

[54] **PLURAL TONE SELECTOR FOR AN ELECTRONIC MUSICAL INSTRUMENT**[72] Inventor: **Syoichi Suzuki**, Hamamatsu, Japan[73] Assignee: **Nippon Gakki Seizo Kabushiki Kaisha**, Shizuoka-ken, Japan[22] Filed: **April 2, 1971**[21] Appl. No.: **130,602**[30] **Foreign Application Priority Data**

April 6, 1970 Japan.....45/32592

[52] U.S. Cl. 84/1.17, 84/1.13, 84/1.26

[51] Int. Cl. G10h 3/06

[58] Field of Search.....84/1.01, 1.17, 1.19, DIG. 2, 84/1.1

[56] **References Cited****UNITED STATES PATENTS**

3,488,515	1/1970	Hiyoshi	84/1.01 X
3,560,628	2/1971	Plunkett et al.....	84/1.19 X
3,407,260	10/1968	Schrecongost.....	84/1.17 X
2,874,286	2/1959	Bode.....	84/DIG. 2
2,905,905	9/1959	George	84/1.01 X
3,178,500	4/1965	Schwartz et al.....	84/1.19 X
3,288,904	11/1966	George	84/1.01

3,395,242	7/1968	Hurvitz.....	84/DIG. 2
3,422,208	1/1969	Barry.....	84/1.01
3,538,804	11/1970	George.....	84/1.01
3,542,935	11/1970	Munch et al.....	84/1.10
3,598,892	8/1971	Yamashita.....	84/1.01

Primary Examiner—Lewis H. Myers

Assistant Examiner—U. Weldon

Attorney—Flynn & Frishauf

[57] **ABSTRACT**

A plural tone selector for an electronic musical instrument comprises first and second latching selectors each having a plurality of input terminals supplied with tone signals of different pitches, a plurality of control terminals corresponding to the input terminals and one common output terminal. A plurality of key switches are provided for causing one of the plural control terminals of the first and second latching selectors respectively to be impressed with control voltage to selectively derive from the common output terminals of the first and second latching selectors two tone signals supplied to the input terminals thereof corresponding to the control terminals upon the selective actuation of the key switches due to key depression. The derived tone signals are supplied to first and second sustain keyers, respectively, which are conducted by control voltage impressed by other key switches actuated upon key depression.

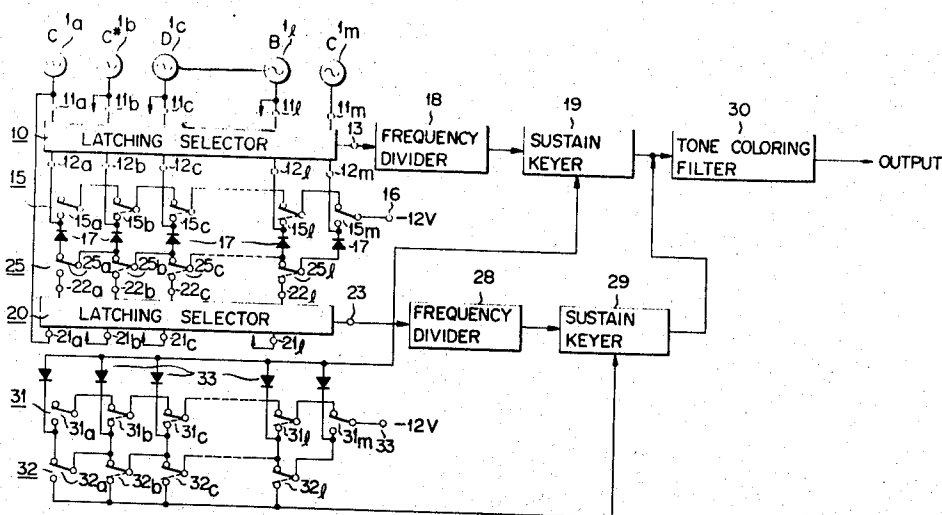
7 Claims, 2 Drawing Figures

FIG. 1

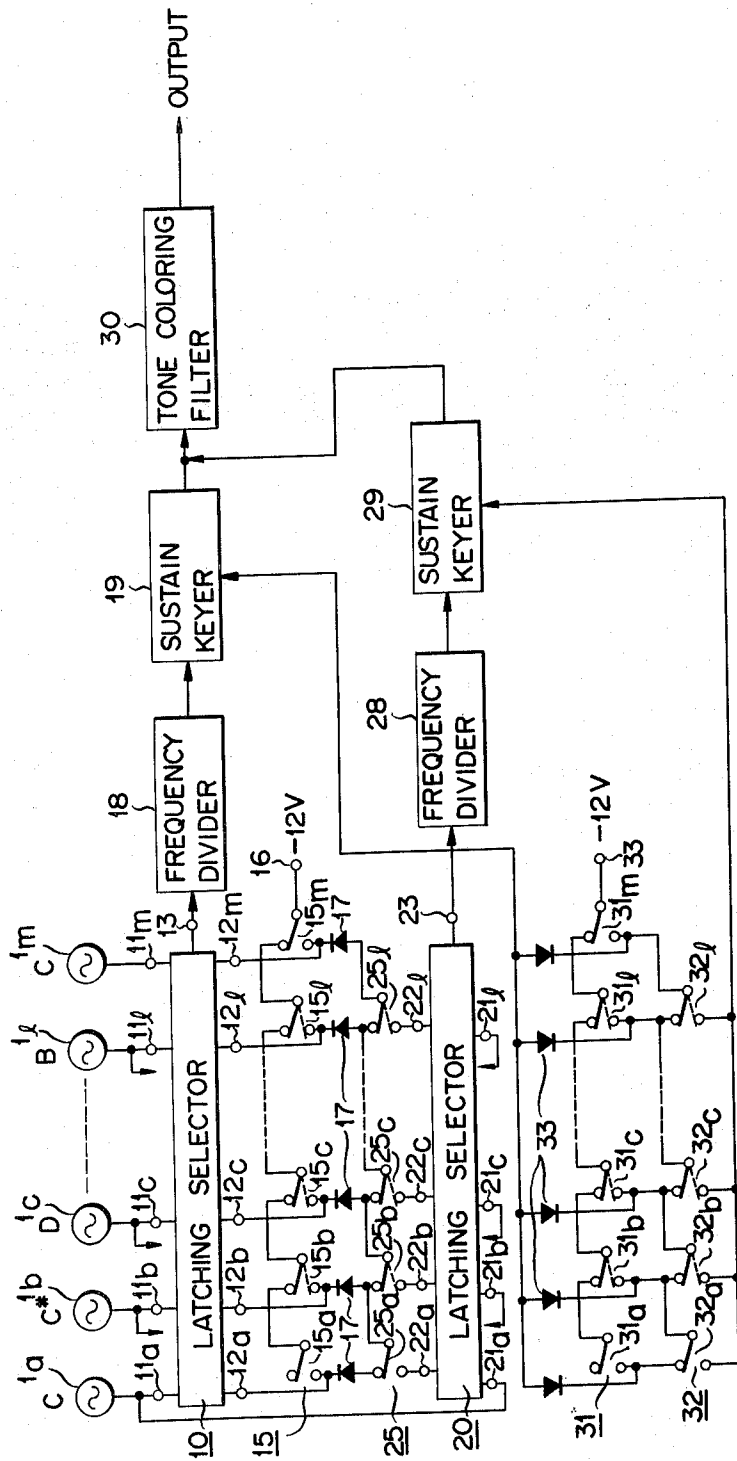
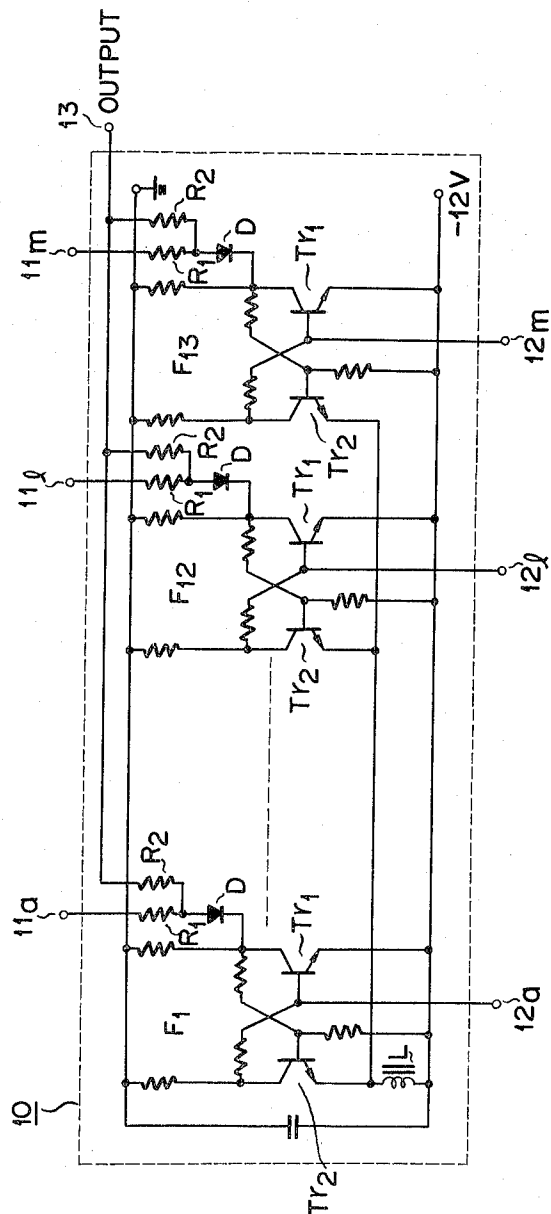


FIG. 2



PLURAL TONE SELECTOR FOR AN ELECTRONIC MUSICAL INSTRUMENT

BACKGROUND OF THE INVENTION

This invention relates to an electronic musical instrument and more particularly to a plural tone selector device for an electronic musical instrument.

An ordinary electronic musical instrument such as an electronic organ is provided with an upper keyboard operated by the right hand, a lower keyboard played by the left hand and a pedal keyboard worked by the left foot. Thus both hands carry out melody and chord performances and the left foot a bass performance. The pedal keyboard is intended for a rhythm performance using bass tones, and is so designed as to generate a single bass tone corresponding to only one of pedal keys even when more than one is depressed at the same time. This is solely for requirements relative to the method of playing the conventional electronic musical instrument as well as for simplification of the pedal keyboard switching circuit. As the result of the wide acceptance of an electronic musical instrument and the development of its playing technique, there is a growing demand to produce at least two bass tones at the same time on the pedal keyboard. If to this end, however, the pedal keyboard switching circuit should be arranged like a manual keyboard switching circuit capable of generating tones separately by key depression the arrangement would be complicated, leading to increased cost. For example, in such case, there would be required the same number of frequency dividers and sustain keyers as the number of pedal keys.

It is accordingly the object of this invention to provide a plural tone selector device for an electronic musical instrument particularly adapted to be used with the pedal keyboard and capable of producing selectively at the same time tones corresponding to at least two of the plural pedal keys when they are depressed.

SUMMARY OF THE INVENTION

According to this invention, there is provided a plural tone selector for an electronic musical instrument comprising first and second latching selectors each having a plurality of input terminals respectively connected to tone signals of different pitches, a plurality of control terminals corresponding to the respective input terminals and one common output terminal; first and second groups of cascade connected key switches each provided with a movable contact and normally open and normally closed fixed contacts. The corresponding key switches of the first and second groups are actuated by one of the keys, the normally open fixed contacts of the key switches of the first group being connected to the corresponding normally closed fixed contacts of the key switches of the second group, and the movable contact of the outermost key switch of the first group being connected to a control power source. When there are depressed a plurality of keys at the same time, there are actuated the corresponding key switches of the first and second groups, thereby causing control voltage to be impressed on the control terminal of the first latching selector connected to that key switch of the first group which is disposed closest to another key switch of the first group connected to the control power source so as to derive as a first signal a tone signal connected to the input terminal corresponding to the control terminal from the common output terminal. At the same time the control terminal of the second latching selector connected to that key switch of the second group which assumes the next closest position among the actuated key switches with respect to the switch of the first group connected to the control source, is supplied with control voltage to derive as a second signal from the common output terminal a tone signal supplied to an input terminal corresponding to the control terminal. The first and second tone signals are supplied to the first and second sustain keyers respectively which are rendered conducting when there is supplied control voltage upon key depression by means of third and fourth groups of cascade connected key switches.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a connection diagram of a plural tone selector device according to this invention; and

FIG. 2 is a circuit diagram of the latching selector of FIG. 1.

DESCRIPTION OF THE INVENTION

Since this invention proves very effective when applied in the pedal keyboard, the following description mainly relates to this application of the invention.

Referring to FIG. 1, the reference numerals 10 and 20 represent first and second latching selectors respectively. The first latching selector 10 includes thirteen input terminals 11a to 11m corresponding to 13 pedal keys and 13 control terminals 12a to 12m corresponding to the input terminals 11a to 11m and one common output terminal 13. The input terminals 11a to 11m are connected to tone generators or tone signals 1a to 1m of different pitches, respectively. The tone signals 1a to 1m are arranged in the order of pitches and may consist of bass tone signals for bass performance or those having pitches an octave or two or more higher than the pedal compass.

The second latching selector 20 comprises 12 input terminals 21a to 21l, 12 control terminals 22a to 22l and one common output terminal 23. The input terminals 21a to 21l are supplied with tone signals 1a to 1l, respectively. Each of the latching selectors 10 and 20 is so designed as to derive from the output terminals 13 and 23 a tone signal supplied to an input terminal corresponding to any of the control terminals when the control terminals are impressed with control voltage.

There are provided first and second groups 15 and 25 of key switches to supply control voltage to the control terminals of the first and second latching selectors. Each key switch has a movable contact and normally open and normally closed fixed contacts. The first key switch group 15 has 13 cascade connected key switches 15a to 15m which are actuated by the respective pedal keys. The normally open fixed contacts of the key switches 15a to 15m are respectively connected to the corresponding control terminals 12a to 12m of the first latching selector 10. The movable contact of the key switch 15a is connected to the normally closed fixed contact of the adjacent key switch 15b, and that of the key switch 15b to the normally closed fixed contact of the adjacent key switch 15c and that of the key switch 15l to the normally closed fixed contact of the adjacent key switch 15m and that of the key switch 15m to one terminal 16 of the control source.

The second key switch group 25 includes 12 cascade connected key switches 25a to 25l. The normally open fixed contacts of the key switches of the second group are connected to the corresponding control terminals 22a to 22l of the second latching selector 20. The movable contact of the key switch 25a is connected to the normally closed fixed contact of the adjacent key switch 25b and that of the key switch 25b to the normally closed fixed contact of the adjacent key switch 25c. The other key switches are connected similarly in cascade relationship. The normally open fixed contacts of the key switches of the first group 15 are respectively connected to the corresponding normally closed fixed contacts of the key switches of the second group 25 through diodes 17 arranged in the forward direction with respect to the polarity of the control source. However, the normally open fixed contact of the key switch 15m at the extreme right end of the first group 15 is differently connected to the movable contact of the key switch 25l at the extreme right end of the second group 25 through the associated diode 17.

Now let it be assumed that the tone signals 1a to 1m have progressively higher pitches from the left end to the right end, that is, correspond to the notes C, C[#], D . . . B, C in turn. When the pedal keys (not shown) representing the notes C[#], D and B are depressed, then the movable contacts of the key switches 15b, 15c and 15l of the first group 15 and the movable contacts of the key switches 25b, 25c and 25l of the second group 25 are moved, as illustrated by broken lines in FIG. 1, from the corresponding normally closed to the normally open

fixed contacts. In this case, as will be easily appreciated, the control power source 16 is connected to the control terminal 12/ alone in the first latching selector 10 and the control terminal 22c alone in the second latching selector 20. Accordingly, there is derived from the output terminal 13 of the first latching selector 10 only a tone signal corresponding to the note B supplied to the input terminal 11/ corresponding to the control terminal 12/. From the output terminal 23 of the second latching selector 20 is derived only a tone signal representing the note D supplied to the input terminal 21c corresponding to the control terminal 22c. Namely, when there are depressed more than two pedal keys, then there are selectively derived only two of the tone signals corresponding to the notes which have higher frequencies than the remainder. Thus it will be apparent that when the cascade connection of the key switches of the first and second groups is reversed and the control source is connected to the movable contact of the key switch at the extreme left end of the first group, then there will be preferentially derived two of the tone signals which have lower frequencies than the remainder.

The first latching selector 10 includes, as shown in FIG. 2, 13 flip-flop circuits F_1 to F_{13} each consisting of a first normally conductive transistor Tr_1 and a second normally nonconductive transistor Tr_2 . The emitter of the first transistor Tr_1 of each flip-flop circuit is directly connected to a negative power source and the emitter of the second transistor Tr_2 is connected thereto through a common impedance element, namely, a choke coil L. The collectors of the transistors Tr_1 and Tr_2 are grounded through the associated resistors.

The input terminals 11a to 11m supplied with tone signals 1a to 1m are respectively connected to the collectors of the first transistors Tr_1 through a resistor R_1 and diode D. The junctures of the resistors R_1 and diodes D are connected to the common output terminal 13 through the respective resistors R_2 respectively. The bases of the first transistors Tr_1 are respectively connected to the control terminals 12a to 12m.

The tone signals supplied to the input terminals 11a to 11m are shunted by the first normally conductive transistors Tr_1 , thereby preventing any tone signal from appearing on the output terminal 13. When any of the control terminals 12a to 12m is impressed with negative control voltage by key depression, then the normally conductive transistor Tr_1 connected to the control terminal is rendered nonconductive. Accordingly, the tone signal supplied to the input terminal connected to the collector of the transistor Tr_1 appears on the output terminal 13 through the resistors R_1 and R_2 . This condition is continued until another control terminal is supplied with control voltage. This means that the latching selector has a memory function to continue the selective withdrawal of the same tone signal even when the pedal key depression is stopped.

When there is impressed negative control voltage on another control terminal, the first transistor Tr_1 connected to that control terminal is rendered nonconductive and the second transistor Tr_2 constituting a flip-flop circuit with the first transistor Tr_1 is rendered conductive thereby to increase the voltage across the choke coil L due to the current passing through the choke coil L. As a result, the second transistor Tr_2 having been conductive up to this time is turned off and the first transistor Tr_1 constituting a flip-flop circuit with that second transistor Tr_2 is turned on. Thus there appears at the output terminal 13 only a tone signal different from that previously supplied thereto.

While the second latching selector 20 has the same arrangement as the first latching selector, the former only requires 12 flip-flop circuits. First and second tone signals derived from the first and second latching selectors 10 and 20 are supplied to first and second frequency dividers 18 and 28 respectively to produce bass tone signals, and then to first and second sustain keyers 19 and 29 respectively. The frequency dividers 18 and 28 may each consist of at least one flip-flop circuit. Needless to say, where the tone signals 1a to 1m to be produced represent bass tone signals, there is no need to provide a frequency divider.

The sustain keyers 19 and 29 may be of an ordinary type used in an electronic musical instrument. Upon depression of the pedal keys, the sustain keyers 19 and 29 are supplied with control voltage and are rendered conducting for a prescribed length of time. That is, they are kept conducting (and gradually decaying) for preferably about one second even when they are reset to their original state after the pedal key depression. Outputs from both sustain keyers 19 and 29 are mixed and coupled to common tone coloring filters 30.

For control of the sustain keyers 19 and 29, there are provided third and fourth groups 31 and 32 of key switches. The third group 31 includes thirteen cascade connected key switches 31a to 31m. The movable contact of the key switch 31a is connected to the normally closed fixed contact of the adjacent key switch 31b and that of the key switch 31b to the normally closed fixed contact of the adjacent key switch 31c. The movable contact of the key switch 31m at the extreme right end of the third group is connected to a negative control power source terminal 33.

The fourth group 32 includes twelve cascade connected key switches 32a to 32l. The movable contact of the key switch 32a is connected to the normally closed fixed contact of the adjacent key switch 32b and that of the key switch 32b to the normally closed fixed contact of the adjacent key switch 32c. The movable contact of the key switch 32l at the extreme right end of the fourth group is connected to the normally open fixed contact of the key switch 31m at the extreme right end of the third group. The normally open fixed contacts of the key switches 31a to 31m are connected to the first sustain keyer 19 for its control through diodes 33 arranged in the forward direction with respect to the polarity of the control source. The normally open fixed contacts of the key switches 31a to 31l of the third group excluding the aforesaid key switch 31m at the extreme right end are connected to the normally closed fixed contacts of the key switches 32a to 32l of the fourth group. The normally open fixed contacts of the key switches 32a to 32l of the fourth group are connected to the second sustain keyer 29 for its control.

When there are depressed those of the pedal keys which correspond to the notes C[#], D and B, the key switches 31b, 31c and 31l of the third group 31 and the key switches 32b, 32c and 32l of the fourth group 32 are actuated in the same manner as the key switches of the first and second groups. Accordingly, the first and second sustain keyers 19 and 29 are rendered conducting by control voltage supplied through the actuated key switches 31l and 32c. First and second tone signals derived from the first and second latching selectors 10 and 20 are supplied to the common tone coloring filters 30 through the first and second sustain keyers 19 and 29. The selected first and second tone signals continue to be supplied, even after the release of a given key, to the first and second sustain keyers 19 and 29 from the first and second latching selectors 10 and 20 until the following key is depressed. As mentioned above, the sustain keyers 19 and 29 are kept conductive for a certain length of time while being gradually reduced from the conductive condition, even when the supply of control voltage ceases due to the release of the previously depressed key. Therefore, there are derived tone signals with a sustain effect from the sustain keyers 19 and 29.

The diodes 17 are provided to prevent the first and second latching selectors 10 and 20 from affecting each other and the diodes 33 are provided to prevent the first and second sustain keyers 19 and 29 from affecting each other.

For the purpose of this invention, it is preferred that the pedal keys be depressed at the same time by both right and left feet. If, in this case, a pedal key corresponding to the note B is operated by the right foot and pedal keys representing the notes C[#] and D (two by mistake) are depressed by the left foot, then there are derived only tone signals corresponding to the notes B and D as described above. Since the tone signals corresponding to the adjacent notes C[#] and D are not derived at the same time, there is prevented the occurrence of turbidity resulting from the generation of two tones which

have frequencies very close to each other. Depression of two adjacent pedal keys with the right foot would of course give rise to turbidity due to the production of tones representing adjacent notes.

The foregoing embodiment relates to the case where there were selectively generated two tones. However, it is possible to obtain three tones selectively by providing a third latching selector and a corresponding group of key switches.

What is claimed is:

1. A plural tone selector for use in a key-type electronic musical instrument comprising:
 - a plurality of tone generators:
 - first and second latching selector means, each having a plurality of input terminals connected with said respective tone generators, each having a plurality of control terminals corresponding respectively to said input terminals and each having one common output terminal;
 - first and second groups of cascade connected key switches, each key switch being adapted to be actuated by corresponding keys of said instruments, each key switch having a movable contact and normally open and normally closed fixed contacts, the normally open fixed contacts of said key switches of said first and second groups being connected to the corresponding control terminals of said first and second latching selector means respectively, said normally open fixed contacts of said key switches of said first group being further coupled to the corresponding normally closed fixed contacts of said key switches of said second group, and said movable contact of the outermost key switch of said first group being connected to a control power source, the normally closed fixed contacts of said cascaded switches in each group being coupled to the movable contact of the next successive switch of each of said cascade of switches;
 - first and second sustain keyers connected to said common output terminals of said first and second latching selector means respectively; and
 - third and fourth groups of cascade connected key switches coupled to and controlling said first and second sustain keyers respectively, each key switch of said third and fourth groups having a movable contact and normally open and normally closed fixed contacts, and each being adapted to be actuated by corresponding keys of said instrument, said normally open fixed contacts of said key switches of said third and fourth groups being connected to said first and second sustain keyers respectively, said normally open fixed contacts of said key switches of said third group being connected to said corresponding normally closed fixed contacts of said key switches of said

fourth group and said movable contact of the outermost key switch of said third group being connected to said control power source.

2. The plural tone selector according to claim 1 wherein the normally closed fixed contacts of each of said third and fourth groups of cascade connected key switches are coupled to the movable contact of the next successive switch of each of said cascade of switches.

3. The plural tone selector according to claim 1 wherein said first and second latching selector means respectively include a plurality of flip-flop circuits each comprising a first normally conductive transistor and a second normally non-conductive transistor each having an emitter, base and collector, said emitter of said first transistor being directly connected to a power source terminal, and said emitter of said second transistor being connected thereto through a common impedance element, said collector of said first transistor of the flip-flop circuit being connected through a resistor to said input terminal connected to one of said tone generators and also to said common output terminal through another resistor, and said base of said first transistor being connected to one of said control terminals.

4. The plural tone selector according to claim 2 wherein said impedance element is a choke coil.

5. The plural tone selector according to claim 1 wherein said normally open fixed contacts of said key switches of said first group are connected to said normally closed fixed contacts of said key switches of said second group through respective diodes disposed in the forward direction with respect to the polarity of said control power source, and said normally open fixed contact of the outermost key switch of said first group is connected through another diode to said movable contact of the outermost key switch of said second group.

6. The plural tone selector according to claim 1 wherein said normally open fixed contacts of said key switches of said third group are connected to said first sustain keyer through respective diodes disposed in the forward direction with respect to the polarity of said control power source.

7. The plural tone selector according to claim 1 for use with a key-type instrument having pedal keys, wherein said key switches of said first, second, third and fourth groups are adapted to be actuated by said pedal keys of said instrument; said tone generators connected to said respective input terminals of said first and second latching selectors have higher pitches than the pedal compass of said instrument; and there is further provided a first frequency divider between said first latching selector means and said first sustain keyer, and a second frequency divider between said second latching selector means and said second sustain keyer.

* * * * *

55

60

65

70

75