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(54) ALARM TIMEPIECE

(71) We, KABUSHIKI KAISHA SEIKOSHA, a Japanese company of 2-chome Kyobashi, Chuo-ku, Tokyo, Japan do hereby declare the invention for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:-

This invention relates to alarm timepieces:

Heretofore an alarm timepiece is known in which an acoustic alarm is repeated when a predetermined time has elapsed since the first sounding of the alarm, the acoustic alarm being stopped after a further pre-set interval. In such an alarm timepiece, a switch is provided for cancelling the acoustic alarm and this switch is in addition to a switch for suspending the acoustic alarm. Such a known alarm timepiece has a relatively large number of parts and, moreover, the provision of two switches controlling the acoustic alarm causes confusion to the user.

According to the present invention there is provided an alarm timepiece comprising: a manually operable switch; time controlled switching means adapted to become operative at a preset time to enable an alarm to be produced; first means adapted to produce output signals in accordance with respective functions of an enabling, a temporary suspension and a disabling of an alarm in response to respective ones of at least three different operational modes of the manually operable switch; a second means adapted to count a predetermined time upon receipt of the output signal of the first means produced in response to the operational mode of the manually operable switch corresponding to the temporary suspension of the alarm to produce an alarm signal therefrom when the predetermined time is counted; and third means adapted to generate an acoustic alarm when the time controlled switching means has operated and either the

operational mode of the manually operable switch corresponds to enabling of the alarm or the said alarm signal has been produced by the second means.

The manually operable switch may comprise movable means displaceable against a spring and to be returned to an initial position by said spring when released, means for limiting the displacement of said movable means to a predetermined distance, preventing means for preventing the return of said movable means when the latter is rotated by a predetermined angle after being displaced by said distance, a shielding means provided on said movable means for effecting shielding from a magnetic field and a combination of a reed switch and a magnet arranged to be shielded from each other by said shielding means positioned therebetween when said movable means is returned to the initial position.

Alternatively, the manually operable switch may comprise movable means displaceable against a spring and to be returned to an initial position by said spring when released, means for limiting the displacement of said movable means to a predetermined distance, means for preventing the return of said movable means when the latter is rotated by a predetermined angle after being displaced by said predetermined distance, and an electrically conductive means mechanically coupled to said movable means so as to move into bridging contact with a pair of electrical contact points.

The invention is illustrated, merely by way of example, in the accompanying drawings, in which:

Figure 1 is a circuit diagram of one embodiment of an alarm timepiece according to the present invention;

Figure 2A is a partial sectional perspective view of a switch of the alarm timepiece of Figure 1;

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Figure 2B is a vertical section of the switch of Figure 2A;

Figure 3 is a time chart for explaining the operation of the alarm timepiece of Figure 1;

Figure 4 is a circuit diagram of another embodiment of an alarm timepiece according to the present invention;

Figure 5 is a circuit diagram of a third embodiment of an alarm timepiece according to the present invention;

Figure 6A shows, in section, a switch of an alarm timepiece according to the present invention;

Figure 6B is a side elevational view of an alarm stopping member incorporated in the switch of Figure 6A;

Figure 6C is a cross section taken on the line 6C-6C of Figure 6A; and

Figure 6D is a section taken along the line 6D-6D of Figure 6A.

Referring first to Figure 1 there is shown one embodiment of an alarm timepiece according to the present invention. An output frequency from a quartz crystal oscillator 1 is divided by a frequency divider 2 to produce frequency signals of several KHz and 1 Hz at terminals -a, b respectively. A motor 3 is arranged to be energised by a 1Hz pulse signal, the rotation of the motor being transmitted to the hands of the timepiece through a gear train, the hands constituting display means 4. A counter 5 is adapted to count the 1 Hz pulse signal and to produce pulse signals of a duty cycle of 1/2 at periods of 20 seconds, 1 minute, 2 minutes, 4 minutes and 64 minutes, at terminals c, d, e, f, g, respectively. The wave forms of the signals at the terminals c, d, e, f, are shown by curves A, B, C, D respectively in Figure 3. In Figure 3 the abscissa represents time t. The symbols T_0 , T_1 , T_2 , T_3 respectively represent durations of 10 seconds, $\frac{1}{2}$ minute, $3\frac{1}{2}$ minutes and 30 seconds. Reference numerals 6 to 8 designate flip-flop circuits, while gate circuits are designated by the reference numerals 9 to 13. The wave form of an output of a gate circuit 13 is shown by curve E in Figure 3. A differentiation circuit 14 is arranged to differentiate the descent of a pulse while differentiation circuits 15 to 17 are arranged to perform differentiation of the ascent of a pulse. An alarm signal is applied by the gate circuit 13 to the base of a transistor 18 to which a DC current is supplied through a resistance 20 from a DC source 24. A time switch 22 is closed at pre-set time by a conventional clock mechanism (not shown). A manual switch 23 is manually operated for enabling and disabling that is to say silencing the alarm for a pre-set period after which the alarm repeats.

Referring to Figures 2A, 2B a shaft 26 has, at one end, a push button 25, a

cylindrical enlarged intermediate portion 27 and protrusions 27a, 27b (the section of Figure 28 passes through the protrusions 27a, 27b) formed integrally therewith and extending from the portion 27. A sleeve 28 has an upper and a lower portion of different wall thicknesses, the junction therebetween being defined by a shoulder 28c. Elongated, slots 28a, 28b are formed in the thicker upper portion of the sleeve 28 for slidably receiving protrusions 27a, 27b. A magnet 29 and a reed switch 30 are attached to fixed structure (not shown). The sleeve 28 is screwed to a fixed plate 31 as shown in Figure 2B and is engaged, at its lower and inner side, by an end of a spring 32 the other end of which is secured to the portion 27 of the shaft 26. Thus the shaft 26 is normally biased upwardly by the spring 32. The shaft 26 carries a shield plate 33 adapted to shield the reed switch 30 when the shaft 26 is in the upwardly biased position. A reference numeral 34 designates an outer frame of the timepiece.

The manner of operation of the alarm timepiece of Figure 1 will now be described. The setting of an alarm time is effected as in a conventional alarm timepiece. The time switch 22 is opened, whilst the reed switch 30 is kept open because the magnetic field produced by the magnet 29 is shielded by the shield plate 33. For the purpose of simplifying the explanation, it is assumed that flip-flop circuits 6, 7 are in a set condition whilst flip-flop circuit 8 is in a reset condition. In this condition, the outputs Q, $\bar{Q}$, Q of the flip-flop circuits 6, 7, 8 respectively are held at the theoretical values of "1", "0", "0" respectively. The theoretical values will be referred to simply as "1" and "0" hereinafter. The gate circuit 9 is kept open by the cooperation of the output "1" from the flip-flop circuit 6 and the positive potential (corresponding to the theoretical value of "1") provided by the DC source. Consequently, the frequency signal of several KHz at the terminal a of the frequency divider 2 is allowed to pass through the gate circuit 9, and the gate circuit 13 to the base of the transistor 18. At the present alarm time, the time switch 22 is closed to allow the frequency signal of several KHz to pass through and to be amplified by the transistor 18 thereby to actuate a speaker 21 to produce an acoustic signal.

Referring to Figures 2A, 2B, the shield plate 33 is lowered to turn the reed switch 30 (corresponding to the switch 23 in Figure 1) on as the push button 25 is depressed. The output of the manual switch 23 is changed or altered from "1" to "0" so that the gate circuit 9 is closed. Accordingly, the frequency signal of several KHz is prevented from passing so that the acoustic signal is termin-

ated. When the manual switch 23 is closed, the differentiation output from the differentiation circuit 14 acts to reset the flip-flop circuits 6, 7 and the counter 5. The spring 32 is sufficiently strong to reset the shaft 26 at its original upwardly biased position after the push button 25 is released. The duration for which the push button is depressed is normally very short.

In this embodiment, the arrangement is such that, when the push button is pressed for a short period of 10 seconds or less, the acoustic signal is re-started 3 minutes and 30 seconds after the first acoustic signal has ceased, thereby preventing the user from falling asleep again.

For this purpose, the output $\overline{Q}$ from the flip-flop circuit 7 is turned to "1" upon the closure of the manual switch 23. Thereafter, when 10 seconds has elapsed a pulse P_1 having the wave form indicated by curve A in Figure 3 is generated at a terminal C of the counter 5, the differentiation output of which turns the flip-flop circuit 7 output to "0". Consequently, the output Q of the flip-flop circuit 7 is maintained "1" only for 10 seconds during which the gate circuit 11 is opened. Thus, supposing that the manual switch 23 is opened within this 10 second period, a differentiation output is generated from differentiation circuit 15 and this output is passed through the gate circuit 11 to the flip-flop circuit 8 to turn its output Q to "1". After time T_2 , i.e. when 3 minutes 30 seconds has elapsed, the gate circuit 12 issues a pulse P_2 as shown by curve E of Figure 3, having a duration T_3 of 30 seconds to open the gate circuit 10. Consequently, the alarm signal of several KHz derived from the terminal a of the frequency divider 2 is allowed to pass through the gate circuits 10, 13 so as to actuate the speaker 21 thereby to generate an acoustic alarm lasting for 30 seconds. It will be understood that the same alarm operation is repeated when the manual switch 23 is closed again to repeatedly produce an acoustic alarm with a duration of 30 seconds at intervals of 3 minutes 30 seconds. If the manual switch 23 is kept open, the acoustic alarm is stopped after 30 seconds and, thereafter, a subsequent pulse P_3 as shown by curve E is generated to produce the acoustic alarm.

A complete termination of the acoustic alarm is effected by depressing the push button 25 to place the upper ends of the protrusions 27a, 27b below the shoulder 28c of the sleeve 28 and then rotating the push button 25 so that the protrusions may be retained by the shoulder 28c. In this condition, the push button 25 is maintained depressed so that the shield plate 33 is maintained in a lowered position to keep the reed switch 30 closed. Thus, referring to Figure 1, the manual switch 23 is kept closed

and thus also the gate circuit 10 so that no acoustic alarm is produced. As the pulse with a period of 64 minutes appears at the terminal g of the counter 5, its differentiated outputs sets and resets the flip-flop circuits 6, 8 respectively so that the alarm timepiece is reset to the initial state.

As will be appreciated from the above description, since one of three modes of control function of the alarm, i.e. the enabling of the alarm, a suspension of the alarm for a predetermined period of time and the termination of the alarm, can be selected by manipulating only one switch, no additional switches are required. Thus the alarm timepiece can conveniently be miniaturised taking full advantage of the integrated circuitry.

In the embodiment described above the acoustic alarm is repeated at predetermined intervals. Alternatively, the time interval between each sounding of the acoustic alarm may be gradually shortened. To this end, a plurality of pulse trains are produced using the output from the counter 5, each pulse train being supplied to its own AND gate. A memory circuit, such as a shift register, is supplied with the output from the gate circuit 11 and delivers its output to each of the AND gates. The alarm signal is also delivered to the AND gates. Other portions of the circuit will be similar to those described above. With each output from the gate circuit 11 the contents of the memory circuit will be altered, and the memory circuit will produce an output to a selected one of the AND gates to shorten the time interval between each sounding of the acoustic alarm.

In the above described embodiment, the generation of the alarm signal is controlled by the time switch 22 connected in series with the speaker 21. Instead, however, the time switch 22 may select the theoretical potential thereby to control the opening and closing of the gate circuits 9, 10.

To this end, the transistor 18 and the speaker 21 may be replaced by an oscillator, such as a blocking oscillator, adapted to be actuated by the output from the gate circuit 13, the output of which is delivered to an acoustic means to generate the acoustic signal.

It will be appreciated from the foregoing description that the alarm timepiece described therein incorporates a switch means consisting of a single member capable of performing a plurality of functions corresponding to three different modes of control function of an alarm. This provides and facilitates the use of and reduces the size of an alarm timepiece.

A second embodiment of an alarm timepiece according to the present invention is illustrated in Figure 4. Like parts in Figures

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1 and 4 have been designated by the same reference numerals. A speaker, a time switch and a DC power source are designated by reference numerals 21, 22, 24 respectively. A manual switch 23 is of the same construction as that illustrated in Figures 2A, 2B. A frequency divider 34 has three terminals *h*, *i*, *j* at which frequency signals of several KHz, 8Hz, 1Hz are respectively produced by dividing the output frequency from the quartz crystal oscillator 1. A counter 35 is adapted to generate pulses of 4Hz and 1/256Hz respectively at terminals *k*, *l*. A shift register 36 has a storage capacity of 4 bits. Reference numeral 37 designates a flip-flop circuit and reference numerals 38 to 44 and 45 to 48 respectively denotes gate circuits and invertors, whilst reference numerals 49, 50 denote a transistor and a resistor respectively.

In operation a normal alarm function is performed in the following manner. At first, the time at which the alarm is to be produced is pre-set by means of an ordinary clock mechanism. Since the manual switch 23 is normally opened, as shown in Figures 2A, 2B, the gate circuit 40 is opened. A terminal *m* of the shift register 36 is kept at a theoretical output of "1" which is written into the shift register 36 by the pulse signal of 8Hz obtained from the terminal *i* of the frequency divider 34. Consequently, each output D1 to D4 of the shift register 36 is "1" whilst the outputs D1 to D4 are "0" respectively so that the output from the inverter 48 to "0" and the resetting of the counter 35 is released. This is because the counter 35 is arranged to be reset by an input of "1". The terminal *l* of the counter 35 is kept at "0" as long as the output of 1/256Hz is not available thereat so that the output of the gate circuit 41 is "1" thereby opening the gate circuit 42. Consequently, a pulse having a frequency of 8Hz is allowed to pass from terminal *i* of the frequency divider 34 to the counter 35 through the gate circuit 42. A time of 256 seconds is counted by the counter 35, and then the terminal *l* thereof becomes "1" so as to maintain one of the inputs to the gate circuit 43 at "1". As the counter 35 is turned to "1" as above, the output at its terminal *k* is necessarily "0" due to the phase relationship between the terminals *k*, *l* so that the output of the inverter 45 becomes "1" as well as the output of the gate circuit 43 so as to reset the flip-flop circuit 37. Consequently, the output Q from the flip-flop circuit 37 is "0" and the output from the inverter 46 is "1", thereby opening the gate circuit 39. The outputs at the terminals *h*, *i* of the frequency divider 34 are applied, through the gate circuits 39, 40 to the base of the transistor 49. Accordingly, when the pre-set time arrives the speaker 21 generates an acoustic

alarm signal, by closure of the time switch 22.

To suspend the acoustic alarm for a predetermined time, the push button 25 is depressed to close the manual switch 23 which, in turn, causes an output of "0" at the terminal *m* of the shift register 36. The shift register 36 also receives a frequency output from the terminal *i* of the frequency divider. Accordingly, the outputs D1 and D4 and D1 to D4 become "0" and "1" respectively whilst the output of the gate circuit 44 is kept unchanged. When the push button 25 is released, the manual switch 23 is opened and "1" is written in to the shift register 36.

Supposing that the output D2 becomes "1", since the subsequent output D4 is "1" at this moment, the output from the inverter 48 becomes "1" thereby re-setting the counter 35. Meanwhile, the flip-flop circuit 37 is triggered to turn its output Q to "1" so that the output from the inverter 46 becomes "0". Thus the gate circuit 39 is closed to prevent the passage of the outputs from the terminals *h*, *i* of the frequency divider so that the generation of the acoustic signal is prevented. As a signal of "1" is written in the shift register 36, the output of the inverter 48 becomes "0" so that the counter 35 is released from the reset condition which starts the counting in the above described manner. After a time of 256 seconds has been counted the acoustic signal is produced again. Thus, the acoustic signal is generated every 256 seconds by depressing and releasing the push button 25 repeatedly. To terminate the acoustic signal, the push button 25 is depressed and then rotated in the manner as aforementioned in connection with Figures 2A, 2B, so as to hold the manual switch 23 closed which in turn keeps the gate circuit 40 closely thereby terminating the acoustic signal.

In some cases, it is necessary to produce an acoustic alarm at any time, this is required, for example, when a dealer demonstrates the function of the timepiece to a customer, in which case it is inconvenient to have to keep the customer waiting for 256 seconds. As the manual switch 23 is closed the output Q of the flip-flop circuit 37 is held "1" and the subsequent closure of the manual switch 23 causes the output of the gate circuit 44 to become "0" which in turn triggers the flip-flop circuit 37 to turn the latter to "0" thereby opening the gate circuit 39. Then the alarm signal is allowed to pass through the gate circuit 39, the inverter 47 and the gate circuit 40 to the transistor 49, thereby actuating the speaker 21 and causing an acoustic signal.

In the second embodiment described above the shift register 36 is provided mainly for removing any trouble caused by

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the possible chattering of the manual switch 23. If it is not necessary to take chattering into account, the logical outputs derived from the opening and closing of the manual switch 23 may be directly fed to the gate circuit 40 and an equivalent performance is obtained by substituting a differentiation circuit for the shift register 36, gate circuit 44 and the inverter 48.

Although suspension of the acoustic signal for 256 seconds has been described, it may be suspended for a longer or shorter interval as designed. As described above this second embodiment is convenient in that the structure is greatly simplified and that an acoustic signal can be produced at any desired time. This advantage is attributable to the provision of a logic circuit adapted to invert its output at each time of manual operation of the switch and adapted to actuate the alarm by one output therefrom.

A third embodiment of an alarm time-piece according to the present invention is illustrated in Figure 5. Like parts in Figures 1, 4 and 5 have been designated by the same reference numerals.

A first counter 51 consists of a frequency divider having a division ratio of $1/64$ and is arranged to produce pulses of 4Hz and $1/4$ Hz at the terminals *s*, *u* respectively. A second counter 52 also consists of a frequency divider having a division ratio of $1/64$. Reference numerals 53 and 54 to 64 inclusive designate respectively a shift register and gate circuits whilst reference numerals 65, 66, 67 represent an inverter, a transistor and a resistor respectively.

In operation, an alarm time switch 22 in the circuit of Figure 5 is preset to operate at a desired time. The manual switch 23 is normally open and one of the inputs of the gate circuit 55 is kept at "1". At this time, an input *v* to the shift register 53 is kept "0" which is written into the shift register 53 by an 8Hz pulse delivered from the terminal *q* of the frequency divider 34. Accordingly the outputs *D1* to *D4* are kept "0" whilst the outputs *D1* to *D4* are maintained at "1". Since the two inputs of the gate circuit 56 are "0" and "1" respectively, the output thereof is kept "1", and the first and second counters 51, 52 are not reset and they count the 8Hz output at the terminal *q* of the frequency divider 34. The output "1" from the gate circuit 56 opens the gate circuit 59. Since the output *D4* from the shift register 53 is kept "0", the output from the gate circuit 57 is "1" which in turn maintains an output of "0" at the gate circuit 59. Consequently, the output from the gate circuit 61 is kept "1" to open the gate circuit 62. The 4Hz output from the terminal *s* of the first counter 51 to the gate circuit 60 is effective to open and close the gate circuit 60. When

the gate circuit 60 is opened, the several KHz output generated at the terminal *n* of the frequency divider 34 is allowed to be passed to the gate circuit 63. Since the output *D2* from the shift register 53 is "1", the gate circuit 63 is kept open so that the frequency signal is delivered to the transistor 66. Thus, as the time switch 22 is closed at the pre-set time, the speaker 21 is actuated to generate an acoustic signal.

To suspend the acoustic signal, this embodiment is arranged so as to produce the alarm signal every 256 seconds when the manual switch 23 is manipulated for less than 4 seconds. As the push button 25 is depressed, the manual switch 23 of Figure 5 is closed to turn the output from the gate circuit 55 to "1". This causes the sequential turning of the outputs *D1* to *D4* of the shift register 53 to "1". When the output *D2* becomes "1", the output *D3* is kept at "1", so that the output from the gate circuit 56 becomes "0". This causes the output from the gate circuit 59 to become "1" which in turn causes the gate circuit 56 to reset the counters 51, 52. Accordingly, both inputs to the gate circuit 61 are held at "1" and its output becomes "0" thereby closing the gate 62 so that the acoustic signal is interrupted. Since the manual switch 23 is subsequently opened, the output from the gate circuit 55 becomes "0" which causes the outputs *D1* to *D4* and *D1* to *D4* to become "0" and "1" respectively in sequence. When 256 seconds have elapsed since the resetting of the counters 51, 52, the output from the latter is turned to "1" thereby to reverse the output from the inverter 65 to "0" which in turn causes the gate circuit 64 to close and, at the same time, causes the output from the gate circuit 61 to become "1". Thus the gate circuit 62 is opened to pass the alarm signal from the gate circuit 60 and this alarm signal is then passed through the gate circuit 63 to the transistor 66 thereby to actuate the speaker 21 to produce an acoustic signal.

When it is required to terminate the acoustic signal, push button 25 is rotated after having been depressed in the manner already described so that it is maintained closed to hold the output from the gate circuit 55 "1". Consequently, the output *D2* from the shift register 53 is kept "0" thereby to close the gate circuit 63 so that the acoustic signal is completely terminated.

In order to produce an acoustic signal at any desired time, the time switch 22 is closed and then the manual switch 23 is closed for more than 4 seconds. The manual switch 23 is then opened. By closing the manual switch 23 for longer than 4 seconds, the output *D2* of the shift register 53 acts to stop the acoustic signal as described. On the other hand, the closure of the manual switch 23 causes the output from the gate circuit 56

to fall to "0" so that the counters 51, 52 are reset to enable the latter to count the time. Meanwhile, the output D4 from the shift register 53 is maintained "1" so that the output from the gate circuit 57 becomes "0" when 4 seconds have been counted by the counter 51 and at that time the output from the counter 51 becomes "1". Accordingly, the output from the gate circuit 58 is turned to "1" which in turn causes the output from the gate circuit 59, to which the output "1" is applied from the gate circuit 56, to become "0". Consequently, the output from the gate circuit 61 becomes "1" to open the gate circuit 62. As the manual switch 23 is opened, the output D2 from the shift register 53 becomes "1" to open the gate circuit 63 so that the alarm signal is allowed to pass the gate circuits 62, 63 to actuate the speaker 21. Thus the acoustic signal is obtained at any desired time.

In the third embodiment described above, the shift register 53, the gate circuits 54, 55 are provided mainly for removing troubles caused by chattering of the manual switch 23. Thus, if it is unnecessary to take chattering into account, the logical outputs derived from the opening and closing of the manual switch 23 can be delivered directly to the gate circuit 57 and to the gate circuit 63 upon reversing the output. The same function can then be obtained by substituting a differentiation circuit for the gate circuit 56.

Although in this embodiment an acoustic alarm is produced every 256 seconds by pressing the manual switch 23 for less than 4 seconds, other intervals and times may be adopted by suitably adjusting the counters 51, 52.

Another example of the manual switch 23 which maybe incorporated into the alarm timepiece shown in Figures 1 and 3 will now be described. Referring to Figure 6A, a depressed portion 69 is formed at an upper end of an outer frame 68 of the alarm timepiece. A push button 70 is biased upwardly by means of a coil spring 71 and is movable to a predetermined extent vertically in the depressed portion 69. Radial convex portions are formed on the upper surface of the push button 70 to provide better engagement with an operator's finger. An alarm stopping member 72 is secured to the push button 70 and projects into the frame 68. As will be seen from Figures 6A, 6B, retaining projections 73 are formed on the alarm stopping member 72. The retaining projections extend radially and have a wedge-like cross section which is narrower at the upper end. Below the retaining projections 73 there is formed a retaining groove 74 which is fitted with an E-ring 75. Thus the stroke of the push button 70 is defined by its lower end surface

and the E-ring 75. At the portion of the depressed portion 69 passed by the alarm stopping member 72, there are formed bores or slots 76 having shapes conforming to those of the corresponding retaining projections 73 so as to allow the latter to pass in the vertical direction. In the open position of the push button 70 as shown by the full line in Figure 6A, the lower portion of the retaining projections 73 is within the bores 76. Therefore, a rotation of the push button 70 is prevented, but axial downward movement is permitted. As the push button 70 is depressed to a position shown by the broken line, the retaining projections 73 leave the slots 76 thereby allowing a rotation of the push button 70. At the lower end of the depressed portion 69 in the frame 68 there are formed stoppers or abutments 77, 78 adapted to engage the retaining projections 73 as will be seen in Figure 6C. These abutments 77, 78 are effective to limit the angular rotation of the push button 70 when the latter is in its lower position. It will be understood that, by rotating the push button 70 whilst it is depressed to engage the abutments 77, 78, the retaining projections 73 are restrained by the lower surface of the depressed portion 69 so that the push button 70 is held at that position even when the pressure on it is removed.

Referring now to Figure 6A, the frame 68 carries a capsule 79 incorporating a time-piece movement (not shown). A journal 80 is formed on the capsule 79 and carries pivotally an alarm stopping lever 81. A coil spring 82 is arranged to bias the alarm stopping lever 81 clockwise, having one end secured to the lever 81 and the other end fixed to a plate member (not shown) which, in turn, is secured to fixed structure. The alarm stopping lever 81 has one end 81a projecting far enough to engage the alarm stopping member and another end 81b which carries a spring piece 84 adapted to be pressed onto and slide along the upper surface of a substrate plate 83 of the circuit, as seen in Figure 6D. On the plate 83, two separate contacts 85, 86 are formed by conventional printing techniques. The arrangement is such that the spring piece 84 is biased to contact both of the contacts 85, 86 simultaneously to bridge the latter and to provide an electrical connection therebetween when the alarm stopping lever 81 is swung to the position shown in broken lines as a result of the depression of the push button 70. The plate 83 also carries a circuit for generating the alarm signal.

When it is required to close the switch for a certain short period, the push button 70 is depressed against the biasing force of the spring 71, the alarm stopping member 72 acts to pivot the alarm stopping lever 81 counter-clockwise, so that the contacts 85,

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5 86 are bridged by the spring piece 84. This is the closing of the switch. As the push button is released, the coil spring 71 acts to move the push button to its initial position to disconnect the contacts 85, 86.

10 If it is required to hold the switch closed, the push button 70 is rotated whilst it is depressed until one of the retaining projections 73 comes into contact with the abutment 78 in the clockwise direction as viewed in Figure 6C. In this position the retaining projections 73 are retained by the lower surface of the depressed portion 69 so that the push button is maintained at this position, even if it is released. Thus, electrical connection is maintained between the contacts 85, 86 by the spring piece 84.

WHAT WE CLAIM IS:

20 1. An alarm timepiece comprising: a manually operable switch; time controlled switching means adapted to become operative at a preset time to enable an alarm to be produced; first means adapted to produce output signals in accordance with respective functions of an enabling, a temporary suspension and a disabling of an alarm in response to respective ones of at least three different operational modes of the manually operable switch; a second means adapted to count a predetermined time upon receipt of the output signal of the first means produced in response to the operational mode of the manually operable switch corresponding to the temporary suspension of the alarm to produce an alarm signal therefrom when the predetermined time is counted; and third means adapted to generate an acoustic alarm when the time controlled switching means has operated and either the operational mode of the manually operable switch corresponds to enabling of the alarm or the said alarm signal has been produced by the second means.

2. An alarm timepiece as claimed in claim 1 in which the manually operable switch comprises movable means displaceable against a spring and to be returned to an initial position by said spring when released, means for limiting the displacement of said movable means to a predetermined distance, preventing means for preventing the return of said movable means when the latter is rotated by a predetermined angle after being displaced by said distance, a shielding means provided on said movable means for effecting shielding from a magnetic field and a combination of a reed switch and a magnet arranged to be shielded from each other by said shielding means positioned therebetween when said movable means is returned to the initial position.

3. An alarm timepiece as claimed in claim 1 in which said manually operable switch comprises movable means displaceable against a spring and to be returned to an initial position by said spring when released, means for limiting the displacement of said movable means to a predetermined distance, means for preventing the return of said movable means when the latter is rotated by a predetermined angle after being displaced by said predetermined distance, and an electrically conductive means mechanically coupled to said movable means so as to move into bridging contact with a pair of electrical contact points.

4. An alarm timepiece substantially as herein described with reference to and as shown in the accompanying drawings.

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86 are bridged by the spring piece 84. This is the closing of the switch. As the push button is released, the coil spring 71 acts to move the push button to its initial position to disconnect the contacts 85, 86.

If it is required to hold the switch closed, the push button 70 is rotated whilst it is depressed until one of the retaining projections 73 comes into contact with the abutment 78 in the clockwise direction as viewed in Figure 6C. In this position the retaining projections 73 are retained by the lower surface of the depressed portion 69 so that the push button is maintained at this position, even if it is released. Thus, electrical connection is maintained between the contacts 85, 86 by the spring piece 84.

WHAT WE CLAIM IS:

1. An alarm timepiece comprising: a manually operable switch; time controlled switching means adapted to become operative at a preset time to enable an alarm to be produced; first means adapted to produce output signals in accordance with respective functions of an enabling, a temporary suspension and a disabling of an alarm in response to respective ones of at least three different operational modes of the manually operable switch; a second means adapted to count a predetermined time upon receipt of the output signal of the first means produced in response to the operational mode of the manually operable switch corresponding to the temporary suspension of the alarm to produce an alarm signal therefrom when the predetermined time is counted; and third means adapted to generate an acoustic alarm when the time controlled switching means has operated and either the operational mode of the manually operable switch corresponds to enabling of the alarm or the said alarm signal has been produced by the second means.

2. An alarm timepiece as claimed in claim 1 in which the manually operable switch comprises movable means displaceable against a spring and to be returned to an initial position by said spring when released, means for limiting the displacement of said movable means to a predetermined distance, preventing means for preventing the return of said movable means when the latter is rotated by a predetermined angle after being displaced by said distance, a shielding means provided on said movable means for effecting shielding from a magnetic field and a combination of a reed switch and a magnet arranged to be shielded from each other by said shielding means positioned therebetween when said movable means is returned to the initial position.

3. An alarm timepiece as claimed in claim 1 in which said manually operable switch comprises movable means displaceable against a spring and to be returned to an initial position by said spring when released, means for limiting the displacement of said movable means to a predetermined distance, means for preventing the return of said movable means when the latter is rotated by a predetermined angle after being displaced by said predetermined distance, and an electrically conductive means mechanically coupled to said movable means so as to move into bridging contact with a pair of electrical contact points.

4. An alarm timepiece substantially as herein described with reference to and as shown in the accompanying drawings.

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ERRATUM

SPECIFICATION NO 1551095

Page 1, line 2, for 4, read 5,

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