

Nov. 28, 1933.

N. LANGER

1,937,389

ELECTRICAL MUSICAL INSTRUMENT

Filed Dec. 26, 1930

3 Sheets-Sheet 1

Fig. 1.

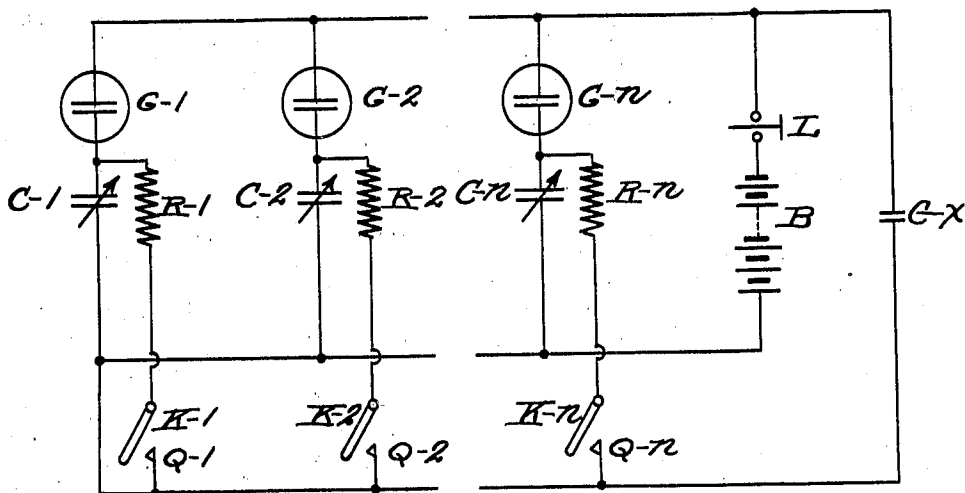
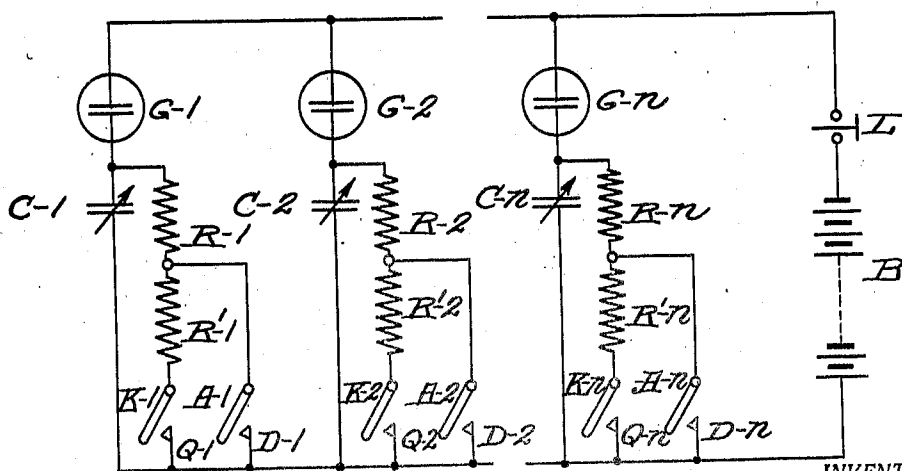


Fig. 2.



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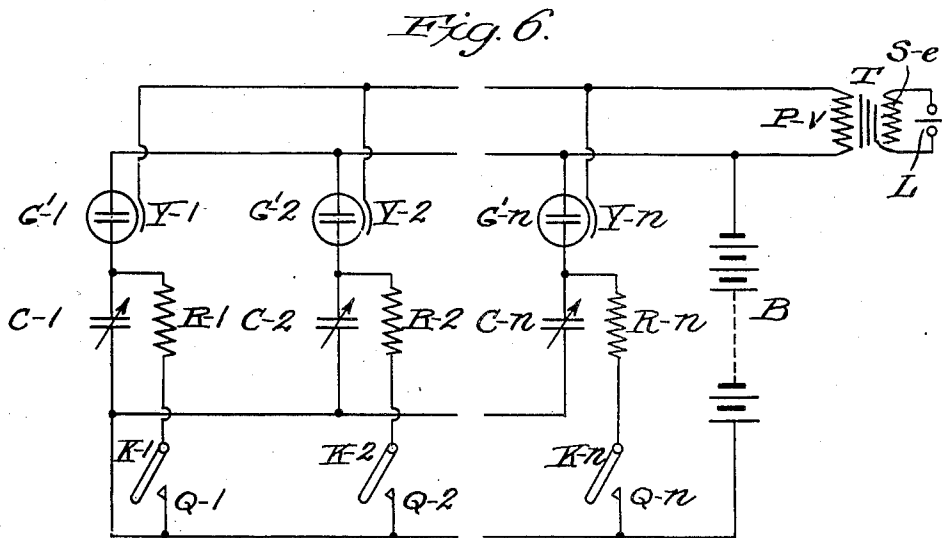
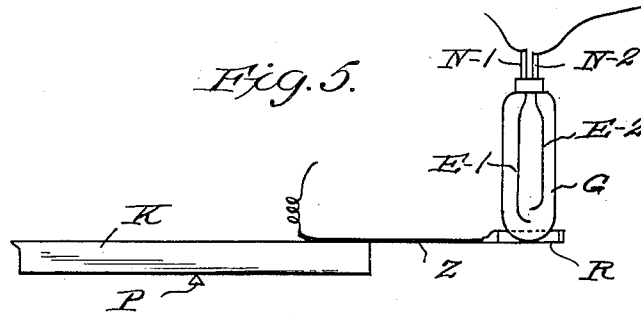
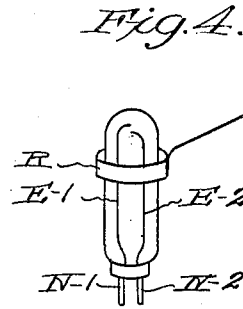
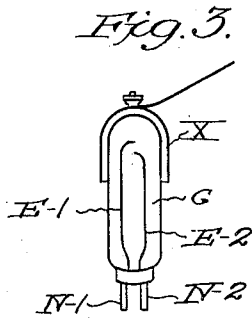
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ELECTRICAL MUSICAL INSTRUMENT

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3 Sheets-Sheet 2



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3 Sheets-Sheet 3

Fig. 7.

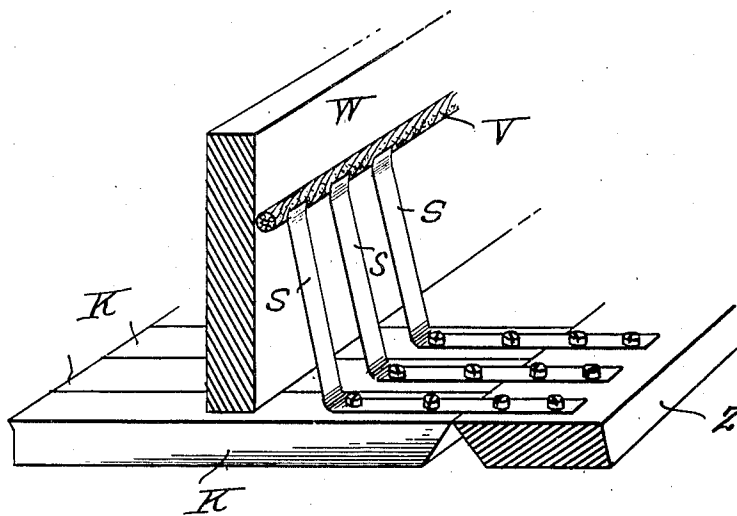
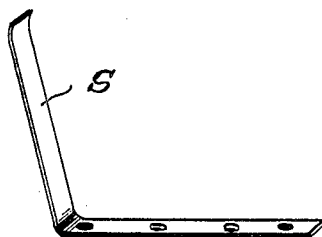


Fig. 8.



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1,937,389

ELECTRICAL MUSICAL INSTRUMENT

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Application December 26, 1930
Serial No. 504,684

18 Claims. (Cl. 84-1)

The present invention relates to an improved electrical musical instrument of the type in which sounds are produced by means of electrical oscillations set up in circuits containing glow-discharge lamps.

It is an object of the present invention to provide an improved electrical musical instrument of the type described hereinabove.

It is a further object of the invention to provide an improved electrical musical instrument which is simple, economical, and compact.

It is another object of the invention to provide an improved electrical musical instrument which is wholly practical and which is substantially free from contact noises and the like.

Other objects and advantages of the invention will become apparent from the following description taken in conjunction with the accompanying drawings in which:

Fig. 1 depicts an electrical diagram of a circuit exemplifying the principles of my invention;

Fig. 2 is a view similar to Fig. 1 of a modified electrical circuit;

Fig. 3 illustrates a glow-discharge lamp used in connection with my improved electrical musical instrument;

Fig. 4 is a view similar to Fig. 3 of a modified glow-discharge lamp;

Fig. 5 is an elevational view of a glow-discharge lamp shown in Fig. 4 in conjunction with a piano key;

Fig. 6 illustrates an electrical circuit embodying my invention and the glow-discharge lamps illustrated in Figs. 3 and 4;

Fig. 7 is a perspective view, somewhat fragmentary, of a portion of a keyboard used in connection with my improved electrical musical instrument; and

Fig. 8 is a perspective view of one of the contact keys used on the keyboard shown in Fig. 7.

Referring more particularly to Fig. 1, glow-discharge lamps $G-1$, $G-2$, ..., $G-n$ are shown arranged in a circuit in parallel with battery B . In this circuit, a sound producing device L , such as a telephone receiver or loud speaker, is illustrated.

In series with each glow-discharge lamp is a condenser $C-1$, $C-2$, ..., $C-n$, which is preferably of the variable type. By providing a variable condenser it is possible to vary the frequency of the oscillations. Across each condenser can be shunted a resistance $R-1$, $R-2$, ..., $R-n$ having an appropriate value by means of switching keys $K-1$, $K-2$, ..., $K-n$ and contacts $Q-1$, $Q-2$, ..., $Q-n$. For example, a resistance having

a value lying within a range from approximately 0.1 megohms to approximately 4 megohms may be used. When a resistance of the aforesaid type is employed, then a condenser having a capacity lying within a range from about 0.0001 microfarads to about 0.1 microfarads is used.

When the switching keys are open, there are no oscillations produced, even though the condensers have been charged up through the glow-discharge lamps. When, however, one of the keys is depressed the resistance $R-1$, etc. is shunted across the condenser and oscillations are set up in the usual way by charging of the condenser through $G-1$ etc. and discharging through $R-1$, etc.

Various advantages flow from the use of the foregoing circuit. Of these the more important are as follows. Only a little part of the current will be interrupted in the circuit each time contact is made because condenser $C-1$, etc. will take up current flowing through resistance $R-1$, etc. and will be charged for operation again. There will be a relatively slow transition between the state of working (oscillating) and rest. Even after a considerable amplification there will be practically no audible indication of the interruption in the sound reproducing device. Moreover, it is apparent from the foregoing that the condenser is connected in series with the source of current and is variable whereby it is possible to vary the frequencies of the oscillations and thus tune the instrument musically to the desired pitch. Furthermore, the glow-discharge lamps are normally inactive and are only rendered active upon closing of the circuits by means of keys $K-1$, etc. In this manner it is possible to produce mellow tones substantially free from contact noises, clicks and the like.

The function of condenser $C-x$ is to decrease the combined audiofrequency resistance of telephone L and battery B , which might otherwise cause a certain amount of undesirable coupling (reaction) of the glow-discharge lamp circuits with each other. By the use of this auxiliary condenser $C-x$, a slight loss of energy results but this loss can be reduced to practically negligible values by the use of a condenser having a capacity of about 0.0001 microfarads. In other words, by placing the auxiliary condenser $C-x$ across the output of the circuit, the foregoing results may be obtained.

In Fig. 2 a circuit is shown which is quite similar to the one shown in Fig. 1 except that instead of using one resistance a pair of resistances are connected in series. As may be clearly seen from

the drawings key $K-1, K-2 \dots K-n$ connects resistances $R-1, R-2 \dots R-n$ in series with resistances $R'-1, R'-2 \dots R'-n$. When keys $A-1, A-2 \dots A-n$ are connected in the circuit only resistances $R-1, R-2 \dots R-n$ are connected in the glow-discharge lamp circuits. By the use of the aforesaid circuit it is possible to eliminate fifty per cent of the glow-discharge lamp required in the electrical musical instrument. In other words, one lamp is capable of being used in the production of notes of a different pitch. In practice, the pitch is preferably adjusted to one-half a tone apart.

In Figs. 3 and 4 glow-discharge lamps are illustrated with external electrodes. In Fig. 3 a cup-shaped electrode X is used to cover the top portion of the glow-discharge lamp G , whereas in Fig. 4 a ring R is employed to surround the glow-discharge lamp. These lamps are provided with internal electrodes $E-1$ and $E-2$ and contact pins $N-1$ and $N-2$.

By utilizing external electrodes in the circuit, undesirable background noises originating in the making and breaking of the circuits, are practically eliminated. In practice, the external electrodes are preferably made of copper, but any other appropriate metal may be used.

In Fig. 5 a glow-discharge lamp with an external electrode is illustrated in conjunction with a piano key K , which is pivoted on a pivot P . When key K is actuated, ring electrode R is slipped over the glow-discharge lamp G . In this manner, it is possible in the case of a piano, for example, to produce varying degrees of volume for each note. The nearer the external electrode is moved to the glow-discharge lamp, the greater is the volume produced.

It is to be observed that the glow-discharge lamps illustrated in Figs. 3 and 4 and the piano key arrangement illustrated in Fig. 5 make it possible to have a loose coupling between the individual circuits and the common sound-producing apparatus or amplifier. In the present instance, the coupling is one of the capacity type which has proved to be very effective in eliminating the undesirable noises and the like resulting from making and breaking the circuits. This type of capacity coupling possesses another important advantage due to the relatively small capacity between the internal and external electrodes. It is possible to produce new and fascinating tone effects due to the selectivity with which the higher oscillations are favored over the lower oscillations.

In Fig. 6 an electrical circuit containing glow-discharge lamps having external electrodes is illustrated. The external electrodes $Y-1, Y-2 \dots Y-n$ of glow discharge lamps $G'-1, G'-2 \dots G'-n$ are depicted as being connected in circuit with a primary winding $P-r$ of a transformer T . This primary winding is also connected with one of the internal electrodes of the glow-discharge lamps. The other internal electrode is connected with a variable condenser $C-1, C-2 \dots C-n$. These condensers are connected together. A resistance $R-1, R-2, \dots R-n$ can be connected in shunt with each variable condenser $C-1, C-2 \dots C-n$ by means of switching keys $K-1, K-2 \dots K-n$ make contact with contacts $Q-1, Q-2 \dots Q-n$. When any key is closed, oscillations are produced in the lamp circuits and in the primary winding of transformer T , corresponding oscillations are produced in the secondary winding $S-e$ of the transformer. This secondary winding is connected to a sound-pro-

ducing device or amplifier (not shown). In operating a circuit of the aforesaid type, practically all of the background noises are eliminated. Although a transformer type of coupling has been specified, other types of coupling, such as capacity, resistance, etc., can be used.

It has been found that the contact noises or clicks may be reduced materially by using a special type of contact which is illustrated in Fig. 7. In this figure, the reference character K designates a piano key, which is secured to an insulating strip or rod Z of bakelite or the like by means of springs S , which are screwed to the strip Z and to the keys K . The free end of the springs make contact with a resilient wire V , which is secured to an upright wall W . I have found that a golden thread V is the best type of wire to use. This golden thread is soft, resilient and possesses good conductivity. The metallic threads are preferably wound about silk or similar threads and a plurality of such threads twisted together to form wire V .

When the aforesaid arrangement is used, a circuit can be closed by depressing key K and causing the spring carried on the movable key to make contact with the golden thread. In practice, spring S is preferably made of spring steel which makes a practically noiseless contact with the golden thread. Moreover, the golden thread does not oxidize or deteriorate in any other manner, so that a reliable and efficient contact is always maintained.

I claim:—

1. An electrical musical instrument comprising a main electrical circuit containing a source of current, a glow-discharge lamp energized by said current, a condenser in series with said lamp, a resistance normally disconnected from the main circuit and capable of being shunted across said condenser, a switching key located between said resistance and said main circuit, said key being normally open to disconnect said resistance from the main circuit and being capable of actuation for shunting said resistance across said condenser and for connecting said resistance in circuit and for causing current to flow through said lamp, and a sound-producing means capable of emitting sound when said lamp is energized.

2. An electrical musical instrument comprising a main electrical circuit containing a source of current and a sound-producing means, a plurality of glow-discharge lamps connected in parallel with said source of current and said sound-producing means, a condenser connected in series with each glow-discharge lamp, a resistance normally disconnected from the main circuit and capable of being shunted across each condenser, and a switching key connected in series with each resistance located between said resistance and said main circuit, said key being normally open to disconnect said resistance from the main circuit and being capable of actuation for shunting said resistance across said condenser and for connecting the resistance in the circuit and for causing current to flow to a lamp to actuate the sound-producing means to emit sound.

3. An electrical musical instrument comprising an electrical circuit containing a source of current, a glow-discharge lamp and condenser connected to said source of current, a pair of resistances connected in series shunted across the condenser, a switching key for connecting the pair of resistances in the circuit, a second switching key for connecting one of said resistances in circuit, and sound-producing means capable of

emitting sound of one tone when one of said switching keys is operated and capable of emitting sound of another tone when the other of said switching keys is operated.

5 4. An electrical musical instrument comprising an electrical circuit containing a source of current and a sound-producing means, a plurality of glow-discharge lamps connected in parallel with said source of current and said sound-producing means, a condenser connected in series with each glow-discharge lamp, a pair of resistances connected in series shunted across each condenser, a switching key connected in series with said pair of resistances for connecting said resistances in circuit and a second switching key for connecting one of said resistances in circuit.

10 5. An electrical musical instrument comprising an electrical circuit containing a source of current and a plurality of glow-discharge lamps connected in parallel therewith, a condenser connected in series with each of said lamps, a resistance shunted across each of said condensers, a switching key for connecting each resistance in circuit, an external electrode for each glow lamp, and a coupling system connecting the external electrodes and one inner electrode in each lamp to an amplifying and sound-producing means.

15 6. An electrical musical instrument comprising a plurality of electrical circuits containing a source of current, a plurality of glow-discharge lamps connected in parallel with said source of current, a condenser connected in series with each lamp, a resistance shunted across each condenser, a sound-producing means and key-board similar to that of a piano for actuating glow-discharge lamps in said circuits and for causing said sound-producing means to emit sound.

20 7. An electrical musical instrument comprising a main electrical circuit containing a source of current, a glow-discharge lamp energized by said current, a condenser in series with said lamp, a resistance normally disconnected from the main circuit and capable of being shunted across said condenser, a switching key for connecting said resistance in circuit and for causing current to flow through said lamp, a sound-producing means capable of emitting sound when said lamp is energized, and an auxiliary condenser shunting across said sound producing means for substantially eliminating contact noises.

25 8. An electrical musical instrument comprising a main electrical circuit containing a source of current and a sound producing means, a plurality of glow-discharge lamps connected in parallel with said source of current and said sound producing means, a variable condenser for the musical tuning in series with each glow-discharge lamp, a resistance normally disconnected from the main circuit and capable of being shunted across each condenser, and a switching key connected in series with each resistance located between said resistance and said main circuit, said key being normally open to disconnect said resistance from the main circuit and being capable of actuation for shunting said resistance across said condenser and for connecting the resistance in the circuit and for causing current to flow to a lamp to actuate the sound-producing means to emit sound.

30 9. An electrical musical instrument comprising a main electrical circuit containing a source of current, a glow-discharge lamp energized by said current, a condenser in series with said lamp, said condenser having a capacity lying within a range extending from about 0.0001 micro-farads to

about 0.1 micro-farads for producing notes of musical frequency, a resistance normally disconnected from the main circuit and capable of being shunted across said condenser, said resistance having a value lying within a range from about 0.01 megohms to about 4 megohms, a switching key for connecting said resistance in circuit and for causing current to flow through said lamp, and a sound producing means capable of emitting sound when said lamp is energized.

35 10. An electrical musical instrument comprising a main electrical circuit containing a source of current, said source of current having a potential lying within a range extending from about 60 volts to about 300 volts, a glow-discharge lamp energized by said current, a condenser in series with said lamp, a resistance normally disconnected from the main circuit and capable of being shunted across said condenser, a switching key for connecting said resistance in circuit and for causing current to flow through said lamp, and a sound-producing means capable of emitting sound when said lamp is energized.

40 11. An electrical musical instrument comprising a main electrical circuit containing a source of current and a sound-producing means, an auxiliary condenser shunted across said sound-producing means, a plurality of glow-discharge lamps connected in parallel with said source of current and said sound-producing means, a condenser connected in series with each glow-discharge lamp, a resistance shunted across each condenser, and a switching key connected in series with each resistance for connecting the resistance in the circuit and for causing current to flow to a lamp to actuate the sound-producing means to emit sound.

45 12. An electrical musical instrument comprising a main electrical circuit containing a source of current and a sound-producing means, a plurality of glow-discharge lamps connected in parallel with said source of current and said sound-producing means, a condenser connected in series with each glow-discharge lamp, each of said condensers being variable for effecting musical tuning, a pair of resistances connected in series shunted across each condenser, a switching key connected in series with said pair of resistances for connecting said resistances in circuit and a second switching key for connecting one of said resistances in circuit.

50 13. An electrical musical instrument comprising a main electrical circuit containing a source of current, a glow-discharge lamp energized by said current, a resistance in series with said lamp, a condenser normally disconnected from the main circuit and capable of being shunted across said resistance, a switching key located between said condenser and said main circuit, said key being normally open to disconnect said condenser from the main circuit and being capable of actuation for shunting said condenser across said resistance and causing said condenser to be charged and discharged through said lamp, and a sound-producing means capable of emitting sound when said lamp is energized.

55 14. An electrical musical instrument comprising a main electrical circuit containing a source of current and a sound producing means, a plurality of glow-discharge lamps connected in parallel with said source of current and said sound-producing means, a resistance connected in series with each glow-discharge lamp, a condenser normally disconnected from the main circuit and capable of being shunted across each re-

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sistance and a switching key connected in series with each condenser, located between said condenser and said main circuit, said key being normally open to disconnect said condenser from the main circuit and being capable of actuation for shunting said condenser across said resistance and causing said condenser to be charged and discharged through said lamp, and a sound producing means capable of emitting sound when said lamp is energized.

15. An electrical musical instrument comprising a main electrical circuit containing a source of current, a glow-discharge lamp and condenser connected to said source of current, a plurality of resistances connected in series and capable of being shunted across the condenser, a switching key for each of these resistors located between each common point of any two adjoining resistances and one point of the condenser, said key being normally open to disconnect the resistances from the main circuit and being capable of actuation for shunting a plurality of said series resistances across said condenser and for connecting said resistances in circuit and for causing current to flow through said lamp, and sound-producing means capable of emitting sound of different pitch for every switching key operated, sound of the highest pitch when only one resistance is connected across the condenser, sound of the lowest pitch when all the series resistances are connected across the condenser.

16. An electrical musical instrument comprising an electrical circuit containing a source of current and a sound-producing means, a plurality of glow-discharge lamps connected in parallel with said source of current and said sound-producing means, a condenser connected in series with each glow-discharge lamp, a multiplicity of resistances connected in series for each condenser and capable of being shunted across the condenser, a switching key for each of these resistors located between each common point of any two adjoining resistances and one point of the condenser, said key being normally open to disconnect the resistances from the main circuit and being capable of actuation for shunting any number of said series resistances across the corresponding condenser and for causing current to

flow through the lamp in series to said condenser, and sound-producing means common to all these circuits capable of emitting sound of different pitch for every switching key operated, sound of the highest pitch when only one resistance is connected across the condenser, sound of the lowest pitch when all the series resistances are connected, and emitting a musical chord when two or more keys belonging to different condensers are operated simultaneously.

17. An electrical musical instrument comprising a main electrical circuit containing a source of current, a glow-discharge lamp and a condenser both in series with said source of current, a plurality of resistors all in series and capable of being shunted across the condenser, a switching key for each of these resistors located between each common point of any two adjoining resistances and one point of the condenser, and being capable of actuation for shunting a definite number of said resistances across said condenser and for causing current to flow through said lamp, a sound producing means and key-board similar to that of a piano operatively connected to said switching key for causing said sound producing means to emit sound of different pitch for every key operated.

18. An electrical musical instrument comprising a main electrical circuit containing a source of current, a glow-discharge lamp and an impedance variable in steps or continuously in series with said source of current, an auxiliary circuit comprising a plurality of impedances arranged in parallel or in series with each other, a switching key for each of these auxiliary impedances located between the particular impedance and the main circuit and capable of connecting each switch a different number of auxiliary impedances in parallel or in series among themselves across the main circuit impedance or disconnecting said auxiliary impedances therefrom, a keyboard similar to that of a piano, every key operatively connected to a switching key, and sound producing means capable of emitting sound of different pitch for every key of the keyboard actuated.

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