Reference Book

Emblem of Satisfaction

1918

FOUR CYLINDER SERIES

E-4-34 Roadster
E-4-35 Touring
E-4-37 Sedan
E-4 - Delivery

BUICK MOTOR COMPANY
FLINT, MICHIGAN, U. S. A.

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FLINT PTG. CO.

NOTICE

This book is not published to instruct the car owner how to assemble or disassemble his car but it is placed at the disposal of the owners and operators of Buick four cylinder motor cars for the purpose of conveying such specific and intelligent information as will enable them to derive the maximum of service.

Like any other fine piece of machinery, an automobile requires a certain amount of regular attention in regard to lubrication and adjustment, to keep it operating at its highest efficiency.

It is quite impossible to compile instructions sufficiently clear to warrant a novice attempting all of the adjustments and inspection which the car requires.

The information in this book is intended to familiarize the owner or driver with the mechanical details of his car so that he can give it attention when necessary, but in case of an accident requiring repair or replacements, it is expected that the owner will call on the nearest Buick Dealer or service station for expert attention.

Repair parts or any additional information may be obtained from the nearest Buick Dealer or from any of the Buick Branches and Distributers listed on page 4. In all correspondence concerning the car be sure to give Model and Serial number. The Model will be found stamped on a plate fastened to upper toe board. The Serial number is stamped on a small oval plate on rear end of frame.

BUICK MOTOR COMPANY.

Flint, Michigan, U. S. A.

Reprint March 1, 1922.

BUICK BRANCHES AND DISTRIBUTERS

Atlanta	Buick Motor Company, 241-243 Peachtree St.
Battle Creek	Buick Motor Company, 82-84 West Main St.
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San Francisco	Howard Auto Company, 1601 Van Ness Ave.
Seattle, Wash.	Eldridge-Buick Co., Eleventh Ave. and E. Union
Washington, D. C.	Buick Motor Co., 1021 Fourteenth St. N. W.

DEALERS EVERYWHERE

LICENSE APPLICATIONS

In those states or territories requiring license under a horse power rating, the following information will be necessary.

Models—(See plate under front seat cushion.)

Serial Number—(See oval plate on front end of frame.)

Motor Number—(See number stamped on left side of crank case near front breather tube.)

Number of cylinders—Four.

Diameter of bore—3.375 inches.

Stroke—4.75 inches.

S. A. E. or N. A. C. C. horsepower rating—18.2 horse power.

Shipping Weight—E-4-34 Roadster, 1980 pounds.
E-4-35 Touring, 2100 pounds.
E-H-37 Sedan, 2350 pounds.
E-4 Delivery, 2050 pounds.

GUARANTEE

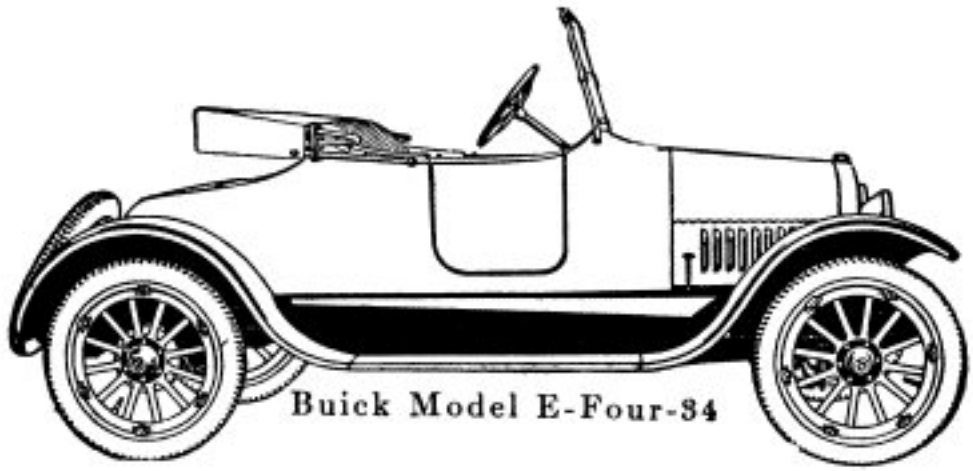
The automobiles furnished by the Buick Motor Company are warranted to be free from defects in material and workmanship under normal use and service, our obligation under this guarantee being limited to making good at our factory any part or parts thereof, which shall within twelve months after delivery to the original purchaser, be returned to us with transportation charges prepaid, and which our examination shall disclose to our satisfaction to have been thus defective; this guarantee being expressly in lieu of all other guarantees expressed or implied, and of all other obligations or liabilities on the part of the Buick Motor Company, and we neither assume, nor authorize any person to assume for us any liability in connection with the sale of Buick automobiles.

This guarantee shall not apply to any Buick automobiles, which shall have been repaired or altered outside of our factory in any way so as, in our judgment, to affect their stability or reliability, nor which have been subject to misuse, negligence or accident.

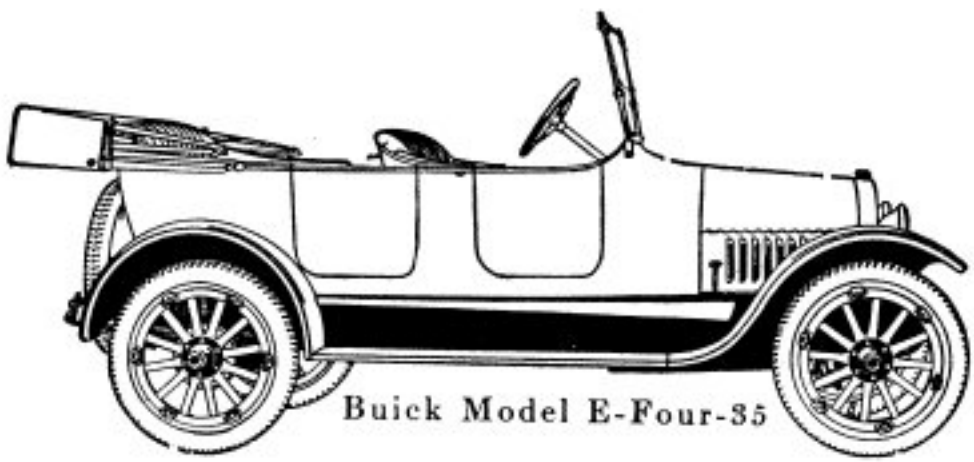
The Buick Motor Company makes no guarantee whatever in respect to tires, rims, ignition apparatus, horns or other signalling devices, starting devices, batteries, speedometers or other trade accessories, inasmuch as they are usually guaranteed separately by their respective manufacturers.

The Buick Motor Company reserves the right to make changes in design or add any improvements on Buick cars at any time without incurring any obligations to install same on cars previously purchased.

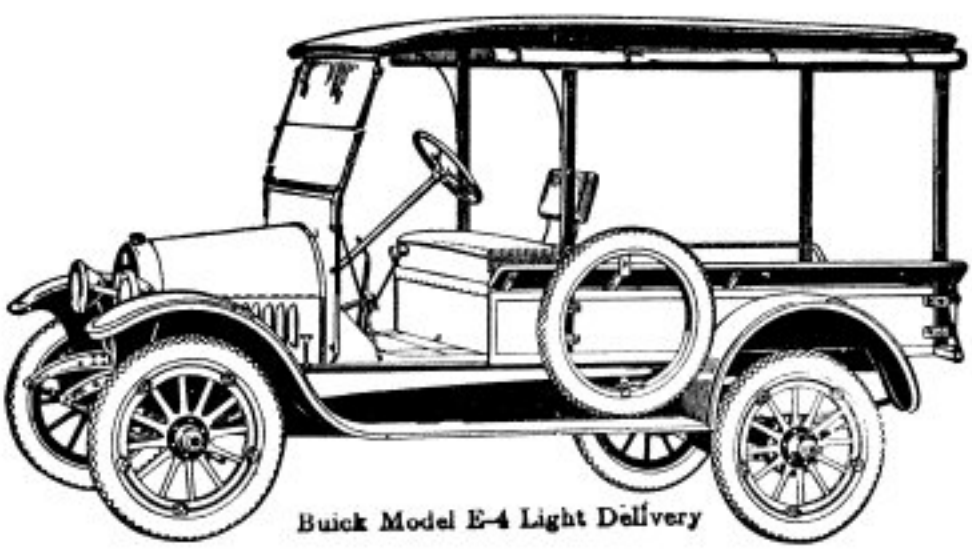
BUICK MOTOR COMPANY,
Flint, Michigan.



Buick Model E-Four-34



Buick Model E-Four-35



Buick Model E-4 Light Delivery

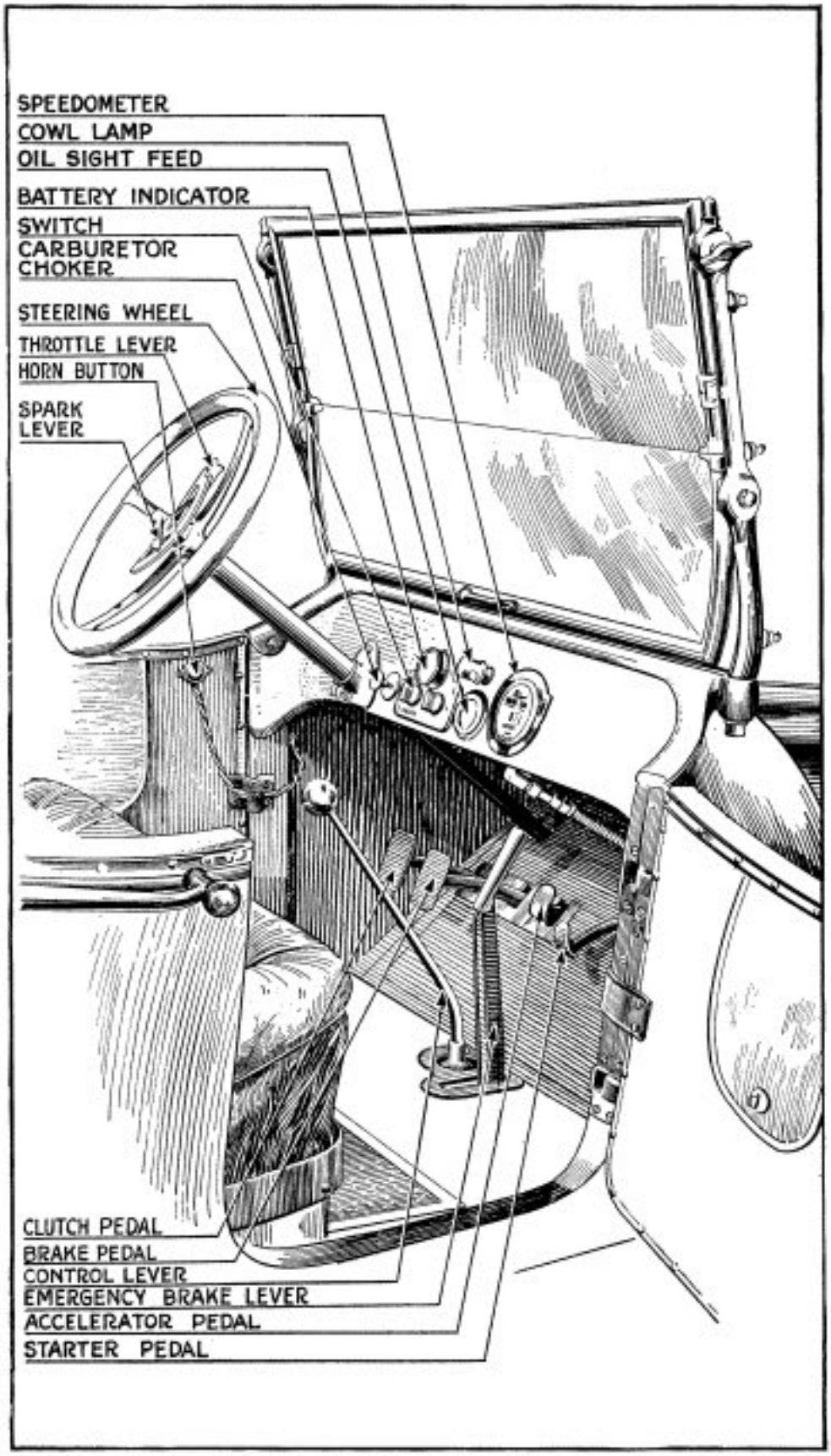


Plate 1
Driving Compartment

OPERATION

Before attempting to drive the car, make sure that it is ready for the road. See that there is gasoline in the tank, that the radiator is filled with water—or with an anti-freezing mixture in cold weather; that the oil in the motor crank case is at the proper level as indicated by the gauge; that the storage battery is properly connected, and that the shut-off cock between the vacuum tank and carburetor is open.

TO START THE MOTOR

Set the ball-topped control lever in the neutral position, where it is free to move sideways. Set spark lever at top of sector and move throttle lever about one-third of the way down. Turn ignition switch to the "on" position. Pull out the choker button, press clutch pedal down with the left foot and press starting pedal with right foot.

Motor should commence to spin as soon as starter pedal is depressed and should start under its own power in thirty seconds. If it does not start promptly, release starting pedal and examine all controls. In cold weather the motor requires more cranking, but starting pedal should never be held down for more than a minute without making an investigation. Continued cranking will merely exhaust the storage battery.

RUNNING POSITIONS

As soon as the motor starts, close throttle lever on steering wheel and advance spark lever three-quarters of the way down the quadrant. As the motor warms up, gradually push choker button in until motor runs without missing.

Never allow the motor to run for any length of time with the choker button pulled out, as this gives an excessively rich mixture and uses an abnormal amount of gasoline.

HAND CRANKING

If the storage battery should be run down or the generator out of order, the motor can be cranked by hand. Set throttle lever one-third of the way down on the sector, and move spark lever slightly away from its topmost position. Pull out choker button and attach hand crank to starting crank shaft under radiator. Start motor by pulling up quickly on crank.

Never try to start motor by pushing down on the starting crank. A backfire is likely to result in a broken arm.

TO START THE CAR

Select a quiet street or level road which has but little traffic on it. Start motor, and after it is running smoothly and evenly, take position in driver's seat behind steering wheel, grasping wheel firmly with the left hand. With right hand release the emergency brake by pressing thumb latch and pushing lever forward. Press the clutch pedal down firmly with the left foot, and with the right hand move the ball-topped control lever to the right and back. (See position marked "1" on the floor mat.)

LOW SPEED

The gearset is now in the first or "low speed" position. Gently release the pressure of the left foot on the clutch pedal, and at the

same time press down lightly on the accelerator pedal with the right foot to increase the speed of the motor. As the clutch takes hold the car will commence to move forward. Continue to press down on the accelerator pedal until the car gains some headway before attempting to change to second speed.

SECOND SPEED

When the car is well under way, quickly disengage the clutch, at the same time releasing the pressure on the accelerator pedal to prevent the motor racing, and with the right hand shift the ball-topped control lever forward to the left, and then forward again, to the position marked "2" on the floor mat. Engage the clutch immediately, and accelerate the motor as before. The car is now in second or "intermediate speed."

HIGH SPEED

Again accelerate the motor until the car is moving forward at a smart pace, then operating clutch and accelerator pedals as before, quickly shift the control lever straight back to the position marked "3" on the floor mat. The car is now in third or "high speed," which is the normal driving position.

The speed of the car can now be controlled entirely by the use of the accelerator pedal. The throttle lever on the steering wheel may be used for the same purpose if desired, but as the right hand is used for shifting gears, the foot will generally be found more convenient for operating the throttle.

SHIFTING GEARS

In shifting from a lower to a higher gear, as in getting under way, it is important that the speed of the car be accelerated just before making the change, so that the two gears that are to be meshed together will be running at approximately the same speed. The proper handling of the clutch pedal and accelerator so as to make the motor "pick up" its load quickly, and at the same time prevent it from "racing" when the clutch is released, requires considerable practice.

In changing gears, and especially when starting the car from a stand-still, always let the clutch pedal come back gently. If the foot is suddenly removed from the pedal it will let the clutch take hold with a violent jerk.

In shifting gears from one speed to another, the motion should be made firmly and without hesitation. The different positions of the lever for the different speeds are plainly marked on the floor mat. If the gears fail to mesh correctly the first time, release the pressure on the control lever and clutch pedal for a moment and try again. With a little experience the various changes can be made easily and without noise.

SHIFTING DOWN

Shifting from a higher to a lower gear, or "shifting down," is accomplished in the same way as shifting up; that is, by releasing the clutch, and moving the control lever quickly to the proper position; and re-engaging the clutch. Shifting down will be found easier if the clutch pedal is pressed down only enough to release the clutch.

DRIVING

Ordinarily the car is always driven in high or third speed and first and second speeds are used only for starting. Occasionally, however, a steep hill or muddy or sandy road will be encountered which requires more power, and since it is for this purpose that the lower speeds are provided, the driver should not hesitate to use them.

The Buick will climb any hill "on high" that any car can climb, but after the driver has demonstrated this to his satisfaction, it is suggested that he make use of a lower gear which will not cause so great a strain on his motor.

STEERING

Steering is largely a matter of practice. Drive slowly at first. Do not attempt to turn corners too sharply or too quickly. Always slow down or stop before crossing railroad and car tracks. In a short time a driver gets the "feel" of his car, and then steering becomes almost an involuntary action, so that all the attention can be concentrated on the road. Learn to watch the road from 100 to 300 feet ahead of the car, depending on the speed. In this way there is always time to prepare for obstacles before the car reaches them.

HANDLING THE SPARK

For all ordinary driving at moderate speeds, the spark lever can be left about three-quarters of the way down the quadrant, but as the motor slows down, as in ascending a steep hill or negotiating a heavy road, the spark lever should be retarded until the motor runs smoothly and without knocking. It is a good rule to keep the spark lever advanced as far as possible, at all times, without causing the motor to knock.

Never allow the motor to run for any length of time with the spark retarded, as such practice only consumes an abnormal amount of gasoline and has a tendency to overheat the motor.

TO STOP THE CAR

To stop the car, slow down the motor by removing the pressure on the accelerator pedal, then release the clutch by pressing down on the clutch pedal with the left foot. If the car retains too much headway apply the service brake by pressing the brake pedal down with the right foot. Shift the control lever into the neutral position. The foot may then be removed from the clutch pedal.

TO REVERSE

To reverse the motion of the car, or drive backwards, first come to a full stop. Release the clutch and shift control lever to the right and forward. (See position marked "R" on the floor mat.) Engage clutch and accelerate motor as before.

Never attempt to reverse the motion of the car before it has come to a complete stop. The car cannot move in two directions at once and the result is certain to be serious if this is attempted.

EMERGENCY STOPS

If for any reason it should become necessary to stop the car suddenly, press down on clutch and brake pedals at the same time, and pull back on the emergency brake lever with the right hand. The car should never be stopped suddenly except in a case of emergency, as

such stopping is extremely hard on the tires, and strains the entire mechanism. A good rule is to use brakes and clutch as little as possible and endeavor to control the car with the accelerator.

TO STOP THE MOTOR

To stop the motor, turn the ignition switch to the "off" position, and at the same time open the hand throttle to the starting position. This will allow the motor to take in a full charge of gas before coming to rest and leave it ready for easy starting next time. Also move the spark lever back to the starting position and set the emergency brake before leaving the car. If the car is to be left for any length of time, turn the lock on the ignition switch.

Never leave the car with the motor running, as this is a useless waste of gasoline, and there is always a chance that children or others may throw the motor into gear.

STARTING ON A GRADE

It sometimes becomes necessary to start a car on an up-grade. To accomplish this, start the motor as before, then release the emergency brake and hold the car with the service brake while shifting gears. Accelerate motor with the hand throttle while gradually releasing the pressure on both pedals together. It takes considerable practice in operating the clutch and brake pedals to make the one take hold while releasing the other without "killing" the motor, but it can be done very easily with a little experience.

SKIDDING

Sudden application of the brakes, especially when turning a corner or on a slippery pavement, is liable to make the car "skid." Skidding is caused by the rear wheels suddenly losing their traction while the car is subject to centrifugal force from turning. The result is that the rear end swings suddenly toward the outside of the curve. The best way to avoid skidding is to drive slowly. When a skid occurs, release the brake for an instant and turn the steering wheel in the direction the car is sliding. This will help to straighten it up.

RACING THE MOTOR

Never open the throttle suddenly or leave it open very far when the car is standing and the motor running idle. This is known as racing the motor, and there is nothing more injurious. More motors have been ruined by racing while idle than have ever been worn out in actual driving under load.

SPEEDING

Drive slowly at first. Extremely high speeds are dangerous under all conditions and fifteen or twenty miles an hour on good roads is plenty fast enough for the inexperienced driver. Learn to handle the car properly under all conditions of roads and traffic before attempting higher speeds.

RULES OF THE ROAD

The following "rules of the road" apply to the entire United States, and the greater part of Canada. Every driver of a motor car should understand and obey them:

1. When meeting a vehicle going in the opposite direction, turn out to the right.

2. When passing a vehicle going in the same direction, turn out to the left.

3. In turning a corner to the right, keep as close as possible to the right hand ditch or curb.

4. In turning a corner to the left, continue past the intersection of the two roads or streets before making the turn.

5. In stopping the car always stop at the right hand curb.

USE OF LIGHTS

Buick cars are provided with electric lights operated from the switchboard on the cowl. For night driving on country roads, the lighting switch should be turned to the point marked "On." For city driving, and when leaving the car standing at the curb, the switch should be turned to the "Dim" position. Do not leave the car standing for any length of time with the large headlights burning, as they require considerable current and will eventually run the storage battery down.

ADJUSTING HEADLIGHTS

The beams from the headlights can be properly directed on the road by loosening the bolts which fasten the lamps to the fenders, and swinging the bottoms of the brackets. The brightest part of the light should strike the road about 300 feet ahead of the car. The lamps can be focused by removing the glass and adjusting the position of lamp bulb in relation to the reflector. When properly focused, the light should form a bright circle not over 18 inches in diameter on a wall fifty feet ahead of car.

WATCH THE INSTRUMENTS

Instruments placed conveniently on the instrument board keep the driver constantly informed as to the operation of his car, and he should form a habit of glancing at these instruments occasionally while driving.

The oil sight glass tells by the motion of its wheel, when sufficient oil is being circulated through the motor lubricating system.

The battery indicator on the switch shows the amount of current, in excess of that being used for lights and ignition, going to the storage battery. It also shows the amount taken from battery when cranking or idling the motor.

The speedometer gives the speed of the car and the number of miles traveled, both total and trip. The trip register may be set back to zero or to any given figure by turning the large milled screw at the right.

TO RAISE THE TOP

In case of rain or as a protection from the sun, the top may be raised as follows: Remove the dust cover and loosen clamps which hold top bows to sides of car. Then pull up and ahead on front bow until top is fully extended. Fasten in this position by attaching to windshield in front. The top can be most easily raised from inside the car.

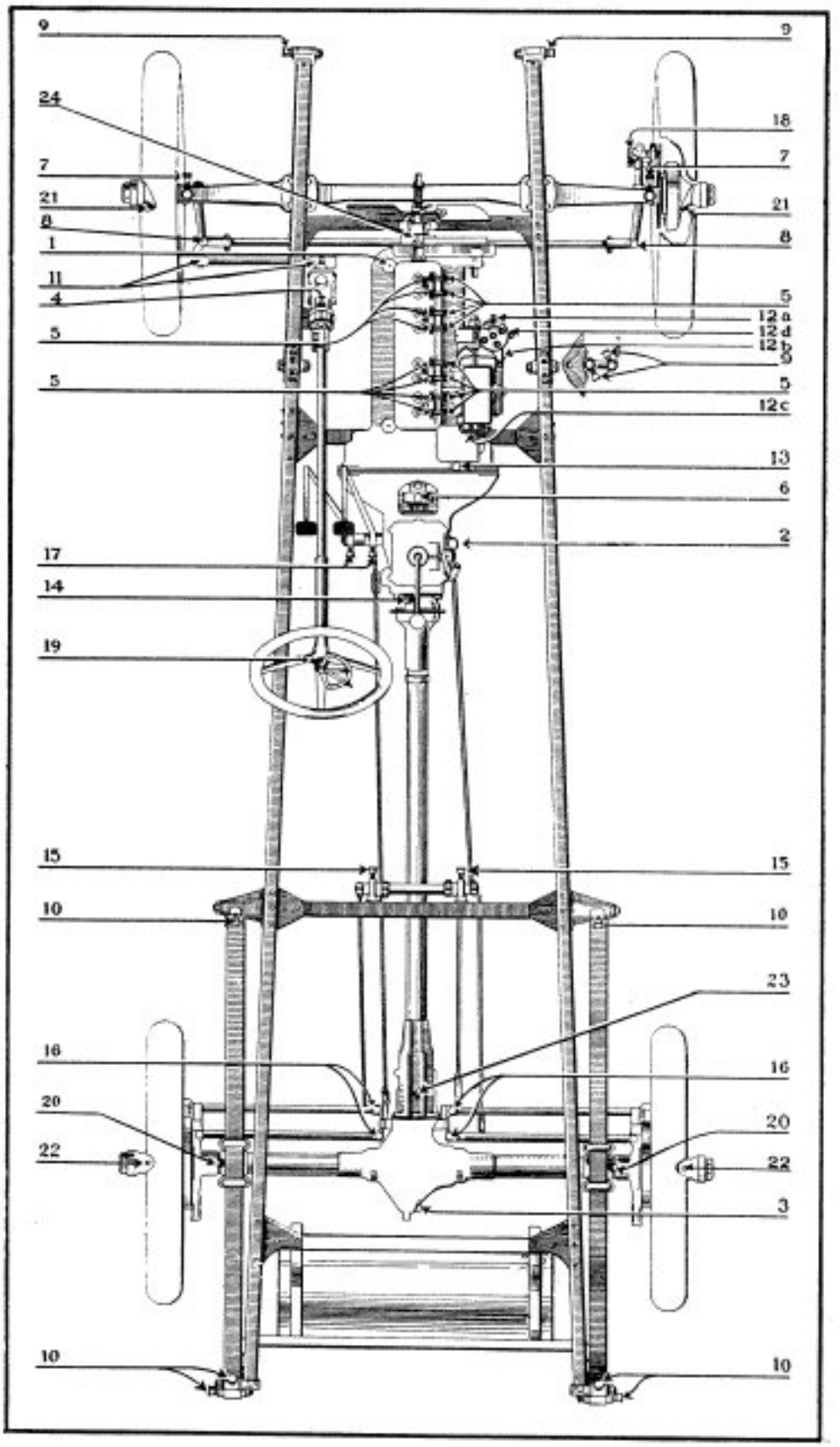


Plate 2
Lubrication Chart

The side curtains are carried in the top and can be attached by unrolling and stretching between the fasteners on the top bows and body.

When folding the top, be sure that the side curtains are properly rolled and folded up first, and that the folds of the top do not get caught between the bow spacers. Do not fold top when wet or damp.

For driving in the rain or snow, the upper glass of the windshield may be pushed out at the bottom, affording a clear view of the road.

DRIVING LICENSES

All states and countries now require motor cars to carry driving licenses and on Buick cars, provision is made for attaching these licenses to the headlight tie rod in front and to the cross bar of the tire carrier in the rear. Full information for making application for license in those states requiring a horsepower and weight rating will be found in the front part of this book.

LUBRICATION

1. **MOTOR—Motor Oil.** Fill crank case reservoir through front breather tube until the oil gauge shows "Full." Test gauge with finger to make sure it is working freely. Do not add oil after gauge shows full, as more oil will simply cause motor to smoke. Add oil as often as necessary to keep gauge at this position.

2. **TRANSMISSION—Use steam cylinder oil for all temperatures above freezing. Thin with motor oil sufficiently to make liquid below freezing temperatures.** Remove filler cap on right side of transmission case and fill to level of opening.

3. **REAR AXLE—Use steam cylinder oil for all temperatures above freezing. Thin with motor oil sufficiently to make liquid below freezing temperatures.** Remove plug on right side of differential housing and fill to level of the opening.

4. **STEERING GEAR—Steam cylinder oil.** Remove pipe plug in top of housing and fill with steam cylinder oil.

EVERY 100 MILES

5. **VALVE ROCKER ARMS—Motor oil.** Give each oil hole a few drops. There are two oil holes in each rocker arm.

EVERY 500 MILES

6. **CLUTCH—Soft Cup Grease.** Give grease cup one or two turns and see that it is filled with fresh grease as often as necessary. Be careful not to allow any excess grease to work out of the bearing and get on the clutch leather or flywheel.

7. **STEERING KNUCKLES—Soft cup grease.** Give each grease cup a turn or two and see that cups are kept filled with grease. There are two cups on each knuckle.

8. **TIE ROD BOLTS—Soft cup grease.** Give each grease cup a turn or two and see that cups are kept filled with grease. There is one grease cup at each end of the tie rod.

9. **FRONT SPRINGS—Soft cup grease.** Give each grease cup a turn or two and see that cups are kept filled with grease. There is one cup at the front end and two at the rear end of each spring.

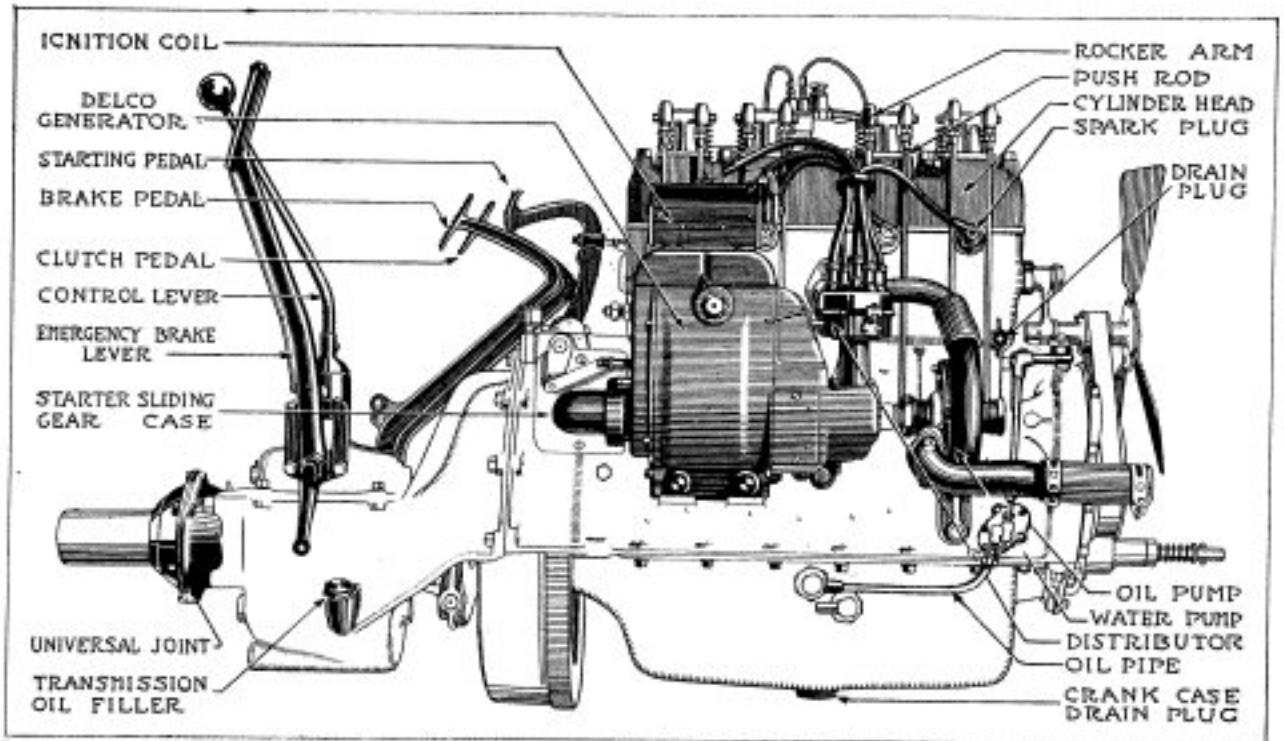


Plate 3
Generator Side of Power Plant

10. REAR SPRINGS—Soft cup grease. Give each grease cup a turn or two and see that cups are kept filled with grease. There is one cup at the front end and two at the rear end of each spring.

11. STEERING CONNECTING ROD—Soft cup grease. Clean joints with gasoline and pack with grease.

12. DELCO GENERATOR—

(A) Motor oil. Turn oiler on front end of distributor housing and inject oil until oiler wick is thoroughly saturated. This is to lubricate the bearings on the distributor shaft.

(B) Motor oil. Remove front brush cover and an oil hole is exposed. Insert 5 to 8 drops of oil and replace vore. This is to lubricate the ball bearing on the forward end of the armature shaft.

(C) Motor oil. Turn oiler on rear end of generator and inject five to eight drops of oil to lubricate the roller bearings on the rear end of armature shaft.

(D) Soft cup grease. Swing cover on front end of distributor housing to one side and inject grease with grease gun, for lubrication of the distributor driving gears and over-running clutch.

13. STARTER SLIDING GEARS—Soft cup grease. Give grease cup a turn or two, and keep cup filled with grease.

14. UNIVERSAL JOINT—Soft cup grease. Remove pipe plug in universal joint housing and fill housing with grease by means of grease gun.

15. BRAKE SHAFT—Soft cup grease. Give grease cups a turn or two and see that cups are filled with grease. There are two cups, one at each end of shaft.

16. BRAKE CAM SHAFTS—Soft cup grease. Give grease cups a turn or two and keep them filled with grease. There are three cups on each side of the axle, two near the differential housing and one just inside the brake drum.

17. CLUTCH AND BRAKE PEDALS—Soft cup grease. Give grease cups a turn or two and keep them filled. There is one cup on each pedal.

18. SPEEDOMETER SWIVEL JOINT—Soft cup grease. Give grease cup on joint a turn or two and keep filled with grease.

19. STEERING WHEEL HUB—Motor oil. Inject a few drops of oil with oil can through oiler on top of wheel.

20. SPRING SEATS—Motor oil. Fill oilers with oil from oil can until felts are thoroughly saturated.

EVERY 1,000 MILES

21. FRONT WHEELS—Soft cup grease. Remove front wheels, clean bearings and pack in grease. See instructions for adjusting front wheels under "Front Axle."

22. REAR WHEELS—Soft cup grease. Move or jack up car and turn wheels until pipe plug in hubs appears on top. Remove plugs, fill hubs with soft cup grease and replace plugs securely.

23. PINION SHAFT BEARING—Soft cup grease. Remove pipe plug in pinion flange and fill with grease from grease gun.

24. FAN HUB—Motor oil. Remove plug and apply a few drops of oil with oil can, through oil hole in hub.

OVERHAULING

Three or four times a year all the oil should be drained out of motor, transmission, and rear axle, and these parts washed out

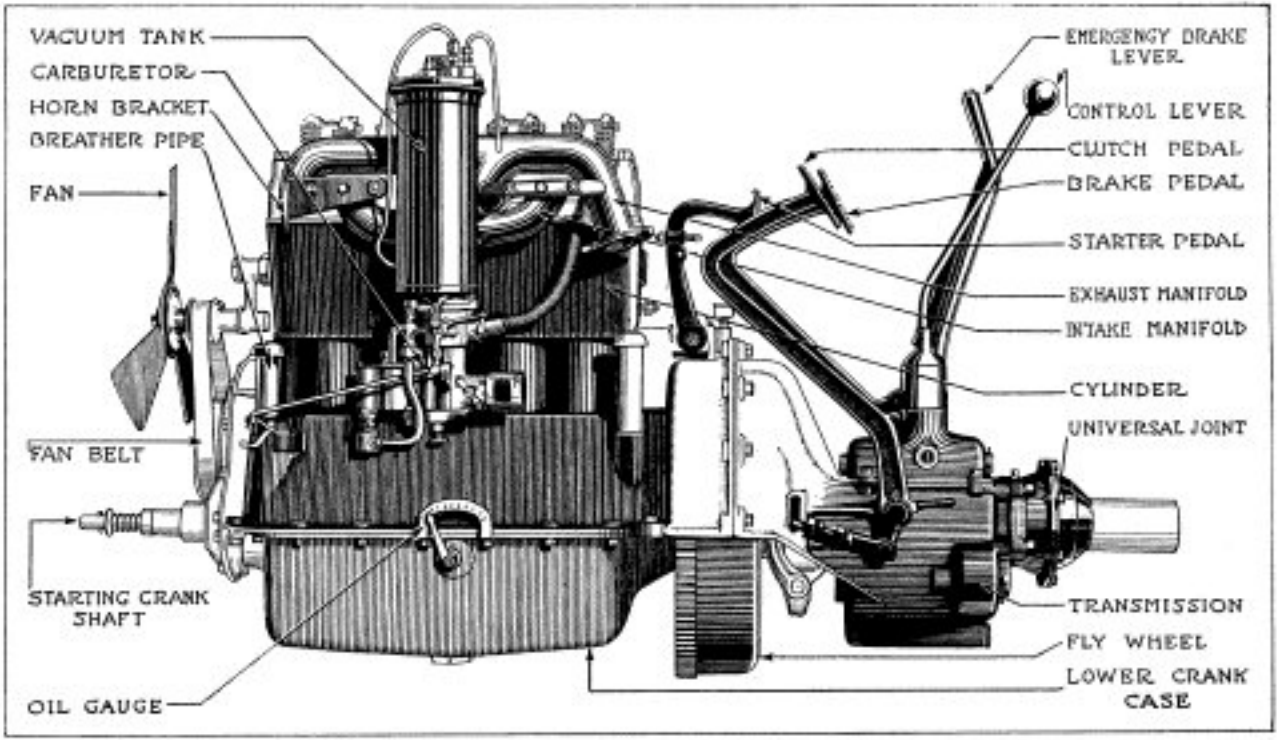


Plate 4
Carburetor Side of Power Plant

thoroughly with gasoline or kerosene, before being filled again with clean oil. It pays to change the oil in the motor frequently, or whenever it gets thin or watery. At least once a year the car should receive a thorough overhauling, at which time the motor, clutch, transmission, universal joint, steering gear and axles should be taken apart and carefully cleaned and adjusted before being reassembled. This work should be done by an experienced mechanic.

LUBRICANTS

Motor Oil should be a high grade, medium heavy, mineral oil, with a flash point of not less than 400 degrees Fahrenheit and a viscosity of 80 to 90 Tagliabue or 62 to 72 Saybolt, at 212 degrees Fahrenheit. This oil should be used exclusively in the motor lubricating system, for valve rocker arms, fan hub, distributor and generator bearings, steering wheel hub, and spring seats, and for all small joints not otherwise provided with lubrication, such as spark and throttle rods, brake rods, etc.

Steam Cylinder Oil should be a heavy mineral oil, free from acid, and should be used exclusively for the transmission, rear axle gears, and steering gear. It is better for this purpose than most of the so-called greases.

Soft Cup Grease should be a pure mineral product and should be used in all grease cups, such as those on the clutch release ring, steering knuckles, tie rod bearings, spring shackles, starter sliding gears, brake shaft, brake cam shafts, clutch and brake pedals, speedometer swivel joint, etc. It should also be used for the lubrication of those bearings which are packed in grease, such as the steering connecting rod, distributor gears, universal joint, wheel hubs, pinion shaft bearings, etc.

Do not use too much oil or grease. The excess will simply run out of the bearings and collect dust and dirt on other parts of the car.

POWER PLANT

The unit power plant is the most important part of the car. It develops the necessary power for driving the car and delivers it to the axle and road wheels, where it is finally converted into motion of the vehicle.

The power plant consists of:

The motor.
The lubricating system.
The fuel system.
The Delco system.
The cooling system.
The exhaust system.
The clutch.
The transmission gearset.
The universal joint.

The motor is the machine which turns the pressure of the exploding gases into rotary motion of the crankshaft.

The lubricating system supplies oil for the different parts of the motor, automatically varying the amount to agree with the speed of the motor.

The fuel system pumps the raw gasoline from the fuel tank at the rear of the car, vaporizes it, mixes it with the proper proportion of air and delivers it to the motor cylinders in quantities proportional to the load.

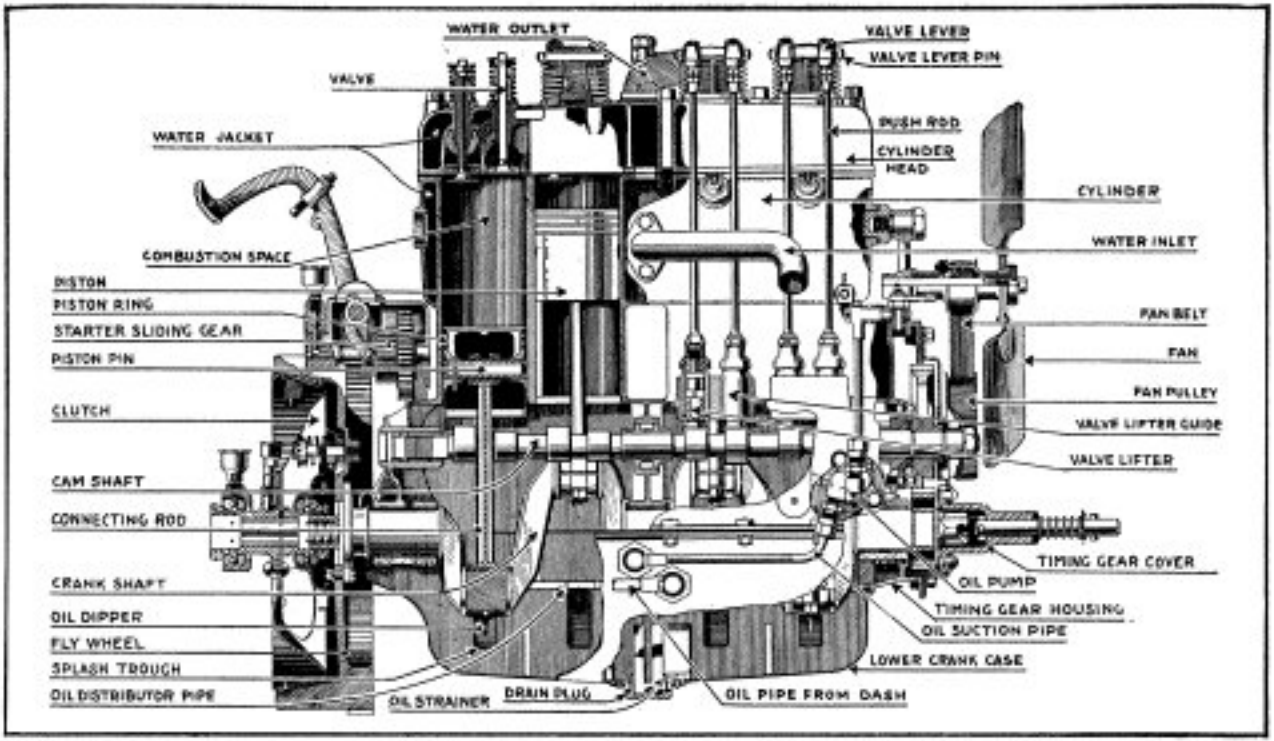


Plate 5

Interior Construction of Motor

The Delco system generates the electric current, increases the voltage sufficiently to enable it to jump the spark gaps, and distribute it to the cylinders in proper rotation. It also supplies the electrical energy which is accumulated in the storage battery to crank or spin the motor for starting, and to operate the electric lights.

The cooling system protects the working parts of the motor by absorbing the excess heat of the explosions and diffusing it to the surrounding atmosphere.

The exhaust system carries the waste products of combustion away from the motor and muffles the noise of the explosions.

The clutch is the connecting link between the motor and the transmission, and connects or disconnects the two units at the will of the operator.

The transmission gearset allows the speed of the motor to be varied in relation to the speed of the rear wheels, so that the energy can be applied at a faster rate under certain conditions.

The universal joint is a flexible coupling which connects the power plant to the rear axle and allows the rear axle to move up and down over the road surface without interrupting the driving effort.

THE MOTOR

The principal part of the motor is the cylinder block, the upper portion of which consists of the four cylinders, or barrels, in which the gas is exploded, and their surrounding water jackets. The lower portion of the cylinder block supports the crank shaft, to which the connecting rods and pistons are attached, and the cam shaft and valve lifters which operate the valve mechanism. The upper ends of the cylinders are closed by the cylinder head which contains the valves, and the lower portion of the cylinder block is enclosed by the crank case, which forms the oil reservoir. The water pump and Delco generator are mounted on the right side of the cylinder block and operated by gears from the cam shaft. The oil pump, which is also mounted on the right side of the cylinder block, is operated by a worm gear on the forward end of the cam shaft.

HOW THE MOTOR WORKS

The power of the motor is produced by burning or exploding a mixture of gasoline and air in the cylinders above the pistons, the resulting pressure forcing the pistons down and turning the crank shaft. In the four cycle engine, of which the Buick motor is an example, there are four strokes of the piston, or two complete revolutions of the crank shaft, for each explosion in any one cylinder. For this reason, the cam shaft is geared to run only one-half as fast as the crank shaft, and the valves open and close alternately, every other revolution of the crank shaft. This action will be more readily understood by reference to the diagram.

On the first downward stroke of the piston, the inlet valve is opened and the piston sucks in a charge of gas.

When the piston starts back on the upward stroke, the inlet valve closes and the charge of gas is compressed in the space at the top of the cylinder.

The compressed gas is next ignited by an electric spark and the resulting explosion creates a large amount of heat and pressure which pushes the piston down during the next, or working stroke, and turns the crank shaft.

On the return upward stroke of the piston, the exhaust valve is opened and the piston pushes the burnt gas out, leaving the cylinder empty and ready for the beginning of a new cycle.

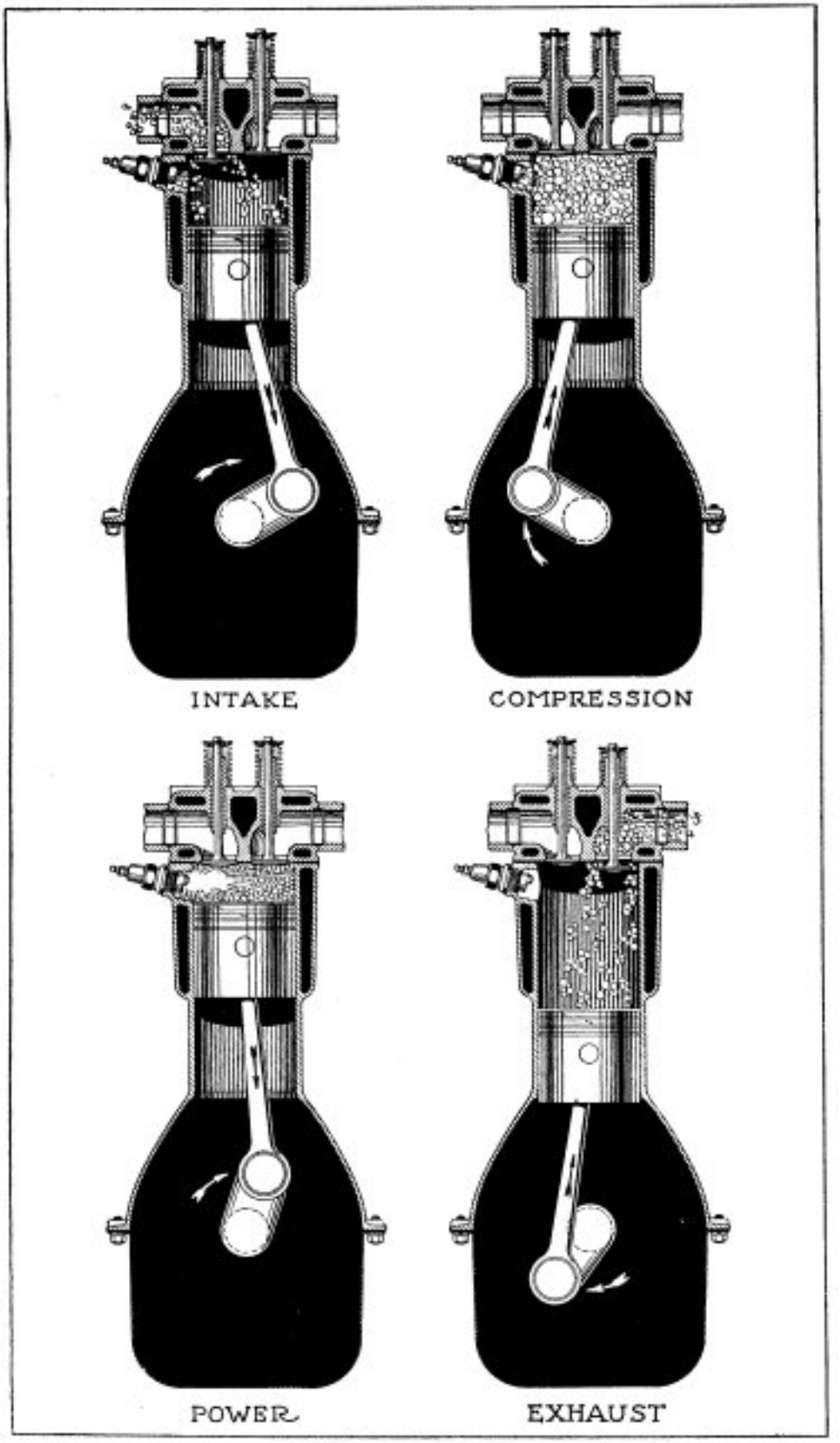


Plate 6
Cycle Diagram

It will be noticed that only one stroke out of the four is a working stroke in any one cylinder, but since the motor has four cylinders, the crank shaft actually receives two impulses during each revolution.

TIMING THE VALVES

The exact point in the cycle at which the valves are opened and closed is determined by the shape of the cams which operate them and by the angular relation between the cam shaft and crank shaft. If it should ever become necessary to remove one of these shafts or the gears which drive them, they must be replaced in proper relation to one another or the valves will be "out of time." To obtain this relation, the punch-marked tooth on the crank shaft gear should be set to match with the punch-marked space on the cam shaft gear.

ADJUSTING PUSH RODS

With the timing gears properly matched, the final setting of the valves can be made by adjusting the push rods to the proper length by means of the adjusting balls and lock nuts. In making this adjustment the flywheel should be turned in a clockwise direction, looking at it from the front of the motor, until the point marked "U. C-1-4" is exactly under the notch on the bell housing above the flywheel. In this position both valves of either cylinder No. 1 or No. 4 (counting from the radiator back) should be fully closed. Adjust push rod to allow .006 inch clearance between end of valve stem and rocker arm. This is approximately the thickness of a light card, or a sheet of heavy paper. Proceed to adjust remaining push rods in the same manner, first making sure that both valves are fully closed. In setting the marks on the flywheel be careful to turn the motor only in a clockwise direction. Otherwise the backlash in the timing gears will affect the result.

To check the timing, turn flywheel to line marked "E. C.-S. R." and note that exhaust valve closes completely. Then turn to line marked "I. O." and note that inlet valve is commencing to open. The valves can be made to open and close exactly on these points by careful adjustment of the push rods.

GRINDING VALVES

To keep the motor up to its maximum efficiency, the valves must be gas tight when closed. When leakage occurs the valves should be ground.

Disconnect water outlet, and the inlet and exhaust manifolds, and remove cylinder head. Compress valve springs and remove the keys which hold valve spring seats on stems. The valves can now be removed and cleaned or ground in with emery flour and oil. Grind by turning valve back and forth on its seat until both valve and seat show a bright ring 1/32 inch wide all the way round.

Be careful to clean out all traces of abrasive material before replacing valves.

REMOVING CARBON

While the cylinder head is removed, all carbon deposit should be carefully scraped off of cylinder walls, cylinder heads and tops of pistons.

ADJUSTING BEARINGS

A sharp metallic knock in the motor, audible every revolution of the crankshaft, may mean that one of the bearings is loose. If

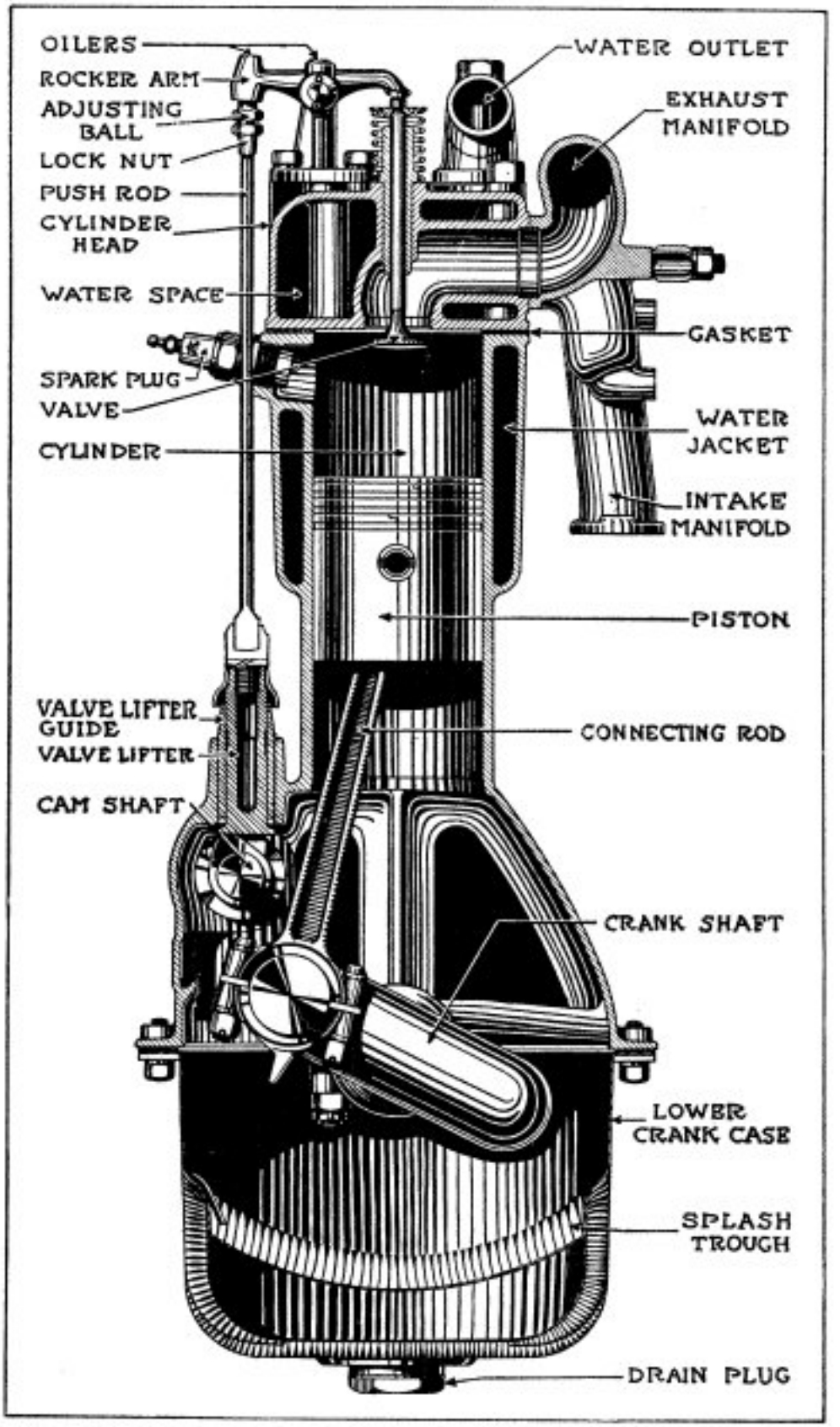


Plate 7
Valve Mechanism

retarding spark or removing the carbon does not stop the noise, remove lower half of crank case and examine bearings. When the loose one is located, it can be taken up by removing the cap and taking out one or more of the thin metal shims. Note that bearing is bright and shows no indication of a lack of lubrication.

INSERTING PISTON RINGS

Piston rings seldom break, but if one does it can be most easily replaced by removing the connecting rod cap and pulling piston and rod out from below. The rings may be slipped on or off the piston by inserting thin strips of sheet metal under them to prevent their dropping into the grooves, until in their proper places.

KEEPING THE MOTOR CLEAN

Nothing will add more to the appearance of the car when the hood is raised, than a clean motor. Use a soft cloth moistened with gasoline or kerosene and a stiff brush to get dirt out of the sharp corners.

MOTOR LUBRICATING SYSTEM

The motor is provided with an automatic lubricating system and a supply of oil is carried in the lower half of the crank case. A small gear pump, located on the right side of the crank case and driven by a spiral gear on the cam shaft, sucks oil from the oil reservoir through a strainer and forces it through a pipe to the sight feed on the instrument board, where the circulation can be watched by the driver. From the sight feed the oil returns through the oil distributor pipe to splash troughs fastened in the lower crank case.

As the connecting rod dippers pass through the oil in the splash troughs, they force some of it up into the connecting rod bearings and splash the remainder over the interior of the crank case and up into the pistons and cylinders. As it drains back it is caught in ducts and led to all the bearings of the motor, the excess falling back into the reservoir to be used over again.

OIL CIRCULATING PUMP

The oil pump consists of two small gears enclosed in a close fitting housing and driven by a shaft and spiral gears from the cam shaft. As the gears turn, they take the oil into the spaces between their teeth and carry it around to the outlet, where the action of the teeth meshing together squeezes the oil out of the spaces and forces it to flow to the sight feed on the instrument board. The pump is automatic in action and requires no attention or adjustments, except the addition of fresh oil to the crank case reservoir, as often as necessary to keep the oil up to the necessary required level.

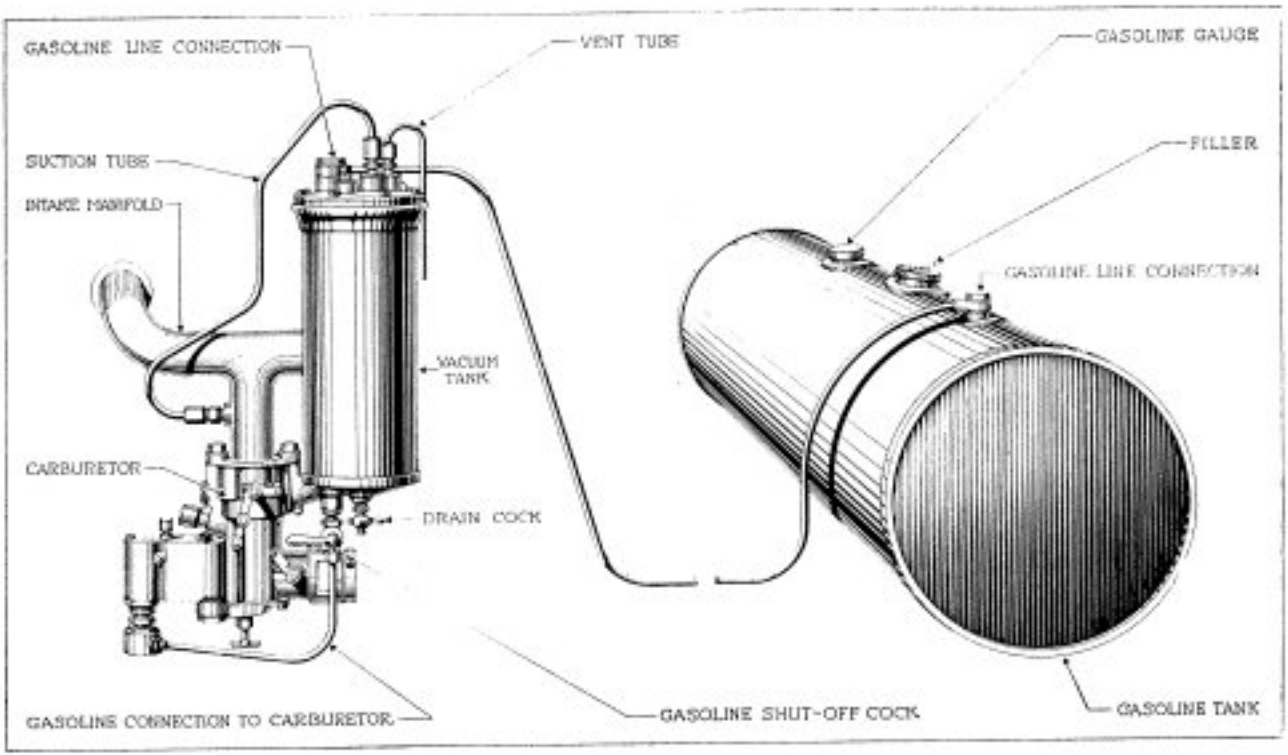
SIGHT FEED

The sight feed merely indicates circulation of the oil, and does not show when the supply in the crank case reservoir is running low. Watch the oil level dial on the crank case and test the oil level by rocking the gauge finger back and forth.

OIL STRAINER

The oil strainer is attached to the crank case drain plug, located in the bottom of the crank case, and can be removed for cleaning by unscrewing the plug. By removing the drain plug and spinning the

Plate 8
Fuel System



motor a few seconds with the electric starter, the crank case can be completely drained.

The crank case should be drained, rinsed out with kerosene, and refilled with fresh oil at least once in every 1,000 miles.

OIL GAUGE

The oil gauge is located on the left side of the crank case and is operated by a float in the oil reservoir. Sufficient oil should be carried in the crank case to keep the oil gauge pointer between the "Full" and the "¾" points on the dial. When examining the gauge always touch it or jar it before reading, to make sure the float is not stuck.

FUEL SYSTEM

The fuel system consists of the gasoline tank, piping, vacuum tank, carburetor, and intake manifold. There is nothing connected with the gasoline tank or piping to get out of order, the chief consideration being to carefully strain all gasoline and to avoid leaks which are sometimes caused by road vibration.

VACUUM TANK

The vacuum tank draws the fuel from the gasoline tank at the rear and delivers it to the carburetor at a constant head as needed. It consists of two steel shells, the inner one of which encloses the float and the valve mechanism attached to the cover, while the outer one acts as the fuel reservoir and is connected to the carburetor. The float operates two small valves which control openings connected to the inlet manifold and the atmosphere. A flapper check valve closes the bottom of the inner shell.

As the inner shell empties, the float falls and opens the atmospheric valve. The suction of the motor tends to create a vacuum in the inner shell, drawing gasoline into the inner tank from the main fuel tank at the rear of the car. When the inner tank has filled, the float rises, closing the suction valve and opening the atmospheric valve, allowing air to enter the inner tank through the vent tube while the gasoline passes through the flapper check valve into the outer tank and from there to the carburetor.

The action of the tank is entirely automatic. There are no adjustments, and it will require no attention aside from an occasional examination of the connections to see that they are tight and free from dirt.

Do not allow the vent tube or the small hole in the gasoline tank filler cap to get stopped up with dirt

CARBURETOR

The carburetor is the instrument which measures the fuel charges for the motor and mixes them with the proper amount of air to form a combustible gas. It consists of a float chamber and a mixing chamber, the former being connected to the gasoline supply and the latter to the intake manifold.

The float chamber contains a cork float attached to a valve in such a manner that the fuel is admitted to the carburetor only as it is needed to maintain a constant level in the spray nozzle. The spray nozzle is located in the mixing chamber. Its opening is regulated by a needle valve which constitutes the gasoline adjustment of the carburetor, and it is surrounded by the venturi tube through which a portion of the incoming air passes at high velocity, picking up the gasoline spray from the end of the nozzle. The mixing chamber also

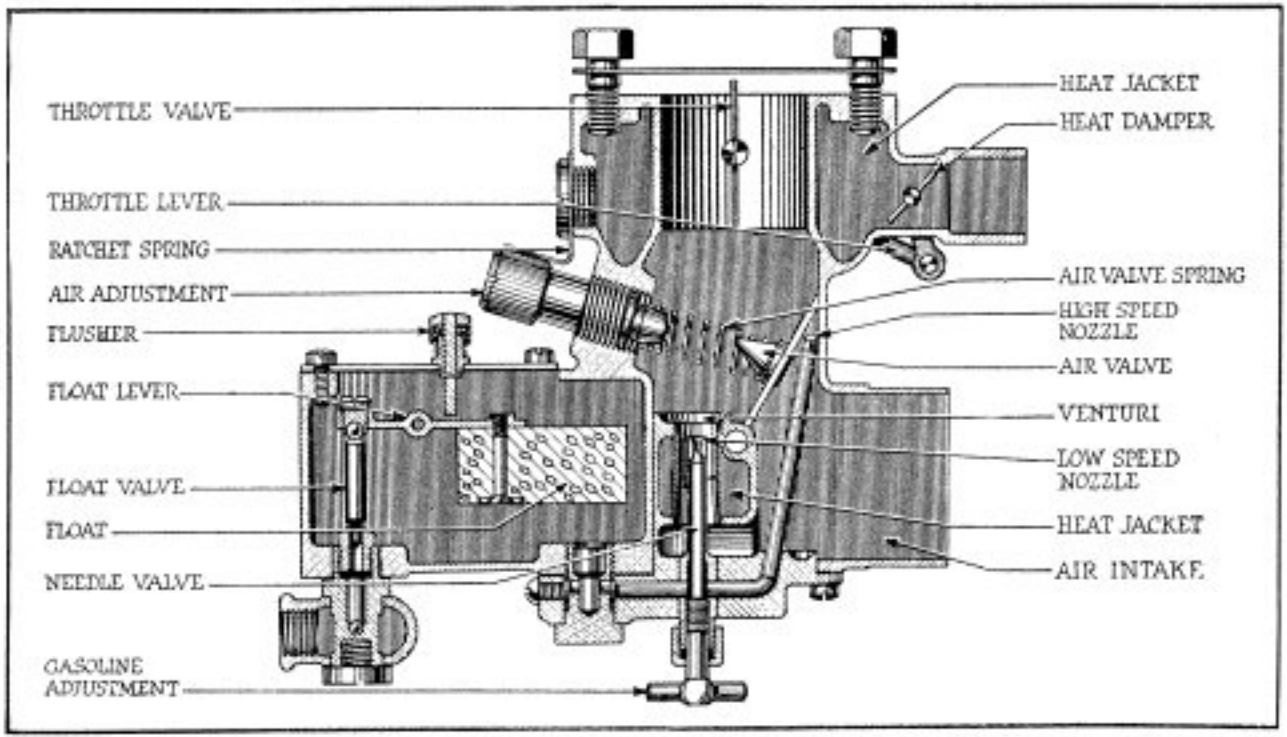


Plate 9
Carburetor

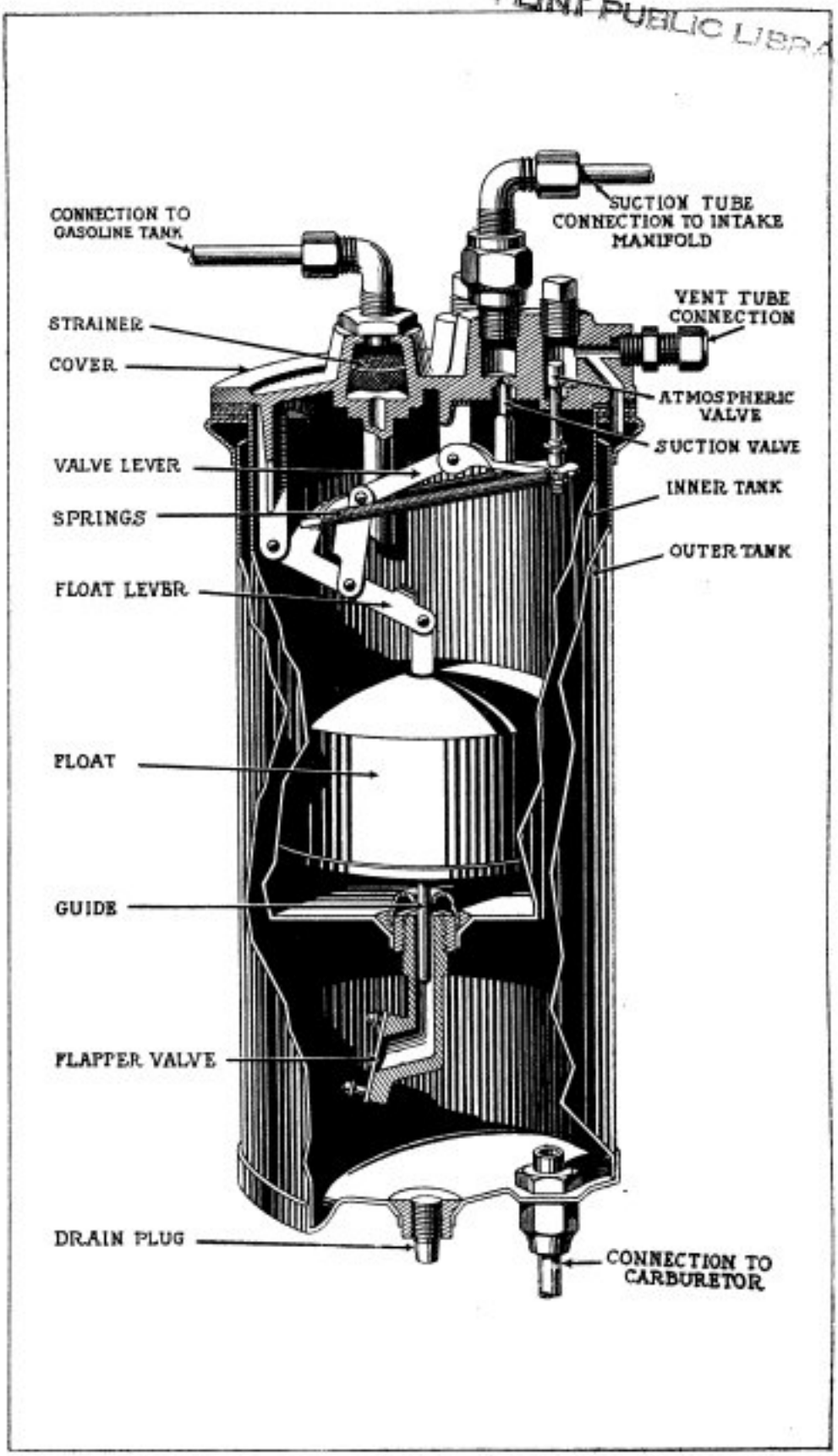


Plate 10
Vacuum Tank

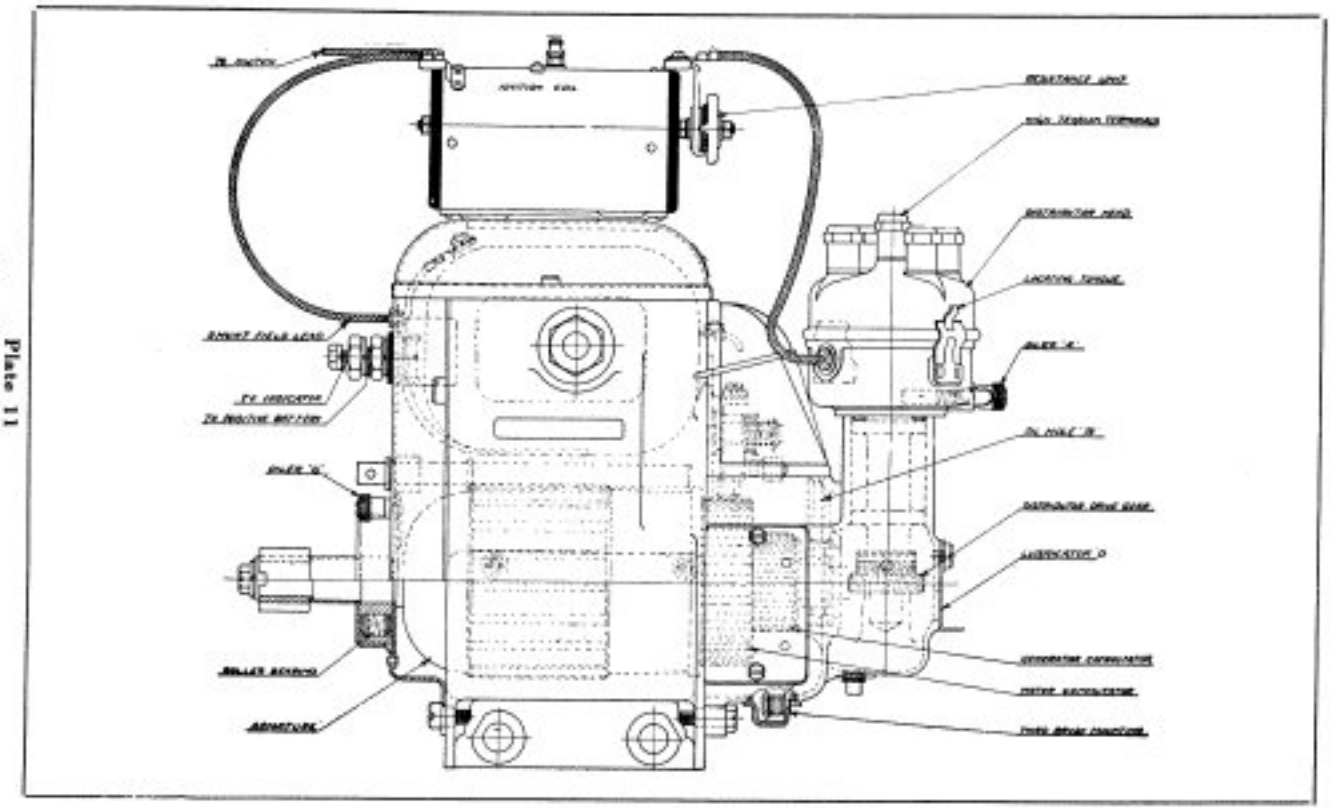


Plate 11
Side View of Generator

contains the air valve and the high speed nozzle. The air valve is held to its seat by an adjustable spring which forms the air adjustment. At high speeds the velocity of the air increases until the air valve is lifted from its seat and an additional quantity of gasoline spray is taken from the high speed nozzle.

The opening between the mixing chamber and the inlet manifold is controlled by throttle lever on the steering wheel, and thus determines the amount of gas being fed to the motor. A choker, operated by the choker button on the instrument board closes the air inlet to the mixing chamber for starting. The upper end of the mixing chamber and the venturi tube are surrounded by jackets through which some of the hot exhaust gas passes to keep the instrument warm and assist vaporization of the fuel. A damper in the jacket opening is connected to the throttle so as to increase the amount of heat as the throttle is closed.

If the motor apparently loses power after becoming thoroughly warmed, remove the diamond shaped shutter on the bottom of the carburetor which will allow the hot gases to escape without passing around the venturi.

ADJUSTMENT OF CARBURETOR

In adjusting the carburetor, proceed as follows:

1. Turn gasoline adjustment to the right until needle valve is completely closed.

2. Set air adjustment so that end of adjusting screw is even with the point of the ratchet spring just above it.

3. Open gasoline adjustment by giving needle valve one full turn to the left.

4. Start motor as usual; if necessary allowing it to run a few minutes with choker button pulled part way out until motor is thoroughly warmed up, and choker button can be pushed clear in.

5. With the spark retarded, turn gasoline adjustment to the right, closing needle valve, until motor idles smoothly.

6. Advance the spark and turn air adjusting screw to the left, a little at a time, until motor begins to slow down, indicating too much air; then turn it back to the right just enough to make motor run well.

To test the adjustment, advance spark and open throttle quickly. The motor should accelerate instantly. If it misses or pops back, open gasoline adjustment slightly by turning needle valve to the left. Do not touch air adjustment again unless it appears absolutely necessary. The best possible adjustment has been secured when gasoline adjustment is turned as far as possible to the right, and air adjustment is turned as far as possible to the left, providing motor idles smoothly and accelerates quickly when throttle is opened.

Never attempt to adjust carburetor until it is certain that motor has good compression in each cylinder; that a good hot spark occurs at each plug at the proper time; and that gasoline is reaching the carburetor regularly from the vacuum tank. The carburetor should be the last thing to touch.

THE DELCO SYSTEM

The electrical equipment is the Delco single unit starting, lighting and ignition system. This is manufactured and guaranteed by The Dayton Engineering and Laboratories Company, Dayton, Ohio. It consists primarily of the following Delco pieces:

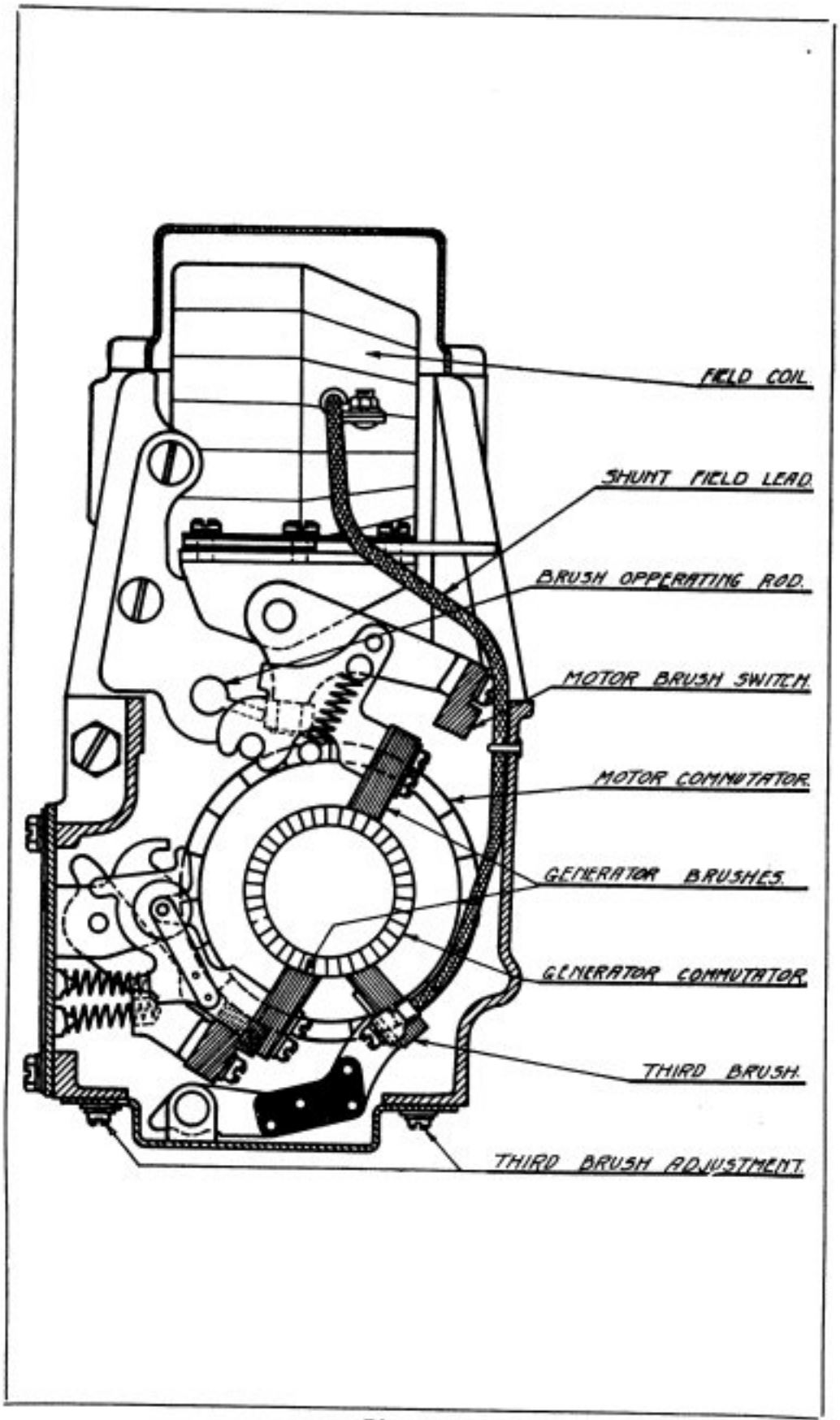


Plate 12
End View of Generator

Motor Generator, No. 121.
Starting Clutch, No. 12647.
Ignition Coil, No. 2157.
Lighting and Ignition Switch, No. 1095.

The Delco apparatus does not include the storage battery, lamps, horn or wiring.

The electrical system on the automobile is for the purpose of supplying electrical energy for lights, ignition and cranking purposes. The storage battery is for the purpose of storing energy so that it is available at any time.

The purpose of the generator is to supply electrical energy when operated by the engine. Part of this electrical energy is used directly for ignition and lights and the surplus is charged into the storage battery.

The motor is for the purpose of performing the cranking operation. It utilizes the energy from the storage battery during the cranking operation. The motor feature and the generator feature are each incorporated in the same unit, and in addition the distributor is incorporated in the forward end of the motor generator. This is for the purpose of securing the proper timing and distribution of the ignition current to the different spark plugs.

MOTOR GENERATOR

The motor generator is mounted on the right side of the engine in the front of the flywheel. It performs the cranking operation through the motor clutch gears which mesh with the small gear on the rear of the armature shaft and with the teeth on the flywheel. The circuit for the cranking operation is completed when the motor brush comes in contact with the motor commutator, making what is known as the motor brush switch. This is operated by the starting pedal and comes in contact immediately after these gears are meshed.

Electrical energy is generated when the armature is revolved by the pump shaft. Current is induced in the generator windings on the armature on account of it being revolved in a strong magnetic field. This current flows from the commutator through the generator brushes.

CONSTRUCTION

The motor generator consists essentially of the armature and the frame. The armature is the revolving element which is made up of an iron core in the slots of which are wound two insulated copper wire windings which connect to the motor and generator commutators respectively. The frame proper consists of cast steel pieces which form pole pieces on opposite sides of the armature, and support the field coil at the top. The current through the field coil magnetizes this frame which places the armature in a strong magnetic field between the pole pieces. The armature is supported by a ball bearing in the front end and a roller bearing in the rear end. These are mounted in the end frames which attach to the main frame. The distributor is mounted at the forward end of the motor generator and is driven by a spiral gear cut on the outer face of the overrunning driving clutch. Its operation in no way affects the operation of the motor generator, it being placed in this position simply as a convenient and accessible method of mounting and driving.

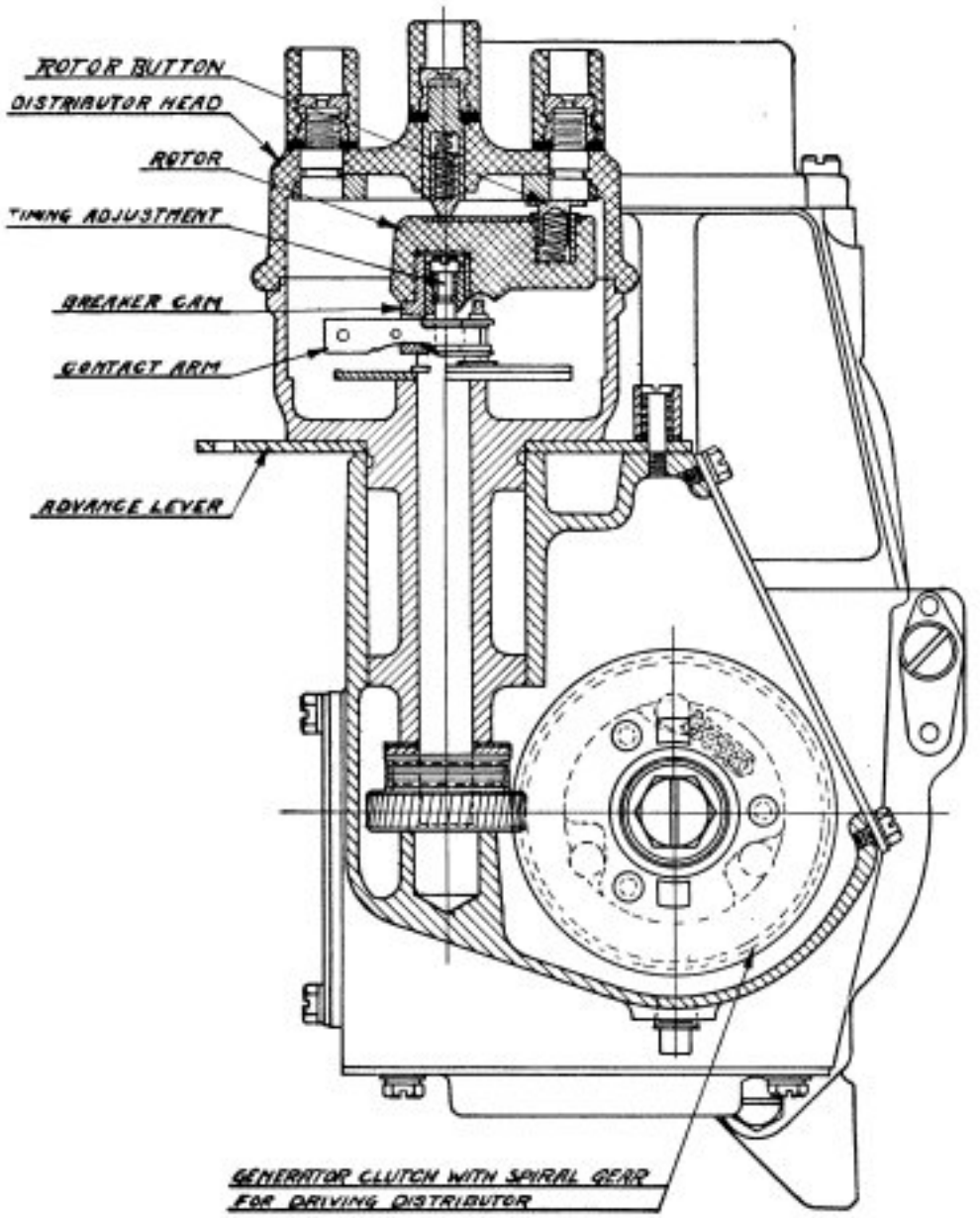


Plate 13
Sectional View of Distributor

OPERATION

There are three distinctively different operations required of the motor generator. These occur in the following order:

1. Motoring the Generator. This operation takes place when the ignition switch is turned to the "on" position, at which time the circuit between the generator and the storage battery is completed. This allows current to flow from the storage battery through the generator windings, causing the armature to revolve as a motor. This is necessary in order that the starting gears may always be brought into mesh. This operation continues until the starting pedal is depressed and brings the gears into mesh and raises the generator brush off the commutator which breaks the circuit.

2. Cranking Operation. The complete depressing of the starting pedal allows the motor brush to make contact with the motor commutator. This completes the circuit from the storage battery through the motor windings of the motor generator, and as it is necessary to have the gears in mesh before this can take place, when the armature revolves the cranking operation is performed. The energy, of course, for this operation comes from the storage battery.

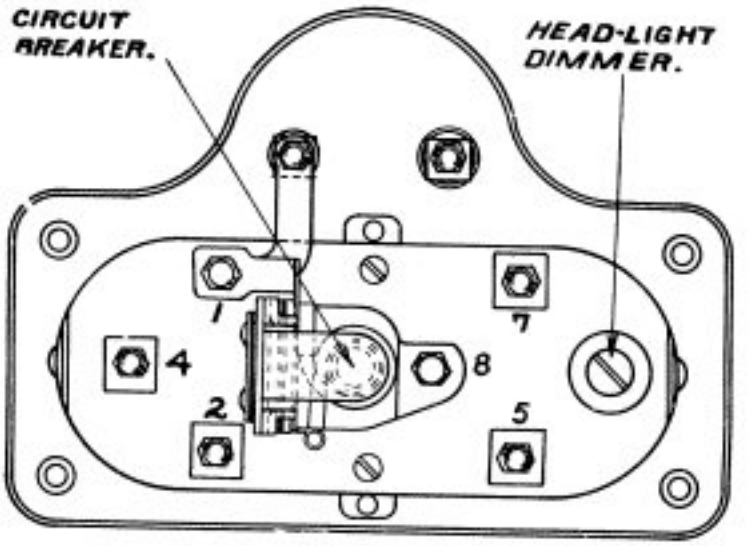
It is well to note in this connection that considerable energy is required for the cranking operation. All conductors of this circuit must be of ample size and all connections securely made. This applies especially to ground and battery connections which may sometimes be disconnected.

3. Generating Electrical Energy. As the cranking operation is completed and the engine is operating on its own power, the starting gears demesh when the starting pedal is released. At the same time the motor circuit is broken by the brush lifting off the commutator, and the generator circuit is completed by the brush making contact with the generator commutator. At normal speeds the voltage generated exceeds that of the storage battery and the pointer on the combination switch will indicate charge unless current is being used for lights. At very low engine speeds, or at medium speeds when the lights are being used, more current will be used than is being generated, and the pointer will indicate "discharge."

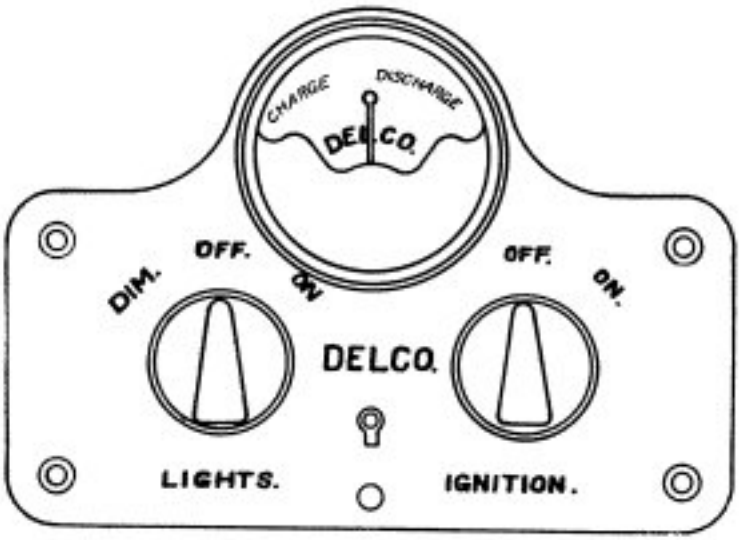
With no lights operating the generator should commence charging the battery at speeds ranging from seven to eight miles per hour on high gear.

REGULATION

The natural function of the generator is such that its output increases with increasing speed unless provision is made to overcome this. On the automobile where the generator must necessarily operate at widely varying speeds and a nearly uniform charging rate is desired, it is necessary that the output be regulated. On this system this is accomplished by what is known as third brush excitation. A circuit of this is very plainly shown in the circuit diagram. It will be noted that the current through the field windings is conducted through an auxiliary brush instead of the main generator brushes. With this connection the natural function of the generator is such that a strong field current is obtained at the low speeds, thus giving the maximum output of the generator. But as the speeds increase the amount of current in the field winding decreases, thus weakening the field and preventing the output of the generator from increasing to excessive values. In fact at very high speeds the output of the generator is decreased slightly over what it is at speeds around twenty to twenty-five miles per hour.



View Showing Switch Wire Terminal



Front View of Switch

ADJUSTING THE OUTPUT OF THE GENERATOR

With this means of regulation it is possible to vary the output of the generator by varying the position of the third brush. Upon leaving the factory these generators are adjusted to give an ample output for normal driving conditions.

Quite frequently cars are operated under conditions which require considerably more or less current than normal. When these conditions are met it is frequently advisable to either increase or decrease the output of the generator. This adjustment should be made only by a competent mechanic. All Buick dealers and repair men are supplied with much more information on this adjustment than is possible to give here. When it is desired to have this adjustment made the car should be taken to the dealer from whom the car was purchased. If not convenient to do this it should be taken to the nearest authorized **Buick Service Station.**

LUBRICATION

There are five places to lubricate this system. Referring to the side view of generator, they are as follows:

1. Oiler "A" is for the purpose of lubricating the bearings on the distributor shaft. This is a wick oiler and should receive enough oil to fill the oil cup every two weeks.

2. Oiler "B" is an oil hole for lubricating the ball bearing on the forward end of the armature shaft. This oil hole is exposed when the front brush cover is removed. This should receive four or five drops of engine oil every two weeks.

3. Oiler "C" is for the purpose of lubricating the roller bearing at the rear end of the armature shaft. This should receive four or five drops of engine oil every two weeks.

4. Lubricator "D" in the forward end of the distributor housing is for the purpose of supplying soft cup grease to the distributor driving gears and overrunning clutch. This is packed with grease upon leaving the factory and it should be re-packed every six months, and in the winter when grease has a tendency to harden, a small amount of lubricating oil should be added.

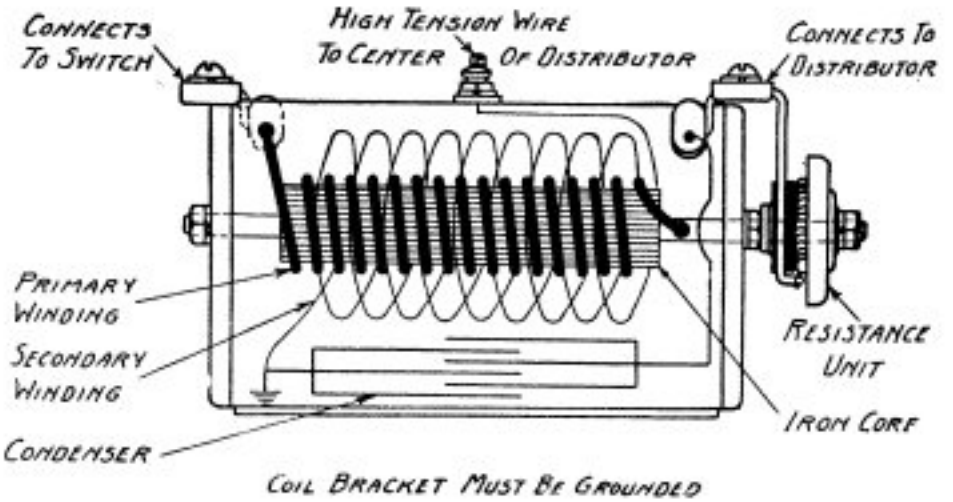
5. The inside of the distributor head upon which the rotor button bears should have a small amount of vaseline applied to prevent the rotor button from wearing the inserts. The rotor button and distributor head should be kept clean. It will not be necessary to lubricate this after the distributor head and rotor become well polished.

DISTRIBUTOR

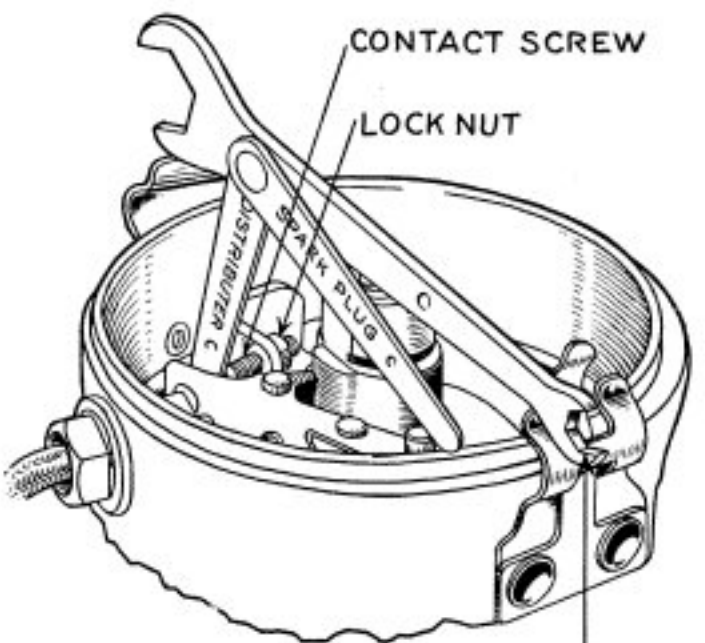
The distributor is mounted on the forward end of the motor generator. It is for the purpose of properly timing and distributing the ignition current. The timing is accomplished by the timing contacts which are operated by the breaker cam. This determines the time at which the high voltage current is induced in the secondary winding of the ignition coil. This high tension current is distributed to the different cylinders at the proper time by means of the distributor head and rotor.

There are four lobes on the breaker cam and this cam is driven at one-half engine speed, thus giving two sparks per revolution which is the number of power impulses on a four cylinder engine.

The distributor is linked up to the spark lever on the steering wheel sector. In starting, the spark lever should be placed in the retarded position. This prevents the spark from occurring before the piston reaches top dead center, and prevents backfire.



Sectional View of Coil



FOR TURNING CONTACT SCREW & LOCK NUT

Plate 15
Adjustment of Distributor Breaker Points

This is important even when starting with the self-starter as the engine kicks the starter just as hard as it would when cranking by hand.

After the engine has been started the spark lever should be placed in the advanced position so that the spark occurs at the spark plugs while the piston is still in the upward stroke. This is necessary in order to get the maximum power as it requires a definite period of time for the mixture to burn after the spark occurs, and the maximum power is only obtained when the mixture is completely burned when the piston is on top dead center. At very high speeds the spark lever should be fully advanced. At lower speeds, and especially on hard pulls, the spark lever should be retarded part way, or just enough to prevent what is known as a spark knock. The proper position for carrying the spark can soon be learned from practice.

ADJUSTING TIMING CONTACTS

The cut shows the proper method of adjusting the timing contacts. When these contacts are held open by the breaker cam they should be open the thickness of the gauge on the distributor wrench marked "Distributor" which is (.018") eighteen thousandths of an inch. Due to the wearing to a seat of the fibre cam these will require one or two adjustments during the first season, after which the wearing is very slight.

CARE OF DISTRIBUTOR HEAD AND ROTOR

The ignition current to the spark plugs is very high voltage current and it is necessary that this be well insulated. Therefore, the high tension wiring must have heavy rubber insulation, and the distributor head and rotor must be kept clean, otherwise the current will find a path to the ground without passing through the spark plug gaps. The inside of the distributor head should be wiped clean occasionally and a small amount of vaseline applied as mentioned under "lubrication." The rotor button should be kept polished bright and the center contact in the distributor head should always make contact with the rotor.

ADJUSTING SPARK PLUGS

The proper gap when adjusting the spark plug electrodes is (.030") thirty thousandths of an inch and the gauge on the distributor wrench should be used for this adjustment.

IGNITION COIL

The ignition coil is mounted on top of the motor generator. This is for the purpose of converting the low voltage current from the generator or storage battery to a high voltage current necessary for ignition purposes. It consists of an iron core and two copper wire windings. The primary winding consists of a comparatively few turns of copper wire. Current is supplied through this winding from either the generator or the storage battery. This magnetizes the iron core and when the primary current is cut off by the timing contacts, a very high voltage current is induced in the secondary winding, which consists of several thousand turns of very fine copper wire wound over the primary winding and insulated from it.

CONDENSER

In the base of the ignition coil is mounted the condenser. This consists of two long strips of tinfoil insulated from each other by strips of paraffined paper. It is for the purpose of increasing the voltage induced in the secondary winding and prevents sparking and burning of the timing contacts.

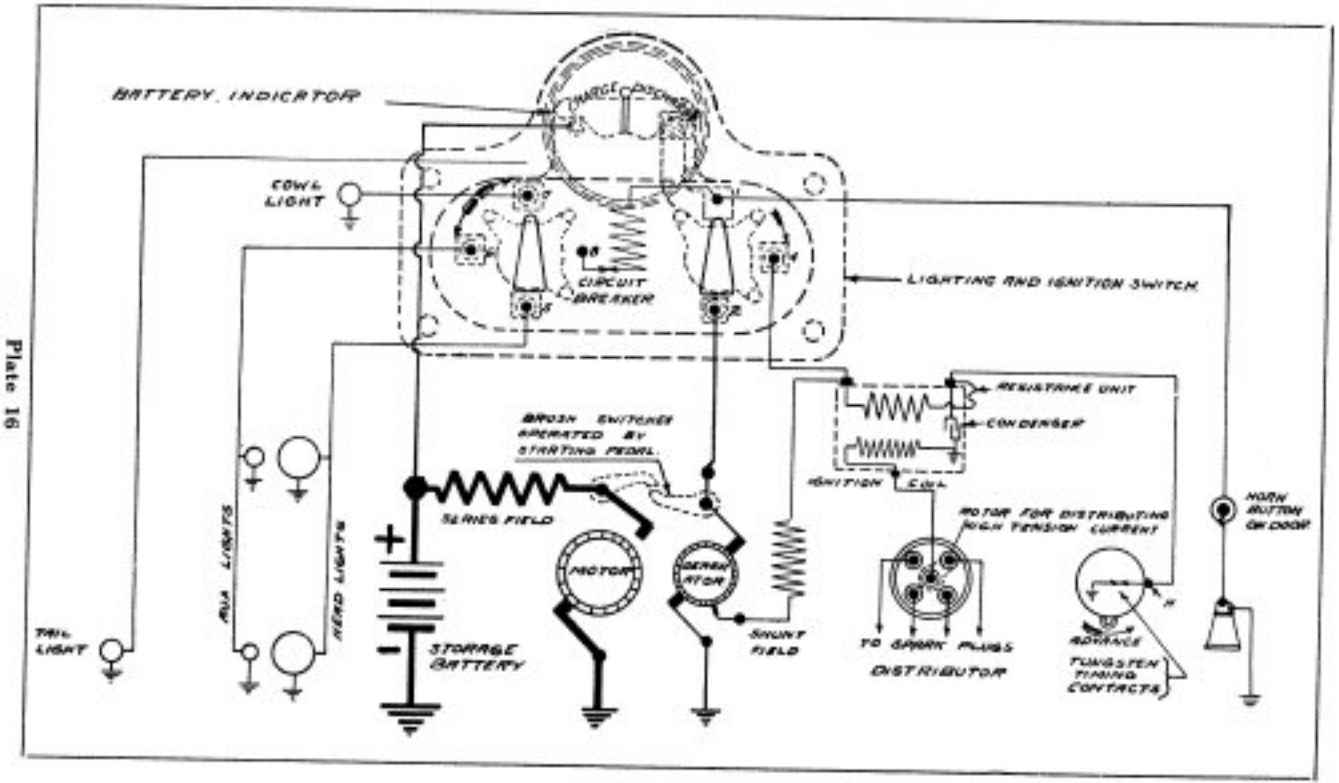


Plate 16
Wiring Diagram

RESISTANCE UNIT

The resistance unit is mounted on the forward end of the ignition coil. It consists of special resistance wire wound on a porcelain spool, and is for the purpose of preventing an excessive discharge from the storage battery when the engine is not running at the time the contacts are closed. It also causes the spark obtained from the ignition coil to be more nearly uniform at the different speeds of the engine.

TIMING THE IGNITION

The ignition system is carefully timed when the car leaves the factory, and under ordinary conditions need not be touched by the car owner, but should it be necessary to retime the ignition for any reason, it can be done as follows:

1. Place the spark lever on the steering wheel in the fully retarded position.

2. Turn engine to seven degree mark (approximately one inch from the dead center) on the flywheel with No. 1 cylinder (which is the one next to the radiator) on the firing stroke.

3. Loosen the timing adjustment screw in the center of the distributor shaft and turn the breaker cam so that the rotor button will be in the position under No. 1 high tension terminal when the distributor head is properly located. Locate the breaker cam carefully in this position so that when the slack in the distributor gears is rocked forward, the contacts will be opened by the breaker cam, and when the slack in the gears is rocked backwards, the contacts will just close.

4. Tighten the adjustment screw securely and replace rotor and distributor head with the head properly located by the locating tongue and the hold-down clip. The cylinders fire in the following order: 1-3-4-2.

COMBINATION SWITCH

The combination lighting and ignition switch is mounted in the instrument plate and is for the purpose of controlling the lighting and ignition circuits. In addition the ignition button controls the circuit between the generator and the storage battery, it being arranged so that when the ignition is in the "on" position the latter circuit is closed. This takes the place of an automatic cut-out, which is sometimes used for this purpose.

CIRCUIT BREAKER

The circuit breaker is mounted on the back of the combination switch. This is a protective device. It is similar to fuses in its purpose and protects the different lighting circuits and the combination switch. It differs from fuses in that there is nothing to replace in the event of a ground or short circuit which causes it to operate. As soon as the trouble is remedied the circuit is immediately restored. It gives a clicking sound whenever a ground on any of the protected circuits occurs. Thus it really announces the trouble and makes it easy to locate.

THE BATTERY INDICATOR

The battery indicator is mounted on the face of the combination switch. This is for the purpose of indicating the current that is being discharged from the storage battery, or being charged into the battery. Its proper indications are more fully described under the heading "Operation of the Motor Generator."

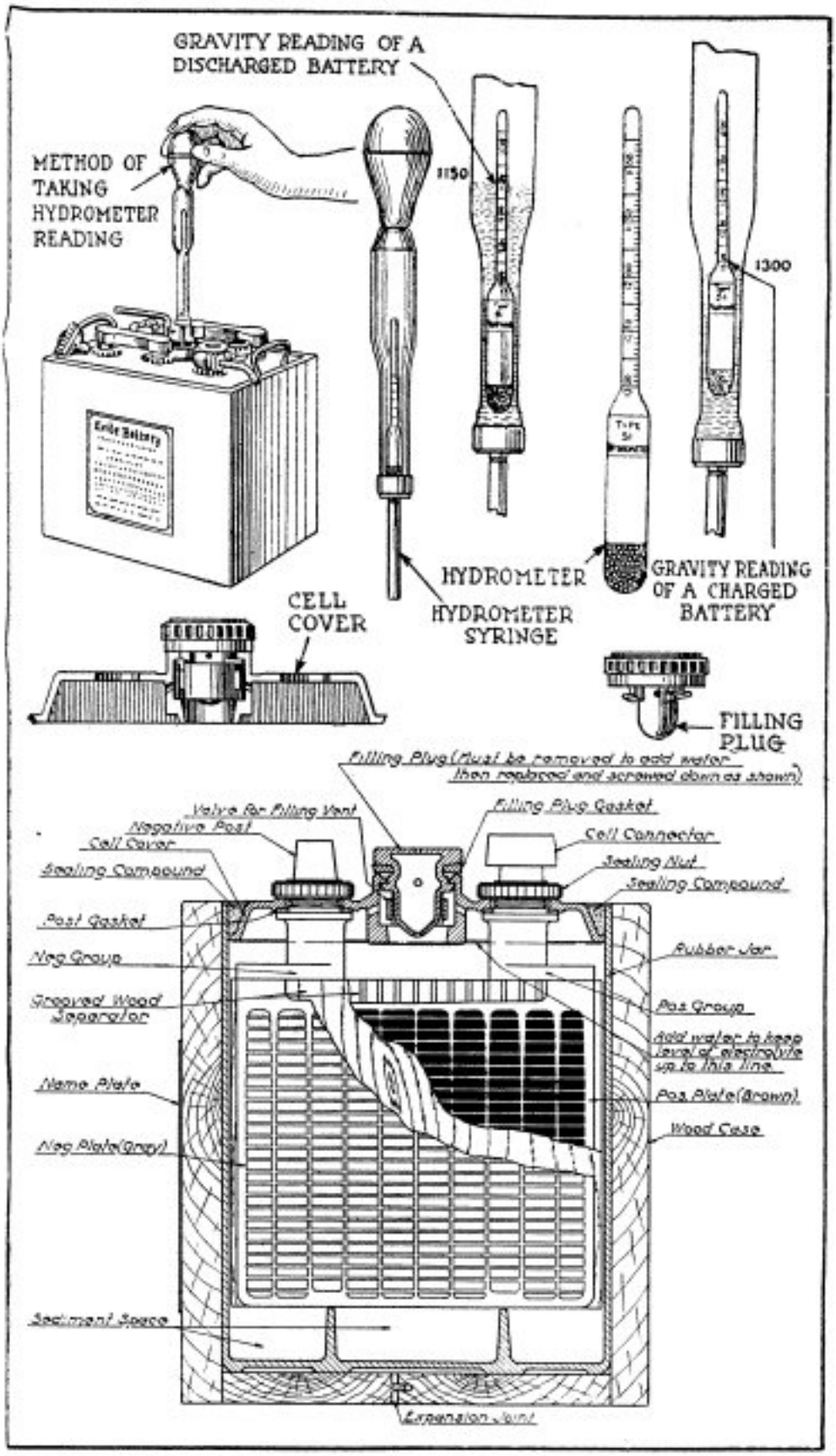


Plate 17
Storage Battery

STORAGE BATTERY

The storage battery used with the Buick-Delco electric starting, lighting and ignition system is known as the "Exide type 3XC-13-1", and is manufactured by the Electric Storage Battery Company of Philadelphia, Pa., by whom it is guaranteed as follows:

BATTERY GUARANTEE

"We guarantee the 'Exide' automobile starting and lighting battery in this car for a period of six months from the date of manufacture, which date is stamped on the battery name plate.

"On delivery at our factory, Philadelphia, Pa., or at any 'Exide' Battery Depot, within six (6) months from date of manufacture, and transportation charges prepaid, we will replace, free of expense, this 'Exide' starting and lighting battery, if defective or incapable of giving its rated capacity for any reason other than lack of charge."

BATTERY SERVICE

The Electric Storage Battery Company maintain "Exide" Battery Depots which carry a complete stock of batteries and battery repairs, and which are fully equipped to do any kind of battery repair work.

BATTERY CONSTRUCTION

The storage battery is essentially the reservoir in which the excess electrical energy, generated by the Delco Generator when the car is running, is stored for future use in cranking the motor and operating the lights. It is composed of three cells or hard rubber jars in which a number of lead plates are immersed in a solution of sulphuric acid and distilled water, known as the electrolyte. The plates are stiff lead grids which hold a paste made of various oxides of lead. Six plates in each cell are joined to the positive terminal and seven plates in each cell are joined to the negative terminal, thin wooden "separators" being inserted between the plates to prevent them touching one another. In the factory forming process the material on the positive plates becomes converted into brown peroxide of lead, while that on the negative plates assumes the form of grey spongy metallic lead. The material on both plates is known as active material.

ACTION OF STORAGE BATTERY

When current is taken from the storage battery for lighting or cranking, the sulphuric acid in the electrolyte combines with the active material of the plates to form sulphate of lead, and when the battery is recharged, either by the current from the Delco generator, or from an outside source, the lead sulphate is again converted into the original active material and the acid set free in the solution.

Sulphuric acid does not evaporate and unless one of the battery jars should leak, the amount of acid in the cell remains always the same, regardless of whether it is combined with the active material

in the form of sulphate, or free in the solution, but since the acid combines with the active material of the plates to form sulphate as the battery is discharged, the amount of free acid remaining in the solution at any time indicates accurately the charged or discharged condition of the battery. Any measurement therefore of the relative amount of acid in the electrolyte will also be a measurement of the battery's charge.

THE HYDROMETER

Sulphuric acid is heavier than water and in a mixture of acid and water such as the electrolyte of the storage battery, the specific gravity will be proportional to the amount of acid. The hydrometer consists of a weighted float with a graduated stem, which when immersed in a solution of acid and water, sinks to a certain depth depending on the specific gravity of the solution. The hydrometer thus measures the relative amount of acid in the electrolyte and consequently reveals the condition of the battery.

In using the hydrometer, each cell should be tested separately by inserting the end of hydrometer syringe in the filler opening and drawing up enough of the electrolyte to float the hydrometer bulb free in the liquid, the reading of the scale at the surface of the liquid being the "specific gravity" of the electrolyte.

A specific gravity of 1.275 to 1.300 indicates a fully charged battery in good condition.

A specific gravity of 1.225 indicates a battery about half charged.

A specific gravity below 1.150 indicates a completely exhausted battery which should have immediate expert attention at an "Exide" Depot or Service Station.

When testing battery with the hydrometer remove the filling plug from only one cell at a time and be sure to put the electrolyte back in the same cell from which it was taken.

ADDING WATER

Sulphuric acid does not evaporate and will not freeze, therefore it is never necessary to add any acid to a battery cell, and there is no danger of a fully charged battery (gravity above 1.250) freezing in the coldest weather. The water in the electrolyte, however, will gradually evaporate, especially in warm weather and during long trips when the battery is being charged continuously. This evaporation should be replaced by the addition of sufficient pure distilled water at frequent intervals to keep the plates completely covered. Keep the filling plugs tight to prevent escape of the solution.

Add nothing but pure distilled water to the battery and do it often enough to keep the plates covered. Fill until level of solution is even with bottom of filling tube. Never add acid. In cold weather always add the water just before charging or running the car, so that the water and electrolyte will be mixed, and freezing thus avoided.

Aside from the addition of water to keep the plates covered with electrolyte the storage battery requires very little attention. The terminals should be kept clean and tight and occasional hydro-

meter reading taken to make sure that the battery is kept charged by the generator. If the battery ever becomes discharged it should be taken to the nearest "Exide" Battery Depot or Service Station at once for a careful inspection.

Never attempt to run the car with the storage battery disconnected.

COOLING SYSTEM

The cooling system includes the radiator, water circulating pump, water connections and the radiator fan.

RADIATOR

The radiator consists of an upper and lower tank connected by a large number of narrow passages in the cellular core. The hot water from the motor enters the upper tank and gradually flows through the passages in the core to the lower tank, while a current of cool air is circulated through the openings in the core by the radiator fan. An enameled shell encloses the radiator and supports it on the frame of the car.

WATER PUMP

The water pump is of the centrifugal type, is located on the left side of the motor and driven by the timing gears. It consists of an impellor having a number of curved blades, which is keyed to the shaft and revolves at high speed inside the air tight casing. As the impellor revolves, water from the bottom tank of the radiator is drawn in at the center of the blades and thrown off at the outer ends, by centrifugal force, flowing through the water jackets of the motor and back into the top tank of the radiator.

The bearings of the water pump are provided with glands or stuffing boxes to keep them air and water tight, and should be repacked with prepared wick packing when they begin to leak. They will require no other lubrication.

RADIATOR FAN

The radiator fan is mounted on the front end of the motor and is driven by a belt from the cam shaft. It should be lubricated at frequent intervals with motor oil introduced through the oiler on the hub. The belt can be tightened by loosening the large screw, which fastens the fan to the motor, and swinging the bracket up.

To prevent overheating, keep radiator filled with clean water, see that fan belt is tight, and avoid leaks at all connections.

DRAINING

The cooling system can be completely drained by opening drain cock in bottom of radiator, opening drain cock in water pump, and front end of cylinder water jackets. The cooling system should always be drained before storing the car for an extended period.

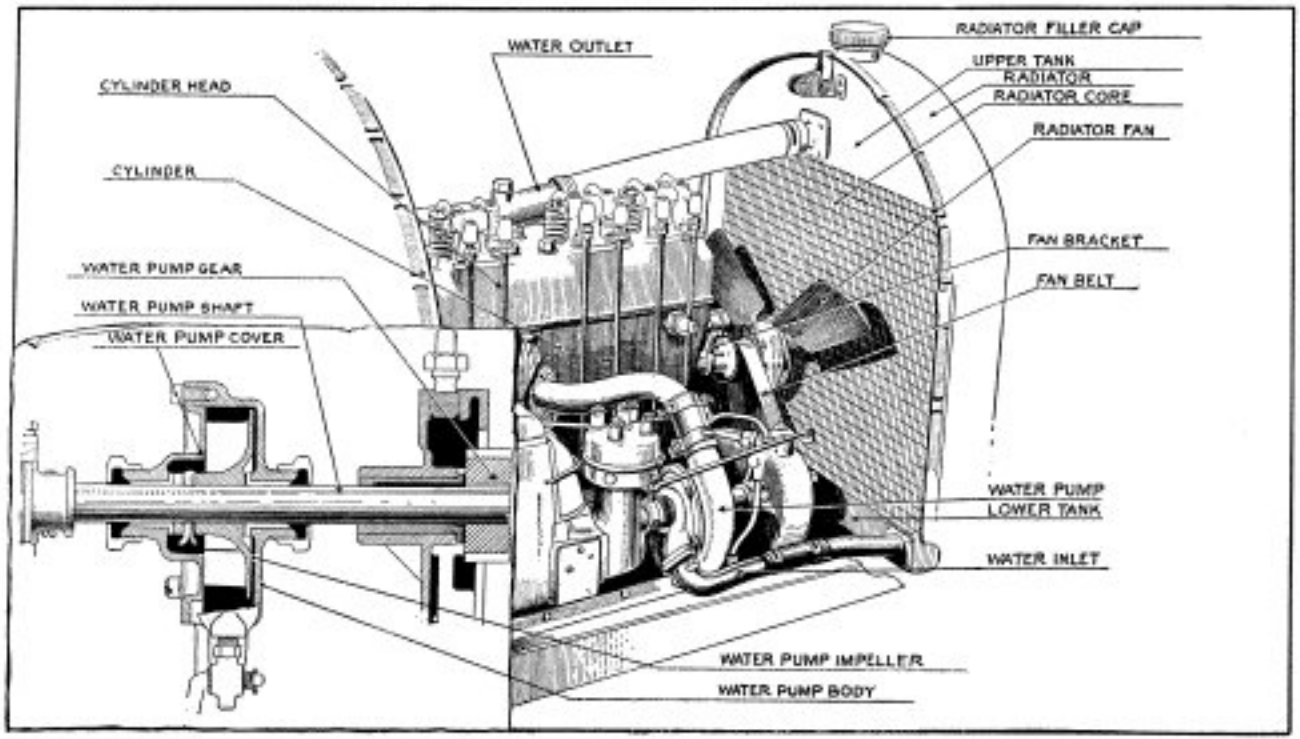


Plate 18
Cooling System

ANTI-FREEZING MIXTURE

In cold weather, the cooling system should be drained and filled with a solution that will not freeze when car is allowed to stand. The best anti-freezing mixtures are composed of denatured alcohol and water, as follows:

Freezing Point	Alcohol	Water
10° above zero	20%	80%
5° below zero	30%	70%
20° below zero	40%	60%
35° below zero	50%	50%

Four ounces of glycerine added to these mixtures will retard the evaporation of the alcohol to some extent, but the alcohol will always evaporate more rapidly than the water and more should be added at frequent intervals to keep the mixture up to strength.

EXHAUST SYSTEM

The exhaust system includes the exhaust manifold, exhaust pipe and muffler.

MUFFLER

The muffler consists of three concentric sheet metal drums which are perforated at opposite ends, so that the gas is compelled to travel the full length of each drum in turn while it is expanding and losing its heat.

The exhaust system requires no attention on the part of the driver. If, after long use, the muffler should become filled with soot, it can be cleaned by removing the rear head.

CLUTCH

A gasoline motor cannot be started under load. For this reason the motor is connected to the driving mechanism by means of a friction clutch which can be released by pressing down the clutch pedal.

The clutch consists of a leather faced cone which engages with the inside of the fly wheel rim. It is keyed to the clutch gear of the transmission in such a manner that it can be engaged or disconnected by sliding back and forth with the pedal. It is held in engagement by three spring, the tension of which can be adjusted to take up wear of the clutch facing by means of the nuts on the ends of the studs which fasten them to the fly wheel.

In adjusting tension of clutch springs be careful to turn all adjusting nuts the same amount to prevent throwing clutch out of line.

The clutch springs and release yoke are connected to the clutch sleeve by ball thrust bearings, and these bearings are lubricated by means of a large grease cup on the hub. This grease cup should be turned down once every 500 miles and should be refilled with soft cup grease whenever necessary.

ADJUSTMENT OF CLUTCH

The position of the clutch pedal may be adjusted by means of the adjusting yoke on the clutch release rod. A stop is also provided on this rod to prevent the release ring interfering with the hub when the clutch is engaged.

Three small expander springs are provided on the rim of the clutch cone to press the leather facing out at these points and make the clutch engage gently. As the leather wears, the washers can be removed from the ends of the expander plugs in order to allow them greater motion.

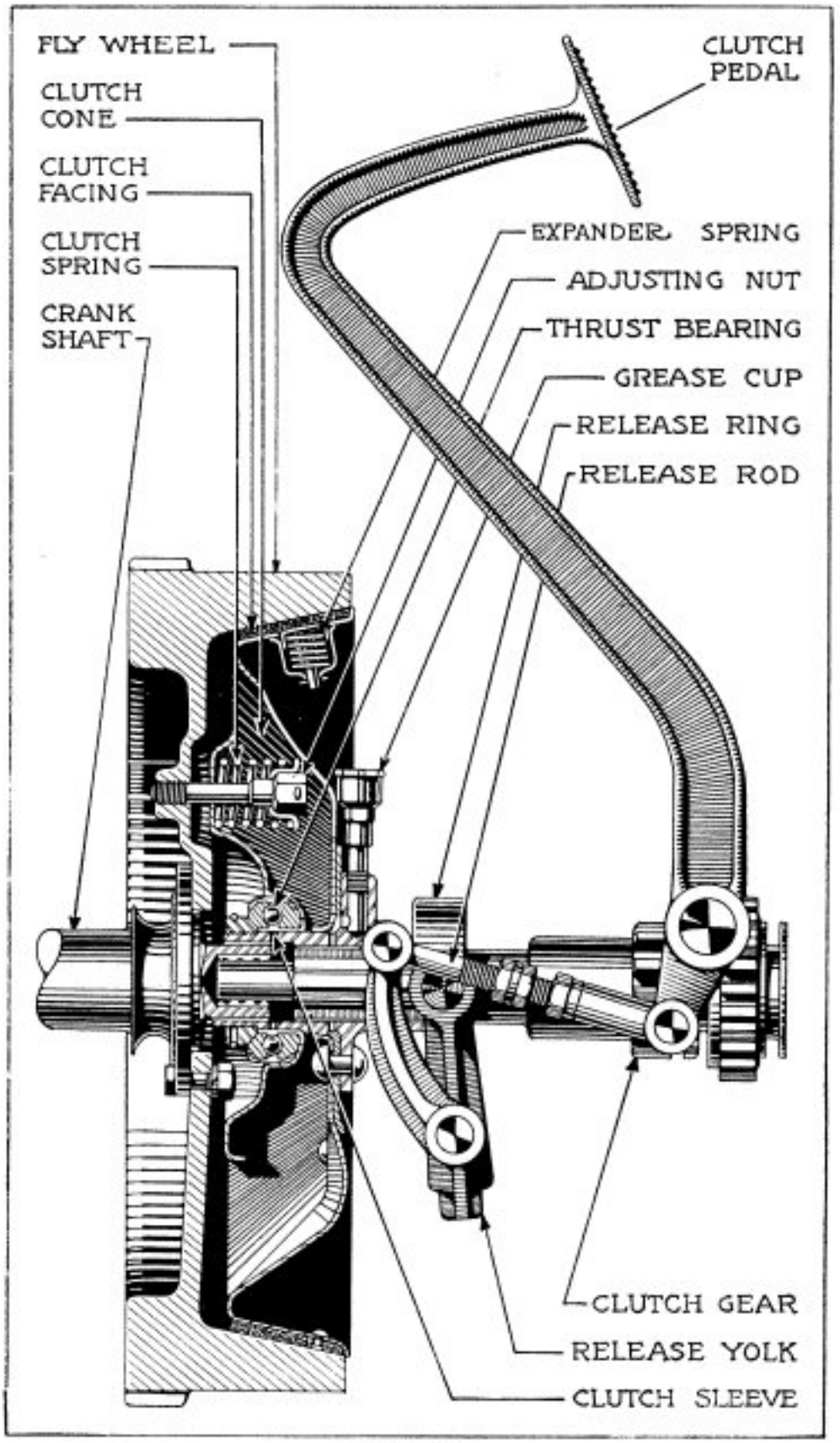


Plate 19
Clutch

To secure smooth action, the clutch leather should be kept soft and pliable by frequent applications of Neat's foot oil. If clutch shows a tendency to slip, wash leather with gasoline or increase tension on clutch springs.

Do not allow oil or grease from the grease cup to get on clutch leather or inside the fly wheel, or the clutch will slip.

TRANSMISSION SYSTEM

The transmission system includes all those parts which transmit the power from the motor to the rear wheels, but generally the transmission gearset alone is described by this term.

GEARSET

The gearset, or change speed gear, is made necessary on account of the fact that a gasoline motor develops power in proportion to its speed; the higher the speed, the greater the power output. On the other hand, the car frequently requires more power at low speeds than at higher ones, and at such times the gearset is used to change the ratio between the speed of the motor and the speed of the rear wheel.

The change speed gears are carried on two shafts the lower of which is known as the countershaft and carries the counter gears. while the upper or main shaft carries the sliding gears. The main shaft is mounted in a ball bearing at its rear end and runs in a bearing in the clutch gear at its forward end. The counter shaft is stationary and the counter gears turn on it. The reverse idler gear is mounted on a separate shaft at one side of the countershaft. The sliding gears are mounted on the main shaft in such a manner that they can be slid along to engage with one or another of the counter gears. The high and intermediate sliding gear is also provided with internal teeth on its forward side so that it can be slid over the clutch gear to lock the main shaft and clutch gear together.

All the gears run in a constant bath of oil which also lubricates the bearings of the main shaft and clutch gear. An oil filler is provided on the side of the transmission case for the introduction of the oil, and a drain plug at the rear end allows emptying and cleaning.

NEUTRAL POSITION

The clutch gear is directly connected to the motor and consequently always turns in the same direction. The constant mesh gear therefore turns opposite to the motor and since all the counter gears are connected together they all turn in the same direction, but when the control lever is in the neutral position, neither of the sliding gears is in mesh with any other gear and therefore the main shaft does not turn.

FIRST SPEED POSITION

If the control lever be moved to the first speed position the low and reverse sliding gear is slid forward on the main shaft until it engages with the low speed counter gear. Since the counter gears always turn in the opposite direction to the motor, the low and reverse sliding gear now turns the main shaft in the same direction as the motor, and the car moves ahead; but owing to the fact that the power is being transmitted from the smaller to the larger gears in each case, the rear wheels only make one revolution for every twelve revolutions of the motor crankshaft.

SECOND SPEED POSITION

When the control lever is moved to the second speed position, the low and reverse sliding gear is drawn out of mesh with the

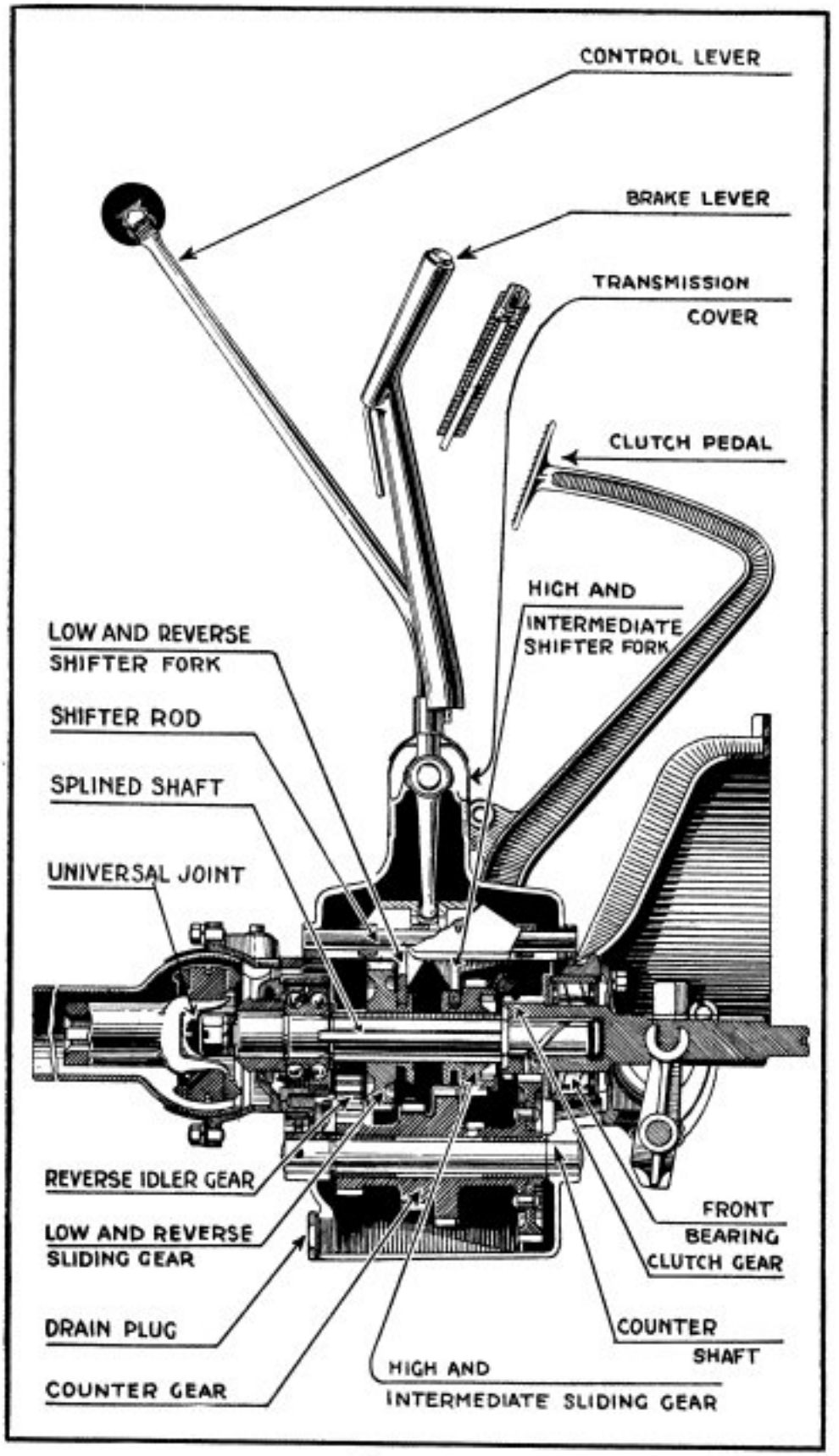


Plate 20
Transmission

counter gear and the high and intermediate sliding gear is moved back into mesh with the intermediate speed counter gear. In this position the main shaft also turns in the same direction as the motor, but the rear wheels now make one revolution for every seven revolutions of the motor.

HIGH SPEED POSITION

When the control lever is moved to the third, or high speed position, the high and intermediate sliding gear is moved forward on the shaft until the internal teeth slip over and engage the teeth of the clutch gear, locking the main shaft and the clutch gear together. In this position the motor is directly connected to the rear axle and the car is said to be in "direct drive." The rear wheels now make one revolution for every four revolutions of the motor, which is the ratio of the driving gears in the rear axle.

REVERSE POSITION

Moving the control lever to the reverse position slides the low and reverse sliding gear back into mesh with the reverse idler gear which in turn is meshed with the reverse counter gear. Since the counter gears turn opposite to the motor, the reverse idler gear will turn in the same direction as the motor, and the main shaft will now turn opposite, driving the car backward. In this position the rear wheels make one revolution for every sixteen revolutions of the motor.

CONTROL LEVER

The sliding gears are moved back and forth on the main shaft by means of shifter forks which are carried on a rod in the transmission cover. The control lever is pivoted in the cover so that it may be swung to one side or the other. When swung to the right it picks up the fork which moves the low and reverse sliding gear and when swung to the left it operates the high and intermediate sliding gear. Small spring plungers in the sides of the cover engage with slots in the shifter forks to hold the sliding gears in position.

UNIVERSAL JOINT

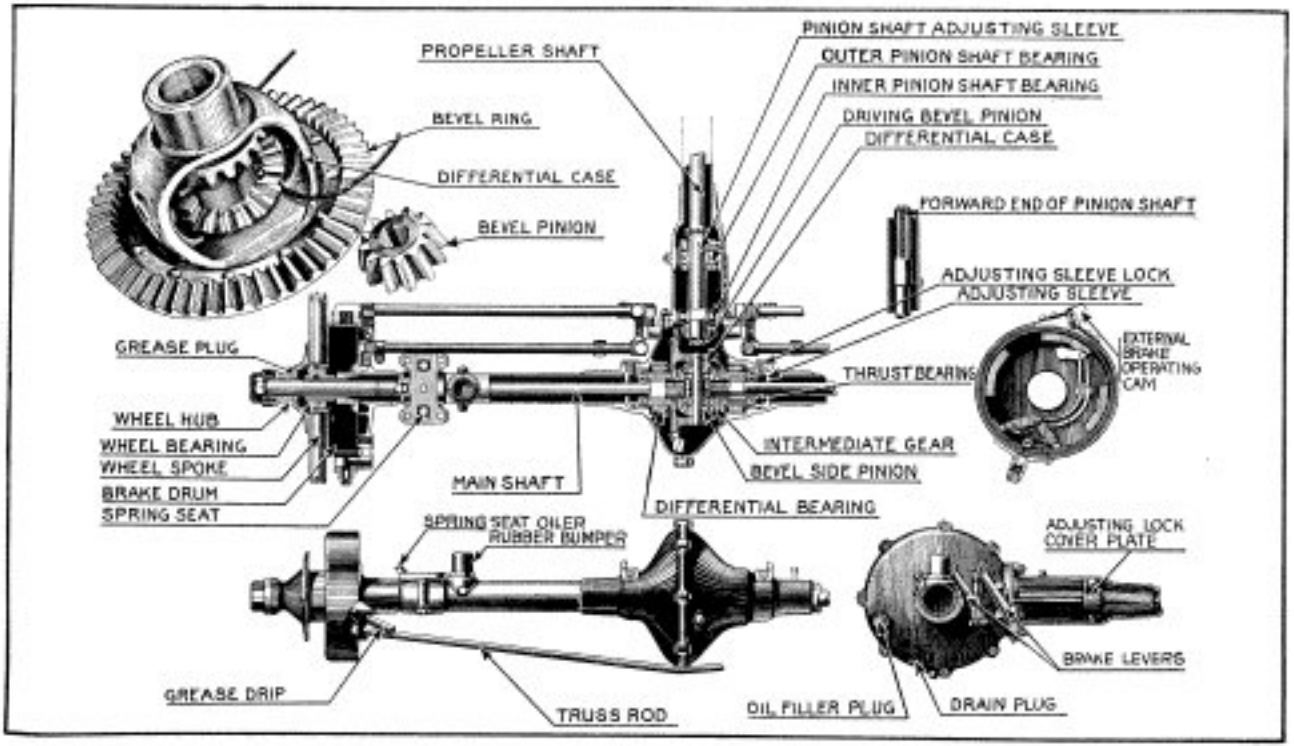
The transmission gearset is fastened solidly to the car frame but the rear axle is hung on springs and must be free to follow the uneven surface of the road. In order to allow continuous transmission of power from the gearset to the rear wheels, the universal joint is interposed between them. It consists, essentially, of a split ring and two yokes, each of which has two bearings in the ring. The forward yoke is connected to the main shaft of the gearset and the rear one to the pinion shaft of the rear axle. The arrangement of the yokes is such that the two shafts may be bent at an angle to each other without interrupting the turning effort.

The universal joint is enclosed in a hollow ball joint which forms the forward end of the pinion tube. A plug at the top provides for the introduction of grease and the joint should be kept filled with soft cup grease at all times.

REAR AXLE

The rear axle assembly includes the pinion shaft, differential, axle shafts, brakes and wheels, and constitutes the final element in the driving mechanism.

Plate 21
Rear Axle



PINION SHAFT

The pinion shaft transmits the power from the universal joint to the driving gears of the differential. It is enclosed for its entire length in a steel tube which also takes the torque and breaking strains of the rear axle. At its forward end the tube is connected to the transmission by means of a large ball and socket joint. At its rear end the pinion shaft is mounted on ball bearings and carries the driving pinion which meshes with the large ring gear on the differential.

The depth to which the pinion meshes with the teeth of the ring gear is adjustable and adjustment can be made by removing the cover plate on the right side of the pinion flange and loosening the adjusting sleeve clamp screw on the left side. The sleeve which carries the outer bearing can then be turned to adjust the position of the pinion.

Adjustment of the pinion shaft should be made only by an experienced mechanic. In case of trouble, take car to nearest Buick dealer or Service Station.

A pipe plug in the top of the pinion flange allows the introduction of grease and the housing should be filled with soft cup grease every 1000 miles.

DIFFERENTIAL

The differential equalizes the amount of power applied to each of the rear wheels and allows one wheel to turn slower or faster than the other wheel when the car is rounding a curve. It consists of a case mounted on roller bearings and held in position between adjustable ball thrust bearings. The large driving ring gear is attached to the outside of the case and meshes with the driving pinion. Within the case is a set of four bevel gears, all of which mesh with each other. Two of these gears, known as the "side pinions," are mounted on a shaft carried by the case, while the other two gears, known as the "intermediates," are attached to the main shafts of the axle.

When the car is being driven straight ahead, the differential gears do not operate, but the driving gear, differential case, side pinions, intermediate gears, and main shafts all turn as a solid unit. When the car turns a corner, the inside wheel slows down, retarding the main shaft and the intermediate to which it is connected in the differential, but since the motor continues to drive the differential case at the same speed, the side pinions commence to revolve on their shaft, thus increasing the speed of the outside wheel.

The differential and its bearings run in a continual bath of oil introduced through the filler plug in the axle housing. Once every 1000 miles the old oil should be drained off, the differential washed out with gasoline and the housing filled with fresh oil.

The position of the differential and driving gear with respect to the driving pinion can be adjusted by removing the cover plates on each side of the housing and turning the adjusting sleeves. Both sleeves must be turned the same amount and in the same direction to prevent any end play in the differential bearings.

Adjustment of the differential should be made only by an experienced mechanic. In case of trouble, take car to nearest Buick Dealer or Service Station.

WHEEL HUBS

The outer ends of the rear axle main shaft are keyed directly to the hubs of the driving wheels which run on roller bearings on the

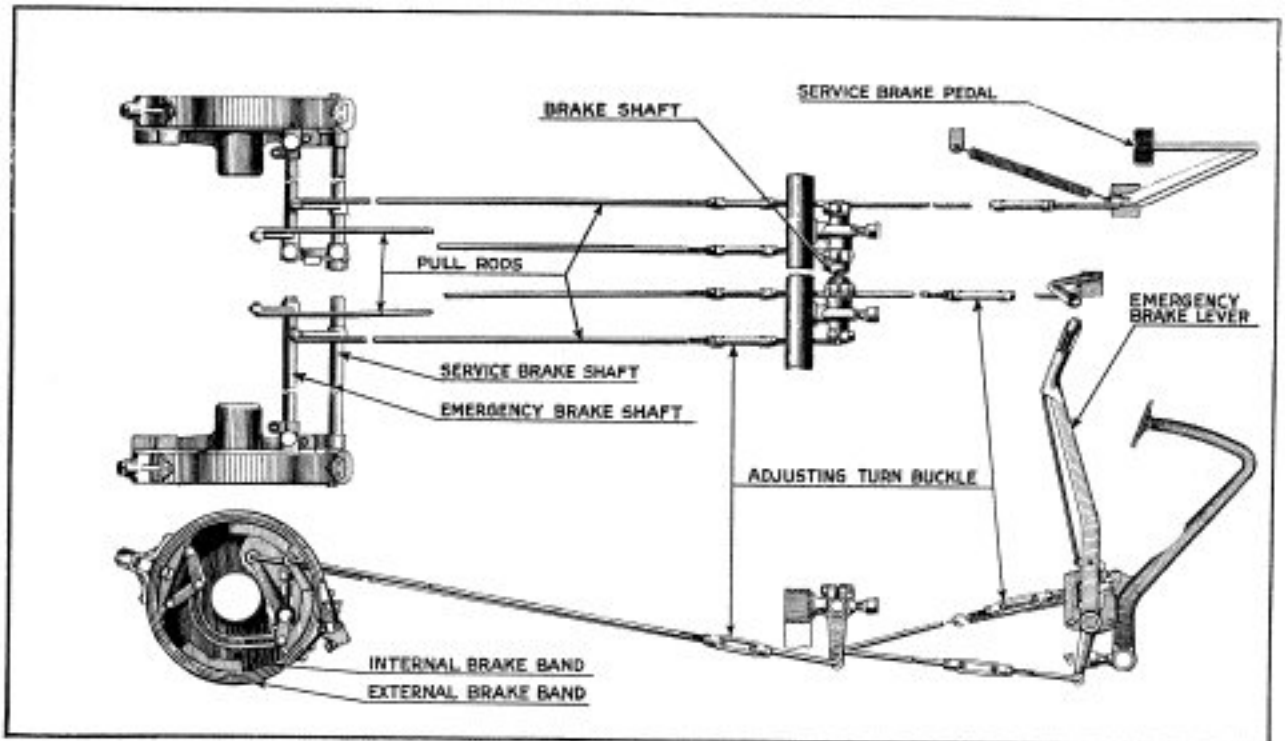


Plate 22
Brake Adjustments

ends of the axle tubes, and which also carry the brake drums. The hub bearings are not adjustable and are lubricated by being packed in soft cup grease introduced through the plug in the circumference of the hub. Grease should be added once every 1000 miles.

The hubs are also provided with felt washers and oil deflectors which throw off any oil which might work out from the differential housing and prevent it from getting on the brake. The surplus oil is drained off through a tube which projects from the inner side of the brake flange underneath the axle tube, and care should be taken to see that these drains are always open and clean.

BRAKES

The brakes are supported by brake flanges attached to the main tubes of the axles and are operated by the brake cam shafts. They consists of steel bands lined with friction fabric and so arranged that they can be expanded or contracted against the circumference of the brake drums by means of a pedal or lever.

SERVICE BRAKES

The external brakes are the service brakes, and are operated by the right pedal in the driving compartment. When in the free position, there should be a clearance of one-sixteenth of an inch between the brake band and the brake drum all around. The clearance may be adjusted to take up wear by shortening the pull rods between the brake shaft and the brake cam shafts by means of the turnbuckles, and clearance may be kept uniform around the entire circumference of the drum by means of the adjusting screw at the rear of the bands.

Care must be taken to see that brakes on both wheels are adjusted alike.

Adjustment of the pedal position is made by means of the turnbuckle in the pull rod between the pedal and the brake shaft. The brakes should be set so that they can be applied by a slight pressure on the pedal, but the brake bands should not rub on the drums when pedal is released.

EMERGENCY BRAKES

The emergency brakes are the internal brakes and are operated by the brake lever in the driving compartment. They are seldom used and hence wear very slowly, but when necessary can be taken up in the same manner as the service brakes, by adjusting the length of the pull rods. Adjust so that both brakes are applied equally when lever is pulled.

SPRING SEATS

The rear springs are attached to the rear axle by means of spring seats which are free to turn on the axle tube. They are provided with felt pads and oilers, and should be filled with motor oil at least once each 1000 miles.

FRONT AXLE

The front wheels are mounted on steering knuckles pivoted to the front axle, so that they may be turned by the steering gear. Steering arms attached to the knuckles are connected together by an adjustable tie rod, and the left steering arm is provided with an extension to which the steering connecting rod is fastened.

The king bolts which fasten the steering knuckles and the tie rod bolts to the axle are provided with grease cups which should receive attention at least once every 500 miles, being refilled with soft cup grease when necessary.

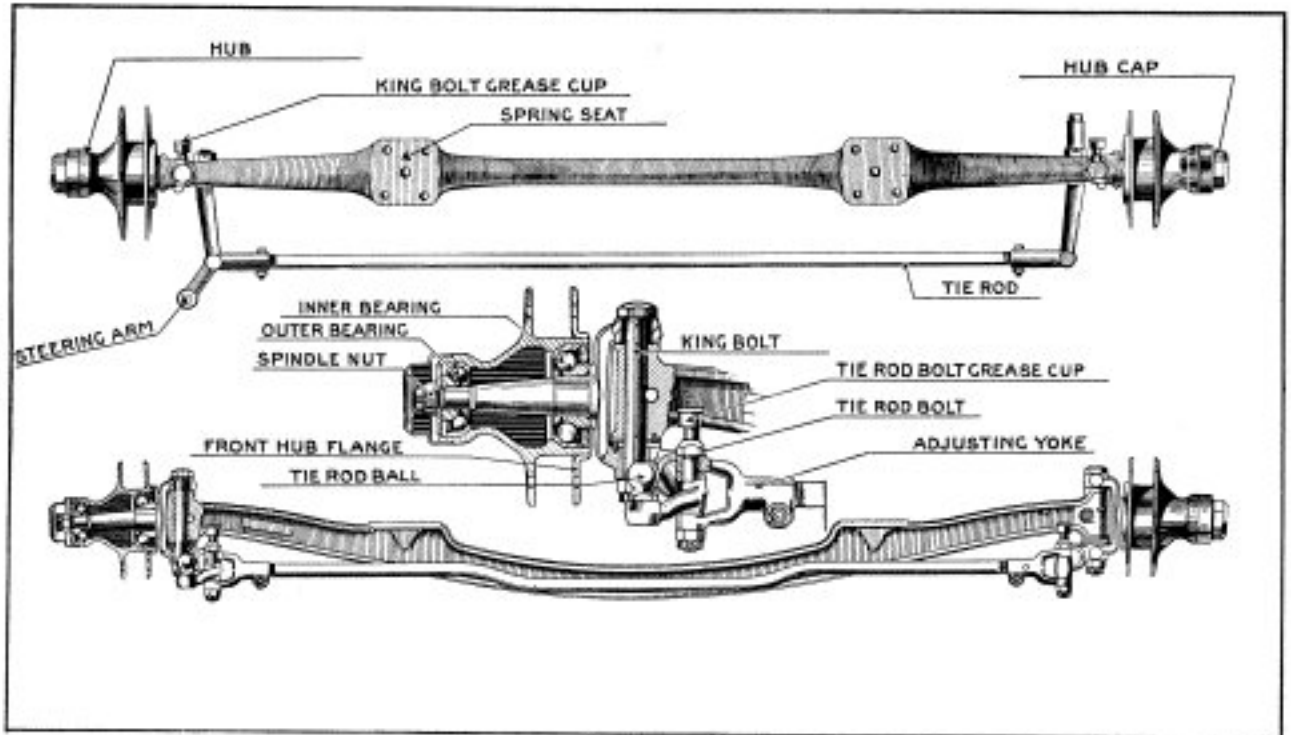


Plate 23
Front Axle

TIE ROD ADJUSTMENT

The front wheels do not stand exactly square, but are set at an angle which makes the car steer easily. This angle can be adjusted by means of the adjusting yokes on the tie rod, if necessary. When in proper adjustment the wheels should measure ⅜-inch closer together in front than at the rear, and one inch closer at the bottom than at the top.

FRONT WHEELS

The front wheels have cup and cone type ball bearings which are lubricated by being packed in soft cup grease introduced through the plug in the circumference of the hub. There are two rows of balls and the small cone on the outer end of the spindle is threaded so that it can be adjusted to take up wear. The bearings should be adjusted so that the wheels have no perceptible end play on the spindles, but run free and will stop with the tire valves at the bottom.

The bearings should be repacked with soft cup grease every 1000 miles.

STEERING GEAR

The steering wheel is attached to a long tube, the lower end of which carries a double threaded worm or screw, engaging with two half nuts which slide up and down in guides in the steering gear housing. The threads on the steering screw are right and left hand, and one of the half nuts has a right hand thread; the other a left hand thread. When the steering wheel is turned, one of the half nuts rises in its guide while the other is forced downward. At their lower ends the half nuts carry hardened steel thrust blocks which push against rollers attached to the steering yoke, and by their motion the yoke is tilted in the housing, moving the steering pitman arm which is keyed to its outer end, and by means of the steering connecting rod, swinging the front wheels to one side or the other.

The steering screw is provided with a ball thrust bearing at its upper end and an adjusting nut, by means of which any back lash or lost motion in the steering wheel can be taken up. For best results the steering wheel should have not over one-half inch of lost motion at its rim.

An oil plug is provided in the steering gear housing and the housing should be kept filled with heavy steam cylinder oil. A small oiler in the steering wheel hub serves to lubricate the upper bearing of the steering tube and should receive a few drops of motor oil every 500 miles. The ball joints of the steering connecting rod should be kept packed with soft cup grease which should also be renewed every 500 miles.

The tubes which operate the spark and throttle levers are carried inside the steering tube and can be lubricated with a few drops of motor oil when necessary.

SPRINGS

The springs are interposed between the axles and the frame to absorb the road shocks before they can be transmitted to the remainder of the mechanism or to the passengers. The springs are provided with grease cups at their ends and these should be given a turn or two every 100 miles and refilled with soft grease as often as necessary. Squeaks and harsh action of the spring can be overcome by jacking up the frame of the car and applying heavy steam cylinder oil to the spring leaves.

Broken springs are almost invariably caused by careless driving or loose spring clips. See that the nuts on the spring clips are tight at all times.

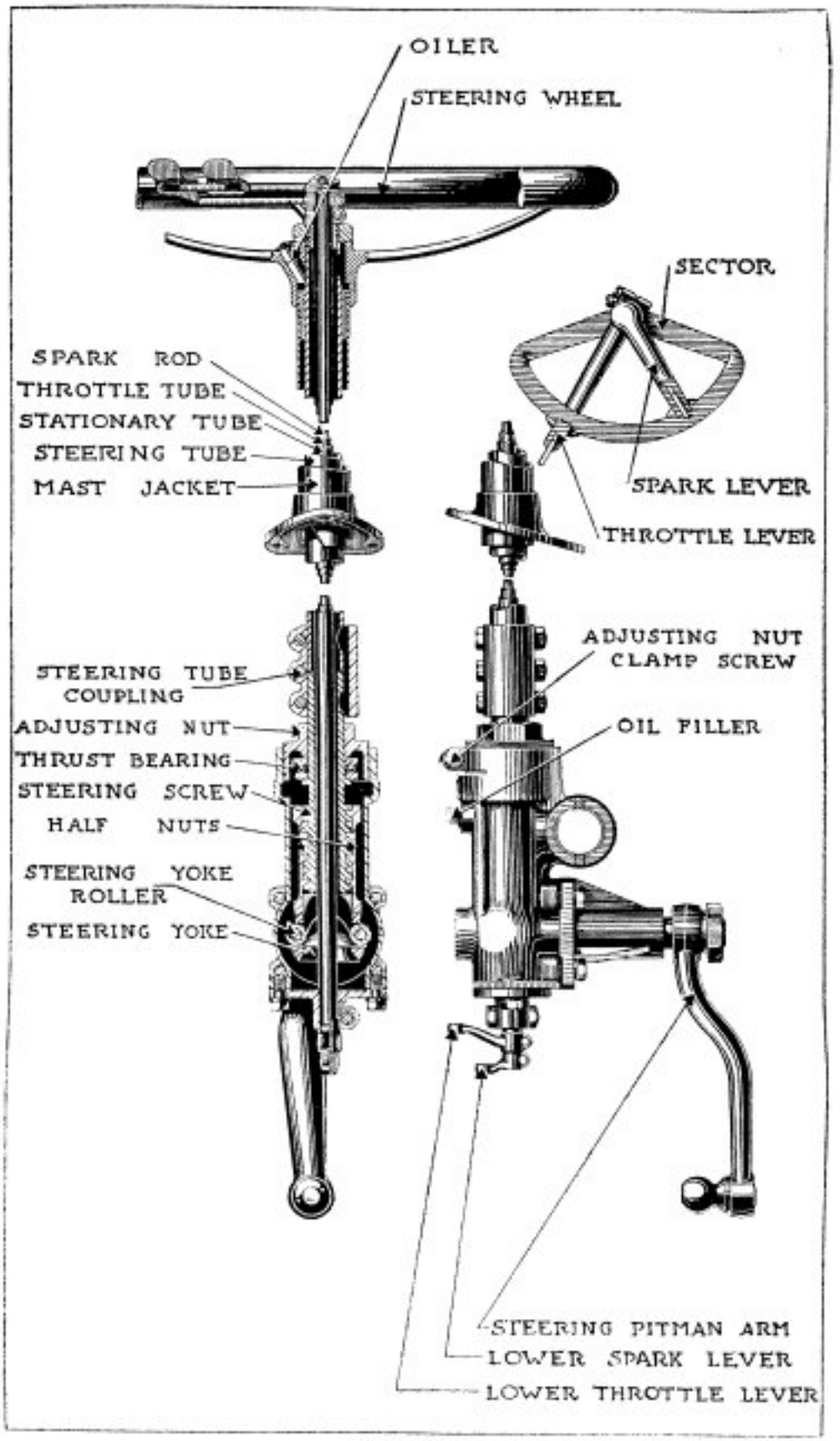


Plate 25
Steering Gear

WHEELS

Automobile wheels are of the artillery type, in which the spokes meet at the center and are bolted between the flanges of metal hubs. A steel felloe band is shrunk on the wooden felloes to carry the demountable rims.

RIMS

The rims are of the solid bolted-on type, and may be removed or exchanged by jacking up the axle and loosening the bolts which operate the wedges.

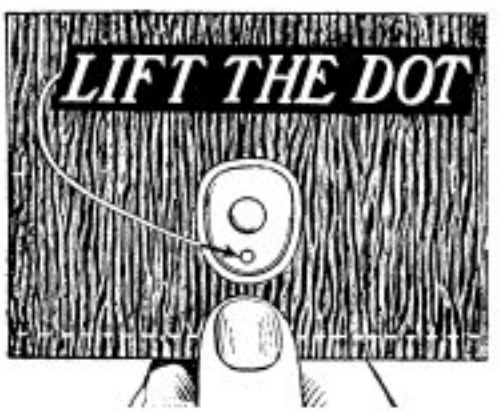
TIRES

Tires are of the wrapped tread clincher, or soft bead type, and can be fitted or removed from the rims when deflated by stretching the bead over the edge of the rim.

Punctures cannot be avoided, but a well inflated tire is less likely to pick up nails and other sharp objects than a soft one. Bruises, cuts and sand boils can generally be avoided by careful driving, but should be repaired as soon as they appear. Gasoline and oil should be kept away from the tires as they tend to soften the rubber. Three-quarters of all tire trouble is due to a lack of pressure. A gauge should be used to determine the pressure, and tires should be kept inflated to 20 pounds pressure per inch of width.

BODY

The body is the passenger carrying part of the car, and consists of a wooden frame covered with a steel shell, and into which the seats and cushions are fitted. To prevent squeaks, the bolts which fasten the body to the frame should be kept tight.



LIFT THE DOT FASTENER

The "lift the dot" fastener is used to fasten the side curtains in place. To remove fastener from over stem, grasp the curtain just below the fastener as shown in cut and give it a sharp quick jerk.

WASHING

In washing the car, soak the dirt off with a gentle stream of cold water. Do not use a nozzle on the hose and do not rub. Mud and dirt should be washed off before it gets dry and hard. Grease can be removed with soap suds and a soft sponge. Rub as little as possible and use a neutral soap. Rinse thoroughly with cold water and dry and polish with a piece of clean soft chamois skin.

INDEX

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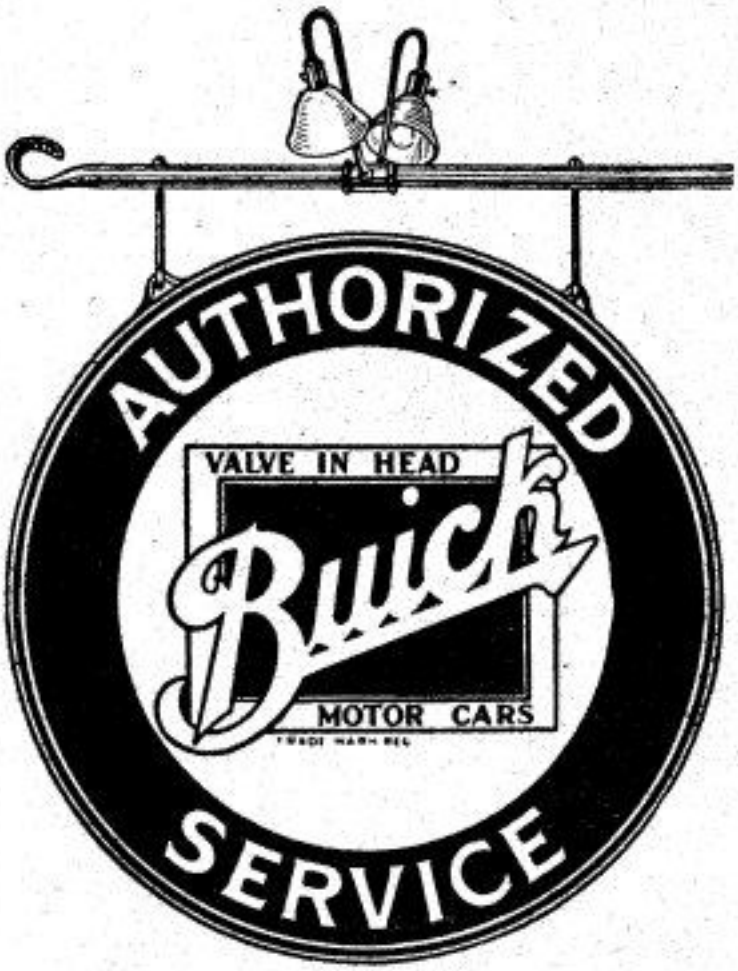

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