Radio Tube Applications

The diversified applications of a radio tube may, within the scope of this chapter, be grouped broadly into five kinds of operation. These are: Amplification, rectification, detection, oscillation, and frequency conversion. Although these operations may take place at either radio- or audio-frequencies and may involve the use of different circuits and different supplemental parts, the general considerations of each kind of operation are basic.

AMPLIFICATION

The amplifying action of a radio tube was mentioned under TRIODES, page 4. A small change in the control-grid voltage for grid voltages less than the cut-off value produces a much larger plate-current change than would be produced by the same change in plate voltage. This action can be utilized in radio circuits in a number of ways, depending upon the results to be achieved. Three distinct classes of amplifier service recognized by engineers are covered by definitions standardized by the Institute of Radio Engineers. This classification depends primarily on the fraction of input cycle during which plate current is expected to flow under rated full-load conditions. The classes are Class A, Class B, and Class C.

A **Class A amplifier** is an amplifier in which the grid bias and the exciting grid voltage are such that the plate current through the tube flows at all times. The ideal Class A amplifier is one in which the alternating component of the plate current is an exact reproduction of the form of the alternating grid voltage, and the plate current flows during the 360 electrical degrees of the cycle. The characteristics of a Class A amplifier are low efficiency and output.

A **Class B amplifier** is an amplifier in which the grid bias is approximately equal to the cut-off value so that the plate current is approximately zero when no exciting grid voltage is applied, and so that the plate current in each tube flows during approximately one-half of each cycle when an exciting grid voltage is present. The ideal Class B amplifier is one in which the alternating component of plate current is an exact replica of the alternating grid voltage for the half cycle when the grid is positive with respect to the bias voltage, and the plate current flows during 180 electrical degrees of the cycle. The characteristics of a Class B amplifier are medium efficiency and output.

A **Class C amplifier** is an amplifier in which the grid bias is appreciably beyond the cut-off value so that the plate current in each tube is zero when no exciting grid voltage is present, and so that the plate current flows in each tube for appreciably less than one-half of each cycle when an exciting grid voltage is present. Class C amplifiers find application where high plate-circuit efficiency is a paramount requirement and where departures from linearity between input and output are permissible. The characteristics of a Class C amplifier are high plate-circuit efficiency and high power output.

It is sometimes convenient to have terms to identify amplifier services when tubes are operated under conditions intermediate to those of Class A and Class B, or to those of Class B and Class C. The proposal has been made that such conditions be classified as Class AB and Class BC, respectively. It is sometimes also of interest to know whether grid current is expected to flow under rated full-load conditions. The proposals follow:

(1) A **Class AB amplifier** is one in which the grid bias and the exciting grid voltage are such that the plate current flows during appreciably more than 180 electrical degrees, but less than 360 electrical degrees of the cycle. This has been called Class "A prime." The characteristics of a Class AB amplifier are efficiency and output intermediate to those of a Class A and a Class B amplifier. The no-signal plate currents and attendant dissipation may be made substantially less than is possible with Class A amplifiers.

(2) A **Class BC amplifier** is an amplifier in which the grid bias and the exciting grid voltage are such that the plate current flows during less than 180 electrical degrees, but yet for a considerable part of the cycle. The characteristics of a Class BC amplifier are efficiency and output intermediate to those of a Class B and a Class C amplifier. Class BC amplifiers are not in general use.

(3) To denote that grid current does not flow during any part of the input cycle, add the suffix 1 to the letter or letters of the class identification. The suffix 2 is used to denote that grid current flows during some part of the cycle.

For radio-frequency amplifiers which operate into a selective tuned circuit, as in radio transmitter applications, or under requirements where distortion is not an important factor, any of the above classes of amplifiers may be used, either with a single tube or a push-pull stage. For audio-frequency amplifiers in which distortion is an important factor, only Class A amplifiers permit single-tube operation. In this case, operating