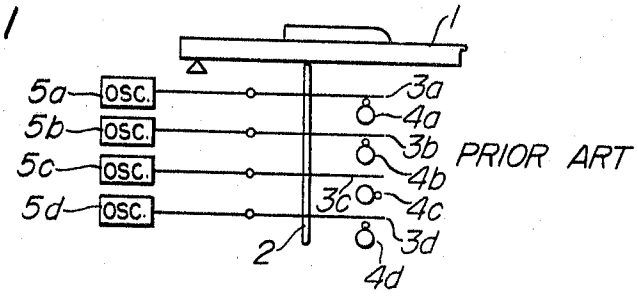
April 1, 1969 IKUTARO KAKEHASHI 3,436,466

COUPLER SYSTEM FOR ELECTRONIC ORGANS

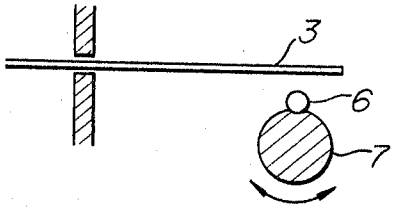
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FIG. 1



PRIOR ART

FIG. 2



PRIOR ART

FIG. 3

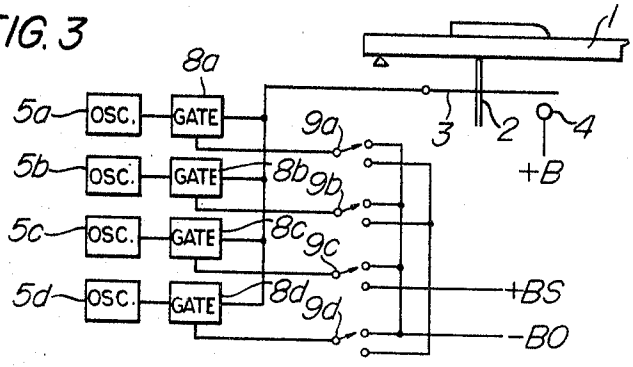
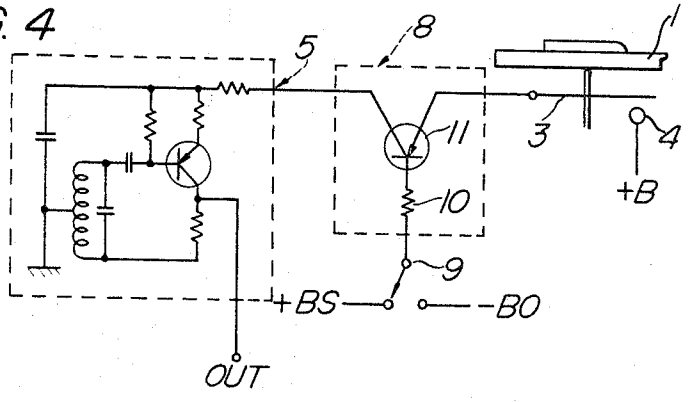


FIG. 4



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FIG. 5

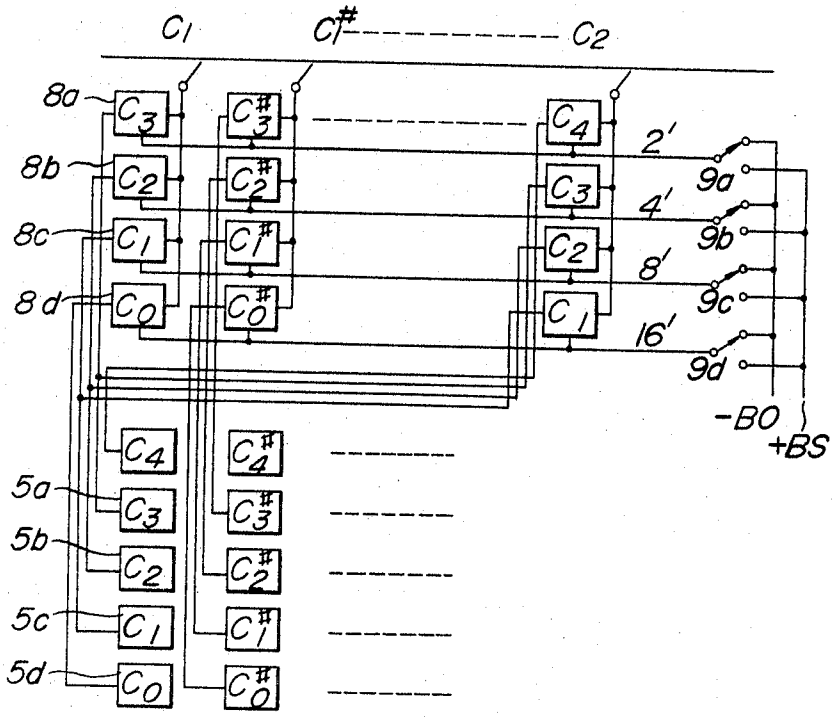


FIG. 6

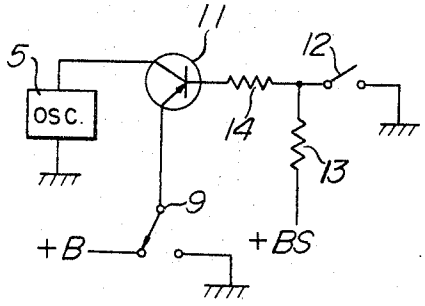
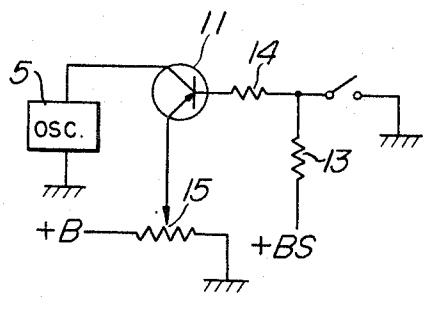


FIG. 7



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FIG. 8

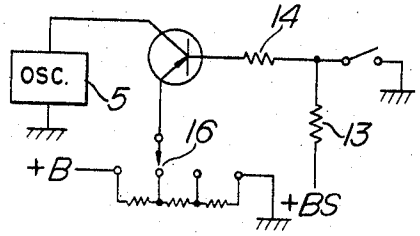


FIG. 10

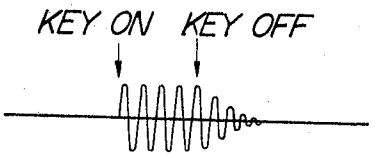


FIG. 9

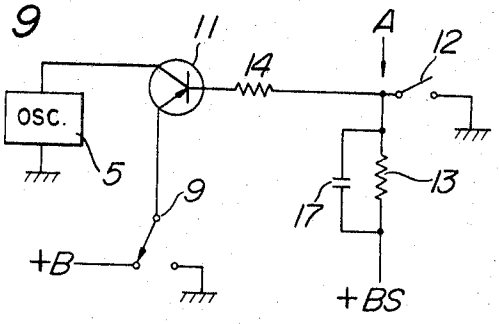
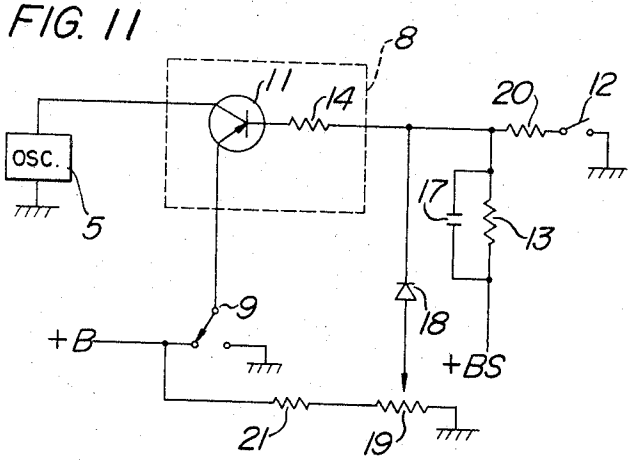


FIG. 11



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3,436,466

COUPLER SYSTEM FOR ELECTRONIC ORGANS

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Int. Cl. G10h 1/00
U.S. Cl. 84—1.01
4 Claims

ABSTRACT OF THE DISCLOSURE

A coupler system for electronic organs of an independent oscillation type in which, instead of conventional multistage key operated switches associated with mechanical couplers for controlling a multiplicity of oscillators, there are provided single stage key operated switches, electronic gating circuit means, such as transistors, and simple electrically operated coupler means, thereby to effectively control a large number of said oscillators in various manners.

The present invention relates to switching systems in electronic organs and the object thereof is to simplify keyboard switches to minimize the occurrence of troubles and to provide effective couplers in spite of simplified arrangement.

Heretofore, an independent oscillation system having one sound source oscillator for each sound has often been employed in high grade electronic organs inasmuch as it has excellent advantages in sound separation, the chorus effect between octaves, the signal to noise ratio, and the like compared with a frequency divider system. However, the advantages of this system cannot be sufficiently manifested unless oscillators being mutually in harmonic relation are actuated at the same time by depressing one key, and hence usually 6 to 12 or more switches are provided to each key.

According to the present invention, the complexity of the above mechanism is much reduced.

A more detailed description of the present invention will be given with reference to the attached drawings in which:

FIG. 1 is a prior art switching system;

FIG. 2 is an enlarged view of the switch portion of the switching system of FIG. 1;

FIG. 3 is a block diagram of the switching system according to the present invention;

FIG. 4 is a circuit diagram of one circuit in the switching system of FIG. 3;

FIG. 5 is a block diagram of the construction of one octave according to the present invention;

FIG. 6 is a circuit diagram of the circuit of FIG. 4 when keying is applied to the base side;

FIG. 7 is a diagram of the circuit of FIG. 6 when the source voltage is made variable by making use of a potentiometer;

FIG. 8 is a diagram similar to FIG. 7 in which a slide switch is used instead of the potentiometer;

FIG. 9 is the circuit diagram of FIG. 6 to which a condenser is added so as to obtain a sustain effect;

FIG. 10 is the output waveform of the circuit of FIG. 9; and

FIG. 11 is the circuit of FIG. 9 modified so that the sustain time is made variable.

Now referring to FIG. 1 which shows the key switch portion of a conventional electronic organ in which four overtones can be sounded concurrently by four switches as well as only one desired tone, the actuater **2** is lowered, when the keyboard **1** is depressed, resulting in concurrent

movements of contact arms **3***a*, **3***b*, **3***c* and **3***d* to contact busbars **4***a*, **4***b*, **4***c* and **4***d*, respectively. Each of the busbars **4***a*, **4***b*, **4***c* and **4***d* is rotatable and comprises, as shown in FIG. 2, an insulating substrate, made of a material such as baked ebonite, and a contact. The busbar **4***c* shown in FIG. 1 is in a rotated state from the normal state. In this state, the contact arm **3***c* does not contact the contact **6**. To each contact of the busbars **4***a*, **4***b*, **4***c* and **4***d*, an electric source which actuates sound source oscillators **5***a*, **5***b*, **5***c* and **5***d* is connected, and hence the sound source oscillators **5***a*, **5***b* and **5***d* connected to the contact arms **3***a*, **3***b* and **3***d* oscillate, but the sound source oscillator **5***c* does not. Thus any desired tone can be modified by rotating the busbars **4***a*, **4***b*, **4***c* and **4***d*.

However, in this system, when the number of contacts are large, a sufficient contact pressure of the contacts exerts an undesirable influence on the touch of the keyboard resulting in difficulty of playing. Moreover, the arrangement for rotating the busbars is complex, and, if the number of the contacts is large, the probability of trouble resulting from malcontacting is high. According to the present invention, these disadvantages are eliminated by simplifying the arrangement.

FIG. 3 shows a switching system for one key according to the present invention. The sound source oscillators **5***a*, **5***b*, **5***c* and **5***d* associated with the keyboard **1** are connected with the contact arm **3** constituting the key switch through gate circuits **8***a*, **8***b*, **8***c* and **8***d*. The contact arm **3** is adapted to contact the busbar **4** to which voltage is applied when, the keyboard is depressed.

FIG. 4 shows one of the gate circuits, wherein the emitter of a transistor **11** is connected to the contact arm **3**, the collector thereof is connected to the sound source oscillator **5**, and the base thereof is connected with a coupler switch **9** through a resistor **10**. When the coupler switch **9** is switched to the $+B_s$ voltage side, this voltage being sufficient for cutting off the transistor **11**, the transistor remains in the cut-off state even if a source voltage $+B$ is applied to the emitter of the transistor **11** by depressing the keyboard **1**, and therefore, a voltage is not applied to the sound source oscillator **5**. On the contrary, when the coupler switch **9** is switched to the voltage $-B_0$ which can put the transistor **11** in a conducting state, the source voltage is applied to the sound source oscillator **5** to actuate it by depressing the keyboard **1**. By connecting in common the emitters of the gate circuits **8***a*, **8***b*, **8***c* and **8***d* arranged in parallel as shown in FIG. 5, and coupling therewith the contact arm **3**, any number of circuits can be switched at a time with the key switch of one circuit.

FIG. 5 shows an example of the construction of a range of notes of one octave according to this method. Of course, any octave can likewise be constructed. The emitter side or voltage supplying side of each gate is connected with the contact arm **3** of the associated key switch, the collector or voltage receiving side thereof is connected with the sound source oscillator **5***a*, **5***b*, **5***c* or **5***d*, and the base or control side of the gates of the same row of tone are integrated into the common couplers **9***a*, **9***b*, **9***c* or **9***d*. By connecting in this manner, any row of tones can be adjusted at will, and even when many overtones for one key are synthesized, the key switch of only one circuit will do.

Although FIG. 5 shows four rows arrangement, similar switching method is also applicable to even more than ten rows. The example shown in FIG. 4 was such that the sound source oscillator **5** was operated by a positive source. If the circuit is to be operated with a negative source, it may be well that the PNP transistor **11** is replaced by an NPN transistor and the switching direction of the coupler switch **9** is reversed.

In a modified connection of the transistor **11** in the gate circuit as shown in FIG. 6, when the key switch **12** is

open, the voltage $+B_s$ is applied to the base through resistors **13** and **14** to cut off the transistor **11**, and when the key switch **12** is closed, the base is grounded to put the transistor **11** in a conduction state resulting in the operation of the sound source oscillator **5**. If the voltage applied to the emitter is adapted to be switched by the coupler switch **9**, when the coupler switch **9** is switched to the grounded side, the sound source oscillator **5** does not operate even if the key switch **12** is closed. This gate circuit is utilized in the same arrangement and for the same purpose as that of FIG. 4.

If the coupler switch **9** in FIG. 6 is replaced by a potentiometer **15** as shown in FIG. 7, or by a slide switch **16** as shown in FIG. 8, the voltage applied to the sound source oscillator **5** can be varied arbitrarily. Since the output signal voltage of the sound source oscillator **5** is proportional to the source voltage, in comparison with the example of FIG. 6 wherein only either the switching on or the switching off of a row of tones can be effected, these arrangements are capable of changing the composition ratio of a series of overtones resulting in the capability of very wide tone color synthesis.

In the circuit of FIG. 9, a condenser **17** is inserted in the base circuit of the transistor **11**. At the moment when the key switch **12** is opened, the potential is such that the transistor **11** is still in conductive state. As the charge on the condenser **17** discharges through the resistor **13**, the voltage applied to the base of the transistor **11** raises the internal resistance, accompanying the increase of which the voltage applied to the sound source oscillator **5** lowers to cease the oscillation of the oscillator. The output wave form of the oscillator **5** at this time is shown in FIG. 10, by which output the sustain effect is actuated. The decay time depends on the time constant of the resistor **13** and the condenser **17**. This decay time can be continuously varied by varying the time constant of the condenser **17** and the forward resistance of a diode **18** by inserting the diode **18** in the circuit and by varying the voltage applied to the diode **18** through a potentiometer as shown in FIG. 11. One set of the condenser **17**, the diode **18** and the resistor **13** will be sufficient even for the case wherein each key has many overtones. A resistor **20** in FIG. 11 controls the rise of oscillation and the value thereof is determined by the time constant in association with the condenser **17**. A resistor **21** is a resistor for adjusting the decay time duration within the operation range of the potentiometer.

As hereinabove described, the switching system according to the invention has the following advantages:

(1) Even when the number of rows of tones is increased, only one circuit of keyboard switch is sufficient.

(2) As a result, the number of contacts becomes very small, resulting in minimization of trouble due to malcontact.

(3) Coupler system is much simplified.

(4) Since the volume of each row of overtones can be varied at will, a very wide range of tone colors can be composed.

(5) Because of the applicability of a printed wiring technique to gate circuits, the assembling thereof is very simple.

What I claim is:

1. A coupler system for an electronic organ of an independent oscillation type comprising

a plurality of oscillators adapted to be octavely related and constitute several rows of controlled tones,

a plurality of electronic gating circuit means, each having at least three terminals,

a first of said at least three terminals of each of said electronic gating circuit means connected to one of said oscillators for supplying a controlled driving voltage to said oscillator,

a key and a key operator switch connected to a second of said at least three terminals of each of said gating circuit means,

and coupler means for setting said oscillators to an arranged predetermined row of tones connected to a third of said at least three terminals of each of said gating circuit means.

2. The coupler system of claim **1**, further characterized by

said second of said at least three terminals of said electronic gating circuit means being a control side,

and a time constant circuit connected between said key switch and said second terminal of said electronic gating circuit means.

3. The coupler system of claim **2**, further characterized by

variable decay time control means including a diode and variable resistor connected to said second terminal.

4. The coupler system of claim **1**, further characterized by said coupler means including a variable resistance means.

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U.S. Cl. X. R.

307—243, 253; 84—1.11, 1.19, 1.21, 1.27