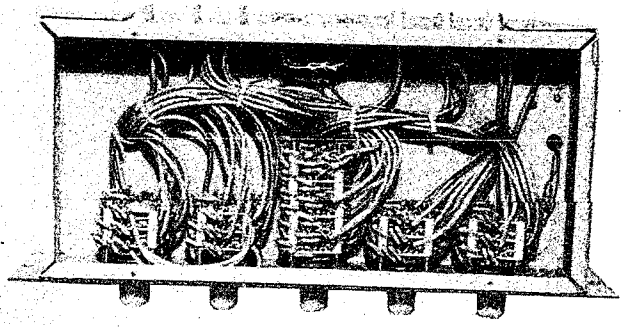

Fig. 9—Bottom view showing ganged tone switches with 1 percent metal film resistors.

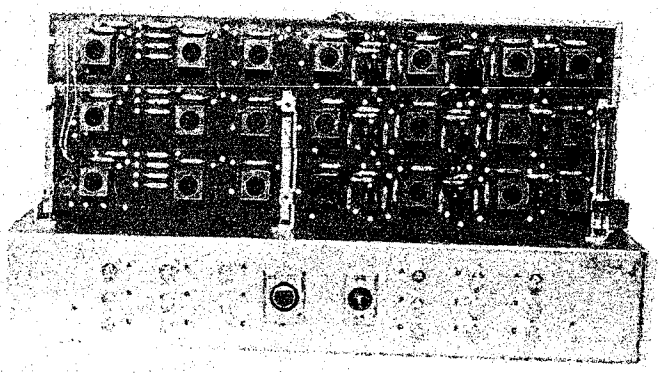

Fig. 11—Rear view showing 21 a.c. operational amplifier modules.

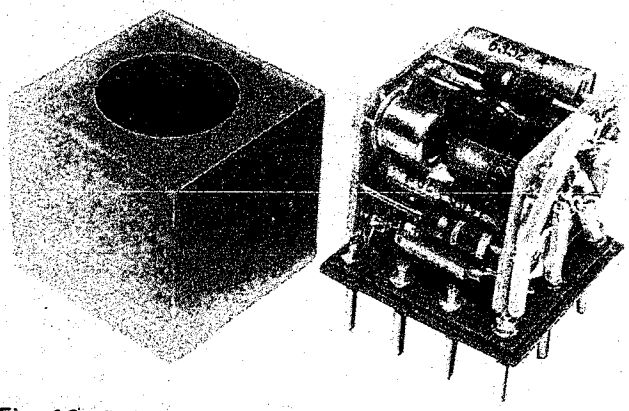

Fig. 12—The a.c. operational amplifier module.

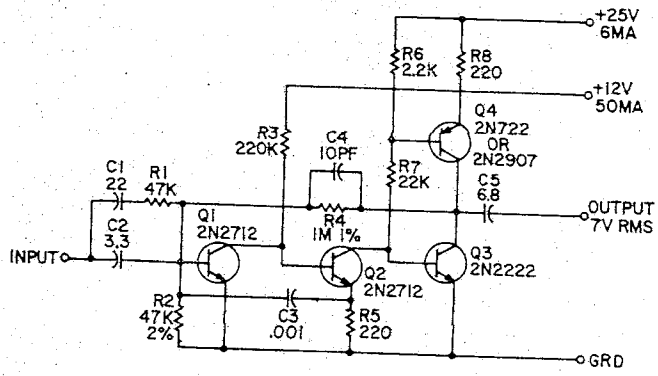

Fig. 13—AC operational amplifier schematic.

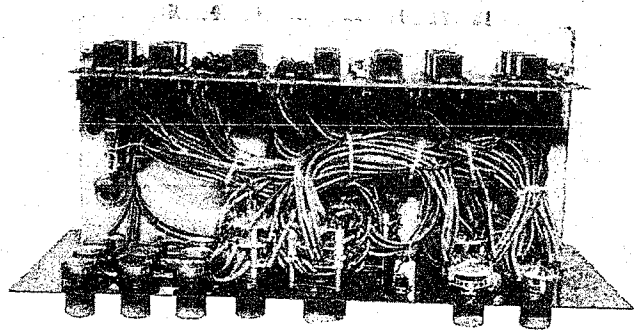

Fig. 10—Top view showing shielded wire bundle.

control is particularly useful in placing the apparent position of a soloist at the center speaker.

In the author's sound system, there are actually five speaker systems, two for the left, two for the right and one for the center. Because of the tendency to exaggerate the stereo effect, it is frequently necessary to partially blend the two outer channels using the 2-CHANNEL SEPARATION control R421 and R621, which is a pair of ganged potentiometers. On the other hand, there is some program material which exhibits very little stereo effect and benefits from exaggeration. For this material, the separation control can be turned in the opposite direction to blend the two outer channels together in opposite phase. Generally, when opposite phase blending is used, it has been found desirable to increase the level of the center channel. When turning the 2-CHANNEL SEPARATION control from one extreme to the other, the effect on the spread of the sound image can be rather dramatic.

Construction

The construction of the main chassis and printed circuit board are shown in Figs. 9, 10, and 11. The system contains no internal power supply except for a current source Q701 and shunt regulator PS701, Fig. 2. This avoids hum pickup from the magnetic field of the power transformer. Shunt regulation maintains a constant signal-free current in the power supply leads and allows a common supply to be used for many pieces of equipment without interaction due to the power supply impedance. All the internal wiring is shielded to prevent crosstalk between channels which is between -65 and -85 dB at 2 kHz. The system involves a total of 750 1-percent resistors, 21 a.c. operational amplifier modules, and 1 shunt regulator.

The A.C. Operational Amplifier

The a.c. operational amplifier module, shown in Fig. 12 and schematically in Fig. 13, provides the tremendous feedback needed to attain the measured 0.003 percent total harmonic distortion through the entire system at 400 Hz. Because the module delivers full output of 7V rms within 1 dB from 10 Hz to 500 kHz, distortion at frequencies as high as 10 kHz is below the measuring equipment limit of 0.025 percent. A most unusual feature of this operational amplifier, in contrast with *the many discrete* component and integrated types on the market today, is that this one contains input and output coupling capacitors plus an internal 1M feedback resistor, R4. These internal coupling capacitors greatly simplify the stereo control system printed circuit board layout and construction, as well as the schematic. The circuit also incorporates a damping network R1 and C1 as part of the input coupling circuit to eliminate low frequency ringing due to feedback around two coupling capacitors when the operational amplifier is connected in any of the feedback configurations in the stereo control system.

Although this operational amplifier was designed in 1963, and