CHAPTER 12

Audio Frequency Mixing Systems

Simple mixing devices — Series and parallel arrangements — T attenuators — Bridge circuit — Common plate load for two valves — Means for preventing loading of one stage by the plate resistance of the other — Use of pentode valves — Complete mixing systems.

In studio equipment, it is generally necessary to provide some convenient method of changing the source of input. The simplest method is to use a change-over switch (Fig. 1), which may have as many contacts as desired. Rotating such a switch, however, gives rise to voltage surges, which if not injurious to the output valves, at least cause objectionable "thumps" in the reproduction. Hence it is usually necessary to insert a volume control after the switch, which may be turned down during the change-over.

When it is desired to "mix" the inputs in controllable proportions, more complicated circuits become necessary.

The simple series mixer of Fig. 2 has three serious drawbacks. (a) Both sides of input B are above earth. (b) Stray capacitances to earth of channel B tend to by-pass the high frequencies of channel A. (c) Any hum picked up in channel B is fed without appreciable attenuation to the following grid. With care the system may be made to give reasonable results, but is limited in its usefulness.

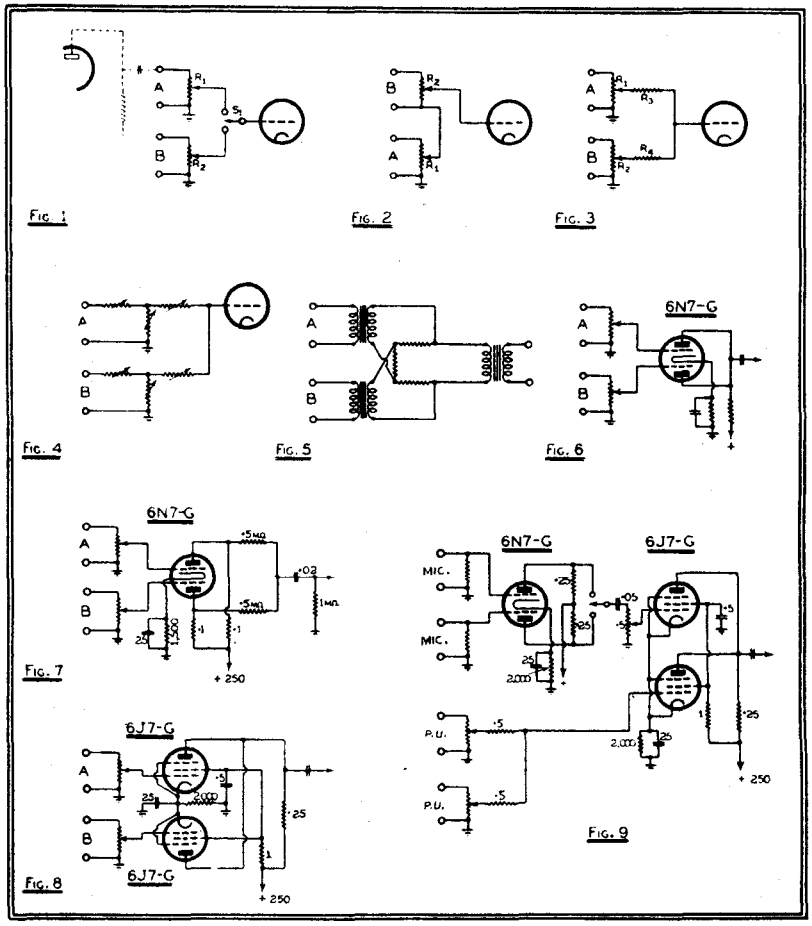
A more satisfactory circuit is shown in Fig. 3. The inputs are really in parallel and one side of each is returned directly to earth. The series resistors R_3 and R_4 prevent either control short-circuiting the other. Too low a value will reduce their effectiveness. The upper limit is set both by the maximum permissible grid resistance and the input capacitance of the following valve.

For very high-Mu triodes, such as type 75, which have a comparatively large input capacitance, attenuation at high audio frequencies becomes serious if R_3 and R_4 exceed 0.25 megohm. For most other valves, 0.5 megohm may be considered a practical limit.

If R_3 and R_4 be each 0.5 megohm, then the potentiometers R_1 and R_2 may have any values up to 0.5 megohm, which is the correct load for high impedance or crystal pick-ups. Under these conditions the maximum loss is 6 db.

Figs. 4 and 5 show two methods widely used in communication engineering. The first uses a pair of T-attenuators, which provide constant input and output impedances for all settings. The second is a bridge circuit. Both circuits are intended for use with low impedance lines, and are too costly for the average experimenter.

Possibly **the most satisfactory arrangement** is to feed the two inputs to the grids of two valves which have a common plate load. In this way the input circuits are quite isolated and the setting of one control can have no effect on the other.



Figures 1 to 9, inclusive

Fig. 6 shows the simplest possible arrangement, using a 6N7-G twin triode valve. It is obvious that the plate resistance of the two sections are in parallel, so that each triode works into an A.C. load less than its own plate resistance. Under such conditions the voltage output for a given percentage of distortion is seriously limited.

The effect is greatly reduced by the insertion of isolating resistors as in Fig. 7. With this arrangement a stage gain of 10 may be obtained with a peak voltage output capability of 35 volts.

The performance of such a mixer may still further be improved by replacing the two triode units with a pair of pentodes. The plate resistance of Radiotron 6J7-G as a resistance coupled amplifier is in the order of 3

megohms, so that the isolating resistors of Fig. 7 are not necessary, and very nearly the full gain of the pentode stage may be realised. With the circuit as Fig. 8 the stage gain will be 120, with a peak voltage output of approximately 45 volts. Omission of the cathode by-pass condenser reduces the gain by one-half, but improves the linearity of the stage.

In any mixing system it is desirable that the input voltages to all channels be as nearly equal as possible, so that similar settings of the controls will produce similar output voltages. Hence where the output from a pick-up is to be mixed with that of a low-level microphone, it will generally be desirable to incorporate one stage of amplification between the microphone and the mixer stage to raise its level to that of the pick-up (cf. **Fig. 1**).

Fig. 9 illustrates a fairly large mixing system which provides adequate control of two microphones and two pick-ups and has sufficient gain to provide from them an output of about 30 volts. Note that no controls have been used in the grid circuits of the 6N7-G, since the low level microphones can never overload that valve.

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