INSTRUCTIONS
for
OPERATING & MAINTAINING
O-36 MODELS
OWEN MAGNETIC MOTOR CARS

THE BAKER R & L CO.
CLEVELAND

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THE instructions contained in this book pertain to O-36 chassis models. No attempt has been made to give an exhaustive technical description of the Owen Magnetic chassis but rather information which the average user can easily understand. Accompanying this instruction book are separate pamphlets treating in greater detail the starting battery, carburetor, vacuum tank and ignition system.

The Baker R&L Company
-- Cleveland --

THE DOYLE & WALTZ PRINTING CO., CLEVELAND

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PREFACE

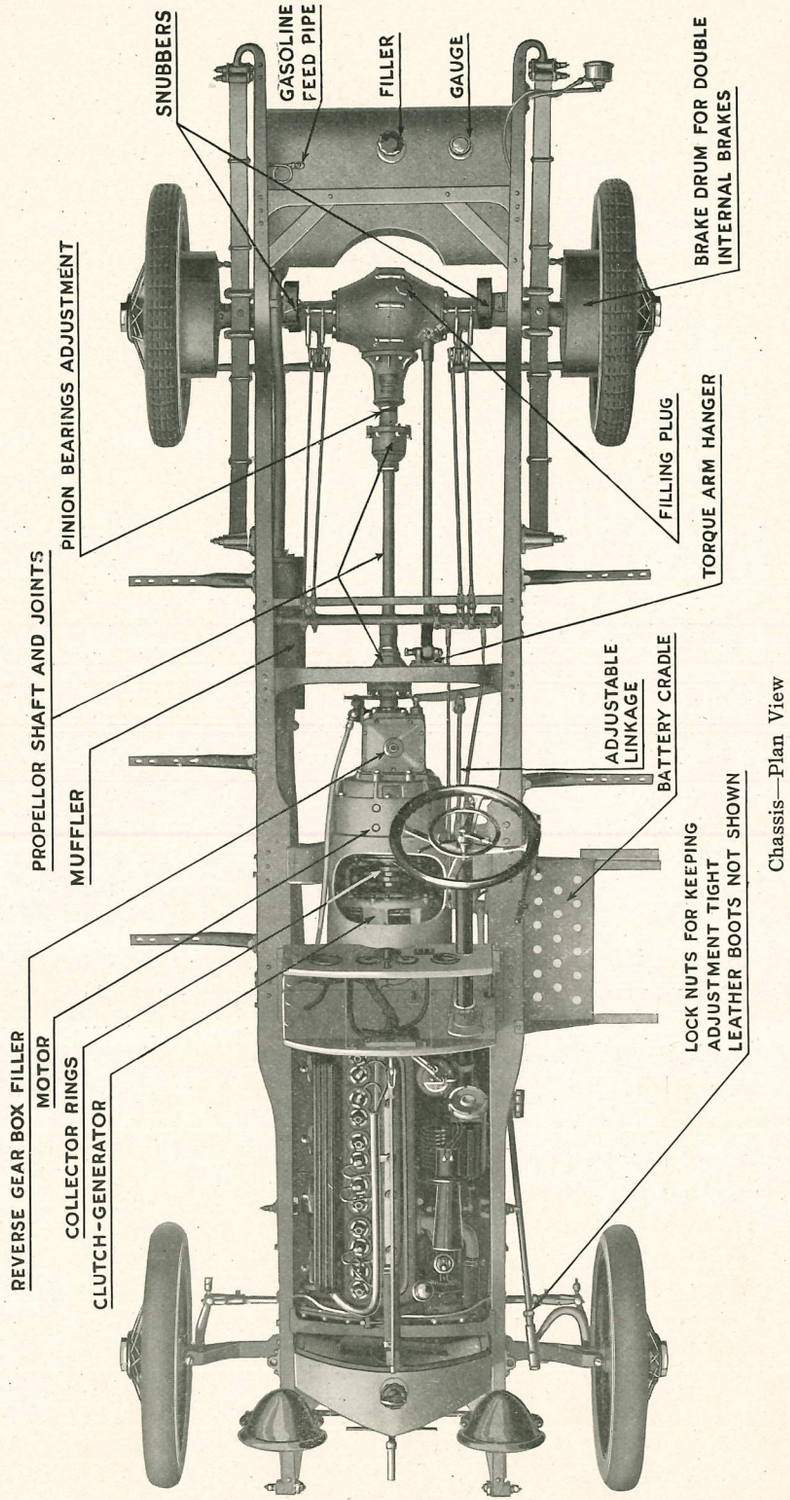
TOO little attention is given by the average user to the care and maintenance of his car, although convenience and comfort in driving, with reasonable operating and maintenance expense are features appealing to every one. These features are easily maintained when Owen Magnetic cars are given proper care and attention.

Every car should be thoroughly looked over at least once a year, and if given hard service, twice a year is none too often to have it thoroughly inspected, lubricated and adjusted.

The person in charge of the car should examine it carefully at regular intervals or after each long run. If in continuous use a casual inspection every day or two is advisable to see that it is in proper condition.

The care and maintenance of an Owen Magnetic car is similar to that required for any well built six cylinder car with the exception of the electric transmission and controller. These parts require less attention than the conventional parts they replace.

It is suggested that the person having charge of the car become familiar with the Repair Parts Book, as much of the construction is thus shown in greater detail than is incorporated in these instructions.



Chassis—Plan View

Operation

COMPARISON WITH CONVENTIONAL CONSTRUCTION

IN presenting the following instructions for operating the Owen Magnetic, it may be helpful to those who are familiar with changing speeds in the conventional gasoline car to note that the changes in speed obtained by a simple movement of the control lever through the six running positions are closely comparable to those obtained by an imaginary gear transmission, in which it is possible to move the gear hand lever freely back and forth through six speed ratios *without disengaging the clutch.*

Such action is impossible to attain in any gear transmission as, aside from the difficulties in engaging gears, it would necessitate slipping the clutch, thus producing energy in the form of heat which would be wasted.

Such action is possible in this form of electric transmission as the slipping of the magnetic clutch or generator is always under control and the energy developed by this slippage is in the form of electric current which is used in propelling the car.

In addition the electric transmission also performs other useful functions such as starting the engine, charging the starting and lighting battery and acting as an electric brake.

PREPARATION

The first requisite is to see that the car is equipped for its work. Fill the tank with gasoline, the radiator with clean water, the engine with oil, taking care to fill it up to the high level mark indicated on the gauge, see that the storage battery is properly flushed, that the pet cock between the vacuum tank and the carburetor is fully open, the tires properly inflated, and that the car has a driving license.

TO START THE ENGINE

Place the spark lever about three inches from the lowest position. Place the throttle lever about an inch and a half from the lowest position. If the engine is cold turn the lever on the air control on side of steering mast toward yourself. (*See that the gear hand lever is in the extreme rear notch for forward car motion.*) Driving members are then properly meshed. See that the emergency brake lever is set. Unlock starting switch putting it into starting position. Release small thumb catch on control lever, moving lever up-

ward to starting position marked "S." Current from starting battery now causes the engine to revolve and the engine should start running under its own power immediately. As soon as engine starts on its own power bring control level to neutral position marked "N." Under all ordinary conditions the engine starts very readily if the above instructions have been followed. If the engine does not start readily try again slightly changing adjustment of air control.

TO START THE CAR

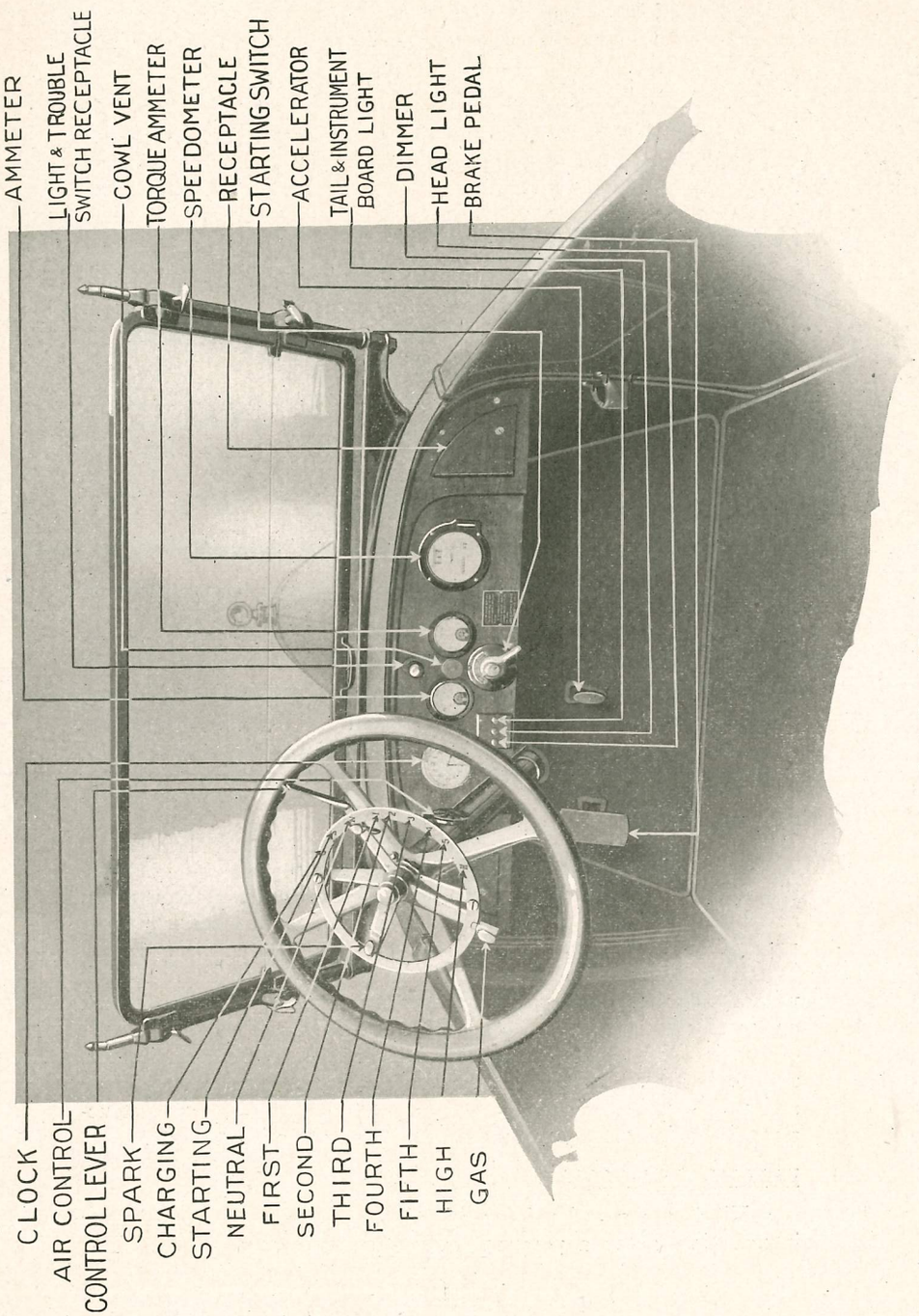
With the engine running and warming up move the air control lever forward, move the throttle lever down against stop and advance spark lever to horizontal position. Engine should now be idling slowly. Fully release the emergency brake lever and bring control lever into first position. Gently press the accelerator pedal to increase the flow of gas to the engine, as the engine speed increases car will slowly move forward. With the car under way and the engine speed increasing the control lever at once may be brought down through the various speed positions. Just prior to passing from fifth to high position release for an instant the pressure on the accelerator pedal. This momentary release is very important as it improves the smoothness of operation.

RUNNING POSITIONS

With the control lever in high position the speed of the car, from barely moving to its maximum speed is governed by the speed of the engine controlled by the accelerator pedal in the usual manner. This is the ordinary running position giving maximum car speed when required.

Maximum car torque or pulling power is developed on first speed position when the engine is running at its highest speed. Between the first and high speed positions are intermediate speed positions, each permitting a range of car speeds by use of the accelerator pedal. Use the control lever position for running, which permits the desired car speed with the slowest efficient engine speed.

If running on high and engine begins to labor on a hill or heavy road, more pulling power is required and it is only necessary to move control lever temporarily into one of the lower speed positions which best suits the conditions, being careful not to allow the engine speed to slow down to a point where it does not develop its greatest power before the change is made. A little practice enables the operator to



determine what combination of control lever position and engine speed is best for each road condition encountered, using high position as much as possible.

After a little experience the operator will be able to keep control lever in high and by releasing accelerator check car to practically a standstill with the brake and accelerate car speed by using accelerator pedal only.

SPARK LEVER HANDLING

For ordinary high speed running, the spark lever may be advanced from the horizontal position midway to extreme point of travel and for high engine speeds may be still further advanced. If engine speed slows down, as may be the case with car ascending a hill, too great an advance will cause the engine to knock and the spark should be retarded until engine runs smoothly. Never allow engine to run for any length of time with spark retarded below the horizontal position as such practice needlessly wastes fuel and heats the engine.

TO STOP CAR AND ENGINE

Remove pressure from accelerator pedal, place control lever in neutral position, press the foot brake pedal and the car will come to a stop. The engine will continue to run until the starting switch is turned to off position. Set emergency brake. Note that stopping car without placing control lever in neutral will cause engine to stall and the result is equivalent to stopping a conventional type of car with gear and clutch engaged.

TO REVERSE

Have car stationary with control lever in neutral. Depress thumb button on reverse lever and push forward to the extreme notch at which point gears are meshed and in position for the car to be reversed. Be sure lever enters this notch on quadrant allowing thumb button to spring back into place. If the gears are not easily meshed with the engine running control lever should be brought to the first or second position for an instant and then back into neutral. If the engine is not running bring control lever into high for an instant, then to neutral. The engaging parts are thus caused to rotate slightly and engage easily. As soon as the gears are meshed the same instructions for driving the car forward apply to reversing the car.

EMERGENCY GEAR

When the gear hand lever is placed in the central position or intermediate notch a powerful emergency gear will be had. The

pulling power of the car is thus doubled for forward movement. While this is seldom necessary there may be a possibility of encountering a driving condition where only an additional reduction or a tow line could produce results. This emergency gear is not a necessity but an insurance.

ELECTRIC BRAKE

When the car is traveling rapidly and the driver is *obliged* to slow down suddenly he may move the control lever from high to neutral, releasing the pressure on the accelerator pedal, bringing into action a powerful electric brake which retards the car to approximately fifteen miles per hour. This brake is too abrupt for ordinary use at high speed, and should not be applied when car is moving faster than 35 miles per hour. It is best adapted for easing a car down long hills where foot and hand operated brakes are tiresome to apply and become heated. It is operative only at speeds approximately above fifteen miles per hour. To release the electric brake bring control lever quickly out of neutral.

EMERGENCY STOPS

Should it become necessary to make a quick stop, push the control lever to neutral. Press down on the foot brake pedal and draw back on the emergency brake lever. The car should not be stopped suddenly except in an emergency as such stopping is extremely hard on the tires and strains the entire mechanism.

COASTING

To coast down a grade keep the control lever in high and release the pressure on the accelerator pedal. This allows the engine to idle and as car is running faster than engine, the magnetic clutch is inoperative and engine is completely declutched. To go down hill at a slower speed, change control lever from high to neutral and the electric brake is applied. Note: If engine should become stalled it is necessary to put control lever in starting position. Car movement will not spin engine.

Be careful to check speed of the car to almost a standstill in such cases, otherwise the sudden starting of the engine with car coasting rapidly, subjects the car to severe strains.

When car is coasting, and is to be picked up by the engine, accelerate engine speed smoothly. A quick opening of the throttle may cause the magnetic clutch to be too abrupt and jerk the car.

INSTRUMENTS

The electrical instruments on the instrument board are a battery ammeter and a torque ammeter. The one located next to the driver is the battery ammeter, which shows the rate at which the current is put into or taken from the battery, the indicating hand reading to the left for charging and to the right for discharging. On the right is the torque ammeter which gives the engine torque or pull in amperes, the indicating hand reading either to the right or left.

CHARGING BATTERIES WHILE RUNNING

The battery is charged while the car is running, only when the control lever is in high position and the starting switch in starting position. This is correct for ordinary operation and where current is frequently taken from the battery for starting and lights. For daylight touring with infrequent stops battery wear may be decreased and danger of overcharging eliminated by turning starting switch to neutral position, battery charging ceasing. It is never necessary to burn lights to reduce battery temperature. The amount of running time on high speed position necessary for charging depends principally on the car speed, condition of battery and amount of current used for lights and starting. The Willard Bulletin tells how to test the battery for temperature and fully charged condition. If car is used for similar service day after day, an occasional test will determine how much charging is necessary. When running on high below approximately fifteen miles per hour place starting switch in neutral position as otherwise battery will have a tendency to discharge as ammeter clearly indicates. This discharge does not harm battery if sufficient current remains in battery for starting and lights.

TO GIVE THE BATTERY A BOOSTING CHARGE

Should the battery ever become discharged to a point where it will not spin the engine, the engine may be cranked by hand. Place the control lever in the emergency charging position marked C and regulate the speed of the engine by the hand throttle lever on the steering wheel, maintaining the desired charging rate, which is indicated by the battery ammeter. This rate should not be more than 25 amperes and should not be maintained more than ten minutes. The battery will receive sufficient boosting charge in this way to crank the engine and light the lamps. The battery will receive additional automatic charging as the car is driven as explained in the above paragraph.

A lesser rate of boosting charge is permissible if it is desired to more fully charge the battery without running the car and a lower rate may be safely maintained for a longer period. The governing feature is to be careful and not to boost at such a rate and for such a period of time as will raise the temperature of the battery above 100 degrees Fahrenheit. This is more fully explained in the Willard Bulletin.

Such boosting is seldom necessary if the car is driven at customary speeds and battery is in good condition. Facilities for such boosting charges are provided for emergencies and constitute one of the exclusive features in this system of transmission. It obviates the necessity of removing battery from the car in order to have it occasionally charged at a service station as is sometimes necessary with the ordinary starting and lighting systems employed.

CAUTION

The lights should not be turned on when the battery is being boosted.

BATTERY

SE-576-148 TYPE

The Willard battery of 12 cells is carried on the left hand side in the running board. Here it is easily accessible for filling with distilled water, temperature and gravity tests. The battery should be carefully cared for as per instructions outlined in the Willard Bulletin No. 40-H.

SPEEDING

Great care should be exercised by the beginners in driving the Owen Magnetic, on account of its smooth gliding qualities. Forty miles an hour with this system of transmission feels more like twenty-five with the conventional type and unless the beginner carefully watches the speedometer until he becomes familiar with this new sensation he is liable to break the speed laws.

The driver should also clearly appreciate that the engine can never *retard* the car movement. Safety requires familiarity with this free coasting feature.

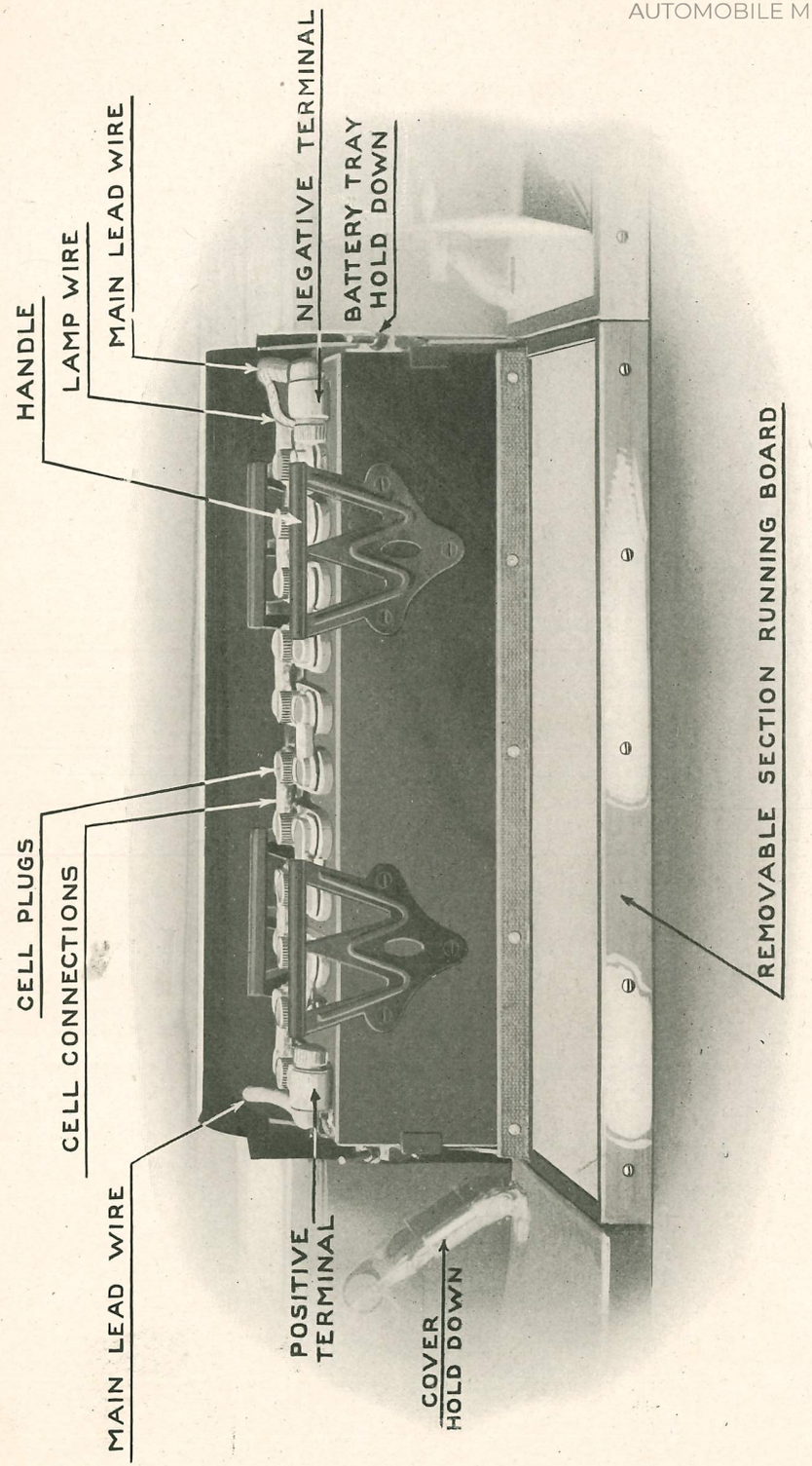
CAUTIONS IN OPERATING CONTROL LEVER

The control lever may be moved freely through all speed positions at any engine or car speed but the following precautions should always be observed to attain the smoothest operation and avoid excessive wear of the controller contacts.

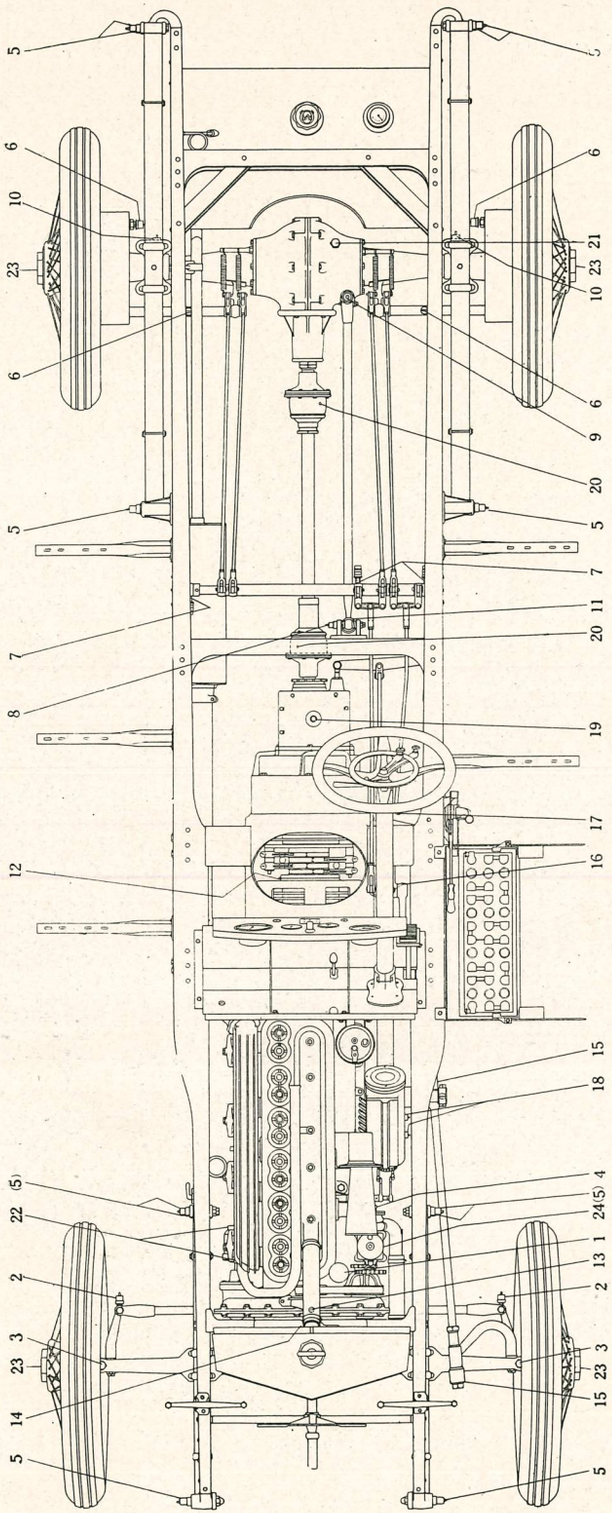
(1) Never stop control lever midway between speed positions. These are established by small stops inside the controller which correspond with the positions marked on the control lever dial.

(2) Never move control lever from fifth to high position without momentarily releasing pressure on accelerator pedal.

(3) Moving control lever out of neutral position with car running over fifteen miles per hour releases the electric brake. Always make this release quickly as moving control lever slowly back and forth between neutral and first speed position with car coasting rapidly may in a short time ruin the particular controller contacts engaged.



Starting and Lighting Battery



Lubrication Chart

Lubrication

NO particular skill or training is necessary to maintain a car economically, but rather a systematic and conscientious care and inspection particularly in regard to lubrication.

A Lubrication chart illustrates the principal points which should be given attention, together with general advices as to the frequency of lubrication desirable. This chart is placed near the first of the book as it is *IMPORTANT*. Other mention of lubrication is made in the explanations of various constructions following:

It is difficult to outline all the different lubricants which give satisfactory results at the many different wearing points, and under various climatic conditions. As a general guide it is believed the following grades or their equivalents present a fair outline of the lubricants required.

These should be applied approximately as follows: The numbers on the lubrication chart will assist in locating the points to be lubricated as detailed above.

Lubrication Chart Data

Chart No.	*Part*	*Grade Lubricant*
1	Engine Crank Case Filler. Fill until gauge registers *Full* as often as necessary. See further instructions under *engine lubrication.*	Monogram Engine Oil (Medium)

Once a week for average service or twice a week if car is driven hard give the following grease cups two or three turns. Keep cups well filled with KOO Non-Fluid Oil. Apply oil can to oil holes and small connections not marked on chart, using engine oil.

Note—when KOO Non-Fluid Oil is too thin owing to hot weather or climate conditions No. 53 Gredag may be used for grease cups.

Chart No.	*Grease Cup Location*	*No. Cups*
2	Steering Cross Tie Rod Pins	2
3	Steering Knuckle Bolts	2
5	Front and Rear Spring Shackle Bolts	12
6	Brake Shoe Anchor Pins and Cam Shafts	4
7	Brake Countershaft	3
8	Torque Arm Hanger Bolt	1
9	Torque Arm Rear Anchor Pin	1
10	Rear Axle Spring Seats	2
13	Fan Bearing	1
14	Engine Front Support	1
16	Foot Brake Pedal Bearing	1
17	Hand Lever Assembly Bearing	1
18	Steering Gear Housing and Bearing	2

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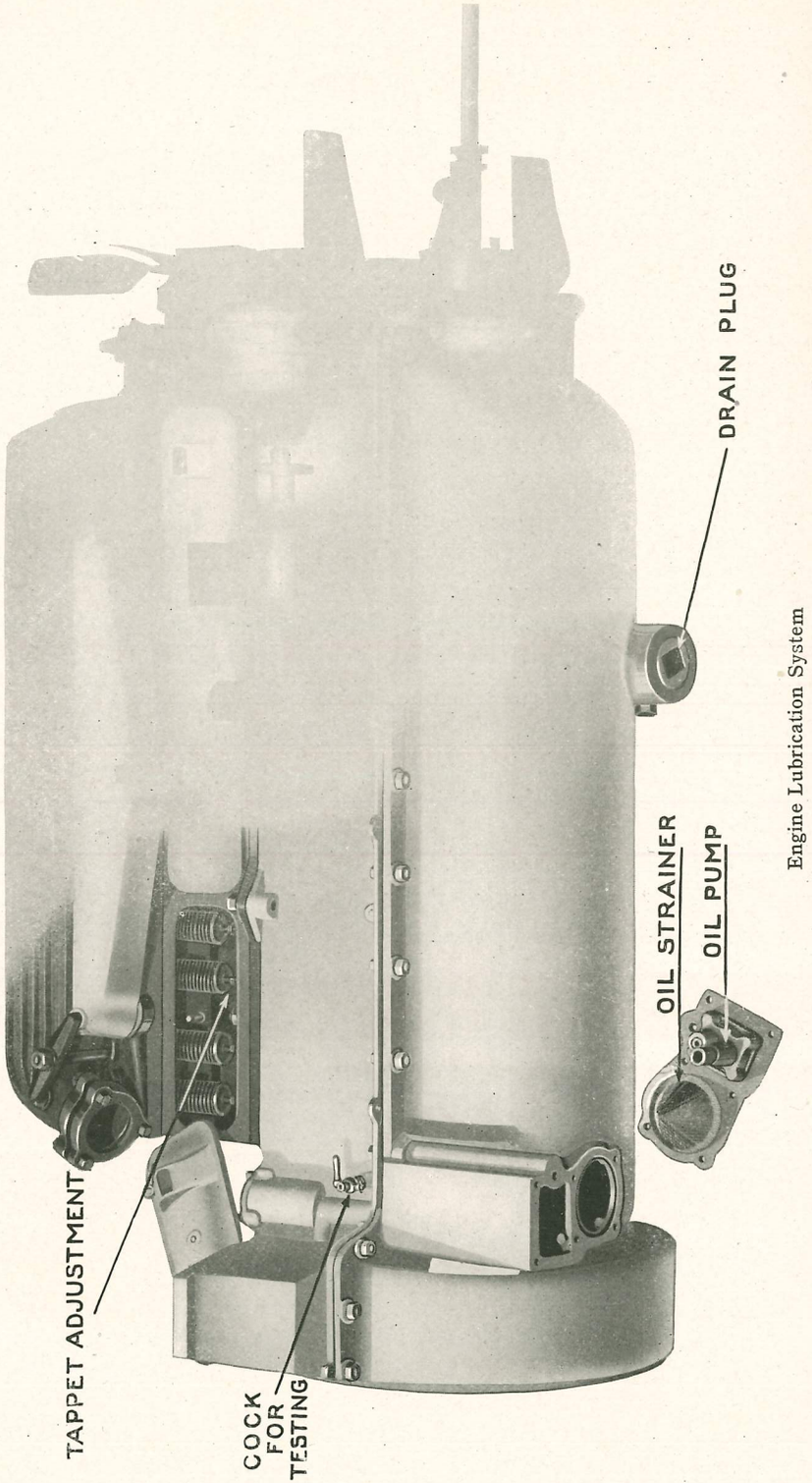
4 Water Pump Bearings—Use No. 3 Albany Grease. Keep rear bronze cap packed (some cars of this series have grease cup also on front bearing).

Chart No.	*Part*	*Grade Lubricant*
	Every month examine and when necessary replenish the lubricant.	
19	Reverse Gear Set. Maintain approximately one-third full.	Tulc. No. 2 V.
20	Propeller Shaft Universal Joints. Inject grease in both joints to keep full.	No. 53 Gredag.
21	Rear Axle Housing. Maintain approximately one-fourth full.	600 W. Vacuum Cylinder Oil
	Every three months replenish lubricant.	
15	Drag Rod—Fore and Aft. Repack joints at both ends, covered with leather boots.	No. 53 Gredag.
11	Torque Arm Hanger. Repack, covered with leather boot.	No. 53 Gredag.
23	Front and Rear Wheel Bearings. Repack, noting instructions for adjustment.	KOO Non-Fluid Oil.
12	Electric Transmission Center Bearing. Remove plug and apply ten drops from oil can.	Monogram Engine Oil (Medium).
22	Magneto. Apply two or three drops —do not use engine oil.	3 in 1 Oil.
	Once a season.	
24	Air Pump. Remove plug and inject grease to fill one quarter full.	KOO Non-Fluid Oil.



Engine Lubrication System

ENGINE LUBRICATION SYSTEM

Lubrication is by means of the splash feed system. Oil is admitted to the crank case through the capped breather pipe, at the forward left-hand side of the engine. On the same side of the engine is located the oil gauge, operated by a float from the oil reservoir. Markings on this gauge indicate the high and low levels. Oil should be replenished when the gauge indicates one-fourth full. It is dangerous to operate the engine with the oil below low level mark. Care should be taken not to fill above high level mark.

A metal oil catch pan is provided, with a trough for each connecting rod. Scoops attached to the connecting rods take oil from these troughs, splashing it against the exposed interior parts of the engine, and by means of oil catch pockets and ducts the oil is conducted to all of the engine bearings. Any surplus of oil not caught in the oil troughs flows downward into the oil reservoir.

To insure the oil troughs being constantly filled, a small gear pump, operated by a vertical shaft from the cam shaft and located at the rear right-hand lower corner of the engine, draws oil from the reservoir through an oil strainer and discharges it through a tube with tap holes opposite each of the oil troughs.

This system of lubrication provides a constant level of oil in the oil troughs, and permits copious lubrication of all engine bearing parts under all conditions of service. The oil strainer catches and holds all foreign substances which might reach the interior of the engine, and insures the pump delivering a clean bath of lubricating oil.

A pet cock is provided on the pump well and by opening this pet cock oil will be discharged if the pump is operating. This should be occasionally tested.

CLEANING ENGINE LUBRICATION SYSTEM

When a car is new the oil should be drained once or twice during the first 1,000 miles. This is done by removing plug provided in the bottom of the crank case.

It is advisable to remove and clean the oil strainer, as particles of sand or other foreign substance may be detached from the interior of the engine, and must not be allowed to remain in the oil circulating system as the grit would rapidly cause the bearings, pistons, cylinders and similar vital parts to cut and wear.

After the car has been operated a few hundred miles the oiling system should be trouble-proof, beyond a thorough cleaning every 1,500 to 2,000 miles. After draining out the burnt oil it is advisable to inject kerosene through the breather pipe and idle the engine for one or two minutes to clean thoroughly. After the kerosene is drawn fill with fresh oil not over the high level mark indicated by the gauge.

Maintenance

UNTIL the operation of the car is well understood and its parts well worked in, it is advisable to take especially good care in its maintenance.

POWER PLANT

The power plant consists of the six cylinder 3¾″ bore by 5½″ stroke gasoline engine. It includes the lubricating, fuel, cooling, exhaust and ignition systems.

The electric transmission—including clutch, self-starting and lighting and electric braking functions.

The reverse gear set.

Engine

KEEP CLEAN AND ADJUSTED

KEEP the exterior parts cleaned with a soft cloth saturated with gasoline. This will keep the carburetor from clogging and drawing particles of dust and dirt into the cylinders. Do not permit fastenings to loosen. The nuts, bolts or screws holding the cylinders to their base, the inlet exhaust manifolds to the cylinders, the carburetor to the inlet manifold, wire connections in the ignition system, etc., should always be looked over when the engine is inspected. Even a slight loosening may permit a small air leak or interruption of the electric spark.

ADJUSTING VALVE TAPPETS

By removing the plates on the right hand side of the engine the valve tappets and springs are exposed. When the engine is warm the space between the valve tappets and the bottom of the valve stem should be about .003″ for intake valves and .004″ for the exhaust valves. If this clearance is too small the valves will not properly seat, causing pitting and the engine will be very noisy. If the clearance is too large, the tappet will be noisy as the cam drives it against the valve stem in opening the valve. Of the two evils it is better to have too much clearance than too little, but as the parts wear slightly it is desirable to make small adjustments of the tappets from time to time, to keep the valve tappets quiet.

REMOVING THE CARBON

Cleaning the engine of carbon is a necessary part of maintenance if a car gets considerable hard usage. The engine may be kept in better shape if the practice is made of squirting a tablespoonful of kerosene in the priming cocks when the car is put up for the night, and while the engine is hot. The vapor of kerosene is a strong solvent and will go far toward preventing the accumulation of carbon deposits. Too much kerosene is likely to thin out the lubricating oil and cause trouble.

If carbon is formed, something may be accomplished by removing the valve caps and carefully scraping away the carbon with a piece of brass. The heads of the pistons may be so scraped by revolving the crank by hand to bring the pistons to their top positions. Care must be taken not to scratch the valve seats.

Most garages are equipped to remove carbon quicker and more thoroughly than by hand scraping.

If kerosene is carefully used it is not probable, except for very heavy service, that the carbon will have to be removed more than once a season, and may then be included in the general tuning up of the engine.

Excessive amount of carbon in the engine will create pre-ignition and will cause engine to knock and overheat.

GRINDING VALVES

If the valves do not properly seat, the engine will rapidly fall off in power, and it is important the seating of all valves be maintained at all times as nearly perfect as possible. To remove the valves for examination, it is first necessary to unscrew the caps over the valves, taking care that the same cap is eventually screwed back in the opening from which it came. By compressing the valve spring, the small locking key and washer holding the lower end of the spring to the lower end of the valve, may be removed and the valve is then readily lifted out of the engine.

To grind a valve—first clean its seat and the seat in the cylinder carefully with gasoline, block up the opening to the cylinder with a clean cloth, so as to keep out every particle of dust and grit. Place a small smear of valve grinding compound on the valve seat and reinsert the valve. It is better to use a fine rather than a coarse compound, particularly for finishing seats, as a coarse compound will leave coarse scratches on the finished surfaces.

By means of the slot in the head of the valve, and a large screw driver, the valve may be held lightly on its seat, so as not to squeeze out the compound, and rotated slightly forward and backward, as permitted by the motion of the wrist. Occasionally lift the valve and turn it part way around before reseating, so any possible inequalities of the surfaces will be evenly distributed over the entire seat. The object is to get a uniform, even surface.

After grinding for a few minutes, remove and clean with gasoline. If properly ground a light silver line will show all around the valve, but if pits still show, or a part of the valve seat is not surfaced, repeat the operation. Slight pits or inequalities, which permit a small leakage of gas will rapidly increase in size, while a tight seat will require re-lapping comparatively seldom. It is well to examine the valves and if necessary relap every 1,500 to 2,000 miles.

When finished, clean the valve and cylinder very carefully with gasoline. Use great care to clean out all particles of grit. Remove

the cloth and seat the valve with a few drops of oil on its face and on the valve stem. Re-assemble the valve spring, and test the tappet adjustment. Replace the cap over the valve and see that the gasket is clean. After the engine is hot the caps should be again tightened.

RETIMING

If cam shaft, magneto or other parts are removed requiring retiming of the engine this work should be done by a competent repair man. The procedure is identical with that for any six cylinder engine with a Bosch magneto ignition and well understood in any first class garage.

While it is always safest to time an engine by the piston position in the governing cylinder rather than by fly wheel markings, it is necessary in this case, owing to the absence of the fly wheel and the conventional markings.

The piston may be readily determined by removing the valve plug in its cylinders. The firing order of the cylinders will be found on the inlet manifold and is 1-5-3-6-2-4.

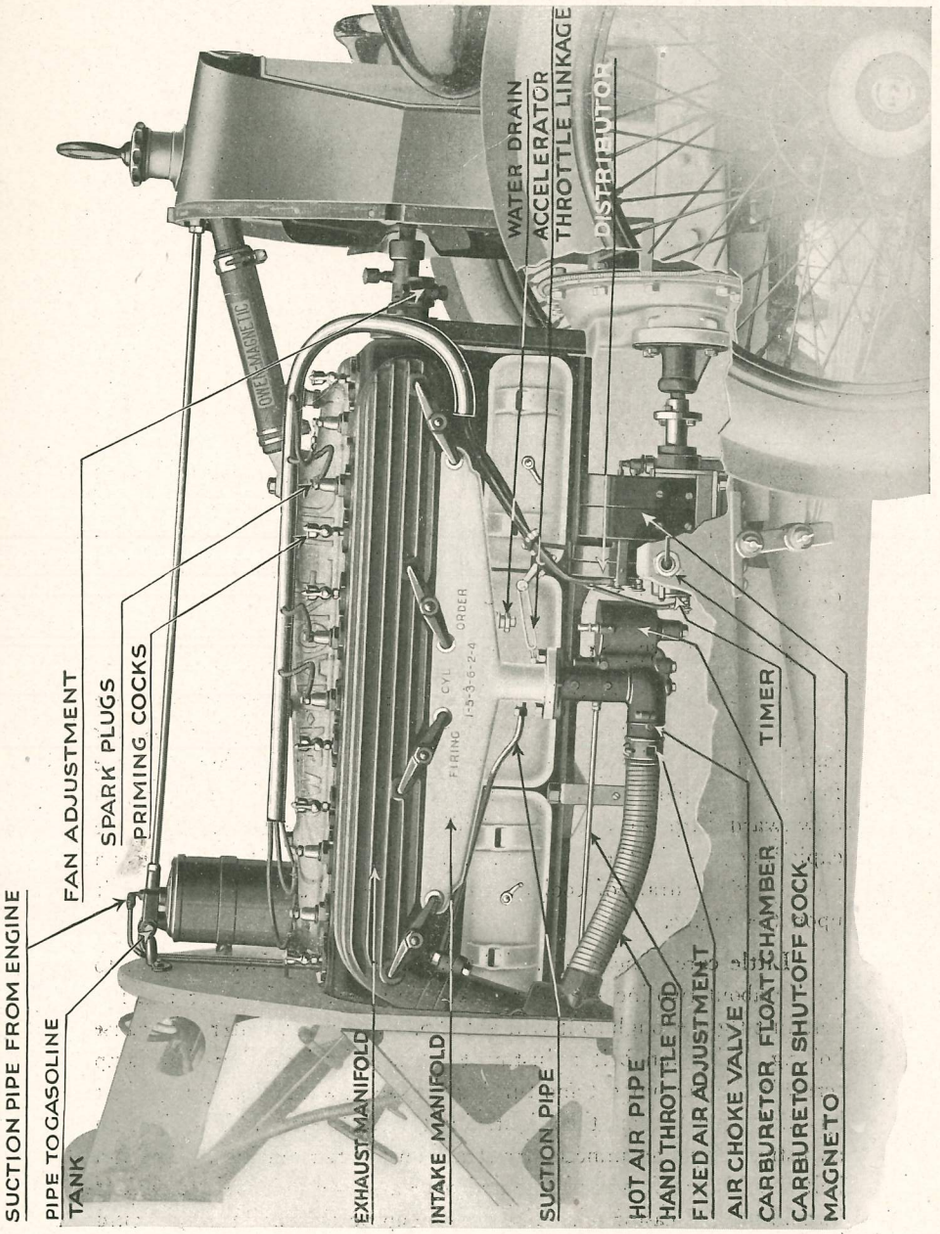
ADJUSTING BEARINGS

Should the engine develop a dull metallic knock most apparent at low speeds with a heavy load as in hill climbing, it is possible the trouble is due to a bearing having become worn and slightly loose on the crank shaft. If the knocking is not eliminated by retarding the spark and making sure the engine is free from carbon the car should be placed in the hands of a competent mechanic for inspection and adjustment of bearings, if necessary.

Many good engines have been harmed by unnecessary and improper adjustment of their bearings and as this work requires a certain amount of skill and experience it is always safer, and often cheaper, to have such troubles corrected in a first-class garage rather than by an amateur. For this reason detail instructions for adjusting bearings are omitted as any person competent to do such work needs none.

LUBRICATION

The lubrication system automatically supplies the proper amount of oil to the different parts of the engine and is treated in detail under the general caption of lubrication.



Engine—Right Hand Side

FUEL SYSTEM

The fuel system consists of the gasoline tank, piping, vacuum tank, carburetor and intake manifold.

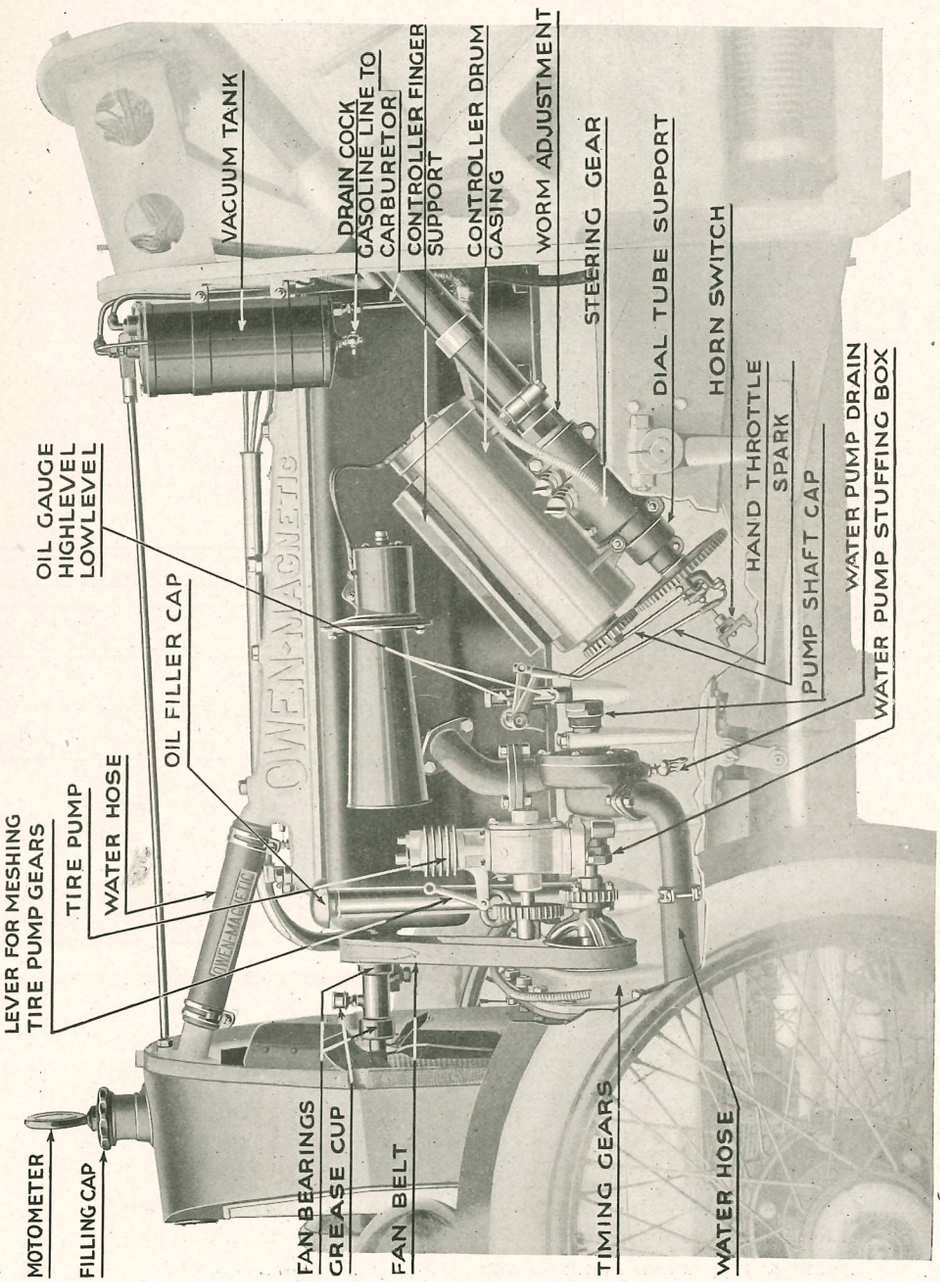
A shut-off cock with an extended handle reaching through the right-hand side member of the frame and located opposite the engine provides a means of shutting off the gasoline supply to the carburetor without lifting the engine hood.

Where possible, gasoline should be strained through a chamois to remove any danger of water entering the tank. A sediment pocket and plug for draining is provided on the bottom of the gasoline tank and a pet cock on bottom of vacuum tank. If gasoline does not flow when cock is open, insert wire to be sure pet cock is not clogged. Drawing off a little gasoline occasionally from these points tends to remove any water and sediment which might accumulate. A small strainer at top of vacuum tank at the end of pipe line from main tank and another strainer on the inlet on the carburetor, catches foreign matter and may become clogged. These should be examined if gasoline fails to reach the carburetor. Additional instructions are included in the comprehensive hand books issued by the manufacturers of the Vacuum Tank and the Carburetor.

COOLING SYSTEM

The cooling system consists of a centrifugal water pump on the left-hand side of the engine, radiator and connecting rubber hose for insuring a circulation of water around the cylinder chambers, and the fan. This rapidly moving volume of water, air cooled as it passes downward through the radiator, dissipates the heat caused by the exploding gases in the cylinders. This cooling is assisted by the fan increasing the draft of cool air through the radiator and blowing it upon the engine.

Little care is necessary. The radiator should always be full to within about two inches under neck, using clean fresh water and fan belt just tight enough so it will not slip. Too much water will cause boiling. The fan belt adjustment is made by loosening the clamp screw in the fan support and turning the fan upward slightly until belt has the proper tension, then tightening the clamp screw. Too tight an adjustment puts an unnecessary strain on the fan bearings. The fan belt should be soft and pliable and once a season it is well to soak it in cold pressed castor oil. The grease cup on the fan bearing should be turned down one or two turns every day or so.



Engine—Left Hand Side

The single stuffing box just ahead of the circulating pump is packed with prepared wicking. If a leakage develops, the bronze nut should be tightened slightly. Too much tightening will cause binding and wear. When worn out this wicking is readily renewed by removing the packing nut.

The motometer in radiator cap registers any undue heating should it ever occur. If water boils and steams, the car is probably being driven with spark too far retarded or the fan belt slipping, assuming the water passages to be unobstructed by worn-out connections or foreign substances. Occasional overheating to the boiling point under severe sustained load conditions should not cause alarm.

CLEANING COOLING SYSTEM

Drain cocks are provided in bottom of pump and radiator. As water becomes impure it should be drained and the system refilled with fresh pure water. It is well to occasionally flush the entire system by connecting a garden hose to the upper radiator inlet, and another short piece of hose to the outlet pipe from the cylinders to conduct the water away from the car. When the engine is started the pump will flush the system.

If the car is stored for the winter be sure cooling system is thoroughly drained by removing radiator cap and opening pet cocks on water pump, radiator, and plug or pet cock on bottom of intake manifold.

WINTER USE

With the approaching of cold weather it is advisable to fill the radiator with some good anti-freezing mixture. A very good mixture for this purpose and one easily obtained is a solution of one part alcohol and three parts cold water for ordinary cold climates. The system should be completely drained and cleaned before filling with anti-freezing mixture.

Never allow the cooling water to freeze as freezing may injure the engine and radiator by bursting.

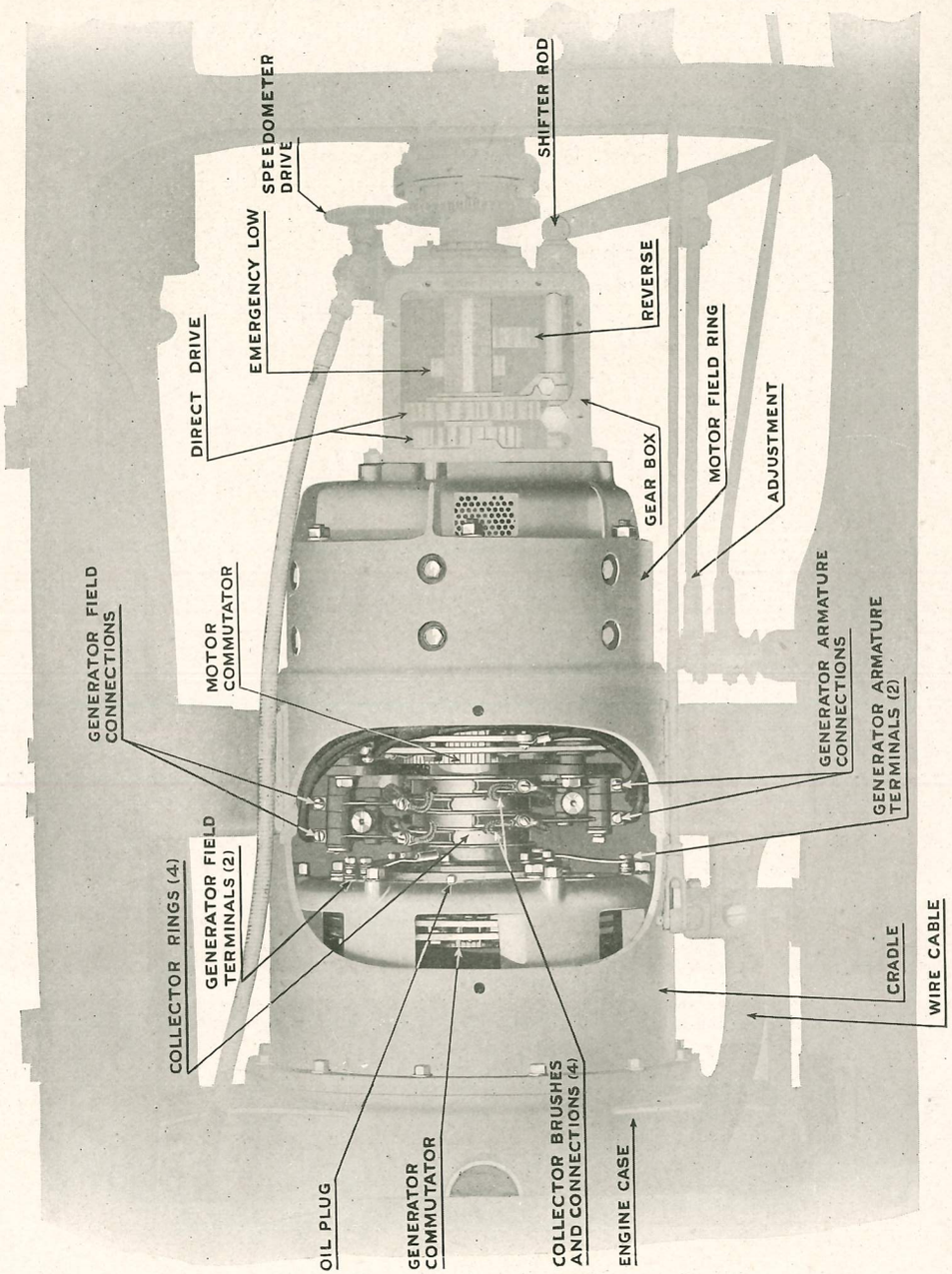
EXHAUST SYSTEM

The exhaust system consisting of the main exhaust pipe, muffler and exhaust tail pipe carries the waste products of combustion away from the engine and muffles the noise of the explosion.

No part of the exhaust system requires any particular care on the part of the driver other than to tighten the joints and attachments should they ever become loose.

IGNITION SYSTEM

The ignition system is independent, and creates the electrical current and distributes it so that the gas in the cylinders will be exploded in the proper firing order and at the proper moment by an electric spark, which jumps across the gap between the points of the spark plugs. Instructions covering the use of DU-6 Bosch Magneto Ignition system are contained in the hand book bearing that title. In removing distributor board, be sure the rotating distributor brush and spring stay in proper position.



Electric Transmission

THE electric transmission is mounted directly back of the engine and is exposed by removing the foot boards under the driver's feet. The easily removed sheet metal cover exposes all the operating parts requiring any attention. The subject is treated in a more technical manner in the "Garage Instructions."

CLUTCH GENERATOR

The transmission consists of two direct current dynamo machines. The forward machine has its field ring attached to the engine crank shaft, taking the place of the ordinary fly-wheel. *This field always revolves at engine speed.* The armature of this machine is mounted on a large hollow shaft which is directly connected to the propeller shaft. This machine is called the clutch generator as it acts both as a clutch and a generator and in the diagrams is marked (G). It is only used as a motor for starting the engine.

MOTOR

The rear dynamo machine has its field stationary at all times as it is attached to the aluminum cradle supported from the frame. Its armature is mounted on the same hollow shaft so that both armatures are connected to the propeller shaft and *always revolve at propeller shaft speed.* This machine is called the motor (M) as it is used mostly as a motor using current produced by the clutch generator to help drive the propeller shaft and boost the effort of the engine power transmitted by magnetic attraction through the clutch generator. On high speed position the motor is used as a generator for charging the battery and on neutral position with the car running over fifteen m.p.h. as a generator acting as an electric brake.

ELECTRIC ACTION

The electric action taking place for each position of the control lever is shown by referring to the diagrams. There is nothing new or strange in these actions as they are the same as those taking place in conventional commercial dynamo machines used the world over. There is no more danger of trouble occurring in this transmission than is possible in any standard electric generator or motor.

DIAGRAMS AND EXPLANATIONS

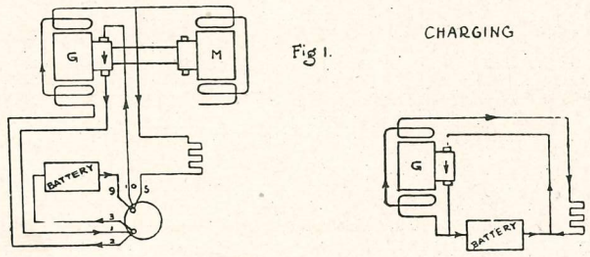


Fig 1.

CHARGING

Fig. 1 shows the electrical connection when control lever is in charging position and used only when desirable to charge the battery at a higher rate than provided when car is running. The motor is inoperative as its circuit is broken and we have at our command a generator driven by a gasoline engine. This is in a way a very useful auxiliary function provided by this transmission system.

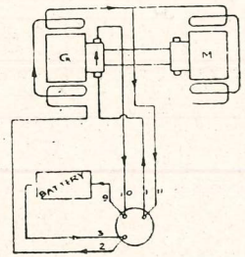


Fig 2.

STARTING ENGINE

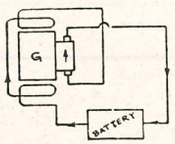


Fig. 2 is the diagram showing the transmission acting as a self starter without any gear connections. When control lever is placed in starting position the electric motor is inoperative but current flows from the starting battery to the clutch generator which for this purpose now acts as a motor. If armature is held stationary owing to the weight of the car and setting of the brake, the generator field ring is free to revolve, spinning the engine. If brake should not be set, car may roll backwards as the current would exert the same effort to revolve the armature backwards as it would to revolve the field forward and spin the engine. For this reason form the habit of starting the engine with the brake *set*.

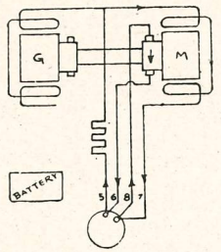


Fig 3

NEUTRAL & ELECTRIC BRAKE

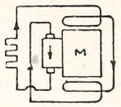


Fig. 3 (A) Control lever on neutral position with car stationary. The clutch generator is inoperative as its circuit is open. The motor is also inoperative as no current can flow to it, the battery being likewise disconnected. The motor circuit remains closed, however, with a resistance coil connected in series.

(B) Control lever in neutral position with car coasting.

There is no change in the electric connections as the control lever is still in neutral position but the reason for leaving the motor circuit, including a resistance coil, intact, is now apparent. The forward movement of the car revolves the motor armature causing the motor to generate a current and act as an electric brake. The braking resistance is not noticeable under a fifteen m.p.h. car speed but for higher speeds its power rapidly increases. At extremely high car speeds the electric brake is too abrupt to use except in an emergency.

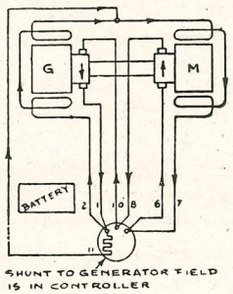


Fig 4

1 ST. SPEED POSITION

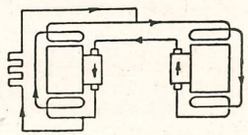


Fig. 4. With control lever in first speed position both clutch generator and motor are transmitting power. Owing to the shunt weakening the generator field the magnetic clutching action is slight and at high engine speeds a heavy slippage current is generated for the motor which consequently transmits the most of the power to propel the car. This permits the greatest difference in speed between the engine and car and the greatest car effort or pull.

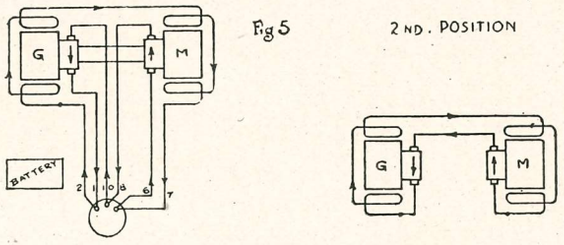


Fig. 5. Second speed position. The connections are the same as in first speed except the shunt or resistance weakening the generator field is eliminated. The magnetic clutching effect and car speed is increased, and with a given power delivered by the engine less slippage current is developed for the motor. Approximately one-half of the engine power is transmitted direct through the magnetic clutch or attraction between the generator field and its armature. The balance of the engine power produces slippage current which the motor applies to the propeller shaft.

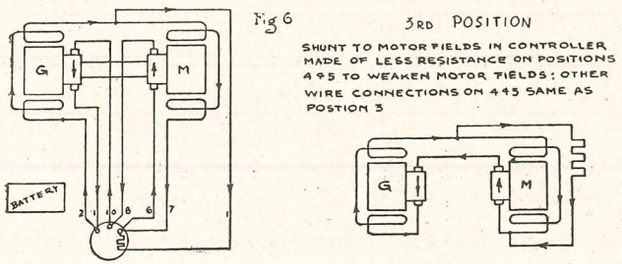


Fig. 6. The connections for third, fourth and fifth speed positions differ from second speed connections only in the use of a shunt to weaken the motor field. The amount of resistance in the shunt is different for each of these positions, the resistance decreasing to give a higher car speed.

The magnetic clutch is tightening up, causing the armature to revolve more nearly at engine speed, the car speed increasing, and the engine transmitting more of its power direct through the magnetic clutch.

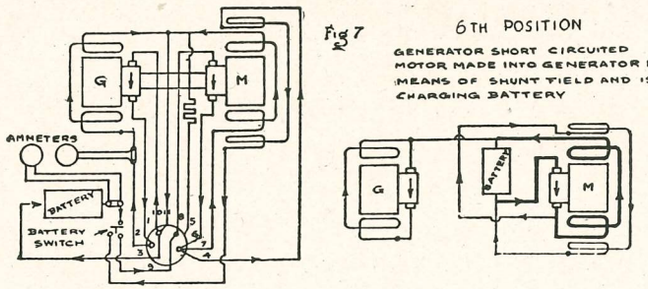


Fig. 7. Control lever in the sixth or high position. The generator now transmits all driving power as its armature is almost magnetically locked to the field revolving with the engine. The motor no longer performs any work in driving the car but now acts as a generator connected to the battery circuit and charges the battery when starting switch is on starting position, and car operating above approximately 15 m.p.h. The motor in this position has a shunt field opposing its series field making the charging rate self-regulating. When starting switch is turned to neutral position, motor circuit is open and motor is inoperative.

While the left hand or battery ammeter and right hand or generator ammeter are shown in this diagram only, they are connected in the same relation in each of the preceding positions.

TRANSMISSION CARE

The electric transmission requires very little care and will continue to operate satisfactorily if the electrical connections, such as brush pigtails, are kept tight and the collector rings, brushes and commutator surfaces clean. With the sheet metal cover removed these points should be carefully looked over each week. It is not probable that any trouble will be found, but it is possible a wire connection might be loosening or collector rings and commutator surfaces not clean. If tightening of connections is done, be conservative in putting strain on the four terminal nuts on end of collector ring spider.

A clean collector ring or commutator has a smooth surface and is free from grease and may be either a bright copper color or attain a darkened tint with service.

No other attention is necessary so long as car performs satisfactorily.

SANDING COLLECTOR RINGS AND COMMUTATORS

Cleaning collector rings, brushes and commutators to ensure freedom from grease or oil is probably all the attention these surfaces will need. It is possible, however, that a roughening or pitting might sometime occur due to arcing, to such an extent it would interfere with the smooth operation of the transmission in one or more of its functions. In such a case a more thorough cleaning is necessary.

Use fine sand paper and finish with a clean soft woolen rag. Apply when surfaces to be cleaned are revolving. To clean collector rings have engine idling slowly. The sand paper may be folded over a piece of wood a little less than the width of one of the copper rings and gently and evenly pressed on the revolving ring, moving from side to side until the ring becomes bright.

To clean commutators have engine stationary and move gear hand lever midway between direct and low emergency notches on its quadrant. Place control lever in high position. Current from the battery will revolve the armature. To reach the generator commutator the piece of wood must be pushed through the most convenient opening in the spider supporting the collector rings. Use wood of such shape and size that sanded surface lays true and flat on commutator and move it in and out on the commutator as the commutator revolves. The motor commutator is cleaned in the same manner except it is more accessible.

If small low spots remain untouched after sanding they will not be detrimental to the action of the car so long as the main surfaces are smooth and true. The purpose of the sanding is to remove slight burrs or roughened points projecting above the surrounding surface.

Never lubricate either commutator or collector ring surfaces as lubrication is an insulator and affects the working of the parts. Occasionally at low engine speed a slight squeak between the collector rings and their brushes is noticeable and the first thought of the novice is to smear the surfaces with vaseline or oil. The result is a jerky action of the car in getting under way as the low pressure current necessary for soft starting is unable to flow through the film of lubricant. The current is baffled until it builds up to a strength where it will flow through the barrier and the car jerks in starting.

BRUSH CARE

The wear on the brushes is negligible and they will not need renewing during the life of the car barring breakage through accident in handling. As a precaution it is well to look at the brush seating when examining the transmission and should it ever be necessary to renew one or more, be sure and use only brushes procured from this company or its agents. The brushes used are carefully tested for their work and any change from the standard adopted is liable to cause trouble.

Examination of the brush mechanism shows the aluminum rings supporting the brushes that are attached by means of studs resting in slots so that by loosening the studs the rings may be rocked. The location established at the factory should never be changed as the correct brush setting has been carefully determined. This precaution is stated to avoid any possibility of some person unfamiliar with the characteristics attempting a change in setting which might be a slight improvement for some functions, thereby spoiling others.

The Reverse Gear Set

THE electric transmission provides six speed ratios between the engine and the propeller shaft of the car. For each of these speeds engine effort or torque is applied directly through the magnetic clutch and as the engine must always revolve in the same direction, a reverse gear is provided between the electrical transmission and the propeller shaft, to permit backward movement of the car.

With the construction employed, the addition of a single part, a low gear on the idler shaft, and slight changes in some of the other parts necessary for reversing, provides an emergency low mechanical gear ratio for forward movement.

The three positions, direct, reverse and emergency low, established by the setting of the gear hand lever to the proper notch in its quadrant, is used in connection with the six speed ratios provided by the electric transmission. The combination results in six forward and six reverse speed ratios, amply sufficient for all ordinary running requirements, and in addition six low forward speed ratios doubling the pulling power of the car for emergency use.

The reverse gear set requires little attention. A large breather cap screwed in the case cover provides an opening for refilling with lubricant and a plug is provided at the bottom of the case for draining. The level of the lubricant should not be higher than the top side of the lower shaft. Care should be taken to allow no dirt or grit to enter. It is well to draw off the old lubricant every season and thoroughly clean the parts. Keep gauze in breather cap clean for air vent.

Removal of the cover exposes a hexagon cap, covering a spring and plunger. The plunger acting in notches in the shifter rod locates the gears in proper mesh. There are four notches, one each for the direct, reverse and emergency low positions with corresponding notches, on the quadrant, the adjustment in the connecting linkage providing for accurate engagements of the hand lever pawl. The fourth notch in the shifter rod is not a running position. It permits locating the gears out of mesh for cleaning the armatures.

PROPELLER SHAFT AND UNIVERSAL JOINTS

Two universal joints connected with a driving shaft join the reverse gear set with the rear axle. These joints transmit all the driving power and require no attention other than careful regard to lubrication. Never allow the joints to operate without plenty of

lubricant as the wearing parts have a constant movement while transmitting the power required to propel the car.

Plugs are provided for renewing lubricant, but to thoroughly repack the lock nuts and collars holding the smaller sheet metal cover may be unscrewed and expose the interior. Once a season the joints should be cleaned and repacked with grease, and the felt washers should be renewed if necessary to keep the lubricant from leaking.

CONTROLLER AND WIRING

These parts should require no attention from the driver other than an occasional inspection for loose connections and an occasional examination of the controller. It is well, however, to have clearly in mind the location of the various parts and the functions they perform, as such information will assist in locating and correcting trouble should it ever occur.

CONTROLLER CONSTRUCTION

The controller, establishing the different electrical circuits, is self-contained in an aluminum casing conveniently located on the steering column under the engine hood. The copper controller fingers to which are attached the wires are mounted in the heavy cover made of insulating material. The proper pressure of these fingers is maintained by coil springs setting into sockets in the cover.

The drum supporting and insulating the copper contacts is mounted on a shaft turning in small annular ball bearings carried in the ends of the aluminum case. This shaft projects at the lower end and by means of a pair of small gears is turned, bringing different contact points in touch with the controller fingers, as the control lever is turned over its dial to the speed positions.

The controller drum is made from insulating material and inside of it are carried two small resistance coils. One of these is the shunt used across the generator field on first speed position as shown in Fig. 4 under Diagrams and Explanations. The other is the resistance used in the motor connections for speeds 3, 4 and 5, as shown in Fig. 6. This part of the controller should never be disassembled, as it requires no inspection.

CONTROLLER INSPECTION

Should trouble ever occur in the controller the cover may be removed and the fingers and contacts examined. Some may be slightly pitted and if impossible to clean and smooth thoroughly with

fine sand paper in the case, the drum may be withdrawn and the contacts made more accessible. In such cases the bearings should be slightly lubricated. Do not pack with grease as little lubrication is required and any lubricant reaching the contact surfaces will cause trouble. Slight pitting will not affect the operation.

If controller is removed or cover opened be sure the wires leading to it are free and not under any strain at the entering point. It is well to look at these occasionally as should anyone carelessly twist and disturb these wires the fingers might be thrown out of contact inside the controller, seriously affecting the operation of the car.

RESISTANCE COIL

The resistance coil mounted midway of the car and under the left side of the frame is used for charging the battery with control lever in charging position, Fig. 1, and also when electric brake is applied with control lever in neutral position, Fig. 3B.

HORN AND WIRING ACCESSORIES

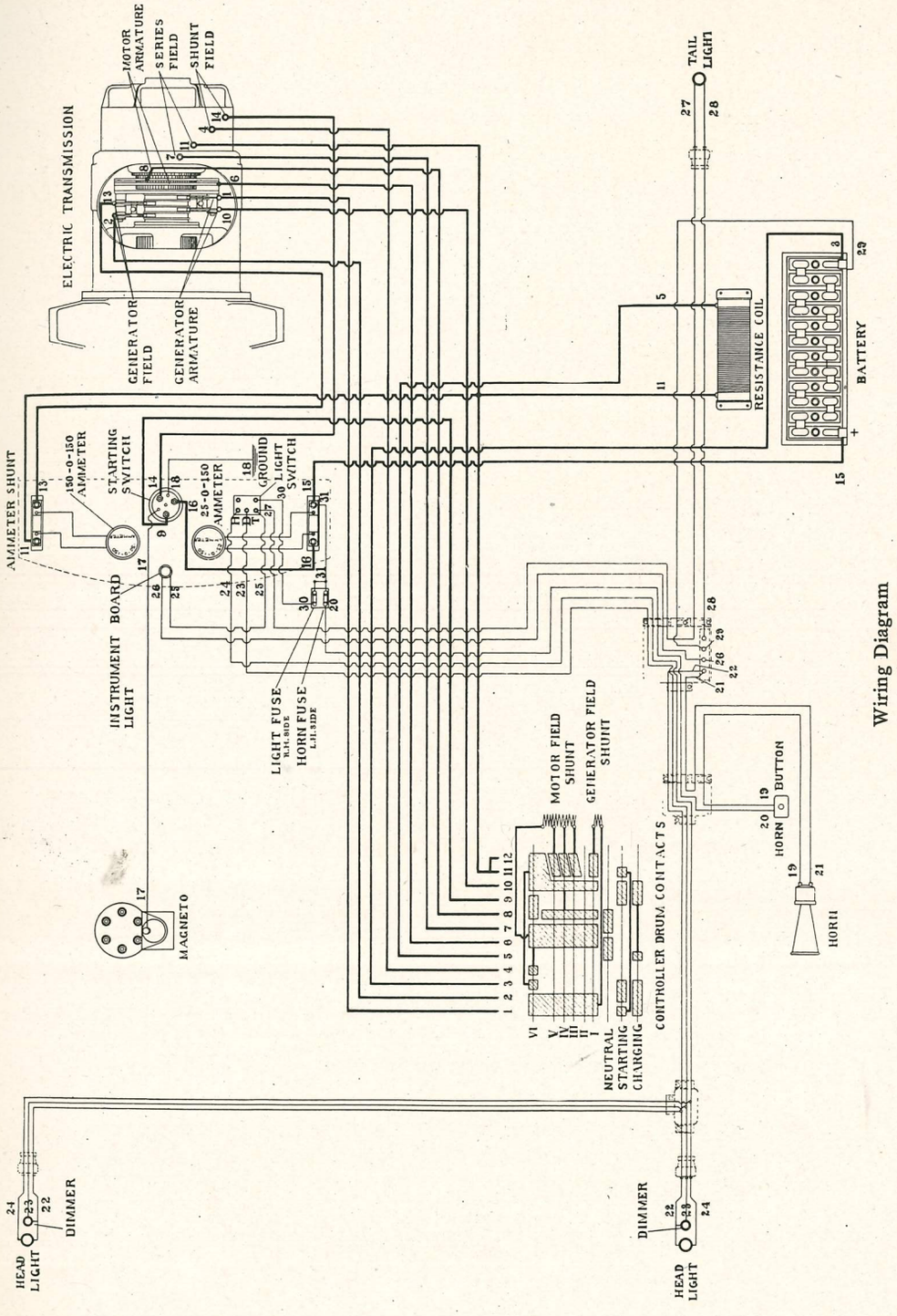
The horn switch push button is supported from the frame directly under the steering gear. Contact is made by the small rod pushed downward from the horn button in the center of the steering column.

Two ammeters, starting switch, lighting switch and trouble lamp socket are located on the instrument board. The two ammeter shunt blocks are carried on the under side of the instrument board. The junction boxes covering branch connections in the lighting and horn circuits are supported by the flexible metallic tubing enclosing and protecting these circuits.

WIRING DIAGRAM

The wiring diagram shows the controller leads and the permanent wire connections in the car. This will be helpful should it ever be necessary to trace one of the circuits. Fig. 1 to 7 inclusive, under Diagrams and Explanations, shows numbers adjacent to the small circles corresponding to the numbering of the controller leads. The grouping of these leads shows what takes place in the controller for each speed position. Noting this grouping is an aid to locating trouble should it ever occur.

For example, Fig. 2 shows leads 2 and 3, 9 and 10, 1 and 11, joined in the controller. These leads are all those which can possibly



Wiring Diagram

affect conditions for this position of control lever. They may be readily traced to their destination by the wiring diagram and tightness of all connections in these leads checked.

Figs. 4, 5 and 6 show controller connections for speed positions 1-2-3-4 and 5. Note that leads 1 and 2, 6 and 7, 8 and 10, are employed for each speed position and the difference in the electrical connections consist entirely in using resistance coils wound in the controller connected by lead 11. If transmission collector rings, brushes and commutator surfaces are free from oil it is evident that if car handles properly on any one of these speed positions and not on all, the trouble will be found in the controller or lead 11.

Note Fig. 7 shows controller connection for high speed position and employs all the leads used on the lower speeds. The additional leads are 3, 4 and 9. If car handles properly on lower speed positions it is evident the trouble has developed in using the extra three leads or the new controller position. Check the lead connections first for tightness before examining the controller.

CAUTIONS

Should trouble occur in operating on any speed position don't form an opinion as to what is to be fixed, too hurriedly. Study the conditions carefully.

Oil or grease smeared on the collector rings or armature commutators affects the operation materially. Be sure these surfaces are clean before a single wire or part is disconnected.

Determine from speed positions which leads are causing trouble. Check the tightness of all connections occurring in these leads.

Dismiss the idea of a broken wire in any of the power leads. They are too large and the trouble is elsewhere.

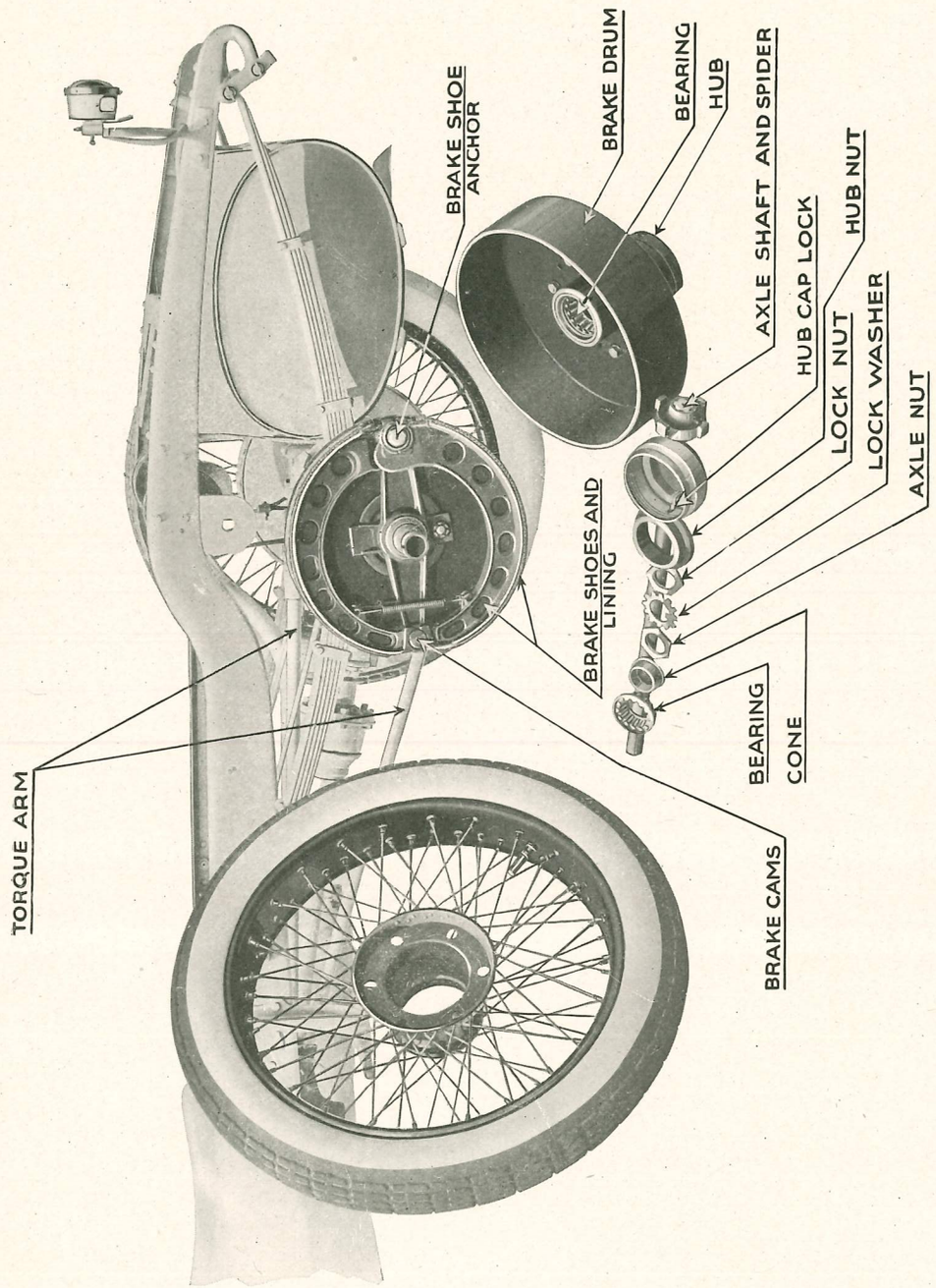
If any wire is disconnected be very sure to mark both sides of the connection, so it will surely be put back the same way. If already marked, note the markings.

See that the leads running to the controller are free and not pulled away from a direct entrance to the controller. The wires must not pull down.

Don't open up the controller until you have checked all other possibilities twice as the trouble is probably elsewhere.

GARAGE INSTRUCTIONS

It is very improbable that any trouble will develop inside the transmission, but if a preliminary checking, as above explained, indicates defects in the transmission, the car should be taken to an experienced automobile repair man. Be sure this man uses the Garage Instructions, as this will greatly facilitate his promptness in locating and correcting the trouble.



Rear Axle and Brakes

Rear Axle and Brakes

THE general specifications are: Full floating type, tapered roller bearings throughout, spiral bevel gears, double internal enclosed brakes, bevel gear differential and "V" shaped torque arm.

ADJUSTING WHEEL BEARINGS

It is well to examine the wheels for tightness of bearings two or three times per year and should looseness develop the bearings should be adjusted.

With wheel jacked up remove the hub cap. Wire wheel caps have a special lock which is disengaged when the wrench is placed over it. The right hand wheel has a left hand thread and the left hand wheel a right hand thread. Wood wheel hub caps all have right hand threads. The hub cap in the wire wheel construction, supports the wheel which should also be removed.

Withdraw the driving dog and axle shaft and loosen the tips of the lock washer holding the outer or lock nut in place and remove these parts. Tighten the inner nut slightly as brake drum is slowly turned, stopping as soon as the bearings bind slightly. With bearings properly tightened, drum should turn freely but there should be no looseness of the hub on its bearings in any direction.

In reassembling be sure that lock washer is in position to lock nuts with tips turned down and that tightening of the lock nut does not turn the inner nut and bind the bearings, making the drum turn hard. A slight binding of the bearings causes them to wear rapidly.

Be sure the axle shaft is entered centrally so as not to push the felt retaining rings inside the axle out of position. See that hub caps are screwed on tightly, and lock, in wire wheel hub cap springs out, so cap will not unscrew.

When wheel bearings are adjusted it is well to repack them with grease in which case the inner nut, and hub would be removed in addition to the other parts above mentioned.

REAR AXLE ADJUSTMENTS

The pinion shaft bearings will not require adjustment for the season. The method is the same as for the wheel bearings. With lock nut and washer removed the inner nut may be tightened until shaft is free from looseness, the slight rotative movement possible by

the clearance in the driving gears may be used in determining when the bearings are tightened properly. Be sure the pinion shaft is free to turn when the adjustment is completed. These bearings will never need lubricating as the spiral bevel gears force lubricant from the axle case to these. The bearings supporting the differential require neither adjustment nor lubrication.

There is no adjustment provided for the driving pinion and gear, as their construction is such they do not require adjustment.

REAR AXLE CARE

The rear axle requires no attention other than draining and washing out with kerosene once a season. Keep the housing about one quarter full of lubricant.

BRAKES AND CONNECTIONS

The internal brake shoes are expanded by means of cams. The asbestos fabric lining should be kept free from grease, cleaning with gasoline if necessary and renewed if ever worn out.

The emergency brake is operated by the hand lever and the service brake by the foot pedal. The former is used comparatively little but the service brake is subject to constant use. Equalizing bars in both brake connections insure even pressure on brake drums. These bars should stand at right angles to the center line of the car when the brakes are applied, the threaded clevices permitting the brake rods to be changed in length.

With brakes released there should be just sufficient clearance between the brake shoe lining and the drum to not show any appreciable friction or dragging. As the lining on the service brake shoes wear, the brake rods and stops controlling this clearance may be adjusted to keep the clearance uniform. Be sure the brakes are in proper order to control the car under all conditions.

FRONT AXLE AND TIE RODS

The wheel bearings are tapered roller and require exactly the same adjustment as outlined in the foregoing for the rear wheel bearings. They are secured on the wheel spindles by castellated axle nuts with right and left hand threads corresponding to the threading arrangements for wire wheel hub caps. When bearings are repacked with grease and properly adjusted be sure axle nut is locked with the cotter pin with its ends spread apart. Be very careful the bearings are not adjusted so tightly they bind. The wheel when jacked up must always spin freely.

ALIGNMENT OF FRONT WHEELS

It is advisable to occasionally check up the alignment of the front wheels as this may become changed by the steering rods and levers striking some obstruction. The wheels should normally stand about ¼" closer in front than at the rear. This measurement should be taken between the inner edges of the rims and at points diametrically opposite on the circumference. It is approximate only and need not be maintained exactly.

The tie rods have threaded ends for adjustment. Clamp bolts or lock nuts are provided to keep these important threaded joints tight. It is advisable to occasionally inspect these parts which are covered by the grease packed leather boots.

WHEELS

It is essential to keep the hub caps tight, as they hold the wire wheel hub on its inner hub, and are not merely dust covers, as in wood wheel construction.

In changing wheels it is well to smear a little grease on the large taper surface and threaded portion of the inner hub and wipe the wire wheel hub clean on the inside, as these two hubs, by means of the taper edge of the hub cap, are locked tightly together. Clean and lubricated surfaces will ensure a close tight fitting mounting, which may be readily taken apart.

In putting on hub caps start them by hand until it is certain the threads are not crossed. Remember the right and left hand threads. Have wheel jacked up.

If spokes are renewed be careful in tightening and not pull wheel out of alignment. All spokes should have the same tension and all those of the same length ring true.

Wood wheel equipments will require occasional tightening of rim bolts to keep rims from creaking.

Keep rims clean and free from rust. Use tire flaps for straight side tires.

STEERING GEAR

The steering gear is the worm and gear type. The use of a complete worm wheel rather than a sector, eliminates the necessity for adjustment between the worm and gear.

Ball thrust bearings are mounted at either end of the worm attached to the steering wheel tube. These bearings carry the end thrust of the worm, and as they wear, backlash will develop in time.

STEERING GEAR ADJUSTMENTS

To adjust, loosen the clamp bolt at the top of the steering gear case and turn the hexagon nut slightly until the backlash on the wheel is eliminated, reclamping the adjusting nut tightly in place.

Clamped on the lower end of the steering gear case is a small part anchoring the tube supporting the control lever dial. Should this dial ever become loosened by carelessly pushing the control lever against the neutral stop with too much force, the re-location should be made with the control lever in charging position, that is with the control lever pushed up away from the driver as far as it will go. Rotate the dial until the letter "C" stamped on it is under the control lever, and tighten the clamp at the bottom of the dial tube.

SPRINGS AND ADJUSTMENTS

No special attention is necessary aside from lubrication and tightness of connecting parts. Every spring bolt is provided with a grease cup and requires lubrication. Not only does lack of lubrication cause squeaks and rattles, but tightness in these joints may develop to such an extent that the riding qualities of the car be affected. Spring clip nuts should always be tight and well locked. If the spring leaves are lubricated once a season with graphite and oil the riding qualities may be improved.

POWER AIR PUMP

The air pump mounted on the engine is not in operation until the gear on its shaft is slid into mesh by means of the small wrench shaped lever with the driving gear on the water pump shaft. This engagement must be made with the engine stationary. With engine running slowly and the flexible air hose provided in the equipment attached to the screw connection on the top of the pump, a ready means is provided for inflating the tires. Keep the air intake holes free from dirt.

LAMPS

The wiring diagram shows the connections for the standard chassis equipment.

The head lamps are 21 candle power, 28 volts.

The dimmer lamps are 4 candle power, 28 volts.

The instrument board and tail lamps are 2 candle power, 28 volts.

All standard lamps are the bayonet type, double contact.

While all lamps are controlled by a single 10 ampere cartridge fuse mounted on the dash the circuits are so arranged that should any one lamp burn out it would not affect the operation of the others.

The lamp switch is mounted on the instrument board and has three buttons for controlling the following lamps numbering from left to right:

No. 1 Headlight.

No. 2 Dimmer.

No. 3 Instrument board and tail lights.

The trouble lamp cord provided in the equipment is used by removing the instrument board lamp from its socket and attaching the cord plug putting the lamp in the cord socket.

LIGHTING TROUBLES

Should all lamps fail to light it is evident the main circuit from the battery is broken either by the fuse being blown out or a loose connection, assuming the battery to be in operation and all lamps not burned out.

Should any of the lamps light and not all it is evident the fuse is working properly and the trouble is probably burned out lamps or loose connections or short circuit in the particular circuits governing the lamps causing trouble.

Should lamps burn dim the battery is discharged and if car is not immediately driven at a sufficient speed on high to recharge the battery the engine should be started by hand crank if necessary, and a freshening charge given the battery by placing control lever in charging position and running the engine as instructed for charging batteries. Do not allow lamps to burn during this boosting charge.

When car is left standing and lights are required use only the dimmers instrument board and tail lamps, as the powerful head lamps require too much current from the battery and are unnecessary.

ENCLOSED CAR LAMPS

All lamps used in enclosed bodies are connected by independent circuits to the battery and are not controlled from the standard lighting switch on the instrument board.

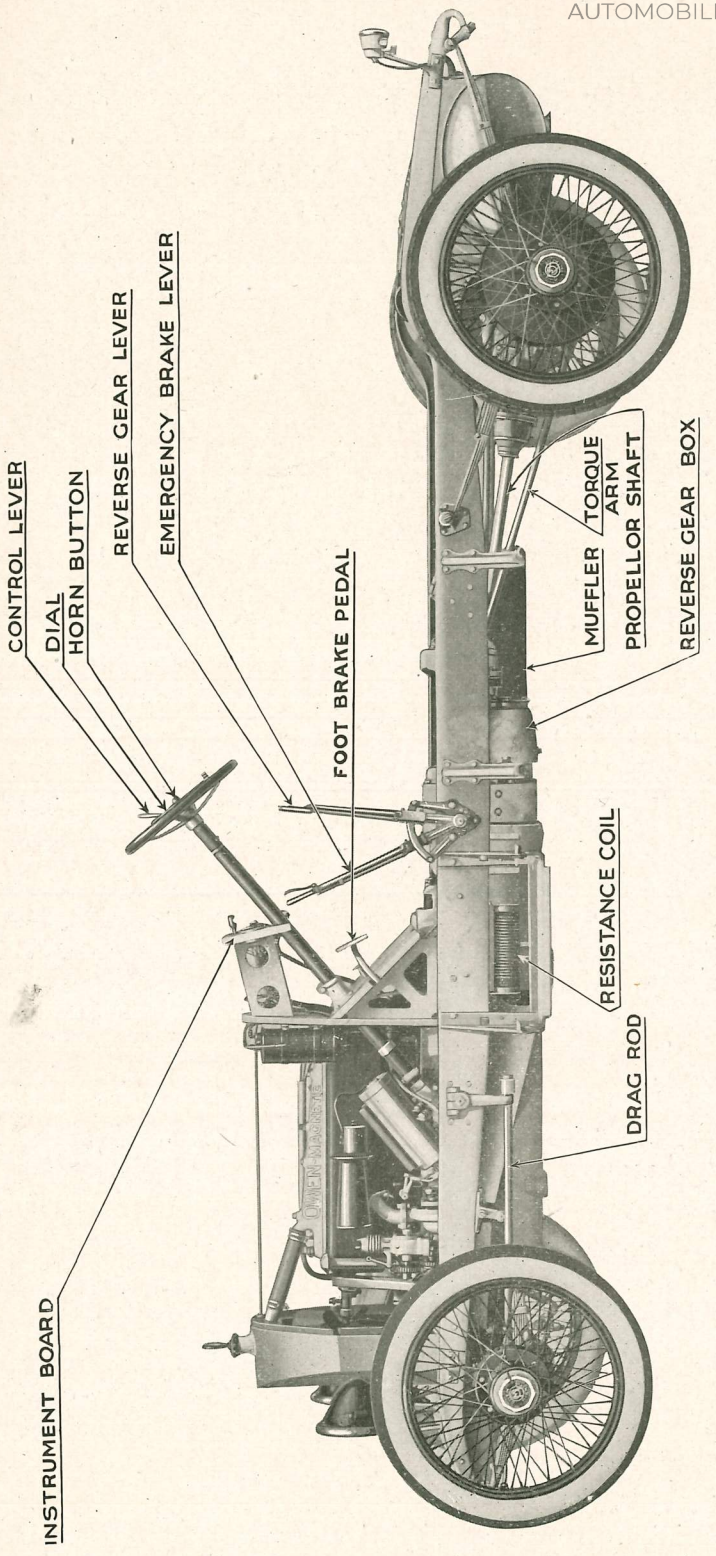
MISCELLANEOUS

SPEEDOMETER

Should speedometer fail it can probably be repaired locally quicker than by getting repairs or new parts from agent or the factory. It is advisable to keep the speedometer in constant operating condition, as car mileage is useful data for checking tire life. Occasional cleaning, lubrication, and inspection of the speedometer drive will increase its life.

GENERAL TIGHTENING

A general inspection and tightening of bolts and nuts should occasionally be made. All fastenings designed to be tight should be kept in that condition, otherwise rattles develop with use and the car wears out faster than is necessary. Some of the parts or groups requiring inspection in regard to the attachments are the following: Radiator, fenders and running boards, windshield, body hold down bolts, tire carrier, engine and electric transmission supports. This tightening is particularly important the first few hundred miles the car is operated, as the parts then seat themselves correctly from actual road work.



Chassis—Side View

Garage Instructions for Inspecting and Repairing Electric Transmissions

UNDER the heading "Electric Transmission" and "Controller and Wiring," in this book, are outlined simple methods for locating and correcting such minor troubles as are at all liable to occur. Should there ever arise the need for more serious garage inspection and repair, the following technical instructions will be helpful to the garage repairmen.

Before deciding the Electric Transmission is at fault, electrically, study the Diagrams and Explanations and the Wiring Diagram so as to have a clear understanding of what happens electrically for each position of the control lever. The trouble may be, and probably is, outside the transmission.

See that the collector rings and commutators are clean, and free from grease or oil. The generator, motor and collector ring brushes seating properly with their pigtail wire connections tight and not in contact with any adjacent metallic surface.

As the control lever is brought into the different positions, different electrical circuits are established as shown in the diagrams, but the following table perhaps more clearly shows how some leads or parts are used in several positions, while other leads and parts are perhaps used in a single position only. By remembering that any lead or part working in one position, is proved active for any other position in which it occurs, it is readily seen that a close location of the trouble may be determined by noting the performance of the car as the control lever is moved in its various positions.

Table

Control Lever Position	Controller Contacts	Circuit Lead Nos. From Controller	Generator Acting as a	Motor Acting as a	Battery
Charging	Charging	1 2 3 — — 5 — — — 9 10 —	Generator	Not in circuit	Charging
Starting	Starting	1 2 3 — — — — — — 9 10 11	Motor	Not in circuit	Discharging
Neutral also Elec. brake	Neutral	— — — 5 6 7 8 — — — — —	Not in circuit	Generator driven by car coasting	Not in circuit
1st	1st	1 2 — — — 6 7 8 — — 10 11	Generator	Motor	Not in circuit
2nd	2nd	1 2 — — — 6 7 8 — — 10 —	Generator	Motor	Not in circuit
3rd	3rd	1 2 — — — 6 7 8 — — 10 11	Generator	Motor	Not in circuit
4th	4th	1 2 — — — 6 7 8 — — 10 11	Generator	Motor	Not in circuit
5th	5th	1 2 — — — 6 7 8 — — 10 11	Generator	Motor	Not in circuit
High	High	1 2 3 4 — 6 7 8 9 10 11	Generator	Generator charging battery only—no effect on car operation	Charging

TESTS FOR LOCATING POINTS OF TROUBLE

For all tests have starting switch on instrument board in starting position, and emergency hand brake lever set. Keep control lever in neutral position except when necessary to move it in other positions for testing, and hand lever in forward speed quadrant notch, unless otherwise specifically stated.

(1) Engine Fails to Spin in Starting Position

Note if battery ammeter shows at least 100 amperes; if less, battery is partially exhausted. Assist battery by cranking engine by hand, being careful not to leave control lever in starting position with engine stationary longer than necessary. With engine running, give battery a boosting charge. Should charging position be inoperative, or engine fail to spin with fully charged battery, see if any of the positions are operative. If so, examine leads 3, 9, 11 for tightness of connections and their fingers, including finger 12 for good contact. If not, refer to Test No. 2.

(2) All the Positions Inoperative

Examine controller wires to see that they are not pulling down and springing fingers away from good contact inside the controller. See that controller drum is tight on its shaft and revolves against hand pressure as control lever is moved. Go over collector rings and generator commutator again to be sure they are clean, brushes seating properly and pigtail connections tight and not short circuited; also the two short pieces of wire connecting the generator brush rings to the armature terminals on the collector ring spider. Check tightness in all connections in leads 1, 2, 3, 9, 10 and 11.

Open Generator Field Circuit Test

With engine stationary, insulate one of the collector ring brushes on the left-hand side of the transmission by means of a piece of paper between the brush and its ring. Place control lever in charging position. If left-hand ammeter shows current flowing, battery not being exhausted and properly connected, the field circuit is closed. If current does not flow, it is open.

Open Generator Armature Circuit Test—Gear Hand Lever Out of Mesh

With engine stationary, insulate one of the collector ring brushes on the right-hand side of the transmission by means of a piece of paper between the brush and its ring. Place control lever in charging position. If left-hand ammeter shows current flowing, battery not being exhausted and properly connected, the armature circuit is closed. If current does not flow, it is open.

The above tests indicate whether the complete circuits are open or closed but before taking down the transmission to repair an open circuit, test the armature and field coils as the defect might be in the collector ring or outside leads or controller. For such tests, battery or other available current may be used with light or bell. Both the armature and field terminals are accessible on the end of the collector ring spider where they connect to the collector rings. Do not disassemble the transmission unless the defect is clearly located in the armature, field, or collector rings.

(3) Car Inoperative for Positions 1, 2, 3, 4, and 5 Starting O. K., and Current on High Position

Examine leads 6, 7 and 8 for tightness connections and controller finger contacts on corresponding drum contacts.

See that motor brushes are seating properly and all wire connections from these brushes and leads to motor are tight and not short circuited on any adjacent metallic surface.

Open Motor Series Field and Armature Test

Before taking down the motor, test both series field and armature windings with outside current and lamp or bell. The terminals are accessible on the motor, wiring diagram showing connections.

(4) Car Inoperative for Positions 1 and 2 with Little Power for Positions 3, 4 and 5

Examine as outlined above for test No. 3 with particular care given lead No. 7 for tightness connections good contact of controller finger.

(5) Positions 3, 4 and 5 Perform Same as Position 2, Car Otherwise Normal

Motor shunt resistance coil in controller drum is probably defective or disconnected. Replace drum.

(6) Position 1 Performs Same as 2, Car Otherwise Normal

Generator shunt resistance coil in controller drum is probably defective or disconnected. Replace drum.

(7) Battery Discharges in High Position, Car Speed Above 20 M.P.H., with Starting Switch on, Car Otherwise Normal

Examine lead No. 4 for tightness of connections and good contact of controller finger. Examine motor shunt field connections and test for open circuit.

(8) Electric Brake Fails to Act on Neutral Position; Car Coasting Rapidly, Car Normal in Running Positions

Examine lead No. 5 for tightness of connections and good contact of controller finger. See that large resistance coil under left-hand side of chassis is not broken or disconnected. See that motor commutator is clean, smooth and runs true and brushes seating properly.

(9) Charging Position Inoperative, Car Normal in Running Position

Examine No. 5 lead and resistance coil as above directed.

TAKING DOWN ELECTRIC TRANSMISSION

If an electrical or mechanical trouble has been clearly located in the transmission it will be necessary to disassemble it wholly or in part. As a general caution all wire terminals should be marked or the previous markings noted so they may be surely reconnected as they were. Also the relation of any of the mechanical parts possible to assemble in a different position should be marked.

DISCONNECTING WIRES

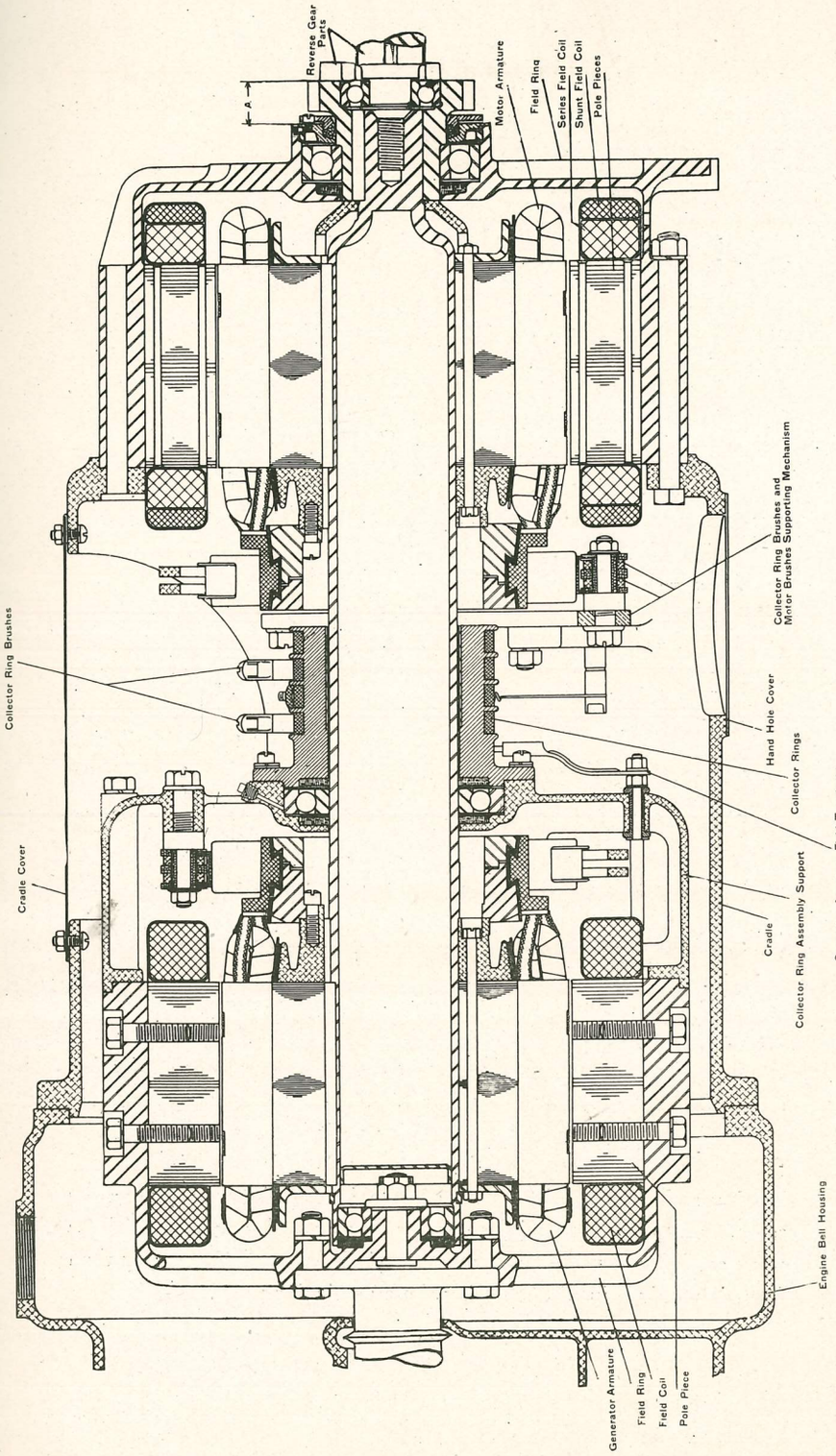
Disconnect the battery wires and untape the rear end of the large wire trunk at the left side of the transmission exposing four taped splices. Untape these and disconnect. It will be noted the four short leads run to the motor field and are the series and shunt field leads.

Six additional leads run directly to the central part of the transmission and are the motor armature and the generator armature and field leads. All these leads are clearly shown on the wiring diagram.

Disconnect the terminals and remove wires from where they enter the aluminum cradle.

UNDOING MECHANICAL CONNECTIONS

Unbolt propeller shaft forward flange and drop shaft. Take off gear box from end of electric motor, gear remaining on end armature shaft. Remove gear by using combination puller or equivalent tool.



Electric Transmission—Section View

REMOVING MOTOR FIELD RING

Remove six nuts holding ring to aluminum cradle. As ring is pulled back rap gently to break joint and when free be careful not to drop on armature and harm windings. Also be careful not to bend the four motor leads where attached to the windings so as to crack the insulation. Check and note exact distance marked A on section drawing so parts may be reassembled in same relation.

REMOVING MOTOR ARMATURE

This armature is pressed on the shaft and held by a long key. To remove use combination puller or equivalent tool, holding the shaft against turning. Remove key.

The brush holder assembly may be removed in a unit by taking out the two fillister head screws supporting it from the lugs cast on the inside of the cradle. Should it be impossible to remove these screws by reason of interference mark the relation of one of the three studs holding the brush supporting rings, loosen the studs and rotate rings to clear screw heads. This rotation changes the setting of the motor brushes and rings must be carefully reassembled in the original position.

REMOVING CRADLE

Disconnect and remove one supporting leg and disconnect the other from the cradle. Undo the screws holding the cradle to the engine and move cradle back and down over the armature shaft.

REMOVING COLLECTOR RING SPIDER

Support the armature shaft so it will not sag and loosen the generator field terminal connections and the screws holding the spider to the field ring. Pull evenly and tap lightly to slide armature bearing along its seat on the armature shaft. Should this bearing stick the shaft may be taken out with the spider on it but care must be taken that the generator armature is not allowed to drop off its forward bearing and harm the insulation on its windings. Care must also be taken not to distort or injure the spider or collector ring. These parts are light in weight and must run in balance so care rather than force is required in disassembling these particular parts.

GENERATOR FIELD RING

It is not necessary to remove the generator field ring, attached the same as a conventional flywheel, unless repairs are required. If it is removed be very careful in assembling that flange and seat are clean so the part will run true when the nuts are drawn up. Turn engine by hand in testing for trueness. Do not run engine until electric transmission is *completely* assembled.

ANNULAR BALL BEARINGS

The ball bearings used are No. 306 front, No. 116 center, No. 212 rear. They are mounted in the usual manner with light tapping fits on the inside supports and close sliding fits in the outer supports.

The forward bearing is packed in a deep grease cavity. The center bearing is also packed and provisions are made for slight lubrication as mentioned in the Instruction Book. Avoid too much lubricant as it might work out on the collector rings. The rear bearing is lubricated from the gear box. It is not necessary to otherwise lubricate these bearings during the life of the car unless the transmission is taken down for other reasons when they may be cleaned and repacked. Under ordinary driving conditions the forward and center bearings have very little movement.

REPLACEMENT PARTS

In ordering replacement parts the generator field ring, pole pieces, field coils and collector ring spider must always be replaced as a unit owing to the necessity of having the rotating parts accurately balanced.

As the motor field is stationary such precaution is not necessary and the individual parts may be replaced if facilities are available for assembling them.

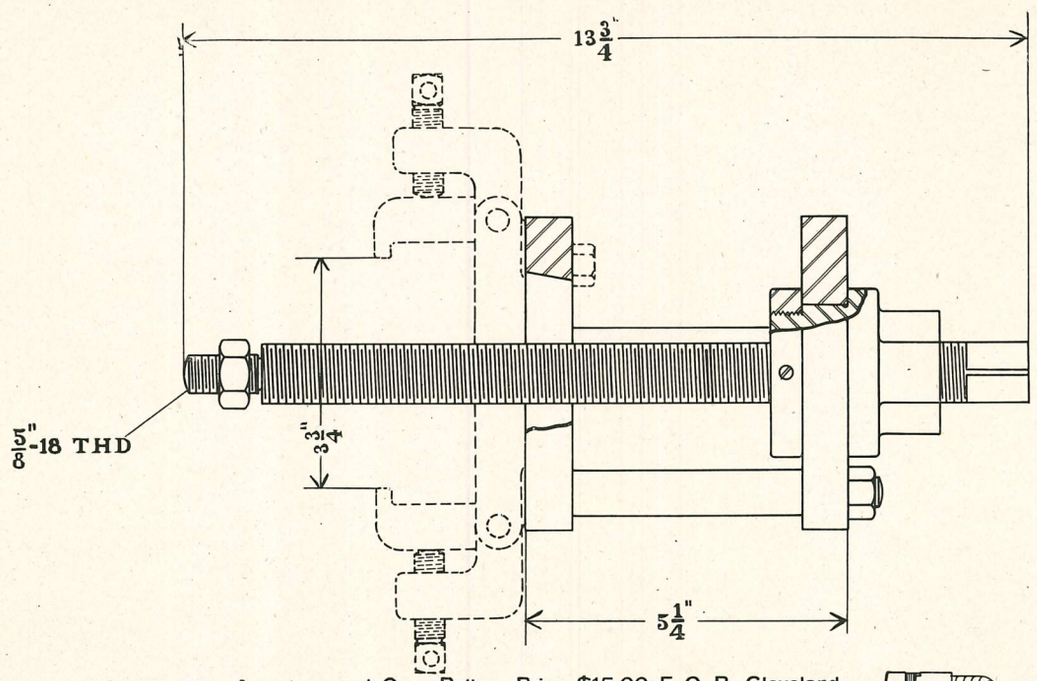
The armature for both the generator and motor may be replaced independently so far as balance is concerned but to ensure perfect mechanical fits it is desirable to replace both armatures and their shaft when time and distance permits.

In the average garage not especially familiar with electrical machinery better results are obtained by replacing all motor parts by units where possible. Arrangements can usually be made to return the defective parts to the factory for credit.

REASSEMBLING

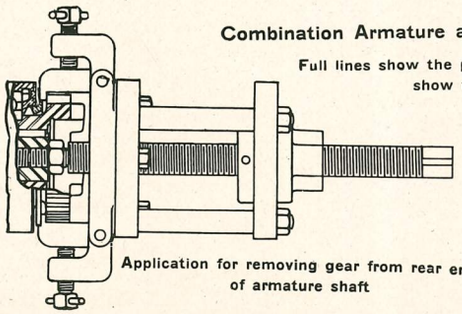
Proceed in the reverse order above outlined. Note that care and accuracy in securing the original locations and connections are required rather than force and haste.

When the job is completed the car should perform normally in all positions of the control lever.

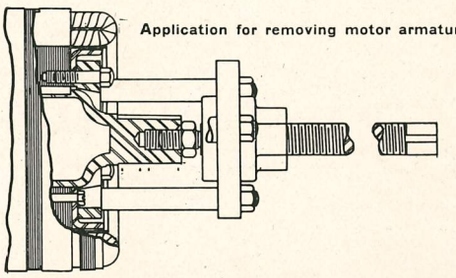


Combination Armature and Gear Puller—Price $15.00 F. O. B. Cleveland

Full lines show the part necessary for removing armature. Dotted lines show the additional parts for removing gear



Application for removing gear from rear end of armature shaft



Application for removing motor armature

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