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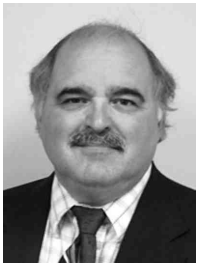

# Powerstat (Variable Transformer) Rectifiers

One of the choices available for electroplaters who do not need a high amperage unit for their operation is the variable transformer or powerstat rectifier. These types of units control output voltage with a cylindrically shaped transformer that has one face flattened and the varnish removed from the windings to expose the copper. A carbon brush rides across this surface, increasing or decreasing the voltage passed through as it engages more or fewer windings. Very small units can be operated with single-phase incoming power, or three of the powerstats can be ganged on a single shaft for three-phase power.

## Design

A typical powerstat rectifier will contain these components:

- A cabinet of painted steel or PVC.
- Cooling will typically be air-cooled with a fan or blower to accommodate convection. Small units (100 amps or less) may simply use radiant and natural convection to remove heat from the cabinet.
- A contactor that engages when the start button is pushed and keeps power on the unit unless the stop button or a thermal overload interrupts the circuit. On smaller units, a circuit breaker may be used in lieu of the start/stop and contactor combination.
- A diode bank to convert the AC to DC.
- A step-down transformer to reduce the voltage from the 230 or 460 VAC incoming to 115 VAC for use in the control circuits of the rectifier. Small units using 115 VAC incoming power will not require this component.
- Meters, either analog or digital, to monitor the voltage and amperage being generated by the rectifier.
- Fuses or overloads to protect the powerstats or fan.
- Overtemp thermals to shut down the rectifier if operating temperatures on critical components exceed specified levels.
- A shunt to generate a signal proportionate to the outgoing amperage for use by the ammeter.
- A main transformer that reduces the incoming 115, 230, or 460 VAC to the maximum output voltage as specified by the size of the rectifier.
- A choke if the rectifier uses single-phase incoming power and the process requires low ripple.

## Operation

Three-phase units of up to 1500 amps or more can be manufactured, although the cost of larger powerstats makes them less competitive in larger sizes. Whether the unit is single-phase or three-phase, a powerstat rectifier has a single large knob that is used to turn the voltage up and down. Optional motor drives allow this adjustment to be made from a separate enclosure, if desired, by use of pushbuttons to raise and lower voltage.

Other options include the addition of circuit boards to allow a motor-driven powerstat to operate in constant current and constant voltage mode. Having this sort of control also allows operation via PLC with the correct I/O cards.

Corrosion in a typical plating environment can have adverse affects on the conductive copper surface of the powerstat, leading to arcing and potential failure of the powerstat. Leaving the powerstat at the same setting can also lead to excessive wear at one setting. As a result, operators of powerstat rectifiers often have a policy to turn the unit all the way up and down on a daily basis.

## Advantages

- Costs are very competitive within the typical range of use (10 to 1000 amps).
- The ability to make very small units (10 amps) using the same overall design, which are useful for laboratory applications or precious metals.
- Basic design utilizes minimal components.
- Optional upgrades allow more sophisticated operation.
- No voltage "steps," smooth adjustment.
- If three-phase power is not available, a coater can still operate a 230 VAC single-phase unit with amperages up to 500.

## Disadvantages

- Vulnerability of the powerstat to damage and failure.
- Limitations in amperage output.
- Brushes must be closely monitored and replaced before damage is done to the conductive surface of the powerstat.
- Basic design does not provide for constant voltage and current. Adding the necessary controls removes some of the cost advantages of this design.

This design is very useful in the correct applications. The plater should consider this another tool for optimizing the application of DC power to the needs of the process. ***P&SF***