Jan. 10, 1967 F. A. CORDRY 3,297,812

GATED FUNCTION SWITCHES IN ELECTRIC ORGAN

Filed June 21, 1963 2 Sheets-Sheet 1

FIG. 1.

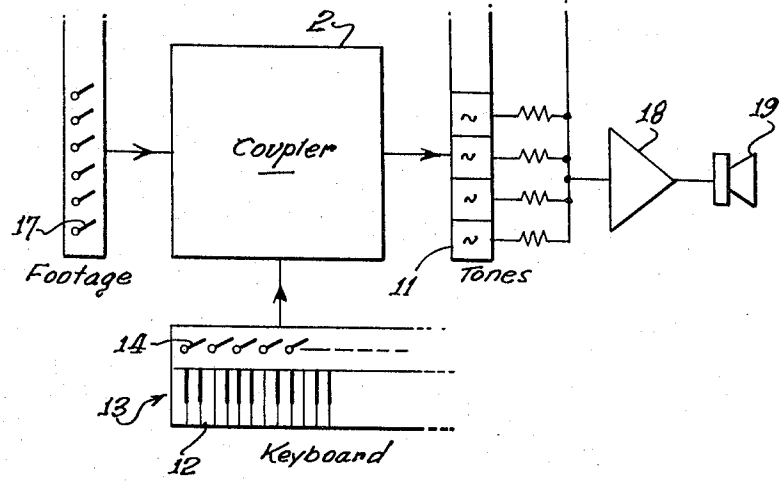


FIG. 5.

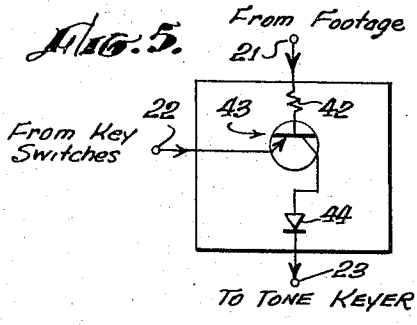
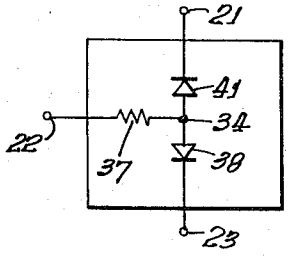


FIG. 4.



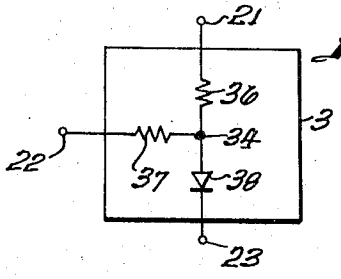


FIG. 3.

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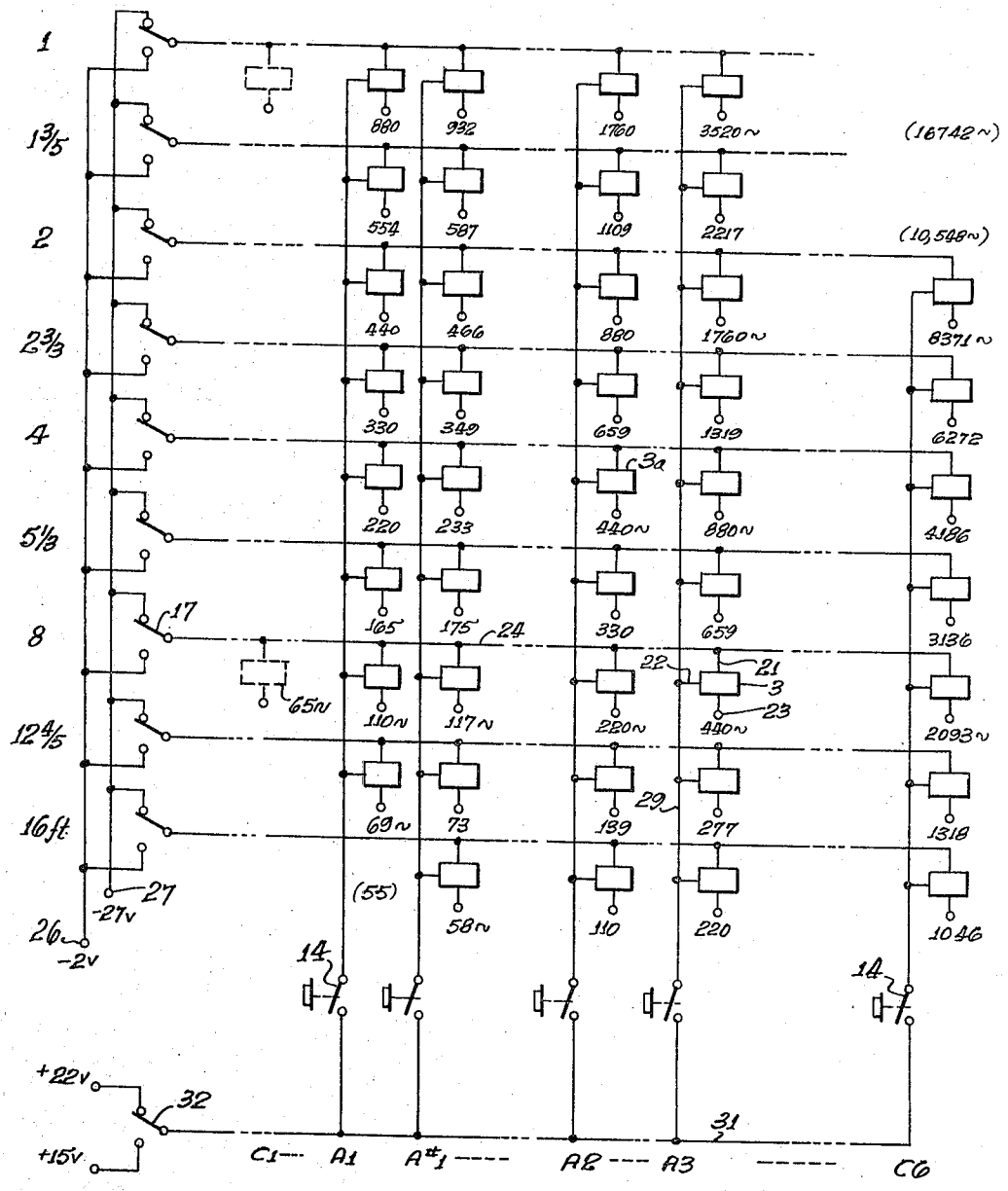
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GATED FUNCTION SWITCHES IN ELECTRIC ORGAN

Filed June 21, 1963 2 Sheets-Sheet 2

FIG. 2.



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United States Patent Office 3,297,812
Patented Jan. 10, 1967

3,297,812

GATED FUNCTION SWITCHES IN ELECTRIC ORGAN

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Filed June 21, 1963, Ser. No. 289,695
2 Claims. (Cl. 84—1.01)

This invention relates to electric organs, and more particularly to a technique for permitting coupling of various footages or pitches in response to actuation of a single key of an organ keyboard, without requiring multi-contact keying switches.

It is an object of this invention to provide simplified mechanical structure for an electric organ in which a single contact closure for each keyboard key serves to actuate any given pitch coupling as well as to provide all other organ functions which are desired upon actuation of that given key.

It is a further object of this invention to provide such a keying system in which one terminal of each of the single contact or single pole switches is connected to a common conductor or buss, thereby making possible a simplified mechanical structure in which key switches may consist of a common buss running the length of the organ keyboard against which a single pole is pressed (one pole for each key), to close the switch in response to depression of the corresponding key of the keyboard.

In accordance with these and other objects which will be apparent hereinafter, preferred forms of the present invention will now be described with reference to the accompanying drawings, wherein

FIG. 1 is a block diagram illustrating symbolically the context or environment in which the present invention is incorporated;

FIG. 2 is a schematic diagram of the coupling pattern or matrix of which the present invention is comprised, and

FIGS. 3, 4 and 5 are alternative schematic diagrams showing how the gating circuits of FIG. 2 may be constructed.

Referring to the drawings, there is illustrated in block form in FIG. 1 certain fundamental organ functions, including a plurality of electric tone sources or generators **11** each of which delivers, in response to appropriate actuation, a tone signal of a given pitch. Actuation of the tone sources **11** is effected by depression of one or more of the keys **12** of a keyboard **13**. Each key **12** has a corresponding single contact switch **14** which is actuated, in this case closed, when the key **12** is depressed.

Closing of a key switch **14** stimulates a coupler matrix **2**, which is also stimulated or controlled by one or more of a plurality of function switches **17**. In the present example the function switches **17** are exemplified as footage couplers which cause tones of various pitch to be sounded in response to actuation of a given keyboard key **12**.

The key switches **14** may, by additional circuitry, also be employed to effectuate other desired organ functions, for example, transient functions, such as percussion, delayed vibrato, sustain and any other desired musical effect. Such functions may be effected, for example, in the manner described in co-pending application Serial No. 288,270, filed June 17, 1963 in the name of John R. Brand, et al.

Tone signals from the sources **11** are applied through amplifying means **18** to a loudspeaker, tone cabinet, or other electro-acoustic translating means **19**. It will be understood that the overall organ circuit may include

many other refinements such as formant or voicing networks, as well as special effects such as percussion, sustain, vibrato, tremolo, etc. These, however, may be added to the organ shown symbolically in FIG. 1 by any means which is well known to those skilled in the art.

The coupler **2** shown in block diagram outline in FIG. 1, is shown as a schematic diagram in detail in FIG. 2.

In accordance with the present invention, this coupler **2** shown in FIG. 2 consists of a plurality of three-terminal gates **3**, which are so connected, and stimulated or controlled, that selected footages may be coupled to the output of the organ in response to actuation of the single contact switch **14** corresponding to a desired tone.

Each of the gates **3** has a pair of control or input terminals **21** and **22** and a single output terminal **23**. The control terminal **21** is connected to a conductor or buss **24** which represents a coupler, for example, the 8 foot coupler. Buss **24** is connected to the pole of a double throw switch **17**, which may be selectively energized from either a minus 27 volts bias **27**, or a minus 2 volts bias **26**. Thus, the terminal **21** may be placed at either minus 27 volts or minus 2 volts at the will of the organist, depending on whether the 8 foot tab is actuated.

The other control terminal **22** is connected to a conductor or buss **29**, which is connected to one terminal of the single contact switch **14** actuated by and corresponding to one of the notes or keys, for example A3, on the organ keyboard **13**. The other terminal of the single contact switch **14** is connected to a common conductor or buss **31** which, by means of the double throw switch **32**, may be placed at either plus 22 volts or plus 15 volts, as shown in FIG. 2.

The output terminal **23** is connected to actuate a given tone source **11**. For example, in the instance being described in FIG. 2, the terminal **23** is connected to actuate the tone source which emits a pitch of 440 cycles, this being A3, or A above middle C in a five octave keyboard. The actuation of the tone source may be effected by any number of ways, as by turning on an oscillator, or preferably by actuating a keyer which allows tone signals from a continuously operating tone source to pass through to the output circuit of the organ. Such a keyer is shown, for example, in co-pending application Serial No. 293,924, filed July 5, 1963 in the name of Floyd A. Cordry.

Each gate **3** is so designed that an actuating output potential will appear on the output terminal **23** only when both the terminal **21** and the terminal **22** have applied thereto potentials residing in predetermined potential ranges. In the example shown, if the control terminal **21** resides at minus 27 volts by virtue of the switch **17** being in its upper position, then no actuating potential or output will appear at the terminal **23**, irrespective of the condition of the key switch **14**, i.e., whether it is open circuited or whether it is at a positive potential by being connected to the buss **31**. Similarly, if the control terminal **21** is at minus 2 volts by virtue of the coupler switch **17** being in its lower position there will still not appear an actuating potential or output at the terminal **23** as long as the key switch **14** is open circuited. Thus both control terminals **21** and **22** must be appropriately energized before an output will appear at **23**. Specifically, in the instance illustrated in FIG. 2, it is necessary that switch **17** be in its lower position to place terminal **21** at minus 2 volts, and key switch **14** must be closed to place terminal **22** at either 15 or 22 volts. Under these circumstances, and as long as the two switches **17** and **14** are in the positions above stated, a continuous potential will be applied to the keyer of one of the tone sources **11**, for example of the 440 cycle tone source, which may then sound continuously, sound percussively, or in any other manner determined by the auxiliary circuits of the organ.

It will be understood by those skilled in the art that each of the gates 3 does not necessarily have exclusive connection to its own individual and corresponding keyer or tone source. For example, the gate 3 serves to actuate the 440 cycle keyer, as also does the gate 3*a*. This is because the gate 3 represents the 8 foot coupler for the key A3, while the gate 3*a* represents the 4 foot coupler for the octave lower key A2.

It will be further understood that not all of the switches 17 necessarily correspond to tabs or pistons which are brought out to the organ console. The 12⅘ foot, for example, is usually incorporated in the chimes tab of the organ.

It will be further noted that not all footage/key combinations have a gate 3. For example, there is no 16 foot gate for the lowest A, i.e., A1. This is because in the example illustrated it is assumed that the various tone sources of the organ do not go down as low as the 55 cycles which would be necessary in order to create such footage. Similarly, some of the higher footages on the higher tones are omitted. For example, it is assumed in this instance that the organ does not have a one foot coupler for C6, because there is no tone generator that goes as high as the 16,742 cycles which would be necessary to create such a pitch. It is to be further understood that the frequencies noted opposite the various output terminals 23 are only approximate, and do not necessarily represent the exact frequency of the source but have been rounded off or approximated in certain instances.

Each gate 3 may assume a variety of forms, among the simplest being sohwn in FIG. 3. In FIG. 3 there is shown a Y-connected network having 3 branches or legs and a common central junction point 34. The upper leg, connected to the control terminal 21, consists of a resistor 36; the side leg, connected to the control terminal 22, consists of a resistor 37; while the bottom leg, connected to the output terminal 23, consists of a diode or any suitable unidirectional conducting device 38, poled so as to conduct in the direction of the polarity determined by the polarities used on the terminals 21 and 22. In the present instance the effective actuating potentials have been shown as positive, and therefore the diode 38 is poled to conduct toward the terminal 23. It will be understood that by the term "unidirectional conducting device" is meant any device which is controlled by balance of voltage—a device which conducts current more easily in one direction than the other. This may be a transistor, but more usually is a diode. The foregoing definition is taken from Modern Dictionary of Electronics, published by Howard Sams & Co., first edition, page 77. Hence, for simplicity, the balance of this description will refer only to diodes, and it will be understood that all devices which conduct in one direction much more readily than the other is intended.

In the network shown in FIG. 3, when the footage switch 17 is in the off position, the terminal 21 resides or is biased at minus 27 volts. Thus, when the terminal 22 is open circuited, as it will be when the key switch 14 is not activated, there will in effect be minus 27 volts residing at point 34, which means that diode 38 will be reverse biased and will not conduct to output terminal 23 unless the potential thereof goes below minus 27 volts. Since the operating keyer connected to the terminal 23 never reaches the condition where the terminal 23 has applied thereto minus 27 volts, it follows that no current will flow through the diode 38 under these conditions. Even when the switch 14 is closed, there will still be a negative potential on the point 34, because in construction the resistors 36 and 37 are substantially equal, each being, for example, 10 kilohms. Thus, there is still a negative voltage on terminal 34, and no output voltage will appear on the output terminal 23. When the footage switch 17 is in on position, the terminal 21 is placed at minus 2 volts. This still produces a negative voltage on

junction 34 as long as terminal 22 is open circuited. When, however, the switch 14 is closed, terminal 22 is placed, for example, at plus 15 volts. The voltage division between the resistors 36 and 37 now produces approximately 8 volts on the terminal 34, which allows the diode 38 to conduct and produce a potential of corresponding magnitude at the terminal 23, where it serves to actuate the keyer in the manner described hereinbefore.

In the particular circuits shown, the keyer to which the terminal 23 is connected is selectively responsive also to a higher voltage, to respond with an emphasized output in a manner which is not a part of this present invention, but which this invention accommodates itself to by applying selectively either 22 or 15 volts to the terminal 22, depending on the position of the switch 32. On the console of a typical organ this tab may be called EMPHASIS, and as indicated, it determines the magnitude of the actuating voltage applied to the keyer and hence the magnitude of the organ output.

In FIG. 4 a refined form of the gate 3 is illustrated, wherein the upper leg is constituted of a diode 41 poled oppositely to the diode 38 in the lower leg. This tends to enhance the effect of the voltage applied at 22 from the key switch 14, since the junction 34 is now more sensitive to the potential at terminal 21 than to the potential applied at 22.

A third form of gate is shown in FIG. 5, where the terminal 21 is connected to one side of a resistor 42, the other side of which is connected to the base of a transistor or three terminal semiconductive device 43. The other control terminal 22 is connected to the emitter of the transistor 43, while the collector of the transistor 43 is connected to a diode or rectifier 44, which, in turn, is connected to the output terminal 23. The net effect of the gate of FIG. 5 is essentially the same as described hereinbefore, namely, an effective output or actuating potential does not appear on the terminal 23 unless the voltage on the control terminal 21 is in the range of about minus 2 volts and the terminal 22 has applied thereto a positive potential in a range suitable for operating the associated tone source or keyer.

While the instant invention has been shown and described herein in what is conceived to be the most practical and preferred embodiments, it is recognized that departures may be made therefrom within the scope of the invention which is therefore not to be limited to the details disclosed herein, but is to be afforded the full scope of the following claims.

What is claimed is:

1. In an electric organ the combination of:

a plurality of single contact key switches

a keyboard having a plurality of keys for actuating respectively said key switches

a plurality of function switches selectively operable to determine the pitch of the tone to be emitted upon actuation of a given key

a plurality of tone sources selectively actuable in response to said key switches to cause selected tones to be sounded

a plurality of gates having output terminals connected to actuate said tone sources

each of said gates having a first control terminal and a second control terminal, and characterized in that both control terminals of a given gate must be placed at preselected potential ranges in order for an actuating output potential to appear at the output terminal of the gate

circuit means for connecting one control terminal of a plurality of said gates to each one of said function switches

circuit means for connecting the other control terminal of a plurality of said gates to each one of said key switches, and

circuit means for connecting tones from said tone sources to an electro acoustic transducer.

2. In an electric organ the combination of:

a plurality of single contact key switches

a keyboard having a plurality of keys for actuating respectively said key switches

a plurality of function switches selectively operable to determine the pitch of the tone to be emitted upon actuation of a given key

a plurality of tone sources selectively actuable in response to said key switches to cause selected tones to be sounded

a plurality of gates having output terminals connected to actuate said tone sources, the number of said gates being substantially equal to the number of said key switches multiplied by the number of said function switches

each of said gates having a first control terminal and a second control terminal, and characterized in that both control terminals of a given gate must be placed at preselected potential ranges in order for an actuating output potential to appear at the output terminal of the gate

circuit means for connecting one control terminal of a plurality of said gates to each one of said function switches

circuit means for connecting the other control terminal of a plurality of said gates to each one of said key switches, and

electro acoustical transducer means for converting tone signals derived from actuated tone sources into corresponding acoustic tones.

References Cited by the Examiner

UNITED STATES PATENTS

2,651,718	9/1953	Levy	84—1.01
2,662,148	12/1953	Slibitz	84—1.17
2,964,735	12/1960	Abbott	307—88.5
2,986,652	5/1961	Eachus	307—88.5
3,037,413	6/1962	Markowitz	84—1.01
3,058,381	10/1962	Schwartz	84—1.01
3,078,375	2/1963	Hedges et al.	307—88.5
3,089,091	5/1963	Lindenthal	307—88.5
3,143,712	8/1964	Peterson	84—1.01
3,150,228	9/1964	Gibb et al.	307—88.5
3,196,201	7/1965	McDonald	84—1.26

FOREIGN PATENTS

613,812	12/1948	Great Britain.
622,910	5/1949	Great Britain.

OTHER REFERENCES

Keister et at.: "The Design of Switching Circuits," D. Van Nostrand Co. Inc., New York, 1951, p. 37, FIGS. 4–1.

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