A METHOD OF MEASURING THE AMPLIFICATION OF TWO OR MORE STAGE AMPLIFIERS.

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The method here explained is an adaptation of the potentiometer method of measuring the amplification constant of an electron tube.

In figure 1 (Audio Amplifier) the negative terminal of the filament is connected to the middle point, b, of a potentiometer made of two ordinary resistance boxes. This negative terminal may be connected to the earth also. An alternating E.M.F., generated by a buzzer working through a telephone induction coil, is connected to the terminals, c, c,

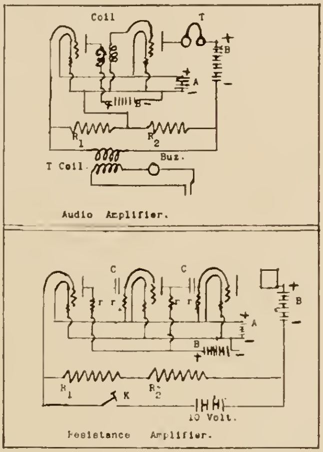

Fig. 1. Diagram of audio and resistance amplifiers.

of the potentiometer. The point, a, is connected to the grid of the first tube and the point, c, is connected through a suitable B battery and telephone to the plate of the last tube.

The tubes are carefully connected with audio frequency coils. The coil must be so connected that when the potential of the grid of tube No. 1 is made positive the potential of the second and of all other tubes is positive. When the grid potential of the first tube is made positive the plate current of all tubes must increase. A second B battery must be used for the plate potential of all tubes except the last.

When the potential of the point a is positive the current runs from a to c through b. The potential of c will be negative, since the potential of b is zero.

If the potential of the grid of tube No. 1 is raised, the current in the plate circuit of the last tube is increased unless the plate potential is decreased. When the plate potential is diminished enough to keep the plate current constant there will be a minimum sound or no sound at all in the telephone.

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If the resistance R_1 is set at some convenient value, 10 ohms, say, and R_2 is adjusted to minimum sound, then the ratio of R_2 to R_1 is the amplification constant of the amplifier.

$A = R_2/R_1$ = Change of plate potential divided by the change of grid potential. If the amplification constant of the tubes has been determined then the amplification constant of the audio coil can be determined. $A = a_1 C_1 a_2 C_2 a_3 — a_n$.

Where $a_1, a_2, — a_n$ is the amplification constant of the various tubes, and C_1, C_2—is the amplification constant of first, second, etc., coils.

Best results are obtained with two tubes and one coil. The plate potential must be such as to let the tubes operate on a point near the middle of the plate current, grid potential curve. C batteries of suitable value may be inserted in the grid circuits of the tubes, if necessary.

In a resistance amplifier (fig. 1, resistance amplifier) an uneven number of tubes must be used. If the grid of the first tube is increased the plate current increases and the potential of the plate diminishes, causing the potential of the grid of the second tube to diminsh and the plate current of the second tube to diminish. This will cause the potential of the second plate to increase and the grid of the third tube will increase and the current in the plate circuit of tube three will tend to increase.

The resistances in the potentiometer can be adjusted until there is minimum sound as in the first case. A mil ammeter can be inserted in place of the telephone and a battery of a few volts can be placed around a c. A key, K, in the battery circuit is opened and closed and the resistances adjusted until there is no change of deflection.

In this resistance amplifier the actual amplification will be less than the product of the amplification constants of the three tubes. If the resistance, r, is four times the resistance of the tube, then the amplification is four-fifths that of the tube alone. The potential of the B battery must be large. If the tube is to work with 40 volts potential on the plate then the battery must be 200 volts if r is four times the resistance of the tube.