VALVES AND THEIR APPLICATIONS

By M. G. SCROGGIE, B.Sc., M.I.E.E.

No. 6: Mullard MERCURY VAPOUR RECTIFIER RG1-240A

GENERALLY speaking, vacuum rectifiers are suitable for domestic receivers, and mercury-vapour for transmitters and high-power amplifiers. The dividing line is in the region of 100 watts; perhaps higher if the load is constant, or lower if it is variable.

The vacuum rectifier is simple and foolproof. But owing to its high resistance it is unduly large, expensive, and wasteful for high-power units. And output voltage varies considerably with current — i.e., it has bad regulation, as shown at A in Fig. 1.

The drop across the mercury rectifier is steady at about 15 V even when passing heavy current, so anode dissipation is slight and quite a small valve serves for d.c. of the kilowatt order. And, as shown at B, regulation is excellent over a wide range of current.

Although one of the suitable circuits (Fig. 2) is, except for the absence of reservoir condenser, identical with the usual vacuum rectifier arrangement, it works differently and requires quite different components and design. Omitting the reservoir condenser is not optional; in the interests of valve life it must never be used, nor must the first smoothing capacitance exceed the valve-makers' limit. The choke is particularly important, because regulation is good only so long as its reactance is sufficient, relative to load resistance, to maintain current through itself uninterrupted. The critical ratio is about 2 : 3.

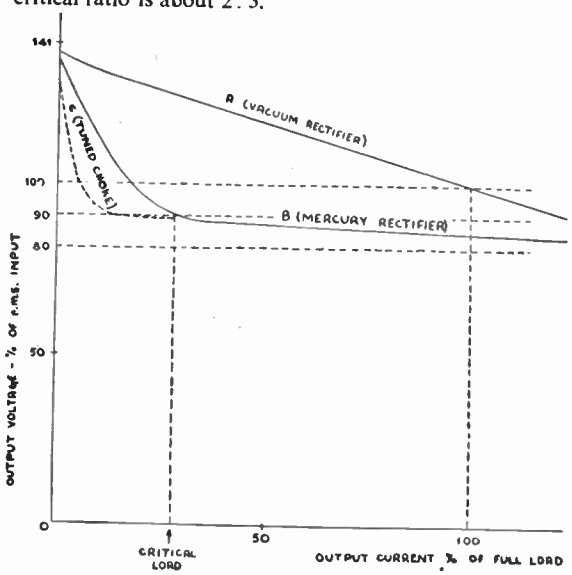

FIG. 1. POWER UNIT REGULATION, USING TYPICAL COMPONENTS.

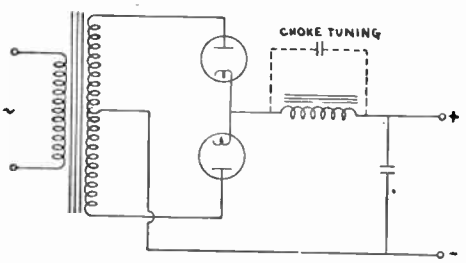

FIG. 2. FULL-WAVE CHOKE INPUT CIRCUIT.

For example, the maximum output rating of two RG1-204A rectifiers in Fig. 2 is 500 mA at 1,500 V — a load resistance of 3,000 ohms. So the choke reactance should be at least 2,000 ohms. With 50 c/s supply, ripple is mainly 100 c/s, and the minimum inductance at full load is $2{,}000/200\pi$, = 3.2H. (To allow a margin, the valve makers advise 4.5H).

If less current is drawn (i.e., load resistance increased), inductance should rise in proportion. Another requirement is low choke resistance. These characteristics are promoted by using no air gap. Ideally, if the undesirable voltage rise shown by curve B is to be avoided, the reactance at zero current should increase to infinity. This being impossible, the load circuit should be arranged to ensure that its resistance never falls below the critical value. One way of extending the permissible load ratio is to tune the choke to the ripple frequency (curve C).

Another thing; the peak voltage across the choke is of the same order as the output, so the winding must be insulated to suit.

If a 3-phase supply is available, six RG1-240A valves can be arranged to give 3.35 kW d.c. at 4,470V, with a r.m.s. input of only 1,920 V per phase and a choke of 1H.

There is no room here for more, but further notes on how to get the best from mercury rectifiers are obtainable from the makers.

This is the sixth of a series written by M. G. Scroggie, B.Sc., M.I.E.E., the well-known Consulting Radio Engineer. Reprints for schools and technical colleges may be obtained free of charge from :

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