Application of Generators to the Job

Courtesy Delco-Remy

The final selection of a generator that will adequately do the job required of it depends upon many factors. The engineer and designer must analyze carefully each factor and the success of their analysis is proven in the ability of the generator to do its job.

The best designed generator will, however, not do its job unless proper maintenance and operating conditions are controlled during the use of the generator.

The normal electrical load on a vehicle determines the capacity of the generator to be used. A satisfactory application requires a generator that can produce 10 to 20 percent more output than is required by the total connected load.

This additional output is required to replace the electrical energy used from the battery when the generator is not at operating speed. Momentary electrical loads, such as cigar lighters or cranking motors are not considered in determining the total load.

Lights + Ignition + Radio + Heater = 29 Amps

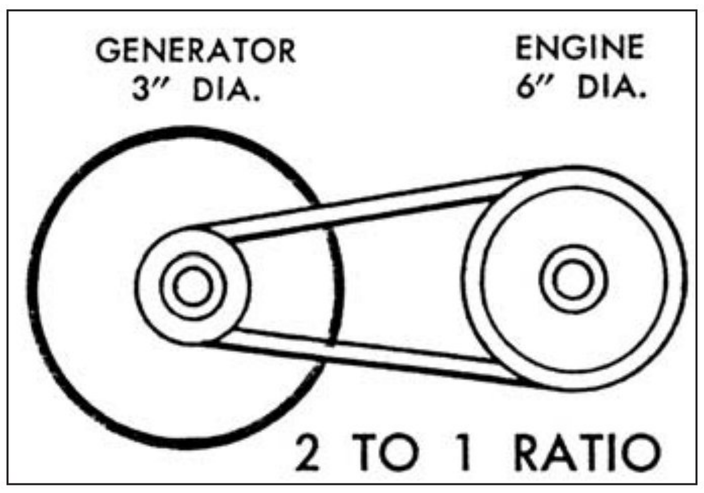
35 Amps

Extremely dirty, dusty, muddy, or wet operating conditions often make it necessary that the generator be totally enclosed to prevent entry of foreign material. Total enclosure does not allow ventilation through the generator, consequently the build up of internal heat is high. The output of an enclosed generator, therefore, must be less than a ventilated unit of the same size.

The ambient or surrounding temperatures in which a generator must operate may also be an important factor in generator design. High temperature surrounding the generator adds to the heat developed by current passing through the armature conductors and by eddy currents. The generator must be designed to withstand the total heat of operation.

The length of service that is to be expected of the generator must be a part of the generator design also. Ease of replacement of parts is another factor in the design of such units.

The speed at which the armature turns is a very critical factor in generator design and application. The drive ratio of an automotive generator (generator speed with reference to engine speed) may vary from 2-to-1, to as high as 3-to-1.

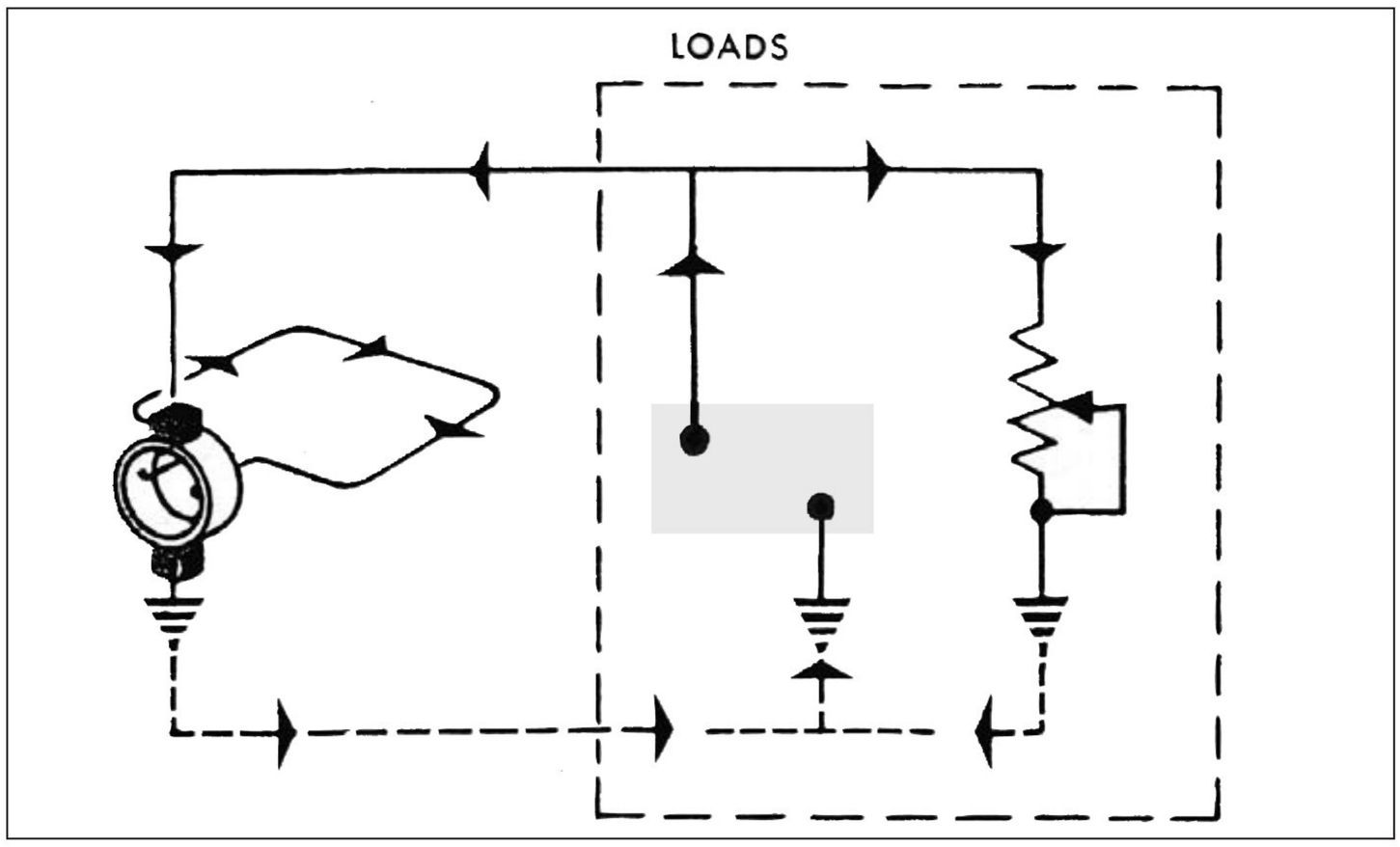


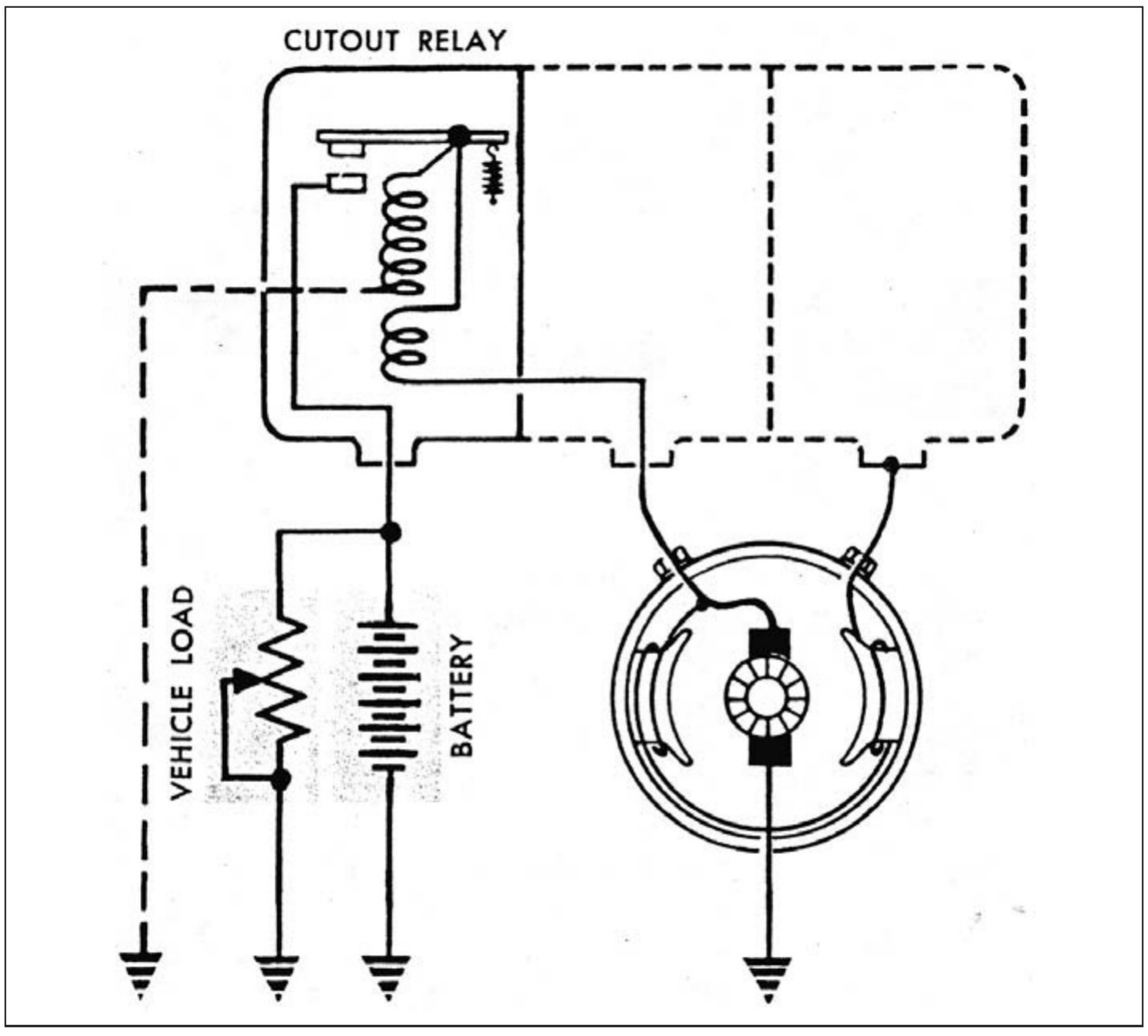
Illustrated is the load circuit only. If the connections between the generator and the battery were joined as shown and the generator voltage is lower than battery voltage, the battery would discharge through the generator to ground and back to the battery.

Due to low resistance in such a circuit, high discharge current would produce rapid deterioration inside the generator in the form of burned insulation and wiring. This would also result in a discharged battery.

The illustration shows how the load circuit is broken by an electrical switch to prevent the battery discharge. The normal position of the switch, called the cut-out relay, is shown. It functions to close the circuit between the generator and battery when the generator has developed sufficient voltage to overcome battery voltage.

The cut-out relay also functions to open the circuit between the battery and generator when the battery voltage is greater than generator voltage. This condition exists only when the speed





of the armature is not sufficient to develop enough voltage to overcome battery voltage.

The engine in an "at-rest" position with the vehicle parked, the engine at idle speeds, or at low operating speeds, are all conditions where the cut-out relay is open unless the generator is designed to develop voltage greater than battery voltage under these conditions.

The contact points of the cut-out relay are closed and opened by magnetic attraction. When the voltage of the generator is great enough to cause a certain current to flow in the operating coils of the relay, a magnetic field of sufficient strength is set up around the coils. This attracts the armature which overcomes spring tension and closes the points and allows the generator to supply current to the load circuit.

Adjustment of spring pressure on the armature of the relay must be such that the generator voltage required to close the points is equal to or slightly greater than battery voltage. The speed at which the generator armature must be turning to develop enough voltage to close the relay points is called the "cut-in speed" of the generator.

When the voltage of the generator drops because of a reduction in speed to a value less than battery voltage, the higher voltage of the battery will force current back through the series coil of the regulator and the generator.

Reversing the direction of current in the series coil causes the magnetic field of the relay to weaken allowing spring tension to open the points of the relay. The generator and battery are then disconnected so that current discharge from the battery will not flow back through the generator and damage it.

It is important that the speed at which the generator "cuts-in" should be at least 100 rpm above or below the engine idle speed. The drive ratio chosen must assure that this condition exists; otherwise, burned out relay points caused by rapid vibration of the contact points will result.

Since no engine idles at a constant speed, it has a certain variance in speed when idling. If the cut-in speed of the generator occurs at the exact speed of idling, the points of the relay will close when idle speed is reached. When the engine speed decreases the generator speed will also decrease. Insufficient voltage will be developed to hold the relay points closed and the points will open. Thus, the change in generator speed at this critical point will cause the relay to open and close and the points will be burned from breaking the circuit repeatedly.

Changing pulleys to speed up the generator in an attempt to get a charge rate at engine idle often causes this condition. A smaller drive pulley on the generator may cause trouble by driving the generator so fast at high engine speeds that the regulator cannot control the voltage. A generator driven at excessively high speeds may also develop bearing failures or the armature windings may be thrown from the core by excessive centrifugal force.

The drive ratio between the pulley and the generator, therefore, is quite critical. Generators must be designed for certain speed and load characteristics. Vehicles operating at slow engine speeds with high electrical loads require a generator with low cut-in to keep the battery in a charged condition. Vehicles operating at high engine speeds and high electrical loads do not require a low cut-in generator.

Vehicles operating normally at low engine speeds but with periods of high speed operation require a low cut-in generator capable of withstanding high speeds.

The proper application of a generator, therefore, depends upon many factors. The electrical needs of the vehicle determine the requirements of generator design. Changing conditions for driving such as more congested city traffic or faster operation on the open highway, change in the designs of engines that produce higher speed engines and higher ambient temperatures or increasing the electrical loads by adding air-conditioning systems, bigger heater blowers, seat controls, etc., require that generator design and application keep pace with the times to provide a unit that is capable of doing the job.

This information is part of the Delco Remy Education Program designed to provide mechanics and students of auto mechanics up-to-date technical information on automotive electrical equipment. For information on other training aids, write to: Edu-Tech Publications, Division of Commercial Service Company, P.O. Box 2499, Anderson, Ind. 46011.

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