

June 28, 1966

J. L. HARRIS

3,258,552

COMBINED TIME-TEMPERATURE SWITCH DEVICE

Filed March 4, 1963

5 Sheets-Sheet 1

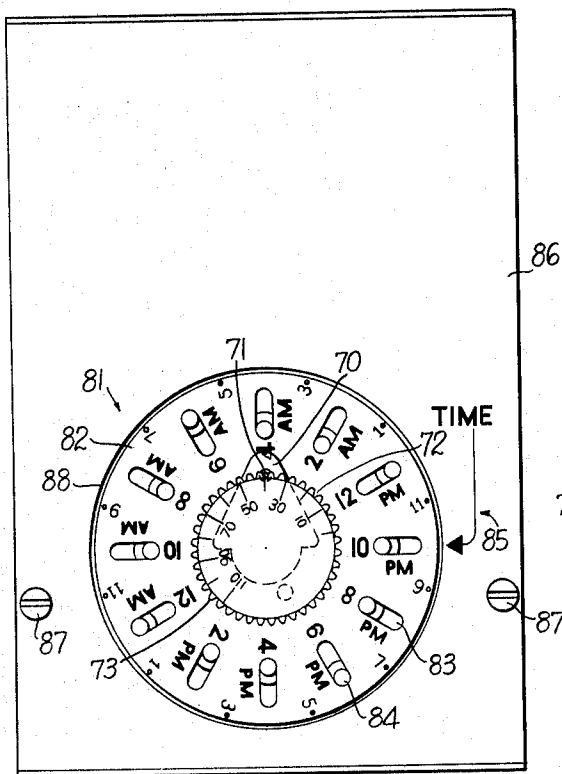


Fig. 1

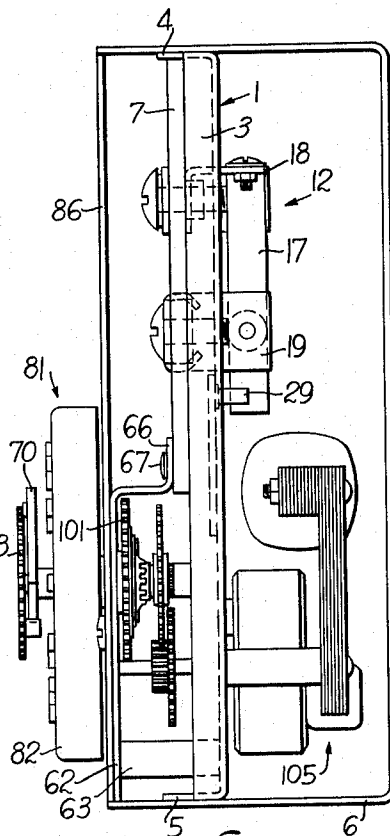


Fig. 2

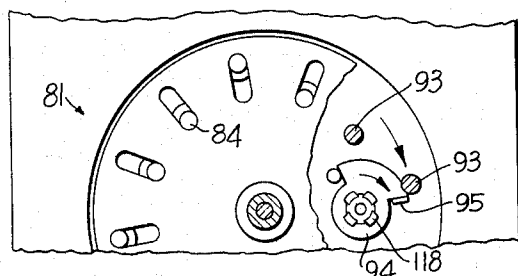


Fig. 3

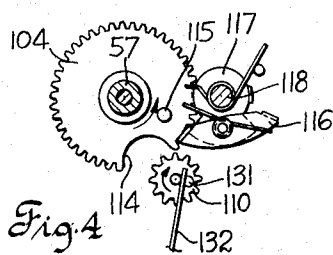


Fig. 4

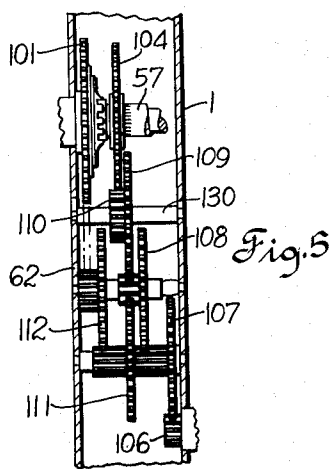


Fig. 5

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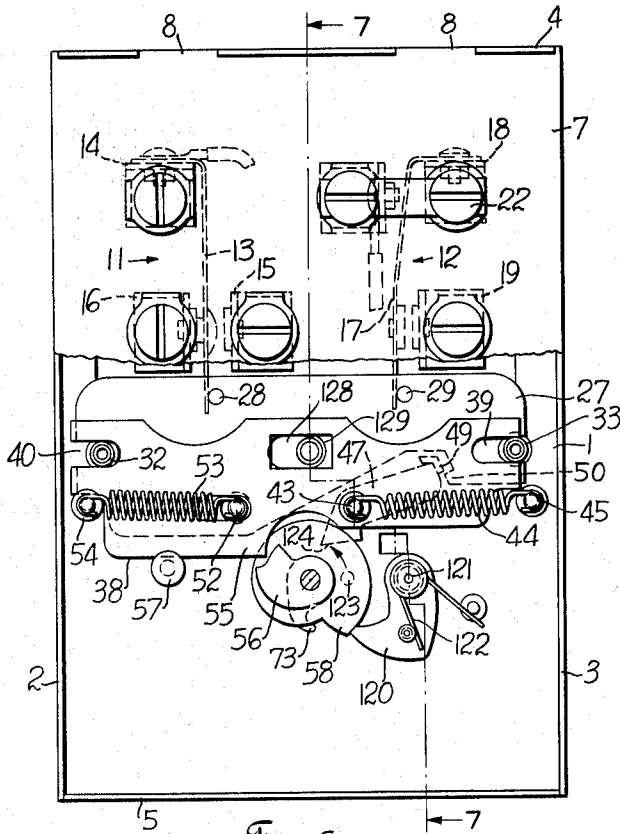


Fig. 6

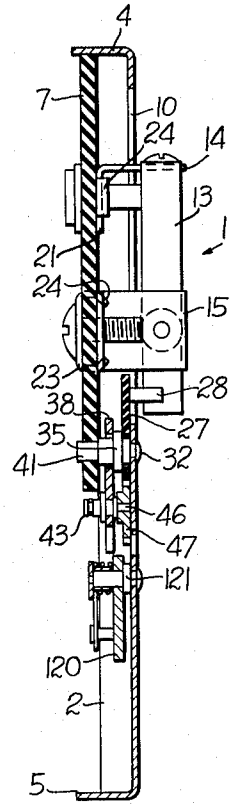


Fig. 7

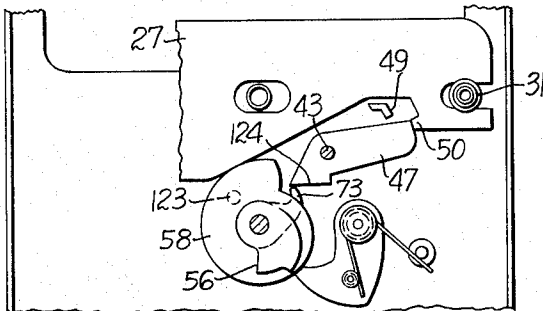


Fig. 8

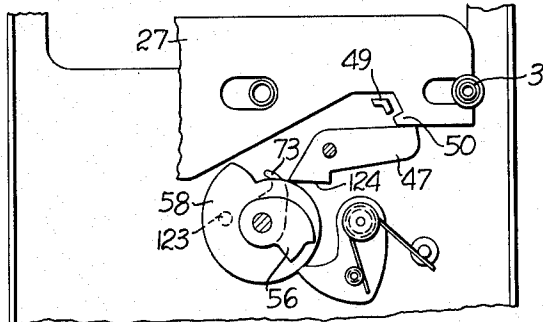


Fig. 9

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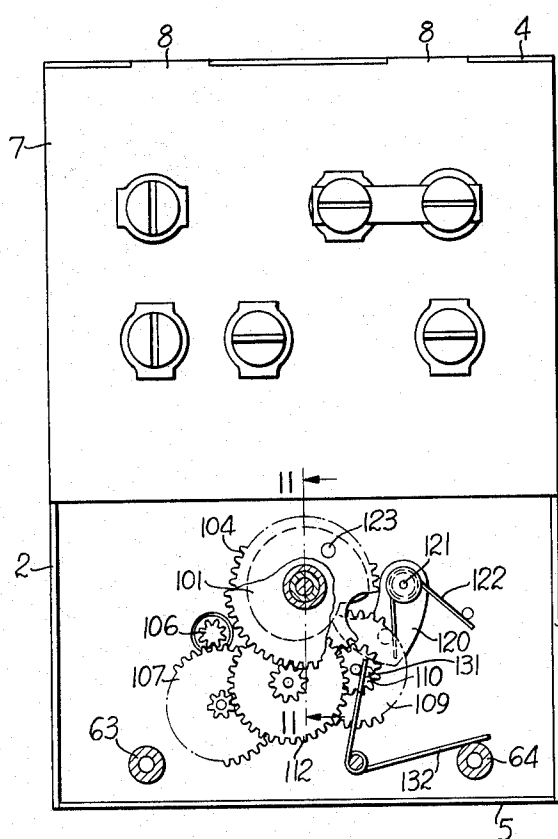


Fig. 10

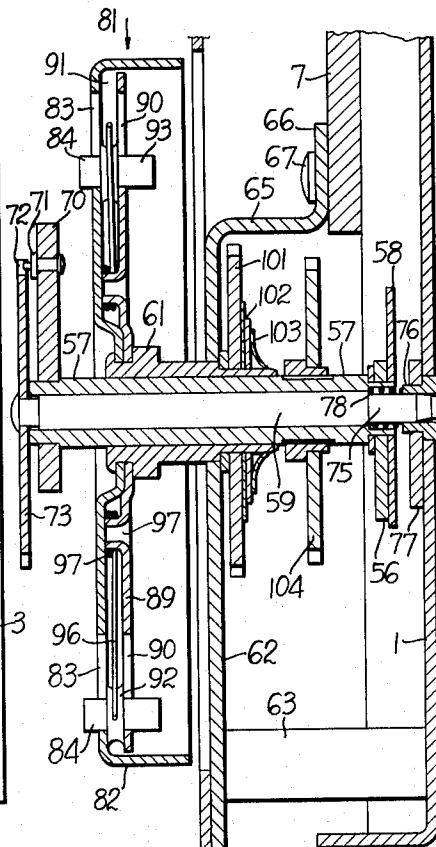


Fig. 11

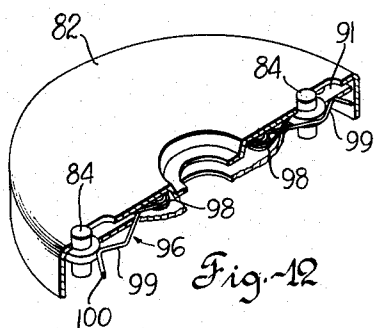


Fig. 12

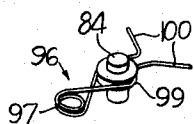


Fig. 13

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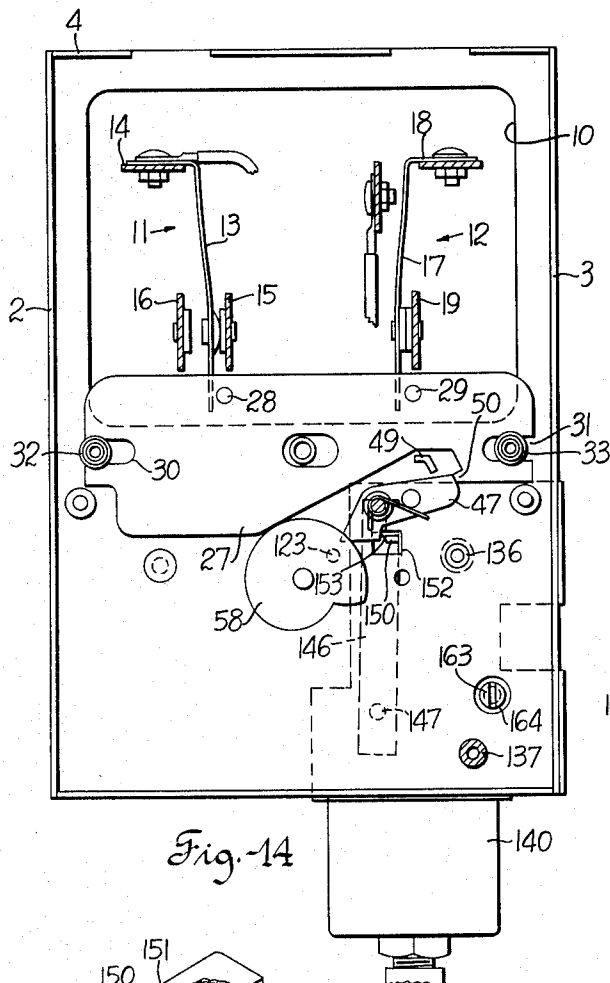


Fig. 14

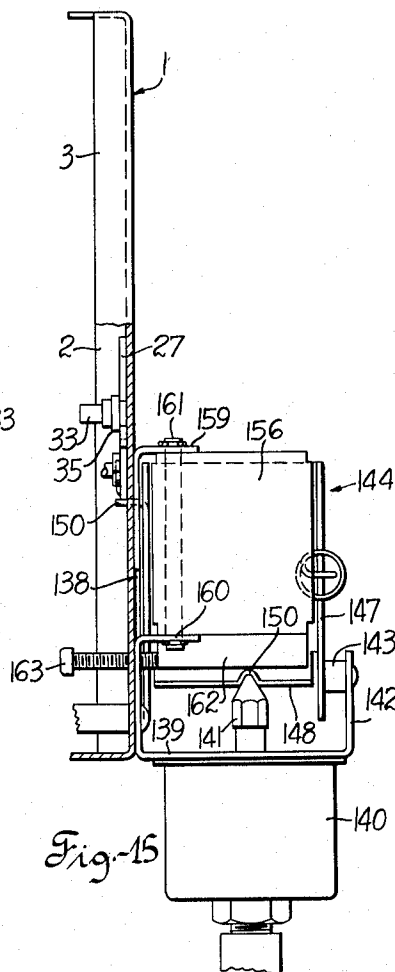


Fig. 15

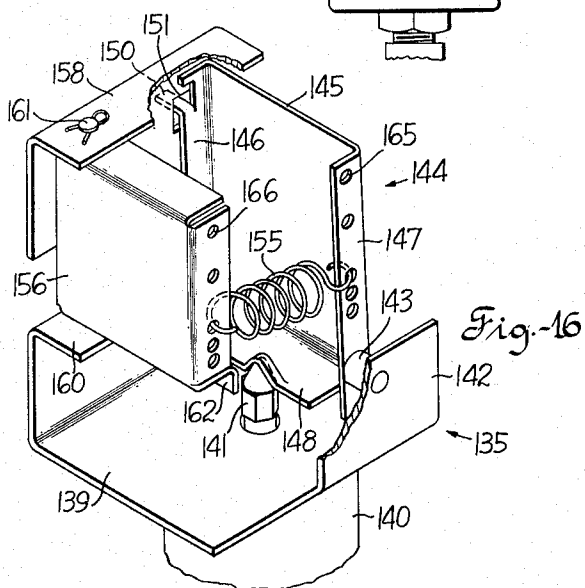


Fig. 16

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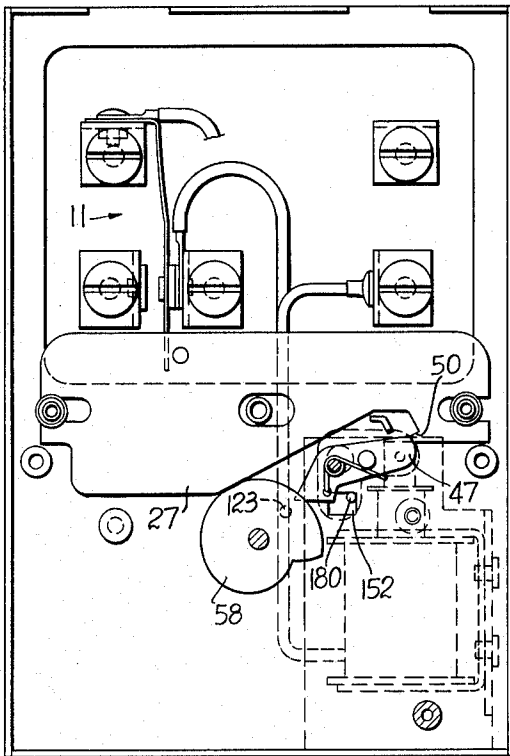


Fig. 17

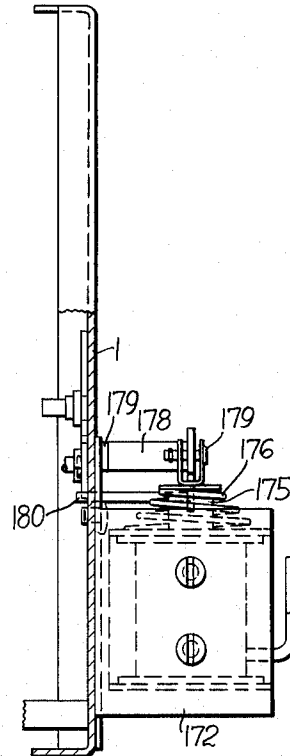


Fig. 18

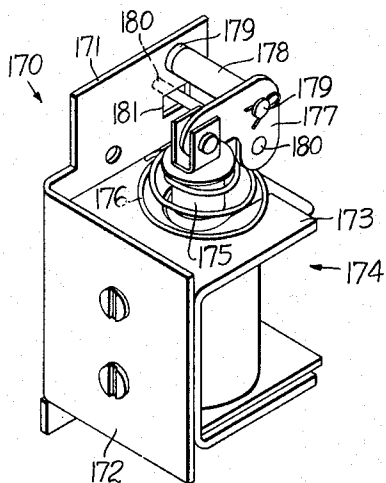


Fig. 19

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COMBINED TIME-TEMPERATURE SWITCH DEVICE

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20 Claims. (Cl. 200—39)

This invention relates to automatic controls and more particularly to time controls for automatic defrosting of frozen food cabinets and other purposes.

The primary object of the invention is to provide a dependable compact unit of simple and heavy duty construction, and which is quick and easy to set, both for time and duration of defrost cycles.

A further object is to provide a basic timer unit which is capable of both starting and terminating a cycle, and which is constructed so that an accessory cut-off unit such as a solenoid or pressure responsive unit can readily be added or omitted.

Another object of the invention is to provide a pressure cut-off unit in which the same spring can be used for a number of different pressure ranges.

Other objects will appear from the following description and appended claims.

For a full disclosure of the invention, reference is made to the following detailed description and to the accompanying drawings in which:

FIG. 1 is a front view of the improved defrost control;

FIG. 2 is a side view of FIG. 1;

FIG. 3 is a fragmentary view in which the dial is broken away to indicate the operation of the trip lever by the dial trip pins.

FIG. 4 is a view corresponding to FIG. 3 but behind the timer front plate, showing the operation of the trip lever for starting a cycle;

FIG. 5 is a schematic view of the gear train;

FIG. 6 is a view similar to FIG. 1 in which the front panel is omitted to show the switch operating mechanism in the normal or run position;

FIG. 7 is a sectional view taken on line 7—7 of FIG. 6;

FIG. 8 is a partial view similar to FIG. 6 but showing the positions assumed by the parts during the defrost cycle and just before the termination thereof;

FIG. 9 is a view similar to FIG. 8 but showing the parts just after the termination of a defrost cycle;

FIG. 10 is a front view with parts omitted to illustrate the gear train and cam shaft assemblies;

FIG. 11 is a sectional view taken on line 11—11 of FIG. 10;

FIG. 12 is a broken away perspective view of the dial assembly illustrating the trip pin and spring construction;

FIG. 13 is a detail view of the spring and trip pin;

FIG. 14 is a view similar to FIG. 6 but illustrating the addition of a pressure cut-off accessory;

FIG. 15 is a side view of FIG. 14;

FIG. 16 is a perspective view of the pressure cut-off accessory;

FIG. 17 is a view similar to FIG. 14 but showing the addition of a solenoid cut-off accessory;

FIG. 18 is a side view of FIG. 17 partly in section;

FIG. 19 is a perspective view of the solenoid cut-off accessory.

Referring particularly to FIGS. 1, 2, 14 and 15, a base member 1 is formed as a channel having side members 2 and 3. The base member also is provided with in-turned portions 4 and 5 at the top and bottom respectively. These portions 4 and 5 serve to mount the base on a mounting bracket 6 as shown in FIG. 2. A switch panel 7 of phenolic material is mounted on the upper portion of the base member 1. As shown in FIGS. 2 and

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10 this switch panel 7 rests directly on the channel members 2 and 3 of the base member and is provided with ears 8 which extend into slots in the upper in-turned section 4 of the base member. As shown in FIG. 14 and also in FIG. 7, the base member 1 is provided with a large opening 10 behind the switch panel. This opening provides electrical clearance for the switches 11 and 12 which are mounted behind the switch panel 7. The switch 11 is illustrated as of the double throw variety and includes a switch blade 13 which is carried on a bracket 14 and which extends between contact brackets 15 and 16. The switch 12 consists of a switch blade 17 carried by a bracket 18, this switch blade carrying a contact which cooperates with a contact carried by the contact bracket 19. In order to conserve space the switch blades 13 and 17 are formed L shaped which permits the switch blade brackets 14 and 18 to be mounted in a horizontal plane.

The switch blade brackets and contact brackets are of identical L shaped construction, one leg serving to hold the switch blade or bracket, and the other leg 21 fitting flat against the switch panel as shown in FIG. 7. This leg 21 is provided with a tapped hole for receiving a terminal screw 22. This portion 21 of the bracket is fastened to the bracket by means of a terminal plate 23 which is generally U-shaped, having leg portions 24 which extend into suitable slots in the switch or contact brackets. These leg portions 24 in extending through the panel and into the switch or contact bracket prevent turning or twisting of these brackets on the panel. In addition the leg portions 24 are crimped over as shown in FIG. 7 which provides a rigid fastening and also insures good electrical contact between the terminal plate 23 and the bracket.

As shown in FIGS. 6 and 7 the switch blades 13 and 17 extend downwardly past the contact brackets. Both of these switch blades are biased to the right as seen in FIG. 6. They are moved against their bias by means of a common sliding switch operator 27. This switch operator is made of insulating material and carries pins 28 and 29 which operate the blades 13 and 17, respectively. The construction of this switch operator is shown more clearly in FIG. 14. This operator is provided with a pair of slots 30 and 31 which ride over studs 32 and 33 mounted on the base member 1. As shown in FIGS. 7 and 15 the switch operator 27 is located adjacent the base member 1 and is held in place by means of enlarged portions 35 on the studs 32 and 33. As shown in FIG. 7, the studs are staked into the base member 1 and thus serve to lock the switch operator 27 to the base but in slideable relationship therewith. It will be noted that substantial portions of the switch operator extend above and below the studs 32 and 33. This prevents rocking motion of the switch operator on the base plate but still permits the switch operator to slide to the left or right on the base member for operating the switch blades.

Mounted in front of the switch operator 27 is an elongated sliding cam follower 38. As shown in FIGS. 6 and 7 this cam follower is formed with slots 39 and 40 which fit over studs 32 and 33 respectively. As shown in FIG. 7 the cam follower 38 rides over reduced portions of the studs 32 and 33 and thus the enlarged portions 35 of these studs serve to space the cam follower 38 from the switch operator 27. As shown in FIG. 7, the terminal panel 7 also fits over reduced portions 41 of the studs 32 and 33. This reduced portion 41 of each stud maintains a space between the terminal panel and the cam follower so that the cam follower is free to slide.

The cam follower 38 is provided with a stud 43 which has a forwardly extending portion which carries a biasing spring 44. This biasing spring is shown as a tension spring and its other end is secured to a stud 45 carried on

the base member 1. This biasing spring 44 biases the cam follower 38 to the right as seen in FIG. 6.

The stud 43 also has a rearwardly extending portion 46 which carries a pawl 47. This pawl 47 is located adjacent the base plate 1 in the same plane with the switch operator 27. As shown more clearly in FIG. 8 the base member 1 is formed with a forwardly extending tab 49. This tab 49 constitutes a stationary abutment which the pawl 47 engages when the defrost control is in the normal position as shown in FIGS. 1 and 6. The switch operator 27 is also formed with an abutment 50 which is adjacent to the tab 49 as shown in FIG. 6 when the control is in the normal position. The switch operator 27 also carries a spring stud 52 which extends through a suitable opening in the cam follower 38. This spring stud 52 is attached to a spring 53 which in turn is secured to a stud 54 attached to the base member 1.

With the parts in the positions shown in FIG. 6 the spring 53 is biasing the switch operator 27 toward the left. The pins 28 and 29 on this switch operator thus urge the switch blades to the left as shown. The spring 44 is biasing the cam follower 38 to the right and the cam follower is held in the position shown by the pawl 47 engaging the stationary abutment 49 on the base member 1.

The cam follower 38 is formed with a cam follower portion 55 which rides a reset cam 56. Preferably a guide 57 is mounted on the base 1 and is slotted to receive the lower edge of the cam follower 38. This prevents rocking motion of the cam follower and insures that the cam follower properly rides the cam 56.

The cam 56 is carried by a cam shaft along with a starting cam 58. As shown in FIG. 11, the cam shaft 57 which carries cams 56 and 58 is hollow and receives a second cam shaft 59. This cam shaft 59 also extends through a hub 61 which is free to rotate in a front bracket 62. This front bracket at its lower end is supported on base 1 by means of spacers 63 and 64. This bracket at its upper end is offset as at 65 and has a portion 66 which covers the lower end of the terminal panel 7. This portion of the front bracket is maintained in place by means of screws 67 which are threaded into the studs 32 and 33 which also support the switch operator 27 and the cam follower 38. The cam shaft 57 at its front end carries a pointer 70 which carries a projection 71 which is adapted to fit into a series of slots 72 of the defrost adjusting dial 73. The shaft 59 is formed with a reduced section 75 at the rear end thereof and carries a bearing member 76 which is fitted into an opening in the back plate 1. This bearing member carries a stopping cam 77 which is adjacent the back plate 1. A compression spring 78 fits over the reduced portion 75 of the shaft 59 and pushes on the bearing member 76 so as to bias the inner shaft 59 rearwardly with relation to the outer shaft 57. This permits the user to change the defrost timing by pulling the dial 73 outwardly far enough to clear the projection 71 on the pointer 70. The dial is then turned to the desired defrost timing and released at which time the spring 78 pulls the dial 73 back into engagement with the projection 71 in its new setting. This turning of the dial 73 changes the position of the off cam 77 relative to the starting cam 58.

The hub 61 fits over the shaft 57 and serves as a bearing for the front end of the cam shaft assembly in the front bracket 62. This hub 61 carries a twenty-four hour dial assembly generally indicated as 81. This dial assembly includes a cup shaped dial or knob member 82 which is provided with a series of radial extending slots 83 receiving trip pins 84. As shown in FIG. 1, a separate slot and trip pin are provided for each two hour period of the day. Also as shown in FIG. 1 the dial 81 is provided with suitable indicia for indicating the hours of a twenty-four hour one day period. This indicia on the dial co-operates with a "Time" arrow 85 which is carried on a cover plate 86. This cover plate 86 is mounted on the front bracket 62 by means of screws 87 and is formed

with a large hole 88 for clearing the knob 82. This cover plate 86 is made of insulation material and in addition to carrying the "Time" arrow also protects the user from the electrical connections on the switch panel.

As shown in FIG. 11 the dial assembly also includes a retainer plate 89 which carries a series of slots 90 which are identical with the slots 83 in dial 82. The dial 82 and the retainer plate 89 are suitably staked to the hub 61 and are offset relative to each other so as to provide a space 91 between these parts and adjacent the slots. This space 91 receives enlarged portions 92 of the trip pins 84. Each trip pin 84 includes a rearwardly extending portion 93 for engaging a trip lever 94 which is carried on the front bracket 62 (FIG. 3). This trip lever 94 is pivotally mounted on the front bracket 62 closely adjacent to this bracket and includes an outturned portion 95 which is adapted to be engaged by the rear portions 93 of the pins 84. When a pin 84 is in its outer position it will engage the trip lever outturned portion 95 and rotate the trip lever 94 in a clockwise direction as the pin passes over the trip lever. However, when a pin 84 is located in its inner position, the pin will miss the outturned portion 95 of the trip lever and no movement of this trip lever will take place when such a pin passes by. Thus the pins when located at the outer edges of their slots serve to start a defrost cycle at the time indicated. However, the pins at the inner ends of their slots are inactive and will not start a defrost cycle.

The space 91 between the dial member 82 and the retainer plate 89 is made slightly larger than the width of the enlarged portions 92 of the pins 84 so that these pins slide freely in their slots. These pins are held at one end or the other by individual springs 96. As shown in FIG. 11 the retainer plate 89 is formed with a series of extrusions 97, one for each slot 90. The springs 96 are of the torsion type having a wound portion 98 which fits over the extrusions 97. The legs of each spring are formed as shown in FIGS. 12 and 13 to provide camming surfaces 99 and 100. These camming surfaces engage the enlarged portions 92 pins 84. Preferably the pin 84 is dished as shown in FIGS. 11, 12 and 13 so as to provide a track for retaining the spring in place. It will be apparent that when a pin 84 is at the outer end of its slot, the camming surface 100 of the spring serves to push the pin towards this end of the slot. When a pin 84 is moved from its outer end of its slot the camming surfaces 100 of the spring causes the spring to open up. When the pin passes from the camming surface 100 to the camming surface 99 of the spring, the spring now serves to cam the pin inwardly and hold the pin against the inner edge of its slot. This arrangement makes it easy for the user to set the pins for the desired defrost cycles and also insures that the pins will stay either at one end or the other of their slots.

Referring again to FIGS. 2 and 11, the hub 61 which carries the twenty-four-hour dial assembly 81 is driven by a gear 101 through a friction drive including a tension washer 102 and a retainer 103. The outer cam shaft 57 which carries the reset cam 56 and the starter cam 58 is driven by a gear 104 which is rigidly secured to this cam shaft. A timer motor 105 (FIG. 2) is mounted at the rear of the base member 1 below the switches and serves to drive both gears 101 and 104 through a gear train, the details of which are shown in FIG. 5. The timer motor includes a pinion 106 which drives gear 107 which in turn drives gear 108. This gear 108 drives the gear 104 through a gear 109 and a pinion 110 which meshes with the mutilated gear 104. The pinion of gear 108 also meshes with a gear 111 which drives the gear 101 through gear and pinion 112. It will be noted that the cam shaft gear 104 is driven by the timer motor through a gear reduction of four gears whereas the twenty-four hour gear 101 is driven by the same timer motor through a gear reduction including five gears. The gear 101 is thus a slow speed gear and the gear reduction is selected to cause

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rotation of the dial assembly one revolution in twenty-four hours and in a clockwise direction. The gear 104 is a high speed gear for the cam shaft and serves to drive the cam shaft in a counterclockwise direction. In the embodiment illustrated the gear reduction for the cam shaft serves to drive the cam shaft in a counterclockwise direction at a speed of one revolution in three hours.

The gear 104 which drives the cam shaft 57 is of the mutilated type including a portion 114 in which the teeth are omitted. (See FIG. 3.) This gear carries a starter pin 115 which is adapted to be engaged by a pawl 116 which is riveted to a lever 117 carried on shaft 118. This shaft 118 extends through the front bracket 62 and carries the starting lever as shown in FIG. 3.

Referring now to FIGS. 6 and 7 a starter cam follower 120 is mounted on a stud 121 carried by the base member 1 and in alignment with the starter cam 58. This cam follower 120 is provided with a torsion spring 122 which urges it into engagement with the starter cam 58. This cam 58 carries a starting pin 123 which is adapted to engage the lower surface 124 of the pawl 47.

Operation of timer unit

FIGS. 3, 4 and 6 show the parts in the positions assumed when the defrost unit is in the normal or run position and just before a new defrost cycle is to be initiated. Referring to FIG. 6 in particular, the cam follower 38 has been cammed to the left by the reset cam 56 to a point at which the pawl 47 is behind the stationary abutment 49. At this point the toothless section 114 of the gear 104 has become adjacent to the pinion 110. As a result, the pinion 110 is incapable of rotating the gear 104 and the cam shaft 57 is stationary with its time indicator 71 in an upright position as shown in FIGS. 1 and 11. At this point, the cam follower portion 55 of the cam follower 38 has disengaged the reset cam 56 and the cam follower is prevented from moving to the right as seen in FIG. 6 due to the pawl 47 engaging the stationary abutment 49. The pressure of the spring 44 is thus carried by the pawl 47 and thus exerts no influence on the cam shaft at this time. The spring 53 has pulled the switch operator to the left and the pins 28 and 29 of this operator have moved switch blades 13 and 17 to the positions shown. Thus a compressor circuit is closed between terminal brackets 14 and 16. The circuits are opened between brackets 14 and 15 and also between brackets 18 and 19.

As the 24-hour dial rotates clockwise and as shown in FIG. 3, the inner end 93 of a trip pin engages the turned up portion 95 of the trip lever 94. This rotates the trip lever shaft 118 in a clockwise direction which in turn rotates the lever 117, causing the pawl 116 to approach the starting pin 115 which is carried by gear 104. The 24-hour dial is thus serving to start rotation of the cam shaft 57 in a counter clockwise direction.

Referring to FIG. 6 this rotation of the cam shaft 57 brings the abrupt drop off portion of the starter cam 58 under the starter cam follower 120. The pressure of the starter cam follower on this portion of the cam 58 causes a snap action counter-clockwise rotation of the cam shaft for bringing gear 104 back into engagement with the pinion 110. At this time the starter pin 123 carried by the starter cam has not contacted the lower portion 124 of the pawl 47. The pressure of the starter cam follower 120 on the starter cam "feeds" the gear 104 into mesh with the pinion 110, and the pinion 110 now begins to drive the gear 104 counter clockwise for one revolution independently of the starter cam follower 120.

After the gear 104 is being positively driven by the pinion 110, the starter pin 123 on the starter cam engages the edge 124 of the pawl 47. This rotates the pawl 47 in a clockwise direction as seen in FIG. 6 and thus the right-hand end of pawl 47 moves downwardly relative to the stationary abutment 49. The pawl 47 now rides off the lower edge of the abutment 49 and the spring 44 be-

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comes free to pull the sliding cam follower 38 to the right. At this time the pawl 47 engages the abutment 50 of the sliding switch operator 27. The spring 44 is stronger than the switch operator spring 53 and thus the switch operator is pulled to the right along with the cam follower. This permits the switch blades 13 and 17 to move to the right for breaking the circuit between brackets 14 and 16 and making circuits between brackets 14 and 15 and between brackets 18 and 19. The defrost cycle is now underway.

It should be noted that the parts are proportioned so that the lower surface 124 of the pawl 47 is substantially horizontal at the time that the pawl 47 disengages the stationary abutment 49. The pawl thus is free to slide relative to the starting pin 123 without disengaging the abutment 50 of the switch operator. It should also be noted that this movement of the pawl 47 along with the cam follower moves the pawl away from the starting pin 123. As a result, the starting pin 123 no longer has any effect on the pawl and passes clear of the pawl as the cam shaft rotates.

As shown in FIG. 6 the cam follower 38 is provided with an opening 128 through which passes a stud 129, this stud being attached to the base member 1 similarly to the studs 32 and 33. The left-hand end of the opening 128 serves as a stop for limiting the motion of the cam follower 38 by spring 44. Thus when the parts are in the defrost position, the location of the cam follower 38 and hence the location of the pawl 47 are definitely predetermined.

As the cam shaft continues to rotate, the stopping cam 73 approaches the lower surface 124 of the pawl 47 as shown in FIG. 8. This stopping cam on continued rotation rotates the pawl 47 counterclockwise to a point at which its end clears the abutment 50 as shown in FIG. 9. The spring 53 for the switch operator is now free to pull the switch operator to the left for returning the switches to the positions shown in FIG. 6. The defrost cycle has now been terminated.

After the cam shaft has been driven to a point slightly beyond the maximum defrost time adjustment, the timer starts its reset phase. At this time the rise portion of the reset cam 56 engages the cam follower and moves the follower to the left thus stretching the spring 44. The parts are proportioned so that the cam 56 moves the cam follower to the left sufficiently to provide a gap between the pawl 47 and the stationary abutment 49. The biasing spring for the pawl 47 now causes the pawl to drop behind the stationary abutment. The cam 56 then clears the cam follower and the cam follower moves slightly to the right and is stopped by the pawl 47 engaging abutment 49. After this has taken place, the cam shaft is stopped due to the teeth of gear 104 running off the pinion 110.

It should be noted that in this position, an intermediate level of the cam 56 is still under the cam follower. This portion is low enough to be clear of the cam follower when the pawl 47 is in engagement with the stationary abutment 49. However, if for some reason the latch 47 failed to engage the stationary abutment, this intermediate portion of cam 56 will prevent the control unit from accidentally getting into a defrost cycle. If the pawl 47 should fail to engage the abutment 49, the pressure of the cam follower spring will now be carried by the reset cam 56. This will greatly increase the torque required for starting the cam shaft into a defrost cycle. Preferably, the friction drive of the dial assembly 81 is set up for insufficient torque to start a cycle under these conditions. Thus if the pawl fails to operate properly, the control unit will fail in a safe position.

It should also be noted that the invention provides a unit in which the timer motor will always fail in a safe position. At the time a defrost cycle is started the spring 44 is the one which applies pressure of the pawl 47 against abutment 49. At the termination of a defrost cycle the spring 53 is the one which applies pressure on the pawl 47 through the abutment. Inasmuch as spring 44 is stronger

than spring 53 it follows that the pressure on the pawl at the start of a defrost cycle is greater than the pressure on the pawl at the termination of a cycle. Thus more torque is required of the timer motor to start a cycle than to terminate it. It is a characteristic of timer motors to gradually diminish in torque output with age. This is a slow process. Thus if the motor has sufficient torque to start a cycle, it will always have enough torque to terminate it.

It should also be noted that the construction described requires no power from the timer motor during a defrost cycle except that required to release the pawl 47 from the switch operator abutment 50. After this has taken place with the unit adjusted for maximum timing, the reset cycle is started in which the cam follower is cammed to the left for stretching spring 44. If a timer motor is going to fail it will usually fail during this reset portion of the cycle. This is further insurance against a motor failure during a defrost cycle.

Another feature provided by the invention is the provision for starting extra defrost cycles without disturbing the automatic set-up. This is done simply by flicking the defrost dial 73 in a counterclockwise direction manually. This has the same effect as starting a cycle by the defrost pins. In addition, the unit may be turned manually through a complete defrost cycle for testing and without disturbing the 24 hour dial setting. This is provided for by the one way drive arrangement disclosed. As shown in FIG. 5 the gear 109 and pinion 110 which drive the cam shaft gear 104 are carried on a shaft 130 which extends between the front bracket 62 and the base plate 1. The front end of the shaft 130 extends into a slot 131 in the front bracket (FIGS. 4 and 10). A biasing spring 132 is provided for urging the shaft in a direction for bringing the pinion 110 into engagement with the gear 104. When the cam shaft is turned counterclockwise manually, it moves the pinion 110 to the right against the tension of the spring 132. This gives a ratcheting effect and permits easy rotation of the cam shaft in its normal direction. However, the reaction of the pinion 110 in driving the gear 104 pulls the pinion into further engagement with the gear and thus a positive drive is provided by the timing mechanism.

From the foregoing description it will be apparent that the present invention provides a simple compact unit which may be readily adjusted by the user for the defrost sequence required. The times that defrost cycles are to start are instantly set simply by flicking the appropriate trip pins on the dial in or out. The duration of a cycle is easily and quickly set simply by pulling out the defrost dial, setting it to the desired timing and releasing it. In addition, the user is completely protected from danger of electric shock during such setting. Also, the timing accuracy of the defrost cycle is improved by the arrangement in which a single pawl serves to both start and terminate a cycle.

Time pressure control

The invention thus far described is a basic unit in which a defrost cycle is started by the timer and in which the timer is the sole means for terminating such cycle. Another requirement in the industry is for a unit which starts a defrost cycle by a timer and which terminates such cycle in response to a pressure rise in the system. In such units, the time termination feature is still retained as a fail safe feature in the event the pressure cut off fails for some reason to operate.

The present invention provides for the conversion of a basic time cut off unit to a time pressure unit simply by adding a pressure control accessory and this feature of the invention is shown in FIGS. 14, 15 and 16.

This pressure cut-off accessory includes a base member generally indicated as 135 which is attached to the rear of the timer base member 1 by screws at 136 and 137. As shown in FIGS. 15 and 16 this base member is generally U-shaped. One leg 138 is parallel with the base member 1 and is secured to the base member by

the screws 136 and 137. The intermediate portion 139 of base member 135 extends rearwardly and carries a bellows assembly 140 including an operating pin 141. The rear portion 142 of the base member extends upwardly serving to strengthen the base member and also to provide a support 143 for the pressure control lever generally indicated as 144. As shown in FIG. 16, this pressure control lever is channel shaped having an intermediate portion 145 and side portions 146 and 147. The side portion 147 is pivoted to the bearing member 143 as shown in FIGS. 15 and 16. The side member 146 is provided with a similar and aligned bearing 147 in the main section 138 of the base member 135. The pressure control lever 144 is also provided with an in-turned portion 148 which extends over the operating pin 141 of the bellows assembly 140. Preferably this lever is provided with a dimple 150 into which the point of the bellows pin 141 fits. It will be noted that the point of contact of the pin 141 with the pressure control lever is in substantial alignment with the bearings of this lever.

This side section 146 of the pressure control lever is struck out to provide a tab 150 which extends through an opening 151 in the base member 135. As shown in FIG. 14 a corresponding opening 152 is provided in the timer base member 1. The tab 150 extends through both openings into alignment with a side portion 153 of pawl 47.

As shown in FIG. 16 the pressure control lever is biased by means of a tension spring 155. This tension spring serves to bias the pressure control lever in a clockwise direction as seen in FIG. 14 and urge the tab 150 against the right-hand edges of the openings 151 and 152.

When the pressure in the refrigeration system is below a set value there will be clearance as shown between the tab 150 and the portion 153 of the pawl 47. As the pressure in the system increases, the bellows assembly 140 will overcome the biasing spring 155 and will move the pressure control lever 146 counterclockwise as seen in FIG. 14. This will cause the tab 150 to engage the pawl 47 and then rotate the pawl clockwise for releasing from the abutment 50 of the switch operator. This terminates the defrost cycle in exactly the same way that it would be terminated by the off cam 77 of the timer mechanism. Thus the invention provides for operation of the pawl to terminate a defrost cycle by two completely independent means. The defrost cycle may be terminated by either the expiration of a predetermined time or the rise in pressure to a predetermined value whichever happens first.

Provision is made for adjusting the tension of the spring 155 from the front of the timer. The other end of the spring 155 is attached to a spring lever 156 which is pivoted in a vertical plane to the pressure control base member 135. The upper end of the base member 135 is formed over as end 158. Also a corresponding tab 159 is struck out from the rear section 138 of the base member. For purpose of rigidity the adjusting lever 156 is formed as a box and the upper and lower edges are provided with holes through which extends a pin 161. The adjusting lever 156 at its bottom is formed with a downwardly extending portion 162 which is engaged by an adjusting screw 163 which is threaded into the base member 135. This adjusting screw extends through an opening 164 in the timer base member 1. A corresponding access opening (not shown) is included in the front brackets 62 of the complete timer so that the screw 163 may be turned for setting the cut-out pressure.

It will be apparent that turning the set screw 163 in will rotate the adjusting lever 156 in a counterclockwise direction as seen in FIG. 16. This will increase the tension of the spring 155 and thus increase the cut-out pressure.

The invention also provides for a unit with a wide range of cut out pressures with exactly the same parts. As shown in FIG. 16 the pressure control lever is provided with a series of holes 165 for receiving the spring 155. The adjusting lever 156 is provided with a similar series of spring receiving holes 166. As indicated in FIG. 14 the pressure control lever is substantially horizontal at the time that it causes the pawl 47 to release from the switch operator abutment 50. In other words, the pressure control lever is in a substantially vertical position at the cut-out point. The pivot for the adjusting lever is also vertical and thus at the cut-out point, the pressure control lever and the adjusting lever are substantially parallel. This means that regardless which sets of holes are used for retaining the spring 155, the elongation of the spring 155 will be the same at the cut-out point.

It will be noted that the leverage of the tension spring 155 on the pressure control lever is dependent upon the distance the spring is away from the pivot of the lever. Thus if the spring 155 is attached to the uppermost set of holes, the leverage of the spring will be at a maximum and the pressure control unit will be set up for a maximum pressure control range. Conversely if the spring is attached to the lowermost set of holes, the leverage of the spring will be at a minimum and the unit will be set up for a minimum pressure range.

From the foregoing, it will be apparent that the present invention provides a unitary pressure control accessory which may be added to the timer for converting the timer to a time pressure type of unit. Furthermore, the invention provides for ready adjustment of the pressure cut-out point and also makes it possible for the same accessory to be used over a wide range of pressure cut-out values.

Time temperature control

The present invention also provides for terminating a defrost cycle in response to temperature from a remote point. For this purpose a solenoid cut-out accessory is added to the basic timer unit instead of the pressure control accessory as described above.

This arrangement is shown in FIGS. 17, 18 and 19. The pressure control accessory includes an L-shaped base member generally indicated as 170. This base member has one leg 171 which mounts on the timer base member 1. The base member 170 also includes a leg 172 to which the frame 173 of a solenoid generally indicated as 174 is attached. This solenoid includes a plunger 175 and a biasing spring 176. This solenoid operates a lever 177 which is carried by a hollow bearing member 178 mounted on a stud 179 carried by the portion 171 of the base member 170.

The lever 177 carries a stud 180 which extends through an opening 181 in the base member 170. This stud also extends through the opening 152 in the timer base member 1 and operates the pawl 47.

When the solenoid is de-energized the parts assume the positions shown in FIG. 17 in which the pin 180 is disengaged from the pawl 47. However, when the solenoid is energized, the plunger 174 moves downwardly for causing a counterclockwise rotation of the lever 177 as seen in FIG. 19. This causes a movement of the stud 180 to the left as seen in FIG. 17 which disengages the pawl 47 from the abutment 50 of the switch operator 27.

It will be understood that the solenoid in this embodiment of the invention will be controlled by a thermostat which indicates the system has been defrosted. In this embodiment of the invention one switch may be omitted from the switch panel and space on the panel may be used for making electrical connections with the timer motor and solenoid. The details of defrost control circuits using a solenoid cut-out are well known in the art and consequently are not described or shown in detail.

From the foregoing description, it will be seen that the present invention provides a basic defrost timer hav-

ing a number of new features and advantages over prior art devices. The basic timer is simple in construction and is easy and quickly set up for any given defrost sequence. It protects the user from electric shock and includes built in safety features to prevent a timer failure during the defrost cycle. In addition, it provides for addition of extra cut-off accessories which may be added to or taken from any given unit without impairing or requiring modification thereof. This provides for economies in manufacturing as the basic units may be made up by the manufacturer without regard as to whether they are to be plain timers or combination units. It also simplifies and reduces inventory requirements in the field as units can be readily converted from one type to another.

While the invention shown and described has particular utility in defrosting applications, it is not limited to the defroster field. The same basic mechanisms may be used in a wide number of other applications. Also while preferred forms of construction and design have been shown and described, it will be apparent that many modifications may be made without departing from the spirit and scope of the invention. It is, therefore, desired to be limited only by the scope of the appended claims.

What is claimed is:

1. In a control device, a movable member, means biasing said member in one direction, a pawl carried by said movable member, a stationary abutment in the path of the said pawl, drive means for moving said movable member to a point where the pawl engages said stationary abutment and then releasing the movable member so that the movable member is held against its bias by the pawl engaging said stationary abutment, a control member, means biasing said control member in the direction opposite to the bias of the movable member but to a lesser degree, an abutment carried by the control member also in the path of said pawl and engaged thereby after its release from the stationary abutment, and means releasing the pawl first from the stationary abutment and then from the control member abutment whereby the control member is first moved against its bias to one position and is then moved by its bias to another position.

2. In a control device, a movable member, being means biasing said member in one direction, a pawl carried by said movable member, a stationary abutment in the path of the said pawl, drive means for moving said movable member to a point where the pawl engages said stationary abutment and then releasing the movable member so that the movable member is held against its bias by the pawl engaging said stationary abutment, a control member, means biasing said control member in the direction opposite to the movable member but to a lesser degree, an abutment carried by the control member also in the path of said pawl and engaged thereby after its release from the stationary abutment, a first operating means arranged to release the pawl from the stationary abutment whereby the movable member moves the control member against its bias, a second operating means arranged to release the pawl from the control member abutment, said first and second operating means being spaced apart and arranged so that the pawl upon release from the stationary abutment moves away from the first operating means and toward said second operating means.

3. In a control device, a cam, a cam follower, means biasing the cam follower toward said cam, a pawl carried by said cam follower, a stationary abutment in the path of said pawl, said cam being arranged to move the cam follower to a point where the pawl engages the stationary abutment and to then release the cam follower so that the cam follower is held against its bias by the pawl engaging said stationary abutment, a switch operator, means biasing the switch operator in the direction opposite to the bias of the cam follower but to a lesser degree, an abutment carried by the switch operator also in the path of said pawl and engaged thereby after its release from the stationary abutment, and means releasing the pawl

first from the stationary abutment and then from the switch operator abutment, whereby the switch operator is first moved against its bias to one position and is then moved by its bias to another position.

4. In a timing device, a timing motor, a cam driven by said motor, a cam follower, means biasing the cam follower toward said cam, a pawl carried by said cam follower, a stationary abutment in the path of the pawl, said cam being arranged to move the cam follower to a position in which the pawl is in engaging relationship with the stationary abutment and then release the cam follower so that it is held against its bias by said pawl, a control member, means biasing the control member in a direction opposite to that of the cam follower but to a lesser degree, a second abutment carried by said control member also in the path of the pawl and adjacent said stationary abutment, means driven by said timer motor for releasing said pawl from the stationary abutment, said pawl being arranged to now engage the second abutment for moving the control member with the cam follower, and means releasing the pawl from the second abutment for permitting said control member to return to its initial position.

5. In a timing device, a cam shaft, a cam carried by said shaft, a gear on said shaft in fixed relationship with said cam, said gear having a portion without teeth, a pinion meshing with said gear for driving the same, a cam follower biased toward said cam, a pawl carried by said cam follower, a stationary abutment in the path of said pawl, said cam being arranged to move the cam follower to a position in which the pawl is in engaging relationship with the stationary abutment and then to release the cam follower so that it is now held by the pawl, whereby the pressure of the cam follower is removed from the cam, said gear being arranged to disengage the pinion so that the cam shaft stops, means advancing said cam shaft to re-engage the gear with the pinion, means operated by said cam shaft for releasing the pawl from the stationary abutment, a control member biased in a direction opposite to the cam follower, a second abutment carried by the control member arranged in the path of said pawl and engaged thereby after its release from said stationary abutment, and means operated by said cam shaft for releasing the pawl from said second abutment.

6. In a timing device, a cam shaft, a cam carried by said shaft, a gear on said shaft in fixed relationship with said cam, said gear having a portion without teeth, a pinion meshing with said gear for driving the same, a cam follower biased toward said cam, a pawl carried by said cam follower, a stationary abutment in the path of said pawl, said cam being arranged to move the cam follower to a position in which the pawl is in engaging relationship with the stationary abutment and then to release the cam follower so that it is now held by the pawl, whereby the pressure of the cam follower is removed from the cam, said gear being arranged to disengage the pinion so that the cam shaft stops, means advancing said cam shaft to re-engage the gear with the pinion, and means operated by said cam shaft for releasing the pawl from the stationary abutment.

7. In a timing device, a slow speed shaft, a high speed shaft means including a pinion and a mutilated gear for driving the high speed shaft through one cycle at a time, means actuated by the slow speed shaft for advancing the high speed shaft to engage the gear with the pinion to start a new cycle, a cam carried by the high speed shaft, a cam follower biased against said cam, latching means associated with the cam follower and arranged to hold the cam follower off the cam when the cam shaft stops due to the mutilated gear disengaging the pinion, and means releasing the latching means after the gear is re-engaged with the pinion.

8. In a control device, a switch panel carrying a switch blade, a sliding switch operator member slideably mount-

ed in a direction at an angle to the switch blade for operating the same, a sliding member adjacent the switch operator and arranged to slide parallel thereto, first spring means biasing the sliding member in one direction, second spring means biasing the switch operator in the opposite direction, a pawl carried by one of said sliding members and arranged to engage an abutment on the other of said sliding members for causing said sliding members to slide together, and means releasing the pawl from said abutment for permitting relative movement of said sliding members.

9. In a control device, a switch panel carrying a switch blade, a sliding switch operator member slideably mounted in a direction at an angle to the switch blade for operating the same, a sliding member adjacent the switch operator and arranged to slide parallel thereto, a pawl carried by one of said sliding members, an abutment on the other of said members, said pawl being arranged to engage said abutment for causing said sliding members to slide together, and means releasing the pawl from said abutment for permitting relative movement of said sliding members.

10. In a control device, a base having a main portion and side portions forming a channel, a switch panel mounted on said base and supported by one of said side portions, said switch panel being spaced from and parallel with the main portion of the base, an opening in the base adjacent the panel, switching mechanism carried by said switch panel and extending through said opening in said base, and a switch operator slideably mounted on the base in the space between the main portion of the base and the switch panel, said switch operator being arranged to actuate said switching mechanism.

11. In a control device, a base having a main portion and side portions forming a channel, a switch panel mounted on said base and supported by one of said side portions, said switch panel being spaced from and parallel with said main portion of the base, an opening in the base adjacent said panel, switching mechanism carried by said switch panel and extending through said opening in said base, a switch operator slideably mounted on the base in the space between the main portion of the base and the switch panel, said switch operator being arranged to actuate said switching mechanism, a second operator slideably mounted adjacent said switch operator in said space, and means including means between said operators for causing movement of the operators separately or in unison.

12. In a control device, a base member, a switch panel mounted on one side of said base member, said base member having an opening adjacent said switch panel, switching mechanism carried by said switch panel and extending through said opening, a switch operator movably mounted on the side of said base member opposite the switching mechanism and arranged to actuate the same, a pawl co-operating with said switch operator for holding the same in one position, said pawl being mounted on the same side of the base member as the switch operator, a first actuating means for the pawl carried on said one side of the base member, and a second detachable actuating means for the pawl, said second actuating means being mounted on the other side of the base member and having a portion extending through the base member to said pawl.

13. In a combination time and condition responsive control, a base member, a switch panel mounted on said base member, a switch blade carried by said switch panel, a switch operator movably mounted on one side of said base member and arranged to actuate said switch blade, timing mechanism moving said switch operator to one position and retaining said switch operator in said one position, said last mentioned mechanism including a pawl which when released allows the switch operator to return to another position, said pawl being located on the same side of the base member as the switch operator and closely adjacent to the base member, time controlled means on said one side of the base member for releasing said pawl, and condition responsive means on the other side of the

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base member and having a portion extending to said pawl for also releasing the same.

14. A device as defined in claim 13 in which the condition responsive means is a self contained detachable unit comprising a base mounted on said base member, said base carrying a responsive element and a lever, said lever having said portion extending to the pawl and another portion extending to the responsive element.

15. In a pressure responsive control unit, a base member, a bellows attached to said base member, a lever pivoted to the base member and having a portion operated by the bellows, a biasing spring, said lever having a second portion arranged to receive said biasing spring at a plurality of points different distances from the lever pivot, an adjusting member also pivoted to the base in a plane generally parallel to said second portions of said lever, said adjusting member also including a portion generally parallel to the second portion of said lever and arranged to receive the biasing spring at a plurality of points, and a set screw carried by the base for adjusting the position of said adjusting member to vary the tension of said spring.

16. A device as defined in claim 13 in which the conditions responsive means is a self contained detachable unit comprising a base mounted on said base member, an electromagnet including a movable member pivoted to said base, said movable member including said portion extending to the pawl.

17. In a timer, a dial member provided with a plurality of slots extending outwardly from the center thereof, a trip member, a plurality of pins in said slots, means for retaining the pins in the slots while permitting movement thereof from one position to another, said slots being arranged relative to said trip member so that the pins in one position travel in a path actuating said trip member, and the pins in another position travel in a path which does not actuate the trip member as the dial rotates.

18. In a timer, a dial assembly comprising a pair of plates secured to a hub for rotating the same, said plates being spaced apart and provided with a plurality of aligned slots extending outwardly from the hub, a plurality of trip pins in the slots, said pins being provided with enlarged portions in the space between said plates, a trip member, said slots being arranged relative to the trip member so that the pins in one position travel in a path actuating the trip member, and the pins in another position travel in a path which does not actuate the trip member as the dial assembly rotates.

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19. A dial assembly for a timer comprising a pair of plates secured to a hub for supporting and rotating the same, said plates being spaced apart and provided with a plurality of aligned slots extending outwardly from the hub, a plurality of trip pins in the slots, said pins being provided with enlarged portions in the space between the plates, said enlarged portions being slightly shorter than the space between the plates so that the pins are free to slide in said slots, and spring means located between said plates for urging said pins toward one end or the other of said slots.

20. In a timer, a pair of concentric shafts each carrying an operating member, means supporting and rotating said shafts, a dial member attached to one end of the inner shaft and having a series of slots, a pointer carried by the outer shaft behind said dial member and having a portion engaged with the slots for maintaining said dial member and pointer in locked relationship, and a spring located between said shafts at the other ends thereof arranged to bias the inner shaft rearwardly relative to the outer shaft for releasably holding said dial member and pointer in said locked relationship.

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