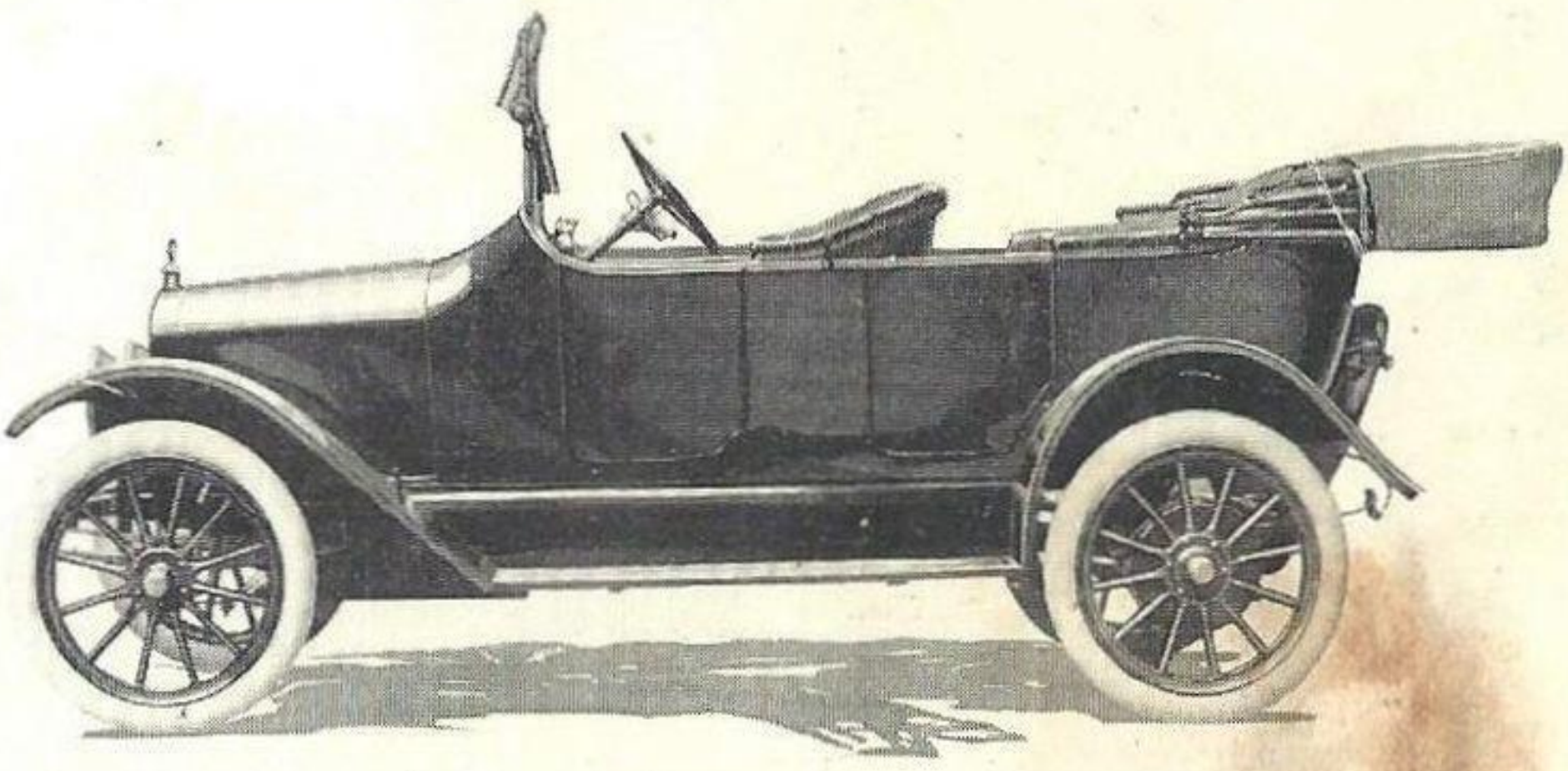
1915

Maxwell

INSTRUCTION BOOK



1915 Maxwell 5-passenger touring car

MAXWELL MOTOR COMPANY
(INCORPORATED)
DETROIT, MICHIGAN

1915 Maxwell Instruction Book

Before Using the Car

When your car is delivered, be sure that gasoline tank is filled with good grade of gasoline; the crank case supplied with lubricating oil, and that such parts as transmission and rear axle have been furnished with the proper lubricants. (See instructions for lubrication on pages 10-11-12 and 13.)

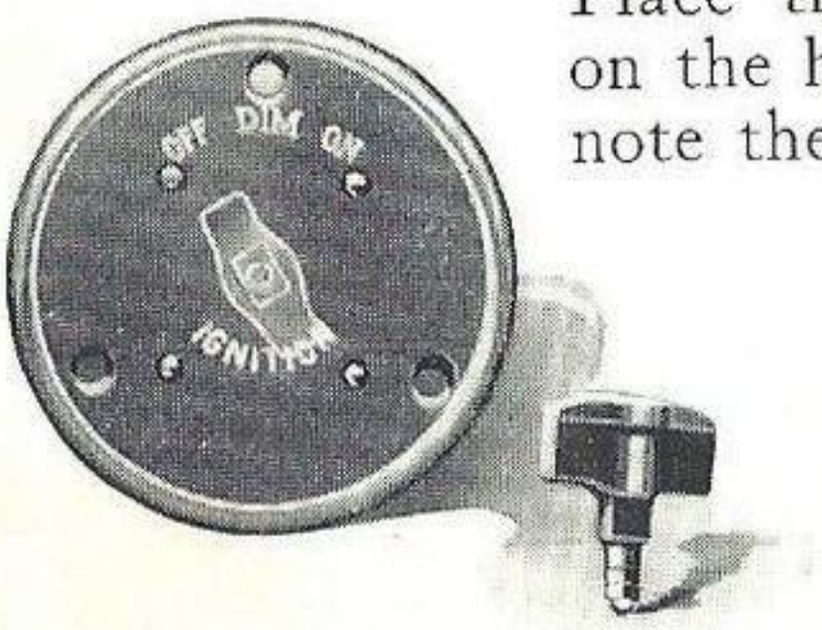
Fill the radiator with clear water. If possible, use water free from alkali, as this has a tendency to make the metal parts corrode, and in a short time causes leaks. Spring water or rain water is the best for this use.

Gasoline tank is located in the cowl of the body. The filler cap is on the right hand side. (See illustration on page 4.)

Before Starting the Motor

See that the gear shift lever is in the neutral position. (See diagram on page 4.)

The spark lever, which is the shorter of the two levers under the steering wheel (see diagram on page 4), should be fully retarded, or placed at the top position; while the throttle lever or longest lever should be moved down about ¾ of an inch on the quadrant.



Place the plug in the switch, which is located on the heel board on the front seat. Be sure and note the different positions of this switch, so you will not be running with the lights on. (See diagram herewith.)

Air control for carburetor is located on the right hand side of instrument board. (See diagram on page 4.) When starting the motor, pull the air control button part way out until motor starts. With the exception for starting in cold weather, you will seldom have to use the carburetor air control. In cold weather, however, it would be almost impossible to get sufficient gasoline (rich mixture) to cylinders unless you cut off air to carburetor by means of air control button on dash.

To Start Motor

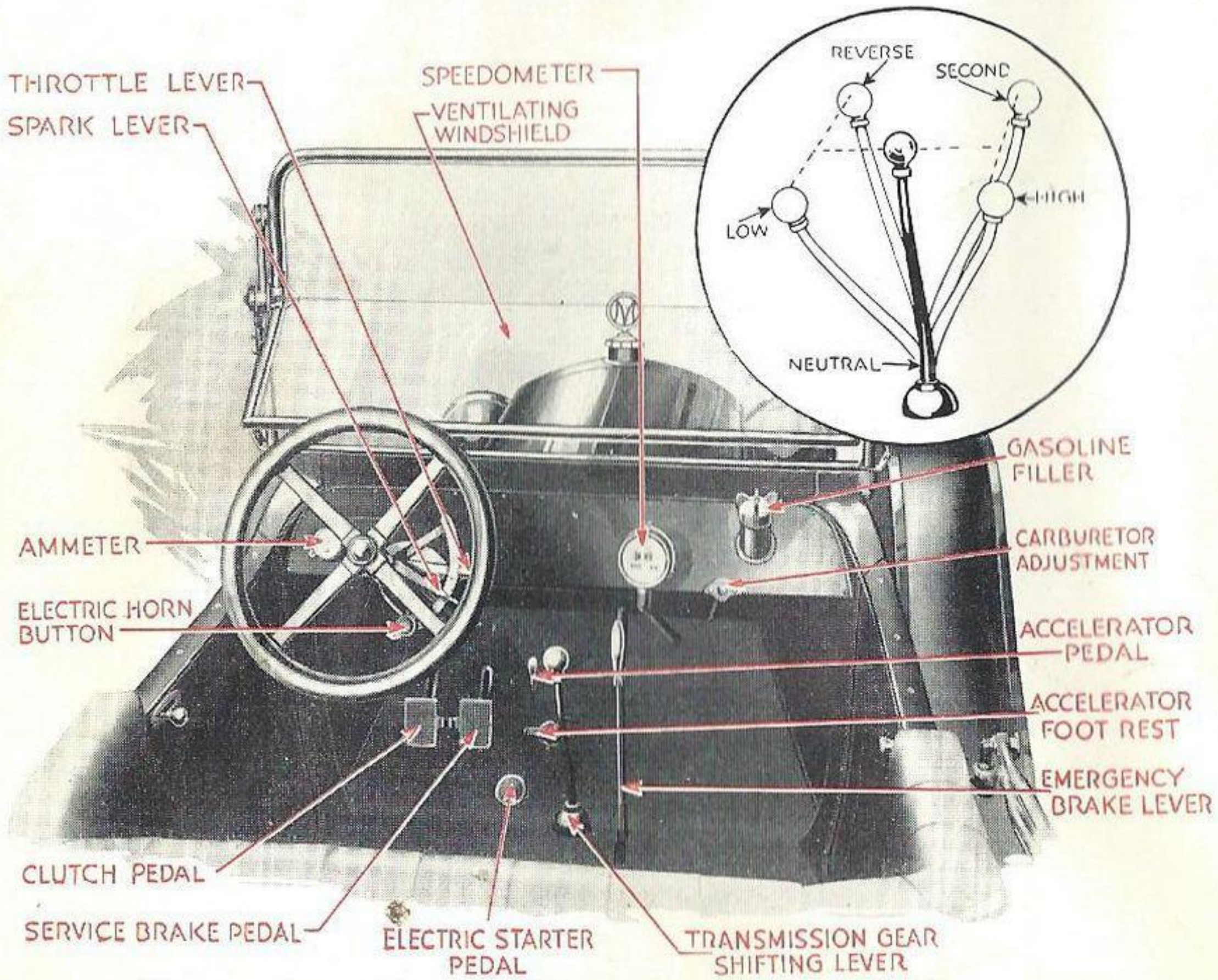
Before attempting to start motor be certain that gear shift lever is in neutral position:

To start motor place right foot on electric starter pedal. (See diagram page 4.) Press this all the way down with a quick movement.

If the pedal is operated slowly the gears are not so liable to mesh as if pushed down quickly. As soon as the motor picks up the revolution on its own power, release the pedal and advance the spark by moving spark lever down about half way on the quadrant.

To Start the Car

After the motor has started, release the emergency brake and disengage the clutch by pushing forward on the left pedal with your left foot. Grasp the gear shift lever with the right hand and pull to the inside rear position or low speed. (See diagram below.) Let the clutch in gently, at the same time slightly increasing the speed of the motor by means of the accelerator foot pedal or the throttle lever under the steering wheel, and the car will move forward slowly.



Changing From First to Second Gear

As soon as the car is under way, again throw out the clutch by pressing forward, and move gear shift lever to outside forward position or second speed. (See diagram above.) Let in the clutch, accelerate the motor until car attains sufficient headway.

Changing From Second to High Speed

Throw out clutch and pull gear shift lever into high speed or straight back from second. (See diagram page 4.) Your car is now in high gear or direct drive, which is always used for general driving.

Changing From a High to a Lower Speed

When it is necessary in traffic or on account of heavy roads to drop to a lower speed, release the clutch and move the gear shift lever into the position for desired speed or gear. In changing from a higher to a lower gear, it is desirable to hold gear shift lever in neutral position and let the clutch engage for an instant, then with quick movement put your gear shift lever into speed desired. The object of this is to equalize the speed of transmission shafts so as to avoid clashing of gears.

To Back the Car

NEVER try to shift the gears to the reverse position unless car is stopped. Throw out the clutch and push gear shift to forward inside position or reverse. (See diagram page 4.) Let in the clutch and accelerate as for other speeds.

In driving always be very careful about applying the brakes when on muddy roads or slippery streets. If the brakes are applied too suddenly there is always danger of skidding.

It is desirable not to drive your car in crowded streets or in heavy traffic until you have become thoroughly familiar with its operations.

Carburetor

It is desirable before stopping engine, that the air control button on dash should be pulled part way out. This enables the engine to retain a rich charge in the cylinders which materially assists starting. In any case when stopping the motor, *use the switch* and have the throttle about ¼ open. In this way the cylinders are prevented from being filled with air. If the cylinders are filled with gas, starting is always easy, while again if the supply of gasoline is cut off, or the throttle closed while the motor is running the cylinders are filled with air, and on re-starting it has to be replaced by gas.

To Adjust the Carburetor

To get best results from motor, a few cautions are necessary:

Be sure compression is good and equal in all cylinders.

Be sure ignition is right.

Be sure there are no air leaks between carburetor and cylinders (at joints).

Be sure there is gasoline in carburetor.

Then turn needle valve to its seat. Do not force. Adjust needle valve about 1½ turns away from seat. This will be a little more than required but will insure easy starting.

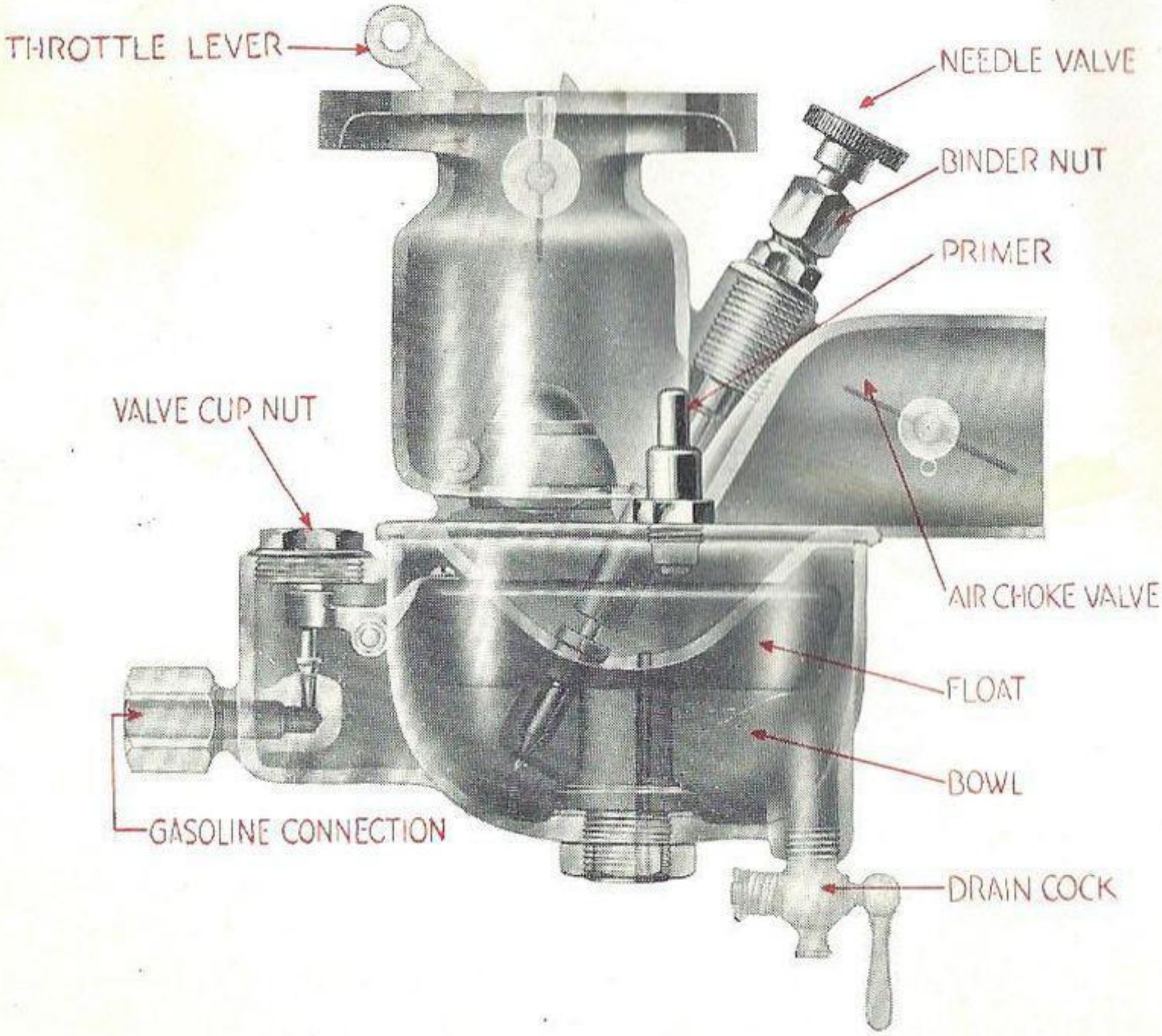
Start motor, retard spark and close throttle to desired idling speed. Motor should be run long enough to warm up to service conditions before final adjustment. Now adjust needle valve towards its seat till motor begins to slow down, indicating a weak mixture, then adjust in opposite direction till motor runs well and positive.

Next, open throttle rapidly—motor should respond strongly. Should acceleration seem slightly weak or motor "split," adjust needle valve away from seat till this is overcome.

The adjustment is now complete. Tighten binder nut under needle valve top till needle valve turns stiffly.

Care of Carburetor

The bowl or "Gasoline Chamber" of the carburetor is supplied with a drain cock at the bottom which should be opened frequently, as water and other foreign matter will collect in bowl and cause trouble.



Gasoline leaks from any cause should be remedied immediately. Should the carburetor "flood," it is a sure indication that the valve which controls the gasoline supply to the bowl is off its seat and is probably caused by dirt lodging at that point. This must be removed before "flooding" or leaking will stop.

To remedy this, remove the cap nut above valve and turn valve back and forth a few times with a small screw driver. This should be done very lightly and carefully.

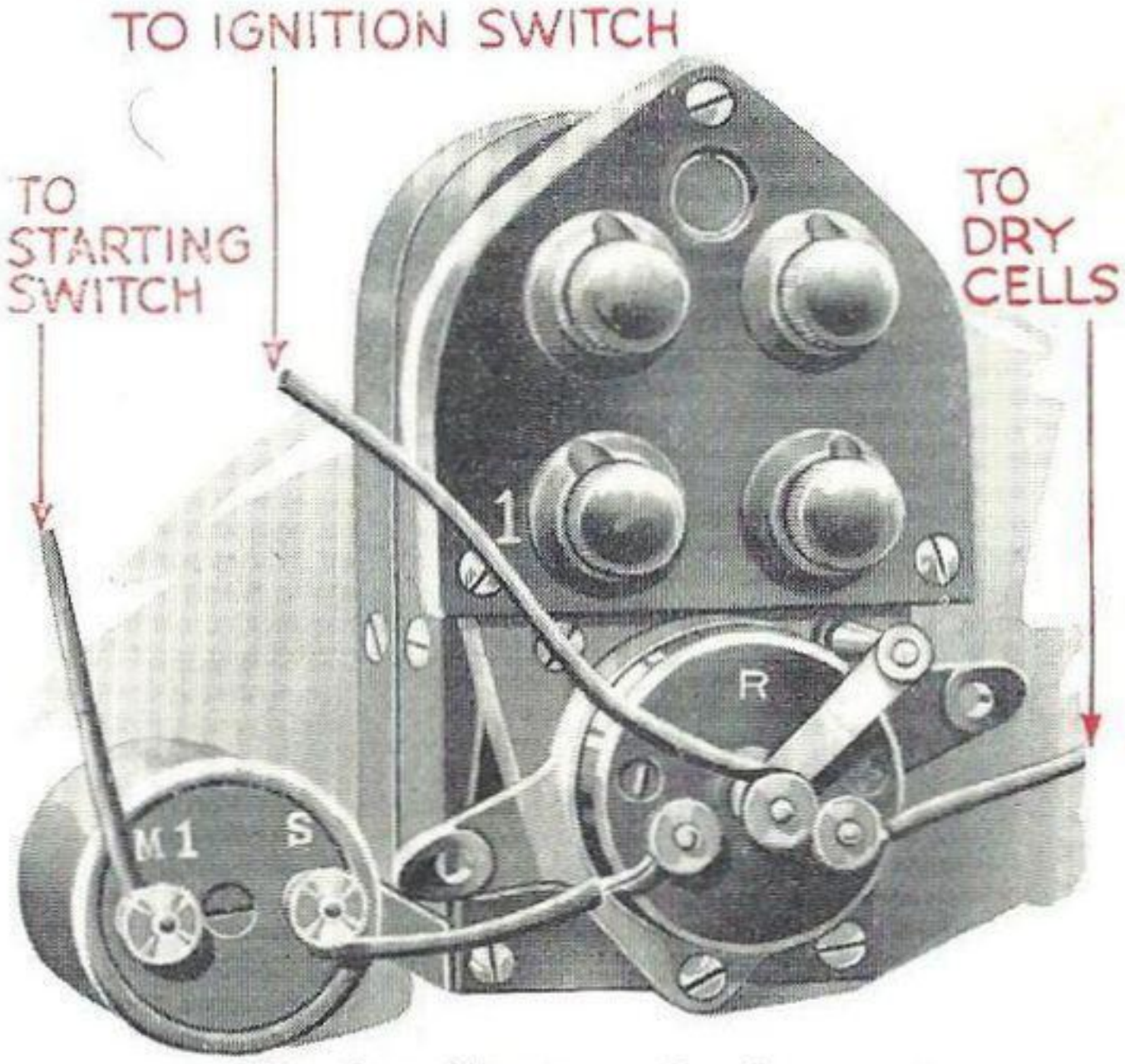
Should leaking continue it will be necessary to remove bowl and thoroughly clean with gasoline. Test valve for leakage by turning cup upside down and placing threaded gasoline connection to the lips, then draw lips tighly against connection. If valve is tight, the lips will be drawn into hole and will stick, if valve leaks, the lips will be released immediately.

If valve does not hold with this test, regrind carefully as advised above. It is best to use oil only when reseating.

Be careful not to change location of float.

Ignition System

The Simms High Tension Magneto used on the 1915 Maxwell consists of a dual system in which is provided a small non-vibrating coil which can be either attached to the frame or dash of car, as the coil



Showing wiring connections for magneto

is unaffected by either moisture or heat. The coil being non-vibrating there is nothing to get out of order or require any adjusting.

Four or five dry cells are to be used in connection with this system and care must be taken to connect them correctly. This is most important and the wiring diagram (pages 16 and 26) should be consulted before disconnecting or connecting any of the ignition wires.

The switch operating the battery circuit is in connection with the starting switch and when the starting pedal is depressed (thereby throwing the starting motor into operation) the current flows through the switch, coil and magneto. As soon as the engine starts or the starting pedal is released the circuit is automatically disconnected; the engine runs on the magneto. It is readily apparent that the operation is extremely simple, with the additional advantage that it is impossible to leave the switch on unconsciously and run down the batteries.

Contact Breaker

The contact breaker is readily accessible and may be easily removed for inspection or cleaning. The platinum points used in the circuit breaker are exceptionally large and will last for several years under proper treatment and ordinary usage. The points should be clean and smooth and correctly adjusted according to the gauge that is furnished with each magneto.

Do not lubricate any part of contact breaker.

Oiling

Two oilers are provided—one on the driving end plate to lubricate ball-bearing on driving end of armature, the other oiler is to lubricate the ball-bearing on the contact breaker end of armature and also the distributor shaft. Each oiler must be given 3 (three) or 4 (four) drops of good light oil every 1,000 miles. This will be ample lubrication. Do not over lubricate.

Timing Magneto to Engine

Turn the engine over by starting crank until No. 1 piston reaches top dead center on compression stroke. Turn the armature shaft of magneto until the figure No. 1 appears in the "Sight Hole" of distributor, which indicates that the distributor brush is in contact with No. 1 segment. Retard the timing lever and move the armature a little to either right or left so that the platinum points just break or open. With the magneto in this position couple it to motor and connect the high tension cable from distributor terminal No. 1 to spark plug in No. 1 cylinder. The remaining terminals must be connected up to spark plugs in the proper firing order of magneto.

Testing the Magneto

If you think that the magneto is at fault and not firing, try the following simple test: While the motor is running, disconnect one of the high tension cables from spark plug, being careful not to touch the metal terminal and hold the cable with the terminal close, about $\frac{1}{8}$ to $\frac{3}{16}$", to any part of the motor. This will show the strength of the spark and each cable may be tested in turn. If the magneto is not delivering a good spark, examine the contact breaker. The break or gap between the platinum points when open due to the cam action, should correspond to the thickness of the gauge furnished, which is approximately .015.

If the break is wider or closer adjust accordingly. However, the contact breaker is adjusted correctly before the magneto leaves this factory, and under ordinary conditions will not require any further adjustment in 15 to 20,000 miles of running.

If engine fails to start and you think the magneto is at fault, carefully examine all wiring and connections. Disconnect grounding cable on center of dust cover. If the engine still refuses to start, remove all spark plugs and lay them on the top of cylinder in such a position that the points may be seen and yet not grounding the spark plug terminal. Give the engine a quick turn, and if a spark occurs at the spark plug points or electrodes, it is almost conclusive proof that the magneto is operating properly.

However, if a spark does not occur, it is advisable to inspect the contact breaker and ascertain if the bell crank lever moves freely. The shaft of this lever works in a fibre bushing, and must not be lubricated. If this has been lubricated, or occasionally on new machines, the fibre will swell and prevent the lever from operating freely. This can be easily remedied by removing the contact breaker and reaming out the bushing, but be careful not to make the hole too large. Just take out sufficient to allow the shaft to move easily.

If, after making the above examinations, you are still unable to obtain a spark, send your magnet, charges prepaid, to our nearest Service Station, or direct to the factory in East Orange, N. J. If the trouble is due to defective material or workmanship the magneto will be put in first class condition and returned at our expense.

Instructions for Lubrication

To Oil Motor—Open the top pet cock in crank case. (See illustration on page 11.) Pour oil in breather pipe (see illustration on page 11) until oil runs out of the opened pet cock. Always be sure that oil level in crank case is level with this pet cock.

In testing for oil level be sure that pet cocks are not stopped up.

Oiling Springs—You will find oil cups on both ends of the front and rear springs, also on the front axle and the front axle tie rods. These should be kept well oiled at all times, as it is absolutely essential to the long life of the car as well as to prevent squeaks.

To Oil Transmission—Remove the filler plug in the top of the transmission case and pour in heavy 600-W steam cylinder oil, or oil of similar grade, until the lower gears are about half covered. When case is empty this will require about one quart of oil. This is sufficient, as the gears, when running, will churn the oil and distribute it evenly throughout the transmission. **Do Not Use Hard Grease.**

Between the transmission and the universal joint there will be found a plug. Remove this, and with a grease gun force heavy grease into the universal joint. This should be done about ounce every two weeks, in order to insure the proper working of this part.

There is a plug in the lower part of the rear axle housing which must be removed when it is desired to lubricate the differential and driving gears. This can be done by means of a grease gun. Use a very heavy oil.

See that the axle is at all times well greased, but do not force in too much oil. About one quart is enough. If too much is used it is liable to work out through the hubs and get in the brakes and materially decrease their efficiency.

About three or four times a year oil the magneto with about three drops of "3-in-1" oil.

"Don'ts"

Don't start on a trip without attention to oil, gasoline and water.

Don't fail to keep your brakes adjusted. It is more necessary to be able to stop a car then to start it.

Don't neglect your lamp connection. It is very easy when washing the car to disconnect one of the wires.

Don't leave the car alone with the motor running.

Don't stop the car on the wrong side of the street.

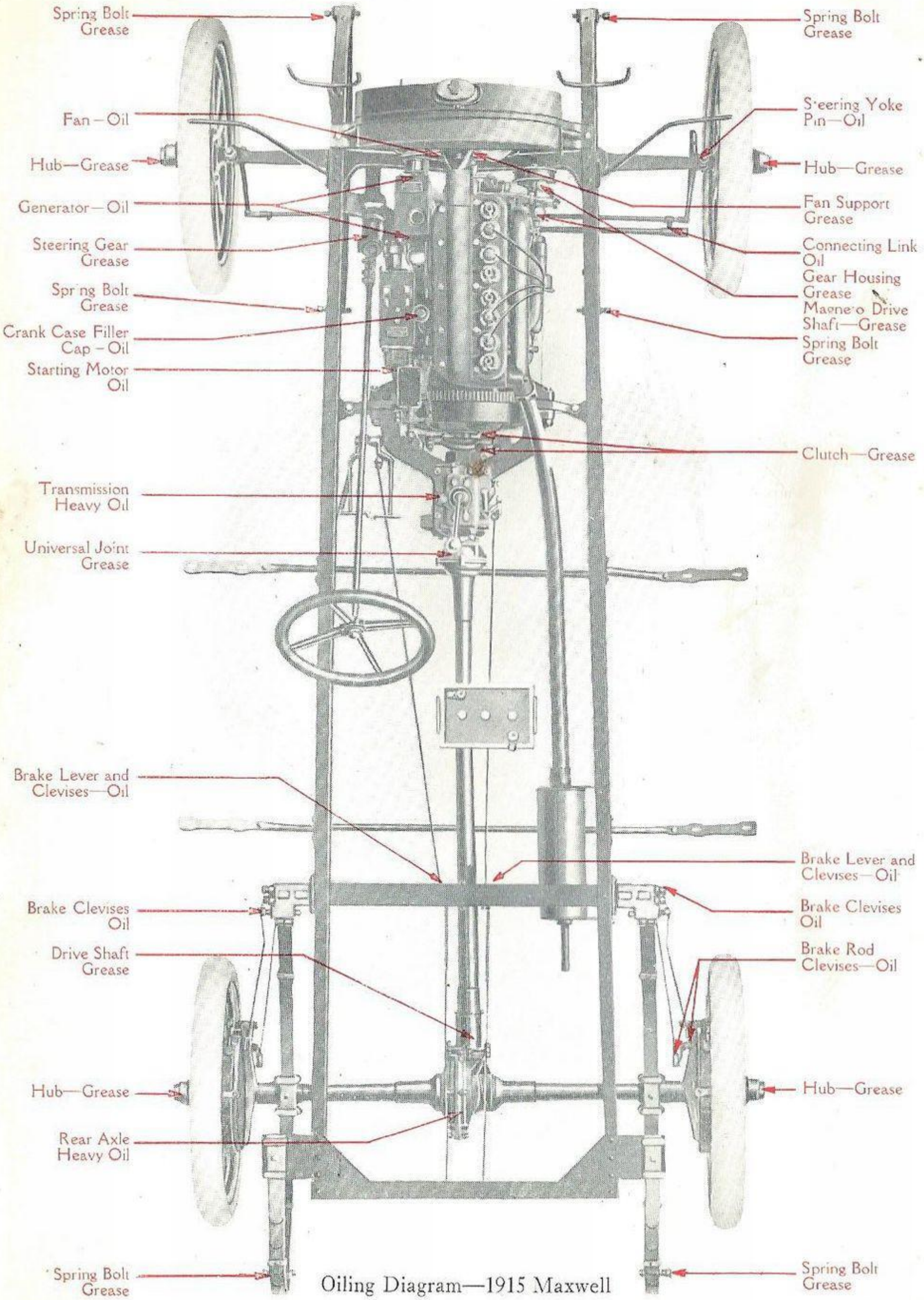
Don't drive faster than the law allows.

Don't fail to release the emergency hand brake before attempting to start.

Don't jump the car by quick openings of the throttle.

Don't forget, above all else, that an automobile is a fine piece of machinery, and that you will be repaid in excellence of service many times over for the care and attention given it.

Don't attempt to start the motor unless the spark is retarded and the switch plug in.



Oiling Diagram—1915 Maxwell

Don't spend a lot of time cranking the motor if it fails to start after a few trials. Look for the cause of the trouble. Continuous cranking runs down the battery.

Don't jam the gear shift lever from low to reverse, or vice versa, until the car has come to a dead stop, and then apply it gently.

Don't drive fast or apply the brakes suddenly on wet pavements.

Don't fail to use plenty of oil and grease where needed before starting on any trip, and do not use a cheap grade of oil or grease at any time.

Don't neglect necessary adjustment and repairs until it is too late and you are laid up by the roadside.

Don't fail to examine electrical connections, gasoline and oil lines and bolts and nuts occasionally, to see that everything is intact.

Lubrication Schedule

Daily

PART	QUANTITY	LUBRICANT
Crank case	See that oil runs out of the top pet cock on right side of motor	Motor oil
All spring bolt oilers	Few drops	Motor oil
Steering yoke pin oiler	Few drops	Motor oil
Fan hub oiler	Few drops	Motor oil

Weekly

Spark and throttle joint connection	Several drops	Motor oil
All brake clevises and oilers	Thoroughly	Motor oil
Universal joint	Grease gun full	Heavy grease

Monthly

Steering gear housing	Grease gun full	Medium cup grease
Magneto oilers	Two drops (no more)	"3 in 1" oil
Transmission	Enough so that gears are half covered	Very heavy oil
Rear axle	Enough to allow differential to dip	Very heavy oil
Front hubs	Pack	Medium cup grease

Every 3000 Miles

Drain crank case and flush thoroughly with fresh motor oil; then refill until oil runs out the top crank case pet cock.

Drain transmission and cleanse thoroughly with kerosene. Refill with fresh heavy oil until the gears are half covered.

Drain rear axle and flush with kerosene. Refill with enough fresh heavy oil to allow differential to dip.

Troubles and Their Source

Never tamper with or destroy the arrangement of parts of the motor or the car until fully satisfied of the real trouble. Note the symptoms and endeavor to determine the seat of the disturbance. If not successful in this, see the nearest Maxwell dealer and have whatever needs attention adjusted in the correct manner.

Motor Fails to Start Because Of

1. Lack of gasoline. See that tank is full and cock in gasoline tank is open.
2. Lack of current. See that switch plug is all the way in, wiring intact and connections made.
3. Dirty or defective spark plugs. (Spark plugs may be excessively sooted or porcelain cracked from too free use of oil. In the first place, take them out and clean them; in the second, replace with new porcelain.)

Motor May be Hard to Start From

1. Fouled spark plugs. (Inspect.)
2. Lean or weak mixture of gas. (Pull carburetor air control button part way out.)
3. Air leaks around manifold, gaskets or valve caps. Such leaks also cause weak gas mixture.

Motor May Stop From

1. Lack of gasoline.
2. Disconnected wires or switch.
3. Overheating from lack of water.

Misses in Motor Caused By

1. Defective spark plugs. Short circuit spark plugs by touching plugs and cylinders simultaneously with a piece of metal. Try each in turn until one is found that does not slow down motor. This cylinder is at fault, and most likely the plug is the cause of the trouble.

2. Broken or disconnected wires. Inspect.

3. Points of spark plugs improperly set. If the points are too close or too far apart, missing may occur. Points should be twenty to twenty-five thousandths apart, or a little less than 1-32 inch. A ten-cent piece may be used, the thickness of which is approximately .018 to .023, in absence of a regular gauge.

4. Incorrect carburetor adjustment. See page 5 or Maxwell dealer or send to Service Department for instruction.

5. Lack of compression in cylinder. Valve may be stuck or carbon may be located on seat. Examine valve tappets to see if valves are not held off seat. Test each cylinder in turn by turning over motor with starting crank.

Motor Will Overheat From

1. Lack of proper lubrication.

2. Defective water circulation. Drain and flush radiator.

3. Motor running on retarded spark. Spark lever should be kept as far advanced as possible without causing motor to knock. Will also save fuel.

4. Slipping fan belt.

5. Too rich a mixture. See carburetor adjustment on page 5.

Knocks in Motor Caused By

1. Loose connecting rods. Take up connecting rod bearings. If not familiar with this work, see nearest dealer or write our Service Department.

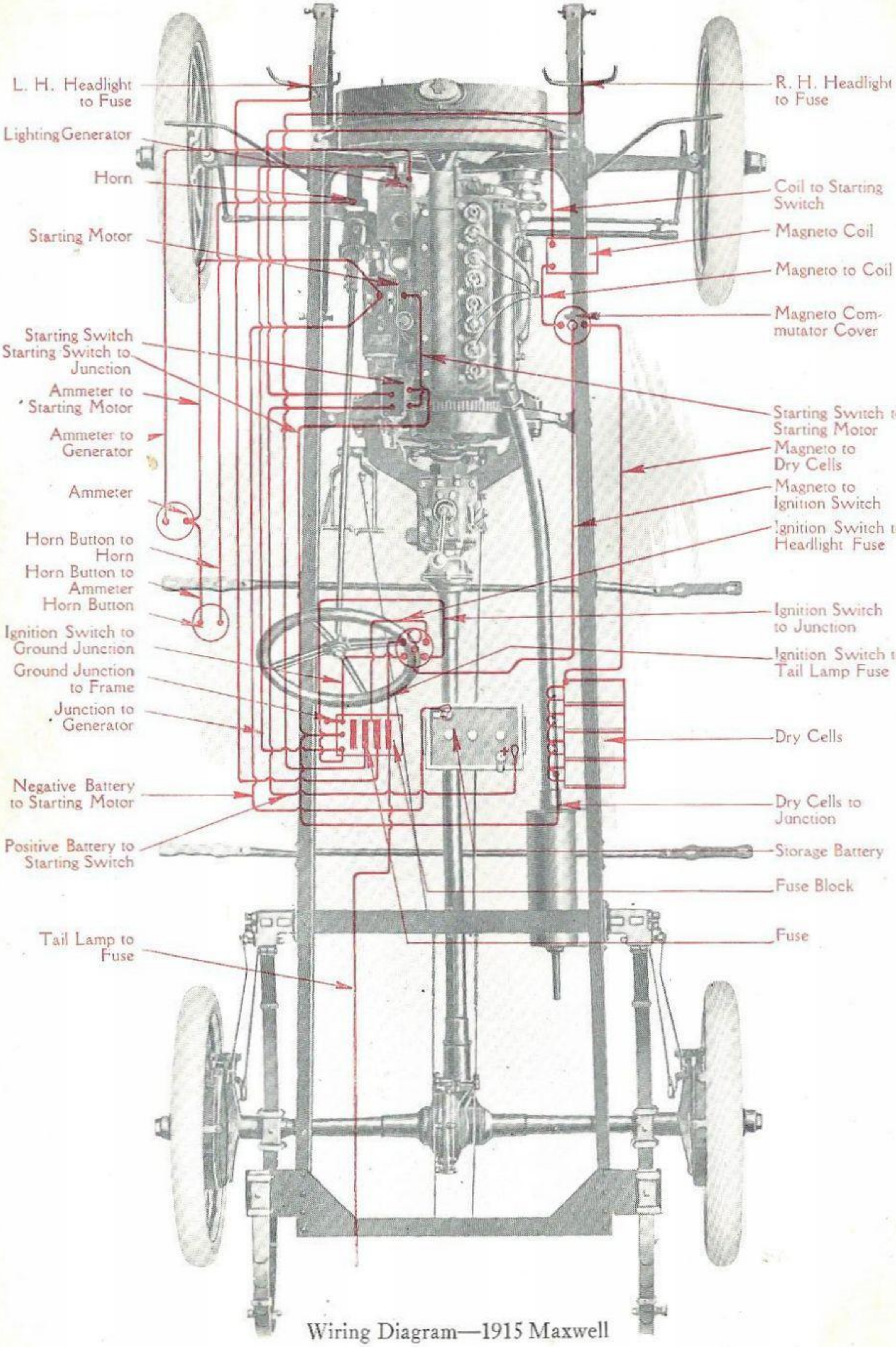
2. Spark too far advanced. Retard spark gradually until knock ceases.

3. Lack of proper lubricant within motor.

4. Faulty carburetor adjustment. See dealer or communicate with Service Department.

5. Carbon in cylinders. This may cause premature ignition. Have carbon removed.

6. Motor overloaded on hill. Shift to next lower speed.



Wiring Diagram—1915 Maxwell

The Dynamo

Function

1 The dynamo, Fig. No. 1, generates electricity for lighting and for charging the battery.

The Regulator Cutout

Regulator cutout construction

2 The regulator cutout has two functions: one to regulate the dynamo for uniform output; the other to connect the dynamo into the system, only when sufficient current is generated, and as dynamo slows down, when voltage is insufficient to charge battery, to disconnect dynamo from the system to prevent discharging through dynamo.

3 The shunt winding, series winding, cutout points, regulator points and field resistance are shown in wiring diagram (Fig. No. 8), page 26.

4 When dynamo is at rest, cutout points are open and regulator points closed.

Dynamo Terminals

Dynamo terminals and connections

5 The dynamo terminals are marked "B" and "L". "B" connects to the battery, through ammeter. "L" connects to the lamps, through lighting switch.

6 Connections between dynamo and regulator are as follows:

The three terminals at end of the regulator cutout opposite terminals marked "B" and "L" connect to dynamo windings, as shown in wiring diagram (Fig. No. 8), page 26.

"A" connects to dynamo negative (–) brush.

"F" connects to one field coil.

"F-1" connects to the other field coil.

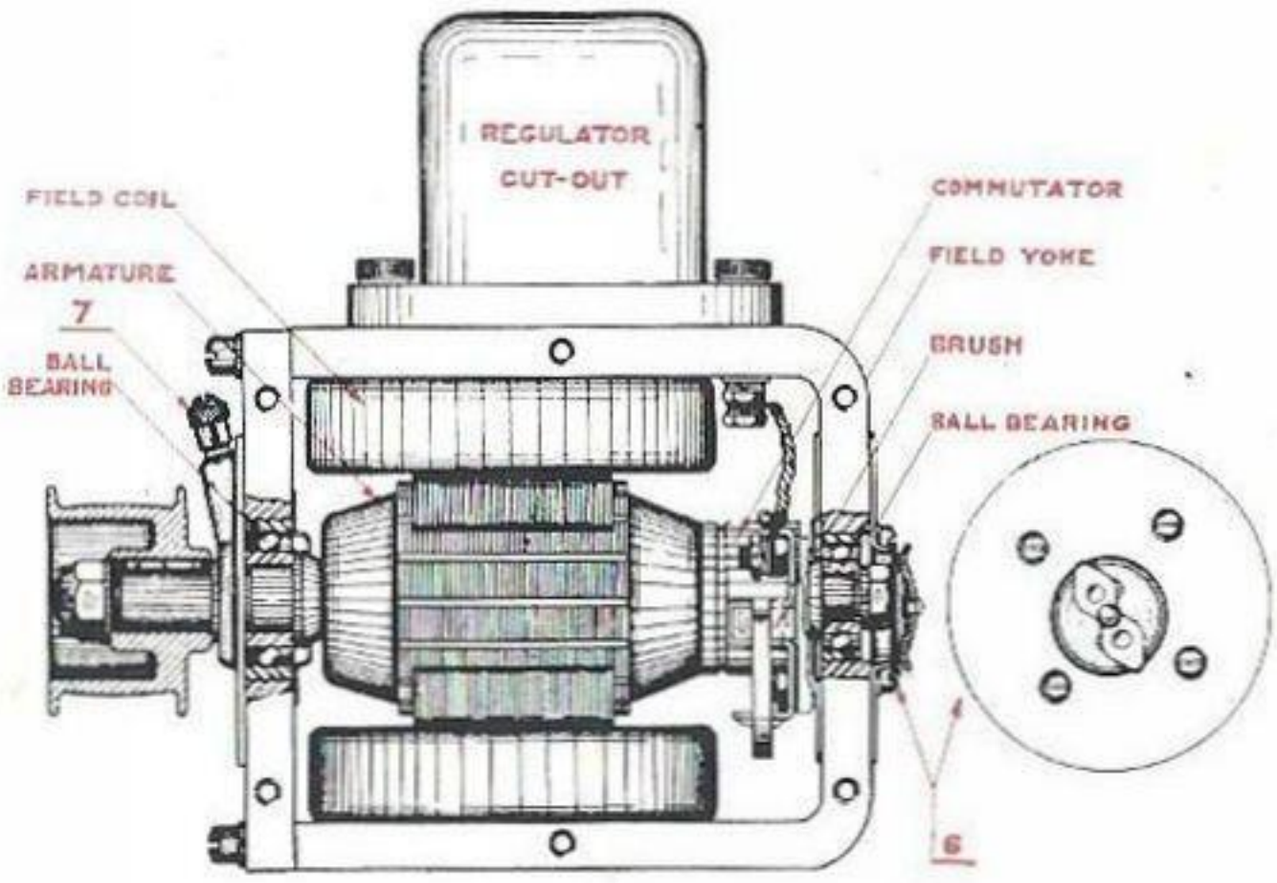


Figure No. 1

Dynamo

Interior accessible

7 The dynamo is shown in the sectional view (Fig. No. 1). Its interior is accessible from opposite sides by removing side covers.

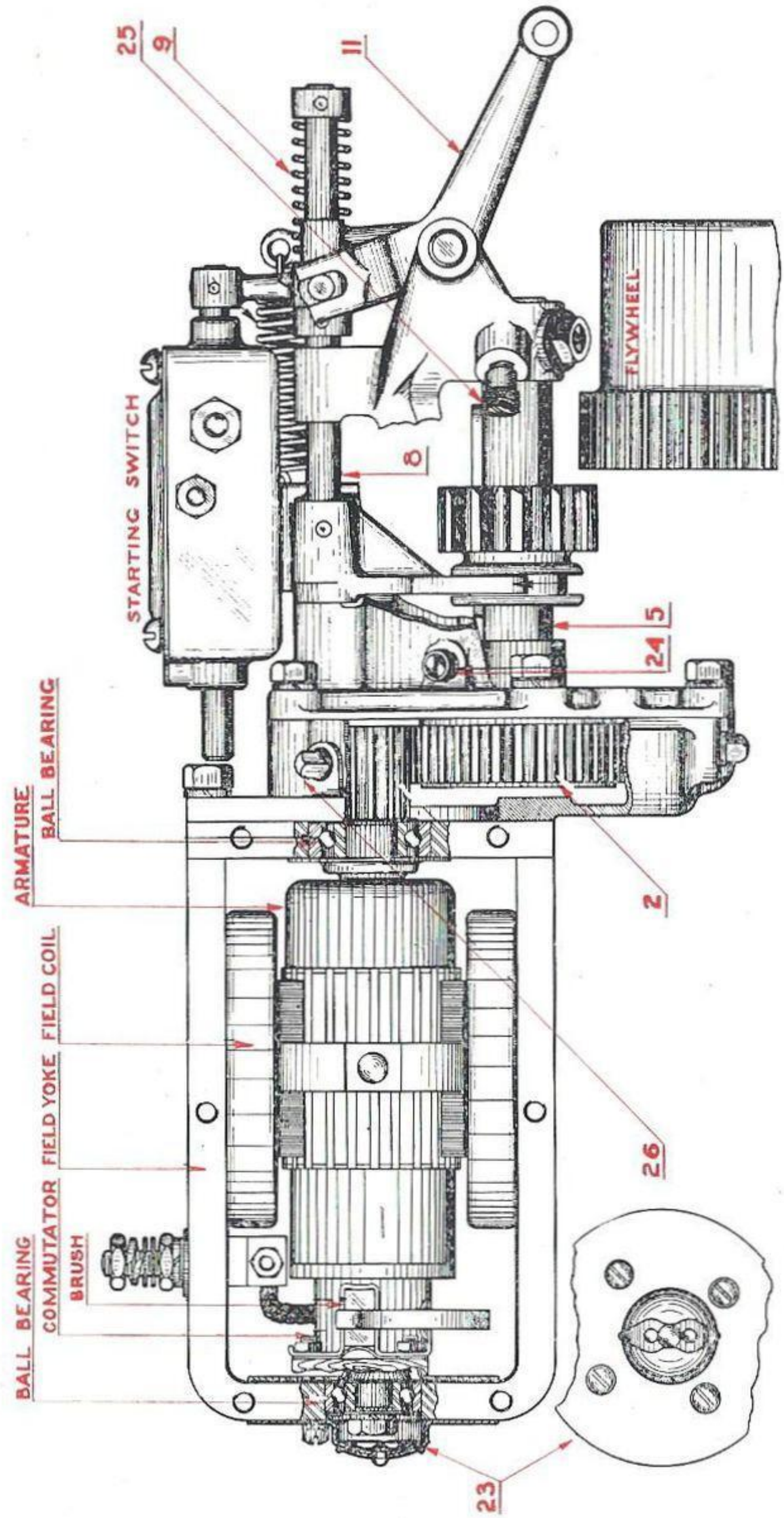

25
9
11
STARTING SWITCH
8
FLYWHEEL
24
5
2
26
ARMATURE
BALL BEARING
FIELD COIL
FIELD YOKE
COMMUTATOR
BRUSH
BALL BEARING
23

Figure No. 2

Lubrication

8 **Oil every two weeks** *The dynamo must be lubricated every two weeks.* Use high grade, medium weight, acid free motor oil. *Oil covers or caps must be turned to closed position after oiling.*

9 No. 6 in Fig. No. 1 shows commutator-end oiling device. Oil is admitted through upper opening. The lower one acts as an overflow.

10 No. 7 shows oiling device at drive end. Eight or ten drops of oil will supply adequate lubrication.

11 Do not assume that oil has reached the bearings, but *be certain.* Overflow of lubricant at oiling places does not always indicate that bearings have been properly lubricated.

Rating

12 The type "T" dynamo is rated at 6½ volts, 10 amperes, 1000 r.p.m., as stamped on name plate. This means that dynamo will deliver current of 10 amperes at 6½ volts (pressure) when armature rotates 1000 revolutions or more per minute.

13 **Output varies slightly** The dynamo is so connected to the engine by belt that it will rotate at 1000 r.p.m. at a car speed of 10 miles per hour, at which speed it should deliver its rated output.

14 **Lamps influence charging rates** At speed above 10 or 12 miles per hour (when lamps are "off") battery receives full charging rate, but as lights are turned on, current is conducted to lamps and charging rate reduced.

15 **Charging necessary** The dynamo will keep battery charged for all lighting and starting services if car is driven at or above 10 miles per hour for a sufficient length of time.

If Dynamo Fails to Generate

16 **Inspection of Dynamo** This is shown by the ammeter which will *not* indicate "Charge" when engine is running at high speed, but indicates "Discharge when lights are on." It is then necessary to remove side plates from dynamo to examine brushes. See that they slide freely in brush holders, make good contact with commutator, and that wires from brush holders and fields to dynamo terminals are firmly connected.

17 The commutator, if coated or dirty, may be cleaned while in motion by holding a clean cloth, slightly moistened with oil, against it.

18 The driving belt may not be tight enough to rotate dynamo at sufficient speed to charge battery.

The Starting Motor

19 **The Starting Motor** The starting motor (Fig. No. 2) cranks the engine until it runs under its own power.

Electrically

20 **Construction** It is connected to battery through heavy cable and starting switch. (See wiring diagram, Fig. No. 8), page 26.

Mechanically

21 It is connected to engine through a gear reduction having a sliding engaging pinion and an over-running clutch. (Fig. No. 2).

Construction of gear reduction The sliding pinion and starting switch are operated by the same operation of starting pedal, in order that electrical and mechanical connection or disconnection occur at the same time. (Fig. No. 2.)

Gear reduction—How operated

22 When the starting pedal is pressed to the limit of its travel, the flywheel pinion is moved forward, and if in meshing position, meshes with the flywheel gear. This is followed by closing of Starting Switch which causes motor to crank engine.

Starting switch closes

23 If flywheel pinion is not in meshing position when the starting pedal is pressed, that is, if the pinion teeth touch the ends of the flywheel gear teeth, instead of sliding between them, the starting pedal continues to the full limit of its travel, compresses the shifter rod spring, and closes battery ignition and starting circuits.

24 The compressed spring on shifter rod throws the flywheel pinion into mesh when starting motor begins to rotate, whereupon the motor cranks the engine.

25 Releasing starting pedal to normal or "off" position, opens starting switch and disengages flywheel pinion, thereby disconnecting starting motor electrically and mechanically, and opens battery ignition switch.

Lubrication

Parts need oil

26 *The starting motor must be oiled regularly every two weeks with high grade, medium weight, acid free motor oil.*

The oil caps and covers must be turned to closed position after oiling (Fig. No. 2 shows the oiling places). No. 23 is the commutator and oiling device. Oil is admitted through the upper opening; the lower opening acts as an overflow.

Nos. 24 and 25 convey to intermediate shaft bearings. No. 26 admits oil to gear case, and driving end bearing. *It should receive one tablespoonful of heavy motor oil every two months.*

Sliding surfaces (shaft No. 5, starter lever No. 11, and pinion shifter rod No. 8) must be oiled once a week.

If Cranking Fails to Start Engine

Why engine does not pick up

27 If the starting motor cranks engine when starting pedal is pressed to the full limit of its travel and engine does not start (run under its own power) after 10 or 15 seconds, release the starting pedal and determine reason for failure. Any of the following troubles may be the cause:

Fuel supply exhausted.

Ignition switch not turned on, or circuit may be open.

Dry cells in ignition circuit exhausted.

Ignition contact in starting switch not making good contact.

Ignition wire loose or misplaced.

Spark plugs defective.

Cylinders need priming.

Fuel of poor grade.

Carburetor not adjusted.

Does Not Crank Engine

Reasons for cranking failures

28 If pressing the starting pedal to its full limit fails to rotate motor and crank engine, release starting pedal and determine the cause. Any of the following may be responsible:

Battery weak (discharged). See battery ("48 to 59") also ("62 to 71").

Battery cables not in firm contact with battery and motor.

Starting switch not making good contact when starting pedal is pressed to the limit of its travel. Press blades outward slightly if good contact is not made.

Crank engine by hand, to determine if engine is at fault.

Examine motor brushes. They should slide freely in holders.

29 If starting motor rotates and engine fails to spin, the following troubles may be responsible:

If same is accompanied by very little noise, the trouble is most likely in roller clutch (located inside gear No. 2) which does not grip properly.

Sliding surface of intermediate shaft may be dry or injured, preventing flywheel pinion sliding easily in mesh with flywheel gear.

30 If accompanied by much noise, the trouble is most likely with sliding pinion, which fails to mesh with flywheel. In this case heavier shifter springs (No. 9) should be used, which are obtainable through G. & D. Service Stations or Factory. (See Fig. No. 2.)

Lighting Switch

Lighting switch failures

31 The rotary switch, incorporated with ignition switch, controls circuits to head and tail lamps respectively. Current from battery and dynamo is conducted to switch terminal "B"; "H" connects to head lamps; "T" connects to tail lamp; "M" connects to magneto; and "G" connects to ground on frame. (See diagram, Fig. No. 8). This switch is furnished by car manufacturers.

If dimming features fail, examine resistance. It may be broken, disconnected, or resistance may be short circuited.

Fuses

Why fuses blow

32 Under front seat, mounted in an accessible position on the fuse block (Fig. No. 8) are the fuses. These are placed in the head and rear lamp circuits to protect the remaining part of the system should the wires leading to these lamps come in contact with metal frame work of car and cause a short circuit.

33 The fuse consists of an enclosed wire, composed of special composition which "blows" or melts (fuses) when excessive current flows through caused by a short circuit. (See 108).

34 Extra fuses may be obtained from Maxwell Service Stations and Factory.

Battery

Battery has important function

35 The battery is the heart or center of the system. The electricity generated by the dynamo when engine is running, is conducted to and stored in battery. This current is used by starting motor for engine cranking, and by the lamps at low car speed and when engine is at rest.

Battery construction

36 It has three compartments or cells. Within each cell are two elements—one positive, the other negative. Each element consists of a number of plates immersed in electrolyte (diluted sulphuric acid). (See "52 and 53.")

37 When electric current generated by dynamo flows through the elements, it arouses a definite chemical action, termed "Charging."

Battery stores electricity

When battery is supplying current to lamps and cranking engine, the chemical action is of an opposite nature, termed "Discharging."

38 The chemical action while "charging" (storing energy) emits a fine spray, principally water. This loss must be replaced by adding distilled water to each cell once a week in warm weather, and once every two weeks in cold weather.

Battery needs water regularly

39 Water is admitted to each cell by unscrewing vent plugs from openings. These openings are also intended for inspection and for ascertaining specific gravity or hydrometer readings.

40 If inconvenient to obtain distilled water, use melted artificial ice or rain water. Never use water containing mineral properties or alkali.

Kind of water

41 Do not store battery water in metallic vessels. Use glass.

42 The battery, to be in good condition, must receive sufficient current from the dynamo.

43 If ammeter shows that battery is not receiving "charge" at or above 12 miles per hour, the cause should be determined. (See "81 to 82.")

If battery becomes discharged

44 The battery, if neglected, will cause the starting-lighting functions to fail. The motor may operate under low voltage, but battery life is thereby shortened. If, however, the battery is kept fully charged and properly supplied with distilled water, it will give uninterrupted service.

Care of Battery

45 The battery should be securely fastened to prevent unnecessary jarring. Immediately upon receipt of a battery or new automobile, equipped with Gray & Davis system, the battery should be inspected. Remove vent plugs. See that battery plates are WELL COVERED WITH SOLUTION, and if same is not up to inside cover, add distilled water, rain water, or melted artificial ice. Filling one cell does not fill all. (See "38 to 40; also 47 and 57.")

Battery inspection necessary

46 The majority of car owners are careless about giving battery the attention it should have. Remember that if the plates are exposed (not covered by liquid) they become sulphated and hard, and battery capacity is greatly reduced. (See "60 to 61.")

Neglected battery

47 When car is in use, inspect battery once a week in warm weather and once every two weeks in cold weather. Supply water as needed.

48 Specific gravity tests are made with hydrometer.

49 When battery does not give the desired results, SPECIFIC GRAVITY tests of each cell will indicate the faulty cell or cells.

50 Expel the air from hydrometer bulb by pressing it. Then insert hydrometer nozzle into battery opening, and allow the depressed bulb to draw sufficient electrolyte into the syringe to FLOAT the hydrometer. The specific gravity or the density of the electrolyte is then indicated by the number on hydrometer at surface of the electrolyte.

51 Take hydrometer readings just previous to adding water.

Hydrometer readings

52 The electrolyte of a fully charged battery is more dense than that of a discharged battery. As battery supplies current to lamp and motor (Discharges) specific gravity will DECREASE. When dynamo charges battery specific gravity INCREASES.

A fully charged battery will indicate between 1.275 and 1.300 sp. gr.

Entire discharge dangerous

53 The battery should not be permitted to discharge lower than 1.150 sp. gr. as it causes the plates to sulphate.

54 The specific gravity of each cell should be almost alike and not vary more than 15 or 20 points. If a greater difference exists the battery efficiency is reduced.

Causes for battery inefficiency

55 If hydrometer readings show that one cell is discharged, or nearly so, while other cells are charged, it indicates that the cell is defective. This may be due to:

1. Short circuit in that particular cell, thus discharging it.
2. Sulphation caused by frequent filling with water. (See "60 and 61.")
3. Leak in cell, thereby requiring more water in other cells, which reduces the gravity.

56 If repeated charging does not show sufficient increase in gravity, the matter should be referred to manufacturer of battery.

57 *Remember that the battery must have enough water to cover plates under all conditions and must never remain in a discharged condition for any length of time.*

Sulphation prevented

58 A fully charged battery cannot sulphate.

Freezing prevented

59 Freezing of electrolyte is avoided by keeping battery fully charged. As specific gravity of electrolyte decreases (result of discharging) freezing will occur at temperatures given below:

Specific gravity	Condition of charge	Freezing point
1.285—1.300	Fully charged	Cannot freeze
1.260	1/4 discharged	15 degrees below zero
1.210	1/2 discharged	45 degrees below zero
1.160	3/4 discharge	0 degrees zero
1.120	7/8 discharge	20 degrees above zero

Neglected Battery

Discharged condition injures battery

60 **If battery is allowed to remain discharged** or if plates are not well covered, the elements become sulphated, and capacity is thereby reduced.

61 Sulphate can sometimes be removed by a prolonged low charging rate, but more frequently the battery is beyond redemption.

The plates should always be well covered and needless discharge prevented.

Symptoms

62 **Symptoms of a discharged or exhausted battery**

1. Car lamps burn dimly.
2. Starting motor refuses to crank engine.
3. Starting motor turns slowly.

4. Lamps burn brightly when first turned on but soon become dim.
5. Specific gravity low.
6. Electric horn less powerful than usual.

Causes

63 Discharged or weak condition of the battery may be attributed to the following:

1. Dynamo not charging battery.
2. Dynamo belt slipping.
3. Wires in contact with frame (short circuit). (Fig. 10; description "104 to 106.")
4. Battery plates not fully covered with electrolyte; defective or leaky cell. (See "55.")
5. Drain on battery due to excessive lamp load. (See "42 and 15.")
6. Excessive use of lamps while engine is not running.
7. Engine not running fast enough to charge at sufficient rate.
8. Incessant use of starter.

When Car is Not in Active Service

64 When car is stored and not in active service one battery wire should be disconnected to minimize the possibility of any drain on battery.

When car is stored

65 The battery should receive a refreshing charge at least once a month. To accomplish this, run the engine at speed equivalent to 12 or 15 miles per hour for 6 or 8 hours. If this is impracticable, battery should be sent to a reliable garage and recharged once a month, and stored in a dry place, protected from cold, until battery is again in active service. Battery at each recharging should be inspected to see that electrolyte fully covers the plates.

Charging battery from

66 The battery can be recharged from a direct current course but make sure that current is direct. Also the VOLTAGE or pressure. This information may be obtained from the electric power or light company.

67 If "direct" current is available, a certain amount of resistance is required in series with the battery, to adjust the charging current. A number of lamps, such as are used for home lighting, may be used as resistance.

Fig. No. 6 shows how such lamps are connected in direct current circuit for battery charging.

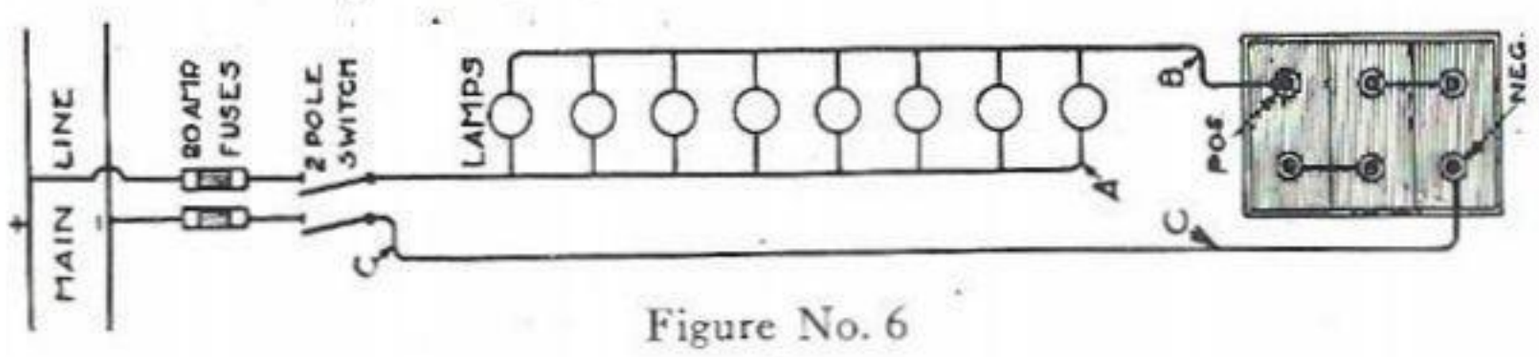


Figure No. 6

68 Connect a wire "A" to one side of these lamps, and to the other side connect another wire "B". Then connect wire "C" to one side of lighting source. When the other end of this third wire "C" is connected to the end of wire "B" the lamps should light. Now determine which is positive (+) and which is negative (—) wire. Disconnect these two wires "C" and "B" which caused lamps to light, and dip the ends in a bowl of water containing a few tablespoonfuls of salt

or 1 tablespoonful of sulphuric acid. Hold the immersed ends about ½ inch apart. The wire from which the bubbles arise is the negative (—) wire. This wire should be connected to the negative battery post marked "Neg." The other wire, which is positive (+) should be connected to the positive battery post marked "Pos" but not until the proper amount of resistance has been determined.

69 If the direct current is 110 volts any of the following lamps can be used as a resistance to permit a current of 4 amperes to flow into the battery to charge it:

8—110 Volts—16 c. p. (50 Watt) Carbon lamps.
4—110 Volts—32 c. p. (100 Watt) Carbon lamps.
16—110 Volts—(25 Watt) Tungsten lamps.
7—110 Volts—(60 Watt) Tungsten lamps.

The charging operation should continue from 20 to 24 hours.

If it is necessary to charge the battery in a shorter time follow directions accompanying battery or obtain said information from battery manufacturers, as per name plate on battery.

70 If the voltage or pressure is 220 volts, use 16 lamps of 16 c. p. 220 volts—or 8 lamps of 32 c. p. 220 volts, and charge from 20 to 24 hours. Recharging should take place once a month when the car is not in use.

When dynamo is disabled, recharge from outside source

71 *If through accident to dynamo it becomes necessary to recharge the battery from outside source*, charging should take place whenever battery becomes weak. (See "66 to 69.")

Defect in Dynamo or Battery

72 When emergencies require temporary correction of troubles, proceed as follows:

If battery fails, how use dynamo for lighting

If battery is defective, short-circuited or is to be removed, disconnect cables from positive (Pos.) and negative (Neg.) terminals and wrap cable ends with insulating tape. All lamps should be turned on to prevent excessive voltage at lamps. Dynamo will then furnish sufficient current to lamps when engine is running at or above 10 miles per hour. (See "13.")

If dynamo fails, use battery for all lighting

73 If dynamo is at fault and its removal becomes necessary, disconnect wires from dynamo terminals "L" and "N" and connect wire ends firmly together. This will complete the battery circuit to lamps when dynamo has been removed. (See wiring diagram, Fig. No. 8.) The joint should be wrapped with tape to avoid contact with other metal.

74 If dynamo is disabled, battery when discharged should be recharged from an outside source. (See "66 to 70.")

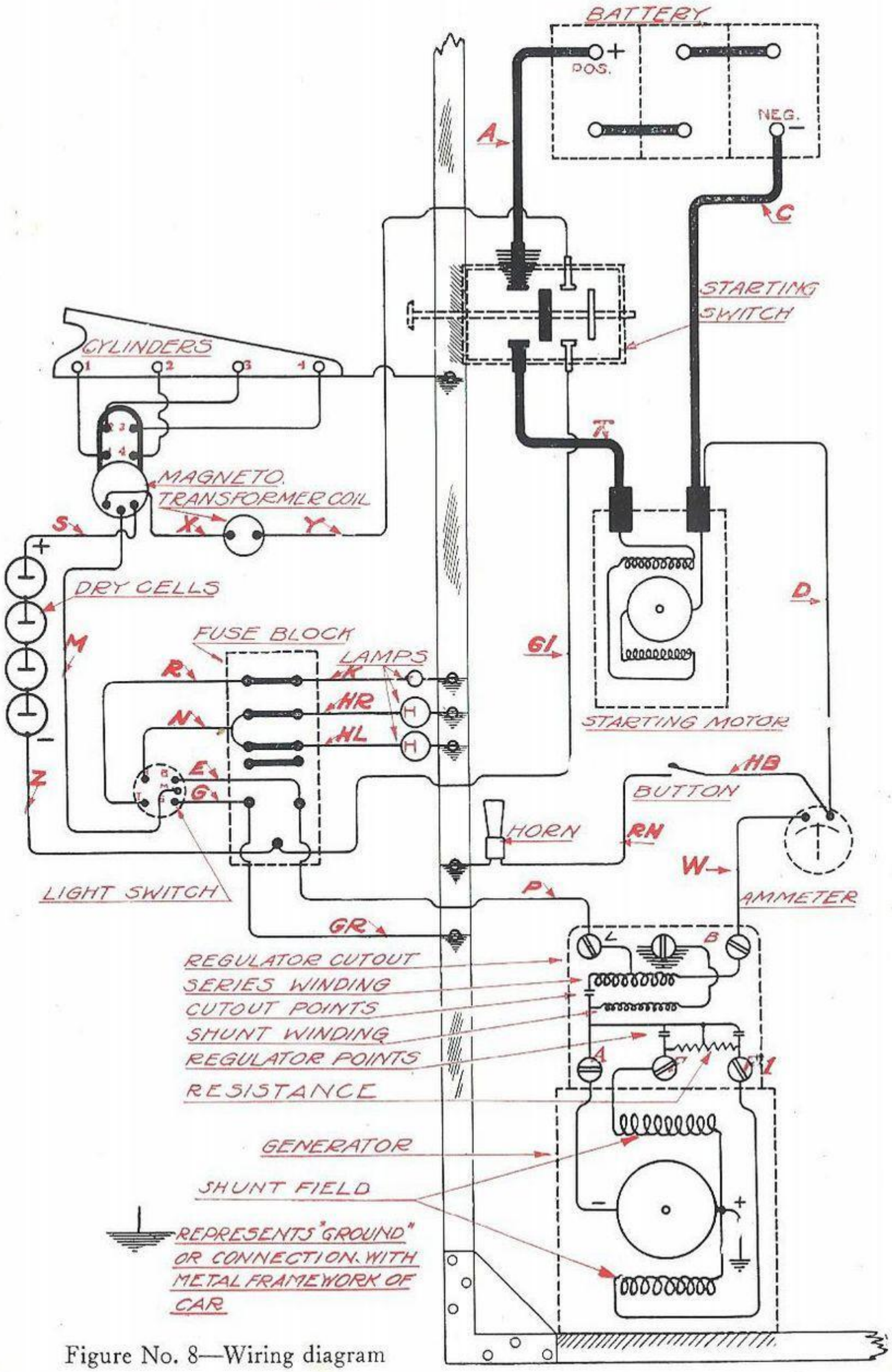


Figure No. 8—Wiring diagram

Ammeter

Purpose

75 The ammeter, an electrical measuring instrument (Fig. No. 7) indicates when the dynamo charges battery, and at what rate. It also indicates the rate of discharge from battery to lamps. It shows whether or not the system is working properly. When battery is neither charging nor discharging, the pointer should indicate "O."

76 If ammeter indicates "Charge" instead of "Discharge" and "Discharge" when it should indicate "Charge" reverse ammeter wires on rear of instrument.

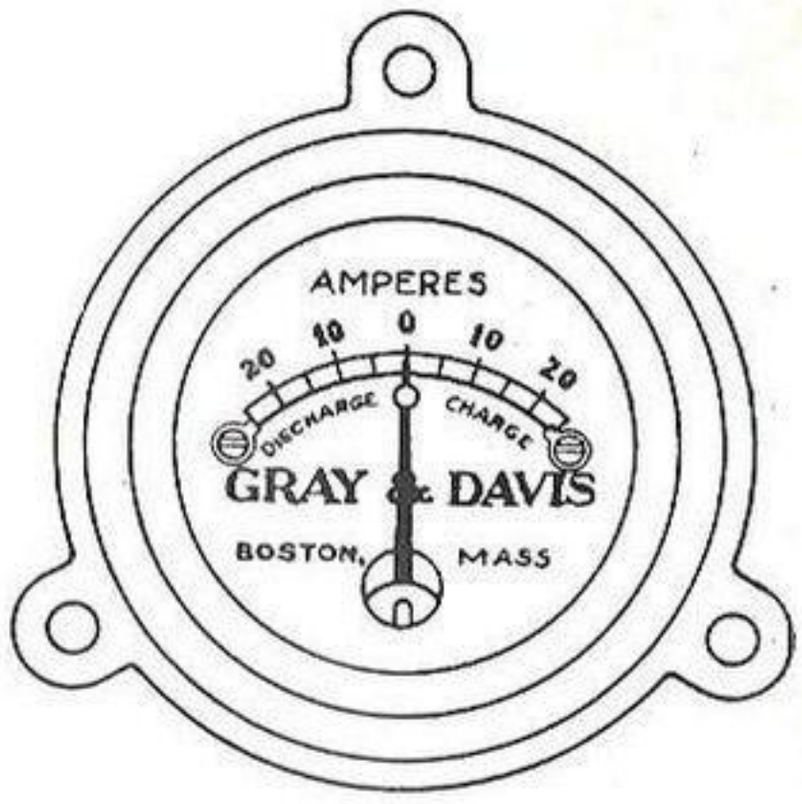


Figure No. 7

Normal Ammeter Readings

Normal readings

77

Car Speed	Lights	Ammeter Readings
12 m.p.h. or over	Off	"Charge" 6 to 9 amp.
12 m.p.h. or over	On	"Charge" ½ to 2½ amp.
At rest	Off	"O"
At rest	On	"Discharge" 5 or 6 amp.

Readings vary

The above is based on lamp equipment of two 15 c. p. 6-volt headlights, and one 2 c. p. rear lamp.

78 "Charge" indications will vary slightly in accordance with the condition of battery, temperature of engine and size and number of lamps used.

79 If pointer is forced to the scale limit on "Discharge" side, it indicates overload or short circuit. (See "104".)

80 If lamps light when turned on and ammeter pointer does not move ammeter is defective.

81 When car runs at 12 miles per hour or over (Lights "off") ammeter should indicate "Charge." If pointer does not move when lamps are turned "on" engine at rest, or when lamps are turned "off" engine up to speed there is an open circuit. (See "111 to 117.")

82 Examination of wires may reveal the difficulty.

1. All terminals should be tight and insulation in good condition.
2. Battery terminals should be firmly connected.
3. Dynamo brushes should slide freely in holders, and make good contact with commutator.

83 Familiarity with the wiring diagram will aid in correcting wiring troubles.

How system is connected

Fig. 8 is a wiring diagram of the starting-lighting system, showing units, wires and cables connected in the proper manner. Connections are as follows:

From battery positive (Pos.) terminal cable "A" connects to grounded starting switch terminal.

From insulated terminal at starting switch cable "T" connects to one motor terminal.

From other motor terminal cable "C" connects to battery negative (Neg.) terminal.

From battery side of starting motor wire "D" connects to left-hand terminal, rear of ammeter.

From dynamo terminal "B" wire "W" connects to other or right-hand ammeter terminal.

From dynamo terminal "L" wire "P" connects to binding post at fuse block. From this post wire "E" connects to "B" lighting switch.

From terminal "T" at lighting switch, wire "R" connects to fuse.

From this fuse wire "K" connects to tail lamp.

From terminal "H" at lighting switch, wire "N" connects to two fuses; from these wires "HL" and "HR" connect to left right-hand lamps respectively.

Battery positive (Pos.) is grounded (connected with metal frames of car) at starting switch grounded terminal.

Dynamo positive (+) is grounded through dynamo frame.

One side of each lamp and horn is "grounded" (connected to frame).

From dry battery and terminal, wire "Z" connects to fuse block binding post, then over wire "G1" to ignition contact at starting switch.

From other ignition contact at starting switch wire "Y" connects to transformer coil. Then, from other terminal of transformer wire "X" connects to magneto battery interrupter terminal and then from other interrupter terminal over wire "S" connects to terminal at other end of dry battery.

Symptoms of Trouble

84 The causes of trouble can be determined by a study of symptoms.

Ammeter does not indicate "charge" engine speed up, but indicates "discharge" when lights are turned on, engine at rest.

Dynamo or regulator not working properly.

Dynamo brushes do not slide freely in holders ("16 and 17").

Dynamo belt too loose to drive dynamo at proper speed ("13 and 18.")

85 **Ammeter does not indicate "charge" engine speeded up, and does not indicate "discharge" lights on, engine at rest.**

Open or loose connection in the battery circuit ("111 to 117").

Battery terminals loose.

Dynamo terminals "B" and "L" loose.

Ammeter may be at fault. (See "80.")

86 **Ammeter indicates "discharge" lights turned off, engine at rest.**

Ameter pointer bent.

Insulation on wires injured, permitted contact with frame, causing short circuit.

87 **Ammeter indicates "charge" engine at rest.**

Ammeter pointer bent.

88 **Ammeter "charge" indications below normal.**

Dynamo belt slipping. (Read note: "Dynamo output varies with condition of battery, 13-15.")

89 **Ammeter "discharge" indications above normal.**

Lamp load excessive.

Lamp wires in contact with frame. (See "106 and 107")

90 **Ammeter pointer jerks intermittently to "discharge" limit of scale while engine is speeding up.**

Short circuit in system. (See "105 to 110.")

91 **Fuses blow out repeatedly.**

Lamp wires in contact with frame. (See "32 to 34.")
(See "107 to 110.")

Lamps defective. Short circuited. Try new bulb.

Engine Cranking Speed Very Low

92 Battery almost discharged. (See "51 to 66.")

Battery sulphated. (See "60 and 61.")
Engine stiff.

93 **Starting motor does not rotate.**

Battery may be discharged. (See "51 to 66.")

94 Starting switch not making good contact. (See "28.")

Motor brush may not make contact with commutator.

Battery terminals may not make good contact.

95 **Starting motor rotates but does not crank engine.**

Roller clutch does not work properly.

Gears not properly meshed.

96 **Starting motor cranks engine a few revolutions and then stops.**

Battery weak—almost discharged. (See "51 to 66.")

97 **Starting motor cranks engine and engine will not pick up under its own power.**

These symptoms indicate that trouble is not in the starting system. Some causes for trouble are given in "27."

98 **Lamps will not light, but starter cranks engine.**

Lamps burned out or filament broken. Try new bulb. System short-circuited.

99 **Lamps seem to burn brightly but fail to illuminate road sufficiently.**

Lamps out of focus.

Rays of light directed too far upwards.

100 **Lamps burn dimly.**

Battery weak—discharged (See "51 to 66.")

Lamps old—blackened. Try new bulbs.

System may be slightly short-circuited. (See "105 to 107.")

Resistance of circuit high, due to loose or dirty connections. (See "Open Circuits, 111 to 112.")

101 **Lamps blackened or burn out quickly.**

Lamps not of the proper voltage. Should be 6-volt lamps.

Dynamo or regulator not working properly.

Lamps defective—poor grade.

102 **Lamps flicker and ammeter unsteady.**

Loose connection in light wires. (See "112").

Loose connection between battery and dynamo. (See "115.")

Loose contact at lamp bulb.

Exposed wire touching frame intermittently, causing short circuit. (See "105.")

103 **Lamps burn very dimly when starting pedal is used.**

Battery very weak, almost discharged. (See "48 to 55.")

Battery injured, due to lack of water. (See "60.")

Battery terminals not rigidly connected.

Test Lamp

We advise the use of a 6-volt test lamp to determine location of trouble in wiring and units. A small bulb such as used for automobile lighting is satisfactory.

A lamp socket and two wires, six or eight feet long, are required.

104 If one test lamp terminal is placed in contact with one battery terminal and other test lamp terminal is in contact with other battery terminal the test lamp should light. If it does not light, an open circuit exists in the wires or bulb of the test lamp itself. Be sure that filament is not broken. It is customary when testing with lamp to touch the conductor leading from source of current frequently to determine if lamp and battery can be depended upon for testing.

Short Circuit

Cause

105 A short circuit is caused by two wires or conductors, one **Positive,** the other **Negative,** coming in actual contact with each other.

106 The positive side of dynamo and battery are permanently connected to "ground" or metal frame of car. The frame, or ground, is therefore **"Positive."** If a wire leading from **Negative** battery terminal, or from **Negative** dynamo terminals, comes in contact with frame or ground which is **Positive,** "short circuit" results.

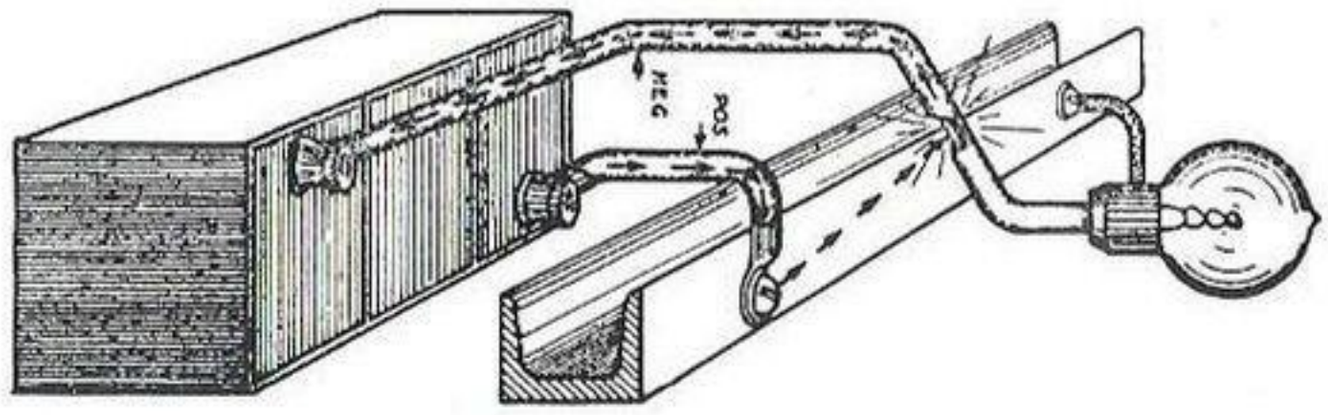


Figure No. 10

107 **A short circuit** discharges the battery, overloads the dynamo, injures ammeter, and robs the lamps of current.

A short circuit is shown in Fig. No. 10. The insulation of the negative wire is injured from contact with sharp edge of frame, permitting the wire to make contact with the frame. The arrows show what happened. The current, instead of passing through the lamps as intended, flowed through the shorter circuit and caused a heavy current to flow, thereby discharging the battery rapidly.

Short Circuit Symptoms

108 Battery will become exhausted, regardless of the charging it receives.

Lamps when turned on will burn dimly.

Ammeter pointer may go to limit of "Discharge" scale.

Starting motor may act sluggishly, or not at all.

Battery will run down (discharge) over night.

Fuses "blow" repeatedly.

109 A short circuit in any lamp circuit will usually cause a fuse to "blow" or melt. If this occurs, it is evident that the wire leading from the fuse is in contact with the "ground" or frame of car, or other metal, or that insulation has been injured and conductor is in contact with other metal, thereby grounding it to frame. The wire must be inspected along its entire length until trouble has been located and corrected.

110 Wire having injured insulation should be wrapped with friction tape to prevent contact with frame or other conductive material.

Open Circuit

111 An open circuit is an incomplete circuit. Therefore, it does not offer a passage for current.

Open Circuit Symptoms

Ammeter does not indicate either "Charge" or "Discharge." Lamps do not light when turned on.

Starting motor does not crank engine when starting pedal is pressed to the full limit of its travel.

112 Open circuits, like grounded or short circuits, may frequently be located by examinations of all wires and terminals. Loose screws and nuts, poorly soldered and insecure wires, corroded connections and terminals are likely to be the cause of open circuit. Go over the wiring carefully before making tests.

113 Wires and terminals should make good contact.

The parts making contact should be clean.

114 If ammeter does not indicate "Charge" when engine is speeded up, or does not indicate "Discharge" with lamps turned on, engine at rest, an open circuit exists between dynamo and battery. Refer to "47 to 55" to determine if battery is discharged.

115 If any one lamp fails to light, it indicates open circuit in that line. "Blown" fuses, broken lamp filament, or broken lamp wire may be responsible.

116 If all lamps fail to light when engine and dynamo are speeded up, the open circuit is most likely located between battery and dynamo, or between dynamo and lighting switch.

117 The "blowing" or melting of a fuse opens the circuit and disconnects from system the short-circuited wire which causes fuse to blow. If trouble is not located, the test lamp can be used in making tests for short circuit as per "104 to 110" and for open circuit as follows:

Emergency

If, because of accident to system, it becomes necessary to have at least one lamp in service, the following will aid in providing an emergency equipment.

Take an insulated wire No. 12 or No. 14 of sufficient length to reach from battery to the furthermost lamp on the car. This wire should have a connector at one end to fit the lamp socket.

Current for this lamp can be secured from either battery or dynamo.

118 Attach other ends of emergency cable to battery negative (Neg.) terminals, also connect a wire from battery positive (Pos.) to the frame of the car. If lamp does not light, battery is discharged, or the system is short circuited, in which case the dynamo can be used to supply current. Disconnect emergency wires from battery.

Disconnect wires from dynamo terminals "B" and "L."

Connect end of emergency cable to dynamo terminal "A." Dynamo is then connected to supply current to the one lamp when engine is running at or above 10 miles per hour.

119 If system shows symptoms of short circuit, disconnect cable "C" from battery to prevent further discharge.

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