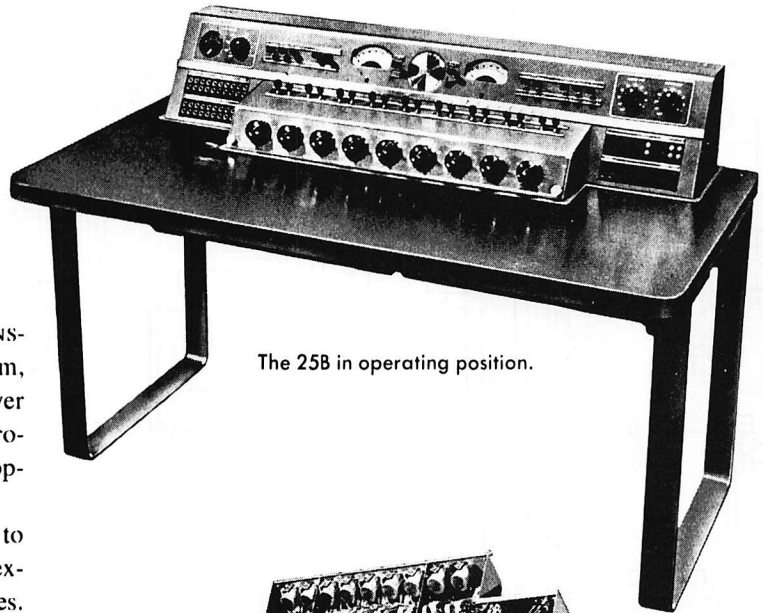


25B Speech Input Console

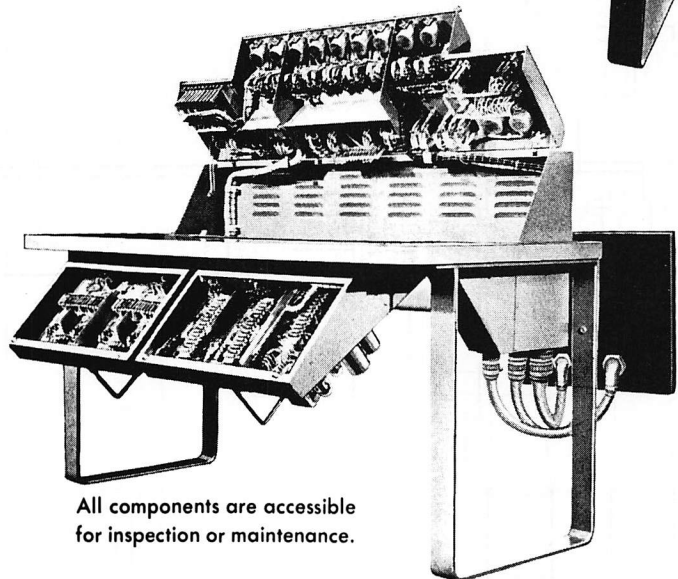
DESIGNED FOR HIGH QUALITY FM TRANSMISSION, the 25B console provides uniform, noise-free, and distortionless operation over a 15,000-cycle range. It provides dual program channels capable of simultaneous operation on different programs.

This console is easy and economical to install, with plug-in cables that carry all external leads to wall-mounted junction boxes. Every portion of the equipment is made available for inspection or maintenance by simply lifting the hinged upper section or lowering the units below the table level.

Among the many features of the 25B are its seven-position mixer; line and microphone transfer keys; dual volume indicators; separate built-in tube checking meter; regulated power supply.



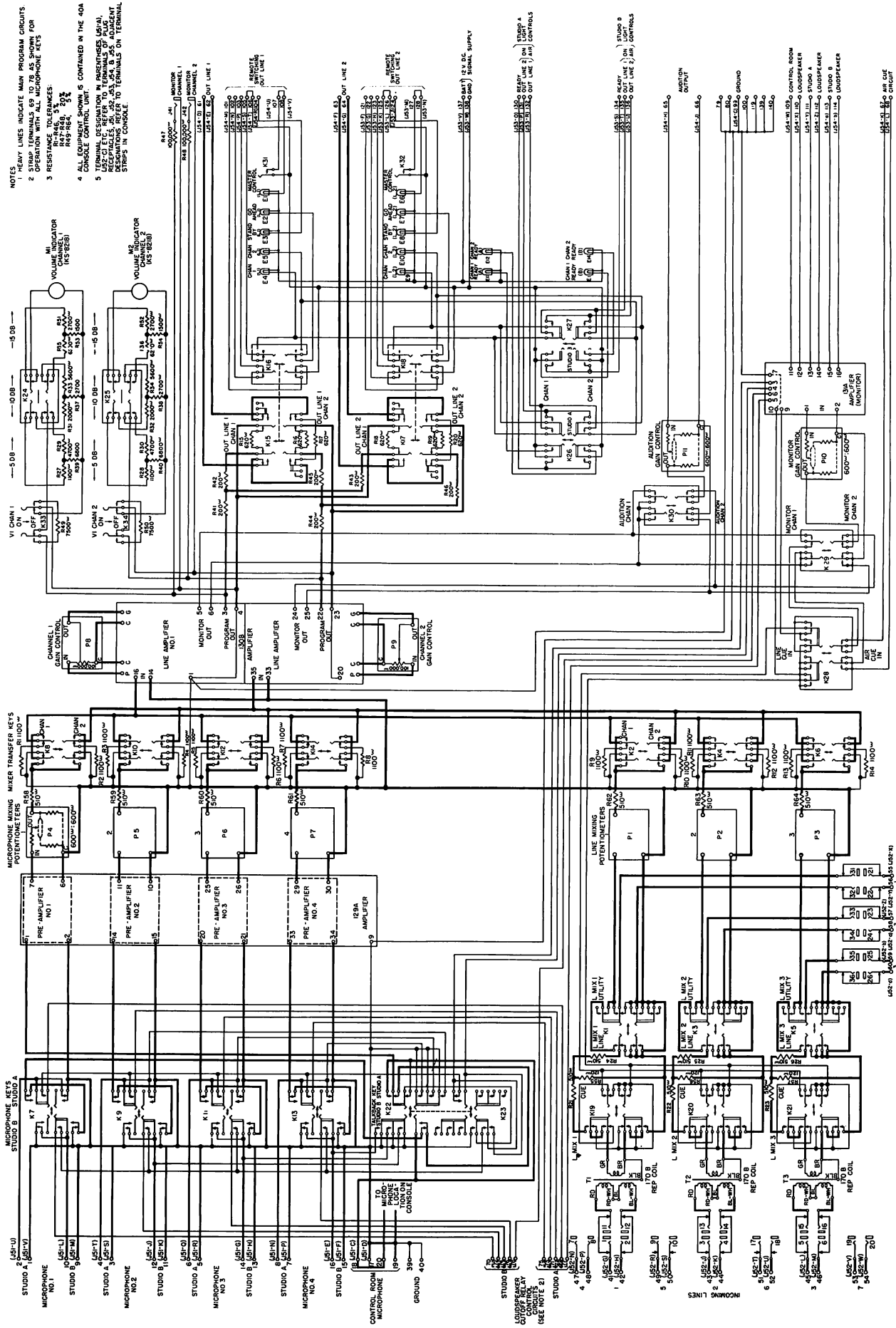
The 25B in operating position.



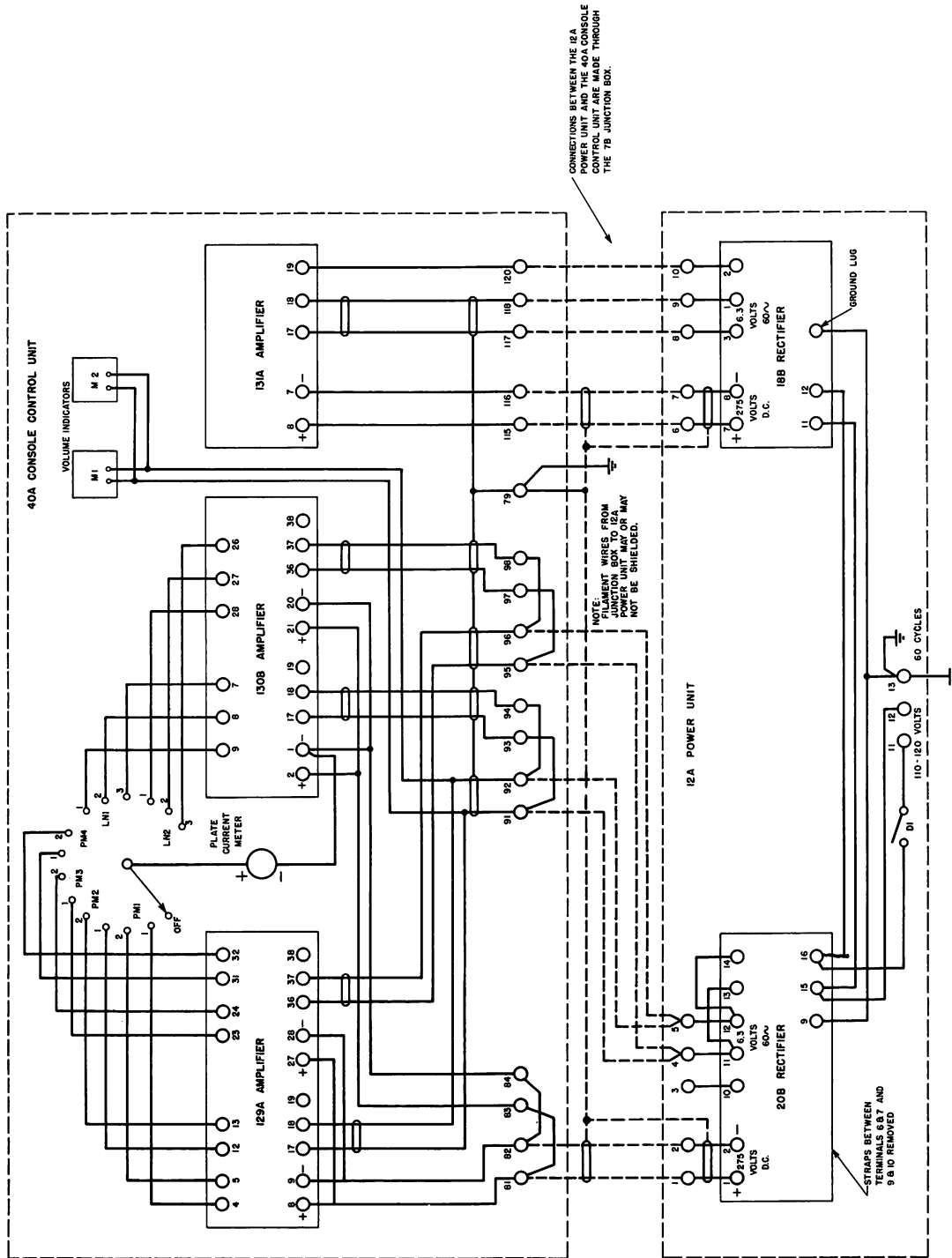
All components are accessible for inspection or maintenance.

Speech Input Equipment

- NOTES
- 1 MANY LINES INDICATE MAIN PROGRAM CIRCUITS
 - 2 STUDIO TERMINALS ARE TO BE AS SHOWN FOR OPERATION WITH ALL MICROPHONE KEYS
 - 3 RESISTANCE TOLERANCES: R47-R48, 5% R49-R48, 1% R49-R48, 5%
 - 4 ALL ELECTRICAL UNITS CONTAINED IN THE 40A CONSOLE CONTROL UNITS
 - 5 TERMINAL DESIGNATION IN PARENTHESES LOCAL, IN BRACKETS REFER TO TERMINALS OF PLUG RECEPTACLE, AND IN SQUARES REFER TO TERMINAL DESIGNATIONS REFER TO TERMINALS ON TERMINAL STRIPS IN CONSOLE.



Signal and Audio Schematic



Power Supply Schematic

25B SPEECH INPUT EQUIPMENT

SECTION 1 — GENERAL DESCRIPTION

The 25B Speech Input Equipment is a complete AC operated console type, program production unit for the amplification, control, and monitoring of programs originated by microphones, transcriptions, remote inputs, or equivalent sources. It has two main program channels, capable of simultaneous operation on separate programs without interference. In addition, it has an independent monitoring channel for loudspeaker listening to programs being transmitted through either of the two main channels, or direct from incoming lines or cue circuits. The monitor channel may also be used to feed cue program back to the remote line circuits, or talkback to one or the other of two studio loudspeakers.

Other facilities provided are an audition, or sound reinforcement output with volume control, two VI meters, headset monitoring jacks, and studio light and signaling control circuits; jack termination for 4 other lines in addition to those mentioned above. In addition to provision for use of an external talkback microphone, a mounting is also provided in the console for such a microphone.

The equipment has a 7 channel parallel mixer. Four of these mixer volume controls are associated with four preliminary amplifiers provided in the equipment for operation from a maximum of eight connected microphones (4 simultaneously), or equivalent low level sources. The other three mixers are associated with higher level inputs which may be incoming program lines. By the use of three externally mounted preamplifiers, three additional microphones or other low level inputs may be operated into these mixers. Any combination of the seven simultaneous inputs may be con-

nected to either one or the other of the two main amplifier channels.

A functional schematic diagram showing these facilities and indicating the operation of the equipment, is given on Figure 1. This diagram also shows levels at various points in the system based on a +8 VU level into a 600 ohm outgoing line. It should be noted, however, that the input levels shown are based on minimum loss in the volume controls and that normal input levels will be higher than those shown. A maximum net gain of about 100 db is provided from the low level input terminals to the output line terminals, about 38 db from the high level lines, and about 58 db from the utility inputs to the outgoing line. The monitor amplifier has a gain of about 50 db.

The 25B Speech Input Equipment consists of four principal units. The main unit is a desk style Control Console mounted on a table; this unit contains all the amplifiers and the controls. The table top stands 27½ inches from the floor and is about 55 inches long by about 28 inches deep. The console occupies about 13½ inches in depth at the rear of the table top, and the amplifiers are housed in hinged tray type enclosures below the table top. The over-all height of the console on the table is 36 inches. The control and amplifier enclosures are hinged so that complete and easy access is obtained to all internal wiring and components. The second unit is a wall mounted cabinet containing the filament transformers and plate supply rectifiers. This unit is about 28 inches wide by 10 inches deep by 16½ inches high.

Two flush type wall mounting connection or junction boxes also form part of the equipment. These are furnished with terminal strips

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to which the permanent connections are made. Extending from the front of the boxes are flexible cables terminated in plug-in connectors, with which all connections to the control con-

sole may be made. Outline dimensions are shown on Figure 2; the construction and other equipment characteristics are described in more detail below:

SECTION 2 — LIST OF EQUIPMENT

The 25B Speech Input Equipment consists of the following separate components:

- 2-1. List of Components**
- 40A Control Console
 - KS-10284 Table
 - 7A Junction Box
 - 7B Junction Box
 - 12A Power Supply

Outline dimensions of this equipment are shown on Figure 2.

2-2. Vacuum Tubes

The following vacuum tubes are required for operation of this equipment but are not furnished with it and they should be specifically called for on the order:

Vacuum Tube Designation	40A Console	12A Power Supply	Total for Equipment
1603	6	—	6
348A	8	1	9

Vacuum Tube Designation	40A Console	12A Power Supply	Total for Equipment
349A	4	—	4
351A	—	1	1
313C	—	1	1
300B	—	1	1
274A	—	2	2

Where the recommended tubes are not available, certain substitutes may be employed. These are listed in the particular referenced instruction books which cover the amplifiers and rectifiers which form part of the 25B Speech Input Equipment, in accordance with the following:

Unit of 25B S.I.E.

Component of Unit
40 A Console
12A Power Supply

Component of Unit
129A Amplifier
130B Amplifier
131A Amplifier
18B Rectifier
20B Rectifier

SECTION 3 — OTHER ACCESSORY EQUIPMENT

The following accessory equipment not furnished as part of the 25B Speech Input Equipment is recommended:

3-1. Patching Cards

The 40A Console is equipped for 3 incoming high level remote program lines and 3 utility inputs which feed through jacks. Also 4 additional line inputs are terminated in jacks on the control console. The use of the P-2AA Cord, 1-foot long, equipped with 241A (black) plugs, or 241B (red) plugs is recommended for patching purposes.

3-2. Monitoring Headset

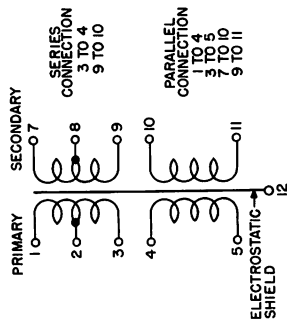
Jacks connected across the outputs of each of the two main amplifier channels are provided for headset monitoring. These are high impedance (100,000 ohms) outputs. A suitable headset is the D-97690 (high quality) Headset equipped with D-90944 Cord and 47B Plug. The 1002F Headset may also be used.

3-3. Repeating Coils

Comments on the use of repeating coils for providing impedance matching or for changing from balanced to unbalanced circuits are given

in more detail elsewhere in this bulletin. The Western Electric Company No. 177C Repeating Coil is a general purpose coil designed for high quality program circuits and specifically for use with the 25B Speech Input Equipment; brackets and mounting plates for mounting 8 such coils are provided in the 40A Console. Space is available for adding additional brackets to mount 5 more coils if desired.

Winding data on the 177C Repeating Coil is shown below:



All windings are identical except that windings 1-3 and 7-8 have a mid-tap (terminals 2 and 8 respectively). These may be used to provide a mid-ground point for the parallel connection; for the series connection terminals 3 and 9 may, of course, be used. The following connections should be used for impedances between 25 ohms and 600 ohms:

Windings		Operating Impedance Ratios	
Primary	Secondary	Series	Parallel
Series	Series	600 ohms to 600 ohms	or
Parallel	Parallel	150 ohms to 150 ohms	
Series	Parallel	25 ohms to 25 ohms	
Parallel	Series	150 ohms to 25 ohms	

Terminal 12 is the insulated electrostatic shield. The coil is also equipped with an electromagnetic shield. For severe electromagnetic exposures, an additional shield (No. 42A) may be added externally.

Both repeating coils and shields should be ordered separately as required.

Additional coil mounting brackets and plates may be ordered as follows:

- 2 Brackets per BA-73883
- 1 or 2 Coil Mounting Plates per BA-73884

3-4. 12 Volt Signal Power Supply

The 25B Speech Input Equipment includes all plate rectifier supplies, filament supply transformers, and voltage supply for the three loud-speaker relays provided in the 131A Amplifier. No supply is provided however, for the 12-volt signs and lamp circuits provided in the 40A Console. The KS-7598 Rectifier which will supply up to 1.2 amperes at 12 volts can be ordered for this purpose.

If a 24-volt supply is wanted, the KS-5653 List 3 Rectifier may be employed. In this case the 12-volt signal lamps in the 40 A Console would have to be changed to 24 volts.

3-5. External Pre-Amplifiers

For use of the "Utility" inputs for additional microphone or low level transcription sources, pre-amplifiers mounted externally may be provided. The following equipment is available for this purpose.

For 19" Relay Rack or Cabinet Mounting, the following apparatus is recommended.

- 3-120B Amplifiers
 - 1-177 Type Mounting Plate
 - 1-296 Type Panel (Face Mat)
- } or {
- 1-129A Amplifier
 - 1-190 B Mounting Plate
 - 1-296 Type Panel (Face Mat)

For mounting in a 21A Cabinet the following apparatus is recommended:

- 1-21A Cabinet
- 1-Terminal Strip per BA-44609 (has 3 terminals)
- 2-Terminal Strips per BL-44607 (each has 10 terminals)
- 1-190A Mounting Plate
- 3-120B Amplifiers, or 1-129A Amplifier
- 1-Mounting Plate per BO-74389 (for mounting up to 4-177C repeating Coils in 21A Cabinet)

The three external 120B Amplifiers, or one 129A Amplifier, may be operated from the 20B Rectifier in the 12A Power Supply in addition to the 129A Amplifier and 130B Amplifier. It operates in the 40A Console. The 20B Rectifier will be more heavily loaded by this addition, however, and rectifier tube life will be reduced to some extent.

SECTION 4 - DESCRIPTION OF OPERATION AND TECHNICAL DATA

The operation of the 25B Speech Input Equipment will be described in some detail to assist in the installation, use, and maintenance of the equipment.

4-1. Audio Circuits

The functional schematic diagram, Figure 1, is a simplified version of the complete signal audio schematic shown on Figure 3. Initial reference to Figure 1 will be helpful in following through the more detailed circuits of Figure 3; Figure 4 showing the actual location of the various keys, jacks, volume controls, etc., on the console may also be of interest in this connection. Control designations, K for keys, etc., are the same on all diagrams.

Low Level Inputs to Mixer Circuit. Each of the four microphone keys (K7, K9, K11 or K13) provide a means of selecting either of two microphones, one in Studio A or the other in Studio B, and connecting this source to a preliminary amplifier, one of which is associated with each microphone key. In the mid-position of these keys, the sources and the amplifier inputs are short circuited and grounded. The output of each preliminary amplifier is connected to a 600-600 ohm ladder type mixer volume control (P4 to P7 inclusive).

In addition to the audio circuits on these keys, contacts are provided in the loudspeaker relay control circuit so that when the keys are thrown to the "STUDIO" position the loudspeaker in the studio is cut off, preventing operation of a loud-speaker with a live microphone. Operation of this circuit is described in more detail under "Talkback".

All these circuits are identical, except that the

The instruction sheets on the 21A Cabinet and 190 type Mounting Plate should be referred to for assembly of this apparatus.

3-6. Talkback Microphone

The 40A Console includes a mounting for a 638A Microphone but the microphone itself is not furnished and should be ordered separately.

Talkback Key (K22), is interposed between the key (K7), for microphone No. 1, and the input of preliminary amplifier No. 1.

Line Inputs and Utility Inputs to Mixer. Connections for 7 incoming lines are provided. Four of these are terminated in jacks on the control console. The other three are each normal through a set of jacks, a 600 ohm to 600 ohm repeating coil (T1 to T3 inclusive) to the "cue-line mixer" keys, (K19, K20 and K21). In the normal or mid-position of these keys, the lines are shorted and the other circuits connected to these keys are open.

In the "line-mix" position of these keys (K19, K20 or K21) the line input is connected through a pad of 20 db loss to the "line-utility" keys. In the "CUE" position of these keys, cue is fed to the line as discussed in more detail later.

The "line-utility" keys (K1, K3 and K5) provide a means for transferring the input to the 3 line mixers (P1, P2 and P3) either to a "line" or a "utility" source. The arrangement of the "utility" input circuits, contemplates levels comparable with the output of the microphone preliminary amplifiers and by use of externally mounted preliminary amplifiers 3 additional microphone inputs or low level transcriptions, are provided for.

The patching jacks associated with the line and utility inputs provide means for substitution of inputs in a variety of combinations.

Seven Channel Mixer. Each of the mixer volume controls (P1 to P7) inclusive, is associated with an individual mixer transfer key, (K2, K4, K6, K8, K10, K12 and K14), which provides means for connecting the output of each mixer to

either of the two line or main amplifier channels, in any desired combination.

Resistance of 1100 ohms (R1, R3, etc.) are substituted across the line amplifier input in place of each actual mixer volume control output when it is off, or when it is connected to another line amplifier, so that each amplifier input is always terminated in approximately 180 ohms, i.e., the equivalent of 7 mixer volume controls. The 600 ohm ladder mixer volume controls are built out to 1100 ohms by series resistance R58, R59, etc., to provide proper impedance terminations.

As indicated in Figure 1, a loss of about 16 db is incurred in the mixer network.

Line Amplifier to Output Lines. Two simultaneous programs may be handled separately by the two line amplifiers, each channel being governed in over-all level by separate master gain controls (P8 and P9), between the 1st and 2nd stages of each line amplifier channel.

Output line keys (K15 for Line 1 and K17 for Line 2) provide means for connecting either of the two channels to either or both of the two outgoing lines.

In any combination of positions of the output line keys, both amplifiers and lines are always terminated in 600 ohms by the output network, made up of resistances R15 to R20 inclusive and R41 to R46 inclusive.

Keys K16 and K18, mechanically coupled to Keys K15 and K17 respectively, provide additional contacts for operation of signals, described in more detail below.

Monitor Output. A monitor output is provided in each channel of the 130B Line Amplifier. This output is isolated electrically by 20 db from the program output through a separate winding on the output transformer, and the input level to the monitor amplifier circuit is that much lower than program level.

Audition Channel. Audition key (K30) provides a means of feeding the output of either main program channel to a separate local amplifier system external to the 25B Speech Input Equipment for audition circuits or sound reinforcement in large audience studios.

Monitor Channel. The monitor key, (K29), permits the output of either main program channel to be fed through a volume control, (P10), to the monitor amplifier input (131A Amplifier). Referring to Figure 7, which is a partial schematic showing the talkback control circuits, the monitor amplifier output is normally connected to the loudspeakers in the control room, Studio A and Studio B, except under the following conditions:

- (1) When the talkback keys, (K22 and K23), are operated to Studio A or B thus operating relay S1 in the 131A Amplifier and cutting off the control room loudspeaker, or
- (2) When any microphone key (K7, K9, K11, or K13) is operated to Studio A or B, operating relay S2 or S3 (respectively) thus cutting off Studio A or B loudspeakers as indicated on Figure 7.

Operation of these circuits is further discussed below in connection with the talkback facilities.

Talkback. Talkback to either of the two studios is provided through the use of one of the 4 preliminary amplifiers (preliminary amplifier associated with microphone No. 1), either one of the line amplifier channels and the monitor amplifier. The audio circuit is indicated in simplified form on Figure 1. Transmission from the studio to the control room is through normal monitoring means as already described above. As already described, the operation of the microphone key on the console to connect the studio microphone, disconnects the studio loudspeaker as indicated on Figure 7.

In talking back to the studio from the control room, the talkback key (K22 and K23) is operated from its normal position to the Studio A or Studio B position. In either position, the operation of the talkback key opens the circuit to Studio microphone No. 1, short-circuits and grounds all other microphones in that studio, and connects the control room talkback microphone to the input of preliminary amplifier No. 1. Also, referring to Figure 7, it removes the relay operating voltage from the relay control contacts of the microphone keys for Studio A or B (depending upon the position to which the talkback key is thrown), thus removing the

operating voltage from relay S2 or S3. This reconnects the studio loudspeaker to the output of the monitor amplifier. At the same time, operation of the talkback key to either Studio A or B position, operates relay S1, cutting off the control room loudspeaker to prevent feedback.

Cue Circuits. Line-cue programs can be fed to the studio and control room loudspeakers (operation of which is automatically prevented in the same room as a live microphone as described above), by operation of a line-key (K19, etc.) to the "cue" position, and the cue key (K28) to the "line" position, with the monitor key (K29) on normal.

Air cue is fed to the monitor loudspeakers with the cue key (K28) to "air cue," with the monitor key on normal, and also to the incoming lines if the line keys (K19, etc.) are operated to the "cue" position.

Also in the normal position of the cue-key (K28) monitor output can be fed to the incoming lines.

VU Circuits. Two volume indicator meters are provided, one connected across each program output. A range key (K24 and K25) for each meter is provided, whereby the sensitivity can be decreased or increased by 5 db. Normally with the 10 db pad in, the meter reads "0" VU when +8 VU is being delivered to the output line. Cutoff keys (K33 and K34) are also provided for each meter.

4-2. Signal and Light Control Circuits

The signal and control circuits provided in the 40A Console consist of keys K26, K27, K16 and K18 (the last two being mechanically coupled to the output line keys K15 and K17 respectively), K31 and K32, signal lamps E1 to E14 inclusive, and associated terminals. These circuits may be used for signalling between the control room and master control, for operating relays or energizing signal indicators at master control, and for operating light signals in the studios. Signal facilities are provided for dispatch of two simultaneous programs.

These facilities may be employed in a number of ways depending upon the method of operation. This, however, is beyond the scope of this

Instruction Bulletin, and this discussion will be confined to the operation of the controls in the 40A Console and a description of the control and signal voltages made available for operation of the external circuits. In many cases, some or all these facilities will not be used.

The signal or control circuits in the 40A Console may be broken down into 3 separate functions, described in turn below. Reference should be made to FIG. 3 in connection with this description.

Studio Light Controls. The "Studio A" and/or "Studio B" keys (K26 and K27 respectively) are thrown to the position "CHANNEL 1" or "CHANNEL 2" depending upon the studio channel assignment.

In either position of the "STUDIO A" key, operating voltage is placed on terminal 130 to operate a "Ready" or "Standby" light in Studio A. Similarly, operating voltage is placed on the "Ready" or "Standby" light circuit for STUDIO B when the STUDIO B key is operated, (terminal 134).

Operation of keys K26 and K27 also cause signal lamps E11 to E14 (one for each of the 4 possible key positions) to light, indicating the position of these keys; i.e., E11 (Channel 1 Studio A) lights with the "STUDIO A" key (K26) in the "Channel 1" position, etc.

The studio "ON AIR" light circuits (terminals 131, 132, 135 and 136) are energized through contacts on the studio keys, K26 and K27, but only if the output line keys (K15 and 16, and K17 and 18) are operated. This is because operating voltage for these circuits is fed through the "STUDIO" and "OUTPUT LINE" keys in series. It will be noted that two "ON AIR" light circuits are provided for each studio to indicate which output line is being fed from the studio.

Signalling Control Room to Master Control. Signal lamps E3, E1, and key K31 provide a signal arrangement for output line No. 1, and corresponding circuit elements for output line No. 2. Key K31 (for output line No. 1) applies the 12-volt signal voltage to terminal 107 and may be used to transmit a signal to master control. At the same time with the strap be-

tween terminals 107 and 108, lamp E1 is lighted. As provided, this lamp merely indicates that key K31 has been operated so as to make contact. The strap between terminals 107 and 108 may be removed and this circuit wired through circuits at Master Control, if desired. Circuits associated with K-32 and E6 provide similar facilities for output line No. 2.

When voltage is applied to terminal 104 from master control, lamp E3 is lighted. Terminal 124 and lamp E8 function similarly for line No. 2.

Signal or Control voltage is applied to terminals 101, 102 and 103 (associated with output line No. 1) depending upon the position of output line key (K15 and K16) as follows:

Terminal	Condition
101	Output line 1 connected to Channel 2
102	Output line 1 connected to Channel 1
103	Output line 1 not connected

Signal and Control voltages are produced at terminals 121, 122 and 123 similarly, corresponding to the position of the output line key (K17 and K18) for line No. 2.

Output Line Signals at 40A Console and Studio On-Air Light Controls. Operation of the output line keys also controls signal lamps on the 40A Console and the Studio "On AIR" light controls. This will be described for circuits associated with output line No. 1.

Operating voltage is fed through a strap connection, terminal 106 to terminal 105, to the output line key for line No. 1 (K16). Signal lamp indication on the 40A Console for the three positions of the key are as follows:

Circuit Condition	Lamp Indication
Line to Channel 1	E4 (Channel 1, Line 1) lighted
Off or Mid-Position of Key	E2 (Go Ahead 1) lighted
Line to Channel 2	E5 (Channel 2, Line 1) lighted

It will also be seen from FIG. 3 that with the output line key operated to either channel that voltage is fed to the contacts of keys K26 and

nection should be made from terminal 3 of the 12A Power Supply to terminal 84 of the 7A Junction Box or to terminal 84 of the 40A Console Control Unit, or to any other ground. Unless such ground is avoided damage to the 313C Vacuum Tube (V5), the reference voltage vacuum tube of the 20B Rectifier, or to other circuit elements of this rectifier may result.

4-4. Technical Data

The functional schematic shown on Figure 1, indicates the system levels when all gain and volume controls are set for minimum loss, i.e., complete clockwise rotation of the control. Insertion losses of the mixer networks, pads, volume controls, etc. may be readily determined from this data. Detailed data on component amplifier and rectifier units will be found in separate instruction bulletins covering these components. The principal characteristics of the 25B Speech Input Equipment are as follows: All data are typical.

Typical Frequency Response.

Within 1 db—50 cycles to 15,000 cycles per second.

Source Impedances

Microphone Inputs } 30 ohms nominal. See 129A Amplifier Instruction Bulletin for other input impedances available.

Line Inputs } 600 ohms, nominal.

Utility Inputs } 600 ohms, nominal.

Air Cue Input } 600 ohms, nominal.

Load Impedances

Line Outputs } 600 ohms, nominal.

Audition Output } 600 ohms, nominal.

Monitor Amplifier Outputs } Furnished adjusted for loudspeaker impedances of 3 to 10 ohms. May be adjusted to a wide range of impedances. See Instruction Bulletin on 131A Amplifier. Cue output circuit is 600 ohms.

Over-All Gains

Microphone Inputs to Line Outputs } Approximately 100 db maximum gain.

Remote Line Inputs to Line Outputs } Approximately 38 db maximum gain.

Utility Inputs to Line Outputs } Approximately 58 db maximum gain.

Cue Input to Monitor Output Loudspeakers } Approximately 38 db maximum.

Air Cue to Remote Line } Approximately 6 db maximum.

Signal to Noise Ratio
Normally the 40A Console will be operated with about a total of 30 db attenuation divided between the mixer volume controls and the master gain control giving a normal operating overall gain from microphone input to line output of about 70 db. With a peak signal, or single frequency output level of +18 dbm into the line as a reference, the signal to noise ratio is about 70 db, unweighted. For noise levels of individual amplifiers, refer to the amplifier Instruction Bulletins.

Distortion

Less than 1.0 percent for single frequency fundamentals from 50 to 15,000 cycles at a normal output level of +8 dbm. When allowing for a ten db peak factor, less than 1.0 percent for single frequency fundamentals from 100 to 7,500 cycles and less than 1.5 percent for fundamentals from 50 to 15,000 cycles at an output level of +18 dbm.

Sectional Gains and Network Losses (Refer to Figure 1)

Microphone Input to Mixer Input (Gain of 129A Amplifier Channel).....	41 db gain, maximum.
Line Input to Mixer Input.....	21 db loss, approximately.
Utility Input to Mixer Input.....	0 db loss.
Mixer Network Loss.....	Approximately 16 db (mixer volume control on minimum loss).
Mixer Volume Controls (600 ohms to 600 ohms ladder type attenuator).....	20 steps total; 34 db loss in steps of 2 db, then tapered to "infinity" in 3 steps (one of about 8 db and one of about 10 db and last step to off).
Mixer Output to Line Amplifier Output (130B Amp.).....	81 db gain maximum.
Master Gain Control (100,000 ohm potentiometer).....	Has same steps as mixer volume control.
Line Amplifier Output to Line Output (Net-work Loss).....	6 db loss.

SECTION 5 — INSTALLATION

The 7A and 7B Junction Boxes, and the 12A Power Supply are completely assembled equipments and are shipped ready for installation. The 40A Console, and the KS-10284 Table and the two table legs are shipped separately and are required to be assembled.

With KS-10284 Table:

12 RHM Screws $\frac{1}{4}'' \times 20 \times 1\frac{1}{4}''$ long.....	For securing legs to table.
12 Washers $\frac{1}{4}'' \times 1\frac{1}{8}'' \times \frac{1}{16}''$	
2 Straps (BA-71660).....	For tying table legs to rear of console.
2 RHM Screws $\frac{1}{4}'' \times 20 \times \frac{7}{16}''$ long.....	
2 Washers $\frac{1}{4}'' \times 1\frac{1}{8}'' \times \frac{1}{16}''$	For fastening straps to rear of legs.
2 Hex Nuts $\frac{1}{4}'' \times 20$	

With 40A Console:

2 Washers $\frac{1}{4}'' \times 1\frac{1}{8}'' \times \frac{1}{16}''$	For attaching table leg straps to cabinet.
2 RHM Screws $\frac{1}{4}'' \times 20 \times \frac{1}{2}''$ long.....	
2 Hex Nuts $\frac{1}{4}'' \times 20$	
5 RHM Screws $\frac{1}{4}'' \times 20 \times 1\frac{1}{4}''$ long.....	For securing console cabinet to table top.

5-11. Assembly of Console and Table. To assemble the KS-10284 Table proceed as follows: The legs are assembled to the underside of the Table top as shown in Figure 2 (view C) by means of $6-\frac{1}{4}'' \times 20 \times 1\frac{1}{4}''$ long round head machine screws and $6-1\frac{1}{4}'' \times \frac{1}{8}'' \times \frac{1}{16}''$ washers for each leg. These screws should be screwed up tightly into the threaded inserts in the table top.

The 40A Console may now be placed to fit into the cut-out portion of the table top by sliding it in from the rear.

The two bend straps should now be attached to

the rear of the legs and to the cabinet as shown in Figure 2 (view B). To secure the screws and nuts holding the straps, and to fasten the console to the table top, the console should be opened up.

5-12. Internal Access to Console. To accomplish this, loosen the 2 Phillips Head Screws (one of each are at the lower corners of the mixer panel on the console) see view A Figure 2. Lift up the top, using the two knobs at the ends of the mixer panel, making sure the stay hinges lock in place.

The amplifier trays may now be lowered. **PRECAUTION:** First make sure that the trays are locked in place by inspecting the latching handles inside the console. One handle is provided for each tray inside the console at the rear. When the handle is parallel to the back of the cabinet, the tray is locked in place. Each tray is also held in place by two thumb screws underneath the tray at the rear (see figure 2, view A). These should be loosened. By grasping the latch handles inside the cabinet and turning the handle clockwise, the trays may be lowered. Each tray is provided with two hooks, one at each side. By lifting up the tray from the front and engaging the hooks with strike plates underneath the table top, the trays may be held in the open position (see end view A, Figure 2). Normally the thumb screws are not needed to hold the amplifier trays in the closed position and the inside latches are all that are necessary. To restore the trays, the hooks in front are disengaged, and the trays are lifted into place by reaching inside the opened top of the console and grasping the latch handles.

5-13. Assembly of Console and Table Top. With the console opened up as described above the console cabinet may be secured to the table top from the inside with 5 round head machine screws ($\frac{1}{4}'' \times 20 \times 1\frac{1}{4}''$) as shown on Figure 2 (views C and D).

5-2. Location of 40A Console and 7A and 7B Junction Boxes. It is intended that the wiring permanently installed in conduit be terminated in the 7A and 7B Junction Boxes. From the junction boxes connections are made to the console by means of flexible shielded cables terminated in connectors which plug

into receptacles on the ends of the 40A Console, as shown in view A, Figure 2. This illustration indicates which plug connects to which receptacle. The plugs and receptacles are so chosen that it is impossible to plug into the wrong receptacle.

Due to the fixed length of the cables (approximately 34 inches) the choice of location of the 7A and 7B Junction Boxes relative to the console is limited. These limitations are indicated in views E and F, Figure 2. View E shows the location if the boxes are located outside of the table legs (as in view A), and view F, the location of the boxes, if located inside the legs.

The optimum location is either inside or outside the legs but as close to the legs as possible. From the appearance standpoint the junction boxes should be located within the legs.

The 7A Junction Box should be located at the left end of the console and the 7B at the right end of the console. The boxes differ only in terminal designations, wiring and the fact that the 7B Box has one more cable than the 7A Box. As indicated in view G, the 7A Box handles the incoming circuits (microphones, remote lines; transcription inputs, etc.) and the 7B junction box is used for outgoing circuits, power, and signal circuits.

5-3. Installation of Junction Boxes. **PRECAUTION:** While the cables of the junction boxes will withstand many flexings in normal use, the shields have a definite minimum bending radius, and forcing beyond this point may result in breakage of the shield. Owing to the length of the cables it is possible to exert considerable leverage on the joint at the 90° elbow entrance to the junction boxes, and care must be exercised in handling the boxes to avoid excessive strain on the cables.

The terminal strips, associated wiring, and the cables may be completely removed from the box as a subassembly, when the boxes are installed in the wall. This may be done by removing the upper front cover, removing the two screws which hold the tops of each of the brackets, on which the terminal strips are fastened, to the box. The screws holding the lower portion of the front cover on the box are

then removed, and the cables and terminal strips can then be removed entirely as a complete unit.

The 7A & 7B Junction Boxes are given only a primer coat of paint so that after installation they may be finished by the customer to match the wall or as desired.

5-4. Installation of 12A Power Supply. The 12A Power Supply, consisting of the rectifiers for plate supply and transformers for filament supply, is contained in a wall mounted box shown on Figure 2. A front door hinged on the right gives access to the vacuum tube and apparatus side, and the terminal connections. The rectifiers are mounted on a hinged rack inside the box. Loosening the screws at the top of the upright mounting flanges allows the rectifiers to be hinged down for access to the wiring side and for access to the mounting holes in the back of the box. The box should be secured to the wall with 4- $\frac{1}{2}$ " or $\frac{1}{2}$ " bolts, or equivalent. Washers should be provided underneath the heads of the bolts inside the box. Mounting dimensions, location of terminal strips, clearance requirements for opening the door, and hinging out the rectifiers, are indicated in Figure 2.

5-5. Conduit Layout. The conduit layout will be determined largely by individual studio requirements. In general, however, various types of circuits should be segregated in separate conduits following the same segregation scheme as used in the cables of the 7A and 7B Junction boxes. This is shown on Figures 5 and 9 where the segregation of circuits is indicated by the cable plug and receptacle designation. Additional conduits will, of course, be necessary to provide the desired conduit runs to different locations. A typical arrangement is listed below: Figures 5 and 9 should be referred to in this connection:

Conduits from 7A Junction Box

1. Microphone Inputs
2. Incoming Lines
3. Utility Inputs

Conduits from 7B Junction Box

4. Outgoing Lines
5. Loudspeaker Circuits
6. Warning Light and Signal Control Circuits
7. Audition Output
8. Air Cue
9. Filament Supply (From 12A Power Supply)
10. Plate Supply

Conduits from 12A Power Supply

9. Filament Supply
10. Plate Supply
11. 115 V 60 Cycles AC

5-6. Wiring Audio Circuits. All audio circuits in the 25B Speech Input Equipment (with the exception of the line side of the remote line inputs) have one side of the circuit grounded. The advantages of utilizing input circuits with one side grounded in assembled equipments where the method of grounding is controlled by design, have long been recognized. These advantages are: Freedom from radio frequency disturbances, control of the high frequency response of the system, relative simplicity of switching circuits where such circuits are necessary, low and controlled crosstalk in two channel systems, and lower maintenance particularly as to switching and control elements. Furthermore, input circuits having no ground or a center tap ground may be achieved by the use of a suitable repeating coil. Such measures are, of course, only essential where (1) long input circuits on which longitudinal noise may exist, are used; (2) where jack circuits are used in inputs and care is not exercised in proper insertion of plugs; or (3) where care is not exercised in the installation of microphone input wiring to insure shield continuity and segregation of the shield from the input circuit, except at the one point where it connects to the system ground. Ordinarily, except for incoming circuits involving telephone lines, the input sources for studio audio facilities are close to the equipment and the wiring from them is subject to controlled installation. In the 25B Speech Input Equipment all audio

circuits are of the unbalanced type with one side grounded with the exception of incoming (remote) lines Nos. 1 to 7, inclusive. Lines 1, 2 and 3 are ungrounded on the input side of the repeating coils provided in each of these three lines; on the equipment side of these lines the circuits have one side grounded. Incoming lines 4, 5, 6 and 7 terminating in jacks, are also ungrounded.

In some operating conditions, particularly where lines 1, 2 or 3 are heavily equalized for transmission over a wide frequency range, the gain from the incoming telephone lines may not be sufficient for maximum operating ease. As much as 14 db of additional gain is available by replacing the resistors making up the pads associated with these three incoming lines. The maximum amount of attenuation should be used at all times, with a minimum of 6 db, to avoid the possibility of overloading the first stage of the 130B Amplifier.

The following is a list of resistors for alternate pads for three amounts of attenuation:

Series	Shunt
6 db	200 ohms R21
10 db	300 ohms to 430 ohms R55, R56 and R57
15 db	430 ohms to 220 ohms R26

All resistors are carbon type, and values should be $\pm 5\%$ RMA Standard.

As described in more detail later, mounting facilities are provided, in the 40A Console for mounting up to 8 Western Electric No. 177C Repeating Coils for providing balanced circuits if desired. Additional brackets may be ordered and added to the equipment to mount 5 more coils.

For the external audio wiring, twisted shielded pairs should be employed and the shield should be well insulated so it may be grounded at the 25B Speech Input Equipment only.

The following illustrations will be of assistance in wiring the system:

Fig. 3 Signal and Audio Schematic

Fig. 5 Wiring and Circuit Assignment Information

Fig. 8 Power Supply Schematic

Fig. 9 Power Supply Wiring Diagram

Fig. 10 Wiring Diagram 7A Junction Box

Fig. 11 Wiring Diagram 7B Junction Box

Fig. 12 Wiring Diagram 40A Console

Fig. 13 Wiring Diagram 12A Power Supply

Figures 5 and 9 consolidate this information with respect to external wiring. Figures 5 and 9 are based on the use of the 7A and B Junction Boxes, but the 7A and 7B Junction Boxes need not be used if they do not fit the installation. In this case, the receptacles J51, J52, J53, J54, and J55 in the 40A Console may be removed and connections may be made directly to the terminal strips in the 40A Console. It should be noted that the terminals in the junction boxes are designated the same as the terminals in the 40A Console, and terminals with the same number have the same circuit function.

Figure 9 shows the power supply wiring required between the 12A Power Supply and the 7B Junction Box.

5-7. Wiring Control Circuits. In devising and installing the control and signal lamp circuits, the description in Section 4-2 should be referred to and the following precautions should be noted:

12 Volt DC Supply. A 12 volt signal supply should be used. A 24 volt supply may be used, however, if the 2F lamps (12 volts) in the 40A Console are changed to 2U lamps, or similar 24 volt lamps. All switching contacts in the control circuits are from the "Ground" side of the 12 volt supply connected to terminal 138. It should be noted that all signal circuits in the 40A Console obtain both sides of the 12 volt DC supply from the supply connected to terminals 137 and 138 in the 7B Junction Box (or 40A Console), with the exception of lamps E3 and E8 which are energized by connection to the "Ground" of the supply at master control.

Key Contact Ratings. The control circuits should not be used to operate signal lamps directly (unless having low current requirements) and the current through any key contact should not exceed 0.25 ampere. The Studio "ON AIR"

and "Ready" lights should therefore be operated through relays, with one side of the relay connected to the circuits from the 40A Console (or 7B Junction Box) and the other side of the relays wired to the side of the 12 volt supply which is connected to terminal 137 in the console. "Spark Killer" filters consisting of a condenser and resistance in series should be connected across all inductive circuits.

Conduits. The control circuits should be run as single conductors in a separate metallic conduit from the 7B Junction Box.

Studio Light Controls. As indicated above these lights should be operated through relays. The "ON AIR" light controls provide for 2 light circuits to indicate the output line in use. If only one such light is desired, 2 relays with their contacts paralleled and their windings connected separately to the signal circuits should be employed. Otherwise false operation of signal lamps in the 40A Console may be obtained. For example, if terminals 131 and 132 are connected together to operate a single relay, operation of, say, the output line key for line 1 applies voltage to terminal 132, and through the cross connection, to terminal 131 also, which would energize the signal lamp for output line No. 2, as well as output line No. 1.

5-8. Adjustments and Special Features. Certain special features and adjustments required before placing the equipment in operation are described below:

5-8-1. Talkback Microphone. An external microphone connected to terminals 17 and 18 may be employed, or a Western Electric No. 633A Microphone may be added to the 40A Console. A mounting for such a microphone is provided between the two volume indicator meters. A single conductor shielded (red-green) lead connected to the 40A Console terminals 19 and 20 at one end and taped up at the other end near the microphone mounting, is provided for connection to a microphone in the 40A Console. Terminals 17 and 19, and 18 and 20 are strapped together at the terminal strip in the 40A Console to provide a parallel connection of the microphones.

To install a 633A Microphone in the 40A

Console, the rear end of the microphone housing should be removed to expose the terminals, and this part of the housing should be left off, since sufficient clearance is not otherwise available inside the 40A Console. The microphone housing in the console includes a cylindrical rubber pad and a clamp. The screw, by which the clamp is tightened, should be loosened and the microphone inserted within the rubber pad until it is felt to touch the metal screen which closes the opening in the cabinet. It should then be withdrawn about $\frac{1}{8}$ " so that it does not touch the screen and the clamp tightened to hold the microphone in place.

5-8-2. Balanced Inputs. As mentioned above, the audio circuits (with the exception of incoming lines) have one side grounded. Ungrounded, or balanced inputs can be employed if repeating coils are added. Brackets are provided inside the 40A Console for adding up to 8 No. 177C Repeating Coils. Circuit and wiring modifications required for the microphone inputs are shown on Figure 6.

The repeating coil brackets are located inside the cabinet on the left hand side on the rear wall of the cabinet. Coils on the upper bracket should be mounted with their terminals down and coils on the lower bracket with their terminals up.

Figure 6 shows the electrostatic shield connected to the shield of the input wiring. Other possible connections include connection to the shield of secondary wiring or to the repeating coil primary mid tap, when a mid tap ground is used, etc. The connection giving minimum noise should be employed.

Additional brackets may be ordered as described elsewhere in this bulletin and installed in the 40A Console for additional repeating coils if desired in other output and input circuits.

5-8-3. Talkback Circuit and Loudspeaker Cutoff Relays. In order to operate the studio and control room loudspeaker cut-off relays, terminals 69 to 78 should be strapped together as required at the terminal strips in the 40A Console. The description of the operation of this circuit and note 3 on Figure 7, should be referred to in this connection.

5-8-4. Loudspeakers. As supplied, the 131A Amplifier is wired to operate loudspeakers having impedances of about 3 to 10 ohms. If the loudspeakers have other impedances, it will be necessary to change the connections and substitute resistance loads in the 131A Amplifier. The bulletin covering the 131A Amplifier should be referred to in this connection.

5-8-5. VI Meter Sensitivity. Referring to Figure 3, the VI meters are provided with a range key (K24 and K25) such that there are 3 selections of meter sensitivity differing by 5 db, i.e., an increase in sensitivity of 5 db or a decrease of 5 db. In the normal or mid-position of the VU Range Key, and with a +8 VU level into the output line, the line amplifier output level is +14 VU, and loss in the meter circuit and the meter sensitivity is such that the meter reads "0 VU". The VU Range Keys then provide a means to also obtain a "0 VU" reading with either +13 VU into the line or +3 into the line.

The circuit associated with this meter may be changed to provide other sensitivity adjustments if desired by changing the loss in the pads associated with keys K24 and K25. The proper meter characteristics are obtained when the resistance of the circuit external to it matches its own resistance, i.e., 3900 ohms. Hence when operating across a 600 ohm line, 3600 ohms should be connected in series with

the meter so that the meter looks back at 3900 ohms. The sensitivity of the meter with this series resistance is such that with a level of +4 VU in the 600 ohm circuit, the meter reads "100%" or "0 VU". With a +14 VU level at the line amplifier output (+8 VU at the output line), a 10 db loss in a pad is therefore required for "0 VU" meter reading.

New resistance pad values for any desired loss can be calculated by determining the series and shunt arms of a symmetrical T pad having the desired loss for matched input and output impedances of 3900 ohms. A resistance of 3600 ohms is then added to the series arm which is connected to the amplifier output. As a result the combination looks like 7500 ohms from the amplifier.

5-8-6. AC Line Voltage Adjustments. Adjustments may be required for the AC line voltage in the 18B Rectifier (part of 12A Power Supply), and the instruction bulletin on this rectifier should be referred to.

5-8-7. Input Impedances. As described in the Bulletin for the 129A Amplifier microphone input impedances of 250 ohms and 600 ohms nominal are also available by changing the terminal connections in the 129A Amplifier. If any changes are made, however, and repeating coils are used, a different connection of the repeating coil may also be necessary.

SECTION 6 - OPERATION

Also before applying power for the first time all volume controls on the 40A Console should be turned to minimum volume, i.e., full counter-clockwise position, so that in event excessive input exists on any of the inputs, damage will not be done to the VI meters, etc.

6-1. Application of AC Power. A power switch controlling the AC power to the 18B and 20B Rectifiers is located on the front of the 12A Power Supply. In addition the 18B and 20B Rectifiers each has an individual power supply switch which is located on the wiring side of the rectifier units. A check should be made to make sure that these switches are "ON".

After wiring is complete and before putting AC power on the system, vacuum tubes should be placed in the component amplifiers and rectifiers which are listed below in accordance with the instructions given in the individual instruction books covering these units.

129A Amplifier (in left hand tray of 40A Console).

130B and 131A Amplifiers (in right hand tray of 40A Console).

18B and 20B Rectifiers (in 12A Power Supply).

The vacuum tube sockets in these units are marked with the designation of the tubes required.

Also, before turning on the power, the potentiometer P1 on the 20B Rectifier should be adjusted as described in the instruction book covering this rectifier.

The main power switch on the front of the 12A Power Supply may now be turned to "ON". The lamps illuminating the VI meters in the 40A Console should light. The plate voltage of the 20B Rectifier may now be adjusted to 275 volts as described in its Instruction Bulletin.

Switch Position	Designation	Amplifier	Tube	Channel
1	PM-1-1	129A	V1A	Preamplifier No. 1
2	PM-1-2	"	V2A	Preamplifier No. 1
3	PM-2-1	"	V3A	Preamplifier No. 2
4	PM-2-2	"	V4A	Preamplifier No. 2
5	PM-3-1	"	V1B	Preamplifier No. 3
6	PM-3-2	"	V2B	Preamplifier No. 3
7	PM-4-1	"	V3B	Preamplifier No. 4
8	PM-4-2	"	V4B	Preamplifier No. 4
9	LN-1-1	130B	V1A	Line Amp. No. 1
10	LN-1-2	"	V2A	Line Amp. No. 1
11	LN-1-3	"	V3A	Line Amp. No. 1
12	LN-2-1	"	V1B	Line Amp. No. 2
13	LN-2-2	"	V2B	Line Amp. No. 2
14	LN-2-3	"	V3B	Line Amp. No. 2

The meter is of the percentage type and normal reading of all tubes is 100%. A variation of $\pm 15\%$ from this reading may be considered normal, and an even greater deviation does not necessarily indicate trouble. For actual plate currents and further comments, the individual amplifier and rectifier bulletins should be referred to.

After application of power as described above the 25B Speech Input Equipment is ready for operation.

6-2. Operating Precautions. It is important that the operator have a thorough understanding of the operation and functioning of all controls as described in this bulletin.

6-21. Normal Volume Control Settings. For normal average input levels, the system

6-11. Plate Current Readings. After this adjustment has been made, the plate currents of the tubes in the amplifiers in the 40A Console may be checked by means of the plate current meter located on the left hand side of the console. A rotary switch associated with the meter permits all plate currents (except for the 131A Amplifier) to be read in turn. Switch positions and the tubes whose plate currents are indicated, are as follows, starting from the "OFF" position of the switch:

tionate setting of controls and with a high line level that the first amplifier stage in the line amplifier (130B) may be overloaded. Overloading of the last stage of the line amplifier may be avoided by observing the VI meters. It is usual to operate at a VU level not exceeding about 10 db below the single frequency load carrying capacity of the amplifier. In the 25B Speech Input Equipment, this corresponds to about +12 VU at the output terminals. For peaks 10 db higher than this the amplifier output stage would introduce about 1% harmonic distortion (on the peaks

only, however,); comparable additional distortion would be introduced in the line amplifier input stages for levels of about -29 VU or higher at the input.

From the amplifier gain and network loss data, it can be determined that such an input level would exist if, with a +12 VU output level, the master gain control was set for about 34 db loss or more. Hence, danger of overloading exists on signal peaks, at output line levels of more than about +12 VU, or if the sum of the line level in VU plus the master gain control loss setting in db exceeds a figure of about 44.

SECTION 7 - MAINTENANCE

In addition to this bulletin, reference should also be made to the bulletins covering the 129A, 130B and 131A Amplifiers and those covering the 18B and 20B Rectifiers.

Normal maintenance will consist of a check of plate current readings at regular intervals as directed under operation, and replacement of vacuum tubes when required. At longer intervals key, jack and relay contacts may require cleaning and potentiometers may require cleaning and lubrication.

7-1. Contacts. Carbon tetrachloride applied with a toothpick may be used to clean relay and key contacts. If this does not clear up noise or poor contact, the contacts should be burnished using a Western Electric 374A Tool.

7-2. Potentiometers. Cleaning of contacts with a cloth moistened with light mineral oil is recommended. A slight film of oil should be left to provide lubrication.

7-3. Location of Trouble. Trouble in the 25B Speech Input Equipment is readily traced and localized by means of the normal operating controls and switches, etc. For example, if the trouble is in one of the two channels of the 130B Amplifier, transfer of all inputs and the output to the other channel would clear the trouble and indicate that the trouble is in the other channel. Similar lines of reasoning apply

to tracing down trouble in other parts of the system.

Schematics and wiring diagrams of the 40A Console, the 7 type Junction Boxes and 12A Power Supply needed for maintenance of this equipment form part of this instruction bulletin. Similar information on the component amplifiers and rectifiers is included in the separate bulletins on these units.

Attention is called to the DC Voltage Data given on the schematic diagrams included in the instruction books on the 129A, 130B and 131A Amplifiers and the 18B, and 20B Rectifiers. In event of trouble a check of the operating voltages will assist in tracing the defect.

Access to the wiring of the component amplifiers is obtained by opening the console and hinging out the amplifier trays. Removal of the cover plates on the bottom of the trays will give access to the amplifier wiring.

CAUTION: Voltages of 275 volts exist at the terminals in the 7B Junction Box, the 40A Console 12A Power Supply (including component rectifiers), and on the wiring side of the amplifiers in the 40A Console.

7-4. Replacement Parts. If replacement parts are required they may be procured through the nearest distributor. Apparatus lists giving ordering information for all component parts of the equipment are shipped with the apparatus.

Western Electric

20B RECTIFIER

Type

Full-wave vacuum-tube rectifier incorporating a vacuum-tube voltage-regulating circuit with provision for preventing the plate voltage from rising above its final value during the warm-up period of the voltage-regulator tube.

Typical Characteristics

Input—105-130 volts, 50 to 60 cycles. Power consumption approximately 55W.-7A at 115 volts for no load and 196W.-1.7A for rated load.

Output—Rated load-plate supply 110 milliamperes at 275 volts d-c and filament supply 10 amperes at 6.3 volts a-c.

Plate Supply Regulation—3 volts max. voltage change from no load and +10 per cent line voltage to rated load and -10 per cent line voltage.

Plate Supply Ripple—Approximately 5 millivolts rms at rated load.

Equipment Characteristics

Dimensions—Mat—19½ x 6¾ inches. **Chassis**—Overall including mounting flanges, 18½ x 6¼ x 2 inches. Width of recessed section, 17 inches.

Maximum Depth of Apparatus—6¾ inches, from front edge of chassis.

Weight—26 pounds.

Mounting—Recessed panel type designed to mount vertically on standard relay rack or speech-input cabinet where it occupies 7 inches of panel space. May also be mounted horizontally on a flat surface by moving the power switch and potentiometer to either

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horizontally on a flat surface. This necessitates moving the power switch D1 and the adjustment potentiometer P1 to one or the other of the long side walls of the chassis. Knockouts are provided at these alternate positions for mounting the switch and the potentiometer. The bracket on which the potentiometer is mounted must be removed if the nearby alternate position in the side wall is used. After mounting the controls in the new positions, the wiring (which is of sufficient length to reach these positions) should be reconnected in accordance with the wiring diagram.

Connections-External

Terminals	Circuits
15-16	A-C power, 15 to grounded side of line
13-14	6.3 volt amplifier filaments, max. 5 amperes
11-12	6.3 volt amplifier filaments, max. 5 amperes
7-9	Ground terminals—connect one to a good ground
1-3-5	Plate supply, positive
2-4-6	Plate supply, negative

NOTE—Negative plate supply is grounded at the rectifier by a strap to terminal 7. In some cases, quieter operation may be obtained by grounding the negative at one of the amplifiers being supplied by the rectifier, in which case disconnect the strap from terminal 6 to 7.

Use 14-gauge twisted-pair copper wire for a-c power. Use shielded twisted-pair copper wire for amplifier filaments and plate supply-22 gauge or larger for plate supply.

If individual pairs are used for the filament of each amplifier the wire may be as small as No. 18 gauge if the length is such that the voltage drop in the wire does not exceed 0.2 volt. If one pair of wires is used for more than one amplifier, its size should be such that the current-carrying capacity of the wire is not exceeded and the voltage

drop in the wire is not more than 0.2 volt. When the total filament load is taken on a number of pairs, the connections of these pairs should be distributed between the two sets of filament supply terminals so as not to exceed approximately 5 amperes per set.

Vacuum Tubes

The following vacuum tubes are required for operation of this rectifier and must be ordered separately.

- 1 Western Electric 274A or type 5Z3
- 1 Western Electric 300B or type 2A3
- 1 Western Electric 351A or type 6X5 or type 6X5G
- 1 Western Electric 348A or type 6J7 or type 6J7G
- 1 Western Electric 313C

NOTE—Special instructions when Type 2A3 tube is used:

1. Limit 275 volts output load to 75 milliamperes for optimum tube life.
2. Make sure filament voltage at socket VS2 is 2.5 volts instead of 5 volts as furnished. 2.5 volts are obtained by moving the WHITE-GREEN wire, normally on terminal 5 of transformer T1, to terminal 6. The WHITE-RED wire normally connected to terminal 6 should remain connected.

CAUTION—High voltages are exposed to the operator's touch whenever the mat is removed. High voltages may be present even with the a-c power off or disconnected. For example, across the filter condensers C1 and C2 after failure or removal of the 300B or 2A3 tube during operation. Exercise extreme care at all times when mat is not in place to avoid contact with dangerous voltages.

Operation

After the rectifier has been installed and connected it should be equipped with vacuum tubes as listed above. The locations of the tubes in their respective sockets can be ascertained by the tube markings stamped beneath each vacuum-tube socket.

WARNING—Before operating the power switch to turn on the rectifier for the first time, be sure that the potentiometer P1 has been turned to the extreme counterclockwise (min. voltage) position, to avoid delivering a higher voltage at the output than the external apparatus connected to the output can stand.

To place the rectifier and associated amplifiers in operation, connect a 1000 ohms per volt voltmeter across the d-c output and operate the power switch to the "ON" position. After allowing 10 or 15 minutes for the rectifier to reach stable operating temperature, adjust the potentiometer P1 until 275 volts is obtained at the output. Turn off power switch, disconnect the voltmeter, replace the mat over the chassis, and the equipment is ready for use.

Circuit Description

A brief description of the functions of the more important elements in this rectifier will clarify the manner in which it operates. Referring to the schematic Figure 1, V1, C1, L1 and C2 comprise a conventional full-wave rectifier with filter delivering approximately 700 volts to the 300B tube, V2, which acts as a variable impedance in series with the positive output circuit reducing this voltage to the value determined by the setting of P1, normally 275 volts. During operation, a fraction of the output voltage is taken by the voltage divider, R1, R2-1, P1 and R2-2, amplified by the 348A tube, V4, and applied to the grid of V2 where it varies the plate impedance of this tube in accordance with small changes in output voltage, thus com-

pensating for the change and maintaining the output voltage constant. The 313C tube, V5, is a cold-cathode gas-filled tube whose function is to establish a reference voltage against which variations in the a-c line and output voltages can be corrected. This tube requires about 70 volts for initial ionization, after which the voltage sustained across the control gap is approximately 60 volts independent of the current.

The function of V3, the 351A tube, is to limit the output voltage at terminal 1 during the warm-up period of V4. This prevents excessive voltage on the plates of the vacuum tubes in the associated amplifiers while the filaments are heating. When the rectifier is first turned on and V1 and V2 become operative the gas tube V5 is ignited at once by voltage applied through V2, R5, R3 and R2-3, and a potential of approximately 60 volts is established across V5. The resistance of R3 and R2-3 combined is low relative to the resistance of R5 so that the cathode and plate of V4, and the grid of V2 are also at a potential of approximately 60 volts. Under these conditions V4 is inoperative and the grid of V2 is highly negative in respect to its filament, consequently its plate resistance is high, limiting the voltage on output terminal 1. During this period V3, being a heater type tube, is non-conducting. As V3 warms up simultaneously with V4 and passes current, R5 is effectively shorted out; current flows through R4 to the plate of V4 creating a potential difference between the plate and cathode of this tube so it can function normally. At the same time this increase of voltage on the plate of V4 is equivalent to a reduction in bias between the filament and plate of V2 which lowers the plate resistance and increases the output voltage until equilibrium is established by the regulator circuit at the value determined by the setting of P1.

In this connection, it should be noted that P1 is provided primarily to adjust for aging of the gas tube V5 and for commercial variations in the resistors used in the regulator circuits. However, output voltages higher or lower than 275 volts may be obtained by adjustment of P1 with the following limita-

tions. As the output voltage is increased the load current which can be obtained without loss of regulation will be reduced. Typical maximum load current values are 20 milliamperes at 450 volts and 70 milliamperes at 375 volts. The output voltage should not be adjusted to more than 450 volts otherwise the current through the 313C tube will exceed its rated value of 10 milliamperes. As the output voltage is decreased the load which must be absorbed by the 300B tube V2 increases and the output current capacity must correspondingly be reduced to avoid overloading the 300B tube. Typical limiting values of output current for several output voltages below 275 volts which will give the same dissipation in the 300B tube as at rated load are 90 milliamperes at 250 volts and 72 milliamperes at 204 volts. At very low output currents and low output voltage some loss in regulation will result. On a typical rectifier supplying a load at 225 volts, 5

Maintenance

Test points are provided for determining the operating characteristics of V5. The voltage across this tube when measured with a voltmeter of at least 1000 ohms per volt should not exceed 65. While the tube may function when the voltage drop across it is in excess of 65, the noise level of the rectified voltage will become excessive and the regulating circuit may oscillate. Consequently, the tube should be replaced.

If replacement parts are required for the 20B rectifier they may be procured through the nearest distributor.

