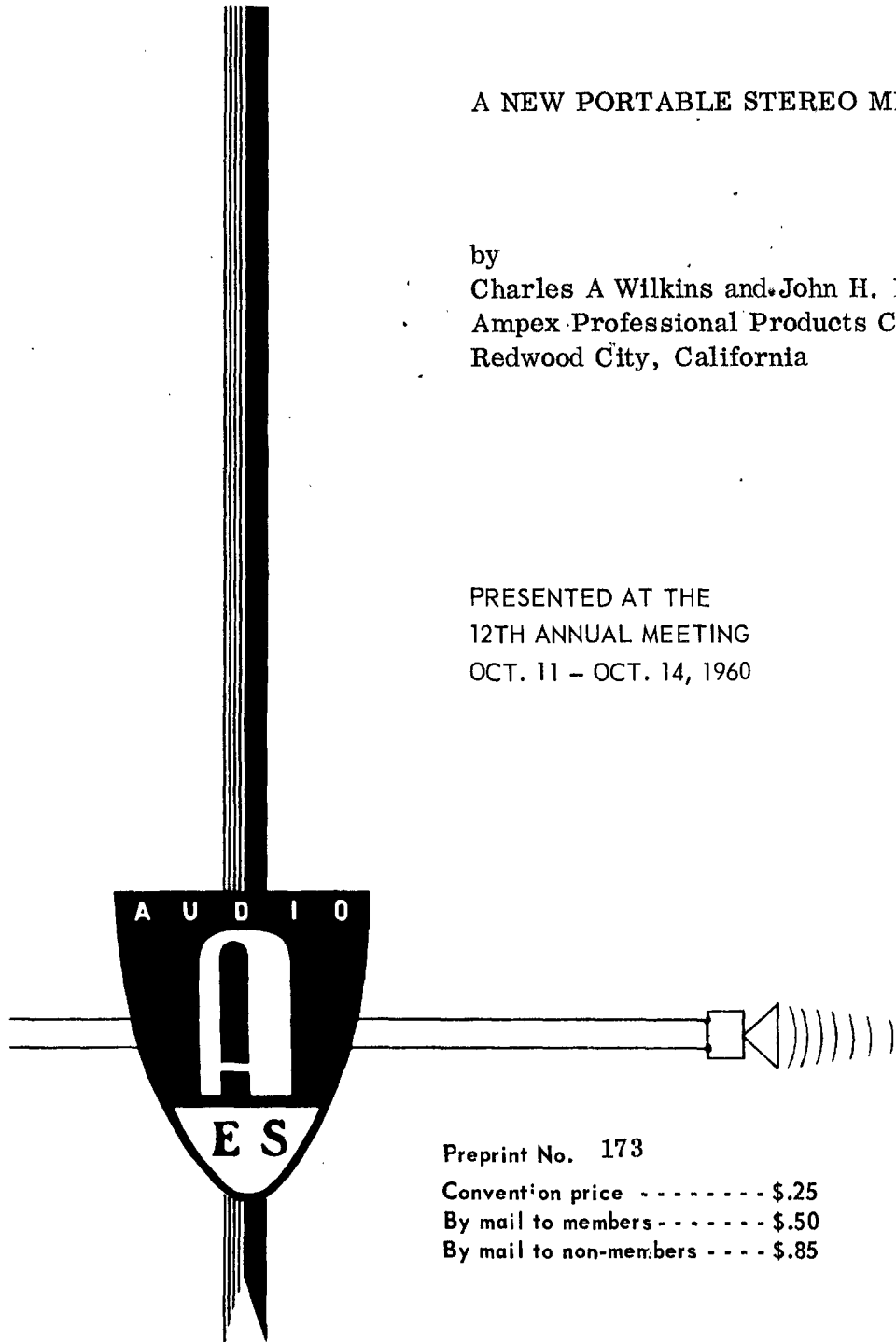


A NEW PORTABLE STEREO MIXER

by  
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Redwood City, California

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## A NEW PORTABLE STEREO MIXER.

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Ampex Professional Products Company.

### INTRODUCTION

As an answer to the growing need for a versatile input system of professional quality for portable as well as small studio use, the MX-10 and MX-35 mixer series were designed. The two models are electrically identical and differ only in front panel styling. Model MX-10 is shown in Figure 1. Six input positions (or stations) can be accommodated, four for low impedance microphone and two for line input. As many as four of the input positions can be used and mixed simultaneously with levels adjustable by four mixer controls. Four front panel key switches allow any of the four input positions to feed either or both of the two output channels. Two other key switches on the front panel permit choosing either microphone or line input for two of the input positions. A Master Gain control permits simultaneous adjustment of signal levels from both channels.

The apparent complexity may best be clarified by examining the system block diagram of Figure 2, in which the salient operational features and signal paths are shown. The mixer assembly consists of a single chassis on which is contained four separate microphone preamplifiers, two separate program (or output) amplifiers, and a semiconductor power supply. Balanced line bridging can be accommodated by use of accessory plug-in transformers.

### MICROPHONE PREAMPLIFIERS

Operation of the four preamplifiers is identical and the circuit shown in Figure 3 is conventional in most aspects. Considerations of the ability to accept high input levels before overload, together with uniformly low noise led to the choice of tube type 6267/EF86 in triode connection. The input transformer is designed to operate from a 200 ohm source impedance and incorporates a Faraday shield between primary and secondary windings to reject RF. Further RF rejection is obtained by the low pass filter formed by isolation resistor R1 in conjunction with the capacitive input admittance of the tube. The isolation resistor serves the additional function of preventing the tube input capacitance from seriously affecting the high frequency response of the transformer within the audio range.

A well filtered dc supply powers all tube heaters but the additional precaution of heavy cathode bypassing precludes introduction of residual hum components. The noise spectrum analysis is shown in Figure 4 in terms of equivalent noise referred to the input. Second and third harmonic distortion components as functions of input level for both 30 and 500 cycles are shown in Figure 5.

## MIXING CIRCUIT

Performance considerations to be met in the design of the mixing circuit were:-

1. The allowable crosstalk produced by resistive paths between the two output channels shall not exceed -40 db under the worst condition of control settings.
2. Interaction of controls and interaction of transfer key switches shall not exceed  $\frac{1}{2}$  db.
3. Input positions must be transferable between feeding one channel and feeding both channels without either signal drop-out or a rise of more than  $\frac{1}{2}$  db in level occurring between positions.

An examination of the complete schematic, Figure 6, will show that a resistive crosstalk path can occur through the Mixer potentiometers. The maximum introduced through each control will occur when the resistance at the slider of the potentiometer is maximum. Since the resistance exhibited by the plate circuit of the preamplifier stage is approximately 3000 ohms, the condition of maximum resistive path occurs when a slider is set to approximately center resistance. At this point, which is 6 db down from maximum level, the driving point resistance is 50K in parallel with 50K or 25K. Three such resistive paths can occur when one position feeds one output channel and the remaining three positions feed both output channels. The value of the mixer resistors was chosen to be 330K each so that the maximum resistive crosstalk will be no greater than -40 db when the controls of the three positions feeding both channels are 6 db less than maximum level. It is easy to see that this particular set of conditions will almost never be met during normal operation.

The choice of parameters together with the use of non-shorting transfer switches, assures meeting both of the other criteria.

## PROGRAM AMPLIFIER

Operation of the two program amplifiers is identical. As shown in Figure 7, each consists of a pentode amplifier directly coupled to a cathode follower. Considerations of noise, gain, and minimizing tube type complement again lead to use of type 6267/EF86 for the pentode. A single 12AU7 serves for two cathode followers, one for each amplifier. The cathode resistor of the cathode follower is interlocked to ground through pentode shield pins 2 and 7 to prevent damage when the pentode is removed from its socket while power is on. For added reliability and compensation for tube aging, the dc voltage for the screen grid is derived from the cathode of the cathode follower through

dropping resistor R46. The dc negative feedback loop established by this means stabilizes tube operating points. Since the screen is bypassed to cathode by C14, the feedback is effective only at dc and at sub-audible frequencies. A non-operational gain adjustment, R32, of limited range is provided on the chassis for use in balancing output levels within certain limits as needed. This control provides a range of  $\pm 10$  db from nominal gain by adjusting the amount of negative feedback from the output of the cathode follower to the control grid of the pentode. By using this means to adjust output stage gain, the equivalent noise resistance of the mixing network becomes a direct function of the amplification following it and the equivalent noise referred to the pentode grid remains constant over the range of the control. Additionally, the gain to a signal introduced at the pentode cathode is also determined by setting of this control in the same manner as for a grid introduced signal. This makes the cathode a suitable point for injecting a signal from the output stage of another mixer assembly for "coupled" operation and at the same time preserves signal phase relationships. The noise spectrum analysis with Master Gain control at maximum is referred to 1 volt output in Figure 8, and the second and third harmonic distortion products as functions of the output level for both 30 and 500 cycles are shown in Figure 9, as functions of the output level in volts.

#### MIXER COUPLING

For each output channel, the Mixer Couple switch S7 located on the back panel can transfer the output of the cathode follower from the Master Gain control to an attenuator resistor that connects to the Coupled Mixer Output terminal on the rear panel terminal board. When this terminal is connected to the Couple Mixer Input terminal on a similar terminal board of a second mixer assembly, the signal from the first mixer assembly output is fed to the pentode cathode of the counterpart output stage in the second assembly. The cathode resistor of the second assembly in conjunction with the attenuator resistor in the first attenuates the signal from the first by an amount equal to the maximum output stage gain of the first (approximately 24 db). As many mixers may be coupled to provide extended facilities as desired but since an approximately 3 db decrease in signal-to-noise occurs with each linkage it is recommended for most professional applications that the number used in this manner be limited to four. The "Mixer Couple" switches of all but the last mixer in such a chain will be in "Mixer Couple" position, thereby all Master Gain controls and output connectors are disabled except the last in the chain. Here, the switch is kept in "Single Mixer Normal" position and its Master Gain control serves the entire system. The signal aggregate of the composite system will be available at two output connectors of the last mixer in the chain.

## EQUIPMENT APPLICATIONS

The Mixer Assembly is a complete, compact, and highly flexible speech input system that should find a great number of applications in the tape recording, small studio, and sound reinforcing fields. Its size (5-7/32 in. H, 19 in. L, and 5-3/16 in. D for 5-1/4 in. rack space) and weight make it suitable for portable as well as studio use. In the tape recording field, when used with a professional quality recorder such as the new Ampex PR-10 series, applications include:-

The recording of live program material, both stereophonic and monophonic; and the dubbing of live program material over previously recorded material, both stereophonic and monophonic. In the sound reinforcing field, the mixer can be used to reliable advantage in plant paging, public address, and music distribution installations because of its great flexibility in switching and channel combinations. The illustrations of Figure 10 show some of the basic applications. These applications have considered only one mixer assembly and only one or two channel operation. Still considering one or two channel operation: up to four mixer assemblies can be "coupled" together to provide as many as sixteen microphone positions and eight line positions. Further, as many mixers as required may be "stacked" together (without coupling) to provide additional output channels (two mixer assemblies will provide four output channels). Finally, mixer assemblies may be both "coupled" and "stacked" in almost any required combination. These are the basic applications. The many variations possible are limited only by the imagination and skill of the user.



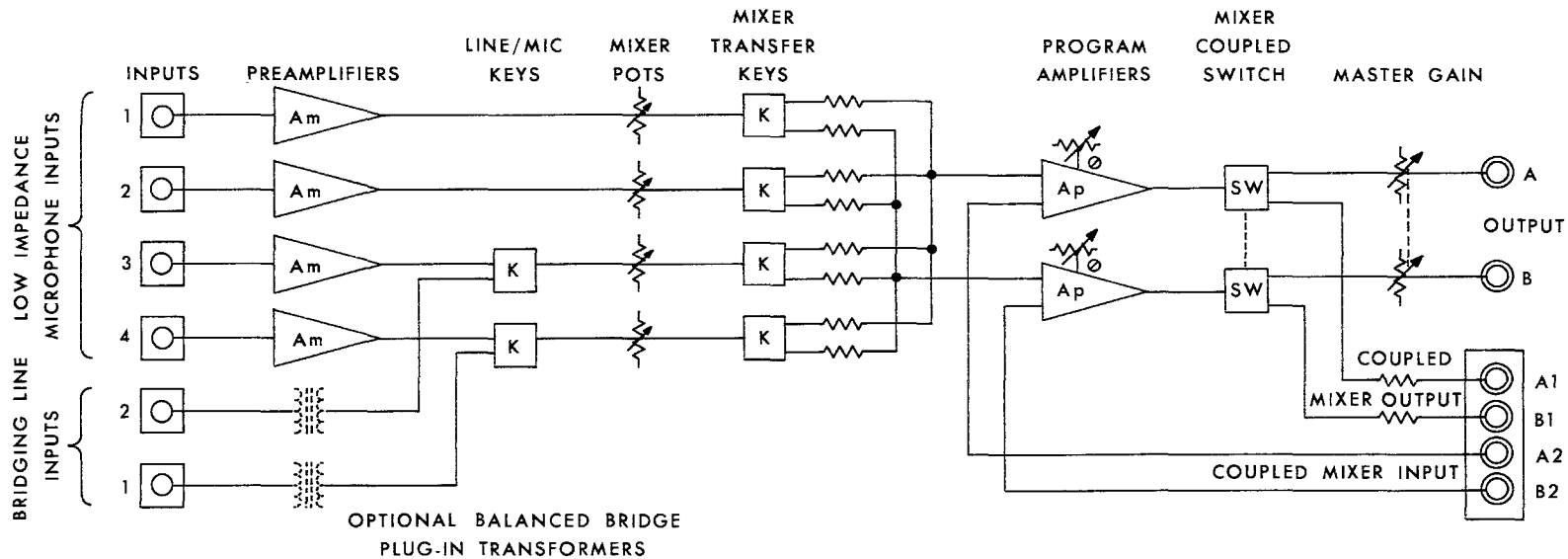


FIG. 2 SYSTEM BLOCK DIAGRAM

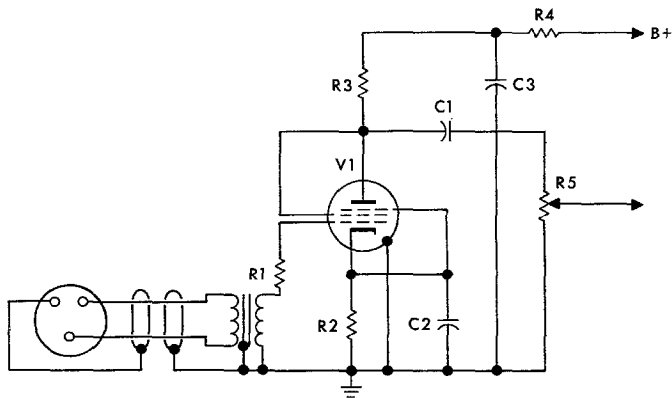
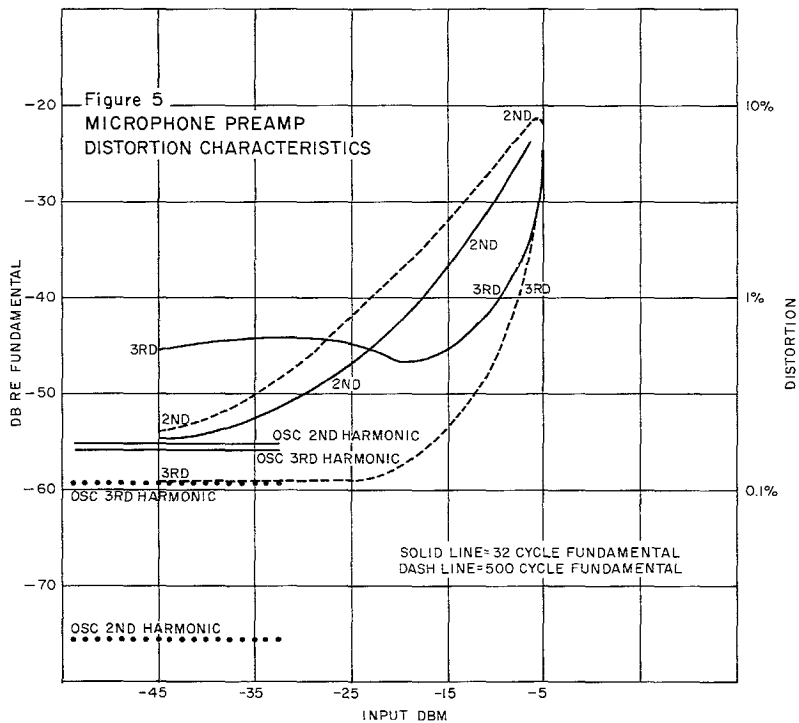
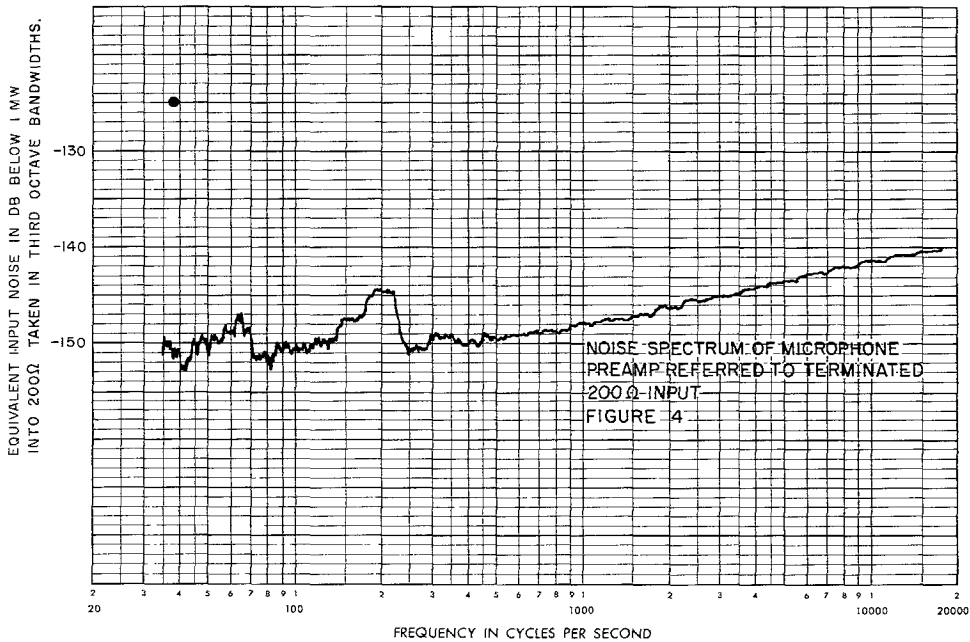
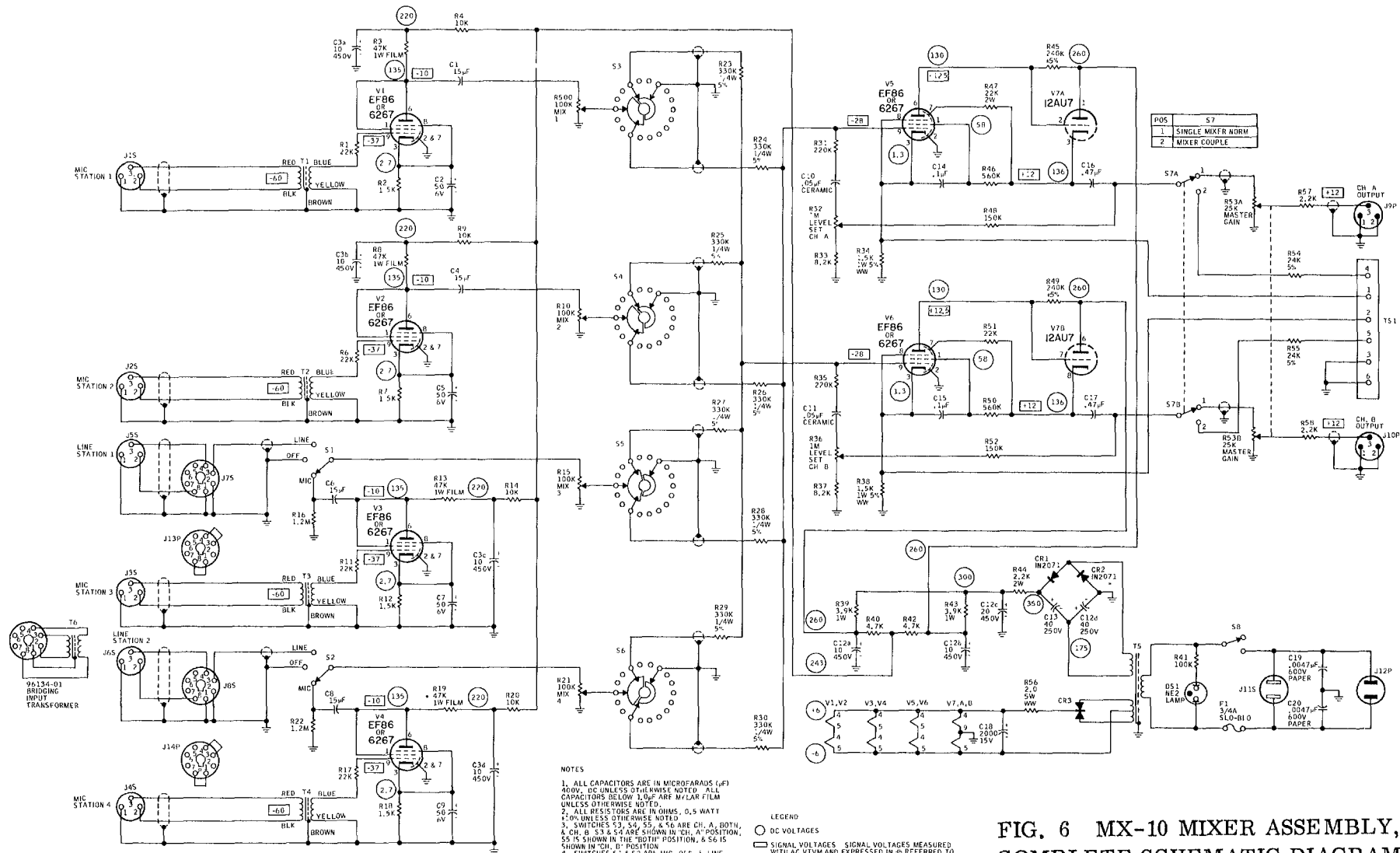


FIG. 3 MICROPHONE PREAMPLIFIER,  
PARTIAL SCHEMATIC DIAGRAM





**FIG. 6 MX-10 MIXER ASSEMBLY, COMPLETE SCHEMATIC DIAGRAM**

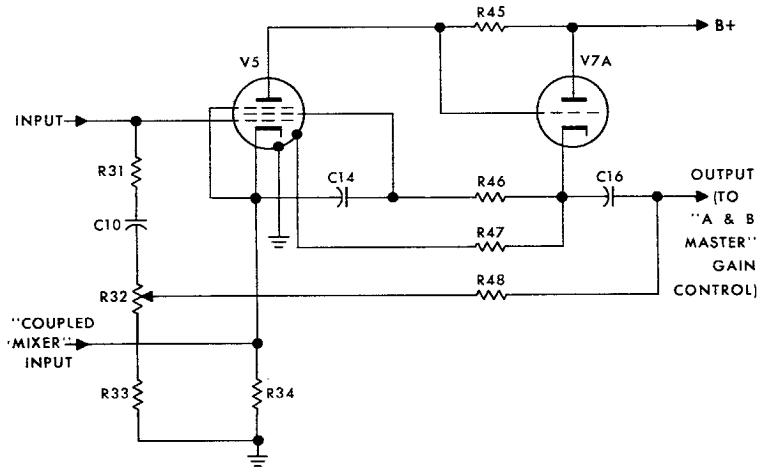
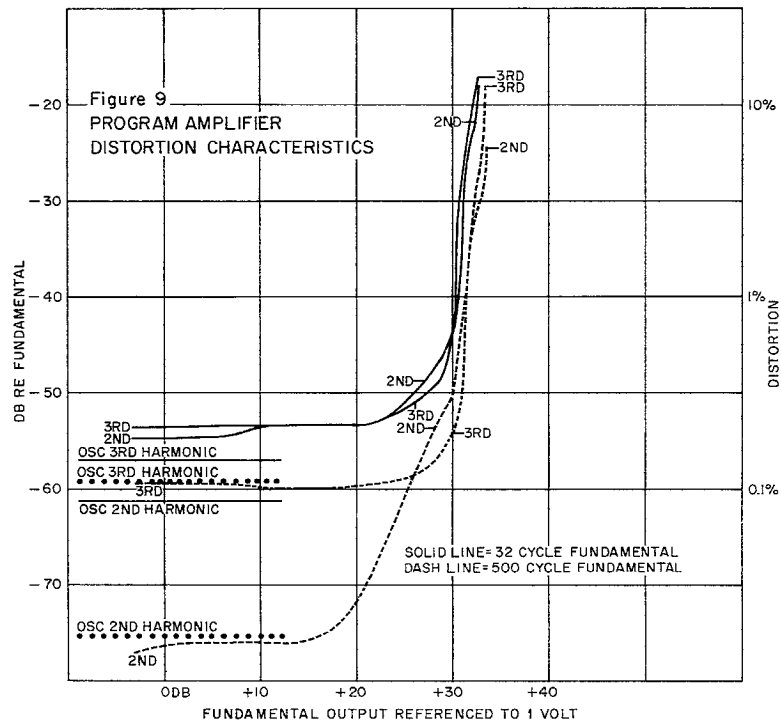
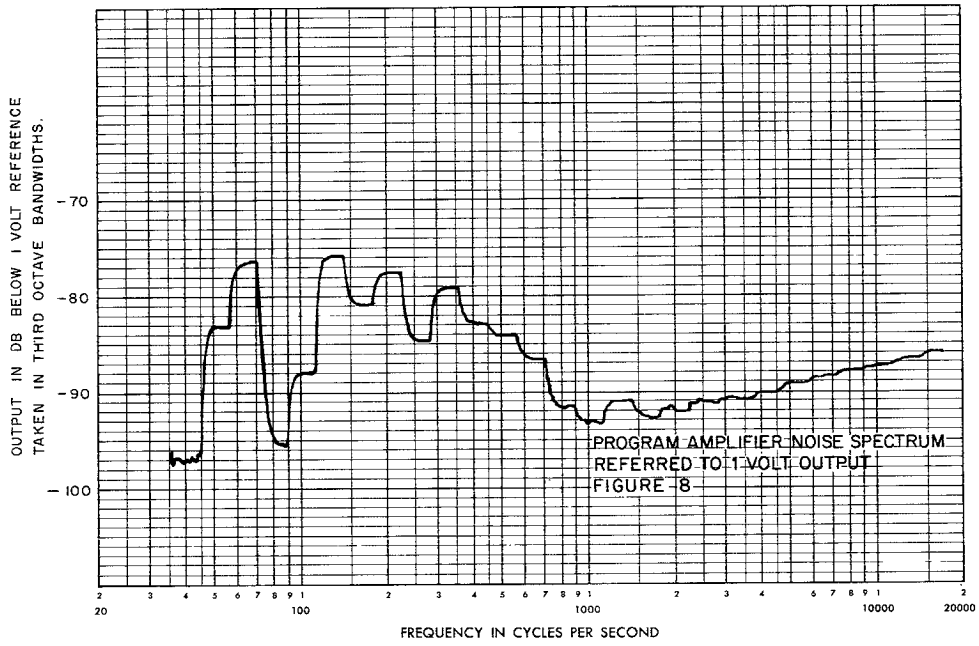
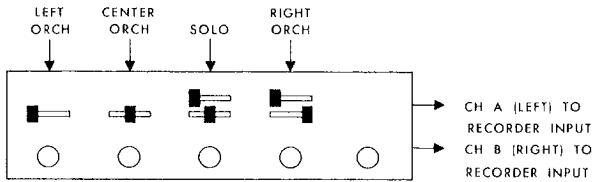


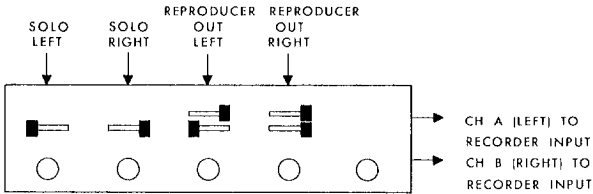
FIG. 7 PROGRAM AMPLIFIER, PARTIAL SCHEMATIC DIAGRAM



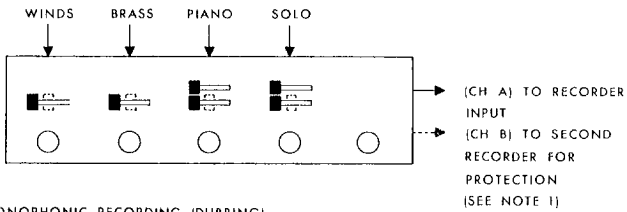
STEREO RECORDING (LIVE)



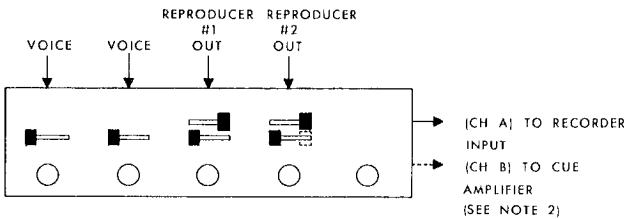
STEREO RECORDING (DUBBING)



MONOPHONIC RECORDING (LIVE)



MONOPHONIC RECORDING (DUBBING)



NOTES:

1. IF A SECOND "PROTECTION" RECORDING IS DESIRED, THE "CH A-BOTH-CH B" SWITCHES SHOULD BE IN THE "BOTH" POSITION
2. REPRODUCER #2 CAN BE "CUED" WHILE RECORDING FROM OTHER INPUTS BY SWITCHING "CH A-BOTH-CH B" SWITCH TO "CH B"

FIG. 10 TYPICAL USES OF THE MIXER