

PATENT SPECIFICATION

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(54) IMPROVEMENTS IN OR RELATING TO CONTROL OPERATING CIRCUITS FOR THE SELECTIVE CONTROL OF PLURAL FUNCTION ELECTRICAL APPARATUS

(71) We, KABUSHIKI KAISHA
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of 3-4, 4-chome, Ginza, 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 control
operating circuits for the selective control
of plural function electrical apparatus that
is to say to electrical apparatus which can
be made, at will, to function in any of two
or more different ways each corresponding
with a different function. More specifically
the invention relates to control operating
circuits for plural function electrical
apparatus of the kind in which operation to
perform a desired one of two or more
functions of which the apparatus is capable
is selected by means of switching which is
selectively controlled in accordance with
the desired function by means of a plural
position control button or knob
(hereinafter referred to simply as a button)
having different positions corresponding
with different functions. The button may
have a push-in/pull-out motion or a
rotational motion or both.

Although not limited exclusively to its
application thereto, the invention is of great
advantage for, and primarily intended for,
plural function electronic timepieces. A
plural function electronic timepiece, with
in the meaning of this specification, is an
electronic timepiece the circuitry of which
is capable not only of performing the
function of time keeping but of being
switched over to perform one or more other
functions, of which examples are (a) the
function of correcting the date, day or time
displayed, and (b) the function of operating
as a stop watch or chronograph displaying
elapsed time.

Known plural function electrical
apparatus of the kind referred to, and
especially known plural function electronic

timepieces of the kind referred to, have the
defect that, if the control button is
incorrectly operated — and, in most cases
this is easy to do — the result is that there is
erroneous operation of the circuitry
controlled, the function desired to be
selected being not selected but some other
function being selected instead. The
present invention seeks to safeguard against
this.

According to one aspect of the invention,
there is provided in a plural function
electrical apparatus of the kind referred to,
a safety arrangement for a function
selecting operating circuit thereof
said safety arrangement comprising an
operating button or handle having a push
in/pull out action or a rotating action and
having a plurality of positions into which it
may be moved and an operation control
circuit actuated in response to the position
adopted by said button or handle wherein
said operation control circuit has a fixed
inhibition time during which its response is
delayed after said button or handle has
been moved from one position to another.

According to another aspect of the
invention there is provided a plural
function electrical apparatus of the kind
referred to wherein function selecting
control circuit which is controlled by a
plural position control button includes an
inhibiting circuit which inhibits selection,
by said circuitry, of a function
corresponding with a chosen operation of
said button, until after the elapse of a
predetermined delay time following said
operation.

According to a further aspect of the
invention there is provided a plural
function electronic timepiece having a
function selecting manually operable plural
position external button wherein function
selecting control circuit controlled by said
button includes an inhibiting circuit which
inhibits selection, by said circuitry, of a
function corresponding with a chosen

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operation of said button, until after the elapse of a predetermined delay time following said operation.

In the case of a timepiece having the function of displayed time correction as well as the function of normal time keeping, a desired unit of displayed time (including, if displayed, day or date) may be selected for correction by actuating the button in one manner, and, following such selection, correction of the selected unit is effected by actuating the button in another manner. In a timepiece having the function of operating as a chronograph as well as the function of normal time keeping, selection of the time keeping function and the chronograph function may be effected by moving the button to the appropriate one of its plural positions and, after the chronograph function has been selected, the starting and stopping of the period of elapsed time displayed may be arranged to be controlled by additional external manually operable control button means, or it may be arranged to be controlled by movement of the function selecting control button in a predetermined manner.

The function selecting control button may have a push-in pull-out action, or a rotational action, or a combination of both.

The delay or inhibition time may conveniently be about half a second.

In most conventional timepieces, particularly wristwatches, time is displayed mechanically, usually by means of time indicating hands though in some timepieces time indicating rotating discs or other mechanical time indicating devices are used. However, with recent advances in electronic technology, timepieces in which time is displayed by electronic means are coming into use. For example, in some timepieces in which a quartz crystal oscillator is used instead of a conventional balance wheel as the time standard, electronic signals are derived from the oscillator output by a suitable electronic circuit, such as a C-MOS integrated circuit, and these signals are used to display the time digitally by means of a liquid crystal, light emitting diode or other electronically actuated display device. Such electronic timepieces can be made of very high time accuracy and may be readily fitted with additional facilities. For example they can be made to act (when required) as stop watches, or alarm timepieces or "universal" timepieces, or may incorporate a calculator, the required extra facility or facilities being provided by extra circuitry, which can be switched in when required, in the integrated circuit structure. There is, therefore, a requirement for reliable operating means, suitable for a high precision timepiece, for providing the

necessary switching operations for enabling correction of the displayed time (usually in hours, minutes and seconds, but sometimes in day and/or date as well), changing over to give a required additional facility provided in the timepiece (e.g. stop watch action or alarm action) or, in some cases, providing control of the additional facility (e.g. in the case of a stop watch facility). Such switching control could be provided by means of operating push buttons, but, from the viewpoint of general design and convenience of use, and also in the interest of maintenance of watertightness, it is extremely desirable to have as few externally operable push buttons as possible. Ordinarily, therefore, there are great advantages, from the practical point of view, in having only a single operating button capable of performing a number of different functions. This can be achieved by providing a multi-position button which can be pushed in or pulled out in one or more steps and rotated in steps in one direction or the other. However known multi-function multi-position control button arrangements, as at present known, have the defect that it is easy to cause erroneous action in the timepiece by not moving the operating button correctly to the required position, i.e. by pulling it out too much or too little, or rotating it too much or too little. The main object of this invention is to overcome this defect and to provide a safety device which will prevent erroneous operation of the multi-position button causing erroneous operation of the timepiece circuitry controlled by the button.

The invention is illustrated in and further explained in connection with the accompanying drawings in which:—

Figure 1 is a block diagram of a known electronic timepiece to which the invention may be applied;

Figures 2 and 3 show two displays which the timepiece of Figure 1 can give;

Figure 4 shows the mechanism of the switch SW1 of Figure 1;

Figure 5 shows diagrammatically one embodiment of the invention;

Figure 6 is an explanatory graphical figure related to Figure 5; and

Figures 7 and 8 show two other timepieces to which the invention may be applied.

Figure 1 is a block diagram of a known electronic watch which is provided with a stop watch facility — a so called chronograph watch. Referring to Figure 1 block 1 is a time standard quartz crystal controlled oscillator having an output frequency of several tens of KHz. 2 is a frequency divider dividing down the output frequency from oscillator 1 to a

3 suitable lower frequency. 3 is a counter circuit arrangement for producing date, hour, minute and (if required) second time signals from the output from the divider 2. 4 is a chronograph circuit for actuating the timepiece as a stop watch on the basis of the output signals from the divider 2. This circuit 4 may, for example, be designed to take time up to 59 minutes 59 seconds as a maximum. 5 is a display control circuit for displaying time in a time display device 6 and can be changed over to take its input signals from 3 or 4 according as to whether normal time display or chronograph time display is required. The display device 6 is electronic. It may, for example, be of the liquid crystal type or of the light emitting diode type.

Figure 2 is a face view of the watch showing the display when the watch is in operation as a normal time keeper. Figure 2 is drawn on the assumption that block 3 provides time control signals appropriate to a display of time in hours and minutes by a 12 hour time display, together with a display of AM or PM and a display of the date. Figure 3 is a view similar to that of Figure 2 showing the display when the watch is in operation as a stop watch. Figure 3 is drawn on the assumption that the display is of elapsed time, up to a maximum of 59 minutes 59 seconds, in minutes and seconds. 7 is an operation control circuit which controls the time counting circuit 3, the chronograph circuit 4 and the display control circuit 5, and is arranged to provide control for correction of the displayed time, chronograph action and change-over of the display in dependence upon the selective actuation of externally operable switches SW1, SW2 and SW3. The contacts 8, 9, 10 and 11 of the switches are connected each through a relatively high resistance to the negative of the supply source (not shown). Each of these switch contacts is normally at "low" potential state. The armatures of switches SW1, SW2, SW3 are connected to the positive terminal of the supply source. Switch SW1 connects with contact 8 when the operating button 12 (see Figure 2) is pushed right in and connects with contact 9 when button 12 is pulled right out. Switches SW2 and SW3 connect with contacts 10 and 11 respectively when the buttons 13 and 14 (Figure 2) respectively, are pushed in.

The structural arrangement of switch SW1 is shown in Figure 4. Here 15 is a substrate which is connected to the positive supply terminal. 12 is again the operating button. 16 is a springy switch lever which is engaged by a collar on the operating button shaft and is actuated by operation of the said button. 17 is a spring detent member for providing the predetermined selectable

positions for 16. 18 is a return spring member. 19 and 20 are contact terminals which are insulated from the substrate 15 and correspond with the terminals 8 and 9 respectively of Figure 1. When the watch is in normal use as a time keeper the button 12 is in the position shown in full lines and the switch lever 16 is held by detent member 17 in a position between contacts 19 and 20 and is in contact with neither of them. When the operating button 12 is pulled out by one step, from its normal central position, the switch lever 16 is brought into contact with the contact terminal 20, and held against it by the spring detent member 17. When the operating button 12 is pushed in from its normal central position, the switch lever 16 is brought into contact with the contact terminal 19. When push-in pressure on the operating button is discontinued, the switch lever 16 is returned to the ordinary position by the return spring member 18. When the operating button 12 is pushed in, i.e. when SW1 is brought into contact with 8, the normal time display is changed over for the chronograph display and, in this condition, i.e. when there is a chronograph display, SW2 and SW3 actuated respectively by the operating buttons 13 and 14 act respectively as a start-stop switch and a lap-reset switch. When time is displayed, SW2 and SW3 have no function. When the operating button 12 is pulled out by one step so that SW1 is brought into contact with the terminal 9, the time correction state is obtained, and the time is displayed in the display portion. In this condition SW2 and SW3 actuated by the operating buttons 13 and 14 act as time correction buttons and time correction can be made by the combined use of both buttons. The time correction state is released by pushing in the operating button 12 by one step to return to its initial central state, whereupon a normal time display is resumed. If, by mistake, the operating button 12 were to be pushed in too strongly so that the force of the return spring 18 were overcome and the button 12 were pushed right in, the lever 16 would be brought into contact with the contact terminal 19, and consequently the display which should display time would be changed to a chronograph display. Accordingly, in order to obtain the time display, the operating button must be actuated again.

The present invention provides a useful and practical safeguard against erroneous action caused by erroneous operation as above described. Conceivably erroneous operation could be made less likely mechanically, i.e. by making the force of the return spring 18 large enough. However, this is not very practical and

would at best provide only a partial solution of the problem and be inconvenient. The present invention provides an electrical method of overcoming the defect pointed out above and Figure 5 shows diagrammatically an embodiment wherein the operation control circuit includes a safety device in accordance with the invention.

Referring to Figure 5 terminals 21, 22, 23 and 24 correspond respectively to the terminals 8, 9, 10 and 11 of the operation control circuit 7 of Figure 1. They are normally at "low" potential state. 25 is a flip-flop circuit provided with reset and which performs a frequency division which produces an output signal of 1 Hz in response to an input signal of 8 Hz. 26 is a S-R type flip-flop circuit the output terminal QB of which is normally at "high" potential state. 27 is a T-type flip-flop circuit. The "high" and "low" potential terminals QC and QC are inverted alternately by the input, and an output appearing at terminals 28 is applied to the display control circuit 5 of Figure 1. G_1 , G_2 and G_3 are gates for actuating the flip-flop circuit 27. G_3 and G_4 are gates for performing the time correction. An output appearing at 29 is applied to the time counting circuit 3 of Figure 1. G_5 and G_6 are gates for controlling the chronograph action. An output appearing at 30 is applied to the chronograph circuit 4.

Figure 6 shows the signal wave-forms at the indicated terminals in Figure 5 at a time when the operating button 12 has been pulled out for time correction and pushed in again after time correction. When the operating button 12 is pulled out, the terminal 22 becomes at "high" potential, and the outputs QA and QB of flip-flops (FF) 25 and 26 become at "low" potential. When the operating button 12 is pushed in, the terminal 22 becomes at "low" potential, and the reset on FF 25 and 26 are released. QA and QB do not become at "high" potential immediately, but only after a fixed time (a practical figure is one of about 0.5 seconds). In the meantime, even if a signal of "high" potential is applied at 21, i.e. even if SW1 is brought into contact with the terminal 8 by pushing in the operating button 12 too far, an output is not produced from the gate G_1 , and FF 27 is not inverted. Therefore, the display is not changed over. Accordingly, a measure of protection against the generation of erroneous action by erroneous operation of the button 12 is provided. What may be termed the "inhibiting" time (0.5 seconds in the example above) can readily be changed to suit requirements by suitable design of the flip-flops.

Figure 7 illustrates, so far as is necessary

to an understanding thereof, another watch to which the invention can be applied with advantage and which displays date, AM or PM and hours and minutes of time and in which time correction can be made by a single operating button. The mechanism actuated by the operating button 31 is the same as that shown in Figure 4. The operation control circuit is actuated by the actions of pulling out or pushing in the operating button 31 which has a normal position 31b, a pushed in position 31a and a pulled out position 31c. When the operating button 31 is pulled out from 31b to 31c, the unit of display to be corrected can be selected. By repeating the actions of pushing in and pulling out the operating button between the positions 31b and 31c, the unit of display to be corrected is selected in the order of second → date → hour → minute → second → After such selection, by pushing in the operating button from the position 31b to the position 31a, the selected unit is corrected by one digit for each push in. With this method of correcting, if date correction is desired without correcting the seconds, the date correction is selected by once pulling out the operating button to select the second correction and then by pulling it out again. Date correction can then be made by pushing in the button as above described. However, with the watch as so far described, if the button 31 were pushed in beyond its normal position after selection of the seconds display for correction, seconds correction would be performed (instead of date correction) and consequently the timepiece display would be made wrong. Such erroneous action can, however, be prevented by providing the control function for correction with a fixed inhibited time of operation in accordance with this invention.

Figure 8 shows another watch to which the invention may be applied. In this watch the time correction is performed by rotation of a single operation button. The unit of display to be corrected is selected in the order second → date → hour → minute → second → . . . by the following method. The operating button 32 is pulled out by one step from the normal position 32a to the position 32b, and the operating button is then rotated clockwise by a fixed angle and returned to its initial position. The unit to be corrected is selected by the repetition of this action. When the operating button is rotated counterclockwise by a fixed angle after selection, the correction is performed, the selected unit to be corrected being changed by one digit for each counter clockwise reciprocating motion of the button. With this correcting method also if date correction is desired without

correcting the seconds, the date unit can be selected by once rotating the operating button clockwise to select the unit of second, rotating it counterclockwise back to its initial position, and then rotating it clockwise again. However, if, in the return counterclockwise motion after the selection of the seconds unit, the button is rotated too far anticlockwise, seconds correction would be performed. This, again, can be prevented by providing the operation control circuit with a fixed inhibition time of operation in accordance with the invention.

As will now be appreciated the invention prevents erroneous action inside the timepiece from being caused by erroneous operation of a control button by providing a predetermined inhibiting time of operation the operation control circuit for controlling time correction, or change-over to some special facility (e.g. stop watch action) controlled by the button. The invention is applicable to a wide variety of control button arrangements and is not limited to the particular arrangements illustrated in Figures 2, 3, 7 and 8. This is the case even when the operating button is utilisable for a considerable number of functions so that the invention facilitates reduction of the number of buttons provided, with consequent improvement in water-tightness of the timepiece case.

Although the invention is primarily intended for timepieces it is not limited thereto but can be applied with advantage to other instruments in which the same problem of possible erroneous internal operation as a result of erroneous actuation of a function selecting and controlling button arises.

WHAT WE CLAIM IS:—

1. In a plural function electrical apparatus of the kind referred to a safety arrangement for a function selecting operating circuit thereof comprising an operating button or handle having a push in/pull out action or a rotating action and having a plurality of positions into which it may be moved and an operation control circuit actuated in response to the position adopted by said button or handle wherein said operation control circuit has a fixed inhibition time during which its response is delayed after said button or handle has been moved from one position to another.

2. A plural function electrical apparatus of the kind referred to wherein function selecting control circuitry which is controlled by a plural position control

button includes an inhibiting circuit which inhibits selection, by said circuitry, of a function corresponding with a chosen operation of said button, until after the elapse of a predetermined delay time following said operation.

3. A plural function electronic timepiece having a function selecting manually operable plural position external button wherein function selecting control circuitry controlled by said button includes an inhibiting circuit which inhibits selection, by said circuitry, of a function corresponding with a chosen operation of said button, until after the elapse of a predetermined delay time following said operation.

4. A timepiece as claimed in Claim 3 having the function of displayed time correction as well as the function of normal time keeping wherein a desired unit of displayed time including, if displayed, day or date is selected for correction by actuating the button in one manner and, following such selection, correction of the selected unit is affected by actuating the button in another manner.

5. A timepiece as claimed in Claim 3 or 4 having the function of operating as a chronograph as well as the function of normal time keeping wherein selection of the time keeping function and the chronograph function is effected by moving the button to the appropriate one of its plural positions.

6. A timepiece as claimed in Claim 5, wherein, when the chronograph function has been selected, the starting and stopping of the period of elapsed time displayed is controlled by additional external manually operable control button means.

7. A timepiece as claimed in Claim 5 wherein, when the chronograph function has been selected, the starting and stopping of the period of elapsed time displayed is controlled by movement of the function selecting control button in a predetermined manner.

8. Apparatus as claimed in any one of the preceding claims wherein the function selecting control button has a push-in pull-out action, or a rotational action, or a combination of both.

9. Apparatus as claimed in any of the preceding claims wherein the delay time provided by inhibition is approximately half a second.

10. An electronic timepiece as claimed in any of the preceding claims and having a control circuit substantially as herein

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5 correcting the seconds, the date unit can be selected by once rotating the operating button clockwise to select the unit of second, rotating it counterclockwise back to its initial position, and then rotating it clockwise again. However, if, in the return counterclockwise motion after the selection of the seconds unit, the button is rotated too far anticlockwise, seconds correction would be performed. This, again, can be prevented by providing the operation control circuit with a fixed inhibition time of operation in accordance with the invention.

15 As will now be appreciated the invention prevents erroneous action inside the timepiece from being caused by erroneous operation of a control button by providing a predetermined inhibiting time of operation the operation control circuit for controlling time correction, or change-over to some special facility (e.g. stop watch action) controlled by the button. The invention is applicable to a wide variety of control button arrangements and is not limited to the particular arrangements illustrated in Figures 2, 3, 7 and 8. This is the case even when the operating button is utilisable for a considerable number of functions so that the invention facilitates reduction of the number of buttons provided, with consequent improvement in water-tightness of the timepiece case.

35 Although the invention is primarily intended for timepieces it is not limited thereto but can be applied with advantage to other instruments in which the same problem of possible erroneous internal operation as a result of erroneous actuation of a function selecting and controlling button arises.

WHAT WE CLAIM IS:—

45 1. In a plural function electrical apparatus of the kind referred to a safety arrangement for a function selecting operating circuit thereof comprising an operating button or handle having a push in/pull out action or a rotating action and having a plurality of positions into which it may be moved and an operation control circuit actuated in response to the position adopted by said button or handle wherein said operation control circuit has a fixed inhibition time during which its response is delayed after said button or handle has been moved from one position to another.

55 2. A plural function electrical apparatus of the kind referred to wherein function selecting control circuitry which is controlled by a plural position control

button includes an inhibiting circuit which inhibits selection, by said circuitry, of a function corresponding with a chosen operation of said button, until after the elapse of a predetermined delay time following said operation. 65

3. A plural function electronic timepiece having a function selecting manually operable plural position external button wherein function selecting control circuitry controlled by said button includes an inhibiting circuit which inhibits selection, by said circuitry, of a function corresponding with a chosen operation of said button, until after the elapse of a predetermined delay time following said operation. 70 75

4. A timepiece as claimed in Claim 3 having the function of displayed time correction as well as the function of normal time keeping wherein a desired unit of displayed time including, if displayed, day or date is selected for correction by actuating the button in one manner and, following such selection, correction of the selected unit is affected by actuating the button in another manner. 80 85

5. A timepiece as claimed in Claim 3 or 4 having the function of operating as a chronograph as well as the function of normal time keeping wherein selection of the time keeping function and the chronograph function is effected by moving the button to the appropriate one of its plural positions. 90 95

6. A timepiece as claimed in Claim 5, wherein, when the chronograph function has been selected, the starting and stopping of the period of elapsed time displayed is controlled by additional external manually operable control button means. 100

7. A timepiece as claimed in Claim 5 wherein, when the chronograph function has been selected, the starting and stopping of the period of elapsed time displayed is controlled by movement of the function selecting control button in a predetermined manner. 105

8. Apparatus as claimed in any one of the preceding claims wherein the function selecting control button has a push-in pull-out action, or a rotational action, or a combination of both. 110

9. Apparatus as claimed in any of the preceding claims wherein the delay time provided by inhibition is approximately half a second. 115

10. An electronic timepiece as claimed in any of the preceding claims and having a control circuit substantially as herein 120

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described with reference to Figures 5 and 6 of the accompanying drawings.

- 5 11. An electronic timepiece as claimed in any of the preceding claims and substantially as herein described with reference to the accompanying drawings.

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