

May 29, 1951

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2,555,039

GENERATOR ASSEMBLY IN ELECTRICAL MUSICAL INSTRUMENT

Filed Feb. 13, 1947

3 Sheets-Sheet 1

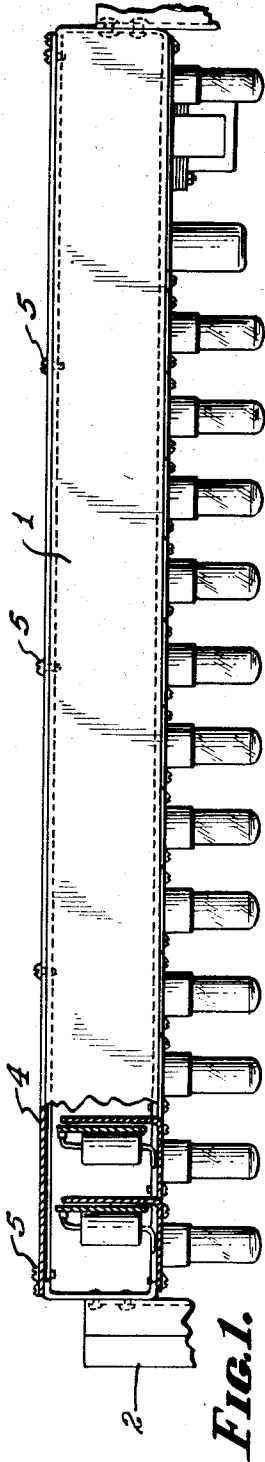


Fig. 1.

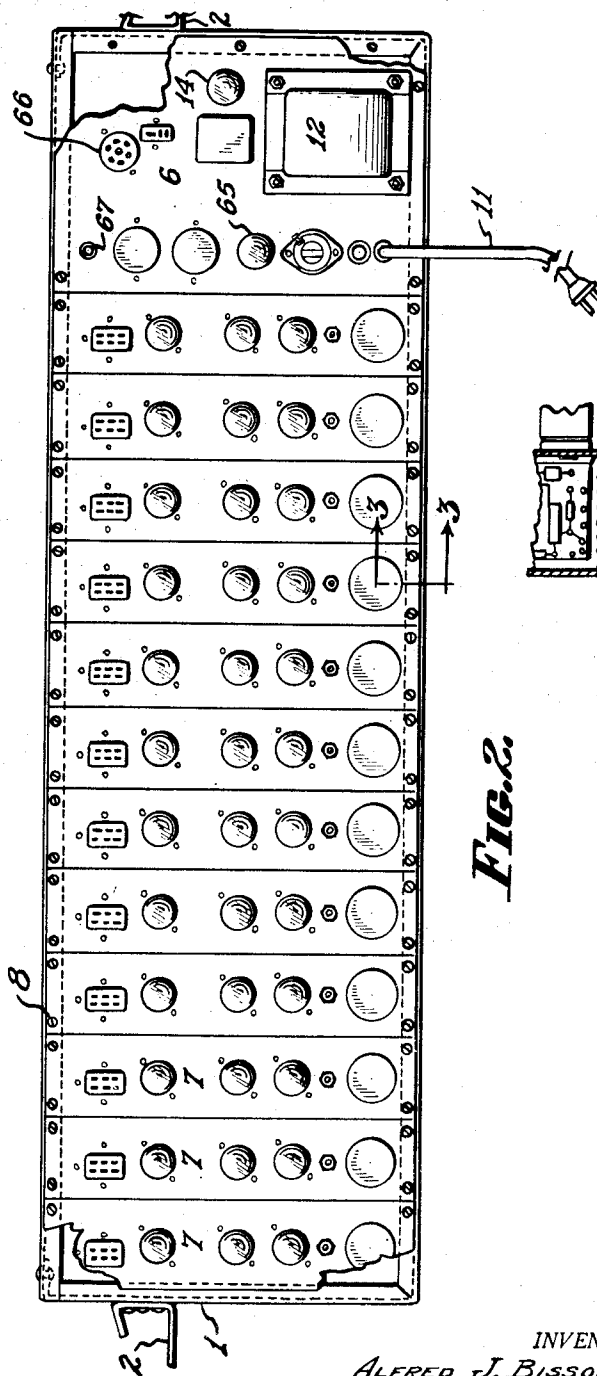


Fig. 2.

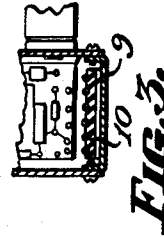


Fig. 3.

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3 Sheets-Sheet 2

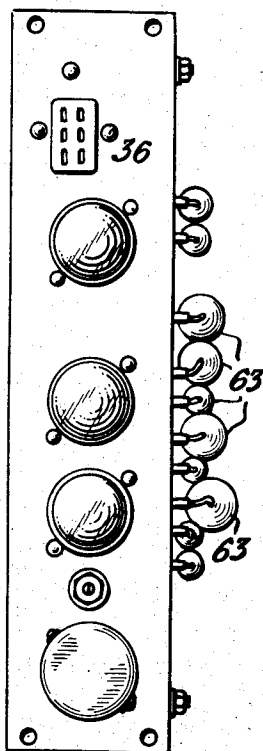


FIG. 4.

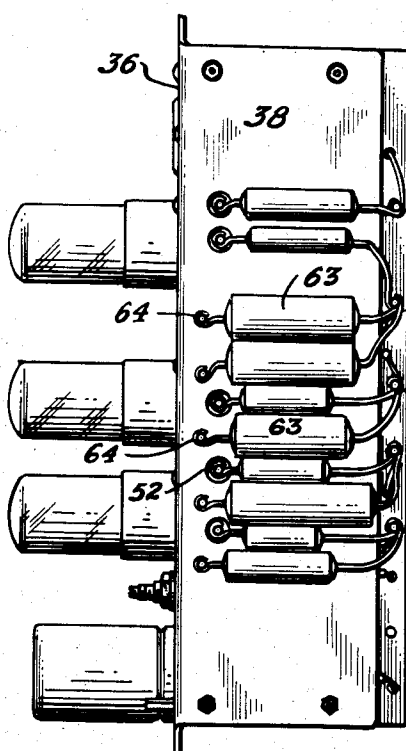


FIG. 5.

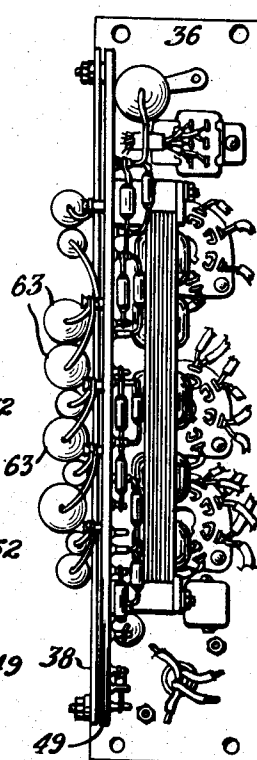


FIG. 6.

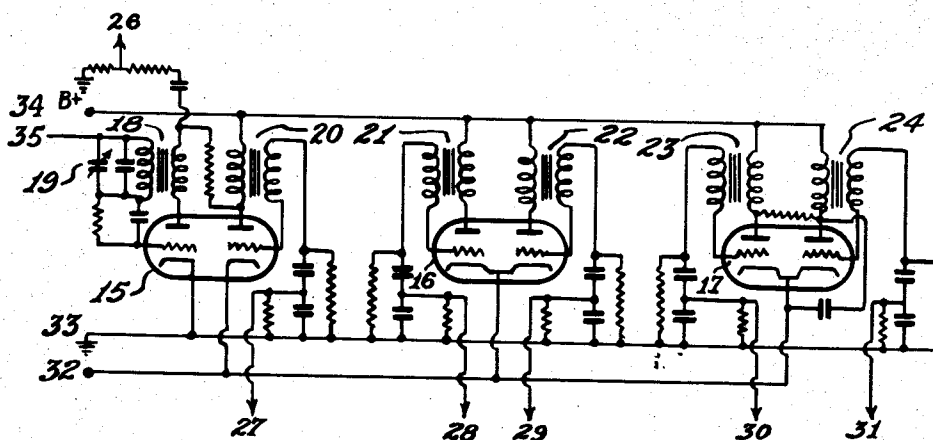


FIG. 7.

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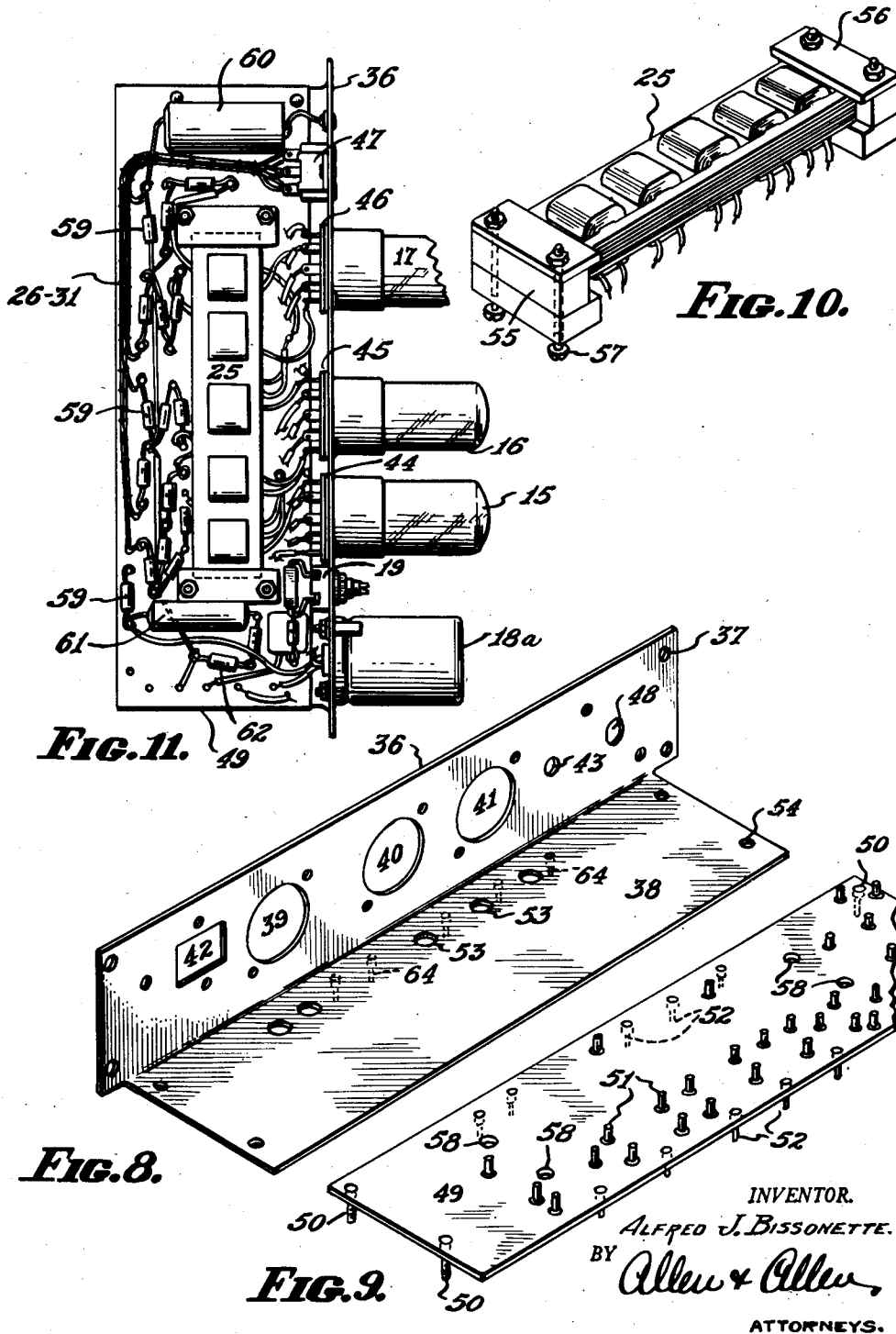
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GENERATOR ASSEMBLY IN ELECTRICAL MUSICAL INSTRUMENT

Filed Feb. 13, 1947

3 Sheets-Sheet 3



UNITED STATES PATENT OFFICE

2,555,039

GENERATOR ASSEMBLY IN ELECTRICAL
MUSICAL INSTRUMENTS

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Application February 13, 1947, Serial No. 728,220

17 Claims. (Cl. 84—1.01)

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My invention relates to the mechanical problems of providing generator assemblies such as may be employed for polyphonic musical instruments in which oscillatory circuits are provided for the generation of musical tones.

In an exemplary instrument of this type a generator circuit involving a thermionic tube structure and associated parts is provided for each note of the musical scale within the range of the instrument, although the swell and great manuals and the pedal manual may derive their tonal output from the same bank of generators. In such an instrument 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 a sub-audio generator for imparting a tremolo to the remainder. 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. Thus, there will be a group of generators, or a generator system, for all of the A notes of the instrument. This group comprises a master oscillator having the frequency of the highest A and a plurality of controlled generators in cascade. The controlled generators are arranged to be incapable of self-oscillation, but produce oscillations by discharges triggered by pulses from either a master oscillator or a controlled generator next above in the octave. The master oscillator and controlled generators are thus so arranged that the highest controls the next lowest, which in turn controls the third, and so on. 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 tubes used elsewhere in the instrument, such as in the power pack, the voicing means, the preamplifier, and the amplifier.

The utility of my invention is not limited to the exemplary instrument which has briefly been described, nor to the number and arrangement of generating units therein. But the reference above to an exemplary instrument will indicate the great complexity of elements involved in a suitable generating system and the origin of a number of the specific problems to which my invention is addressed.

The fundamental object of my invention is the provision in as inexpensive a fashion as possible of an assembly of generator and power pack units as a structural element in an instrument.

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It is an object of the invention also to provide a novel simplified and economical unit assembly for each generator group or cascade unit.

It is an object of my invention to provide a generator assembly which is in unitary structure capable of being installed in or removed from an electrical musical instrument with a minimum of disturbance of other units and without the disturbance of permanent electrical connections. Thus, it is an object of my invention to provide a generator and power pack assembly capable of being attached to or disconnected from the other electrical elements of the instrument by simple plug-in connections.

It is an object of my invention to provide a power pack and generator assembly which not only is self-contained, but occupies a minimum of space in the instrument, and hence is capable of advantageous placement in the console.

It is an object of my invention to provide an assembly of power pack and generator units in which the fabricating and wiring have been greatly simplified.

It is an object of my invention to provide an assembly of power pack and generator units in which the individual generator cascade units are displaceable individually for adjustment, repair, or replacement of parts without disturbing adjacent units.

It is an object of my invention to provide an assembly in which entire cascade units may be removed and replaced with a minimum of soldered connections.

It is an object of my invention to provide an assembly of power pack and generators in which all thermionic tubes, all plug-in connections, and all adjustable tuning means are available from a single side and without any disassembly.

These and other objects of my invention which will be set forth hereinafter or will be apparent to one skilled in the art upon reading these specifications, I accomplish in that construction and arrangement of parts of which I shall now disclose an exemplary embodiment. Reference is made to the accompanying drawings, wherein:

Figure 1 is a plan view with parts in section of my assembly of power pack and generators.

Figure 2 is a vertical elevation thereof.

Figure 3 is a partial sectional view taken along the line 3—3 of Figure 2.

Figures 4, 5, and 6 are, respectively, a vertical or front elevation, a side elevation, and a back elevational view of my individual cascade unit.

Figure 7 is a circuit diagram indicative of the circuit elements of an individual cascade unit in its preferred form.

Figure 8 is a perspective view of the metal frame element of one of my cascade units.

Figure 9 is a perspective view of an insulating connector plate employed by me.

Figure 10 is a perspective view of a multiple-transformer unit and its mounting as employed in my units.

Figure 11 is an elevational view of one of my units from the side opposite that shown in Figure 5.

In the practice of my invention, I provide a frame 1 (Figures 1 and 2) formed of channel shaped elements. At each end of the frame, I attach mounting means 2 by which the frame may be suspended in the console in a musical instrument. While it is not a limitation on my invention, the frame is usually hung in a vertical position inside the rear of the console, the mounting means 2 engaging suitable rails therein. The unexposed side of the frame may be closed by a metal plate 4, held in place by screws 5 or the like engaging arms of the channels of the main frame. The exposed side of the frame is closed by the face plates of a power pack assembly indicated at 6 and a plurality of individual cascade unit assemblies 7. There are twelve of these, representative of the twelve semitones in the equitempered musical scale.

The units 6 and 7 have flange portions for attachment to the frame 1 as by means of removable screws 8.

Inside one of the side rails of the frame, I mount an insulative panel 9 (Figure 3). This panel has embedded in it, or otherwise carries, a plurality of bus bars or wires 10. There are in the exemplary embodiment six of these, serving as follows:

Two are for supplying electric power for the cathode heaters of the various tubes in the generator cascade units, one is for the positive B voltage supply, another is for the positive voltage supply biasing the cathodes of the controlled generators, another is for the tremolo voltage, and the final one is for ground connections. Flexible leads from the power pack unit 6 are connected to these bus bars, as are also flexible leads from the individual cascade units, the leads being long enough to permit any of these units to be detached from the frame 1 and pulled outwardly for repair or adjustment. Any unit can, of course, be entirely removed upon unsoldering its flexible lead connections to the bus bars, and without disturbing adjacent units. Excepting for the bus bars 10, the frame of my assembly carries none of the electrical connections. All wiring of the individual units, excepting the flexible leads connected to the bus bars, is brought to a plug-in receptacle for each generator unit, as will hereinafter be described, or to a flexible power connection from the power pack unit, as indicated at 11. It is the practice in the exemplary instrument to provide in the lower part of the console a connection box into which may be plugged the flexible cable 11 and any other connections to power consuming parts of the instrument, as well as a connection to the main amplifier and loud speaker, usually located outside the console. It will be evident that by unplugging the connections to each of the individual cascade units, and by unplugging the flexible lead 11, my entire generator assembly may be taken from the console of the instrument, without breaking any other electrical connections.

The power pack, indicated generally at 6, is built up on a plate, as shown, which may be fastened to the frame 1. The elements going to

make up the power pack may be mounted to either side of the plate. The transformer 12 for the power pack may be mounted to the outside of the plate as well as power pack condenser elements, if desired; and it is advantageous to provide the plate with sockets for the acceptance of such elements as rectifier tube 14 so that these may extend from the outer surface of the plate and be readily replaced. The electrical details of the power pack proper do not form a limitation on this invention. It will be understood that suitable leads from power pack elements are connected to the bus bars 10. In the exemplary embodiment certain other elements will be mounted to the power pack mounting plate as will hereinafter be set forth, certain of these elements comprising an oscillator at sub-audio frequency to impart a tremolo to the various generator cascade units.

The circuit arrangement for an exemplary and preferred cascade generator unit is shown in Figure 7. 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, 1943, 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 15, 16, and 17. The first section of the first tube is used for a master oscillator and has an appropriate circuit for that purpose including a transformer 18, a variable capacity 19 in the nature of a trimmer condenser and various other elements including fixed condensers and resistors. The controlled generators utilize the remaining tube sections. These generators have each a transformer 20, 21, 22, 23, or 24. The cascade coupling between the controlled generators is inductive, and in the preferred embodiment the several transformers 20 to 24 have their windings located upon a common magnetic core. Such a structure is illustrated at 25 in Figure 10.

Each controlled 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 the diagram of Figure 7, the signal leads are indicated at 26, 27, 28, 29, 30, and 31. The cathodes of the tube sections of the several controlled generators are biased to a positive potential serving to prevent continuous oscillation in these generators. A lead for this potential is indicated at 32. There is also a grounded lead 33, a lead 34 for the positive plate potential of the several generators and a lead 35 by means of which the grid circuit of the master oscillator may be connected with the tremolo frequency generator mentioned above. These four leads, 32 to 35, 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 10, described above.

In forming my cascade unit assemblies, I first provide the basic elements illustrated in Figures 8 and 9. A metal plate 36 forms the main support of each such unit. It is of a length to extend across between the side elements of the

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frame 1 and may be perforated as at 37 for the acceptance of screws by which it may be attached to the frame. It has an angular, preferably integral, metal extension 38 of a length permitting it to fit between the side elements of the frame and a depth somewhat less than the depth of the frame. The plate 36 is perforated as at 39, 40, and 41 to expose socket members for the several thermionic tubes 15, 16, and 17. It is perforated as at 42 to receive the six-contact plug-in receptacles which have been mentioned. It is perforated as at 43 to permit passage of the operating element of the variable tuning condenser 19. Other perforations may be provided as shown for the passage of rivets or the like to hold these elements in place. Reference to Figure 11 will show the tuning condenser 19, socket elements 44, 45, and 46, and the plug-in receptacle 47 mounted to the underside of the plate 36. The tubes 15, 16, and 17 are also shown engaged in the sockets.

The transformer 18 for the master oscillator is preferably contained in a can 18a, and being somewhat bulky is conveniently mounted on the face side of the plate 36, as shown. A perforation 48 is provided in the plate 36 and is preferably lined with an insulating grommet for the passage of the leads from the transformer 18. I provide next an insulative connector plate or panel 49. This plate is to be connected to the angle flange 38 as by means of screws 50 or other suitable fastening means. The connector plate 49 will be spaced from the metal flange 38 as shown in Figure 6. For the convenient formation of soldered connections between electrical circuit elements as well as for retaining these elements in position where their size and weight is such as to permit them to be mounted by soldered connections, I provide the mounting plate with a number of tubular grommets firmly mounted in perforations in the plate. Some of the grommets, as at 51, extend from the inside surface of the plate, while others, as at 52, extend from the outside surface. This permits the mounting of circuit elements to both sides of the connector plate. Perforations, as at 53, are provided in the angular flange 38, to give access from beyond the flange to grommets extending from the outer surface of the connector plate. These perforations are large enough to avoid contact between the flange and the grommets. The flange 38 is also perforated as at 54 to accept the mounting bolts 50 for the connector plate.

The transformer structure 25 (Figure 10) is mounted to the connector plate by means of suitable fixtures 55 and 56 and bolts 57, the connector plate being perforated as at 58 for the acceptance of these bolts. Various other circuit elements such as the resistors 59 forming part of the networks mentioned above may be mounted in place between the appropriate grommets. Connections from the windings of the transformer structure 25 may be made to these resistors, and the various leads soldered to the several grommets. Connections may also be made in this fashion to the several signal take-off leads 26 to 31, inclusive, which may be formed into a combined cable, so marked.

Certain other circuit elements, such as condensers 60 and 61, resistors 62, and the like, may be mounted to the inner surface of the connector plate 49; but the greater number of the capacitative elements, being bulky, are preferably mounted to the outer surface of the connector plate, as will hereinafter be described. A sub-

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stantial part of the wiring of the generator cascade unit can, however, be done on the connector plate 49 before this is attached to the metal flange 38. When the attachment has been made, it then becomes possible to complete another very substantial part of the wiring. The cable containing the leads 26 to 31 is connected to the various terminal eyelets of the plug-in receptacle 47. Likewise, the tube sockets 44, 45, and 46 may be wired to the windings of the transformer unit 25. The tuning condenser 19 and associated parts, as well as the transformer 18 of the master oscillator, may be connected into the several circuits. Flexible leads (not shown) are provided for soldering to the bus bars 10 when the generator cascade unit is installed in the frame 1.

In these ways, the wiring for the generator cascade unit may be substantially completed, excepting for the installation and wiring of certain condensers forming parts of the networks set forth above. These condensers are preferably installed beyond the outer surface of the connector plate 49 and beyond the metal flange 38. The positions of these condensers can be most clearly understood from Figures 4, 5, and 6, where they are indicated generally at 63. Again these elements may be held in place solely by the soldered connections between their leads and the grommets 52 extending from the outer surface of the connector plate 49. Where the circuit connections require grounding, of course, connections may be made directly with the metal plate 36 or the flange 38, and these may be provided with grommets as at 64 to facilitate the making of these connections.

The metal flange 38 lies at one side of the plate 36, and hence condensers of the group 63 extend beyond the dimensional limits of the plate 36, as will be evident in Figures 4 and 6. But, as will also be evident from the latter of these figures, there is a substantial unoccupied space beneath the plate 36 extending inwardly from the opposite edge thereof. Thus, the condensers of the group 63 of any one cascade generator unit can occupy this space beneath the plate 36 of the next adjacent generator unit, or beneath the plate of the power pack unit G, as the case may be. The several plates of the cascade generator units and the plate of the power pack unit may thus come together in side by side relationship, covering the entire area of one side of the frame 1 and making a substantially dust-tight construction, as will be clear from Figures 1 and 2. Yet, any of these units may be detached from the frame and pulled outwardly to the extension permitted by the length of the flexible leads from that unit to the bus bars 10. In this way, most repairs, adjustments or replacements which are capable of being made on the job can be easily and effectively done. Where it becomes necessary for any reason to remove and substitute an entire unit, whether power pack or generator, it is only necessary to unsolder the connections between the said flexible leads and the said bus bars. For a guide to the repair man in effecting such changes, the six flexible leads from each unit may be colored differently or otherwise marked.

The several cascade generator units are each arranged to produce six octavely related frequencies, thus providing an instrument with a range of 72 semi-tones. For some purposes, one or more additional notes are desired. In the exemplary instrument, a C note an octave lower

than the lowest note in the C cascade generator unit is provided. To this end I mount in the power pack a socket for another double thermionic tube 65. Half of this tube is wired to circuit elements appropriate for discharge at the required frequency. These circuit elements are mounted to the power pack panel. Discharge is triggered by a connection between these circuit elements and the last controlled generator in the C cascade generator unit. The connection is not shown but is easily effected by means of a flexible lead, the C cascade generator unit being located adjacent the power pack. A signal take-off for the low C generator is wired to a jack or a connector 66.

The other half of the tube 65 is employed, together with appropriate circuit elements, in the formation of an oscillator operating at a sub-audio frequency appropriate for a tremolo. The circuit elements are likewise mounted to the power pack plate. The output lead for the sub-audio generator is connected to one of the bus bars 10, as has already been indicated.

Additional leads may be desired to the power pack assembly. In another part of the instrument containing various filter means for voicing, it may be desired to provide electronic means acting as a pre-amplifier, and electronic means for outphasing the signal from one of the collector headers. Power for the heaters and plates in these electronic means is conveniently derived from the power pack in the generator assembly. Also it is usually desired to control the tremolo oscillator, either to render it effective or ineffective in imparting vibrato (frequency tremolo) to all generators, or to control the strength of signals from the tremolo oscillator and hence the degree of vibrato imposed upon the generator signals. In the preferred embodiment the latter is done by varying the plate current of the tremolo oscillator with a potentiometer having an operating handle on the front board of the organ.

To take care of these various leads I provide on the mounting plate of the power pack of my generator assembly, a plug-in receptacle 66. This receptacle presents six contact means, appropriately connected to the various circuits of the power pack assembly, and comprising two contact means for vibrato control, two contact means for the heater supply for electronic tubes located elsewhere, one contact means for plate voltage supply, and one grounded contact means.

In the described construction of my cascade generator units it will be seen that I have arrived at a self-contained construction in which assembly and wiring are easily done and have been simplified as much as possible. The entire generator assembly is complete with all units and with the power pack. The connections between the generator assembly and the remainder of the electrical musical instruments (which are simply the connections to the signal leads 26 to 31, inclusive, of each cascade generator unit, plus the additional one aforesaid), are made in the exemplary embodiment to a connector panel elsewhere in the musical instrument. From this panel extend twelve flexible, six-wire cables terminating in six-prong plug-in connectors engageable with the receptacles 47. One of these cables has an extra wire and a bayonet connector adapted to be plugged into the jack or receptacle 67 on the power pack. The flexible power cable 11 can readily be unplugged from the connection box aforesaid; and my entire generator and

power pack assembly may thus be removed from an instrument and replaced as may be desired.

It will be also noted that tuning of the generator system may be accomplished by manipulation of the tuning condensers 19 without disassembling anything. Further, the replacement of any of the tubes in the power pack or generator units may be accomplished without the removal of any parts.

A further advantage of my unit assemblies for the cascade generators is that the unit assemblies lend themselves to treatment of the several electrical parts after wiring, as where it is desired to moisture-proof them by dipping.

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 a unitary assembly of generators for the purpose described, a frame, electric power pack means mounted to a plate attachable to said frame, a plurality of generator units each comprising generators for the production of all the octavely related oscillations for one of the half-tones of a musical scale and each mounted to a plate attachable to said frame, the aggregate area of the several plates, including said first mentioned plate, serving to close one side of said frame, a series of bus bars mounted within said frame, and connections between said power pack and generator units to said bus bars, said connections being flexible and of sufficient length to permit detachment of a plate from said frame and displacement of said plate and the unit or power pack supported thereby from said frame to permit adjustment and repair without disconnection and without disturbing any of the other of said units.
2. In a unitary assembly of generators for the purpose described, a frame, electric power pack means mounted to a plate attachable to said frame, a plurality of generator units each comprising generators for the production of all the octavely related oscillations for one of the half-tones of a musical scale and each mounted to a plate attachable to said frame, the aggregate area of the several plates serving to close one side of said frame, a series of bus bars mounted within said frame, and connections between said power pack and generator units to said bus bars, said connections being flexible and of sufficient length to permit detachment of a plate from said frame and displacement of said plate and the unit or power pack supported thereby from said frame to permit adjustment and repair without disconnection and without disturbing any of the other of said units, and a plate closing the opposite side of said frame.
3. In an assembly unit for the purpose described, a main plate, a mounting flange extending at an angle from said main plate, and an insulative connector plate attached to said flange and spaced therefrom, said connector plate overlying substantially all of said flange, said main plate having end portions extending beyond the ends of the other recited elements whereby said main plate may be fastened to a support, said main plate having perforations, and sockets for thermionic tubes mounted with respect to said perforations so that tubes may be engaged therein extending from the side of said main plate opposite said flange and insulative connector plate.
4. In an assembly unit for the purpose de-

scribed, a main plate, a mounting flange extending at an angle from said main plate, and an insulative connector plate attached to said flange, said main plate having end portions extending beyond the ends of the other recited elements whereby said main plate may be fastened to a support, said main plate having perforations, and sockets for thermionic tubes mounted with respect to said perforations so that tubes may be engaged therein extending from the side of said main plate opposite said flange, and a multi-lead, plug-in receptacle and a trimmer condenser also mounted to said main plate, both in a position of operative access from the side of said mounting plate opposite said flange.

5. In an assembly unit for the purpose described, a main plate, a mounting flange extending at an angle from said main plate, and an insulative connector plate attached to said flange, said main plate having end portions extending beyond the ends of the other recited elements whereby said main plate may be fastened to a support, said main plate having perforations, and sockets for thermionic tubes mounted with respect to said perforations so that tubes may be engaged therein extending from the side of said main plate opposite said flange, and a multi-lead, plug-in receptacle and a trimmer condenser also mounted to said main plate, both in a position of operative access from the side of said mounting plate opposite said flange, said connector plate having grommets engaged in perforations therein to which circuit elements for generator means may be wired whereby both to mount said elements and to connect them to other circuit elements.

6. In an assembly unit for the purpose described, a main plate, a mounting flange extending at an angle from said main plate, and an insulative connector plate attached to said flange, said main plate having end portions extending beyond the ends of the other recited elements whereby said main plate may be fastened to a support, said main plate having perforations, and sockets for thermionic tubes mounted with respect to said perforations so that tubes may be engaged therein extending from the side of said main plate opposite said flange, and a multi-lead, plug-in receptacle and a trimmer condenser also mounted to said main plate, both in a position of operative access from the side of said mounting plate opposite said flange, said connector plate having grommets engaged in perforations therein to which circuit elements for generator means may be wired whereby both to mount said elements and to connect them to other circuit elements, certain of said grommets having extensions to one side and certain having extensions to the other side of said connector plate, said flange being cut away around the grommets extending to its side, whereby circuit elements may be mounted to both sides of said connector plate.

7. A unit assembly for a series of coupled harmonically related generators which series comprises a master oscillatory generator having thermionic means, a transformer, and oscillatory circuit means, together with a plurality of control generators each having discharge circuit means and coupling means comprising transformer windings, said transformer windings being located upon a common core, said unit assembly comprising a metal plate, metal flange means angularly related thereto, and an insulative connector plate mounted on said flange means, said

metal plate bearing sockets for the thermionic tubes of the several generators, and tuning means for said master generator, said connector plate having mounting means for said common core, and connector means to which various circuit elements may be wired.

8. A unit assembly for a series of coupled harmonically related generators which series comprises a master oscillatory generator having thermionic means, a transformer, and oscillatory circuit means, together with a plurality of control generators each having discharge circuit means and coupling means comprising transformer windings, said transformer windings being located upon a common core, said unit assembly comprising a metal plate, metal flange means angularly related thereto, and an insulative connector plate mounted on said flange means, said metal plate bearing sockets for the thermionic tubes of the several generators, and tuning means for said master generator, said connector plate having mounting means for said common core, and connector means to which various circuit elements may be wired, said metal plate also carrying a plug-in connector for signal take-offs from said various generators.

9. A unit assembly for a series of coupled harmonically related generators which series comprises a master oscillatory generator having thermionic means, a transformer, and oscillatory circuit means, together with a plurality of control generators each having discharge circuit means and coupling means comprising transformer windings, said transformer windings being located upon a common core, said unit assembly comprising a metal plate, metal flange means angularly related thereto, and an insulative connector plate mounted on said flange means, said metal plate bearing sockets for the thermionic tubes of the several generators, and tuning means for said master generator, said connector plate having mounting means for said common core, and connector means to which various circuit elements may be wired, said metal plate also carrying a plug-in connector for signal take-offs from said various generators, and said unit assembly having flexible leads whereby it may be connected to power means, said metal plate having flange portions for connection to a mounting frame, and said flexible leads being of sufficient length to permit detachment of said metal plate from said mounting means and displacement of the unit for adjustment and repair without disconnection.

10. A unit assembly for a series of coupled harmonically related generators which series comprises a master oscillatory generator having thermionic means, a transformer, and oscillatory circuit means, together with a plurality of control generators each having discharge circuit means and coupling means comprising transformer windings, said transformer windings being located upon a common core, said unit assembly comprising a metal plate, metal flange means angularly related thereto, and an insulative connector plate mounted on said flange means, said metal plate bearing sockets for the thermionic tubes of the several generators, and tuning means for said master generator, said connector plate having mounting means for said common core, and connector means to which various circuit elements may be wired, said metal plate also carrying a plug-in connector for signal take-offs from said various generators, and said unit assembly having flexible leads whereby it may be connected

to power means, said metal plate having flange portions for connection to a mounting frame, and said flexible leads being of sufficient length to permit detachment of said metal plate from said mounting means and displacement of the unit for adjustment and repair without disconnection, certain of said circuit elements being mounted to one side of said connector plate and certain of said circuit elements being mounted to the other side beyond said angular flange means whereby said last circuit elements extend beyond an edge of said plate, the other edge of said plate extending sufficiently beyond the first mentioned circuit elements to permit the circuit elements of an adjacent unit assembly to extend therebeneath.

11. In an electrical musical instrument, a generator assembly comprising a frame having an open side and a closed side and a series of individually removable chassis units located in side by side relation and closing said open side at least in part, each unit comprising all the parts and electrical components required for the production of all the octavely related oscillations for one of the half-tones of a musical scale, each of said units being removable from said frame without disturbing any of the other of said units.

12. The instrument of claim 11 in which an additional unit comprising electric power pack means is provided, said additional unit being so mounted as to close a portion of said open side, said first mentioned units closing the remainder of said side.

13. The instrument of claim 12 in which there are twelve of said removable chassis units, there being twelve half-tones in said musical scale.

14. In an electrical musical instrument, a generator assembly comprising a frame having an open side and a closed side, a series of twelve individually removable chassis units closing a substantial portion of said open side, and an additional removable unit comprising electric power pack means, said additional unit serving to complete the closure of said open side, each of said twelve units comprising all the parts and electrical components required for the production of all the octavely related oscillations for one of the twelve half-tones of a musical scale, said frame and said units in close position comprising a dust-proof structure there being closure elements provided for the remaining sides of said frame, each of said units being removable from said frame without disturbing any of the other of said units.

15. In an assembly for the purpose described, a main plate, a mounting flange extending at an angle from said main plate, and an insulative connector plate attached to said flange, said main plate having end portions extending beyond the end of said plate whereby said plate may be fastened to a support, said main plate having perforations, and sockets for thermionic tubes mounted with respect to said perforations so that tubes may be engaged therein extending from the side of said main plate opposite said flange, and a multi-circuit connector and a variable im-

pedance element also mounted to said main plate.

16. In an assembly for the purpose described, a main plate, a mounting flange extending at an angle from said main plate, and an insulative connector plate attached to said flange, said main plate having end portions extending beyond the end of said plate whereby said plate may be fastened to a support, said main plate having perforations, and sockets for thermionic tubes mounted with respect to said perforations so that tubes may be engaged therein extending from the side of said main plate opposite said flange, and a multi-circuit connector and a variable impedance element also mounted to said main plate, said connector plate having connector members to which circuit elements for generator means may be wired whereby both to mount said elements and to connect them to other circuit elements.

17. In a unitary assembly of generators for the purpose described, a frame having channeled edges, electric power pack means mounted to a plate extending between said edges, a plurality of generator units each for the production of all the octavely related oscillations for one of the half-tones of a musical scale and each mounted to a plate extending between said edges, all of said plates closing a substantial portion of one side of said frame, a series of power distribution conductors mounted along one of said edges, connections between said power pack and said conductors, connections between each of said generator units and said conductors, and plug-in connectors on each generator unit plate for generator signal take-off connections.

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