The theoretical man knows *why*. The practical man knows *how*. The man who would lead must know why *and* how.

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Automobile Engineering

A Reading Course and General Reference Work for

Auto-Mechanics, Chauffeurs, and Owners, Covering the Construction, Care, and Repair of Pleasure Cars, Commercial Cars, and Motorcycles, with Special Attention to Ignition, Starting, and Lighting Systems, Aviation Engines, Welding, Etc.

Prepared by a Staff of
Automobile Experts, Designers, and Consulting Engineers

Over Fifteen Hundred Illustrations
Six Volumes

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Grateful acknowledgment is here made also for the invaluable cooperation of the foremost Automobile Firms and Manufacturers in making these volumes thoroughly representative of the very latest and best practice in the construction, operation, and repair of Automobiles, Aviation Engines, etc.; also for the valuable drawings, data, illustrations, suggestions, criticisms, and other courtesies; also to the National Automotive Service who publish the National Service Manual which gives the wiring diagrams of all Automobiles released from 1915 to date together with complete information and necessary instructions for the care, adjustment, trouble shooting, and repair of all the electrical equipment.

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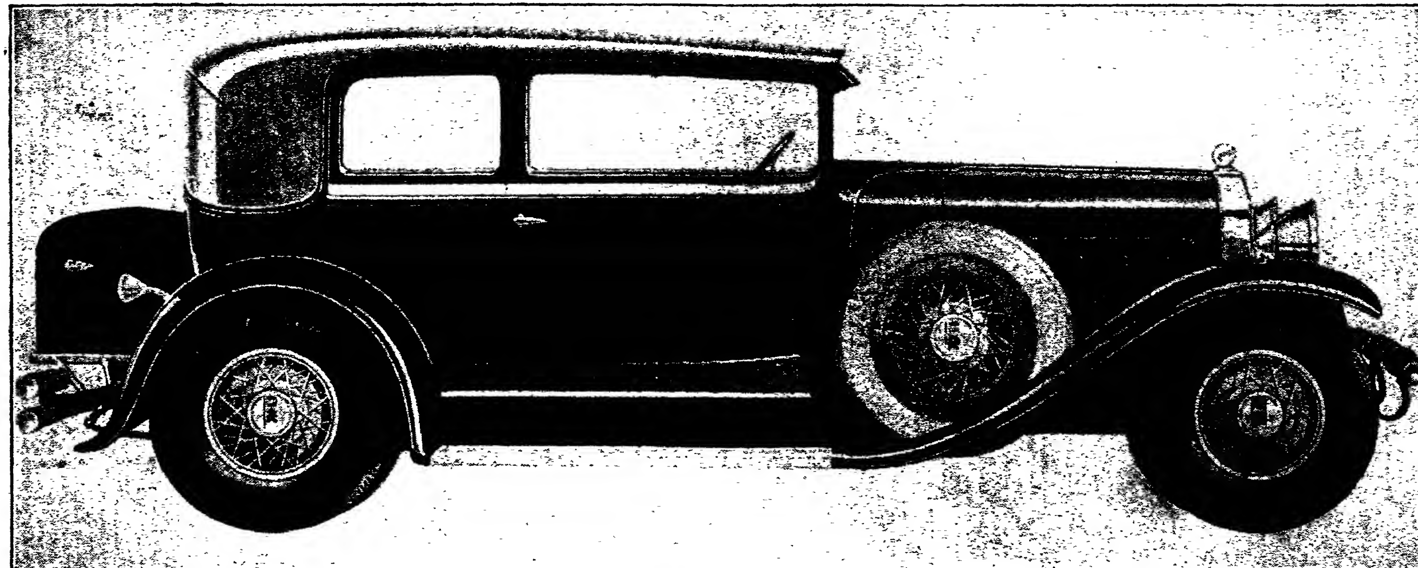
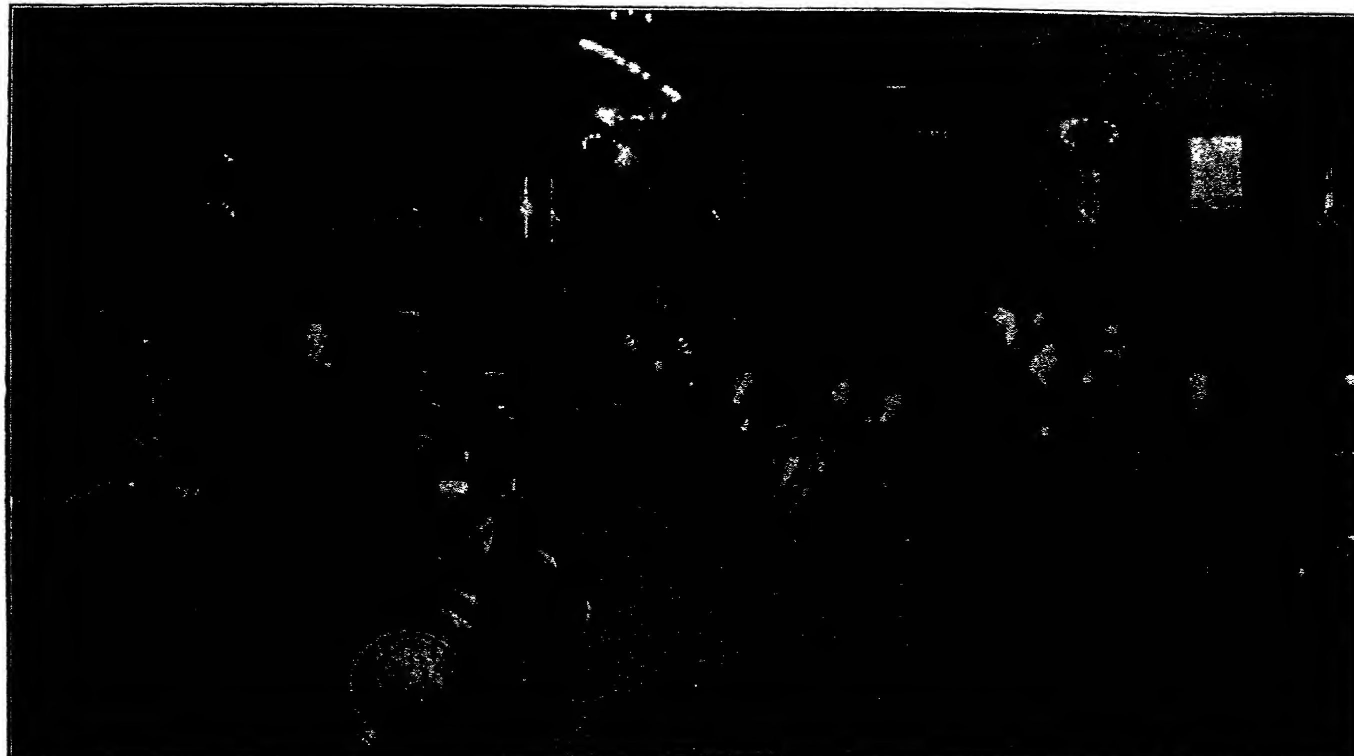


WILLYS-KNIGHT "GREAT SIX" FIVE-PASSENGER COUPE



STUDEBAKER SALON HELD AT SOUTH BEND, INDIANA

Foreword

THE period of evolution of the automobile does not span many years, but the evolution has been none the less spectacular and complete. From a creature of sudden caprices and uncertain behavior, it has become today a well-behaved thoroughbred of known habits and perfect reliability. The driver no longer needs to carry war clothes in momentary expectation of a call to the front. He sits in his seat, starts his engine by pressing a button with his hand or foot, and probably for weeks on end will not need to do anything more serious than feed his animal gasoline or oil, screw up a few grease cups, and pump up a tire or two.

¶ And yet, the traveling along this road of reliability and mechanical perfection has not been easy, and the grades have not been negotiated or the heights reached without many trials and failures. The application of the internal-combustion engine, the electric motor, the storage battery, and the steam engine to the development of the modern types of mechanically-propelled road carriages has been a far-reaching engineering problem of great difficulty. Nevertheless, through the aid of the best scientific and mechanical minds in this and other countries, every detail has received the amount of attention necessary to make it as perfect as possible. Road troubles, except in connection with tires, have become almost negligible and even the inexperienced driver, who knows barely enough to keep to the road and shift gears properly, can venture on long touring trips without fear of getting stranded.

¶ The refinements in the ignition, starting, and lighting systems have added greatly to the pleasure in running the car. Altogether, the automobile as a whole has become standardized, and unless some unforeseen developments are brought about, future changes in either the gasoline or the electric automobile will be merely along the line of greater refinement of the mechanical and electrical devices used.

¶ Notwithstanding the high degree of reliability already attained, the cars, as they get older, need the attention of the repair man. This is particularly true of the cars two and three seasons old. A special effort, therefore, has been made to furnish information which will be of value to the men whose duty it is to revive the faltering action of the engine and to take care of the other internal troubles in the machine.

¶ Special effort has been made to emphasize the treatment of the Electrical Equipment of Gasoline Cars, not only because it is in this direction that most of the improvements have lately taken place but also because this department of automobile construction is least familiar to the repair men and others interested in the details of the automobile. A multitude of diagrams have been supplied showing the constructive features and wiring circuits of the majority of the systems. In addition to this instructive section, particular attention is called to the articles on Welding, Shop Information, and Electrical Repairs.

¶ The great stimulus enjoyed by the aeronautical industry since the crossing of the Atlantic by Lindbergh and the conquering of this and other oceans by later pilots has resulted in a great number of men seeking training in the ground or engine work in that field. Most of the airplane engine men are recruited from the automobile field. The constructional features of the modern airplane engine are fundamentally the same as for the automobile engine. Standards of workmanship are the same. The best only is acceptable. There are certain differences in standard clearances allowed in repair work. In the main, however, the thoroughly trained and expert auto-mechanic may expect to find success in the airplane engine field if he devotes the same effort to it which he had to give to the automobile work to earn a name as an expert auto-mechanic. It likewise holds true that the beginner in either field must make a study of the underlying theory of the construction of the automotive power plants and he must develop skill and knowledge of proper methods of repair. These volumes are devoted to imparting the information on theory of construction and methods of repair which will insure authentic knowledge of all phases of automotive work.

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VOLUME VI

Electrical Equipment

By Charles B. Hayward　　*Revised by Ray F. Kuns*

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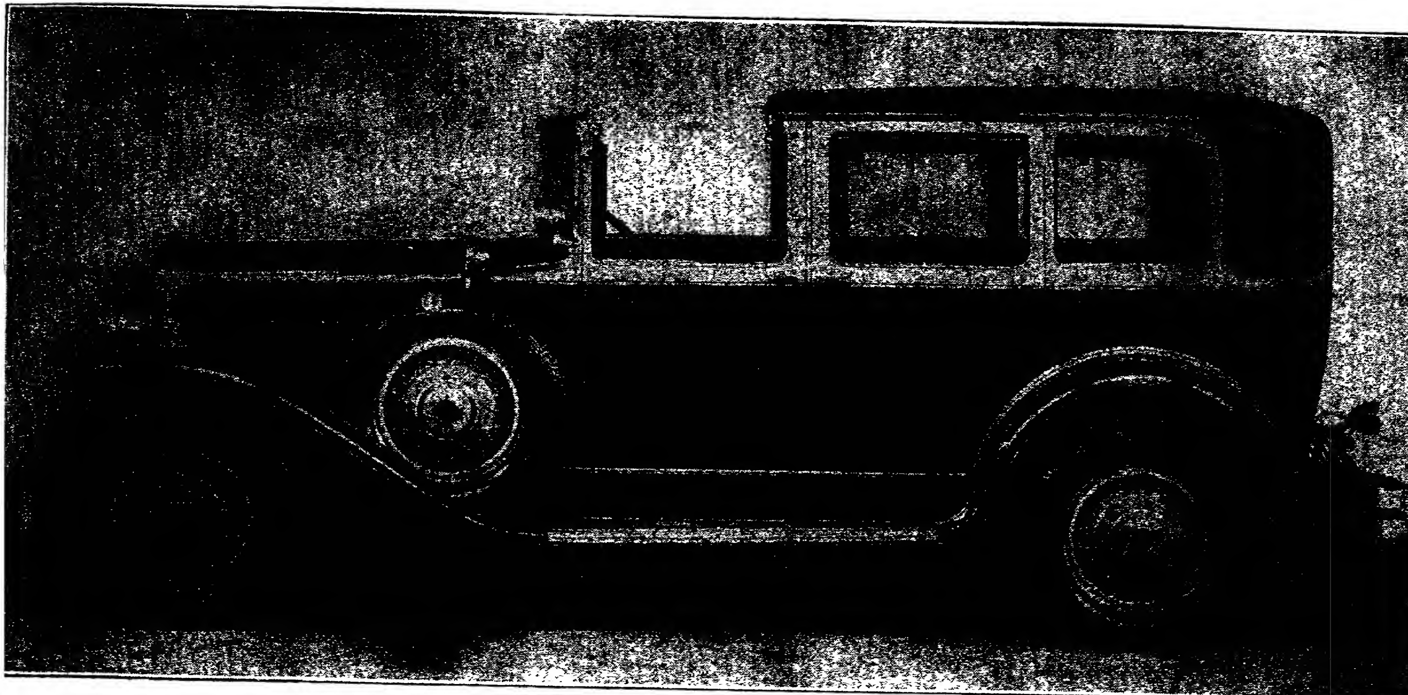


YELLOW CAB SPECIAL METROPOLITAN MODEL

READING WIRING DIAGRAMS AND AUXILIARY ELECTRICAL EQUIPMENT

EXPLANATION OF WIRING DIAGRAMS

The first requisite in the work of electrical trouble shooting and repair work is the ability to trace a circuit on a wiring diagram. The wiring diagram is very useful both for rewiring work and for checking up correct connections in trouble shooting.

In the making of a wiring diagram, it would be a difficult task to write in the names of the different parts of the several pieces of electrical equipment. The manufacturers have compiled a number of symbols which are used to show these different parts. In Figs. 1 to 12 inclusive, are shown the symbols that are used in the Delco installation. While these symbols are standard for Delco only, they may be considered standard for all since they bear a close resemblance. These symbols should be carefully studied so that the different parts of the circuits can be easily recognized on sight. Switches, contact points, resistances, etc., are points at which trouble occur. If the repair man can find the part on the wiring diagram and trace the circuit on the diagram to the part, he can easily find the circuit on the car.

Current Direction. The plus and minus, or positive and negative signs, + positive, — negative, scarcely call for any extended explanation. They indicate the direction in which the current flows. It is of the utmost importance, where the manufacturers' directions are to connect certain apparatus with a given wire to the plus, or positive, side, and another wire to the negative, that these instructions be followed explicity. Otherwise, the apparatus either will refuse to work or it may be damaged, as in the case of a storage battery on which the connections have been reversed. Wherever it is necessary that the current flow through a piece of apparatus in a certain direction, the manufacturer stamps plus and minus signs at the terminals.

+ Positive

— Negative

Fig. 1. Battery, Either Storage or Dry Cells

Fig. 2. Generator, Commutator, and Brushes

Fig. 3. The Proper Method of Showing a Coil Which Surrounds an Iron Core

Fig. 4. The Method Used in Showing a Coil Where There Is No Chance of Confusion—Used in Field Coils, Ignition Coils, Etc.

Fig. 5. The Method Used to Show Resistance Such as a Resistance Unit and Charging Resistances

Fig. 6. Ground Connection Where the Wire Is Connected to the Chassis, Engine, or Generator

Fig. 7. Contact Points Such as in Switches, Distributors, Etc.

Fig. 8. Method Used to Show Lighting Switches

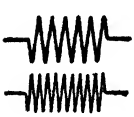


Fig. 9. Primary and Secondary Windings of an Ignition Coil

Fig. 10. Condenser

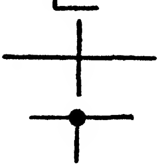


Fig. 11. Upper Showing Crossed Wires not Connected. Lower Showing Connection in the Wiring

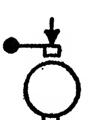


Fig. 12. Motor Commutator and Brushes with Brush Lifting Switch

Battery; Generator. A battery, regardless of its type, is always shown by alternate heavy and light lines, as indicated in Fig. 1, each pair of lines representing a cell, so that the number of cells in the battery may be told at a glance. Other sources of current, such as generators, are indicated by a conventional sign consisting of a circle with two short heavy lines tangent to its circumference at opposite points and usually at an angle to the horizontal, as shown in Fig. 2. The origin of this sign will be apparent in its resemblance to the end view of a commutator with a pair of brushes bearing on it. This sign is also used to indicate a motor, in which case the letter M is inserted in the circle.

Coils. Coils which are wound on an iron core are generally indicated by a conventional sign consisting of a few loops of wire, as in Fig. 3, but this is only the case where such a coil occurs at a place in the circuit where there might be a chance of confusion in identifying it. Where there is no possibility of confusion—as in the case of the windings of a generator or motor, ignition coils, and the like—the sign shown in Fig. 4 is often used. Where the lines are heavy, a coarse wire, such as is employed for series windings of generators or motors, or the primary winding of an ignition coil, is intended.

Resistance. Resistance in a circuit is usually shown by an arbitrary sign, Fig. 5, similar in outline to a piece of the cast-iron grid frequently used in charging resistances, though sometimes shown as a coil and marked "resistance".

Grounds. The sign of a ground connection is the inverted pyramid of short lines, Fig. 6, and indicates that the circuit is grounded. This may be either by a wire directly connected at some point with the frame, as in the case of the storage battery, or it may be through an internal ground connection in the apparatus itself, as in the lamps and sometimes the generator or motor, the connection being made simply by fastening them in place. In any case, the sign indicates that the circuit is completed through a ground.

Contacts. There are a number of signs employed to indicate contact points, switches, and the like, and, where they are not of an arbitrary character, such as Fig. 7, which shows contact such as used in switches, distributors, etc., and Fig. 8, which indicates a lighting switch (Delco diagrams), they usually will be found to bear sufficient resemblance to the apparatus itself to make their identification easy.

Induction Coil. Fine lines indicate a generator shunt winding, the secondary of an ignition coil, or the coil of a relay or cut-out. The primary and secondary windings of an induction coil as used for ignition are indicated by a fine and a coarse coil sign, as in Fig. 9.

Condenser. A condenser with its overlapping plates is shown in Fig. 10.

Crossed Wires. To show wires that cross one another without making connection, a straight-line cross is made at that point to show that the wires do not touch, as in Fig. 11, while wires that are connected are shown by a black dot at the junction.

General and Special Usage. While these signs are not universally used in exactly the form shown here, their employment is very general and in the majority of cases, such as the positive and negative, battery, ground, generator, induction-coil windings, and coil signs, they are never changed. In some instances special signs are employed, such as that shown in Fig. 12, which indicates the motor commutator of the Delco single-unit machine or *dynamotor,* and shows the special brush lifting switch. Incandescent lamps are almost always indicated by small circles, though the lamp itself is sometimes drawn in. As a matter of fact, very little system is followed by different makers in making these wiring diagrams. In an effort to simplify its reading to the uninitiated, a diagram will sometimes picture most of the apparatus in such form that it will be recognized from its resemblance to the original, including the battery, generator, lamps, and the like, using only signs for showing coils and ground connections; others go to the opposite extreme and show nothing but signs.

Tracing the Circuit. The correct point at which the tracing of the circuit should begin is at the source of supply, which in the automobile is the battery. Irregardless of whether it is the positive or the negative terminal that is connected to the frame of the car, the current always flows from the battery through the positive and returns through the negative. Examples of both of these connections are shown in the diagrams. A line, which represents a wire in the system, is followed to the apparatus to which the connection is to be made. If, in the tracing of the circuit, a resistance unit is found on the diagram, there must be a resistance in the circuit on the car. By tracing the circuit, the repair man finds the position of the apparatus in each of the circuits.

In tracing the headlight circuit on the wiring diagram of the Dodge car, Diagram F, the positive terminal of the battery is attached to the frame of the car. The current flows from the positive terminal of the battery through the frame to the ground connection of the lamp and out by way of the wire to the switch terminal *H*. At this point the switch is closed and the current cannot complete the circuit. Open the switch and the current will flow out at the point *B* to the ammeter, across the ammeter to the battery side of the starting switch and then to the negative terminal of the battery, completing the circuit. It will be found that both headlights are attached to the terminal *H*. The battery side of the switch for the headlights is point *B*. If, in tracing the circuit on a car, it is found that the headlights are attached to the point marked *IG*, the repair man would know that the connection was not correct and he would know exactly how to make the proper connection.

In tracing the ignition primary circuit on the same diagram, start from the positive terminal of the battery. The current flows to the grounded side of the contact points in the breaker housing and, when the points come together, passes through the wire and the primary winding of the coil, out through the resistance and to the ignition and lighting switch marked *IG*. If this switch is open, the current returns to the negative side of the battery by way of the point *B* on the ignition and lighting switch and through the wire to the ammeter. It finally passes across the ammeter to the battery side of the starting switch and to the battery. In tracing this primary circuit, the proper switch connections have been found and the location of the resistance unit. If there was trouble in the primary current to the extent that there was no current found at the contact points, the repair man would know where to look for the resistance unit to see whether it was broken or burnt out. He would also know where to look for other connections to see if everything was correct in the primary circuit or system. It will be seen that the current in this system always returns to the battery by way of the ammeter and starting switch and the supply is by way of the frame connection.

The Delco system, as installed on the Roamer car, Diagram C, shows that the battery negative terminal is connected to the frame. This is a true ground-return system and the current supply is furnished by way of a wire and returns by way of the frame. In tracing the ignition primary circuit, the current flows to the battery side of the starting switch from the positive side of the battery to the ammeter and across to the main point marked *6*. When the switch is open, the current flows out of the switch, at *5*, to the resistance unit, through the primary winding of the coil, across the timing contact points to the grounded point and back to the battery by way of the ground connection which, in this case, is the metal part of the car. In tracing the circuit to the headlights for the dim position, the flow of the current is from the positive side of the battery to the starter switch, through the ammeter to the main switch at point *6*, through the switch connections and out at point *3*, through the dimmer resistance back to point *2* of the switch. It then goes to the headlight bulbs and out from the lamps to the battery by way of the ground connection. All the current except the starter current passes through the ammeter.

TYPICAL ELECTRICAL SYSTEMS

The six sample diagrams here given are typical of the wiring systems used on the present-day car and embrace the Remy, Delco, Atwater-Kent and Westinghouse. The single and double units are also shown in these diagrams. If the operation of one system is understood, the other systems of the same manufacture and the tests for troubles will be understood. The explanation on the operation of the systems mentioned should be sufficient to give the repair man a good working knowledge and enable him to make satisfactory repairs in any other system. The operation and control of all parts of the electrical equipment as installed on the automobile have been explained and discussed in previous sections. The reader should be able to follow the points mentioned in connection with the sample diagrams.

Diagram A. Diagram A shows the wiring for the Remy system as used on the Studebaker Models *EG* and *EH*. The ignition and lighting system in this installation is Remy throughout. A Remy lighting system can usually be recognized by the thermostatic control

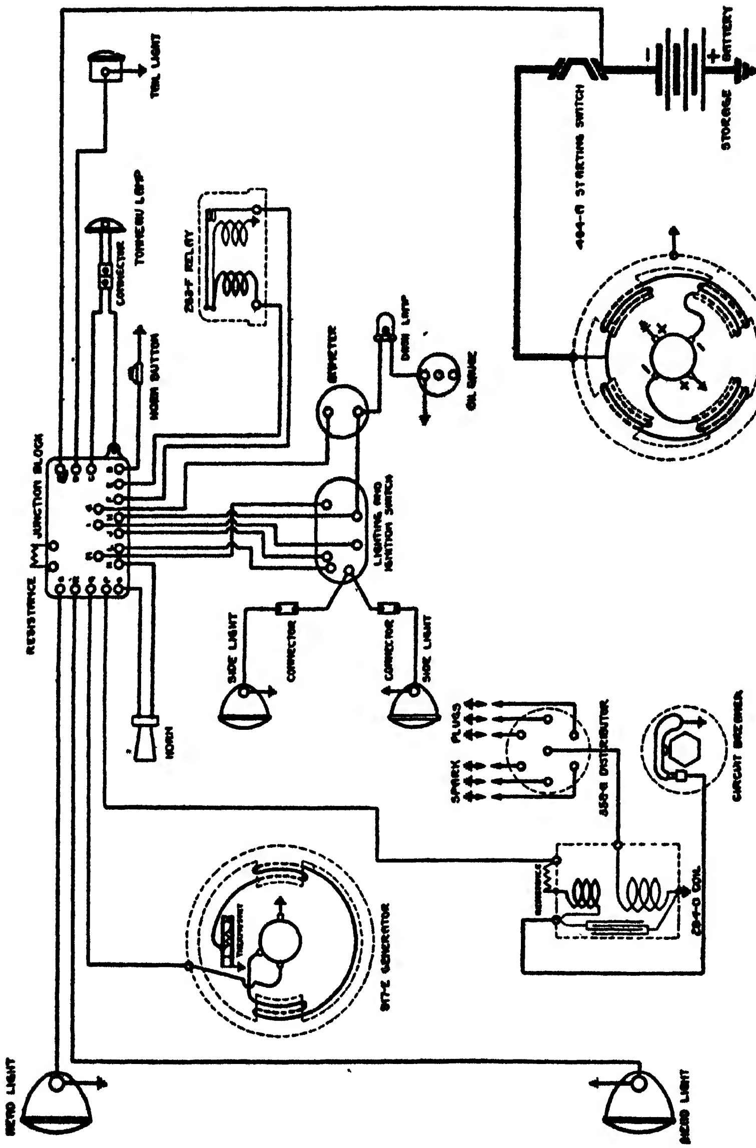


Diagram A. Studebaker. Remy Lighting and Ignition installed in the generator. The operation of this control is fully discussed in the lesson on "Generators." This type of control is typical of the Remy and is a patented feature. The system is a two-unit installation with the thermostatic control used in conjunction with a third brush. The relay is separate from the generator and is usually fastened to the outside of the generator rather than built into the generator itself.

In the ignition system it will be noted that the resistance unit as well as the condenser is built into the coil or, at least, located in connection with it.

The battery, which is fastened to the frame by the battery terminal, is of the three-cell type indicating a six-volt system, and the ground connections show it to be a single-wire system.

It is interesting to note that the current supply for all units of this installation is taken through a junction block instead of directly through the switch as in other systems. When trouble is experienced in this system, the fuses in the junction block should be the first point of examination and a blown fuse is the indicator for the circuit in which there is trouble.

Diagram B. Diagram B is the wiring diagram for the two-unit Delco installation as used on the Oldsmobile. The generator control is by the third-brush method. There is no relay in this generator circuit and the battery and generator connection is made when the switch is turned to the "on" position. A circuit breaker is found in place of the relay and is located at the switch to protect the battery should any excess current start to flow through any of the lighting circuits. In addition to the regular side and head lamps, additional low candlepower lamps for city driving and parking are used.

In the ignition, a very marked change from the preceding Diagram A is found. The condenser and resistance units have been placed in the breaker housing instead of at the coil. A double set of breaker contacts are used and are arranged for synchronous timing. The battery to frame connection is negative instead of positive and a six-volt single-wire system is again used.

In tracing the circuit in this diagram beginning at the battery terminal, opposite to the one connected to the frame, the circuit is regular as far as the starting switch. A lead goes to the ammeter

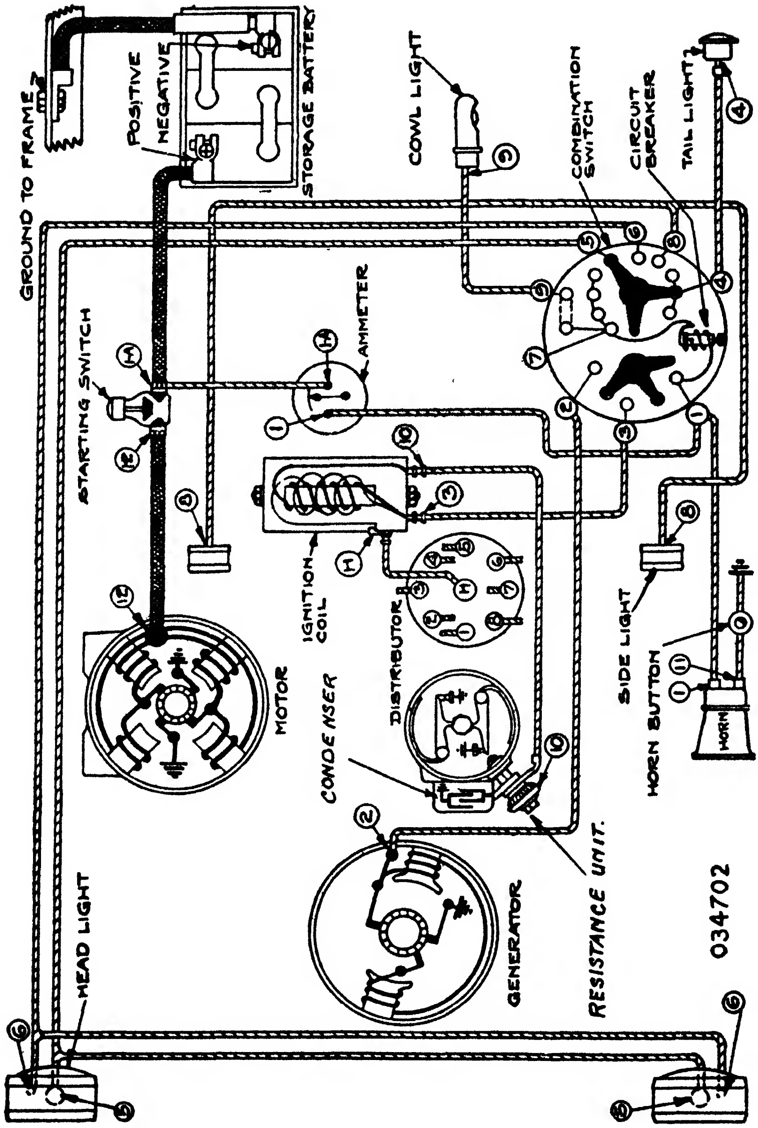


Diagram B. Oldsmobile. Delco Two-Unit

for ignition, lighting, and signal purposes. When the starting switch is closed, the battery circuit is completed through the starter fields and armature to the ground. With such short and direct connections and with the low resistance of the starting motor it is very evident that there can be little excess battery current for lights and ignition when the starting-motor circuit is complete especially if the battery is low. Low battery power accounts for the frequent lack of brilliancy from the lights and sometimes for the failure of the ignition when the starting motor is in use on any automobile.

A lead goes to the ignition and lighting switch from the ammeter. It should be noted that the horn circuit is so arranged that the current consumed by it is recorded by the ammeter. It cannot be broken by either the ignition or lighting switches. We do, however, find that the circuit breaker is usually so arranged that the horn circuit is completed through it.

From the circuit breaker, the current can be traced to the various contact points on the lighting switch (marked combination switch). The cowl or dash light can be operated from the contact points at will. The current can go no further without moving the switch which can be done by rotating it in a clockwise direction. The idle finger will come into contact with the supply taps. The finger resting on contact *5* will rest on *6* completing the current for the low candlepower lights, commonly called dimmers. The finger resting on contact *4* will soon be connected to the same contact and the tail light circuit will be completed. By turning the switch in a counter clockwise direction past the "off" position, the finger resting on contact *5* will be brought into connection with the supply taps. The finger resting on *4* will rest on contact *8* and the idle finger will connect the tail light circuit. At this point the side lights will be connected and by rotating it still farther the head lamps will be connected instead of the side lamps.

On the ignition side, there is but one throw, that being in the clockwise direction, one finger coming in contact with the top by which the primary ignition circuit is completed through the primary winding of the coil to the breaker contacts and ground. The other two fingers complete the circuit between the generator and battery. It will be noticed that the ignition and lighting circuits are so placed as to "float" on the generator to the battery line. What actually happens is that the ignition and lighting circuits are first supplied and the surplus current output of the generator is driven through the ammeter to the battery, giving a lower charging reading when lights are on than when they are off. The circuit breaker is necessary should short cuts occur anywhere past this point since all the generator output, as well as the battery output, would flow directly through the short, being limited only by the capacity of the wires which would soon fuse and cause trouble. When the engine is not running and the ignition switch is turned on, there is nothing to prevent the battery from discharging through the generator, which would consume about 5 amperes. It is therefore very important that the ignition switch be closed when the engine is not running. This is usually taken care of by the relay but as none is used in this installation the warning given is very important.

Diagram C. Diagram C is the diagram for the Delco system as installed on the Roamer. This is also a two-unit system with the third brush regulation. The relay is in the generator and battery circuit. The operation of the relay has been explained in the section on generator control.

A cut-out relay is used to protect the battery and close the generator when a sufficient charging rate has been reached. The horn circuit is so arranged that the current consumed by it does not pass through the ammeter.

A circuit breaker is located on the lighting and ignition switch and, in addition, there is a dimmer resistance in conjunction with it, which is brought into the head lamps circuit when the switch is rotated to its proper position. The dash and tail lights are so arranged as to burn at full capacity irregardless of whether the lighting switch is in the dim or bright position. No side lights are used. The ignition wiring shows the resistance located at the ignition coil and the condenser located with the breaker contacts. A six-volt battery is used and the one negative terminal is connected to the frame.

Diagram D. Diagram D is the wiring diagram for that used on the Pan-American car. The starting and lighting system in this car is the Westinghouse, while the ignition is Atwater-Kent. The installation is of the two-unit type and the generator control is by the third-brush method. The relay is built into the generator and

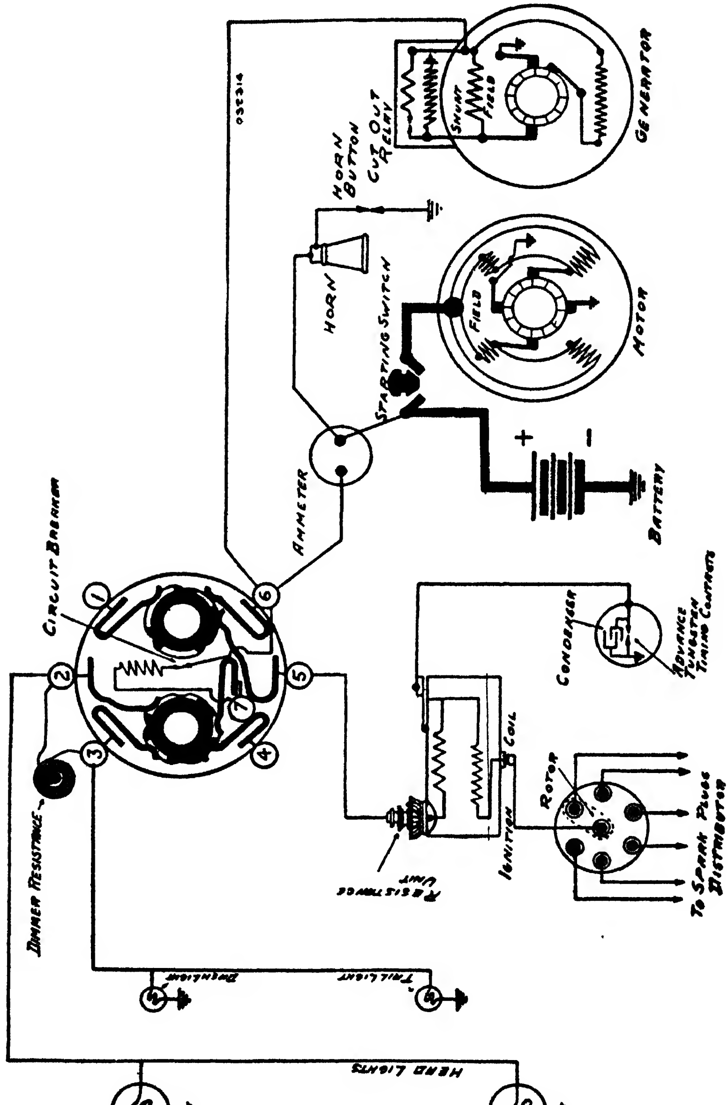


Diagram C. Roamer. Delco Two-Unit

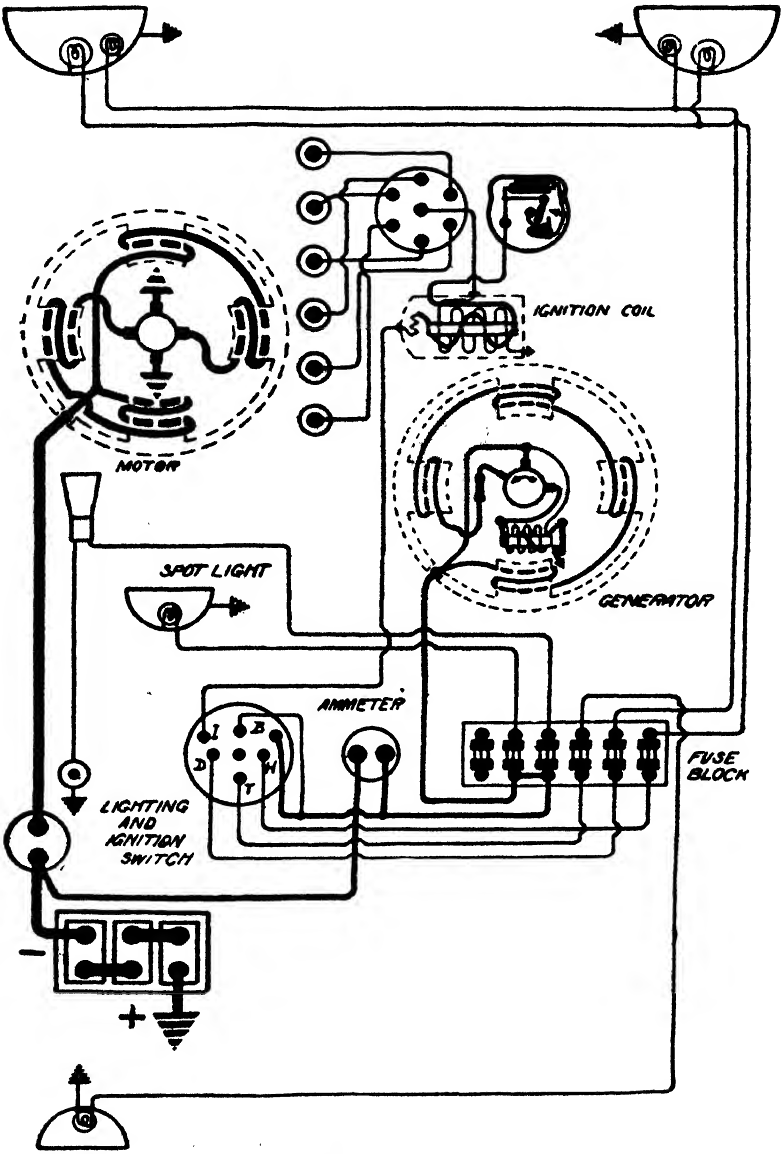


Diagram D. Pan-American. Westinghouse Lighting. Atwater-Kent Ignition the latter is protected against damage should the relay become inactive or by some connection becoming loose or broken by a fuse being inserted in the field winding. Should any trouble occur that would cause a heavy load to be thrown on the generator, this fuse will melt or blow out allowing no current to flow through the field winding which would prevent generation. The ignition, being the Atwater-Kent, is of the open-circuit type. Note the peculiar shape of the part in the diagram which represents the breaker unit. The Atwater-Kent ignition system can always be recognized by this formation.

The condenser is located with the contacts and the resistance in connection with the coil. A fuse block is used in place of a circuit breaker and the spot lamp and horn circuits are not connected to the ignition and lighting switch but are connected through the ammeter.

The battery is a six-volt type with the positive terminal connected to the frame. The four-brush series-wound starter seems to be the common type used in most electrical systems.

Diagram E. Diagram E is the diagram for the Delco single-unit system as installed on the Essex. The system on this car is entirely different from the previous systems in respect to the generator and starting-motor units. The Delco single unit is one in which two commutators are used on the same end of the armature shaft: one for the generator and the other for the starting motor. The ground brushes are brought into operation by the action of the foot pedal thus closing the starting motor circuit. The ignition and starting motor circuits are so arranged that when the ignition switch is closed the battery current will flow through the shunt winding of the generator, causing the armature to rotate slowly—the driving connection to the engine being through an overrunning clutch. As the starting pedal is operated, it slides a double idler gear into mesh with a gear on this rotating armature and finally into the gear cut on the face of the flywheel. The purpose of rotating the armature is to make the engaging of these gears positive and easy. As soon as the gears have been fully engaged the foot pedal brings the brushes into contact with the commutator and the starting action takes place. The rotating armature causes a clicking noise at the generator clutch which can be heard when the

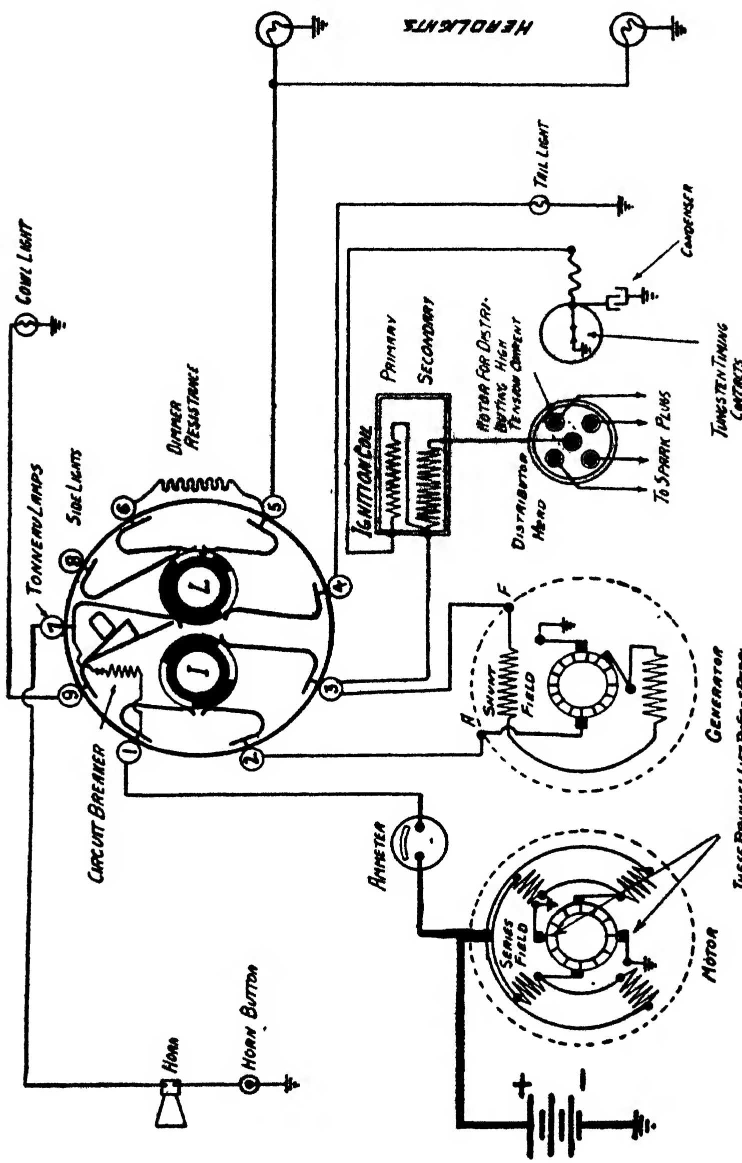


Diagram E. Delco Single-Unit

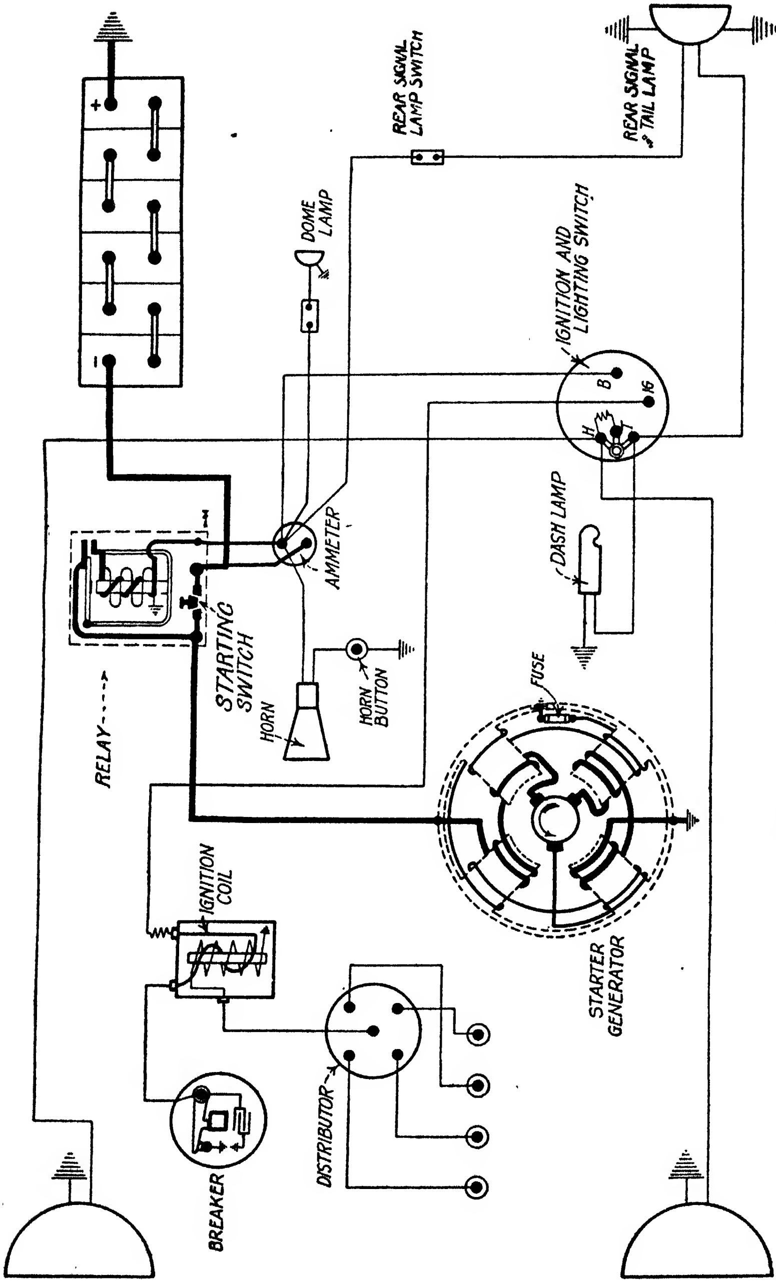


Diagram F. Dodge (1923-24). North-East System ignition switch is turned on and often when the engine is permitted to idle below the rotating speed of the armature.

In the ignition wiring, the resistance and the condenser are located with the breaker contacts. A circuit breaker and dimmer resistance are located on the switch and all circuits, except that of the starting motor, are connected through the ammeter.

Diagram F. Diagram F is the wiring diagram for the North-East system as installed on the Dodge car. It illustrates another single unit in which the armature has only one commutator on the armature shaft and which is used for both starting motor and generator. The field winding is of the differential-wound type. It consists of a series winding, which is the starter motor winding, and the shunt winding, which is the generator winding. When the unit is operating as a starter motor, the two windings operate together, that is, the series winding is helped by the shunt winding. When the unit is operating, the shunt winding acts as a bucking coil for regulating purposes. A fuse is installed in the field winding which burns out if the charging rate rises above 10 amperes. A relay, which is combined with a starting switch is placed in the generator and battery circuit. The current taken for ignition, lights, and horn is shown on the ammeter. It will be noticed that the system is of the 12-volt type, while in the previous systems it was a 6-volt type. The condenser is located with the points and the resistance at the coil in the ignition system. The dimmer resistance, for use in connection with the head lights, is located at the switch. A 12-volt battery is used and the positive terminal is connected to the frame.

While in these systems there is a little different arrangement of the several units, the principle of operation and the tests for troubles are practically the same. If the previous systems have been studied carefully, all systems will be understood. For instance, if the operation of one ignition coil or the operation of one relay or the test for one type of field winding is understood in one, they will be understood in all.

Two typical magneto ignition circuits are shown in Fig. 13, which is the Bosch, and in Fig. 14, which is the Dixie.

Size of Conductors. The influence of the factor of resistance makes plain the reason for using wires of different sizes for the various circuits of the ignition starting and lighting systems of the automobile. If an ample flow of compressed air is desired for power purposes, a liberal outlet must be provided, while if only a small spray is required, as for cleaning purposes, a small-bore tube will suffice. If we try to employ the small-tube line for power purposes, we shall not gain the desired result because its resistance is so great that it will not permit a sufficient flow of air. For the

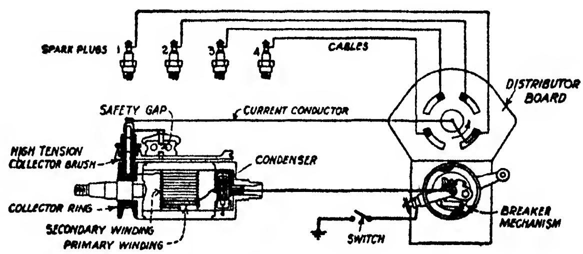


Fig 13 Bosch Magneto Ignition Circuit

same reason a conductor of much larger diameter and, therefore, of correspondingly low resistance must be employed to handle the

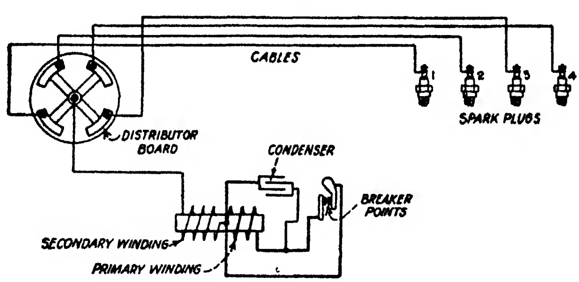


Fig 14 Dixie Magneto Ignition Circuit

heavy current necessary to operate the electric starting motor, than is needed for the comparatively small current which is demanded by the ignition system.

Whether it is mechanical or electrical in its nature, the power necessary to overcome resistance is liberated in the form of heat. Mechanical resistance is friction and its presence between moving bodies always generates heat. Electrical resistance may, for the purpose of illustration, be termed internal or molecular friction, and it also results in heat. The extent of the rise in temperature of a conductor or wire, depends entirely upon the proportion that its size and, consequently, its current-carrying ability bear to the amount of current that is sent through it. Roughly speaking, if a wire is three-fourths the size it should be to carry the starting current, it will become uncomfortably warm to the hand after the motor has been operated several times in succession. If it is only one-half the size it should be, continuous operation of the starting motor for a few minutes will doubtless burn off most of the insulation. Further reducing its size would cause the wire to become so hot as to set fire to the insulation the moment the current was turned on, and any great decrease in diameter would result in the immediate fusing of the wire itself. The wire would literally "burn up" and in a flash.

It would not be practical to attempt to conduct live steam at high pressure through a cardboard tube. Nor is it any more so to attempt to send a heavy current through "any old piece of wire." Electric lighting and starting systems as they exist on cars today are of all degrees of merit. The cars themselves have reached a stage of reliability where their useful life is now on the average from five to ten years or more. Consequently, there are a great many cars in service equipped with electric systems that were brought out several years ago. These are the cars on which the repair man will get a great deal of his early experience, and he need not take it for granted that just because the electric systems have worked for a certain length of time they were properly designed at the outset. Overheated conductors not only indicate excessive resistance caused by small wires or poor joints, but they also indicate a waste of power that is being drawn from the battery and dissipated in the air. The utilization of this energy or rather the prevention of its transformation into heat would mean all the difference between poor and good operation between an efficient and a wasteful system.

Since the amount of current received by the electrical unit is in direct proportion to the size of the wire or conductor, it is necessary to see that the correct size wire is installed when and where replacements are made. Suppose that a new wire must be installed on the starting motor. If the wire is too small, the machine will not get enough current to make it operate correctly. The following is a rule by which the correct size of the wire may be found. Test the starting motor with a high-reading ammeter (scale should read to at least 300 amperes) after having made certain by hydrometer and voltage tests that the storage battery is fully charged. Carefully note ammeter reading exactly at instant of closing switch, to determine maximum current flow. Measure the length of cable between the battery and the starting motor, i.e., both sides of starting switch. Then maximum starting current times 10.7 times number of feet of cable used, divided by .25 will give the cross-section of the wire in circular mils. 'For example, assume that the starting motor required a maximum of 300 amperes momentarily to break away the engine, and five feet of cable are employed for the connections. Then

$$\frac{300\times 10.7\times 5}{25}=64{,}200 \text{ circular mils}$$

By referring to Table I, which gives the various size wires in circular mils and their equivalent in gage sizes, it will be noted that the closest approach to this is No. 2 cable, which is 66,373 circular mils, so that the largest size cable would have to be used. If the starting cable used on an old system which does not show particularly good efficiency is much smaller than this, it would probably be an advantage to replace it with larger cable, assuming, of course, that every other part of the system is in good condition and working properly. Table II shows the carrying capacity of various sized wires.

AUXILIARY ELECTRICAL EQUIPMENT

Electrical signaling devices are becoming more popular with regard to the noise signal and the stoppping and turning light which is placed at the rear of the car.

Electric Horns. The use of a storage battery which is of sufficient capacity for starting purposes and which is kept constantly charged by the lighting generator has made it possible to employ numerous auxiliary electrical devices. The electrical horn is the chief of these, and it has to a very large extent displaced warning devices of every other class. Two different types of electric horns are used, in both of which the sound is produced by the vibrations of a sheet-metal diaphragm several inches in diameter. The only

TABLE I

American Wire Gage (B. & S.)

No.	Diameter in Mils	Diameter in Mm.	Circular Mils	Ohms per 1000 Ft.	No.	Diameter in Mils	Diameter in Mm.	Circular Mils	Ohms per 1000 Ft.
0000	460.00	11.684	211600.0	.051	19	35.89	.912	1288.0	8.617
000	409.64	10.405	167805.0	.064	20	31.96	.812	1021.5	10.566
00	364.80	9.266	133079.4	.081	21	28.46	.723	810.1	13.323
0	324.95	8.254	105592.5	.102	22	25.35	.644	642.7	16.799
1	289.30	7.348	83694.2	.129	23	22.57	.573	509.5	21.185
2	257.63	6.544	66373.0	.163	24	20.10	.511	404.0	26.713
3	229.42	5.827	52634.0	.205	25	17.90	.455	320.4	33.684
4	204.31	5.189	41742.0	.259	26	15.94	.405	254.0	42.477
5	181.94	4.621	33102.0	.326	27	14.19	.361	201.5	53.563
6	162.02	4.115	26250.5	.411	28	12.64	.321	159.8	67.542
7	144.28	3.665	20816.0	.519	29	11.26	.286	126.7	85.170
8	128.49	3.264	16509.0	.654	30	10.03	.255	100.5	107.391
9	114.43	2.907	13094.0	.824	31	8.93	.277	79.7	135.402
10	101.89	2.588	10381.0	1.040	32	7.95	.202	63.2	170.765
11	90.74	2.305	8234.0	1.311	33	7.08	.108	50.1	215.312
12	80.81	2.053	6529.9	1.653	34	6.30	.160	39.7	271.583
13	71.96	1.828	5178.4	2.084	35	5.61	.143	31.5	342.433
14	64.08	1.628	4106.8	2.628	36	5.00	.127	25.0	431.712
15	57.07	1.450	3256.7	3.314	37	4.45	.113	19.8	544.287
16	50.82	1.291	2582.9	4.179	38	3.96	.101	15.7	686.511
17	45.26	1.150	2048.2	5.269	39	3.53	.090	12.5	865.046
18	40.30	1.024	1624.1	6.645	40	3.14	.080	9.9	1091.865

TABLE II

Carrying Capacity of Wires

B. & S. Gage	Circular Mils	Rubber Insulation Amperes	Other Insulation Amperes
18	1,624	3	5
16	2,583	6	8
14	4,107	12	16
12	6,530	17	23
10	10,380	24	32
8	16,510	33	46
6	26,250	46	65
5	33,100	54	77
4	41,740	65	92
3	52,630	76	110
2	66,370	90	131
1	83,690	107	156
0	105,500	127	185
00	133,100	150	220
000	167,800	177	262
0000	211,600	210	312

difference between the two forms lies in the method of causing this diaphragm to vibrate, one employing a small electric motor and the other a simple electric magnet. Fig. 15, which is a phantom view of the operating mechanism of a Klaxon horn, shows the first type. On the upper end of the armature shaft of the electric motor is fastened a toothed wheel which strikes the button in the center of the diaphragm and sets it vibrating at the rate of several thousand times per minute, giving rise to the raucous squawk which has come to be identified with automobile warning signals. A variation of the Klaxon horn is one in which the armature is in a horizontal position with the notched ratchet which rubs against a diaphragm as in the Klaxon vertical type. As shown in Fig. 16, which illustrates a section of the Apollo horn, this type is nothing more nor less than an ordinary buzzer on an enlarged scale. The armature of the electromagnet vibrates at high speed producing a sound by taps on the rod attached to the diaphragm.

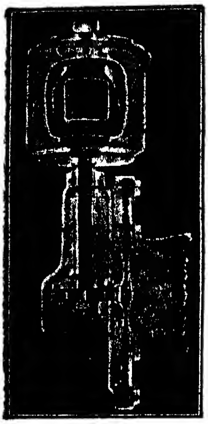


Fig 15. Phantom View Klaxon Horn

Care of the Electric Horn. As the operation of the electric horn is based upon exactly the same principles as the essentials of the

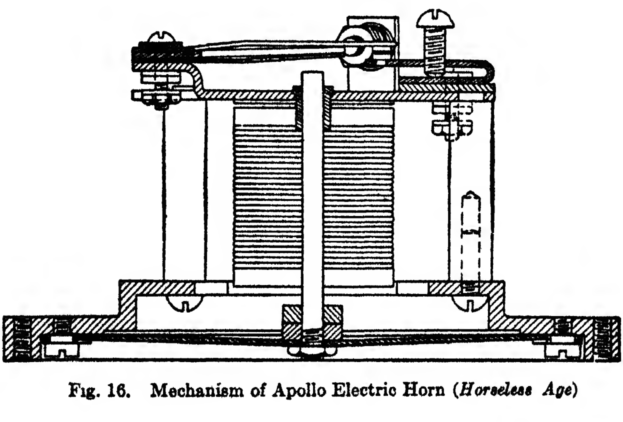


Fig. 16. Mechanism of Apollo Electric Horn (*Horseless Age*)

starting and lighting systems, the instructions given for the care and adjustment of the latter will apply to it as well. In the case of the motor-driven type of horn, the commutator and brushes of the motor will require attention from time to time. Failure to operate may be due to a broken connection at the horn or at the battery; ground in the circuit between it and the battery; brushes not bearing properly on the commutator; or an excess of oil and dirt on the latter. If the motor runs properly, but the horn produces either no sound or a very weak sound, the trouble will be due to the poor contact of the toothed wheel with the button on the diaphragm. This button is made glass hard to obviate wear at that point, but, in time, replacement of either the button or the toothed wheel or of both may be necessary.

While the brushes and commutator should be kept free of oil, the oiling of the small bearings of the horn should not be neglected. The best oil for this purpose is a thin grade of sewing machine oil. A few drops occasionally will be found sufficient to keep the armature turning freely in its bearings.

The attention required by the vibrating type of horn, of which there are many thousands in use, is very similar to that described for the battery cut-out and the voltage regulator. The contact points will require cleaning, truing up, and adjustment at intervals, and the spring may also need occasional attention. Failure to operate may be caused by a loose connection or break in the circuit, or by a lack of adjustment which causes the contacts to be held apart so that no current can pass through the winding of the electromagnet. A weak sound from this horn will result either from insufficient current or from lack of adjustment.

LIGHTING

For automobile headlights, side lamps, tail lamps, and general illumination, electric lighting has superseded all other systems. In the best electric-lighting systems the current is supplied by a dynamo driven constantly by the engine, with a storage battery auxiliary.

Incandescent Lamps. *Tungsten and Other Filaments.* Incandescent lamps are usually provided with tungsten filaments. These filaments are much shorter and much stronger than in standard lamps, a condition that is further contributed to by the necessities of low voltage and high amperage, which require short and thick rather than long and thin filaments. A good tungsten lamp will afford 1 candle power of illumination for each 1.2 watts of current.

Mazda Type. Fig. 17 shows the standard types of lamps generally used. These are Westinghouse Mazda lamps for 6 volts, those at the left being 15 c.p. headlight lamps; the next two, 6 c.p.

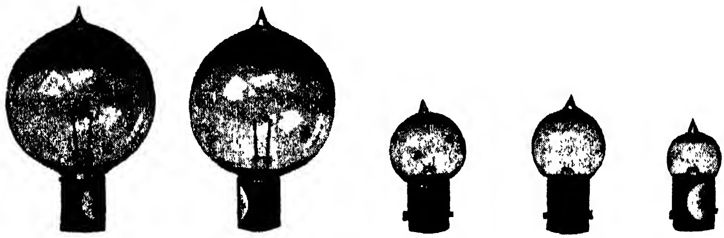


Fig. 17. Westinghouse Lamps—Head, Side, and Tail

side-light lamps; and the smallest one is a 2 c.p. size designed for the tail light, meter light, and for interior lighting of closed cars. At 6 volts, the 15 c.p. lamps require 2.5 amperes, the 6 c.p. side lights 1.25 amperes, or where 4 c.p. lamps are employed—a better size for the purpose—.85 ampere; the 2 c.p. lamps take .42 ampere. The larger lamps have the filament in the form of a spiral coil occupying the

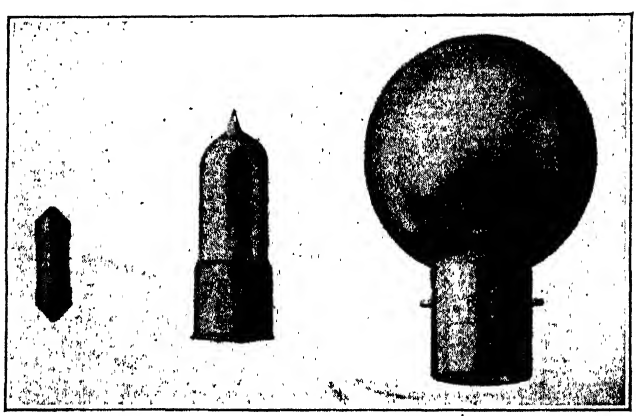


Fig. 18. Bosch Type Automobile Incandescent Bulbs

minimum space so that the whole source of light can be placed at the exact focus point of the paraboloidal reflector.

When lamp bulbs are bought for replacement, care should be taken to see that they are the correct type of bulb in regard to the voltage, amperage, and base contact. The lamps can be purchased with the single-contact and double-contact base but the two types are not interchangeable. In other words, the single-contact base bulbs will not burn in the double contact socket or vice versa.

Bosch Type. Fig. 18 shows the Bosch lamps, which are of special form. The headlight lamp at the right is of 25 c.p. and has the filament stretched horizontally across wire supports, while the side lamps of 8 c.p. have a loop of corrugated wire, and the tail lamp, of tubular form, a single filament running straight across it. Tail lamps are usually in series with the instrument lamp so that failure of the latter to light also indicates a failure of the tail lamp.

Lamp Voltages. When Edison was asked how he came to hit upon 110 volts as the standard for incandescent lighting, he said he "just guessed it." Evidently the 6-volt standard came about in pretty much the same way. It is not practicable to operate small lamps at a high voltage, as the lamp of that type requires a long slender filament. Many manufacturers of starting apparatus have deemed it necessary to employ a higher voltage, but the lamps are usually run at 6 volts, so that the batteries employed are accordingly some multiple of 3, as 6, 9, or 12 cells, giving 6, 12, 18, or 24 volts. Where more than three cells are used, this necessitates operating the lamps from a part of the battery, which is not advantageous, as it involves discharging the battery unevenly. As a battery capable of delivering current at 12 volts weighs and costs about 35 per cent more than one giving current at 6 volts and the attention required is greater, the lower voltage is generally favored.


Fig. 19. Typical Electric Automobile Headlight

A recent addition to the lighting equipment on the automobile is the signal light placed at the rear of the car. Some of these lights not only have the stop signal but right-hand and left-hand turn direction signals as well. They are operated by a pull switch which is attached to the foot or service-brake pedal. Where the service and emergency brake operate together, care should be taken in installing the lights or when the emergency brake is set it will pull the switch and the signal light will burn continuously and discharge

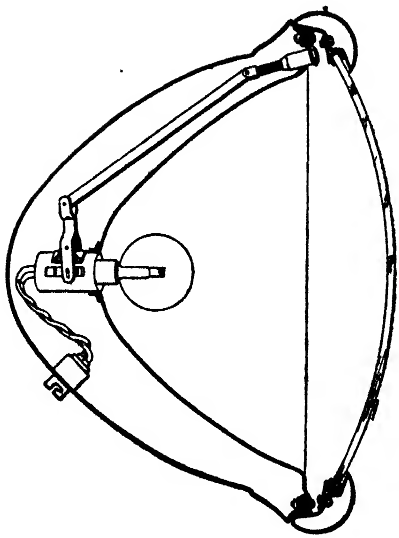


Fig. 20. Section of Fig 19

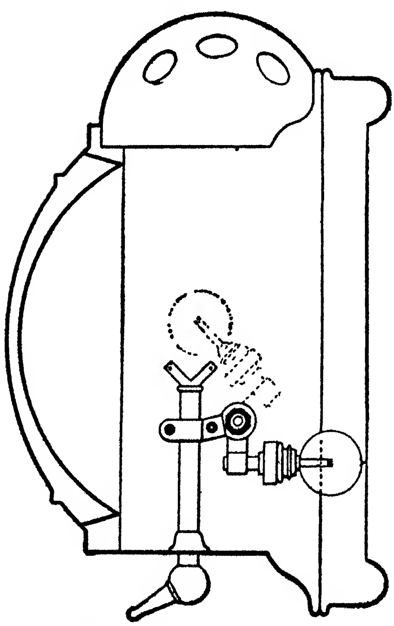


Fig. 21. Early Type of Reflector

the battery. If there is trouble in the stop-light system, it can usually be traced to the switch mechanism. The pull wire may have been broken and the lamp will not light. The pull-off spring may become weak, preventing the operation of the switch and cause the lamp to burn continuously. When the lamp is being installed, it is best to make connection to some current supply point outside of the battery. If attached to the battery, the wires will soon corrode and break off at the battery terminals.

Reflectors. Much attention has been directed to the problem of defining the best type of reflectors for automobile headlights, and the conditions of lighting by acetylene gas have been determined to be very different from those involved when electric lighting is used.

Parabolic Type. A typical electric headlight for automobile use is that illustrated in Fig. 19. The plain form affords a minimum tendency to catch dirt and mud and greatly simplifies cleaning. The position of the lamp is adjusted to give correct focus, as this is essential to give a properly projected beam of light ahead on the road.

Comparison of Parabolic with Lens Type. The reflector in the foregoing lamp is of the deeply parabolic metal type, illustrated in Fig. 20. The advantage of this type of reflector is that it intercepts a much larger proportion of the light rays from the lamp than the lens-mirror type of reflector, Fig. 21.

Types for Various Locations. Fig. 22 *-a, -b, -c, -d,* and *-i* show the usual types of lamps employed. These are, in the order given, an outside side lamp, flush-type side lamp, two types of electric tail lamps, and a cowl or dash lamp for illuminating the instruments, such as the ammeter, oil telltale, and the like. Fig. 22-*f* shows a magnetic trouble-hunting lamp, the base of which attaches itself to any metal part of the chassis.

Headlight Glare. The increased efficiency of electric headlights has brought with it, in far more aggravated degree, the blinding

Fig 22 Types of Side, Dash, Tail, and Trouble-Hunting Lamps

glare first experienced with the acetylene lamps. Originally, strong headlights bothered pedestrians; but since the introduction of electric lighting, they have been objected to most strongly by automobilists themselves, because to the driver of an automobile, the blinding glare from the headlights of an approaching car means not only annoyance but danger. Acuteness of vision is wholly destroyed for a period of thirty seconds or more during which only a slow-down to a walking pace will insure absolute safety to the automobilist, as a pedestrian or the usual black and lampless buggy are practically invisible.

Dimming Devices. Owing to the fact that glare and illumination are so closely related and that there is no objection to glare on

Fig. 23. Type of Headlight Dimming Switch

deserted country roads where the necessity for road illumination is greatest, permanently dimmed lights are naturally not practicable.

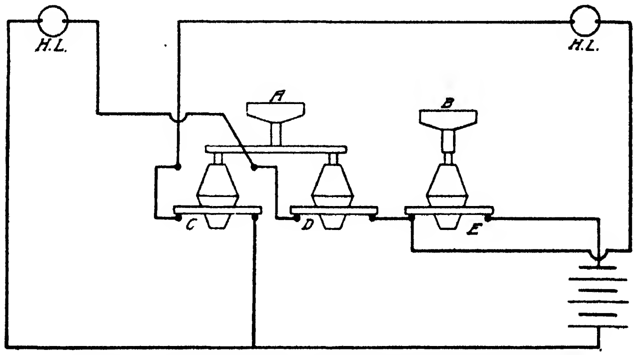


Fig. 24. Wiring Diagram of Parallel Control for Headlights
Courtesy of Horseless Age, New York City

What is required is a device under the control of the driver, so that either the full illuminating power of the head lamps or a subdued or dispersed light, free from glare, may be had as required.

A great many fundamentally different devices have been offered as a solution of the problem. While differing radically, practically

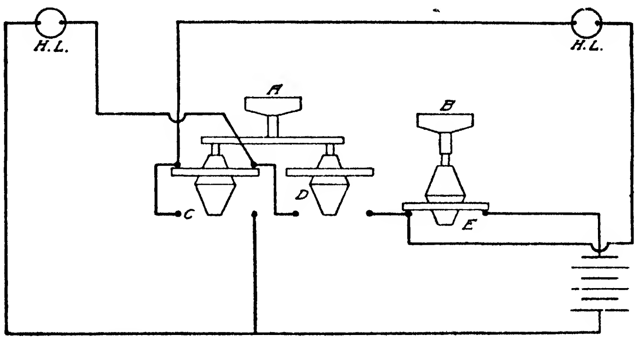


Fig. 25. Wiring Diagram of Series Control for Dimming Headlights
Courtesy of Horseless Age, New York City

all of them may be classed under two heads, i.e., electrical and mechanical.

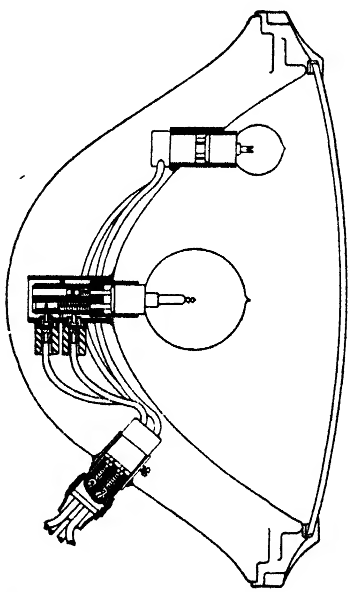


Fig. 26. Section of Hall Double Headlight

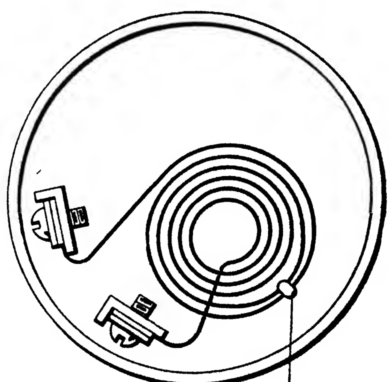


Fig. 27. Variable Dimming Resistance

Electrical Devices. One of the simplest of this class that has met with considerable favor is nothing more nor less than a *resistance* that may be inserted in the circuit of the headlights by turning a small switch, mounted either on the steering wheel or in some other easily accessible location. This cuts the voltage down and causes the lamps to burn a dull red, instead of the filaments being the dazzling white reached at full incandescence. A dimmer of this type is shown in Fig. 23. An equally simple and practical device is a switch to throw the headlights into series for a dim light and back into parallel again when full illumination is desired. With the series connection, the current must pass through both lamps successively and each bulb thus receives but half the voltage and, as even a comparatively slight drop in voltage causes the efficiency of an incandescent lamp to fall off very markedly, the same result is attained. It is equivalent to burning a 6-volt lamp on a 3-volt current. With the normal, or parallel, connection, the current flows through each lamp separately, and both receive the full voltage of the battery so that they burn at full brilliance. A switch of this kind is marketed by the Cutler-Hammer Company. Fig. 24 illustrates the connection for parallel arrangement, or full illumination, switches *D* and *B* being closed and the button *A* pulled out to make *C* contact with its lower set of connections. Fig. 25 shows the connections for series burning, effected by pulling out button *B* and pushing in *A*, this closing switch *E*, opening *D*, and contacting *C* with the upper connections.

The use of *two bulbs in each headlight* is also commonly resorted to, the method of effecting this being shown in Fig. 26. The second bulb is of the size ordinarily employed for side lights and is, moreover, entirely out of the focus of the reflector, so that the diminished light produced is entirely without glare and is mostly diverted downward.

Inserting a resistance in the headlight circuit is also done to dim the headlights. Fig. 27 shows a method of adjusting the intensity of the dimmers. The coils are connected together by a piece of wire as shown. This cuts out some of the resistance and causes the lights to burn brighter. Any desired intensity may be secured by experimenting with the position of this jumper.

FORD MODEL "A" FINAL ASSEMBLY LINE
Courtesy of Ford Motor Company

WIRING DIAGRAMS AND DATA SHEETS

INTRODUCTION

Since a great number of abbreviations are used on each of the data pages, a short explanation regarding the abbreviations will be in order and make perfectly clear the material which it is intended these data pages should convey. The first part dealing with the name of the car, model and year, or years, in which it was produced, is entirely clear, as is also the material with reference to the make of starting, generating and ignition systems.

Under the heading of "Generators," regulation may be of several kinds. The majority of cars, however, use the standard *third brush type* of regulation. Several makes of cars use methods of regulation other than the third brush type, such as the *relay regulation* type and that known as the "*inherent*" or "*bucking coil*" type.

The maximum charging rate is that with a normal setting of the regulator and taken when the generator is cold. The maximum armature speed at which the maximum charging rate is given is also shown on the data sheet.

A reference to the speed at which the relay points close is given. This speed is armature speed and where this cannot be given, the miles per hour of the car is given at the point of relay point closing. The air gap is always measured with the contact points closed.

On a large number of cars a *relay* is not used, the circuit being closed by the *ignition switch* when the switch is turned to the "on" position.

The *direction of rotation* of the starter is always determined from the *commutator end* and is thus recorded in all cases on the wiring diagram.

The standard method of indicating *firing orders* is used, and where given in connection with the V-type engine, the letters "R" and "L" refer to the *right* and *left* sides of the engine as determined from the *driver's position.* This corresponds in all cases to the material furnished by manufacturers. Some abbreviations are used with reference to *ignition timing.* The letters "TDC" refer to *top dead center* whenever used and when such a phrase as "TDC at retard" is used, it means that the *ignition advance* and *retard control* is set in *retard* position and the *contacts* are just starting to open when the *piston* of the firing cylinder is at *top dead center.* Methods of securing this position are carefully outlined. In some cases, the *number of degrees* or *inches* before *top dead center* are given, and this position can be determined from the marks on the *flywheel.* Wherever letters such as "IN-OP-6" appear, it means that these letters are stamped on the *rim* of the *flywheel* and that they must be brought in line with an *indicator* when the contacts start to open, the spark control being set at retard. In some cases, the letters "UD" are stamped on the rim of the flywheel. Also, "45" and "RET."

The bore and stroke of the engine are always given in inches and the taxable horsepower is also given on the data sheet. This material is useful when making out applications for State taxes and license plates. The *valve tappet clearance* is given in *thousandths* of an inch and should be *measured* only when the engine is *hot.*

In most cases, the make of the carburetor is given. In one case, a Zenith-Duplex carburetor is used and is indicated by "Zenith-Dup."

The width and diameter of the piston ring is given and the gap distance is also shown. This material is very useful when ordering oversized rings and also judging the amount of wear which has taken place on the piston rings where renewal of the rings is considered.

The *capacity* of the *oiling system* is given in *quarts* and the *type* indicated is based upon the standard nomenclature of *lubricating systems.* "Press" indicates a system where the *oil* is lifted from the *oil sump* by the *pump* and *forced up* to the *main bearings,* the overflow from these bearings running into oil troughs, which supply the *connecting rods* and other parts of the engine. The *pump* may be of either the *gear, vane* or *plunger* type. In some cases, the pressure is even carried to the *camshaft* and *piston pin bearings.* A recent modern tendency is to extend this pressure to the *hollow rocker arm* bearings on the overhead valve motors. Wherever the

CHART OF ABBREVIATIONS

GENERAL

Amps.—Amperes
V.—Volts
C. P.—Candle Power
Bat. to Frame Con.—Battery to Frame Connection
U. S. L.—United States Lighting
R. & L. of Firing Order—Right and left determined from driver's seat
Max. Chg. Rate—Maximum Charging Rate
R. P. M.—Revolutions per Minute
M. P. H.—Miles per Hour
Thermo—Thermosyphon Cooling
Zenith-Dup.—Zenith-Duplex

IGNITION

T. D. C. at Retard—Top Dead Center; Spark Control Retarded
½ Advance at T. D. C.—Spark Control ½ Advanced, Piston at T. D. C.
12° past T. D. C.—Piston 12° past T. D. C. Spark Control Retarded
2½" before T. D. C.—Piston 2½", on Flywheel, before T. D. C.
"Ret" at Retard—Marks "Ret" on Flywheel
1" B. H. C. on F. W.—"T. D. C." on Flywheel 1" before T. D. C.
"Spark" at Rt. Sup.—"Spark" on Flywheel at Right Engine Support
"IN-OP-6" at Retard, "UD" at Retard—Marks on Flywheel at Indicator, Spark Control Retarded
"45" at T. D. C.—Adv.—Marks on Flywheel at Indicator, Spark Control Advanced

LUBRICATION SYSTEM

Cap.—Capacity
Qt.—Quart
Press.—Pressure to Main Bearings
Splash.—Pressure Circulating Splash
Splash—Connecting Rod Dips

CLUTCH

Disc—Multiple disc, either wet or dry
Cone—Cone
R-Cone—Reverse Cone
Plate—Single or Double Plate Type

TRANSMISSION

D. G. & M.—Detroit Gear and Machine Company

REAR AXLE

Semi—Semi-Floating
¾ Flt.—Three-quarters Floating
Full Flt.—Full Floating

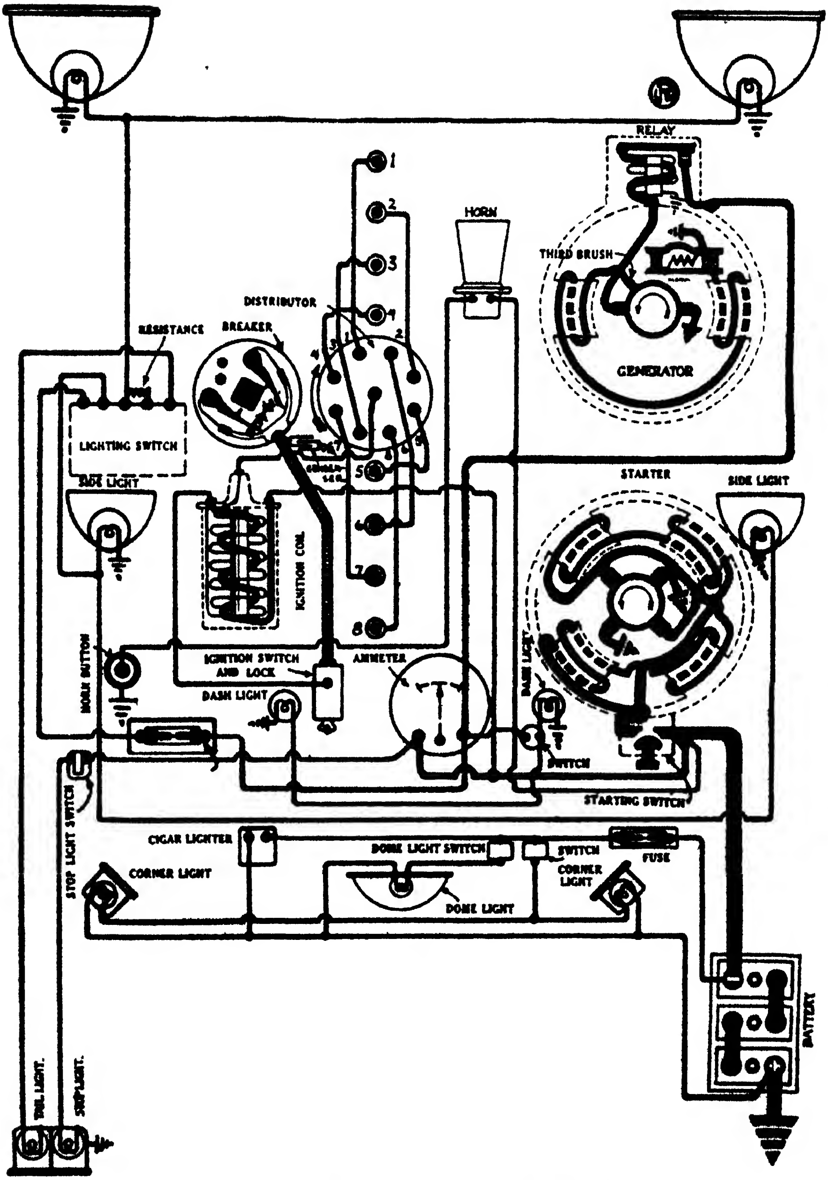
BRAKES

Front—Front Wheels
Rear—Rear Wheels
Hand—Hand Brake
Trans.—Transmission Brake

abbreviation "Splash. Press." appears, it indicates that the "Circulating System" is used, in which case the oil is merely circulated to the oil troughs, either by means of a *pump* or by the *flywheel,* no effort being made to maintain a pressure at any of the bearings.

The *size* and *type* of *clutch* is indicated, the size of the disc being shown in *inches* for the outside diameter and thickness. The word "disc" refers to the *multiple disc type* and may be either *dry* or *running* in oil. The word "plate" refers to the *single plate* type or *double plate* type of clutch. The word "cone" refers to the *cone* clutch and when preceded by the letter "R" means that it is of the *reversed cone* type. The *gear ratio* has to do with the *final drive* and, in all cases, the number given indicates the number of revolutions that the motor must make in order to turn the rear wheels one complete revolution when in high gear. A great many manufacturers give a choice between two gear ratios, the *lower gear ratio* generally being used with the *closed* and *heavier* models.

Wherever four-wheel brakes are used, the thickness, length, and width, of the brake lining will be given for each of the brakes. Under the heading of "Front" will be the dimensions of the brake lining given for front-wheel brakes; under the heading of "Rear" will be the dimensions for the brake linings given for brakes on the rear wheel and the dimensions for the "hand brakes" is given under that title. Where transmission brakes are used, the word "Transmission" will be written in either under hand brake or rear brake. Where there are no dimensions shown, the information is not available or the type of brake above the vacant space is not fitted on the car in question.



AUBURN WIRING DIAGRAM, 1928, MODEL 115

Reproduced from National Service Manual by permission of National Automotive Service

Auburn Model 115 Year 1928

Delco-Remy Starter & Generator Delco-Remy Ignition

Regulation — Max. Chg. rate and speed

Third Brush — 12 amp. hot, 21 cold, 1450 r.p.m.

RELAY Air Gap	Contact Gap	Cut-in R.P.M.
.014" - .018"	.015" - .025"	600 r.p.m.

BATTERY U.S.L. Type XX-15E6 Volts 6 Amps 104

Bat. to Frame Con. Positive CONTACT BREAKER Gap .018" - .024"

Firing Order 1-6-2-5-8-3-7-4 Ignition Timing 6° - 7° A.T.D.C. ret.

SPARK PLUG		ENGINE		Taxable Hp.
Size 7/8"	Gap .025"	Bore 3-1/4"	Stroke 4-1/2"	33.80

INTAKE VALVE TIMING		EXHAUST VALVE TIMING	
Open T.D.C.	Close 45° A.B.D.C.	Open 50° B.B.D.C.	Close 10° A.T.D.C.

VALVE CLEARANCE Hot Intake .006" Exhaust .008"

CARBURETOR	COOLING SYSTEM		OILING SYSTEM	
Schebler	Type Pump	Cap. 25 Qt.	Type Force	Cap 8 Qt.

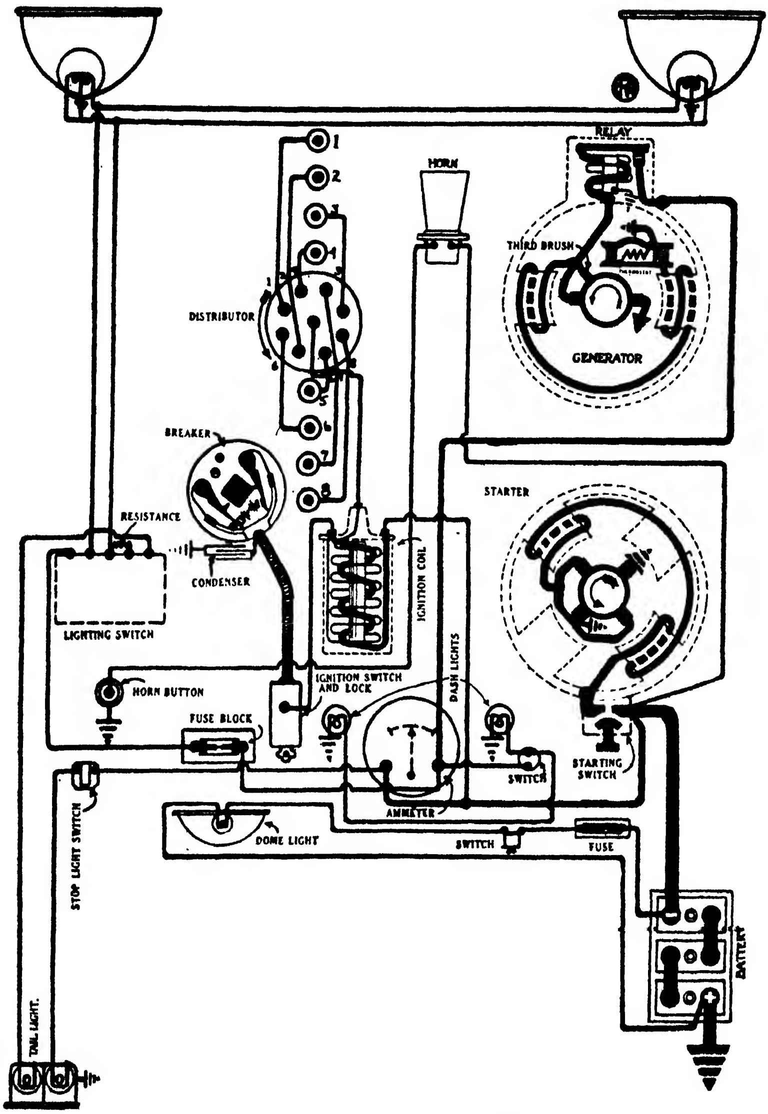
PISTON RING: Width 1/8" Comp. 3/16" Oil Diam. 3-1/4" Gap .012"

CLUTCH Long #10-A Dry Single Pl. GEAR RATIO 4.45 AXLE Semi-floating

BRAKES

Front	Rear	Hand
5/32"x1¾"x25" per wheel	5/32"x1¾"x25" per wh.	3/16"x2"x23" total

Lighting	Headlights	Dash & Tail	Side Lamps
Single Contact	21 C.P.	3 C.P.	3 C.P.



AUBURN WIRING DIAGRAM, 1928, MODEL 88

Reproduced from National Service Manual by permission of National Automotive Service

Auburn Model 88 Year 1928

Delco-Remy Starter & Generator Delco-Remy Ignition

Regulation	Max. Chg. rate and speed
Third Brush	9-12 amp.hot,19-21 cold,1450 r.p.m.

RELAY Air Gap	Contact Gap	Cut-in R.P.M.
.014" - .018"	.015" - .025"	600 r.p.m.

BATTERY U.S.L. Type XY-13X6 Volts 6 Amps 87

Bat. to Frame Con. Positive CONTACT BREAKER Gap .018" - .024"

Firing Order 1-6-2-5-8-3-7-4 Ignition Timing 6° -7° A.T.D.C. ret.

SPARK PLUG	ENGINE		Taxable Hp.
Size 7/8" Gap .025"	Bore 2-7/8"	Stroke 4-3/4"	26.45

INTAKE VALVE TIMING		EXHAUST VALVE TIMING	
Open T.D.C.	Close 45° A.B.D.C.	Open 50° B.B.D.C.	Close 10° A.T.D.C.

VALVE CLEARANCE Hot Intake .006" Exhaust .008"

CARBURETOR	COOLING SYSTEM	OILING SYSTEM
Schebler	Type Pump Cap. 20 Qt.	Type Force Cap. 7 Qt.

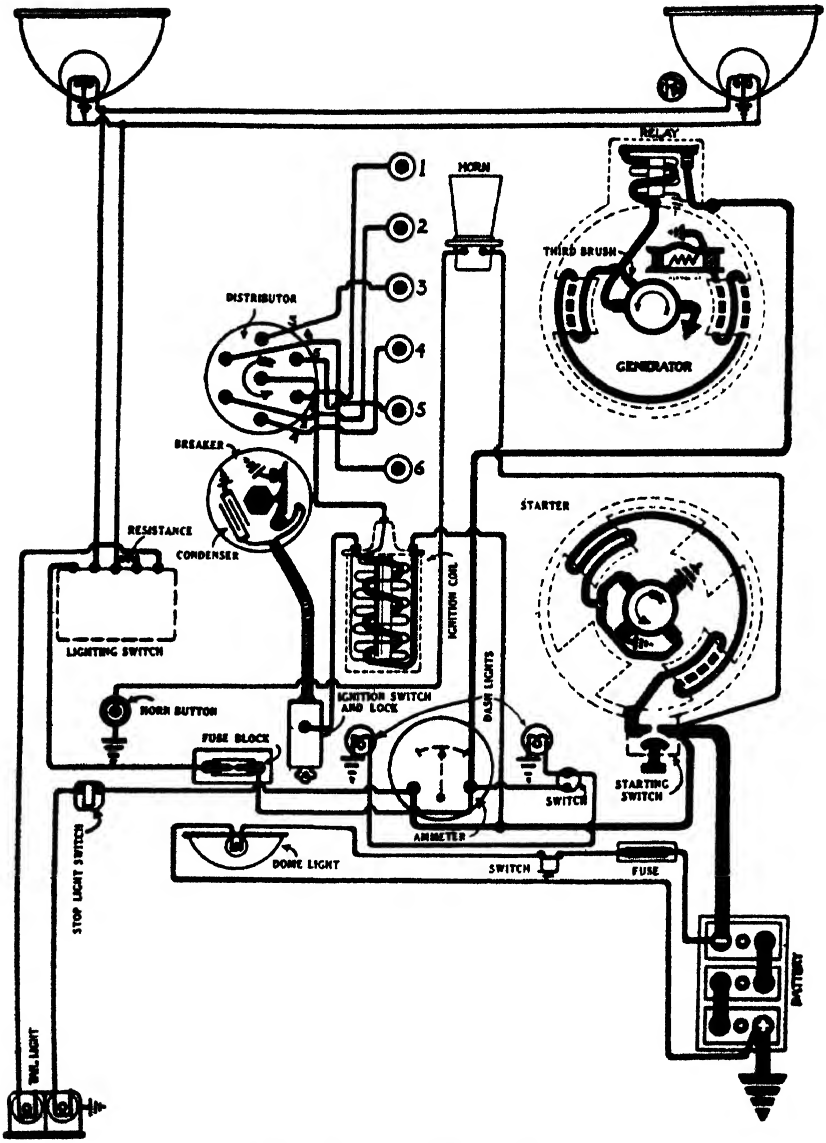
PISTON RING: Width 1/8" Diam. 2-7/8" Gap .012"

CLUTCH Long #9C GEAR RATIO 4.7 AXLE Semi-floating

BRAKES

Front	Rear	Hand
5/32"x1¾"x21" per wheel	5/32"x1¾"x21" per wh.	5/32"x2"x23" Total

Lighting	Headlights	Dash & Tail	Side Lamps
Single Contact	21 C.P.	3 C.P.	3 C.P.



AUBURN WIRING DIAGRAM, 1928, MODEL 76

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Auburn ... Model 76 ... Year 1928

Delco-Remy ... Starter & Generator ... Delco-Remy ... Ignition

Regulation — Max. Chg. rate and speed

Third Brush ... 9-12 amp. hot, 19-21 cold, 1450 r.p.m.

RELAY Air Gap — Contact Gap — Cut-in R.P.M.

.014" - .018" ... .015" - .025" ... 600 r.p.m.

BATTERY ... U.S.L. ... Type XY-13X6 ... Volts 6 ... Amps 87

Bat. to Frame Con. Positive ... CONTACT BREAKER Gap .018" - .024"

Firing Order 1-5-3-6-2-4 ... Ignition Timing 6° - 7° A.T.D.C. ret.

SPARK PLUG — ENGINE — Taxable Hp.

Size 7/8" Gap .025" ... Bore 2-7/8" Stroke 4-3/4" ... 19.84

INTAKE VALVE TIMING — EXHAUST VALVE TIMING

Open T.D.C. Close 45° A.B.D.C. ... Open 50° B.B.D.C. Close 10° A.T.D.C.

VALVE CLEARANCE Hot ... Intake .006" ... Exhaust .008"

CARBURETOR — COOLING SYSTEM — OILING SYSTEM

Schebler ... Type Pump Cap. 19 Qt. ... Type Force Cap. 6 Qt.

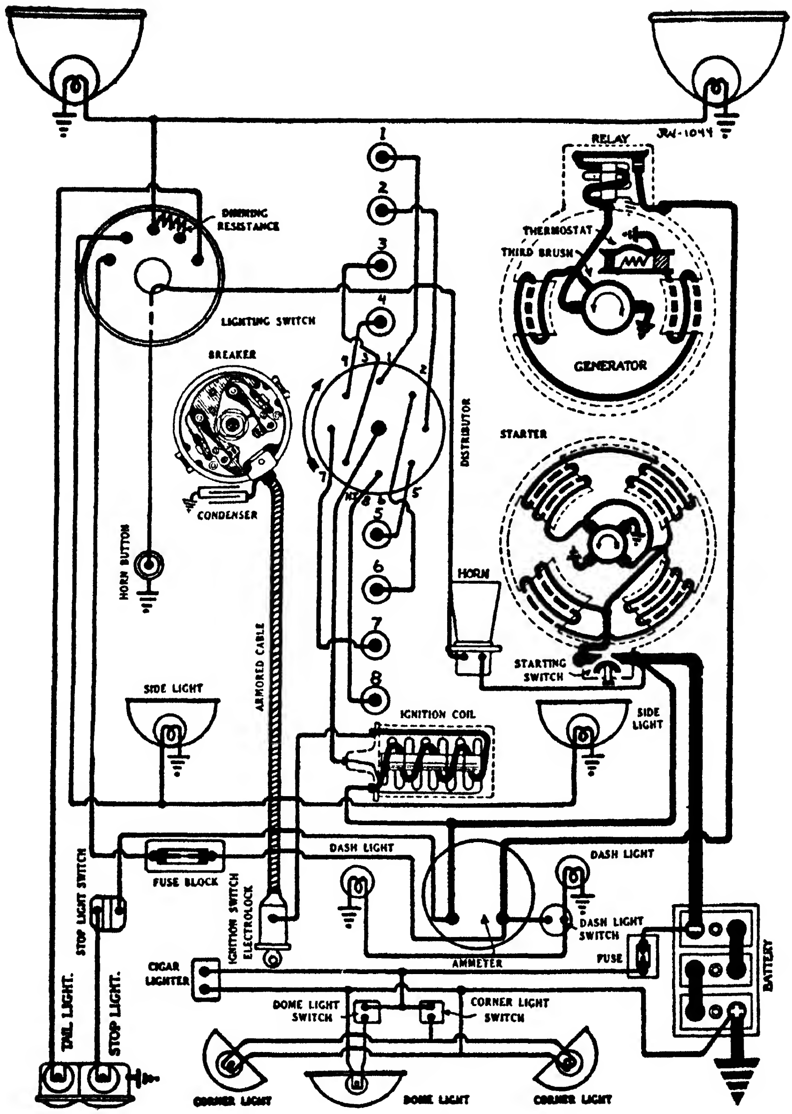
PISTON RING: Width 1/8" ... Diam. 2-7/8" ... Gap .012"

CLUTCH S.P. Dry ... GEAR RATIO 4.9 ... AXLE Semi-floating
Long #8 F

BRAKES

Front	Rear	Hand
5/32"x1¾"x21" per wheel	5/32"x1¾"x21" per wh.	5/32"x2"x18" total

Lighting	Headlights	Dash & Tail	Side Lamps
Single Contact	21 C.P.	3 C.P.	-- C.P.



AUBURN WIRING DIAGRAM, 1929, MODEL 120

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Auburn Model 120 Year 1929

Delco-Remy Starter & Generator Delco-Remy Ignition

Regulation — Max Chg rate and speed

Third Brush — 12 amp.hot,21 cold, 1450 r.p.m.

RELAY Air Gap	Contact Gap	Cut in R P M
.014"- .018"	.015" - .025"	600 R.P.M.

BATTERY U.S.L. Type XY-15X6 Volts 6 Amps 104

Bat to Frame Con Positive CONTACT BREAKER Gap .018" - .024"

Firing Order 1-6-2-5-8-3-7-4 Ignition Timing 6° - 7° A.T.D.C. ret.

SPARK PLUG		ENGINE		Taxable Hp
Size 7/8"	Gap .025"	Bore 3-1/4"	Stroke 4-1/2"	33.80

INTAKE VALVE TIMING		EXHAUST VALVE TIMING	
Open T.D.C.	Close 45°A.B.D.C.	Open 50°B.B.D.C.	Close 10°A.T.D.C.

VALVE CLEARANCE Hot Intake .006" Exhaust .008"

CARBURETOR	COOLING SYSTEM		OILING SYSTEM	
Schebler	Type Pump	Cap 25 Qt.	Type Force	Cap 8 Qt.

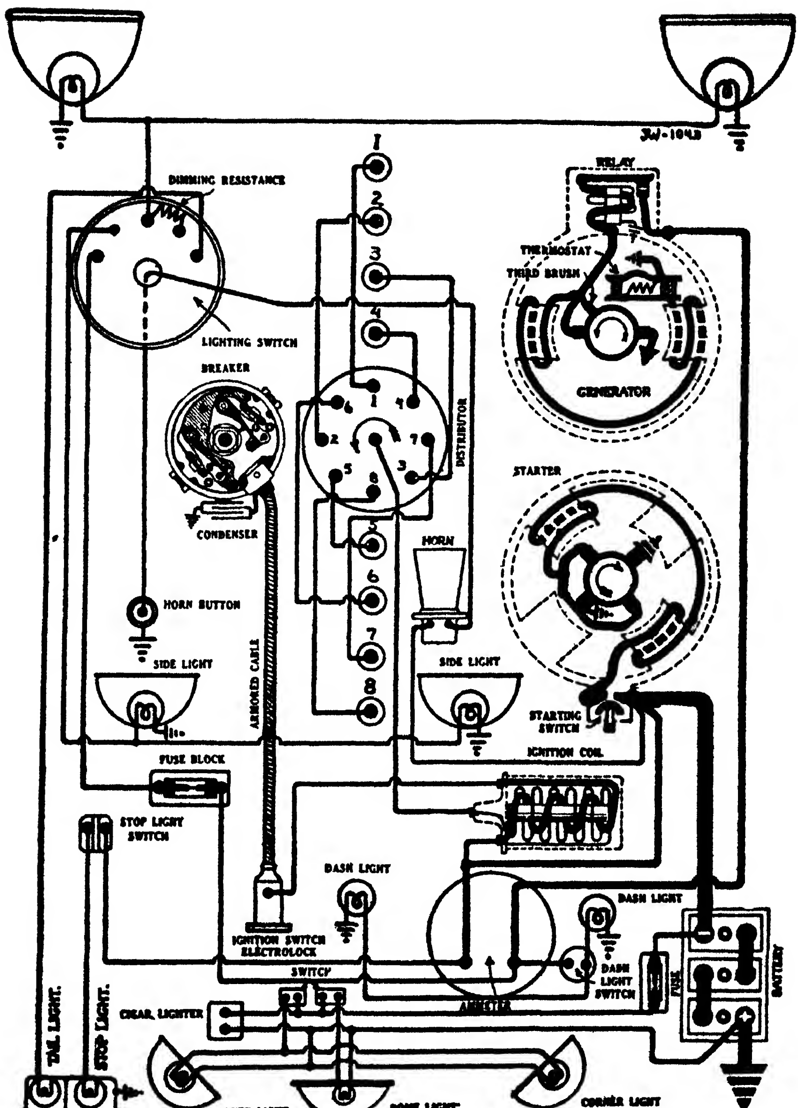
PISTON RING Width 1/8" Diam 3-1/4" Gap .012"

CLUTCH Long #28 AM Double Pl.Dry GEAR RATIO 4.45 AXLE Semi-floating

BRAKES

Front	Rear	Hand
5/32"x1¾"x25" per wheel	5/32"x1¾"x25" per wh.	3/16"x2½"x22¾" total

Lighting		Headlights		Dash & Tail		Side Lamps	
Single	Contact	21	C P	3	C P	3	C P.



AUBURN WIRING DIAGRAM, 1929, MODEL 8-90

Reproduced from National Service Manual by permission of National Automotive Service

Auburn Model 8-90 Year 1929

Delco-Remy Starter & Generator Delco-Remy Ignition

Regulation: Third Brush

Max Chg rate and speed: 12 amp, hot, 21 cold, 1450 r.p.m.

RELAY Air Gap .014" - .018" Contact Gap .015" - .025" Cut-in R P M 600 r.p.m.

BATTERY U.S.L. Type XY-13X6 Volts 6 Amps 87

Bat to Frame Con Positive

CONTACT BREAKER Gap .018" - .024"

Firing Order 1-6-2-5-8-3-7-4

Ignition Timing 6° - 7° A.T.D.C. ret.

SPARK PLUG Size 7/8" Gap .025"

ENGINE Bore 2-7/8" Stroke 4-3/4"

Taxable Hp 26.45

INTAKE VALVE TIMING Open T.D.C. Close 45°A.B.D.C.

EXHAUST VALVE TIMING Open 50°B.B.D.C. Close 10°A.T.D.C.

VALVE CLEARANCE Hot Intake .006" Exhaust .008"

CARBURETOR Schebler

COOLING SYSTEM Type Pump Cap 22 Qt.

OILING SYSTEM Type Force Cap 7 Qt.

PISTON RING. Width 1/8". Diam 2-7/8" Gap .012"

CLUTCH Long #9 C Dry Single Pl.

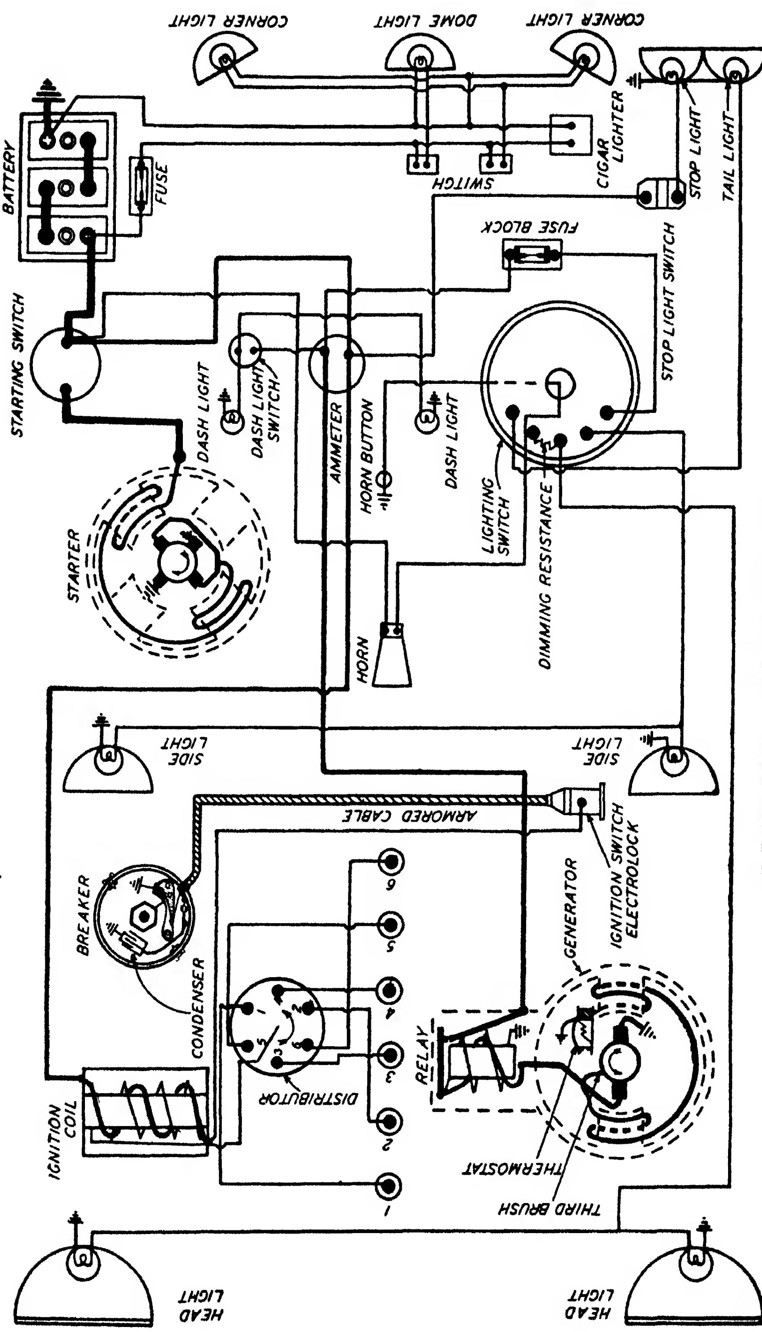
GEAR RATIO. 4.45

AXLE Semi-floating

BRAKES

Front	Rear	Hand
5/32"x1¾"x21" per wheel	5/32"x1¾"x21" per wh.	5/32"x2"x24-5/8" Total

Lighting	Headlights	Dash & Tail	Side Lamps
Single Contact	21 C P.	3 C P.	3 C P.



AUBURN WIRING DIAGRAM, 1929, MODEL 6-80

Reproduced from National Service Manual by permission of National Automotive Service

Auburn Model **6-80** Year **1929**

Delco-Remy Starter & Generator **Delco-Remy** Ignition

Regulation — Max Chg rate and speed

Third Brush — **12 amp.hot,21 cold,1450 r.p.m.**

RELAY Air Gap	Contact Gap	Cut in R P M
.014" - .018"	.015" - .025"	600 R.P.M.

BATTERY **U.S.L.** Type **XY-13X6** Volts **6** Amps **87**

Bat to Frame Con **Positive** CONTACT BREAKER Gap **.018" - .024"**

Firing Order **1-5-3-6-2-4** Ignition Timing **6° - 7° A.T.D.C. ret.**

SPARK PLUG	ENGINE	Taxable Hp
Size **7/8"** Gap **.025"**	Bore **2-7/8"** Stroke **4-3/4"**	**19.84**

INTAKE VALVE TIMING	EXHAUST VALVE TIMING
Open **T.D.C.** Close **45° A.B.D.C.**	Open **50°B.B.D.C.** Close **10°A.T.D.C.**

VALVE CLEARANCE **Hot** Intake **.006"** Exhaust **.008"**

CARBURETOR	COOLING SYSTEM	OILING SYSTEM
Schebler	Type **Pump** Cap **19 Qt.**	Type **Force** Cap **6 Qt.**

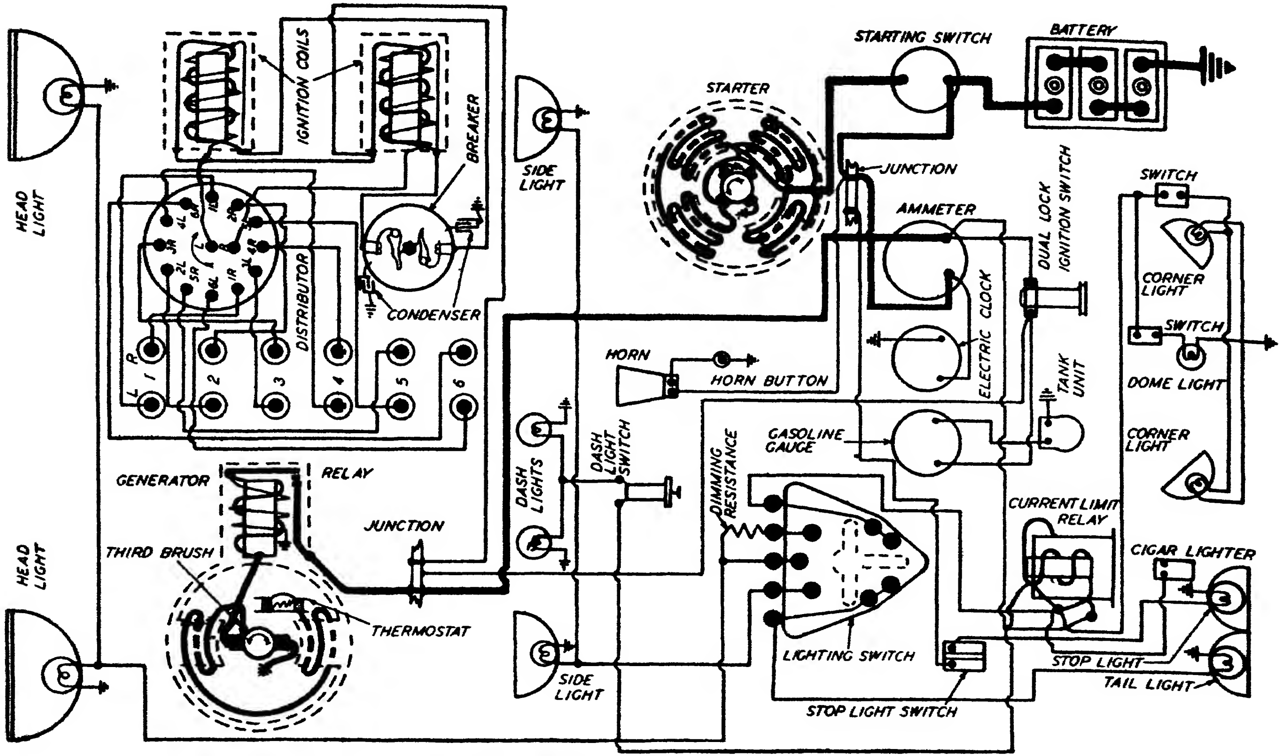
PISTON RING Width **1/8"** Diam **2-7/8"** Gap **.012"**

CLUTCH **Long #8 FI Dry Single Pl.** GEAR RATIO **4.9** AXLE **Semi-floating**

BRAKES

Front	Rear	Hand
5/32"x1¾"x21" per wheel	5/32"x1¾"x21" per wh.	5/32"x2"x18-9/16" Total

Lighting	Headlights	Dash & Tail	Side Lamps
Single Contact	**21** C P	**3** C P	**3** C P



BLACKHAWK WIRING DIAGRAM 1929 MODEL L-6

Reproduced from National Service Manual by permission of National Automobile Service

Blackhawk Model L-6 Year 1929

Delco-Remy Starter & Generator Delco-Remy Ignition

Regulation / Max. Chg. rate and speed

Third Brush / 9-12 amps. 2000 r.p.m.

RELAY Air Gap / Contact Gap / Cut-in R.P.M.

.019" - .025" / .012" - .030" / 575 r.p.m.

BATTERY Prest-O-Lite Type 615 J Volts 6-8 Amps. 120

Bat. to Frame Con. Negative CONTACT BREAKER Gap .017"

Firing Order 1-5-3-6-2-4 Ignition Timing 15° B.T.D.C. full adv.

SPARK PLUG / ENGINE / Taxable Hp.

Size 7/8" Gap .022" Bore 3-3/8" Stroke 4-1/2" 27.3

INTAKE VALVE TIMING / EXHAUST VALVE TIMING

Open 7° A.T.D.C. Close 47° A.T.D.C. Open 49° B.T.D.C. Close 7° A.T.D.C.

VALVE CLEARANCE Hot Intake .028" Exhaust .028"

CARBURETOR / COOLING SYSTEM / OILING SYSTEM

Zenith Duplex 105DC Type Pump Cap. 6 Gal. Type Press Cap. 9 Qts.

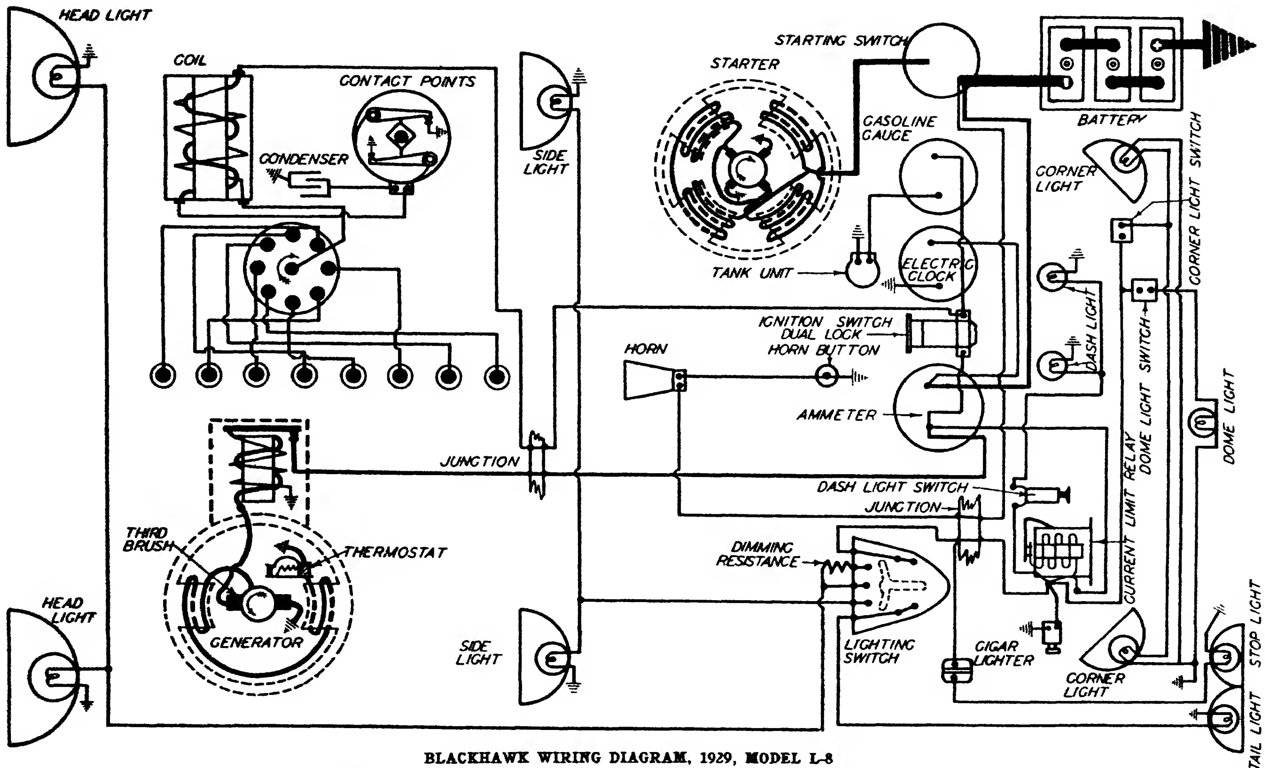
PISTON RING: Width Oil 3/16" Comp 1/8" Diam. 3-3/8" Gap .012"

CLUTCH Single Plate 6½x10-7/8x1/8" GEAR RATIO 4.75 AXLE Semi-floating

BRAKES

Front	Rear	Hand
36¼"x1¾"x3/16" (4 pcs)	36¼"x1¾"x3/16" (4 pcs)	20"x2¼"x1/8" (1 pc)

Lighting	Headlights	Dash & Tail	Side Lamps
Single Contact	32 C.P.	3 C.P.	3 C.P.



BLACKHAWK WIRING DIAGRAM, 1929, MODEL L-8

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Blackhawk ...... Model L-8 ...... Year 1929

Delco-Remy ...... Starter & Generator ...... Delco-Remy ...... Ignition

Regulation — Max. Chg. rate and speed

Third Brush ...... 10-12 amps, 1500 r.p.m.

RELAY Air Gap — Contact Gap — Cut-in R.P.M.

.019" - .025" ...... .012" - .030" ...... 500 r.p.m.

BATTERY Prest-O-Lite ...... Type 615 J ...... Volts 6-8 ...... Amps 120

Bat. to Frame Con. Negative ...... CONTACT BREAKER Gap .017"

Firing Order 1-6-2-5-8-3-7-4 ...... Ignition Timing 10° A.T.D.C. full adv.

SPARK PLUG — ENGINE — Taxable Hp.

Size 7/8" ...... Gap .022" ...... Bore 3" ...... Stroke 4-3/4" 28.8

INTAKE VALVE TIMING — EXHAUST VALVE TIMING

Open 8° A.T.D.C. ...... Close 40° A.B.D.C. ...... Open 40° A.B.D.C. ...... Close 8° A.T.D.C.

VALVE CLEARANCE Hot ...... Intake .012" ...... Exhaust .012"

CARBURETOR — COOLING SYSTEM — OILING SYSTEM

Zenith Duplex 105DC ...... Type Pump ...... Cap 6½ Gal. ...... Type Press ...... Cap 7 Qts.

PISTON RING: Width Comp 1/8" Oil 3/16" ...... Diam 3" ...... Gap .010"

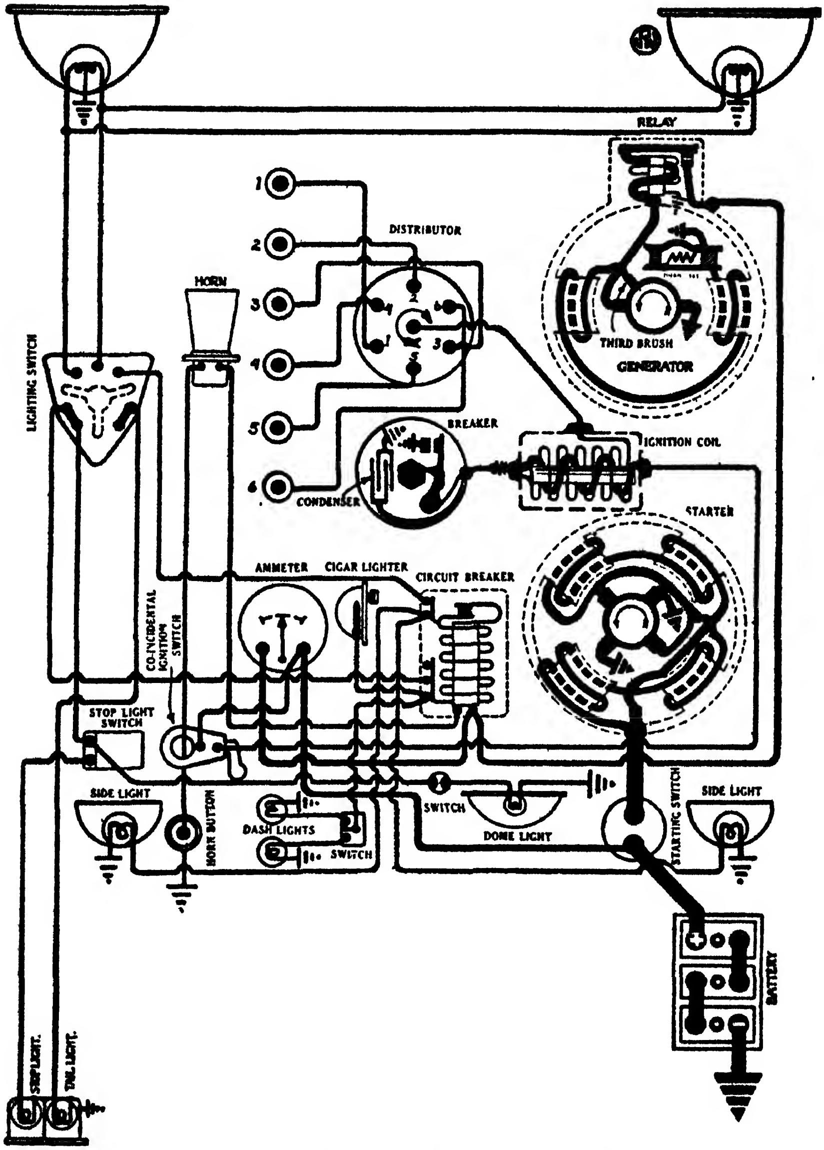
CLUTCH Single Plate 6¾x10-1/8x1/8" ...... GEAR RATIO 4.75 ...... AXLE Semi-floating

BRAKES

Front	Rear	Hand
36½"x1¾"x3/16" (4 pcs)	36½"x1¾"x3/16" (4 pcs)	20"x2¼"x1/8" (1 pc)

Lighting — Headlights — Dash & Tail — Side Lamps

Single ...... Contact ...... 32 ...... C.P. ...... 3 ...... C.P. ...... 3 ...... C.P.



BUICK WIRING DIAGRAM, 1927-28, MODELS 120 AND 128 W.B.
Reproduced from National Service Manual by permission of National Automotive Service

Buick Model 120 - 128 W.B. Year 1927-28

Delco Starter & Generator Delco Ignition

Regulation Max Chg rate and speed

Third Brush 18 - 20 amps. 1425 r.p.m.

RELAY Air Gap Contact Gap Cut-in R P M

.019"- .025" .018" - .026" 725

BATTERY Exide Type 3XC-15-1 Volts 6 Amps 105

Bat to Frame Con Negative CONTACT BREAKER Gap .020"

Firing Order 1-4-2-6-3-5 Ignition Timing 17° B.T.D.C. full adv.

SPARK PLUG ENGINE Taxable Hp

Size 7/8" Gap .025" Bore 3½" Stroke 4⅝" 29.4

INTAKE VALVE TIMING EXHAUST VALVE TIMING

Open 25°50' BTDC Close 81°10' ABDC Open 101°50' BBDC Close 45°10' ATDC

VALVE CLEARANCE Hot Intake .008" Exhaust .008"

CARBURETOR COOLING SYSTEM OILING SYSTEM

Marvel Type Pump Cap 4½ Gal Type Press Cap 6 Qts

PISTON RING Width 1/8" Diam 3½" Gap .006"-.008"-.012"

CLUTCH Mult. Disc 5¾ I.D. x 5/32" GEAR RATIO 4.54 & 4.73 AXLE Full floating

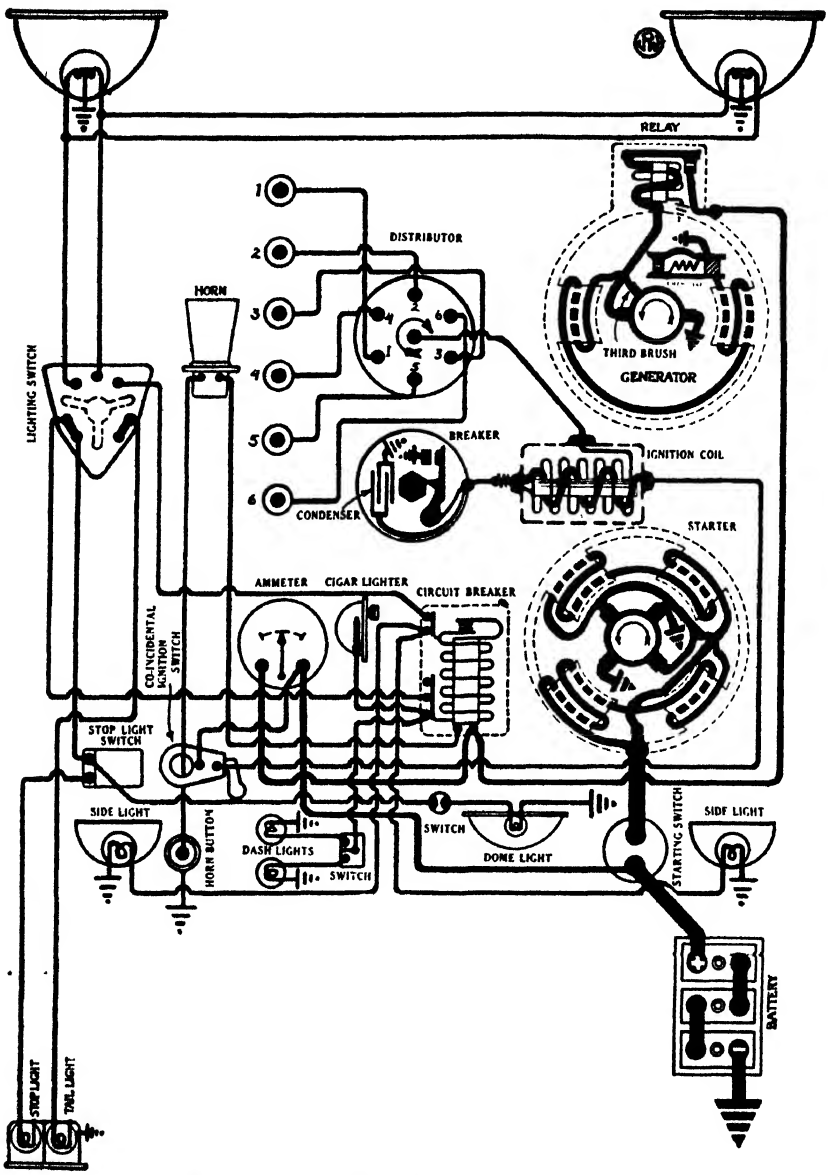
BRAKES

Front Rear Hand

3/16" x 2" x 13¾" (2 pcs) 3/16" x 2" x 13¾" (2 pcs) 5/32" x 1-5/8" x 10-11/16" (2 pcs)

Lighting Headlights Dash & Tail Side Lamps

. . Contact Dbl 21 C.P. Sgl 3 C.P. Sgl 3 C.P.



BUICK WIRING DIAGRAM, 1927-28, MODEL 114½ W.B.

Reproduced from National Service Manual by permission of National Automotive Service

Buick ......Model 114½ W.B. ......Year 1927-28

Delco ......Starter & Generator ...... Delco ......Ignition

Regulation ...... Max. Chg. rate and speed

Third Brush ...... 18-20 Amps, 1425 r.p.m.

RELAY Air Gap ...... Contact Gap ...... Cut-in R.P.M.

.019" -.025" ...... .018" - .026" ...... 725 r.p.m.

BATTERY ......Exide ......Type 3XC-13-1 ......Volts 6 ......Amps 90

Bat. to Frame Con. Negative ...... CONTACT BREAKER Gap .020"

Firing Order 1-4-2-6-3-5 ...... Ignition Timing 17°B.T.D.C. full adv.

SPARK PLUG ...... ENGINE ...... Taxable Hp.

Size 7/8" ......Gap .025" ...... Bore 3-1/8" ......Stroke 4-1/2" 23.4

INTAKE VALVE TIMING ...... EXHAUST VALVE TIMING

Open 25°50' BTDC ......Close 81°10' ABDC ...... Open 101°50' BBDC ......Close 45°10' ATDC

VALVE CLEARANCE ...... Hot ......Intake .008" ......Exhaust .008"

CARBURETOR ...... COOLING SYSTEM ...... OILING SYSTEM

Marvel ...... Type Pump ......Cap. 3½ Gal ...... Type Press ......Cap. 5 Qts.

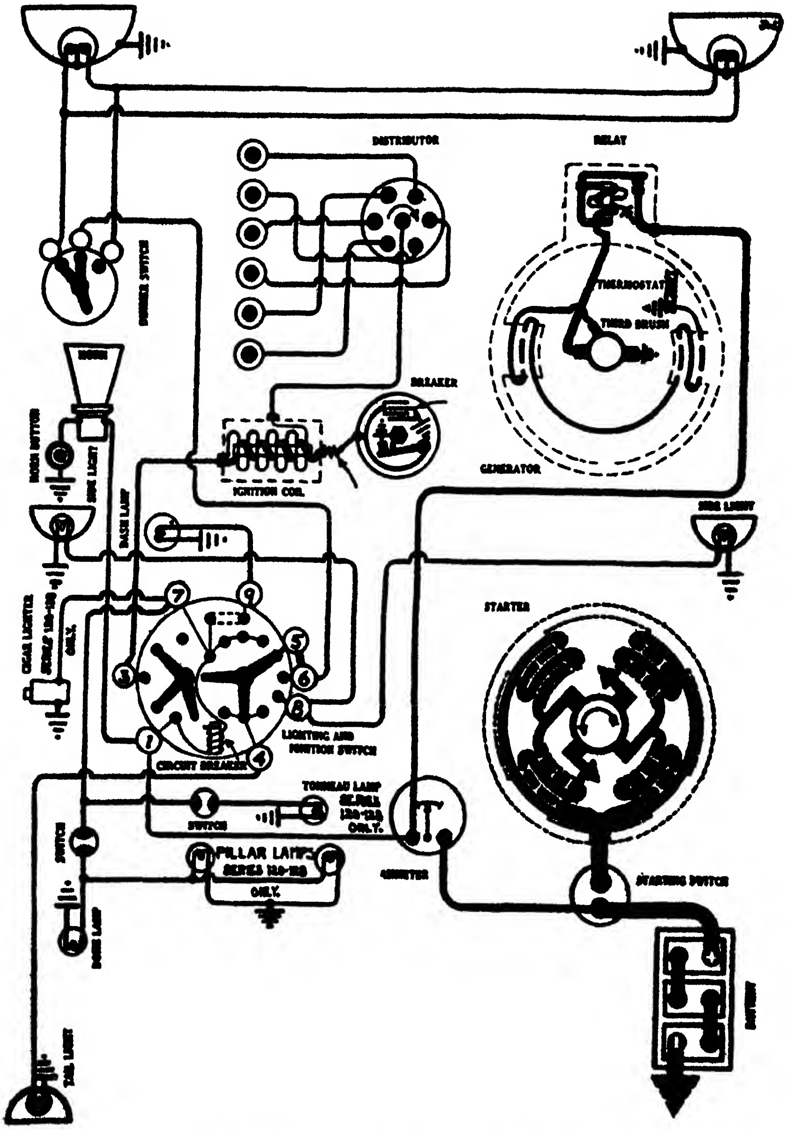
PISTON RING: Width 1/8" ...... Diam. 3-1/8" ......Gap .005"-.007"-.009"

CLUTCH Mult. Disc 5⅝ I.D.x1/8" ...... GEAR RATIO 4.9 ...... AXLE Three-quarter float.

BRAKES

Front	Rear	Hand
3/16"x1¾"x38-5/8" (2 pcs)	3/16"x1¾"x38-5/8" (2 pcs)	3/16"x1-3/8"x35-9/16" (2 pcs)

Lighting	Headlights	Dash & Tail	Side Lamps
......Contact	Dbl-21 ......C.P.	Sgl - 3 ......C.P.	Sgl - 3 ......C.P.



BUICK WIRING DIAGRAM, 1928, MODEL 115 W.B.
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Buick Model 115 W.B. Year 1928

Delco-Remy Starter & Generator Delco-Remy Ignition

Regulation: Third Brush

Max. Chg. rate and speed: 18-20 amps. 1450 r.p.m.

RELAY Air Gap	Contact Gap	Cut-in R.P.M.
.019" - .025"	.018" - .024"	700

BATTERY Exide Type 3XC-13-10 Volts 6-8 Amps 90

Bat. to Frame Con. Negative CONTACT BREAKER Gap .018" - .024"

Firing Order 1-4-2-6-3-5 Ignition Timing 17° B.T.D.C. full adv.

SPARK PLUG		ENGINE		Taxable Hp.
Size 7/8"	Gap .025"	Bore 3½"	Stroke 4½"	23.44

INTAKE VALVE TIMING		EXHAUST VALVE TIMING	
Open T.D.C.	Close 54° A.B.D.C.	Open 62° B.B.D.C.	Close 25° A.T.D.C.

VALVE CLEARANCE Hot Intake .008" Exhaust .008"

CARBURETOR	COOLING SYSTEM	OILING SYSTEM
Marvel T-3	Type Pump Cap. 4 Gal.	Type Press Cap. 5 Qts.

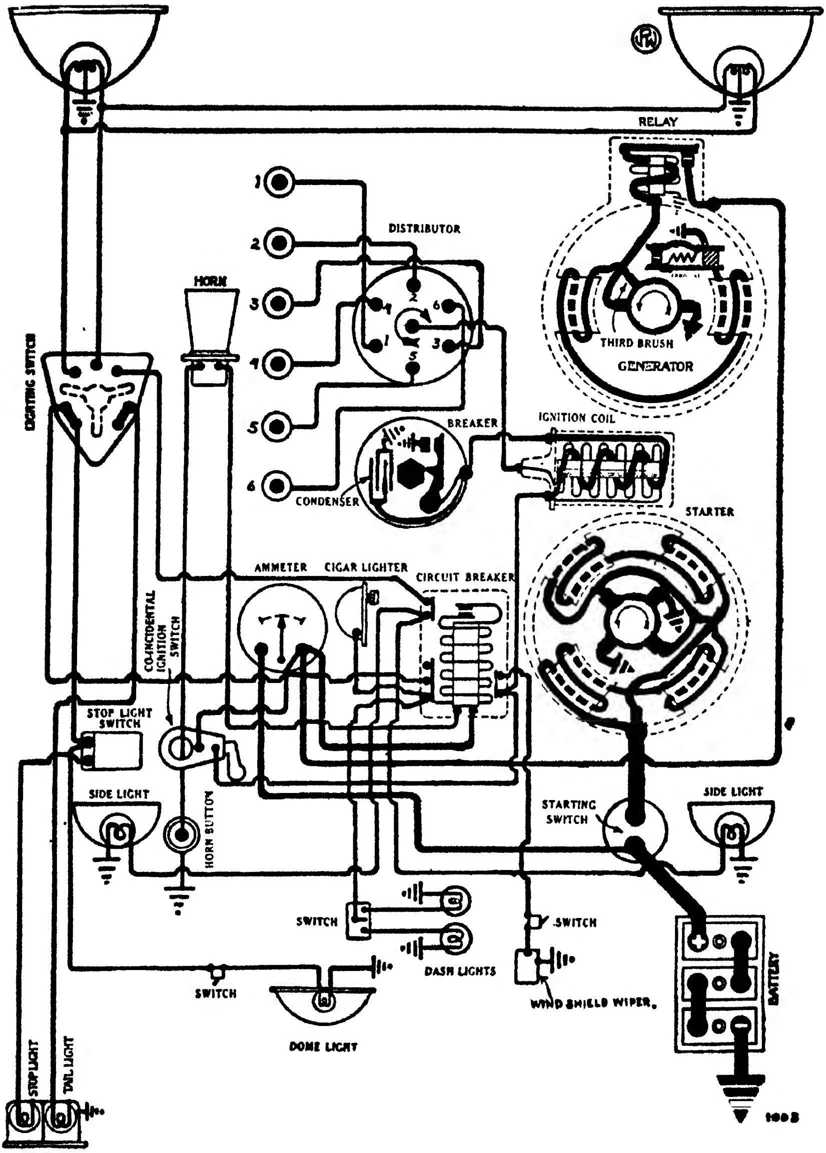
PISTON RING: Width 1/8" Diam. 3½" Gap .006"-.010"-.012"

CLUTCH Mult. Disc 5¾" I.D. x 1/8" GEAR RATIO 4.9 & 5.1 AXLE 3/4 Floating

BRAKES

Front	Rear	Hand
3/16"x1¾" x 38-5/8" (2 pcs)	3/16"x1¾" x 38-5/8" (2 pcs)	3/16"x1-3/8"x35-9/16" (2 pcs)

Lighting	Headlights	Dash & Tail	Side Lamps
Contact	Dbl 21 C.P	Sgl 3 C.P.	Sgl 3 C.P.



BUICK WIRING DIAGRAM, 1929, MODEL 116 W.B.

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Buick Model 116 W.B. Year 1929

Delco-Remy Starter & Generator Delco-Remy Ignition

Regulation — Max. Chg. rate and speed

Third Brush — 18 - 20 amps 1450 r.p.m.

RELAY Air Gap — Contact Gap — Cut-in R.P.M.

.019" - .025" — .018" - .024" — 750

BATTERY Exide Type 3MXV-13-1 Volts 6-8 Amps 100

Bat. to Frame Con. Negative CONTACT BREAKER Gap .018" - .024

Firing Order 1-4-2-6-3-5 Ignition Timing 17° B.T.D.C. adv.

SPARK PLUG — ENGINE — Taxable Hp.

Size Metric Gap .025" - .030" Bore 3-5/16" Stroke 4-5/8" 26.33

INTAKE VALVE TIMING — EXHAUST VALVE TIMING

Open 2° A.T.D.C. Close 42° A.B.D.C. Open 50° B.B.D.C. Close 20° A.T.D.C.

VALVE CLEARANCE Hot Intake .008" Exhaust .008"

CARBURETOR — COOLING SYSTEM — OILING SYSTEM

Marvel Type Pump Cap. 4½ Gal. Type F.Feed Cap. 5½ Qts.

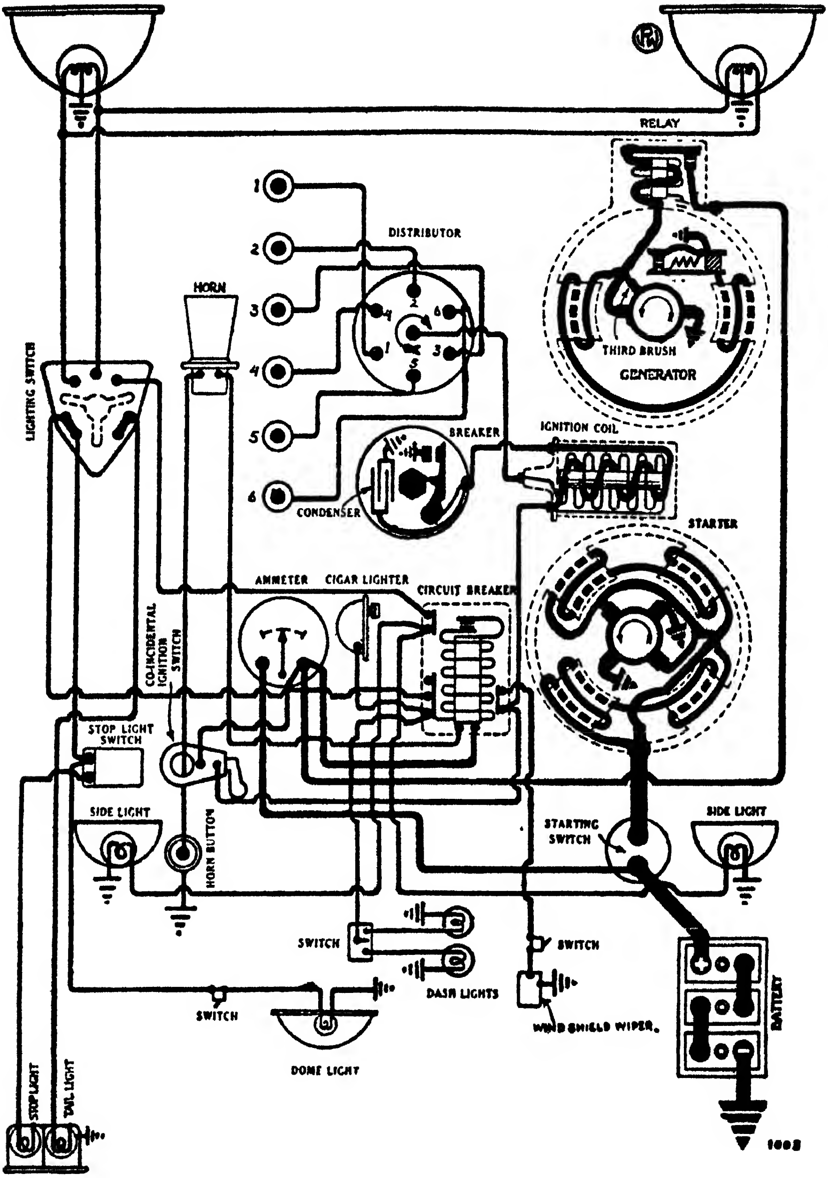
PISTON RING: Width Comp 1/8" Oil 3/16" Diam. 3-5/16" Gap .006"-.008"-.010"

CLUTCH Plate I.D. 5¾, 7¾ O.D. GEAR RATIO 4.9 AXLE 3/4 Floating

BRAKES

Front	Rear	Hand
3/16"x1-3/4"x38-5/8" (2 pcs)	3/16"x1-3/4"x38-5/8" (2 pcs)	3/16" x 1-3/8" x 35-9/16" (2 pcs)

Lighting	Headlights	Dash & Tail	Side Lamps
Single Contact	21 C.P. (two-filament)	3 C.P.	3 C.P.



BUICK WIRING DIAGRAM, 1929, MODELS 121 AND 129 W.B.

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Buick Model 121 & 129 W.B. Year 1929

Delco-Remy Starter & Generator Delco-Remy Ignition

Regulation	Max. Chg. rate and speed
Third Brush	18 - 20 amps 1450 r.p.m.

RELAY Air Gap	Contact Gap	Cut-in R.P.M.
.019" - .025"	.018" - .024"	750

BATTERY Exide Type 3MXV-15-1 Volts 6-8 Amps 120

Bat. to Frame Con. Negative CONTACT BREAKER Gap .018" - .024"

Firing Order 1-4-2-6-3-5 Ignition Timing 17° B.T.D.C. adv.

SPARK PLUG	ENGINE	Taxable Hp.
Size Metric Gap .025" - .030"	Bore 3-5/8" Stroke 5"	31.54

INTAKE VALVE TIMING	EXHAUST VALVE TIMING
Open 17°54' ATDC Close 52½° A.B.D.C.	Open 50°20' BBDC Close 20°4' A.T.D.C.

VALVE CLEARANCE Hot Intake .008" Exhaust .008"

CARBURETOR	COOLING SYSTEM	OILING SYSTEM
Marvel	Type Pump Cap 5-5/8 Gal	Type F. Feed Cap 6½ Qts.

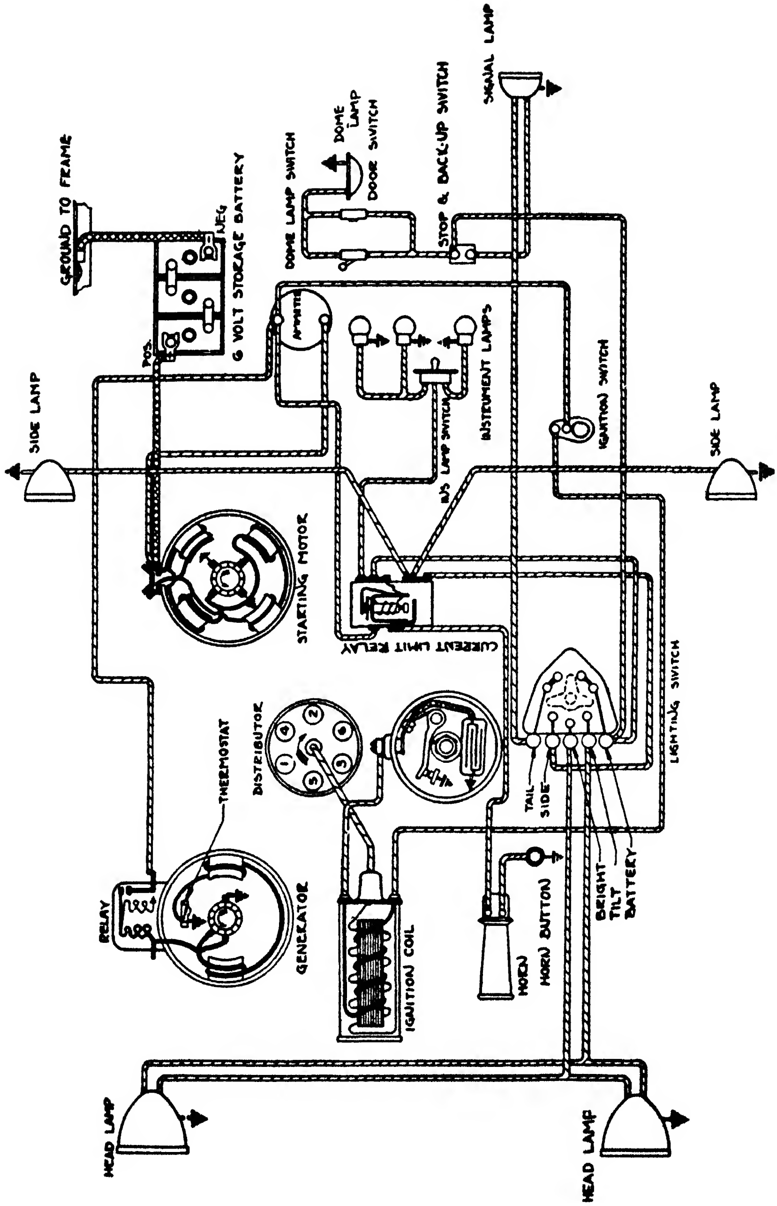
PISTON RING: Width Comp 1/8", Oil 3/16" Diam. 3-5/8" Gap .006"-.009"-.012"

CLUTCH Plate I.D. 5⅛, 7⅞ O.D. GEAR RATIO 4.077 AXLE 3/4 Floating

BRAKES

Front	Rear	Hand
3/16" x 2" x 43⅞" (2 pcs)	3/16" x 2" x 43⅞" (2 pcs)	5/32" x 1-5/8" x 40-11/16" (2 pcs)

Lighting	Headlights	Dash & Tail	Side Lamps
Single Contact	21 C.P. (two filament)	3 C.P.	3 C.P.



BUICK WIRING DIAGRAM, 1930, MODEL 40

BUICK Model 40 Year 1930

Delco-Remy Starter & Generator Delco-Remy Ignition

Regulation	Max. Chg. rate and speed
Third Brush	19 amps. at 25 m.p.h.

RELAY Air Gap	Contact Gap	Cut-in R.P.M.
.015" - .025"	.015" - .025"	750

BATTERY Exide Type 13 Plate Volts 6 Amps 120

Bat. to Frame Con. Negative CONTACT BREAKER Gap .018

Firing Order 1-4-2-6-3-5- Ignition Timing 16° B.T.D.C.

SPARK PLUG	ENGINE	Taxable Hp.
Size Metric Gap .025	Bore 3-7/16 Stroke 4-5/8	28.39

INTAKE VALVE TIMING	EXHAUST VALVE TIMING
Open 10° A.T.D.C. Close 51° A.B.D.C.	Open 52° B.B.D.C. Close 23° A.T.D.C.

VALVE CLEARANCE Hot Intake .008 Exhaust .008

CARBURETOR	COOLING SYSTEM	OILING SYSTEM
Marvel	Type Pump Cap 4	Type Force Cap Refill-5½, Dry-7½

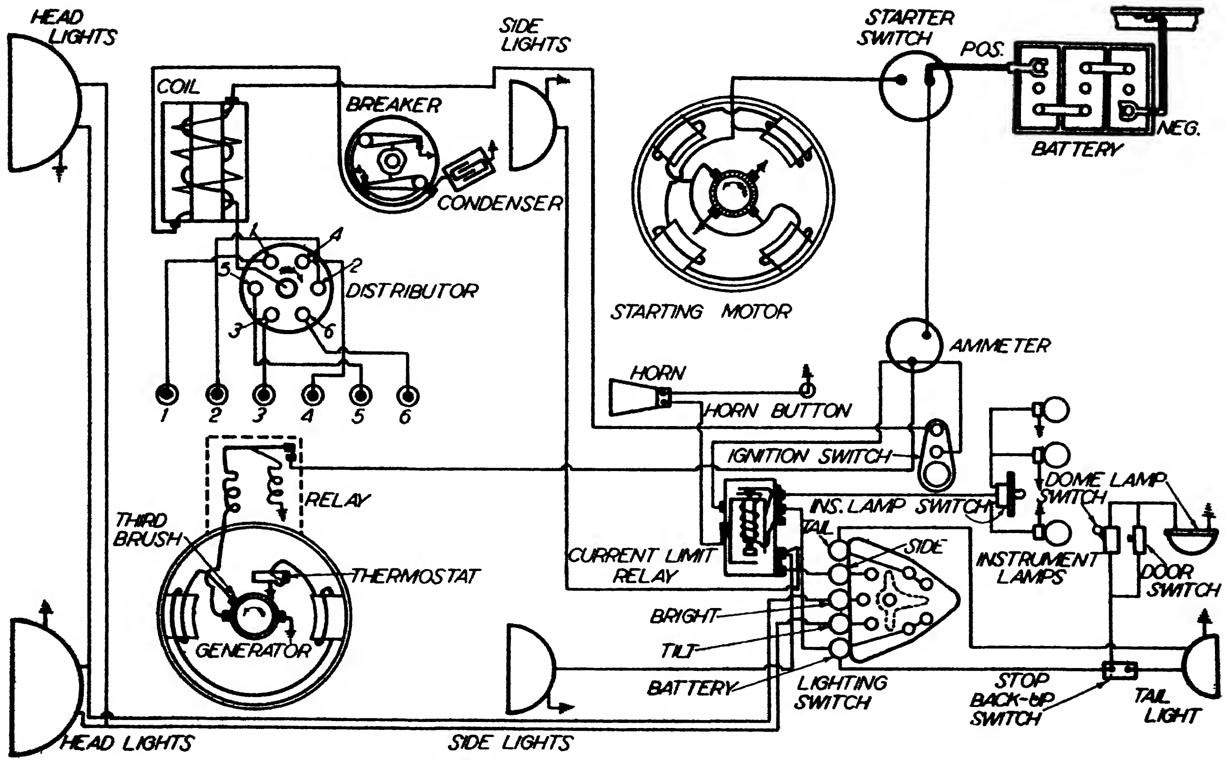
PISTON RING: Width 1/8-3/16 Diam. 3-7/16 Gap .012-.010-.008

CLUTCH Multiple Disc. GEAR RATIO AXLE Semi-Float

BRAKES

Front	Rear	Hand
Own - Int. Mech.	Own Int. Mech.	Own - Int. Rear Wheels

Lighting	Headlights	Dash & Tail	Side Lamps
Single	Contact 21-21 C.P.	3 C.P.	3 C.P.



BUICK WIRING DIAGRAM, 1930, MODEL 50-60

B U I C K Model 50-60 Year 1930

Delco-Remy Starter & Generator Delco-Remy Ignition

Regulation	Max. Chg. rate and speed
Third Brush	19 amp. at 25 m.p.h.

RELAY Air Gap	Contact Gap	Cut-in R.P.M.
.015" - .025"	.015" - .025"	750

BATTERY Exide Type 13 Plate Volts 6 Amps 120

Bat. to Frame Con. Negative CONTACT BREAKER Gap .018

Firing Order 1-4-2-6-3-5 Ignition Timing 17° B.T.D.C.

SPARK PLUG		ENGINE		Taxable Hp.
Size A. C. Metric	Gap .025	Bore 3-3/4	Stroke 5	33.75

INTAKE VALVE TIMING		EXHAUST VALVE TIMING	
Open 18° A.T.D.C.	Close 52°-30' ABDC	Open 50°-30' BBDC	Close 20° ATDC

VALVE CLEARANCE Hot Intake .008 Exhaust .008

CARBURETOR	COOLING SYSTEM		OILING SYSTEM	
Marvel	Type Pump	Cap. 5-1/2	Type Force	Cap. Dry -8 Refill-6

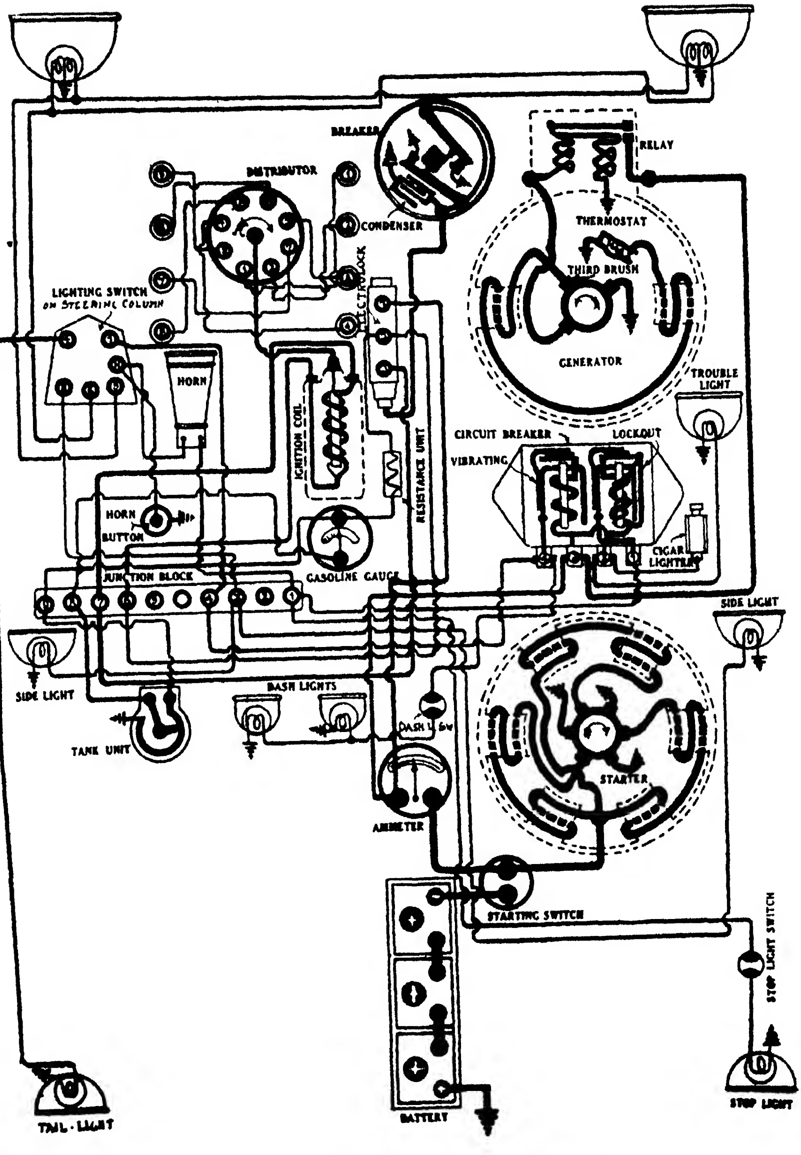
PISTON RING: Width 1/8-3/16 Diam. 3-3/4 Gap .015-.012-.010

CLUTCH Multiple Disc. GEAR RATIO 57-4.27-1 60-4.54-1 AXLE Semi-Float

BRAKES

Front	Rear	Hand
Own- Int. Mech.	Own - Int. Mech	Own-Int. Rear Wheels

Lighting	Headlights	Dash & Tail	Side Lamps
Single Contact	21-21 C.P.	3 C.P.	3 C.P.



CADILLAC WIRING DIAGRAM, 1928, MODEL 341

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Cadillac Model 341 Year 1928

Delco-Remy Starter & Generator Delco-Remy Ignition

Regulation	Max. Chg. rate and speed
Third Brush	Hot 10-12 amps, 1600 r.p.m. Cold 18-20 amps, 1400 r.p.m.

RELAY Air Gap	Contact Gap	Cut-in R.P.M.
.014" - .021"	.015" - .025"	700

BATTERY Exide Type 3-LXRV-15-20 Volts 6 Amps 130

Bat. to Frame Con. Positive CONTACT BREAKER Gap .022" - .027"

Firing Order 1R-4L-4R-2R-3L-3R-2L-1L Ignition Timing 7° B.T.D.C. ret.

SPARK PLUG	ENGINE	Taxable Hp.
Size 7/8" Gap .032" - .035"	Bore 3-5/16" Stroke 4-15/16"	35.1

INTAKE VALVE TIMING	EXHAUST VALVE TIMING
Open 11°B.T.D.C. Close 59°A.B.D.C.	Open 38°B.B.D.C. Close 7°A.T.D.C.

VALVE CLEARANCE Cold Intake .004" Exhaust .006"

CARBURETOR	COOLING SYSTEM	OILING SYSTEM
Own	Type Pump Cap. 6 Gal	Type Press Cap. 8 Qts.

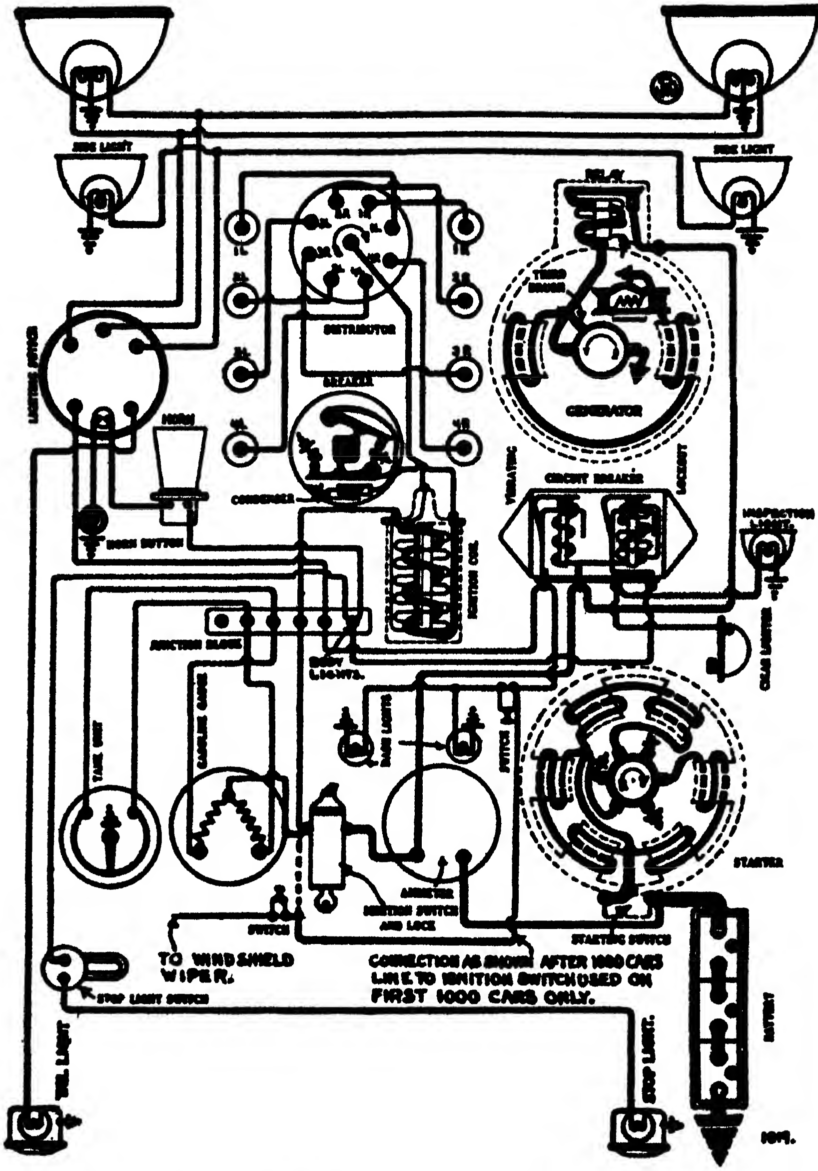
PISTON RING: Width 3/16" Diam. 3-5/16" Gap .025"

CLUTCH Plate -9½" GEAR RATIO 5 AXLE Full floating

BRAKES

Front	Rear	Hand
3/16" x 2¼" x 48½"	3/16" x 2¼" x 48½"	3/16" x 2¼" x 20-5/8"

Lighting	Headlights	Dash & Tail	Side Lamps
Single Contact	21 C.P.	3 C.P.	3 C.P.



CADILLAC WIRING DIAGRAM, 1929, MODEL 341-B

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Cadillac Model 341-B , Year 1929

Delco-Remy Starter & Generator Delco-Remy Ignition

Regulation Max Chg rate and speed

Third Brush Hot 10-12 amps, 1600 r.p.m.
Cold 18-20 amps, 1400 r.p.m.

RELAY Air Gap Contact Gap Cut-in R P M

.014" - .021" .015" - .025" 700

BATTERY Exide Type 3LXV-15-2Q Volts. 6 Amps 130

Bat to Frame Con Positive CONTACT BREAKER Gap .0225" - .0275"

Firing Order 1L-4R-4L-2L-3R-3L-2R-1R Ignition Timing 7° B.T.D.C. ret.

SPARK PLUG ENGINE Taxable Hp

Size Metric Gap .025" - .028" Bore 3-5/16" Stroke 4-15/16" 35.1

INTAKE VALVE TIMING EXHAUST VALVE TIMING

Open 9½ B.T.D.C. Close 58½° A.B.D.C. Open 46° B.B.D.C. Close 5° A.T.D.C.

'ALVE CLEARANCE Cold Intake .004" Exhaust .006"

CARBURETOR COOLING SYSTEM OILING SYSTEM

Own Type Pump Cap 6 Gal Type Press Cap 8 Qts

PISTON RING Width 3/16" Diam 3-5/16" Gap .010" - .020"

CLUTCH Plate 6.5" x 9.5" GEAR RATIO 4.75 AXLE Full floating

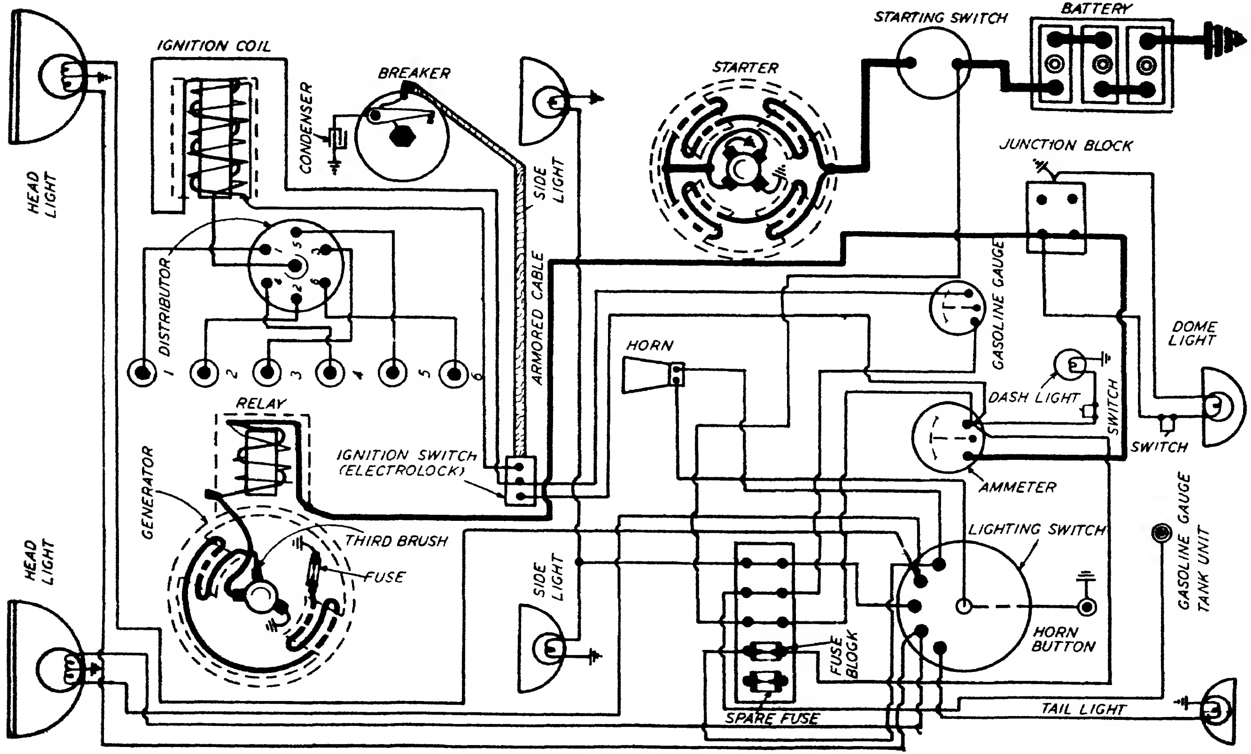
BRAKES

Front Rear Hand

3/16" x 2¼" x 22-5/16" per wheel 3/16" x 2¼" x 22-5/16" per wheel 3/16" x 2¼" x 10-5/16" per drum

Lighting Headlights Dash & Tail Side Lamps

Single Contact 21 C.P. 2 C P. 3 C.P.



CHANDLER WIRING DIAGRAM, 1927-28-29, MODEL 65

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Chandler Model 65 Year 1927-28-29

Autolite Starter & Generator Autolite Ignition

Regulation: Third Brush

Max. Chg. rate and speed: 18 amps, 1600 r.p.m.

RELAY Air Gap	Contact Gap	Cut-in R.P.M.
.015" - .025"	.014" - .024"	500

BATTERY Prestolite Type A-613-J Volts 6 Amps 100

Bat. to Frame Con. Positive CONTACT BREAKER Gap .022"

Firing Order 1-5-3-6-2-4 Ignition Timing One tooth B.T.D.C. full advance

SPARK PLUG	ENGINE	Taxable Hp.
Size 7/8" Gap .025"	Bore 3-1/8" Stroke 4-1/4"	23.4

INTAKE VALVE TIMING	EXHAUST VALVE TIMING
Open T.D.C. Close - - -	Open - - - Close 1½ tooth A.T.D.C.

VALVE CLEARANCE Hot Intake .007" Exhaust .007"

CARBURETOR	COOLING SYSTEM	OILING SYSTEM
Schebler	Type S Cap 3 Gal	Type Press Cap 7 Qts.

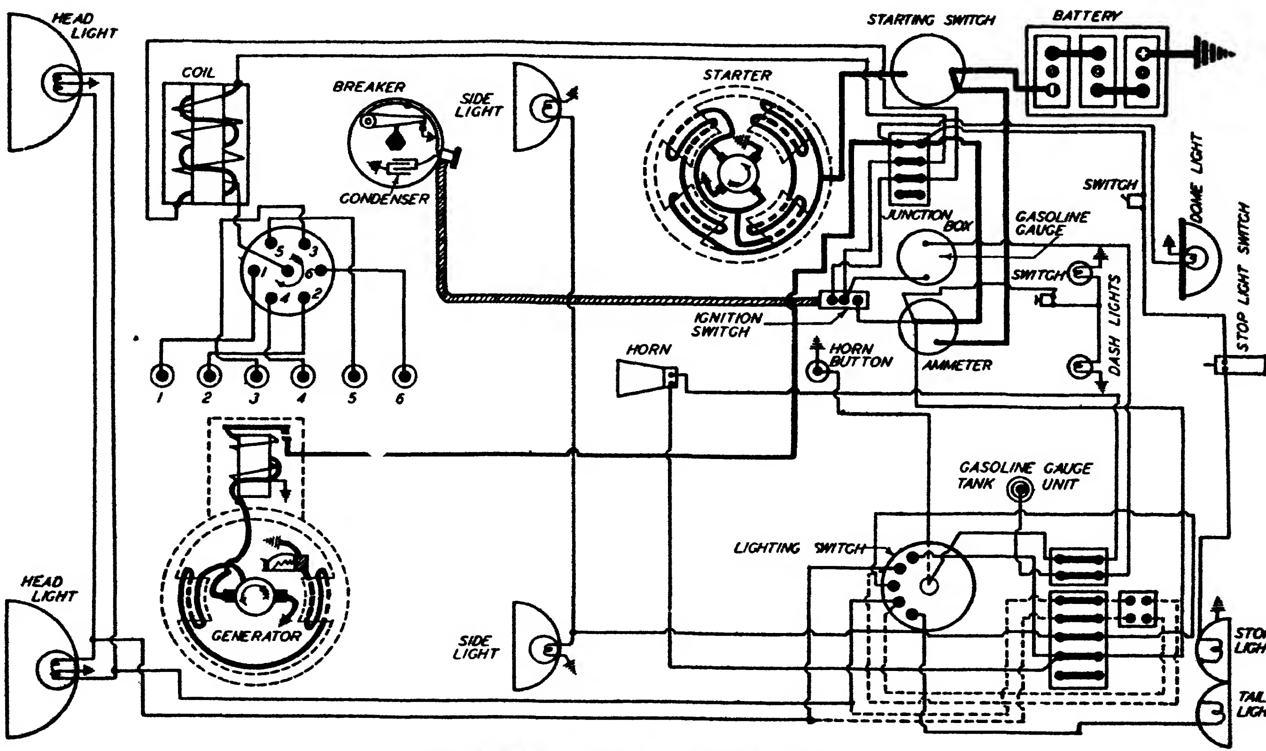
PISTON RING: Width Oil 3/16" Comp 1/8" Diam. 3-1/8" Gap .006" - .009"

CLUTCH Single Disc GEAR RATIO 4.9 AXLE Half Floating

BRAKES

Front	Rear	Hand
5/32" x 1¾" x 18" (4 pcs)	5/32" x 1¾" x 18" (4 pcs)	5/32" x 1¾" x 22-1/8" (1 pc)

Lighting	Headlights	Dash & Tail	Side Lamps
Single Contact	21 C.P.	3 C.P.	3 C.P.



CHANDLER WIRING DIAGRAM, 1927-28-29, BIG SIX

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Chandler Model Big Six Year 1927-28-29

Delco Starter & Generator Delco Ignition

Regulation	Max. Chg. rate and speed
Thermostat	20 amps, 1500 r.p.m.

RELAY Air Gap	Contact Gap	Cut-in R.P.M.
.015" - .025"	.014" - .024"	600

BATTERY Prestolite Type A-615-J Volts 6 Amps 110

Bat. to Frame Con. Positive CONTACT BREAKER Gap .022"

Firing Order 1-5-3-6-2-4 Ignition Timing One tooth B.T.D.C., full advance

SPARK PLUG		ENGINE		Taxable Hp.
Size 7/8"	Gap .025"	Bore 3¼"	Stroke 5"	33.75

INTAKE VALVE TIMING		EXHAUST VALVE TIMING	
Open T.D.C.	Close - - -	Open - - -	Close 1½ teeth A.T.D.C.

VALVE CLEARANCE Hot Intake .006" Exhaust .006"

CARBURETOR	COOLING SYSTEM		OILING SYSTEM	
Schebler	Type S	Cap 5 Gal	Type Press	Cap 8 Qts.

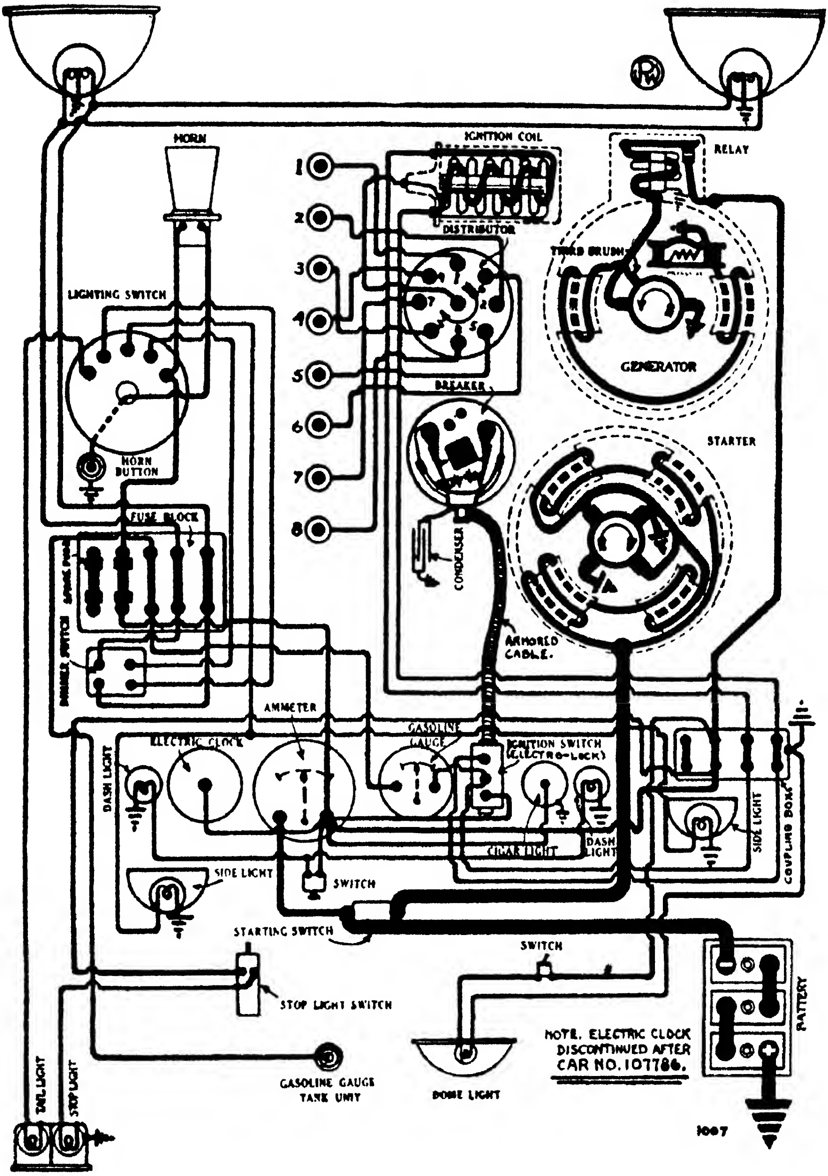
PISTON RING: Width .011 Comp 3/16" 1/8" Diam 3-3/8" Gap .006" - .009"

CLUTCH Single Disc GEAR RATIO 4 AXLE 3/4 Floating

BRAKES

Front	Rear	Hand
3/16" x 2" x 18-7/8" (4 pcs)	3/16" x 2" x 20½" (4 pcs)	5/32" x 1½" x 10-3/8" (2 pcs)

Lighting	Headlights	Dash & Tail	Side Lamps
Single Contact	21 C.P.	3 C.P.	3 C.P.



CHANDLER WIRING DIAGRAM, 1927-28-29, ROYAL 85

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Chandler Model Royal 85 Year 1927-28-29

Delco Starter & Generator Delco Ignition

Regulation	Max. Chg. rate and speed
Thermostat	20 amps, 1500 r.p.m.

RELAY Air Gap	Contact Gap	Cut-in R.P.M.
.015" - .025"	.016" - .024"	600

BATTERY Prestolite Type A-615-J Volts 6 Amps 110

Bat. to Frame Con. Positive CONTACT BREAKER Gap .022"

Firing Order 1-6-2-5-8-3-7-4 Ignition Timing One tooth B.T.D.C. full advance

SPARK PLUG		ENGINE		Taxable Hp.
Size 7/8"	Gap .025"	Bore 3-3/8"	Stroke 4-3/4"	36.45

INTAKE VALVE TIMING		EXHAUST VALVE TIMING	
Open T.D.C.	Close ---	Open ---	Close 1½ tooth A.T.D.C.

VALVE CLEARANCE Hot Intake .007" Exhaust .007"

CARBURETOR	COOLING SYSTEM		OILING SYSTEM	
Schebler	Type S	Cap 5½ Gal	Type Press	Cap 9 Qts.

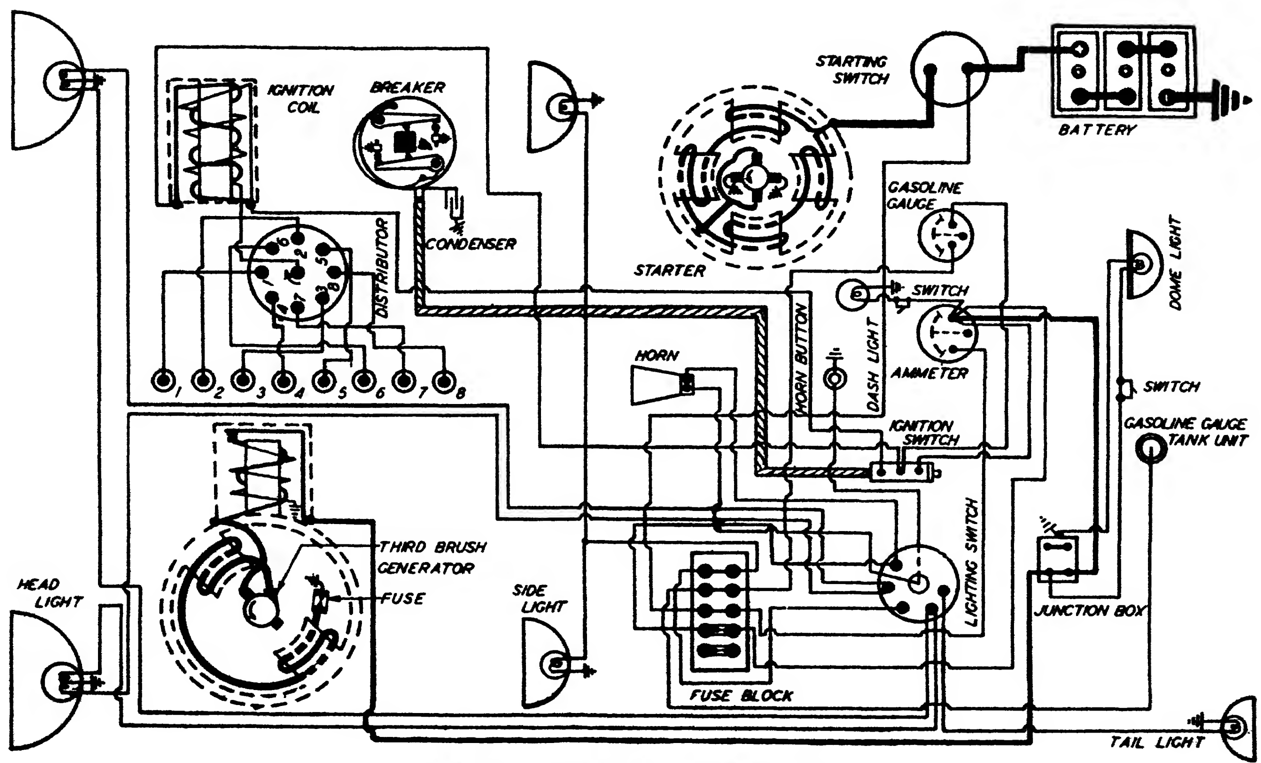
PISTON RING: Width Oil 3/16" Comp 1/8" Diam. 3-3/8" Gap .006" - .009"

CLUTCH Single Disc GEAR RATIO 4.45 AXLE 3/4 Floating

BRAKES

Front	Rear	Hand
3/16" x 2" x 18-7/8" (4 pcs)	3/16" x 2" x 20½" (4 pcs)	5/32" x 1¾" x 10-3/8" (2 pcs)

Lighting	Headlights	Dash & Tail	Side Lamps
Single Contact	21 C.P.	3 C.P.	3 C.P.



CHANDLER WIRING DIAGRAM, 1928-29, ROYAL 75
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Chandler Model Royal 75 Year 1928-29

Autolite Starter & Generator Autolite Ignition

Regulation	Max. Chg. rate and speed
Third Brush	18 amps, 1600 r.p.m.

RELAY Air Gap	Contact Gap	Cut-in R.P.M.
.015" - .025"	.014" - .024"	500

BATTERY Prestolite Type A-615-J Volts 6 Amps 110

Bat. to Frame Con. Positive CONTACT BREAKER Gap .022"

Firing Order 1-6-2-5-8-3-7-4 Ignition Timing One tooth B.T.D.C. full advance

SPARK PLUG	ENGINE		Taxable Hp.
Size 7/8" Gap .025"	Bore 3"	Stroke 4½"	28.8

INTAKE VALVE TIMING		EXHAUST VALVE TIMING	
Open T.D.C.	Close - - -	Open - - -	Close 1½ Teeth A.T.D.C.

VALVE CLEARANCE Hot Intake .007" Exhaust .007"

CARBURETOR	COOLING SYSTEM	OILING SYSTEM
Tillotson	Type Pump Cap. 4½ Gal	Type Press Cap. 8 Qts

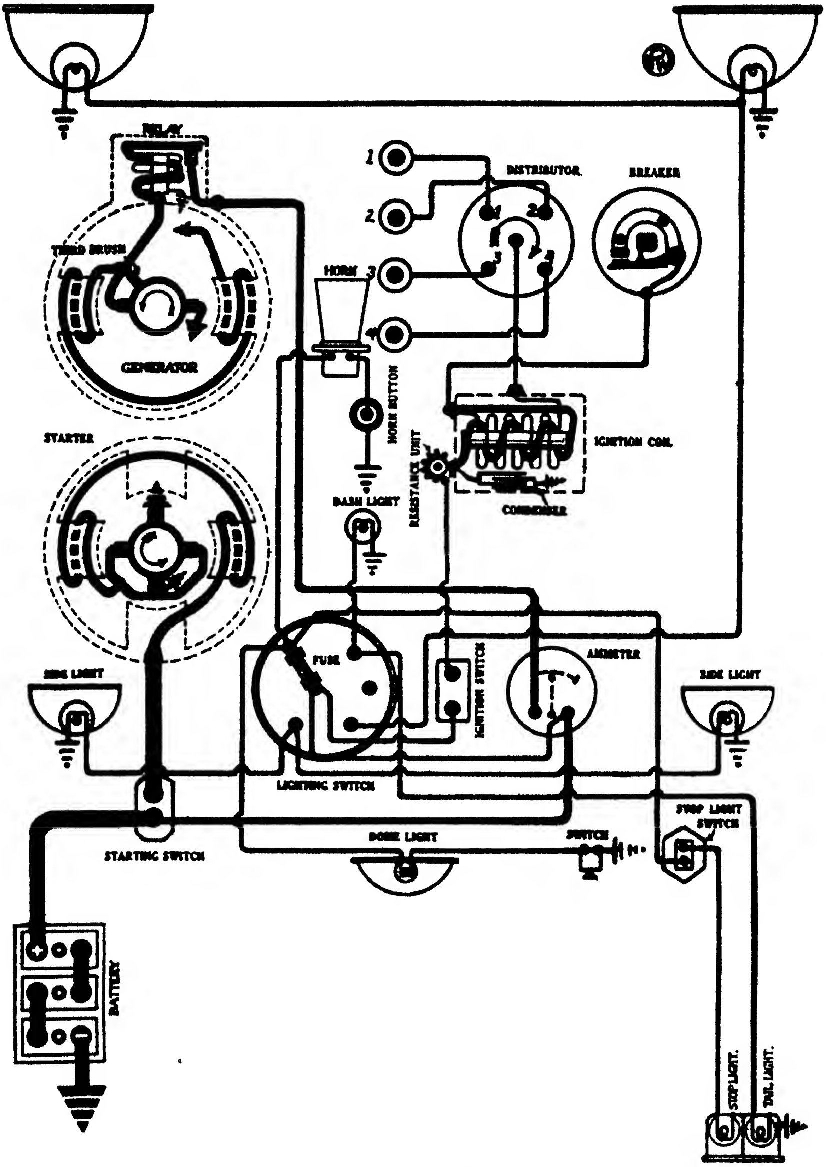
PISTON RING: Width Oil 3/16" Comp 1/8" Diam. 3" Gap .006" - .009"

CLUTCH Single Disc GEAR RATIO 4.9 AXLE Half Floating

BRAKES

Front	Rear	Hand
5/32" x 1¾" x 18" (4 pcs)	5/32" x 1¾" x 18" (4 pcs)	5/32" x 1¾" x 22-1/8" (1 pc)

Lighting	Headlights	Dash & Tail	Side Lamps
Single Contact	21 C.P.	3 C.P.	3 C.P.



CHEVROLET WIRING DIAGRAM, 1927, CAPITOL.

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Chevrolet Model Capitol Year 1927
Passgr & Lt. Del.

Delco-Remy Starter & Generator Delco-Remy Ignition

Regulation	Max. Chg. rate and speed
Third Brush	18 amps. 2100 r.p.m.

RELAY Air Gap	Contact Gap	Cut-in R.P.M.
.012" - .017" (contacts closed)	.015" - .025"	750

BATTERY Exide, U.S.L., Willard Type XWB-13, XY-13-C, WCB-13 Volts 6 Amps 90

Bat. to Frame Con. Negative CONTACT BREAKER Gap .018" - .020"

Firing Order 1 - 2 - 4 - 3 Ignition Timing T.D.C. retard

SPARK PLUG	ENGINE	Taxable Hp.
Size 7/8" Gap .025"	Bore 3-11/16" Stroke 4"	21.7

INTAKE VALVE TIMING	EXHAUST VALVE TIMING
Open 16° A.T.D.C. Close 52° A.B.D.C.	Open 40° B.B.D.C. Close 16° A.T.D.C.

VALVE CLEARANCE Hot Intake .006" Exhaust .008"

CARBURETOR	COOLING SYSTEM	OILING SYSTEM
Carter	Type Pump Cap 17½ Qts.	Type Pump & Splash Cap 5 Qts.

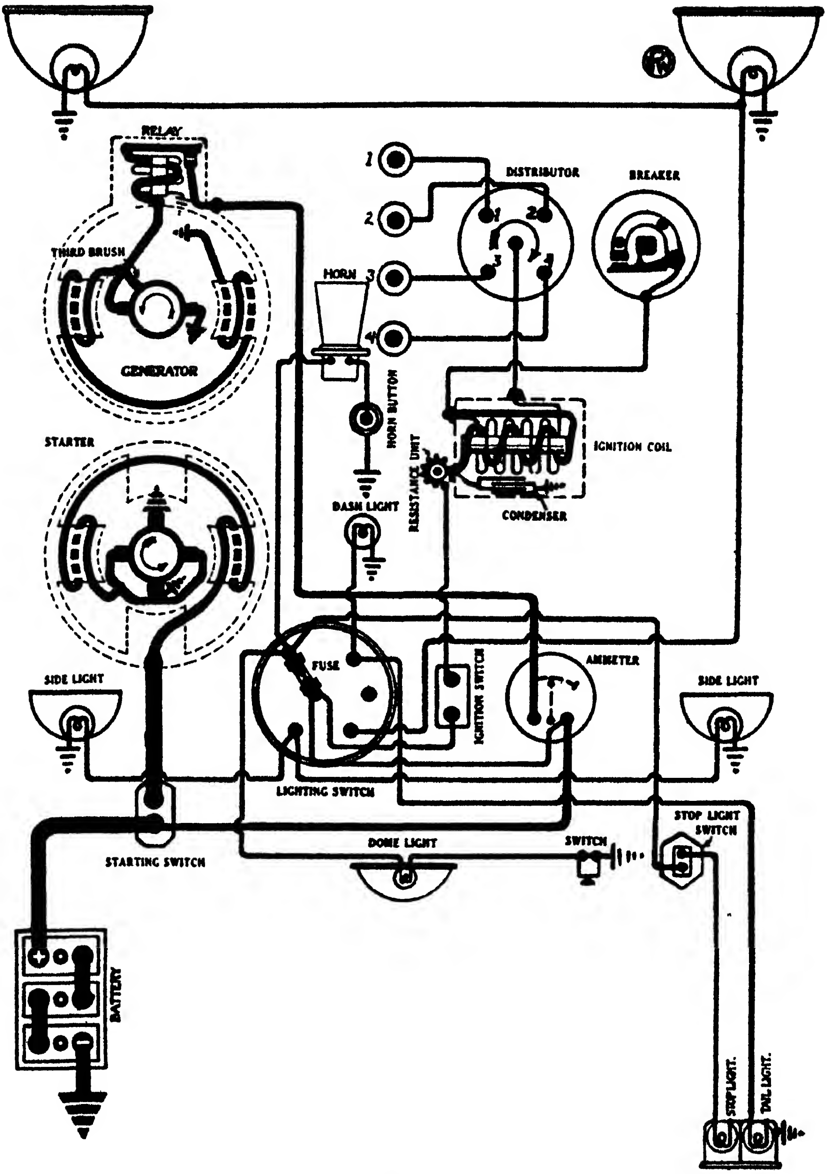
PISTON RING: Width 3/16" Diam. 3-11/16" Gap .014"

CLUTCH Single Plate GEAR RATIO 3.818 AXLE Semi-floating

BRAKES

Front	Rear	Hand
None	3/16" x 2" x 33-15/16" (2 pcs)	5/32" x 1¼" x 28" (2 pcs)

Lighting	Headlights	Dash & Tail	Side Lamps
Single Contact	21 C.P.	3 C.P.	3 C.P.



CHEVROLET WIRING DIAGRAM, 1927-28, CAPITOL UTILITY Ex.

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Chevrolet Model Capitol Utility Ex. Year 1927 - July 1928

Delco-Remy Starter & Generator Delco-Remy Ignition

Regulation Max Chg rate and speed

Third Brush 18 amps, 2100 r.p.m.

RELAY Air Gap	Contact Gap	Cut in R P M
.012" - .017" (contacts closed)	.015" - .025"	750

BATTERY Exide, Willard, U.S.L. Type XWR-13, WCB-13, IY-13-C Volts 6 Amps 90

Bat to Frame Con Negative CONTACT BREAKER Gap .018" - .020"

Firing Order 1-2-4-3 Ignition Timing T.D.C. retard

SPARK PLUG		ENGINE		Taxable Hp
Size 7/8"	Gap .025"	Bore 3-11/16"	Stroke 4"	21.7

INTAKE VALVE TIMING		EXHAUST VALVE TIMING	
Open 16° A.T.D.C.	Close 52° A.B.D.C.	Open 40° B.B.D.C.	Close 16° A.T.D.C.

VALVE CLEARANCE Hot Intake .006" Exhaust .008"

CARBURETOR	COOLING SYSTEM	OILING SYSTEM
Carter	Type Pump Cap 7¾ Qts	Type Pump & Splash Cap 5 Qts.

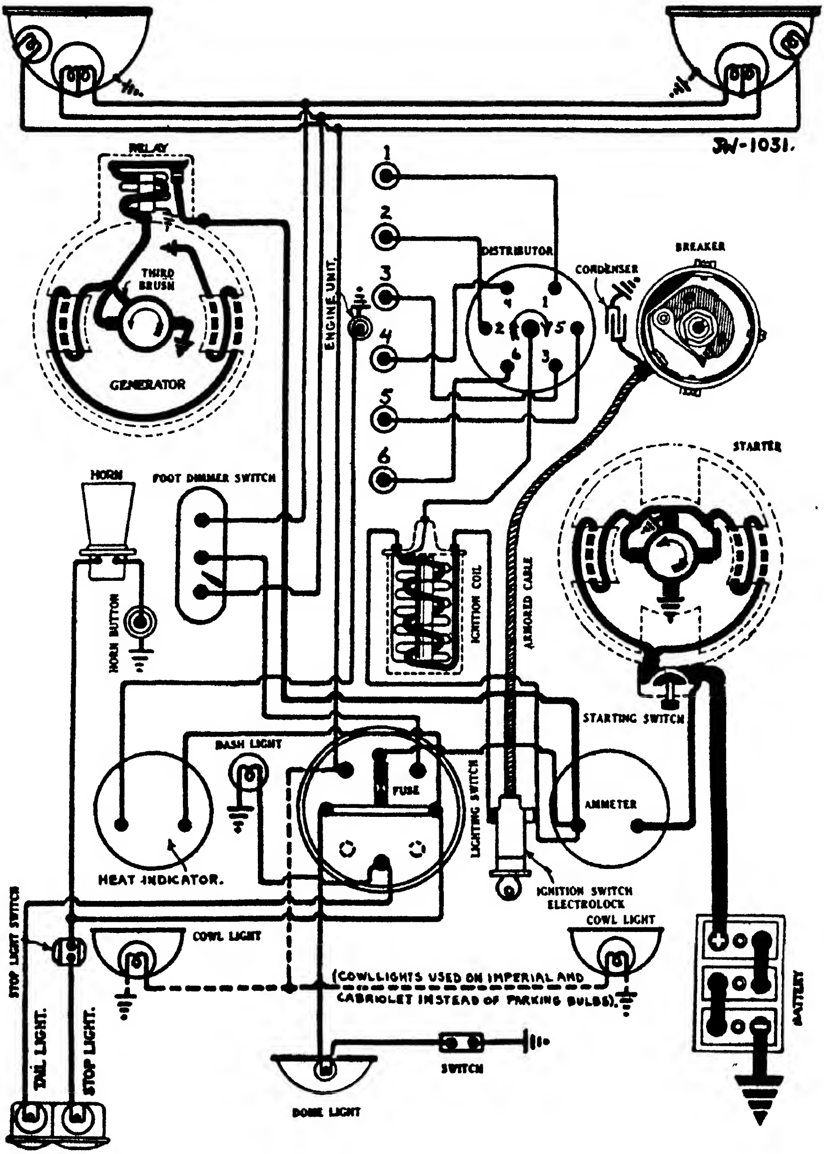
PISTON RING Width 3/16" Diam 3-11/16" Gap .014"

CLUTCH Single Plate GEAR RATIO 5.43 AXLE Semi-floating

BRAKES

Front	Rear	Hand
None	3/16" x 2" x 35" (2 pcs)	5/32" x 1¼" x 34" (2 pcs)

Lighting	Headlights	Dash & Tail	Side Lamps
Single Contact	21 C P	3 C P	3 C P



CHEVROLET WIRING DIAGRAM, 1928 (AFTER JULY 1), CAPITOL

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Chevrolet ... Model Capitol ... Year 1928 after July 1
Utility Ex. after July 1

Delco-Remy ... Starter & Generator ... Delco-Remy ... Ignition

Regulation ... Max. Chg. rate and speed

Third Brush ... 18 amps, 2100 r.p.m.

RELAY Air Gap ... Contact Gap ... Cut-in R.P.M.

.012" - .017 (contacts closed) ... .015" - .025" ... 750

BATTERY ... Exide, U.S.L., Willard ... Type 3-XC-13, XY-13, XW-13 ... Volts 6 ... Amps 90

Bat. to Frame Con. ... Negative ... CONTACT BREAKER Gap ... .018" - .020"

Firing Order ... 1-2-4-3 ... Ignition Timing ... 15° B.T.D.C. adv.

SPARK PLUG ... ENGINE ... Taxable Hp.

Size 7/8" ... Gap .025" ... Bore 3-11/16" Stroke 4" ... 21.7

INTAKE VALVE TIMING ... EXHAUST VALVE TIMING

Open 7° B.T.D.C. Close 75° A.B.D.C. ... Open 56° B.B.D.C. Close 32° A.T.D.C.

VALVE CLEARANCE ... Hot ... Intake .006" ... Exhaust .008"

CARBURETOR ... COOLING SYSTEM ... OILING SYSTEM

Carter ... Type Pump ... Cap. 5 Qts ... Type Pump & Splash ... Cap. 7½ Qts

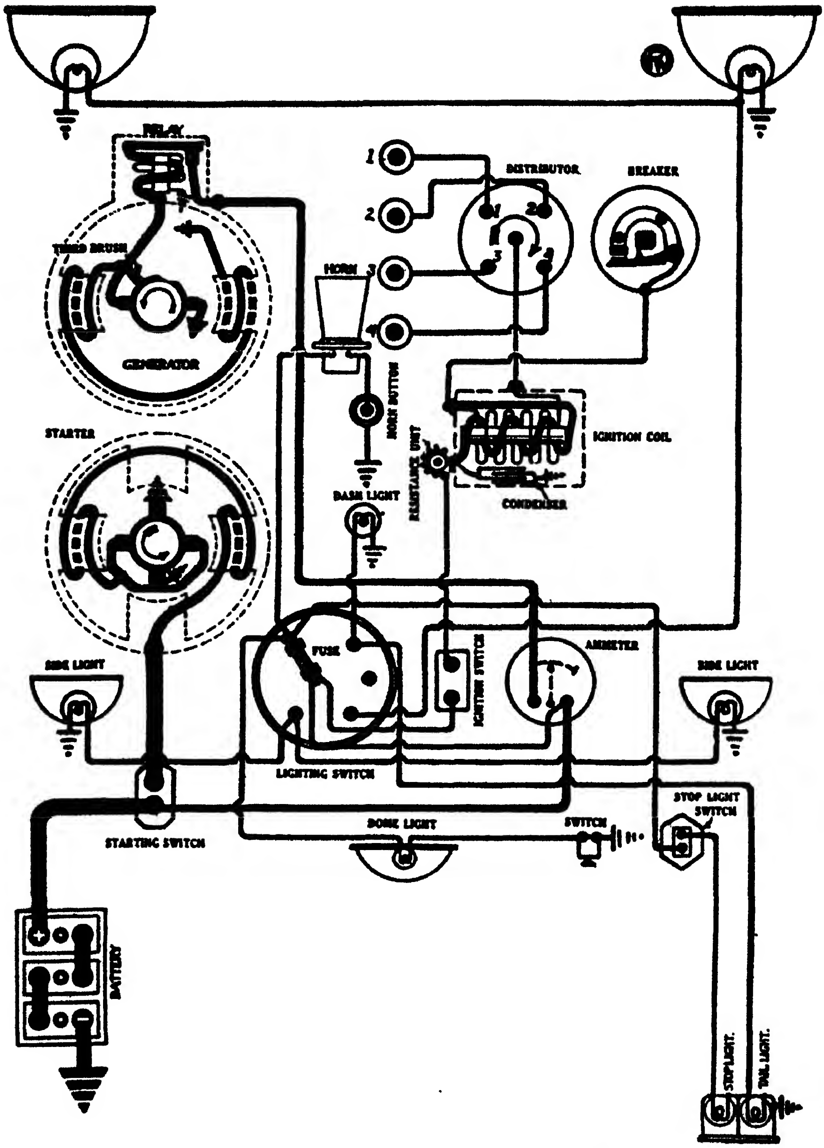
PISTON RING: Width 1/8" ... Diam. 3-11/16" ... Gap .014"

CLUTCH ... Single Plate ... GEAR RATIO 5.43 ... AXLE ... Semi-floating

BRAKES

Front	Rear	Hand
5/32" x 1½" x 32¾"	3/16" x 2" x 71½"	5/32" x 1½" x 66¾"

Lighting	Headlights	Dash & Tail	Side Lamps
Single Contact	21 C.P.	3 C.P.	3 C.P.



CHEVROLET WIRING DIAGRAM, 1928, NATIONAL

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Chevrolet Model National Year 1928
Passgr, Sedan Del, Lt. Del.

Delco-Remy Starter & Generator Delco-Remy Ignition

Regulation	Max. Chg. rate and speed
Third Brush	18 amps, 2100 r.p.m.

RELAY Air Gap	Contact Gap	Cut-in R.P.M.
.012" - .017" (contacts closed)	.015" - .025"	750

BATTERY U.S.L. Exide Willard Type XX-13 3-XC-13 XW-13 Volts 6 Amps 90

Bat. to Frame Con. Negative CONTACT BREAKER Gap .018" - .020"

Firing Order 1-2-4-3 Ignition Timing 15° B.T.D.C. adv.

SPARK PLUG	ENGINE	Taxable Hp.
Size 7/8" Gap .020" - .030"	Bore 3-11/16" Stroke 4"	21.7

INTAKE VALVE TIMING	EXHAUST VALVE TIMING
Open 7° B.T.D.C. Close 75° A.B.D.C.	Open 56° B.B.D.C. Close 32° A.T.D.C.

VALVE CLEARANCE Hot Intake .006" Exhaust .008"

CARBURETOR	COOLING SYSTEM	OILING SYSTEM
Carter	Type Pump Cap. 8-3/8 Qts	Type Pump & Splash Cap. 5 Qts

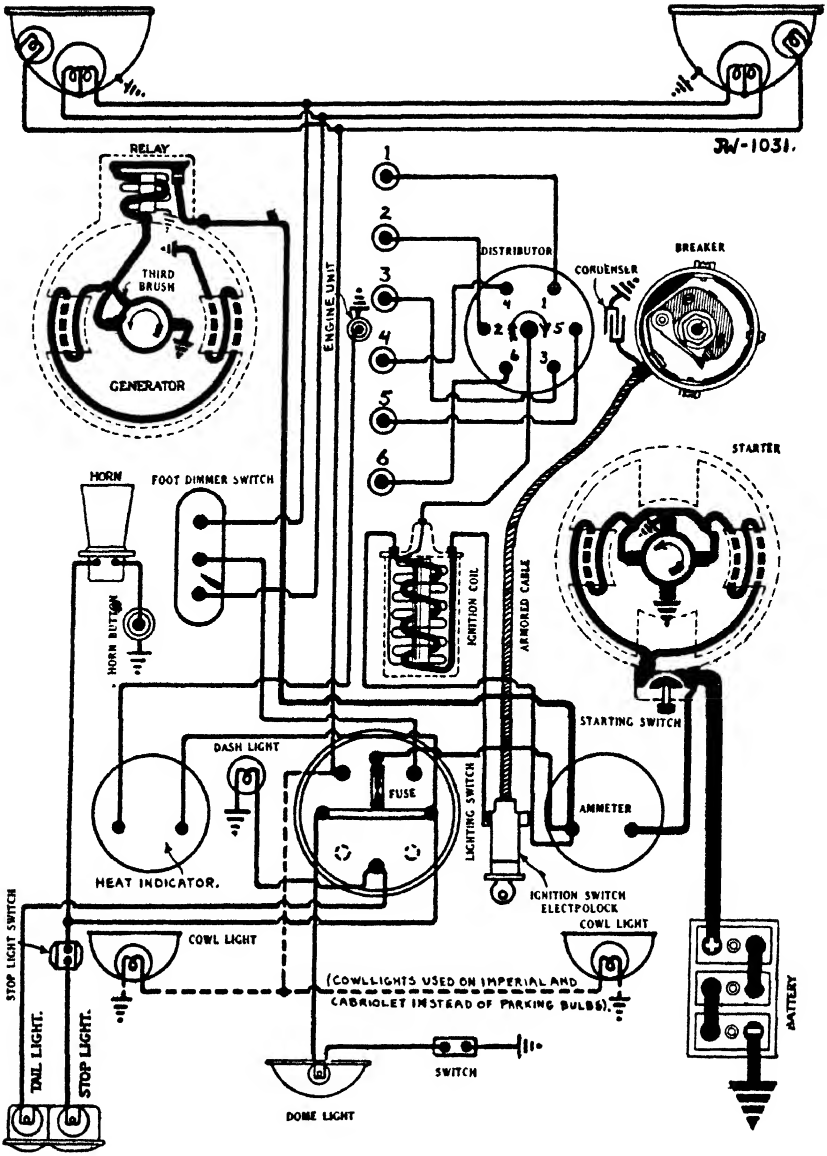
PISTON RING: Width 5/32" Diam. 3-11/16" Gap .014"

CLUTCH Single Plate GEAR RATIO 3.818 AXLE Semi-floating

BRAKES

Front	Rear	Hand
5/32" x 1¾" x 9-1/32" (4 pcs)	3/16" x 2" x 33-15/16" (2 pcs)	5/32" x 1¼" x 28" (2 pcs)

Lighting	Headlights	Dash & Tail	Side Lamps
Single Contact	21 C.P.	3 C.P.	3 C.P.



CHEVROLET WIRING DIAGRAM, 1929, INTERNATIONAL

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Chevrolet Model International Year 1929
Psgr, Sedan Del., Lt Del.

Delco-Remy Starter & Generator Delco-Remy Ignition

Regulation: Third Brush

Max Chg rate and speed: 18 amps, 2100, r.p.m.

RELAY Air Gap	Contact Gap	Cut in R P M
.012" - .017" (contacts closed)	.015" - .025"	750

BATTERY: Exide Type XWR-13; U.S.L. Type XX-13-C; Willard WCB-13; Delco-Remy 13B-CO — Volts 6 Amps 90

Bat to Frame Con Negative CONTACT BREAKER Gap .030"

Firing Order 1-5-3-6-2-4 Ignition Timing 15° B.T.D.C. adv.

SPARK PLUG	ENGINE	Taxable Hp
Size Metric Gap .025"	Bore 3-5/16" Stroke 3-3/4"	26.3

INTAKE VALVE TIMING	EXHAUST VALVE TIMING
Open 4° A.T.D.C. Close 47° A.B.D.C.	Open 47° B.B.D.C. Close 4° A.T.D.C.

VALVE CLEARANCE Hot Intake .006" Exhaust .008"

CARBURETOR	COOLING SYSTEM	OILING SYSTEM
Carter	Type Pump Cap 2½ Gal	Type Pump & Splash Cap 5 Qts

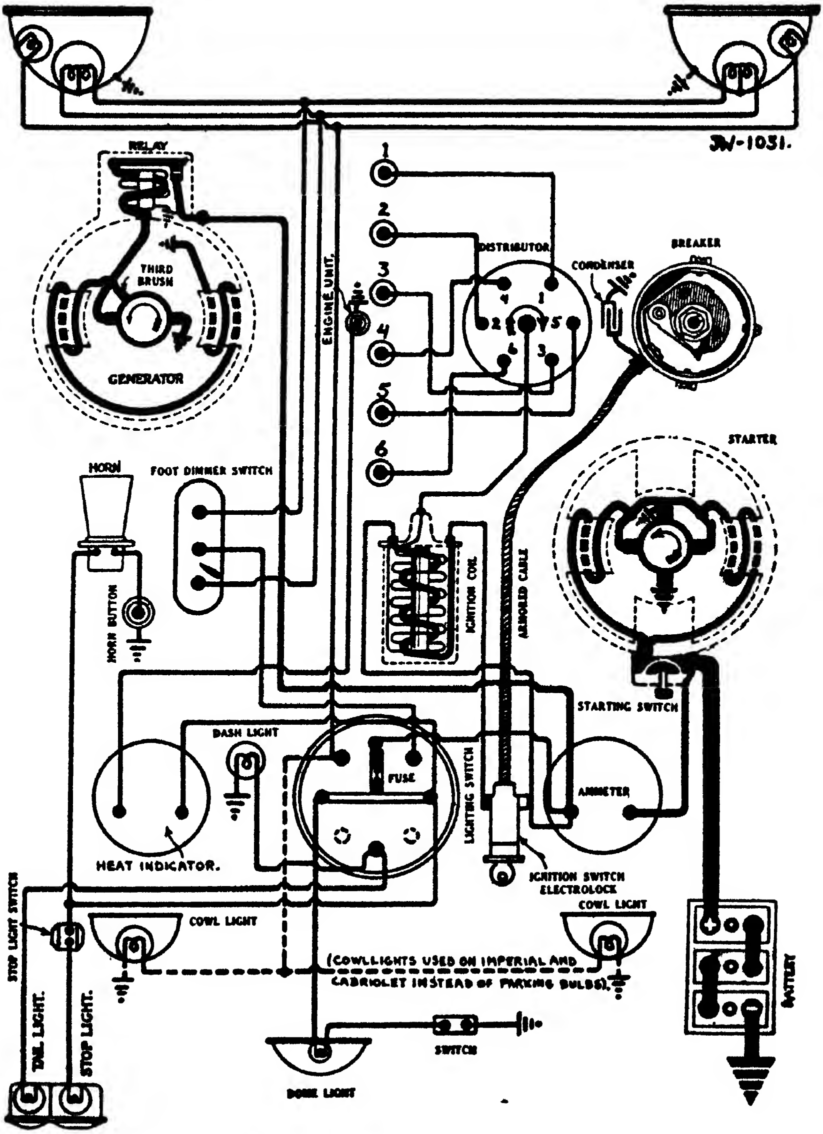
PISTON RING Width 5/32" Diam 3-5/16" Gap .002" - .004"

CLUTCH Single Plate GEAR RATIO 3.818 AXLE Semi- floating

BRAKES

Front	Rear	Hand
5/32" x 1½" x 9-1/16" (4 pos)	3/16" x 2" x 16-13/32"; 3/16" x 2" x 13-61/64" (2 pos)	5/32" x 1¼" x 28" (2 pos)

Lighting	Headlights	Dash & Tail	Side Lamps
Single Contact	21 C P	3 C P	3 C P (In Cabriolet & Imperial Landau only)



CHEVROLET WIRING DIAGRAM, 1929, INTERNATIONAL UTILITY Ex.
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Chevrolet Model International Utility Ex. Year 1929

Delco-Remy Starter & Generator Delco-Remy Ignition

Regulation	Max. Chg. rate and speed
Third Brush	18 amps. 2100 r.p.m.

RELAY Air Gap	Contact Gap	Cut-in R.P.M.
.012" - .017" (contacts closed)	.015" - .025"	750

BATTERY Exide / U.S.L. / Willard / Delco-Remy Type XWR-13 / XY-13-C / WCB-13 / 13B-CU Volts 6 Amps 90

Bat. to Frame Con. Negative CONTACT BREAKER Gap .030"

Firing Order 1-5-3-6-2-4 Ignition Timing 15° B.T.D.C. adv.

SPARK PLUG	ENGINE	Taxable Hp.
Size Metric Gap .025"	Bore 3-5/16" Stroke 3-3/4"	26.3

INTAKE VALVE TIMING	EXHAUST VALVE TIMING
Open 4° A.T.D.C. Close 42° A.B.D.C.	Open 47° B.B.D.C. Close 4° A.T.D.C.

VALVE CLEARANCE Hot Intake .006" Exhaust .008"

CARBURETOR	COOLING SYSTEM	OILING SYSTEM
Carter	Type Pump Cap 2½ gal	Type Pump & Splash Cap 5 Qts.

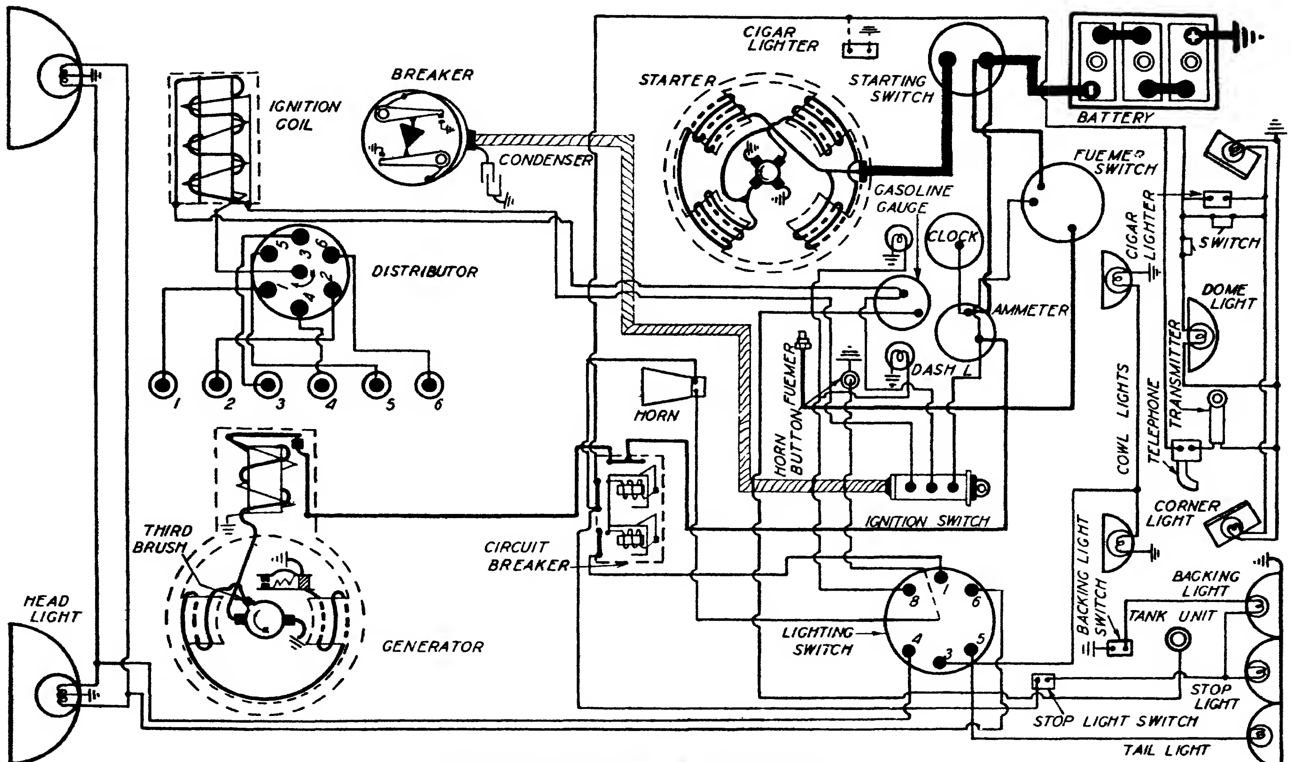
PISTON RING: Width 5/32" Diam 3-5/16" Gap .004" - .008" - .014

CLUTCH Single Plate GEAR RATIO 4.88 AXLE Semi-floating

BRAKES

Front	Rear	Hand
5/32" x 1¼" x 9-1/32" (4 pcs)	3/16" x 2" x 16-13/32" 3/16" x 2" x 13-61/64" (2 pcs)	5/32" x 1¼" x 28" (2 pcs)

Lighting	Headlights	Dash & Tail	Side Lamps
Single Contact	21 C.P.	3 C.P.	-- C.P.



CHRYSLER WIRING DIAGRAM, 1928-29, MODEL 75

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Chrysler Model **75** Year **1928-29**

Delco-Remy Starter & Generator **Delco-Remy** Ignition

Regulation: **Third Brush**
Max Chg rate and speed: **11-14 amps, 1700 - 1800 r.p.m.**

RELAY Air Gap	Contact Gap	Cut in R P M
.016"	.020"	575

BATTERY **Willard** Type **- -** Volts **6** Amps **117**

Bat to Frame Con **Positive** CONTACT BREAKER Gap **.018" - .024"**

Firing Order **1-5-3-6-2-4** Ignition Timing **Piston .074 B.T.D.C. adv.**
(Red Head) " .004 B.T.D.C. adv.

SPARK PLUG		ENGINE		Taxable Hp
Size 7/8"	Gap .025"	Bore 3¼"	Stroke 5"	25.35

INTAKE VALVE TIMING		EXHAUST VALVE TIMING	
Open 6°A.T.D.C.	Close 46°A.B.D.C.	Open 42°B.B.D.C.	Close 8°A.T.D.C.

VALVE CLEARANCE **Hot** Intake **.004"** Exhaust **.006"**

CARBURETOR	COOLING SYSTEM	OILING SYSTEM
Penberthy	Type Pump Cap 4½ Gal	Type Press Cap 6 Qts.

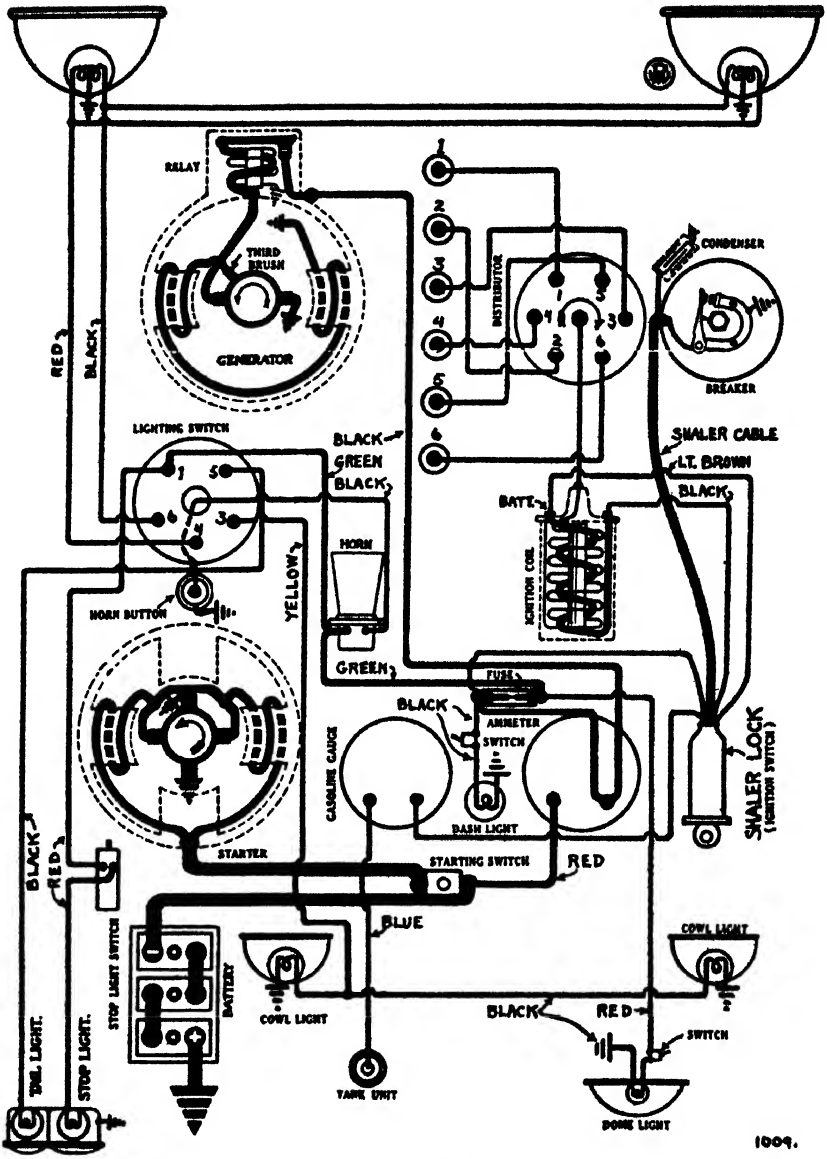
PISTON RING Width **Comp 9/64"** **Oil 1/8"** Diam **3-1/4"** Gap **.005"-.007"-.010"**

CLUTCH **Single Dry Pl.** GEAR RATIO **3.9 & 4.3** AXLE **Semi-floating**

BRAKES

Front	Rear	Hand
3/16" x 1¾" x 13" 3/16" x 1¾" x 14-29/32" (2 pcs)	3/16" x 1¾" x 13" 3/16" x 1¾" x 14-29/32" (2 pcs)	5/32" x 2" x 24-5/8" (1 piece)

Lighting	Headlights	Dash & Tail	Side Lamps
Single Contact	21 C P	3 C P	3 C P



CHRYSLER WIRING DIAGRAM, 1928-29, MODEL 65

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Chrysler Model 65 Year 1928-29

Delco-Remy Starter & Generator Delco-Remy Ignition

Regulation	Max. Chg. rate and speed
Third Brush	11-13 amps. 1750-1850 r.p.m

RELAY Air Gap	Contact Gap	Cut-in R.P.M.
.016"	.020"	575

BATTERY Willard Type LWR-4 Volts 6 Amps 100

Bat. to Frame Con. Positive CONTACT BREAKER Gap .018" - .024"

Firing Order 1-5-3-6-2-4 Ignition Timing Piston .030 B.T.D.C. adv.

SPARK PLUG	ENGINE	Taxable Hp.
Size 7/8" Gap .025"	Bore 3-1/8" Stroke 4-1/4"	23.43

INTAKE VALVE TIMING	EXHAUST VALVE TIMING
Open 6° A.T.D.C. Close 46° A.B.D.C.	Open 42° B.B.D.C. Close 8° A.T.D.C.

VALVE CLEARANCE Hot Intake .004" Exhaust .006"

CARBURETOR	COOLING SYSTEM	OILING SYSTEM
Stromberg	Type Pump Cap 2¾ Gal	Type Press Cap 6 Qts

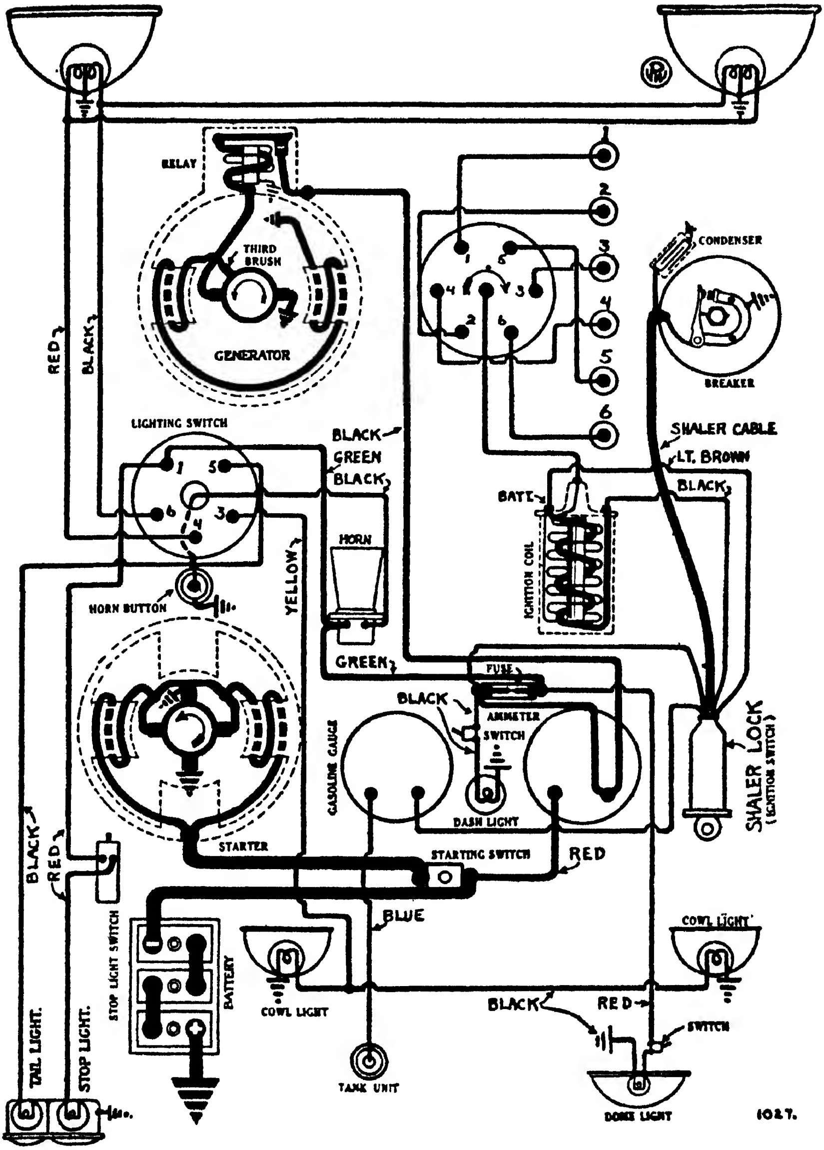
PISTON RING: Width 1/8" Diam 3-1/8" Gap .004"-.006"-.010"

CLUTCH Single Dry Pl. 9-7/8" Dia. GEAR RATIO 4.3 & 4.6 AXLE Semi-floating

BRAKES

Front	Rear	Hand
3/16" x 1¾" x 13" 3/16" x 1¾" x 14-29/32" (2 pcs)	3/16" x 1¾" x 13" 3/16" x 1¾" x 14-29/32" (2 pcs)	5/32" x 2" x 24-5/8" (1 pc)

Lighting	Headlights	Dash & Tail	Side Lamps
Single Contact	21 C.P.	3 C.P.	3 C.P.



DE SOTO WIRING DIAGRAM, 1928-29

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DeSoto Model -- Year 1928-29

Delco-Remy Starter & Generator Delco-Remy Ignition

Regulation	Max. Chg. rate and speed
Third Brush	11-13 amps. 1750-1850 r.p.m.

RELAY Air Gap	Contact Gap	Cut-in R.P.M.
.016"	.020"	575

BATTERY Willard Type -- Volts 6 Amps. 90

Bat. to Frame Con. Positive CONTACT BREAKER Gap .020"

Firing Order 1-5-3-6-2-4 Ignition Timing Piston .030 B.T.D.C. adv.
Red Head " .010 B.T.D.C. adv.

SPARK PLUG	ENGINE	Taxable Hp.
Size Metric Gap .025"	Bore 3" Stroke 4-1/8"	21.6

INTAKE VALVE TIMING	EXHAUST VALVE TIMING
Open 6° A.T.D.C. Close 46° A.B.D.C.	Open 42° B.B.D.C. Close 8° A.T.D.C.

VALVE CLEARANCE Hot Intake .004" Exhaust .006"

CARBURETOR	COOLING SYSTEM	OILING SYSTEM
Stromberg	Type Pump Cap 2½ Gal.	Type Press Cap 6 Qts

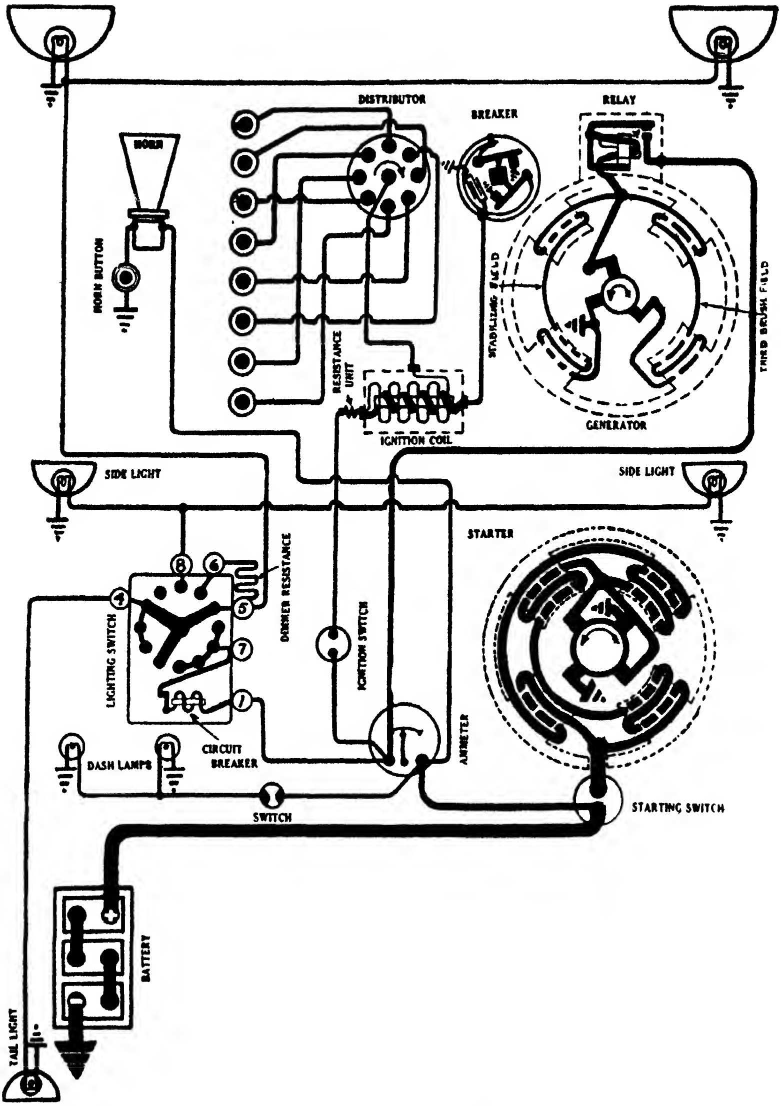
PISTON RING: Width Comp 9/64", Oil 1/8" Diam. 3" Gap .006" - .010"

CLUTCH Single Dry Pl. GEAR RATIO 4.7 AXLE Semi-floating

BRAKES

Front	Rear	Hand
3/16" x 1½" x 9½" 3/16" x 1½" x 11½" (2 pcs)	3/16" x 1½" x 9½" 3/16" x 1½" x 11½" (2 pcs)	5/32" x 2" x 21-3/8" (1 pc)

Lighting	Headlights	Dash & Tail	Side Lamps
Single Contact	21 C.P.	3 C.P.	3 C.P.



DIANA WIRING DIAGRAM, 1927-28

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Diana	Model	Year 1927-28
Delco Starter & Generator		Delco Ignition
Regulation		Max. Chg. rate and speed
Third Brush		12-15 amps. 1600 r.p.m.

RELAY Air Gap	Contact Gap	Cut-in R.P M
.009" - .010"	.015" - .020"	600

BATTERY U.S.L. Type XY-15 Volts 6 Amps 115

Bat to Frame Con Negative CONTACT BREAKER Gap .025"

Firing Order 1-6-2-5-8-3-7-4 Ignition Timing T.D.C. ret.

SPARK PLUG	ENGINE	Taxable Hp.
Size 7/8" Gap .025"	Bore 3" Stroke 4½"	28.8

INTAKE VALVE TIMING	EXHAUST VALVE TIMING
Open 4° A.T.D.C. Close 46° A.B.D.C.	Open 41° B.B.D.C. Close 1° A.T.D.C.

VALVE CLEARANCE Hot Intake .004" Exhaust .006"

CARBURETOR	COOLING SYSTEM	OILING SYSTEM
Stromberg	Type Pump Cap 4½ Gal	Type Press Cap 7½ Qts

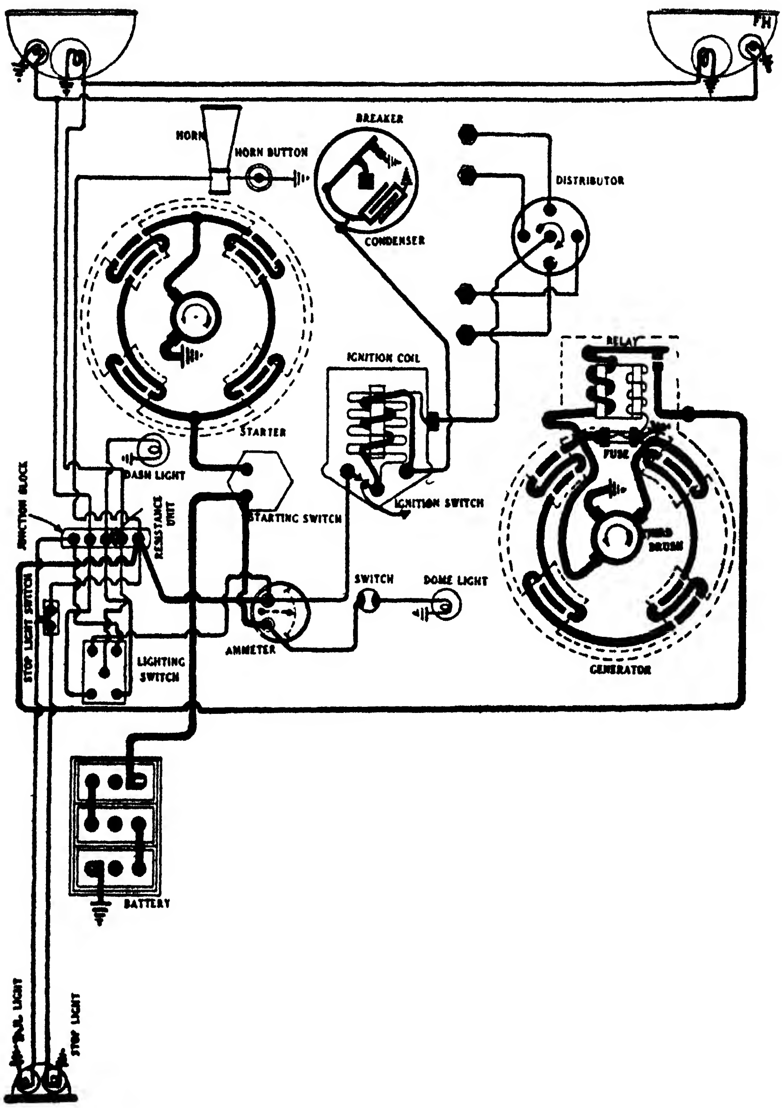
PISTON RING Width 1/8" Diam 3" Gap .004" - .006" -.010"

CLUTCH Single Plate GEAR RATIO 5.1 AXLE 3/4 Floating

BRAKES

Front	Rear	Hand
3/16" x 1¾" x 9-5/8" 3/16" x 1¾" x 19-1/4" (2 pcs)	3/16" x 1¾" x 9-5/8" 3/16" x 1¾" x 19-1/4" (2 pcs)	5/32" x 2" x 24-5/8" (1 pc)

Lighting	Headlights	Dash & Tail	Side Lamps
Single Contact	21 C.P.	3 C P.	3 C.P



DODGE WIRING DIAGRAM, 1927, 4 CYLINDER

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Dodge Model 4 Cyl Year 1927

Northeast Starter & Generator Northeast Ignition

Regulation Max Chg rate and speed

Third Brush 15 amps, 1350 r.p.m.

RELAY Air Gap Contact Gap Cut in R P M

.015" .020" - .025" 660

BATTERY Willard Type WR-13 Volts 6 Amps 84

Bat to Frame Con Positive CONTACT BREAKER Gap .020"

Firing Order 1-3-4-2 Ignition Timing 12° B.T.D.C. adv.

SPARK PLUG ENGINE Taxable Hp

Size 7/8" Gap .025" Bore 3-7/8" Stroke 4½" 24.03

INTAKE VALVE TIMING EXHAUST VALVE TIMING

Open 3° A.T.D.C. Close 46° A.B.D.C. Open 42° B.B.D.C. Close 1° A.T.D.C.

VALVE CLEARANCE Hot Intake .004" - .006" Exhaust .004" - .006"

CARBURETOR COOLING SYSTEM OILING SYSTEM

Stewart Type Pump Cap 3½ Gal Type Grav. & splash Cap 6 Qts

PISTON RING Width Comp 1/8" Oil 5/32" Diam 3-7/8" Gap .005" min. comp. .1004" min. oil.

CLUTCH Single Dry Disc GEAR RATIO 3.769 AXLE Semi-floating

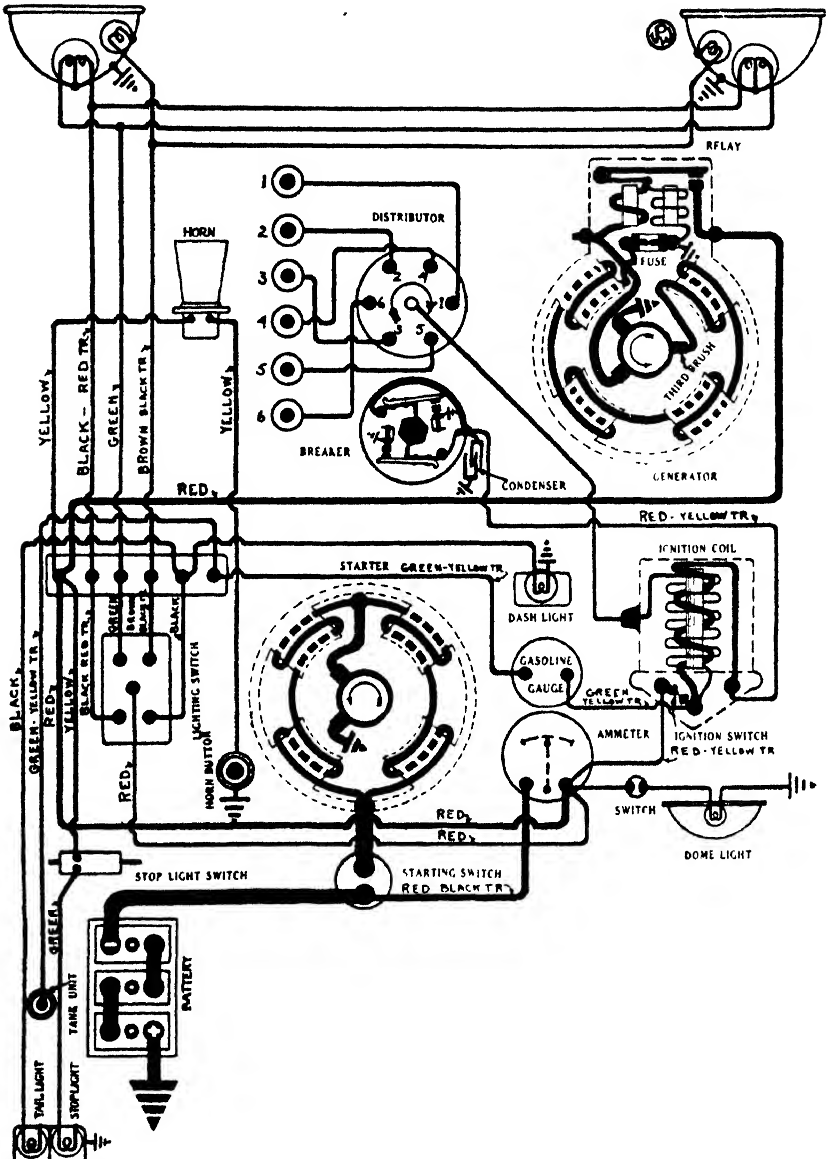
BRAKES

Front Rear Hand

3/16" x 2" x 36-1/8" (per wheel) do (per wheel) 3/16" x 2½" x 17-15/32"

Lighting Headlights Dash & Tail Side Lamps

Contact Dbl. 21-21 C P. Sgle 3 C P -- C P.



DODGE WIRING DIAGRAM, 1927-28, VICTORY SIX

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Dodge Model Victory Six Year 1927-28

Northeast Starter & Generator. Northeast Ignition

Regulation Max. Chg. rate and speed

Third Brush 15 amps, 1350 r.p.m.

RELAY Air Gap .015" Contact Gap .020" - .025" Cut-in R P M 660

BATTERY Willard Type CWR-15 Volts 6 Amps 100

Bat to Frame Con Positive CONTACT BREAKER Gap .020"

Firing Order 1-5-3-6-2-4 Ignition Timing 4° B.T.D.C. full adv.

SPARK PLUG Size 7/8" Gap .025"

ENGINE Bore 3-3/8" Stroke 3-7/8"

Taxable Hp 27.34

INTAKE VALVE TIMING Open T.D.C. Close 48°A.T.D.C.

EXHAUST VALVE TIMING Open 50°B.B.D.C. Close 6° A.T.D.C.

VALVE CLEARANCE Hot Intake .004" - .006" Exhaust .004" - .006"

CARBURETOR Stromberg

COOLING SYSTEM Type Pump Cap 3-9/16 G.

OILING SYSTEM Type Press Cap 6 Qts.

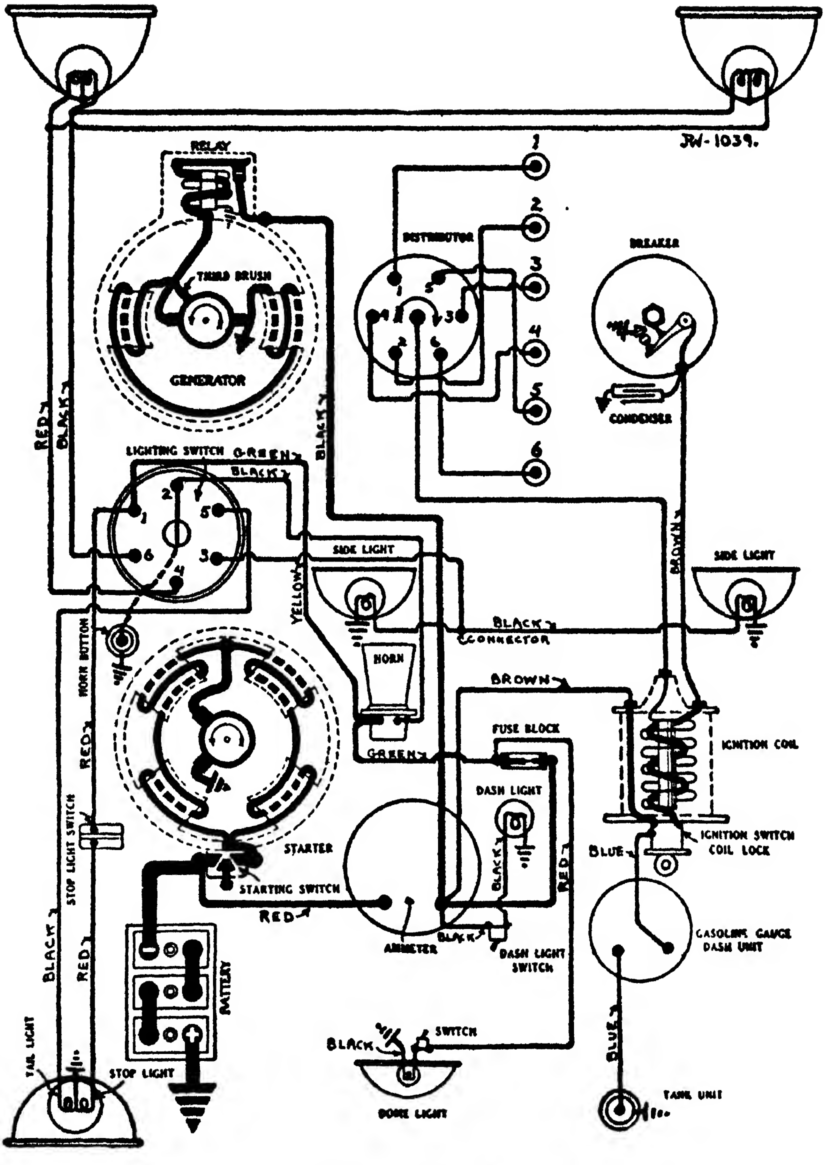
PISTON RING Width Comp 1/8" Oil 5/32" Diam 3-3/8" Gap Comp .005" min. Oil .004" "

CLUTCH Single Dry Disc GEAR RATIO 4.455 AXLE Semi-floating

BRAKES

Front	Rear	Hand
3/16" x 1¾" x 22-3/16" (per wheel)	do	3/16" x 2½" x 17-15/32"

Lighting	Headlights	Dash & Tail	Side Lamps
Contact	Dbl-21-21 C P.	Sgl 3 C P.	Sgl 3 C P



DODGE WIRING DIAGRAM, 1928, SIX

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Dodge Model Standard Six Year 1928

Northeast Starter & Generator Northeast Ignition

Regulation	Max. Chg. rate and speed
Third Brush	15 amps. 1350 r.p.m.

RELAY Air Gap	Contact Gap	Cut-in R.P.M.
.015"	.020" - .025"	660

BATTERY Willard Type CWR-15 Volts 6 Amps 100

Bat. to Frame Con. Positive CONTACT BREAKER Gap .020"

Firing Order 1-5-3-6-2-4 Ignition Timing 4° B.T.D.C. full adv.

SPARK PLUG	ENGINE	Taxable Hp.
Size 7/8" Gap .025"	Bore 3-3/8" Stroke 3-7/8"	27.34

INTAKE VALVE TIMING	EXHAUST VALVE TIMING
Open T.D.C. Close 48° A.T.D.C.	Open 50° B.B.D.C. Close 6° A.T.D.C.

VALVE CLEARANCE Hot Intake .004" - .006" Exhaust .004" - .006"

CARBURETOR	COOLING SYSTEM	OILING SYSTEM
Stromberg	Type Pump Cap 3-3/8 Gal	Type Press Cap 6 Qts

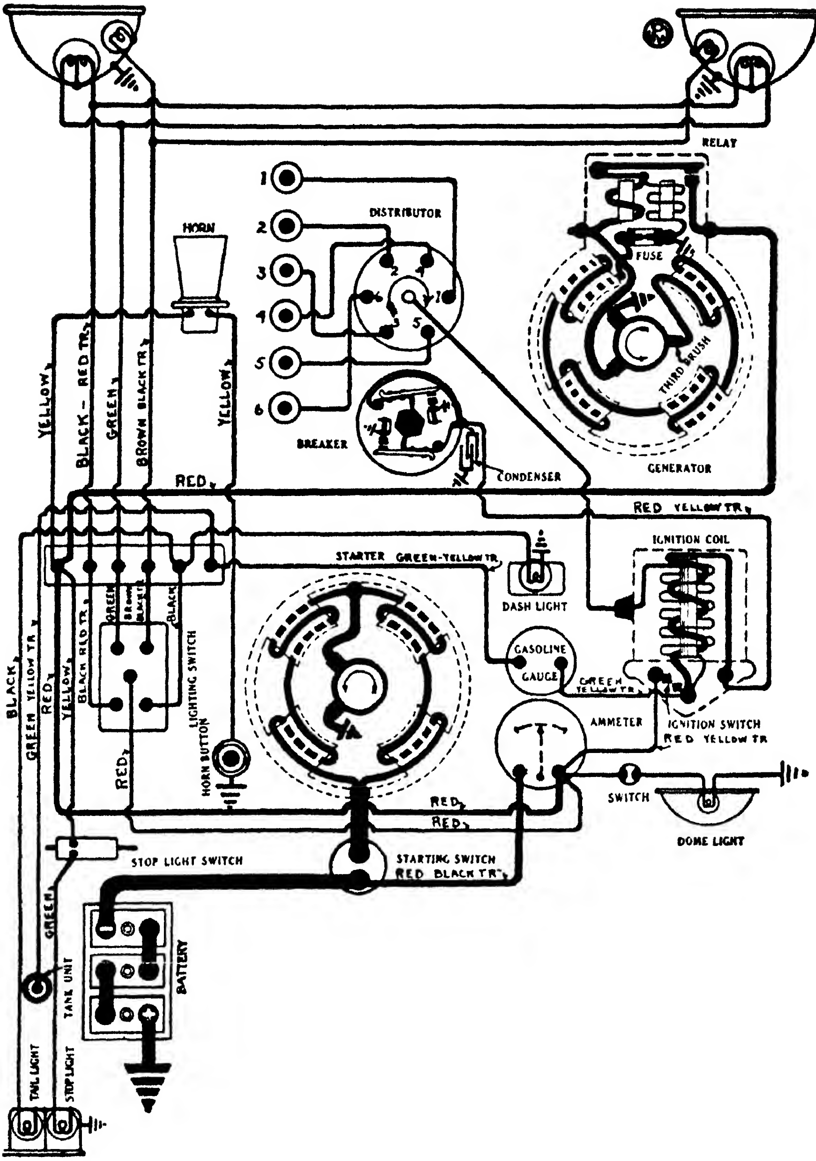
PISTON RING: Width Comp 1/8", Oil 5/32" Diam 3-3/8" Gap Comp .005" min, Oil .004" "

CLUTCH Single Dry D. GEAR RATIO 4.455 AXLE Semi-floating

BRAKES

Front	Rear	Hand
3/16" x 2" x 36-1/8" (per wheel)	do	3/16" x 2½" x 17-15/32"

Lighting	Headlights	Dash & Tail	Side Lamps
Contact	Dbl-21-3 C.P.	Sgl 3 C.P.	Sgl 3 C.P.



DODGE WIRING DIAGRAM, 1928, STANDARD SIX

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Dodge Model Six Year 1928

Northeast Starter & Generator Northeast Ignition

Regulation	Max. Chg. rate and speed
Third Brush	12 amps, 2000 r.p.m.

RELAY Air Gap	Contact Gap	Cut-in R.P.M.
.015"	.020" - .025"	660

BATTERY Willard Type WSB-15 Volts 6 Amps 100

Bat. to Frame Con. Positive CONTACT BREAKER Gap .020"

Firing Order 1-5-3-6-2-4 Ignition Timing 4° B.T.D.C. full adv.

SPARK PLUG	ENGINE	Taxable Hp.
Size 7/8" Gap .025"	Bore 3-3/8" Stroke 3-7/8"	27.34

INTAKE VALVE TIMING	EXHAUST VALVE TIMING
Open T.D.C. Close 48° A.B.D.C.	Open 50° B.B.D.C. Close 6° A.T.D.C.

VALVE CLEARANCE Hot Intake .004" - .006" Exhaust .004" - .006"

CARBURETOR	COOLING SYSTEM	OILING SYSTEM
Stromberg	Type Pump Cap. 4 Gal	Type Press Cap. 6 Qts

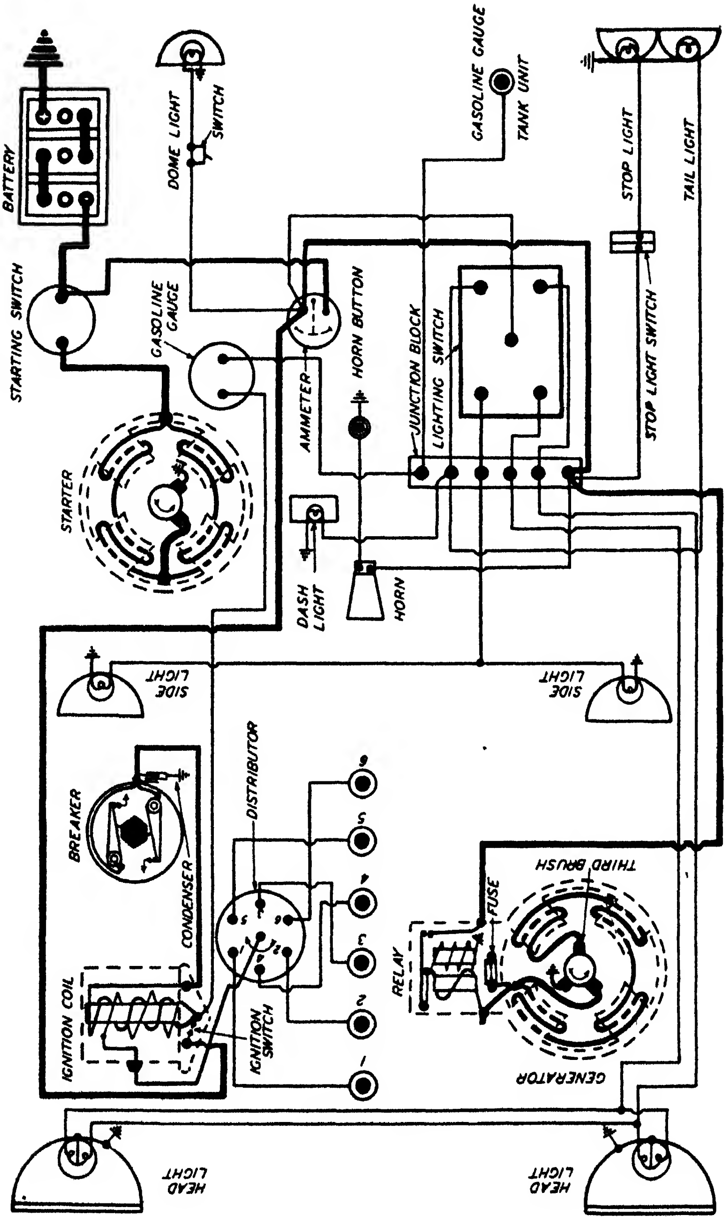
PISTON RING: Width Comp. 1/8" Oil 5/32" Diam. 3-3/8" Gap Comp. .005" min Oil .004" "

CLUTCH Single Dry Dis GEAR RATIO 4.727 AXLE Semi-floating

BRAKES

Front	Rear	Hand
3/16" x 1¾" x 27-5/8" (per wheel)	Same	5/32" x 2½" x 19¼"

Lighting	Headlights	Dash & Tail	Side Lamps
Contact	Dbl 21-21 C.P.	Sgl 3 C.P	Sgl 3 C.P.



DODGE WIRING DIAGRAM, 1928-29, SENIOR SIX

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Dodge ... Model ... Senior Six ... Year ... 1928-29

Northeast ... Starter & Generator ... Northeast ... Ignition

Regulation — Max. Chg. rate and speed

Third Brush ... 14½ - 15½ amps, 1350 r.p.m.

RELAY Air Gap — Contact Gap — Cut-in R.P.M.

.015" ... .020" - .025" ... 660

BATTERY ... Willard ... Type ... WSB-17 ... Volts ... 6 ... Amps ... 117

Bat. to Frame Con. ... Positive ... CONTACT BREAKER Gap ... .020"

Firing Order ... 1-5-3-6-2-4 ... Ignition Timing ... 10° B.T.D.C. full adv.

SPARK PLUG — ENGINE — Taxable Hp.

Size ... 7/8" ... Gap ... .025" Bore ... 3-3/8" ... Stroke ... 4½" ... 27.34

INTAKE VALVE TIMING — EXHAUST VALVE TIMING

Open ... T.D.C. ... Close ... 48° A.B.D.C. Open ... 50° B.B.D.C. Close ... 6° A.T.D.C.

VALVE CLEARANCE ... Hot ... Intake ... .004" .006" ... Exhaust ... .004" - .006"

CARBURETOR — COOLING SYSTEM — OILING SYSTEM

Stromberg ... Type ... Pump ... Cap ... 4-5/16 G. Type ... Press ... Cap ... 7 Qts.

PISTON RING: Width ... Comp 1/8" Oil 5/32" ... Diam ... 3-3/8" ... Gap ... Comp. .005" min. Oil. .004" "

CLUTCH ... Single Dry Disc GEAR RATIO ... 4.455 ... AXLE ... Semi-floating

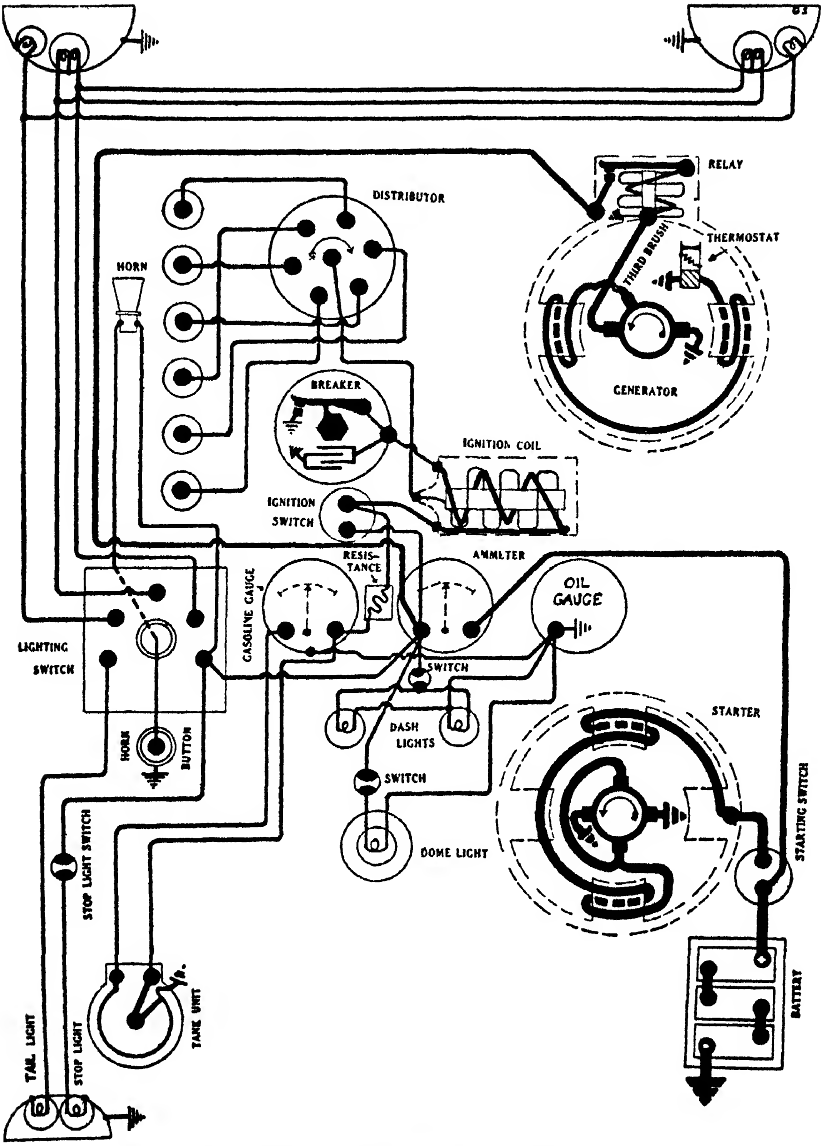
BRAKES

Front — Rear — Hand

3/16" x 1¾" x 26⅝" (per wheel) ... 3/16" x 1¾" x 26⅝" (per wheel) ... 3/16" x 2½" x 17-15/16"

Lighting — Headlights — Dash & Tail — Side Lamps

... Contact ... Dbl 21-21 C.P. ... Sgl 3 C.P. ... Sgl 3 C.P.



ELCAR WIRING DIAGRAM, 1927-28, MODEL 6-70

Reproduced from National Service Manual by permission of National Automotive Service

Elcar Model 6-70 Year 1927-28

Delco-Remy Starter & Generator Delco-Remy Ignition

Regulation	Max. Chg. rate and speed
Third Brush	11-13 amps, 1800-2000 r.p.m.

RELAY Air Gap	Contact Gap	Cut-in R.P.M.
.014" - .018"	.018" - .024"	600

BATTERY U.S.L. Type XY-13 Volts 6-8 Amps 100

Bat. to Frame Con. Negative CONTACT BREAKER Gap .018"

Firing Order 1-5-3-6-2-4 Ignition Timing T.D.C. to 5° after

SPARK PLUG	ENGINE	Taxable Hp.
Size 7/8" Gap .030"	Bore 2-7/8" Stroke 4-3/4"	19.84

INTAKE VALVE TIMING	EXHAUST VALVE TIMING
Open T.D.C. Close 35° A.B.D.C.	Open 42° B.B.D.C. Close 5° A.T.D.C.

VALVE CLEARANCE Hot Intake .006" Exhaust .008"

CARBURETOR	COOLING SYSTEM	OILING SYSTEM
Swan	Type Pump Cap 3-1/4 G.	Type Press Cap 5 Qts

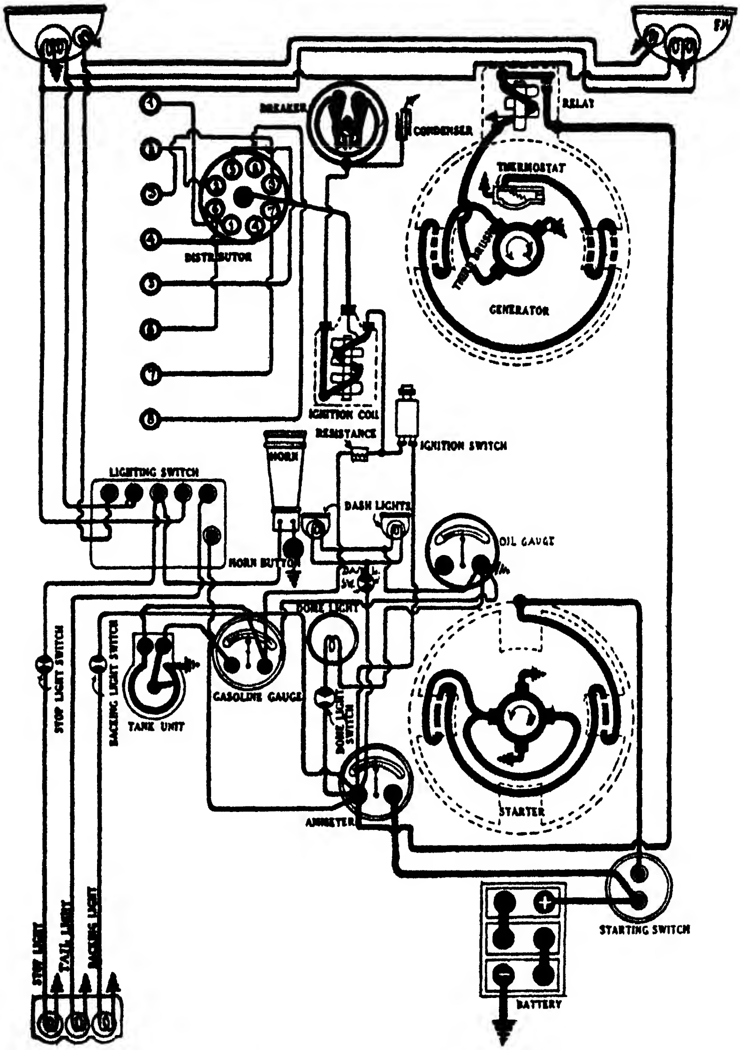
PISTON RING: Width 1/8" Diam 2-7/8" Gap .006-.012"

CLUTCH Long HP GEAR RATIO 3.07 AXLE Semi-floating

BRAKES

Front	Rear	Hand
3/16" x 1½" x 11½" (2 pos)	Same	5/32" x 2" x 18½"

Lighting	Headlights	Dash & Tail	Side Lamps
Double Contact	21-21 C.P.	2 C.P.	none C.P.



ELCAR WIRING DIAGRAM, 1928, MODEL 8-120

Reproduced from National Service Manual by permission of National Automotive Service

Elcar Model 8-120 Year 1928

Delco-Remy Starter & Generator Delco-Remy Ignition

Regulation: Third Brush

Max Chg rate and speed: 15 amps, 1800 r.p.m.

RELAY Air Gap .014"-.018" Contact Gap .018"-.024" Cut in R P M 700

BATTERY U.S.L. Type 3 HVX Volts 6 Amps 90

Bat to Frame Con Negative CONTACT BREAKER Gap .018"

Firing Order 1-6-2-5-8-3-7-4 Ignition Timing T.D.C. to 5° A.T.D.C.ret.

SPARK PLUG: Size 7/8" Gap .030"

ENGINE: Bore 3-1/4" Stroke 4-1/2"

Taxable Hp 33.8

INTAKE VALVE TIMING: Open 5°A.T.D.C. Close 45°A.B.D.C.

EXHAUST VALVE TIMING: Open 50°B.B.D.C. Close 10°A.T.D.C.

VALVE CLEARANCE Hot Intake .006" Exhaust .006"

CARBURETOR: Schebler

COOLING SYSTEM: Type Pump Cap 5½ Gal

OILING SYSTEM: Type Press Cap 8 Qts

PISTON RING Width 1/8" Diam 3-1/4" Gap .004-.012"

CLUTCH Long 78 A GEAR RATIO 4.82 AXLE Semi-floating

BRAKES

Front: 3/16" x 2" x 40" per wheel

Rear: 3/16" x 2" x 40" per wheel

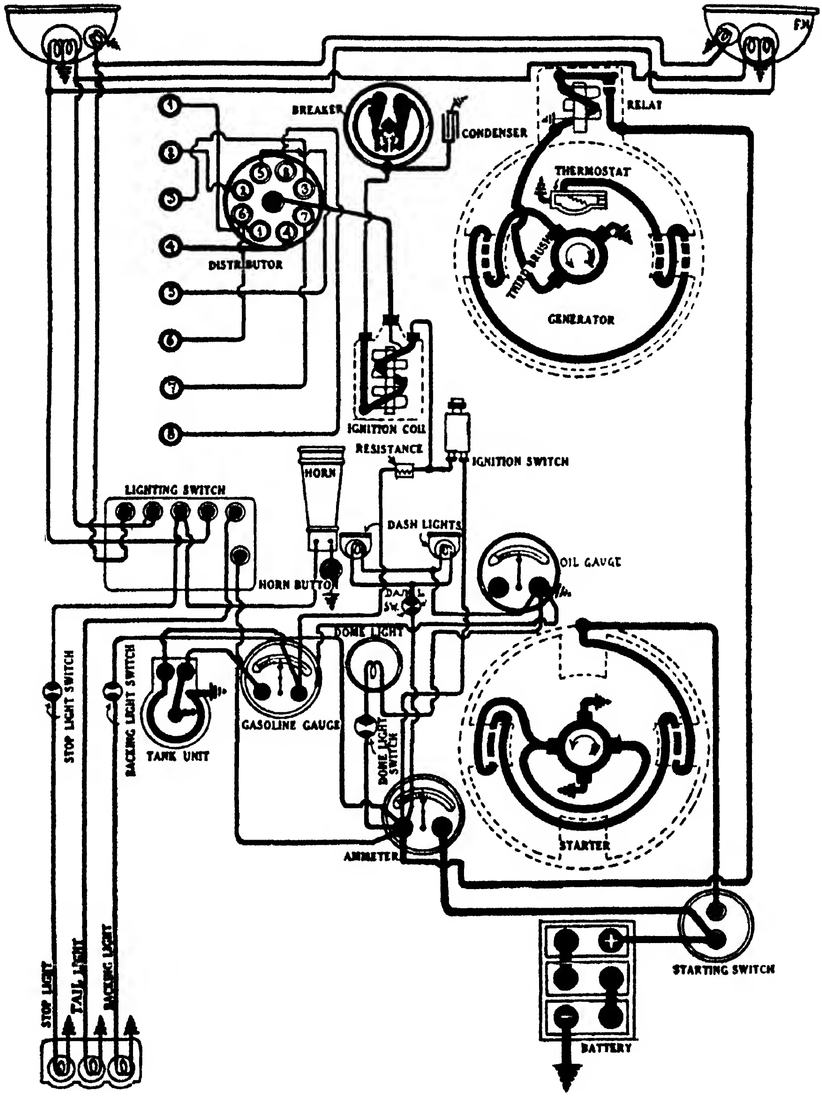
Hand: 5/32" x 2" x 24-5/8"

Lighting: Double Contact

Headlights: 21 C P

Dash & Tail: 3 C P

Side Lamps: 3 C P



ELCAR WIRING DIAGRAM, 1929, MODELS 8-95 AND 8-96

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Elcar Model 8-95, 96 Year 1929

Delco-Remy Starter & Generator Delco-Remy Ignition

Regulation: Third Brush

Max Chg rate and speed: 11-13 amps, 18-2000 r.p.m.

RELAY Air Gap	Contact Gap	Cut-in R P M
.014"-.018"	.018-.024"	675

BATTERY U.S.L. Type -- Volts 6-8 Amps 100

Bat to Frame Con Negative CONTACT BREAKER Gap .030"

Firing Order 1-6-2-5-8-3-7-4 Ignition Timing T.D.C. to 5° A.T.D.C. ret.

SPARK PLUG		ENGINE		Taxable Hp
Size 7/8"	Gap .030"	Bore 2-7/8"	Stroke 4-3/4"	26.45

INTAKE VALVE TIMING		EXHAUST VALVE TIMING	
Open T.D.C.	Close 35°A.B.D.C.	Open 42°B.B.D.C.	Close 5°A.T.D.C.

VALVE CLEARANCE Hot Intake .006" Exhaust .008"

CARBURETOR	COOLING SYSTEM	OILING SYSTEM
Schebler	Type Pump Cap 4½ Gal	Type Press Cap 8 Qts

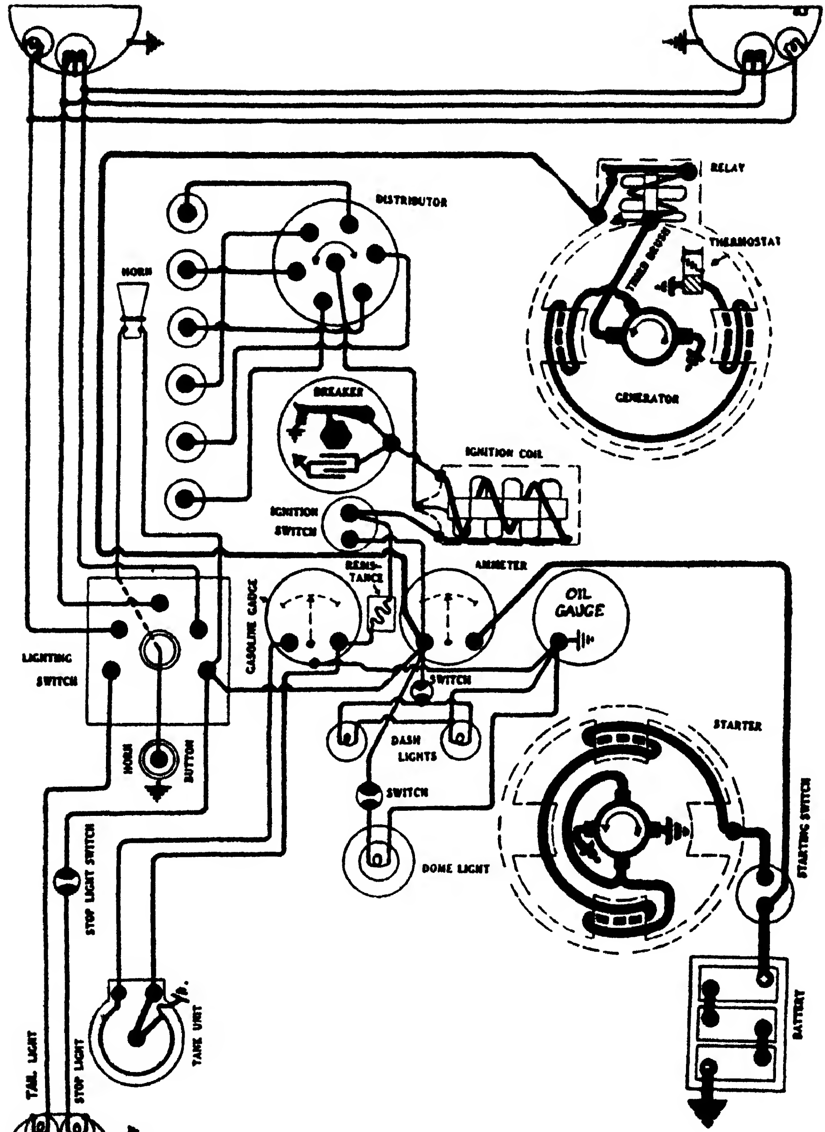
PISTON RING Width 1/8" Diam 2-7/8" Gap .003-.010"

CLUTCH Long TC GEAR RATIO --- AXLE Semi-floating

BRAKES

Front	Rear	Hand
3/16" x 1¾" x 26-5/8" per wheel	3/16" x 1¾" x 26-5/8" per wheel	5/32" x 2" x 18"

Lighting	Headlights	Dash & Tail	Side Lamps
Double Contact	21 C P	3 C P	3 C.P



ELCAR WIRING DIAGRAM, 1929, MODEL 6-75

Reproduced from National Service Manual by permission of National Automotive Service

Elcar Model 6-75 Year 1929

Delco-Remy Starter & Generator Delco-Remy Ignition

Regulation	Max. Chg. rate and speed
Third Brush	11-13 amps,18-2000 r.p.m.

RELAY Air Gap	Contact Gap	Cut-in R.P.M.
.014"-.018"	.018"-.024"	675

BATTERY U.S.L. Type X-V-13 Volts 6-8 Amps 100

Bat. to Frame Con. Negative CONTACT BREAKER Gap .030

Firing Order 1-5-3-6-2-4 Ignition Timing T.D.C. to 5° A.T.D.C. ret.

SPARK PLUG	ENGINE	Taxable Hp.
Size 7/8" Gap .030"	Bore 2-7/8" Stroke 4-3/4"	19.84

INTAKE VALVE TIMING	EXHAUST VALVE TIMING
Open T.D.C. Close 35° A.B.D.C.	Open 42° B.B.D.C. Close 50° A.T.D.C.

VALVE CLEARANCE Hot Intake .006" Exhaust .008"

CARBURETOR	COOLING SYSTEM	OILING SYSTEM
Schebler	Type Pump Cap 3½ Gal	Type Press Cap 6 Qts

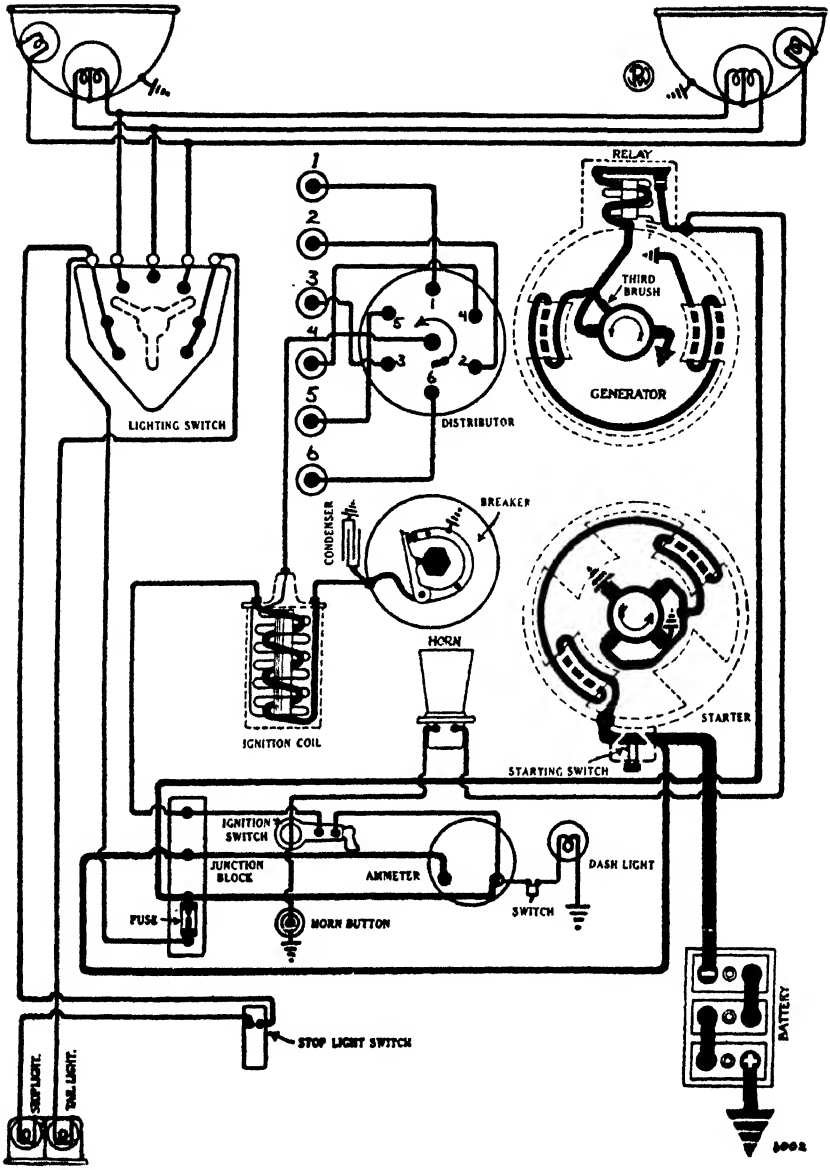
PISTON RING: Width 1/8" Diam 2-7/8" Gap .003-.010"

CLUTCH Long GEAR RATIO 44.9 AXLE Semi-floating

BRAKES

Front	Rear	Hand
3/16" x 1½" x 21-23/32" per wheel	3/16" x 1½" x 21-23/32" Per wheel	5/32" x 2" x 18"

Lighting	Headlights	Dash & Tail	Side Lamps
Double Contact	21 C.P.	3 C.P.	3 C.P.



ERSKINE WIRING DIAGRAM, 1928-29, MODELS 50, 51, AND 52
Reproduced from National Service Manual by permission of National Automotive Service

Erskine Model 50-51-52 Year 1928-29

Delco-Remy Starter & Generator Delco-Remy Ignition

Regulation	Max Chg rate and speed
Third Brush	16 amps, 1700 r.p.m.

RELAY Air Gap	Contact Gap	Cut in R P M
.014" - .018"	.015" - .025"	800

BATTERY Willard Type WR-13 Volts 6 Amps 84

Bat to Frame Con Positive CONTACT BREAKER Gap .016"-.024"

Firing Order 1-5-3-6-2-4 Ignition Timing 7½°A.T.D.C.

SPARK PLUG		ENGINE		Taxable Hp.
Size 7/8"	Gap .020-.030"	Bore 50-2-5/8" 51-52-2-3/4"	Stroke 4-1/2"	18.15

INTAKE VALVE TIMING		EXHAUST VALVE TIMING	
Open 5°A.T.D.C.	Close 45°A.B.D.C.	Open 43°B.B.D.C.	Close 12°A.T.D.C.

VALVE CLEARANCE Hot Intake .008" Exhaust .008"

CARBURETOR	COOLING SYSTEM	OILING SYSTEM
Schebler	Type Pump Cap 3¼ Gal	Type Press Cap 5 Qt.

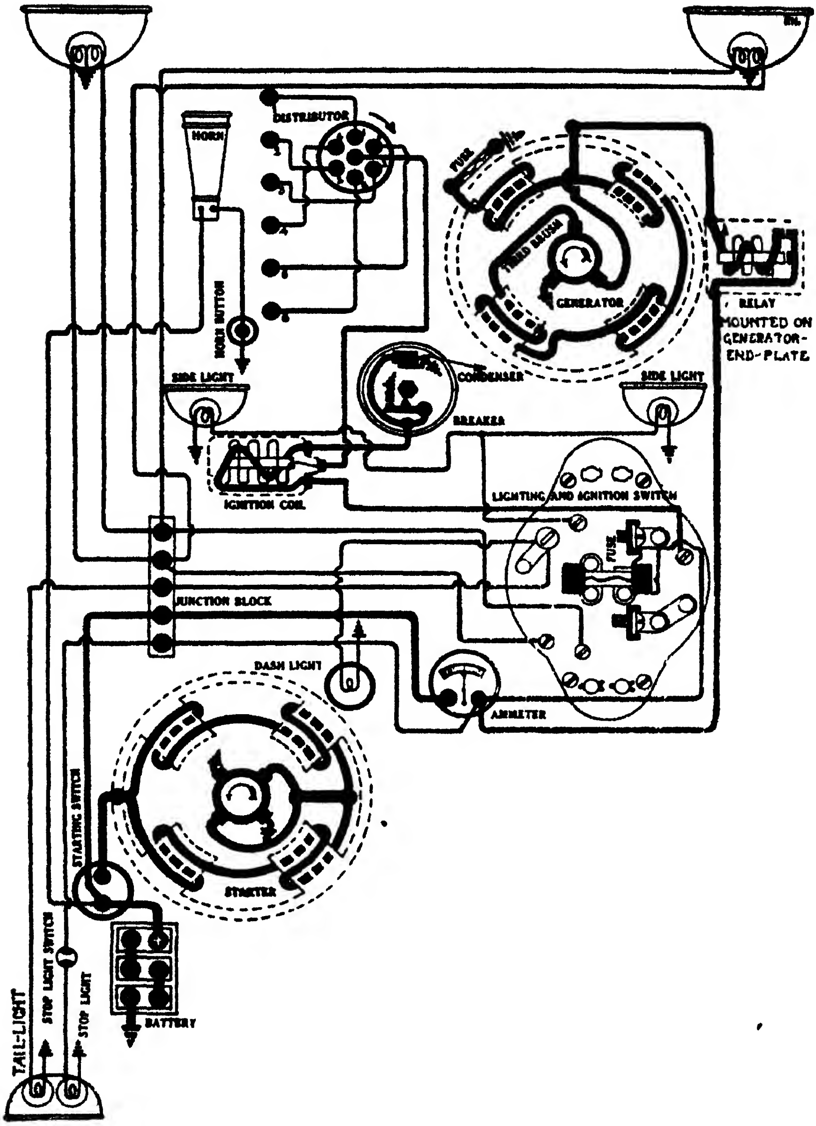
PISTON RING W'd'th Comp 1/8", Oil 3/16" Diam 2-5/8", 2-3/4" Gap .008"-.016"

CLUTCH 8⅝" x 9/64" GEAR RATIO 4-7/9, 5-1/8 AXLE Semi-floating

BRAKES

Front	Rear	Hand
5/32" x 1¾" x 12" (2 pcs) 5/32" x 1¾" x 9¼" (4 pcs)	Same	Same as service

Lighting	Headlights	Dash & Tail	Side Lamps
Single Contact	21 C P	3 C P	3 C P



ESSEX WIRING DIAGRAM, 1927

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Essex Model Year 1927

Autolite Starter & Generator Autolite Ignition

Regulation | Max. Chg. rate and speed

Third Brush | 13 amps. 1500 r.p.m.

RELAY Air Gap .006" Contact Gap .030" Cut-in R.P.M. 650

BATTERY Prestolite Type Volts 6 Amps. 105

Bat. to Frame Con. Negative CONTACT BREAKER Gap .020" - .024"

Firing Order 1-5-3-6-2-4 Ignition Timing 3/4" ahead T.D.C.

SPARK PLUG | ENGINE | Taxable Hp.

Size Metric Gap .030" Bore 2-11/16" Stroke 4-1/4" 17.32

INTAKE VALVE TIMING | EXHAUST VALVE TIMING

Punch marks on chain coincide with those on sprockets
Open Close Open Close

VALVE CLEARANCE Hot- Intake .004" Exhaust .006"

CARBURETOR | COOLING SYSTEM | OILING SYSTEM

Stewart Type Ther. Sy Cap 19 Qts Type Cir. Sp. Cap 5 Qts.

PISTON RING: Width 1/8" Diam. 2-11/16" Gap .008"

CLUTCH Single Plate GEAR RATIO 5.6 AXLE Semi-floating

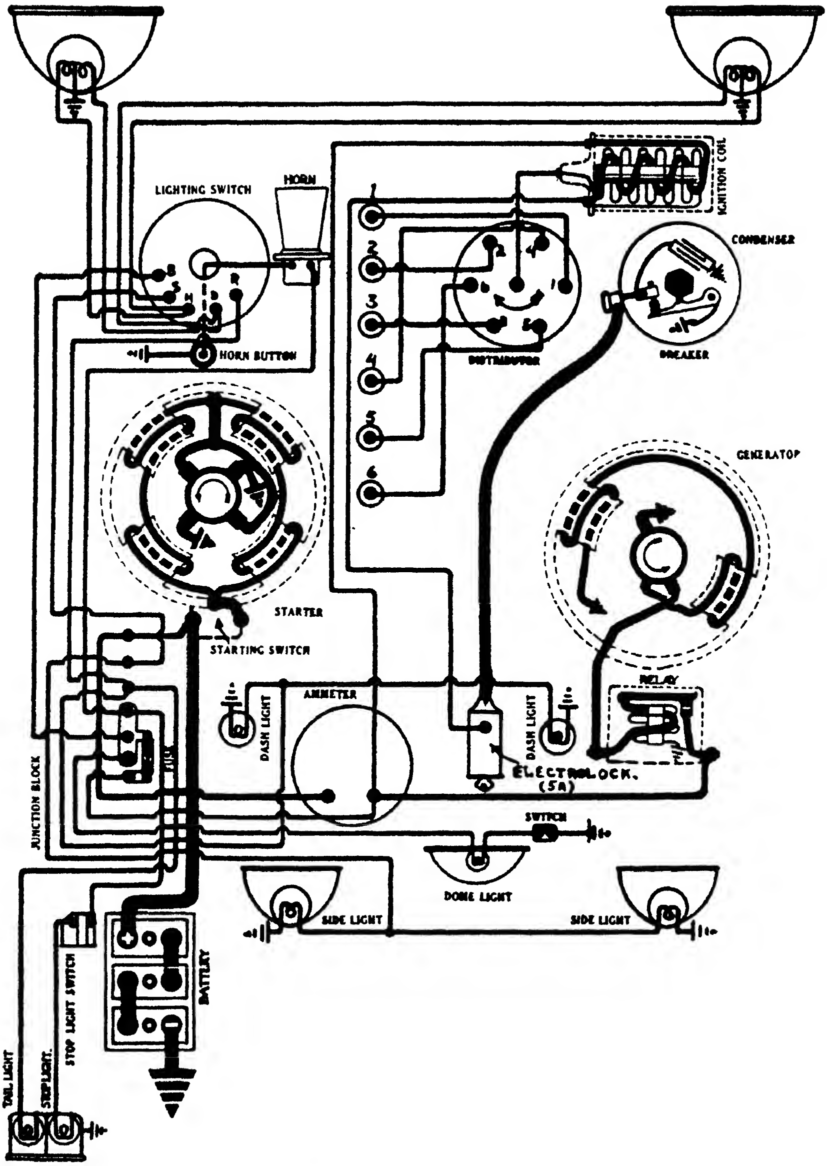
BRAKES

Front none

Rear 3/16" x 1¾" x 39-3/8" (2 pcs)

Hand 3/16" x 1¾" x 35" (2 pcs)

Lighting Single Contact | Headlights 21 C.P. | Dash & Tail 2 C.P. | Side Lamps 2 C.P.



ESSEX WIRING DIAGRAM, 1928

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Essex .... Model .... Year 1928

Autolite .... Starter & Generator .... Autolite .... Ignition

Regulation — Max. Chg. rate and speed

Third Brush .... 13 amps, 1500 r.p.m.

RELAY Air Gap — Contact Gap — Cut-in R.P.M.

.006" .... .030" 650

BATTERY .... Exide .... Type .... Volts .... 6 .. Amps. 105

Bat. to Frame Con. .... Negative .... CONTACT BREAKER Gap .... .020"-.024"

Firing Order .... 1-5-3-6-2-4 .... Ignition Timing .... 3/4" ahead T.D.C.

SPARK PLUG — ENGINE — Taxable Hp.

Size Metric .... Gap .... .030" .... Bore 2-11/16" Stroke .... 4½" 17.32

INTAKE VALVE TIMING — EXHAUST VALVE TIMING

(Punch marks on chain coincide with those on sprockets

(Open .... Close .... Open .... Close ....

VALVE CLEARANCE .... Hot .... Intake .004" .... Exhaust .... .006"

CARBURETOR — COOLING SYSTEM — OILING SYSTEM

Stewart .... Type Therm. Cap. 19 Qt. Type Cir Splash .... Cap. .... 5 Qts.

PISTON RING: Width .... 1/8" .... Diam. .... 2-11/16" .... Gap .... .008"

CLUTCH Single Plate .... GEAR RATIO .... 5.6 .... AXLE .... Semi-floating

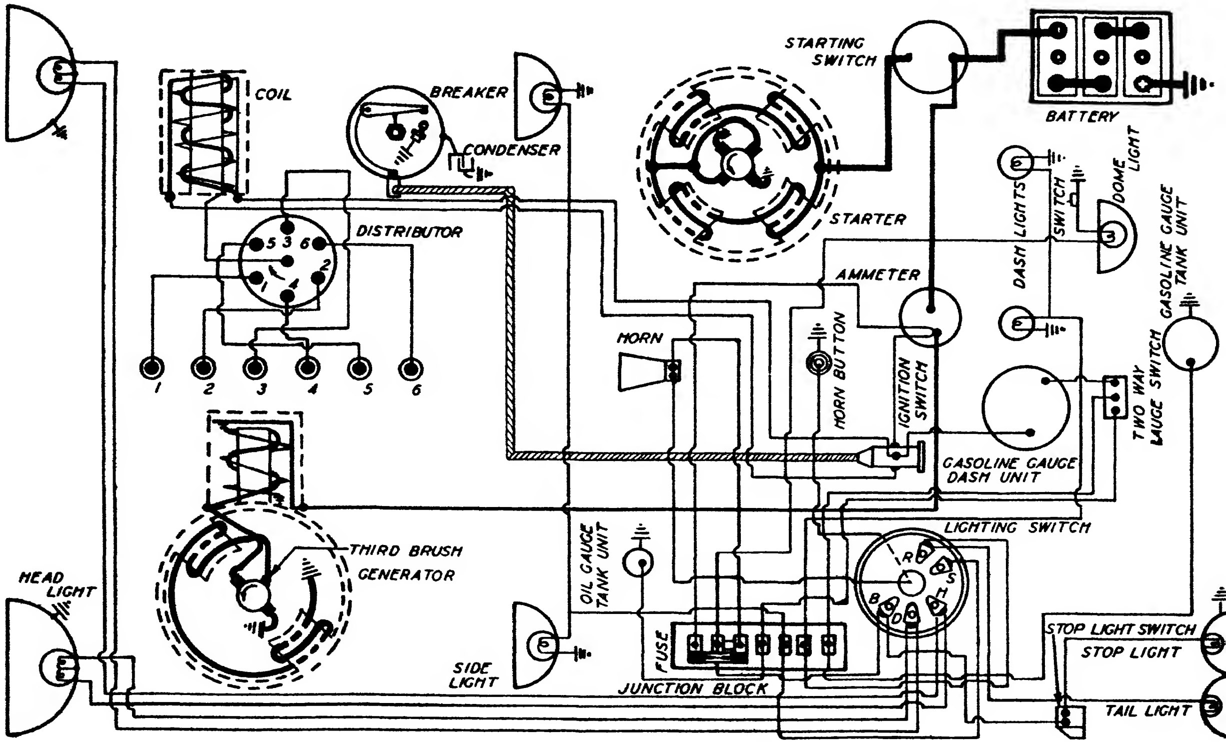
BRAKES

Front — Rear — Hand

5/32" x 1½" x 9½" (4 pcs) .... Same ....
5/32" x 1½" x 12" (2 pcs)

Lighting — Headlights — Dash & Tail — Side Lamps

Single .... Contact .... 21 .... C.P. .... 2 .... C.P. .... 2 .... C.P.



ESSEX WIRING DIAGRAM, 1929, CHALLENGER

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Essex Model Challenger Year 1929

Autolite Starter & Generator Autolite Ignition

Regulation Max Chg rate and speed

Third Brush 13 amps, 1500 r.p.m.

RELAY Air Gap Contact Gap Cut in R P M

.006" .030" 650

BATTERY Exide Type Volts 6 Amps 105

Bat to Frame Con Negative CONTACT BREAKER Gap .020"-.024"

Firing Order 1-5-3-6-2-4 Ignition Timing 3/4" ahead T.D.C.

SPARK PLUG ENGINE Taxable Hp

Size Metric Gap .020" Bore 2-3/4" Stroke 4-1/2" 18.2

INTAKE VALVE TIMING EXHAUST VALVE TIMING

(Punch marks on chain coincide with those on sprockets
(Open Close Open Close

VALVE CLEARANCE Hot Intake .004" Exhaust .006"

CARBURETOR COOLING SYSTEM OILING SYSTEM

Marvel Type Thermo Cap 19 Qts Type Cir. Splash Cap 6 Qts

PISTON RING Width 1/8" Diam 2¾" Gap .008"

CLUTCH Single Plate GEAR RATIO 5-1/11 AXLE Semi-floating

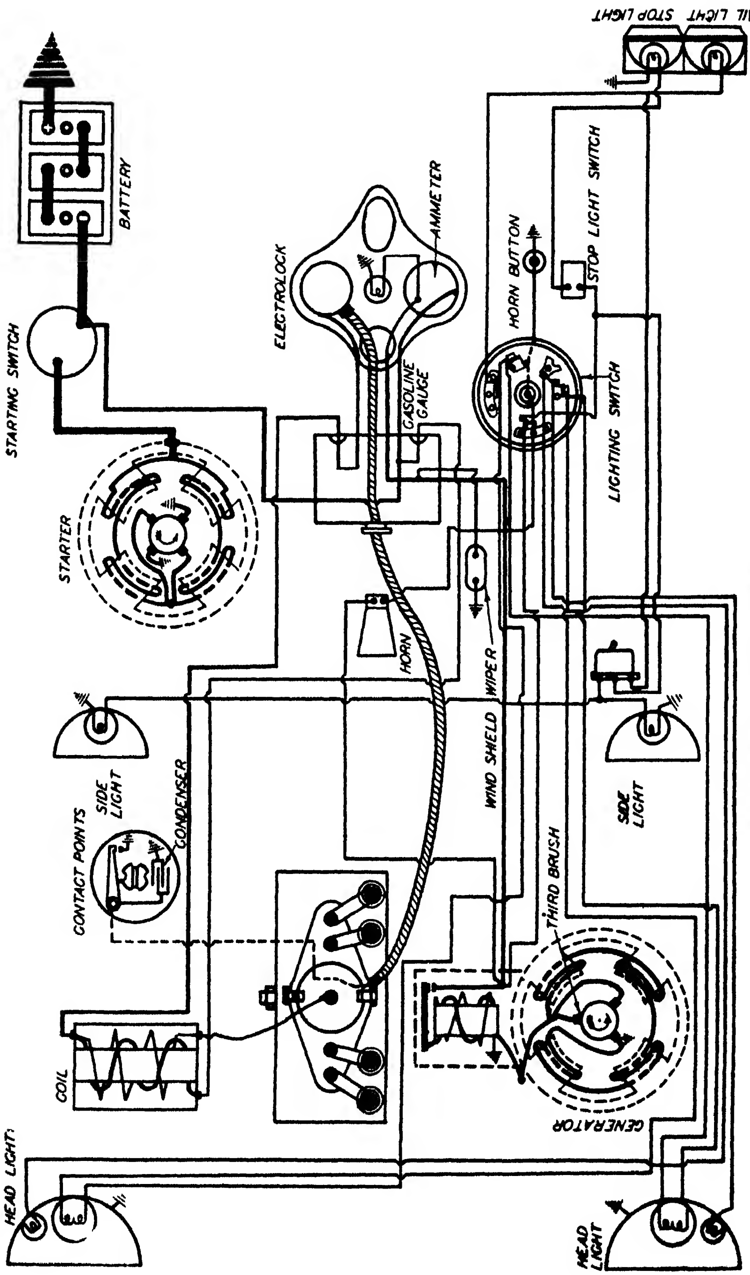
BRAKES

Front Rear Hand

5/32" x 1½" x 12¼" (4 pcs) Same

Lighting Headlights Dash & Tail Side Lamps

Single Contact 21 C P 2 C P 2 C P



FORD WIRING DIAGRAM, 1928-29, MODEL A

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Ford Model A Year 1928-29

Ford Starter & Generator Ford Ignition

Regulation	Max. Chg. rate and speed
Third Brush	6 amps sum. 10 amps wint.

RELAY Air Gap	Contact Gap	Cut-in R.P.M.
.010"	.015"-.020"	725

BATTERY Ford Type 11 plate Volts 6 Amps 98

Bat. to Frame Con. Positive CONTACT BREAKER Gap .015"-.018"

Firing Order 1-2-4-3 Ignition Timing Use timing pin

SPARK PLUG	ENGINE	Taxable Hp.
Size 7/8" Gap .025"	Bore 3-7/8" Stroke 4-1/4"	24.03

INTAKE VALVE TIMING	EXHAUST VALVE TIMING
Open 7½° B.T.D.C. Close 48½° A.B.D.C.	Open 51½° B.B.D.C. Close 4½° A.T.D.C.

VALVE CLEARANCE Cold Intake .011-.013" Exhaust .011-.013"

CARBURETOR	COOLING SYSTEM	OILING SYSTEM
Ford-Zenith	Type Pump Cap. 3 Gal	Type Splash Cap. 5 Qts

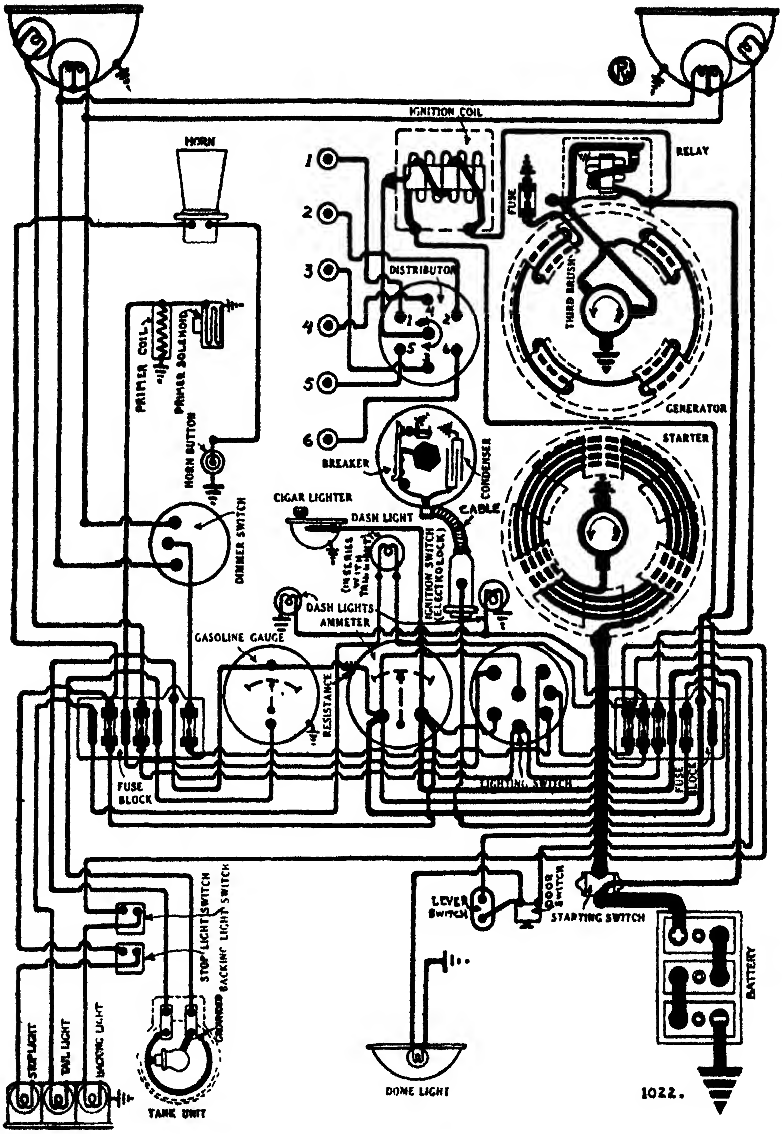
PISTON RING: Width 1/8" Diam. 3-7/8" Gap .006-.014"

CLUTCH Mult. Disc GEAR RATIO 3.7 AXLE 3/4 floating

BRAKES

Front	Rear	Hand
1½"x.182"x14-3/8" (4 pcs)	Same	1"x.182"x 28¾" (2 pcs)

Lighting	Headlights	Dash & Tail	Side Lamps
Single Contact	21 C.P.	3 C.P.	3 C.P



FRANKLIN WIRING DIAGRAM, 1927, MODEL 12-A

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Franklin Model 12-A Year 1927

Dyneto Starter & Generator Northeast Ignition

Regulation	Max. Chg. rate and speed
Third Brush	12-16 amps, 1200 r.p.m.

RELAY Air Gap	Contact Gap	Cut-in R.P.M.
.032"	.032" open	400

BATTERY Willard Type CBR-19 Volts 6 Amps 135

Bat. to Frame Con. Negative CONTACT BREAKER Gap .020"

Firing Order 1-4-2-6-3-5 Ignition Timing 1" B.T.D.C.

SPARK-PLUG	ENGINE	Taxable Hp.
Size 7/8" Gap .031"	Bore 3-1/4" Stroke 4-3/4"	25.3

INTAKE VALVE TIMING	EXHAUST VALVE TIMING
Open T.D.C. Close 57° A.B.D.C.	Open 43½° B.B.D.C. Close 25° A.T.D.C.

VALVE CLEARANCE cold Intake .010" Exhaust .010"

CARBURETOR	COOLING SYSTEM	OILING SYSTEM
Stromberg	Air cooled Type Cap	Type Press. Cap 6 Qts.

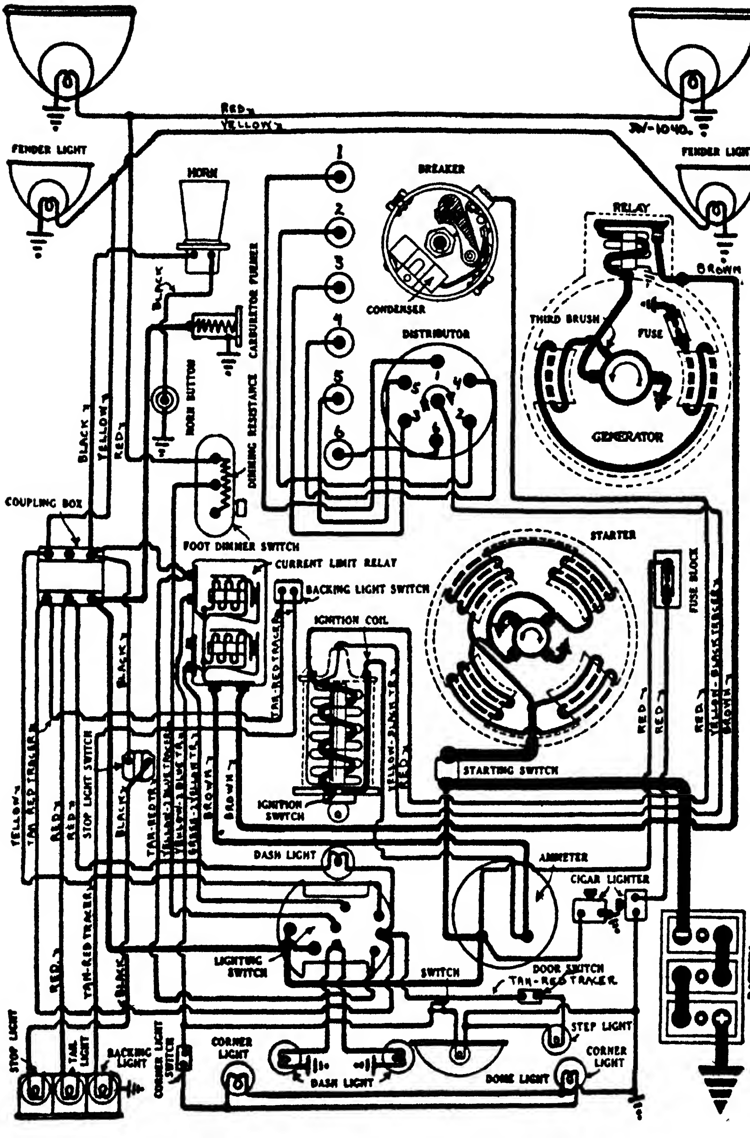
PISTON RING: Width 1/8" Diam. 3-1/4" Gap .010"-.015"

CLUTCH Single Pl. Dry GEAR RATIO 4.73 AXLE Semi-floating

BRAKES

Front	Rear	Hand
3/16" x 1¾" x 21-1/8" (per wheel)	3/16" x 1¾" x 25-7/16" (per wheel)	5/32" x 2" x 23-7/8"

Lighting	Headlights	Dash & Tail	Side Lamps
Single Contact	21 C.P.	2 C.P.	C.P.



FRANKLIN WIRING DIAGRAM, 1928, MODELS 135 AND 137

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Franklin Model 135-137 Year 1928

Delco-Remy Starter & Generator Delco-Remy Ignition

Regulation	Max. Chg. rate and speed
Third Brush	14-18 amps. 1700 r.p.m.

RELAY Air Gap	Contact Gap	Cut-in R.P.M.
.015" - .025"	.014" - .018"	570

BATTERY U.S.L. Type XX-19X Volts 6 Amps. 135

Bat. to Frame Con. Positive CONTACT BREAKER Gap .020"

Firing Order 1-4-2-6-3-5 Ignition Timing 1-5/8" B.T.D.C.

SPARK PLUG	ENGINE	Taxable Hp.
Size Metric Gap .025"	Bore 3-1/2" Stroke 4-3/4"	29.4

INTAKE VALVE TIMING	EXHAUST VALVE TIMING
Open T.D.C. Close 57° A.B.D.C.	Open 43½° B.B.D.C. Close 25° A.T.D.C.

VALVE CLEARANCE cold Intake .012" Exhaust .012"

CARBURETOR	COOLING SYSTEM	OILING SYSTEM
Stromberg	Type air cooled Cap.	Type Press Cap. 6 Qts

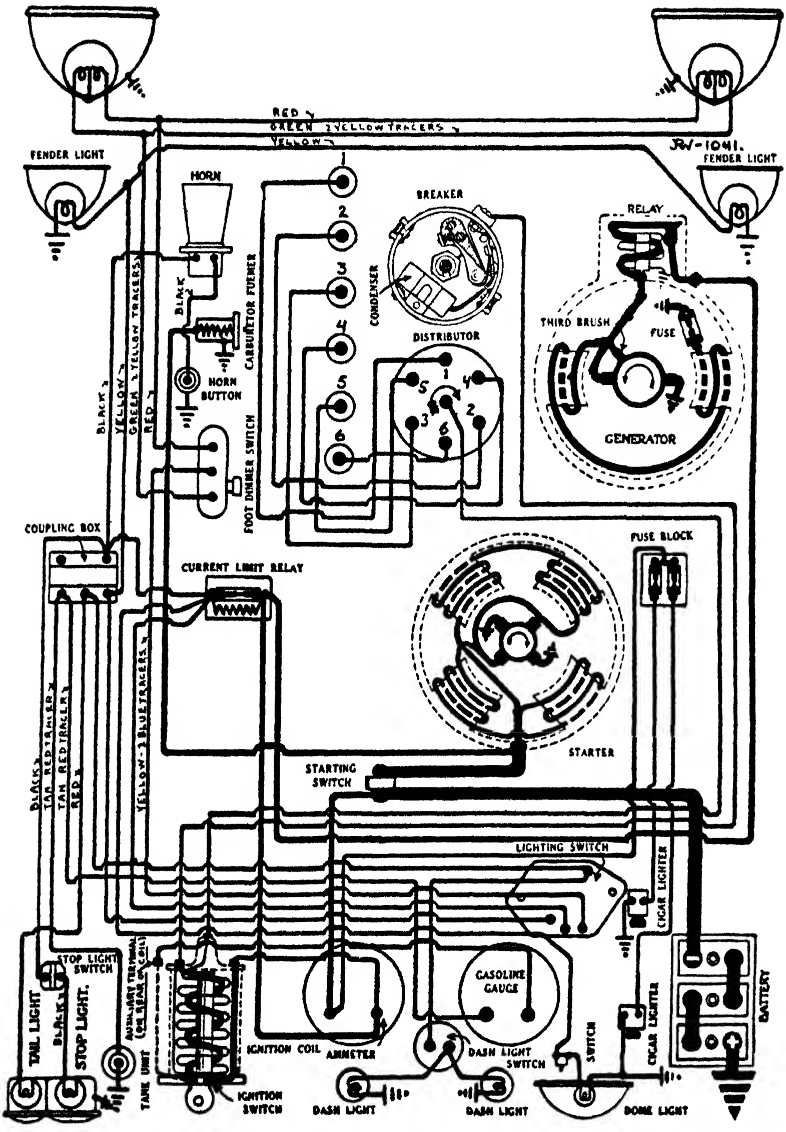
PISTON RING: Width 1/8" Diam. 3-1/2" Gap .010"-.015"

CLUTCH Single Pl. Dry GEAR RATIO 4.54 & 4.73 AXLE Semi-floating

BRAKES

Front	Rear	Hand
3/16" x 1¼" x 21-1/8" (per wheel)	3/16" x 1¼" x 21-1/8" (per wheel)	5/32" x 2" x 22½"

Lighting	Headlights	Dash & Tail	Side Lamps
Single Contact	21 C.P.	2 C.P.	2 C.P.



FRANKLIN WIRING DIAGRAM, 1928, MODEL 130

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Franklin Model 130 Year 1928

Delco-Remy Starter & Generator Delco-Remy Ignition

Regulation	Max. Chg. rate and speed
Third Brush	14-18 amps. 1700 r.p.m.

RELAY Air Gap	Contact Gap	Cut-in R.P.M.
.015" - .025"	.014"-.018"	570

BATTERY U.S.L. Type XX-17 X Volts 6 Amps 117

Bat. to Frame Con. Positive CONTACT BREAKER Gap .020"

Firing Order 1-4-2-6-3-5 Ignition Timing 1-5/8" B.T.D.C.

SPARK PLUG	ENGINE	Taxable Hp.
Size Metric Gap .025"	Bore 3-1/4" Stroke 4-3/4"	25.3

INTAKE VALVE TIMING	EXHAUST VALVE TIMING
Open T.D.C. Close 57° A.B.D.C.	Open 43½° B.B.D.C. Close 25° A.T.D.C.

VALVE CLEARANCE cold Intake .012" Exhaust .012"

CARBURETOR	COOLING SYSTEM	OILING SYSTEM
	air cooled	
Stromberg	Type Cap.	Type Press Cap. 6 Qts

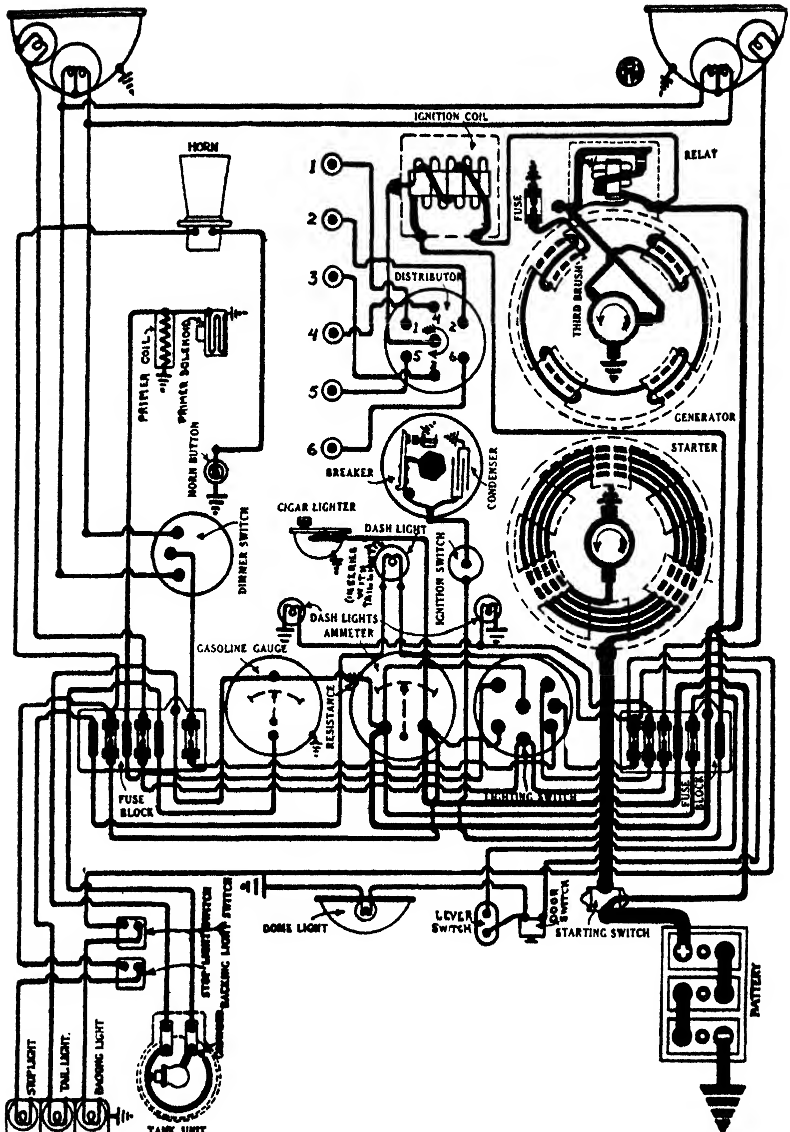
PISTON RING: Width 1/8" Diam. 3-1/4" Gap .010"-.015"

CLUTCH Single Pl. Dry GEAR RATIO 4.54 AXLE Semi-floating

BRAKES

Front	Rear	Hand
3/16" x 1¾" x 21-1/8" (per wheel)	3/16" x 1¾" x 21-1/8" (per wheel)	5/32" x 2" x 22½"

Lighting	Headlights	Dash & Tail	Side Lamps
Single Contact	21 C.P.	2 C.P.	2 C.P.



FRANKLIN WIRING DIAGRAM, 1928, MODEL 12-B

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Franklin Model 12-B Year 1928

Dynete Starter & Generator Northeast Ignition

Regulation — Max. Chg. rate and speed

Third Brush — 14-16 amps. 1200 r.p.m.

RELAY Air Gap .032" — Contact Gap .032" open — Cut-in R.P.M. 400

BATTERY Willard Type CRR-19 Volts 6 Amps 135

Bat. to Frame Con. Negative — CONTACT BREAKER Gap .020"

Firing Order 1-4-2-6-3-5 — Ignition Timing 1-5/8" B.T.D.C.

SPARK PLUG Size Metric Gap .025" — ENGINE Bore 3-1/4" Stroke 4-3/4" — Taxable Hp. 25.3

INTAKE VALVE TIMING Open T.D.C. Close 57° A.B.D.C. — EXHAUST VALVE TIMING Open 43½° B.B.D.C. Close 25° A.T.D.C.

VALVE CLEARANCE cold Intake .010" Exhaust .010"

CARBURETOR Stromberg — COOLING SYSTEM Type air cooled Cap. — OILING SYSTEM Type Press Cap. 6 Qts

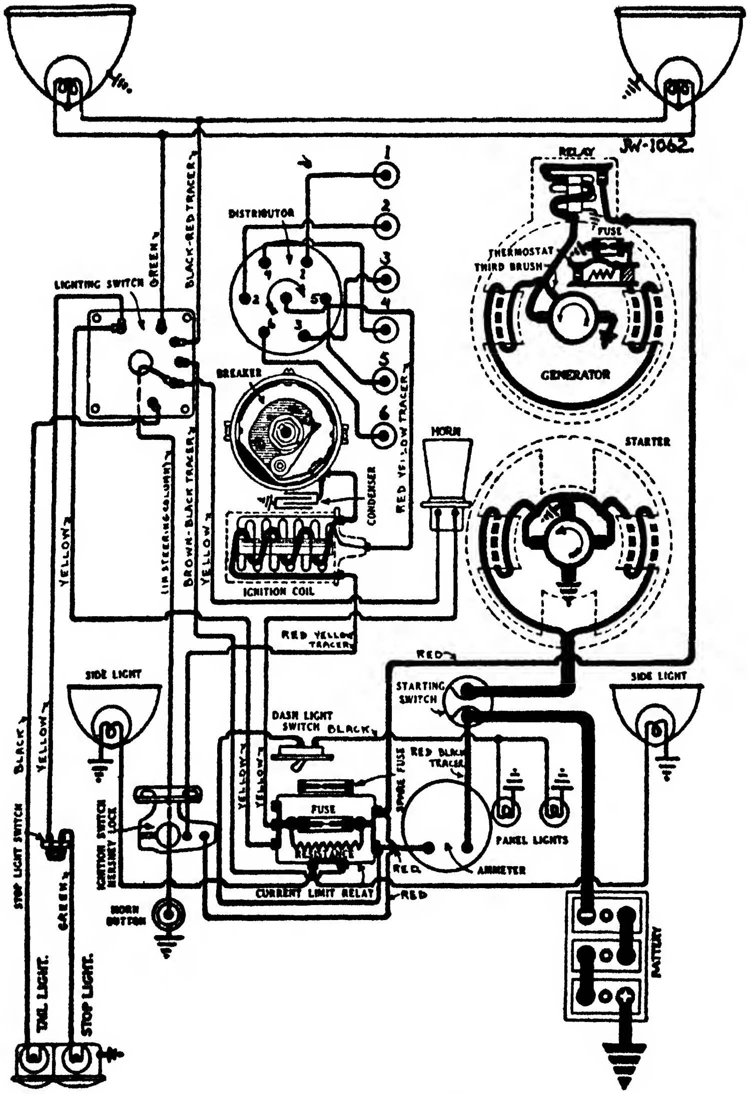
PISTON RING: Width 1/8" Diam. 3-1/4" Gap .010"-.015"

CLUTCH Single Pl. Dry — GEAR RATIO 4.73 — AXLE Semi-floating

BRAKES

Front	Rear	Hand
3/16" x 1¾" x 21-1/8" (per wheel)	3/16" x 1¾" x 25-7/16" (per wheel)	5/32" x 2" x 23-7/8"

Lighting	Headlights	Dash & Tail	Side Lamps
Single Contact	21 C.P.	2 C.P.	C.P.



GRAHAM PAIGE WIRING DIAGRAM, 1929, MODEL 612

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Graham Paige Model 612 Year 1929

Delco-Remy Starter & Generator Delco-Remy Ignition

Regulation — Max. Chg. rate and speed

Third Brush — 10.5 amps. 30 m.p.h.- hot

RELAY Air Gap .016" Contact Gap .020" Cut-in R.P.M. 600

BATTERY Willard Type WSB-13 Volts 6 Amps 84

Bat. to Frame Con. Positive CONTACT BREAKER Gap .020"

Firing Order 1-5-3-6-2-4 Ignition Timing 1° B.T.D.C. full adv.

SPARK PLUG Size 7/8" Gap .023"

ENGINE Bore 3" Stroke 4-1/2"

Taxable Hp. 21.6

INTAKE VALVE TIMING Open T.D.C. Close 40° A.B.D.C.

EXHAUST VALVE TIMING Open 40° B.B.D.C. Close 10° A.T.D.C.

VALVE CLEARANCE Hot Intake .006" Exhaust .010"

CARBURETOR Johnson

COOLING SYSTEM Type Pump Cap 4½ Gal.

OILING SYSTEM Type Press Cap 6 Qts

PISTON RING: Width 1/8" 3/16" Diam 3" Gap .008"-.012"

CLUTCH Single Plate GEAR RATIO 4.7 AXLE Semi-floating

BRAKES

Front 3/16" x 1¾" x 21-15/16" (per wheel)

Rear 3/16" x 1¾" x 21-15/16" (per wheel)

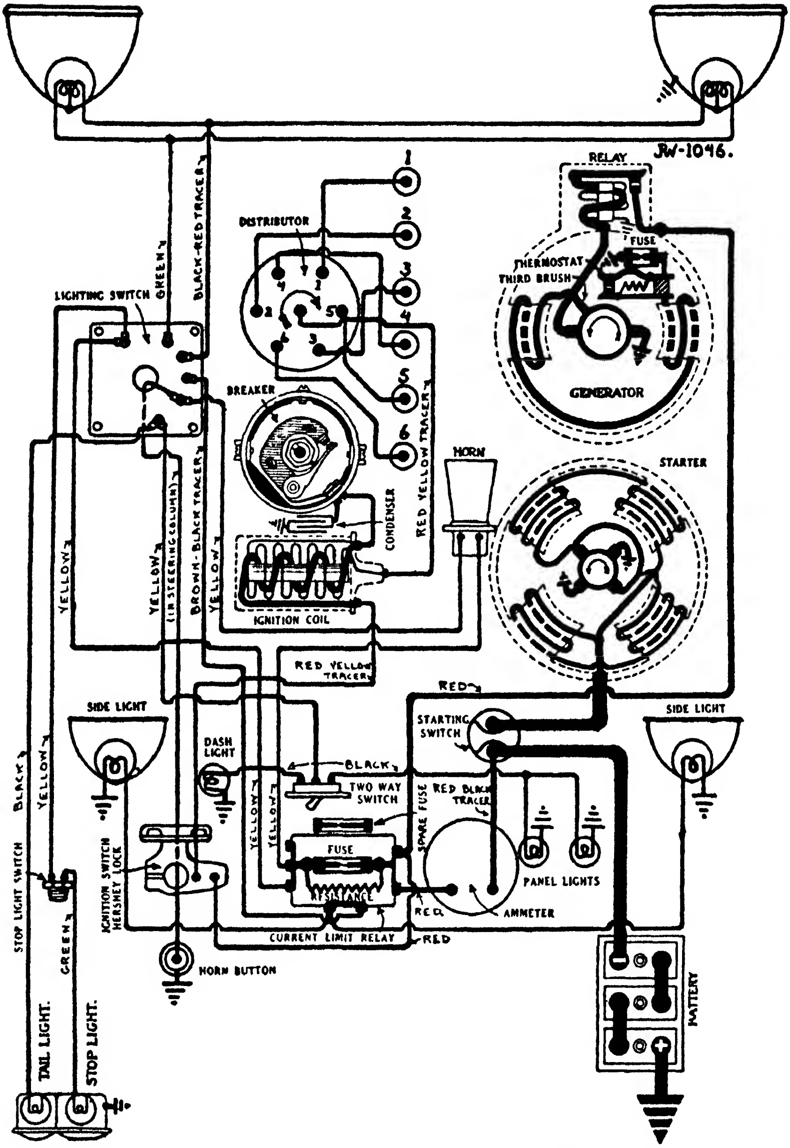
Hand 5/32" x 2" x 18-9/16"

Lighting Single Contact

Headlights 21-21 C.P.

Dash & Tail 3 C.P.

Side Lamps 3 C.P.



GRAHAM PAIGE WIRING DIAGRAM, 1929, MODEL 615

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Graham-Paige Model 615 Year 1929

Delco-Remy Starter & Generator Delco-Remy Ignition

Regulation: Third Brush

Max. Chg. rate and speed: 10.5 amps. 26 m.p.h. - hot

RELAY Air Gap .016" Contact Gap .020" Cut-in R.P.M. 500

BATTERY Willard Type WSB-15 Volts 6 Amps 100

Bat. to Frame Con. Positive CONTACT BREAKER Gap .020"

Firing Order 1-5-3-6-2-4 Ignition Timing 1° B.T.D.C. full adv.

SPARK PLUG Size 7/8" Gap .023"

ENGINE Bore 3-1/4" Stroke 4-1/2"

Taxable Hp. 25.35

INTAKE VALVE TIMING Open T.D.C. Close 40° A.B.D.C.

EXHAUST VALVE TIMING Open 40° B.B.D.C. Close 10° A.T.D.C.

VALVE CLEARANCE Hot Intake .006" Exhaust .010"

CARBURETOR Johnson

COOLING SYSTEM Type Pump Cap. 5 Gal

OILING SYSTEM Type Press Cap. 6 Qts

PISTON RING: Width 1/8" 3/16" Diam. 3-1/4" Gap .008" - .012"

CLUTCH Single Plate GEAR RATIO 3.916 AXLE Semi-floating

BRAKES

Front: 3/16" x 1¾" x 26-23/32" (per wheel)

Rear: 3/16" x 1¾" x 26-23/32" (per wheel)

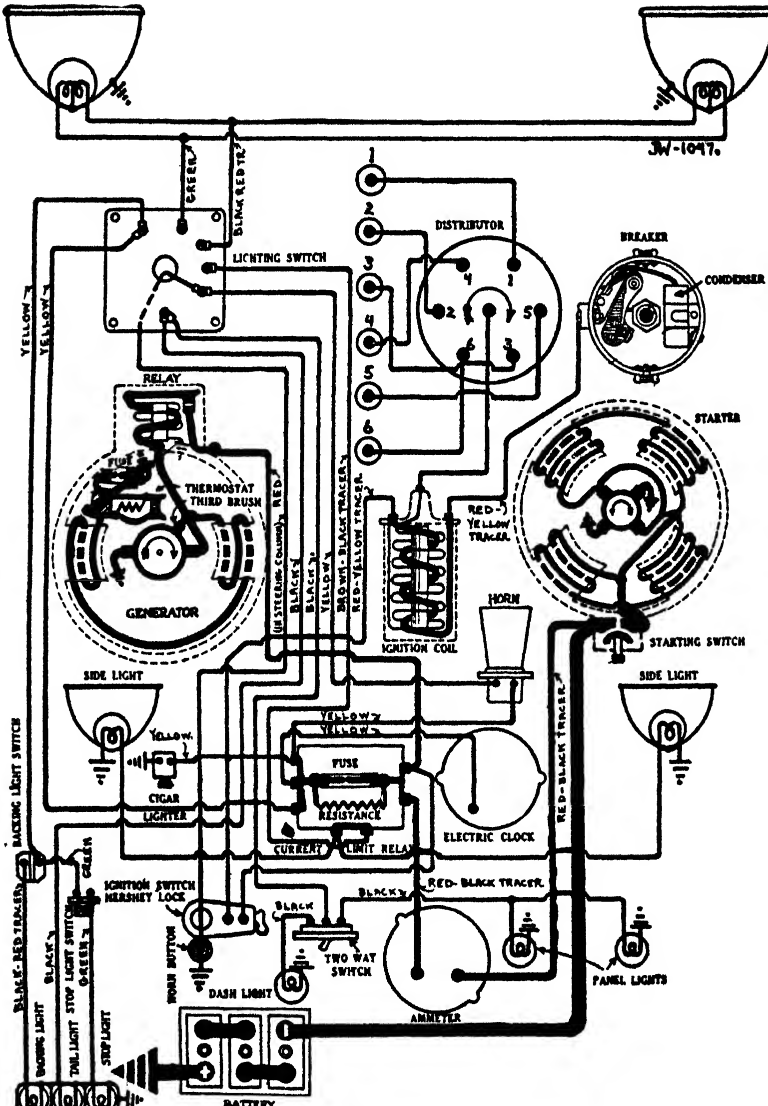
Hand: 5/32" x 2½' x 18-9/16"

Lighting Single Contact

Headlights 21-21 C.P.

Dash & Tail 3 C.P.

Side Lamps 3 C.P.



GRAHAM PAIGE WIRING DIAGRAM, 1929, MODEL 621

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Graham Paige Model 621 Year 1929

Delco-Remy Starter & Generator Delco-Remy Ignition

Regulation Max Chg rate and speed

Third Brush 10.5 amps, 25 m.p.h. -hot

RELAY Air Gap Contact Gap Cut-in R.P.M.

.016" .020" 600

BATTERY Willard Type WSB-17 Volts 6 Amps 114

Bat. to Frame Con. Positive CONTACT BREAKER Gap .020"

Firing Order 1-5-3-6-2-4 Ignition Timing 1° B.T.D.C. full adv.

SPARK PLUG ENGINE Taxable Hp.

Size 7/8" Gap .023" Bore 3½" Stroke 5" 29.4

INTAKE VALVE TIMING EXHAUST VALVE TIMING

Open T.D.C. Close 45° A.B.D.C. Open 50° B.B.D.C. Close 10° A.T.D.C.

VALVE CLEARANCE Hot Intake .010" Exhaust .010"

CARBURETOR COOLING SYSTEM OILING SYSTEM

Johnson Type Pump Cap. 6¾ Gal Type Press Cap. 7 Qts

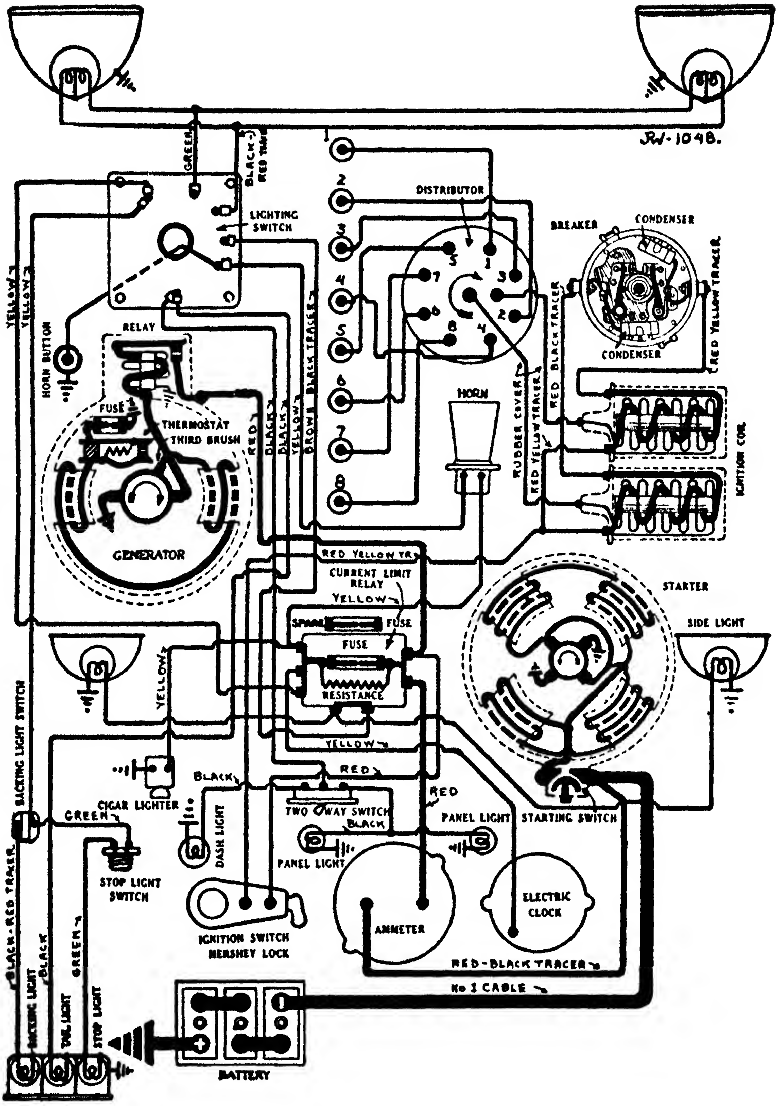
PISTON RING: Width 1/8" 3/16" Diam. 3-1/2" Gap .008" - .012"

CLUTCH. Double Plate GEAR RATIO 3.643 AXLE Semi-floating

BRAKES

Front	Rear	Hand
3/16" x 1¾" x 26-17/32" (per wheel)	3/16" x 1¾" x 26-17/32" (per wheel)	5/32" x 2¼" x 23-5/8"

Lighting	Headlights	Dash & Tail	Side Lamps
Single Contact	21-21 C.P.	3 C.P.	3 C.P.



GRAHAM PAIGE WIRING DIAGRAM, 1929, MODEL 827

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Graham-Paige Model 827 Year 1929

Delco-Remy Starter & Generator Delco-Remy Ignition

Regulation Max Chg rate and speed

Third Brush 10.5 amps. 25 m.p.h. - hot

RELAY Air Gap .016" Contact Gap .020" Cut in R P M 600

BATTERY Willard Type WSB-17 Volts 6 Amps 114

Bat to Frame Con Positive CONTACT BREAKER Gap .020"

Firing Order 1-6-2-5-8-3-7-4 Ignition Timing 2° B.T.D.C. full adv.

SPARK PLUG Size Metric Gap .023'

ENGINE Bore 3-3/8" Stroke 4-1/2"

Taxable Hp 36.45

INTAKE VALVE TIMING Open 2°B.T.D.C. Close 47°A.B.D.C.

EXHAUST VALVE TIMING Open 43°B.B.D.C. Close 2°A.T.D.C.

VALVE CLEARANCE Hot Intake .010" Exhaust .010"

CARBURETOR Johnson

COOLING SYSTEM Type Pump Cap 6¾ Gal

OILING SYSTEM Type Press Cap 8 Qts

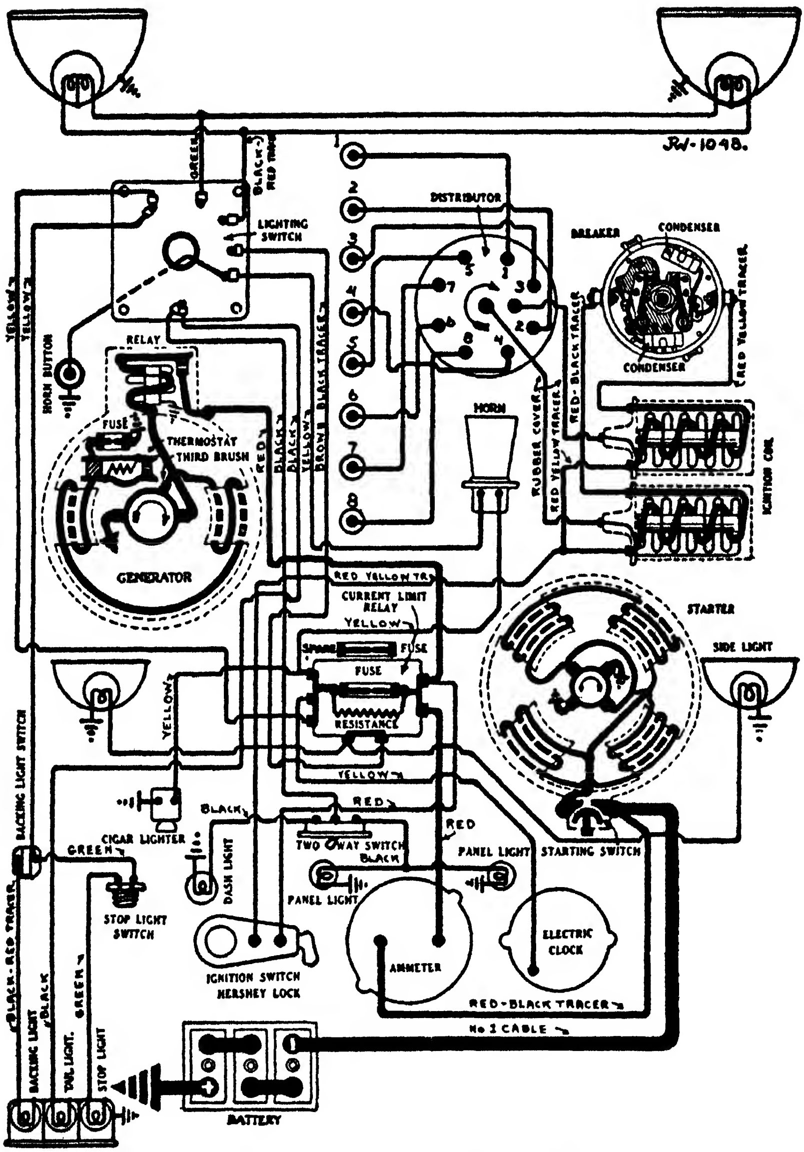
PISTON RING Width 1/8" 3/16" Diam 3-3/8' Gap .008" - .012"

CLUTCH Double Plate GEAR RATIO 3.643 AXLE Semi-floating

BRAKES

Front	Rear	Hand
3/16" x 1¾" x 26-17/32" (per wheel)	3/16" x 1¾" x 26-17/32" (per wheel)	5/32" x 2½" x 24-5/8"

Lighting	Headlights	Dash & Tail	Side Lamps
Single Contact	21-21 C P	3 C P	3 C P



GRAHAM PAIGE WIRING DIAGRAM, 1929, MODEL 837

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Graham-Paige Model 837 Year 1929

Delco-Remy Starter & Generator Delco-Remy Ignition

Regulation	Max. Chg. rate and speed
Third Brush	10.5 amps, 25 m.p.h. - hot

RELAY Air Gap	Contact Gap	Cut-in R.P.M.
.016"	.020"	600

BATTERY Willard Type WSB-17 Volts 6 Amps 114

Bat. to Frame Con. Positive CONTACT BREAKER Gap .020"

Firing Order 1-6-2-5-8-3-7-4 Ignition Timing 20° B.T.D.C. full adv.

SPARK PLUG	ENGINE	Taxable Hp.
Size Metric Gap .023"	Bore 3-3/8" Stroke 4½"	36.45

INTAKE VALVE TIMING	EXHAUST VALVE TIMING
Open 2° B.T.D.C. Close 47° A.B.D.C.	Open 43° B.B.D.C. Close 2° A.T.D.C.

VALVE CLEARANCE Hot Intake .010" Exhaust .010"

CARBURETOR	COOLING SYSTEM	OILING SYSTEM
Johnson	Type Pump Cap 6¾ Gal	Type Press Cap 8 Qts

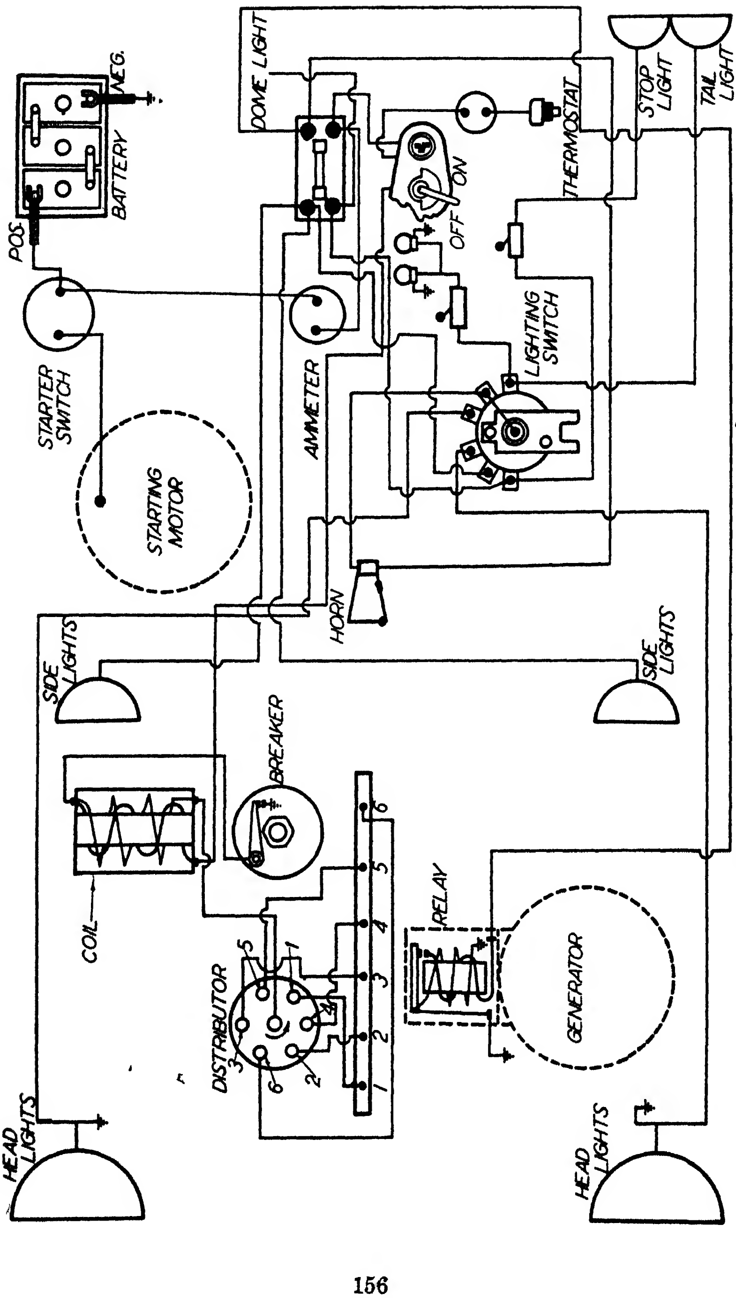
PISTON RING: Width 1/8" 3/16" Diam. 3-3/8" Gap .008" - .012"

CLUTCH Double Plate GEAR RATIO 3.92 AXLE Semi-floating

BRAKES

Front	Rear	Hand
3/16" x 1⅝" x 26-17/32" (per wheel)	3/16" x 1⅝" x 26-17/32" (per wheel)	5/32" x 2½" x 24-5/8"

Lighting	Headlights	Dash & Tail	Side Lamps
Single	Contact 21-21 C.P.	3 C.P.	3 C.P.



GRAHAM PAIGE WIRING DIAGRAM, 1930, MODEL 612

GRAHAM-PAIGE Model 612 Year 1930

Delco-Remy Starter & Generator Delco-Remy Ignition

Regulation	Max. Chg. rate and speed
Third Brush	19½ Amps. cold at 22 M.P.H.

RELAY Air Gap	Contact Gap	Cut-in R.P.M.
.016	.020	7-7.4 Volts

BATTERY Willard Type WSB-13 Volts 6 Amps 84

Bat. to Frame Con. Woven Strap CONTACT BREAKER Gap .020

Firing Order 1-5-3-6-2-4 Ignition Timing Semi Automatic

SPARK PLUG		ENGINE		Taxable Hp.
Size 7/8-18	Gap .023	Bore 3-1/8	Stroke 4-1/2	23.4

INTAKE VALVE TIMING		EXHAUST VALVE TIMING	
Open Top Center	Close 40°A.B.C.	Open 40°B.B.C.	Close 10°A.T.C.

VALVE CLEARANCE Warm Intake .010 Exhaust .016

CARBURETOR	COOLING SYSTEM		OILING SYSTEM	
Detroit Lubricator	Type Air Valve	Cap. 4-½ Gal.	Type Pres.	Cap. 6 Qts.

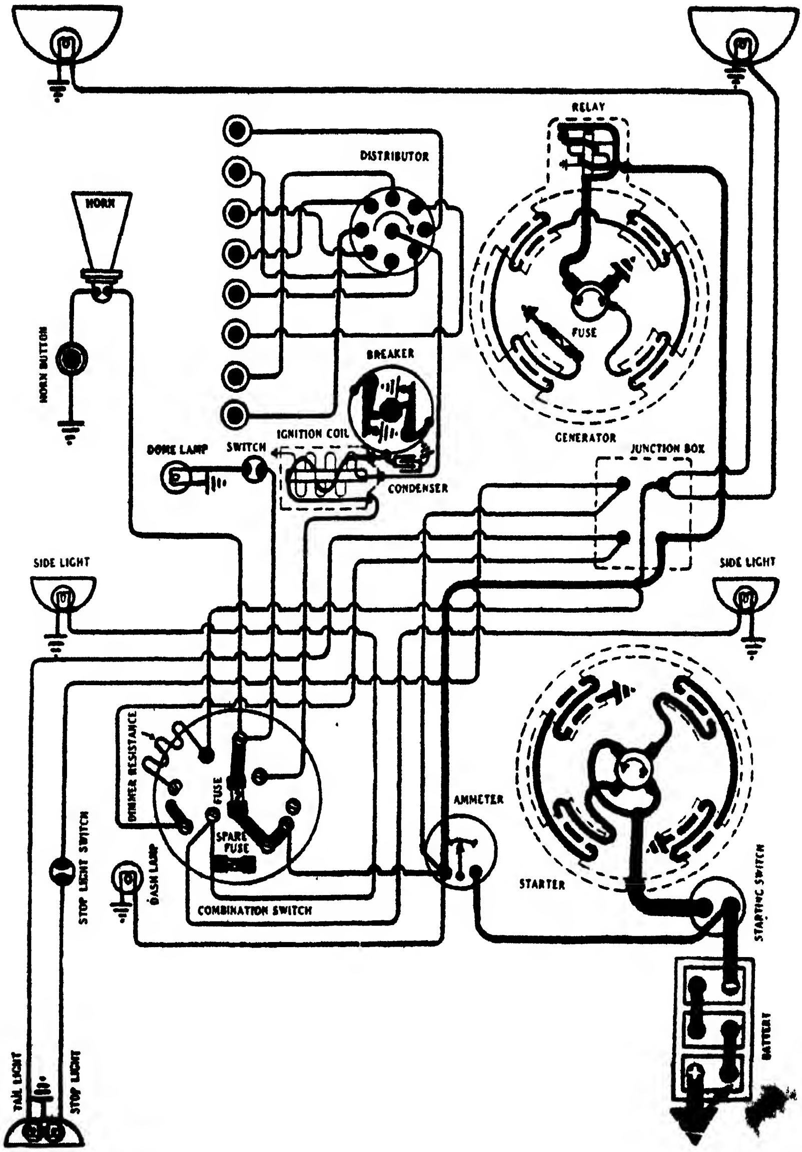
PISTON RING: Width 2-1/8 and 1-3/16 Diam. 3-1/8 Gap .008-.012

CLUTCH Single Dry Plate GEAR RATIO 4.7-1 AXLE Clark

BRAKES

Front	Rear	Hand
1-1/2 x 21-15/16	1-1/2 x 21-15/16	2 x 18-9/16

Lighting	Headlights	Dash & Tail	Side Lamps
Single Contact	21-21 C.P.	3 C.P.	3 C.P.



HUPMOBILE WIRING DIAGRAM, MODEL E1

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Hupmobile Model E-1 Year

Atwater-Kent Starter & Generator Atwater-Kent Ignition

Regulation	Max. Chg. rate and speed
Third Brush	16-18 amps. 1200 r.p.m.

RELAY Air Gap	Contact Gap	Cut-in R.P.M.
.010" - .030"	.025" - .035"	550

BATTERY Willard Type SJRR-6 Volts 6 Amps 153

Bat. to Frame Con. Positive CONTACT BREAKER Gap .009-.012"

Firing Order 1-5-2-3-8-4-7-6 Ignition Timing T.D.C. 1/2 adv.

SPARK PLUG	ENGINE	Taxable Hp.
Size 7/8" Gap .028" .030"	Bore 2-7/8" Stroke 4-3/4"	26.45

INTAKE VALVE TIMING	EXHAUST VALVE TIMING
Open 4° A.T.D.C. Close 51° A.T.D.C.	Open 47° B.B.D.C. Close T.D.C.

VALVE CLEARANCE Hot Intake .007" Exhaust .007"

CARBURETOR	COOLING SYSTEM	OILING SYSTEM
Stromberg	Type Pump Cap. 4 3/4 Gal	Type Press Cap. 8 Qts

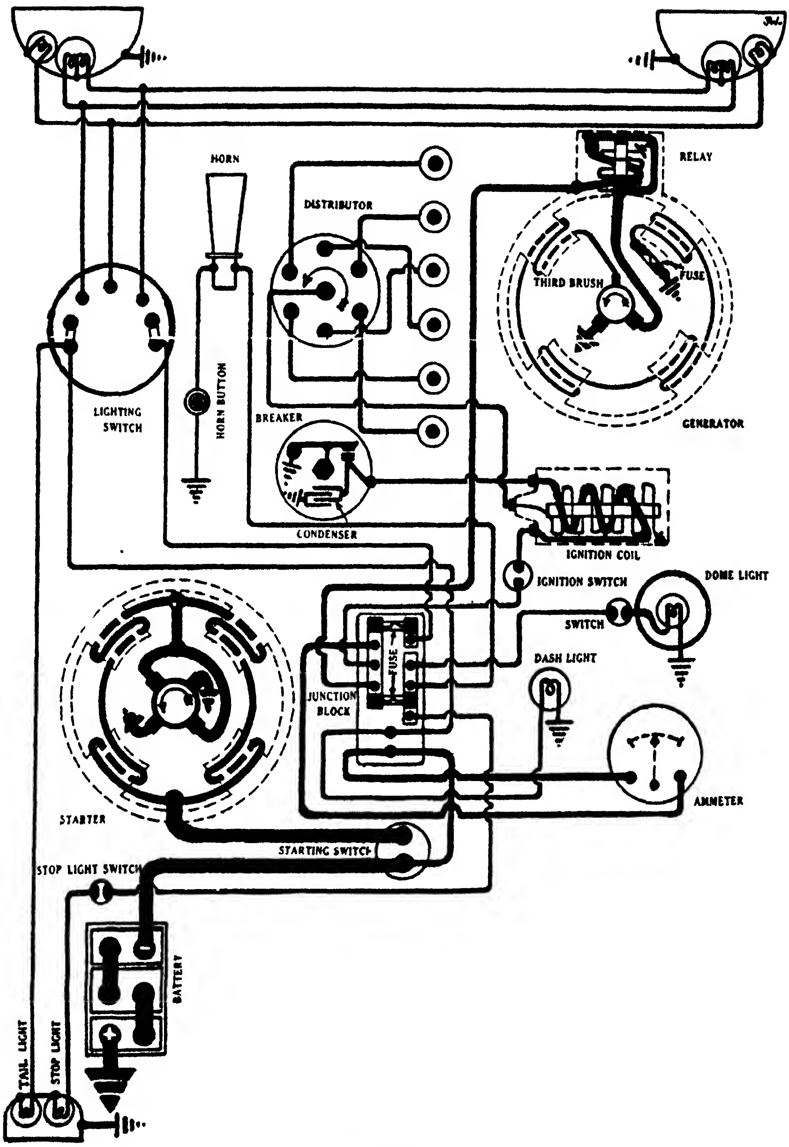
PISTON RING: Width comp 1/8" oil 3/16" Diam. 2-7/8" Gap .007-.015"

CLUTCH Long-2 plate GEAR RATIO 4.64-4.9 AXLE Semi-floating

BRAKES

Front	Rear	Hand
3/16" x 2" x 12-1/32" (2 pcs) 3/16" x 2" x 23-9/32" (2 pcs)	Same	3/16" x 2" x 22-5/8"

Lighting	Headlights	Dash & Tail	Side Lamps
Double	Contact 21 C.P.	3 C.P.	3 C.P.



HUPMOBILE WIRING DIAGRAM, 1926-27-28, MODEL A1-5

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Hupmobile Model A-1-5 Year 1926-27-28

Autolite Starter & Generator Autolite Ignition

Regulation	Max. Chg. rate and speed
Third Brush	10 amps, 1300-1700 r.p.m.

RELAY Air Gap	Contact Gap	Cut-in R.P.M.
.010 - .030"	.025" - .035"	605

BATTERY Willard Type SRR 15 Volts 6 Amps 100

Bat. to Frame Con. Positive CONTACT BREAKER Gap .015"-.018"

Firing Order 1-5-3-6-2-4 Ignition Timing 10°B.T.D.C. adv.

SPARK PLUG	ENGINE	Taxable Hp.
Size 7/8" Gap .025" .028"	Bore 3-1/8" Stroke 4-1/4"	23.44

INTAKE VALVE TIMING	EXHAUST VALVE TIMING
Open 4°A.T.D.C. Close 51°A.B.D.C.	Open 47°B.B.D.C. Close T.D.C.

VALVE CLEARANCE Hot Intake .006" Exhaust .006"

CARBURETOR	COOLING SYSTEM	OILING SYSTEM
Stromberg Stewart	Type Pump Cap. 3½ Gal	Type Press Cap. 6 Qts

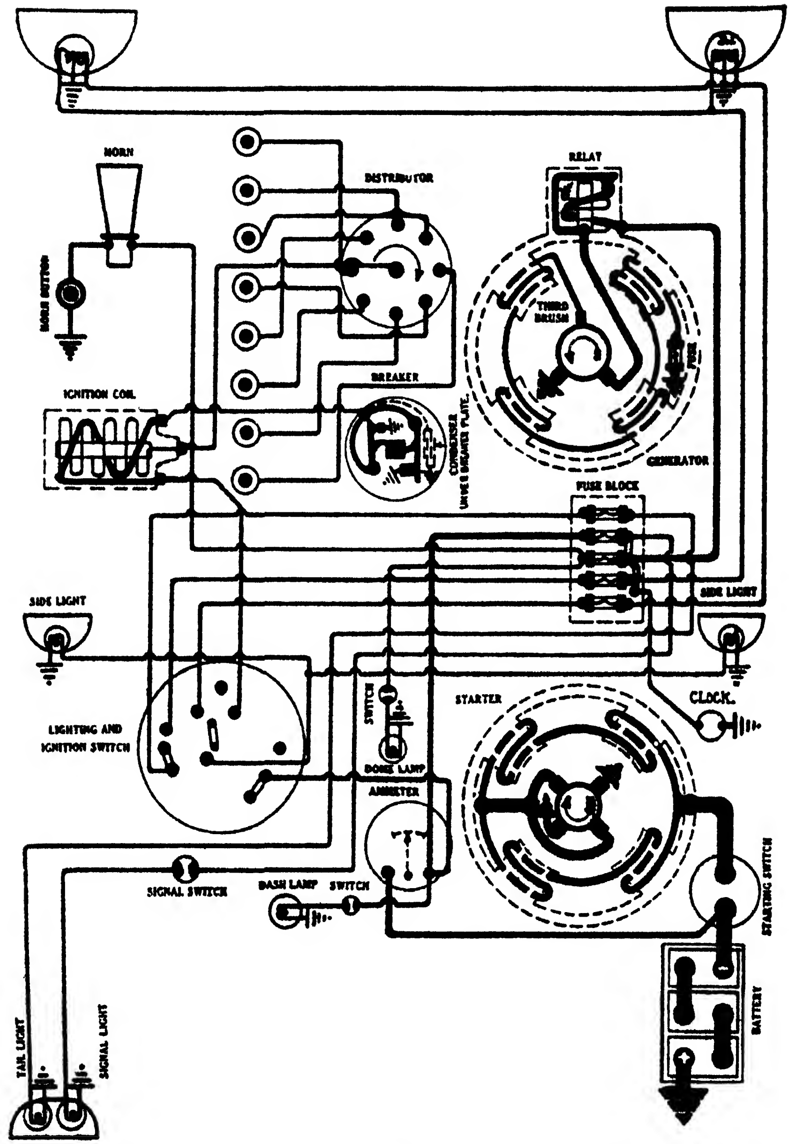
PISTON RING: Width Comp. 1/8" Oil 3/16" Diam. 3-1/8" Gap .007 - .015"

CLUTCH Borg& Beck GEAR RATIO 4.9-5.22 AXLE Semi-floating

BRAKES

Front	Rear	Hand
3/16"x1¾" x 9-7/8"(4 pcs) 3/16" x1¾"x12-7/8"(2 pcs)	3/16"x 2" x 33-1/8" (2 pcs)	same as foot

Lighting	Headlights	Dash & Tail	Side Lamps
Double Contact	6-21 C.P.	Sgl 3 C.P.	Sgl 3 C.P.



HUPMOBILE WIRING DIAGRAM, 1927, MODEL E2

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Hupmobile Model E-2-3-4- Year 1927

Autolite Starter & Generator Delco Ignition

Regulation	Max. Chg. rate and speed
Third Brush	16-18 amps, 1200 r.p.m.

RELAY Air Gap	Contact Gap	Cut-in R.P.M.
.010"-.030"	.025"-.035"	550

BATTERY Willard Type S.J.R.R.6 Volts 6 Amps 153

Bat. to Frame Con. Positive CONTACT BREAKER Gap .022-.027

Firing Order 1-5-2-3-8-4-7-6 E2
1-4-7-3-8-5-2-6 E3,4 Ignition Timing 15° B.T.D.C. adv

SPARK PLUG	ENGINE	Taxable Hp.
Size 7/8" Gap .028" .030"	Bore 3" Stroke 4-3/4"	28.8

INTAKE VALVE TIMING	EXHAUST VALVE TIMING
Open 4° A.T.D.C. Close 51° A.B.D.C.	Open 47° B.B.D.C. Close T.D.C.

VALVE CLEARANCE Hot Intake .006" Exhaust .007"

CARBURETOR	COOLING SYSTEM	OILING SYSTEM
Stromberg	Type Pump Cap 4½ Gal	Type Press Cap 8 Qts

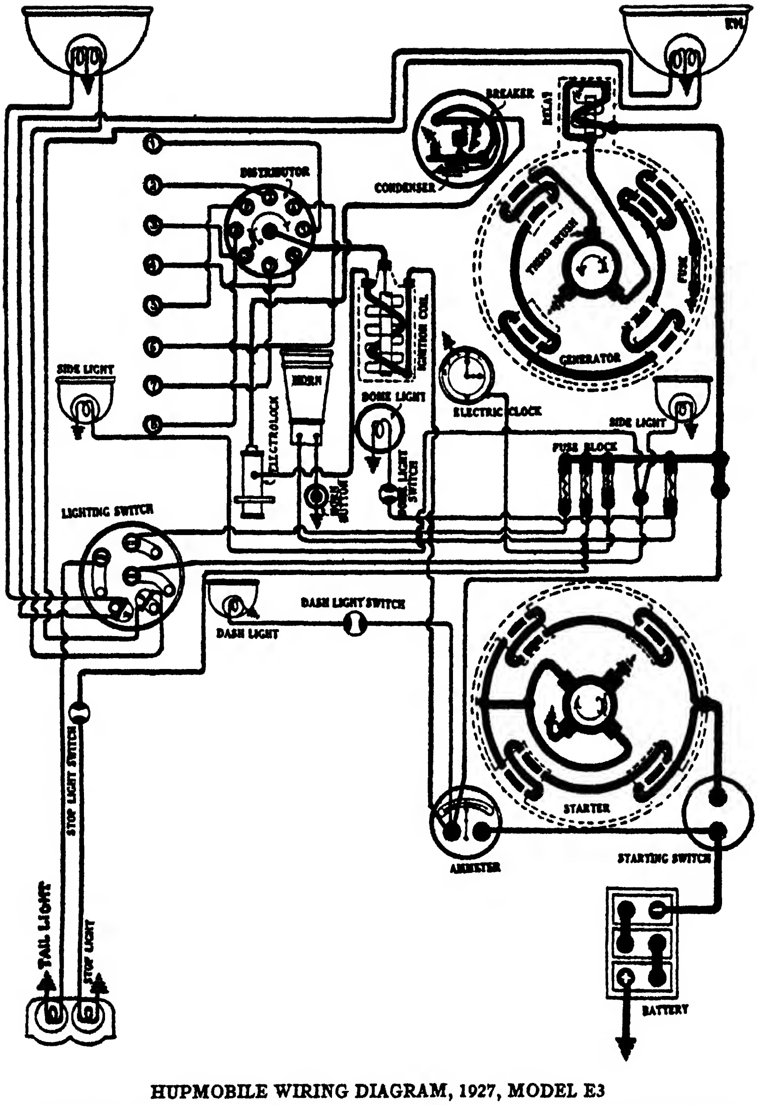
PISTON RING: Width Comp 1/8" oil 3/16" Diam 3" Gap .007-.015"

CLUTCH Long-2 plate GEAR RATIO 4.9-5.3 AXLE Semi-floating

BRAKES

Front	Rear	Hand
3/16" x 2" x 23-9/32" (2 pcs) 3/16" x 2" x 12-1/32" (2 pcs)	Same	3/16" x 2" x 22-5/8"

Lighting	Headlights	Dash & Tail	Side Lamps
Double Contact	21 C.P.	3 sgl C.P.	3 sgl C.P.



HUPMOBILE WIRING DIAGRAM, 1927, MODEL E3

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Hupmobile Model E-2-3-4- Year 1927

Autolite Starter & Generator Delco Ignition

Regulation	Max. Chg. rate and speed
Third Brush	16-18 amps, 1200 r.p.m.

RELAY Air Gap	Contact Gap	Cut-in R.P.M.
.010"-.030"	.025"-.035"	550

BATTERY Willard Type S.J.R.R.6 Volts 6 Amps 153

Bat. to Frame Con. Positive CONTACT BREAKER Gap .022-.027 "

Firing Order 1-5-2-3-8-4-7-6 E2
1-4-7-3-8-5-2-6 E3,4
Ignition Timing 15°B.T.D.C. adv

SPARK PLUG	ENGINE	Taxable Hp.
Size 7/8" Gap .028" .030"	Bore 3" Stroke 4-3/4"	28.8

INTAKE VALVE TIMING	EXHAUST VALVE TIMING
Open 4°A.T.D.C. Close 51°A.B.D.C.	Open 47°B.B.D.C. Close T.D.C.

VALVE CLEARANCE Hot Intake .006" Exhaust .007"

CARBURETOR	COOLING SYSTEM	OILING SYSTEM
Stromberg	Type Pump Cap $4\frac{3}{4}$ Gal	Type Press Cap 8 Qts

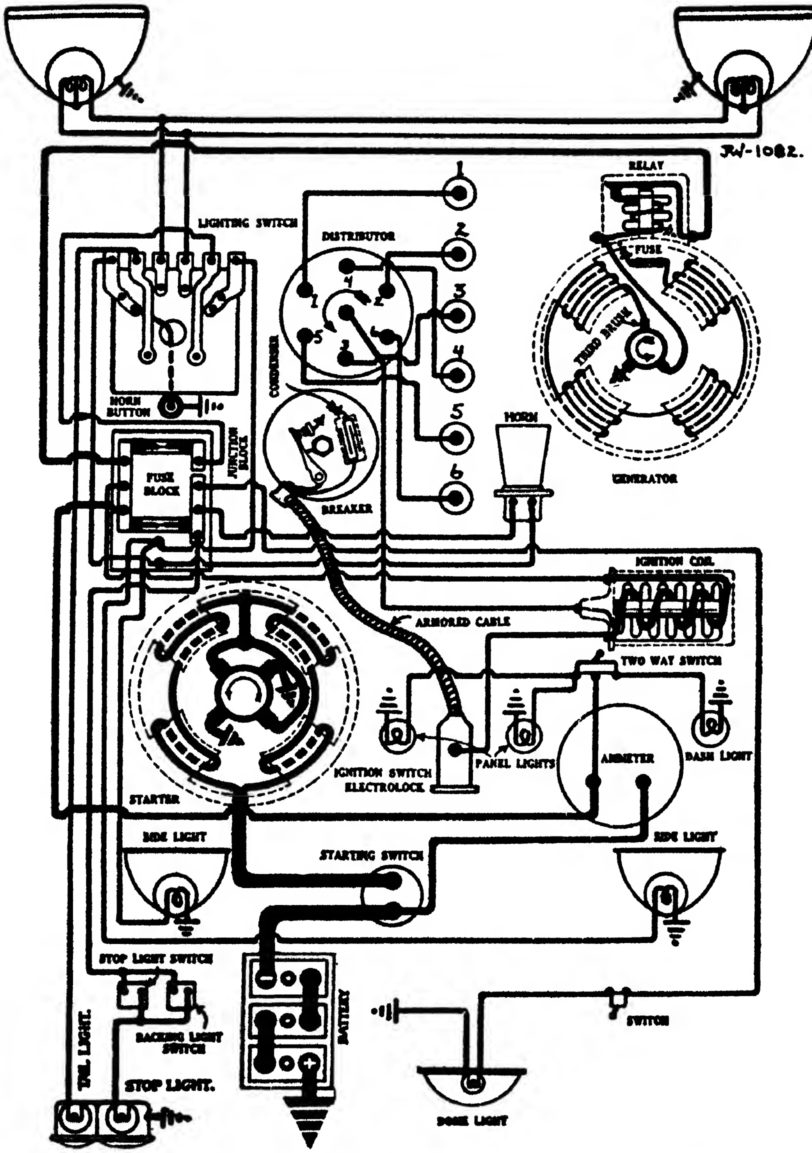
PISTON RING: Width Comp 1/8" oil 3/16" Diam 3" Gap .007-.015"

CLUTCH Long-2 plate GEAR RATIO 4.9-5.3 AXLE Semi-floating

BRAKES

Front	Rear	Hand
3/16" x 2" x 23-9/32" (2 pcs) 3/16" x 2" x 12-1/32" (2 pcs)	Same	3/16" x 2" x 22-5/8"

Lighting	Headlights	Dash & Tail	Side Lamps
Double Contact	21 C.P.	3 sgl C.P.	3 sgl C.P.



HUPMOBILE WIRING DIAGRAM, 1928-29, MODELS A-6 AND A-10
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Hupmobile Model A-6, A-10 Year 1928-29

Autolite Starter & Generator, Autolite Ignition

Regulation	Max. Chg. rate and speed
Third Brush	10 amps, 1300-1700 r.p.m.

RELAY Air Gap	Contact Gap	Cut-in R.P.M.
.010" - .030"	.025" - .035"	605

BATTERY Willard Type CRR 15 Volts 6 Amps 100

Bat. to Frame Con. Positive CONTACT BREAKER Gap .015"-.018"

Firing Order. 1-5-3-6-2-4 Ignition Timing 9° B.T.D.C. adv.

SPARK PLUG	ENGINE	Taxable Hp.
Size 7/8" Gap .025"-.028"	Bore 3¼" Stroke 4¾"	25.35

INTAKE VALVE TIMING	EXHAUST VALVE TIMING
Open 4° A.T.D.C. Close 51° ABDC	Open 47° B.B.D.C. Close T.D.C.

VALVE CLEARANCE. Hot Intake .006" Exhaust .006"

CARBURETOR	COOLING SYSTEM	OILING SYSTEM
Stromberg	Type Pump. Cap. 3½ Gal.	Type Press Cap. 6 Qts

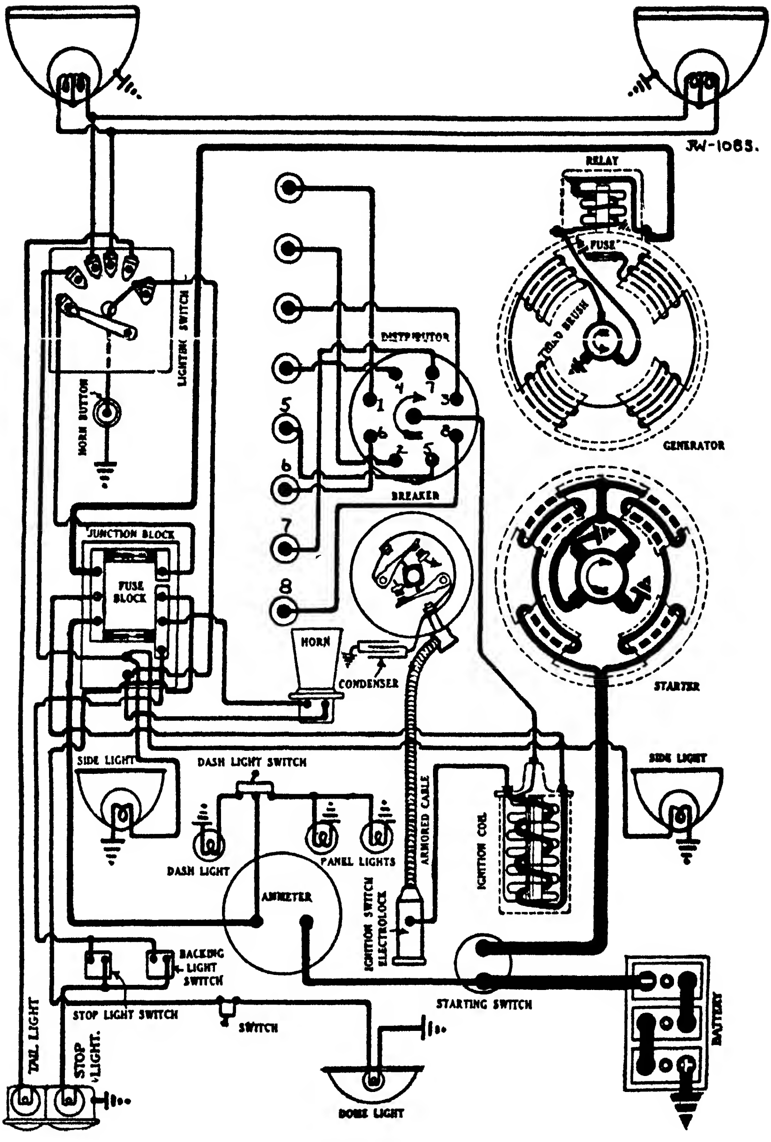
PISTON RING: Width Comp 1/8" Oil 3/16" Diam. 3¼" Gap .007" - .015"

CLUTCH Borg & Beck GEAR RATIO A-6 5.22, 4.9 A-10 4.72, 4.9, 4.07 AXLE Semi-floating

BRAKES

Front	Rear	Hand
3/16" x 2" x 18" (4 pcs)	3/16" x 2" x 18" (4 pcs)	

Lighting	Headlights	Dash & Tail	Side Lamps
Contact	Dbl 21 C.P.	Sgl 3 C.P.	Sgl 3 C.P.



HUPMOBILE WIRING DIAGRAM, 1929, MODEL M

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Hupmobile Model M Year 1929

Autolite & Delco Starter & Generator Autolite Ignition

Regulation	Max. Chg. rate and speed
Third Brush	15 amps, 1600 r.p.m.

RELAY Air Gap	Contact Gap	Cut-in R.P.M.
.010 - .030"	.025" - .035"	650

BATTERY Willard Type SJRR 4 Volts 6 Amps 130

Bat. to Frame Con. Positive CONTACT BREAKER Gap .020-.022"

Firing Order 1-4-7-3-8-5-2-6 Ignition Timing 9° B.T.D.C. adv.

SPARK PLUG	ENGINE		Taxable Hp.
Size Metric Gap .028" .030"	Bore 3"	Stroke 4-3/4"	28.8

INTAKE VALVE TIMING		EXHAUST VALVE TIMING	
Open 4° A.T.D.C.	Close 51° A.B.D.C.	Open 47° B.B.D.C.	Close T.D.C.

VALVE CLEARANCE Hot Intake .006" Exhaust .007"

CARBURETOR	COOLING SYSTEM	OILING SYSTEM
Stromberg	Type Pump Cap 5¼ Gal	Type Press Cap 8 Qts

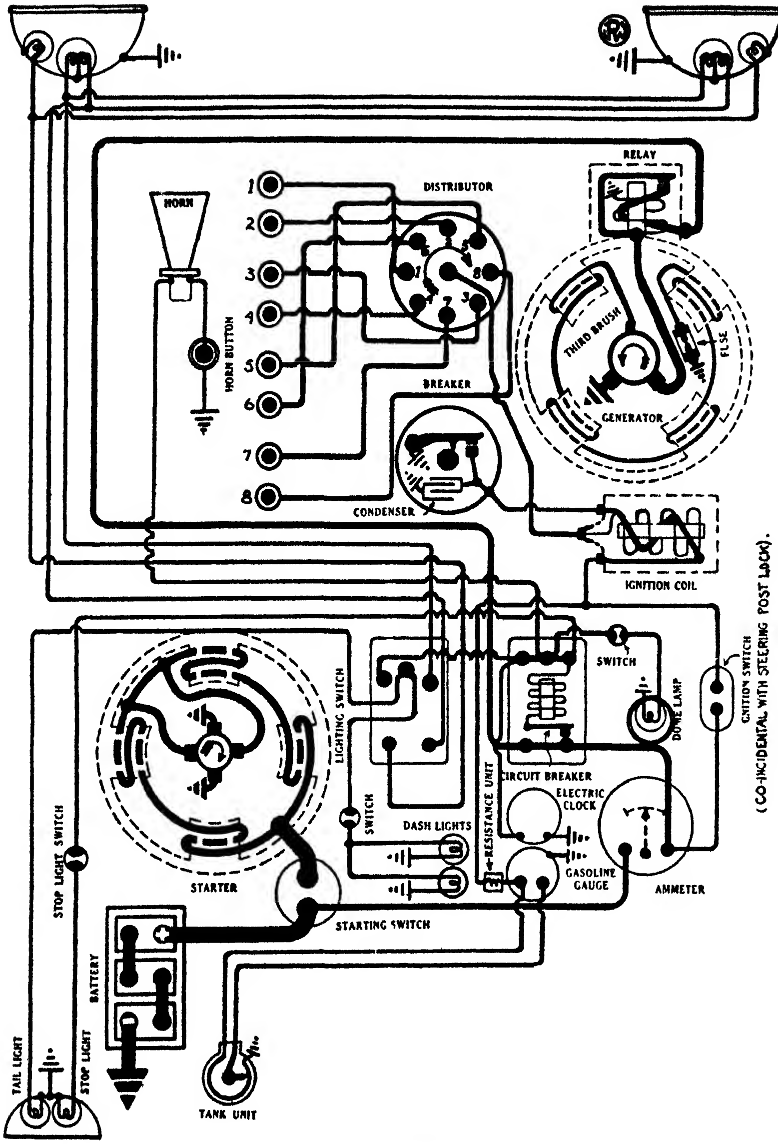
PISTON RING: Width Comp 1/8" Oil 3/16" Diam 3" Gap .007-.015"

CLUTCH Long 9-AM GEAR RATIO 4.7-4.36 AXLE Semi-floating

BRAKES

Front	Rear	Hand
3/16" x 2" x 18" (4 pcs)	3/16" x 2" x 18" (4 pcs)	

Lighting	Headlights	Dash & Tail	Side Lamps
Double Contact	21 C.P.	Sgl 3 C.P.	Sgl 3 C.P.



JORDAN WIRING DIAGRAM, 1928, MODEL JE

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Jordan Model JS Year 1928

Autolite Starter & Generator Autolite Ignition

Regulation	Max. Chg. rate and speed
Third Brush	18 amps, 1400 r.p.m.

RELAY Air Gap	Contact Gap	Cut-in R.P.M.
.010" - .030"	.025"-.035"	625

BATTERY Willard Type Volts 6 Amps 105

Bat. to Frame Con. Negative CONTACT BREAKER Gap .020-.-.24"

Firing Order 1-6-2-5-8-3-7-4 Ignition Timing 14°B.T.D.C. adv.

SPARK PLUG		ENGINE		Taxable Hp.
Size 7/8"	Gap .025"	Bore 3"	Stroke $4\frac{3}{4}$"	28.9

INTAKE VALVE TIMING		EXHAUST VALVE TIMING	
Open 8°A.T.D.C.	Close 40°A.B.D.C.	Open 40°B.B.D.C.	Close 8°A.T.D.C.

VALVE CLEARANCE Hot Intake .004" Exhaust .006"

CARBURETOR	COOLING SYSTEM		OILING SYSTEM	
Stromberg	Type Pump	Cap. 7 Gal	Type Press	Cap. 8 Qts

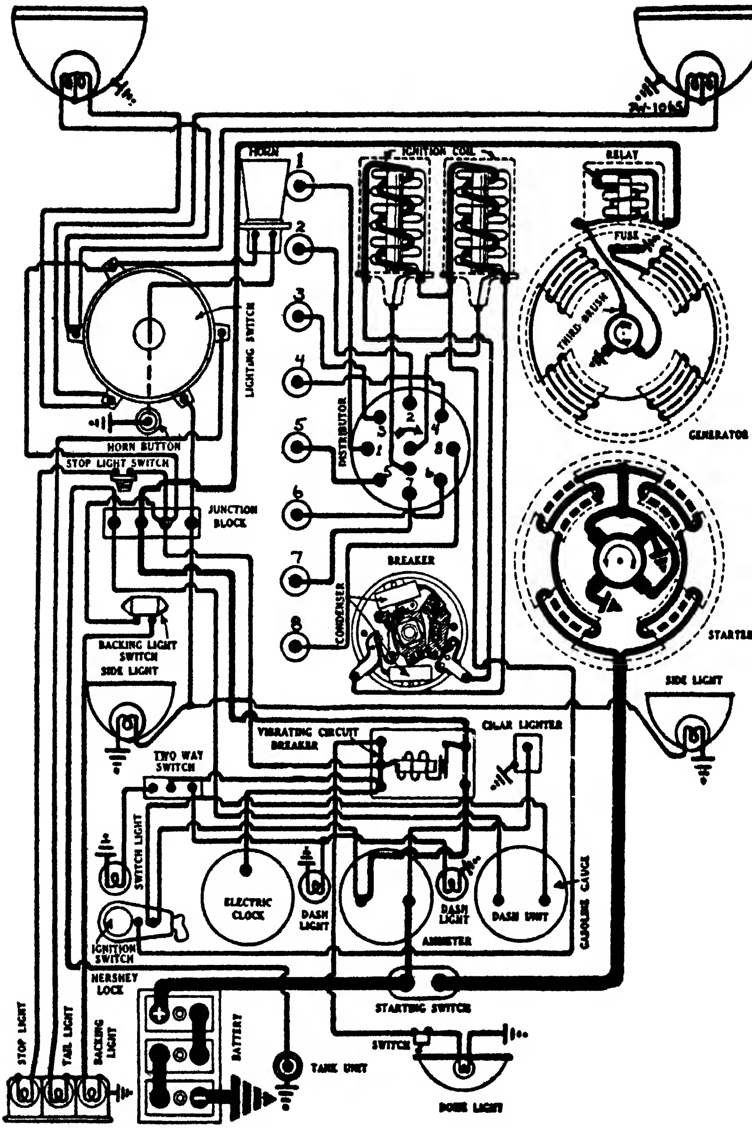
PISTON RING: Width Comp 1/8" Oil 3/16" Diam. 3" Gap .004 - .012"

CLUTCH Dry Plate GEAR RATIO -- AXLE --

BRAKES

Front	Rear	Hand
3/16" x 2" x 18" (4 pcs)	Same	3/16" x $2\frac{1}{2}$" x 23-3/8"

Lighting	Headlights	Dash & Tail	Side Lamps
Single Contact	21 C.P.	3 C.P.	3 C.P.



JORDAN WIRING DIAGRAM, 1929, MODEL G

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Jordan Model G Year 1929

Autolite Starter & Generator Autolite Ignition

Regulation / Max. Chg. rate and speed

Third Brush ... 12 amps

RELAY Air Gap	Contact Gap	Cut-in R.P.M.
.010" - .030"	.030"	550

BATTERY Willard Type WSB 15 Volts 6 Amps 105

Bat. to Frame Con. Negative CONTACT BREAKER Gap .024"

Firing Order 1-6-2-5-8-3-7-4 Ignition Timing 10°B.T.D.C. adv.

SPARK PLUG	ENGINE	Taxable Hp.
Size Metric Gap .025"	Bore 3" Stroke 4½"	28.9

INTAKE VALVE TIMING	EXHAUST VALVE TIMING
Open 8°A.T.D.C. Close 50°A.B.D.C.	Open 40°B.B.D.C. Close 8°A.T.D.C.

VALVE CLEARANCE Hot Intake .004" Exhaust .006"

CARBURETOR	COOLING SYSTEM	OILING SYSTEM
Stromberg	Type Pump Cap 18 Qts	Type Press Cap 8 Qts

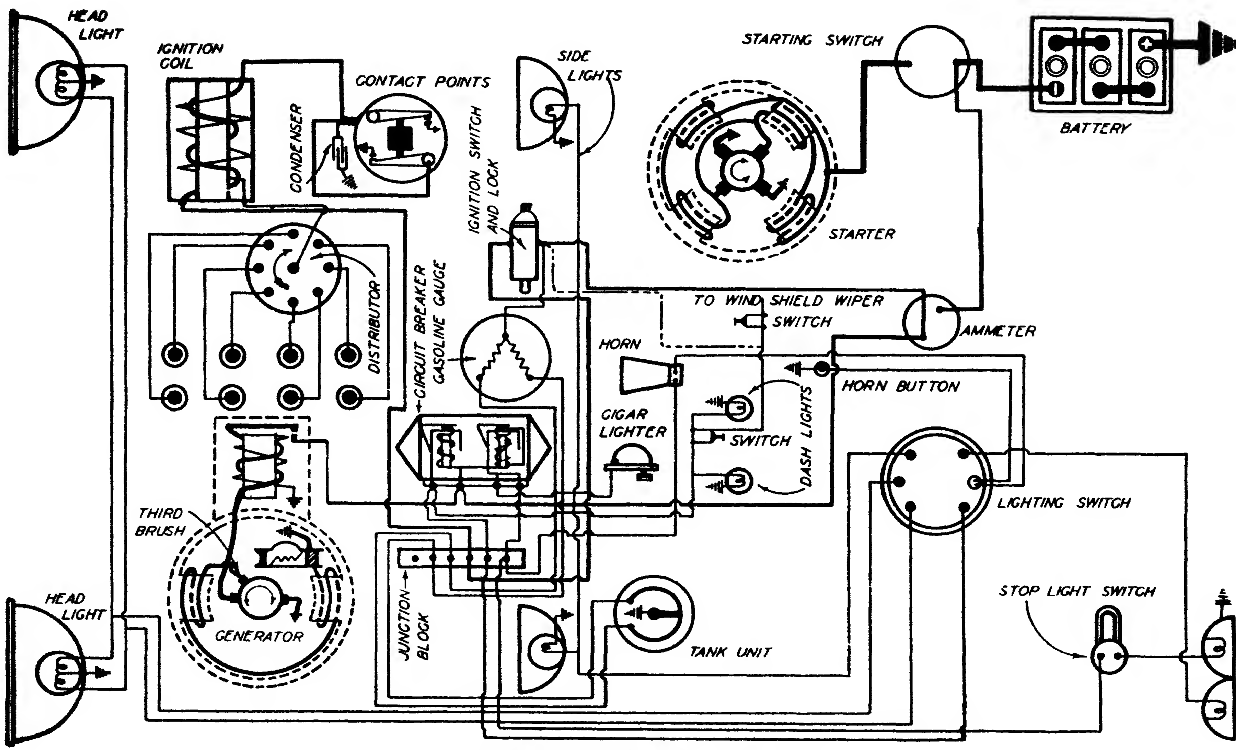
PISTON RING: Width Comp 1/8" Oil 3/16" Diam 3" Gap .005" - .014"

CLUTCH Dry plate GEAR RATIO -- AXLE --

BRAKES

Front	Rear	Hand
3/16" x 1¾" x 17" (4 pcs)	Same	3/16" x 2" x 24½"

Lighting	Headlights	Dash & Tail	Side Lamps
Single Contact	21 C.P.	3 C.P.	3 C.P.



LA SALLE WIRING DIAGRAM, 1929, MODEL 328

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LaSalle Model 328 Year 1929

Delco-Remy Starter & Generator Delco-Remy Ignition

Regulation — Max. Chg. rate and speed

Third Brush — 18-20 - 1600 r.p.m.

RELAY Air Gap — Contact Gap — Cut-in R.P.M.

.014" -.018" — .015" - .025" — 600

BATTERY Exide Type 3MXV-15-1 Volts 6 Amps 100

Bat. to Frame Con. Positive CONTACT BREAKER Gap .025"-.027"

Firing Order 1L-4R-4L-2L-3R-3L-2R-1R Ignition Timing 7/8" ahead of center or 7°

SPARK PLUG — ENGINE — Taxable Hp.

Size Metric Gap .025" .028" Bore 3¼" Stroke 4-15/16" 33.8

INTAKE VALVE TIMING — EXHAUST VALVE TIMING

Open 9½° B.T.D.C. Close 58½° A.B.D.C. Open 46° B.B.D.C. Close 5° A.T.D.C.

VALVE CLEARANCE Cold Intake .004" Exhaust .006"

CARBURETOR — COOLING SYSTEM — OILING SYSTEM

Own Type Pump Cap 5¼ Gal Type Press Cap 8 Qts

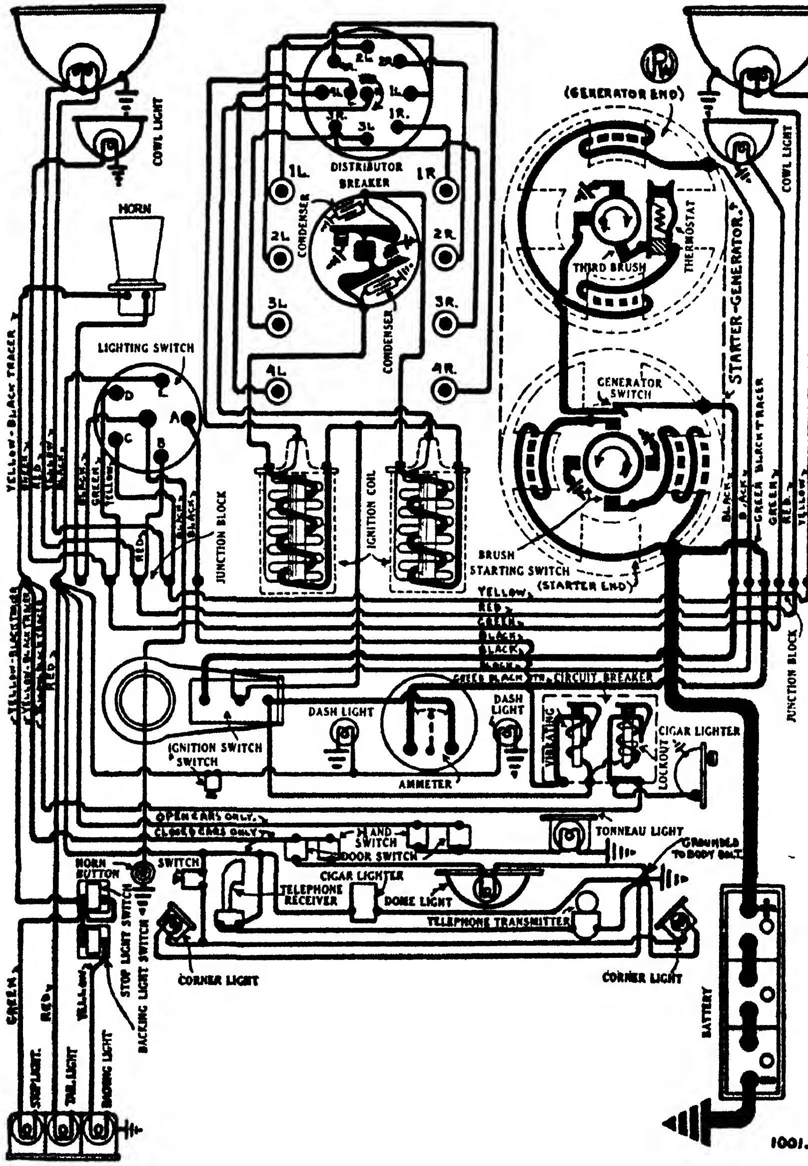
PISTON RING: Width 3/16" Diam 3¼" Gap .008"-.015"

CLUTCH Plate GEAR RATIO 4.5 AXLE 3/4 Floating

BRAKES

Front	Rear	Hand
3/16" x 2" x 20-5/32" per wheel	Same	3/16" x 2" x 9-1/8"

Lighting	Headlights	Dash & Tail	Side Lamps
Single Contact	21 C.P.	3 C.P.	3 C.P.



LINCOLN WIRING DIAGRAM, 1929

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Lincoln Model .... Year 1929

Delco Starter & Generator Delco Ignition

Regulation	Max. Chg. rate and speed
Third Brush	16-18 amps, 2500 r.p.m.

RELAY Air Gap	Contact Gap	Cut-in R.P.M.
.014" - .018"	.018" - .025"	600

BATTERY Exide Type 3L-XRV-15-2 Volts 6 Amps 135

Bat. to Frame Con. Negative CONTACT BREAKER Gap .015"-.020

Firing Order R-B. 1-3-7-5 L-B. 6-8-4-2 Ignition Timing 4° A.T.D.C. ret.

SPARK PLUG		ENGINE		Taxable Hp.
Size 7/8"	Gap .025"	Bore 3½"	Stroke 5"	39.2

INTAKE VALVE TIMING		EXHAUST VALVE TIMING	
Open 2½° B.T.D.C.	Close 46° A.B.D.C.	Open 48½° B.B.D.C.	Close T.D.C.

VALVE CLEARANCE Hot. Intake .004" Exhaust .004"

CARBURETOR	COOLING SYSTEM		OILING SYSTEM	
Stromberg	Type Pump	Cap. 8 Gal	Type Press	Cap 10 Qts.

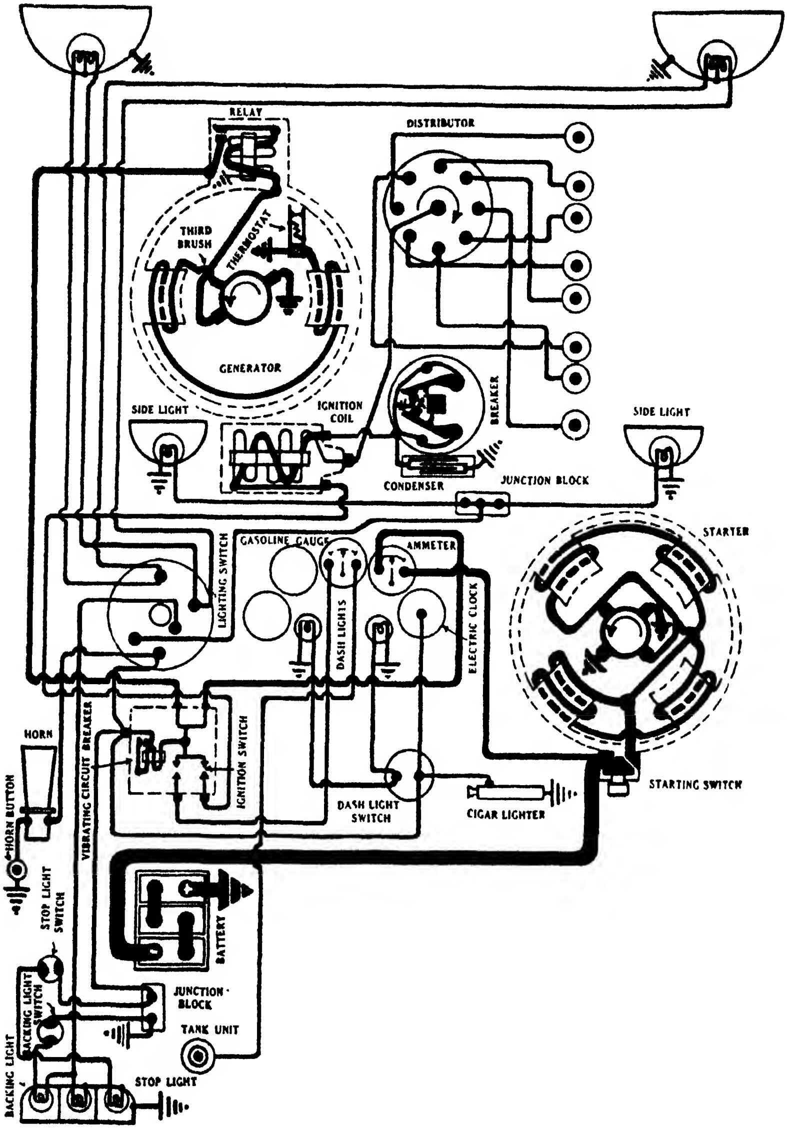
PISTON RING: Width 1/8" Diam. 3½" Gap .015"

CLUTCH Disc GEAR RATIO 4.58 AXLE Full floating

BRAKES

Front	Rear	Hand
¼" x 29" x 2½"	1/4" x 2½" x 29"	1/4" x 2" x 21¼"

Lighting	Headlights	Dash & Tail	Side Lamps
Single Contact	21 C.P.	2 C.P.	2 C.P.



MARMON WIRING DIAGRAM, 1927, MODEL L

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Marmon Model: L Year 1927

Delco-Remy Starter & Generator Delco-Remy Ignition

Regulation	Max. Chg. rate and speed
Third Brush	12 amps, 25 mph

RELAY Air Gap	Contact Gap	Cut-in R.P.M.
.014" - .021"	.015" - .025"	575

BATTERY Prestolite Type Volts 6 Amps 100-120

Bat. to Frame Con. Positive CONTACT BREAKER Gap .022"

Firing Order 1-6-2-5-8-3-7-4 Ignition Timing Five flywheel teeth early, control full adv.

SPARK PLUG	ENGINE	Taxable Hp.
Size 7/8" Gap .025"	Bore 2-3/4" Stroke 4"	24.2

INTAKE VALVE TIMING	EXHAUST VALVE TIMING
Open 6° B.T.D.C. Close 40° A.B.D.C.	Open 40° B.B.D.C. Close 6° A.T.D.C.

VALVE CLEARANCE. Hot Intake .007" Exhaust .007"

CARBURETOR	COOLING SYSTEM	OILING SYSTEM
Schebler	Type Pump Cap 5 Gals	Type Press Cap 6 Qts

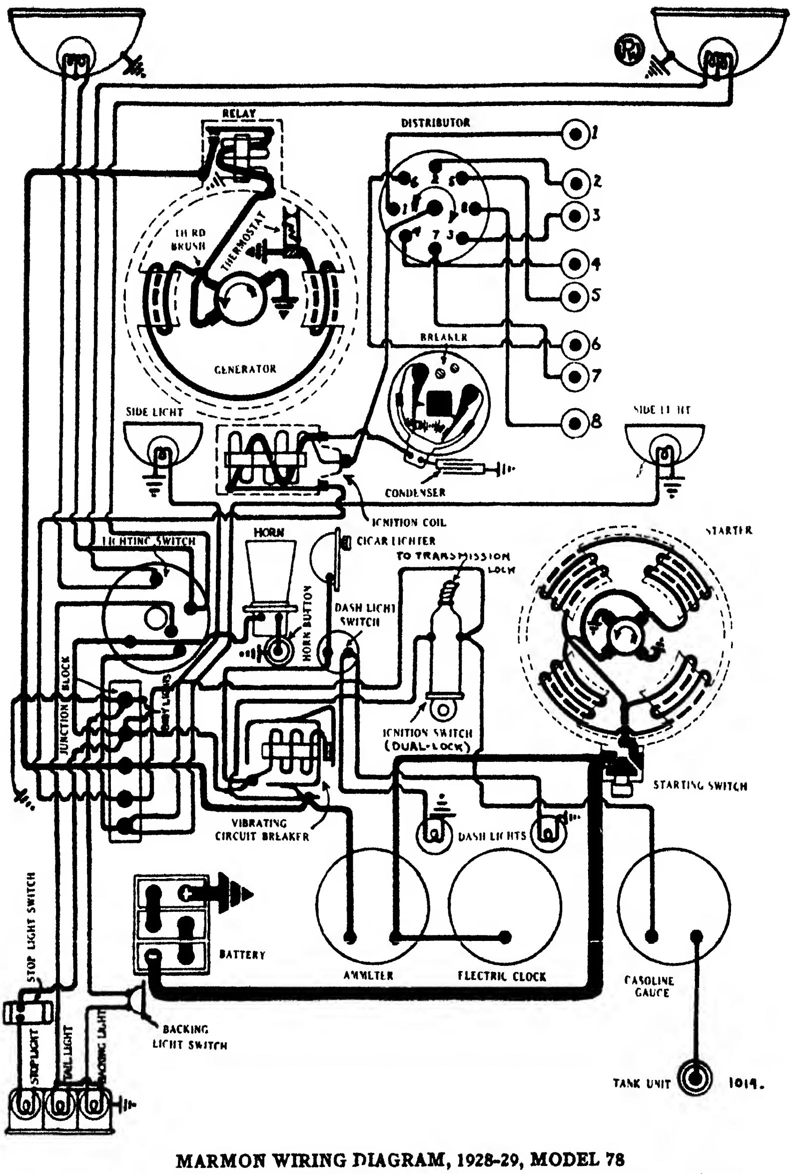
PISTON RING: Width 1/8" 3/16" Diam. 2-3/4" Gap .002" - .007"

CLUTCH 9" plate GEAR RATIO 5.1 & 4.7 AXLE Semi-floating

BRAKES

Front	Rear	Hand
3/16" x 1¾" x 32-1/16" (per wheel)	Same	On foot

Lighting	Headlights	Dash & Tail	Side Lamps
Single Contact	21 C.P. Dbl Fil	3 C.P.	3 C.P.



MARMON WIRING DIAGRAM, 1928-29, MODEL 78

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Marmon Model 78 Year 1928-29

Delco-Remy Starter & Generator Delco-Remy Ignition

Regulation	Max. Chg. rate and speed
Third Brush	12 amps, 25 m.p.h.

RELAY Air Gap	Contact Gap	Cut-in R.P.M.
.014" - .021"	.015" - .025"	575

BATTERY Prestolite Type 615-JFK Volts 6 Amps 120

Bat. to Frame Con. Positive CONTACT BREAKER Gap .022"

Firing Order 1-6-2-5-8-3-7-4 Ignition Timing Two flywheel teeth early, control full adv.

SPARK PLUG	ENGINE	Taxable Hp.
Size 7/8" Gap .025"	Bore 2-15/16" Stroke 4"	27.6

INTAKE VALVE TIMING	EXHAUST VALVE TIMING
Open 6° B.T.D.C. Close 40° A.B.D.C.	Open 40° B.B.D.C. Close 6° A.T.D.C.

VALVE CLEARANCE Hot Intake .008" Exhaust .008"

CARBURETOR	COOLING SYSTEM	OILING SYSTEM
Stromberg	Type Pump Cap 5¾ Gal	Type Press Cap 6 Qts

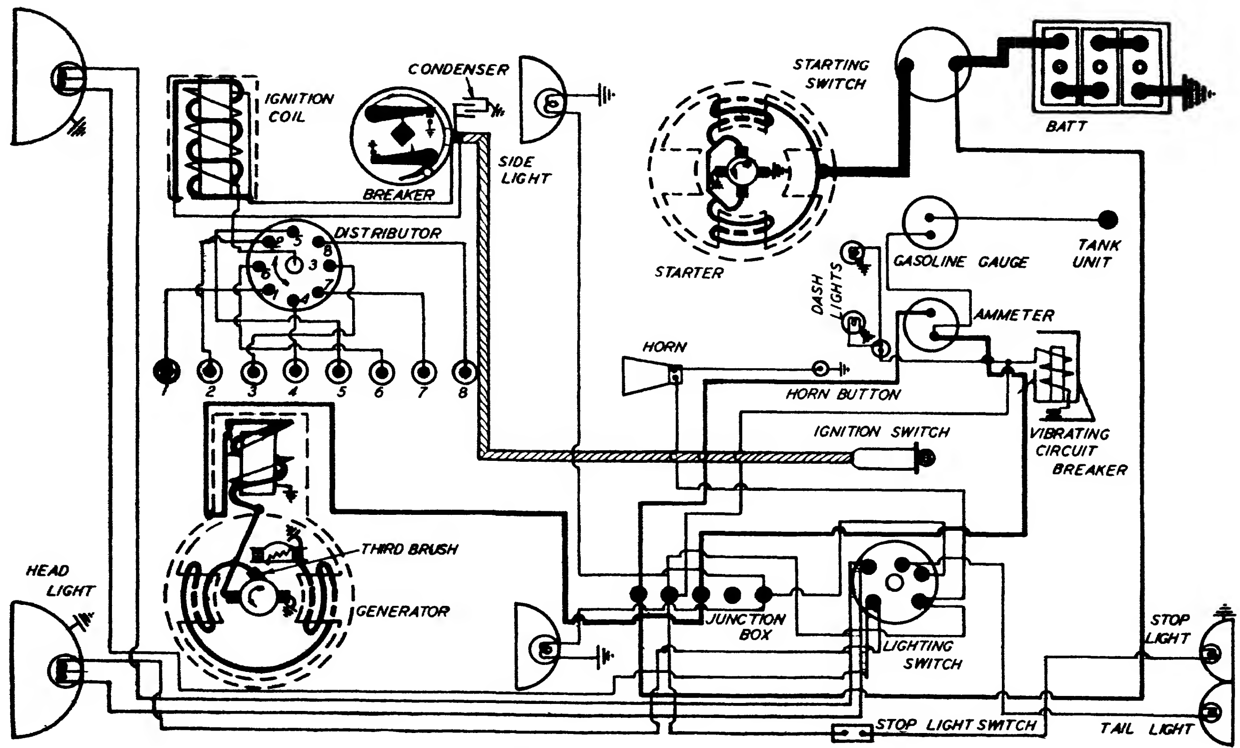
PISTON RING: Width 1/8" 3/16" Diam. 2-15/16" Gap .002" - .007"

CLUTCH 10" plate GEAR RATIO 4.9 AXLE Semi-floating

BRAKES

Front	Rear	Hand
3/16" x 1¾" x 32-1/16" (per wheel)	Same	On foot

Lighting	Headlights	Dash & Tail	Side Lamps
Single	Contact 21 C.P. Dbl Fil	3 C.P.	3 C.P.



MARMON WIRING DIAGRAM, 1928-29, MODEL 68
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Marmon Model 68 Year 1928-29

Delco-Remy Starter & Generator Delco-Remy Ignition

Regulation	Max Chg rate and speed
Third Brush	12 amps, 25 m.p.h.

RELAY Air Gap	Contact Gap	Cut in R P M
.014" - .021"	.015" - .025"	575

BATTERY Prestolite Type 615-JFK Volts 6 Amps 120

Bat to Frame Con Positive CONTACT BREAKER Gap .022"

Firing Order 1-6-2-5-8-3-7-4 Ignition Timing IG mark on flywheel control advanced

SPARK PLUG		ENGINE		Taxable Hp
Size 7/8"	Gap .025"	Bore 2-13/16"	Stroke 4-1/4"	25.32

INTAKE VALVE TIMING		EXHAUST VALVE TIMING	
Open 6°B.T.D.C.	Close 40°A.B.D.C.	Open 40°B.B.D.C.	Close 6°A.T.D.C.

VALVE CLEARANCE Cold Intake .006"-.008" Exhaust .006" - .008"

CARBURETOR	COOLING SYSTEM	OILING SYSTEM
Stromberg	Type Pump Cap 5½ Gal	Type Press Cap 6 Qts

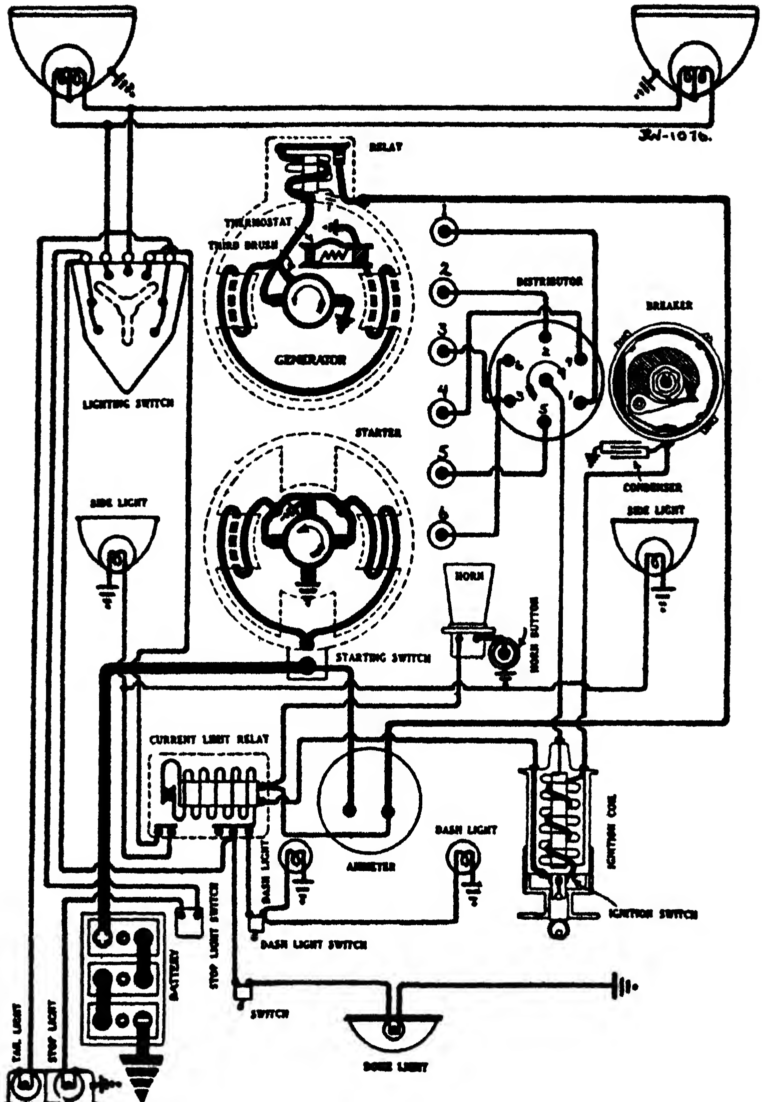
PISTON RING Width 1/8" 3/16" Diam 2-13/16" Gap .002" - .007"

CLUTCH 10" plate GEAR RATIO 4.9 AXLE Semi-floating

BRAKES

Front	Rear	Hand
3/16" x 1¾" x 32-1/16" (per wheel)	Same	on foot

Lighting	Headlights	Dash & Tail	Side Lamps
Single	Contact 21 Dbl Fil C P	3 C P	3 C P.



MARQUETTE WIRING DIAGRAM, 1930, 30 SERIES

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Marquette Model 30 Series Year 1930

Delco-Remy Starter & Generator Delco-Remy Ignition

Regulation	Max. Chg. rate and speed
Third Brush	18-20 amps

RELAY Air Gap	Contact Gap	Cut-in R.P.M.
.014"-.020"	.015" - .025"	--

BATTERY Delco & Exide Type 13 plate Volts 6 Amps 85

Bat. to Frame Con. Negative CONTACT BREAKER Gap .018"-.024"

Firing Order 1-5-3-6-2-4 Ignition Timing 7° Adv.

SPARK PLUG	ENGINE	Taxable Hp.
Size Metric Gap .025"	Bore 3-1/8" Stroke 4-5/8"	23.44

INTAKE VALVE TIMING	EXHAUST VALVE TIMING
Open. 5°B.T.D.C. Close 45°A.B.D.C.	Open 45°B.B.D.C. Close 18°A.T.D.C.

VALVE CLEARANCE Intake Exhaust

CARBURETOR	COOLING SYSTEM	OILING SYSTEM
Marvel	Type Pump Cap. 3 Gal	Type Press Cap. 7 Qts

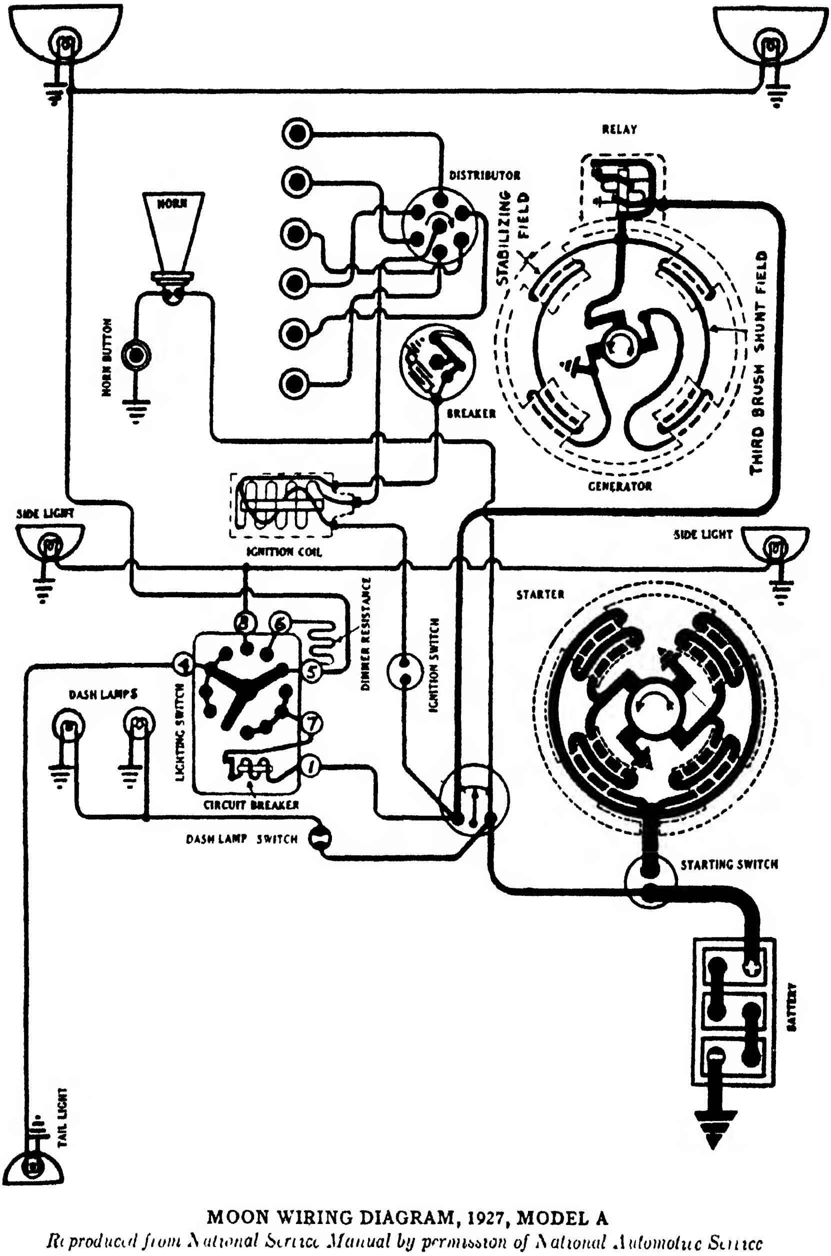
PISTON RING: Width 1/8" Diam. 3-1/8" Gap .010"-.015"

CLUTCH Single Plate GEAR RATIO 4.54 AXLE Semi-floating

BRAKES

Front	Rear	Hand
1¾" x 13" (4 pcs)	Same	

Lighting	Headlights	Dash & Tail	Side Lamps
Single Contact	21-21 C.P.	3 C.P.	3 C.P.



MOON WIRING DIAGRAM, 1927, MODEL A

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Moon Model A Year 1927

Delco Starter & Generator — Delco Ignition

Regulation: Third Brush

Max Chg rate and speed: 9-12 amps, 2000 r.p.m.

RELAY Air Gap	Contact Gap	Cut in R P M
.019" - .021"	.015" - .025"	600

BATTERY U.S.L. Type XY-131 Volts 6 Amps 98

Bat to Frame Con Negative CONTACT BREAKER Gap .014"-.020"

Firing Order 1-5-3-6-2-4 Ignition Timing T.D.C. spark ret.

SPARK PLUG		ENGINE		Taxable Hp
Size 7/8"	Gap .025"	Bore 3-1/8"	Stroke 4-1/4"	23.45

INTAKE VALVE TIMING		EXHAUST VALVE TIMING	
Open 4°A.T.D.C.	Close 46°A.B.D.C.	Open 41°B.B.D.C.	Close 1°A.T.D.C.

VALVE CLEARANCE Warm Intake .004" Exhaust .006"

CARBURETOR	COOLING SYSTEM	OILING SYSTEM
Stromberg	Type Pump Cap 4 Gal	Type Full Force Cap 8 Qts

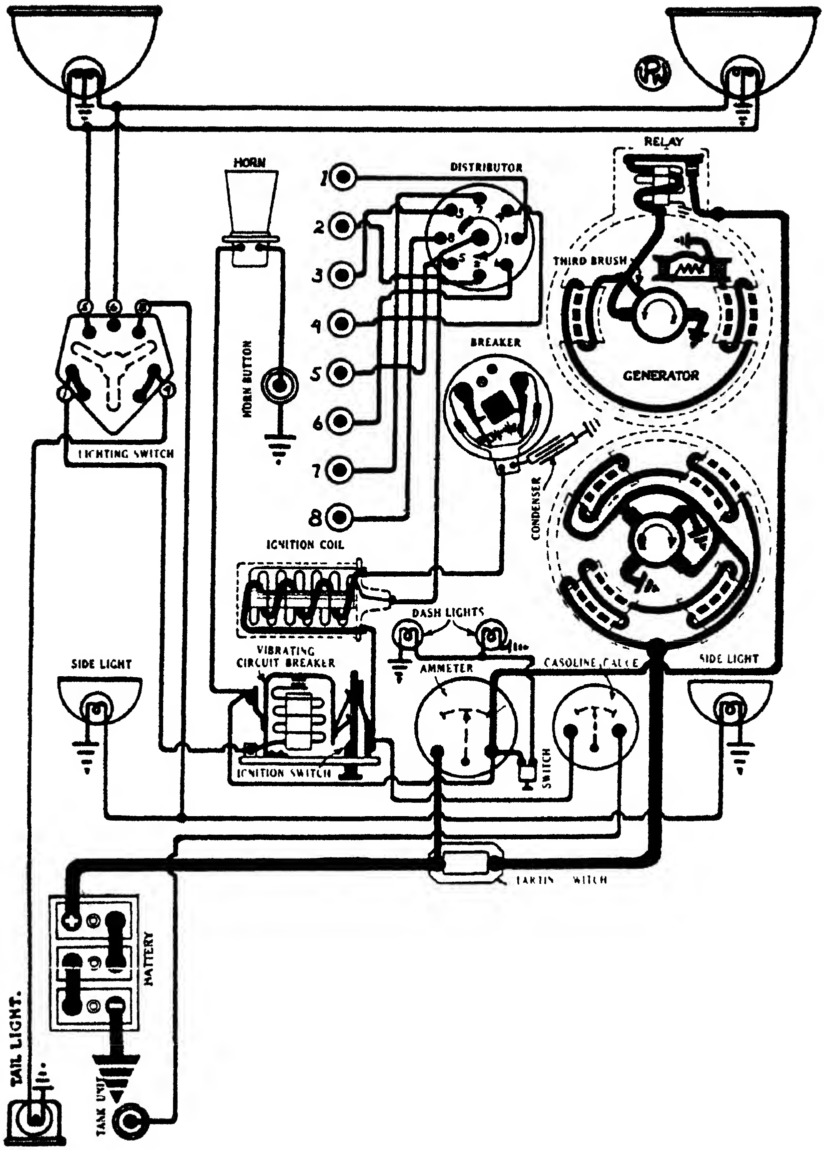
PISTON RING Width 3/16" Diam 3-1/8" Gap .006"-.008"-.010"

CLUTCH Single Plate GEAR RATIO 4.9 AXLE 3/4 Floating

BRAKES

Front	Rear	Hand
3/16" x 1¾" x 9-1/4" 3/16" x 1¼" x 19" (2 pcs)	3/16" x 1¾" x 9½" 3/16" x 1¼" x 19 (2 pcs)	5/32" x 2" x 18" (1 pc)

Lighting	Headlights	Dash & Tail	Side Lamps
Single Contact	21 C P	3 C P	3 C P



MOON WIRING DIAGRAM, 1928, MODEL 8-80

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Moon Model 8-80 Year 1928

Delco-Remy Starter & Generator Delco-Remy Ignition

Regulation: Third Brush

Max Chg rate and speed: 9-12 amps, 2000 r.p.m.

RELAY Air Gap	Contact Gap	Cut in R P M
.019" - .021"	.015" - .025"	600

BATTERY U.S.L. Type 3-HVX-7X Volts 6 Amps 148.5

Bat to Frame Con Negative CONTACT BREAKER Gap .018" - .024"

Firing Order 1-6-2-5-8-3-7-4 Ignition Timing T.D.C. ret.

SPARK PLUG		ENGINE		Taxable Hp
Size 7/8"	Gap .025"	Bore 3"	Stroke 4-3/4"	28.8

INTAKE VALVE TIMING		EXHAUST VALVE TIMING	
Open 8°A.T.D.C.	Close 40°A.B.D.C.	Open 40°B.B.D.C.	Close 8°A.T.D.C.

VALVE CLEARANCE Warm Intake .004" Exhaust .006"

CARBURETOR	COOLING SYSTEM	OILING SYSTEM
Stromberg	Type Pump Cap 4 Gal	Type Press Cap 8 Qts.

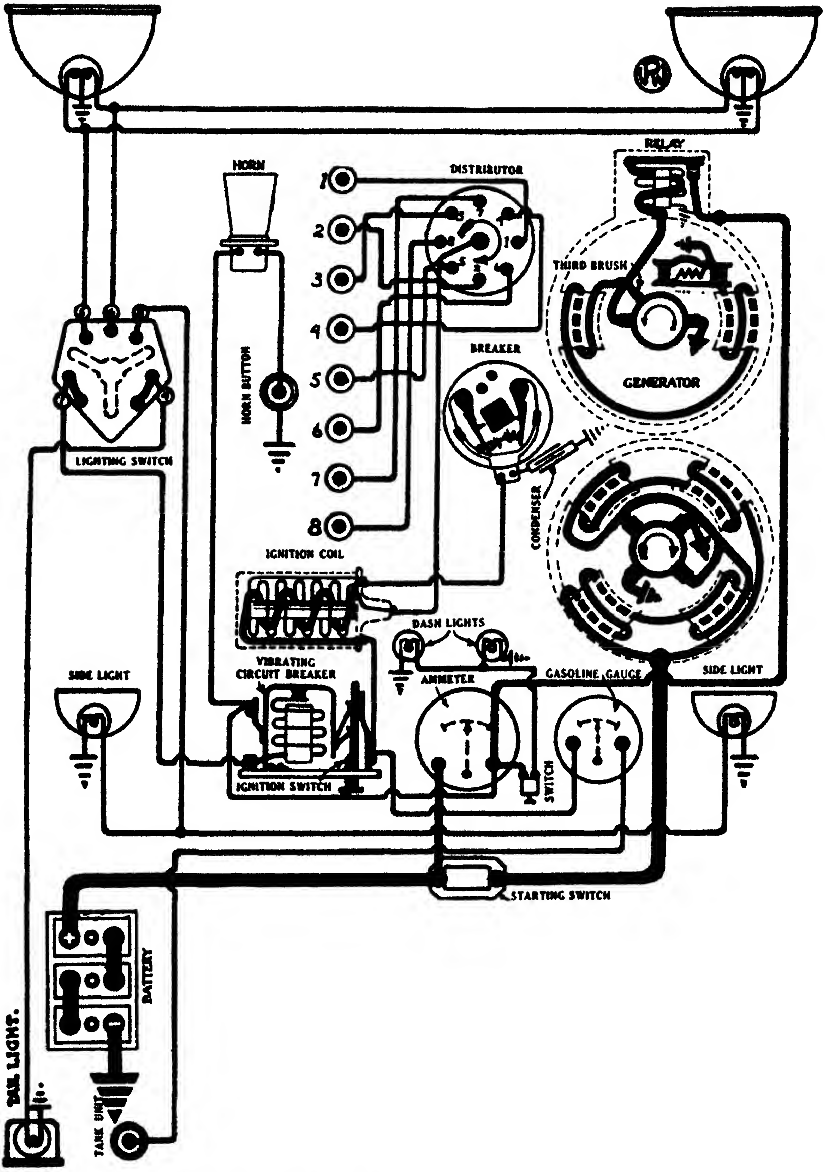
PISTON RING Width 3/16" Diam 3" Gap .008"

CLUTCH Single Plate GEAR RATIO 4.67 AXLE 3/4 floating

BRAKES

Front	Rear	Hand
5/32" x 2" x 13" 5/32" x 2" x 23" (2 pcs)	5/32" x 2" x 13" 5/32" x 2" x 23" (2 pcs)	5/32" x 2" x 24-5/8" (1 pc)

Lighting	Headlights	Dash & Tail	Side Lamps
Single Contact	21 C P	3 C P	6 C P



MOON WIRING DIAGRAM, 1929, MODEL 8-92
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Moon Model 8-92 Year 1929

Delco Starter & Generator **Delco** Ignition

Regulation Max Chg rate and speed

Third Brush 9-12 amps, 2000 r.p.m.

RELAY Air Gap	Contact Gap	Cut in R P M
.014" - .021"	.015" - .025"	600

BATTERY U.S.L. Type 3-4VX-7X Volts 6 Amps 148.5

Bat to Frame Con Negative CONTACT BREAKER Gap .018" - .024"

Firing Order 1-6-2-5-8-3-7-4 Ignition Timing T.D.C. spark ret.

SPARK PLUG	ENGINE	Taxable Hp
Size Metric Gap .025"	Bore 3" Stroke 4-3/4"	28.8

INTAKE VALVE TIMING	EXHAUST VALVE TIMING
Open 8°A.T.D.C. Close 40°A.B.D.C.	Open 40°B.B.D.C. Close 8°A.T.D.C.

VALVE CLEARANCE Hot Intake .004" Exhaust .006"

CARBURETOR	COOLING SYSTEM	OILING SYSTEM
Stromberg	Type Pump Cap 4 Gal	Type Press Cap 8 Qts

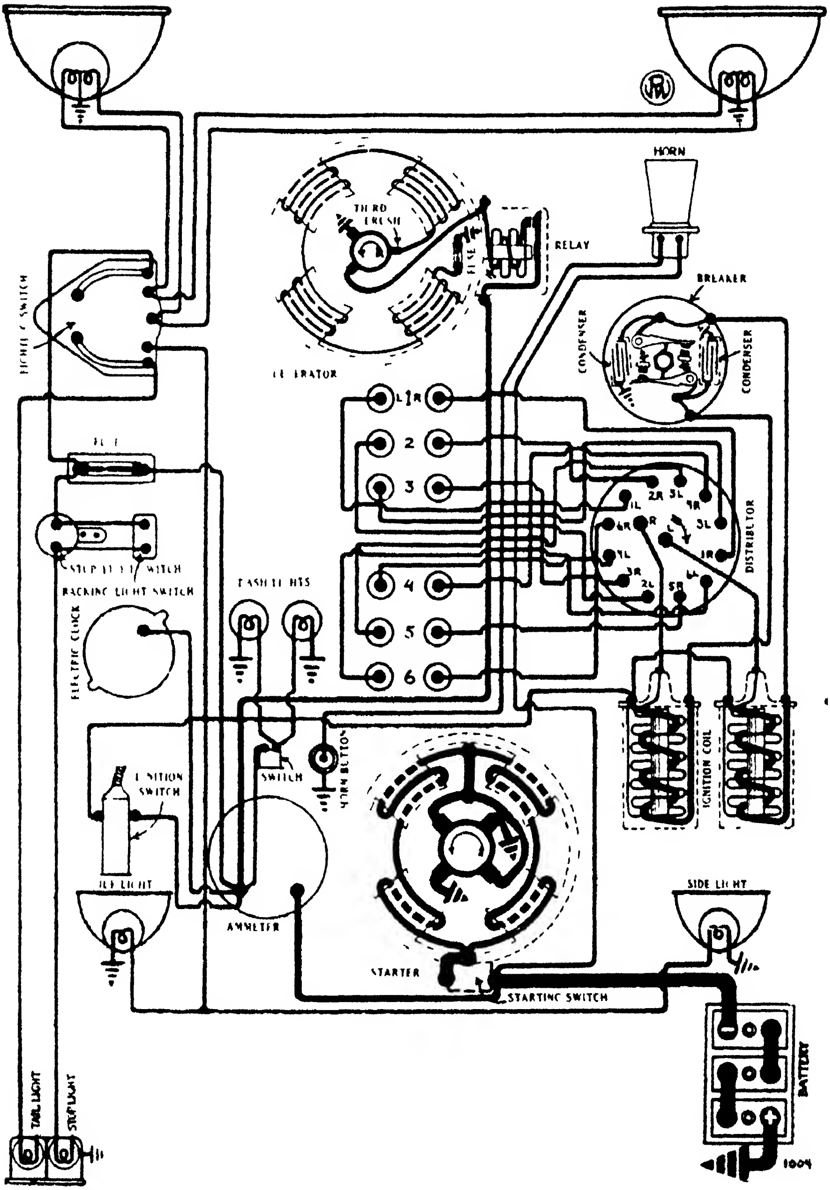
PISTON RING Width 1/8" Diam 3" Gap .004" - .006" - .010"

CLUTCH Single Plate GEAR RATIO 3.9 AXLE 3/4 Floating

BRAKES

Front	Rear	Hand
5/32" x 2" x 36" (per wheel)	Same	5/32" x 2" x 24-5/8" (1 pc)

Lighting	Headlights	Dash & Tail	Side Lamps
Single Contact	21 C P	3 C P	6 C P



NASH WIRING DIAGRAM, 400 SERIES, ADVANCE

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Nash Model Advanced Year 400 Series

Autolite Starter & Generator Autolite Ignition

Regulation Max Chg rate and speed

Third Brush 15-17 amps. 2000 r.p.m.

RELAY Air Gap .015" Contact Gap .025" - .035" Cut-in R P M 600

BATTERY U.S.L. Type 23275-B Volts 6 Amps 120

Bat to Frame Con Positive CONTACT BREAKER Gap .020"

Firing Order 1-5-3-6-2-4 Ignition Timing 15°B.T.D.C. adv.

SPARK PLUG / ENGINE / Taxable Hp

Size Metric Gap .025" Bore 3-7/16" Stroke 5" 28.3

INTAKE VALVE TIMING / EXHAUST VALVE TIMING

Open 15°A.T.D.C. Close 38°A.B.D.C. Open 45°B.B.D.C. Close 10°A.T.D.C.

VALVE CLEARANCE Hot Intake .012" Exhaust .012"

CARBURETOR / COOLING SYSTEM / OILING SYSTEM

Marvel Type Pump Cap 19 Qts Type Press Cap 8 Qts

PISTON RING Width 1/8", 1/4" Diam 3-7/16" Gap .020"

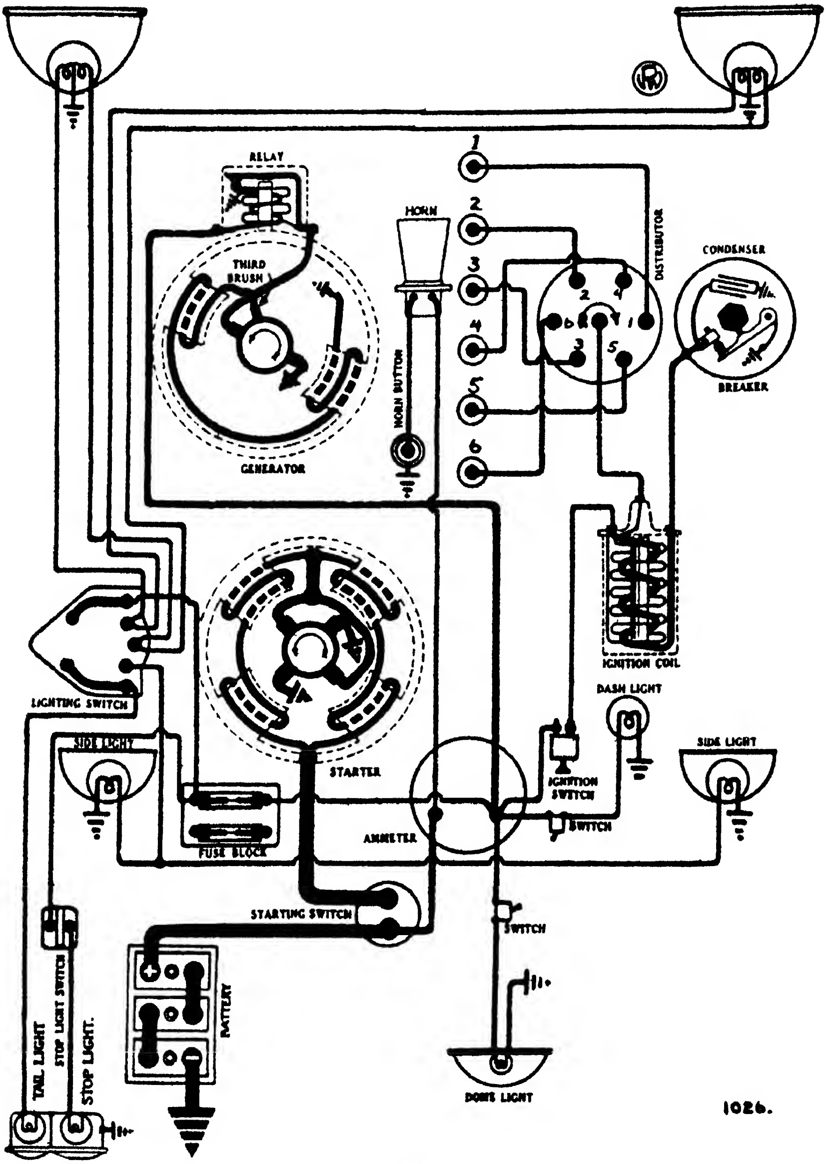
CLUTCH Single Plate GEAR RATIO 4.5 AXLE Semi-floating

BRAKES

Front	Rear	Hand
5/32" x 2" x 13-7/16" 5/32" x 2" x 18-5/16" (2 pcs)	5/32" x 2½" x 22¼" (4 pcs)	3/16" x 2½" x 6-27/32" (2 pcs)

Lighting Headlights Dash & Tail Side Lamps

Single Contact 21 Dbl Fil C P 3 C P 3 C P



NASH WIRING DIAGRAM, 400 SERIES, STANDARD

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Nash Model Standard Year 400 Series

Autolite Starter & Generator Autolite Ignition

Regulation	Max. Chg. rate and speed
Third Brush	17 amps, 1800 r.p.m.

RELAY Air Gap	Contact Gap	Cut-in R.P.M.
	.025"-.035"	600, 9 m.p.h.

BATTERY U.S.L. Type 3-HUX-5X6 Volts 6 Amps 105

Bat. to Frame Con. Negative CONTACT BREAKER Gap .080"

Firing Order 1-5-3-6-2-4 Ignition Timing 1/2" B.T.D.C. no manual control

SPARK PLUG	ENGINE	Taxable Hp.
Size Metric Gap .020"	Bore 3-1/8" Stroke 4"	23.5

INTAKE VALVE TIMING	EXHAUST VALVE TIMING
Open 5°A.T.D.C. Close 45°A.B.D.C.	Open 45°B.B.D.C. Close 5°A.T.D.C.

VALVE CLEARANCE. Hot or cold Intake. .008" Exhaust .008"

CARBURETOR	COOLING SYSTEM	OILING SYSTEM
Marvel	Type Pump Cap 10 Qts.	Type Press Cap 5 Qts.

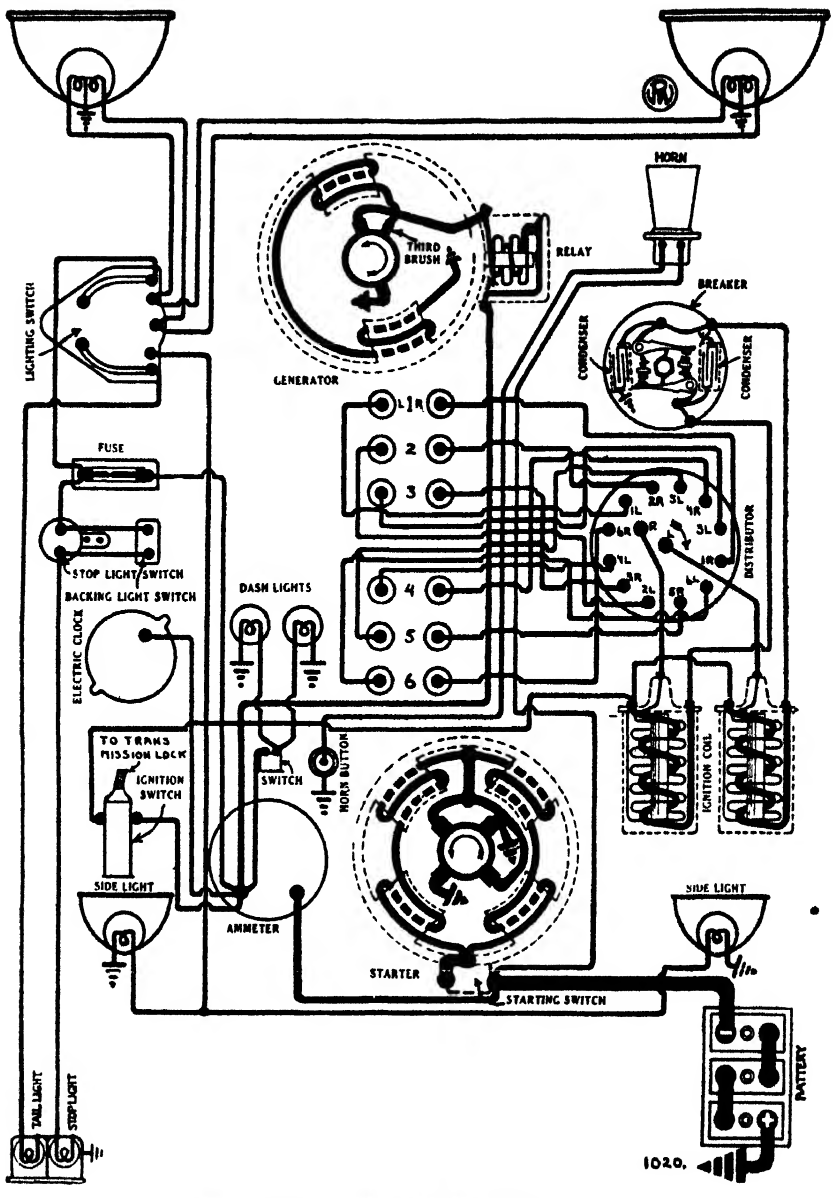
PISTON RING: Width. 1/8" 1/4" Diam. 3-1/8" Gap .020"

CLUTCH. Single Plate GEAR RATIO 4.77 AXLE Semi-floating

BRAKES

Front	Rear	Hand
5/32" x 1¾" x 11-1/2" 5/32" x 1¼" x 7-13/16" (2 pcs ea.)	5/32" x 2" x 22-1/4" (4 pcs)	3/16" x 2¼" x 6-27/32" (2 pcs)

Lighting	Headlights	Dash & Tail	Side Lamps
Single Contact	21 C.P. Dbl Fil	3 C.P.	3 C.P.



NASH WIRING DIAGRAM, 400 SERIES, SPECIAL
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Nash Model Special Year 400 Series

Autolite Starter & Generator Autolite Ignition

Regulation	Max. Chg. rate and speed
Third Brush	15-17 amps. 2000 r.p.m.

RELAY Air Gap	Contact Gap	Cut-in R.P.M.
.015"	.025" - .035"	600

BATTERY U.S.L. Type 3-HUX-5X6 Form E Volts 6 Amps 105

Bat. to Frame Con. Positive CONTACT BREAKER Gap .020"

Firing Order 1-5-3-6-2-4 Ignition Timing 20° B.T.D.C.

SPARK PLUG	ENGINE	Taxable Hp.
Size Metric Gap .025"	Bore 3-1/4" Stroke 4-1/2"	25.3

INTAKE VALVE TIMING	EXHAUST VALVE TIMING
Open 15° A.T.D.C. Close 38° A.B.D.C.	Open 45° B.B.D.C. Close 10° A.T.D.C.

VALVE CLEARANCE Hot Intake .012" Exhaust .012"

CARBURETOR	COOLING SYSTEM	OILING SYSTEM
Marvel	Type Pump Cap 17 Qts	Type Press Cap 7 Qts

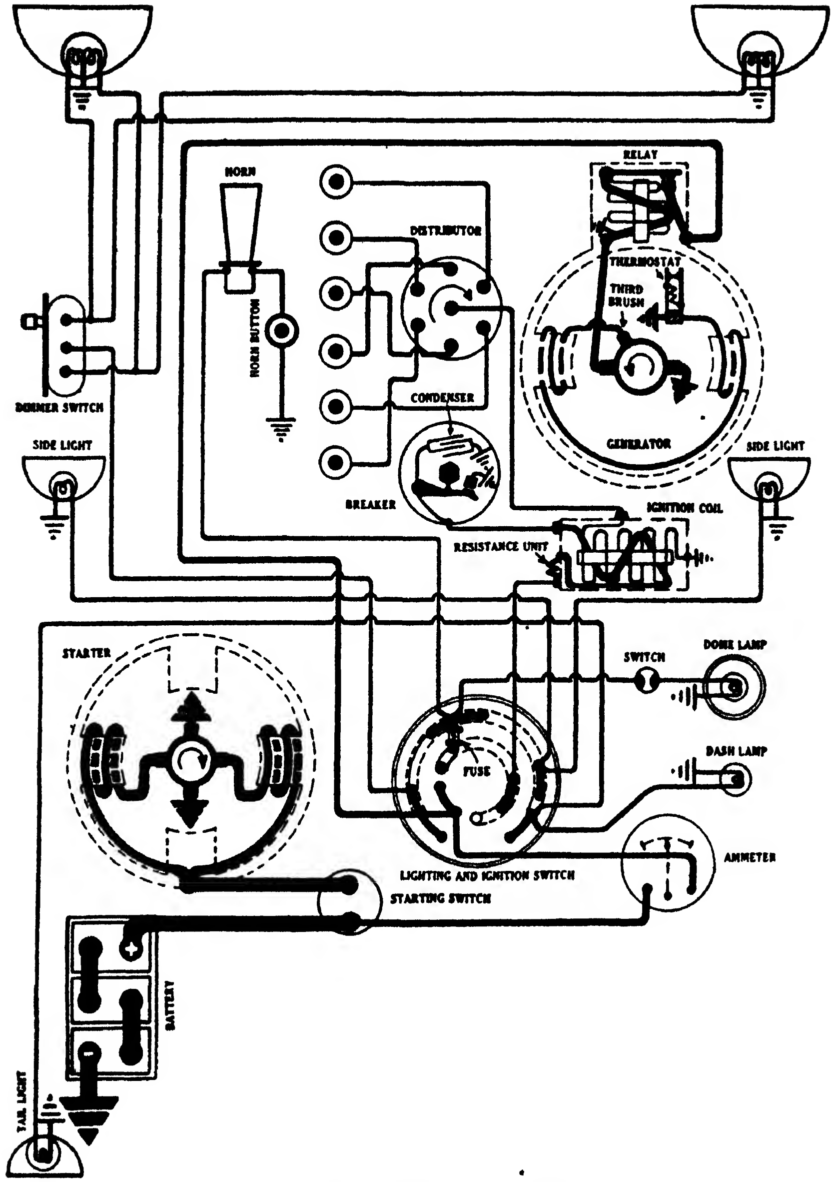
PISTON RING: Width 1/8" 1/4" Diam 3-1/4" Gap .020"

CLUTCH Single Plate GEAR RATIO 4.88 AXLE Semi-floating

BRAKES

Front	Rear	Hand
5/32" x 2" x 13-1/8" 5/32" x 2" x 16-11/16" (2 pcs)	5/32" x 2" x 23" 5/32" x 2" x 14-1/8" (2 pcs)	3/16" x 2½" x 6-27/32" (2 pcs)

Lighting	Headlights	Dash & Tail	Side Lamps
Single Contact	21 C.P. Dbl Fil	3 C.P.	3 C.P.



OAKLAND WIRING DIAGRAM, 1927, MODEL O.S.

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Oakland Model O.S. Year 1927

Delco-Remy Starter & Generator Delco-Remy Ignition

Regulation	Max. Chg. rate and speed
Third Brush	14 amps, 1450 R.P.M.

RELAY Air Gap	Contact Gap	Cut-in R.P.M.
.016"	.020"	575

BATTERY Willard Type CWR-15 Volts 6 Amps 100

Bat. to Frame Con. Negative CONTACT BREAKER Gap .020 - .023"

Firing Order 1-5-3-6-2-4 Ignition Timing IGN UDC marked

SPARK PLUG	ENGINE		Taxable Hp.
Size 7/8" Gap .022"	Bore 2-7/8"	Stroke 4-3/4"	19.8

INTAKE VALVE TIMING		EXHAUST VALVE TIMING	
Open 5°A.T.D.C.	Close 40°A.B.D.C.	Open 45°B.B.D.C.	Close 5°A.T.D.C.

VALVE CLEARANCE Hot Intake .007 - .009" Exhaust .007"-.009"

CARBURETOR	COOLING SYSTEM	OILING SYSTEM
Marvel	Type Pump Cap. $2\frac{3}{4}$ Gal	Type Press Cap. $6\frac{1}{2}$ Qts

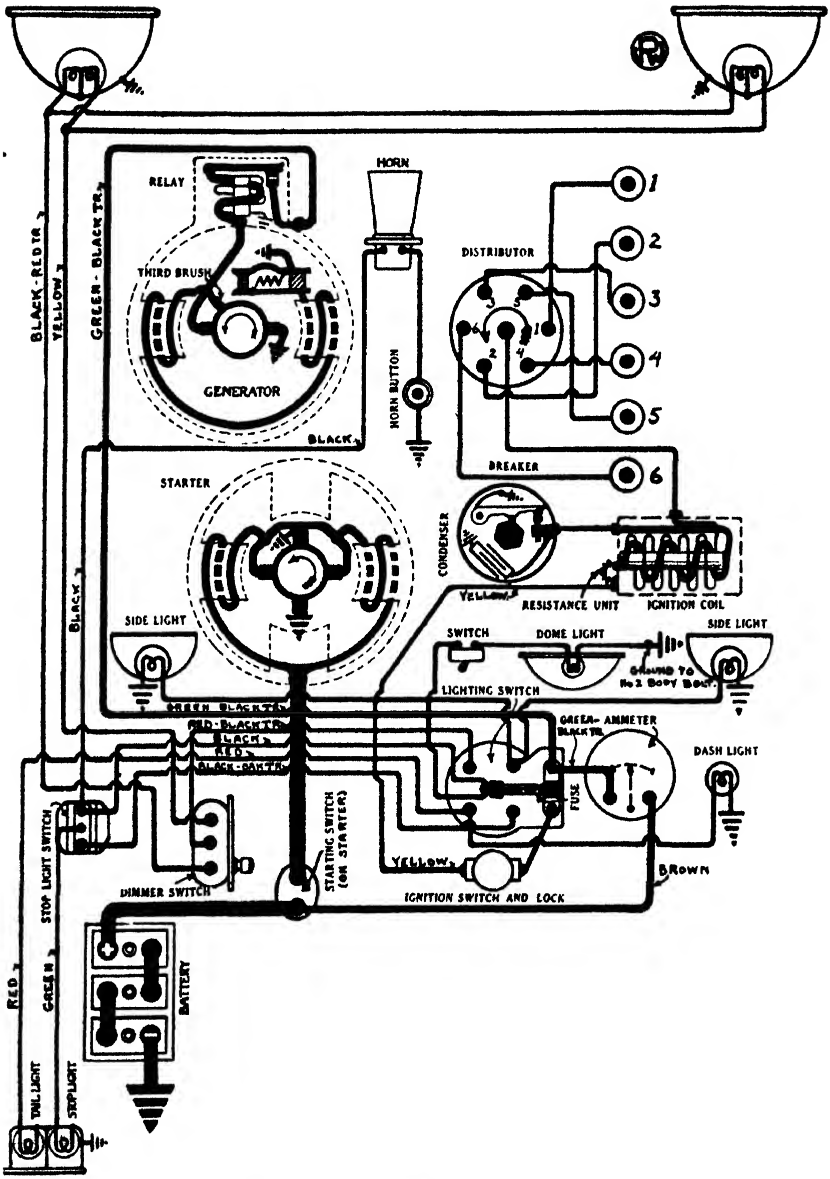
PISTON RING: Width 1/8" Diam. 2-7/8" Gap .004-.012"

CLUTCH Plate GEAR RATIO 4.72 AXLE Semi-floating

BRAKES

Front	Rear	Hand
5/32" x 1-7/8" x 22-1/8" 5/32" x 1-7/8" x 12-7/16" (2 pcs ea.)	Same	3/16" x $2\frac{1}{2}$" x $16\frac{1}{2}$"

Lighting	Headlights	Dash & Tail	Side Lamps
Single Contact	21 C.P.	3 C.P.	3 C.P.



OAKLAND WIRING DIAGRAM, 1928, MODEL A.A.S.

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Oakland Model A.A.S. Year 1928

Delco-Remy Starter & Generator Delco-Remy Ignition

Regulation	Max. Chg. rate and speed
Third Brush	14 amps, 1450 r.p.m.

RELAY Air Gap	Contact Gap	Cut-in R.P.M.
.014"	.015 - .025"	575

BATTERY Willard Type CWR 15 Volts 6 Amps 100

Bat. to Frame Con. Negative CONTACT BREAKER Gap .018-.024"

Firing Order 1-5-3-6-2-4 Ignition Timing IGN UDC marked

SPARK PLUG		ENGINE		Taxable Hp.
Size 7/8"	Gap .022"	Bore $3\frac{1}{4}$"	Stroke $4\frac{1}{4}$"	25.35

INTAKE VALVE TIMING		EXHAUST VALVE TIMING	
Open 5°A.T.D.C.	Close 40°A.B.D.C.	Open 45°B.B.D.C.	Close 5°A.T.D.C.

VALVE CLEARANCE Hot Intake .004-.007" Exhaust .007-.009"

CARBURETOR	COOLING SYSTEM		OILING SYSTEM	
Marvel	Type Pump	Cap. 12 Qts	Type Press	Cap. 6 Qts

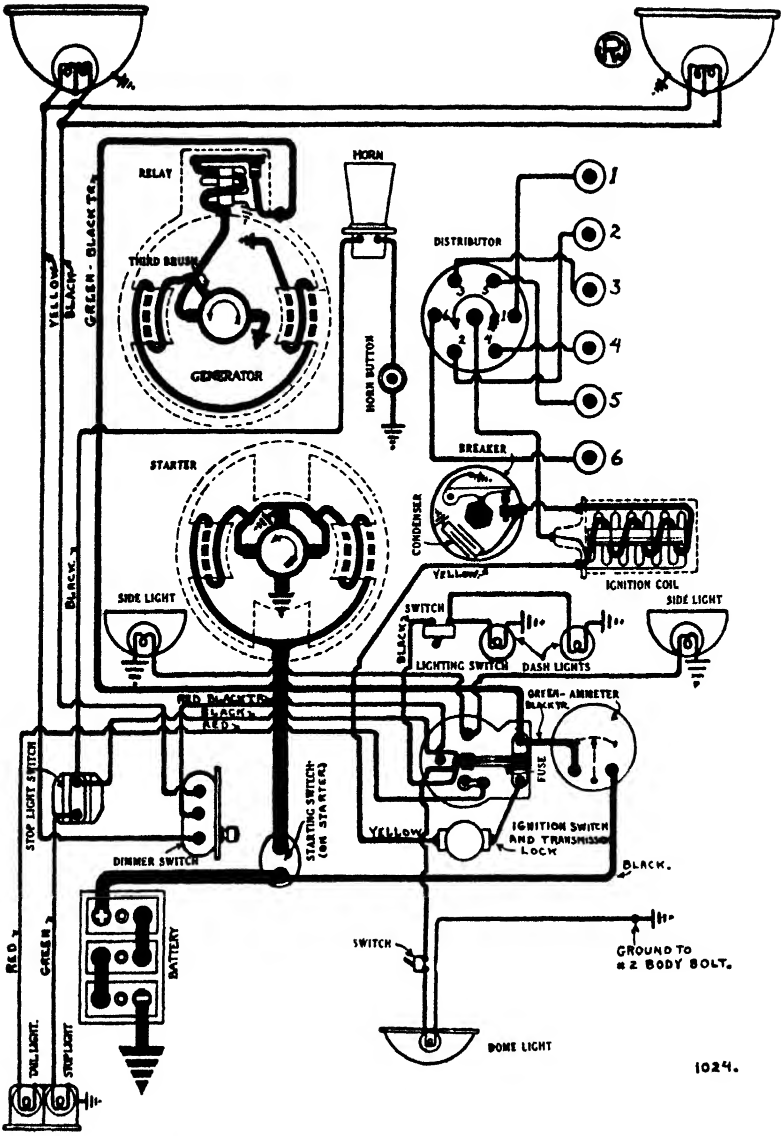
PISTON RING: Width 3/16" Diam. $3\frac{1}{4}$" Gap .004-.012"

CLUTCH Plate GEAR RATIO 4.42 AXLE Semi-floating

BRAKES

Front	Rear	Hand
5/32" x 1-7/8" x 34-9/16" (2 pcs)	Same	3/16" x $2\frac{1}{8}$" x $16\frac{1}{2}$"

Lighting	Headlights	Dash & Tail	Side Lamps
Single Contact	21 C.P.	3 C.P.	3 C.P.



OAKLAND WIRING DIAGRAM, 1929, MODEL A.A.S.

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Oakland Model A.A.S. Year 1929

Delco-Remy Starter & Generator Delco-Remy Ignition

Regulation	Max. Chg. rate and speed
Third Brush	17 amps, 1400 r.p.m.

RELAY Air Gap	Contact Gap	Cut-in R.P.M.
.014" - .021"	.015" - .025"	575

BATTERY Willard Type WSB-15 Volts 6 Amps 100

Bat. to Frame Con. Negative CONTACT BREAKER Gap .022"

Firing Order 1-5-3-6-2-4 Ignition Timing 4° A.T.D.C.

SPARK PLUG	ENGINE	Taxable Hp.
Size 7/8" Gap .022"	Bore 3-3/8" Stroke 4-1/4"	27.3

INTAKE VALVE TIMING	EXHAUST VALVE TIMING
Open 5° A.T.D.C. Close 40° A.B.D.C.	Open 45° B.B.D.C. Close 5° A.T.D.C.

VALVE CLEARANCE Hot Intake .007" - .009" Exhaust .007" - .009"

CARBURETOR	COOLING SYSTEM	OILING SYSTEM
Marvel	Type Pump Cap. 22 Qts	Type Press Cap. 6 Qts

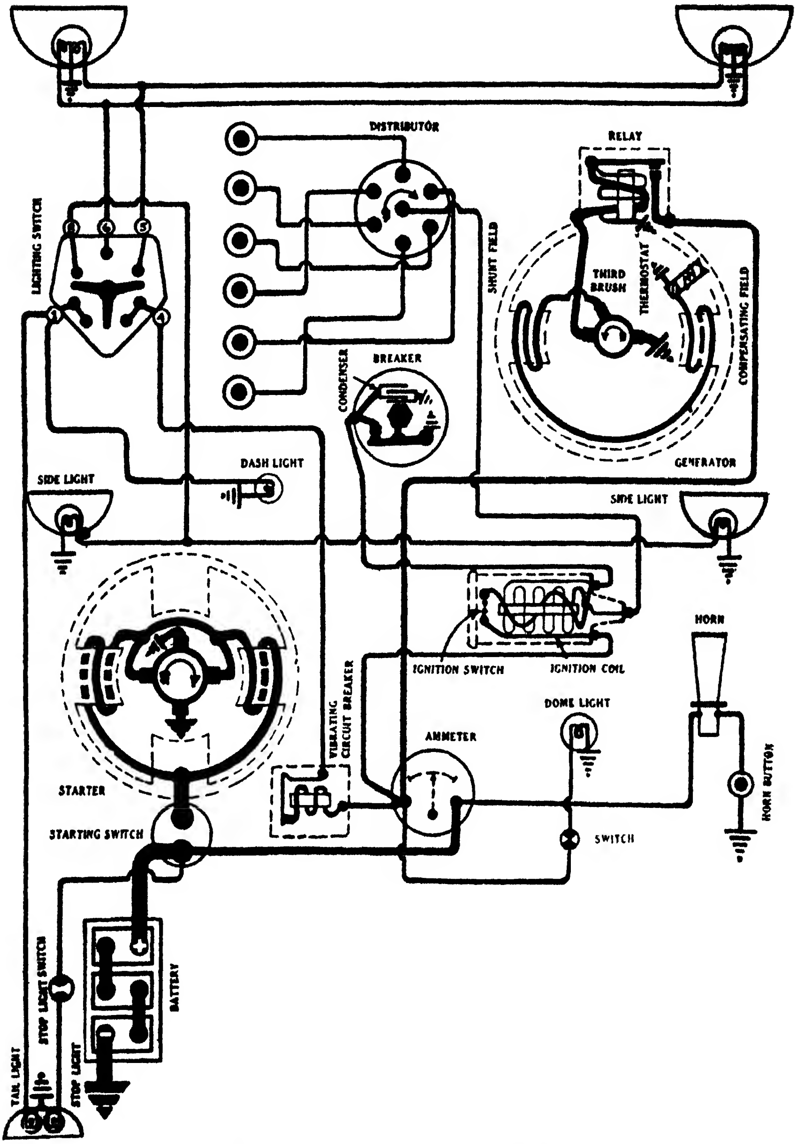
PISTON RING: Width 3/16" Diam 3-3/8" Gap .010" - .015"

CLUTCH Single Plate GEAR RATIO 4.42 & 4.72 AXLE Semi-floating

BRAKES

Front	Rear	Hand
3/16" x 2" x 18" (4 pcs)	Same	

Lighting	Headlights	Dash & Tail	Side Lamps
Single Contact	21 C.P.	3 C.P.	3 C.P.



OLDSMOBILE WIRING DIAGRAM, 1927, MODEL E

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Oldsmobile Model E Year 1927

Delco-Remy Starter & Generator Delco-Remy Ignition

Regulation	Max. Chg. rate and speed
Third Brush	12 amps, 2000 r.p.m.

RELAY Air Gap	Contact Gap	Cut-in R.P.M.
.014-.018"	.018-.025"	575

BATTERY Willard Type XW 13 Volts 6 Amps 80

Bat. to Frame Con. Negative CONTACT BREAKER Gap .018 -.024"

Firing Order 1-5-3-6-2-4 Ignition Timing T.D.C. up to E24922
E24922 up - .020 -.030 B.T.D.C.

SPARK PLUG		ENGINE		Taxable Hp.
Size 7/8"	Gap .025 .030	Bore 2-7/8"	Stroke 4-3/4"	19.84

	INTAKE VALVE TIMING		EXHAUST VALVE TIMING	
	Open	Close	Open	Close
To E52407	2°A.T.D.C.	34°A.B.D.C.	42°B.B.D.C.	T.D.C.
After "	T.D.C.	40°A.B.D.C.	35°B.B.D.C.	5°A.T.D.C.

VALVE CLEARANCE Hot Intake .005-.008" Exhaust .005"-.008"

CARBURETOR	COOLING SYSTEM	OILING SYSTEM
Johnson	Type Pump Cap. 14 Qts	Type Press Cap. 6 Qts

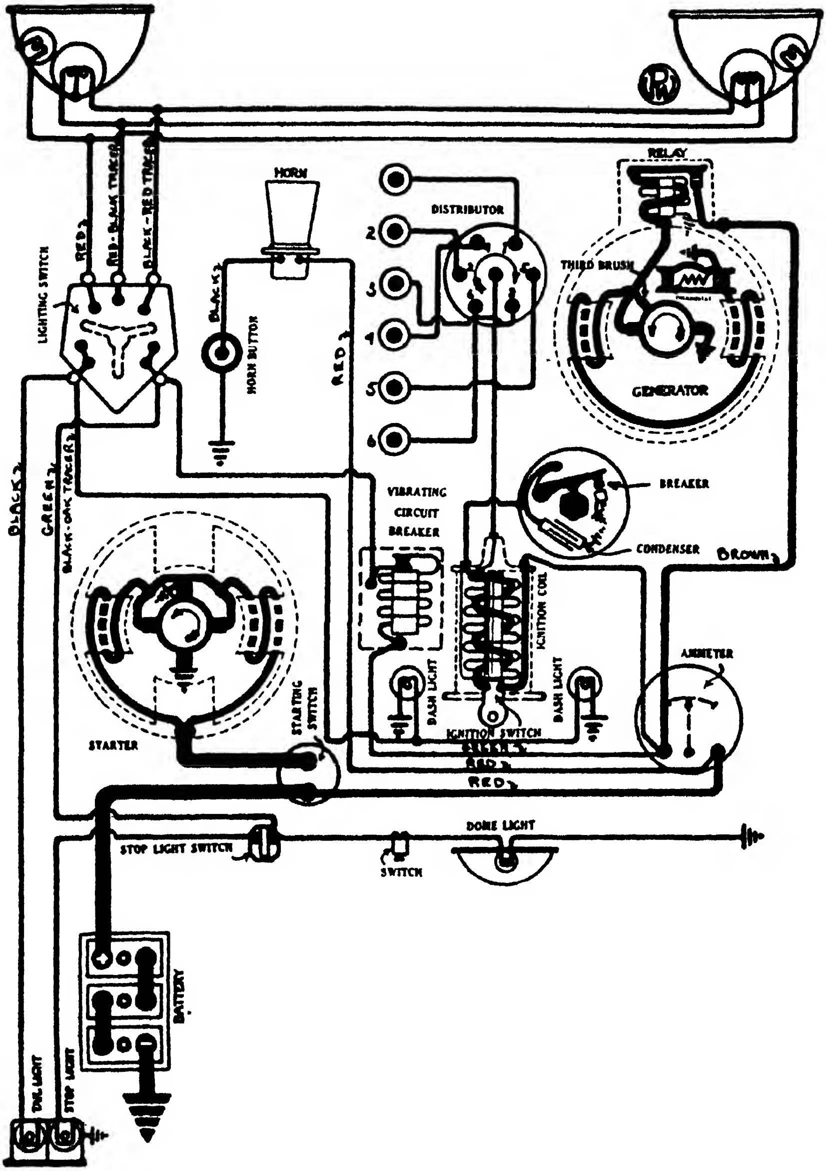
PISTON RING: Width Comp 1/8" Oil 3/16" Diam. 2-7/8" Gap .003 - .013"

CLUTCH Borg & Beck GEAR RATIO 4.73 AXLE Semi-floating

BRAKES

Front	Rear	Hand
3/16" x 1¾" x 32-1/16"	5/32" x 1¾" x 37-5/8"	same as rear

Lighting	Headlights	Dash & Tail	Side Lamps
Single Contact	21 C.P.	3 C.P.	3 C.P.



OLDSMOBILE WIRING DIAGRAM, 1928, MODEL F-28

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Oldsmobile Model F-28 Year 1928

Delco-Remy Starter & Generator Delco-Remy Ignition

Regulation: Third Brush

Max Chg rate and speed: 9-12 amps, 1800-2000 r.p.m.

RELAY Air Gap .014" Contact Gap .015 - .025" Cut in R P M 600

BATTERY Willard Type XWR 13 Volts 6 Amps 80

Bat to Frame Con Negative CONTACT BREAKER Gap .018"-.024"

Firing Order 1-5-3-6-2-4 Ignition Timing 8°B.T.D.C.

SPARK PLUG Size Metric Gap .025" .030"

ENGINE Bore 3-3/16" Stroke 4-1/8" Taxable Hp 24.4

INTAKE VALVE TIMING Open T.D.C. Close 50°A.B.D.C.

EXHAUST VALVE TIMING Open 40°B.B.D.C. Close 10°A.T.D.C.

VALVE CLEARANCE Hot Intake .008" Exhaust .010"

CARBURETOR Schebler

COOLING SYSTEM Type Pump Cap 13 Qts

OILING SYSTEM Type Press Cap 7 Qts

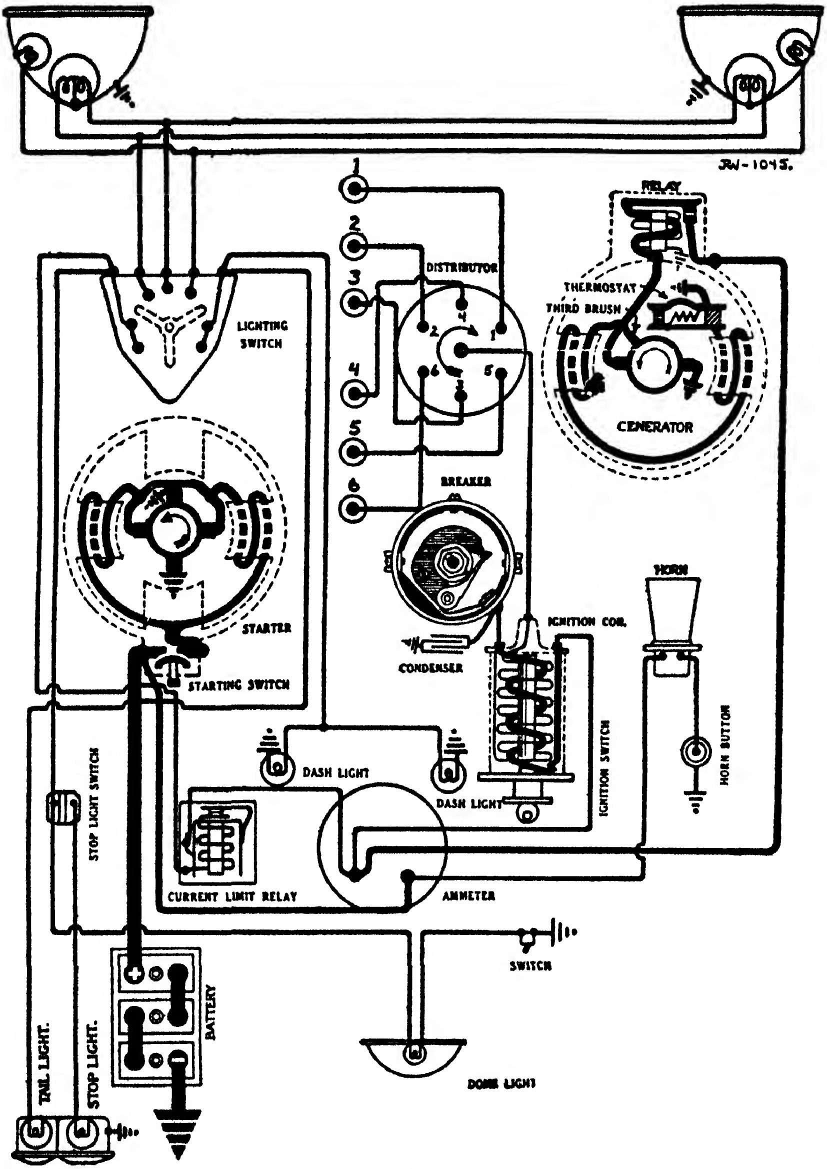
PISTON RING Width Comp 1/8" oil 3/16" Diam 3-3/16" Gap .005 - .015"

CLUTCH Borg & Beck GEAR RATIO 4.42 AXLE Own

BRAKES

Front	Rear	Hand
3/16" x 1¾" x 32-1/16"	5/32" x 1¾" x 37-5/8"	same as rear

Lighting	Headlights	Dash & Tail	Side Lamps
Single Contact	21 C P	3 C P	3 C P



OLDSMOBILE WIRING DIAGRAM, 1929, MODEL F-29

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Oldsmobile Model F-29 Year 1929

Delco-Remy Starter & Generator Delco-Remy Ignition

Regulation	Max. Chg. rate and speed
Third Brush	7-10 amps, 1800 r.p.m.

RELAY Air Gap	Contact Gap	Cut-in R.P.M.
.014"	.015-.025"	600

BATTERY Willard Type XWR 13 Volts 6 Amps 90

Bat. to Frame Con. Negative CONTACT BREAKER Gap .022"

Firing Order 1-5-3-6-2-4 Ignition Timing .020"-.030" B.T.D.C.

SPARK PLUG		ENGINE		Taxable Hp.
Size Metric	Gap .025"	Bore 3-3/16"	Stroke 4-1/8"	24.4

INTAKE VALVE TIMING		EXHAUST VALVE TIMING	
Open T.D.C.	Close 50°A.B.D.C.	Open 40°B.B.D.C.	Close 10°A.T.D.C.

VALVE CLEARANCE Hot Intake .008" Exhaust .010"

CARBURETOR	COOLING SYSTEM		OILING SYSTEM	
Schebler	Type Pump	Cap 13 Qts	Type Press	Cap 7 Qts

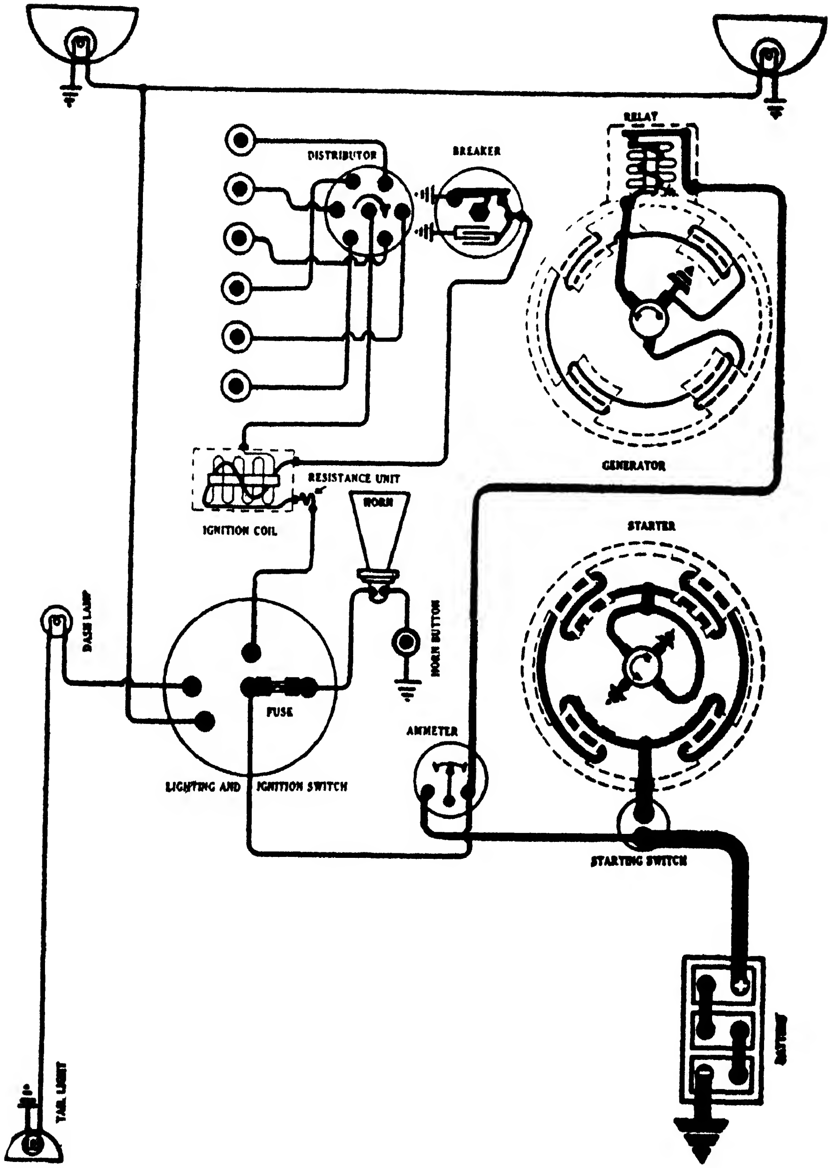
PISTON RING: Width Comp .125 Oil .1865 Diam. 3-3/16" Gap .013"

CLUTCH Dry plate GEAR RATIO 4.41 AXLE Own

BRAKES

Front	Rear	Hand
3/16" x 1½" x 19"	3/16" x 1½" x 18-5/8"	att. to rear service

Lighting	Headlights	Dash & Tail	Side Lamps
Contact	Dbl - 21 C.P.	Sgl 3 C.P.	- - C.P.



OVERLAND SIX WIRING DIAGRAM, 1925-26-27, MODEL 93

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Overland Six Model 93 Year 1925-26-27

Autolite Starter & Generator Autolite Ignition

Regulation	Max. Chg. rate and speed
Third Brush	14 amps, 1300 r.p.m.

RELAY Air Gap	Contact Gap	Cut-in R.P.M.
.010 - .030"	.025" - .035"	650

BATTERY U.S.L. Type 3CVX6X6 Volts 6 Amps 96

Bat. to Frame Con. Negative CONTACT BREAKER Gap .018"

Firing Order 1-5-3-6-2-4 Ignition Timing 6 °B.T.D.C. adv.

SPARK PLUG	ENGINE	Taxable Hp.
Size 7/8" Gap .025"	Bore 3" Stroke 4"	21.6

INTAKE VALVE TIMING	EXHAUST VALVE TIMING
Open 5°A.T.D.C. Close 45°A.B.D.C.	Open 39°B.B.D.C. Close 5°A.T.D.C.

VALVE CLEARANCE Hot Intake .008" Exhaust .008"

CARBURETOR	COOLING SYSTEM	OILING SYSTEM
Tillotson	Type Pump Cap 3 Gal	Type Press Cap 6 Qts

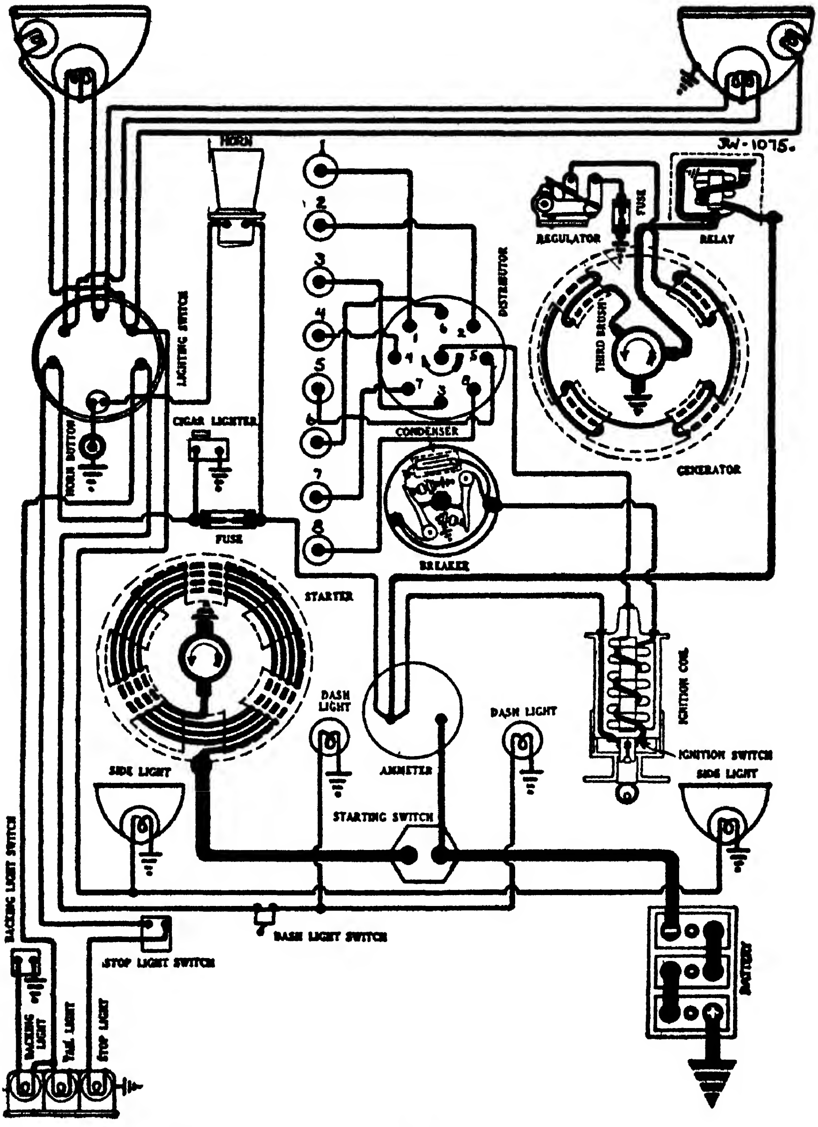
PISTON RING: Width 1/8" Diam. 3" Gap .010"

CLUTCH Disc GEAR RATIO 5.11 AXLE Semi-floating

BRAKES

Front	Rear	Hand
3/16"x1¾"x9-7/8" (4 pcs) 3/16"x1¼"x12-7/8" (2 pcs)	Same	

Lighting	Headlights	Dash & Tail	Side Lamps
Single Contact	21 C.P.	2-2 C.P.	C.P.



PACKARD WIRING DIAGRAM, 1929, MODELS 640 AND 645

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Packard Model 640-645 Year 1929

Dyneto Starter & Generator Dyneto Ignition

Regulation	Max. Chg. rate and speed
Third Brush	14-16 amps, 1300 r.p.m.

RELAY Air Gap	Contact Gap	Cut-in R.P.M.
		600

BATTERY Prestolite Type A 615 SF Volts 6 Amps 160

Bat. to Frame Con. Negative CONTACT BREAKER Gap .015 - .020"

Firing Order 1-6-2-5-8-3-7-4 Ignition Timing 21/32" B.T.D.C. adv.

SPARK PLUG	ENGINE	Taxable Hp.
Size 7/8" Gap .025" .030"	Bore 3½" Stroke 5"	39.2

INTAKE VALVE TIMING		EXHAUST VALVE TIMING	
Open T.D.C.	Close --	Open --	Close T.D.C.

VALVE CLEARANCE Warm Intake .004" Exhaust .004"

CARBURETOR	COOLING SYSTEM	OILING SYSTEM
Packard	Type Pump Cap. 640 6¼ Gal, 645 6½ Gal	Type Press Cap. 8 Qts

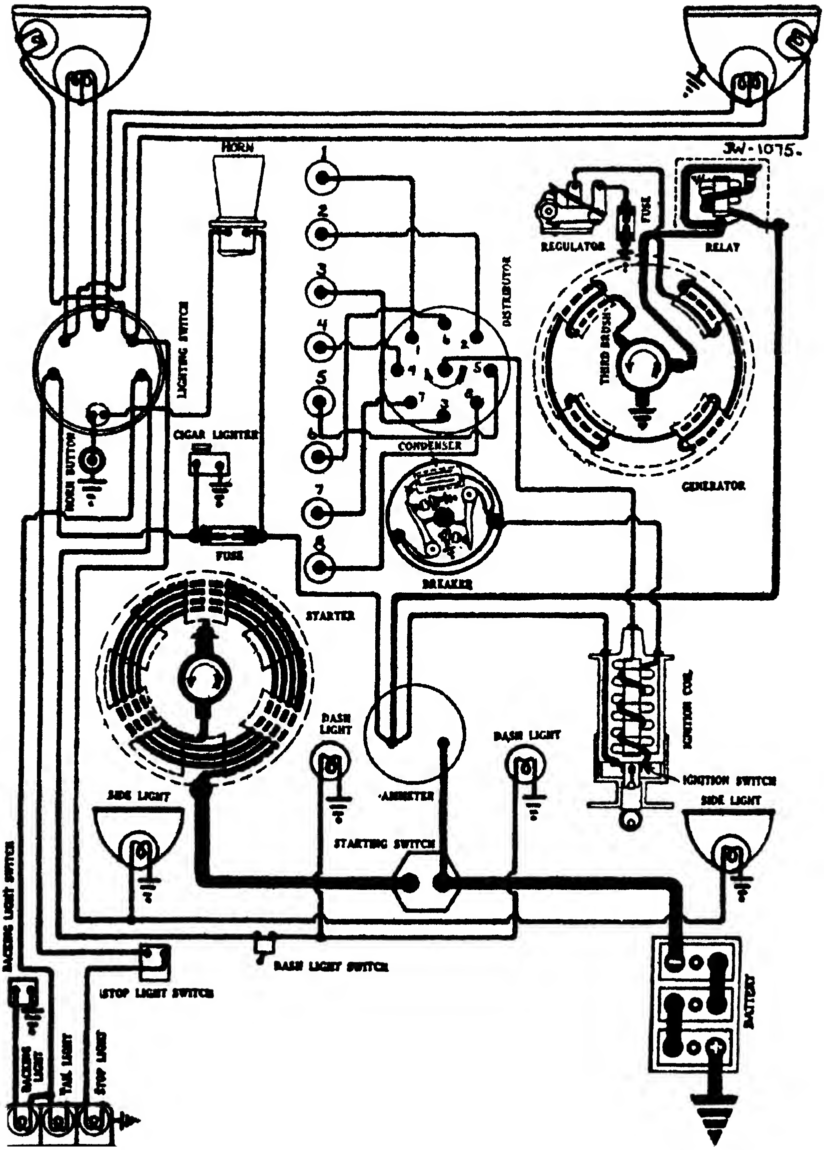
PISTON RING: Width 1/8" Diam. 3-1/2" Gap .008 - .016"

CLUTCH Plate GEAR RATIO -- AXLE Semi-floating

BRAKES

Front	Rear	Hand
3/16" x 2" x 17¼" (2 pcs) 3/16" x 2" x 14" (4 pcs)	Same	

Lighting	Headlights	Dash & Tail	Side Lamps
Contact	Dbl 21 C.P.	Sgl 5 C.P.	Sgl 3 C.P.



PACKARD WIRING DIAGRAM, 1929, MODELS 626 AND 633

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Packard Model 626-633 Year 1929

Dyneto Starter & Generator Dyneto Ignition

Regulation	Max. Chg. rate and speed
Third Brush	14-16 amps, 1300 r.p.m.

RELAY Air Gap	Contact Gap	Cut-in R.P.M.
		600

BATTERY Prestolite Type A 615 SF Volts 6 Amps 150

Bat. to Frame Con. Negative CONTACT BREAKER Gap .015-.020"

Firing Order 1-6-2-5-8-3-7-4 Ignition Timing 21/32" B.T.D.C. adv

SPARK PLUG	ENGINE	Taxable Hp.
Size 7/8" Gap .025" .030"	Bore 3-3/16" Stroke 5"	32.5

INTAKE VALVE TIMING	EXHAUST VALVE TIMING
Open T.D.C. Close --	Open -- Close A.T.D.C.

VALVE CLEARANCE Warm Intake .004" Exhaust .004"

CARBURETOR	COOLING SYSTEM	OILING SYSTEM
Packard	Type Pump Cap. 5 Gal	Type Press Cap. 7 Qts

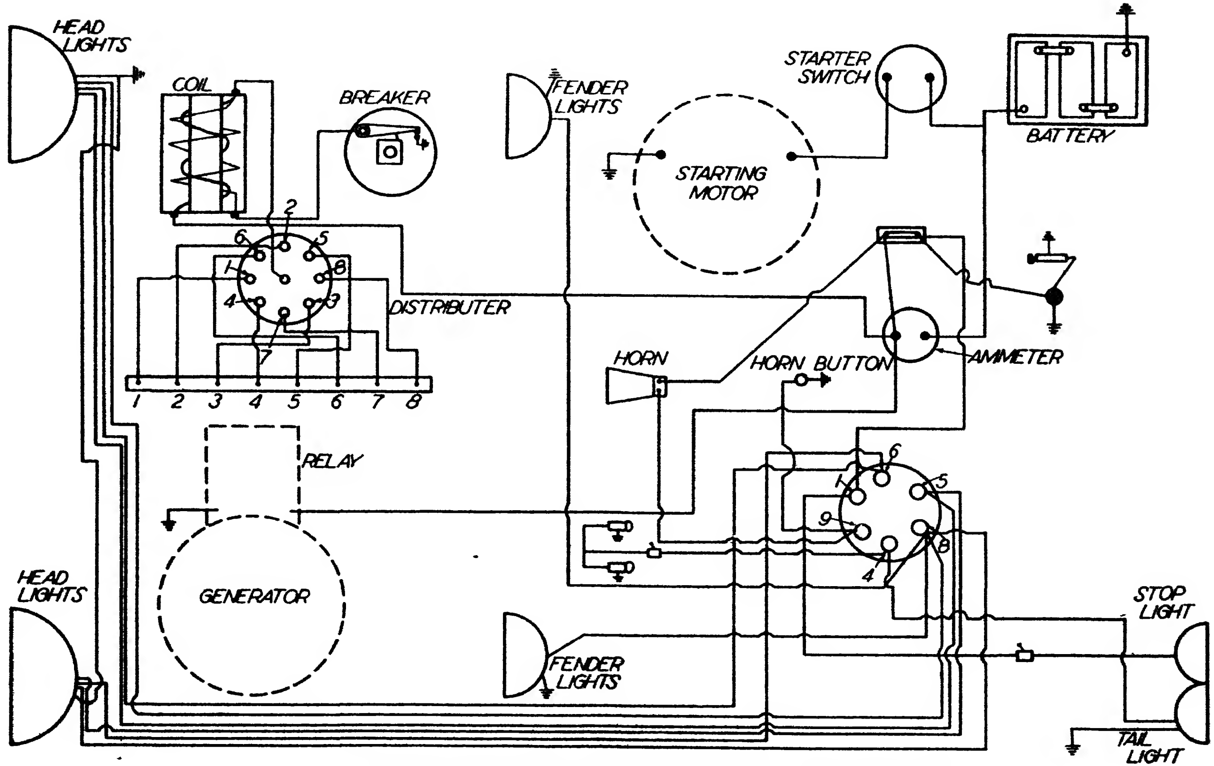
PISTON RING: Width 1/8" Diam. 3-3/16" Gap .006 - .015"

CLUTCH Plate GEAR RATIO -- AXLE Semi-floating

BRAKES

Front	Rear	Hand
3/16" x 2" x 17-1/4" (2 pcs)	Same	
3/16" x 2" x 14" (4 pcs)		

Lighting	Headlights	Dash & Tail	Side Lamps
Contact	Dbl 21 C.P.	Sgl 3 C.P.	Sgl 3 C.P.



PACKARD WIRING DIAGRAM, 1930, MODEL 726-753-740-745

P A C K A R D Model 726-753-740-745 Year 1930

Owen-Dynete Starter & Generator North East Ignition

Regulation Max. Chg. rate and speed

Voltage 9 to 11 amps. - Hot

RELAY Air Gap Contact Gap Cut-in R.P.M.

Adjustable .015 to .020 600 R.P.M.

BATTERY Prest-O-Lite Type 15 Plate Volts 6.8 Amps. 140 on 726 160 on 740

Bat. to Frame Con. Yes CONTACT BREAKER Gap .015 - .020

Firing Order 1-6-2-5-8-3-7-4- Ignition Timing Full advance occurs 29/32" B.T.D.C.

SPARK PLUG ENGINE Taxable Hp.

Size Metric Gap .025 Bore 3-3/16 and 3-1/2 Stroke Both Engines 5"

INTAKE VALVE TIMING EXHAUST VALVE TIMING

Set the Crank and Cam Gears with marks in line

Open Close Open Close

VALVE CLEARANCE Hot Intake .004 Exhaust .004

CARBURETOR COOLING SYSTEM OILING SYSTEM

Packard Type Pump Cap 726-5 Gal. 740-6½ Type Pres. Cap

PISTON RING: Width 1/8" All Diam. 726-3 3/16 740-3 1/2 Gap .010

CLUTCH Dry Plate GEAR RATIO 4.08 4.38 4.67 5.08 AXLE Own Semi F.

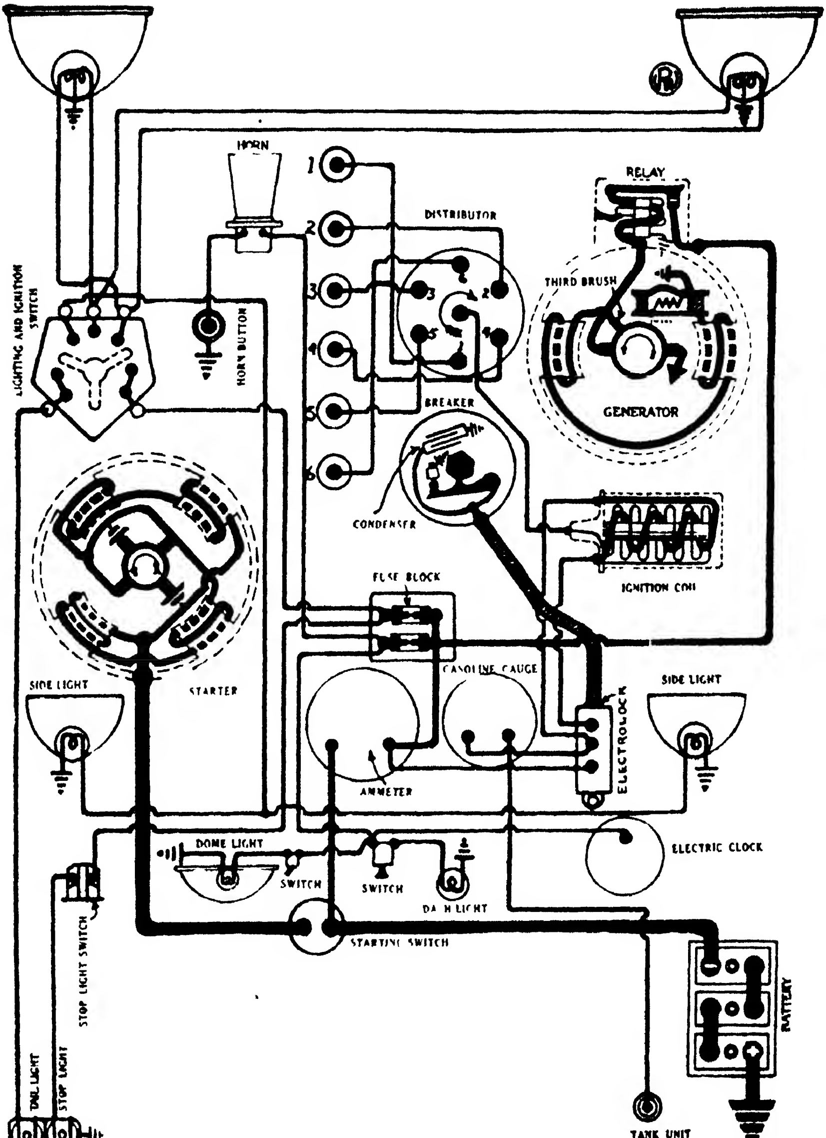
BRAKES

Front Rear Hand

Bendix 3-Shoe - Servo 4 Wheel Same

Lighting Headlights Dash & Tail Side Lamps

Double Contact 21 C.P. 3 C.P. 3 C.P.



PEERLESS WIRING DIAGRAM, 1928, MODEL 6-91

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Peerless Model 6-91 Year 1928

Delco Starter & Generator Delco Ignition

Regulation	Max. Chg. rate and speed
Third Brush	14 -18, 1200 r.p.m.

RELAY Air Gap	Contact Gap	Cut-in R.P.M.
.014 - .021"	.015 - .025"	500

BATTERY U.S.L. Type XY-15 X Volts 6 Amps. 100

Bat. to Frame Con. Positive CONTACT BREAKER Gap .018 - .024"

Firing Order 1-5-3-6-2-4 Ignition Timing F.M. IGN under points, adv.

SPARK PLUG	ENGINE	Taxable Hp.
Size 7/8" Gap .020" .030"	Bore 3½" Stroke 5"	29.4

INTAKE VALVE TIMING	EXHAUST VALVE TIMING
Open T.D.C. Close 50° A.B.D.C.	Open 50° B.B.D.C. Close T.D.C.

VALVE CLEARANCE Hot Intake .0075" Exhaust .0075"

CARBURETOR	COOLING SYSTEM	OILING SYSTEM
Stromberg	Type Pump Cap 14 Qts	Type Press Cap 9 Qts

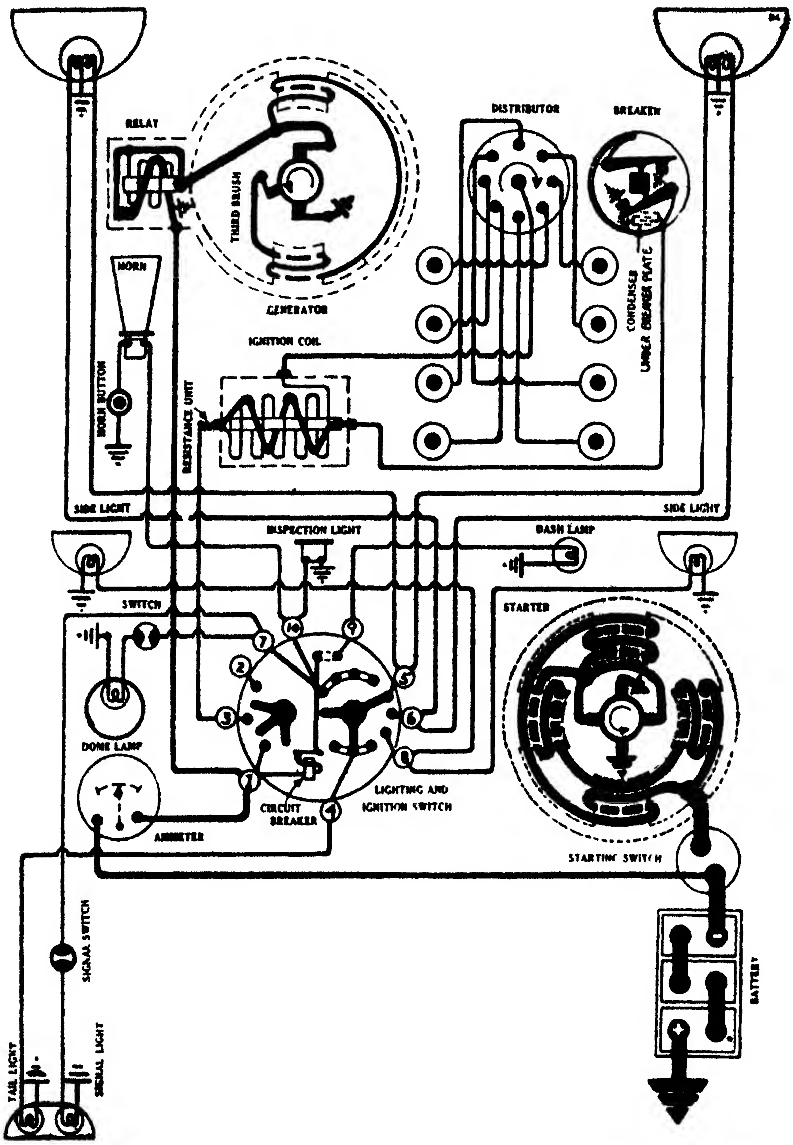
PISTON RING: Width 1/8" Diam. 3½" Gap .005 - .012"

CLUTCH Disc GEAR RATIO 4.25 AXLE Columbia

BRAKES

Front	Rear	Hand
3/16" x 1¾" x 11½" (2 pcs) 3/16" x 1¾" x 15-1/16" (2 pcs)	Same	5/32" x 1¾" x 19-3/8"

Lighting	Headlights	Dash & Tail	Side Lamps
Single Contact	21 C.P.	3 C.P.	3 C.P.



PEERLESS WIRING DIAGRAM, 1929, MODEL 8-69

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Peerless Model 8-69 Year 1928

Delco Starter & Generator — Delco Ignition

Regulation: Third Brush

Max Chg rate and speed: 16 amps, 1500 r.p.m.

RELAY Air Gap	Contact Gap	Cut-in R P M
.025 - .035"	.015 - .020"	500

BATTERY Exide / Willard Type 3XX-19-1 / CR-19 Volts 6 Amps 100

Bat to Frame Con Positive CONTACT BREAKER Gap .022-.028"

Firing Order 1R-1L-4R-4L-2L-3R-3L-2R Ignition Timing — 15°B.T.D.C. adv.

SPARK PLUG			ENGINE		Taxable Hp
Size 7/8"	Gap .020" .030"	Bore 3¼"	Stroke 5"		33.8

INTAKE VALVE TIMING		EXHAUST VALVE TIMING	
Open T.D.C.	Close 47°A.B.D.C.	Open 47°B.B.D.C.	Close T.D.C.

VALVE CLEARANCE -- Intake .0075" Exhaust .0075"

CARBURETOR	COOLING SYSTEM	OILING SYSTEM
Stromberg	Type Pump Cap 2 Qts	Type Press Cap 10 Qts

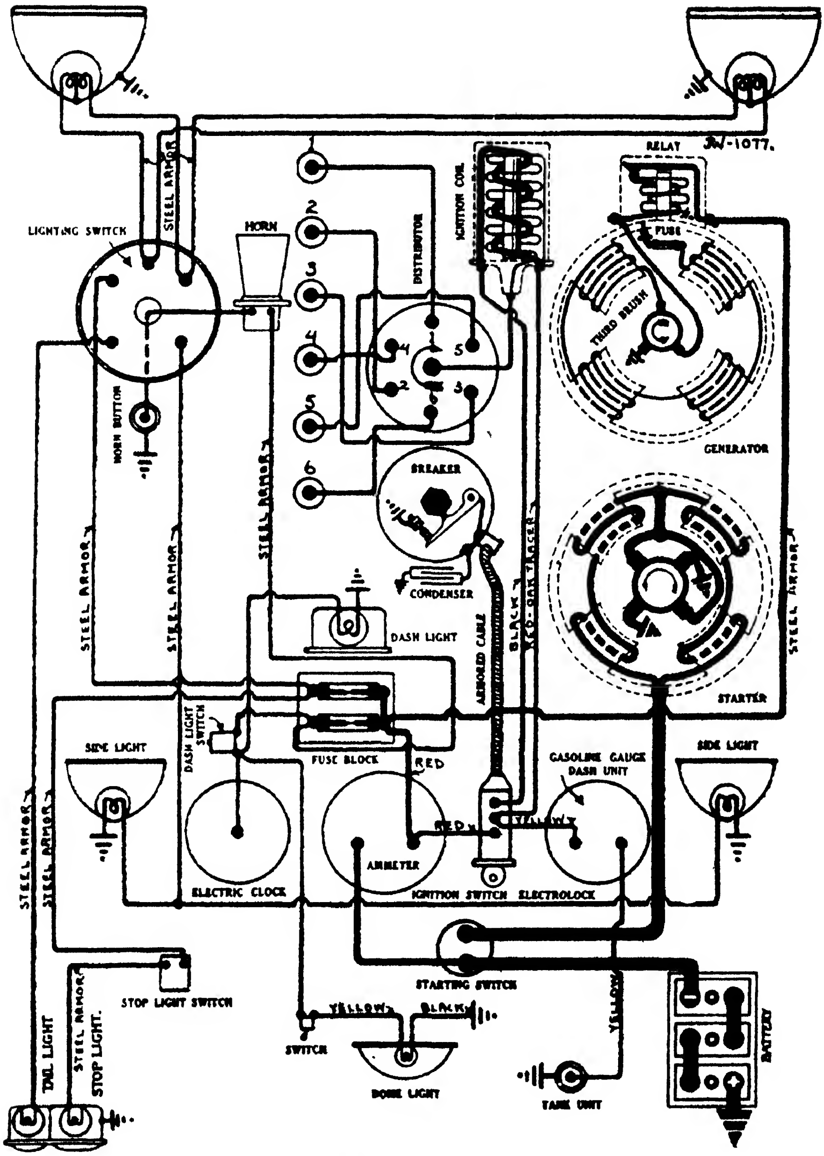
PISTON RING Width 1/8" Diam 3-1/4" Gap .005 - .012"

CLUTCH Disc — GEAR RATIO 4.42 AXLE Semi-floating

BRAKES

Front	Rear	Hand
3/16" x 2" x 38¼" per wheel	3/16" x 2" x 38-5/16" per wheel	5/32" x 1¾" x 42¼" per wheel

Lighting	Headlights	Dash & Tail	Side Lamps
Single Contact	21 C P	3 C P	3 C P



PEERLESS WIRING DIAGRAM, 1929, MODEL 6-81

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Peerless Model 6-81 Year 1929

Autolite Starter & Generator Autolite Ignition

Regulation	Max. Chg. rate and speed
Third Brush	16 amps. 1300 r.p.m.

RELAY Air Gap	Contact Gap	Cut-in R.P.M.
.014 - .021"	.015 - .025"	600

BATTERY U.S.L. Type XY-15-X6 Volts 6 Amps 100

Bat. to Frame Con. Positive CONTACT BREAKER Gap .018 - .024"

Firing Order 1-5-3-6-2-4 Ignition Timing FM IGN under pointer, adv.

SPARK PLUG	ENGINE	Taxable Hp.
Size Metric Gap .020" .030"	Bore 3-3/8" Stroke 4-5/8"	27.34

INTAKE VALVE TIMING	EXHAUST VALVE TIMING
Open 5°A.T.D.C. Close 45°A.B.D.C.	Open 40°B.B.D.C. Close 5°A.T.D.C.

VALVE CLEARANCE. Hot Intake .006" Exhaust .006"

CARBURETOR	COOLING SYSTEM	OILING SYSTEM
Stromberg	Type Pump Cap. 13½ Qts	Type Press Cap. 7 Qts

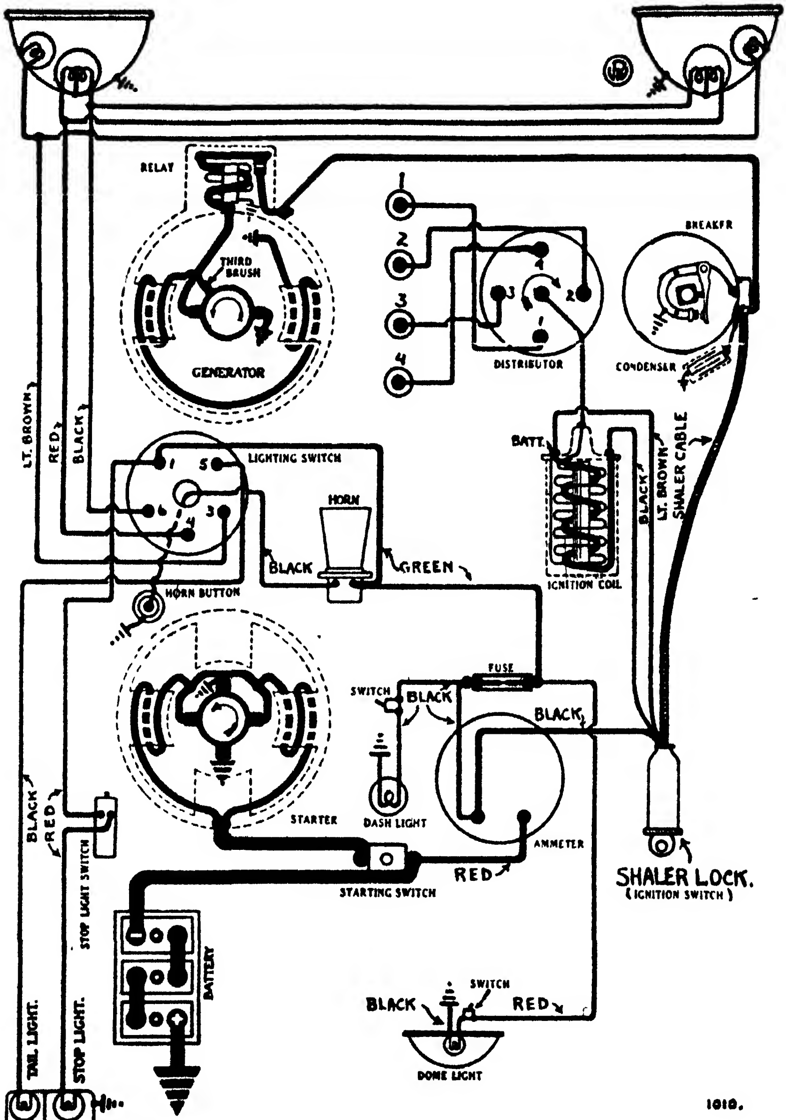
PISTON RING: Width Diam. 3-3/8" Gap .008-.016"

CLUTCH Disc GEAR RATIO — AXLE Columbia

BRAKES

Front	Rear	Hand
3/16" x 1¾" x 19-3/8" (2 pcs) 3/16" x 1¾" x 10" (2 pcs)	Same	5/32" x 1¾" x 19-3/8"

Lighting	Headlights	Dash & Tail	Side Lamps
Single Contact	21 C.P.	3 C.P.	3 C.P.



PLYMOUTH WIRING DIAGRAM, 1928-29, MODEL 55

Reproduced from National Service Manual by permission of National Automotive Service

Plymouth Model 55 Year 1928-29

Delco-Remy Starter & Generator Delco-Remy Ignition

Regulation — Max. Chg. rate and speed

Third Brush — 11-13 amps, 1800-2000 r.p.m.

RELAY Air Gap	Contact Gap	Cut-in R.P.M.
.014 - .018"	.015 - .020"	625

BATTERY Willard Type Volts 6 Amps 90

Bat. to Frame Con. Positive CONTACT BREAKER Gap .018-.024"

Firing Order 1-3-4-2 Ignition Timing 7° B.T.D.C. adv.

SPARK PLUG	ENGINE		Taxable Hp.
Size 7/8" Gap	Bore 3-5/8"	Stroke 4-1/8"	21.03

INTAKE VALVE TIMING		EXHAUST VALVE TIMING	
Open 5°A.T.D.C.	Close 45°A.B.D.C.	Open 49°B.B.D.C.	Close 3°A.T.D.C.

VALVE CLEARANCE Hot Intake .004" Exhaust .006"

CARBURETOR	COOLING SYSTEM	OILING SYSTEM
Carter	Type Pump Cap. 3½ Gal	Type Press Cap. 4 Qts

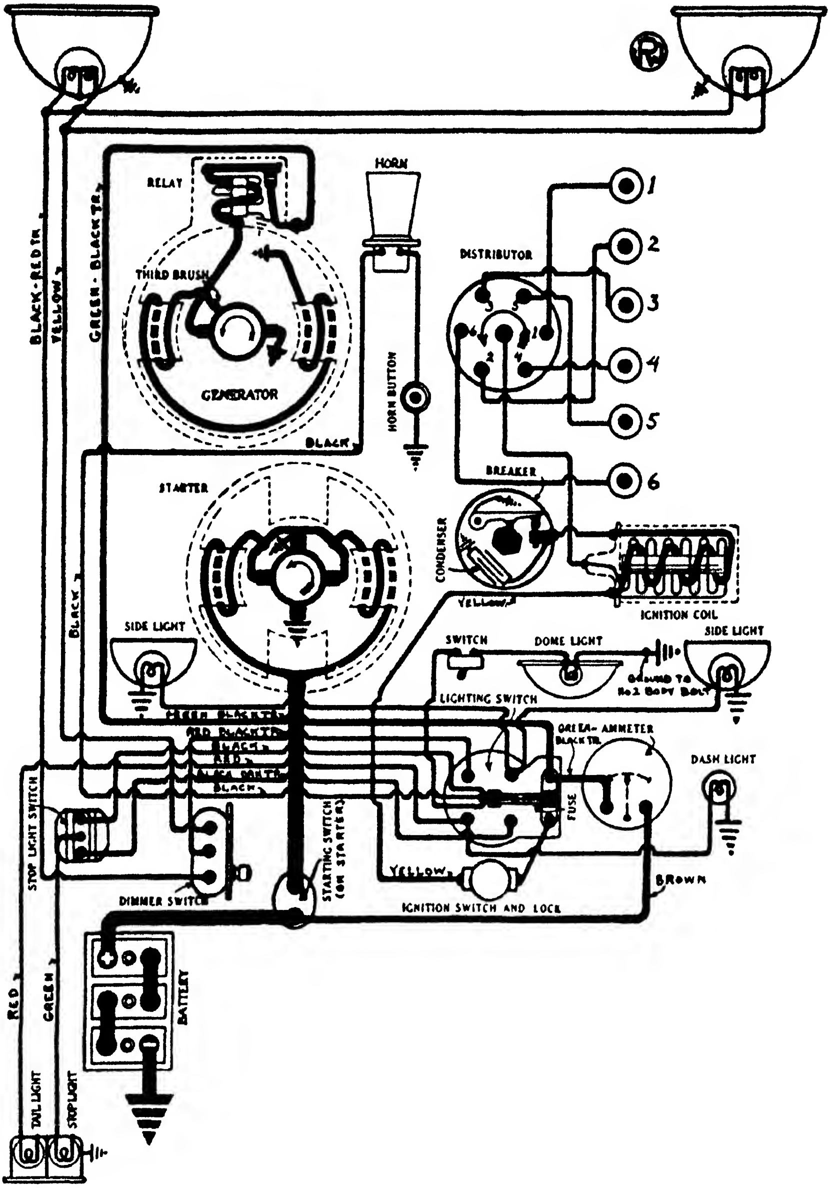
PISTON RING: Width 1/8" Diam. 3-5/8" Gap .007 - .015"

CLUTCH Single Dry P GEAR RATIO 4.3 AXLE Semi-floating

BRAKES

Front	Rear	Hand
3/16" x 1½" x 9½" (2 pcs) 3/16" x 1½" x 11½" (2 pcs)	same	5/32" x 2" x 21-3/8"

Lighting	Headlights	Dash & Tail	Side Lamps
Single Contact	21 C.P.	3 C.P.	3 C.P.



PONTIAC WIRING DIAGRAM, 1927-28, MODELS 6-27 AND 6-28

Reproduced from National Service Manual by permission of National Automotive Service

Pontiac Model 6-27 - 6-28 Year 1927-28

Delco-Remy Starter & Generator Delco-Remy Ignition

Regulation	Max. Chg. rate and speed
Third Brush	17 amps, 1700 r.p.m.

RELAY Air Gap	Contact Gap	Cut-in R.P.M.
.016"	.018"	515

BATTERY Willard Type WR-13 Volts 6 Amps 80

Bat. to Frame Con. Negative CONTACT BREAKER Gap .022"

Firing Order 1-5-3-6-2-4 Ignition Timing IGN UDC marked

SPARK PLUG	ENGINE	Taxable Hp.
Size 7/8" Gap .022"	Bore 3-1/4" Stroke 3-3/4"	25.35

INTAKE VALVE TIMING	EXHAUST VALVE TIMING
Open 7° A.T.D.C. Close 39° A.B.D.C.	Open 42° B.B.D.C. Close 7° A.T.D.C.

VALVE CLEARANCE Hot Intake .007" - .009" Exhaust .007" - .009"

CARBURETOR	COOLING SYSTEM	OILING SYSTEM
Carter	Type Pump Cap 10 Qts	Type Press Cap 6 Qts

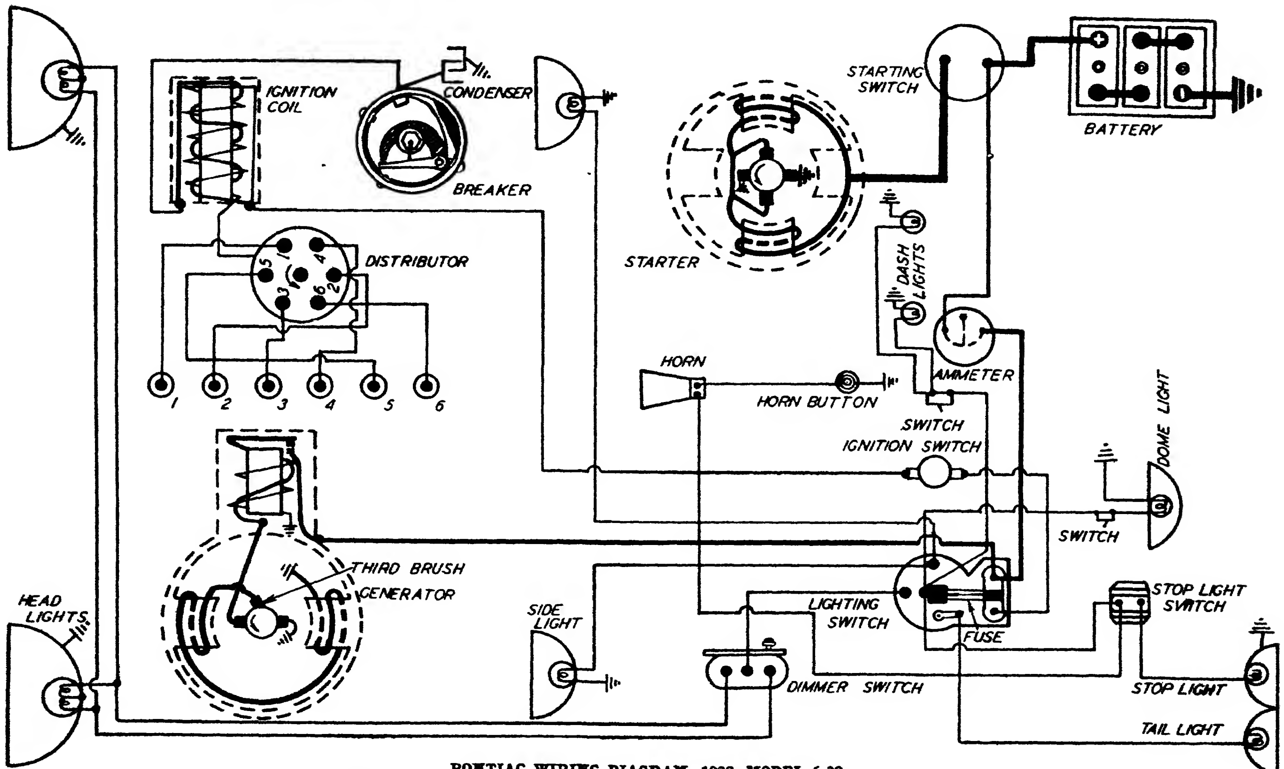
PISTON RING: Width 3/16" Diam 3-1/4" Gap .010" - .015"

CLUTCH Single Pl. Dry GEAR RATIO 4.18 AXLE Semi-floating

BRAKES

Front	Rear	Hand
5/32" x 1½" x 9-1/32" (4 pcs)	3/16" x 2" x 33-15/16" (2 pcs)	5/32" x 1¼" x 28" (2 pcs)

Lighting	Headlights	Dash & Tail	Side Lamps
Single Contact	21 C.P.	3 C.P.	3 C.P.



PONTIAC WIRING DIAGRAM, 1929, MODEL 6-29

Reproduced from National Service Manual by permission of National Automotive Service

Pontiac Model 6-29 Year 1929

Delco-Remy Starter & Generator Delco-Remy Ignition

Regulation: Third Brush

Max Chg rate and speed: 14 amps

RELAY Air Gap .016" Contact Gap .018" Cut in R P M 515

BATTERY Willard Type WSB Volts 6 Amps 80

Bat to Frame Con Negative

CONTACT BREAKER Gap .020"-.024"

Firing Order 1-5-3-6-2-4

Ignition Timing IGN U.D.C. marked

SPARK PLUG Size 7/8" Gap .022"

ENGINE Bore 3-5/16" Stroke 3-7/8"

Taxable Hp 26.3

INTAKE VALVE TIMING Open 7°A.T.D.C. Close 39°A.B.D.C.

EXHAUST VALVE TIMING Open 42°B.B.D.C. Close 7°A.T.D.C.

VALVE CLEARANCE Hot Intake .007" - .009" Exhaust .007" - .009"

CARBURETOR Marvel

COOLING SYSTEM Type Pump Cap 14 Qts

OILING SYSTEM Type Press Cap 6 Qts

PISTON RING Width 3/16" Diam. 3-5/16" Gap .010"-.015"

CLUTCH Single Plate GEAR RATIO 4.42 AXLE Semi-floating

BRAKES

Front: 3/16" x 1½" x 16-7/32" (4 pcs)

Rear: Same

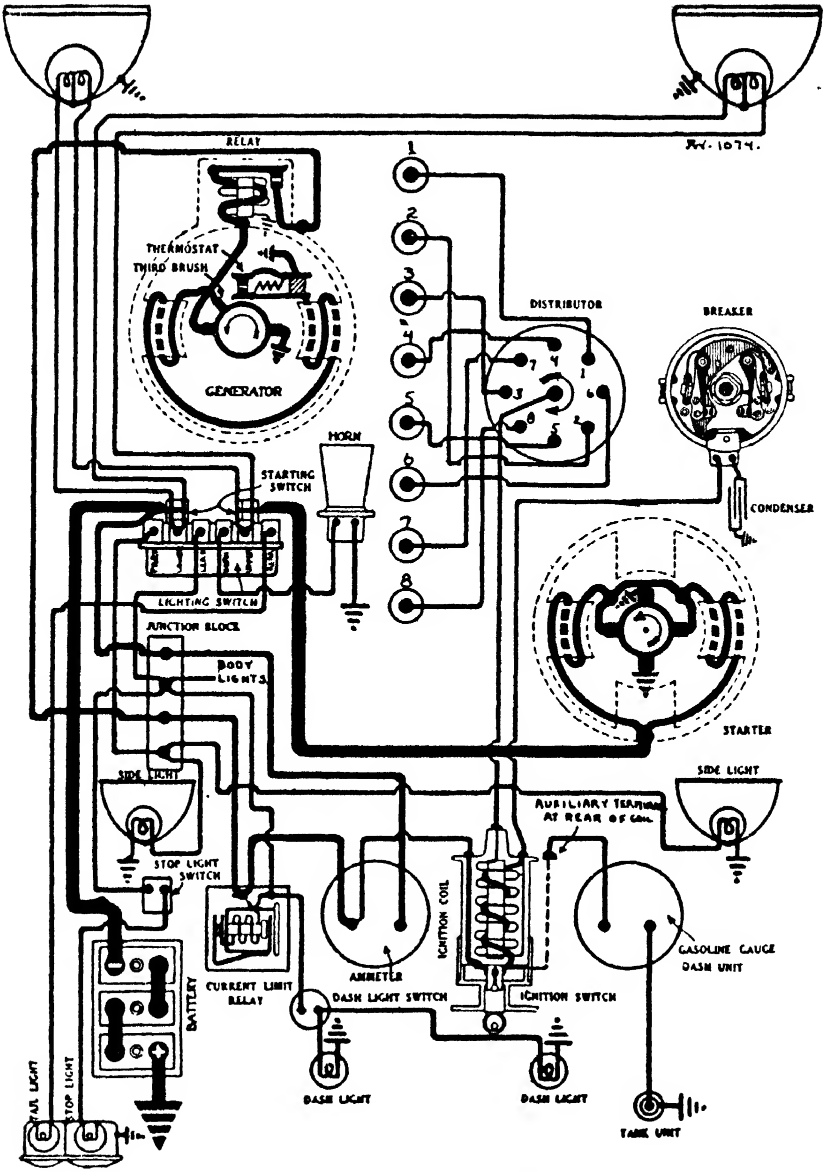
Hand: - -

Lighting: Single Contact

Headlights: 21 C P

Dash & Tail: 3 C P

Side Lamps: 3 C P



ROOSEVELT WIRING DIAGRAM, 1929

Reproduced from National Service Manual by permission of National Automotive Service

Roosevelt Model Year **1929**

Delco-Remy Starter & Generator **Delco-Remy** Ignition

Regulation: **Third Brush**

Max Chg rate and speed: **12 amps, 25 m.p.h.**

RELAY Air Gap	Contact Gap	Cut in R P M
.014" - .021"	.015" - .025"	575

BATTERY **National** Type Volts **6** Amps **120**

Bat to Frame Con **Positive** CONTACT BREAKER Gap **.022"**

Firing Order **1-6-2-5-8-3-7-4** Ignition Timing **IG mark on flywheel control adv.**

SPARK PLUG		ENGINE		Taxable Hp
Size 7/8"	Gap .025"	Bore 2-3/4"	Stroke 4-1/4"	24.2

INTAKE VALVE TIMING		EXHAUST VALVE TIMING	
Open 6°B.T.D.C.	Close 40°A.B.D.C.	Open 40°B.B.D.C.	Close 6°A.T.D.C.

VALVE CLEARANCE **cold** Intake **.006" - .008"** Exhaust **.006" - .008"**

CARBURETOR	COOLING SYSTEM	OILING SYSTEM
Stromberg	Type Pump Cap 5 Gal	Type Press Cap 6 Qts

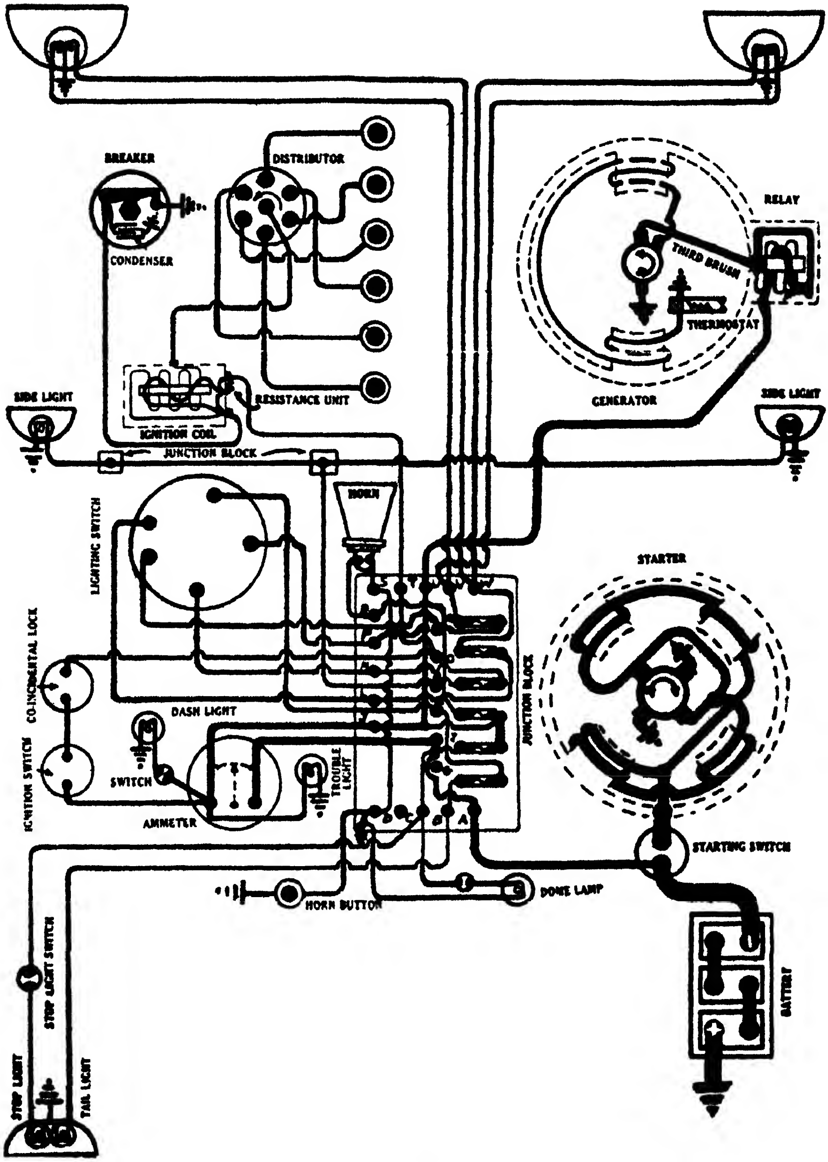
PISTON RING Width **1/8" 3/16"** Diam **2-3/4"** Gap **.002" - .007"**

CLUTCH **9" Plate** GEAR RATIO **4.9** AXLE **Semi-floating**

BRAKES

Front	Rear	Hand
5/32" x 1¾" x 24-7/16" (per wheel)	Same as front	Same as foot

Lighting	Headlights		Dash & Tail		Side Lamps	
Single Contact	21 Dbl Fil	C P	3	C P	3	C P



STUDEBAKER WIRING DIAGRAM, 1927, MODELS EW AND E8

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Studebaker Model EW-ES Year 1927

Delco-Remy Starter & Generator Delco-Remy Ignition

Regulation	Max. Chg. rate and speed
Third Brush	18½ amps. 2096 r.p.m.

RELAY Air Gap	Contact Gap	Cut-in R.P.M.
.014" - .018"	.015" - .025"	550

BATTERY Willard Type SJWR-4 Volts 6 Amps 111

Bat. to Frame Con. Positive CONTACT BREAKER Gap. .018"-.024"

Firing Order 1-5-3-6-2-4 Ignition Timing 7½° A.T.D.C.

SPARK PLUG	ENGINE	Taxable Hp.
Size 7/8" Gap .025"	Bore 3-7/8" Stroke 5"	36.04

INTAKE VALVE TIMING	EXHAUST VALVE TIMING
Open T.D.C. Close 48° A.B.D.C.	Open 38° B.B.D.C. Close 10° A.T.D.C.

VALVE CLEARANCE Hot Intake .006" Exhaust .006"

CARBURETOR	COOLING SYSTEM	OILING SYSTEM
Stromberg & Ball & Ball	Type Pump Cap 5 Gal	Type Press Cap 8 Qts

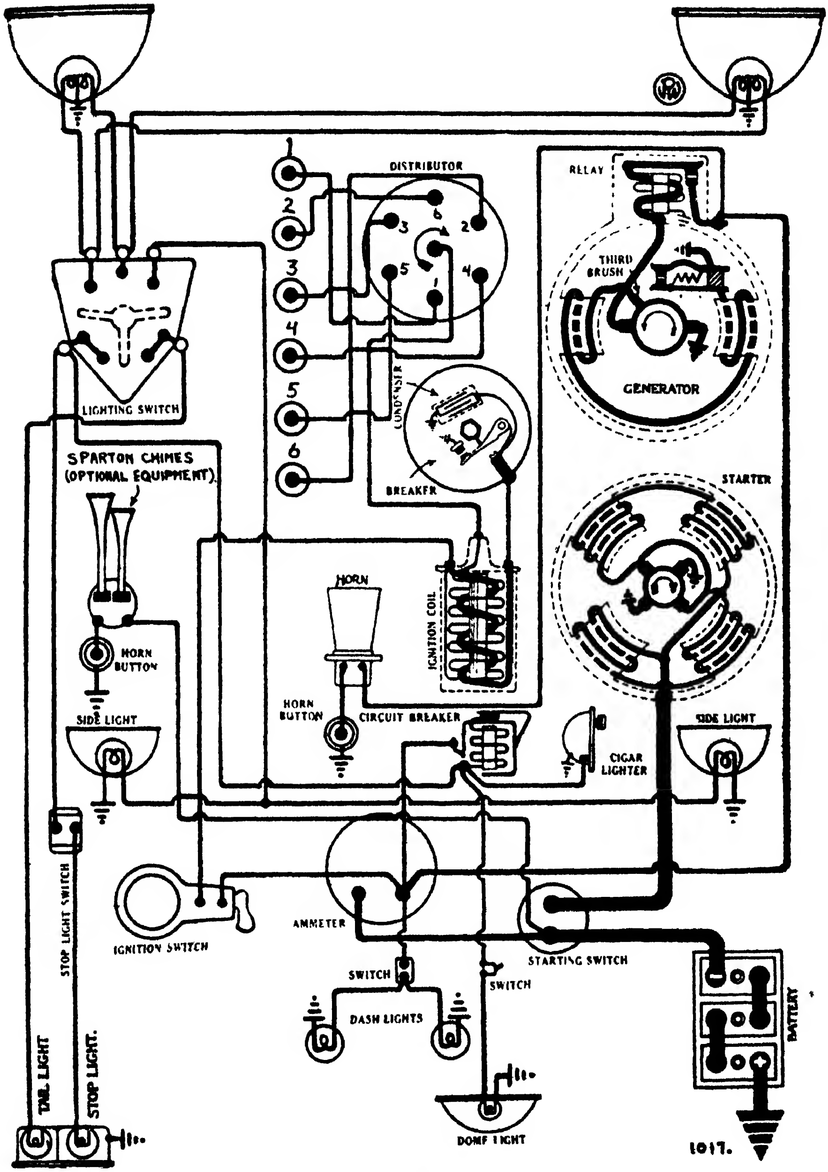
PISTON RING: Width 3/16" Diam. 3-7/8" Gap .020"-.030"

CLUTCH Plate GEAR RATIO 3.31 AXLE Semi-floating

BRAKES

Front	Rear	Hand
3/16" x 2" x 14" (4 pcs)	3/16" x 2¼" x 21½" (4 pcs)	3/16" x 2" x 24-5/8"

Lighting	Headlights	Dash & Tail	Side Lamps
Single Contact	21-21 C.P.	3 C.P.	3 C.P.



STUDEBAKER WIRING DIAGRAM, COMMANDER, 1928, MODELS GB AND GH

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Studebaker - Commander Model GB-GH Year 1928

Delco-Remy Starter & Generator Delco-Remy Ignition

Regulation	Max. Chg. rate and speed
Third Brush	18½ amps, 2096 r.p.m.

RELAY Air Gap	Contact Gap	Cut-in R.P.M.
.014" - .018"	.015" - .025"	550

BATTERY Willard Type SJWR-4 Volts 6 Amps 111

Bat. to Frame Con. Positive CONTACT BREAKER Gap .018"-.024"

Firing Order 1-5-3-6-2-4 Ignition Timing 17½° A.T.D.C.

SPARK PLUG	ENGINE	Taxable Hp.
Size 7/8" Gap .025"	Bore 3-7/8" Stroke 5"	36.04

INTAKE VALVE TIMING	EXHAUST VALVE TIMING
Open T.D.C. Close 48° A.B.D.C.	Open 38° B.B.D.C. Close 10° A.T.D.C.

VALVE CLEARANCE Hot Intake .006" Exhaust .006"

CARBURETOR	COOLING SYSTEM	OILING SYSTEM
Ball & Ball	Type Pump Cap 8 Gal	Type Press Cap 8 Qts

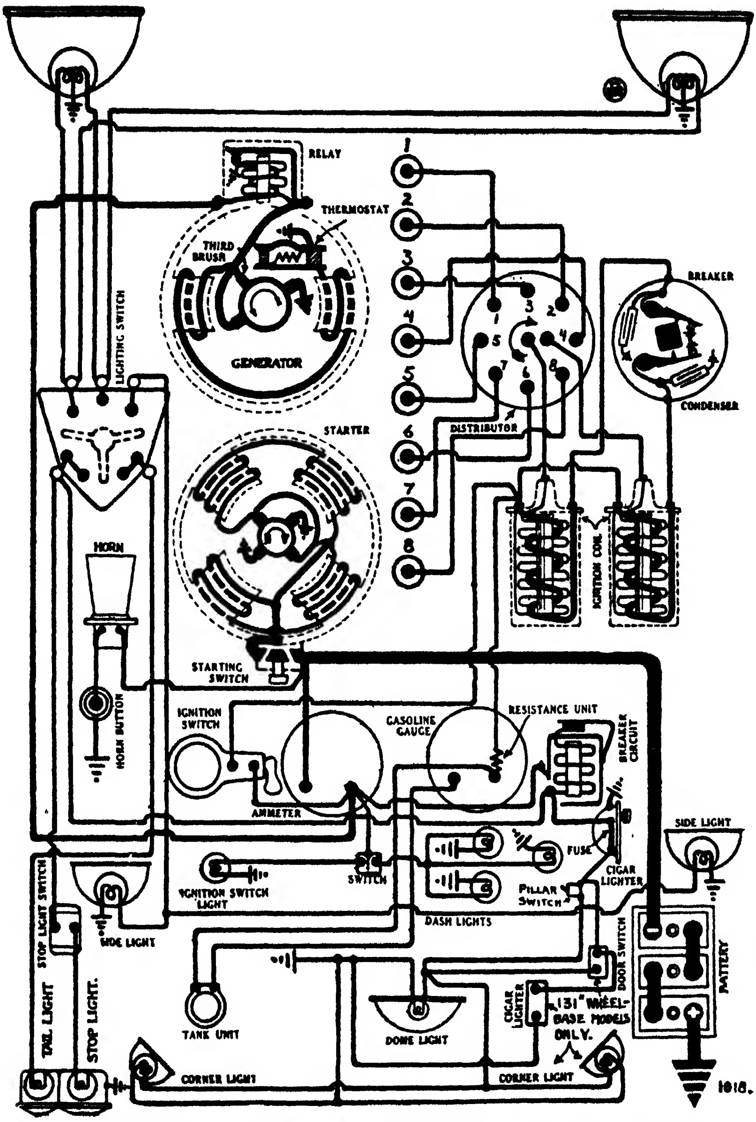
PISTON RING: Width 3/16" Diam 3-7/8" Gap .020"-.030"

CLUTCH 11 x 9/64" GEAR RATIO 3.31 AXLE Semi-floating

BRAKES

Front	Rear	Hand
3/16" x 1½" x 9-7/8" (4 pcs)	Same	3/16" x 2" x 24-1/16"

Lighting	Headlights	Dash & Tail	Side Lamps
Single Contact	21 C.P.	3 C.P.	3 C.P.



STUDEBAKER WIRING DIAGRAM, PRESIDENT, 1928, MODELS FA AND FB

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Studebaker - President Model FA-FB ..Year 1928

Delco-Remy Starter & Generator Delco-Remy Ignition

Regulation	Max. Chg. rate and speed
Third Brush	19 amps, 1650 r.p.m.

RELAY Air Gap	Contact Gap	Cut-in R.P M.
.014" - .018"	.015" - .025"	650

BATTERY Willard Type STR-4 Volts 6 Amps 111

Bat to Frame Con Positive CONTACT BREAKER Gap .018"

Firing Order 1-6-2-5-8-3-7-4 Ignition Timing 17° A.T.D.C.

SPARK PLUG	ENGINE	Taxable Hp
Size 7/8" Gap .025"	Bore FA-3-3/8" FB-3-1/2" Stroke 4-3/8	39.2

INTAKE VALVE TIMING		EXHAUST VALVE TIMING	
Open 5°A.T.D.C.	Close 48°A.B.D.C.	Open 40°B.B.D.C	Close 12°A.T.D.C.

VALVE CLEARANCE Cold Intake .003" Exhaust .007"

CARBURETOR	COOLING SYSTEM	OILING SYSTEM
Schebler	Type Pump Cap 5½ Gal	Type Press Cap 8 Qts.

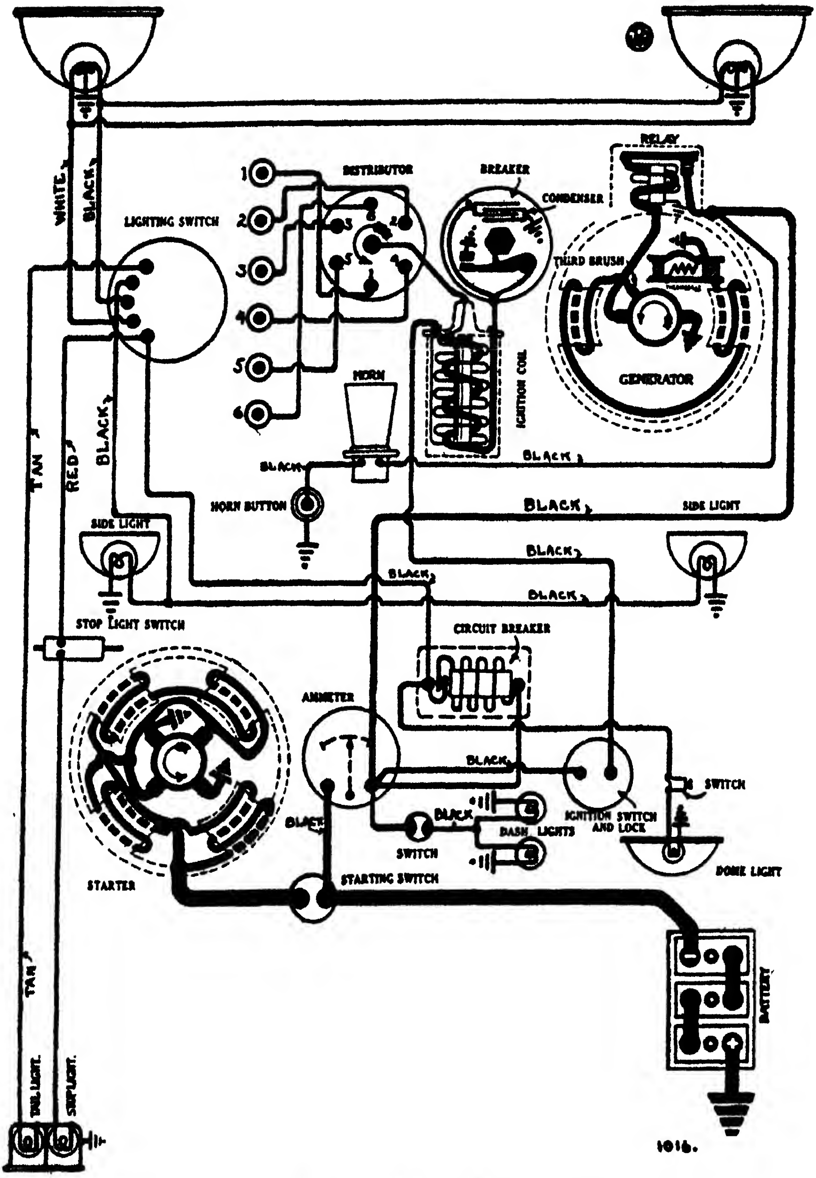
PISTON RING Width Comp 1/8" oil 3/16" Diam. 3-3/8" 3-1/2" Gap .022" - .028"

CLUTCH 2-8¾ x 9/64 GEAR RATIO 4.1 & 4.6 AXLE Semi-floating

BRAKES

Front	Rear	Hand
3/16" x 1¾" x 9-7/8" (4 pcs)	Same	3/16" x 2" x 24-1/16"

Lighting	Headlights	Dash & Tail	Side Lamps
Single Contact	21 C.P.	3 C.P.	3 C.P.



STUDEBAKER WIRING DIAGRAM, DICTATOR, 1928, MODEL GE
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Studebaker-Dictator Model GE Year 1928

Delco-Remy Starter & Generator Delco-Remy Ignition

Regulation | Max. Chg. rate and speed

Third Brush 19½ amps - 1650 r.p.m.

RELAY Air Gap | Contact Gap | Cut-in R.P.M.

.014" - .018" | .015" - .025" | 600

BATTERY Willard Type SJWR-3 Volts 6 Amps 90

Bat. to Frame Con. Positive CONTACT BREAKER Gap .018" - .024"

Firing Order 1-4-2-6-3-5 Ignition Timing 7½° A.T.D.C.

SPARK PLUG | ENGINE | Taxable Hp.

Size 7/8" Gap .025" Bore 3-3/8" Stroke 4-1/2" 27.3

INTAKE VALVE TIMING | EXHAUST VALVE TIMING

Open 5° A.T.D.C. Close 53° A.B.D.C. Open 38° B.B.D.C. Close 10° A.T.D.C.

VALVE CLEARANCE Cold Intake .003"-.005" Exhaust .005"-.007"

CARBURETOR | COOLING SYSTEM | OILING SYSTEM

Stromberg Type Pump Cap 3½ Gal Type Press Cap 8 Qts

PISTON RING: Width Comp 1/8" Diam 3-3/8" Gap .017"-.022"
Oil 3/16" .015"-.020"-oil

CLUTCH 9¾ x 9/64 GEAR RATIO 4.3 & 4.64 AXLE Semi-floating

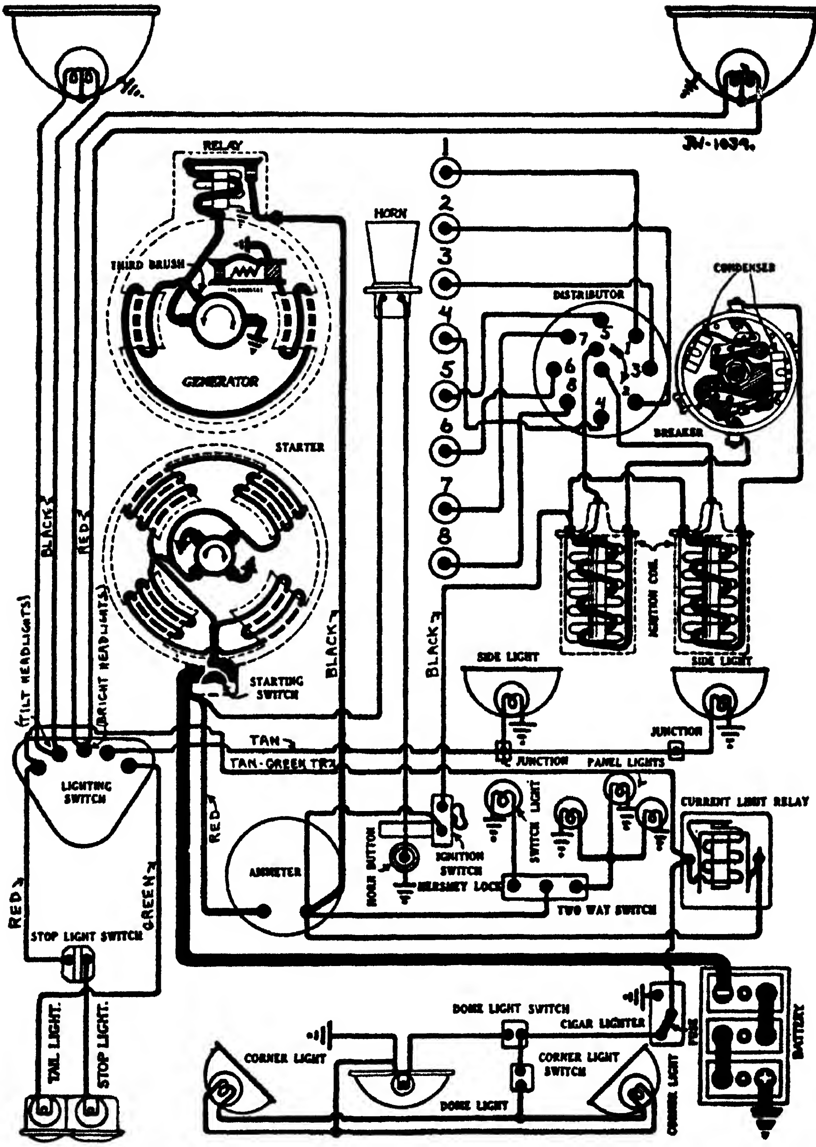
BRAKES

Front | Rear | Hand

3/16" x 1¾" x 12-7/8" (2 pcs) Same 3/16" x 2" x 24-1/16"
3/16" x 1¼" x 9-7/8" (4 pcs)

Lighting | Headlights | Dash & Tail | Side Lamps

Single Contact 21 C.P. 3 C.P. 3 C.P.



STUDEBAKER WIRING DIAGRAM, PRESIDENT. 1929, MODELS FE AND FH

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Studebaker-President Model FE-FH Year 1929

Delco-Remy Starter & Generator Delco-Remy Ignition

Regulation	Max. Chg. rate and speed
Third Brush	$19\frac{1}{2}$ amps, 1650 r.p.m.

RELAY Air Gap	Contact Gap	Cut-In R.P.M.
.014" - .018"	.015" - .025"	650

BATTERY Willard Type SJWR-4 Volts 6 Amps. 111

Bat. to Frame Con. Positive CONTACT BREAKER Gap .018"-.024"

Firing Order 1-6-2-5-8-3-7-4 Ignition Timing 17°A.T.D.C.

SPARK PLUG	ENGINE	Taxable Hp.
Size 7/8" Gap .025"	Bore 3-1/2" Stroke 4-3/8	39.2

INTAKE VALVE TIMING	EXHAUST VALVE TIMING
Open 5°A.T.D.C. Close 45°A.B.D.C.	Open 40°B.B.D.C. Close 12°A.T.D.C.

VALVE CLEARANCE Cold Intake .003" Exhaust .007"

CARBURETOR	COOLING SYSTEM	OILING SYSTEM
Stromberg	Type Pump Cap $5\frac{1}{4}$ Gal	Type Press Cap 8 Qts

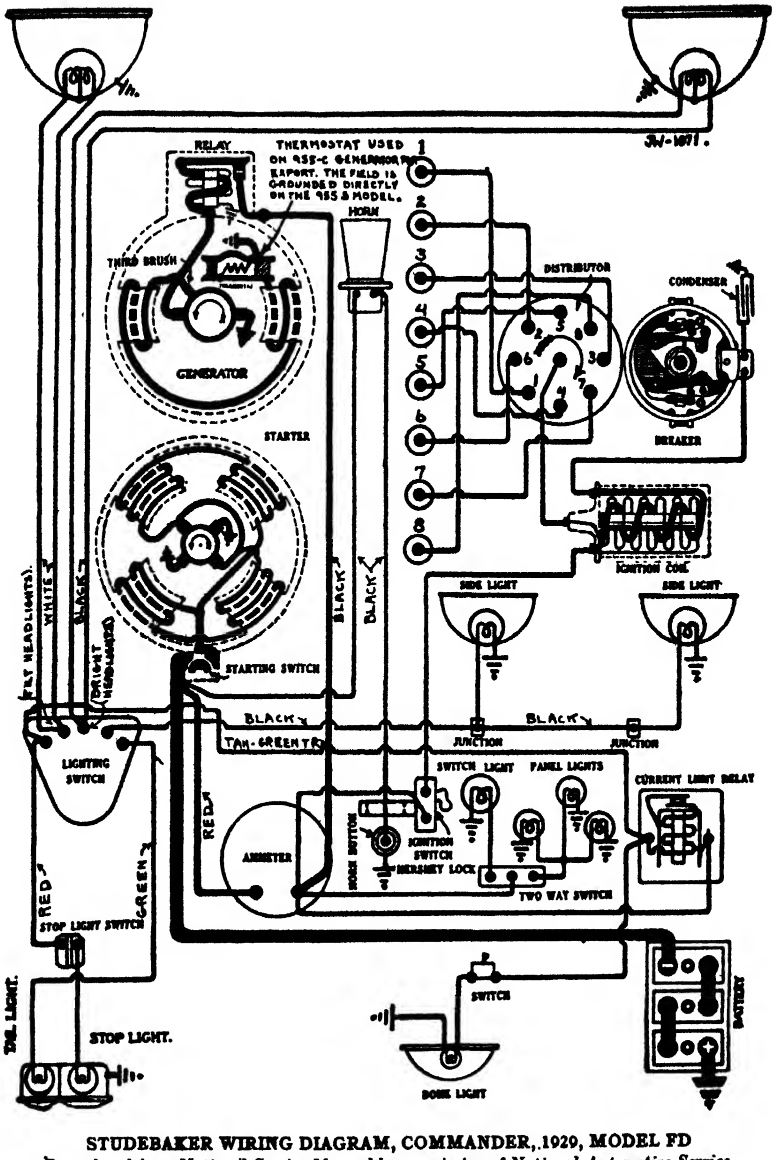
PISTON RING: Width Comp 1/8", Oil 3/16" Diam. 3-1/2" Gap .022"-.028"

CLUTCH 2-$8\frac{3}{4}$" x 9/64" GEAR RATIO 3.47-4.08, 4.31-4.64 AXLE Semi-floating

BRAKES

Front	Rear	Hand
3/16" x $2\frac{1}{4}$" x 14-3/8" (2 pcs) 3/16" x $2\frac{1}{4}$" x 12-7/8" (4 pcs)	Same	same as service

Lighting	Headlights	Dash & Tail	Side Lamps
Single Contact	21 C.P.	3 C.P.	3 C.P.



STUDEBAKER WIRING DIAGRAM, COMMANDER, 1929, MODEL FD

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Studebaker-Commander Model FD Year 1929

Delco-Remy Starter & Generator Delco-Remy Ignition

Regulation	Max. Chg. rate and speed
Third Brush	19½ amps, 1650 r.p.m.

RELAY Air Gap	Contact Gap	Cut-in R.P.M.
.014" - .018"	.015" - .025"	550

BATTERY Willard Type SJWR-3 Volts 6 Amps 90

Bat. to Frame Con. Positive CONTACT BREAKER Gap .018"-.020"

Firing Order 1-6-2-5-8-3-7-4 Ignition Timing 17° A.T.D.C.

SPARK PLUG	ENGINE	Taxable Hp.
Size 7/8" Gap .025"	Bore 3-1/16" Stroke 4-1/4"	30.04

INTAKE VALVE TIMING	EXHAUST VALVE TIMING
Open T.D.C. Close 48° A.B.D.C.	Open 43° B.B.D.C. Close 12° A.T.D.C.

VALVE CLEARANCE Hot Intake .004" Exhaust .006"

CARBURETOR	COOLING SYSTEM	OILING SYSTEM
Stromberg	Type Pump Cap. 3½ Gal	Type Press Cap. 6½ Qts

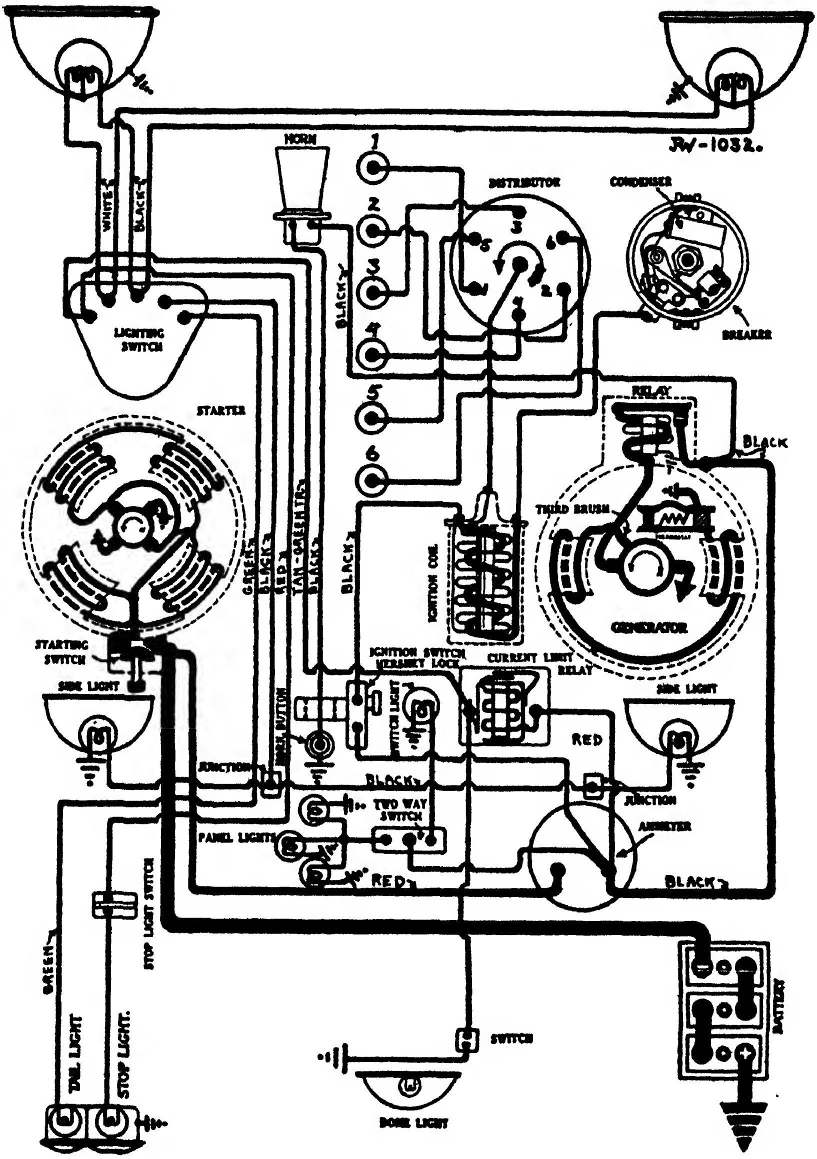
PISTON RING: Width Comp 1/8" Oil 3/16" Diam 3-1/16" Gap .020"-.025"

CLUTCH 9-3/4"x9/64" GEAR RATIO 4.18&4.36 AXLE Semi-floating

BRAKES

Front	Rear	Hand
3/16"x 1¾" x 12-7/8" (2 pcs) 3/16"x1¾" x 9-7/8" (4 pcs)	Same	Same as service

Lighting	Headlights	Dash & Tail	Side Lamps
Single Contact	21 C.P.	3 C.P.	3 C.P.



STUDEBAKER WIRING DIAGRAM, COMMANDER, 1929, MODEL GJ

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Studebaker-Commander Model GJ Year 1929

Delco-Remy Starter & Generator Delco-Remy Ignition

Regulation: Third Brush

Max Chg rate and speed: 19½ amps, 1650 r.p.m.

RELAY Air Gap .014" - .018" Contact Gap .015" - .025" Cut in R P M 600

BATTERY Willard Type SJWR-3 Volts 6 Amps 90

Bat to Frame Con Positive CONTACT BREAKER Gap .018" - .024"

Firing Order 1-4-2-6-3-5 Ignition Timing 7½°A.T.D.C.

SPARK PLUG — ENGINE — Taxable Hp

Size 7/8" Gap .025" Bore 3-3/8" Stroke 4-5/8" 27.3

INTAKE VALVE TIMING — EXHAUST VALVE TIMING

Open 5°A.T.D.C. Close 53°A.B.D.C. Open 38°B.B.D.C. Close 10°A.T.D.C.

VALVE CLEARANCE Cold Intake .003-.005" Exhaust .005-.007"

CARBURETOR — COOLING SYSTEM — OILING SYSTEM

Stromberg Type Pump Cap 3½ Gal Type Press Cap 8 Qts.

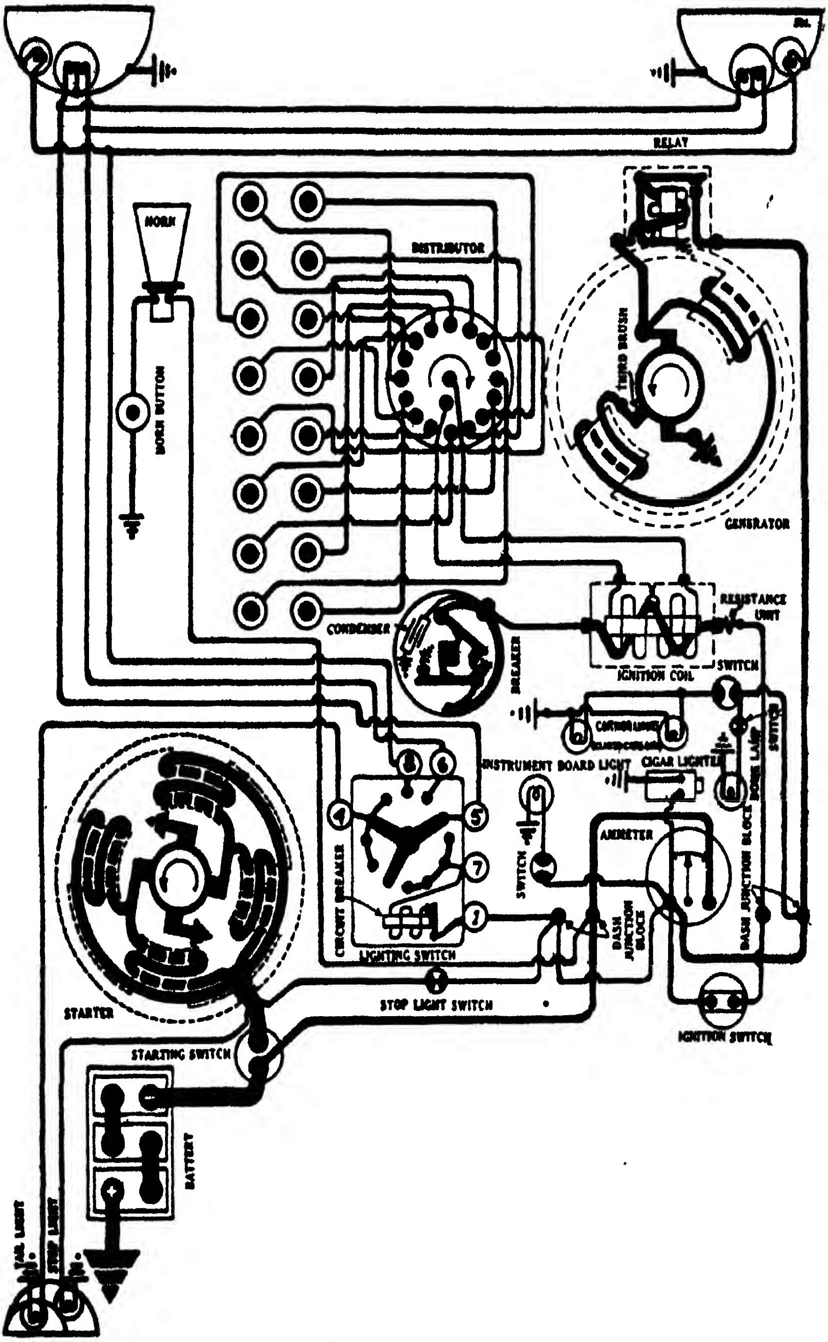
PISTON RING Width Comp 1/8" Oil 3/16" Diam 3-3/8" Gap .015"-.020" Oil .017"-.022" Pl.

CLUTCH 9⅝ x 9/64" GEAR RATIO 3.91 & 4.1 AXLE Semi-floating

BRAKES

Front	Rear	Hand
3/16" x 1⅝" x 12-7/8" (2 pcs) 3/16" x 1¼" x 9-7/8" (4 pcs)	Same	Same as Service

Lighting	Headlights	Dash & Tail	Side Lamps
Single Contact	21 C P	3 C P	3 C P



STUTZ WIRING DIAGRAM, 1926, SERIES AA

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Stutz Model Series AA Year 1926

Delco-Remy Starter & Generator Delco-Remy Ignition

Regulation: Third Brush

Max Chg rate and speed: 9-12 amps, 1800-2000 r.p.m.

RELAY Air Gap .014 - .018" Contact Gap .018" - .025" Cut in R P M 575

BATTERY Prestolite Type 617 SHK Volts 6 Amps 170

Bat to Frame Con Negative CONTACT BREAKER Gap .018 - .024"

Firing Order 1-6-2-5-8-3-7-4 Ignition Timing 15° B.T.D.C. adv.

SPARK PLUG Size Metric Gap .022"

ENGINE Bore 3-3/16" Stroke 4-1/2"

Taxable Hp 32.52

INTAKE VALVE TIMING Open 10° A.T.D.C. Close 50° A.B.D.C.

EXHAUST VALVE TIMING Open 46° A.B.D.C. Close 10° A.T.D.C.

VALVE CLEARANCE Hot Intake .028" Exhaust .028"

CARBURETOR Zenith

COOLING SYSTEM Type Pump Cap 7 Gal

OILING SYSTEM Type Force Cap 12 Qts

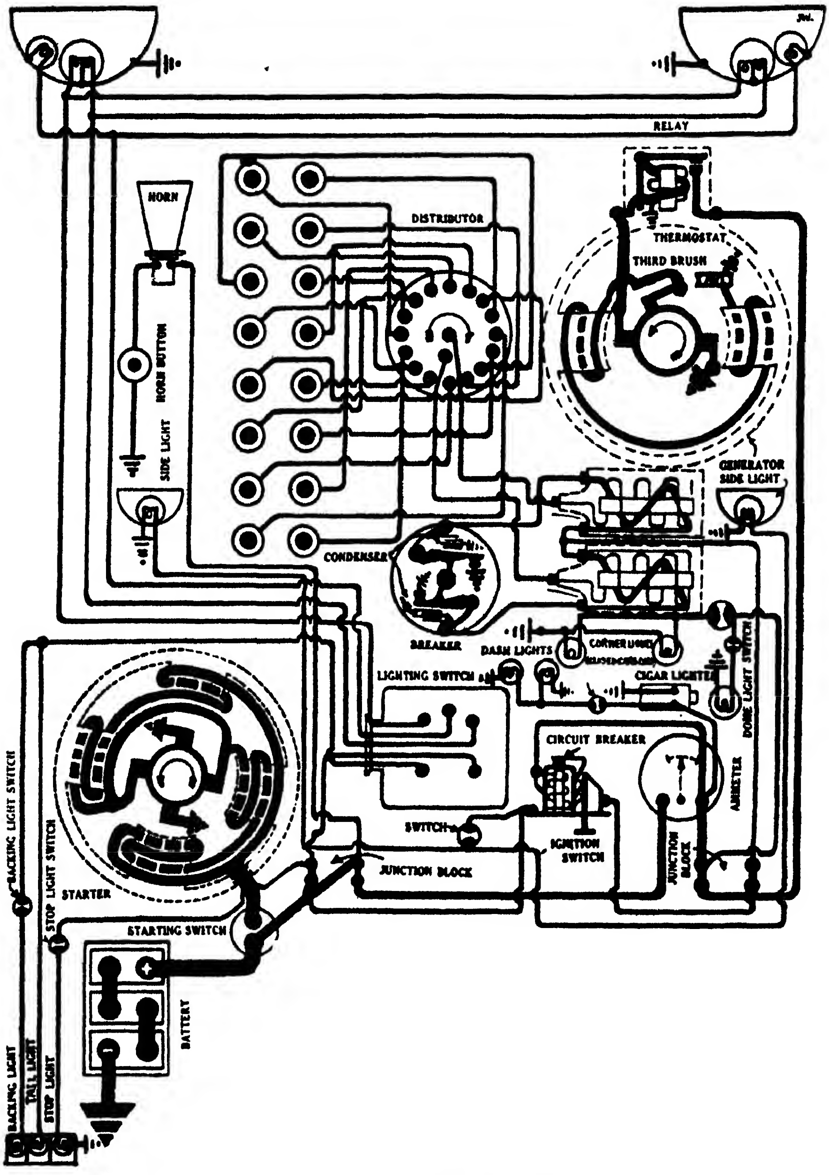
PISTON RING Width 1/8" Diam 3-3/16" Gap .005 - .008"

CLUTCH B & B GEAR RATIO 5 AXLE Semi-floating

BRAKES

Front	Rear	Hand
1/8" x 1-7/8" x 6¾" (6 pcs)	Same	3/16" x 2½" x 18⅛"

Lighting	Headlights	Dash & Tail	Side Lamps
Single Contact	21-21 C P	2 C P	-- C P



STUTZ WIRING DIAGRAM, 1927, SERIES AA

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Stutz Model Series AA Year 1927

Delco-Remy Starter & Generator Delco-Remy Ignition

Regulation	Max. Chg. rate and speed
Third Brush	9-12 amps, 1800-2000 r.p.m.

RELAY Air Gap	Contact Gap	Cut-in R.P.M.
.010"	.025"	575

BATTERY Prestolite Type 617 SHK Volts 6 Amps. 170

Bat. to Frame Con. Negative CONTACT BREAKER Gap .015 - .020"

Firing Order 1-6-2-5-8-3-7-4 Ignition Timing 15° B.T.D.C. adv.

SPARK PLUG	ENGINE	Taxable Hp.
Size Metric Gap .022"	Bore 3-1/4" Stroke 4-1/2"	33.8

INTAKE VALVE TIMING	EXHAUST VALVE TIMING
Open 10°A.T.D.C. Close 50°A.B.D.C.	Open 46°A.B.D.C. Close 10°A.T.D.C.

VALVE CLEARANCE Hot Intake .028" Exhaust .028"

CARBURETOR	COOLING SYSTEM	OILING SYSTEM
Zenith	Type Pump Cap. 7 Gal	Type Force Cap. 12 Qts

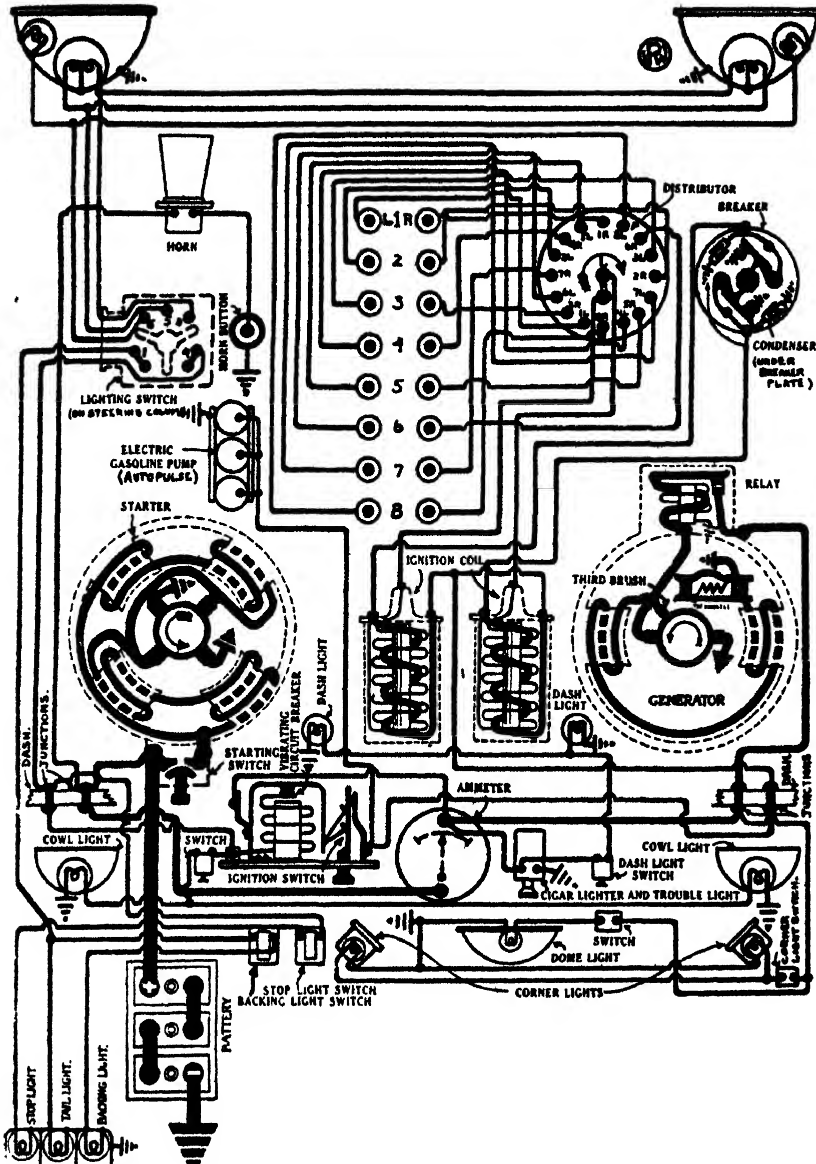
PISTON RING: Width 1/8" Diam. 3-1/4" Gap .005 - .008"

CLUTCH B & B GEAR RATIO 4.75 AXLE Semi-floating

BRAKES

Front	Rear	Hand
1/8" x 1-7/8" x 6¾" (6 pcs)	Same	3/16" x 2½" x 18½"

Lighting	Headlights	Dash & Tail	Side Lamps
Single Contact	21-21 C.P.	2 C.P.	6 C.P.



STUTZ WIRING DIAGRAM, 1928, SERIES BB

Reproduced from National Service Manual by permission of National Automotive Service

Stutz Model Series BB Year 1928

Delco-Remy Starter & Generator Delco-Remy Ignition

Regulation	Max. Chg. rate and speed
Third Brush	9-12 amps. 1800-2000 r.p.m.

RELAY Air Gap	Contact Gap	Cut-in R.P.M.
.010"	.025"	575

BATTERY Prestolite Type 617 SHK Volts 6 Amps 170

Bat. to Frame Con. Negative CONTACT BREAKER Gap .017"

Firing Order 1-6-2-5-8-3-7-4 Ignition Timing 15° B.T.D.C. adv.

SPARK PLUG	ENGINE	Taxable Hp.
Size Metric Gap .022"	Bore $3\frac{1}{4}$" Stroke $4\frac{1}{2}$"	33.8

INTAKE VALVE TIMING	EXHAUST VALVE TIMING
Open 10° A.T.D.C. Close 50° A.B.D.C.	Open 46° A.B.D.C. Close 10° A.T.D.C.

VALVE CLEARANCE Hot Intake .028" Exhaust .028"

CARBURETOR	COOLING SYSTEM	OILING SYSTEM
Zenith	Type Pump Cap 7 Gal	Type Force Cap 12 Qts

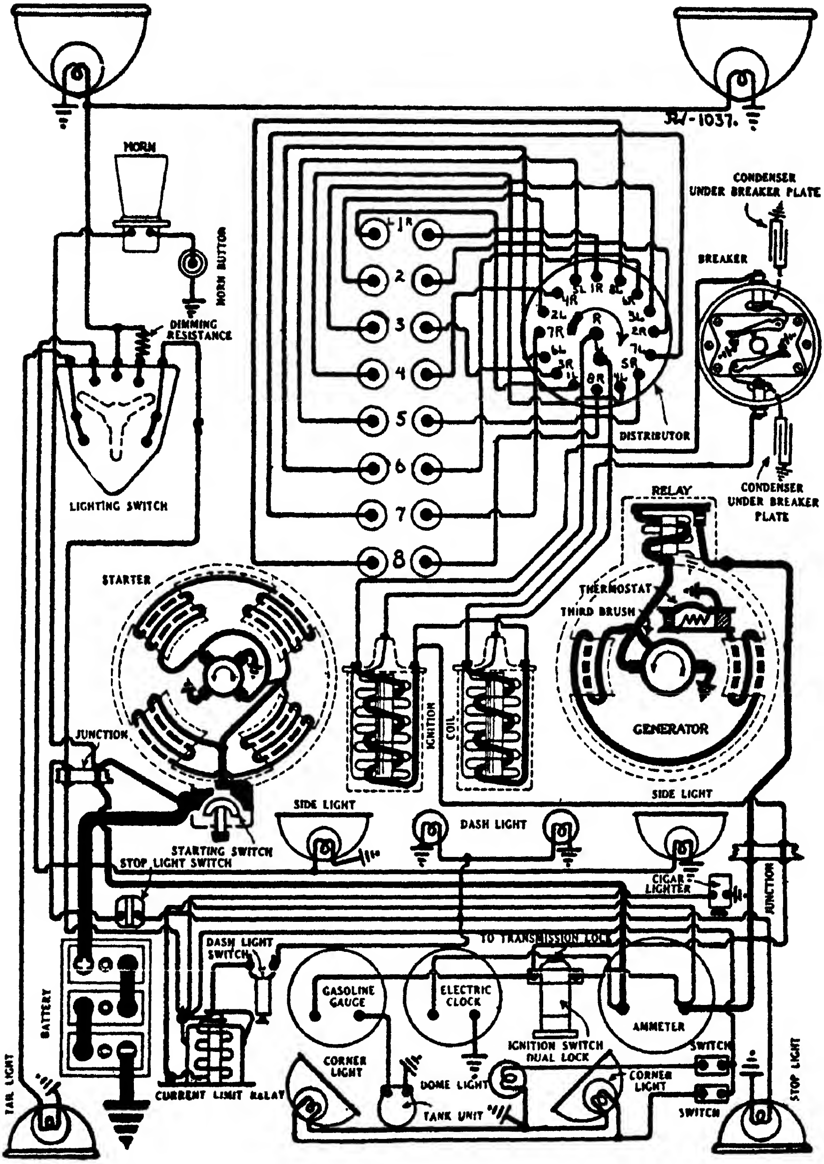
PISTON RING: Width 1/8" Diam $3\frac{1}{4}$" Gap .005 - .008"

CLUTCH B & B GEAR RATIO 4.75 AXLE Semi-floating

BRAKES

Front	Rear	Hand
3/16" x $1\frac{3}{4}$" x 17" (4 pcs)	same	1/8" x $2\frac{1}{4}$" x 20"

Lighting	Headlights	Dash & Tail	Side Lamps
Single Contact	21 C.P.	2 C.P.	6 C.P.



STUTZ WIRING DIAGRAM, 1929, MODEL M

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Stutz Model M Year 1929

Delco-Remy Starter & Generator Delco-Remy Ignition

Regulation	Max. Chg. rate and speed
Third Brush	10-12 amps, 1600 r.p.m.

RELAY Air Gap	Contact Gap	Cut-in R.P.M.
.014 - .020"	.015 - .020"	600

BATTERY Prestolite Type A 6175 H Volts 6-8 Amps 170

Bat. to Frame Con. Negative CONTACT BREAKER Gap .017"

Firing Order 1-6-2-5-8-3-7-4 Ignition Timing 15° B.T.D.C. adv.

SPARK PLUG	ENGINE	Taxable Hp.
Size 7/8" Gap .022"	Bore 3-3/8" Stroke 4½"	36.45

INTAKE VALVE TIMING	EXHAUST VALVE TIMING
Open 7°A.T.D.C. Close 47°A.T.D.C.	Open 49°B.T.D.C. Close 7°A.T.D.C.

VALVE CLEARANCE Hot Intake .028" Exhaust .028"

CARBURETOR	COOLING SYSTEM	OILING SYSTEM
Zenith Duplex	Type Pump Cap 7 Gal	Type Press Cap 12 Qts

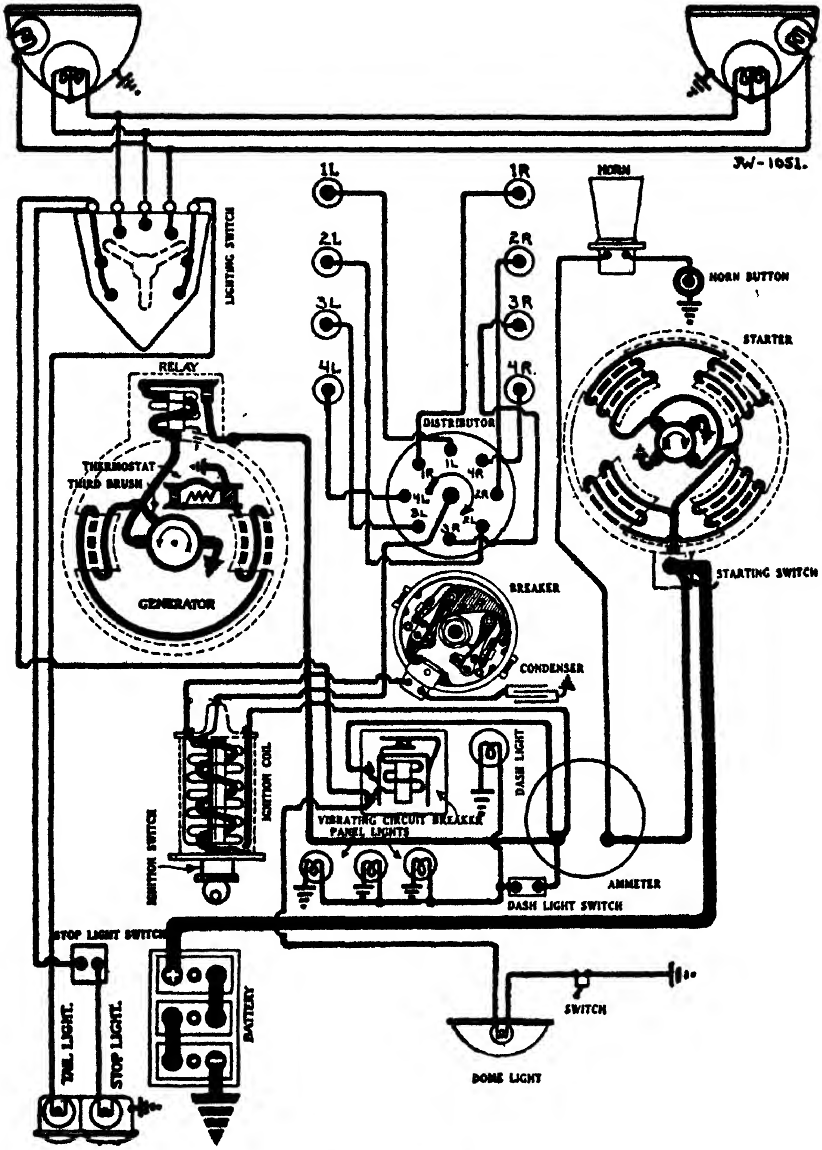
PISTON RING: Width Comp 1/8" Oil 3/16" Diam. 3-3/8" Gap .005 - .008 "

CLUTCH Single Disc GEAR RATIO 4.5 AXLE Semi-floating

BRAKES

Front	Rear	Hand
3/16" x 1¾" x 34" per wheel	3/16" x 1¾" x 34" per wheel	1/8" x 2¼" x 20"

Lighting	Headlights	Dash & Tail	Side Lamps
Single Contact	32 C.P.	3 C.P.	3 C.P.



VIKING WIRING DIAGRAM, 1929, MODEL V-29

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Viking Model V-29 Year 1929

Delco-Remy Starter & Generator Delco-Remy Ignition

Regulation — Max. Chg. rate and speed

Third Brush — 9-12 amps, 1800-2000 r.p.m.

RELAY Air Gap .014 - .020" — Contact Gap .015 - .025" — Cut-in R.P.M. 600

BATTERY Willard Type WSB 15 Volts 6 Amps 100

Bat. to Frame Con. Negative — CONTACT BREAKER Gap .022"

Firing Order 1-5-4-2-6-3-7-8 — Ignition Timing .045" B.T.D.C. adv.

SPARK PLUG — ENGINE — Taxable Hp.

Size Metric Gap .025" — Bore 3-3/8" Stroke 3-5/8" — 36.5

INTAKE VALVE TIMING — EXHAUST VALVE TIMING

Open 1°20' Close 50° 20' — Open 41° 20' Close 11° 20'

VALVE CLEARANCE Hot Intake .008" Exhaust .012"

CARBURETOR — COOLING SYSTEM — OILING SYSTEM

Johnson — Type Pump Cap 8.5 Gal — Type Press Cap 7 Qts

PISTON RING: Width ... Diam 3-3/8" Gap .005 - .015"

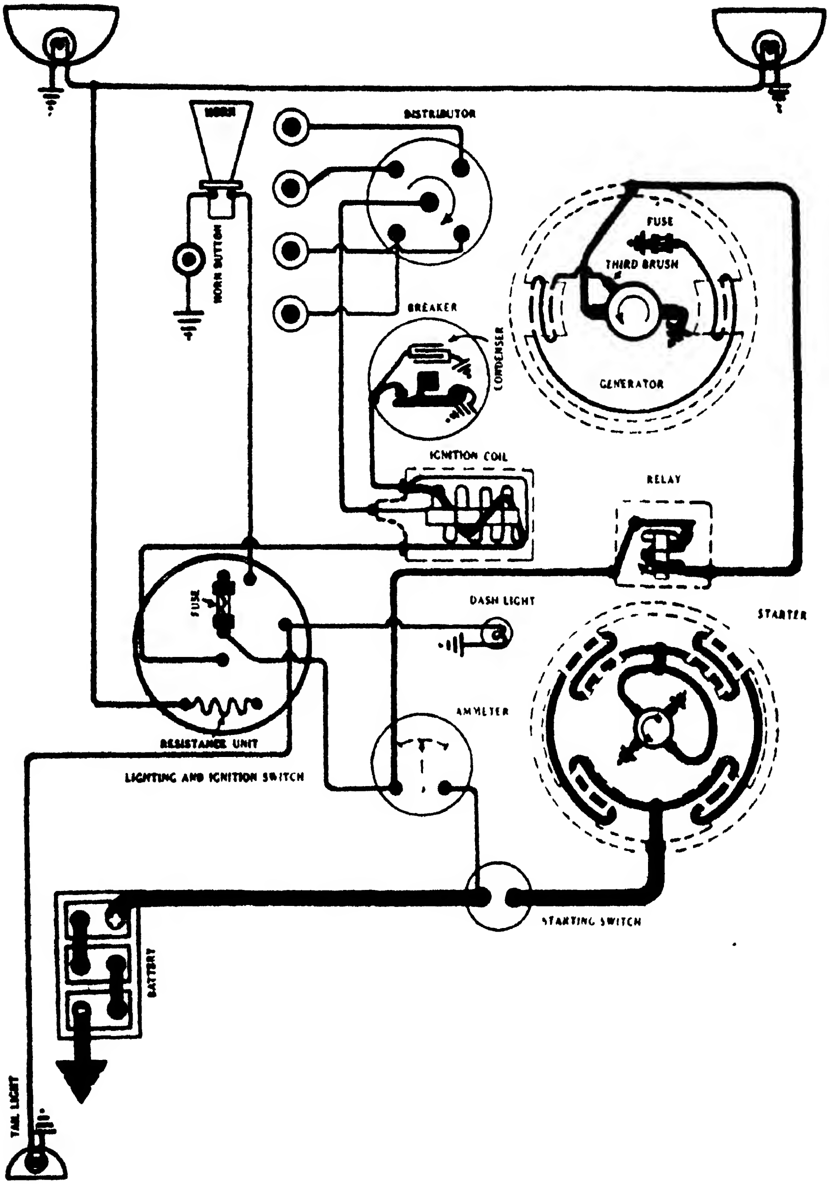
CLUTCH Dry Plate — GEAR RATIO 4.45 — AXLE Own

BRAKES

Front — Rear — Hand

Lighting — Headlights — Dash & Tail — Side Lamps

Single Contact Dbl - 21 C.P. Sgl 3 C.P. Sgl 3 C.P.



WHIPPET FOUR WIRING DIAGRAM, 1926-27-28, MODEL 96

Reproduced from National Service Manual by permission of National Automotive Service

Whippet — Model 96 — Year 1926-27-28

Autolite — Starter & Generator — Autolite — Ignition

Regulation	Max. Chg. rate and speed
Third Brush	12 amps, 2000 r.p.m.

RELAY Air Gap	Contact Gap	Cut-in R.P.M.
.010" - .030"	.025 - .035"	675

BATTERY U.S.L. Type 3CVX5A 6 Volts 6 Amps 80

Bat. to Frame Con. Negative CONTACT BREAKER Gap .018"

Firing Order 1-3-4-2 Ignition Timing 7° B.T.D.C. adv.

SPARK PLUG		ENGINE		Taxable Hp.
Size 7/8"	Gap .025"	Bore 3-1/8"	Stroke 4-3/8"	15.6

INTAKE VALVE TIMING		EXHAUST VALVE TIMING	
Open T.D.C.	Close 40° A.B.D.C.	Open 46° B.B.D.C.	Close T.D.C.

VALVE CLEARANCE Hot Intake .006" Exhaust .006"

CARBURETOR	COOLING SYSTEM		OILING SYSTEM	
Tillotson	Type Pump	Cap $2\frac{3}{4}$ Gal	Type Press	Cap 5 Qts

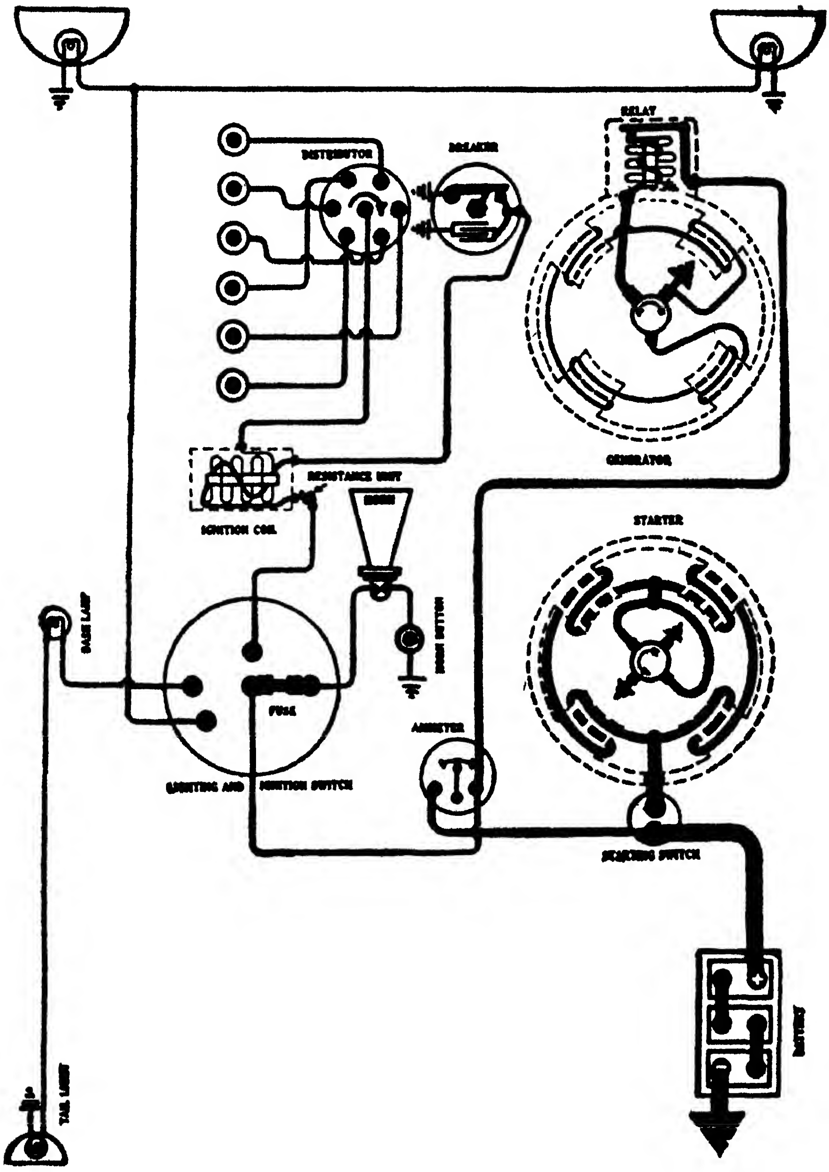
PISTON RING: Width 1/8" Diam. 3-1/8" Gap .005" - .010"

CLUTCH Disc GEAR RATIO 4.89 AXLE Semi-floating

BRAKES

Front	Rear	Hand
5/32" x $1\frac{1}{2}$" x $19\frac{3}{4}$"	5/32" x 1-7/8" x 34-7/8"	5/32" x 1-7/8" x 34-7/8"

Lighting	Headlights	Dash & Tail	Side Lamps
Single Contact	21 C.P.	3 C.P.	C.P.



WHIPPET SIX WIRING DIAGRAM, 1927-28, MODEL 93A

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Whippet Six Model 93A Year 1927-28

Autolite Starter & Generator Autolite Ignition

Regulation	Max Chg rate and speed
Third Brush	12 amps, 2000 r.p.m.

RELAY Air Gap	Contact Gap	Cut-in R P M.
.010 - .030"	.025 - .035"	675

BATTERY U.S.L. Type 3 CVX 6X6 Volts 6 Amps 96

Bat to Frame Con Negative CONTACT BREAKER Gap .018"

Firing Order 1-5-3-6-2-4 Ignition Timing 6° B.T.D.C. adv.

SPARK PLUG				ENGINE				Taxable Hp
Size	7/8"	Gap	.025"	Bore	3"	Stroke	4"	21.6

INTAKE VALVE TIMING				EXHAUST VALVE TIMING			
Open	5°A.T.D.C.	Close	45°A.B.D.C.	Open	39°B.B.D.C.	Close	5°A.T.D.C.

VALVE CLEARANCE Hot Intake .008" Exhaust .008"

CARBURETOR	COOLING SYSTEM	OILING SYSTEM
Tillotson	Type Pump Cap 3-1/8Gal	Type Press Cap 6 Qts

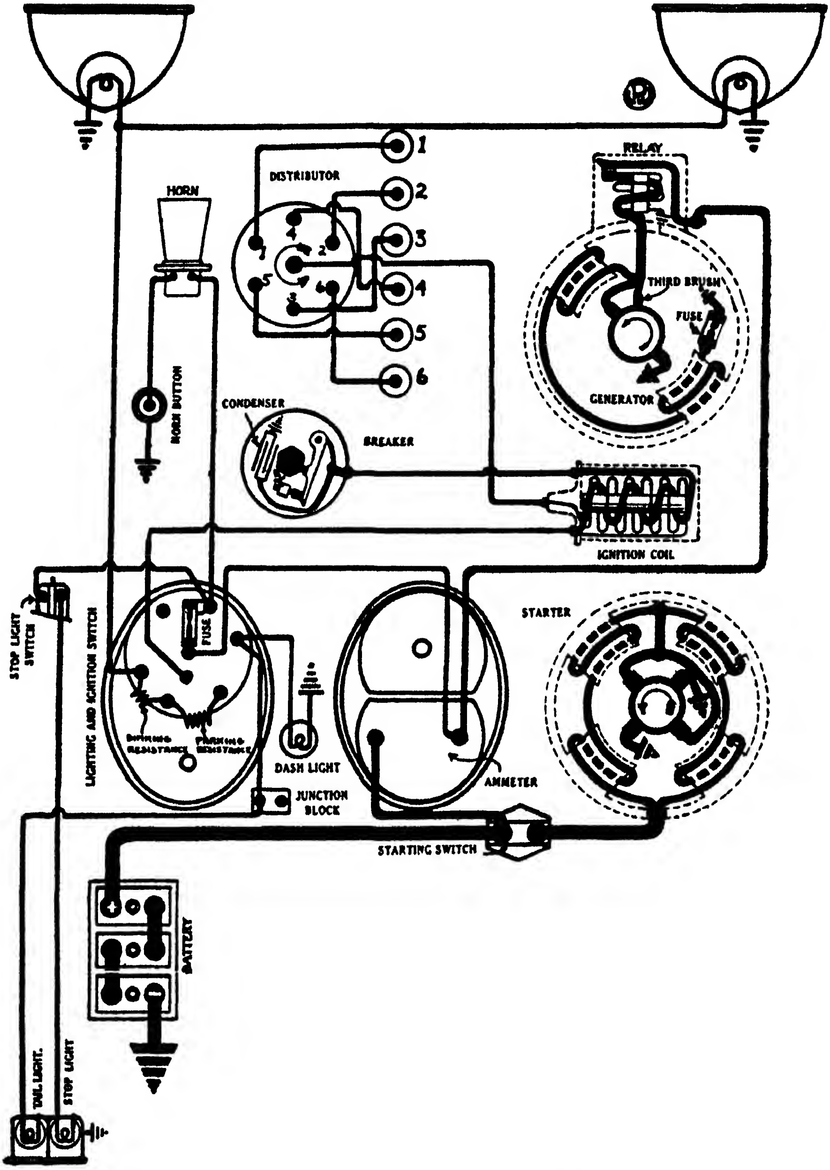
PISTON RING Width 1/8" Diam 3" Gap .005 - .010"

CLUTCH Disc GEAR RATIO 5.11 AXLE Semi-floating

BRAKES

Front	Rear	Hand
5/32" x 1½" x 29-45/64"	5/32" x 1-7/8" x 34-7/8"	5/32" x 1-7/8" x 34-7/8"

Lighting	Headlights	Dash & Tail	Side Lamps
Single Contact	21 C P	3 C P	-- C P



WHIPPET SIX WIRING DIAGRAM, 1928, MODEL 98

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Whippet Six Model 98 Year 1928

Autolite Starter & Generator Autolite Ignition

Regulation	Max. Chg. rate and speed
Third Brush	12 amps, 2000 r.p.m.

RELAY Air Gap	Contact Gap	Cut-in R.P.M.
.010 - .030"	.025 - .035"	675

BATTERY U.S.L. Type 3CVX 6X6 Volts 6 Amps. 96

Bat. to Frame Con. Negative CONTACT BREAKER Gap. .018"

Firing Order. 1-5-3-6-2-4 Ignition Timing 10°B.T.D.C. adv

SPARK PLUG	ENGINE		Taxable Hp.
Size 7/8" Gap .025"	Bore 3-1/8"	Stroke 3-7/8"	23.4

INTAKE VALVE TIMING		EXHAUST VALVE TIMING	
Open 7°A.T.D.C.	Close 39°A.B.D.C.	Open 38°B.B.D.C.	Close 2°B.T.D.C.

VALVE CLEARANCE Hot Intake .006" Exhaust .006"

CARBURETOR	COOLING SYSTEM	OILING SYSTEM
Tillotson	Type Pump Cap 3¾ Gal	Type Press Cap 7 Qts

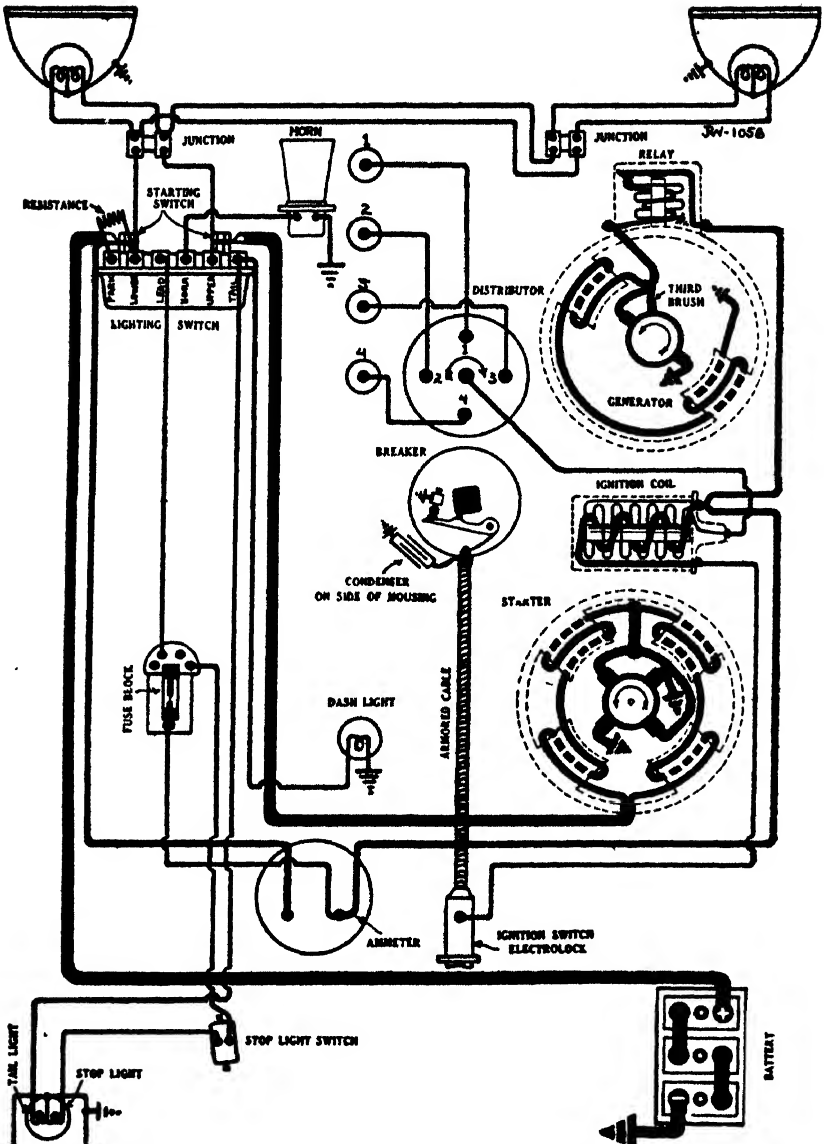
PISTON RING: Width 2-1/8" 1-5/32" Diam 3-1/8" Gap .005 - .010"

CLUTCH Disc GEAR RATIO 4.89 AXLE Semi-floating

BRAKES

Front	Rear	Hand
5/32" x 1½" x 19¾"	5/32" x 1-7/8" x 34-7/8"	5/32" x 1-7/8" x 34-7/8"

Lighting	Headlights	Dash & Tail	Side Lamps
Single Contact	21 C.P.	3 C.P.	— C.P.



WHIPPET FOUR WIRING DIAGRAM, 1929, MODEL 96A

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Whippet Model 96A Year 1929

Autolite Starter & Generator Autolite Ignition

Regulation	Max. Chg. rate and speed
Third Brush	12 amps, 2000 r.p.m.

RELAY Air Gap	Contact Gap	Cut-in R.P.M.
.010 - .030"	.025-.035"	675

BATTERY U.S.L. Type 3CVX5X6A Volts 6 Amps 96

Bat. to Frame Con. Negative CONTACT BREAKER Gap .018"

Firing Order 1-3-4-2 Ignition Timing T.D.C. adv.

SPARK PLUG	ENGINE	Taxable Hp.
Size 7/8" Gap .025"	Bore 3-1/8" Stroke 4-3/4"	15.6

INTAKE VALVE TIMING	EXHAUST VALVE TIMING
Open. 7°A.T.D.C. Close 39°A.B.D.C.	Open 38°B.B.D.C. Close 2°A.T.D.C.

VALVE CLEARANCE Hot Intake .004" Exhaust .006"

CARBURETOR	COOLING SYSTEM	OILING SYSTEM
Tillotson	Type Pump Cap 2-1/8 G.	Type Press Cap 5 Qts.

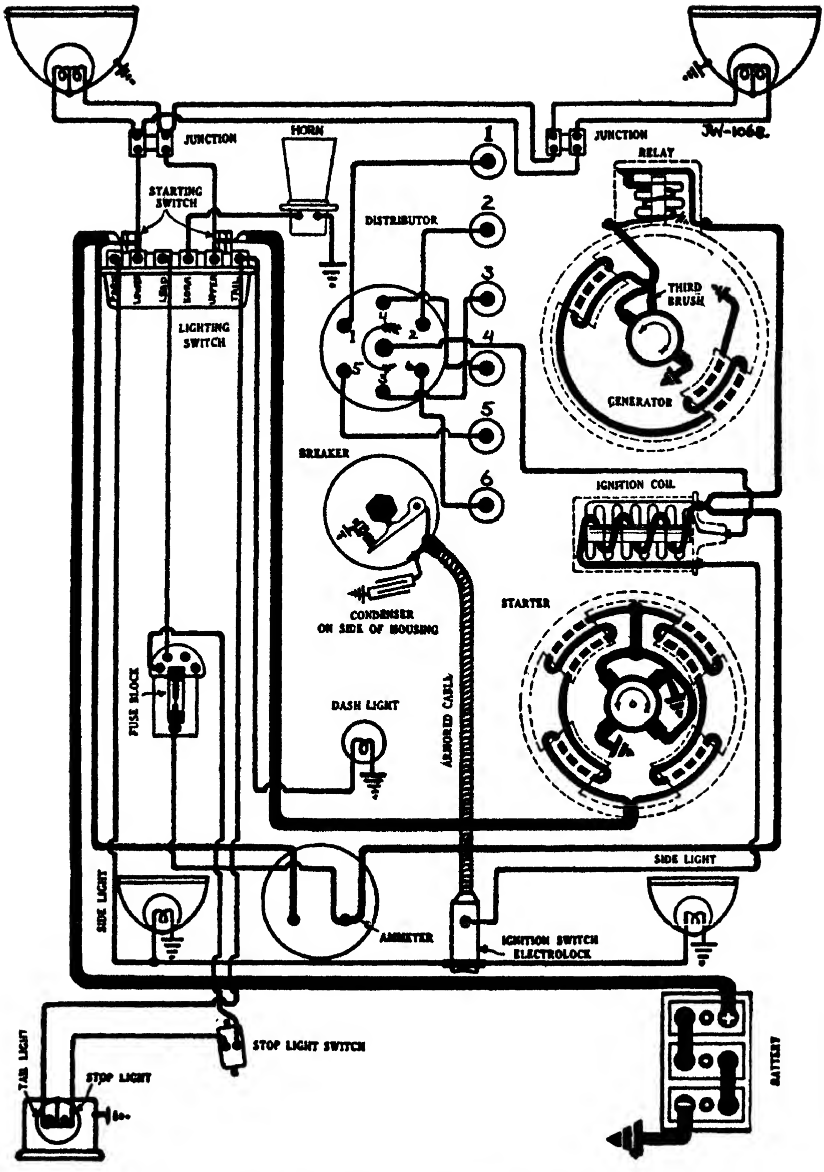
PISTON RING: Width 2-1/8" 1-5/32" Diam. 3-1/8" Gap .005 - .010"

CLUTCH Disc GEAR RATIO 4.55 AXLE Semi-floating

BRAKES

Front	Rear	Hand
5/32" x 1¼" x 19¾"	5/32" x 1-7/8" x 34-7/8"	5/32" x 1-7/8" x 34-7/8"

Lighting	Headlights	Dash & Tail	Side Lamps
Double Contact	2-21 C.P.	3 2-21 C.P.	C.P.



WHIPPET SIX WIRING DIAGRAM, 1929, MODEL 98A

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Whippet Six Model 98 A Year 1929

Autolite Starter & Generator Autolite Ignition

Regulation	Max. Chg. rate and speed
Third Brush	12 amps, 1500 r.p.m.

RELAY Air Gap	Contact Gap	Cut-in R.P.M.
.010-.030"	.025 - .035"	675

BATTERY U.S.L. Type 3CVX6X6A Volts 6 Amps 115

Bat. to Frame Con. Negative CONTACT BREAKER Gap .018"

Firing Order 1-5-3-6-2-4 Ignition Timing 8° B.T.D.C. adv.

SPARK PLUG		ENGINE		Taxable Hp.
Size 7/8"	Gap .025"	Bore 3-1/8"	Stroke 3-7/8"	23.4

INTAKE VALVE TIMING		EXHAUST VALVE TIMING	
Open 7°A.T.D.C.	Close 39°A.B.D.C.	Open 38°B.B.D.C.	Close 2°B.T.D.C.

VALVE CLEARANCE Hot Intake .006" Exhaust .006"

CARBURETOR	COOLING SYSTEM		OILING SYSTEM	
Tillotson	Type Pump	Cap 3-7/8 G	Type Press	Cap 6 Qts

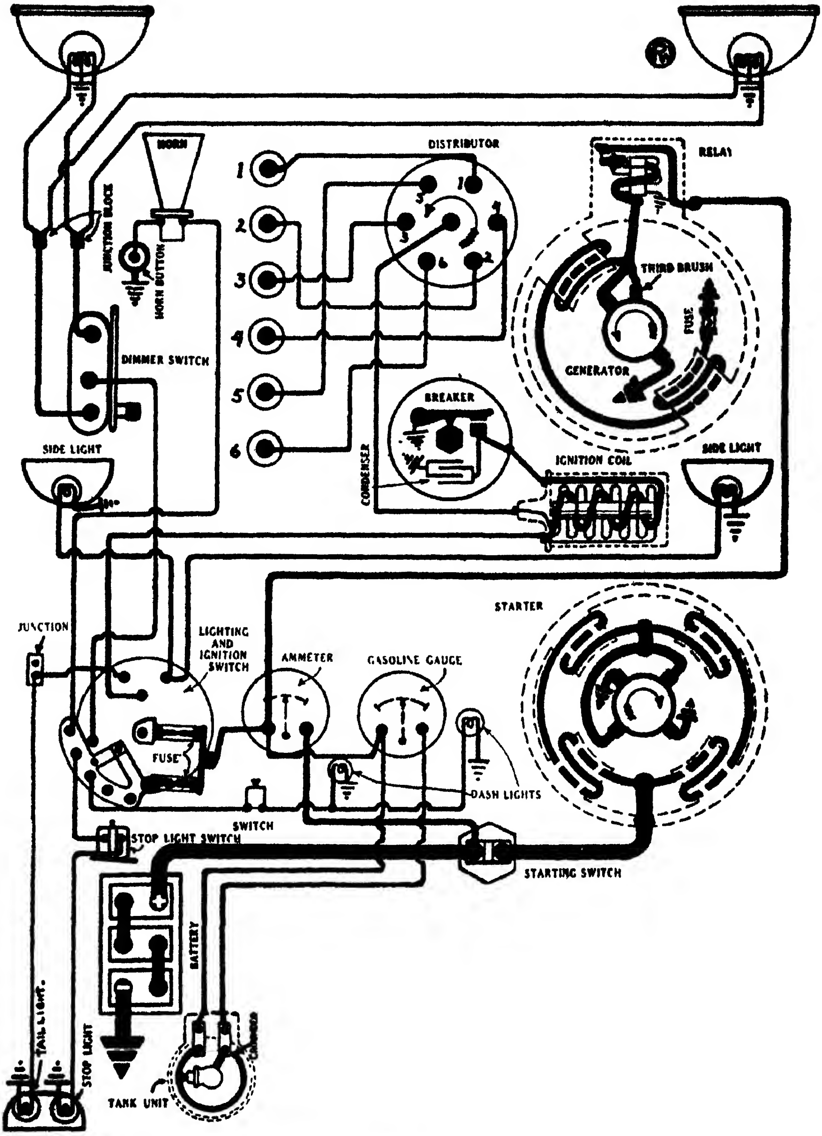
PISTON RING: Width 2-1/8" 1-5/32" Diam 3-1/8" Gap .005 - .010"

CLUTCH Disc GEAR RATIO 4.55 AXLE Semi-floating

BRAKES

Front	Rear	Hand
5/32" x 1½" x 24-3/32"	5/32" x 1-7/8" x 34-7/8"	5/32" x 1-7/8" x 34-7/8"

Lighting	Headlights	Dash & Tail	Side Lamps
Double Contact	2-21 C.P.	3 2-21 C.P.	-- C.P.



WILLYS KNIGHT WIRING DIAGRAM, 1928, MODEL 56

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Willys-Knight Model 56 Year 1928

Autolite Starter & Generator Autolite Ignition

Regulation	Max. Chg. rate and speed
Third Brush	12 amps, 1800 r.p.m.

RELAY Air Gap	Contact Gap	Cut-in R.P.M.
.010" - .030"	.025" - .035"	750

BATTERY U.S.L. Type 3CVX-6X6 Volts 6 Amps 117

Bat. to Frame Con. Negative CONTACT BREAKER Gap .018"

Firing Order 1-5-3-6-2-4 Ignition Timing 8°B.T.D.C. adv.

SPARK PLUG	ENGINE	Taxable Hp.
Size 7/8" Gap .025"	Bore 2-15/16" Stroke 3-7/8"	20.7

INTAKE VALVE TIMING	EXHAUST VALVE TIMING
Open 10°A.T.D.C. Close 35°A.B.D.C.	Open 50°B.B.D.C. Close 5°A.T.D.C.

VALVE CLEARANCE (sleeve) Intake Exhaust

CARBURETOR	COOLING SYSTEM	OILING SYSTEM
Tillotson	Type Pump Cap. 3½ Gal	Type Press Cap. 8 Qts

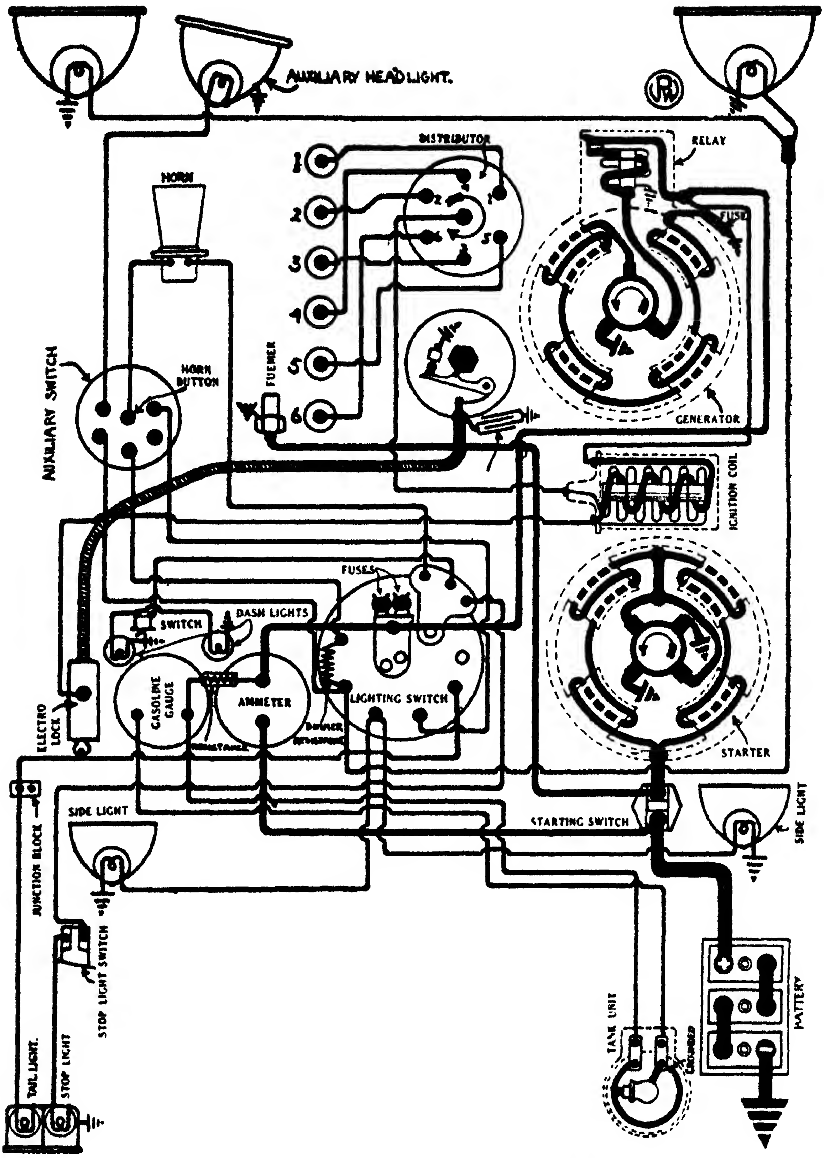
PISTON RING: Width 1/8" Diam. 2-15/16" Gap .010" top .005-.010" other

CLUTCH Disc GEAR RATIO 5.11 AXLE Semi-floating

BRAKES

Front	Rear	Hand
3/16"x1¾"x32-1/16"	5/32"x1-7/8"x34-7/8"	5/32"x1-7/8"x34-7/8"

Lighting	Headlights	Dash & Tail	Side Lamps
Double Contact	21-21 C.P.	3 3-15 C.P.	3 C.P.



WILLYS KNIGHT WIRING DIAGRAM, 1927-28, MODEL 66A

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Willys Knight Model 66A Year 1927-28

Autolite Starter & Generator Autolite Ignition

Regulation	Max. Chg. rate and speed
Third Brush	12 amps, 2000 r.p.m.

RELAY Air Gap	Contact Gap	Cut-in R.P.M.
.010 - .030"	.025 - .035"	675

BATTERY U.S.L. Type 3 HVX 8 X 4 Volts 6 Amps 166

Bat. to Frame Con. Negative CONTACT BREAKER Gap .018"

Firing Order 1-5-3-6-2-4 Ignition Timing 12° B.T.D.C. adv.

SPARK PLUG	ENGINE	Taxable Hp.
Size 7/8" Gap .025"	Bore 3-3/8" Stroke 4-3/4"	27.34

INTAKE VALVE TIMING	EXHAUST VALVE TIMING
Open 10° A.T.D.C. Close 35° A.B.D.C.	Open 50° B.B.D.C. Close 5° A.T.D.C.

VALVE CLEARANCE (Sleeve) Intake Exhaust

CARBURETOR	COOLING SYSTEM	OILING SYSTEM
Tillotson	Type Pump Cap $5\frac{1}{4}$ Gal	Type Press Cap 8 Qts

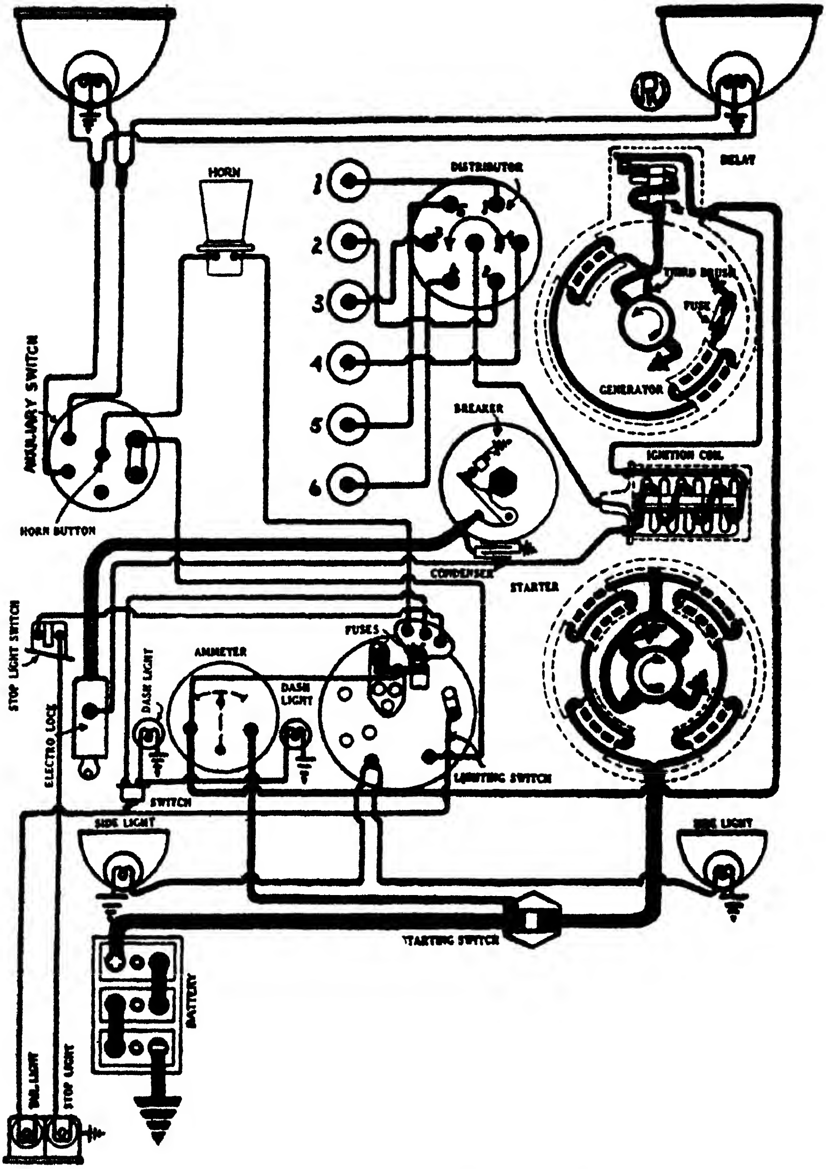
PISTON RING: Width 3-1/8" 1-3/16" Diam. 3-3/8" Gap .005 - .010"

CLUTCH Disc GEAR RATIO 4.7 AXLE 3/4 floating

BRAKES

Front	Rear	Hand
3/16" x 2" x 31-7/8"	3/16" x 2" x 39-1/4"	5/32" x 1-5/8" x 40-7/16"

Lighting	Headlights	Dash & Tail	Side Lamps
Single Contact	21 C.P.	3 3-21 C.P.	3 C.P.



WILLYS KNIGHT WIRING DIAGRAM, 1927-28, MODEL 70A

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Willys Knight Model 70 A Year 1927-28

Autolite Starter & Generator Autolite Ignition

Regulation Max Chg rate and speed

Third Brush 12 amps. 2000 r.p.m.

RELAY Air Gap .010-.030" Contact Gap .025-.035" Cut in R P M 675

BATTERY U.S.L. Type 3HVX 7 X 4 Volts 6 Amps 142

Bat to Frame Con Negative CONTACT BREAKER Gap .018"

Firing Order 1-5-3-6-2-4 Ignition Timing 8° B.T.D.C. adv.

SPARK PLUG Size 7/8" Gap .025"

ENGINE Bore 2-15/16" Stroke 4-3/8"

Taxable Hp 20.7

INTAKE VALVE TIMING Open 10°A.T.D.C. Close 35°A.B.D.C.

EXHAUST VALVE TIMING Open 50°B.B.D.C. Close 5°A.T.D.C.

VALVE CLEARANCE (sleeve) Intake Exhaust

CARBURETOR Tillotson

COOLING SYSTEM Type Pump Cap 4 Gal

OILING SYSTEM Type Press Cap 8 Qts

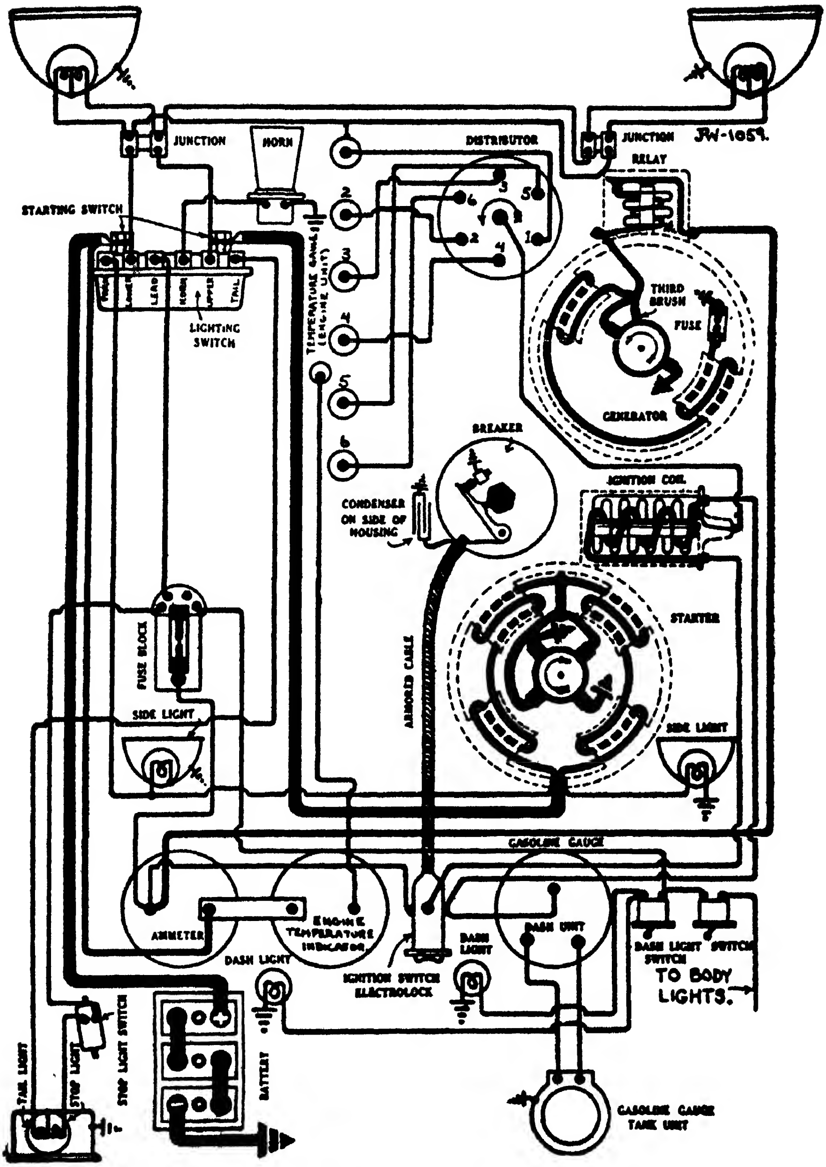
PISTON RING Width 1/8" Diam 2-15/16" Gap .005 - .010"

CLUTCH Disc GEAR RATIO 5.11 AXLE Semi-floating

BRAKES

Front	Rear	Hand
3/16" x 1¾" x 31-7/16"	3/16" x 1¾" x 39¼"	3/16" x 1¾" x 20¾"

Lighting	Headlights	Dash & Tail	Side Lamps
Double Contact	21-21 C P	3 3-21 C P	3 C P



WILLYS KNIGHT WIRING DIAGRAM, 1929, MODEL 70B

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Willy-Knight Model 70B Year 1929

Autolite Starter & Generator Autolite Ignition

Regulation	Max. Chg. rate and speed
Third Brush	12 amps, 1800 r.p.m.

RELAY Air Gap	Contact Gap	Cut-in R.P.M.
.010" - .030"	.025" - .035"	750

BATTERY U.S.L. Type 3HVX6-X6A Volts 6 Amps 127

Bat. to Frame Con. Negative CONTACT BREAKER Gap .018"

Firing Order 1-5-3-6-2-4 Ignition Timing 8° B.T.D.C. adv.

SPARK PLUG	ENGINE	Taxable Hp.
Size 7/8" Gap .025"	Bore 2-15/16" Stroke 4-3/8"	20.7

INTAKE VALVE TIMING	EXHAUST VALVE TIMING
Open 10° A.T.D.C. Close 35° A.B.D.C.	Open 50° B.B.D.C. Close 5° A.T.D.C.

VALVE CLEARANCE (Sleeve) Intake Exhaust

CARBURETOR	COOLING SYSTEM	OILING SYSTEM
Tillotson	Type Pump Cap 4½ Gal	Type Press Cap 8 Qts

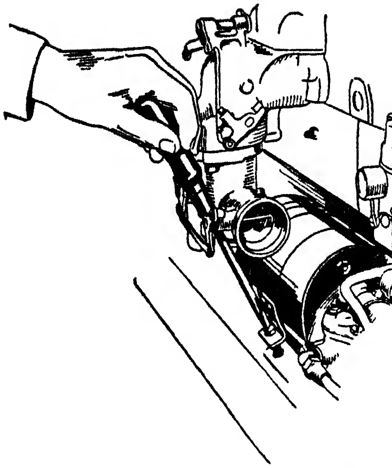
PISTON RING: Width 1/8" Diam. 2-15/16" Gap .010" top, .005-.010" other

CLUTCH Disc GEAR RATIO 4.89 AXLE Semi-floating

BRAKES

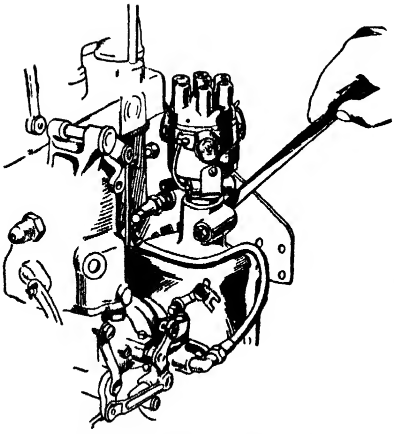
Front	Rear	Hand
3/16" x 1¾" x 32-1/16"	5/32" x 1-7/8" x 34-7/8"	5/32" x 1-7/8" x 34-7/8"

Lighting	Headlights	Dash & Tail	Side Lamps
Double Contact	2-21 C.P.	3 2-21 C.P.	3 C.P.

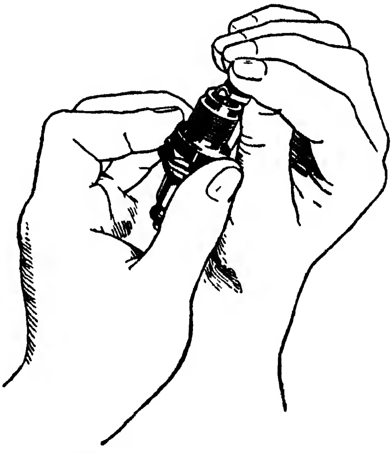


TIGHTENING GENERATOR BAND

CHECKING DISTRIBUTOR POINT GAP



ADJUSTING GENERATOR CHAIN



CHECKING SPARK PLUG GAP

ELECTRICAL REPAIRS

PART I

TESTING EQUIPMENT

The repair of electrical equipment is not often attempted by the ordinary garage repair man because he does not understand the methods of testing the different units or does not have the necessary equipment.

Every repair man should know how to test for trouble in connection with the electrical units and a knowledge of the different parts of the electrical equipment is essential if correct electrical repairs are to be made. If the principle upon which the different units operate is known, a test can readily be made. Of course, there are parts of the electrical system which need special tools and equipment, as in the case of armature repairs, but the simple tests should be made before the unit is sent out for repair in order to determine the cost of the repair.

The best type of equipment proves to be the most economical in the end, and it should be purchased from manufacturers who make a specialty of such equipment. Instruments, such as voltmeters and ampere meters, should always be purchased, and only the best instruments can be relied upon to give accurate readings. In the following pages some equipment is shown that is used for electrical tests. Some parts of this equipment can be made by a person who is handy with tools.

The simple lamp test outfit is the handiest type to use in making general tests. The set, Fig. 1, is for use with outside power, but a similar set can be made for use with the ordinary storage battery. The difference between the two sets is in the type of bulb used in the socket. A 6-volt lamp must be used in a car having a 6-volt battery, and a 12-volt lamp must be used with a 12-volt battery.

A service station or repair shop that can make repairs to electrical equipment will find that a great deal more business will come to the shop than if only mechanical repairs can be made. A repair man who knows how to make accurate tests when hunting trouble in the electrical side of the automobile will find that his services will always be in demand and a study of the following pages on the equipment and methods used for electrical work will be very helpful to all who are interested in the automobile.

Take a porcelain base socket, screw it to a piece of board to form a base. Connect one side of this lamp socket to a standard

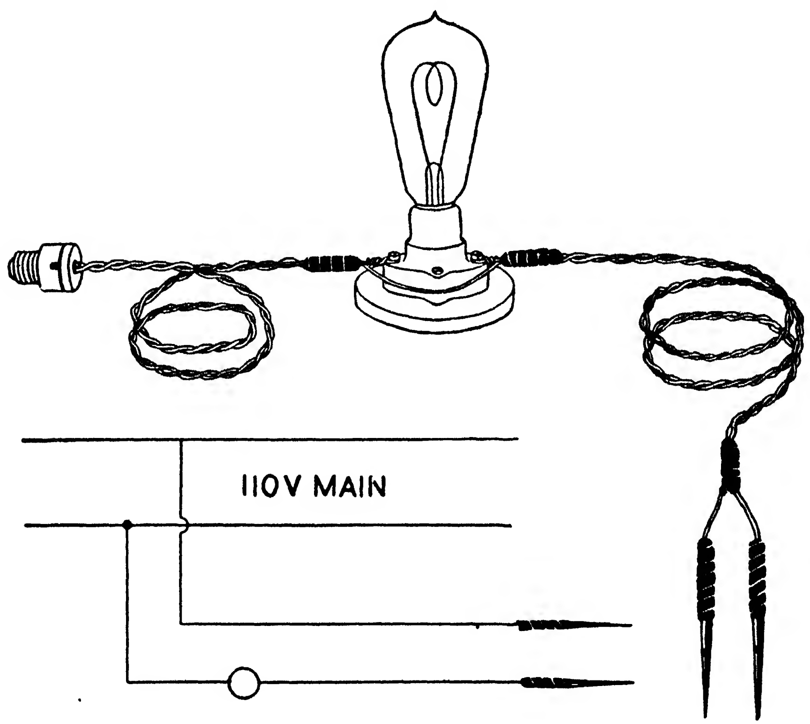


Fig. 1. Handy Testing Set

screw plug. Procure two pieces of brass or steel rod and file or grind them to a long tapering point. These rods should be about 6 inches long and tapering half their length to a sharp point. Connect the other side of the lamp socket to one of these points and connect the second point to the other terminal of the screw plug. Ordinary lamp cord can be used for the connections. For fastening to the test points it should be bared for several inches, wrapped solidly around the metal rods at their blunt ends, and soldered fast in place. The joints should be heavily wrapped with tape or covered with other insulating material to form a handle, as shown in the illustration, Fig. 1. As shown by the diagram forming part of this illustration, it will be seen that the lamp is in series with one of the points, but that when the circuit is closed by bringing the two points together, the lamp is in multiple with the main circuit. The lamp should be of the carbon-filament type owing to its greater durability. As a lamp of this type of 16 c-p. only consumes a little over 50 watts at 110 volts, or approximately half an ampere of current, there is no danger of injuring any of the apparatus on the automobile through its use. Sufficient cord should be allowed on either side of the lamp to permit of connecting it up with the outlet conveniently.

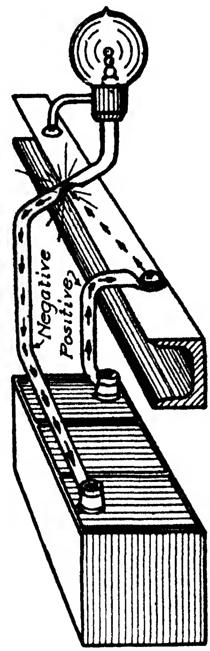


Fig. 2. Diagram of Ground or Short Circuit
Courtesy of Gray and Davis Company

In using this test outfit, the two test points are pressed on places between which no current should pass, and if the lamp lights it indicates that there is a ground between those points. For example, suppose there were a ground between the generator and the switch so that no current reached the latter, the lamp would not light when the test points were placed on terminals 1 and 7 of the diagram, the generator then being in operation. But a little searching along this circuit would soon show where it was grounded, thus making it easy to locate the break or ground. Fig. 2 is a graphic illustration of a ground causing a short circuit, due to worn insulation. Much more satisfactory results can be obtained with a test set of this nature than with either an expensive hand ringing magneto test set, or with a set consisting of a bell or buzzer and a few dry cells. The former is unnecessarily expensive for the purpose while the latter has not sufficient potential to force the current through grounds or breaks that present too great a resistance, whereas the higher voltage of the lamp test set will cause it to give an indication where the battery set would not. With the aid of such a set, every circuit shown on even the most complicated of man who knows how to make accurate tests when hunting trouble in the electrical side of the automobile will find that his services will always be in demand and a study of the following pages on the equipment and methods used for electrical work will be very helpful to all who are interested in the automobile.

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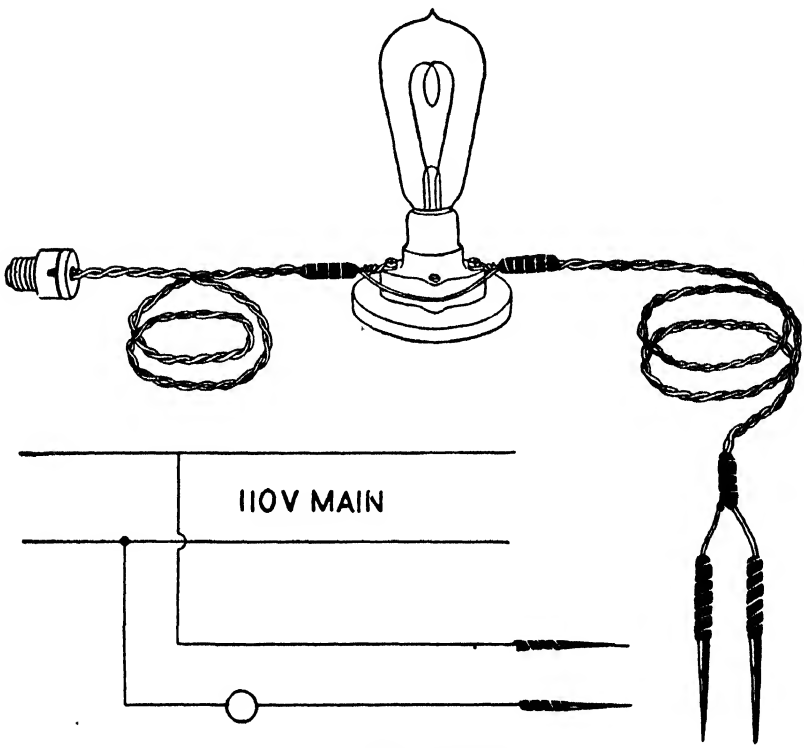

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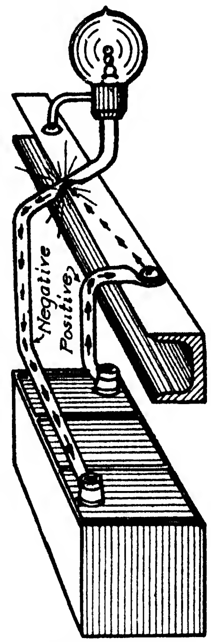

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If preferred, owing to greater convenience, a 6-volt lamp can be used in the socket of the test set and current from the car battery can be utilized for testing. In case the car happens to have either a 12-volt or a 24-volt system, connect lamp terminals to but three of the cells. Should the lamp not light to full incandescence it

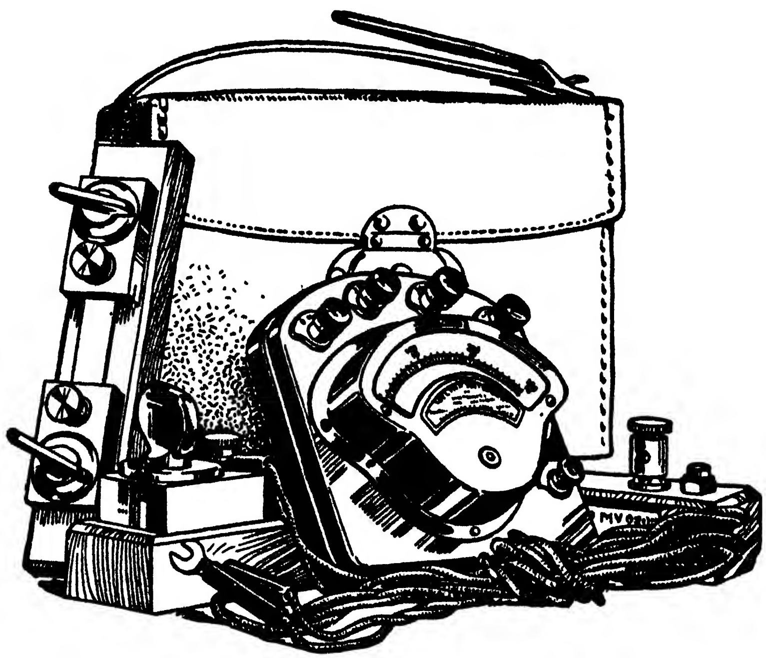


Fig 3 Portable Combination Volt-Ammeter for Testing

will indicate that the battery is weak, and a battery that is in good condition should replace the weak one.

In case the battery does not respond to any of the ordinary methods of treatment given then, it will usually be found preferable to refer it to the nearest service station of the battery manufacturer. This is particularly the case where after refilling with distilled water to the proper level and slowly recharging, the battery does not increase in voltage and specific gravity reading with the hydrometer, as it will need overhauling before it can give good service.

Always Test the Lamp. Whether a standard 110-volt lamp or one of the 6-volt type (for which an adapter may be necessary to fit the standard socket) is used, it is a good precaution always to test the lamp itself before going over the wiring on the car. This will avoid the necessity for blaming things generally after failing to find any circuit at all—after fifteen miutes of trying everything on the car—due to the lamp having a broken filament or one of its connections having loosened up.

Special Testing Instruments. For the garage that claims to be fully equipped to give all necessary attention to the electrical system of the modern car, something more than the simple lamp testing outfit is necessary. Portable volt-ammeters such as shown in Fig. 3 are made specially for this purpose. This is a Weston combination volt-ammeter, the voltmeter being provided with a 0–30, 0–3, and 0 to $\frac{1}{10}$ scales for making voltage tests, together with three shunts having a capacity of 0–300, 0–30, and 0–3 amperes, respectively, which are used in connection with the $\frac{1}{10}$-volt scale for making current measurements. A special set of calibrated leads for use with these shunts is also provided. With the aid of such an outfit, accurate tests can be made covering the condition and performance of every part of a starting-lighting and ignition installation. For example, a starting system may be otherwise in perfect working condition, but its operation causes

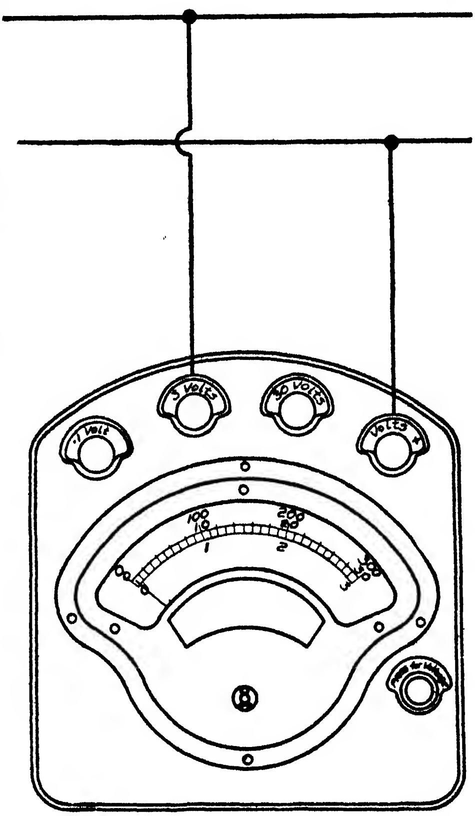


Fig. 4. Diagram Showing 3-Volt Scale Connected across a Circuit

such an excessive demand on the storage battery that the generator is not capable of keeping the latter sufficiently charged. Generator tests, which are described later, having failed to show anything wrong with the dynamo, a test of the starting motor, using the 0–300-ampere shunt of the instrument would doubtless show that an unnecessarily large amount of current was being demanded by the motor for its operation, and indicate a fault in the latter.

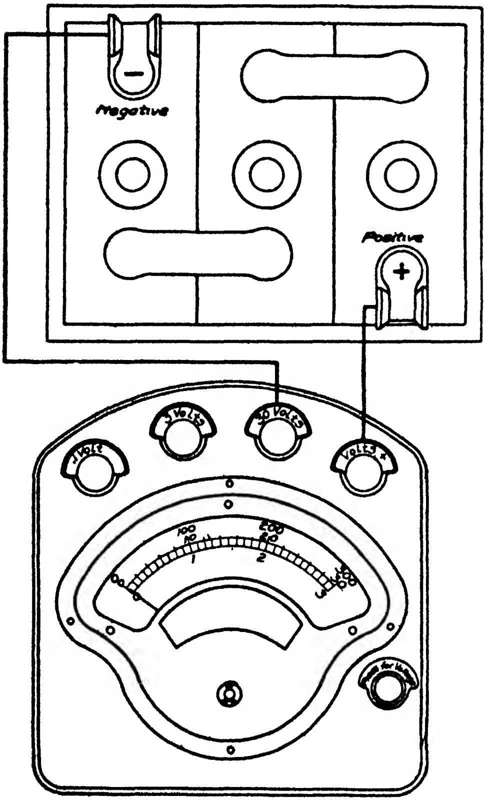


Fig. 5 Diagram Showing 30-Volt Scale Connected across Storage Battery Terminals

Voltage Tests. When the instrument is used as a voltmeter it is necessary to select the proper scale for the circuit, and if there is any doubt it is well to start with the 30-volt scale. For testing individual cells of the storage battery the 3-volt scale would naturally be used, while for testing the entire battery, the 30-volt scale would be the proper one to apply. The proper method of connecting the voltmeter to the circuit is shown by the diagrams, Figs. 4 and 5. It is necessary to connect the positive side of the meter to the positive side of the circuit and the other terminal to the negative. Where the polarity of the circuit is not known, this can be readily determined by a trial reading. If the pointer moves to the right, the connections are properly made; in case it moves to the left, it will be necessary to reverse the connections, which should be done at the circuit terminals and not at the meter, to avoid any accidental short circuits.

Ammeter Readings. When using the ammeter to determine the amount of current consumed by any of the apparatus, such as the starting motor or the lamps, it is necessary to first select the proper shunt. Should the value of the current to be measured be unknown, it is well always to start with the 300-ampere shunt

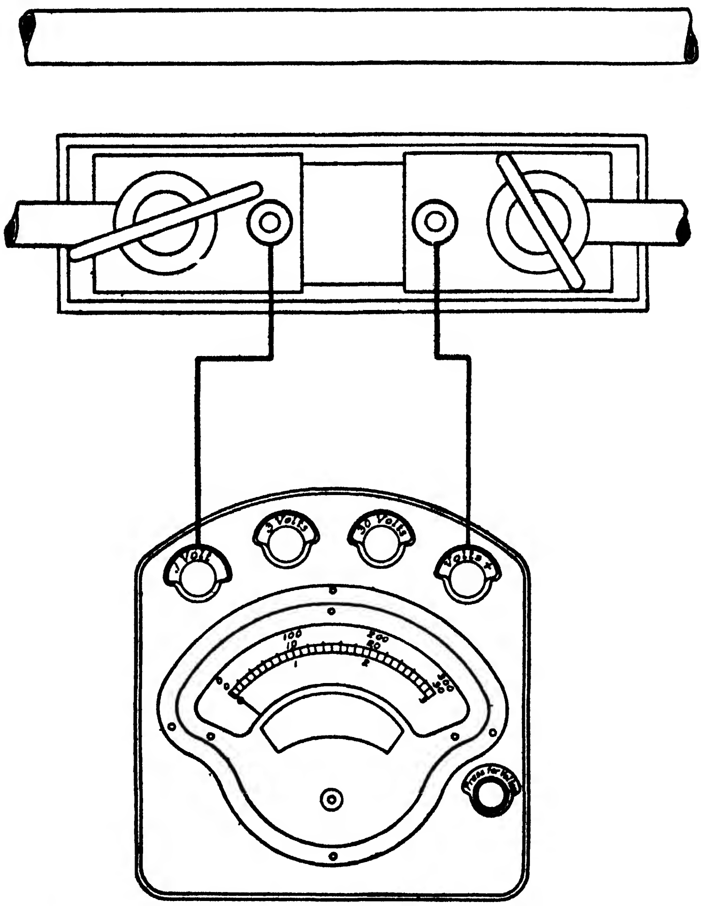


Fig. 6. Diagram Showing Method of Connecting Ammeter to 300-Ampere Shunt

and then insert the 30-ampere shunt in case the reading shows the current to be less than 30 amperes. These shunts are connected in the manner shown by Fig. 6, and as will be plain from this diagram, all shunts are connected in the circuit in a similar manner. The connections always remaining the same, it is only necessary to substitute the different shunts as required by the circuit to be measured. If the polarity be reversed, it is only necessary to shift the connections from the ammeter to the shunt which should be done at the latter, there being no necessity to change the connections of the shunt itself to the circuit.

The 300-ampere shunt must always be used for measuring the starting current, as the latter will rarely have a value of less than 200 amperes when the switch is first closed owing to the necessity of exerting great power at first to overcome the inertia of the gasoline engine, particularly at a low temperature when the lubricating oil has become gummed. Cables of the same size as those employed on the starting-motor circuit of the car should be provided for connecting up the shunt to make the tests. The 30-ampere shunt is employed for measuring the charging current to the battery, while the 3-ampere shunt is used for the individual lighting circuits or for the primary ignition current.

Care should be taken to use instruments of the proper capacity so that no damage will be done to the delicate mechanism of the testing instrument. If an ammeter of 30 ampere capacity is used to test the amperage in a battery of 200 ampere capacity the mechanism inside the instrument will be damaged beyond repair.

Growler Armature Tester. This type of tester is the most efficient, and results are obtained quicker than by other methods. Several makes may be had. In selecting one, be sure that it has sufficient strength to do the work, as some of them are too small or have insufficient saturation to give results.

The principle of the *growler* is the same as that of the transformer, and it operates on alternating current, generally 110 volts. Fig. 7 shows a good design. The two coils *A* form the primary of the transformer; the frame and pole pieces *B*, the magnetic circuit, which is open.

When an armature is placed between the pole pieces, the armature core completes this circuit. The armature conductors form the secondary winding, and if there are no short-circuits in the coils, very little current or voltage is induced in the windings, as in any transformer. Should there be a shorted coil, a heavy current is induced owing to the closed circuit of the short-circuited coil. This sets up a heavy vibration at the slot carrying the shorted coil, which can be felt, or heard, by placing a piece of thin steel or a hack-saw blade over the slot.

Operation. In testing, the armature is slowly revolved in the growler, and each slot is felt with the saw blade, as it comes to the top. If the armature is left on for a few minutes, the short-circuited coil will become hot and will eventually burn out. Commutator shorts due to small particles of copper dragged over the insulation when turning, commonly called "bugs," will be burned off by this heavy induced current. A poorly designed growler will not do this. In testing for an open coil, short-circuit each commutator segment in turn as the armature is revolved; each segment should give a spark owing to the induced current. In case of an open coil, no spark will result. In testing for grounds such as between the commutator and the armature shaft, a grounded winding will cause a spark.

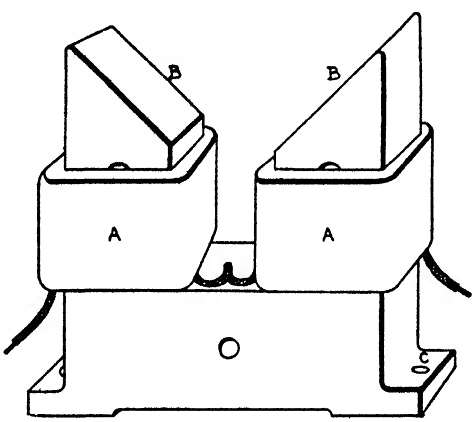


Fig 7 Growler for Testing Armature

Design. The following is an efficient design of growler that may be readily built in the shop, in case it is not desired to buy one:

In Fig. 8 is shown a lamination of the proper shape and size cut from ordinary sheet iron and with three holes drilled for the holding bolts. There should be enough laminations to build up to a thickness of $2\frac{1}{4}$ inches, and the whole assembly should then be bolted together. Although sheet-iron laminations are the most efficient, the lessened efficiency of cast iron makes very little difference, as the growler is only used for a short time and the cast iron does not have time to heat.

To make the cast laminations, a pattern should be cut from $\frac{1}{4}$-inch pine to the shape of Fig. 8. The small lugs at the bottom are for the feet to bolt to the bench. The holes should be drilled after casting. The pattern should have three coats of shellac and should be sandpapered after each coat has been applied. Nine castings are necessary. Smooth up the castings on the sides and stack them together; hold them with clamps, then drill three ¼-inch holes through the whole assembly, as located in Fig. 8; and with the clamp still in place, rivet them together with ¼-inch iron rod. Do not set the rivets too tightly as the iron is likely to crack. Drill two ¼-inch holes in the legs, as at *C*, Fig. 7; these holes can be drilled from the bottom very easily.

The assembled frame can now be smoothed up on the emery wheel, especially the surface of the pole pieces *B*. The coils *A*

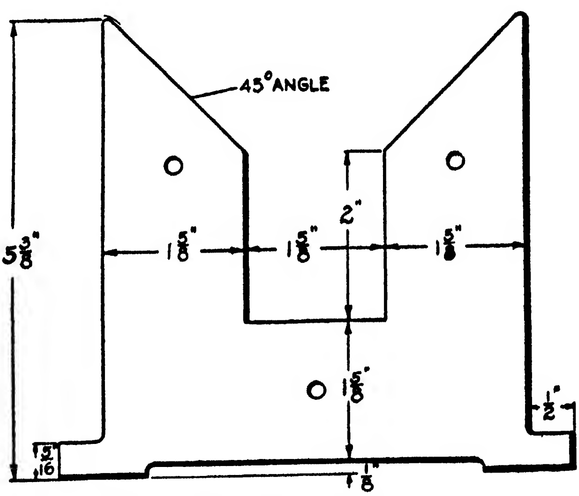


Fig. 8. Construction of Growler Lamination

are wound up on a wooden form, and each coil consists of 175 turns of No. 14 B.& S. gage copper magnet wire, each wound in the same direction. Leads should be brought out, using lamp cord. The coils are taped as shown in the illustration and are well shellacked. The two coils are placed on the frame, with the two inner leads at the same side; these two leads are connected together, and the two outside leads are brought out and connected to a 110-volt alternating-current circuit through a switch. As it is easy to forget to turn off the growler and as it makes no noise when there is no armature on it, it is well to connect a lamp in the circuit, Fig. 9, using a snap switch to turn it off and on.

Undercutting Machine. Most undercutting of commutators is done by hand with an old hack-saw blade and is both slow and unsatisfactory. There are several types of machines for doing this mechanically; some do a smooth job, but others take longer

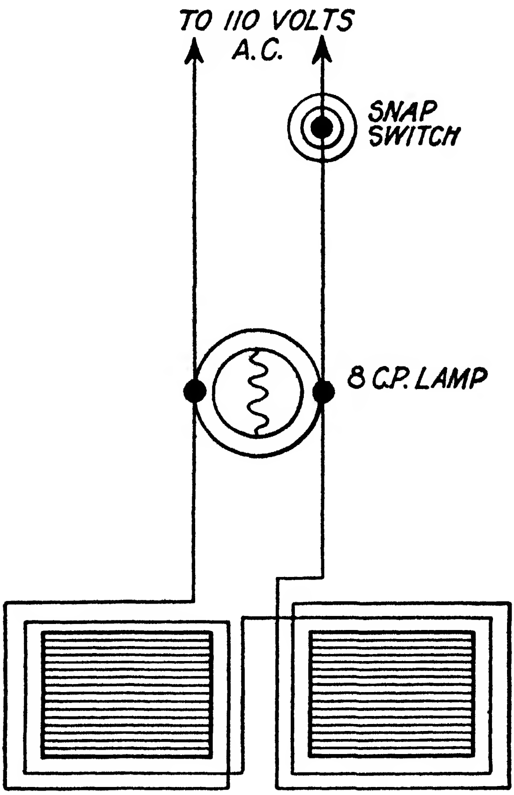


Fig 9 Method of Wiring Growler

and give worse results than the hack-saw blade. The revolving needle gives excellent results and is the quickest of any type. Its adaptability to commutators of various sizes and to different conditions and its quickness in setting up make it very valuable for quick repair and service work.

Its work is clean cut and uniform, with no scratches left on the

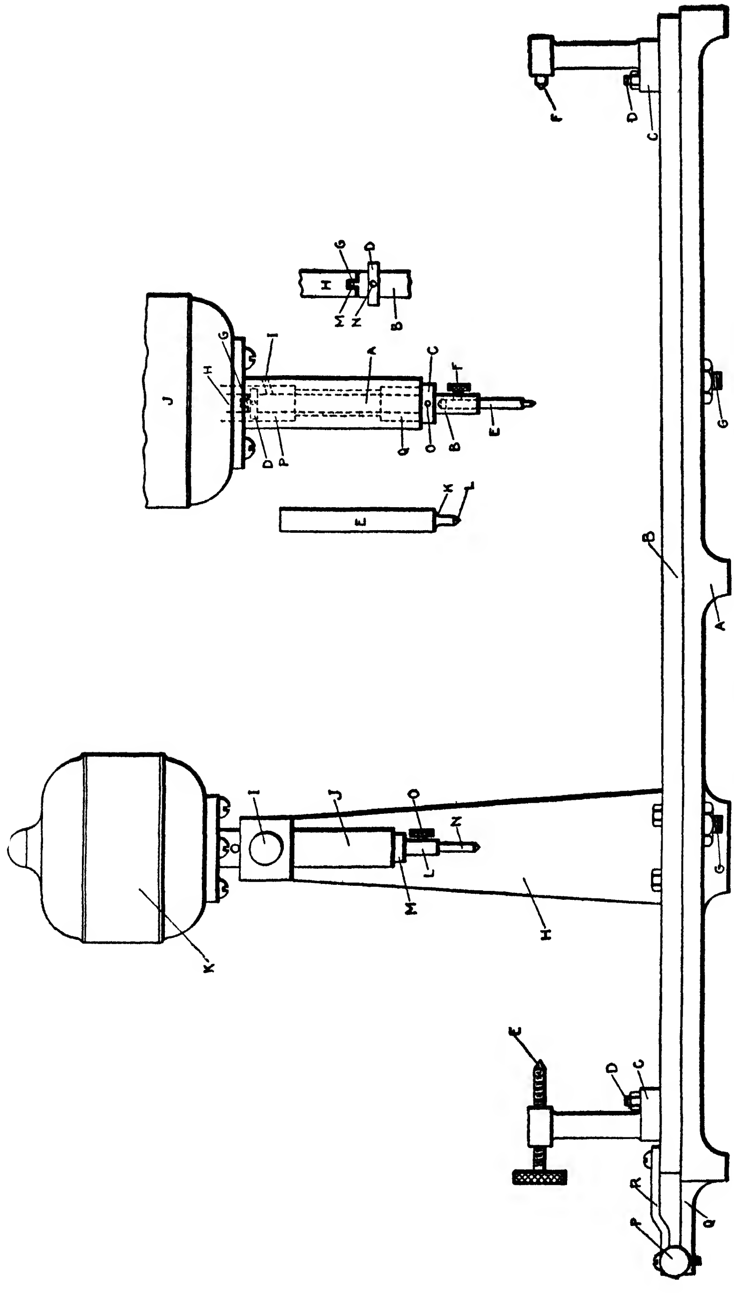


Fig. 10. Machine for Removing Mica from Between the Commutator Segments

commutator. A design for a machine of this type is given for those wishing to make one, as there are but few on the market at present.

Design. In Fig. 10 is given a side view of a motor-driven machine. The base *A* is made of cast iron 24 inches long, 5½ inches wide, and 1½ inches high; sliding on this base is a carriage

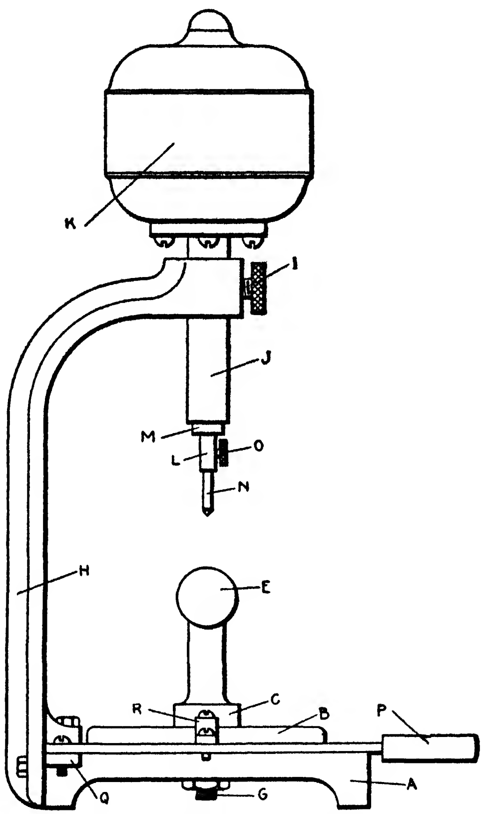


Fig. 11. End View of Mica Undercutting Machine

B, made 3 inches wide and ⅝ inch thick, which slides on rails cut on the base. Mounted on the carriage are two center brackets *C*; these are bolted on with the nut *D*. The center screw *E* is adjustable; the center *F* is solid. The column *H* holds the motor and cutter assembly. The motor *K* should be about a ⅛-horsepower, 110-volt, high-speed universal type, using either alternating-current or direct-current. The motor is mounted on the spindle *J* and is held in adjustment by the set screw *I* on the column. The needle *N* is held in the shaft *L* by the set screw *O*.

The armature is placed between centers, the spindle *J* is adjusted to the proper height, and the carriage is moved back and forth by the handle *P* through the linkage *R*, cutting out the mica to the required depth. Fig. 11 shows an end view. The column *H* is ribbed for strength and is fastened to the base, 8 inches from the end, with four $\frac{5}{16}$-inch standard cap screws, an extra wide leg being cast on the base to support it. The set screw *I* is $\frac{5}{16}$-inch S.A.E. thread and is knurled. The handle operating the carriage is of $\frac{3}{8}$-inch fiber, and the lever is hinged on the bracket *Q*, which is cast on the base. The bracket *Q* is $1\frac{1}{2}$ inches long and has a hole drilled and tapped for 10–32 screws; this bracket should be $\frac{1}{4}$ inch thick and $\frac{3}{4}$ inch wide. The base *A* has two rails cut on its top, the carriage *B* being planed to fit. These rails need not extend more than 6 inches on each end, as a lessened surface will reduce friction of the carriage. A bolt, or stud, is mounted rigid in the carriage, and a nut and washer hold it on; the slot should be slightly larger than the stud. The thread on this stud should be rather tight to prevent loosening, while the washer may be a spring or cupped washer to take up any variation in the machining.

The carriage also has a groove cut $\frac{1}{2}$ inch wide, extending within 6 inches of each end in the center of the casting. This is for the center standards *C* to slide in; by having both centers slide, any armature may be fitted quickly. The standards have a tongue which fits into the groove and is held by a $\frac{7}{16}$-inch carriage bolt with the head turned thin; the squared portion of the bolt prevents turning while adjusting. The rear center is solid in the standard, while the front center is adjustable. The knurled screw *E* should be of $\frac{7}{16}$-inch stock with an S.A.E. thread, both centers having a 60-degree taper.

The needle assembly, Fig. 10, consists of a spindle *A*, on which is mounted the motor *J* screwed to the flange. The shaft *B* is a piece of $\frac{1}{4}$-inch drill rod, which comes perfectly true and smooth. A collar *C* is pinned on with a $\frac{1}{16}$-inch pin *O;* the spindle is bored out to take two bronze bushings *P* and *Q*, which are pressed in and reamed to ¼ inch. An oil hole *I* is drilled to oil the upper bearing, the surplus oil running down the shaft and oiling the lower bearing. The shaft is placed in the spindle and a collar is pinned on at the top *D*. The detail sketch in Fig. 10 shows the end of the shaft, which has a tongue *G* fitting into a slot *M* in the motor shaft *H*, giving a positive, though flexible, drive.

The lower end of the shaft is drilled to take the needle *E*, which is held in by the knurled screw *F*. The needles are made of ⅛-inch drill rod, turned down and having a round shoulder *K* for strength, the lower shank being of various diameters, depending on the width of the slot to be undercut. It is best to make

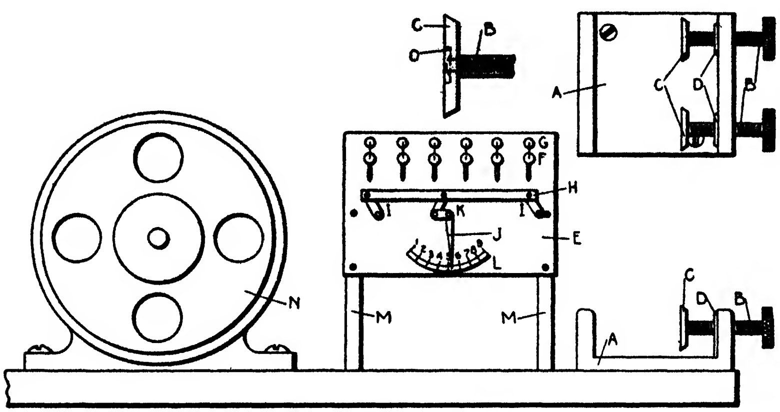


Fig. 12. Magneto Test Stand

about three sizes of shanks. The point or cutting edge should be pointed and ground three sided, being careful to get each side the same and preserving a true center of the point. After the points are shaped, they should be tempered to a dull blue and finished with an oil stone. When the carriage is assembled on the base, place a little fine valve grinding compound and oil on the rails and grind in the surfaces to a smooth finish; this will ensure easy operation. Holes should be drilled in the base *A* and the machine fastened to the bench.

Operation. To undercut an armature, place the armature between the centers, moving the centers so that the commutator will come under the needle, and screw up the adjustable center so that the armature will be fairly tight. Select the size of needle suitable for the width of commutator slot, lower the needle so that it will cut away about $\frac{1}{32}$ inch of mica, hold the armature steady with the slot opposite the needle, and steadily draw the needle into the slot, cutting a smooth groove the full length of the commutator; still holding the armature steady, withdraw the needle and cut the next slot, and so on. A little practice will make a smooth quick job. After all the slots are cut, place the armature in the lathe and take off the slight burrs with No. 00 sandpaper.

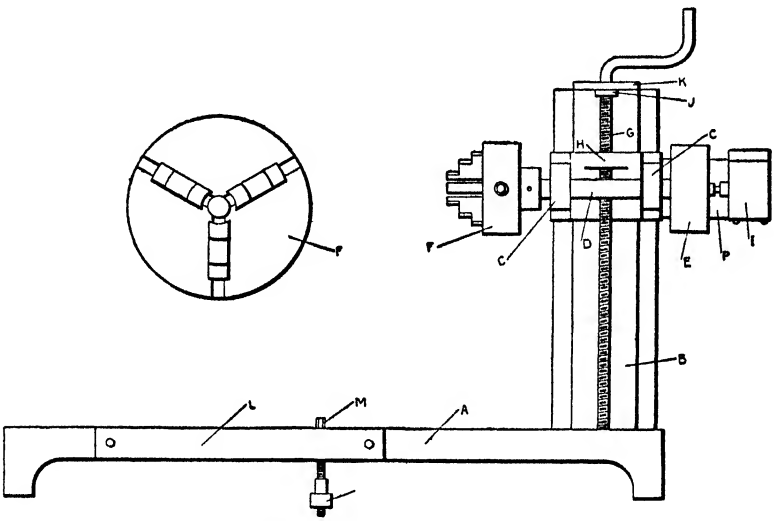


Fig 13. Generator Test Stand

Magneto Test Stand. For testing magnetos, a substantial device that may be quickly set up is necessary. Fig. 12 shows a simple design for such an apparatus. The vise *A* holds the magneto to be tested, clamping it tightly by the two screws *B*. The magneto has a pulley provided with the standard taper, which is 5 degrees, or if a coupling is on the magneto that may be used for a pulley, a $\frac{3}{4}$-inch leather belt connecting this coupling with the motor pulley. The high-tension wires are connected to the adjustable spark gap, and the magneto is then tested. The motor *N* should be a variable-speed, 110-volt, and, if possible, direct-current machine. A starting box is used, taking the return spring from the handle and using it for a regulator. This will not damage the resistance, as it is only on a short time and the load is light.

The magneto vise should have a brass base *A*. The screws are $\frac{3}{8}$-inch S.A.E. thread with a knurled handle, a flat button *C* being riveted to the screw at the countersunk portion *O;* this prevents marring the magneto paint. The boss *D* on the base casting makes the threaded hole stronger. The spark gap is mounted on a fiber base *E*, $4\frac{1}{2}'' \times 6\frac{1}{2}'' \times \frac{1}{4}''$, fastened to the bench by the

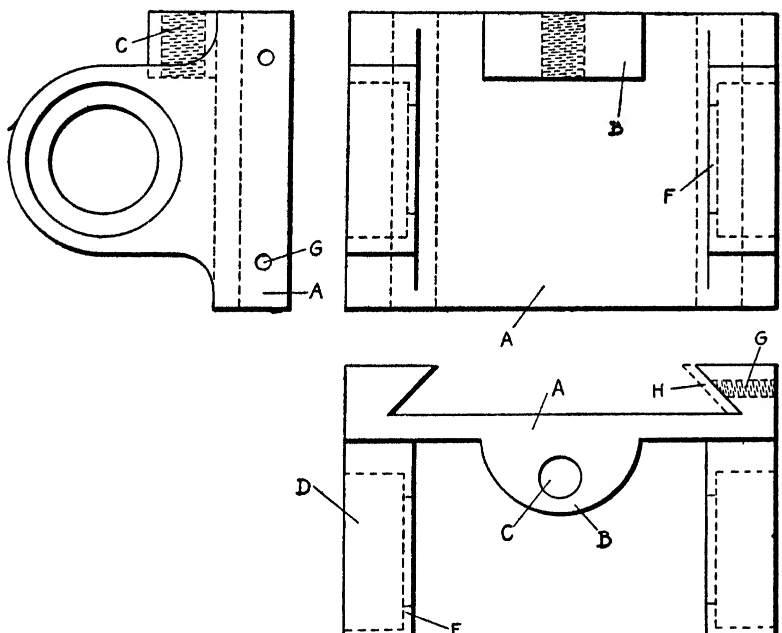


Fig. 14. Carriage of Generator Test Stand

supports *MM*. The binding posts *G* are connected to the gap points *F*, which can be phonograph needles. The adjustable bar *H* is $\frac{1}{4}$ inch square, iron or brass, and swings on the links *II;* the indicator hand *J* moves on the dial *L* and is connected to the bar by the link *K*. These three links are made of $\frac{1}{16}'' \times \frac{1}{4}''$ iron. The link *K* is so made that when the hand rests on *I*, the points *F* should clear the bar $\frac{1}{16}$ inch, and the dial is laid off so that each calibration represents $\frac{1}{16}$ inch; this gives a quick adjustment. The link *I* on the right-hand side should be connected to the support *M*, which, in turn, is grounded to the vise *A*.

Generator Test Stand. To test and regulate generators properly after repairing and before placing on the car, some means must be provided to run the generator at various speeds. Such a test stand must be universal and easily set up. A test stand meeting these requirements is shown in Fig. 13. The baseplate *A* is cast iron, 10″×16″, surfaced on the top. Column *B* is bolted to the baseplate and carries an adjustable head, which holds the driving assembly. The location of the column should be such that the center line of the chuck is in the center of the base. A threaded rod bent into a crank *G* raises and lowers the head; the rod should be $\frac{7}{16}$ inch with an S.A.E. thread. The lower end of the rod is turned with a $\frac{1}{4}$-inch shoulder and fits into a

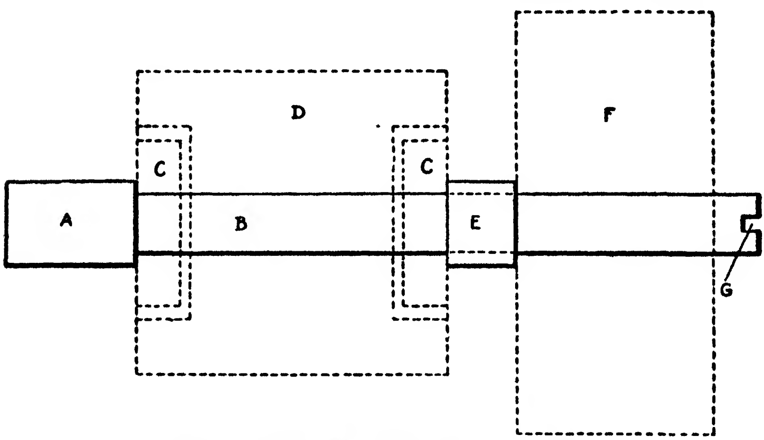


Fig. 15. Pulley Assembly for Generator Test Stand

hole bored in the base; the upper end has a collar *J* pinned on, and the plate *K* takes the thrust in lowering the head.

The head has a 45-degree angle groove cut in the body of the casting, Fig. 14, which fits into a similar tongue cut on the column. One side of the body casting *A* has the groove cut away slightly more to make room for a gib *H* and two adjusting screws *G* to take up the wear in the head. These screws *G* should be 12–24 iron screws and should have lock nuts. The boss *B* is for the adjusting rod and is threaded to receive it. The shaft runs on two annular ball bearings, the head casting being recessed at *D* to a press fit while the shoulder *E* prevents them from working loose. The hole *F* is for the shaft and is slightly larger than the shaft, Fig. 15. *A* is the end that fits into the chuck collar; *B* is turned to a good light press fit in the bearings; the collar *E* is placed between the outer bearing and the pulley *F* and prevents the shaft from working out; the slot *G* is to drive the speed indicator; *CC* are the bearing seats; and *D* is the body casting. Between *A* and *C* and between *E* and *C* are two thin brass plates to keep the dirt out of the bearings.

The chuck *F*, Fig. 13, is a 4-inch, three-jawed, universal type, fastened to a flange and pinned to the shaft *D*. Any chuck will do for this, as being out of true will not make much difference. The speedometer is made from a Corbin-Brown head, and the scale should have an 80 m.p.h. limit. The hand is taken off and a blank glued to the old dial. The instrument is then recalibrated

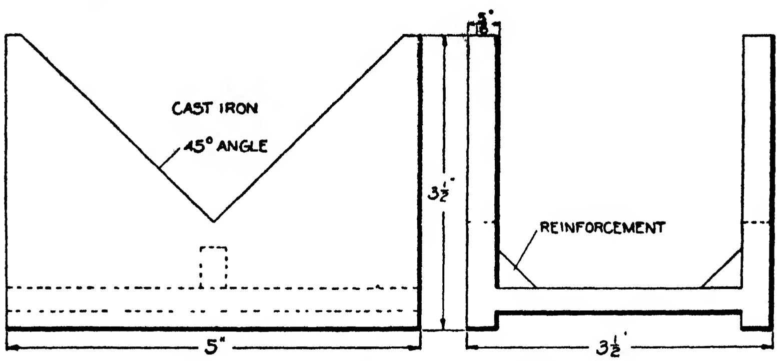


Fig. 16. Mounting Blocks for Generator in Test Stand

with a speed counter to read r.p.m. Having obtained this data on the blank, a neat dial may be drawn and glued on. The speedometer head is held on the carriage by an angle iron made of $\frac{1}{8}'' \times 3''$ iron, the coupling of the head fitting into the slot *G*, Fig. 15. Take care to line up the head so that the coupling will be free at all positions of the shaft. Having the speedometer always operative saves time in testing. The pulley *E*, Fig. 13, should be about 4 inches in diameter and with a 2-inch face, while the motor pulley *A* should be 6 inches.

The generators are held in the stand by a motorcycle chain attached to the screw *M*, Fig. 13, and hooked onto a stud. It is tightened by the hand nut *N*, this screw sliding in a slanting guide *L*; this guide is about 8 inches long and allows for different sizes of generators. There are three studs to which the chain may be hooked. Holes are drilled in the base to fasten the generator to the bench. Square generators line themselves when placed in the stand, while round-type generators are placed in a V-shaped casting, Fig. 16. This is a simple casting requiring no machine work, the bottom edges being filed so that it will set flat on the baseplate.

Generator Test Bench. Fig. 17 shows a test bench that can be made for testing generators. The bench consists of a generator stand; a direct-current or an alternating-current motor, according to the power available; a 6- and 12-volt cut-out; switches of the 10-ampere double and single pole, single- and double throw type; 15-volt meter; and ammeter to read 30-0-30 of the direct-current type. A pair of test points to work from a 110-volt line, a red lamp in series to test the armature and field windings, with binding posts and lamp and socket to light the bench, complete the equipment. Fig. 17a shows the front of the board with the instruments in place, and the back of the board with the proper connections for the different units on the test stand. If there is a cut-out on the machine being tested, the cut-outs on the board are not required and the cut-out switch may be closed. The switch can be opened for the use of the cut-outs, if desired, by using the right-hand switch for either 6- or 12-volt generators.

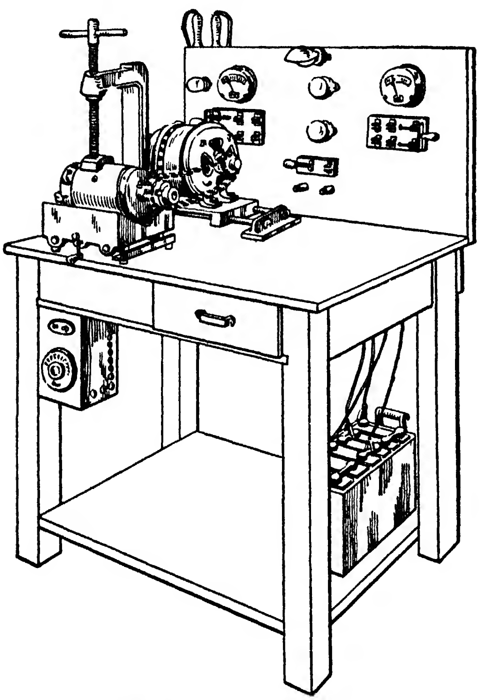


Fig. 17 Electrical Test Bench
Courtesy of Motor Age

The stand can be used to test the generator as a motor by simply opening the cut-out shorting switch so that the generator can take current from a battery that is used in conjunction with the test stand. The output of the generator can be tested, also,

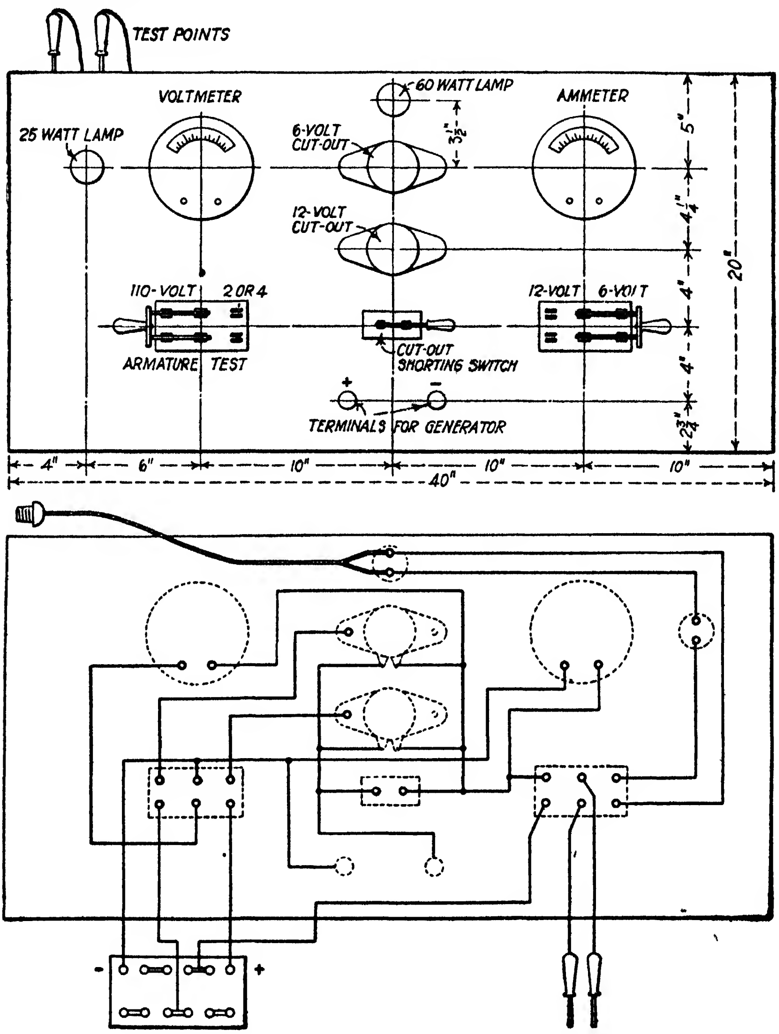


Fig. 17a. Front and Back View of Electrical Test Bench
Courtesy of Motor Age

by driving it with the motor and throwing the desired cut-out into the circuit, and the ammeter will show the current output while the voltmeter will show the voltage of the battery.

The test points can be used on the 110-volt line by placing the left-hand switch in the left position, or used for low voltage test by placing in the right hand position. These test points are handy for carrying out armature and field winding tests as stated. When the switch is at the right hand position the points are connected to the battery.

Ignition Switchboard. For quickness in operation, the single break must be connected so that any type of coil can be tested without using separate ballast coils or leads. This is accomplished by having everything on one switch, as shown in Fig. 18. The

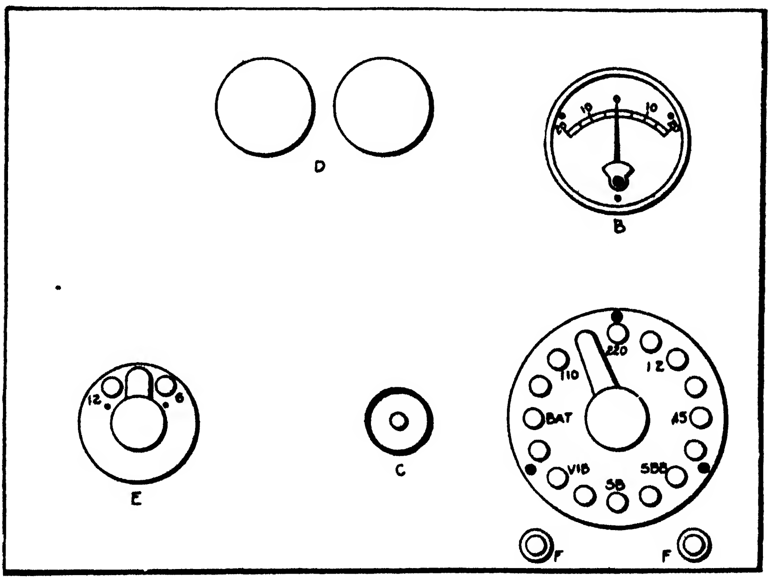


Fig 18 Ignition Switchboard

switch *A* has eight combinations: 220 volts in series with two 110-volt lamps *D* mounted in sign receptacles so that the lamps project through the board; 110 volts in series with one lamp; a battery contact which gives either 6 or 12 volts, depending on the position of the switch *E*. This switching of the battery current allows either voltage to be used on any of the other switch points. There is also a master vibrator; a single-break tester operated by the handle *C;* the same single break with a 0.45-ohm ballast coil in series; a 0.45-ohm ballast coil; and a 1.2-ohm ballast coil. An ammeter *B* shows the current used.

In Fig. 19 is shown the wiring for the board. The switch *A* is connected to the various units and has the three ballast coils mounted directly on it. The single break *C* has a condenser *I*

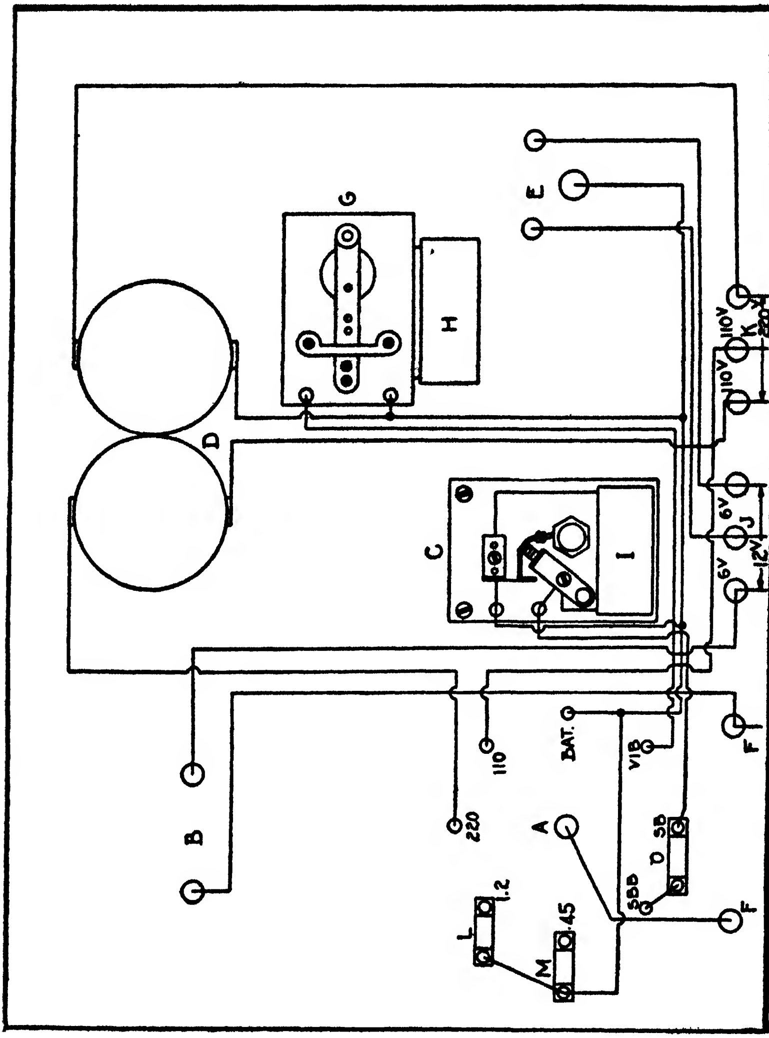


Fig. 19. Reverse Side of Fig. 18 Showing Wiring of Ignition Switchboard

connected across the points; the master vibrator *G* also has a condenser *H* across the points. The terminal posts *J* connect to the battery and the terminals *K* to the 110- and 220-volt line. The posts *F* are the test leads and should have test clips attached to flexible cables. The whole board may be of wood and enclosed in a box frame, the front swinging on hinges.

The construction of the switch is shown in Fig. 20. The base *A* is made of ½-inch red fiber, mounted on a mandrel and turned in the lathe to a true circle. It is then placed in the chuck without the mandrel and the two sides faced off; sixteen 12–24 right-hand brass screws are then screwed into the base, Fig. 18. The base is again chucked and the heads are

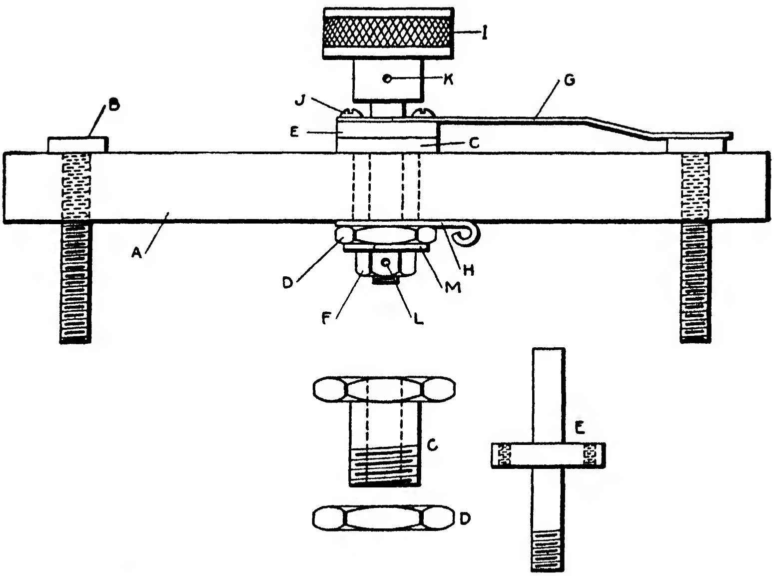


Fig. 20. Construction of Combination Switch for Ignition Test Board

turned off to $\frac{1}{16}$ inch thick. These screws should be 2 inches long so as to extend through the switchboard. Every other screw is cut off flush on the back, as there is a dead point between each two contacts to prevent short-circuits in switching from one point to another.

A center sleeve is made for the switch shaft to rotate in. This is made from a ⅜-inch S.A.E. cap screw with the head and nut *C* and *D* turned thin and a ¼-inch hole drilled in it to receive the shaft *E*. The sleeve *C* is fastened in the base with a terminal clip *H* under the nut *D;* this is for the center connection. The shaft *E* has a blade of phosphor bronze *G* screwed to the flange with two 4–36 screws *J;* the shaft itself is held by the nut *F,* under which is a washer *M;* a pin through at *L* prevents the nut from working loose. A fiber handle *I,* pinned on at *K,* completes the switch.

Bearing Puller. There are several bearing pullers on the market, but they are not adaptable to every kind of job and are weak when it comes to a real hard pull. A practical puller is shown in Fig. 21. The base *A* is of cast iron, having a front vertical standard *J* and a boss *B* cast to receive the screw *C.* This screw is $\frac{3}{4}$ inch with a standard thread. A good snug fit

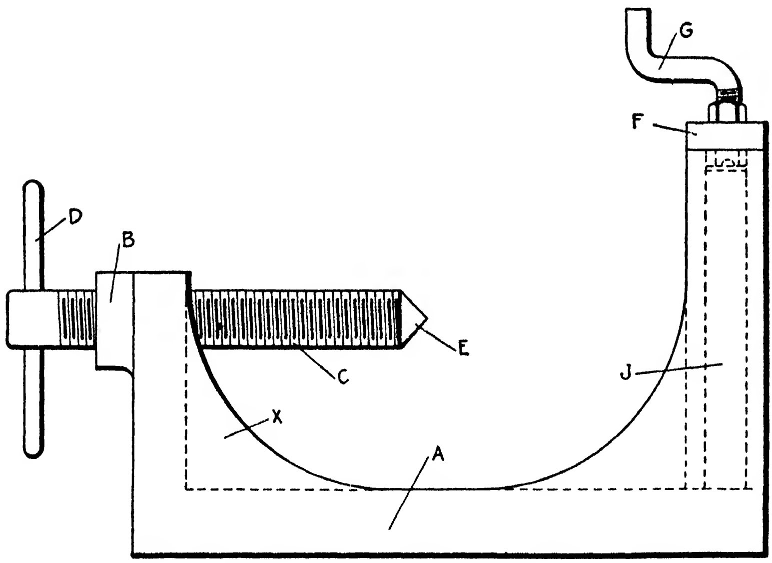


Fig 21. Bearing Puller Side View

should be made, as wear will eventually cause it to become slightly loose; the crossbar *D* is used in turning the screw. The plate *F* on the front standard is held on by two $\frac{3}{8}$-inch cap screws and carries the clamp screw *G,* which holds the jaws together. The ribs are placed on each end to strengthen the base, and four holes are drilled in the base to bolt it to the bench. Fig. 22 shows the sliding jaws *H* and *I* which fit into a slot in the end standard *J;* the slot is cut from top to bottom. The top plate *F* carries the clamp screw *G* which is $\frac{3}{8}$ inch with an S.A.E. thread; the lower end has a groove turned in it. This plate fits on the screw *G* and is held on the sliding block *H* by two 8–32 screws. The block is counter bored to allow the end of the screw to turn free; this device is to raise the block in changing jaws.

The sliding blocks are shown in Fig. 23; these blocks are cut away, as shown, to receive the jaws, which are held by the two small pins *M*. In recessing the blocks, place them in the lathe

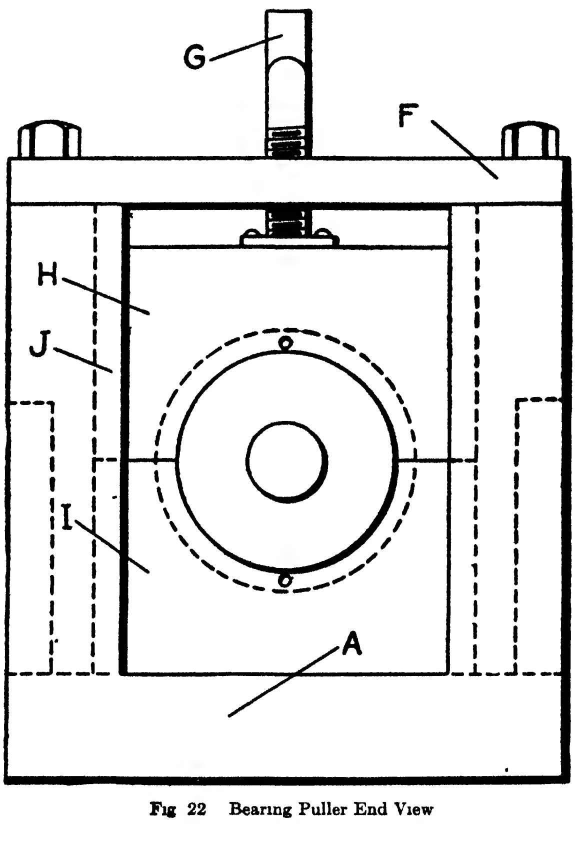


Fig 22 Bearing Puller End View

with a piece of ⅛-inch metal between them at *W;* this will make it possible to tighten the jaws in place. The jaws used to grip the bearing are shown in Fig. 24 and should be made of steel, either tool or cold rolled, and case hardened. They are made of round stock of the proper outside size, cut off in lengths, faced off, bored out at *P*, and turned round in the chuck with the shoulder *R*. The jaw face at *Q* is bored and rounded to fit the face of the bearing. The jaws are made for several sizes of bearings, a different set of jaws being made for each, such as 12-millimeter, 15-millimeter, 17-millimeter, etc. The only change in any of these jaws is the size of the face *Q*. Make the jaws for the largest bearing first and then make up the rest the same, with the exception of the face *Q*. After the jaws are machined, the holes *O* are

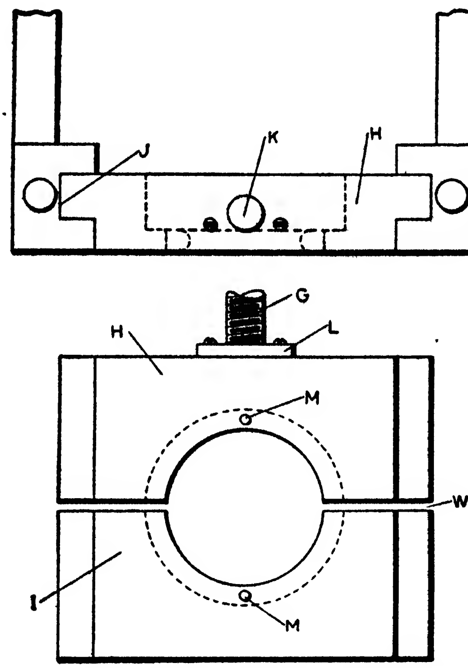


Fig. 23. Assembly of Bearing Puller Clamps

drilled and the finished ring is cut in half as at *S;* this can be done in a milling machine or with a hack saw.

As the push rods used in pulling the bearings turn and burr the work, an end piece or point is made, Fig. 25. This end piece *E* is made of tool steel and hardened. The screw *C* is drilled as at *T*, and a ball-bearing *U* is placed in the hole the end piece rests on. This ball takes the thrust, allowing the end piece to turn. As the screw cannot be used against the work, the push rods shown in Fig. 26 are used. These are madè of ⅜-inch cold-rolled steel with different shaped ends; *A* is used for general work,

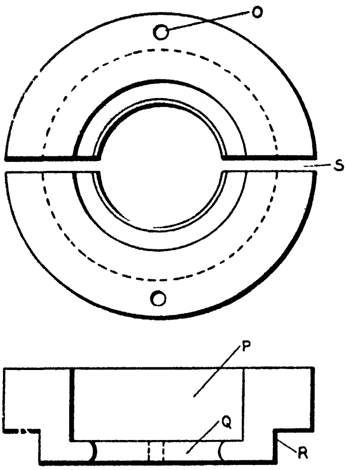


Fig 24 Bearing Puller Clamps

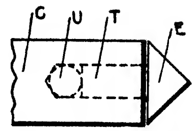


Fig 25. Free Center

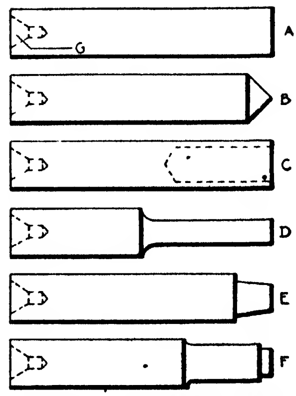


Fig. 26. Push Rods for Testing Generators

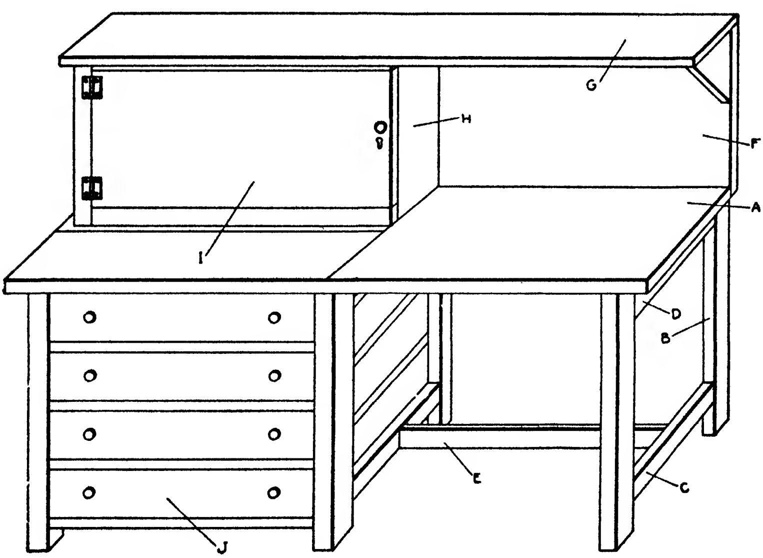


Fig. 27. Handy Electrical Work Bench

B for shafts with centers, *C* is hollow and fits over magneto drive shafts to protect the threads, *D* is for small bearings, *E* is for Bosch breaker end bearings and *F* is for Eisemann breaker end bearings. Various other shaped rods may be made to meet requirements. These rods should all be case hardened. In using the puller, the bearing is placed in the proper sized jaws and screwed down with the clamp screw, the proper rod being used to push off the bearing.

Work Bench. To work with neatness and precision a neat and handy one-man bench is required. It helps create the right atmosphere as a dirty and disorderly shop is sure to produce poor

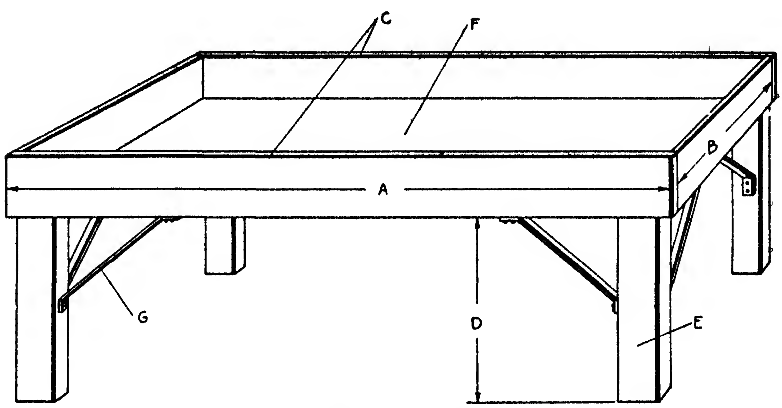


Fig 28 Wash Rack for Cleaning Generator Parts

workmanship. Where the benches are separate, no workman is crowded, and the tendency to keep the shop clean is greater. A very convenient bench of this type is shown in Fig. 27. This is made of dressed pine, the top being of 2″×12″ planks two wide; the legs *B* and the crosspieces *C* and *D* are 2″×4″ with the top of the bench 32 inches from the floor. A crosspiece *E* is placed for a foot rest, the other half of the bench being used for the drawers *J*. The bench has a back *F*, 18 inches high with a shelf *G* of 8-inch board. To the left is a tool cupboard with a locking door *I*. On the board back *F* are hung the tools that are used most. The portion of the bench used for work should be covered with 28-gage sheet steel. The gas furnace can be placed at the extreme left. The test switches and lights can be placed at *H* on

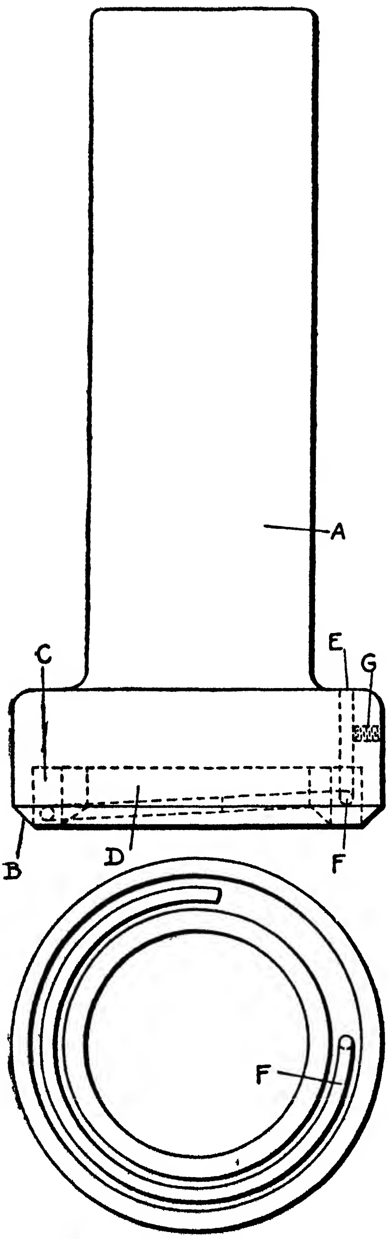


Fig. 29. Gasket Punch

the end of the cupboard, the wires being run inside the cupboard. These benches may be used singly or built double with a right and left unit to fit between a window.

Wash Rack. A serviceable wash rack is shown in Fig. 28. This is placed wherever convenient and a pail is set under it to catch the drip. The sides *C* and the bottom are made of 1-inch pine; the legs *E* are 2″×4″. The iron brackets *G* support the legs, which may be any desired height. The length *A* should be 3 feet, and the width *B*, 18 inches; if made too large the rack collects trash. The inside is lined with 28-gage galvanized iron with a drain hole at *F*. Some shops put casters on this rack and move it from bench to bench.

Small Tools. As the gaskets used in insulating magneto bearings are sometimes hard to get, a punch to make them is shown in Fig. 29. The handle of the punch *A* may be made of tool steel or of soft steel with a steel cutter. A groove is cut at *C* to form an edge *B*, while the center is turned out at *D*, leaving two cutting edges to form the gasket. By relieving the cutting edges on the outside, it makes a clean-cut gasket. In order to get the finished gaskets out of the punch, an extractor is placed in the slot.

The hole *E* is drilled, and a wire circle *F* is placed in the hole and is held by the set screw *G;* this wire is bent so that it will force the gasket out as soon as the pressure is taken from the punch. There are several sizes of these gaskets, such as insulation

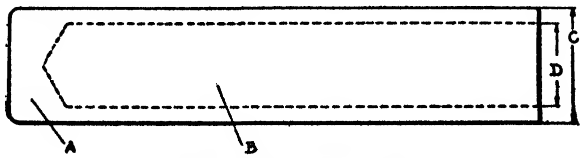


Fig 30. Cone Bearing Drift

for 12-, 15-, and 17-millimeter bearing cups, and shims for the same sizes, the 15-millimeter being used the most.

Cup Drift. In Fig. 30 is shown a drift for driving on cone bearings. The body *A* is made of cold-rolled steel of the size needed for the drift. It is drilled out at *B* to the desired size; the dimensions *C* and *D* should be to fit 15-millimeter and 17-millimeter bearings. As these are very handy tools around the shop, a variety of sizes should be made.

Bearing Cup Puller. As it is very hard to get a bearing cup out of an end plate, such a puller as shown in Fig. 31 is quick and efficient. The body *A* is made of cold-rolled steel, the lower end being shaped to a sharp angle and slotted so that it will

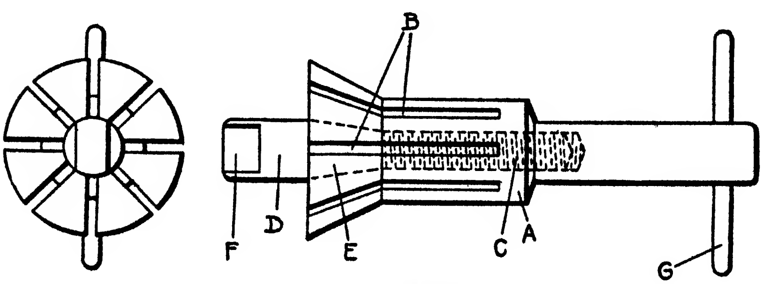


Fig 31 Cone Puller

expand. These slots *B* may be milled or cut with a hack saw. A $\frac{7}{16}$-inch hole *C* is drilled and threaded with an S.A.E. thread, and a taper bolt *D* is screwed into the hole. This screw has a taper *E* which expands the body of the puller, a flattened portion

F being made for a wrench. A T handle is placed in the shank at *G*, and the whole tool is case hardened. In using this puller, the screw is backed out and the sharp angle points placed back of the cup. The screw is then turned up tight and the whole assembly struck sharply on the bench, striking the screw, when the cup will be forced out without damaging the cup or the end plate.

ELECTRICAL REPAIRS

PART II

Ohm's Law. Where new wires have to be installed in electrical repairs, a thorough knowledge of the relation existing between current, pressure, and resistance is of great benefit to the repair man, especially when armature winding enters into the repair work. Certain sizes of wires have a known resistance to the flow of current. Therefore, to get the desired result, we must have a correct size wire to get a certain pressure with a certain quantity of flow.

In 1827, a scientist named Ohm discovered that a certain definite relation existed between electrical current, pressure, and resistance. He arranged these relations into a law, called Ohm's Law, which forms the basis for most of the electrical measurements of steady currents. The law is stated as follows: *The strength of a current equals the pressure divided by the resistance.*

The three units of electrical measurement are: Amperes—rate of flow; volts—pressure causing current to flow; ohm—resistance to flow. In making calculations symbols are used instead of the terms. Amperes are represented by the letter I, volts by the letter E, and ohms by the letter R, which denotes the resistance in the circuit. If any two of these quantities or units are known, the third can be found. The formulas for these calculations are as follows:

$$\text{Amperes} = \frac{\text{volts}}{\text{ohms}} \text{ or } \frac{E}{R}$$

$$\text{Ohms} = \frac{\text{volts}}{\text{amperes}} \text{ or } \frac{E}{I}$$

$$\text{Volts} = \text{ohms} \times \text{amperes or } R \times I$$

The following are examples of the calculations: A circuit has a 50-volt pressure with a resistance of 5 ohms in the circuit. How many amperes will flow in the circuit?

$$I = \frac{E}{R} \text{ or } \frac{50}{5} = 10$$

To find the number of ohms, proceed as follows:

$$R=\frac{E}{I} \text{ or } \frac{50}{10}=5$$

To find the number of volts:

$$E=R\times I \text{ or } 5\times 10=50$$

These same units are used to find the power of an electrical machine. The unit of power is the *watt.* One horsepower is equivalent to 746 watts. The formula for this calculation is as follows:

$$P=\frac{I\times E}{746} \text{ or } \frac{\text{amperes}\times\text{volts}}{746}$$

Substituting from the above calculation we have power $=\frac{50\times 10}{746}$ or $\frac{500}{746}$, which is a little more than ½ horsepower.

Take another example: A starting motor takes 250 amperes at a pressure of 6 volts. What is the horsepower developed by the motor?

$P=\frac{250\times 6}{746}=2$ plus, which is the horsepower developed by the starting motor.

Wiring. *Necessity for High-Tension Cables.* In early days much trouble was experienced with poorly insulated and poorly mounted wires. This was particularly the case with the secondary circuits, the insulation of which was frequently inadequate to carry currents at the high potentials employed, so that there was more or less leakage. This was further aggravated by the chafing, or rubbing, of these wires against moving parts. The former trouble was eliminated by the adoption of specially constructed cables which are tested to carry 30,000 volts. Cables of this type are illustrated in Fig. 32, which also shows the cables employed for electric lighting and starting installations, where the chief difficulty has usually been the selection of a cable of too small a carrying capacity for the current used.

The importance of using heavily insulated cables for both the primary and secondary cables of the ignition, and more particularly the latter, has come to be generally understood, and cables especially designed for this service have now been in use for a number of years; but the importance of using wiring of ample capacity, in the lighting and starting circuits, is not so well appreciated. In the former instance, the problem was one of insulation only, the amount necessary to prevent leakage of the secondary current not being fully realized in the early days; nor was the necessity for thoroughly protecting the primary cables from the effects of oil and water taken into account. Trouble from these sources, however, have long since been a matter of the past; even the well-insulated cables now in general

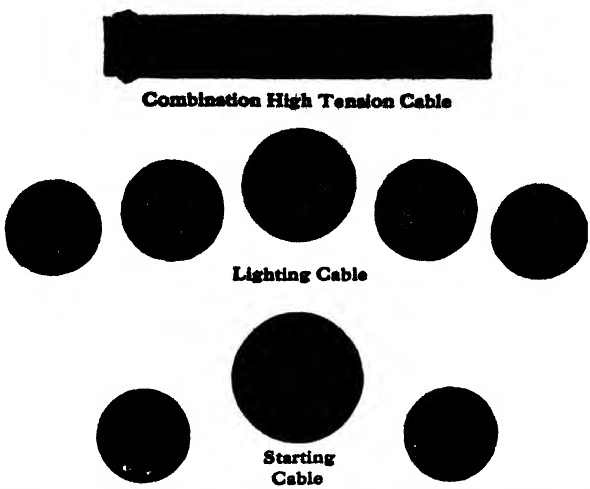


Fig. 32. Types of Cables Employed in Electrical Equipment of Automobiles

use become oil soaked in time, but, when faulty ignition is thought to be due to them, they are promptly replaced.

In many of the early electric starting and lighting systems, the wiring has been as poorly adapted to the purpose as was that of the pioneer ignition systems. This was not on account of improper insulation but owing rather to poor design or to a lack of consideration of the importance that proper wiring has on the efficient operation of the system. No electrical system of this kind is any better than its storage battery; and, as the amount of energy that can be husbanded in the latter is limited, every effort must be made to avoid waste in its use. What constitutes waste in a standard lighting system using current at 110 to 115 volts, and what may be so termed where the available potential is only 6 volts, are two very different things. A voltage drop of one to 5 volts in an incandescent lighting system is negligible. A drop of 5 volts below the 110-volt standard will cause a perceptible dimming of the lamps, but the life of the lamp filaments themselves will be greatly increased, other factors remaining the same, so that the loss in efficiency is not of such great moment.

Importance of Voltage Drop. But, in an electric starting and lighting system, the loss of even a fraction of a volt due to the wiring represents a substantial falling off in the power. As mentioned in the introductory, the unit of potential, or voltage, times the unit of current flow, or ampere, equals the watt or power unit, and there are 746 watts in an electrical horsepower. Take the case of an electric-starting motor with an unusually long connection between the battery and the electric motor. Assuming that the length and diameter of this wire is such that there is a loss of *1 volt* between the battery and the motor and that, at the moment of starting, 300 amperes are required to *break away* the engine, i.e., free the pistons and bearings when the lubricating oil has thickened from the cold so as to bind them. In the actual power consumed, this voltage drop represents 300×1, or 300 watts, equivalent to more than $\frac{3}{7}$ horsepower.

The loss of but $\frac{1}{2}$ volt, other factors remaining the same, is equivalent to almost $\frac{1}{6}$ horsepower, or about what a strong man can exert for a limited time. This appears to be getting things down pretty fine, but in the case of the Dyneto system, the manufacturers specify that the cable between the starting motor and the storage battery must be large enough to transmit *400 amperes with a total loss not to exceed $\frac{1}{4}$ volt.* With this amount of current, the voltage drop in question represents 100 watts, or nearly $\frac{1}{7}$ horsepower. Of course, this loss only takes place at the instant of starting, but that is just the time when the highest efficiency and the full power of the battery is required. Moreover, the starting motor frequently has to be operated a number of times, especially in cold weather when the battery efficiency is at its lowest, before the engine will start. Even at the lower-current values necessary for turning the engine over after it has been broken away, a drop of one volt represents an appreciable power loss, as the current consumed is anywhere from 50 to 100 amperes. It will be apparent from this why the manufacturers lay such emphasis on their instructions not to lengthen connections, if avoidable,

TABLE I
American Wire Gage (B. & S.)

No.	Diameter in Mils	Diameter in Mm.	Circular Mils	Ohms per 1000 Ft.	No.	Diameter in Mils	Diameter in Mm.	Circular Mils	Ohms per 1000 Ft.
0000	460 00	11.684	211600.0	.051	19	35.89	.912	1288.0	8.617
000	409.64	10 405	167805.0	.064	20	31.96	.812	1021.5	10.566
00	364.80	9.266	133079.4	.081	21	28.46	.723	810.1	13.323
0	324.95	8.254	105592.5	.102	22	25.35	.644	642.7	16.799
1	289.30	7.348	83694.2	.129	23	22.57	.573	509.5	21.185
2	257.63	6.544	66373.0	.163	24	20.10	.511	404.0	26.713
3	229.42	5 827	52634.0	.205	25	17.90	.455	320.4	33.684
4	204.31	5.189	41742.0	.259	26	15.94	.405	254.0	42.477
5	181.94	4.621	33102.0	.326	27	14.19	.361	201.5	53.563
6	162.02	4.115	26250.5	.411	28	12.64	.321	159.8	67.542
7	144.28	3.665	20816.0	.519	29	11.26	.286	126.7	85.170
8	128.49	3.264	16509.0	.654	30	10.03	.255	100.5	107.391
9	114.43	2.907	13094.0	.824	31	8.93	.277	79.7	135.402
10	101.89	2.588	10381.0	1.040	32	7.95	.202	63.2	170.765
11	90 74	2.305	8234.0	1.311	33	7.08	.108	50.1	215.312
12	80.81	2.053	6529.9	1.653	34	6.30	.160	39.7	271.583
13	71.96	1.828	5178.4	2.084	35	5.61	.143	31.5	342.433
14	64.08	1.628	4106.8	2.628	36	5.00	.127	25.0	431.712
15	57.07	1.450	3256 7	3.314	37	4.45	.113	19.8	544.287
16	50.82	1.291	2582.9	4.179	38	3.96	.101	15.7	686.511
17	45.26	1.150	2048.2	5.269	39	3.53	.090	12.5	865.046
18	40.30	1.024	1624.1	6.645	40	3.14	.080	9.9	1091.865

TABLE II
Carrying Capacity of Wires

B. & S. Gage	Circular Mils	Rubber Insulation Amperes	Other Insulation Amperes
18	1,624	3	5
16	2,583	6	8
14	4,107	12	16
12	6,530	17	23
10	10,380	24	32
8	16,510	33	46
6	26,250	46	65
5	33,100	54	77
4	41,740	65	92
3	52,630	76	110
2	66,370	90	131
1	83,690	107	156
0	105,500	127	185
00	133,100	150	220
000	167,800	177	262
0000	211,600	210	312

and then only to use wire of the same size and kind. This, of course, does not apply to the starting motor connection, as that should never be lengthened without increasing the diameter of the wire to compensate for the increase in length.

Calculating Size of Cable. It is not advisable to do so where it can possibly be avoided, but, when made necessary by the fitting of an enclosed body, the following formula should be used for calculating the size of cable that should be employed:

$$\frac{\text{Maximum current} \times 10.7 \times \text{number of feet of wire}}{.25} = \text{diameter or cross-section of wire in circular mils}$$

For example, in the case cited above, where the maximum current at the instant of starting is 300 amperes and the distance between the battery and the starting motor is four feet (measured from battery to switch and from the latter to the starting-motor terminal), the size of wire necessary would be:

$$\frac{300 \times 10.7 \times 4}{.25} = 51{,}360 \text{ circular mils}$$

As shown in the table on page 37, which gives the corresponding sizes of the B & S gage, the nearest to this is No. 3 wire of 52,634 circular mils cross-section, but, to allow for a factor of safety, either a No. 2 or a No. 1 wire would be used for such an installation. Now, in case it becomes necessary to take the battery from the running board close to the engine and place it under the floor of an enclosed body, increasing the length of wire needed to 8 feet, the cross-section of the wire required would be 102,720 circular mils, the closest gage number to this being the No. 0 cable. In other words, doubling the length of the cable would make it necessary to double its cross-section in order to prevent exceeding the minimum permissible drop in the voltage. This will make plain why some of the amateur experiments in re-locating the essentials of an electric starting system have had such disastrous effects on its efficiency.

Effect on Lights. In the case of the lamps, the effect of an increased drop in the voltage is not so serious; though, because of the very low-battery voltage available, what would otherwise be a negligible loss assumes important proportions. On the 3-cell 6-volt battery now so generally used, the lamp filaments are designed to burn to full brightness on a potential of 6 to 8 volts, this variation being provided to compensate for the difference in the battery voltage when fully charged and when partly discharged, as the voltage of the battery decreases as it discharges, dropping to but 1.50 volts per cell when practically exhausted, or a total of 4½ volts. Even if receiving this full voltage, the 6-volt bulbs would burn very dimly, but there must be deducted from it the voltage drop due to the wiring and the switches. This is the reason why the brightness of the lamps (with the generator idle) affords such an excellent indication of the state of charge of the battery.

It will be apparent from the above that a drop in potential of but one volt in the lighting circuit would cause a serious loss of efficiency at the bulbs. Assuming that the headlights consume 4 to 5 amperes, and applying the above formula on the basis of a maximum distance of 10 feet from the battery, it is found that a No. 16 wire is necessary; but, in order to provide a large factor of safety, nothing smaller than No. 14 wire is ordinarily employed for the lighting circuits, and, in some cases, it is No. 12.

Importance of Good Connections. Under the head of "Resistance", however, attention has been called to the fact that not alone the length and size of the connecting wires, but also all switches and joints are factors in calculating the total resistance of a circuit. Consequently, it is poor practice ever to make a joint in a wire where a single length may be employed. Whenever a wire is broken by accident, the trouble should always be remedied by replacing it with an entirely new piece rather than by making a joint in the old wire. Loose connections also add greatly to the total resistance in a circuit, as well as connections in which the contact faces of the terminals are dirty or corroded. In replacing or tightening connections, care should be taken to see that the parts in contact are scraped or filed bright and that both the terminal nut and its lock nut are screwed down firmly. The switches are also an important factor where voltage drop is concerned and switch blades or contacts that are dirty or corroded, or that are not held firmly in contact when closed, will be responsible for an appreciable drop in the voltage that will become increasingly perceptible as the battery becomes discharged.

Some Ignition Cable Pointers. At the beginning of the automotive industry, but little attention was paid to high-tension spark-plug wires. Today, however, automotive engineers are giving this subject more serious consideration, realizing the importance of this unit in the proper operation of the internal-combustion motor. As these wires are required to carry a voltage ranging from 6000 to 18,000 volts, it will be necessary to insulate them thoroughly. The material to be used should be a compound which has high dielectric characteristics. The reason for this is that continual satisfactory operation of the ignition depends upon the quality of this material.

Installations Used. Three general installations are used in automobile work: (1) open wiring between distributor and spark plugs, the wires being supported by brackets or running free; (2) wiring in fiber or other insulating conduits; and (3) wiring in grounded metal conduit.

Installation No. 1 can be successfully used on those motors where the distance between the distributor and the spark plugs is short and thus the wires will be prevented from striking the motor or other metal and injuring their insulation.

The disadvantages of this installation, however, are lack of mechanical protection and a development of electrostatic surface capacity when insulated brackets are used. If the wires are run through holes in brackets larger than the wires, the insulation will be chafed and weakened. On the other hand, if the wires are clamped in position, the thickness of the insulation will be lessened because of compression.

Installation No. 2 offers mechanical protection, but it has the great disadvantage of allowing the electrostatic charge to attain a high pressure before discharging to the ground.

Installation No. 3 can be used advantageously on the majority of four- and six-cylinder motors. This method also offers mechanical protection of the wires and greatly reduces the strength of the electrostatic charge, but this type of assembly is likely to cause more trouble because of the poor insulation of the porous cables. Invisible pores may be present in the insulation and allow the current to discharge through these pores into the conduit or ground, thereby weakening the current at the plug if a spark occurs in that unit. This installation also offers another advantage as cross fire is practically eliminated. The current lost through poor insulation will go to the ground and not take a path through another porous lead into the wrong combustion chamber.

High-tension wire failures are generally due to one of the following causes: mechanical stress, heat, chemical action, dielectric stress.

Mechanical Stress. A conductor of sufficient strength to withstand ordinary handling and vibration and possessing sufficient flexibility is secured by using copper stranded wire with an insulating material whose base is rubber. Of course, injuries resulting from handling high-tension wires should be taken into consideration. Wires should be guarded to secure proper protection. Faults to be avoided in eliminating unnecessary mechanical stresses are unsupported wires, tight wires, sharp bends, sharp edges, tightly clamped brackets, or brackets with holes too large.

Heat. There is a wide variation of heat under the automobile hood, and while these temperatures are seldom high enough to endanger the rubber insulation, they are well above those conducive to its normal life. When the motor is in operation, the temperature seldom exceeds 175° F., but this temperature may rise to about 200° F. for a short period after the motor is stopped. Oxidation is also greatly increased by the additional heat.

Chemical Action. Gasoline is a very destructive agent when in contact with rubber, although this action is not long, as the vaporization is so rapid. Oil, however, does not evaporate so readily and when once in contact, continues to act on the rubber, greatly weakening its insulating strength.

Dielectric Stress. The voltage of the high-tension current passing through these leads has a wide range, depending upon the width of the spark gap and the pressure in the cylinder at the time the spark occurs. Various tests indicate the voltage to be between 6000 and 18,000. The dielectric stress is generally sufficient to cause a brush discharge on the surface of the insulating wall of the high-tension lead at points where this lead comes in close proximity to grounded metal parts. This is especially true when wires are contained in a grounded metal conduit. This brush discharge or corona produces ozone and oxide of nitrogen, and these gases are very detrimental to the insulation. For instance, the gases will start cracks on the surface, generally near the bend in the cable.

Exhaustive investigations have shown that this cracking in the insulation is a phenomenon requiring the combination of several factors, namely, mechanical stress, electrification, and the presence of air. It is well known that ozone actively attacks rubber, and when the rubber is under mechanical stress, the products of reaction are pulled apart, forming small cracks which, when started, rapidly increase in size until the insulation is open to the cable.

Plain and Braided Cables. Braided covers over the insulation simply conceal this cracking; they do not prevent it. Braided covering also absorbs oil, thus producing an undesirable action as previously stated. The proper conductor must be of sufficient strength to prevent its breaking under ordinary conditions, and the insulation must be sufficiently durable to withstand mechanical, thermal, dielectric, and chemical conditions. Insulation will gradually fail as the porosity of the wall increases. This porosity may increase to a point where it will interfere with proper spark-plug functioning and even then the defect will not be visible.

Plain and braided cables formerly were extensively used, but a larger per cent of assemblies are now being equipped with plain cables. Braided cables are generally used where it is necessary to provide additional protection against mechanical injury; also in a few cases when the temperature is somewhat above 225° F., in which case the insulation softens and the cable is in danger of being seriously damaged at its pointed support. With the foregoing exceptions, plain cables have distinct advantages over braided cables for the reason that more insulation can be provided with a given diameter, thus ensuring a larger factor of safety in dielectric strength. Then again, plain cables have an electrostatic capacity, smooth finish, and high surface insulation.

Make-up of Cables. The size of the conductor cannot be computed on its carrying capacity. With a magneto system, the current will not exceed 0.4 ampere and with the battery systems it is probably never in excess of 0.1. These high values are sometimes reached when compression is low and the width of the spark-plug gap is small. It is true that a very small wire would carry this current, but it is necessary to use a larger wire on account of insufficient mechanical strength in the smaller wire. High tension cables such as Kerite have a large number of these qualities.

Ford Magneto. The Ford magneto consists of a stationary spider on which are placed sixteen coils of flat copper ribbon, each coil wound in the opposite direction to the next and the whole assembly connected in series, thus making the coils alternately north and south poles. One end of this coil circuit is grounded

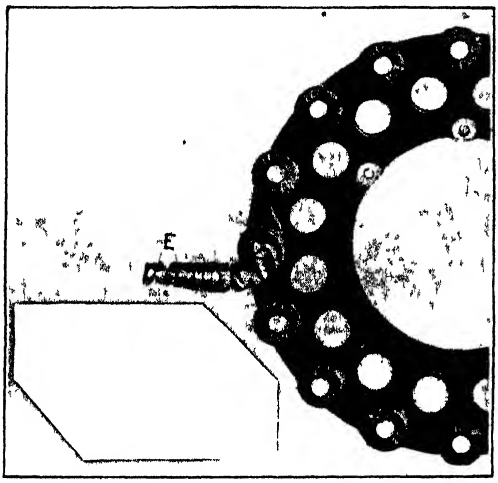


Fig 33 Copper Ribbon Coils of Ford Magneto

through a copper rivet in the spider, and the other end is soldered to a terminal block at the top of the spider. The current is carried out through a terminal post on the flywheel cover by means of a pointed spring attached to the post and bearing on the terminal block.

The magnetic field is produced by sixteen magnets fastened to the rim of the flywheel. The magnets are placed with their north poles together and their south poles together. Over each pole thus formed is placed a flat iron pole piece. The magneto is assembled with a $\frac{1}{32}$-inch clearance between the magnets and coils, and this clearance is adjusted by means of metal shims. Fig. 33 shows the coils.

Capacity. As this magneto has no commutator the current produced is alternating, with sixteen reversals per revolution. The voltage produced is from 6 to 30, depending upon the load and the speed. The ignition requires 1 ampere and the headlights about 3; as this magneto was designed to take care of this load only, an increased load on the magneto is inadvisable. Numerous devices have been made to charge a battery from this magneto, but the majority of these devices are unsatisfactory owing to an insufficient current capacity to offset the rectifying losses.

Testing. Through use, the current is decreased either by weak magnets or by partial grounds in the coils. In making a test with an alternating voltmeter, the voltage is taken with the engine running at a car speed of about 25 miles per hour. With the ignition only as a load, the voltmeter should show about 20 volts when the magneto is up to strength.

Recharging. When the magnets become weak, it is necessary to recharge or replace them. They may be recharged without removing them from the car, with the flywheel off but with the magnets still attached, or with the magnets removed from the flywheel; new magnets may be used.

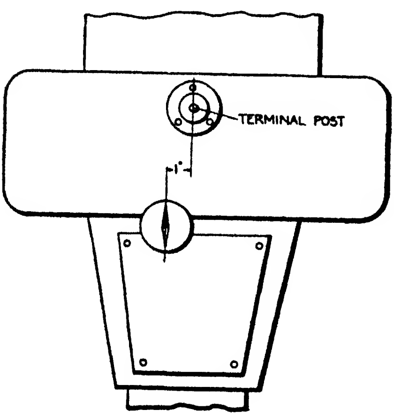


Fig 34. Position of Compass

Recharging in Car. Recharging in the car is done by sending a current through the coils, causing each coil to become a separate magnet charger, charging each magnet which is placed opposite to it. As it takes direct current to charge a magnet properly, there must be a direct current supply. Two 6-volt starting batteries may be satisfactory to use, the connections being made between the batteries and the magneto with No. 6 wire. In order to saturate the magnets, 40 amperes should flow through the coils. Since about 1917 the resistance of the Ford magneto coils has been 0.25 ohm. Applying 12 volts to the coil from two storage batteries connected in series will allow 48 amperes to flow through the coils.

Before the current is applied to the magneto, the flywheel must be set in proper relation to the coils. This is done by putting a compass over the flywheel, Fig. 34. Take out the forward floor boards; disconnect all wires from the terminal post; place the compass slightly back and 1 inch to the left of the post; raise the left-hand side of the hood so that the compass will be in sight while cranking. Then crank the engine slowly until the compass needle points with the north to the front of the car. It is well to shake the compass a little after it is pointing straight to be sure of a correct reading. Now place the positive battery wire with the clip on the terminal post, and then touch the large nut on the exhaust pipe several times with the lead. Do not hold the contact more than a second as it may burn off a connection on the inside of the magneto because of the heavy flow of current.

The first application of the current charges the magnets, but several applications give the owner, who may be a spectator, the assurance of a job well done. Remove the charging wires and replace the ignition wire on the terminal post, then connect the test instrument and note the rise in strength. In some cases it will be found that the magneto is weaker or entirely dead; this may be due to any one of four causes:

Poor setting of magnets with compass
Reverse setting
Polarity of charging current reversed
Magneto coil connections reversed

The first condition is caused by the needle of the compass sticking, thus giving a false reading; therefore, reset and charge again. If it fails to come up, reverse the setting; that is, set with the south pole up instead of the north pole as in the original setting.

The second condition is generally caused by the compass needle becoming reversed; therefore, recharge the compass needle correctly on the magnet charger, and be sure that the dark end of the needle points north. To correct this second condition, reverse the setting of the magneto as before described and again charge.

To remedy the third condition, test the polarity of the charging wires; if it is reversed, change back and charge again, first reversing the setting.

The fourth condition is caused by the coils being connected in the opposite direction at the factory. The remedy is to reverse the setting and again charge.

In some cases the magnetism has practically disappeared; then the only remedy is to charge in any position and continue the charging process until a polarity is found.

Recharging on Flywheel. In recharging without removing from the flywheel, it is handy to use a small 6-volt charger having Ford charging pole pieces. Find the north pole of the charger and mark it with chalk; then find the north pole of the magnets and mark; place the north pole of the charger to the south pole of the first magnet and apply the current for one second. Skip the next magnet, as that is of opposite polarity; go around the wheel

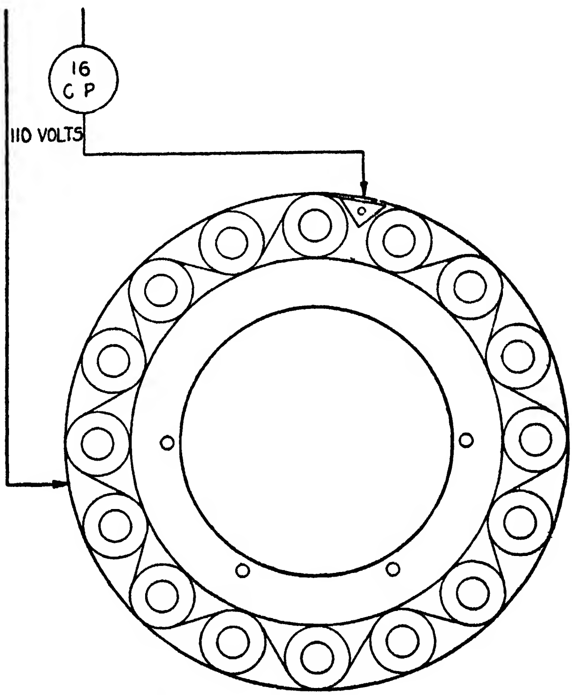


Fig. 35. Testing Coils for Grounds

and charge the seven other magnets of the same polarity as the first magnet. Now reverse the wires on the charger, and charge the remaining magnets in like manner.

Recharging out of Car. If the magnets are removed from the flywheel, the first operation is to sort out the right- and left-hand magnets and place them in separate piles. Start with one pile and charge it to its proper polarity and again pile separately or place on the flywheel in alternate sequence. Charge the other pile in the reverse direction; that is, simply turn the magnet over when charging, thus charging the magnet in the opposite direction; replace on the flywheel in the remaining spaces.

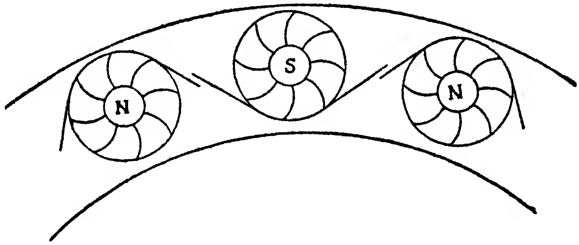


Fig. 36. Winding of Old-Style Coils

Repairing Magneto Coils. The coils on the spider after a time become grounded by fine particles of metal and carbon in the

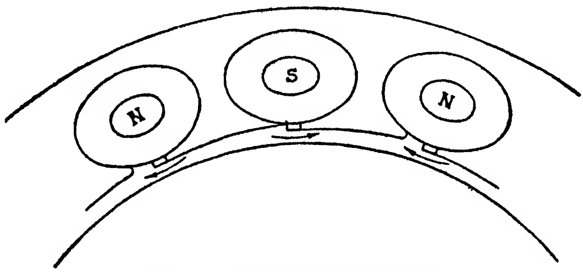


Fig. 37. Winding of New-Style Coils

oil which work through the coil insulation and ground a portion of the magneto. Where a magneto fails to come up on charge, it is

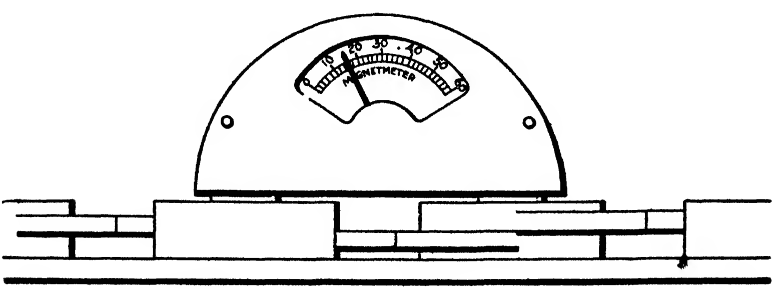


Fig. 38. Testing for Shorted Coils

generally owing to this cause, and while washing out the crankcase rarely remedies the trouble, still it helps to prevent further trouble.

The spider must be removed and the grounded portion reinsulated. The coils are tested by applying 110 volts with a lamp in series as in Fig. 35, first unsoldering the ground connection. If the lamp lights, a ground is present; slight grounds will cause a white smoke at the point of trouble but heavy grounds will not. By applying about 12 volts from a battery to the grounded coil, the ground will generally show up. If this fails, unsolder in the middle and test each half, when the ground may soon be found. The grounded coil should be forced off by using two screw drivers as levers.

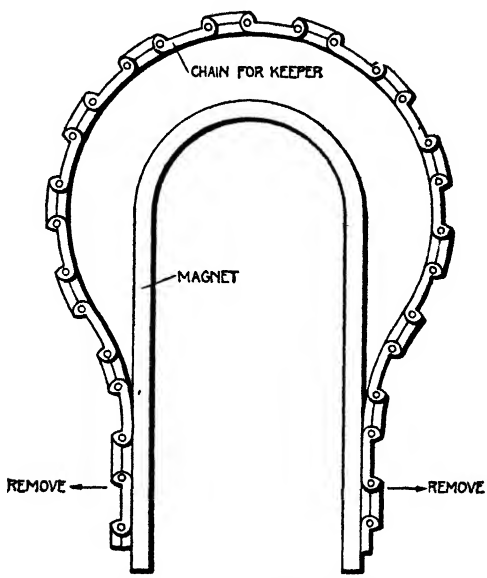


Fig 39 Flexible Magnet Keeper

The old tape should be cut off and new tape put on, using cotton tape $\frac{3}{4}$ inch wide, wound with a lap of half the width of the tape; more than this will be too thick.

Where the fiber end pieces are broken, be sure to cut new ones from $\frac{1}{32}$-inch fiber. After taping, shellac well. In replacing the coils, connect each coil so that the polarity of adjoining coils will be opposite, the old style being shown in Fig. 36 and the new style in Fig. 37. After all the grounds are cleared and a final test is made, the ground connection may be replaced on the spider. A 6-volt battery current should now be applied to the whole assembly and each coil tested with a compass for polarity, thus proving that each pole is of opposite polarity to the poles on either side of it. This is very important.

To be sure that there are no shorted coils, the 6-volt current should be left on and each coil tested with the magnetmeter as in Fig. 38. The coil is now finished and should be given one more coat of shellac.

Testing and Charging Magnets. The permanent magnets used in magnetos are generally made of tungsten or chrome steel. Tungsten magnets were in extensive use until the cost of this metal became so great during the World War that it was necessary to develop a less expensive material. A few prominent manufacturers are having excellent results with properly treated chrome steel, and as it is less expensive, it is considered the ideal magnet material.

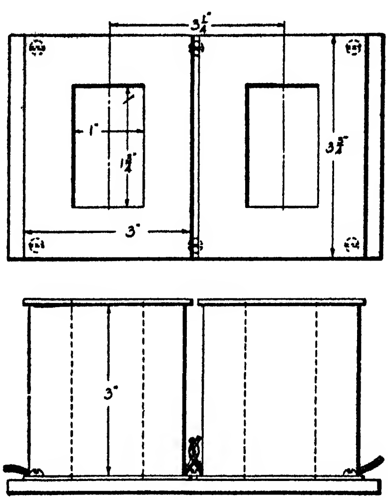


Fig. 40. Construction of Magnet Recharger

Keeper. A keeper must be used when the magnet is removed from the magneto or when the armature is removed from the field. A careful test has shown that a magnet will lose about thirty per cent of its strength if a keeper is not used while removing the magnet from the charger to its proper position on the magneto, or vice versa; the magnet was again removed and replaced without a keeper, with an additional loss of two or three per cent. The magnet was then allowed to stand on a shelf for three or four days without a keeper; on testing it was found to have lost an additional five or ten per cent. The same magnet was charged, a keeper being installed before removing the magnet from the charger, and it was then tested for strength. After the magnet had stood for six months, a test showed the strength to be the same as on the first day.

From the foregoing it will be noted that thirty per cent—the greatest amount of lost strength—was lost at the instant the magnet was removed, either from the charger or from the magneto without a keeper. There are a number of testers on the market, but several of them are of little use as the first loss occurs before the tester can be placed in operation. The aforementioned test was made by measuring the voltage between the brushes of a direct-current constant-speed generator, the magnets to be tested forming the field of the generator. Any loss in magnet strength would cause a lower voltage reading.

A prominent manufacturer recommends that a keeper be constructed from an old silent chain. After annealing, the chain is put over the magnet, Fig. 39, in such a way that the magnet can be placed in position before it is necessary to remove the keeper.

Testing. There are several ways of testing a magnet, such as with a compass, by the scale method, or by a voltage test as above described. When a compass is used, it is placed on a table with the needle at rest and pointing north; the magnet to be tested is placed in a line at right angles to the needle and about 3 feet from it and the deflection noted. This method is inaccurate as the deflection does not vary much from weak to strong, and it takes too much time.

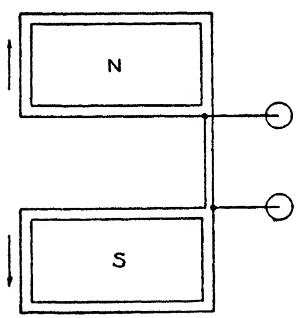


Fig. 41. Wiring Magnet Charger

The scale method is not entirely satisfactory as there is a loss during the test. The magnet has a keeper; this keeper is pulled away until it leaves the magnet and the pull in pounds noted.

Charger. In charging a magnet it is necessary to saturate it in order that it will retain the maximum charge. This can best be done with a charger having a heavy field and a short magnetic circuit with sufficient cross-section of iron to keep down the reluctance. It has been found by experience that to obtain the strongest magnet, there must be a short magnetic circuit. Therefore, if the magnet projects into the coils as in a solenoid, the magnetic circuit has been reduced to the length of the magnet plus the keeper on the bottom. If we have, in addition, a core in each coil 3 inches long, 6 inches of length have been added to the magnetic circuit, and the result is poor saturation.

A satisfactory magnet charger may be obtained at a low price in any voltage from 6 to 220, or one may be made as follows:

Two brass spools are made, Fig. 40, with a hollow center $1'' \times 1\frac{3}{4}'' \times 3''$, to which are soldered the end pieces. To operate on 6 volts, these spools are wound full of No. 14 magnet wire, with the coils wound in opposite directions, Fig. 41, and the two coils connected in multiple. If 110 volts is used, wind with No. 22 wire and connect in series.

Charging. In charging, the magnet is held above and at right angles to the charger and the current applied for a second, when the magnet will swing to the position it should occupy in the charger to receive a proper charge. Place the magnet in the coils, apply current for one second and the magnet is charged; any longer application is a waste of current and time.

If a keeper be placed on a magnet and pulled toward the top of the magnet, most of the magnetism will vanish because of the distortion of the magnetic lines of the circuit.

Testing Magneto Armatures. It is an easy matter to make a test of the strength of secondary current in magneto armatures and such a test will always give an indication as to the condition of the windings on the armature. To satisfactorily make this test it is

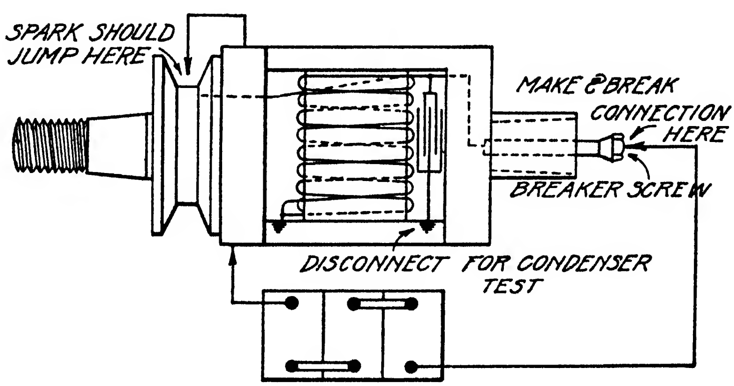


Fig 42 Testing Secondary Spark

necessary to remove the magneto armature from the magneto and remove the breaker mechanism from the armature. After the breaker mechanism has been removed, replace the long screw which holds the breaker mechanism in place back in the end of the armature, as shown in Fig. 42.

Next take a piece of high tension wire and attach it to the magneto frame and bend it around so that it is about one-quarter inch from the brass part of the collector ring. Take a six-volt battery and connect a piece of wire to each terminal. Hold the negative wire to the armature frame and then make and break a contact on the end of the long breaker screw in the end of the armature with the wire which is attached to the positive side of the battery. This induces a current in the secondary and, if the armature is in good condition, a spark should jump from the collector ring to the wire each time the contact is broken. If the spark does not jump this gap, there is something wrong in the armature winding, and tests should be made to find out which one of the windings is faulty. If the condenser is defective and the armature windings are in good condition, the spark will not jump the gap at the collector ring, and a test for a defective condenser must be made.

Magneto Primary Winding Test. In this test use a six-volt battery with an ammeter in series as shown in Fig. 42-a. Connect

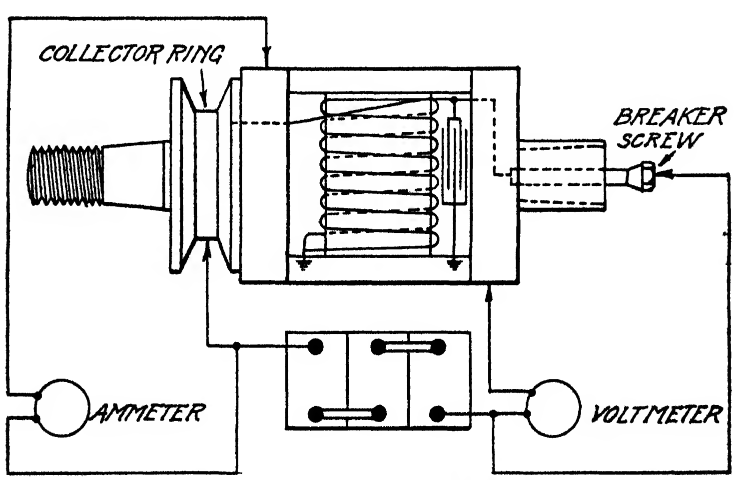


Fig 42-a Testing Secondary Winding with Voltmeter and Testing Primary Winding with Ammeter

one battery terminal to the ammeter, and from the other ammeter terminal make a connection to the magneto frame. From the other battery terminal make a connection to the long breaker screw.

If there is a reading of six to ten amperes, the winding is O.K. If there is no reading, then there must be an open circuit in the primary winding. If the reading is more than twelve amperes, it indicates a short circuit. There is only one remedy for a defective armature and that is to install a new one.

Magneto Secondary Winding Test. The secondary winding, being a fine winding, an ammeter cannot be used to make the test as enough current cannot flow through the winding to show a reading. To make this test use a six-volt battery with a voltmeter in series with the battery. Connect one terminal of the voltmeter to the battery and the other terminal of the voltmeter to the frame of the armature. From the other battery terminal make a connection to the collector ring. If the secondary winding is in good condition, there should be a reading of about two and one-half to three volts on the voltmeter. If there is no reading, the winding is broken somewhere, giving an open circuit. If the reading is high, then the windings are short circuited.

In making these tests it should be remembered that there will be a variation in the maximum readings for different models and different makes of magnetos as the windings vary; so if an accurate check is required, the reading should be taken from an armature of the same model and make which is known to be in perfect condition. The reading should be compared with that of the armature being tested.

Magneto Condenser Test. The condenser on the ordinary shuttle type magneto cannot be removed for testing as it is incorporated in the armature. One side of the condenser is grounded on the frame of the armature and this part must be disconnected before the test can be made; if it is not disconnected, the test lamp will light through the primary winding and a false indication will be obtained.

Condenser tests use the 110-volt lamp test sets, as shown in Fig. 1, page 2. Place one test point on the end of the long screw and the other test point on the disconnected side of the condenser and, if the lamp lights, the condenser is out of order.

If the lamp does not light, test the condenser for open circuit in the following way. Attach a piece of wire on the long screw in such a way that it does not touch the frame of the magneto and bend it around until it is near the disconnected side of the condenser.

Touch the test point to the screw and the condenser terminal, as in the previous test, and then touch the wire on the screw to the disconnected side of the condenser terminal, as shown in Fig. 42-a. If the condenser is in good condition, there should be a short, small, and snappy spark between the two wires as they come together.

In magnetos where the condenser can be removed, such as the Dixie, the condenser test can be carried out in the same manner as for a condenser in a battery ignition.

Testing High Tension Coils for Battery Ignition. Before the windings in the high tension coil can be tested, the different terminals of the winding and the condenser connections must be found. The following test may be made to locate the different windings and connections, and after these have been located and marked, the test can be made to find the condition of the coil winding and condenser.

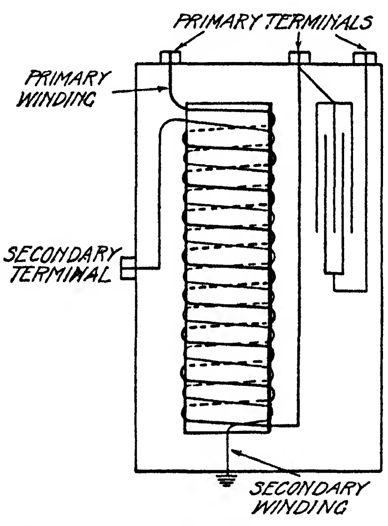


Fig. 43. Coil with Three Primary Terminals with Condenser Incorporated

High tension coils are of two types: one, in which the condenser is incorporated in the coil; and the other in which the condenser is not incorporated but is attached to the breaker point.

Of the first type there are those which have three primary connections on the external surface, as shown in Fig. 43; and those which have two primary connections on the external surface, as shown by Fig. 43-a.

The plain coil which has no condenser incorporated, as shown in Fig. 43-b, usually has only two primary external connections.

It should be remembered when making the test that the high tension external terminals are usually placed in the center of the coil and are heavily insulated, and the other end is usually grounded at the base. Secondary windings on the high tension coil cannot be tested with such low tension current as 6 or 12 volts because of the many turns of fine wire used for the secondary winding.

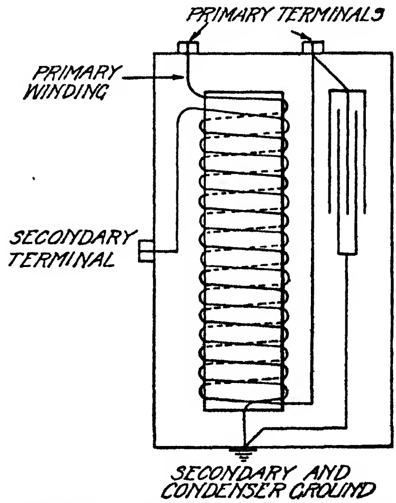


Fig. 43-a. Coil with Two Primary Terminals with Condenser Incorporated

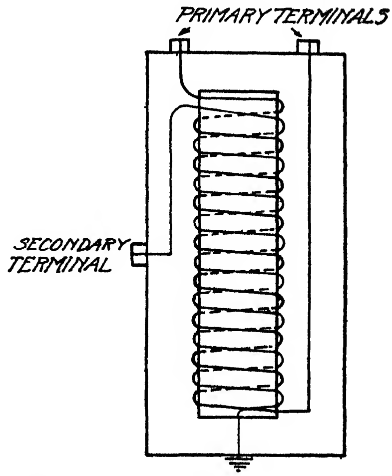


Fig. 43-b. Coil with Two Primary Terminals without Condenser

Before tests can be made on these coils the different windings must be located. This can be done with either a 6- or 12-volt battery.

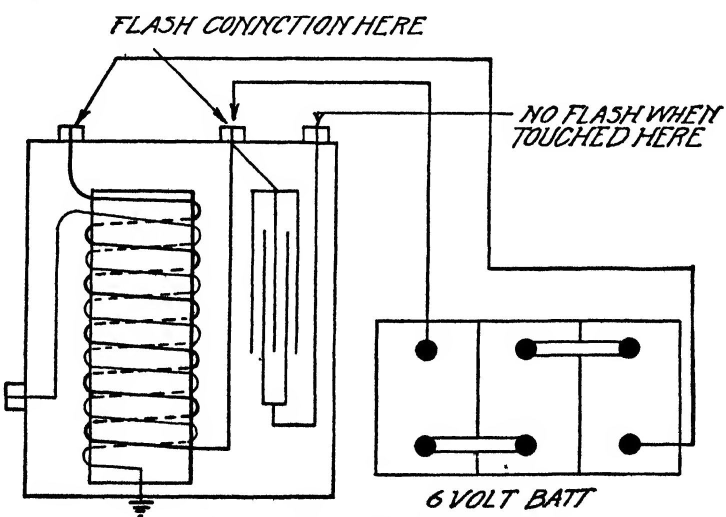


Fig. 43-c. Finding Primary Winding in Coil

To locate primary windings in any of these coils: Attach a piece of wire to each of the battery terminals, as shown in Fig. 43-c, and touch one primary terminal on the coil with one wire attached to the battery; with the other battery wire make a flash connection to the other primary terminals on the coil. When a short flashing spark is obtained, the ends of the primary winding have been found. This will account for two of the primary terminals.

To locate condenser and primary connections on three terminal coils: Having found two of the primary terminals, the third is the one to which the dead side of the condenser is attached, and there will be no flash shown at this terminal when the foregoing test is being made. The other side of the condenser is connected to one of the other primary terminals and to find out which one make the following test: Connect a piece of wire to the secondary terminal and bend it so that the free end is about three-eighths inch from the base of the coil. Next take one of the wires attached to the battery and cut off some of the insulation. Attach this wire to the dead terminal and allow the end to hang over and touch one of the other primary terminals. Now, take the other battery wire and make a flash connection to the vacant primary terminal. If there is a good spark at the gap between the end of the wire attached to the secondary and the base of the coil, the condenser connection has been found. The one side of the condenser is connected to the dead terminal and the other side is connected to the terminal on which the flash connection is being made when the heaviest spark is obtained at the end of the wire connected to the secondary terminal.

To locate condenser and primary terminals on two terminal coils: The test is made in exactly the same way as with the three-terminal coil excepting that the dead side of the condenser or ground will be on the base of the coil. In the two-terminal coil all that is necessary is to find the two ends of the primary winding for with this coil the condenser is placed at or near the breaker point.

To test primary windings on high tension coils: When making this test on primary windings of coils, with three primary terminals, care should be taken in making the connections because if one connection is made on the condenser dead side terminal, no reading will be given and the wrong impression as to the condition of the coil will be obtained.

To make the test connect an ammeter in series with a six-volt battery. Connect one wire from the battery to one end of the primary and connect the other end of the primary to one terminal of the ammeter and the other terminal of the ammeter to the vacant battery terminal, as shown in Fig. 43-d.

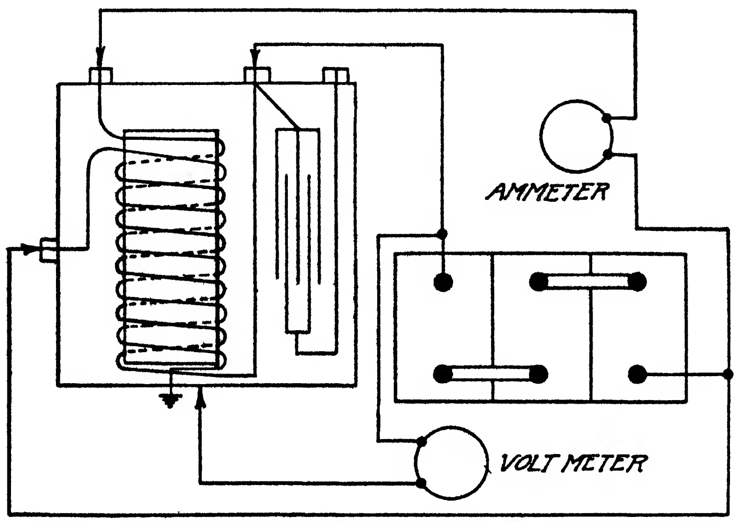


Fig 43-d. Testing Primary Winding with Ammeter and Testing Secondary Winding with Voltmeter

If there is no reading on the ammeter, the winding is open-circuited. If there is a high reading, this indicates that the windings are short-circuited. If the ammeter shows a reading of about 8 amperes, the winding is in good condition.

When using the ammeter, care should be taken not to damage the instrument. It is a good plan to be sure that there is enough resistance in the circuit to limit the current flow to the capacity of the instrument being used.

To test secondary windings on high tension coils: Either a voltmeter in series with a 6-volt battery may be used for this test or the 110-volt lamp test set may be used. With the voltmeter test one lead from the battery should be placed on the end of the secondary winding. A wire from the voltmeter should be attached to the base of the coil and the other voltmeter terminal should be connected to the battery, Fig. 43-d. If the winding is in good condition, the voltmeter should show a reading of about 2½ volts; if the winding is short-circuited, the reading will be higher; and if open-circuited, there will be no reading.

With the 110-volt test the test points should be placed one on the base of the coil and the other on the secondary winding terminal. If the lamp lights, the windings are short-circuited. If the lamp does not light and there is a small spark when the test points are removed from the secondary terminal, the winding is correct. If the lamp does not light and there is no spark when the connection at the secondary terminal is broken, then the winding is open-circuited. The reason why the lamp does not light even though the winding is in good condition is because the resistance of the secondary winding is so high that there is not sufficient current flowing to cause the lamp to light. If the secondary windings are short-circuited, the resistance is lessened and enough current then flows to cause the lamp to light.

To test a condenser incorporated in high tension coils: For this test the 110-volt lamp test should be used. In the preliminary test the terminals on the coil to which the condenser is attached will have been found. Attach a wire to each of the terminals of the condenser and bend them around so that they are close together. Next place the lamp test points on these terminals and, if the lamp lights, the condenser is faulty and short-circuited. If the condenser is in good condition, a sharp, snappy spark will be obtained as the two wires attached to the condenser terminal are brought together.

To test a condenser not incorporated in coils: This test may be made by judging the condition of the spark or by the direct application of current. Where the condenser is enclosed in a coil the best test is the spark test. Have the switch on and while an assistant turns the crank, watch the spark. If there is a faint spark at the condenser points as they open, the condenser is in good condition. If the spark is heavy, the condenser is faulty. This same test can be used on a condenser that is attached to a magneto armature. Another test that can be made in regard to the condition of the spark is as follows: Use the 110-lamp test outfit and connect the grounded side of the condenser to one test point. Connect the other test point to the low tension terminal of the coil and form a connection at the two points. Break the connection, and if the condenser is in good condition, there will be a short, snappy spark. If it is faulty, the spark will be heavy and a deeper yellow.

The direct-current application test is shown in Fig. 44-a. To find if there is a short circuit in the condenser, use the lamp test outfit. Place one test point on each of the condenser terminals. If the lamp lights, the condenser is short circuited.

The test for a grounded condenser is shown in Fig. 44-b, and each side of the condenser is tested. Place one test point on the

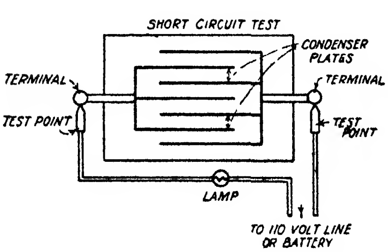


Fig. 44-a. Short-Circuited Condenser Test on D C. Current

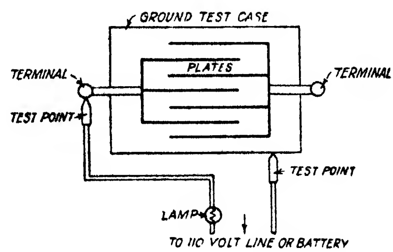


Fig. 44-b. Grounded Condenser Test on D C. Current

case of the condenser and the other on the condenser terminal. If the lamp lights, that side of the unit is grounded. Test the other side of the condenser in like manner. One side of the condenser is used to complete the ground in some units, and the lamp will light on this test. If the lamp lights on touching the test point to the case and the external terminal, the unit is out of order.

Testing High Tension Coils under Working Conditions. *Astatic Gap.* The astatic gap has three points, Fig. 45. Point *A* is connected to the high-tension lead of the coil or armature, while the point *B* is insulated and is the static point. The function of the static point is to maintain an even resistance between the points *A* and *C*, thereby giving a definite resistance for a given distance; this is of prime importance to provide a reliable test.

The action of the static point is to produce a capacity at the points in tune with the oscillations of the high-tension discharge. As the secondary current from any high-tension coil is of high frequency, although greatly damped because of the amount of iron in the coil or armature, the introduction of a capacity or condenser action into the circuit has a direct bearing on the gap.

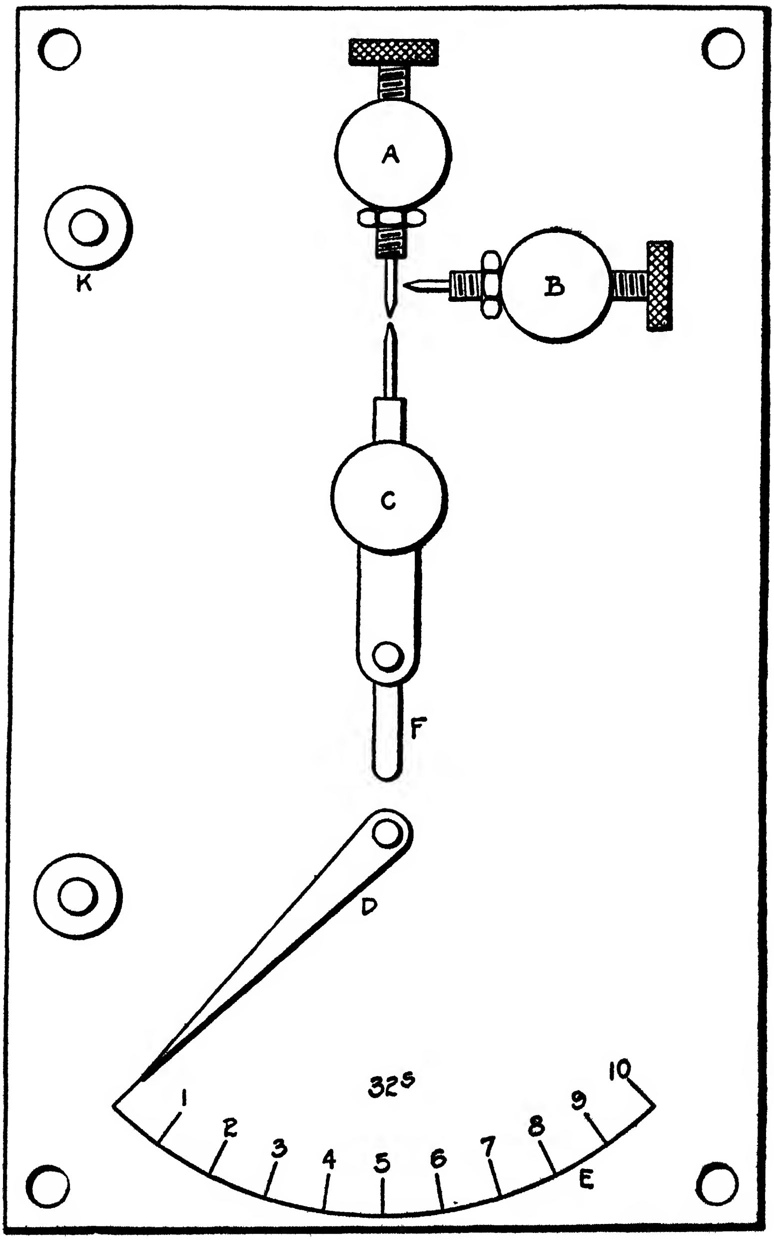


Fig. 45. High-Tension Test Points with Astatic Gap

The distance between the points *A* and *B* should be 0.002 inch. The two terminal posts should be connected on the back of the fiber base by a small wire. The body of the posts *A, B, C* should be ⅜ inch in diameter, especially the static point; too small a mass will not furnish sufficient capacity to work properly. Phonograph points are good for this purpose and are easily mounted. Lock nuts should be used on screws *A* and *B* and also on *C* if necessary.

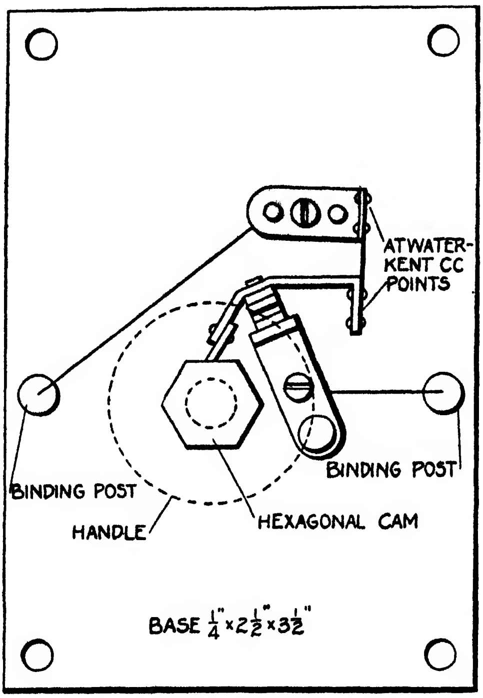


Fig. 46. Breaker-Point Test Set

Vibrator. A master vibrator is placed in series with a 6-volt storage battery and the coil to be tested, the high-tension lead being connected to the terminals on *A* and *C* and grounded to the primary of the coil. With the spark jumping the gap, the point *C* is opened until the spark will just jump it continuously. If the gap measurement is taken with a good coil a standard is obtained.

After the vibrator is once set it should not be changed; any change in adjustment will mean a change in the quality of the spark. As some high-tension armatures have such a high primary resistance that a vibrator will not operate through them, a single-break interrupter may be used to overcome this difficulty.

Single-Break Test. A simple cheap breaker may be made as in Fig. 46. A piece of $\frac{1}{4}$-inch red fibre $2\frac{1}{2}'' \times 3\frac{1}{2}''$ forms the base; Atwater-Kent type CC points are used for contacts; the hexagon cam is made from a $\frac{3}{8}$-inch hexagon iron rod turned down to a shoulder $\frac{1}{4}$ inch in diameter and projects through the base, with a fiber handle about an inch in diameter attached. A condenser is connected across the points, and the whole assembly mounted on the test board. To test with this apparatus, the coil is connected as in Fig. 47; the battery coil primary and breaker are connected in series; the coil secondary is connected to the gap, and the spark is noted. As this type of breaker has no resistance to speak of and is operated by hand, the coil has plenty of time to saturate its core, the spark produced being uniform.

Special Dial Gap. For quick results, utilize the special dial gap, Fig. 45. This gap has a fiber base $\frac{1}{4}'' \times 3\frac{1}{4}'' \times 5\frac{1}{2}''$, on which are mounted two stationary points marked *A* and *B* and a grounded movable point *C;* below is a pointer *D*, which moves on the scale

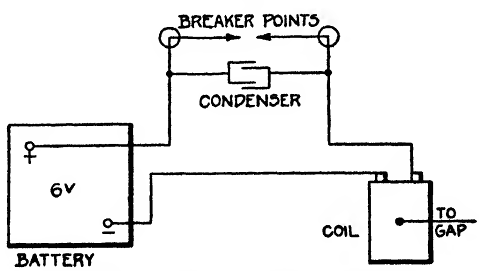
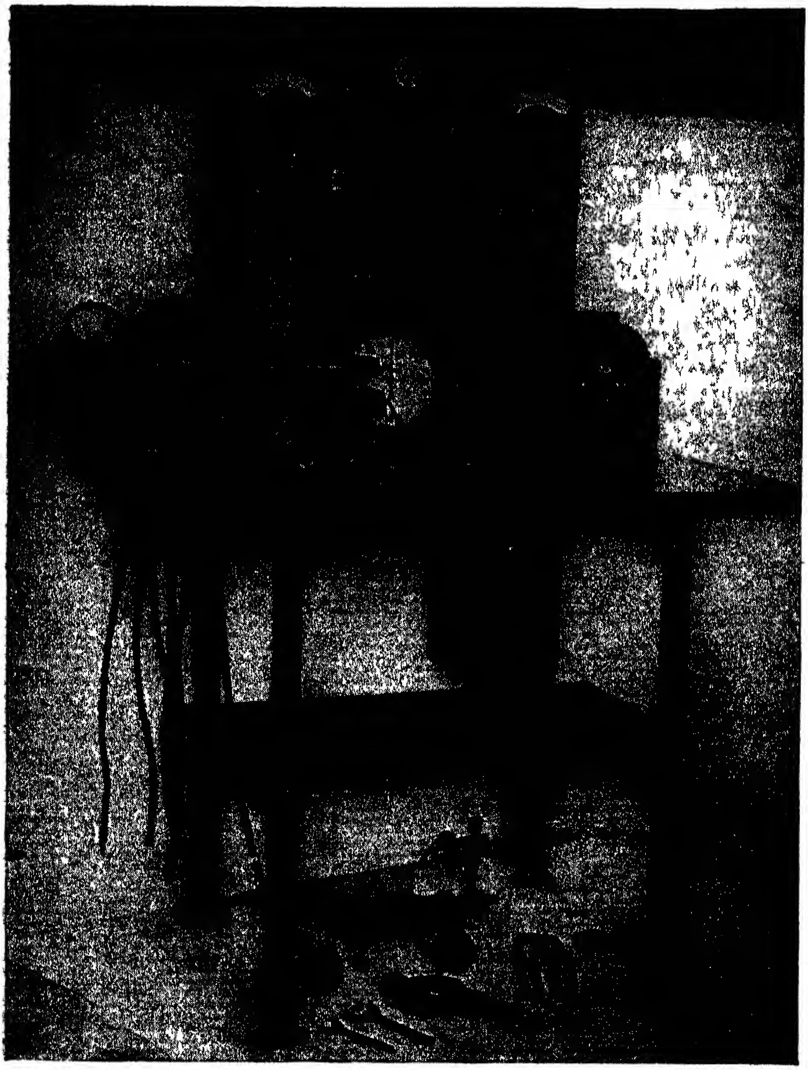


Fig 47 Method of Connecting for Test

E. The movable point *C* slides in the slot *F* and is held by a plate and two rivets. The lower part of the body *C* projects through and forms one rivet, while the other projects through the plate about $\frac{1}{4}$ inch, and the cam bears on it, as well as the spring, holding the plate assembly against the cam. Point *A* is connected on the back to terminal *K*.

The dial *E* is cut in the fiber and white lead put in the cuts. This dial is laid out in ten divisions, marked 1, 2, 3, 4, etc., and moving the pointer one division causes the gap to change $\frac{1}{32}$ inch. In using this apparatus, the dial makes it possible to get a quick positive reading. A table can be made up to show just what each type of armature or coil should test, thus eliminating all guesswork.



WEIDENHOFF ELECTRICAL TEST BENCH COMPLETE

ELECTRICAL REPAIRS

PART III

TESTING WIRING

Locating Grounds. By referring to any of the Delco diagrams of the one-wire type, it will be noted that certain parts of the circuits are normally grounded, i.e., they are connected to the common return represented by the chassis of the car. For example, the negative battery terminal, one terminal of each lamp, one motor, one generator brush, one timer contact, one terminal of the horn push button, and one terminal of the condenser in the coil are grounded. Before testing the wiring for grounds, it will be necessary to remove these normal, or intentional, grounds. This is carried out, in the order in which they are mentioned, by disconnecting the negative battery lead and removing all the lamps, placing a piece of cardboard between each generator and each motor brush, including the third brush of the former and the commutator against which it ordinarily bears, disconnecting the leads from the horn button and from the distributor, and raising the base of the ignition coil so that it is insulated from the top cover of the generator motor. The system will then be in the condition shown in Fig. 48.

One of the test points is then placed on the frame of the car and the other point on the negative terminal *A* of the battery. If the lamp lights, it will indicate a ground somewhere on the switch or in the motor windings (all of the switch buttons being pushed in). Then, with one test point still grounded on the frame of the car, test with the other point the different terminals of the combination switch. If the lamp lights during this test, it will indicate a ground on that particular circuit, which can be remedied without any particular difficulty.

Locating Shorts. To test for short-circuits between wires that are normally insulated from each other, place one test point on the end of one wire and the second test point on the end of the other, as shown in Fig. 49. If the lamp lights, it will indicate a short-circuit

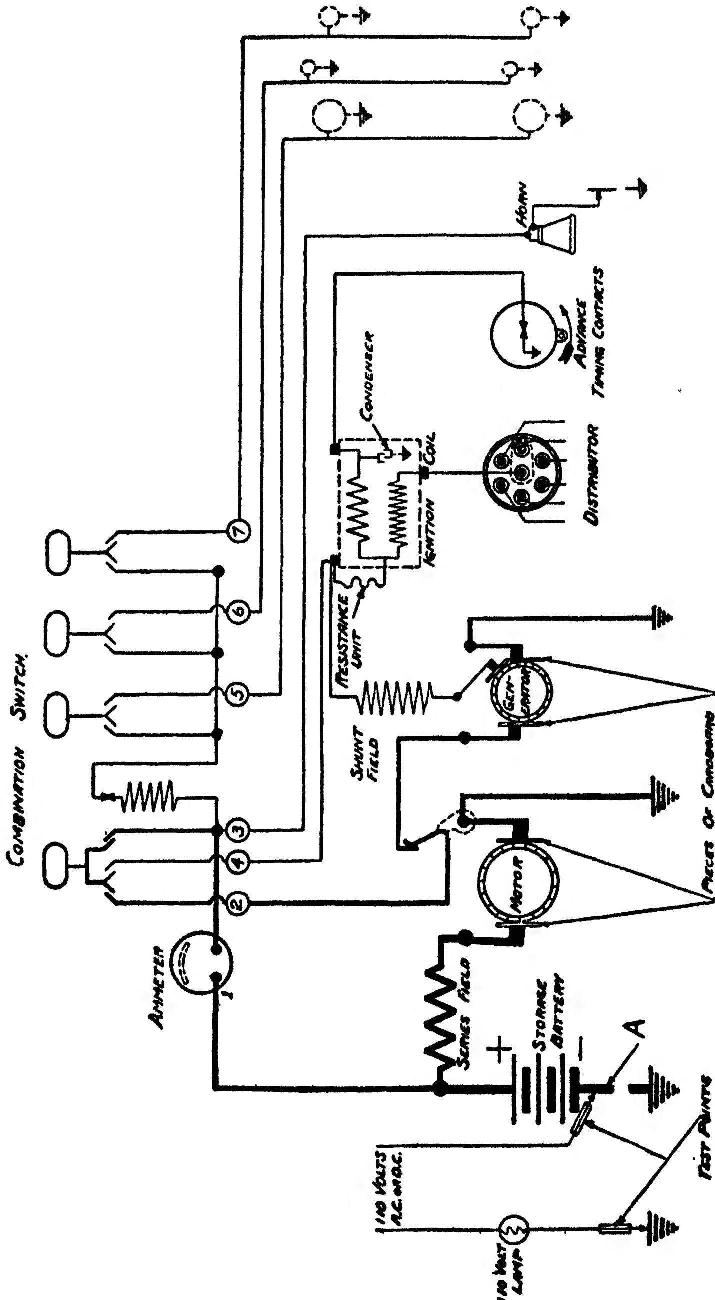


Fig. 48. Wiring Diagram Showing Method of Using Lamp-Testing Set for Locating Grounds
Courtesy of Dayton Engineering Laboratories Company, Dayton, Ohio

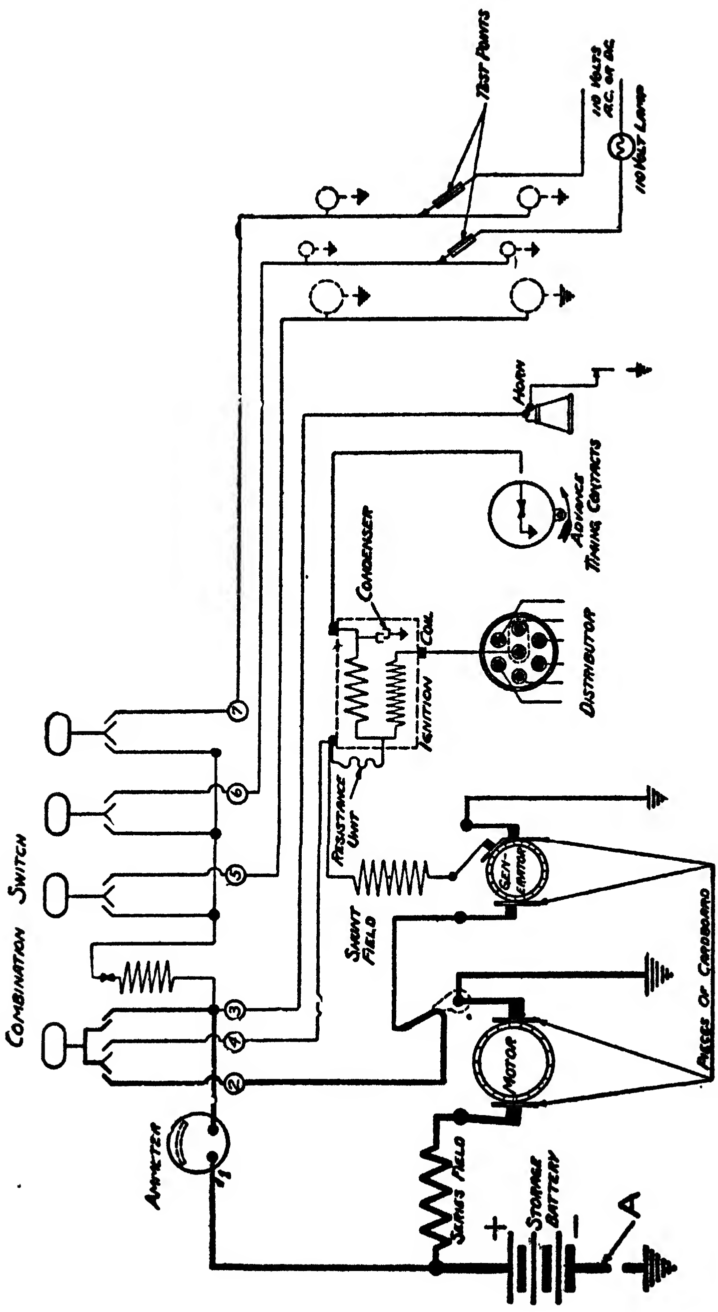


Fig 49. Wiring Diagram Showing Method of Using Lamp-Testing Set for Locating Short-Circuits
Courtesy of Dayton Engineering Laboratories Company, Dayton, Ohio

between these two wires, which can then be carefully inspected to locate the exact position of the fault. Failure of the lamp to light when the test is made will indicate that the wires in question are in good condition; the tests can then be applied to other parts of the circuits which should be insulated from each other.

Locating Breaks in Wires. Where the failure of the apparatus in a particular circuit makes it apparent that a wire, or lead, may be broken, it may be tested by placing one of the points on each end of the wire in question. The lighting of the lamp will indicate that there is a complete circuit through the wire, while its failure to light is evidence of a break in the wire. If at all difficult to locate the break, the easiest method of repairing is it to replace the wire with a new lead of the same size and type of insulation. The method of carrying out this last test is illustrated in Fig. 50 and it is naturally applicable to any of the wires, not only of this type of installation but of any other lighting and starting system. In making this test, care must be taken not to apply the points at places on the terminals where a ground connection will result, as this will complete the circuit through the lamp without the current passing through the wire supposedly under test. This method of locating grounds, short-circuits, or open circuits will be found much better than the use of a buzzer, bell, or magneto, and it is recommended wherever a 110-volt current is available. However, where it is not available, a lamp, bell, buzzer, or the portable voltmeter may be used in connection with the storage battery on the car, after detaching its usual connections to the system.

Ground in Starting or in Lighting 2-Wire Circuits. When the blowing of a fuse in any lighting circuit is due to a ground, or a similar fault is suspected in the starting system, it may be tested for either with the lamp outfit or with the low-reading voltmeter, as follows:

Disconnect one battery terminal, taping the bare end to prevent contact with any metal parts of the car, and connect one side of the voltmeter to this terminal. Attach a length of wire having a bared end to the other terminal of the voltmeter, as shown in Fig. 51. Connect the bared end of the free wire to some part of the car frame; making certain that good electrical contact is made. Disconnect the generator and starting motor completely, open all lighting switches, and be sure that the ignition switch is off. If there is no ground in the

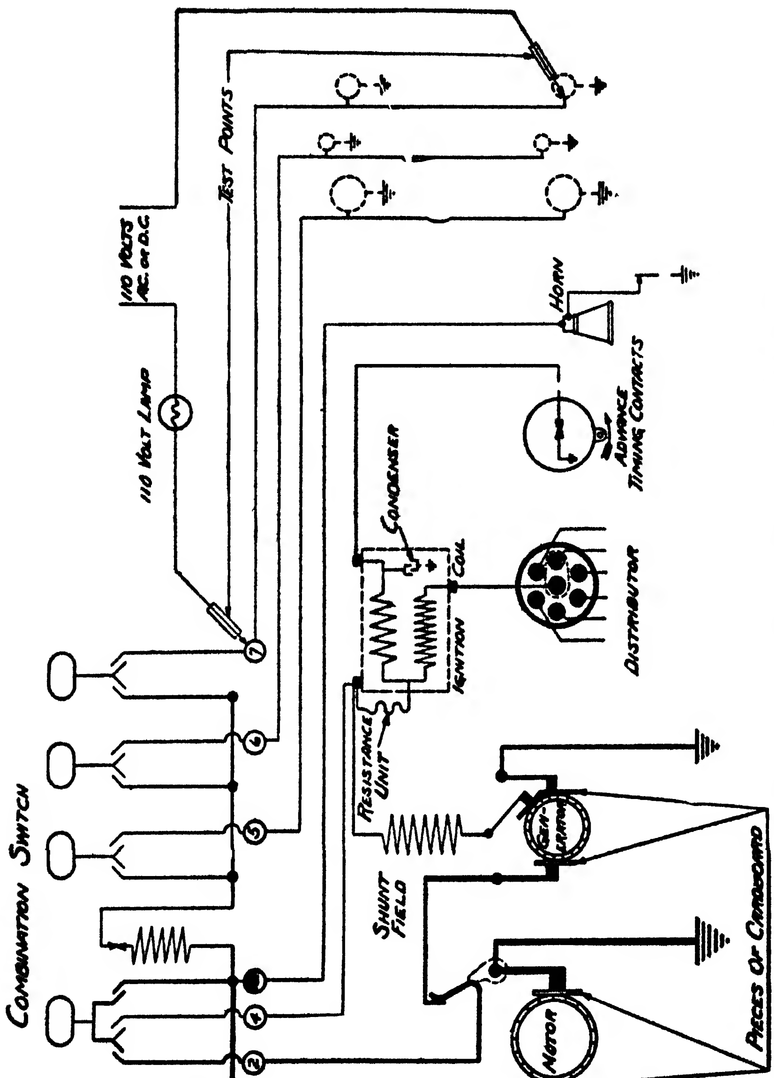


Fig. 50. Wiring Diagram Showing Method of Using Lamp-Testing Set for Discovering Breaks in Wires
Courtesy of Dayton Engineering Laboratories Company, Dayton, Ohio

circuit, the voltmeter will give no indication. Be sure that none of the disconnected terminals are touching the engine or frame; to insure this, tape them.

Should the voltmeter give a reading of 4 volts or more, it indicates that there is a ground in the wiring between the battery and the junction box, or in the wiring between the junction box and the generator or the starting motor. If the voltmeter reads less than 4 volts but more than ½ volt, all wiring and connections should be carefully inspected for faults. This test should be repeated by reversing the connections, that is, by reconnecting the wires on the side of the battery circuit that has been opened and disconnecting the other side.

Localizing Any Ground. To localize any fault that the reading of the voltmeter may show, reconnect the wires to the starting motor

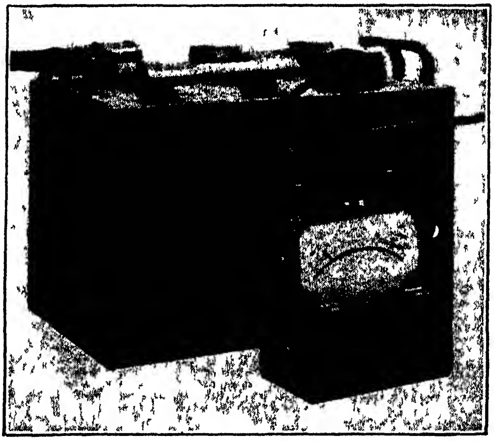


Fig. 51 Testing for Grounds with Voltmeter in Two-Wire System

and close the starting switch; any reading of the voltmeter with such connections will indicate that the ground is in this circuit. Should no ground be indicated with these connections, disconnect the starter again and reconnect the generator; if the voltmeter records any voltage, the ground is in the generator circuit. With both starter and generator disconnected, the voltmeter being connected first to one side of the battery and then to the other, operate the lighting switches, the ignition switch, and the horn, one at a time, and note whether the voltmeter needle moves upon closing any of these switches. A voltage reading upon closing any of these switches will indicate a ground in that particular circuit.

Short-Circuit Tests. To test for short-circuits, substitute the ammeter for the voltmeter, but do not connect the instrument to

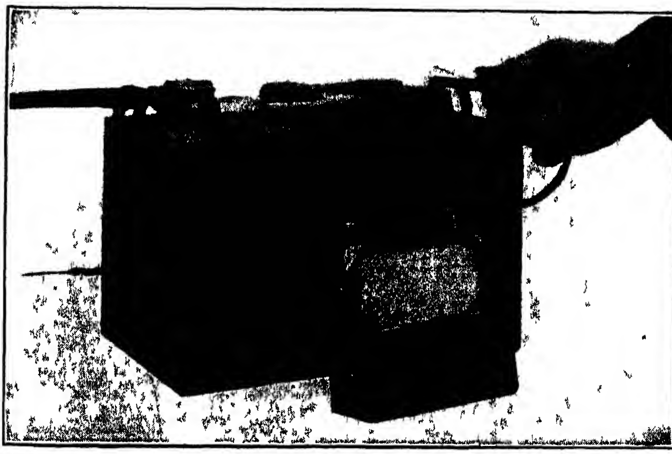


Fig 52 Testing for Short-Circuits with Ammeter in Two-Wire System

the battery. The shunt reading to 20 amperes should be employed, one side of the ammeter being grounded on the frame as previously described, and the other being connected with a short wire that can be touched to the open side of the battery, Fig. 52. Disconnect the starter and the generator and open all the switches, then touch the bare end of the wire to the battery terminal on the open side as shown. Any reading, no matter how small, will indicate a short-circuit (two-wire system) in the wiring between the battery and junction box or between the latter and the starter, or generator. If the ammeter reading shows a heavy current, there is a severe short-circuit.

Localizing a Short-Circuit. The short-circuit may be localized in the same manner as described for the voltmeter test, i e., connect the starter and test; disconnect the starter, connect the generator and test. A reading on the generator test may be due to the contacts of the cut-out sticking together. If the cut-out contacts are open and the ammeter registers, there is a short-circuit in the generator windings.

Disconnect the generator again, remove all the lamps from the sockets, and turn on the lighting-circuit switches one at a time, touching the wire to the battery terminal after closing each switch. A reading with any particular switch on indicates a short-circuit in the wiring of the lamps controlled by that switch. Only one switch should be closed at a time, all others being open. This test should be made also with the ignition switch on but with the engine idle. The ammeter should then register the ignition current, which should not exceed 4 to 5 amperes. If greater than this, the ignition circuit should be examined.

Cautions. Do not attempt to test the starter circuit with the ammeter as it will damage the instrument. To test the starter circuit, reconnect as for operating, removing the ammeter. Close the starting switch; a short-circuit in the wiring will result either in failure to operate or in slow turning over of the engine. See that the switch parts are clean and that they make good contact. If the short-circuit is in the winding of the starting motor, there will be an odor of burning insulation or smoke.

The battery must be fully charged for making any of these tests. While the effect either of a ground or of a short-circuit will be substantially the same, its location and the remedy will be more easily determined by ascertaining whether it is the one or the other.

Lamp Troubles. When short-circuits, grounds, or open-circuits are suspected as the cause for lights failing to burn, it is advisable to examine the different lamps in the system before starting to test or to pull out any of the wiring. In the single-wire or grounded system, the circuit is completed by grounding the lamp through the reflector. They often become rusted or dirty, failing to make good electrical contact and the lamp will not light. The lamp sockets may become rusted or dirty with the same result and the wires will break inside the lamp causing an incomplete connection. The plunger springs in the sockets may get weak, making poor connection, and the socket will have to be renewed. Cleaning and making good connections will often cure other troubles. If the bulbs are not of the same voltage in the dash and tail lamps which are in series connection, one lamp will burn brighter than the other or may not burn at all. The lamps should be half the voltage of the battery. If the system is 6 volts, the lamp bulbs should each be 3 volts.

Testing Cut-Out. If the battery is not charging properly, the generator being in good condition, or it is discharging too much current through the cut-out, the latter should be tested and adjusted to remedy the trouble. The cut-out is designed to close when the voltage across the terminals of the voltage coil is $6\frac{1}{2}$ to $7\frac{3}{4}$ volts. To check this a voltmeter should be connected across the terminals, noting the reading at the point that the contacts close. It is designed to break the circuit when the discharge current is less than 1 ampere, preferably as close to the zero mark as possible to reduce the arc on breaking the contacts. This can be checked by placing an ammeter in the circuit in series with the current coil of the cut-out, noting the value of the current at the moment that the contacts separate. When properly adjusted the air gap should be $\frac{1}{32}$ inch.

To adjust the cut-out, the influence of both the air gap and of the spring tension must be taken into consideration. The air gap has little or no effect upon the point of cut-out, this being governed almost entirely by the spring tension, whereas the point of cutting in is governed by both the air gap and the spring tension. The following examples will illustrate the adjustments necessary in cases of excess voltage and current, excess voltage alone, insufficient voltage and excess current, and insufficient voltage alone.

Where the relay cuts in at 8 volts and cuts out when the discharge current is 2 amperes: Decrease the air gap, as this will lower the voltage of the cut-in point, but it will also increase the discharge current on cutting out. To overcome the latter, increase the spring tension slightly, noting the effect on the ammeter until the latter registers less than 1 ampere on cutting out.

Where the relay cuts in at 8 volts and cuts out at 1 ampere: Decrease the spring tension as this will cause the relay to cut in at a lower voltage and also to cut out after the current starts to discharge through it.

Where the relay cuts in at 6 volts and cuts out at 2 amperes: Increase the spring tension, causing the relay to cut in at a higher voltage and also to cut out at a discharge-current value of less than 2 amperes.

Where the relay cuts in at 6 volts and cuts out with a discharge current of 1 ampere: Increase the air gap slightly and also increase the spring tension so as to cause the relay to cut in at a higher voltage and also cut out at a discharge current of less than 1 ampere.

In this connection *cut in* signifies the closing of the contacts when the voltage coil becomes energized as the generator starts up; *cut out* indicates the opening of the generator battery circuit when the current from the battery reverses the polarity of the current coil of the relay, thus opening the circuit and cutting out the generator from the battery circuit when the generator slows down and there is insufficient voltage from charging the battery. While these instructions apply particularly to the Delco relay or cut-out, all devices of this nature operate on the same principles.

Before making any adjustments, the contact points should be examined. If they are blackened or pitted, take two narrow strips of emery cloth about $\frac{3}{8}$ inch wide and both the same length. Place them together, emery sides out, insert between the contacts and while an assistant holds the points together, draw back and forth. If no assistance be obtainable, use a single strip and apply alternately to each contact point until its face is bright all over and true so that when the two points come together they touch evenly all over their surfaces. Do not take off any more than is necessary for this purpose, particularly where the contacts are platinum, as this simply wears them away uselessly and they are very expensive to replace. After cleaning, test for cutting in voltage and cutting out current and it frequently will be found that no adjustment is necessary.

These instructions regarding the cleaning of contact points apply with equal force to all instruments having contacts by means of which the circuit is frequently made and broken, for even platinum is burned away by the electrical action of the current which tends to carry the metal of the positive contact over to the negative in finely divided form this making a hole, or crater, on the positive and a cone, or peak, on the negative.

If the contacts are too badly burned to permit of their being put in good condition in this way, it will be necessary to replace them. After the relay has been reassembled with the new contacts, it should be adjusted in accordance with the instructions already given. When the contacts are correctly adjusted, both pairs will make contact at the same instant and clear across the 'ine of contact so that when the relay is held up to the light, it is impossible to see light passing through any portion of the line of contact. When adjusting the relay make sure that all insulating bushings are in good condition and that the connections and coil terminals are free from breaks or grounds, as these would cause uncertainty in its operation.

Testing Circuit-Breaker. In case the circuit-breaker vibrates constantly, it indicates a ground in one of the circuits. Should it continue to vibrate when all of the buttons of the combination switch have been pushed in, the ground will almost invariably be found in the horn or its connections. In case no ground can be found in any of the circuits with the aid of the testing lamp, and the circuit-breaker still continues to vibrate, connect the portable testing ammeter in the circuit, using the 30-ampere shunt. Then hold the circuit-breaker closed and note the ammeter reading when it opens. This must be done quickly as the current necessary to keep it operating is small so that the ammeter reading will quickly drop to a value of 3 to 5 amperes. However, the circuit-breaker should not open on a current of less than 25 amperes. If the ammeter reading indicates that it does so, increase the tension of the spring until the current necessary to operate it shows that it is properly adjusted. In case the instrument shows that the circuit-breaker is opening at the proper point but still continues to vibrate, another series of tests for a ground must be made as the latter is the cause of the trouble.

Testing Armatures. In reading the foregoing instructions as well as those that follow here concerning the Delco system, it should be borne in mind that they apply in principle, and in many cases in actual detail, to the majority of other systems described. In other words, all starting and lighting systems are based on the same principles and, while many of them differ in detail and in design, the application of the instructions in question will very frequently be evident by comparing them point for point and modifying the instructions to compensate for any slight differences in design or wiring.

Armature troubles are of much less frequent occurrence than the majority of defections, such as worn brushes, dirty commutator, or the like, which temporarily put the system out of commission, so that every part of the system which might be at fault should be investigated before attempting to test the armature for faults. To carry out these tests, the voltmeter and the lamp-testing set are necessary. Where no previous experience has been had in making tests with these aids, it will be well to become familiar with the detailed instructions given for their use in connection with the dtermination of other faults, as already described. It is not necessary to remove the dynamotor from the car for this purpose. When tests of the remainder of the system indicate no faults and when grounds in the armature-

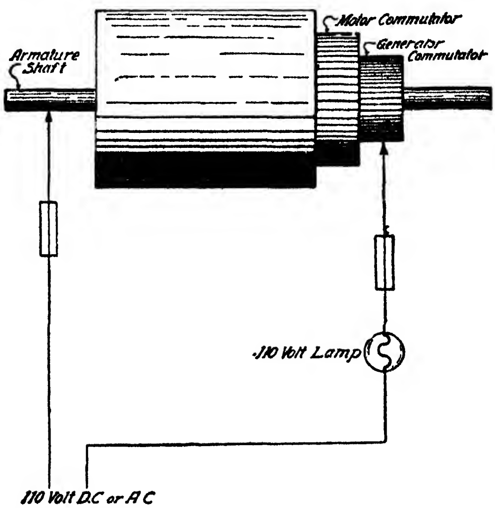


Fig 53 Diagram for Locating Grounded Generator Coil with Lamp-Testing Set

windings or short-circuits between them are not suspected, raise all the brushes from the commutator and slip pieces of cardboard between the brushes and the commutator so as to insulate them from each other. These instructions cover the single-unit Delco machine, so the foregoing applies as well to testing for short-circuits between generator and motor armature windings. For greater simplicity, the possible faults and the tests for locating them are treated under different heads, as follows:

(a) *Grounded Generator Coil.* On one-wire systems of the single-unit type, the presence of a grounded generator coil will materially reduce the charging rate to the battery and will also result in slow cranking of the engine. To determine whether a generator coil has become grounded, place one of the test points on the frame or on the armature shaft, both of which are grounded, and the other on the generator commutator, as shown in Fig. 53. If the lamp lights, it indicates a ground on the commutator. The test of the generator of a two-unit set would be carried out in exactly the same manner.

(b) *Grounded Motor Coil.* According to the nature of the fault, a grounded motor coil may either prevent operation of the starting

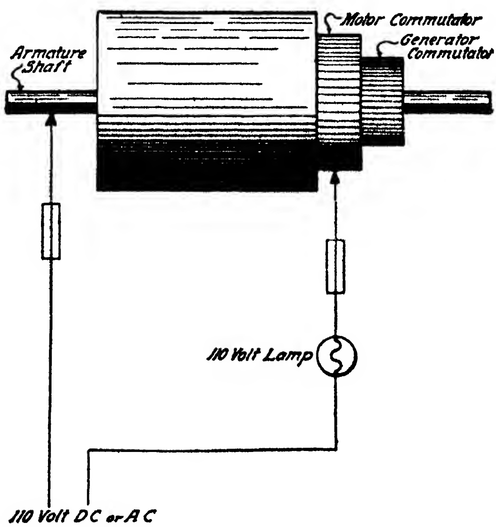


Fig 54 Diagram for Locating Grounded Motor Coil with Lamp-Testing Set

motor altogether or it may result only in an excessive consumption of current for starting. The test is carried out in the same manner as described for the generator, except that the second point of the test set is placed on the motor commutator, Fig. 54. It will likewise be evident that an independent starting motor can be tested in the same way.

(c) *Short-Circuits between Motor and Generator Armature Coils.* In most cases short-circuits between motor and generator armature coils will decrease the speed of cranking and will cause the armature to continue to run after the engine has been shut down. This test is carried out by simply placing one test point on the generator commutator and the other on the motor commutator. If the lamp lights, it indicates a short-circuit between the generator and motor windings, Fig. 55. This test is naturally only applicable to single-unit machines having two independent windings on the same armature core, as in the case of the Delco, the type in question.

(d) *Open- or Short-Circuited Generator Armature Coils.* When testing for open- or short-circuited generator armature coils, the gen-

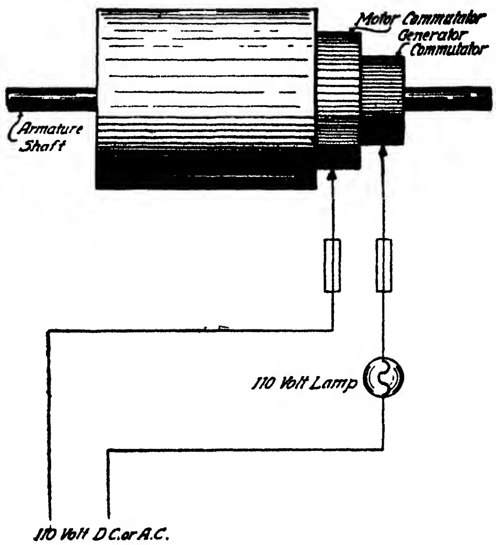


Fig. 55. Diagram for Locating Short-Circuits between Motor and Generator Armature Coils

erator brushes should be left in contact with the commutator, but the storage battery should be disconnected from the system, carefully taping the loose battery terminals before proceeding. Then disconnect the shunt field from the brushes and tape these terminals so that they do not accidentally come in contact with the frame or other parts of the unit. Connect up a dry cell and the portable ammeter, using the 30-ampere shunt, as shown in Fig. 56. Turn the armature over slowly by hand. If the commutator is clean and bright and the brushes are making good contact with it, a very noticeable change in the ammeter reading will indicate an open- or a short-circuited armature coil. To determine whether the coil is open- or short-circuited, the following tests can be made:

(1) *Open-Circuited Coils.* Connect the brushes to the terminals of the dry cell so that a current of about 10 amperes is flowing through the brushes. The field should be entirely disconnected and its terminals either taped or held out of the way. Then, with a special pair of points connected to the voltmeter using the 3-volt scale, measure the voltage across each two adjacent commutator bars. If there is an open-circuited coil in the armature, the voltage reading will increase considerably, Fig. 57.

(2) *Short-Circuited Coils.* If there are no open-circuited coils and the preceding tests indicate that there is trouble with

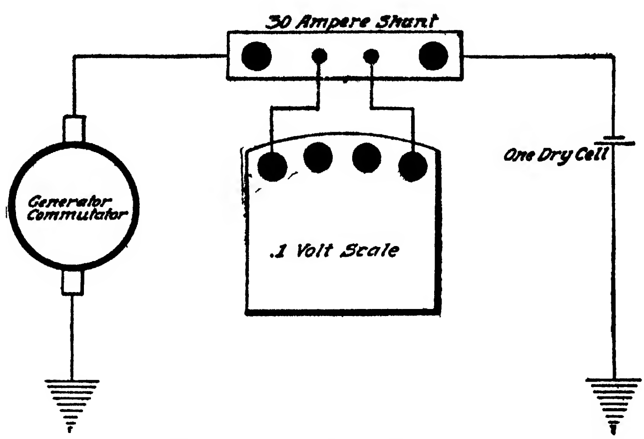


Fig 56 Diagram for Testing Open or Short-Circuited Generator Armature Coil with Ammeter

the armature, it should be tested for short-circuited coils. This should be done only after the preceding tests have been made, as and open-circuited coil might cause the .1-volt scale of the voltmeter to burn out if this test were made first. The armature is connected as indicated in (1), but for this test the .1-volt scale instead of the 3-volt scale of the voltmeter is used, Fig. 58. The voltage drop between adjacent commutator bars is then measured by slowly turning the commutator over by hand. The readings should be approximately the same. If any of them drop nearly to zero, it will indicate that one or more of the armature coils are short-circuited. In taking these readings, care must be observed to keep the points

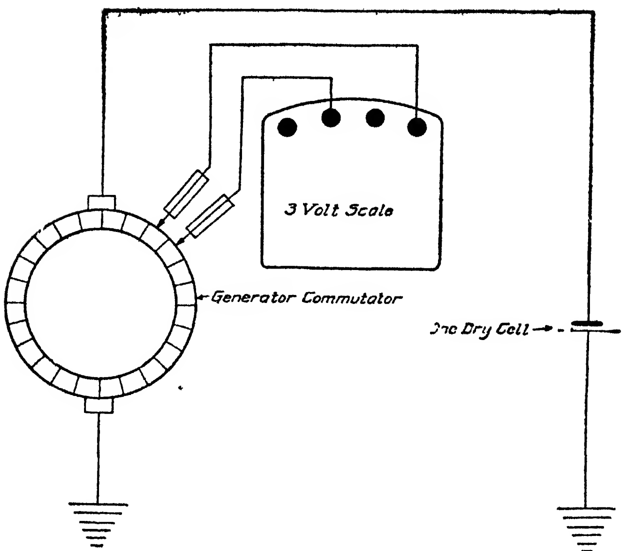


Fig 57 Diagram of Set-Up when Coils Are Open-Circuited

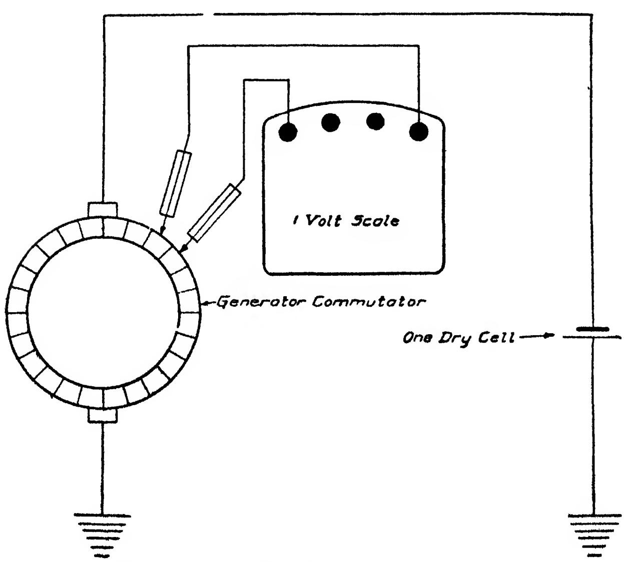


Fig 58 Diagram of Set-Up when Coils Are Short-Circuited

always on adjacent commutator bars and not allow them to span more than two bars at any time; otherwise, the voltage drop may be sufficient to injure the voltmeter.

Should any of these tests indicate open- or short-circuited coils in the armature, it is advisable to send the armature to the manufacturer for repairs, or to install a new armature. Unless the fault is plainly visible, as where a coil-terminal connection at the commutator bar has broken or become short-circuited, the average establishment will find the repair entirely beyond its facilities to make, so that time and expense will be saved by promptly referring it to the factory. Special equipment and skill in the handling of such

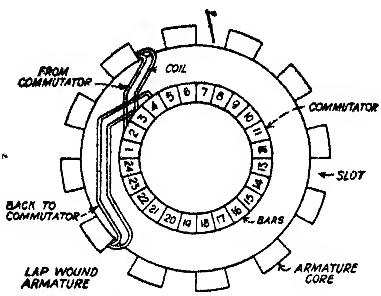


Fig 59 Lap Winding for Armature

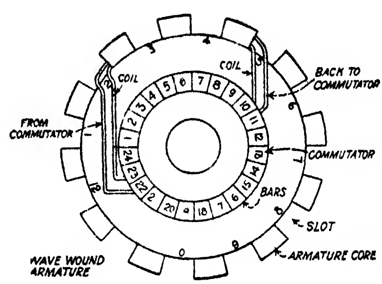


Fig 60 Wave Winding for Armature

repairs are indispensable and are beyond the province of the garage man. These tests can also be used for testing generator and starting-motor windings where two units are used separately.

Armature Winding. It is necessary to remove the damaged coils for repairs after the armature windings have been tested, and the short-circuits, grounds, and open circuits in the coils have been found. It usually means that the armature must be entirely rewound for in order to reach the damaged coils, others must be disturbed. There are two types of windings, "lap" and "wave," but there are many connections and combinations used.

The segments in the commutator are termed "bars"; the grooves in which the coils are placed are called "slots"; the coils are spoken of as so many "turns" per coil and so many coils per slot.

The wire generally used in armature winding is covered with enamel or a double layer of cotton. Silk is often used for it makes a thinner wire. This is important for the wire must not stand above the top of the slot. The wires vary in thickness in practically every unit. If a repair man wishes to make a specialty of armature work, he must carry a large stock of wires and ribbons of all sizes. It is much cheaper to send the armature to the makers and receive a

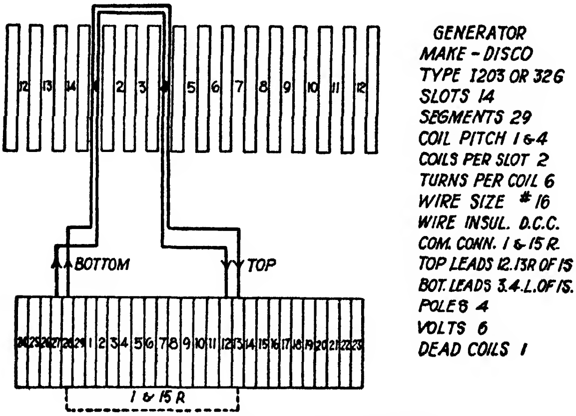


Fig. 61. Armature Rewinding Diagram
Courtesy of Chittenden

correctly rewound armature in exchange. Special equipment is necessary and it does not pay the average garage man to do this work.

Two typical winding diagrams are given with an explanation of the terms used. Fig. 59 shows the "lap" winding, and Fig. 60, the

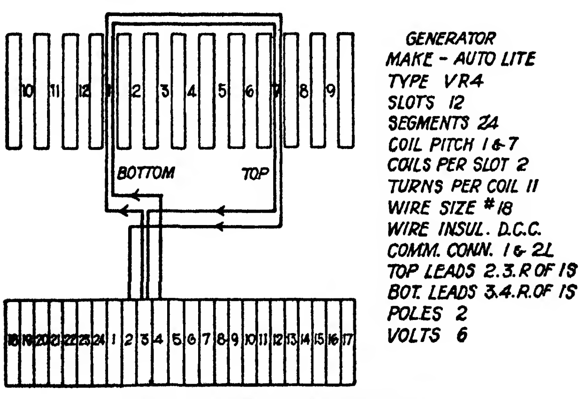


Fig. 62. Armature Rewinding Diagram
Courtesy of Chittenden

"wave" winding. The two charts, Figs. 61 and 62, show one method used in giving the data for rewinding and the specifications for a "lap" and a "wave" winding, respectively. The data in Fig. 62 means:

1. "Slots 14"—there are 14 slots or grooves in which the coils are placed.

2. "Segments 29"—there are 29 bars in the commutator.

3. "Coil pitch 1 and 4"—the coils pass through the slots numbered 1 and 4, or that the number of slots between the coils are 4 including the two outside slots.

4. "Coils per slot 2"—there are 2 coils to each slot, giving 4 coil sides to each slot.

5. "Turns per slot 6"—there are 6 turns of wire for each coil.

6. "Wire size 16"—a wire of number 16 Brown and Sharpe gauge is to be used.

7. "Wire insul D.C.C."—The wire must be insulated with a double layer covering of cotton.

8. "Comm conn 1 and 15"—there should be 15 bars between the connections of the wire and the commutator. The first and last bars are included in this number.

9. "Top leads 12 13 R of 1S"—the coils that are to be put in the top half of the slot should be connected to commutator bars 12 and 13 and to the right of the slot chosen as slot 1 for the beginning connection.

10. "Bott leads 3 4 L of 1S"—the coils that are to be in the bottom half of the slot should be connected to the bars 3 and 4 and to the left of the slot chosen as slot number 1.

11. "Lead"—the number of bars to the right or left of the slot through which the coil passes.

12. "Poles 4"—a 4-pole machine.

13. "Dead coils 1"—there is one coil not connected to the commutator.

The commutator bar that is in direct line with the slot numbered 1, is also numbered 1. They are used as the starting point for the numbering and the winding connections.

Let us trace the path of the wire as shown in Fig. 61. The coil starts at bar 27, which is the number 4 bar, and to the left of slot 1 through which it passes. It is carried to slot 4 and passes through it from the top of the slot. It is wound in this manner until there are 6 turns in the coil and is then connected to bar 12 which is the 12th bar to the right of slot 1.

If a coil is connected to bar 29, it would pass through the bottom of slot 2 and over to slot 5 with 6 turns in it and connected to bar 14. It will be seen that there are 4 slots between the the coils and 15 bars between the connections at the commutator. Always count the beginning slot or bar. This same method is carried throughout the winding until each slot has two top and two bottom leads in it and each commutator bar has two coils connected to it.

Commutator Maintenance. In the course of time, the commutator bars of the generator will wear down until they are flush

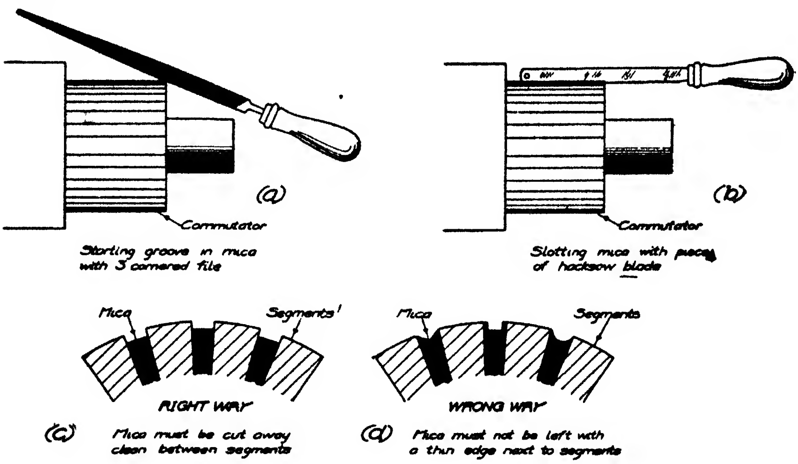


Fig 63 Method of Undercutting Mica Insulation on Commutator
Courtesy of Auto Electric Systems Publishing Company, Dayton, Ohio

with the mica insulation separating them. When this occurs there will be excessive arcing in the brushes which, in turn, will cause the copper to be burned away until it is level with, or below, the surface of the mica. This condition will be indicated by a rusty black color on the commutator bars. To prevent this condition, the commutator should be cleaned occasionally with sandpaper as directed. If the mica is *high,* it should be undercut as follows:

The armature is removed from the machine and placed in a lathe, truing up both commutators until they are perfectly concentric. This should be done carefully and then as fine a cut as possible taken to avoid wasting the copper needlessly. When the commutators have been trued up in the lathe, cut out mica between the commutator bars of the generator only. For this purpose a piece of hacksaw blade should be fixed in a handle, as shown in Fig. 63, and its teeth ground off until they will cut a slot that is just slightly wider than the mica insulation. The cut need not be more than $\frac{1}{32}$ inch deep. In this way a rectangular slot, free from mica, will be obtained between each two adjacent commutator bars. After undercutting the mica, the edges of these slots should be beveled very slightly with a three-corned file in order to remove any burrs which would cause excessive wear of the brushes.

It is unnecessary to undercut the mica on the motor commutator, as, wherever metal or metallic brushes are used on Delco machines, they are sufficiently hard to keep the mica flush with the surface of the copper as it wears down without any undue arcing at the brushes, whereas in the case of generators provided with carbon brushes, the carbon is not hard enough to do this. After completing the undercutting, the commutator when viewed from the end should show clean-cut retangular slots between the bars, as in the left-hand view, Fig. 63. The machine should then be reassembled and the brushes sanded-in to the commutator, as previously described. This operation of fitting the brushes to the commutator will be necessary whenever anything has been done to the commutator, when new brushes are installed, or when the third-brush location is readjusted to vary the ouput of the machine on generators having this type of regulation.

These instructions for fitting the brushes, cleaning the commutator, and undercutting the mica of the commutator of any machine equipped with soft-carbon brushes, apply with equal force to all makes of generators and starting motors employed on automobiles. Next to the battery the brushes and commutators will be found to demand most attention—or to put it in another way, they will be found to constitute a cause of trouble only second in importance to the battery. It must not be assumed, however, that all blackening of the commutator is caused always by high mica. Any one of the following conditions may cause the commutator to assume an appearance similar to that produced by high mica: (1) generator brushes of improper size or material, as where replacements other than those supplied by the manufacturer of the machine have been installed; (2) insufficient spring tension on brushes—all springs slacken up in time and they should be examined at intervals to see that the brushes are being held firmly against the commutator; (3) overloading of the generator caused by partial failure of the regulating device or other cause; and (4) an open- or short-circuit in the generator windings, or a short-circuit between generator and motor windings in a single-unit machine like the Delco.

Sometimes, when the armature has been overheated, the solder will work from between the commutator bars making them loose and causing the commutator to become black and give poor generation. If the commutator is not perfectly round, it will cause the ammeter needle to vibrate at high engine speeds. Any connections loose in the circuit will cause the same trouble.

Seating the Brushes. To insure proper operation of the machine either as a generator or as a motor, it is necessary that the brushes fit the commutator exactly and that they make good contact over their entire surface. If they do not, sparking will occur and the commutator will become burned and blackened, cutting down the efficiency of the machine. The brushes are the only wearing parts of a direct-current generator or motor, and, as this wear on them is constant, they will require attention at intervals to keep them in good condition. Whenever sufficient wear has taken place to make the contact uneven, the brushes must be fitted to the commutator or *sanded-in*. Cut a sheet of No. 00 sandpaper in strips slightly wider than the brush. Emery cloth must *never* be used for this purpose. It is metallic and will tend to cause short-circuits in the commutator. The strip of sandpaper is wrapped around the commutator so as to make contact with at least half of its circumference in the manner illustrated in (*a*) and (*c*) of Fig. 64. The smooth side of the paper is laid on the commutator so that the sanded side rubs the brush. By drawing the sandpaper back and forth, it is possible to fit the brush very accurately to the commutator. It will be obvious that if the sandpaper be applied to the commutator, as shown in (*b*) and (*d*) of the same illustration, that the brush will only touch at its center and there will be excessive sparking between the gaps thus formed.

A high squeaking note caused by the operation of either the generator or motor is an indication that either the brushes or the commutator need sanding-in as the latter will become roughened from the wear. It should be smoothed up by taking strips of the same grade of sandpaper sufficiently wide to cover the commutator, applying them by wrapping in the same manner but with the sanded surface on the commutator bars. This can be done most effectively by running the machine through its other commutator

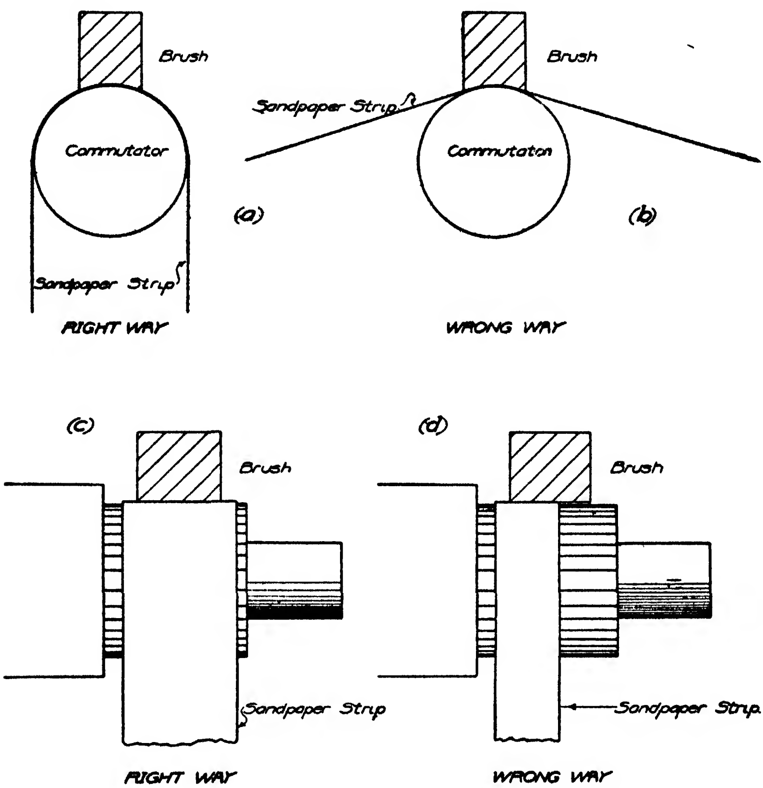


Fig 64 Method of Sanding-In Brushes
Courtesy of Auto Electric Systems Publishing Company, Dayton, Ohio

for a few moments while holding the sandpaper strip in place on the first. If, after this smoothing up, the mica insulation between the bars of the commutator is flush with the surface of the copper bars, it must be undercut. On most of the Delco machines it will be found possible to sand-in the upper and lower brushes separately by this method, but in a number of cases on account of the construction of the machine, it will be found advisable to sand-in both motor brushes, as well as both generator brushes at the same time. It is unnecessary to lubricate either the motor, the generator brushes, or the commutators, as this simply results in gumming them and causes grit and dirt to collect on the commutator and cut grooves in both it and the brushes.

Brushholder Tests and Troubles. When fitting new brushes, care should be taken to see that they slide freely in the holder, for if they stick, the brush will not make good contact with the commutator. The brush must not be too loose or it will twist or

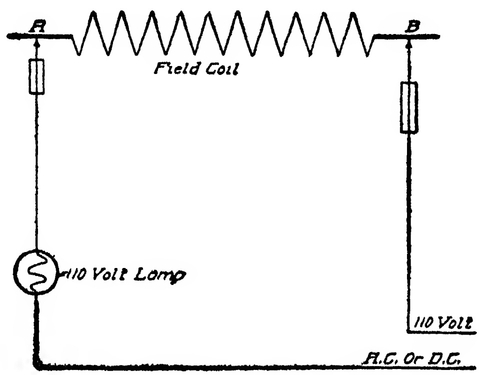


Fig. 65. Diagram for Locating Open Circuits in Field Coils with Lamp-Testing Set

cock in the holder which will not allow full brush contact and low generator output will result.

The following test can be made for a grounded brush holder: insulate the brush by putting some paper between it and the commutator. Place one test point on the holder and the other test point on the frame of the machine. If the lamp lights, it indicates that the holder is grounded. In the case of the third-brush holder the windings must be disconnected from the brush while making this test or the brush taken completely out of the holder.

Testing Field Coils. The tests of field coils are simpler than those of the armature, and they apply in large measure to practically any system.

Open-Circuits in Fields. To test for open-circuits in fields, the test set is the only apparatus required, and the points should be placed as shown in Fig. 65. By placing one point on each terminal of the particular winding to be tested, failure of the lamp to light will indicate that the coil is open-circuited, as the wire of the coil will afford a path for the current, unless broken. The fact that the lamp may not light to full brilliance in some of these coil tests is no indication of trouble, as the difference is simply due to the additional resistance represented by the coil itself. In case an open-circuited coil is found, the only remedy is to return it to the manufacturer for repair or replacement.

Grounded Fields. To test for grounds in the field windings, place one test point on the frame of the machine and the other on a terminal of the field coil. Before doing this, however, all intentional ground connections made by the terminals should be removed.

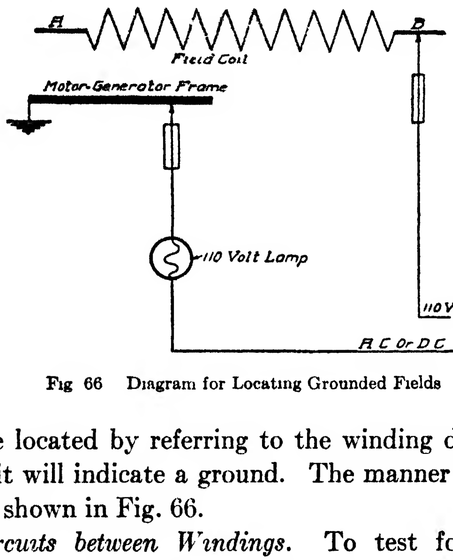


Fig 66 Diagram for Locating Grounded Fields

These can be located by referring to the winding diagram. If the lamp lights, it will indicate a ground. The manner of applying the test points is shown in Fig. 66.

Short-Circuits between Windings. To test for short-circuits between windings not normally connected, as for example the shunt and series winding of a field coil, place one test point on the terminal of one winding and the other test point on the terminal of the other field winding, as shown in Fig. 67. If the lamp lights, it will indicate a short-circuit between the windings. The field coils can also be tested with a voltmeter, the 30-volt scale being used in connection with a 6-volt storage battery for this purpose, Fig. 68. As all lighting generators have more than one winding on their fields, i.e., shunt and series windings (the latter termed "bucking coils" when reversed), these tests are equally applicable to all makes.

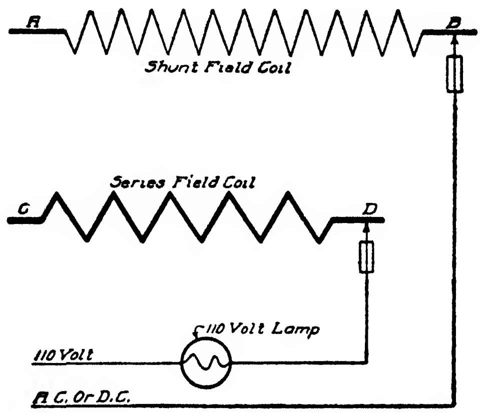


Fig 67. Diagram for Testing Short-Circuits between Windings

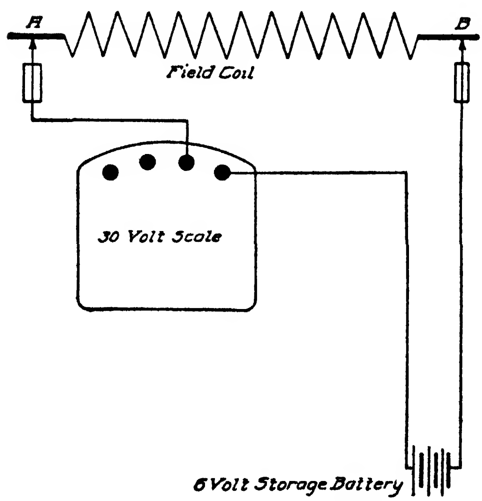


Fig. 68. Voltmeter Test Diagram for Open-Circuited Field

Voltmeter Field Tests. The method of employing the voltmeter for making field tests, shown in Figs. 68 and 69, is as follows:

To test for an open-circuited field, connect up as shown in Fig. 68. The positive terminal of the voltmeter is connected to the positive terminal of the battery. An insulated copper wire of convenient length, with the insulation stripped off for about one inch at each end, is then attached to the terminal of the voltmeter marked "30 volts," and a similar wire is attached to the negative terminal of the battery. The free ends of these wires are then used in the same manner as the points of the test set, except that the voltmeter reading is the indication sought instead of the lighting of a lamp. Before making the test, touch the free ends of the wires together. This reading will be the total voltage of the storage battery, and it should be kept in mind when making the tests.

If, instead of touching the free ends of the wire together, they are placed on the terminals of a high resistance, the voltmeter reading will naturally be much less. In other words, the value of the voltmeter reading will always depend upon the amount of resistance offered by the coil or other circuit that is being tested. When there is no circuit, as with the free ends held apart in the hands, there will be no indication on the voltmeter scale. An open-circuited coil will accordingly be indicated by a zero reading of the voltmeter when the two free ends, or points, are placed upon the terminals of the coil, Fig. 68. If, on the other hand, the voltmeter reading is nearly half of that of the battery voltage, the coil is in good condition. This test corresponds to that with the lamp-testing set using the 110-volt current, illustrated in Fig. 65. It is a method which also permits one coil to be checked against another of the same kind, as the readings given by the two coils should be approximately the same. Where neither a 110-volt current nor a portable voltmeter are available, these tests may be carried out with the aid of a 6-volt bulb in connection with the storage battery, as shown for the voltmeter tests. In this case, the lamp will light brightly when the free ends of the wires are brought together, but it will dim in proportion to the amount of extra resistance added to the circuit, as represented by the coil under test. While not so accurate as the tests with the voltmeter, comparative tests are also possible with the low-voltage lamp, a very perceptible difference in the lighting of the lamp indicating a greatly increased resistance. When using current from a storage battery for testing, care must be taken to have the points of the test set, or ends of the wire, clean and bright, and to make good, firm contact. If necessary, places on the machine at which the test points are to be applied should first be scraped or filed clean, otherwise, additional resistance will be inserted by the poor contact at the points, as for example, where the latter are applied to a painted surface.

To test for grounds in a field, after having removed all ground connections, as mentioned in a previous paragraph, place one end,

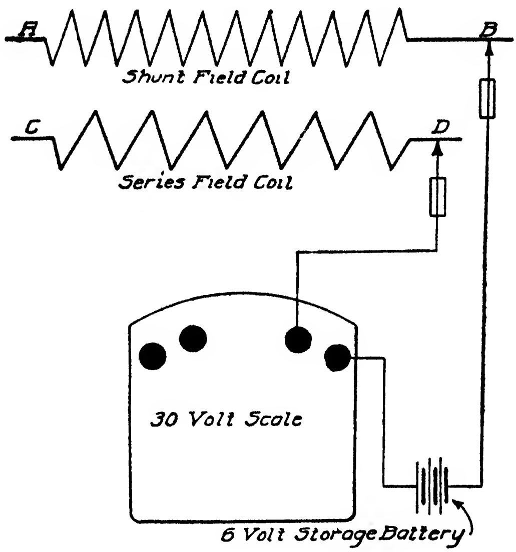


Fig 69 Voltmeter Test Diagram for Short-Circuit between Coils

or point, on a terminal of the field coil and the other on the frame of the machine. The method of making the test is identical with that shown in Fig. 66, except for the substitution of the voltmeter for the 110-volt light circuit. If the coil is free from grounds, the voltmeter needle will remain at zero; in case, there is a ground, there will be an indication on the instrument and the worse the ground the greater the value of this reading will be. This test corresponds to that illustrated in Fig. 54.

Short-Circuits between Coils. The test for short-circuits between coils is similar to that shown in Fig. 55 and naturally applies to all lighting generators where the two windings of the fields are concerned. Place one end, or point, on the terminal of one winding and the other end on the terminal of the other winding, as shown in Fig. 69. If there is no connection between the coils, as should be the case, the voltmeter needle will remain stationary. Any movement of the voltmeter needle indicates a short-circuit and the greater the value of the reading, the more complete is the short-circuit between the two coils.

In order to make these tests without removing the machine from the car, disconnect the storage battery and tape the disconnected terminals; then, insulate all the brushes by placing pieces of cardboard between them and the commutators. Disconnect all wires leading to generator terminals, and likewise, all wires leading to field-coil terminals. By referring to the circuit and wiring diagrams for the particular car under consideration, all these leads can readily be identified, and after disconnecting them, the field coils of the machine can be tested. When the tests indicate that the field coils are not in perfect condition, it will usually be found advisable to remove the field coils from the machine and send them to the manufacturer for repair or replacement, for unless the fault is plainly apparent, which will seldom be the case, the repair will usually be found to be beyond the average garage facilities.

GLOSSARY

GLOSSARY

THE following glossary of automobile terms is not intended in any sense as a dictionary and only words used in the articles themselves have been defined. The definitions have been made as simple as possible, but if other terms unfamiliar to the reader are used, these should be looked up in order to obtain the complete definition.

A

A. A. A.: Abbreviation for American Automobile Association.

Abrasive: Any hard substance used for grinding or wearing away other substances.

Absorber, Shock: See "Shock Absorber".

Accelerate: To increase the speed.

Acceleration: The rate of change of velocity of a moving body. In automobiles, the ability of the car to increase in speed. Pickup.

Accelerator: Device for rapid control of the speed for quick opening and closing of the throttle. Usually in the form of a pedal, spring returned, the minimum throttle opening being controlled by the setting of the hand throttle.

Accessory: A subordinate machine that accompanies or aids a more important machine; as, a horn is an accessory of an automobile.

Accumulator: A secondary battery or storage battery. It usually consists of chemically prepared lead plates combined with an acid solution. Upon being charged with an electric current from a primary source, a chemical change takes place which enables the plates in their turn to give a current of electricity when used as a source of power, the plates at the same time returning to their original chemical state.

Acetone: A liquid obtained as a by-product in the distillation of wood alcohol, and used in connection with reservoirs for storing acetylene for automobile lights, as it dissolves many times its own volume of acetylene gas.

Acetylated Alcohol: Alcohol which has been denatured by the addition o' acetylene, which also increases its fuel value. See "Alcohol, Denatured".

Acetylene: A gaseous hydrocarbide used as an illuminant; is usually generated for that purpose by the action of water on calcium carbide.

Acetylene Generator. A closed vessel in which acetylene gas may be produced by the action of water on calcium carbide and which supplies the gas under uniform pressure.

Acetylene Lamp: A lamp which burns acetylene gas.

Acetylite: Calcium carbide which has been treated with glucose. It is used to obtain a more uniform and slower production of acetylene gas than can be obtained with the untreated calcium carbide.

Acid: In connection with automobiles the term usually means the liquid or electrolyte used in the storage battery. See "Electrolyte".

Acid Cure. Method of rapid vulcanisation of rubber without heat. Used in tire repairs. The agent is sulphur chloride.

Acidimeter. An instrument for determining the purity of an acid.

Active Material: Composition in grids that forms plates of a storage battery. It is this material in which the chemical changes occur in charging and discharging.

Adapter: Device by which one type of lamp burner may be used instead of the one for which the lamp was designed. Usually a fitting by which a gas or oil lamp may be converted into an electric lamp.

Adhesion: That property of surfaces in contact by virtue of which one of them tends to stick to the other. It is used as synonymous with friction. The adhesion of wheels acts to prevent slipping.

Adjustment: The slackening or tightening up of parts to compensate for wear, reduce friction, or secure better contact.

Admission: In a steam engine, the letting in of the steam to the cylinder; in gas engine, the letting in of mixture of gas and air to the cylinder.

Advanced Ignition: Usually called *advancing the spark.* Setting the spark of an internal-combustion motor so that it will ignite the charge at an earlier part of the stroke.

Advance Sparking: A method by which the time of occurrence of the ignition spark may be regulated, by completing the electric circuit at the earlier period.

Advancing the Spark: See 'Advanced Ignition".

Aerodynamics: The science of atmospheric laws, i.e., the effects produced by air in motion.

After-Burning: Continued burning of the charge in an internal-combustion engine after the explosion.

After-Firing: An explosion in the muffler or exhaust passages.

A-h: Abbreviation for *ampere hour.*

Air Bottle: A portable container holding compressed air or carbon dioxide for tire inflation.

Air-Bound: See "Air Lock".

Air Compressor: A machine for supplying air under pressure for inflating tires, starting the motor, etc.

Air Cooled: Cooled by air direct. Usually referring to the cylinder of an engine, whose heat caused by the combustion within it is carried away by air convection and radiation.

Air Cooling: A system of dispersing by air convection the heat generated in the cylinder of an internal-combustion motor.

Air Intake: An opening in a carbureter to admit air.

Air Leak: Entrance of air into the mixture between carbureter and cylinder.

Air Lock: Stoppage of circulation in the water or gasoline system caused by a bubble of air lodging in the top of a bend in the pipe.

Air Pump: A pump operated by the engine or by hand to supply air pressure to the oil tank or gasoline tank; sometimes called *pressure pump*.

Air-Pump Governor: A device to regulate the speed of the air pump so as to give a uniform air pressure.

Air Resistance: The resistance encountered by a surface in motion. This resistance increases as the square of the speed, which makes it necessary to employ four times as much power in order to double a given speed.

Air Tube: See "Pneumatic Tire".

Airless Tire: Name of special make of nonpuncturable resilient tire.

A. L. A. M.: Abbreviation for Association of Licensed Automobile Manufacturers, now out of existence.

A. L. A. M. Horsepower Rating: The horsepower rating of an automobile found by the standard horsepower formula approved by the Association of Licensed Automobile Manufacturers. Since the dismemberment of this organization, the formula is usually called the S.A.E. rating. This formula is h.p. = bore of cylinder (in inches) squared × No. of cylinders ÷ 2.5, at a piston speed of 1000 feet per minute.

Alarm, Low-Water: See "Low-Water Alarm".

Alcohol: A colorless, volatile, inflammable liquid which may be used as fuel for internal-combustion engines.

Alcohol, Denatured: Alcohol rendered unfit for drinking purposes by the addition of wood alcohol, acetylene, and other substances.

Alignment: The state of being exactly in line. Applied to crankshafts and transmission shafts and to the parallel conditions of the front and rear wheels on either side.

Alternating Current: Electric current which alternates in direction periodically.

Ammeter: An instrument to measure the values of current in an electric circuit directly in amperes. Also called *ampere meter*.

Amperage: The number of amperes, or current strength, in an electric circuit.

Ampere: The practical unit of rate of flow of electric current, measuring the current intensity.

Ampere Hour: A term used to denote the capacity of a storage battery or closed-circuit primary battery. A battery that will deliver three amperes for six hours is said to have an eighteen-ampere-hour capacity.

Ampere Meter: See "Ammeter".

Angle-Iron Underframe: An underframe constructed of steel bars whose cross section is a right angle.

Anneal: To make a metal soft by heating and cooling. To draw the temper of a metal.

Annular Gear: A toothed wheel upon which the teeth are formed on the inner circumference.

Annular Valve: A circular valve having a hole in the center.

Annunciator: An installation of electric signals or a speaking tube to allow the passengers in an enclosed car to communicate with the driver.

Anti-Freezing Solution: A solution to be used in the cooling system to prevent freezing in cold weather; any harmless solution whose freezing point is somewhat below that of water may be used.

Anti-Friction Metal: Various alloys of tin and lead used to line bearings, such as Babbitt metal, white metal, etc.

Anti-Skid Device: Any device which may be applied to the wheels of a motorcar to prevent their skidding, such as tire coverings with metal rivets in them, chains, etc.

Apron: Extensions of the fenders to prevent splashing by mud or road dirt.

Armature: In dynamo-electric machines, the portion of a generator in which the current is developed, or in a motor, the portion in which the current produces rotation. In most generators in automobile work, the armature is the rotating portion. In magnetic or electromagnetic machines the armature is the movable portion which is attached to the magnetic poles.

Armature Core: The iron portion of the armature which carries the windings and serves as part of the path for the magnetic flux.

Armature Shaft: The shaft upon and with which the armature rotates.

Armature Winding: Electrical conductors, usually copper, in an armature, and in which the current is generated, in case of a generator, or in which they produce rotation in a motor.

Artillery Wheel: A wheel having heavy wood spokes.

Aspirating Nozzle: An atomizing nozzle to make the liquid passing through it pass from it in the form of a spray.

Assembled Car: A car whose chief parts, such as engine, gearset axles, body, etc., are manufactured by different parts makers, only the final process of putting them together being carried out in the car-making plant.

Atmospheric Line: A line drawn on an indicator diagram at a point corresponding with the pressure of the atmosphere.

Atmospheric Valve: See "Suction Valve".

Atomizer: A device by which a liquid fuel, such as gasoline, is reduced to small particles or to a spray; usually incorporated in the carbureter.

Auto: (1) Popular abbreviation for automobile. (2) A Greek prefix meaning self.

Auto-Bus: An enclosed motor-driven public conveyance, seating six or more people; usually has a regular route of travel.

Autocar: A motorcar or automobile; a trade name for a particular make of automobile.

Auto-Cycle: See "Motorcycle".

Autodrome: A track especially prepared for automobile driving, particularly for races.

Autogenous Welding: See "Welding, Autogenous".

Auto-Igniter: A small magneto generator or dynamo for igniting gasoline engines, the armature of which is connected with the flywheel by gears or by friction wheels, so that electric current is supplied as long as the engine revolves.

Autoist: One who uses an automobile.

Automatic Carbureter: A vaporizer or carbureter for gasoline engines whose action is entirely automatic.

Automatic Cut-Out: See "Cut-Out, Automatic".

Automatic Spark Advance: Automatic variation of the instant of spark occurrence in the cylinder. Mechanical advancing and retarding of the spark to correspond with and controlled by variations in crankshaft speed.

Auto-Meter: Trade name for special make of combined speedometer and odometer.

Automobile: A motor-driven vehicle having four or more wheels. Some three-wheeled vehicles are properly automobiles, but are usually called *tricars*.

Automobilist: The driver or user of an automobile.

Auto Truck: A motor-driven vehicle for transporting heavy loads; a heavy commercial car.

Auxiliary Air Valve: Valve controlling the admission of air through the auxiliary air intake of a carbureter.

Auxiliary Air Intake: Opening through which additional air is admitted to the carbureter at high speeds.

Auxiliary Exhaust: Ports cut through cylinder walls to permit exhaust gases to be released from the cylinder when uncovered by the piston. These are sometimes used as an additional scavenging means for the regular exhaust valves.

Auxiliary Fuel Tank: See "Fuel Tank, Auxiliary".

Auxiliary Spark Gap: See "Spark Gap, Outside".

Axle: The spindle with which a wheel revolves or upon which it revolves.

Axle, Cambered: An axle whose ends are slanted downwards to camber the wheels.

Axle, Channel: An axle which is U-shaped in cross section.

Axle, Dead: Solid, fixed, stationary axle. An axle upon which the wheels revolve but which itself does not revolve.

Axle, Dropped: An axle in which the central portion is on a lower level than the ends.

Axle, Floating: A full-floating axle. A live axle in which the shafts support none of the car weight, but serve only to turn the wheels.

Axle, I-Beam: An axle whose cross section is in the shape of the letter I.

Axle, Live: An axle in which are comprised the driving shafts that carry the power of the motor to the driving wheels.

Axle, Semi-Floating: A live axle in which the driving shafts carry all of the car weight as well as transmitting the driving torque.

Axle, Three-Quarters Floating: A live axle in which the shafts carry a part of the weight of the car, while the housing carries the balance of the weight. It is intermediated by a floating axle and the semi-floating axle.

Axle, Trussed: An axle in which downward bending is prevented by a truss.

Axle, Tubular: An axle formed of steel tubing. Usually applied to the front axles, but sometimes used in referring to tubular shafts of rear axles.

Axle Casing: That part of a live axle that encloses the driving shafts and differential and driving gears Axle housing.

Axle Housing: See "Axle Casing".

Axle Shaft: The member transmitting the driving torque from the differential to the rear wheels.

B

Babbitt: A soft metal alloy used for lining the bearings of shafts.

Back-Firing: An explosion of the mixture in the intake manifold or carbureter caused by the communication of the flame of explosion in the cylinders. Usually due to too weak a mixture. Popping.

Back Kick: The reversal of direction of the starting, caused by back-firing.

Backlash: The play between a screw and nut or between the teeth of a pair of gear wheels.

Back Pressure: Pressure of the exhaust gases due to improper design or operation of the exhaust system.

Baffle Plate: A plate used to prevent too free movement of a liquid in the container. In a gas engine cylinder, a plate covering the lower end of the cylinder to prevent too much oil being splashed into it. The plate has a slot through which the connecting rod may work.

Balance Gear: See "Differential Gear".

Balancing of Gasoline Engines: Insuring the equilibrium of moving parts to reduce the vibration and shocks.

Ball-and-Socket Joint: A joint in which a ball is placed within a socket recessed to fit it, permitting free motion in any direction within limits.

Ball Bearing: A bearing in which the rotating shaft or axle is carried upon a number of small steel balls which are free to turn in annular paths, called *races*.

Balladeur Train: A French name for a sliding change-speed gear.

Barking: The sound made by the explosions caused by after-firing.

Base Bearing: See "Main Bearing".

Base Explosion: See "Crankcase Explosion".

Battery: A combination of primary or secondary cells, as dry cells or storage cells.

Battery, Dry: See "Dry Battery".

Battery, Storage: See "Accumulator".

Battery Acid: The electrolyte in a storage battery.

Battery-Charging Plug: Power terminals to which the leads of a storage battery may be connected for charging the battery.

Battery Gage: (1) Voltmeter or ammeter or voltammeter for testing the specific gravity of the electrolyte in a secondary battery.

Battery Syringe: A syringe used to draw out a part of the electrolyte or solution from a storage battery cell to test its density and specific gravity.

Baumé: A scale indicating the specific gravity or density of liquids and having degrees as units. Gasoline of a specific gravity of .735 has a gravity of 61 degrees Baumé.

Bearing: A support of a shaft upon which it may rotate.

Bearing, Annular Ball: A ball bearing consisting of two concentric rings, between which are steel balls.

Bearing, Ball: A bearing in which the rotating shaft and the stationary portion of the bearings are separated from sliding contact by steel balls. A steel collar fitted to the shaft rolls upon the balls, which in turn roll upon steel collar attached to the stationary portion of the bearing.

Bearing, Cup and Cone: A ball bearing in which the balls roll in a race, which is formed between a cone-shaped fixed collar and a cup-shaped shaft collar.

Bearing, Main: The bearing in which rotates the crankshaft of an engine.

Bearing, Plain: A bearing in which the rotating shaft is in sliding contact with the bearing supporting it.

Bearing, Radial: A bearing designed to resist loads from a direction at right angles to the axis of the shaft.

Bearing, Roller: A bearing in which the journal rests upon, and is surrounded by, hardened steel rollers which revolve in a channel or race surrounding the shaft.

Bearing, Thrust: A bearing designed to resist loads or pressures parallel with the axis of the shaft.

Bearing Cap: That portion of a plain bearing detachable from the stationary portion, and which holds the bearing bushing and shaft.

Bearing Surface: The projected area of a bearing in a perpendicular plane to the direction of pressure.

Beau de Rochas Cycle: The four-stroke cycle used in most internal-combustion engines. This cycle was proposed by M. Beau de Rochas and put into practical form by Dr. Otto. See "Four-Cycle".

Belt and Clutch Dressing: A composition to be applied to belts and clutches to prevent them from slipping.

Belt Drive: A method of transmitting power from the engine to the countershaft or jack shaft by means of belts.

Benzine: A petroleum product having a specific gravity between that of kerosene and gasoline. Its specific gravity is between 60 degrees and 65 degrees Baumé.

Benzol: A product of the distillation of coal tar. Coal tar benzine. Used as a rubber solvent and in Europe as a motor fuel.

Berline Body: A limousine automobile body having more than two seats in the back part.

Bevel-Gear: Gears the faces of whose teeth are not parallel with the shaft, but are on a beveled edge of the gear wheel.

Bevel-Gear Drive: Method of driving one shaft from another at an angle to the first. The chief method of transmitting the drive from the propeller shaft to the rear axle shafts.

B. H. P.: An abbreviation for brake horsepower.

Bicycle: A two-wheeled vehicle propelled by the pedaling of the rider.

Binding Posts: See "Terminals".

Bleeder: A by-pass in the sight-feed of a mechanical oiling system by which the oil delivered through that feed is allowed to pass out instead of going to the bearings.

Blister: A defect in tires caused by the separation of the tread from the fabric.

Block Chain: A chain used in automobiles, bicycles, etc., of which each alternate link is a steel block.

Blow-Back: The backward rushing of the fuel gas through the inlet valve into the carbureter.

Blower Cooled: A gas engine cooled by positive circulation of air maintained by a blower.

Blow-Off: A blow-out caused by the edge of the bead of tire becoming free from the rim and allowing the tube to protrude through the space thus formed.

Blow-Out: The rupture of both the inner tube and outer casing of a pneumatic tire.

Blow-Out Patch: See "Patch, Tire Repair".

Body: (1) The superstructure of an automobile; the part that resembles and represents the body of a horse-drawn vehicle. (2) In oils, the degree of viscosity. The tendency of drops of oils to hang together.

Body Hangers: Attachments to or extensions of the frame for holding the body of the vehicle. They should be properly called frame hangers.

Boiler: A vessel in which water is evaporated into steam for the generation of power.

Boiler, Fire-Tube: A tubular steam boiler in which the end plates are connected by a number of open ended thin tubes, the spaces around which are filled with water, the hot gases passing through the tubes.

Boiler, Flash: A steam boiler in which steam is generated practically instantaneously. There is practically no water or steam stored in the boiler. A flash generator.

Boiler, Water-Tube: A steam boiler in which the water is carried in metal tubes, around which the hot gases circulate.

Boiler Alarm: See "Low-Water Alarm".

Boiler Covering: A non-conducting substance used as a covering for boilers to prevent loss of heat by radiation.

Boiler-Feed Pump: An automatic and self-regulating pump for supplying a boiler with feed water.

Boiler-Feed Regulator: A device to make the feed-water supply of the boiler automatic.

Bonnet: (1) The hood or metallic cover over the front end of an automobile. See "Hood". (2) The cover over a pump-valve box, or a slide-valve casing. (3) A cover to enclose and guide the tail end of a steam-engine-valve spindle or the cover of a piston-valve casing. (4) The pan underneath the engine in an automobile.

Boot: A covering to protect joints from dirt and water or to prevent the leakage of grease. (2) Space provided for baggage at the rear of a car.

Bore: The inside diameter of the cylinder.

Boss: An enlarged portion of a part to give a point for attachment of another part.

Bottom: The meshing of gears without clearance.

Bow Separator: A part to prevent chafing of the bows of a top when folded.

Boyle's Law of Gases: A law defining the volume and pressure of gases at constantly maintained temperatures It states that the volume of a gas varies inversely as the pressure so long as the temperature remains the same, or, the pressure of a gas is proportional to its density.

Brake: An apparatus for the absorption of power by friction, and by clamping some portion of the driving mechanism to retard or stop the forward motion of the car.

Brake, Air-Cooled: A brake whose parts are ridged to present a large surface for transferring to the air the frictional heat generated in them.

Brake, Band: A brake which contracts upon the outside of a drum attached to some part of the driving mechanism.

Brake, Constricting Band: A form of brake applied by tightening a band around a pulley or drum.

Brake, Differential: A brake acting upon the differential gear.

Brake, Double-Acting: A brake which will hold when the drum is rotating in either direction.

Brake, Drum, and Band: See "Brake, Band".

Brake, Emergency: A brake intended to be used in case the service brake does not act to a sufficient extent.

Brake, Expanding-Band: A drum brake in which the braking force is exerted by a band forced outward against the inner rim of a pulley.

Brake, External-Contracting: A brake consisting of a drum affixed to a rotating part, the outer surface of which is encircled by a contracting band.

Brake, Foot: A brake designed to be operated by the driver's foot. A pedal brake. Usually the service brake.

Brake, Front-Wheel: A brake designed to operate on the front wheels of the car.

Brake, Gearset: A brake designed to act on the transmission shaft and attached to the gearbox.

Brake, Hand: A brake designed to be operated by means of a hand lever. Usually the emergency brake.

Brake, Hub: A brake consisting of a drum secured to one of the wheels. This is the usual type.

Brake, Internal: A brake in which an expanding mechanism is contained within a rotating drum, the expansion bringing pressure to bear on the drum.

Brake, Internal-Expanding: A brake consisting of a drum, against the inside of which may be expanded a band or a shoe.

Brake, Motor: A brake in an electric vehicle which acts upon the armature shaft of the motor.

Brake, Service: A brake designed to be used in ordinary driving. It is usually operated by the driver's foot.

Brake, Shoe: A brake in which a metal shoe is clamped against a revolving wheel

Brake, Transmission: A brake designed to act upon the transmission shaft

Brake, Water-Cooled: A brake through which water may be circulated to carry off the frictional heat.

Brake Equalizer: A mechanism applied to a system of brakes operated in pairs to assure that each brake shall be applied with equal force

Brake Horsepower: The horsepower supplied by an engine as shown by the application of a brake or absorption dynamometer.

Brake Housing: A casing enclosing the brake mechanism

Brake Lever: The lever by which the brake is applied to the wheel.

Brake Lining: The wearing surface of a brake, usually arranged to be easily replaced when worn.

Brake Pedal: Pedal by which the brake is applied.

Brake Pull Rod: A rod transmitting the tension from the lever or pedal to the movable portion of the brake proper.

Brake Ratchet: A device by which the brake lever or brake pedal can be set in position and retained there, usually consists of a notched quadrant with which a movable tongue on the lever head or pedal engages

Brake Rod: The rod connecting the brake lever with the brake

Brake Test: A test of a motor by means of a dynamometer to determine its power output at different speeds.

Braking Surface. The surface of contact between the rotating and stationary parts of a brake.

Braze: To join by brazing

Brazing: The process of permanently joining metal parts by intense heat

Breaker Strip: A strip of canvas placed between the tread and body of an outer tire casing to increase the wearing qualities.

Breather: An opening in the crankcase of a gas engine to permit pressure therein to remain equal during the movement of the pistons.

British Thermal Unit. The ordinary unit of heat. It is that quantity of heat required to raise the temperature of one pound of pure water one degree Fahrenheit at the temperature of greatest density of water.

Brougham Body: A closed-in automobile body having windows at the side doors, and in front, but with no extension of the roof over the front seat.

Brush Holder: In electrical machinery, an arrangement to hold one end of a connection flexible in contact with a moving part of the circuit.

B. T. U.: Abbreviation for *British Thermal Unit.*

Buckboard: A four-wheeled vehicle in which the body and springs are replaced by an elastic board or frame

Buckling: Irregularities in the shape of the plates of storage cells following a too rapid discharge.

Bumper: (1) A contrivance at the front of the car to minimize shock of collision; it consists of plungers working in tubes and gaining elasticity from springs. (2) A bar placed across the end of a car, usually the front end, to take the shock of collision and thus prevent damage to the car itself. A rubber or leather pad interposed between the axle and frame of a car.

Burner, "Torch" Igniter: A movable auxiliary vaporizer for starting the fire in steam automobile burners.

Bushing: A bearing lining. Usually made of anti-friction metal and capable of adjustment or renewal.

Bus-Pipe: A manifold pipe.

Butterfly Valve: A valve inserted in a pipe, usually circular and of nearly the same diameter as the pipe, designed to turn upon a spindle through its diameter and thus shut off or permit flow through the pipe. Usually employed for throttle valves and carbureter air valve..

Buzzer: (1) A name sometimes applied to the vibrator or trembler of a jump-spark ignition coil. (2) A device used in place of a horn, and consisting of a diaphragm which is made to vibrate rapidly by an electromagnet.

By-Pass: A small valve to provide a secondary passage for fluids passing through a system of piping.

C

C: Abbreviation for a centigrade degree of temperature.

Calcium Carbide: A compound of calcium and carbon used for the generation of acetylene by the application of water.

Calcium Chloride: A salt which dissolved in water is used as an anti-freezing solution.

Cam: A revolving disk, irregular in shape, fixed on a revolving shaft so as to impart to a rod or lever in contact with it an intermittent or variable motion.

Cam, Exhaust: A cam designed to operate the exhaust of an engine.

Cam, Ignition: A cam designed to operate the ignition mechanism. In magnetos it operates the make-and-break device.

Cam, Inlet: A cam designed to operate the inlet valve of an engine.

Camber: (1) The greatest depth of curvature of a surface. (2) The amount of bend in an axle designed to incline the wheels.

Camber of Spring: The maximum distance between the upper and lower parts of a spring under a given load.

Cambered Frame: A narrowing of the front of a motor car to permit of easier turning.

Cam Gear: The gear driving the camshaft of a gas engine. In a four-cycle engine this is the same as the two-speed gear.

Camshaft: A shaft by which the valve cams are rotated; also known as the *secondary shaft.*

Camshaft, Overhead: The camshaft carried along or above the cylinder heads, to operate overhead valves.

Camshaft Gears: The gears or train of gears by which the camshaft is driven from the crankshaft. Half-time gears, timing gears, distribution gears.

Canopy: An automobile top that can not be folded up.

Capacity of a Condenser: The quality of electricity or electrostatic charge. Of a storage battery, the amount of electricity which may be obtained by the discharge of a fully charged battery. Usually expressed in ampere hours.

Cape Hood: An automobile top which is capable of either being folded up or extended.

Car: A wheeled vehicle.

Carbide: See "Calcium Carbide".

Carbide Feed: A type of acetylene generator in which the calcium carbide is fed into the water.

Carbon Bridge: Formation of soot between points of spark plug.

Carbon Deposit: A deposit upon the interior of the combustion chamber of a gasoline engine composed of carbonaceous particles from the lubricating oil, too rich fuel mixture, or road dust.

Carbon Remover: A tool or solution for removing carbon deposits from the cylinder, piston, or spark plug of a gasoline engine.

Carbonization: The deposit of carbon.

Carbureter: An appliance for mixing an inflammable vapor with air. It allows air to be passed through or over a liquid fuel and to carry off a portion of its vapor mixed with the air, forming an explosive mixture.

Carbureter, Automatic: A carbureter so designed that either the air supply alone or both the air and gasoline supplies are regulated automatically.

Carbureter, Constant-Level: A carbureter the level of the gasoline in which is maintained automatically at a constant height. A float-feed carbureter.

Carbureter, Exhaust-Jacketed: A carbureter whose mixing chamber is heated by the circulation of exhaust gas.

Carbureter, Multiple-Jet: A carbureter having more that one spray nozzle or jet.

Carbureter, Water-Jacketed: A carbureter whose mixing chamber is heated by the circulation of water from the cooling system.

Carbureter Float: A buoyant part of the carbureter designed to float in the gasoline and connected to a valve controlling the flow from the fuel tank, designed to maintain automatically a constant level of the gasoline in the flow chamber.

Carbureter Float Chamber: A reservoir containing the float and in which a constant level of fuel is maintained.

Carbureter Jet: The opening through which liquid fuel is ejected in a spray from the standpipe of a carbureter nozzle.

Carbureter Needle Valve: A valve controlling the flow of fuel from the flow chamber to the standpipe.

Carbureter Nozzle: See "Carbureter Jet".

Carbureter Standpipe: A vertical pipe carrying the nozzle.

Carburetion: The process of mixing hydrocarbon particles with the air. The action in a carbureter.

Cardan Joint: A universal joint or Hooke's coupling.

Cardan Shaft: A shaft provided with a Cardan joint at each end.

Casing: The shoe or outer covering of a double-tube automobile tire.

Catalytic Ignition: See "Ignition, Catalytic".

Cell: One of the units of a voltaic battery.

Cell, Dry: See "Dry Cell".

Cell, Storage: See "Accumulator".

Cellular Radiator: A radiator in which the openings between the tubes are in the form of small cells. The same as a *honeycomb radiator*.

Cellular Tire: A cushion tire which is divided into compartments or cells.

Center of Gravity: That point in a body, which, if the body were suspended freely in equilibrium, would be the point of application of the resultant forces of gravity acting upon the body.

Center Control: The location of the gear-shift and emergency brake levers of a car in the center of a line parallel to the front of the front seat.

Centigrade Scale: The thermometer scale invented by Celsius. Used universally in scientific work.

Century. In automobiling, a hundred-mile run.

C. G. S. System: Abbreviation for centimeter-gram-second system of measurement; the standard system in scientific work.

Chain, Drive: A heavy chain by which the power from the motor may be transmitted to the rear wheels of an automobile.

Chain, Roller: A sprocket chain, the cross bars of whose links are rollers.

Chain, Silent: See "Silent Chain".

Chain, Tire: A small chain fastened about the tire to increase traction and prevent skidding.

Chain Wheel: A sprocket wheel for the transmission chains of a motor-driven vehicle.

Change-Speed Gear: See "Gear, Change-Speed".

Change-Speed Lever: See "Lever, Change-Speed".

Charge: The fuel mixture introduced into the cylinder of a gas engine. The act of storing up electric energy in an accumulator.

Charging: The passing of a current of electricity through a storage cell.

Charles' Law of Gases: See "Gases, Gay Lussac's Law of".

Chassis. The mechanical features of a motor car assembled, but without body, fenders, or other superstructure not essential to the operation of the car.

Chauffeur: In America this term means the paid driver or operator of a motor car. The literal translation from the French means stoker or fireman of a boiler.

Check, Steering: See "Steering Check".

Check Valve: An automatic or non-return valve used to control the admission of feed water in the boiler, etc.

Choke: The missing of explosions or poor explosions due to too rich mixture.

Circuit, Primary: See "Primary Circuit".

Circuit, Secondary: See "Secondary Circuit".

Circuit Breaker: A device installed in an electric circuit and intended to open the circuit automatically under predetermined conditions of current flow.

Circulating Pump: A pump which keeps a liquid flowing through a series of pipes which provides a return circuit. In a motor car, water and oil circulation is maintained by circulating pump.

Circulation Pump: A mechanically operated pump by which the circulation of water in the cooling system is maintained.

Circulating System: The method or series of pipes through which a continuous flow of water or oil is maintained and in which the liquid is sent through the system over and over.

Clash Gear: A sliding change-speed gear.

Clearance: (1) The distance between the road surface and the lowest part of the under-body of an automobile. (2) The space between the piston of an engine when at the extremity of its stroke, and the head of the cylinder.

Clearance, Valve: See "Valve Clearance".

Clearance Space: The space left between the end of the cylinder and the piston plus the volume of the ports between the valves and the cylinder.

Clevis: The fork on the end of a rod.

Clevis Pin: The pin passing through the ends of a clevis and through the rod to which the clevis is joined.

Clincher Rim: A wheel rim having a turned-in edge on each side, forming channels. Into this the edge or flange of the tire fits, the air pressure within locking the tire and rim together.

Clincher Tire: A pneumatic tire design to fit on a clincher rim.

Clutch: A device for engaging or disconnecting two pieces of shafting so that they revolve together or run free as desired.

Clutch Cone: A clutch whose engaging surfaces consist of the outer surface of the frustrum of one cone and the inner surface of the frustrum of another.

Clutch, Contracting-Band: A clutch consisting of a drum and band, the latter contracting upon the former.

Clutch, Dry-Plate: A clutch whose friction surfaces are metal plates, not lubricated.

Clutch, Expanding-Band: A clutch consisting of a drum and band, the latter expanding within the former.

Clutch, Jaw: A clutch whose members lock end to end by projections or jaws in one entering corresponding depressions in the other.

Clutch, Multiple-Disk: A clutch whose friction surfaces are metal plates or disks, alternate disks being attached to one member and the rest to the other member of the drive.

Clutch Brake: A device designed to stop automatically the rotation of the driven member of a clutch after disengagement from the driving member.

Clutch Lining: The wearing surface of a clutch. This may be easily removed and replaced when worn.

Clutch Pedal: The pedal by which the clutch may be disengaged, engagement being obtained automatically by means of a spring.

Clutch Spring: A spring arranged to either hold a clutch out of gear or throw it into gear.

Coasting: The movement of the car without constant applications of the motive power, as in running downhill with the aid of gravity or on the level, through the momentum obtained by previous power applications.

Cock, Priming: A small cock, usually operated by a lever, for admitting gasoline to the carbureter to start its action.

Coil, Induction: See "Spark Coil".

Coil, Non-Vibrator: A coil so designed that it will supply a sufficient spark for the ignition with one make and break of the primary circuit.

Coil, Primary: See "Primary Coil".

Coil, Secondary: See "Secondary Spark Coil".

Coil, Spark: See "Spark Coil".

Coil, Vibrator: A spark coil with which is incorporated an electromagnetic vibrator to make and break the primary circuit.

Coil Vaporizer: An auxiliary vaporizer to assist in starting a steam boiler. It is a coil of tubing into which liquid gasoline is admitted and burned to start the generation of gas in the main burner.

Cold Test: The temperature in degrees Fahrenheit at which a lubricant passes from the fluid to the solid state.

Combustion Chamber: That part of an explosive motor in which the gases are compressed and then fired, usually by an electric spark.

Combustion Space: See "Clearance" and "Clearance Space".

Commercial Car: A motor-driven vehicle for commercial use, such as transporting passengers or freight.

Commutator: In the ignition system of an explosive motor, the commutator is a device to automatically complete the circuit of each of a number of cylinders in succession.

Commutator of Dynamo or Motor: That part of a dynamo which is designed to cause the alternating current produced in the armature to flow in one direction in the external circuit; in a motor, to change the direct current in the external circuit into alternating current.

Compensating Carbureter: An automatic attachment to a carbureter controlling either air or fuel admission, or both, so that the proportion of one to the other is always maintained under any vibration of power required.

Compensating Gear: See "Differential Gear".

Compensating Joint: See "Universal Joint".

Compound Engine: A multiple-expansion steam engine in which the steam is expanded in two stages, first in the high-pressure cylinder and then in the low-pressure cylinder.

Compression: (1) That part of the cycle of a gas engine in which the charge is compressed before ignition; in a steam engine it is the phase of the cycle in which the pressure is increased, due to compression of the exhaust steam behind the piston. (2) The greatest pressure exerted on the gas in the compression chamber.

Compression Chamber: The clearance volume above the piston in a gas engine; also called "Compression Space".

Compression Cock: See "Compression-Relief Cock".

Compression Line: The line on an indicator diagram corresponding to the phase of the cycle in which the gas is compressed.

Compression-Relief Cock: A small cock by which the compression chamber of an internal-combustion motor may be opened to the air and thus allow the compression in the cylinder to be relieved to facilitate turning by hand, or *cranking*.

Compression Space: See "Compression Chamber".

Compression Tester: A small pressure gage by which the degree of compression of the mixture in a gas-engine cylinder may be tested.

Compressor, Air: See "Air Compressor".

Condenser: (1) In a steam motor, an apparatus in which the exhaust steam is converted back into water. (2) A device for increasing the electric capacity of a circuit. Used in an ignition circuit to increase the strength of the spark.

Cone Bearing: A shaft bearing in which the shaft is turned to a taper and the journal turned to a conical or taper form.

Cone Clutch: A friction clutch in which there are two cones, one fitting within the other.

Connecting Rods: The part of an engine connecting the piston to the crank, and by means of which a reciprocating motion of the piston is converted into the rotary motion of the crank.

Constricting Band Brake: See "Brake, Constricting Band".

Constricting Clutch: A friction clutch in which a band is tightened around a drum to engage it.

Contact Breaker: A device on some forms of gasoline motors having an induction coil of the single jump-spark type, to open and close the electric circuit of the battery and coil at the proper time for the passage of the arc or spark at the points of the spark plug.

Contact Maker: See "Contact Breaker".

Continental Drive: Double-chain drive.

Control: The levers, pedals, etc., in general with the speed and direction of a car is regulated by the driver. In speaking of right, left, or center control, the gearshift and emergency brake levers only are meant.

Control, Spark: Method of controlling the power of an engine by varying the point in the stroke at which ignition takes place.

Control, Throttle: Method of governing the power of the engine by altering the area of the passage leading to the admission valve so that the amount of the fuel introduced into the cylinder is varied.

Controller, Electric: Apparatus for securing various combinations of storage cells and of motors so as to vary the speed of the car at will.

Converter: A device for changing alternating current into direct current for charging storage batteries, etc. Converters may be any of three kinds: rotary, electrolytic, or mercury-vapor. The mercury-vapor converter is most widely used.

Convertible Body: An automobile body which may be used in two or more ways, usually as an open or closed carriage, or in which several seats may be concealed, and raised to increase the seating capacity.

Cooling Fan: Fan used in automobiles to increase the current of air circulating around the cylinders, or through the radiator.

Cooling System: The parts of a gas engine or motor car by which the heat is generated in the cylinder by the combustion of the fuel mixture. See "Water Cooling" and "Air Cooling".

Cork Inserts: Pieces of cork inserted in friction surfaces of clutches or brakes to give softer action.

Cotter Pin: A split metal pin designed to pass through holes in a bolt and nut to hold the former in place.

Coulomb: The unit of measure of electrical quantity. Sometimes called "Ampere Second". It is equivalent to the product of the current in amperes by the number of seconds current has been flowing.

Counterbalance: Weights attached to a moving part to balance that part.

Countershaft: An intermediate or secondary shaft in the power-transmission system.

Coupé: An enclosed body seating one or two passengers and the driver, all within.

Coupling, Flexible: See "Universal Joint".

Cowl: That portion of the body of the car which forms a hood over the instrument board or dash.

Cowl Tank: A fuel tank carried under the cowl and immediately in front of the dash

Crank: A lever designed to convert reciprocating motion into rotating motion or *vice versa;* usually in the form of a lever formed at an angle with the shaft, and connected with piston by means of connecting rod.

Crank, Starting: A handle made to fit the projecting end of the crankshaft of a gas engine, so that the engine may be started revolving by hand.

Crankcase: The casing surrounding the crank end of the engine.

Crankcase Explosion: Explosion of unburned gases in the crankcase.

Crank Chamber: The enclosed space of small engines in which the crank works.

Cranking: The act of rotating the motor by means of a handle in order to start it. Turning the flywheel over a few times causes the engine to take up its cycle, and after an explosion it continues to operate.

Crankpin: The pin by which the connecting rod is attached to the crank.

Crankshaft: The main shaft of an engine.

Crankshaft, Offset: A crankshaft whose center line is not in the same plane as the axis of its cylinders.

Creeping of Pneumatic Tires: The tendency of pneumatic tires to push forward from the ground, and thus around the rim, in the effort to relieve and distribute the pressure.

Cross Member: A structural member of the frame uniting the side members.

Crypto Gear: See "Planetary Gear".

Crystallization. The rearrangement of the molecules of metal into a crystalline form under continued shocks. This is often the cause of the breaking of the axles and springs of a motor car.

Cup, Priming: A small cup-shaped device provided with a cock, by which a small quantity of gasoline can be introduced into the cylinder of a gasoline engine.

Current: The rate of flow of electricity; the quantity of electricity which passes per second through a conductor or circuit.

Current Breaker: See "Contact Breaker".

Current Indicator: A device to indicate the direction of current flow in a circuit; a polarity indicator.

Current Rectifier: A device for converting alternating current into direct current. See "Converter".

Cushion Tire: See "Tire, Cushion".

Cut-Off, Gas Engine: That point in the cycle of an internal-combustion engine at which the admission of the mixture is discontinued by the closing of the admission valve.

Cut-Off, Steam Engine: That point in the cycle of a steam engine, or that point on an indicator diagram, at which the admission of steam is discontinued by the closing of the admission valve.

Cut-Out, Automatic: A device in a battery charging circuit designed to disconnect the battery from the circuit when the current is not of the proper voltage.

Cut-Out, Muffler: A device by which the engine is made to exhaust into the air instead of into the muffler.

Cut-Out Pedal: Pedal by means of which the engine is made to exhaust into the air instead of into the muffler.

Cycle: A complete series of operations beginning with the drawing in of the working gas, and ending after the discharge of the spent gas.

Cycle, Beau de Rochas: See "Beau de Rochas Cycle".

Cylinder: A part of a reciprocating engine consisting of a cylindrical chamber in which a gas is allowed to expand and move a piston connected to a crank.

Cylinder Bore: See "Bore".

Cylinder Cock: A small cock used to allow the condensed water to be drained away from the cylinder of a steam engine, usually called a *drain cock.*

Cylinder Head: That portion of a cylinder which closes one end.

Cylinder Jacket: See "Jacket, Water".

Cylinder Oil: Lubricant particularly adapted to the lubrication of cylinder walls and pistons of engines.

D

Dash: The upright partition of a car in front of the front seat and just behind the bonnet.

Dash Adjustment: Connections by which a motor auxiliary may be adjusted by a handle on the dash. Usually applied to carbureter adjustments.

Dash Coil: An induction coil for jump-spark ignition, having an element for each cylinder, with dash connections to the commutator on the engine or camshaft.

Dash Gage: A steam, water, oil, or electric gage placed upon the dash of the car.

Day Type of Engine: The two-cycle internal-combustion engine with an air-tight crankcase.

Dead Axle: See "Axle, Dead".

Dead Center: The position of the crank and connecting rod in which they are in the same straight line. There are two positions, and in these positions no rotation of the crankshaft is caused by pressure on the piston.

Decarbonizer: See "Carbon Remover".

Deflate: Reduction of pressure of air in a pneumatic tire.

Deflector: In a two-cycle engine, the curved plate on the piston head designed to cause the incoming charge to force out the exhaust gases and thus assist in scavenging.

Deflocculated Graphite: Graphite so finely divided that it remains in suspension in a liquid.

Demountable Rim: A rim upon which a spare tire may be mounted and carried, and so arranged that it may be easily and quickly taken off or put on the wheel.

Denatured Alcohol: See "Alcohol, Denatured".

Densimeter: See "Hydrometer".

Depolarizer: Material surrounding the negative element of a primary cell to absorb the gas which would otherwise cause polarizing.

Detachable Body: A body which may be detached from and placed upon the chassis.

Detachable Rim: See "Demountable Rim".

Diagram Indicator: See "Indicator Card".

Diagram, Jeantaud: A diagrammatic representation of the running gear of an automobile, showing it turning corners of various radii for the purpose of determining the front-axle and steering connections.

Diesel Gas Engine: Four-cycle internal-combustion engine in which the explosion of the charge is accomplished entirely by the temperature produced by the high compression of the mixture.

Differential, Bevel-Gear: A balance gear in which the equalizing action is obtained by means of bevel gears.

Differential, Spur-Gear: A differential gear in which the equalizing action is obtained by spur gears.

Differential Brake: See "Brake, Differential".

Differential Case: See "Differential Housing".

Differential Gear: A mechanism to permit driving the wheels and yet allow them to turn a corner without slipping. An arrangement such that the driving wheels may turn independently of each other on a divided axle, both wheels being under the control of the driving mechanism. Sometimes called *balance, compensating,* or *equalizing gear.*

Differential Housing: The case that encloses the differential gear.

Differential Lock: A device which prevents the operation of the differential gear, so that the wheels turn as if they were on a solid shaft.

Dimmer: An arrangement for lowering the intensity of, or reducing the glare from headlights.

Direct Current: A current which does not change its direction of flow, as the current from a battery or a direct-current generator. Distinguished from an alternating current, which reverses its direction many times a minute.

Direct Drive: Transmission of power from engine to the final driving mechanism at crankshaft speed.

Discharge: In a storage battery, the passage of a current of electricity stored therein. In the ignition circuit, the flow of high-tension current at the spark gap.

Disk Clutch: A clutch in which the power is transmitted by a number of thin plates pressed face to face.

Distance Rod: See "Radius Rod".

Distribution Shaft: See "Camshaft".

Distributor: That part of the ignition system which directs the high-tension current, to the respective spark plugs in the proper firing order.

Double Ignition: A method of ignition which comprises two separate systems, either of which may be used independently of the other, or both together as desired. Usually distinguished by two current sources and two sets of plugs.

Drag: That action of a clutch or brake which does not completely release.

Drag Link: That rod in a steering gear which forms the connection between the mechanism mounted on the frame and the axle stub, and transmits the movements of steering from steering post to wheels.

Drive Shaft: The shaft transmitting the motion from the change gears to the driving axle; the torsion rod.

Driving Axle: The axle of a motor car through which the power is transmitted to the wheels.

Driving Wheel: The wheel to which or by which the motion is transmitted.

Dry Battery: A battery of one or more dry cells.

Dry Cell: A primary voltaic cell in which a moist material is used in place of the ordinary fluid electrolyte.

Dual Ignition: An ignition system comprising two sources of current and one set of spark plugs.

Dust Cap: A metal cap to be screwed over a tire valve to protect the latter from dust and water.

Dynamo: The name frequently applied to a dynamo-electric machine used as a generator. Strictly, the term *dynamo* should be applied to both motor and generator.

Dynamometer: The form of equalizing gear attached to a source of power or a piece of machinery to ascertain the power necessary to operate the machinery at a given rate of speed and under a given load.

E

Earth: See "Ground".

Economizer, Gas: An appliance to be attached to a float-feed carbureter to improve the mixture by automatically governing the amount of air in the float chamber.

Eccentric: A disk mounted off-center on a shaft to convert rotary into reciprocating motion.

Economy, Fuel: The fuel economy of a motor is the relation between the heat units in the fuel used in the motor and the work or energy given out by the motor.

Efficiency: The proportion of power obtained from a mechanism as compared with that put into it.

Efficiency of a Motor: The efficiency of a gasoline motor is the relation between the heat units consumed by the motor and the work of energy in foot-pounds given out by it. Electrical efficiency of a motor is the relation between the electrical energy put into the motor and the mechanical energy given out by it.

Ejector: An apparatus by which a jet of steam propels a stream of water in almost the same way as an injector, except that the ejector delivers it into a vessel having but little pressure in it.

Electric Generator: A dynamo-electric machine in which mechanical energy is transformed into electrical energy; usually called *dynamo*.

Electric Horn: An automobile horn electrically operated.

Electric Motor: A dynamo-electric machine in which electrical energy is transformed into mechanical energy.

Electric Vehicle: An automobile propelled by an electric motor, for which current is supplied by a storage battery carried in the vehicle.

Electrolyte: A compound which can be decomposed by electric current. In referring to storage batteries, the term electrolyte means the solution of sulphuric acid in water in which the positive and negative plates are immersed.

Electromagnet: A temporary magnet which obtains its magnetic properties by the action of an electric current around it and which is a magnet only as long as such current is flowing.

Electromotive Force: A tendency to cause a current of electricity to flow; usually synonymous with *potential, difference of potential, voltage*, etc.

Element: The dissimilar substances in a battery between which an electromotive force is set up, as the plates of a storage battery.

Emergency Brake: A brake to be applied when a quick stop is necessary; usually operated by a pedal or lever.

En Bloc: That method of casting the cylinders of a gasoline engine in which all the cylinders are made as a single casting. Block casting; monoblock casting.

End Play: Motion of a shaft along its axis.

Engine, Alcohol: An internal-combustion engine in which a mixture of alcohol and air is used as fuel.

Engine, Gasoline: An internal-combustion motor in which a mixture of gasoline and air is used as fuel.

Engine, Kerosene: An internal-combustion engine in which a mixture of kerosene and air is used as fuel.

Engine, Steam. An engine in which the energy in steam is used to do work by moving the piston in a cylinder.

Engine Primer: A small pump to force fuel into the carbureter.

Engine Starter: An apparatus by which a gasoline engine may be started in its cycle of operations without use of the starting crank. It belongs usually to one of four classes: (1) Mechanical or spring actuated, such as a coil spring wound up by the running of the engine or a strap around the flywheel; (2) fluid pressure, such as compressed air or exhaust gases induced into the cylinder to drive the piston through one cycle; (3) the electric system, in which a small motor is used to turn the engine over; (4) combinations of these.

Epicyclic Gear: See "Planetary Gear".

Equalizing Gear: See "Differential Gear".

Exhaust: The gases emitted from a cylinder after they have expanded and given up their energy to the piston; the emission of the exhaust gases.

Exhaust, Auxiliary: See "Auxiliary Exhaust".

Exhaust Horn: An automobile horn in which the sound is produced by the exhaust gases.

Exhaust Lap: The extension of the inside edges of a slide valve to give earlier closing of the exhaust. Also called *inside lap.*

Exhaust Manifold: A large pipe into which the exhaust passages from all the cylinders open.

Exhaust Port: The opening through which the exhaust gases are permitted to escape from the cylinder.

Exhaust Steam: Steam which has given up its energy in the cylinder and is allowed to escape.

Exhaust Stroke: The stroke of an internal-combustion motor during which the burned gases are expelled from the cylinder.

Exhaust Valve: A valve in the cylinder of an engine through which the exhaust gases are expelled.

Expanding Clutch: A clutch in which a split pulley is expanded to press on the inner circumference of a ring which surrounds it, and thus transmits motion to the ring.

Expansion, Gas Engine: That part of the cycle of a gas engine immediately after ignition, in which the gas expands and drives the piston forward.

Expansion, Steam Engine: That portion of the stroke of the steam engine in which the steam is cut off by the valves and continues to perform work on the piston, increasing in volume and decreasing in pressure.

Explosive Motor: See "Internal-Combustion Motor".

F

Fan, Cooling: A mechanically operated fan for producing a current of air for cooling the radiator or cylinder of a gas engine.

Fan, Radiator: A mechanically operated rotary fan used to induce the flow of air through the radiator to facilitate the cooling of the water.

Fan Belt: The belt which drives the cooling fan.

Fan Pulley: A pulley permanently attached to the fan and over which the fan belt runs to drive it.

Fat Spark: A short, thick, ignition spark.

Feed Pump: A pump by which water is delivered from the tank to the boiler of a steam car.

Feed Regulator: A device to maintain a uniform water level in a steam boiler by controlling the speed of the feed pump.

Feed-Water Heater: An apparatus for heating the boiler-feed water, either by means of a jet of steam or steam-heated coils.

Fender: A mud guard or shield over the wheels of a car.

Field, Magnetic: Space in the neighborhood of the poles of a magnet in which the magnetism exerts influence. Field also refers to the coils which produce the magnetism in an electromagnet.

Fierce Clutch: A clutch which cannot be engaged easily. A grabbing clutch.

Filler Board: Woodwork shaped to fill the space between the lower edge of the windshield and the dash.

Fin: Projections cast on the cylinders of a gas engine to assist in cooling.

Final Drive: That part of a car by which the driving effort is transmitted from the parts of the transmission carried on the frame to the transmission parts on the rear axle. The propeller shaft in a shaft-drive car.

Fire Test: A test of a lubricant to determine the temperature at which it will burn.

Firing: (1) Ignition of the charge in a gas engine. (2) The act of furnishing fuel under the boiler of a steam engine.

First Speed: That combination of transmission gears which gives the lowest gear ration forward. Slow speed, low speed.

Flash Boiler: A boiler arranged to generate highly superheated steam almost instantaneously, by allowing water to come in contact with very hot metal surfaces.

Flash Generator: See "Flash Boiler".

Flash Point: The temperature at which an oil will give off a vapor that will ignite when a flame comes in contact with it.

Flash Test: A test to determine the flash point of oils.

Flexibility: In an engine the ability to do useful work through a range of speeds.

Flexible Coupling: See "Universal Joint".

Flexible Shaft: A pliant shaft which will transmit considerable power when revolving.

Flexible Tubing: A tube for the conduction of liquids or gases, which may be bent at a small radius without leaking.

Float Carbureter: A carbureter for gasoline engines in which a float of cork or hollow metal controls the height of the liquid in the atomizing nozzle. Sometimes called *float-feed carbureter*.

Float Valve: An automatic valve by which the admission of a liquid into a tank is controlled through a lever attached to a hollow sphere which floats on the surface of the liquid and opens or closes the valve according as it is high or low.

Floating Axle: See "Axle, Floating".

Floating the Battery on the Line: Charging the battery while it is giving out current.

Flooding: Excessive escape of fuel in a carbureter from the spraying nozzle.

Flushing Pin: In a float-feed carbureter, a pin arranged to depress the float in priming. Also called *primer* and *tickler*.

Flywheel: A wheel upon the shaft of an engine which, by virtue of its moving mass, stores up the energy of the gas transmitted to the flywheel during the impulse stroke and delivers it during the rest of the cycle, thus producing a fairly constant torque.

Flywheel Marking: Marks on the face of a flywheel to indicate the time of valve opening and closing and thus assist in valve setting.

Foaming: See "Priming".

Fore Carriage: A self-propelled vehicle in which the motor is carried on the forward trucks, and propelling and steering is done with the forward trucks.

Fore-Door Body: An automobile body having doors in the forward compartment.

Four-Cycle or Four-Stroke Cycle: The cycle of operations in gas engines occupying two complete revolutions or four strokes.

Four-Wheel Drive: Transmission of driving effort to all four wheels.

Fourth Speed: That combination of transmission gears which gives the fourth from the lowest gear ratio forward. Usually the highest speed.

Frame: The main structural part of a chassis. It is carried upon the axles by the springs and carries the different elements of the car.

Frame Hangers: See "Body Hangers".

Free Wheel: A wheel so arranged that it can rotate more rapidly than the mechanism which drives it.

Friction: The resistance existing between two bodies in contact which tends to prevent their motion on each other.

Friction Clutch: A device for coupling and disengaging two pieces of shafting while in motion, by the friction of cones or plates on one another.

Friction Disk: The thin plate used in a disk or friction clutch. See "Disk Clutch".

Friction Drive: A method of transmitting power or motion by frictional contact.

Fuel: A combustible substance by whose combustion power is produced. Gasoline and kerosene are the chief automobile fuels.

Fuel Economy. See "Economy, Fuel".

Fuel Feed, Gravity: See "Gravity Fuel Feed".

Fuel Feed, Pressure: See "Lubrication, Force-Feed".

Fuel Feed, Vacuum. See "Vacuum Fuel Feed".

Fuel-Feed Regulator: A device in the fuel system of steam motor by which the rate of flow of fuel to the burner is automatically regulated.

Fuel Level: The height of the top of the fuel in the float chamber of a carbureter.

Fuel-Level Indicator: An instrument either permanently connected to the fuel tank or which may be inserted thereon to indicate the quantity of fuel in the tank.

Fuel Tank, Auxiliary: A tank designed to hold a supply of fuel in addition to that carried in the main shaft.

Fuse: A length of wire in an electric circuit designed to melt and open the circuit when excess current flows through it and thus prevent damage to other portions of the circuit.

Fusible Plug: A hollow plug filled with an alloy which melts at a point slightly above the temperature of the steam in a boiler, as when the water runs low, thus putting out the fire and preventing the burning out of the boiler.

G

Gage: (1) Strictly speaking, a measure of, or instrument for determining dimensions or capacity. Practically, the term refers to an instrument for indicating the pressure or level of liquids, etc. (2) The distance between the forward or rear wheels measured at the points of contact of the tires on the road. Tread; track.

Gage Cock: A small cock by which a pipe leading to a gage may be opened or closed

Gage Lamp: Lamp, usually electric, placed above or near the gages to enable them to be read at night.

Gage, Oil: See "Oil Gage".

Gage, Tire: See "Tire-Pressure Gage".

Gap: In automobiles, the spark gap

Garage: A building for storing and caring for automobiles.

Garage, Portable: A garage which may be moved from one place to another either as a whole or in sections.

Gas: Matter in a fluid form which is elastic and has a tendency to expand indefinitely with reduction in pressure.

Gas Economizer: See "Economizer".

Gas Engine: An internal-combustion motor in which a mixture of gas and air is used as fuel. The term is also applied to the gasoline engine.

Gas Engine, Otto: A four-stroke cycle engine developed by Otto and using the hot-tube method of ignition.

Gas Generator: An apparatus in which a gas is generated for any use

Gas Lamp: See "Acetylene Lamp"

Gases, Boyle's Law of: See "Boyle's Law of Gases".

Gases, Gay Lussac's Law of Called *Charles's Law* and the *Second Law of Gases* Law defining the physical properties of gases at constantly maintained pressure It states that at constant pressure the volume of gas varies with the temperature, the increase being in proportion to the change of temperature and volume of the gas.

Gasket: A thin sheet of packing material or metal used in making joints, piping, etc.

Gasoline: A highly volatile fluid petroleum distillate; a mixture of fluid hydrocarbons

Gasoline-Electric Transmission: A system of propulsion in which a gasoline engine drives an electric generator, and the power is transmitted electrically to motors which drive the wheels.

Gasoline Engine: An internal-combustion motor in which a mixture of gasoline and air is used as a fuel.

Gasoline Primer: The valve on the carbureter of a gasoline engine by which the action of the engine can be started.

Gasoline-Tank Gage: A fuel-lever indicator for gasoline.

Gasoline Tester: A hydrometer graduated to indicate the specific gravity of gasoline, usually in degrees Baumé.

Gate: A plate which guides the gearshift lever in making speed changes.

Gather: Convergence of the forward portions of the front wheels. Toeing in.

Gay Lussac's Law of Gases: See "Gases, Gay Lussac's Law of".

Gear, Balance: See "Differential Gear".

Gear, Bevel: See "Bevel Gear".

Gear, Change-Speed: An arrangement of gear wheels which transmits the power of the motor to the differential gear at variable speeds independently of the motor speed.

Gear, Differential: See "Differential".

Gear, Fiber: A gear cut from a vulcanized fiber blank.

Gear, Helical: A gear whose teeth are not parallel to the axis of the cylinders.

Gear, Internal: A gear whose teeth project inward toward the center from the circumference of gear wheel

Gear, Planetary: See "Planetary Gears".

Gear, Progressive: See "Progressive Change-Speed Gears"

Gear, Rawhide: A gear cut from a blank made up of compressed rawhide

Gear, Selective: See "Selective Change-Speed Gears"

Gear, Timing. See "Timing Gears".

Gear, Worm: A helical gear designed for transmitting motion at angles, usually at right angles and with a comparatively great speed reduction.

Gearbox: The case covering the change-speed gears.

Gear Shifting: Varying the speed ration between motor and rear wheels by operating the change-speed gears.

Gear-Shift Lever: A lever by which the change-speed gears are shifted

Geared-Up Speed: A speed obtained by an arrangement of gears in the gearset such that the propeller shaft rotates more rapidly than the crankshaft.

Gearset: See "Gear, Change-Speed"

Generator, Acetylene: See "Acetylene Generator"

Generator, Electric: See "Electric Generator".

Generator, Steam: A steam boiler.

Generator Tubing: Tubing by which acetylene is conducted from the generator to the lamp

Gimbal Joint: A form of universal joint.

Gong: A loud, clear sounding bell, usually operated either electrically or by foot power

Governor: A device for automatically regulating the speed of an engine.

Governor, Dynamo: A method of automatic control of the generator (usually an ignition generator, in automobile work) by which its speed is maintained approximately constant.

Governor, Hydraulic: A governor applied to engines cooled by a pump circulation of water in such a way that the throttle opening is controlled by the pressure of the water.

Governor, Spark: A method of automatically controlling the speed of the engine by varying the time of ignition. See "Governor".

Grabbing Clutch: See "Fierce Clutch".

Gradometer: An instrument for indicating the degree of the gradient or the per cent of the grade. It consists of a level with a graduated scale.

Graphite: One of the forms in which carbon occurs in matter. Also known as *black lead* and *plumbago*. Used as a lubricant in powdered or flake form in the cylinders of explosive engines.

Gravity-Feed Oiling System: See "Lubrication, Gravity".

Gravity Fuel Feed: Supply of fuel to the carbureter from the tank by force of gravity.

Grease and Oil Gun: A syringe by means of which grease or oil may be introduced into the bearings of the machinery.

Grease Cup: A device designed to feed grease to a bearing by the compression of a hand screw.

Grid: A lead plate formed in the shape of a gridiron to sustain and act as a conductor of electricity for the active material in a storage battery.

Grinding Valves: See "Valve Grinding".

Gripping Clutch: See "Fierce Clutch".

Ground: An electric connection with the earth, or to the framework of a machine.

H

Half-Motion Shaft: See "Half-Time Shaft".

Half-Time Gear: See "Timing Gears".

Half-Time Shaft: The cam shaft of a four-cycle gas engine. It revolves at one-half the speed of the crankshaft.

Hammer Break: A make-and-break ignition system in which the spark is produced when the moving terminal strikes the stationary terminal like a hammer.

Header: A pipe from which two or more pipes branch. Manifold.

Heater, Automobile: A device for warming the interior of an automobile, usually electric, or by means of exhaust gases or jacket water.

High Gear: That combination of change-speed gears which gives the highest speed.

High-Tension Current: A current of high voltage, as the current induced in the secondary circuit of a spark coil.

High-Tension Ignition: Ignition by means of high-tension current.

High-Tension Magneto: A magneto which delivers high-tension current.

Honeycomb Radiator: A radiator consisting of many very thin tubes, giving it a cellular appearance.

Hood: (1) That part of the automobile body which covers the frame in front of the dash. The engine is usually under the hood. (2) The removable covering for the motor.

Hooke's Coupler: See "Universal Joint".

Horizontal Motor: A motor the center line of whose cylinder lies in a horizontal plane.

Horn, Automobile: A whistle or horn for giving warning of the approach of the automobile.

Horsepower: The rate of work or energy expended in a given time by a motor. One horsepower is the rate or energy expended in raising a weight of 350 pounds one foot in one second, or raising 33,000 pounds one foot in one minute.

Horsepower, Brake: The power delivered at the flywheel of an internal combustion engine as ascertained by a brake test.

Horsepower, Rated: The calculated power which may be expected to be delivered by a motor. In America the term usually refers to the horsepower as calculated by the S.A.E. formula.

Hot-Air Intake: The pipe or opening conveying heated air to the carburetor.

Hot-Head Ignition: The method of igniting the charge in a gas-engine cylinder by maintaining the head of the combustion chamber at a high temperature from the internal heat of combustion, as in the Diesel engine.

Hot-Tube Ignition: An ignition device formerly used for gas engines in which a closed metal tube is heated red-hot by a Bunsen flame. When the compressed gases in the cylinder are allowed to come in contact with this, ignition takes place.

Housing: A metallic covering for moving parts.

H.P.: (1) Abbreviation for *horsepower.* (2) Abbreviation for *high pressure.*

Hub Cap: A metal cap placed over the outer end of a wheel hub.

Hydrocarbons: Chemical combinations of carbon and hydrogen in varied proportions, usually distillates of petroleum, such as gasoline, kerosene, etc.

Hydrometer: An instrument by which the specific gravity or density of liquids may be ascertained.

Hydrometer Scale, Baumé's: An arbitrary measure of specific gravity.

I

I-Beam: Sometimes called *I-Section.* A structural piece having a cross section resembling the letter I. I-Beam front axle.

Igniter: An insulated contact plug without sparking points, used in make-and-break ignition with low-tension magneto.

Igniter, High-Speed: An igniter having a short spark coil for high-speed engines.

Igniter, Jump-Spark: A system of ignition in which is used a current of high pressure, which will jump across a gap in the high-pressure circuit, causing a spark at the gap.

Igniter, Lead of: Amount by which the ignition is advanced. See "Advanced Ignition".

Igniter, Primary: The apparatus in a primary circuit for making and breaking the circuit.

Igniter Spring: A spring to quickly break the circuit of a primary igniter.

Ignition, Advancing: See "Advanced Ignition".

Ignition, Battery: A system which gets its supply of current from a storage battery or dry cells. This system usually consists of a battery, a step-up coil, and a distributor for sending the current to the different spark plugs.

Ignition, Catalytic: Method of ignition for explosive motors based on the property of some metals, particularly spongy platinum, of becoming incandescent when in contact with coal gas or carbonized air.

Ignition, Double: See "Double Ignition".

Ignition, Dual: See "Dual Ignition".

Ignition, Fixed: Ignition in which the spark occurs at a given point in the cycle and cannot be changed from that point at the will of the operator except by retiming the ignition system. Fixed spark.

Ignition, Generator: Ignition current which is furnished by a combination lighting generator and magneto. The generator is fitted with an interrupter and distributor. Sometimes refers to system in which a generator charges a battery and the latter furnishes the ignition current in connection with a coil and distributor.

Ignition, High-Tension: Sometimes called jump-spark. Ignition which is effected by means of a high-tension or high-voltage current which is necessary to jump a gap in the spark plug.

Ignition, Hot-Head: See "Hot-Head Ignition".

Ignition, Jump-Spark: See "Ignition, High-Tension".

Ignition, Low-Tension: See "Ignition, Make-and-Break".

Ignition, Make-and-Break: A system in which the spark is produced by the breaking or interruption of a circuit, the break occurring in the combustion space of the cylinder. The current used is of low-voltage, hence the synonym, low-tension ignition.

Ignition, Magneto: Ignition produced by an electric generator, called a magneto, which is operated by the gas engine for which it furnishes current. Dynamo ignition. Generator ignition.

Ignition, Master Vibrator: A system which uses as many non-vibrator coils as there are cylinders, and one additional coil, called the master vibrator, for interrupting the primary circuit for all coils. The master vibrator also is used with vibrator coils in which the vibrators are short-circuited.

Ignition, Premature: Ignition occurring so far before the top dead center mark that the explosion occurs before the piston has reached upper dead center.

Ignition, Primary: An ignition system in which a low-tension current flows through a primary coil, the circuit being mechanically opened, allowing a high-tension spark to jump across the gap. See "Primary Coil".

Ignition, Retarding. Setting the spark of an internal-combustion motor so that the ignition will occur at a later part of the stroke.

Ignition, Self: Explosion of the combustible charge by heat other than that produced by the spark. Incandescent carbon will cause this. Motor overheating because of lack of water is another cause.

Ignition, Single: A system using but one source of current.

Ignition, Synchronized: Ignition by means of which the timing in each cylinder of a multicylinder engine is the same. In synchronized ignition the spark occurs at the same point in the cycle in each cylinder. This type of ignition is obtained with a magneto and is lacking in a multi-coil system using vibrator coils.

Ignition, Timing of: The adjustment of the ignition system so that ignition will take place at the desired part of the cycle.

Ignition, Two-Independent: See "Ignition, Double".

Ignition, Two-Point: A system comprising two ignition sources, or a double-distributor magneto, and two sets of spark plugs, both of which spark at the same time.

Ignition Distributor: See "Distributor."

Ignition Switch: A control or switch for turning the ignition current on and off voluntarily

I. H. P.: Abbreviation for *indicated horsepower.*

Indicated Horsepower: (1) The horsepower developed by the fuel on the pistons, in contradistinction to brake horsepower. See "Horsepower, Brake". (2) The horsepower of an engine as ascertained from an indicator diagram.

Indicator: An instrument by which the working gas in an engine records its working pressure.

Indicator Card: A figure drawn by means of an indicator by the working gas in an engine. Also called *indicator diagram.*

Induction Stroke: The downstroke of a piston which causes a charge of mixture to be drawn into the cylinder.

Inflammation: The act or period of combustion of the mixture in the cylinder.

Inflate: To increase the pressure within a tire by forcing air into it.

Inflator, Mechanical Tire: A small power-driven air-pump for inflating the tire; either driven by gearing, chain, or belt from the engine shaft, or by friction from the flywheel.

Inherent Regulation: Expression applied to electric generators which use no outside means of regulating the output, the regulation being affected by various windings of the armature and fields.

Initial Air Inlet: See "Primary Air Inlet".

Initial Pressure: Pressure in a cylinder after the charge has been drawn in but not compressed.

Injector: A boiler-feeding device in which the momentum of a steam jet, directed by a series of conical nozzles, carries a stream of water into the boiler, the steam condensing within and heating the water which it forces along.

Inlet, Valve: The valve which controls the inlet port and so allows or prevents mixture from passing to the cylinder.

Inlet Port: Passage or entrance in the cylinder wall through which the fuel mixture is taken. Sometimes called intake port.

Inlet Manifold: Sometimes called intake manifold or header. A branched pipe connected to the mixing chamber at one end and at the branch ends to the cylinders so as to communicate with the inlet ports.

Inlet Manifold, Integral: A manifold or header cast integral with the cylinder.

Inner-Tire Shoe: A piece of leather or rubber placed within the tire to protect the inner tube.

Inner Tube: A soft air-tight tube of nearly pure rubber, which fits within a felloe upon the casing.

Inside Lap: See "Exhaust Lap".

Intake Manifold: The large pipe which supplies the smaller intake pipes from each cylinder of a gas engine.

Intake Pipe: Sometimes made synonymous with inlet manifold. Correctly, the pipe from the carbureter to the inlet manifold.

Intake Stroke: See "Induction Stroke".

Intensifier: See "Outside Spark Gap".

Intermediate Gear: A gear in a change-speed set between high and low. In a three-speed set it would be second speed. In a four, either second or third.

Intermediate Shaft: See "Shaft, Intermediate".

Internal-Combustion Motor: Any prime mover in which the energy is obtained by the combustion of the fuel within the cylinder.

Internal Gear: See "Gear, Internal".

Interrupter: See "Vibrator".

J

Jack: A mechanism by which a small force exerted over a comparatively large distance is enabled to raise a heavy body. Used for raising the automobile axle to remove the weight from the wheels.

Jacket, Water: A portion of the cylinder casting through which water flows to cool the cylinder.

Jacket Water: The cooling water circulating in a water-cooling system.

Jackshaft: Shaft used in double-chain drive vehicles. Shaft placed transversely in the frame and driving from its ends chains which turn the rear wheels mounted on a dead axle.

Jeantaud Diagram: See "Diagram, Jeantaud".

Joint Knuckle: See "Swivel Joint."

Joule's Law of Gases: See "Gases, Joule's Law of".

Jump Spark: A spark produced by a secondary jump-spark coil.

Jump Spark, Circuit Maker: A mechanically operated switch by which the circuit in a jump-spark ignition system is opened and closed.

Jump-Spark Coil: An electrical transformer and interrupter, consisting of a primary winding of a few turns of coarse wire surrounding an iron core, and a secondary winding consisting of a great number of turns of very fine wire. The condenser is usually combined with this. Also known as *secondary spark coil.*

Jump-Spark Igniter: See "Igniter, Jump-Spark".

Jump-Spark Plug: See "Spark Plug".

Junction Box: A portion of an electric-lighting system to which all wires are carried for the making of proper connections.

Junk Ring: A packing ring used in sleeve-valve motors. It has the same functions as a piston ring. See "Piston Ring".

K

Kerosene: A petroleum product having a specific gravity between 58° and 40° Baumé. It is used as a fuel in internal-combustion engines and can often be used in gasoline engines by starting the engine on gasoline, then switching to kerosene.

Kerosene Burner: A burner especially adapted to use kerosene as a fuel.

Kerosene Engine: An engine using kerosene as fuel.

Key: A semicircular or oblong piece of metal used to hold a member firmly on a revolving shaft so as to prevent the member from rotating.

Key, Baldwin: A key with an oblong section.

Key, Woodruff: A key with a semicircular section.

Keyway: Slot in a rotating member used to hold the key

Kick Switch: Ignition switch mounted so that the driver can operate it with the foot.

Kilowatt: An electrical unit equal to 1000 watts.

Knuckle Joint: See "Swivel Joint".

L

Labor: The jerky operation of an engine. The engine is said to labor when it cannot pull its load without misfiring or jerking.

Lag, Combustion: The time between the instant of the spark occurrence and the explosion.

Lag, Ignition: The time between the instant of spark occurrence and the time at which the spark mechanism producing it begins to act.

Lamp, Trouble: Sometimes called inspection lamp. A small electric bulb carried in a suitable housing, and attached to a long piece of lamp cord. Used for inspecting parts of the car.

Lamp Bulb: The incandescent bulb used in a lamp.

Lamp Bracket: A support for a lamp.

Lamp Lighter: An apparatus for lighting gas lamps by electricity. The lamps are usually so arranged that by pushing the button the gas is turned on and the spark made at the same time.

Landaulet: A type of car which may be used as an open or closed car. The rear portion of the body may be folded down like a top.

Landaulet Body: An automobile body resembling a limousine body, but having a cover fitted to the back, which may be let down, leaving the back open. The top generally extends over the driver.

Lap: To make parts fit perfectly by operating them with an abrasive, such as ground glass, between the rubbing surfaces. To finish.

Lap of Steam Valves: In the slide valve of a steam engine, the amount by which the admission edges overlap the steam port when the valve is central with the cylinder case.

Layshaft: A countershaft or secondary shaft of a gearset operated by the main or shifter shaft.

Lead, or Lead Wire: Any wire carrying electricity.

Lead: In a steam engine the amount by which the steam port is opened when the piston is at the start of its stroke.

Lead Battery: See "Accumulator".

Lead of Igniter: See "Igniter, Lead of".

Lead of Valve: In an engine the amount by which the admission port is opened when the piston is at the beginning of the stroke; according as this is greater or less, the admission of working fluid is varied through several fractions of the stroke.

Lean Mixture: Fuel after leaving the carbureter, which contains too much air in proportion to the gasoline. Sometimes called thin mixture, rare mixture, or weak mixture.

Lever, Brake: See "Brake Lever."

Lever, Change-Speed: Lever by which the different combinations of change gears are made so as to vary the speed of the driving wheels in relation to the speed of the engine; also called gearshift lever.

Lever, Spark: Lever by which the speed and power of the engine are controlled by adjusting the time of ignition.

Lever, Steering: See "Steering Lever".

Lever, Throttle: A lever by which the speed and power of the engine are controlled by adjusting the amount of mixture admitted to the cylinder.

Lever Lock: An arrangement for locking the gearshift lever in free position so that with the engine running the driving axle will not be driven.

Lift: The distance through which a poppet valve is moved in opening from fully-closed to fully-open position.

Lifting Jack: See "Jack".

Lighting Outfit, Electric: An outfit for electrically lighting an automobile. This usually consists of a dynamo, storage battery, and lamps and switchboard, with the necessary wiring and cut-outs.

Limousine Body: An enclosed automobile body having the front and sides with side doors. The top extends over the seat of the driver.

Liner: One or more pieces of metal placed between two parts so they may be adjusted by varying the thickness of the liner Sometimes called a shim. Also refers to a tool used for lining up parts.

Liner, Laminated: A liner or shim made in a number of parts, the thickness being varied by removing or adding parts.

Lines of Force: See "Field, Magnetic".

Link Motion: In a steam engine the name for the arrangement of eccentric rods, links, hangers, and rocking shafts by which the relative motion and position of the slide valves are changed at will, providing for varying rates of expansion of the steam and thus varying the speed for either forward or backward motion.

Live Axle: See "Axle, Live".

Lock, Auto Safety: A device arranged so that it is impossible to start the motor car except by the proper combination or key.

Lock Nut: A nut placed on a bolt immediately behind the main nut to keep the main nut from turning.

Lock Switch: A switch in the ignition circuit so arranged that it can not be thrown on except by the use of a key.

Lock Valve: A valve capable of being secured with lock and key.

Long-Stroke: A gas engine whose stroke is considerably greater than its bore.

Lost Motion: Sometimes called play or backlash. Looseness of space between two moving parts.

Louver: A slit or opening in the side of a hood or bonnet of a motor car. Used to allow air from the draft to escape. A ventilator.

Low Gear: The lowest speed gear. First speed in a change-speed set.

Low-Speed Adjustment: A carbureter adjustment which regulates the mixture when the motor is operating slowly, with little throttle opening.

Low-Speed Band: The brake or friction band which controls the low speed of a planetary change-speed set.

Low-Tension Current: A current of low voltage or pressure, such as is generated by dry cells, storage battery, or low-tension magneto.

Low-Tension Ignition: See "Ignition, Make-and-Break".

Low-Tension Magneto: A magneto which initially generates a current of low voltage.

Low-Tension Winding: The winding of a transformer or induction coil through which the primary or low-tension current flows.

Low Test: Gasoline which has a high density, thus giving a low reading on the Baumé scale. Low-grade gasoline.

Low-Water Alarm: An automatic arrangement by which notice is given that the water in the boiler is becoming too low for safety.

Lubricant: An oil or grease used to diminish friction in the working parts of machinery.

Lubrication: To supply to moving parts and their bearings grease, oil, or other lubricant for the purpose of lessening friction.

Lubrication, Circulating: A system in which the same oil is used over and over.

Lubrication, Constant-Level: A system in which the level in the crankcase is kept to a predetermined level by means of a pump.

Lubrication, Force-Feed: Method of lubricating the moving parts of an engine by forcing the oil to the points of application by means of a pump.

Lubrication, Gravity: Method of supplying oil to moving parts of an engine by having a reservoir at a certain height above the highest point to be lubricated and allowing the oil to flow to the points of application by gravity.

Lubrication, Non-Circulating: A system in which the same oil is used but once.

Lubrication, Pressure-Feed: See "Lubrication, Force-Feed".

Lubrication, Sight-Feed: System of lubrication in which the oil pipe to different points of application is led through a glass tube in plain sight; usually at a point on the dashboard.

Lubrication, Splash: Method of lubricating an engine by feeding oil to the crankcase and allowing the lower edge of the connecting rod to splash into it.

Lubricator: A device containing and supplying oil or grease in regular amounts to the working parts of the machine.

Lubricator, Force-Feed: A pump-like device which automatically forces oil to the moving parts.

M

Magnet: A piece of iron or steel which has the characteristic properties of being able to attract other pieces of iron and steel.

Magnet, Horseshoe: A magnet shaped like the letter U.

Magnet, Permanent: A magnet which when once charged retains its magnetism.

Magnetic Field: See "Field, Magnetic".

Magnetic Spark Plug: A spark plug used in a make-and-break system of ignition in which contact is obtained by means of a magnet.

Magneto: See "Ignition, Magneto".

Magneto: See "Magneto-Electric Generator".

Magneto, Double-Distributor: A magneto with two distributors feeding two sets of spark plugs, two in each cylinder and both sparking at once. See "Ignition, Two-Point."

Magneto, High-Tension: A magneto has two armature windings and requires no outside coil for the generation of high-tension current.

Magneto, Induction: A type of magneto in which the armature and fields are stationary and a rotator or spool-shaped piece of metal is used to break the lines of force.

Magneto, Low-Tension: See "Low-Tension Magneto".

Magneto, Rotating Armature: A magneto in which the armature winding revolves.

Magneto Bracket: A shelf or portion of the crankcase web used to support the magneto.

Magneto Coupling: A flexible joint which connects the magneto with a revolving motor shaft.

Magneto Distributor: See "Distributor".

Magneto-Electric Generator: A machine in which there are no field magnet coils, the magnetic field of the machine being due to the action of permanent steel magnets. Usually contracted to *magneto.*

Main Bearing: A bearing, used for supporting the crankshaft.

Manifold: A main pipe or chamber into which or from which a number of smaller pipes lead to other chambers. See "Intake Manifold", "Exhaust Manifold", and "Inlet Manifold".

Manometer: A device for indicating either the velocity or the pressure of the water in the cooling system of a gasoline motor.

Master Vibrator: A single vibrator which interrupts the current to each of a set of several spark coils in order.

Mean Effective Pressure: The average pressure exerted upon a piston throughout its stroke.

M. E. P.: Abbreviation for *mean effective pressure.*

Mercury Arc Rectifier: A mercury vapor converter. See "Mercury Vapor Converter".

Mercury Vapor Converter: An apparatus for converting alternating current into direct current by means of a bubble of mercury in a vacuum. The vapor of mercury possesses the property of allowing the flow of current in one direction only. Its principal use is for charging storage batteries.

Mesh: Two gears whose teeth are so positioned that one gear will drive the other are said to be in mesh.

Misfire: Failure of the mixture to ignite in the cylinder; usually due to poor ignition or poor mixtures.

Miss: The failure of a gas engine to explode in one or more cylinders. Sometimes called misfiring.

Mixing Chamber: A pipe or chamber placed between the carbureter and inlet manifold. Sometimes integral with the carbureter or manifold.

Mixing Tube: A tubular carbureter for a gas or gasoline engine.

Mixing Valve: A device through which air and gas are admitted to form an explosive mixture. The carbureter of a gasoline engine combines the mixing valve and vaporizer.

Mixture: The fuel of a gas engine, consisting of sprayed gasoline mixed with air.

Monobloc: Cast *en bloc* or in one piece. Refers usually to cylinders, which are cast two or more at once.

Motocycle: A trade name for a special make of motorcycle.

Motor, Electric: See "Electric Motor".

Motor, Gasoline: See "Gasoline Motor".

Motor, High-Speed: A gas engine whose rotative speed is very high and whose power output goes up with the speed to an unusual degree.

Motor, Horizontal: A gas engine whose cylinder axis lies in a horizontal plane.

Motor, I-head: A gas engine which has cylinders, a section of which resembles the letter I. This type has the valves in the head.

Motor, L-Head: A gas engine in which a section of cylinders resembles the letter L. The valves in this type are all on one side.

Motor, Long-Stroke: See "Long-Stroke Motor".

Motor, Non-Poppet: A gas engine whose valves are not of the poppet type. In this class is the Knight sleeve valve, the rotary valve, and the piston valve.

Motor, Overhead Valve: A motor with cylinders whose valves are in the head.

Motor, Piston Valve: A gas engine using valves which are in the form of pistons.

Motor, Poppet: A gas engine using poppet-type valves. See "Poppet Valve".

Motor, Revolving Cylinder: A motor whose cylinders revolve as a unit.

Motor, Rotary Valve: One in which the valves consist of slots cut out along cylindrical rods which rotate in the cylinder casting.

Motor, Sliding Sleeve: The Knight type motor in which thin sleeves slide up and down in the cylinder, the sleeves having ports which register with the inlet and exhaust manifolds.

Motor, T-Head: A gas engine with the valves on opposite sides of the cylinders, a section of which resembles the letter T.

Motor, V-Type: A motor whose cylinders are set on the crankcase so as to form an angle of 45 to 90 degrees between them.

Motor, Vertical: A motor with the cylinder axis in a vertical plane.

Motorcycle: A bicycle propelled by a gasoline engine.

Mud Guard: Metal or leather strips placed over the wheels to catch the flying mud and to prevent the clothing from coming in contact with the wheels when entering and leaving the car.

Muffler Cut-Out: See "Cut-Out, Muffler".

Muffler Cut-Out Pedal: See "Cut-Out Pedal".

Muffler, Exhaust: A vessel containing partitions, usually perforated with small holes and designed to reduce the noise occasioned by the exhaust gases of an engine, by forcing the gases to expand gradually.

Muffler Explosion: Explosion of unburned gases in exhaust passages of the muffler, usually due to poor ignition or poor mixture.

Multiple Circuit: A compound circuit in which a number of separate sources or electrically operated devices, or both, have all their positive poles connected to a single positive conductor and all their negative poles to a single negative conductor.

N

N.A.A.M.: Abbreviation for National Association of Automobile Manufacturers.

Naphtha: A product of the distillation of petroleum used to some extent for marine engines.

Needle Valve: A valve in a carbureter used for regulating the amount of gasoline to flow in with the mixture.

Negative Plate: Plate of a storage battery to which current returns from the outside circuit.

Negative Pole: That pole of an electric source through which the current is assumed to enter or flow back into the source after having passed through the circuit external to the source.

Neutral Position: The position of the change-speed lever which so places the gears that the motor may run idle, the car remaining still.

Non-Deflatable Tire: See "Tire, Non-Puncturable".

Non-Freezing Solution: A solution placed into the radiator of a motor car to prevent the water therein from freezing. Alcohol and glycerine are the usual anti-freezing agents. See "Anti-Freezing Solution".

Non-Puncturable Tire: See "Tire, Non-Puncturable".

Non-Skid Device: See "Anti-Skid Device".

O

Odometer: (1) The mileage-recording mechanism of a speedometer. (2) An instrument to be attached to an automobile wheel to automatically indicate the distance traveled.

Odometer, Hub: A speed-recording device which is placed on the hub cap of a wheel.

Offset: Off center, as a crankshaft in which a line vertically through the crankpins does not coincide with a line vertically through the center of the cylinder.

Ohm: (1) Unit of electrical resistance. (2) Amount of electrical resistance. Such resistance as would limit the flow of electricity under an electromotive force of one volt to a current of one ampere.

Ohm's Law: The law which gives the relation between voltage, resistance, and current flow in any circuit. Expressed algebraically, $C = \frac{I}{R}$ where C is the current flowing in amperes, I the voltage and R the ohmic resistance.

Oil Burner: A burner equipped with an atomizer for breaking up liquid fuel into a spray.

Oil Engine: An internal-combustion motor using kerosene or other oil as fuel.

Oil Gage: (1) A gage to indicate the flow of oil in the lubricating system. (2) Used to show the level of oil in a compartment in the base of a gas engine.

Oil Gun: A cylinder with a long point and a spring plunger for squirting oil or grease into inaccessible parts of a machine.

Oil Pump: A small force pump providing a constant positive supply of oil under pressure; usually considered to be more reliable than a lubricator.

Oiler: An automobile device for oiling machinery.

Opposed Motor: A gasoline engine whose cylinders are arranged in pairs on opposite sides of the crankshaft, both connecting rods of each pair being connected to the same crank, so that the shock of the explosion in one will be balanced by the cushioning effect of the compression in the other. In general these motors are two-cylinder, horizontal.

Otto Cycle: See "Four-Stroke Cycle".

Outside Spark Gap: See "Spark Gap, Outside".

Overcharged: The state of the storage battery when it has been charged at too high a rate or for too great a length of time.

Overhead Camshaft: A camshaft which is placed above the cylinder of a gas engine.

Overhead Valves: See "Motor, Overhead Valve".

Overheating: The act of allowing the motor to reach an excessively high temperature due to the heat of combustion being not carried away rapidly enough by the cooling devices, or to insufficient lubrication. Overheating of a bearing is due to insufficient lubrication.

P

Packing: The material introduced between the parts of couplings, joints, or valves, to prevent the leakage of gas or liquids to or from them.

Panel, Charging: A small switchboard for charging a storage battery.

Parallel Circuit: See "Multiple Circuit".

Patch, Tire-Repair: Rubber strips for making repairs in punctured or ruptured tires.

Petcock: A control cock which when open allows gas or liquid to escape from the chamber to which it is attached.

Petrol: Word used in England for gasoline.

Picric Acid: Acid which may be added to gasoline to increase the motor efficiency. Gasoline will absorb about five per cent of its weight of picric acid.

Pin, Taper: A conically shaped pin.

Pinch: A cut in an inner tube caused by the tube being caught or pinched between the outer casing and the rim.

Pinion: (1) The smaller of any pair of gears. (2) A small gear made to run with a larger gear.

Piston: The hollow, cylindrical portion attached to the connecting rod of a motor. The reciprocating part which takes the strain caused by the explosion.

Piston Air Valve: A secondary air valve in the piston of earlier types of gas engines to compensate the imperfect operation of surface carbureters used with those engines and to secure the injection of a sufficient quantity of air to insure the combustion of the charge.

Piston Head: The top of the piston.

Piston Pin: A pin which holds the connecting rod to the piston.

Piston Ring: (1) A metal ring inserted in a groove cut into a piston assisting in making the latter tight in the cylinder. There are usually three rings on each piston. (2) Rings about the circumference of a piston, whose diameter is slightly greater than that of the piston. These are to insure closer fit and prevent wearing of the piston, as the wear is taken up by the rings which may be easily removed.

Piston Rod: Usually called connecting rod. The rod which connects the piston with the crankshaft.

Piston Skirt: The portion of a piston below the piston pin.

Piston Speed: The rate at which the piston travels in its cylinder.

Piston Stroke: The complete distance a piston travels in its cylinder.

Pitted: Condition of a working surface which has become covered with carbon particles which have been imbedded in the metal.

Planetary Gear: An arrangement of spur and annular gears in which the smaller gears revolve around the main shaft as planets revolve around the sun.

Planetary Transmission: A transmission system in which the speed changes are obtained by a set of planetary gears.

Plate: Part of a storage battery which holds active material. See "Negative Plate".

Pneumatic Tire: A tire fitted to the wheels of automobiles, consisting usually of two tubes, the outer of India rubber, canvas, and other resilient wear-resisting material, and the inner composed of nearly pure rubber which is inflated with compressed air to maintain the outer tube in its proper form under load.

Polarizing: Formation of gas at the negative element of a cell so as to prevent the action of the battery. This formation of gas is caused by the violent reaction taking place in a circuit of low resistance.

Pole Piece: A piece of iron attached to the pole of a magneto used in an electric generator.

Poppet Valve: A disk or drop valve usually seating itself through gravitation or by means of springs, and frequently opening by suction or cams.

Port: An opening for the passage of the working fluid in an engine.

Portable Garage: See "Garage, Portable".

Positive Connection: A connection by which positive motion is transmitted by means of a crank, bolt, or key, or other method by which slipping is eliminated.

Positive Motion: Motion transmitted by cranks or other methods in which slipping is eliminated.

Positive Plate: Plate in a storage battery, from which the current flows to the outside circuit.

Positive Pole: The source from which electricity is assumed to flow; the opposite of negative pole. In a magnet the positive pole is the end of the magnet from which the magnetic flux is assumed to emanate.

Pounding in Engine: Pounding noise at each revolution, usually caused by either carbon deposit, loose or tight piston, loose bearing or other part, or pre-ignition.

Power Stroke: The piston stroke in a gas engine in which the exploded gases are expanding, thus pushing the piston downward.

Power Tire Pump: A pump which is operated by a gas engine and is used to inflate the tires of a motor car.

Power Unit: The engine with fuel, cooling, lubrication, and ignition systems, without the transmission or running gears. Sometimes the gearset and driving shaft are included by the term.

Pre-Ignition: See "Premature Ignition".

Premature Ignition: Ignition of fuel before the proper point in the cycle.

Pressure-Feed: See "Lubrication, Force-Feed".

Pressure Gage: A gage for indicating the pressure of a fluid confined in a chamber, such as steam in a boiler, etc.

Pressure Lubricator: A lubricating device in which the oil is forced to the bearings by means of a pump or other device for maintaining pressure.

Pressure Regulator: A device for maintaining the pressure of the steam in the principal pipe at a constant point irrespective of the fluctuations of pressure in the boiler.

Primary Air Inlet: The main or fixed air intake of a carbureter.

Primary Circuit: The circuit which carries low-tension current.

Primary Coil: A self-induction coil consisting of several turns of wire about an iron core.

Primary Spark Coil: An induction coil which has only a single winding composed of a few layers of insulated copper wire wound on a bundle of soft iron wires, known as the *core*, also as a *wipe*, or *touch, spark coil*

Primer: A pin in a float-feed valve so arranged that it may depress the float in priming a gasoline engine. Also called *tickler* and *flushing pin.*

Priming: (1) The carrying of water over with the steam from the boiler to the engine, due to dirty water, irregular evaporation, or forced steaming. (2) Injecting a small amount of gasoline into the cylinder of a gasoline engine to assist in starting.

Priming Cock: A control cock screwed into the cylinder and which when open communicates with the combustion chamber allowing gasoline to be poured into the cylinder.

Progressive Change-Speed Gears: Change-speed gears so arranged that higher speeds are obtained by passing through all the intermediate steps and *vice versa.*

Prony Brake: A dynamometer to indicate the horsepower of an engine. A band encircles the flywheel of the engine and is secured to a lever, at the other end of which is a scale to measure the pull.

Propeller Shaft: The shaft which turns the rear axle of a motor car. The drive shaft.

Pump, Centrifugal: A pump with a hollow hub and curved blades which by centrifugal force throw water or oil into the system requiring it.

Pump, Circulation: See "Circulation Pump".

Pump, Fuel-Feed: A mechanically operated pump for insuring positive feed of fuel to the burner of a steam engine or carbureter of a gas engine.

Pump, Oil: See "Oil Pump".

Pump, Plunger: Sometimes called piston pump. One containing a piston which forces a liquid to a system.

Pump, Power Tire: See "Tire Pump".

Pump, Steam Boiler-Feed: See "Boiler-Feed Pump".

Pump, Water Circulating: See "Circulation Pump".

Pump Gear: A pump composed of two gears in mesh placed in a housing. When the gears revolve they carry oil or water, as the case may be, on their teeth, which deliver it to an outlet.

Puncture: The perforation of an inflated rubber automobile tire by some sharp substance on the roadbed.

Puncture-Closing Compound: A viscous compound placed within the inner tire tube to close the hole caused by a puncture.

Push Rod: A rod which operates the valves of a poppet-valve motor. A rod which imparts a pushing motion.

R

Race: (1) The parts upon which the balls of a ball bearing roll. (2) When referring to a gas engine, to operate at high speed without a load.

Racing Body: A low, light automobile body, having two seats with backs as low as possible; designed for large fuel capacity and very high speed.

Radiator: A device consisting of a large number of small tubes, through which the heated water from the jacket of the engine passes to be cooled, the heat being carried away from the metal of the radiator by air.

Radiator, Cellular: See "Honeycomb Radiator".

Radiator, Tubular: A radiator consisting of many tubes, through which water passes to be cooled.

Radiator Protector: See "Bumper".

Radius Rod: A bar in the frame of an automobile to assist in maintaining the proper distance between centers. Also called *distance rod.*

Rawhide Gear: Tooth gears, built up of compressed rawhide, used for high-speed drive. Sometimes a metal gear is merely faced with rawhide for the purpose of reducing noise.

Reach Rod: See "Radius Rod".

Reciprocating Parts: The parts such as pistons and connecting rods which have a reciprocating motion.

Rectifier, Alternating-Current: See "Current Rectifier".

Relief Cock: See "Compression-Relief Cock".

Removable Rim: See "Demountable Rim".

Resiliency: That property of a material by virtue of which it springs back or recoils on removal of pressure, as a spring.

Resistance, Electrical: (1) A part of an electric circuit for the purpose of opposing the flow of the current in the circuit. (2) The electrical resistance of a conductor is that quality of a conductor by virtue of which the conductor opposes the passage of electricity through its mass. Its unit is the *ohm.*

Retard: With reference to the ignition system, causing the spark to occur while the piston is retarding or moving downward on the working stroke.

Retarding Ignition: See "Ignition, Retarding".

Retarding the Spark: See "Ignition, Retarding".

Retread: To replace the tread of a pneumatic tire with a new one.

Reverse Cam: On a gasoline engine a cam so arranged that by reversing its motion or shifting it along its shaft it will operate the valves and cause the engine to reverse.

Reverse Gear: In a steam engine, a device by which the valves may be set to effect motion of the car in either direction. In a gasoline automobile, the reversing gear is usually incorporated with the change-speed gears.

Reverse Lever: A lever by which the direction of movement of the driving wheels may be reversed without reversing the engine. This is usually combined with the change-speed levers.

Rheostat: A device for regulating the flow of current in a closed electrical circuit by introducing a series of graduated resistances into the circuit.

Rim: The portion of a wheel to which a solid or pneumatic tire is fitted. A circular, channel-shaped portion attached to the wheel felloe.

Rim, Demountable: A rim which may be removed from the wheel easily in order that another with an inflated tire may take its place.

Rim, Quick-Detachable: A rim made of two or more parts so that the tire may be detached and attached quickly.

Rim, Removable: See "Demountable Rim".

Road Map: A map of a section or locality showing the best roads for motor-car travel, and usually the best stopping places and repair stations.

Roadster: A small motor car designed to be fairly speedy; usually has carrying capacity for an extra large quantity of fuel and supplies; generally seats two persons, with provision for one or two more, by the attachment of a rumble seat in the rear.

Rocker Arm: A pivoted lever used to operate overhead valves in a T-head motor.

Rod, Radius: See "Radius Rod".

Rod, Steering: See "Steering Rod".

Roller Bearings: See "Bearing, Roller".

Roller Chain: A chain whose links are provided with small rollers to decrease the friction and the noise.

Rotary Valve: A type of valve somewhat similar to the Corliss engine valve used on automobile motors.

Rumble: A small single seat to provide for an extra passenger on a two-seated vehicle. Usually detachable.

Runabout: A small two-seated vehicle, usually of a lower power and lower speed, as well as lower operating radius, than a roadster.

Running Board: A horizontal step placed below the frame and used to assist passengers in leaving and entering a motor car.

Running Gear: The frame, springs, motor, wheels, speed-change gears, axles, and machinery of an automobile, without the body; used synonymously with *chassis*.

S

Safety Plug: See "Fusible Plug".

Safety Valve: A valve seated on the top of a steam boiler, and loaded so that when the pressure of the steam exceeds a certain point the valve is lifted from the seat and allows the steam to escape.

Saturated Steam: The quality of the steam when no more steam can be made in the closed vessel without raising the temperature or lowering the pressure.

Scavenging: The action of clearing the cylinder of an internal-combustion motor of the burned-out gases.

Score: To burn, or abrade a moving part with another moving part.

Screw: An inclined plane wrapped around a cylinder; a cylinder having a helical groove cut in its surface.

Searchlight: A headlight designed to throw a very bright light on the road. Electricity or acetylene is usually used as an illuminant, and the lamp has a parabolic reflector and may be turned to throw the light in any direction.

Secondary Battery: See "Accumulator".

Secondary Current: A current in which the electromotive force is generated by induction from a primary circuit in which a variable current is flowing. The high-tension current of a jump-spark ignition system.

Secondary Circuit: The circuit which carries high-tension current.

Secondary Spark Coil: An induction coil having a double winding upon its core. The inner winding is composed of a few layers of insulated wire of large size, and the outer winding consists of a great many layers of very small insulated copper wire. Also known as a *jump-spark coil*.

Seize: Refers to moving parts which adhere because of operation without a film of oil between the working surfaces.

Selective Change-Speed Gears: Change-speed gears so arranged that any desired speed combination can be obtained without going through the intermediate steps.

Self-Firing: Ignition of the mixture in a gas engine due to the walls of the cylinder or particles attached to them becoming overheated and incandescent.

Self-Starter: See "Engine Starter".

Separator, Steam: A device attached to steam pipes to separate entrained water from live steam before it enters the engine, or to separate the oily particles from exhaust steam on its way to the condenser.

Series Circuit: A compound circuit in which the separate sources or the separate electrical receiving devices, or both, are so placed that the current supplied by each, or passed through each, passes successively through the other circuits from the first to the last.

Set Screw: A small screw with a pointed end used for locking a part in a fixed position to prevent it from turning.

Setting Valves: See "Valve Setting".

Shaft, Intermediate: The shaft placed between the first and third motion gearing and acting as a carrier of motion between the two.

Shaft Drive: System of power transmission by means of a shaft.

Shim: See "Liner".

Shock Absorber: A device attached to the springs or hangers of motor cars to decrease the jars due to rough roads, instead of allowing them to be transmitted to the frame of the carriage.

Short Circuit: A shunt or by-path of comparatively small resistance around a portion of an electric circuit, by which enough current passes through the new path to virtually cut out the part of the circuit around which it is passed, and prevent it from receiving any appreciable current.

Sight Feed: An indicator covered with glass which shows that oil is flowing in a system. A telltale sight. A check on the oiling system.

Side-Bar Steering: See "Steering, Side-Bar".

Side-Slipping: See "Skidding".

Silencer: See "Muffler, Exhaust".

Silent Chain: A form of driving chain in which the links are comprised of sections which so move over the sprocket that practically all noise is eliminated. Silent chains are used specially for driving timing gears, gearsets, etc.

Skidding: The tendency of the rear wheels to slide sideways to the direction of travel, owing to the slight adhesion between tires and the surface of the roadbed, also called *side-slipping*.

Skip: See "Miss".

Sleeve Valve: A form of valve consisting of cylindrical shells moving up and down in the cylinders of such a motor as the Silent Knight.

Sliding Gears: A change-speed set in which various gears are placed into mesh by the sliding on a shaft of one or more gears.

Sliding Sleeve: See "Motor, Sleeve-Valve".

Slip Cover: A fabric covering for the top when down or for the upholstery of a motor vehicle.

Smoke in Exhaust: Smoky appearance in the exhaust due to too much oil, too rich mixture, low grade of fuel, or faulty ignition.

Solid Tire: See "Tire, Solid".

Sooting of Spark Plug: Fouling of the spark plug with soot, due to poor mixture, impure fuel, or improper lubrication.

Spare Wheel: An extra wheel complete with inflated tire, carried on the car for quick replacement of wheel with damaged tire.

Spark, Advancing: See "Advanced Ignition".

Spark Coil: A coil or coils of wire for producing a spark at the spark plug. It may be either a secondary or primary spark coil.

Spark Gap: A break in the circuit of a jump-spark ignition system for producing a spark within the cylinder to ignite the charge. The spark gap is at the end of a small plug called the *spark plug*.

Spark Gap, Extra: See "Spark Gap, Outside".

Spark Gap, Outside: A device to overcome the short circuiting in the spark gap due to fouling and carbon deposits between the points of the high-tension spark plug. It is a form of condenser, or capacity in which the air acts as the dielectric between two surfaces at the terminals of a gap in a high-tension circuit.

Spark Intensifier: See "Spark Gap, Outside".

Spark Lever: See "Timing Lever".

Spark Plug: The terminals of the secondary circuit of a jump-spark ignition system mounted to leave a spark gap between the terminals projecting inside the cylinder for the purpose of igniting the fuel in the cylinder by means of a spark crossing the gap between them.

Spark Plug, Pocketing: Mounting the spark plug in a recess of the cylinder head to reduce the sooting of the sparking points.

Spark Plug, Sooting of: See "Sooting of Spark Plug".

Spark Regulator: A mechanism by which the time of ignition of the charge is varied by a small handle on or near the steering wheel.

Spark, Retarding: See "Ignition, Retarding".

Spark Timer: See "Timer, Ignition".

Speaking Tube: See "Annunciator".

Specific Gravity: The weight of a given substance relative to that of an equal bulk of some other substance which is taken as a standard of comparison. Air or hydrogen is the standard for gases, and water is the standard for liquids and solids.

Specific Heat: The capacity of a substance for removing heat as compared with that of another which is taken as a standard. The standard is generally water.

Speed-Change Gear: A device whereby the speed ratio of the engine and driving wheels of the car is varied.

Speed Indicator: An instrument for showing the velocity of the car.

Speedometer: A device used on motor cars for recording the miles traveled and for indicating the speed at all times.

Speedometer Gears: Gears used to drive a shaft which operates the speedometer.

Speedometer Shaft: A flexible shaft which operates a speedometer.

Spiral Gear: A gear with helically-cut teeth.

Splash Lubrication: See "Lubrication, Splash".

Spline: A key.

Spontaneous Ignition: See "Self-Firing".

Sprag: A device to be let down (usually at the rear of the car) to prevent its slipping back when climbing a hill.

Spray Nozzle: That portion of a carbureter which sprays the gasoline.

Spring: An elastic body, as a steel rod, plate, or coil, used to receive and impart power, regulate motion, or diminish concussion.

Spring, Cantilever: A type of spring which appears like a semi-elliptic reversed; and which is flexibly attached in the center, rigidly at one end, and by a shackle at the other.

Spring, Elliptic: A spring, elliptic in shape, and consisting of two half-elliptic members attached together.

Spring Semi-Elliptic: A spring made up of a number of leaves, the whole resembling a portion of an ellipse.

Spring, Supplementary: See "Shock Absorber".

Spring, Underslung: A spring which is fastened under the axle instead of over it.

Spring Hangers: See "Body Hangers".

Spring Shackle: A link attached to one end of a spring which allows for flattening of the spring.

Sprocket: A wheel with teeth around the circumference, so shaped that the teeth will fit into the links of a chain which drives or is driven by the sprocket.

Starboard: The right-hand side of a ship or vessel.

Starter, Engine: See "Engine Starter".

Starting, Gas Engine: The operation necessary to make the engine automatically continue its cycle of events. It usually consists of opening the throttle, retarding the spark, closing the ignition circuit, and cranking the engine.

Starting Crank: A crank by which the engine may be given several revolutions by hand in order to start it.

Starting Device: See "Engine Starter".

Starting on Spark: In engines having four or more cylinders with well-fitting pistons, it is often possible to start the motor after it has stood idle for some time by simply closing the ignition circuit, provided that the previous stopping of the engine was done by opening the ignition circuit before the throttle was closed, leaving an unexploded charge under compression in one of the cylinders.

Steam: The vapor of water; the hot invisible vapor given off by water at its boiling point.

Steam Boiler: See "Boiler".

Steam Condenser: See "Condenser".

Steam, Cycle of: A series of operations of steam forming a closed circuit, a fresh series beginning where another ends; that is, steam is generated in the boilers, passes through the pipes of the engine, doing work successively in its various cylinders, escaping at exhaust pressure to the condenser, where it is converted into water and returned to the boiler, to go through the same operations once more.

Steam Engine: A motor depending for its operation on the latent energy in steam.

Steam Gage: See "Pressure Gage".

Steam Port: See "Admission".

Steering, Side-Bar: Method of guiding the car by means of an upright bar at the side of the seat.

Steering Angle for Front Wheels: Maximum angle of front wheels to the axle when making a turn; should be about 35°.

Steering Check: A device for locking the steering gear so that the direction will not be changed unless desired.

Steering Column: See "Steering Post".

Steering Gear: The mechanism by which motion is communicated to the front axle of the vehicle, by which the wheels may be turned to guide the car as desired.

Steering Knuckle: A knuckle connecting the steering rods with the front axle of the motor.

Steering Lever: A lever or handle by which the car is guided.

Steering Neck: The vertical spindle carried by the steering yoke. It is the pivot of the bell crank by which the wheel is turned.

Steering Pillar: See "Steering Post".

Steering Post: The member through which the twist of the steering wheel is transmitted to the steering knuckle. The steering post often carries the spark and throttle levers also.

Steering Rod: The rod which connects the steering gear with the bell cranks or pivot arms, by means of which the motor car is guided.

Steering Wheel: The wheel by which the driver of a motor car guides it.

Steering Yoke: The Y-shaped piece in which the front axle terminates. The yoke carries the vertical steering spindle or steering neck.

Stephenson Link Motion: A reversing gear in which the ends of the two eccentric rods are connected by a link or quadrant sliding over a block at the end of the valve spindle.

Step-Up Coil: A coil used to transform low- into high-tension current.

Storage Battery: See "Accumulator".

Stroke: See "Piston Stroke".

Strainer, Gasoline: A wire netting for preventing impurities entering the gasoline feed system.

Strangle Tube: The narrowing of the throat of the carbureter just above the air inlets in order to increase the speed of the air, and thus increase the proportion of gas which will be picked up.

Stroke: The distance of travel of a piston from its point of farthest travel at one end of the cylinder to its point of farthest travel at the other end. Two strokes of the piston take place to every revolution of the crankshaft.

Stud Plate: The plate or frame in a planetary transmission system carrying studs upon which the central pinions revolve.

Suction Valve: The type of admission valve on an internal combustion engine which is opened by the suction of the piston within the cylinder and admits the mixture. The valve is normally held to its seat by a spring.

Sulphating of Battery: The formation of an inactive coating of lead sulphate on the surface of the plates of a storage battery. It is a source of loss in the battery.

Superheated Steam: Steam which has been still further heated after reaching the point of saturation.

Supplementary Air Valve: See "Auxiliary Air Valve".

Swivel Joint: The joint for connecting the steering arm of the wheel or lever-steering mechanism to the arms on the steering wheel. Also called *knuckle joint.*

T

Tachometer: An instrument for indicating the number of revolutions made by a machine in a unit of time.

Tandem Engine: A compound engine having two or more cylinders in a line, one behind the other, and with pistons attached to the same piston rod.

Tank Gage: See "Fuel-Level Indicator".

Tappet Rod: See "Push Rod".

Taxicab: A public motor-driven vehicle in which the fare is automatically registered by the taximeter.

Taximeter: An instrument in a public vehicle for mechanically indicating the fare charged.

Terminals: The connecting posts of electrical devices, as batteries or coils.

Thermal Unit: Usually called the *British Thermal Unit,* or *B. t. u.* A measure of mechanical work equal to the energy required to raise one pound of water one degree Fahrenheit.

Thermostat: An instrument to automatically regulate the temperature.

Thermosiphon Cooling: A method of cooling the cylinder of a gas engine. The water rises from the jackets and siphons into a radiator from whence it returns to the supply tank, doing away with the necessity for a circulating pump.

Three-Point Suspension: A method used for suspending motor car units, such as the motor, on three points.

Throttle: A valve placed in the admission pipe between the carbureter and the admission valve of the motor to control the speed and power of the motor by varying the supply of the mixture.

Throttle, Foot: See "Accelerator".

Throttle, Lever: A lever on the steering wheel which operates the carbureter throttle. See "Throttle".

Throttling: The act of closing the admission pipe of the engine so that the gas or steam is admitted to the cylinder less rapidly, thus cutting down the speed and power of the engine.

Thrust Bearing: A bearing which takes loads parallel with the axis of rotation of the shaft upon which it is fitted.

Tickler: A pin in a carbureter arranged to hold down the float in priming, also called *flushing pin* and *primer.*

Timer, Ignition: An ignition commutator.

Timing Gears: The gears which operate the camshaft and magneto shaft. The camshaft gear is twice as large as the crankshaft gear.

Timing Lever: A lever fitted to gas engines by means of which the time of ignition is changed. Also called *spark lever.*

Timing Valve: In a gas engine using float-tube ignition, a valve controlling the opening between the combustion space and the igniter.

Tip, Burner: A small earthen, aluminum, or platinum cover for the end of the burner tube of an acetylene lamp. It is usually provided with two holes, so placed that the jets from them meet and spread out in a fan shape.

Tire, Airless: See "Airless Tire".

Tire, Clincher: A type of pneumatic tire which is held to a clincher.

Tire, Cushion: Vehicle tire having a very thick rubber casing and very small air space. It is non-puncturable and does not have to be inflated, but is not as resilient as a pneumatic tire.

Tire, Non-Deflatable: See "Tire, Non-Puncturable".

Tire, Non Puncturable: A tire so constructed that it cannot be easily punctured or will not become deflated when punctured.

Tire, Punctures in: Holes or leaks in pneumatic tires caused by foreign substances penetrating the inner tube and allowing the air to escape.

Tire, Single-Tube: A pneumatic tire in which the inner and outer tubes are combined.

Tire, Solid: A tire made of solid, or nearly solid rubber.

Tire Band: A band to protect or repair a damaged pneumatic tire. See "Tire Protector".

Tire Bead: Lower edges of a pneumatic tire which grip the curved portion of a rim.

Tire Case: (1) A leather or metal case for carrying spare tire; same as *tire holder*. (2) The outer tube.

Tire Chain: See "Anti-Skid Device".

Tire Filling: Material to be introduced into the tire to take the place of air and do away with puncture troubles

Tire Gage: Gage used for measuring the air pressure in a pneumatic tire.

Tire Holder: A metal or leather case for carrying spare tires.

Tire-Inflating Tank: A tank containing compressed air or gas for inflating the tires.

Tire Inflater, Mechanical: A small mechanical pump for inflating pneumatic tires.

Tire Patch: See "Patch, Tire Repair".

Tire-Pressure Gage: A pressure gage to indicate the pressure of air in the tire.

Tire Protector: The sleeve or band placed over a tire to protect it from road wear.

Tire Pump: A pump for furnishing air under pressure to the tire, may be either hand- or power-operated.

Tire Sleeve: A sleeve to protect the injured part of a pneumatic tire. It is a tire protector which covers more of the circumference of the wheel than a tire band. See "Tire Protector".

Tire Tape: Adhesive tape used to bind the outer tube to the rim in repairing tires.

Tire Tool: Tool used to apply and remove a tire.

Tire Valve: A small valve in the inner tube to allow air to be pumped into the tube without permitting it to escape.

Tires, Creeping of: See "Creeping of Tires".

Tonneau: The rear seats of a motor car. Literally, the word means a round tank or water barrel.

Torque: Turning effort, or twisting effort of a rotating part.

Torque Rod: A rod attached at one end to the rear axle and at the other to the frame; used to prevent twisting of the rear-axle housing.

Torsion Rod: The shaft that transmits the turning impulse from the change gears to the rear axle. Usually spoken of as the *shaft*.

Touch Spark: See "Wipe Spark".

Tourabout: A light type of touring car.

Touring Car: A car with no removable rear seats, and a carrying capacity of four to seven persons.

Town Car: A car having the rear seats enclosed but the driver exposed.

Traction: The act of drawing or state of being drawn. The pull (or push) of wheels.

Tractor: A self propelled vehicle for hauling other vehicles or implements; a traction engine.

Transmission, Individual Clutch: A transmission consisting of a set of spur gears on parallel shafts which are always in mesh, different trains being picked up with a separate clutch for each set.

Transmission, Planetary: A transmission system in which a number of pinions revolve about a central pinion in a manner similar to the revolution of the planets about the sun; usual type consists of a central pinion surrounded by three or more pinions and an internal gear.

Transmission, Sliding Gear: A transmission system in which sliding change-speed gears are used.

Transmission Brake: Brake operating on the gearset shaft or end of the propeller shaft.

Transmission Gears: A set of gears by which power is transmitted. In automobiles, usually called *change-speed gears*.

Transmission Ratio: The ratio of the speed of the crankshaft to the speed of the transmission shaft or driving shaft.

Tread: That part of a wheel which comes in contact with the road.

Tread, Detachable: A tire covering to protect the outer tube, which may be taken off or replaced.

[illegible] primary [illegible] in connection with jump-spark ignition.

Truck: (1) A strong, comparatively slow-speed vehicle, designed for transporting heavy loads. (2) A swiveling carriage having small wheels, which may be placed under the wheels of a car.

Try Cock: A faucet or valve which may be opened by hand to ascertain the height of water in the boiler.

Tube Case: See "Tire Case".

Tube Ignition: See "Hot-Tube Ignition".

Tubing, Flexible: See "Flexible Tubing".

Tubular Radiator: An automobile radiator in which the jacket water circulates in a series of tubes.

Tungsten Lamp: Incandescent bulb with the filament made of tungsten wire.

Turning Moment: See "Torque".

Turning Radius: The radius of a circle which the wheels of a car describe in making its shortest turn.

Turntable: Device installed in the floor of a garage and used for turning motor cars around.

Two-Cycle or Two-Stroke Cycle Engine: An internal-combustion engine in which an impulse occurs at the beginning of every revolution, that is, at the beginning of every downward stroke of the piston.

Two-to-One Gear: The system of gearing in a four-cycle gas engine for driving the camshaft, which must revolve once to every two revolutions of the crankshaft.

U

Under Frame: The main frame of the chassis or running gear of a motor vehicle.

Unit-Power Plant: A power system consisting of a motor, gearset, and clutch which may be removed from the motor car as a unit.

Universal Joint: A mechanism for endwise connection of two shafts so that rotary motion may be transmitted when one shaft is at an angle with the other. Also called *universal coupling, flexible coupling, Cardan joint* and *Hooke's joint.*

Upkeep: The expenditure for maintenance or expenditure required to keep a vehicle in good condition and repair.

V

Vacuum Fuel Feed: A system of feeding the gasoline from a tank at the rear of an automobile by maintaining a partial vacuum at some point in the system, usually at the dash, the fuel flowing from this point by gravity to the carbureter.

Vacuum Line: In an indicator diagram, the line of absolute vacuum. It is at a distance corresponding to 14.7 pounds below the atmospheric line.

Valve: A device in a passage by which the flow of liquids or gases may be permitted or stopped.

Valve, Admission: The valve in the admission pipe of the engine leading from the carbureter to the cylinder by which the supply of fuel may be cut off.

Valve, Automatic: See "Automatic Valve".

Valve, Inlet: See "Inlet Valve".

Valve, Mixing: See "Mixing Valve".

Valve, Muffler Cut-Out: See "Cut-Out, Muffler".

Valve, Overhead: See "Overhead Valve".

Valve, Poppet: See "Poppet Valve".

Valve, Rotary: See "Motor, Rotary Valve".

Valve, Suction: An admission valve which is opened by the difference between the pressures in the atmosphere and in the cylinder.

Valve Cage: A valve-retaining pocket which is attached to the cylinder.

Valve Clearance: The clearance of play between the valve stem and the tappet.

Valve Gear: The mechanism by which the motion of the admission or exhaust valve is controlled.

Valve Grinding: The act of removing marks of corrosion, pitting, etc., from the seats and faces of poppet or disk valves. The surfaces to be ground are rotated in contact with each other, an abrasive having been supplied.

Valve Lift: See "Lift".

Valve Lifter: A device for raising a poppet valve from its seat.

Valve Seat: (1) That portion of the engine upon which the valve rests when it is closed. (2) The portion upon which the face of a valve is in contact when closed.

Valve Setting: The operation of adjusting the valves of an engine so that the events of the cycle occur at the proper time. Also called *valve timing.*

Valve Spring: The spring which is around the valve stem and is used to return the valve to closed position after it has been opened by the cam:

Valve Stem: The rod-like portion of a poppet valve.

Valve Timing: See "Valve Setting".

Vaporizer: A device to vaporise the fuel for an oil engine. In starting it is necessary to heat the vaporizer, but the exhaust gases afterwards keep it at the proper temperature. The carbureter of the gas engine properly belongs under the general head of *vaporizer*, but the term has become restricted to the vaporizer for oil engines.

Variable-Speed Device: See "Gear, Change-Speed".

Vertical Motor: An upright engine whose piston travel is in a vertical plane.

Vibrator: The part of the primary circuit of a jump-spark ignition system by which the circuit is rapidly interrupted to give a transformer effect in the coil.

Vibrator, Master: See "Master Vibrator".

Volatile: Passing easily from a liquid to a gaseous state, in opposition to *fixed.*

Volatilization: Evaporation of liquids upon exposure to the air at ordinary temperatures.

Volt: Practical unit of electromotive force; such an electromotive force as would cause a current of one ampere to flow through a resistance of one ohm.

Voltammeter: A voltmeter and an ammeter combined; sometimes refers to wattmeter.

Voltmeter: An instrument for measuring the difference of electric potential between the terminals of an electric circuit. It registers the electric pressure in volts.

Vulcanization: The operation of combining sulphur with rubber at a high temperature, either to make it soft, pliable, and elastic, or to harden it.

Vulcanizer: A furnace for the vulcanization of rubber.

W

Walking Beam: See "Rocker Arm".

Water Cooling: Method of removing the heat of an internal-combustion motor from the cylinders by means of a circulation of water between the cylinders and the outer casing.

Water Gage: An instrument used to indicate the height of water within a boiler or other water system. It consists of a glass tube connected at its upper and lower ends with the water system.

Water Jacket: A casing placed about the cylinder of an internal-combustion engine to permit a current of water to flow around it for cooling purposes.

Watt: The unit of electric power. It is the product of the current in amperes flowing in a circuit by the pressure in volts. It is $\frac{1}{746}$ of a horsepower.

Watt Hour: The unit of electrical energy. The given watt-hour capacity of a battery, for instance, means the ability of a battery to furnish one watt for the given number of hours or the given number of watts for one hour, or a number of watts for a number of hours such that their product will be the given watt hours.

Welding, Autogeneous: A method of joining two pieces of metal by melting by means of a blow torch burning acetylene in an atmosphere of oxygen. This melts the ends of the parts and these are then run together.

Wheel, Artillery: A wood-spoked wheel whose spokes are in line with a line drawn vertically through the hub.

Wheel, Dished: A wheel made concave or convex so that the hub is inside or outside as compared with the rim. This is to counteract the outward inclination of the wheel due to the fact that the spindle is tapered and that its outward center is lower than its inner center.

Wheel, Double-Interacting: The mechanism by which two wheels are hung on one hub or axle the outer being shod with an ordinary solid tire and the inner with a pneumatic tire, so that the weight of the vehicle bears against the lowest point of the pneumatic tire of the inner wheel to give the durability and tractive properties of a solid tire with the resiliency of a pneumatic.

Wheel, Spare: See "Spare Wheel".

Wheel Steering: See "Steering Wheel".

Wheel, Wire: A wheel with spokes made of wire.

Wheel Puller: A device used for pulling automobile wheels from their axles

Wheel Steer: A method of guiding a car by means of a hand wheel.

Wheel, Steering Angle for: The angle which the steering column makes with the horizontal. It varies from 90° to 30° or less

Wheelbase: The distance between the road contact of one rear wheel with the point of road contact of the front wheel on the same side.

Wheels, Driving on All Four: The method of using all four wheels of an automobile as the driving wheels.

Wheels, Driving on Front: The method of using the two front wheels as the drivers.

Wheels, Steering on Rear: Method of guiding the vehicle by turning the rear wheels.

Whistle: An automobile accessory consisting of a signalling apparatus giving a loud or harsh sound. Also called a *horn*

Wind Guard: See "Wind Shield".

Wind Shield: A glass front placed upright on the dash to protect the occupants of the car from the wind.

Wipe Spark: Form of primary sparking device in which a spark is produced by a moving terminal sliding over another terminal, the break thus made causing a spark. Also called *touch spark.*

Wipe-Spark Coil: A primary spark coil with which the spark is made by wiping contact.

Wire Drawing: The effect of steam passing through a partially closed valve or other constricted opening, so called from the thinness of the indicator diagram.

Working Pressure. The safe working pressure of a boiler usually estimated as ⅙ of the pressure at which a boiler will burst.

Worm: A helical screw thread

Worm and Sector: A worm gear in which the worm wheel is not complete but is only a sector. Used especially in steering devices.

Worm Drive: A form of drive using worm gears. See "Gears, Worm"

Worm Gear: The spiral gear in which a worm or screw is used to rotate a wheel

Worm Wheel: A wheel rotated by a worm

Wrist Pin: See "Piston Pin".

X

X Spring: A vehicle spring composed of two laminated springs so placed one upon the other that they form the letter X

Y

Yoke, Steering: See "Steering Yoke".

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