June 12, 1962 S. H. BERGMAN 3,038,364

ELECTRICAL MUSICAL INSTRUMENTS

Filed Feb. 25, 1959 2 Sheets-Sheet 1

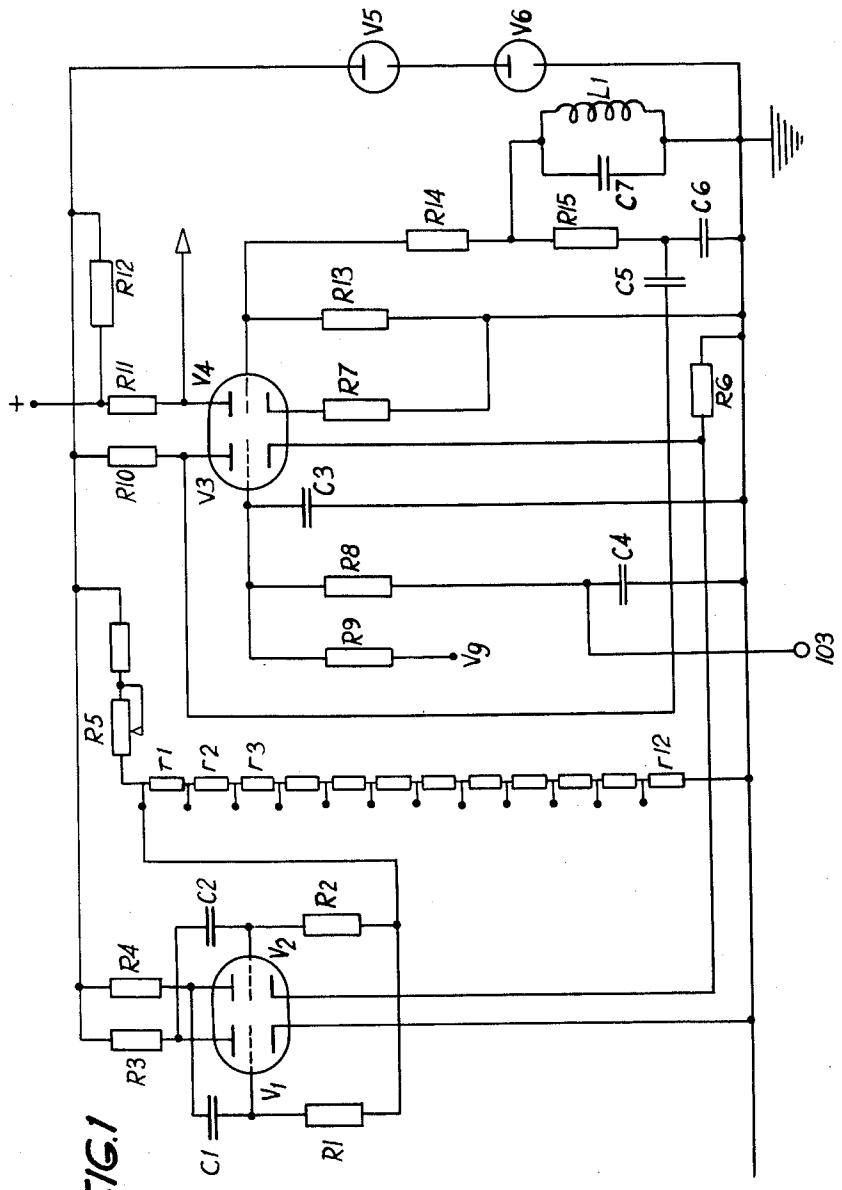

FIG. 1

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Filed Feb. 25, 1959 2 Sheets-Sheet 2

FIG. 2

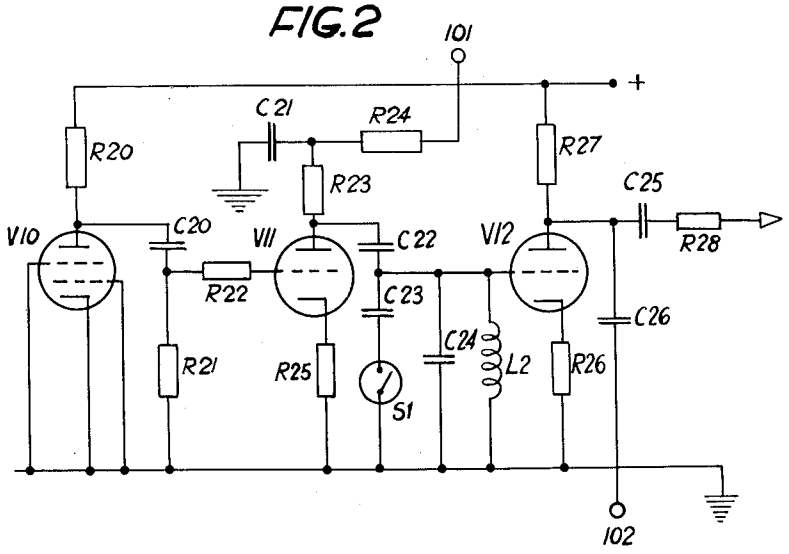
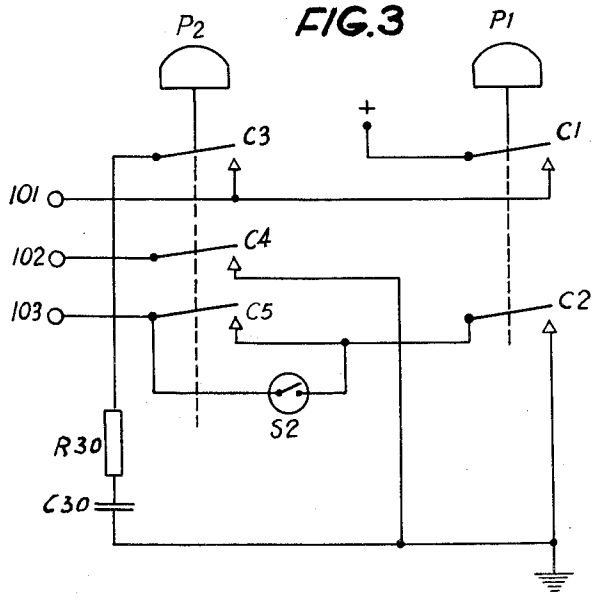


FIG. 3



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United States Patent Office 3,038,364 Patented June 12, 1962

3,038,364

ELECTRICAL MUSICAL INSTRUMENTS

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Filed Feb. 25, 1959, Ser. No. 795,392
Claims priority, application Sweden Feb. 25, 1958
1 Claim. (Cl. 84—1.24)

The present invention relates to an electrical, preferably an electronic musical instrument, i.e. an instrument in which the sounds to be produced by the instrument are generated in the form of or transformed into corresponding electrical voltages or currents which after amplification, if desired, are fed to the sound reproducing means of the instrument.

An object of the invention is to provide an instrument on which a single executor may in a relatively simple manner produce accompanying sound and rhythm effects corresponding to those sound effects which are produced by e.g. the so called rhythm section of a modern orchestra, simultaneously as playing a desired melody and harmonies thereto, e.g. on a key-board.

A musical instrument according to the invention is characterized by at least two self-returning pedals controlling electrical contacts connected to means for producing electrical signals corresponding to desired sound effects, the contacts of the one pedal being arranged to pass or block the electrical signals to the sound reproducing means of the instrument and the contacts of the other pedal being arranged by means of suitable circuit elements and by suitable connections to the electrical sound producing means and to the contacts of the first pedal to determine desired modification or completion of the sounds produced by actuating the first pedal.

By "modification" in the sense of the invention is meant a change of the sound initiated by actuating the first pedal, e.g. so that this sound is weakened or amplified, changed with respect to the sound character or the like. By completion is meant the production of sounds before, simultaneously with or after the sounds initiated by the first pedal, especially for obtaining rhythmical effects which are suitable for accompanying purposes.

In an embodiment of the invention the first pedal is arranged by means of its contacts to pass a bass tone from an oscillator, multivibrator or other bass tone generator, said bass tone being selected by means of other pedals or keys, the first pedal also being arranged to pass accompanying sounds of other character, e.g. sound effects like those which are produced by a cymbal, a drum or other beat instrument, so that these tones or other sounds are reproduced in the sound reproducing means of the instrument without attenuation, while the other pedal is arranged by means of its contacts to bring about an attenuation or damping of the sound effects produced by the first pedal and/or an attenuated continuation of this sound effect as the first pedal is released after having been actuated. In these respects many modifications are of course possible for meeting different demands for rhythmical effects to be produced by a single executor in a simple manner.

The invention will hereinafter be more fully described with reference to the accompanying drawings showing an embodiment of the electronic part of the instrument with control circuits according to the invention. FIG. 1 shows the circuit diagram of an embodiment of a bass tone generator and a so called "gate stage" by means of which a bass tone may be initiated and ended in a suitable manner. FIG. 2 shows the circuit diagram of an embodiment of a device for producing other accompaniment sounds, more specifically such sounds which are produced by means of a cymbal or a drum which is treated with a so called "whisk." FIG. 3 shows the circuit diagram of an

embodiment of a pedal arrangement according to the invention comprising electrical contacts, circuit elements and connections to terminals shown in FIGS. 1 and 2.

The instrument according to the invention comprises conventional means for amplifying the generated sound frequency oscillations and for reproducing said oscillations after amplification. These means and the exterior of the musical instrument will not be described since they are independent of the invention and may be the object of different design for suiting various demands.

In FIG. 1 V1 and V2 designate two electronic tubes, in the form of a double triode, which are interconnected in such a manner so as to form a multivibrator. The cathode of V1 is connected to earth, the grid of the triode is connected to the point of connection between a condenser C1 and a resistance R1 and its anode is connected to the positive terminal + of the anode voltage source via the resistance R3 and a further resistance R12. The cathode of V2 is connected to earth via the resistance R6 and the components C2, R2 and R4 are connected in the same manner as C1, C2 and R3. The terminal of C1 remote from the grid is connected to the anode in V2. C2 is connected in a similar manner. The terminals of the resistances R1 and R2 remote from the grid are connected to each other and also connected to a chain of resistances *r*1, *r*2, *r*3 etc., the other end of this chain being connected to earth.

Between the resistances of this chain tapping points are arranged, which may be connected to earth by means of a contact actuated by a corresponding pedal or key of a pedal group or keyboard for playing a melody. The end of the chain of resistances remote from the earthing point of the chain is connected to + via the setting resistance R5 and the resistance R12. Since the contacts of the pedals or keys are arranged to short-circuit the resistances below the corresponding tapping point of the chain *r*1, *r*2 etc. the grids of the multivibrator are set to different potentials which results in different frequences of the oscillator. The steps are chosen in such a manner that they correspond to the pitch intervals of the chromatic scale.

In order to avoid initial transient oscillations of the oscillator or multivibrator at the start of same being reproduced in the sound reproducing means of the musical instrument, or generally spoken, in order to produce an enjoyable striking and ending of a note a so called gating stage, V3, with suitable circuit elements has been arranged. The cathode of V3 is connected to the cathode of V2 so that the triode V3 is controlled on its cathode by means of the generated oscillation. The anode of V3 is connected to + via the resistances R10 and R12. A condenser C3 is connected between the grid and earth. Furthermore the grid is connected via the resistance R9 to the negative terminal of a grid voltage source V*g* and via the resistance R8 and the condenser C4 to earth. The terminal 103 is connected between R8 and C4 and it is understood that this terminal is to be connected to the corresponding terminal 103 of the pedal arrangement according to FIG. 3.

The output of V3 is via the condenser C5 connected to the grid of the amplifying stage V4 via the resistances R14 and R15. The cathode of V4 is connected to earth via the cathode resistance R7 and a resistance R13 is connected between earth and the grid of V4. The anode of V4 is connected to + via the anode resistance R11. The point of connection between C5 and R15 is connected to earth via the condenser C6. The point of connection between R14 and R15 is connected to earth via a parallel resonant circuit consisting of the inductance L1 and the capacitance C7.

This L-C-circuit together with R15 and C6 produces the desired tone character of the signal transmitted from

the oscillation generator V1, V2, so that signals produced by the circuit arrangement will be satisfying in musical respect. It will for instance correspond to a bass violin tone or the like. Said signal, after further amplification, if desired, is fed to a sound reproducing means of the musical instrument.

In order to stabilize the anode voltage the two voltage stabilizing tubes V5 and V6 are connected in series between earth and the terminal of R12 not connected to +.

The circuit arrangement according to FIG. 1 operates in the following manner:

In the non-operative condition the stage V3, the so called gating stage, is blocked by the negative voltage of the bias voltage source Vg. The multivibrator V1, V2, operates on a frequency which is set by a melody tone selecting pedal or key of the musical instrument, said pedal or key being associated with a corresponding tap between the resistances of the chain *r*1, *r*2, *r*3 etc. Now, if the terminal 103, which is connected to a "rhythm determining" pedal, which will be described in more detail with reference to FIG. 3, is connected to earth the potential of the grid of V3 is raised so that the tube is conducting and transmits the generated tone frequency signal which is generated in V1, V2, a sufficient time interval previous to the earthing of contact 103 so that the signal has passed its initial transient part on the frequency which is selected by actuating the pedal or key connected to the tap of the chain *r*1, *r*2, *r*3 etc. referred to. When the terminal 103 is connected to earth the tube V3 will not be conducting at once, since it takes a certain time for the condenser C3 to discharge over the resistance R8, said condenser C3 having previously been charged negatively by the bias voltage source Vg. The resistance R9 is much large than R8, so that Vg can not maintain the negative voltage on the grid of V3 when the terminal 103 is connected to earth. Thus when the terminal 103 is connected to earth the note is not initiated abruptly but softly with a pleasant strike in musical respect, said note being transmitted not until it have been stabilized after its transient initial portion. When the terminal 103 is connected to earth the note does not cease abruptly which would be unpleasant in musical respect but "dies away" in similar manner as the note produced by a natural instrument, since it takes a certain time for the bias voltage source to charge the condensers C3 and C4 via the large resistance R9. Thus, the gating stage V3 makes possible both the beginning and ending of the note in a satifactory manner in musical respect.

The circuit arrangement according to FIG. 1 is intended for producing typical bass notes for accompaniment purposes. FIG. 2 shows a circuit arrangement for a device intended for producing other types of sound which are suitable for accompaniment, especially sounds corresponding to those which are produced by means of a cymbal or by a drum which is treated with a so called "whisk."

This circuit arrangement comprises according to the invention a primary stage with an electronic tube (or transistor) which is coupled for generating a rich frequency spectrum, for instance a noise spectrum, in the sound frequency range, means for passing or blocking these signals, other means for modifying the noise signal for obtaining a desired sound effect and means for imposing a desired damping or attenuation of the signal coming from the circuit arrangement, said signal being fed, after amplification, if desired, to the sound reproducing unit of the instrument.

In FIG. 2 V10 designates a tetrode, the cathode and the both grids of which are connected to earth, while the anode is connected to the positive terminal of an anode voltage source via the resistance R20. By this coupling the tube V10 will generate a continuous noise signal, i.e. a substantially continuous spectrum of sound frequencies. The noise signal is fed to the grid of the triode V11 via the condenser C20 and the coupling resistance R22, the end of which remote from the grid is connected to the point of connection between the condenser C20 and a resistance R21, the other end of which being connected to earth.

The cathode of V11 is connected to earth via the resistance R25 and the anode is connected to a terminal 101 via the series connection of the resistances R23 and R24. The point of connection between these resistances is decoupled to earth via the resistance C21.

The terminal 101 is intended to be connected to the terminal with the corresponding designation of the pedal arrangement according to FIG. 3 which will be disclosed in more detail herein below. In said pedal arrangement the terminal 101 can be connected to the positive terminal of the anode voltage source. The stage V11 is connected via the condenser C22 to the grid of a stage V12. Between this grid and earth a network for modifying the transmitted noise signal is inserted. The network consists of a L-C-circuit comprising the inductance L2 and the condensers C23 and C24, the condenser C23 being connected in such a manner that it can be shifted out of circuit by means of a switch S1, so that it will be possible to choose between two alternatives with respect to the oscillation characteristics of the L-C-circuit and thus with respect to the character of the sound signal which is fed to the grid of tube V12. One of these characteristics may for instance correspond to the sound produced on a drum by means of a "whisk" in the "rhythm section" of a modern orchestra. The other signal character may for instance correspond to the sound which is obtained by beating a cymbal plate. The cathode of tube V12 is connected to earth via the cathode resistance R26 while the anode is connected to + via the resistance R27. From the anode of V12 the amplified signal is taken via the condenser C25 and the resistance R28 after the signal has been damped, if desired, by means of the condenser C26, one terminal of which being connected to the anode of V12 and the other terminal of which being connected to a second terminal 102 which via a contact of the pedal arrangement according to FIG. 3 is connectable to earth.

When the terminal 101 is connected to the positive terminal of the anode voltage source and the terminal 102 is not connected to earth the signal obtained from the output of the circuit arrangement according to FIG. 2 will produce an undamped, relatively strong or sharp sound corresponding for instance to the sound obtained by a relatively hard treatment of the drum of a modern orchestra by means of a "whisk." When the damping condenser C26 is made operative by connecting the terminal 102 to earth, a softer "whisk"-sound is obtained from the sound reproducing means of the instrument. In this manner it is possible to "phrase" the "whisk"-sound in a desired manner.

In FIG. 3 an embodiment of a pedal arrangement according to the invention is shown schematically. The device comprises two pedals P1 and P2 which may be mounted side by side either as one unit or associated with pedals which may be arranged for selecting single notes for instance from a device according to FIG. 1. In the latter case each of these pedals may, as mentioned before, be connected to one tapping point between the resistances of the chain of resistances *r*1, *r*2, *r*3 etc., it being possible to substitute said pedals by keys of a keyboard which is also mentioned before.

The pedal P1 is coupled with the make contact *c*1 and *c*2 while the pedal P2 operates the make contacts *c*3, *c*4 and *c*5. One of the terminals of the contact *c*1 is connected to the positive terminal + of the anode voltage source, the other being connected to the terminal 101 which is connectable to the terminal with the corresponding designation in FIG. 2. The one terminal of the contact *c*2 is connected to earth, the other being connected to the one terminal of contact *c*5. This contact may be short-circuited by the switch S2. The other terminal of contact *c*5 is connected to the terminal 103 which can be

connected to the terminal with the corresponding designation in FIG. 1. The one side of contact *c*3 is connected to the terminal **101**, the other side being connected to earth via the series connection of a resistance R30 and a condenser C30. The one side of contact C4 is connected to earth, the other side being connected to the terminal **102** which can be connected to the terminal with the corresponding designation in FIG. 2.

By actuating the pedals P1 and P2 the instrument operates as follows.

When only the pedal P1 is actuated the contact *c*1 will cause a damped "whisk"-sound (or a "cymbal"-sound) to be reproduced in the sound reproducing means of the instrument, said sound being generated and "stroken" in a suitable manner in the circuit arrangement according to FIG. 2. At the same time a bass tone or the like which is generated and "stroken" in the circuit arrangement according to FIG. 1 is reproduced by the sound reproducing means, provided that the switch S2 is closed or the pedal P2 is operated.

When only the pedal P2 is actuated without previous actuation of the pedal P1 nothing happens.

When the pedal P2 is actuated after P1 has been actuated and is in its contact closing position the contact *c*4 causes the condenser C26 to be connected to earth and thus to dampen the signal coming from the circuit arrangement according to FIG. 2, so that this signal become more soft and corresponds to the sound produced by light treatment of a drum of a conventional orchestra by means of a so-called "whisk." If the switch S2 was open the contact *c*5 causes a bass tone to be reproduced by the sound reproducing means of the instrument.

The closing of contact *c*3 causes the condenser C30 to be charged from the positive terminal of the anode voltage source via resistance R30. This results in that when the pedal P1 is again released, while the pedal P2 is held in the contact closing position, the terminal **101** is disconnected from the positive terminal of the anode voltage source, it is true, but instead receives a certain decreasing anode voltage from the relatively large condenser C30. The "whisk" sound from the circuit arrangement according to FIG. 2 is therefore not interrupted abruptly but is dying out successively, and this effect is much usable in different musical connections, in that it makes it possible to produce many different rhythm effects which are required in modern music.

A typical rhythm effect which may be produced by the shown device is the following. Shortly before the first part of a beat of a musical piece the pedal P2 is actuated which results in a relatively damped "whisk"-sound being reproduced in the sound reproducing device of the instrument owing to the remaining charge of the condenser C30.

Then, exactly on the first part of the beat the pedal P1 is actuated for a short moment the pedal P2 still being held down in its contact closing position. This results in that the condenser C30 is charged via the contacts *c*1 and *c*3 and at the same time a damped, decreasing "whisk"-sound is reproduced. Moreover the contact *c*2 is connected to earth, so that the terminal **103** (via *c*5, which is closed in this moment) receives earth potential with the result that a bass tone is heard in the sound reproducing means.

On the second part of the beat the pedal P1 is again actuated for a short moment and at the same time the pedal P2 is released, whereby an undamped, short "whisk"-sound is reproduced, since the contacts *c*3 and *c*4 are opened in this moment. At the same time the terminal **103** receives earth potential if the switch S2 is closed which does not happen if the switch is opened, since the contact *c*5 is already open.

Such a rhythm which comprises two beat parts and which may be repeated is a typical modern rhythm produced by the rhythm section of a conventional orchestra.

It is evident that it is possible to produce different other rhythm effects by means of an instrument according to the invention.

The switch S1 is intended to adjust the circuit L2, C23, C24 to different sound characters, and it is to be understood that this makes it possible to produce still more variations of the rhythm effect.

In a practical embodiment of the circuit arrangement according to FIG. 1 the components had the following values.

*V*1, *V*2, *V*3, *V*4=ECC83 (double triode)	*R*11=47
	*R*12=5
*V*5, *V*6=90C1	*R*13=100
*R*1=2.2 MΩ	*R*14=22
*R*2=2.2 MΩ	*R*15=150
*R*3=47kΩ	*L*1=10 h.
*R*4=47 kΩ	*C*1=2200 pf.
*R*5=10 kΩ+68K.	*C*2=2200 pf.
*R*6=1 kΩ	*C*3=0.12 mf.
*R*7=1 kΩ	*C*4=0.12 mf.
*R*8=68 kΩ	*C*5=0.1 mf.
*R*9=1.5 MΩ	*C*6=0.25 mf.
*R*10=68 kΩ	*C*7=0.18 mf.

In an embodiment of the circuit arrangement according to FIG. 2 the components had the following values.

*V*10=2D21	*R*27=100 kΩ
*V*11, *V*12=ECC81 (double triode)	*R*28=50 kΩ
	*C*20=0.01 mf.
*R*20=68 kΩ	*C*21=0.01 mf.
*R*21=470 kΩ	*C*22=0.01 mf.
*R*22=100 kΩ	*C*23=1000 pf.
*R*23=100 kΩ	*C*24=500 pf.
*R*24=10 kΩ	*C*25=2200 mf.
*R*25=1 kΩ	*C*26=2200 mf.
*R*26=1 kΩ	*L*=1 h.

The invention is not restricted to the embodiments shown and described, since said embodiments may be modified in different ways within the scope of the invention.

I claim:

An electrical musical device for producing rhythm effects comprising generating means for producing electrical signals with a substantially continuous frequency spectrum in the sound frequency range corresponding to that of noise, means to reproduce electrical signals applied thereto in said sound of frequency range, first and second pedals, and means responsive to the actuation of said first pedal to apply said electrical signals produced by said generating means to said reproducing means, responsive to the actuation of said first and second pedals to dampen the electrical signals applied to said reproducing means, and responsive to the release of said second pedal after actuation of said first and second pedals to cause the signal applied to said reproducing means to die out after prolongation.

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