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ELECTRICAL MUSICAL INSTRUMENT

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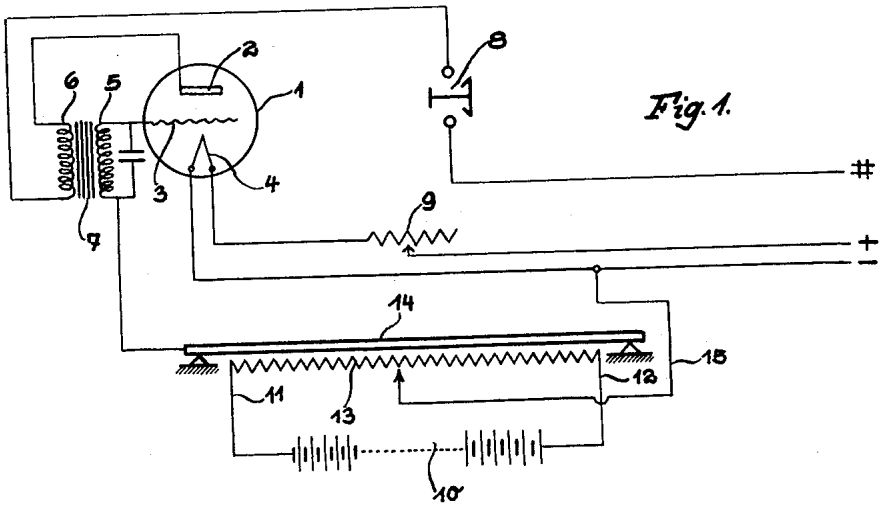

Fig. 1.

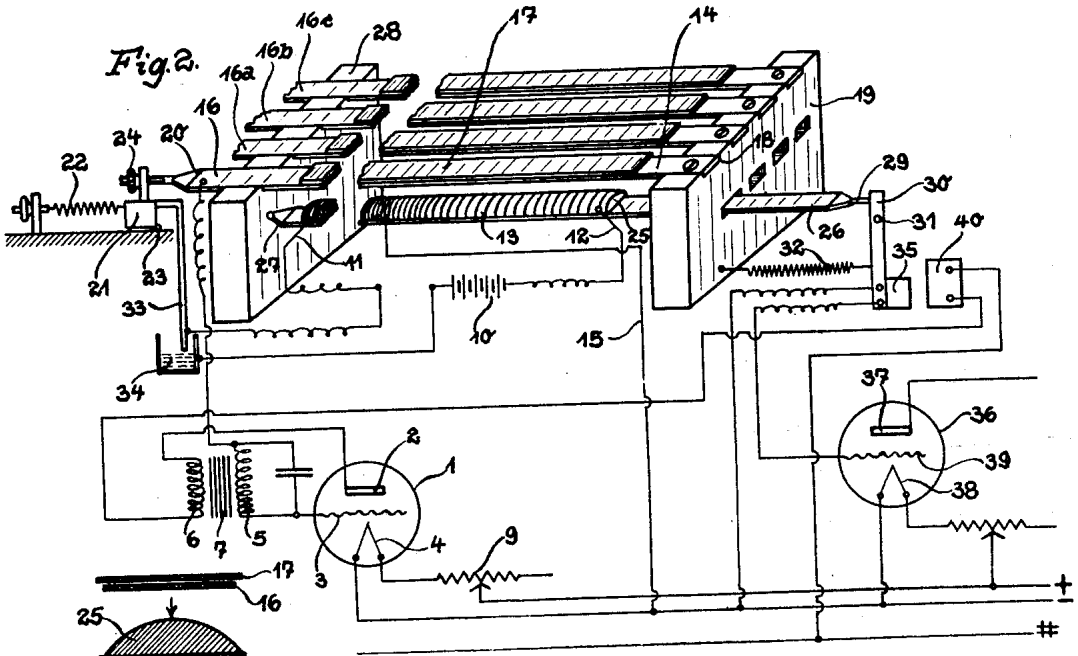

Fig. 2.

Fig. 3.

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UNITED STATES PATENT OFFICE

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ELECTRICAL MUSICAL INSTRUMENT

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This invention relates to a musical instrument in which sound effects are produced by a change in the frequency of a thermionic tube oscillator and in which the variation in the pitch is effected by a variable resistance. Such a musical instrument has already been described in the U. S. A. specification No. 1,543,990 (Lee de Forest). This known musical instrument has the disadvantage that a separate manipulation has to be effected in order to obtain the range of pitch required for the reproduction of a composition. One of the objects of the present invention is to avoid this disadvantage. The known musical instrument is constructed as a key instrument and therefore does not allow a continuous change in the pitch to be obtained. Musical instruments are already known in which sound effects are produced by a change in the frequency of a thermionic tube oscillator and which allow a continuous change in the pitch to be effected. In these musical instruments the pitch is varied by means of capacity effects, either by the performer approaching and removing the hand from a part of the musical instrument or by the relative movement of the plates of a condenser.

The present invention solves the problem of obtaining a continuous change in the pitch in a manner which does not require such great skill of manipulation as is necessary in the case of a control by capacity effects, such as by approaching or removing the hand of the performer from a stationary part of the instrument, and in which it is not necessary to move heavy masses, as is necesary when the pitch is varied by the displacement of a condenser plate.

The invention further solves the problem of increasing the pitch range. Moreover, a musical instrument is produced according to the present invention on which sounds of different pitch can be produced simultaneously.

In all the musical instruments hitherto known of the kind referred to, two manipulations were required in order to produce a sound of a definite pitch and having a definite volume. The present invention solves the problem of securing by the movement of a single finger both the pitch and the volume of sound.

The invention is illustrated, by way of example, in the accompanying drawings, wherein

Fig. 1 is a diagram of connections of one form of construction,

Fig. 2 illustrates the mechanical construction of a musical instrument and the diagram of connections, whilst

Figure 3 is a cross-section on an enlarged scale through the contact device of the musical instrument according to Fig. 2.

In order to vary the pitch, it is necessary to vary the frequency of a thermionic tube oscillator. This may be effected in various ways by means of a resistance. Thus, for instance, a third coil may be provided on the iron core which carries the two reaction coils of the thermionic tube oscillator, which reaction coils effect a magnetic coupling between the anode and the grid circuit, the said third coil being inserted in a circuit containing a variable resistance. By varying this resistance the strength of the current which flows through the third coil is varied and thereby also the saturation of the iron core on which the two reaction coils are mounted. As a result of the change in the saturation of the iron core the frequency of the thermionic tube acting as an oscillator is varied. According to another arrangement, the frequency of such a tube is varied by this that its cathode is connected to the grid by means of a battery and a variable resistance connected in series therewith, the pitch being varied by varying the adjustment of the said resistance.

According to a still further arrangement in which an adjustable resistance is employed, the pitch may be varied as follows:— By connecting a source of current to a resistance, a voltage drop is obtained along the latter and the different potentials which are thus obtained along the resistance are applied to the grid of the tube working as an oscillator. To each grid potential there corresponds a definite frequency of the oscillator and thus a definite pitch.

Fig. 1 shows a diagram of connections

based on the principle just mentioned. The thermionic tube 1 with the anode 2, grid 3 and cathode 4 is connected to the two coils 5 and 6 which are mounted on the iron core 7 in such a manner that the tube acts as an oscillator. The voltage necessary for heating the filament is applied to the leads marked + and − and the anode voltage is applied to the conductors indicated by # and −. The loud speaker 8 is inserted in the anode circuit of the tube 1 while the adjustable resistance 9 is inserted in the circuit of the incandescent cathode 4. The source of current 10 shown in the form of a battery, is connected near the two ends 11 and 12 of a rectilinear resistance 13 which has the form of a coil of wire wound around a bar 25. Above the latter resistance there is placed a contact bridge 14 consisting of a bendable material, which contact bridge is mounted at its two ends in such a manner that it can be displaced when it is pressed down into contact with the resistance 13 at some point intermediate its ends. The contact bridge 14 is electrically connected over the coil 5 to the grid 3 of the tube 1. The lead 15 connects the cathode 4 of the tube 1 to approximately the middle of the resistance 13. The potentials of the resistance 13 on the one side of that middle point are higher, while the potentials of the points lying on the other side of the said middle point are lower than the potential of the incandescent cathode 4.

By depressing the contact bridge 14 on to the resistance 13 a definite negative or positive potential is imparted to the grid 3 of the tube 1. To this potential there corresponds a definite frequency of the oscillator and therefore a definite pitch, which is reproduced by the loudspeaker 8.

Referring to Fig. 2, the parts illustrated therein which correspond to the parts shown in Fig. 1 are referred to by the same reference letters and therefore they need not be again described.

The contact brige 14 is constituted by a metal band 16 on which there is provided a flexible layer 17 of insulating material, for instance leather. The one end 18 of the metal band 16 is rigidly secured to the support 19. The other end 20 of the said metal band is secured to a member 21 to which the spring 22 is attached and which can be turned around a hinge 23. The adjustment of the tension of the metal band 16 may be effected by means of a screw nut 24 which is provided on a screw-bolt secured to the end 20 of the metal band 16. Underneath the band 16 there is placed the resistance 13 which consists of a wire wound round a straight profile bar 25 which is convex at its upper part. The profile bar 25 is secured to a band 26 made of insulating material. The end 27 of the band 26 is secured to a support 28 and the other end 29 of the said band is secured to a lever 30 which can pivot around an axle 31 and is under the action of a spring 32. An electric switch comprising the contacts 33, 34 is arranged in the circuit of the source of current 10. The contact 34 consists of mercury contained in a cup while the contact 33 is constituted by a rigid metal rod. The contact 33 is mechanically connected with the metal band 16 through the member 21. A coil 35 is secured to the lever 30, which coil is inserted in the grid circuit of a thermionic tube 36, which is connected to act as an amplifier. The latter tube has an anode 37, the heating filament 38 and a grid 39. Opposite the coil 35, which is not provided with an iron core, there is arranged a coil 40 provided with an iron core, and which lies in the anode circuit of the tube 1 acting as an oscillator. By displacing the coil 35 relatively to the coil 40, the coupling between the anode circuit of the oscillating tube 1 and the grid circuit of the amplifying tube 36 is varied. As a result thereof, the degree of the amplification, that is to say the volume of the sound which is reproduced by a loudspeaker (not shown) is varied.

As will be seen from Fig. 3, the flexible insulating layer 17 covering the metal band 16 is slightly wider than the latter band in order to ensure that when the layer 17 is touched by the finger of the performer the band 16 shall not be directly touched. In Fig. 3 the flexible insulating layer 17 is, for convenience, drawn slightly above the metal band 16 in order to show clearly the difference in width between the two bands. Actually, however, the insulating band 17 lies directly on the metal band 16 and may be attached firmly thereto.

The arrow in Fig. 3 indicates that the member 16 is operated by moving it down into contact with the member 25.

The convex construction of the profile bar 25 is intended to ensure the production of a pure tone, since it enables the point of contact between the metal band 16 and the wire of the resistance 13 to be accurately determined. The wire consists of a single piece and is wound with a non-uniform pitch on the profile bar 25. The non-uniform pitch of the wound-on wire produces such a distribution of the resistance along the profile bar 25 that points of contact between the band 16 and the resistance 13 which are at equal distances from one another correspond to degrees of pitch of equal intervals. The same result may be secured by using a wire comprising different parts of unequal resistance but such an arrangement would not be so suitable as the one above referred to.

According to a modification for varying the volume of sound, the lever 30 is provided with a telephone which lies in the anode circuit of the oscillating tube 1, the telephone

being arranged opposite a microphone by means of which the current flowing through a loud-speaker is controlled. The volume of the sound produced in the loudspeaker is in this case determined by the distance between the telephone and the microphone while the pitch is determined solely by the frequency of the oscillator.

The metal bands 16, 16^a, 16^b, 16^c are arranged parallel and next to one another on the supports 19 and 28 at different heights, the band 16^a lying slightly higher than the band 16, the band 16^b slightly higher than the band 16^a and so on. This arrangement of the individual manuals at different heights facilitates the operation of the instrument. The resistances associated with the bands 16, 16^a, 16^b, 16^c are all arranged at the same distance below the corresponding contact band. The switch 33, 34 is provided in order to reduce the load on the battery 10 as much as possible. As long as the contact bridge 14 and the metal band 16 have not been pressed down on to the resistance 13 by the finger of the performer, the circuit of the battery 10 remains open, since the contacts 33 and 34 do not yet make contact with one another. When the band 16 is depressed the member 21 is rotated against the action of the spring 22 around a hinge 23. The contact rod 33 then dips into the mercury 34, thereby closing the circuit of the battery 10. Consequently the said battery is used only when a sound is actually produced. Upon the further depression of the band 16, the corresponding part of the band touches the point of the resistance wire lying underneath. The grid circuit of the tube 1 is thereby closed and a sound of a definite frequency is produced. The sound is first of all very soft because the coupling between the anode circuit of the oscillating tube 1 and the grid circuit of the amplifying tube 36 which is produced between the coils 35 and 40 is very loose at the beginning.

The stronger the metal band 16 is pressed down in the same position, the more is the insulating band 26 displaced against the action of the spring 32 without any change in the pitch of the sound thereby taking place. However, by the displacement of the band 26, the coils 35 and 40 are approached towards one another with the result that a tighter coupling is produced between the anode circuit of the oscillating tube 1 and the grid circuit of the amplifying tube 36 and thereby the volume of sound is increased whilst the pitch remains the same. It will thus be seen that by using one finger only it is possible to adjust the pitch of the sound as well as its volume. By depressing the band 16 at different points, sounds of different pitch are produced. By moving the finger along the insulating layer 17 of the band 16 a constant volume sound of varying pitch is thereby produced. If, at the same time, the pressure exerted by the finger is increased, also the volume of sound which is produced is increased.

By arranging a plurality of similar devices next to one another it is possible to produce simultaneously a plurality of sounds of different pitch and strength. As a single finger is sufficient for producing a sound, one of the hands of the performer is free when the instrument is manipulated. Therefore the new instrument may be placed before the key-board of a key-board instrument, for instance a piano, so that the performer can operate the instrument according to the invention with the one hand and with the other hand operate the key-board instrument. The combined effect of the key-board instrument and of the instrument according to the invention allows sound effects to be produced which could not hitherto be obtained.

According to another modification, the movement of the band 26 is caused to vary the value of a liquid resistance which lies in the anode circuit of the tube 1 acting as an oscillator. However, the two modifications just referred to are not so convenient as the arrangement in which the volume of sound is varied by varying the magnetic coupling between the anode circuit of the tube 1 and the grid circuit of the tube 36.

The manual hereinbefore described and which essentially consists of the straight-line contact bridge 14 and the resistance 13 arranged underneath it can be conveniently constructed in the form of an instrument capable of producing a plurality of sounds of different pitch. Such an instrument is illustrated in Fig. 2. A plurality of bands 16, 16^a, 16^b, 16^c are arranged parallel to one another on the supports 19 and 28, each one of the said bands being covered by a flexible layer of insulating material. Underneath each one of the bands there is provided a resistance winding coiled around a profile bar. However, for the sake of clearness, only the profile bar associated with the band 16 has been shown. The bands 16^a, 16^b, 16^c and the resistances associated therewith are each one of them connected with an oscillatory system, in the same manner as the band 16 and the resistance 13. Each one of the supporting bands for the resistances which corresponds to the resistance 13 lying in front is connected with a coil (not shown) corresponding to the coil 35. All these coils are arranged in front of the coil 40, the tube 36 being used for amplifying in common the sounds produced by means of all the bands.

A special musical advantage consists in this that a performer can accompany himself.

When a sound of a definite pitch and strength has been struck by means of the instrument, the same can be interrupted suddenly or its strength can be allowed to die

out slowly. When the finger is suddenly removed from the insulating layer of the band 16, the latter is removed so quickly by the spring 22 that the resistance 33 which is displaceable cannot follow suit. Consequently he sound is interrupted suddenly. However, if the finger is removed slowly from the band 16 the band 26 carrying the resistance 13 can follow the movement of the band 16 so that first of all the contact is not interrupted but only the coupling between the coils 40 and 35 is made looser. In consequence thereof the sound which is produced first of all dies down slowly and finally ceases entirely when the contact between the band 16 and the resistance 13 is interrupted.

In order to regulate the volume of sound the special mechanical device illustrated in Fig. 2 is not absolutely necessary. In order to regulate the volume of sound it is only essential to use means which will permit the resistance to be displaced in a vertical plane passing through its longitudinal axis. For instance, instead of securing the resistance 13 on to the insulating band, which is displaceable against the action of the spring 32, the profile bar 25 of the resistance may be arranged in a different manner to be capable of movement in a vertical direction and its downard movement effected by means of the band 16 may be transmitted by a suitable link mechanism on to any desired device for varying the volume of sound.

What we claim is:—

1. An apparatus for regulating the volume of sound in musical instruments in which currents of acoustic frequency are produced by an oscillator and are then amplified in a thermionic tube acting as an amplifier, consisting of a device for coupling the circuit of the oscillator through which the currents of acoustic frequency pass with the grid circuit of a thermionic tube acting as an amplifier, means for varying the said coupling as desired and constructional parts by means of which the movement of the members for the adjustment of the pitch is transmitted to the means for varying the coupling.

2. An apparatus for regulating the volume of sound in musical instruments in which currents of acoustic frequency are produced by an oscillator and are then amplified in a thermionic tube amplifier, consisting of a device for electromagnetically coupling the circuit of the oscillator carrying the currents of acoustic frequency with the grid circuit of a thermionic tube acting as an amplifier, a straight-line, stretched constructional part carrying a resistance for varying the frequency of the oscillator and which is positively connected with the coupling device, a source of power which tends to return the coupling device and the straight-line stretched constructional part into their initial positions and a second straight-line stretched constructional part which is arranged parallel above the first constructional part and is mounted in such a manner as to be capable of displacement in a vertical direction.

3. In a musical instrument in which sound effects are produced by a change in the frequency of a thermionic tube oscillator and in which the change in pitch is effected by the variation of a resistance, the combination of a straight-line contact bridge consisting of bendable material with a resistance member which is also in the form of a straight line like the contact bridge and is arranged parallel thereto at a distance therefrom such that the contact bridge can be bent into contact with the resistance, and a source of current connected to the resistance to produce a drop in potential along it.

4. In a musical instrument in which sound effects are produced by a change in the frequency of a thermionic tube oscillator and in which the change in pitch is effected by the variation of a resistance, the combination of a straight-line contact bridge with a resistance member which is also in the form of a straight line like the contact bridge and which is arranged parallel thereto underneath it at a distance such that the contact bridge can be bent into contact with the resistance, means which permit the resistance member to be displaced in a vertical plane passing through its longitudinal axis, means to allow the latter movement to be transmitted to a device for carying the volume of sound, and a source of current connected to the said resistance.

5. In a musical instrument in which sound effects are produced by a change in the frequency of a thermionic tube oscillator and in which the change in pitch is effected by the variation of a resistance, the combination of a straight-line, tensioned metal band the upper side of which is provided with a flexible insulating layer, a resistance member having the same straight line form as the metal band and arranged parallel thereto and underneath it at a distance such that the metal band can be bent into contact with the resistance, means permitting the resistance member to be displaced in a vertical plane passing through its longitudinal axis, means to allow the said movement of the resistance member to be transmitted to a device for varying the volume of sound, and a source of current connected to the said resistance.

6. In a musical instrument in which sound effects are produced by a change in the frequency of a thermionic tube oscillator and in which the change in pitch is effected by the variation of a resistance, the combination of a straight-line tensioned metal band, the upper side of which is provided with a flexible insulating layer, a resistance member which has the same straight line form as the metal band and which lies underneath it and par-

allel thereto at a distance such that the metal band can be bent into contact with the resistance, means to allow the resistance member to be displaced in a vertical plane passing through its longitudinal axis, means to transmit the movement of the resistance member to a coil which magnetically couples the anode circuit of the oscillator with the grid circuit of a thermionic tube, and a source of current connected to the resistance.

7. In a musical instrument in which sound effects are produced by a change in the frequency of a thermionic tube oscillator and in which the change in the pitch is effected by the variation of a resistance, the combination of a straight-line, tensioned metal band, the upper side of which is provided with a flexible insulating layer, a straight-line profile bar lying parallel to the metal band and beneath it, a coil of resistance wire wound on said profile bar, a second band supporting said profile bar one end of said second band being connected to a fixed member and the other end to a movable member, means to allow the movement of the lower band to be transmitted to a coil, which magnetically couples the anode circuit of the oscillator with the grid circuit of a thermionic tube, and a source of current connected to the said resistance.

8. In a musical instrument in which sound effects are produced by a change in the frequency of a thermionic tube oscillator and in which the change in pitch is effected by the variation of a resistance, the combination of a straight-line, tensioned metal band, the upper side of which is provided with a flexible insulating layer, a straight-line profile bar which is arranged beneath the metal band and parallel thereto, a winding consisting of a resistance wire on the said profile bar, a second band on which the profile bar lies and the one end of which is connected to a fixed member and the other one to a movable member, means capable of transmitting the movement of the lower band to a coil having no iron core, said coil being connected to the grid circuit of a thermionic tube acting as an amplifier, a second coil magnetically coupled with the said first coil, which second coil is stationary, has an iron core and is connected to the anode circuit of the oscillator, and a source of current connected to the resistance.

9. In a musical instrument in which sound effects are produced by a change in the frequency of a thermionic tube oscillator and in which the change in pitch is effected by the variation of a resistance, the combination of a straight bar resistance member, with a source of current connected near the two ends of the said resistance, a straight-line contact bridge arranged above the resistance at a distance such that the contact bridge can be bent into contact with the resistance, a thermionic tube connected to act as an oscillator and with metallic connections including said contact bridge capable of producing a potential difference between the cathode and the grid of the oscillating tube corresponding to the potentials of the individual points of the resistance.

10. In a musical instrument in which sound effects are produced by a change in the frequency of a thermionic tube oscillator and in which the change in pitch is effected by the variation of a resistance, the combination of a straight rod resistance member, a source of current connected near the two ends of the resistance, a thermionic tube acting as an oscillator, a metallic conductor which connects the cathode of the oscillating tube to approximately the middle point of the resistance, a contact bridge arranged above the resistance at a distance such that the contact bridge can be bent into contact with the resistance, and a metallic connection between the said bridge and the grid of the oscillating tube.

11. In a musical instrument in which sound effects are produced by a change in the frequency of a thermionic tube oscillator and in which the change in pitch is effected by the variation of a resistance, the combination of a straight rod resistance member with a source of current, one pole of which is connected near the one end of the said resistance, an electric switch, one contact member of which is connected with the other pole of the said source of current while the second contact thereof is electrically connected near the other end of the resistance, a thermionic tube acting as an oscillator, a metallic conductor connecting the cathode of the oscillating tube to approximately the middle point of the resistance, a contact bridge arranged above the resistance at a distance such that the contact bridge can be pressed into contact with the resistance, an electric connection between the said bridge and the grid of the oscillating tube and a mechanical connection between the said bridge and one contact of the switch.

12. In a musical instrument in which sound effects are produced by a change in the frequency of a thermionic tube oscillator and in which the change in pitch is effected by the variation of a resistance, the combination of a straight rod resistance member with a source of current, the one pole of which is connected near the one end of the resistance with an electric switch, the one contact of which switch is constituted by a vessel containing mercury and the other contact by a solid metal member, a conductive connection between the other pole of the source of current and one contact of the switch, an electrical connection between the other contact of the switch and approximately the other end of the resistance, a thermionic tube acting as an oscillator, a metallic conductor connecting the cathode of the oscillating tube

to approximately the middle point of the resistance, a metal band arranged above the resistance and carrying on its upper side a flexible layer of insulating material, one end of the said metal band being fixed and the other end thereof resiliently clamped, an electrical connection between the said band and the grid of the oscillating tube, and a mechanical connection between the end of the band which is resiliently clamped and one contact of the switch.

13. In a musical instrument in which sound effects are produced by a change in the frequency of a thermionic tube oscillator and in which the change in the pitch is effected by the variation of a resistance, the combination of two supports, two bands arranged on these supports, one underneath the other, the upper band being of metal and the lower band of insulating material, each one of these bands having one end fixed to a different support from the other band while the free ends of the two bands are resiliently clamped, a profile bar carrying a wire resistance wound thereon lying on the band which consists of insulating material, a source of current connected to the said resistance winding, and a device for varying the volume of sound mechanically connected to the lower band.

14. In a musical instrument in which sound effects are produced by a change in the frequency of a thermionic tube oscillator and in which the change in pitch is effected by the variation of a resistance, the combination of a stretched metal band with a profile rod convex at its upper part and arranged underneath the said metal band and parallel thereto at a distance such that the metal band can be pressed into contact with said rod, a winding of resistance wire on the said profile rod and a source of current connected to the said winding.

15. In a musical instrument in which sound effects are produced by a change in the frequency of a thermionic tube oscillator and in which the change in the pitch is effected by the variation of a resistance, the combination of a stretched metal band with a profile rod convex at its upper part and arranged underneath the said metal band, a winding of resistance wire on the said rod, said wire consisting of a single piece wound with a non-uniform pitch, and a source of current connected to the said winding.

16. In a musical instrument in which sound effects are produced by a change in the frequency of a thermionic tube oscillator and in which the change in the pitch is effected by the variation of a resistance, the combination of a plurality of contact devices, each one of which consists of a stretched metal band having a flexible insulating layer at its upper side and a resistance member in the form of a rod arranged parallel to the said metal band and underneath it, and a source of current to which the resistance is connected.

17. A playing manual for musical instruments on which a plurality of sounds of different pitch can be produced, the sound effects being produced by variations in the grid circuit of a thermionic tube acting as an oscillator, which variations are produced by the variation of a resistance, comprising a plurality of straight-line, tensioned metal bands which are arranged parallel and next to one another at unequal heights and of rod-like resistance members arranged underneath the said metal bands at distances such that the metal bands are bendable into contact with said resistances at any one of a plurality of points.

18. An apparatus for the regulation of the volume of sound in musical instruments in which currents of acoustic frequency are produced by means of an oscillator and are then amplified by means of an amplifier, comprising a device for coupling the circuit of the oscillator carrying the currents of acoustic frequency with the grid circuit of a thermionic tube acting as an amplifier, and means for varying the coupling at will.

19. A musical instrument comprising a thermionic vacuum tube oscillator, a resistance, a source of current, means connecting said source to the terminals of said resistance so as to produce a drop in voltage along said resistance, an elongated contact member of bendable material arranged adjacent and parallel to said resistance at a distance such that the contact member can be pressed into contact with said resistance at any one of a plurality of points along its length, and means connecting said contact member and an intermediate point of said resistance respectively to the input electrodes of said oscillator.

In testimony whereof we have signed our names to this specification.

PETER LERTES.
BRUNO HELBERGER.

CERTIFICATE OF CORRECTION.

Patent No. 1,847,119. Granted March 1, 1932, to

PETER LERTES ET AL.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 3, line 87, beginning with the word "According" strike out all to and including the word "bands." in line 124, and same page, after line 8, insert the following paragraphs:-

> According to another modification, the movement of the band 26 is caused to vary the value of a liquid resistance which lies in the anode circuit of the tube 1 acting as an oscillator. However, the two modifications just referred to are not so convenient as the arrangement in which the volume of sound is varied by varying the magnetic coupling between the anode circuit of the tube 1 and the grid circuit of the tube 36.
>
> The manual hereinbefore described and which essentially consists of the straight-line contact bridge 14 and the resistance 13 arranged underneath it can be conveniently constructed in the form of an instrument capable of producing a plurality of sounds of different pitch. Such an instrument is illustrated in Fig. 2. A plurality of bands 16, 16a, 16b, 16c are arranged parallel to one another on the supports 19 and 28, each one of the said bands being covered by a flexible layer of insulating material. Underneath each one of the bands there is provided a resistance winding coiled around a profile bar. However, for the sake of clearness, only the profile bar associated with the band 16 has been shown. The bands 16a, 16b, 16c and the resistances associated therewith are each one of them connected with an oscillatory system, in the same manner as the band 16 and the resistance 13. Each one of the supporting bands for the resistances which corresponds to the resistance 13 lying in front is connected with a coil (not shown) corresponding to the coil 35. All these coils are arranged in front of the coil 40, the tube 36 being used for amplifying in common the sounds produced by means of all the bands.;

page 4, line 99, claim 4, for "carying" read varying; and that the said Letters Patent should be read with these corrections therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 26th day of April, A. D. 1932.

M. J. Moore,
Acting Commissioner of Patents.

(Seal)