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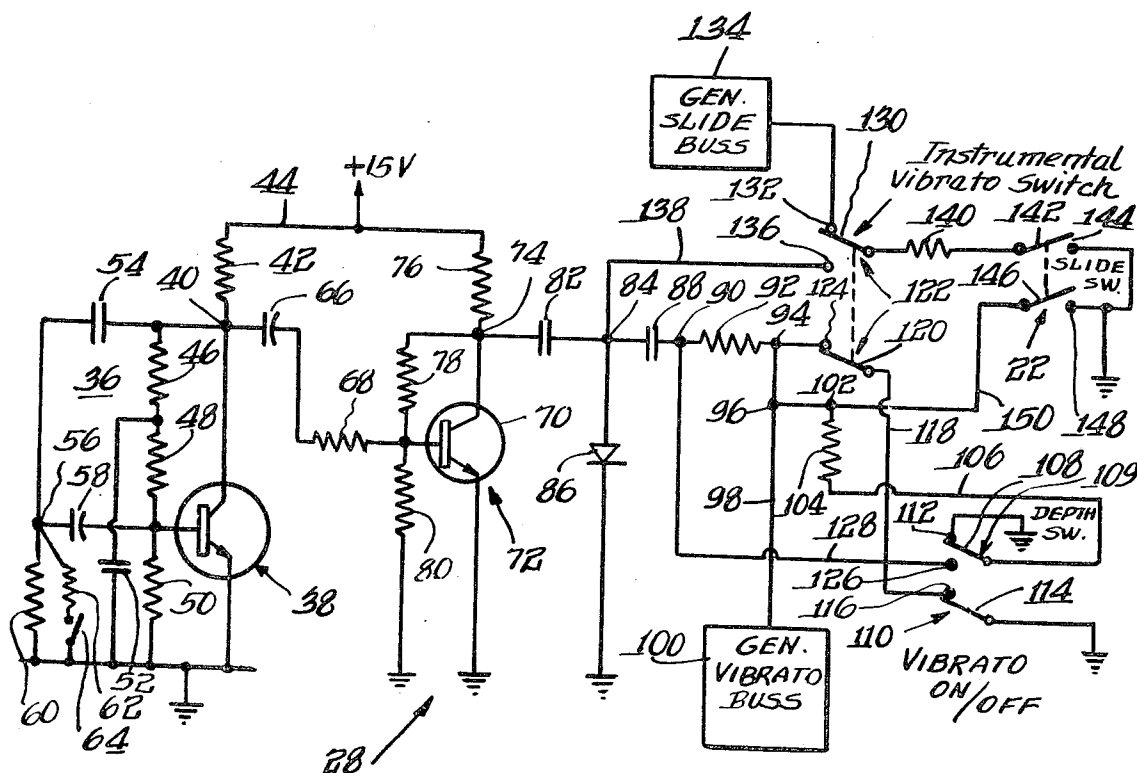
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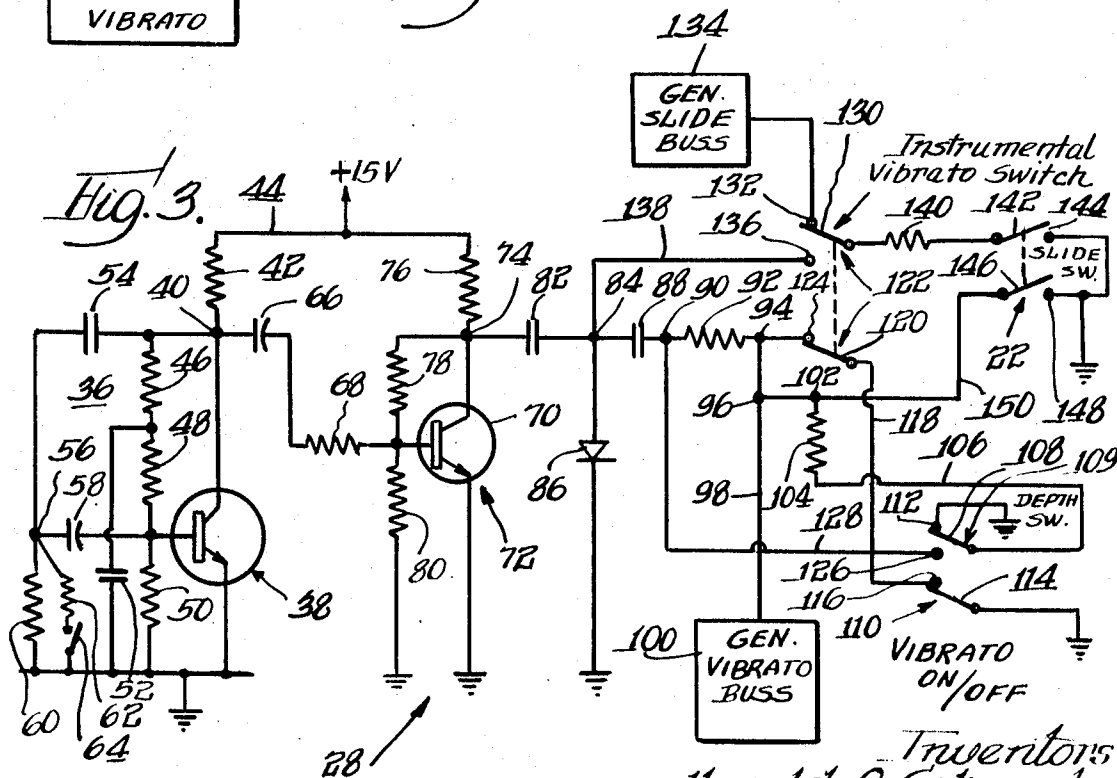
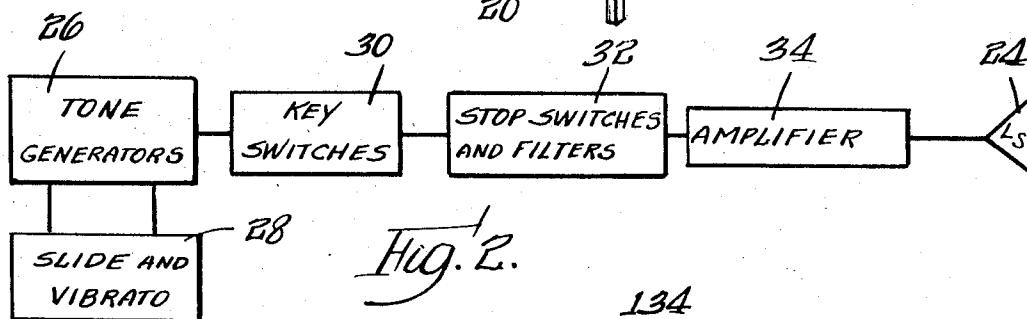
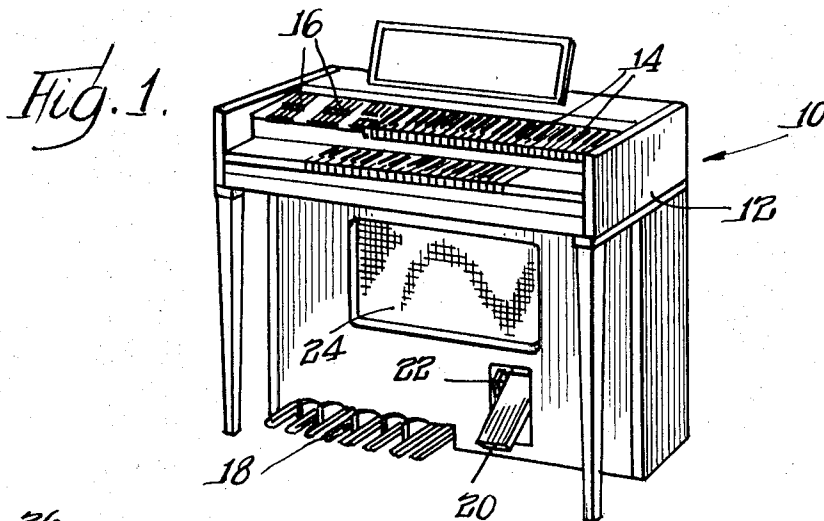
[54] **VARIABLE AMPLITUDE VIBRATO AND GLISSANDO CIRCUITRY FOR ELECTRONIC MUSICAL INSTRUMENTS**
8 Claims, 3 Drawing Figs.

[52] U.S. Cl. **84/1.24, 84/1.25**
[51] Int. Cl. **G10h 1/02, G10h 1/04**
[50] Field of Search **84/1.24, 1.27, 1.25**

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ABSTRACT: A vibrato oscillator on the order of 6 cycles per second frequency is supplied in an electronic organ. A diode shunts the output of the vibrato oscillator, and when the diode is conductive, no vibrato oscillations are provided to the organ oscillators and no vibrato appears in the organ output. A manually operable switch is provided which causes a capacitor to charge through the diode, gradually biasing the diode off and applying the vibrato signal at a controlled rate to the organ oscillators to produce an increasing vibrato in the organ output. Glissando circuitry is also provided but the vibrato and glissando cannot coexist.





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VARIABLE AMPLITUDE VIBRATO AND GLISSANDO CIRCUITRY FOR ELECTRONIC MUSICAL INSTRUMENTS

It is well recognized in the musical arts that vibrato enhances the character of many kinds of music. Vibrato can make a great difference in the type of sound produced by an electronic organ. For example, for a cathedral type organ used in playing liturgical music, little or no vibrato is desired. On the other hand, a theater type organ requires a rather extensive amount of vibrato. Particular compositions may require greater or lesser amounts, and it has been found that especially desirable musical results can be obtained by controlling the presence or absence of vibrato during the rendition of a composition, and by controlling the rate at which vibrato is introduced, substantially as is done in the playing of certain conventional musical instruments, violin being exemplary.

Vibrato, as is well known, comprises a variation in the musical signal at a cyclic rate. According to some authorities, vibrato is a periodic variation in frequency (pitch) or phase, whereas tremolo is a periodic variation in intensity. The term "pulsato" has been used on occasion in a generic sense to include either pitch change or intensity change, or a combination thereof. Although the present invention is concerned primarily with pitch change, the principles thereof also are applicable to intensity change, and the use throughout the present specification of the term "vibrato" will be understood as exemplary.

In accordance with the present invention, a toe switch is provided on the swell pedal of an electronic organ, which toe switch is operable by shifting the toe end of the right foot to the left. When this toe switch is so pressed to the left, a diode is rendered conductive to shunt the output of a vibrato oscillator. When the toe switch is released, a capacitor charges through the diode, cutting off the diode at a controlled rate, and allowing a progressively greater amount of the vibrato signal to be applied to the organ oscillators or tone generators, thereby producing a progressively more effective vibrato.

Thus, in accordance with the principles of the present invention, it is an object thereof to produce in an electronic organ or the like a vibrato, the effectiveness of which is selectively controlled by the player during the rendering of a composition.

More particularly, it is an object of the present invention to provide a vibrato effect in an electronic organ which is readily switched on and off by the organist during the rendering of the composition, and which becomes effective at a controlled rate upon being turned on.

Yet another object of the present invention is to provide a vibrato effect in an electronic organ as heretofore set forth, in combination with a slide or glissando effect, both being controlled by a common instrumentality, and the slide or glissando effect being turned off when the vibrato is used.

Other and further objects and advantages of the present invention will be apparent from the following description when taken in connection with the accompanying drawings wherein:

FIG. 1 is a perspective view of an electronic organ constructed in accordance with the principles of the present invention;

FIG. 2 is a block diagram of the electronic organ; and

FIG. 3 is a schematic wiring diagram of the delayed vibrato portion of the organ.

Turning now in greater particularity to the drawings, and first to FIG. 1, there will be seen an electronic organ 10 constructed in accordance with the principles of the present invention. The organ includes a case 12, and is illustrated as being of the spinet organ type having two overlapping end shortened keyboards 14 comprising the usual organ keys. Various stop tablets and other controls 16 are included adjacent the keyboards, and the organ is also provided with a pedal clavier 18. In addition, as is common, the organ is provided with a swell pedal 20 for controlling the overall volume

level of the instrument. The swell pedal is provided near the upper end with a toe switch 22 which is actuable by movement of the toe end of the foot to the left. The organ further is provided with a loudspeaker system 24 comprising one or more suitable loudspeakers mounted behind grill cloth.

Turning now to FIG. 2, the organ will be seen to include various tone generators 26. Suitable tone generators are known in the art, and in accordance with the present invention it is preferred that these tone generators be of the type including one octave of master oscillators and a succession of strings of slave oscillators respectively controlled by the master oscillators. In accordance with the present state of the art, the master oscillators are preferably LC tuned transistor oscillators of significant stability, but being capable of being varied in frequency to produce a vibrato effect. The slave oscillators preferably comprise transistorized multivibrato or flip-flop oscillators and shift in frequency with the master oscillators when vibrato is applied.

A slide and vibrato circuit 28 comprises a slide switch for detuning the oscillators flat, and subsequently allowing them to come back up to pitch to produce a glissando or sliding tone, and also a vibrato oscillator and suitable controls for varying the pitch of the tone generators 26 alternately sharp and flat. The tone generators 26 are connected through suitable key switches 30 operated by the keys 14 and pedals of the clavier 18 to stop switches and filters 32, which may be of more or less known types.

The signals which are passed by the tone generators through the key switches 30 and modified by the filters are applied to an amplifier 34, and the amplifier output is applied to the loudspeaker system 24, which, as noted, may be one or more loudspeakers. Indeed, the output may include a jack for earphones for private listening by the organist.

The slide and vibrato circuit 28 is seen in greater detail in FIG. 3. The vibrato oscillator 36 is an RC phase shift oscillator including a transistor 38. The transistor actually is preferably two transistors connected in the well-known Darlington circuit, i.e., two transistors in cascade. The transistor is of the NPN type, and the emitter thereof is connected to ground. The collector is connected to a junction 40 which, in turn, is connected through a resistor 42 to a positive supply line 44 of 15 volts DC potential. The junction also is connected back to the transistor base by means of a voltage divider comprising series-connected resistors 46, 48, and 50, the latter of which is grounded. The junction between the resistors 48 and 50 is connected to the base. In addition, the junction between the resistors 46 and 48 is shunted to ground by a capacitor 52. A capacitor 54 is connected from the junction 40 to a junction 56, and this in turn is connected through a capacitor 58 to the transistor base, and also through a resistor 60 to ground. The resistor 60 may be paralleled by a resistor 62 having a normally open switch 64 connecting it to ground for controlling the speed of the vibrato oscillator which is normally on the order of 6 cycles per second.

The output from the oscillator 38 is taken through a capacitor 66 from the junction 40, and further through a resistor 68 to the base of an NPN transistor 70 forming a part of a buffer amplifier stage 72. The emitter of the transistor 70 is grounded, while the collector is connected to a junction 74 which is connected through a resistor 76 to the positive supply line 44. The base of the transistor is connected between voltage divider resistors 78 and 80, respectively connected to the junction 74 and to ground.

The output of the transistor 70 is taken from the collector by way of a capacitor 82 connected to the junction 74. The opposite side of the capacitor 82 is connected to the junction 84, and this junction is connected to the anode of a diode 86, the cathode of which is grounded.

The junction 84 is connected through a capacitor 88 to a junction 90 which is connected to a resistor 92 leading to a junction 94. The junction 94 is connected to another junction 96 which leads through a line 98 to a generator vibrato bus 100. This bus alternately rises and falls in potential in ac-

cordance with the frequency of the vibrato oscillator 38 when the vibrato oscillator output is applied thereto, and shifts the frequency of the tone generators 26 alternately sharp and flat.

The junction 96 further is connected to a junction 102 to which there is connected a resistor 104 leading through a line 106 to a movable contact 108 of a vibrato depth switch 109. The movable switch contact 108 is engageable with a fixed contact 112 which is grounded. A vibrato On-Off switch 110 includes a grounded switch contact 114. The movable switch contact 114 in the "Off" position shown engages a fixed contact 116 which leads through a line 118 to a movable switch contact 120 of the instrumental vibrato (delayed vibrato) switch 122. The instrumental vibrato switch is shown in the "Off" position, and in this position the movable switch contact 120 engages a fixed switch contact 124 which is connected to the junction 94.

When the vibrato On-Off switch 110 is moved to its "On" position, the movable switch contact 114 does not engage anything.

The instrumental vibrato switch 122 further includes a movable switch contact 130 ganged with the movable switch contact 120, and in the "Off" position shown engageable with a fixed switch contact 132 leading to a generator slide bus 134, whereby to detune the generators flat a half tone, and subsequently to allow them to come up to normal pitch to produce a glissando or slide effect. In the "On" position, the instrumental vibrato switch has the movable contact 130 thereof in engagement with a fixed contact 136 which is connected through a line 138 to the junction 84, while the movable switch contact 120 is out of engagement with anything. (Note that the "Off" position for the instrumental vibrato switch is "On" for the production of slide or glissando.)

The movable switch contact 130 is connected through a resistor 140 to a movable switch contact 142 of the toe operated slide switch 22. This switch is normally open, and when closed, the movable switch arm 142 engages a grounded fixed contact 144. The slide switch also includes a second movable switch contact 146 ganged with the movable switch contact 142, and which, when closed, engages a grounded fixed switch contact 148. The second movable contact 146 is connected through a line 150 to the junction 102.

OPERATION

With the instrumental vibrato switch 122 in the "Off" position shown, the upper movable contact 142 of the slide switch is connected to the generator slide bus 134 through the movable switch contact 130. Thus, when the slide switch 22 is moved to closed position by the organist's toe, the generator slide bus is placed nearer ground potential. This causes the tone generators 26 to be detuned a half tone flat, and when the slide switch 22 is released and allowed to open, the generator slide bus comes back up to its normal potential, and a rising sliding tone is produced as the tone generators return to their normal frequency.

When the slide switch 22 is closed, the movable switch contact 146 grounds the junction 96, and hence the line 98, whereby to short out the output of the vibrato oscillator, and to prevent the production of vibrato during the production of the slide or glissando effect.

Considering now specifically the vibrato depth switch 109, with this switch in the position shown, the junction 94 is grounded through the resistor 104 and through line 106 and switch contacts 108, 112, whereby minimum vibrato output is applied to the generator vibrato bus 100. With the vibrato depth switch turned to its opposite position, the resistor 104 is connected in parallel with the resistor 92 by the switch contacts 108, 126. This reduces the resistance of the path from the vibrato oscillator to the generator vibrato bus 100, and maximum vibrato is impressed on the tone generators 26.

As to the vibrato On-Off switch 110, it will be apparent that in the "Off" position shown, the vibrato oscillations are shorted to ground and there is no vibrato. Conversely, with the

switch 110 moved to its other or "On" position, ground is removed from the vibrato bus.

Turning now to the instrumental vibrato switch 122, when this is moved to its "On" position by means of one of the stop tablets 16 (the vibrato On-Off switch 110 is also controlled by one of these stop tablets), the switch contacts 120, 124 are opened, and the ground circuit therefore is broken. Simultaneously, the switch contact 130 moves from the fixed contact 132 to the fixed contact 136, thereby rendering the slide ineffective, since there is no longer any connection to the generator slide bus 134. The output of the buffer amplifier stage 72 is always positive, and during steady state operation the capacitor 82 charges from the positive voltage line 44 through the resistors 76 and through the diode 86, the left side of the capacitor 82 being at positive potential, and the right side therefore being at negative potential, and cutting off the diode 86. Accordingly, the diode under such conditions does not shunt the output of the buffer amplifier 72, and the vibrato signal carries through the capacitor 88 and resistor 92 to the line 98 leading to the generator vibrato bus, thus producing a vibrato effect. However, when the slide switch 22 is closed by the organist's toe, the junction 84 is brought toward ground potential through the resistor 140, while the junction 94 is brought directly to ground potential through the lead 150, whereby no vibrato oscillations are applied to the generator vibrato bus 100.

When the slide switch 22 is subsequently released by the organist and it opens, the junction 84 at the top of the diode initially is close to ground potential. The alternating but always positive signal from the output junction 74 of the buffer amplifier stage is passed by the capacitor 82 and is shunted to ground by the diode 86. However, as the diode conducts, the capacitor 82 charges, being positive on the left and negative on the right, therefore progressively cutting off the conduction of the diode 86 and concomitantly rendering it less effective as a shunt, whereby progressively more of the vibrato output is applied through the capacitor 88 and resistor 92 to the line 98, and hence to the generator vibrato bus 100, thereby to cause the vibrato to be increasingly effective. The right side of the capacitor 82 eventually reaches a negative potential, which in the illustrative example is -0.5 v. The threshold of the diode in this illustrative example is -0.5 v., and the diode therefore is most effectively cut off.

In the illustrative example, the wave shape from the buffer amplifier 72 is essentially trapezoidal. The potential at the junction 74 is determined by the conduction of the transistor 70, and although the potential for charging the capacitor 82 is derived from the positive supply line 44 through the resistor 76, it is actually the output wave of the buffer amplifier that controls the charging, at a rate determined by the time constant effected by the capacitor 82 and diode 86.

The specific example of the invention as herein shown and described is for illustrative purposes only, as will be understood, and various changes in structure as may occur to those skilled in the art will be understood as coming within the ambit of the present invention insofar as they fall within the spirit and scope of the appended claims.

We claim:

1. A pulsato circuit for an electronic musical instrument having a plurality of keys and key switches comprising a pulsato oscillator for producing pulsato oscillations, said oscillator having an output, a capacitor in series with said output, a shunting diode connected to said series capacitor, means connecting said series capacitor to produce pulsato in the output of said electronic musical instrument, means including a switch selectively manually operable to cause said diode to conduct and to shunt the pulsato signal, subsequent reverse operation of said switch effecting charging of said capacitor through said diode progressively to cut off said diode and to produce progressively increasing pulsato in the output of said musical instrument.

2. A pulsato circuit as set forth in claim 1 and further including means for producing a glissando effect in said elec-

tronic musical instrument, said glissando producing means including means including said switch, and means for rendering said glissando producing means ineffective to produce glissando during the production of pulsato.

3. A pulsato circuit for an electronic musical instrument comprising means for providing a pulsato signal, means connected to said pulsato signal providing means for utilizing said pulsato signal to produce a pulsato effect in said electronic musical instrument, means connected to said pulsato signal producing means and including a manually selectively operable switch for rendering the pulsato signal ineffective to produce pulsato means connected to said pulsato signal producing means and including said switch and a circuit having a predetermined time constant for subsequently rendering the pulsato signal ineffective to produce pulsato at a predetermined increasing rate, and means for producing a glissando effect in said electronic musical instrument, said glissando producing means including means including said switch, and means for rendering said glissando producing means ineffective to produce glissando during the production of pulsato.

4. An electronic musical instrument comprising means including a plurality of keys and key switches for producing musical tones, means for providing a pulsato signal, means connected to said pulsato signal to produce a pulsato effect in said musical tones, means connected to said pulsato signal producing means and including a manually selectively operable switch for rendering the pulsato signal ineffective to produce pulsato, and means connected to said pulsato signal producing means and including said switch and a circuit having a predetermined time constant for subsequently rendering the pulsato signal effective to produce pulsato at a predetermined increasing rate, said switch being selectively operable independent of said keys and key switches whereby said musical

cal tones may be produced independently of pulsato effect.

5. An instrument as set forth in claim 4 wherein said switch comprises a foot operated switch.

6. An instrument as set forth in claim 4 wherein the means for rendering the pulsato signal ineffective comprises a diode connected to said pulsato signal producing means, said switch being connected to said diode to render the diode conductive to shunt the pulsato signal.

7. An instrument as set forth in claim 6 wherein the means for subsequently rendering the pulsato signal effective comprises a series capacitor connected to said pulsato signal producing means for carrying the pulsato signal and connected to said diode for charging to cut off said diode.

8. A pulsato circuit for an electronic musical instrument comprising means for providing a pulsato signal, means connected to said pulsato signal providing means for utilizing said pulsato signal to produce a pulsato effect in said electronic musical instrument, means connected to said pulsato signal producing means and including a manually selectively operable switch for rendering the pulsato signal ineffective to produce pulsato, said means for rendering the pulsato signal ineffective including a diode connected to said pulsato signal producing means, said switch being connected to said diode to render the diode conductive to shunt the pulsato signal, and means connected to said pulsato signal providing means and including said switch and a circuit having a predetermined time constant for subsequently rendering the pulsato signal effective to produce pulsato at a predetermined increasing rate, said means for subsequently rendering the pulsato signal ineffective comprising a series capacitor connected to said pulsato signal producing means for carrying the pulsato signal and connected to said diode for charging to cut off said diode.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,590,133

Dated June 29, 1971

Inventor(s) Harold O. Schwartz and Roger J. McNerney

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

Column 2, line 2, change "actuatable" to --actuatable--.

Column 5, line 24, after "signal" insert --providing means for utilizing said pulsato signal--.

Signed and sealed this 25th day of January 1972.

(SEAL)

Attest:

EDWARD M. FLETCHER, JR.
Attesting Officer

ROBERT GOTTSCHALK
Commissioner of Patents