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ELECTRIC ORGAN AND METHOD OF ELECTRICALLY PRODUCING TONES

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3 Sheets-Sheet 1

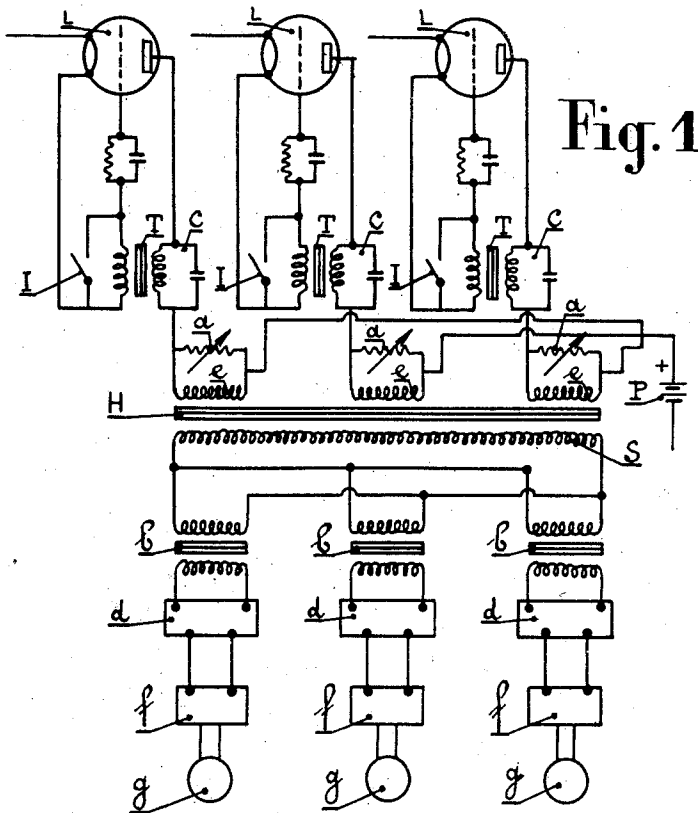
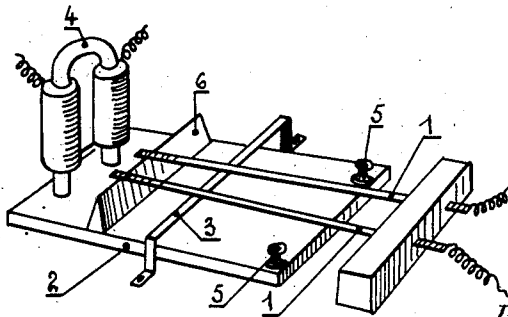


Fig. 2



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Fig. 3

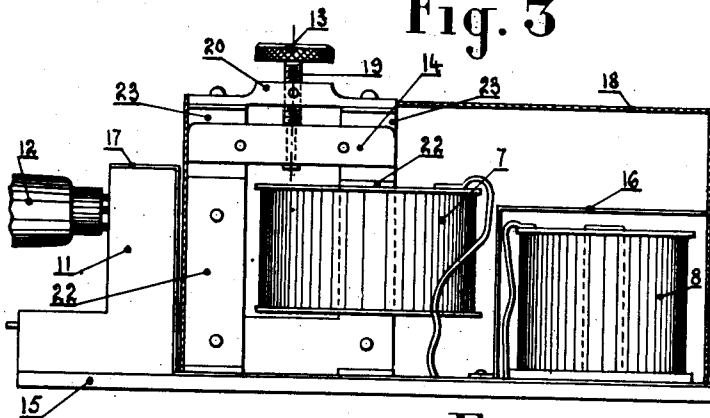


Fig. 4

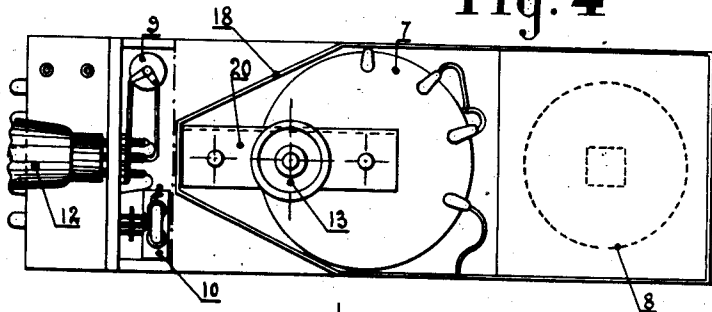
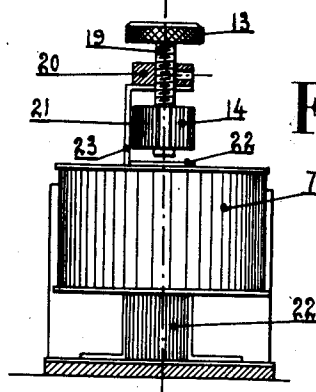


Fig. 5



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Fig. 6

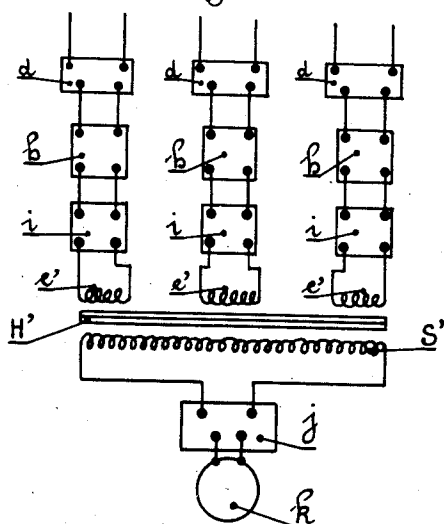
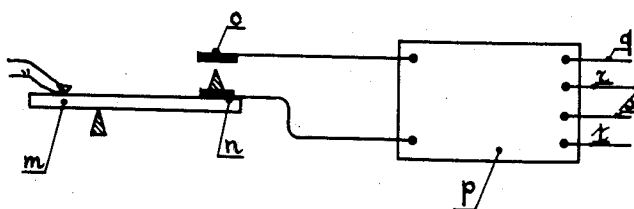


Fig. 7



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UNITED STATES PATENT OFFICE

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ELECTRIC ORGAN AND METHOD OF
ELECTRICALLY PRODUCING TONESEdouard Eloi Coupleux and Joseph Armand
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In France October 16, 1931

17 Claims. (Cl. 84-1)

This invention has for its object to provide improvements in organs playing by means of electron valves in order to avoid certain interfering noises and to ensure the uniformity of the sounds of the notes produced and a very great variety of the timbres.

In one arrangement, use is made of a relay excited by means of the key of the organ manual which actuates a special contact placed preferably in the grid circuit of the oscillator tube and intended to normally short-circuit the coil of the grid circuit, and to remove the short-circuit when the corresponding note is to be played. By operating in a circuit in which there flows current of weak intensity, disagreeable noises are avoided in the loud-speaker at the moment of starting and stopping the note.

This short-circuiting contact returns to the closed position by the force of its own gravity, when the key of the note is not actuated, so that the involuntary production of notes cannot take place. Besides, this contact is assembled with the other parts and the whole forms a unit or block which is removable individually for any given note.

The equalization of the intensity of notes and their harmonization are obtained by applying energy to the multiple primaries of the transformer or transformers, comprising one single secondary and equipped with suitable adjustable resistances. Furthermore, the grid voltage of the controlled valves may be varied by means of a common control by resistance in groups of several notes.

Special devices enable to obtain simultaneously the various timbres. In order to produce different timbres, use is made of any suitable means which have influence on the number and the quality of the harmonic waves, such as especially filters, self-inductance coils, condensers and resistances. In order to obtain simultaneously different timbres on the same note (one single valve), transformers are connected in series or in parallel to the single secondary of the transformer comprising a plurality of primaries which receive their oscillations directly. Filters are placed between the secondary of the transformer having several primaries and the sound-reproducers. In this way, when one single valve produces a note, several loud-speakers which may be connected to the selecting transformers by the medium of amplifiers, will each produce a different and simultaneous timbre for that note in accordance with the various filters. This arrangement will be maintained for the direct modulation of an oscillator without passing through a

microphone, when employing an output transformer with multiple primaries and a single secondary and combined with an amplifier of suitable type and ample power.

A very great diversity of timbres may be obtained by inserting supplementary filters before the input side of the primaries of the output transformer with a single secondary and by means of a filter placed on the terminals of a loud-speaker, it is possible to vary all the timbres in the same direction.

The mutations to different registers such as tierce, octave, quint, may be simplified in the following manner: In an ordinary pipe organ, the mutation stops operate by means of several complete rows of pipes placed on the same wind-chest, which the key or contact causes to vibrate. In the electric organ (with oscillation valves), the mutations are obtained by employing as harmonics the ordinary notes of the organ with those of the special stop provided for this purpose. These combinations may be multiplied without requiring the application of multiple rows in order to obtain the same sound effects. In the electric organ, the harmonics may be obtained by means of contacts placed on the fundamental note of the key-board for the intervals required for the intended effect: that is, registers such as the tierce, octave, quint, as they are employed in the organ, whereby the note of the key-board, by means of one single contact, will control a relay which actuates the desired notes. The advantage of this system resides in the fact that the mutations to tierce, octave, or quint, may be obtained by means of the same valves or tubes which serve to produce the notes, without any supplementary valves, while in the pipe-organ for example, it is necessary to apply supplementary pipes, when mutations are to be made. This mutation device may be controlled by means of relays, from a system which serves in the ordinary organs to actuate the reed-stops; in this manner, it is possible to cause simultaneously mutations of two, three or more notes, when the corresponding relay is placed in operation.

The accompanying drawings show by way of example, some embodiments of the present invention.

Fig. 1 is the diagram of a circuit, comprising short-circuiting device, equalization of the notes and simultaneous diversity of the timbres.

Fig. 2 is a perspective view of the short circuiting device.

Fig. 3 is a side elevation of the assembled parts associated with each valve.

Fig. 4 is a plan view thereof.

Fig. 5 shows an example of adjustment of the variable inductance tuning device.

Fig. 6 is a modified embodiment of Fig. 1, permitting to increase the diversity of the timbres.

Fig. 7 is a diagrammatic view of a key actuating a relay for causing mutation.

As shown in Fig. 1, L is the valve, the plate thereof comprising the oscillating circuit C, a. This valve is provided with an interrupter or switch I, placed in the grid circuit and intended to short-circuit the primary of the transformer T, a transformer H with one single secondary S and multiple primaries e. Adjustable resistances are shunted on these primaries and adjusted so as to equalize the notes; these resistances are adjusted once for all as soon as the equalization is obtained; auxiliary transformers b have their secondaries connected to filters d, which are connected to loud-speakers g, so as to obtain simultaneous timbres as explained before. Amplifiers j may be inserted between the filters d and the loud speakers. A reactance coil may be inserted between the oscillator and the corresponding primary.

Referring to Fig. 2, two contact blades 1, preferably made of spring metal, are connected to the grid circuit for example, and normally, the metal plate 2 which will fall by its own weight, has no influence on the blades 1, which are put in short-circuit by means of a fixed metal cross bar 3. When the operating of a key feeds the current to the electro-magnet 4, the latter attracts the plate 2 which acts upon the blades 1, lifts the same and breaks their contact with the short-circuiting cross bar 3. As the projection 6 is insulated, the short-circuit between the two blades 1 is opened, which corresponds to the opening of the interrupter I of Fig. 1. When there is no current in the electro-magnet 4, the normal short-circuit is established and there cannot be involuntary undesired production of notes.

The plate 2 is mounted for pivoted displacement on pins 5. The raising wedge projection 6 raises the blades 1 and puts them out of short-circuit by causing them to move away from the cross bar 3.

The described relay constitutes preferably one group with all the parts particularly adapted to affect the note.

Figs. 3 and 4 show the assembly of the electron valve oscillator or generating units, and Fig. 5 shows the detailed structure of the adjustable inductance used for tuning the valve generating circuit.

On a base 15 covered with a copper plate or sheeting, are mounted: the iron core inductance coil 7, the reactance or choke coil 8, the capacity 9 with the resistance, the relay 10, the valve 12, the latter as well as the knob 13 for the adjustment of the iron self-inductance coil being mounted on the exterior of the casing.

All these parts are shielded from each other by means of screens or sheets such as 11, 16, 17 and 18, which together with the covering plate of the base 15 separate the various parts in a kind of Faraday cages avoiding any mutual electromagnetic inductance on one another. The connecting wires are reduced to the minimum and the output and input leads are disposed on the same end of the group near the valve 12.

The iron core self-inductance coil comprises preferably a U-shaped frame 22 with one or a plurality of windings on one or both the legs and an adjustable pole-piece may be moved to and from the pole ends of the frame 22. This pole-

piece 14 is preferably controlled by means of a screw 19 with a milled knob or handle knob 13, the copper plate 20 forming the nut for the screw 19. By turning the knob 13 the pole-piece 14 is caused to slide and is guided by means of a part 23 projecting from the frame 22 and supporting also the fixed part 20. In order to avoid any undesired magnetic action, the screw 19 and the plate 20 are made of copper or any other non-magnetic metal. A furring-wedge 21 is also provided on the pole-piece 14 and is also made of copper to ensure a complete magnetic insulation of this pole-piece from the other parts of the self-inductance coil.

In a modified embodiment of the adjustment on a self-inductance coil with a core consisting of a single rod the magnetic circuit is completed by a disk whose distance from the core end is varied by means of a screw.

In a particular kind of a U-shaped frame, the control screw of the disk may be eccentric with relation to the axis of the self-inductance coil so that the surface of the disk acts on the two pole ends of the yoke.

In another embodiment with a U-frame, the pole-piece is articulated so as to turn around a screw pivot and to approach or depart from the pole ends.

Fig. 6 shows a modified form of the circuit of Fig. 1 with a single loud-speaker. The filters d correspond to the filters d of Fig. 1 and are connected to individual secondaries of auxiliary transformers b of Fig. 1. The amplifiers h, mounted after the filters d, are relatively weak and comprise for example only one or two stages, and the out-puts of the amplifiers are respectively sent into the individual primaries e' of the final common output transformer H' with one single secondary S'. This single secondary is connected to an amplifier j of ample design and whose power is determined by the effect to be obtained. This amplifier will actuate the single loud-speaker k.

Supplementary filters i may be connected between the individual primaries e' and the output of the amplifiers h. These filters are to permit the production of a greater diversity of timbres than can be obtained with the filters d alone.

It is also to be noted that the out-put transformer H' with one single secondary S' and a plurality of primaries e' feed always one amplifier, but the out-put wires may be connected directly to a transmitter without going through a microphone.

Fig. 7 shows a relay for causing mutation of the register produced; the key m carries a stud n which closes the circuit by means of the stud o on a single or multiple relay p. The latter may be placed by means of groups of single relays which control at will a certain number of note contacts connected by pairs of wires terminating on pairs of terminals q, r, s, t, etc., in order to actuate in parallel through the means which has been described the valves or tubes which produce the series of harmonics which are required to obtain a determined desired mutation of the register of notes sounded, as has been shown above.

Each pair of wires, as q, is connected to an electromagnet as shown at 4 in Fig. 2, which in turn actuates a switch or interrupter I corresponding to an individual valve L, as shown in Fig. 1. When key m is depressed, the pairs of wires q, r, s, t, are actuated in parallel.

In the electric organ of our invention, the effect of mutation stops is obtained without the necessity of employing a special auxiliary set of electron valves. Instead, the mutation registers are produced by the same corresponding tubes of the organ that produce the principal fundamental notes. These mutation notes are controlled by means of a special contact mounted on each key of the organ, and the relays actuating the tubes corresponding to the notes which are the harmonics of the fundamental note of a given key for the mutation of that key which is desired, tierce, octave, quint, are controlled in parallel by that special contact. For instance, if the key corresponding to C of the third octave is played, there will be produced a combination of mutation notes formed by the actuation of relays corresponding respectively to C of the fourth octave, E of the fourth octave, C of the fifth octave. These constitute three harmonics which are naturally played with less intensity than the principal note, and the adjustment of the intensity is obtained by suitable resistances.

These simplified mutation devices may also be applied to common pipe-organs.

The operation of the organ is as follows: The valve L with its oscillating circuit in the plate circuit, is supplied with current in the usual manner, but this oscillating circuit, as will be understood, can produce oscillations at the intended musical frequency only if the grid coil is coupled through the transformer T to the coil of the oscillating circuit; therefore, when the interrupter I is closed the grid coil is short circuited and consequently the oscillating circuit is inoperative.

Upon actuation of the key corresponding to the valve L, that is, corresponding to the note which the valve is to produce because of the characteristics of the oscillating circuit C, the interrupter I is opened, as is shown in Fig. 1, and the oscillating circuit produces oscillations at musical frequency, which pass in the coil *e* of the transformer H. The intensity of each note produced by the valve L may be regulated by means of the adjustable resistance *a*.

Following this action, all notes produced by the valve L are collected in the secondary S of the transformer H. The transformers *b* act to each take a fraction of this divided whole, which in principle is of the same nature for all primaries of the transformers *b*, but due to the provision of the filters *f* following the secondaries of all said transformers *b*, it is possible to obtain the same action in each of the loud speakers *g* but at different timbres which are precisely determined by the characteristics of the filters *f*. If, for instance, a musical theme is played by means of the valves L, it is possible to obtain in the first loud speaker this musical theme with the timbre of the violin, in the second loud speaker, the same theme but in the timbre of the flute, in the third, the same theme in the timbre of the trumpet, etc.

As shown in Fig. 6, the filtering may be perfected by means of supplementary filters, but once the timbres have been determined, the whole is combined to constitute the reproduction of an orchestra in the single loud speaker *k*.

We claim:

1. In an electric organ, an electron valve, a coil in the grid circuit of the valve, a coil in the plate circuit of the valve, said coils being in inductive relation, a connector shunted on the grid coil normally short-circuiting the same thereby rendering the valve inoperative, and means acting upon said connector to break the short-circuit of the

grid coil and thus placing the valve in operative position.

2. In an electric organ, an electron valve, a coil in the grid circuit of the valve, a coil in the plate circuit of the valve, said coils being in inductive relation, a connector shunted on the grid coil normally short-circuiting the same thereby rendering the valve inoperative, and a relay acting upon said connector to break the short-circuiting of the grid coil and thus placing the valve in operative position.

3. In an electric organ, an electron valve, a coil in the grid circuit of the valve, a coil in the plate circuit of the valve, said coils being in inductive relation, a connector connected across said grid coil normally short-circuiting the same thereby rendering the valve inoperative, a relay acting upon said connector to break the short-circuiting of the grid coil and thus placing the valve in operative position, and means coupled in the circuit of the valve for transforming its oscillations into sound.

4. In an electric organ, an electron valve, a coil in the grid circuit of the valve, a coil in the plate circuit of the valve, said coils being in inductive relation, a connector connected across said grid coil normally short-circuiting the same thereby rendering the valve inoperative, a relay acting upon said connector to break the short-circuiting of the grid coil and thus place the valve in operative position, means coupled to the circuit of the valve for transforming its oscillations into sound, and sound amplifying means electrically connected to said transforming means.

5. In an electric organ, an electron valve, a coil in the grid circuit of the valve, a coil in the plate circuit of the valve, said coils being in inductive relation, a connector connected across said grid coil normally short-circuiting the same, a relay acting upon said connector to break the short-circuiting of the grid coil and thus place the valve in operative position, means coupled to the circuit of the valve for transforming its oscillations into sound, sound amplifying means electrically connected to said transforming means, and a filter between said transforming means and sound amplifying means.

6. In an electric organ, an electron valve, a coil in the grid circuit of the valve, a coil in the plate circuit of the valve, said coils being in inductive relation, a connector connected across said grid coil normally short-circuiting the same, thereby rendering the valve inoperative, means acting upon said connector to break the short-circuiting of the grid coil and thus place the valve in operative position, a transformer coupled to the valve circuit, said transformer having multiple primaries and a single secondary, an adjustable resistance on each primary of the transformer, and sound reproducing means electrically connected to the secondary of said transformer.

7. In an electric organ, an electron valve, a coil in the grid circuit of the valve, a coil in the plate circuit of the valve, said coils being in inductive relation, a connector connected across said grid coil normally short-circuiting the same thereby rendering the valve inoperative, means acting upon said connector to break the short-circuiting of the grid coil and thus place the valve in operative position, a transformer coupled to the valve circuit, said transformer having multiple primaries and a single secondary, an adjustable resistance on each primary of the transformer, selecting coils connected in parallel to the single secondary of the transformer, and

sound reproducing means electrically connected to the secondary of said transformer through said selecting coils.

8. In an electric organ, an electron valve for each note, a coil in the grid circuit of each valve, a coil in the plate circuit of each valve, said coils being in inductive relation, a connector connected across said grid coil of each valve normally short-circuiting the coil thereby rendering the valve inoperative, means acting upon said connectors to break the short-circuiting of the coils, a transformer having a single secondary and multiple primaries one for each valve, and sound reproducing means electrically connected to the secondary of the transformer.

9. In an electric organ, a unit for each note comprising, an electron valve, a connector in the circuit of the valve normally short-circuiting the same, a relay acting upon said connector to break the short-circuit, a capacity, a self-inductance coil and a resistance electrically connected to the valve, and screens disposed to insulate the parts from mutual magnetic influence.

10. In an electric organ, a plurality of electron tube oscillators generating fundamental notes corresponding respectively to the keys of the keyboard, individual input and output circuits therefor, individual transformers for respectively coupling the input and output circuits of each tube oscillator, individual means for respectively controllably short-circuiting the input circuit winding of each of said transformers, said means being respectively actuatable by the keys of said organ to remove the short circuit from the input circuit winding of the oscillator generating the fundamental note corresponding to the key depressed, auxiliary individual mutation means actuatable respectively by the keys of said organ for removing the short-circuit from the input circuit winding of the oscillator generating the mutation register note corresponding to the key depressed, and means for converting the electrical energy generated by said tube oscillators into sound.

11. In an electric organ, a plurality of electron tube oscillators generating fundamental frequencies corresponding respectively to the keys of the keyboard, individual input and output circuits therefor, individual keying means for each of said tube oscillators, a plurality of fundamental key control means actuated respectively by the keys of the keyboard and connected for causing the actuation of the keying means of the oscillator of the fundamental frequency corresponding to the key depressed, a plurality of auxiliary individual mutation keying control means actuated respectively by the keys of the keyboard and connected for causing the actuation of the keying means of the oscillator of the frequency of the mutation register note corresponding to the key depressed, and means for converting the electrical energy generated by said tube oscillators into sound.

12. In the electrical production of organ music using individual keyed electron tube oscillators generating different fundamental notes, the method of producing tones of musical characteristics corresponding to different organ stops which consists in electrically combining the outputs of said oscillators, dividing said combined outputs into a plurality of parts, filtering the different parts of said combined output according to different frequency characteristics corresponding to different desired organ stops, and converting into sound the output energy so filtered.

13. In an electric organ, a plurality of electron tube oscillators generating fundamental frequencies corresponding respectively to the keys of the keyboard, individual input and output circuits therefor, individual transformers for respectively coupling the input and output circuits of each tube oscillator, individual means for respectively controllably short-circuiting the input circuit winding of each of said transformers, said means being respectively actuatable by the keys of said organ to remove the short-circuit from the input circuit winding of the tube oscillator generating the fundamental frequency corresponding to the key depressed, a common output transformer having a single secondary winding and a plurality of individual primary windings connected respectively to the output circuits of said oscillators, and means connected to the secondary winding of said output transformer for converting electrical energy into sound.

14. In an electric organ, a plurality of electron tube oscillators generating fundamental frequencies corresponding respectively to the keys of the keyboard, individual input and output circuits therefor, individual transformers for respectively coupling the input and output circuits of each tube oscillator, individual means for respectively controllably short-circuiting the input circuit winding of each of said transformers, said means being respectively actuatable by the keys of said organ to remove the short-circuit from the input circuit winding of the tube oscillator generating the fundamental frequency corresponding to the key depressed, a common output transformer having a single secondary winding and a plurality of individual primary windings connected respectively to the output circuits of said oscillators, a plurality of individual auxiliary output transformers having primary windings connected to the secondary winding of said common output transformer, a plurality of individual converting means for converting electrical energy into sound corresponding respectively to said tube oscillators, and a plurality of individual filters connected respectively between the secondary winding of each of said auxiliary output transformers and the corresponding one of said individual converting means, said filters having different frequency characteristics which are controllably adjustable to correspond to different organ stops.

15. In an electric organ, a plurality of electron tube oscillators generating fundamental frequencies corresponding respectively to the keys of the keyboard, individual input and output circuits therefor, individual transformers for respectively coupling the input and output circuits of each tube oscillator, individual means for respectively controllably short-circuiting the input circuit winding of each of said transformers, said means being respectively actuatable by the keys of said organ to remove the short-circuit from the input circuit winding of the tube oscillator generating the fundamental frequency corresponding to the key depressed, a common output transformer having a single secondary winding and a plurality of individual primary windings connected respectively to the output circuits of said oscillators, a plurality of individual auxiliary output transformers having their primary windings connected to the secondary winding of said common output transformer, a final reproducer output transformer having a single secondary winding and a plurality of individual primary windings corresponding to said tube oscillators, a plurality of individual

filters connected respectively between the secondary winding of each of said auxiliary output transformers and the corresponding primary winding of said final output transformer, said	
5 filters having different frequency characteristics which are controllably adjustable to correspond to different organ stops, and means for converting electrical energy into sound connected to the secondary winding of said final output transformer.	
10 16. In an electric organ, a plurality of electron tube oscillators generating fundamental frequencies corresponding respectively to the keys of the keyboard, individual input and output circuits therefor, means actuated respectively by the keys	80
15 of said organ for controlling the generating action of said oscillators, means for electrically combining the outputs of said tube oscillators, a plurality of groups of filters for varying the frequency characteristics of the electrical energy passing	85
20 therethrough, each of said groups comprising a plurality of filters in mutual electrical relation, and the frequency characteristics of said filters being controllably different from each other, each	90
of said groups of filters receiving electrical energy from said combining means, and means actuated by the outputs of said groups of filters for trans-	95
forming electrical energy into sound.	
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