A Twin-Channel Utility Amplifier

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Designed especially for use by a broadcaster in making remote pickups, this unit would find many applications in the experimental shop of many an audio engineer or hobbyist.

CATALOG SEARCHING for an extremely portable remote amplifier with a dual output for feeding P.A. as well as broadcast lines brought to light many fine units, but none which seemed to fit the primary requirement—small size. Hence it was decided to build one which would combine certain features peculiar to the operation intended, at the same time making it flexible enough to permit general use. The result is described here.

In the original design, it was intended to have two separate amplifier channels available for covering sports pickups where only one mike was needed. The second channel was intended to feed the P.A. with a separate program from another mike, which facility was supplied by the station. Since this setup was used frequently, it was felt desirable to combine the two channels, rather than have several pieces of apparatus to carry and clutter the limited working area. To allow the amplifier to be used for other small pickups using more than one mike, a switch was installed which allowed mixing the two input channels, thus providing a two-channel mixer, with both input signals mixed together and appearing at both output channels. To have a second channel instantly available in case of the failure of one, a changeover switch was installed to permit reversing the line connections to the two outputs. Thus if one line or output channel fails, it is a simple matter to switch over to the other, coordinating the switch with the studio.

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Circuit Features

An inspection of *Fig.* 1 shows that all the tubes are of the miniature variety, all chosen for high gain. As a result it is possible to get the necessary gain with only three stages. Though it has never been accurately measured, the calculated gain is around 85 db which is adequate for most ordinary needs, with some gain to spare. The first stage operates in an entirely conventional manner, with the possible exception of the loaded input. While it is a matter for discussion whether or not this is necessary, the response is somewhat improved when working from ribbon mikes, and the stage is stabilized by its inclusion. If the two cathodes of the 6AG5's are to be tied together as shown, it is essential that they be well by-passed, to prevent interchannel coupling through the cathodes. Since the screens operate at the same voltage as the plate, the decoupling filter R_{16}–C_{11} provides sufficient bypassing for the screens.

The second or mixer stage is a standard hi-mu triode with the two units in the tube operating independently. The essential difference is in the grid circuit. When the two stages are isolated, R_8 and R_9 have no function in their respective circuits other than to maintain a fixed minimum impedance in the grid circuit. However, when S_1 is closed, paralleling the grids of the 6J6, isolation resistors R_8 and R_9 are needed to prevent shorting out one input when the other is at minimum. Both grids receive the signal coming from the two input stages, and the signals are in phase through the rest of the amplifier. In later changes, a cathode coupled mixer stage was tried. This was accomplished by merely removing the cathode bypass, thus allowing the cathode potential to rise and fall with the signal. Since a signal on either grid will cause the cathode potential to change, any change will appear in both halves of the 6J6, and thus be amplified in both halves equally. However, the signal on the non-driven half will be out of phase with the driven half. This is of little consequence since the two outputs will not be feeding the same circuit. Another change in the grid circuit to eliminate the isolation resistors along with the modified cathode circuit are shown in *Fig.* 2, although this connection has a tendency to reduce bass at low settings of R_6 and R_7.

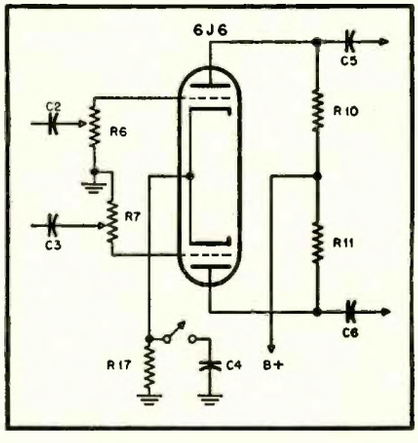

Fig. 2. Revised version of the second-stage mixer.

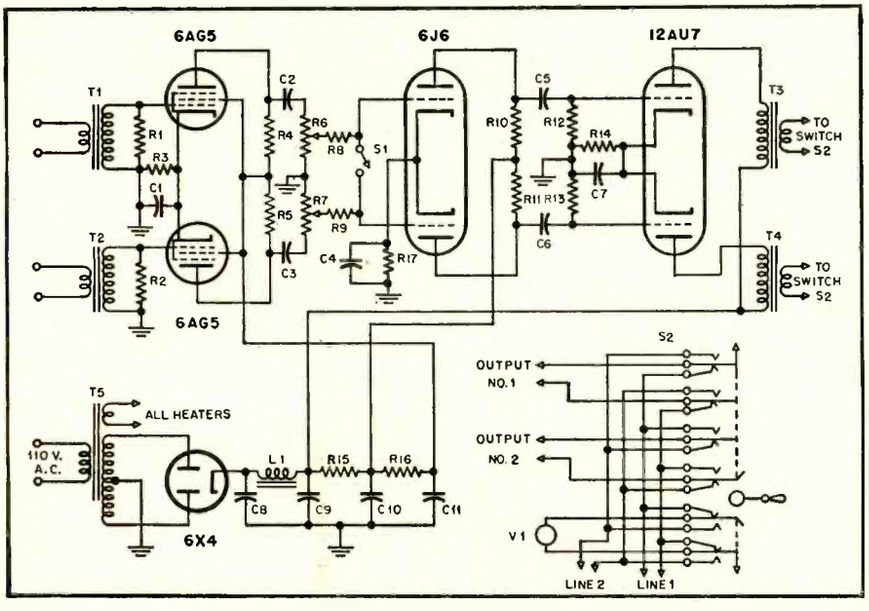

Fig. 1. Over-all schematic of twin-channel amplifier.

The two halves of the 12AU7 output stage operate independently into separate output transformers. The cathodes could have separate bias resistors if desired to insure complete circuit isolation, but sufficient bypassing will prove adequate and saves on parts. The heater of the 12AU7 is connected for 6-volt operation. The output windings are connected to the proper line through the operation of the locking-type key switch. In the

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normal position, Line 1 is connected to Output 1 and Line 2 is connected to Output 2. When operated to one position, the lines are reversed. The other throw of the switch connects the volume indicator, normally connected to Line 1, to Line 2. The volume indicator operates at a fixed level, although a variable resistor could easily be installed to vary the output signal over a small range.

Since the output of each channel is the same when operating with the channels tied together, it may be desirable to install a master control for each output. This can be put after S_1, in the grid circuit of each channel. This will allow free mixing of the input channels, and still give independent control of output level. When feeding a P.A. from one channel, this would help to prevent feedback while maintaining level on the broadcast circuit. In the power supply, the circuit shown in *Fig.* 1 is the one included in a second model of this amplifier that was built. Although the original operated well, it was felt that it did not have the gain necessary for all applications. The first model has a transformerless supply for the plate voltage, and uses a single-section selenium rectifier. The output from this arrangement is only about 120 volts, and did not provide the power necessary for long-line operation. A small transformer was mounted under the chassis for the filament supply and no hum was encountered with this arrangement. In the second model, the power transformer introduced some hum, but it was reduced to almost zero by putting it in its own shield can and mounting it at the side of the chassis next to the output transformers.

In the original model, the intent was to keep the size down to a minimum. Two 12AX7's were used in the first two stages, and a 12AU7 in the output. The gain of this unit was only about 50 db, and the output was quite low, but in its original use, the lines were quiet and short, so no trouble was encountered. This might be sufficient if the unit were to be used in a small town. The chassis was 3 in. wide, 12 in. long and 2 in. deep, and was mounted in a $3\frac{1}{2} \times 6 \times 12$ cabinet with a hinged top. The leads to the two gain controls were brought out from the chassis in shielded leads, and mounted on the front of the cabinet. It is desirable to keep the controls close to the paralleling switch S_1 to prevent stray pickup. The original model did not need any extra shielding around S_1, but it would not do any harm to include it, lest one get caught with a pickup in a location with high electrical noise.

While this unit is admittedly designed primarily for a specific application, so much use has been made of it that it was felt that other stations may have had similar problems. It is presented therefore, not with the intention of establishing a policy of operation for a station, but merely as a suggestion as to the possibilities of deviating from standard practice to accomplish a specific problem.

Parts List

C_1, C_4	1.0 μf, paper
C_2, C_3, C_5, C_6	.01 μf, mica
C_7	100 μf, 15 v. electrolytic
C_8	40 μf, 450 v. electrolytic
C_9	20 μf, 350 v. electrolytic
C_{10}, C_{11}	10 μf, 350 v. electrolytic
L_1	8 Hy, 50-ma, a.c./d.c. choke
R_1, R_2, R_8, R_9 R_{12}, R_{13}	0.47 meg, ½ watt
R_3	180 ohms, ½ watt
R_4, R_5	0.1 meg, ½ watt
R_6, R_7	0.5-meg potentiometer, audio taper
R_{10}, R_{11}	15,000 ohms, ½ watt
R_{14}	390 ohms, ½ watt
R_{15}	3300 ohms, 1 watt
R_{16}	2200 ohms, 1 watt
R_{17}	51 ohms, ½ watt
S_1	SPST toggle switch
S_2	4PDT and DPDT locking-type telephone key
T_1, T_2	Microphone to grid, miniature type input transformer
T_3, T_4	Plate to line, miniature type output transformer, 20,000 ohms to 600/150
T_5	350-0-350 v. at 50 ma; 6.3 v. at 2 amps.