SERVICE MANUAL

M-100
M-3
M-2
M

INCLUDING PARTS LIST

CAUTION
SEE SAFETY NOTICE ON INSIDE COVER SHEET

HOOO-006059

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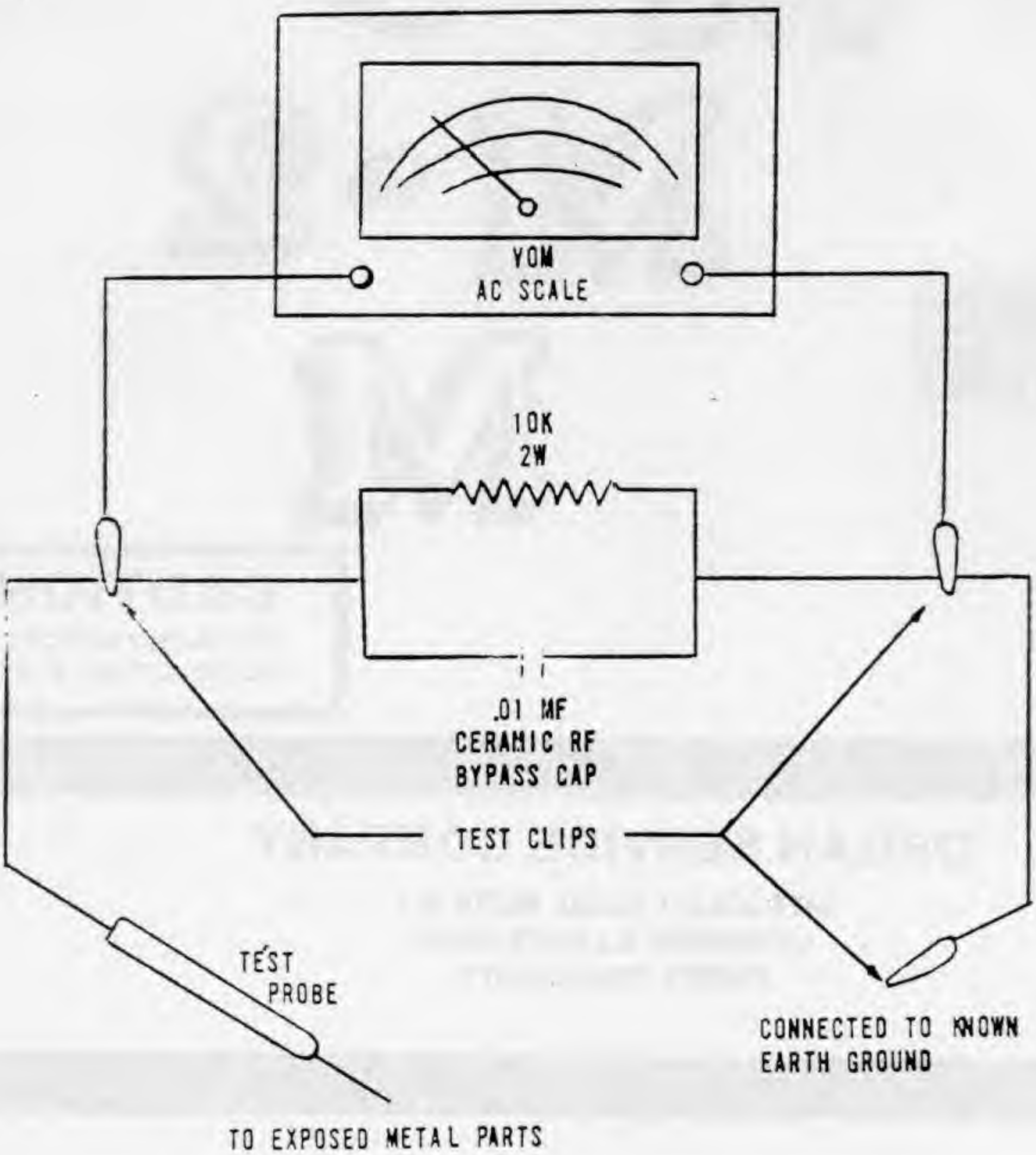
SAFETY NOTICE

Great care has been taken in the design and manufacture of this product to assure that no shock hazard exists on any exposed metal parts. Internal service operations can expose the technician to hazardous line voltages and accidentally cause these voltages to appear on exposed metal parts during repair or reassembly of product components. To prevent this, work on these products should only be performed by those who are thoroughly familiar with the precautions necessary when working on this type of equipment.

To protect the user, it is required that all enclosure parts and safety interlocks be restored to their original condition and the following tests be performed before returning the product to the owner after any service operation.

Plug the AC line cord directly into a line voltage AC receptacle (do not use an isolation transformer for this test) and turn the product on. Connect the network (as shown below) in series with all exposed metal parts and a known earth ground such as a water pipe or conduit. Use an AC VOM of 5,000 ohms per volt or higher sensitivity to measure the voltage drop across the network. Move the network connection to each exposed metal part (metal chassis, screw heads, knobs and control shafts, escutcheon, etc.) and measure the voltage drop across the network. Reverse the line plug and repeat the measurements. Any reading of 4 volts RMS or more is excessive and indicates a potential shock hazard which must be corrected before returning the product to the user.



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GENERAL DESCRIPTION

The Hammond Organ "M" Series Spinet Consoles are completely self contained, requiring no external tone cabinet. All Models have two (2) manuals of forty-four (44) keys each, a 12 (M, M-2, M-3) or 13 (M-100) note pedal keyboard, and an expression (or swell) pedal for controlling the volume. All tones are produced by electro-magnetic tone generators and electrically amplified. Selection of tone colors is made by adjusting eighteen(18) drawbars, and other characteristics of the music are adjusted by means of tilting control tablets and tab switches. A push button and a toggle switch or two toggle switches located in the front of the Console are used to turn on the organ.

Figures 1 thru 7 show the front and rear views of the "M" Series Models. The rear views are shown with the dust covers removed. Console rear panels are an optional accessory and are not shown.

INSTALLATION AND MAINTENANCE

A card packed with the playing instructions or located in the bench gives full information on installing the organ, oiling, and packing for moving or shipment. (See Back Cover)

MUSICAL TERMS

The service man who has had no musical training will find the following information helpful in studying the operation of the organ.

NOTES AND OCTAVES

Keyboard instruments are divided into "octaves" of 12 keys or notes, each with seven (7) "naturals" (white keys) and five (5) "sharps" or "flats" (black keys) in a definite sequence. Black keys occur in groups of two and three in each octave and offer a convenient way to identify the notes of the octave. Technically there is no difference between a black key and a white one, since each key has a frequency 1.059 times the frequency of the next one below it.

Each note has a frequency exactly one half that of the corresponding note in the next higher octave. Each white key is called by a letter for A to G and these letters are known as "note of the musical scale". A black key may be called a "sharp"of the notes below it or a "flat" of the notes above it; for instance, the black key between C and D may properly be called C# (Sharp) or D^b (D flat).

HARMONICS OR OVERTONES

Any musical note has a definite fundamental pitch or frequency and also a certain "tone quality" or "timbre" depending on its wave shape. A complex note is one which includes not only a fundamental frequency but also one or more "harmonics" or "overtones," each of which is an integral multiple of the fundamental frequency. Such a combination is more pleasing musically than a note having only a single frequency. The ear does not distinguish the harmonics independently, but instead identifies the note as a complex tone having the pitch of the lowest component, or fundamental.

HOW THE ORGAN WORKS

Most tone sources, such as strings, reeds, or pipes, produce complex tones. The Hammond tone producing mechanism, however, generates individual frequencies which can be combined by means of harmonic drawbars to produce any desired tone quality. The block diagrams in Figures 8 thru 11 show the chief components of the instruments.

Electrical impulses of various frequencies are produced in the "tone generator" which contains a number of "tone wheels" driven at predetermined speeds by a motor and gear arrangement. Each tone wheel is a steel disc similar to a gear, with high and low spots, or teeth, on its edge (see figure 12). As the wheel rotates these teeth pass near a permanent magnet, and the resulting variations in the magnetic field induce a voltage in a coil wound on the magnet. This small voltage, when suitably filtered, produces one note of the musical scale, its pitch or frequency depending on the number of teeth passing the magnet each second.

A note played on either manual of the organ consists of a fundamental pitch and a number of harmonics, or multiples of the fundamental frequency. The fundamental and eight harmonics available on each playing key are controllable by means of drawbars. By suitable adjustment of these controls the player may vary the tone colors at will. The M-100 Console has several preset tabs which make several pre-selected tones available.

MODEL M

Mixed tones from the manuals are amplified and then pass through the vibrato mechanism, the expression control, and additional stages of amplification before reaching the loudspeaker.

MODEL M-2, M-3, M-100

Mixed tones from either the upper or the lower manual may go through either the "Vibrato" channel or the "No Vibrato" channel, depending on the position of the corresponding vibrato selector of "Vibrato Cancel" tabs. (The upper manual is called "Solo" on the selector tab of the M-2 and M-3 to indicate that it is best suited for playing melody or solo parts of the music.) The tones are then combined and passed through the expression control and additional stages of amplification before reaching the speaker(s).

MODEL M-3, M-100

Percussion tones are produced by borrowing a signal from the upper manual 2nd harmonic drawbar, 3rd harmonic drawbar, or both, amplifying it, returning part of the signal to the same drawbar, and conducting the balance of the signal through push-pull control tubes where its decay characteristics are controlled. The percussion signal is then combined with the signal from the manuals after the vibrato system but before the expression control. The control tubes are keyed through the 6th harmonic key contacts and bus bar.

The pedal tones do not require drawbars for tone color variation, because they are produced as complex tones by special tone wheels. From the pedals these tones go to a pedal amplifier, where the attack and decay characteristics are controlled. The single pedal drawbar adjusts the volume of the pedals relative to that of the manuals, and the pedal signal than is combined with the signal from the manual before passing through the expression control, but after the vibrato system.

CONSTRUCTION AND OPERATION OF COMPONENTS

In reviewing this section refer to the schematic circuits of the entire organ systems in the back of this manual. Connections between components are shown in the wiring diagrams and control assembly wiring drawings, also in the back of the manual.

MOTORS AND POWER SWITCHES

The tone generator assembly in which all tones of the organ originate, is driven at constant speed by a synchronous motor, located at the left side as you look in at the back of the Console. Attached to it is the vibrato scanner. As the synchronous motor is not self-starting, it must be brought up to speed by a starting motor at the opposite end of the generator.

The procedure for turning on the organ is as follows: Push the "start" switch up (M-3, M-100) or in (M, M-2) and hold it for approximately eight seconds. This allows time for the starting motor to bring the generator up to slightly above it synchronous speed. While still holding the "start" switch, push the "run" switch upward to its "on" position. This turns on the synchronous motor and at the same time introduces a resistor in series with the starting motor to reduce its power. Hold the "start" switch about four seconds longer and then release it.

During this time the braking action of the synchronous motor, together with the reduction in power of the starting motor, brings the system to synchronous speed so that the synchronous motor can carry the load.

To turn off the organ, push the "run" switch downward to the "off" position.

TONE GENERATOR

All tones of the organ originate as electrical signals in the tone generator assembly. The M, M-2 and M-3 contains 86 tone wheels while the M-100 has 87. Each of these wheels has various numbers of teeth, with suitable gears for driving them at various speeds from a main shaft extending along the center. Each pair of tone wheels is mounted on a shaft and between them is a bakelite gear held between two coil springs, forming a mechanical vibration filter. As the gear is not rigidly attached to the shaft, any pair of wheels which may be stopped accidentally will not interfere with the operation of the others.

Adjacent to each tone wheel is a magnetized rod with a pick-up coil wound on it. These magnets extend through the front and back of the generator, and are held by set screws which can be loosened in case adjustment is ever necessary. Figure 13 shows where to find the magnet for any frequency number. In this drawing the dotted lines indicate frequencies whose tone wheels are on the same shaft.

On top of the tone generator assembly are small transformers and condensers, forming tuned filters for the higher frequencies. They are not likely to need replacing. In case one filter becomes inoperative, both the transformers and condenser must be replaced with a matched set from the factory. Figures 14, 15, 16 and 17 show the locations of these filters on the indicated models. A few frequencies use untuned filters consisting of coils alone.

The output frequencies of the tone generator are numbered, for convenience, in order of increasing frequency. The lowest, number 1, is about 32 cycles per second, and the highest, number 91, is about 6000 cycles per second. Frequency numbers 1 to 12 (1 to 13 on M-100) are used for pedals; numbers 13 to 17 (14 to 17 on M-100) are omitted; and numbers 18 to 91 are used for the manuals.

In case any generator frequency is weak or absent, refer to "Practical Service Suggestions" for the procedure to be used in locating and correcting the trouble.

The output terminals of the generator consist of solder lugs mounted on the filter transformers, to which the manual cable and pedals are connected. The frequency numbers of all terminals are indicated in Figures 14, 15, 16 and 17.

MANUALS

Musical frequencies from the tone generator go through the manual cable to terminal strips on the two manuals and from them to the key contact springs.

Each of the two manuals has forty-four (44) playing keys, or approximately 3-1/2 octaves. The two manuals do not cover exactly the same pitch range, but they are arranged so that keys of like pitch are in line. Middle "C" is the first C on the upper manual and the key in line with it on the lower manual.

Under each key are a number of contact springs (for the fundamental and harmonics of that key) which touch an equal number of busbars when the key is pressed. (Some keys at the right end of each manual have fewer springs, as noted below). All contact springs and busbars have precious metal contact surfaces to avoid corrosion, and the manuals are sealed to exclude dust so far as possible. In case a contact becomes dirty in spite of these precautions, a busbar shifter (shown in Figures 3, 5,7) is provided in each manual to slide the busbars endwise and thus provide a fresh contact surface.

The busbar shifting mechanism is somewhat different on the M-100 than on prior models of the Hammond Orgam Models M, M-2 and M-3. Looking under the lower manual on the left hand end, a black wood end block will be observed. One half inch from the front of this block is a drilled hole. Within this drilling is a small metal tongue with a punched hole. Using either long nose pliers or a hook, this tongue can be moved in and out and it in turn moves the busbars. The upper manual shifter is in a similar place, but requires removal of the generator dust cover to gain access to it.

The key contacts are connected through resistance wires to the manual terminal strips. The manual wiring chart Figure 18, shows how the contact of each key are connected to the proper frequencies to supply the fundamental and harmonics of that particular key. The blank spaces indicate that no key contact is used, inasmuch as the highest harmonics of the highest keys are above the range of the tone generator and are not required. Since the percussion control tubes in the M-3 and M-100 are keyed through the 6th harmonic busbar, the blank spaces in this row have contacts connected to ground through resistance wires.

The busbars of each manual, each one carrying a certain harmonic, are wired to the harmonic drawbars for that manual in the M, M-2, M-3 and through the "Drawbars" tab in the M-100.

HARMONIC DRAWBARS

The left group of eight (8) harmonic drawbars (Figure 19) is associated with the lower manual, and the right group of nine (9) drawbars controls the upper manual. By sliding these drawbars in and out, the organist is able to mix the fundamental and harmonics (or overtones) in various porportions. The distance a bar is pulled out determines the strength of the corresponding harmonic; and if a drawbar is set all the way in, the harmonic it represents is not present in the mixture. Neither manual will play unless at least one of its drawbars is pulled out at least part of the way in the case of the M, M-2, M-3, or with the "Drawbars" tab pressed or preset tab pressed in the M-100.

The drawbars slide over nine (9) busbars, representing intensity levels, and each drawbar has two contacts connected together by a one ohm resistor. As the drawbar moves, at least one of the contacts is touching some busbar at all times, and therefore there is no "dead spot" in the drawbar motion. The one ohm resistor avoids an actual short circuit between adjacent busbars. These busbars extend the length of the drawbar assembly but are split in the middle to form two groups of nine (9). Those in the left group, under the lower manual drawbars, are connected to low impedance primary taps on the lower manual matching transformer. Similarly, those in the right group, under the upper manual drawbars, are connected to taps on the upper manual matching transformer. Signals from the high impedance secondaries of these two transformers go through the lower manual "Vibrato Cancel" and upper manual "Vibrato Cancel" tabs to the apmplifier input terminals.

PEDAL DRAWBAR

The 12 (M, M-2, M-3) or 13 (M-100) playing pedals are operated by the left foot and are connected to the lowest 12 or 13 frequencies of the generator. The center drawbar adjusts the volume of the pedals. It operates a variable condenser (shown in Figures 3, 5, and 7) which is connected to the pedal section of the amplifier. For operation of the circuit see description of "amplifier."

PEDAL KEYBOARD

The 13 playing pedals are operated by the left foot and are connected to the lowest 13 frequencies of the generator. Like the manuals, they have light and dark keys arranged in the standard octave pattern. Figures 20 and 21 identifies the pedals and shows the generator frequency number associated with each.

A "pedal contact" on each pedal opens when the pedal is pressed, thereby allowing the correct generator frequency to reach the amplifier. In addition there is a "pedal keying contact" for all pedals, which closes when any pedal is operated. It serves to key the pedal amplifier, causing the note to sound at the desired rate.

When a pedal is pressed its "pedal contact" opens first, selecting the correct note. Immediately the "pedal keying contact" closes, causing the note to sound. When the pedal is released a mechanical latch keeps the "pedal contact" open, so that the last-played pedal note continues to sound for a length of time determined by the position of the pedal "Fast Decay" and "Pedal Legato" tabs in the M-100. In the M, M-2, and M-3, the time which the pedal sound is heard is determined by the setting of the "Pedal Decay" tablet and a "Pedal sustaining control" attached to the expression control. The electrical operation of these circuits is described under "amplifier".

EXPRESSION PEDAL

The "expression" pedal, sometimes called "swell" pedal (Figures 1, 2, 4, and 6) is operated by the player's right foot and varies the volume of both manuals and pedals together. It is connected mechanically to a special variable air condenser mounted on the amplifier. When the pedal is tilted back (closed) by pushing on the player's heel the music is softest, and when pushed forward (opened) by the player's toe the music is loudest.

In the M, M-2, and M-3, attached to the expression pedal is a "pedal sustaining control" lever, which is operated by sliding the foot sidewise on the pedal. If this lever is not pressed, each pedal note dies away rapidly or slowly, depending on the setting of the "pedal decay" tablet. If the lever is pressed to the left, the last-played pedal note dies away much more slowly.

CONTROL TABLETS

The Model M has 6, while the M-2 and M-3 have 7 of these control tablets and each has two positions (figures 1, 2 and 4). The "volume" tablet changes the overall volume and thus supplements the expression pedal. The "pedal attack" tablet determines how fast a pedal note sounds after a pedal is depressed, and "pedal decay" determines how fast the sound dies away after the pedal is released.

The "vibrato lower manual" and "vibrato solo manual" tablets turn the vibrato effect on and off independently on the lower and upper manuals respectively. The next tablet provides a choice of "normal vibrato" or "vibrato chorus" (it is effective only when the vibrato effect is on). The last tablet can be set for "small" or "normal" vibrato to adjust the extent of the pitch variation provided by the vibrato mechanism.

The M-100 has 24 tabs, each providing some change in the instruments operation, To have the instrument sound after turning it on, tabs such as "Full Organ" and "Ensemble" will place the upper and lower manual in operation. A tab is in use when in the down position. Functions of the various tabs from left to right as they appear on the instrument are given in the following paragraphs.

PERCUSSION CONTROL TABLETS

The M-3 and the M-100 are the only two Models which contain percussion and each unit has four (4) associated tabs.

In the M-100, these tabs operate only when the upper manual "Drawbars" tab is pressed. Pressing either "Second Harmonic" or "Third Harmonic" will, when the Upper manual is played, cause the tone to sound percussively (in addition to sustained organ tones). Both tabs can be pressed, giving a combination percussive tone. "Fast Decay" causes the percussive tones to fade away with greater rapidity. "Percussion Soft" reduces the volume for the percussive signal.

In the M-3, when the "Percussion" on-off tablet is "On", the Solo (Upper) manual will play 2nd or 3rd harmonic tones percussively (in addition to the sustained organ tones). The "Volume" tablet in "Normal" position allows the per cussion tones to sound percussively as with the M-100 and reduces the level of the Solo manual sustained organ tones to maintain proper balance between the manuals. In "Soft" position it allows the percussion tones to sound only softly and restores the full level of the Solo manual sustained organ tones. The "Decay" tablet determines how fast the percussion tones fade away when the Solo manual key is pressed.

Operation of the electrical circuits associated with the percussion feature are described in the percussion section of the amplifier theory.

VIBRATO TABLETS

The Model M vibrato uses three control tabs. Two degrees of vibrato are available with the "amount of Vibrato" tablet and the "Vibrato Chorus". A third tablet marked "Vibrato" turns the effect on or off.

The M-2, M-3, and M-100 have a selective vibrato system, using four (4) control tablets to vary the vibrato effect. On the M-100 series only, an additional stop (Vibrato Cancel) to the right of the preset tabs permits any Vibrato effect to be cancelled immediately.

The vibrato effect is created by a periodic raising and lowering of pitch, and thus is fundamentally different from a tremolo, or loudness variation. It is comparable to the effect produced when a violinist moves his finger back and forth on a string while playing, varying the frequency while maintaining constant volume.

The Hammond Vibrato equipment (See Fundamental Diagram of Vibrato System, Figures 22, 25,26) varies the frequency of all tones (excepting the pedal and percussive tones) by continuously shifting their phase. It includes a phase shift network or electrical time delay line, composed of a number of low pass filter sections, and a capacity type pickup or scanner, which is motor driven so that it scans back and forth along the line.

Electrical waves fed into the line are shifted in phase by each line section (the amount per section being proportional to frequency), so that at any tap of the line the phase is retarded relative to the previous tap.

The scanning pickup traveling along the line will thus encounter waves increasingly retarded in phase at each successive tap. As a shift in phase is equivalent to an instantaneous change in frequency, the continuous change in phase becomes a continuous frequency variation. Since the scanner sweeps from start to end of the line and then back, it alternately raises and lowers the output frequency, the average remaining equal to the input frequency.

The exact amount of frequency shift depends not only on the amount of phase shift in the line but also on the scanning rate. This rate, however, is constant because the scanner is driven by the synchronous running motor of the organ.

In the M, M-2, and M-3, the "Amount of Vibrato" tablet varies the amount of frequency shift by causing the whole line to be scanned for "Normal Vibrato" and only one fourth of it for "Small Vibrato".

In the M-100, the "Vibrato Small" Tablet varies the amount of frequency shift by causing two thirds of the line to be scanned, in contrast to the entire line when in the up position.

A vibrato chorus effect, similar to the effect of two or three slightly out-of-tune frequencies mixed together, is obtained when the vibrato output signal is mixed with a portion of signal without vibrato. This is accomplished by the "Vibrato Chorus" tab, which causes only part of the incoming signal to appear across the vibrato line and the rest across a resistor in series with the line. As the vibrato effect is applied to the part of the signal appearing across the line but not to the part appearing across the resistor, the combination produces a chorus effect.

In the M-100, a Celeste effect is obtainable by the use "Vibrato Celeste I" and "Vibrato Celeste II" tabs. These can be used independently or together. Use of these tabs introduces a resistor network at the far end of the Vibrato line, changing the termination impedance. This in turn causes a reflective signal to appear in the line, which is picked up by the scanner.

In the Model M, to remove the vibrato effect entirely, the "vibrato" tablet in "off" position places a very large resistor in series with the vibrato line. Practically all of the signal appears across this resistor and the vibrato effect is virtually eliminated. A compensation circuit consisting of R1 and C1 maintains constant volume by introducing negative feedback with the "vibrato" tablet "off". (See Figures 23 and 24).

Figures 23 thru 26 show only the "Vibrato" channel of the amplifier. All tones sent through this channel have the vibrato effect. In the M-100, when vibrato is not desired on one manual or both, the "Vibrato Cancel" tabs in the down position feed their signals through the "no Vibrato" channel of the amplifier.

Figures 27, 28 and 29 show the vibrato line box. See figures 3, 5, and 7 for location of line box.

The scanner is mounted on the synchronous motor and driven at 412 revolutions per minute. It is a multi-pole variable condenser with 16 sets of stationary plates and a rotor whose plates mesh with the stationary ones. Figure 30 shows the construction of the scanner, with two sets of plates removed to show the rotor.

Signals coming from the vibrato line appear on the stationary plates and are picked up, one at a time, by the rotor. Connection to the rotor is made by carbon brushes as shown in Figure 30. Two brushes touch the sides of the contact pin and a third presses on the end, in order to eliminate the possibility of contact failure.

The complete electrical circuit of the vibrato system is shown in the schematic diagrams contained in the back of this manual.

PRESET TABS (M-100)

Four tabs are provided for each manual. As indicated, they provide a choice of using the drawbars or playing the preset tones indicated on them.

REVERBERATION AND VOLUME SOFT TABS (M-100)

Several degrees of reverberation are obtained by the use of either or both tabs labeled "Reverberation I" and "Reverberation II". These tabs in addition to turning this feature on, govern the loudness or amount of reverberation by a resistive network used in conjunction with the speaker. The "Volume Soft" tab controls the overall volume of the organ and is especially useful where playing might disturb others.

AMPLIFIER ASSEMBLY

In the M and M-2 models, the amplifier assembly is on a single chassis, but is actually composed of four sections: Manual, Pedal, Intermediate, and Output, as indicated in the block diagrams, figures 8 and 9, and in the schematics in the schematic section of this manual.

In the M-3 and M-100 models there is one additional section, the percussion amplifier. The block diagrams appear in Figures 10 and 11.

The M-100 model alone has one additional amplifier assembly, the Reverberation Amplifier. This separate amplifier is used to secure the Reverberation effect in conjunction with the Reverberation unit. This amplifier has its own speaker.

MANUAL SECTION OF AMPLIFIER MODEL M

The manual section, composed of tubes V1 and V2, receives its signal from the matching transformer T1. The "special input" jack, connected through a network to the cathode of V1, provides a low impedance input circuit (see "Special Equipment"). Some treble attenuation is provided by a feedback network consisting of C2, R2, and R3, connected from cathode follower tube V2 to the input of V1. The output signal obtained from the cathode of V2 drives the vibrato line (see "Vibrato system") and the manual signal, after passing through the vibrato system, is combined with the pedal signal at the grid of V3.

MODEL M-2, M-3

The manual section is composed of two channels connected to the "Vibrato" and "no Vibrato" input terminals. Either of the two matching transformers can feed a signal into either input channel, depending on whether the corresponding control tablet is set for Vibrato "on" or "off".

Signals entering the "no Vibrato" channel (tube V2) are amplified and fed directly into the intermediate section of the amplifier while signals going into the "Vibrato" channel (tubes V1 and V3) pass through the Vibrato system first. The output signal of the Vibrato system is combined with the "no Vibrato", Percussion, and Pedal signals at the grid of the intermediate amplifier.

Suitable tonal balance is secured in the "no Vibrato" channel by a feedback network connected from plate to grid of V2. Similar tonal balance is provided in the "Vibrato" channel by a feedback network connected from cathode follower V3 to the gird of V1. The two channels are matched by selecting R27 (M-3), and R20 (M-2) at the factory.

M-100

The manual section is composed of two channels connected to the "Vibrato" and "no Vibrato" input terminals. Either of the two matching transformers can feed a signal into either input channel, depending on whether the corresponding control tablet is set for vibrato "on" or "off".

Signals entering the "no Vibrato" channel (tube V2) are amplified and fed directly into the intermediate section of the amplifier, while signals going into the "Vibrato" channel (tubes V1 and V3) pass through the Vibrato system first. The output signal of the Vibrato system is combined with the "no Vibrato" and pedal signals at the grid of the intermediate amplifier.

Suitable tonal balance is secured in the "no Vibrato" channel by a feedback network consisting of C6, R12, R13 and R13A connected from plate to grid of V2. Similar tonal balance is provided in the "Vibrato" channel by a feedback network including C1, R1, R2, and R2A connected from cathode follower V3 to the input of V1. The two channels are matched by selecting R20 at the factory.

PEDAL SECTION OF AMPLIFIER - M, M-2, M-3

The pedal amplifier, composed of one tube, V7, receives its signal directly from the pedal generators. When a pedal key is pressed its "pedal contact" opens, delivering a signal voltage of the proper frequency to the grid of V7. The note cannot sound instanly, however, because the tube is normally cut off by a negative 21 volt grid bias.

Near the end of the pedal stroke the "pedal keying contact" (common to all pedals) closes. This shunts a resistance from the bias point to ground, discharging the bias condenser C57 and allowing the note to sound.

If "pedal attack" is at "normal" only a single resistor R68 is placed across the bias condenser when the pedal keying contact closes. This very quickly discharges the condenser, and the note sounds quickly, although not abruptly.

In case "pedal attack" is set at "slow", the shunting resistor is increased by the addition of R69 and so the bias condenser cannot discharge as quickly. It takes an appreciable time, therefore, for the bias to drop low enough so that the note sounds.

When the pedal key is released, the pedal keying contact opens, allowing cutoff bias to be applied again to the tube. With "pedal decay" set at "fast" this occurs rapidly, since R74 charges C57 in a short time. With "pedal decay" set at "normal" the increased resistance delays the charging of C57 and permits the tone to sound for a longer time.

If the "pedal sustaining control" is operated (lever on expression pedal pressed to left), an additional resistor R76 is introduced. This delays the charging of C57 still further and causes the note to sound for a much longer time.

A latching mechanism holds the last-played pedal contact open until some other pedal is operated, in order to insure that the correct note will sound throughout the decay period.

The pedal cutoff adjustment R73 varies the screen voltage of the pedal amplifier tube. It must be adjusted so that the pedal tone is just inaudible with the pedal drawbar and expression pedal set in loudest position, as instructed in "Practical Service Suggestions".

M-100

The pedal amplifier, composed of one tube, V10, receives its signal directly from the pedal generators. When a pedal key is pressed its "pedal contact" opens, delivering a signal voltage of the proper frequency to the grid of V10.

The note cannot sound instantly, however, because the tube is normally cut off by a negative 22 volt grid bias.

Near the end of the pedal stroke the "pedal keying contact" (common to all pedals) closes. This shunts a resistance from that bias point to ground, discharging the bias condenser C57 and allowing the note to sound.

When the pedal key is released, the pedal keying contact opens, allowing cutoff bias to be applied again to the tube. With the pedal "Fast Decay" tab depressed this occurs rapidly, since R81 charges C57 in a short time. With the tab up, the increase resistance delays the charging of C57 and permits the tone to sound for a longer time.

If the "Pedal Legato" stop is depressed, an additional resistor R82 is introduced. This delays the charging of C57 still further and causes the note to sound for a much longer time.

A latching mechanism holds the last-played pedal contact open until some other pedal is operated, in order to insure that the correct note will sound throughout the decay period.

The "Bass Mute" tab varies a filtering circuit in the V10 tube output so the higher frequencies are bypassed to ground, giving a deeper tone to the pedals.

The pedal cutoff adjustment R85 varies the bias voltage of the pedal amplifier tube. It must be adjusted so that the pedal tone is just inuadible with the pedal drawbar and expression pedal set in loudest position, as instructed in "Practical-Service Suggestions."

To prevent a pedal note from sounding when the organ is first turned on, a resistance of five ohms inserted in series with the heater of the pedal amplifier tube lengthens its warm-up time so that the cutoff bias is applied before the tube is conductive.

INTERMEDIATE SECTION OF AMPLIFIER

From the plate of the pedal amplifier tube the pedal signal passes through a variable air condenser (operated by the pedal drawbar) to the intermediate amplifier (half of V3)(M), V4 (M-2, M-3, M-100). At this point the pedal signal is mixed with the vibrato, non-vibrato, and percussion signals from the manuals (M-3, M-100).

Depressing the "Volume Soft" tab reduces the overall volume of both manuals and pedals by shunting a small condenser across the input of the intermediate amplifier. At the same time it provides pedal compensation by adding R65 in series with the pedal generators and thereby increasing the relative volume of the pedals.

The small feedback condenser from plate to grid of the intermediate amplifier is a means of increasing the effective input capacity of the tube. In this circuit the effective input capacity is this value multiplied by the amplification factor of the tube,or a total of about 1500 micromicrofarads. This provides a suitable load for the output of the scanner and the pedal drawbar.

The combined manual and pedal signals go through the intermediate amplifier to the expression control (operated by the expression pedal), which is a special variable air condenser with a single set of movable plates and two sets of stationary plates. With the expression pedal in "loud" position the signal is transitted directly to the grid of the following tube, while in "soft" position the signal goes through a tone-compensated attenuating network. At intermediate positions the signal is obtained from both sources, providing continuously variable control.

OUTPUT SECTION OF AMPLIFIER (M)

V4 is a common-cathode-impedance phase inverter driving push-pull output tubes V5 and V6. The second grid of V4 provides a radio-phonograph input channel (see "Special Equipment"). A small feedback condenser from voice coil to grid of V4 makes the pedal response more uniform by reducing speaker resonance. (In model M consoles below serial number 3000, with amplifiers marked type M-A, this feedback connection is not used; C46 is omitted, C37 is omitted, C42 is .00135 mfd., and T2 does not have a secondary center tap).

M-2, M-3

The second half of V3 is a phase inverter driving push-pull output tubes V5 and V6. A small feedback condenser C22 (M-2), C23 (M-3) from voice coil to grid of V4 makes the pedal response more uniform by reducing speaker resonance. This condenser (located in the expression control unit) is variable and is adjusted at the factory.

M-100

The second half of V3 is a phase inverted driving push-pull input tubes V5 and V6, which in turn drive two 16 ohm speakers connected in parallel. A small feedback condenser C23 from output transformer secondary to grid of V4 makes the pedal response more uniform by reducing speaker resonance. This condenser (located in the expression control unit) is variable and is adjusted at the factory.

PERCUSSION SECTION OF AMPLIFIER

The 2nd or 3rd harmonic signal (M-3) or both (M-100)(depending on position of the harmonic selector tabs) is conducted through the percussion matching transformer and amplified by tube V7. The resistive feedback on this tube provides proper loading on the matching transformer to fix the primary impedance at about 5 ohms. This provides a volume compensating effect so that the percussion output signal is about the same whether one key or several are played. Besides providing push-pull signal for the control tube (V9), transformer T5 has another winding which feeds signal to the 2nd or 3rd harmonic drawbar through equivalent key circuit resistors.

The control tube (V9) is normally conducting, so when a key is pressed the second or third harmonic percussion signal first sounds loudly. It passes through the control tube, transformer T6, a band pass filter network, and terminal D to the grid of V4.

Immediately the note begins to fade away, giving the characteristic percussion effect. This fading is accomplished as follows: When the percussion switch is "on", terminal K (normally held at plus 25 volts through anti-spark resistor (R-53) is connected to the solo manual 6th, (8th in M-3) harmonic busbar. When a key is pressed, terminal K is grounded through the key contact and the tone generator filter. This virtually grounds the plate of V8 (connected as a diode), open-circuiting the tube and isolating the control tube grid circuit. The grids then drift from their operating potential of about plus 25 volts to a cut-off potential (about plus 15 volts) at a rate determined by the time required for C31 to discharge through R59 and R60.

The percussion signal is now blocked. No percussion notes can sound until all keys of the solo manual are released and the control grids again rise to plus 25 volts. The time of this rise (that is, how quickly the control tubes turn on again after a key is released) is the time required to change C31 to plus 25 volts through R57 and R58.

When the percussion "Second Harmonic" or Third Harmonic" (M-3) or both (M-100) tabs are down, the corresponding upper manual harmonic drawbars are disconnected from their lead wires and these wires (which come from the manual busbars) are connected to the percussion matching transformer. The 6th harmonic (M-100) or 8th (M-3) drawbar is also disconnected from its lead wire and this wire (which is grounded through the generator magnets when any key is pressed)is used to turn off the push-pull control tube. Therefore, the 6th harmonic (M-100) or 8th (M-3) is not available on the upper manual when the percussion is in use.

When the "Percussion Soft" tab is depressed, it reduces the volume by shunting resistor R50 across the percussion output transformer.

The percussion "Fast Decay" tab determines how fast the sound fades away after a key is pressed. When a key is pressed with the tab up, resistor R60 discharges capacitor C31, reducing the D.C. voltage on the control tube grids to cutoff in about 2-1/2 seconds. When the tab is pushed down another resistor is shunted across the original resistor R60, reducing the time to discharge capacitor C31 and thereby reducing the D.C. voltage on the control tube grids to cutoff in less than 1/2 second. To preserve about the same effective loudness between "slow" and "fast" decay settings, shunt resistor R62 is disconnected when the decay tab is in "fast" position. This reduces the effective control tube bias and thus increases the loudness.

With the "Second Harmonic" tab depressed, the upper manual 2nd harmonic drawbar wire is connected to the percussion matching transformer and a signal is fed back to the 2nd harmonic drawbar. With the "Third Harmonic" tab depressed the upper manual 3rd harmonic drawbar wire is connected to the percussion matching transformer and a signal is fed back to the 3rd harmonic drawbar. Both tabs can be used at the same time in the M-100, however in the M-3, only one or the other is available.

POWER SUPPLY (ALL MODELS)

The power supply uses a 5U4 rectifier tube with a conventional filter circuit.

TUBE SOCKET VOLTAGES

Voltages shown on the schematics are taken with a 20,000 ohm-per-volt meter. Line variations may cause up to 20% variation in the indicated voltages.

To make tube sockets accessible, remove lever from shaft of expression unit on amplifier; loosen cable clamp on lower shelf; remove four amplifier mounting screws and turn amplifier upside down, being careful not to rest on expression unit lever. The tabs and expression lever may be in any position, and no key should be depressed unless specified.

REVERBERATION AMPLIFIER (M-100)

When either "Reverberation I," "Reverberation II," or both are used, the music played will be reverberated. This reverberation signal is in addition to the normal sound produced through the two 12" speakers connected to the main amplifier. A separate amplifier and speaker are incorporated in the instrument for this purpose.

A signal from the voice coil terminals of the regular speakers in the console goes through a resistor network and two incandescent lamps to the drive coils of the reverberation unit, as shown under "input to reverberation unit" in the schematic diagram.

The incandescent lamps are used as volume limiters or volume compression circuit. When the organ is played loudly, the lamp filaments become hot and increase in resistance, and, therefore, the amount of signal furnished to the reverberation unit does not increase as fast as the volume of the no-reverberated signal. This is a desirable musical effect, since a greater proportion of reverberated signal is needed at low volume levels.

The drive coils introduce vibration in two coil springs. These vibrations bounce back and forth in the coils springs to simulate natural echoes of sound. in a large room. Pickup coils at the other end of the two springs drive the input of the amplifier. The amplifier output drives an 8 ohm 8" speaker.

SPECIAL EQUIPMENT

RADIO, PHONOGRAPH, OR MICROPHONE

A phonograph, radio, or microphone amplifier will play through the organ speaker if connected to the pin jack marked "RADIO-PHONO" located on the expression control unit of the organ amplifier. The device should have an output level of about 1/2 volt maximum, and must have its own volume control, as neither the expression pedal nor the "Volume" tablet will affect it. The organ may be played at the same time.

In the Model M only, occasionally for special effects it may be desirable to apply vibrato to the signal from a phonograph, radio or microphone. In this case connect to the pin jack market "SPEC-INPUT". This point has a low impedance to ground (about 7000 ohms) and may conveniently be driven from the voice coil terminals of an amplifier having a level of about 5 volts maximum. The expression pedal, "volume" tablet, and three vibrato tablets will then be effective on the input signal just as they are on the organ music.

EXTENSION SPEAKER

An additional speaker, of the permanent magnet dynamic type, may be attached to the organ if special circumstances make it desirable. It should be connected to the two voice coil terminals on the amplifier. It is essential that the speaker be at least 10" in diameter and be mounted in an adequate baffle to bring out the organ pedal notes properly. The console speaker voice coil wires may be left connected or not, as desired.

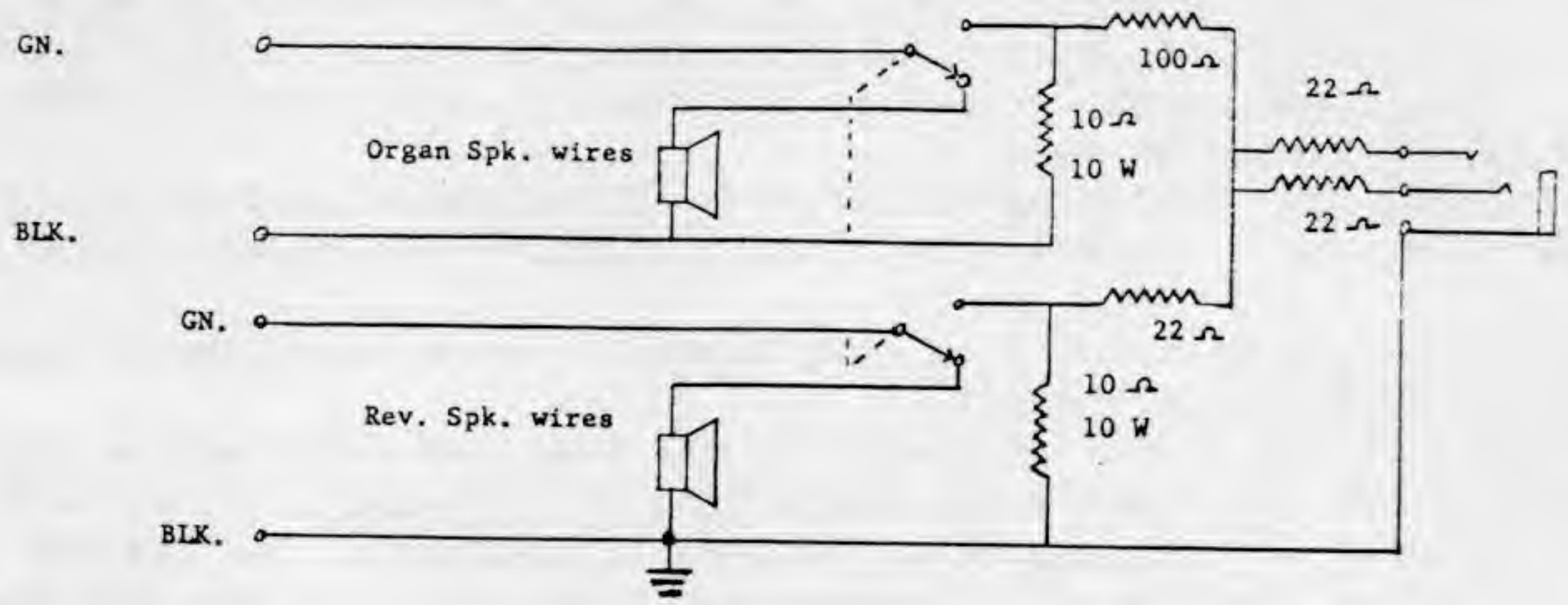
Hammond Organ tone cabinets may be used as extension speakers. A kit for making the necessary connections can be secured from your dealer.

EAR PHONE (MONAURAL)

Ear phones may be connected to the organ if someone wishes to practice without disturbing others. They will generally give adequate volume when connected to the "voice coil" terminals of the amplifier, with the speaker disconnected. A resistor of 6 to 10 ohms, with power rating not less than 10 watts must be connected across these terminals whenever the speaker is disconnected.

EAR PHONE (STEREO)

Stereo ear phones can give pleasing results when attached as shown in the schematic below. A separate two pole double throw switch is required in addition to the listed resistors and jack. Use of good quality ear phones made by David Clark, Koss, or Telex are recommended and can be secured from any parts supply house.



SPECIAL POWER SOURCES

The organ must always be connected to an alternating current source of the voltage and frequency specified on the name plate. If the only available power source is direct current or has a frequency different from that specified, it will be necessary to provide a converter or motor generator of at least 170 watts capacity.

PRACTICAL SERVICE SUGGESTIONS

ORGAN DOES NOT PLAY

(a) If the starting motor does not operate when the "Start" switch is pressed and if the tubes do not light with the"Run" switch on, check the power wiring, power switch, line cord, line cord plug, and wall outlet.

(b) If the generator turns and the tubes light, but no sound can be obtained with all controls in playing position, the most likely source of trouble is the amplifier. In most respects this is a conventional amplifier circuit, and the schematic diagrams will enable the service man to locate the trouble.

ONE KEY DOES NOT PLAY OR A HARMONIC IS MISSING

(Tests to be made with "Drawbars" tab depressed)

This may mean a dirty key contact, a broken connection, or a dead note in the generator. The steps below will serve to isolate the trouble.

(a) Ordinarily only one of the several frequencies used on the key will be missing. This can be determined by holding the key and operating each drawbar for that manual, observing on which drawbar the key fails to play. Reference to the manual wiring chart, figure 18 will tell which frequency number is missing.

(b) See whether the same frequency is missing where it is used on other keys of the same manual. The wiring chart will tell with what other key and what other drawbar you should get the same frequency. If it is missing on one key but not on others, a key contact is probably dirty. In some cases it may be cleared by striking the key 15 or 20 times in a rapid staccato manner to loosen the dirt. If this procedure is not effective, adjustment of the busbar shifter for that manual will clear it. (See "manuals" section on a prior page for location and manner of adjustment). This will slide the busbars endwise so they present a clean contact surface. In extreme cases, it may be necessary to hold down the faulty key while making the adjustment.

(c) If the frequency is missing on all keys of one manual but not on the other manual, look for a break in the cable connecting one manual to the other.

(d) If the frequency is missing on both manuals, check the manual-to-generator cable or the generator itself.

(e) The output of any signal frequency on the tone generator may be checked by pulling out any drawbar and connecting a clip lead from the back end of the drawbar to the generator terminal in question. See Figures 14, 15, and 16 for location of all generator terminals. If the generator is all right, the note will play loudly.
CAUTION: Never test the tone generator with an outside source of current such as a continuity meter, as serious damage may result to the sensitive filter transformers and permanent magnets. By the above method, all necessary tests of the tone generator may be made with the current supplied by the generator itself.

(f) If it fails to play, try touching the clip to the input side of the filter coil (not the grounded tap) and the input side of the filter condenser (Figures 14, 15 and 16) in order to check these parts. Disconnect the condenser to eliminate the possibility of a grounded transformer. If the signal is still missing at the magnet coil terminal, it means that the tone wheel is not turning, the coil is defective, or the magnet is not properly adjusted.

(g) If the tone wheel is not turning, the frequency of the other wheel on the same shaft will also be missing (with the exception of a few wheels which are alone). On the generator magnet location drawing (Figure 13), the two frequencies whose numbers are connected by a dotted line are on the same shaft. Antoher way to check the wheel is to raise the generator slightly and feel the wheel with your finger to see if it is turning. Each wheel is located directly behind its magnet, shown in Figure 13.

(h) If the magnet coil is defective, the generator must be returned to the factory, as replacement of a coil necessitates dismantling the entire generator.

(i) It is possible, although unlikely, that the magnet may have become loose and moved so far from the wheel as to make the not inaudible. It may be adjusted as described in the following paragraph.

ONE NOTE IS WEAK

(a) Trace the note as described in the preceding section to see whether weakness is due to dirty contact, poor connection, defective filter or reduced output of magnet coil. Check at each point by comparing intensities with higher and lower frequency numbers.

(b) It is possible that one or more notes may be acoustically weak, due to the room and the furnishing, although the actual signal level is equal to that of adjacent notes. This can be checked by reading voltages of the various notes on an output meter connected to the voice coil terminals on the amplifier. All notes will not give equal output, but voltage should vary smoothly from note to note. In this test variations of less than 30% should be ignored.

(c) Each magnet is set at the factory by tapping it gently, with the set screw partially loosened, while observing an output meter. Experience has shown that the magnets seldon need adjustment and that setting them without proper equipment involves danger of damaging both magnet and wheel. Therefore, it is not recommended that the service man attempt this adjustment.

PERCUSSION NOTES WEAK, DO NOT PLAY, OR DO NOT DECAY PROPERLY

(a) Adjust percussion cutoff control; with expression pedal wide open, "Volume Soft" tab up, upper "Drawbars" tab down, all drawbars pushed in, press "Third Harmonic" and "Fast Decay" tabs. Hold down first C key on upper manual and adjust percussion cutoff control to the exact point of cutoff or silence.

(b) Check tubes V7, V8, V9.

(c) Always adjust percussion cutoff control after replacing V9 (12AU7).

PEDAL NOTE SOUNDS AT FULL VOLUME (WHEN PEDAL IS NOT BEING PLAYED)

(a) It is possible to make a black pedal lock down and play continuously by striking it very hard at an angle so that it moves sidewise as well as downward. This will never occur if the pedals are used properly, as only slight pressure with the toe is required for playing.

(b) A pedal locked down in this way will remain visibly depressed and tilted. It can be released by pressing it down very hard, with a slight pressure opposite to the direction of tilt. No permanent damage will result.

PEDAL NOTE SOUNDS FAINTLY (WHEN ORGAN IS NOT BEING PLAYED)

In this case the pedal cutoff control may be adjusted as follows:

(a) Set expression pedal wide open, pull pedal drawbar to its loudest position, and leave three pedal tabs up.

(b) Play highest pedal key and then release it. Wait at least 15 seconds for pedal note to die away.

(c) Slowly turn pedal cutoff adjustment (on face of amplifier) clockwise until pedal note just disappears. Do not turn it any farther.

(d) Always recheck this adjustment when replacing the 6BA6 tube.

HUM

(a) A loud 60 cycle or 120 cycle hum in the speaker may come from some nearby electrical appliance, as explained on the instruction card. It may be picked up by the matching transformer, the vibrato line, or the console wiring. Hum from this source will disappear if you ground the signal input terminals on the amplifier to the chassis. It may be eliminated by moving either the console or the appliance.

(b) The faint pedal note heard when the pedal cutoff adjustment needs setting may sometimes be mistaken for hum. Check it as described under "Pedal note sounds faintly when organ is not being played.

(c) Any other hum must originate in the amplifier circuit, and can generally be cured by replacing one or more of the electrolytic condensers.

(d) In case hum originates in the amplifier but is not due to the electrolytic condensers, its source can be isolated by successively removing tubes or by grounding successive points in the signal circuit.

REPLACING TUBES

(a) The vacuum tubes are all standard radio types and can be tested in the usual way.
(b) If the 6BA6 tube is replaced, check the pedal cutoff adjustment as explained under "Pedal note sounds faintly when organ is not being played".
(c) If tube V9 is replaced, check percussion cutoff adjustment as explained under "Percussion notes weak, do not play, or do not decay properly".

PROCEDURE FOR REMOVING PARTS IN NEED OF REPAIR OR REPLACEMENT

TO REMOVE KEY FROM UPPER MANUAL (M, M-2, M-3)

(a) Remove music rack by unscrewing thumb screw, unhooking brace, and lifting it from console.
(b) Remove music rack base by taking out two screws in upper manual end blocks.
(c) Remove metal angle fastened across keyboard by two screws.
(d) To remove a black key loosen its key mounting screw (See Figure 3), unhook key from screw and lift out key.
(e) To remove a white key loosen its key mounting screw and those of adjacent black keys. Unhook these keys from screws, push them back, and lift out white key.

M-100

(a) Remove music panel and top.
(b) Remove four screws which secure metal cover on control panel assembly.
(c) Remove two large screws located at ends of control assembly, which secure it to upper manual.
(d) Pull out drawbar on extreme left and fold control assembly back.
(e) To remove a black key, loosen its key mounting screw (See Figure 7), unhook key from screw and lift out key.
(f) To remove a white key, loosen its key mounting screw and those of adjacent black keys. Unhook these keys from screws, push them back, and lift out white key.

TO REMOVE A KEY FROM LOWER MANUAL (M, M-2, M-3)

(a) Remove music rack by unscrewing thumb screw, unhooking brace, and lifting it from console.
(b) Remove music rack base by taking out two screws in upper manual end blocks.
(c) Detach pedal volume control (Figure 3) by removing two machine screws, loosening wood screw which holds friction clip to top of console, and unhooking from drawbar.
(d) Remove upper manual mounting bolts "A" and "B" under keyboard (Figure 33)
(e) Place a 3/4" board under each upper manual chassis mounting block; this will hold up upper manual sufficiently to make lower manual key mounting screws accessible.
(f) To remove a black key loosen its key mounting screw (See Figure 3), unhook key from screw and lift out key.
(g) To remove a white key loosen its key mounting screw and those of adjacent black keys. Unhook these keys from screws, push them back, and lift out white key.

M-100

(a) Remove music panel and top
(b) Remove generator dust cover by taking out seven screws from edge of generator shelf and loosening four screws in cover just below upper manual assembly.
(c) Remove upper manual mounting bolts (2) which are located at ends of console directly above front corners of generator.
(d) Remove two screws which pass through angle brackets into upper manual,

mounted on inside of cheek blocks. These screws are accessible from front of organ.

(e) Tilt manual from front, being careful that it does not slip back.
(f) Using 1/4" box ratchet, loosen key mounting screw.
(g) To remove a black key, loosen its key mounting screw (see Figure 7), unhook key from screw and lift out key.
(h) To remove a white key loosen its key mounting screw and those of adjacent black keys. Unhook these keys from screws, push them back, and lift out white key.

TO REMOVE A DRAWBAR CONTACT SPRING (M, M-2, M-3)

(a) Push drawbar all the way in.
(b) Remove screw and nut at back end of drawbar (Figure 3).
(c) Pull out contact spring while pressing with thumb to release pressure on contact. To disconnect spring entirely, unsolder wire.
(d) Do not under any circumstances pull drawbar forward while contact spring is off, as damper spring will catch in slot and necessitate removal of entire drawbar assembly.

M-100

(a) Remove music panel and top.
(b) Remove four screws which secure metal cover on control panel assembly.
(c) Pull out contact spring while pressing with thumb to release pressure on contact. To disconnect spring entirely, unsolder wire.
(d) Do not under any circumstances pull drawbar forward while contact spring is off, as damper spring will catch in slot and necessitate removal of entire drawbar assembly.

TO REMOVE A DRAWBAR OR DRAWBAR KNOB (M, M-2, M-3)

(a) Remove music rack by unscrewing thumb screw, unhooking brace, and lifting it from console.
(b) Remove music rack base by taking out two screws in upper manual end blocks.
(c) Remove 8 hexagonal head machine screws holding drawbar assembly and one screw fastening angle across upper manual keys.
(d) To remove knob, pull drawbar assembly toward front of console (be careful not to scratch control panel surface), prop it up, and remove screw which holds knob.
(e) To remove drawbar and contact spring, pull them out at back of assembly, while pressing with thumb to release pressure on contact.
(f) To separate drawbar from contact spring remove screw and nut at back end of drawbar.

M-100

(a) Remove music panel and top.
(b) Remove four screws which secure metal cover on control panel assembly.
(c) Remove two large screws located at ends of control assembly which secure it to upper manual (Pull out drawbar on extreme left) and fold back.
(d) Remove 4 hexagonal head machine screws holding drawbar assembly.
(e) To remove knob, pull drawbar assembly toward front of console (be careful not to scratch control panel surface), prop it up, and remove screw which holds knob.
(f) To remove drawbar and contact spring, pull them out at back of assembly, while pressing with thumb to release pressure on contact.
(g) To separate drawbar from contact spring remove screw and nut at back end of drawbar.

TO REMOVE UPPER MANUAL (M, M-2, M-3)

(a) Remove music rack by unscrewing thumb screw, unhooking brace, and lifting it from console.
(b) Remove music rack base by taking out two screws in upper manual end blocks.
(c) Remove dust cover over generator by taking our seven screws from edge of generator shelf and loosening four screws in cover just below upper manual assembly.
(d) Detach control panel by removing 6 machine screws from top of panel, and lay panel on generator, being careful not to damage generator wiring. Control panel wires need not be disconnected.
(e) Detach pedal volume control (Figure 3) by removing two screws which hold it and loosening wood screw which holds friction clip to top of console; unhook control from drawbar and lay it on generator, being careful not to damage generator wiring. Volume control wires need not be disconnected.
(f) Remove two screws fastening matching transformer bracket to upper manual, take off round cover held by two screws, unsolder and detach shielded wires and black wire from transformer.
(g) Re-attach matching transformer to upper manual.
(h) Unsolder wires from lower manual drawbars.
(i) Remove upper manual mounting bolts "A" and "B" under keyboard (Figure 33).
(j) Remove the two upper manual stop plates, held by two wood screws (Figure 3).
(k) Prop up front of upper manual so that its terminal strip is accessible. Be careful when raising and lowering manual that its terminal strip is not damaged by rubbing lower manual keys.
(l) Unsolder manual cable from terminal strip. Lower manual into normal position.
(m) Detach vibrato line box by removing two screws in sides of box fastening it to underside of console top; lay line box on top of generator, being careful not to damage wiring on generator. Line box wires need not be unsoldered (early M-3 only).
(n) Where line box is of metal construction unsolder wires from scanner leaving it attached to manual.
(o) Carefully lift manual assembly (including drawbars and matching transformer) out through back of console.
(p) Remove metal angle fastened across keyboard by two screws.
(q) Take out 8 hexagonal head machine screws from drawbar assembly and carefully lift off drawbar assembly and matching transformer assembly.

M-100

(a) Remove music panel and top.
(b) Remove four screws which secure metal cover on control panel assembly.
(c) Remove two large screws located at ends of control assembly which secure it to upper manual.
(d) Remove generator dust cover by taking out seven screws from edge of generator shelf and loosening four screws in cover just below manual assembly.
(e) Remove two manual hold-down bolts located at ends of console directly above front generator corners. Reinstall dust cover temporarily.
(f) Remove two screws fastening matching transformer bracket to upper manual.
(g) Detach pedal volume control by removing two screws which hold it to manual assembly. Unhook control from drawbar and lay it on generator cover. Volume control wires need not be disconnected.
(h) Remove vibrato line box by taking out four screws attaching it to rear of upper manual.
(i) Remove screws holding four plastic clamps containing wiring.

(j) Locate nine coded wires coming from busbars inside manual. Tehse are found at right rear of manual. Trace this troup of wires to upper manual preset tabs and unsolder. Note location and routing as shown on wiring diagram and in console.
(k) Take out four hex head machine screws from drawbar assembly.
(l) Entire control panel, drawbar assembly, line box, pedal volume control and matching transformer can now rest on generator cover.
(m) Reinsert two bolts which held the control assembly to the manual assembly.
(n) Remove two screws which pass through angle brackets into upper manual.
(o) Prop up front of upper manual so that its terminal strip is accessible. Be careful when raising and lowering manual that its terminal strip is not damaged by rubbing lower manual keys.
(p) Unsolder manual cable from terminal strip. Lower manual into normal position.
(q) Carefully lift manual assembly out of console.

TO REMOVE LOWER MANUAL (M, M-2, M-3)

(a) Remove music rack by unscrewing thumb screw, unhooking brace, and lifting it from console.
(b) Remove music rack base by taking out two screws in upper manual end blocks.
(c) Remove dust cover over generator by taking out seven screws from edge of generator shelf and loosening four screws in cover just below upper manual assembly.
(d) Loosen wood screw holding friction clip of pedal volume control (Figure 3) to top of console.
(e) Remove upper manual mounting bolts "A" and "B" under keyboard. (Figure 33)
(f) Prop up front of upper manual as far as possible. Be careful when raising and lowering upper manual that its terminal strip is not damaged by rugging lower manual keys.
(g) Remove two hexagonal head mounting bolts from rear end of lower manual chassis mounting blocks.
(h) Remove three screws X, Y, Z under keyboard (Figure 33).
(i) Remove lower manual end blocks by taking out screws C, D, E, and F under keyboard (Figure 33).
(j) Unsolder manual cable wires from terminal strip.
(k) Lift manual out through front of console, being careful not to damage woodwork.

M-100

(a) Remove screws holding four plastic clamps containing wires, on rear of upper manual.
(b) Locate nine coded wires coming from busbars inside of lower manual. These are found at right rear of manual. Trace this group of wires to lower manual preset tabs and unsolder. Note location and routing as shown on wiring diagram and in console.
(c) Prop upper manual from front, being careful it does not slip back.
(d) Remove both lower manual end blocks, by removing two screws through manual frame and one screw through bracket in check block.
(e) Remove lower manual terminal cover, hedl by four screws under keyboard.
(f) Remove two hex bolts which secure lower manual to case.
(g) Loosen (don't remove) four hex screws holding front of lower manual to front rail of case.
(h) Lift out lower manual.

TO DETACH AND OPEN CONTROL PANEL (M, M-2, M-3)

(a) Remove dust cover over generator by taking out seven screws from edge of generator shelf and loosening four screws in cover just below upper manual assembly.
(b) Remove six machine screws from top of panel. Control tablet box may now be lowered and pulled toward rear of console.
(c) Lay box upside down on generator (being careful not to damage wiring on generator) and remove bottom cover by taking out four screws. Care should be taken not to pull the wires or cables excessively during this procedure. None of the wires or cables need be disconnected.

TO DETACH AND OPEN PERCUSSION CONTROL SWITCH (M-3 ONLY)

(a) Remove screws C and D under keyboard (Figure 33).
(b) Remove four fastenings holding panel to wood block.
(c) Turn tablet assembly upside down and remove bottom cover by taking out two screws. Wires need not be disconnected.

TO REMOVE GENERATOR (M, M-2, M-3, M-100) FIRST PULL OUT LINE PLUG

(a) Remove dust cover over generator by taking out seven screws from edge of generator shelf and loosening four screws in cover just below upper manual assembly.
(b) Unsolder, at line panel, six wires (5 wires on M, M-2, M-3) to running and starting switches.
(c) Unsolder, at line panel, three wires to amplifier.
(d) Unsolder pedal and manual cables from generator.
(e) Disconnect scanner shielded wire from amplifier terminal.
(f) Unsolder cable of six green wires from scanner terminals.
(g) Unsolder scanner wires from terminals 3, 4, and 5 (12, 13, and 14 on M, M-2, M-3) on vibrato line box.
(h) Unsolder two black wires from generator cover near start motor end, and also grey wire (connected to junction of two carbon resistors on generator cover).
(i) Remove 4 generator hold down screws (4 cotter pins from clamping screws and remove screws on M and M-2).
(j) Unhook four suspension springs from generator.
(k) Carefully lift out generator.

TO REMOVE STARTING MOTOR (M, M-2, M-3, M-100) FIRST PULL OUT LINE PLUG

(a) Remove dust cover over generator by taking out seven screws from edge of generator shelf and loosening four screws in cover just below upper manual assembly.
(b) Remove oiling threads (tied to two motor bearings) from oil trough by pulling or cutting them. (When replacing threads be sure they go under felt in trough).
(c) Provide more slack in lead wires at starting motor by pulling wires carefully.
(d) Unscrew two hexagonal studs extending beyond outer edge of motor.
(e) Lift motor out and unsolder its lead wires. (Be careful to remove and replace all threads).

TO REPLACE PILOT LIGHT (M-100 ONLY)

(a) Remove music panel and top.
(b) Remove four screws which secure metal cover on control panel assembly.
(c) Lift fiber shield over bulb and replace bulb.

NOTE: Use No. 12GE 6.3V .15A Minature 2 pin.

TO REPLACE A BROKEN TAB (M-100 ONLY)

(a) Remove music panel and top.
(b) Remove four screws which secure metal cover on control panel assembly.
(c) Remove two Phillips screws from front of control panel that hold bank of switches associated with tab to be replaced.
(d) Remove lock washer from either end of switch assembly, and pull rod out so it just clears broken tab. It may be necessary to tilt assembly so that free end of rod will clear adjacent switch assembly.
(e) Remove remains of broken tab and insert new piece.

NOTE: A small bronze spring washer will be found between tab and one side of switch assembly. Be sure this is reinserted with new tab.

TO REMOVE VIBRATO LINE BOX (M, M-2, M-3, M-100)

(a) Unsolder wires from line box terminals.
(b) Remove two screws in bottom edge of box fastening it to underside of console top. On later units, remove four screws fastening it to rear of upper manual.

TO REMOVE PEDAL KEYBOARD (M, M-2, M-3, M-100)

(a) Remove dust cover over generator by taking out seven screws from edge of generator shelf and loosening four screws in cover just below upper manual assembly.
(b) Unsolder pedal cable from generator.
(c) Rémove three pedal keyboard twisted wires from amplifier terminal panel.
(d) Place suitable wooden strips under pedal keyboard assembly to support it when screws are removed. First remove two screws in back of console (Figure 3), and then remove three screws on lower shelf toward front of console over pedal keyboard.

NOTE: It may be necessary to remove two speakers to take out these latter mentioned screws.

(e) Lift console and pull out keyboard and strips. (When re-installing pedal keyboard replace two screws in back of console first, leaving these screws loose until remaining screws are replaced).

TO REMOVE EXPRESSION PEDAL (M, M-2, M-3, M-100)

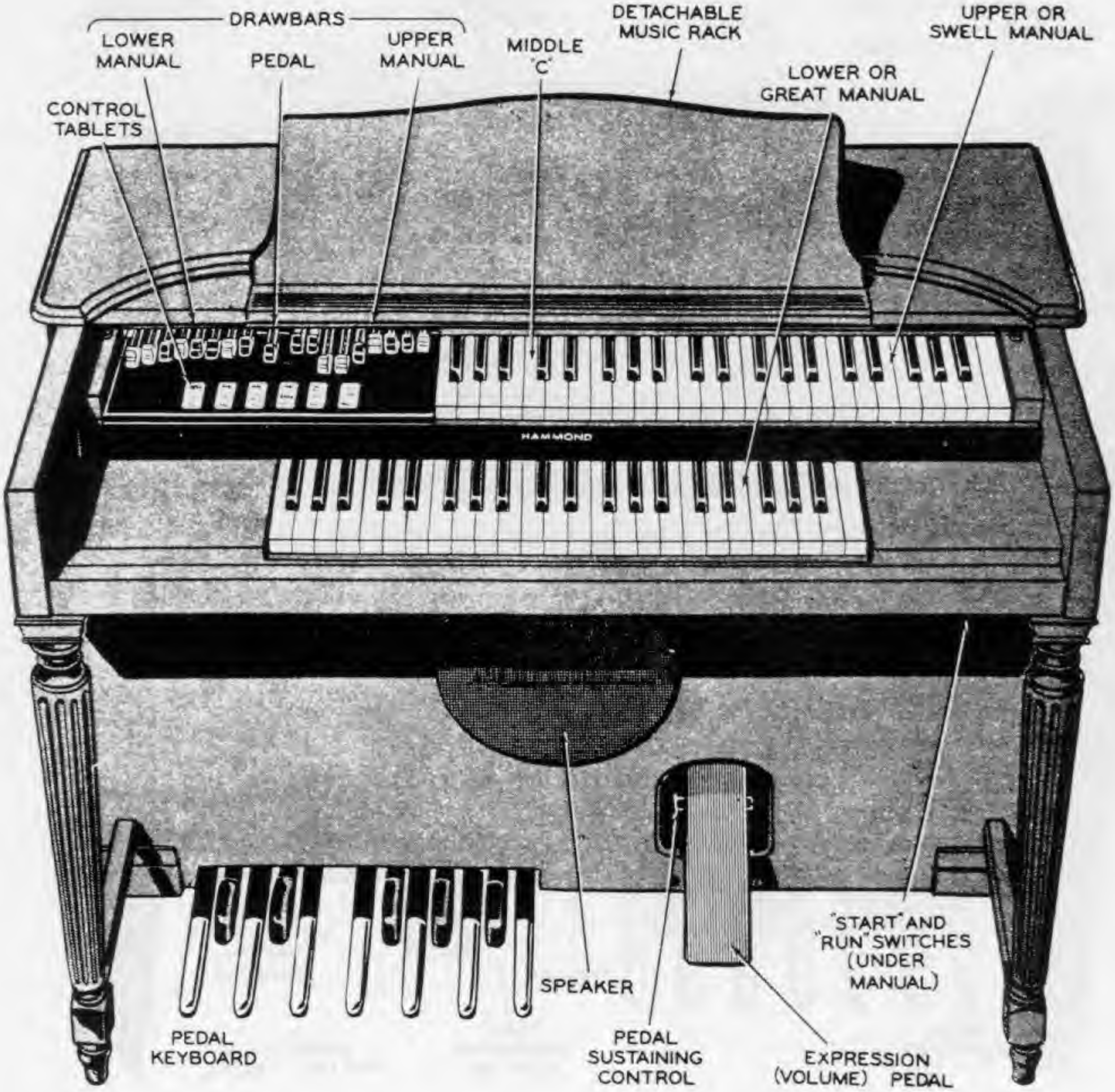
(a) Disconnect two twisted wires from "SUS SW" terminals on amplifier. (Model M, M-2) terminals "W" and "X" on M-3).
(b) Prop up right end of console at least 6 inches from floor.
(c) Unhook coil spring from expression unit arm.
(d) Remove screw linking expression unit on amplifier to expression pedal.

NOTE FOR M-3 ONLY

A change in all amplfiier coded "H" and above removes the positive voltage from the stators of the swell assembly. This can be incorporated in earlier amplifiers by following the steps below. The end result will place a block-condenser (.02mfd. 600V) between pin 1 of the 12AX7 and the swell stators. This change will insure continued noise free operation of earlier amplifiers.

SEE FIGURE 36A OF SERVICE MANUAL

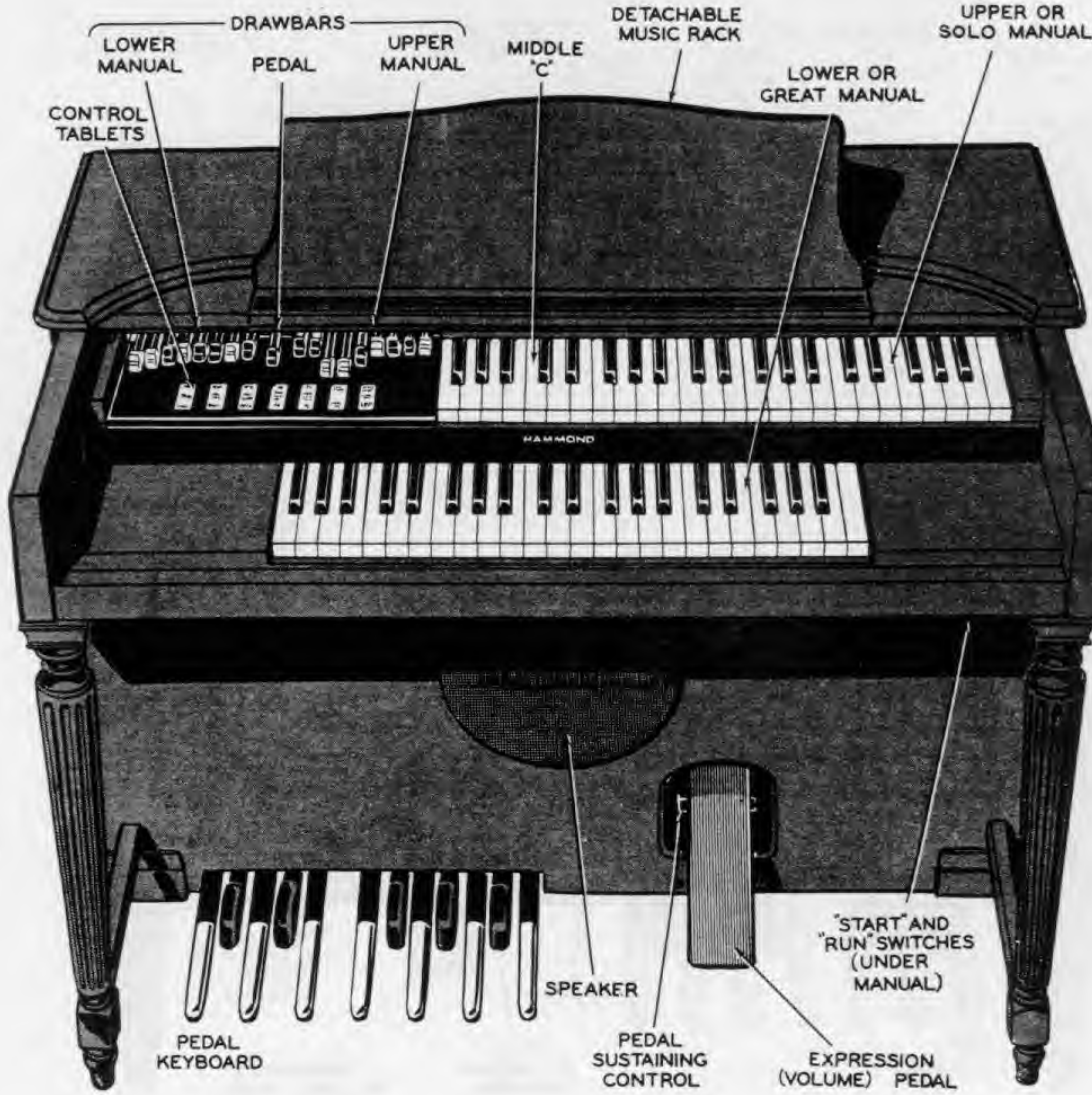
STEP #1 - Move lower lead of C16 from lug B to lug A. Remove jumper.
STEP #2 - Move lower leads of R33, R35, C16 and green lead from lug C to lug B.
STEP #3 - Move lower lead of R32, C15 and blue lead (C15 from lug D to lug C)
STEP #4 - Add C9 from lug C to D.



FRONT VIEW OF CONSOLE-MODEL M ORGAN

FIGURE 1

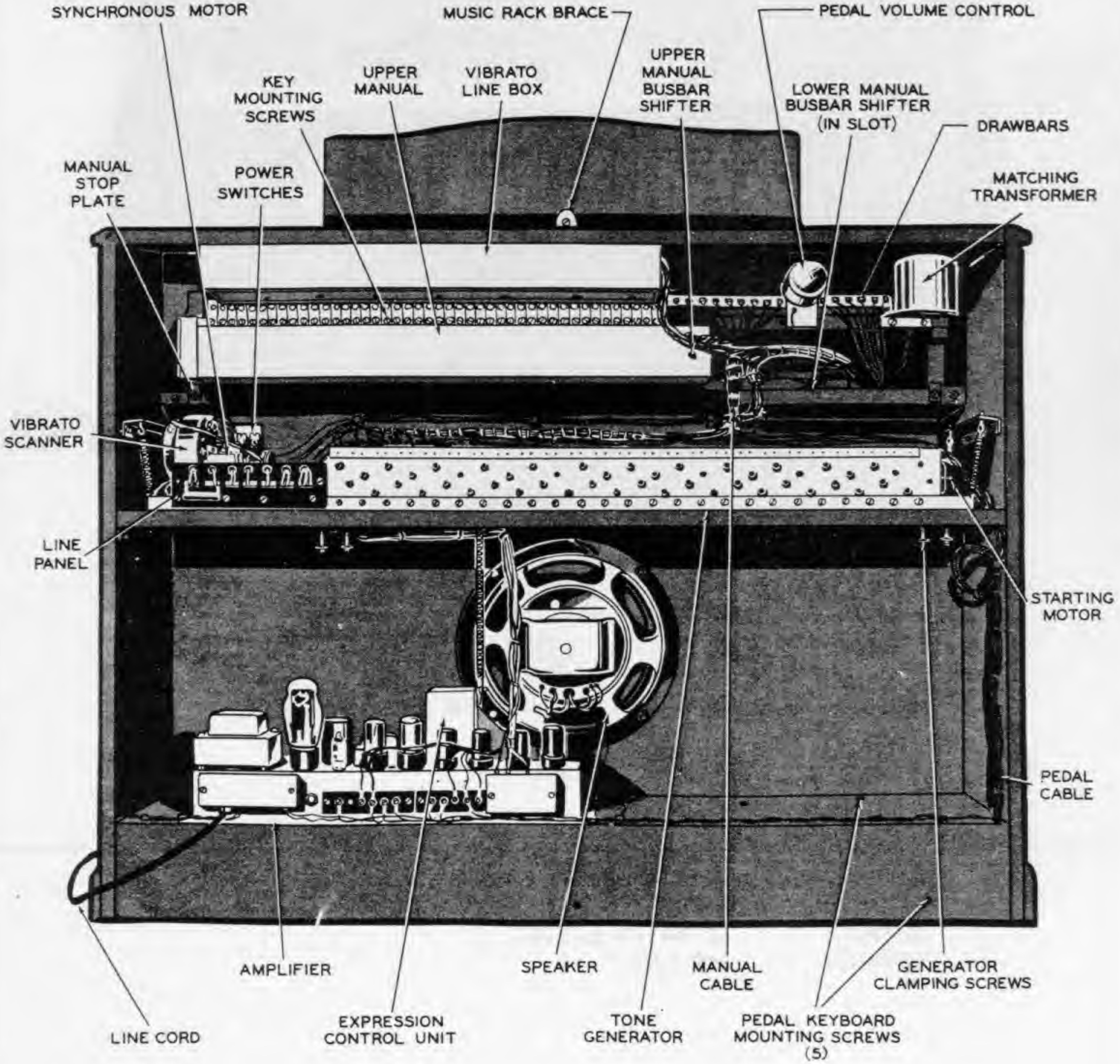
DIMENSIONS:	45-5/8" WIDE; 25-3/8" DEEP; 42"HIGH
AC INPUT:	103 WATTS
OUTPUT:	11 WATTS E.I.A.
WEIGHT:	249 LBS.



FRONT VIEW OF CONSOLE - MODEL M-2 ORGAN

FIGURE 2

DIMENSIONS:	45-5/8" WIDE; 25-3/8" DEEP; 42" HIGH
AC INPUT:	103 WATTS
OUTPUT:	11 WATTS E.I.A.
WEIGHT:	249 LBS.



-BACK VIEW OF CONSOLE - MODEL M-2 ORGAN
(WITH DUST COVER REMOVED)
FIGURE 3

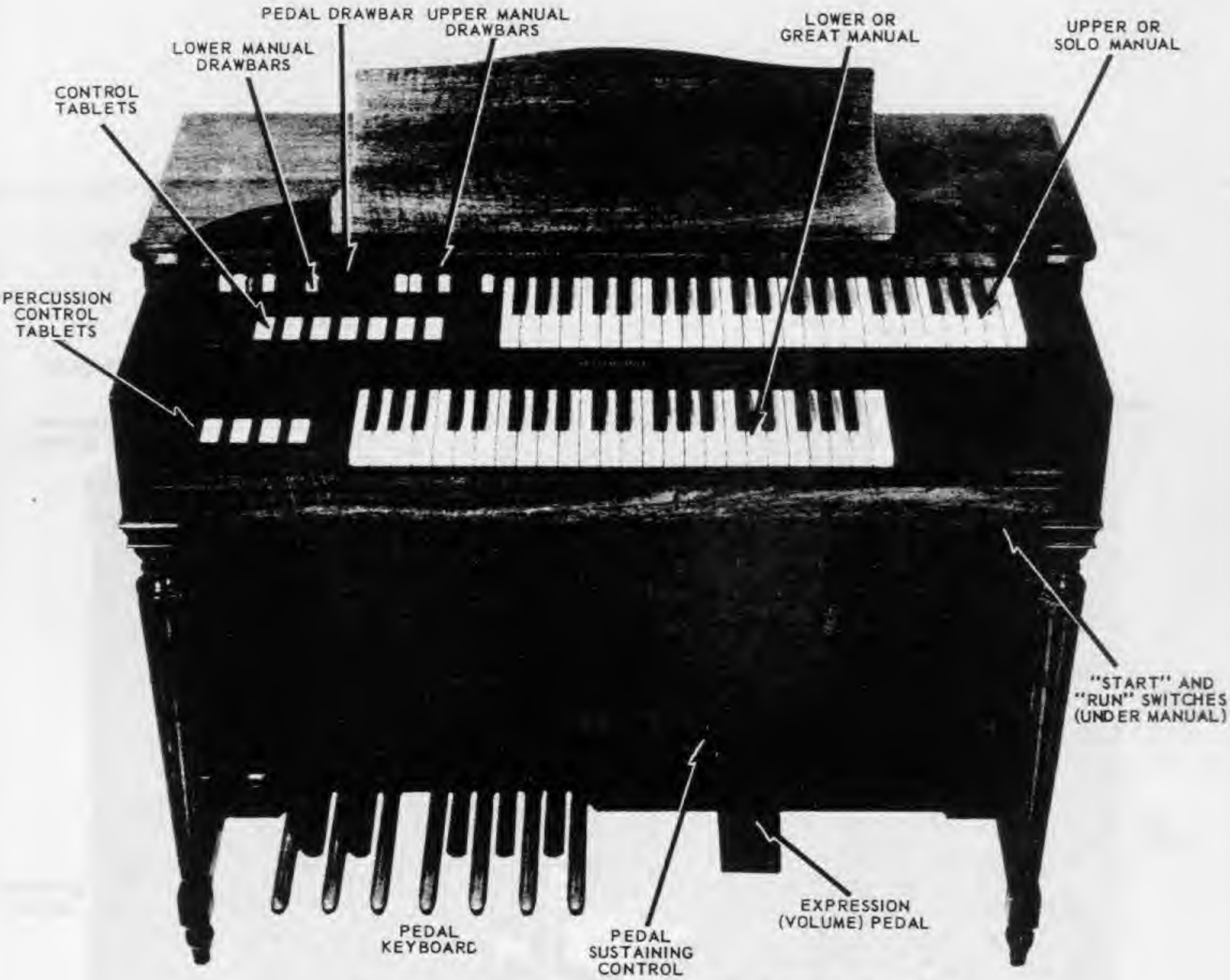
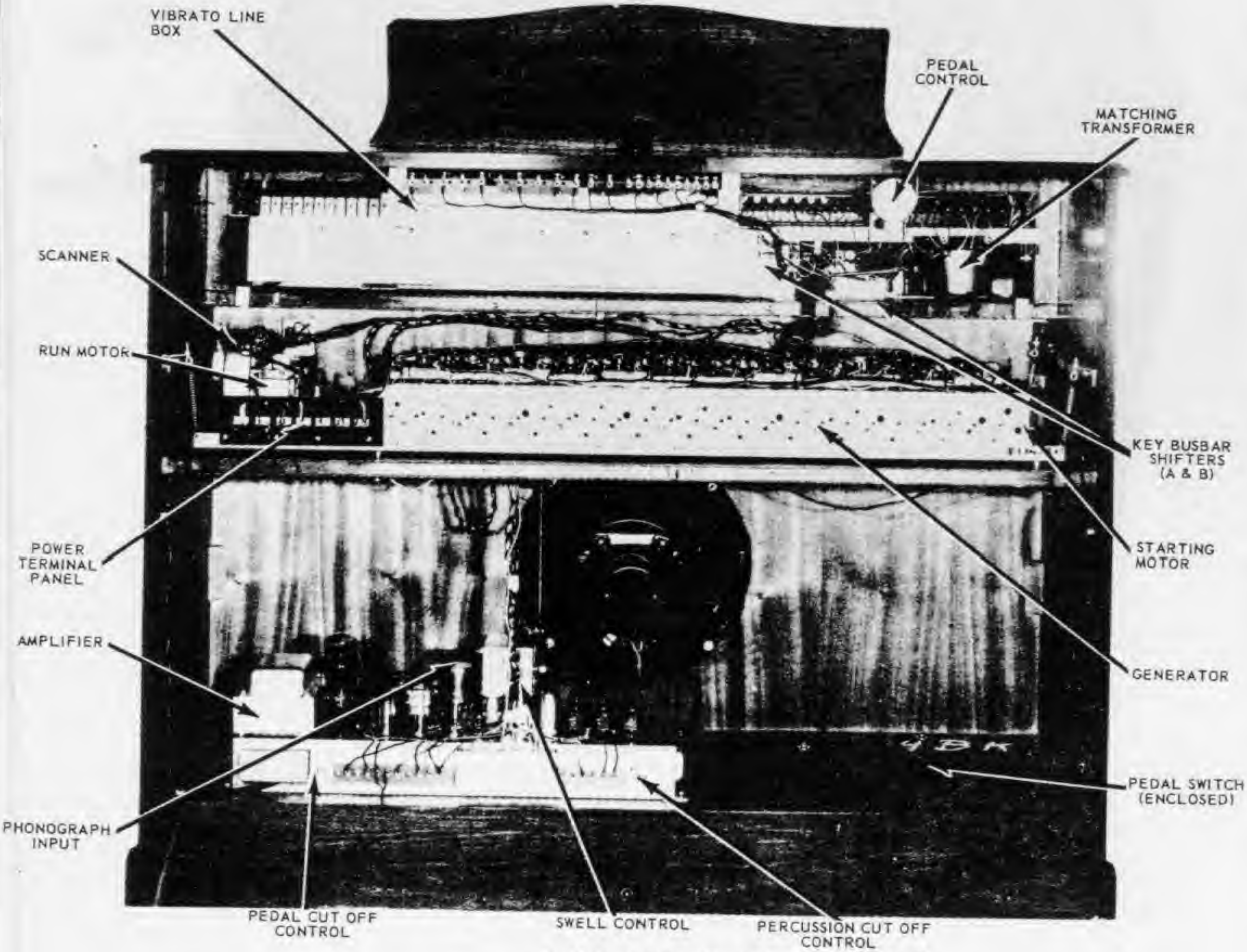


FIGURE 1 FRONT VIEW OF CONSOLE M-3

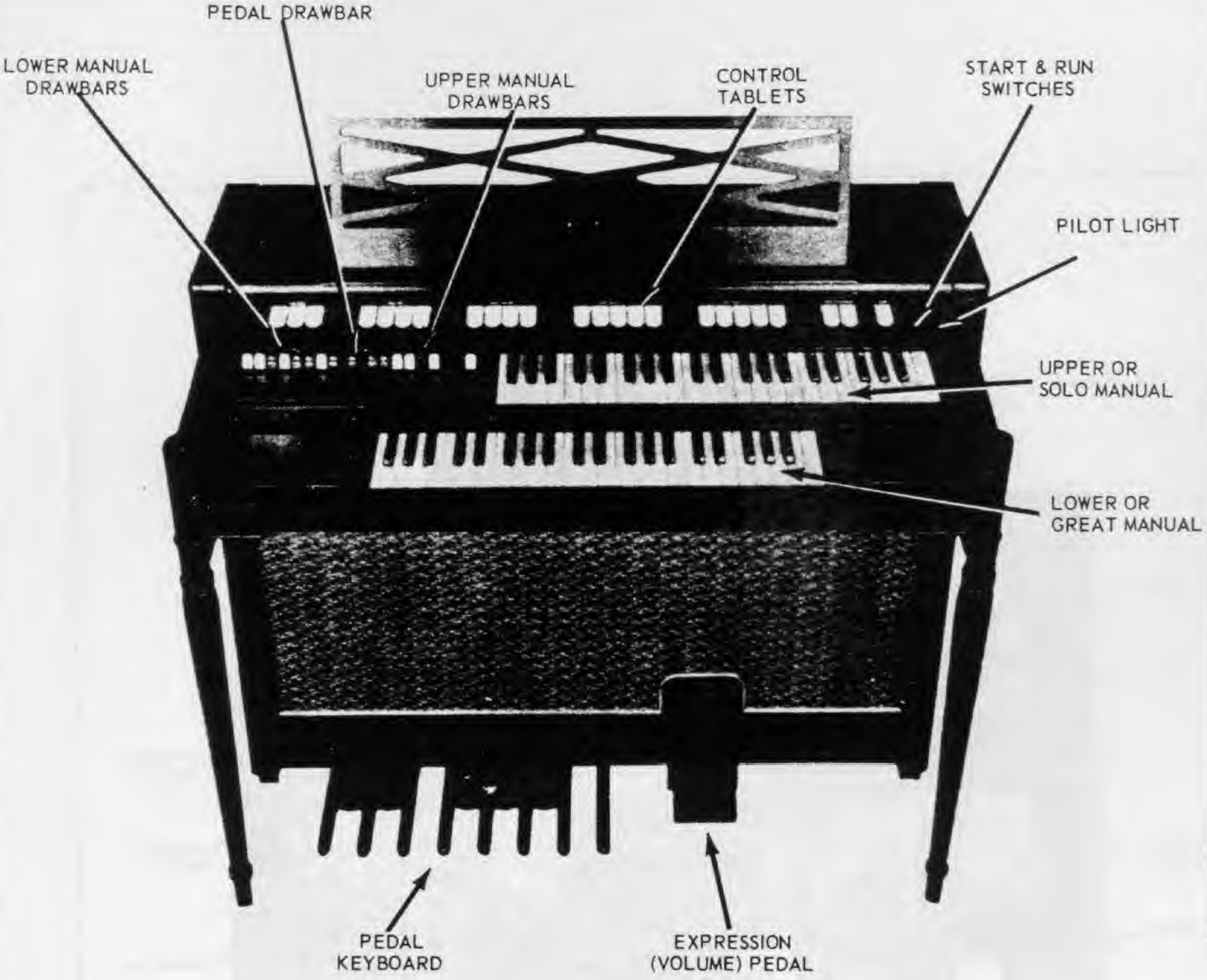
FIGURE 4

DIMENSIONS: 45-5/8" WIDE; 25-3/8"DEEP; 42" HIGH
AC INPUT: 103 WATTS
OUTPUT: 11 WATTS E.I.A.
WEIGHT: 249 LBS.



BACK VIEW OF CONSOLE **M-3**
(WITH DUST COVER REMOVED)

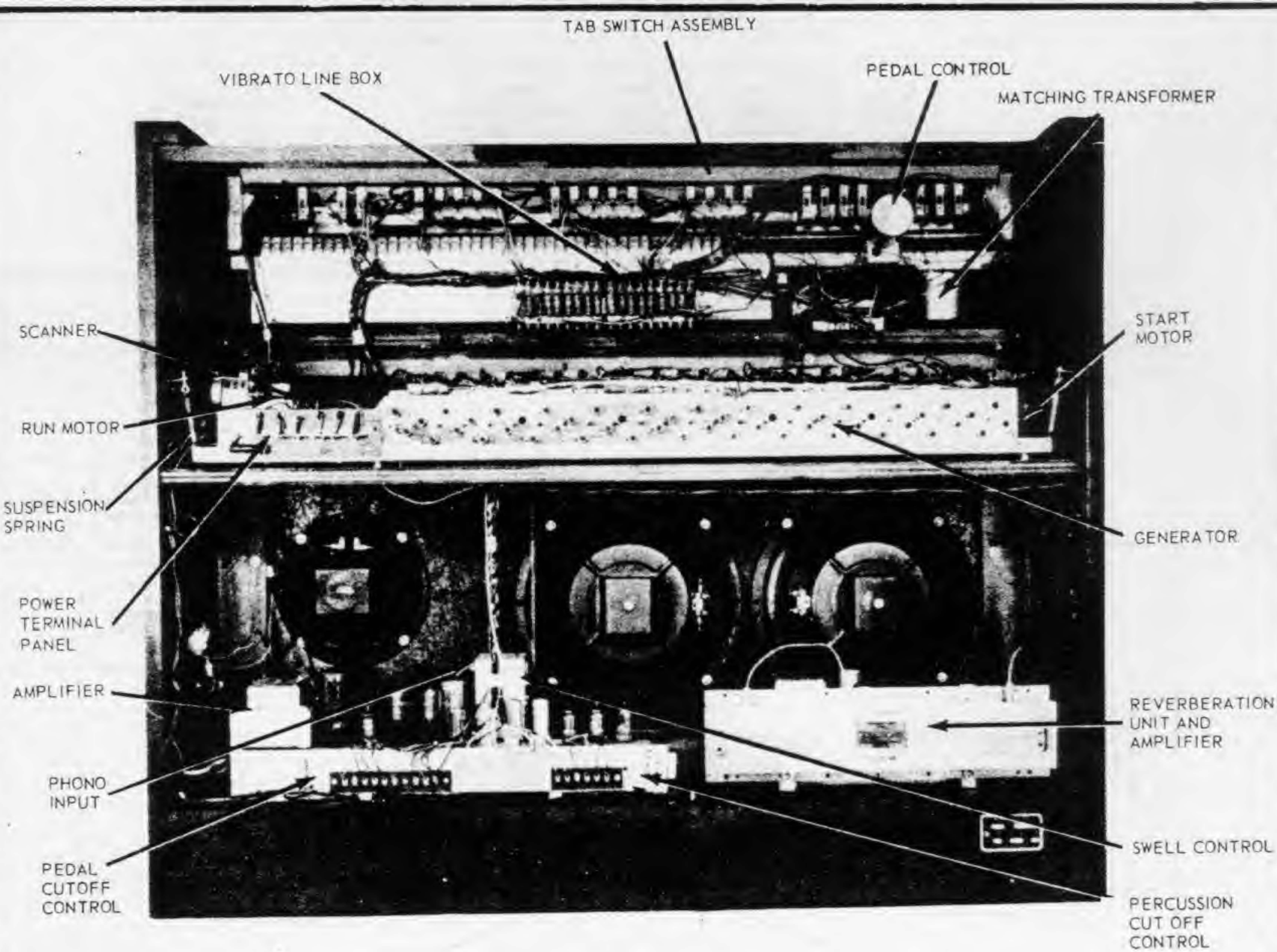
FIGURE 5



TYPICAL M-100 SERIES INSTRUMENT

DIMENSIONS:	44-3/4" WIDE; 25-1/2" DEEP; 44-1/2" HIGH
AC INPUT:	155 WATTS
OUTPUT:	22 WATTS E. I. A.
WEIGHT:	268 LBS.

FIGURE 6



M-100

BACK VIEW OF CONSOLE
GENERATOR DUST COVER REMOVED

FIGURE 7

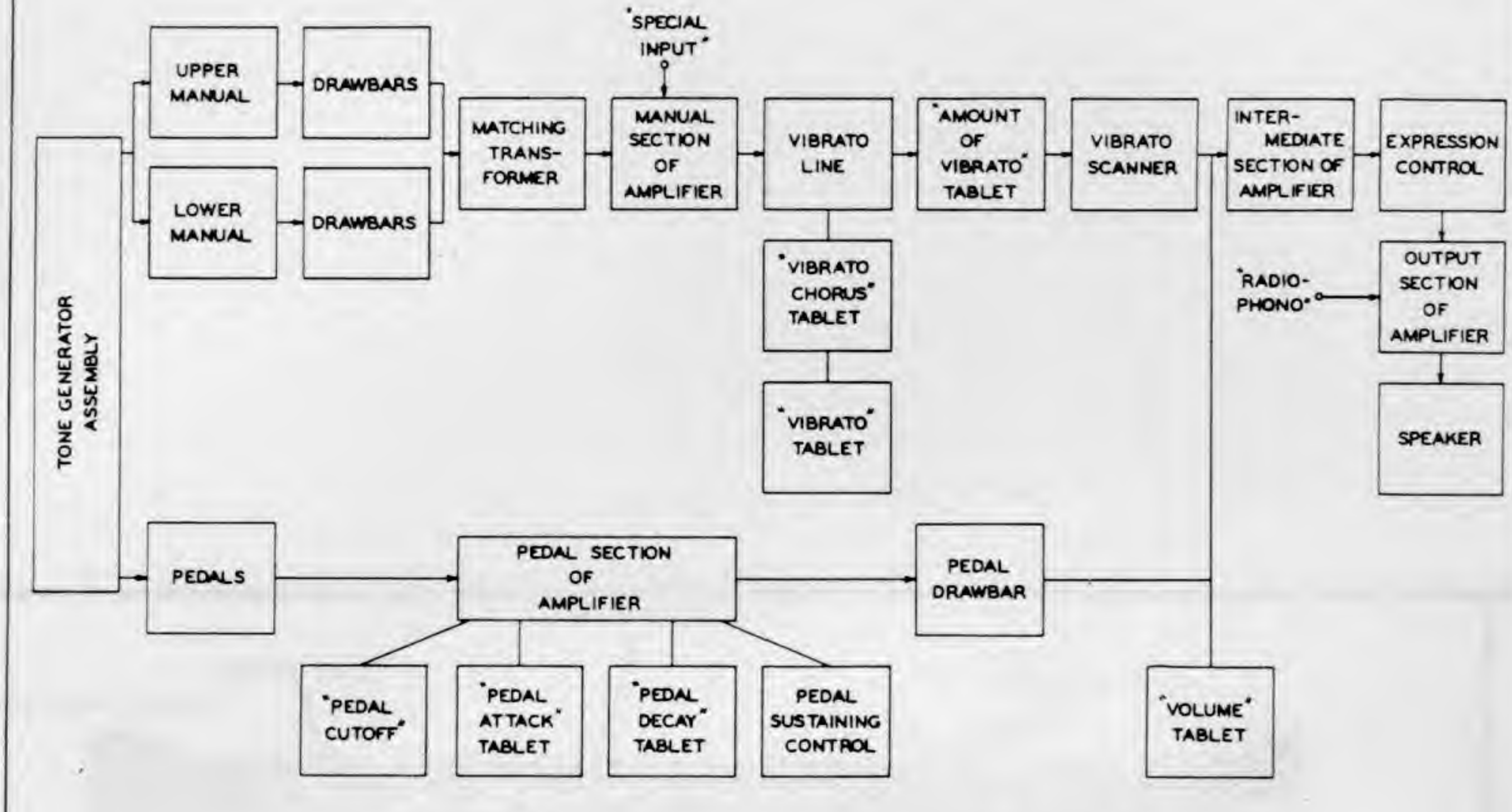


FIGURE 8 BLOCK DIAGRAM - MODEL M ORGAN

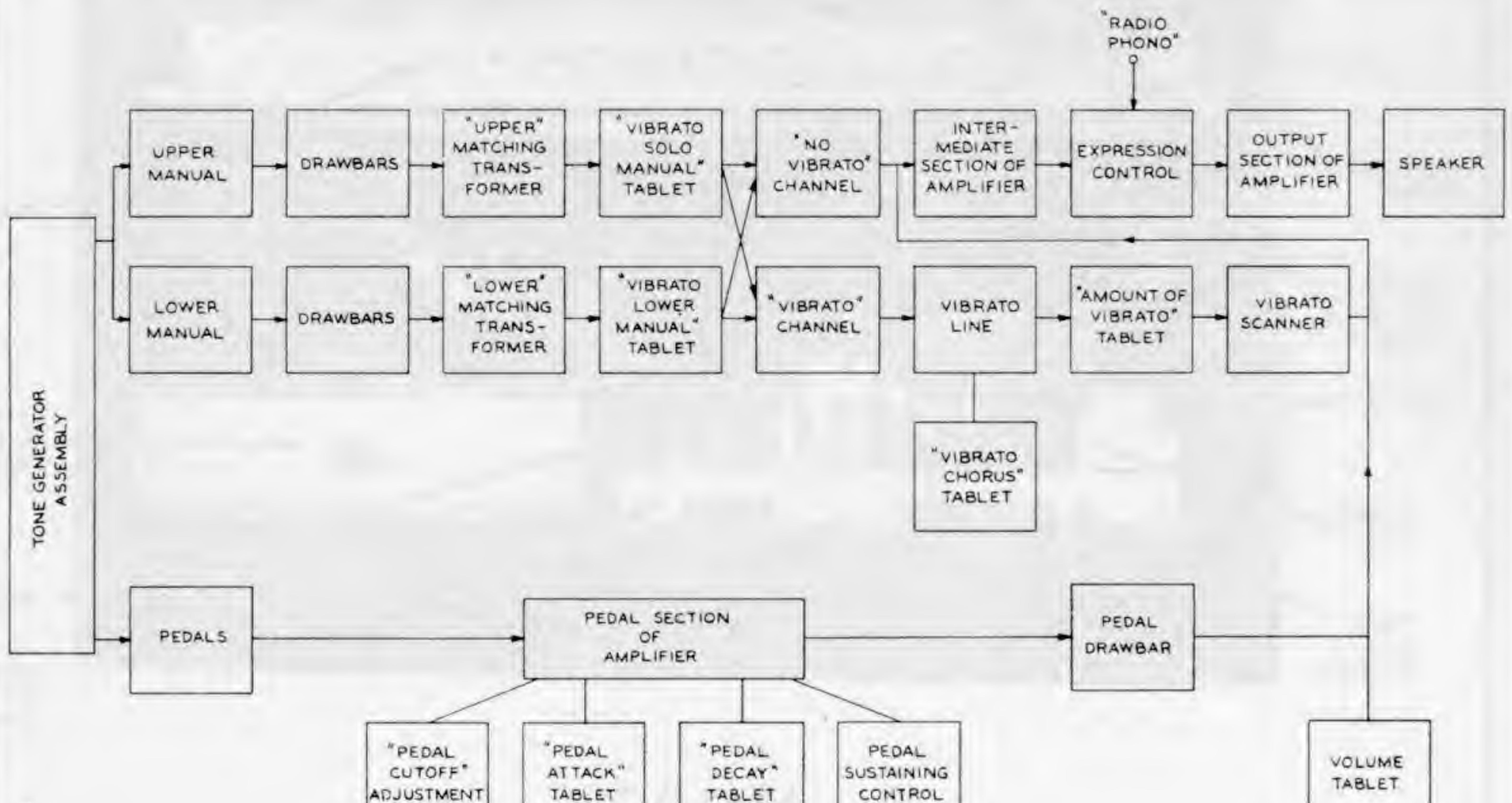


FIGURE 9 - BLOCK DIAGRAM - MODEL M-2

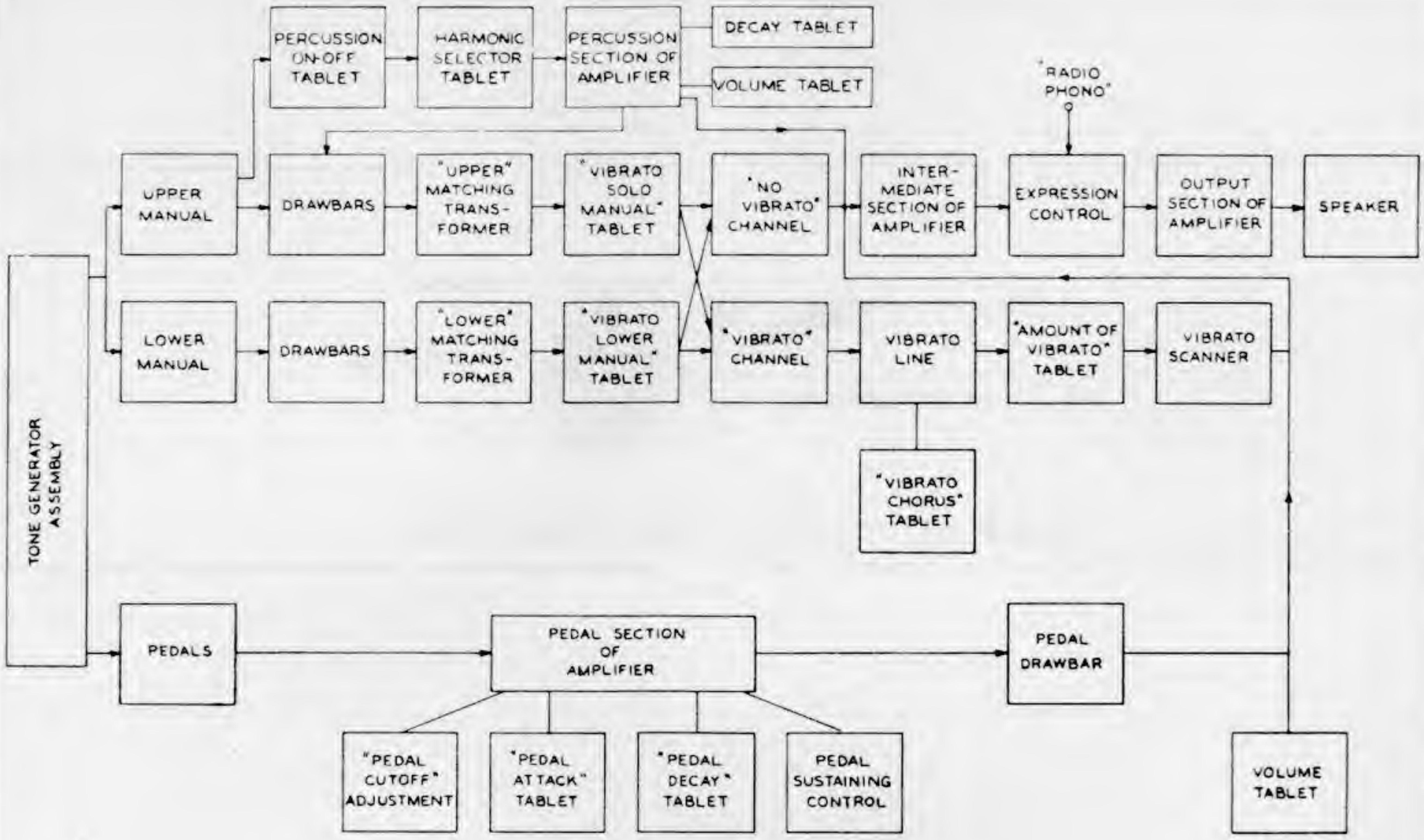
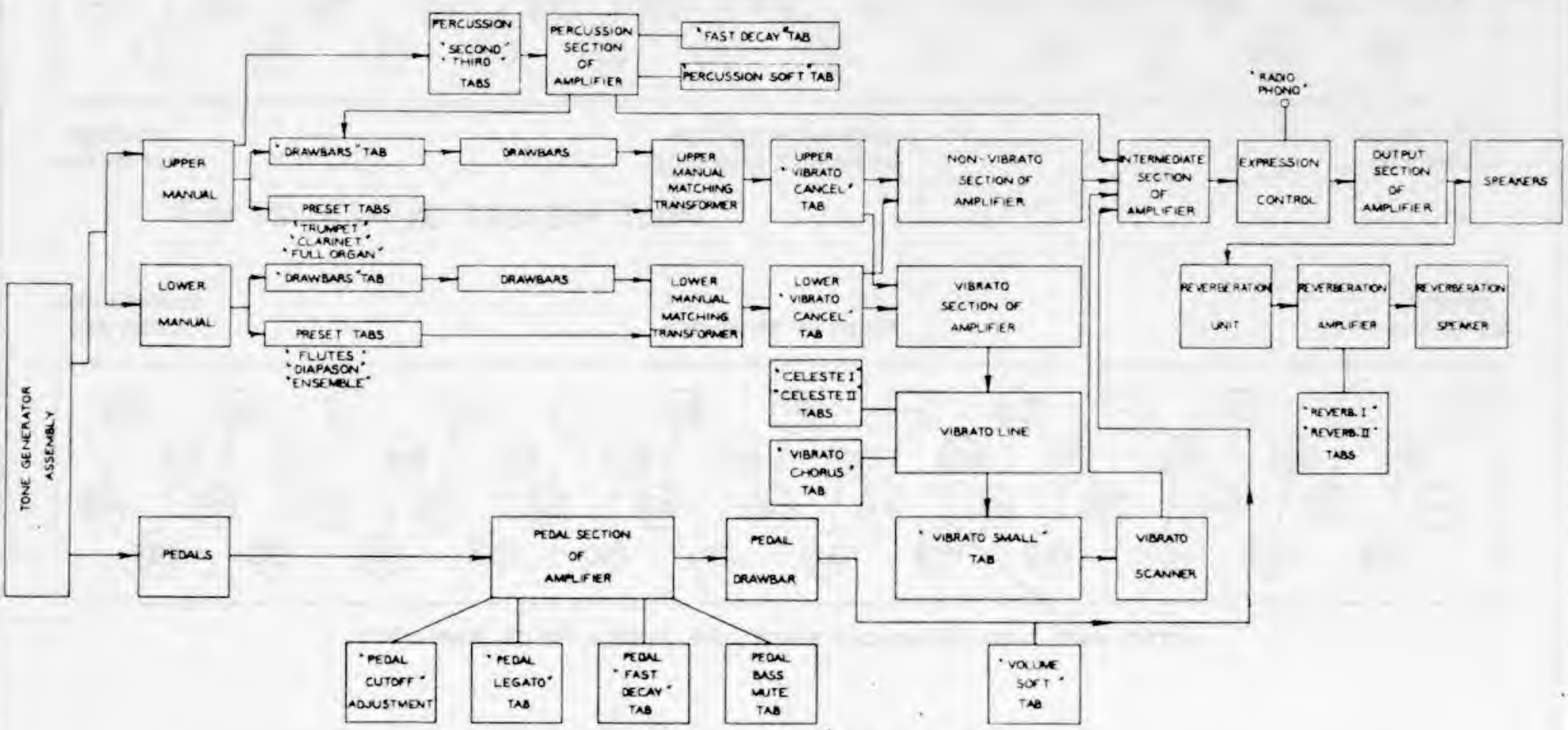


FIGURE 10 BLOCK DIAGRAM MODEL M-3



BLOCK DIAGRAM MODEL M-100

FIGURE 11

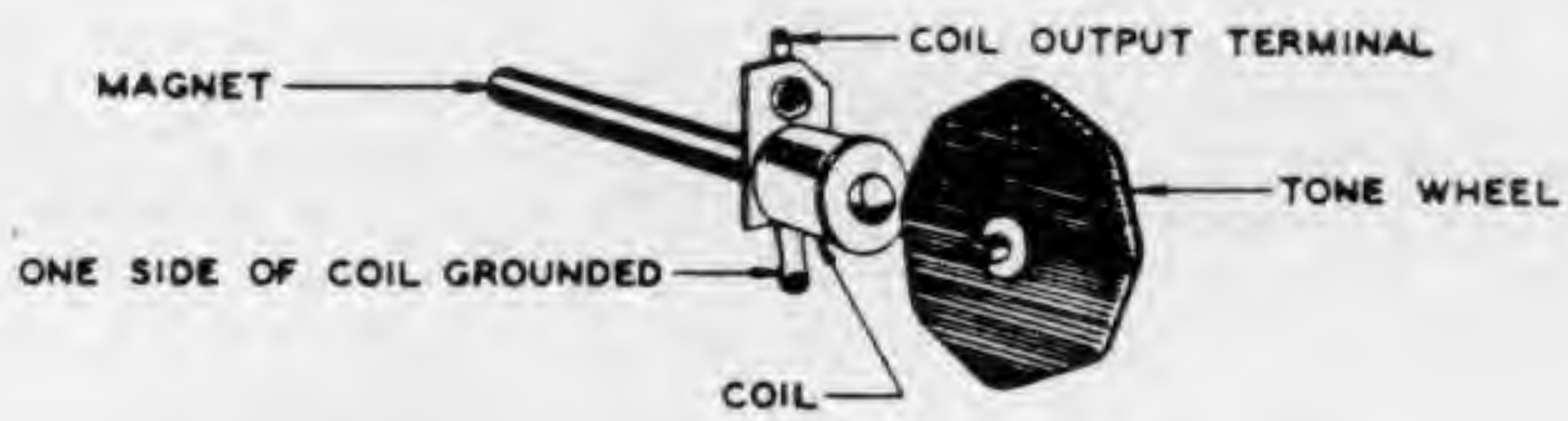


FIGURE 12 - TYPICAL TONE GENERATOR

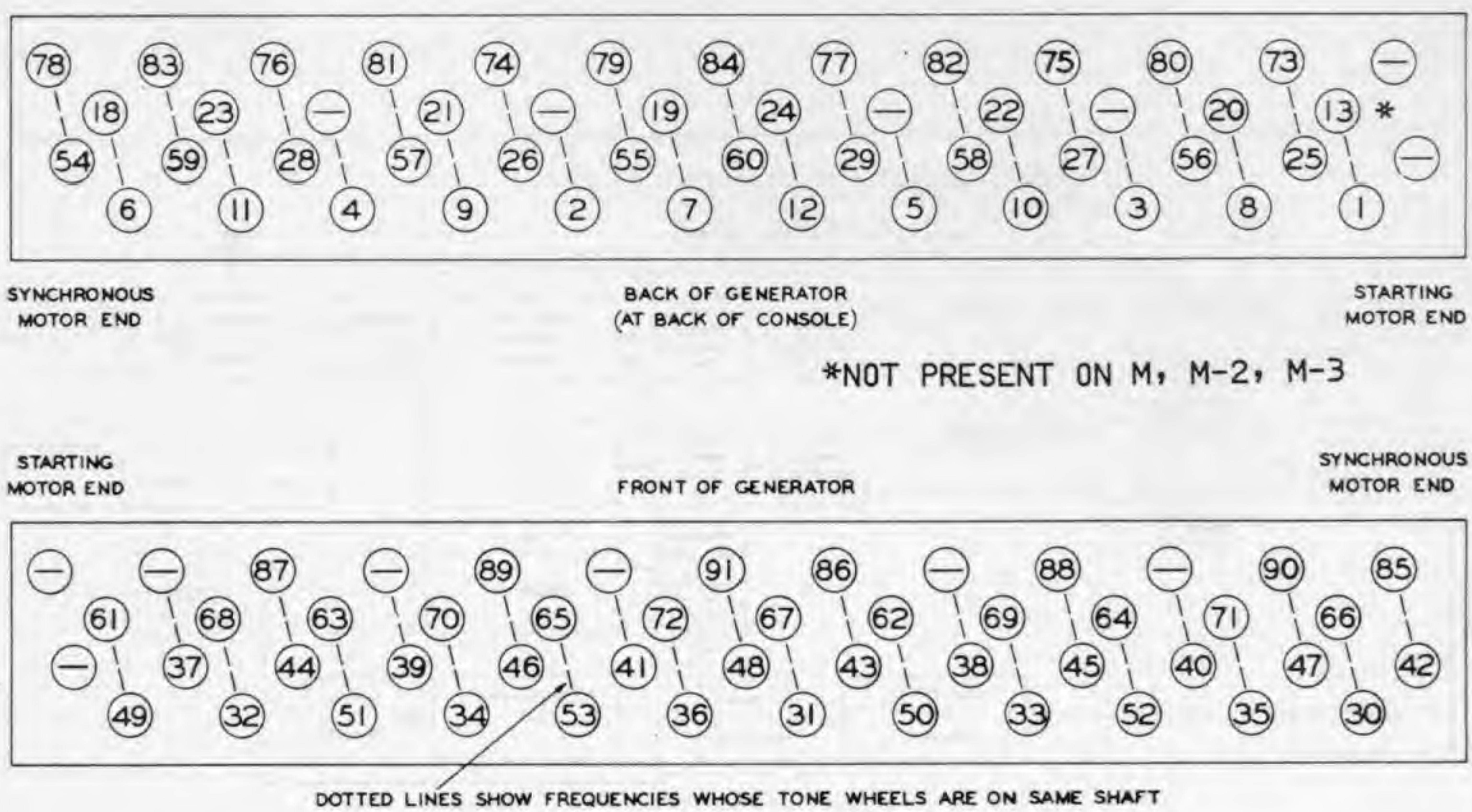
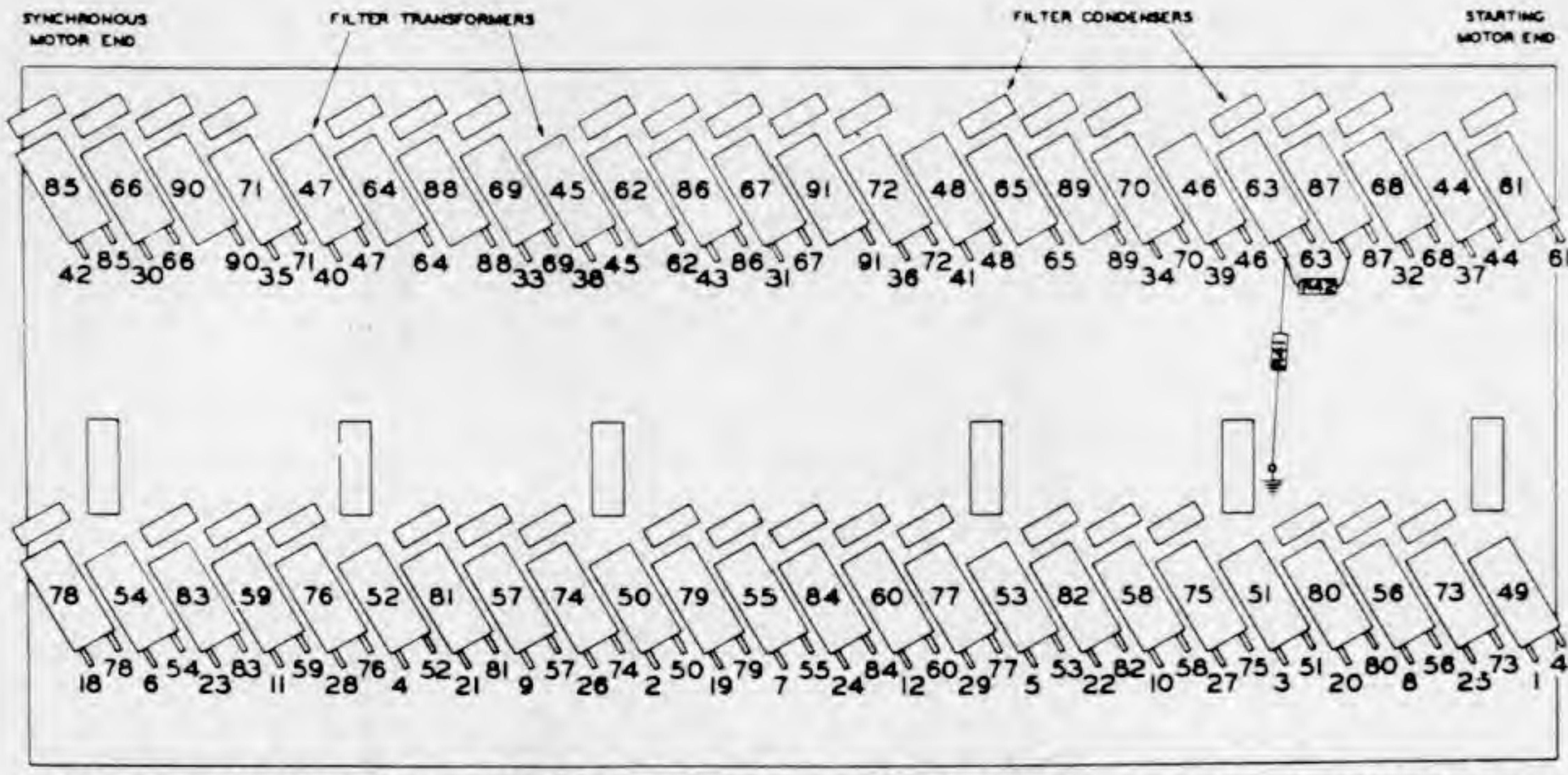


FIGURE 13 - MAGNET LOCATIONS - ON TONE GENERATOR



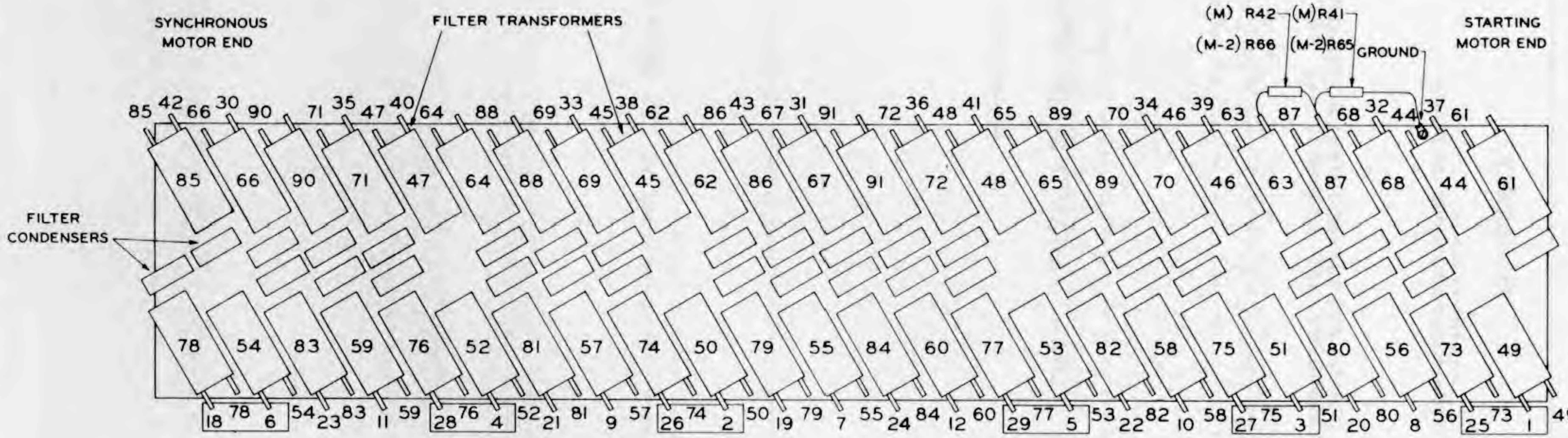
NUMBERS ON FILTER TRANSFORMERS ARE FREQUENCY NUMBERS OF TRANSFORMERS
NUMBERS BELOW TRANSFORMERS ARE OUTPUT TERMINAL FREQUENCY NUMBERS

FIGURE 14 · GENERATOR COVER - MODEL M ORGAN

NUMBERS ON FILTER TRANSFORMERS ARE FREQUENCY NUMBERS OF TRANSFORMERS
NUMBERS ABOVE AND BELOW TRANSFORMERS ARE OUTPUT TERMINAL FREQUENCY NUMBERS

FIGURE 8A - GENERATOR COVER - MODEL M ORGAN
SERIAL NUMBER 15083 AND UP

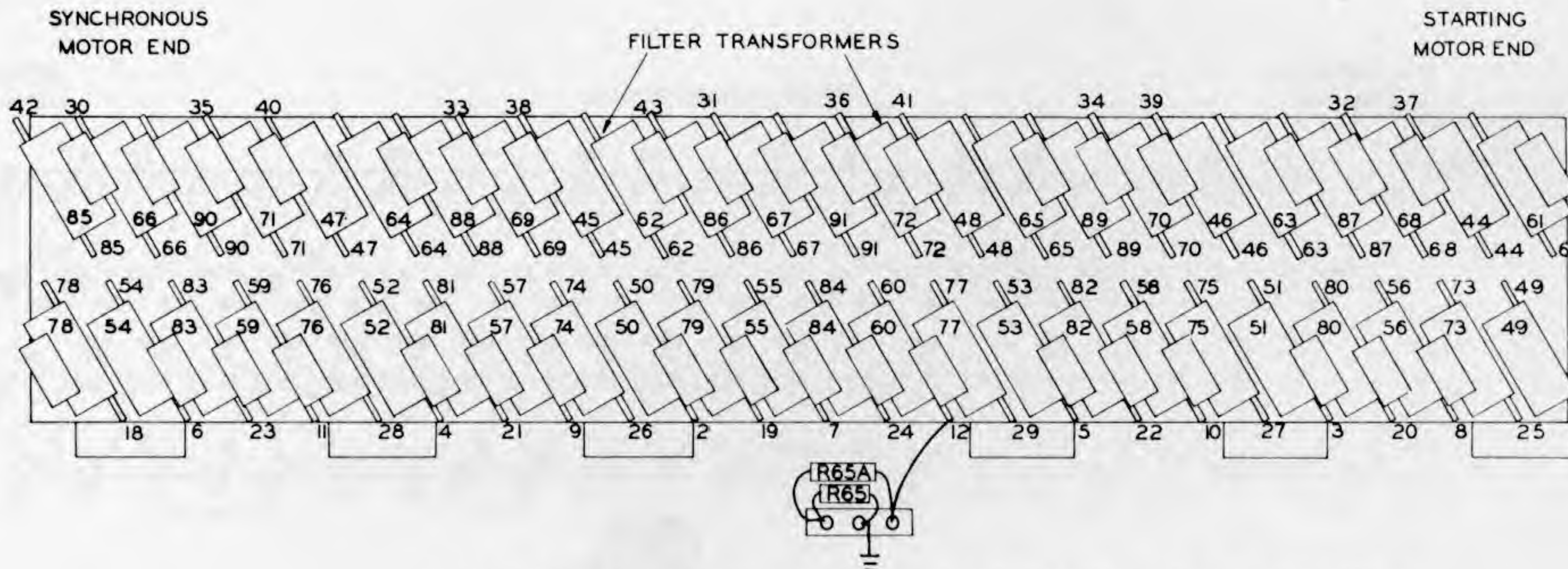
FIGURE 14A



NUMBERS ON FILTER TRANSFORMERS ARE FREQUENCY NUMBERS OF TRANSFORMERS
NUMBERS ABOVE AND BELOW TRANSFORMERS ARE OUTPUT TERMINAL FREQUENCY NUMBERS

FIGURE 15 - GENERATOR COVER - MODEL M, M-2 AND M-3

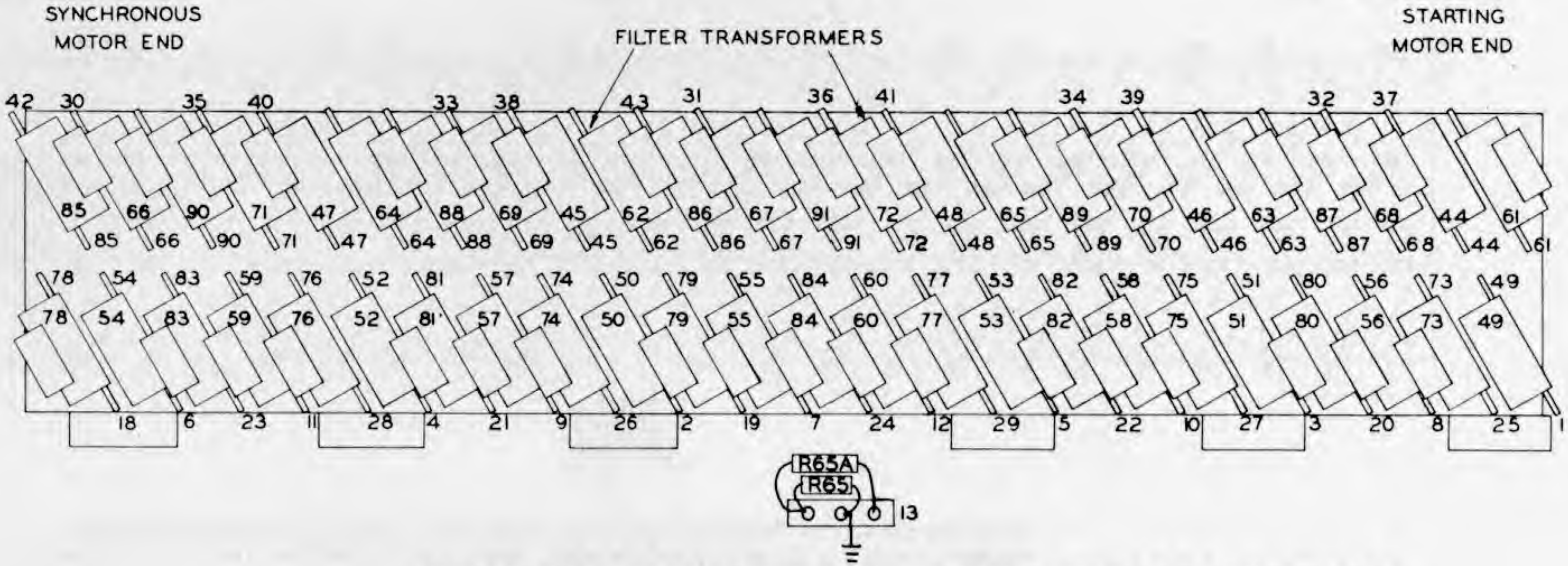
MODEL M SERIAL NUMBER 15083 AND ABOVE
MODEL M-2 SERIAL NUMBER 19000 AND ABOVE



NUMBERS ON FILTER TRANSFORMERS ARE FREQUENCY NUMBERS OF TRANSFORMERS
NUMBERS ABOVE & BELOW TRANSFORMERS ARE OUTPUT TERMINAL FREQUENCY NUMBERS

FIGURE 16 – GENERATOR COVER

MODEL M-3 APPROX. NO. 90485 & ABOVE



NUMBERS ON FILTER TRANSFORMERS ARE FREQUENCY NUMBERS OF TRANSFORMERS
NUMBERS ABOVE & BELOW TRANSFORMERS ARE OUTPUT TERMINAL FREQUENCY NUMBERS

FIGURE 17 GENERATOR COVER M-100 SERIES

UPPER MANUAL

HARMONIC	BUSBAR LEAD COLOR	FREQUENCY NUMBERS																																									
SUB-FUND	BROWN	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61
SUB-3RD	RED	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80
FUND	ORANGE	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73
2ND	YELLOW	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85
3RD	GREEN	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	
4TH	BLUE	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91						
5TH	VIOLET	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91										
6TH	GREY	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91													
8TH	WHITE	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*

NOTES

F	F#	G	G#	A	A#	B	C	C#	D	D#	E	F	F#	G	G#	A	A#	B	C	C#	D	D#	E	F	F#	G	G#	A	A#	B	C	C#	D	D#	E	F	F#	G	G#	A	A#	B	C	C#	D	D#	E	F	F#	G	G#	A	A#	B	C
6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61

KEY NUMBERS

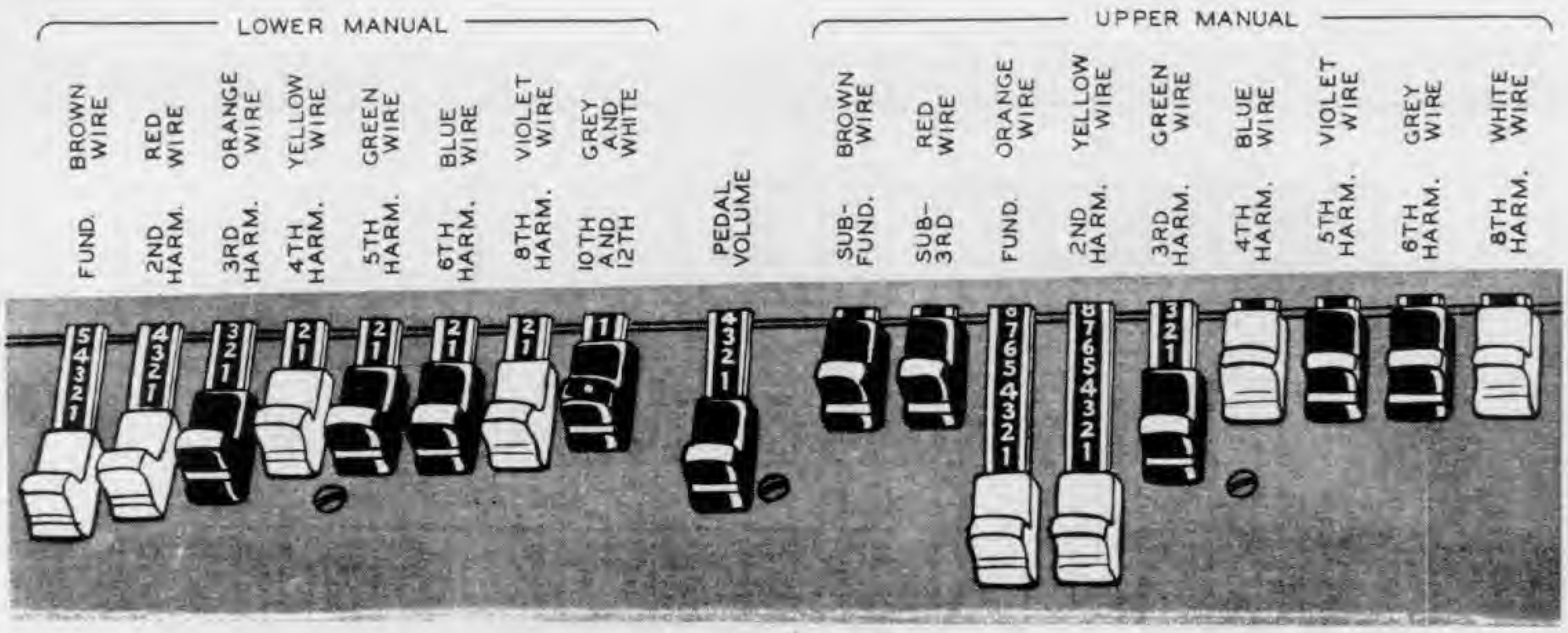
LOWER MANUAL

FREQUENCY NUMBERS																																												BUSBAR LEAD COLOR	HARMONIC
18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	BROWN	FUND
30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	RED	2ND
37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	ORANGE	3RD
42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	YELLOW	4TH
46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	GREEN	5TH
49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91		BLUE	6TH
54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91							VIOLET	8TH
58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91											GREY	10TH
61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91														WHITE	12TH

*CONTACTS GROUNDED THROUGH 16 OHMS IN MODEL M-3 AND M-100. **NO** CONNECTION IN MODEL M AND M-2

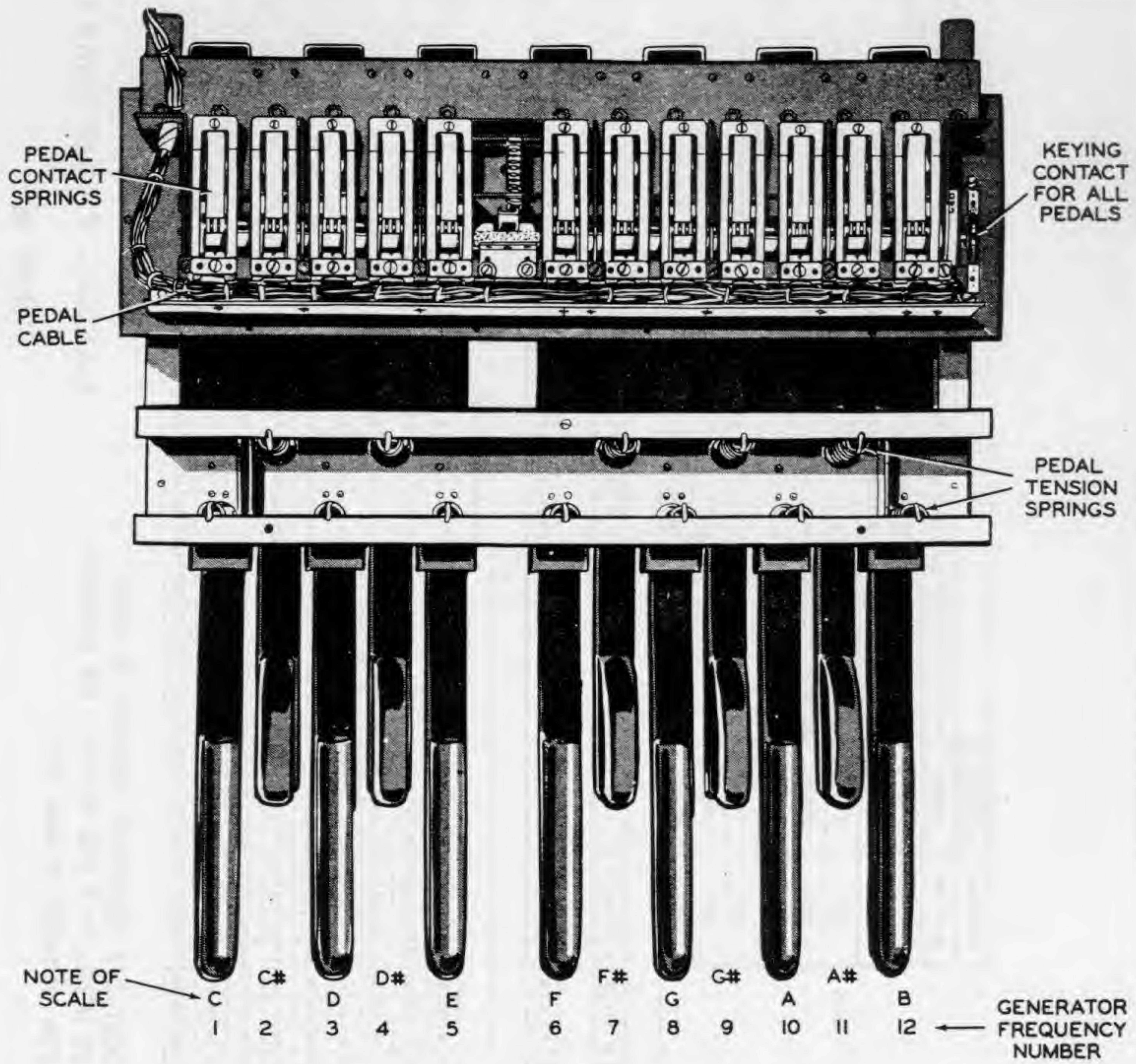
MANUAL WIRING CHART

FIGURE 18



DRAWBAR ASSEMBLY

FIGURE 19



PEDAL KEYBOARD — MODEL M, M-2, AND M-3

FIGURE 20

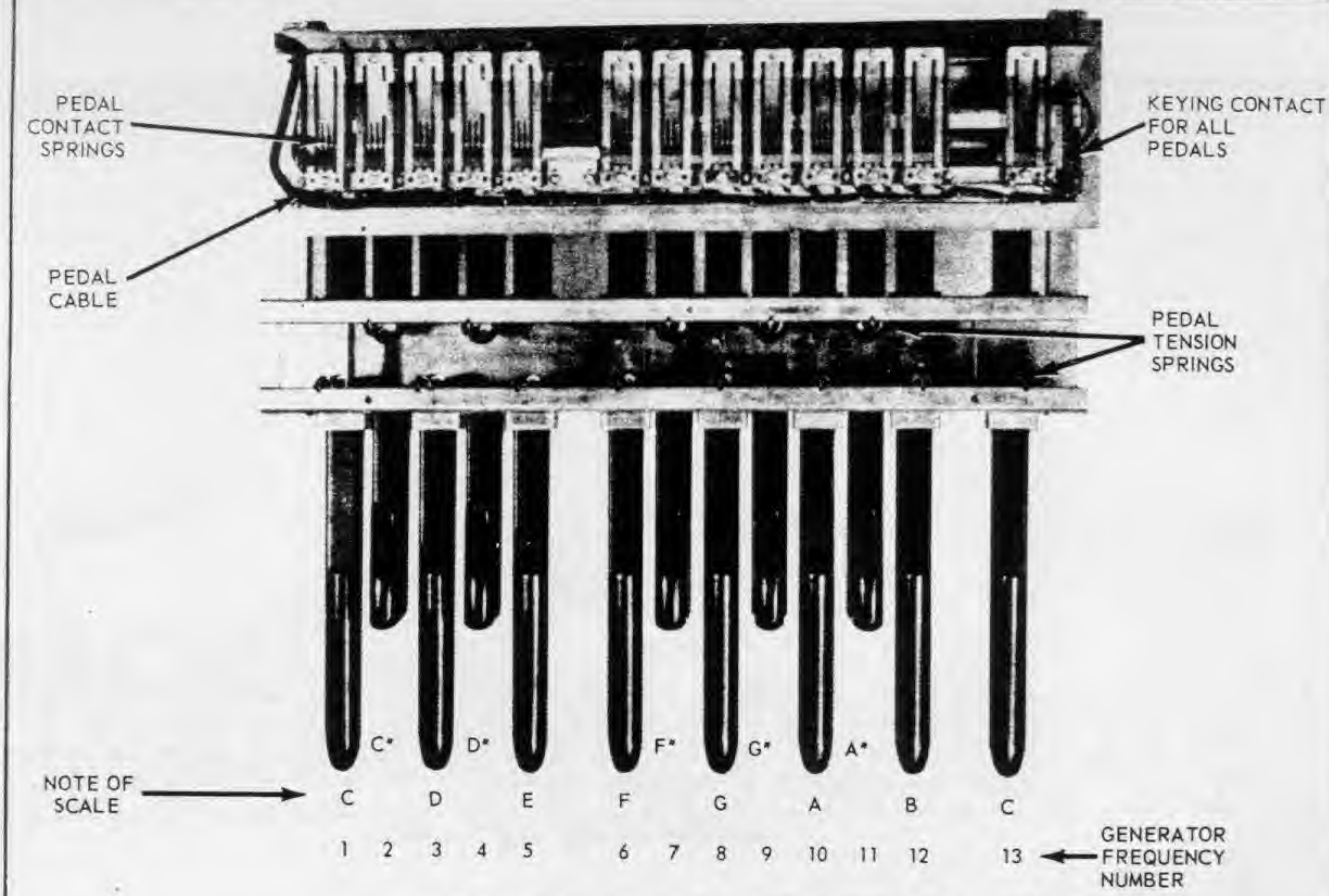


FIGURE 21. PEDAL KEY BOARD MODEL M-100

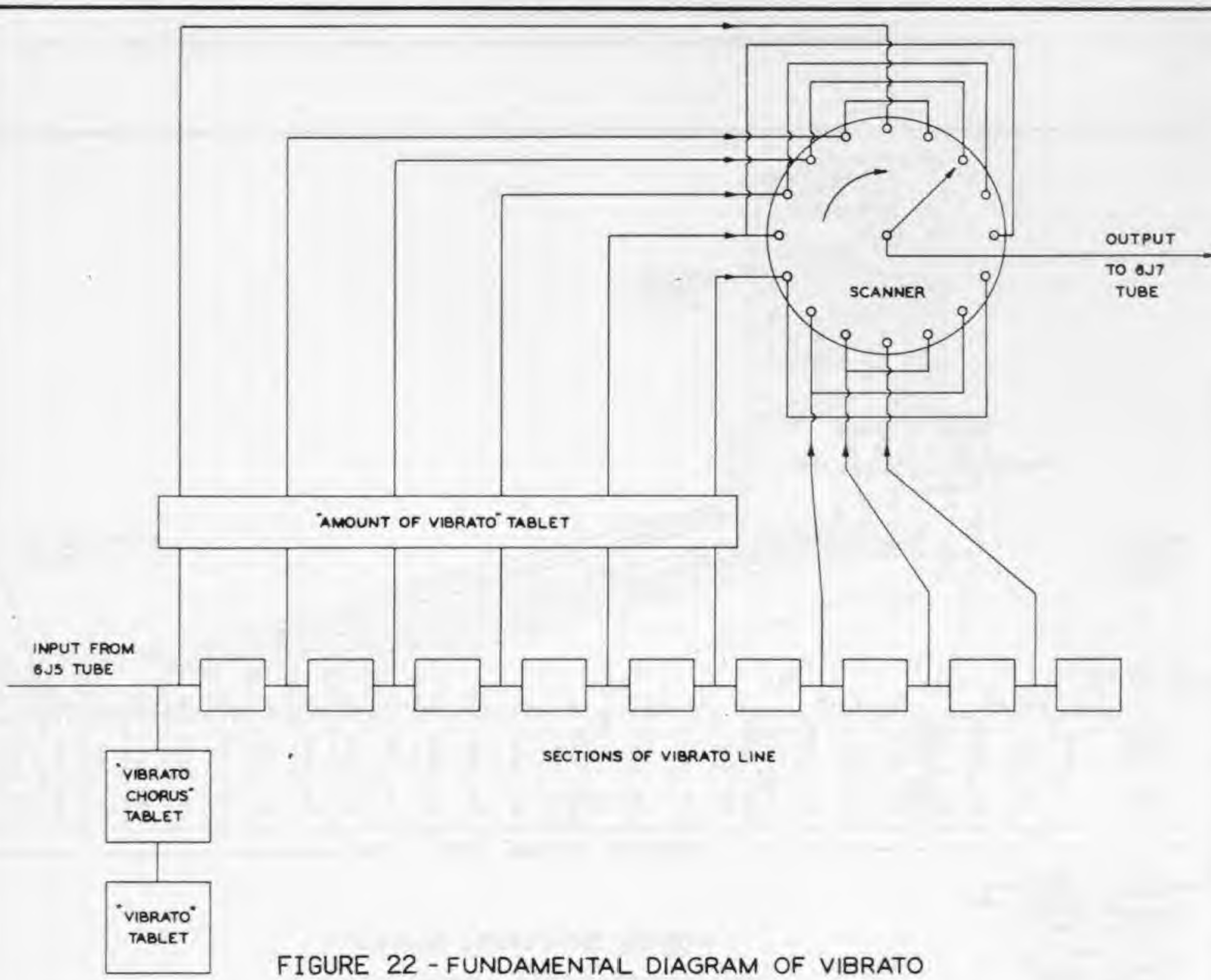


FIGURE 22 - FUNDAMENTAL DIAGRAM OF VIBRATO SYSTEM IN MODEL M ORGAN

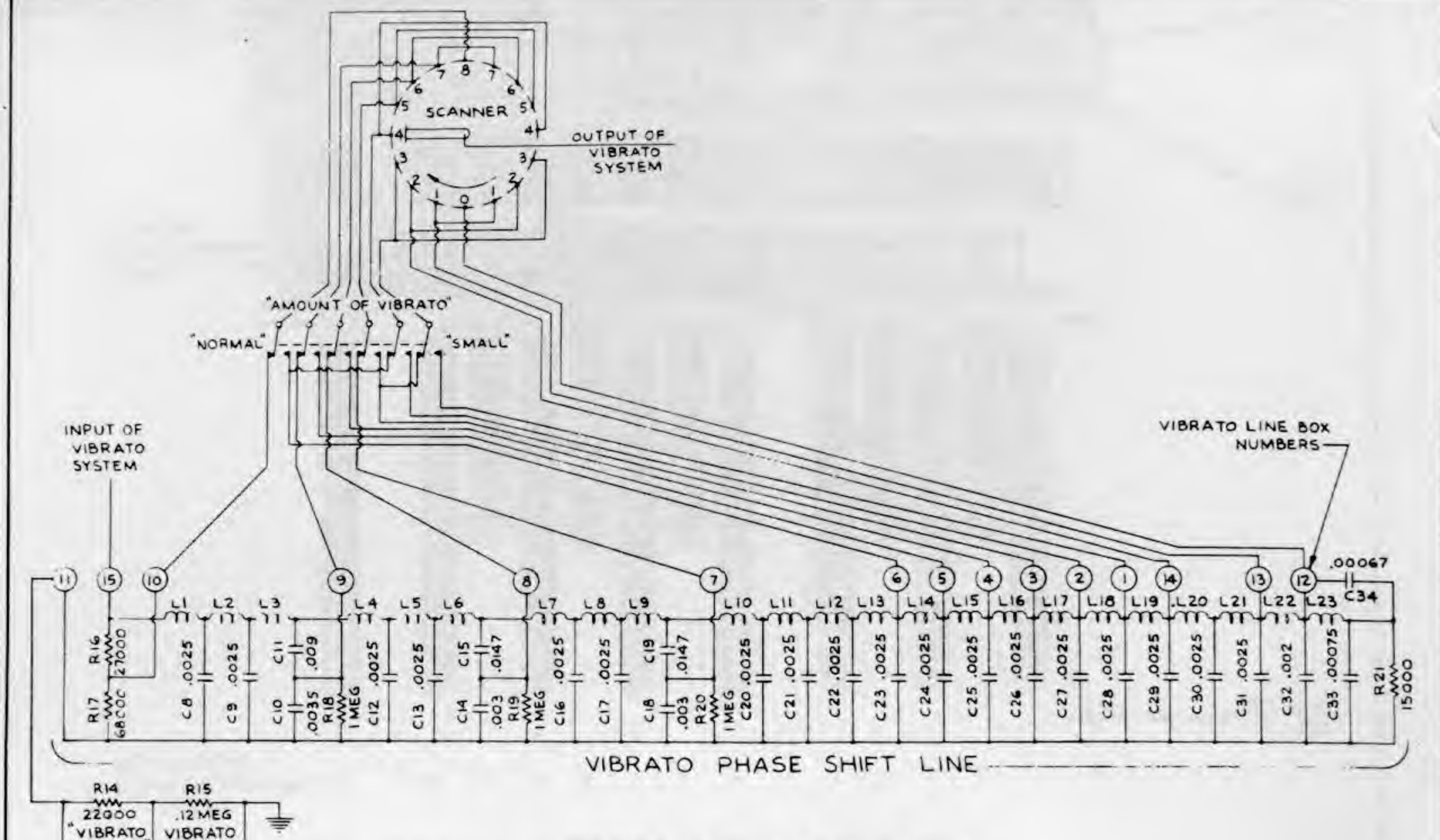


FIGURE 23 - VIBRATO SYSTEM

MODEL M CONSOLES BELOW SERIAL NUMBER 13509

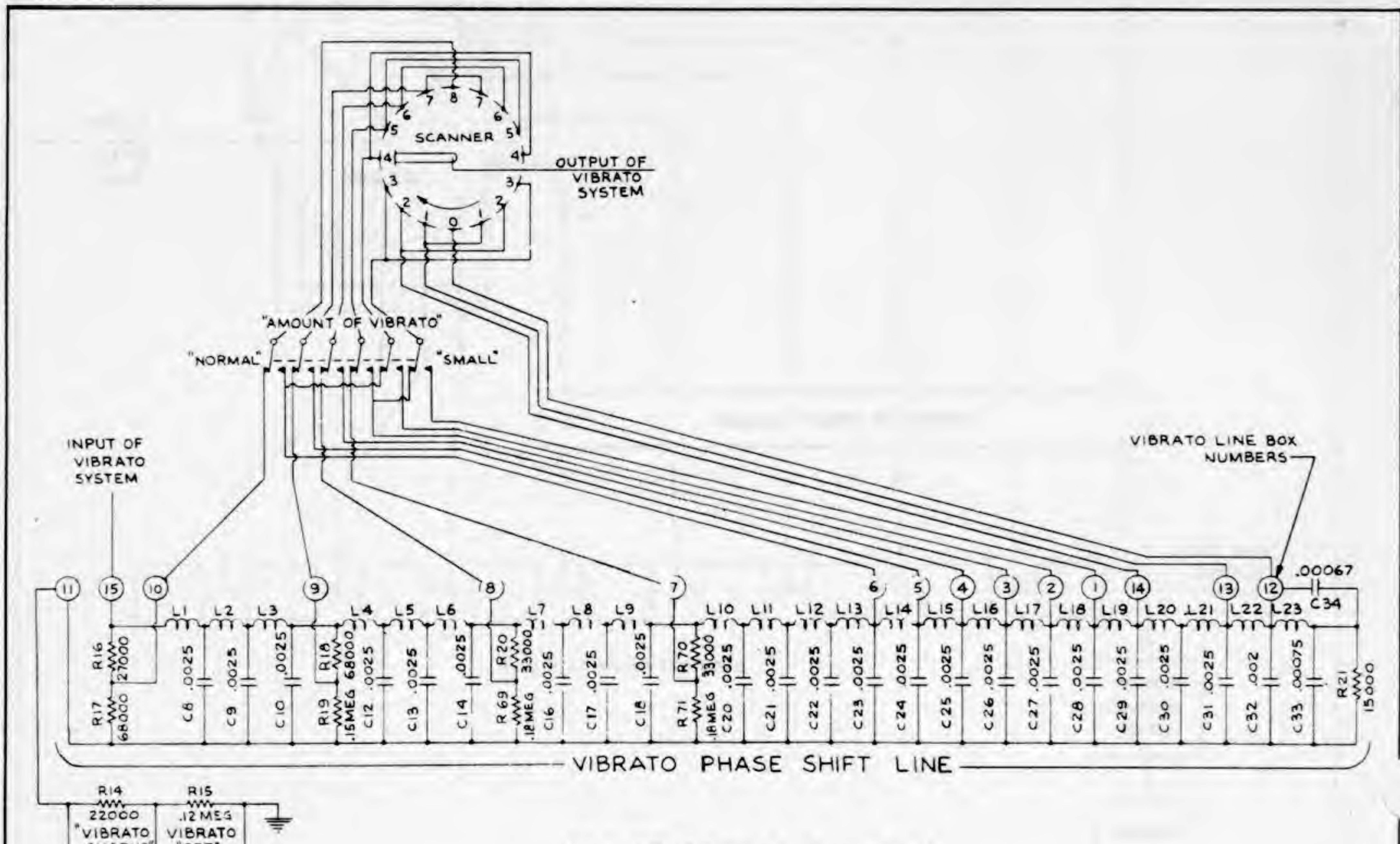


FIGURE 24 - VIBRATO SYSTEM

MODEL M CONSOLES SERIAL NUMBER 13509 AND ABOVE

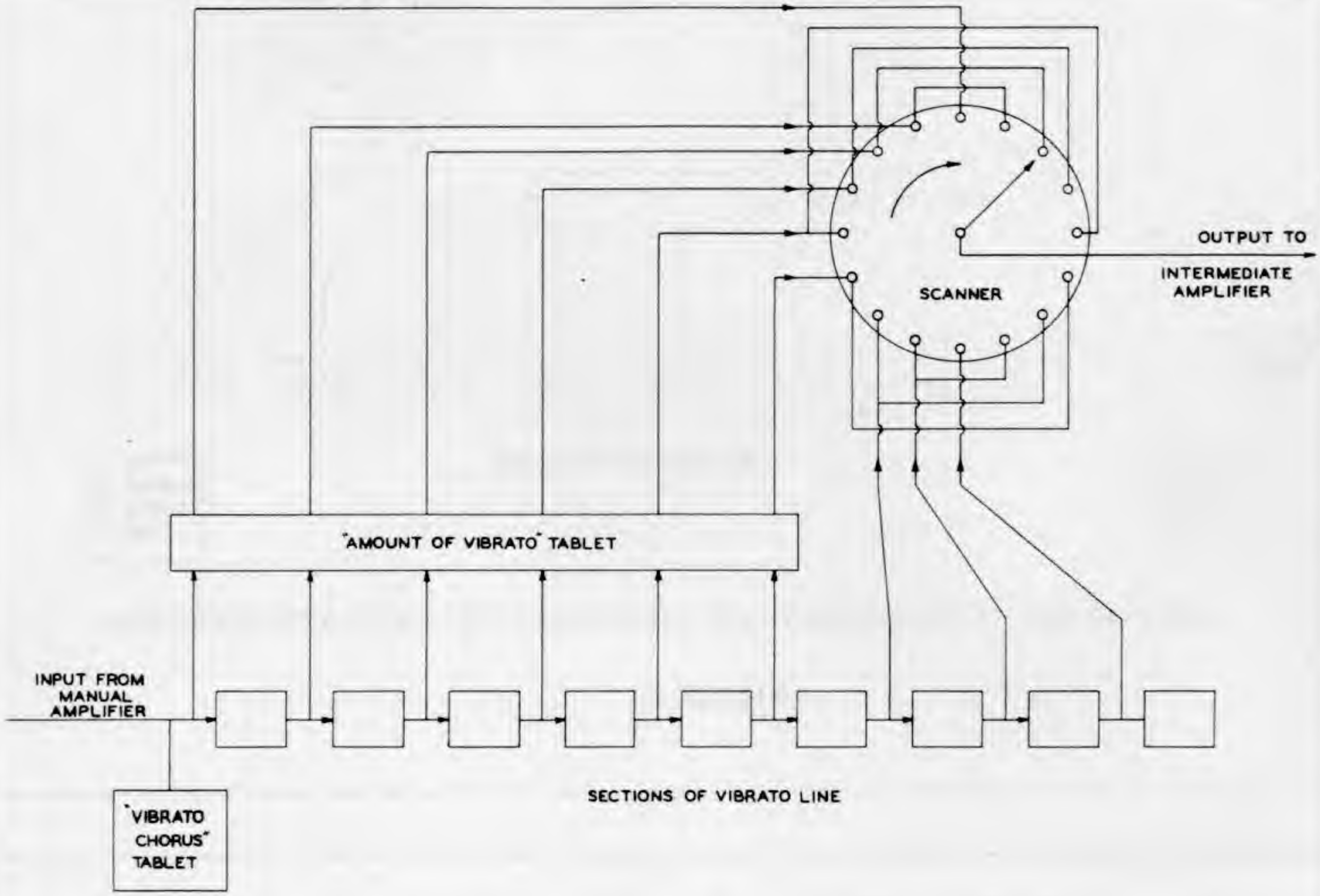
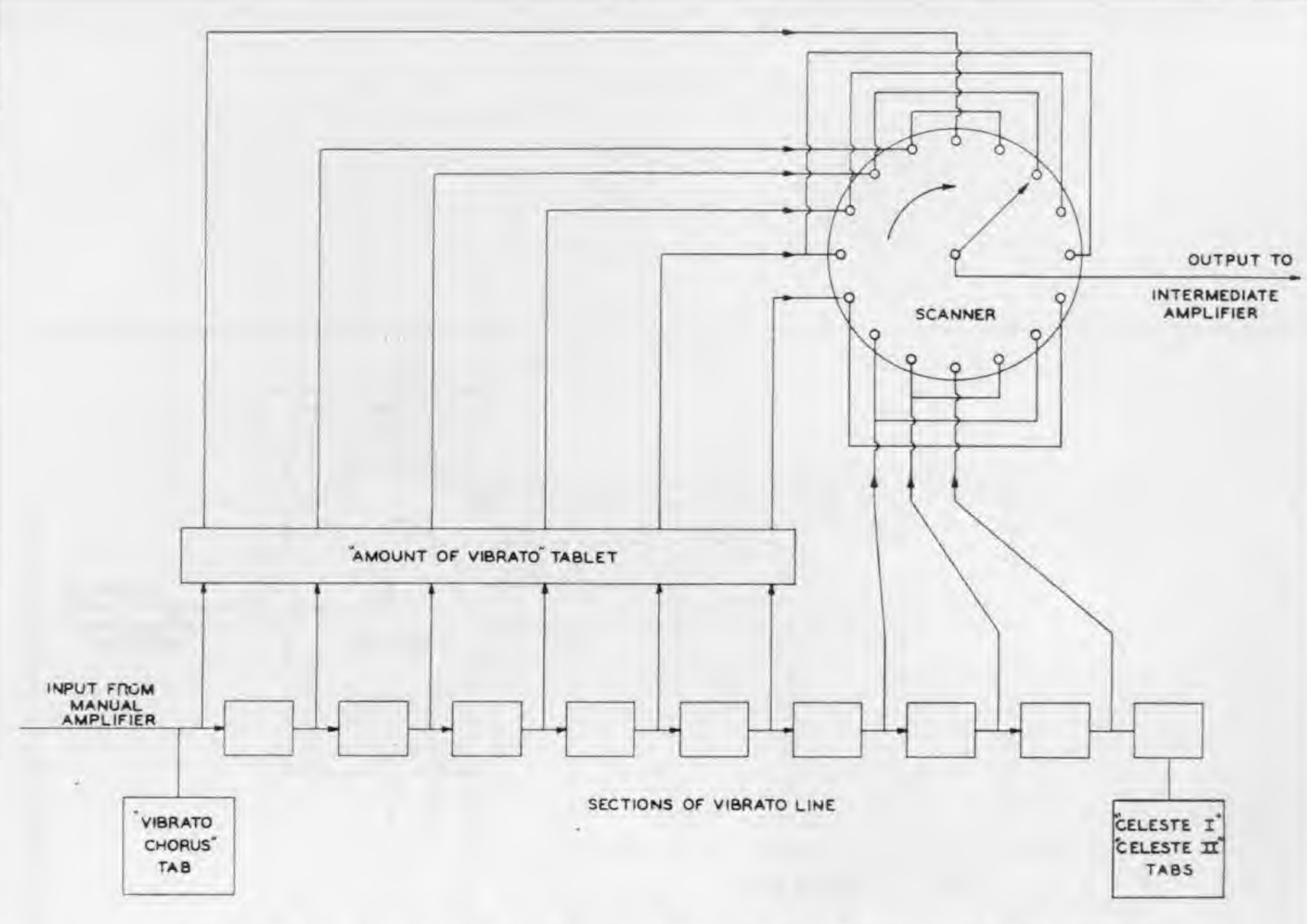


FIGURE 25 -FUNDAMENTAL DIAGRAM OF VIBRATO SYSTEM IN MODEL M-2 AND M-3



MODEL M-100 FUNDAMENTAL DIAGRAM OF VIBRATO SYSTEM

FIGURE 26

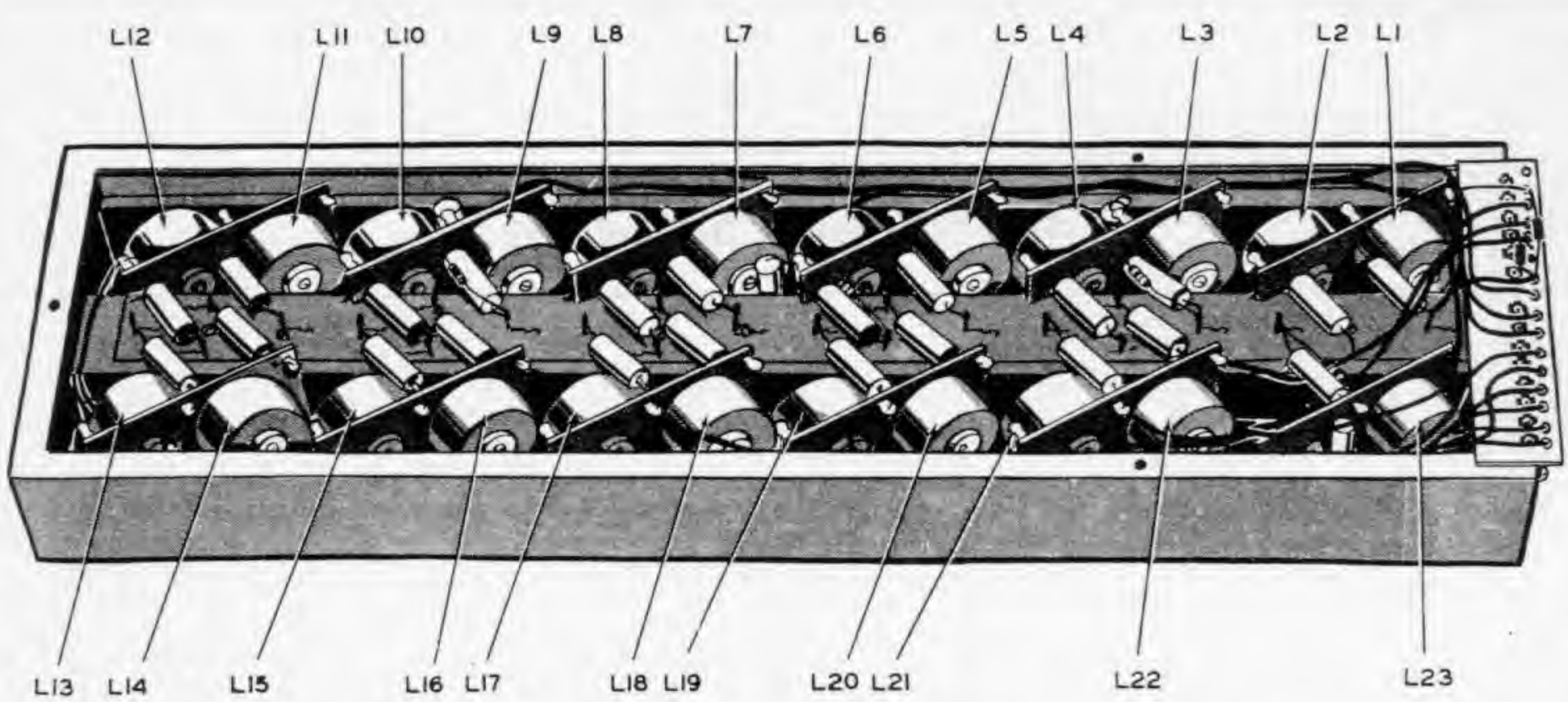
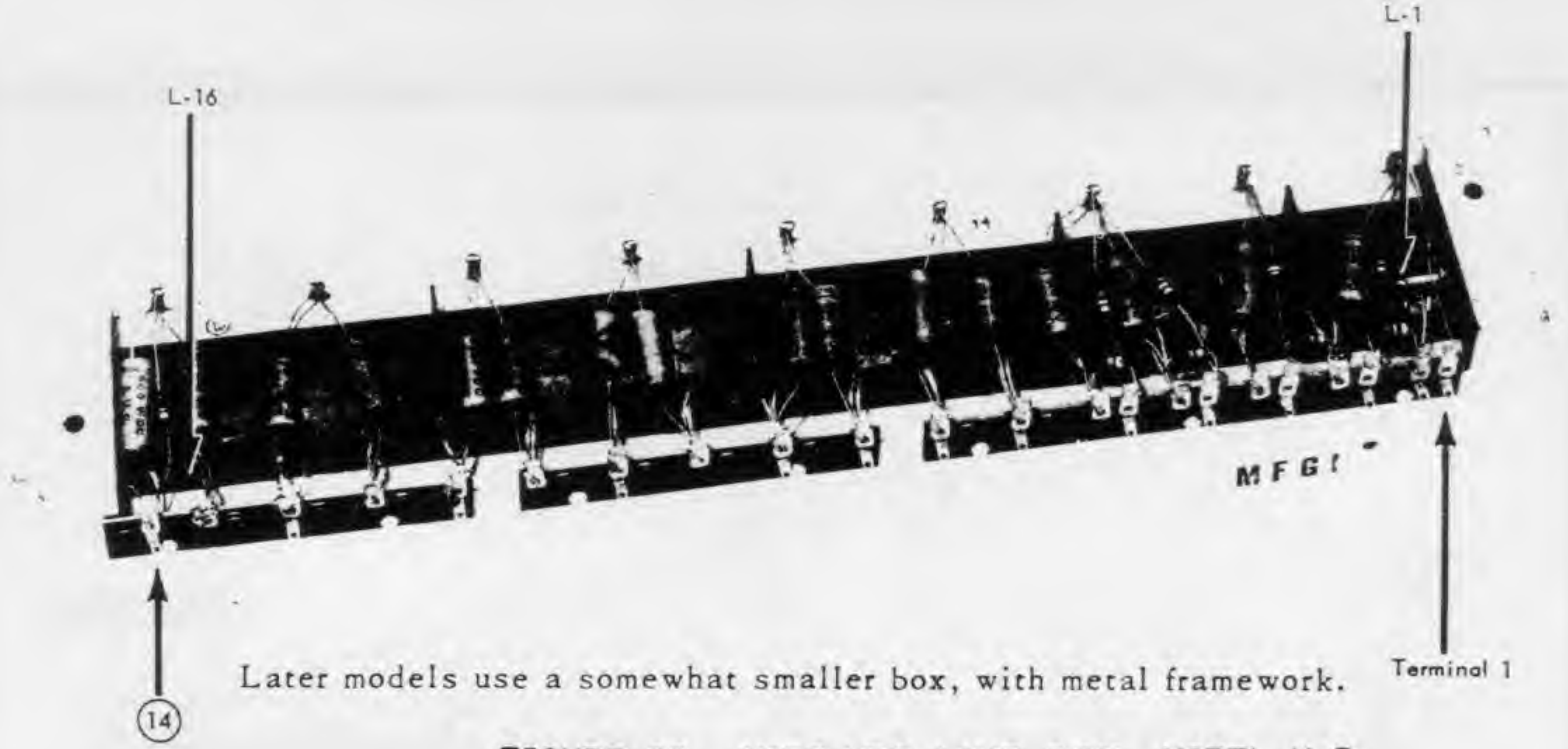


FIGURE 27 -VIBRATO LINE BOX-MODEL M AND M-2 ORGAN



Later models use a somewhat smaller box, with metal framework.

FIGURE 28 VIBRATO LINE BOX MODEL M-3

FIGURE 29 VIBRATO LINE BOX MODEL M-100

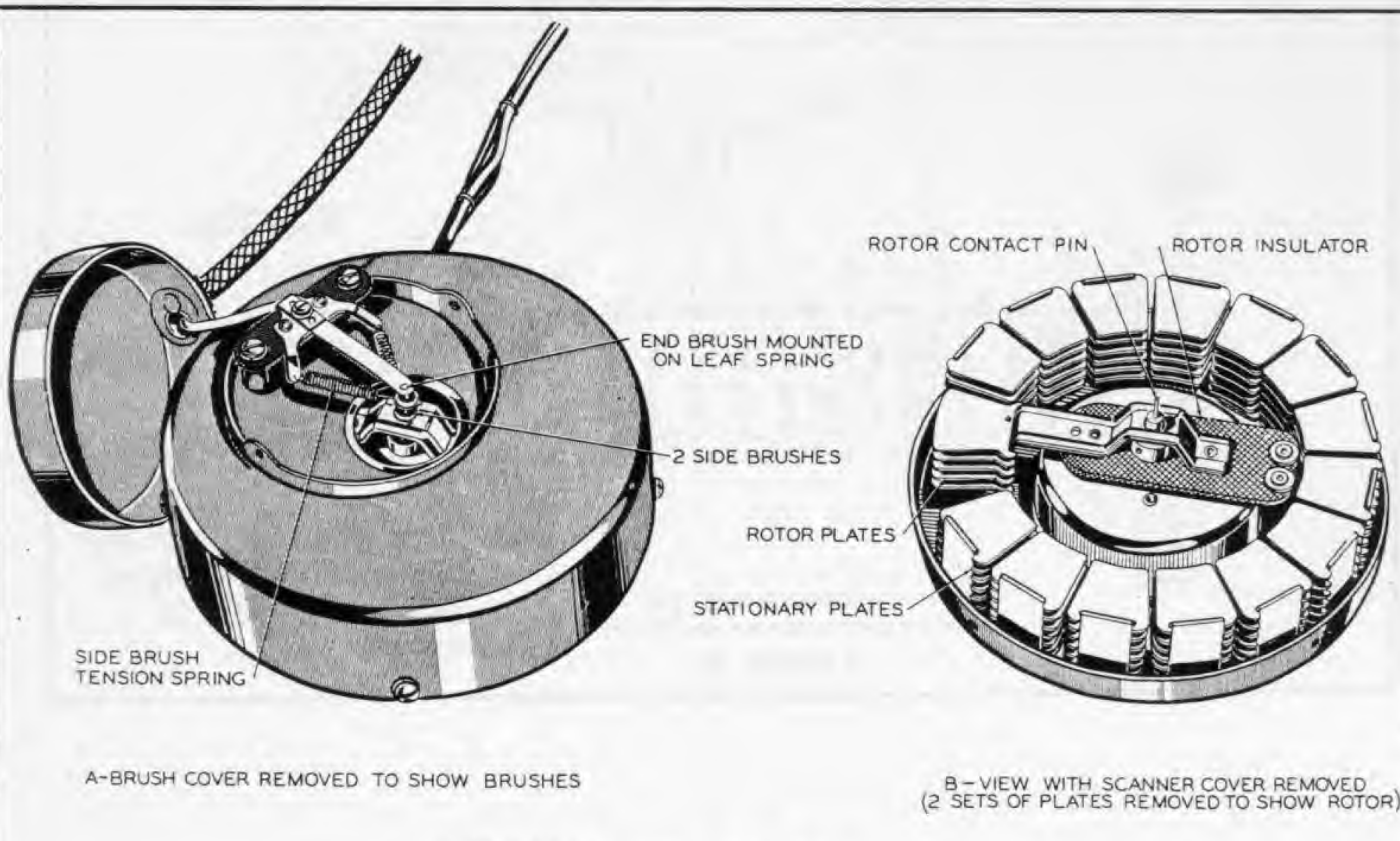
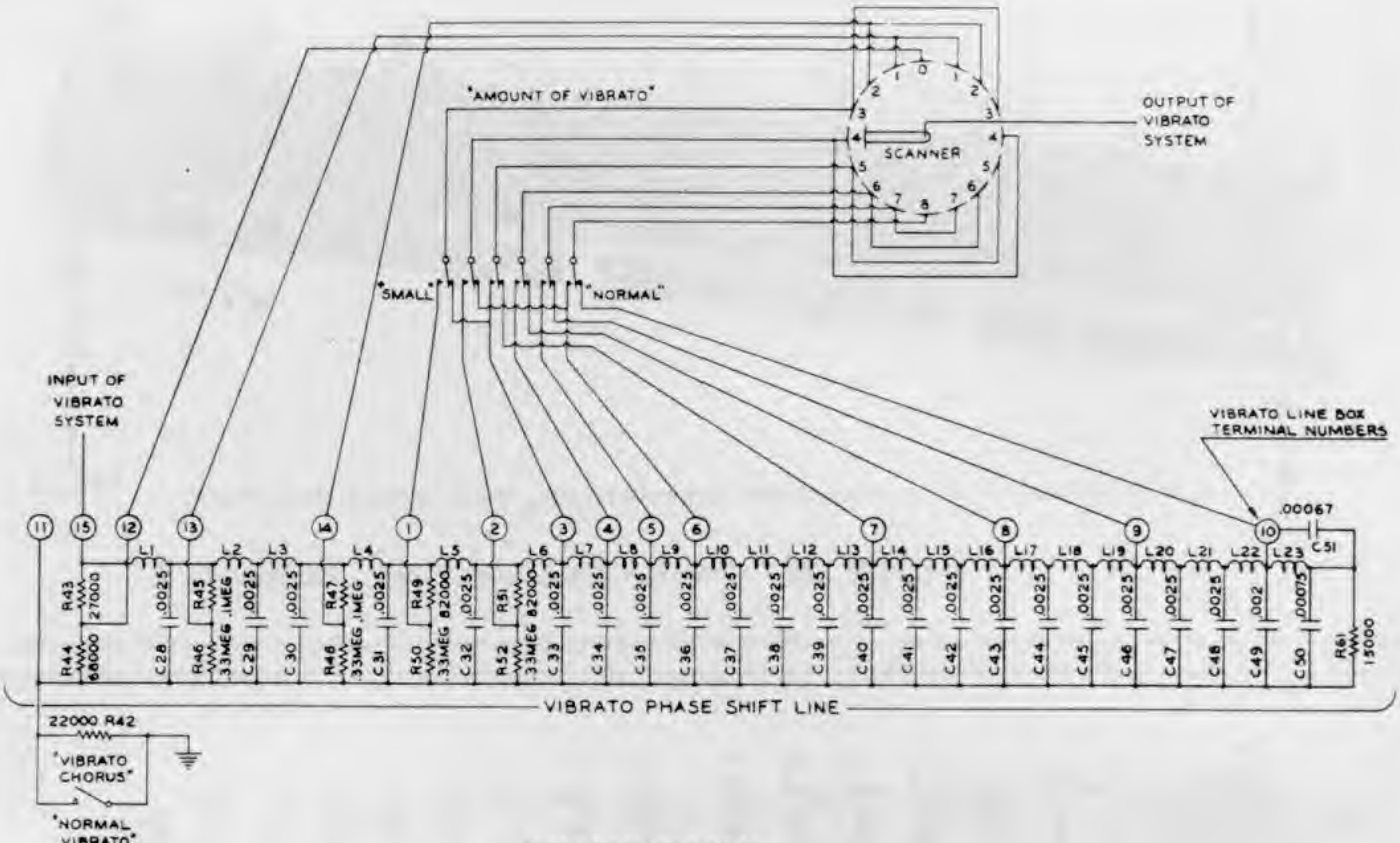
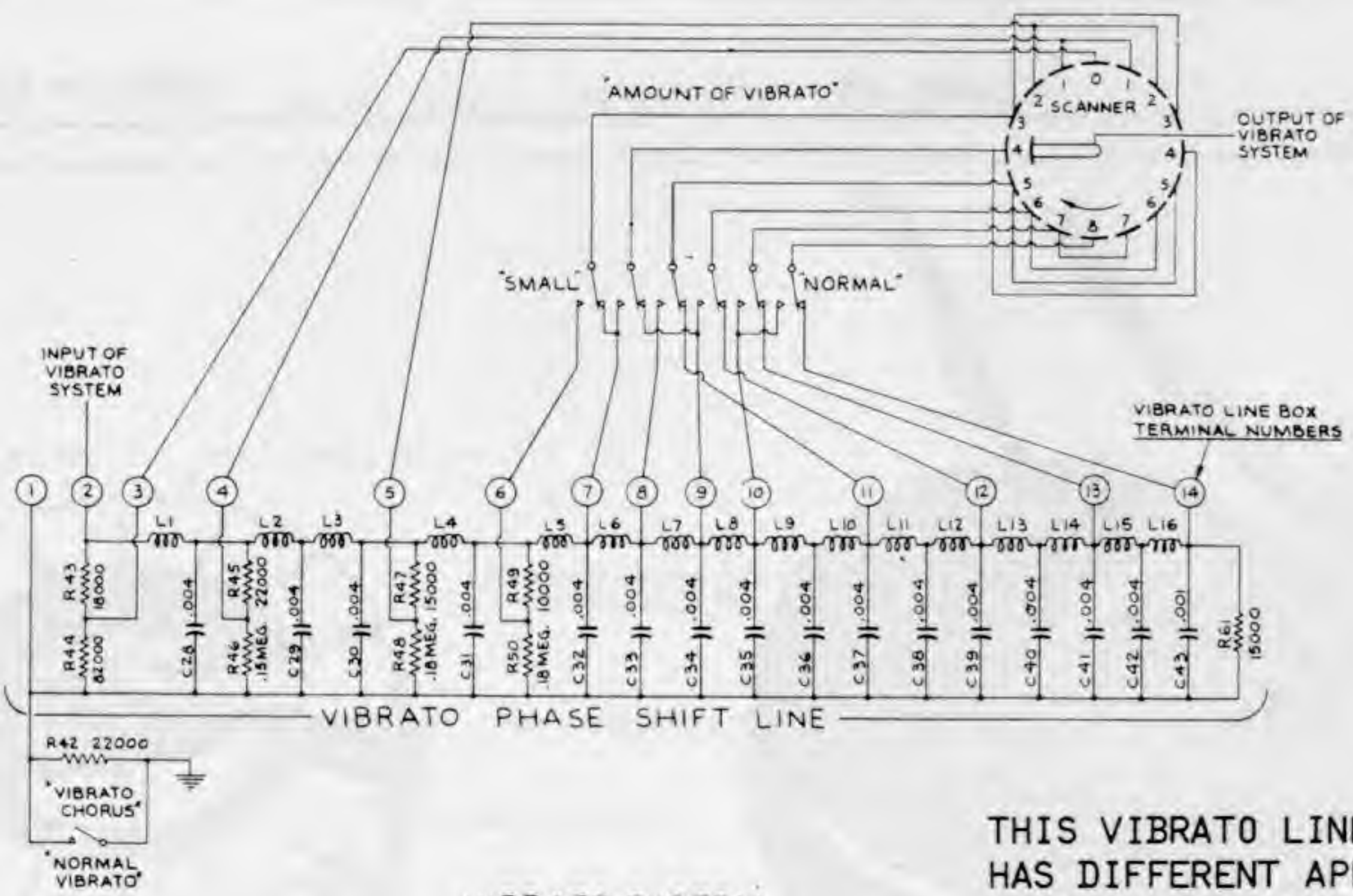


FIGURE 30 VIBRATO SCANNER



VIBRATO SYSTEM
(MODEL M-2 CONSOLES SERIAL NUMBER 19000 TO 25253)

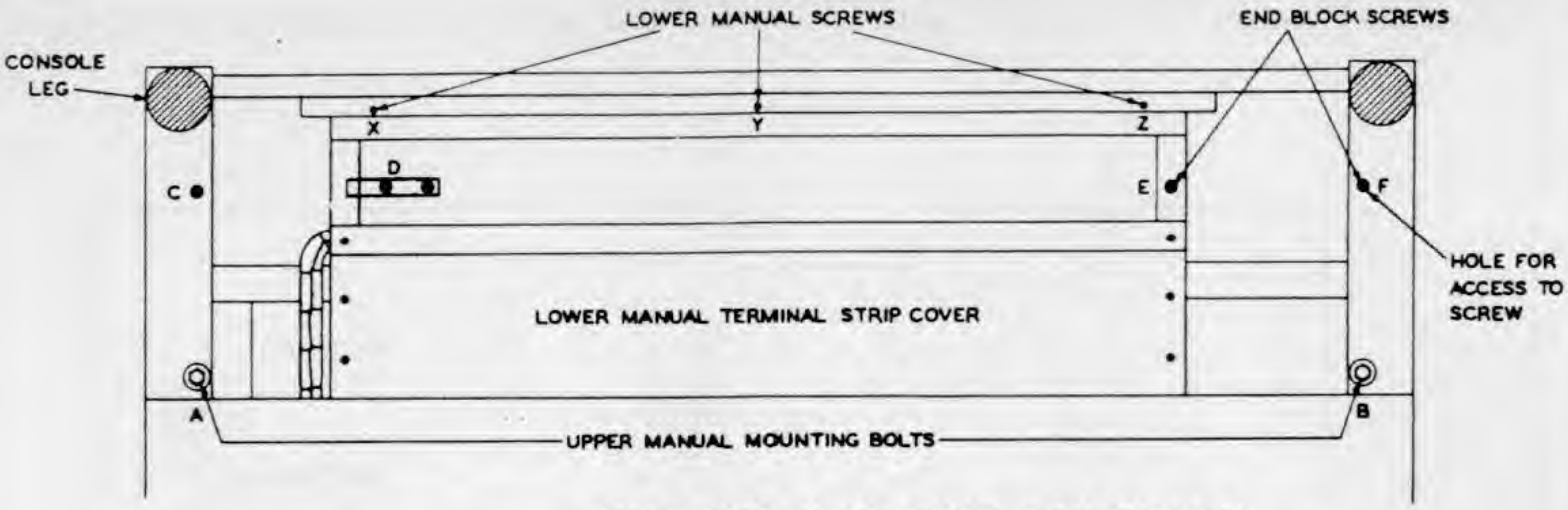
FIGURE 31



VIBRATO SYSTEM
MODEL M-2 CONSOLES SERIAL NUMBER 25254 AND ABOVE

FIGURE 32

THIS VIBRATO LINE BOX HAS DIFFERENT APPEARANCE THAN UNIT IN FIGURE 31



SCREWS HOLDING MANUALS
(VIEW LOOKING UP UNDER KEYBOARD)
FIGURE 33

NOTES

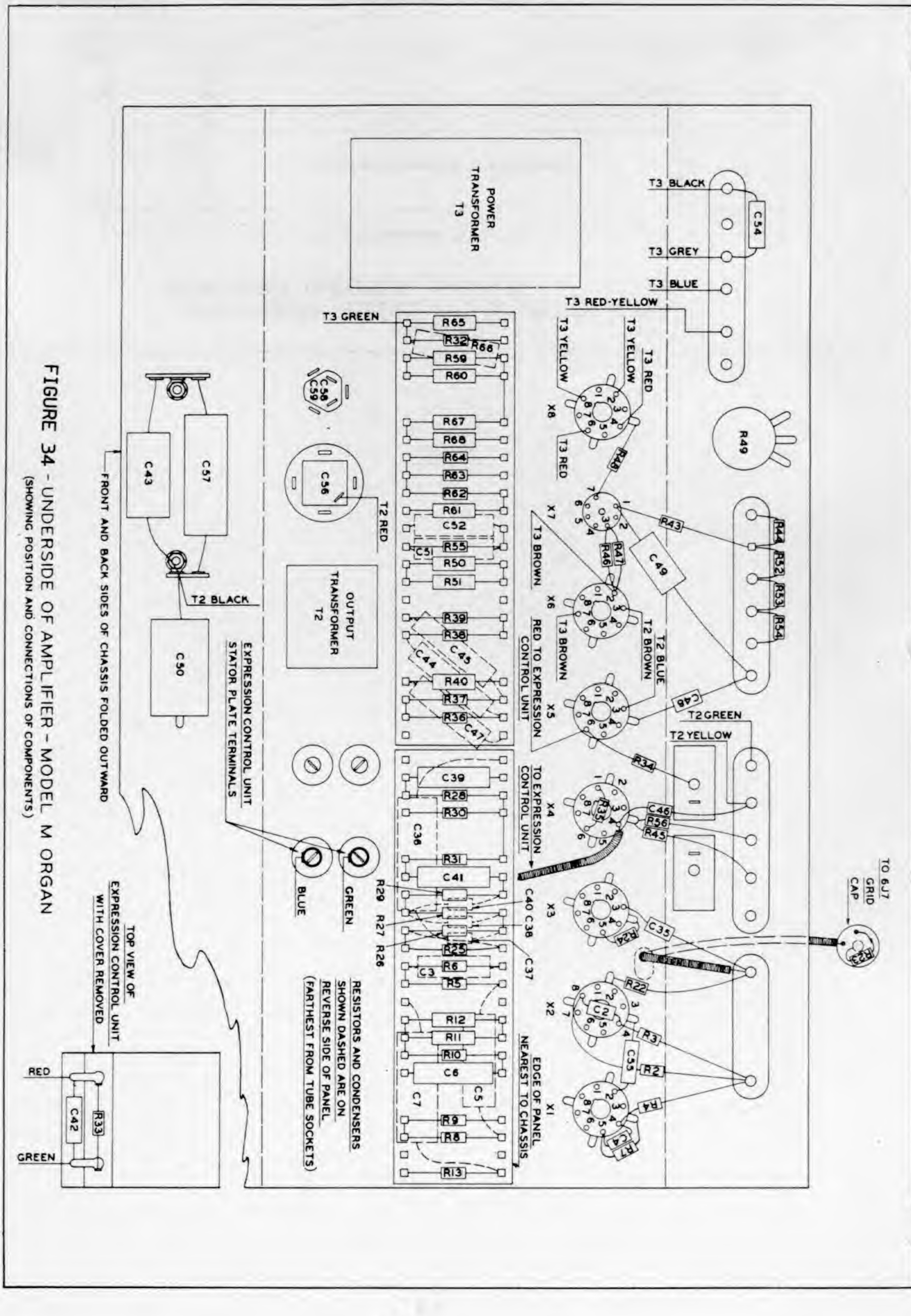
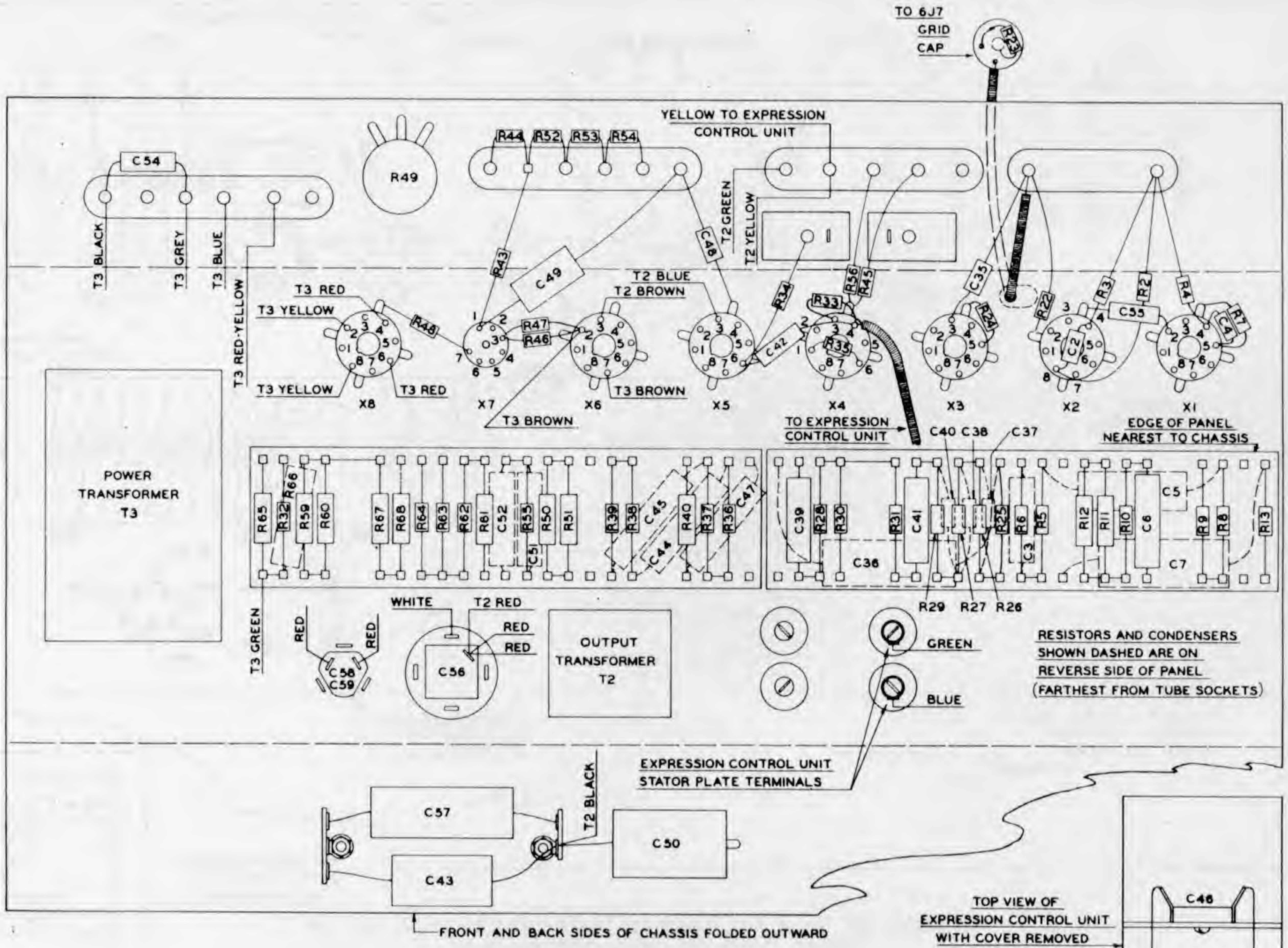


FIGURE 34 - UNDERSIDE OF AMPLIFIER - MODEL M ORGAN
(SHOWING POSITION AND CONNECTIONS OF COMPONENTS)



SERIAL NUMBER
8411 AND ABOVE

FIGURE 35 - UNDERSIDE OF AMPLIFIER - MODEL M ORGAN
(SHOWING POSITION AND CONNECTIONS OF COMPONENTS)

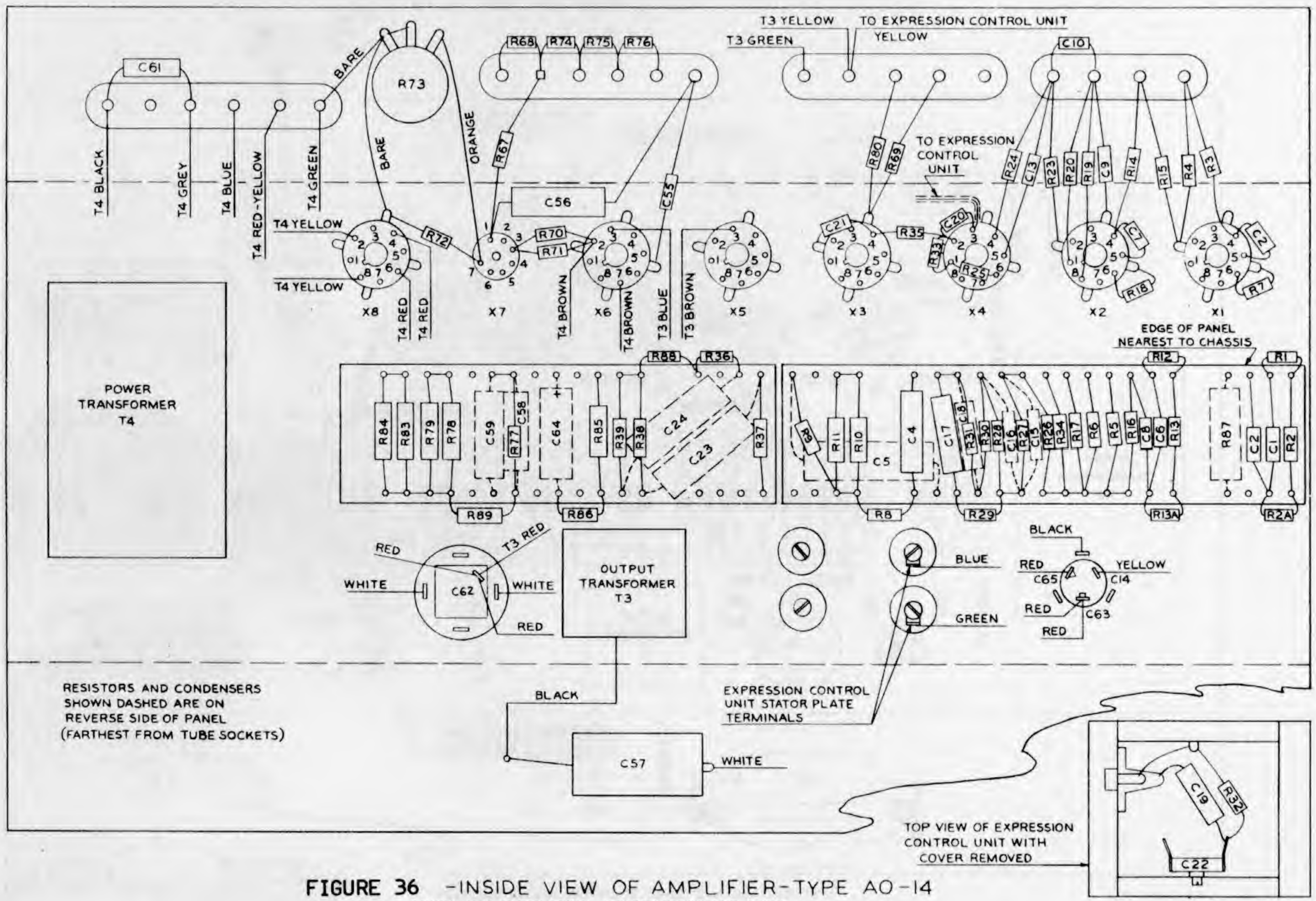


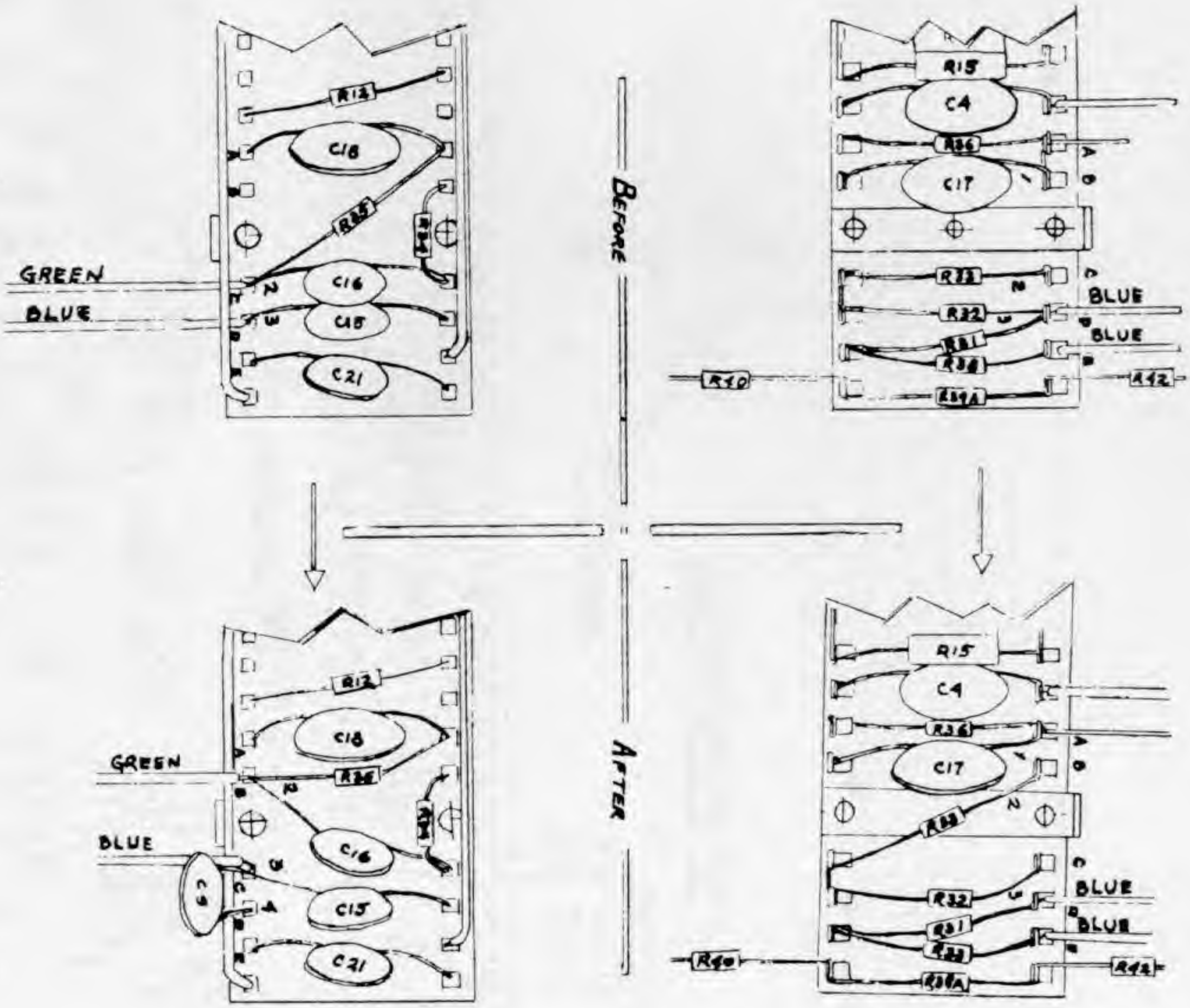
FIGURE 36 -INSIDE VIEW OF AMPLIFIER-TYPE AO-14

MODEL M-2 ORGAN SERIAL NUMBER 19000 AND ABOVE

NOTE:

A change in all amplifiers coded "H" and above removes the positive voltage from the stators of the swell assembly. This can be incorporated in earlier amplifiers by following the steps below. The end result will place a blocking condenser (.02 mfd, 600v) between pin 1 of the 12AX7 and the swell stators. This change will insure continued noise free operation of earlier amplifiers.

Step #1 – Move lower lead of C17 from lug B to lug A. Remove jumper.
Step #2 – Move lower leads of R33, R35, C16 and Green lead from lug C to lug B.
Step #3 – Move lower lead of R32, C15 and Blue lead (C15) from lug D to lug C.
Step #4 – Add C9 from lug C to D.



PICTORIAL M-3 AMP (PARTIAL)

FIGURE 36A

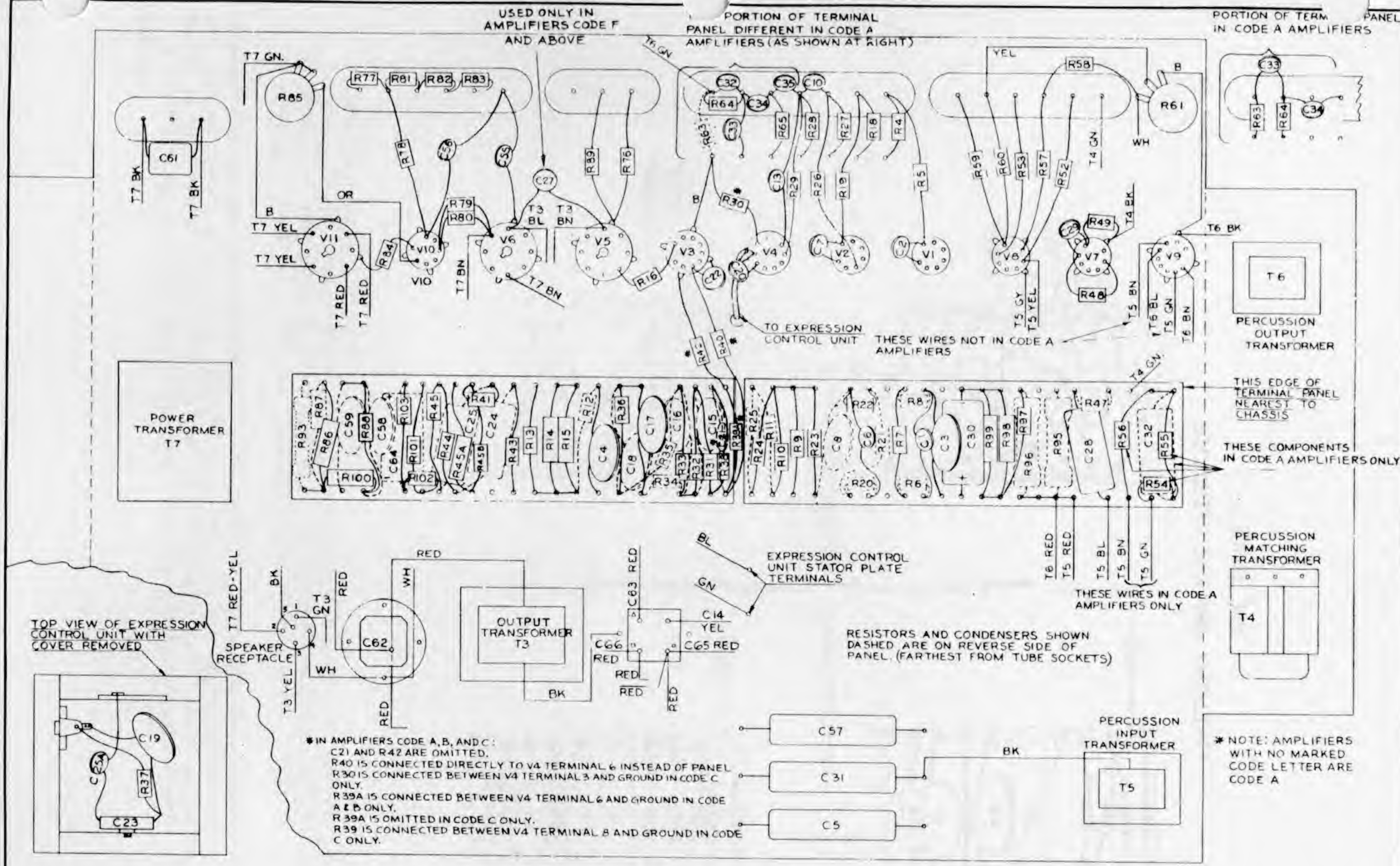


FIGURE 36B -UNDERSIDE OF AMPLIFIER-TYPE AO-29-MODEL M3 CONSOLE

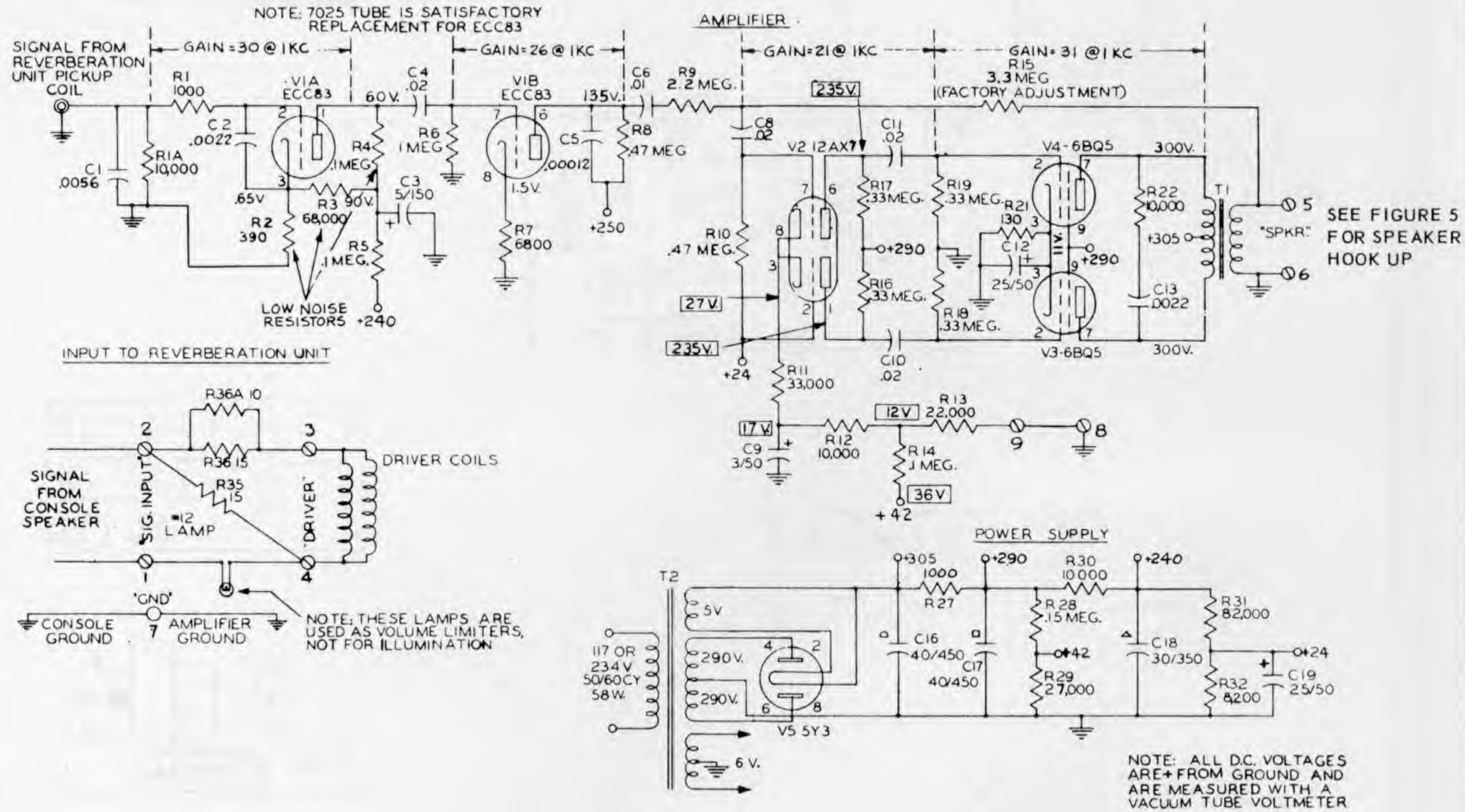
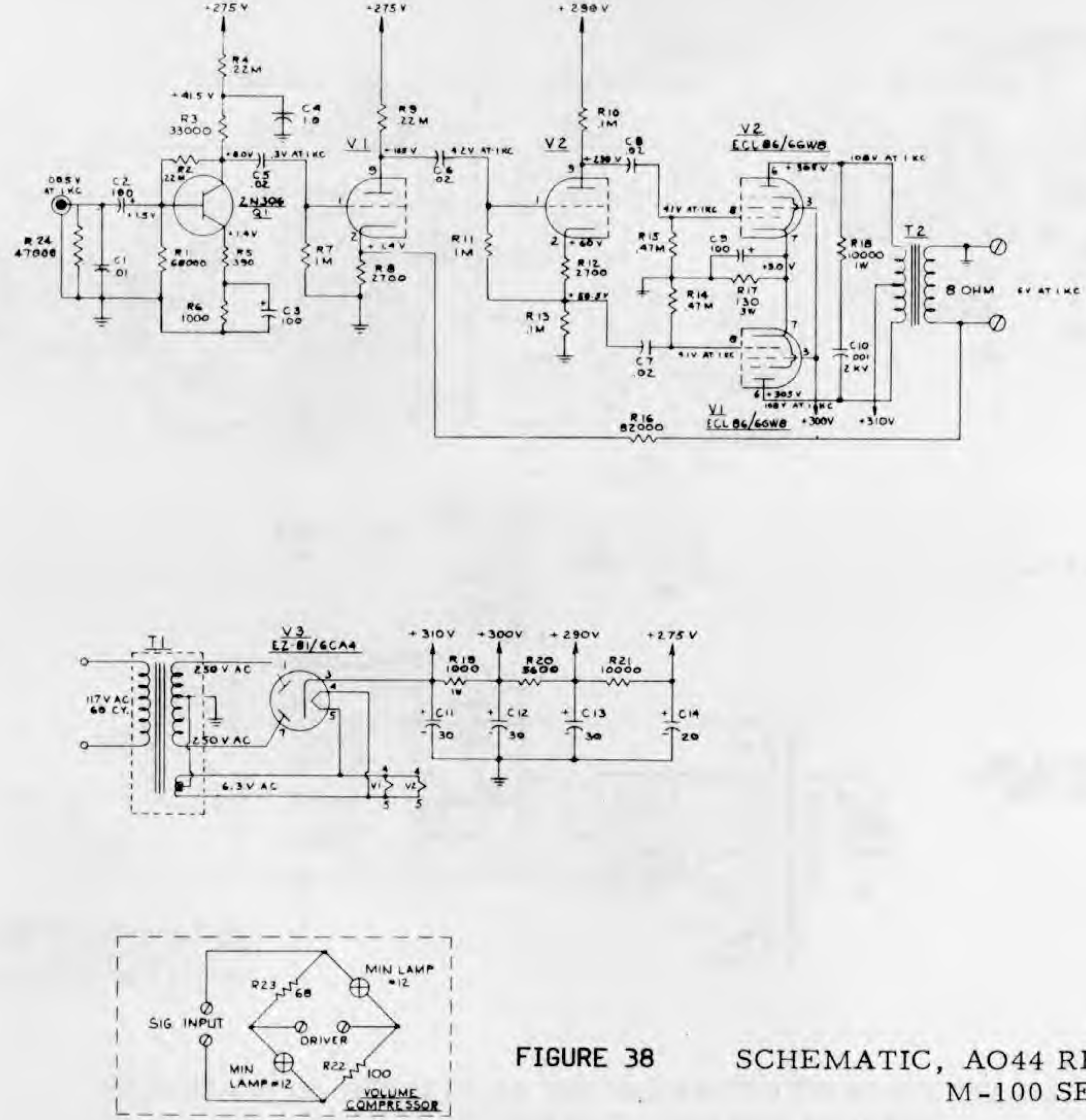


FIGURE 37 SCHEMATIC AO 35 REVERBERATION AMPLIFIER M-100 SERIES USED IN EARLIER CONSOLES

NOTES:
ALL AC VOLTAGES MEASURED WITH A VTVM (INPUT IMPEDANCE 1 MEG. OHM OR HIGHER)
ALL DC VOLTAGES MEASURED WITH A 20,000 OHMS/VOLT METER
ALL RESISTORS ½ W AND 10% UNLESS OTHERWISE SPECIFIED.



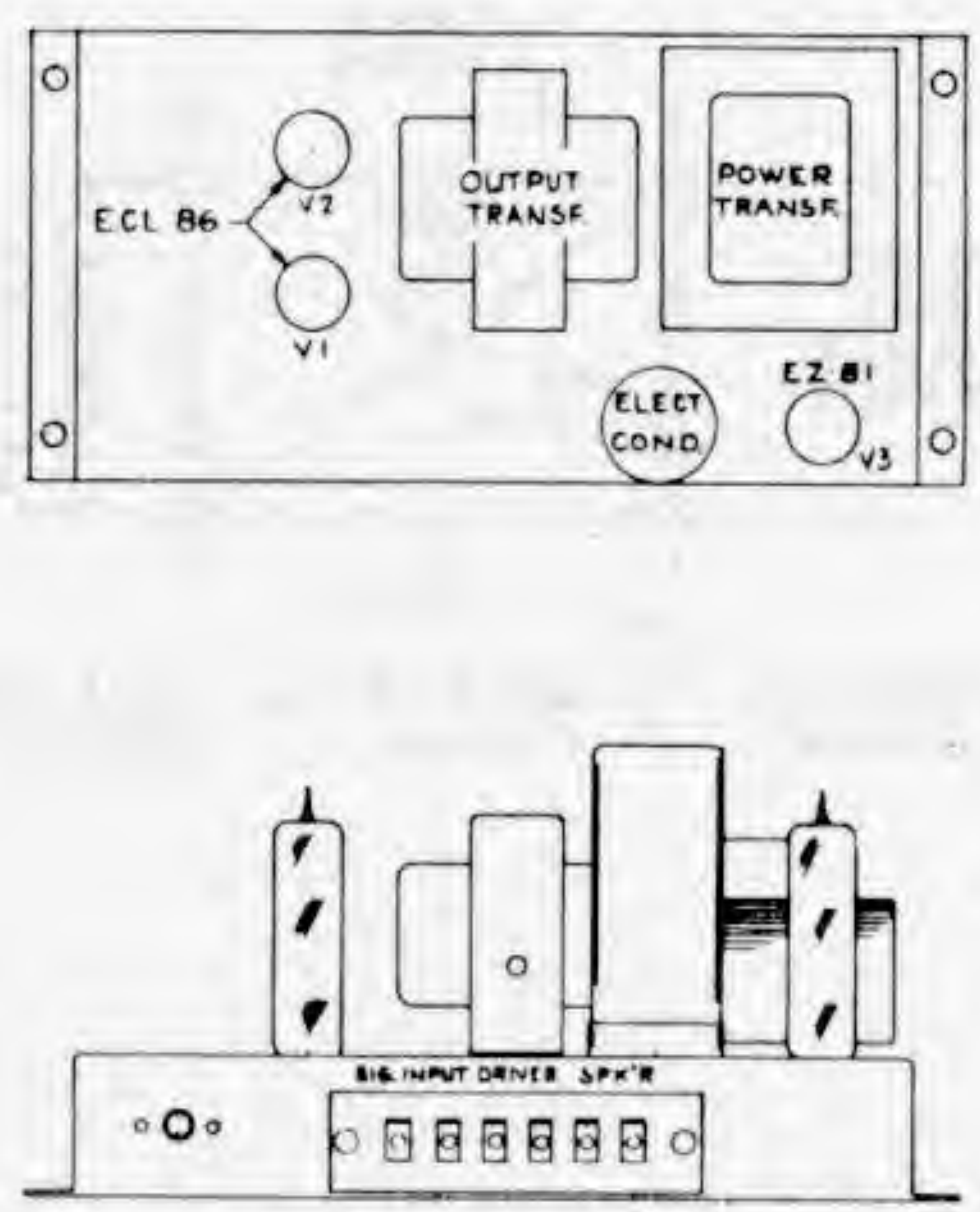
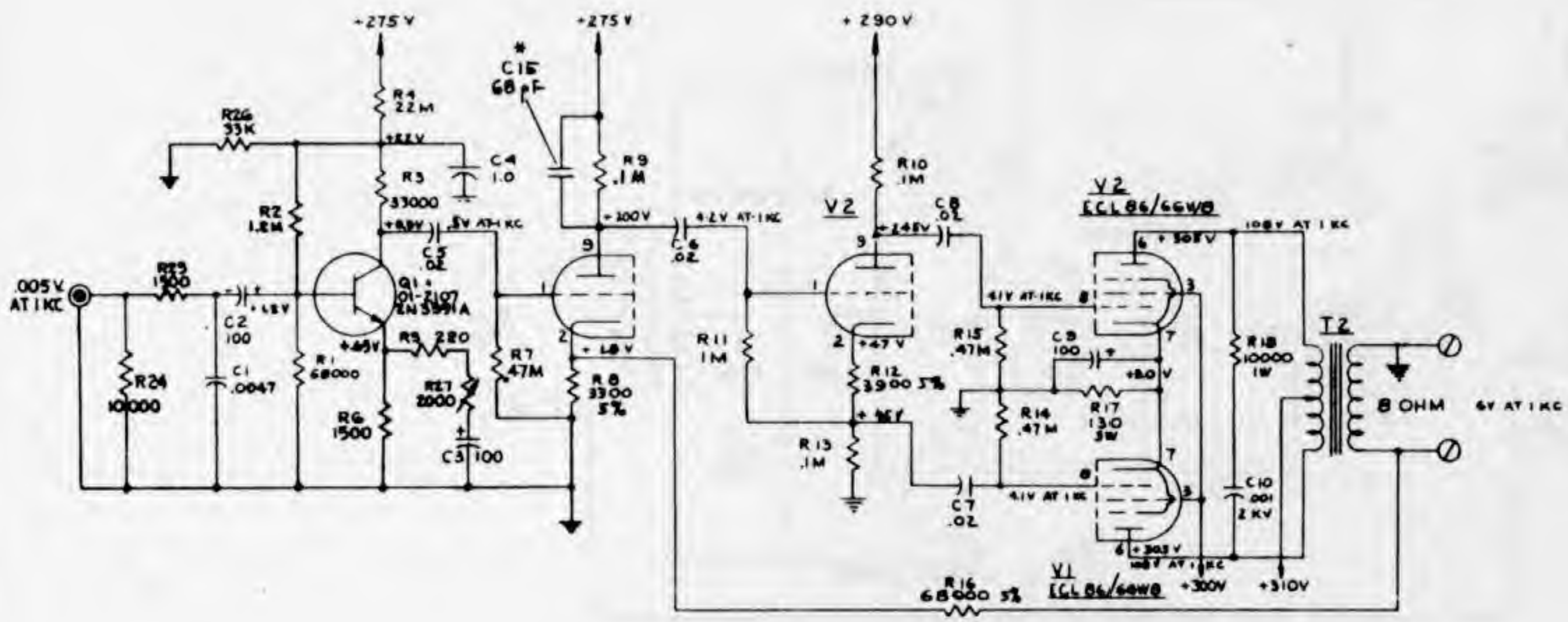
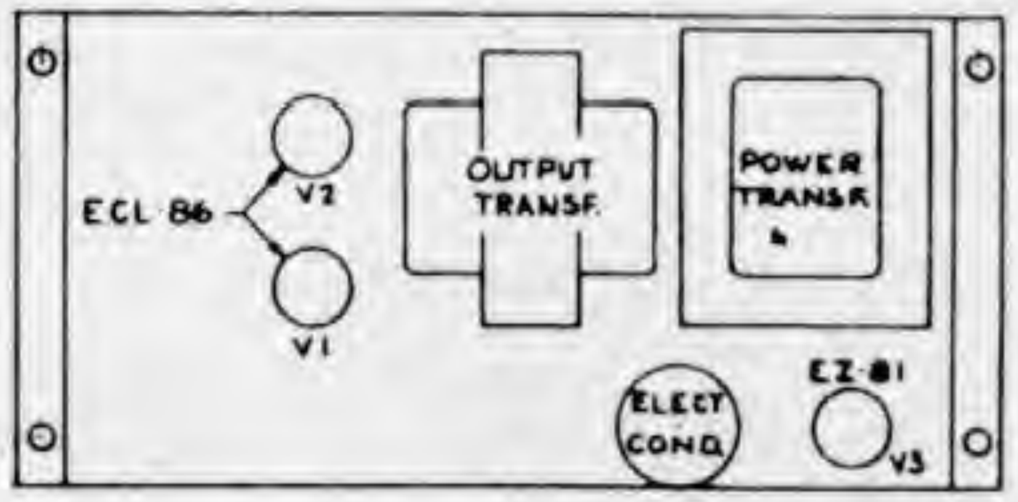


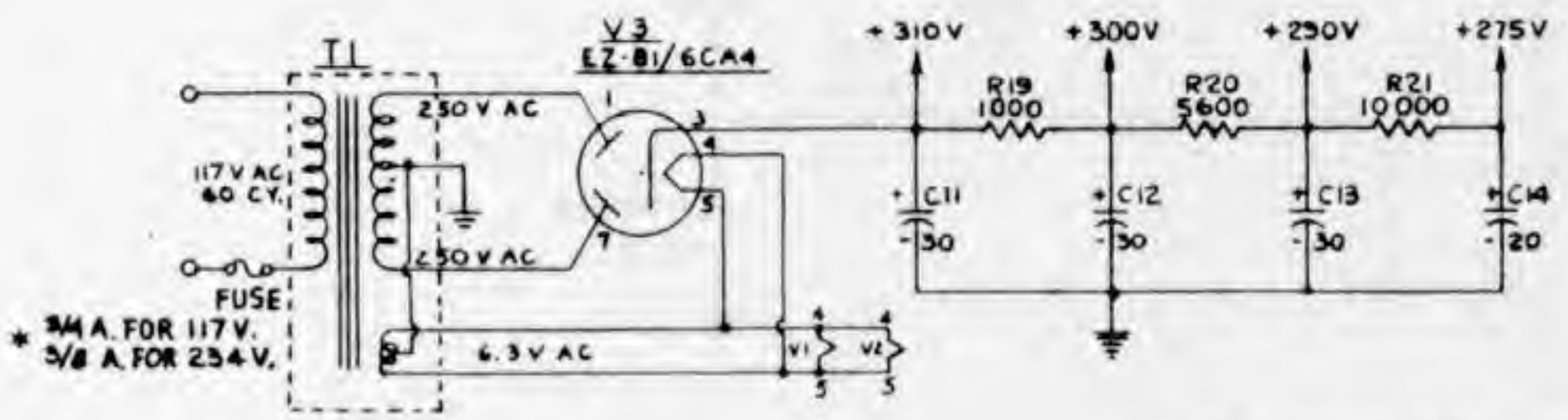
FIGURE 38 SCHEMATIC, AO44 REVERBERATION AMPLIFIER, M-100 SERIES

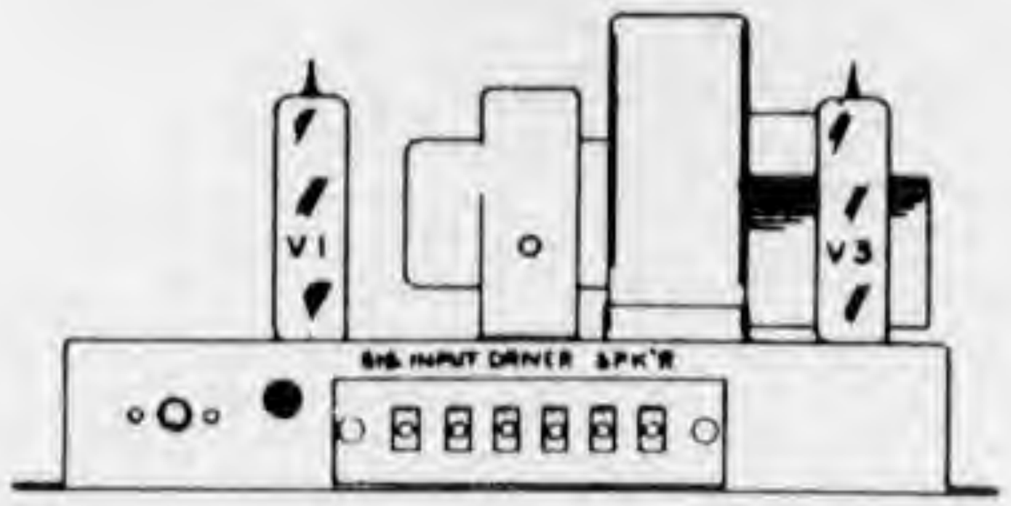
NOTES:
ALL AC VOLTAGES MEASURED WITH A VTVM. (INPUT IMPEDANCE 1 MEG. OHM OR HIGHER)
ALL DC VOLTAGES MEASURED WITH A 20,000 OHMS/VOLT METER
ALL RESISTORS ½ W AND 10% UNLESS OTHERWISE SPECIFIED.



M101 61905 AND ABOVE
M102 63482 AND ABOVE
M103 61387 AND ABOVE
M111 64580 AND ABOVE
M143 62351 AND ABOVE
M162 56511 AND ABOVE
M165 52255 AND ABOVE







*These components will only be found in AO-44 amplifiers marked with Code "E"

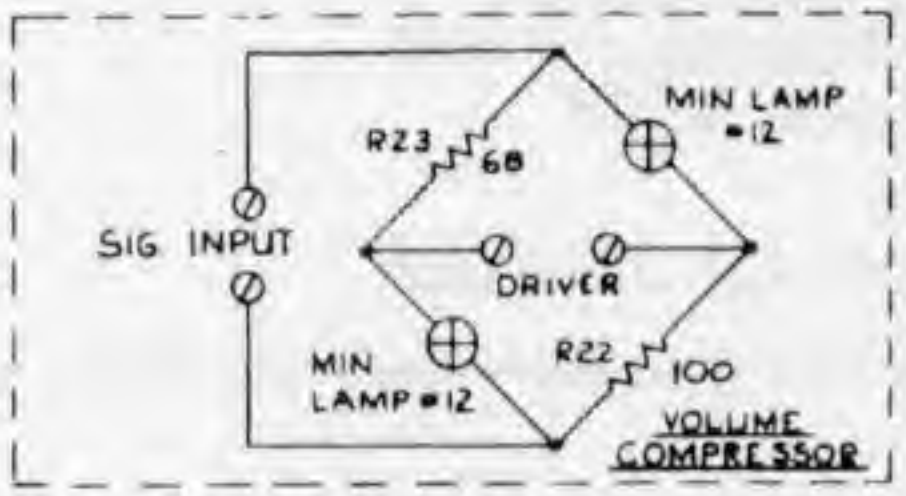
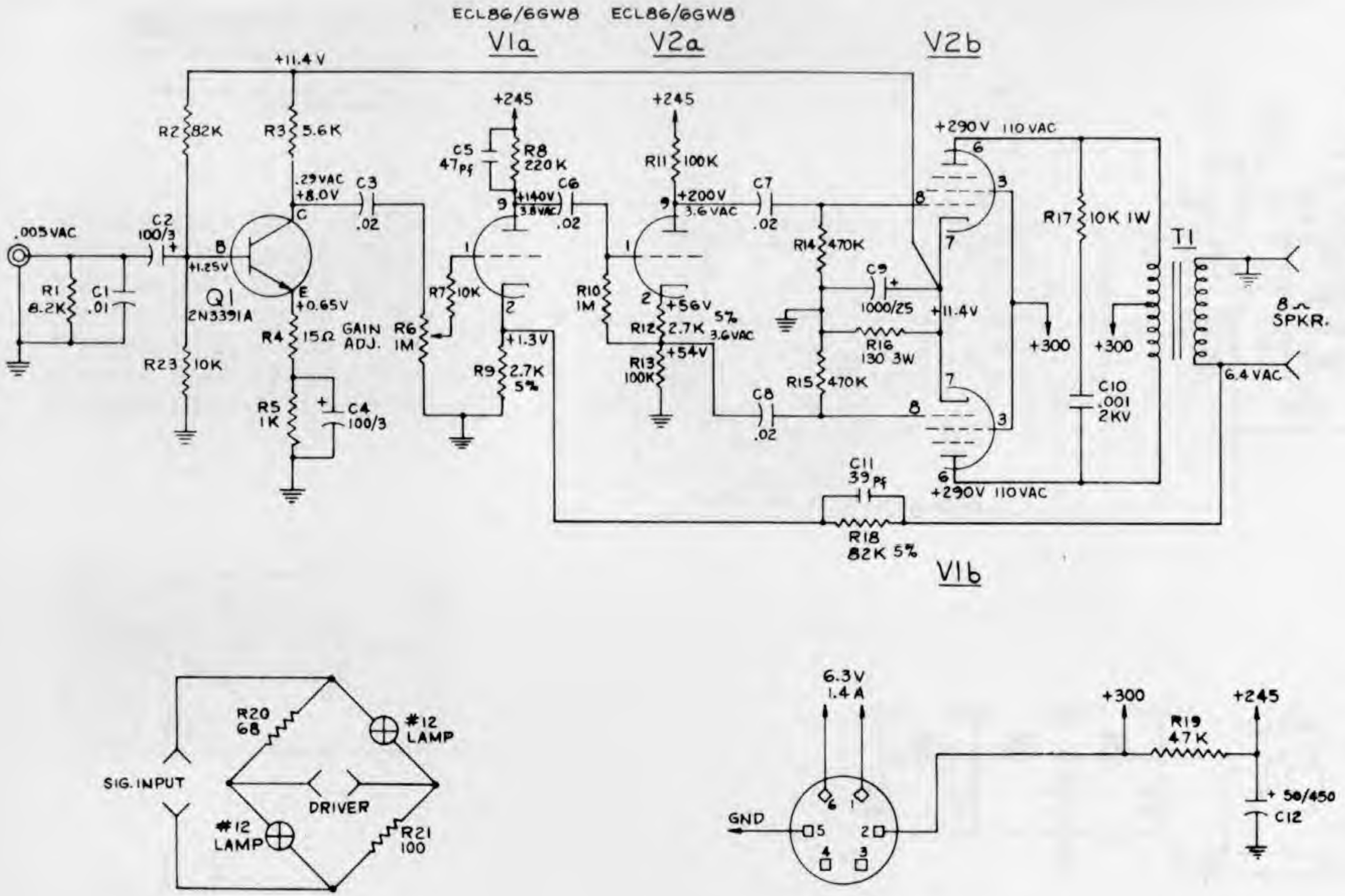


FIGURE 38A - SCHEMATIC AO44 REVERBERATION AMPLIFIER M100 SERIES



SCHEMATIC NOTES:

1. ALL RESISTORS ARE 1/2 WATT, 10%, UNLESS OTHERWISE INDICATED.
2. ALL CAPACITANCE VALUES ARE IN MFD UNLESS OTHERWISE INDICATED.
3. DC VOLTAGES ARE MEASURED TO GROUND WITH A 20,000 OHMS/VOLT METER.
4. AC SIGNAL VOLTAGES MEASURED AT 1KC."GAIN ADJ" AT MAXIMUM.

FIGURE 39 - SCHEMATIC AO66 REVERBERATION AMPLIFIER M100 SERIES

SCHEMATIC DIAGRAM - MODEL M ORGAN

SCHEMATIC DIAGRAM
MODEL M
FIGURE 40

WIRING DIAGRAM
MODEL M
FIGURE 41

WIRING DIAGRAM - MODEL M ORGAN

REVISED GENERATOR COVER
SERIAL NO. 15083 AND ABOVE

WIRING DIAGRAM-MODEL M ORGAN

WIRING DIAGRAM
MODEL M - 15083 AND ABOVE
FIGURE 41A

SCHEMATIC DIAGRAM
MODEL M-2 - 19000 AND ABOVE
FIGURE 42

SERIAL NO 19000 AND ABOVE

WIRING DIAGRAM OF HAMMOND ORGAN CONSOLE MODEL M-2

WIRING DIAGRAM
MODEL M-2 - 19000 AND ABOVE
FIGURE 43

WIRING DIAGRAM
MODEL M-2 - 25254 AND ABOVE
FIGURE 43A

WIRING DIAGRAM OF HAMMOND ORGAN CONSOLE MODEL M-2

COUPLED VIBRATO LINE SERIAL 25254 AND ABOVE

SCHEMATIC DIAGRAM
MODEL M-3
FIGURE 44

SCHEMATIC DIAGRAM
MODEL M-3 - 90485 AND ABOVE
FIGURE 44A

[redacted]

SCHEMATIC DIAGRAM
MODEL M-3 - 109466 AND ABOVE
FIGURE 44B

WIRING DIAGRAM
MODEL M-3
FIGURE 45

WIRING DIAGRAM OF HAMMOND ORGAN CONSOLE MODEL M-3

WIRING DIAGRAM OF HAMMOND ORGAN CONSOLE MODEL M-3
REVISED GENERATOR COVER - APPROX. NO. 90165 AND ABOVE
REVISED VIBRATO LINE - APPROX. NO. 92748 AND ABOVE

WIRING DIAGRAM
MODEL M-3 - 90485 AND ABOVE
FIGURE 45A

FIGURE 46
SCHEMATIC DIAGRA
M-100 SERIES WITH AO-35
AMPLIFIER & AO-29
POWER SUPPLY

FIGURE 46

FIGURE 47
SCHEMATIC DIAGRAM
M-100 SERIES WITH AO-44
AMPLIFIER & AO-29
POWER SUPPLY

FIGURE 48
SCHEMATIC DIAGRA
M-100 SERIES WITH A
& AO-67 AMPLIFIERS

FIGURE 48

FIGURE 49
WIRING DIAGRAM
HAMMOND ORGAN
M-100 SERIES
WITH AO35
AMPLIFIER

FIGURE 50

FIGURE 50

WIRING DIAGRAM
HAMMOND ORGAN
M-100 SERIES
WITH AO44
AMPLIFIER

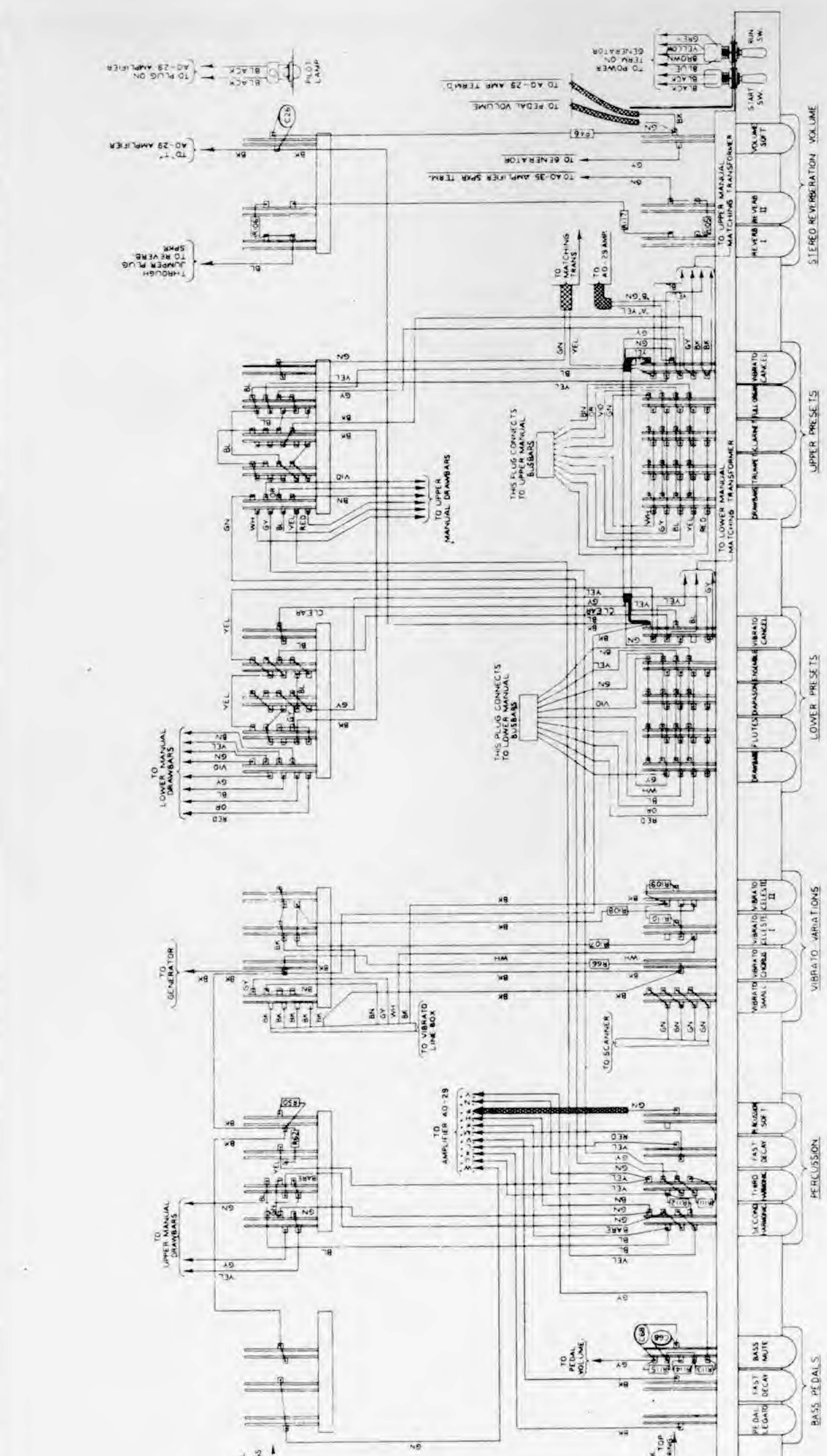
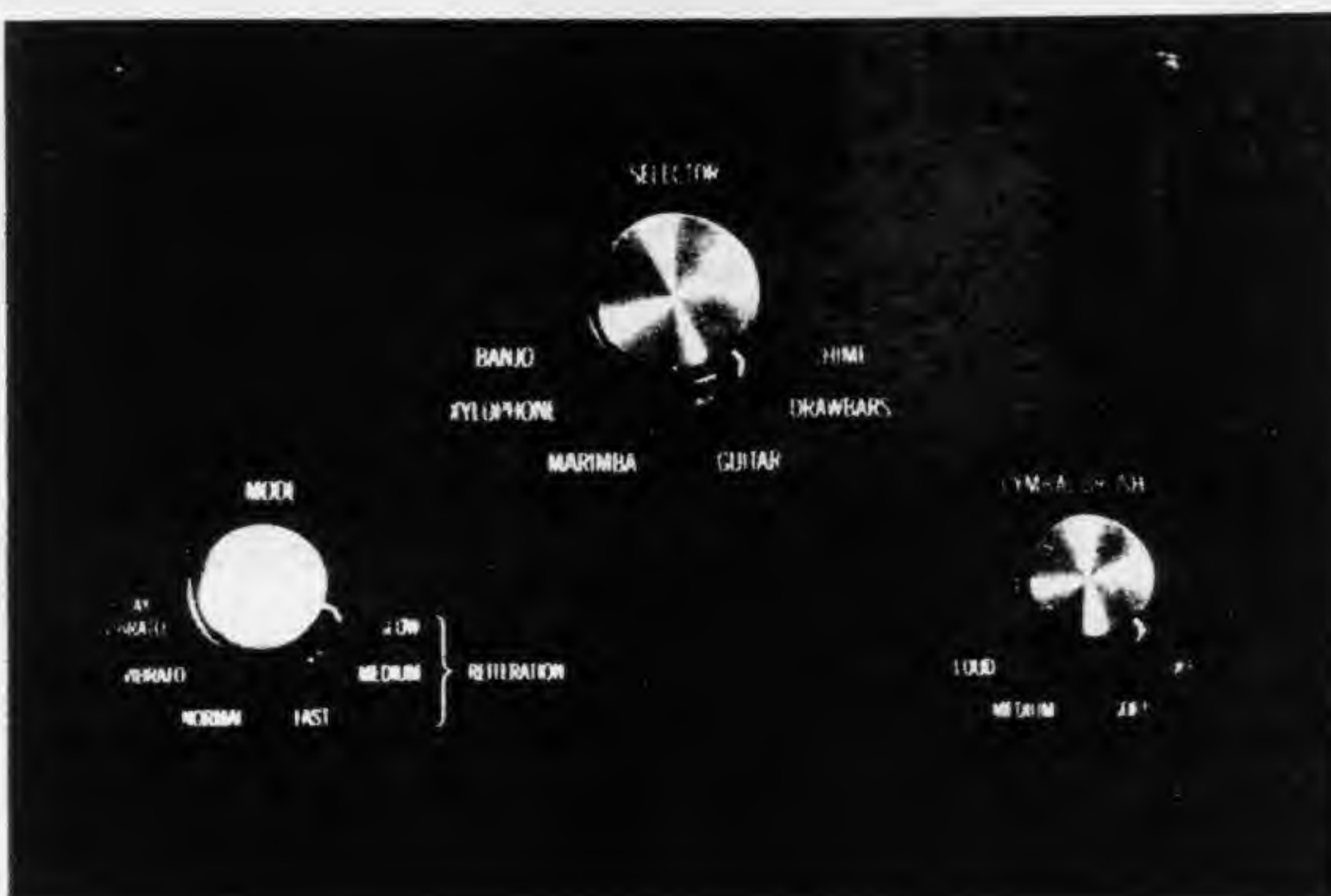


FIGURE 51 CONTROL PANEL WIRING

NOTES

THE HAMMOND ORGAN
SERVICE INFORMATION
M-100A
SERVICE MANUAL
SUPPLEMENT



HAMMOND ORGAN COMPANY

M-100A PRESET PERCUSSION UNIT

When added to the M-100 series instrument, this unit adds five pre-voice percussion effects, including reiteration in three speeds. It also provides three percussion effects, "Normal (Non-Vibrato)", "Vibrato", and "Delayed Vibrato". For the rhythm accompaniment it also provides a "Cymbal-Brush" effect, the "Brush" being on the lower manual, and available when played in a legato fashion each time a key is depressed. The "Cymbal" is available on the pedal and sounds each time a pedal is depressed. The "Cymbal-Brush" control turns these effects on and selects the "Cymbal-Brush" volume.

SELECTOR SWITCH

With the "Selector Switch" in the "Drawbar" position, the signals from the upper manual harmonic busbars are routed to their proper drawbar in the upper manual group. The following is a breakdown of the harmonic switching used in this kit:

HARMONIC BUSBAR SWITCHING AND REITERATION SPLIT

UPPER MANUAL

The Sub-Fundamental, sub-third and eighth harmonics are not switched. The sixth harmonic busbar is used for percussion keying. With the "Selector Switch" in the "Drawbar" position, all harmonic busbars are routed to their proper drawbar.

REITERATION SPLIT

	"A" CHANNEL	"B" CHANNEL	DRAWBARS
Chime	2nd 3rd 4th (5th to Freq. Div.) (1-1/4 From Freq. Div.)		Fundamental
Guitar	Fundamental 3rd 4th 5th		2nd
Marimba	Fundamental	2nd	3rd 4th 5th
Xylophone	Fundamental	3rd	2nd 4th 5th
Banjo	2nd 3rd 4th 5th		Fundamental

MODE SWITCH

With the "Mode Switch" in any of the reiteration positions, the harmonics necessary to produce the "Chime", "Guitar", and "Banjo" are all fed into the "A" reiteration channel only, while the "Marimba" and "Xylophone" effects feed harmonics into both the "A" and the "B" channels. This split into the "A" and "B" channels only occurs with the use of reiteration. Without reiteration, all effects are routed into the regular percussion system. The two reiteration channels are identical. You will note that across the secondary windings of the two input transformers is located a fieldeffect transistor. The gates Q200 and Q207 are fed alternating pulses from a bistable multivibrator which supplies alternate pulses to each one of these gates. That is; one is on, while the other one is off. These gates shunt the signal to ground, thereby making the channel inoperative. These individual signals are further amplified by a one stage transistor amplifier, Q201 for the "A" channel, and Q208 for the "B" channel. They are then mixed together and fed to a common amplifier which in turn feeds the percussion output terminal, terminal P on the A0-67 amplifier. The multivibrator which supplies the keying pulses for these two gates does not run continually, but rather is turned off and on each time a key is depressed on the upper manual. The multivibrator consists of Q205 and Q206. Q202, Q203 and Q204 provide the necessary switch pulse to start the multivibrator.

NOTE: Whenever the reiteration is used, it completely bypasses the percussion section of the A0-67 amplifier.

With the "Mode Switch" in the "Normal", "Vibrato", or "Delayed Vibrato" position, the various pre-voiced percussions are routed into the regular Hammond percussion system, in which case these percussion effects are now available at the percussion output terminal, terminal P on the A0-67 amplifier. With the "Mode Switch" in the normal position all percussion voices sound as normal, that is, they have no "Vibrato". With the "Mode Switch" in the "Vibrato" position, a portion of the signal available at the P terminal is routed through an isolating resistor into the "Vibrato" input terminal, terminal "B" of the A0-67 amplifier, so that the percussion voices appear with the "Vibrato". In the "Delayed Vibrato" position, a portion of the signal available from the P terminal is routed to the base of Q214. It will be noted that the emitter of this stage is not bypassed and the output of this stage is relatively low. During keying, after a predetermined time lag, Q210 and Q211 turn off, and Q212 and Q213 go into conduction, thereby placing C211 across the emitter resistor of Q214. This materially increases the gain of the stage and as the percussion is dying away, feeds this amplified portion of the fading percussion signal into the "Vibrato" channel of the amplifier giving a "Vibrato" tail-off to all the percussion voices. Two positions of the "Mode Switch", "Vibrato" and "Delayed Vibrato" also effect the normal Hammond percussions when they are in use.

FREQUENCY DIVIDER

When using the "Chime" effect, it is necessary to create a 1-1/4 harmonic for the proper reproduction of the "Chime" tone. This is accomplished by routing the 5th harmonic into an amplifier made up of Q227 and Q228. Q229 and Q230 rectify and further amplify this pulse which is then fed to a two-stage frequency divider, made up of Q231, Q232, Q233 and Q234. The output of this second frequency divider is then routed back to the "Selector Switch", and is used as one of the harmonics in the "Chime" effect.

NOTE: Because a frequency divider can only handle one frequency at a time, any attempt to play two or more "Chime" notes at a time will result in distortion.

CYMBAL AND BRUSH

The "Cymbal-Brush" switch when in the "off" position disables the keying functions necessary to produce the "Cymbal and Brush" effect. With the "Cymbal-Brush" switch in any one of the "on" positions, the 8th harmonic of the lower manual is disabled and this harmonic busbar is used for keying the "Brush" effect. The pedal keying contact is likewise switched into its proper keying circuitry so that it will activate the "Cymbal" effect each time a pedal is depressed.

BRUSH KEYING

With the "Cymbal-Brush" switch in any of the "on" positions, the base of Q217 is routed now to the 8th harmonic busbar in the lower manual. Anytime a key is depressed, the base voltage of this transistor is routed to ground, and this stage stops conducting. The attendant rise in collector voltage is impressed on one plate of C217 and on R262. The other plate of C217 responds by driving excess electrons off to ground through diode D204, the resultant positive voltage is then fed to the base of Q222, the "Brush" gate. To the base of this "Brush" gate is also fed the noise from the noise generator Q218. This noise is now tuned in the collector circuit and fed through R279 into the "Cymbal and Brush" amplifier section.

CYMBAL KEYING

With the "Cymbal-Brush" switch in the "off" position, the pedal keying contact in the pedal switch is routed to the pedal control terminal, terminal "S" on the A0-67 amplifier. With the "Cymbal-Brush" switch in any of the "on" positions this keying contact is transferred to the base of Q216. Q215 is connected between the pedal keying terminal, terminal "S" and ground. With no pedal pressed and Q216 conducting, reverse bias is supplied from the emitter of Q216 to the base of Q215. Each time a pedal is depressed the base of Q216 is routed to ground. With Q216 not conducting the reverse bias on Q215 disappears and forward bias is supplied through R255, Q215 now conducts and routes the pedal keying terminal to ground. With Q216 in a state of non conduction its rising collector voltage is impressed on one plate of C219 and on R216. This rapidly rising pulse is fed to the base of Q219 and Q220. Here the pulses are sufficiently amplified and fed through the diode D203 and on to the base of Q221, the "Cymbal" gate. To the base of this "Cymbal" gate is also fed the noise from the noise generator, Q218. The collector circuit of Q221 is tuned for the best "Cymbal" effect, and the output of this gate is coupled through R281 into the "Cymbal and Brush" amplifier section.

CYMBAL-BRUSH AMPLIFIER & NOISE GATE

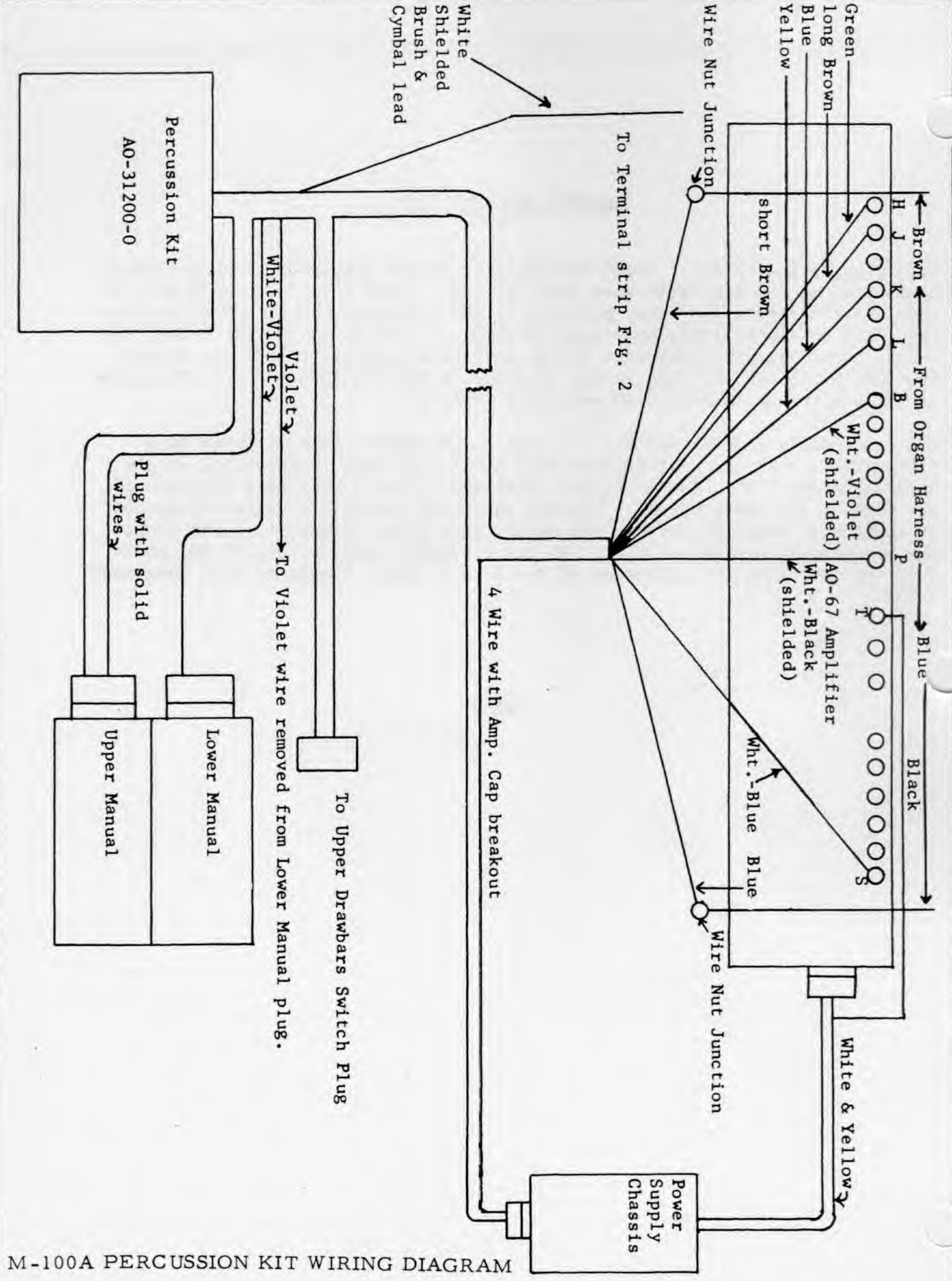
The "Cymbal-Brush" amplifier section consists of Q224 and Q225. The output is taken from the emitter of Q225 and fed to the volume switch. The output of the volume switch is then fed back to the noise gate. This noise gate, Q226, effectively shorts the signal line to ground when neither of the "Brush" or "Cymbal" effects are in use. R261 and 262 feed a positive voltage to the base of Q223 anytime that a lower manual key or pedal is depressed when the "Cymbal-Brush" switch is in any of the "on" positions. When this occurs, Q223 goes into conduction, thereby depleting the base voltage applied to Q226. With Q223 in a state of non conduction ("Cymbal-Brush" not keyed), sufficient base bias is supplied through R287 to the base of Q226, putting it into a state of conduction and thereby shorting the signal line to ground.

CHANGES AND REVISIONS

Referring to Figure 56 of the M-100A Service Manual Supplement, the following components on the schematic have been deleted. These four components will be found in the middle and lower portions of the Brush and Cymbal keying circuitry. The following items have been deleted: C-218, R-265, R-275, D-204, and C-243. The following component values have been changed: R-283 was 47K is now 10K; R-285 was 470 ohms is now 100 ohms; R-296 was 10K is now 4.7K; resistor R-279 which was selected is now fixed at 4.7K.

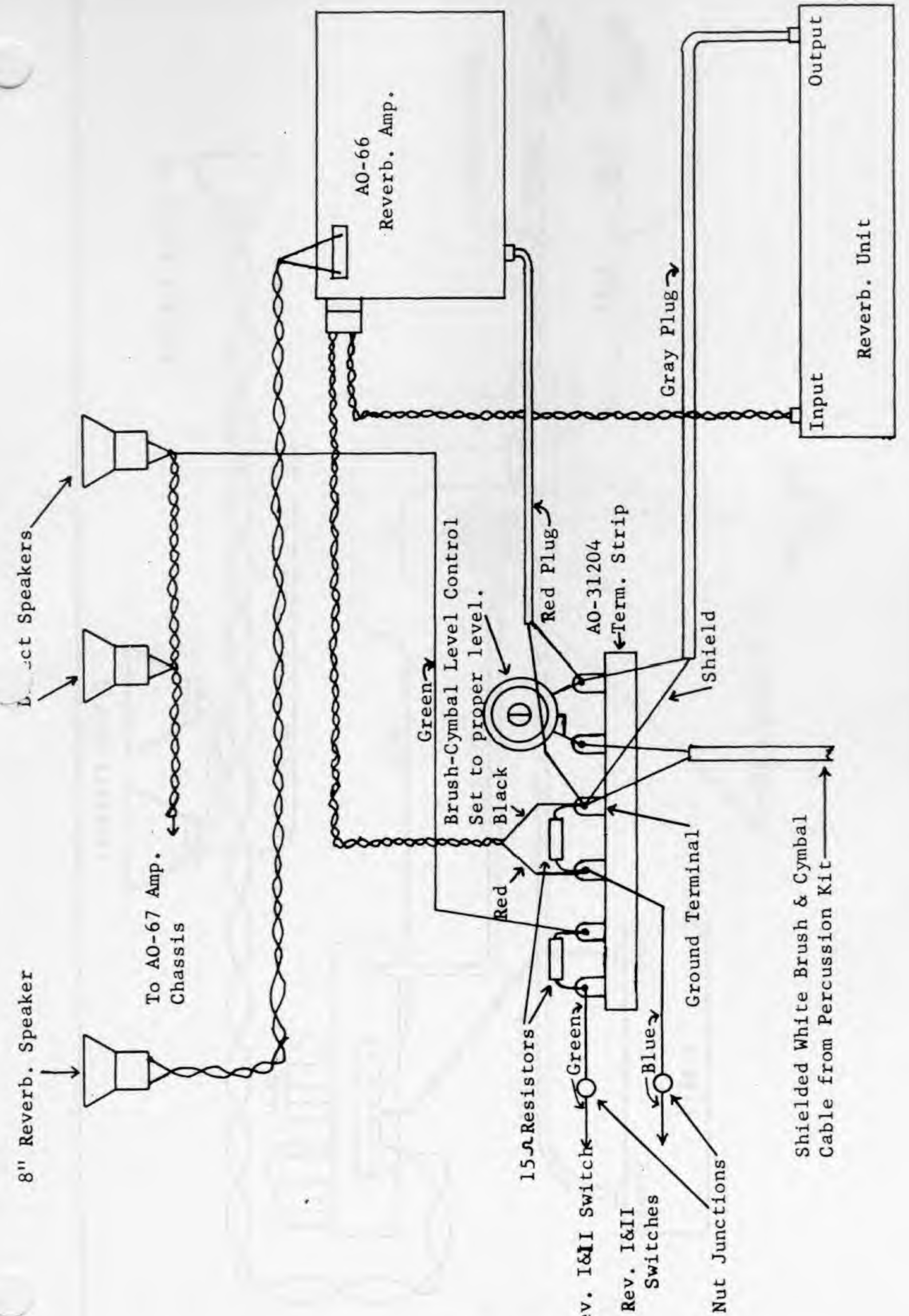
Two Zener diodes, D-209 and D-211 in the power supply, have likewise been eliminated. D-209 is now replaced with a 68K half-watt resistor and should be designated R-325. These changes alter the voltages available from two of the taps on the power supply. The tap which was marked +91 volts should now be changed to read +80 volts. The supply previously marked -12 volts should now be changed to read -9 volts. On the schematic diagram, Figure 56, add a 220K resistor from the collector of Q-213 to ground. Designate this component R-330.

NOTES



M-100A PERCUSSION KIT WIRING DIAGRAM

FIGURE 52



BRUSH & CYMBAL WIRING DIAGRAM M-100A ONLY

FIGURE 53

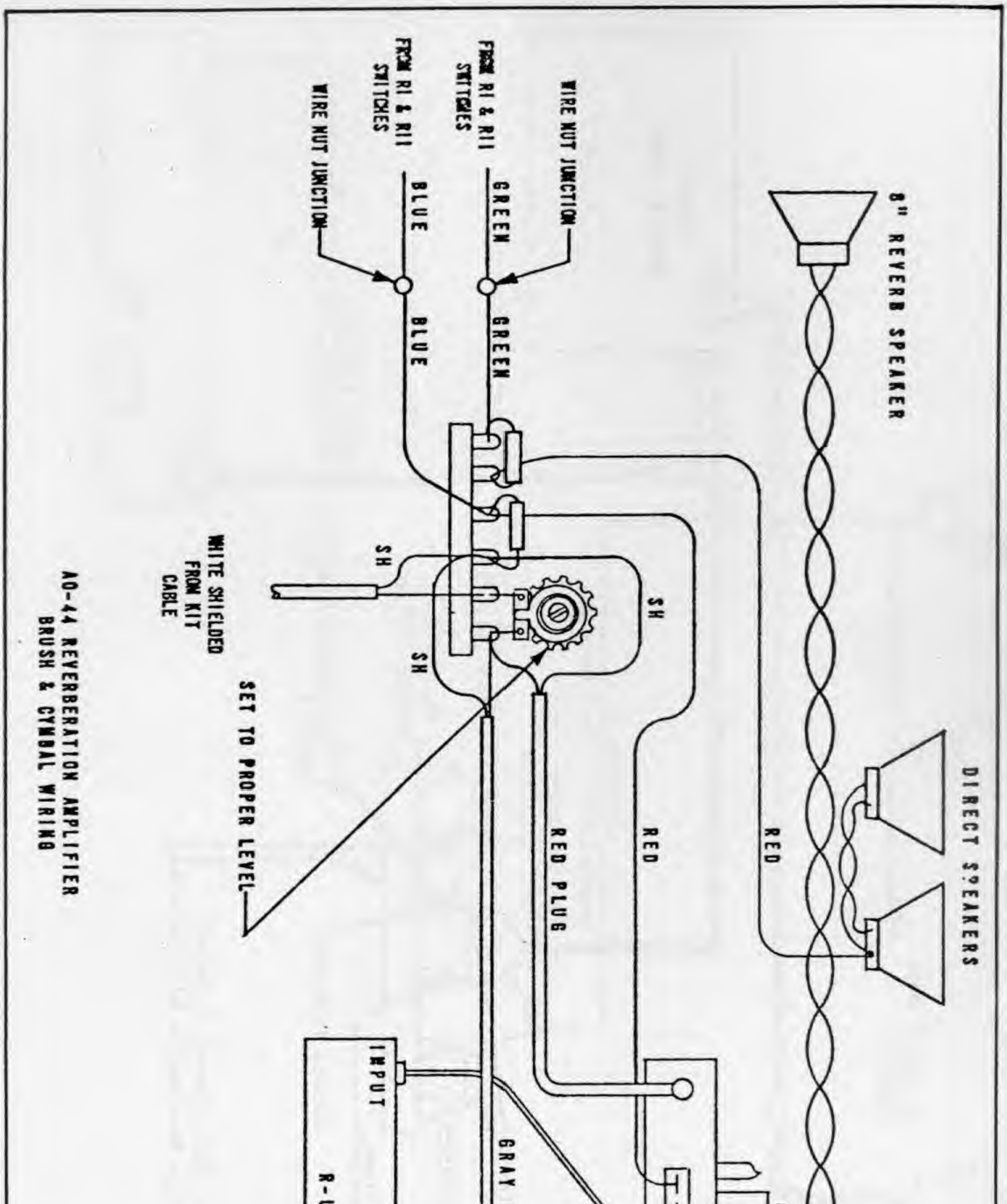

8" REVERB SPEAKER
DIRECT SPEAKERS
WIRE NUT JUNCTION
FROM RI & RII SWITCHES
GREEN
GREEN
WIRE NUT JUNCTION
FROM RI & RII SWITCHES
BLUE
BLUE
SH
SH
SH
WHITE SHIELDED FROM KIT CABLE
SET TO PROPER LEVEL
RED
RED
RED PLUG
GRAY PLUG
INPUT
R-UNIT
OUTPUT
AO-44
AO-44 REVERBERATION AMPLIFIER
BRUSH & CYMBAL WIRING

FIGURE 54

FIGURE 55
SCHEMATIC DIAGRAM
PERCUSSION
PRESET UNIT

CONSOLE SCHEMATIC DIAGRAM

M-100A

FIGURE 56

WIRING DIAGRAM M-100A

FIGURE 57

WIRING DIAGRAM M-100A

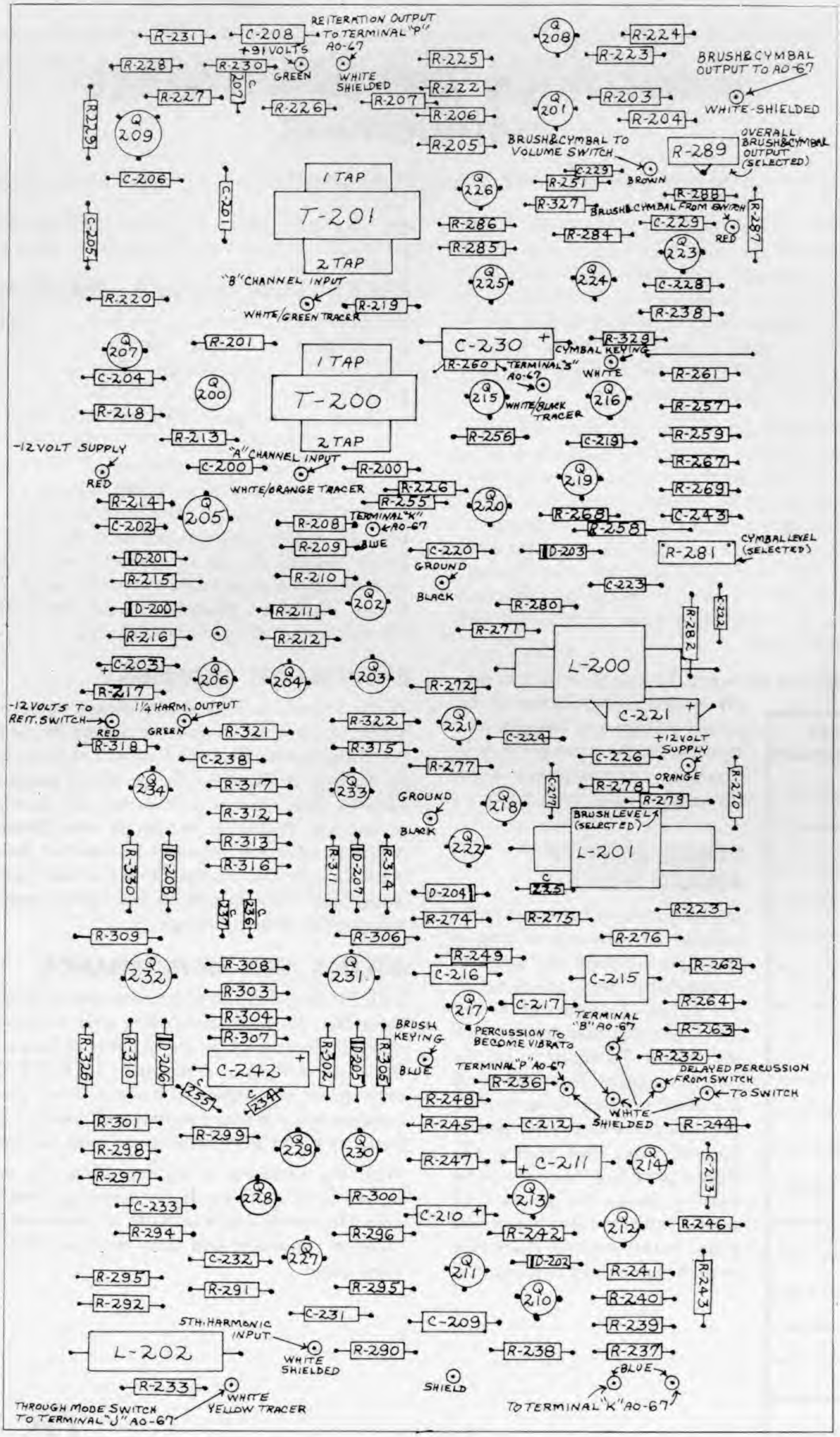


FIGURE 58 PERCUSSION UNITS PARTS DIAGRAM

INSTALLATION AND MAINTENANCE INSTRUCTIONS

IMPORTANT—When the organ is set up for operation, the generator should be freely suspended. To do this remove four hexagon head screws under shelf, turn four sleeve and washer assemblies over so that washers are down, and replace screws, tightening them securely. Use shims under console, if necessary, to set level in order that generator is free to move in any direction. Failure to do this will cause noisy operation.

The console back should be at least 1½" from the wall to allow proper ventilation. Be sure that the motion of the pedals is not restricted by rugs or unevenness of the floor. When playing the console, see that no piece of electrical equipment having a strong magnetic field is close to it. For example, an electric clock standing on the console can in some cases produce a loud hum in the speaker. This may occur also if a clock or other piece of electrical equipment is in an adjoining room close to the wall opposite to the organ.

Before plugging in the organ, be sure your electric supply is alternating current of the proper voltage and frequency as specified on the name plate. If it is not, or if the frequency is not regulated, consult your dealer.

DATE OILED

PEDAL CUTOFF ADJUSTMENT

If you find that a faint pedal note is heard continuously as long as the organ is turned on, this control probably needs adjusting. It is a slotted shaft located on the face of the amplifier and is set at the factory. To adjust it, set the expression pedal wide open, pull the pedal drawbar to its loudest position, leave all control tablets up, and play, then release, the highest pedal key. Allow the pedal note to decay for at least 15 seconds, and then slowly turn the pedal cutoff control clockwise until the faint pedal note just disappears. Do not turn it any farther. This procedure will probably be necessary in case the 6BA6 tube is replaced.

PERCUSSION CUTOFF ADJUSTMENT

If the percussion tones do not fade away or their decay is unusually fast or slow, this control probably needs adjusting. It is a slotted shaft located on the face of the amplifier and is set at the factory. To adjust it, push in all drawbars, and push down only the tablets marked "Percussion Second Harmonic." "Percussion Fast Decay," and "Upper Presets-Drawbars." Use a weight to hold down several keys on upper manual, and set expression pedal to loudest position. After about 5 seconds turn percussion cutoff control until the tones are just barely audible. Do not turn control any farther since this setting will provide the smoothest decay. This procedure should be followed in case the 12AU7 tube (nearest to end of chassis) is replaced.

MOVING OR SHIPMENT

If the organ is moved at all, always be sure that its weight is supported by the case and not by the pedals or pedal mechanism. Be careful also not to put undue strain on the legs. Aside from this, no special precautions are required if the organ is to be moved only from one room to another. If it is to be moved some distance, it is important that the generator be fastened down to the shelf. Remove and reassemble the four sleeve and washer assemblies with sleeves down and tighten securely. This will prevent serious damage.

OILING AND MAINTENANCE

CAUTION: Oil at end of first year and only once a year thereafter. NOTE: Before oiling refer to oiling instruction label located on generator cover or back panel. Use the chart at right as a reminder. IMPORTANT: Use only special oil supplied with organ. When your supply is exhausted, you may purchase additional oil from your dealer or direct from Hammond Organ Company.

With the exception of regular oiling, the organ will require little attention. If any servicing is required, call your Hammond dealer or write to the factory. Always mention the model and serial number, shown on the name plate.

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HOOO-006059 9/83 1300

M - SERIES
PARTS LIST

PARTS ORDERING INFORMATION

When ordering replacement parts from the Hammond Organ Company, the following guidelines should be observed:

1) Address all parts orders to:

   HAMMOND ORGAN COMPANY
   PARTS DEPARTMENT
   4200 W. DIVERSEY
   CHICAGO, IL. 60639

2) All orders should specify the model and serial numbers of the instrument that is being serviced. (Note: On late model instruments the model and serial numbers are printed on the tag attached to the underside of the organ keyboard.)

3) All orders should specify the Hammond part numbers of the desired parts.

4) All orders should provide a specific description of the desired parts. (For example: Power transformer, 15 volt zener diode, F through B key module, etc.)

PARTS LIST EXPLANATION

This parts list begins by listing all the major assemblies (designated) by a ◯) on pages 6-3 thru 6-4. Major assembly breakdowns are then listed numerically (①, ② , ③, etc. . .) on the following pages. The format for which major assemblies are broken down is shown below.

```
(6)  Major Assembly

     1    Minor Assembly
     2      "      "
     3      "      "
     .
     .
     .
          a    Component of Minor Assembly
          b        "     "    "      "
          c        "     "    "      "
               i    Sub-Component
               ii        "
               iii       "
```

Example:

```
(6)  Lower Keyboard Assembly                    119-000095

     1    Preset Key Module                     057-054157
     2    Preset Key Module                     057-054156
     3    Key Module                            057-054077-005
     .
     .
     .
     37   Visual Memory Cancel Assembly         060-053454-001
          a    Spring                           012-028799
          b    Grommet                          043-053308
          .
          .
          .
          m    Screw                            999-054489
               i    Washer                      999-000810
```

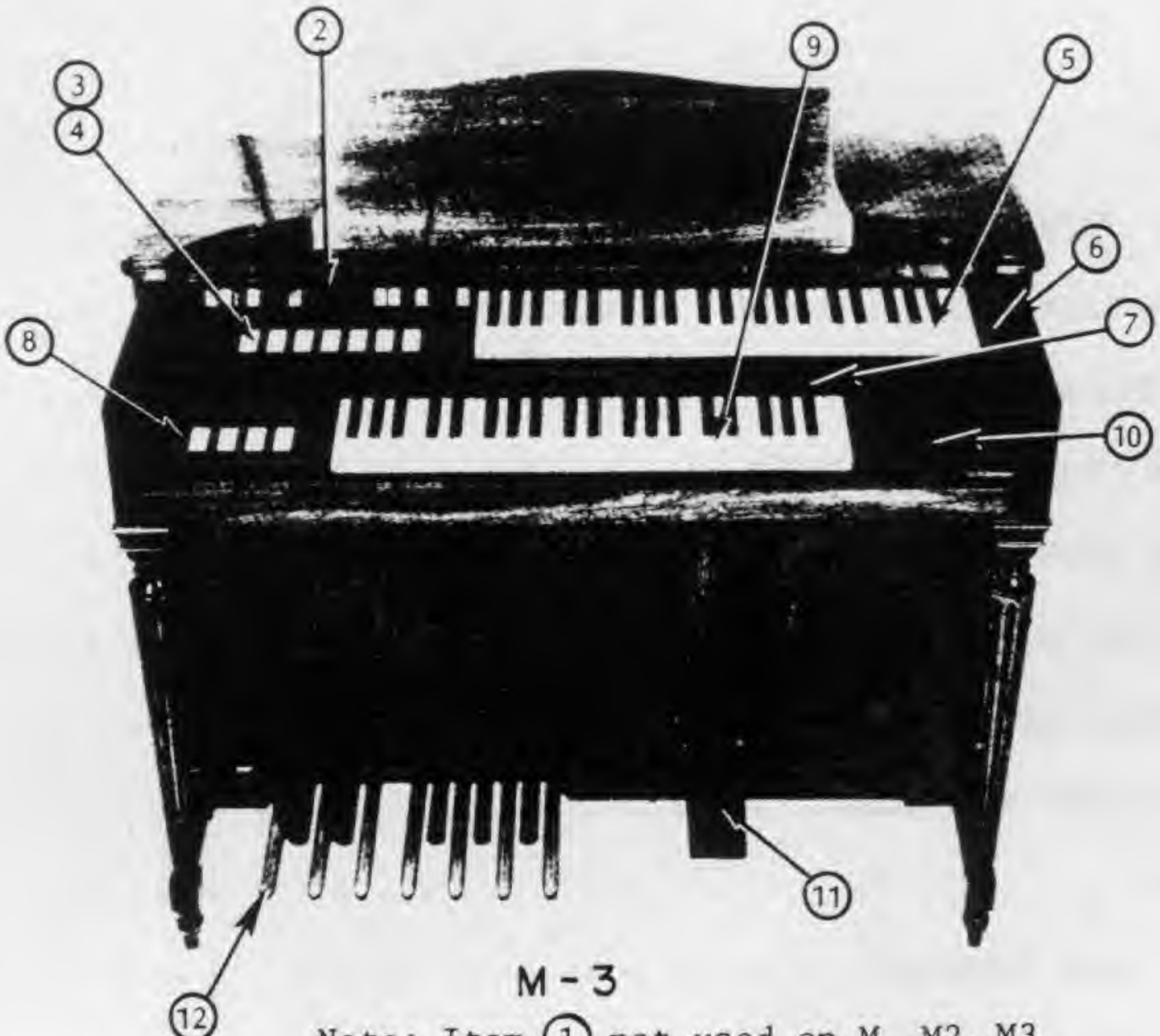
NOTES:

1. Assemblies not shown are NO LONGER AVAILABLE - NLA.

2. Items without part numbers are NLA.

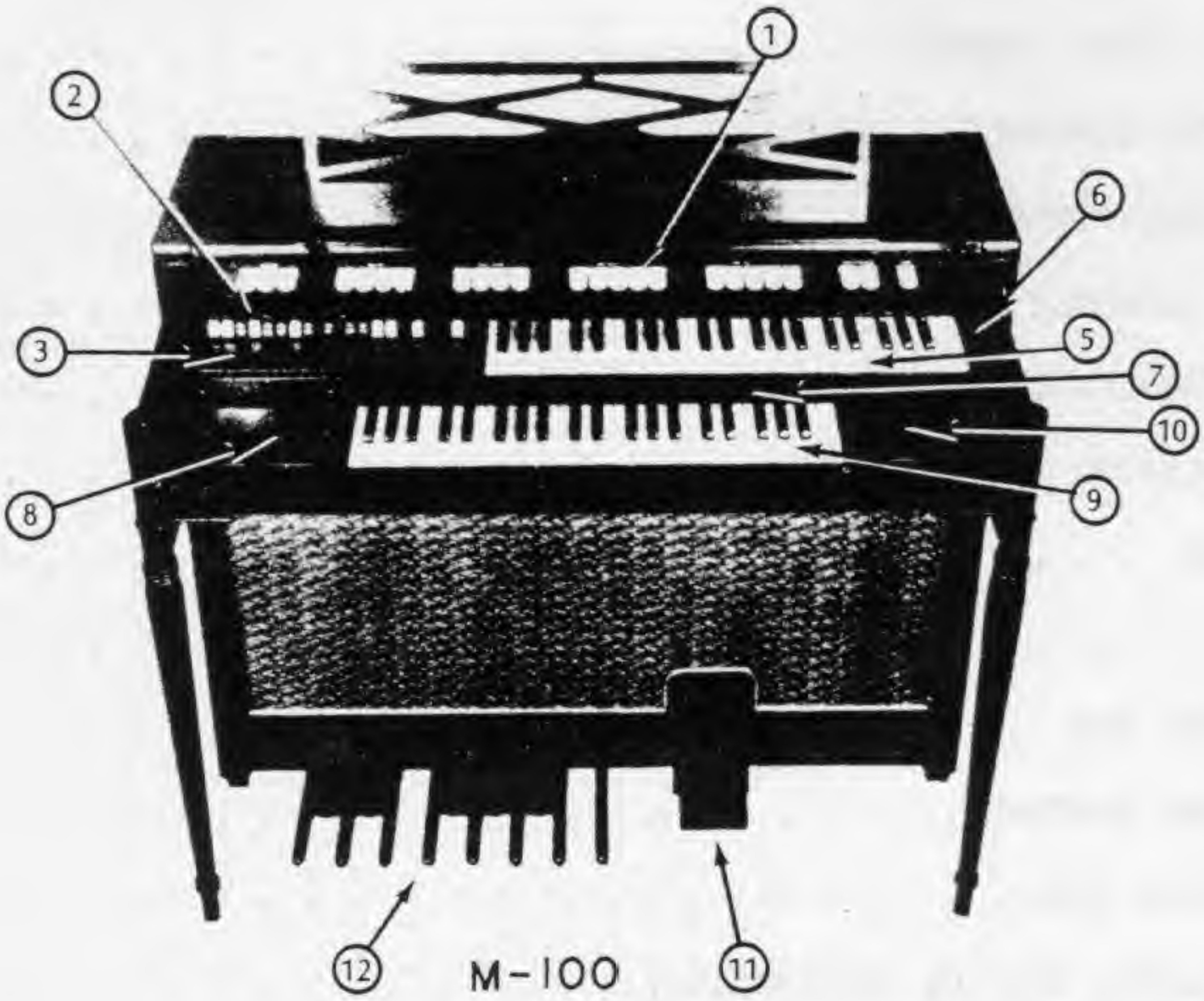
3. Parts listing does not insure availability.

TABLE OF CONTENTS
MODEL M,M2,M3,M100



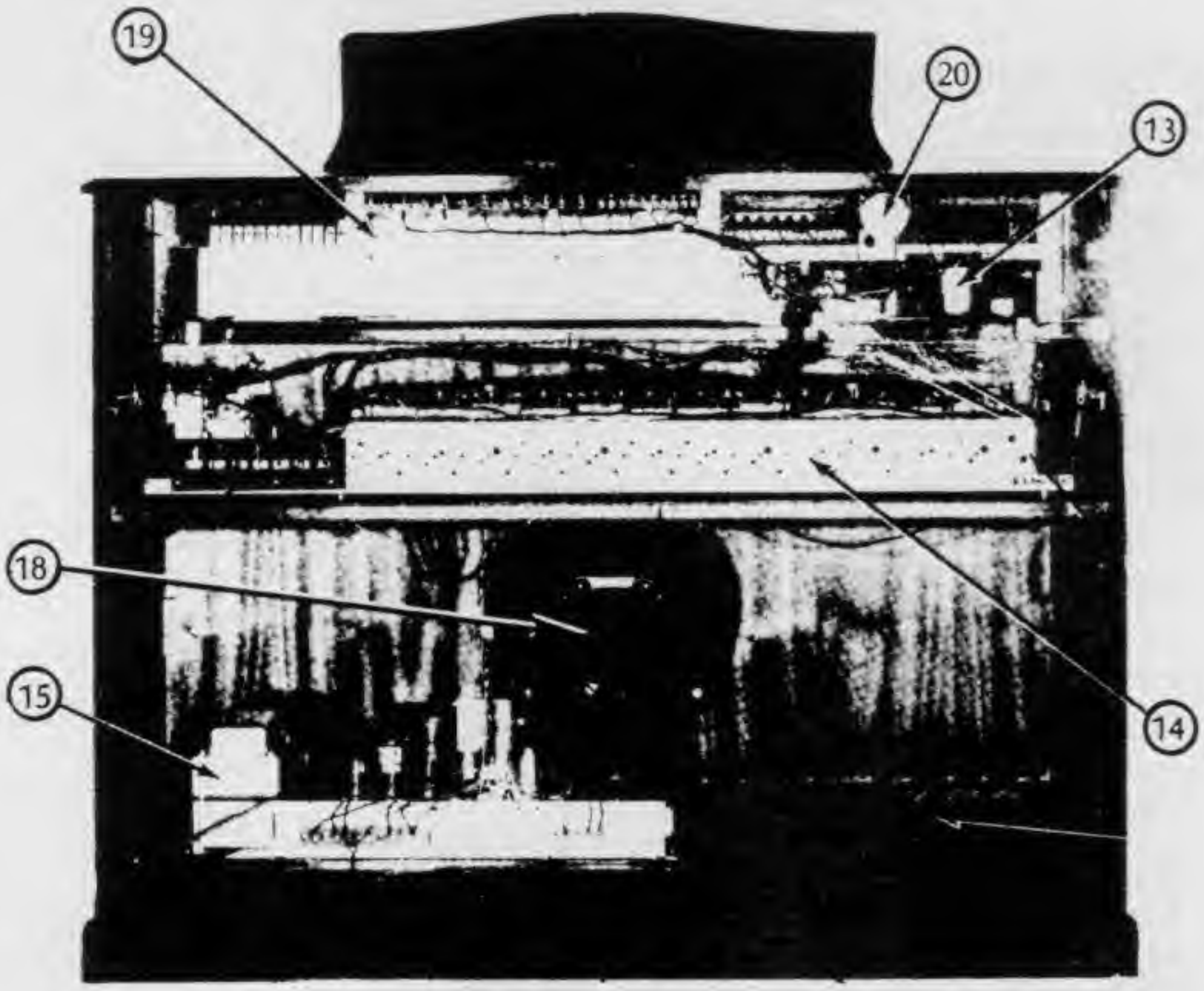
M-3

Note: Item 1 not used on M, M2, M3



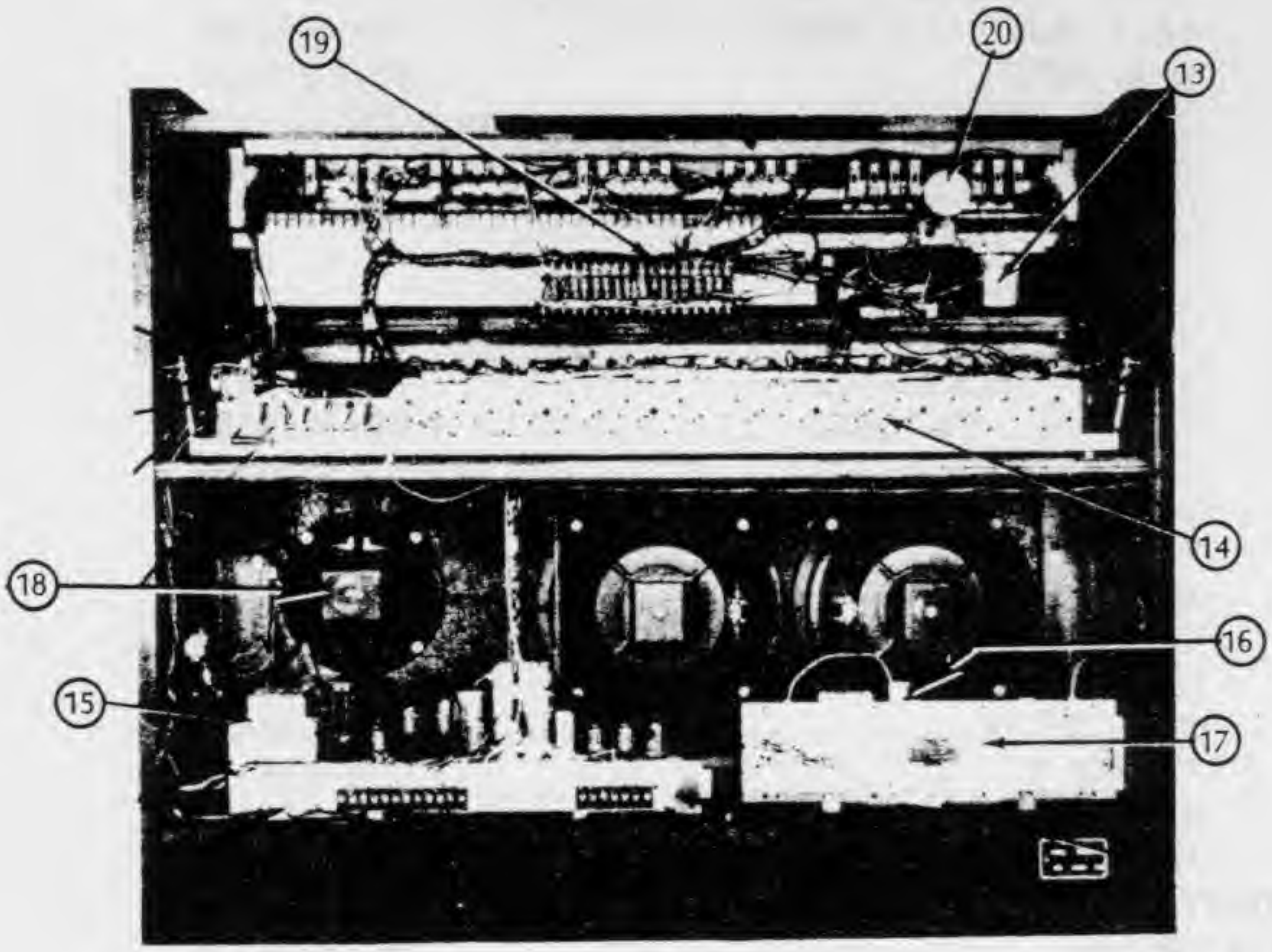
M-100

Note: Item 4 not used on M-100



M - 3

Note: Item 16, 17 not used on M, M2, M3



M - 100

PARTS LIST M, M-2, M-3, M-100

1. CONTROL PANEL ASSEMBLY (M-100 ONLY)
   1. CONTROL PANEL
   2. SWITCH ASSEMBLIES

BASS PEDALS	
PERCUSSION	
VIBRATO	
LOWER PRESETS	008-024530
UPPER PRESETS	
REVERB & VOLUME	

   3. INDIVIDUAL SWITCH

VIBRATO SMALL	008-024602
REVERB I & II	
FAST DECAY	
SECOND & THIRD HARMONIC	008-024605
PERCUSSION SOFT	008-024606
FAST DECAY	
VOLUME SOFT	
BASS MUTE	
VIBRATO CHORUS & PEDAL LEGATO	
VIBRATO CELESTE I & II	
DRAWBARS,FLUTES,DIAPASON,ENSEMBLE	
TRUMPET	008-024613
VIBRATO CANCEL	008-024619
CLARINET & FULL ORGAN	008-024626

   4. CONTROL TABS

PEDAL LEGATO	031-036656
FAST DECAY (2 USED)	031-036488
BASS MUTE	031-036657
SECOND HARMONIC	031-036486
THIRD HARMONIC	031-036487
PERCUSSION SOFT	031-036489
VIBRATO SMALL	
VIBRATO CHORUS	
VIBRATO CELESTE I	031-036658
VIBRATO CELESTE II	031-036659
DRAWBARS (2 USED)	031-036481
FLUTES	031-036661
DIAPASON	031-036660
ENSEMBLE	031-036482
VIBRATO CANCEL (2 USED)	031-036662
TRUMPET	031-036483
CLARINET	031-036484
FULL ORGAN	031-036485
REVERB I	031-036493
REVERB II	031-036494
VOLUME SOFT	031-036495

5. START SWITCH	008-024537
6. RUN SWITCH	008-024536
7. PILOT LAMP	016-022885
a. LENS	016-031454
b. PUSH ON CLIP	013-031468

2. STOP SWITCH (TONE BAR) ASSEMBLY

MODEL M,M2,M3...........................120-021620-001

MODEL M-100

1. TONEBAR KNOBS BLACK 025-035570

IVORY 025-035571

BROWN...................025-035572

WITH RED DOT

a. KNOB SCREWS 821-070514

2. TONEBAR CONTACT WITH SLIDER 060-036603

3. BUS BARS

4. BUS BAR INSULATORS.......................043-020574

5. BUS BAR PANELS 025-020373

6. PEDAL TONEBAR SLIDER ASSEMBLY M,M2,M3

M100 060-035984

a. COUPLING INSULATOR M,M2,M3..........045-020727

M100 045-024517

3. STOPSWITCH BASE

MODEL M

MODEL M2,M3

MODEL M100

4. CONTROL SWITCH ASSEMBLY

MODEL M

MODEL M2

MODEL M3

1. ROCKER TABS VIBRATO ON/OFF (M ONLY)

VOLUME SOFT/NORMAL..........025-020655-002

PEDAL ATTACK 025-020655-003

PEDAL DECAY 025-020655-004

VIBRATO LOWER MANUAL........025-020655-005

VIBRATO SOLO MANUAL 025-020655-006

VIBRATO NORMAL/VIBRATO CHORUS 025-020655-007

AMOUNT OF VIBRATO

2. TOGGLE SPRING

5. UPPER KEYBOARD ASSEMBLY

MODEL M

MODEL M2,M3

MODEL M100

1. BUS BAR CONTACTS M,M2,M3

M100...............030-033445

2. KEY CONTACTS 012-033530

3. KEY COMB ASSEMBLY M,M2,M3 (1 USED) 057-021239

M,M2,M3 (3 USED).....057-021238

M100 (1 USED) 057-038083

M100 (3 USED) 057-037989

4. KEY CHANNEL ASSEMBLIES M,M2,M3 (SHARPS) 057-035832

M,M2,M3 (NATURALS).057-035831

M100 (SHARPS & NATURALS) 060-033392

5. KEY SCREWS (ALL) 850-000002

a. WASHERS

6. UPSTOP FELT M,M2,M3..............042-022369

M100

7. DOWNSTOP FELT M,M2,M3 042-001701

M100.................042-031227

8. KEYS M,M2,M3

KEYS M,M2,M3	SHARPS	(18 USED)	025-036295
	C	(3 USED)	025-035666
	D	(3 USED)	025-035667
	E	(3 USED)	025-035668
	F	(4 USED)	025-035669
	G	(4 USED)	025-035670
	A	(4 USED)	025-035671
	B	(4 USED)	025-035672
	CX	(1 USED)	025-035673
KEYS M100	SHARPS	(18 USED)	025-032672
	C	(3 USED)	025-042279
	D	(3 USED)	025-042280
	E	(3 USED)	025-042281
	F	(4 USED)	025-042282
	G	(4 USED)	025-042283
	A	(4 USED)	025-042284
	B	(4 USED)	025-042285
	CX	(1 USED)	025-042286

6. UPPER RIGHT HAND ENDBLOCK
   - MODEL M,M2,M3
   - MODEL M100..............................025-024307

7. FRONT STRIP
   - MODEL M,M2,M3 061-020371
   - MODEL M100 051-024165

8. LOWER LEFT HAND ENDBLOCK
   - MODEL M,M2
   - MODEL M3
   - MODEL M100..............................025-024848

   1. PERCUSSION SWITCH ASSEMBLY (M3 ONLY) 125-000023
      - a. ROCKER TABS PERC ON/OFF 025-036083
        - PERC VOLUME............025-036084
        - PERC DECAY 025-036082
        - PERC HARMONIC SELECTOR 025-036081
      - b. TOGGLE SPRING
      - c. SWITCH PANEL ASSEMBLY

9. LOWER KEYBOARD ASSEMBLY
   - MODEL M,M2,M3
   - MODEL M100..............................119-000010

   NOTE: PARTS FOR LKB ASSEMBLY ARE SIMILAR TO THOSE USED ON THE UKB ASSEMBLY 5

10. LOWER RIGHT HAND ENDBLOCK
    - MODEL M,M2,M3
    - MODEL M100..............................025-024847

11. EXPRESSION PEDAL ASSEMBLY
    MODEL M,M2
    MODEL M3
    MODEL M100
  1. PEDAL ASSEMBLY M,M2,M3
                    M100
  2. RUBBER MAT   M,M2,M3
                    M100.................... 043-046347
  3. PEDAL SUSTAIN CONTROL M,M2,M3
  4. LINK & BEARING STRAP ASSY M,M2,M3 028-020458
  5. PEDAL ARM M,M2,M3 041-020456-003
              M100

12. PEDAL SWITCH ASSEMBLY
        M,M2,M3
        M100
  1. PEDAL CABLE M,M2,M3
                 M100........................ 011-024545
  2. ACTUATOR 045-020436
  3. PEDAL KEYS BLACK (SHARPS) (5 USED) 025-031469
                BROWN (NATURALS) (7 OR 8 USED) 025-031666
  4. GUIDE FELTS (2 PER PEDAL)........... 042-021255
  5. UPSTOP FELT (26 USED) 042-020410
  6. DOWNSTOP FELT (13 USED) 042-031898
  7. ACTUATOR SPRING......................... 012-020972

13. MATCHING TRANSFORMER
    MODEL M,M2,M3 003-021752
    MODEL M100 003-024498

14. GENERATOR ASSEMBLY
    MODEL M,M2,M3
    MODEL M100
  1. RUN MOTOR (ALL)....................... 021-035903
  2. START MOTOR (ALL) 021-035137
  3. VIBRATO SCANNER M
                     M2
                     M3,M100
  4. DRIVE COUPLING ASSEMBLY (RUN MOTOR TO
                              GENERATOR) 064-035769
  5. DRIVE GEARS COUPLING SPRING............ 012-031463
  6. MOTOR COUPLING SPRING (FLYWHEEL SPRING) 012-002345
  7. MAGNET AND COIL ASSEMBLIES
                     FREQ #1 065-036583
                M100 FREQ #1 065-033268
                     FREQ #2,4,6,9,11
                     FREQ #3,5,7,8,10,12
                     FREQ #13 THRU 17 065-036582
                M100 FREQ #13 065-033271
                     FREQ #18
                     FREQ #19 THRU 24
                     FREQ #25 THRU 30 065-033273
                     FREQ #31 THRU 36 065-033275
                     FREQ #37 THRU 43

M3	FREQ #42	065-033277
	FREQ #44 THRU 48	
	FREQ #49 THRU 54	065-033176
	FREQ #55 THRU 60	065-033177
	FREQ #61 THRU 72	065-033160
	FREQ #73 THRU 91	065-033161

15. AMPLIFIER ASSEMBLY
    MODEL M
    MODEL M2
    MODEL M3
    MODEL M100

1.	POWER TRANSFORMER	M,M2................	003-028526
		M3,M100	003-024157
2.	OUTPUT TRANSFORMER	M,M2,M3	003-024954
		M100...............	003-024111
3.	PERCUSSION MATCHING TRANSFORMER		
		M3,M100 (T4)	003-036229
4.	PERCUSSION INPUT TRANSFORMER		
		M3,M100 (T5)........	003-036498
5.	PERCUSSION OUTPUT TRANSFORMER		
		M3,M100 (T6)..........	003-024112
6.	FILTER CAPACITORS		
		50MFD/450V	450-010070
		DUAL 50MFD/450V	450-040400
		50/50/50MFD/450V	
		20/20/30MFD/400V,30V	
		40/20/20/30MFD/400V,25V.....	450-040300
	a. MOUNTING INSULATOR		045-021032
7.	SWELL CONTROL		
	a. TRIMMER CAPACITOR		499-021468
	b. LEVER BUSHING ASSEMBLY.........		060-020765
8.	POTENTIOMETER (PERC & PEDAL CUT OFF)		676-000124
9.	VACUUM TUBES	5U4	002-005201
		6V6..............	002-006703
		6SC7	002-006305
		6J7	T000-000000-6J7
		6J5	
		6SJ7.............	002-006502
		6BA6	002-006501
		6SN7	002-006306
		6AU6.............	002-006500
		6C4	002-006300
		12AU7	002-012300
		12AX7............	002-012301
10.	LINE CORD (ALL)		011-053851

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16. REVERB AMPLIFIER  (M100 ONLY)
      AO-35  (EARLY MODELS)
      AO-44 OR AO-66  (LATER MODELS)
  1.  POWER TRANSFORMER  AO-35
                         AO-44 (DOMESTIC)      003-024956
                         AO-44 (EXPORT).......003-036756
  2.  OUTPUT TRANSFORMER AO-35
                         AO-44,AO-66           003-036552
  3.  FILTER CAPACITOR   AO-35                 450-040200
                         AO-44
  4.  MINIATURE LAMP   GE#12    6.3V/.15A.....016-022885
  5.  LAMP HOLDER
  6.  POTENTIOMETER      AO-44    R27 2K
                         AO-66     R6 1M       676-000101
  7.  TRANSISTOR         AO-44,AO-66           001-021260
  8.  FUSE      AO-44 ONLY DOMESTIC 3/4A......016-039512
                           EXPORT   3/8A
  9.  VACUUM TUBES         5U4/5Y3             002-005201
                           ECC83/12AX7         002-012301
                           6BQ5...............002-006700
                           EZ81/6CA4           002-006200
                           ECL86/6GW8          002-006401

17. REVERB UNIT M100 ONLY......................121-000046

18. SPEAKER  M,M2,M3
             M100   (REVERB)...................014-046896
                    (LOW FREQ)                 014-030812
                    (HIGH FREQ)                014-024347

19. VIBRATO LINE BOX...........................121-000053
  1.  COIL (LATER MODELS)                      003-033303
           (EARLY MODELS)                      003-021842-003

20. PEDAL VOLUME CONTROL

21. MISCELLANEOUS PARTS
  1.  GENERATOR SUSPENSION SPRING.............012-033227
  2.  EYE SCREW
      a. NUT
  3.  GENERATOR HOLD DOWN SCREW                824-000003
      a. SLEEVE WASHER ASSY                    060-021751
  4.  START SWITCH M,M2,M3....................008-016944
  5.  RUN SWITCH   M,M2,M3                     008-024536
  6.  KNOB FOR START OR RUN SWITCH             025-002071
  7.  MUSIC RACK BRACE M,M2,M3
  8.  MUSIC RACK THUMB SCREW M,M2,M3
  9.  MUSIC RACK HINGE M100 ONLY..............032-033414
 10.  REAR COVER M100 ONLY
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Technical Bulletin

HAMMOND ORGAN COMPANY
DIVISION OF HAMMOND CORPORATION
11700 Copenhagen Court / Franklin Park, Illinois 60131
(312) 766 - 6950

REPAIR AND DISASSEMBLY OF VIBRATO SCANNERS

(A) Although this technical bulletin is based on scanner repair, it is not the single source of vibrato problems. Check existing switches, vibrato pre-amp. (tubes, etc), phase shift line box, and cables both to and from the scanner.

(B)

SYMPTOM	CAUSE	REPAIR
(1) Dead	(1a) Vibrato Switch (b) Vibrato pre-amp. (Tubes, etc.) (c) Open Signal Wire to Line-box (d) Open From Scanner shielded cable.	(1a) Replace Switch (b) Replace tubes or other defective components. (c & d) Replace wires or repair connections.
(2) Choppy Vibrato	(2a) Shorted capacitors on line-box (b) Open coils on line box (c) Oil saturated bakelite insulators which pick up impurities and short out the stationary plates to the main assembly chassis of scanner. (d) Rotor plates rubbing against the stationary plates inside scanner.	(2a & b) Replace defective components (c) Clean Stationary and rotor plates and replace insulators, isolating the stationary plates from the main chassis. (d) Check end play and height of rotor on gear and shaft assembly.
(3) Slow Vibrato	(3a) Semi-frozen bearing on gear and shaft assembly (b) Poor tension on drive springs of the gear and shaft assembly.	(3a) Check oiling threads and for proper oiling. (b) Replace gear and shaft assembly.
(4) No Vibrato	(4) Frozen bearing on gear and shaft assembly	(4) Replace gear and shaft assembly.
(5) Squeaking Sound.	(5a) Tension springs of the carbon brushes mispositioned causing the brushes to make a squeaking sound against the rotor contact pins. (b) Dry bearings	(5a) Heat spring connection with soldering iron and spring will fall into its proper position. (b) Check for proper oiling.

PARTS LIST

A	Syn. Motor & Scanner	
B	Oil Cup Assembly	064-016844
C	Oil Felt	
D	Felt Retainer Spring	012-002996
E	Screws (3)	
F	Screws (2)	
G	Shielded lead and Cover Assembly	066-033247 and 066-033248
H	Brush Lug & Insulator Assembly	
I	End Brush Spring Assembly	066-016821
J	Brush Assembly	066-016958
K	Screws (2)	846-040314
L	Screw (1)	
M	Housing Cover Assembly	
N	Screw (4)	
O	Cable Clip	
P	Stationary Plate (16)	066-016829
Q	Rotor Assembly	066-016828
R	Screws (16)	816-080720
S	Insulators (16)	036-016747
T	Insulators (16)	045-021942
U	Front Plate Assembly	
V	Bristol Set Screw (2)	999-002032
W	Gear Housing Assembly	
X	Screws (4)	
Y	Gear & Shaft Assembly	018-033192 and 018-033193

(1) DETACH MOTOR AND SCANNER ASSEMBLY (A) FROM THE GENERATOR ASSEMBLY BY REMOVING FOUR (4) NUTS FROM THE SYNCHRONOUS MOTOR WHICH ANCHORS THE MOTOR TO THE "L" BRACKETS OF THE GENERATOR ASSEMBLY.

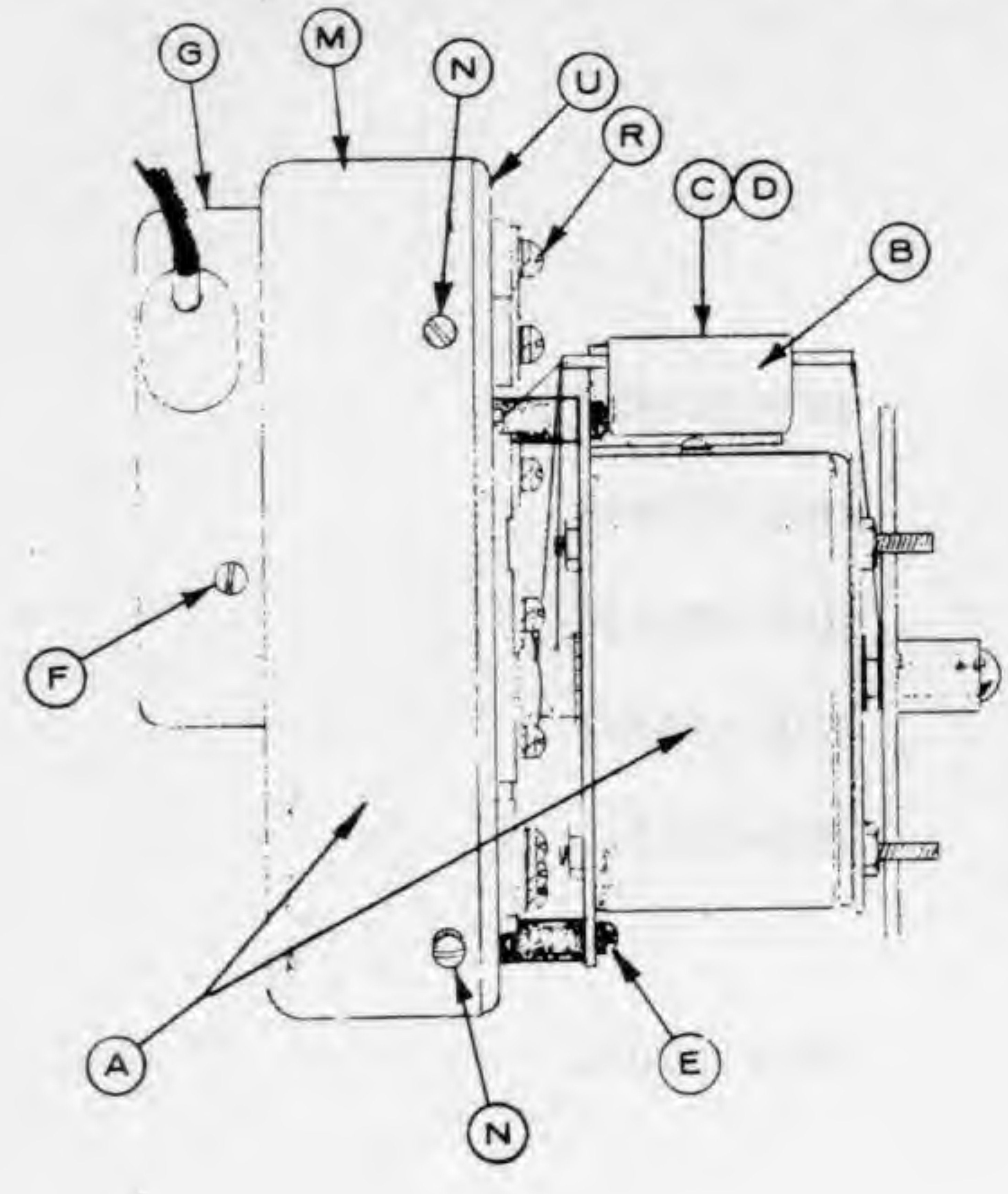
(2) REMOVE THE CABLE CONNECTIONS IN THE ORGAN SO MOTOR AND SCANNER ASSEMBLY IS FREE FROM ORGAN.

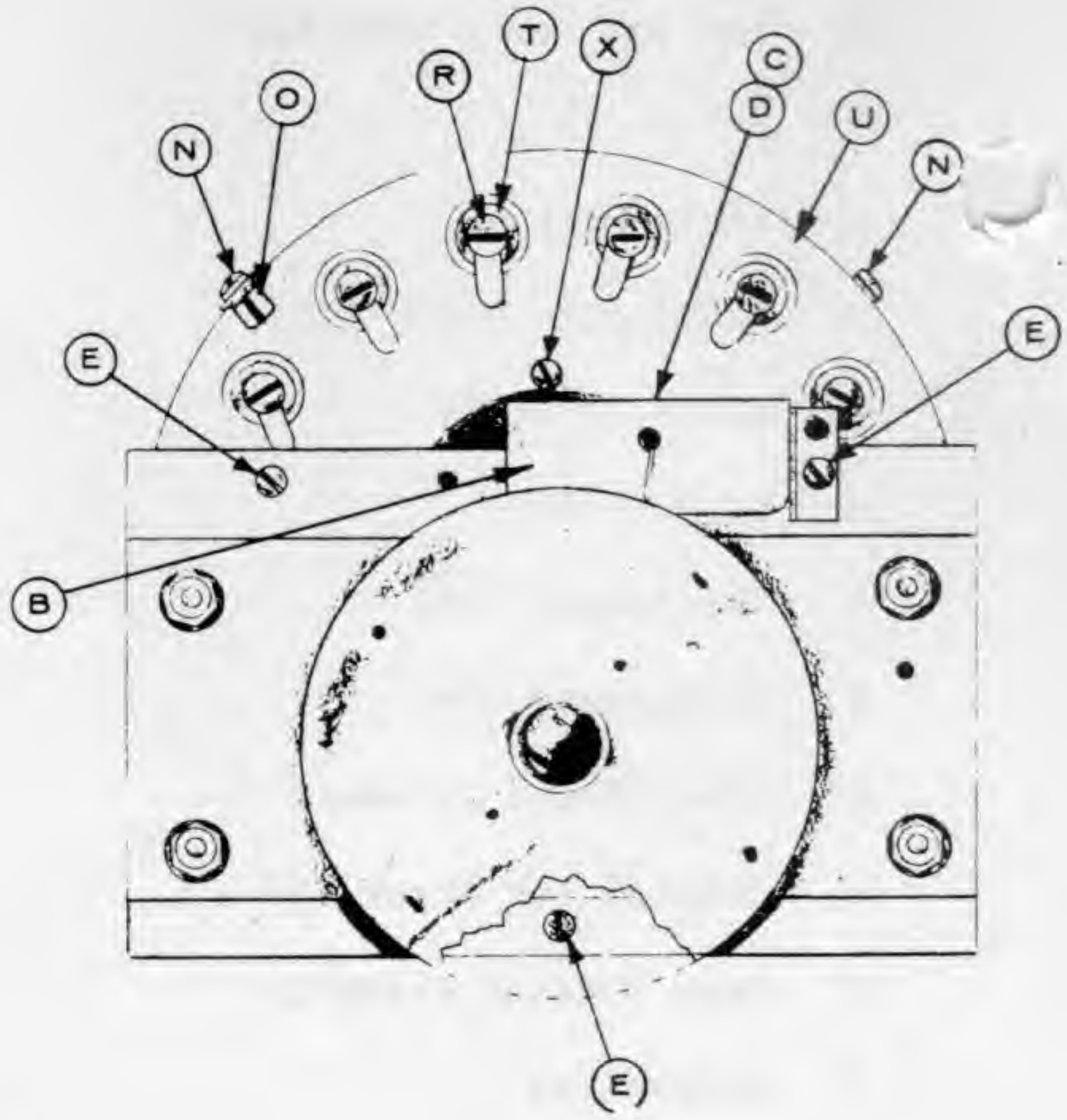
(3) NOTE A.C., LINE BOX, AND OUTPUT CONNECTIONS FOR REASSEMBLY.

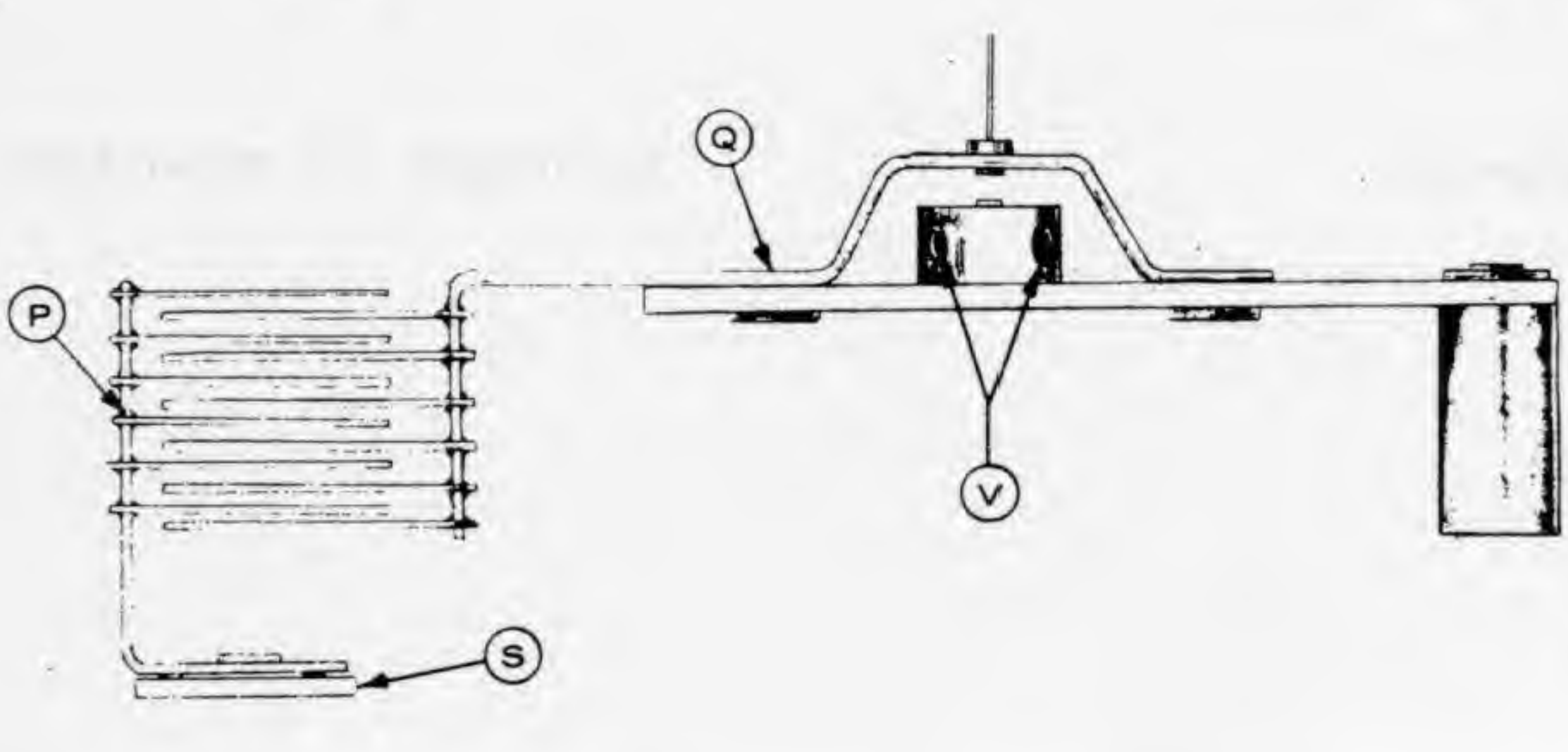
(4) LOCATE OIL CUP (B) AND OIL FELT (C) INSIDE CUP. THE OIL FELT MUST BE REMOVED AND THE COTTON THREADS UNWRAPPED FROM THE FELT BEFORE SEPARATING THE SCANNER AND MOTOR. REMOVE FELT RETAINER SPRING (D) AND LIFT UP ON THE FELT TO REMOVE THE THREADS. (DO THIS VERY CAREFULLY TO AVOID BREAKING THE COTTON THREADS).
AFTER REMOVING THE THREADS FROM THE OIL FELT TAKE A PICK OR A PAPER CLIP AND REMOVE THE THREE THREADS FROM THE ONE SIDE OF THE OIL CUP BY PULLING THEM THROUGH THE HOLE IN THE CUP. THE THREAD FROM THE OTHER SIDE OF THE CUP NEED NOT BE REMOVED.

(5) LOCATE SCREWS (E) WHICH HOLD THE MOTOR AND SCANNER ASSEMBLY TOGETHER. REMOVE THE SCREWS AND PULL THE MOTOR AND SCANNER ASSEMBLY APART. NOTE: THERE IS A GEAR ON THE END OF THE MOTOR SHAFT AND MUST BE GUIDED THROUGH THE HOLE OF THE SCANNER HOUSING TO SEPARATE THE MOTOR AND SCANNER.

(6) REMOVE TWO SCREWS (F) FROM THE REAR COVER (G) OF THE SCANNER. BEFORE REMOVING THE COVER NOTE THAT THERE IS A SHIELDED WIRE ATTACHED TO THE COVER. THIS WIRE IS CONNECTED INSIDE THE SCANNER AND THERE IS VERY LITTLE SLACK IN THE WIRE. REMOVE THE COVER AND TIP IT BACK CAREFULLY SO YOU CAN SEE INSIDE. LOCATE THE CARBON BRUSH AUDIO PICK-UP ASSEMBLY (J). THE CARBON BRUSHES MUST BE REMOVED BEFORE THE MAIN HOUSING ASSEMBLY COVER (M) IS REMOVED, IN ORDER TO PREVENT DAMAGE TO THE CARBON BRUSHES AND TENSION SPRINGS. LIFT END BRUSH (I) AND SLIP THE TWO CARBON BRUSHES (H) OFF THE ROTOR CONTACT PIN. (BE EXTREMELY CAREFUL OF THE ROTOR CONTACT PIN DURING DISASSEMBLY SO YOU DO NOT BEND OR BREAK THE PIN).







SHOULD IT BE NECESSARY TO REMOVE THE CARBON BRUSH AUDIO PICK-UP ASSEMBLY (J), DESOLDER THE AUDIO WIRE FROM THE BRUSH ASSEMBLY AND REMOVE THE TWO (2) SCREWS (K). TO REMOVE THE END BRUSH (I) REMOVE SCREW (L) AND SEPARATE FROM THE BRUSH ASSEMBLY.

(7) REMOVE THE FOUR (4) SCREWS (N) AND SLIP THE HOUSING COVER (M) OFF THE MAIN ASSEMBLY. NOTE: MARK THE HOUSING COVER (M) AND THE MAIN ASSEMBLY CHASSIS (U) TO INDICATE THE STARTING POINT OF THE SCANNER CABLE, ALSO MARK THE LOCATION OF THE CABLE CLIP (O).

(8) STATIONARY PLATES (P) AND ROTOR (Q) ARE MOUNTED ON THE MAIN ASSEMBLY CHASSIS (U). REMOVE TWO (2) OF THE STATIONARY PLATES (P), BY REMOVING SCREWS (R). WHEN REMOVING THE STATIONARY PLATES FROM THE ASSEMBLY YOU WILL NOTICE THAT THERE ARE INSULATOR (S) AND (T) ON BOTH SIDES OF THE MAIN ASSEMBLY CHASSIS, INSULATING THE STATIONARY PLATES FROM THE ASSEMBLY (U). THEN REMOVE THE ROTOR ASSEMBLY (Q) BY LOOSENING THE TWO (2) BRISTOL TYPE SET SCREWS (V), TO AVOID DAMAGING THE ROTOR CONTACT PIN DURING DISASSEMBLY.

(9) REMOVE THE REMAINING (14) STATIONARY PLATES AND INSULATORS.

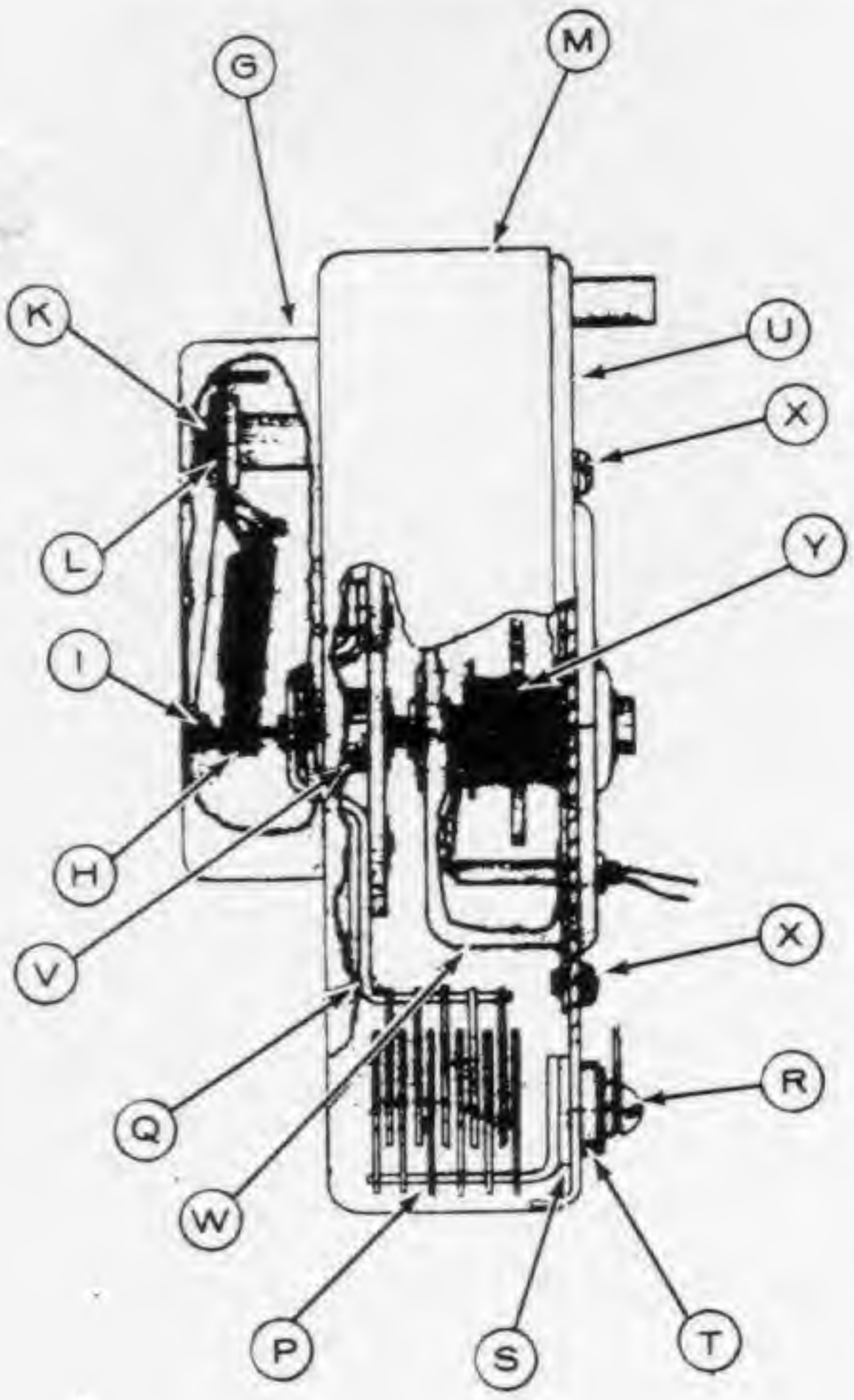
(10) CLEAN THE STATIONARY PLATES, ROTOR PLATES AND OTHER METAL PARTS USING A FREON SPRAY OR OTHER CLEANING SOLVENTS THAT DO NOT LEAVE ANY RESIDUE AFTER DRYING. AN ABSORBENT CLOTH OR SWAB CAN BE USED IN CONJUNCTION WITH THE CLEANER.

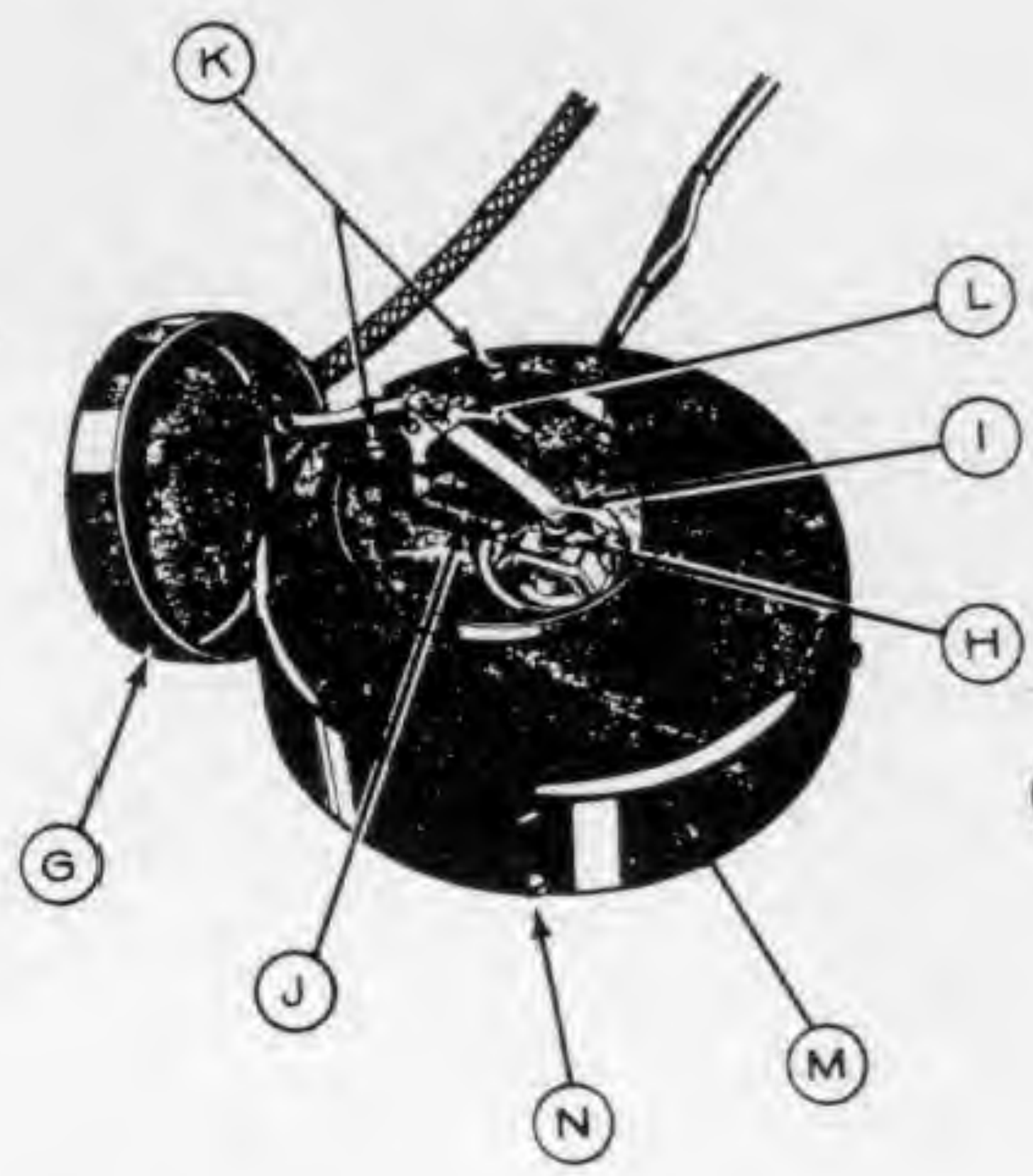
(11) SPRAY METAL COATED PARTS WITH KRYLON CORONA DOPE (CLEAR). CAUTION: DO NOT ALLOW SPRAY TO GET ON OIL THREADS OR ROTOR PICK-UP PIN.

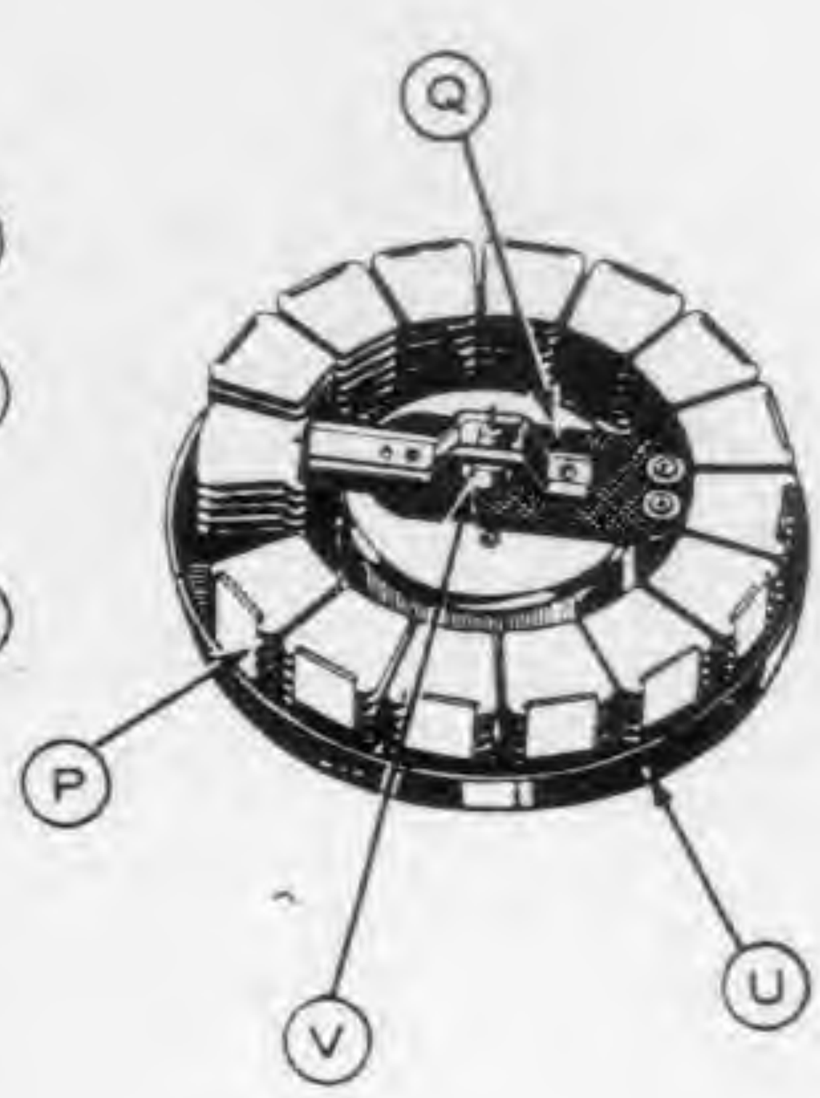
(12) IN MOST SCANNER REPAIR YOU NEED NOT GO FURTHER IN DISASSEMBLY THAN STEP NUMBER ELEVEN (11) BUT SHOULD CONDITIONS WARRANT FURTHER DISASSEMBLY CONTINUE WITH NUMBER (13), OTHERWISE INSTALL NEW INSULATORS AND REASSEMBLE THE SCANNER.

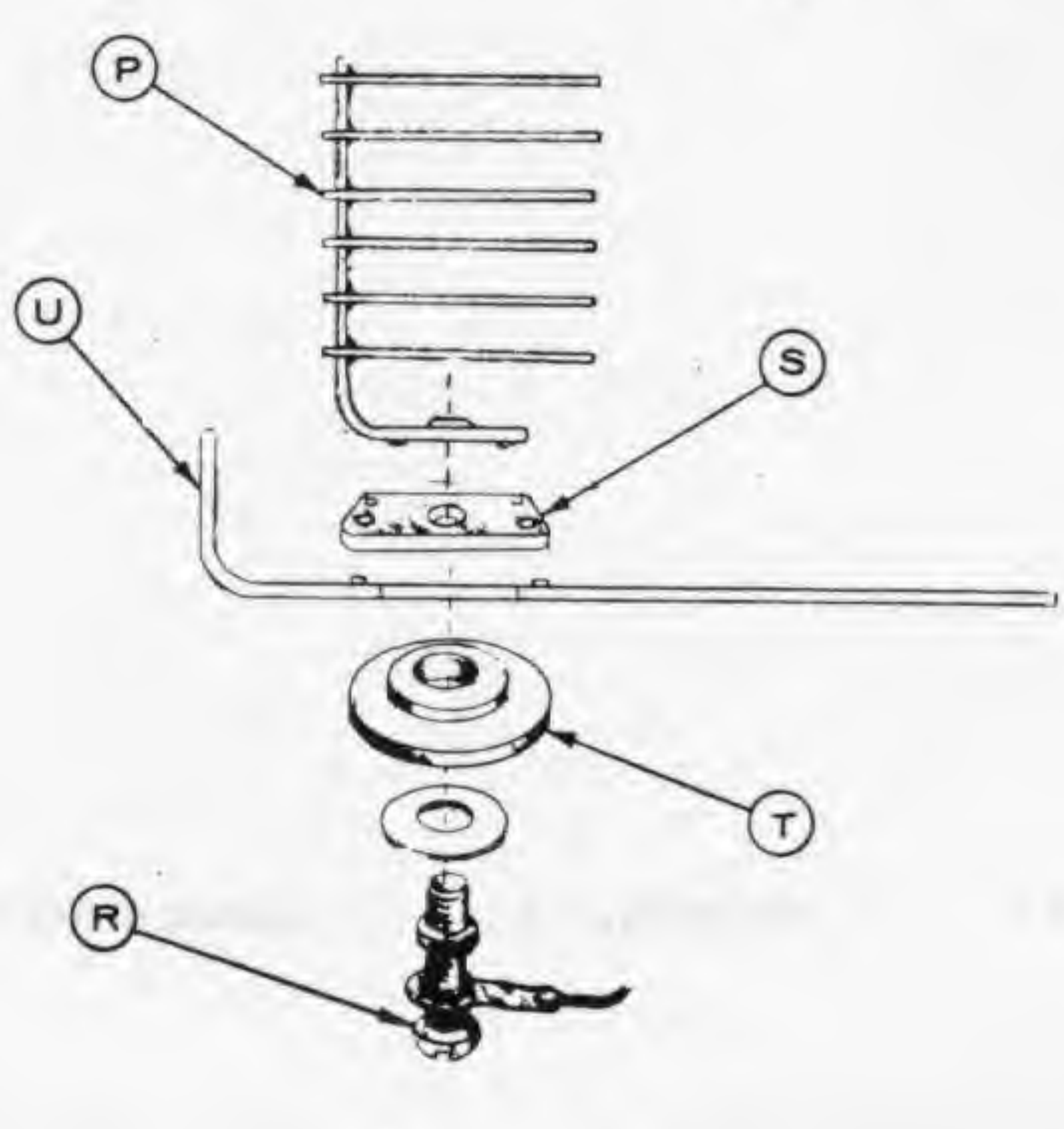
(13) IN REMOVING THE GEAR HOUSING ASSEMBLY (W) THERE ARE FOUR (4) SCREWS (X) HOLDING THE ASSEMBLY ON TO THE MAIN ASSEMBLY CHASSIS (U). UPON REMOVING THE GEAR HOUSING ASSEMBLY YOU WILL NOTICE THE BAKELITE GEAR AND SHAFT ASSEMBLY (Y). THE SPRINGS ON EITHER SIDE OF THE BAKELITE GEAR ALSO INTERMESHES WITH THE METAL GEAR OF THE SYNCHRONOUS MOTOR TO DRIVE THE SCANNER.

(14) TO REASSEMBLE THF SCANNER REVERSE THIS PROCEDURE.









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