Power Supplies

The electrical power required to operate amateur radio equipment is usually taken from the a.c. lines when the equipment is operated where this power is available; in mobile operation the prime source of power is usually the storage battery.

The high-voltage d.c. for the plates of vacuum tubes used in receivers and transmitters is derived from the commercial a.c. by the use of a transformer-rectifier-filter system. The transformer changes the voltage of the a.c. to a suitable value, the rectifier(s) converts it to pulsating d.c., and the filter reduces the pulsations to a suitably low level. Essentially pure direct current is required to prevent hum in the output of receivers, speech amplifiers, modulators and transmitters. In the case of transmitters, pure d.c. plate supply is also dictated by government regulations.

When the prime power source is d.c. (battery), the d.c. is first changed to a.c. and is then followed by the transformer-rectifier-filter system.

The cathode-heating power can be a.c. or d.c. in the case of indirectly-heated cathode tubes, and a.c. or d.c. for filament-type tubes if the tubes are operated at a high power level (high-powered audio and r.f. applications). Low-level operation of filament-type tubes generally requires d.c. on the filaments if undue hum is to be avoided.

Power-supply filters are low-pass devices using series inductors and shunt capacitors. A configuration in which the first element following the rectifier is an inductor is called a **"choke-input** filter," to distinguish it from a "**capacitor-input** filter." The type of filter (choke or capacitor input) has a large effect on the peak current through the rectifiers and upon the output voltage.

RECTIFIER CIRCUITS

Half-Wave Rectifier

Fig. 12-1 shows three rectifier circuits covering most of the common applications in amateur equipment. Fig. 12-1A is the circuit of a half-wave rectifier. The rectifier is a device that will conduct current in one direction but not in the other. During one half of the a.c. cycle the rectifier will conduct and current will flow through the rectifier to the load. During the other half of the cycle the rectifier does not conduct and no current flows to the load. The shape of the output wave is shown in (A) at the right. It shows that the current always flows in the same direction but that the flow of current is not continuous and is pulsating in amplitude.

The average output voltage—the voltage read by the usual d.c. voltmeter—with this circuit (no filter connected) is 0.45 times the r.m.s. value of the a.c. voltage delivered by the transformer secondary. Because the frequency of the pulses is relatively low (one pulsation per cycle), considerable filtering is required to provide adequately smooth d.c. output, and for this reason this circuit is usually limited to applications where the current involved is small, such as supplies for cathode-ray tubes and for protective bias in a transmitter.

The *peak reverse voltage*, the voltage the rectifier must withstand when it isn't conducting, varies with the load. With a resistive load it is the peak a.c. voltage (1.4 E_{RMS}) but with a capacitor load drawing little or no current it can rise to 2.8 E_{RMS}.

Another disadvantage of the half-wave rectifier circuit is that the transformer must have a considerably higher primary volt-ampere rating (approximately 40 per cent greater), for the same d.c. power output, than in other rectifier circuits.

Full-Wave Center-Tap Rectifier

The most universally used rectifier circuit is shown in Fig. 12-1B. Essentially an arrangement in which the outputs of two half-wave rectifiers are combined, it makes use of both halves of the a.c. cycle. A transformer with a center-tapped secondary is required with the circuit.

The average output voltage is 0.9 times the r.m.s. voltage of half the transformer secondary; this is the maximum voltage that can be obtained with a suitable choke-input filter. The peak output voltage is 1.4 times the r.m.s. voltage of half the transformer secondary; this is the maximum voltage that can be obtained from a capacitor-input filter (at little or no load).

The peak reverse voltage across a rectifier unit is 2.8 times the r.m.s. voltage of half the transformer secondary.

As can be seen from the sketches of the output wave form in (B) to the right, the frequency of the output pulses is twice that of the half-wave rectifier. Therefore much less filtering is required. Since the rectifiers work alternately, each handles half of the load current, and the load-current rat-