

Sept. 22, 1931.

M. L. E. MARTENOT

1,824,402

ELECTRIC MUSICAL INSTRUMENT

Filed March 27, 1929

2 Sheets-Sheet 1

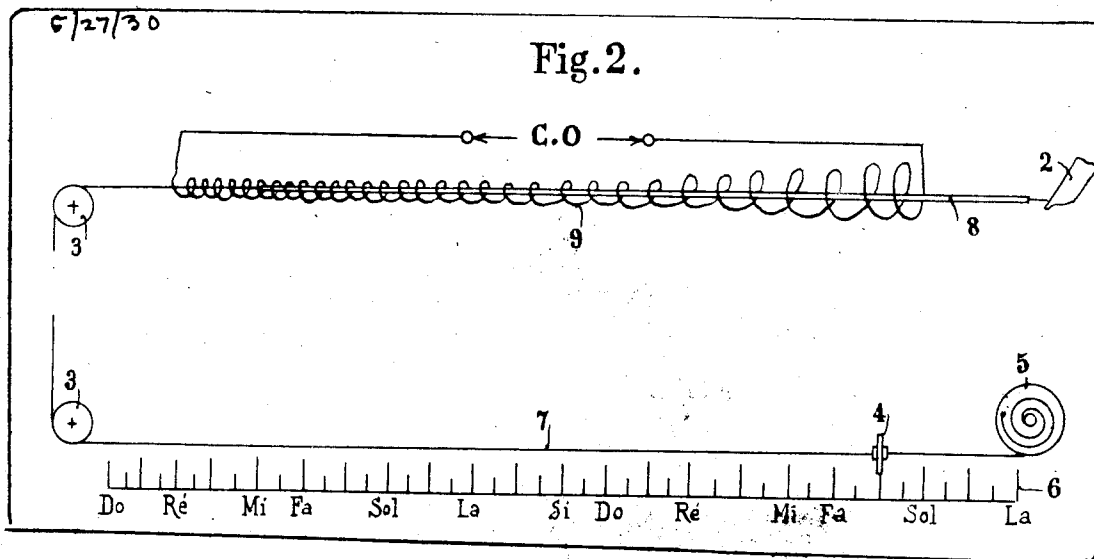
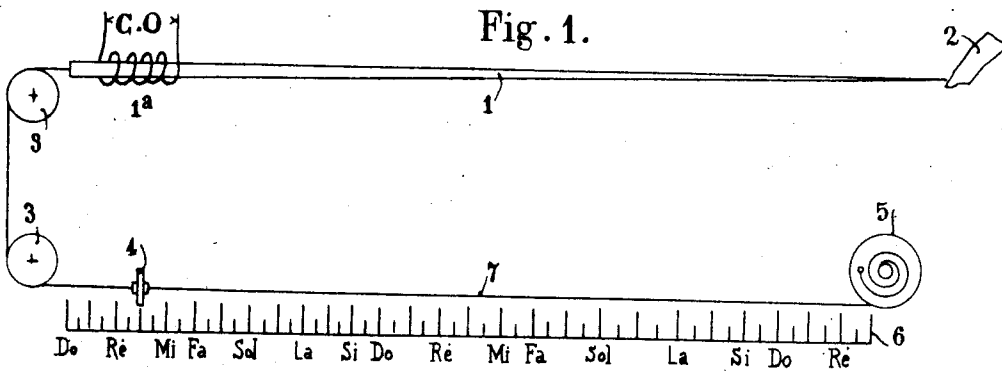


Fig. 2.

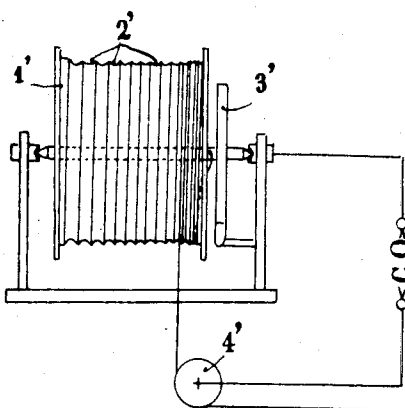
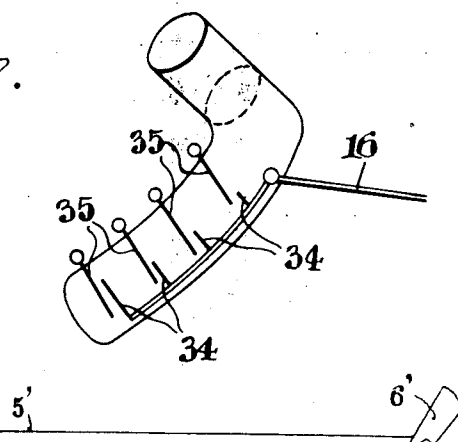


Fig. 7.



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Fig. 3.

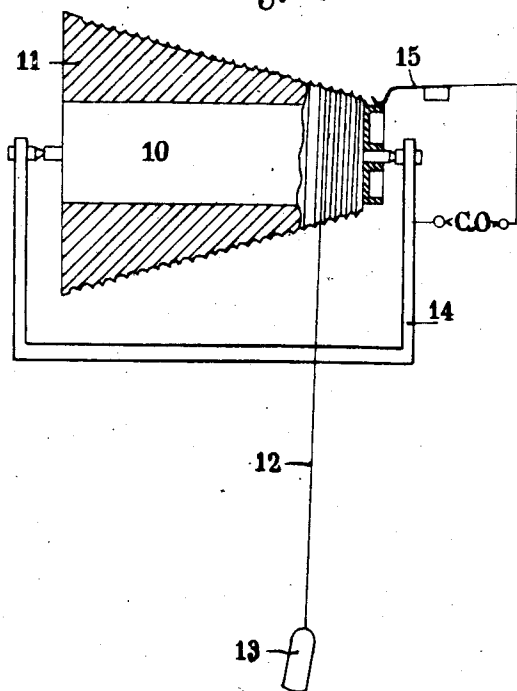


Fig. 4.

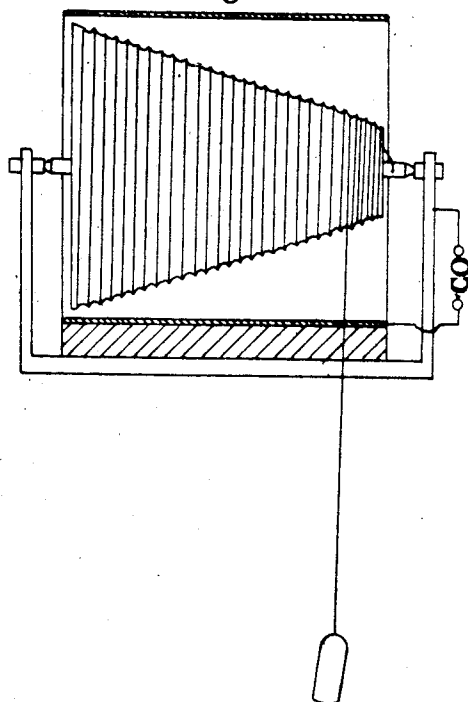


Fig. 5.

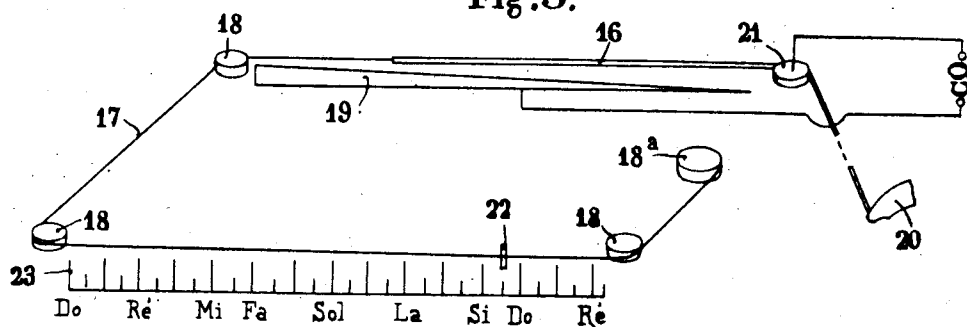
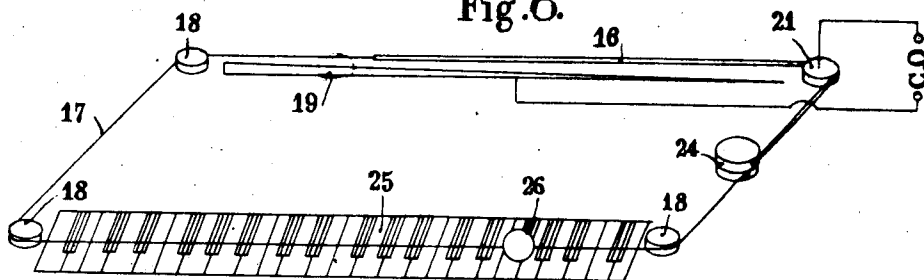


Fig. 6.



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ELECTRIC MUSICAL INSTRUMENT

Application filed March 27, 1929, Serial No. 350,357, and in France April 2, 1928.

This invention relates to electric musical instruments of the kind, in which thermionic valves, having two or three electrodes, are used for producing oscillating currents, of adjustable frequency, which are caused to act upon telephone receivers, these currents being combined with each other so as to reproduce sounds of varying pitch and character.

In instruments of this nature it is also known to vary the frequency of the currents produced by the valve or valves by modifying either the self-inductance of the oscillating circuit, or the capacity of this circuit, or again both the self-inductance and the capacity, or finally by acting on the resistance of the said circuit.

These different variations, which allow one to obtain all the musical frequencies and, consequently to reproduce any piece of music chosen, may be impressed upon the oscillating circuit, either by a remote action exerted upon the aerial (for instance by the displacements of the hand of the performer), or by a direct action upon the regulating elements inserted in the circuit (variable condensers, resistances, self-inductances having a movable core, etc.).

Means are also known for varying the capacity, self-inductance or the resistance, which are based on the relative displacement of said capacity, said self-inductance or said resistances and the control elements associated therewith or on the relative displacement of the armatures of condensers. The winding and unwinding of wires or bands on drums have also been utilized in different devices of this type.

In the foregoing cases the constitution either of the electrical members themselves, or of their regulating elements, such as buttons, levers, commutators etc., does not enable the executant to obtain with facility the musical intervals required on account of the inertia of the movable parts, or on account of the difficulty encountered in obtaining adequate displacements, able to be easily measured.

The invention has for its object to apply these means for variation to electric musical instruments, also—as is hereinafter de-

scribed—with the aid of a special constructional form, to elements which contribute to the variation of the capacity, self-inductance or resistance and permit one to obtain the musical intervals in a continuous manner in all or part of the scale of musical frequencies. For this purpose, the control means or elements are given equal or progressively variable displacements analogous to those used for the playing of ordinary musical instruments (intervals of "attack" on the violin et cetera).

This special constructional form consists in giving to one of said elements or control means, which contribute to the variation by their relative displacement such a dimension that a constant variation is produced and that substantial displacements, which are easily and definitely measured, are obtainable even for fractional musical intervals. The playing on electric instruments of the type in question thereby becomes practically possible and accurate and all the necessary finesse for a good performance is obtainable.

The variation of the self-inductance, capacity or resistance of the oscillating circuit can, for instance, be effected by means of wires or other flexible conductors having throughout their length a constantly increasing section, or again by utilizing flexible wires, ribbons, et cetera, of uniform section throughout their length and moving relatively to elements of the oscillating circuit of regularly varying dimension.

The accompanying drawings represent different embodiments of the invention.

Figure 1 shows an embodiment of the invention in which the production of the different sounds is obtained by the varying of the self-inductance of the oscillating circuit.

Figure 2 shows a form of the variation of the self-inductance, wherein the number of turns which are put into operation varies in a continuous manner and is dependent upon the unwinding of a similar length of wire on a drum.

Figures 3-6 show embodiments wherein the capacity of the oscillating circuit is varied.

Figure 7 shows diagrammatically a modification of the finger-stall by means which

the performer operates displacements of the movable members of the different constructional forms of the invention.

According to the example illustrated in Fig. 1, use is made of a metallic wire 1, of variable thickness, connected to the finger of the performer through the medium of an insulating finger-stall 2. This metallic wire moves through a self-induction coil 1^a inserted in an oscillating circuit C O. The return of the wire 1 is effected by means of a winding drum 5, through the medium of a wire 7 passing over the pulleys 3. This wire 7 moves an index 4 in front of a graduated scale 6.

In Fig. 2, 1' designates an insulating drum with grooves 2' of variable pitch; 3' is the return spring of said drum; 4' designates the metal contact pulley over which passes the wire 5' connected to the finger of the performer by the insulating finger-stall 6'.

Both poles of the oscillating circuit C O are connected, one to the admission side of the turns of the wire 5' through the medium of the shaft of the pulley 4', the other to the end of the shaft of the insulating drum 1'.

The preceding device may be devised for acting as a variometer, either by superposing, on the drum, two self-inductances, one mixed and the other variable, or by arranging a fixed self-inductance by the side of the drum of the variable self-inductance.

The variation of the capacity of the oscillating circuit may be obtained by means of a condenser provided with a flexible conductor serving as a movable intermediate member.

An example of this special condenser is shown in Figure 3.

In this figure, the fixed armature of the condenser is constituted by a cylinder 10 covered with a dielectric 11, of variable thickness, this thickness varying in a continuous manner along the generating lines of the drum, for the purpose of obtaining the desired scale of variations. On this dielectric, winds, in suitable grooves, a metallic wire 12 the turns of which constitute the movable armature of the condenser. This metallic wire is attached to an insulating finger-stall 13.

The oscillating circuit C O is connected, on the one hand, to the shaft of the condenser through a frame 14 and, on the other hand, by a contact brush 15, to the other end of the turns.

Fig. 4 illustrates a modification which differs from the preceding example only by the fact that the turns formed by the metallic wire constituting the movable armature of the condenser are inside the cylinder illustrated constituting the fixed armature of the condenser.

The condenser described above may be connected mechanically by reduction gear to a condenser of the same type or to a variable

self-inductance as described above. In the case of two condensers connected by reduction gear, the condensers may be electrically connected in parallel or in series, whereby very fine variations of capacity are obtainable.

Another type of condenser, in accordance with the invention and suited to the same purpose, is constituted by a movable armature made of a wire or metallic ribbon which can be progressively moved towards another fixed wire, or towards any other metallic body of suitable shape constituting the fixed armature.

In practice (Fig. 5) the movable armature of the condenser is constituted by a very fine metallic wire 16, wound around a thread of insulating material, over a determined length. This wire 16 is extended by an insulating thread 17 which, passing on guide pulleys 18—18, winds on a returning drum 18^a. The fixed armature is constituted, in the example of Fig. 6, by a member 19 of wedge shape, as illustrated in the said figure. The displacement of the movable armature, relatively to the fixed armature, is effected by means of a finger-stall 20, on which the performer acts.

The oscillating circuit C O is connected, on the one hand, to the fixed armature 19 and, on the other hand, to a metallic pulley 21 in electric contact with the movable armature 16. For setting purposes, the insulating thread 17 carries an index 22 which moves in front of a fixed scale 23.

In another modification, illustrated in Fig. 7, the wire 16 and the thread 17 are attached and wound upon a double drum 24, so as to constitute an endless wire, the winding of the strand 16 corresponding to the unwinding of the strand 17.

In the same example, the graduated scale 23 is replaced by a dummy fictitious keyboard 25, in which the position of the notes is indicated in suitably arranged depressions.

After having passed this finger into a ring 26, interposed on the thread 17, the performer plays by placing the end of the finger in the hollow formed by each of said depressions corresponding to the usual keys.

In the examples which have just been described, the index carried by the wires, or ribbons is movable relatively to a fixed graduation. Inversely, graduations may be provided on the movable part constituted, for instance by sections of different colours and moving in front of a fixed reference mark.

Another object of the invention resides in the utilization of a wire, metallic ribbon, et cetera for varying the frequency of the oscillatory circuit by acting upon variable resistances.

It is possible to provide the following forms of construction:

A truncated drum, made of insulating ma-

terial, is covered with a film acting as a resistance, for instance a thin layer of graphite. On the drum thus prepared, a wire or metallic ribbon is wound or unwound.

5 In order to vary rapidly the frequency of the variations, and, consequently the pitch of the sounds, the invention also provides for the further addition of the capacity of the fingers of a person placed indirectly in connection with a point of the oscillating circuit through the medium of condensers of determined values.

10 An example of the same is given in Fig. 8, in which 16 designates the metallic wire, for instance that of Fig. 5. To this wire are attached small fixed armatures 34 of varying size arranged opposite small fixed metallic keys 35, constituting variable armatures. 36 designates an insulating supporting finger-stall.

15 The performer engages his thumb in said finger-stall 36 and obtains a different variation of frequency by placing one of his other four fingers of the same hand on one of the keys 35.

20 The present invention also relates to various means allowing to obtain vibrated sounds, with keyboard instruments of the type of those which have just been described, or with other instruments.

25 This keyboard, preferably made of materials as light as possible, is arranged on an assemblage of metallic or resilient springs which allow it to slightly oscillate in any direction under impulse of the "vibrato" of the performer's hand.

30 A condenser armature is secured to this movable keyboard, the other armature being fixed; the slight oscillations of the keyboard then give a vibrato of the sound.

35 The condenser can be replaced by a variable self-induction coil having an iron core, or by a variometer, etc., and generally speaking by any means used in wireless telephony for causing the frequency of an oscillating circuit to vary.

40 Another kind of "vibrato" can be obtained by the variations of intensity of the sound. For obtaining such effects in accordance with the invention the oscillations of the keyboard are transmitted to a resistance acting on a suitable circuit of the instrument.

45 In all the cases above considered, if the necessary length and, consequently, the weight of the keyboard prevented an easy oscillation, the keyboard would be divided, (for instance into octaves and even down to a single key). The devices previously described would be applied to each of these divisions.

50 The devices according to the invention may also be combined with means for ensuring the automatic mechanical or similar performance.

Claims:—

65 1. Electric musical instrument utilizing

oscillating currents of variable frequency for producing different musical sounds, comprising electrical regulating means for varying said frequency and flexible movable means actuable by the executant for controlling said electrical regulating means. 70

2. Electric musical instrument utilizing oscillating currents of variable frequency for producing different musical sounds, comprising electrical regulating means for varying said frequency and flexible movable means made of an insulating material associated therewith and capable of manipulation by the executant for controlling said electrical regulating means. 80

3. Electric musical instrument utilizing oscillating currents of variable frequency for producing different musical sounds, comprising electrical regulating means for varying said frequency, flexible movable means made of an insulating material and capable of manipulation by the executant for controlling said electrical regulating means, a movable part of said latter being directly connected to said movable control means, so as to form therewith a continuous movable member and insulating means for connecting said member to one finger of the executant. 90

4. Electric musical instrument utilizing oscillating currents of variable frequency for producing different musical sounds comprising electrical regulating means for varying said frequency and flexible movable means made of an insulating material associated therewith and capable of manipulation by the executant for controlling said electrical regulating means, the amplitude of movement of said control means being such that an extensive scale of musical notes may be obtained and at the same time a substantial displacement of said movable means corresponds to the interval between two successive musical notes. 105

5. Electric musical instrument utilizing oscillating currents of variable frequency for producing different musical sounds, comprising electrical regulating means for varying said frequency, flexible movable means made of an insulating material associated therewith and capable of manipulation by the executant for controlling said electrical regulating means, the length of said control means being such that an extensive scale of musical notes as well as a substantial displacement for each of said notes may be obtained and visible means enabling the executant to survey the manipulation of said control means. 115

6. Electric musical instrument utilizing oscillating currents of variable frequency for producing different musical sounds, comprising electrical regulating means for varying said frequency, flexible movable means made of an insulating material associated therewith and capable of manipulation by the executant for controlling said electrical regu- 130

lating means, the length of said control means being such that an extensive scale of musical notes as well as a substantial displacement for each of said notes may be obtained and visible means enabling the executant to actually and precisely determine the amplitude of each movement of said control means.

7. Electric musical instrument utilizing oscillating currents of variable frequency for producing different musical sounds, comprising electrical regulating means for varying said frequency, flexible movable means made of an insulating material and capable of manipulation by the executant for controlling said electrical regulating means, a movable part of said latter having a constantly varying cross-section and being directly connected to said movable control means so as to form therewith a continuous movable member and insulating means for connecting said member to one finger of the executant.

8. Electric musical instrument utilizing oscillating currents of variable frequency for producing different musical sounds, comprising an inductance having a core moving coaxially within it for varying said frequency and flexible movable means made of an insulating material associated therewith and capable of manipulation by the executant for controlling the movements of said core, said latter having a constantly varying cross-section throughout its length and being directly connected to said movable control means, so as to form therewith a continuous movable member.

9. Electric musical instrument utilizing oscillating currents of variable frequency for producing different musical sounds, comprising an adjustable inductance for varying said frequency, flexible movable means made of an insulating material associated therewith and capable of manipulation by the executant for controlling the adjustment of said inductance and resilient means for automatically restoring said inductance to its initial position when said control means are released, said adjustable inductance consisting of a grooved drum and a wire of constant diameter wound over said drum, the helicoidal groove of which has a constantly varying pitch throughout its length and said wire being directly connected to said movable control means, so as to form therewith a continuous movable member.

10. Electric musical instrument utilizing oscillating currents of variable frequency for producing different musical sounds, comprising an adjustable condenser for varying said frequency, flexible movable means made of an insulating material associated therewith and capable of manipulation by the executant for controlling the adjustment of said condenser and resilient means for automatically restoring said condenser to its initial position when said control means are released,

said adjustable condenser comprising a fixed armature constituted by a metallic cylinder covered with a dielectric of constantly varying thickness and a movable armature formed by the winding of a metallic wire on this dielectric and said metallic wire being directly connected to said movable control means, so as to form therewith a continuous movable member.

11. Electrical musical instrument utilizing oscillating currents of variable frequency for producing different musical sounds, comprising an adjustable condenser for varying said frequency and flexible movable means made of an insulating material associated therewith and capable of manipulation by the executant for controlling the adjustment of said condenser, said adjustable condenser comprising a fixed armature constituted by an elongated metallic bar of constantly varying thickness and a movable armature formed by a metallic wire which may be displaced along said bar and is directly connected to said movable control means, so as to form therewith a continuous movable member.

12. Electric musical instrument utilizing oscillating currents of variable frequency for producing different musical sounds, comprising an adjustable condenser for varying said frequency, a movable insulated flexible wire one end of which is associated therewith and which is capable of manipulation by the executant for controlling the adjustment of said condenser, a recoil drum over which the other end of said wire is wound for automatically restoring said condenser to its initial position when said control wire is released, guiding means for said wire, a pointer carried by said wire and a graduated scale cooperating with said pointer and enabling the executant to actually and precisely determine the amplitude of each movement of said control wire, said adjustable condenser comprising a fixed armature constituted by a wedge shaped metallic bar and a movable armature formed by a metallic wire which may be displaced along said bar and is directly connected at one end to said control wire, so as to form therewith a continuous movable member, while its other end is provided with a finger-stall, in which the executant may engage one of his fingers.

13. Electric musical instrument utilizing oscillating currents of variable frequency for producing different musical sounds, comprising an adjustable condenser for varying said frequency, a movable insulated flexible ribbon one end of which is associated therewith and which is capable of manipulation by the executant for controlling the adjustment of said condenser, a recoil double drum having two winding systems over one of which the other end of said ribbon is wound, guiding means for said ribbon, a ring inserted in said ribbon and through which the executant may pass one of his fingers and a keyboard with fixed

keys over which the executant may displace the finger passed through said ring, said adjustable condenser comprising a fixed armature constituted by a wedge shaped metallic bar and a movable armature formed by a metallic wire which may be displaced along said bar and is directly connected at one end to said control ribbon, so as to form therewith a continuous movable member, while its other end is wound over the second winding system of said recoil drum at the same time as said ribbon is unwound from the first winding system of said drum and vice versa.

ing electrical regulating means for varying said frequency and flexible movable means made of an insulating material capable of manipulation by the executant for controlling said electrical regulating means, a movable part of said latter having a reduced amplitude of movement with respect to the relatively large amplitude of movement of said movable control means and being connected thereto by the intermediary of a reduction gear.

The foregoing specification of my "Improvements in electric musical instruments"; signed by me this 15th day of March, 1929.

MAURICE LOUIS EUGÈNE MARTENOT.

14. Electric musical instrument utilizing oscillating currents of variable frequency for producing different musical sounds, comprising an adjustable resistance for varying said frequency, a movable insulated flexible means associated therewith and capable of manipulation by the executant for controlling the adjustment of said resistance and resilient means for automatically restoring said resistance to its initial position when said control means is released, said resistance comprising a truncated drum made of insulating material and covered with a film acting as an electric resistance and a metallic wire directly connected to said movable control means, so as to form therewith a continuous movable member.

15. Electric musical instrument utilizing oscillating currents of variable frequency for producing different musical sounds, comprising electrical regulating means for varying said frequency and flexible movable means made of an insulating material capable of manipulation by the executant for controlling said electrical regulating means, a flexible part of said latter being directly connected at one end to said movable control means, so as to form therewith a continuous flexible and movable member while its other end is provided with an insulated thumb-stall and with four small condensers arranged in series on said thumb-stall, each of said condensers having one armature electrically connected to said flexible part of the regulating means and a second armature able to form contact for one of the four free fingers of the executant.

16. Electric musical instrument utilizing oscillating currents of variable frequency for producing different musical sounds, comprising electrical regulating means for varying said frequency and flexible movable means made of an insulating material capable of manipulation by the executant for controlling said electrical regulating means, a movable part of said latter having a length at least equal to the maximum displacement of said movable control means and being directly connected thereto, so as to form therewith a continuous movable member.

17. Electric musical instrument utilizing oscillating currents of variable frequency for producing different musical sounds, compris-

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