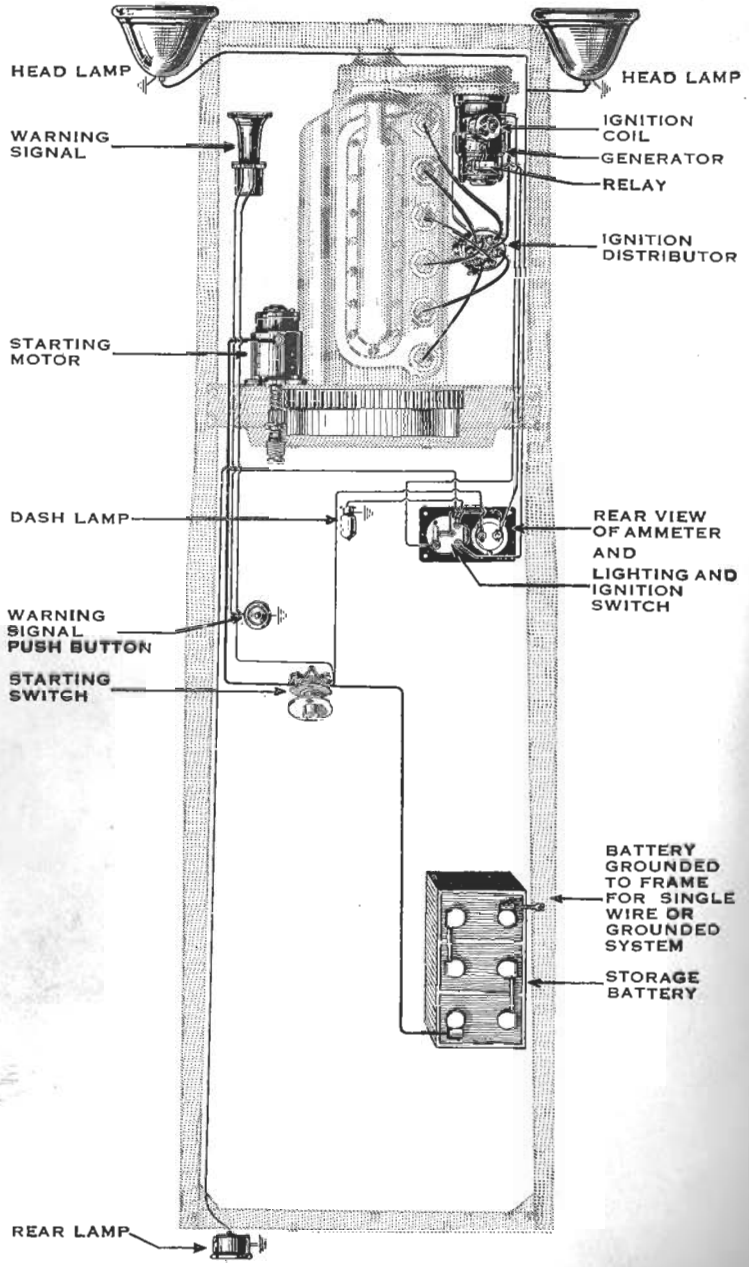
STARTING
LIGHTING
IGNITION

— SIMPLIFIED



This illustrates a complete electric system without reference to any particular model of car

STARTING LIGHTING IGNITION

—SIMPLIFIED

REMY ELECTRIC COMPANY

Motor Equipment Division, Detroit, Mich.

General Offices and Factories:
Anderson, Indiana

Tractor Equipment Division:
Chicago, Illinois

Second Edition

CONTENTS

FOREWORD

EVERY motorist should know and understand the mechanical features of his car. Of these features perhaps there is none more important than the electrical system, because on the electrical system depends the smoothness and steady running of the engine, and the safety, comfort and convenience of the passengers and driver.

In the pages that follow, we aim to tell the reader not versed in electrical science in a very simple manner the story of the electrical equipment on the car. A careful perusal of this booklet will help the motorist to understand and grasp more clearly the principles underlying the Starting, Lighting and Ignition system.

What Electricity Does for the Motorist

FEW motorists of the present day appreciate the important functions performed by the electrical equipment on their cars. Looking back a few years we can recall the day of cranking—when the Starting Motor was still undeveloped—when the driver endeavored to be back home before nightfall because he feared driving in the dark with dim lights; when few motorists ventured out on distant trips for fear of encountering ignition trouble.

Electrical science and progress, however, overcame these objectionable features, until today the motorist can start his car, travel distances under the most severe conditions by night as well as by day, with every comfort, safety and convenience that can possibly be afforded.

The car is equipped electrically to make it more pleasant for the passenger in three ways: First: To save him the trouble and inconvenience of cranking. Second: To enable him to ride with perfect safety and comfort at night. Third: To provide a reliable means of keeping his engine running smoothly at all speeds.

The starting of the engine is accomplished with a Starting Motor. Proper lighting for night driving is accomplished through the Generator and Battery Lighting System. The continuous and satisfactory operation of the engine is accomplished through the Battery Ignition Coil and Distributor. The principle and operation of all these units will be described later.

A little knowledge of electricity is of great value in helping the reader to grasp more clearly the principles underlying the operation of the various units comprising the electric starting, lighting, and ignition systems of the modern motor car. If the reader, therefore, will carefully study the electrical explanations given in the next few pages, he will better understand the functions of the electrical equipment as explained in this book.

The Principles of Electricity and Magnetism

MAGNETISM—Magnetism is the property some bodies have of attracting iron and steel, and those having this property are called magnets. Almost everyone has at some time played with toy horseshoe magnets and all are familiar with the action of a compass.

Many centuries ago it was discovered that certain iron ore in Asia Minor had very peculiar properties. If a small piece of this material was suspended from the center by a silk fibre, one end of it always pointed toward the north. The ancients, therefore, called this a lodestone or leading stone, for it helped lead the way for them in piloting the seas. They also discovered that a lodestone attracted bits of iron and soon they found that a piece of hardened iron assumed the properties of the lodestone if they were properly rubbed together. They were a long time finding out all this, and it was centuries afterward that the first electro-magnet was built.

All of the first artificial magnets were of the so-called permanent type. A permanent magnet, as the name implies, retains its magnetism for a long period of time and is made of hardened iron or steel.

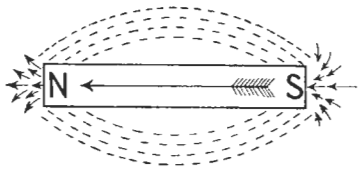
A temporary magnet, on the other hand, is usually made of soft iron or annealed steel and loses its magnetism as soon as the magnetizing force is removed. A common form of temporary magnet is the one used in the ordinary electric door-bell.

Certain parts of any magnet seem to possess the most power for attracting iron or steel. These parts are called the poles and are located at the ends of the magnet—a north pole at one end, and a south pole at the other.

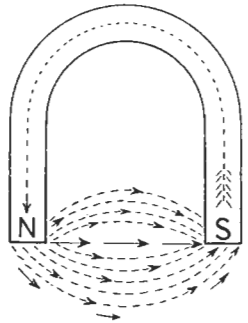
Scientists have called the magnetic influence which passes between the poles of a magnet, lines of force. These lines of force flow out of a north pole, around to the south pole and then through the magnet back to the north pole. Curiously, they do not stay bunched together but spread out in their

travel through the air. Figures 1 and 2 show two forms of permanent magnets with the path of these lines of force. The space about a magnet occupied by these lines of force is called the "field" of a magnet.

Magnets also possess another property. The pole of any magnet will attract the pole of any other magnet if it is of opposite polarity and will



No. 1. Bar Magnet



No. 2. Horse Shoe Magnet

repel it if it is of the same polarity. Since the earth is a huge magnet, the compass needle points to the north because it is attracted by the earth's magnetic pole of opposite polarity, which is located near the geographical north pole. If the compass needle is turned around by the fingers, it immediately resumes its normal position when released, because the pole which was presented is actually pushed away or repelled by the earth's north pole, while at the same time the opposite end is being attracted to it.

ELECTRO MAGNET—If a current of electricity is passed through a wire, the wire is immediately surrounded by a magnetic field. If the wire is wound in the form of a helix, it will form a magnet. If a bar of iron or soft steel is placed inside the helix or coil of wire, the bar will become magnetized and possesses the properties of a bar magnet, that is, it will have a north and south pole and will attract iron and steel. As soon as the current ceases to flow, the bar will quickly lose its magnetism. These forms of magnets are called temporary or electro magnets, and are one of the fundamentals about which all electrical machinery is designed.

It has just been shown in the preceding paragraph how a magnet is produced by means of an electrical current. Next

will be shown the relation between electricity and magnetism, and the application of these forms of energy.

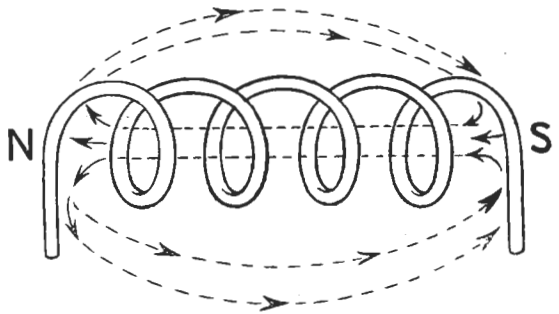


Fig. 3. Current flowing through a wire wound in the form of a helix will produce a magnet

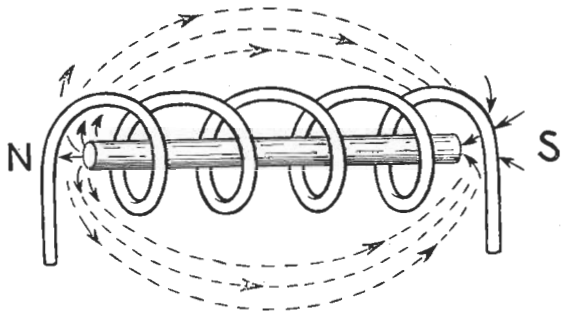


Fig. 4. An iron or steel bar placed inside the helix becomes magnetized

ELECTRICITY—Electricity is a form of energy which exists in the universe, the nature of which is not known, but we do know it is capable of doing work. By its means energy spent in generating electrical forces in one part of a system can be made to reappear as energy in the form of light, heat or work in some other part of the system.

There are many points in which electricity and magnetism are alike. For instance: Air is a medium that offers considerable resistance to the passage of both magnetism and electricity, although it offers more resistance to the passage of the latter.

Minerals like iron or steel are very easily influenced by magnetism and easily penetrated by it. When one of these is present in the magnetic circuit, the magnetism will flow through the metal in preference to going through the air. Any metal is a good conductor for the passage of electricity, but few metals are good conductors of magnetism.

It was learned that current passing through the coil of wire produced a magnet. The introduction of the iron bar greatly increased the magnetic effect because it was much easier for the magnetism to travel through the iron than it was through the air inside the coil of wire. For this reason an iron core is almost always used in an electro-magnet.

It has been shown that if an electric current is passed through a conductor a magnetic field is produced about the conductor.

It is also true that if a conductor is passed between the poles of a magnet through the magnetic field an electric pressure is generated in the conductor which will cause current to flow. This is the principle of the electric generator.

Figure 5 shows an elementary generator in which a loop of wire is revolved between the poles of a magnet. In order to carry the current that is generated in the loop of wire out into the external circuit (C) a commutator A, A is connected to the ends of the wire. Two brushes B, B rub on this commutator to collect the current. The electrical pressure generated may be increased either by increasing the speed of rotation or by increasing the number of turns in the loop of wire.

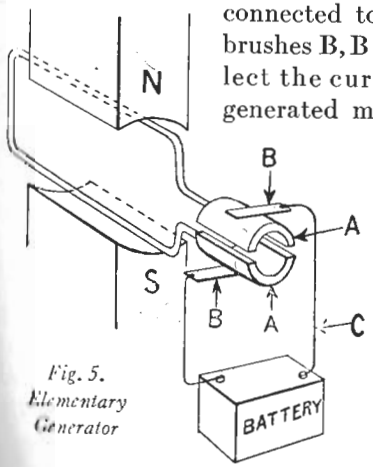


Fig. 5. Elementary Generator

In the modern generator a number of loops of wire are mounted in a rigid manner on a laminated iron core. This is called the armature.

The ends of each loop of wire are connected to commu-

tator bars. The brushes are so placed on the commutator that the current which is collected by them flows from one brush through the external circuit and back to the other brush.

The magnetic field of a generator through which the wires on the armature pass, is usually produced by electro-magnets which receive their current from the generator itself. These electro magnets are called the generator fields.

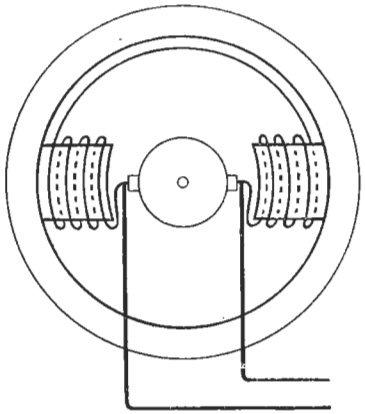


Fig. 6. Shunt Wound

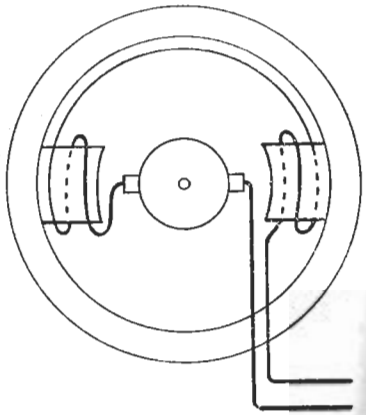


Fig. 7. Series Wound

When the current from the main or external circuit is passed through the wire around the generator fields, the generator is said to be "series" wound. When only a part of the current is diverted or shunted into the field wires the generator is said to be "shunt" wound. It is also possible to use a combination of these two methods, and a generator is then said to be a "compound" wound.

The electric motor has practically the same parts and construction as a generator, but operates in a different manner. Fig. 8 shows an elementary electric motor. The current is carried into the loop of wire through the brushes and commutator in the direction as shown by the arrow "C."

As may be seen in the description of the helix on Page 9, the loop of wire becomes a magnet with a north and south pole as shown by the arrows N-S. The north pole of the loop

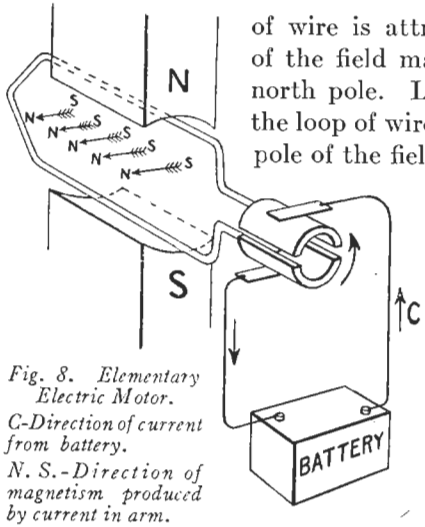


Fig. 8. Elementary Electric Motor.
C-Direction of current from battery.
N. S.-Direction of magnetism produced by current in arm.

of wire is attracted by the south pole of the field magnet and repelled by the north pole. Likewise the south pole of the loop of wire is attracted by the north pole of the field magnet and repelled by the south pole. This causes the loop of wire to revolve.

The modern electric motor is composed of a series of loops of wires rigidly mounted on an iron core in a manner similar to that described for the generator.

In order to better understand something about the measurement of electrical current, the action of an electrical Generator in regulating the distribution of electricity may be considered to be similar to that of a pump which takes water from a tank and supplies it to a reservoir at a higher level.

The difference in level produces a certain pressure which is similar to the so-called electrical pressure or voltage.

The amount of pressure largely determines the amount of water which flows in a given pipe, and in electricity the difference in voltage between two points largely determines the amount of current which flows between those two points. In other words, voltage or electrical pressure forces current through the electrical circuit just as water pressure forces water through the pipe. The quantity of water that flows through the pipe per second is similar to the current of the electrical circuit. The measure of electrical current is called the ampere.

If the water pipe were reduced in size or a series of obstructions were placed inside the pipe, the flow of water would be decreased due to the increased resistance offered to the water. In the electrical circuit, if the wire is reduced in size or if its material is changed so as to offer more resistance to the flow

of the electrical current, the current will be reduced. This resistance to the flow of current has been measured and a unit quantity is called an ohm. In the water system a valve

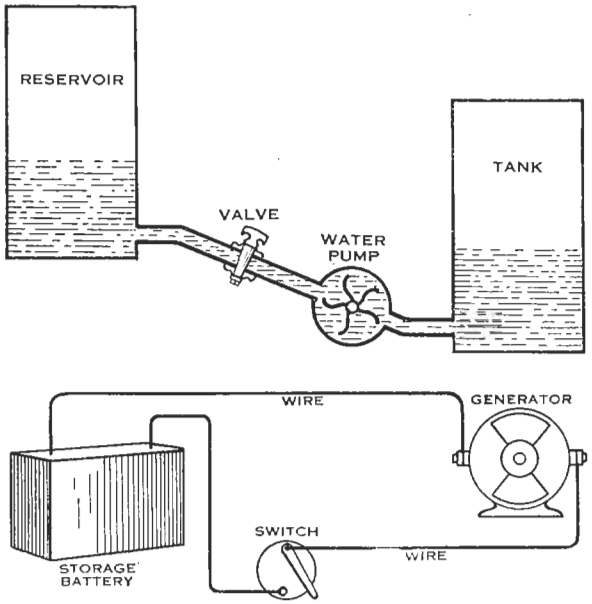


Fig. 9. Showing water pump, valve, pipe and reservoir compared to generator, switch, wires and storage battery respectively

may be introduced which will prevent the pump from forcing any more water through the pipe. In the electrical system a switch is introduced which opens a contact and blocks the path or circuit and likewise stops the flow of electricity.

Storage Battery—In the automobile the reservoir may be likened to the storage battery, as it is also a reservoir into which current is pumped and stored for later use. The storage battery used on automobiles is usually of the 6 volt type and has three compartments or cells. Within each cell are two elements, one positive and the other negative. Each element consists of a number of plates immersed in a battery solution known as electrolyte (diluted sulphuric acid). These plates

are composed of lead cast into grids, with a composition of lead oxide pasted into them. This composition is called the active material and sets hard like cement when dry, remaining so throughout the life of the battery.

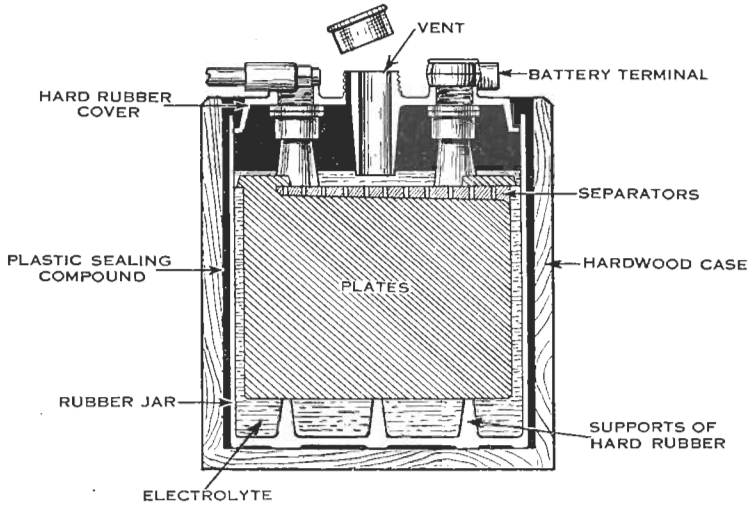


Fig. 10. Storage Battery

When a storage battery is being charged by current passing into it, the electrolyte and plates undergo a certain chemical change. When the battery is being discharged by current taken out of it, the plates and electrolyte again undergo a chemical change, which returns them to their former state. This change from the fully-charged condition to the fully discharged condition produces a change in the specific gravity of the electrolyte. In a fully charged battery the gravity should read between 1.275 and 1.300 on the battery hydrometer, while in the fully discharged condition the electrolyte will test about 1.150.

The plates or elements of opposite polarity are separated from each other by thin sheets of wood or hard rubber composition. The jars which contain the plates are made of hard rubber to prevent the acid from acting upon them. The

plates do not extend to the bottom of the jar, a space being left for sediment that will accumulate as the battery wears.

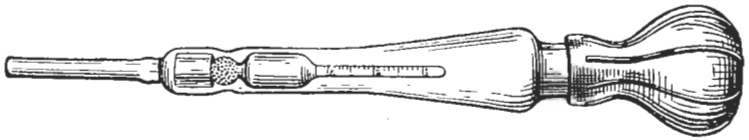


Fig. 11. Battery hydrometer used for testing gravity of storage battery electrolyte

It might be imagined that if a water wheel were placed at the end of a pipe connected with a reservoir and the valve were opened, the wheel would immediately revolve. It would continue to revolve until the reservoir were empty, but it would run faster at first and continue to run slower and slower as the height of the water decreased in the reservoir. In the same way an electric motor may be connected through a switch to a storage battery, so that it will run as long as there is any current left in the battery and it also will run slower and slower as the voltage in the battery decreases.

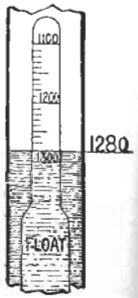
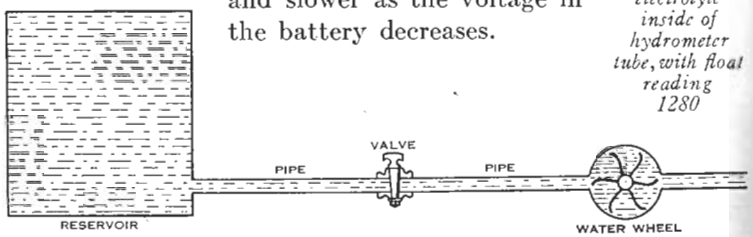


Fig. 12 Enlarged view, showing electrolyte inside of hydrometer tube, with float reading 1280



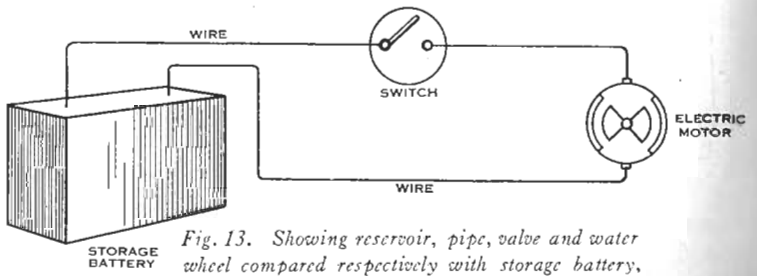
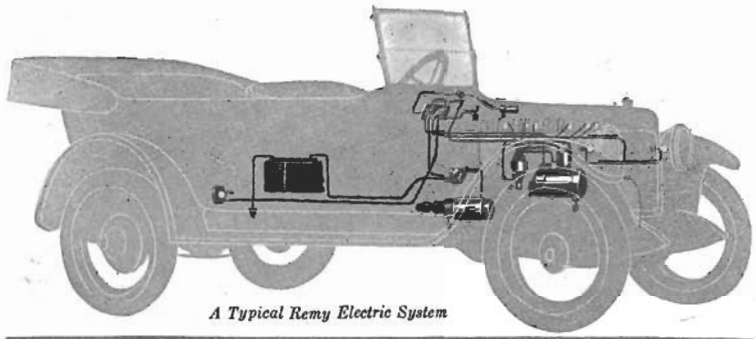


Fig. 13. Showing reservoir, pipe, valve and water wheel compared respectively with storage battery, wires, switch and electric motor



A Typical Remy Electric System

Electric Systems on Motor Cars

AN electric cranking system, as the name implies, is a system in which electricity is used to crank a gasoline engine. It consists of an electric motor driven from a storage battery. When the driver presses his foot on the starting pedal, he closes a switch connecting the motor to the battery, so that the motor starts and is automatically engaged with the engine, which it drives until firing commences in the engine cylinders. As soon as the engine starts to operate under its own power and the starting pedal is released by the foot, the motor is automatically disengaged from the engine.

A Generator which is driven by the engine is provided for charging the battery. When the engine reaches a certain speed at which the generator voltage is equal to or above the battery voltage, the Generator commences to charge the battery.

The Ignition and Lighting Systems are connected to the battery so that when the engine is not running fast enough to charge the battery, these circuits are fed from the battery. When the engine speed is sufficient for the Generator to charge the battery, these circuits are supplied from the Generator while the remainder of the current goes to the battery. A regulator is provided which automatically regulates the current output of the Generator at high speeds, so that the battery will not receive too heavy a charging current.

What the Thermostat Control Means to the Motorist

WE have seen the purpose for which the Thermostat Control was designed. Let us now see just how it meets conditions and what this means to the motorist.

It means that at all times of the year, in all kinds of weather, the generator will keep the battery charged without injuring it. It also meets fully the requirements of the battery for all kinds of driving conditions. Obviously, the motorist, such as a physician who is driving in the city with numerous stops, short calls and subsequent starts, requires a large amount of current to keep the battery charged. This system of regulation does meet just this condition, because of the Thermostat Control. On the other hand, if the motor car is driven continuously for long periods of time, the thermostat opens and the charging rate is diminished, so the battery is thoroughly protected from overcharge.

The Thermostat Control furnishes current to the battery at the time it is needed, and in the proper amount. This means long life to the battery and the elimination of a considerable source of trouble to the motorist.

RELAY CUT-OUT—As previously mentioned, when the Generator attains a certain speed, it is automatically connected to the storage battery. This is accomplished by a device known as a relay cut-out which consists of a small electro magnet that operates a set of contact points, the windings of the electro magnet being connected to the Generator. As the Generator increases in speed, it energizes the electro magnet of the relay so that the contact points are closed when the Generator has reached such a point that it is capable of charging the storage battery. When the engine is stopped, unless a relay is used in the circuit, the current from the battery would pass back through the Generator with the result that the Generator might be seriously over-heated or the storage battery drained.

All systems are not provided with relay cut-outs. In such cases the Generator is connected to the storage battery whenever the ignition switch is on. Usually a ratchet or overrunning clutch is then used to warn the driver that current is being drawn from his battery. The relay, however, automatically opens the circuit as soon as the Generator is no longer capable of charging the battery, and thereby prevents any waste of current.

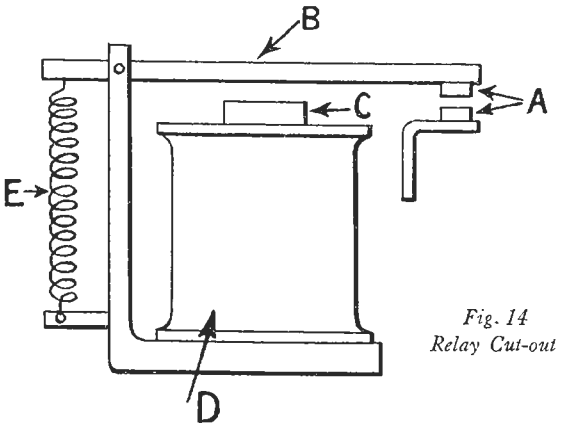


Fig. 14
Relay Cut-out

D—shows the coil of wire of the electro magnet.
C—shows the iron core which is magnetized by the generator current passing through the coil D.
B—shows the moving contact arm which is attracted by C and pulled down so that the contacts A are closed.
When the current flowing through coil D decreases to a certain value, the spring E opens the contacts A by moving B.

STARTING MOTOR—The Starting Motor is an easy and convenient way of cranking the engine. It receives its current directly from the storage battery the moment the starting pedal is depressed. It then cranks the engine until the engine is running under its own power and then is automatically disengaged. Starting Motors are series wound of comparatively simple construction, and under normal conditions require little attention. There are a number of methods whereby the Starting Motor is mechanically connected to the

engine for cranking, such as the over-running clutch, the mechanical gear shift, and the automatic screw shift.

Motor Generators—In a certain few systems, the motor and generator have been combined into one single unit. The working principle of a "single unit" system is much the same as that of a separate motor and generator. The machine operates as a motor on starting and when the car speed is sufficiently high, acts as a generator. The use of a single unit has been confined to a very few cars on account of the difficulty of adapting this unit to an engine which is not especially designed for its use.

Ignition System—Automobiles are generally driven by gasoline motors, whose power comes from the explosion of compressed gas in the engine cylinders. The expansion drives down a piston which produces power in a way similar to that of a steam engine. The cylinders are alike and the gas expands inside of them, one at a time in quick succession.

These charges of gas are ignited by a spark made in the engine cylinder by a Magneto or a Battery Ignition System. Inasmuch as the battery type of Ignition is used on the greater majority of cars, it will be fully described.

The exact position of the piston at which the spark should occur, depends largely upon the speed of the engine. This is due to the fact that a certain definite time is required after the spark has occurred for the flame to spread through the gas and cause the maximum power. If the spark always occurred at the same position of the piston, it is clear that at high speed the piston would travel much farther before the gas had been completely ignited. For this reason the spark should occur earlier in the piston stroke at high speeds and most ignition systems provide means for advancing and retarding the spark to meet these conditions.

The spark may be advanced manually through a system of levers which terminate on the quadrant of the steering wheel. It may also be accomplished by a governor consisting of a set of weights which are rotated by the engine and which operates the timing mechanism by centrifugal force or a combination of the two methods may be used.

The characteristics of the gasoline engine, however, are such that the timing of the spark in the cylinder is not only dependent on speed but also on load. At a given speed the spark advance for quarter load is more than that required for full load. The spark advance operated by centrifugal means is therefore usually supplemented by a small amount of manual control. Theoretically this combination might seem to be the best obtainable but practically it depends largely upon the characteristics of the engine as to what sort of spark advance method is best.

A Battery Ignition System consists of a mechanically operated circuit-breaker, a transformer coil, and a distributor for distributing the high tension current to the spark plugs.

The circuit-breaker consists of a set of contact points, which are mechanically opened so that the circuit may be broken at the proper moment to produce a spark in the cylinder.

The coil consists of an iron core, about which is wound a few turns of heavy wire and a very large number of turns of very fine wire. The coarse wire is known as the primary winding, while the fine wire is known as the high tension or secondary winding. When the contact points are closed, current from the storage battery passes through the primary winding and magnetizes the iron core. The instant the points open and the current is broken, a very high voltage is produced in the secondary winding. In other words, the low voltage of the battery is stepped up or multiplied by the coil, so that a high voltage is produced which is sufficiently strong to jump the spark plug gap in the engine cylinder and fire the awaiting charge.

The Distributor, so called, is merely a high voltage switch which has a rotating member so that the spark plug of each cylinder is automatically connected to receive the high tension current at the proper time. The Distributor parts are heavily insulated to carry the high voltage.

In order to reduce the injurious sparking which occurs at the circuit breaker contact points when they are opened, a condenser must be connected across the points. An ele-

mentary condenser consists of two metal plates placed close together but insulated from each other. In order to increase the capacity of the condenser, the size of the plates may be increased or several may be connected together. In practice, the metal plates are composed of sheets of very thin tinfoil which are insulated from each other by paper. Usually the paper is treated or impregnated with some compound that will increase its insulating strength and make it moisture proof.

LIGHTING—The average motorist is more or less familiar with the system on the motor car. In many respects it is typical of the Lighting System in the modern home, except that it receives its current from the generator and storage battery, while the current for the house lighting is supplied by a distant power station.

HORNS—The need for adequate warning signal is apparent to all familiar with motoring. The warning signal is also electrically operated through a push button switch and receives its current from the same source as the lighting system.

SWITCHES—Switches on the automobile are merely convenient mechanical means of making such electrical connections as the motorist requires to obtain the proper functioning of his electrical equipment.

AMMETER—The ammeter indicates the amount of current flowing in the circuit. It tells whether the system is working properly. When it indicates "Charge," current produced in the generator is flowing to the battery. When it indicates "Discharge," the stored current is flowing from the battery to the lamps and ignition. When the pointer is at zero, the battery is neither receiving or discharging current. Sometimes an "Indicator" is used which does not show the amount of the charge or discharge but merely shows that either condition exists.

WIRING—Until a few years ago the electrical equipment on automobiles was connected by the so-called two wire system, in which both sides of the circuit were connected by insulated wire. In recent years, however, the one-wire system has become almost universally used. In this method the return

circuit to the battery is made through the metallic frame of the car. This latter system, of course, reduces the number of wires on the car by half, and consequently results in greater simplification.

The sizes of the various wires are selected according to the part of the circuit in which they are used. The wires to the lights and ignition are comparatively small, while the connections between the starting motor and battery must be quite large, in order to adequately carry the starting current. All of the wires are of the stranded, flexible type, so that road vibrations will not cause them to crystallize and break. They are all heavily insulated to prevent short circuits or grounds.

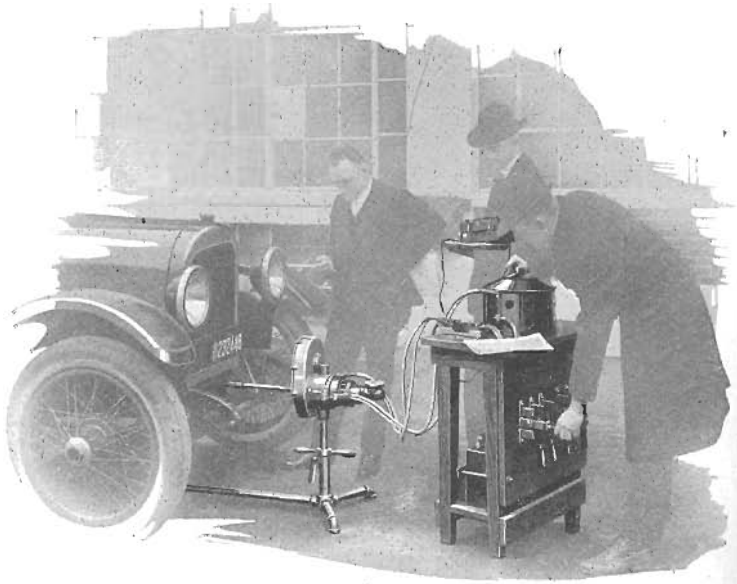
Assuming that the reader has gained a fair knowledge of the functioning of the various units comprising the electrical system on the motor car, the following pages are devoted to brief descriptions of Remy Starting, Lighting and Ignition Systems.

To describe this equipment fully would require pages of detailed explanations and the introduction of many technical terms, but since it is the purpose of this book to eliminate technicalities, the story of their construction and care only is briefly told.

The Remy Starting Motor

THE starting motor which takes the place of the common hand crank, is operated by current from the storage battery. It is designed and built to crank the engine in the most dependable way possible.

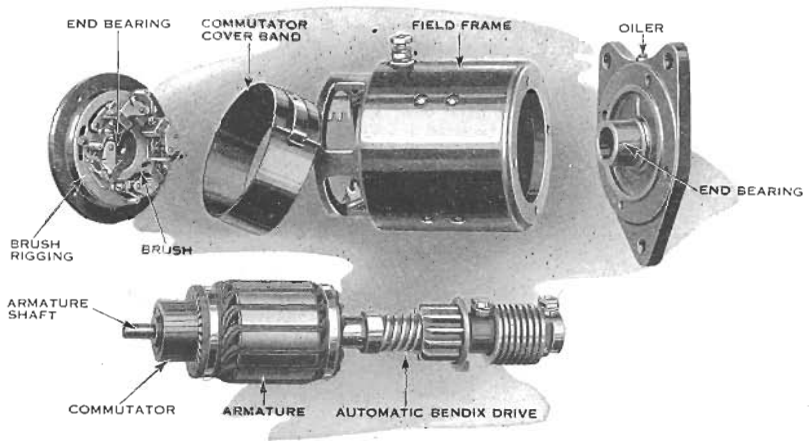
Many starting motors can be designed which will crank an engine under favorable conditions, but it is the ultimate power that can be exerted under unfavorable conditions that determines its real value.



Torquemeter used to determine the exact power required to crank an engine

The exact requirements of the Remy starting motor to be furnished the motor car manufacturer are accurately determined by the engineers of the Remy Electric Company. The power actually required to crank the engine under all conditions is carefully measured so that the motorist is assured of dependable performance. Cold weather conditions are especially investigated, for it is in the winter time that starting motors

are prone to give trouble. Special apparatus has been developed for the purpose of making tests quickly and accurately on the car itself, so that no condition can possibly be overlooked.



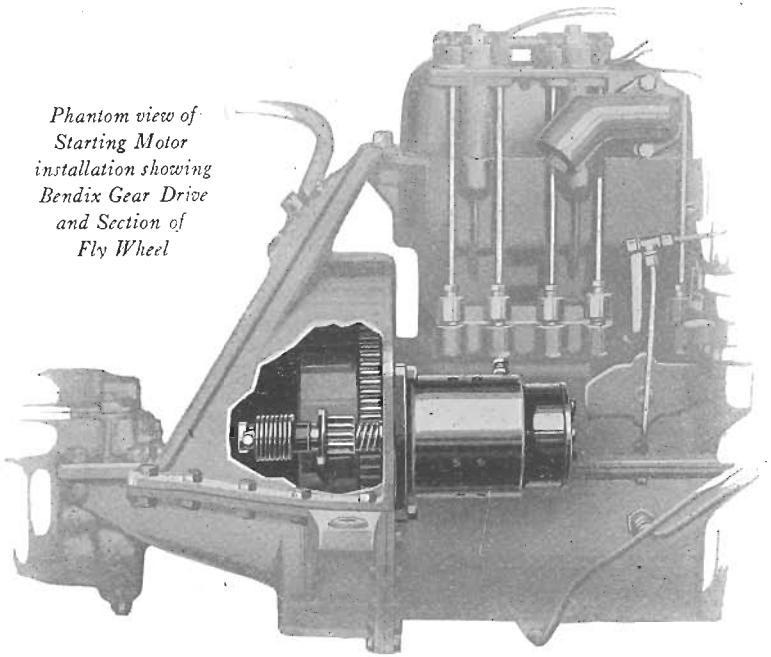
Disassembled view of a Remy Starting Motor

The Remy Starting Motor is of the four-pole series wound type, of very compact and sturdy construction. It is designed to crank the engine at a high rate of speed and at the same time consume the minimum amount of current commensurate with the demand for positive operation.

The windings are thoroughly impregnated with insulating compound so that they are moisture proof. A removable band around the commutator end of the motor excludes dust and water.

A Bendix transmission is used which automatically engages and disengages the Starting Motor with the engine. The extended shaft of the Starting Motor carries a hardened steel sleeve upon which is cut a screw thread. Operating upon this sleeve is a steel pinion having a lateral travel of about one and one-half inches for engaging the gear teeth on the flywheel. A helical steel spring serves as a flexible coupling between the Starting Motor and the pinion, and it also facilitates engagement of the gears and absorbs all shocks.

When the Starting Motor is supplied with current, its armature being free starts to revolve at a high rate of speed. The pinion, by reason of its inertia, tends to lag behind the rotation of the shaft, whose screw thread thus draws the

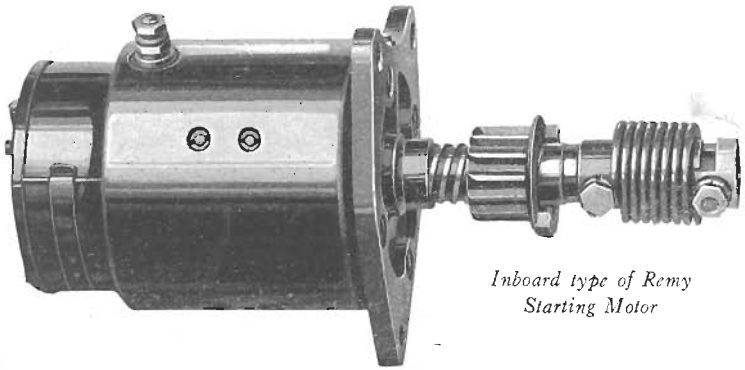


Phantom view of Starting Motor installation showing Bendix Gear Drive and Section of Fly Wheel

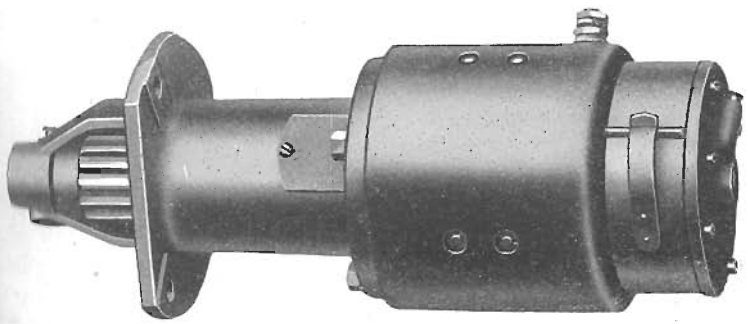
pinion into mesh with the gear teeth of the flywheel; but as soon as the engine starts firing, its increased speed of rotation threads the pinion back in the opposite direction, thus disengaging the Starting Motor from the engine.

A large starting torque is obtained in this way, by bringing the Starter pinion into mesh with the Flywheel while the Motor is running at high speed. This engaging device is entirely automatic, and also "fool-proof," for if the starting switch should accidentally be pushed while the engine is running, the starter pinion would be thrown against the faster revolving flywheel teeth, and be immediately thrown back without meshing and without damage.

To meet the mounting requirements of various engines, the Bendix transmission is installed two ways, giving what is known as the outboard and inboard types of mesh. In the inboard type the pinion travels toward the starting motor as it meshes with the flywheel gear. In the outboard type the pinion travels away from the starting motor to the end of the shaft, which must therefore be supported. The armature shaft of the Remy outboard type starting motor is made extra large and is well supported so that there can be no springing or misalignment while the motor is cranking the engine.



Inboard type of Remy Starting Motor



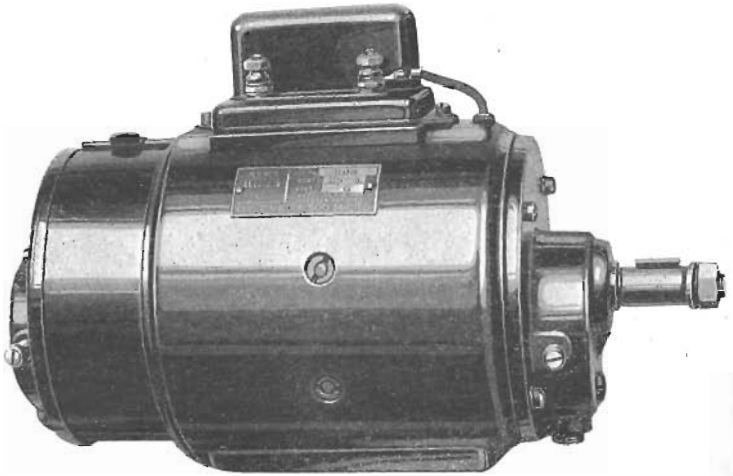
Outboard type of Remy Starting Motor

The commutator and brushes of the Remy Starting Motor are designed to carry very heavy current without injury, and under normal conditions will require practically no attention during the life of the car.

The commutator should be cleaned about once a year by an experienced man. The removable cover makes the commutator and brushes easily accessible.

The bearings of the Starting Motor are generously proportioned and require only a few drops of good light oil every 5,000 miles to furnish ample lubrication under all ordinary usage.

The Remy Generator

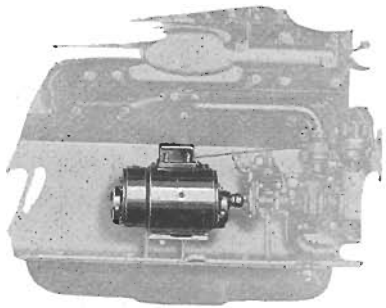


One type of Remy Generator

THE Remy Generator supplies the Storage Battery with all current required for starting, lighting and ignition.

In order for a generator to be of value on a motor car it must be capable of charging the battery at comparatively low car speeds. In each Remy installation the relation between generator speed and car speed has been obtained and the generator so designed that it adequately meets this condition.

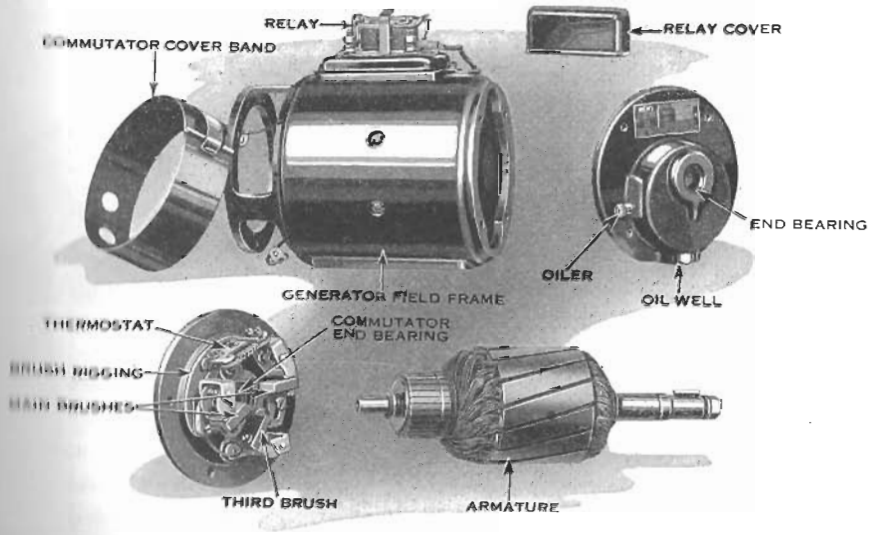
Remy generators are made with either ball bearings or plain sleeve bearings and special attention has been paid to adequate lubrication facilities. When the generator is



View showing an installation of a Remy Generator of the Coupling Drive Type

gear driven, the front bearing is so arranged that it will be constantly lubricated by the oil in the engine timing gearcase. Bearings not lubricated in this way are also adequately taken care of. A ball bearing is packed with grease at the time the generator is assembled, so that perfect lubrication is assured at the start. An oiler is also provided through which the bearing is subsequently oiled.

When the sleeve-type bearing is used a large oil well is provided with wick feed so that a constant positive lubrication is assured as long as there is oil in the well. A convenient oiler is provided through which the oil well may be filled when necessary. If properly lubricated Remy generator bearings will last indefinitely.



Disassembled view of a Remy Generator

Generator Regulation

NECESSITY FOR AUTOMATIC REGULATION OF GENERATOR OUTPUT—The necessity for some form of automatic regulation to control the output of the generator used on motor cars is quite apparent. We have seen that fundamentally the current produced by a generator increases with the speed. Since the speed of an automobile engine varies between wide limits, the current value would also fluctuate unless properly controlled. If the charging rate is too high, the generator is overheated and the battery may become overcharged.

FORMS OF REGULATION—There have been numerous forms of generator regulation, and some of the more prominent types will be outlined.

Among the early forms of regulation that have been discarded were the Bucking Series Field and Automatic Field Rheostat types.

The vibrating type of Voltage or Current Regulator has also been quite extensively used, but it also has its limitations. These regulating devices are more or less delicate; they do not maintain their adjustment, and when once out of order are most difficult for the average motorist to correct.

One of the most simple and successful forms of regulation has been the so-called Third Brush. This type gets its name from the fact that an additional or Third Brush placed on the generator commutator is connected to the field windings. Due to the inherent characteristics thereby produced, the charging current is reduced at the high generator speeds.

DEFICIENCIES OF MOST FORMS OF REGULATION—Most of the above types of regulation have limitations due to mechanical complications, but even the Third Brush regulation with its great simplicity has one great outstanding objection. This objection is due to the wide difference in the demands of the storage battery during cold and hot weather.

When the temperature is at zero and it is necessary to step on the starter pedal several times to get the cold engine going, when short dark days necessitate the long use of the lights, a great deal of current is required from the battery. This, of course, can be replaced if the generator is of sufficient capacity. If, however, the generator is of sufficient capacity to adequately care for these conditions, other difficulties are obtained in the hot summer months.

During the summer, the engine starts more easily, the lights are used less, and much less current is required from the battery. With the large capacity generator, however, which was needed to supply sufficient battery charging current for winter conditions, the battery is soon overheated, overcharged and deteriorates. The battery deteriorates partly because the large charging rate heats it up so that the active material of the plates is loosened and sheds or falls out. Since the active material, so-called, is the life of the battery, it is clear that the battery will soon have only a portion of its capacity available.

As a matter of fact, in order that the battery would not be quickly ruined in the summer, the capacity of the generator was usually reduced. This immediately caused an undercharge in the winter, with the result that the battery was quite frequently in a partly or wholly-drained condition, with considerable discomfiture to the motorist, who had to have his battery removed from his car to be recharged at a Service Station.

Thermostat Control

IN order to meet these conditions a new system of regulation was developed which utilizes Thermostat Control in addition to the Third Brush method. This device assures the motorist of perfect automatic control of the charging of the storage battery in his car. It has none of the limitations of the former types of regulation, but many advantages far beyond their scope. By its use a generator can be made of large capacity for winter charging conditions without danger to the battery in the summer.

What the Thermostat Control Means to the Motorist

WE have seen the purpose for which the Thermostat Control was designed. Let us now see just how it meets conditions and what this means to the motorist.

It means that at all times of the year, in all kinds of weather, the generator will keep the battery charged without injuring it. It also meets fully the requirements of the battery for all kinds of driving conditions. Obviously, the motorist, such as a physician who is driving in the city with numerous stops, short calls and subsequent starts, requires a large amount of current to keep the battery charged. This system of regulation does meet just this condition, because of the Thermostat Control. On the other hand, if the motor car is driven continuously for long periods of time, the thermostat opens and the charging rate is diminished, so the battery is thoroughly protected from overcharge.

The Thermostat Control furnishes current to the battery at the time it is needed, and in the proper amount. This means long life to the battery and the elimination of a considerable source of trouble to the motorist.

RELAY CUT-OUT—As previously mentioned, when the Generator attains a certain speed, it is automatically connected to the storage battery. This is accomplished by a device known as a relay cut-out which consists of a small electro magnet that operates a set of contact points, the windings of the electro magnet being connected to the Generator. As the Generator increases in speed, it energizes the electro magnet of the relay so that the contact points are closed when the Generator has reached such a point that it is capable of charging the storage battery. When the engine is stopped, unless a relay is used in the circuit, the current from the battery would pass back through the Generator with the result that the Generator might be seriously over-heated or the storage battery drained.

All systems are not provided with relay cut-outs. In such cases the Generator is connected to the storage battery whenever the ignition switch is on. Usually a ratchet or overrunning clutch is then used to warn the driver that current is being drawn from his battery. The relay, however, automatically opens the circuit as soon as the Generator is no longer capable of charging the battery, and thereby prevents any waste of current.

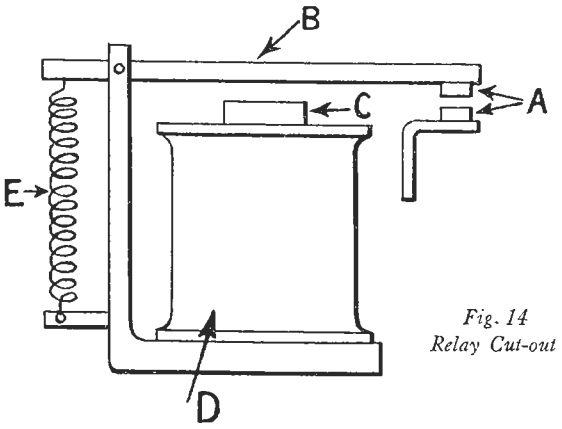


Fig. 14
Relay Cut-out

D—shows the coil of wire of the electro magnet.
C—shows the iron core which is magnetized by the generator current passing through the coil D.
B—shows the moving contact arm which is attracted by C and pulled down so that the contacts A are closed.
When the current flowing through coil D decreases to a certain value, the spring E opens the contacts A by moving B.

STARTING MOTOR—The Starting Motor is an easy and convenient way of cranking the engine. It receives its current directly from the storage battery the moment the starting pedal is depressed. It then cranks the engine until the engine is running under its own power and then is automatically disengaged. Starting Motors are series wound of comparatively simple construction, and under normal conditions require little attention. There are a number of methods whereby the Starting Motor is mechanically connected to the

engine for cranking, such as the over-running clutch, the mechanical gear shift, and the automatic screw shift.

Motor Generators—In a certain few systems, the motor and generator have been combined into one single unit. The working principle of a "single unit" system is much the same as that of a separate motor and generator. The machine operates as a motor on starting and when the car speed is sufficiently high, acts as a generator. The use of a single unit has been confined to a very few cars on account of the difficulty of adapting this unit to an engine which is not especially designed for its use.

Ignition System—Automobiles are generally driven by gasoline motors, whose power comes from the explosion of compressed gas in the engine cylinders. The expansion drives down a piston which produces power in a way similar to that of a steam engine. The cylinders are alike and the gas expands inside of them, one at a time in quick succession.

These charges of gas are ignited by a spark made in the engine cylinder by a Magneto or a Battery Ignition System. Inasmuch as the battery type of Ignition is used on the greater majority of cars, it will be fully described.

The exact position of the piston at which the spark should occur, depends largely upon the speed of the engine. This is due to the fact that a certain definite time is required after the spark has occurred for the flame to spread through the gas and cause the maximum power. If the spark always occurred at the same position of the piston, it is clear that at high speed the piston would travel much farther before the gas had been completely ignited. For this reason the spark should occur earlier in the piston stroke at high speeds and most ignition systems provide means for advancing and retarding the spark to meet these conditions.

The spark may be advanced manually through a system of levers which terminate on the quadrant of the steering wheel. It may also be accomplished by a governor consisting of a set of weights which are rotated by the engine and which operates the timing mechanism by centrifugal force or a combination of the two methods may be used.

The characteristics of the gasoline engine, however, are such that the timing of the spark in the cylinder is not only dependent on speed but also on load. At a given speed the spark advance for quarter load is more than that required for full load. The spark advance operated by centrifugal means is therefore usually supplemented by a small amount of manual control. Theoretically this combination might seem to be the best obtainable but practically it depends largely upon the characteristics of the engine as to what sort of spark advance method is best.

A Battery Ignition System consists of a mechanically operated circuit-breaker, a transformer coil, and a distributor for distributing the high tension current to the spark plugs.

The circuit-breaker consists of a set of contact points, which are mechanically opened so that the circuit may be broken at the proper moment to produce a spark in the cylinder.

The coil consists of an iron core, about which is wound a few turns of heavy wire and a very large number of turns of very fine wire. The coarse wire is known as the primary winding, while the fine wire is known as the high tension or secondary winding. When the contact points are closed, current from the storage battery passes through the primary winding and magnetizes the iron core. The instant the points open and the current is broken, a very high voltage is produced in the secondary winding. In other words, the low voltage of the battery is stepped up or multiplied by the coil, so that a high voltage is produced which is sufficiently strong to jump the spark plug gap in the engine cylinder and fire the awaiting charge.

The Distributor, so called, is merely a high voltage switch which has a rotating member so that the spark plug of each cylinder is automatically connected to receive the high tension current at the proper time. The Distributor parts are heavily insulated to carry the high voltage.

In order to reduce the injurious sparking which occurs at the circuit breaker contact points when they are opened, a condenser must be connected across the points. An ele-

mentary condenser consists of two metal plates placed close together but insulated from each other. In order to increase the capacity of the condenser, the size of the plates may be increased or several may be connected together. In practice, the metal plates are composed of sheets of very thin tinfoil which are insulated from each other by paper. Usually the paper is treated or impregnated with some compound that will increase its insulating strength and make it moisture proof.

LIGHTING—The average motorist is more or less familiar with the system on the motor car. In many respects it is typical of the Lighting System in the modern home, except that it receives its current from the generator and storage battery, while the current for the house lighting is supplied by a distant power station.

HORNS—The need for adequate warning signal is apparent to all familiar with motoring. The warning signal is also electrically operated through a push button switch and receives its current from the same source as the lighting system.

SWITCHES—Switches on the automobile are merely convenient mechanical means of making such electrical connections as the motorist requires to obtain the proper functioning of his electrical equipment.

AMMETER—The ammeter indicates the amount of current flowing in the circuit. It tells whether the system is working properly. When it indicates "Charge," current produced in the generator is flowing to the battery. When it indicates "Discharge," the stored current is flowing from the battery to the lamps and ignition. When the pointer is at zero, the battery is neither receiving or discharging current. Sometimes an "Indicator" is used which does not show the amount of the charge or discharge but merely shows that either condition exists.

WIRING—Until a few years ago the electrical equipment on automobiles was connected by the so-called two wire system, in which both sides of the circuit were connected by insulated wire. In recent years, however, the one-wire system has become almost universally used. In this method the return

circuit to the battery is made through the metallic frame of the car. This latter system, of course, reduces the number of wires on the car by half, and consequently results in greater simplification.

The sizes of the various wires are selected according to the part of the circuit in which they are used. The wires to the lights and ignition are comparatively small, while the connections between the starting motor and battery must be quite large, in order to adequately carry the starting current. All of the wires are of the stranded, flexible type, so that road vibrations will not cause them to crystallize and break. They are all heavily insulated to prevent short circuits or grounds.

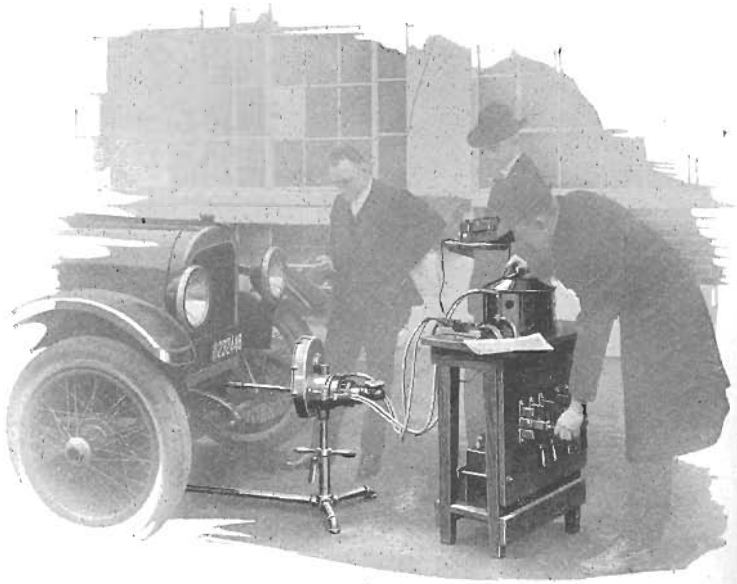
Assuming that the reader has gained a fair knowledge of the functioning of the various units comprising the electrical system on the motor car, the following pages are devoted to brief descriptions of Remy Starting, Lighting and Ignition Systems.

To describe this equipment fully would require pages of detailed explanations and the introduction of many technical terms, but since it is the purpose of this book to eliminate technicalities, the story of their construction and care only is briefly told.

The Remy Starting Motor

THE starting motor which takes the place of the common hand crank, is operated by current from the storage battery. It is designed and built to crank the engine in the most dependable way possible.

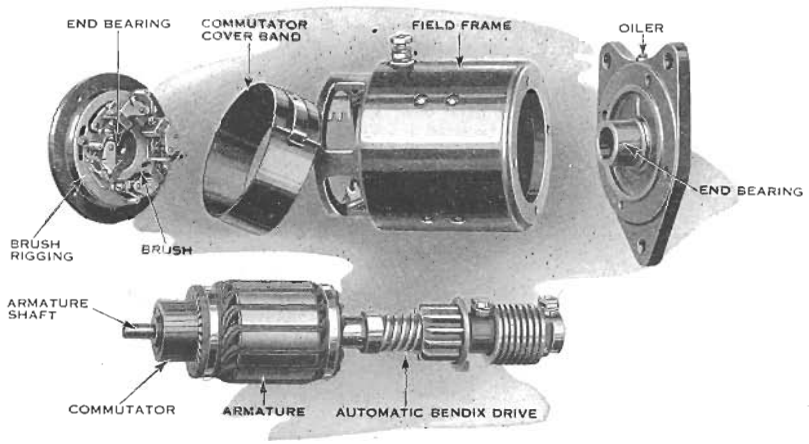
Many starting motors can be designed which will crank an engine under favorable conditions, but it is the ultimate power that can be exerted under unfavorable conditions that determines its real value.



Torquemeter used to determine the exact power required to crank an engine

The exact requirements of the Remy starting motor to be furnished the motor car manufacturer are accurately determined by the engineers of the Remy Electric Company. The power actually required to crank the engine under all conditions is carefully measured so that the motorist is assured of dependable performance. Cold weather conditions are especially investigated, for it is in the winter time that starting motors

are prone to give trouble. Special apparatus has been developed for the purpose of making tests quickly and accurately on the car itself, so that no condition can possibly be overlooked.



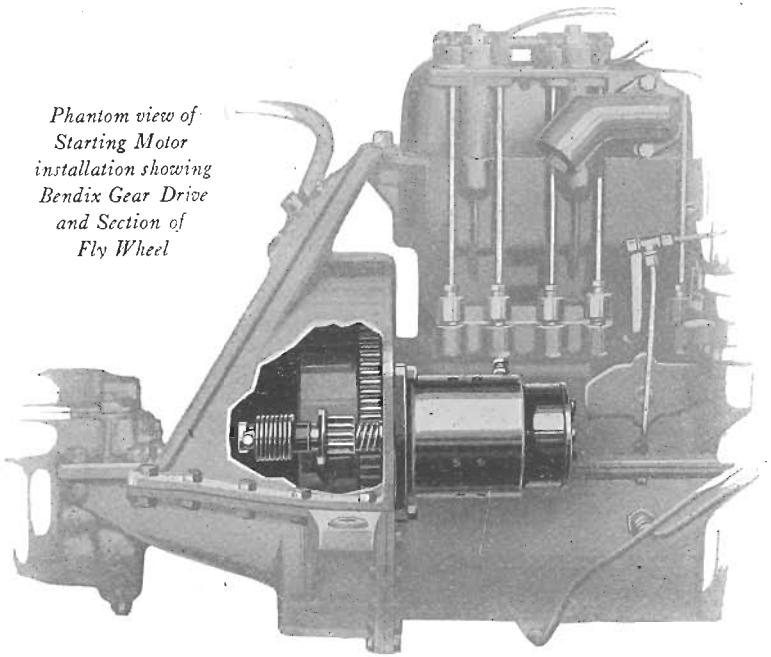
Disassembled view of a Remy Starting Motor

The Remy Starting Motor is of the four-pole series wound type, of very compact and sturdy construction. It is designed to crank the engine at a high rate of speed and at the same time consume the minimum amount of current commensurate with the demand for positive operation.

The windings are thoroughly impregnated with insulating compound so that they are moisture proof. A removable band around the commutator end of the motor excludes dust and water.

A Bendix transmission is used which automatically engages and disengages the Starting Motor with the engine. The extended shaft of the Starting Motor carries a hardened steel sleeve upon which is cut a screw thread. Operating upon this sleeve is a steel pinion having a lateral travel of about one and one-half inches for engaging the gear teeth on the flywheel. A helical steel spring serves as a flexible coupling between the Starting Motor and the pinion, and it also facilitates engagement of the gears and absorbs all shocks.

When the Starting Motor is supplied with current, its armature being free starts to revolve at a high rate of speed. The pinion, by reason of its inertia, tends to lag behind the rotation of the shaft, whose screw thread thus draws the

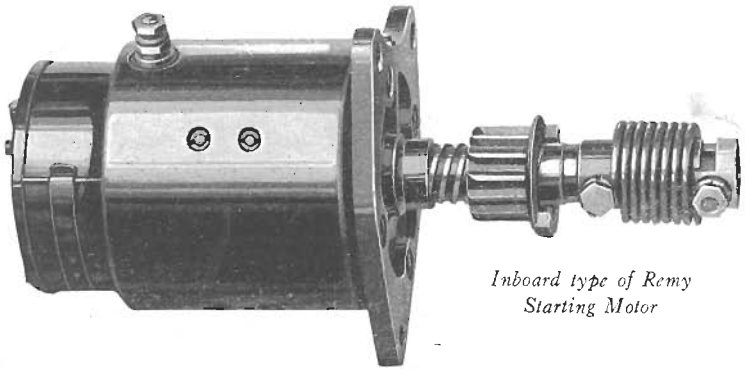


Phantom view of Starting Motor installation showing Bendix Gear Drive and Section of Fly Wheel

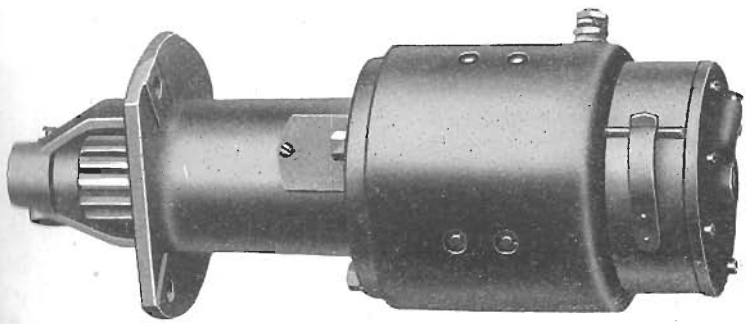
pinion into mesh with the gear teeth of the flywheel; but as soon as the engine starts firing, its increased speed of rotation threads the pinion back in the opposite direction, thus disengaging the Starting Motor from the engine.

A large starting torque is obtained in this way, by bringing the Starter pinion into mesh with the Flywheel while the Motor is running at high speed. This engaging device is entirely automatic, and also "fool-proof," for if the starting switch should accidentally be pushed while the engine is running, the starter pinion would be thrown against the faster revolving flywheel teeth, and be immediately thrown back without meshing and without damage.

To meet the mounting requirements of various engines, the Bendix transmission is installed two ways, giving what is known as the outboard and inboard types of mesh. In the inboard type the pinion travels toward the starting motor as it meshes with the flywheel gear. In the outboard type the pinion travels away from the starting motor to the end of the shaft, which must therefore be supported. The armature shaft of the Remy outboard type starting motor is made extra large and is well supported so that there can be no springing or misalignment while the motor is cranking the engine.



Inboard type of Remy Starting Motor



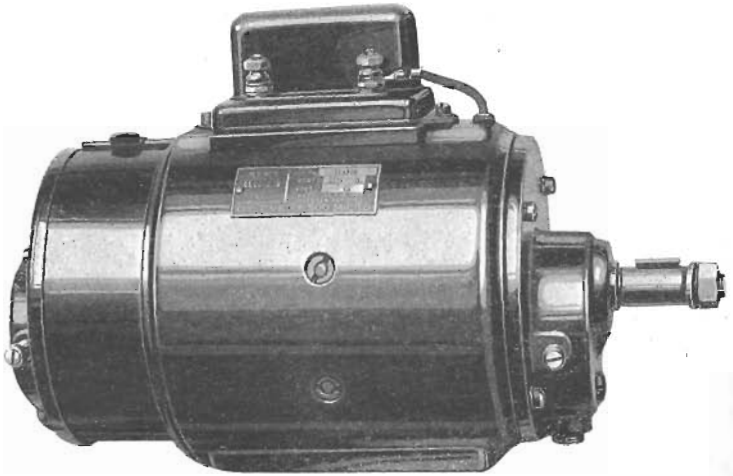
Outboard type of Remy Starting Motor

The commutator and brushes of the Remy Starting Motor are designed to carry very heavy current without injury, and under normal conditions will require practically no attention during the life of the car.

The commutator should be cleaned about once a year by an experienced man. The removable cover makes the commutator and brushes easily accessible.

The bearings of the Starting Motor are generously proportioned and require only a few drops of good light oil every 5,000 miles to furnish ample lubrication under all ordinary usage.

The Remy Generator

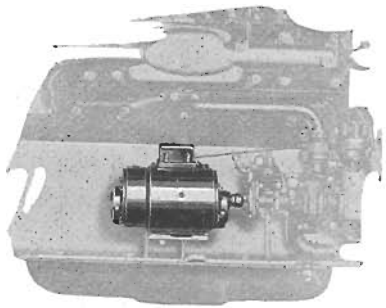


One type of Remy Generator

THE Remy Generator supplies the Storage Battery with all current required for starting, lighting and ignition.

In order for a generator to be of value on a motor car it must be capable of charging the battery at comparatively low car speeds. In each Remy installation the relation between generator speed and car speed has been obtained and the generator so designed that it adequately meets this condition.

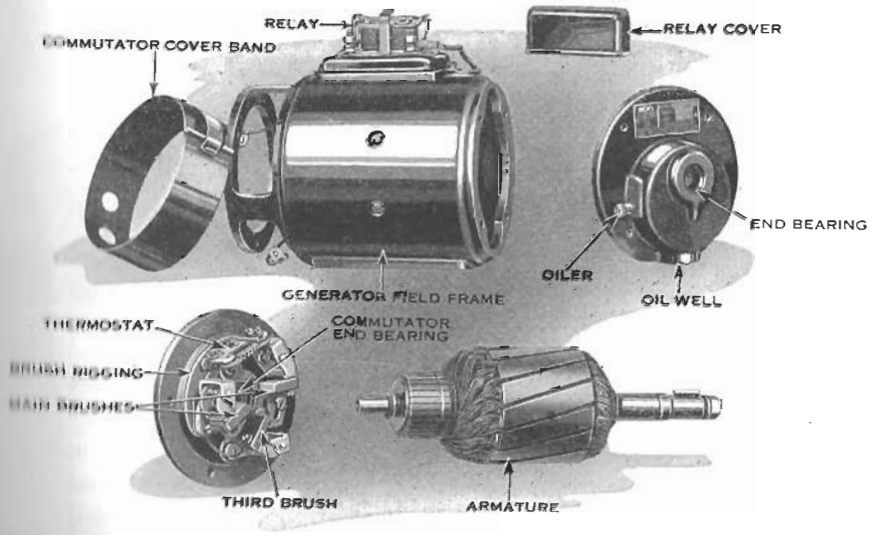
Remy generators are made with either ball bearings or plain sleeve bearings and special attention has been paid to adequate lubrication facilities. When the generator is



View showing an installation of a Remy Generator of the Coupling Drive Type

gear driven, the front bearing is so arranged that it will be constantly lubricated by the oil in the engine timing gearcase. Bearings not lubricated in this way are also adequately taken care of. A ball bearing is packed with grease at the time the generator is assembled, so that perfect lubrication is assured at the start. An oiler is also provided through which the bearing is subsequently oiled.

When the sleeve-type bearing is used a large oil well is provided with wick feed so that a constant positive lubrication is assured as long as there is oil in the well. A convenient oiler is provided through which the oil well may be filled when necessary. If properly lubricated Remy generator bearings will last indefinitely.



Disassembled view of a Remy Generator

COMMUTATOR AND BRUSHES—A removable dust-tight cover around the commutator end of the generator provides easy access to the commutator and brushes. Inspection twice in a season will forestall any tendency to score the commutator.

The brushes used with this Generator are of special carbon-copper composition, and under average conditions will last indefinitely.

These brushes have been selected by the Remy Electric Company after exhaustive tests and they are perfectly adapted to the duty they are called upon to perform.

Third-Brush Regulation

THE current output of the Generator is regulated at all speeds by means of the Thermostat control, supplemented by the third-brush construction, in which the field winding of the Generator, instead of being connected across the two main brushes, as in the ordinary shunt-wound type, is connected from one main brush to a third brush.

The Generator starts to charge at a low driving speed and delivers its full charging current at average driving speed. Above average speeds, the third-brush regulation reduces the current automatically, so that the battery is not subjected to an excessive charge rate, if the car is driven at high rates of speed.

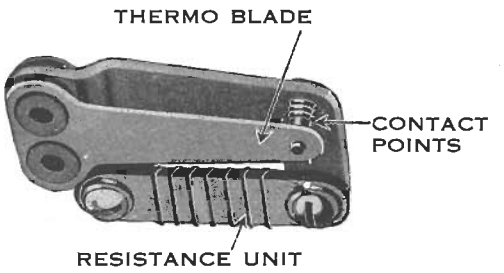
Thermostat Control

THE battery is called upon for considerably more current in winter than in summer, because of the increased use of lights, and longer application of the Starting Motor required to start a stiff, cold engine. Furthermore, since the condition of the streets in winter imposes slower driving, the battery does not receive even the normal amount of recharge from the ordinary type of Generator, and as a result it has been found necessary on some makes of cars to have the battery charged several times during the winter at considerable inconvenience.

A larger capacity Generator could not safely be used, without some means of protecting the battery from overheating, which a continuous high charge rate would cause, especially in the summer time. Overheating will seriously damage the plates and materially shorten the life of the battery.

The Remy Electric Company realized that the old methods of generator regulation were fundamentally inadequate. After a very lengthy and exhaustive study of the conditions, they evolved the Thermostat Control, which is an exclusive patented feature of Remy generators.

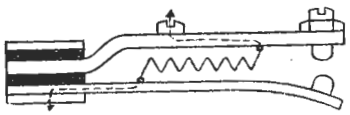
The Remy Patented Thermostat Control has made it possible to furnish a Generator of the large current capacity needed for winter use. It insures against the overheating of the battery, which a continuous high charge rate would cause, with consequent damage to the plates in the summer time. The Thermostat thus insures not only maximum battery life, but enables the highest charging rate to be used which the battery may safely receive at different temperatures.



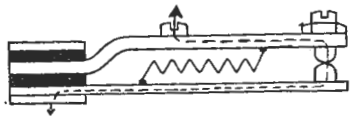
The Remy Thermostat

Mechanically, the Thermostat is very simple in construction and operation. It is composed of a resistance unit, a contact point rigidly mounted, and a spring blade holding another contact point. The blade is made of a strip of spring brass welded to a strip of nickel steel—a combination which warps at its free end when heated due to the greater expansion of the brass side. The blade is permanently

riveted through insulation washers to the bracket, and the spring tension is fixed so that it holds the two contacts firmly together at low temperatures, but as soon as the temperature rises to approximately 175 deg. F. the blade bends, and separates the contacts.



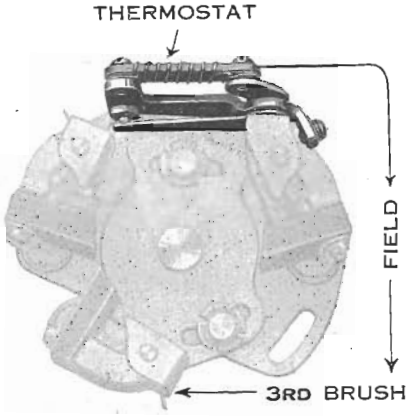
Remy Thermostat hot and open



Remy Thermostat cold and closed

When the Thermostat contacts are closed, full field current passes through them and permits full current output from the Generator. After the engine has been run for a sufficient time to cause the full current output to heat up the battery, the automatic Thermostat inserts the resistance into the field circuit, and thus reduces the output.

It is thus seen that the control is centered in a simple compact unit. This unit is mounted in an accessible place inside the generator itself where it is thoroughly protected from any mechanical injury, so that the generator with its control is entirely self-contained.



BRUSH RIGGING INSIDE

THIRD-BRUSH ADJUSTMENT—If it should be considered necessary to change the current output of the Generator, it is advisable to have this done only by an authorized Service man. Adjustment should be made only after the Generator has cooled down to atmospheric temperature. All Remy generators are provided with an easily accessible means of adjusting the third brush. On some types of generators, there is a small headless screw in the commutator end of the generator. By turning the screw, the output may be either raised or lowered.

On other types, the removal of the cover band exposes a lock nut on the third brush plate. This nut may be loosened, the brush plate moved with the fingers and the nut again tightened.

Unless most of the driving in summer is made up of unusually long daylight runs with few stops, and with little or no use of the lamps, the Thermostat will be found to control the current output without any attention to this adjustment whatever.

LOW CURRENT OUTPUT—The protection which the Thermostat affords against continuous high charge rate, permits the use of the highest charging current that the battery can safely receive. The maximum charging current is 18-20 amperes, and this is reduced by Thermostat control to a safe amount after a period of running depending upon the speed and the atmospheric temperatures. The reduction may therefore occur within a few minutes or not at all if the weather is cold or the stops are frequent, but it will always occur before the battery reaches an excessive temperature.

THERMOSTAT RESISTANCE—The Thermostat Resistance acts as a protective fuse to the Generator in case the battery or generator charging circuit should ever become disconnected in operation from either accident or neglect, as the Resistance wire would then burn out and prevent the Generator windings from being damaged.

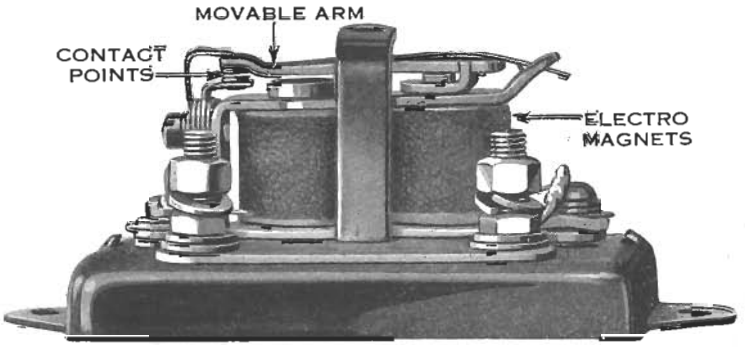
A new Thermostat should be installed after the generator charging circuit has been reconnected. If the generator circuit be connected again without installing a new Thermostat, the Generator will produce full charging current at the start, but after the car has been run long enough to cause the Thermostat to open, the output will drop to zero, since the burn-out resistance cuts off the field current entirely. Under

this condition the Thermostat Contact Points will arc and flash badly at the time the Thermostat opens, and for that reason a new Thermostat should be installed promptly or else the contact points will be destroyed. The Thermostat is made as an easily-replaced unit.

THERMOSTAT ADJUSTMENT—The Thermostat is entirely automatic and is substantially made to withstand the most excessive vibration without impairing its operation. Any attempts at adjustment will only destroy its accuracy.

The Relay

THE Relay is simply an automatic switch for connecting and disconnecting the battery charging circuit. If the battery were left connected to the Generator when the engine stops or when the car is driven too slowly for the Generator to charge, reverse current would flow from the battery, back through the Generator windings, and would soon exhaust



The Remy Relay

the battery. The Relay is therefore provided to act like a check valve, permitting the charging current to flow to the battery when the Generator is driven fast enough to produce current, and opening the circuit when the engine slows down or stops, so the battery current cannot flow in the opposite direction.

The Relay shown in the illustration, with the cover removed, is composed of two contact points, a movable arm with a spring hinge, and a simple electro-magnet. The spring holds the contacts apart when the engine comes to rest; but when the Generator is driven at sufficient speed to develop voltage equal to battery voltage, the "shunt" coil is energized and pulls down the arm, thus closing the contacts through which the Generator current can reach the battery. The charging current must also pass through the "series coil" which increases the magnetism and insures that the arm will be held down to a firm contact.

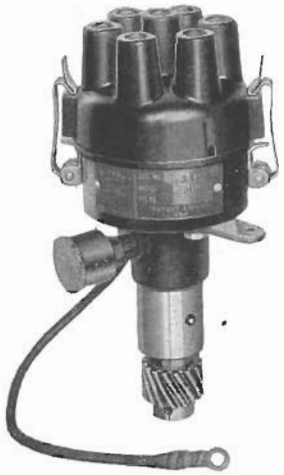
As soon as the engine slows down or stops, the Generator no longer energizes the shunt coil, but the arm would tend to stay down, due to a slight "Residual" magnetism were it not for the action of the series coil. As soon as current starts to flow from the battery in a reverse direction back through the Generator it passes through the series coil, so that the magnet is demagnetized and the contacts are released.

Wherever it is possible, the Relay is mounted on the Generator. Usually it is mounted on the dust cover over the commutator end of the generator. This makes the generating unit complete in itself, and greatly simplifies the wiring on the car.

The Remy Ignition Distributor

IN ignition, the Remy Electric Company has always been pre-eminent and the present system is the result of years of experience. It consists of an ignition coil and a combined circuit breaker and distributor.

When you mention ignition, it is taken for granted that ignition produces, times and distributes the sparks in the various cylinders in their proper firing order, also that the spark is produced from the battery source as distinguished from the magneto. The magneto has enjoyed a popular distinction largely because it is used on almost all racing cars which have no use for a battery and not because the battery ignition is less effective. But on the business and



A Remy Ignition Distributor

passenger car the battery has become indispensable for lighting and starting, and here the magneto can well be displaced by the lighter and simpler Battery Ignition apparatus, consisting of the Ignition Distributor and Ignition Coil. All the mechanism for producing, timing and distributing the sparks in the cylinder is combined in the design of Remy Distributor, installed as a unit on the engine and operated by a single rotating shaft which is geared to the engine. In some installations the Ignition Distributor is mounted directly on the engine, while in others it is mounted integral with the generator.

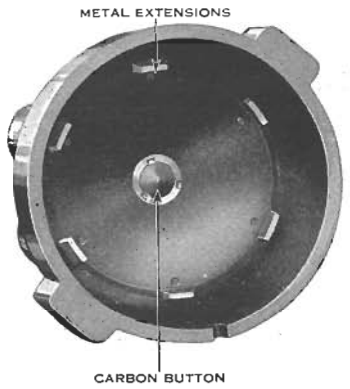
The distributor cap forms a dustproof and waterproof protection for the working parts inside.

Distributor Cap—Each spark plug of the engine is connected by a heavily-insulated wire to one of the terminals on top of the Distributor Cap. These terminals have alloy metal extensions on the under side of the Cap as shown in the illustration on page 39. The center terminal for the high tension cable which leads to the Ignition Coil has a carbon button on the under side of the Cap which makes electrical contact with the spring K (shown in the cut of the Circuit Breaker on page 39) which is a part of the Segment. The Segment L fits upon the shaft only in the one correct position relative to the cam, so that, as it rotates, it always comes opposite the correct extension in the Cap, to conduct the spark to the proper cylinder, when the cam separates the Circuit Breaker contact points. The outer edge of the distributor Segment rotates close to the terminal extensions without quite touching them.

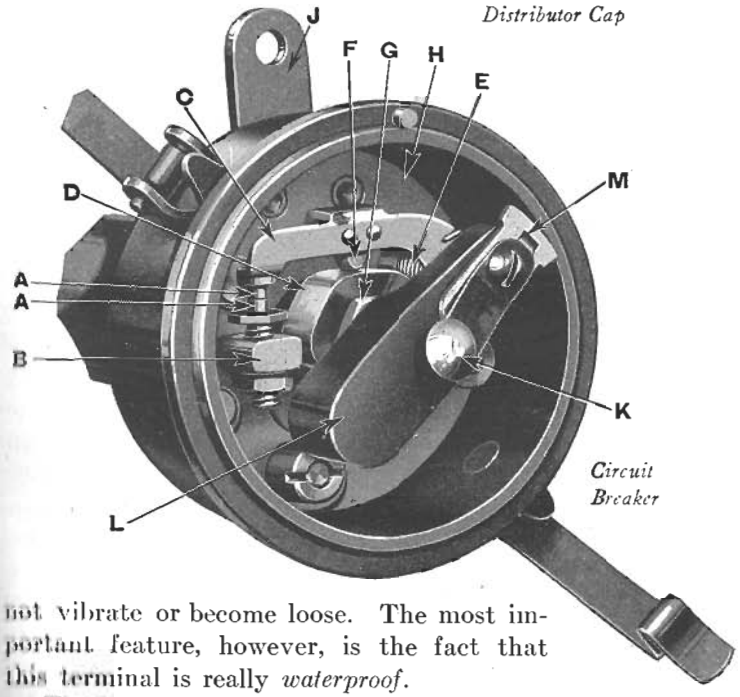
The distributor Cap in which terminals are embedded is moulded Condensite, a material which possesses great moisture proof and insulating properties even under excessive heat.

The special alloy metal blade M of the Segment is embedded in a block of the same material.

The ends of the spark plug cables are fitted with spring brass terminals or ferrules. The cable with its ferrule is pushed down into the insulated bushing on the distributor Cap and connection is automatically made with the alloy extension inside. This method produces a high tension terminal that is extremely simple and that does not vibrate or become loose. The most important feature, however, is the fact that this terminal is really *waterproof*.



Distributor Cap



Circuit Breaker

The Distributor is provided with a grease cup, which should be kept full of medium grease and turned to the right two or

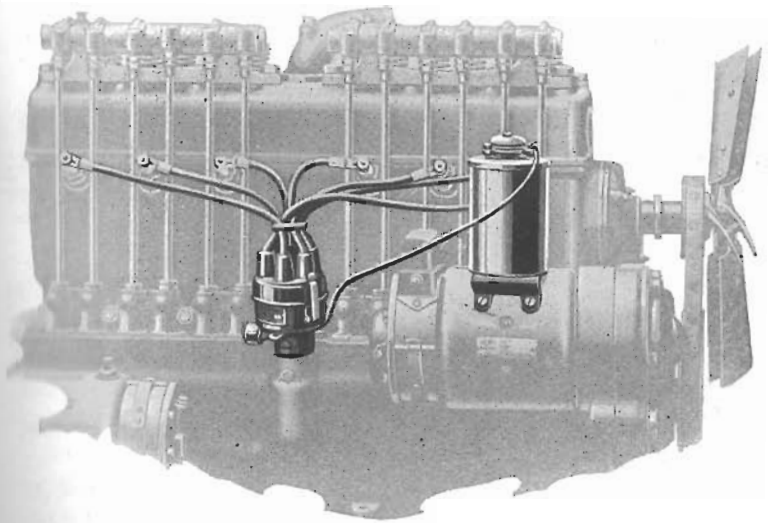
three turns every 1000 miles of running to force a little grease into the bearing. All parts of the mechanism are made readily accessible by simply releasing the two spring clips with the fingers and removing the cap, with all of its high tension wires intact, and without disturbing any wiring connection whatever.

The Circuit breaker consists essentially of two contact points, A, A. One point is mounted in the block B, and is stationary, while the other point is mounted on the free end of the pivoted arm, C. A spring, E, on the arm pivot, tends to hold the two contact points closed in contact, but the arm is forced out by the rotation of the "cam" D, which is mounted on the shaft, and is securely fastened by the lock nut, G. The "cam" is a hardened steel piece having faces equal to the number of engine cylinders and corners which are accurately ground. The corners bear against a piece of hard fibre, F, riveted in the arm, so that as the cam rotates, it closes and opens the circuit breaker contact points at regular intervals. Each time the circuit-breaker contact points open, a spark is produced at the spark plug.

The exact position of the pistons at which the spark should occur, depends upon the speed and load of the engine. For this reason, the circuit breaker arm and stationary point are mounted upon a circular plate, H, which can be shifted, by means of the lever, J, attached to the plate and extending out through the bottom of the case. This lever is connected by a rod to the spark control lever on the steering wheel and when it is shifted, it will be seen that the cam opens the contacts at a different place in its rotation. The exact time when the sparks occur, relative to the position of the engine pistons, is therefore variable. From full retard to full advance stops, a range is provided which depends upon the requirements of the engine but it usually is equivalent to about 40 degrees difference in the position of the engine flywheel. The shifting of the circuit breaker mechanism is accomplished by this construction of movable plate, without moving the distributor case as in some forms of distributors.

It should be noted that the number of moving parts in the circuit breaker has been reduced to a minimum of two, the pivoted arm and the rotating cam. The wear is extremely little during the lifetime of the car, due to the combination of hard steel against hard fibre.

The simplicity of this circuit breaker forestalls the probability of anything getting out of order, and the parts are so accessible that inspection and adjustment is exceedingly simple.



A typical Remy Ignition Installation

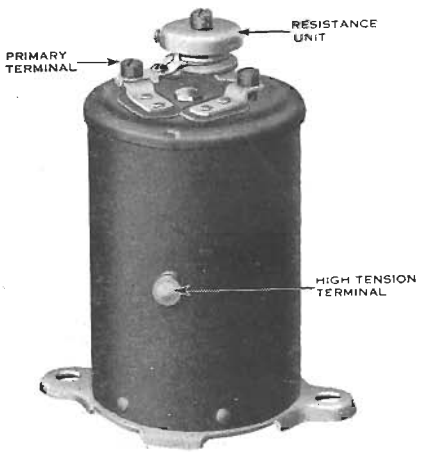
The Remy Electric Company also produces an ignition distributor in which the timing of the spark is automatically advanced with increase of speed. This is accomplished by a set of weights enclosed in the circuit breaker housing which are mounted on the distributor shaft and rotate with it. As the speed increases, these weights are thrown out by centrifugal force and manipulate the advancing mechanism, which for simplicity operates on the cam instead of the circuit breaker. Where the supplementary manual advance is used, however, the circuit breaker is moved as has been previously described.

The Remy Ignition Coil

THE current from the battery does not have sufficient pressure or "Voltage" to jump the gap of the spark plug, and therefore the Ignition Coil is provided which transforms the battery current into high tension current. The high tension current is conducted by a heavily-insulated wire from the terminal on the side of the coil to the center terminal of the Distributor, which then directs the spark to the cylinders in proper order of firing. The return circuit for the high tension current from the spark plug is through the engine back to the metal base of the Coil.

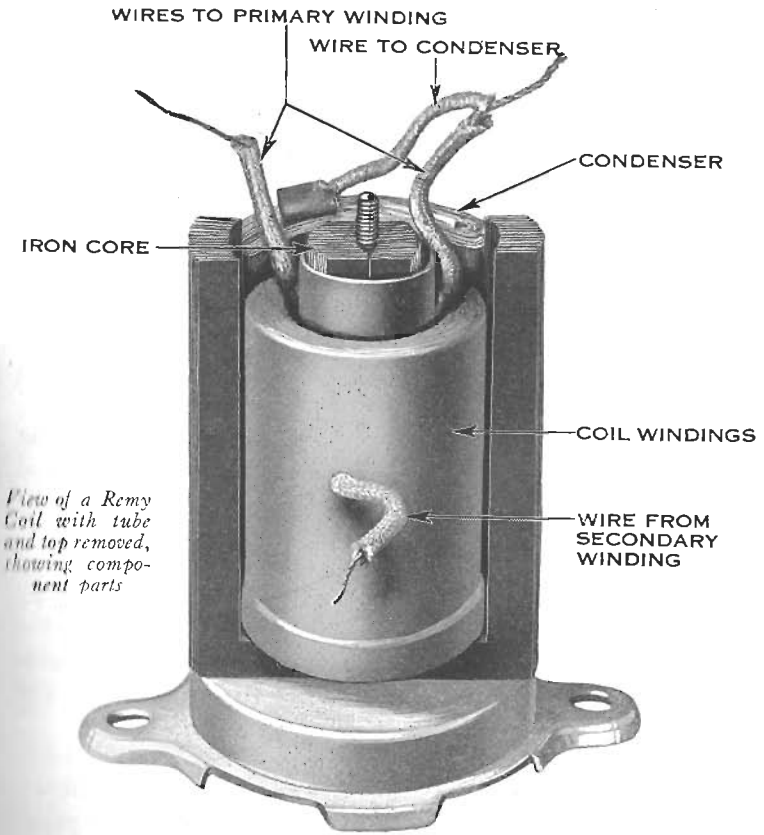
The Coil supplied with the Remy system has been especially developed so that an exceptionally efficient spark is produced at all speeds. It possesses the further distinct advantage of operating satisfactorily on as low as 2½ volts, should the battery voltage ever fall that low due to indiscriminate use of the Starting Motor or lights, or to other causes.

The coil itself consists of two separate windings, wound on a single iron core. One winding, called the "primary," is composed of a few turns of wire through which the battery current is passed to magnetize the iron core, while the other winding, called the "secondary," or high tension winding, is composed of hundreds of turns of very fine wire. These windings are carefully insulated and are thoroughly impregnated in special insulating compounds, so that they withstand the high electrical pressures that are generated in the coil.



Remy Ignition Coil

All connections inside the coil are made with flexible wire composed of many



View of a Remy Coil with tube and top removed, showing component parts

strands, so that vibrations on the car will not tend to crystallize the wire and cause it to break. It is this attention to minute details that makes Remy Ignition absolutely dependable.

RESISTANCE UNIT—It can be seen that the time during which the circuit-breaker contact points remain closed is exceedingly brief at high speeds. At lower speeds the circuit-breaker remains closed for comparatively longer periods of time, so that the current consumption is slightly greater at low speeds than at high. In order to limit the increase of current to an amount which will not overheat the coil, the resistance unit is placed on top of the coil under a protecting cap, and connected in series with the primary winding.

This resistance is made of an alloy possessing the property of increasing its resistance as it is heated up. The effect of a slight increase of current through the coil at low speeds is to heat up this resistance unit which thus automatically checks the current at low speeds and yet permits sufficient current to flow through the coil at high speeds to produce an effective spark.

It also assists the coil to produce a hotter spark when the battery voltage is low, because at that time the current is low and consequently the resistance of the unit does not increase greatly.

CONDENSER—The Condenser is simply an electrical reservoir which prevents injurious arcing or flashing at the Circuit Breaker contact points. The Condenser is either sealed up in the Coil case or in a metal container mounted near the Distributor. It is electrically connected across the Circuit Breaker points, through the Coil terminals.

Here again Remy experience has proven its worth. Remy condensers are the result of years of careful attention to all details. Special materials are used to give the Condenser the greatest insulating strength possible and the system of manufacture developed insures the maximum possible advantage of these materials.

The Condenser is composed of two long strips of tinfoil which are insulated by several sheets of very thin paper. Specially-built machines mount the rolls of tin-foil and paper so that they are wound in proper relation on a mandrel. After the Condenser is wound, it is folded flat and impregnated in a special wax of very high electrical capacity and insulating strength. After it is impregnated in the wax, it is allowed to cool, then reheated and pressed in a press so that it is given a proper shape for mounting in the coil tube or metal box.

The Coil Tube which houses the Condenser and the coil itself is made of a vulcanized fibre material. Each tube is carefully tested for insulating strength and is specially treated to make it waterproof. The metal top and base is carefully treated to give it rust-resisting qualities.

Remy Service

DON'T tamper with your Remy system merely out of curiosity. Know its functions, give it the little attention it does need—and it will serve you well. Should it, however, fail to perform its functions properly at any time, and the difficulty cannot be easily corrected with the assistance of the electrical instruction book furnished with the car and the knowledge obtained from the foregoing pages, the Car Owner is advised to call on the nearest Service Station.

For the Owner's convenience the Remy Electric Company conducts a national service system through the United Motors Service, Inc., whose branches and service stations are listed on the attached sheet.

Remy Growth a Result of Remy Quality

The mammoth Remy Factories at Anderson, Indiana

FROM a small beginning, twenty years ago, the business of the Remy Electric Company has grown until forty-five buildings have been made necessary by the increasing demand for their products. And still more new buildings are being erected.

This has come about not by chance, but has been a steady development, the assembling of expert electrical brains, the building up of an organization, and the extension of the Remy laboratories—all of which stand for one thing—quality.

From the raw material to the finished product, every part is subjected to rigid tests throughout every department. Each working part is made to withstand the most rigorous wear. Every modern and scientific method is used in determining the fitness of these parts for the duty they will be called upon to perform. In this way, complete quality units are built and satisfactory service to the user is assured.

These strict standards of construction—these many tests and inspections—give Remy systems the ability and stability that has earned them their title: "Products of Constant Performance."

The satisfactory service of over a million Remy Systems now in use as standard equipment, offers a wonderful testimonial to the careful designing and constructing of Remy Equipment.