SERVICE MANUAL

Extravoice*

*Trademark

MODEL F-100

HAMMOND ORGAN
1740 N. 25th Avenue • Melrose Park, Ill. 60160

SERVICE INFORMATION

Extravoice*

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ORGAN

BY HAMMOND

(Model F100)

Figure 1 - FRONT VIEW

Dimensions	With Music Rack Raised, 37-3/4" Wide, 21-1/8" Deep, 42-3/8" High. With Music Rack Down 35-1/4" High.
Finish	Modern Walnut
AC Input	117 or 234 Volts, 155 to 160 Watts 50 or 60 Cycles
Weight	161 Lbs.

Instruments Above Serial No. 8556 Do Not Have Vibrato Pedal

EXTRAVOICE ORGAN BY HAMMOND
(Model F100)

The Extravoice by Hammond is a new and somewhat different instrument as compared to Hammond Organs produced heretofore.

The single 52 note keyboard controls the output of three independent tone generating systems. The 12 bass pedals are served by an additional tone generator. This operation will be covered in detail in this manual.

The Extravoice is self-contained (with provisions for attaching special tone cabinets if required). It has 12 bass pedals, 24 stop tablets for controlling the character of tones produced, and three rotating controls on each end of the keyboard for controlling various features.

A knee-operated expression control regulates the volume of the entire instrument. A single short pedal will turn the vibrato on or off; it is operated by the right foot.

INSTALLATION AND MAINTENANCE

To install the Extravoice it is necessary only to raise the music rack, and to plug the line cord into a wall outlet. The power source must be alternating current of the approximate voltage and frequency indicated on the name plate. The frequency need not be constant, but must remain within the indicated range. Oiling is not required.

MUSICAL TERMS

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

Notes and Octaves

Keyboard instruments are divided into "octaves" of 12 keys or notes, each with 7 "naturals" (white keys) and 5 "sharps" or "flats" (black keys) in a definite sequence. The pitch or frequency increases smoothly from left to right on the keyboard, and each note has a frequency twice that of the corresponding note in the next lower octave. Figure 2 shows the appearance of a typical octave of keys. The octave shown starts with C, but an octave may start with any key.

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 6 percent greater than the frequency of the next one below it. The musical interval between any two adjacent keys is called a semitone. Each white key is called by a letter from A to G. A black key may be called a "sharp" of the note below it or a "flat" of the note above it; for instance, the black key between C and D may be called C# (C sharp) or D^b (D flat).

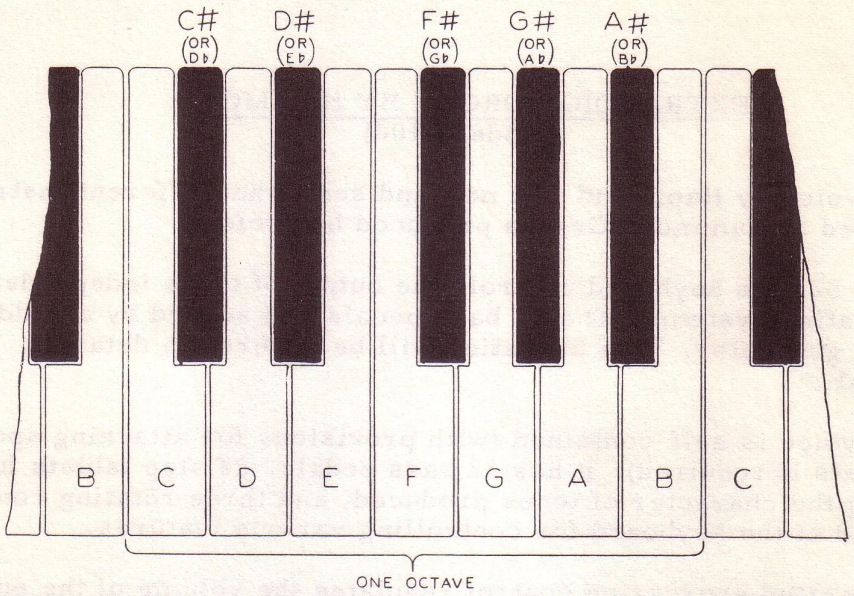


FIGURE 2 - ARRANGEMENT OF PLAYING KEYS IN AN OCTAVE

Tone Qualities

Any musical note has a definite fundamental pitch or frequency and also a certain "tone quality" or "timbre" depending on its wave shape. A simple flute-like tone contains only a single frequency. A complex tone includes not only the fundamental frequency but also one or more "harmonics" or "overtones", which are multiples of the fundamental frequency. The ear does not distinguish the harmonics independently, but instead identifies the note as a complex tone having the pitch of the fundamental.

Melody and Accompaniment

Music requires not only a melody (one note played at a time) but also an accompaniment consisting of additional notes which are in harmony with the melody. A group of notes which blend harmoniously when played together is called a chord.

Attack, Decay, Percussion, and Sustain

"Attack" describes the promptness with which a note sounds after a key is pressed, and "decay" describes the rate at which it fades away. "Percussion" describes a note that sounds with fast attack and gradually fades away while the key is held down, such as a piano note or chime. "Sustained" notes do not fade away but remain at constant loudness.

Vibrato

The vibrato effect is created by a periodic raising and lowering of pitch at a rate of about six times a second. It is comparable to the effect produced when a violinist "wiggles" his finger back and forth on a string while playing, varying the pitch but maintaining constant loudness.

MAKING THE EXTRAVOICE PLAY

The organ is turned on by actuating the on-off switch at the upper left. Volume is increased by swinging the expression control lever down and pushing it to the right.

Musical Divisions

The "Extravoice" division is played by the keyboard, and is used for playing a melody with the right hand. This division plays only one note at a time. If several keys are played at once, only the highest note will sound.

The "Treble" division is independent of the Extravoice division but is played by the same keys. Its notes augment those of the Extravoice division and also make it possible to play full chords.

The "Accompaniment" division is independent of the treble and other divisions, and, as the name implies, provides a means of playing accompaniment chords and counter melodies.

The "Pedal" division has 12 pedals (C to B) which provide bass notes. Only one pedal note can be called upon at a time because of the sustaining circuit employed.

Rotating Controls

"Maximum Volume" adjusts the maximum level of the entire instrument. It is normally left in horizontal position. For small living rooms it should be turned down to retain the full range of expression.

"Accompaniment Melody Lead" adjusts the volume balance between the Treble and Accompaniment divisions of the manual after pressing the "Accompaniment Melody Lead" tablet. The purpose of this is to permit the player to shift the melody to the accompaniment division.

"Extravoice Volume" regulates the volume of the Extravoice division relative to the other division of the organ. Normally it is horizontal but for special emphasis can be advanced.

"Pedal Volume" adjusts volume of the pedals relative to other divisions.

"Pedal Sustain" permits varying decay times for the pedals.

"Extravoice Percussion Time" makes longer or shorter decay time available for the Extravoice division.

Control Tablets

The twenty-four stop tablets control range, tone quality, vibrato, attack, and decay, in conjunction with the rotating controls. A tablet is "on" for the effect indicated on it when it is pressed down.

"Accompaniment Flutes", "Accompaniment Strings", "Accompaniment Reeds" (Tan)

These stops control the tones of the lower portion of the keyboard (from left end to arrow under the "Extravoice Deep Tone" stop). The Accompaniment Flute stop provides very mellow and pure tones, Accompaniment Strings produces bright tones similar to strings in an orchestra, Accompaniment Reeds provides a brilliant and piercing tone quality. One or more of these stops is always used.

"Bright Tone", Accompaniment Melody Lead" (Blue)

The Bright Tone tablet will make all tones of the organ more brilliant. Accompaniment Melody Lead will cause a melody played on the Accompaniment Division to stand out from the other divisions, to the degree that the control knob with the same legend has been advanced.

"Treble Flutes", "Treble Strings", "Treble Reeds" (Yellow)

These control the upper portion of the keyboard above the range of the TAN tablets. One of these is always used, and they correspond in tone quality to the accompaniment tablets.

Extravoice Stops (two lower groups of 4 white tablets)

The operation of the Extravoice portion requires that at least one Timbre stop ("Deep Tone", "Full Tone", "Brilliant", "Resonator") and at least one Register stop ("Contra Bass", "Sub Octave", "Unison", "Super Octave") be used. Having depressed at least one each, it will be playable down to A# or to the right of the grey keys.

The Extravoice Register Stops control the pitch range of this division. "Contra Bass" causes the Extravoice to sound two octaves below the Treble division, "Sub Octave" moves it up one octave, "Unison" brings it to the same pitch, and "Super Octave" makes the pitch one octave above the Treble.

The Extravoice Timbre Stops alter the frequency characteristic of this division to modify the quality of tones selected by the register stops. "Deep Tone" emphasizes the low frequencies to provide a pure mellow type of tone while "Full Tone" leaves the frequency essentially flat and gives a generally useful bright quality. "Brilliant" emphasizes the higher frequencies and gives a piercing quality. "Resonator" emphasizes a group of overtones characteristic of brass type instruments.

Tablets in these two groups can be combined to produce a great variety of effects.

Extravoice "Extension B" and "Extension G" (Grey)

As the name implies these tablets extend the range of the Extravoice Division to include all a part of the grey keys.

"Extravoice Woodwinds" (White)

This tone tablet changes the string-like tones of the Extravoice division to hollow-sounding tones of the woodwind or clarinet family.

"Extravoice Fast Attack and Long Percussion Time", "Extravoice Percussion" (White)

When neither control is used, the tonal attack of the Extravoice division is very smooth and is well-suited for playing slow-moving melodies such as ballads. When only "Extravoice Fast Attack and Long Percussion Time" is used, the attack becomes very prompt and is useful for fast-moving melodies. When only "Extravoice Percussion" is used, the attack is percussive and the note fades away (while key is held down) at a comparatively rapid rate. When "Extravoice Fast Attack and Long Percussion Time" is used with "Extravoice Percussion" the note fades away more slowly. In both cases the exact rate of fading away is dependent on the setting of the "Extravoice Percussion Time" rotary control.

Vibrato Tablets (Red)

"Extravoice Small Vibrato" adds a small amount of vibrato to that division while "Extravoice Wide Vibrato" has a greater effect. Using both, the maximum vibrato effect will be obtained. The "Accompaniment and Treble Vibrato" tablet adds vibrato to these two divisions. A Vibrato Pedal, played with the right foot, will add full vibrato to all divisions regardless of setting of the vibrato tablets.

HOW THE EXTRAVOICE ORGAN BY HAMMOND WORKS

All tones of the Extravoice Organ are generated by vacuum tube oscillators and are mixed and amplified by additional vacuum tube circuits. Figure 3 is a simplified block diagram of the entire instrument.

As indicated in Figure 3, the playing keys control the Extravoice, accompaniment, and treble generating systems. Tones from any or all systems may sound, depending on the setting of the corresponding control tablets and knobs.

Pedal tones are generated by their own oscillator system, controlled by the pedals. These tones are capable of being mixed with the keyboard-controlled tones by proper adjustment of the pedal controls.

All tones are combined in the amplifier section and are regulated in volume by the expression pedal before energizing the speaker.

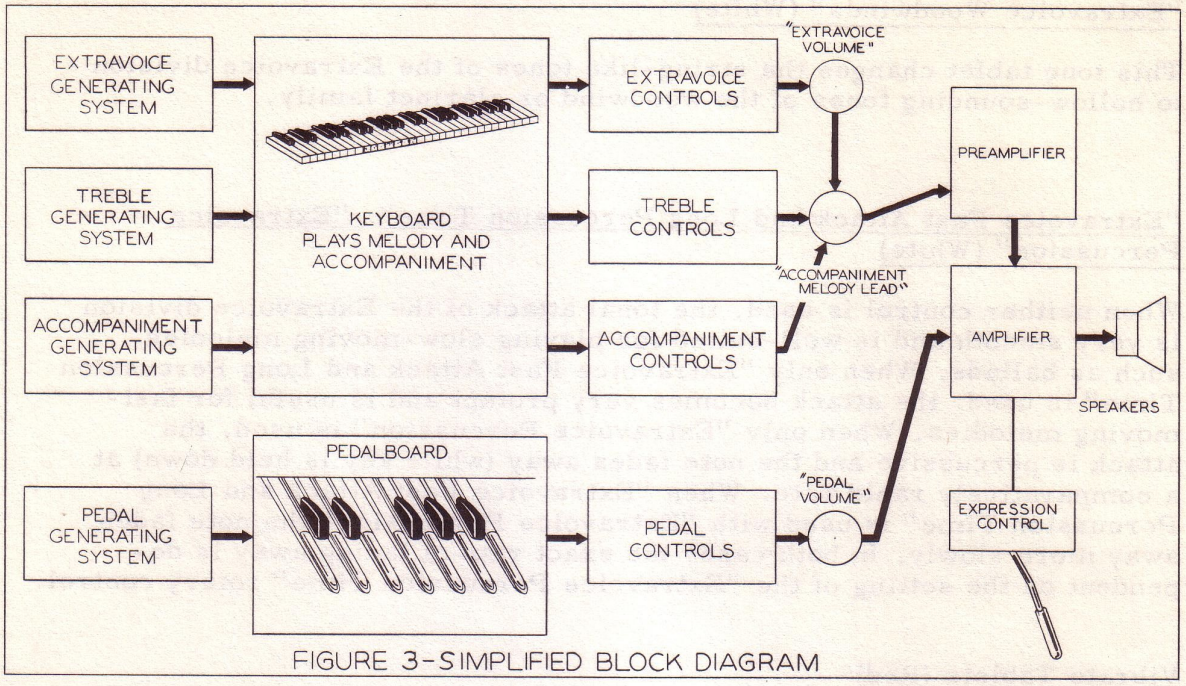


FIGURE 3-SIMPLIFIED BLOCK DIAGRAM

Fig. 3 SIMPLIFIED BLOCK DIAGRAM

DESCRIPTION OF ELECTRICAL CIRCUITS

When studying this section refer to the complete block diagram, figure 4, in which the parts are connected by arrows showing the signal paths. Controlling circuits are indicated by lines without arrows. The schematic circuit diagram, figure 8, shows all circuits in detail. It will be found helpful also to refer to the wiring diagram, figures 9, and 10, which shows cables and other connections between parts of the instrument. Figures 8, 9 and 10 are foldout pages in the rear of this book.

Keyboard

Four sets of contact springs are operated by the playing keys; tuning contacts and control contacts for the "Extravoice" division, plus tuning contacts and control contacts for the Accompaniment and Treble divisions. These four rows of springs make contact with four busbars extending the length of the keyboard. Some keys use four contacts and some use only three, as shown in the schematic diagram. The tuning contact of each division always closes, tuning to the desired note, before the control contact of that division closes and causes the note to sound.

The control contacts of the Accompaniment and Treble divisions start the oscillators, by connecting them with the high voltage supply, only when the key is pressed. The control contacts of the Extravoice division remove the cut-off bias from the control tubes causing that division to sound.

The busbars are movable a short distance endwise, and a slotted stud under the keyboard can be turned to provide a fresh contact surface in case a particle of dust prevents a contact from closing.

Vibrato

A single low frequency oscillator provides the vibrato effect for the entire instrument. It is composed of a triode tube in a phase shift circuit (see left end of schematic), giving a frequency of about 6 cycles per second. The vibrato switch tube has a square wave output and its plate circuit acts as a switch to connect and disconnect small condensers across the Extravoice oscillator tuned circuit. The two Extravoice vibrato tablets connect compensating condensers when the vibrato is "off" in order to maintain the correct mean frequency with the vibrato on or off.

The Accompaniment and Treble divisions receive their vibrato from the same vibrato oscillator and switch tube, but in opposite phase. The vibrato effect is achieved by applying a varying bias voltage to the grid resistor of each oscillator tube. Since the grid capacitors are current-limiting, this varies the frequency of all the oscillators.

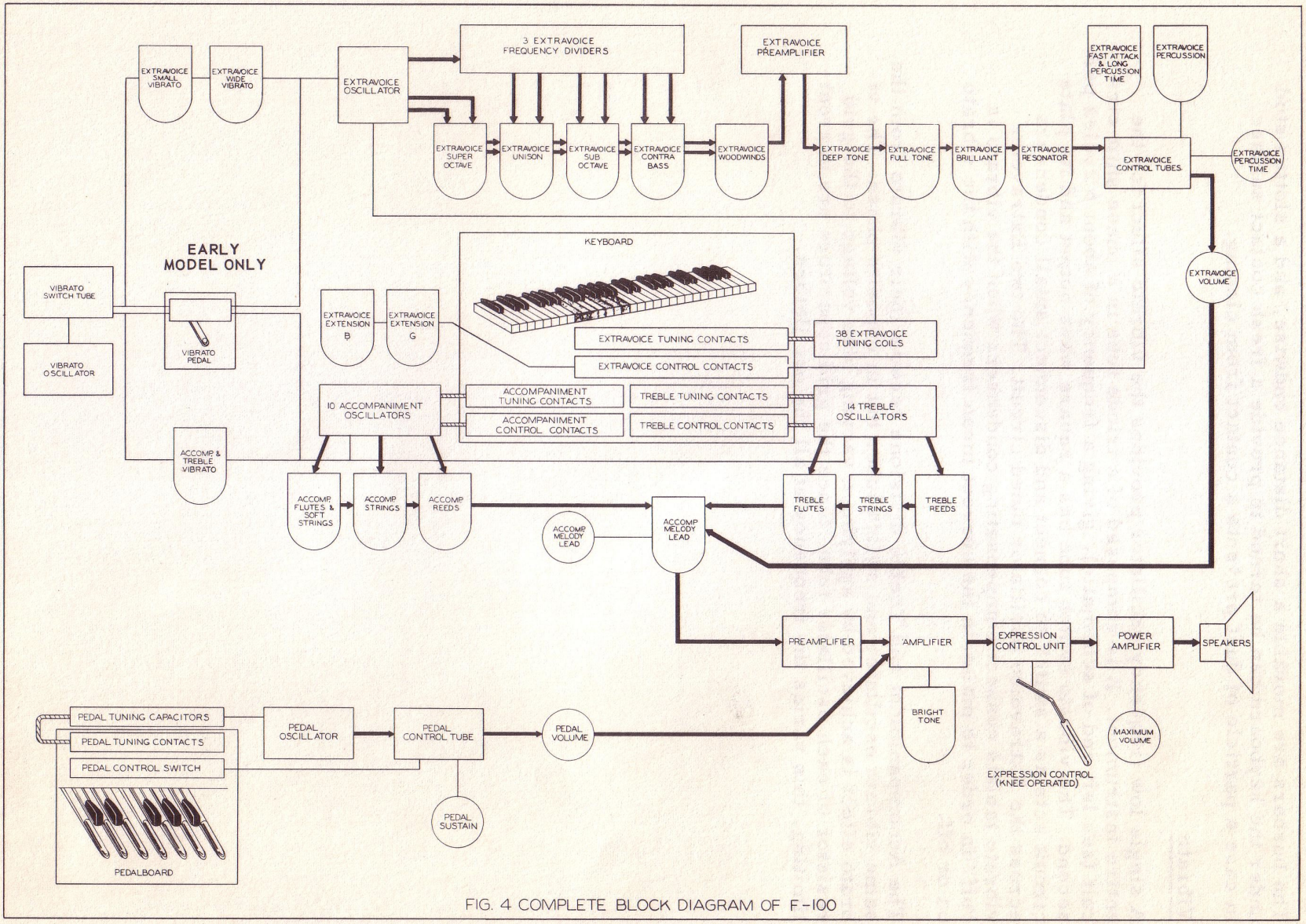


FIG. 4 COMPLETE BLOCK DIAGRAM OF F-100

Extravoice Oscillator

The Extravoice oscillator is a tuned-grid sine wave oscillator with positive feedback over two stages. Each Extravoice tuning contact tunes the oscillator to the pitch of the "Super Octave" note associated with that key. When the lowest Extravoice note (key 15) is played, all 38 adjustable tuning coils are connected in series to form the total grid circuit tuning inductance. When any other key is pressed, its tuning contact shorts out some of the coils (making less total inductance) and thus tunes the oscillator to the higher pitch associated with that note. If two keys are pressed, the oscillator sounds only the pitch at the higher key. The frequency range of the oscillator is 494 to 4189 cycles per second. All Extravoice notes are simultaneously tuned by a slotted shaft on the generator, which shunts small capacitors across the oscillator.

Extravoice Frequency Dividers and Register Controls

The three Extravoice frequency dividers supply the "Unison" tone (from the first divider), "Sub Octave" tone (from the second) and "Contra Bass" tone (from the third).

Each divider supplies two signals of the same frequency but different wave shape. After passing through suitable tone filter circuits, the two sets of signals furnish tones of the woodwind family if the "Extravoice Woodwinds" tablet is on, or of the string family, if this tablet is off.

Each divider includes three triodes. One of the triodes acts as a driver and pulse rectifier, supplying short and narrow negative pulses to actuate a symmetrical feed-back tripping circuit comprising two triodes. Either one (but only one) of these two triodes can be conducting at a time, for by drawing plate current it holds the other in a cut-off condition.

Suppose, for example, that the first triode is conducting and the second is cut off. Now a negative input pulse, impressed on the grids of both triodes, will not affect the second one, which is already cut off, but will cut off the first. This produces a positive pulse at the plate of the first triode, which is applied to the grid of the second triode through its feedback connection. The second triode then suddenly conducts current, producing a negative pulse at its plate. This negative pulse, applied to the first triode grid through its feedback connection, insures that the first triode remains cut off. The situation is now exactly reversed, with the first triode cut off and the second conducting.

The next input pulse will act on the second triode, cutting it off again and making the first conductive; and thus two input cycles are required to produce one output cycle. Each frequency divider circuit therefore divides its input frequency in half, producing an output signal one octave lower than the preceding divider. One triode plate of each divider stage furnishes a signal of rectangular wave shape to the following driver tube, and output signals are taken from the driver and divider plates.

Extravoice Tone Controls

After preliminary amplification the solo signal reaches the four timbre or tone controls, which are in series across the signal line. When "Deep

Tone" is on, the signal develops across a condenser which emphasizes the low frequencies; "Full Tone" has only a resistor, which leaves the frequency response essentially flat; "Resonator" involves a resonant circuit which peaks near 2000 cycles; and for "Brilliant" the signal appears across an inductance, emphasizing the higher frequencies.

When both Resonator and Brilliant tablets are on, a higher resonance effect (about 3500 C.P.S.) is observed, since a small capacitor is shunted across the brilliant coil. Each control tablet, except Brilliant, has a second contact connected in a volume compensating circuit to avoid excessive increase in volume when two or more controls are used at once.

Extravoice Control Tubes

The Extravoice input transformer T1 drives two control (or Keying) tubes in push-pull. These are pentodes and are normally cut off because their grid circuit is at about + 5 volts while their cathodes are held at about + 37 volts by a voltage divider composed of R89, R90, and R91. Whenever a key is pressed, an Extravoice control contact grounds this voltage divider, removing the cut-off bias and causing the note to sound.

When the "Extravoice Fast Attack and Long Percussion Time" tablet is off, condenser C53 makes the attack comparatively slow because a sudden decrease in the positive cathode voltage (caused by pressing a key) causes a negative surge through the condenser, charges C52 negatively, and moves the grid voltage temporatily in the negative direction. This maintains the cut-off condition for an instant after the key is pressed, until the charge in C52 leaks off through R81.

With the "Extravoice Fast Attack and Long Percussion Time" tablet on, C53 is disconnected and the attack is comparatively fast.

Extravoice Percussion

When the "Extravoice Percussion" tablet is on and a key is pressed, the control tubes are turned on by removing the cutoff voltage from their cathodes and the note first sounds loudly; then a charging condenser C52 in the control tube grid circuit causes the signal to fade away at a predetermined rate depending on the setting of the "Extravoice Percussion Time" control. When this control (R87) is maximum left, and a key is pressed, the signal turns off almost instantly since the time for C52 and the control tube grids to reach cut-off is very short. When the percussion time control is maximum right, the time for C52 and the control tube grids to reach cut-off is about 3 seconds.

If the "Fast Attack and Long Percussion Time" tablet is turned "on" (with Percussion on) the decay time is about 3 seconds if percussion time control is maximum left; the decay time is about 6 seconds if percussion time control is maximum right.

This percussion circuit operates as follows. With no key pressed, the control tubes are cut off because their grids are at about + 5 volts and the cathodes are at about + 37 volts. When a key is pressed, the + 37 volts on the cathodes drops to about + 5 volts and the control tubes

conduct until C52 charges through R85 and R87 to about – 30 volts which cuts them off. The time it takes C52 to reach this cutoff voltage is the percussion decay time. The note no longer sounds, and it will not sound again until after all keys are released. When all keys are released, the control tube cathodes quickly rise to + 37 volts (cutoff). Simultaneously the control tube grids return to + 5 volts.

The percussion circuit uses three diodes in one tube. One is a rectifier for a separate ungrounded 30 volt supply. The other two are clamp and switch diodes which maintain a constant + 5 volt potential on the control tube grids until a key is pressed.

When a key is pressed the plates of the clamp and switch diodes are reduced to – 30 volts, making them both non-conducting and leaving C52 free to charge as described above.

The signal from the control tube plates passes through the "Extravoice Volume" control to the amplifier.

Accompaniment and Treble Oscillators

Each of these oscillators (10 accompaniment and 14 treble) uses a single triode and tapped coil. Twenty of them are used for two adjacent notes each, and two each at the high and low ends of the keyboard play three adjacent notes. It happens that adjacent notes are almost never desired to be played together, and this arrangement enables the 24 oscillators to supply the 52 organ notes for the keyboard. The frequencies of these notes range from 110 to 2092 cycles.

In each case the highest note is produced by a tuning condenser connected permanently across the entire tuning coil, and so the highest note of each oscillator requires no tuning contact. The oscillator does not operate, however, unless a key is pressed, for the control contact of each key supplies plate voltage to its oscillator.

For the lower note of each oscillator, the tuning contact connects a second condenser across the lower part of the tuning coil. The coil tap is so located that this condenser may have the same capacity as the one permanently connected across the coil.

In the case of the top and bottom two oscillators, serving three notes each, the middle tuning contact connects a third condenser in series with the one connected to the tap. This third condenser has a small resistor in series so that all three condensers may be of equal capacity.

The tuning busbar is divided between F# and G near the center of the keyboard to provide independent tones from the accompaniment and treble sections of the keyboard.

Each coil may be tuned by sliding half of the iron core toward or away from the other half, as described under "Tuning".

Accompaniment and Treble Control Tablets

Three types of tone are supplied by each oscillator and selected by the flute, string and reed tablets. The string signal comes from the lower end of the tuning coils of all the oscillators; the reed tone is actually a "bright string" obtained from the string signal passing through a current-limiting capacitor. The flute signal comes through a decoupling resistor from the upper end of each tuning coil.

Accompaniment Melody Lead

The "Accompaniment Melody Lead" tablet increases the playing flexibility of the instrument by increasing the accompaniment volume and decreasing the treble volume so that melodies can be played on the accompaniment portion of the keyboard. The amount by which the Accompaniment division stands out over the other divisions is controllable with the "Accompaniment Melody Lead" knob.

Bass Pedals

The twelve playing pedals are operated by the left foot and are connected to the pedal oscillator. Like the manuals they have light and dark keys arranged in a standard octave pattern.

A tuning contact on each pedal opens when a pedal is depressed and inserts a resultant capacity across the pedal oscillator, tuning it to the desired frequency. In addition there is a "pedal control contact" for all pedals which closes when the pedal is depressed. It serves to turn on the pedal amplifier, causing the note to sound at the desired rate and volume in accordance with the setting of the "Pedal Sustain" and "Pedal Volume" knobs.

When a pedal is pressed its tuning contact opens first, tuning the oscillator to the correct note. Immediately the pedal control contact closes, causing the note to sound. When the pedal is released a mechnical latch keeps the tuning contact open so that the last-played pedal note continues to sound for a length of time determined by the setting of the "Pedal Sustain" control.

Pedal Oscillator

The pedal oscillator is a tuned-grid sine wave oscillator with positive feedback over two stages. The frequency range is 44 to 82 CPS. The lowest frequency is pedal F which has no tuning contact but does activate the pedal control circuit. The frequency of the oscillator is varied as mentioned above. For further understanding of this refer to the schematic diagram. All pedal notes are simultaneously tuned by a slotted shaft on the generator, which moves part of the core of the tuning coil.

Pedal Control Tube

When the pedal control contact is closed by pressing a pedal, the cut-off bias is removed from the control tube by raising the positive DC

grid voltage to within 20 volts of the cathode voltage; the note then sounds with a controlled rate of attack as determined by C216 and R222. When the pedal is released, the tube is cut off again as the current through R224 and R225 charges condenser C216.

When the "Pedal Sustain" control is maximum left, the tube cuts off very rapidly as the resistance in this leak path is greatly reduced, allowing the condenser to charge to the cut-off voltage sooner. When the control is maximum right, the tube cuts off slowly and the signal takes about three seconds to fade away.

Preamplifier

Signals from all oscillators with the exception of the pedal oscillator are fed to the preamplifier circuit (V26B). This is a resistance coupled stage providing a signal level suitable for input to the amplifier.

Amplifier, Expression Control and Output Stage

A resistor-capacitor-coupled amplifier precedes the expression control. This stage also accepts the signal from the pedal oscillator. It is followed by the "Bright Tone" tablet, which removes a small condenser shunted across the signal line.

The expression control unit is a variable air condenser, consisting of two sets of fixed plates and a set of movable plates coupled to the knee-operated expression control lever, which regulates the volume of the entire instrument.

With the lever in "loud" position, the signal goes directly through the unit, while in "soft" position it goes through a tone-compensated attenuating network. The movable plates of the expression control unit connect to the input of tube V27, a common-cathode-impedance phase inverter, which drives the push-pull output tubes. The "Maximum Volume" control operates by varying the amount of feedback.

Power Supply

The power supply circuit is conventional in design, using resistance-capacity filters.

TUNING THE EXTRAVOICE

Tuning Instructions

The Extravoice Organ has been accurately tuned before leaving the factory and can be expected to remain in tune indefinitely under normal circumstances. However, after long use under extremely adverse humidity conditions, it is possible that some notes may not be exactly in tune with each other. Before concluding that retuning is necessary, be absolutely sure that the notes are actually far enough out of tune to make them unsatisfactory. Remember that small differences in tuning are highly desirable because they add a "chorus effect" which gives added richness to the tone. This "chorus effect" accounts for the tonal beauty of large choirs of singing voices or of many violins playing in unison.

The Extravoice Organ may be tuned in several different ways. The simplest tuning may be done by merely turning the Extravoice Tuning Switch which is inside at the back on the main chassis. See Schematic drawing, which also shows layout of generator and organ oscillator chassis.

Adjustment of Extravoice Tuning Switch

To make this adjustment, turn organ on and allow to warm up approximately 15 minutes. Set up the following registration of stops (with the wording of the rotating controls horizontal): Accompaniment Strings, Treble Strings, Extravoice Extension "B", Extravoice Full Tone, Extravoice Unison. Now press the middle A# key on the keyboard (11th black key from the left end). When this key is pressed, two different notes will be heard together. They are close together, and the object is to bring them exactly together, so they sound like one good note. A screwdriver will be required for this tuning operation.

As they get closer, you will hear a "beating" sound. The beats get slower and slower as the two notes get closer and closer, and stop completely when perfectly tuned. Merely find the position of the Extravoice Tuning Switch where the beat rate is the slowest.

After you have followed the above procedure you may wish to check the tuning on other notes of the keyboard. Do not be surprised if some notes tune with the tuning switch set one or two steps higher or lower than the setting for the middle A# key. This is of no consequence because one step only changes the tuning by one twelfth of a semitone. This change in pitch is so small that it can only be detected by the "beats" which can be heard when the tone is sounded along with another note. You will not be able to check notes to the left of the grey keys as only one signal is present on these. Detailed instructions further on in this book describe the checking of these notes.

Tuning of Accompaniment and Treble Divisions

If, after tuning as above described, it is considered that some notes are far enough out of tune to be unsatisfactory, the individual notes of the keyboard may be tuned also as described below. The tuning should

be acceptable when the beat rate of the grey key section does not exceed 10 beats in 5 seconds, and the beat rate of the notes to the right of the grey keys does not exceed 15 beats in 5 seconds.

The various notes of the keyboard may be individually tuned by adjusting the coils located in the lower chassis. As shown on the schematic each coil is marked with a series of numbers indicating to which keys it supplies notes.

It is to be observed that there are more notes on the keyboard than there are coils. Each coil simultaneously tunes at least two adjacent notes on the keyboard and four of the coils tune three adjacent notes. For example, the three lowest notes on the keyboard A, A# and B are all tuned by the coil marked "1, 2, 3". Thus, if there is any particular note (or group of adjacent notes) on the keyboard which seems to be out of tune, you can determine which coil to tune by relating the key number with the coil bearing that number. Steps 1, 2, 3, 4 and 5 below explain how to tune the keyboard notes.

STEP 1. Adjust Extravoice Tuning Switch as described above. This consists in finding the setting of the tuning switch which gives the slowest rate of beats on Middle A# as explained previously. Mark this setting with a pencil on chassis.

The object is to tune various notes, in the manner described below, so that each one is best on this same setting.

STEP 2. Press 2nd lowest "C" key on the keyboard (key 16) and wedge it down with a pencil at the back of the key so that the note will continue to sound. Hold the expression control in a position to secure adquate volume (for instance, by placing a chair against it). If the "beats" are very slow, this coil does not require tuning adjustment.

If in doubt, turn the tuning switch one step either way from your marked point. If you must go two or more steps in either direction to find the best tuning, then that particular note needs tuning. Otherwise not.

If you decide to tune that note, place the tuning switch back on your marked position.

STEP 3. If the tuning in step 2 was not satisfactory, it is remedied by an adjustment of the position of the iron in one particular coil in the Lower Chassis, in this case coil marked 15 - 16.

The position of the iron laminations in the coils is easily adjusted with great accuracy, provided the construction of these units is understood. BEFORE DOING ANY ADJUSTING, HOWEVER, BE SURE THAT THE TUNING SWITCH IS SET AT POSITION YOU MARKED.

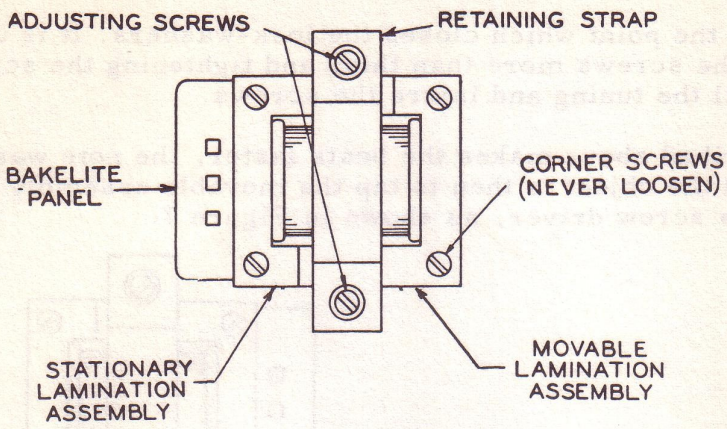


Figure 5

Figure 5 shows a typical coil and lamination assembly in the Lower Chassis. The movable lamination assembly is to the right, and the stationary assembly is to the left. The two assemblies are held in place by a retaining strap, secured by the two adjustment screws.

Never loosen the corner screws on any coil.

In order to tune, first loosen the two adjustment screws holding the strap by two or three turns, but not more. A plain washer and a strong split-steel lock-washer are located under the head of each screw. The object is to loosen the two screws to the point where each lock-washer is partly open but still exerts a moderate pressure to hold the assembly in place. In this condition the laminations cannot readily be moved with the fingers, but may be tapped with a small hammer or similar hard object. Each small tap moves the movable assembly by an invisibly small amount which is nevertheless entirely adequate to change the tuning, and makes very precise tuning possible.

To lower the pitch, that is make the note more flat, tap on the right end of the laminations, as shown in Figure 6.

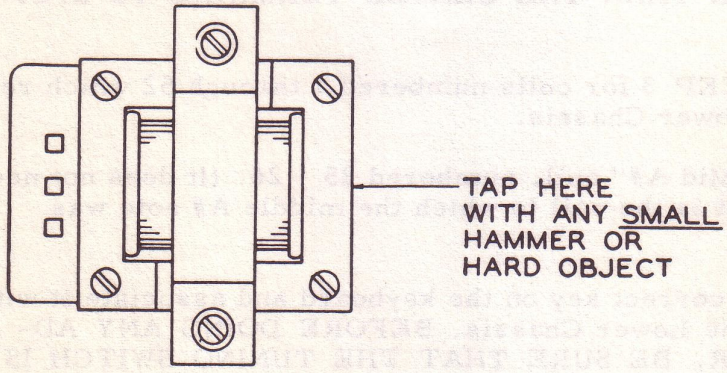


Figure 6

If the note being tuned was too sharp in the first place, each small tap will make the beats slower. When the beats stop, tighten the screws

gently, but only to the point which closes the lock-washers. It is unnecessary to tighten the screws more than this, and tightening the screws too much may spoil the tuning and injure the screws.

If tapping as described above makes the beats faster, the note was already too flat, and the object is then to tap the movable assembly away. This is done with a screw driver, as shown in Figure 7.

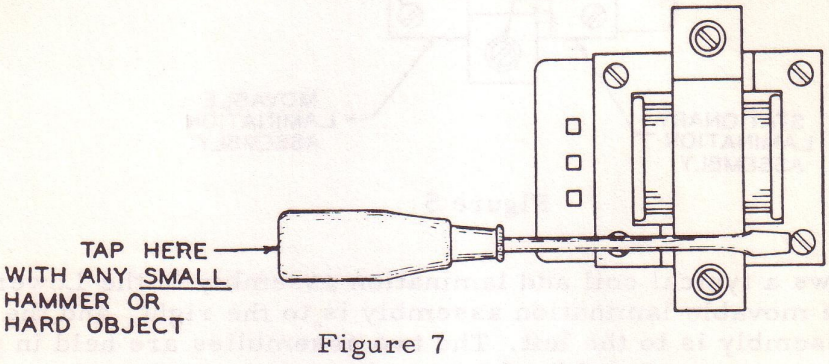


Figure 7

Holding the screw driver against the side of one of the right corner screws, tap gently on the end of the handle of the screw driver and listen to the beat rate. Do not use the same corner screw all the time, but alternate between the two right screws. Tapping on the screw driver in this position makes the note sharper. Very little practice is necessary to find out how to tune in this manner.

> Note: It is important not to make the mistake of tapping a coil which is not associated with the note to which one is listening. To avoid this mistake, it is a good idea to touch the end of the screw driver to the MIDDLE terminal on the bakelite panel, at the same time touching the side of the screw driver to the iron laminations, so as to connect this terminal to the iron lamination. If it is the correct note, a sudden reduction in volume will be heard. HOWEVER, BE SURE NOT TO TOUCH OTHER THAN THE CENTER TERMINAL TO STOP THE NOTE.

STEP 4. Repeat STEP 3 for coils numbered 1 through 52 which require tuning in the Lower Chassis.

Do NOT adjust the "Mid A#" coil, numbered 25 - 26. (It does not need adjustment because it is the coil to which the middle A# note was tuned in STEP 1.)

Each time press the correct key on the keyboard and associate it with the coil marked on the Lower Chassis. BEFORE DOING ANY ADJUSTING, HOWEVER, BE SURE THAT THE TUNING SWITCH IS SET AT POSITION YOU MARKED.

STEP 5. Because of the construction of the Extravoice Organ, tuning of coils 1 through 14 (notes lowest A through A# one octave up), requires a somewhat different procedure.

Assuming the notes 15 through 52 are now in tune, having followed steps 1 through 4, this lowest octave is tuned against 2nd octave up, keys 25 through 38, using the following registration:

Accompaniment Strings, Extravoice Extension "B", Deep Tone, Extravoice Woodwinds, Extravoice Contra Bass. Hold down similar keys in each octave. If the beat indicates an out of tune condition on one note, the appropriate coil should be adjusted.

WARNING -- Remember the only coils adjusted in this step are those numbered 1 through 14.

STEP 6. Tuning the pedal notes of the Extravoice Organ requires only the adjustment of the knurled slotted knob to the left of the large coil at the right lower end of the upper chassis. If tuning is required, set up the following registration:

Extravoice extension "B", Extravoice Deep Tone, Extravoice Contra Bass.

Hold down "B" key in grey section and "B" pedal. Turn tuning knob as required, clockwise or counterclockwise.

TUNING THE EXTRAVOICE WITH AO 26 CHORD ORGAN TUNING STANDARD

1. Tuning of greater accuracy can be performed by use of the AO 26 Chord Tuning Standard available from the Hammond Organ Service Department. To use the AO 26, turn on the Extravoice Organ and Standard to warm up at least 15 minutes. If Standard has been kept at temperatures below freezing, increase warm-up time to 45 minutes.

2. Connect shielded wire from STANDARD into "Phono" input on Extravoice Organ. Note from STANDARD will be heard through Extravoice Organ speakers.

3. Connect oscilloscope terminals (vertical and ground) to "SCOPE" and "GND" terminals on STANDARD.

4. Connect the grey clip lead wire from STANDARD to either speaker voice coil terminal of Extravoice Organ.

5. To insure proper tuning of STANDARD, its "E" note should be compared with tuning fork. Turn NOTE SELECTOR to "E" and strike fork gently on a medium-hard (non-metallic) surface. Hold tuning fork with one tine near the ear. A beat will be heard between the tuning fork note and the "E" note of the TUNING STANDARD. If necessary, turn the "ADJ" screw (recessed in front panel) to give zero beat. This adjusts all 12 notes simultaneously.

   To ascertain quickly that zero beat is reached, observe that the two beat rates caused by moving the TUNING TOLERANCE lever to the "Sharp" and "Flat" positions are the same.

6. EXTRAVOICE SECTION: Remove top cover of Extravoice Organ, exposing Extravoice tuning coils. The generator and the control assembly cover must be in their normal positions. If coil numbers (from 1 to 38) are not legible, refer to Figure 9 for their location.

   Note: While any single Accompaniment or Treble oscillator of the Extravoice Organ can be tuned individually, no Extravoice note can be adjusted without affecting the ones below it. If any Extravoice note has to be retuned, it will be necessary to retune all Extravoice notes below it.

7. Observe setting of coil 38. End surface of coil bobbin should not be more than 1/32" from end of iron core; if it is, loosen clamping screw, slide coil carefully forward or backward until bobbin end is even with core, and tighten screw.

8. Raise all control tablets and then depress the Extravoice Extension "B", Extravoice Full Tone, Extravoice Woodwinds, Extravoice Unison.

9. Hold down highest key (C) of the Extravoice Organ and turn "Note Selector" on STANDARD to "C".

   The best beat pattern, now and throughout this procedure, is obtained when the Extravoice Organ note is made nearly equal in loudness to the STANDARD note.

   As noted above, to ascertain quickly that zero beat is reached, observe that the two beat rates caused by moving the TUNING TOLERANCE lever to the "sharp" and "flat" positions are the same. This method should be used throughout the procedure. This lever shifts the frequencies of the STANDARD both sharp and flat by one-third of one per cent which is the maximum allowable tuning error.

   When tuning low notes where beats are slow, they should be tuned to exact zero beat. For the very high notes where it is difficult to stop the beats, it is sufficient to tune within the limits shown by moving the TUNING TOLERANCE lever. When a note is beating slowly but is within tolerance, moving the TOLERANCE lever one way will make the pattern move faster (in the same direction) and moving the lever the other way will cause the beat pattern to reverse in direction.

10. Adjust Extravoice tuning switch to make beat pattern as slow as possible.

11. If pattern is moving more than one beat in two seconds, readjust coil 38 to bring it within this limit.

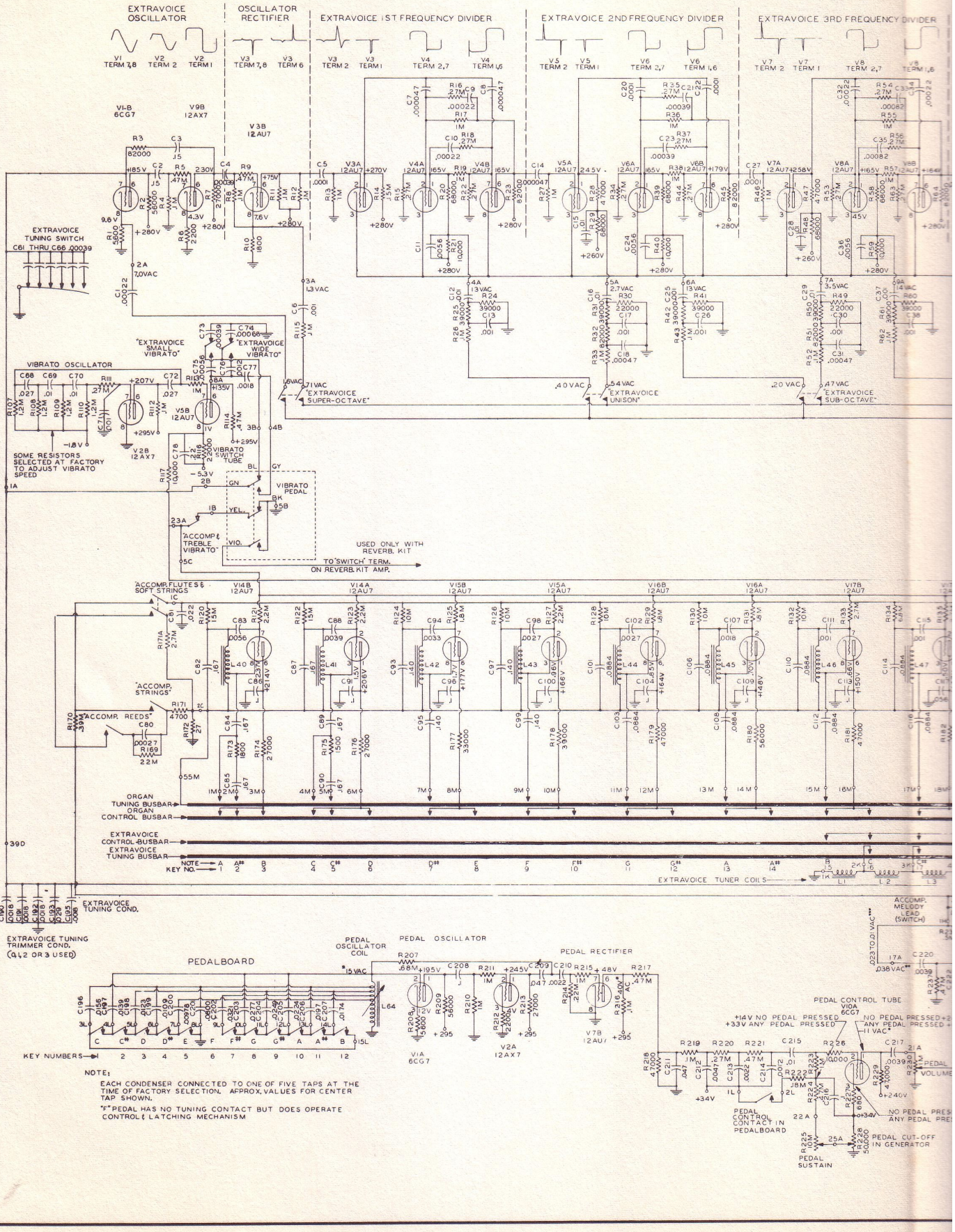
12. Release "C" key and hold down next lower key (B), turn STANDARD "note Selector" to "B" and adjust #37 coil to as near zero beat as possible.

13. Repeat for all other keys in chromatic order downward. After completing top 20 keys (down to "F"), the wave pattern may be improved by turning off Unison and turning on Super Octave. It is essential to start tuning with the highest note and progress down one key at a time, because the tuning of lower notes is dependent upon all of the higher coils. Proceed downward to lowest grey key (coil No. 1).

14. After tuning, re-check all notes to see that all coils are tuned accurately.

15. ACCOMPANIMENT AND TREBLE SECTION: Remove shielded wire from "Phono" input on Extravoice Organ and connect pigtail on shield lead to clip on back of generator chassis, and proceed as outlined in step 3 through 5, using oscilloscope to determine when note is in tune.

16. PEDAL SECTION: Tune as described in Step 6.


EXTRAVOICE OSCILLATOR
OSCILLATOR RECTIFIER
EXTRAVOICE 1ST FREQUENCY DIVIDER
EXTRAVOICE 2ND FREQUENCY DIVIDER
EXTRAVOICE 3RD FREQUENCY DIVIDER
V1 TERM 7,8
V2 TERM 2
V2 TERM 1
V3 TERM 7,8
V3 TERM 6
V3 TERM 2
V3 TERM 1
V4 TERM 2,7
V4 TERM 1,6
V5 TERM 2
V5 TERM 1
V6 TERM 2,7
V6 TERM 1,6
V7 TERM 2
V7 TERM 1
V8 TERM 2,7
V8 TERM 1,6
V1-B 6CG7
V9B 12AX7
V3B 12AU7
EXTRAVOICE TUNING SWITCH C61 THRU C66 .00039
"EXTRAVOICE SMALL VIBRATO"
"EXTRAVOICE WIDE VIBRATO"
VIBRATO OSCILLATOR
V5B 12AU7
V2B 12AX7
VIBRATO SWITCH TUBE
SOME RESISTORS SELECTED AT FACTORY TO ADJUST VIBRATO SPEED
VIBRATO PEDAL
"ACCOMP. TREBLE VIBRATO"
USED ONLY WITH REVERB. KIT
TO "SWITCH" TERM. ON REVERB. KIT AMP.
"EXTRAVOICE SUPER-OCTAVE"
"EXTRAVOICE UNISON"
"EXTRAVOICE SUB-OCTAVE"
"ACCOMP. FLUTES & SOFT STRINGS"
"ACCOMP. STRINGS"
"ACCOMP. REEDS"
ORGAN TUNING BUSBAR
ORGAN CONTROL BUSBAR
EXTRAVOICE CONTROL BUSBAR
EXTRAVOICE TUNING BUSBAR
EXTRAVOICE TUNER COILS
EXTRAVOICE TUNING COND.
EXTRAVOICE TUNING TRIMMER COND. (Q42 OR 3 USED)
PEDALBOARD
PEDAL OSCILLATOR COIL
PEDAL OSCILLATOR
PEDAL RECTIFIER
V1A 6CG7
V2A 12AX7
V7B 12AU7
PEDAL CONTROL TUBE V10A 6CG7
PEDAL CONTROL CONTACT IN PEDALBOARD
PEDAL SUSTAIN
PEDAL VOLUME
PEDAL CUT-OFF IN GENERATOR
ACCOMP. MELODY LEAD (SWITCH)
KEY NUMBERS
NOTE:
EACH CONDENSER CONNECTED TO ONE OF FIVE TAPS AT THE TIME OF FACTORY SELECTION. APPROX. VALUES FOR CENTER TAP SHOWN.
"F" PEDAL HAS NO TUNING CONTACT BUT DOES OPERATE CONTROL & LATCHING MECHANISM

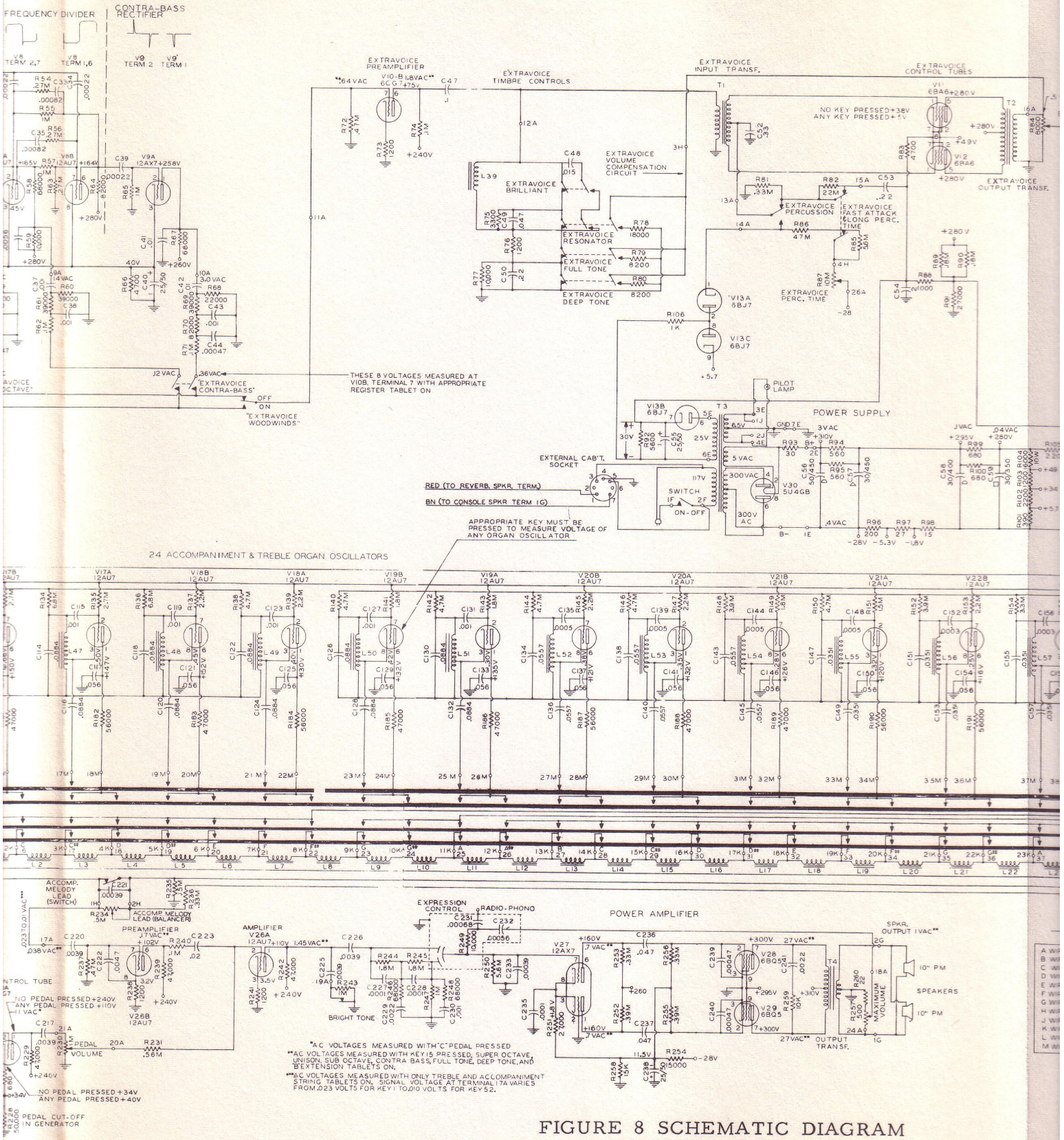
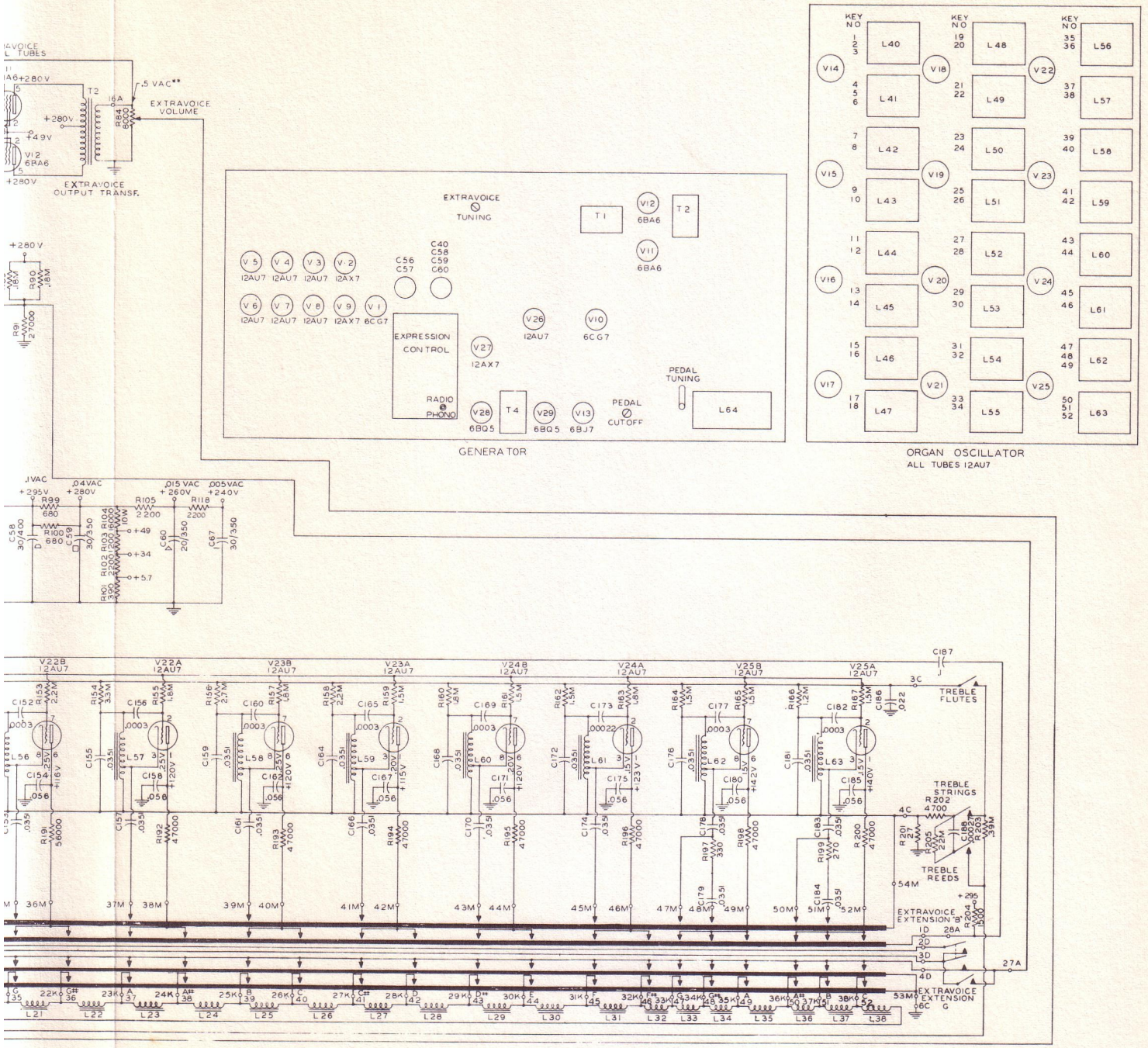


FIGURE 8 SCHEMATIC DIAGRAM
EXTRAVOICE ORGAN
MODEL F-100



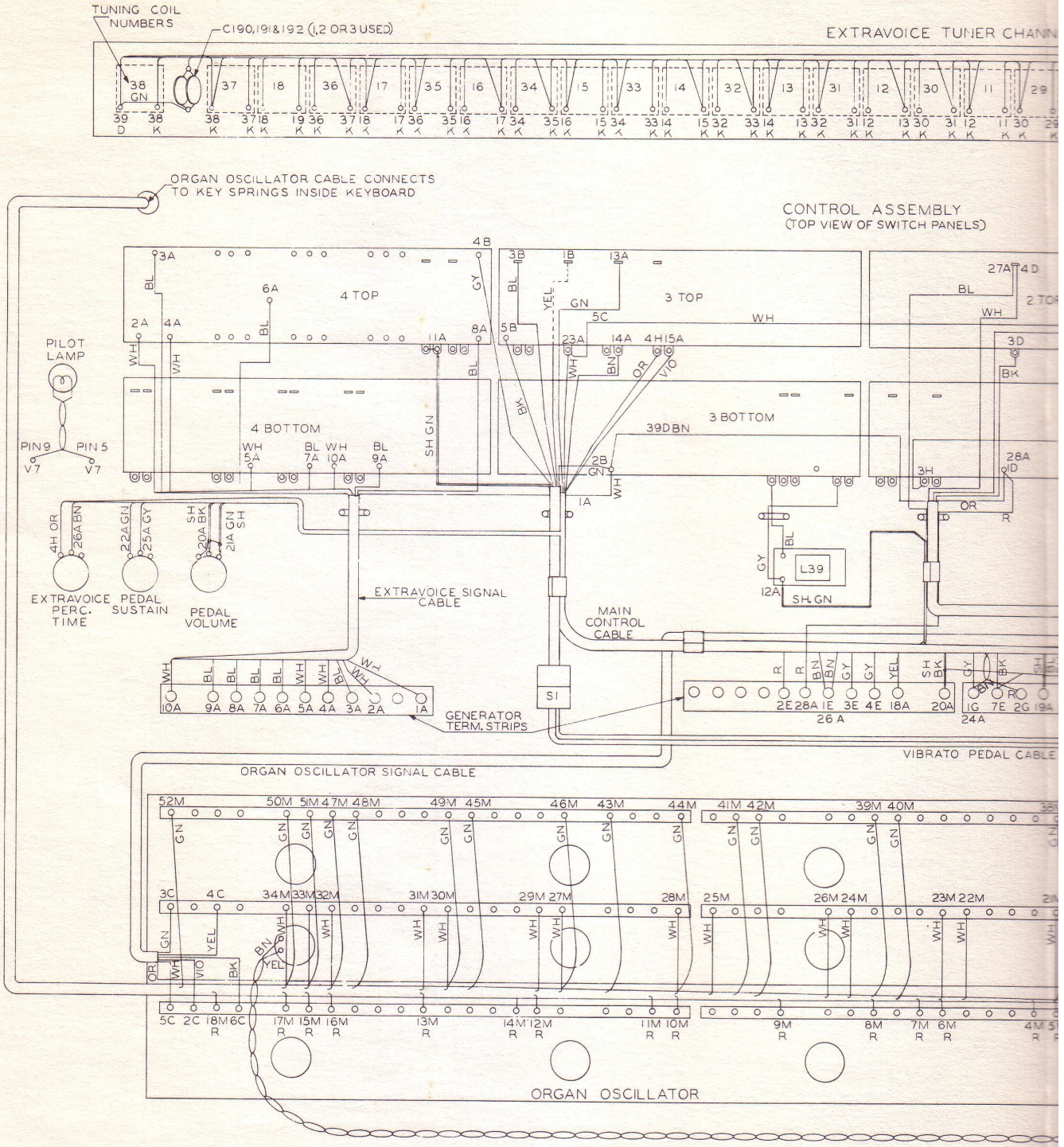
16A ——o—— MEANS WIRE 16 IN GROUP A

A WIRES CONNECT GENERATOR TO CONTROL ASSEMBLY
B WIRES CONNECT CONTROL PEDAL TO CONTROL ASSEMBLY
C WIRES CONNECT ORGAN OSCILLATOR ASSEM. TO CONTROL ASSEMBLY
D WIRES CONNECT KEYBOARD TO CONTROL ASSEMBLY
E WIRES CONNECT POWER SUPPLY TO GENERATOR
F WIRES CONNECT POWER SUPPLY TO CONTROL ASSEMBLY
G WIRES CONNECT GENERATOR TO SPEAKERS
H WIRES CONNECT CONTROL PANEL TO CONTROL SWITCH ASSEMBLY
J WIRES CONNECT ORGAN OSCILLATOR ASSEM. TO POWER SUPPLY
K WIRES CONNECT TUNER CHANNEL TO KEYBOARD
L WIRES CONNECT PEDAL KEYBOARD TO GENERATOR
M WIRES CONNECT ORGAN OSCILLATOR ASSEM. TO KEYBOARD

ALL SWITCHES SHOWN IN OFF POSITION
ALL VOLTAGES SHOWN ARE + FROM GROUND EXCEPT WHERE NOTED
ALL VOLTAGES MEASURED WITH V.T.V.M.
SIGNAL VOLTAGES MAY VARY ±1½ DB FROM VALUE SHOWN. THEY ARE MEASURED WITH EXPRESSION CONTROL AT MAX., ALL KNOBS HORIZONTAL AND ALL TABLETS OFF UNLESS OTHERWISE NOTED.

NOTE: Instruments serial # 8556 and above do not have "External cabinet socket" shown in power supply.

Instruments serial # 8556 and above do not have "Vibrato Pedal" making C77 and wire 4B unnecessary. Wire 3B is connected permanently to Wire 2B, Wire 1B is grounded.

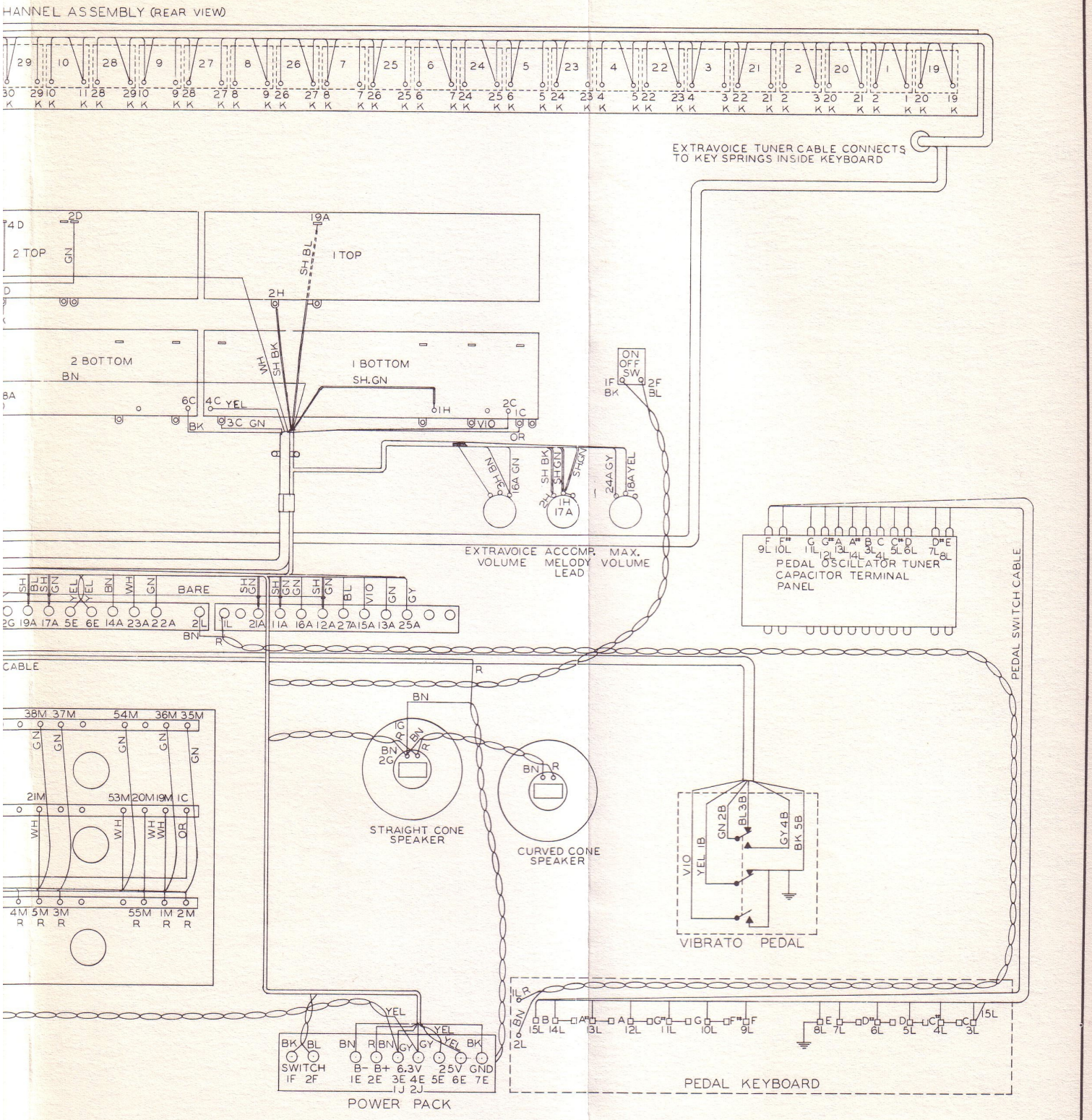


A	WIRES CONNECT GEN. TO CONTROL ASSEM.
B	WIRES CONNECT CONTROL PEDAL TO CONTROL ASSEM.
C	WIRES CONNECT ORGAN OSC. TO CONTROL ASSEM.
D	WIRES CONNECT KYBD. TO CONTROL ASSEM.
E	WIRES CONNECT POWER SUPPLY TO GEN.
F	WIRES CONNECT POWER SUPPLY TO CONTROL ASSEM.
G	WIRES CONNECT GEN. TO SPKRS.
H	WIRES CONNECT CONTROL PANEL TO CONTROL SWITCH ASSEM.
J	WIRES CONNECT ORGAN OSC. TO POWER SUPPLY
K	WIRES CONNECT TUNER CHANNEL TO KYBD.
L	WIRES CONNECT PEDAL KYBD TO GEN.
M	WIRES CONNECT ORGAN OSC. TO KYBD.

1B	3B	4B
YEL	BL	GY
2B		
GN	VIO	
5B		RED
BK		

S1 SOCKET (FACE VIEW)

FIGURE 9 WIRING D
EXTRAVOICE OR
MODEL F-10



G DIAGRAM
ORGAN
-100

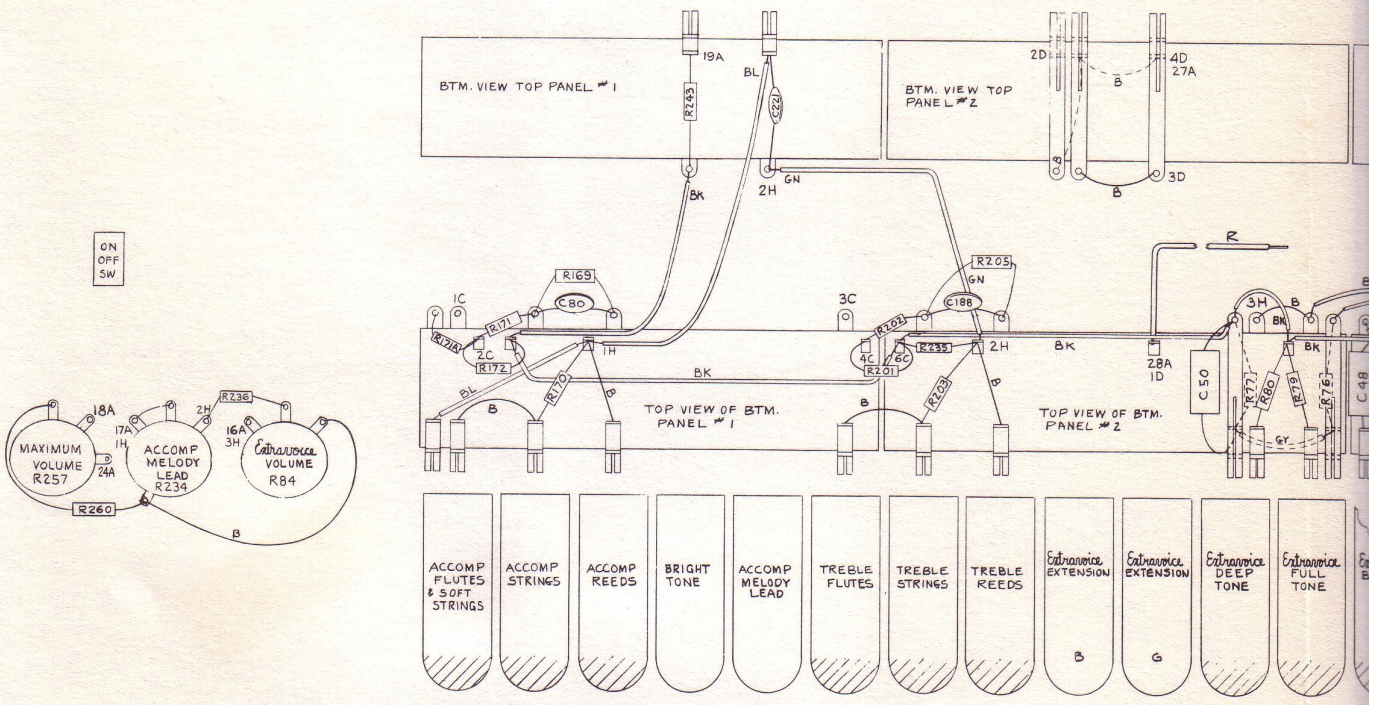
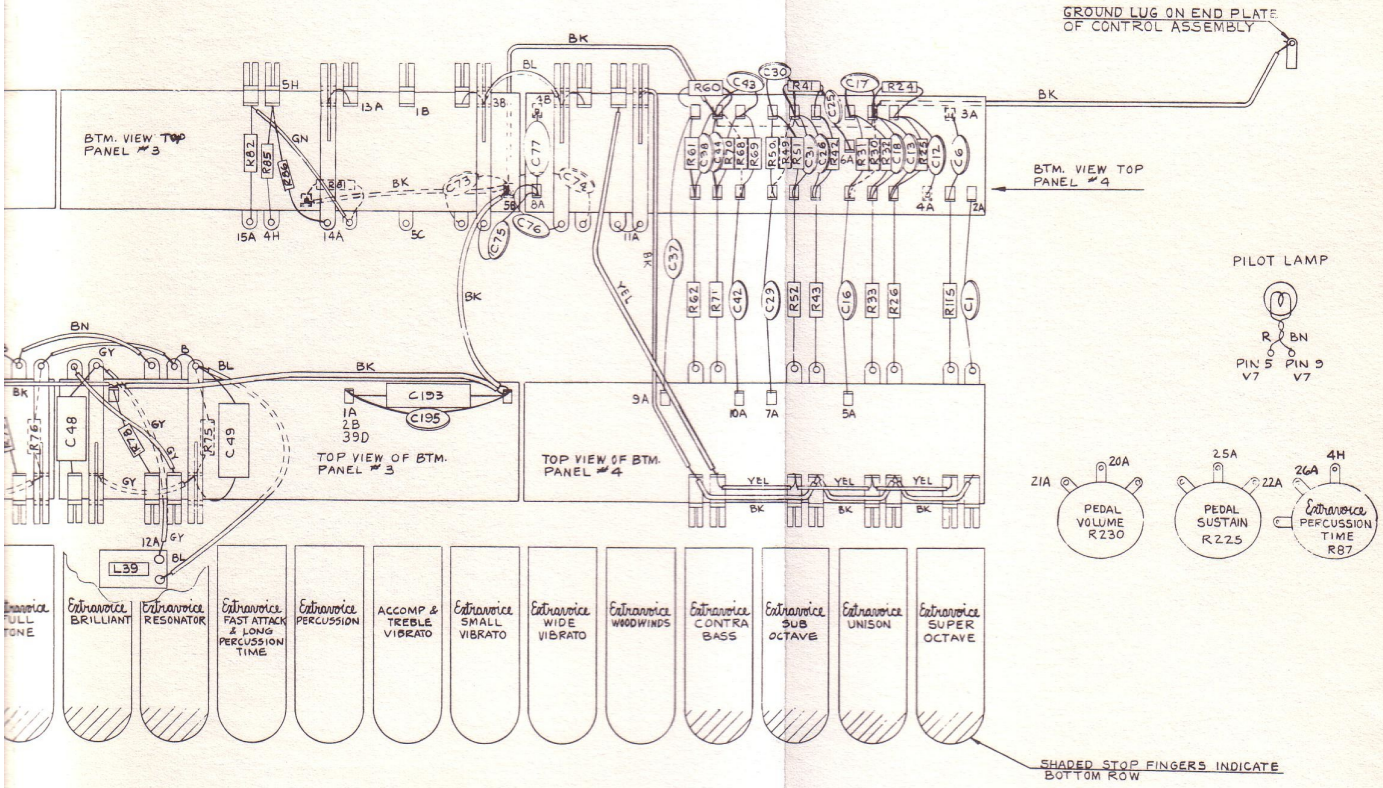


FIGURE 10 WIRI
CONTROL AND S
EXTRAVOIC
MODEL



NOTE: ROUTE OF LEADS FOR CLARITY ONLY

E 10 WIRING DIAGRAM
OL AND SWITCH ASSM.
TRAVOICE ORGAN
MODEL F-100