IS AN OLD GENERATOR CAPABLE ENOUGH?

Dear Editor

I read with interest your article in the April 2010 issue of SK about the idiosyncrasies of driving an old car, and while I can relate to most of what you say, there is one point you make that I must strongly disagree with. You say in the next to the last paragraph that an old car driven regularly at night will show a discharge, and that this is normal. In my experience, this is NOT normal! Over the years, I have had a 1935 Buick, a 1931 Pontiac, and numerous Model A Fords, including two Tudors, a pickup, a 1½ ton stake body AA, and am currently driving a 1929 Murray body Town Sedan. In 40 years of driving these, including one of the Tudors that was my everyday car, summer and winter, for 5 years, I have never had any problem with them discharging with the headlights on (on an ongoing basis). If you are driving at night and find that the ammeter is showing a discharge, this only means that the charging rate of the generator needs adjusting. Most cars of this vintage have generators with a third brush which is moved back and forth to set the charging rate, and I have found that a setting which, with the headlights on at highway speed, gives an ammeter setting of 0, i.e. neither charging nor discharging, seems to be about right. This will give enough current for sufficiently bright headlights at night, but will not charge so much in the daytime, with the lights off, that it will 'boil off' the water in the battery. In a Model A, that seems to be about a charging rate of 10 amps at highway speed with the lights off. It may take a little trial and error before the best setting is determined for any particular car, but once you get it, there should never be a need to charge the battery when you get back from a nighttime drive.

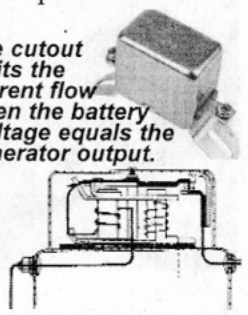
Gary Irish
Jericho, VT

Dear Gary,

We are faced (again) with differences between early cars and later automobile systems. Newer cars use voltage and current regulators to limit the amount of current from the generator (and on even later cars, alternators) to the battery.

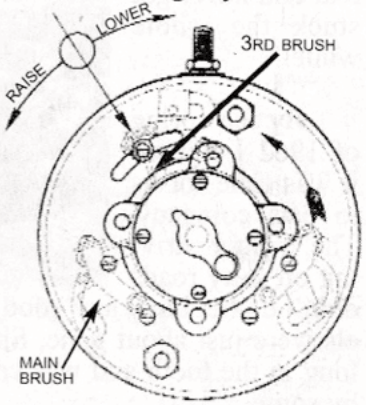
In actuality, the generator does not produce electricity. It converts mechanical energy into electrical energy. We have covered the mechanics of generators in past issues, but essentially the engine drives the generator - through a belt or gears so that the armature and commutator rotate within field coils and develop a magnetic field of direct current electricity.

Early cars used a cutout in place of the voltage regulator. The cutout is designed to close (and allow current to pass through) when the battery voltage is lower than the generator output. When the battery and load demand is less than generator output, the cutout points open preventing the current from going to the battery. Too much current going into the battery can boil off the water and eventually bake the battery.



The cutout limits the current flow when the battery voltage equals the generator output.

The early generators also used a 'third' brush which was a 'variable' charge system. The third brush is adjustable. It can be moved closer to the main brush (in the direction of the generator rotation) to increase the charging rate, or away (in the direction opposite to generator rotation) to lower the charging rate*. At lower speeds the generator output is lower. As the car reaches normal operating speed (about 25 mph) the charge reaches its maximum, and as car speed increases beyond that



The 3rd brush affords the ability to raise or lower the charging rate of the generator.

speed the charging rate drops off. Some cars such as the English Sunbeam had a switch on the dash that allowed for full charge for nighttime operation and half charge for daytime operation that would otherwise ruin the battery.

Early generators were designed to produce between about 12 and 18 amps. Smaller cars were at the lower end of the charging rate, while larger, more expensive cars often exceeded the 18 amp figure. (The very popular British car, the Austin Seven, produced only 8 amps.)

When first starting a car, a major amperage drain occurs. The starting motor uses a lot of electricity. But it is only for a very short duration. The generator replaces the energy lost in starting the car. Once started, adequate current must be available to run the ignition system, PLUS whatever ancillary equipment might be in use. During the day, the demand for electricity in an old car was minimum. But at night the demand increased. The biggest drain occurred from the headlamps. But added to this there was the tail light, cowl lights, and instrument panel lights. The stop light was often a major drain, but for only short durations. If auxiliary driving lights (like Trippe lights) were used, it could almost double the demand for amperage. And accessories like a tube-type radio can demand massive amount of amperage.

The chart on the following page indicates typical bulb sizes and candlepower. There is no definitive correlation between candlepower and watts. In the 1920s and '30s, bulbs were rated in candlepower (CP). Subsequently the ratings changed and are now based on watts, lumens and candelas. We did locate one source which rates light bulbs in both watts and candlepower. We expect that the ratings are close, if not dead-on. We have mentioned this before, but it is important enough to reiterate: the Watt (wattage) rating is the total of the amperage times the volts. Often bulbs are rated in a range of volts, for example 6-8 volts or 12-14 volts. In such cases we used the intermediate figure (6-8 volts we used 7 volts for our calculations). A twelve volt bulb, used in a six volt circuit, will NOT give half the light output for which it is rated. The resistance of the 12 volt filament requires the 'push' of the full 12 volts to maximize light output.

* Theoretically the third brush adjustment can be made to increase the charging rate prior to using the car at night (with the increased demand of the lighting), and lowered during the day when the higher output is not necessary, to reduce the chance of overcharging. Some Remy generators even utilized a built-in thermostat so that the generator provided a higher charging rate when the car was cold and a lower charging range when the car was hot.

Mathematically, the amperage output on an average-sized generator should be adequate for powering not only the ignition, but also the necessary lights for night driving. But, and it's a big 'but,' electrical systems are not always up to optimum levels. There are a finite number of amps coming from a generator - most American cars probably produce 12 to 18. The snag is that 75 - 80 years after everything was new and fresh, the lack of maintenance, poor insulation and general degradation of everything within the charging and electrical systemmeans you could be 'running on empty electrically' with all the lights on. We have written this before but cannot repeat it enough: the ground circuit must be in top-notch condition. Corrosion, paint, rust, dirt and other factors that weren't there when the car was new have caused resistance in the ground system. We tend to overlook the ground system when maintaining the electrical system. The direct current system must have a total loop of electricity, and the ground is half of that circuit. Remove the ground wire from battery to the car's frame, clean the terminals to bright, shiny metal, clean the frame - using a wire brush or sandpaper if necessary - to eliminate anything - like rust, paint, etc. that could be causing resistance. And especially in a six volt system, be sure that the cables are of a large enough size (the smaller the number, the larger the wire diameter) to carry the current necessary for proper lighting, starting, and ignition. The ground cable from the battery should be at least '0' or even '00.' Make sure that the engine and frame are electrically connected. A braided ground strap from a clean, corrosion-free terminal on the frame should be connected to a similar connection on the engine

Use a braided ground strap to electrically connect the frame to the block.

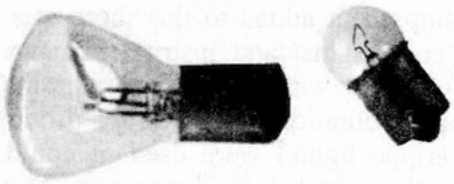
block. Do not rely on the engine mounts or other mechanical connections. Dirt and grease get into those joints, often making the ground connection between the engine block and frame rather problematic.

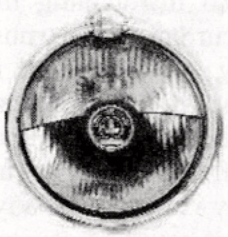
With bulb sockets cleaned and corrosion-free, wiring replaced where electrical 'leaks' and shorts might occur, connection terminals cleaned, and with adequate ground connections perhaps the ammeter will show a charge with the lights on and while driving at night.

Thank you, Gary, for opening up this topic. It is obvious that your cars are well maintained and that the electrical system is kept in top-notch condition. Keep driving them, both day and night.

VOLTAGE	AMPERAGE	WATTS	CANDLEPOWER	LUMENS	BULB SIZE	APPLICATION
6-8	0.40	2.8 (nom)	2	25.1	55	instrument panel
6-8	0.63	4.41 (nom.)	3	37.7	63	cowl, parking
6.4	2.62	16.8	21	264	1129	taillight
6.4	2.62	16.8	21	264	1130	taillight
6.2	3.90	24.2	32	402	1133	spotlight
5.5	6.25	34.4	50	629	1184	headlight

APPLICATION	WATTS
Headlight bulbs (21 - 35 candlepower) X 2	33.6 - 50
Cowl lights (3-4 candlepower) X 2	8.8
Dash lamps (3-4 candlepower) X 2+	8.8 - 13.2
Taillight (3 candlepower) 1	4.1
Stop light (21 candlepower) 1	16.8
Total.....	**72.1 - 92.9 watts** (10.3 - 13.3 +/- amps)
Ancillary driving lights (Trippe lights)	50
Modified electric drain.....	**122.1 - 142.9 watts** (17.4 - 20.4 +/-amps)

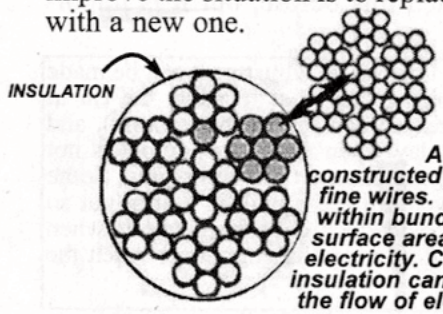




INTERNAL CORROSION

Another major, yet often overlooked source of resistance is within the cable itself. It may be a battery to starter cable, or a battery to ground cable, or a cable from the starter switch to the starter motor. Corrosion forms under the insulation, and no amount of cleaning the terminals will cure that problem.

Electricity travels (primarily) on the outside of a wire. If you were to use a very large, single strand wire, corrosion could easily block the flow of electricity. But almost all cables are made of many very fine wires twisted together to provide massive amounts of surface area for electricity to travel. Nevertheless, when corrosion begins, it spreads. Effectively the only way to improve the situation is to replace the entire cable with a new one.



A stranded cable is constructed of many bundles of fine wires. There are bundles within bundles, each providing surface area to carry the electricity. Corrosion under the insulation can effectively block the flow of electricity.

AFTER THE 3rd BRUSH GENERATOR...

Newer generators have only two brushes. The field supply comes from an external regulator which is part of the feedback loop. The external regulator adjusts the field current and so provides a constant voltage. The third brush system provides a constant current in an open loop system.

Electricity is measured by the flow of electrons and the flow is called amperes. The 'push' or the 'pressure' forcing the amperes through the wire is called voltage. The Brillman Company describes amperes and voltage in their ad (see page 46) by comparing electricity to water in a hose. "...Let's compare it to something that we can see, a fire hose. A combination of both adequate pressure and sufficient volume is necessary to put out a fire. With electricity the 'pressure' is known as VOLTAGE. The 'volume' is called AMPERAGE. The two combined are known as WATTS, or WATTAGE.

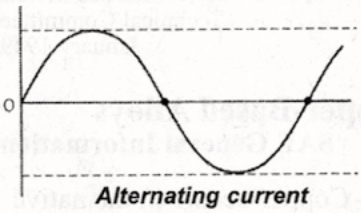
"A very large diameter fire hose will allow a large volume (AMPERAGE) of water to flow through, but without pressure (VOLTAGE) it will just dribble out of the hose end.

"A very small diameter hose will permit a lot of pressure (VOLTAGE) but without an adequate amount of volume (AMPERAGE) so the result is water that sprays hard but without any appreciable quantity.

"The same is true of electricity. It takes a combination of pressure and volume to make a device operate."

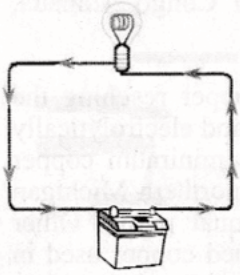
The voltage regulator limits the 'pressure' going to the ammeter, battery, and electrical system of the car. It is limited to nominally 6.9 volts in a 6 volt system, and to 13.8 volts in a 12 volt system. The current regulator is often not needed because the capabilities of a generator are capped at a certain current output. Most generators, even the newer ones, would not produce more than about 25 or so amps. Too many amps will burn out an appliance, or even worse, overheat the wiring to the point that it will ignite. Where a current regulator is not used, 'mini' regulators are. They are called fuses, and they are rated at a maximum number of amps before they burn out. By burning out a fuse, you are protecting the wiring and appliances in the circuit.

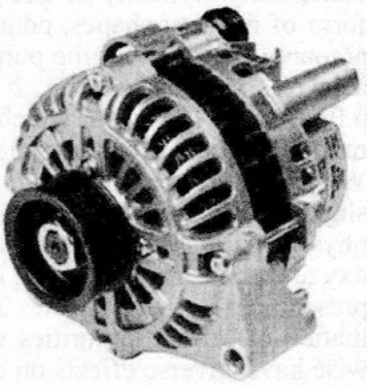
Newer generators were designed to produce more amps than their 1920s and '30s predecessors, but not by much. Whereas a 1920s/'30s generator offered up 12-18 amps, newer ones, even 12 volt, did not produce much more than about 25 amps or so. Newer cars were fitted with a radio, a heater, spotlights, and other electricity-eating accessories. They required the extra amperage.



Alternating current

When the demand got so high for electricity, the industry switched over to the alternator. Where the generator produces direct current - the same type of current that the battery supplies and the automobile electric appliances require - the alternator produces alternating current - the type of current used in the home. The AC has to be converted to DC to be usable in the car. Diodes, which are essentially electronic one-way valves, rectify the AC current so that the final output of the alternator is in direct current to charge the battery and supply the electrics in the car. Newer cars and trucks are loaded with electrical appliances that were not available years ago - air conditioning, towing rigs, extra lighting, seat heaters, mirror heaters, rear-window defrosters, entertainment systems - well the list goes on and on. The alternator has the capability of supplying enough electricity to run all of those appliances and still charge the battery and operate the ignition system. Where a generator might really be pushing to produce close to 30 amps, a typical passenger or light truck alternator will produce anywhere from about 35 amps at the low end up to about 140 amps at the high end. Large trucks and heavy equipment alternators can supply as much as 200 amps, much more than is needed for the passenger car, but it requires a very large alternator to supply that much current.


Direct current requires a complete loop circuit.


The alternator develops Alternating Current which is converted to Direct Current for use by the battery and by electric appliances.

Alternators designed for a 12 volt circuit are now available in 6 volt models. I suppose that if a car is used regularly with a radio, extra lights, perhaps a heater, CB radio and other accessories not original to the car, then the extra amperage might be needed. But I've stated my position many times before: authentic restoration!

S.K.