MUSICAL INSTRUMENT HAVING AUTOMATIC FILL-IN MEANS

Inventor: George Robert Hall, 13613 Huston St., Sherman Oaks, Calif. 91403

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References Cited

UNITED STATES PATENTS
3,023,659 3/1962 Bode 84/1.01 X
3,247,310 4/1966 Stinson 84/1.17
3,283,056 11/1966 Cookerly et al. 84/1.01
3,359,358 12/1967 Brand et al. 84/1.01
3,407,260 10/1970 Schrecongost 84/1.13
3,509,263 4/1970 Cordry 84/1.13
3,476,866 11/1969 Cunningham 84/1.26
3,499,092 3/1970 Buner 84/DIG. 22

ABSTRACT

A musical instrument, such as an organ, includes conventional circuitry, and in addition a series of key-operated switches associated with one manual and respectively connected to a series of electronic switches that are normally nonconductive, each key-operated switch and each electronic switch being connected in series between a source of dc-keying potential and a corresponding tone signal source, and a second series of key-operated switches under the control of another manual, each such switch being resistively connected to control the electronic switch of a noncorresponding key along with musically adjacent noncorresponding keys. By this arrangement, in response to playing a chord on the first mentioned manual and a single note on the other manual, harmony is automatically added.

14 Claims, 2 Drawing Figures
MUSICAL INSTRUMENT HAVING AUTOMATIC FILL-IN MEANS

BACKGROUND OF THE INVENTION

1. Field of the Invention
This invention relates generally to musical instruments, and more specifically to an automatic fill-in means for a solo keyboard note.

2. Prior Art
The earliest prior art that I am aware of that obtains a similar result is shown in U.S. Pat. No. 3,283,056 of which I am a co-inventor, and the only other prior art device that I know of is shown in U.S. Pat. No. 3,247,310, both owned by the assignee of the present application. These earlier forms of the invention have been utilized to advantage for a number of years, but have a disadvantage in complexity, and/or an excessive number of moving parts.

SUMMARY OF THE INVENTION

In accordance with the present invention, I have provided means for automatically filling in harmony on one manual below a solo note being played utilizing as intelligence the notes or chords being played on the other manual simultaneously with the solo note. In addition to conventional keying, a dc-keying potential is brought through a key switch typically under the control of the keys of the lower manual of an organ and is conducted thence to an electronic switch which is normally biased "off" but which is connected to deliver such keying potential to a tone signal source that normally includes a gate which is keyed for conventional playing. The electronic switch has a control terminal that is connected through a resistance network to be controlled by supplemental key switches operated by the other manual. The electronic switch that is primarily rendered conductive is connected to control the tone signal source that is approximately one-half octave below the playing key that controls such electronic switch, and the potential at the control terminal is passed by the resistance network to adjacent electronic switches that are associated with signal sources that are arranged both upwardly and downwardly therefrom, preferably all spaced a few notes below the solo note being played.

Accordingly, it is an object of the present invention to provide an automatic fill-in means for a musical instrument which employs an absolute minimum of moving parts.

Another object of the present invention is to provide an automatic fill-in means for a musical instrument which utilizes simplified circuitry.

A still further object of the present invention is to provide an automatic fill-in means for a musical instrument which is as low-cost as possible and which requires a minimum of potential servicing.

Many other advantages, features and additional objects of the present invention will become manifest to those versed in the art upon making reference to the detailed description and the accompanying sheets of drawings in which a preferred structural embodiment incorporating the principles of the present invention is shown by way of illustrative example.

On the drawings:
FIGS. 1 and 2 jointly comprise a schematic diagram of a musical instrument having an automatic fill-in circuitry provided in accordance with the present invention.

As shown on the drawings:
The principles of this invention are particularly useful when embodied in a musical instrument which typically comprises an electronic organ. It is customary for such instruments to have a solo keyboard and an accompaniment keyboard, the former of which is usually played with the right hand while the latter of which is usually played with the left hand. However, such type of construction is intended to be representative of utility and not necessarily restrictive as to instrument type. As shown in the drawings, a musical instrument is provided which has automatic fill-in means and is generally indicated by the numeral 10. FIGS. 1 and 2 jointly comprise a simple schematic diagram when placed end to end with the horizontal lines in registration with each other. The instrument 10 includes conventional output means 11, here comprising an amplifier 12 and a speaker 13. In a conventional instrument, there is provided a series of 41 tone signal sources, two of which are illustrated at 15 and 16. Each tone signal source comprises a point in circuitry at which a desired frequency having a desired harmonic content is obtained, and the tone signals derived therefrom are normally continuously present at one portion 17 which is coupled to the amplifier 12 whenever a gate 18 forming a part thereof is rendered active or conductive by a dc-keying potential. On the drawings, certain components are supplementarily identified by a note or pitch with a subscript, the subscripts being terms of reference and not necessarily the subscripts used in tables of standards. Thus F<sub>s</sub> is indicative of any of several octavely related F's of any of several possible voices. Thus while only two tone signal sources 15,16 have been illustrated, the others that have not been shown are connected with them to a bus 19 which leads to the amplifier 12. The tone signal sources 15,16 provide the voices associated with the upper or right-hand manual in this embodiment, and there are other tone signal sources (not shown) which are associated with the keys of the lower manual or left-hand manual. They likewise are connected to the bus 19.
A source of dc-keying potential 20 is provided, the same being shown here as +22 volts. The source of potential 20 is connected via an on-off switch 21 and through a protective diode 22 to a first series of key operated switches 23. There are 28 such switches 23 each of which has a movable contact under the control of one of the keys of the lower manual, the switches 23 having a stationary contact or bus 48 common thereto. The switches 23 are supplemental to any other key switches controlled by the keys of the lower manual and are actuated with them by such keys. The switches 23 are thus actuated and controlled by 28 consecutive keys that make up a chromatic scale that extends for more than 1 octave, and the movable contacts on the 12 key switches 23 that make up 1 octave are connected in parallel with corresponding key switches of the other octaves. Thus there are 12 lines 24 that lead from the lower manual to a switching circuit.
At the upper portion of FIG. 1 there is shown a second series of key-operated switches 25, there being 37 such switches in this embodiment. These key switches 25 are under the control of the keys of the upper or right-hand manual and are supplemental to any other key switches that the upper manual controls. The
switches 25 have a movable contact and they have a stationary contact or keying bus 6 common thereto which is grounded and thus has a potential lower than the source of dc-keying potential 20. The switches 25 are each connected by a separate line 26 to the switching circuitry.

A series of 41 electronic switches 27 is provided, octavely related inputs of such electronic switches 27 being connected together, and the 12 sets of switches are respectively connected to the lines 24. Each electronic switch 27 has a control terminal, an input terminal and an output terminal. In this embodiment, the electronic switch 27 is a transistor of the npn type, the emitter being the input that is connected to octavely related inputs and to the corresponding key switch 23, the output being a collector which is connected by a line 28 to the corresponding tone signal source 15, and the control terminal being the base which is connected by a resistor 29, which typically has a resistance value of 47K, to a tap 30 which in turn is connected to one of the switches 25 that is associated with a noncorresponding key. Thus in this example, the tone signal $F_0$ is controlled by a C, key switch 25 which is above it. This same offset relationship exists uniformly.

A series of 41 biasing resistors 31 is respectively connected between the source of dc-potential and the base or control terminal of each electronic switch 27, and these resistors 31 provide a potential for biasing each electronic switch to nonconductivity. A typical size for the resistors 31 is 22K. Each of a series of 40 coupling resistors 41 typically has a value of 4.7K and connects together adjacent taps 30 that are associated with chromatologically related keys and tone signal sources. Collectively, the resistors 41 comprise a group of coupling resistors that are connected in series to provide a resistive coupling bus that has the taps 30 connected to one end of each of the resistors 29. A further resistor 42, which has a typical size of 18K, is connected between the source of dc-keying potential and one of the taps 30. With this arrangement, one control terminal is connected to the adjacent control terminal by means of their respective resistors 29 and the coupling resistor 41. The network thus described provides resistive connections between ground and the electronic switches 27, and in addition, through the resistive coupling bus made up of the resistors 41 and the taps 30, to adjacent electronic switches of noncorresponding key or note. Further, the resistors 41 connect together musically adjacent key switches 25 as shown.

A third series of key-operated switches 43 is connected between the source of dc-potential and the tone signal sources 15,16 and comprise the conventional switches under the control of the keys of the upper key manual for normal playing. Thus in this embodiment, there are 41 such switches. The switches 43 and the switches 25 are thus actuated simultaneously by each of the 37 keys that have both types of switches.

In normal operation of the instrument, the instrument 10 can be utilized with the fill-in feature left "off" by leaving the switch 21 in an open position. Under this arrangement, the keys close the conventional key switches 43 so as to key whatever tone signal sources that have been selected by means of the conventional stop tabs.

When the present invention is utilized, the switch 21 is closed and a chord typically comprising three or four harmonically related notes is produced by playing the same on the lower manual thus closing a corresponding number of key switches 23, thereby bringing dc-keying potential to the input or emitter of all of the transistors 27 that are associated with corresponding notes or tones, not only in the octave played, but also in all octaves provided. At that moment, since the same potential is present on the base as is present on the emitter, the transistor or electronic switch 27 remains nonconductive. However, when any one of the switches 25 associated with the upper manual is closed by the depression of one of the keys, the associated tap 30 becomes grounded, and this produces a substantial decrease in potential on the control terminal or base that is connected by the transistor 29 to such tap 30. If there is a potential then on the emitter, the base becomes somewhat less positive than the emitter, thereby rendering the electronic switch or transistor 27 conductive so that the potential can pass from the switch 23 with current flowing through the line 28 to activate the tone signal source, even though its main playing key 43 is not then closed. At the adjacent tap 30, because of the coupling resistor 41, there will also be a reduction in voltage, but not as much and at the next tap 30 a still lesser reduction in voltage, etc. Even though the voltage reduction is less, there is still enough voltage reduction to render the associated electronic switch 27 conductive. Using the parameters here given, typically four transistors will be rendered conductive in either direction, and thus potentially a total of nine transistors will have a potential on the base low enough to make them conduct if there is a potential on the emitter. Because of the offset mentioned above, which is seven semitones downward, the tone that is octavely related to the solo note will not be enabled, and neither will the two semitones immediately below the solo note thereby minimizing the likelihood of dissonance.

In summary, the left-hand switches 23 provide keying potential at all the selected electronic switches 27 and this by itself has no effect. However, the grounding of the base through the resistor 29 renders the transistor 27 conductive and current flows through the emitter to the tone signal source 15,16. At the same time, the control terminals or bases of the next four higher and the next four lower electronic switches have their potential sufficiently lowered to render them also conductive sufficient to control the tone signal sources 15,16, but because of the cumulative effect of the resistances, the fifth transistor above and the fifth transistor below the one with the lowest potential will not have sufficient reduction in potential to overcome the bias thereon.

There is also provided a series of 41 unidirectional diodes 44 which basically have nothing whatever to do with the present invention. However, it has been found that certain other keying circuits under abnormal conditions can inadvertently apply a reverse potential to the transistors 27 of such magnitude as to cause them to break down. The diodes 44 are thus provided as protective devices to guard the circuitry herein disclosed.

Although various minor modifications might be suggested by those versed in the art, it should be understood that I wish to embody within the scope of the patent warranted hereon all such embodiments as reasonably and properly come within the scope of my contribution to the art.

I claim as my invention:

1. A musical instrument comprising:
a. output means for converting electrical tone signals into sound;
b. a series of tone signal sources each connected to said output means and operative to provide it with a tone signal in response to a dc-keying potential applied thereto;
c. a source of dc-keying potential;
d. a first series of accompaniment-key-operated switches and a series of electronic switches, each key-operated switch and each electronic switch being connected in series between said source of dc-keying potential and one of said tone signal sources of corresponding key; and
e. a second series of solo-key-operated switches, each resistively connected to a plurality of said electronic switches to control one of said electronic switches of noncorresponding key and musically adjacent ones of said electronic switches.

2. A musical instrument according to claim 1 including a third series of accompaniment key-operated switches respectively actuable with the switches of said first and second series and respectively connected between said source of dc-keying potential and said tone signal sources.

3. A musical instrument according to claim 1 in which said first series of key-operated switches extends for more than an octave, the switches of the keys in one octave of said first series being respectively connected in parallel to the switches of the other corresponding keys in said first series for controlling keying potential.

4. A musical instrument according to claim 1 in which said series of tone signal sources extends for more than an octave, the inputs of said electronic switches for one octave of said tone signal sources being respectively connected to the inputs of the other corresponding electronic switches.

5. A musical instrument according to claim 1 which includes a series of unidirectional diodes connected respectively to said electronic switches to block any reverse current flow.

6. A musical instrument according to claim 1 in which each of said electronic switches is a transistor.

7. A musical instrument according to claim 6 in which said transistor is of the pnp type with its emitter connected to the key-operated switch, its collector connected to the tone signal source, and its base connected to the noncorresponding key of said second series.

8. A musical instrument according to claim 1 in which each of said electronic switches has a control terminal which has the resistance connection with the switch in said second series, and means connected to said control terminal and biasing each said electronic switch to be normally nonconducting.

9. A musical instrument according to claim 1 in which the musically adjacent ones of said second series of solo key-operated switches are connected together by a resistor.

10. A musical instrument according to claim 1 in which each of said electronic switches has a control terminal, each such control terminal being connected by a resistance to the control terminal of the musically adjacent electronic switch.

11. A musical instrument according to claim 1 in which each of said electronic switches has a control terminal connected through a first resistor to the noncorresponding key switch, and a group of coupling resistors connected in series to form a resistive coupling bus having taps connected to one end of each of said first resistors.

12. A musical instrument according to claim 11 including a further resistor connecting said resistive coupling bus to said source of dc-keying potential.

13. A musical instrument according to claim 11 including a series of resistors respectively connecting each of said control terminals to said source of dc-keying potential.

14. A musical instrument according to claim 1 in which said second series of solo key-operated switches are connected to a source of potential that is less positive than said source of dc-keying potential.
UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,745,225  Dated July 10, 1973

Inventor(s) George Robert Hall

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

On the cover page, insert the following: --[73] Assignee: Chicago Musical Instrument Co., Lincolnwood, IL, by direct and mesne assignments.--;
Col. 5, line 20, delete "accompaniment";
Col. 5, line 26, after "of" insert --accompaniment--.

Signed and sealed this 27th day of November 1973.

(SEAL)
Attest:

EDWARD M. FLETCHER, JR.
Attesting Officer

RENE D. TEGTMeyer
Acting Commissioner of Patents
UNITED STATES PATENT OFFICE
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