RCA MANUFACTURING COMPANY, INC.
A RADIO CORPORATION OF AMERICA SUBSIDIARY
Harrison, New Jersey

RCA RADIOTRON
DIVISION

APPLICATION NOTE NO.107

APPLICATION NOTE ON A MINIATURE-TUBE HEARING-AID AMPLIFIER FOR USE WITH AN AIR-CONDUCTION EARPIECE

For use in hearing-aid amplifiers, the miniature tubes have the advantages that they are small, operate well at low plate and screen voltages, and employ commercially available sockets which are very small. The miniature tubes are especially well suited for use in a hearing-aid amplifier which employs an air-conduction earpiece; sufficient gain and power output for such a unit can be provided by two miniature voltage-amplifier tubes drawing a total filament current of 100 ma.

Tests have shown that the best miniature-tube complement for an air-conduction hearing aid is a 1S5 followed by a 1T4. The 1T4 is desirable for use in the second stage because it can provide more power output than the 1S5; the 1S5 is desirable in the first stage because it can provide more gain than the 1T4. A circuit using this tube complement is shown in **Fig.1.**

It was found desirable to use choke coupling, rather than resistance coupling, for the output of the 1T4 in this circuit. With resistance coupling, the voltage at the plate of the 1T4 was so low that the gain and output of the 1T4 were inadequate. Suitable chokes, small enough and light enough for use in a wearable hearing aid, are commercially available.

The filament rheostat R_2 is the "battery saver" frequently used in hearing aids. This rheostat should be set so that filament current is at the lowest value providing adequate signal output. It is possible to use the rheostat as the volume control and thus to eliminate potentiometer R_7. However, volume can be controlled more smoothly by means of R_7 than by means of R_2. It is not advisable to insert a volume-control potentiometer in place of R_1 or R_5 because suitable potentiometers having a resistance as high as 10 megohms are not generally available. A resistance of less than 10 megohms for R_1 or R_5 would reduce the circuit's sensitivity.

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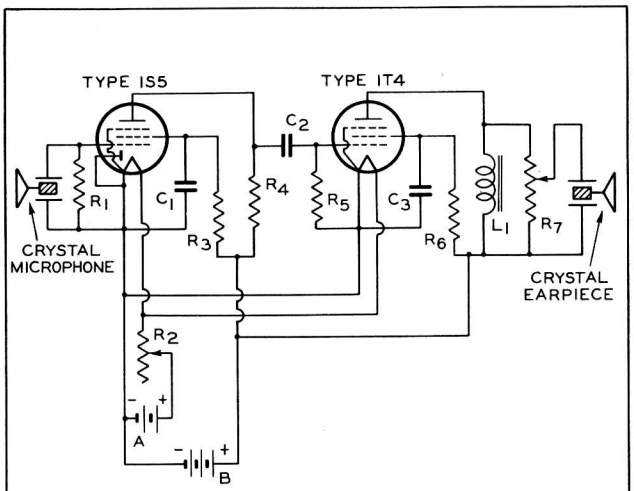
Fig.2 shows the performance of the circuit with a 45-volt, and with a 30-volt B-supply. These curves were measured at a signal frequency of 420 cycles. The capacitance of the earpiece was 0.0015 μf. It can be seen from Fig.2 that, with a 45-volt supply, a 5-millivolt signal from the microphone produces an output voltage of 20 volts across the earpiece with 6% distortion. This output voltage is large enough for most people who use an air-conduction unit. With a 30-volt supply, a 5-millivolt signal produces approximately 10 volts output with 4% distortion. This output voltage is large enough for many people whose hearing loss is not severe. The total plate and screen current drawn by the circuit from a 45-volt supply is approximately 0.6 ma.; from a 30-volt supply, the drain is approximately 0.4 ma. At these low drains, good life can be obtained from a very small B-battery.

HEARING-AID CIRCUIT



C_1 = 0.02 μf
C_2 = 0.002 μf
C_3 = 0.03 μf
L_1 = 500-HENRY CHOKE, 6000 OHMS D-C RESISTANCE, SMALL LIGHT-WEIGHT DESIGN
R_1 = 10 MEGOHMS
R_2 = 100 OHMS FILAMENT RHEOSTAT
R_3 = 3 MEGOHMS
R_4 = 1 MEGOHM
R_5 = 10 MEGOHMS
R_6 = 0.15 MEGOHM
R_7 = 1 MEGOHM, VOLUME CONTROL

FIG. 1

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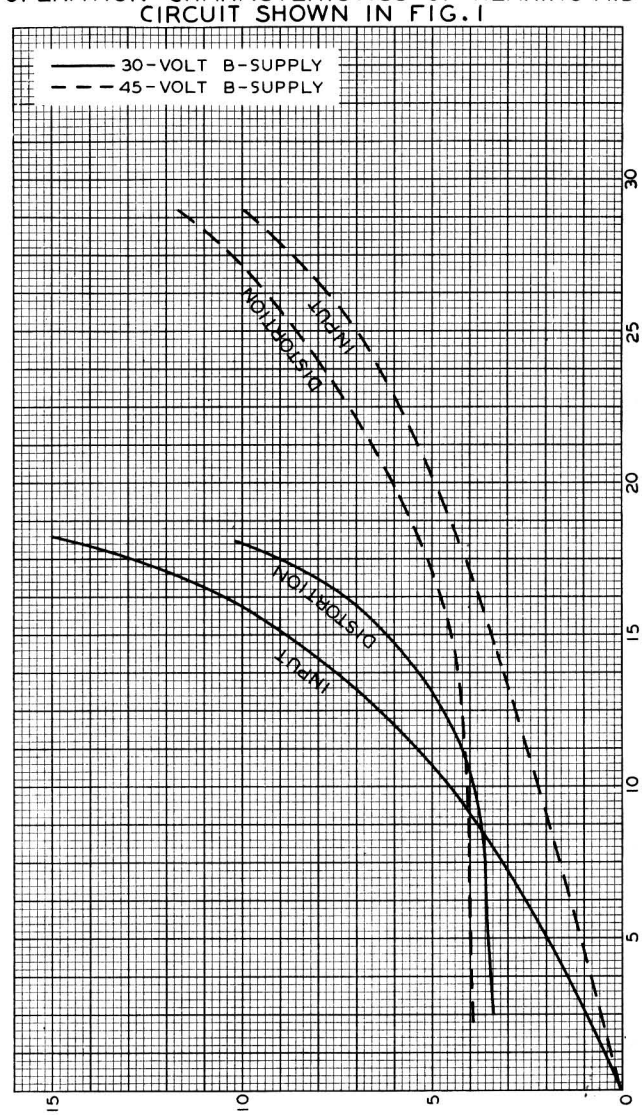
OPERATION CHARACTERISTICS OF HEARING-AID CIRCUIT SHOWN IN FIG. 1



VOLTAGE INPUT-MILLIVOLTS
DISTORTION-PER CENT

FIG. 2

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