CHARGING SYSTEMS

MOTORCYCLE CHARGING SYSTEMS

Charging System Overview

The motorcycle charging system consists of the alternator, current rectifier, voltage regulator, and battery. The alternator produces alternating current, and this is where the term “alternator” originated.

Motorcycle alternator charging systems are considered to be “AC charging systems”. They are classified as the permanent magnet alternator, electromagnet alternators with excited fields, and the magneto alternator. The AC current produced is rectified to DC current for the purpose of charging the battery. The final voltage produced is also regulated to be no more than about 14 to 15.5 DC volts.

The main function of the alternator is to charge the battery and to provide power for the electrical system during engine operation. Alternators are constructed as one piece or as three pieces. Three-piece alternators are made up of a separate stator, rotor and rectifier/regulator.

One-piece alternators can generate more power and are more dependable than three-piece alternators. However, they are very large in size and are primarily used on only a few of the larger touring motorcycles.

Because of limited space around the motorcycle engine, the only practical option for nearly all motorcycles is the three-piece alternator. The stator and rotor fit compactly around the engine crankshaft, and the rectifier is housed in the regulator that is typically bolted to the front of the bike where it can be air-cooled.

The regulator uses a Zener diode to regulate the amount of voltage and current that is sent to the battery. This diode gets hot during normal use.

The current generating capacity of alternators is rated in volts and amps. For example, the regulated voltage output, (charging output), of a GSXR-1000 alternator is 14.0 to 15.5 DC volts (DCV) at 5,000 rpm. This is direct current after the current has been rectified from AC current to DC current.

This is also current that has been regulated by the regulator to put out no more than 15.5 DC volts.

Some service manual specifications refer to the un-rectified AC voltage output. For example, the Harley evolution engine alternator puts out 16.0 to 20.0 AC volts (ACV) per 1,000 rpm of the engine. In some respects this is a better measure of the current producing power of the alternator, because alternator current from any alternator must be reduced to roughly 14.0 to 15.5 DC volts to charge the battery

In everyday descriptions of alternator output, a typical three piece alternator for the Harley evolution engine, for example, will put out 32 amps of electrical current. A more powerful aftermarket three-phase alternator for the same engine may be rated at 40 amps. It will generate 25 amps at idle rpm, and 40 amps continually with the engine running over 2,800 rpm.

Late model Harley touring bikes with fuel injection feature 45 amp charging systems. The electrical demands of fuel injection require more amperage.

If the charging system develops a problem and begins to produce less current than it should, the battery will make up the difference required by the electrical system components, until the battery goes dead. In such case, a dead battery may not mean the battery is bad. It may be the result of a faulty charging system that is not keeping the battery charged.

Alternators are considered AC charging systems even though the rectifier will change the AC current to DC current for use in the motorcycle electrical system. A motorcycle requires DC current, not the AC current produced by the alternator. Alternators produce AC current and are sometimes referred to as “AC generators”, although this term is not often used.

In contrast to the 1999 Harley, a 2007 Suzuki GSXR 1000 charging system is powered by a three-phase AC generator. It produces a regulated voltage (charging output) of 14.0 to 15.5 volts at 5,000 rpm. It still uses a stator to generate current. The stator is also called a generator coil or generator stator. This charging system also utilizes a rectifier and regulator. Note again that AC alternators are also called AC generators.

PERMANENT MAGNET ALTERNATORS

Alternators use the principle of electromagnetism to produce alternating current (AC current). In other words, alternators generate electrical current by harnessing the magnetic forces of magnetism.

Electrical voltage is created when a conductor cuts across – or is "pushed into" – a magnetic field. When this event happens, electrical voltage is induced into the conductor. In other words, the action of moving a coil of wire (the conductor) through a magnetic field will induce voltage into the coil of wire.

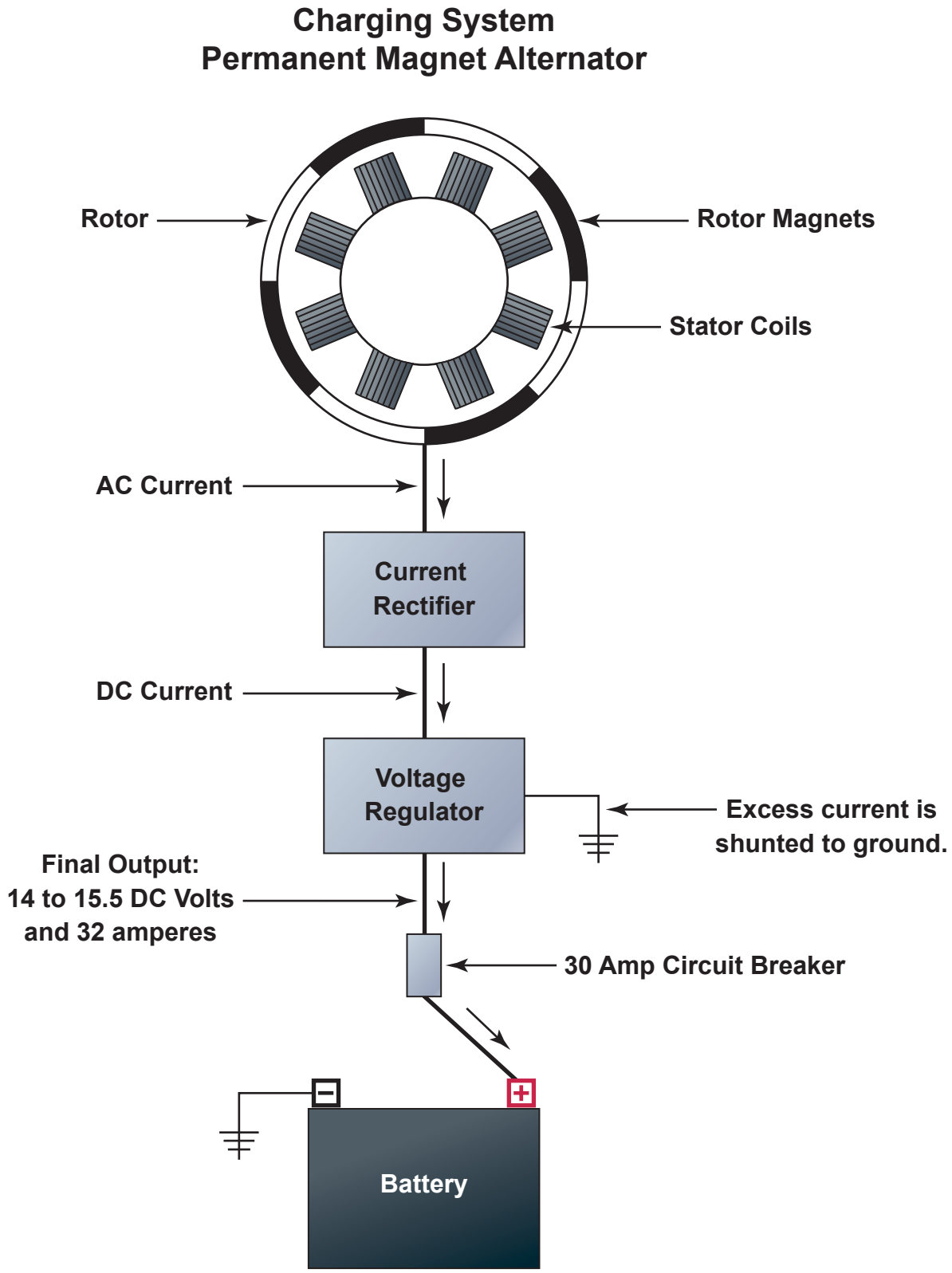
There must be movement of the conductor (the coil of wire), or the magnetic field (the magnet), in order for current to be induced into the conductor.

Consider the simple three-piece alternator that consists of a stator and a rotor. The stator consists of multiple coils of copper wire that are wound around soft iron poles. The stator is the "conductor". The rotor is a flywheel that spins around the stator. Attached to the rotor are multiple magnets.

As the rotor magnets orbit (spin) around the stator coils, electrical current is created. This electrical current is absorbed by the stator coils. In electrical terms, the electrical current is "induced" into the stator coils.

The electrical current produced is called "alternating current". For example, as the magnetic north pole of one of the rotor magnets approaches a stator winding, a weak "coupling" - a weak current is produced in the winding. The current moves in one direction.

As the magnet moves toward the middle of the winding, the highest magnetic coupling is produced and the most current is induced into the winding at that location.



The three-piece alternator is the most common as used on motorcycles.