

When the clutch is disengaged the pedal should be pushed down as far as it will go before shifting from one speed to another. With the clutch in a fully released position, a brake which serves to stop the gears in the transmission is brought into play. If the clutch does not seem to release freely and the gears clash despite all precautions, then look to the clutch adjustment. It may need some attention, or perhaps the main clutch shaft bushing may not be receiving lubrication. In that event take up the floor board, remove the clutch cover plate and place a few drops of cylinder oil on the clutch shaft, working the clutch pedal up and down so that the oil will work its way onto the bearing surfaces.

Propeller Shaft and Universal Joint Assembly

Connection between the transmission and differential is by means of a propeller shaft, equipped with universal joints.

With the car in motion, the uneven position of the rear axle as it travels over a rough road is equalized by the universals insuring smooth and uninterrupted transmission of power, the front end of the shaft sliding in and out of the front universal joint with cach up and down motion of the springs.

The universal joints are in constant use. Lubrication is important and should not be neglected. Parts of the universal joints are subject to wear, and their life will be considerably shortened if allowed to run dry.

If the front universal joint is not kept properly filled with grease the front end of the shaft, and hub in which it slides, will become dry and not operate smoothly.

THE TORQUE ARM

The torque arm, so called, since it equalizes the tendency of the rear axle housing to turn slightly forward as the power is applied, and backward as the brakes are applied, is secured to the rear axle housing by a heavy bolt, called the torque arm king pin. The front end rests within a ball socket mounted on the third cross member of the frame.

The tension of the springs in the torque arm buffer is adjustable. When assembled in proper position the adjusting plug or nut in the bottom of the torque tube should be threaded into the tube at least one-eighth of an inch above the lower edge when new.

The plug or nut above mentioned should be inspected regularly and tightened as necessary in order to hold the front end of the torque arm securely in its seat.

The six bolts which fasten the front and rear universal joint flangers to the universal joints should be inspected and tightened at regular intervals.

TRANSMISSION BEARING RETAINERS

Whenever the torque arm buffer plug is adjusted, examine the retaining nuts at the rear of the transmission main shaft, particularly the large nut which threads into the case and acts as a retainer for the bearing at the rear of the transmission. See that that nut is drawn up tightly so the bearing does not have an opportunity to float; the nut is secured with a lock wire. Release the locking wire before attempting to turn the nut. Also see that the nuts on the rear transmission shaft itself are tight, and make sure that the nuts holding the tapered flanges in position on the rear of the main transmission shaft and front end of the pinion shaft are tight, so there is no opportunity for play.

Differential

The differential, carried in the center of the rear axle, consists of eight gears, two drive gears—one a spiral bevel

driving pinion and the other a spiral bevel driving gear; the other six gears which go to make up the differential proper are carried inside a separate housing, to which the large spiral bevel gear is riveted. Four of the small gears are of equal size and placed in position an equal distance from one another; the two larger ones, one on either side, are in constant mesh with them.

When one rear wheel travels faster than the other, as when turning corners, or when one wheel loses its traction, spinning faster than the other, the differential comes into play.

Under ordinary conditions the drive will be divided equally between the rear wheels, and they will revolve together at the same speed unless tires of different size are used.

The rear wheels should always be equipped with the same size tire; one wheel should not be equipped with a rough tread and the other with a plain tread tire. Whenever chains are used they should be applied to both rear wheels and not to only one of them.

Proper lubrication of the rear axle is important, for if neglected will result in serious harm to the gears and bearings.

When the cars leave the factory the spiral bevel gear and pinion are properly adjusted in their relation to one another and will run quietly. Noise from the rear axle usually indicates lack of lubrication. If any other condition such as improper adjustment of the gear is thought to be the fault, consult the dealer for the purpose of adjustment.

The bevel gear and pinion are easily adjusted, and usually results can be obtained simply by adjustment of the bevel pinion. Since the adjustment necessary may only mean moving the pinion a distance equal to a few thousandths of an inch, it is quite important that it be handled by an expert, since improperly adjusted gears will be noisy, resulting in damage to them. (See paragraph on page 38.)

The entire differential unit is removable simply by disconnecting the universal joint where bolted to the front of the pinion shaft. Then by removal of the bolts and nuts holding the pinion housing on the front of the rear axle housing, followed by removal of the brake cam shafts, the inner ends of which are mounted on carriers that are a part of the front cap or pinion housing. Before final removal, the assembly will have to be turned at almost right angles, allowing the large gear to come through the opening in the axle.

CARE AND MAINTENANCE

By exercising reasonable care, with proper attention to the details of lubrication, a Chandler Light Six can be operated a number of years with minimum upkeep cost. Certain points, however, have to be taken care of once or twice during the year, in order to keep the car in proper condition and to insure smoothness in operation at all times.

Cleaning Carbon

Carbon deposits may in time form on top of the pistons, cylinder heads and valves, and, while the motor will continue to operate smoothly even with heavy carbon deposits, it will lose some of its efficiency, cause the motor to fire unevenly and develop loss of power, due to carbon working onto the valve seats, not allowing the valves to close properly. An inferior lubricating oil will leave large carbon deposits and rich mixture from the carburetor will also have its effect.

Running kerosene through the motor will aid in keeping down carbon deposits. Kerosene may be used after the motor has been allowed to run until hot, the same as under operating conditions, when the kerosene can be poured into the carburetor air valve. The motor should be allowed to run idle at a rate of speed about equal to twenty-five miles an hour of car speed. A small amount of kerosene should be poured in at a time, never putting in enough to stall the motor. The motor will smoke excessively while the kerosene is passing through and for a few minutes afterwards until it is all burned out. That method will serve to soften particles of carbon that have collected around the valves and will also aid in removing carbon that may have accumulated on top of the pistons. If this practice is followed at least once each month it will help quite materially. One-half pint of kerosene is sufficient at any one time, but be careful to feed the kerosene very slowly so that it will be consumed as it enters the combustion chamber.

Carbon deposits make themselves known through lack of power, causing loss of compression through the valves not closing properly, and sometimes through knocking noises noticeable in the engine, due to preignition caused by particles of carbon holding heat, remaining incandescent and igniting the charge in the cylinders before the spark occurs.

The oxygen method of burning carbon has proven quite satisfactory and can be used to advantage when handled by one thoroughly familiar with the process.

When burning out the carbon, as each cylinder is treated the piston in that cylinder should be brought to stop dead center in order to prevent the flame injuring the cylinder walls. When the oxygen is admitted to the cylinder it has to be ignited, and will burn as long as carbon is present.

After removal of the carbon it is a good plan to grind the valves.

Grinding the Valves

The first step is to remove the exhaust and inlet valve caps, directly over the valve chambers, using the valve cap wrench furnished with the tool equipment. Then remove the valve cover plates on the side of the motor which enclose the valve springs.

With the aid of a valve spring tool compress the springs so their pressure is not applied directly on the key which holds the valve spring seat in place. Remove the key and

raise the valve so it may be removed through the top of the cylinder; a piece of wire coiled into suitable shape will enable one to take them out more easily.

The heads of the valves are slotted so that they may be rotated upon their seats. Apply a small quantity of grinding compound to the seat of the valve, rotate the valve on its seat for a few minutes, first in one direction and then the other. Remove the valve, clean off the compound and note if it is bearing evenly for the entire distance.

It will be found the exhaust valves need more attention than the inlet valves. Each valve can usually be ground within a very few minutes, unless a large carbon deposit has formed, which may result in pitting the valves making it harder to secure a uniform seat. In extreme cases it may be necessary to face the valve and reseat the valve seat in the cylinder.

The valve chambers are water jacketed for the purpose of keeping the valves at an even temperature. If the supply of water carried in the circulating system is neglected the valves may become too hot, and in some cases warp, making it extremely hard to grind the valves to an even seat.

When the grinding operation is completed, see that all particles of the grinding compound are cleaned from the valves and valve seats, then reassemble the valves and valve springs in the same openings from which removed. Adjust the valve plungers with a clearance of .004 of an inch between the bottom of the valve stem and the top of the valve plungers.

For best result the valve plungers should be adjusted after the motor has run long enough to become thoroughly warm.

Cleaning and Adjusting Spark Plugs

Whenever the valves are ground the spark plugs should be cleaned in gasoline and the points polished with a very fine piece of emery cloth. Before replacing in the motor, the spark plug points should be set with a clearance of .026 of an inch.

Motor Bearings

Once or twice during the year, depending on the mileage the car has had, it may be necessary to take up the connecting rod and main crankshaft bearings, equalizing the wear which has taken place.

Unless one is thoroughly competent to handle this work it should not be attempted, since improperly fitted bearings are liable to burn out, resulting in extensive injury.

To get at the bearings the lower half of the crankcase or oil pan should be removed, exposing the crankshaft to which the connecting rods are attached. When removing the caps on the connecting rods care should be taken to see that they are reassembled in exactly the same position, the oil dips pointing in the proper direction; that is, toward the right of the car. Care should also be taken to see that each cap is reattached to the same rod from which it was removed.

Shims are used between the upper and lower halves of the connecting rod and main bearings. If the bearings are loose probably removal of the thinner shim is all that is required. In the event more than one shim is removed be careful to see that the bearings are not too tight.

After the cap has been removed from the connecting rod the piston may be withdrawn from the cylinder and the fit of the connecting rod bearings be determined by allowing the connecting rod to hang in an inverted position from the crankshaft.

When removing the pistons through the bottom of the motor it will be found that the pistons in No. 2 and 5 cylinders come through very easily. The pistons in cylinders No. 1, 3, 4 and 6 will not come through so readily but will have to be drawn down slowly and the crankshaft turned slowly, so that they will pass one another. With a little care and patience, however, all of the pistons may be withdrawn through the bottom of the motor. Be careful to see that in turning the crankshaft it does not come in contact with the piston, jamming the skirt of the piston between the crankshaft and crankcase wall and throwing the piston out of round.

When reinstalling a piston be careful not to push it up into the cylinder as far as it will go, the upper ring may jump over the valve opening, holding the piston until the piston ring is released.

The main crankshaft bearings are provided with shims of varying thickness, and, should occasion require that the bearings be adjusted or taken up, the removal of one shim on either side of the bearings should be sufficient. If the motor has been abused or allowed to run without proper lubrication a greater amount of wear than would ordinarily occur will take place, and under those conditions the connecting rod and main bearings may have to be refitted.

Improper lubrication, the result of not maintaining the oil level at the proper point or allowing the oil to remain in the motor until it has thinned and lost its lubricating qualities, will result in excessive wear within the bearings and cylinder walls. The cylinder oils should be changd every five hundred miles, both winter and summer.

Piston Pin Bushings

Whenever the piston is removed it would be well to test the fit of the piston pin bushing.

By holding the connecting rod in a vise, with the piston in position, the fit of the piston pin bushing can be tested to note if there is any up and down play.

When replacing the pistons and connecting rods, after they have been removed, see that they are properly lined up. The markings on the piston will indicate whether or not the piston has been bearing properly in the cylinder wall.

Before replacing the piston in the cylinder, see that the piston rings are not in position with the slots in line. Move

them around so that the slots in the piston rings do not come in line with one another; separate them as widely as possible.

Motor Timing

The firing order of the cylinders is 1-5-3-6-2-4.

The inlet valves are No. 2-4-6-8-10-12.

The exhaust valves are No. 1-3-5-7-9-11, counting from the front of the motor.

The exhaust valves are timed to close 1⅝ inches past dead center on the suction stroke.

The inlet valves are timed to open 1⅞ inches past dead center on the same stroke.

Top dead center on the compression stroke may be determined by turning the flywheel until the mark on the flywheel comes opposite the marks on the case. (Removal of the large pipe plug in the top of the flywheel housing underneath the upper floor board will enable one to find the marks without any difficulty.) When the marks on the flywheel and case are opposite one another number one piston is at top center.

With the valves closed, the clearance between the valve plungers and valve stems should be .004 of an inch with the motor hot.

To check the setting of the camshaft remove the front cover over the chain compartment, exposing the timing sprockets and the chains; with the camshaft in proper relation to the crankshaft, the punch marks on both sprockets will line up with the sprocket centers. The two points in question being on the edges of the sprockets nearest one another.

When the cars leave the factory they are properly timed, and an examination should not be necessary unless in the event the timing has been disturbed.

The timing of the magneto may be checked by bringing number one piston to top dead center on the compression stroke, after which remove the oblong plate between the two poles of the magneto, exposing the magneto armature. When properly timed, the armature should be half open. Should the position of the armature need to be changed, loosen the lock nut which holds the magneto coupling, then loosen the magneto coupling (which is a tapered fit on the magneto shaft) by striking it a sharp, quick blow, sufficient to loosen it so the magneto shaft may be turned by exerting pressure on the distributor at the rear of the magneto, when the coupling should be driven back into position again and the nut drawn up tight.

Do not under any circumstances touch the armature with any object liable to injure the windings.

Clutch Adjustment

Clutch adjustments, for the purpose of taking up wear within the clutch friction discs, are easily made. Take up the floor board, then remove the clutch hand hole cover. It will be noticed after removal of the cover above mentioned that

the heads of two bolts project through radial slots in the face of the clutch proper. Before changing the clutch adjustment the clutch pedal must be held in a fully released position, then the bolt which is uppermost may be loosened. Turn the crankshaft a distance equal to one-half a revolution, bringing the lower adjusting bolt to the top, when that should also be loosened, then tap the bolt to the right, or clock wise, a distance equal to about one-half an inch, and tighten both of them securely.

The clutch is now ready for use again, with the possible exception that perhaps the position of the clutch pedal will have to be changed to prevent its riding against the floor board. Each adjustment of the clutch made as above also changes the position of the clutch pedal.

Examination will show the clutch pedal is bolted to a notched flange on the clutch shaft. If necessary, loosen the bolt, move the clutch pedal ahead one or two notches and then tighten again securely.

Adjustment of the clutch pedal is only for the purpose of preventing the pedal from riding against the underside of the floor board. When the clutch pedal does ride against the floor board it prevents full engagement of the clutch. When it is noticed that the pedal does ride against the floor, have the proper adjustment made. Very often it may be only necessary to change the position of the clutch pedal, without disturbing the clutch adjustment.

It is intended that the clutch should run dry. It is only necessary that the clutch thrust bearing be oiled frequently.

An excessive amount of lubricant placed in the transmission will work into the clutch compartment. Care should be taken to see that the transmission is never filled higher than a point even with the center of the secondary shaft, requiring three pints of lubricant when the transmission case is empty.

Steering Gear and Steering Gear Adjustment

The steering gear is known as the irreversible type, easily adjusted to take up wear, and if properly lubricated will enable one to steer with remarkable ease under all conditions.

All of the roadster and some of the touring car steering gears are adjustable in the following manner:

The main adjusting nut, located in the top of the steering gear case proper is clamped in position. The locking bolt, passing through the two halves of the clamp, will have to be loosened or removed, when the clamp can be loosened sufficiently so that the large nut above mentioned may be turned to the right as much as necessary.

Play in the steering column may be eliminated by turning the adjusting nut to the right a short distance, tightening the clamp in position again when adjustment is completed.

Lost motion in the steering worm and steering worm shaft may be adjusted by taking off the cap on the right of

the steering gear case and removing one or more of the spacing washers, that will be found directly underneath the plate. When a sufficient number of washers have been removed see that the cap is replaced and drawn into position tightly, as it formerly was.

The majority of the touring cars are equipped with a steering gear slightly different than the one just described. While the adjustments are practically the same, they vary to some extent. For instance, the upper adjusting nut, instead of being held in position by means of a clamp, is locked with the aid of a set screw that is threaded into the left of the steering gear case proper. Before attempting to adjust the large bushing this square head set screw must be released.

The side adjustment, or adjustment for the worm gear and shaft, is by means of another large nut, with a countersunk head. It is also held in position by means of a locking screw that has to be loosened before the nut may be turned. In the case of the latter adjustment, wear is taken up by turning the nut to the right as far as necessary.

In both steering gears the steering wheel is keyed to the upper end of the column and is held in position by means of a large hexagon nut, located directly above the center of the steering wheel. Up and down play in the wheel or column may mean that the steering wheel nut is loose. See that it is properly tightened down.

Steering Gear Lubrication

Lubrication of the steering gear parts is very important. The case should be kept well filled with a good grade of soft cup grease, and occasionally, perhaps twice a year, it would be well to remove the pipe plug in the top of the case and introduce a small quantity of heavy gear oil.

Difficult steering is, in practically all cases, due to lack of lubrication in the steering gear proper or connections to the front axle.

After continual use during a year's service the wear taking place between the worm gear and worm may cause some play in the steering gear, but it can in most cases be offset by disconnecting the bell crank at the side of the frame, where connection is made with the drag link, then turning the steering wheel until the worm gear shaft has revolved to ninety degrees, bringing new surfaces into action.

A new groove will have to be filed in the shaft for proper fastening of the ball crank if the gear is turned as above.

Brakes and Their Adjustment

Two sets of brakes are provided, both operating directly on the rear wheel brake drums. The service brake, sometimes called the foot brake since it is operated by the right-hand foot pedal in the driving compartment, is of the external contracting type, while the emergency brake is of the internal expanding type.

Service Brake Adjustment

Since the brake shoe facings or linings are subject to wear, they will have to be taken up or adjusted occasionally, in order to keep them in a state of highest efficiency.

With the brakes in proper adjustment, the clearance between the brake shoe facing and brake drum should be one thirty-second of an inch.

Most adjustments, when they are necessary, can be made with the aid of the adjusting thumb screws, mounted on the front of each brake band. It will be noticed that the clevis pin, connecting the two ends of the brake shoe, is threaded, and before any adjustment can be made the lock nuts must be loosened, then the thumb screws may be turned down two or three turns or more, if necessary, after which the lock nuts should be tightened again.

After changing the brake adjustment, make sure the brakes take hold evenly on both rear wheels. When the brake adjustments are completed raise the rear of the car, so the wheels are free of the floor, block the front wheels, then start the motor, place the gears in mesh, engage the clutch and, speeding the motor, throw out the clutch and apply the brakes.

Emergency Brake Adjustment

The emergency brakes are adjustable by means of the turnbuckles located in the center of the rear pull rods.

The turnbuckles are locked with the aid of a locking nut, which will have to be loosened before the turnbuckles can be moved. The brakes may be taken up by turning the turnbuckles to the right two or three turns or more, as required.

Make sure that the emergency brake shoes take hold equally well on each wheel and then lock the adjustment by tightening down the nuts previously loosened.

When the brakes need relining, the new lining should be fastened with copper or soft iron rivets, countersinking the fabric or lining so the rivets will not come in contact with the brake drum.

Should it happen that the brakes suddenly prove ineffective, investigation may show that probably the rear axle has shifted its position slightly, due to the fact that the spring clips have not been kept properly tightened.

The rear springs are anchored to the spring seat on the rear axle, and held in position by means of the spring clips. Anything that will allow the rear axle to shift its position even slightly will naturally throw the brakes out of adjustment—hence the importance of seeing to it that the spring clips are kept tight and inspected at regular intervals.

Rear Axle Gear Adjustment

When adjustment of the rear axle drive gears is made, it should only be undertaken by an experienced mechanic. Chandler distributors and dealers always employ efficient help who thoroughly understand this adjustment and it is always best to

have someone do this work who is thoroughly familiar with the mechanism, since improper adjustment may injure the gears as well as other parts of the rear axle and differential assembly.

See that the differential compartment is kept supplied with the proper amount of lubricant. Use only a good grade of heavy gear oil. Under normal conditions the rear axle gears will probably perform their function properly throughout several seasons without any attention other than the one as regards lubrication.

Usually the first indication of difficulty within the gears is made known through an unusual noise, which in most cases is traceable to lack of proper lubrication. For instance, if grease is used in the transmission or differential compartment it will form, pile up on the sides of the housing and allow the gears to run practically dry. Then again, if the matter of correct lubrication is overlooked, and not sufficient oil furnished, the gears will run dry, resulting in serious damage, not only to the gears, but to the bearings as well.

Steering Knuckle Pins

The front axle king bolts, or steering knuckle pins, are held in position by means of a locking pin passing through the steering knuckle at a point near the center.

One side of the pin is flat and registers with a flat surface at a point in the king pin, holding the king pin stationary and locking it securely. To remove the king pin, in order to take out the steering knuckle, it will be necessary to first take out the locking pin referred to. The locking pin is a tapered fit in the knuckle and can be driven back through the knuckle from the front.

Removal of Wheels and Wheel Bearings

Front Wheels—The front wheels, mounted on roller bearings, are locked on the knuckle by a locking nut and washer at the outer end of the steering spindle.

For inspection of the wheel bearings and removal of the wheel, the hub caps must be taken off, then the nut and washer above referred to. It will be noted the large nut is cotter pinned, consequently the cotter pin will have to be taken out before the nut can be loosened.

After the nut and washer have been removed the wheel is ready to pull off over the bearings. Sometimes quite a little pull will have to be exerted in order to get the wheel started.

When reassembling the wheel be careful to see that the bearings are well packed with a good grade of soft cup grease. See that the bearings are not jammed when the wheel is applied. Replace the washer, then the locking nut, drawing the latter up snugly, but not tight enough to bind the bearings. See that the wheel revolves freely, without any side motion.

After the car has been run a few miles, raise the front wheels from the ground and note if they balance. In the event they do not, readjust the nuts.

With fresh grease in the bearings the grease is ordinarily stiff enough to hold the wheel so that it will not balance freely—hence the reason for driving the car a few miles and then testing the wheels again for balance.

Always make sure that the large nut is properly cotter pinned before putting on the hub cap.

Rear Wheels—Removal of the rear wheels is accomplished, after the rear axle shaft has been removed, by loosening the large nut and locking washer at the end of the rear axle wheel tube. When the nut and washer have been removed the wheel can be withdrawn from the axle, bringing the wheel bearing with it. A steady, even pressure should be exerted in order to start the wheel.

It will be noted the rear axle drive shaft flange is held in position against the center of the wheel by means of six acorn nuts. Those will have to be removed before the rear axle drive can be withdrawn.

The rear wheel bearing is held in proper position within the rear wheel hub by means of a large locking nut threaded into the inside of the wheel hub. Two cotter pins are employed to lock the nut in position. If the nut is removed, be sure to see that same is securely cotter pinned before reinstalling the wheel. When reinstalling the wheel, after drawing up the nut on the outer end of the wheel tube, and before installing the drive shaft, see that the wheel turns freely and then install the drive shaft, being careful to see, first of all, that the bearing is properly packed with soft grease.

Aligning the Front Wheels

Unusual wear on the front tires will result if the front wheels are not in proper alignment. Reasonable care should be exercised in driving the car not to bring the front wheels sharply against a curb or into a deep rut in the road with sufficient force to spring the tie rod between the front wheel steering arms.

The tie rod is threaded at either end and equipped with adjustable yokes, making it possible to shorten or lengthen the tie rod whenever necessary. Each yoke is equipped with a clamping bolt, which serves to clamp it firmly on the tie rod threads. Therefore, before attempting to change the position of the tie rod yokes, the clamping bolt must be loosened and then securely tightened again after an adjustment is made.

The rear wheels will not get out of alignment, unless in the event the nuts on the rear spring clips are allowed to loosen.

Provided the spring clips are kept properly tightened and the front wheels do not come in forcible contact with any object in the road with sufficient force to spring them out of

position, the wheels should remain in line throughout the life of the car.

When properly aligned the front wheels "toe in" approximately one-quarter to three-eighths of an inch. In other words, with the wheels pointing straight ahead, the distance between the felloe bands of the front wheels in front of the axle should be one-quarter to three-eighths of an inch less than the same distance between the wheels back of the front axle.

MOTOR OILING SYSTEM

Motor Oiling

Proper lubrication of the motor bearing surfaces will not be obtained unless one is careful to use a good grade of medium cylinder oil. The oil should be changed frequently, at intervals equal to every five hundred miles, both summer and winter. That change is advised, owing to the fact the heavy grades of gasoline in general use are not always entirely consumed when a cold motor is started, consequently a small portion of gasoline finds its way into the combustion chamber and past the piston rings into the oil, thinning the oil and cutting down its lubricating qualities. Under those conditions it is false economy to continue driving the car a greater distance without changing the oil, as recommended. If the motor is continually used and the old oil added to, without a complete change of lubricant, the wear within the bearing surfaces will be much more rapid than it should be.

The old oil may be drained through the pipe plug, located in the bottom of the oil pan. It is a good plan occasionally to pour a quart or more of kenosene through the oil filler after the old oil is taken out, allowing the kerosene to drain out through the hole in the bottom. Kerosene will serve to cleanse the oil pan, and after it has drained two gallons of fresh oil should be placed in the motor.

The oil indicator, located on the instrument board, simply indicates the passage of oil through the oiling system. It does not indicate the amount of oil contained within the motor, but it will be noted, as the car is driven further on one filling of oil, and as the oil thins, that the gauge will not commence to register until a higher rate of speed is obtained. That condition is owing to the fact the pump will not pick up the thin oil and drive it through the system with as much force as it does an oil that is in good condition and has not thinned.

The strainer, located in the bottom of the oil pan into which the oil supply pipe on the outside of the crankcase is threaded at its lower end, should be taken out occasionally and thoroughly cleaned. In order to remove the strainer it is only necessary to disconnect the lower end of the oil pipe, leading to it, then disconnect the large nut, which holds it in position on the side of the oil pan. When it has been cleaned reassemble

it again and see that the joints are tight and do not leak oil.

The two gallons of oil carried within the oil pan is passing through the oiling system continuously. The oil pump driven off the camshaft draws the oil from the motor base and distributes it through separate leads to each of the main bearings and to the chain compartment in the front of the motor.

A trough underneath each connecting rod collects the oil so that the caps on the rod dip with each revolution of the crankshaft, splashing oil to the cylinder walls, and at the same time through the dipping action of the rod forcing oil into the connecting rod bearings themselves.

The oil within the connecting rod troughs is constantly maintained at the proper level, the overflow from the troughs finding its way back into the oil pan through drain holes that are provided in the splash pans for that purpose.

The oiling system is so designed a sufficient supply of lubricating oil is constantly furnished to all of the wearing surfaces, the amount of oil so furnished being increased with the speed of the motor.

The oil level within the motor should be inspected each and every day, and at times, when the car is en-tour and is probably driven several hundred miles in the course of a day's travel, the oil level should be inspected several times.

The oil level should be maintained at the proper height on all occasions. If only a very small supply is in the motor it may not be sufficient to cover the oil outlet, with the result the pump cannot pick it up, or then again, if the oil supply is very low and the car is being driven down long steep grades with the motor running, the small supply of oil will naturally collect in the front of the oil pan, uncovering the strainer or oil outlet, so that the pump cannot furnish a supply of oil to the motor. Consequently, if the motor is running during the descent of a long hill under those conditions, the bearing surfaces may probably be injured through lack of oil.

The oil pump furnishes the maximum amount of oil required at all times and is non-adjustable. While the motor is in operation, the oil gauge, located on the instrument board, serves to show that the pump is distributing oil. In the event the gauge fails to register do not drive the car further but investigate and learn what has happened. Make sure the oil pan is provided with the proper amount of oil. See that there are no leaks through which the oil may escape, and if necessary, remove the oil pump itself. The oil pump is bolted to the right hand side of the crankcase, a short distance back of the carburetor and can be removed in a few minutes simply by disconnecting the oil pipes which lead to and away from it, and then by taking off the two nuts which hold it in position on the case.

The oil pump is of the plunger type. A heavy spring serves to hold the plunger in constant contact with an eccentric

on the camshaft. Each stroke of the plunger serves to create a vacuum within the pump, drawing oil from the oil pan and forcing it directly to the bearing surfaces.

In the event of an accident to the oil pump itself, an additional supply of oil should be placed in the motor base, so that the car may be driven slowly under its own power to the nearest point where help may be obtained.

Provided the oil pan is filled to the proper level, namely, with two gallons of oil, an additional gallon and one-half of oil will serve to bring the level above the splash pan, insuring lubrication of the motor from the splash of the connecting rods, as they dip into the oil with each revolution.

The engine may smoke a little bit under those conditions but that will not result in any harm.

During the winter weather in extreme cold climates, the oil in the motor will congeal. Although the oil may not freeze solid, it will be very sluggish in its action, so much so that in extreme temperatures it will not flow through the oil lines. Consequently, if the motor is started under those conditions and the oil indicator does not register the passage of oil, the motor should be stopped and arrangements made to have the car taken to a warm place, where it can remain long enough for the oil to thin sufficiently so that it will flow.

If the car has been laid up for any length of time without being used, watch the oil indicator closely as the motor is started. If it fails to register it may be necessary to take off the oil pump and lubricate all of the parts. Moisture may have settled and formed rust, causing the plunger to stick to the inside of the pump body.

Whenever the oil pump is removed for any purpose, see that all parts of it are thoroughly saturated in oil before installation.

Lubricating Oils

Inferior oils will prove less expensive at first cost, but in the end may prove more costly through extra expense incurred in removal of carbon, grinding valves and adjusting worn bearing surfaces.

RATTLES

Rattles are usually the result of neglect. See to it that the bolts and nuts on the fenders, mud splashers and hood sills are tightened at regular intervals. They may not need tightening every time or perhaps only can be tightened a trifle, but in any event if they are looked after regularly it will prevent the parts from loosening and rattling at a later date.

The nuts on the bolts, holding the body in position should also be inspected and tightened.

At least once every month the nuts on the ends of the

shackle bolts should be taken up, particularly those at the rear of the front springs and the rear of the rear springs.

The shackle bolt nuts are not cotter pinned. A patent lock washer is used for securing the nuts. Before attempting to tighten the nuts raise the lip of the washer where it is turned over the square of the nut, tighten the nut and then turn down the lip of the washer again.

Torque Arm

The torque arm king bolt, which anchors the rear of the torque arm to the axle housing, should be inspected regularly and the nut on the bottom of the king bolt tightened as necessary when required.

The front end of the torque arm, or rather the torque arm ball, rests in two ball seats, which are suspended between springs located in the torque arm buffer tube. The tension of the springs is adjustable by means of a plug, threaded into the bottom of the torque arm buffer hanger. The plug is locked in position with a cotter pin. Remove the cotter pin and turn the plug to the right in order to increase the tension of the springs.

See that the torque arm hanger bolt is kept well lubricated.

Doors

The door frames are provided with adjustable rubber bumpers. They may be shimmed to bring the door bumpers in closer contact with the door when desired.

Rear Axle Spring Seats

The rear axle spring seats are provided with grease cups; they should be kept well filled and turned down, to insure proper lubrication of the spring seat, so that it is free to revolve upon the axle as necessary. If those points are not kept well lubricated wear will occur, resulting in the spring seat not fitting properly on the axle housing.

Steering Connections

The yokes on either end of the steering cross rod, back of the front axle, are subject to wear, more especially if not lubricated properly. The nuts on the bottom of the steering cross pins may be tightened for the purpose of taking up the small amount of wear when it occurs.

SQUEAKS

Squeaks nearly always denote lack of lubrication. If proper attention to the details in connection with lubrication are taken care of squeaks are not liable to develop.

Squeaks most commonly occur in the spring shackle bolts and at the point between the ends of the springs and the shackles.

Spring Shackle Bolts

Dust and dirt from the road will collect at the ends of the springs and around the ends of the shackles, causing squeaks. A few drops of oil around the ends of the springs will very often be the means of removing an annoying squeak, provided the shackle bolts are not in need of lubrication.

Doors

Keep the door hinges and door locks lubricated. Dust will collect at those points and cause squeaks. You will note the dovetails in the door frames are equipped with felts. They should be oiled occasionally.

Fenders

Fender squeaks are usually the result of loose nuts and bolts. See that the nuts are tightened and see that the bolts holding the hood rail in position, and which in turn also secure the apron of the front fender, are kept tight.

Body

Liners are used between the body and frame and provided the body bolts are kept tight squeaks from that source should not develop.

Occasionally during the life of a car incidents may occur, interfering with its proper operation. They are always annoying, more especially when not close to a point where help can be obtained. The following paragraphs enumerate common difficulties that may be overcome by following the suggestions given.

STARTER WILL NOT OPERATE

A Weak or Run Down Battery

If the supply of water in the battery is not replenished at regular intervals, as it should be, the battery will soon lose its strength and need to be recharged from an outside source.

The best test of a battery's condition is made with the aid of a hydrometer syringe. If the solution tests lower than 1.175 it will mean that the battery should be recharged from an outside source.

If the means for testing a battery in that manner are not at hand, another test would be to turn on the lights before engaging the starting motor. If, as the starting motor is used, the lights grow very dim the battery will undoubtedly be found weak.

Before deciding the battery is at fault, unless a test has shown that to be the case, examine the wiring to the starting motor, generator and battery, see that all the connections are tight. A loose ground connection, making imperfect contact, will sometimes have the same effect as though the battery actually were run down.

If the car is used a great deal during the evening, while

the lights are lit, and not driven much during the day time, the battery will need to be recharged oftener, since the continual use of the lights without much driving will drain the battery faster than the generator can restore the electrical energy that is used.

If the battery is found to be in good condition and there are no loose connections or short circuits in the wiring, the difficulty may be located in the starting motor switch, perhaps proper contact is not being made. The starting motor switch is bolted to the under side of the upper floor board.

Since engagement of the starting motor with the flywheel is made by means of a gear located on the front end of the starting motor shaft, anything that will interfere with the gear coming into mesh with the flywheel will necessarily result in non-operation of the starting motor. There is very little likelihood of anything occurring to prevent the gear traveling into engagement with the flywheel, unless in the event moisture has collected within the starting motor gear housing. In that case, the moisture might form rust on the starting motor screw shaft and gear, causing the gear to remain in stationary position.

If the starting motor gear remains in mesh with the flywheel after the starting button or pedal is released, the same condition might also exist, namely, that rust had formed, holding the gear in mesh with the flywheel. In that event the starting motor should be taken down. The screw shaft and gear should be thoroughly cleaned with kerosene before reinstalling. Do not use oil on the gear or worm shaft.

The starting motor is located on the under side of the crankcase, at a point directly underneath the steering column. It is held in position by means of four bolts, which pass through the web of the crankcase into the starting motor, and two additional bolts, which pass through the flange of the starting motor into the crankcase arm. Disconnect the wiring connections to the starting motor before taking it down. The entire operation of taking down and reinstalling the starting motor probably will not consume more than one hour's time.

STARTING CRANK

When the starting motor refuses to crank the engine use the hand crank.

Proceed the same as for ordinary starting with the exception that the spark lever should be placed in retarded position. Place the spark lever in a position half way between full advance and full retard.

When using the starting crank never push down but always pull up. If the motor should back fire while pushing down on the crank it might result in injury to the operator.

CARE OF ELECTRICAL APPARATUS

The electrical instruments, namely, magneto, generator

and starting motor, are provided with oils for the purpose of lubricating the various bearing surfaces. Do not make a practice of flooding the oilers, a few drops at a time is usually sufficient and more than that amount will work its way into the brushes and contact points, gumming them up.

MOTOR WILL NOT START

This refers to cases where the motor will not start under its own power while the starting motor is cranking it.

Lack of Gasoline

Due to either an empty gasoline tank, failure of the vacuum tank to perform its function, gasoline shut off underneath the vacuum tank, dirt in the gasoline line or in the strainers located in the top of the vacuum tank or bottom of the carburetor.

Open the pet cock underneath the carburetor to determine if gasoline is being fed to the carburetor.

Take off the cap over the needle valve on top of the float chamber. Flood the carburetor by raising the needle valve several times.

Prime the cylinders by introducing a small quantity of gasoline through the pet cocks on top of the cylinders.

See that the wiring connections between the spark plugs and the magneto are tight.

Disconnect the magneto ground wire (the ignition switch may be out of order) and see if the motor will start.

If the car has been driven a considerable distance, carbon deposits may have accumulated in the engine, with the result the spark plug points may be very dirty and in need of cleaning. Remove the spark plugs, clean the points and set the points with a clearance between them equal to .026 of an inch.

Dirt on the magneto distributor contact points may need to be cleaned. The distributor is the fibre block at the rear of the magneto to which the six spark plug wires are attached. The block is clamped in position and may be removed for the purpose of cleaning without disturbing the wiring. Clean the contact points with a plain cloth or fine emery cloth.

If it is thought the magneto is at fault have the ignition timing checked, and also examine the insulation of the magneto pencil or conductor bar and the collector ring brush holder.

Provided the motor is apparently supplied with sufficient gasoline the motor should start after the ignition points have been cleaned and put in order. If the motor still refuses to start prime the cylinders, although that should not be necessary if the choker is pulled way back as far as it will go, and the cam on the choker arm registers with the plunger in the carburetor, closing the plunger and opening the duct for pas-

sage of raw gasoline from the float chamber directly into the carburetor mixing chamber, from which point it is drawn into the cylinders.

Water

Water may have collected in the carburetor or vacuum tank, and such being the case the carburetor and vacuum tank drain cock should be opened and a small quantity of gasoline allowed to escape.

If the drain cock underneath the vacuum tank is clogged insert a long pin or a thin wire through the opening, when the pet cock is open. Allow some of the gasoline to run out, close the pet cocks again, floor the carburetor and try to start the motor.

While on the subject it might be well to mention that the gasoline drain cocks underneath the carburetor and vacuum tank should be opened occasionally and a small quantity of gasoline allowed to escape. Water will collect at the lowest point in the carburetor and vacuum tank and when the drain cocks are opened will naturally be drained first.

Occasionally the nuts or plugs under the carburetor float chamber and strainer should be removed, allowing water and sediment (that may have collected) to drain.

When cleaning strainer or draining carburetor shut off gasoline supply at shut off under vacuum tank.

Occasionally, when the supply of gasoline in the tank runs low, remove the drain plug in the bottom of the tank and allow a small quantity of gasoline to escape from that point. Water will collect around the drain plug, since that is the lowest point in the tank.

In very cold weather, with a temperature below freezing, if the car has been exposed to the weather, the water mixed with the gasoline may freeze. If water has collected in the bottom of the gasoline tank it may freeze and prevent the passage of gasoline since the gasoline line or stand pipe extends to the bottom of the tank and the ice that might form would close the opening in the pipe. Water in the carburetor will collect in the drain cock and in freezing weather if the drain cock is opened the ice which has formed will prevent the escape of gasoline.

When the motor will not start under its own power with the aid of the starting motor, do not crank the motor indefinitely, exhausting the storage battery, but look for the reason.

If the vacuum tank apparently is not furnishing gasoline as it should it may be dirty and in need of cleaning.

If you have reason to believe the vacuum tank is empty remove the pipe plug in the top and pour in a small quantity of gasoline, not more than a half pint, then try to start motor.

Another point to investigate is to see that the vent hole in the gasoline tank cap is open for the passage of air. The hole in the gasoline tank cap should not be plugged.

Sometimes through carelessness in washing, water will be thrown through the openings in the hood onto the magneto allowing the spark to jump across through the water. It should be wiped dry if that condition exists.

For starting in cold weather refer to paragraph under COLD WEATHER PROCEDURE.

If the vacuum tank is not operating properly refer to card and booklet of instructions furnished with the tool equipment of each car, or communicate with the nearest Service Station conducted by Stewart Warner Speedometer Corporation.

MOTOR RUNS BUT MISSES

When starting, either in warm or cold weather, the motor will not operate evenly, unless in the event it is warm from previous running.

During cold weather the motor will have to run a longer length of time in order to warm up to its work properly. Use the choker on the dash. Keep it pulled out at least half way until the motor temperature rises to a point where the gasoline will vaporize.

The various points mentioned in connection with the motor not starting should be checked over.

It is not necessary, however, to look into any of these points until the motor has run a sufficient length of time to become thoroughly warm. Do not attempt to make any mechanical adjustments or change the carburetor adjustment until the motor has become warm and you are satisfied it is missing.

The first step would be to determine which cylinder is missing regularly. That may be determined by one of two methods. One would be to partially open the pet cocks on top of the cylinders. A forcible expulsion of gases through the open pet cock with each upward stroke of the piston will indicate that cylinder is firing correctly but a weak double sound would probably mean that cylinder was missing, caused by the valves not seating properly. Another method would be, by alternately short circuiting the plugs in each cylinder to learn which one is missing regularly. That can be determined, since when the plug which is missing regularly is shorted, there will be no apparent difference in the running of the motor. The spark plugs, wiring and valves of that cylinder can then be checked over.

Spark Plugs

If the spark plug porcelain is cracked, current from the magneto, following the point of least resistance, will jump across the gap, shorting within the plug, with the result the plug will not fire evenly or may not fire at all.

When the cylinder which is misfiring regularly is located, the first step would be to take out the spark plug and see that

it is in good condition. Lay it on top of the cylinder and note if it sparks regularly, or if it sparks inside, the porcelain is cracked and a new plug will have to be installed. If the plug is firing regularly the difficulty is undoubtedly located in the valve.

Before taking out the valve, make sure that the carburetor is properly adjusted. The mixture may be too lean or too rich. Also make sure that the valve plunger is not adjusted too high, holding the valve open. The clearance between the valve plunger screw and valve stem should be .004 of an inch.

One thing to keep in mind is the fact that the motor will not idle evenly with the spark advanced, the spark must be fully retarded on the steering column before the motor will fire evenly when running idle. With the spark in advanced position the motor will sound as though one or more of the cylinders are misfiring.

If it is not practical to take up the matter of carburetor adjustment with the Rayfield Service Station or with the dealer, consult the paragraph on CARBURETOR ADJUSTMENTS.

Air Leaks

Air leaks between the carburetor and cylinder will upset any carburetor adjustment, and in consequence the carburetor cannot be adjusted properly until air leaks, if they exist, have been located and corrected. See that the nuts holding the combination manifold in position on the cylinders are tight. If you are in doubt as to whether or not an air leak exists pour a small quantity of oil around the flanges of the manifold where attached to the cylinders. If there is an air leak the oil will seem to bubble and suck into the manifold at that point.

Vacuum Tank Strainer

The strainer within the top of the vacuum tank has become clogged it will interfere with the proper flow of gasoline and when nearly stopped up will probably not allow a sufficient quantity of gasoline to pass through, for proper operation of the motor.

The strainer is located directly underneath the pipe leading into the vacuum tank from the gasoline tank in the rear of the car. Disconnect the union nut on the gasoline tubing and then unscrew the nut threading into the top of the vacuum tank. The strainer is located within the nut. Clean it and reinstall again.

Carburetor Strainer

The strainer within the carburetor may be clogged with dirt and sediment and that should be removed.

The carburetor strainer is located directly underneath the float chamber. Unscrew the nut in the bottom of the float chamber, take out the strainer, clean it and install again. Be-

fore taking out the strainer shut off the gasoline supply at the valve underneath the vacuum tank.

The float chamber should also be drained occasionally. That can be done by removing the plug threaded into the bottom of the carburetor just ahead of the strainer. Refer to cut of the Rayfield Carburetor and pamphlet furnished with each car.

Valves

Valves not seating properly, due to improperly adjusted plungers or to carbon forming underneath the valve seats, will result in loss of compression and cause the motor to miss. A sticking valve, due to carbon having worked onto the valve stem, will also have the same effect.

Missing due to a valve sticking or to several of the valves sticking, is usually more noticeable at slow motor speeds. When that condition occurs it is necessary to take out the valve, clean the carbon from the stem and regrind the valve to a new seat.

OVERHEATING

Overheating is usually the result of running the motor without sufficient lubrication or without sufficient water.

Lack of Water

When overheating occurs through lack of water it makes itself noticeable through gradual slowing down of the motor. due to the inclination of the bearing surfaces to seize. If the water supply is insufficient and the motor is very warm, do not pour cold water into the motor at once, but allow the motor to cool first before doing so.

Look for the water leaks to determine where located so they may be remedied. Perhaps the water pump stuffing nuts need to be tightened or repacked. The nut on the front of the water pump may be tightened by turning it to the right. The one on the rear of the water pump has a left hand thread, consequently will have to be turned to the left in order to tighten it further.

If you have reason to believe the water pump packing needs replacement take the nuts off altogether, then repack the pump and turn up the nuts.

If the car has been in use for a considerable length of time, or during the winter season has been driven with various freezing solutions that are liable to eat the interior of the hose connections, make sure that the lower hose connection between the cylinder and water pump is not so thin that the suction of the water pump will cause the walls of the hose to collapse, partially shutting off the supply of water to the cylinders. Watch the hose connection to see if that condition exists. Have some one speed the motor suddenly and note if the walls of the hose seem to collapse. If they do so the hose will have to be replaced or a coiled spring, the same size as the inside diameter of the hose, may be inserted. A spring made from

No. 12 or 14 brass wire will answer the purpose very nicely. Of course, the spring should be the same length as the distance between the radiator outlet and the water pump inlet.

Fan Not Operating Properly

If the belt is loose or broken the fan will not drive at the proper speed. See that the belt is in good condition and not slipping. Also see that the fan compartment is supplied with oil. If the fan shaft should stick within its bearing through lack of lubrication the belt would undoubtedly slide over the fan pulley without driving it.

Should the fan belt not be tight enough, loosen the three nuts which hold the fan bracket in position and move the fan to the right far enough to take up the slack in the belt. Then tighten the nuts securely and see that the fan is in proper alignment.

Retarded Spark

Driving the car with the spark lever in retarded position will cause the motor to overheat if driven far enough with the spark lever in that position.

Lack of Oil

When the motor shows any signs of overheating do not continue to drive it in that condition but stop and investigate the cause. Watch the oil indicator gauge to see that it denotes the passage of oil through the oiling system; if not, learn the reason why. Perhaps the supply of oil is low.

Overheating resulting from lack of oil makes itself known through pounding noises occurring within the motor and gradual slowing up. In either case the motor should be stopped immediately and the cause investigated. No attempt to start again should be made until the motor has become thoroughly cool.

A low supply of oil, or very thin oil, will make itself known through failure of the oil sight gauge to register, indicating either lack of oil within the motor or stoppage of the pump. Examine the oil line and oil sight gauge, see that the connections are tight. Air leaks in the line between the oil gauge and connections with the oil pump will interfere with the operation of the indicator.

If the oil level is at the proper height, start the motor, watching oil sight indicator on instrument board. Should the hand not show pressure, stop the motor at once. Place an additional supply of oil in the motor, using about eight quarts, provided it already contains eight quarts, or, if not, a greater quantity to bring the oil level above the splash pans, insuring constant splash, under which condition the car may be driven at moderate speed to the nearest point where help may be obtained.

If the motor has run without sufficient lubrication for any

length of time, or even a short length of time, it may result in serious injury to the bearing surfaces.

If the oil level is at the proper height and the gauge indicates the passage of oil through the oiling system the difficulty is undoubtedly located in the cooling system or the magneto setting may have been retarded.

If the connections between the magneto and spark lever are in good order, so that the spark advance occurs as it should, have the magneto setting checked to learn if the coupling has slipped or any other condition is responsible.

In a car that has been driven for several seasons, it is possible the chain driving the magneto has worn to the extent it may disturb the magneto timing. In that event the chain cover will have to be removed and one of the offset links taken out of the chain. That will serve to shorten the chain and make it to all intents and purposes good as new again.

Anti-Freezing Solution

If an anti-freezing solution has been used in the cooling system during cold weather it should be withdrawn on the approach of warmer weather.

MOTOR NOISES

Motor noises that appear suddenly, gradually increasing in volume, should be investigated. They may be the result of a worn bearing and should be corrected before harm results.

Cold Motor

When first starting during cold weather the motor will not run evenly and will sound rougher than when all cylinders are firing smoothly. The same condition applies to a motor that is missing.

Climbing Hills

When pulling a hill slowly on high gear, if the spark is carried in advance position as the car loses its momentum, the motor may begin to pound, the result of what is known as a spark knock. Retard the spark lever until the car gains momentum again or shift to a lower speed, but do not strain the motor unnecessarily when climbing hills or traveling through heavy roads—make use of the lower speeds.

Oil

Failure of the oil supply will cause the motor to knock, the result, injured bearing surfaces.

Carbon

Carbon deposits forming within the cylinders will sometimes cause preignition, resulting in a knock similar to a spark knock.

Bushings

A worn wrist pin bushing will cause a light metallic rap,

noticeable when accelerating under a load.

A heavier knocking noise might be the result of a worn connecting rod or main bearing.

LOSS OF POWER

Loss of Power May Be the Result of

Dragging brakes.
Flat tires.
Running with retarded spark.
Loss of compression.
Improper adjusted carburetor.
Running motor without proper amount of water in circulating system.
Running motor without proper lubrication.
The first two causes will suggest their own remedy.

Retarded Spark

You will find, after a little experimenting, that driving with the spark lever retarded makes quite a difference in power and speed. For that reason the spark lever should be carried in an advanced position under ordinary driving conditions.

If, judging from the feel of the motor, you believe sufficient spark advance is not being obtained it would be well to have the magneto setting checked by the dealer. Refer to paragraph under MOTOR TIMING.

Loss of Compression

Due to improperly adjusted valves or carbon forming underneath the valves, not allowing them to close properly. Refer to paragraph on GRINDING VALVES.

Loss of power through leakage of compression past the valves is gradual and does not appear suddenly.

Carburetor

For carburetor adjustment refer to paragraph on CARBURETOR ADJUSTMENT.

Water

Insufficient water in the cooling system. The radiator and cooling system should be kept filled with water at all times. If water is lost through leakage the motor will overheat and lose power, owing to the tendency of the bearing surfaces to seize as the metal expands with heat.

If the motor has been driven without water until the motor seizes, be very careful with it. Do not pour water into it until thoroughly cooled, then handle gently and have the motor tested and examined at the first opportunity.

Lack of Oil

Lack of oil or failure of the oil supply will cause loss of

power, much the same as lack of water, with the exception that the motor will commence to slow down sooner and will feel stiff or feel as though it were working very hard. When that is noticed push out the clutch immediately and stop the motor.

Running the motor without sufficient oil will very quickly result in injury to the bearing surfaces. When that has happened have an examination made by the dealer to determine the extent of the damage. Further running under the same conditions will not improve matters.

LIGHTS NOT OPERATING PROPERLY

If any one bulb is not burning, the first step is to see that the connections to the lamp are tight and in proper position. Then examine the bulb, it may be burned out or the filament broken, necessitating a new bulb. Inspect fuses located within fuse compartment. If one is blown replace it with extra fuse furnished with every car.

Lamps Flicker

Noticeable when car is passing over a rough road, indicating a loose connection in the wiring system.

If it is noticed that as the car speed is increased the lights brighten and then grow dim as the speed is decreased, it will sometimes indicate a loose ground connection. See that the terminals on the wires leading to the battery are not loose. See that the generator connection is tight. Also see that the connections to the junction boxes are tight.

In the case of a weak battery the lights will also brighten as the car speed is increased and grow dim as the car slows down. In the case of the latter, however, the change will not be so pronounced as in the case of the former.

Headlamps

The head lamp bulbs are grounded within the lamp, the nickeled head lamp rim forming the ground connection. Press it firmly into place around the circumference of the lamp.

Broken Insulation

A wire rubbing against the metal conduit or metal of the car. Examine the wiring connection to lamps; see that they are firmly in position.

Dim Lights

Dim lights indicate a weak battery, or if only one lamp is dim and the others bright it may be due to a loose connection in one of the head lamp bulbs, a loose ground connection (press the head lamp rim firmly into place), or short circuit in the wiring to the bulb.

If the lights grow very dim when the starting pedal is used it will indicate a weak battery.

Bulbs in One Lamp Burn Out in Succession

That indicates a short circuit or lamps not of proper voltage.

COOLING SYSTEM

The motor is cooled with the aid of water constantly circulating through the cooling system, the water being kept in motion by a water pump mounted just ahead of the magneto. With the motor in operation the water is drawn from the bottom of the radiator through the pump to the lower portion of the cylinder water jacket, circulating around the cylinders into the top of the radiator and through the radiator. As the water reaches the cylinders it absorbs their heat and as it passes through the radiator it is cooled by a current of air drawn through the radiator by the fan mounted on the front of the motor base.

When empty, the cooling system will require five gallons of water. The amount of water contained within the cooling system should be inspected every day and fresh water added as required.

The cooling system is so designed the motor will not overheat under normal conditions during the hottest weather and for that reason it is a good plan to cover part of the radiator during cold weather, shutting off some of the circulation of cold air, allowing the motor to reach a temperature more nearly normal and where it is most efficient.

The use of freezing solutions during cold weather lowers the boiling point of water and consequently it should be drained and clean water substituted with the approach of warm weather.

The radiator should be drained of all water and filled with a fresh supply at least once every month.

If leaks develop in the radiator consult a radiator repair shop where repairs are fully understood.

CARE OF THE SPRINGS

The springs as used under the Chandler Light Weight Six are manufactured from the best grades of material and with proper care and attention will last indefinitely.

Spring Clips

Most frequent cause of spring breakage is failure to keep the spring clips properly tightened. When a new car is placed in commission the clips should be examined every two or three days and tightened as necessary. A certain amount of stretch takes place within the clips themselves and that in connection with the settling of the springs should be taken up.

If this point is given the attention it deserves spring breakages will be reduced to a minimum.

Advance spark lever on steering wheel to a point where ordinarily carried, accelerate motor quickly by opening throttle. If motor picks up quickly without back firing or without appearing sluggish it will indicate an adjustment about right.

Should motor seem sluggish, indicating a mixture too rich, turn high speed adjusting nut one or two notches in direction for Less Gas. At the same time it may be found advisable to turn low speed nut one or two notches in same direction.

If motor hesitates and backfires when throttle is opened suddenly it will indicate a mixture too lean, turn high speed adjusting nut one or two notches in direction for More Gas, manipulating low speed nut one or two notches in same direction.

It only takes a few minutes' time to properly adjust a Rayfield Carburetor that is in need of adjustment and for that reason adjustments had better be handled by the dealer or Rayfield Service Station.

A good mechanic, familiar with the Rayfield Carburetor and the Chandler Motor, should be able to so adjust the carburetor with the motor running idle that it will operate satisfactorily under running conditions.

The adjustments are extremely simple when one understands how to go about it, but it requires quite a little nicety of judgment to properly adjust the carburetor for power, speed and economy.

The adjustments are permanent and when made the carburetor will not get out of adjustment of its own accord. It is far better not to change the adjustment if the car is running satisfactorily. This applies not only to the carburetor but to all other mechanical adjustments on the car. If they are left alone and not disturbed the car will always be ready for use.

FOCUSING LAMPS

The large head lamp bulb may be focused so that a small beam will light the road a considerable distance in advance of the car or their rays may be spread out illuminating a larger space of the road more directly in front of the car.

A small adjusting screw is placed in the back of each head lamp. Turning the screw to the right will serve to bring the large bulb in closer contact with the center of the reflector, projecting the light further ahead. Turning the screw to the left will have the opposite effect.

If one lamp seems to throw a ray of light further ahead than the other they may not be focused evenly or one lamp may be tilted a little higher than the other one. Spring the lamp bracket with the aid of a bending iron to bring them both in line.

Since practically all city ordinances prohibit the use of glaring head lamps within the city limits small dimmer bulbs are provided for use in city driving.

FUSES

Fuses for the electric lighting system and horn are carried within the metal compartment on the instrument board. The markings beside each fuse indicate the circuit to which it belongs.

Failure of a lamp to burn may indicate a burned out fuse. Remove cover plate, note if fuse wire inside the glass is broken. As a further test interchange the fuses to note if that has any effect on the lights not operating.

When the cars leave the factory an extra fuse is provided in each fuse box.

The fuses employed are of the glass enclosed type, twenty ampere.

THINGS TO KEEP IN MIND

Apply brakes gradually.
Keep car under control.
Keep battery supplied with distilled water.
Test battery frequently.
Keep exterior of motor clean. This adds to appearance of car.
Keep the car clean.
Turn corners slowly.
Drive carefully on wet or slippery pavements.
Make use of choker when starting.
Allow motor to warm up to its work before attempting to drive fast.
If curtains and top are wet do not fold back before they dry out.
Keep spring clips tight.
Keep all bolts and nuts tight.
Oil clutch thrust bearing regularly.
Change oil in motor every five hundred miles.

Do Not

Tinker with mechanical adjustments.
Forget to inspect level of water in radiator every day.
Forget to inspect oil level every day.
Allow motor to run if oil sight feed on instrument board does not register passage of oil.
Use starting pedal instead of accelerator pedal when motor is running.
Attempt to force starting motor pedal. If gears do not engage with first attempt release pedal and try over again.
Change gears with a lot of noise. Learn to handle shifting lever correctly.
Forget to inspect gasoline supply before starting on a trip.
Forget lubrication of various parts.
Overlook tightening spring clips at regular intervals.

Index

A

Page

Aligning Front Wheels - 40

B

Battery Inspection - - 22
Battery Run Down - - 48
Brakes, Adjustment - - 40
Brakes, Use of - - - 13

C

Carbon - - - - - 56
Carburetor - - - - 57
Carburetor Adjustment - - 60
Carburetor Strainer - - 53
Care and Maintenance - - 34
Care of Springs - - - 59
Chandler Guarantee - - - 5
Cleaning Carbon - - - 35
Clutch Adjustment - - - 38
Cold Weather Procedure - 17
Cooling System - - - 59
Cover Radiator - - - 20

D

Descending Hills - - 16
Description - - - - 25
Differential - - - 33
Doors - - - - - 47-48
Driving - - - - - - 14
Driving Compartment 9

E

Electrical Apparatus - - 49

F

Fan Not Operating Properly - 55
Fenders - - - - 48
Focusing Headlamps - - 62
Freezing Solution - - 18-19-56
Fuses - - - - - 63

G

Gasoline System - - - 25
General Description - - 30
Generator - - - - 25
Grinding Valves - - - 35

I

Identification Sheet - - 3
Ignition System - - - 24
Inspection and Care - - 26
Insulation - - - - 58
Introductory - - - 6

L

Lighting System - - - 25
Lights Not Operating Properly - - - - 58
Loss of Power - - - 57

M

Page

Motor Missing - - - 52
Motor Noises - - - - 56
Motor Oiling System - - 44
Motor Will Not Start - - 50

O

Oil Cups - - - - - 27
Oil Level - - - - - 27
Oil Sight Feed - - - 15
Oiling Chart (illustration) - 29
Oiling System—Motor - - 41
Ordering Parts - - - - 7
Overheating - - - - 54

P

Parts Orders - - - 7
Preparation - - - 10
Propeller Shaft - - - 33

R

Radiator - - - - - 11
Rattles - - - - - - 46
Rear Axle Adjustment - 41
Rear Wheels - - - 40
Retarded Spark - - 55-57

S

Schedule of Lubrication and Inspection - - - 27
Shackle Bolts - - - 48
Shifting Gears - - 12-14-20
Spark Lever - - 16
Spark Plugs - - - - 52
Spring Lubrication - - - 60
Spring Seats - - - 47
Squeaks - - - - - 47
Starter Will Not Operate - 48
Starting Car - - - - 12
Starting Crank - - 49
Starting Motor - - - 10
Steering Gear - - - 39-40
Storage Battery - - - 14-17
Storing Car - - - - 17

T

Things to Keep in Mind - 63
Top - - - - - - 17
Torque Arm - - - 33-47
Transmission Bearing Retainers - - - - 33

U

Universal Joints - - - 33
Use of Brakes - - - 13

V

Vacuum Tank Strainer - 53
Valves - - - - - 54

W

Warning - - - - - 8
Washing Car - - - - 15
Water - - - - - 51-57
Wheels - - - - - 42-43
Winter Driving - - - 18
Wiring Diagram (illustrated) 21

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