Edited by A. C. SHANEY

SOUND ENGINEERING — No. 25

This department is conducted for the benefit of RADIO-CRAFT subscribers. All design, engineering, or theoretical questions of general interest on PA installation, sound equipment, and audio amplifier design will be answered in this section. No circuit diagrams can be supplied by mail, all answers being printed in order of their receipt.

(Note: when questions refer to circuit diagrams published in past issues of technical literature, the original, or a copy of the circuit should be supplied in order to facilitate reply.)

PRE-AMPLIFIER

The Question . . . .

I am enclosing stamped self-addressed envelope and circuit diagram (Fig. 1) of a pre-amplifier I wish to build. It is actually an old single stage unit, rebuilt, with separate power supply. I wish to use the old power supply with the new unit.

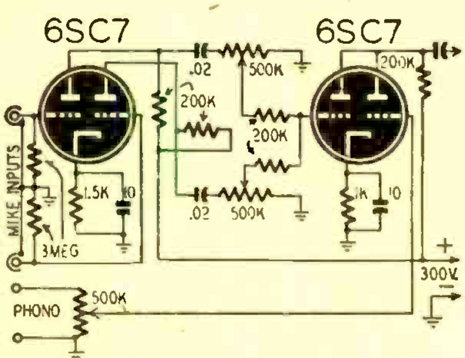

Fig. 1—Original circuit of a pre-amplifier.

The new unit is to feed into the phono jack of my present amplifier which uses a 1612 in the first stage. Will you kindly have your Sound Department check part values on enclosed diagram and finish output circuit, to feed former phono input?

RALPH LEBRUN
Geneva, New York

The Answer . . . .

I am sorry that questions to this department cannot be answered by mail. They can only be answered through publication in this section. A corrected circuit diagram of the type of pre-amplifier you are interested in is indicated in Fig 2. You will note that six major changes have been incorporated, which will insure satisfactory operation. The cathode resistor and by-pass condenser in the first stage have been eliminated to avoid excessive hum and noise pick-up. The mixer circuit has been altered to keep inter-action between controls at a minimum. In the circuit indicated, approximately 2-db change will be noted in the level of one microphone circuit when the remaining "mike" control is varied from minimum to maximum. Your original circuit produced a change of approximately 6 db. The bias of the second 6SC7 has been increased to enable this stage to handle 1 volt input adequately without introducing excessive distortion. A decoupling resistor has been inserted between the two stages to avoid possibility of motor-boating. The plate load of the first stage has been increased from 200.000 ohms to 500,000 ohms to provide increased gain and to limit plate current as the stage is operating under a "no bias" condition. The coupling condensers between stages have been increased from .02 to .05 µf to provide a better low frequency response.

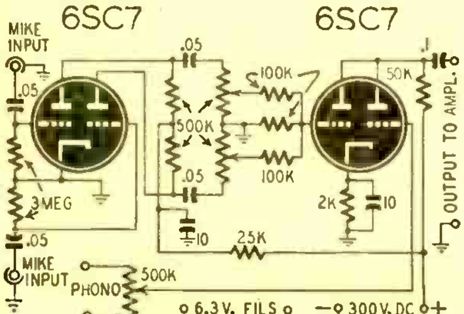

Fig. 2—Circuit of Fig. 1 with improvements.

MIDGET AMPLIFIER

The Question . . . .

I intend to build the Midget Amplifier as shown on the enclosed diagram (Fig. 3). But, I am not sure about the voltage ratings of the condensers and wattage ratings of the resistors. Also, the two 20 µf units, 10 µf unit, and the 40 µf unit. Must they be electrolytic condensers? I am under the impression that the two 20 µf units are bypass condensers.

Please send me a complete parts list giving the wattage of resistors and voltage rating of condensers. Also, I would like to know if this amplifier would handle an 8-inch PM speaker as well as a 3- or 4-inch. Inform me whether the high frequency cut is an ordinary 0.5 megohm tone control, or whether it is a special control.

Thanking you kindly.

DEAN HORN
Columbus, Indiana

The Answer . . . .

The voltage rating of the condensers and the wattage rating of the resistors follow:

Condensers	*Resistors*
40 µf—200 v	500,000 ohms—½ watt
20 — 25 v	250,000 —½ watt
20 — 25 v	25,000 — 1 watt
10 —150 v	3,000 — 2 watt
0.1 —200 v	1,000 — 1 watt
0.1 —200 v	200 — 2 watt
.003—200 v	50 —½ watt

The power output of the amplifier will be approximately 2 watts. This should be adequate to operate an 8-inch speaker. However, a 3- or 4-inch speaker, if operated at low levels, will probably provide better frequency response. The high-frequency control may employ an ordinary ½-meg potentiometer. One with an audio grid taper will probably provide smoother high-frequency cut-off action.

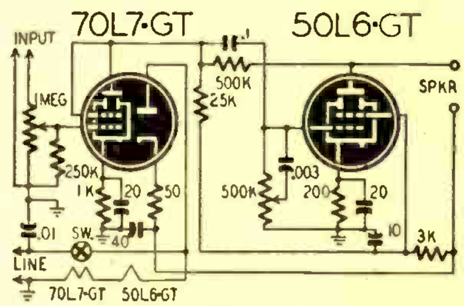

Fig 3—The 2-tube Midget Amplifier circuit.

TRANSFORMER DATA

The Question . . . .

Will you kindly tell me what should be the a.c. RMS voltage of the two plate transformer windings for the Direct-Coupled Recording Playback Amplifier described in the November 1940 issue of RADIO-CRAFT? Also, I would like to know the current rating for the winding supplying the plates of the 5U4-G rectifier tube.

WARREN E. HAIGHT
Wilmington, Delaware

The Answer . . . .

The loaded a.c. RMS voltages of the transformer windings together with their indicated current carrying capacities are listed below:

1. High Voltage Secondary—380 volts each side of center tap at 250 mils.
2. Bias Secondary—187 volts each side of center tap at 250 mils. The voltage and current ratings of the remaining windings also follow:

5U4G filament—5 volts at 3 amp.
5V4G filament—rated at 5 volts at 2 amp.

(Continued on page 63)

SOUND ENGINEERING

(Continued from page 31)

6.3-volt heater winding for the 6L6G output tubes—2 amps.

The remaining 6.3-volt winding is rated at 3 amps.

If you have any difficulty in locating a transformer with these secondary voltages, you might be able to construct one yourself or possibly have it built in accordance with the following manufacturing specifications:

Transformer Core—1½ x 2¼-inch Transformer Grade.

Primary—218 turns of No. 19 wire. Electrostatic Shield.

High-Voltage Secondary—1520 turns center-tapped No. 30 wire.

Bias Secondary—750 turns center-tapped No. 30 wire.

5-volt 3-amp. winding—10 turns center-tapped No. 16 wire.

6.3-volt 3-amp. winding — 13 turns center-tapped No. 16 wire.

5-volt 2-amp. winding — 10 turns center-tapped No. 18 wire.

6.3-volt 2-amp. winding — 13 turns center-tapped No. 18 wire.

The high voltage winding should be insulated from other windings and core to withstand 1750 volts RMS 60 cycles. The bias winding should withstand 1500 volts. The 5-volt 3-amp winding should withstand 2,000 volts.

HUM PICKUP, LINE IMPEDANCE

The Question . . . .

I am operating a sound moving picture system in an auditorium and have considerable trouble with hum at the loud-speaker and boominess. The room is not treated acoustically but some portable machines that have been operated there give satisfactory results.

The output of the amplifier (push-pull 2A3's) is coupled to the line through a "2A3 P-P to 500-ohm" transformer. The line is made up of a pair of No. 14 flexible wires, twisted, with heavy insulation, and is about 250 feet long. It terminates in the primary of a 500-ohm-to-voice-coil transformer. The line is unshielded and the speaker, when plugged in at the amplifier, shows no sign of hum. The amplifier is well grounded. The monitor speaker, a pm dynamic, shows lots of hum also when the main speaker is coupled to the other end of the line.

I am at present experimenting with the input end, photocell lines, etc., to see how much hum is originating there.

In connection with the output end, I would like to know how the impedance of an audio frequency line may be computed. Have tried feeding the line with and terminating it in 250-ohm transformers but did not get as good results as with 500-ohm terminations.

George F. Swartz
San Francisco, Calif.

The Answer . . . .

The excessive boominess you mention is undoubtedly caused by an extended

(Continued on page 64)

SOUND ENGINEERING

(Continued from page 63)

low-frequency response in the entire reproducing system. If other machines operate satisfactorily in the same auditorium, you undoubtedly can correct the trouble with your particular machine, by reducing the low frequency response of either the amplifier or the loud-speaker.

The hum may be picked either by the long unshielded line, particularly if it runs parallel to some power line carrying high currents, or, the coupling transformer at the speaker may be picking up hum from some hum-producing equipment on the stage of the auditorium. The fact that no hum is noticed in the monitor speaker when the auditorium speaker is connected directly at the amplifier, indicates that the hum is not being produced at the input end of the amplifier. An increase of hum in the PM speaker (at the amplifier) when the stage speaker is connected at the remote end of the line, clearly indicates that the line circuit is involved in the hum pickup. You can check if the speaker coupling transformer is picking up the hum by orienting the speaker while it is on the stage to see if the hum is reduced. If not, I suggest that you either shield the line or re-locate it so as to keep it away from high-current-carrying power lines.

The impedance of a terminated audio

frequency line may be checked with a power output level indicator. This device should be connected at the remote end of the line and adjusted so that maximum transfer of power takes place. The impedance setting of the indicator shows the proper terminal impedance.

The impedance of a non-terminated line is a function of its distributed capacity, inductance, d.c. resistance and insulation characteristics. For rough approximations, the impedance of a line should be at least twenty times its d.c. resistance. The distributed capacity of the line should have a capacitative reactance, at the highest frequency which the line is to transmit, of at least ten times the impedance of the source. The 250-foot line that you describe should be suitable for impedances ranging from 25 to 250 ohms, if 10,000 cycles is the upper frequency limit of transmission, or 25 to 500 ohms, if 5,000 cycles is the upper frequency limit.

The fact that you did not get as good results with 250-ohm terminations should not lead you to any false conclusions. The 250-ohm termination may have added some undesirable high frequency response in the system, and possibly provided less pleasing results. On the other hand, the 500-ohm transformers may have been much more efficient.