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- Neale, Craig Daniel
Castleton
Hope Valley S33 8WR (GB)
- King, Martin
Sheffield, S3 9PP (GB)
- Ridley, Mark
Fulbourn, Cambridge CB1 5NZ (GB)
- Hosking, Iam Michael
Cherry Hinton, Cambridge CB1 9JP (GB)

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(71) Applicant: Pegler Limited
Doncaster,
South Yorkshire DN4 8DF (GB)

(74) Representative: Wilson Gunn
5th Floor
Blackfriars House
The Parsonage
Manchester M3 2JA (GB)

(72) Inventors:
• Bourne, Nicholas James
Rawcliffe
Goole DN14 8QR (GB)

(54) Timing control unit

(57) A timing control unit 100 for a heating and hot water system comprises a rotatable knob 110 disposed within a ring of illuminable segments 120. Each segment in the ring 120 corresponds to a fifteen minute time interval during a day. A ring of numbers 130 is provided within the ring of segments 120 to indicate the hours of the day that the segments 120 correspond to. In order to set activation periods for the heating/hot water, a user

selects a start time by rotating the knob 110 to the desired start of the activation period; pressing the knob 110 to select the desired start of the activation period; rotating the knob 110 to the desired end of the activation period, and pressing the knob to select the end of the desired activation period. Whilst setting the activation periods, the time interval segment currently selected by the knob is indicated by being illuminated intermittently.

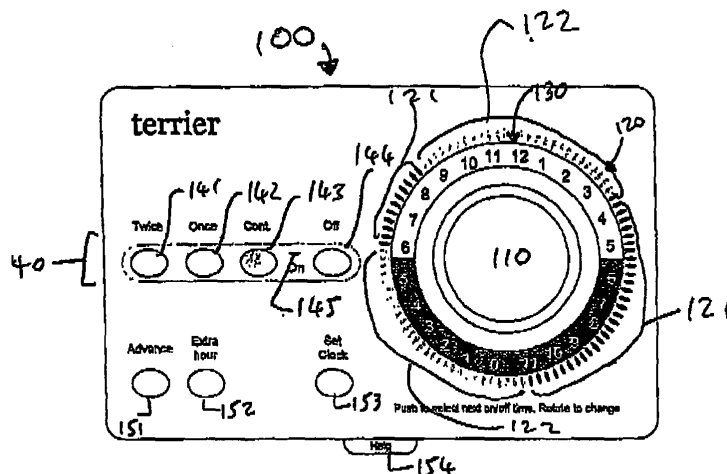


FIGURE 1

Description

[0001] The present invention relates to a timing control unit and in particular to a timing control unit for a central heating or hot water system. The invention further relates to a switch suitable for use in such a control unit and to a central heating or hot water system incorporating such a control unit.

[0002] Domestic central heating/hot water systems are typically provided with a timing control unit to allow user to set the heating and or hot water to be switched on or off automatically at desired times throughout the day. A number of different control units for such systems are available.

[0003] One well known type of timing control unit for such systems comprises a rotating dial having particularly one or two pairs of tappets slideably attached to its circumference. The dial rotates fully once every twenty four hour period and is marked round its outer edge with the hours of the day. A reference mark is provided adjacent to the dial indicating the current time. In operation, as the first tappet of a pair passes the reference mark the heating or hot water is switched on. Similarly, as the second tappet of a pair passes the reference mark the heating or hot water is then switched off. The control unit is typically provided with additional switches allowing user to set whether the tappets control the heating, the hot water or both. These additional switches particularly also allow the user to override the timed element of the timing control unit if desired. Timing control units of this type are relatively cheap and robust. Such timing control units are very simple and intuitive to use, however they provide very limited flexibility for a user in how they wish to control their heating or hot water system.

[0004] An alternative form of timing control unit is a digital timing control unit. Such control units are particularly provided with a digital clock and various user actuable push buttons, which allow a user to program to the nearest minute the times at which the heating and hot water systems will be switched on and off. These units typically allow more accurate and more flexible programming than the simpler units described above. These units are considerably less simple and intuitive for a user to program. As a result users may not utilise the full range of functions of the control unit or may even find it difficult to use the basic functions of the control unit without consulting an instruction manual.

[0005] It is therefore an object of the present invention to provide a new timing control unit suitable for use for controlling a central heating system or a hot water system.

[0006] According to a first aspect of the present invention there is provided a timing control unit of the type operable to activate or deactivate one or more external devices at predetermined times comprising: a display means in the form of a plurality of illuminable segments, each segment corresponding to a particular time interval and each segment being either illuminated or not illumi-

nated to indicate whether the external device or devices are to be activated or deactivated during the corresponding time interval; and means for varying the activation times of the external devices, the means comprising a rotatable element, movement of the element resulting in corresponding variations in the activation times of the external devices and the illumination of the illuminable segments.

[0007] This provides a control unit that may be easily and intuitively operated by a user.

[0008] Preferably, illumination of a segment corresponds to activation of the external device or devices during the time interval represented by that segment.

[0009] In a preferred embodiment, the rotatable element comprises a rotatable control element. In such embodiments, rotation of the rotatable control element varies the periods of time when the external device or devices are activated and correspondingly varies the illumination of the segments. Preferably the rotatable control element is adapted such that a particular segment may be selected by pressing the rotatable control element.

[0010] Preferably, the illuminable segments are arranged in a ring around the rotatable control element. The segments preferably correspond to equal time intervals throughout a control period. The control period is preferably a twenty four hour period. The segments may correspond to any desired time interval within the control period including, but not limited to, any one of: ten minutes, fifteen minutes, twenty minutes, thirty minutes and one hour. The segment corresponding to the time interval in which the present time falls may be illuminated intermittently.

[0011] The control unit may be adapted to activate the device or devices during one or more activation periods during a control period. The activation periods may be a single time interval; an extended time interval comprising a plurality of consecutive time intervals; a plurality of extended time intervals each comprising a plurality of consecutive time intervals; or any other such times or time intervals as desired. The possible durations of such activation periods and the possible separation of individual activation periods is limited by the duration of the time interval to which each segment corresponds, for instance, activation periods may only have durations and separations that are multiples of fifteen minutes if each segment corresponds to a fifteen minute time interval. The control unit may be adapted to provide for control of a plurality of different devices at different activation periods. This can be achieved by providing a plurality of output channels, actuable means being provided for selecting a particular output channel. The actuable means may be one or more push switches. Preferably, when one output channel is selected, the ring of segments is illuminated to indicate the activation periods during which the device or devices controlled by the selected channel are activated, and when a second channel is selected, the ring of segments is illuminated to indicate the activation periods during which the device or devices controlled

by the second selected channel are activated.

[0012] Preferably, the activation periods for a time period are set by the method of: selecting an output channel using the actuable means; rotating the rotatable control element to the desired start of the activation period; pressing the rotatable control element to select the desired start of the activation period; rotating the rotatable control element to the desired end of the activation period; and pressing the rotatable control element to select the end of the desired activation period. If the control unit is so adapted, further desired time intervals may be set by repeating the above process. The actuable means may also be used to select whether one or more activation periods are desired. In the above process, the time interval segment currently selected by the rotatable control element may be indicated by being illuminated intermittently. Once a start time is selected, as the rotatable control element is rotated to the desired end time, selected segments are progressively illuminated.

[0013] The control unit may be adapted to allow the activation periods of an output channel to vary during successive control periods. For example, the ring of segments may correspond to a day and it may be desired to provide different activation periods on different days of the week. This may be indicated by providing a separate set of illuminable segments corresponding to the days of the week. The actuable means may be used to select each day of the week individually and then the above method may be used to select the desired activation periods on each particular day.

[0014] An additional information display unit may be provided on the control unit. The additional information display unit may be operable to display any suitable type of information relating to the operation or settings of the control unit.

[0015] According to a second aspect of the present invention, there is provided a central heating system or a hot water system or a combined central heating and hot water system controlled by a timing control unit of the type hereinbefore described.

[0016] In a combined system, the heating system may be controlled by one output channel and the hot water system may be controlled by a second output channel. In more complex heating or hot water systems, different parts or subsystems of the heating or hot water systems may be controlled by separate output channels.

[0017] In one embodiment, the control unit may be adapted to send and/or receive signals to and/or from an external sensor or sensors. In such embodiments the control unit is preferably operable to activate the external devices or systems during the activation periods in response to the received signals from the external sensor or sensors. In a heating or hot water system, the external sensor or sensors may be temperature sensors. Preferably, the control unit only activates the heating and/or hot water systems when the signals received from the temperature sensor or sensors indicate that the temperature local to the sensor or sensors is less than a desired

target temperature.

[0018] According to a third aspect of the present invention there is provided a rotatable control element, suitable for use in a timing control unit according to the first aspect of the present invention, said rotatable control element comprising: a knob; a knob housing, said knob mounted within said housing and being free to rotate about its axis within the housing but being constrained by the housing such that axial movement of the knob is restricted to a range between a first axial position and a second axial position; biasing means, provided to generally retain the knob in the first axial position; rotation tracking means operable to track the rotational position of the knob; and axial position detecting means operable to determine whether the knob is in the first or the second axial position.

[0019] The rotatable control element of the third aspect of the present invention may be implemented in a timing control unit according to the first aspect of the present invention or a heating and/or hot water system according to the second aspect of the present invention.

[0020] The knob may be provided with a toothed rim portion and the rotation tracking means may be operable to detect the passing of said teeth as the toothed rim portion rotates. The toothed rim portion may be provided integrally with the knob or may be a separate component linked to the knob so as to co-rotate with the knob. If the toothed rim portion is a separate component, the knob may be moveable axially in relation to the toothed rim portion. In such embodiments, preferably the toothed rim portion maintains its axial position when the knob moves axially.

[0021] Preferably, the rotation tracking means comprises an optical emitter and an optical sensor positioned on either side of the toothed rim portion, the sensor adapted to detect the presence or absence of a tooth from the signal level. Preferably there are provided a pair of laterally spaced sensors. There may also be provided a pair or laterally spaced emitters aligned with said sensors. By using the output of both sensors to determine the presence or absence of a tooth, a more accurate count can be made. By monitoring the phase difference between the outputs of the two sensors, the direction of rotation can be determined.

[0022] The axial position detecting means may be a push switch positioned so as to be actuated by the knob when the knob is in the second axial position and so as not to be actuated by the knob when the knob is in the first axial position.

[0023] The rotation tracking means and axial detection means may be provided upon a printed circuit board (PCB). The knob and/or the rim portion may be held in position relative to the PCB by one or more suitable suspension units. The housing may also be mounted securely relative to the PCB.

[0024] The knob may be provided with one or more dimples around its surface adjacent to said housing. The housing may be provided with corresponding surface for-

mations. This provides a user rotating the knob with feedback as to how far the knob has been rotated.

[0025] The knob may be provided with an aperture aligned with its axis. An additional information display unit may be mounted in the aperture or in alignment with the aperture. In one embodiment, said additional information display unit may be mounted on said PCB in alignment with said aperture. In such embodiments, a lens may be provided in the aperture to enable the additional information display unit to be viewed more clearly.

[0026] According to a fourth aspect of the present invention there is provided a rotatable control element suitable for use in a timing control unit according to the first aspect of the present invention comprising: a rotatable knob, said knob being provided with a ring of light sensing elements around its outer edge; a light emitting means provided adjacent to the outer edge of the knob and aligned with the ring of light sensing elements such that light emitted by the light emitting means is incident on only one light sensing element at any one time; and a push switch operable by pressing the knob.

[0027] The rotatable control element of the fourth aspect of the present invention may be implemented in a timing control unit according to the first aspect of the present invention or a heating and/or hot water system according to the second aspect of the present invention.

[0028] Preferably the knob is partially provided within a housing which substantially prevents any light from sources other than the light emitting means being incident upon the light sensing elements. The push switch is preferably provided within the housing. The portion of the knob which is not within the housing may be pressed back into the housing to operate the push switch.

[0029] In order that the present invention may be more clearly understood it will now be described further herein, with reference to the accompanying drawings, in which: -

- Figure 1 shows a first embodiment of a heating/hot water control unit according to the present invention;
- Figure 2 shows a second embodiment of a heating/hot water control unit according to the present invention;
- Figure 3 shows a third embodiment of a heating/hot water control unit according to the present invention;
- Figure 4 shows a fourth embodiment of a heating/hot water control unit according to the present invention;
- Figure 5 shows a fifth embodiment of a heating/hot water control unit according to the present invention; and
- Figure 6 shows a sixth embodiment of a heating/hot water control unit according to the present invention;
- Figure 7a shows a cross-sectional view of an embodiment of a knob for the heating/hot water control units of the present invention;

Figure 7b shows an exploded view of the components of the knob of figure 7a;

Figure 7c is a schematic plan view of a rotation tracking means for the knob of figure 7a; and

5 Figure 8 shows an alternative embodiment of a knob for the heating/hot water control units of the present invention.

[0030] Referring now to figure 1, a first embodiment of a timing control unit 100 for a heating and hot water system according to the present invention is shown. The control unit comprises a rotatable knob 110 disposed within a ring of illuminable segments 120. Each segment in the ring 120 corresponds to a fifteen minute time interval during a day. A ring of numbers 130 is provided adjacent to the ring of segments 120 to indicate the hours of the day that the segments 120 correspond to. In the embodiment shown in the drawings, part of ring 130 is shaded darkly 131 to indicate nighttime hours whilst the remaining part 132 is shaded brightly to indicate daytime hours.

[0031] In the example shown in figure 1, two sets of segments 121 are illuminated and two sets of segments 122 are not illuminated. The illuminated segments correspond to the times of the day when the heating/hot water system is activated, referred to herein as activation periods. At any one time one segment will be illuminated intermittently to indicate the present time, typically at a frequency of say, 1Hz. Conveniently, the segments may be illuminated by a ring of dedicated LEDs.

[0032] A number of actuatable push switches 141-144 are provided. The actuatable switches 141-144 are used to change the operable mode of the control unit 100. switch 141 sets the control unit to activate the heating/hot water system for two time periods during the day. Switch 142 sets the control unit to activate the heating/hot water system for one time period during the day. Switch 143 sets the control unit to activate the heating/hot water system continuously. Switch 144 sets the control unit to deactivate the heating/hot water system continuously. An indicator light 145 is provided, the light 145 being illuminated to indicate that the heating/hot water system is activated.

[0033] The activation periods are set by first selecting either switch 141 or 142, then the knob 110 is pressed. This causes the segment corresponding to the start of the activation period to flash intermittently at an increased rate, say, 2Hz. The knob 110 is then rotated, the flashing segment moving as the knob rotates, until the flashing segment is moved to the desired start time for the activation period. As the flashing segment moves, any segments that were not within the activation period but are now within the activation period are illuminated and any segments that were within the activation period and are not now within the activation period are not illuminated. The knob 110 is then pressed to set this as the start time for the activation period. Once the knob 110 has been pressed, the segment corresponding to the end time of

the activation period starts to flash at the increased rate. The knob 110 can then be rotated to the desired end time of the activation period. As above, any segments that were not within the activation period but are now within the activation period are illuminated and any segments that were within the activation period and are not now within the activation period are not illuminated. The knob 110 is then pressed to set the end of the activation period. As a result, the segment corresponding to the start of the second activation period starts to flash at the increased rate. The above process is then repeated to set the second activation period. If it is desired not to set a particular activation period, the start time can be set to be the same as the end time. The period will then only be displayed when in setting mode.

[0034] The control unit 100 is also provided with additional actuatable control switches 151, 152 and 153. Switch 151 advances the control unit 100 to the next activation period. When it is actuated, all the segments from the present time to the start of the next activation period are illuminated and the heating/hot water system is activated. As time elapses, the segments are progressively switched off until the start of the set activation period is reached. As time then passes the segments then remain illuminated. Similarly, if the switch 151 is actuated when the heating/hot water system is activated, then the heating/hot water system is deactivated for the rest of the activation period and the corresponding segments between the present time and the end of the activation period are switched off. As time progresses, the segments within the set activation period are progressively re-illuminated. By actuating switch 151 for a second time, the advance mode is cancelled.

[0035] Selecting switch 152 activates the heating/hot water system for one hour from the present time or if the heating/hot water system is already turned on, the period of activation is extended by one hour. When this is pressed, the corresponding segments are illuminated. As time passes, the segments are progressively switched off. Actuating switch 152 twice, activates the heating/hot water system for two hours (or for two extra hours) and actuating the switch 152 three times activates the heating/hot water system for three hours (or for three extra hours). Actuating the switch 152 for a fourth time cancels the extra activation of the heating/hot water system. A tab 154 is provided, which can be pulled down to reveal a card with operating instructions printed thereupon.

[0036] A switch 153 is provided to allow a user to set the present time. When switch 153 is actuated, the current set time flashes at the increased rate. The knob 110 is rotated until the flashing segment corresponds to the correct time. The knob 110 is then pressed to set the correct time.

[0037] Figure 2 shows an alternative embodiment of the control unit, which operates in the same manner as described above except that separate output channels are provided for controlling the heating and hot water systems. In this embodiment, actuatable switches 141a,

142a, 143a and 144a control the hot water system in the manner described above and actuatable switches 141b, 142b, 143b and 144b control the heating system in the manner described above. Indicator lights 145a and 145b are provided to indicate whether the heating or hot water systems are currently activated. In alternative embodiment, the switches 141a, 142a, 143a, and 144a or the switches 141b, 142b, 143b and 144b may be illuminated to indicate the selected channel. The control unit of figure 2 is also provided with separate advance switches 151a and 151b for advancing the heating and hot water systems individually.

[0038] In alternative multi-channel embodiments a single set of channel controls may be provided with an additional select channel switch and a channel selection indicator. Successive actuations of the select channel switch will cycle through the available channels, the currently selected channel being indicated by the channel selection indicator. The channel selection indicator may comprise a display unit or one or more illuminable indicators.

[0039] Figure 3 shows a further alternative embodiment of the control unit 100. In this embodiment, the device is provided with actuatable switches 146-149, 153 and 156-158 and additional illuminable segments 160 corresponding to the days of the week. The heating and/or hot water are controlled by a single channel and may be switched on continuously by actuating switches 146, 147 together. Alternatively, switch 146 may be actuated to advance the heating/hot water system as described above or switch 147 may be actuated to activate the heating for one hour. The heating/hot water may be deactivated or activated in timed mode by actuating switch 148. In some embodiments, a user may cycle through a number of different operational modes by pressing switch 148 such as: off; one timed period; two timed periods; three timed periods; on constantly. A light 145 is provided as before to indicate activation of the heating/hot water system. In alternative embodiments a series of indicators, possibly in the form of illuminable segments, may be provided to indicate the current operational mode.

[0040] The activation periods may be set by use of the set/review switch 149. When actuated, switch 149 causes the activation periods to be displayed. A user may then set or reset the activation periods as described above except that the segment corresponding to the selected day of the week is also illuminated. The different days of the week may be selected by rotating the knob 110 past midnight, in the appropriate direction. In this embodiment it is possible to set more than two activation periods per day (three activation periods are shown in figure 3) but the activation periods may not extend past midnight. The user may set the activation periods for each day individually or may set one day and use the copy to day switch 158 to set the same activation periods for more than one day. In this case, once switch 158 is actuated the knob 110 can be rotated to select the day of the week the activation period is to be copied to. Addi-

tionally, during normal (non-setting) operation, rotating the knob 110 will allow the programmed settings for successive days to be reviewed, the day being indicated by intermittent illumination of the appropriate segment 160. If there is no rotation for a preset time, the displayed day reverts to the present day.

[0041] The control unit may also be adapted such that one setting may be made for weekdays and a second setting may be made for weekends. The embodiment is also provided with a reset switch 157 which, when actuated, clears all the set programs. To indicate this action, all segments may be illuminated temporarily.

[0042] This embodiment is also provided with a holiday mode, which suspends activation of the heating/hot water system for up to thirty one days, if switch 156 is actuated. The length of the suspension is set by rotating the knob 110. If no rotation is detected within a preset period, say 20 seconds, then holiday mode is exited.

[0043] Referring now to figure 4, a further embodiment of a control unit 100 is shown which provides three output channels controlled in the same manner as described above: the first channel controlling the activation of a hot water system by switches 146a, 147a, 148a and 149a; the second channel controlling the activation of a first heating system or subsystem by switches 146b, 147b, 148b and 149b; and the third channel controlling the activation of a second heating system or subsystem by switches 146c, 147c, 148c and 149c.

[0044] Figure 5 shows a further alternative embodiment of the control unit 100 wherein the control unit 100 is provided with a temperature sensor. The temperature sensor may be a plurality of temperature sensors mounted internally or externally to the control unit 100, as required. Typically, there may be one internal temperature sensor and two external temperature sensors. The temperature sensor (or sensors) may be connected to the control unit by any suitable link, including both wires and wireless links.

[0045] The control unit 100 may be used to select a target temperature for the temperature sensor and the heating system is then only activated during activation periods when the temperature as measured by the temperature sensor is less than the target temperature. The target temperature is set once the activation periods have been set. When knob 110 is pressed to set the end time of the final activation period, a target temperature display 170, comprising a number of illuminable segments flashes. The knob 110 can then be rotated to increase or decrease the target temperature. When the desired temperature is reached, the knob is pressed to the target temperature. The temperature display 170 then stops flashing and is permanently illuminated.

[0046] In other embodiments, such as that shown in figure 6, an additional information display unit 103 may be provided. This additional information display unit may display any suitable information relating to the status or operation of the timing control unit 100 as desired, as is described further below. In other respects the operation

of the embodiment of figure 6 is in line with the description above.

[0047] The embodiments illustrated in figures 1-6 are examples of possible embodiments. It is of course obvious to the skilled man that different combinations of the control and display features described in relation to these embodiments may be provided on a control unit as is required or desired, depending on the number of output channels and the desired operation of the unit in respect of these output channels. Additional control or display features may also be added to such a control unit, including but not limited to: an 'undo' switch operable during setting operation to cancel the previous selection made by the user; or a movable cover provided over some switches, which may improve the aesthetic appearance of the unit and prevent accidental changes of modes or activation periods.

[0048] Referring now to figures 7a- 7c, one possible embodiment of the knob 110 is shown. The knob 110 is mounted within a housing 101 such that it is rotatable about its axis and such that it is constrained to a limited range of axial movement. The housing 101 may be the same housing provided around other components of the control unit 100.

[0049] In this embodiment, this is achieved by means of a projecting rim 110a which fits within a corresponding channel 101a. The channel 101a is larger than the rim 110a such that the channel 101a defines a permitted range of axial movement for the knob 110.

[0050] Also mounted on the housing 101 and free to rotate is the toothed rim portion 112 of the knob 110. The rim portion 112 is retained in a desired axial position by means of corresponding formations 101b and 112b provided on the housing 101 and the rim portion 112 respectively. The rim portion 112 is provided with a plurality of regularly spaced downwardly projecting teeth 113.

[0051] The rim portion 112 is connected to the knob 110 by a plurality of spokes 110c. The distal ends of the spokes 110c fit into grooves 112c provided in the rim portion 112. In this manner, the knob 110 may move axially in relation to the rim portion 112 but the knob 110 and rim portion 112 will co-rotate about the knob axis.

[0052] The knob 110 is supported by one or more suspension units 111. The suspension unit or units 111 act to provide a bias urging the knob to remain at the top of its permitted axial range defined by channel 101a, a first axial position of the knob 110 (the bottom of the permitted range comprising a second axial position of the knob 110). The suspension unit or units 111 are mounted on a PCB 102, which may be the same PCB as contains other electrical components of the control unit 100.

[0053] Also mounted on PCB 102 are a knob rotation tracking means 114 and a knob axial position detecting means 117. The axial position detecting means 117 comprises a push switch which is actuated by the knob 110 when the knob 110 is in the second axial position and is not actuated by the knob 110 when the knob 110 is in the first axial position.

[0054] Additionally shown on figure 7b is a light pipe 104. This is mounted between the PCB 102 and the housing 101 and is operable to direct light output by each of the LEDs provided on the PCB 102 to individual apertures provided in the housing 102 corresponding to the illuminable segments 120. In this way, the segments 120 are clearly and separately illuminated.

[0055] Referring particularly to figure 7c, the rotation tracking means 114 comprises a pair of light emitting means aligned with a pair of light sensors. The light sensing means 115 are provided upon one upstanding prong 114a of the rotation tracking means 114 and the light emitting means 116 are provided upon the other upstanding prong 114b of the rotation tracking means 114. The rotation tracking means 114 is located such that as the toothed rim portion 112 rotates, the teeth 113 pass between the upstanding prongs 114a, 114b of the rotation tracking means 114. As the teeth 113 pass between the upstanding prongs they intermittently block the transmission of light between the emitting means 116 and the sensors 115.

[0056] By monitoring the output of the sensors 115 for a rising signal, the passage of a tooth 113 can be detected. By maintaining a count of the passage of teeth 113, the rotation of knob 110 can be tracked. By monitoring the phase difference in the signals output by the two sensors 115, the direction of rotation can be determined. Additionally, the provision of two sensors 115 spaced at an appropriate separation (typically around one half a tooth width) prevents count errors occurring when a tooth edge comes to rest directly adjacent to a sensor 115 and vibration of the unit causes light to intermittently be permitted to pass between the emitting means 116 and the sensor 115.

[0057] In operation, a user may rotate the knob 110 by gripping it on its outer surface, which may be provided with suitable gripping formations. The passage of the teeth 113 is monitored during rotation to determine the direction of an angular distance of rotation such that a suitable change to the illumination of the segments may be made. When a desired position has been reached, the knob 110 may be pressed into the second position so as to actuate switch 117. In order to provide an appropriate tactile sensation during rotation, suitable formations may be provided on the knob 110 where adjacent to the housing 101. These may take the form of a series of dimples 1110d.

[0058] In the embodiment shown, an aperture 118 is provided in the top of knob 110. The aperture 118 may be filled with an additional information display unit 103. Alternatively, as is shown in the illustrated embodiment, the aperture 118 is filled with a lens 119. The lens 119 is adapted to enable the output of an additional information display unit 103 mounted on the PCB 102 to be viewed through the aperture 118. The additional information display unit 103 may be adapted to display any suitable information related to operation of the control unit including but not limited to any one or more of: mode

information; time/date information; status information; temperature information; software update information (this information might typically be displayed whenever the device is reset). It may be possible to alter or vary the type of information displayed in response to particular operations of the control unit 100.

[0059] Figure 8 shows an alternative possible embodiment of the knob 110, suitable for use in embodiments wherein a display is not required on the knob 110. The knob is of cylindrical form having an outer portion, which projects clear of the housing 101 of the control unit, and an inner portion within the housing 101 of the control unit. The knob 110 is mounted above a PCB 102, which may be the same PCB as the other electronic components of the control unit are mounted on. Below the knob 110 is provided a push switch 117, which is actuated when knob 110 is pressed. The rotational position of the knob 110 is tracked by an arrangement comprising a light emitting means 116 provided on the PCB 102 adjacent to the inner portion of the knob 110 and a plurality of light sensing elements 115 mounted on the inner portion of the knob 110. The light sensing elements 115 are adapted such that the light from the light emitting means 116 is incident upon only one light sensing element 115 at a time. Each light sensing element 115 corresponds to one segment of the segment ring 120. As the knob 110 rotates, the light sensing element 115 upon which light is incident changes. In this manner, the rotation of the knob 110 can be used to illuminate or switch off segments of the segment ring 120 to set activation periods as previously described.

[0060] It is of course to be understood that the invention is not to be restricted to the details of the above embodiments, which are described by way of example only. For instance, it may be desirable to select an activation period by pressing down on knob 110 (or pulling up on knob 110) whilst rotating it.

Claims

1. A timing control unit of the type operable to activate or deactivate one or more external devices at pre-determined times comprising: a display means in the form of a plurality of illuminable segments, each segment corresponding to a particular time interval and each segment being either illuminated or not illuminated to indicate whether the external device or devices are to be activated or deactivated during the corresponding time interval; and means for varying the activation times of the external devices, the means comprising a rotatable element, movement of the element resulting in corresponding variations in the activation times of the external devices and the illumination of the illuminable segments.
2. A timing control unit as claimed in claim 1 wherein illumination of a segment corresponds to activation

of the external device or devices during the time interval represented by that segment

3. A timing control unit as claimed in claim 2 wherein rotation of the rotatable control element varies the periods of time when the external device or devices are activated and correspondingly varies the illumination of the segments. 5
4. A timing control unit as claimed in claim 3 wherein the rotatable control element is adapted such that a particular segment may be selected by pressing the rotatable control element. 10
5. A timing control unit as claimed in any preceding claim wherein the illuminable segments are arranged in a ring around the rotatable control element. 15
6. A timing control unit as claimed in any preceding claim wherein the segments correspond to equal time intervals throughout a control period. 20
7. A timing control unit as claimed in any preceding claim wherein the segment corresponding to the time interval in which the present time falls is illuminated intermittently. 25
8. A timing control unit as claimed in claim 6 or claim 7 wherein the control unit is adapted to activate the device or devices during one or more activation periods during a control period. 30
9. A timing control unit as claimed in claim 8 wherein the activation periods may each comprise any one of: a single time interval; an extended time interval comprising a plurality of consecutive time intervals; or a plurality of extended time intervals each comprising a plurality of consecutive time intervals. 35
10. A timing control unit as claimed in claim 8 or claim 9 wherein the control unit is provided with a plurality of output channels, each channel for the control of a different device or plurality of devices at different activation periods. 40
11. A timing control unit as claimed in claim 10 wherein actuable means are provided for selecting a particular output channel and/or wherein the actuable means are also used to select whether one or more activation periods are desired. 45
12. A timing control unit as claimed in claim 11 wherein the actuable means are one or more push switches. 50
13. A timing control unit as claimed in any one of claims 10 to 12 wherein when one output channel is selected, the ring of segments is illuminated to indicate the activation periods during which the device or devices controlled by the selected channel are activated and when a second channel is selected, the ring of segments is illuminated to indicate the activation periods during which the device or devices controlled by the second selected channel are activated. 55
14. A timing control unit as claimed in any one of claims 10 to 13 wherein the activation periods during a control period are set by the method of: selecting an output channel using the actuable means; rotating the rotatable control element to the desired start of the activation period; pressing the rotatable control element to select the desired start of the activation period; rotating the rotatable control element to the desired end of the activation period; and pressing the rotatable control element to select the end of the desired activation period.
15. A timing control unit as claimed in claim 14 wherein the time interval segment currently selected by the rotatable control element is indicated by being illuminated intermittently.
16. A timing control unit as claimed in claim 14 or claim 15 wherein once a start time is selected, as the rotatable control element is rotated to the desired end time, selected segments are progressively illuminated.
17. A timing control unit as claimed in any one of claims 8 to 16 wherein the control unit is adapted to allow the activation periods of an output channel to vary during successive control periods.
18. A timing control unit as claimed in any preceding claim wherein the rotatable element comprises a knob.
19. A central heating system or a hot water system or a combined central heating and hot water system controlled by a timing control unit according to any one of claims 1 to 21.
20. A system as claimed in claim 22 wherein the heating system is controlled by one output channel and the hot water system is controlled by a second output channel.
21. A system as claimed in claim 22 or claim 23 wherein different parts or subsystems of the heating or hot water systems are controlled by separate output channels.
22. A system as claimed in any one of claims 22 to 24 wherein the control unit is adapted to send and/or receive signals from and to an external sensor or sensors.

23. A system as claimed in claim 25 wherein the control unit is operable to activate the external devices or systems during the activation periods in response to the received signals from the external sensor or sensors. 5
24. A system as claimed in claim 25 or claim 26 wherein the external sensor or sensors are temperature sensors. 10
25. A system as claimed in claim 27 wherein the control unit only activates the heating and/or hot water systems when the signals received from the temperature sensor or sensors indicate that the temperature local to the sensor or sensors is less than a desired target temperature. 15
26. A rotatable control element, suitable for use in a timing control unit according to any one of claims 1 to 18 or a system as claimed in any one of claims 19 to 25, said rotatable control element comprising: a knob; a knob housing, said knob mounted within said housing and being free to rotate about its axis within the housing but being constrained by the housing such that axial movement of the knob is restricted to a range between a first axial position and a second axial position; biasing means, provided to generally retain the knob in the first axial position; rotation tracking means operable to track the rotational position of the knob; and axial position detecting means operable to determine whether the knob is in the first or the second axial position. 20 25 30
27. A rotatable control element, as claimed in, claim 26 wherein the knob is provided with a toothed rim portion and the rotation tracking means is operable to detect the passing of said teeth as the toothed rim portion rotates. 35
28. A rotatable control element, as claimed in claim 27 wherein the toothed rim portion is a separate component linked to the knob so as to co-rotate with the knob. 40
29. A rotatable control element, as claimed in claim 28 wherein the knob is moveable axially in relation to the toothed rim portion and wherein the toothed rim portion maintains its axial position when the knob moves axially. 45 50
30. A rotatable control element, as claimed in any one of claims 27 to 29 wherein the rotation tracking means comprises a pair of laterally spaced sensors and a pair of laterally spaced emitters aligned with said sensors, said sensors and emitters positioned on either side of the toothed rim portion. 55
31. A rotatable control element, as claimed in any one of claims 26 to 30 wherein the axial position detecting means is a push switch positioned so as to be actuated by the knob when the knob is in the second axial position and so as not to be actuated by the knob when the knob is in the first axial position.
32. A rotatable control element, as claimed in any one of claims 26 to 31 wherein the rotation tracking means and axial detection means are provided upon a printed circuit board (PCB).
33. A rotatable control element, as claimed in claim 32 wherein the knob and/or the rim portion are held in position relative to the PCB by one or more suitable suspension units.
34. A rotatable control element, as claimed in any one of claims 26 to 33 wherein the knob is provided with one or more dimples around its surface adjacent with said housing.
35. A rotatable control element, as claimed in any one of claims 26 to 34 wherein the knob is provided with an aperture aligned with its axis and a display unit is mounted in alignment with the aperture.
36. A rotatable control element, as claimed in claim 35 wherein a lens is provided in the aperture.
37. A rotatable control element, suitable for use in a timing control unit according to any one of claims 1 to 18 or a system as claimed in any one of claims 19 to 25, said rotatable control element comprising: a rotatable knob, said knob being provided with a ring of light sensing elements around its outer edge; a light emitting means provided adjacent to the outer edge of the knob and aligned with the ring of light sensing elements such that light emitted by the light emitting means is incident on only one light sensing elements at any one time; and a push switch operable by pressing the knob.
38. A movable element as claimed in claim 37 wherein the knob is partially provided within a housing which substantially prevents any light from sources other than the light emitting means being incident upon the light sensing elements.
39. A movable element as claimed in claim 37 or claim 38 wherein the push switch is provided within the housing and wherein the portion of the knob which is not within the housing is pressed back into the housing to operate the push switch.

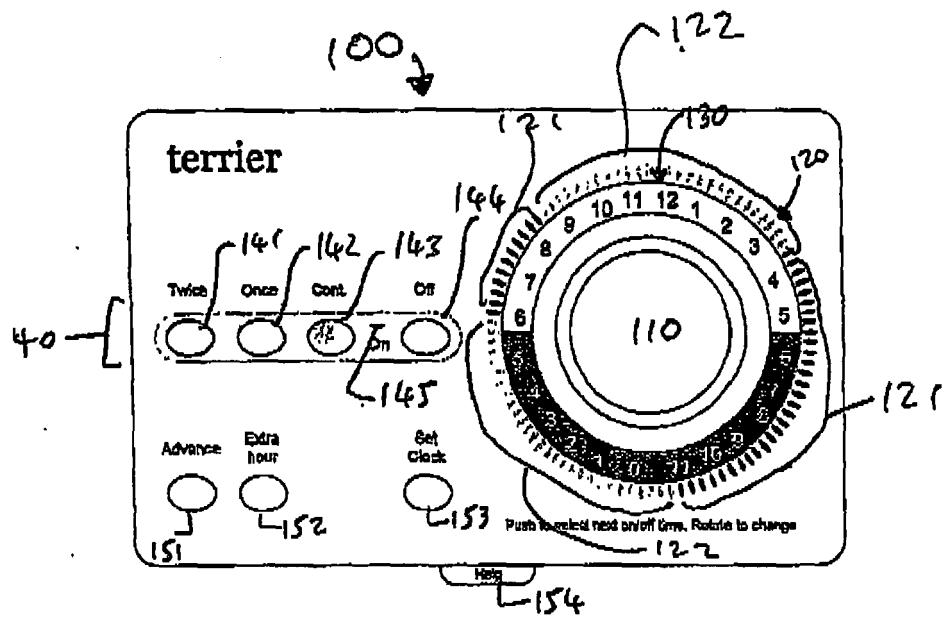


FIGURE 1

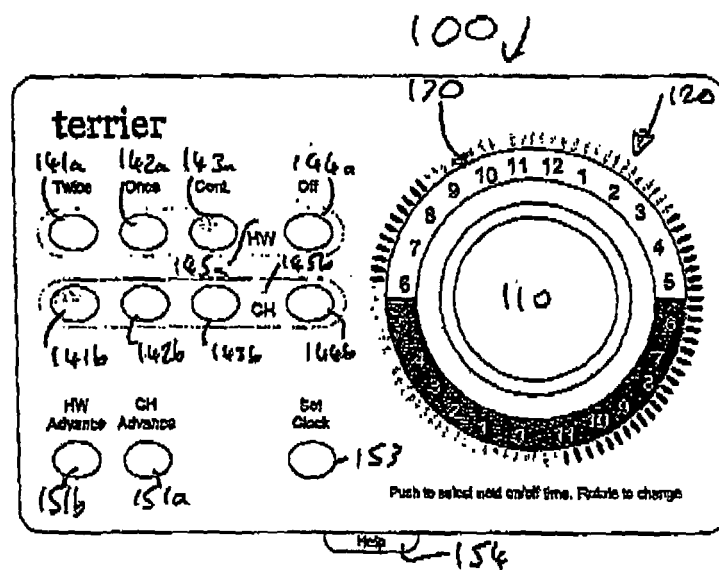


FIGURE 2

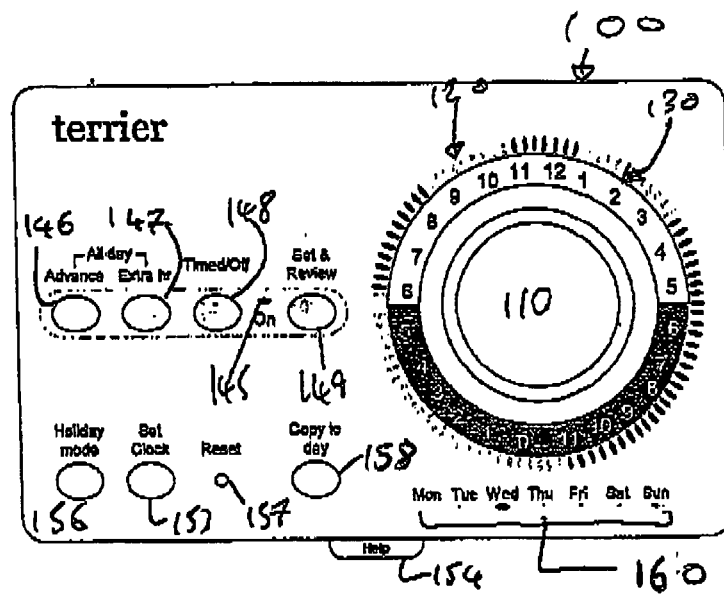


FIGURE 3

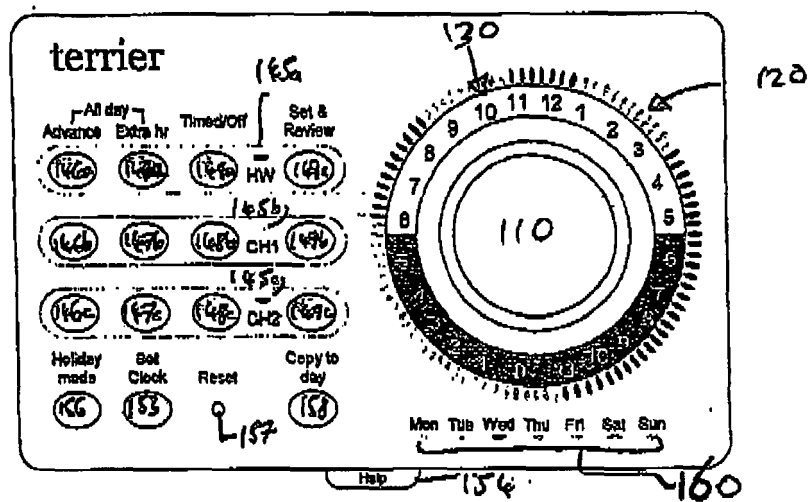


FIGURE 4

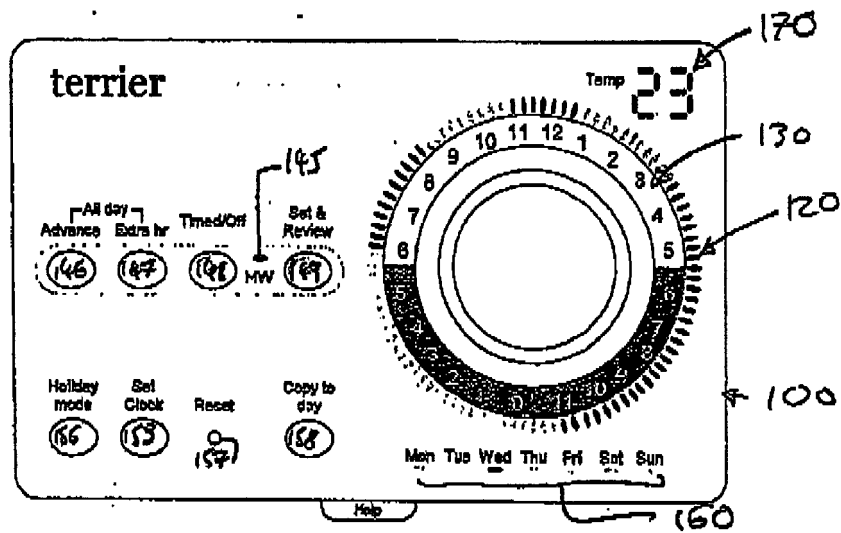


FIGURE 5

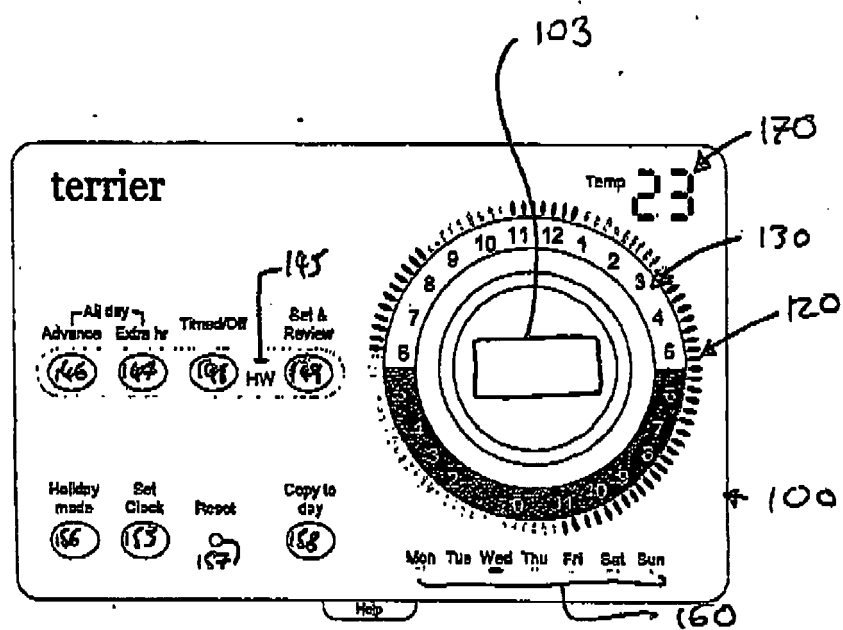


FIGURE 6

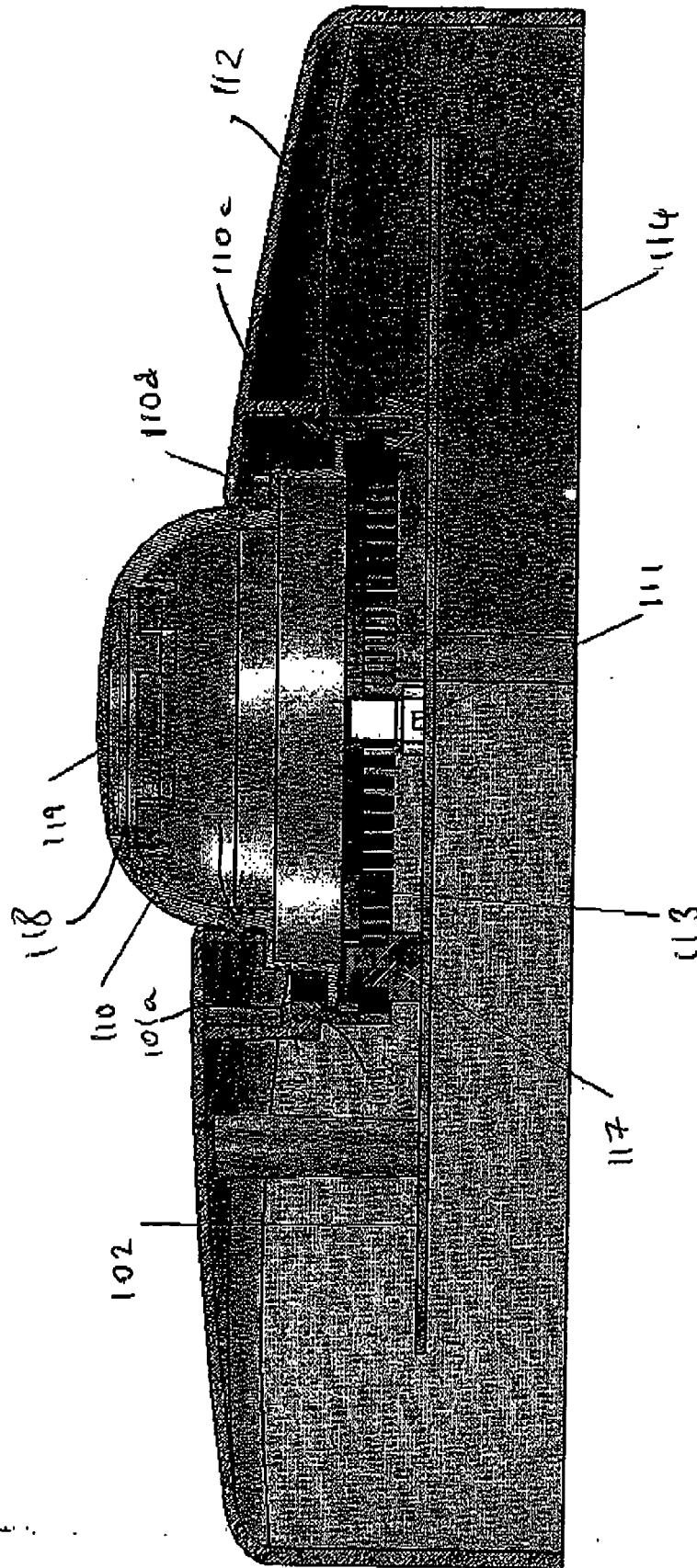


fig 7a

Fig 7b

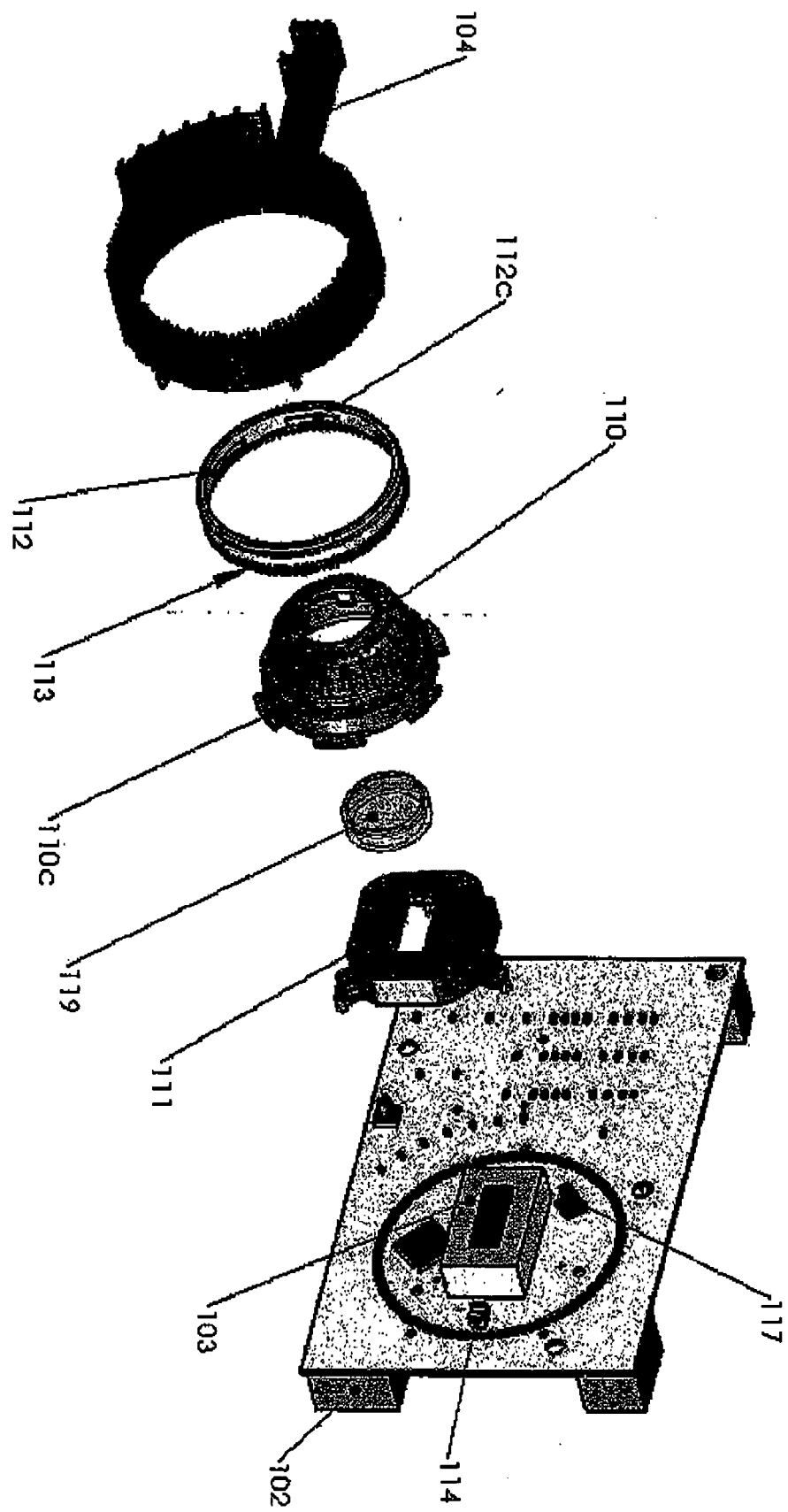
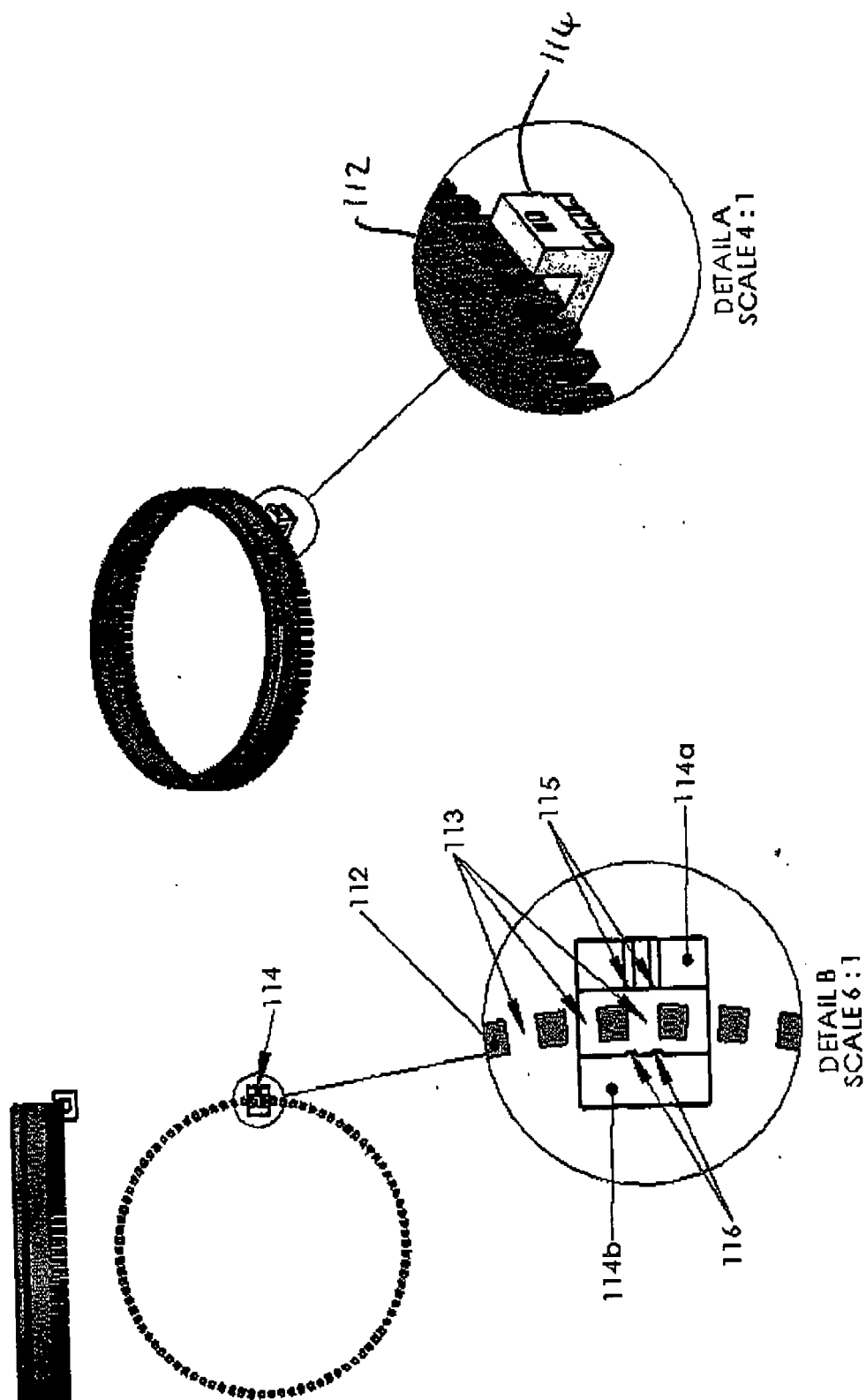


Fig 7c



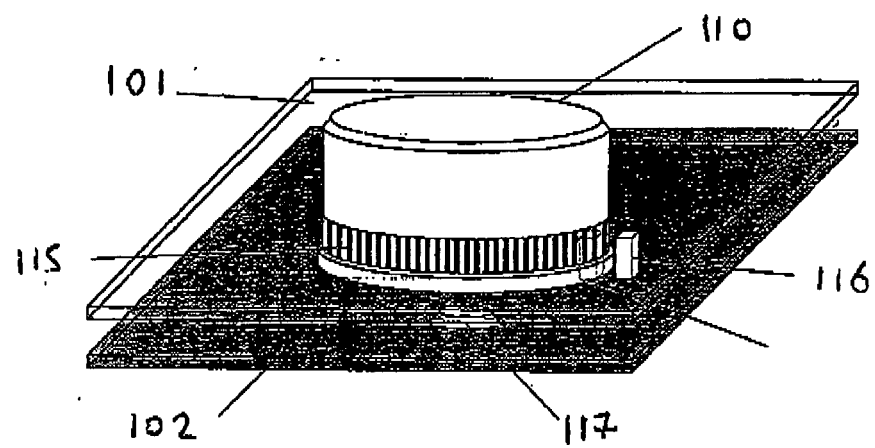


Figure 8