VOLTAGE CHANGING

Series Voltage-Dropping Resistor

Certain plates and screens of the various tubes in a transmitter or receiver often require a variety of operating voltages differing from the output voltage of an available power supply. In most cases, it is not economically feasible to provide a separate power supply for each of the required voltages. If the current drawn by an electrode, or combination of electrodes operating at the same voltage, is reasonably constant under normal operating conditions, the required voltage may be obtained from a supply of higher voltage by means of a voltage-dropping resistor in series, as shown in Fig. 12-15A. The value of the series resistor, R_1, may be obtained from Ohm's Law, $R = \frac{E_d}{I}$, where E_d is the voltage *drop* required from the supply voltage to the desired voltage and I is the total rated current of the load.

> Example: The plate of the tube in one stage and the screens of the tubes in two other stages require an operating voltage of 250. The nearest available supply voltage is 400 and the total of the rated plate and screen currents is 75 ma. The required resistance is
>
> $$R = \frac{400-250}{0.075} = \frac{150}{0.075} = 2000 \text{ ohms.}$$
>
> The power rating of the resistor is obtained from P (watts) = $I^2R = (0.075)^2$ (2000) = 11.2 watts. A 20-watt resistor is the nearest safe rating to be used.

Voltage Dividers

The regulation of the voltage obtained in this manner obviously is poor, since any change in current through the resistor will cause a directly proportional change in the voltage drop across the resistor. The regulation can be improved somewhat by connecting a second resistor from the low-voltage end of the first to the negative power-supply terminal, as shown in Fig. 12-15B. Such an arrangement constitutes a **voltage divider**. The second resistor, R_2, acts as a constant load for the first, R_1, so that any variation in current from the tap becomes a smaller percentage of the total current through R_1. The heavier the current drawn by the resistors when they alone are connected across the supply, the better will be the voltage regulation at the tap.

Such a voltage divider may have more than a single tap for the purpose of obtaining more than one value of voltage. A typical arrangement is shown in Fig. 12-15C. The terminal voltage is E, and two taps are provided to give lower voltages, E_1 and E_2, at currents I_1 and I_2 respectively. The smaller the resistance between taps in proportion to the total resistance, the lower the voltage between the taps. For convenience, the voltage divider in the figure is considered to be made up of separate resistances R_1, R_2, R_3, between taps. R_3 carries only the bleeder current, I_3; R_2 carries I_2 in addition to I_3; R_1 carries I_1, I_2 and I_3. To calculate the resistances required, a bleeder current, I_3, must be assumed; generally it is low compared with the total load current (10 per cent or so). Then the required values can be calculated as shown in the caption of Fig. 12-15C, I being in decimal parts of an ampere.

The method may be extended to any desired number of taps, each resistance section being calculated by Ohm's Law using the needed voltage drop across it and the total current through it. The power dissipated by each section may be calculated by multiplying I and E or I^2 and R.

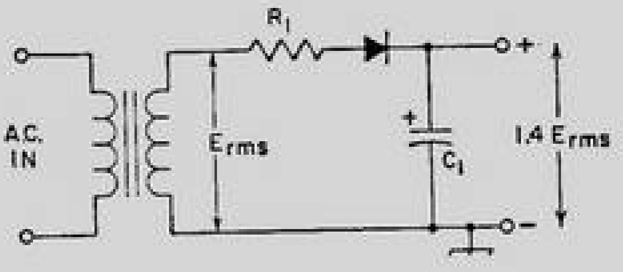

Fig. 12-16—If the current demand is low, a simple half-wave rectifier will deliver a voltage increase. Typical values, for E_{rms} = 117 and a load current of 1 ma.:
C_1—50-µf., 250-v. electrolytic.
E_{output}—160 volts.
R_1—22 ohms.

The "Economy" Power Supply

In many transmitters of the 100-watt class, an excellent method for obtaining plate and screen voltages without excessive loss of power in dropping resistors is through the use of the "economy" circuit for full-wave use (center-tapped secondary) with a bridge-rectified configuration. The voltage at E_1 is the normal voltage obtained with the full-wave circuit, and the voltage at E_2 is that obtained with the full-wave circuit (see Fig. 12-1). The *total* d.c. power obtained from the transformer is, of course, the same as when the transformer is used in its normal manner. In c.w. and s.s.b. applications, additional power can usually be drawn without excessive heating, especially if the transformer has a rectifier filament winding that isn't being used.

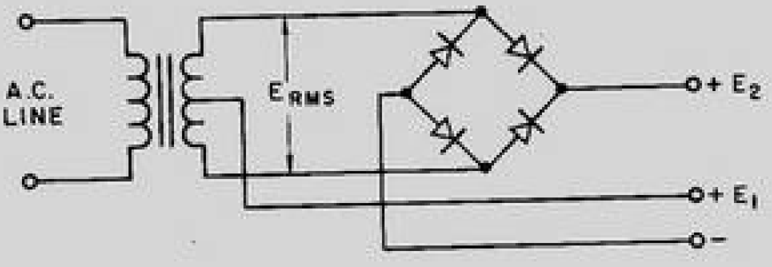

Fig. 12-17—The "economy" power supply circuit is a combination of the full-wave and bridge-rectifier circuits.