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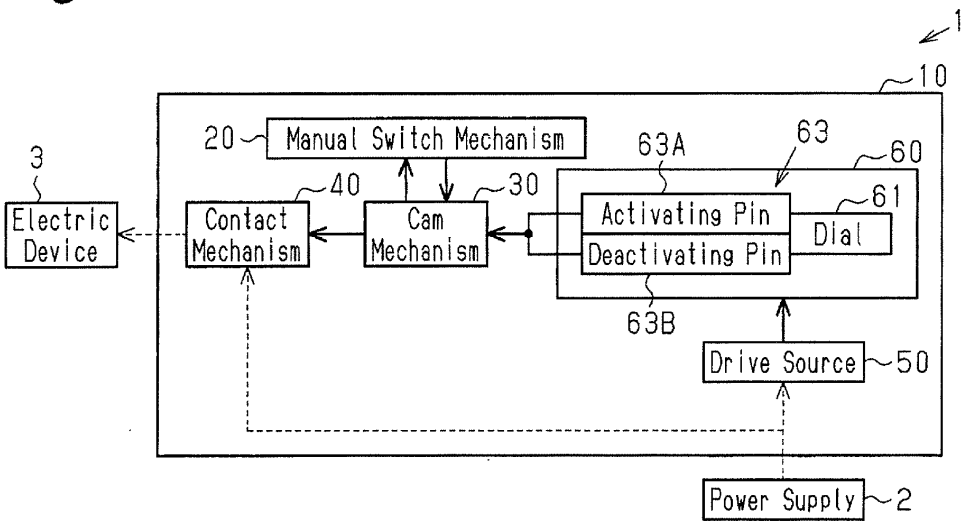
(54) TIME SWITCH

(57) A time switch (1) includes a contact mechanism (40) switched to an activation state, in which the contact mechanism (40) electrically connects a power supply (2) and an electric device (3), or a deactivation state, in which the contact mechanism (40) electrically disconnects the power supply (2) and the electric device (3). The time switch (1) further includes a cam mechanism (30) that mechanically drives the contact mechanism (40) to switch the contact mechanism (40) between the activation state and the deactivation state, a rotation shaft (21) capable of transmitting torque to the cam mechanism (30), and a knob (22) that is coupled to the rotation shaft (21) to switch an operation state of the contact mechanism (40). In addition, the time switch (1) includes a ratchet mechanism (25) that allows rotation of the rotation shaft (21) when the knob (22) receives force that rotates the knob (22) in a first direction and restricts rotation of the rotation shaft (21) when the knob (22) receives force that rotates the knob (22) in a second direction.

Fig.1



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Description

[0001] The present invention relates to a time switch.

[0002] A known time switch, which is arranged in an electric power line that electrically connects a power supply and an electric device, manages the time at which the supply of power from the power supply to the electric device is started and the time at which the supply of power from the power supply to the electric device is stopped. Japanese Laid-Open Patent Publication No. 2005-63923 discloses one example of a conventional time switch that includes a contact mechanism, a cam mechanism, and a timer mechanism. The contact mechanism is switched between an activation state in which the contact mechanism closes the electric power line and a deactivation state in which the contact mechanism opens the electric power line. The cam mechanism switches the operation state of the contact mechanism. The timer mechanism operates the cam mechanism in accordance with the measured time. The time switch further includes an electric motor, which drives the timer mechanism with power supplied from a commercial power supply, and an activating pin and a deactivating pin, which are attached to the timer mechanism to switch the operation state of the contact mechanism. The activating pin and the deactivating pin are coupled to the timer mechanism in a removable manner.

[0003] In the above time switch, the timer mechanism to which the activating pin and the deactivating pin are attached is driven to change the rotation positons of the activating pin and the deactivating pin relative to the cam mechanism as time elapses. For example, if the activating pin comes into contact with the cam mechanism when the contact mechanism is deactivated, the torque of the timer mechanism moves the cam mechanism so that the operation state of the contact mechanism is switched from the deactivation state to the activation state. This starts the supply of power from the power supply to the electric device. If the deactivating pin comes into contact with the cam mechanism when the contact mechanism is activated, the torque of the timer mechanism moves the cam mechanism so that the operation state of the contact mechanism is switched from the activation state to the deactivation state. This stops the supply of power from the power supply to the electric device.

[0004] In addition to the above mechanism that uses the timer mechanism to switch the operation state of the contact mechanism, the above switch includes a knob that is rotated by a user to switch the operation state of the contact mechanism. The torque applied to the knob is transmitted to the cam mechanism by a rotation shaft. The knob may be rotated to and positioned at a first operation position, at which the knob switches the operation state of the contact mechanism to the activation state, and a second operation position, at which the knob switches the operation state of the contact mechanism to the deactivation state. The knob is rotated in a first direction, which may be the clockwise direction, to alternately switch the operation position of the knob to the first operation position and the second operation position.

[0005] When the operation position of the knob is changed to the first operation position, the rotation of the knob moves the cam mechanism so that the operation state of the contact mechanism is switched from the deactivation state to the activation state. When the operation position of the knob is changed to the second operation position, the rotation of the knob moves the cam mechanism so that the operation state of the contact mechanism is switched from the activation state to the deactivation state.

[0006] In the time switch, even if the knob receives an external force that acts to rotate the knob in a second direction, which is a direction opposite to the first direction and may be the counterclockwise, the relationship of the cam mechanism and the contact mechanism does not allow the knob, the rotation shaft, and the cam mechanism to rotate in the second direction. Thus, even when the user erroneously applies force to the knob in the second direction, the force does not rotate the knob. This allows the user to recognize that the knob is rotated in the opposite, or incorrect, direction. However, if the user cannot understand that the knob is configured to be rotatable in only one direction, the user may apply a strong force to the knob in the second direction. The force, when transmitted to the contact mechanism, may deform or damage the components of the contact mechanism.

[0007] It is an object of the present invention to provide a time switch that restricts the application of a large load to a contact mechanism.

[0008] According to one aspect of the present invention, a time switch for use with a power supply and an electric device is provided. The time switch includes a contact mechanism switched to an activation state, in which the contact mechanism electrically connects a power supply and an electric device, or a deactivation state, in which the contact mechanism electrically disconnects the power supply and the electric device, a cam mechanism that mechanically drives the contact mechanism to switch the contact mechanism between the activation state and the deactivation state, a rotation shaft capable of transmitting torque to the cam mechanism, and a knob coupled to the rotation shaft. When the knob is set at a first operation position, the knob switches an operation state of the contact mechanism to the activation state. When the knob is set at a second operation position, the knob switches the operation state of the contact mechanism to the deactivation state. The time switch includes a ratchet mechanism that allows rotation of the rotation shaft when the knob receives force that rotates the knob in a first direction and restricts rotation of the rotation shaft when the knob receives force that rotates the knob in a second direction, which is opposite to the first direction.

[0009] In the time switch according to the above aspect, the application of a large load to the contact mechanism is restricted. Other aspects and advantages of the

invention will become apparent from the following description, taken in conjunction with the accompanying drawings, illustrating by way of example the principles of the invention.

[0010] The invention, together with objects and advantages thereof, may best be understood by reference to the following description of the presently preferred embodiments together with the accompanying drawings in which:

Fig. 1 is a block diagram showing one embodiment of a time switch;
Fig. 2 is a front view showing one example of the time switch of Fig. 1;
Fig. 3 is a cross-sectional view taken along line D3-D3 in Fig. 2;
Fig. 4 is a perspective view of a manual switch mechanism and a cam mechanism shown in Fig. 3;
Fig. 5 is a rear view showing a contact mechanism when activated; and
Fig. 6 is a rear view showing the contact mechanism when deactivated.

[0011] Fig. 1 is a block diagram showing the relationship between the main components of a time switch 1 according to one embodiment. In Fig. 1, the solid lines show the mechanical connection between the components of the time switch 1, and the broken lines show the electrical connection between the components of the time switch 1.

[0012] The time switch 1 is arranged in an electric power line that electrically connects a power supply 2 and an electric device 3. One example of the power supply 2 is a commercial power supply. One example of the electric device 3 is an electric lock installed in a building. When a contact mechanism 40 of the time switch 1 is activated, the power supply 2 and the electric device 3 are electrically connected. When the contact mechanism 40 of the time switch 1 is deactivated, the power supply 2 and the electric device 3 are electrically disconnected.

[0013] In addition to the contact mechanism 40, the time switch 1 includes a cam mechanism 30, which mechanically drives the contact mechanism 40 to switch the operation state of the contact mechanism 40, a timer mechanism 60, which operates the cam mechanism 30 in accordance with the measured time, and a drive source 50, which drives the timer mechanism 60. One example of the drive source 50 is an electric motor. The timer mechanism 60 includes a dial 61, which is rotated by the drive force of the drive source 50. The dial 61 is essentially a clock that measures the present time.

[0014] The time switch 1 further includes a case 10, which forms the contour of the time switch 1, a setting pin 63, which uses the torque of the timer mechanism 60 to operate the cam mechanism 30, and a manual switch mechanism 20, which is operated to switch the operation state of the contact mechanism 40. The contact mechanism 40, the cam mechanism 30, the timer mechanism 60, and the drive source 50 are accommodated in the case 10.

[0015] The setting pin 63, which is coupled to the dial 61 in a removable manner, rotates integrally with the dial 61 when attached to the dial 61. The time switch 1 includes two types of setting pins 63, namely, an activating pin 63A and a deactivating pin 63B. The activating pin 63A is attached to the dial 61 to switch the operation state of the contact mechanism 40 to the activation state. The deactivating pin 63B is attached to the dial 61 to switch the operation state of the contact mechanism 40 to the deactivation state.

[0016] The manual switch mechanism 20 may be located at a first operation position, at which the manual switch mechanism 20 sets the operation state of the contact mechanism 40 to the activation state, and a second operation position, at which the manual switch mechanism 20 sets the operation state of the contact mechanism 40 to the deactivation state. The operation position of the manual switch mechanism 20 is changed by the user. When the operation position of the manual switch mechanism 20 is set to the first operation position, the cam mechanism 30 is operated regardless of the rotation position of the activating pin 63A. This switches the operation state of the contact mechanism 40 to the activation state. When the operation position of the manual switch mechanism 20 is set to the second operation position, the cam mechanism 30 is operated regardless of the rotation position of the deactivating pin 63B. This switches the operation state of the contact mechanism 40 to the deactivation state.

[0017] Fig. 2 is a front view showing one example of the time switch 1.

[0018] The case 10 includes a main wall 11, which forms the front surface of the case 10, side walls 12, which form the side surfaces of the case 10, and a dial arrangement portion 13, in which the dial 61 is arranged. The dial arrangement portion 13 is a recess that is formed in the substantially middle portion of the case 10 and opens in the main wall 11.

[0019] The time switch 1 further includes a terminal group 14, to which power supply wires (not shown) and device wires (not shown) are connected. The power supply wires are connected to the power supply 2 (refer to Fig. 1), and the device wires are connected to the electric device 3 (refer to Fig. 1). The terminal group 14, which is located in the lower portion of the case 10, includes a first terminal 14A, a second terminal 14B, a third terminal 14C, and a fourth terminal 14D.

[0020] A power supply wire connected to the positive terminal of the power supply 2 is connected to the first terminal 14A. A power supply wire connected to the negative terminal of the power supply 2 is connected to the second terminal 14B. A device wire connected to the negative terminal of the electric device 3 is connected to the third terminal 14C. A device wire connected to the positive terminal of the electric device 3 is connected to the fourth terminal 14D. The first and second terminals 14A

and 14B may be referred to as power input terminals. The third and fourth terminals 14C and 14D may be referred to as power output terminals.

[0021] In addition, the time switch 1 includes a transparent protection cover 15 and a back cover 16 (refer to Fig. 3), which are coupled to the case 10 in a removable manner. The protection cover 15 is attached to the case 10 to cover the front surface of the case 10. The back cover 16 is attached to the case 10 to cover the back portion of the manual switch mechanism 20 and the back portion of the cam mechanism 30 (refer to Fig. 3).

[0022] The timer mechanism 60 includes the dial 61 and a time plate 62, which indicates the present time. In one example, the dial 61 rotates once every twenty-four hours. The front surface of the dial 61 includes time marks (not shown) indicating twenty-four hours of time.

[0023] The time plate 62 includes a present time indicator 62A, which indicates the present time, and a rotation direction indicator 62B, which is represented by an arrow that indicates the rotation direction of the dial 61. When the rotation position of the dial 61 relative to the time plate 62 is set so that the time mark indicating the present time on the dial 61 is aligned with the present time indicator 62A of the time plate 62, the time measured by the dial 61 corresponds to the present time. From this state, when the dial 61 continues to be operated by the drive force of the drive source 50 (refer to Fig. 1), the time mark of the dial 61 corresponding to the present time indicator 62A of the time plate 62 will indicate the present time.

[0024] The structure of the manual switch mechanism 20 will now be described with reference to Figs. 3 and 4.

[0025] The manual switch mechanism 20 includes a rotation shaft 21, which is supported by a bearing 16A of the back cover 16 rotationally relative to the case 10, a shaft case 24, which partially covers the rotation shaft 21, a ratchet mechanism 25, which restricts the rotation direction of the rotation shaft 21, a knob 22, which is operated to switch the operation state of the contact mechanism 40, and a first gear 23, which is engaged with a second gear 34 of the cam mechanism 30. The shaft case 24 is formed integrally with the back cover 16. The rotation shaft 21 is slidable with respect to the shaft case 24 in the axial direction.

[0026] The ratchet mechanism 25 includes movable pawls 25A, which are formed on the outer circumference of the rotation shaft 21, and immovable pawls 25B, which are formed on the end surface of the shaft case 24. The movable pawls 25A and the immovable pawls 25B are formed at regular intervals in the circumferential direction. The rotation shaft 21, the knob 22, the first gear 23, and the movable pawls 25A may be formed integrally as a single member. The knob 22 projects toward the front of the case 10 through a hole that is formed in the main wall 11 of the case 10. The first gear 23 is an external gear that is formed on the outer circumference of the rotation shaft 21.

[0027] Each movable pawl 25A includes an end surface that extends in the axial direction of the rotation shaft 21, and each immovable pawl 25B includes an end surface that extends in the axial direction of the rotation shaft 21. Further, the end surface of each movable pawl 25A is opposed to the end surface of one of the immovable pawls 25B in the circumferential direction of the rotation shaft 21. When force is applied to the knob 22 to rotate the knob 22 in a first direction, which may be the clockwise direction in a front view of the case 10, the movable pawls 25A of the rotation shaft 21 move over the immovable pawls 25B of the shaft case 24. This rotates the rotation shaft 21 in the first direction relative to the shaft case 24. The ratchet mechanism 25 may produce, by means of the pawls 25A and 25B, a clicking feedback that is perceivable by the user when the user rotates the knob 22 in the first direction.

[0028] When force is applied to the knob 22 to rotate the knob 22 in a second direction, which is opposite to the first direction, the movable pawls 25A of the rotation shaft 21 are caught by the immovable pawls 25B of the shaft case 24. More specifically, the end surfaces of the movable pawls 25A of the rotation shaft 21 abut against the end surfaces of the immovable pawls 25B. This restricts rotation of the rotation shaft 21 in the second direction relative to the shaft case 24.

[0029] Thus, the ratchet mechanism 25 allows rotation of the rotation shaft 21 when the knob 22 receives force that acts to rotate the knob 22 in the first direction and restricts rotation of the rotation shaft 21 when the knob 22 receives force that acts to rotate the knob 22 in the second direction. The first direction is the same as the direction in which the dial 61 rotates to measure time.

[0030] As viewed in Fig. 2, the knob 22 is located in a longitudinally upper portion of the case 10 at a lateral end of the case 10. The main wall 11 of the case 10 includes a first operation position mark 17 and a second operation position mark 18, which indicate the operation positions of the knob 22, that is, the operation positions of the manual switch mechanism 20. In one example, each of the first operation position mark 17 and the second operation position mark 18 includes symbols and characters printed on the main wall 11.

[0031] The knob 22 includes a hollow tubular portion 22A, which opens in a distal end of the knob 22, and a mark 22B, which indicates the operation position of the knob 22 and the operation state of the contact mechanism 40 (refer to Fig. 3). In one example, the mark 22B is a rib arranged in the hollow tubular portion 22A and has a rectangular front surface. When the knob 22 rotates relative to the case 10, the mark 22B rotates. This changes the positions of the short sides (outermost ends of mark 22B) of the rectangular front surface.

[0032] When the operation position of the knob 22 is set to the first operation position, the mark 22B (in particular, one short side of rectangular front surface) is directed toward the first operation position mark 17. From the relationship of the mark 22B (one short side of rectangular front surface) and the first operation position

mark 17, the user can acknowledge that the operation position of the manual switch mechanism 20 is set to the first operation position and that the operation state of the contact mechanism 40 is set to the activation state.

[0033] When the operation position of the knob 22 is set to the second operation position, the mark 22B (in particular, one short side of rectangular front surface) is directed toward the second operation position mark 18. From the relationship of the mark 22B (one short side of rectangular front surface) and the second operation position mark 18, the user can acknowledge that the operation position of the manual switch mechanism 20 is set to the second operation position and that the operation state of the contact mechanism 40 is set to the deactivation state.

[0034] The structure of the contact mechanism 40 will now be described with reference to Figs. 5 and 6.

[0035] The contact mechanism 40 includes a first metal plate 41 and a second metal plate 42, which are electrically connected to the terminals (refer to Fig. 2) of the terminal group 14, and a base 43, which supports the metal plates 41 and 42. The base 43 is fixed to the case 10 (refer to Fig. 3). Each of the metal plates 41 and 42 is press-fitted to a groove 43A, which is formed in the base 43.

[0036] In one example, the first metal plate 41 is electrically connected to the fourth terminal 14D (refer to Fig. 2), and the second metal plate 42 is electrically connected to the first terminal 14A (refer to Fig. 2). The first metal plate 41 includes a first contact 41A. The second metal plate 42 includes a second contact 42A. The cam mechanism 30 moves the metal plates 41 and 42 to change the distance of the first contact 41 A and the second contact 42A.

[0037] When the first metal plate 41 and the second metal plate 42 move toward each other so that the first contact 41 A and the second contact 42A contact each other, the power supply 2 and the electric device 3 (refer to Fig. 1) are electrically connected. When the first metal plate 41 and the second metal plate 42 move away from each other so that the first contact 41 A and the second contact 42A are separated from each other, the power supply 2 and the electric device 3 are electrically disconnected.

[0038] The structure of the cam mechanism 30 will now be described with reference to Figs. 3 and 4.

[0039] The cam mechanism 30 includes a camshaft 31, which is supported by a bearing 10A of the case 10 and the bearing 16A of the back cover 16 rotationally relative to the case 10, and setting pin cams 32, which are configured to contact the setting pins 63 (refer to Fig. 2). The cam mechanism 30 further includes switch cams 33, which are configured to contact the metal plates 41 and 42, and the second gear 34, which is engaged with the first gear 23. The camshaft 31, the setting pin cams 32, the switch cams 33, and the second gear 34 are formed integrally as a single member. The second gear 34 is an external gear that is formed on the outer circumference of the camshaft 31. In one example, the second gear 34 has twice as much teeth as the first gear 23.

[0040] The setting pin cams 32 include four first setting pin cams 32A, which contact the activating pin 63A (refer to Fig. 2), and four second setting pin cams 32B, which contact the deactivating pin 63B (refer to Fig. 2). Each of the first setting pin cams 32A and each of the second setting pin cams 32B radially project from the outer circumference of the camshaft 31 and are formed at regular intervals in the circumferential direction of the camshaft 31.

[0041] The phase of each first setting pin cam 32A and the phase of each second setting pin cam 32B in the circumferential direction of the camshaft 31 have a predetermined phase difference. One example of the predetermined phase difference is 45°. Further, each first setting pin cam 32A and each second setting pin cam 32B are located at different positions in the axial direction of the camshaft 31.

[0042] When the rotation shaft 21 is rotated in the first direction, the camshaft 31 is rotated in the second direction. In one example, whenever the rotation shaft 21 is rotated by 90° in the first direction, the camshaft 31 rotated by 45° in the second direction. Rotation of the camshaft 31 in the second direction changes the positions of each setting pin cam 32A and each setting pin cam 32B relative to the dial arrangement portion 13.

[0043] When the operation position of the knob 22 is set to the first operation position, the rotation phase of the camshaft 31 is set to a first rotation phase. One of the second setting pin cams 32B projects from the dial arrangement portion 13, and all of the first setting pin cams 32A are accommodated in the case 10. The second setting pin cam 32B that projects from the dial arrangement portion 13 and the tab of the deactivating pin 63B that is attached to the dial 61 are located at substantially the same position in the axial direction of the dial arrangement portion 13. Thus, the first rotation phase of the cam mechanism 30 allows the deactivating pin 63B to come into contact with the second setting pin cam 32B, and the first rotation phase of the cam mechanism 30 does not allow the activating pin 63A to come into contact with the first setting pin cam 32A. In the illustrated cam mechanism 30, four rotation phases correspond to the first rotation phase. The four rotation phases are, for example, 0°, 90°, 180°, and 270°.

[0044] When the operation position of the knob 22 is set to the second operation position, the rotation phase of the camshaft 31 is set to a second rotation phase. In this case, one of the first setting pin cams 32A projects from the dial arrangement portion 13, and all of the second setting pin cams 32B are accommodated in the case 10. The first setting pin cam 32A that projects from the dial arrangement portion 13 and the tab of the activating pin 63A that is attached to the dial 61 are located at substantially the same position in the axial direction of the dial arrangement portion 13. Thus, the second rotation phase of the cam mechanism 30 allows the activating

pin 63A to come into contact with the first setting pin cam 32A, and the second rotation phase of the cam mechanism 30 does not allow the deactivating pin 63B to come into contact with the second setting pin cam 32B. In the illustrated cam mechanism 30, four rotation phases correspond to the first rotation phase. The four rotation phases are, for example, 45°, 135°, 225°, and 315°.

[0045] The switch cams 33 include four first switch cams 33A, which are configured to contact the first metal plate 41, and four second switch cams 33B, which are configured to contact the second metal plate 42. The first switch cams 33A and the second switch cams 33B radially project from the outer circumference of the camshaft 31 and are formed at regular intervals in the circumferential direction of the camshaft 31.

[0046] The phase of each first switch cam 33A and the phase of each second switch cam 33B in the circumferential direction of the camshaft 31 have a predetermined phase difference. One example of the predetermined phase difference is 45°. Further, each first switch cam 33A and each second switch cam 33B are located at different positions in the axial direction of the camshaft 31.

[0047] As shown in Fig. 5, when the rotation phase of the camshaft 31 is set to the first rotation phase, the second switch cams 33B push the second metal plate 42 toward the first metal plate 41, and the first switch cams 33A do not push the first metal plate 41. Thus, the first contact 41 A and the second contact 42A come into contact with each other. That is, the operation state of the contact mechanism 40 is set to the activation state. Further, in this state, a distal end of the first metal plate 41 comes into contact with an end surface of the first switch cam 33A. Accordingly, even if the camshaft 31 receives the torque that acts to rotate the first switch cam 33A in the first direction, the distal end of the first metal plate 41 comes into contact with the end surface of the first switch cam 33A to restrict rotation of the camshaft 31 in the first direction.

[0048] As shown in Fig. 6, when the rotation phase of the camshaft 31 is set to the second rotation phase, the first switch cams 33A push the first metal plate 41 so that the first metal plate 41 is separated from the second metal plate 42, and the second switch cams 33B do not push the second metal plate 42. Thus, the first contact 41A does not come into contact with the second contact 42A. That is, the operation state of the contact mechanism 40 is set to the deactivation state. Further, in this state, a distal end of the second metal plate 42 comes into contact with an end surface of the second switch cam 33B. Accordingly, even if the camshaft 31 receives the torque that acts to rotate the second switch cam 33B in the first direction, the distal end of the second metal plate 42 comes into contact with the end surface of the second switch cam 33B to restrict rotation of the camshaft 31 in the first direction.

[0049] The operation of the time switch 1 will now be described with reference to Fig. 3.

[0050] The time switch 1 allows the user to use a first mode, in which the contact mechanism 40 is automatically operated by a timer function of the timer mechanism 60, and a second mode, in which the contact mechanism 40 is manually operated by the manual switch mechanism 20.

[0051] In the first mode, the time switch 1 is operated in the following manner. For example, the contact mechanism 40 is initially deactivated. From this state, the timer function of the timer mechanism 60 switches the operation state of the contact mechanism 40 from the deactivation state to the activation state at a first predetermined time and switches the operation state of the contact mechanism 40 from the activation state to the deactivation state at a second predetermined time, which follows the first predetermined time.

[0052] First, the protection cover 15 is removed from the case 10. The activating pin 63A (refer to Fig. 2) is attached to a position of the dial 61 corresponding to the first predetermined time, and the deactivating pin 63B (refer to Fig. 2) is attached to a position of the dial 61 corresponding to the second predetermined time. Then, the protection cover 15 is reattached to the case 10. The setting of the operation position of the knob 22 and the attachment of the setting pin 63 (refer to Fig. 2) may be performed in any order.

[0053] Rotation of the dial 61 moves the activating pin 63A toward the first setting pin cam 32A that projects from the dial arrangement portion 13. When the present time reaches the first predetermined time, the activating pin 63A comes into contact with the first setting pin cam 32A and continues to rotate while pushing the first setting pin cam 32A. When the first setting pin cam 32A is pushed by the activating pin 63A, the camshaft 31 rotates in the second direction. This changes the rotation phase of the camshaft 31 from the second rotation phase to the first rotation phase.

[0054] Thus, as shown in Figs. 5 and 6, the operation state of the contact mechanism 40 is switched from the deactivation state to the activation state. The rotation of the camshaft 31 is transmitted to the contact mechanism 40. Further, as shown in Fig. 4, the rotation of the camshaft 31 is transmitted to the rotation shaft 21 by the engagement of the second gear 34 with the first gear 23 of the rotation shaft 21. Accordingly, as the rotation phase of the camshaft 31 changes from the second rotation phase to the first rotation phase, the rotation shaft 21 rotates to change the operation position of the knob 22 from the second operation position to the first operation position.

[0055] Further rotation of the dial 61 moves the deactivating pin 63B toward the second setting pin cam 32B that projects from the dial arrangement portion 13. When the present time reaches the second predetermined time, the deactivating pin 63B comes into contact with the second setting pin cam 32B and continues to rotate while pushing the second setting pin cam 32B. When the second setting pin cam 32B is pushed by the deactivating

pin 63B, the camshaft 31 rotates in the second direction. This changes the rotation phase of the camshaft 31 from the first rotation phase to the second rotation phase.

[0056] Thus, as shown in Figs. 5 and 6, the operation state of the contact mechanism 40 is switched from the activation state to the deactivation state. The rotation of the camshaft 31 is transmitted to the contact mechanism 40. Further, as shown in Fig. 4, the rotation of the camshaft 31 is transmitted to the rotation shaft 21 by the engagement of the second gear 34 with the first gear 23 of the rotation shaft 21. Accordingly, as the rotation phase of the camshaft 31 changes from the first rotation phase to the second rotation phase, the rotation shaft 21 rotates to change the operation position of the knob 22 from the first operation position to the second operation position.

[0057] In the second mode, the time switch 1 is operated in the following manner.

[0058] First, the protection cover 15 is removed from the case 10. The user rotates the knob 22 from the second operation position to the first operation position. The rotation of the knob 22, that is, the rotation of the rotation shaft 21 shown in Fig. 4, is transmitted to the camshaft 31 via the first gear 23 and the second gear 34. As a result, the rotation phase of the camshaft 31 changes from the second rotation phase to the first rotation phase. Accordingly, as shown in Figs. 5 and 6, the operation state of the contact mechanism 40 is switched from the deactivation state to the activation state.

[0059] The user rotates the knob 22 from the first operation position to the second operation position. The rotation of the knob 22, that is, the rotation of the rotation shaft 21 shown in Fig. 4, is transmitted to the camshaft 31 via the first gear 23 and the second gear 34. As a result, the rotation phase of the camshaft 31 changes from the first rotation phase to the second rotation phase. Accordingly, as shown in Figs. 5 and 6, the operation state of the contact mechanism 40 is switched from the activation state to the deactivation state.

[0060] In the second mode, when the knob 22 receives a force that acts to rotate the knob 22 in the second direction, the force is received by the movable pawls 25A (refer to Fig. 4) and the immovable pawls 25B (refer to Fig. 4) of the ratchet mechanism 25. Thus, as compared to when the ratchet mechanism 25 does not exist, a force transmitted from the knob 22 to the metal plates 41 and 42 is small. This reduces situations in which the metal plates 41 and 42 are deformed or damaged.

[0061] The time switch 1 has the advantages described below.

(1) The knob 22 includes the mark 22B. In this structure, the user can easily acknowledge the operation position of the knob 22 and the operation state of the contact mechanism 40 from the mark 22B. This reduces situations in which the knob 22 is operated erroneously.

(2) The case 10 includes the first operation position mark 17 and the second operation position mark 18. This ensures that the user is able to acknowledge the operation position of the knob 22 and the operation state of the contact mechanism 40 based on the relationship of the mark 22B of the knob 22 and each of the operation position marks 17 and 18. This further reduces situations in which the knob 22 is operated erroneously.

(3) The rotation direction of the knob 22 that switches the operation state of the contact mechanism 40 is the same as the rotation direction of the dial 61. This structure allows the user to intuitively acknowledge the correct operation direction of the knob 22 as compared to when these directions are different. Thus, the user rotates the knob 22 in the second direction less frequently. This further limits deformation or damage of the contact mechanism 40.

[0062] The description of the above embodiment illustrates the time switch according to one embodiment of the the present invention and is not considered to be restrictive. In addition to the above embodiment, the time switch according to the present invention may include, for example, the following modified examples and an embodiment in which at least two of the modified examples that do not contradict with one another are combined.

[0063] In the time switch 1 of a modified example, the mark 22B is omitted from the knob 22.

[0064] In the time switch 1 of a modified example, at least one of the first operation position mark 17 and the second operation position mark 18 is omitted from the case 10.

[0065] In the ratchet mechanism 25 of a modified example, instead of the immovable pawl 25B of the shaft case 24, the shaft case 24 includes a recess that is shaped in conformance with the shape of the movable pawl 25A of the rotation shaft 21. In another modified example, instead of the movable pawl 25A of the rotation shaft 21, the rotation shaft 21 includes a recess that is shaped in conformance with the shape of the immovable pawl 25B of the shaft case 24.

[0066] The time switch 1 of a modified example includes a second knob, which is coupled to the camshaft 31, a second shaft case, which partially covers the camshaft 31, and a second ratchet mechanism, which restricts the rotation direction of the camshaft 31. In this modified example, the manual switch mechanism 20 is formed by the second knob, the second shaft case, and the second ratchet mechanism. In one example, the second knob includes a structure similar to the knob 22, the second shaft case includes a structure similar to the shaft case 24, and the second ratchet mechanism includes a structure similar to the ratchet mechanism 25. The user operates the knob 22 or the second knob to switch the operation state of the contact mechanism 40. Thus, even when the second knob is operated, it is possible to gain the same advantage as that obtained when the knob 22 is operated.

[0067] In the above example, the manual switch mech-

anism 20 may include a structure that does not include the rotation shaft 21, the shaft case 24, and the ratchet mechanism 25.

[0068] The above description is intended to be illustrative, and not restrictive. For example, the above-described examples (or one or more aspects thereof) may be used in combination with each other. Other embodiments can be used, such as by one of ordinary skill in the art upon reviewing the above description. Also, in the above detailed description, various features may be grouped together to streamline the disclosure. This should not be interpreted as intending that an unclaimed disclosed feature is essential to any claim. Rather, inventive subject matter may lie in less than all features of a particular disclosed embodiment. Thus, the following claims are hereby incorporated into the detailed description, with each claim standing on its own as a separate embodiment. The scope of the invention should be determined with reference to the appended claims, along with the full scope of equivalents to which such claims are entitled.

Claims

1. A time switch (1) for use with a power supply (2) and an electric device (3), the time switch (1) comprising:

a contact mechanism (40) switched to an activation state, in which the contact mechanism (40) electrically connects the power supply (2) and the electric device (3), or a deactivation state, in which the contact mechanism (40) electrically disconnects the power supply (2) and the electric device (3);
a cam mechanism (30) that mechanically drives the contact mechanism (40) to switch the contact mechanism (40) between the activation state and the deactivation state;
a rotation shaft (21) capable of transmitting torque to the cam mechanism (30);
a knob (22) coupled to the rotation shaft (21), wherein when the knob (22) is set at a first operation position, the knob (22) switches an operation state of the contact mechanism (40) to the activation state, and when the knob (22) is set at a second operation position, the knob (22) switches the operation state of the contact mechanism (40) to the deactivation state; and
a ratchet mechanism (25) that allows rotation of the rotation shaft (21) when the knob (22) receives force that rotates the knob (22) in a first direction and restricts rotation of the rotation shaft (21) when the knob (22) receives force that rotates the knob (22) in a second direction, which is opposite to the first direction.

2. The time switch (1) according to claim 1, further comprising a mark (22B) that rotates integrally with the knob (22), wherein the mark (22B) indicates whether the operation state of the contact mechanism (40) is set to the activation state or the deactivation state.

Fig.1

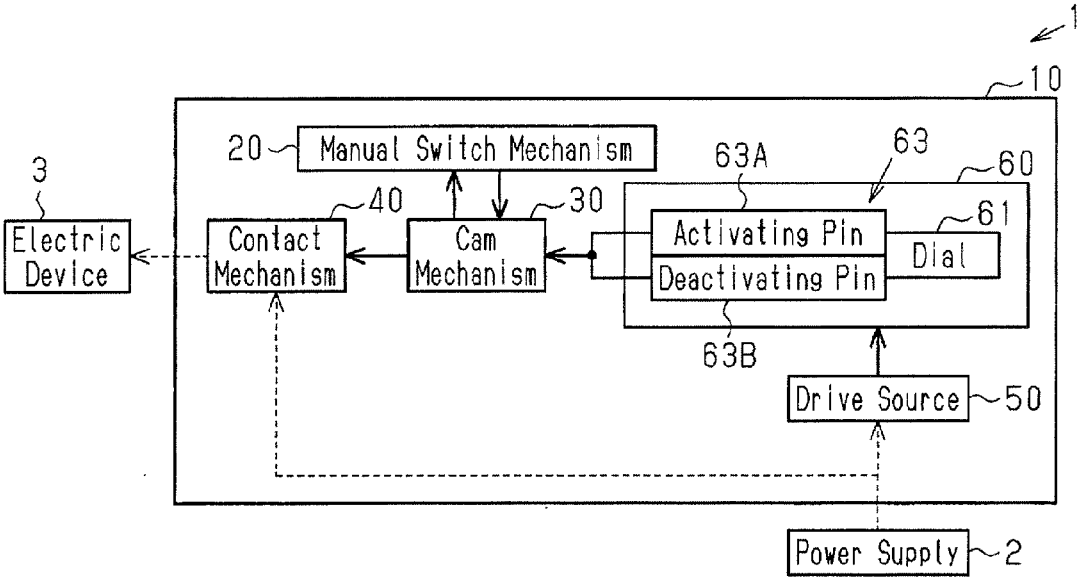

1
10
20
Manual Switch Mechanism
63A
63
60
3
40
30
61
Electric Device
Contact Mechanism
Cam Mechanism
Activating Pin
Dial
Deactivating Pin
63B
Drive Source
50
Power Supply
2

Fig.2

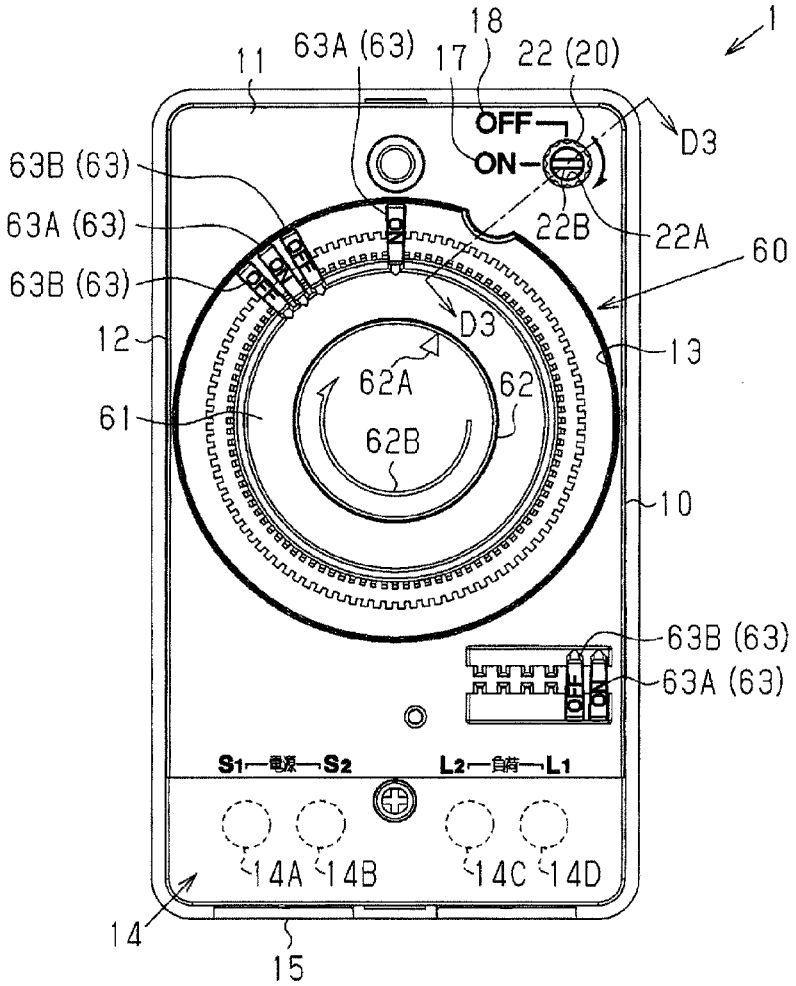

1
18
11
63A (63)
17
22 (20)
OFF
ON
D3
63B (63)
63A (63)
63B (63)
22B
22A
60
12
D3
13
62A
62
61
62B
10
63B (63)
63A (63)
S1—電源—S2
L2—負荷—L1
14A
14B
14C
14D
14
15

Fig.3

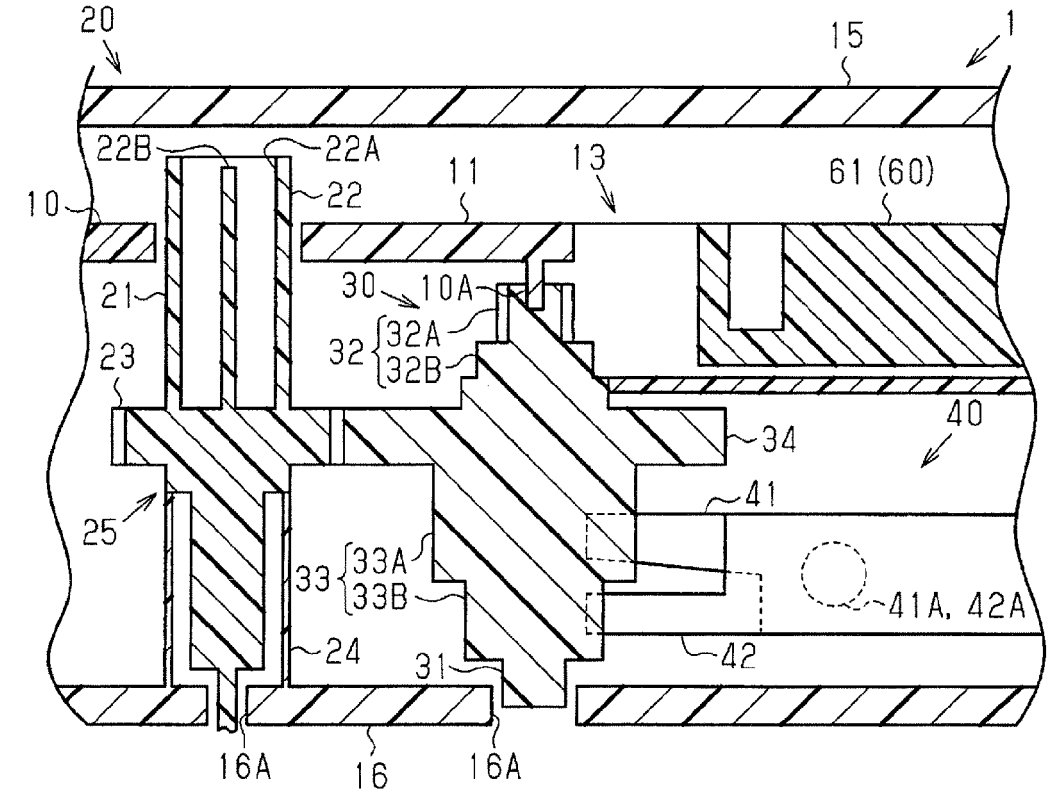

20
15
1
22B
22A
22
11
13
61 (60)
10
21
30
10A
32
32A
32B
23
34
40
41
25
33
33A
33B
41A, 42A
24
31
42
16A
16
16A

Fig.4

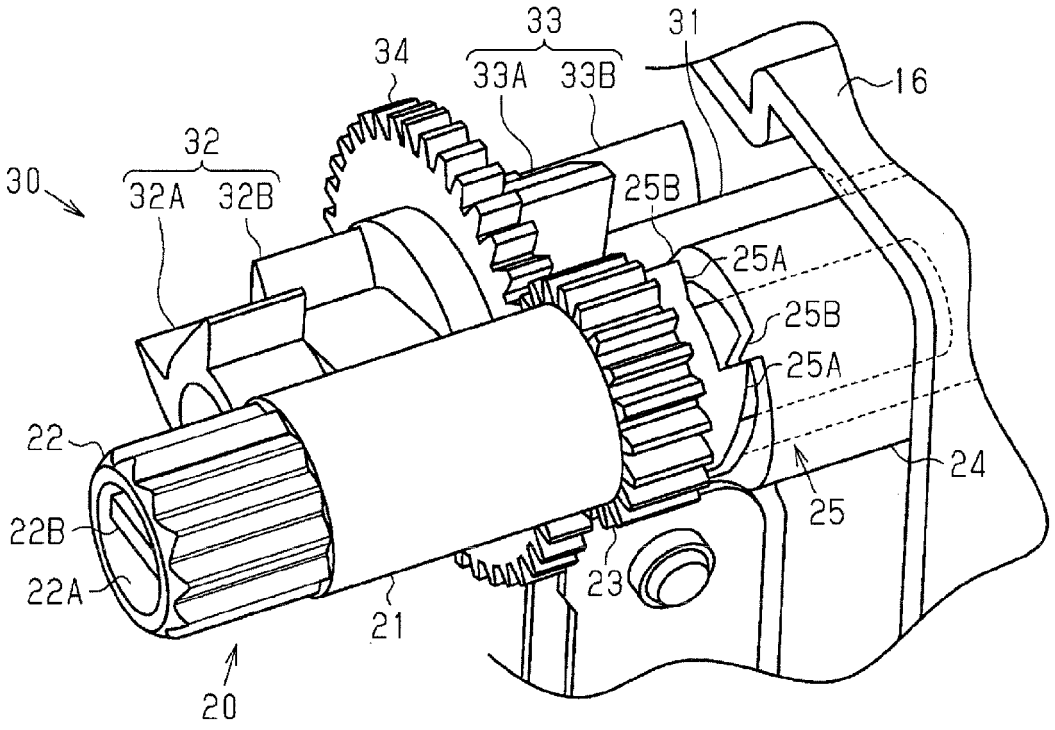

33
31
34
33A
33B
16
32
30
32A
32B
25B
25A
25B
25A
22
24
22B
25
22A
23
21
20

Fig.5

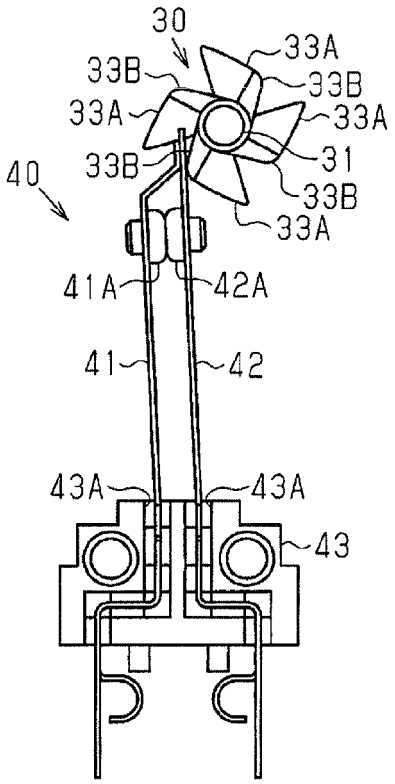
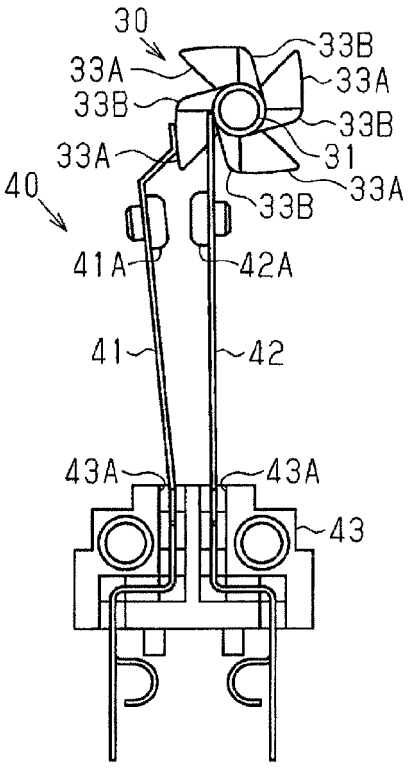

30
33A
33B
33B
33A
33A
33B
31
40
33B
33A
41A
42A
41
42
43A
43A
43

Fig.6


30
33B
33A
33A
33B
33B
33A
31
33A
40
33B
41A
42A
41
42
43A
43A
43

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EUROPEAN SEARCH REPORT

Application Number
EP 15 19 9461

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X	US 2005/045456 A1 (MUROI HIROAKI [JP] ET AL) 3 March 2005 (2005-03-03) * paragraphs [0040] - [0047]; figures 1, 5-7 *	1,2	INV. H01H43/02 H01H43/10
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H01H
G04C

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	6 May 2016	Bräckelmann, Gregor

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