March 13, 1951 T. R. ELLEFSON 2,545,023

ELECTRIC ORGAN

Filed May 9, 1949 2 Sheets-Sheet 1

Fig. 1

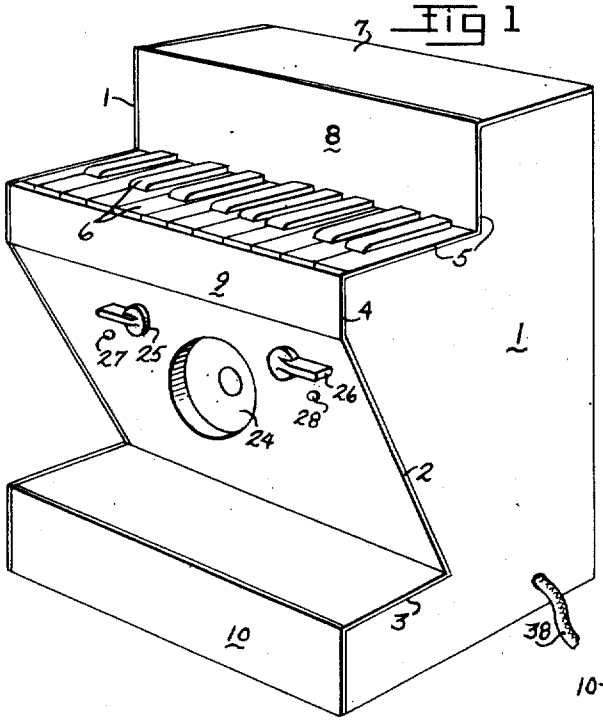


Fig. 2

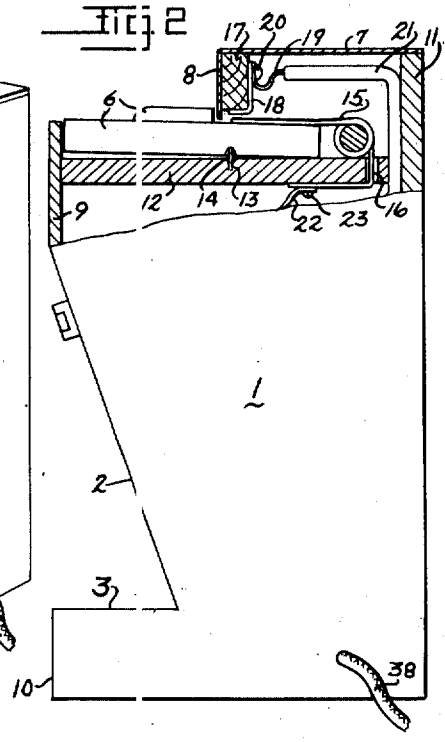


Fig. 3

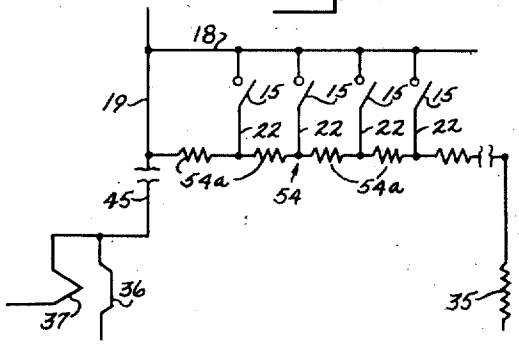


Fig. 4

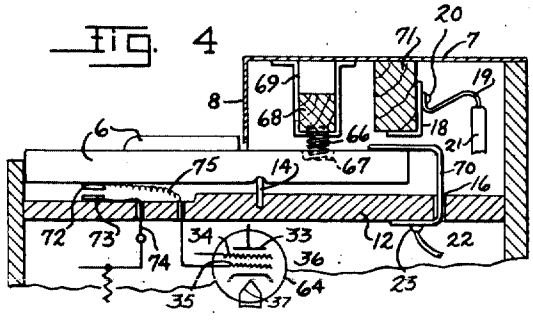
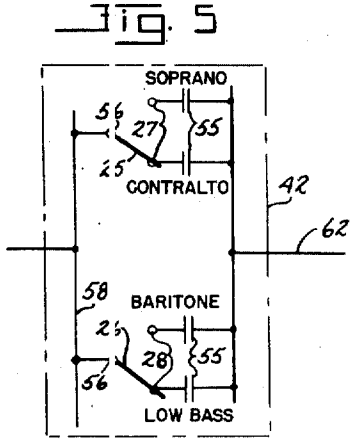


Fig. 5



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Fig. 6

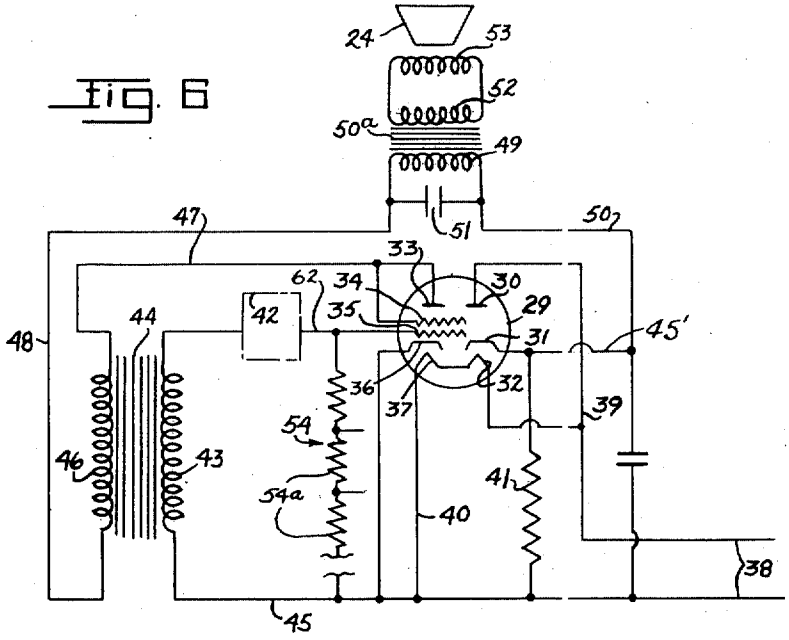


Fig. 8

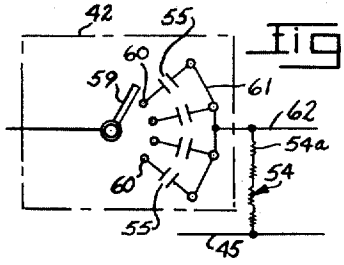


Fig. 7

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ELECTRIC ORGAN

Theodore R. Ellefson, Dayton, Ohio, assignor of one-third to Harold H. Singer and one-third to Morris P. Felman, both of Dayton, Ohio

Application May 9, 1949, Serial No. 92,116

9 Claims. (Cl. 84—1.01)

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The present invention relates to apparatus for producing sustained musical sounds and tones, more particularly to toy organs, although the principles of my invention can be equally applied to organs of conventional size or to organ attachments for any standard piano.

Many attempts have been made heretofore to provide an electric organ of practical design, using either a single controllable oscillator or a separate pre-tuned fixed oscillator for each of the various notes of the register, but in every case the making and breaking of the circuits has necessitated complicated and impractical structures. Even in those cases where the sustained notes are produced by a single thermionic oscillator in which the pitch is changed by a variable resistance under the control of the playing keys, the tune changing devices are inefficient, changeable with temperature conditions and key pressure, and in general, so expensive as not to be adaptable to toy organs.

The primary object of the invention is to provide an improved electric organ or organ attachment in which the operating parts are so effective, yet inexpensive, as to be readily adaptable to use as a toy.

Another object is to provide an improved toy electric organ in which the parts are so few in number and of such simple design as to be relatively inexpensive, thus permitting the toy to be sold at a reasonable price.

A still further object is to provide an improved electric organ or organ attachment employing an electric oscillator system of standard type, adaptable for alternating current, and with simple changes usable with direct current energization, together with a key-board of either limited or standard length.

A further object is to provide a toy organ which carries a number of tone stops, similar to a conventional organ, and in which the tone registers are effected by control knobs or switches, serving to raise or lower the average pitch of the organ in accurately pre-determined amounts.

An additional object is to provide an improved toy organ which will maintain the predetermined tone relation between notes and remain in tune regardless of changes of ambient temperature or humidity conditions.

A still further object is to provide a toy organ of study construction which can be readily disassembled, parts replaced, and which can be manufactured in quantity production with complete reproducibility of operation and tone per unit.

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Other objects and features will be apparent as the following specification is perused in connection with the accompanying drawings, in which:

Figure 1 represents a perspective view of the improved organ shown in toy form;

Figure 2 is a side elevational view of the organ with parts broken away to reveal the make and break mechanism for controlling the production of the tones;

Figure 3 shows the key-board and associated grid resistors, with the switch mechanism indicated diagrammatically for clearness;

Figure 4 is a fragmentary view of a modified form of the individual switching devices operated by the keys;

Figure 5 shows a system including a series of reactances, specifically condensers, for changing the pitch of the tones as a whole;

Figure 6 is an electrical system including the oscillator, rectifier and loud speaker employed in the improved organ for producing the musical sounds;

Figure 7 shows a modified system, somewhat similar to that illustrated in Figure 6, but including a different arrangement of oscillator and rectifier devices, and;

Figure 8 depicts a modified form of the tone changing condensers.

Referring more particularly to Figs. 1 and 2, reference character 1 designates the sides of a compartment, preferably made of an ornamental wood and sufficiently thin as to have good resonance characteristics. These side members are cut to an irregular shape with an inwardly tapering edge as indicated at 2, which meets with a horizontal portion 3 to give the effect of an ordinary organ console in miniature with a place left for imaginary foot pedals. These side pieces are provided with a vertical portion indicated at 4 and a combined stepped-back portion indicated at 5, the latter serving to accommodate a series of keys indicated at 6, black and white notes which extend slightly above the vertical side portion 4. These sides are connected together at the top by a transverse piece 7 of thin board, plywood, etc., and by a narrow vertical piece 8 just above the keys. A thin board 9 connects the portions 4 of the end members and, in addition, the vertical portion 10. Similar pieces of wood extend between the re-entrant portions 2, 3 of the end members, and the compartment or box is completely closed by means of a fairly thick back member 11.

There is a horizontally extending shelf 12 made of wood and positioned just below the upper edge

of the vertical piece 9, this shelf extending for the full width of the box and being made somewhat heavier than the side and the front portions as indicated in Fig. 2. A groove 13 is cut into the shelf member along its upper surface and about midway between the front member 9 and the back member 11 to receive an upright metal bar 14. Playing keys 6, preferably constituted of hardwood, and painted white and black, as in the case of an ordinary organ, rest upon the bar 14 and are located by means of a notch extending transversely across the lower surface of each of the keys. The latter are held in position against the bar by means of looped springs 15, the lower leg of which is secured to the shelf 12, and the upper leg is affixed in any suitable manner, as by simple pressure, to the upper surface of the playing keys.

The convolutions of the springs preferably rest on the upper surface of the shelf and openings 16 for receiving the short vertical portions of the springs just below these convolutions are provided in the shelf member. Thus, it is seen that the effect of the spring 15 is to press the rear portion of each of the playing keys, black and white, downwardly to elevate the front or playing surface of these keys. There is a block or bar of wood 17 secured within the corner of the box portions 7, 8 to which is attached an angular metal strap 18. The lower or bent portion of this strap is positioned directly above a portion of each of the springs 15 so that when the keys 6 are de-pressed to elevate their rear portions the springs 15 make respective contact with the bar 18 as long as the key or keys remain de-pressed. A conductor 19 is secured to the bar 18 by means of a screw 20, this conductor passing through an insulated cable 21 to an electrical system which will be described presently. Conductors 22, as many as there are springs and playing keys 6, are connected respectively to each of the springs and secured thereto by means of a screw indicated at 23. These conductors also extend to an electrical system.

As shown in Fig. 1, there is a loud speaker 24, conveniently located in the re-entrant front portion and also a pair of levers 25, 26, each of which may have two positions of which one per lever is indicated at 27, 28. The purpose of the loud speaker and levers will be described in connection with the system.

Referring to Fig. 6, I have illustrated a typical form of electrical system that can be used for translating the downward movements of the respective keys 6 into musical sounds at the loud speaker. In this figure, reference character 29 designates a combined tetrode and rectifier tube provided with an indirectly heated cathode. Tubes of this character can be procured on the open market. The rectifier unit is comprised of an anode 30, a cathode 31 and a filament or heater 32. The tetrode portion of the tube includes an anode 33, a screen grid 34, a control grid 35, a cathode 36 and a filamentary heater 37. The grid 34 is connected directly to the anode 33. The filamentary heaters 37 are connected together across the mains 38 of any suitable source of alternating voltage. The anode 30 of the rectifier portion of the tube is connected to the filamentary heater and to one side of the alternating current mains by a conductor 39. The other side of the heaters 32, 37 is connected through a conductor 40 to the other side of the mains.

The control grid 35 is connected through a tone changing system indicated by the dot-dash rectangle 42, then through the primary coil 43 of an audio frequency transformer 44 back to the cathode 36 through a conductor 45. The cathode 36 is connected to the conductor 45 and the cathode 31 is connected to the same conductor through a resistor 41. One terminal of the secondary 46 of the transformer 44 is connected through a conductor 47 to the anode 33 of the tetrode. The other terminal of the secondary is connected through a conductor 48 to one side of the primary coil 49 of an audio frequency transformer. The other side of the primary 49 is connected through a conductor 50 to one side of the line 38. A conductor 45' is connected between the cathode 31 and the conductor 50. A radio frequency condenser 51 is shunted across the winding 49. A secondary 52 of the transformer 50a is connected to the energizing coil 53 of a loud speaker 24 of any suitable and well known type.

A circuit of the type shown and described in connection with Fig. 6 constitutes an audio frequency oscillation generator, the feed back between the grid and anode circuits being obtained at the windings 43, 46. The tetrode portion of the tube 29 serves to translate the direct current furnished by the rectifier portion of the tube into audio frequency oscillations so that the oscillator and the rectifier portions of the tube perform their functions more or less independently of one another to provide considerable efficiency in changing the alternating current at the mains 38 into higher frequency currents of a musical range in the coil 49.

The frequency developed by the generator is determined in part by the combined grid resistor 54 and the combined grid condensers contained within the rectangle 42 which will be described presently.

Obviously any change in the resistors or condensers will cause the frequency of the generator to either raise or lower and thus produce a change in the pitch of the musical note emitted at the loud speaker. The grid leak 54 is constituted of a large number of individual resistors 54a interconnected in series and bridged between the grid 35 and the conductor 45. Connections 22 are taken from points, preferably equi-distantly spaced between the several resistance units, these conductors making contact with the individual springs 15 (Fig. 2). The elements 15 which are indicated as switches in Fig. 3 correspond with the circuit making portion of the springs 15 in Fig. 2 which make and break contact with the longitudinally extending bar 18. The latter is connected through the conductor 19 to the cathode 36 of the tube 29.

It is obvious that as any of the keys 6 are depressed and contact is made between the ends of the individual springs 15 and the plate or bar 18, variable amounts of the resistor 54 is short-circuited by the bar 18 to change the magnitude of the grid resistance and thus change the frequency generated by the tube 29. The magnitude of the various resistor units 54a is so predetermined as to give the proper variation in tone from note to note, and obviously this variation remains the same regardless of any temperature or humidity changes that might effect the resistance as a whole, because the parts change relatively in the same amount. Thus, increases or decreases of resistance in fixed amounts are effected by manipulating the playing keys 6 so that the generated frequencies are always in rela-

tive tune as translated into sound impulses at the loud speaker.

In order to prevent the production of a sustained audiable note during the periods that the keys are not being depressed, it is desirable to so predetermine the constants of the oscillation generator that the latter will generate oscillations only of inaudible frequency. This can be accomplished by proper selection of the magnitude of the grid resistor 54 as a whole. Thus when the value of this resistor is decreased, as by being partially short-circuited by the bar 18 upon manipulation of the keys, the generator will develop oscillations of an audible character and these oscillations will revert to inaudibility when none of the keys remain depressed. It is important that any direct current component of the generator output shall be completely excluded from the energizing coil 53 of the loud speaker in order that there shall be no excessive drain on the generator when a child would inadvertently leave the organ connected to the electric outlet, but more especially, to provide greater purity of tone in the speaker without the hampering effect of rectified direct current.

In order to give as much variety to the character of the tones as possible in a toy, I have provided a step by step variable condenser in the grid circuit. Referring to Fig. 5, a series of condensers 55 are connected in parallel to the grid 35 and brought out to contacts 27, 28. A pair of levers 25, 26, pivoted at 56, is arranged to make contact with any one condenser of the group. These levers are connected in parallel through a conductor 58 to one side of the primary winding 43.

Thus by moving one or the other of these levers to contact any one of the condensers 55, the latter is effectively inserted in the grid circuit, thereby serving to change the entire register of the notes emitted by the loud speaker. In other words, this register may be shifted to anyone of a soprano, contralto, baritone or low bass range, depending on which of the levers 25, 26 is operated and therefore which of the four condensers are inserted into the grid circuit. A child playing the toy organ can therefore obtain considerable variation in the character of the musical notes and this enhances the attraction of the toy.

Various other forms of condenser-inserting apparatus may be employed and another typical example is shown in Fig. 8 in which the condensers 55 are of different size to represent the various tone registers and contact is made to any one of these condensers by means of a lever 59 which can rest on one of the terminals 60 connected to one side of the respective condensers. A switching lever 59 may be connected to the winding 43, and the other side of the condensers is connected through a conductor 61 to the grid conductor 62.

Still another type of oscillation generator that can be employed in accordance with my invention is shown in Fig. 7. This system differs from Fig. 6 in using a rectifier tube 63 separate from the oscillation generator 64. These tubes 64, 63 are also of standard types, readily procureable on the market, and the heaters 37, 32 normally take a lower voltage than the tube 29 shown in Fig. 6 and for that reason may have to include a voltage reducing resistor 65. Inasmuch as the remaining elements shown in this figure are similar to those described in connection with Fig. 6, such elements have been given corresponding reference characters.

In general, the system in Fig. 7 operates similarly to that described in connection with Fig. 6 in that audio frequency oscillations are generated in the tube 64 which is supplied with rectified voltage by the tube 63. The frequency of these oscillations is momentarily changed by varying the magnitude of the resistor 54 upon de-pressing any one of the keys 6 and the tone register can be changed from soprano to contralto, etc. by simply changing the value of the grid resistor in the manner described in connection with Figs. 5 and 8. It will be noted that the system shown in Fig. 6 is a little more compact than that in Fig. 7 but the latter offers the advantage in case either the oscillation generator or the rectifier tube needs replacement, then only one of the tubes has to be replaced and does not involve a combined oscillator and rectifier tube which would be more expensive to purchase on the market.

While I prefer to employ the contact making and breaking structure shown in Fig. 2, which is simple to construct, less likely to get out of order and yet is very effective, nevertheless other structures can be used for the same purpose. In Fig. 4, the playing keys 6 are fulcrumed on the bar 14 and instead of employing a coil spring for holding the playing ends of the keys in an elevated position, I may employ a compression spring 66 for each key positioned between the bar 14 and the innermost end of the key. The spring is located in a circular socket 67 formed in each of the keys and enters a similar socket at the top formed in a wooden bar 68 which extends the length of the organ. The bar is supported by metal brackets 69 secured to the top cover 7 at the end or side members 1 of the compartment. Inverted C-shaped straps 70 may be secured to the lower surface of the shelf 12 and passing upwardly through the opening 16 to extend over the inner end of each key 6.

When the latter is depressed about the fulcrum 14, the upper horizontal end of the strap 70 is caused to move upwardly and to make contact with a metal strap 18 which is secured to a wooden bar 71 which extends along the length of the box. This bar is electrically connected through conductor 19 to the cathode 36 of the oscillator, while the clamp 70 is electrically connected through the conductor 22 to the grid 35 of the oscillator. Thus the spring 66 tends to keep the playing end of the keys 6 in an elevated position and when the latter is depressed the spring is compressed and the upper end of the strap 70 contacts the bar 18. Inasmuch as the conductors 22 are connected to fixed contacts on the grid resistor 54, the downward movement of the key will cause frequencies of different tone value to be generated by the oscillator in the same manner as described in connection with Fig. 2.

Another feature of my invention is in controlling the generation of oscillations to only that period when any one of the playing keys is depressed rather than have the oscillator continuously generate oscillations when none of the keys are depressed and in that manner involve energy that is not being used for audible sounds. Each of the playing keys carries a metal contact 72 which, when the key is depressed, is adapted to contact a metal strip 73 extending along the shelf 12. The bar is connected through a conductor 74 passing through the shelf to connect with one end of the winding 43. The individual contacts 72 are connected through a very flexible

wire 15 to the control grid 35 of the oscillator, this wire passing through an opening in the shelf 12. The arrangement is such that the grid circuit of the oscillator is open at all times except when any one of the keys is depressed, so that the oscillator will generate oscillations only during the time that any key is actually pressed downward. This arrangement conserves energy and obviously can be applied to the key depressing structure shown in Fig. 2, if desired.

The electrical inertia of the system shown in Figs. 6 and 7 is so small and also has such a sharp cut-off that even if any appreciable time elapses between depressing successive keys, the oscillator will not oscillate during this small, almost imperceptible period of time. The use of the make and break contacts 72, 73 are additionally desirable where it may be advantageous to prevent any residual current from passing through the loud speaker so that the latter is effective only during the time that the musical notes of desired tone are being emitted.

It will be understood that various modifications and arrangements in structure could be made without departing from the spirit of my invention and, accordingly, I desire to comprehend such modifications and substitutions of equivalents as may be considered to come within the scope of the appended claims.

Having thus fully described my invention, what I claim as new and desire to secure by Letters Patent, is:

1. A musical instrument comprising an audio frequency oscillation generator, including a thermionic device and a contained grid and cathode, a grid resistor for said tube, said resistor being subdivided into predetermined portions which cause the generator to develop oscillations of different tone frequencies, means including playing keys for individually connecting preselected subdivisions of said resistor to the cathode of said generator, said means including an equi-potential metal bar connected to the cathode, contacts on said keys connected respectively to said resistor subdivisions, and adapted to contact the bar when the respective keys are depressed, and an audio receiving device responsive to changes in said frequency caused by the depressing movement of said keys.

2. A musical instrument comprising an audio frequency oscillation generator, including a thermionic tube and a contained grid and cathode, a grid resistor for said tube, and means including playing keys for individually controlling the magnitude of said resistor in order to change the frequency of the oscillations developed by the generator when any one of the keys is depressed, said keys being fulcrumed on a bar, springs serving to hold the rear ends respectively of the keys down, said springs being connected individually to portions of the grid resistor, an equipotential metal bar connected to the cathode of the tube and located in contact-making relation with respect to said springs when the keys are depressed, and a sound-producing device in the output circuit of said generator.

3. A musical instrument comprising an audio frequency oscillation generator, including a thermionic device and a contained grid and cathode, a grid resistor for said tube, taps taken from said resistor at predetermined positions, means including playing keys for connecting pre-selected taps to the cathode of said generator to cause the latter to develop oscillations of different tone frequencies, said means including make and break contacts at the end of the keys which are respectively connected to said resistor taps, springs for maintaining the contacts open until the keys are operated, a sound-producing device in the output circuit of said generator and means for supplying the alternating current component only of said generator to the sound-producing device.

4. A musical instrument comprising an oscillation generator, including a thermionic device and a contained grid and cathode, a resistor connected between the cathode and grid of said tube and having a magnitude such that the oscillation generator will develop oscillations outside the range of audio frequency, taps taken from said resistor at predetermined positions which are so located that when resistance as determined at that position is connected between the cathode and grid of the tube, the oscillator will generate audio frequencies having a tone determined by the position of the taps, means including playing keys for connecting predetermined taps directly to the cathode in order to short-circuit the resistance intervening between the cathode and the selected tap and thereby change the tone frequency of the generator, said means including make and break contacts at the ends of the keys which are respectively connected to said resistance taps, means for maintaining the contacts open until any one of the keys is operated, a sound-producing device in the output circuit of said generator and means for supplying the alternating current component only of said generator to the sound-producing device.

5. A musical instrument comprising an audio frequency oscillation generator, including a thermionic device and a contained grid and cathode, a grid resistor connected between said grid and cathode, taps taken from said resistor at predetermined positions, means including playing keys for connecting preselected taps to the cathode of said generator to cause the latter to develop oscillations of different tone frequencies, said means including make and break contacts at the ends of the keys which are respectively connected to said resistance taps, means for maintaining the contacts open until any one of the keys is depressed, a sound-producing device in the output circuit of said generator, means for changing the tone register as a whole of the instrument and means for supplying the alternating current component only of said generator to the sound-producing device.

6. A musical instrument comprising an audio frequency oscillation generator, including a thermionic device and a contained grid and cathode, a grid resistor connected between said grid and cathode, taps taken from said resistor at predetermined positions, means including playing keys for connecting preselected taps to the cathode of said generator to cause the latter to develop oscillations of different tone frequencies, said means including make and break contacts at the ends of the keys which are respectively connected to said resistance taps, means for maintaining the contacts open until any one of the keys is depressed, a sound-producing device in the output circuit of said generator, means for supplying to said sound-producing device the oscillations of different tone frequencies only, and means for changing the tone register as a whole of the instrument, said last mentioned means comprising a plurality of grid condensers of different capacities, one of

which is selected by a lever on the instrument to give the desired change in the tone register.

7. A musical instrument comprising an audio frequency oscillation generator, including a thermionic device and a contained cathode, grid and anode, a grid resistor connected between said grid and cathode, means including a rectifier tube for energizing the circuit between the cathode and anode, with rectified alternating voltage, taps taken from said resistor at predetermined positions which impart changes in the constants of the oscillation generator such as to provide changes in the tone frequencies developed by the generator, means including playing keys for connecting preselected taps directly to the cathode and thereby short-circuiting the portion of the grid resistor between the selected tap and the cathode, said means including a resilient metal strap secured to the instrument and serving to press the inner end of each playing key downwardly, said keys being fulcrumed on a common bar so that the straps additionally serve to elevate the playing end of the keys on the fulcrum, and a metal bar positioned directly above said metal strap and adapted to be contacted by the strap when any one of the keys is de-pressed against the pressing action of the strap, said bar being connected to said cathode and said straps being connected to the taps of the grid resistor, a sound-producing device in the output circuit of said generator and means for supplying to said device oscillations of different tone frequencies to the exclusion of the rectified alternating current.

8. A musical instrument comprising an oscillation generator having constants including a resistor which normally require the generator to develop frequencies outside the range of audibility, taps on said resistor at positions such that when a connection is made from any predetermined tap to the cathode, the constants of the generator cause the development of oscillations of audio frequency of different tones depending on the particular tap selected, means including playing keys for selecting said taps, said means including make and break contacts at the ends of the keys, said contacts being connected to said taps, means for maintaining the contacts open until the keys are operated, a sound-producing device, and means including a transformer in the output circuit of said generator for delivering audio frequency of different tones only to said device.

9. A musical instrument comprising an audio frequency oscillation generator, including a thermionic device and a contained grid and cathode, a resistor connected between the cathode and grid, means including playing keys for changing the magnitude of said resistor in order to cause the oscillator to generate oscillations of different tone frequencies, said means including make and break contacts at the ends of the keys which interrupt the circuit to the respective taps, said oscillation generator being normally rendered inoperative, and means associated with said keys for causing the generator to generate oscillations at frequencies determined by the preselection of said resistor taps when the keys are successively depressed, said means serving to restore the inoperative condition of the generator when the keys selectively return to their original undepressed position.

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