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Berman et al.

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[54] **MULTICHANNEL INTERVAL TIMER**

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[52] **U.S. Cl.**.....**340/309.1**, 328/129, 235/92 T

[51] **Int. Cl.**.....**G04c 21/16**

[58] **Field of Search**.....340/309.1, 271; 235/92 EA, 235/103, 103.5, 104, 92 PC, 92 AC, 92 PD, 92 CD, 92 T; 328/129, 130; 307/293

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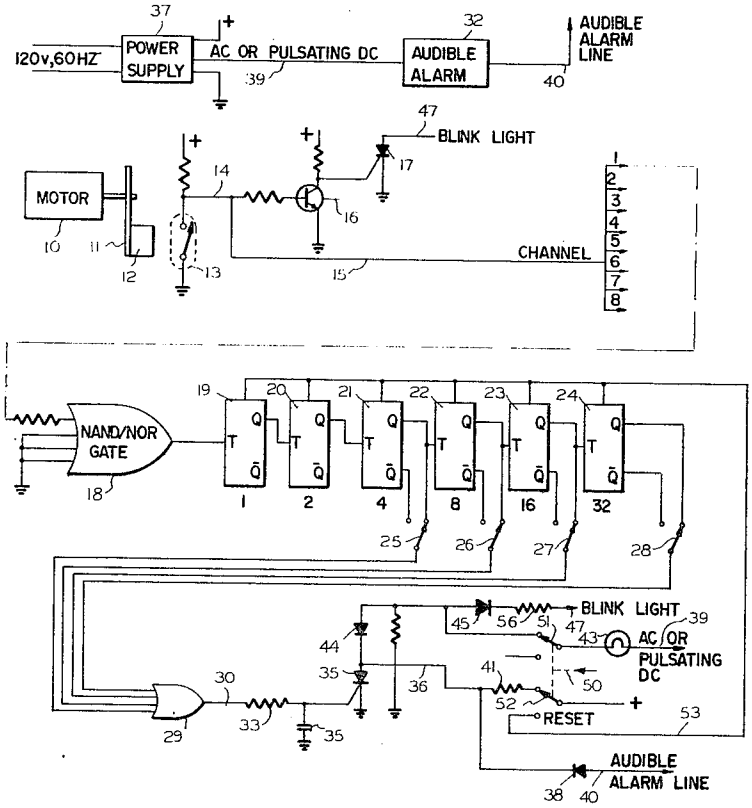
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[57] **ABSTRACT**

A multichannel time interval measuring and control instrument using solid-state logic providing individually preset, programmed or presettable timing channels supplying a wide range of time intervals, in which each timing channel is individually selectable by a pushbutton, or automatically programmed in sequence or in parallel to initiate the operation being controlled, and wherein the timer audibly and usually signals the human operator at the end of the selected interval, or automatically terminates or starts the operation being monitored or controlled.

7 Claims, 2 Drawing Figures



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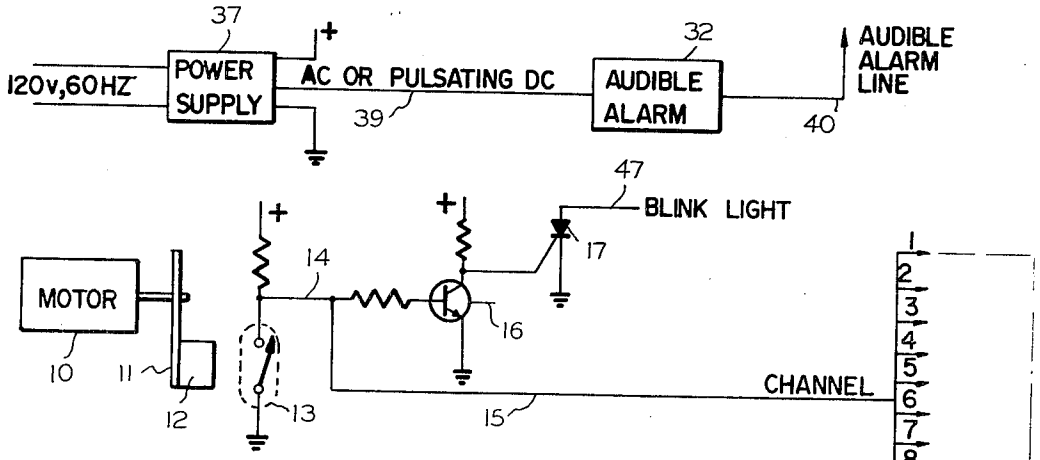
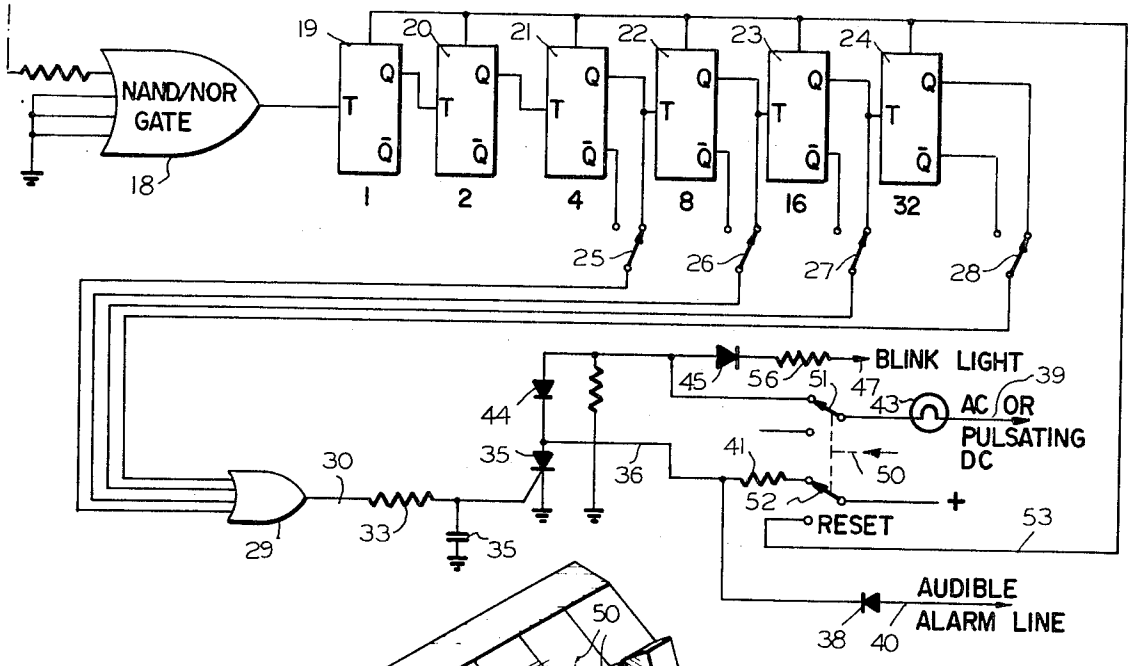


FIG.1



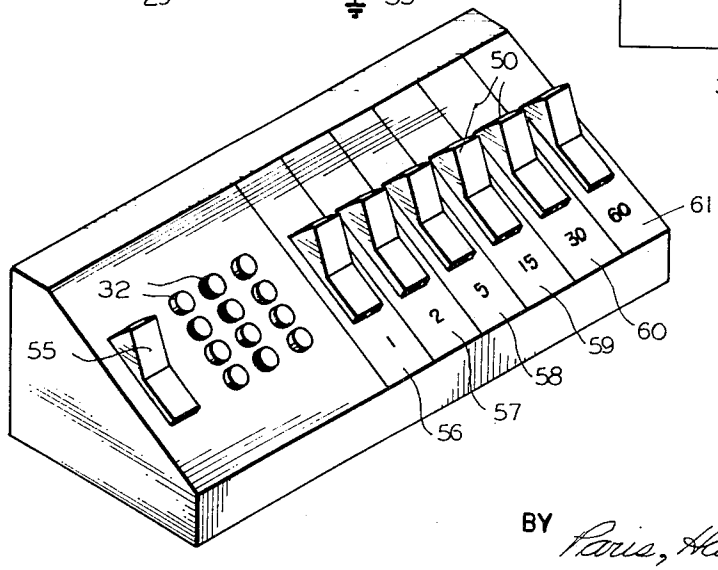


FIG.2

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MULTICHANNEL INTERVAL TIMER

STATEMENT OF THE PRIOR ART

Many timing or time-controlled devices are available and known but few are capable of providing a wide range of independently preset or presettable time intervals, any one of which may be rapidly selected or reset by a pushbutton or switch to independently time each of a series of independent events either in sequence or simultaneously.

SUMMARY OF THE INVENTION

The present invention provides a multichannel solid-state timing device having a central clock pulse generator producing one or more timing patterns and a series of preset or presettable electronic timing channels, each of which are individually selectable to time a preset time interval. Each selected channel provides an indication of the time interval selected and a signal or indication at the termination of the timed operation, and each channel is both independently initiated and reset by means of a separate pushbutton, switch, or relay. By the use of a common clock and solid-state prepackaged electronic circuits, this multipurpose unit is small and readily portable as well as requiring low power consumption and being inexpensive. The built-in accuracy remains unchanged during the life of the controller. Additionally, further plug-in modules may be supplied to be operated by the same clock and provide additional time intervals.

DRAWINGS

FIG. 1 is an electrical schematic illustration showing one common clock and one timing channel and signaling means; and

FIG. 2 is a perspective view illustrating the housing, indicators, and individually selectable pushbutton switches.

DETAILED DESCRIPTION

Referring to FIG. 1, the clock mechanism for supplying electrical pulses to all timing channels preferably comprises one or more constant speed motors **10** whose output shaft rotates an arm **11** carrying one or more permanent magnets **12** past a magnetically susceptible reed switch **13**. The contacts of switch **13** are therefore repetitively closed at a constant rate for each passage of a magnet **12** past the contacts, thereby changing the voltage or potential on line **14** from the more positive potential of the power source to ground to provide a negative-going electrical pulse. An additional magnet or magnets on the opposite side of arm **11** (not shown) and additional reed switches may be employed to provide more than one clock source, if desired.

These constant rate negative-going clock pulses are directed over a common line **15** to some or all of the timing channels and are also directed to the base of a switching transistor **16** to repetitively operate a controlled rectifier **17**. The on-and-off condition of the controlled rectifier **17** operates a blinking or flashing light indicator for each selected channel as will be more fully discussed below.

Each of the timing channels is preferably comprised of a prepackaged integrated electronic circuit, commonly purchasable on the open market from a number of different suppliers, and including, as shown, an input gate **18** feeding a series of cascaded flip-flop stages **19** to **24**, inclusive, each stage having a pair of on-off output terminals selectively engageable by switches, such as switches **25**, **26**, **27**, and **28** as shown. The signals from these switches are directed in parallel to a summing or AND-gate **29**.

As is known to those skilled in the electronic arts, the function provided by the input gate **18**, cascaded counter stages **19** to **24**, switches **25** to **28**, and the gate **29** is to provide a preset or presettable pulse counter that will sum a given number of the clock pulses received over line **15** and provide an output pulse over line **30** when such preset or given number of clock

pulses have been received. Since these clock pulses are generated at a constant frequency, or at uniform time intervals, this provides a precise measurement of a given time interval as determined by the number of pulses counted before operating the gate **29**, which count is determined by the initial setting or presetting of the switches **25**, **26**, **27**, and **28**.

More specifically, each of the flip-flop stages **19** to **24** counts two pulses, and on the second received pulse, directs a pulse to the next succeeding stage and returns to its original condition. Therefore, the first stage **19** counts every pulse, and after each second received pulse directs or transmits a pulse to the second stage **20**. The second stage, therefore, is energized only in response to every second pulse received from the clock source. The third stage **21** is in turn energized by the second stage in response to every fourth clock pulse, and so forth, until the last stage **24** which is energized in response to every 32nd clock pulse. Therefore, if the clock pulses over line **15** from one time base are generated at the rate of one each second, then the first stage **19** is operated each second, the second stage **20** is operated every 2 seconds, the third stage **21** every 4 seconds, etc., until the last stage **24** is operated every 32 seconds.

The switches **25** to **28** being selectively connected to the output lines of each of these stages can therefore be used to detect any desired time interval within the capacity of this counter; and by interconnecting all of these switches to a common AND-gate **29**, the resulting output pulse over line **30** is produced at any time interval preselected within the capacity of this counter.

In the arrangement illustrated in FIG. 1, the switches **25**, **26**, **27**, and **28** are connected to detect the on condition of the last four stages of the six-stage counter and therefore the counter will respond to a count of 60 clock pulses. If the clock pulses are generated at the above discussed rate of one each second, this channel of the timer will respond or produce a time interval measurement of 60 seconds or 1 minute.

However, with a six-stage counter, as shown, the maximum count capacity is 64 and therefore this counter may be preset by the selector switches to time any interval from 1 to 64 seconds. Similarly, by adding one additional flip-flop stage, the range may be extended to 128 seconds and by adding two additional stages, the range may be extended to 256 seconds, and so forth. The addition of each further stage therefore, substantially doubles the time interval of that channel.

The output pulse produced over line **30** at the end of the preset interval operates an audible indicator **32** in the following manner, thereby to alert the human operator that the timed operation has been completed.

The pulse over line **30** is directed to a low pass filter resistor **33** and capacitor **34** to trigger a controlled rectifier **35** into conduction thereby connecting line **36** to ground potential. The audible indicator or alarm **32**, as shown, has one terminal energized by the power supply line **39** and its other terminal on line **40** being connected through diode **38** to line **36**. Line **36** is normally not connected to ground whenever rectifier **35** is not conducting and therefore during the timed interval, the audible alarm **32** is not energized. However, at the end of the timed interval, the pulse over line **30** triggers the rectifier **35** into conduction thereby connecting line **40** of the audible alarm to ground and energizing the alarm **32** to provide an audible signal that the time interval has been completed.

The output pulse over line **30** from the counter stages occurring at the end of the selected time interval, also functions to continuously energize the lamp **43**, thereby to visually indicate or signal the completion of the measured time interval.

This is performed by connecting one terminal of lamp **43** to power supply line **39** and the other terminal through diode **44** to the controlled rectifier **35**. Therefore, at the end of the timed interval when the controlled rectifier **35** is fired, the other terminal of the lamp **43** is grounded to continuously visually indicate the expiration of the timed interval.

As generally discussed above, during the measured time interval, the lamp **43** is flashed on and off or is "blinked" to alert

the human operator that this channel is operating to measure a preset time interval. Therefore, when the lamp **43** stops blinking and is continuously energized, the operator is usually alerted to the fact that the time interval has been completed.

For blinking operation of the lamp **43**, it is noted that during the timing operation, the second terminal of the lamp **43** is also connected through a diode **45** and resistor **56** to the blink light line **47** which in turn is connected to the anode of the controlled rectifier **17** (shown at the top of the drawing). Whenever the controlled rectifier **17** is not conducting, the lamp **43** is not energized and therefore not illuminated. However, each of the clock pulses produced over line **14** is directed to the switching transistor **16** which in turn energizes or fires the rectifier **17** to energize the lamp **43**. Consequently, in response to each clock pulse, the rectifier **17** is fired to momentarily energize the lamp **43**. It will be noted that the other terminal of the lamp **43** is connected to line **39** energized by an alternating current signal or a pulsating direct current signal. Consequently, on alternative half-cycles, the voltage applied to the controlled rectifier **17** is made negative or zero to automatically extinguish the controlled rectifier **17** and turn off the light or lamp **43** until the next clock pulse is generated. This provides the pulsing or blinking operation desired to visually indicated to the human operator that one of the timer channels is functioning.

It will be noted that the controlled rectifier **35** is energized by a constant direct current over line **36** and resistor **41** and therefore at the end of the timed interval, the controlled rectifier **35** remains in a conducting or fired condition to continuously illuminate the lamp **43** until such time as the timing channel is reset.

Upon the termination of the timed interval, it is therefore noted that the audible alarm is turned on or operated continuously as is the electric lamp indicator **43**. These two indicators remain continuously energized until such time as the human operator depresses a reset button **50** to operate the switches **51** and **52**. The operation of switch **51** disconnects the left-hand terminal of the lamp **43** from the ground connection through rectifier **35** and therefore deenergizes the indicator lamp **43**. Operation of the other switch **52** disconnects the direct current power supply from the anode of the controlled rectifier **35** to reset the rectifier **35** to a nonconducting condition and also applies the positive potential of the power source over line **53** to all of the stages of the counter **19** to **24** to reset all of the stages to their zero or initial condition. This completely resets the channel to its initial condition and maintains the channel deactivated until such time as the human operator again depresses the two-way button **50** to place the contacts **51** and **52** into their upper position to commence a new timing interval.

FIG. **2** illustrates one preferred construction of a multichannel interval timer. As shown, there is provided an on-off or power applying two-position switch **55** that is connected to apply power to all of the channels. Next to the on-off power switch **55** is provided openings for a speaker, buzzer, or the like to provide the audible alarm **32** signalling the end of each interval, and alongside of the audible alarm area **32** is provided the series of individual two-position pushbutton switches, such as **50** discussed above, with one such switch for each separate one of the timing channels. In the arrangement shown, there are provided six independent timing channels **56** to **61**, inclusive, with each channel providing a different preset time interval extending from 1 minute, 2 minutes, 5 minutes, 15 minutes, 30 minutes, and 60 minutes, all as shown. Each one of these channels is substantially as shown in FIG. **1** but provided with a preset number of counting stages to count the desired preset interval desired. At least one common motor **10** and clock-pulse-producing mechanism feeding all of the channels as shown in FIG. **1** and discussed above is provided inside the housing.

It is preferred that the electric lamp **43** provided for each channel be disposed inside of the housing and underneath each of the transparent pushbuttons **50** so as to indicate to the human operator after pushing the button for that channel, that channel is then in operation as would be shown by the blinking light underneath that transparent pushbutton **50**.

It will be appreciated that since each of the timing channels operates independently of the others, that more than one of these channels can be employed simultaneously to time more than one function or operation if desired. Alternatively, the multichannel timer can be used to time only one operation but permitting the operator the selective choice of any one of the preset time intervals for timing such operation.

For automatic operation, a relay or solid-state control circuit (not illustrated) may be energized by firing of the controlled rectifier **35**, and the closing of such relay contacts being connected to automatically control a particular operation at the ending of the time interval. This would be termed the delay mode of operation. Alternatively, the relay winding may be connected in parallel with controlled rectifier **35** to be energized and operated at the beginning of the timed interval upon closure of switch **52** to its upper position and upon firing of rectifier **35** at the end of the timed interval, this relay would be deenergized to automatically terminate the operation. This would be termed the interval mode. Other relay connections may also be made as desired for automatic operation.

Instead of operating independently, the separate timer channels may be interconnected in cascade to provide a continuous sequence of preset timed intervals, with a relay of the first channel automatically turning on the switch of the second channel at the end of the first time interval. Other presettable timing arrangements in sequence or in parallel may be made as desired.

What is claimed is:

1. In a multichannel interval timer, a plurality of independent presettable timing channels, a common clock source, and a plurality of independently actuable selector switch means, with one for each channel; each selector switch means actuable to interconnect is related channel for operation by said clock source to measure a preset time interval, a visual indicator for each channel and energized by said channel for flashing operation during the timing operation of said channel and for continuous visual operation at the termination of the preset interval of that channel, a common audible indicator interconnected with all channels to provide an audible signal at the termination of the preset interval measured by any one of the channels, and means interconnecting said switch means for each channel in circuit with the visual indicator for said channel and with said common audible indicator whereby actuation of the switch means of an operating channel terminates the operation of both the associated visual indicator and common audible indicator.

2. A multichannel interval timer comprising an electromechanical constant frequency clock source of pulses, and a plurality of independently selectable time intervals channels energizable by said source; each channel having a presettable electronic pulse counter to sum a preset number of clock pulses and count a preset time interval and a selector switch means to initiate operation of said counter, means energizable by said counter at the termination of said preset interval, and circuit means interconnecting said previous means and said switch for deenergizing said previous means and resetting said counter upon further activation of said switch means, a visual indicator for each channel and electrical circuit means for repetitively connecting said visual indicator means in circuit with the selector switch for the related channel for flashing operation in response to said clock source of pulses, and additional circuit means in each channel responsive to said pulse counter in said channel summing said preset number of clock pulses for providing continuous operation of said visual indicator.

3. A multichannel interval timer comprising an electromechanical constant frequency clock source of pulses, and a plurality of independently selectable time interval channels energizable by said source; each channel having a presettable electronic pulse counter to sum a preset number of clock pul-

ses and count a preset time interval and a selector switch to initiate operation of said counter, means energizable by said counter at the termination of said preset interval, and circuit means interconnecting said previous means and said switch for deenergizing said previous means and resetting said counter upon further activation of said switch means, said clock source of pulses including a constant speed motor driving a pulse producing means,

a visual indicator for each channel disposed proximate the selector switch means, circuit means electrically interconnecting said visual indicator with the selector switch means to intermittently energize said indicator after actuation of said selector switch means during said preset time interval, said circuit means controlled by said counter to continuously energize said visual indicator at the expiration of said preset interval, and said selector switch means being actuable to deenergize said visual indicator.

4. In the timer of claim 3, an audible indicator continuously energized by said circuit means at the expiration of said preset interval and being deenergized upon actuation of said selector switch means.

5. A multichannel interval timer comprising an electromechanical constant frequency clock source of pulses, and a plurality of independently selectable time intervals channels energizable by said source; each channel having a presettable electronic pulse counter to sum a preset number of clock pulses and count a preset time interval and a selector switch to initiate operation of said counter, means energizable by said counter at the termination of said preset interval, and circuit means interconnecting said previous means and said switch for deenergizing said previous means and resetting said counter upon further activation of said switch means, a visual indicator for each channel, and means interconnecting said visual indicator and switch means for flashing visual indication during said preset interval and for continuous visual indication at the termination of said preset interval and for disabling said indicator by said switch means.

6. In the timer of claim 5, an audible indicator, and means interconnecting said audible indicator with said switch means for continuous indication at the termination of said preset interval and for selectively disabling said audible indicator by said switch means.

7. In the multichannel timer of claim 6, each channel comprised on an integrated electronic circuit having electronic gate means and a presettable electronic pulse counter, and said switch means for each channel being independently actuable to initiate operation of said counter in response to said clock source, and being independently actuable for resetting said counter and terminating the operation of the visual indicator and audible indicator.

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