

# Understanding Charging Systems

**A** SHOW OF HANDS—how many of you pack a spare regulator/rectifier in your duffel bag before hitting the road? How about extra alternator brushes to go along with your tire repair kit?

Right, few of us do, yet after a flat tire, a smoked charging system component is probably the second biggest cause of a riding vacation cut short—and they always seem to die after dealership hours, miles from nowhere.

The one great truth about the parts that keep your bike's battery charged, is that no one pays any attention to them until they have gone belly-up—probably because most folks liken them to electrical witchcraft. But stick with me here, and I'll explain in simplistic terms how these voltage devils work...and ultimately croak.

There are two prevailing systems in modern motorcycles that keep the battery all happy and smug with 12+ jolts of power. The most common one is what I like to call the "two-piece" system because, well—there's two parts involved, you see. In fancy electrical terms, one of these parts is referred to as a "Three-Phase Alternator" but I like to call it the "juice maker." It consists of a steel ring, with wound-copper coils spaced around its circumference; three wires coming off of it, and the whole device lives down inside the engine at one end of the crankshaft. Attached to the end of the crank is a cereal-bowl shaped magnet that, when spun around those copper coils, creates alternating current, but let's call it AC juice. That juice comes out of the three wires (usually color coded all-white or yellow) and heads out to the battery. But, before it gets there, it has to pass through the second component which is called a regulator/rectifier. About the size of a pack of smokes, and normally finned to aid cooling, this guy generally lives amidships on a lot of bikes, but Harley owners would recognize it as the piece at the bottom-front of the chassis.

The regulator/rectifier performs two jobs: First up, the raw AC juice has to be changed to direct-current voltage (DC juice) by the *rectifier* side before it can go into a DC battery and electrical system. No sweat there. And because the alternator produces an over-abundance of electrical power which would surely boil the battery and pop bulbs, the *regulator* side restricts the amount of DC juice down to an average maximum of 14.8 volts, by sending the excess to ground on the bike's frame.



A two-piece system, this one from the infamous early Suzuki GS-series—nicely toasted.

The biggest problem with this style of charging system is heat. The alternator is attached to a hot engine after all and living in scalding oil—which eventually cracks and crumbles the insulating plastic coating of those wound-copper coils, shorting them to ground in a good old fry-up.

The most notorious was the Suzuki GS-series of street bikes of a few years back, affecting all models from 250cc–1150cc. For these alternators to survive longer than 20,000 miles was rare, especially in hotter climates, and I've forgotten how many barbequed units I swapped out back then. To be fair, when Suzuki introduced the completely redesigned GSX-R750 in '96, the alternator had oiling jets pointed right at it for positive cooling, rather than being simply slopped by oil, and this helped reliability.

And then there are those bikes which have the alternator buried deep inside and require engine removal just to replace it; the Kawasaki 750 Vulcan and old Honda 1200 Gold Wing come to mind—*ka ching*.

The regulator/rectifier also gets seriously toasty, and when the diodes inside it burn up, voltage can't pass through to keep the battery charged. Although it's rare anymore, occasionally the regulator side could go haywire, as well, allowing big voltage to get out and cook the battery.

What I find funny is that a lot of model-specific internet forums believe the early death of their bikes' alternators or regulator/rectifiers is a conspiracy that only happens to them—a plot to sell absurdly priced parts. I will not argue about the outrageous O.E.M. prices (it's not for nothing that mechanics call rectifiers, "Rectum Fryers") but the two-piece charging system is an old, dumb idea that dies pretty regularly on all the motorcycles that employ it. Whenever possible, I'll go to the giant Tucker Rocky or Parts Unlimited catalogs for aftermarket charging pieces that are half the price of original equipment.



The air-cooled one-piece alternator with its regulator/rectifier inside—much more durable.

The most reliable method of keeping a battery charged up looks just like what you'll find under the hood of your car or truck. It's one-piece, air-cooled, sits on top of the engine and, depending upon engine design, is driven by either belt, gear or damper vane. Unfortunately, because of its size, it has few motorcycle applications, with the most popular exceptions being the flat, or boxer-style, engines such as the Honda 1500/1800 Gold Wings, Valkyries and most BMWs. However, several Japanese and Triumph in-line motors also use it, as it fits neatly under a rack of carburetors or throttle bodies. Hold one of these big alternators in your hands, squint at a V-twin and you'd be hard pressed to figure where to put it, without the result looking grotesque. Of course, cutting-edge sport-bike motors sneer at it because of its weight.

I've seen many examples of this 'stator go well in excess of 100,000 miles without skipping a beat, and the only downside is that when they do stop charging the battery, the individual internal components are not offered separately and the manufacturer wants heart attack money for a complete assembly—Triumph, are you listening? However, some designs have two carbon brushes riding on the spinning armature—which do wear out—and if you can get them at the parts counter, I would urge anyone to carry a spare pair along, as they're usually inexpensive. You might not have the ability to separate the alternator and solder-in new brushes roadside, but that little ol' repair shop in rural Nowhere probably will.

My own bike has the wretched, two-piece charging system and, having just passed the 20,000 mile mark, I joked with the guys at work that I should start thinking about swapping the parts out *before* they snuff. Raised eyebrows agreed, better to do it here in the shop than kick myself in the butt alongside some desolate road. Good advice. 🍌

—Andrew MacDonald