April 4, 1967 W. C. SPENCER 3,312,768

NEON MATRIX CIRCUIT FOR AN ELECTRONIC ORGAN

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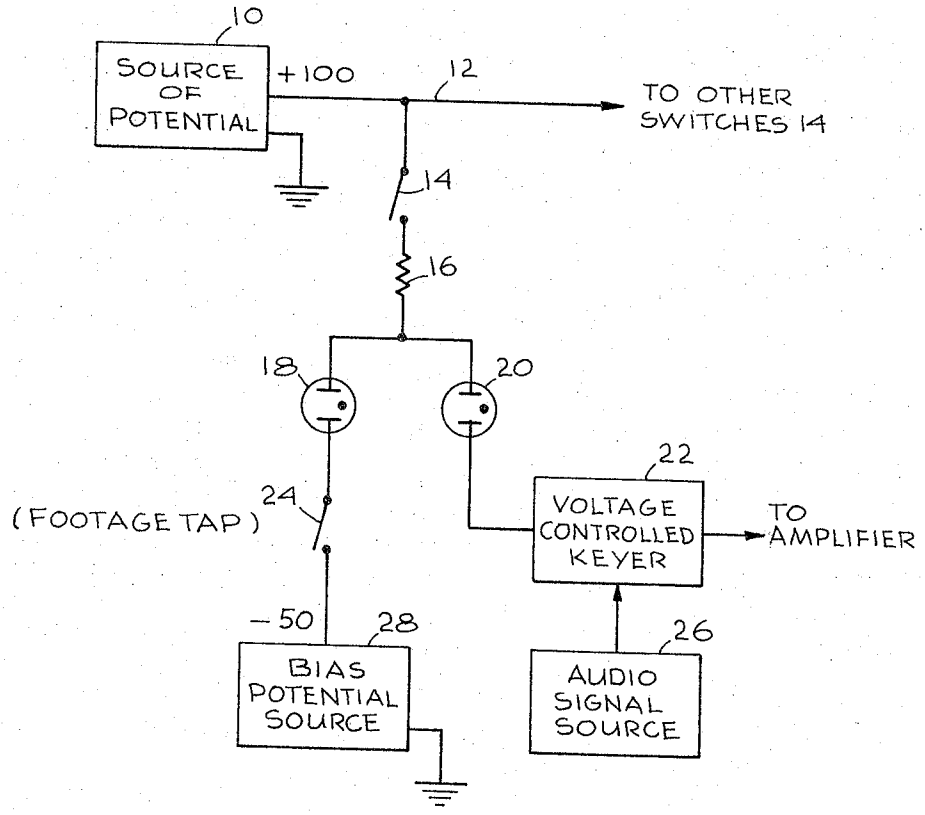


Fig. 1

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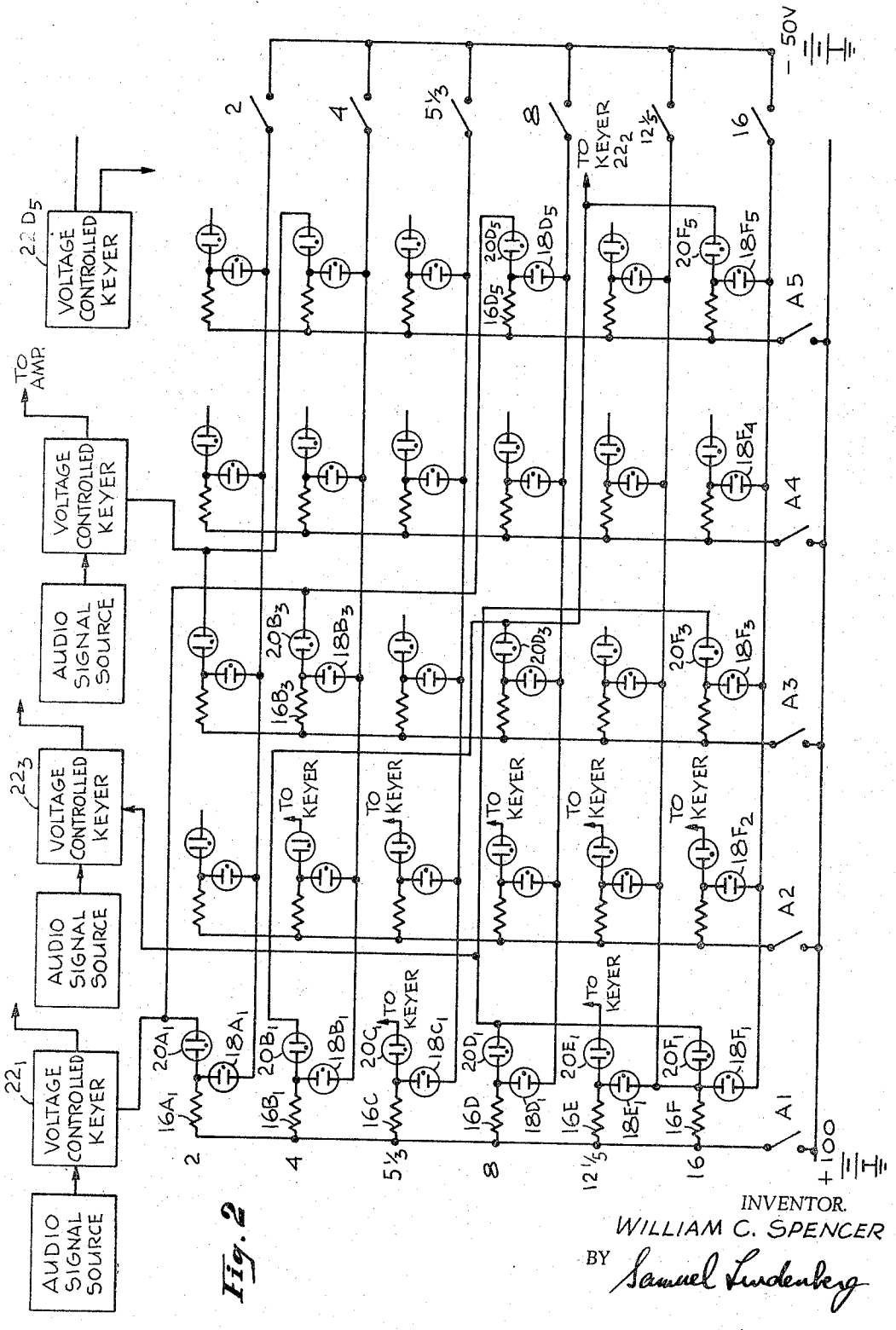


Fig. 2

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NEON MATRIX CIRCUIT FOR AN ELECTRONIC ORGAN

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3 Claims. (Cl. 84—1.01)

This invention relates to switching circuits used in electronic organs and more particularly to improvements therein.

When an electronic organ is played the player depresses the keys, buttons, foot pedals, etc. Actually, these are merely switches which select signals from electrical tone generators. The selected signals are then applied to voicing circuits the outputs from which are then amplified and applied to one or more loudspeakers to be converted into audible signals. One of the problems arising is that of preventing the operation of the key to select a tone from being injected into the output in a form known as a "key click." Also, when keys on the chord keyboard are depressed it is necessary to operate a plurality of keys to select a plurality of tones. Here, in addition to preventing "key clicks" a switching arrangement must be provided which simultaneously selects the various tones in response to actuation of the chord key, otherwise the various tones which make up the chord will be heard singly before being combined into the chord. Still another switching problem which occurs in an electronic chord organ is that of blocking out a number of switches and enabling a number of others to be operated in response to playing the keyboard when it is desired that the chord organ simulate different footages.

An object of this invention is a provision of a switching system for an electronic chord organ which avoids the effect of the "key clicks."

Yet another object of the present invention is the provision of a switching matrix for an electronic chord organ wherein in response to the actuation of a key on the keyboard a simultaneous connection is made when desired to a plurality of tone signal sources.

Still another object of the present invention is the provision of a switching matrix which simplifies the problem of blocking out certain switches and enabling others to be operated.

Another object of the present invention is the provision of a novel, useful and simple switching matrix whereby an improved operation of an electronic organ may be effectuated.

These and other objects of the invention may be achieved in a matrix employing neon tubes for switching purposes. In place of each key contact used in the organ for switching, there may be provided instead a pair of discharge tubes neon lamps. These have operating potentials applied thereto in a manner so that when a key on the keyboard is selected one of these neons is rendered conductive or is illuminated, whereby a voltage controlled keyer may select signals from a suitable audio signal source. In the event that it is desired to prevent signals from this audio signal source from being selected, a switch applies a potential to the other neon lamp whereby it becomes conductive. Upon becoming conductive it biases off the first neon lamp which cannot become conductive despite the actuation of the key whereby it was initially selected.

The novel features that are considered characteristic of this invention are set forth with particularity in the appended claims. The invention itself, both as to its organization and method of operation, as well as additional objects and advantages thereof, will best be understood from the following description when read in connection with the accompanying drawings, in which:

FIGURE 1 is a circuit diagram of an arrangement in accordance with this invention of neon tubes which may be substituted for switch contacts in an electronic organ, and

FIGURE 2 is a circuit arrangement in accordance with this invention of a neon matrix suitable for use in an electronic organ in place of a switching matrix.

Reference is now made to FIGURE 1 which is a circuit diagram illustrating how, in accordance with this invention, two neon lamps may be substituted for two switch contacts. The circuit shown in FIGURE 1 is for only one note key of an electronic organ. Actually, the circuit shown in FIGURE 2 is the one which would be employed with an electronic organ. FIGURE 1 is shown for the purpose of simplifying the description of this invention as it is illustrated in FIGURE 2.

Referring now to FIGURE 1 a source of potential **10**, on the order of 100 volts is connected to a bus-bar **12**. The note keys on the organ exemplified by the switch **14** may be selectively actuated to connect to the bus-bar **12**.

A resistor **16** serves to connect the key **14** to one end of two neon lamps respectively **18**, **20**. One of these neon lamps **20**, connects to a voltage controlled keyer **22**. The other of the neon lamps **18**, connects to a switch **24** which is the footage tap of the electronic organ. The voltage controlled keyer **22** is a well known circuit arrangement in the electronic organ field which acts as a gate circuit. In the absence of a potential being applied thereto, signals from an audio signal source **26**, cannot pass through the voltage controlled keyer to the amplifier circuits which follow. When a positive voltage is applied to the voltage controlled keyer, it can pass audio signals from the source **26** to the succeeding amplifiers. When the key **14** is closed, the neon lamp **20** is illuminated and becomes conductive and thereby the voltage is applied to the voltage controlled keyer **22** to enable it to pass signals from the audio signal source **26**.

The switch **24**, when closed, connects a negative source of bias potential **28**, on the order of minus 50 volts, to the cathode of the neon tube **18**. Should the note key **14**, also be closed, then the neon tube **18** will fire ahead of the neon tube **20** since it has a higher potential applied thereacross. The current which is drawn through the resistor **16** drops the voltage at the anode of the neon lamp **20**, below the ignition potential value required for the neon lamp **20** to become ignited and therefore neon lamp **20** remains unignited and nonconductive despite the fact that the note key **14** is closed. As a result, the voltage control keyer **22**, remains closed and no audio signals are passed from the source **26** therethrough. Therefore, when the footage tap **24** is operated, the neon lamp **20** is prevented from operating.

As briefly indicated above, when playing chords, and also when actuating the various footage keys or taps of an electronic organ, a complex switching problem is presented. It is necessary to inhibit the selection from some audio sources in response to the operation of the note keys and to permit the selection from other audio sources, depending upon which tap switches are closed. Heretofore, this problem has been met in a not too satisfactory fashion, by the employment of multiple leaf contact switches of the type which are usually found in telephone systems. FIGURE 2 shows a circuit diagram of a switching matrix in accordance with this invention in an organ in which there are five footages for example, 2, 4, 5⅓, 8, 12⅔, and 16, and further exemplifying only five note keys which are the octave notes. Thus, the

footage switches have reference numerals respectively **2**, **4**, **5⅓**, **8**, **12⅕**, and **16**, applied thereto and the keys have reference numerals respectively **A1**, **A2**, **A3**, **A4**, **A5**. Since there are six footage taps and five octave keys the matrix should contain 30 sets of neon lamps of the type shown in FIGURE 1. However, in order to simplify both FIGURE 2 and the explanation thereof, not all of these will be shown. To do so would complicate the drawing and would only serve to confuse without assisting in a comprehension thereof. A sufficient number of the neon sets will be shown and their interconnections to enable those skilled in the art to understand this invention and to easily duplicate the construction thereof.

One contact of all of the switches **A1** through **A5** are connected to a common bus which is connected to a source of operating potential on the order of plus 100 volts. One contact of all of the footage switches respectively **2** through **16** are connected to a common bus which is connected to a source of potential on the order of minus 50 volts. The other contact of the switch **A1** is connected to one side of the six limiting resistors respectively **16A**, **16B**, **16C**, **16D**, **16E**, **16F**. The other end of each one of these limiting resistors is connected to the anodes of a pair of neon lamps respectively $\mathbf{20A_1}$, $\mathbf{18A_1}$, $\mathbf{20B_1}$, $\mathbf{18B_1}$, $\mathbf{20C_1}$, $\mathbf{18C_1}$, $\mathbf{20D_1}$, $\mathbf{18D_1}$, $\mathbf{20E_1}$, $\mathbf{18E_1}$, $\mathbf{20F_1}$, $\mathbf{18F_1}$. The cathodes of each one of the neon lamps $\mathbf{18A_1}$ through $\mathbf{18F_1}$, are respectively connected to other contacts of the switches **2**, **4**, **5⅓**, **8**, **12⅕** and **16**. The anode of the neon $\mathbf{20A_1}$ is connected to a voltage controlled keyer circuit $\mathbf{22_1}$ and is also connected to the cathode of a neon $\mathbf{20B_3}$ and a cathode of another neon $\mathbf{20D_5}$. The neon associated with the neon lamp $\mathbf{20B_3}$ is designated as $\mathbf{18B_3}$ and its anode together with the anode of $\mathbf{20B_3}$ is connected through a resistor $\mathbf{16B_3}$ to the key switch **A3**. The cathode of the neon $\mathbf{18B_3}$ together with the cathode of the neon $\mathbf{18B_1}$ is connected to the footage switch **4**.

Associated with the neon $\mathbf{20D_5}$ is the neon $\mathbf{18D_5}$. The anodes of these two neons are connected to the resistor $\mathbf{16D_5}$. This resistor has its other end connected to the key **A5**. The cathode of the neon $\mathbf{18D_5}$ together with the cathode $\mathbf{18D_1}$ is connected to the footage switch **8**.

When none of the footage switches are closed then should the **A1** key be closed every one of the neons $\mathbf{20A_1}$, $\mathbf{20B_1}$, $\mathbf{20C_1}$, $\mathbf{20D_1}$, $\mathbf{20E_1}$, $\mathbf{20F_1}$, would be ignited whereby each of the voltage control keyers to which these respective neons are connected will be opened and the audio signal sources **26** to which the voltage controlled keyers are connected, can pass audio signals to the subequent circuits. From the arrangement shown in FIGURE 2 it will be seen that the neons $\mathbf{20A_1}$, $\mathbf{20B_3}$ and $\mathbf{20D_5}$ all control the same voltage controlled keyer $\mathbf{22_1}$. The neon $\mathbf{20B_1}$ together with neons $\mathbf{20D_3}$ and $\mathbf{20F_5}$ control the voltage controlled keyer $\mathbf{22_2}$. The neon $\mathbf{20C_1}$ controls its own voltage controlled keyer (not shown). The neon $\mathbf{20D_1}$ together with the neon $\mathbf{20F_3}$ and the neon $\mathbf{20F_2}$ control the voltage controlled keyer $\mathbf{22_3}$. The neon $\mathbf{20E_1}$ controls its own individual voltage controlled keyer (not shown).

Assume now that the footage switch **16** is closed. This causes all the neons $\mathbf{18F_1}$ through $\mathbf{18F_5}$ to be ignited. As a result, none of the neons $\mathbf{20F_1}$ through $\mathbf{20F_5}$ can be ignited even if the switches A_1 through A_5 are closed. Thus, the voltage controlled keyers which are opened by the neons $\mathbf{20F_1}$ through $\mathbf{20F_5}$ cannot be fired unless the voltage controlled keyer is controlled in common with a neon on one of the other open footage lines. For example, voltage controlled keyer $\mathbf{22_3}$ can still be open by the closing of the A_1 key even though the footage key **16** is closed since the A_1 key can cause the firing of the neon $\mathbf{20D_1}$ which also controls the voltage controlled keyer $\mathbf{22_3}$.

From the foregoing description, the operation of the matrix should become apparent. Stated concisely, the operation of any one of the switches **A1** through **A5** applies igniting potential to a bus and the neons $\mathbf{20A_1}$ through $\mathbf{20F_1}$ which are connected to that bus are ignited except for those neons associated with an ignited one of the neons $\mathbf{18A_1}$ through $\mathbf{18F_1}$. The closure of one of the footage switches **2** through **16** applies an igniting potential to a bus and all the neons **18** which are connected to that line are ignited, whereby they will prevent the ignition of the associated neons **20**. Control of the voltage controlled keyer may be achieved by more than one of the neons **20**, in accordance with the requirements of the musical scale, the matrix represented in FIGURE 2 exemplifying the switching arrangements required for five octaves of the A chords.

The previous complications in wiring, switch construction and operation, which are replaced by the neon matrix of this invention shown in FIGURE 2, should be apparent. Each one of the neon pairs respectively **18**, **20**, not only performs the "off" "on" and inhibit function but also ties together with other neon pairs to provide alternate control functions when required.

There has accordingly been described and shown herein a novel, useful, neon matrix arrangement which provides less troublesome operation, better operation and less maintainance than the switching arrangement supplanted thereby.

I claim:

1. In an electronic organ of the type wherein a switching matrix is employed which is operated in response to key switches and footage switches for selectively applying enabling voltages to a plurality of voltage controlled keyers whereby they can pass signals from a plurality of audio signals sources to be reproduced, the improvement in said switching matrix comprising a plurality of neon switching circuits, there being as many switching circuits in said plurality as the product of said key switches and footage switches, each said neon switching circuit comprising a resistor, a first and second neon lamp, each having an anode and a cathode, the anodes of said neon lamps being connected to one end of said resistor, means connecting the cathode of said first neon lamp to one of said plurality of voltage controlled keyers, means connecting the other end of said resistor to one of said key switches, means connecting the cathode of said second neon lamp to one of said footage switches, means for providing ignition potential to said first neon lamp when the key switch to which said other end of said resistor is operated whereby said voltage controlled keyer is enabled to pass audio signals, and means for providing ignition potential to said second neon lamp when said key switch and the footage switch to which the cathode of said second neon lamp is connected is operated whereby said first neon lamp is prevented from being ignited.

2. In an electronic organ of the type wherein the actuator of a key on a keyboard operates a first switch to apply a gating signal to a voltage controlled keyer to enable it to pass signals to be reproduced, the improvements comprising:

a first and a second discharged tube each having a first and a second electrode,

a resistor,

a first source of voltage potential,

means for connecting said resistor, said first switch, and the first electrodes of said first and second discharge tubes in series with said first source of potential,

means connecting the second electrode of said first discharge tube to one of said voltage controlled keyers for enabling said one keyer when said first discharge tube is ignited upon closing of said first switch,

a second source of voltage potential, and

a second switch for connecting the second electrode of said second discharge tube to said second source

of voltage potential, said latter potential being selected so that upon closing said first switch when said second switch is closed said second discharge tube will ignite and the voltage drop across the resistor preventing said first discharged tube from igniting.

3. In an electronic organ of the type having a plurality of key switches and a plurality of footage switches, said key switches and said footage switches being connected to a matrix for enabling selected ones of a plurality of voltage control keyers is, each keyer when enabled passing signals to be reproduced from an audio signal source in response to operation of selected ones of said key switches and footage switches, an improved matrix circuit for selectively operating said voltage controlled keyers, comprising:

a plurality of discharge control circuits, there being as many discharge control circuits as the product of key switches and footage switches, each of said discharge control circuits containing a first and second discharge tube, each discharge tube having a first and a second electrode,

means for connecting the second electrode of the first discharge tube of said each control circuit to at least one of said plurality of said voltage controlled keyers,

means connecting the second electrode of the associated second discharge tube to one of said plurality of footage switches,

resistive means connecting the first electrodes of said

first and second discharge tubes to one of said plurality of key switches,

a source of ignition potential connected upon operation of the one of said key switches to said first electrodes of said first and second discharge tubes to ignite said first discharge tube whereby the voltage controlled keyer is enabled to pass audio signals, and

means including said source of potential responsive to the operation of said footage switch to which the associated second discharge tube is connected and of the key switch to which the second discharge tube is also connected to apply an ignition potential to said second discharge tube whereby said first discharge tube is prevented from being ignited.

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