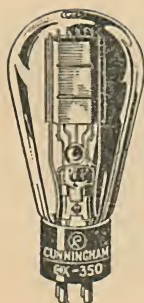


Cunningham

RADIO TUBES

BULLETIN

Type CX-350 POWER AMPLIFIER



Type CX-350 is a heavy duty power amplifier tube. It is intended for use in installations where more undistorted power output is required than for average home use. In appearance it is somewhat larger than type CX-310.

This tube has been designed to operate at plate voltages from 250 to 450 volts maximum. Equipment designed to use the CX-350 must be capable of supplying the high plate current and the necessary grid bias, which is from -45 to -84 volts as shown in the tabulation.

Its performance characteristics are similar to the CX-371A and CX-345 having an amplification factor of 3.8, plate resistance of 1,800. ohms and mutual conductance of 2,100. at a plate voltage of 450 volts.

BULB

The bulb provided for the CX-350 is larger than that used for the CX-310, the bulb diameter being 2 11/16 inches. The overall length of the tube is 6 1/4 inches.

FILAMENT

The filament rating is 7.5 volts, 1.25 amperes. The material used is the rugged coated ribbon type similar to that used in Type CX-381, the filament operating at a dull red heat. The current required may be supplied from the 7.5 volt winding of a power transformer. The low operating temperature and the increased size of this type of filament results in minimum ripple voltage or "hum" when operated from such a source. The transformer should be so designed that the voltage across the filament does not exceed 7.9 volts (rated voltage plus 5%).

ELEMENTS

The plate of this tube is of special construction to permit ample radiation. It is supported by a collar on the stem so that a maximum B voltage of 450 volts can be used.

BASE

The standard large four prong base is employed.

MOUNTING

It is preferable to mount the tube in a vertical position and provision should be made for circulation of air around the tube to prevent overheating. An indication of overheating is obtained from the appearance of the tube, the plates of which should never exceed a barely visible red at any spot on either side of the plate.

OPERATING CONDITIONS

Filament Volts	7.5
Filament Amperes	1.25
Plate Volts (Max.)	450.
Plate Current (Max.)	55 m.a.
Grid Volts	See Table

AVERAGE TUBE CHARACTERISTICS

Plate Volts	Neg. Grid Bias Volts	Mu	Plate Resist.	Mutual Conduct.	Plate Current	Bias Resistor Ohms	Undistorted Power Output Milliwatts
250	-45	3.8	2100	1800	28	1600	1000
350	-63	3.8	1900	2000	45	1400	2400
400	-70	3.8	1800	2100	55	1300	3400
450	-84	3.8	1800	2100	55	1550	4600

USE

Maximum life is obtained from the CX-350 when the tube is used at conservative plate voltages. Voltages between 250 and 400 volts are recommended, and the voltage must not exceed a maximum value of 450 volts. When the tube is used in place of the CX-310 (as noted below circuit changes should be made before the tube is substituted for this type) the plate voltage need not exceed 300 volts if the power output obtainable from the CX-310 operated at 425 volts has proven adequate. Thus for equivalent power output a considerably lower plate voltage may be used with the CX-350, the total required for the tube and grid biasing voltage being $300+54$, or 354 volts as compared with $425+35$ or 460 volts for the CX-310.

The higher current required by the CX-350 can be conveniently supplied by a CX-381 rectifier (or by two such tubes

with full wave connection). The average plate current required ranges from 28 m.a. at 250 volts to 55 m.a. at 400 volts. Since the CX-381 is rated at 85 m.a. output (see Fig. 4) sufficient margin is available so that the same rectifier used for the CX-350 may also supply the plate current required by the remaining tubes in the receiver.

The CX-350 is of the low mu type, the amplification factor being 3.8. The normal plate current is relatively high, and will reach values which may result in damage to the tube unless certain precautions are taken in using this model, as follows:

1. The grid bias must be applied at all times while the tube is in operation. If the grid circuit is opened the plate current will increase to a high value, overloading both the power tube and particularly the rectifier tube—if the current is supplied from such source—and is very apt to cause burnout of the filament in the latter. It is very desirable to protect both by a fuse, or similar device, operating at about .1 ampere, and which should be placed in the rectifier circuit between the rectifier and the filter. It is possible to use the .1 ampere 6 volt dial lamp, type T3, which, although not designed for high voltage, will usually break the circuit.

2. The coated filament is not affected by traces of gas, and a slight blue glow will not impair or affect the performance of the tube provided the resistance in the grid circuit is kept low, preferably not over 10,000 ohms, to avoid a decrease in bias which may otherwise result from the flow of gas current to the grid. The tube is not intended for use in resistance coupled amplifiers.

It is desirable that the bias required by the tube be supplied from the drop across a resistor in series with the -B return, as shown in Fig. 5. It will be found that this connection compensates almost completely for changes in plate voltage which may occur as a result of line voltage variations, as an increase in plate voltage causes a small increase in plate current which in turn raises the applied "C" bias sufficiently to compensate for the new value of plate voltage, thus maintaining the proper operating condition at all times. If a decrease in voltage occurs, the reverse action takes place. This desirable operating condition is sacrificed if a fixed "C" bias derived from a battery or other source is provided, as in such cases a decrease in plate

voltage will cause a large decrease in plate current which will greatly reduce the power output obtainable from the tube, while an increase in plate voltage will overload the tube.

A low resistance output choke with a condenser, or a transformer capable of handling the heavy plate current of the CX-350 without saturation of the core, or overheating of the windings must be provided for this tube to prevent excessive voltage drop in the plate circuit and to protect the loud speaker windings.

CURVES AND DATA—(Page 80)

The curves, Fig. 1, show the average filament current and the filament emission of type CX-350.

Fig. 2 gives the average plate current over a range of plate voltages, with no applied grid bias. In taking this data, the grid return was connected to the midpoint of the filament, and for this reason the plate current does not reach zero until a negative plate voltage is applied.

Fig. 3 shows the amplification factor (μ), plate resistance (r_p), and mutual conductance (G_m) plotted as a function of plate current. This method of showing tube characteristics is convenient, since a single measurement, that of plate current, suffices to determine the operating point.

Fig. 4, furnished for convenient reference, shows the voltage and current output of the CX-381 at various loads. The full lines show the output of a single CX-381 with the usual filter arrangement, while the dotted lines show the output obtained from two CX-381 tubes in a full wave rectifier, using a filter in which the first filter condenser is omitted. The IR drop in the filter must be taken into consideration before this data is complete. As soon as the resistance of the filter chokes is measured the output voltage obtainable can be computed.

Fig. 5 shows circuit arrangements suitable for the CX-350. When substitution of this type for type CX-310 is desired the necessary circuit changes include a change in the resistance R to the proper value as indicated below, and substitution of an output device having higher current carrying capacity if that provided for the CX-310 is inadequate.

CX-350 AVERAGE CHARACTERISTICS

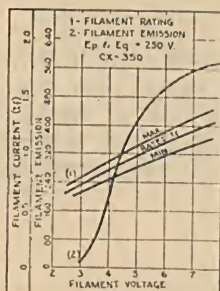


FIGURE 1

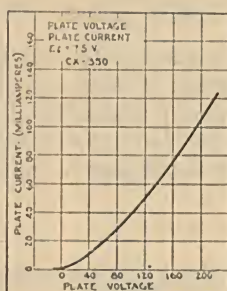


FIGURE 2

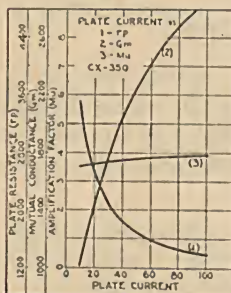


FIGURE 3

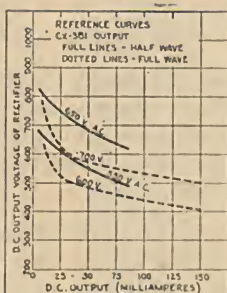


FIGURE 4

AUDIO FREQUENCY POWER STAGE

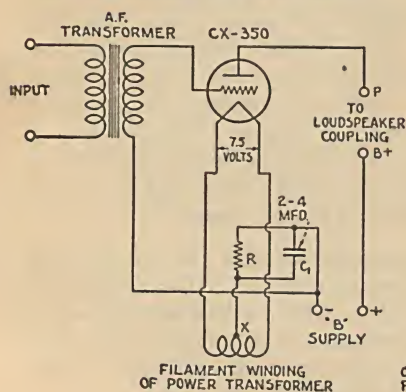


FIG. 5

LOUDSPEAKER COUPLING

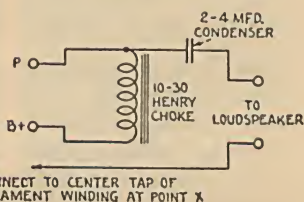
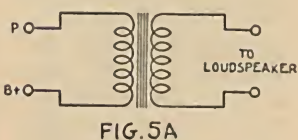


FIG. 5B