ELECTRICAL EQUIPMENT SECTION

The Equipment pages comprise wiring diagrams, performance and adjustment data and trouble shooting instructions on the important Magnetos, special devices and complete electrical systems that have been adapted for automobile use.

Often special equipment is found on cars which was not factory installed. Such Equipment is fully covered in this section so that no trouble will be experienced in Service work.

New Equipment pages will be issued in every supplement. File them in the order of the page numbers at the end of this section.

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315	732
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327	1424
332	875
333	1712
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ANTI-STALL

DESCRIPTION:—Anti-Stall is an automatic starting switch designed to start the automobile engine whenever the engine goes dead while the ignition switch is 'On'. It is an electrical device and draws current from the ignition line to operate an electro-magnetic starting switch and can be used on all cars with inertia principle starter pinion engagement. The starter switch is automatically opened when the engine begins to fire and the Anti-Stall remains inoperative until the engine stops.

INSTRUCTIONS:—To Start Engine. The spark, throttle and choke levers must be operated in the usual way. Turning on the ignition switch connects the Anti-Stall to the battery through the switch and it operates the starting switch cranking the engine. When the engine starts the Anti-Stall is automatically cut out without attention from the operator.

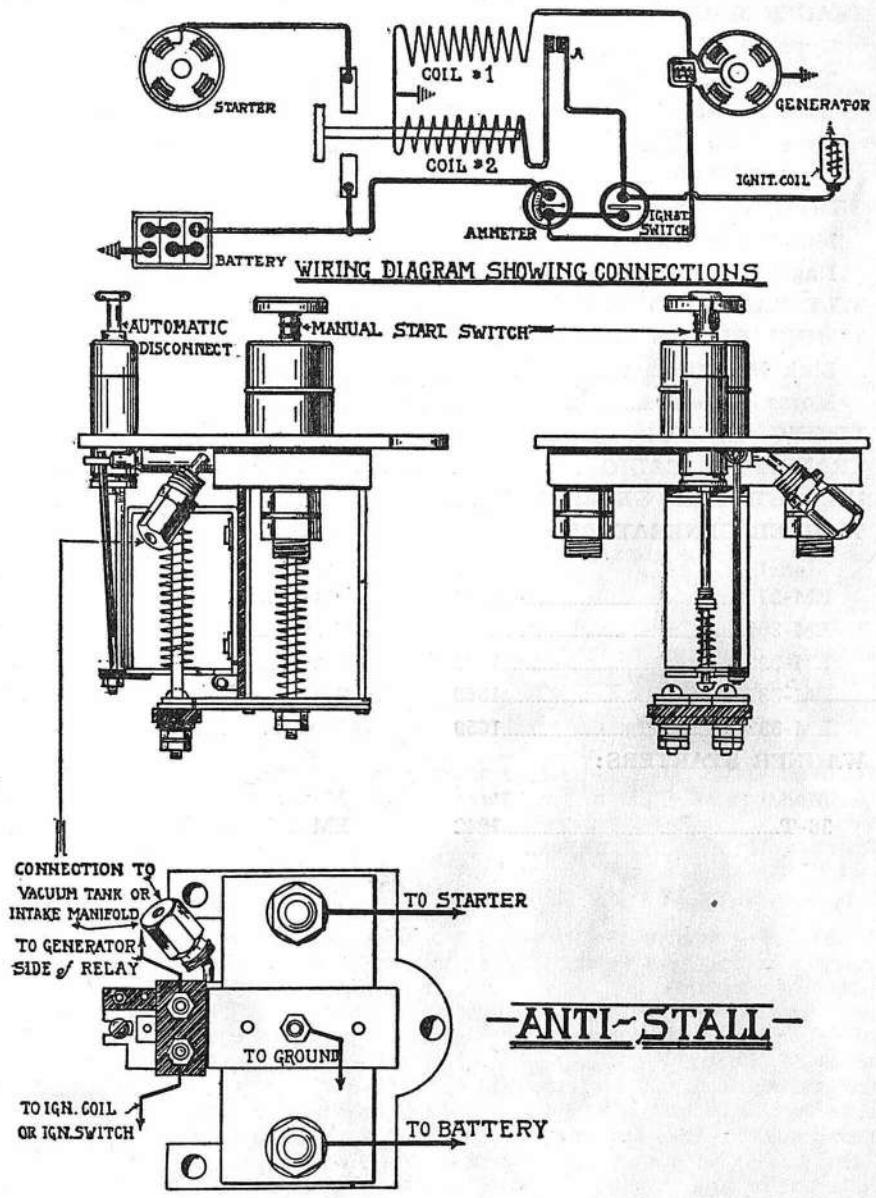
To Stop Engine. To stop the engine it is only necessary to cut off the ignition by turning the ignition switch to the 'Off' position. The Anti-Stall can not function with the switch off.

When Engine Stalls. If engine stalls with car at dead stop the clutch must be thrown out or the gear shift lever must be placed in neutral. If this is not done, the starter will move the car requiring a large current. This is the safety feature and will move the car from a dangerous position such as a railroad crossing. On cars with full manual advance where it is necessary to start with retarded spark, the spark lever must be retarded if the engine is cold. In actual use, the action of the Anti-Stall is so quick that there is no opportunity to retard the spark.

OPERATION:—With engine dead, Anti-Stall contacts (a) are normally closed. When the ignition is turned on current flows through the contacts and through coil (2). This is a solenoid with an iron core connected to the contactor in the starting switch. Movement of the contactor closes the starting switch contacts completing the starting circuit. The starter then cranks the engine. When the engine begins to fire the voltage built up in the generator causes a small current to flow through the coil (1). This attracts the contact armature drawing it toward the coil core and opening the contacts. When contacts open the circuit through coil (2) is broken. A spring then opens the starting switch contacts and the starter is thrown out of gear. On the new Model 6-V a vacuum piston operates an auxiliary arm which also opens the contacts providing a more positive operation at low speeds. As long as the engine is running, the generator voltage and the vacuum from the intake manifold hold the contacts open so that the starting switch can not operate or the starter gear mesh with the flywheel teeth.

ADJUSTMENT:—On the model with generator control only, no adjustment is necessary. With vacuum models the suction from the intake manifold is controlled by a small screw in side of special 'T' used to connect vacuum line with vacuum tank or intake manifold. If starting motor cuts out before engine starts the vacuum is too great and must be cut down by turning the adjusting screw. If vacuum attachment does not cut off starter after engine starts the vacuum suction must be increased by backing off the screw slightly. The adjustment must be locked by tightening up the locknut.

INSTALLATION:—The Anti-Stall can be mounted in any convenient position on the dash or the instrument board. The two buttons on the front of the device are designed for manual operation. The top button must be pulled out to render the automatic action inoperative. The lower button can then be used as an ordinary starting switch. These buttons are normally covered by nickel plated caps. When the Anti-Stall is mounted on a wood base the case must be grounded to the car frame by a wire connected to the ground terminal on the back of the case. This should be done wherever possible even on metal dash mounting to secure best results. In wiring the Anti-Stall regular starter cable should be used on the starting switch lines. A very satisfactory mounting is secured by leaving the car starting switch on the car and wiring the Anti-Stall starter switch across this so that the two switches are connected in parallel. This is shown in the sketch. A wire should be run from the Anti-Stall terminal marked 'IGN' to the ignition terminal on the switch or to the switch terminal of the ignition coil which is lkely to be the most convenient mounting post. The 'GEN' terminal on the Anti-Stall must be connected to the generator side of the cutout relay. If the relay has two terminals connect the Anti-Stall line to the one from which the wire goes into the generator. If the relay has only one terminal outside the case which is connected to the ammeter the relay cover must be removed and the other terminal will then be visible. Make the connection and insulate the line so that the wire will not be shorted when the relay cover is replaced. On Westinghouse generators with the relay



inside the generator endframe, it will be necessary to render the regular generator relay inoperative by positively closing the points and then intall a new relay outside from which the proper connections can be made. On cars without relays where the generator is connected directly to the switch, it will be necessary to install a relay. Make certain that the relay, when installed, is properly grounded.

Ford Installation. On Ford installations a special lighting switch must be installed to insure proper operation of Anti-Stall when car is run on magneto ignition. This switch is provided by Anti-Stall manufacturer.

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DESCRIPTION:—Finger Tip Control consists of a switch mounted on a bracket at the base of the steering gear operated by a single button located in the center of the steering wheel which is connected to the switch by a single tube running through the steering column. The horn is sounded in the usual manner by depressing the button. Pulling up on the button closes the starting switch and permits the starter to crank the engine. Rotating the button, which is notched for ease in grasping, controls the lights. The several positions of the button control the various lighting circuits, such as 'Bright', 'Dim' and 'Park'. The lighting switch, starter switch and horn switch are thus combined in one unit with centralized control.

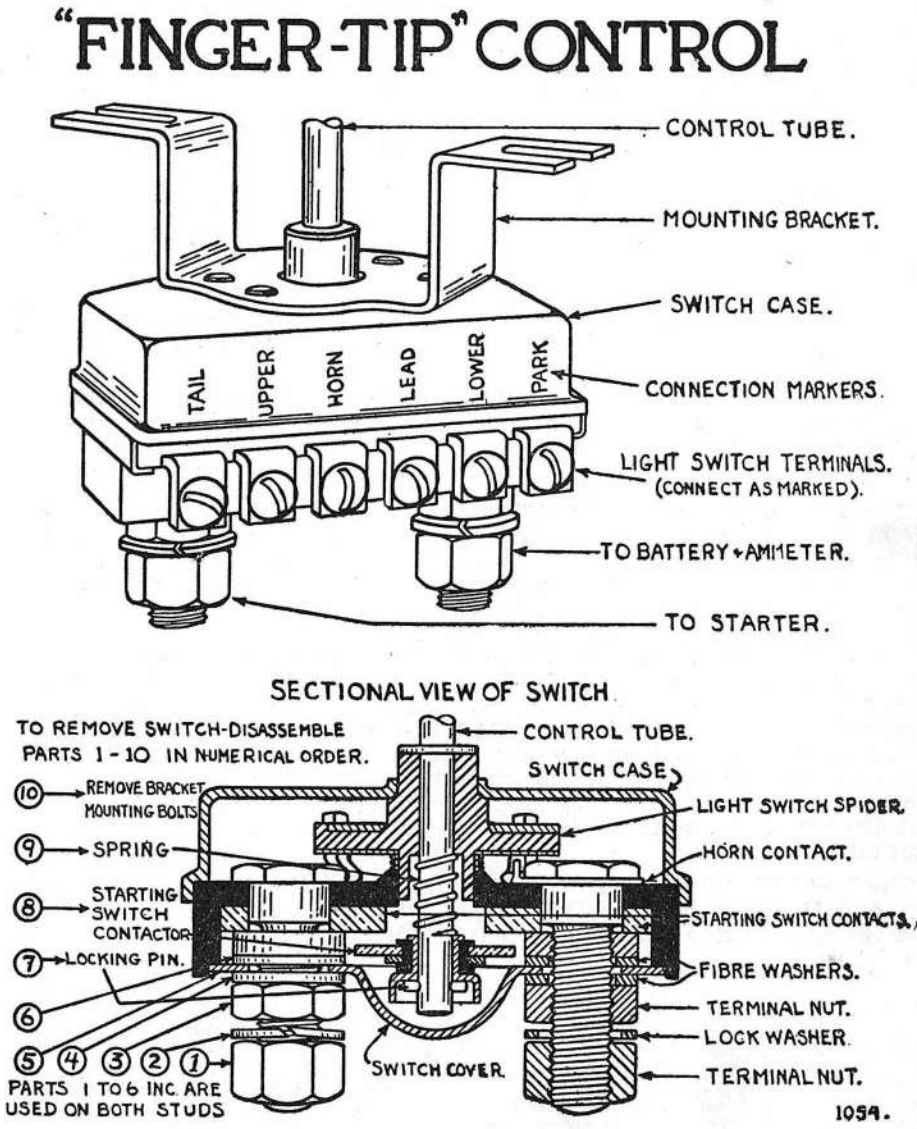
OPERATION:—The construction of the switch is illustrated in the Sectional View adjoining. The two large terminals on the base of the switch are the starting switch terminals. The right hand terminal is connected to the battery and a lead is taken from this terminal for lighting. The lighting lead is connected through the ammeter to the lighting switch terminal marked 'Lead'. The left hand starting switch terminal is connected to the starting motor. Both connections are made with regular starting cable, at least No. 1 flexible braided cable. The two terminals consist of studs mounted in the insulating block which forms the switch body. Each stud has mounted on it a copper block which forms the starter switch contact. The contactor mounted on the end of the steering column tube is directly under the two contacts. When the button on the steering wheel is pulled up this contactor is pulled up and connects the two contacts completing the starting circuit. The spring directly above the contactor on the control tube end shaft breaks the circuit when the button is released and returns the contactor to the 'Off' position. The horn contact is mounted on the upper end of the stud forming the starting terminal which is connected to the battery. When the button on the steering wheel is depressed a connection is made between the contact and the terminal on the lighting switch marked 'Horn', completing the horn circuit. The lighting switch spider is mounted in the upper part of the switch case on the control tube and turns with the movement of the button on the steering wheel.

SERVICING:—It is not practical to disassemble the switch further than is necessary to remove it from the steering gear mounting and the manufacturer recommends that no service work be attempted. Test circuits through the switch with a lamp and test points and when it is determined that the switch is defective the entire unit should be replaced. To remove switch from the car, follow the directions in the following paragraph:

REMOVAL:—To remove the switch from the car, first remove nuts and lock washers from the two starting switch terminals. Take off cables and remove the lock nut and fiber washer from each stud. The switch cover plate and the fiber washer on each stud inside the cover plate can then be removed. Then push up starter switch contactor until the pin under the contactor in the control tube end shaft is visible. Remove the pin and take off the contactor and spring on the shaft. Then take out the cap screws or bolts in the bracket above the switch mounting the switch on the steering gear housing. Pull the switch straight down to clear control tube and lift from place. In mounting switch be very careful to replace the washers both inside and outside the cover plate on each stud. This is very necessary to prevent grounding the battery.

SERVICE PARTS OBTAINABLE
(Aid Mfg. Co., 2625 Stewart Ave., Chicago, Illinois)

Part No.	Description
311	Complete Switch Assembly (Willys Knight and Whippet Type).
54	Switch Assembly, less Parts listed below:
5	Insulating Washer (4 used).
23	Switch Cover Plate (1 used).
29	Stud Lock Washer (2 used).
31	Contact Bar Pin (1 used).
34	Contact Bar Spring (1 used).
38	Stud Nut (4 used).
50	Contact Bar Assembly (1 used) (Contactor).
56	Switch Tube End Lower Shaft.



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FINGER TIP CONTROL
SECOND TYPE

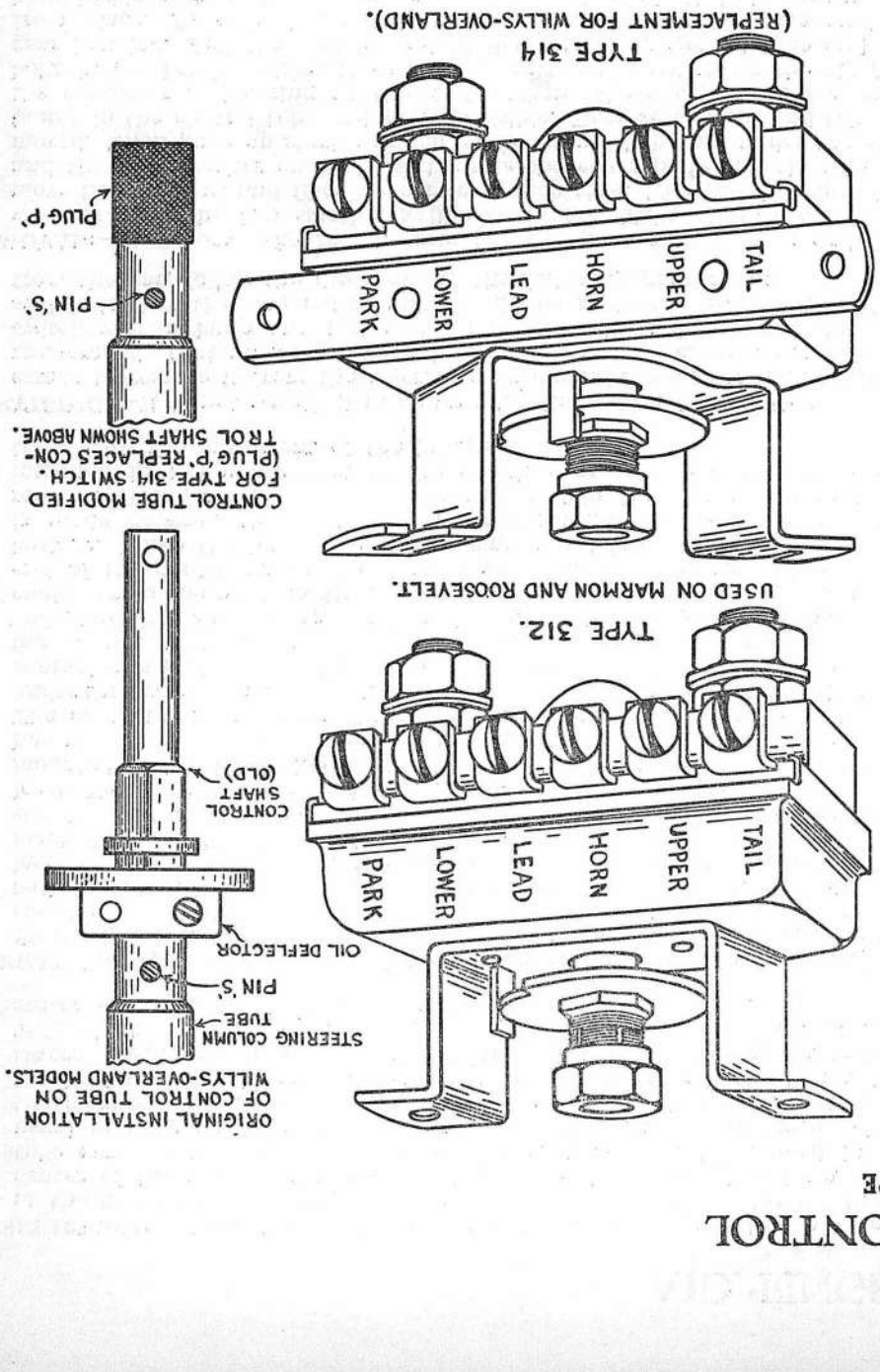
DESCRIPTION:—This type 'Finger Tip Control' switch as manufactured by the Aid Manufacturing Company differs from the first type in that the switch shaft is an integral part of the switch. It is connected to the control tube in the steering column through a split bushing and lock nut directly above the switch. This lock nut should be backed off and the switch disconnected at this point whenever the switch is taken off the car. In all other respects the design and operation of the switch is identical with the first type.

SERVICING:—The switch cannot be disassembled further than is necessary to remove it from the car and whenever tests indicate the switch is defective, it should be removed and replaced with a new unit. To remove the switch, disconnect battery terminal to avoid possibility of short circuits. Then remove all switch connections. Loosen the lock nut on the control tube directly above the switch body (on early types not equipped with stop plate and stop, it will be necessary to hold switch shaft with a second wrench while the nut is loosened to avoid damaging the switch spider). Then loosen bracket bolts. Pull switch away from the steering column until the control tube in the column clears the split bushing of the switch and lift switch from place.

The starting switch contacts can be inspected by disassembling nuts and washers on the starting switch studs and removing the cover plate. In replacing the cover make certain that the insulating washers are placed both inside and outside the cover on the studs.

REPLACEMENT OF OLD SWITCH:—Whenever it is necessary to replace a switch of the first type with a second type switch it will be necessary to modify the control tube in the steering column to take the new type switch. After removing the old switch, drive out the pin in the control tube and remove the oil slinger and switch shaft. Then insert the control tube plug 'P' in the end of the control tube and drill a .067 inch hole (No. 51 drill) through the control tube and the control tube plug. Insert the 1/16 inch pin in this hole and rivet both ends. Both the control tube 'P' and the pin 'S' are furnished with the replacement switch Model 314, which should be used as a service replacement on all Model 311 Willys Knight and Whippet switches. This control tube plug is furnished with a knurled lower end which engages the split bushing of the switch operating shaft. The switch should be mounted in place and the plug engaged in the split bushing and the lock nut tightened. Connections should then be made in accordance with the illustration.

The Model 312 'Finger Tip Control' switch as furnished for use on Roosevelt and Marmons is regularly equipped with this new type switch shaft and the positive stop plate and stop (see illustration).



FINGER TIP CONTROL

PINES TYPE

DESCRIPTION:—The Pines Type 'Finger Tip Control' consists of a starting switch, lighting switch, and horn button combined in a single unit which is designed to be mounted at the lower end of the steering column and controlled by a button on the steering wheel. The starting switch is operated by lifting the button slightly, the horn circuit is closed by depressing the button, and the various lighting circuits are completed by rotating the button. There is no electrical connection between the starting switch unit and the lighting and horn control unit, which permits an ammeter to be placed in circuit to show the discharge current. The two terminals on the side of the unit are the starting switch terminals and one terminal should be connected to the car battery. The lead for the generating and lighting circuits should be taken from this terminal. The other starting switch terminal should be connected directly to the starting motor. The six lighting switch terminals are grouped on the front of the switch. These terminals should be connected as follows (left to right facing the bottom of the switch):

1. Headlight (High Beam—lower filament).
2. Lead—Connect to ammeter through fuse or circuit breaker.
3. Tail—Tail light. On some cars, the dash light is taken off also.
4. Park—Parking bulbs, fender lights or side lights.
5. Horn—This is the horn feed lead. The other horn terminal is grounded.
6. Headlight (Low or depressed beam—upper filament).

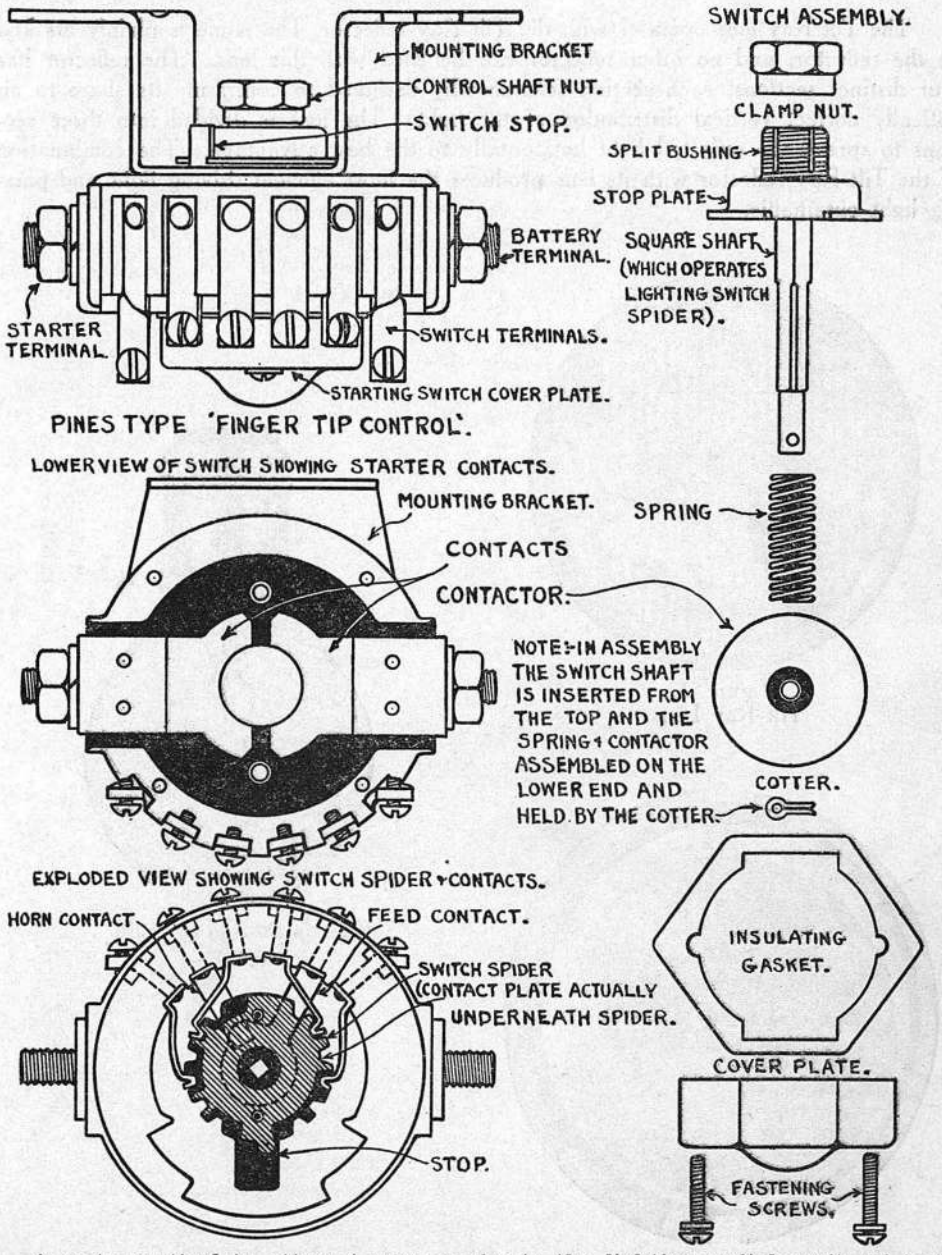
The lighting switch terminals terminate in switch fingers within the switch housing (see exploded view of switch). These switch fingers rest on the notched edge of the switch spider which carries a contact plate on its lower surface. This contact plate bears against the circular plate connected to the 'Lead' terminal and is kept in contact with it by a spring under the plate. The horn terminal contact is directly under this contact plate and they are brought together whenever the control shaft is pushed downward.

The switch control shaft extends through the switch housing to the starting switch housing on the lower end of the switch. The starting switch terminals terminate in two semi-circular copper contacts. A circular contactor is mounted on the lower end of the control shaft below these contacts and is normally separated from them by a spring on the control shaft above the contactor. When the control button is lifted up, this spring is compressed by the upward movement of the control shaft and the contactor completes the circuit between the two starting switch contacts. The contactor is insulated from the control shaft.

MOUNTING:—The switch is fitted with a universal mounting bracket so that it can be mounted on the steering column or on the chassis frame at the lower end of the column. The control shaft upper end is fitted with a slotted bushing and lock nut and grips the control tube in the steering column when the lock nut is tightened. To remove the switch, first disconnect battery cable and tape to prevent short-circuits. Then disconnect starter cable and all lighting lines. Loosen the lock nut on the upper end of the control shaft. Then take out bolts or screws in mounting bracket. The switch can be removed by pulling it straight downward until the control tube slips out of the control shaft bushing.

SERVICING:—The starting switch contacts can be examined by taking off the lower cover plate. To remove cover plate, take out the two screws and lift off the plate and insulating gasket. The contactor on the control shaft can be removed by taking out the cotter pin in the lower end of the shaft. The spring, which will come off with the contactor, must be replaced when the switch is reassembled. If the control shaft is removed, it must be replaced so that the slot in the stop plate is against the stop when the lug on the switch spider is against the stop on the switch body. To secure this result, insert the control shaft and turn the switch spider as far as possible in one direction. Then remove shaft and assemble so that the stop on the top of the switch body prevents the shaft from turning any further in that direction.

The cover plate over the lighting switch spider is riveted in place and it



is not practical to attempt any repairs to the lighting switch unit. If tests through the lighting switch with a voltmeter or lamp and test points indicate that the lighting switch is defective, it should be replaced with a new unit.

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TILT RAY HEADLAMPS

The Tilt Ray Headlighting device consists primarily of a special lens operating in conjunction with a special reflector and a bulb having two 21 cp. filaments separated about one eighth of an inch and equidistant from the bulb axis. The front view of the Tilt Ray lens, bulb, and reflector are shown by figures 1, 2 and 3, respectively.

The Tilt Ray lens operates with the Tilt Ray reflector. The name is plainly marked on the reflector, and no other reflector can be used with this lens. The reflector has four distinct sections, each section scientifically designed to contribute its share to an optically correct vertical distribution of the light. The lens is divided into three sections to spread the reflected light horizontally to the best advantage. The combination of the Tilt Ray reflector with its lens produces the most efficient driving light and passing light obtainable.

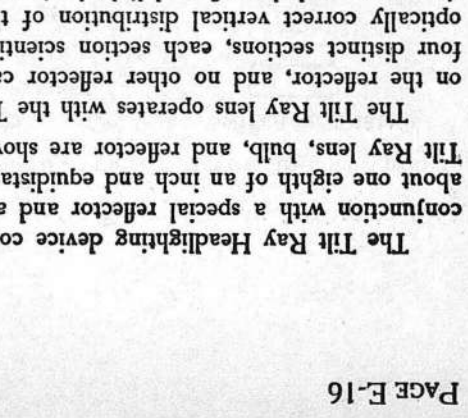


Figure 1.
Tilt Ray Lens.

Mazda No. 1110 Bulb.
Figure 2.

Figure 3.
Tilt Ray Reflector.

Two distinct and separate beams of light, one higher than the other, are available with Tilt Ray Headlamps. The upper beam, which is the driving beam, is produced by the lower filament. By switching from the lower filament to the upper filament, the lower beam may be used when passing approaching vehicles, or when driving around town. Figures 4 and 5 illustrate the difference in elevation between the two beams.

Place the car, with the rear seat fully loaded, on a level stretch with a garage door or other light colored vertical surface twenty-five feet ahead. Draw a horizontal line on this vertical surface at a level with the lamp centers. Sight through the center of the rear window over the radiator cap and so determine a point on the horizontal line midway between the head lamps. Locate points at the right and left of this center point directly ahead of the center of each headlamp.

Place lighting switch on position marked "Bright." Be sure when making the adjustments that the lower filaments, which produce the upper beams, are illuminated. Reverse the connections in the plug if lower filaments are not illuminated.

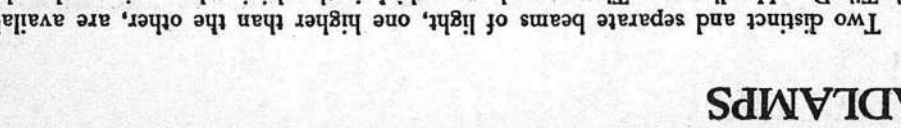


Figure 4.
Lower Beam from Tilt Ray Headlamps.

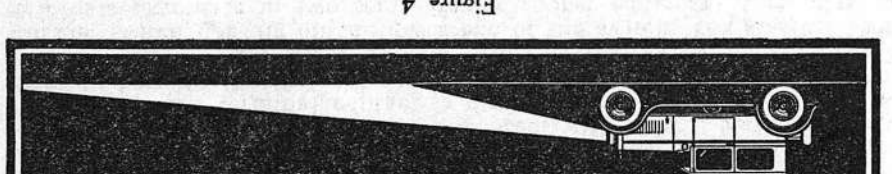


Figure 5.
Upper Beam from Tilt Ray Headlamps.

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TILT RAY HEADLAMPS

Cover one headlamp to obscure the light beam. The best driving beam is obtained when there is a high intensity near the top of the beam. Turn the focus adjustment screw in the back of the uncovered lamp until the beam having a high intensity at the top and a sharp upper outline is as narrow as possible measured from top to bottom. Then by loosening the bracket adjusting bolt, aim the lamp so that the top of the beam coincides with the horizontal line on the vertical surface, and is equally divided by the vertical line directly ahead of the headlamp center. Tighten the bracket bolt securely. The correct adjustment for the right headlamp will look like Figure 6. Repeat operations with the other lamp and the headlamps will be adjusted properly.

No further adjustments for the lower beams are needed.

One point that should be kept in mind is that the top of the beam should cut off as sharply as possible, and results frequently can be improved by turning the bulb over in the socket when the beam is not satisfactory with the bulb as first installed.

This equipment is designed to operate with Mazda No. 1110 lamps illustrated by figure 2.

Care should be taken when replacing a lens, to engage the lug which anchors the lens in the lens notch to prevent rotation and also to insure the flutes being vertical. Both the reflector and lens are notched and also marked "TOP" so that they can be mounted only in the correct position. Tilt Ray and Tilt Beam headlamps are equipped with the standard S.A.E. headlamp mounting or its equivalent.

No portion of main beam should rise higher at twenty-five feet than the level of the centers of the lamps when car is loaded.

Tilt Ray headlamps are approved by the various State Lighting Commissions and manufactured under the patents controlled by and pending to the Guide Motor Lamp Manufacturing Company, Cleveland, Ohio.

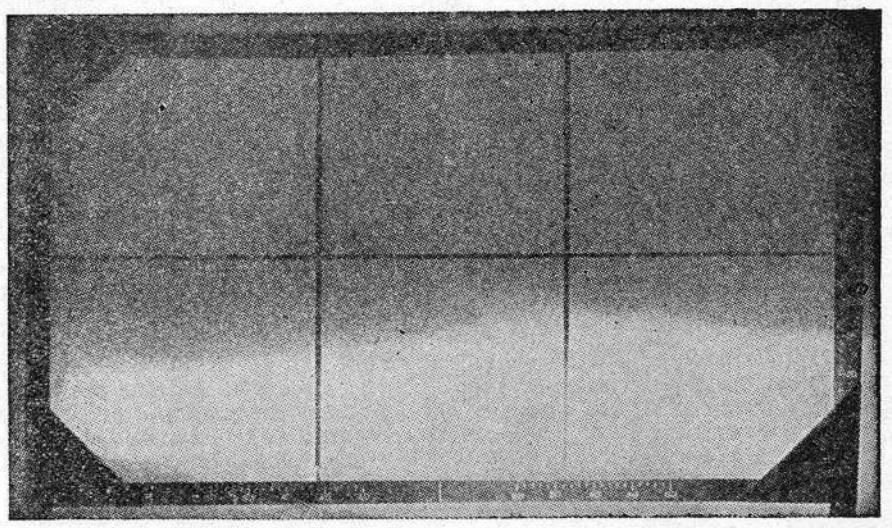


Figure 7.
Lower Beam of Tilt Ray Headlamp shown in Figure 6.

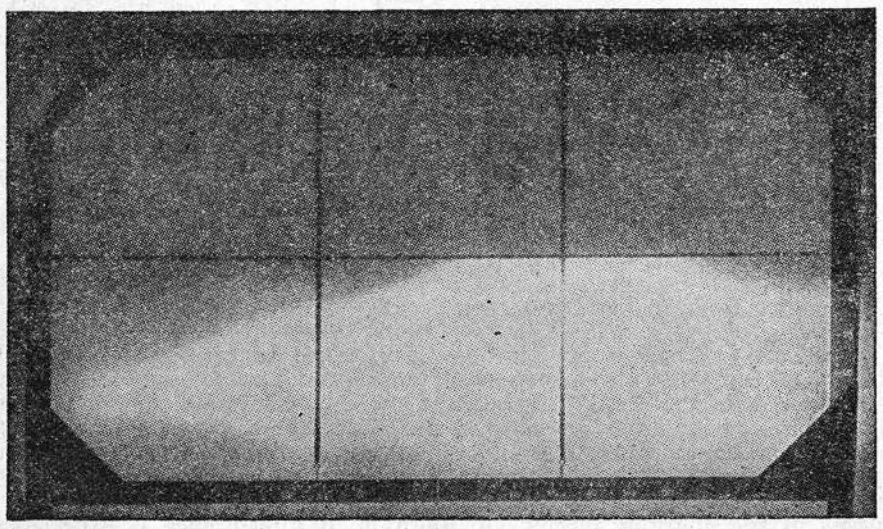


Figure 6.
Upper beam of right hand Tilt Ray Headlamp correctly focused and aimed.

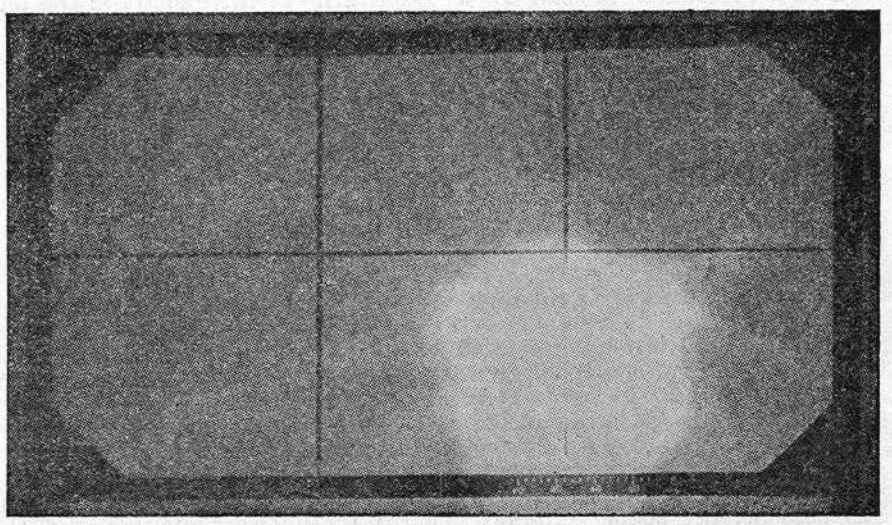


Figure 8.
Upper Beam from Tilt Ray Headlamp without lens.

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BOSCH RADIO
MODEL 80

DESCRIPTION:—The Bosch Model 80 Radio for automotive use is a five tube set with three stages of radio-frequency amplification, a detector and one stage of audio-frequency amplification. The three radio-frequency tubes and the detector tube are of the 'Screen Grid' type (Type 224 tubes). The audio-frequency stage is equipped with a power tube (Type 112-A). The entire set is mounted on the dash with the speaker mounted on the front of the case. A control unit is clamped to the instrument board and operates the set through a universal shaft. The 'B' batteries are contained in a battery box which can be mounted in any convenient location, usually under the floor boards of the front compartment. The set is equipped with a counterpoise or Capacitor plate which is mounted to the car frame under the body. This Capacitor plate is connected to the set and for this reason no antenna in the roof of the car is necessary. The car battery is used for filament current and no additional 'A' or 'C' batteries are required.

MOUNTING:—Radio Set. The Radio Set has two adjustable brackets by which it is mounted to the dash. The brackets can be assembled and used as a template in drilling the mounting holes. These should be placed so that the set will not interfere with the instruments which project back of the instrument board and the holes will not strike the vacuum tank or other accessories mounted on the engine side of the dash. If the dash is entirely free from obstructions, the brackets may be discarded and the set mounted directly on the dash. In any case the set should be mounted on the mounting frame so that it is protected from vibration by the rubber cushions. The tubes can then be placed in the tube sockets and the tube shield replaced. The speaker is mounted on the front of the set.

Control Unit. The Control Unit can be mounted on the instrument board in any position so long as the universal shaft which operates the set does not bind. Use the universal bracket as a template in drilling the mounting holes and then bolt this bracket in place. The small angle bracket can then be installed. The universal bracket is slotted so that the angle bracket can be leveled. The control unit can then be bolted in place. The drive shaft is made in two pieces and the long solid piece must be cut to fit individual installations. Slip the shaft in place in the sleeve on the set, turn the station selector to '100' and turn the drive shaft to the left as far as possible. Then tighten the set screw in the universal joint on the control unit.

'B' Battery Box. The battery box can be mounted in any convenient location provided it is not placed too near the exhaust pipe or muffler. The battery box cover should be bolted to the floor with four bolts. The box can then be mounted by using the four long bolts which mount the box on the cover. A special armored cable is provided for 'B' battery connections. Connect wires as shown on the diagram.

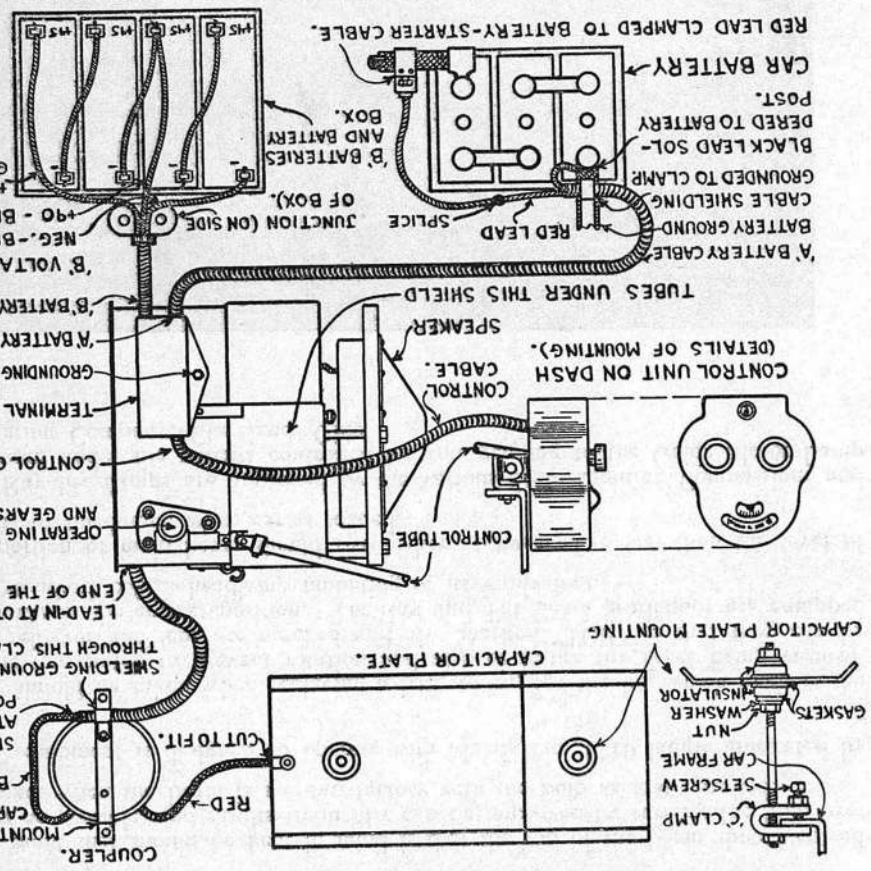
Capacitor Plate. The capacitor plate should be mounted underneath the chassis in any location. It can be mounted on either side of the car or across the chassis if desired. The nut on the capacitor plate mounting bolt must be tight before the set screw in the 'C' clamp which mounts the plate on the car frame is tightened. The capacitor plate should be mounted as low as possible without interfering with road clearance and should not be placed too near the engine, muffler, 'B' battery box or other large metal objects. The capacitor plate is adjustable and should be extended as much as possible when it is mounted on the car frame. A capacitor coupler is provided which must be connected between the plate and the radio set. The coupler should be mounted on the car frame near the plate and the red lead must be connected to the plate. This lead should be cut as short as possible, the spade terminal soldered to the lead and fastened to the capacitor plate. The black lead from the coupler should be connected to the shielded lead-in to the set. This lead is meant to be clamped in the coupler mounting band and if the shielding is drawn up under the clamp it will be properly grounded. It must, however, be kept back from the coupler splice to prevent the capacitor plate being grounded.

'A' Battery Cable. A shielded cable is used to tap the automobile battery for the 'A' current supply for the set. A special ground clamp is provided to replace the ordinary ground lead on the battery. This is provided with a clamp to hold the 'A' cable and the shielding on the cable must be drawn under the clamp so that it will be properly grounded. The black or ground lead in the cable should be soldered to the battery terminal which is grounded and the red lead should be spliced to the battery cable which leads to the starting motor. A special clamp is provided with a pointed set screw. This clamp should be slipped over the cable about one inch from the battery terminal and the set screw tightened until it punctures the insulation and makes contact with the conductor.

Interference Suppressors. Ignition interference suppressors are provided to be connected in the ignition high tension leads. One suppressor should be mounted on the distributor head at the center terminal and a suppressor should be mounted on each spark plug. These suppressors are high resistance resistors and will not interfere with the operation of the ignition system. A condenser is also provided which should be connected between the generator terminal and ground. This will prevent interference due to surges in the charging circuit. In addition, if interference is experienced with the set operating, the armored cable from the set to the control unit may be grounded at the control head end and any loops in the wiring should be straightened out. If desired the ignition coil can be relocated further away from the set.

The three cables, 'A' supply, 'B' battery cable, and control unit cable terminate in a special connector plug on the side of the set. The screw

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TM-1251.

BOSCH RADIO

MODEL 80

which holds the terminal plug in position also grounds the three cables and for this reason the screw must always be in place. The speaker can be removed from its mounting on the set and mounted on the roof of the car, which will improve the tone. A special mounting bracket and extension cord is provided for this purpose.

ADJUSTMENT AND TESTING ON THE CAR:—When the radio set is first installed, tune in a station between '30' and '50 on the dial. Reduce the volume until the station can be heard only faintly. Insert the special Bosch service wrench, Part No. 387, in the opening at left of the set near the capacitor cable connector and adjust for maximum volume by turning the wrench back and forth until the best position is found. This setting should be checked if the capacitor plate mounting or location is changed.

Low 'B' Battery Voltage, or No Voltage. No battery voltage indicates an open circuit either at the 'B' battery terminals or in the cable. This can be tested by a 'continuity' test, using a 'C' battery in series with a voltmeter and two test points which are placed on the ends of the battery lead. If the lead is not open, the voltmeter will indicate the total voltage of the 'C' battery. The voltage between the brown and blue battery leads should be 90 volts and between the green and blue leads 180 volts. Test with a voltmeter. If the voltage is below 70 and 140 volts, the 'B' batteries should be tested individually and any battery with a voltage lower than 35 volts should be replaced.

Low 'A' Battery Voltage. Ordinarily whenever the voltage of the car is high enough to operate the car satisfactorily it will be sufficient for operation of the radio set. It is possible, however, that the 'A' battery connections may be faulty or the leads open-circuited and these should be examined.

Capacitor Plate Disconnected or Grounded. Examine the capacitor plate lead and terminal on the plate. Make sure that the grounded shielding on the lead does not touch the plate.

Defective Tubes. The tubes should be tested with a tube tester. If the tube tester is not available, replace the suspected tube with a new tube and see if the operation of the set is satisfactory.

Defective Speaker. Check the speaker by connecting it to another set or touch the speaker terminals to the terminals of a 'C' battery momentarily. A click indicates that the speaker is not open-circuited. The speaker has a balanced armature mounted between laminated pole pieces. The armature must be correctly centered so that it does not touch the pole pieces. The position of the armature is adjusted by using thickness gauges .009 inch thick to center the armature while the mounting screws are tightened.

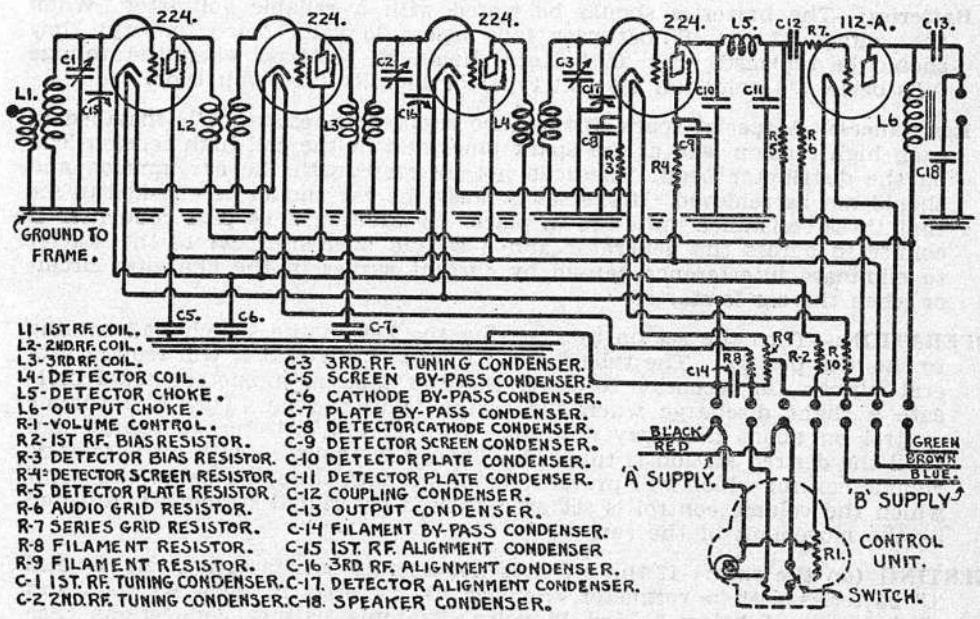
Ignition Interference. This will be particularly noticeable when the engine is idling. Examine the interference suppressors and see that they are mounted on each spark plug and on the center terminal of the distributor head.

Defective Set Chassis. The chassis of the radio set can only be satisfactorily tested by a systematic 'General Test'. A Set Analyzer should be used for this purpose. The analyzer is designed to completely test the set at the tube sockets and is much more thorough and accurate than any other testing methods. However if an analyzer is not available the set can be tested with a voltmeter having scales reading 0-8 volts and 0-200 volts. The voltmeter should be connected to leads ending in test prods which can be inserted in the tube sockets after the tube has been removed. Complete directions for a General Test follow.

TESTING:—The voltmeter should be used to test the tube voltages of the radio-frequency tubes. Filament voltage tests are made from filament to filament terminals, using the low scale on the voltmeter. No reading indicates an open tube, open filament resistor, or an open circuit in the filament wiring. Plate voltages are measured between the plate and cathode terminals, using the high scale of the voltmeter. No reading indicates an open primary on one of the radio-frequency coils, defective wiring or an open connection in the cathode wiring. Screen voltages are measured between the screen and the cathode terminals with the high voltage scale of the voltmeter. No reading indicates an open circuit in the screen or cathode wiring. Grid voltages are measured between the grid terminal (on top of the tube on the Type 224 screen-grid tubes) and the cathode with the low voltage scale of the voltmeter. No reading indicates an open volume control or open radio-frequency bias-register or an open circuit in the cathode wiring.

In testing the detector, the plate voltage registered on the voltmeter will not be the true voltage but will indicate that the circuit is not open. No reading may indicate an open circuit in the cathode wiring. In testing the screen circuit the voltmeter readings may vary due to the voltage drop across the detector screen resistor. No reading may indicate an open circuit in the cathode wiring. In testing the grid circuit, no reading an open secondary winding in the detector coil, defective wiring or an open circuit in the cathode wiring. An open circuit in the cathode wiring may be caused by the detector bias resistor. The detector filament is in series with the third radio-frequency tube. In testing the filament no reading may indicate an open radio-frequency tube, poor socket contact or open filament resistor or wiring.

In testing the audio-frequency tube, no reading in the filament test indicates an open filament resistor, or defective wiring. In the plate circuit test, no reading indicates an open output choke. In the grid test, the high resistance of the series grid resistor will prevent more than a slight movement of the voltmeter pointer.



Tube Socket Voltages for Testing

Stage	Tube Type	Filament	Plate	Screen	Grid
1st Radio-frequency	224	2.0	170	75	3.5
2nd "	224	2.0	170	75	3.5
3rd "	224	2.0	170	75	3.5
Detector	224	2.0	50	15	1.0
Audio-frequency	112-A	4.8	165	..	0.1

In making all tests great care must be used in selecting the correct scale of the voltmeter since the voltage across some terminals is as high as 170-180 volts. This will damage the voltmeter if the low voltage scale is used.

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DELCO RADIO

DESCRIPTION:—The Delco-Remy Radio designed for automobile installation is a five tube set using two stages of radio frequency (224 or 424 tubes), a detector (224 or 412-A tube) and two stages of audio-frequency amplification (227 or 427 tube in the first stage and a 112A or 412-A tube in the second or power stage). All tubes are of the new 'screen grid' type. Two types of receiver are in use. These differ primarily in wiring (see diagram) and 'C' batteries used. The first type is equipped with three 4½ volt batteries and a three terminal volume control switch while the second set uses a single 22½ volt 'C' battery and a two terminal volume control. Sets may be identified by this means. The receiving set is contained in a single case mounted under the cowl. It is tuned by a dial on the instrument panel connected to the set through a flexible cable control. The volume control is mounted at the left of the tuning dial and a switch is mounted at the right of the dial. The speaker is also concealed under the cowl. The 'C' batteries are mounted on a bracket on the dash. The 'B' batteries are located in a metal battery box under the floor boards of the front compartment on the right hand side. A connection is made to the car battery through the switch and this current is used to heat the tube filaments. No separate 'A' battery is used.

Antenna:—The antenna is concealed in the roof of closed cars and the lead wire from the antenna is concealed in the right windshield post. On open cars the antenna is concealed in the webbing between the bows and the lead is carried down at the rear of the car and along the body sill to the set.

Batteries:—The batteries should be tested with a reliable voltmeter. When the voltage of the 'B' batteries falls below 35 volts (each battery) they should be replaced. The 'C' battery should be replaced when the voltage falls below 3½ volts (on 4½ volt type) or 15 volts (22½ volt type).

Resistances:—A special spark disturbance suppressor resistance is installed in each high tension lead at the spark plugs and in the coil high tension lead on the distributor head. These do not interfere with the car ignition and should not be removed. If the set is noisy the car should be checked to see that these resistance units are in place. In addition a by-pass condenser is connected across the generator and a second condenser across the starter to eliminate interference caused by current surges in the charging circuit or when the car is started.

OPERATION:—Turn the set on by inserting the key in the switch and turning to the 'On' position. The tube filaments heat slowly and it will require several minutes for reception to start. However, the car ammeter should indicate a slight discharge when the switch is turned on. Turn the volume control on about half way and then turn station selector or tuning dial until the desired station is tuned in. The set is equipped with an automatic volume control which will prevent signal strength dropping below the point which the volume control is set even though the signal strength is affected by the movement of the car.

TESTING (on the car):—If the set does not operate satisfactorily, test 'B' and 'C' batteries with a voltmeter. Replace 'B' batteries if below 35 volts and 'C' batteries if below 3½ or 15 volts. Examine battery connections. See that antenna wire is not touching any of the wires under the cowl. Check connections on terminal block on speaker (see diagram). Test tubes. The set must be removed from the mounting brackets and the cover removed by taking out nine screws before the tubes can be removed. The two radio-frequency tubes are in series and the detector tube is in series with the first audio-frequency tube (second type), while the two radio-frequency tubes and the detector tube are all connected in series on the first type set.

Failure of any one tube will prevent the other tubes in the circuit from heating. If possible, tubes should be tested in a regular tube tester. If tube tester is not available, substitute a new tube for the one that is suspected. If these tests do not locate trouble, the set should be removed from the car for further tests on the bench.

DELCO-REMY RADIO - FIRST TYPE.

SECOND TYPE

DELCO RADIO

REMOVAL OF SET:—To remove the radio set from the car for bench testing, first disconnect the 'B' batteries at the battery box. This is very important as it will prevent any damage to the tubes when the battery leads are being disconnected at the terminal block. There is also danger of shock, as the line voltage across the 'B' batteries is 180 volts. Then disconnect the aerial lead wire. Disconnect the tuning control by loosening the nut at the end of the control conduit at the set. Disconnect the leads on the terminal block on the loud speaker. Remove the ignition lock (Dual Lock) on the instrument board on Cadillac and La Salle cars. Then remove the plates on the bottom of the mounting brackets and lift the set from place.

TESTING (On the Bench):—Accurate testing requires the use of a test 'Analyzer' or a specially designed test panel. The Jewell Set Analyzer, Pattern No. 134, is recommended by a car manufacturer using this type radio. With the set analyzer, tests are made by removing one tube at a time, inserting cable plug of the analyzer in the tube socket and inserting the tube in the socket of the analyzer. The volume control should be turned to the extreme loud position. Test readings should correspond to the following table:

Position	Tube Type	Filament Volts	Plate Volts	Control Grid Volts	Screen Volts	Plate MA Current
1. RF.	224	1.8	135	3.25	110	2.4
2. R.F.	224	1.8	80	00	50	1.8
Detector	224	2.0	25	10.0	15	2.2
1. A.F.	227	1.8	40	.4	....	.2
2. A.F.	212-A	4.0	140	.4	....	.4

This set can be tested for grounds with a 25 watt, 110 volt test line. All external connections should be disconnected in making this test. In checking the operation of the set, it should be kept in mind that the two radio-frequency tubes and the detector tube on the first set are connected in series, and that the two radio-frequency tubes in the second type set are in series, while the detector tube is in series with the first audio-frequency tube. If one of these tubes is burned out, neither tube will heat up when the set is turned on. Whenever a tube is suspected, the tube socket should be examined to see that the contact springs are touching tthe tube prongs. If the reception is apparently satisfactory but weak, it may indicate faulty radio-frequency tubes.

TRANSITONE RADIO

DESCRIPTION:—The Transitone Radio is a six tube set using three stages of radio-frequency (201-A or 301A tubes), a detector (200-A or 300-A tube in the first set and a 112-A tube in the second type) and two stages of audio-frequency amplification. A 201-A or 301-A tube is used for the first stage of audio-frequency and a 112-A tube in the second or power stage. Two types of receivers are in use. The first type has the complete receiver mounted in a single shielded box mounted on the dash of the car. With this type the loud speaker was placed above the windshield of the car (some cars are fitted with two loud speakers, one in the front compartment and one in the rear) and are connected to a toggle switch on the dash. Where only one speaker is used, connections are made to the auxiliary output jack on the instrument panel. This jack permits a portable loud speaker to be plugged in, disconnecting the car speaker, and providing reception at a distance.

The second type set is mounted in two shielded cabinets both mounted on the dash. The cabinet containing the tuning condensers (connected with the tuning dial on the instrument panel through a flexible cable control) contains the three stages of radio-frequency and the detector tube. The second cabinet contains the two stages of audio-frequency amplification. With this installation the loud speaker is mounted on the dash and is plugged in a jack in the side of the second box. A portable speaker can be plugged in after the regular car speaker has been disconnected.

Antenna:—The antenna is built in the roof of colsed cars and the lead wire is run down the windshield post to the set. On open cars the antenna is concealed in the roof and the lead is carried down at the back of the top and through the body of the car.

Batteries:—The filament current for the tubes is taken from the regular car battery and no 'A' battery is installed. The current consumption will be approximately 1½ amperes. Three 45 volt vertical 'B' batteries are installed in a metal battery box under the car floor. Two 4½ volt 'C' batteries are also located in the battery box. Batteries should be tested with a voltmeter while the set is in operation. When the voltage of the 'B' batteries falls below 35 volts (each battery) and the 'C' battery voltage below 4 volts, the batteries should be replaced with standard radio batteries, preferably the same make and type as originally used.

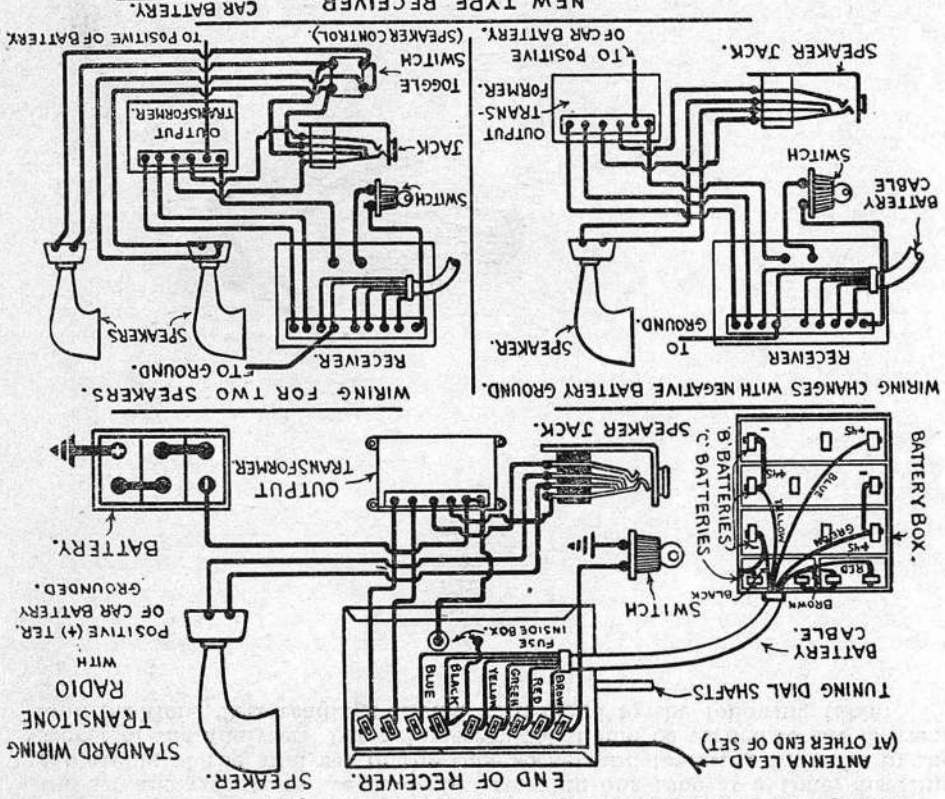
Interference. To eliminate interference caused by th electrical system of the car, 'suppressors' or spark disturbance eliminators are connected in the high tension leads at each spark plug and in the coil to distributor lead on the distributor head. These do not interfere with the car ignition and should not be removed. A special by-pass condenser is also connected across the car generator to eliminate interference caused by current surges in the charging circuit.

OPERATION:—Turn the set on by inserting the key in the switch on the instrument panel and turning to the right. This switch controls the filament current of the tubes. The tuning dial (second type) or two tuning dials (first type) should then be turned to bring in the desired station. Volume is controlled by the small knob in the center of the tuning dial (second type). Reception on cars is affected by the location of the car in respect to distance and the shielding action of surrounding objects. Reception may not be uniform with the car in motion.

TESTING:—Turn on set. There should be a distinct click from the speaker as the switch is turned off and on. If this click is not heard, examine battery connections and see that 'A' battery is properly connected. The set must be connected exactly as shown on the diagrams. Test 'B' and 'C' batteries. If 'B' batteries test less than 35 volts and 'C' batteries less than 4 volts, they should be replaced. On first type set open cover and examine fuse on side of case. Examine tubes. If any tube does not light, replace with a tube of the same type. Disconnect speaker and plug in a test speaker or set of headphones. If the set operates satisfactorily the speaker must be replaced. The first type set is connected to the speaker through an output transformer mounted on the front dash. The transformer should be tested by a voltmeter in series with a battery. If the voltmeter indicates voltage reading with the test leads clipped first to the speaker terminals on the transformers and then to the two set terminals indicating that the two windings are in good order the transformer is all right.

If Reception is Weak. Test batteries with radio turned on. Replace 'B' batteries if voltage reading is less than 40 volts. Replace tubes which do not light up properly. The tubes should be tested on a regular tube tester if possible since the filament test is not conclusive. Examine car battery for poor connections due to corrosion or loose terminals.

If Reception is Noisy. On the first type set turn the two tuning dials until the index numbers are widely different. This will eliminate outside signals. If the noise stops it has been caused by external conditions due to location of car, etc. If noise continues, turn off volume control. If this does not eliminate noise the detector tube should be replaced. Noisy reception while the car is traveling which disappears when the car is stopped may be caused by loose connections or faulty connections in the tube sockets. Remove tubes and see that contact prongs on tubes are clean and making firm contact with the contacts in the socket.



LINK BELT TIMING CHAINS

DESCRIPTION:—Link Belt Timing Chains are made in center guide, 'Side Flange' guide, and Duplex types. The center guide type for use with slotted sprockets is ordinarily used. The Duplex type is used with the Link Belt automatic adjustment idler sprocket.

Chain construction is of the 'bushed pin' link type. A round pin is assembled between two segmental bushings. The bushing is held rigidly in place in the end of the link but is free to turn in the intermediate links. The pin is free to turn within the bushings and will wear evenly (see illustration). To disassemble the chain, to remove a hunting link or for any other purpose, turn the chain until the hunting link is on a sprocket. Then split the washer under the riveted head of the pin, push out the pin and remove the segmental bushings. The chain will then come apart and the link can be removed after the pin at the other end is similarly taken out.

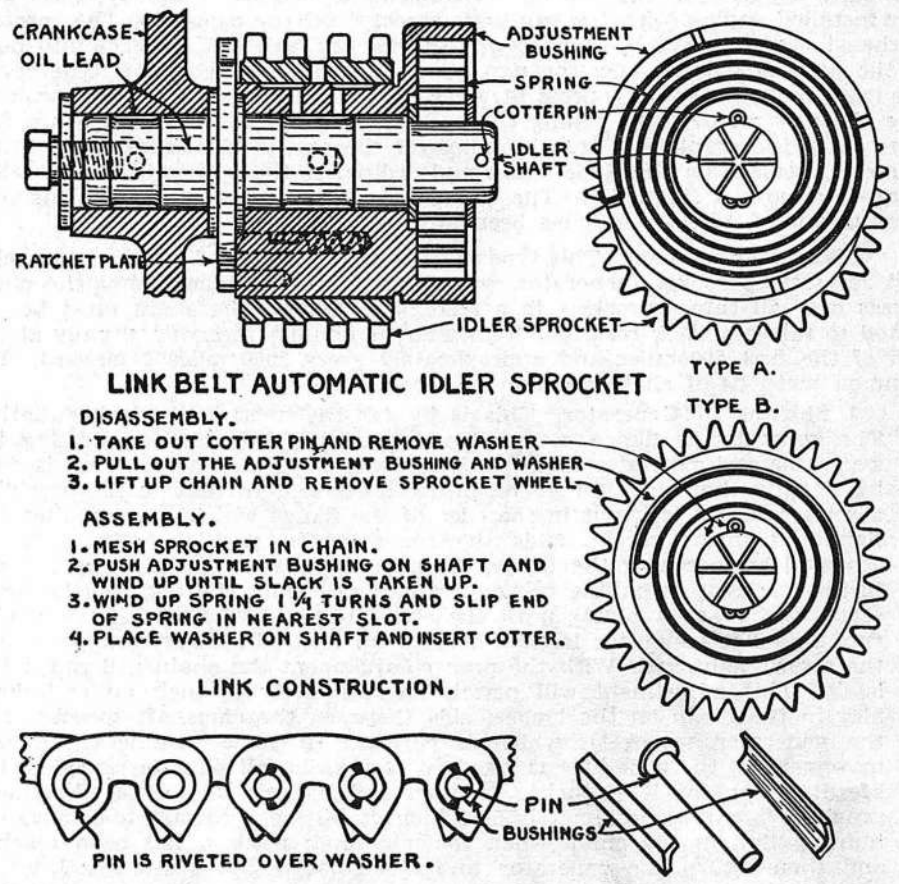
ADJUSTMENT TYPES:—Link Belt Chains are used with the various types of adjustments listed on the previous page. In addition a special type of eccentric manual adjustment and a special automatic adjustment idler sprocket have been developed.

Eccentric Manual Adjustment. On this type the sprocket revolves on an eccentric stub shaft which is mounted in the crankcase and which can be rotated by hand to take up the timing chain. The accessory drive shaft passes through the center of the chain (its center does not shift). A toothed flange is bolted on the end of the accessory shaft and corresponds with teeth on the forward end of the drive sprocket. The two are held together by a small chain which is assembled around them directly in front of the timing chain. This type of mounting permits the removal of the accessory shaft or generator (where the generator shaft extends through the eccentric mounting) without disturbing the timing chain simply by removing the nut on the end of the shaft which holds the drive flange in place. Any desired relation between the crankshaft and accessory shaft can be secured (where this is necessary for timing, etc.) by removing the small coupling chain and rotating the accessory shaft.

Automatic Adjustment Idler Sprocket. This type sprocket is designed in two types which differ in construction principally in the manner of mounting the take-up spring (see illustration). It is used with a duplex type chain and is ordinarily mounted between the accessory drive sprocket and the crankshaft sprocket and engages the back of the chain (where the chain is wrapped around the crankshaft sprocket), or inside the chain (where the chain passes over the crankshaft sprocket). The sprocket revolves on an eccentric sleeve which is mounted on a short stub shaft mounted in the crankcase. A spiral spring is placed under tension in such a manner as to tend to revolve the eccentric sleeve (one end of the spring is engaged in the slotted end of the stub shaft and the other end is fastened to the eccentric sleeve) thus forcing the sprocket toward the chain and taking up the slack. The sprocket is designed to take up all slack developed during the life of the chain and no adjustment is necessary.

To Remove Automatic Idler Sprocket. First take out the cotter pin in the end of the stub shaft. Then take hold of the adjustment bushing (eccentric sleeve) and pull out by hand. The washer, adjustment bushing and spring will come out together. The chain can then be lifted up and the sprocket wheel lifted off.

To Install Automatic Idler Sprocket. Place the sprocket wheel on the shaft and mesh it in the chain. Push the adjustment bushing or eccentric bushing on the shaft until the spring is close to the slotted end of the shaft and rotate the bushing by hand until the spring slack is all taken



up. Wind up the spring one and one quarter turns (not more than one and one half turns) and push the end of the spring into the nearest slot of the shaft. A special spring winder should be used in winding up the spring. Press the spring back into the spring box, place the washer on the shaft and insert the cotter pin. The assembly can be checked by turning the eccentric bushing in a direction opposite to the winding direction. The spring should return it to the initial position when it is released.

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2. Eccentric Mounting of the Accessory Sprocket. On this type of drive the accessory drive sprocket is mounted on an eccentric bushing and provision is made for rotating the bushing thus moving the sprocket outward and tightening the chain. The accessory drive is taken through tongue and slot on the face of the sprocket to the shaft on which the eccentric bushing or the generator is flange mounted and provision is made for shifting the generator and generator drive sprocket away from the engine. This is done by slotting the upper flange mounting holes and in some cases providing a set screw and lock nut in the edge of the flange which bears against the flange mounting screw holds the generator in position. The chain is adjusted by loosening the flange mounting screws and turning up the adjustment screw or pulling the generator away from the engine (the lower screw serving as a pivot) until the chain begins to hum with the engine running. The generator is then slacked up until the noise disappears and the screws tightened. With the proper adjustment the chain will run noiselessly. This adjustment will permit approximately ½ inch up and down play in the chain on the longest side (between the camshaft sprocket and the generator sprocket), which is correct. In some instances sufficient movement of the generator is provided to take up all play developed in the life of the chain (⅛-⅝ inch). In other installations where the adjustment provided is only approximately 5/16 inch, it will be necessary to remove the hunting link in the chain when the maximum position has been reached and then return the generator to its original position. A second set of adjustments can then be made. In any case not more than one link (the hunting link) should be removed from the chain and a hunting link should never be connected in an old chain. The chain adjustment is usually sufficient to take up all allowable wear before the chain teeth spread to such an extent that they will not mesh satisfactorily in the sprocket teeth and when this occurs a replacement chain should be installed.

On ordinary installations of this type the sprocket is bolted directly on the generator shaft and it will be necessary to remove the chain case cover and remove the chain or to take off the nut on the generator shaft and pull the sprocket before the generator can be taken off the engine. A variation of this type drive which is being used extensively has the sprocket mounted on a sleeve which is mounted independently of the generator. The generator is driven through a short shaft carried within the sprocket sleeve and driven by a tongue engaged in the face of the sprocket.

1. Shifting of Generator. This is by far the most common installation. The generator is flange mounted and provision is made for shifting the generator and generator drive sprocket away from the engine. This is done by slotting the upper flange mounting holes and in some cases providing a set screw and lock nut in the edge of the flange which bears against the flange mounting screw holds the generator in position. The chain is adjusted by loosening the flange mounting screws and turning up the adjustment screw or pulling the generator away from the engine (the lower screw serving as a pivot) until the chain begins to hum with the engine running. The generator is then slacked up until the noise disappears and the screws tightened. With the proper adjustment the chain will run noiselessly. This adjustment will permit approximately ½ inch up and down play in the chain on the longest side (between the camshaft sprocket and the generator sprocket), which is correct. In some instances sufficient movement of the generator is provided to take up all play developed in the life of the chain (⅛-⅝ inch). In other installations where the adjustment provided is only approximately 5/16 inch, it will be necessary to remove the hunting link in the chain when the maximum position has been reached and then return the generator to its original position. A second set of adjustments can then be made. In any case not more than one link (the hunting link) should be removed from the chain and a hunting link should never be connected in an old chain. The chain adjustment is usually sufficient to take up all allowable wear before the chain teeth spread to such an extent that they will not mesh satisfactorily in the sprocket teeth and when this occurs a replacement chain should be installed.

On ordinary installations of this type the sprocket is bolted directly on the generator shaft and it will be necessary to remove the chain case cover and remove the chain or to take off the nut on the generator shaft and pull the sprocket before the generator can be taken off the engine. A variation of this type drive which is being used extensively has the sprocket mounted on a sleeve which is mounted independently of the generator. The generator is driven through a short shaft carried within the sprocket sleeve and driven by a tongue engaged in the face of the sprocket.

2. Eccentric Mounting of the Accessory Sprocket. On this type of drive the accessory drive sprocket is mounted on an eccentric bushing and provision is made for rotating the bushing thus moving the sprocket outward and tightening the chain. The accessory drive is taken through tongue and slot on the face of the sprocket to the shaft on which the eccentric bushing or the generator is flange mounted and provision is made for shifting the generator and generator drive sprocket away from the engine. This is done by slotting the upper flange mounting holes and in some cases providing a set screw and lock nut in the edge of the flange which bears against the flange mounting screw holds the generator in position. The chain is adjusted by loosening the flange mounting screws and turning up the adjustment screw or pulling the generator away from the engine (the lower screw serving as a pivot) until the chain begins to hum with the engine running. The generator is then slacked up until the noise disappears and the screws tightened. With the proper adjustment the chain will run noiselessly. This adjustment will permit approximately ½ inch up and down play in the chain on the longest side (between the camshaft sprocket and the generator sprocket), which is correct. In some instances sufficient movement of the generator is provided to take up all play developed in the life of the chain (⅛-⅝ inch). In other installations where the adjustment provided is only approximately 5/16 inch, it will be necessary to remove the hunting link in the chain when the maximum position has been reached and then return the generator to its original position. A second set of adjustments can then be made. In any case not more than one link (the hunting link) should be removed from the chain and a hunting link should never be connected in an old chain. The chain adjustment is usually sufficient to take up all allowable wear before the chain teeth spread to such an extent that they will not mesh satisfactorily in the sprocket teeth and when this occurs a replacement chain should be installed.

On ordinary installations of this type the sprocket is bolted directly on the generator shaft and it will be necessary to remove the chain case cover and remove the chain or to take off the nut on the generator shaft and pull the sprocket before the generator can be taken off the engine. A variation of this type drive which is being used extensively has the sprocket mounted on a sleeve which is mounted independently of the generator. The generator is driven through a short shaft carried within the sprocket sleeve and driven by a tongue engaged in the face of the sprocket.

1. Shifting of Generator. This is by far the most common installation. The

DISTRIBUTORS

SYNCHRONIZATION OF CONTACTS

CHECKING OF CONTACTS

SINGLE CONTACT BREAKERS:—An accurate determination of the instant the breaker contacts open with relation to the position of the piston and crankshaft cannot be made with sufficient accuracy by observing the contacts and the use of test lamps is strongly recommended. However in simple ignition systems (using a single breaker arm and one set of contacts) it may be sufficient to determine when the spark occurs by watching the ammeter or the spark at the spark plugs. In making this test, the engine should be turned over until piston No. 1 (or the piston to be used for timing—see car data sheet) is approaching top dead center on the compression stroke. The ignition should then be turned on and the engine turned over slowly by tapping the crank with the hand. The ammeter will indicate the current drawn by the ignition coil, ordinarily 2-5 amperes. At the instant the contacts open, the ammeter pointer will swing back to '0'. If the piston is at the firing position when this occurs the ignition setting is satisfactory. If no one is available to turn the engine over while the ammeter is being watched, the spark plug cable can be detached from the spark plug in the cylinder being used for timing and placed so that a spark gap of ⅛ inch is formed between the cable terminal and the engine block. The spark will jump this gap at the instant the contacts open.

DOUBLE CONTACTS—ALTERNATE OPENING:—This method can also be applied to distributors using two breaker arms and two sets of contacts with alternate opening. In all systems of this type, both sets of contacts must be open to secure a spark; this is accomplished by arranging one set of contacts to open an instant before the previous set have closed. It is important to keep the contact gap for both sets of contacts exactly the same and the contacts should be examined and adjusted whenever the ignition is checked. When test lamps are used, one test lamp lead should be clipped to the breaker terminal on the distributor housing and the second test lamp lead grounded to the distributor housing. The ignition should be turned on. The lamp will light at the instant the contacts open. If it is not possible to turn on the car ignition, one test lamp should be clipped to the distributor terminal and the other lead connected to a 'hot' terminal such as the relay terminal on the generator, or the horn feed. The lamp will remain lighted as long as the contacts are closed and will go out at the instant the contacts open.

DOUBLE CONTACTS—SIMULTANEOUS OPENING:—On distributors using two sets of breaker contacts connected in parallel in the coil primary circuit, a test lamp will only indicate the opening of the second or last set of contacts if the contacts are not synchronized so as to open simultaneously. Each set of contacts must be tested separately. In making these tests with the test lamp connected as directed above, block open one set of contacts with an insulator (piece of cardboard, etc.), and check the opening of the second set of contacts. Make a mark on the flywheel to indicate the point of contact opening, or see that the contacts open when the ignition mark is opposite the indicator. Then turn the engine through one complete revolution, remove the insulation from the first set of contacts and block open the other set. Check the opening of the first set of contacts and see that the same point on the flywheel is at the indicator. See data on distributors for specific instructions on adjusting the breaker to secure this simultaneous opening.

DUAL IGNITION OR DOUBLE COIL SYSTEMS:—Systems of this type either have two spark plugs in each cylinder fired by separate coils or each coil fires half of the total number of spark plugs. There are two sets of breaker contacts, each controlling one coil and electrically separate from the other. The contact opening of each set of contacts must be checked individually by connecting a test lamp in each primary circuit. The test is similar in all respects to the test for 'Double Contacts—Alternate Opening'.

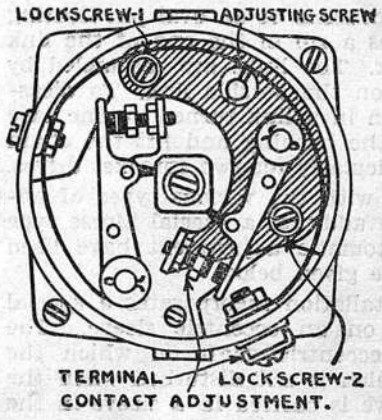
DELCO-REMY

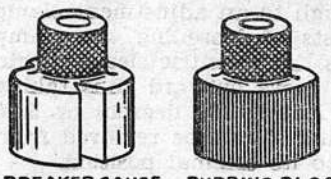
CADILLAC AND PACKARD TYPE

DESCRIPTION:—These distributors have two breaker arms operating on a four (1928) Packard Eight was fitted with two breaker arms operating on a four lobe cam. The sets of contacts were designed to open alternately at intervals of 45 degrees corresponding to the 90 degree firing interval of the engine. Each set of contacts controlled one ignition coil and fired the spark plugs in four cylinders (Packard type). Contacts are connected in parallel on Cadillac distributor.

CONTACT ADJUSTMENT:—The contact gap should be set at .018-.024 inch. Set contact gap by loosening the lock nut on the stationary contact mounting stud and turning up the stud. Resurface contacts when necessary on a medium hard oilstone or use a fine flat contact file. The breaker gap must be measured with the breaker arm on the lobe of the cam. The breaker arm spring tension should be 17-21 ounces. This can be measured with a small spring balance, hooking the balance under the breaker arm at the contacts and noting the scale reading necessary to open the contacts. The contact gap must be accurately set before the contacts are synchronized. This type distributor is fitted with a removable cam held in place on the distributor shaft by a taper lock screw.

SYNCHRONIZATION OF CONTACTS:—A special Delco-Remy tool, Part No. 822965, has been developed for use in synchronizing the Type 4033 Packard distributor. The standard Type 822572 synchronizing tool should be used on Cadillacs. This tool is a dummy cam which is placed on the distributor shaft after the regular firing cam has been removed. To synchronize contacts, loosen the taper lock screw in the center of the breaker cam and remove the cam. Place the synchronizing tool on the shaft so that the fiber bumper of the first set of contacts (mounted directly on the breaker plate) fits in the notch in the face of the tool. Then loosen the lock screws on the movable sub-plate (on which the second set of contacts is mounted) and turn the adjusting screw until the fiber bumper on the second breaker arm fits in the other notch on the tool. The two contact arms are then properly synchronized and will open at 45 degree intervals. Remove the synchronizing tool and replace the regular firing cam. It will be necessary to correctly locate the cam by timing the distributor to the engine. See car data sheet on these car models.





RESURFACING BREAKER ARM RUBBING BLOCKS:—The point at which the contacts open is controlled largely by the bearing surface of the breaker arm rubbing block or fiber bumper on the face of the cam. If these rubbing blocks do not wear evenly or do not bear on the cam across their entire face, it will be necessary to resurface them. A special rubbing block file, Delco-Remy Part No. 822571, has been developed for this purpose. This tool is designed in the shape of the synchronizing tool and can be slipped on the shaft after the regular firing cam has been removed. The rubbing block file should be placed on the shaft and the distributor shaft turned to true the face of the rubbing blocks. The breaker arm rubbing blocks should be examined and resurfaced if necessary when the regular cam is removed for purposes of synchronizing the contacts.

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MORSE SILENT TIMING CHAINS

CHAIN TYPES:—Morse Silent Timing Chains are furnished in center guide and duplex types. Three types of joint construction will be found in service. These are Rocker Joint, Bushed Joint, and Oscillating Joint types

1. Rocker Joint. The Rocker Joint link assembly consists of two pins, a ribbed seat pin, and a plain rocker pin. The chain is designed to operate in one direction which is indicated by an arrow stamped on the face of the outside links. The seat pin is the leading pin and is assembled with the rib pointing in the direction of the arrow. This rib engages in a slot cut in the end of the links and prevents the seat pin from turning. The rocker pin is free to oscillate in the link. In assembly the two pins are slipped in place in the link and a retaining washer is slipped over the end of the seat pin. The seat pin is then riveted over the washer. To disassemble the chain, first turn the chain until the link which is to be taken out is directly over one of the sprockets, then split the washers at each end of the link with a cold chisel and push out the pins. The chain can then be removed and the link will fall from place.

2. Bushed Joint. In Bushed Joint construction, the links are held in place by a round pin and two half round bushings. The bushing is held rigidly in the end of the link but is free to turn in the intermediate links, permitting the chain to adapt itself to the sprockets. In assembling the chains the bushings are slipped in place and the outer link assembled with the 'D' shaped end of the pin projecting through the link. The pin is then riveted over the link. To disassemble the chain, turn chain until the hunting link is on the sprocket. Then drive out the pin at each end of the link and take out the pin and bushings. Chains of this type without direction arrows are designed to run in either direction. Certain chains are marked with direction arrows on the outside links. The chain should be assembled so as to run in the direction of the arrow.

3. Oscillating Joint. The Oscillating Joint consists of an oval pin floating between two bushings. Each bushing engages a rib in the end of the link but is free to turn in the intermediate link. The links are assembled by riveting the end of the pin over a washer on the outside link. To disassemble the chain, split the washer of one pin in a link turned on the face of the sprocket. Push out the pin, remove the bushing and lift the chain from place. This type chain is designed particularly for two sprocket drives.

ADJUSTMENT TYPES:—Morse Chains are used with the various types of adjustment detailed on the preceding page. In addition a special Morse type eccentric manual adjustment drive and automatic adjustment have been developed. Details concerning these types are given below.

1. Eccentric Manual Adjustment. This installation incorporates a special accessory drive sprocket which is carried on an eccentric sleeve. The accessory drive shaft passes through the eccentric shaft on which the sprocket revolves and has a fixed center which is not disturbed when the timing chain is adjusted. The eccentric sleeve is carried in a sleeve in the rear of the timing chain case and extends through to an adjustment clamp arm on the rear face. The adjustment consists of loosening the clamp screw and turning the clamp arm. This revolves the eccentric sleeve within the accessory sprocket, causing the sprocket to move outward thus taking up the chain slack. The full range of adjustment is 180 degrees or 5/16 inch. When this point is reached the hunting link should be removed from the chain and the adjustment clamp returned to its original position.

2. Morse Automatic Adjustment. The Morse Automatic Adjustment consists of an idler sprocket engaging the rear face of a Duplex type timing chain. The idler sprocket revolves on a bushing which is mounted eccentrically on a stationary shaft. Three coil springs in the shaft maintain a constant pressure on the bushing tending to move the sprocket toward the chain and thus take up the chain slack. Two dogs or ratchets are held in engagement with serrations in the sides of the shaft. These provide stops for the adjustment and prevent reverse action. Provision is made for force lubrication. The adjustment range is sufficient to take up all allowable wear in the chain. When the sprocket reaches the point of maximum adjustment the chain should be replaced. Shortening the chain will cause excessive wear on the sprockets since the chain teeth will not mesh properly.

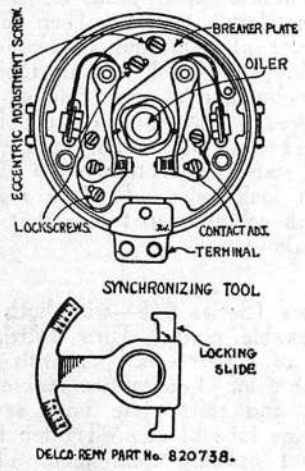
To replace the chain, take off the hexagon nut, lock washer and large retaining washer. This will expose the sprocket mounting on the stud shaft. Insert a small flattened pin in the two slots in the slide adjacent to the shaft. This will release the ratchets. Then press down on the sprocket compressing the springs and insert a hardwood plug in the slide opening under the stud shaft to hold the sprocket in place. The chain can then be replaced. If it is desired to disassemble the automatic sprocket this can be done after the chain has been removed by sliding the sprocket off and then forcing the bushing outward. After the bushing has been removed the slide can be removed and disassembled. Be careful to save the five springs used in the assembly. In reassembling, the large retaining washer must not be clamped tight against the face of the sprocket. The clearance at this point should be .006-.008 inch.

DISTRIBUTORS

SYNCHRONIZATION OF CONTACTS

DELCO-REMY
TYPE 658

These breakers have two sets of contacts operating on a four sided cam and opening alternately at intervals of 45° which corresponds to 90° of crankshaft rotation. This is the correct firing interval for the 90° 'V' type engines and eight cylinder 'Line' engines on which these units are used. Ignition timing on these breakers is done by loosening advance arm clamp screw and rotating distributor housing and breaker plate around cam. Cam is integral with upper distributor shaft.

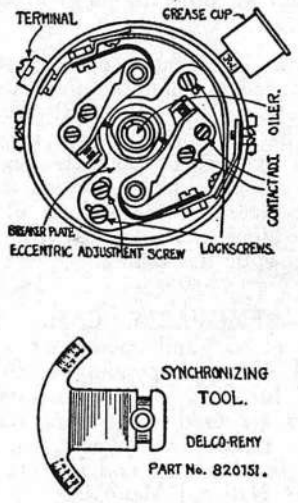


To set firing interval use Delco-Remy Part No. 820738. First check contact gap of both sets of contacts. Turn shaft until contact arm is on lobe of cam. Then loosen lockscrew and turn eccentric adjusting screw until contact gap is .022 inch. Tighten the lockscrew. After checking both contact gaps, place synchronizing tool over cam locking it in place by pushing slide tight so that arrow visible on slide points in direction of rotation. Turn shaft in direction of rotation until stationary set of contacts open. Note reading on leading side of tool which is opposite the edge of the terminal block on edge of distributor cup. Continue to turn shaft until the same reading on the second scale is opposite the same point on distributor cup. Loosen two lockscrews and turn eccentric adjusting screw until second set of contacts separate. Tighten lockscrew. Check contact opening with contact arm on lobe of cam. It must be within limits of .018-.024 inch. If it is not, reset contact gap at .022 and repeat synchronizing operation. Tool scales are graduated in degrees of engine rotation. The allowable variation is 2°.

Timing Distributor to Engine. To time the distributor to the engine, crank engine over until piston No. 1 reaches firing position (see individual car data sheets). Note whether timing should be set with distributor in advance or retard position and see that advance lever and breaker assembly are correctly placed. Distributor should be turned against direction of rotation to advance the spark. Then loosen the advance arm clamp screw and rotate the distributor cup until the first set of contacts (mounted directly on base plate) begin to open. Tighten the clamp screw. If contacts are correctly synchronized, the second set (mounted on the movable base plate) should begin to open 45° after this point when the next piston to fire reaches position.

DELCO-REMY
TYPE 656

These breaker have two sets of contacts with a three sided cam opening alternately at intervals of 60° corresponding to 120° of crankshaft rotation. This is the correct firing interval for the six cylinder engines on which this unit is used. Ignition timing on these breakers is done by loosening advance arm clamp screw and rotating distributor housing and breaker plate around cam. Cam is integral with upper distributor shaft.

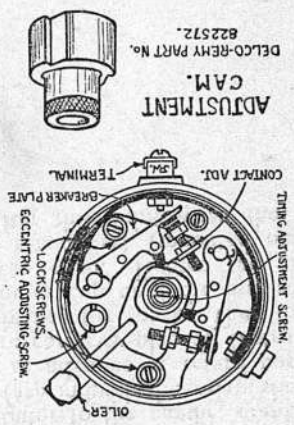


To set firing interval use Delco-Remy Part No. 820751. First check contact gap of both sets of contacts. Turn shaft until contact arm is on lobe of cam. Then loosen lockscrew and turn eccentric adjusting screw until contact gap is .022 inch. Tighten the lockscrew. After checking both sets of contacts, place synchronizing tool over cam with left hand spring in slot in shaft for clockwise rotation and the right hand spring in the slot for counter-clockwise rotation. Then turn shaft in direction of rotation until stationary contacts separate. Note reading on leading scale of tool opposite the approaching edge of the slot in the edge of the distributor cup. Continue to rotate shaft until the same reading on the other scale is opposite the same point on the distributor cup Loosen the two lockscrews on the mounting plate and turn eccentric adjusting screw until the second set of contacts begin to separate. Tighten the lockscrews and check contact gap with contact arm on lobe of cam. It must be within limits of .018-.024 inch. If it is not, reset gap to .022 inch and repeat synchronizing operation. The tool scale is graduated in degrees of engine rotation. The allowable variation is 2°.

Timing Distributor to Engine. To time the distributor to the engine, crank engine over until piston No. 1 reaches firing position (see individual car data sheets). Note whether timing should be set with distributor in advance or retard position and see that advance lever and breaker assembly are correctly placed. Distributor should be turned against direction of rotation to advance the spark. Then loosen the advance arm clamp screw and rotate the distributor cup until the first set of contacts (mounted directly on base plate) begin to open. Tighten the clamp screw. If contacts are correctly synchronized, the second set (mounted on the movable base plate) should begin to open 60° after this point when the next piston to fire reaches position.

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DISTRIBUTORS

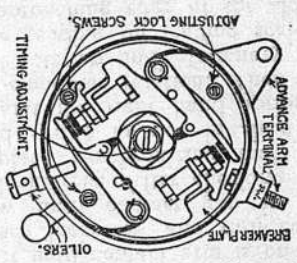
SYNCHRONIZATION OF CONTACTS

DELCO

REMOVABLE CAM TYPES

DOUBLE BREAKERS—SYNCHRONOUS OPERATION. Breakers using two sets of contacts operating on a single cam and opening at the same instant must be synchronized, which means both sets of contacts must open at the same instant. If this is not done the breaker contacts opening last will carry all the load and will burn up in service where the contacts are connected in parallel. Where double ignition is used one set of plugs will fire at the wrong time affecting ignition. However, in special cases manufacturers specify certain intervals of time between firing of plugs in double ignition systems and these intervals must be accurately set.

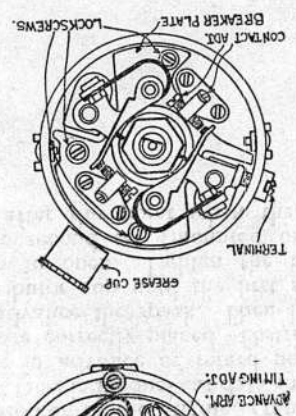
Delco Distributors. Set contact opening at correct figure recommended by manufacturer as given on car data sheets in the National Manual. Contact arm must be on lobe of cam. Turn distributor shaft until one set of contacts begin to separate. Then loosen three lockscrews on mounting plate and shift plate until second set of contacts also begin to separate. Tighten the lockscrews and proceed with the timing.

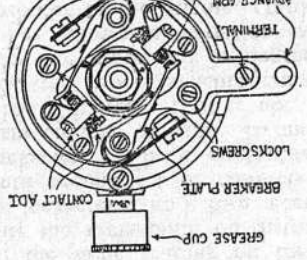


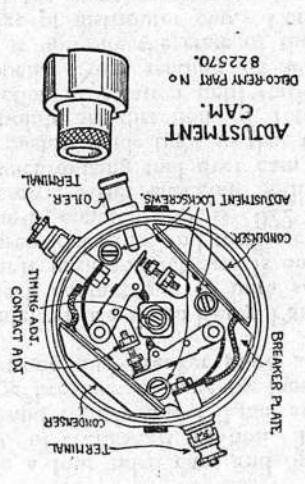
DOUBLE BREAKERS—ALTERNATE OPENING—REMOVABLE CAM. These breakers use two sets of contacts mounted at an angle of 45° and operate on a four sided cam. Contacts open alternately at intervals of 45° corresponding to 90° of crankshaft rotation. This is the correct firing interval for 90° 'V' type engines and eight cylinder 'Line' engines on which these distributors are used. The firing interval must be accurately set or timing of four cylinders will be thrown out. Timing on these breakers is set by loosening taper screw or lockNut on breaker cam and shifting cam. For specific car timing directions see car data sheets in National Manual.

Delco and Remy Distributors. Use Delco-Remy Part No. 822572 to set correct firing interval. First set contact gap to .0225-.0275 inch on Delco breakers and .018-.024 inch on Remy breakers with contact arm on high point of cam. Then with breaker arm on high point and with distributor shaft and check to see that contacts open at the same instant. If they do not, adjust contact opening keeping within limits of .018-.024 inch. Increasing contact gap will make contacts open sooner while decreasing contact gap will make contacts open later.

Remy Distributors (Series 648)—with one set of contacts on movable plate and one set stationary. Turn distributor shaft until contact arm mounted on stationary plate is on lobe of cam. Set contact opening at .022 inch. Then loosen three lockscrews and shift plate until second contact arm is also on high point of cam. Tighten lockscrews and set contact opening at .022 inch. Then turn shaft and check contacts to see that they open at the same instant. If they do not, change contact opening by varying contact gap. Increasing the contact gap will make contacts open sooner and decreasing gap will make contacts open later. The contact gap must be kept within the limits of .018-.024 inch.







REMY
TYPE 648

120° periods. Two breaker arms are mounted on an angle on a four sided cam and open alternately. Ignition timing on these engines is set by loosening taper screw in center of cam and shifting cam until one set of contacts begins to open with piston in firing position.

To set firing intervals use Delco-Remy Part No. 822570. First set contact gap at .0225-.0275 inch with contact arm on lobe of cam. Then loosen taper screw in center of cam and remove cam. Replace with synchronizing tool placing tool on shaft so that fiber bumper of one contact arm rests in notch in tool. Then loosen three lockscrews on plate and shift plate until bumper of second contact arm rests in the other notch of the tool. Then tighten lockscrews. Replace regular firing cam and check contact gap to see that it is within limits given above.

Remy Distributors (Series 648—with both sets of contacts on movable plate. Turn distributor shaft until one set of contacts is open with contact arm on lobe of cam. Loosen two lockscrews on mounting plate and shift plate until second contact arm is also on lobe of cam. Tighten lockscrews. Set contact opening .022 inch. Then rotate shaft and check to see that contacts open at the same instant. If they do not, adjust contact opening keeping within limits of .018-.024 inch. Increasing contact gap will make contacts open sooner while decreasing contact gap will make contacts open later.

DISTRIBUTORS

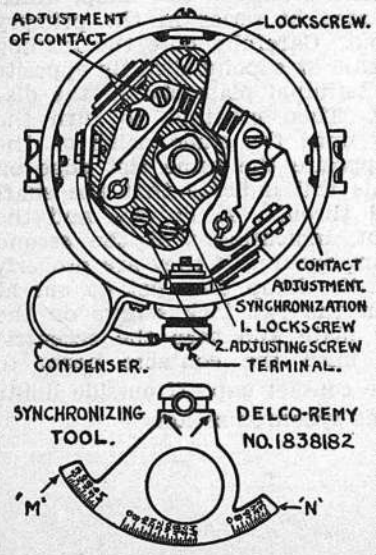
SYNCHRONIZATION OF CONTACTS

DELCO-REMY
TYPE 660 AND 661

DESCRIPTION:—This type distributor is designed for use on eight cylinder engines. It is fitted with two sets of contacts operating on a four sided cam. The contacts open alternately at intervals of 45 degrees corresponding to the 90 degree firing interval of the engines on which it is used. Both sets of contacts are connected in parallel in the primary circuit of the ignition coil. One condenser mounted on the side of the distributor shaft housing is used for both contacts. The breaker arms are designed so that one set of contacts closes immediately after the other set opens which provides a longer period of time for building up the coil primary current. Both sets of contacts must open to secure a spark at the plugs.

CONTACT ADJUSTMENT:—Contacts should be set at .022 inch and must be held within limits of .018-.024 inch. Set contact gap by loosening the lock screw on the stationary contact mounting plate (directly behind the breaker arm) and turning the eccentric adjusting screw. The breaker gap must be measured with the breaker on the lobe of the cam. Tighten the lock screw. Contacts can be resurfaced when necessary with a fine flat contact file or on a medium hard oilstone. The contact gap must be set before the contacts are synchronized and should be checked after the synchronization has been completed. If synchronizing has affected the gap sufficiently to throw it outside the limits of .018-.024 inch, reset the gap at .022 inch and repeat the synchronization.

SYNCHRONIZATION OF CONTACTS:—A special Delco-Remy synchronizing tool, Part No. 1838182, has been developed for use in synchronizing contacts on Type 660 distributors. Place the synchronizing tool in position on the upper end of the distributor shaft with the spring on the left or 'M' side of the tool in the slot in the cam (if the distributor rotates clockwise) or with the right or 'N' side of the spring in the cam slot (if the distributor rotates counter-clockwise) and connect a test lamp or ammeter in the primary circuit and turn on the ignition so that an accurate check of the contact opening can be made. Then turn the distributor shaft in the direction of rotation until the first set of contacts (mounted directly on the breaker plate—the so-called stationary contacts) begin to open. Note the reading on the center scale which is directly in line with the leading edge of the slot in the distributor housing. Continue to turn the distributor until the same reading on the 'N' side of the scale (for clockwise distributors) or the 'M' side of the scale (for counter-clockwise distributors) is in line with the same edge of the distributor housing slot. Then loosen the two lock screws on the movable sub-plate (on which the second set of contacts are mounted) and turn the eccentric adjusting screw until the contacts begin to open. Tighten the lock screws and check synchronization by turning the distributor shaft through a complete revolution and again noting scale readings as contacts open. The variation must not be greater than 2 tool graduations which corresponds to 2 degrees of crankshaft rotation. The contact gap must be checked after synchronizing contacts. If outside limits of .018-.024 inch, reset at .022 inch and repeat synchronization.

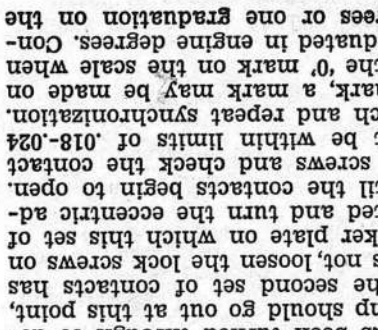


DELCO-REMY
TYPE 668

DESCRIPTION:—This type distributor has two sets of contacts operating on a four sided cam. Contacts open alternately at intervals of 45 degrees which corresponds with the 90 degree firing interval of the eight cylinder engines on which the distributor is designed to be used. Each set of contacts is fitted with a condenser and there is no electrical connection between the two sets. The distributor is used with two ignition coils and each set of contacts controls one coil, firing four cylinders of the engine. The synchronization of the contacts is very important in that the timing of four cylinders will be thrown out if the contacts are allowed to get out of synchronization and the engine performance will be unsatisfactory.

CONTACT ADJUSTMENT:—Breaker contacts should be set at .022 inch and must be held within limits of .018-.024 inch. Set contact gap by loosening lock screw on stationary contact mounting plate and turning eccentric adjusting screw until correct gap is secured with breaker arm rubbing block on lobe of cam. Tighten the lock screw. Contacts can be resurfaced when necessary with a fine flat contact file or on a medium hard oilstone. The contact gap must be set before the contacts are synchronized and should be checked after the synchronization has been completed. If synchronizing has affected the gap sufficiently to throw it outside the limits of .018-.024 inch, reset the gap at .022 inch and repeat the synchronization.

SYNCHRONIZATION OF CONTACTS:—One set of contacts is mounted on the base plate while the second set of contacts is mounted on a movable breaker plate. To synchronize contacts, first connect a six volt test lamp in series with each primary circuit. Then remove distributor head and turn distributor shaft until the first set of contacts begin to open when the lamp will go out. Clip the special synchronizing tool, Delco-Remy Part No. 1835009, on the edge of the distributor housing so that the '0' mark on the scale is opposite the leading edge of the rotor contact (for clockwise distributors) or with the '90' mark on the scale opposite the rotor (counter-clockwise distributors). Then turn the distributor shaft until the same edge of the rotor contact is opposite the '90' mark (if the '0' mark was used) or opposite the '0' mark (if the '90' mark was used for initial reference). This will indicate that the distributor shaft has been turned through 45 degrees and if the contacts are in synchronization the second lamp will go out at this point, indicating that the second set of contacts have begun to open. If the lamp does not go out, loosen the two lock screws on the movable breaker plate and turn the eccentric adjusting screw until the contacts begin to open. Tighten the lock screws and check the contact gap. If outside limits of .018-.024 inch, reset at .022 inch and repeat synchronization. The tool is graduated in engine degrees. The allowable variation in contact synchronization is 2 degrees or one graduation on the tool.



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DISTRIBUTORS

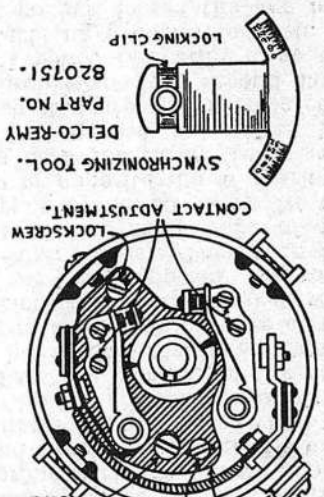
SYNCHRONIZATION OF CONTACTS

DELCO-REMY
TYPES 650, 659

DESCRIPTION:—These types are designed for use on six cylinder engines. They are fitted with two sets of contacts operating on a three sided cam. Contacts open alternately (one set opening an instant before the other set closes) at intervals of 60 degrees which corresponds with the 120 degree firing interval of the engines on which they are designed to be used. The two sets of contacts control the same coil and are connected in parallel in the primary circuit of the ignition system. All these types are identical in principle and are synchronized in the same manner although they differ in constructional details.

CONTACT ADJUSTMENT:—Contacts should be set at .022 inch and must be held within limits of .018-.024 inch at all times. Set contact gap by loosening lock screw on stationary contact mounting plate (located directly behind breaker arm) and turning eccentric adjusting screw until correct gap is secured with breaker arm rubbing block on lobe of cam. This must be done before attempting to synchronize contacts. If the synchronizing operation affects the setting sufficiently to throw the gap outside the limit of .018-.024 inch it must be reset at .022 inch and the synchronization repeated.

SYNCHRONIZATION OF CONTACTS:—A special tool has been developed to synchronize contacts. This is Delco-Remy Part No. 820751. To synchronize contacts, remove distributor head and rotor. Set contact gaps. Then place the synchronizing tool on shaft so that the 'A' side of the spring rests in the slot on the shaft (clockwise distributors) or the 'B' side of the shaft spring rests in the slot (counter-clockwise distributors). Rotate the distributor shaft until the gradautions on the leading tool scale approach the slot in the distributor housing. Connect a six volt test lamp in series with the coil primary and turn on the ignition. Continue to turn the shaft until the lamp goes out, indicating that the contacts have opened. Note the scale graduation which is in line with the edge of the slot. Then continue to turn shaft until the same figure on the other scale is opposite the same edge of the slot. This will indicate that the distributor has been turned through 60 degrees and the lamp should go out at this point, indicating that the second set of contacts have begun to open. Tighten the lock screws and check the contact gap. If outside limits of .018-.024 inch, reset at .022 inch and repeat synchronization. The tool is graduated in engine degrees. The allowable variation in contact synchronization is 2 degrees or one graduation on the tool.

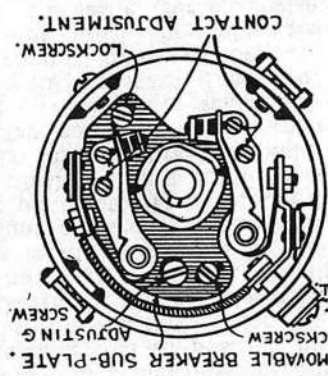


DELCO-REMY
TYPES 651, 652, 657

DESCRIPTION:—These types are designed for use on eight cylinder engines. They are fitted with two sets of contacts on a four sided cam. The contacts open alternately at intervals of 45 degrees corresponding to the 90 degree firing interval of the engines on which they are used. Both sets of contacts control the same coil and they are connected in parallel in the primary circuit of the ignition system. Both contacts must be open to secure a spark at the spark plug. This is accomplished by designing one set of contacts to close immediately after the other set opens. All these types operate on the same principle although they differ in constructional details.

CONTACT ADJUSTMENT:—Contacts should be set at .022 inch and must be held within limits of .018-.024 inch. Set contact gap by loosening lock screw on stationary contact mounting plate (directly behind breaker arm) and turning eccentric adjusting screw until correct gap is secured with breaker arm rubbing block on lobe of cam. Tighten the lock screw. Contacts can be resurfaced when necessary with a fine flat contact file or on a medium hard oilstone. The contact gap must be set before the contacts are synchronized and should be checked after the synchronization has been completed. If synchronizing has affected the gap sufficiently to throw it outside the limits of .018-.024 inch, reset the gap at .022 inch and repeat synchronization.

SYNCHRONIZATION OF CONTACTS:—A special Delco-Remy synchronizing tool, Part No. 820738, has been developed for this purpose. To synchronize contacts, remove distributor head and rotor and check contact gap. Then place synchronizing tool on shaft and lock it in place by pushing the slide through from the side. The slide is marked with an arrow at each end. One arrow will be visible when the tool is locked on the shaft and the slide should be locked so that the visible arrow points in the direction of distributor rotation. Turn the distributor shaft until the contact set mounted on the base plate begins to open when a six volt test lamp, which should be connected in series in the primary circuit, will go out. Carefully note the reading on the leading scale at a point directly opposite the edge of the terminal plate slot in the distributor housing. Then continue to turn the distributor shaft until the same point on the other scale is opposite the same slot edge on the housing. This will indicate that the shaft has been turned through 45 degrees and the lamp will go out, indicating that the second set of contacts are opening if they are properly synchronized. If the lamp does not go out at this point, loosen the two lock screws on the movable breaker plate and turn the eccentric adjusting screw until the contacts begin to open. Tighten the lock screws and check the contact gap. If outside limits of .018-.024 inch, reset at .022 inch and repeat synchronization.



DISTRIBUTORS

SYNCHRONIZATION OF CONTACTS

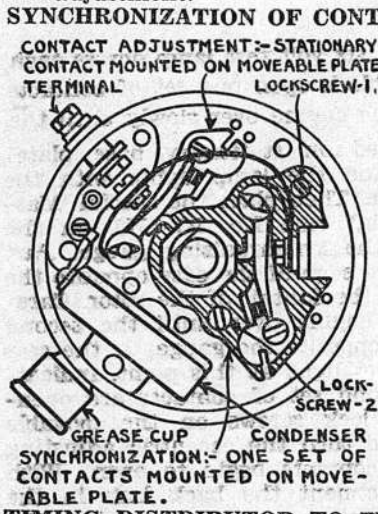
NORTH EAST

PACKARD AND CUNNINGHAM TYPES

DESCRIPTION:—These distributors are designed for eight cylinder engines and have two sets of contacts operating on an eight lobe cam. Contacts must be synchronized so as to open at the same instant in order to distribute the ignition load equally. If one set of contacts opens early, it will have no effect on the timing, which will be determined by the second set of contacts, but this second set will carry all the ignition load and will consequently wear more rapidly than would be the case if the contacts were properly synchronized. Contacts should be synchronized whenever the contacts are resurfaced and synchronization should be checked whenever the ignition timing is checked or set.

CONTACT ADJUSTMENT:—Contact gap should be set at .020 inch. Set contact gap by loosening the lock nut on the stationary contact mounting stud and turning up the stud until the gap is .020 inch with breaker arm rubbing block on lobe of cam. On the new type distributor (new Packard equipment) the stationary contact is carried on a moveable sub-plate. The lock screw on this plate should be loosened and the plate shifted by inserting the point of a screwdriver in the slot in the end of the plate and prying sideways on the screwdriver. Tighten the lock screw after making the adjustment.

SYNCHRONIZATION OF CONTACTS:—First Type. Distributors of this type were constructed with both breaker arms and contact assemblies mounted on a plate which was constructed with .020 inch clearance in the distributor cup. To synchronize contacts, loosen the lock screws on the breaker plate and shift the entire plate within the distributor cup until both contacts open simultaneously.



Second Type. Distributors of this type were constructed with one set of contacts mounted on a movable sub-plate. To synchronize contacts, loosen the two lock screws on the sub-plate, insert the point of a screwdriver in the slot in the plate and pry the plate to one side. Two small pins in the base-plate are designed to be used as fulcrums for the screwdriver. Tighten the lock screws after making the adjustment. The synchronization can be checked as part of the timing operation (see next paragraph.

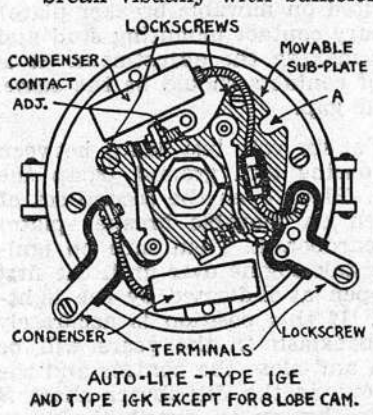
TIMING DISTRIBUTOR TO ENGINE:—The synchronization can be accurately and easily checked while the distributor is being timed to the engine by using one set of contacts at a time. First block open the second set of contacts (mounted on the movable sub-plate) with a piece of cardboard or fiber insulator and proceed with the timing operation, using a test lamp to check the contact opening. Then change the insulator to the first set of contacts and repeat the timing operation except that the distributor advance plate clamping screw should be loosened and the plate shifted until the second set of contacts begin ot open. Check the contact gap after synchronization has been completed.

AUTO-LITE

TYPES IGE AND IGK

CONTACT ADJUSTMENT:—Breaker contact gap when new or with new breaker arms should be .020-.024 inch. After 1000 miles of operation the gap should be set at .018-.020 inch. Set contact gap by loosening lock nut on stationary contact mounting stud and turning up stud until correct gap is secured with breaker arm rubbing block on lobe of cam. Use a feeler gauge and set contacts carefully. It is very important that both contacts have the same gap.

SYNCHRONIZATION OF CONTACTS:—Some means of determining when the contacts open must be used as it is absolutely impossible to determine the break visually with sufficient accuracy. The most satisfactory method is to connect six volt test lamps across each set of contacts so that the lamp will light at the instant the contacts open. To synchronize contacts with test lamps in circuit, turn on ignition and turn engine over slowly until contacts open. If both lamps light at exactly the same instant, the contacts are correctly synchronized. If they do not, loosen the three 'lock screws' on the movable breaker plate and shift the plate until the set of contacts mounted on the plate open at the same instant as the set mounted on the base plate. The breaker plate can be shifted by turning the eccentric adjusting screw 'A' on the first models of this type. The eccentric adjusting screw was later discontinued and distributors are now issued having a slot in the plate at this point. The plate can be shifted by placing the point of a screwdriver in the slot and turning the screwdriver.



AUTO-LITE -TYPE IGE AND TYPE IGK EXCEPT FOR 8 LOBE CAM.

Another method of testing the contact opening is to connect an ammeter in the ignition primary circuit (the two coils are connected in parallel) and noting the ammeter reading. The ammeter should register 8-10 amperes with both sets of contacts closed. If the ammeter reading drops to 4-5 amperes and then to 0 in two steps as the distributor shaft is slowly turned, it is an indication that the contacts must be synchronized. With the proper adjustment, the ammeter should drop from the initial reading of 8-10 amperes to 0 at once.

TIMING DISTRIBUTOR TO ENGINE:—The distributor is timed to the engine in the usual manner by first cranking the engine over until piston No. 1 reaches firing position and then loosening the advance arm clamp bolt and rotating the distributor housing and breaker assembly until the contacts open. Full directions are given on each individual car model page.

TYPE IGK

The Type IGK distributor is synchronized and timed exactly the same as the Type IGE. It is designed for eight cylinder engines and has an eight lobe cam.

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DISTRIBUTORS

SYNCHRONIZATION OF CONTACTS

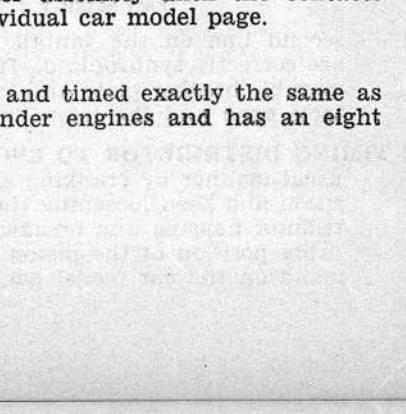
AUTO-LITE

TYPE IGH

DESCRIPTION:—The two sets of contacts on the Type IGH distributors are connected in parallel to the breaker terminal on the distributor housing. The condenser is mounted on the side of the case. Only one ignition coil is used and the primary circuit is broken by the two sets of contacts alternately. For this reason it will be necessary to use a special synchronizing tool to establish the correct relation between the contacts.

CONTACT ADJUSTMENT:—Breaker contacts separate .020-.024 inch. This gap should be maintained at all times. To set contact gap (fixed contacts mounted on base plate), loosen the two lock screws on the stationary contact mounting plate and turn eccentric adjusting screw until correct gap is secured with breaker arm rubbing block on lobe of cam. Then tighten the lock screws. The other set of contacts (mounted on movable breaker plate) are adjusted by loosening lock nut on stationary contact mounting stud and turning up stud. Tighten the lock nut after making the adjustment. It is important that the contact gap of each set of contacts should be the same. Use a feeler gauge to accurately determine the gap.

SYNCHRONIZATION OF CONTACTS:—Connect a six volt test lamp between the primary terminal inside the breaker housing and ground (snap the other test lamp lead on the distributor case). Block open the second set of contacts (mounted on movable breaker plate) with a piece of cardboard. Then turn on ignition and slowly crank engine over until the first set of contacts open as indicated by the lighting of the lamp. If this position is accurately determined the backlash in the gears will be sufficient to open and close the contacts and the lamp should go out as the distributor shaft is rocked. Place rotor button on distributor shaft. It will be noted that rotor is built with a 'fantail' marked with two lines. These lines are exactly 45 degrees apart (distributor degrees) and represent the firing interval of the distributor. Clamp the special synchronizing gauge (Auto-Lite Part No. IGH-1) on the side of the distributor case so that the pointer of the gauge is directly opposite the leading line (determined by direction of rotation of the distributor) on the fantail. Then carefully crank engine over 90 degrees until the second line on the fantail is directly opposite the synchronizing gauge. Remove the insulation from between the breaker contacts and block open the first set in the same manner. If the lamp lights when the second line on the fantail is opposite the gauge the distributor contacts are correctly synchronized. If it does not, loosen the two lock screws on the movable breaker plate and turn the eccentric adjusting screw until the contacts open and the lamp lights. Tighten the lock screws.



TIMING DISTRIBUTOR TO ENGINE:—Distributor is timed to the engine in the usual manner by cranking engine over until piston No. 1 reaches firing position and then loosening the advance arm clamp bolt and rotating the distributor housing and breaker assembly until the contacts open. To synchronize contacts with test lamps in circuit, turn on ignition and turn engine over slowly until contacts open. If both lamps light at exactly the same instant, the contacts are correctly synchronized. If they do not, loosen the three 'lock screws' on the movable breaker plate and shift the plate until the set of contacts mounted on the plate open at the same instant as the set mounted on the base plate. The breaker plate can be shifted by turning the eccentric adjusting screw until the contacts open and the lamp lights. Tighten the lock screws.

NOTE:—All production rotors furnished as car equipment will be equipped with the fantail and timing marks. However, rotors have been used without these marks. It is possible to secure special rotors to use in timing these distributors from the Auto-Lite Company. These are known as "Special Master Timing Rotors" and carry the regular production rotor part number IG-1576.

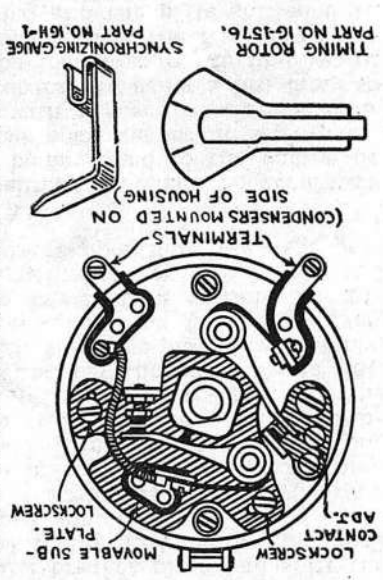
AUTO-LITE

TYPE IGJ

DESCRIPTION:—This type distributor is used in conjunction with two coils, each coil controlled by one set of contacts. There is no electrical connection between the two breakers although they operate on the same cam. It is very important to synchronize these contacts as the ignition of one half the entire number of cylinders will be thrown off if the contacts are allowed to get out of synchronization.

CONTACT ADJUSTMENT:—Breaker contacts separate .020-.024 inch. Set contact gap by loosening lock nut on stationary contact mounting stud and turning up stud until correct gap is secured with breaker arm rubbing block on lobe of cam. The other set of contacts (mounted on fixed base plate) are adjusted by loosening the two lock screws on the stationary contact mounting plate and turning the eccentric screw. Tighten the lock screws. The contact gap should be the same on both sets and a feeler gauge should be used to accurately set contacts.

SYNCHRONIZATION OF CONTACTS:—Connect a six volt test lamp across each set of contacts. It will not be necessary to block open one set of contacts since they are electrically separate. Crank the engine over slowly until the contacts (mounted on stationary base plate) begin to open and the lamp lights with the ignition turned on. Then place the special 'Master Timing Rotor,' Part No. IG-1576, on the shaft and clip the synchronizing gauge, Part No. IGH-1, on the edge of the case opposite the leading mark on the fantail of the rotor. Carefully crank the engine over until the second mark is directly opposite the gauge. If the second lamp does not light at this point, indicating that the second set of contacts are opening, loosen the lock screws on the movable breaker plate and turn the eccentric adjusting screw until the contacts begin to open. With the correct adjustment the back lash in the gears will be sufficient to open and close the contacts and the lamp should light and go out as the distributor shaft is rocked. The regular production rotor used on these distributors will be equipped with timing marks and it will only be necessary to use the special master timing rotor on the early equipment.



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MALLORY IGNITION DISTRIBUTOR

DESCRIPTION:—Mallory Ignition Distributors incorporate two new features, a second set of 'coil loading' contacts and a new automatic advance governor. The breaker has two sets of contacts, of which only one set is used to time the distributor to the engine. The second set of contacts can be regulated to increase the length of time the primary circuit is closed between the successive firings of the spark plugs.

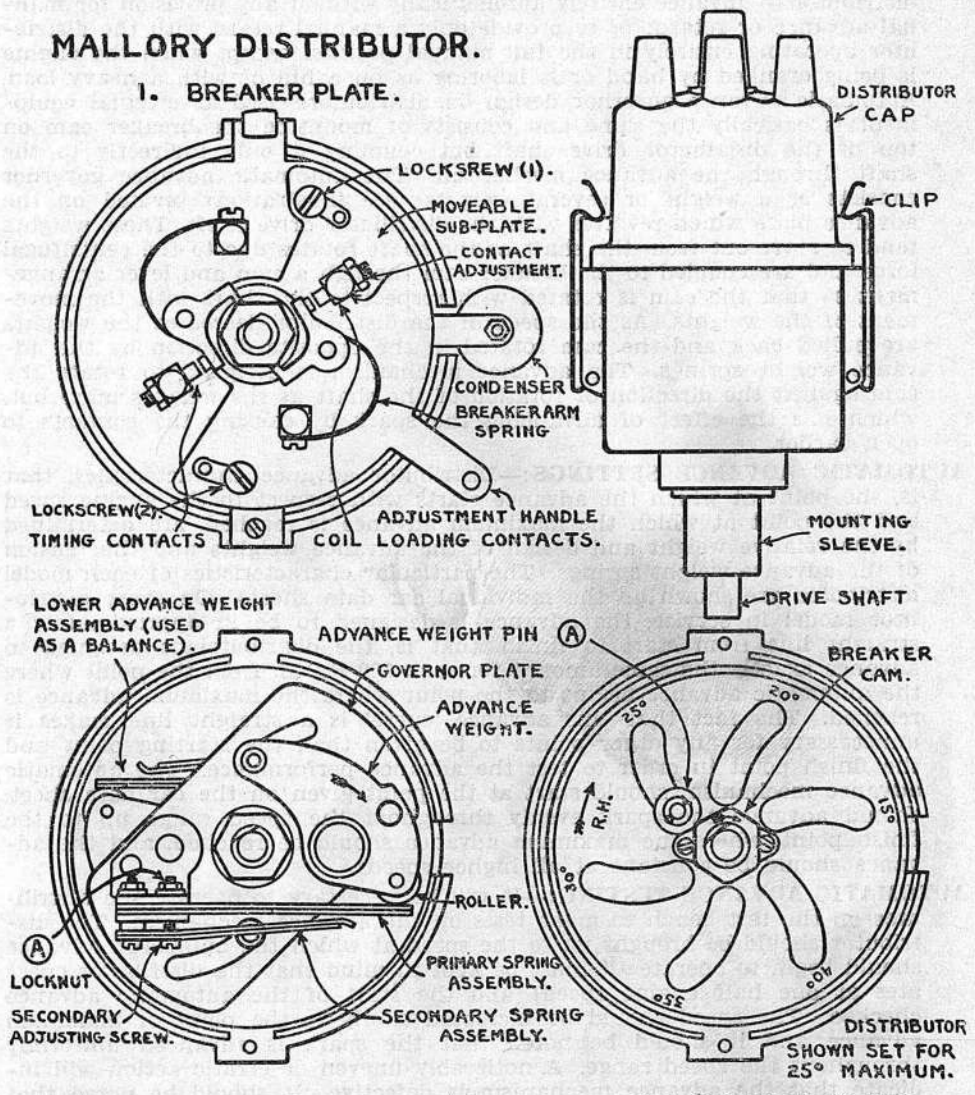
CONTACT ADJUSTMENT:—Breaker arms are pivoted in the center of the contact on one end of the arm and the cam rubbing block at the other end. The stationary contact stud is mounted on a bracket. Contacts are adjusted by loosening the lock screw and lock nut on the stud and turning up the stud with a screwdriver (the end of the stud is slotted). Breaker contact gap should be set at .015 inch (both sets). The second set of contacts is mounted on a movable sub-plate provided with an adjustment handle which extends through the side of the distributor cup (see illustration). This set of contacts should be adjusted by loosening the two lock screws on the sub-plate and shifting the plate in a direction opposite to the rotation of the cam. Shifting the plate in this manner will cause the contacts to close earlier and will result in a longer building-up period for the coil primary before the timing contacts open. The only precaution to observe is that this set of contacts should not close before the regular timing contacts open.

AUTOMATIC ADVANCE GOVERNOR:—The automatic advance governor consists of a specially designed advance weight pivoted on the governor plate and operating against the tension of a spring assembly made up of two sets of leaf springs. The primary set (A) is directly in contact with the roller on the advance weight. The secondary spring set (B) does not normally touch the primary set with the distributor at rest and in the retarded position. These springs come into action after the cam has been partially advanced and acting in conjunction with the lessened centrifugal effect of the weight at higher speeds (due to the design of the weight) provide a very positive and even advance curve.

INSTALLATION:—The automatic advance mechanism can be adjusted to adapt the distributor to any particular engine. As shipped, the distributor is set so that the automatic advance begins at approximately 500 R.P.M. of the engine. The governor advances relatively rapidly up to an engine speed of 800 R.P.M. and then in a straight line to the maximum point, which is reached at 2800 R.P.M. This advance setting is normally used when it is desired to time the engine rather late to provide considerable retard. If this type curve is desired, it will only be necessary to see that the maximum advance is correct (see paragraph on 'Settings').

On engines where less retard is desired, the automatic advance mechanism can be adjusted so that the advance curve is perfectly straight from the beginning point to the maximum point, which will provide a less rapid advance between 500 R.P.M. and 800 R.P.M. This is accomplished by loosening the lock nut on the secondary spring assembly ('A' on illustration 2) and turning up the screw until the secondary springs almost touch the primary spring group. With this setting, the automatic advance will sart at 500 R.P.M. and reach the maximum point at 3000 R.P.M. of the engine.

AUTOMATIC ADVANCE SETTING:—The automatic advance assembly can be set to provide 15, 20, 25, 30, 35, or 40 degrees of advance at the maximum point (2800 or 3000 R.P.M.). The governor weight pin ('A' on illustration 1) fits into a slot in the cam advance plate (illustration 3). These slots are numbered to correspond with the maximum advance. The pin should be placed in the slot corresponding to maximum advance desired. Note that only the upper weight on the governor assembly is used for automatic advance. The lower weight acts merely as a balance. The governor assembly can be turned over to reverse the direction of rotation so that the other weight is used for advance, but in any event the lower weight is used as a balance.



Special Advance Curves. The settings as outlined above will provide maximum advance of 15, 20, 25, 30, 35, 40 degrees at either 2800 R.P.M. or 3000 R.P.M., depending on the setting of the secondary spring assembly. If it is desired that the maximum point should be reached at a lower speed, the lock nut on the secondary spring adjusting screw can be loosened and the screw backed off slightly. Special spring assemblies are furnished (primary springs, secondary springs or both) to provide any desired advance curve.

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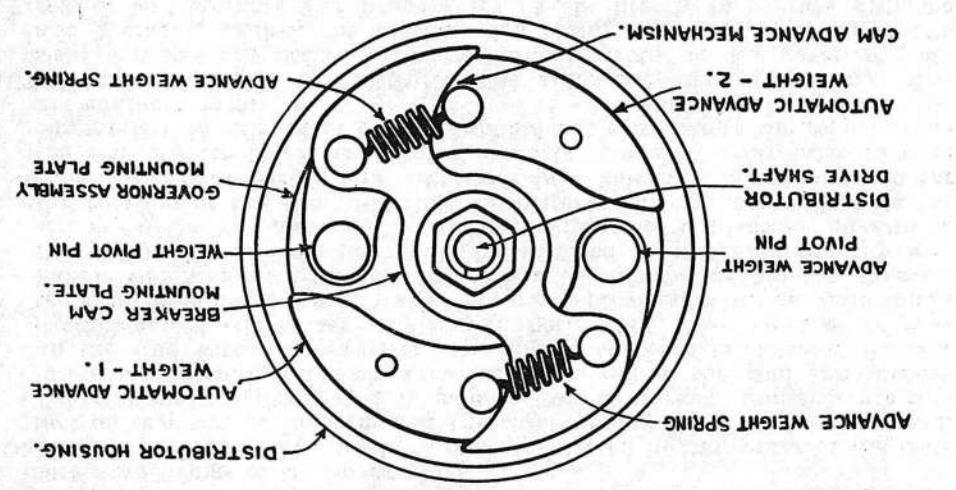
DISTRIBUTOR AUTOMATIC ADVANCE

DESCRIPTION:—Practically all distributors are now equipped with automatic advance mechanism, and the tendency at the present time is to reduce the manual advance to a position of minor importance, either by designing the distributor to advance entirely automatically without any provision for manual advance or retard; or to provide only a manual retard with the distributor operating entirely in the full manual position except when the engine is being cranked by hand or is laboring as on a hill or with a heavy load. Automatic advance governor design on distributors used as original equipment is basically the same and consists of mounting the breaker cam on top of the distributor drive shaft but coupling it only indirectly to the shaft through the advance mechanism. The automatic advance governor consists of a weight or several weights (see illustration) pivoted on the advance plate which revolves with the distributor drive shaft. These weights tend to move out from the shaft as the shaft rotates due to the centrifugal force and are coupled to the breaker cam through a cam and lever arrangement so that the cam is rotated with respect to the shaft with the movement of the weights. As the speed of the distributor decreases the weights are pulled back and the cam rotated in the opposite direction by the advance weight springs. The advance mechanism is designed to rotate the cam against the direction of rotation of the shaft as the weights move out, which has the effect of advancing the spark by causing the contacts to open earlier.

AUTOMATIC ADVANCE SETTINGS:—Distributor advance characteristics, that is, the point at which the advance starts with respect to the engine speed and the point at which the maximum advance is reached, are determined by the relative weight and design of the advance weights and the tension of the advance weight springs. The particular characteristics of each model distributor are shown on the individual car data sheets. On every distributor model in service, the advance is designed to be in approximately a straight line from start to finish, that is, the distributor is designed to advance exactly the same amount for each 100 R.P.M. from the point where the automatic advance begins to the point where the maximum advance is reached. The fact that this advance 'curve' is a straight line makes it unnecessary for any other points to be given than the starting point and the finish point in order to test the advance performance. The automatic advance mechanism should start at the point given on the car data sheet, should advance the spark evenly throughout the speed range up to the finish point, where the maximum advance should be reached, and the advance should be constant at all higher speeds.

AUTOMATIC ADVANCE TESTING:—It will be necessary to operate the distributor on the test bench to make tests on the advance mechanism. The distributor should be brought up to the speed at which the automatic advance should begin to operate (it must be kept in mind that the distributor operates at one half engine speed) and the start of the automatic advance checked. The speed should be increased slowly to the point of maximum advance and it should be noted that the spark is advanced uniformly throughout the speed range. A noticeably uneven or erratic action will indicate that the advance mechanism is defective. It should be noted that the maximum advance is reached at the proper speed and that the position of the spark remains constant at all higher speeds. In making this test, if the automatic advance begins early and reaches the maximum figure at a lower R.P.M., the advance weight springs may be broken or weak. A 'spark knock' when the engine speed is decreased, as in ascending a hill, is an indication of weak springs or sticking weights. If the advance begins late, it is an indication of sticking weights. An erratic advance action may indicate worn bearings.

NOTE:—The table shown illustrates automatic advance performance and may be used to determine any number of points in any particular distributor advance curve. The horizontal divisions (from left to right) refer to engine R.P.M. in hundreds. The vertical divisions (reading up the page) refer to distributor advance in terms of engine degrees, as marked. The particular curve for any distributor may be found by marking the beginning point (the lower left hand corner) with the figure at which the automatic advance on the distributor in question should begin to operate and then marking each horizontal division to indicate an additional 100 R.P.M. engine speed. The line which refers to the particular distributor will be that one which crosses the line indicating the maximum engine R.P.M. at a point up the page corresponding to the maximum automatic advance. Every point on that line will then refer to the advance characteristics of the distributor in question. Whenever distributor advance performance and characteristics require additional data, this will be given on the car data sheets.

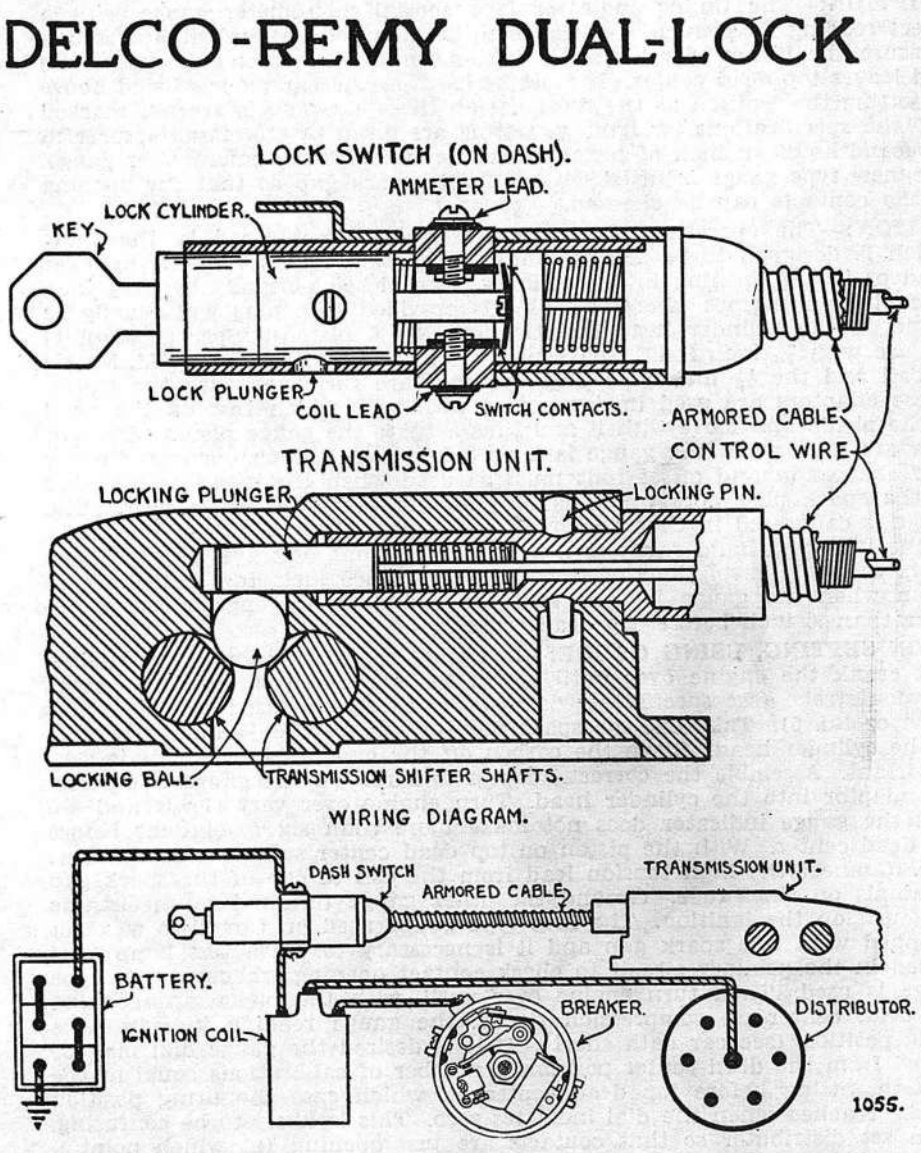


DELCO-REMY DUAL LOCK

DESCRIPTION:—The Delco-Remy Dual Lock is a co-incidental ignition switch lock and transmission lock. It consists of an ignition switch and lock mounted on the dash and connected through a flexible control wire with a transmission lock on the transmission case cover. The control wire is protected by an armored steel cable throughout the entire distance between the dash switch and the transmission. This makes it impossible to tamper with the lock action and prevents operation of the tranmission with the switch locked. The ignition switch is fitted with a tumbler lock and acts as a straight ignition switch connected between the battery and the ignition coil.

OPERATION:—The dash switch unit is shown in sectional view in the illustration. When the ignition key is inserted in the lock and turned to unlock the ignition, the spring behind the lock cylinder forces the lock cylinder and the cup on the forward end of the control wire (which fits in a recess in the rear of the lock cylinder) forward withdrawing the locking plunger in the transmission case cover. This permits the locking ball to move upward freeing the transmission shafts and permitting the transmission to be operated. The movement of the control wire assembly in the lock case on the dash permits the spring behind the contacts to force the contactor block forward and close the circuit between the two switch terminals. One of these terminals is connected to the ignition coil and the other is connected to a 'hot' terminal in the car circuit usually the ammeter. When the lock cylinder is pressed in to cut off the ignition and stop the engine, the movement of the control wire assembly positively opens the switch contacts and forces the locking plunger across the top of the locking ball which in turn is forced down into the grooves of the transmission shifter shafts. The transmission must be in neutral to operate the lock.

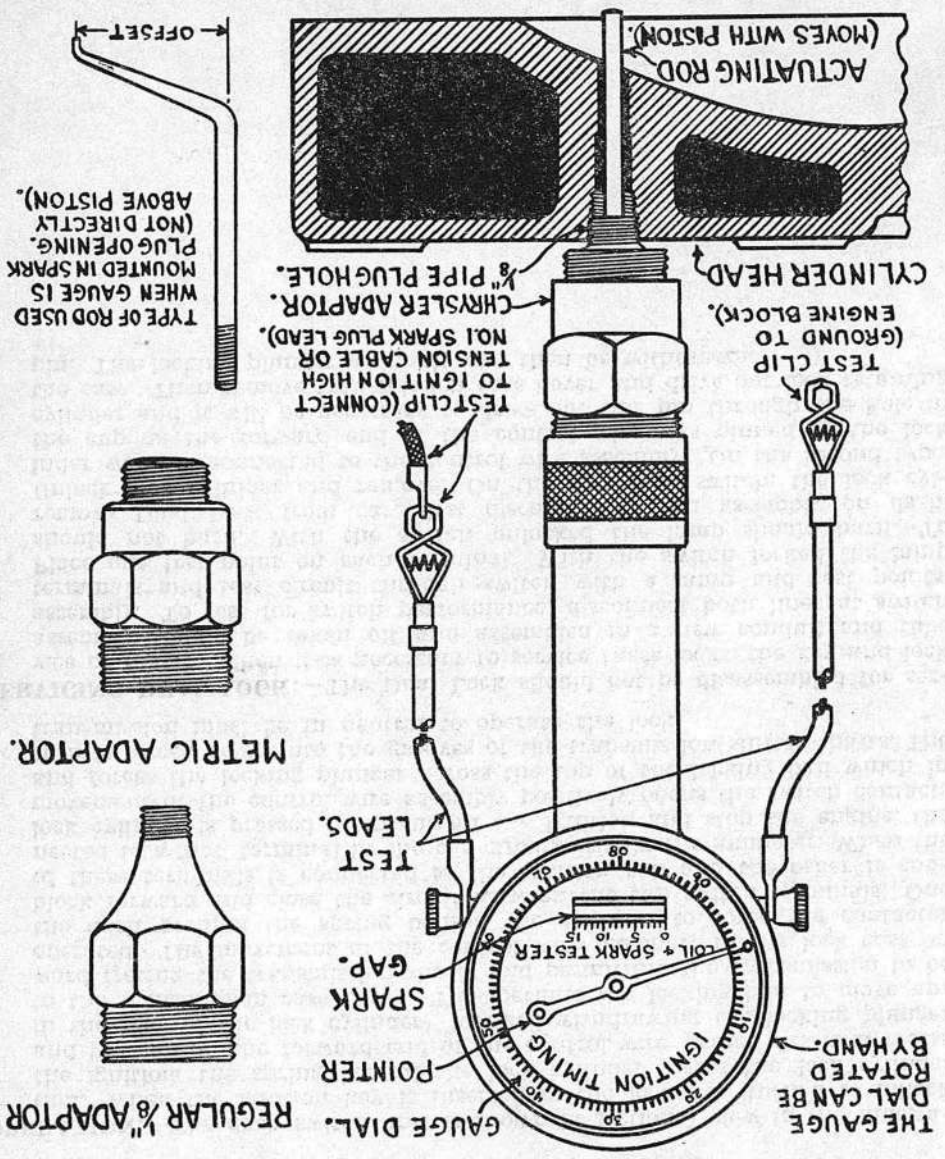
SERVICING DUAL LOCK:—The Dual Lock should not be disassembled for service or repair. When it is necessary to service these locks, the key and lock assembly should be taken off and assembled in a new conduit and tube assembly. To test for switch performance, disconnect both lines at switch terminals and test circuit through switch with a lamp and test points. Place one test point on each terminal. With the switch locked the lamp should not burn. With the switch unlocked the lamp should burn. To remove Dual Lock from car, first disconnect switch assembly on dash. Unlock lock cylinder and remove. On the first type switch, the lock cylinder was not connected to the control wire assembly. On the second type, the cup on the forward end of the control wire was pinned to the lock cylinder and it will be necessary to drive out this pin through the hole in the case. Then remove transmission case cover and drive out lock retaining pin. The locking plunger assembly can then be withdrawn.



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This gauge is Chrysler tool No. DC-150. It is manufactured by the Joseph Weidenhoff Company of Chicago.



DESCRIPTION:—The timing indicator is a special micrometer gauge with a direct reading dial which is designed to be mounted on the cylinder head to measure the piston travel directly in thousandths of an inch as it approaches and leaves top dead center. It must be used on the car models listed above in setting the ignition as the flywheels on these car models are not marked and the specifications for ignition setting are given by the manufacturer in thousandths of an inch of piston travel for use with the micrometer gauge. The new type gauge is fitted with a visible spark gap so that the opening of the contacts can be checked.

OPERATION:—The operating piston of the gauge is contained in the shaft which is designed to be screwed into the spark plug port in the cylinder head or in the opening in the cylinder head closed normally by a ⅛ inch pipe plug on engines where this plug is provided (the plug will usually be found in the cylinder head directly over No. 6 piston). Special adaptors for use with ⅞ inch S.A.E. spark plug, ½ inch pipe thread, 18 MM. Metric thread and the ⅛ inch pipe plug openings are furnished with the gauge. These adaptors are used in connection with rods which rest on the head of the piston and move with it and thus actuate the gauge piston. Straight rods are used when the gauge is mounted in the ⅛ inch opening directly over the piston and offset rods must be used when the gauge is mounted in the spark plug port which is not directly over the piston head. The gauge is calibrated in thousandths of an inch and one complete revolution of the indicator hand registers .100 inch. The limit of travel of the gauge is six complete revolutions of the indicator or .600 inch and care must be taken when the gauge is used that the rod does not engage the piston more than .6 inch before top dead center.

IGNITION SETTING, USING GAUGE:—In timing the distributor to the engine, first crank the engine over until piston to be used in timing is on compression stroke (see specific car data sheet—the piston used may be No. 1, No. 4 or No. 6). Take out the spark plug or remove the ⅛ inch pipe plug in the cylinder head. Clean the carbon off the cylinder head. This is very important. Assemble the correct adaptor and rod on the gauge and screw the adaptor into the cylinder head. Turn engine over very slowly and see that the gauge indicator does not make more than six revolutions before top dead center. With the piston on top dead center set the gauge dial at zero. Connect the high tension lead from the coil to one of the spark gap terminals on the gauge. Ground the other gauge terminal to the engine and turn on the ignition. The first type gauge used on Chryslers was not equipped with this spark gap and it is necessary to use a test lamp connected in the primary circuit to check contact opening whenever this type gauge is used. Then turn engine over until, with the piston approaching top dead center on compression stroke, the gauge reading indicates the firing position (see car data sheet). If it is desired the gauge dial may be moved from the dead center position a number of calibrations equal to the ignition setting before top dead center, in which case the firing position will be reached when the dial indicates zero. This is likely to be confusing. Then set distributor so that contacts are just opening (at which point a spark will appear in the spark gap on the gauge).

SYNCHRONIZATION OF CONTACTS, USING GAUGE:—The timing gauge can be used to synchronize contacts on distributors using double breakers if it is not desired to use the regular synchronizing tools. To synchronize contacts on a six cylinder engine (distributors with two sets of contacts opening alternately at intervals of 60 degrees corresponding to 120 degrees of crankshaft rotation) after the distributor has been timed to the engine, crank the engine over 180 degrees until the piston again approaches top dead center on the exhaust stroke. Repeat the timing operation by stopping the crankshaft when the gauge reading indicates the firing position and shift the second set of contacts (mounted on the movable sub-plate) until they open, when a spark will be visible in the spark gap. Full details on distributor design and synchronization will be found on 'Distributor' pages.

In synchronizing contacts on eight cylinder engines (with two sets of contacts opening alternately at intervals of 45 degrees corresponding to 90 degrees of crankshaft rotation) it will be necessary to move the timing gauge to the next firing cylinder after the distributor has been timed to the engine and repeating the timing operation except that the distributor should not be disturbed and the second set of contacts should be adjusted by shifting the movable sub-plate until the spark is seen in the spark gap on the gauge. The spark gap can also be used to test the intensity of the ignition spark by varying the gap.

TIMING GAUGE

FOR USE ON CHRYSLER, DODGE, DE SOTO, AUSTIN

DELCO-REMY ELECTROLOCK

DESCRIPTION:—The Electrolock is an ignition switch mounted on the dash and connected to the distributor housing terminal through an armored steel cable. The breaker lead from the coil is taken through the switch and then to the distributor through this cable which is fastened to the distributor by a special non-removable clip connection. The breaker is grounded through the switch case when the switch is in the 'Off' position. This absolutely prevents tampering with the car when the ignition is locked since it is impossible to wire around the switch.

OPERATION:—The dash switch consists of a tumbler lock cylinder mounted directly in front of a spring in the lock case. The switch contact is mounted on the rear of the lock cylinder. When the key is inserted in the lock and turned to the right as far as possible, the lock is released and the lock cylinder is forced out by the spring closing the switch contacts and breaking the ground connection. The key may then be removed. To turn off the ignition, the lock cylinder is pressed in. This opens the switch, grounds the distributor and locks the ignition. It is only necessary to make certain that the lock cylinder remains in the 'In' position and that the lock has snapped. This feature makes it impossible for the driver to neglect to lock the switch.

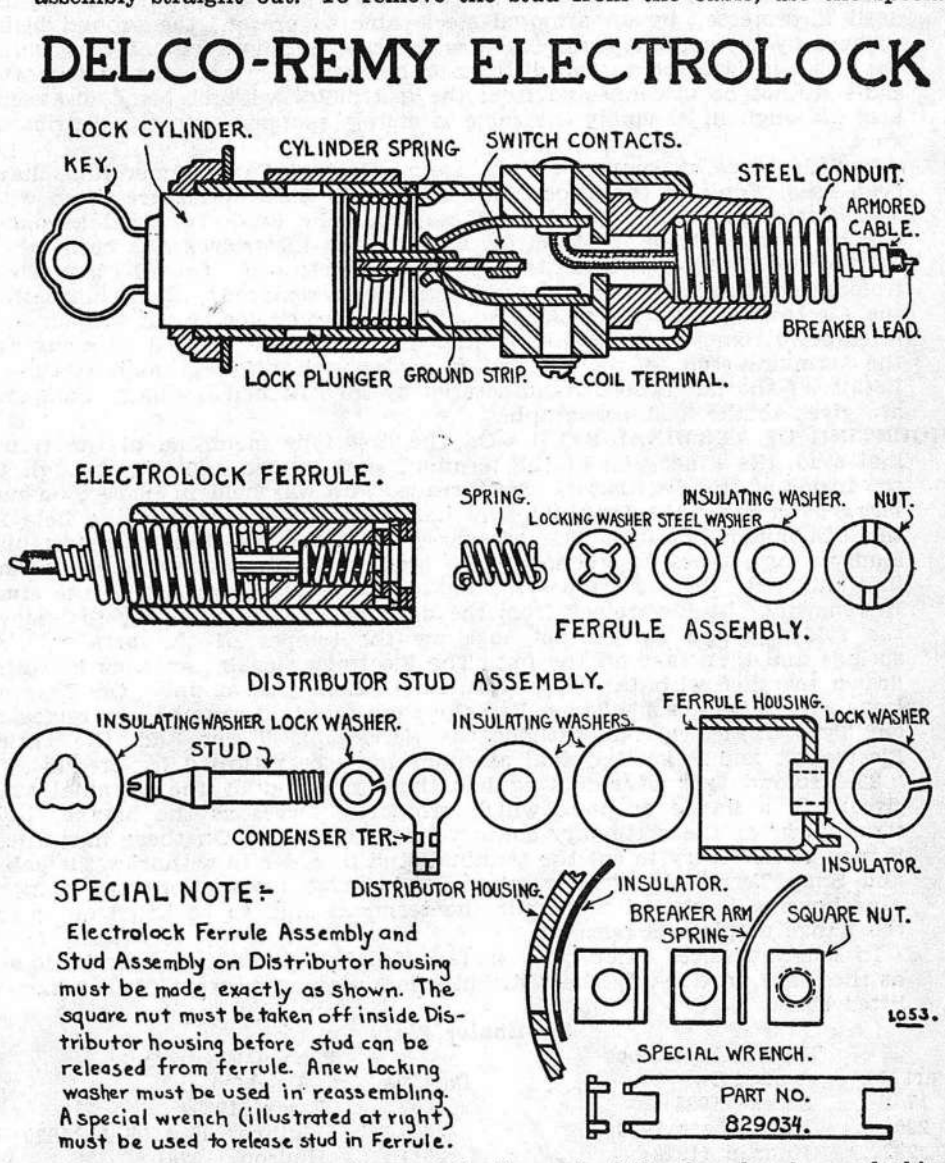
TROUBLE SHOOTING:—To test the Electrolock for possible ignition trouble, first disconnect wire on Electrolock case leading to coil. Turn the distributor shaft until contacts open or block open contacts with a piece of cardboard or any insulating substance. Then make the following tests with a lamp and test points:

1. Place one test point on the terminal stud inside the distributor housing and place the other test point on the terminal on the side of the Electrolock case from which the coil lead was disconnected. With the switch unlocked the lamp should burn. With the switch locked the lamp should not burn.

2. Place one test point on the distributor terminal stud as in test (1) and place the second test point on the switch case. With the switch locked the lamp should burn. With the switch unlocked the lamp should not burn. If the lamp burns with the switch unlocked the condenser may be shorted or grounded. Disconnect the condenser and repeat the test. If these tests indicate Electrolock is operating satisfactorily, check coil, breaker contacts, distributor, spark plugs and wiring. If tests indicate trouble in Electrolock, disassemble as directed in the following paragraph:

DISASSEMBLY OF ELECTROLOCK:—Remove mounting nut with a spanner wrench and remove switch assembly from dash. Then unlock the switch and depress the plunger in the elongated slot in the side of the case. Then remove the contact assembly and inspect. In reassembling switch make certain that the retainer washer which holds the lock return spring in position does not touch either of the switch contacts. Assemble contact assembly so that the small tang on the side next to the lock cylinder is opposite the terminal screw. The tang fits into a hole in the lock cylinder. If the contact assembly is not replaced correctly the battery will be grounded when the switch is in the 'Off' position.

SERVICING DISTRIBUTOR:—To remove the distributor to the bench for service, remove the Electrolock from the dash and remove distributor from the engine as directed on the car data sheet. Then take entire distributor and Electrolock off the car. To remove Electrolock from the distributor, use special Electrolock wrench Part No. 829034 to remove square nut on terminal stud inside the distributor housing. On the Chevrolet distributor (on which this type Electrolock is standard equipment), it will first be necessary to turn the distributor shaft until advance weight mounting plate studs are 90 degrees from terminal stud, remove the three screws mounting the breaker plate and tilt the breaker plate down on the side nearest the terminal stud. The breaker arm must be slid up on the pin at the same time. Then remove the square nut and pull the Electrolock cable and stud assembly straight out. To remove the stud from the cable, use the special



wrench to loosen the retainer nut in the end of the ferrule. A new locking washer must be used in reassembling. The various parts of the ferrule and stud assembly are illustrated in proper positions. Assemble these parts in order as shown. It will be necessary to remove the Electrolock from the distributor to replace the condenser and it is advisable also in replacing breaker arms.

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ELECTROLOCK

INSTALLATION AND REMOVAL

DESCRIPTION:—The theft-proof feature of the Electrolock is centered in the fact that the breaker is grounded through the Electrolock case at the dash and the terminal assembly at the distributor when the Electrolock is turned 'Off'. The breaker lead between the distributor and the Electrolock on the dash is protected by an armored steel cable to prevent the ground being relieved by cutting this lead. Likewise the snap terminal assembly by which the cable is fastened to the distributor housing is so constructed that the cable cannot be disconnected from the distributor without being disassembled although in assembly the cable is merely snapped onto the distributor stud.

Various types of Snap Terminal assemblies and Cable Timer Ends have been used. Some of the Type 5 and all Type 9 Electrolocks are fitted with the 'Serviceable Timer End'. On these types the Snap Terminal assembly can be removed from the Electrolock (after the Electrolock has been taken off the distributor) without destroying the Electrolock. On all other Electrolocks the Snap Terminal assembly cannot be removed without mutilating the Electrolock. The Electrolock should be returned for credit without any attempt to remove the Snap Terminal assembly. The method of mounting the terminal stud in the distributor varies with different manufacturers. Details of the mountings manufactured by the Mitchell Specialty Company are given in the next paragraph.

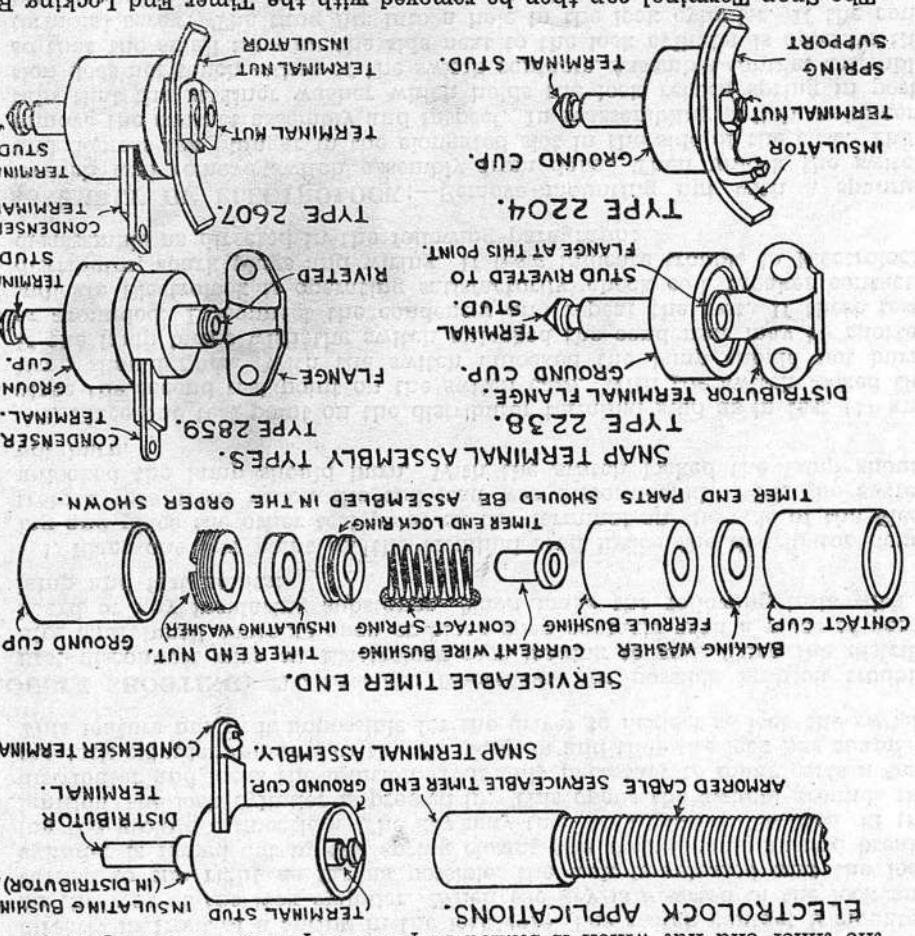
MOUNTING OF TERMINAL STUD:—On the first type mounting of the terminal stud, the inner end of the terminal stud (which projects through to the inside of the distributor) was threaded and was held in place by a nut screwed on after the terminal stud had been passed through the hole in the distributor housing. The breaker lead was taken from the terminal stud, in some types, by anchoring the breaker arm spring under the terminal stud nut. On these types the nut was ordinarily soldered to the stud. In removing the Electrolock from the distributor, it is necessary to remove the solder (being careful not to draw the temper of the breaker arm spring) and then take off the nut. The Electrolock cable can then be withdrawn together with the Snap Terminal Assembly as a unit. On Electrolocks with a Serviceable Timer End the snap terminal can then be removed. On Type 5 Electrolocks, without the Serviceable Timer End, the entire Electrolock and Snap Terminal assembly must be returned for credit.

The second type of mounting has the inner end of the terminal stud riveted to a flange or plate which ordinarily serves as the breaker lead terminal or as the stationary contact mounting plate. On these mountings it may be necessary to cut the terminal stud in order to withdraw the cable and Snap Terminal assembly, although in some installations the distributor housing is slotted to permit the terminal stud to be lifted out after the flange or plate is released.

In some instances other types of Terminal Stud mountings may be found as these are provided by the distributor manufacturer except for car models listed below.

Distributor Parts

Type 5 Electrolock Part No.	Used On	Type 9 Electrolock Part No.	Used On
1761	Essex (1928)	2607	Essex (1929)
2204	Essex, Late 1928	2607	Whippet 96-A, 98-A (1929)
2232	Hudson (1928)	2611	Hudson (1929)
2232	Falcon Knight (1928)	2544	Willys Knight 70-B (1929)
2232	Stearns Knight 6-80 (28-29)	2544	Hupmobile S (1929-31)
2232	Willys Knight 66-A (1928)	2544	Hupmobile L (1930-31)
2232	Willys Knight 70-A (1928)	2784	Essex SS (1930-31)
2232	Peerless 80 (1928)	2859	Hudson 8 (1930-31)
2232	Velie 88 (1928)		Type 14 Electrolock
2238	Chandler 75, 85 (1928-29)		
2238	Hupmobile Cent. 6 (1928)	3560	Auburn 8-98 (1931)
2238	Hupmobile Cent. 8 (1928)		



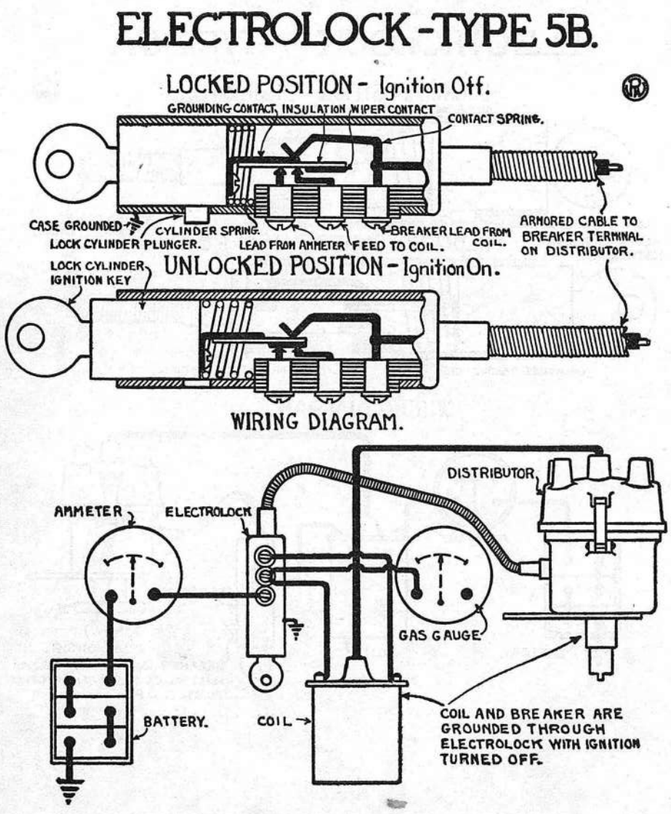
DISASSEMBLY OF SERVICEABLE TIMER END:—The Electrolock must first be removed from the distributor. Then remove the grounding cup and insulating washer which are slipped over the terminal stud. On distributors with a threaded terminal stud held in place by a nut on the inner end, the ground cup can be slipped off. On distributors with the terminal stud riveted to a flange or plate, it will be necessary to cut the terminal stud in order to slip off the ground cup. In this case it will be necessary to use a new terminal stud in reassembling the Snap Terminal assembly. Unscrew the timer end nut which is staked in place to prevent loosening in service.

The Snap Terminal can then be removed with the Timer End Locking Ring still in place on the end of the terminal stud. Free the Locking Ring from the terminal stud. The Locking Ring is made up of two segments held together by a spring and can ordinarily be used with a new terminal stud in reassembling the Electrolock.

The Timer End contact spring assembly is soldered to the current wire bushing. The current wire (or breaker lead within the cable) is crimped and soldered in the bushing. The current wire has sufficient slack so that it may be pulled out of the cable while the contact spring assembly is being examined. In replacing in service, it will be sufficient to solder the wire to the current wire bushing. The parts should be assembled in the order shown in the illustration. The Timer End nut must be staked in place to prevent it loosening in service.

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ELECTROLOCK
TYPE 5-B



Connections:—The Type 5-B Electrolock has three connections on the side of the case. The ignition feed wire from the ammeter is connected to the terminal nearest the front or lock cylinder end of the case. The ignition coil lead and all accessories such as gasoline gauges or temperature indicators are connected to the middle terminal. The breaker lead from the coil is connected to the third terminal and the breaker circuit is completed through the armored cable to the terminal on the side of the distributor housing.

Servicing Distributor:—To remove distributor from car, unlock Electrolock, disconnect wires from side of case and remove Electrolock from mounting on dash. Then remove distributor from engine as directed on car data sheet. Lift out entire distributor and Electrolock assembly and remove to bench for distributor tests or repairs.

Trouble Shooting on Car:—Disconnect all wires on side of lock case and block open distributor contacts with a piece of cardboard or turn cam until contacts open. Then make following tests with six volt lamp circuit and test points:

(1) Place one test point on the primary terminal inside the distributor and place the second test point on the lock case. With the switch locked the lamp should burn. With the switch unlocked the lamp should not burn.

(2) Place one test point on the primary terminal inside the distributor and place the second test point on the No. 2 (or center) terminal of the switch. Unlock the switch, push the lock cylinder in half way and release it. The lamp should not light during this movement of the lock cylinder.

(3) Place one test point on the lock case and place the second test point on the No. 3 (or last) terminal. With the switch locked the lamp should burn. With the switch unlocked the lamp should not burn. If the lamp burns the Electrolock is grounded or the condenser is shorted or grounded. Disconnect condenser and repeat test.

If these tests indicate Electrolock is operating satisfactorily look for ignition trouble in the coil, breaker, distributor or spark plugs. If tests indicate trouble in the Electrolock, disassemble, examine and repair Electrolock as directed in the following paragraph.

SERVICING ELECTROLOCK:—Unlock Electrolock and remove from dash mounting. Disconnect all wires from case. Then take out small set screw on side of lock case and take out lock cylinder. Remove the coil spring directly behind the lock cylinder and pull out metal wedge holding bakelite terminal block in position. With terminal screws removed, the part of the bakelite piece in which the terminal screws are located can be pushed into the lock casing and the lock casing can then be slid back on the cable allowing the switch to be inspected. Any trouble in the switch due to broken parts can then be discovered. New parts for replacement can be obtained and the lock repaired.

If the lock cylinder does not work freely because of dirt in the lock case, the lock cylinder should be removed and cleaned off. Do not put oil or grease in the lock cylinder. If tumblers stick use graphite. In assembling Electrolock make certain that all terminals are insulated down to the screw heads to avoid possibility of short circuits.

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ELECTROLOCK
TYPE 5-A

DESCRIPTION:—The Electrolock is an ingnition switch mounted on the dash consisting of a lock cylinder in a steel case which is connected to the distributor housing terminal by an armored cable. The breaker lead from the coil is carried inside the cable which is fastened to the breaker terminal by a special design non-removable clip connection. This absolutely prevents tampering with the ignition circuit and prevents the car being started with the ignition turned off since the breaker is grounded through the Electrolock case and through the distributor attachment.

To unlock Electrolock, insert key in lock cylinder and turn ¼ turn to right. The lock cylinder will spring out closing the ignition switch. The key should then be removed since it is not necessary to lock the ignition. To turn off ignition, press lock cylinder in and make certain that it does not spring out again. This will turn off ignition, ground the breaker and lock the Electrolock itself to the car.

The Electrolock is manufactured in two types, the 5-A with one terminal on the side of the case, and the Type 5-B with three terminals on the side of the case.

Connections:—The terminal on the side of the Electrolock case should be connected to the breaker terminal of the ignition coil. The feed for the coil is taken directly off the ammeter or from the relay terminal of the generator. The breaker circuit is completed through the armored cable from the Electrolock to the terminal on the distributor housing.

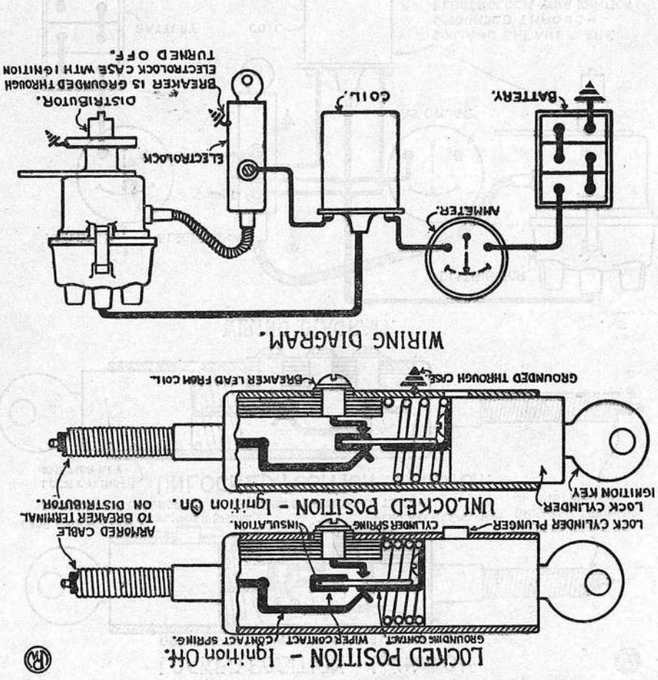
Servicing Distributor:—To remove distributor from car for bench tests or repairs, unlock Electrolock and remove from dash. Remove distributor from engine as directed on the car data sheet. Then remove entire distributor and Electrolock assembly from car.

Trouble Shooting on Car:—Disconnect wire from side of case. Insulate breaker contacts with a piece of cardboard or turn cam until contacts separate. Then make following tests with six volt lamp circuit and test points:

(1) Place one test point on breaker terminal inside distributor and place the other point on the terminal on the side of the Electrolock case. With Electrolock in the unlocked position, the lamp should burn. With Electrolock locked the lamp should not burn.

(2) Place one test point on the breaker terminal inside the distributor. Place the other point on the Electrolock case. With the switch locked the lamp should burn. With the switch unlocked the lamp should not burn. If the lamp burns there is a ground in the Electrolock or the condenser is shorted or grounded. Disconnect the condenser and repeat the test.

If these tests indicate the Electrolock is operating satisfactorily look for ignition trouble in coil, breaker, distributor or spark plugs. If tests indicate trouble in the Electrolock, disassemble as directed in paragraph on 'Servicing Electrolock' under Type 5-B (see next page).



ELECTROLOCK

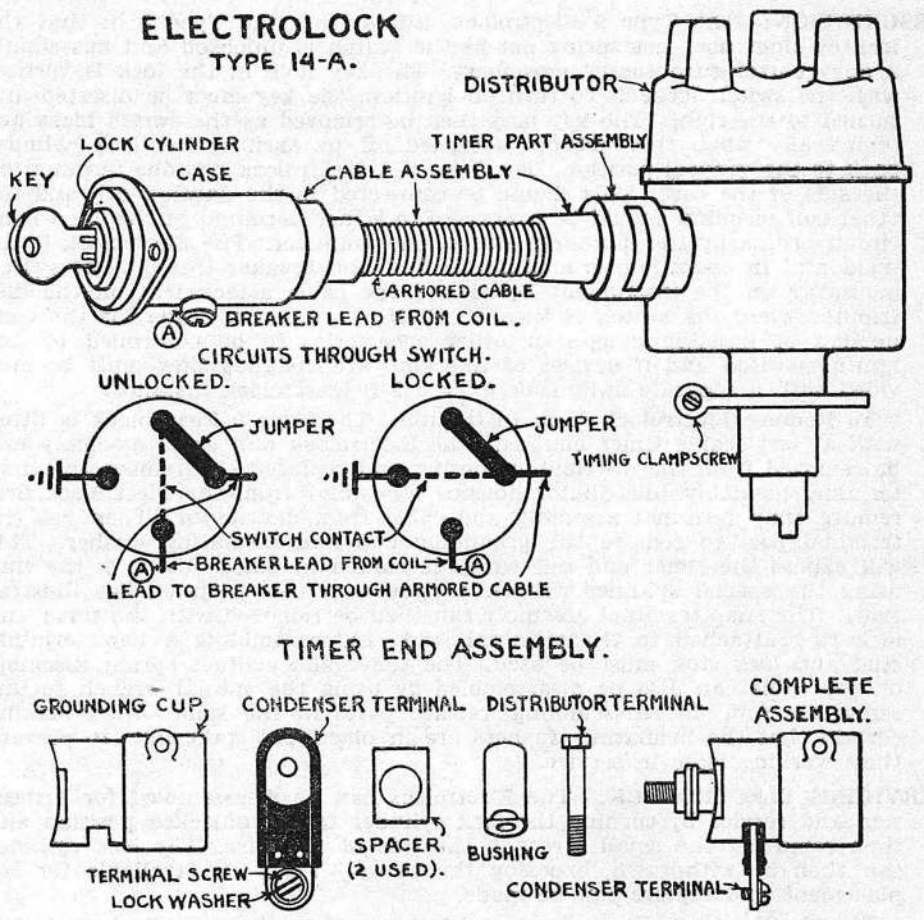
TYPE 14

DESCRIPTION:—The Type 14 Electrolock differs from the Type 9 in construction (see illustration), although it is similar in operation. There is one terminal on the side of the case. This should be connected to the ignition coil and the other ignition coil primary terminal connected to a 'hot' terminal of the car wiring circuit. The Electrolock is co-incidental in operation, grounding the breaker through the switch mounting on the instrument board and the cable attachment on the distributor when the switch is turned off. No provision is made for the attachment of gasoline gauges or other accessories to be controlled by the ignition switch and if they are installed a separate switch must be used.

SERVICING ELECTROLOCK:—The Electrolock can be disassembled for inspection and service by turning the lock cylinder to the unlocked position and then removing the small screw in the side of the case. The lock cylinder can then be withdrawn, exposing the switch. Parts are available for replacement and repairs can be made.

Trouble Shooting. Use a lamp and test points to check Electrolock switch circuits. Disconnect wire at terminal on side of case and block open breaker contacts. Place one test point on primary terminal inside breaker case and the other test point on the terminal on the side of the case. The lamp should light with the switch unlocked and should not light with the switch locked. If test lamp indicates switch circuits are not being completed correctly, the lock cylinder should be removed and the switch inspected. With one test point on the primary terminal inside the distributor housing place the second test point on the lock case. The lamp should light with the switch off or locked and should go out when the switch is unlocked.

If the lamp remains lighted with the switch unlocked, the Electrolock is grounded or the condenser is grounded. Disconnect the condenser and repeat the test. If this indicates that the condenser is at fault it should be replaced. If these tests indicate that the Electrolock is all right and ignition trouble continues, check the ignition coil, breaker contacts, distributor, spark plugs and spark plug cables.



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ELECTROLOCK

TYPE 9

TYPE 9-A

DESCRIPTION:—The Type 9 Electrolock differs from the Type 5 in that the lock cylinder does not spring out as the switch is unlocked and has simply a one-quarter turn rotary movement. The key hole in the lock is vertical with the switch locked. To turn on ignition, the key must be inserted and turned to the right. The key may then be removed as the switch locks automatically when the ignition is turned off by turning the lock cylinder back to the vertical position. The Type 9-A Electrolock has one terminal on the side of the case. This should be connected to the ignition coil and the other coil terminal should be connected to a 'hot' terminal of the car wiring circuit ordinarily the discharge side of the ammeter. The Electrolock is co-incidental in operation, grounding the coil and breaker through the switch mounting on the instrument board and the cable attachment on the distributor when the switch is turned off. No provision is made for the connection of gasoline gauges or other accessories to be controlled by the ignition switch and if these are installed a separate switch, or a Type 9-B Electrolock installed.

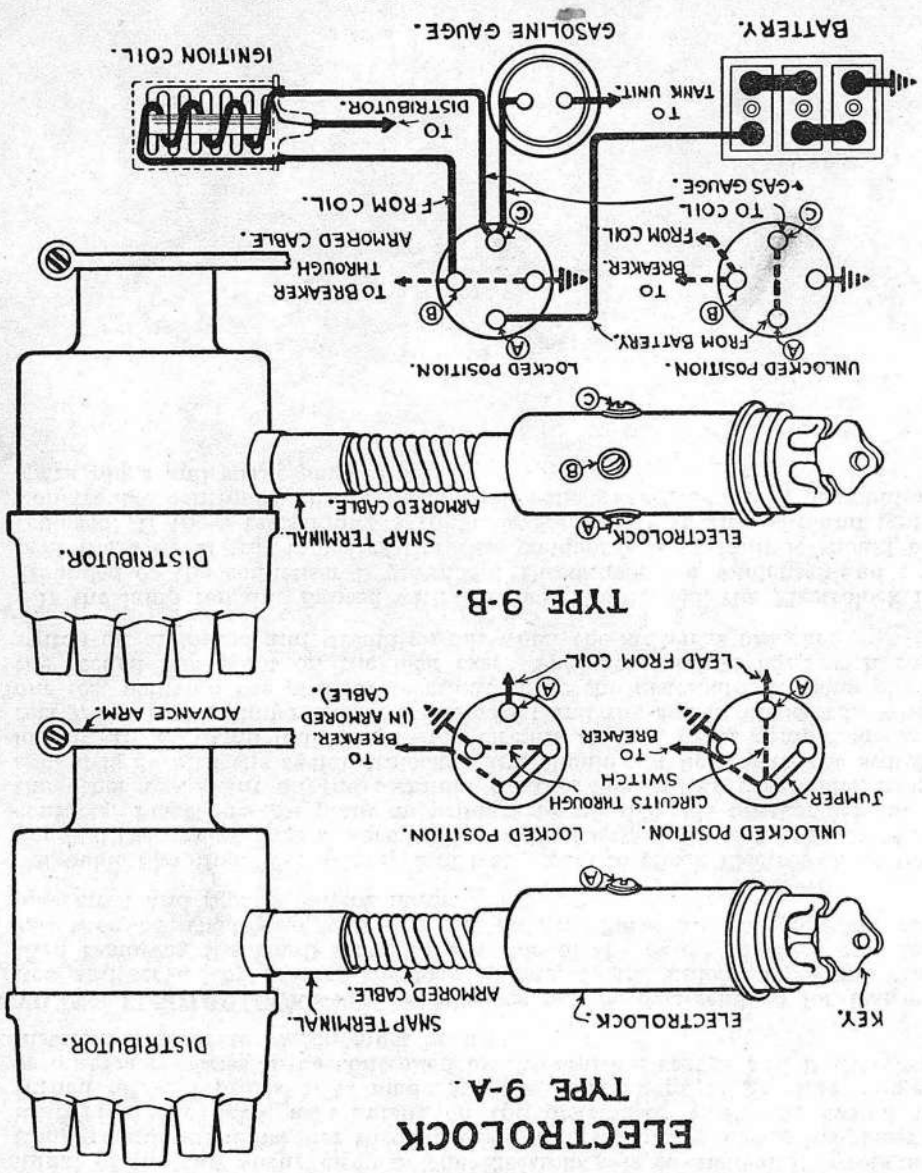
To Remove Electrolock from Distributor. The Type 9 Electrolock is fitted with a 'serviceable timer end' and the Electrolock and cable assembly can be removed from the distributor housing and replaced. To remove the snap terminal assembly (distributor housing assembly) from the Electrolock, first remove snap terminal assembly and cable from distributor. Then cut the terminal post to remove the grounding cup and insulating washer. This will expose the timer end nut which is staked in place. Unscrew the nut, using the special spanner wrench designed for this purpose (see illustration). The snap terminal assembly can then be removed with the timer end lock ring attached to the terminal stud. In reassembling a new terminal stud and lock ring must be used. The timer end contact spring assembly on the cable can also be disassembled by using the special wrench to unscrew the nut. In reassembling, replace parts in the same order, making certain that the insulating washers are in place and stake nuts to prevent their working loose in service.

SERVICING ELECTROLOCK:—The Electrolock can be disassembled for inspection and service by turning the lock cylinder to the unlocked position and then removing the small screw in the side of the case. The lock cylinder can then be withdrawn, exposing the switch. Parts are available for replacement and repairs can be made.

TYPE 9-B

DESCRIPTION:—The Type 9-B Electrolock is similar in design to the Type 9-A except that it is provided with three terminals on the side of the case and should be used when gasoline gauges or other accessories are used which must be controlled by the ignition switch. The ignition lead is connected to one terminal on the case and the two coil leads are connected to the other two terminals. The gasoline gauge and other accessories should be connected to the feed terminal of the coil on the case (and never to the breaker lead from the coil). The breaker lead from the coil is completed through the Electrolock armored cable in the usual manner and the coil and breaker are grounded when the switch is locked.

SERVICING DISTRIBUTOR AND ELECTROLOCK:—The Electrolock is removed and serviced in exactly the same manner as the Type 9-A. In making tests with lamp and test points, disconnect wires at Electrolock terminals and use terminal marked 'Coil.' In rewiring ignition circuit make certain that all leads are insulated down to the screw heads to avoid any possibility of short circuit to the case. Never use grease or oil in the lock cylinder. If the tumblers stick a small amount of graphite may be used on them.



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SHALER CO-INCIDENTAL IGNITION LOCK

SECOND TYPE

DESCRIPTION:—The Shaler Co-incidental Ignition Switch consists of an upper assembly composed of the lock cylinder and ignition switch of molded bakelite enclosed in a pressed steel case, a cable containing six conductors all insulated from each other, and a trap assembly mounted on the side of the distributor housing. The cable connects the Upper switch assembly and the Trap assembly. The switch assembly has four terminals connected as shown on the diagram. Three of the wires from the switch, the breaker lead, the ground wire and a live wire which is connected to the live terminal at the switch but is insulated at the other end of the cable, are contained in the cable. The other three wires in the cable are connected to the trap mechanism on the distributor but are insulated at the upper end of the cable. The trap mechanism consists of a ground spring which is normally held out of contact by a ribbon. This ribbon is stretched across a nichrome resistance wire which is connected to the trap wires. When the trap wires are energized the heated resistance cuts the ribbon and allows the ground spring to ground the distributor.

OPERATION:—Normally, the Shaler Co-incidental Switch acts as an ignition switch grounding the breaker at the trap mounting on the distributor housing when the switch is in the 'Off' position. With the switch 'Off' the circuits through the switch are as follows: (1) Terminal 2 disconnected although the live wire in the cable is always in circuit since this terminal is connected to the car battery through the ammeter. (2) Terminal 4 disconnected. (3) Terminals 1 and 3 connected—this means that both the coil and breaker are grounded. With the switch 'On' the circuits through the switch are as follows: (1) Terminal 1 disconnected. (2) Terminal 3 disconnected—this means that the coil and breaker are in series but are not grounded. (3) Terminals 2 and 4 connected—this provides current for the ignition coil and any accessories such as gas gauges or temperature indicators which may be used on the car and which should be connected to terminal 4 of the switch. The live wire in the cable is of course in circuit.

The theft-proof feature of the lock lies in the fact that the grounding of the breaker and coil occurs at the distributor and cannot be relieved by disconnecting the switch assembly at the dash. This means that the cable must be cut. However, in cutting the cable contact is certain to be made between the live wire and one or more of the trap wires which are interwound with the other wires in the cable. This supplies current to the trap mechanism and the ground spring permanently grounds the breaker. This ground can only be removed by removing and replacing the trap mechanism. Still further protection is afforded in that even if the hot lead was disconnected at the ammeter before the cable was cut so that the trap mechanism was not operated in cutting the cable, it would still be necessary to sort out the breaker lead from the other wires in the cable in connecting a new coil in the ignition circuit. There is an even chance that one of the trap wires would be selected so that the trap mechanism would be operated when the current was turned on.

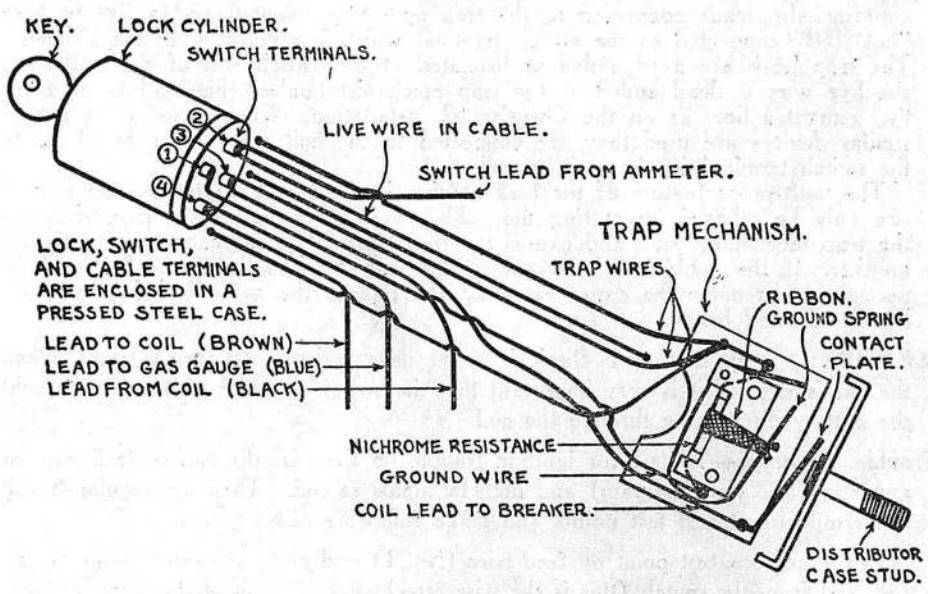
The key is inserted in the lock and turned to unlock the switch when the ignition is turned on. The action of cutting off the ignition locks the switch so that it is impossible for the car operator to forget to operate the lock.

TROUBLE SHOOTING:—To test Shaler Lock for ignition trouble, use a lamp and test points and make the following tests:

(1) Disconnect the ignition coil and gas gauge and turn the distributor shaft until the breaker contacts open or block contacts open with a piece of cardboard. Then place one test point on primary terminal inside distributor housing and place the other test point on the ammeter terminal from which the lead is taken to the switch. With the switch locked or in the 'Off' position the lamp should not burn. With the switch in the 'On' position the lamp should burn.

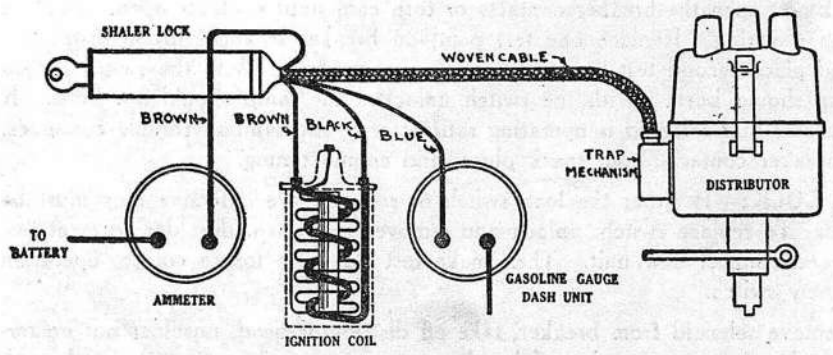
(2) Then place one test point on primary terminal as in test (1) and ground the other test point by touching it to the distributor housing or engine block. With the switch in the 'On' position the lamp should not burn. With the switch in the 'Off' position the lamp should burn. If the lamp burns in the 'On' position disconnect the condenser and repeat the test. If the lamp still burns the trap mechanism is defective. If the lamp does not burn the condenser is shorted or grounded.

RW-1090.



SHALER LOCK SWITCH

WIRING DIAGRAM.



(3) Place one test point on ammeter terminal connected to switch and touch the other test point to the brown wire connected to the ignition coil. With the switch in the 'Off' position the lamp should not burn. With the switch in the 'On' position the lamp should burn.

If these tests indicate the switch is operating satisfactorily, check the ignition coil, breaker contacts, spark plugs and high tension wiring for defects causing the ignition trouble.

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SHALER CO-INCIDENTAL LOCK

FIRST TYPE

DESCRIPTION:—The Shaler Ignition Lock consists of tumbler lock switch in a pressed steel case mounted on the dash and a solenoid operated latch mounted in a box on the side of the distributor housing. The two units are connected by a woven cable. When the ignition is turned off at the switch, the ignition coil is grounded and the breaker is grounded at the latch or trap mechanism on the distributor housing by a special ground wire contained in the cable. In addition to the breaker lead, ground wire and coil leads (where the coil leads are taken into the cable at the trap mechanism as on the Durant installation) the cable contains also leads connected to the trap operating solenoid and a live wire or "hot lead" connected to the switch terminal which is connected to the ammeter. The trap leads are dead ended or insulated at the switch end of the cable and the live wire is dead ended at the trap mechanism unless this lead is used for the generator line, as on the Chrysler 52 installation. When gasoline gauges or similar devices are used they are connected to the coil side of the switch or to the switch terminal on the ignition coil.

The theft-proof feature of the lock consists in the fact that the breaker ground can only be relieved by cutting the cable. This short-circuits the live wire and the trap mechanism lead and causes the trap solenoid to permanently ground the breaker. If the cable has been cut or the trap mechanism operated it will be necessary to remove the entire assembly and replace the cable and trap mechanism as directed below.

OPERATION:—Insert the key in the lock on the dash and turn ¼ turn to right. When the car is stopped it is very important that the switch should be locked to prevent the battery discharging through the coil.

Trouble Shooting:—To test for ignition trouble on the car, disconnect feed wire at ammeter (No. 1 on diagram) and both terminals at coil. Then use regular 6 volt test lamp circuit and test points and make following tests:

(1) Place one test point on feed wire (No. 1) and place the other point on the coil lead from the switch (this is the wire attached to the coil at the terminal from which the gasoline gauge is taken off). The lamp should burn with the switch unlocked and should go out when the switch is locked. If switch is operating satisfactorily make following test for correct operation of solenoid:

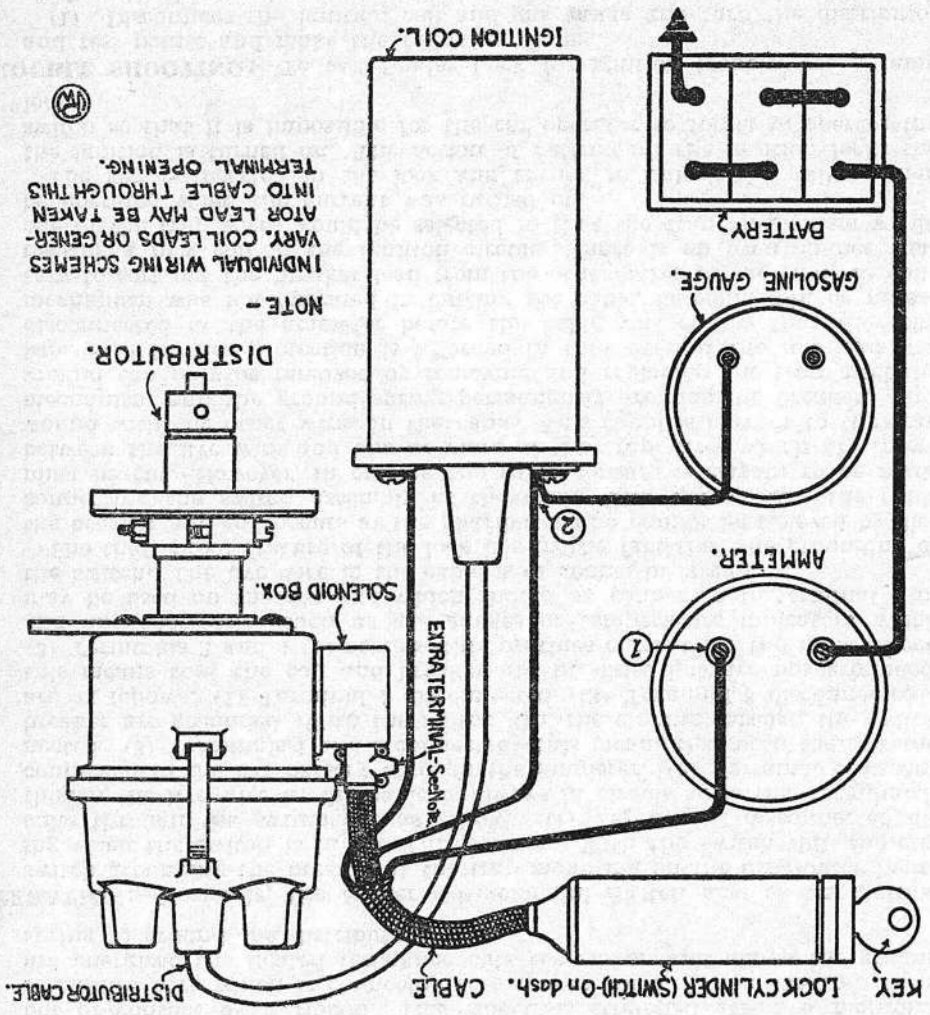
(2) Block open the breaker contacts or turn cam until contacts open. Replace all ignition wiring. Replace one test point on breaker terminal inside distributor case and place second test point on switch case on dash. With the switch locked the lamp should burn. With the switch unlocked the lamp should not burn. If test indicates that solenoid is operating satisfactorily and ignition trouble continues, check breaker contacts, coil, spark plugs, and engine timing.

SERVICING LOCK:—If either the lock switch or solenoid are defective they must be replaced. To replace switch, unlock and remove from dash, unsolder wires at terminals and connect new unit. Then make test No. 1 to insure correct operation of the new switch.

To remove solenoid from breaker, take off distributor head, unsolder nut on terminal inside, remove nut, take off breaker arm spring and push stud out through case. In installing new unit make certain that the insulating washers are replaced in proper order so as to insulate stud from case. After testing to make certain that solenoid is operating satisfactorily, resolder nut, being careful not to use too much heat as this will draw out temper of breaker arm spring.

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SHALER LOCK



DESCRIPTION:—The AC Fuel Pump is a mechanically operated gasoline pump. The pump is mounted on the side of the engine block and is driven through a rocker arm by an eccentric cam on the camshaft. It supplies gasoline at a positive pressure directly to the float chamber of the carburetor. The gasoline flow is controlled entirely by the needle valve in the carburetor float chamber and by the speed of the car so that the operation of the pump is entirely automatic.

Two types of the pump, Series A and B, have been developed and are in use as standard equipment on 1929 car models. The principle of operation of the two types is similar although they differ in constructional details as shown in the illustrations.

OPERATION:—The shaft (G) which supplies power to operate the pump is ordinarily the camshaft of the engine. When the camshaft is rotated, the eccentric cam (H) causes the rocker arm (D) to move backward and forward. The movement of the rocker arm which is pivoted at (E) pulls down the pull rod (F) together with the pump diaphragm (A) which is bolted on the upper end of the pull rod between the cup shaped metal discs (B). This creates a vacuum in the pump chamber (M) which causes gasoline from the fuel tank at the rear of the car to enter the pump through the inlet (J) into the sediment bowl (K) through the filter screens (L) and the inlet valve (N) and fill the pump chamber. As the eccentric completes a revolution the rocker arm ceases to pull on the pull rod and the driving spring (C) forces the pull rod and diaphragm upward. This closes the inlet valve and opens the pressure valve (O) causing the gasoline to flow through the outlet (P) to the carburetor float chamber. When the carburetor bowl is filled and the float needle valve closes, the pressure of the gasoline backed up in the pump chamber is sufficient to hold the driving spring (C) compressed, holding the pull rod and diaphragm in its lowest position. The movement of the rocker arm which continues as long as the engine is running is absorbed by the linkage (T) in the Series A Pump and by the break or cam action of the rocker arm (R) which is made in two pieces on the Series B Model. The pump thus remains inoperative until sufficient gasoline has been used from the carburetor float chamber to allow the driving spring to force the pull rod upward again when the pump resumes operation. This spring (S) is used merely to keep the rocker arm in contact with the eccentric to eliminate noise and to take up the free motion of the linkage and rocker arm break.

TROUBLE SHOOTING:—Check faulty gasoline feed to engine which may be caused by defective pump, from the following table:

Insufficient fuel is delivered at carburetor starving engine and causing it to stop or lack power.

1. Leaky tubing or connections allowing gasoline to be lost or permitting air to be drawn in the system. Check gas line and connections and watch sediment bowl for air bubbles.
2. Bent or kinked tubing. This will obstruct gas line and prevent gasoline reaching pump.
3. Sediment bowl loose. This will destroy pump vacuum and interfere with pump action. Tighten the thumb nut under the bowl and examine cork gasket to make sure that it is in place and lies flat around upper rim of sediment bowl.
4. Dirty screen. This will obstruct gasoline flow. Remove sediment bowl, take out and clean screen.
5. Loose valve plug. This will destroy pump vacuum or cause gasoline leak. Examine plug gasket and tighten plug.
6. Defective valves. Remove valve plugs and valves. Wash valves in gasoline and examine. If warped or damaged, replace. Examine valve seat. Replace valves, making certain that spring is around lower end of valve plug and that valve is placed with polished side down. Use new cap gaskets if necessary.

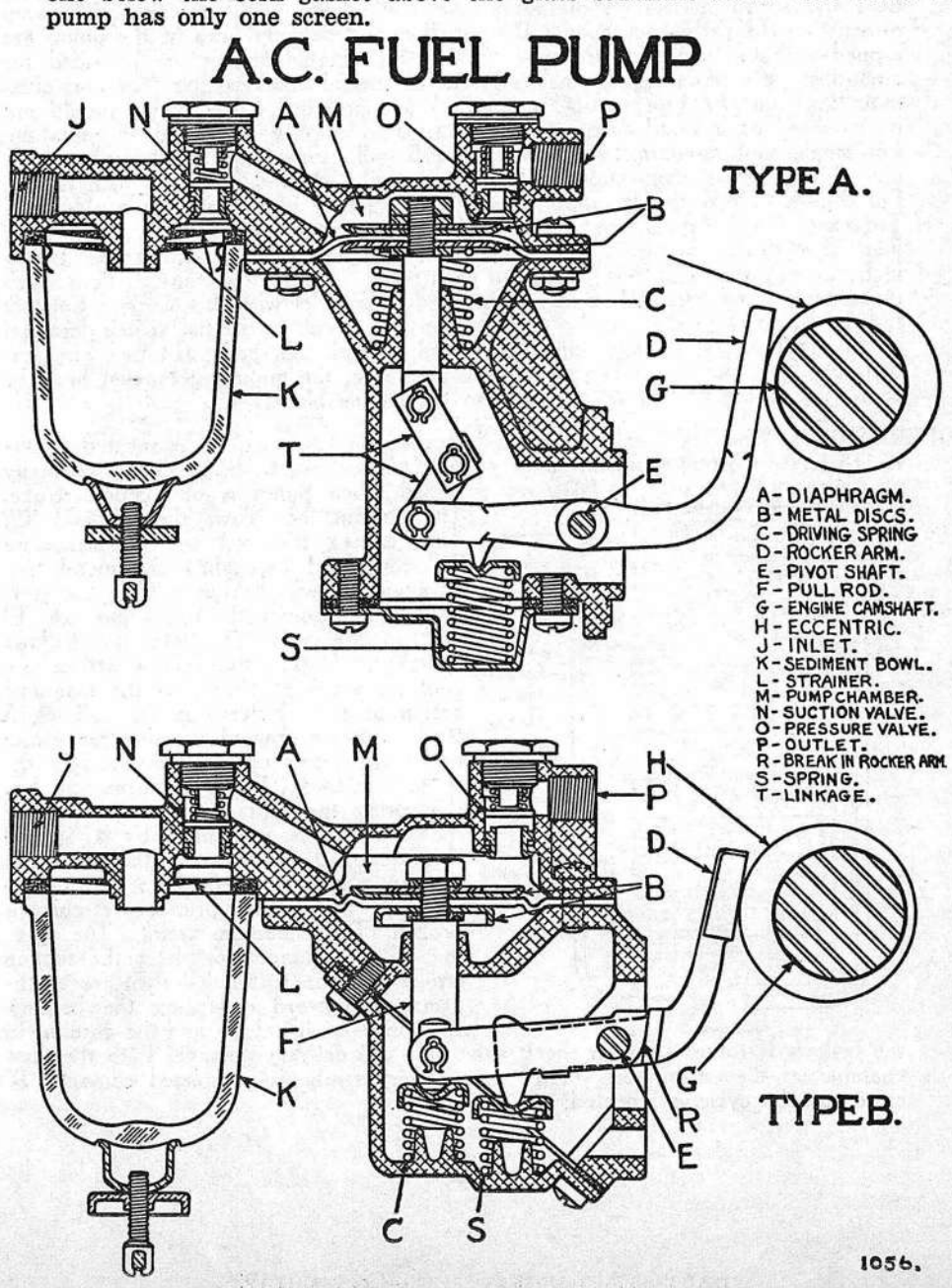
Gasoline leaks around Diaphragm.

Tighten the cover screws alternately and evenly. Do not disassemble pump body.

Carburetor Floods.

Check float needle valve for correct seating. Check float level.

SERVICING:—The AC Spark Plug Company, who manufacture these pumps, recommend that no attempt be made to disassemble the pump other than as described above as special jigs and fixtures are necessary to properly align parts to insure correct operation of the pump. The pump should be returned to them or to their service representatives whenever major repairs or adjustments are necessary. In ordinary installations these pumps are oiled by splash from the crankcase and no service adjustments are necessary other than to remove and clean the sediment bowl and filter screens occasionally. There are two screens on the Series A pump, one above and one below the cork gasket above the glass sediment bowl. The Series B pump has only one screen.



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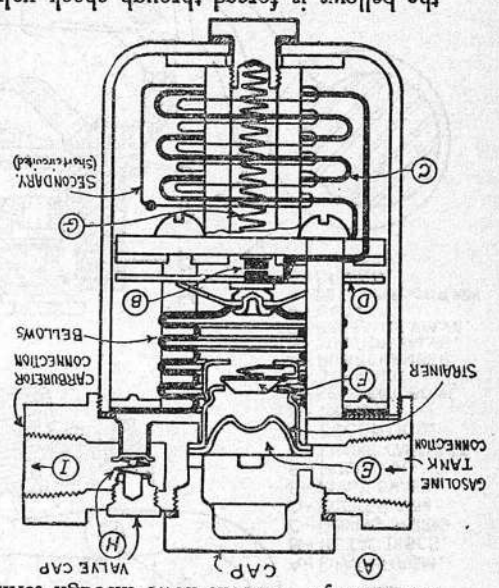
AUTOPULSE

FIRST TYPE

DESCRIPTION:—The Autopulse consists of a bellows pump operated by a new design electric motor. The bellows are made of metal with reinforced and soldered flanges and it is claimed that they will outlast the ordinary life of an automobile engine. No lubrication or service adjustments are necessary.

INSTALLATION:—The pump should be mounted as near the carburetor as is practical and approximately on the same level. Wherever possible mount the pump directly on the carburetor bowl. Both suction and delivery lines of the pump are tapped with 1/8 inch standard pipe thread and suitable fittings are provided for mounting. For mounting on chassis or engine special brackets 266 (for horizontal mounting) or 267 (for vertical mounting) are provided. The pump should not be mounted on a wood dash as this will tend to amplify the sound of operation. For single unit mounting where less than 5 gallons per hour is desired use 1/4 inch tubing for all connections. If full capacity is desired use 5/16 inch tubing. For Duplex or two unit installation, use 1/8 or 1/4 inch pipe thread manifolds. On Triplex or Quad installations use two 5/16 inch tubes or one 1/8 inch tube with 1/4 inch pipe thread manifolds. On Quintette and Sextette installations use two 3/8 inch tubes with 1/4 inch pipe thread manifolds. On multiple installations each unit operates independently and is connected in parallel with the others. Connect the flexible lead to the ignition terminal on the switch or to the switch terminal on the ignition coil. The pump is grounded through the shell. On two wire systems or where pump is mounted on insulated base, the mounting bracket must be connected to the battery or grounded to the engine block.

OPERATION:—When the ignition switch is turned on the pump is connected to the battery. Current flows through terminal 'A' to contacts 'B' which are normally closed when pump is on suction stroke. The current then flows through coil 'C'. This causes the coil to pull armature 'D' downward expanding the metal bellows and drawing gasoline from the storage tank through the inlet passage 'E' and suction valve 'F' into the bellows chamber. During the suction stroke the contacts are kept closed by the magnetic action of a steel sleeve in the coil which tends to move upward stressing the spring under the lower contact and holding the contacts closed. When the armature hits the spring the contacts open. Arcing of the contacts is prevented by a special short-circuited secondary winding which sets up a current opposite to that of the primary when the primary circuit is broken. This eliminates arcing. The opening of the contacts completes the suction stroke and the spring 'G' then forces the armature upward collapsing the bellows. Suction valve 'F' closes and the gasoline in the bellows is forced through check valve 'H' and delivery passage 'I' to the float chamber of the carburetor. When the delivery stroke is completed contacts 'B' close and the cycle is repeated.



REGULATION:—The operation of the pump is controlled entirely by the hydraulic pressure of the gasoline in the float chamber of the carburetor. When the float valve closes with the float chamber filled with gasoline the hydraulic pressure in the line prevents the pump completing its delivery stroke and the contacts remain open. The pump thus remains inoperative until gasoline is drawn from the carburetor float chamber and does not draw any current even though the ignition switch is on. The pump can only operate while the engine is running unless there is a leak in the line.

CAPACITY:—The Autopulse draws .25-.5 amperes at 6 volts when operating at full capacity. It is normally rated at 5 gallons per hour but will pump 7-8 gallons at full load. On larger engines or where a very even flow of gasoline is desired two, three, four, five or six units may be operated in parallel on the same feed and delivery lines. In this case each unit operates independently. A five unit or Quintette installation will pump 35-40 gallons per hour drawing approximately 2 amperes at 6 volts. Other units are designed for 12 and 32 volt installation.

TROUBLE SHOOTING:—Installation Test. When installing pump partially drain carburetor bowl. Then close ignition switch but do not crank engine. The pump will operate at high speed for several seconds and should then stop. If pump continues to operate at slow speed this is an indication of leakage in the suction or delivery lines.

Test for Gasoline Leakage. This is indicated by continued action of pump with engine stopped and with ignition switch on. Check carburetor for leaking float valve and check delivery line for poor connections. Then check pump for leaking suction valve.

Test for Air Leakage. This is indicated by noisy or uneven operation of the pump. Crank engine and allow it to idle. The pump should operate uniformly. If it speeds up or is noisy, turn ignition switch on after engine has been standing for several seconds but do not crank engine. If there is air in the suction line the pump will vibrate without pumping even after the carburetor chamber is full. The gasoline tank must be full in making this test.

Test for Clogged Line. With pump operating and engine idling watch the dash ammeter. The pump normally draws 1/2 ampere which may not be noticeable on dash ammeter. If needle vibrates noticeably with each stroke check the gasoline line for clogged openings and clean all screens.

Multiple units should be tested individually by disconnecting lead wires and connecting one unit in the circuit at a time. Actual capacity of unit can be tested by placing container under delivery port and turning on ignition switch. The unit will pump at full capacity until the switch is turned off.

SERVICING:—The large filter screen in the air chamber above suction valve should be cleaned when the test indicates a clogged line. Remove the cap on top of unit and remove screen for cleaning. In replacing, carefully shellac cap gasket before replacing cap. If the suction valve has been removed, replace spring in pronged cap with small hole up and replace valve inserting the valve boss in the hole. The polished side must be up. Make certain that cork gasket is in place and snap cap over end of valve cage. The cap must be tight.

SEDIMENT TRAP:—A special sediment trap has been designed for mounting on delivery side of pump. It is fitted with a fine mesh brass screen and separates water and sediment from the gasoline. It also acts as an expansion chamber assuring an even flow of gasoline to the carburetor. The pump may be mounted directly on the side of the sediment trap.

AUTOPULSE

THIRD TYPE

DESCRIPTION:—The new type Autopulse has been considerably modified in construction and can be completely disassembled for inspection and service although the principle of operation remains the same as in the earlier types. The two valves are assembled in the pump base casting and are accessible after removing the filter and filter base casting and taking out the two brass screws under the filter screen. The driving motor is accessible by taking out the two screws on the side of the base cover.

OPERATION:—The operation of the pump is entirely automatic and is controlled by the back-pressure of the gasoline in the float chamber of the carburetor. The Autopulse feed wire should be connected to the coil side of the ignition switch or to the switch side of the ignition coil. In special cases where neither of these terminals is available the Autopulse can be connected to the ammeter through a special switch. This switch must be turned on when the engine is started.

INSTALLATION:—The Autopulse should be mounted near the carburetor and preferably at a slightly lower level than the carburetor bowl. If possible it should be mounted on the chassis frame under the front floor boards so that the filter may be easily reached for cleaning. The suction line should be shielded from the engine exhaust pipe if it is necessary to run them together, to prevent vaporizing of the gasoline in the line. Likewise the pump should not be mounted above the carburetor as this will allow air to be trapped in the delivery line which will cause the pump to flutter. The Autopulse should not be mounted on the dash.

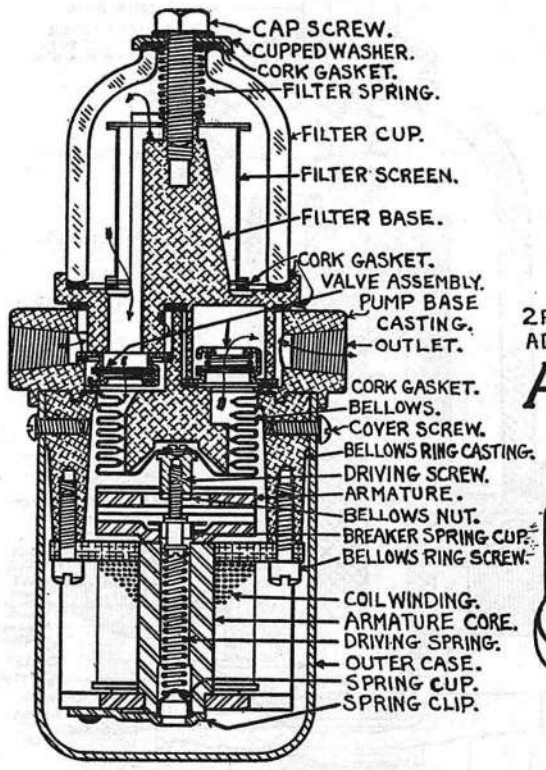
CAPACITY:—The Autopulse will pump approximately 12 gallons per hour. The standard unit is fitted with ⅛ inch openings which will take either ¼ or 5/16 inch tubing. The ¼ inch tubing will be sufficient for engines requiring up to ten gallons per hour. The pump is also furnished with ¼ inch pipe thread couplings which will accommodate ⅜ inch tubing. On multiple units inlet and suction manifolds are used. One end of the manifold can be closed with a pipe plug or if greater capacity is desired, two suction and delivery lines can be used connected to each end of the manifold. Additional pressure can be secured by reversing the small brass stamping on the lower end of the driving spring in the coil core which provides two pounds pressure instead of the standard one pound pressure. To make this change, first remove the motor cover. Then insert a small screwdriver in the slot in the spring support on the base of the motor, compress the spring and slip the support to one side. This will allow the spring and stamping to be removed. Reverse the stamping so that the small knob is against the spring and replace. Make certain that the support is snapped in place (see illustration).

SERVICING:—Check for Correct Installation:—After installing pump, turn on ignition but do not start engine. The pump should start at once and pump rapidly until the carburetor bowl is fulll. The pump should then stop. If the pump strokes rapidly and air bubbles are noticeable in the filter chamber, there is a leak in the suction line. If the pump does not stop and continues to pump slowly, there is a leak in the delivery line or the carburetor float valve is not properly seated.

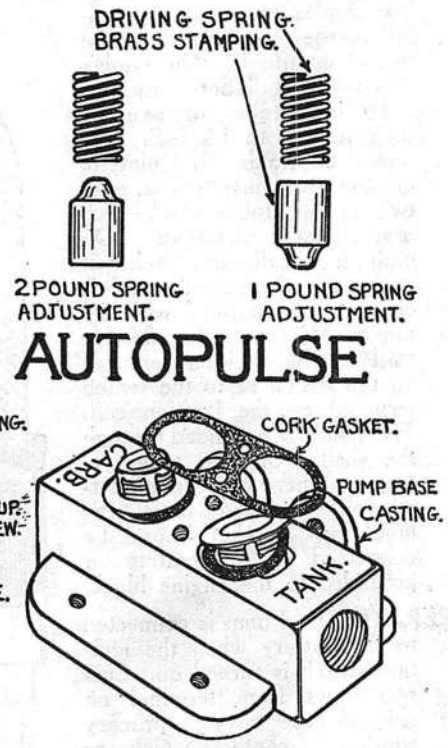
Cleaning Filter:—The filter is designed to trap all foreign matter and water in the filter chamber. To clean filter, take out the cap screw at the top, lift off the filter bowl and remove screen. In replacing the filter, carefully check the gaskets and replace if they are worn or damaged.

Valves:—To check valves, remove the filter and screen and take out the two screws in the filter base casting. Remove the filter base. The valves can then be taken out. Carefully examine the gaskets and replace if necessary. The valve on the 'Tank' side of the base should be inserted with the flange at the top and the valve on the 'Carb' side should be inserted with the flange at the bottom.

Pump Bellows:—To replace bellows, remove motor cover, take out driving spring by slipping spring clip at lower end to one side. Then loosen the nut on the driving screw directly below the bellows stud and loosen the driving screw by inserting a thin screwdriver in the spring hole. Then take out two screws in bellows ring casting and remove coil and armature. Take out the four screws in the bellows ring. The bellows ring and bellows can then be removed. After replacing the bellows, be careful to leave a clearance of .040 inch between the armature and the top of the magnet. The lock nut on the driving screw should be tightened to hold this adjustmet.



SECTIONAL VIEW.



VALVE ASSEMBLY.

Armature and Magnet:—When the lower contacts become worn it will be necessary to replace the armature. This operation requires the use of a special tool, a plain sleeve .341 inch outside diameter and .316 inch inside diameter, to align the breaker spring cup on which the lower contacts are mounted to insure proper clearance. To replace armature, disassemble as directed in above paragraph. Then remove armature by taking out two bolts. In reassembling, insert the special tool in the hole in the magnet to hold cup in alignment while the bolts are being tightened. Be careful to leave .040 inch clearance between the armature and the magnet. The magnet is installed in the same manner. If the upper contacts are worn they may be replaced by riveting a new upper contact bridge in place.

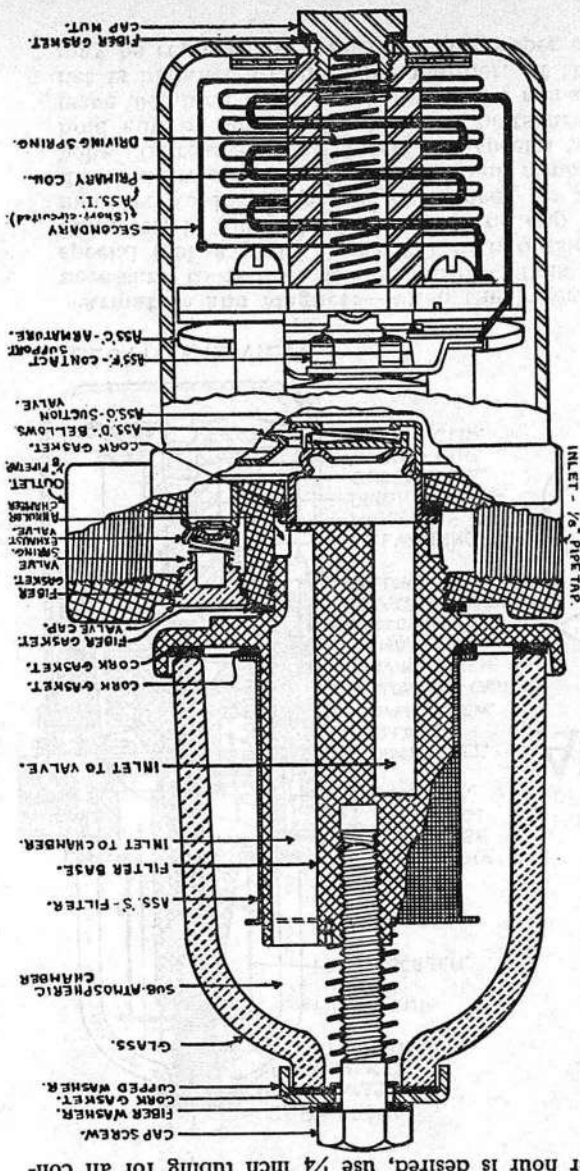
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AUTOPULSE

SECOND TYPE

DESCRIPTION:—The Autopulse consists of a bellows pump operated by a new design electric motor. The bellows are made of metal with reinforced and soldered flanges and it is claimed they will outlast the ordinary life of an automobile engine. No lubrication or service adjustments are necessary.

INSTALLATION:—The pump should be mounted as near the carburetor as is practical and approximately on the same level. Wherever possible mount the pump directly on the carburetor bowl. Both suction and delivery lines of the pump are tapped with ⅛ standard pipe thread and suitable fittings are provided for mounting. For mounting on chassis or engine special brackets 266 (for horizontal mounting), or 267 (for vertical mounting) are provided. A special rubber insulated bracket is supplied for mounting on wooden dash to eliminate sound. For single until mounting where less than 5 gallons per hour is desired, use ¼ inch tubing for all connections. If full capacity is desired, use 5/16 inch tubing. For Duplex or two unit installation, use ⅛ or ¼ inch pipe thread manifolds. On Triplex or Quad installations, use two 5/16 inch tubes or one ⅜ inch tube with ¼ inch pipe thread manifolds. On Quintette or Sextette installations, use two ⅜ inch tubes with ¼ inch pipe thread manifolds. On multiple installations each unit operates independently and is connected in parallel with the others. Connect the flexible lead to the ignition terminal on the switch or to the switch terminal on the ignition coil. The pump is grounded through the shell. On two wire systems or where pump is mounted on insulated base, the mounting bracket must be connected to the battery or grounded to the engine block.



OPERATION:—Pump is connected to the battery when the ignition switch is turned on. Current flows from terminal on side of case through primary winding to contacts which are normally closed on suction stroke and grounds through case. The coil draws the armature downward expanding the bellows chamber and draws gasoline from tank through inlet to filter chamber then through filter screen and suction valve to bellows chamber. During suction stroke contacts are kept closed by action of steel sleeve in the coil which stresses the spring under the lower contacts. When the armature hits the spring the contacts open and primary circuit is broken. A special design short circuited secondary coil prevents arcing at the contacts. The driving spring in the coil core then forces the armature upward collapsing the bellows and forcing the gasoline through the check valve and outlet passage to the carburetor bowl. When the delivery stroke is completed, contacts close and Autopulse repeats suction stroke.

REGULATION:—The operation of the pump is controlled entirely by the hydraulic pressure of the gasoline in the float chamber of the carburetor. When the float valve closes with the float chamber filled with gasoline the hydraulic pressure in the line prevents the pump completing its delivery stroke and the contacts remain open. The pump thus remains inoperative until gasoline is drawn from the carburetor float chamber and does not draw any current even though the ignition switch is on. The pump can only operate while the engine is running unless there is a leak in the line.

CAPACITY:—The Autopulse draws .25-.5 amperes at 6 volts when operating at full capacity. It is normally rated at 5 gallons per hour but will pump 7-8 gallons at full load. On larger engines or where a very even flow of gasoline is desired two, three, four, five or six units may be operated in parallel on the same feed and delivery lines. In this case each unit operates independently. A five unit or Quintette installation will pump 35-40 gallons per hour drawing approximately 2 amperes at 6 volts. Other units are designed for 12 and 32 volt installation.

TROUBLE SHOOTING:—Installation Test. When installing pump, partially drain carburetor bowl. Then close ignition switch but do not crank engine. The pump will operate at high speed for several seconds and should then stop. If pump continues to operate at slow speed this is an indication of leakage in the suction or delivery lines.

Test for Gasoline Leakage. This is indicated by continued action of pump with engine stopped and with ignition switch on. Check carburetor for leaking float valve and check delivery line for poor connections. Then check pump for leaking suction valve.

Test for Air Leakage. This is indicated by noisy or uneven operation of the pump. Crank engine and allow it to idle. The pump should operate uniformly. If it speeds up or is noisy, turn ignition switch on after engine has been standing for several seconds but do not crank engine. If there is air in the suction line the pump will vibrate without pumping even after the carburetor chamber is full. The gasoline tank must be full in making this test.

Test for Clogged Line. With pump operating and engine idling watch the dash ammeter. The pump normally draws ½ ampere which may not be noticeable on dash ammeter. If needle vibrates noticeably with each stroke check the gasoline line for clogged openings and clean all screens. **Multiple units** should be tested individually by disconnecting lead wires and connecting one unit in the circuit at a time. Actual capacity of unit can be tested by placing container under delivery switch is turned off.

SERVICING:—If Autopulse fails to pump with carburetor bowl empty, and pump properly connected and grounded, check outlet valve by raising valve off seat and rotating with a pen knife inserted through outlet passage. Then blow through pump from inlet side. If obstructed take off filter base and press gently on suction valve to test for gummed seat. To assemble suction valve after removal, place spring in retainer with small hole up. Place valve over spring, polished side up, with boss on lower side of valve in hole on spring. Then snap retainer over valve cage and replace in chamber with cork gasket under cage flange. The delivery valve screw should not be removed as valve can be checked through outlet passage.

FILTER:—A fine mesh screen filter is enclosed in the glass chamber on top of the unit. To remove filter, take out cap screw and lift off glass cover. The filter screen can then be cleaned.

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STEWART WARNER FUEL PUMP

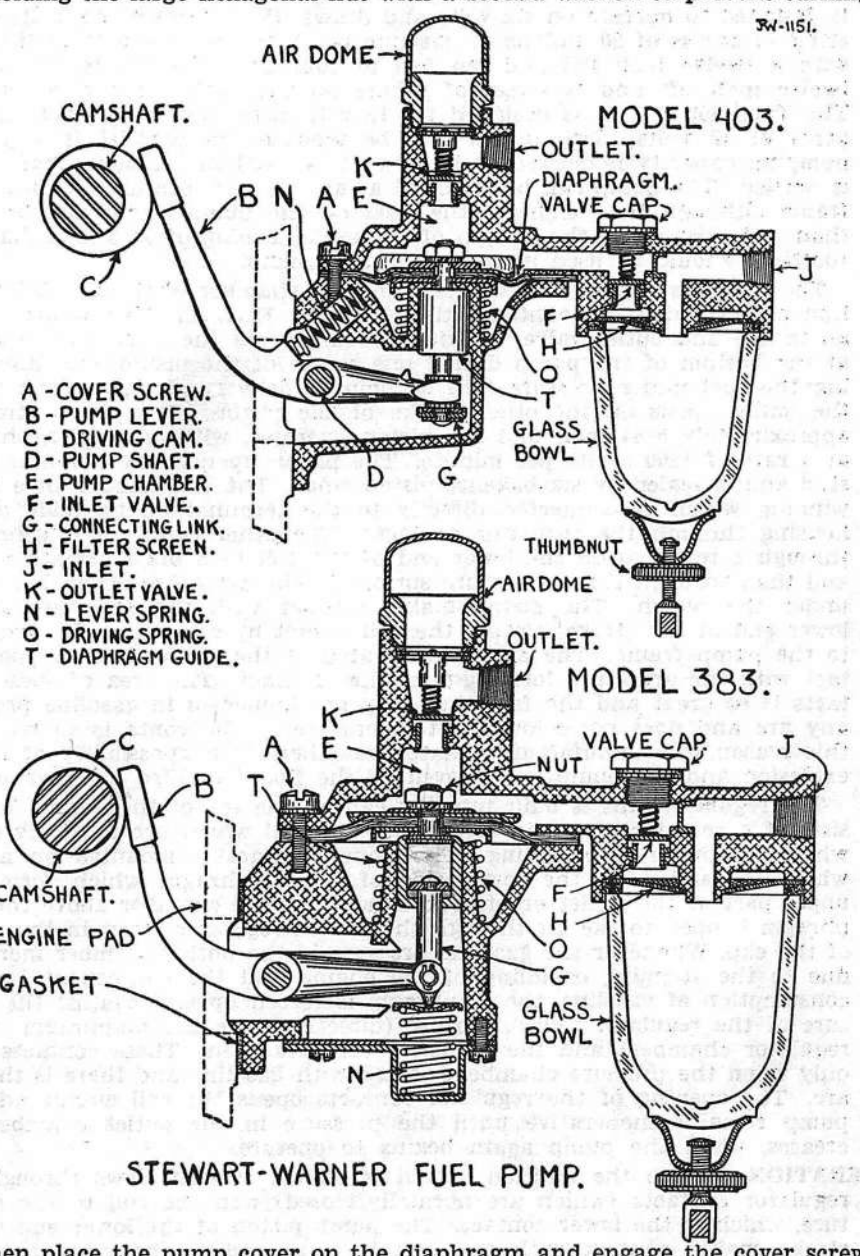
MODELS 383 AND 403

DESCRIPTION:—The Stewart Warner Fuel Pump is a mechanical diaphragm pump driven from the cam shaft of the engine and designed to deliver gasoline from the fuel tank at he rear of the car to the float chamber of the carburetor. A filter and glass sediment bowl are incorporated in the supply line of the pump so that all fuel passes through the glass bowl and then through a fine mesh strainer before it enters the pump chamber. From the pump chamber it is forced to the carburetor bowl, maintaining a constant supply which is designed to be in excess of the actual requirements of the engine. There is an air dome on the pump directly over the outlet valve which relieves the carburetor float valve of excessive pressure on the delivery stroke of the pump by allowing the air in the dome to be compressed.

OPERATION:—On the suction stroke of the pump the special cam on the camshaft forces the lever 'B' down, drawing the pump shaft and diaphragm downward. This creates a vacuum in the pump chamber 'E' which opens the inlet valve 'F' and causes gasoline from the fuel tank at the rear of the car to flow through the inlet 'J' into the glass reserve bowl or sediment chamber and then through the filter screen 'H' and the inlet valve to the pump chamber. As the camshaft rotates the pump lever moves upward through the action of the spring 'N'. This allows the driving spring 'O' to force the diaphragm upward closing the inlet valve, opening the outlet valve 'K' and forcing the gasoline out through the outlet to the carburetor. Air and gasoline vapor are compressed in the air dome during this delivery stroke and expand during the subsequent suction stroke so that the flow of gasoline in the line is kept more uniform and the rate is increased about twenty five per cent. When the diaphragm reaches the top of the stroke the outlet valve closes and the inlet opens and the cycle of operations is repeated. The pump is designed to operate at a maximum pressure of 2.5 pounds per square inch. The actual flow of gasoline to the carburetor is controlled by the carburetor float valve. When the float chamber of the carburetor is filled the float closes this valve. The back pressure of gasoline in the line (when it has built up to 2.5 pounds) is then sufficient to hold the diaphragm at the bottom of the stroke against the pressure of the driving spring. The pump lever continues to move with the action of the cam as long as the engine is running but the pump shaft moves freely in the diaphragm guide 'T' until sufficient gasoline in the carburetor bowl is used so that the driving spring can force the diaphragm up on the delivery stroke when the pumping action begins. The spring 'N' is used only to keep the pump lever in contact with the cam on the camshaft.

TROUBLE SHOOTING:—If the pump fails to deliver gasoline to the carburetor, disconnect delivery line and watch pump action while turning the engine over with the starter. If gasoline spurts from the delivery tube, the line to the carburetor is clogged or the carburetor needle valve is clogged. Observe breather hole in pump housing. If gasoline flows from this hole, the pump diaphragm is cracked and must be replaced. Disconnect supply line to gasoline tank and check for stoppage by blowing through the line. Then examine inlet and outlet valves, clean valves and valve seats and check valve springs. If the valves are warped or gummed, replace valves using new gaskets under the valve retaining nuts. Draw nuts down tight and tighten diaphragm screws. Clean out vent hole in pump housing to prevent back pressure in pump. If this does not correct trouble, remove pump from engine and test by connecting short pieces of rubber tubing to the inlet and outlet. Immerse the inlet tube in a glass of gasoline and operate pump by hand. Gasoline should spurt out of the outlet tube. If the pump does not operate it will be necessary to disassemble and examine the diaphragm and diaphragm driving spring. A weak spring or cracked or leaky diaphragm must be replaced.

To Replace Diaphragm:—Remove the pump cover by taking out cap screws. Unscrew the nut holding diaphragm on pump plunger using a second wrench to hold the large hexagonal nut from turning (this is very important to prevent tearing diaphragm and injuring pump). Remove old diaphragm and lay four pieces of diaphragm material in position on the spring retainer. Insert two cover screws to line up holes. Then place the two washers on the diaphragm, lining up the keyways in the washers and diaphragm with the key on the pump plunger stud. Compress driving spring by forcing these parts down on the stud until they seat properly with the key engaged in the keyway and screw the retaining nut down (holding the large hexagonal nut with a second wrench to prevent turning).



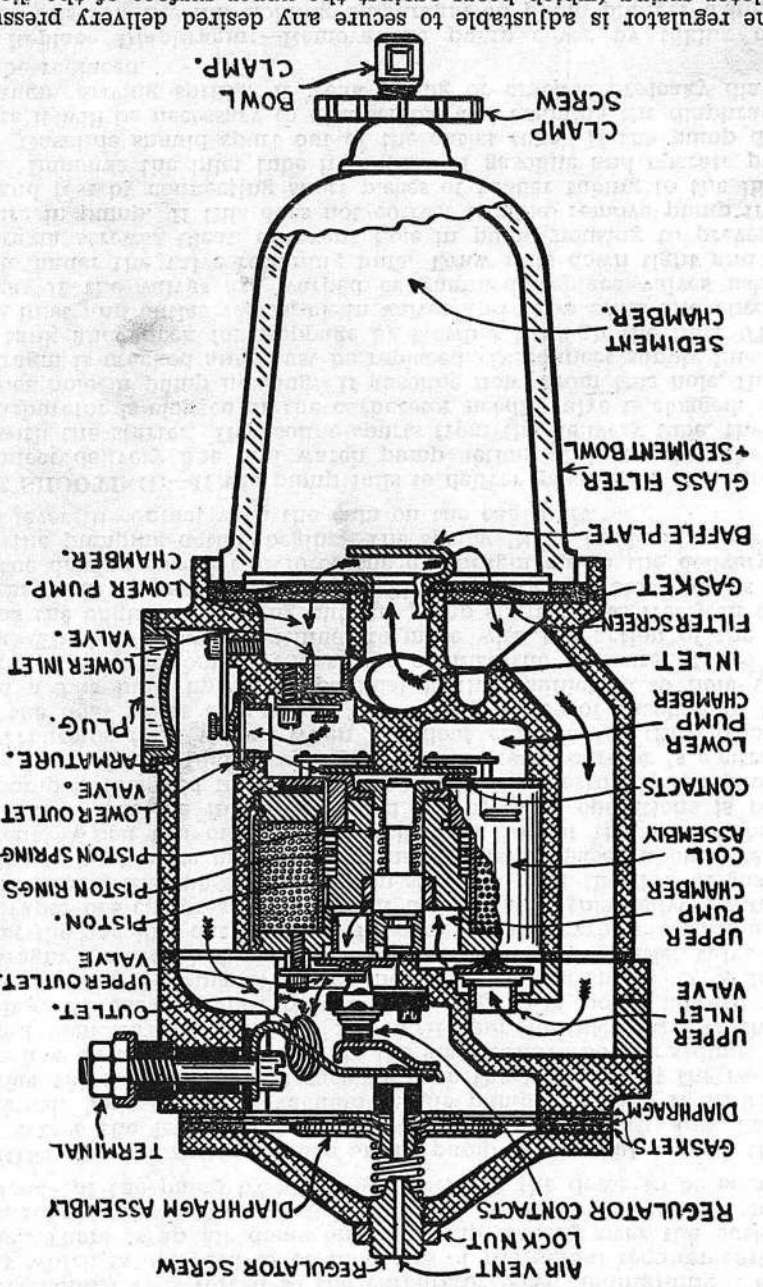
STEWART-WARNER FUEL PUMP.

Then place the pump cover on the diaphragm and engage the cover screws. Turn these screws down about three threads and then flex diaphragm by pushing the pump lever toward the pump as far as possible. Hold it in this position while the cover screws are tightened. This is very important to allow the proper pump action. In replacing the pump on the engine make certain that he gasket is in place between the pump and the engine pad. The pump will prime itself in approximately 20 strokes or 40 R.P.M. of the engine.

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The regulator is adjustable to secure any desired delivery pressure. The regulator spring (which bears against the upper surface of the diaphragm) is carried on the lower end of the regulator screw in the center of the cap and the spring tension can be varied by turning this screw in or out.



The regulator is adjustable to secure any desired delivery pressure. The regulator spring (which bears against the upper surface of the diaphragm) is carried on the lower end of the regulator screw in the center of the cap and the spring tension can be varied by turning this screw in or out.

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OPERATION:—When the ignition switch is closed, current flows through the regulator contacts (which are normally closed) and the coil to the armature, which is the lower contact. The pump piston at the lower end of the stroke makes contact with the armature, grounding the current to the pump housing. The energizing of the coil draws the piston upward forcing the gasoline in the upper pump chamber out through the outlet valve and is broken. The spring within the piston then pulls the piston down on the down stroke drawing gasoline into the upper pump chamber through the outlet chamber from which it flows to the carburetor. At the same time a suction is created in the lower pump chamber under the piston and gasoline is drawn from the fuel tank at the rear of the car through the inlet into the filter bowl and through the screen and the lower inlet valve into the lower pump chamber. As the piston moves upward, the contacts open (as the piston moves away from the armature) and the coil circuit upper inlet valve and forcing the gasoline in the lower pump chamber out through the lower outlet valve into the outlet or pressure chamber. As the piston reaches the bottom of the stroke the contacts again close.

The pump is constructed with a pumping chamber above and below the iron piston which is mounted within the coil. Each chamber is fitted with an intake and outlet valve, drawing gasoline from the filter bowl chamber at the bottom of the pump during one stroke of the piston, and discharging the fuel under pressure into a common delivery chamber from which the outlet opens on the other stroke of the piston. The piston stroke is approximately 5/64 inch and the piston operates, with wide open throttle, at a rate of 1200 cycles per minute. The piston operates on a center guide stud and is sealed by six bakelite piston rings. The coil consists of a single winding which is connected directly to the terminal on the side of the housing through the regulator contacts. The other coil lead is connected through a terminal on the lower end of the coil to a brass armature plate and then through three armature springs to the armature which is directly under the piston. The piston makes contact with the armature at the lower end of the stroke, closing the coil circuit by grounding the armature to the pump frame. The entire lower area of the piston is thus one contact with the armature forming the other contact. The area of these contacts is so great and the fact that they are immersed in gasoline prevents any arc and does not allow the temperature of the contacts to rise. For this reason the manufacturers state that there is no possibility of fire or explosion and the pump is approved by the Board of Fire Underwriters.

The regulator unit is built into the cap on the top of the pump. It consists of a set of contacts in series with the coil which are normally closed when the pump is operating. The upper contact is mounted on a stud which is carried on the lower side of the diaphragm which forms the upper part of the outlet or pressure chamber. The chamber above the diaphragm is open to the air through the vented regulator screw in the center of the cap. Whenever the gasoline pressure in the outlet chamber increases, due to the stopping or idling of the engine and the consequent lessened consumption of gasoline, the diaphragm is forced upward against the pressure in pump. Clean out vent hole in pump housing to prevent back due to the stopping or idling of the engine and the consequent lessened consumption of gasoline, the diaphragm is forced upward against the pressure of the regulator tension spring (directly above the diaphragm in the regulator chamber) and the regulator contacts open. These contacts open only when the pressure chamber is filled with gasoline and there is thus no arc. The opening of the regulator contacts opens the coil circuit and the pump remains inoperative until the pressure in the outlet chamber decreases, when the pump again begins to operate.

DESCRIPTION:—The Stewart Warner Fuel Pump is a double acting, piston type, electrical pump designed to replace the original equipment on automobiles in service or for installation in motor boats. The Type 409-A pump is designed to operate on six volts and draws .75 amperes at six volts delivering in excess of 20 gallons of gasoline per hour through 5/16 inch tubing with a twelve inch lift and ten feet of tubing on the intake side and a twelve inch lift and two feet of tubing on the outlet or carburetor side. The Type 409-B unit is designed for 12 volt installations. It draws .5 amperes at 12 volts. Two pumps can be mounted in parallel if a greater pumping capacity is desired or in series if a total litt of more than 2 feet is needed. The pump can be mounted at any desired location on the chassis frame although the height of the inlet on the pump should not be more than 18 inches above the bottom of the tank. Tubing of 5/16 inch diameter (outside) should be used in connecting the pump.

STEWART WARNER FUEL PUMP

TYPES 409A, B

AC ELECTRIC GASOLINE GAUGE

DESCRIPTION:—The AC Gasoline Gauge is of the electric type and consists of two units, a dash unit or recording gauge and a tank unit or measuring device mounted on the gasoline tank. The dash unit is mounted on the instrument panel. It consists of two coils in which an armature is free to move. The pointer of the gauge is fixed to this movable armature. The dash gauge is connected to the ignition circuit and to the tank unit through insulated wires. The tank unit consists of a fixed resistance and a movable contact arm which is connected to a double float which floats on top of the gasoline in the tank.

OPERATION:—Terminal (1) of the Dash Unit is connected to coil side of the ignition switch so that current is supplied to the gauge whenever the ignition is turned on. The current flows through coil 'A' of the gauge to terminal (2). The second coil is connected to this terminal and the other end of the coil is grounded. The tank unit is likewise connected to terminal (2). The tank unit consists of a resistance coil 'C' of Chromel wire. A movable arm 'D' which is grounded moves across the resistance coil. This arm is connected to the float which rises and falls with the gasoline in the tank so that the resistance is cut in or out of the gauge circuit as the gasoline level in the tank changes. When the gasoline tank is empty the float will be at its lowest position and the contact arm will be in position 'E'. This means that the resistance is entirely out of the circuit and that coil 'B' of the dash unit is shorted. Current will flow through coil 'A' to ground attracting the armature and swinging the pointer to the 'Empty' position. As the level of gasoline in the tank rises the contact arm will swing to the right, cutting more of the resistance in series with coil 'A' and causing more of the current to flow through coil 'B' until when the float reaches the highest position with the gasoline tank full the resistance will be entirely in series with coil 'A' and entirely out of the circuit of coil 'B'. Coil 'B' will thus attract the armature and cause the pointer to swing to the 'Full' position of the dial.

The gauge is of the 'Balanced Coil' type and variations in battery voltage will have no effect on the accuracy of the gauge readings. The current consumption is 1/6-1/16 ampere while the gauge is operating and need not be considered.

MOUNTING:—Both the dash unit and tank unit are grounded. If they are taken off the car care must be used in mounting to see that a good ground is provided. It is not practical to attempt repairs to either the dash unit or tank unit and if units are defective they should be replaced. If the gauge does not register correctly, check trouble from following table:

Pointer does not move when ignition switch is turned on.

The line from the ignition switch to the dash unit is open. Check connections and supply a new lead from the coil side of the ignition switch to the 'IGN' terminal of the gauge.

Gauge indicates 'Full' at all times.

The line from the dash unit to the tank unit is open. Test connections and if necessary replace line with insulated wire.

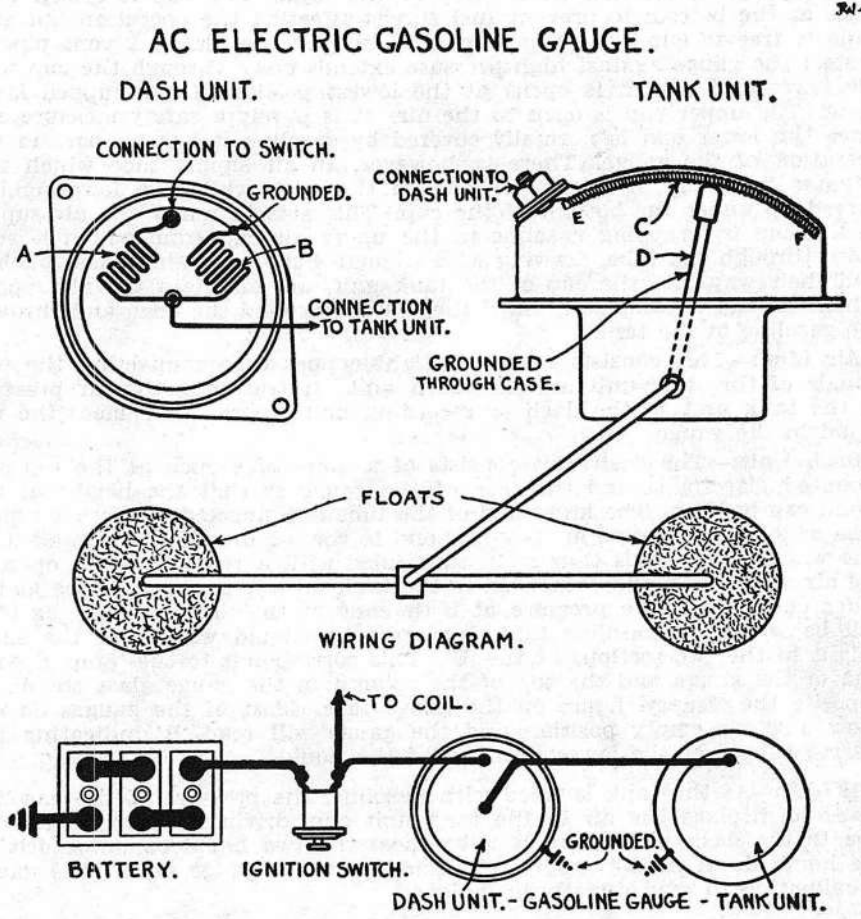
Wires reversed on dash unit. Reverse connections and see if gauge registers correctly.

Gauge indicates 'Empty at all times.

Dash unit not grounded. See that unit is properly grounded to car frame. If gauge still does not register correctly, the dash unit must be replaced.

Tank unit not grounded. See that tank unit is grounded to gasoline tank or car frame. If gauge does not register the tank unit must be replaced.

JW-1152.



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K-S 'TELEGAUGE' FUEL GAUGE

DESCRIPTION:—The K-S Telegauge is a hydrostatic gasoline gauge. The gauge actually measures the pressure due to the weight of the gasoline in the tank on a column of trapped air in the tank unit of the gauge. This is recorded by the height of the liquid column in the dash unit of the gauge. Since the height of the column depends upon the height of the gasoline in the tank the dash unit is calibrated to read directly in gallons. It should be remembered that there are three distinct units to the gauge; the dash unit or recording unit, the tank unit or pressure unit, and the air line which connects them. These will be taken up individually.

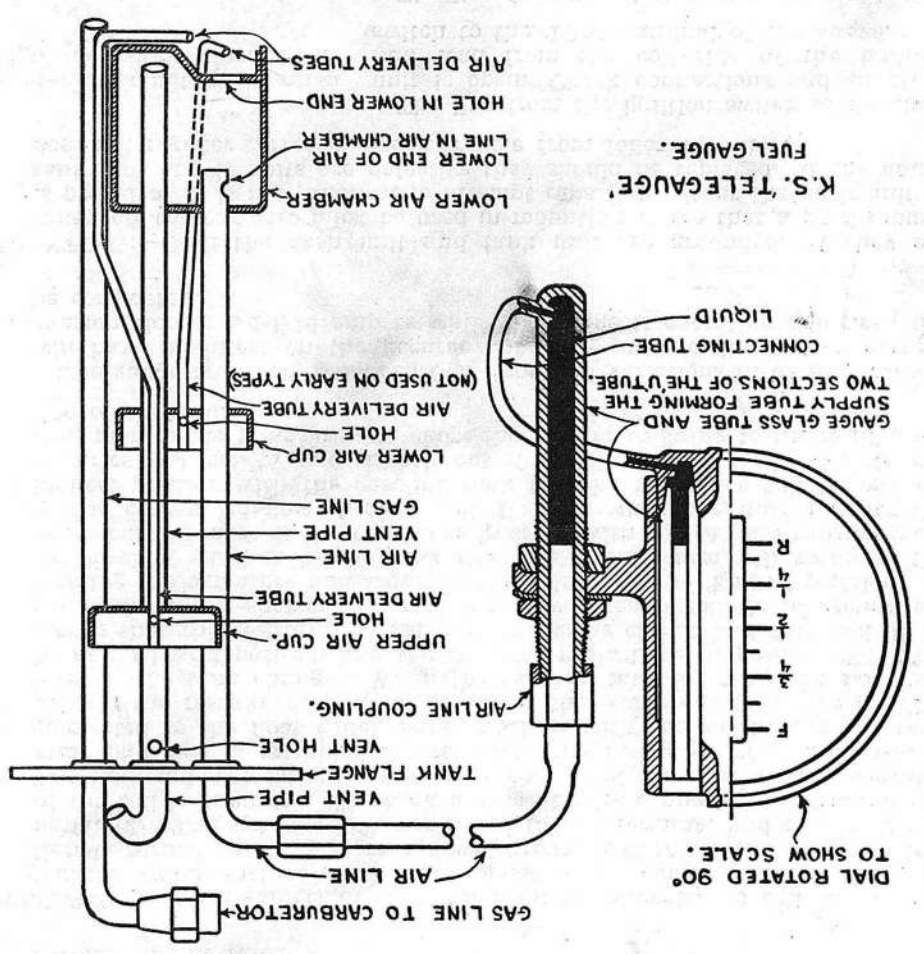
Tank Unit:—The tank unit consists essentially of an inverted cup mounted in the bottom of the gasoline tank and connected through an air-tight tube to the gauge connection on the top of the tank. The cup is closed by a plate at the bottom to prevent fuel surges affecting the operation but gasoline is free to enter the cup through a hole in the plate. A vent pipe to protect the gauge against high pressure extends down through the cup with the lower end (which is open) at the lowest portion of the cupped lower plate. The upper end is open to the air. It is purely a safety measure and since the lower end is normally covered by gasoline it has no part in the operation of the gauge. There is, however, an air supply tube which terminates in a cup at the upper end in the tank while the lower end is curved up under the bottom of the cup. This acts to renew the air supply in the cup by trapping gasoline in the upper air cup from which it runs down through the tube, drawing with it small bubbles of air. These bubbles find their way into the cup of the tank unit and maintain the air supply. When the cup is completely filled they escape around the edge and through the gasoline in the tank.

Air Line:—This consists of an air-tight copper tube connecting the terminals of the tank unit and the dash unit. It transmits the air pressure in the tank unit to the dash or recording unit where it displaces the red liquid in the gauge.

Dash Unit:—The dash unit consists of a glass tube open at the top and mounted directly behind the face of the gauge so that the height of the liquid can be seen. The lower end of the tube is connected to a brass supply tube which is connected at its upper end to the air line from the tank unit. The whole assembly is thus a 'U' tube filled with a red liquid and open to the air at one end and connected to the tank unit or pressure source at the other end. When the pressure at both ends of the 'U' are equal, as they will be when the gasoline tank is empty, the liquid will be of the same height in the two sections of the 'U'. This corresponds to the 'Empty' position of the gauge and the top of the column in the gauge glass should be opposite the 'Empty' figure on the gauge face. Most of the gauges do not show a '0' or empty position and the gauge will read 'R' indicating the reserve supply at the lowest position of the liquid.

OPERATION:—As the tank is filled with gasoline, the pressure of the gasoline tends to displace the air in the tank unit cup, driving it through the air line to the dash unit. Here it unbalances the two liquid columns, driving the liquid down in the supply tube and up in the gauge glass. The gauge is calibrated to read directly in gallons.

SERVICING:—The liquid in the dash unit should be opposite the lowest mark on the gauge with the air line disconnected at the top of the supply tube. To check, disconnect the air line and note the reading. The level of the liquid can be adjusted by using a toothpick to absorb excess or by adding additional liquid. This can be secured from the manufacturer and only genuine King-Seeley Telegauge liquid should be used for this purpose. The air line should then be dried out by connecting the dash end to a hand pump and pumping approximately 40 full strokes of air through the line. This should be done whenever the air line is disconnected for any reason. Do not use the air compressor line as the pressure will be excessive. Check the dash unit to see that it has held the reading. If it does not, the dash unit must be replaced. Test the air line for leaks by disconnecting at both ends and plugging the gasoline tank end and then sucking on the dash unit end. The vacuum should be sufficient to hold the tongue against the tube for a minute. If it does not, the line leaks and should be replaced. Then connect up the air line, making certain that connections at both ends are tight, and drive the car to place the gauge in operation. Driving in such a manner as to cause the gasoline to splash in the tank will hasten the building up of the air supply in the tank unit cup. If the gauge does not register after a short period of driving and if the reading is not held after the car is stopped, the tank unit is defective and must be replaced.



MOTOMETER TEMPERATURE GAUGES

TYPES US, UL, NS, N, L, AND FS (FORD SPECIAL)

DESCRIPTION:—These Motometer Temperature Gauges are of the Vapor Tension type. They consist of a dash unit calibrated to read in degrees of engine temperature, an operating bulb or engine unit, and a capillary tube connecting the dash unit with the engine unit. The Types US, UL, and NS are designed for steering column or dash mounting with the engine unit mounted in a special cylinder head nut or screwed into the engine block in place of the special half inch plug which is provided for this purpose on some engines. The bulb of the engine unit is filled with a liquid and the remainder of the system (capillary tubing and dash instrument) is evacuated. For this reason the capillary tubing must never be disconnected from the bulb or the dash unit and must not be cut or kinked.

OPERATION:—The bulb is exposed to the heat of the engine block (or the water in the cooling system in the Type N and L gauge) and the liquid in the system is raised to the same temperature. The pressure which results from this increase in temperature causes the dash unit to indicate a reading which is calibrated in degrees. All these models are of the illuminated 'Red Ball' type and must be connected to the lighting system of the car. See Mounting.

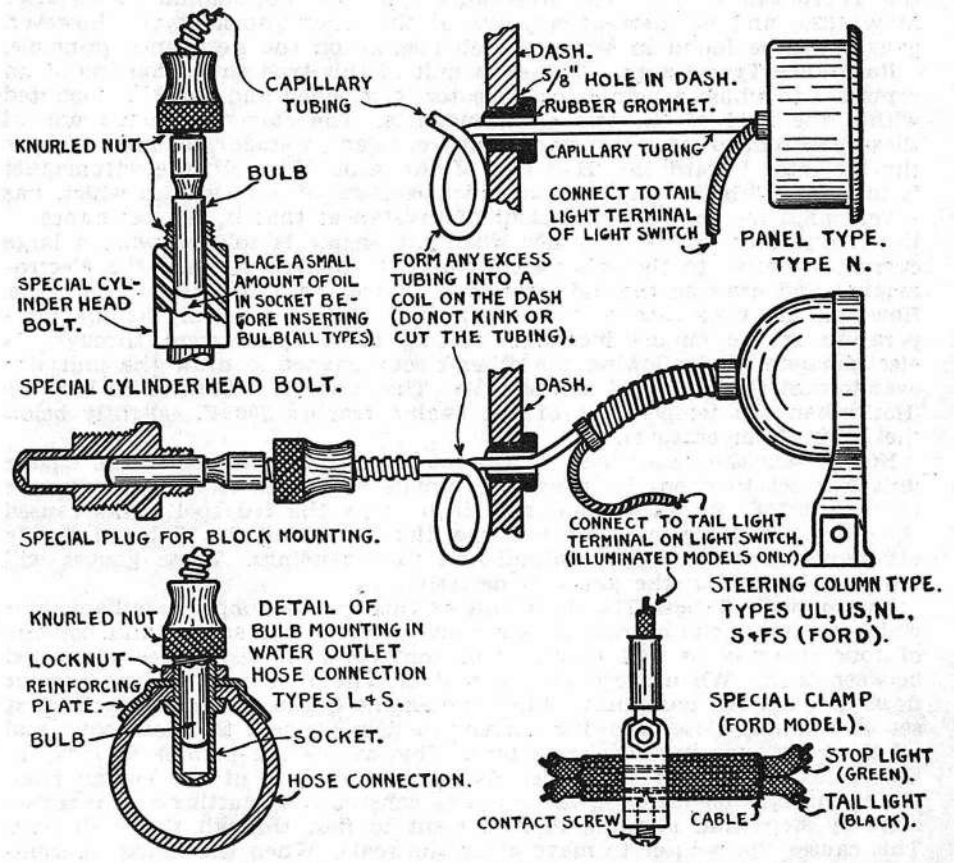
MOUNTING:—Types US, UL NS. These gauges are of the 'Distance Type' and are designed to be mounted on the steering column or on the dash with the engine unit or operating bulb mounted on the engine block. They are furnished with a special cylinder head bolt and with a special plug which is screwed in the engine block on engines where provision is made for this mounting (these engines are equipped with a half inch plug which should de taken out and the special mounting plug screwed in the opening). To mount the gauge, first mount the dash unit on the steering column or drill a 2 1/16 inch hole in the dash for dash mounting. The securing clamp on the dash mounting type is adjustable for mounting on dash boards of various thicknesses. Then drill ⅝ inch hole in the partition at the left of the engine and pass the engine bulb, capillary tubing and knurled nut through this hole. A special rubber plug or grommet is supplied for this opening to prevent the capillary tubing chafing on the edge of the hole. Then remove the nut from the second cylinder head stud at the left of the engine and take out the stud with a Stillson wrench. Screw the special cylinder head bolt in place. Put a small quantity of oil in the bulb socket, insert the bulb and tighten the knurled nut.

If the engine is equipped with the half inch plug for gauge mounting, take out the plug, and screw the special half inch motor block connection in this hole. Put a small quantity of oil in the bulb socket, insert the bulb and tighten the knurled nut. The bulb lead on the dash instrument should be connected to the tail light terminal of the lighting switch. The capillary tubing should not be allowed to chafe against the engine and must not be under tension.

Types L and S. The engine unit or bulb on these types is designed to be inserted in the water outlet hose connection at the front of the engine. Mount the dash instrument as directed above, connect the lead to the tail light terminal of the switch and pass the capillary tubing and bulb through to the engine compartment. Drain the water from the engine, and with the special cutter cut a half inch hole in the hose midway between the ends. Force the bulb socket through this opening, place the reinforcement plate on the outside of the hose and tighten the lock nut. This will make a water tight connection. Form a one inch coil in the tubing and insert the bulb in the socket and tighten the knurled nut. This coil will take up any strain and allow for vibration. Form the surplus tubing into a coil and fasten to the dash. Support the tubing on the radiator tie rod so there is no strain on the tubing at any point. Under no circumstances should any attempt be made to remove surplus tubing by cutting the tube or disconnecting it from the dash gauge or operating bulb as this will destroy the instrument.

If it is necessary to replace the lamp in these instruments, remove the two screws holding the bottom case at the rear of the gauge and insert a 6-8 volt, 2 cp. single contact bulb. If this provides too much light, a 12 volt bulb can be used.

Type FS (Ford). This type gauge is designed to be mounted on the steering column. The second cylinder head stud on the left of the engine should



be removed and the special cylinder head bolt screwed in place. The bulb should then be inserted in the socket in the bolt and the knurled nut tightened. A special clamp is provided to tap the tail light lead at a point near the lighting switch (on the lower end of the steering column). This clamp is provided with a pointed set screw which pierces the insulation on the lead and makes contact with the conductor. The tail light lead and stop light lead are both contained in a braided cable and care must be used to connect the gauge lead to the tail light wire. The lamp in the gauge is replaced as directed above.

SERVICING:—It is not possible to repair these instruments and they must be replaced whenever they are found to be defective.

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DESCRIPTION:—The Nagel Temperature gauges are of the electrical type. They consist of a dash unit or recording gauge calibrated to read in degrees of engine temperature, an engine unit mounted on the block or in the water outlet at the front of the engine and exposed to the heat of the engine, and an electrical connection or conductor between these two units. The current required to operate the gauge is taken from the battery of the car and the dash gauge is connected to the ammeter or lighting switch. The gauge automatically turns itself off when the engine is cold and for this reason it is not necessary to have a switch in the gauge circuit. All of the above types except the Model LP are illuminated by a bulb in the dash unit and a second lead is connected to the tail light terminal of the lighting switch so that the gauge lamp is lighted whenever the car lights are on.

OPERATION:—These gauges are of two distinct types, the Resistance type and the Thermostatic type. The Resistance type was not manufactured after May, 1929, and all new gauges are of the Thermostatic type. However, gauges will be found in service which operate on the Resistance principle.

Resistance Type Gauges. The dash unit of this type gauge consists of an armature to which a pointer or indicator is attached and which is mounted within the field of the two electromagnets. The current through one of these electromagnets is constant (with constant voltage) tending to draw the indicator toward the 'Hot' end of the scale. The other electromagnet is in series with the engine unit which consists of a resistance which has a very high temperature coefficient of resistance; that is, the resistance of the engine unit will be very low when the engine is cold allowing a large current (relative to the other electromagnet) to flow through the electromagnet and drawing the indicator over toward the 'Cold' side of the scale. However, the resistance of the engine unit increases rapidly as the temperature of the engine increases, cutting down the current through its electromagnet and allowing the other electromagnet to draw the indicator over toward the 'Hot' end of the scale. The gauge is calibrated to indicate 'Hot' when the temperature of the engine reaches 200°F. (slightly below the boiling temperature).

NOTE:—On the gauge used on Durant (1928) a thermostat in the engine unit was set to open the resistance circuit when the engine temperature reached 207°F. with the pointer ¼ inch below the red spot. This caused the pointer to jump suddenly into the 'Hot' section of the dial and clearly differentiated between the normal and 'Hot' readings. These gauges will indicate 'Hot' when the gauge is defective.

Thermostatic Types. The dash unit of this type is simply a millammeter which measures the current in the gauge circuit. The engine unit consists of four thermostats and four sets of contacts with resistances connected between them. When the engine is cold the circuit is open and no current flows through the dash unit. When the engine begins to warm up the first set of contacts close, allowing current to flow through the dash unit and all the resistance in the engine unit. This causes the pointer to move to the 'Cold' position on the scale. As the temperature of the engine rises, the thermostat blades close the contacts consecutively, cutting out the resistance by steps and allowing more current to flow through the dash unit. This causes the pointer to move along the scale. When the fourth thermostat blade closes the contacts all the resistance is cut out of the engine unit and the pointer moves to the red portion of the scale, indicating 'Hot'. The standard setting of these gauges is: 'Cold'—under 120°F.; 'Normal'—from 120°F. to 197°F.; 'Hot'—above 200°F.

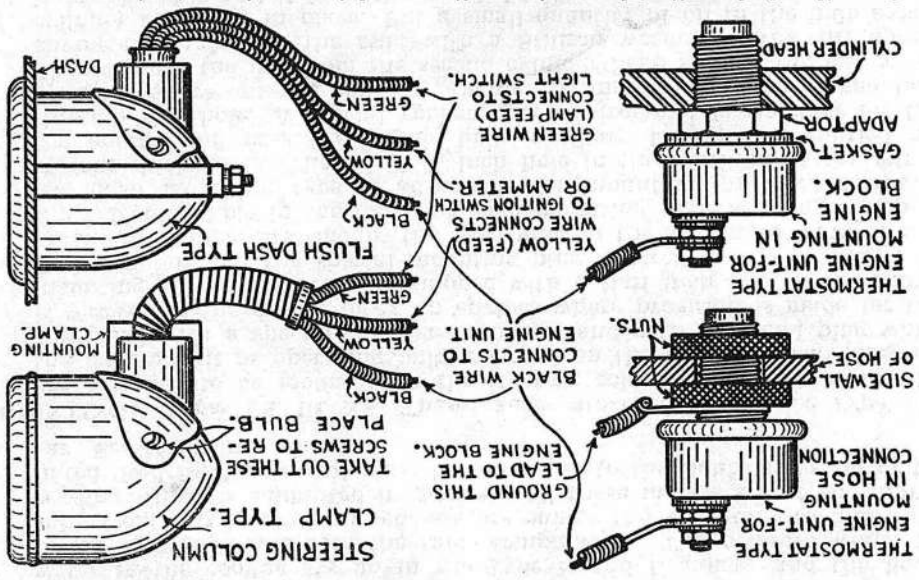
SPECIAL NOTE:—The dash units and engine units of the Resistance type and Thermostatic Type gauges are not interchangeable. The models are similar in appearance and the model numbers have been continued except that the new gauges of the Thermostatic Type are known as 'Series T'. The engine units of the Thermostatic Type are equipped with a nut and binding post instead of the Fahnestock clip used on the Resistance Type and all Thermostatic Type dash units have a tag attached marked 'Series T'.

MOUNTING:—Dash units are designed for steering column mounting, clamp mounting on the dash, and flush dash mounting. It is very important the dash unit be properly grounded (Resistance Type—the Thermostatic Type is not grounded). In steering column mounting it will be sufficient to scrape the paint from under the mounting clamp band on the steering column. Where the dash unit is clamped on the dash, the ground will be taken care of by the mounting clamp screw on metal dash providing the screw makes contact with the dash directly.

The engine unit can be mounted in the hose connection at the front of the engine (the water outlet at the top of the radiator) or directly on the cylinder block through the use of a special adapter. The hose should be removed from the engine and cut with the special cutter furnished with the gauge. The engine unit is mounted on the hose (see illustration) and grounded to the motor block by a separate ground wire. When the engine unit is mounted on the engine block, by drilling a 23/32 inch hole and tapping for a ½ inch pipe plug, no separate ground need be provided. The terminal on top of the engine unit should be connected to the black lead from the dash unit. The engine unit ground is very important.

The yellow lead from the dash unit is the feed wire and should be connected to any live terminal of the car circuit, usually the ammeter or feed terminal of the ignition switch. On illuminated models the third lead, a green wire, should be connected to the tail light terminal of the lighting switch so that the gauge lamp will be lighted whenever the car lights are on. The Model LP is not illuminated and this green wire is not used. The lamp bulb can be removed and replaced by taking out the two screws on the back of the instrument, which will release the plate on which the bulb is mounted.

TROUBLE SHOOTING:—If the temperature gauge does not register correctly, check the ground at the dash unit and engine and examine connections. On flush dash mounting type gauges see that connections are properly made. The engine unit should be connected to the terminal marked 'E' and the feed wire to the terminal marked 'S'. The indicator can be checked by running the engine with retarded spark with the radiator covered until the cooling water boils. Check to see if the gauge reads 'Hot'. If indicator fails to register, disconnect the lead at the engine unit and ground to the engine block. If the pointer goes to 'Hot', the dash unit is probably all right. If the dash unit fails to register, it is defective or the lead wire is open. These instruments cannot be repaired and must be replaced when they are found to be defective.



NAGEL TEMPERATURE GAUGES

MODELS SC, CM, DM, RP, LP, FH (FORD TYPE)

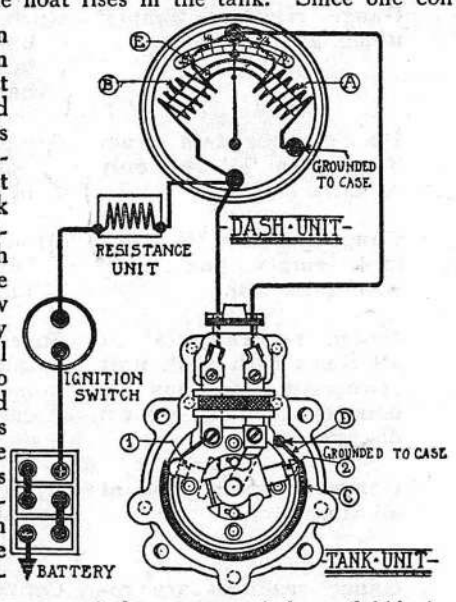
NAGEL GASOLINE GAUGE

Model R.K.D.

Electric Gasoline Gauges will be found as standard equipment on a large number of passenger car models. These units do not require attention in service other than tests to locate trouble when the gauge does not register correctly. As long as the gauge works properly no attention is necessary.

DESCRIPTION:—The Model R.K.D. gauge consists of two parts, the recording gauge mounted on the dash and the tank unit mounted on the gasoline tank at the rear of the car. They are connected by two wires running along the car frame from the dash to the tank. A lead from the No. 1 terminal of the dash unit is connected to the ignition terminal of the switch or directly to the ammeter through a special resistance unit. It is important that this resistance be wired in the circuit.

OPERATION:—The gauge is an accurate current balancing device with two coils 'A' and 'B'. A variable resistance 'C' in the tank unit is cut in or out of each coil circuit by the action of the float in the gasoline tank rising or falling with the gasoline level. The magnetic action of the coils causes the pointer of the gauge to move from the 'Empty' to 'Full' as the float rises in the tank. Since one coil is balanced against the other a variation of the battery voltage has no effect on the reading of the gauge and a correct reading will be obtained with a discharged battery as well as when the battery is fully charged. When the gas tank is entirely empty and the float is at its lowest position the contact arm 'D' of the tank unit will be in position 1 and the resistance 'E' will be entirely in series with coil 'A' and will be entirely out of the circuit of coil 'B'. Coil 'B' will thus draw a slightly greater current from the battery and the greater magnetic attraction will draw the circular solenoid 'E' around so that the pointer attached to the solenoid will register 'Empty' on the gauge. As the gasoline level and the float rise in the gasoline tank the contact arm 'D' moves along the resistance unit cutting the resistance out of the coil 'A' circuit and in the circuit of coil 'B'. At the top of the stroke with the gasoline tank full the contact arm reaches position 2 with the resistance entirely cut out of the coil 'A' circuit and entirely in series with coil 'B'. At this point the solenoid has reached a position in coil 'A' and the pointer indicates 'Full'. When the ignition switch is turned off the gauge becomes inoperative and the pointer may rest in any position. It will be necessary to switch the ignition on momentarily to secure a gauge reading.



MOUNTING:—It is very important that the wiring of the instrument is exactly as shown. The gauge will not operate correctly with reversed connections. Both the dash unit and the tank unit must be grounded. If the gauge is mounted on a wooden dash it will be necessary to run a wire from one of the mounting screws on the case to the engine block or to the car frame. The tank unit must be well grounded to the gasoline tank.

TROUBLE SHOOTING:—Minor adjustments can be made on the tank unit. No attempt should be made to repair the dash unit and it should be returned to the manufacturer for repairs if tests indicate that it is defective. Neither dash unit or tank unit require lubrication in service. In making tank unit repairs use alcohol to clean parts. Do not use gasoline or oil.

Check gauge trouble from the following table:

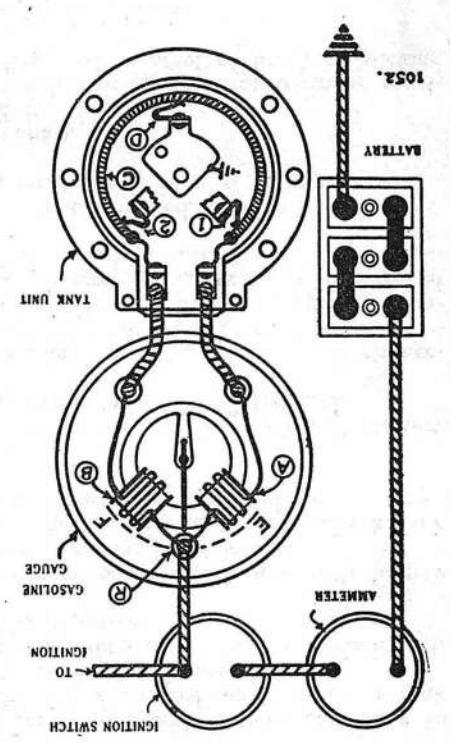
Gauge does not give any definite reading.	1. Ground in Number 1 line or ground in line at dash terminal or tank terminal. 2. Open battery circuit caused by open resistance unit, loose terminal at gauge or switch, or broken switch wire.
Gauge registers empty until tank is nearly full; then no definite reading.	1. Ground in Number 2 line or ground in line at dash terminal or tank terminal. 2. Dash unit is not properly grounded. 3. Dash unit is defective.
Gauge registers 'Empty' with tank empty and '¼' with tank full.	1. Open circuit in Number 1 line or open circuit at dash terminal or tank terminal. 2. Open circuit in tank unit resistance.
Gauge registers 'Full' until tank is nearly empty. Then no definite reading.	1. Reversed connections with battery connected to terminal Number 2 on dash unit. Examine tank unit resistance for fused grounded end. 2. Open circuit at Number 1 terminal on dash unit. 3. Dash unit is defective.
Gauge does not give definite reading with tank empty. Registers '¾' with tank ¼ full. Registers 'Full' with tank filled.	1. Reversed connections on dash unit with battery connected to terminal Number 1. 2. Reversed connections on tank unit. Check tank unit resistance for fused grounded end.
Gauge registers '½' with tank empty. Registers 'Full' with tank ¼ to completely filled.	1. Reversed connections on dash unit with battery improperly connected to No. 2 terminal.
Gauge registers '½' at all times.	1. Open circuit in Number 2 line or loose connection at dash terminal or tank terminal. 2. Tank unit is defective. Check for sticking plunger, weak plunger spring or poor contact of center brush caused by dirt.
Gauge registers '¾' with tank empty. Registers 'Full' with tank full.	1. Tank unit is not grounded. 2. Tank unit resistance is open at grounded end.
Gauge inaccurate or erratic.	1. Loose terminals. 2. Number 2 line broken. 3. Tank unit defective. Check for irregular resistance winding, poor contact of brush or sticking plunger. 4. Damp car terminal block. 5. Defective dash unit.
Gauge registers high. Does not reach 'Empty' with tank empty or gauge registers low and does not reach 'Full' with tank completely filled.	1. Bent float rod. Float rod should be straight. 2. Loose screws holding tank unit contactor in place. Check to see that contactor is at extreme end of resistance unit when tank is empty.

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NECO GASOLINE GAUGE

DESCRIPTION:—The Neco Gasoline Gauge consists of two units; a dash unit or recording gauge calibrated to read from "Empty" to "Full" on which the amount of gasoline in the fuel tank is indicated by a movable pointer, and a tank unit mounted on the gasoline tank at the rear of the car which is actuated through a gear system by a float which rises and falls with the level of the gasoline in the tank. The two units are connected by two wires which are ordinarily included in the regular car wiring harness. In addition the dash unit is connected to the coil side of the ignition switch or to the switch side of the ignition coil so that current is supplied to the gauge whenever the car is in operation. The gauge will not indicate the amount of gasoline in the tank when the ignition is turned off but if a reading is desired the ignition may be turned on momentarily. The tank unit is grounded through the mounting. The dash unit is not grounded.



OPERATION:—The gauge is essentially a current balancing device. The two coils 'A' and 'B' are both connected to the current source at the terminal 'R'. Each coil is in series with a portion of the resistance coil 'C' in the tank unit and is grounded through the moving contact 'D'. There are thus two independent circuits connected to a common current source. For this reason variations in battery voltage have no effect on the operation or accuracy of the gauge. The moving contact or brush 'D' is connected through a gear system to the float in the gasoline tank. When the tank is empty and the float at its lowest position, the contact 'D' will be in position '1'. At this point the resistance will be entirely cut in the circuit of coil 'B' and entirely out of the circuit of coil 'A'. Due to the lower resistance of the coil 'A' circuit, the coil will draw a relatively larger current than coil 'B' and the movable vane or armature will be drawn into coil 'A' and away from coil 'B'. The pointer is affixed to this vane and will consequently move to the extreme left or empty position opposite the dial figure 'E'. When the gasoline tank is full the contact 'D' will have moved to position '2' and the conditions will have been reversed so that the vane will be drawn into coil 'B' and the pointer will be in the full position opposite the dial figure 'F'.

TROUBLE SHOOTING:—There are no service adjustments as all resistances and parts assemblies are absolutely fixed. If the gauge is properly installed and registers correctly, no attention is required. If the gauge does not register correctly, check trouble from the following trouble shooting table:

Gauge does not register. Pointer assumes any position regardless of gasoline level in tank.	1. Open circuit in line from gauge to battery. Test for current at gauge terminal. 2. Tank unit is not grounded. Carefully ground tank unit to tank or car frame.
Gauge registers 'Empty' under all conditions.	Open circuit in line between coil 'B' and tank unit. Connect these terminals of dash and tank unit with a jumper outside car wiring harness.
Gauge registers from 'Empty' to '½' full only as tank is filled.	Ground in line between coil 'A' and tank unit. Disconnect this line at both ends and connect a jumper outside the car wiring harness.
Gauge registers '½' with tank empty and 'Full' with tank full.	Ground in line between coil 'B' and tank unit. Disconnect line at both ends and connect a jumper outside the car wiring harness.
Gauge registers '½' at all times with tank unit connected and has no definite reading when disconnected.	Short circuit in lines between dash unit and tank unit. Disconnect both lines and connect jumpers between the units outside the car wiring harness.
Gauge registers 'Full' at all times.	Open circuit in line between coil 'A' and tank unit. Disconnect line and connect jumper outside car wiring harness.
Gauge readings are reversed at dash unit or tank unit when tank is empty and 'Empty' when tank is full.	Connections reversed at dash unit or tank unit. Connect lines correctly and check gauge readings.

If these tests indicate that either the dash unit or tank unit is defective the unit should be returned to the manufacturer for repair. It is not practical to attempt repairs and parts are not furnished for replacement.

MOUNTING:—It is very important in mounting the tank unit that all paint and grease be removed from the edges of the tank so that a good ground is secured between the unit and the frame. The wiring must be made exactly as shown. If the wires are reversed the gauge readings will be reversed. **It will not be necessary to ground the dash unit and it can be** mounted on a wooden dash.

ROBERT BOSCH GENERATOR

"NO BATTERY" TYPE

DESCRIPTION:—The Bosch No-Battery Generator has been developed for use on trucks and tractors and is designed to operate lights at six volts without a battery. The generator is of the voltage control type and the regulator holds the voltage at a constant figure throughout all speeds so that lamp filaments will not burn out at high speeds. It will not operate with a battery in circuit and no battery should be used. The internal winding of the Bosch Generator for use with a battery differs (see next page) and this generator should be used with battery circuits. The No-Battery Generator is a four pole shunt wound machine with a shunt coil wound on each pole. In addition there is a series winding on one pole. The regulator operates in conjunction with a fixed resistance which is cut in the shunt field circuit.

OPERATION:—When the generator is operated at low speeds with all lamps turned off, Contact 'A' of the regulator is closed and Contact 'B' is open. This means that the shunt field of the generator is grounded at both ends since the other side of the shunt field is connected to the lamp side of the lighting switch. Likewise Contact 'C' of the relay cutout is open. The generator is thus entirely inoperative. When the lighting switch is turned on at low speeds the shunt winding is connected directly across the main brushes with the resistance coil shorted out. The current generated flows through the series coil and helps to strengthen the field. As the speed of the generator increases Contact 'A' of the regulator opens inserting the resistance in series with the shunt field. When the voltage of the generator rises to the maximum figure for which the regulator has been set, Contact 'C' closes shorting out the series winding. At higher speeds Contact 'B' of the regulator alternately opens and closes which momentarily short circuits the shunt field and holds the voltage constant.

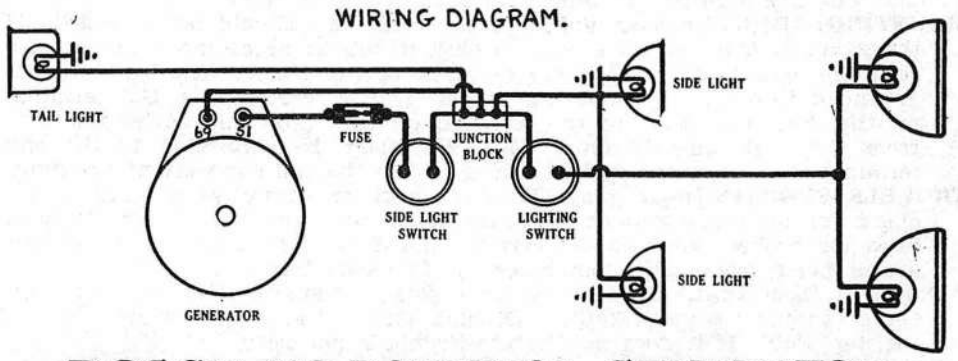
INSTALLATION:—The generator is designed for either cradle or flange mounting. Each type is provided with a shaft extension for accessory drive. It must be driven at crankshaft speed or higher (a ratio of 1½ times engine speed will probably be most satisfactory). The generator is supplied in various types for different outputs although the type K 50/6 500 rated at 50 watts and designed to operate two headlights (21 cp), two side lights, and dash and tail light will be found in most installations. There are two terminals on the generator (51), which is the main terminal and should be connected to the lighting switch through a ten ampere fuse, and (69), which is the field lead and must be connected to the lamp side of the lighting switch.

ROTATION:—The generator is designed to be operated in the direction marked on the commutator end of the generator. However, the direction of rotation can be changed by reversing the connections on the shunt field and series field coils. The field leads are distinctly colored and marked and are brought out to the junction block on the commutator end of the generator directly under the regulator and relay cutout.

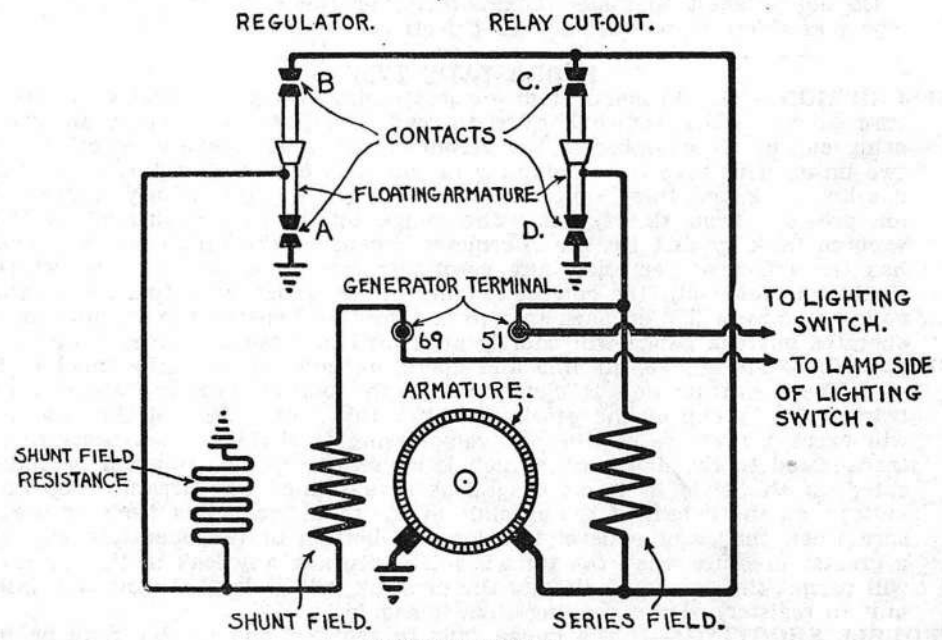
PERFORMANCE:—The output of the generator under load is shown on the following table:

Amperes	Volts	R.P.M.
2.2	1.0	200
3.75	3.5	300
5.0	5.6	400
5.4	6.4	600
5.5	6.7	800
5.5	6.75	1000
5.5	6.75	2000

ADJUSTMENT:—The regulator is contained in a turned steel case with a floating armature in the center of the coil having a contact on each end. The stationary contact of each set is contained in the end cap of the regulator case and is mounted on a threaded plug. One contact plug has a very fine thread which makes it possible to secure fine adjustments. The Robert Bosch Company have developed special service tools to set the regulator and it will not be possible to secure as satisfactory a setting without their use.



BOSCH NO-BATTERY GENERATOR.



INTERNAL WIRING.

OILING:—The armature shaft is carried on ball bearings which are packed with special heat resisting grease. These bearings will not require any attention in service but if the generator is disassembled for service work they should be repacked with this special grease secured from the Robert Bosch Company.

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NATIONAL GASOLINE GAUGE

ELECTRIC AND HYDROSTATIC TYPES

ELECTRIC TYPE

DESCRIPTION:—The National Gasoline Gauge is of the balanced coil type and consists of a dash recording unit and a tank resistance or variable resistance connected to a float in the gasoline tank. The gauge operates only when the ignition switch is on and indicates 'Empty' with the switch off. With engine stopped it will be necessary to turn the switch on to secure a correct reading. The gauge is not affected by changes in battery voltage and will give a correct reading with a discharged battery.

MOUNTING:—Both the dash unit and the tank unit should be grounded. If the gauge is mounted on a wooden dash it will be necessary to run a wire from the gauge case to the engine block or car frame. The tank unit is grounded through the mounting screws. One wire from the 'Ga' terminal on the dash unit runs to the terminal on the tank unit. A second wire from the dash unit terminal 'IGN SW' should be connected to the coil terminal of the ignition switch. Make certain that all connections are tight.

TROUBLE SHOOTING:—If gauge does not register correctly in service, first check for loose connections at switch, dash unit, or tank unit and check lines for broken wires. Make certain that both dash unit and tank unit are properly grounded. Then make the following tests:

Defective Dash Unit. Turn on ignition switch. Remove wire at tank unit. Gauge should register 'Empty'. Ground wire to car frame. Gauge should register 'Full'. If it does not, the dash unit is defective.

Defective Tank Unit. If the above tests indicate that the dash unit is operating correctly and the gauge will not operate in service, the tank unit is probably defective.

Do not attempt to make repairs to either the dash unit or tank unit. The manufacturer will replace all defective instruments.

HYDROSTATIC TYPE

DESCRIPTION:—The National Hydrostatic Gasoline Gauge consists of a pressure gauge on the dash calibrated to read in gallons of gasoline, an operating cup or air chamber in the gasoline tank, and a tube connecting the two units. This tube has a coupling at the dash unit and at the top of the gasoline tank and these couplings must be tight to prevent any leakage of air pressure from the system. The gauge line is also connected to the vacuum tank so that the air is removed whenever the tank operates. This has the effect of removing any gasoline vapor from the air line, which would interfere with the correct reading of the gauge. For this reason the gauge reading will drop back to zero or 'Empty' whenever the vacuum tank operates but the gauge will shortly afterward indicate a correct reading.

OPERATION:—The gauge, air line and operating cup are normally filled with air. The operating cup is open only at the bottom and the air will be trapped in the cup by the gasoline in the tank. The weight of the gasoline will exert a pressure on the air, compressing it slightly. This pressure is transmitted to the dash unit, which is a pressure gauge, and will be indicated on the scale in terms of gallons of gasoline. The pressure depends entirely on the height of the gasoline in the tank, increasing from no pressure when the gasoline level is below the bottom of the operating cup to a greater pressure when the tank is full. Naturally any leak in the air line will permit the escape of air and the pressure will be lost, causing the dash unit to register a lower reading than it should.

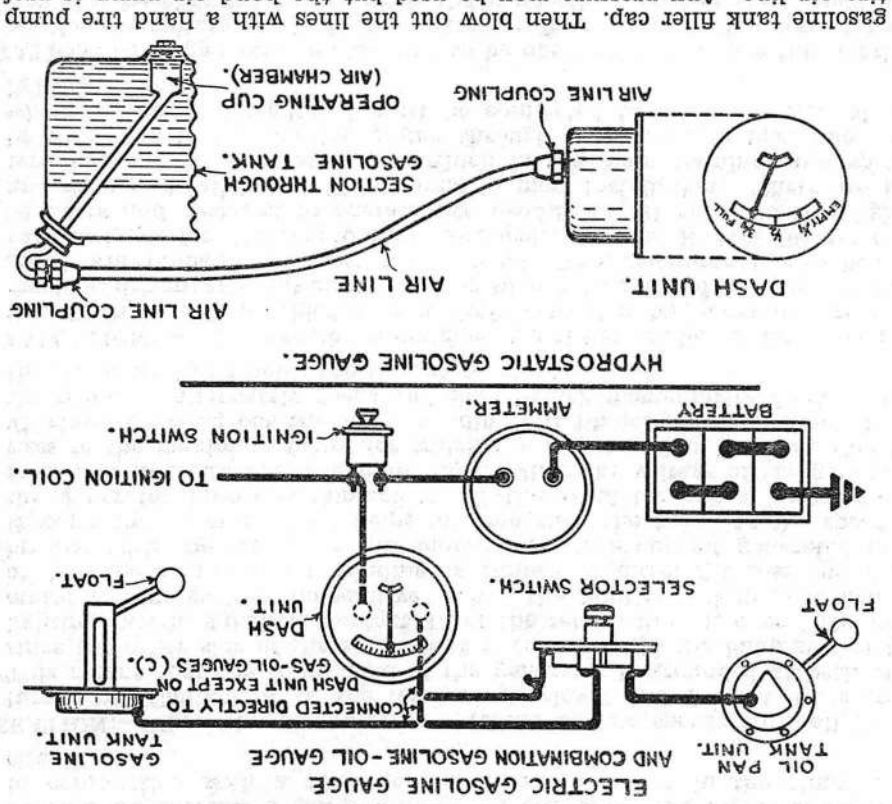
TROUBLE SHOOTING:—If the gauge fails to register, the trouble may be in the gauge or dash unit, the air line may be clogged, or the coupling may be loose. Check as follows:

Testing Dash Unit. Disconnect the air line at the back of the dash unit and slip a short piece of rubber tubing over the gauge socket and then blow through the tubing until the gauge reading is approximately ¾ 'Full'. Any excessive pressure will destroy the gauge. Seal the rubber tube and watch to see if the gauge holds the reading. Tap the gauge glass slightly. If the pointer remains at the ¾ mark, the dash unit is operating satisfactorily. If the pointer drops back to '0', indicating that the pressure is being lost, the dash unit is defective and must be replaced. No repairs are possible.

To Free Air Line. Disconnect the air line at the dash unit. Remove the gasoline tank filler cap. Then blow out the lines with a hand tire pump or tire air line. Any pressure may be used but the hand air pump is preferable. When the air bubbles through the gasoline in the tank, showing the air line is open, connect the air line to the dash unit. Use two wrenches to prevent damage to the dash unit. It will be necessary to run the engine to free the operating cup from gasoline which fills it whenever the air line is disconnected.

If the gauge registers less than the actual contents of the tank, it is an indication that the air line is not tight. Blow out the line and tighten the couplings, using two wrenches to avoid twisting the dash unit and tank unit.

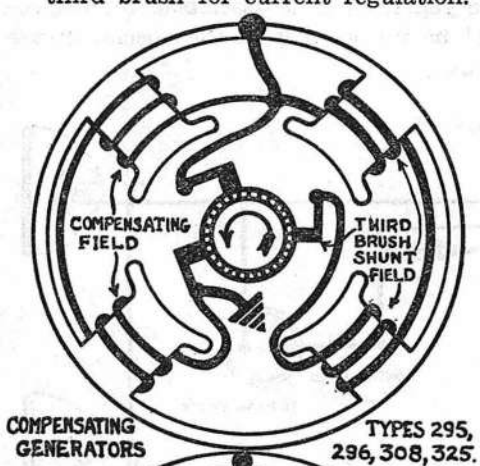
If the gauge registers more than the actual contents of the gasoline tank, it is an indication that the dash unit has been subjected to excessive pressure. The dash unit must be replaced.

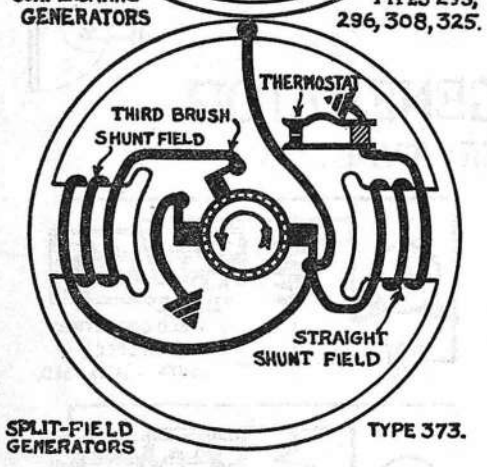


DELCO-REMY SPECIAL GENERATOR

DELCO COMPENSATING GENERATORS

Description:—These are four pole generators with two main brushes and regular third brush for current regulation. The third brush shunt field connected between the third brush and one main brush is wound on two field poles either adjacent or opposite as shown in the illustrations. A straight shunt field called the compensating or stabilizing field connected between the two main brushes is wound on the other two poles. The two fields work together. One main brush is grounded and the lead to the relay is taken from the other insulated main brush.





Operation:—The third brush shunt field builds up until the peak output is reached. Above this point the voltage at the third brush drops off and the strength of the third brush shunt field decreases. The compensating field, however, continues to increase in strength which tends to maintain the field at normal strength regardless of the armature speed. This compensating or stabilizing action results in a very even charging rate at all speeds above the peak, and the falling off of the charging rate which is characteristic of ordinary third brush generators does not occur.

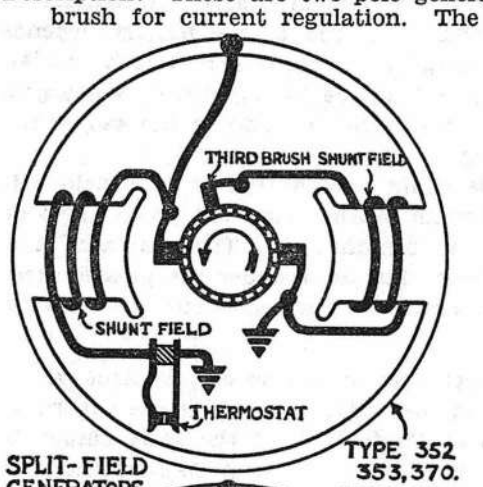
Performance and Adjustment:—See specific car data sheets on which these generators are used for performance data, adjustment of charging rate and details of mounting. Compensating generators are used on the following cars:

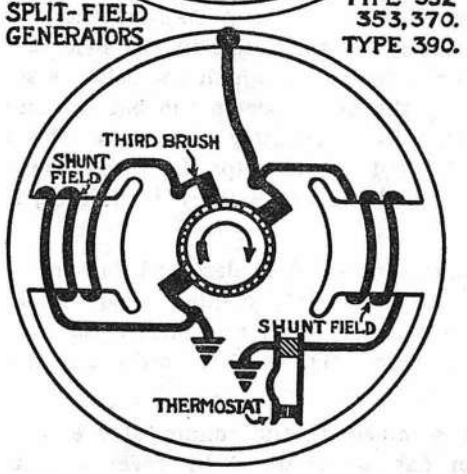
Generator Model	Car	Model	Year
295	Oldsmobile	30	1925
296	Moon	A	1925
308	Moon	A	1925-26-27
325	Diana	8	1925-26-27
325	Davis	92, 93	1926

Trouble Shooting:—If the charging rate is below normal and falls off at speeds above 25 M.P.H. test the stabilizing field for shorted or grounded coils, open circuits, or reversed field coil. If the charging rate is below normal but continues to increase at speeds above 25 M.P.H., test the third brush field for shorted or grounded coils, open circuit or reversed field coil. Check field connections and see that they are correct as shown in the illustrations. Test polarity of field coils around the frame with the generator terminal of the cutout relay connected to a battery but with the grounded main brush off the commutator. They should test alternately North and South around the frame. All other tests may be made exactly as for ordinary third brush generators.

DELCO-REMY SPLIT-FIELD GENERATORS

Description:—These are two-pole generators with two main brushes and third brush for current regulation. The third brush shunt field connected between the third brush and one main brush is wound on one field pole. A straight shunt field is wound on the other field pole. One end of this field is connected to the insulated main brush and the other end is grounded through a thermostat—the circuit being completed to the grounded main brush through the frame. One main brush is grounded and the relay cutout lead is taken from the other insulated main brush. The two fields work together and are wound so that the two poles are North and South.





Operation:—The third brush shunt field builds up until the peak output is reached. Above this point the voltage at the third brush drops off and the strength of the third brush field decreases. At low speeds when the generator is cold, the straight shunt field adds to the strength of the field. When the generator temperature reaches 175 degrees F. the thermostat in the straight shunt field circuit opens. The thermostat has no resistance coil and acts as a switch to make this inoperative at temperatures above 175 degrees. Above this point the generator operates as a third brush machine of the consequent pole type with the one third brush field coil supplying all the field strength. This provides a higher charging rate at low speeds and for short runs, and automatically cuts down the charging rate on long tours.

Performance and Adjustment:—See specific car data sheets on which these generators are used for performance data, adjustment of charging rate and mounting details. Split-field generators are used on the following cars:

Generator Model	Car	Model	Year	
352	Oldsmobile	E-30	1927	First 12000
353	Nash	Spec. 6	1927	
370	Cadillac	314	1927	
370	La Salle	303	1927	First 12000
373	Nash	Advan. 6	1926-27	

Trouble Shooting:—If the charging rate is below normal and falls off at speeds above 25 M.P.H., test the straight shunt field for shorts or grounds, open circuits or defective thermostat contacts. If the charging rate is below normal and drops to '0' after a short time, test the third brush shunt field for shorts or grounds, open circuits, or defective third brush. If the charging rate is normal but does not drop off after continued operation test for defective thermostat. Do not attempt to repair thermostat. If tests prove thermostat to be defective, remove and replace unit. All other tests may be made exactly as for ordinary third brush generators.

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ROBERT BOSCH GENERATOR

BATTERY TYPE

DESCRIPTION:—This type Bosch Generator has been developed for use with a battery. It is of the voltage regulation type which charges the battery at a constant voltage so that the current delivered to the battery depends directly on the battery itself. The charging current will be relatively high with a discharged battery and tapers off as the battery becomes charged. This keeps the battery in a fully charged condition and at the same time eliminates all danger of overcharging.

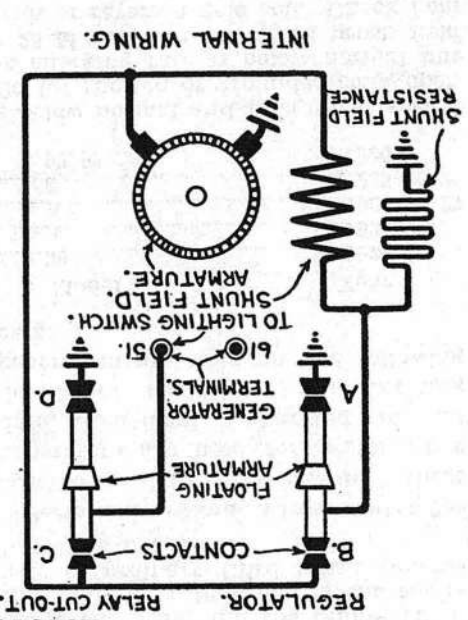
The generator is of the four pole shunt wound type with a field coil wound on each pole. There are two main brushes mounted at an angle of 90 degrees on the lower side of the commutator. The regulator and cutout are mounted directly above the commutator under the pressed steel end cover. In addition there is a fixed resistance which is cut in the shunt field circuit by the regulator.

OPERATION:—When the generator is operating at low speeds, Contact 'A' of the regulator is closed, short circuiting the resistance so that the generator operates as a straight shunt machine. Contact 'C' of the relay cutout is likewise open and the lamp load is carried by the battery. As the generator speed increases Contact 'A' opens inserting the resistance in the field circuit. As the generator voltage reaches the figure for which the relay is set to operate Contact 'C' closes, connecting the generator to the battery and lamp circuits. At higher speeds Contact 'B' alternately opens and closes which momentarily short circuits the shunt field and helps the voltage constant. The series coil, which is a feature of the 'No-Battery' Generator, is not used on this type.

INSTALLATION:—The generator as ordinarily supplied is designed for cradle mounting. It should be driven at approximately 1½ engine speed. There are two main terminals (51) which is the main lead and should be connected to the light switch and battery, and (61) which is ordinarily not used.

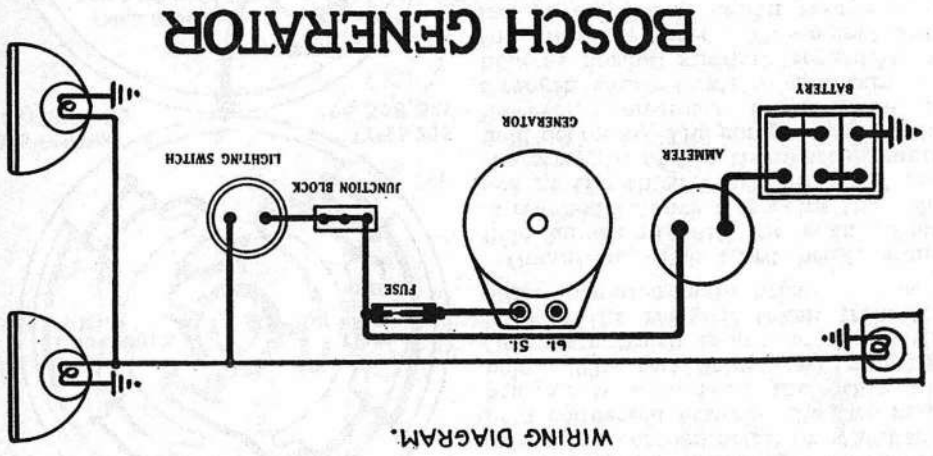
ROTATION:—The direction of rotation is stamped on the commutator end of the generator. However, the rotation can be changed by reversing the shunt field leads. These are brought out to the terminal block directly under the regulator and cutout and are marked by red and green insulation.

ADJUSTMENT:—The regulator is contained in the turned steel case. There is a floating armature in the center of the coil with a contact on each end. The second contact of each set is mounted on a threaded plug in the end cap of the regulator case. One contact plug is fitted with a very fine thread for fine adjustments. The regulator is adjusted by varying the contact gap. The Robert Bosch Company have developed special tools for use in setting the regulator and it will not be possible to secure as satisfactory an adjustment without their use.



BOSCH GENERATOR

BATTERY TYPE.



WIRING DIAGRAM.

OILING:—The armature shaft is carried on ball bearings which are packed with a special heat resisting grease. These bearings will not require any attention in service but whenever the generator is disassembled for inspection or servicing, the bearings should be repacked with the special grease secured from the Robert Bosch Company.

OWEN-DYNETO 'LAMP CONTROL' GENERATORS

TYPES CD-836, CD-839, CD-846

DESCRIPTION:—The Owen-Dyneto Lamp Control Generator is designed to deliver a set amount of current to the battery regardless of the load on the generator. It will charge the battery at pratically the same rate whether the car lamps are burning or not. It is a compound wound machine with two shunt coils wound on opposite poles and connected between the third brush and ground through a five ampere field fuse. There are two main brushes, one being grounded and a lead from the other being taken out to the relay cutout and then to the battery. A series field is wound on the other two field poles. This field is connected in series with the lamp load through a 15 ampere fuse mounted on the generator field frame and consists of two coils in series with each other. This field circuit is open with the lamp switch off.

OPERATION:—With the lamp switch 'Off' and lamps not burning, the generator operates as a third brush shunt wound generator with two field coils and 'consequent' poles between the field poles which are energized. When the lamp switch is turned on the lamp circuit current which is taken from the battery side of the generator relay cutout flows through the 'series' windings strengthening the field and increasing the generator output in proportion to the current drawn by the lamps. The 15 ampere fuse in the lighting circuit is designed to prevent overload and the lamp load should be so regulated as to keep the current below this figure. The ignition current should never be taken through the generator and the coil lead should be connected directly to the generator side of the ammeter.

PERFORMANCE:—The generators are set at the factory to give the following performance:

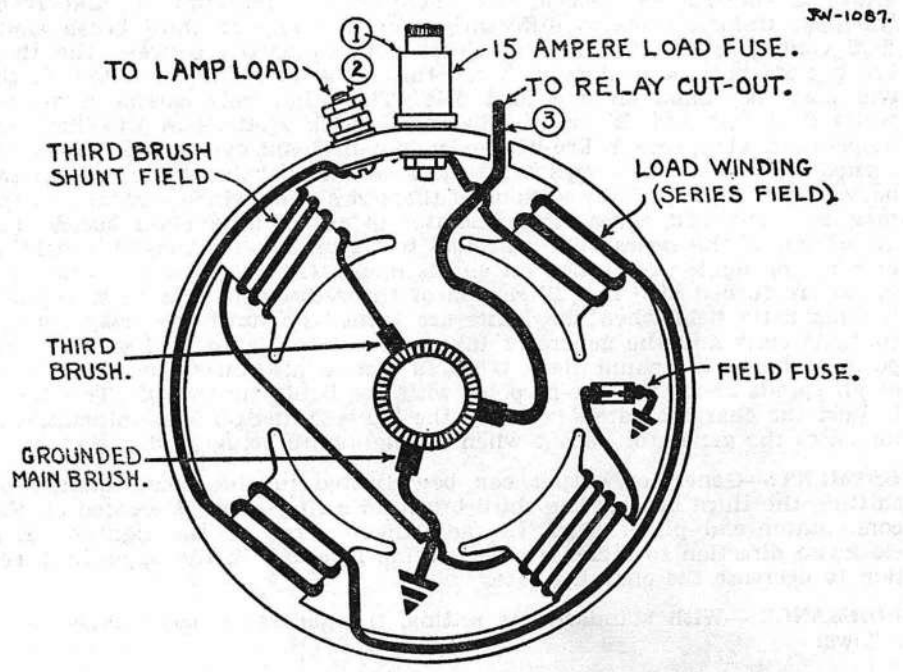
Generator Data

Load	Amperes	Volts	R.P.M.
Without Lamp Load.	0	12.4	1200
With Lamp Load.	0		900
Without Lamp Load.	7		2320
With Lamp Load.	4		1800
Without Lamp Load.	6		3200
With Lamp Load.	1		3200

The above table indicates current supplied to the battery by the generator at various speeds and under different conditions. The maximum output of the generator is 15 amperes. The normal lamp load is approximately 11 amperes.

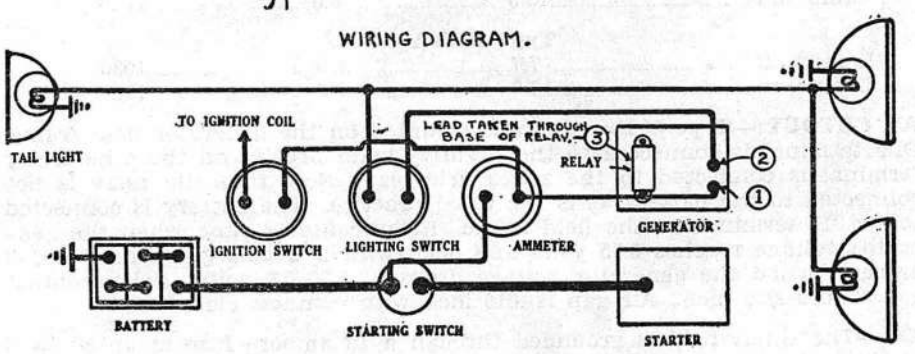
ADJUSTMENT:—The third brush setting is adjustable. To adjust third brush, remove the commutator end cover and turn the slotted shifter shaft on the generator end plate.

RELAY:—**Type 20070.** Relay is mounted on the generator. Relay contacts close at 900 R.P.M. with lamp load and 1200 R.P.M. without lamp load when the generator voltage reaches 12.4 volts.



OWEN-DYNETO GENERATOR

Types CD-836,838,839,846.



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NORTH EAST LAMP CONTROL GENERATOR

MODEL LAB, TYPE 6620 AND 6564-A, CHECKER CAB AND MACK EQUIPMENT

DESCRIPTION:—This type generator, although it resembles the ordinary generator in construction (except that there are two terminals 'L' and 'B' on the field frame), operates differently than the regular third brush shunt field control types. The regular shunt field connected between the third brush and the grounded main brush through a field fuse mounted on the end plate is wound on one field pole. The other pole carries a divided series field ('A' and 'B' on the diagram). Both sections of this field are inoperative at speeds below the relay cut-in point when the lamps are turned off. When the lamps are turned on, the lighting current from the battery goes through both sections of the series field, which strengthens the magnetic field and causes the generator to cut in at a lower speed. The 'A' section of the series field continues to strengthen the magnetic field as long as the lights are turned on and is inoperative at all speeds when the lights are turned off. The 'B' section of the series field acts to strengthen the magnetic field when the lights are turned on until the relay cut-out contacts close and the generator takes care of the lamp load when it opposes or bucks the shunt field. This 'B' section also bucks the shunt field at all speeds above the cut-in point with the lights turned off. This tends to hold the charging rate down with the lights turned off and automatically increases the generator output when the lights are being used.

ADJUSTMENT:—Generator output can be adjusted in the usual manner by shifting the third brush. The third brush adjusting screw is located on the commutator end plate. Turn the adjustment screw to the right or in a clockwise direction to increase the charging rate and in the opposite direction to decrease the charging rate.

PERFORMANCE:—With standard car setting, the generator performance is as follows:

Generator Data—Type 6620

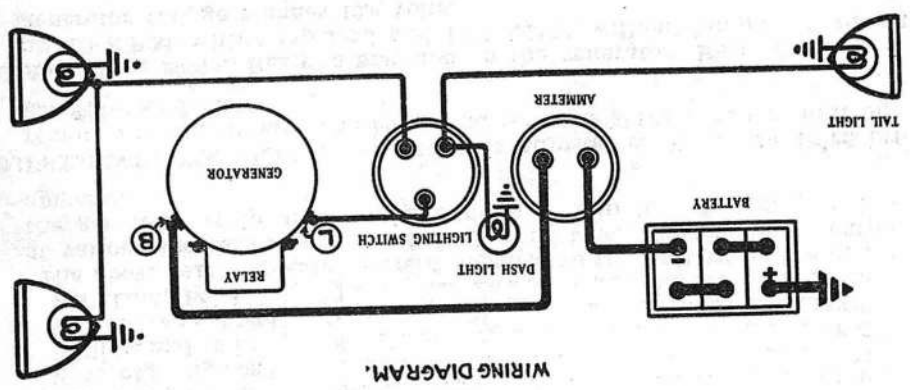
Load	Amperes	Volts	R.P.M.
Lamps off	9	8.0	1620
Lamps on	13.5	8.0	1600

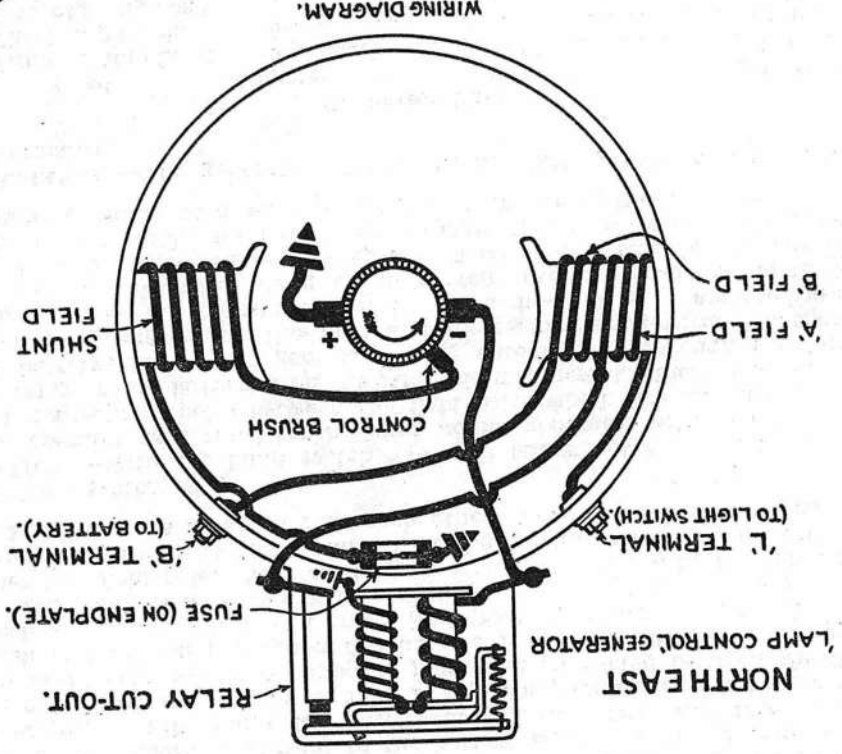
Type 6564-A

Lamps off	7.7	8.0	1930
Lamps on	13.0	8.0	1900

RELAY CUTOUT:—**Type 20220.** Relay is mounted on the generator field frame. One terminal is connected to the negative main brush and the other relay terminal is connected to the series field lead. Note that the relay is not connected to the battery as is the usual practice. The battery is connected to the 'B' terminal on the field frame. Relay contacts close when the generator voltage reaches 6.75 volts and open with a discharge current of 1-2 amperes when the generator voltage drops to 5.75-6.0 volts. Relay contact gap is .020-.025 inch. Air gap is .015 inch with contacts closed.

FUSES:—The shunt field is grounded through a 10 ampere fuse mounted in a plug on the commutator end plate. No other size fuse should be used for replacement.





OWEN-DYNETO BATTERY CHARGE REGULATOR

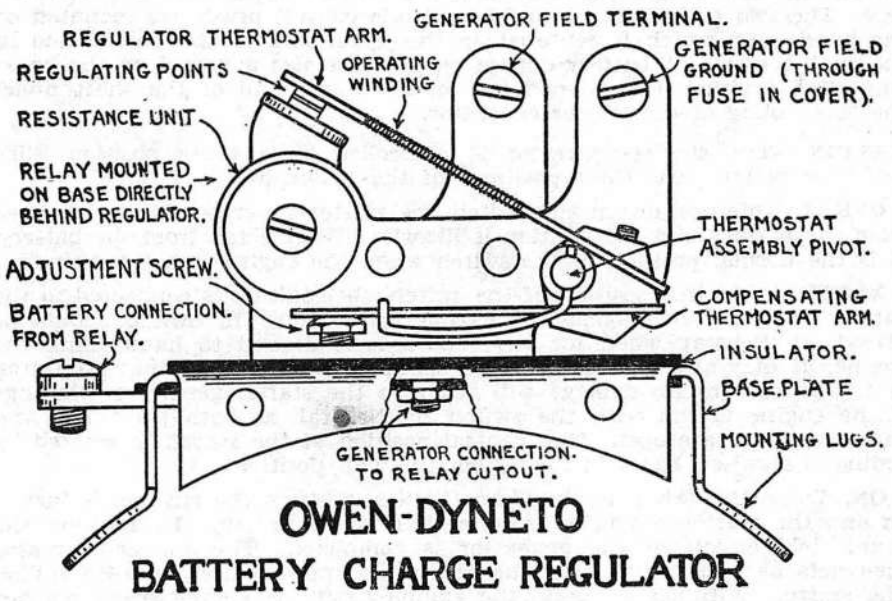
DESCRIPTION:—The Owen-Dyneto Battery Charge Regulator consists of an electrically operated thermostatic regulator and a relay cut-out mounted in a single case which is designed to be mounted on top of the generator. It is standard equipment on certain models of Owen-Dyneto generators and can be installed on generators of other manufacture by making minor alterations in the relay mounting and wiring hookup. The regulator permits a relatively high charging rate without danger of damaging the battery and automatically varies the charging rate to cover different driving conditions by permitting the high charging rate over short periods of time or for short trips and automatically cutting down the rate after the regulator thermostat heats up which will occur on long trips or after the generator has nearly completed the battery charge.

OPERATION:—The regulator consists of two thermostat arms mounted on a pivot. The upper arm carries the regulator contacts and has a fine resistance unit wound on it. This resistance is connected directly between the generator relay terminal in the base of the unit and ground and is thus connected directly across the main brushes of the generator. The lower thermostat arm is a compensating unit and carries no winding. It is designed to compensate the regulator for temperature changes. The spring which normally keeps the regulator contacts closed engages the lower thermostat arm. The two upper terminals of the regulator should be connected to the field as marked in the illustration. The field resistance is wound on a spool on the regulator frame and is connected between the two regulator terminals and across the contacts. It is thus connected in series with the generator field winding but is short circuited by the regular contacts when the contacts are closed.

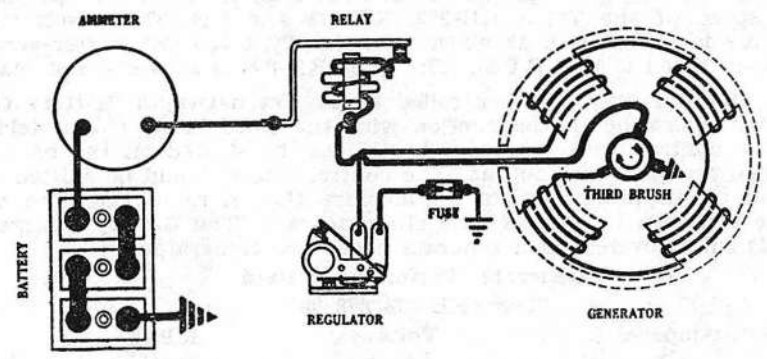
In operation with the regulator contacts closed the generator operates as a straight third brush shunt machine charging the battery at the rate determined by the third brush setting. Current likewise flows through the winding on the upper thermostat arm. When the generator voltage reaches 8 volts (cold) or 7.5 volts (hot) this winding heats up causing the arm to flex and open the contacts which inserts the resistance in the field circuit. This reduces the charging rate to the finish rate of the battery.

ADJUSTMENT:—The regulator is set at the factory and should not require adjustment. However, if adjustment is necessary, connect a voltmeter between the battery terminal of the generator and ground and operate the generator for several minutes to allow the thermostat winding to heat. The regulator cover must be in place or the air blast of the fan will prevent the proper functioning of the thermostat. Then turn the adjusting screw under the lower thermostat arm clockwise to increase the operating voltage and counter-clockwise to decrease the voltage. The regulator should operate at 8.0 volts cold or 7.5 volts hot.

INSTALLATION:—The regulator can be installed on practically any generator after removing the old relay cutout and modifying the old relay mounting to take the regulator mounting screws. Then connect the old relay lead from the generator main brush to the terminal in the base of the regulator unit. Disconnect the generator shunt field ground and bring this lead out of the generator, drilling a hole through the commutator cover band to take the wire. Connect this lead to the regulator field terminal. The other regulator terminal should be grounded through the fuse mounted in the regulator cover. On Owen-Dyneto generators or generators with the field grounded through a fuse mounted on the generator frame, the field should be disconnected from the fuse terminal and brought out to the regulator and a second lead should be brought out from the fuse terminal to the regulator ground terminal. On generators with the field grounded through a thermostat, it will be necessary to take off the resistance connected across the thermostat contacts and then render the thermostat inoperative by bending one arm back so that the contacts are permanently open.



WIRING DIAGRAM.



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Generator Performance Data

Types KB-873, 878, 897

Amperes	Volts	R.P.M.
0	6.3	1000
16	7.6	2500
13	7.4	4500

Type KB-890

Amperes	Volts	R.P.M.
0	13	1500-1600
9	14	3500
8	14	4500

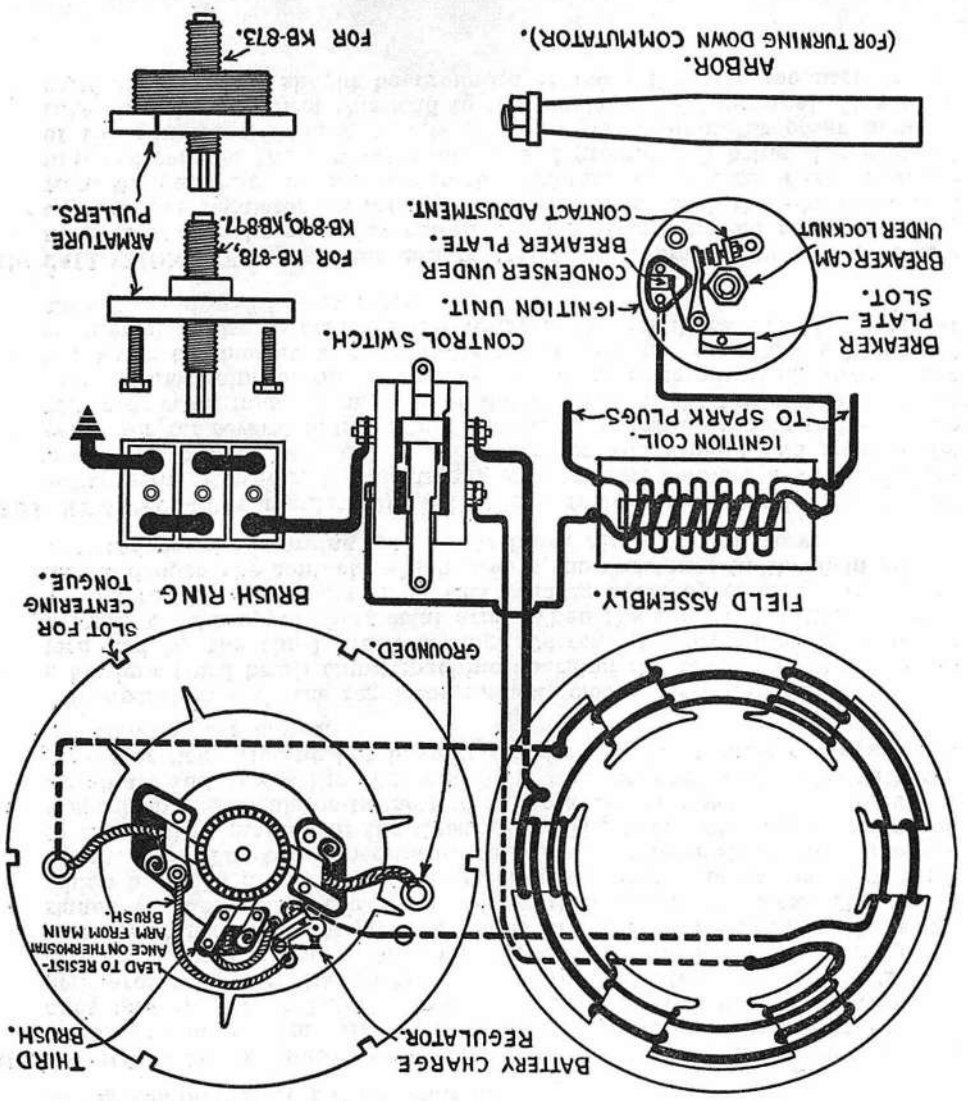
DESCRIPTION:—The Owen-Dyneto Starter-generator for outboard engines is a six pole, compound wound machine. The armature is keyed directly on the upper end of the crankshaft and serves as the engine flywheel. It revolves within the field frame which is mounted on the upper end of the crankcase. The two main brushes and a movable control brush are mounted on the brush ring which is centered on the upper end of the field frame by six small tongues. A battery charge regulator is also mounted on the brush ring. The ignition unit is mounted on the upper end of the shaft under the cover plate of the starter-generator.

OPERATION:—The starter-generator is controlled by a three position 'slide bar' type switch. The three positions of the switch are:

OFF. In this position of the switch the starter-generator is disconnected from the battery and the ignition is likewise disconnected from the battery. It is the normal position of the switch when the engine is not running.

NEUTRAL. In this position of the switch, the ignition is connected to the battery but the starter-generator is not connected. The switch should be placed on 'Neutral' when for any reason it is desired to hand-crank the engine. It may also be used for high speed operation to eliminate the drag of the generator. No damage will occur to the starter-generator windings if the engine is run with the switch in 'Neutral' as both the series and shunt windings are open. The neutral position of the switch is secured by sliding the switch bar 3/16 inch from the 'OFF' position.

ON. When the switch is placed on the 'On' position the ignition is turned on and the starter-generator is connected to the battery. In addition the shunt field circuit of the generator is completed. The starter-generator then acts as a motor to spin the engine at approximately 400-450 R.P.M. The starter continues to assist the engine until the engine speed reaches 1000 R.P.M. when it begins to charge the battery. At all speeds above 1000 R.P.M. the machine will operate as a generator to charge the battery. Whenever the engine speed drops below 1000 R.P.M. the machine operates as a motor which prevents the engine from stalling at low speeds. The starter-generator is connected on and the starter-generator is connected to the battery. In addition the shunt field circuit of the generator is completed. The starter-generator then acts as a motor to spin the engine at approximately 400-450 R.P.M. The starter continues to assist the engine until the engine speed reaches 1000 R.P.M. when it begins to charge the battery. At all speeds above 1000 R.P.M. the machine will operate as a generator to charge the battery. Whenever the engine speed drops below 1000 R.P.M. the machine operates as a motor which prevents the engine from stalling at low speeds. The generator is fully covered on a separate page. See Generators.



Starter Performance Data

Types KB-873, 878, 897

Torque	R.P.M.	Volts	Amperes
4 lb. ft.	400	6	65
27 "	Lock	5.5	290

Type KB-890

Torque	R.P.M.	Volts	Amperes
14 lb. ft.	400	11	130
35 "	Lock	9.5	330

OWEN-DYNETO STARTER-GENERATOR

TYPES KB-873, KB-897, KB-878 AND KB-890

OUTBOARD EQUIPMENT ON JOHNSON, CAILLE AND OUTBOARD CORP. ENGINES

OWEN-DYNETO STARTER-GENERATOR

TYPE KA-894

FOR LYCOMING ENGINE ON DODGE BOATS

DESCRIPTION:—The Owen-Dyneto Starter-generator fitted on the Lycoming engine used in the Dodge boats is a twelve volt, eight pole, compound wound machine mounted on the end of the crankcase. The armature is bolted directly on the crankshaft and serves as a flywheel. The field frame is bolted on the crankcase. The two main brushes and the control brush (third brush) are mounted on a brush ring which is centered on the field frame by small tongues. An aluminum cover plate fits over the commutator and brush assembly. The ignition system on these engines is entirely separate from the starter-generator.

OPERATION:—The starter-generator is controlled by an Owen-Dyneto electric starting switch. When the starting button is closed, the solenoid in the electric starting switch is energized. This closes the starting switch contacts and the machine operates as a compound wound motor to crank the engine. It should crank the engine at 200-300 R.P.M. drawing approximately 160 amperes at 11 volts.

Starter Data

Torque	R.P.M.	Volts	Amperes
27 lb. ft.	250	11	160
78 "	Lock	9.5	400

When the starting button is released the starting circut is broken and the machine is driven by the engine as a generator. It begins to charge the battery at 1150 R.P.M. and reaches the maximum charging rate of 10 amperes at 3250 R.P.M. of the engine.

Generator Data

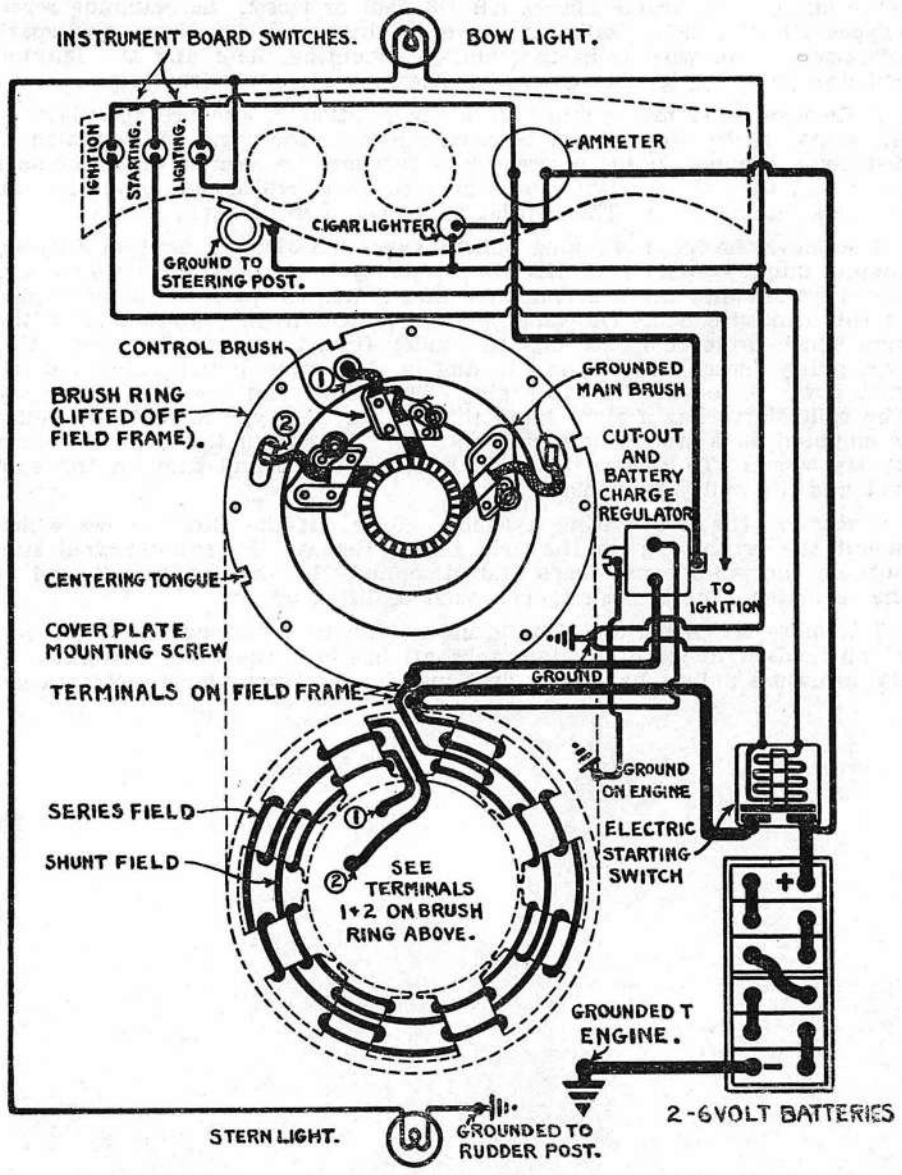
Amperes	Volts	R.P.M.
0	13.4	1150
10	16	3250
9.8	16	3500

The generator output is controlled by an Owen-Dyneto 'Battery Charge Regulator, operating in conjunction with third brush shunt field control. The control brush or 'third brush' can be shifted on the brush ring to adjust the charging rate. Shift the control brush in the direction of armature rotation to increase the charging rate and in the opposite direction to decrease the charging rate. The Battery Charge Regulator is fully described on a separate page in the Manual (see Generators).

MOUNTING:—The starter-generator must be disassembled before it can be removed from the engine. To remove the starter-generator, perform the following operations, in order:

1. Remove the cover. Loosen the holding screw in the field frame and turn the cover counter-clockwise slightly. It can then be lifted off.
2. Remove the Brush Ring Assembly. Take out the screws mounting the Brush Ring on the field frame, take off the terminal stud nuts on the main brush leads and disconnect the shunt field lead from the control brush holder. The brush ring can be lifted from place.
3. Remove the Armature Assembly. Remove the stud bolt which holds the armature in place on the end of the crankshaft. The armature can then be taken off the shaft. A special armature puller has been developed for this purpose by the Owen-Dyneto Corporation.
4. Remove the Field Assembly and Cut-out Regulator. Take out the screws mounting the field frame on the end of the crankcase and disconnect the battery lead at the Regulator.

The Cut-out and Regulator are mounted as a single unit. The cut-out closes at 1150 R.P.M. when the voltage of the generator reaches 13.4 volts. The regulator is set to control the voltage at 16 volts. The electric starting switch is mounted on one end of the storage battery.



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OWEN-DYNETO STARTER-GENERATOR

TYPES KB-873, KB-897, KB-878 AND KB-890

OUTBOARD EQUIPMENT ON JOHNSON, CAILLE AND OUTBOARD CORP. ENGINES

MOUNTING:—The starter-generator must be disassembled before it can be removed from the engine. To remove the starter-generator, perform the following operations in order:

1. Remove the cover. Take out the six screws that hold the cover in place on the field frame (Types KB-878, 890) or loosen the clamping screw (Types KB-873, 897). Raise the cover slightly and disconnect the spark advance control wire from the ignition mounting plate and the ignition coil lead from the breaker assembly. Then lift the cover from place.

2. Remove the ignition unit. Mark the position of the breaker plate on the armature (so that it may be reassembled in the same position without disturbing timing). Insert a screwdriver through the opening of the breaker plate and take out the six screws mounting the ignition unit on the end of the armature shaft. The ignition unit may then be lifted off.

3. Remove the hand cranking pulley (Types KB-873, 897, used on Johnson engines only). On the Type KB-873 the pulley is mounted on a split sleeve which screws into the armature hub and is held in place by a taper plug in the armature hub. The taper plug is locked in place by a nut on the stud which projects up through the pulley from the plug. To remove this type pulley, loosen the nut on the stud in the center of the pulley and tap stud down to loosen the taper plug. The pulley can then be unscrewed. The split sleeve has a right hand thread. On the Type KB-897 the pulley is mounted on a stud which is mounted on the end of the armature shaft by six screws. To remove pulley, take off the nut and cam on the stud bolt and lift pulley from place.

4. Remove the Brush Ring assembly. Take out the three screws which mount the brush ring on the field frame. Remove the two terminal stud nuts on the main brush leads and disconnect the shunt field coil lead at the regulator. The brush ring can then be lifted off.

5. Remove the Armature. The armature can be withdrawn after the nut which holds it in place on the crankshaft has been taken off. Several special armature pullers have been developed by the Owen-Dyneto Corporation for this purpose.

6. Remove the Field Frame Assembly. The field frame is mounted on the crankcase by four machine screws. These screws are accessible after the machine has been disassembled as directed above.

NOTE:—Since the armature is designed to be mounted on the crankshaft there is no armature shaft. If the armature is to be mounted in a lathe to turn down the commutator a special arbor must be used. This can be secured from the Owen-Dyneto Corporation.

IGNITION

OPERATION:—The ignition unit is of standard automotive design with a single lobe cam mounted on the crankshaft revolving at engine speed. The coil for two cylinder ignition is of the two spark type with both ends of the secondary brought out to high tension terminals which are connected to the spark plugs. Both cylinders fire simultaneously once in each revolution of the crankshaft. On four sylinder engines a double coil is used with two primaries and two secondaries which terminate in four high tension terminals. One coil fires the two upper cylinders and the other coil fires the two lower cylinders. Two breakers are used, each breaker controlling one coil. Both breakers are mounted on the breaker plate and operate on the same cam. The condensers for the breakers are mounted under the breaker plate.

TIMING THE ENGINE:—To set the ignition timing, turn the engine over until the pistons reach top dead center (the extreme outer end of the stroke). Fully retard the spark advance. Loosen the locking nut on the upper end of the breaker shaft and carefully locate the cam so that contacts are beginning to open. Tighten the locking nut and connect the coil secondary leads to the spark plugs. With the spark advanced the contacts will be wide open at top dead center. Breaker contact gap should be .022-.025 inch. Set contact gap by loosening lock nut on stationary contact mounting stud and turning up stud. Resurface contacts when necessary with a fine flat contact file or on a medium hard oilstone.

AMERICAN BOSCH MAGNETO

TYPES AT-4 AND AT-6 FOUR AND SIX CYLINDER MODELS

DESCRIPTION:—Bosch Magneto, Type AT, is of the high tension armature type. A single magnet is mounted over the armature and end plates completely enclose all working parts. Magneto can be equipped with Type IC-200 automatic impulse coupling or Type EC impulse coupling which is entirely enclosed in a water and dust-proof housing. Type G automatic advance governor can also be fitted to Type AT magneto. The Type AT-4 should be driven at crankshaft speed on four cylinder, four cycle engines and the Type AT-6 should be driven at one and one half times engine speed on six cylinder four cycles engines. Magneto must be driven in direction indicated on frame.

OILING:—Put one or two drops of light machine oil in the oiler at each end of the magneto every 500 miles. Do not oil interrupter.

BREAKER:—Breaker contacts separate .4 millimeter or 1/64 inch with interrupter arm on highest point of cam. Breaker contacts and mounting are fixed on end of armature shaft and rotate while cam and cam ring are stationary. To set contact gap, turn armature shaft until fiber bumper is on highest point of cam. Then loosen lock nut on stationary contact stud and turn contact until proper gap is secured. Tighten the lock nut. Contacts are made of platinum. Resurface contacts with worn No. 00 sandpaper or with a fine flat jeweler's file. Do not use emery cloth.

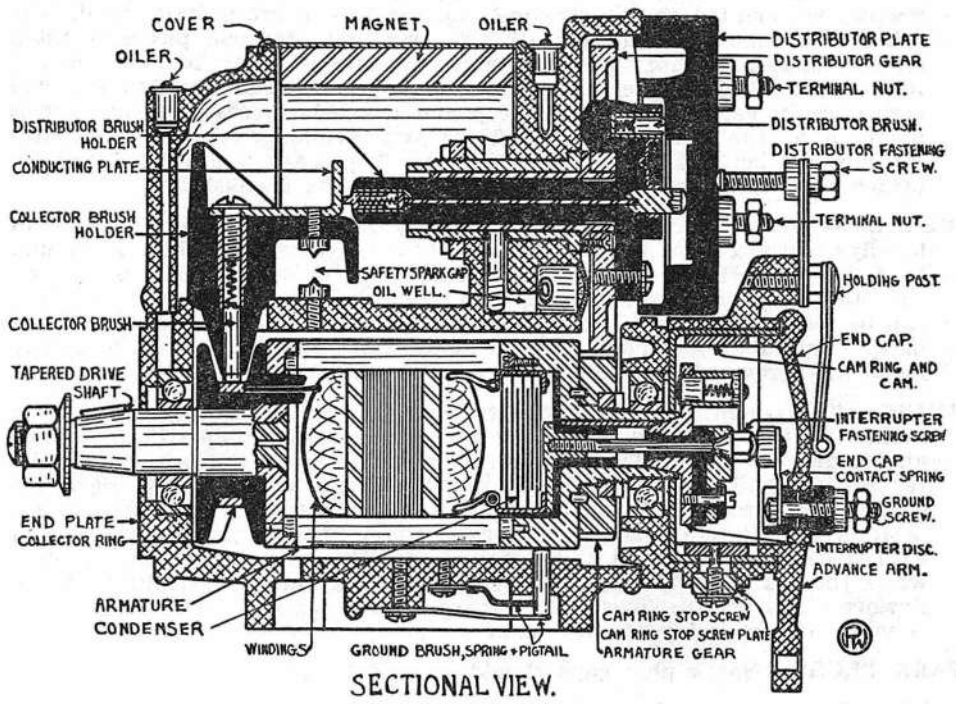
TIMING:—Crank engine until crankshaft reaches proper position for piston in No. 1 cylinder with manual advance lever fully retarded. See manufacturers' specifications as given on specific car data sheets in the National Manual. Fully retard magneto advance arm and turn magneto in direction of rotation until contacts begin to separate when the fiber bumper of the interrupter arm reaches the steel segment in the cam ring. Make certain that magneto is firmly bolted to base mounting and couple drive shaft to engine without disturbing either crankshaft or magneto armature shaft. Remove distributor cover and note position of distributor brush. Connect the segment directly over the brush to the spark plug in cylinder No. 1 and connect remaining plugs in proper firing order around the distributor plate in a direction opposite to rotation of the interrupter.

When manufacturers' specifications are not available, the engine may be timed to fire with piston on top dead center entering power stroke with full retard. Crank engine over until piston No. 1 enters compression stroke (the upstroke with both valves closed). Then continue to crank engine slowly noting dead center on flywheel or checking piston travel with a wire inserted in spark plug port until the piston reaches top dead center. Then connect magneto as directed above.

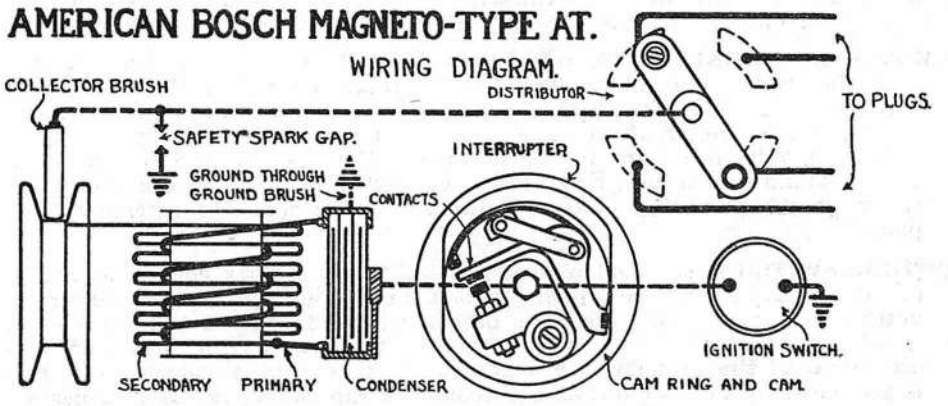
Timing Magneto with Impulse Coupling:—Turn magneto in direction of rotation until coupling is released from arrester plate. This point will be after proper firing position since impulse coupling will spin magneto over firing position. Then turn magneto backward in direction opposite to rotation until the breaker contacts open and begin to close as fiber bumper passes off steel segment in cam ring. This is the correct firing position and the magneto can then be coupled to the engine.

SPARK PLUG GAPS:—Spark plug gaps must be set at .020 or 1/50 inch. It is important that the gap be set at this figure. If spark plug gap is too wide engine will miss at low speeds and will be difficult to start. A safety spark gap is located above the armature. If spark jumps safety gap frequently check magneto and spark plugs to locate trouble.

TROUBLE SHOOTING:—Engine Misses on One Cylinder:—Check spark plugs for correct gap. Check spark plug in missing cylinder for short circuit due to fouling or cracked insulator. Check for chafed or burnt insulation on cable. Check distributor plate for dirty distributor track or segment.



SECTIONAL VIEW.



Irregular Firing on All Cylinders:—Check interrupter contacts and set gap. Resurface contacts if necessary. Tighten fastening screw in center of interrupter plate. Check ground brush under armature in base plate. Check collector brush and collector ring. Check distributor plate and wipe out with a clean rag moistened with gasoline if dirty or gummed with oil.

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BOSCH FLYWHEEL MAGNETO

TYPE FY-2, ED. 1

EQUIPMENT ON CAILLE MASTER TWIN OUTBOARD

DESSCRIPTION:—The Bosch FY-2, Ed. 1 magneto is of the high tension flywheel type. The windings are stationary and are mounted on a mounting plate which is clamped on the crankcase under the flywheel. A permanent magnet is mounted on the flywheel and revolves at crankshaft speed. The coil core is laminated and dovetails with two laminated pole pieces mounted on the mounting plate. The two screws (A and B) serve to hold the coil in position. The magnet completes the magnetic field through the coil core once in each revolution as it passes the pole pieces. The breaker is mounted on the flywheel. The coil has two secondary windings and fires the plugs in both cylinders simultaneously. The spark is advanced and retarded by rotating the mounting plate around the crankshaft.

BREAKER:—Breaker contacts can be adjusted through an inspection hole in the flywheel after the starting pulley has been removed. Breaker gap should be 1/64-1/32 inch. Contact gap is adjusted by loosening the lock nut on the stationary contact mounting stud and turning up the stud. Contact can be resurfaced when necessary with a fine flat contact file or fine sandpaper. The breaker assembly is held in place on the mounting plate by two mounting screws. The condenser is also mounted on the plate.

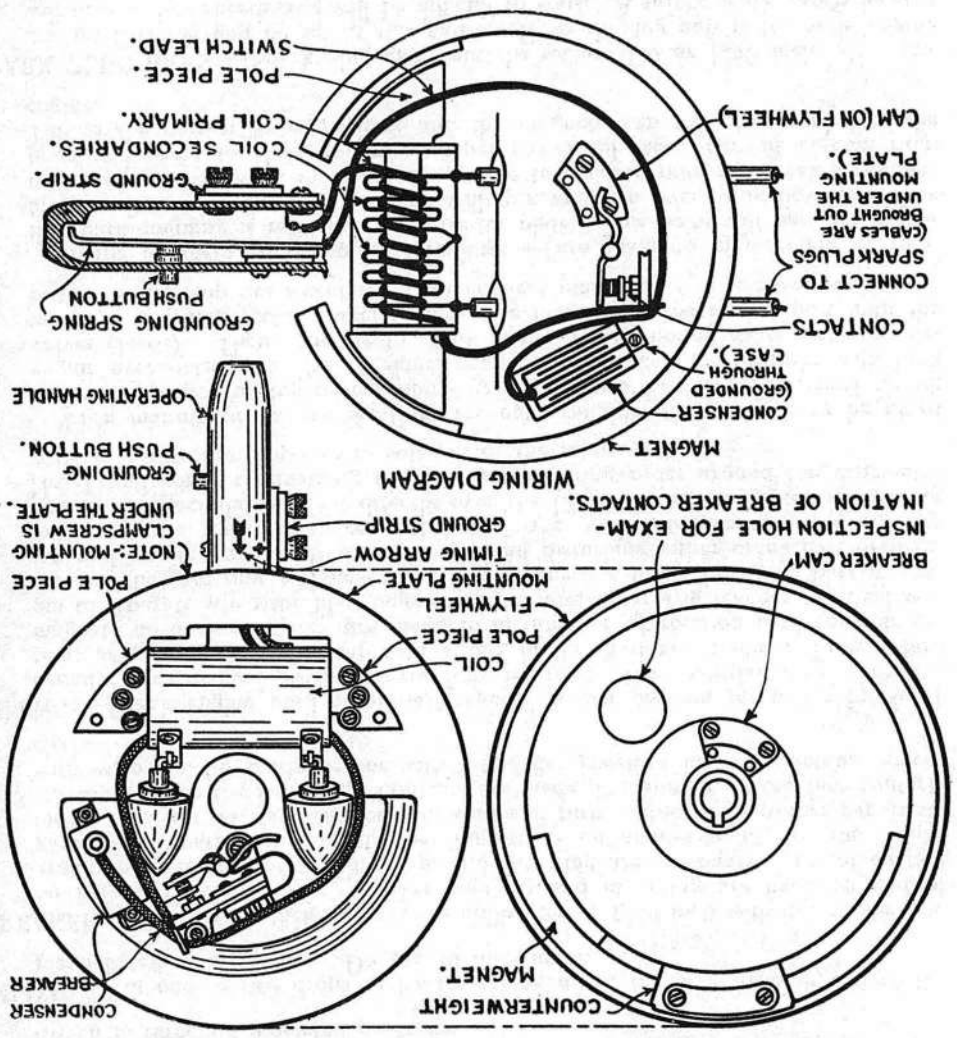
TIMING:—The mounting plate is swung around the crankshaft by means of a handle on the plate (which also serves as the control switch) to advance and retard the spark. The handle should be swung to the left (in the direction of crankshaft rotation) to retard the spark and to the right (or against the direction of rotation) to advance the spark. The extreme left position or full retard is the starting position. The engine should be run with spark fully advanced at normal speeds. Breaker contacts should open when the mark on the flywheel (a straight line on the periphery of the flywheel) is directly opposite the arrow on the spark control lever. This is set in the assembly of the engine.

SPARK PLUGS:—Spark plug gaps should be 1/32 inch.

OILING:—Put one drop of oil on the wick which oils the breaker lever bearing once each month. This is the only moving part which requires attention.

REMOVAL OF MAGNETO:—To remove the magneto from the engine, disconnect the spark plug cables. Remove the three screws on the top of the starting pulley and take off the hexagonal nut. Lift off the pulley or starting plate and the flywheel. The flywheel is mounted on a tapered shaft and it may be necessary to use a puller. The magnet and breaker cam will be found on the under surface of the flywheel. Then loosen the clamp screw on the mounting plate and lift the entire magneto assembly from place.

CONTROL SWITCH:—The control switch is built in the spark control lever and consists of a push button which grounds the magneto primary whenever the button is pressed. This ground is broken when the button is released and it will not be necessary to open the switch when the engine is started. The other end of the primary is brought out to the terminal marked (+) and is grounded to the (—) terminal through a strap connector. If it is desired to use a battery to facilitate starting, this strap connector should be disconnected and the positive terminal of a dry cell should be connected to the (+) terminal. The negative terminal of the battery should be connected to the (—) terminal. This practice is not recommended except in emergencies.



AMERICAN BOSCH MAGNETO

TYPES U-1, ED. 1; U-2, ED. 1; U-2, ED. 2; U-4, ED. 1; U-4, ED. 2

DESCRIPTION:—This magneto is of the high tension, rotating armature type and has been developed for high speed, heavy duty engines and also for heavy duty, slow speed work. For this latter type engine, an Ed. 4 impulse coupling may be installed. The U-4, Ed. 1 type is equipped with screw terminals while the U-4, Ed. 2 has sleeve terminals. In all other respects the two types are identical.

ROTATION:—Magnetos are furnished for both clockwise and counter-clockwise rotation (viewed from the drive end). The direction of rotation of a particular magneto is indicated by an arrow stamped on the lower part of the shaft end plate. In order to change the direction of rotation it will be necessary to replace the interrupter assembly with the unit designed for the opposite rotation and to change the position of the distributor disc on the distributor gear. The distributing segment is mounted in a hard rubber block which is held on the face of the distributor gear by two screws. Holes are provided for two separate positions. For clockwise rotation the disc must be mounted so that one screw is in the hole marked 'C' on the gear. For counter-clockwise rotation the screw must be inserted in the hole marked 'A'.

BREAKER:—The breaker or interrupter is mounted on the end of the armature shaft. The contact assembly and interrupter arm rotate with the armature while the cam ring and cam segments are stationary. The spark is advanced or retarded by rotating the cam ring. Interrupter contacts are made of platinum. They should separate .4 millimeter or approximately 1/64 inch with the interrupter arm on the high point of the cam segment. Set contact gap by loosening lock screw and turning up stationary contact mounting stud. Resurface contacts when necessary with worn No. 00 sandpaper or a fine flat contact file. Do not use emery cloth.

TIMING:—Crank engine over until piston No. 1 reaches firing position with spark fully retarded. (See manufacturer's specifications.) Mount magneto on engine and turn armature until contacts begin to separate with the spark lever fully retarded. Couple magneto to engine, being careful not to change position of crankshaft or magneto shaft.

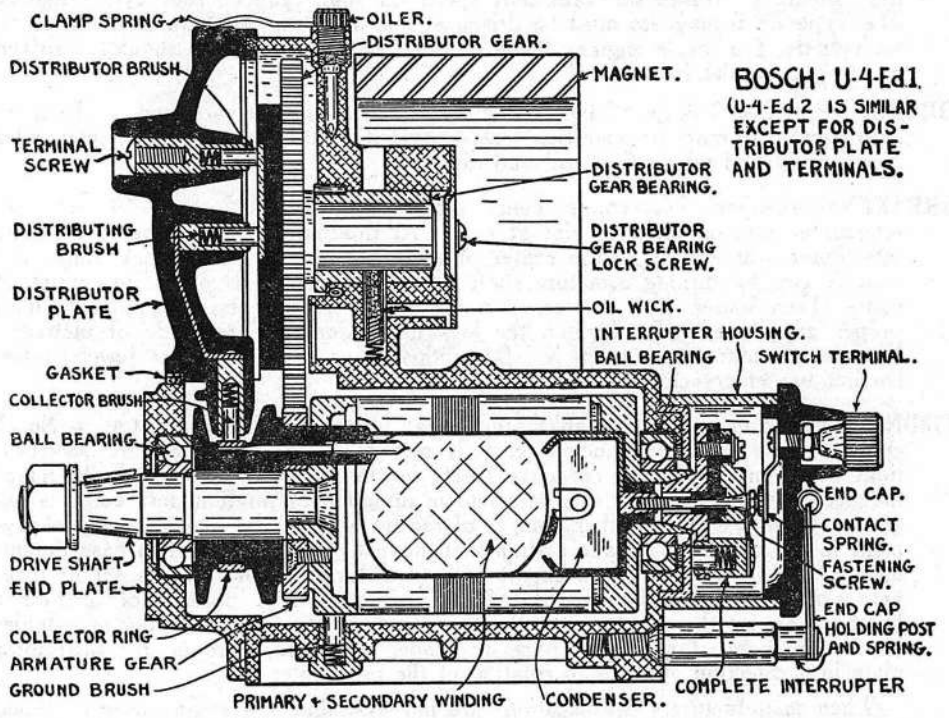
The magneto is fitted with a spark advance range of 25-35 degrees. It can be used with fixed ignition if desired. The distributor gear and armature gear are marked and must be correctly assembled to insure correct position of the distributor segment when the contacts open. One tooth of the armature gear is beveled. This should be meshed with the distributor gear tooth marked by a punch mark.

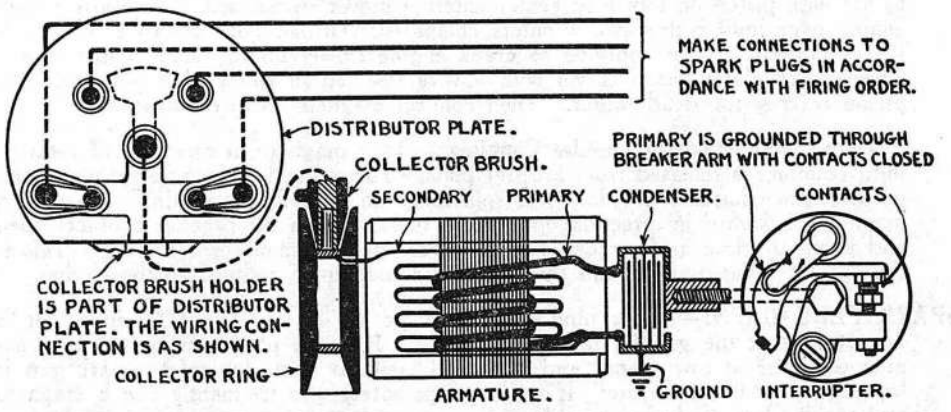
OILING:—The armature shaft is carried on ball bearings which are packed in grease and require no oil. The distributor gear shaft is carried on a plain bushing and is fitted with an oil hole at the top of the magneto. Put 2 or 3 drops of light machine oil in this oiler every 500 miles of operation.

SPARK PLUGS:—Spark plug gaps should be correctly set. This will depend on the type of engine used and in general should be .020-.025 inch. A safety spark gap consisting of a pointed screw extending through the shaft end plate to within a short distance of the collector ring is provided. This will protect the windings if the plug gaps are too wide or if cables become disconnected. The current should not be allowed to jump across the safety gap for any length of time and the ignition system should be checked whenever this occurs.

SERVICING:—The magneto is very simple in design and can be disassembled without difficulty. Disassemble in the following order: (1) Remove ground brush from under plug in base plate. (2) Swing spring on holding post to one side, remove end cap, remove interrupter housing. Then remove interrupter assembly using special Tool No. 339 to first take out interrupter fastening srcew. (3) Press the holding screws to one side and remove distributor plate. Be careful not to damage collector brush which is carried on the lower end of the plate. (4) Carefully pull the distributor gear and armature assembly out together.

In reassembling the magneto be careful to properly mesh the gears (see Timing). Make certain that the oil wick does not interfere with the distributor gear shaft. If the gears are replaced it will be necessary to see that they are properly meshed. The gear mesh is adjustable by turning the distributor gear bushing slightly. This bushing is slightly eccentric and turning it will raise or lower the distributor gear. It is held in place by the distributor gear bearing lock plate which engages in the slot in the end of the bearing. The lock plate is slotted for two mounting screws to retain the bearing position.





TIMING:—Crank engine until crankshaft reaches proper position for piston in No. 1 cylinder with manual advance lever fully retarded. See manufacturers' specifications as given on specific car data sheets in the National Manual. Fully retard magneto advance arm and turn magneto in direction of rotation until contacts begin to separate when the fiber bumper of the interrupter arm reaches the steel segment in the cam ring. Make certain that magneto is firmly bolted to base mounting and couple drive shaft to engine without disturbing either crankshaft or magneto armature shaft. Remove distributor cover and note position of distributor brush. Connect the segment directly over the brush to the spark plug in cylinder No. 1 and connect remaining plugs in proper firing order around the distributor plate in a direction opposite to rotation of the interrupter.

When manufacturers' specifications are not available, the engine may be timed to fire with piston on top dead center entering power stroke with full retard. Crank engine over until piston No. 1 enters compression stroke (the upstroke with both valves closed). Then continue to crank engine slowly noting dead center on flywheel or checking piston travel with a wire inserted in spark plug port until the piston reaches top dead center. Then connect magneto as directed above.

Timing Magneto with Impulse Coupling:—Turn magneto in direction of rotation until coupling is released from arrester plate. This point will be after proper firing position since impulse coupling will spin magneto over firing position. Then turn magneto backward in direction opposite to rotation until the breaker contacts open and begin to close as fiber bumper passes off steel segment in cam ring. This is the correct firing position and the magneto can then be coupled to the engine.

SPARK PLUG GAPS:—Spark plug gaps must be set at .020 or 1/50 inch. It is important that the gap be set at this figure. If spark plug gap is too wide engine will miss at low speeds and will be difficult to start. A safety spark gap is located above the armature. If spark jumps safety gap frequently check magneto and spark plugs to locate trouble.

TROUBLE SHOOTING:—Engine Misses on One Cylinder:—Check spark plugs for correct gap. Check spark plug in missing cylinder for short circuit due to fouling or cracked insulator. Check for charred or burnt insulation on cable. Check distributor plate for dirty distributor track or segment.

Irregular Firing on All Cylinders:—Check interrupter contacts and set gap. Resurface contacts if necessary. Tighten fastening screw in center of interrupter plate. Check ground brush under armature in base plate. Check collector brush and collector ring. Check distributor plate and wipe out with a clean rag moistened with gasoline if dirty or gummed with oil.

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AMERICAN BOSCH MAGNETO

TYPE ZR-4 AND ZR-6 FOUR AND SIX CYLINDER MODELS

DESCRIPTION:—The Bosch Magneto Type ZR is of the high tension armature type. Two magnets are mounted above the armature and the end plates completely enclose all working parts. A safety spark gap is located above the armature under the magnets. The Type ZR magneto can be used with a Bosch Duplex Vibrating ignition coil to provide dual battery and magneto ignition. The Type ZR-4 magneto should be driven at crankshaft speed on four cylinder four cycle engines. The Type ZR-6 magneto must be driven at one and one half crankshaft speed on six cylinder four cycle engines. The direction in which magneto should be driven is stamped on the frame.

OILING:—Put 2 or 3 drops of light machine oil in the oiler at each end of the magneto every 500 miles of operation. Do not oil the interrupter. Examine interrupter occasionally and wipe off all oil and dirt.

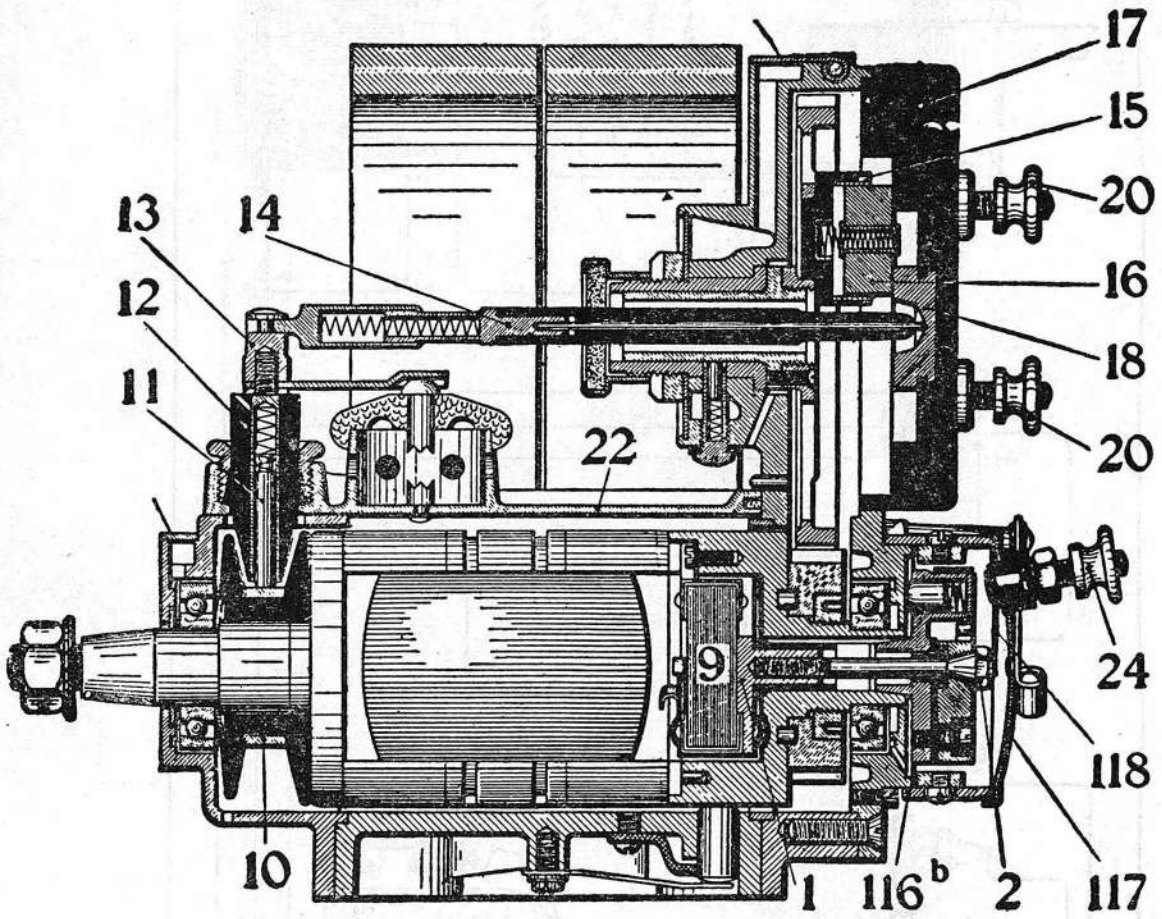
BREAKER:—Breaker or interrupter contacts separate .4 millimeter or 1/64 inch with interrupter arm on highest point of cam. At this point the fiber bumper of the interrupter arm will be in the center of the steel segment of the cam ring. Set contact gap by turning armature shaft until fiber bumper is on highest point of cam. Then loosen lock nut on stationary contact stud and turn contact until proper gap is secured. Tighten the lock nut. Contacts are made of platinum. Resurface contacts with worn No. 00 sandpaper or with a fine flat jeweler's file. Do not use emery cloth.

TIMING:—Crank engine until crankshaft reaches proper position for piston in No. 1 cylinder with manual advance lever fully retarded. See manufacturers' specifications as given on specific car data sheets in the National Manual. Fully retard magneto advance arm and turn magneto in direction of rotation until contacts begin to separate when the fiber bumper of the interrupter arm reaches the steel segment in the cam ring. Make certain that magneto is firmly bolted to base mounting and couple drive shaft to engine without disturbing either crankshaft or magneto armature shaft. Remove distributor cover and note position of distributor brush. Connect the segment directly over the brush to the spark plug in cylinder No. 1 and connect remaining plugs in proper firing order around the distributor plate in a direction opposite to rotation of the interrupter.

When manufacturers' specifications are not available, the engine may be timed to fire with piston on top dead center entering power stroke with full retard. Crank engine over until piston No. 1 enters compression stroke (the upstroke with both

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Longitudinal Section of DU4 Magneto



1. Brass plate for connecting the end of armature primary circuit.
2. Fastening screw for magneto interrupter.
9. Condenser.
10. Slipring.
11. Slipring brush.
12. Slipring brush holder.
13. Cap nut for slipring brush holder.
14. Connecting bar.
15. Distributor brush holder.
16. Distributor brush.
17. Distributor plate.
18. Central distributor contact.
20. Terminal nut for distributor plate.
22. Dust cover over armature.
24. Terminal nut for grounding terminal.
116. Interrupter housing and timing arm.
117. Cover for interrupter housing.
118. Contact spring for grounding terminal.

BOSCH MAGNETO

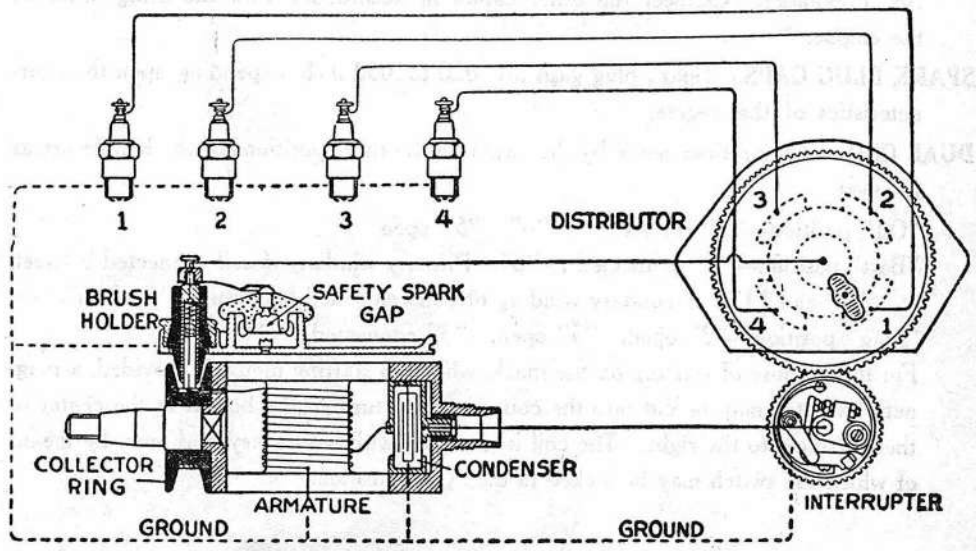
TYPES DU4 AND DU6, SINGLE SPARK, INDEPENDENT

BREAKER CONTACTS.—Breaker contacts separate .014 to .016 inch. They are made of platinum. When the condition of the contacts affects the ignition, resurface with a fine, flat jeweler's file or worn No. 00 sandpaper.

OILING.—Put 2 or 3 drops of light engine oil in each of the magneto oilers every two weeks. Apply a small amount of vaseline to the fiber bumper of the contact arm with a toothpick. If the car is driven more than 500 miles in two weeks, these attentions must be given every 500 miles.

TIMING.—Turn the engine crankshaft until the piston in No. 1 cylinder is in the position where the spark is desired to occur. Place the breaker housing in the fully retarded position by turning it as far as it will go in the direction of the armature rotation. Remove the breaker cap and turn the armature shaft until the breaker contacts are just beginning to separate. Then couple the magneto to the engine, being careful not to change the relative position between the armature shaft and driving member. Remove the distributor block and note which segment is in contact with the distributor brush. Replace block and connect the terminal of this segment with the plug in No. 1 cylinder. Connect the other cables in accordance with the firing order of the engine.

SPARK PLUG GAPS.—Spark plug gaps are .020 to .025 inch.

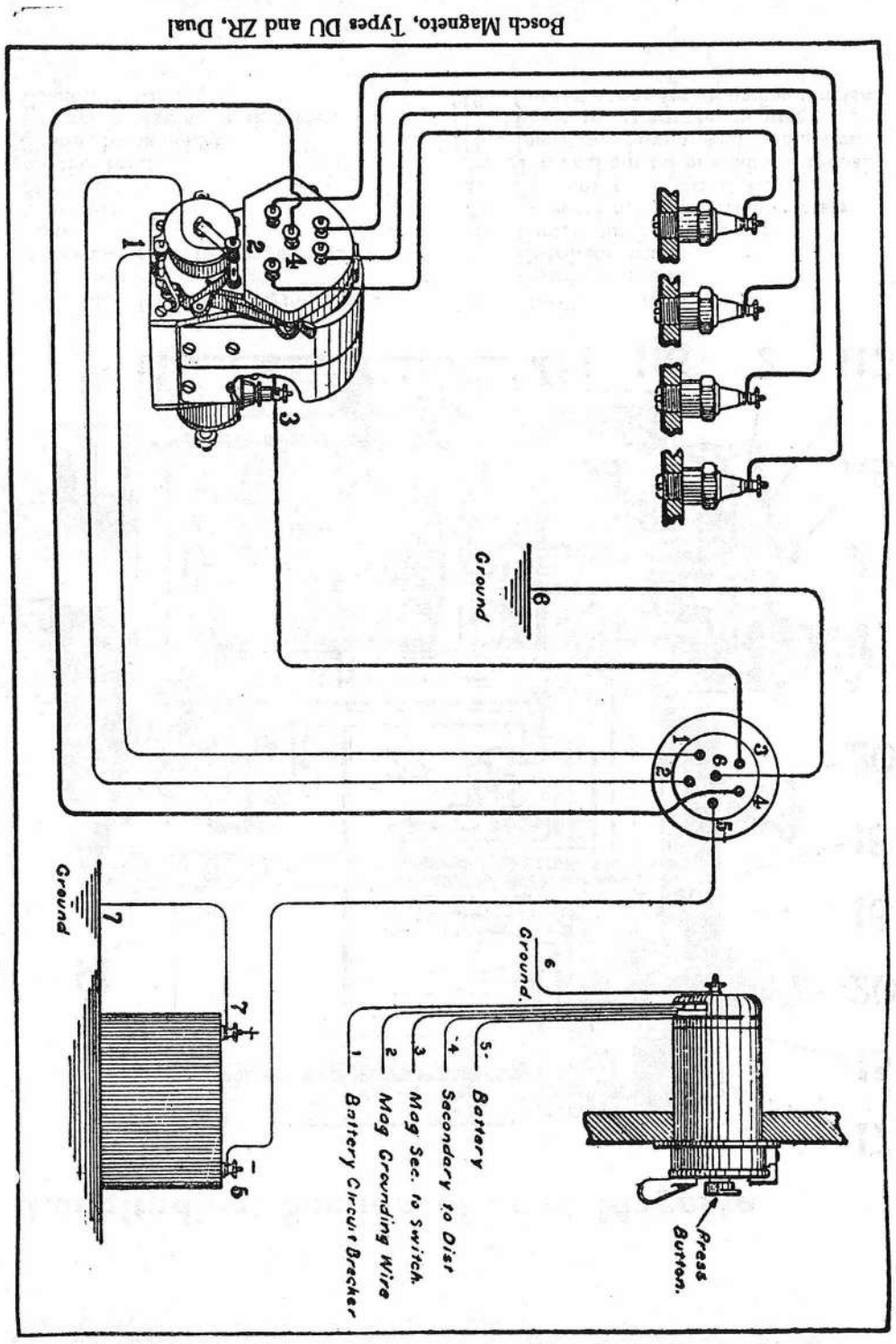


Bosch Magneto, Circuit Diagram, Type DU4

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Bosch Magneto, Type DU and ZR, Dual



BOSCH MAGNETO

TYPES DU AND ZR, DUAL

ROTATION.—The direction in which the magneto must be driven is indicated by an arrow at the drive end.

BREAKER CONTACTS.—Breaker contacts separate .014 to .016 inch. They are made of platinum. When the condition of the contacts affects the ignition, resurface with a fine, flat jeweler's file or worn No. 00 sandpaper.

OILING.—Put 2 or 3 drops of light engine oil in each of the magneto oilers every two weeks. Apply a small amount of vaseline to the fiber bumper of the contact arm with a toothpick. If car is driven more than 500 miles in two weeks, these attentions must be given every 500 miles.

TIMING.—Turn the engine crankshaft until the piston in No. 1 cylinder is in the position where the spark is desired to occur. Place the breaker housing in the fully retarded position, by turning it as far as it will go in the direction of armature rotation. Remove the breaker cap and turn the armature shaft until the breaker contacts are just beginning to separate. Then couple the magneto to the engine, being careful not to change the relative position between the armature shaft and driving member. Remove the distributor block and note which segment is in contact with the distributor brush. Replace block and connect the terminal of this segment with the plug in No. 1 cylinder. Connect the other cables in accordance with the firing order of the engine.

SPARK PLUG GAPS.—Spark plug gaps are .020 to .030 inch, depending upon the characteristics of the engine.

DUAL COIL.—Connections made by the switch in the three positions of the handle are as follows:

"Off" position—"2" connected to "6". "5" open.

"Batt" position—"2" connected to "6". Primary winding of coil connected between "5" and "1". Secondary winding of coil connected between "4" and "6".

"Mag" position—"2" open. "5" open. "3" connected to "4".

For the purpose of starting on the spark, where no starting motor is provided, a magnetic vibrator may be cut into the coil circuit by turning the button in the center of the coil face, to the right. The coil is provided with with a key and lock, by means of which the switch may be locked in the "Off" position.

ROBERT BOSCH MAGNETO

TYPES FF4A AND FF6A. FOUR AND SIX CYLINDER MODELS

DESCRIPTION:—The Robert Bosch Magneto Types FF4A and FF6A are of the armature type with all moving parts entirely enclosed. They are furnished with cylindrical base for cradle mounting or with flat base with locating pins for bracket mounting. Magneto should be driven only in direction shown by arrow on collector ring brush holder.

ADVANCE:—Type FF4A has 40° manual advance range. This is equal to 40° measured on flywheel since magneto must be driven at crankshaft speed. Type FF6A has 60° manual advance range equal to 40° on the flywheel since the magneto must be driven at 1½ times crankshaft speed. An automatic advance device may be fitted to all FF4A and FF6A magnetos giving an automatic advance range of 30°. This may be used in conjunction with the manual advance or the manual advance mechanism may be locked by inserting a set screw screwed in the endplate so that it fills the notch in the interrupter housing. The interrupter must first be turned to the fully advanced position. The manual advance arm may be set in any desired position to facilitate connecting of advance control rod. The advance arm ring is held in position by friction against the interrupter housing. To set arm, loosen set screw in side of arm and turn to desired position. Then tighten the set screw.

BREAKER:—Breaker is mounted on end of armature shaft and rotates with armature. Contacts separate 1/64 inch with bumper of contact arm on cam. Clean contacts with a soft brush and gasoline. Contacts may be trued up with a fine flat contact file or on a medium hard oilstone. To replace contacts, remove hexagonal headed screw and remove breaker. Replace in correct position.

OILING:—The armature shaft is mounted on ball bearings packed with heavy grease. The breaker arm pivot pin is oiled by wick oiler saturated with oil. This is sufficient for a running period of 35,000-50,000 miles and need be renewed only when the magneto is disassembled for servicing. Every 4500 miles remove the oil plug in the top of the magneto at rear of distributor housing and fill oil hole with heavy machine oil. It may be necessary to warm the oil but it is essential to use heavy oil so that it will not get in the distributor or breaker housing.

TIMING:—To check magneto for correct position of armature when contacts open. Remove the distributor plate. There are two circular windows in the large gear marked 'R' and 'L'. Fully advance manual control arm and turn magneto shaft in direction of rotation until red line on stationary pole piece is visible through proper window. Use 'R' window in timing clockwise magnetos and 'L' window in timing counter-clockwise drive magnetos. Slowly turn the shaft until the red mark on the end of the armature lines up with the red mark on the pole piece. If magneto is correctly assembled the breaker contacts will just begin to separate at this point.

To time magneto to engine. Crank engine until crankshaft reaches proper firing position of No. 1 cylinder with manual advance lever fully retarded. See manufacturer's specifications as given on specific car data sheets in the National Manual. Then fully retard manual advance arm and turn magneto shaft in direction of rotation until red line on pole piece appears through proper window in distributor gear. Continue to turn the shaft until breaker contacts begin to separate. Couple the magneto to the engine being careful not to disturb the relative position of the magneto and crankshaft. Connect the segment opposite the carbon brush in the distributor head to the spark plug in cylinder No. 1. Connect the remaining terminals to the spark plugs following the proper firing order of the engine.

IMPULSE COUPLING:—Both the FF4A and FF6A magnetos can be fitted with impulse couplings to furnish a very hot spark at low speeds to start the engine. To time engines where impulse couplings are used, it will be necessary to turn the magneto in the opposite direction from that in which the magneto is driven (as given by arrow on collector brush holder). If this is not done the impulse coupling will spin the armature over the timing position so rapidly that it will be impossible to set magneto.

SPARK INTENSIFIER:—A spark intensifier or auxiliary spark gap can be fitted to the magneto. This is provided with a switch on the dash and inserts a second spark gap in the secondary circuit when the plugs are fouled. To install spark intensifier it is necessary to remove collector brush holder and install special unit with two terminals for cables to the switch. If it is desired to operate magneto equipped for spark intensifier without this device, it will be necessary to connect a short piece of high tension cable between the two terminals on the side of the collector brush holder.

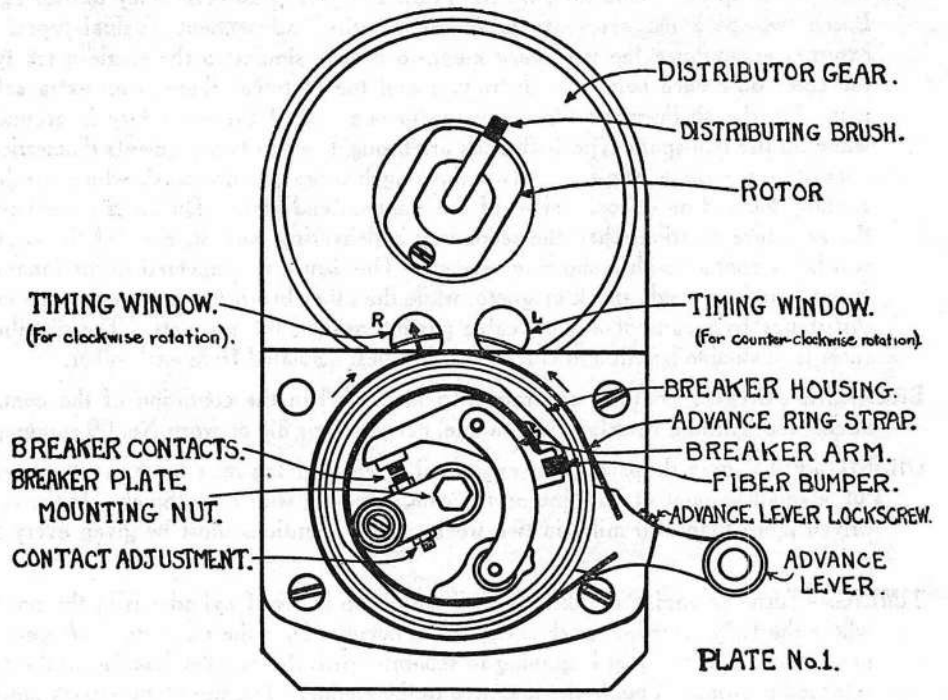


PLATE No.1.

ROBERT BOSCH MAGNETO - MODELS FF4A-FF6A.

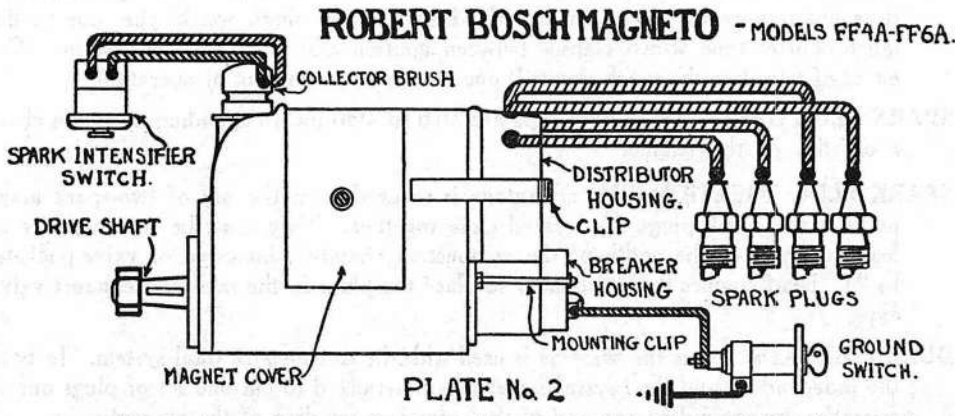


PLATE No. 2

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BOSCH MAGNETO

TYPES D, DR AND ZR, TWO-SPARK, INDEPENDENT AND DUAL

OPERATION.—The purpose of a two-spark ignition system is to produce ignition at two points in the combustion chamber, thus cutting down the time interval between ignition and complete combustion, which in turn adds power and efficiency to the engine. Bosch two-spark magnetos are produced in either independent or dual types. In external appearance the two-spark magneto is very similar to the single-spark type, the chief difference being the distributor and the fact that there is an extra safety gap. On the single-spark type of magneto one end of the secondary is grounded, while on the two-spark type both ends are brought out to two segments diametrically opposite on a single slip-ring. Two slip ring brushes are provided, which are horizontally located on opposite sides of the magneto end plate. During the portions of the armature rotation when the secondary is delivering current, each of the brushes will be in contact with a slip ring segment. One brush is connected to the inner distributor as in a single-spark magneto, while the other brush is connected to the outer distributor by means of a short cable passing around the magnets. The distributor rotor is of double length and carries two brushes, insulated from each other.

BREAKER.—Breaker contacts separate .015 inch. When the condition of the contact affects the ignition, resurface with a fine, flat jeweler's file or worn No. 00 sandpaper

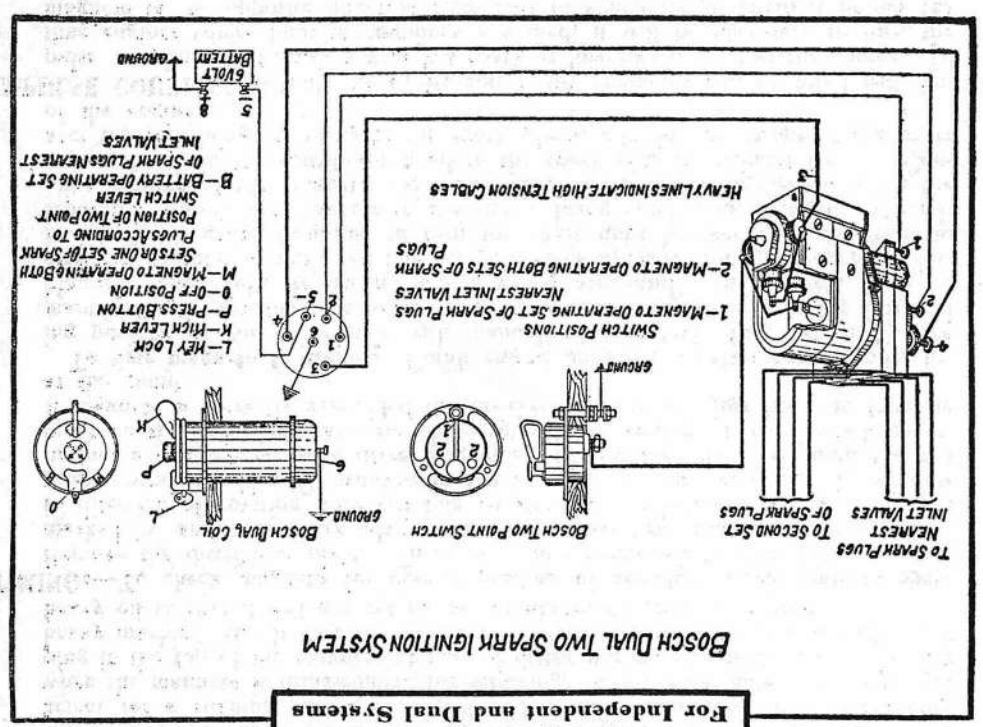
OILING.—Put 2 or 3 drops of light engine oil in each of the oil cups every two weeks. Put a small amount of vaseline on the cam, applying with a toothpick. If the car is driven more than 500 miles in two weeks, these attentions must be given every 500 miles.

TIMING.—Turn the engine crankshaft until the piston in No. 1 cylinder is in the position where the fully retarded spark is desired to occur. Turn the magneto shaft until the breaker contacts are just beginning to separate, with the breaker housing in the fully retarded position. Couple the magneto to the engine. The use of two-spark ignition does not require the same amount of advance as the single-spark type, due to the much shorter time which elapses between ignition and complete combustion. The effect of retarding the spark results if one set of plugs is cut out of operation.

SPARK PLUG GAPS.—Spark plug gaps are .016 to .030 inch, depending upon the characteristics of the engine.

SPARK PLUG LOCATION.—No advantage is secured from the use of two-spark magnetos if the spark plugs are located close together. They must be separated by at least one-half of the width of the combustion chamber, inclusive of valve-pockets. In "T" head engines it is customary to place the plugs in the inlet and exhaust valve caps.

DUAL COIL.—The coil is the same as is used with the single-spark dual system. In both the independent and dual systems a switch is arranged to cut one set of plugs out of operation by grounding one end of the secondary winding of the magneto.



ROBERT BOSCH MAGNETO

TYPES FR4B AND FR6C. FOUR AND SIX CYLINDER MODELS

DESCRIPTION:—The Robert Bosch Magneto Types FR4B and FR62 are powerful magnetos of the armature type with all moving parts entirely enclosed. They are furnished with flat base and tapped holes for bracket mounting. Magneto should be driven only in direction shown by arrow on top of magneto frame.

ADVANCE:—Type FR4B has 30° manual advance range. This is equal to 30° measured on the flywheel since magneto must be driven at crankshaft speed. Type FR6C has 45° manual advance range equal to 30° on the flywheel since the magneto must be driven at 1½ times crankshaft speed. The manual advance mechanism may be locked by inserting a set screw screwed in the breaker housing so that the latter is held in advance position. The manual advance arm may be set in any desired position to facilitate connecting of advance control rod. The advance arm ring is held in position by friction against the interrupter housing. To set arm, loosen set screw in side of arm and turn to desired position. Then tighten the set screw.

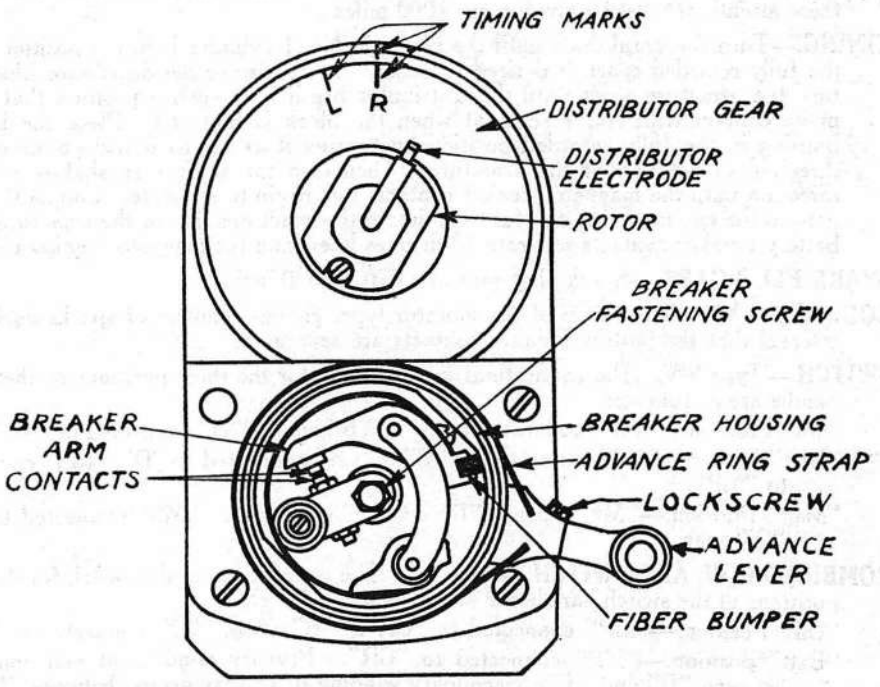
BREAKER:—Breaker is mounted on end of armature shaft and rotates with armature. Contacts separate 1/64 inch with bumper of contact arm on cam. Clean contacts with a soft brush and gasoline. Contacts may be trued up with a fine flat contact file or on a medium hard oilstone. To replace contacts, take out breaker fastening screw and remove breaker. Replace in correct position, with key properly engaging the corresponding keyway.

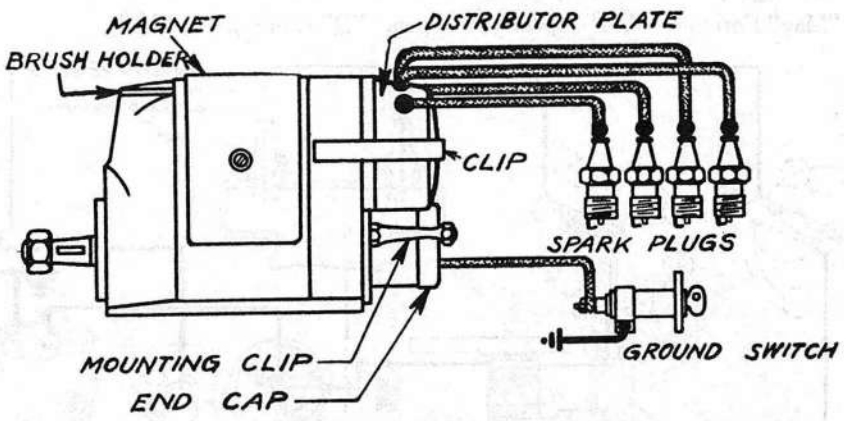
OILING:—The armature shaft is mounted on ball bearings packed with heavy grease. The breaker arm pivot pin is oiled by wick oiler saturated with oil. This is sufficient for a running period of 35,000-50,000 miles and need be renewed only when the magneto is disassembled for servicing. Every 4500 miles fill oil cup in the top of the magneto with light machine oil, preferably Robert Bosch non-freezing oil US-506.

TIMING:—To Check Magneto for Correct Position of Armature When Contacts open. Remove the distributor plate. There are two lines in the large gear marked 'R' and 'L'. Fully advance manual control arm and turn magneto shaft in direction of rotation until proper line on gear is opposite timing mark on magneto frame. Use 'R' mark in timing clockwise magnetos and 'L' mark in timing counter-clockwise drive magnetos. If magneto is correctly assembled the breaker contacts will just begin to separate at this point.

To Time Magneto to Engine. Crank engine until crankshaft reaches proper firing position of No. 1 cylinder with manual advance lever fully retarded. See manufacturer's specifications as given on specific car data sheets in the National Manual. Then fully retard manual advance arm and turn magneto shaft in direction of rotation until proper mark ('R' for clockwise, 'L' for anti-clockwise rotation) is opposite timing mark on magneto frame. Continue to turn the shaft until breaker contacts begin to separate. Couple the magneto to the engine being careful not to disturb the relative position of the magneto and crankshaft. Connect the distributor head segment opposite the distributor electrode to the spark plug in cylinder No. 1. Connect the remaining terminals to the spark plugs following the proper firing order of the engine.

IMPULSE COUPLING:—Both the FR4B and FR6C magnetos can be fitted with impulse couplings to furnish a very hot spark at low speeds to start the engine. To time engines where impulse couplings are used, it will be necessary to turn the magneto in the opposite direction from that in which the magneto is driven (as given by arrow on top of magneto frame). If this is not done the impulse coupling will prevent the proper setting of the magneto.





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BERLING MAGNETO

TWO SPARK DUAL, TYPES DD-44, DD-66 AND DD-88

BREAKER.—Breaker contacts separate .016 to .020 inch. They are made of platinum. When the condition of the points affects the ignition, resurface with a fine flat jeweler's file or worn No. 00 sandpaper. See that the brush in the back of the breaker base makes good contact with the surface on which it rubs.

OILING.—Put 10 drops of light engine oil in each oil cup every month. Put a small amount of vaseline on the cams and on the two rubbing surfaces of the fiber lever, applying with a toothpick. If the car is driven more than 1000 miles in a month, these attentions must be given every 1000 miles.

TIMING.—Turn the crankshaft until the piston in No. 1 cylinder is in the position where the fully retarded spark is desired to occur. Then remove the distributor block and turn the armature shaft until the distributor brush is in such a position that it will make contact with No. 1 segment when the block is replaced. Place the breaker housing in the fully retarded position by turning it as far as it will go against the direction of rotation of the armature. Then turn the shaft very slightly in either direction until the magneto breaker contacts just begin to separate. Couple the magneto to the engine, being careful to maintain the exact position of the armature. The battery breaker contacts separate 10 degrees later than the magneto breaker contacts.

SPARK PLUG GAPS.—Spark plug gaps are .020 to .030 inch.

COIL.—Type VN. The coil is of the vibrator type, giving a shower of sparks during the interval that the battery breaker contacts are separated.

SWITCH.—Type SW. The connections in the switch for the three positions of the switch handle are as follows:

"Off" Position.—"MP" connected to "G". "B" open. "D" connected to "MS".
"Batt" Position.—"B" connected to "G". "CS" connected to "D". "MS" connected to "MP".
"Mag" Position.—"MP" open. "B" open. "CS" open. "MS" connected to "D". "G" open.

COMBINED COIL AND SWITCH.—Type SC. The connections in the switch for the three positions of the switch handle are as follows:

"Off" Position.—"MP" connected to "GR". "B" open. "D" connected to "MS".
"Batt" position.—"MP" connected to "GR". Primary winding of coil connected between "B" and "T". Secondary winding of coil connected between "D" and "GR".
"Mag" Position.—"MP" open. "B" open. "D" connected to "MS".

Internal Circuits of Type DD Magneto

Type DD Magneto, Type SC Combined Coil and Switch

Type DD Magneto, Type VN Coil, Type SW Switch

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BERLING MAGNETO

TYPES S-17, S-18, S-28

DESCRIPTION:—The Berling Magneto is of the rotating armature type. The armature is carried on ball bearings. No armature ground brush is used. There is an interrupter ground brush on the breaker plate. The Type S-17 and S-18 magnetos are designed for one cylinder engines. The conventional distributor is not used and the high tension lead to the spark plug is connected to the terminal of the collector ring brush holder. The Type S-28 is designed for use on two cylinder engines and two collector ring brushes are used in conjunction with a segmental collector ring which distributes the high tension current to each of the two brushes alternately. The magneto can be used for either fixed or variable spark ignition. It should be driven at crankshaft speed on two cycle engines and one half crankshaft speed on four cycle engines. It produces two sparks per revolution when equipped with the cam ring used on the Type S-28 (with two cam segments) and one spark per revolution with the single segment cam ring used on the Type S-17 and S-18.

ROTATION:—As originally installed the magneto is designed for rotation in one direction, clockwise or counter-clockwise. If it is desired to change the direction of rotation it will be necessary to remove the breaker assembly and disassemble completely. Then replace interrupter base and interrupter block with units designed for opposite rotation and reassemble the complete breaker or interrupter. The rotation should not be changed except as an emergency measure.

BREAKER:—Breaker contacts separate .018-.020 inch. Set contact gap by turning up stationary contact mounting stud until correct gap is secured with interrupter arm fiber bumper on the high point of the cam ring segment. Contacts are made of platinum. Resurface contacts when necessary with a piece of worn No. 00 sandpaper. Keep oil and grease out of the interrupter housing. Wash breaker assembly out with gasoline and thoroughly dry before again operating the magneto.

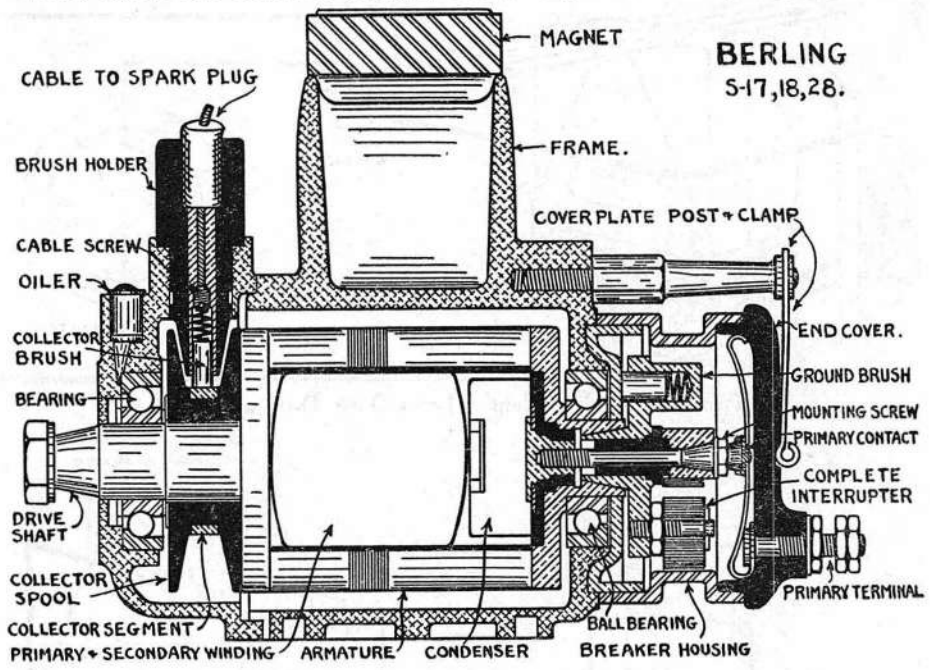
OILING:—There is an oiler at each end of the magneto. Put 10 drops of light machine oil in each oiler every 50 hours of operation. At the same time put a small amount of vaseline on the surface of the cam ring segments and on the contact spring where the interrupter lever bears on it. On special installations where the magneto is mounted on an angle or upside down the oilers can not be used and the magneto bearings are packed with vaseline. In this case it will be necessary to disassemble the magneto once each year and repack bearings with vaseline. See paragraph on 'Disassembly.'

TIMING:—If variable spark ignition is used crank engine over until piston reaches firing position with spark fully retarded. This point will depend on the type of engine and manufacturer's specifications should be carefully followed for correct performance. If these are not available the piston may be timed at top dead center for emergency service. Then locate magneto on mounting bracket and turn magneto shaft in the direction of rotation until the contacts begin to separate with the interrupter lever bumper in contact with the leading edge of the cam segment. Couple the magneto to the engine in this position and connect the spark plug to the high tension terminal directly over the collector ring on the drive end of the magneto. The timing lever must be placed in the fully retarded position or rotated as far as possible in the direction of rotation before the timing is set. On the Type S-28, designed for two cylinder engines, the operation is similar except that the spark plug in the cylinder which is about to fire must be connected to the high tension terminal which is on the collector ring segment. The second cylinder can then be connected to the remaining high tension terminal. The method of connecting the cables to the terminals is shown in the illustration.

In timing fixed spark magnetos it will be necessary to know the firing position of the piston. Use manufacturer's specifications or flywheel marks to determine the firing point.

SPARK PLUGS:—The spark plug gap should be .025 inch. This will vary somewhat, depending on the compression and design of the particular engine on which the magneto is used.

DISASSEMBLY:—To take down the magneto for inspection or oiling, perform the following operations in order: Unscrew the high tension terminal directly above the collector ring, by hand. Slip aside the spring and remove

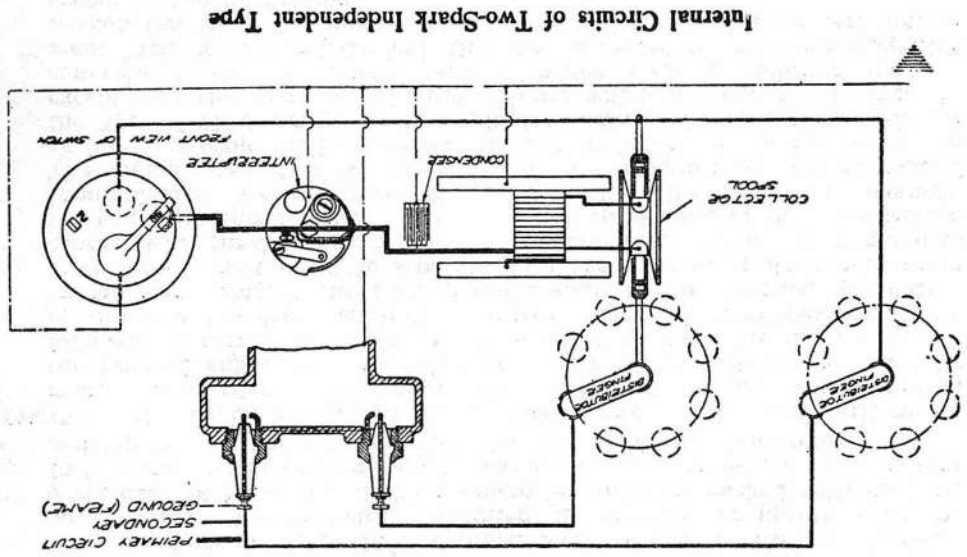


the interrupter assembly cover plate. Remove the cam ring or interrupter housing after marking position to insure correct reassembly. Free the lock clamp and take out the hexagonal mounting screw in the interrupter assembly. Remove the interrupter assembly. Remove the four cap screws in the drive end bearing plate. Then pull the armature and bearing assembly out of the frame. The bearings can then be pried off the shaft. They should be cleaned in gasoline, examined and repacked with vaseline. A piece of soft iron should be placed between the pole pieces inside the frame while the armature is out to prevent the magnet becoming demagnetized.

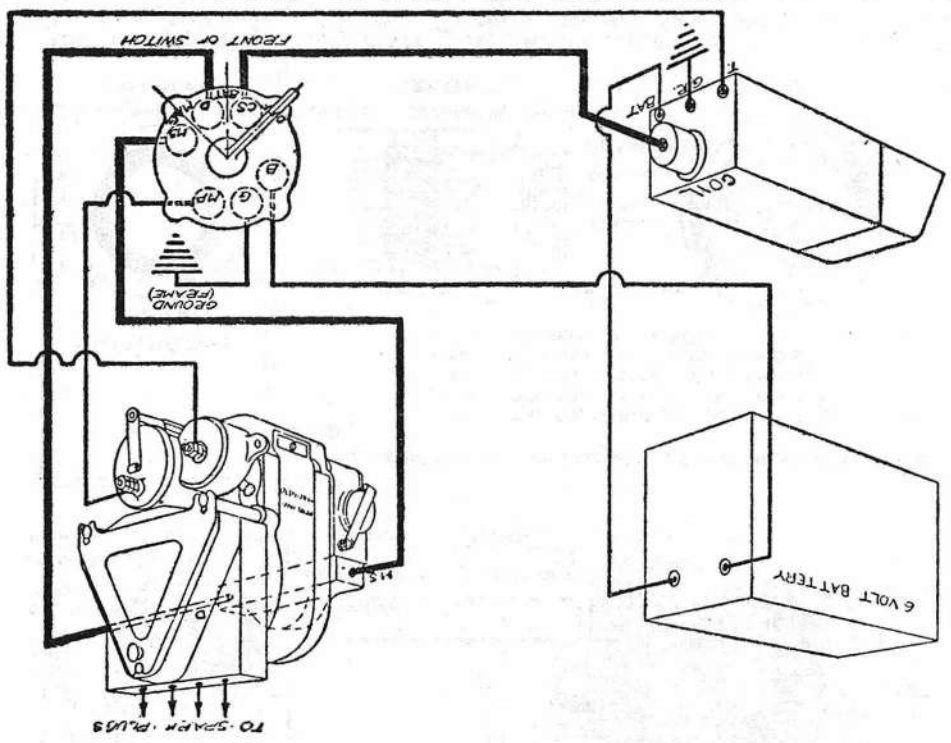
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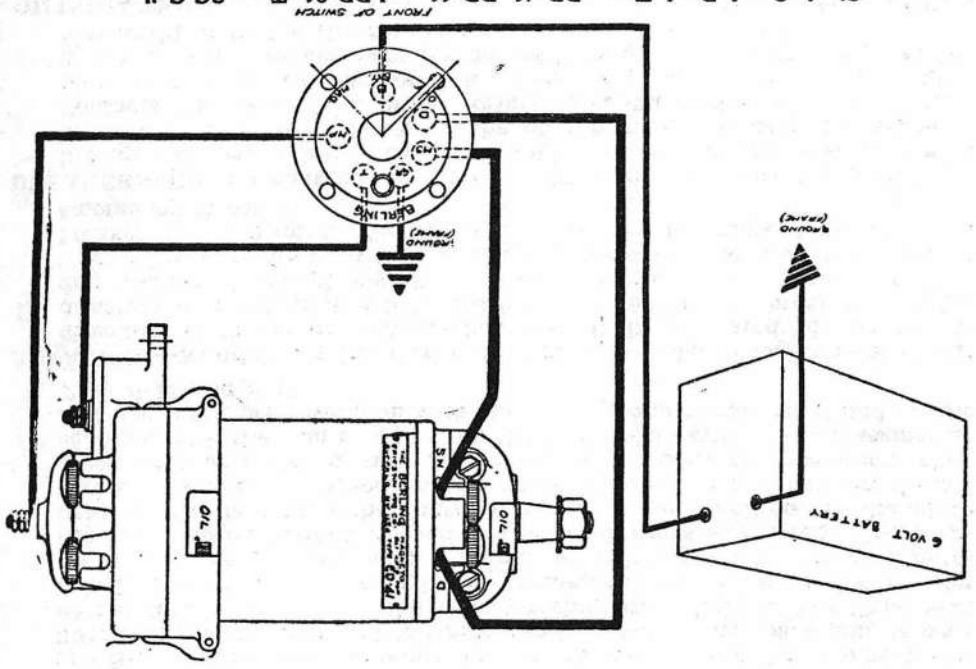
Internal Circuits of Two-Spark Independent Type



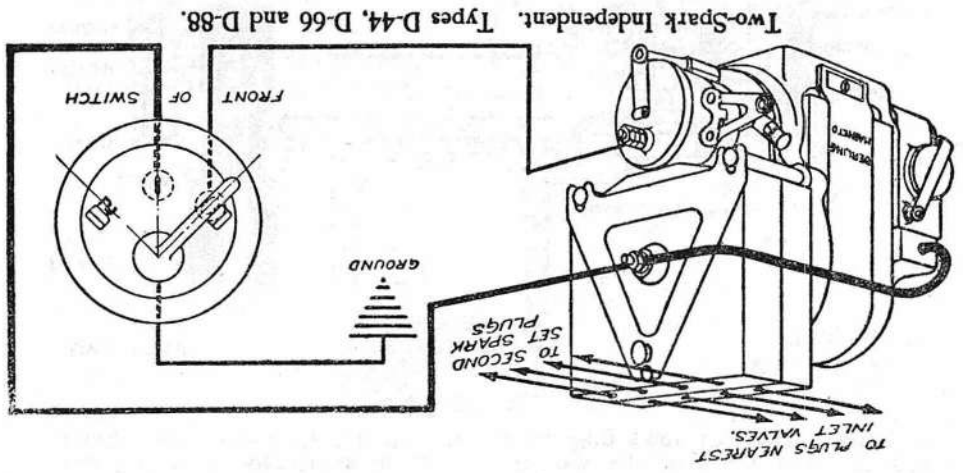
Single-Spark Dual, Type ED-41, Type SC Coil



Single-Spark Dual, Types DD-41, DD-61 and DD-81, Type SC Coil



Two-Spark Independent. Types D-44, D-66 and D-88.



BERLING MAGNETO

SINGLE SPARK DUAL, TYPES ED-41, DD-41, DD-61 AND DD-81
TWO SPARK INDEPENDENT, TYPES D-44, D-66 AND D-88

EISEMANN MAGNETO

TYPE G-4, THIRD EDITION

DESCRIPTION:—The Type G-4 III Magneto is of the armature type. The shuttle wound armature is carried on ball bearings which are insulated from the frame. The armature is grounded through a special ground brush in the base so that no current flows through the shaft bearings. The 'U' shaped magnets are mounted directly above the armature. Magneto should be driven at crankshaft speed on four cylinder four cycle engines and at twice crankshaft speed on four cylinder two cycle engines. Magnetos are fitted with drilled and tapped base plates for base mounting and can also be mounted by a mounting strap of brass or non-magnetic metal if dowel pins are used in the base to hold the magneto rigid. The base mounting bolts must not enter the base of the magneto more than 5/16 inch or they will bottom in the holes, distorting the magneto frame. Magneto is regularly furnished with a variable spark advance of 30 degrees. Special timing levers allowing a greater or smaller advance can be secured for special installations. The magneto is likewise furnished with fixed spark.

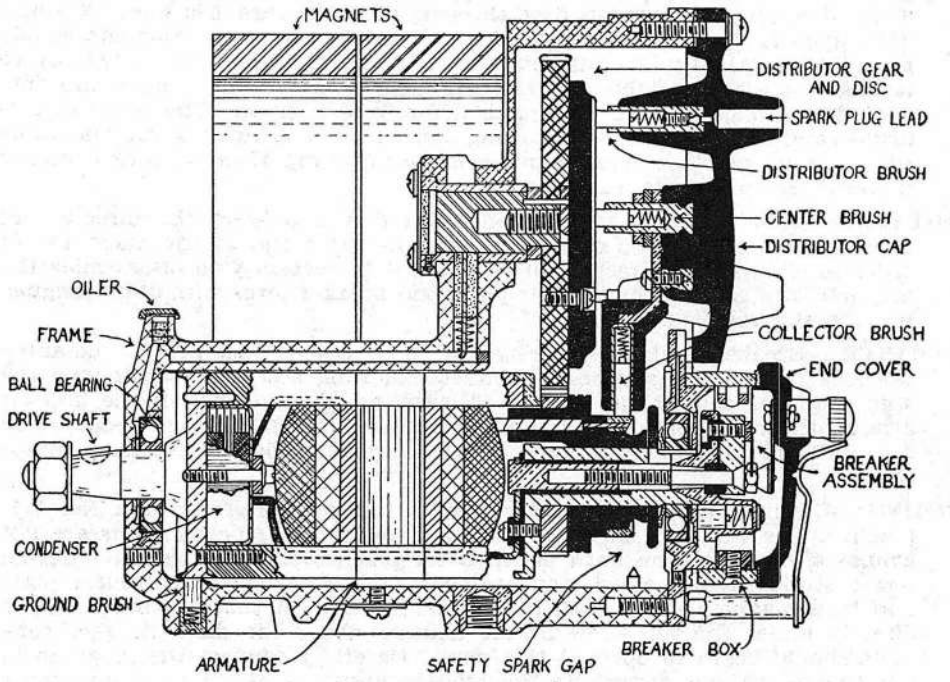
ROTATION:—The magneto can be driven in only one direction which is stamped on the drive end plate. If it is desired to change direction of rotation, it will be necessary to remove the breaker plate and breaker lever and replace with similar units designed for opposite rotation.

BREAKER:—Breaker contacts separate .012 inch with the breaker lever on the high point of the cam. Resurface contacts whenever necessary, using worn No. 00 sandpaper on platinum points and a fine flat contact file or a medium hard oilstone on tungsten points. Magneto is furnished with platinum or tungsten contacts for special service. To adjust contacts, loosen the lock nut on the stationary contact stud and turn up the stud until the correct gap is secured.

TIMING:—Crank engine over until correct firing position is reached for No. 1 piston with spark retarded. See car data sheets for this information. If specifications are not available, crank engine until piston reaches top dead center. Then remove distributor plate on magneto and turn shaft until the white line on the distributor plate is opposite or directly under the timing pin in the frame directly over the distributor gear. Fully retard spark lever and make certain that breaker contacts are begining to open. Then carefully couple the magneto to the engine without disturbing the relative position of the crankshaft or magneto armature shaft. Replace the distributor plate and connect the lower left hand terminal on the distributor plate to the spark plug in cylinder No. 1. Connect the other spark plugs in accordance with the firing order of the engine. Distributor cables are held in the terminals by special ball pointed screws under the carbon brushes. To fasten cables, remove distributor plate, take out carbon brush and spring and back out the screw which is in the base of the brush holder. Then insert the cable with the insulation removed from the end of the conductor, in the front of the plate and make certain that the conductor goes through to the ball seat in the brush holder. Then replace the screw and check to see that the cable is firmly held in place.

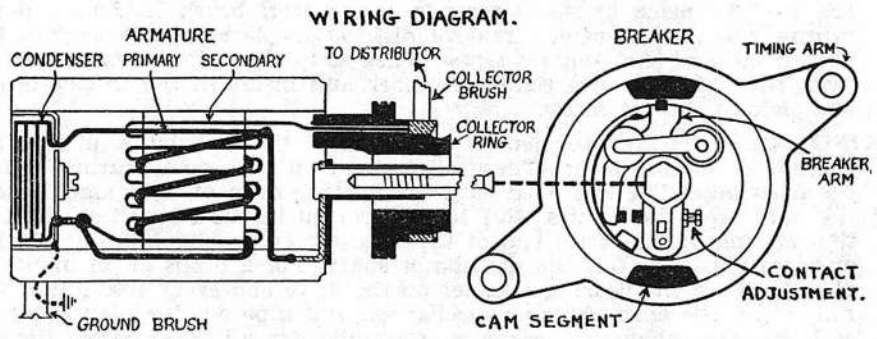
OILING:—Oil wells are provided at each side of the distributor plate at the breaker end of the magneto. One of these oilers should be given one drop of oil every 1000 miles or 100 hours of operation. Both oilers oil the same bearing and only one need be used. The oiler at the drive end of the magneto should be given 15 drops of light machine oil every 1000 miles or each 100 hours. Carefully clean the entire breaker mechanism with gasoline every 100 hours. Carefully clean the entire breaker mechanism with gasoline occasionally and wipe out the inside of the distributor plate. Do not use sandpaper on the brush track of the distributor disc.

SPARK PLUG:—Spark plugs should be set at 1/64-1/32 inch, depending on the compression ratio of the engine. A safety spark gap of 8 MM. is provided by the pointed set screw mounted directly under the collector ring on the breaker end of the magneto.



SECTIONAL VIEW.

EISEMANN MAGNETO-TYPE G-4-III



WIRING:—The terminal on the breaker cover should be connected to the ground switch. The magneto can be furnished with a special short circuiting end cap which short circuits the magneto in the fully retarded position.

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EISEMANN MAGNETO

TYPE GN-6

DESCRIPTION:—The Type GN-6 Magneto is of the high tension shuttle wound armature type. The rotating armature is carried on ball bearings which are insulated from the frame. The armature is grounded through a special ground brush mounted in the base plate at the drive end of the magneto. This prevents any current flow through the armature bearings. A single 'U' shaped magnet is mounted directly above the armature. Magneto should be driven at 1½ times crankshaft speed. It is furnished with a 30 degree timing range for variable ignition although special timing ranges are furnished and magneto can be equipped for fixed ignition. The base plate is drilled and tapped for base mounting bolts. It may likewise be strap mounted with a brass or other non-magnetic mounting strap if dowel pins are used in the base to provide alignment.

ROTATION:—The magneto is designed to be driven only in the direction of rotation stamped on the oil well cap on the drive end of the magneto. In order to change the direction of rotation, it is necessary to disassemble the magneto and replace the breaker plate and breaker lever with units designed for opposite rotation.

BREAKER:—Breaker contacts separate .012 inch. Set contact gap by loosening the lock nut on the stationary contact mounting stud and turning up the stud until the correct gap is secured with the fiber bumper of the breaker arm on the high point of the cam. Resurface contacts when necessary with a fine flat contact file. Platinum contacts are furnished as standard equipment.

TIMING:—Crank engine over until correct firing position for piston No. 1 is reached. See car data sheets for this information. If specifications are not available, crank engine until piston No. 1 reaches top dead center entering power stroke. Fully retard magneto timing lever. Remove distributor plate and turn magneto shaft until the indicator mark on the distributor disc is directly under the set screw in the housing above the disc. Breaker contacts should begin to open at this point. Carefully connect the magneto to the engine without disturbing the relative positions of the armature shaft and crankshaft. Connect the extreme left hand terminal of the distributor plate to the spark plug in cylinder No. 1. Connect the remaining spark plugs in accordance with the firing order of the engine. Distributor cables are held in place by set screws in the carbon brush holders under the brushes. To fasten cables, remove distributor plate, remove carbon brush and spring and back out set screw. Then strip insulation from end of cable, twist the stranded wire tightly together and insert in the proper terminal and tighten the set screw.

OILING:—Oil wells are provided at each side of the distributor plate directly behind the timing lever. These oilers both oil the same bearing and only the most accessible one need be used. Put one drop of light machine oil in the oiler every 1000 miles. Put 15 drops of oil in the oil well at the top of the housing on the drive end of the magneto every 1000 miles or 100 hours of operation. This oils the distributor shaft. Put 2 drops of oil in the oiler directly above the bearing retainer on the drive end every 1000 miles. Carefully clean the entire breaker mechanism and wipe out the distributor plate with gasoline whenever necessary. Carefully dry all parts before the magneto is again operated.

SPARK PLUGS:—Spark plugs should be set at 1/64-1/32 inch. This will depend largely on the compression ratio of the engine. A safety spark gap of 8 MM. is provided by the set screw in the base plate directly under the collector ring.

