United States Patent

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[54] **SOLID STATE CONTROL SYSTEM FOR STRIKING BELLS**
4 Claims, 3 Drawing Figs.

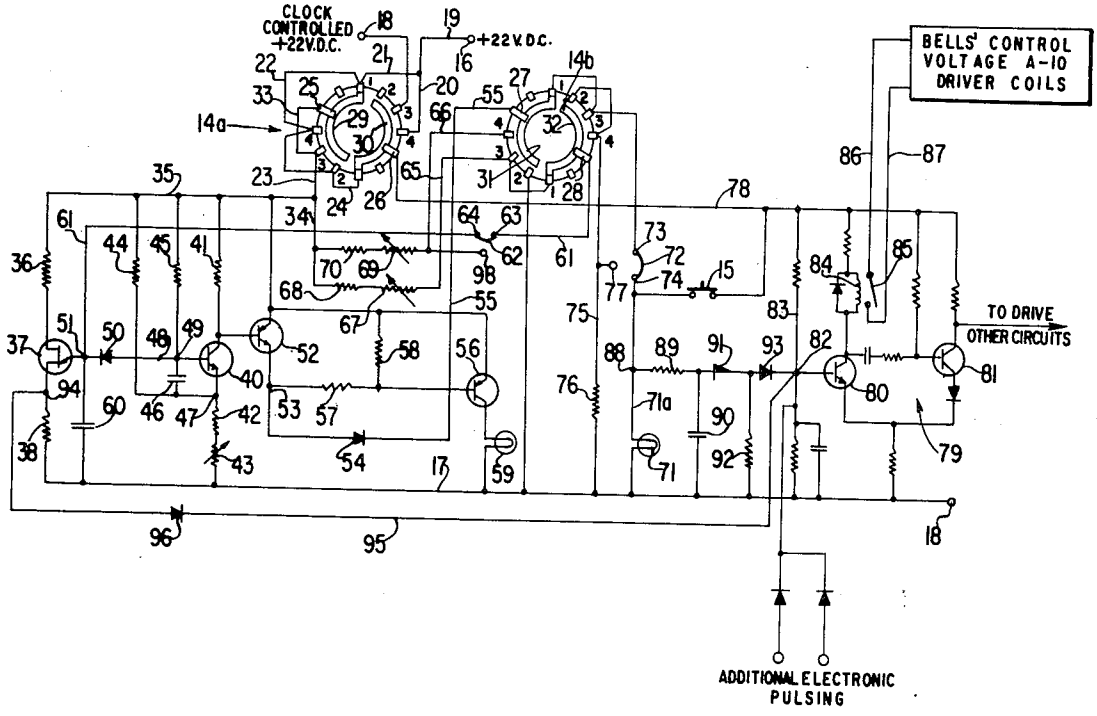
[52] **U.S. Cl.** ..... **340/384 E,** 340/331
[51] **Int. Cl.** **G08b 3/00**
[50] **Field of Search** 340/331, 384; 84/405, 407

[56] **References Cited**
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ABSTRACT: A solid state control system particularly adapted for the striking of bells in which separate circuits operated by a common control provide variable rate and variable symmetry signals for operating a reed-type output switch. Automatic or manual control is provided.



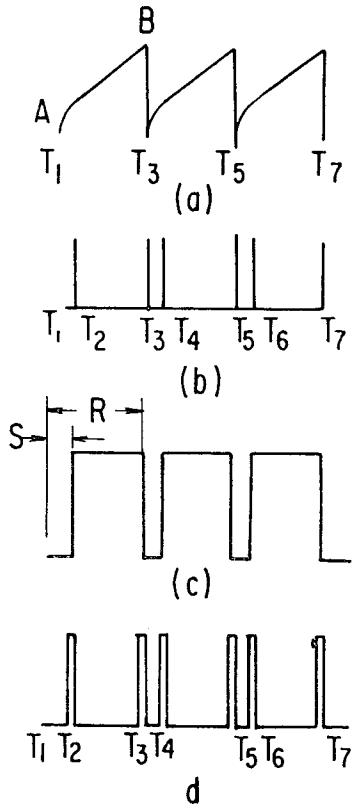


FIG. 2

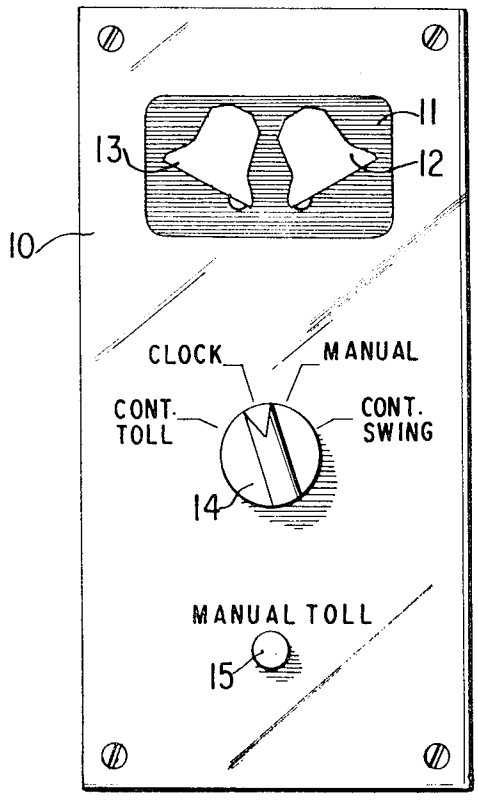


FIG. 1

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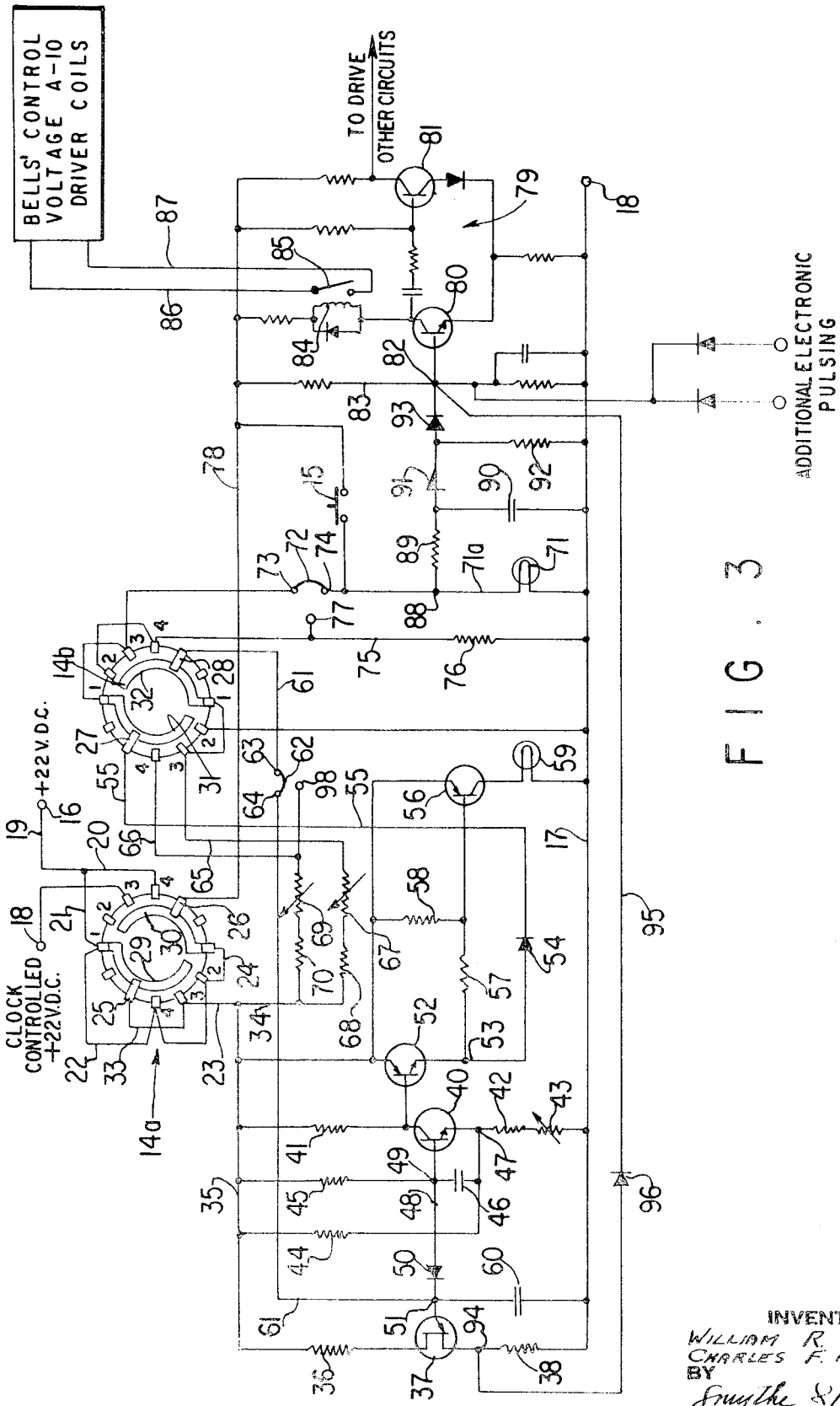


FIG. 3

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SOLID STATE CONTROL SYSTEM FOR STRIKING BELLS

This invention relates primarily to bells, either cast or of the vibrating rod type, and more particularly to a solid state control system for the striking thereof.

Electromechanical systems for ringing bells have been previously proposed, one such system being disclosed in U.S. Pat. No. 2,791,146. It is sometimes desirable, however, to further control the rate and symmetry of strikes.

One of the objects of the present invention is to provide solid state circuitry for controlling the striking of bells, so as to effect great versatility in the swinging and tolling sounds.

A further object is the provision of an electronic control system for the striking of bells in which the rate of striking and deviation from symmetry are independently controlled.

A further object is the provision of a bell-striking system in which a stationary bell can simulate either a swinging bell or a tolling bell.

A further object is the provision of an electronic bell-striking system which provides either variable continuous swing, variable continuous toll, manual toll, or manually interrupted continuous toll.

A further object is to provide an electronic bell-striking system in which lamps forming a part of the striking circuitry provide an illuminated display of a striking or tolling operation.

A further object is to provide a solid state switching circuitry for driving any device which requires both variable rate and variable symmetry.

A still further object is to provide a solid state control system in which a monostable multivibrator drives a reed-type switch whereby the closure duration of the switch is independent of both the control settings of the system and the closure time of a manually operated switch provided in the system.

The above and other objects, features, and advantages of the invention will become apparent from the following description taken in conjunction with the accompanying drawings which are merely exemplary.

In the drawings;

FIG. 1 is an elevational view of a cabinet for the control circuit of the present invention;

FIGS. 2*a*, 2*b*, 2*c*, and 2*d* illustrate wave forms at various points in the circuit diagram of FIG. 3; and

FIG. 3 is a schematic wiring diagram of the control circuits of the present invention.

Referring to the drawings and more particularly to FIG. 1, there is shown a cabinet **10** having a darkened window **11** on which the representation of two swinging bells **12** and **13** are translucently delineated. Positioned below the window **11** is the operating knob **14** for a switching means contained in the cabinet **10** which operates the control circuit to either continuous swing, manual, clock, or continuous toll as indicated on FIG. 1. Also positioned on the front panel of cabinet **10** is a manually operated pushbutton switch **15** for effecting the manual tolling of the bell.

Referring now to FIG. 3, a +22 volts DC for example, is applied to the terminal **16** while a common or neutral line **17** is connected to the terminal **18**. Two switching elements **14***a* and **14***b* operated by the knob **14** of FIG. 1 are each provided with a plurality of outer fixed contacts marked **1**, **2**, **3**, and **4** corresponding to the various positions indicated on the panel of FIG. 1, a pair of bridging contacts **25**, **26**, and **27**, **28**, respectively, and a pair of rotary segmental elements **29**, **30**, and **31**, **32**, respectively. The terminal **16** is connected by lines **19**, **20**, **21**, **22**, **23**, and **24** to various of the fixed contacts of switching element **14***a*, and a line **33** connects the bridge **25** with one of the fixed contacts **3** and lines **34** and **35**. The line **35** is connected to the neutral line **17** through a resistor **36**, a unijunction transistor **37**, and a resistance **38**.

Also connected across the lines **35** and **17** is the operating circuit for an NPN-transistor **40** having its collector connected to the line **35** through the resistor **41** and its emitter connected to line **17** through fixed resistor **42** and variable resistor **43**. Parallel circuits comprising a resistance **44** and a series-connected resistance **45** and capacitor **46** shunt the transistor **40** with one side of the capacitor being connected to the emitter at a point **47**. A connection **48** connects the base of transistor **40** to the other side of capacitor **46** at a point **49** and to the emitter of unijunction transistor **37** through a diode **50** and a junction point **51**.

A PNP-transistor **52** has its emitter connected to the line **35** and its base to the collector of transistor **40**. The collector of transistor **52** is connected by line **53**, diode **54**, and line **55** to the bridging contact **27** of switching element **14***b*. A second PNP-transistor **56** has its emitter connected to the line **35** and the emitter of transistor **52** and its base connected to the collector of transistor **52** through a resistor **57**, a biasing resistor **58** being connected therebetween. The collector of transistor **56** is connected to neutral line **17** through an illuminating lamp **59**.

A capacitor **60** is connected from the line **17** through the point **51** and line **61** to the bridging contact **28** of switch element **14***b*. Interposed in the line **61** is a jumper **62** having contacts **63** and **64** for a purpose hereinafter to be described. Lines **65** and **66** connected to switch element **14***b* provide a positive supply for capacitor **60** through either variable resistor **67**, fixed resistor **68** and line **34** or through variable resistor **69**, fixed resistor **70** and line **34**.

A second illuminating lamp **71** is also connected between the line **17** and switch element **14***b* through line **71***a*, a jumper **72** and contacts **73** and **74**. The line **17** is further connected to switching element **14***b* through a line **75** having a resistor **76** and a contact **77** included therein. The pushbutton **15** is connected to one side of the jumper **72** and to a line **78** leading from the bridging contact **26** of switching element **14***a*.

A monostable or one-shot multivibrator **79** is connected between the lines **78** and **17** and includes the transistors **80** and **81** in a well-known manner, the transistor **80** being normally nonconductive and the transistor **81** conductive. The base of transistor **80** is connected to a triggering junction **82** contained in a line **83** also connected between the lines **78** and **17**. The output of transistor **80** is connected to the operating coil **84** of a reed switch **85**. Reed switch **85** is connected to the conductors **86** and **87** which connect the control system to bell-ringing solenoids or the like (not shown).

The line **71***a* also includes a junction point **88** which is connected through resistor **89**, unilateral switch **91**, and diode **93** to the triggering junction **82** of multivibrator **79**. A capacitor **90** and a resistor **92** connect opposite sides of switch **91** with the line **17**. A line **95** connects a point **94** on one side of unijunction transistor **37** to the triggering junction **82** through a diode **96**. The multivibrator **79** can thus be triggered to operate the reed switch **85** by either the unijunction transistor **37**, herein referred to as the rate control, or by the transistors **40**, **52**, and **56**, herein referred to as the symmetry control.

Referring now to FIG. 2, diagram **2**(*a*) represents the sawtooth wave applied to unijunction transistor **37** to provide the odd numbered rate intervals T_1, T_3, T_5, etc. Diagram **2**(*b*) illustrates the triggering impulses applied to the multivibrator **79**, the even numbered intervals T_2, T_4, and T_6 representing the symmetry control. Diagram **2**(*c*) illustrates the square wave for effecting symmetry control. Diagram **2**(*d*) represents operation of multivibrator **79** to effect operation of reed switch **85** for a time interval which is independent of other parts of the control circuit.

By adjusting either resistor **67** and **69**, the charging rate of capacitor **60** can be varied to change the slope of the curve A–B in FIG. **2**(*a*) thereby varying the time (R in FIG. **2**(*c*)) for firing the unijunction transistor **37** and controlling the rate. By adjusting resistor **43**, the square wave of FIG. **2**(*c*) can be moved (flattened laterally) to provide any desired distance S from unsymmetrical on one side of R/2 to symmetrical at R/2 and unsymmetrical on the other side of R/2, thereby varying the symmetry rate.

More particularly, the operation of the system is as follows. Assuming the control knob **14** to be set at continuous swing, position 1, and a suitable DC source of power, 22 volts for ex-

ample, connected to the terminals 16 and 18, capacitor 60 begins to charge through lines 19 and 21, switch element 14a, resistors 68 and 67, switch element 14b, and line 61. Simultaneously, capacitor 46 beings to charge through line 35 and resistors 45, 42, and 43. At this point transistor 40 is "off" due to positive potential maintained on its emitter by the resistive network 44, 42, and 43. Transistor 52 is "off" because it receives the control current through transistor 40 which is "off." Transistor 56 is in an "on" or saturated state with lamp 59 glowing thereby to illuminate the right hand bell 12 of FIG. 1. Its base current is drawn through lamp 71, switching element 14b, line 55, diode 54, and resistor 57. The small base current for transistor 56 drawn through the lamp 71 is insufficient to illuminate the lamp 71. Transistor 80 of multivibrator 79 is "off" and transistor 81 is "on."

When the capacitor 60 charges to the point B of FIG. 2a, the unijunction transistor 37 fires, thereby imposing a positive voltage signal to the trigger point 82 of the multivibrator 79, and causing discharge of capacitor 60. The charging and recharging of capacitor 60 as determined by the variable resistor 67 thus establishes the swing rate of the bell. At the same time the capacitor 46 is charging, it increases the base voltage of transistor 40 at point 49 until the base-emitter junction of transistor 40 is forward biased, thereby to turn it "on" and cause transistor 52 to conduct. Upon conduction of transistor 52, enough current passes through the lamp 71 to cause illumination thereof and lighting of the left-hand bell 13 of FIG. 1. This is also the point at which the high level of FIG. 2c is reached. At the same time transistor 56 turns "off" and extinguishes lamp 59 which previously illuminated the bell shape 12 of FIG. 1.

The turn-on time S (FIG. 2c) of transistor 52 is variable as heretofore described and depends upon the setting of the variable resistor 43. This turn-on of transistor 52 provides a voltage at point 88 and causes charging of capacitor 90 through resistor 89 to a point where the breakdown voltage of unilateral switch 91 is reached. Capacitor 90 then discharges through switch 91 and resistor 92, thereby providing a positive voltage pulse through diode 93 to point 82 and causing even interval triggering of multivibrator 79, as designated in FIG. 2b. The time constant of capacitor 90 and resistor 89 is much less than the time dimension R–S of FIG. 2c and much greater than the time constant of capacitor 90 and resistor 92 thus permitting passage of current through diode 91 until the voltage at point 88 drops below a holding level. As shown in FIGS. 2a, b, and c, the even interval spikes occur almost instantaneously as the voltage at point 88 switches to its maximum level.

For manual operation, position 2 of knob 14, both the rate circuit including capacitor 60 and the symmetry circuit including capacitor 46 are rendered inoperative. Instead, the manually operated switch 15 is depressed to cause a signal at point 88 thereby to operate the multivibrator circuit 79. Switch closure lights lamp 71 and duplicates the high-level potential of the rectangular wave of FIG. 2c. Thereafter the circuit operates in the manner above described with the exception that the opening of the manual switch 15 restores initial conditions rather than the sawtooth wave of FIG. 2a.

Clock operation, position 3 of knob 14, is accomplished by connecting the +22 volts DC to the point 97 of switching element 14a. This produces a swing operation. To provide a toll operation, it is merely necessary to connect the jumper 62 to span terminals 64 and 98 and the jumper 72 to span terminals 73 and 77. Such switching operation can be accomplished by any desired switching means such as a relay (not shown).

For continuous toll, position 4 of FIG. 1, the DC charging source for capacitor 60 is changed via switch elements 14a and 14b to the resistors 69 and 70 rather than resistors 67 and 68. Adjustment of resistor 69 affects the interval T_1, T_3, etc. of FIG. 2a in the same manner as did resistor 67, but increases the interval between strikes to produce the tolling function. The even interval pulses appearing on FIG. 2b are not generated during the continuous toll operation, however, since the rectangular wave of FIG. 2c is switched from point 88 to resistor 76 via switch element 14b. Lamp 59 will still light as a result of the circuit operation previously described for continuous swing to indicate each bell strike. Lamp 71, however, will be inoperative unless the switch 15 for manual toll is depressed, in which event an impulse is created at point 82 and produces additional closure of reed switch 85.

While an exemplary embodiment of the invention has been shown and described, it will be apparent that alterations, changes, and modifications may be made without departing from the spirit of the invention, and it is intended to be limited only by the scope of the appended claims.

We claim:

1. In a solid state electronic system for controlling the operation of bells or the like, the combination comprising first manually operated switching means, means for providing a DC voltage to said switching means, a monostable multivibrator, a second switching means operated by said multivibrator connected to a bell or the like operator, first circuit means including a solid state switching means for triggering said multivibrator connected to said first switching means, means in said first circuit means for varying the firing rate of said solid state switching means, a second circuit means including solid state switching devices for providing triggering impulses to said multivibrator, said second circuit means being connected to said first switching means, and means in said second circuit means for varying the timing of said triggering impulses, said first circuit means and said second circuit means being arranged to provide alternate triggering impulses to said multivibrator when said first switching means is set for a swing operation.

2. In a solid state electronic system for controlling the operation of bells or the like, the combination comprising first manually operated switching means, means for providing a DC voltage to said switching means, a monostable multivibrator, a second switching means operated by said multivibrator connected to a bell or the like operator, first circuit means including a solid state switching means for triggering said multivibrator connected to said first switching means, means in said first circuit means for varying the firing rate of said solid state switching means, a second circuit means including solid state switching devices for providing triggering impulses to said multivibrator, said second circuit means being connected to said first switching means, and means in said second circuit means for varying the timing of said triggering impulses, said first switching means being arranged to render said second circuit means inoperative to produce signal impulses during a toll operation.

3. In a solid state electronic system for controlling the operation of bells or the like, the combination comprising first manually operated switching means, means for providing a DC voltage to said switching means, a monostable multivibrator, a second switching means operated by said multivibrator connected to a bell or the like operator, first circuit means including a solid state switching means for triggering said multivibrator connected to said first switching means, means in said first circuit means for varying the firing rate of said solid state switching means, a second circuit means including solid state switching devices for providing triggering impulses to said multivibrator, said second circuit means being connected to said first switching means, and means in said second circuit means for varying the timing of said triggering impulses, said second circuit means including a pair of lamps each adapted to illuminate a representation of a pair of swinging bells, said lamps being connected to two of said solid state switching devices, and said circuit means providing for alternate operation of said two switching devices thereby to effect alternate illumination of said lamps during a swing operation of said system.

4. A control system as defined in claim 3 wherein a circuit means connected to said first switching means renders one of said lamps inoperative during a tolling operation of the system.

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