Obsolete Rectifier Types

Rectifiers have a long history beginning with mechanical rectifiers in the 1800s to today's abundant variety of semiconductor devices. While many different devices have been created for this purpose, they all have the characteristic that they block current flow in the reverse direction, withstanding substantial reverse voltage and allowing current flow in the forward direction with minimum voltage drop. The simplest rectifiers are diodes, but it is also possible to have three-terminal devices (such as a thyristor) that can be controlled to regulate the output dc in addition to providing rectification. It is also possible to use devices like MOSFETs as synchronous rectifiers with very low forward drop during conduction. This is typically done to improve efficiency for very low voltage outputs. The following is a brief description of several of the more common examples.

Vacuum Tube

Once the mainstay of the rectifier field, the vacuum-tube rectifier has largely been supplanted by the silicon diode, but it may be found in vintage equipment. Vacuum-tube rectifiers require filament power and are characterized by high forward voltage drop during conduction, which leads to inherently poor regulation of the output voltage. They are largely immune to ac line transients (also known as "spikes") that can destroy other rectifier types.

Mercury Vapor

The mercury-vapor rectifier was an improvement over the vacuum tube rectifier in that the electron stream from cathode to plate would ionize vaporized mercury in the tube and greatly reduce the forward voltage drop. Because of the lower voltage drop, the power dissipation was much lower for a given current and these tubes could carry relatively high currents. They were popular in transmitter high-voltage power supplies, some of which amateurs may still encounter.

Mercury rectifiers have to be treated with special care. When power is initially applied, the tube filament has to be turned on first to vaporize condensed mercury before high-voltage ac can be applied to the plate. This could take from one to two minutes. Also, if the tube was handled or the equipment transported, filament power would have to be applied for about a half hour to vaporize any mercury droplets that might have been shaken onto tube insulating surfaces. Mercury vapor rectifiers have mostly been replaced by silicon diodes.

Early Solid-State Rectifiers

Copper oxide and selenium rectifiers were the first of the solid-state rectifiers to find their way into commercial equipment. Voltage breakdown per rectifying junction was only a few volts for the copper oxide rectifiers and about 20 V for selenium. Multi-junction stacked versions of selenium rectifiers were used for higher voltage and had a relatively low forward voltage drop. Selenium rectifiers found their way into the plate supplies of test equipment and accessories that needed only a few tens of milliamperes of current at about a hundred volts. Examples include such as grid-dip meters, VTVMs and so forth.

Selenium rectifiers had a relatively low reverse resistance leading to high reverse leakage currents and were therefore inefficient. These may still be encountered in older equipment but they are usually replaced with silicon diodes. Very conveniently, a key indicator of a failed selenium rectifier is the smell of hydrogen selenide, similar to rotten eggs.

A word of caution is warranted when replacing older rectifiers such as vacuum tubes, mercury-vapor rectifiers, selenium or copper oxide. The voltage drop introduced by these rectifiers would have been included in the design of the equipment. When replaced with silicon diodes, the output voltage of the rectifier is very likely to be higher than with the original design. Care should be taken to make sure the higher voltage will not damage the filter elements or load circuits. Furthermore, mercury and selenium are toxic and should not be disposed of with regular household trash. Contact your local recycling agency for information about where to dispose of these devices.