

May 29, 1951

J. F. JORDAN
ELECTRIC ORGAN

2,555,040

Filed June 21, 1947

7 Sheets-Sheet 1

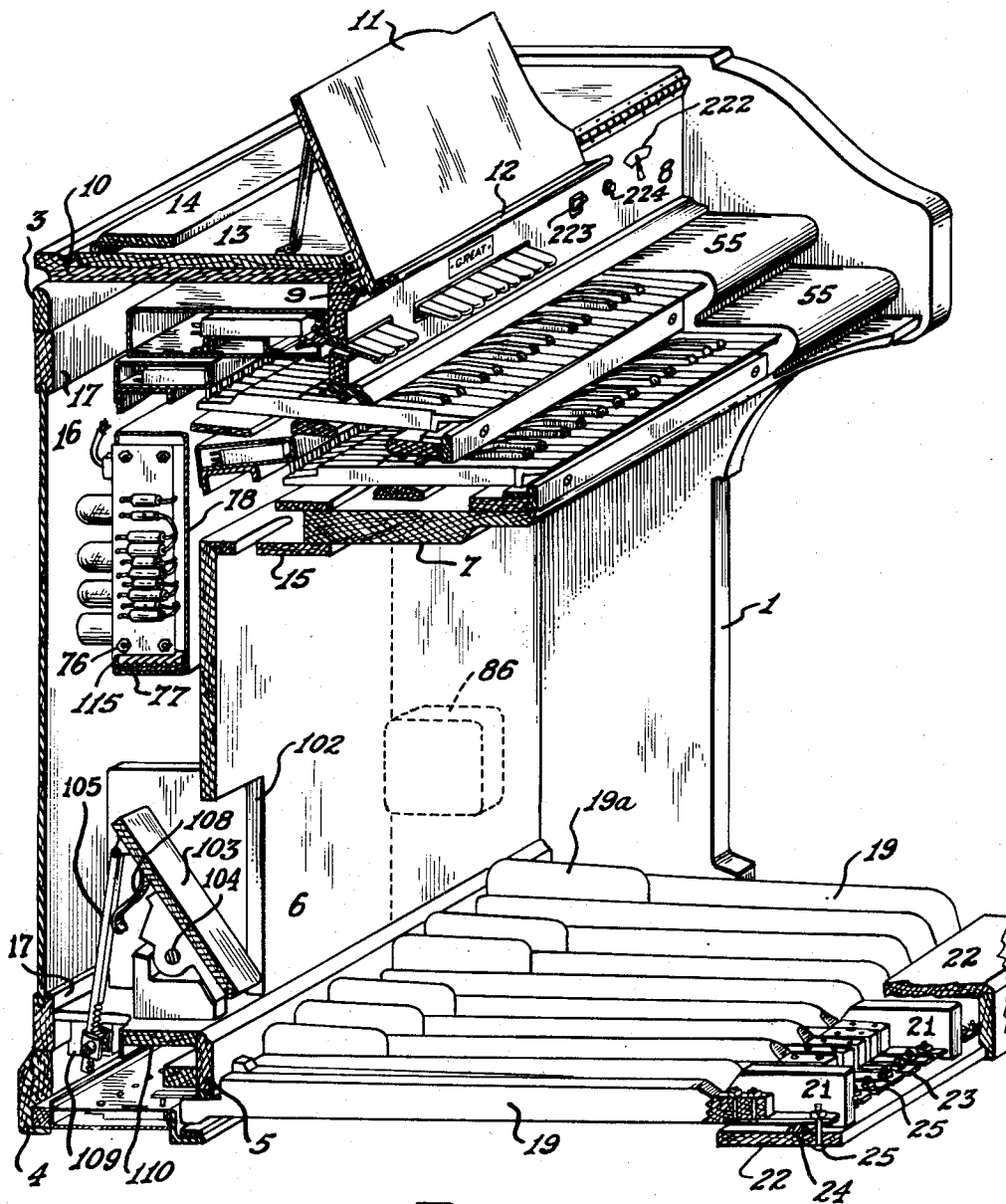


Fig.1.

INVENTOR.
JOHN F. JORDAN.
BY *Allen & Allen*
ATTORNEYS.

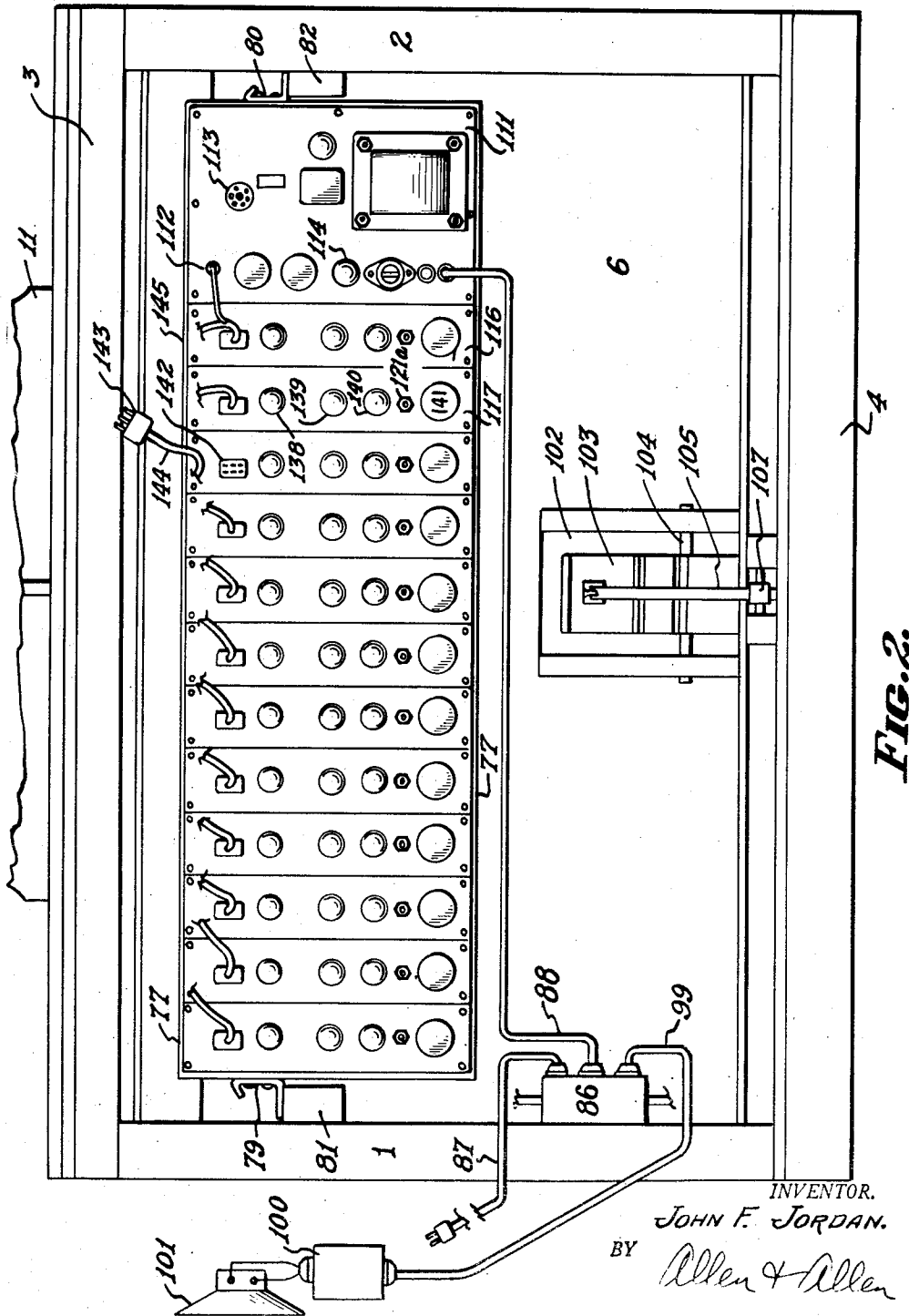
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7 Sheets-Sheet 2



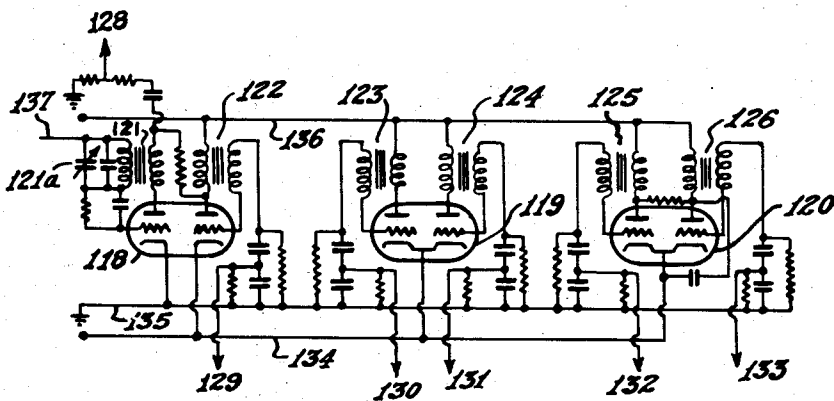
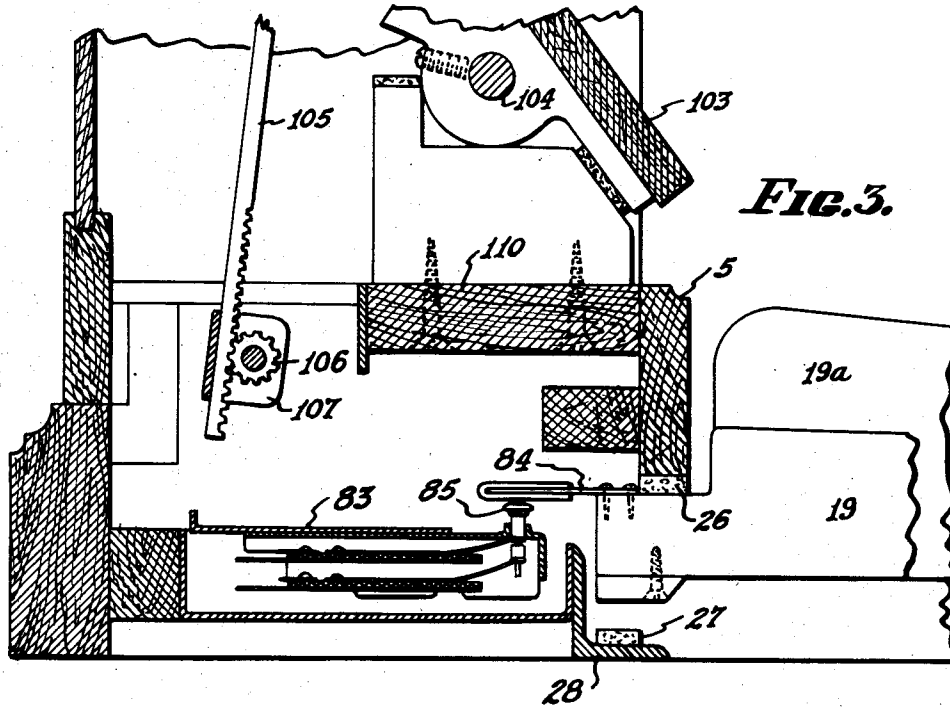
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7 Sheets-Sheet 3



INVENTOR.
JOHN F. JORDAN.
BY *Allen & Allen*
ATTORNEYS.

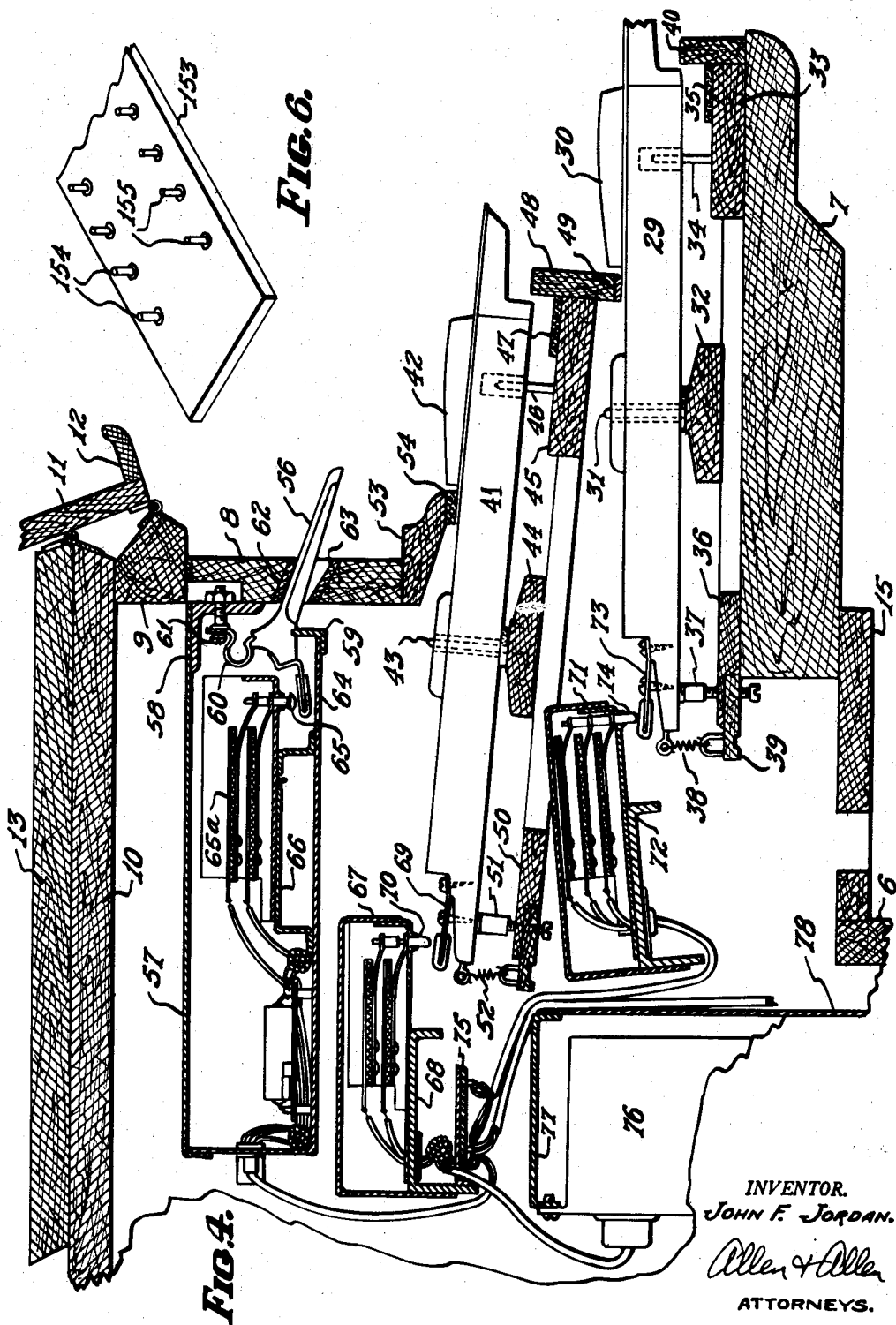
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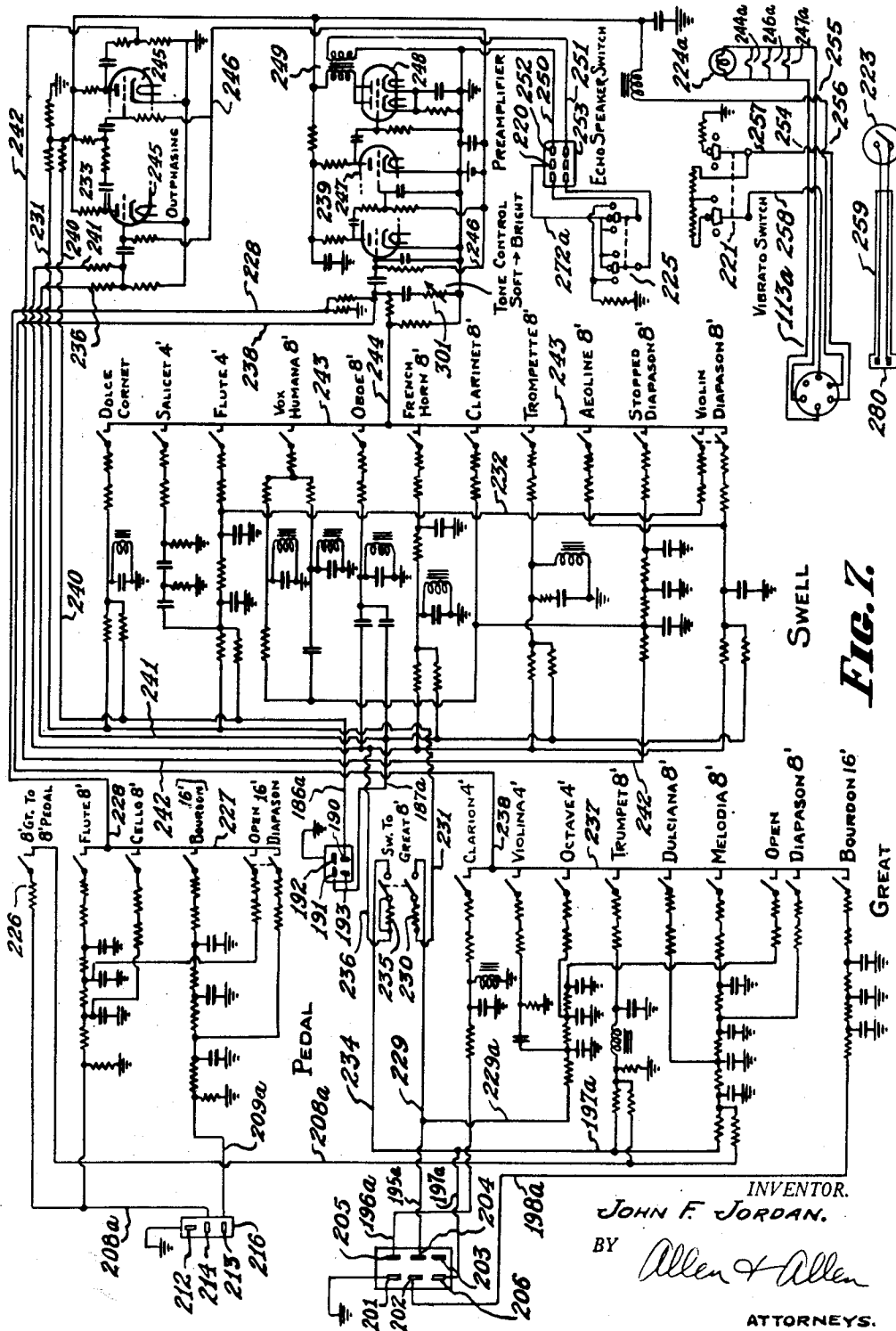
J. F. JORDAN

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J. F. JORDAN
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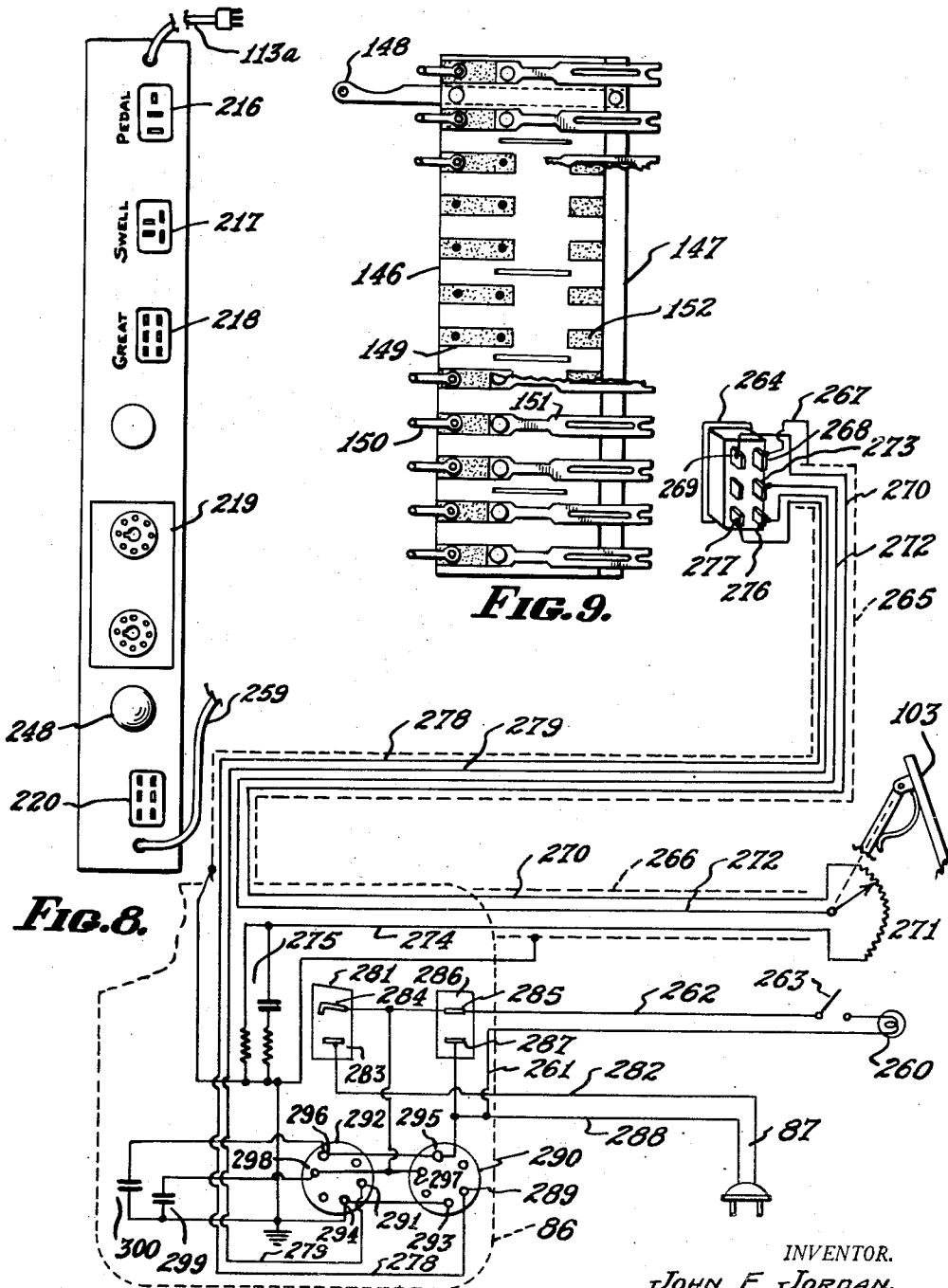


FIG. 11.

INVENTOR.
JOHN F. JORDAN.
BY *Allen & Allen*
ATTORNEYS.

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J. F. JORDAN
ELECTRIC ORGAN

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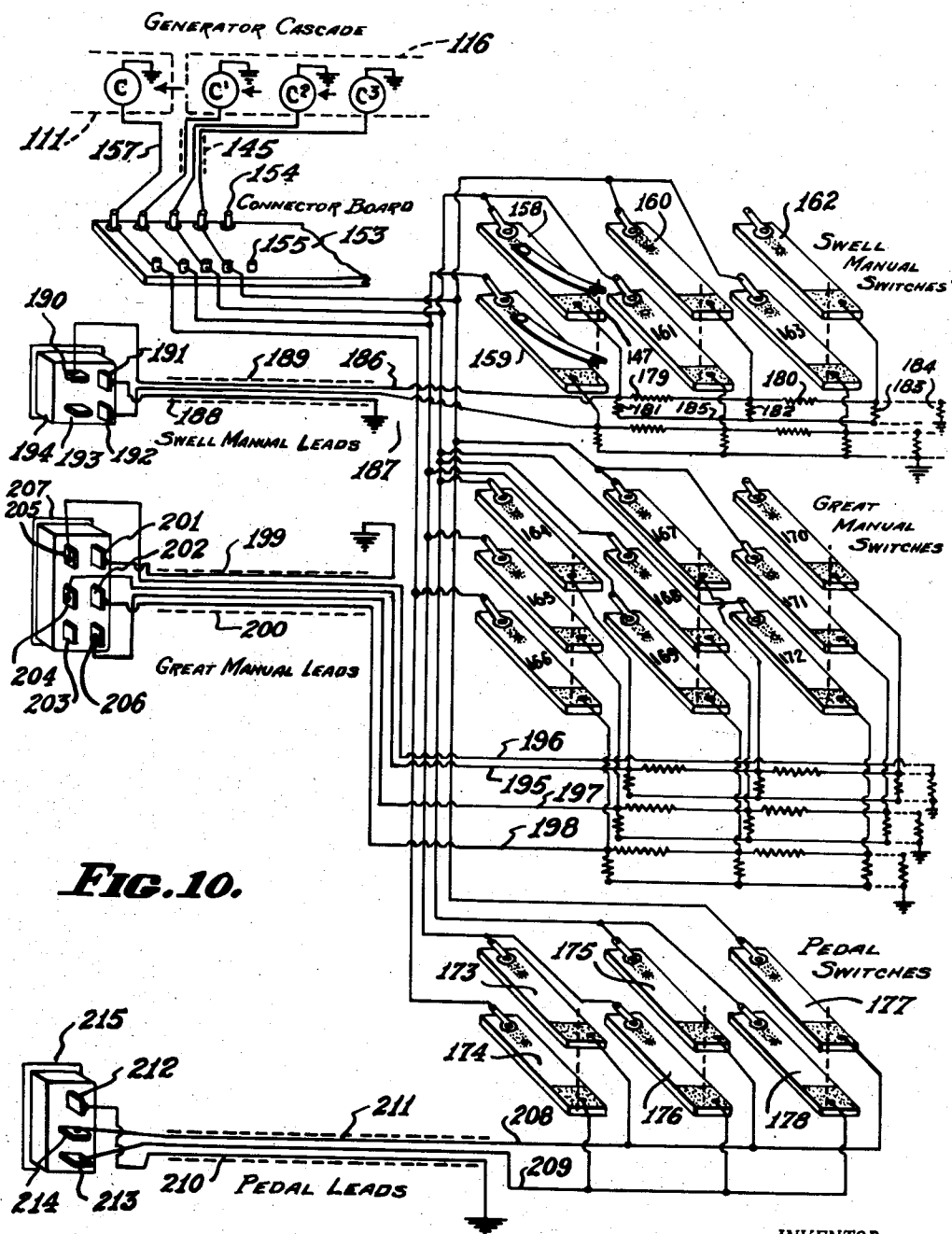


FIG. 10.

INVENTOR.
JOHN F. JORDAN.
BY *Allen & Allen*
ATTORNEYS.

UNITED STATES PATENT OFFICE

2,555,040

ELECTRIC ORGAN

John F. Jordan, Terrace Park, Ohio, assignor to
The Baldwin Company, Cincinnati, Ohio, a cor-
poration of Ohio

Application June 21, 1947, Serial No. 756,126

36 Claims. (Cl. 84—1.01)

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My invention relates to electrical musical instruments, and in particular to an electric organ.

One of the objects of the invention is the provision of an instrument which in physical structure and in manipulation simulates the pipe organ and requires no technique on the part of the operator beyond the customary technique in the playing of the pipe organ.

An object of the invention is the provision of a novel and improved organization of electrical circuit elements.

Another object of the invention is the provision of a novel and improved physical organization of parts. In this connection it is my object to provide an organization of electrical and physical elements into groups or assemblies which may be constructed and wired as units, thus considerably simplifying manufacture.

It is an object of my invention to provide in an electrical musical instrument a physical organization of the aforesaid units such that all of them are readily accessible for adjustment and minor repair, and such that all of them are easily disconnectable from other units, with a minimum of labor for more extensive repair, or replacement.

It is further an object of my invention to provide an organization of parts such as will not require disassembly for ordinary tuning, and for the replacement of certain elements normally requiring periodic renewal.

These more general objects of my invention, and the specific ones which will be pointed out hereinafter or will be apparent to one skilled in the art upon reading the specifications I accomplish in those constructions and arrangements of parts of which I shall now set forth an exemplary embodiment. Reference is made to the drawings forming a part hereof, and wherein:

Fig. 1 is a view partly in perspective and partly in section showing the arrangement of console and interior mechanism.

Fig. 2 is an elevational view of the rear of the console with the back board removed.

Fig. 3 is a partial sectional view of the lower part of the console and the end of the pedal clavier.

Fig. 4 is a partial sectional view on an enlarged scale of an upper portion of the console.

Fig. 5 is an electrical circuit diagram of one of the generator units which I preferably employ.

Fig. 6 is a partial perspective view of a connector board.

Fig. 7 is an electrical circuit diagram showing the voicing arrangement in my organ.

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Fig. 8 is an elevational view of the rear panel of the voicing assembly.

Fig. 9 is a plan view of one of my switch elements.

Fig. 10 is a circuit diagram showing exemplary connections to my key switches.

Fig. 11 is a circuit diagram showing the connections between the voicing assembly, the volume control and the main distributor box.

The console

Referring first to Figs. 1 to 4 inclusive, I have shown an organ console having side members 1 and 2. At the rear of the console these members are interconnected by a top back rail 3 and a bottom back rail 4. At the front of the console they are interconnected by a front bottom rail 5, a lower front board 6, a key bed 7, and an upper front board 8. Above the upper front board there is a rail 9. A top or cover member 10 is provided, adapted to rest upon the rails 3 and 9. A music desk 11 having a ledge 12 may be hinged to the rail 9. A fall board 13 is shown as hinged to the cover 10, and as carrying a hinged front lip 14. A horizontal board 15 may be employed to connect the key bed 7 and the lower front board 6, as shown.

At the rear, the console is closed by a panel 16 framed in members indicated at 17 and engageable between the side members 1 and 2 of the console and its upper and lower back rail members 3 and 4. This closure member is removable from the position shown in Fig. 1 to disclose the interior mechanism of the console as will be apparent from Fig. 2. The details of the construction of the console may be widely varied within the scope of my invention.

A pedal clavier comprising the usual pedal keys 19 and 19a is provided. The forward ends of these keys enter a housing 22, which is held to the organ console by rail means 21. Resilient mounting means in the form of leaf springs 23 are provided in the housing 22. These springs pass over an abutment 24 and are held in adjusted position by bolts 25. The spring means 23 urge the pedal keys to the upper position.

The inner ends of the pedal keys are reduced in thickness, as shown in Fig. 3, and extend beneath the front lower rail 5 of the console. This rail may be provided with a felt damping strip 26 and another felt damping strip for the downward position of the pedal keys may be located as at 27 on a metal rail 28 extending between the console side members.

The pedal clavier may be of standard size, shape, and position.

I provide my organ with a great manual comprising keys 29 and 30 in Fig. 4. These keys are pivoted on pins 31 on a rail 32 supported in conjunction with the key bed 7. A front key rail 33 carries pins 34 which, entering recesses in the keys, serve in conjunction with the pins 31 to maintain key alignment. The rail 33 may also carry a felt damping strip 35. There is a rear rail structure 36 beneath the keys of the great manual. This rail bears adjustable, felt topped stop means 37 to limit the downward movement of the rear ends of the keys. The normal key position is controlled by spring means 38 engaging between the rear ends of the keys and finger means 39 affixed to the rear rail 36. To impart a finished appearance to the front side of the great manual I provide a toe strip 40 on the key bed as shown.

A swell manual comprising keys 41 and 42 is located in a slightly tilted position above the great manual. These keys are pivoted upon pins 43 on a rail 44 extending between the side members of the console. There is a front rail 45 similarly mounted, bearing aligning pins 46 and a felt damping strip 47. A toe strip 48 may be provided as shown, and it may carry on its under surface a felt damping strip 49 for the great manual keys in their upper positions. For the swell manual I provide a similar construction of rear rail 50, adjustable stops 51, and spring controlling means 52.

The upper front board 8 of the organ may carry a toe strip member 53, bearing on its lower surface a felt damping strip 54 for the keys of the swell manual in their upper positions.

The rail and key assemblies for the great and swell manuals may be, and preferably are, constructed as units removable individually from the console for adjustment, repair, or replacement.

Filler blocks 55 in Fig. 1 may be employed at the ends of the swell and great manuals to accommodate the greater length of the console as determined by the length of the pedal clavier assembly. The upper front board 8 is perforated to permit stop tabs 56 of conventional form to extend through it into positions of convenient access for the performer. These stop tabs are organized into groups marked respectively for the great, swell, and pedal claviers. The front board 8 also carries certain other operating instrumentalities which must be available to the performer, as will be set forth hereinafter.

The usual organ bench will be supplied but has not been illustrated in the drawings.

General arrangement of assemblies

Within the console the various physical and electrical elements are organized into units which are arranged and mounted as will be next described. Behind the upper front board 8 of the organ, there is a metal box 57 (see Fig. 4) which contains a preamplifier, electronic out-phasing means, the inductances, condensers, resistances, and similar elements making up the voicing circuits, the stop switches, additional controlling means, and the mounting means for the stop tabs.

The voice box has an upper front rail 58 and a lower front rail 59. Each of the stop tabs 56 is pivoted by the engagement of the lower rail 59 in a notch in the stop tab body. The pivotal engagement is maintained by means of a compression spring 60 engaged between the stop tab body and a stud 61 on the upper rail 58. The

arrangement provides for the operation of the stop tabs in either direction past dead center, so that they have upper and lower positions in which they tend to maintain themselves. The stops 56 as aforesaid pass through perforations in the front board 8, which perforations may be lined with felt strips 62 and 63 for quiet operation. I attach a finger 64 to the rear end of each stop tab body. This finger is covered with felt and serves to operate the plunger 65 of a stop switch mechanism 65a. The stop switches are mounted on a bracket 66 which forms part of the voice box 57.

The stop switches are preferably gradual contact switches of a type hereinafter described, and are preferably the same in construction as the various key switches of my instrument.

Behind the swell manual comprising the keys 41 and 42 I provide key switch elements indicated at 67. These elements are preferably in gangs, and are mounted on a rail 68 extending between the side elements 1 and 2 of the console. To the rear ends of the keys 41 and 42 I attach fingers 69 preferably adjustable and preferably felt covered. These fingers operate the plungers 70 of the gang switch units 67.

Located behind the keys 29 and 30 of the great manual I provide additional gangs of key switch elements indicated at 71. These are supported by a rail 72 extending across between the side elements of the console. Fingers 73 are provided as before on the rear ends of the keys to operate the plungers 74 of the gang key switches.

In connection with one or the other of the key switch assemblies 67 or 71, I mount a connector board assembly indicated generally at 75. Connections from the oscillation generators are brought to this board, and from it pass the signal lines to the several key switches as will hereinafter be more fully described.

The next unit assembly employed in my electric organ is indicated generally at 76. It is a unitary assembly of cascades of oscillation generators plus a power pack, as will hereinafter be described. It is assembled on a rectangular framework 77 having a back closure plate 78. Brackets 79 and 80 (Fig. 2) are fastened to the ends of the frame 77 and serve to support the generator and power pack assembly in the console of my instrument upon abutments 81 and 82 on the side elements of the console.

Key switches 83, most clearly shown in Fig. 3 are provided for the keys 19 and 19a of the pedal clavier. These keys are provided with fingers 84 to operate the plungers 85 of the key switch units. Since there is considerable space between the inner ends of the keys 19 and 19a in the pedal clavier, I do not ordinarily gang the switch elements for this clavier but instead employ individual units mounted as shown.

Referring to Figs. 1 and 2, I provide on one of the side frame members of the console a main distributor box 86 (Fig. 2). This is provided with a flexible cord connector 87 which may be plugged into an external source of power. It is also provided with a plug-in outlet to which a flexible lead 88 to the power pack may be connected. It is provided with additional connection means for the organ output leads from the voice box 57, for a cable to the swell device, for a switch cable to the voice box, and for a pedal light cable, all as will be described hereinafter. It is finally provided with one or more output connector means such as a lead 99 to a main amplifier 100 and one or more loud speakers 101. The main amplifiers

and reproducing devices may if desired be located in the console; but for most uses are preferably located elsewhere as hereinafter described.

Finally, as a feature of general construction, I provide a swell device or volume control means. There may be one of these controlling the general output of the organ, or individual ones may be provided if desired for the several claviers. The lower front board of the organ is perforated or cut away as at 102 (Figs. 1, 2 and 3) to disclose the foot pedal 103. This is pivoted as at 104 to a suitable bracket on a base as illustrated. A rack 105, held in engagement with a pinion 106 by means of a yoke 107, as is most clearly shown in Figs. 1 and 3, is pivoted at its upper end to the foot pedal 103. To prevent lost motion and to make for quieter operation, I cause a leaf spring 108, affixed to the pedal, to engage the rack 105. The pinion 106 is affixed to the shaft of a volume controlling rheostat 109 mounted beneath the base 110.

The generator assembly

In my exemplary instrument, a generator circuit involving a thermionic tube and associated parts is provided for each note of the musical scale within the range of the instrument, although the swell, great, and pedal claviers may derive their tonal output from the same bank of generators. There are seventy-two sets of thermionic elements, one for each of the several generators, plus two additional sets which provide respectively for a low C note and for imparting a tremolo to the remainder of the generators. The generators are divided into groups. Each group contains generators for all of the octavely related notes of the same nomenclature, excepting for the low C note aforesaid.

Each group comprises a master oscillator having the frequency of the highest note in the cascade, and a plurality of controlled generators operating at sub-multiples of the first frequency. The controlled generators are arranged to be incapable of self-oscillation, but produce oscillations by discharges triggered by pulses from either the master oscillator or a controlled generator next above in the octave series. To diminish the physical number of tubes, double ones are employed, namely tubes with two sets of thermionic elements in each envelope. This reduces the number of tubes to thirty-six for the several generating systems of the instrument, plus an additional tube as noted above, neglecting those tubes used elsewhere in the instrument, such as in the power pack, the voicing means, the preamplifier and the amplifier.

The unitary generator and power pack assembly used in my instrument is preferably that described and claimed in the copending application of Alfred J. Bissonette, entitled *Generator Assemblies in Electrical Musical Instruments*, Serial No. 728,220, filed February 12, 1947.

In the power pack part of the unit assembly as shown most clearly in Figure 2, face plate 111 is mounted to the frame 77; and the various elements making up the power pack assembly are mounted to both sides of this plate. The elements mounted to the face side of the plate may include one or more rectifier tubes, a transformer, condensers, and the like. They will also include a double tube 114 for use as the low C oscillator and the tremolo generator, as set forth above. Power for the power pack will be derived through the flexible connector 88. There will also be a jack connector 112 for deriving a signal from the low C generator, and a six-way, plug-in recep-

tacle 113 for additional leads from the power pack assembly. These include power leads for the heaters and plates in the preamplifier and in the electronic out-phasing means located in the voice box 57, and leads for controlling the tremolo oscillator to vary the degree of vibrato imposed upon the generator signals.

Within one of the side frame members of the frame 77, and mounted upon an insulating board, there are provided a series of six bus bars shown at 115 in Figure 1. These are connected by flexible leads to elements of the power pack assembly, and function as follows:

Two of the bus bars are for supplying electric power to the cathode heaters of the various tubes in the generator cascade units, one is for positive B voltage supply, another is for positive voltage supply biasing the cathodes of the controlled generator, another is for the tremolo voltage, and the final one is a grounded bus. The flexible leads aforesaid are long enough so that when the connectors are unplugged from the receptacles 112 and 113, and the face plate 111 disconnected from the frame 77, the entire power pack assembly may be removed far enough to permit adjustment and repair.

The individual cascade generator assemblies are each mounted to face plates such as 116, 117. There are twelve of these, and the combined area of them plus the area of the power pack face plate 111 fills the rear side of the frame 77 and provides a substantially dust-tight construction.

The circuit arrangement for an exemplary and preferred cascade generator unit is shown in Figure 5. A specific description of the connections and mode of operation of the cascade unit is not here required, but is included in the copending application of Edward M. Jones, Serial No. 714,601, filed December 6, 1946, and entitled *Interlocked Generator Circuits*. It may be pointed out that the cascade unit assembly is one designed for the production of six harmonically related frequencies. It comprises three double thermionic tubes 118, 119, and 120. The first section of the first tube is used for a master oscillator and has an appropriate circuit for that purpose including a transformer 121, a variable capacity 121a, in the nature of a trimmer condenser, and various other elements including fixed condensers and resistors. The control generators utilize the remaining tube sections. These generators have each a transformer 122, 123, 124, 125, or 126. The cascade coupling between the control generators is inductive, and in the preferred embodiment the several transformers 122 to 126 have their windings located upon a common magnetic core.

Each control generator also has a network of fixed resistances and capacities as illustrated. These networks serve a number of functions; but they determine, for one thing, the frequency of discharge in the controlled generators as initiated by impulses received from the next preceding generator, and for another, they permit the derivation of suitable signals from the several generators. In Figure 5, the signal leads are indicated at 128 to 133, inclusive. The cathodes of the tube sections of the several control generators are biased to a positive potential serving to prevent continuous oscillation in these generators. A lead for this potential is indicated at 134. There is also a grounded lead 135, and a lead 136 for the positive plate potential of the several generators, and a lead 137 by means of

which the grid circuit of the master oscillator may be connected with the tremolo frequency generator mentioned above. These four leads, 134 to 137, inclusive, plus two additional ones, not shown, for supplying power to the heaters of the cathodes in the several tube sections, make up the six leads which are connected to the six bus bars 115, described above. These leads are flexible and long enough so that the face plates 116 and 117 of any generator unit assembly may be disconnected from the frame 77, and, without unsoldering the leads, displaced far enough to permit repair and adjustment.

For details of the manner in which the various elements making up the cascade generator units are mounted to the several face plates, reference is made to the copending Bissonette application set forth above. It is sufficient for the purposes of this application to point out that certain of the elements are mounted to the exposed side of the face plates. Thus, the thermionic tubes indicated at 138, 139 and 140, in Figure 2, are mounted in positions of convenient accessibility for replacement. By reason of its bulk, the transformer 121 for the master oscillator is mounted in a can 141 on the face plate. Adjusting means for the variable condenser 121a are also made accessible, as shown so that the instrument may be tuned and retuned without any disassembly. The several signal leads 128 to 133 are brought to a six-prong receptacle 142 for each cascade generator unit. A plug 143 is provided for the cable 144 carrying the signal leads to the connector plate hereinafter described. An extra lead is bound to the six-wire cable 145 for the C cascade generator unit and bears a jack which can be inserted in the jack receptacle 112 on the power pack unit. This is for deriving signals from the extra or low C generator located in the power pack.

The face side of the generator assembly is exposed when the rear panel 16 is removed from the organ console. It will be evident that any of the generator tubes and the rectifier tube or tubes of the power pack may be replaced without disassembly. Likewise, the organ may be tuned. For minor adjustments or repair of any of the generator cascade units or of the power pack, these may be disconnected from the frame 77 and drawn outwardly sufficiently to permit access to their various parts. Moreover, the entire generator and power pack assembly may have all of its connections with other portions of the organ broken by unplugging, and may then be removed bodily. All of this may be done without the breaking of any soldered connections. The replacement of an entire generator assembly thus becomes a matter of a few minutes time.

Switch assemblies

My invention is not limited to the use of any particular switch construction, but I prefer that described and claimed in Patent 2,215,124 in the names of Koch and Jordan, issued September 17, 1940. Reference is made to this patent for the details of the preferred switch construction.

The preferred switch is a gradually acting, resistance type of switch which controls the onset of the tones. Each switch assembly comprises a housing within which are supported one or more insulative platforms such as indicated at 146 in Figure 9. At the right hand edge of the platform there is a metallic strip 147 which acts as a header, and is common to a plurality of switch elements. It has a con-

ductor indicated at 148. Adjacent the left-hand edge of the platform there are a series of strips 149 of resistive substance. Each of these strips is provided with a connector 150 to which a signal lead may be attached. A switch finger 151 is connected to the opposite end of each resistance strip and extends beyond the metallic header 147 as shown. Adjacent the metallic header and under each of the switch fingers there is a strip of resistive substance 152 having electrical connection with the header. In the open position, the switch finger 151 does not contact the area 152, but when actuated by a playing key it rolls over the resistive area 152 until finally it comes into direct electrical contact with the header element 147. The header element and the resistive coatings may be formed directly upon the insulative platform 146 by spraying, electroplating, or the like.

Switch assemblies employing the structure illustrated in Figure 9 are easily made in gang formation. As many of the platforms 146 may be employed in superposed and spaced relationship as are dictated by the number of headers required from any particular manual. Switch fingers 151 lying above each other and designed to be operated by the same key are interconnected by a plunger element such as 70 or 74 most clearly shown in Figure 4 of this application. The platforms may be made of any length desired, and consequently as many switches as may be found necessary may be incorporated in a single assembly in side by side relationship. For the swell and great manuals I ordinarily provide switch constructions in which the switches are ganged in groups of twelve. For the pedal clavier, as set forth above, I ordinarily employ single switch assemblies. In the exemplary organ two signal headers are to be derived from the swell manual which therefore, in each switch assembly, employs two of the platforms 146. The number of headers required for the great manual necessitates the use of a switch construction in which three platforms are employed. Two headers are desired from the pedal clavier.

Connections to the key switches

Connections to the key switches are made from a connector board mounted, as shown in several of the views, to the same rail which holds the key switch assemblies for the swell organ manual. The connector board may consist of an insulative panel 153 as shown in Figure 6 made of laminated resinous material, hard rubber, or any other suitable substance. To facilitate the making of connections I prefer to provide lines of grommets 154 and 155 along the edges of the connector board or panel. These grommets are of a type and material to which soldered connections may be made. The various switch assemblies are wired directly to the connector board; and cables such as 144 and 145 in Figure 2 come from the connector board and are plugged into the generator assembly. Cables from the several header combinations of the switch assemblies of the various manuals, which cables may be plugged into the voice box, are also provided, as will hereinafter be described.

The manner in which these connections are made is illustrated diagrammatically in Figure 10. At the top of this figure a series of generators C, C¹, and so on, are diagrammed. The first of these, marked C, may be considered as

the low C generator located in the power pack 111. The remainder may be considered as part of the C cascade generator unit assembly 116 in Figure 2. Dashed arrows in Figure 11 are used to suggest the cascade arrangement in which the generators control each other successively in the direction of descending frequency. The signal take-off 157 from the low C generator is the extra lead attached to cable 145 described above. The leads from the other generators in the cascade series go to make up the six wire cable 145. The several leads are brought to the connector board and soldered to grommets in the row 154. For simplicity a number of the connections actually made on the board are shown else where in the diagram.

I have also indicated diagrammatically a portion of the switch assembly for the swell manual. Each key on this manual controls two switches. The lowest C key controls switch elements 158 and 159. An octave above, the next C key switch controls key switches 160 and 161. Yet another octave above, the third C key controls switches 162 and 163. The remainder of the key switch assembly for the swell manual has not been shown.

Below the swell manual switches I have indicated a series of switches for the great manual. Here each playing key controls three switches. The low C key on the great manual operates switches 164, 165, and 166. The key an octave above operates switches 167, 168, and 169, while the next or third C key of the great manual operates 170, 171, and 172.

Two headers are desired from the pedal clavier. The lowest C key operates switches 173 and 174. The next C key operates switches 175, 176; and the third C key, 177 and 178.

Thus the swell manual has two headers, respectively for eight foot and four foot tones. The great manual has three main headers, respectively for sixteen foot, eight foot and four foot tones. The pedal clavier has two main headers, respectively for sixteen foot and eight foot tones.

The signal lead 157 from the lowest C generator is connected through the connector board to switch 166 of the great manual and switch 174 of the pedal clavier. The C generator an octave above and marked C' is similarly connected to switch 159 of the swell manual, switches 165 and 169 of the great manual, and switches 173 and 176 of the pedal clavier. The third generator, C², is connected by appropriate leads to switches 153 and 161 of the swell manual, to switches 164, 168, and 172 of the great manual and to switches 175 and 178 of the pedal clavier. The fourth generator C³ is connected to switches 160 and 163 of the swell manual, switches 167 and 171 of the great manual and switch 177 of the pedal clavier. A similar mode of connection is practiced throughout all of the key switches for the several manuals. While the leads have been shown as branching in positions remote from the connector board 153, in actual practice I prefer to carry wires from the several key switches directly to the connector board, and to make on this board all cross-overs and connections. When any given key in my organ is depressed, connections are made to a plurality of generators simultaneously, these generators being related harmonically as octaves. The oscillations from the several generators are collected separately in different headers in accordance with their relationship a sixteen foot, eight foot or four foot tones. The metallic strips 147 on the key switch

platforms (see Figure 10) form parts of these headers. As indicated above, the key switches are usually ganged in groups of twelve, and in the connections between the header elements 147 of the various groups of switches I insert resistances as shown at 179 and 180. Intermediate these resistances the header is connected to a grounded lead 185 through resistances 181, 182, 183, and 184. The purpose of this construction is to balance the tonal scale, the lower frequency tones normally tending to reproduce louder than the higher frequency tones.

The resistances 179 to 184, inclusive, as well as the connections between the header strips 147 on the upper platforms of the swell manual switch assemblies may be located on the connector board 153. By means of the resistive network which has just been described all upper switches of the swell manual assembly are connected together and to a four foot header 186.

In a similar manner all lower switches of the swell manual assembly are connected together and to a common eight foot header 187. A similar resistive network for balancing the scale is shown. The four and eight foot headers 186 and 187 together with a ground lead 188 are combined into a cable 189 coming from the connector board. Various leads in this cable are further connected to a plug-in element 194. This is a four-way element having a series of connector prongs. The eight foot lead 187 is connected to prong 192, as shown. The four foot lead 186 is connected to the prong 190. The ground lead 188 is connected to the prong 191. The prong 193 is unused.

In the great manual assembly, the upper switches of the group 164, 167 and 170, constituting a four foot group of switches, are in a similar manner interconnected by a resistive network and to a normal four foot lead 195. It will be noted in Figure 10 that there is another lead 196 which is also a four foot lead for this manual. This lead, however, is connected to the opposite end of the resistive network aforesaid. The reason for this is that for one or more voices of the organ, for example the clarion four foot voice, it is desirable to have an unbalanced tonal scale in which the lower frequency notes are reproduced in great relative volume. The lead 196 thus constitutes a "reverse" four foot header.

Key switches of the group 165, 168 and 171 are interconnected by a resistive network and are connected to an eight foot lead 197.

Great manual key switches of the group 166, 169 and 172 are interconnected by a resistive network and are connected to a sixteen foot lead 198. These leads, together with a ground lead 199, are combined into a cable 200 coming from the connector board 153. These various leads are also brought to a plug-in connector member 207. This is a six prong connector. The reverse four foot header 196 is connected to a prong 205. The normal four foot header 195 is connected to prong 204. Prong 203 is blank, or unused. The normal eight foot header is connected to prong 206, the normal sixteen foot header is connected to prong 202, and the ground lead 199 is connected to prong 201.

In the pedal switch assembly, key switches of the group 173, 175 and 177, being an eight foot group are connected to each other and to an eight foot lead 208. In a similar manner, key switches of the group 174, 176 and 178, being a sixteen foot group, are interconnected and are connected to a sixteen foot lead 209. These

leads, together with a ground lead 210, are combined into a cable 211. The leads are further connected to a plug-in connector member 215. This is a three pronged device. The ground lead 210 is connected to a prong 212, the eight foot lead 208 is connected to prong 214 and the sixteen foot lead 209 is connected to prong 213.

It will be noted in Figure 10 that signal leads from the several generators are not only connected to the several manuals but are also connected to a plurality of switches in each manual. Thus, when the low C key in the great manual is depressed oscillations are simultaneously derived not only from the low C generator, but also the next two generators above it in the cascade. These oscillations are, however, derived in separate headers. In connecting a single generator in this fashion to a plurality of key switches, the resistive coatings 149 ahead of the switch fingers (see Figure 10) serve to make the response equal from each of these connections. These resistances are high in value as compared with the impedance of the output circuit generally.

While the connector board 153 is wired directly to switches in the several switch assemblies (wires from the connector board to the pedal switches passing downwardly inside the lower front board of the organ) the connector board otherwise simply serves as the terminus for a plurality of cables having plug-in connectors at their ends. Signals from the generators are derived through a series of twelve cables, such as the cables 144 and 145 in Figure 2. After the signals so derived have been controlled by the key switches of the several manuals in accordance with the requirements of a musical score, these signals leave the series of switch assemblies through the three plural wire cables 189, 200 and 211. These cables are also provided with plug-in connectors and are designed to be plugged into the voice box hereinafter described.

I prefer that all of these cables be provided with flexible metallic sheaths which are grounded.

The voice box

The voice box of my organ comprises the metallic casing 57 located directly behind the upper front board 8 of the organ and beneath the top board 10. At the rear of this casing, as shown in Figure 8, I provide a series of plug-receptacles. There is a receptacle 216 to receive the plug-in connector member 215 of the pedal cable 211. There is a receptacle 217 to receive the connector member 194 of the swell manual cable 189. There is a receptacle 218 to receive the plug-in connector 207 of the cable 200 from the great manual switch assemblies.

The double-lead receptacle 219 for thermionic tubes is provided so that the tubes 245 and 247 of the outphasing means and preamplifier may be located for replacement outside the voice-box proper. Yet another receptacle is provided for the tube 248 of the preamplifier. There is a six-way receptacle 220 into which may be plugged a cable, as hereinafter described, passing to the volume control pedal and to the main distributor box 86.

A cable for the main organ switch is shown at 259. A cable to be plugged into receptacle 113 of the power pack is indicated at 113a.

The opposite or front face of the voice box has the stop tabs 56 projecting from it, as hereinabove described. These stop tabs 56 also project through the upper front board 8 of the organ

in a position of easy access for the performer. A vibrato control switch, indicated diagrammatically in Figure 7 at 221, is mounted on the front face of the voice box. This switch has a shaft which projects through the upper front board 8 of the organ and is provided with a dial and operating handle combination 222, as shown in Figure 1. A main control switch 223 for the organ is carried by the upper front board and is connected with the voice box by the cable 259. The voice box carries a lamp with a suitable bezel and jewel serving to indicate whether the power of the organ is off or on. This projects through a perforation in the upper front board of the organ, as indicated at 224 in Figure 1. There is another switch near the opposite end of the voice box. This switch is diagrammatically indicated in Figure 7 at 225. Its shaft passes through a perforation in the upper front board 8 of the organ and is preferably provided with a dial and operating handle similar to that illustrated at 222 in Figure 1.

The stop tabs 56 operate resistive switches mounted upon the platform 66 in the voice box, as has been described above. The apparatus and circuit elements contained in the voice box are diagrammatically illustrated in Figure 7 in an exemplary embodiment. A continuation 208a of the pedal lead 208 passes, inside the voice box, to a resistive switch indicated at 226. This switch is connected to a suitable stop tab and serves to couple the 8-foot pedal to the 8-foot great organ. The 8-foot pedal lead passes from this switch to points in the great organ voice assembly where it is connected through resistances to the great organ 8-foot lead 197a. The 8-foot pedal lead is also directly connected as shown to the 8-foot flute filter circuit of the pedal stops. The 16-foot pedal lead 209a is connected to the voicing means for a bourdon 16-foot and for an open diapason 16-foot stop, the latter requiring a double resistive switch, as shown, and having connection with 8-foot pedal voices. For the pedal clavier in the exemplary instrument, I provide an 8-foot flute voice, an 8-foot cello voice, a 16-foot bourdon voice and a 16-foot open diapason voice, together with the coupler aforesaid.

In my organ the tones are initially generated as complex oscillations. Their tone color is changed through the application of voicing means acting primarily as filters, and also by the combination of in-phase and out-of-phase relationship of harmonically related oscillations. The filtering means employed by me comprise condensers, resistances, and in some instances, inductances. They are arranged as shown in the circuit diagram, Figure 7, but do not require particular description here. Reference may be made to the patent in the name of Kock, No. 2,233,948, issued March 4, 1941, for a description of particular filter circuits which are suitable for my use.

Oscillations passing through the various voicing means for the pedal assembly, as controlled by its several stop switches, are collected in a header 227 which is connected by a lead 228 to a preamplifier in the voice box, hereinafter described.

The reverse 4-foot lead 196a from the great organ assembly is connected directly to a clarion 4-foot filter and stop switch, so marked in Figure 7. The normal 4-foot header 195a from the great organ assembly is connected as at 229 to a stop switch 230 and thence, as at 231, to various

ones of the swell organ voicing means, namely the dolce cornet, salicet 4-foot, and flute 4-foot. There is a connection from the latter voicing means as at 232 to a violin diapason 8-foot stop in the swell organ group. Lead 231 also passes as shown to an outphasing device indicated generally at 233. There is a connection between the lead 229, as at 229a, and an octave 4-foot stop in the great organ group, this stop being coupled with a violina 4-foot stop as shown.

The 8-foot great organ lead 197a is connected directly to trumpet and melodia voicing means in the great organ group, and is also connected, as at 234, to a stop switch 235 and thence, as at 236, to certain of the swell organ voice assemblies and to the outphasing means 233. The two switches 230 and 235 are arranged to be operated by a single stop tab; and they serve as means for coupling the swell and great organ manuals.

The 16-foot great organ header 198a is connected as shown directly to the voicing means for a bourdon 16-foot great organ stop, so marked.

The output of the several great organ voicing means, as controlled by the great organ stop switches, is collected in a header 237 which is connected by a lead 238 to the preamplifier 239. For the great organ in the exemplary instrument, I provide, clarion, violina and octave stops in the 4-foot class. There are also trumpet, dulciana, melodia and open diapason stops in the 8-foot class. Finally, there is a bourdon 16-foot stop, all of these stops being marked on the circuit diagram of Figure 8.

A 4-foot swell organ lead 186a is connected as shown to the 4-foot stops of the swell organ assembly, and is further connected by a lead 240 to the outphasing means 233. It will be noted that there is also a lead 242 from the outphasing means 233 to the stopped diapason 8-foot voicing means of the swell organ assembly.

The oscillations from the voicing means of the swell organ, as determined from the stop switches, are collected in a header 243, which is connected as at 244 to the preamplifier 239.

In the exemplary instrument I provide dolce cornet, salicet, and flute voices in the 4-foot group for the swell organ. Vox humana, oboe, French horn, clarinet, trompette, aeoline, stopped diapason and violin diapason voices are provided in the 8-foot group.

The specific outphasing means does not require particular description here. Reference is made to Kock Patents Nos. 2,148,478 and 2,233,948, issued February 28, 1939, and March 4, 1941, respectively, for complete descriptions of this feature. The outphasing means acts to reverse the phase of 4-foot oscillations, and after adjusting their amplitude, to combine them with 8-foot oscillations. The even-order harmonics of the 4-foot oscillations cancel harmonics of the same frequencies in the 8-foot oscillations, and the result is an 8-foot tone in which the even-order harmonics are absent or greatly diminished so that the tone becomes one rich in odd-order harmonics and hence useful in the production of voices of the woodwind type.

For the outphasing means I employ various circuit elements illustrated in Figure 7 plus the two components of the double thermionic tube 245. There is a connection 246 from the grid circuits of these components to the preamplifier 239.

The pre-amplifier is a three-stage, cascade resistance coupled amplifier employing double

thermionic tubes 247 and 248. The input to the amplifier is derived from leads 228, 238, 244 and 245, described above. The plates of the tube 248 are connected to an output transformer 249.

The secondary leads of this transformer, 250 and 251, the first of these being grounded as shown, are connected to prongs 252 and 253 of the six-prong receptacle 220 on the rear face of the voice box (see Figure 8). One prong of this receptacle is blank. The remaining three prongs are connected as shown to the echo speaker switch 225. This switch is a double-pole, triple-throw switch, so arranged that, depending upon its position, it will cause the oscillations which are the output of the pre-amplifier 239 to be fed to the amplifier 100 of the main speaker 101, or to the amplifier of an echo speaker (not shown), or to both simultaneously.

The cable 43a from the rear of the voice box is adapted as indicated above to be connected to the receptacle 113 on the power pack portion of the generator assembly. From the plug a pair of leads 254 and 255 carry current to the heaters 244a, 246a and 247a of the thermionic tubes in the outphasing means and in the pre-amplifier. These leads also supply current to a lamp 224a located behind the bezel and jewel 224 shown in Figure 1 as extending through the upper front board 3 of the organ console. This lamp will thus give an indication to the performer whether or not the power has been turned on in the organ.

A lead 256 in the cable 113a is connected with the plate circuits of the tube 245 in the outphasing means and the tubes 247 and 248 in the preamplifier. This lead supplies B+ or plate voltage to these tubes from the power pack. A pair of leads 257 and 258 are connected by the cable means aforesaid into the plate circuit of the vibrato generator in the power pack. The leads 257 and 258 pass to the vibrato switch 221. This is in the form of a double-pole, triple-throw switch similar to 225. Circuit connections including resistances are supplied in the voice box so that the switch 221 has an off position for the vibrato and two other positions giving selectively two vibrato intensities.

The main off-on switch for the organ 223 is connected by a two-lead sheathed cable 259 to a two-prong plug 280. This plug is adapted to be engaged in a receptacle 281 on the main outlet box 85 of the organ, as hereinafter described.

Main distributor box and volume control

The main outlet and connection box is located in the lower part of the organ console and is shown at 86 in Figures 1 and 2. For circuit arrangements in connection with this box and with the volume control, reference is made to Figure 11. In this figure a closed outline in dots is representative of the outlet and distributor box itself. There is a main power cable 87 coming from the distributor box 86 by means of which the organ may be connected to a suitable source of power. One of the leads 282 in this cable is connected to one side of the two-prong receptacle 281, as at 283. The other side, 284, of this receptacle is connected to the side 285 of another two-prong receptacle 286. The side 287 of this last mentioned receptacle is connected to the other lead 288 of the power cable 87. It will thus be seen that the receptacle 281 provides a break in the power circuit. The connector 280, having the cable 259 going to the

main organ switch 223, is plugged into the connector 281 so that the switch 223 can serve as the main power switch for the instrument.

The power cable 88 from the power pack means of the generator assembly (see Figure 2) is plugged into the receptacle 286.

I may provide an electric lamp 260 mounted beneath the key bed 7 of the instrument and serving to illuminate the pedal clavier for the convenience of the player. One of the leads 261 from this lamp is connected to the power lead 268, while the other 262, which includes a switch 263, is connected to the element 285 of the receptacle 286. The switch 263 may be mounted wherever desired, but is conveniently located beneath the key bed.

A six-way plug 264, having a sheathed cable 265, is adapted to be plugged into the receptacle 220 on the voice box. The cable 265 passes to the connector box 86, and certain of the leads in it pass from this box through another sheathed cable 266 to the pedal volume control of the organ.

The lead 267 connected to the prong 268 is a ground lead and is shown attached to the sheath of the cable 265. By means of the receptacle 220 it is connected to the grounded lead 250 of the output circuit of the pre-amplifier 239. The other pre-amplifier lead 251 is connected by means of the prong 269 to a lead 270 in the cable 265. This lead is connected to one side of the resistance element of the potentiometer 271 which is operated by the volume control foot pedal 183. A lead 272 connected to the prong 273 also passes through the cables 265 and 266 and is connected to the variable arm of the potentiometer 271. The other side of the resistance element of this potentiometer is grounded by a lead 274 passing through the cable 266, the grounding being done through a network of condenser and resistances indicated at 275. It will be noted that by means of the prong 273 in the connector 264, the lead 272 is connected as at 272a in Figure 7 to the echo speaker switch 225. Two other leads from this switch are connected through prongs 276 and 277 to leads 278 and 279 in the cable 265. The first of these leads is connected to an element 289 in a main speaker receptacle 290. The other lead 279 is connected to an element 291 of an echo speaker receptacle 292. Elements 293 and 294 of these receptacles respectively are grounded as shown.

The power lead 288 is connected to elements 295 and 296 in the speaker receptacle, while the opposite power lead 282 is connected through the main organ switch (by means of receptacle 281) to elements 297 and 298 in the speaker receptacles.

The reason for this construction is that the main and echo speakers are located in appropriate boxes containing also main amplifiers for these speakers, and it is ordinarily desired that all power be derived from the main outlet box 86 of the organ and controlled through the main organ switch 223.

I prefer to connect condensers indicated at 299 and 300 between the power leads of the speakers and ground, to suppress radio interference, it being convenient to locate these condensers also in the main outlet box 86.

Finally, it may be noted in Figure 7 that there is in connection with the pre-amplifier 239 a tone control circuit embodying a variable resistor 301. This is mounted on the voice box and has

a shaft which projects through the top front board of the organ and is provided with a control knob or handle.

Modifications may be made in my invention without departing from the spirit of it. Having thus described my invention in an exemplary embodiment, what I claim as new and desire to secure by Letters Patent is:

1. In an electric organ a console having upright side members, a key bed extending across between said members, sets of playing keys mounted in partially offset superposed relationship above said bed, and a console front board above the upper set of keys, playing key switch assemblies for each set of playing keys mounted respectively on rails extending between said side members and located in positions to be actuated by said keys, a voice box assembly located above said switch assemblies and adjacent said upper front board, a unitary assembly of electric generators located behind said key bed, and a connector board, said generator assembly, said voice box assembly and said switch assemblies being removable as units from said console, said generator assembly and said switch assemblies having connections with said connector board.

2. The structure claimed in claim 1 wherein said voice box assembly has stop mechanisms operating switches therein, said stop mechanisms having stop tabs projecting forwardly from said voice box and extending through perforations in said upper front board.

3. The structure claimed in claim 2 wherein said generator assembly includes a power pack, a plurality of octavely related cascaded generator units, and a frame, said power pack and said generator units being mounted on plates removably mounted to said frame, said power pack and generator units having plug-in connector means whereby said generator assembly can be completely disconnected from other units in the organ and bodily removed therefrom.

4. The structure claimed in claim 3 wherein said switch assemblies include a plurality of switches for each key in the playing key sets, wherein the switches of each such plurality handle octavely related tones, said connector board being mounted with respect to one of said switch assemblies, wired to both switch assemblies so as to connect switches from the said pluralities to the same generators, and further wired so as to provide plug-in cables for connection with said cascaded generator units.

5. The structure claimed in claim 4 wherein the switches of the several pluralities are interconnected at the output side to form headers for tones of four foot, eight foot, and like frequencies, said headers terminating in cables having plug-in connections with receptacles on said voice box.

6. The structure claimed in claim 5 wherein said interconnections forming headers are provided with resistive networks for balancing the scale.

7. The structure claimed in claim 6 wherein said power pack and said generator units have thermionic tubes, said tubes being mounted in sockets on said plates so that said tubes are available for replacement without disassembly of said generator assembly.

8. The structure claimed in claim 7 wherein said voice box contains filter circuits selectively operated by said switches connected with said stop mechanisms, and wherein said voice box con-

tains thermionic apparatus and plug-in connector means for connecting said thermionic apparatus with the said power pack in said generator assembly.

9. The structure claimed in claim 8 wherein said thermionic apparatus comprises a preamplifier and an outphasing means.

10. The structure claimed in claim 9 wherein said thermionic apparatus comprises thermionic tubes, said voice box having receptacles for said tubes at its rear face so that said tubes may be located outside said voice box for ready replacement.

11. The structure claimed in claim 10 wherein said power pack contains a generator operating at a subaudio frequency and connected to the several cascaded generator units for imparting vibrato to the outputs thereof, and wherein said last-mentioned plug-in connector includes leads connected with said subaudio generator, said leads being connected with switching means mounted on said voice box and having an operating shaft extending therefrom through said upper front board.

12. The structure claimed in claim 11 wherein the sets of playing keys are divided into a swell manual and a great manual, wherein the header leads from the swell manual include four foot and eight foot header leads, wherein the header leads from the great manual including four foot, eight foot and sixteen foot header leads together with a reverse four foot header lead connected to the opposite end of the four foot resistive network, and wherein said several leads are connected within the voice box to a plurality of filter circuits.

13. The structure claimed in claim 12 wherein the last mentioned connections include means operated by a stop mechanism for coupling the swell and great organ manuals.

14. The structure claimed in claim 13 wherein certain of said filter circuits include connections to said out-phasing means such that in said filter circuits four foot and eight foot oscillations are combined in out-of-phase relationship.

15. The structure claimed in claim 14 wherein the console is provided with a pedal clavier having pedal keys, wherein switches are arranged to be operated by said pedal keys, and wherein said switches are wired to said connector board so as to be connected therethrough to generators in said generator assemblies and so as to provide pedal clavier headers for eight foot and sixteen foot oscillations, said headers having a plug-in connection with said voice box.

16. The structure claimed in claim 15 wherein said last mentioned headers are connected within said voice box to filter circuits operated by stop tab mechanisms.

17. The structure claimed in claim 16 wherein the eight foot pedal header is connected within said voice box with means for coupling it to the eight foot header from the great manual.

18. The structure claimed in claim 17 wherein said preamplifier is provided with tone control means, said tone control means mounted on said voice box and having an operating shaft extending through said upper front board.

19. The structure claimed in claim 18 wherein said preamplifier is connected to a plug-in receptacle on said voice box, and wherein said receptacle includes connections to a switch for selectively operating main and echo loud speakers, and wherein said switch has an operating shaft extending through said upper front board.

20. The structure claimed in claim 19 wherein said console is provided interiorly with a main distributor box, and is further provided with a volume control means operated by a pedal accessible through an opening in a lower front board, and wherein said volume control means and said distributor box have a common plug-in connection with said last mentioned receptacle.

21. The structure claimed in claim 20 wherein said distributor box is provided with a plug-in cable connection to a source of power, wherein said distributor box is provided with a plug-in cable connection for delivering power to said power pack, and wherein said distributor box is provided with a pair of plug-in receptacles for delivering power and signal to main and echo loud speaker and amplifier assemblies.

22. The structure claimed in claim 21 wherein the said power cable from said distributor box is interrupted therein by a plug-in receptacle, said plug-in receptacle having a cable connection with a main switch for said organ, said main switch having operating means extending through said upper front board.

23. The structure claimed in claim 22 wherein said voice box is provided with a lamp connected into electric circuits of said organ in such a way that it will be energized when power is applied to said organ, said lamp having a jewel and mounting extending through a perforation in said upper front board.

24. In an electric organ, a console having upright side members, a key bed extending across between said members, sets of playing keys mounted in partially offset superposed relationship above said bed, and a console front board above the upper set of keys, playing key switch assemblies for each set of playing keys mounted respectively on rails extending between said side members and located in positions to be actuated by said keys, a voice box assembly located above said switch assemblies and adjacent said upper front board, a unitary assembly of electric generators located behind said key bed, and a connector board, said generator assembly, said voice box assembly and said switch assemblies being removable as units from said console, said generator assembly and said switch assemblies having connections with said connector board, said generator assembly including a power pack, a plurality of octavely related cascaded generator units, and a frame, said power pack and said generator units being mounted on plates removably mounted to said frame, said power pack and generator units having plug-in connector means whereby said generator assembly can be completely disconnected from other units in the organ and bodily removed therefrom.

25. In an electric organ a console having upright side members, a key bed extending across between said members, sets of playing keys mounted in partially offset superposed relationship above said bed, and a console front board above the upper set of keys, playing key switch assemblies for each set of playing keys mounted respectively on rails extending between said side members and located in positions to be actuated by said keys, a voice box assembly located above said switch assemblies and adjacent said upper front board, a unitary assembly of electric generators located behind said key bed, and a connector board, said generator assembly, said voice box assembly and said switch assemblies being removable as units from said console, said generator assembly and said switch assemblies hav-

ing connections with said connector board, said switch assemblies including a plurality of switches for each key in the playing key sets, the switches of each such plurality being arranged to handle octavely related tones, said connector board being mounted with respect to one of said switch assemblies, wired to both switch assemblies so as to connect switches from the said pluralities to the same generators, and further wired so as to provide plug-in cables for connection with said assembly of electric generators.

26. The structure claimed in claim 25 wherein the switches of the several pluralities are interconnected at the output side to form headers for tones of four foot, eight foot, and like frequencies, said headers terminating in cables having plug-in connections with receptacles on said voice box, said interconnections forming headers being provided with resistive networks for balancing the scale.

27. The structure claimed in claim 26 wherein the sets of playing keys are divided into a swell manual and a great manual, wherein the header leads from the swell manual include four foot and eight foot header leads, wherein the header leads from the great manual include four foot, eight foot and sixteen foot header leads together with a reverse four foot header lead connected to the opposite end of the four foot resistive network, and wherein said several leads are connected within the voice box to a plurality of filter circuits.

28. In an electric organ a console having upright side members, a key bed extending across between said members, sets of playing keys mounted in partially offset superposed relationship above said bed, and a console front board above the upper set of keys, playing key switch assemblies for each set of playing keys mounted respectively on rails extending between said side members and located in positions to be actuated by said keys, a voice box assembly located above said switch assemblies and adjacent said upper front board, a unitary assembly of electric generators located behind said key bed, and a connector board, said generator assembly, said voice box assembly and said switch assemblies being removable as units from said console, said generator assembly and said switch assemblies having connections with said connector board, said voice box assembly being provided with stop mechanisms operating switches therein, said stop mechanisms having stop tabs projecting forwardly from said voice box and extending through perforations in said upper front board, said generator assembly including a power pack, a plurality of octavely related cascaded generator units, and a frame, said power pack and said generator units being mounted on plates removably mounted to said frame, said power pack and generator units having plug-in connector means whereby said generator assembly can be completely disconnected from other units in the organ and bodily removed therefrom, said voice box containing filter circuits selectively operated by said switches connected with said stop mechanisms, said voice box containing thermionic apparatus and plug-in connector means for connecting said thermionic apparatus with the said power pack in said generator assembly.

29. In an electric organ a console having upright side members, a key bed extending across between said members, sets of playing keys mounted in partially offset superposed relationship above said bed, and a console front board

above the upper set of keys, playing key switch assemblies for each set of playing keys mounted respectively on rails extending between said side members and located in positions to be actuated by said keys, a voice box assembly located above said switch assemblies and adjacent said upper front board, a unitary assembly of electric generators located behind said key bed, and a connector board, said generator assembly, said voice box assembly and said switch assemblies being removable as units from said console, said generator assembly and said switch assemblies having connections with said connector board, said console being provided with a pedal clavier having pedal keys, and switches arranged to be operated by said pedal keys, said switches being wired to said connector board so as to be connected therethrough to generators in said generator assemblies and so as to provide pedal clavier headers for eight foot and sixteen foot oscillations, said headers having a plug-in connection with said voice box.

30. In an electric organ, a console having a set of playing keys, an assembly of octavely-related cascaded generator units, an assembly of switches in said console, said assembly comprising a plurality of switches for each key in said set, said switches of each such plurality handling octavely related tones, a connector board, said switches being wired to said connector board, plug-in connections from said connector board to respective generator units, a power pack in said generator assembly, a voice box removable as a unit from said console, plug-in connections between said voice box and said power pack, and plug-in connections between said voice box and said key switches.

31. The electric organ of claim 30 wherein the switches of the several pluralities are interconnected at the output side to form headers for tones of four foot, eight foot, and like frequencies, said headers being between said key switches and said last mentioned plug-in connections.

32. In an electric organ, a console having playing keys, switches in said console operated by said keys, a connector board, said switches being wired to said connector board, an assembly of generators in said console, plug-in connections from said connector board to the respective generators, a voice box removable as a unit from said console, and plug-in connections between said voice box and said key switches.

33. In an electric organ, a console having playing keys, switches in said console operated by said keys, a connector board, said switches being wired to said connector board, an assembly of generators in said console, plug-in connections from said connector board to the respective generators, a power pack in said assembly, a voice box removable as a unit from said console, and plug-in connections between said voice box and said power pack, and plug-in connections between said voice box and said key switches.

34. In an electric organ, a console having playing keys, switches in said console operated by said keys, a connector board, said switches being wired to said connector board, an assembly of generators removable as a unit from said console, plug-in connections from said connector board to the respective generators, a main distributor box, a power-pack in said generator assembly, and a plug-in connection between said distributor box and said power pack.

35. The structure claimed in claim 34 including a voice box removable as a unit from said

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console and plug-in connections between said voice box and said power pack, between said voice box and said key switches, and between said voice box and said distributor box.

36. The structure claimed in claim 35 in which said console has a pedal operated volume control means and wherein said connection between said voice box and said distributor box includes a connection to said volume control means.

JOHN F. JORDAN.

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