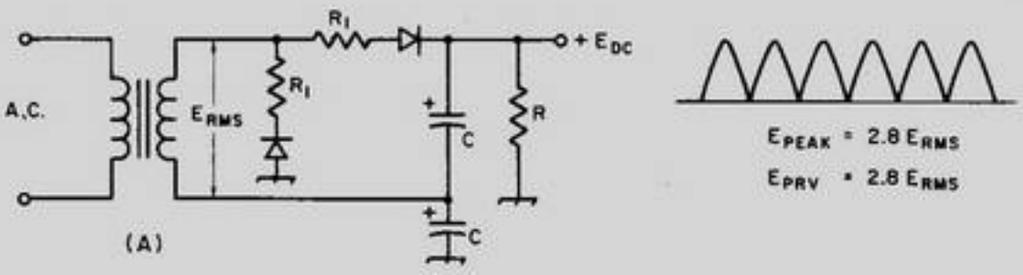

Fig. 12-18—Full-wave voltage-doubling circuit. Values of limiting resistors, R_1, depend upon allowable surge currents of rectifiers.

VOLTAGE-MULTIPLYING CIRCUITS

Although vacuum-tube rectifiers can be used in voltage-multiplying circuits, semiconductor rectifiers are usually more convenient. Selenium can be used in the low-voltage ranges; silicon rectifiers singly or in series are used at the higher voltages.

A simple half-wave rectifier circuit is shown in Fig. 12-16. Strictly speaking this is not a voltage-multiplying circuit. However, if the current demand is low (a milliampere or less), the d.c. output voltage will be close to the peak voltage of the source, or $1.4E_{rms}$. A typical application of the circuit would be to obtain a low bias voltage from a heater winding; the + side of the output can be grounded by reversing the polarity of the rectifier and capacitor. As with all half-wave rectifiers, the output voltage drops quickly with increased current demand.

The resistor R_1 in Fig. 12-16 is included to limit the current through the rectifier, in accordance with the manufacturer's rating for the diode. If the resistance of the transformer winding is sufficient, R_1 can be omitted.

Several types of voltage-doubling circuits are in common use. Where it is not necessary that one side of the transformer secondary be at ground potential, the voltage-doubling circuit of Fig. 12-18 is used. This circuit has several advantages over the voltage-doubling circuit to be described later. For a given output voltage, compared to the full-wave rectifier circuit (Fig. 12-1B), this full-wave doubler circuit requires only half the p.i.v. rating. Again for a given output voltage, compared to a full-wave bridge circuit (Fig. 12-1C) only half as many rectifiers (of the same p.i.v. rating) are required.

Resistors R_1 in Fig. 12-18 are used to limit the surge currents through the rectifiers. Their values are based on the transformer voltage and the rectifier surge-current rating, since at the instant the power supply is turned on the filter capacitors look like a short-circuited load. Provided the limiting resistors can withstand the surge current, their current-handling capacity is based on the maximum load current from the supply.

Output voltages approaching twice the peak voltage of the transformer can be obtained with the voltage-doubling circuit of Fig. 12-18. Fig. 12-19 shows how the voltage depends upon the ratio of the series resistance to the load resistance, and the product of the load resistance times the filter capacitance.

When one side of the transformer secondary must be at ground potential, as when the a.c. is derived from a heater winding, the voltage-multiplying circuits of Fig. 12-20 can be used. In the voltage-doubling circuit at A, C_1 charges through the left-hand rectifier during one half

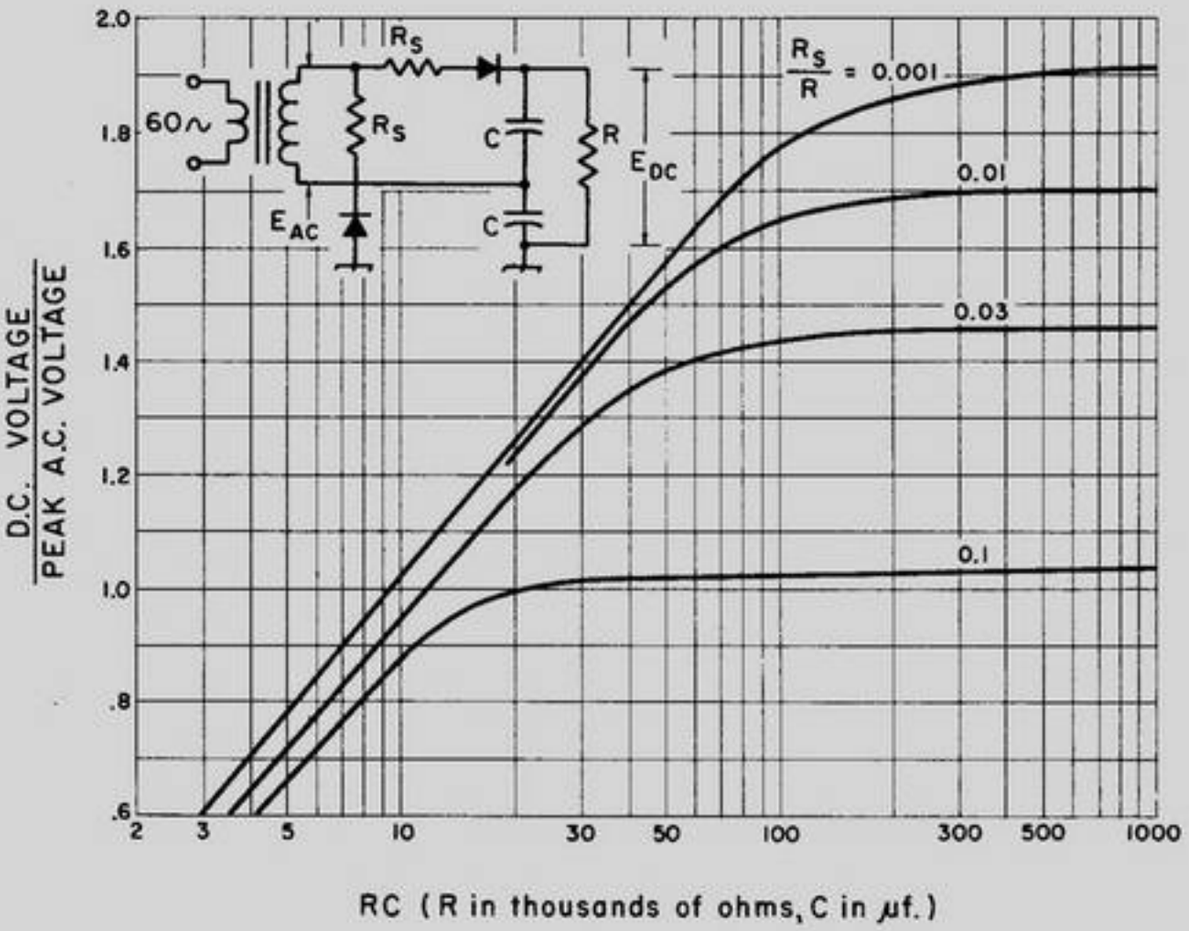

Fig. 12-19—D.c. output voltages from a full-wave voltage-doubling circuit as a function of the filter capacitances and load resistance. For the ratio R_s/R, both resistances are in ohms; for the RC product, R is in thousands of ohms.