What Does This Thing Do? — Rectifiers

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Published on
July 12th, 2021

There are a lot of mysterious components within any guitar amp, many of which remain puzzling even to hobbyists who have built a DIY project or two. In the second part of Mojotone's new series What Does This Thing Do? we're taking a look at rectifiers, those essential and often misunderstood components within the high-voltage power supply of any tube amp.

The rectifier, which can comprise either a tube or solid-state diodes, is one of the more enigmatic parts of any tube amplifier, and they all have them. This component—which is responsible for converting AC voltage from your receptacle to the DC voltage that the tubes use in their amplification duties—isn't in contact with the guitar signal that flows through other parts of the amp's circuit, yet the way in which it does its job can impact the playing feel of any amplifier, and therefore will also influence certain elements of its sound.

That being said, there's really no good/better/best relationship between different types of rectifiers; it's all a matter of using one that's appropriate to the design of the amplifier itself, and which enhances the type of performance the maker seeks to achieve from that amp.

Not that many of today's amp makers would admit that, of course. Many promote the inclusion of a tube rectifier as if it's inherently superior to solid-state, which—as hinted at above—it is not. A tube rectifier is better if you're trying to build an amplifier that benefits from aspects of that component's properties, and if that's the kind of amplifier that's best for your music and playing style. In other cases, though, a tube rectifier will work against what you're hoping to achieve from a guitar amp, which makes it inferior in that circumstance, by definition.

Let's cover the rectifier's function in a little more detail, while still keeping it simple. Normally located relatively close to the amp's power transformer (PT), the rectifier converts the positive and negative lines of AC current from the PT into a single line of DC current that enables the preamp and output tubes to do their thing. Tube and solid-state rectifiers in guitar amps are all diodes, just of different types.

In the course of this AC-to-DC conversion, a rectifier usually increases the resultant DC voltage level. In fact, the voltage levels are increased twice on their way to the big output tubes: using a Fender Deluxe Reverb as an example, the AC comes into the amp from your wall socket at around 120V, is ramped up by the PT to around 330V AC, and converted by the tube rectifier to more than 400V DC to feed a pair of 6V6GT output tubes. (Big power resistors reduce this voltage by roughly half by the time it gets to the preamp tubes.)

The rectifier's affect upon the feel, and therefore to some extent the sound, of an amp comes into play according to how quickly and efficiently it performs this voltage-conversion task, and that differs somewhat from rectifier to rectifier, and amp to amp.

As tube rectifiers run from larger and more powerful to smaller and less so, they tend by and large to both produce a little less DC from the AC voltage that is input, and to also do the job a little more slowly. For example, the GZ34 (or functionally near-equivalent 5AR4) in a pre-CBS Fender Super Reverb or a JMI Vox AC30 is one of the more robust tube rectifiers in use for guitar amps. It will produce higher levels of DC when asked to, and will recover more quickly to full efficiency when hit for a demand for power while working hard. One of the smaller tube rectifiers in common use, the 5Y3—original equipment to tweed Deluxes and Princetons and many other small to medium-sized amps—is not only incapable of producing the same amount of DC voltage from any given AC supply, but it also struggles a little to get back up to full efficiency when demand is high. There are other factors involved here, and other tube types in between, but this gives us a good comparison, at least.

In use, with both amps working similarly hard (say, at 2 o'clock on their respective volume controls), the difference between these two examples will be a tighter, punchier, more articulate and more immediately responsive feel from the amps with the GZ34 rectifier, with a relatively softer, more compressed, and slightly more sluggish response from the 5Y3-equipped

amps, and the impression of some “bloom” and swell as their power stages recover. Either might be perfectly appealing, it just depends on what you’re after, and the type of dynamics, touch responsiveness and compression best suit your playing style.

Compared to these, solid-state rectification is the most efficient of all, yielding maximum DC from the AC input, and also recovering quickly. This makes it the choice of many high-powered amps where a bold response and high-volume performance are key, and solid-state diodes have been the rectifiers of choice for amps like the Fender Twin Reverb, Marshall 50- and 100-watt Plexi types, Hiwatts, and many others as a result.

But does this mean that amps with solid-state rectifiers don’t sag and compress? No, not at all, because the preamp and output tubes themselves will also sag and compress and bloom in response to their workload when you’re playing hard and pretty loud—more in some designs, less in others—and that also contributes to the touch-sensitivity element of any given guitar amp. Indeed, some very talented designers of smaller high-quality amps have occasionally found tube rectifiers unnecessary even when a slightly softer, more touchy-feely playing response was desired, because when used right the output tubes in their designs will do that job for them.

Given a good amp designer and builder’s ability to manipulate many factors regarding playing feel and response, and the broad range of rectifier performance discussed above, chances are that in many cases most

guitarists wouldn’t immediately notice the effect of one type of rectifier or another, unless it’s drastically underrated for the task at hand. In others, the change from a rectifier type favorable to the amp’s overall design to one that is less so might be readily apparent. Overall, though, makers of higher-quality tube amps generally aren’t selecting their rectifier type according to cost savings or promotional considerations, but purely because the choice is correct for the intended sonic goal.

On the other hand, many of the more affordable, mass-manufactured tube amplifiers available today do use solid-state rectifiers in favor of tube largely because that approach is more affordable. The change-up involves not only replacing the tube itself, the socket, and related wiring with a few pennies’ worth of silicon diodes, but also enables the use of a somewhat simpler and therefore less-expensive power transformer, which doesn’t need the extra windings used to produce the specific current that heats the rectifier tube’s filament (and which is different from that which heats the filaments of standard preamp and output tubes).

In general, though, it’s worth learning to see an amp’s rectifier type not as an “upgrade” or “deluxe feature,” but as something that should be appropriate to the design, and which helps make the amp as a whole suitable to your playing needs.

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