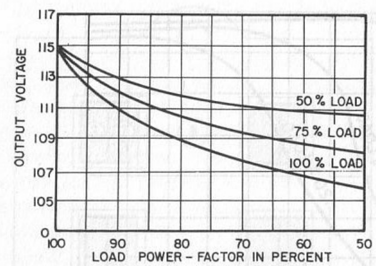

Fig. 8.101. Output voltage change versus load power-factor for Sola constant-voltage transformer.

installed at least 50 to 100 feet distant from amplifier equipment having a considerable amount of gain. This is particularly true for photocell and microphone preamplifiers. Magnetic recording and reproducing equipment due to its nature should not be placed within less than 50 feet of such transformers, and further if practical. Voltage measurements at the load side must be made using a dynamometer type voltmeter. If the voltage is measured using a rectifier or vacuum tube voltmeter, the reading may vary anywhere from 120 to 127 volts for an actual voltage of 115 volts.

The change in output voltage resulting from a resistive load is usually small, running to less than one per cent. The power-factor will cause the output voltage to vary from the normal rating of the transformer if the load circuit has a power-factor other than that specified on the transformer data plate. Load regulation will also be relatively greater as the inductive load power-factor is decreased. Typical power-factor curves for the Sola constant-voltage transformer are shown in Fig. 8.101. Because of the design of a constant-voltage transformer, changes in the frequency of the supply voltage will be directly reflected in the output voltage. A change of approximately 1.8% in output voltage will occur for every 1% change of frequency, and in the direction of the frequency change.

8.102 *Can Constant-voltage Transformers Be Connected in Tandem to Improve Regulation?*—Yes, however, when two units are connected in tandem, the output of the second unit will show little or no detectable change arising from supply line variations up to about 15%. Cascade or tandem operation is recommended for special applications where the regulation must be in the region of 0.25%.

8.103 *Can Constant-voltage Transformers Be Connected in Parallel?*—If the transformers are of the same voltage rating and capacity, the primaries or secondaries may be connected in parallel to obtain a greater power output. However, regulation may suffer.

8.104 *How May Three Variacs Be Connected for Three-phase Operation?*—As shown in Fig. 8.104. Connected as shown, the load capability of each individual Variac is increased three times its normal load capacity, due to the fact that each Variac carries only one-third of the load. The three individual Variacs are mechanically connected by a common shaft for rotation. The over-voltage connections should not be used for this type of operation. (See Question 22.121 under Test Equipment.)

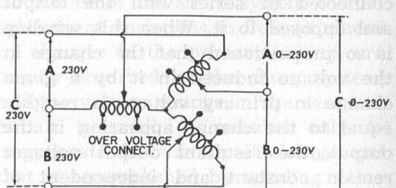

Fig. 8.104. Three 115/135 volt Variacs connected for the over-voltage connection should not be used on lines of 230 volts. However, the over-voltage connection may be used on a 208-volt four-wire circuit.

REFERENCES

8.100 "The Sola Constant Voltage Transformer, Theory of Design and Operation," Sola Electric Co. 1954.
8.101 Same as above.
8.102 Same as above.
8.103 Same as above.

Section 9

SOUND MIXERS

9.1 *What Is a Sound Mixer?*—A resistive network designed to provide a means of combining several separate audio signal sources into one composite signal. The signal sources may consist of dialogue, music, and sound effects. The sources of signal may be from a broadcast line, optical or magnetic film sound tracks, records, a live pickup, or any combination of these sources.

The network is designed so that changing the level of any one of the individual signal sources has no effect on the level or frequency characteristics of the other signal sources in the network. For broadcasting and recording purposes, at least ten positions are required. For recording purposes, equalizers, filters, and other devices are included in the mixer console but do not form a part of the mixer network. A mixer console designed for broadcast use is shown in Fig. 9.1.

9.2 *What Is Low-level Mixing?*—A mixing network similar to that shown in Fig. 9.2 which uses no amplification between the signal source and the mixer control. The signal-to-noise ratio is low for this system and it is not used in professional installations. This method of mixing is now obsolete.

9.3 *What Is High-level Mixing?*—A mixing network which uses a pre-amplifier between the signal source and the mixer control as shown in Fig. 9.3. The advantage of high level mixing is that the signal-to-noise ratio is increased in proportion to the gain of the preamplifier.

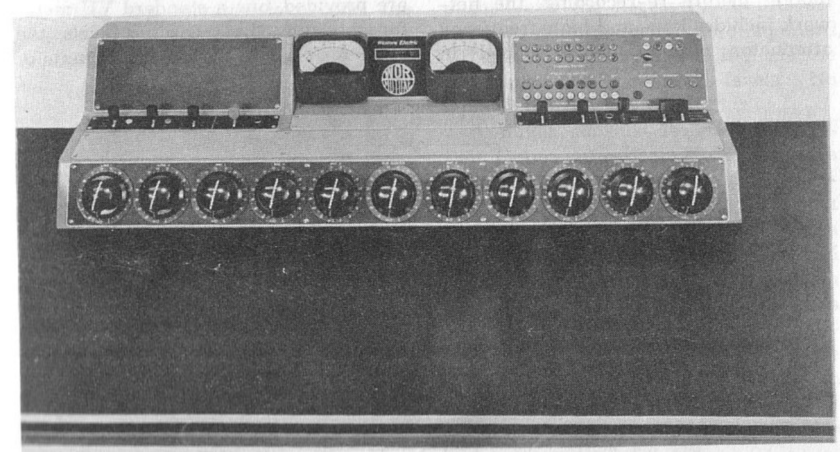

Fig. 9.1. An 8-position, Western Electric broadcast mixer console.

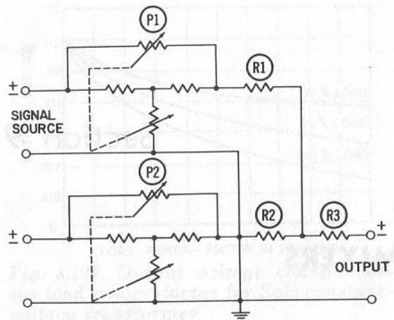

Fig. 9.2. Two-position low-level mixing network. Signal source is fed direct to mixer controls without amplification.

9.4 What Is the Gain of an Average Mixer-preamplifier?—About 40 db for broadcasting use and from 36 to 46 db for recording purposes. Generally, some equalization is included in the pre-amplifier circuits for recording. For broadcast use the system has a flat frequency response over the entire spectrum. Preamplifiers are discussed in Question 12.72 under Audio Amplifiers.

9.5 What Are the Principal Components of a Mixer Network?—A group of mixer controls, building-out resistors, a sub-master and master gain control for making over-all fade-outs, hybrid mixing coils, and booster amplifiers. In mixer networks designed for motion picture re-recording, the network includes low- and high-frequency attenuator circuits, as described in Questions 6.80 and 6.81 under Equalizers. Booster amplifiers are included to compensate for the loss of the sub- and over-all master controls. Jack fields, push buttons for setting the program up in advance, control circuits for switching on cue, a VU meter and its attenuator, as well as other equipment necessary for ready operation are also included.

For motion picture re-recording, at least 10 positions will be required. These are generally split up into groups, each group controlled by a sub-master control, with the sub-master controls combined into a master control. This type design is necessary for the control of multiple sound tracks.

9.6 Show the Construction of a Typical Broadcast Mixer Console.—Typical mixer consoles used for broadcast and motion picture re-recording are shown in Fig. 9.6A through D.

A mixer console designed by the Langevin Co. for small studio recording purposes is shown in Fig. 9.6A. At the left of the console are several jack strips. Below these are two controls for adjusting the level of incoming lines. At the right of the jacks are two controls, one for the control of signals sent into an echo chamber and the second for the control of the level of the slating microphone (not shown). Two meters are provided, one a standard VU meter for observing the recording levels, the other for checking the plate currents of the various amplifiers contained in the lower part of the console. A rotary switch in the center selects the proper circuit.

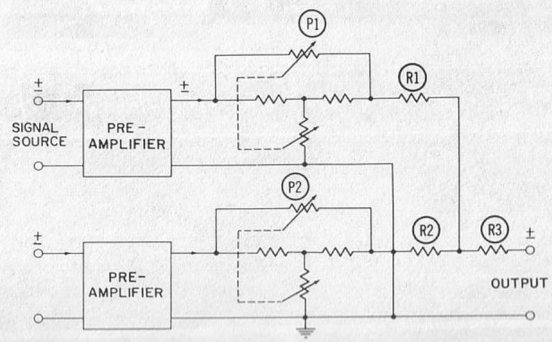

Fig. 9.3. Two-position high-level mixing network. Signal source is amplified then fed to the mixer control.

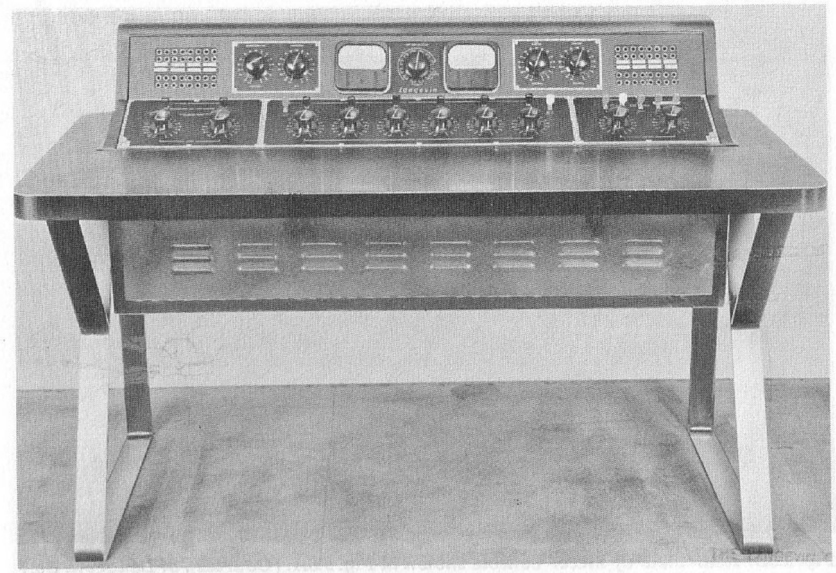

Fig. 9.6A. Small studio mixer console. (Courtesy of Langevin Co.)

In the center of the console is a six-position mixer network for the control of incoming program material. Between the second meter and the right-hand jack strips are two controls, one for adjusting the monitor level and the other is a sub-master. The two controls at the extreme right are both sub-masters as this is a split-mixer network. One control regulates the three right-hand pots and the other the three left-hand pots.

The rear of the mixer console is shown in Fig. 9.6B. To facilitate servicing, the mixer panel may be lifted, exposing the under side of the controls and key switches. The rear panel may be removed for servicing the preamplifiers. The table top is constructed from 10-ply wood and is supported on ¼-inch steel legs. The over-all frequency response is within 1 db from 30 to 16,000 cps. The preamplifiers have extremely low noise level and distortion.

A mixer console designed for broadcast station WOR by Western Electric was shown in Fig. 9.1. Eight mixer positions are provided with one sub-master, one over-all master, and one emergency master control. A push button preset circuit panel is shown at the upper right. Circuits may be pre-set and, on cue, a changeover button is pushed and the necessary circuits are switched automatically. Two standard VU meters are provided to indicate the incoming and program levels. No equalization is provided.

A mixer console designed for motion picture rerecording which uses a split-channel configuration (see Question 18.345) is shown in Fig. 9.6C. At the left is the usual jack field which permits the mixer pots, equalizers, and filters to be patched to any position desired. Several booster amplifiers, a compressor, and a background amplifier are contained in the console and are accessible at the rear of the cabinet. In the center of the console is a neon VI meter which is described in Question 10.7 under VU and Volume Indicator Meters. A copper oxide medium speed

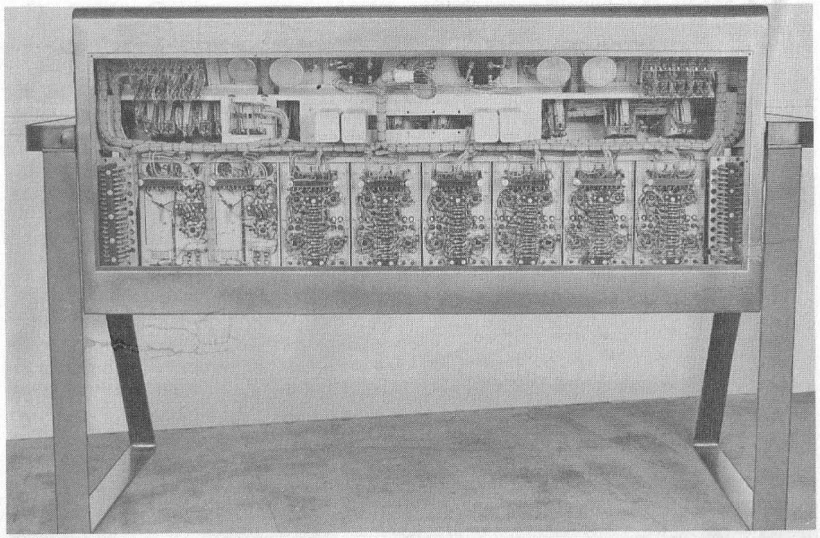

Fig. 9.6B. Rear view of mixer console shown in Fig. 9.6A. (Courtesy of Langevin Co.)

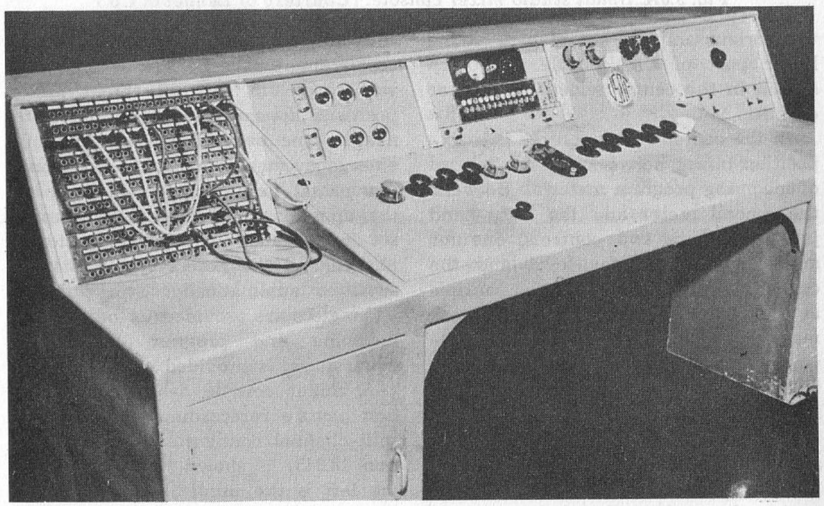

Fig. 9.6C. A 10-position, split channel motion picture rerecording mixer console. (Courtesy of USAF Lookout Mt. Lab.)

meter is used for lining up the channel before recording and for setting the compression amplifier ratio.

A 10-position music mixing console designed by Cinema Engineering for use in recording high quality magnetic tape and disc records is shown in Fig. 9.6D. The console contains 10 microphone inputs with individual high- and low-frequency equalizers in 8 of the 10 positions. Individual equalizers in each input permit equalization of separate groups of instruments. The microphone preamplifiers and associated

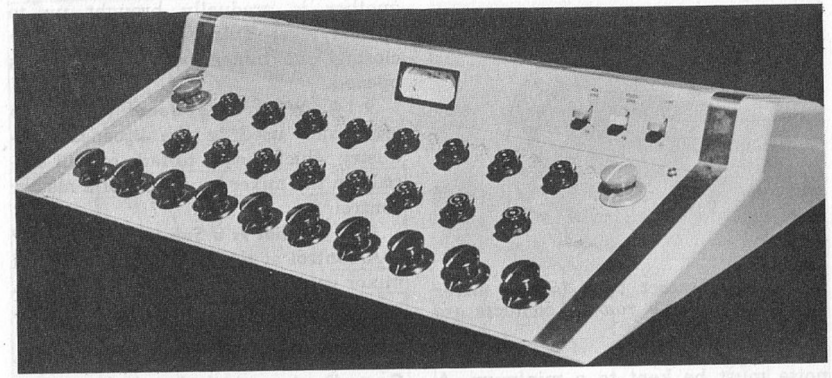

Fig. 9.6D. A 10-position music mixer with individual high- and low-frequency equalizers for music recording, manufactured by Cinema Engineering Co.

equipment are mounted in a standard relay rack apart from the console.

9.7 *What Type Mixer Controls Are Recommended for Rerecording Purposes?* —Ladder or bridged-T. The ladder type is preferred because it is continuously variable in fractions of a

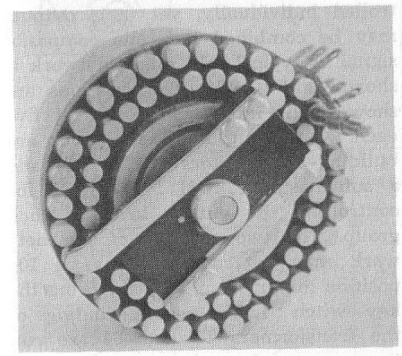

Fig. 9.7. Bridged "T" mixer control, showing the two rows of contacts.

decibel. However, many rerecording mixers are equipped with the bridged-T attenuator because of its simplicity. Bridged-T attenuators and ladder-type mixer controls are discussed in Questions 5.36 and 5.51, respectively, under Attenuators. A typical bridged-T pot is illustrated in Fig. 9.7.

9.8 *What Is a Ladder Pot?*—A variable attenuator based on a ladder configuration, as described in Question 5.51 under Attenuators. Ladder pots may be of the contact or continuously variable (slide wire) type. A typical slide-wire ladder pot is shown in Fig. 9.8A. It will be noted that only one contact is required and that it rides on the edge of a resistor card. Ladder pots

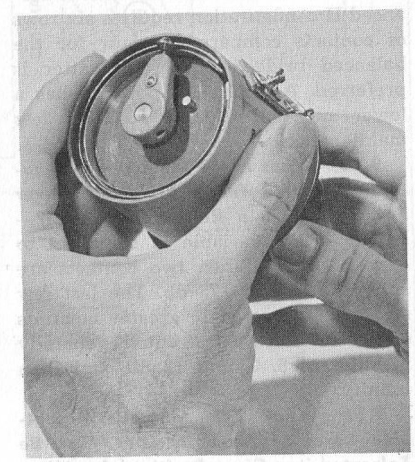

Fig. 9.8A. Slide-wire, ladder mixer control.

have a 6 db insertion loss, exclusive of the loss setting, which must be taken into consideration when designing a mixer network. In a ladder pot the contact noise is reduced in proportion to the loss setting which is an advantage in motion picture recording, because

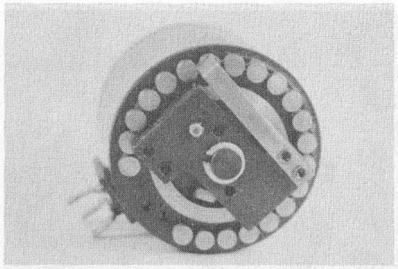

Fig. 9.8B. Contact type ladder mixer control. Only one row of contacts are required.

noise must be kept to a minimum. A contact type mixer control is shown in Fig. 9.8B.

9.9 *Are Balanced Configurations Used in Mixer-pot Design?*—Yes. In special cases balanced mixer pots are used. These are generally of the balanced bridged-T type as shown in Fig. 5.38 under Attenuators. Balanced H configurations may also be used; however, because of the cost and the fact a balanced H configuration requires six rows of contacts compared to four for the balanced bridged-T pot, the latter is preferred. A bridged-T pot also has a lower noise level and requires less maintenance.

9.10 *What Is the Maximum Attenuation Required for a Bridged-T Mixer Pot for Use in a Rerecording mixer?*—About 45 db, variable in steps not to exceed 1.5 db. When two contacts are split, the loss is 0.75 db. The last few steps are increased in greater amounts of loss to afford a fast cutoff, generally in steps of 6, 9, and 12 db, and then infinity.

9.11 *What Is the Minimum Acceptable Level of Leakage That May Be Tolerated in a Given Position of a Mixer Network?*—A minimum of 70 db. The leakage is measured at a frequency of 10,000 cps as shown in Question 23.67 under Audio Frequency Measurements.

9.12 *What Does the Term Fade Mean?*—To attenuate a signal slowly to infinity.

9.13 *What Is Cross-fading?*—The gradual attenuation of one signal as another is gradually brought up to normal level. This is accomplished by closing one mixer pot as another is opened.

9.14 *What Is a Board Fade?*—An expression used in the broadcast industry which means to fade out all signals on the mixer by means of a master control.

9.15 *What Is a Sub-master Control?*—A control at the output of a group of mixer controls such as a split mixer. A sub-master control affects only a particular group of controls.

9.16 *What Is an Over-all Master Control?*—A control that is located at the output of the mixer network for the purpose of controlling all of the mixer positions simultaneously.

9.17 *What Is a Grand Master Control?*—It is the same as an over-all master control.

9.18 *What Is a Split Mixer?*—A mixer network split into two or more sections whereby a given group, or groups, of mixer controls may be controlled individually, yet their outputs may be combined into one composite signal. A typical split mixer network is shown in Fig. 9.18. Ten positions are shown split into two groups of five each. At the output of each group are building-out resistors (R1 to R8) and a sub-master control P5 and P6 for controlling the output level of each group. The two sections of the network may be combined into a 10-position mixer or split by throwing the key switch S1. The output windings of the transformers T3 and T4 are run to separate channels or to a single recording channel. Fig. 18.344 under Optical Film Recording is a block diagram showing how split channels are used for the recording of an orchestra and choral group.

9.19 *What Is a Parallel-connected Mixer Network?*—A configuration in which the mixer pots are connected in parallel as shown in Fig. 9.19. It will be noted that the building-out resistors R1 through R4 are connected in series with the output of each mixer control and an extra one (R5) is located at

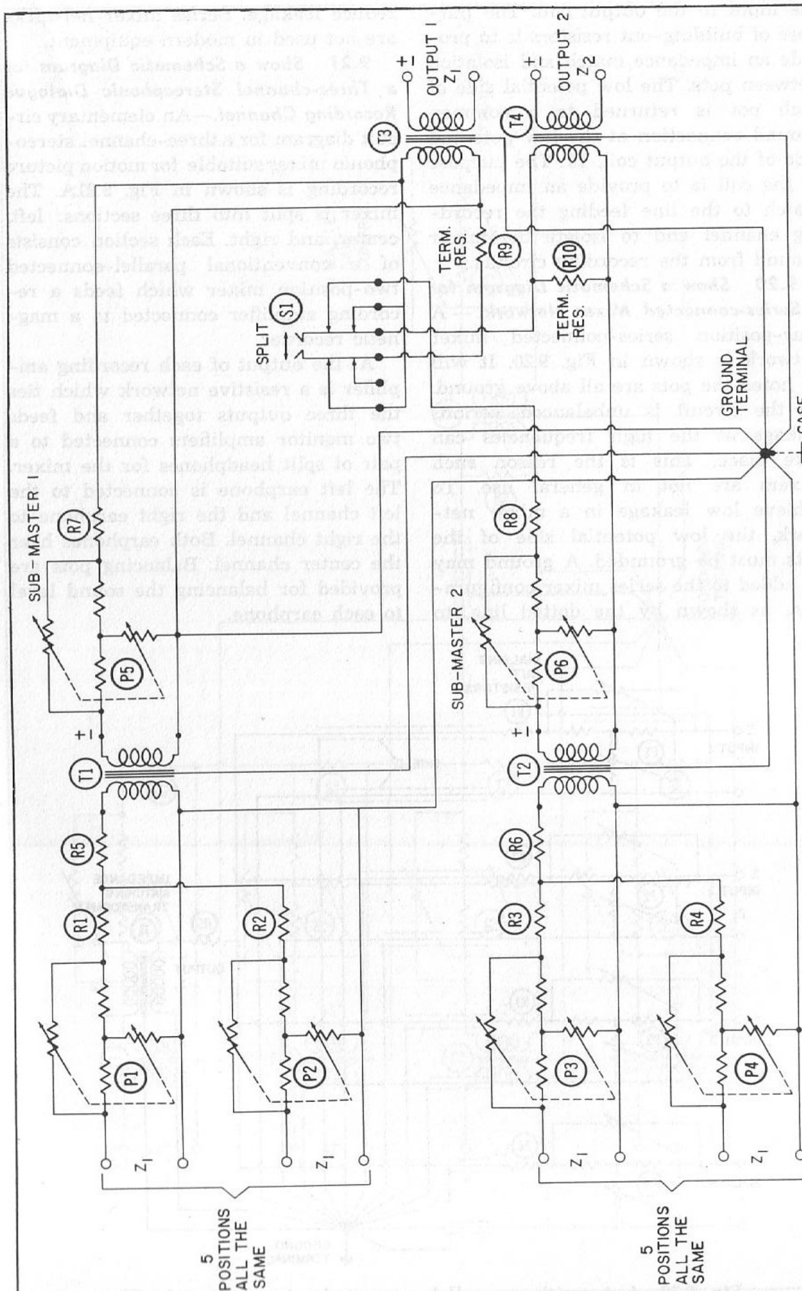

Fig. 9.18. A 10-position split mixer network with a key switch S1, for combining the two sections into a single network.

the input to the output coil. The purpose of building-out resistors is to provide an impedance match and isolation between pots. The low potential side of each pot is returned to a common ground connection at the low potential side of the output coil, T1. The purpose of the coil is to provide an impedance match to the line feeding the recording channel and to isolate the mixer ground from the recording circuits.

9.20 Show a Schematic Diagram for a Series-connected Mixer Network.—A four-position series-connected mixer network is shown in Fig. 9.20. It will be noted the pots are all above ground. As the circuit is unbalanced, serious leakage at the high frequencies can take place. This is the reason such mixers are not in general use. To achieve low leakage in a mixer network, the low potential side of the pots must be grounded. A ground may be added to the series mixer configuration, as shown by the dotted line, to reduce leakage. Series mixer networks are not used in modern equipment.

9.21 Show a Schematic Diagram for a Three-channel Stereophonic Dialogue Recording Channel.—An elementary circuit diagram for a three-channel stereophonic mixer suitable for motion picture recording is shown in Fig. 9.21A. The mixer is split into three sections: left, center, and right. Each section consists of a conventional parallel-connected two-position mixer which feeds a recording amplifier connected to a magnetic recorder.

At the output of each recording amplifier is a resistive network which ties the three outputs together and feeds two monitor amplifiers connected to a pair of split headphones for the mixer. The left earphone is connected to the left channel and the right earphone to the right channel. Both earphones hear the center channel. Balancing pots are provided for balancing the sound level to each earphone.

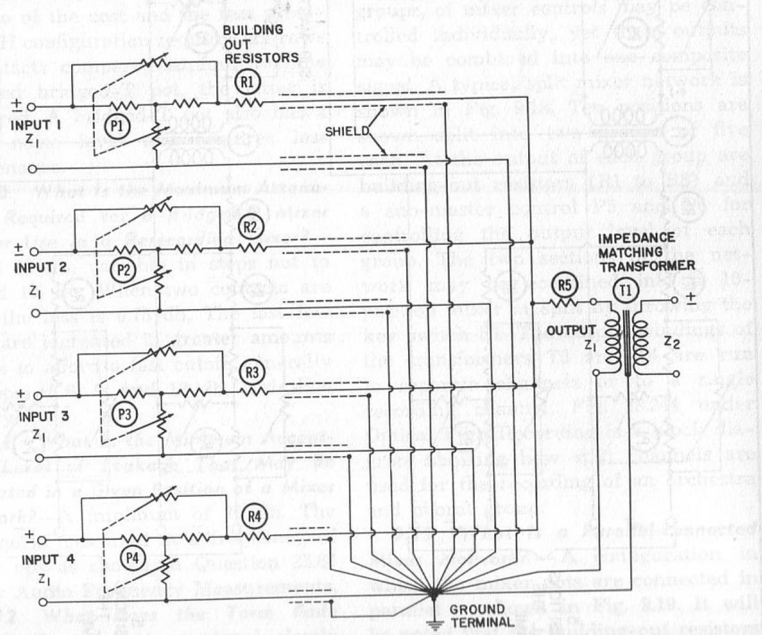

Fig. 9.19. A 4-position parallel connected mixer network. The ground side of each mixer control is brought to a common ground point.

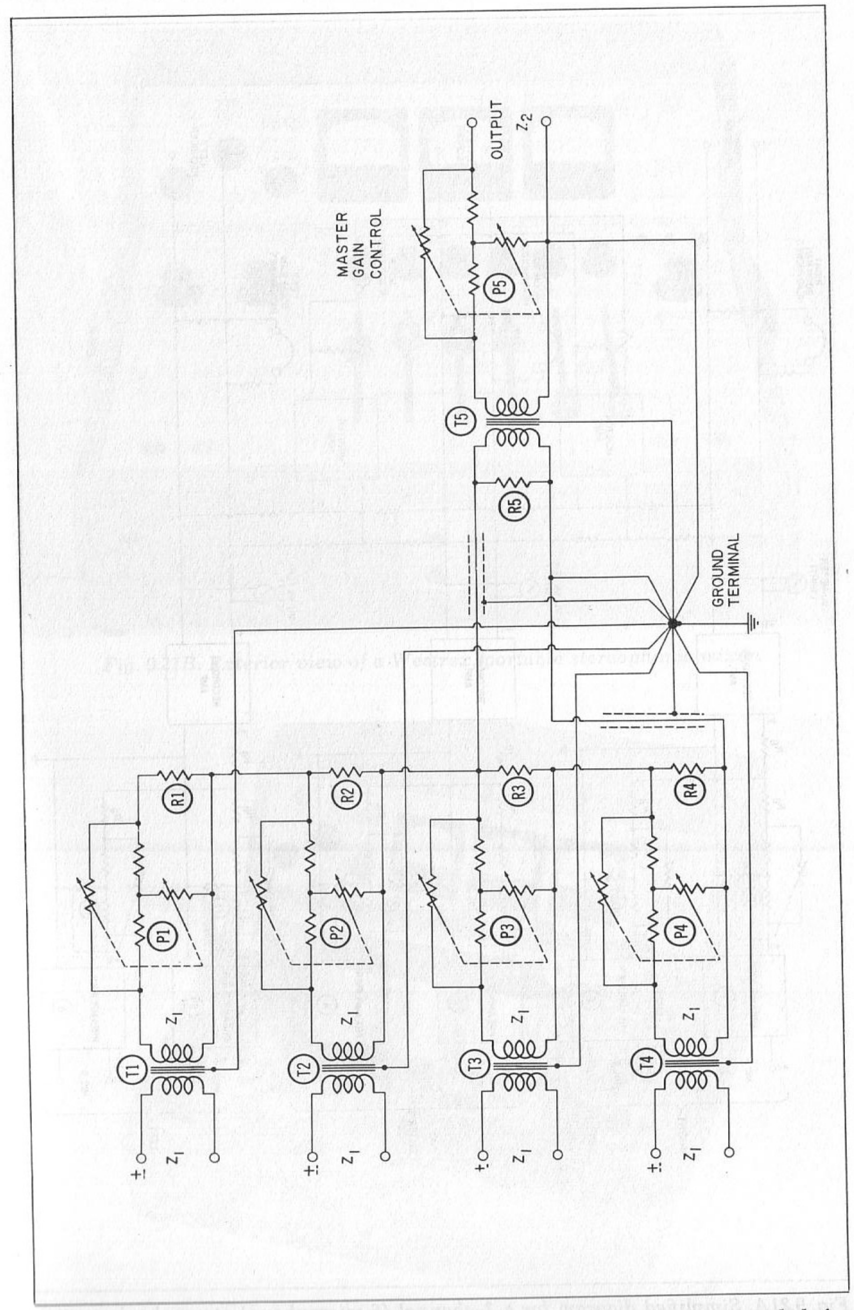

Fig. 9.20. A 4-position series connected mixer network, not recommended for critical work.

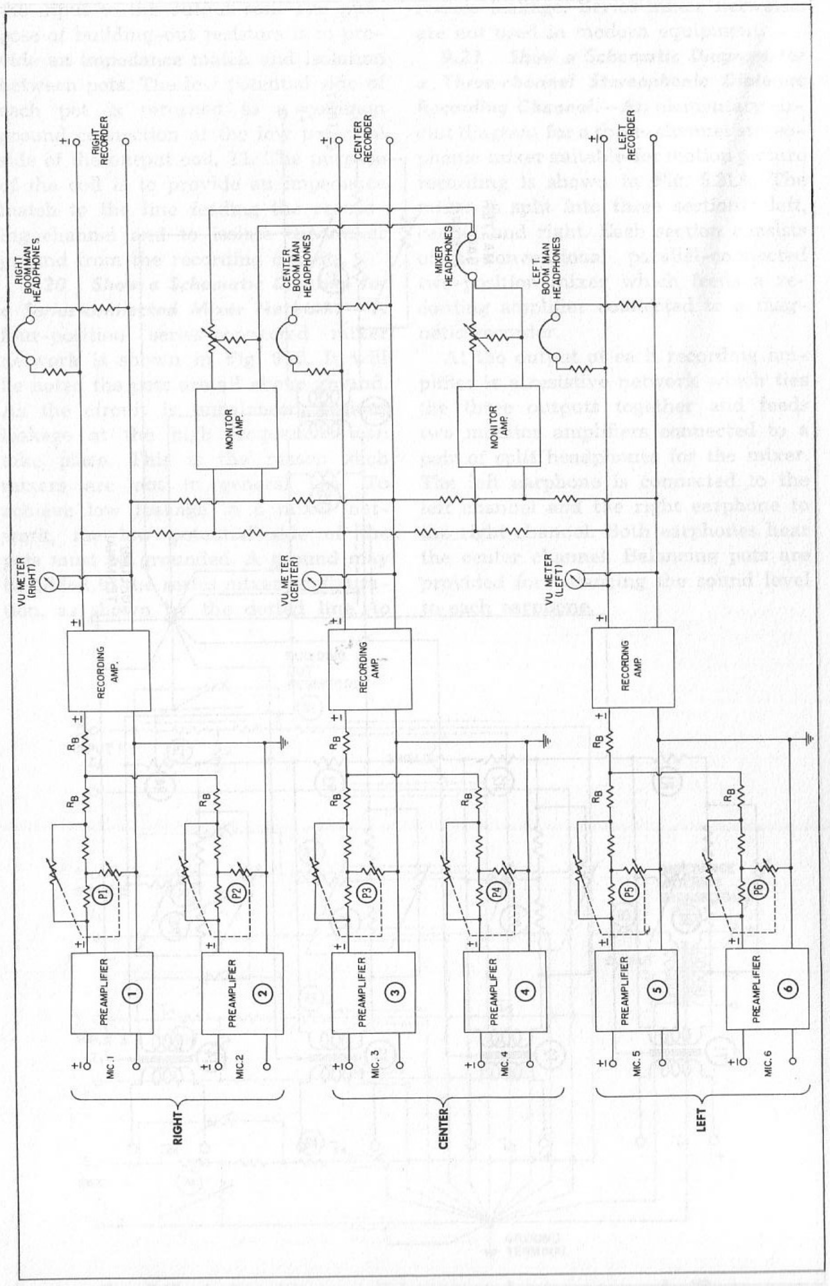

Fig. 9.21A. Simplified diagram for a 3-channel (6 microphone) stereophonic motion picture production mixer. Split headphones are used for the mixer, and individual headsets for the boom operators.

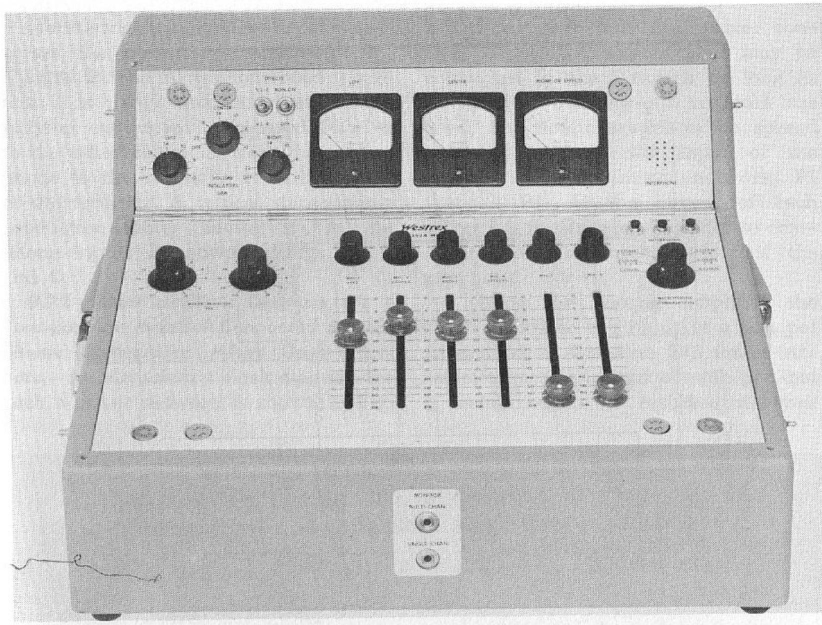

Fig. 9.21B. Exterior view of a Westrex, portable stereophonic mixer.

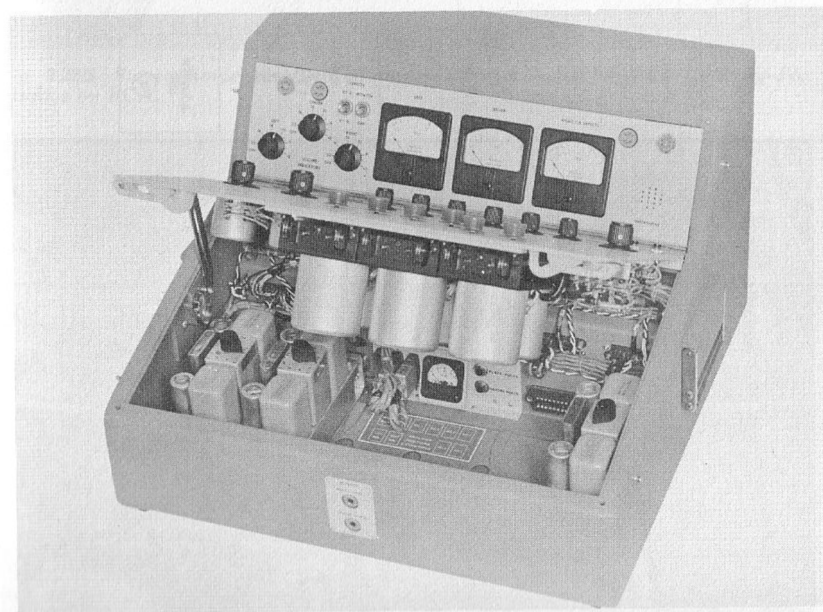

Fig. 9.21C. Interior view of Westrex portable stereophonic production mixer.

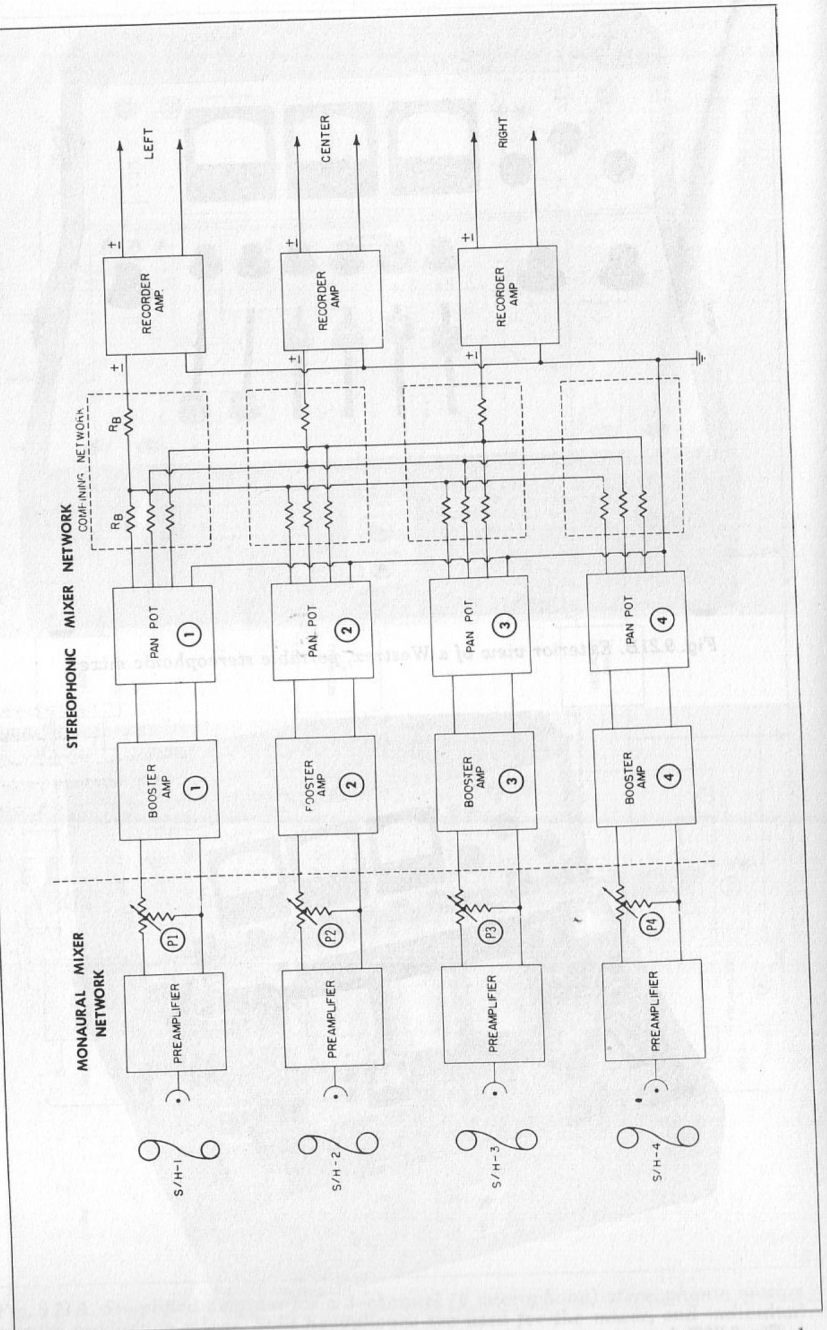

Fig. 9.22A. Simplified diagram for a 4-position pan-pot rerecording mixer networks.

Monitoring headphones are connected across the output of each recording channel for the microphone boom operator. It is highly important that all amplifying equipment be phased relative to the other channels, from the microphone to the magnetic recording head at the recorder. A typical stereophonic production mixer having six microphone inputs is shown in Figs. 9.21B and C.

9.22 *Show a Block Diagram for a Four-position Parallel Connected Stereophonic Rerecording Mixer Using Panpots.*—An elementary block diagram for such a mixer network is shown in Fig. 9.22A. Although only four mixer controls are shown, any number may be connected in the network as long as the proper building-out resistors are used. The sound tracks to be spread are connected to the input of the regular monaural mixer network, P1 through P4. At the output of each mixer pot is a booster amplifier to compensate for the insertion loss of the pan pots.

Leaving the booster amplifier the signal is fed to the input of a pan pot (described in Question 5.73 under Attenuators). The output of each pan-pot is combined in a resistive network

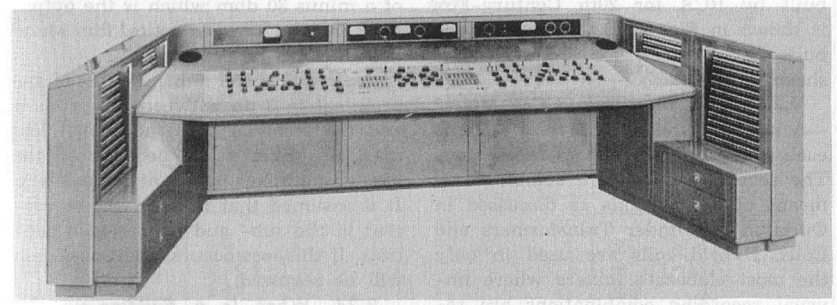

Fig. 9.22B. Stereophonic rerecording mixer console built for 20th Century-Fox Studios by RCA.

Fig. 9.22C. Stereophonic rerecording mixer console built by Westrex for Todd-A-O.

which feeds the input of three recording channels. The building-out resistors R_b, are used to achieve an impedance match between the pan-pots.

The mixer network shown may be used for stereophonic rerecording using original stereophonic sound tracks, or monaural sound tracks. In the latter case, the stereophonic effect is called pseudo-stereophonic sound and is quite widely used in the motion picture industry.

A complete block diagram and the explanation of such a system appears in Question 18.347 under Optical Film Recording.

A stereophonic rerecording mixer built by RCA for 20th Century-Fox is shown in Fig. 9.22B. A similiar type built by Westrex for Todd-A-O is shown in Fig. 9.22C.

9.23 *What Is a Hybrid Coil Mixer?* —A network split into several sections each containing a group of mixer pots. The several sections are combined by means of hybrid coils as discussed in Question 8.66 under Transformers and Coils. Hybrid coils are used in only the most elaborate mixers where unusual recording combinations are required. Typical uses for a hybrid coil mixer are for stereophonic rerecording, and recording large orchestras and choral groups. It is not unusual for such mixers to have up to 20 positions. A block diagram for a 16-position mixer network using hybrid coils appears in Fig. 9.23. Basically, the network consists of four separate, four-position, resistive networks (1 to 4).

Starting at network one at the upper left, the output of this network is connected to one side of the primary of hybrid coil T1. The output of network two is connected to the other side of the primary of the coil. The secondary of this coil feeds a booster amplifier having 30 db gain. The output of the booster amplifier feeds a sub-master control P1 for fading out all the pots in the four-group mixer network simultaneously. The sub-master control terminates in one side of the primary of hybrid coil T3 and, from there, to the secondary and a master control P3, and thence to the recording circuits. Normal jacks are connected in all inputs and outputs, for testing and patching. Resistors R1, R2, and R3 are the balancing resistors normally used with hybrid coils. The bottom ends of these resistors are brought to a common ground point. Booster amplifiers 1 and 2 compensate for the insertion loss of the coils and other network components. If the recording circuits are unbalanced, an unbalanced pot may be substituted for the balanced control P3.

The signal levels indicated are based on an assumed signal level, at the input of the four-position mixer group, of a minus 30 dbm which is the output level from an average optical film sound head.

Each hybrid coil induces a loss of approximately 3 db between the primary and the secondary. An additional loss of 6 db takes place because of the two-group mixer panels at the primary. It is assumed that no loss will be carried in the sub- and master-gain controls. If this loss occurs, additional gain will be required.

9.24 *What Is a Building-out Resistor?* —A noninductive resistor used for obtaining an impedance match in a mixer or combining network. The symbol for this register is R_B.

9.25 *What Is the Equation for Calculating the Value of a Building-out Resistor for a Parallel-connected Mixer Network Similar to That Shown in Fig. 9.19?*

$$R_B = \left(\frac{N-1}{N+1}\right) Z_1$$

where,

N is the number of mixer controls,

Z_1 is the impedance of the mixer control.

9.26 *What Is the Insertion Loss of a Mixer?* —The fixed loss caused by the building-out resistors and coils, if used, in the network. This loss is independent of the mixer control setting.

9.27 *How Is the Insertion Loss of the Parallel-connected Mixer Network Shown in Fig. 9.19 Calculated?*

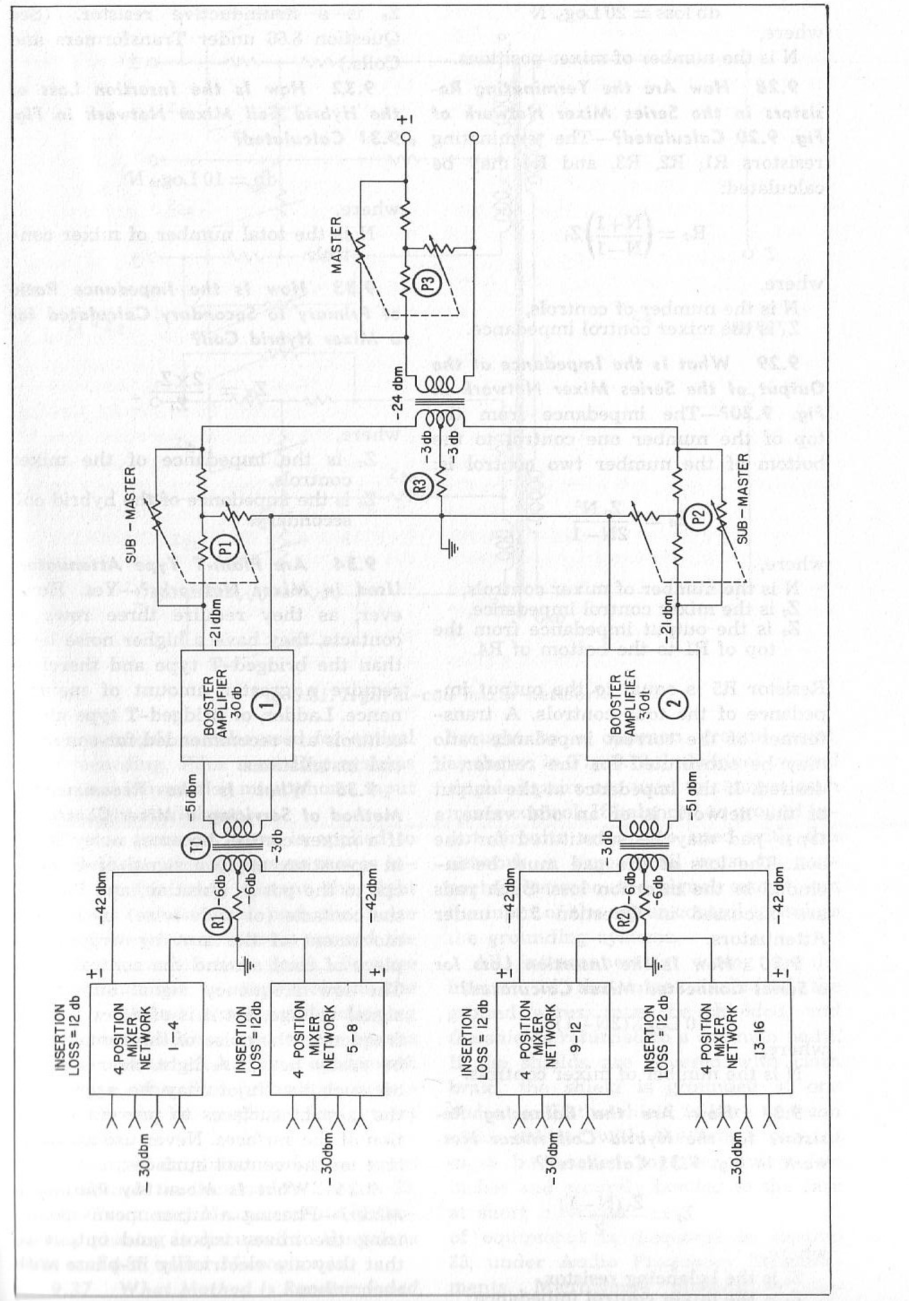

Fig. 9.23. A 16-position hybrid-coil mixer network. Losses are indicated for the coils, and control networks.

$$\text{db loss} = 20 \text{ Log}_{10} N$$

where,

N is the number of mixer positions.

9.28 *How Are the Terminating Resistors in the Series Mixer Network of Fig. 9.20 Calculated?*—The terminating resistors R1, R2, R3, and R4 may be calculated:

$$R_T = \left(\frac{N+1}{N-1}\right) Z_1$$

where,

N is the number of controls,
Z_1 is the mixer control impedance.

9.29 *What Is the Impedance at the Output of the Series Mixer Network in Fig. 9.20?*—The impedance from the top of the number one control to the bottom of the number two control is:

$$Z_2 = \frac{Z_1 N^2}{2N-1}$$

where,

N is the number of mixer controls,
Z_1 is the mixer control impedance,
Z_2 is the output impedance from the top of R1 to the bottom of R4.

Resistor R5 is equal to the output impedance of the four controls. A transformer of the correct impedance ratio may be substituted for the resistor, if desired. If the impedance at the output of the network is of an odd value, a taper pad may be substituted for the coil. The loss of the pad must be included in the insertion loss. Such pads are discussed in Question 5.34 under Attenuators.

9.30 *How Is the Insertion Loss for a Series Connected Mixer Calculated?*

$$10 \text{ Log}_{10} (2N-1)$$

where,

N is the number of mixer controls.

9.31 *How Are the Balancing Resistors for the Hybrid Coil Mixer Network in Fig. 9.31 Calculated?*

$$Z_3 = \frac{Z_1 (N-1)}{2}$$

where,

Z_3 is the balancing resistor,
Z_1 is the mixer control impedance,
N is the total number of mixer controls.

Z_3 is a noninductive resistor. (See Question 8.66 under Transformers and Coils.)

9.32 *How Is the Insertion Loss of the Hybrid Coil Mixer Network in Fig. 9.31 Calculated?*

$$\text{db} = 10 \text{ Log}_{10} N$$

where,

N is the total number of mixer controls.

9.33 *How Is the Impedance Ratio of Primary to Secondary Calculated for a Mixer Hybrid Coil?*

$$Z_R = \frac{2 \times Z_1}{Z_4}$$

where,

Z_1 is the impedance of the mixer controls,
Z_4 is the impedance of the hybrid coil secondary.

9.34 *Are Plain-T Type Attenuators Used in Mixer Networks?*—Yes. However, as they require three rows of contacts, they have a higher noise level than the bridged-T type and therefore require a greater amount of maintenance. Ladder, or bridged-T type mixer controls are recommended for commercial installations.

9.35 *What Is the Recommended Method of Servicing a Mixer Control?*—If a mixer control becomes noisy while in operation, apply a signal of 40 to 60 cps to the pot in question, and burnish the contacts (or slide-wire) by a rapid movement of the arm by wrapping a piece of cord around the control knob. The low frequency signal supplies a signal voltage, yet it is of a low enough frequency, the noise of the contact may be easily heard. A light clear mineral oil such as Nujol may be applied to the contact surfaces to prevent oxidation of the surfaces. Never use an abrasive on the contact surfaces.

9.36 *What Is Meant by Phasing a Mixer?*—Phasing a mixer means polarizing the mixer inputs and output so that they are electrically in-phase with each other.

The phasing of a mixer network is quite important, particularly if the

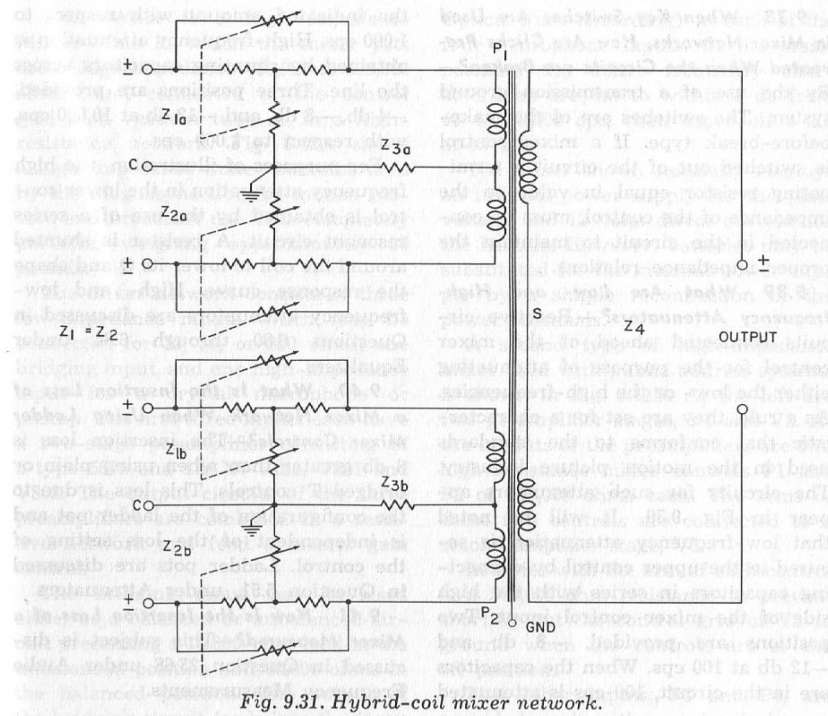

Fig. 9.31. Hybrid-coil mixer network.

mixer network is to be used for optical film recording. Film recording systems are phased from the microphone input to the light modulator.

When a pressure wave is applied to a microphone, the diaphragm moves inward. At the same instant the light modulator is deflected and the noise reduction equipment moves toward the maximum cancellation point. Because the human voice is unsymmetrical, the system is phased to prevent the clipping of the modulation peaks by means of the noise reduction equipment. Therefore, the film recording system must always be in-phase for correct operation.

Phasing of amplifiers and other types of equipment is discussed in Section 23, Audio Frequency Measurements. Microphone phasing is discussed in Questions 4.84 and 4.85 under Microphones.

9.37 *What Method Is Recommended for Grounding Mixer Networks?*—The ground side of each mixer control is brought to a common ground point, as shown in Fig. 9.19. Individual twisted shielded pairs are used to connect each mixer control. If balanced to ground input circuits are to be used with this network, a repeat coil must be connected between the signal source and the input of the mixer control to isolate the grounding systems.

All interconnecting wiring in the interior of the mixer including the ground wires, must be shielded, and the shields returned to a common point. If the shields are covered with cloth braid, the shield is grounded at one end only. If the shield is bare and can make contact with the mixer case, it must be bonded together every few inches and securely bonded to the case at short intervals.

of equipment is discussed in Section 23, under Audio Frequency Measurements. Microphone phasing is discussed in Questions 4.84 and 4.85 under Microphones.

9.38 When Key Switches Are Used in Mixer Networks, How Are Clicks Prevented When the Circuits are Broken?—By the use of a transmission ground system. The switches are of the make-before-break type. If a mixer control is switched out of the circuit a terminating resistor equal in value to the impedance of the control, must be connected in the circuit to maintain the proper impedance relations.

9.39 What Are Low- and High-frequency Attenuators?—Reactive circuits connected ahead of the mixer control for the purpose of attenuating either the low- or the high-frequencies. As a rule, they are set for a characteristic that conforms to the standards used in the motion picture industry. The circuits for such attenuators appear in Fig. 9.39. It will be noted that low-frequency attenuation is secured in the upper control by connecting capacitors in series with the high side of the mixer control input. Two positions are provided, −8 db and −12 db at 100 cps. When the capacitors are in the circuit, 100 cps is attenuated the indicated amount with respect to 1,000 cps. High-frequency attenuation is obtained by shunting capacitors across the line. Three positions are provided, −4 db, −8 db, and −12 db at 10,000 cps, with respect to 1,000 cps.

For purposes of illustration, the high frequency attenuation in the lower control is obtained by the use of a series resonant circuit. A resistor is shunted around the coil to lower its Q and shape the response curve. High- and low-frequency attenuators are discussed in Questions 6.80 through 6.84 under Equalizers.

9.40 What Is the Insertion Loss of a Mixer Network When Using Ladder Mixer Controls?—The insertion loss is 6 db greater than when using plain or bridged-T controls. This loss is due to the configuration of the ladder pot and is independent of the loss setting of the control. Ladder pots are discussed in Question 5.51, under Attenuators.

9.41 How Is the Insertion Loss of a Mixer Measured?—This subject is discussed in Question 23.68 under Audio Frequency Measurements.

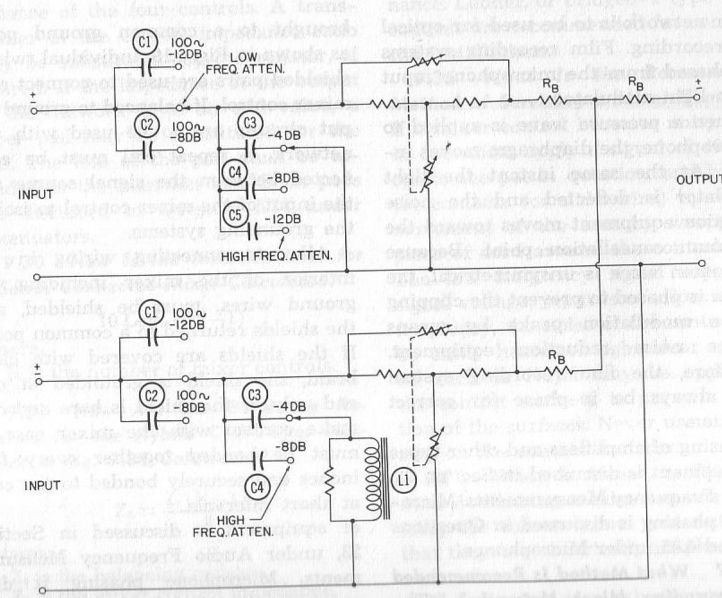

Fig. 9.39. A 2-position mixer.

9.42 What Is a High Impedance Mixer?—One in which the mixer pots are of high impedance (50,000 to 500,000 ohms) and connected at the control grid of a vacuum tube or in a high-resistance network. Fig. 9.42A shows a high impedance mixer manufactured by the Magnasync Co., for motion picture and broadcast use. It is completely portable, weighing approximately 30 pounds.

The mixer network consists of three low-impedance inputs which may be connected for 30, 50, or 250 ohms, one bridging input, and one high-impedance input for a crystal microphone or pickup. The first three inputs each have a two-stage preamplifier consisting of a type 5879 and 12AX7 tube, V801 and V802. The output circuits of the three preamplifiers are combined in a resistive network and feed a master gain control.

The bridging input may be used either as a balanced or unbalanced circuit presenting a 10,000-ohm load in the unbalanced position and 20,000 ohms in the balanced position. The output of the bridging circuit feeds into the input of the third preamplifier. The high impedance input uses a single preamplifier stage, V807, which feeds directly to the combining network at the outputs of preamplifiers 1 to 3.

The output of the master gain control is fed to the input of a two-stage amplifier, V809 and V810, and to the output transformer and VU meter. The output of the transformer may be used to feed a line or a recording channel at a plus 4 dbm level.

A cathode follower, V811, used for headphone monitoring, is fed from the plate of V810. Talking facilities from the mixer are provided by a crystal microphone and a single-stage amplifier V808 and switch S805 which are coupled into the control grid circuit of V809. No facilities are provided for talking back to the mixer from other parts of the system.

Standard dialogue equalization as used by the motion picture industry is provided (see Question 18.81 under Optical Film Recording) in each of the four microphone inputs. In the music position, the mixer frequency characteristics are flat to within 1 db from 40 to 10,000 cps, then taper off 4 db at 15 kc.

The mixer shown normally employs an internal power supply for the plate voltage and 12 volts direct current for the heaters. However, batteries may be substituted for the internal power supply by a simple reconnection of the power terminals.

A second type of high-impedance mixer used with public address systems is shown in Fig. 9.42B. At the left are two preamplifier stages, V1 and V2. At the outputs of the preamplifiers are two high-resistance mixer controls P1 and P2 of 250,000 ohms each. The arms of these two controls are connected to a second amplifier stage, V3.

In series with the arm of each control is a 500,000-ohm resistance to prevent shorting out the control grid of V3 to ground when the controls are in the off position.

Two other inputs, P3 and P4, are provided, each with a series resistance in the variable arm, for the same purpose as for P1 and P2. Tube V4 is used as an equalizer-amplifier stage.

9.43 What Is an Electronic Mixer?—This is a term which is sometimes used to identify a compressor amplifier employed for motion picture recording. Electronic mixers are discussed in Questions 18.84 through 18.102 under Optical Film Recording.

9.44 What Are the Values of Building-out Resistors Used for Parallel Type Mixer Networks?—The values of the building-out resistors and the insertion loss for mixers using a parallel mixer network (Fig. 9.19) are given in Fig. 9.44. The number of mixer positions appears at the left and the impedance of the network at the top of the chart.

The insertion loss is the loss caused by the building-out resistors, with only a single input at its minimum attenuation. The measurement of insertion loss is discussed in Question 23.68 under Audio Frequency Measurements.

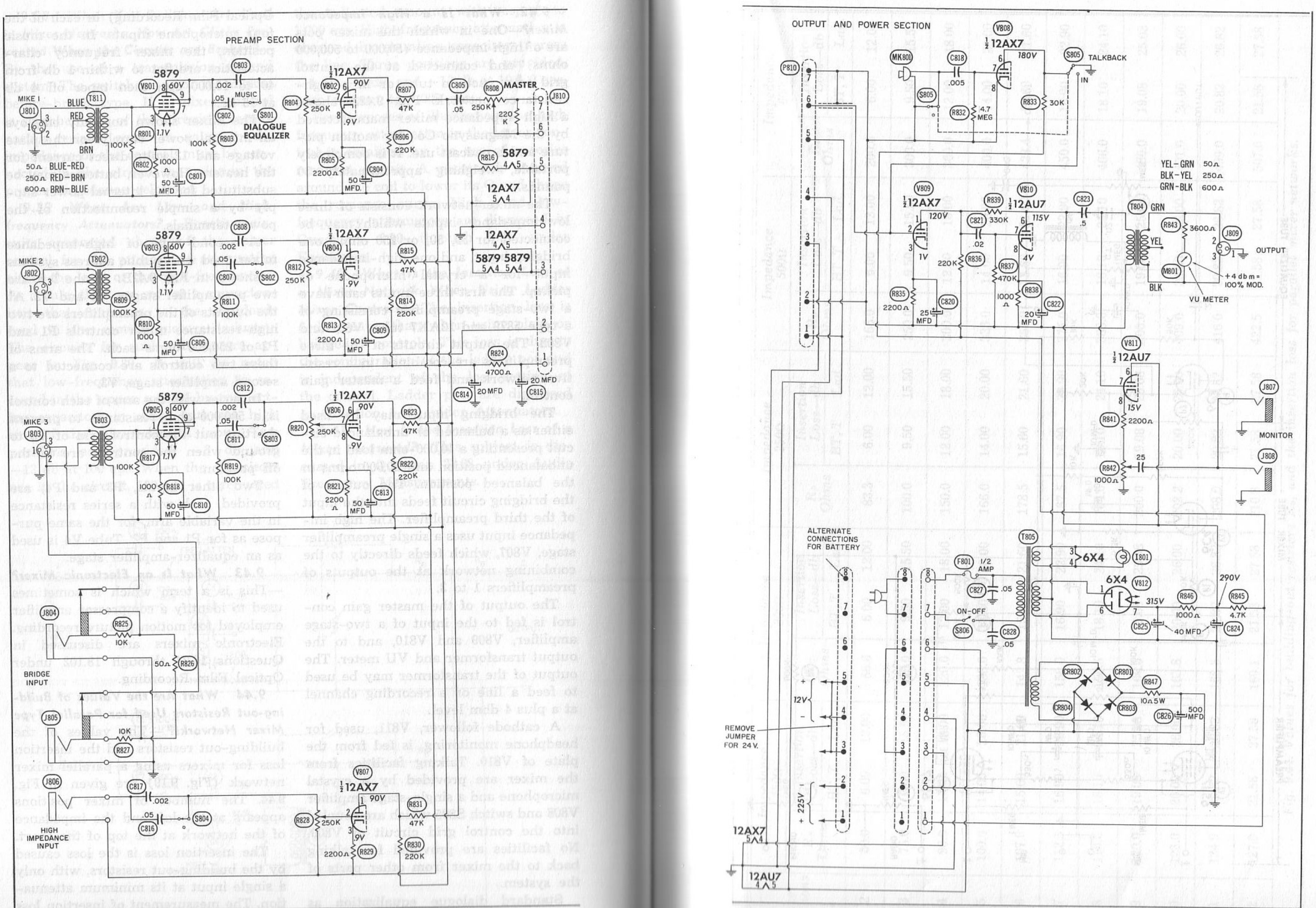

Fig. 9.42A. Schematic diagram of Model 924 portable mixer manufactured by Magnasync.

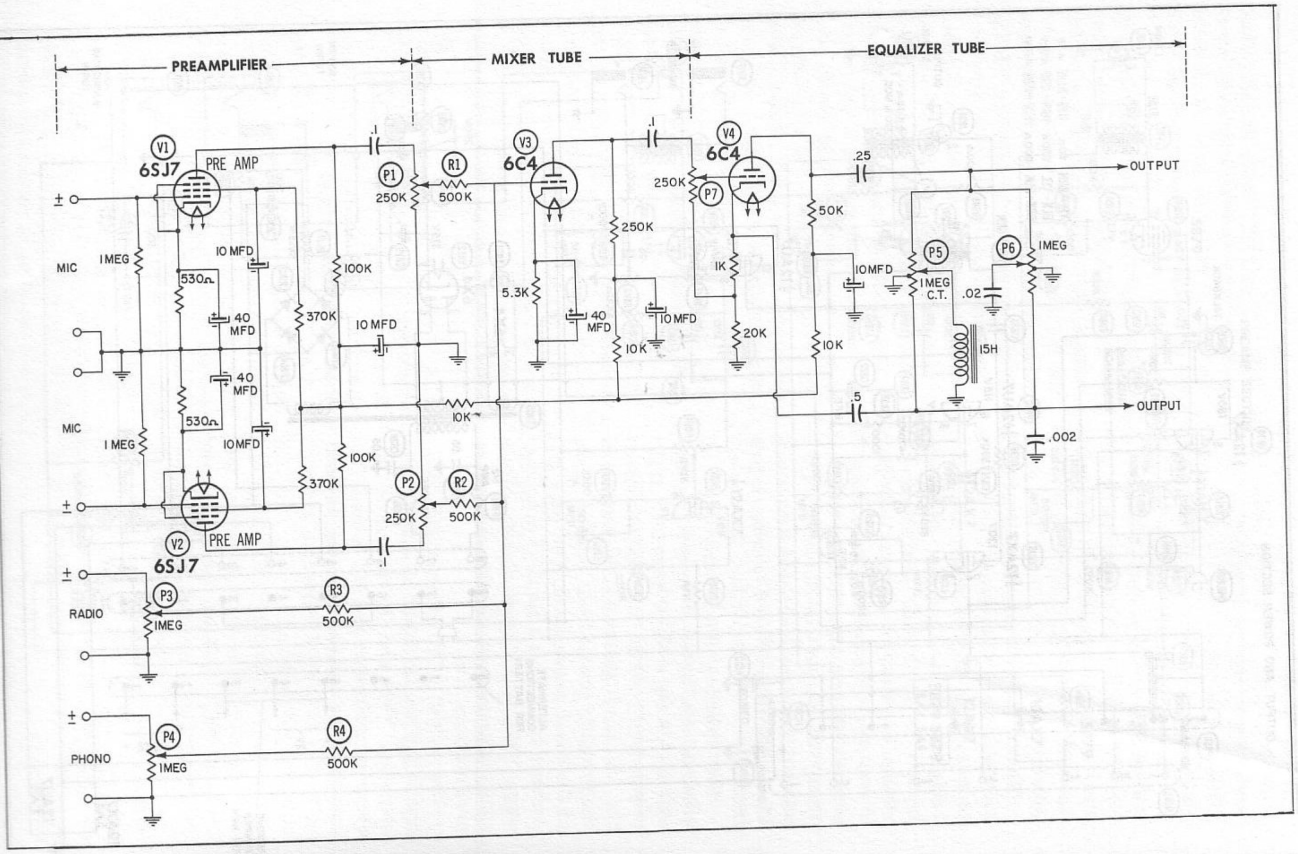

Fig. 9.42B. High-impedance mixer amplifiers, and equalizer used with public address systems.

Mixer Positions	Impedance 150Ω			Impedance 200Ω			Impedance 250Ω			Impedance 500Ω			Impedance 600Ω		
	R_B Ohms	Insertion Loss—db		R_B Ohms	Insertion Loss—db		R_B Ohms	Insertion Loss—db		R_B Ohms	Insertion Loss—db		R_B Ohms	Insertion Loss—db	
		BT, T	Lad.		BT, T	Lad.		BT, T	Lad.		BT, T	Lad.		BT, T	Lad.
2	50.0	6.00	12.00	66.6	6.00	12.00	83.3	6.00	12.00	166.0	6.00	12.00	200.0	6.00	12.00
3	75.0	9.50	15.50	125.0	9.50	15.50	100.0	9.50	15.50	250.0	9.50	15.50	300.0	9.50	15.50
4	90.0	12.00	18.00	120.0	12.00	18.00	150.0	12.00	18.00	300.0	12.00	18.00	360.0	12.00	18.00
5	100.0	14.00	20.00	133.0	14.00	20.00	166.0	14.00	20.00	333.0	14.00	20.00	400.0	14.00	20.00
6	107.0	15.60	21.60	142.8	15.60	21.60	178.5	15.60	21.60	357.0	15.60	21.60	428.4	15.60	21.60
7	112.5	16.90	22.90	150.0	16.90	22.90	187.5	16.90	22.90	375.0	16.90	22.90	450.0	16.90	22.90
8	116.6	18.10	24.10	155.5	18.10	24.10	194.0	18.10	24.10	388.0	18.10	24.10	466.0	18.10	24.10
9	120.0	19.08	25.08	160.0	19.08	25.08	200.0	19.08	25.08	400.0	19.08	25.08	480.0	19.08	25.08
10	123.0	20.00	26.00	163.8	20.00	26.00	202.2	20.00	26.00	409.0	20.00	26.00	491.0	20.00	26.00
11	124.9	20.82	26.82	166.5	20.82	26.82	208.0	20.82	26.82	416.0	20.82	26.82	499.0	20.82	26.82
12	127.0	21.58	27.58	169.1	21.58	27.58	210.8	21.58	27.58	422.5	21.58	27.58	507.0	21.58	27.58

Fig. 9.44. Values for building-out resistors R_B, and the insertion loss for parallel mixer networks.