

Sept. 28, 1948.

J. R. MACINTYRE

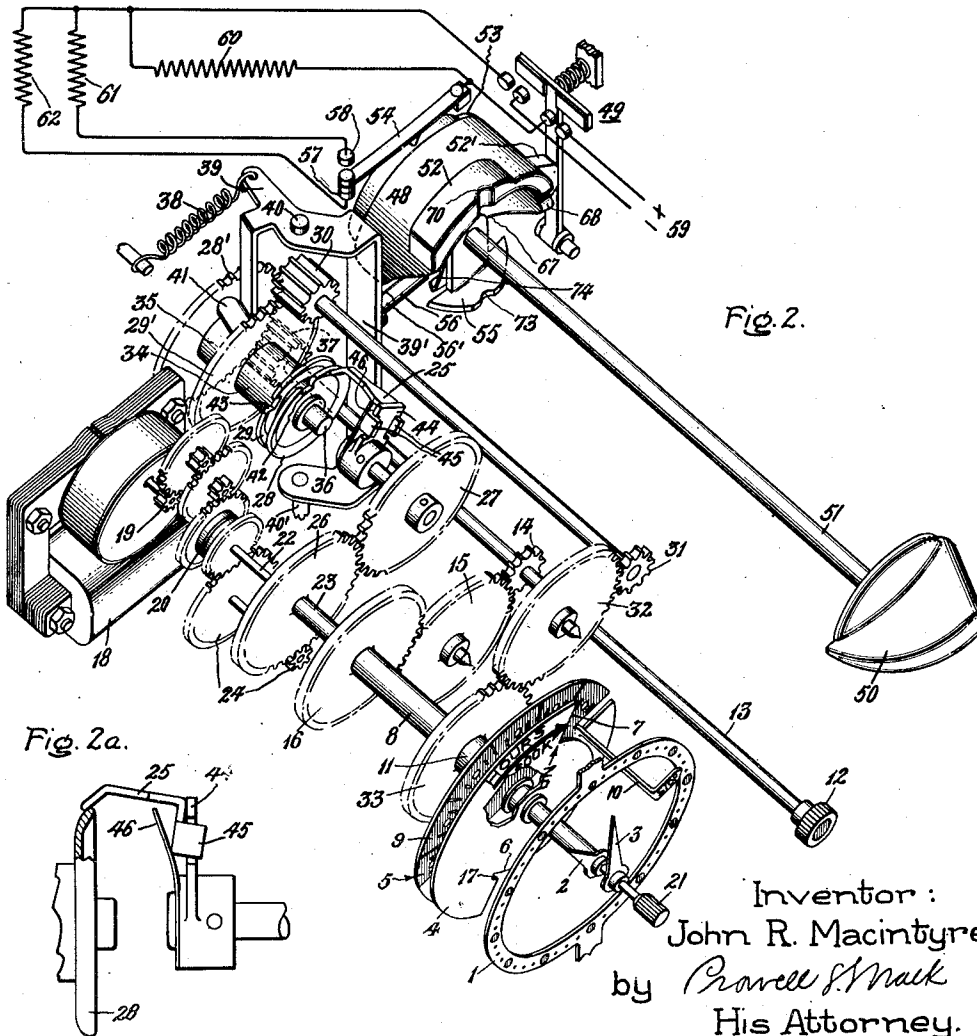
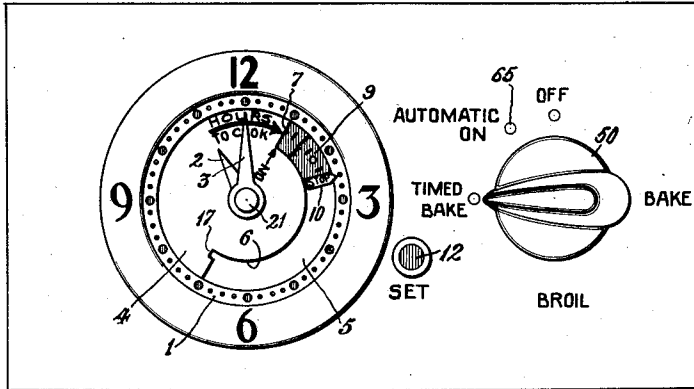
2,450,287

RANGE TIMER

Filed March 15, 1946

2 Sheets-Sheet 1

Fig. 1.



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2 Sheets-Sheet 2

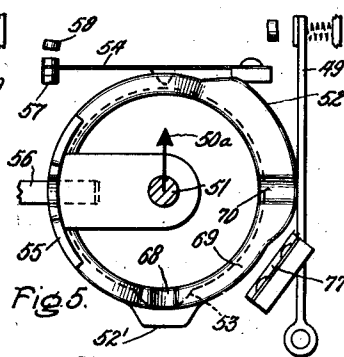
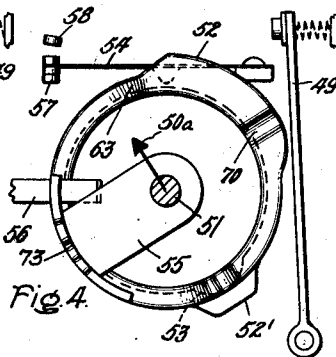
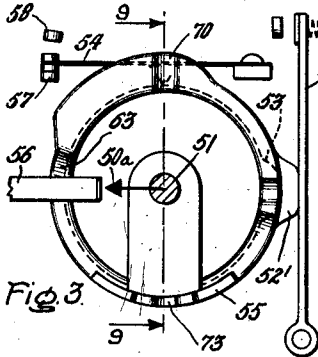


Fig. 6.

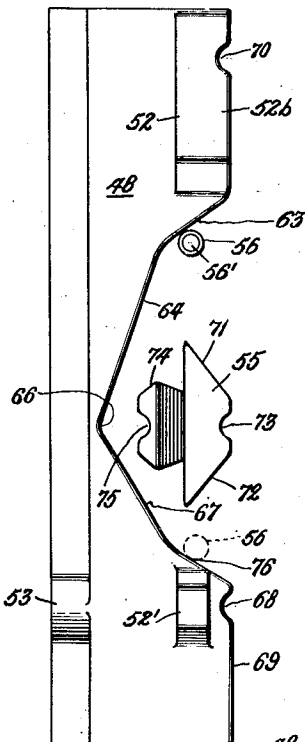


Fig. 7.

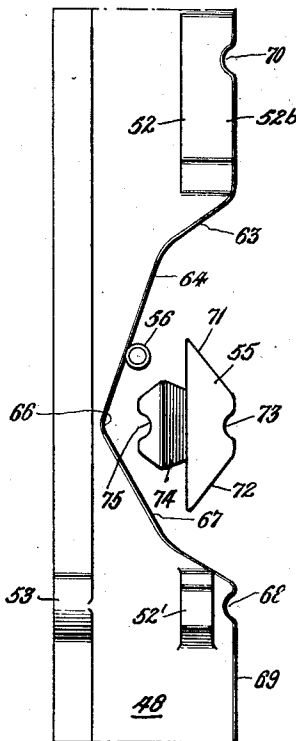


Fig. 8.

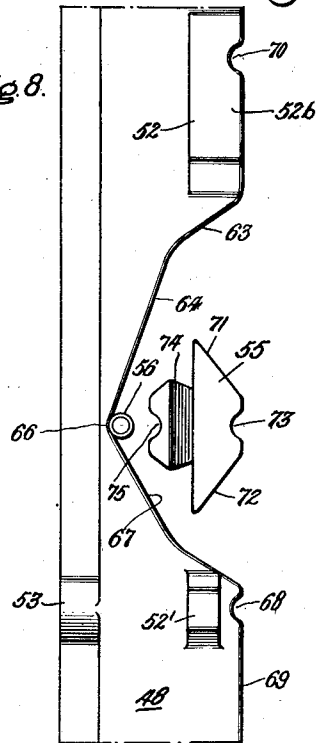
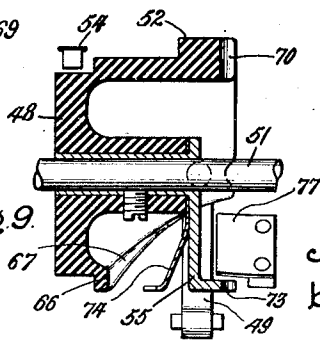


Fig. 9.



Inventor:
John R. Macintyre,
by *Prance S. Mark*
His Attorney.

UNITED STATES PATENT OFFICE

2,450,287

RANGE TIMER

John R. Macintyre, South Peabody, Mass., assign-
or to General Electric Company, a corporation
of New York

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9 Claims. (Cl. 161—1)

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My invention relates to range timers or time switches used primarily on cooking ranges to turn on and off the electricity or other energy used for heating the oven, for example. An important object of my invention is to provide a range timer which is simple and easy for a housewife, unfamiliar with the mechanism of a time switch, to set and operate to control the usual operations whether automatic or nonautomatic.

Another important aim of my invention is to provide an accurate, reliable, and foolproof mechanism for the above purposes.

Other objects and advantageous features of my invention will appear as the description proceeds.

The features of my invention which are believed to be novel and patentable will be pointed out in the claims appended hereto. For a better understanding of my invention, reference is made in the following description to the accompanying drawings in which Fig. 1 is a front view of a range timer embodying my invention and showing preferred time setting features. Fig. 2 is an exploded perspective view of essentially the complete range timer mechanism. Fig. 2a shows a detailed portion of the mechanism of Fig. 2 in a different operating position. Figs. 3, 4 and 5 are front views of a switch operating master cam in three different positions. Figs. 6, 7 and 8 are developed views of portions of the cam and cam follower surfaces of the switch operating cam when in the positions represented in Figs. 3, 4 and 5, respectively. Fig. 9 is a sectional view through the switch operating cam taken on line 9—9 of Fig. 3.

The range timer will be described for controlling an electric switch in the heating circuit of an electric oven and in combination with manual means for the complete automatic and nonautomatic control of the heating circuits of such oven. The control apparatus consists of an electrically driven clock, control means which is manually cocked and released by the clock for automatically opening and closing a switch at selected times, both of which times are adjustable by a single manual adjusting device, and another single manual control means for selecting automatic or nonautomatic control, conditioning the control means for automatic operation and for manually controlling all of the heating circuits of the oven. Thus the complete automatic and nonautomatic control of the oven heating circuits is made possible by two simple manual adjusting devices accessible at the front of the timer. These controls are designed from the point of view of being easily understood and being foolproof in their operation.

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Referring now primarily to Fig. 1 and to corresponding parts thereof shown in Fig. 2, the exposed front appearance of the range timer is preferably that shown in Fig. 1 and comprises a time telling clock having a clock dial with a minute division ring 1, and hour and minute hands 2 and 3 cooperating with the dial and giving a continuous indication of correct time as in an ordinary clock. In addition there are arranged concentric with and within the minute graduation circle two adjustable disks 4 and 5 with disk 4 on top or to the front of disk 5. The upper disk 4 has about 180 degrees of its periphery cut back at 6 to expose a correspondingly shaped sector of the lower disk 5. The upper disk 4 has an inscription thereon "Hours to cook" with a pointer pointing to the counterclockwise edge 7 of the cutaway sector portion of such disk. The outer end of edge 7 indicates on the minute graduation ring 1 and indicates thereon the time at which the switch is set to go on in any automatic operation thereof, and such disk 4 is mounted on and is rotatively adjustable with a hollow shaft 8 for that purpose.

The lower disk 5 has approximately one half of its periphery at 9 graduated with hour and fractional hour time graduations as from one to six hours, reading counterclockwise, and any desired portion of such graduated sector may be exposed in the cutout sector at 6 of the upper dial 4. Dial 5 also has a pointer 10 marked "Stop" at the zero or clockwise end of the graduated sector thereon which pointer extends forward through the cutaway sector of upper dial 4 and indicates on the minute ring 1 of the clock dial. Such pointer indicates on the clock dial the time when the switch will go off in any automatic operation thereof and it with its disc 5 is mounted on and is rotatively adjustable with a hollow shaft 11 for that purpose. It will now be evident that the time during which the switch will be on during any automatic operation will be indicated on the exposed portion of the graduated time sector 9 of lower disk 5. Hence, the arrangement gives complete and direct information without computation as to the times the switch will be turned on and turned off, and the time period during which it will be on. Thus, in Fig. 1 the adjustment is such as to turn the switch on at one o'clock indicated by line 7 on the clock dial minute ring 1 and off at 2:30 o'clock indicated by pointer 10 marked "Stop" on the clock dial minute ring 1, and with a time on or "Hours to cook" of 1½ hours indicated on the exposed time graduated portion 9 of lower disk 5. The time graduated portion 9 of

the lower setting dial 5 is also preferably of a color which contrasts with the upper dial 4 and the ungraduated exposed portion of lower dial 5, so that one can tell at a glance from some distance away from the clock the approximate setting information above described. If desired, the edge 7 may be marked with the further inscription "On" or "Start" with a radial arrow pointing outwardly as indicated in Fig. 1, but this is generally considered to be unnecessary in view of the marked simplicity and obvious manner of use of the arrangement. The discs 4 and 5 with pointer 10 are covered with the transparent glass clock dial bezel and are thus kept clean.

To simplify further the automatic time setting operation, I prefer to use only one thumbpiece 12 for adjusting and setting both dials 4 and 5. To this end the shaft 13 carrying thumbpiece 12, which is accessible from the front of the clock in full view of the clock dial and setting disks, is geared to hollow shaft 8 through gears 14, 15 and 16. Thus, turning thumbpiece 12 rotates shaft 8 and upper disk 4 secured to such shaft. Setting disk 5 is adjusted through the same means by reason of the pointer 10 on disk 5 extending up through the cutaway sector in upper disk 4, so that it is in lost motion driving relation with disk 4 through the radial surfaces at the extremities of the cutaway portion of disk 4 whenever such surfaces are moved against such pointer. Thus, to move disk 5 counterclockwise, disc 4 is rotated counterclockwise while its radial edge is against pointer 10; and to move disk 5 clockwise, disc 4 is rotated clockwise while the pointer 10 is against the other radial surface of disc 5 at 7. It is thus evident that in a setting operation the "Off" time is set first by rotating both dials 4 and 5 while in driving relation, and the "On" time is then set by positioning disc 4 all by the same setting knob 12. Thus, in Fig. 1 to set the switch to go on at 12 o'clock and off at three o'clock, disc 4 would first be rotated clockwise to move pointer 10 to three o'clock and then rotated counterclockwise to position its edge 7 opposite 12 o'clock on the clock dial.

To set the switch to go on at one o'clock and off at two o'clock, disc 4 would be rotated counterclockwise into engagement with pointer 10 to drive pointer 10 counterclockwise until it registers with two o'clock on the clock dial, and then disc 4 is rotated clockwise to position its edge 7 at one o'clock on the clock dial. The notch at 17 is simply to provide for a reasonably wide symmetrical shaped "Stop" pointer and allow for a full six-hour "Time on" period, without uncovering the upper time graduations on disc 5 when the adjustment is for a very short "On" period.

In keeping with the simplicity and ease of setting of the mechanism, the arrangement is such that either dial 4 or 5 may be set in either direction clockwise or counterclockwise and when once set remain stationary as neither rotates with any part of the clock such as with the hour hand. The front panel of the device preferably carries the inscription "Set" directly beneath knob 12 to indicate its purpose.

The clock is driven by a synchronous timer motor 18 through suitable reduction gearing generally indicated at 19 and a slip friction clutch 20 which permits the clock hands to be set by means of a thumb button 21 which may be located on the front end of the minute hand shaft 22. The hollow hour hand shaft 23 is driven from the minute hand shaft 22 through suitable back gearing generally indicated at 24. The arrange-

ment is such that the clock hands are driven in the proper direction and at the proper rate to keep accurate time on the clock dial when the clock is properly set, the arrangement being a usual one in these respects.

The automatic switch operating mechanism includes a resiliently mounted finger 25 driven in synchronism and at the same rate but in the opposite direction to the hour hand 2 of the clock through gears 26 and 27. This finger 25 has no axial movement. The finger 25 is resiliently mounted on a rotary arm 44 and extends to the rear with its rear end bent inwardly toward the axis of rotation of this unit, so that it may bear against the forward surface of one or the other of two disks 28 and 29, also part of the automatic switch operating mechanism. The rear disk 29 is rotatively mounted with a hollow bushing 34 and a gear 29'. Gear 29' is connected to the rear setting disk 5 through gears 30, 31, 32 and 33, and hence, rear disk 29 is rotatively adjusted whenever rear setting disk 5 is rotatively adjusted. The front disk 28 is rotatively mounted on a hollow shaft 35 which passes through the bushing 34 and on which is fastened a gear 28' connected to setting shaft 13 by a gear 37. Hence, the front disk 28 is connected to front setting disk 4 and is rotatively adjusted whenever setting disk 4 is rotatively adjusted. The gear arrangement is such that the disks 28 and 29 are adjusted in the opposite direction but by the same amount as setting disks 4 and 5, respectively.

Although disks 28 and 29 and connected gearing are independently rotatively adjustable, the complete slotted disk assembly comprising disks 28 and 29 with their hollow bushings and gears 28' and 29' is slidably mounted as a unit on a part 36, located on the axis of rotation of the gear 27 and the arm 44 which carries finger 25. The gears 30 and 37 are long enough always to stay in mesh with gears 29' and 28' in any axial position of the latter. Also the assembly which includes the disks 28 and 29 is biased forward on part 36 toward finger 25 by spring means such as shown at 38 acting through a bell crank lever 39 which is part of a framework 39' pivoted at top and bottom on pivots 40 and 40'. A downward extension of the bell crank lever 39 has a head 41 adapted to fit, without binding in any position, between the gear wheels 28' and 29', thus biasing the assembly which is slidably mounted on part 36 toward finger 25 such that in the so-called cocked position of this automatic switch operating mechanism disk 28 is pressed against the rearward projecting end of finger 25. Likewise, if the framework 39' is turned about its pivot in a clockwise direction to tension spring 38, the assembly which is slidably mounted on part 36 will be moved through the bell crank 39 in a direction away from finger 25. The two disks 28 and 29 have radial slots 42 and 43 in their peripheries of such dimensions that when the finger 25 is opposite a slot, it can pass therethrough and allow the slotted disk assembly to move forward on part 36 under the urge of spring 38 in steps as the clock rotates finger 25 opposite such slots.

Assuming the automatic switch settings and clock time are as indicated in Fig. 1, with the clock in operation finger 25 is rotating counterclockwise with its end bearing against and sliding on stationary disk 28. At one o'clock it will register with slot 42 and the slotted disk assembly will be released and will jump forward quickly and be stopped in a new endwise position where the end of finger 25 bears against the

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forward surface of disk 29. The finger is now free to continue rotating counterclockwise without carrying disk 28 along with it, because the part of finger 25 now opposite slot 42 is outside the periphery of the disk 28 due to the bend in the finger. At 2:30 o'clock the finger will register with slot 43 in stationary disk 29 and again the slotted cam assembly will be released and will jump forward, sliding on part 36 to a new endwise position which new position is determined by a suitable stop before the finger 25 contacts gear 29'. As will be described later, these forward endwise movements of the slotted disk assembly are used to effect automatic closing and opening of a switch at predetermined adjustable times. Following such automatic operation, the forward end of finger 25 is no longer in contact with any surface and hence, the friction encountered during an automatic timing operation by reason of the finger riding on the disks 28 and 29 exists only during such operation.

To recock the release mechanism for a subsequent automatic timing operation, the slotted disk assembly is moved to the rear sliding on part 36, tensioning spring 38 by means yet to be described. In such cocking operation it is unnecessary to bring the slots 42 and 43 into alignment with finger 25 because the finger is resiliently mounted on its arm for outward movement, and the bent shape of its forward end and a slightly dished shape of the disks 28 and 29 cause the rear end of the finger to swing outwardly and allow the slotted disks to slide readily thereunder as they move to the rear as indicated in Fig. 2a. The finger then snaps back into the position represented in Fig. 2 to lock the slotted cam assembly in the cocked position. In this cocking action finger 25 acts like a ratchet pawl. A preferred structure of the arm and finger for the purpose described is represented in the drawing.

The base of the finger 25 is flat and normally rests flat against the flat side of arm 44 with projections 45 from the finger inserted through holes or notches in arm 44, and is held in this position by a (flat leaf) spring 46 secured on the arm, tending to retain the base of the finger flat against arm 44. When the outer bent end of the finger is raised by movement of the slotted disks to the rear, the lower end of the base of the finger moves away from arm 44, tensioning spring 46 as represented in Fig. 2a. This construction provides the necessary stiffness and position accuracy to the finger 25 and its holder when in the cocked position of the mechanism as represented in Fig. 2, but permits the easy cocking action as represented in Fig. 2a. The mechanism may be cocked from either the half-cocked position (automatic switch on position) when the end of finger 25 is pressing against the front of slotted disk 29, or from the fully uncocked position (automatic switch off position) when the end of finger 25 is to the rear of slotted disk 29 with the two slotted disks in any rotative position. The slotted disks 28 and 29 and co-operating finger 25 comprise a cockable release mechanism which can be set and which will operate with a high timing accuracy.

It will be evident that a switch could be operated to perform the automatic switching operations directly by the endwise movement of the slotted disk assembly. However, it is desirable for the user to be able to operate the same switch manually, when desired, as well as automatically.

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A multiple-purpose rotary master cam member 48 is inserted between the slotted cam assembly and the switch 49 to enable the user to control the switch automatically or manually at will, to perform additional switching operations which are desirable in the complete control of the oven heater circuits and to cock the slotted disk automatic switch operating mechanism, all by a single rotary knob 50 connected for rotating the cam member 48 through a shaft 51 and available on the front of the range timer as represented in Fig. 1. This master cam with its knob 50 has no axial movement.

The multiple-purpose master cam member 48 has three separate main cam surfaces, one of which surrounds the larger forward periphery of the cam member and includes the cam lobes 52 and 52' for operating the main switch at 49 both manually and automatically. A second cam surface surrounds the rear reduced periphery of the cam member 48 and includes the cam lobe 53 best shown in dotted lines in Figs. 3, 4 and 5. This cam surface cooperates with and operates a switch member 54. Switch 54 is operated manually and not automatically. A third cam surface is cut in the forward end of cam member 48 which surface together with supplementary cam members 55 and 74 cooperates with a cam follower lever 56 secured to the framework 39 and which swings about the axis of pivots 40 and 40' with such framework. Motion can be transferred in either direction through cam follower lever 56; that is, the cam member 48 may be turned by rotation of framework 39, this occurring during automatic switching operations; or framework 39 may be turned by rotation of cam member 48, this occurring during a cocking action of the slotted cam assembly. It will be evident that since the slotted cam assembly is on one side and the cam follower lever 56 extends to the other side of the axis of rotation of frame 39, lever 56 swings forward when the slotted cam assembly moves to the rear and vice versa. The cam lever 56 swings in an arc in a plane which includes shaft 51. In addition there are several positioning detents and a cam surface friction brake associated with the master cam as will be described.

The various cam surfaces of cam member 48 and their corresponding cam followers are so rotatively located that their various operations are properly coordinated to perform the various related functions in the desired order or sequence as will be hereinafter described.

The manner in which the cam member 48 operates switch 49 is evident from Fig. 2. Here the switch is held open by cam lobe 52'. If the master cam 48 be turned in either direction from the position shown, the switch, which is biased to closed position by a spring, will close. It will be opened again when any portion of the long lobe 52 is opposite the switch 49. The auxiliary double throw switch 54 is normally resiliently biased toward the cam and hence, is closed on its lower stationary contact 57 at all times except when cam member 48 is in position to bring the cam lobe 53 opposite switch 54, at which time this switch is closed on the upper stationary contact 58.

These switches close circuits from a source of supply 59 to oven heating resistors 60, 61 and 62. The main switch 49 is a double pole switch opening and closing both sides of the power line. When open, all resistors are deenergized and when closed, resistor 60 is energized and one or

the other resistors 61 or 62 is energized, depending on the position of switch 54. Switch 54 receives energy only when switch 49 is closed. As here arranged, resistors 60 and 62 are intended to be used for baking and resistors 60 and 61 for broiling, and will have heating values designed for these purposes. All resistors are assumed to be for heating the same oven or cooking unit. It will of course be evident that these switching details and circuits can be varied to suit the type of installation for which intended and instead of controlling electric energy might control gas or other heating energy. The term "switch" is used in the broad sense to mean a device for switching on and off the flow of electricity, gas, oil, etc. The cam 48 is preferably made primarily of insulating material so that there are no electrical connections made there-through between the switch blades 49 and 54.

The operation of cam 48 during a cocking action and automatic switch operating action will now be explained in connection with Figs. 3 to 8. In Figs. 3 to 6 the small arrow 50a represents the position in which the pointer shaped knob 50 located on the front end of shaft 51 points for the three positions represented. To avoid excessive friction and to promote ease of operation, the portion of lever 56 which contacts with the cam surface of 48 is a sleeve roller freely rotatable on a center part 56' (see Fig. 6). When in the low notch of the cam 48 as shown in Fig. 8, the finger 56 and the cam 48 constitute the stop which limits the forward movement of the slotted disk assembly when said assembly moves forward on part 36 to the "Switch off" position.

In Figs. 1, 2, 3 and 6 the knob 50 and the automatic switch operating parts are in the cocked position. The pointer knob 50 points to an inscription "Timed bake" on the front panel. In such position of knob 50 and its master cam the apparatus is set for automatic operation and if the setting disks 4 and 5 are adjusted as shown in Fig. 1 and the clock is running, the switch 49 will be closed at one o'clock, pointer knob 50 moving to "automatic on" position, and will be opened at 2:30 o'clock, pointer knob 50 moving to "Off" position automatically. In the "Timed bake" position of knob 50, cam 48 is in the rotative positions shown in Figs. 2, 3 and 6 with cam lobe 52' holding switch 49 in the open position with all heater circuits deenergized and with the cam follower lever 56 on the steep slope part 63 of the cam surface in position to drive cam 48 clockwise, Figs. 2 and 3, or up in Fig. 6, when such lever swings to the left. Now at one o'clock finger 25 comes opposite slot 42 in disk 28 and the slotted disk assembly jumps forward until stopped by finger 25 contacting with disk 29. This swings cam follower roller lever 56 to the left, driving cam member 48 clockwise (Figs. 2 and 3) and upward (Fig. 6) to the position represented in Figs. 4 and 7. Switch 49 is now closed and heaters 60 and 62 become energized. In the first part of this driving action of roller lever 56 on cam 48 the cam slope 63 is sufficiently steep to cause positive and energetic driving action while the switch member 49 is pressing against cam lobe 52'. Turning of the cam brings the roller lever 56 to a decreased slope of cam surface 64. The cam driving action between these two points is aided by resilient switch member 49 as cam lobe 52' rotates away therefrom. The closing of the switch 49 is quick and positive, and the cam member comes to a stop in the position shown in Figs.

4 and 7, since driving action thereon has ceased with the movement of the roller lever 56 stopped in about the position shown in Fig. 7 by reason of slotted cam 29 striking the end of finger 25. The inertia of cam 48 may be absorbed by roller 56 striking a resilient detent 74 which is too stiff to move to the right under the influence of the inertia force. At this time the pointer knob 50 points to a mark 65 on the front panel which indicates that the switch is on and will be turned off automatically at the time indicated by pointer 10. Such point 65 may be given the legend "Automatic on" or "Auto on" if desired.

At 2:30 o'clock finger 25 will have rotated opposite slot 43 in slotted disk 29, the slotted disk assembly will jump forward, and roller cam lever 56 will swing further to the left to the position shown in Fig. 8, thereby driving the cam member clockwise (Figs. 2 and 4) and up (Fig. 7) to the position shown in Figs. 5 and 8. Such action causes the quick opening of switch 49 by lobe 52 as shown in Fig. 5, and pointer knob 50 will now point to "Off" on the front panel. At this time the low point 66 of the cam slope with lever 56 resting therein (Fig. 8) forms a detent for rotatively positioning the master cam 48 and knob 50. The automatic switch operating mechanism may be cocked by simply turning knob 50 from "Off" to "Timed bake." In such cocking action roller lever 56 is forced to the right by the cam slopes 64, 63, thereby moving the slotted cam assembly to the rear on part 36 and storing energy in spring 37. In such cocking action the knob 50 is turned counterclockwise slightly beyond the "Timed bake" position, so that finger 25 will snap over to the front of slotted disk 28 and then the knob is released and when released, will move back to the "Timed bake" position by itself due to the positioning action of cam lever 56 on cam member 48 and the detenting action of the flat surface on surface 52' cooperating with the switch lever 49. A complete cocking action is also indicated by a slight clicking sound produced by finger 25 when it snaps to the proper full-cocked position and in the event that knob 50 is not turned far enough completely to cock the mechanism when released, it will move to the "Automatic on" position, thus indicating that it has not been fully cocked. From this it is apparent that the mechanism may be moved from the "Off" position to half-cocked or "Automatic on" position, if desired, instead of the fully cocked position. This will be called for when the operator desires the oven to start heating at the time the switch is cocked and to be turned off automatically at a desired time later. In the fully cocked position the flat peripheral surface of cam lobe 52' acts with resilient switch member 46 pressing against it as a detent to position knob 50 in the "Timed bake" position. When the switch mechanism is in either the fully cocked or half-cocked position, it can be turned to "Off" position manually by simply turning knob 50 to "Off." This will open switch 49 by cam lobe 52. Such action will not uncock the automatic operating mechanism but if such mechanism is then uncocked automatically, it will perform no action on cam member 48. Thus the knob 50 and the switches operated by the master cam 48 are also used for the manual control of the oven heating circuits. This is a very desirable feature, since it eliminates extra circuits, extra switches and switch operating knobs and instructions for their use likely to be confusing to the type of person

who usually is called upon to operate such apparatus.

However, such single control switch must also be foolproof. To this end the master cam 48 and associated parts are so designed that the knob 50 may be turned in either direction from any position to any other position and perform the operations which are indicated by the pointer position of such knob. When the knob 50 points to "Bake," the same heater circuits are closed as when the switch is in the "Automatic on" position, the difference being that "Bake" indicates manual control whereas "Timed bake" indicates automatic control. In turning the knob 50 clockwise from "Off" to "Bake," assuming the roller 56 is at the low point 66 of its cam surface, a cocking action of the automatic switch operating mechanism will be performed, roller lever 56 being forced to the right by the slope 67 of its cam surface. Hence, the knob 50 may be turned from "Off" to "Timed bake" in either direction to condition the switch for automatic operation. At the "Bake" position roller finger 58 snaps into a positioning detent 68 in the front edge of the master cam 48. In moving from "Off" to "Bake" or vice versa, the long lobe 52 holds switch 49 open but as the bake position is reached, the end of lobe 52 clears the switch member 49 and allows it to close. This closing action occurs simultaneously with the snap detent action at 68, so that there is a quick closing action of the switch. In moving from "Bake" to "Broil" switch 49 remains closed, roller 56 rolls upon the extreme forward surface 69 of the master cam and snaps into a detent depression 70 (see Fig. 5) as the "Broil" position is reached. At the "Broil" position the back cam lobe 53 moves auxiliary switch 54 from contact 57 to contact 58. This switching operation occurs only at the selected "Broil" position in the non-automatic operating range of rotation of the cam.

In rotating knob 50 clockwise from "Broil" to "Timed bake" switch blade 54 is returned to contact 57 and the main switch 49 is opened by cam lobe 52'.

In rotating the knob 50 counterclockwise from "Timed bake" to "Off" the same switching operations described above for the different positions occur but the sequence is reversed.

During rotation of the master cam from "Timed bake" to "Bake" in the counterclockwise direction and vice versa, roller lever 56 rolls on the outer front surface 69 of the master cam and snaps into and out of the detents 68 and 70 at the "Broil" and "Bake" positions. In any of these extreme right swing positions of roller lever 56, the slotted disk assembly release mechanism which slides on part 36 is withdrawn sufficiently to the rear away from releasing or cocked position to prevent finger 25 from touching slotted disk 28. This withdrawn position may be termed an inactive cocked position and is desirable since during a large portion of the time the mechanism will not be used for automatic operations and, during such time, it is desirable to relieve the clock motor of the extra load and the parts of unnecessary wear caused by friction when finger 25 is pressing against slotted disk 28 during an automatic operation.

I prefer to include the supplemental cam part 55 opposite the low portion 66 of the roller lever cam surface to serve the last-mentioned purpose when the knob 50 is moved manually to "Off" position. Part 55 is secured to and rotates with part 48. It is evident that when the knob 50 is

moved from "Off" to any of the positions, "Bake," "Broil" or "Timed bake," the automatic switch operating mechanism will be cocked if it is not already cocked. Hence, it will remain cocked when the knob is moved manually from any of the three positions mentioned to "Off," unless it should so happen that at the time of such manual movement to "Off" position the slots 42 and 43 in disks 28 and 29 happen to be in alignment with finger 25, and with the ordinary use of the mechanism this is not likely to occur. To relieve the mechanism of the extra motor load, wear and friction of finger 25 rubbing on slotted disk 28, and the wear incident to unnecessary automatic uncocking of the release mechanism when no automatic switch operation is desired, I provide the auxiliary cam part 55 to keep roller lever 56 from riding down into the V-shaped depression at 64 of its cam when the knob 50 is moved manually to "Off" position from any other operating position.

It is evident that with the automatic switch mechanism cocked, the farthest roller lever 56 can swing to the left is the position represented in Fig. 6 because this is its position when finger 25 is riding on the front surface of slotted disk 28. Hence, if the master cam be turned manually in either direction to "Off" position to thus bring the low part 66 of its cam opposite roller lever 56, the roller will ride up the sloping cam surface 71 or 72 of such auxiliary cam part 55 into a detent 73, positioning the knob 50 and the master cam in the "Off" position with the slotted disk assembly withdrawn to the rear away from the cocked to the inactive cocked position where finger 25 does not contact with slotted disk 28.

A second supplemental resilient cam part 74 functions in somewhat the same manner in case the knob 50 is turned manually from "Automatic on" to "Off" with the automatic switch mechanism half cocked. In this case the lateral position of roller finger would be as shown in Fig. 7 and if the master cam is turned to align with low point 66, roller 56 will move against the sloping surface of cam part 74. This cam part is of metal and is resilient and secured to shaft 51 with the master cam 48 as shown in Fig. 9. Hence, it flexes to the right in Fig. 7 and allows the roller finger 56 to snap into a detent depression 75 therein. The primary purpose of this cam part 74 is as a detent for positioning the master cam and its operating knob to "Off" position under the circumstances last described. If the cam roller lever 56 remains in the detent 75 at the time set for the other parts of the automatic switch mechanism to move from the half-cocked or "Automatic on" position to "Off," lever 56 will simply snap from the depression 75 to the V notch 66 opposite thereto.

Provision is made to prevent any automatic switching operation in case the mechanism is cocked and the master cam happens to be unintentionally left in the nonautomatic operating range and in a position where cam roller 56 rests at point 76 as represented in dotted lines in Fig. 6. The pointer knob 50 would indicate a position between "Off" and "Bake" and nearer the latter, and switch 49 would be open under the circumstances assumed. When the time arrives for an automatic "Switch on" operation, roller lever 56 tends to swing to the left and if not prevented would turn the master cam counterclockwise (Fig. 3) and down (Fig. 6) and cause switch 49 to close automatically. To prevent such unintentional automatic closing of switch 49, the master cam is prevented from being turned by the automatic

turning force available under these circumstances and for this purpose a friction brake is provided, comprising a spring member 77 which presses against a portion of cam lobe 52 which is built out to the forward edge of the master cam and designated 52b (see Figs. 5 and 9). As shown in Fig. 9, the spring brake does not extend over that part of the cam lobe 52 which is contacted by switch arm 49, and hence, the cam surfaces of these parts may be shaped to best serve their individual purposes without interference. This spring brake also improves the "feel" of the switch when turning from "Off" to "Bake."

This friction brake is applied to the master cam only during the time when the pointer knob 50 is turned through the quadrant between "Off" and "Bake" and the extent of this braking action is adjusted, so that at that time the cam will not be turned by any pressure that might be applied thereto by roller lever 56 in response to an automatic uncocking action. This friction, however, is not sufficient to prevent the master cam from being readily turned manually by means of knob 50. This automatic switch operation can occur only when the master cam is in its intended automatic operating range of rotation.

From the foregoing description it is seen that the master cam and related parts serve for a plurality of coordinated purposes related to the fool-proof manual and automatic operation of all of the heating circuit switches of a cooking unit, the cocking of the automatic switch operating mechanism, and the selection of automatic or manual operation. These various operations are all under the control of the single knob 50 which may be turned from any position to any other position in either direction without danger of doing something wrong or injuring the control apparatus. The knob and its master cam 48 has no axial movement and does not have to be pulled out and turned for certain operations and pushed in and turned for certain other operations as is often the case with a multiple-purpose control shaft of this general character.

The purpose of different positions of knob 50 is clearly indicated. These positions are easily established by the various detents associated with the master cam.

The operations of knob 50 and of the time setting knob 12 in no way interfere with each other. A time setting may be made either before or after a cocking operation with knob 50 in any position. Of course, if the knob 50 is in the "Timed bake" position and in the time setting the slot in disk 28 is moved past finger 25, the equivalent of an "Automatic on" operation will be performed, requiring that the knob 50 be turned back to "Timed bake" to fully recock the mechanism. Hence, in preparing for an automatic operation, the on and off times are set by knob 12 and then knob 50 is turned to "Timed bake" if not already in such position.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. A time switch comprising a clock, an automatic switch operating release mechanism of the cockable type, including a pivoted cam follower lever adapted to swing in a fixed plane about its pivot, spring means for driving said lever about its pivot in one direction, clock controlled means for delaying the driving action of said spring on said lever and releasing such action in two distinct steps whereby the lever is driven by said spring in two distinct steps, said clock controlled releasing means being adjustable with respect to

the times of said releasing operations, a switch adapted to be operated between two positions in response to said two releasing operations, a master cam interposed between said lever and said switch, said master cam being rotatively mounted in a fixed axial position about a given axis and having a cam surface cooperating with said lever and a cam surface cooperating with said switch such that starting with the cam in a given rotary position the clock controlled step operations of said lever turn the cam in a given direction in corresponding distinct steps and the switch is operated to and from a given position respectively by such rotative steps, means for manually rotating said cam in either direction to said given position from any other position, said manual operation causing the cam to swing said lever in the direction to tension said spring means and to perform a cocking action on said releasing mechanism if not in a cocked condition.

2. A time switch including a master cam said cam being rotatable about a fixed axis without axial movement, a switch operated by the rotary movement of said cam, a pointer knob secured to said cam said cam being rotatable manually in either direction by any desired amount at all times by said knob, said knob and cam having five consecutively arranged rotative positions identified as follows, "Timed bake," "Automatic on," "Off," "Bake," and "Broil," said switch being open in the "Timed bake" and "Off" positions and closed in the remaining identified positions, a clock, a two-step automatic releasing mechanism adjustable as to its times of operation controlled by said clock, said mechanism having a cocked position, a half-cocked position, and a fully released position, spring means associated with said mechanism for biasing the same from cocked through half-cocked to the fully released position, and a pivoted cam follower lever bearing against said master cam and operated by said releasing mechanism for rotating said cam in steps in one direction only first from the "Timed bake" position to the "Automatic on" position and second from the "Automatic on" position to the "Off" position automatically to close and open said switch respectively at predetermined adjustable times in response to the two-step releasing action of said mechanism, the manual rotation of said knob from the "Off" position to the "Timed bake" position in either direction serving to cock said release mechanism if not in the cocked condition.

3. A time switch comprising a clock, a switch, automatic means controlled by said clock for closing and opening said switch at predetermined adjustable times, and manual means for closing and opening said switch as and when desired, a single setting knob and shaft rotatable about a fixed axis without axial movement associated with said automatic means for selectively adjusting the times of the "Automatic on" and "Off" operations, and a single knob and shaft rotatable about a fixed axis without axial movement for conditioning said automatic means for automatic operation, selecting between automatic and nonautomatic operation and for manually operating said switch, said two knobs and shafts being rotatable independently of each other and in either direction of rotation.

4. A time switch including a clock, a master cam, said cam being rotatable about a fixed axis without axial movement, switch means operated by the rotary movement of said cam, a knob

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secured to said cam by means of which the cam may be manually rotated in either direction by any desired amount at all times, said cam having a range of operation intended for automatic operation, a two-step automatic releasing mechanism adjustable as to its times of operation controlled by said clock, said mechanism having a cocked position, a half-cocked position and a fully released position, spring means associated with said mechanism for biasing the same from cocked position through half-cocked position to fully released position, and a pivoted cam follower lever bearing against said master cam and operated by said releasing mechanism for rotating said cam in steps in one direction only through its intended automatic operating range to effect automatic timed operation of said switch means said cam and lever being designed to operate the releasing mechanism from fully released to cocked position by manual rotation of said knob, and means for preventing rotation of said cam by said cam follower lever in response to any automatic releasing operation except when the cam is in the intended automatic operating range.

5. A time switch including a clock, a master cam, said cam being rotatable about a fixed axis without axial movement, a knob secured to said cam, said cam being rotatable manually in either direction by any desired amount at all times by said knob, a first switch operated between open and closed positions by rotation of said cam, said cam having automatic and nonautomatic ranges of operation over different selected portions of a revolution, both for such operation of said first switch, means controlled by said clock for rotating said cam through its automatic operating range in two steps at predetermined adjustable times to actuate said first switch from open to closed and back to open position at said predetermined adjustable times, and a second switch operated by rotary movement of said cam only when in a selected portion of its non-automatic range of rotation.

6. A time switch comprising a clock, a master cam which is rotatable about a fixed axis and without axial movement, a knob secured to said cam for manually rotating the cam in either direction by any amount in any condition of the time switch, switching means operated between closed and open positions by the rotation of said cam, the complete rotary range of rotation of said cam being divided into automatic and non-automatic switch operating ranges, both ranges having a common switch "Off" position, a two-step automatic releasing mechanism adjustable as to its times of operation controlled by said clock, said mechanism having a fully released position, a half-cocked position, a cocked position and an inactive cocked position, spring means associated with said mechanism for biasing the same from the inactive cocked position through cocked and half-cocked positions to the fully released position, a pivoted cam follower lever bearing against said master cam and operatively connected to said releasing mechanism for automatically rotating said cam in steps through its automatic operating range to said "Off" position when the releasing mechanism moves from the cocked position through half-cocked position to fully released position under the control of said clock to operate said switch from open to closed and back to open position, said cam being designed to cock the releasing mechanism through said lever when the cam is rotated in either direction from said "Off" po-

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sition if said mechanism is not already cocked and to withdraw the releasing mechanism from cocked to the inactive cocked position when the cam is in the greater portion of its nonautomatic operating range of rotation.

7. A time switch comprising a clock, a master cam rotatable about a fixed axis and without axial movement, switching means operated by the rotary movement of said cam, said cam having an automatic range of rotation and a non-automatic range of rotation with a common switch "Off" position for the automatic and manual operation of said switching means, respectively, a knob for turning said cam in either direction by any desired amount in any condition of the time switch whereby said switch means can also be operated manually when the cam is in the automatic operating range, an automatic switch operating releasing means having fully released, half-cocked, cocked, and inactive cocked positions, spring means for biasing said releasing means from the inactive cocked position through cocked and half-cocked to fully released position, means operated by said clock for releasing the releasing means from cocked and half-cocked positions at predetermined adjustable times, a lever operated with said releasing means bearing on said master cam for rotating the cam in one direction only through its automatic operating range to said "Off" position to effect automatic operation of said switch, said cam being designed to move said releasing means from fully released to inactive cocked position when said cam is rotated manually in either direction from said "Off" position into its nonautomatic operating range, and an auxiliary cam means rotatable with said master cam for engagement with said lever when the master cam is rotated manually to said "Off" position with the releasing means in cocked position for withdrawing said releasing means from cocked to inactive cocked position.

8. A time switch comprising a clock, first and second switches, a spring operated automatic releasing mechanism which is manually cocked to tension its spring and released by said clock for effecting automatic operation of said first switch at predetermined adjustable times, a master cam interposed in driving relation between said release mechanism and first switch and through which said switching operation is accomplished, said cam being rotatively mounted on a fixed axis without endwise movement, and a knob secured to said cam by means of which the cam may be rotated in either direction by any desired amount in all conditions of said time switch, said master cam having a cam surface cooperating with said releasing mechanism for rotating said cam in response to automatic releasing operations and for cocking said releasing mechanism by manual rotation of said cam, a cam surface cooperating with said first switch for operating the same when the cam is rotated, and a cam surface cooperating with said second switch for operating the same when the cam is rotated, the coordination of said cam surfaces and cooperating parts being such with respect to the rotative position of the cam that the first switch may be operated automatically without operating the second switch, the first switch alone and the first and second switches together may be operated manually without interference from the automatic operating mechanism, said master cam also having detent surfaces coordinated with certain of said cam surface cooperating parts to assist in rota-

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tively positioning the cam in different desired rotary positions, and a friction brake for said master cam comprising resilient means cooperating with another cam surface of said cam for preventing rotary movement thereof in response to any automatic releasing operation when the cam is in a certain rotative range where automatic operation is not desired.

9. A time switch comprising a clock, a switch, means controlled by said clock for closing and opening said switch automatically, said means including a part driven by said clock and front and rear superimposed normally stationary disk members mounted for rotary adjustment concentric with the dial of said clock, one for determining the time when said switch will close and the other for determining the time when said switch will open, the front disk member having a cut-out sector one end of which serves as an indicator to indicate on the dial of the clock the switch operating time for which the front disk is set, the rear disk member having a scale thereon exposed through the cutout sector of the front disk to indicate the time duration during which the switch will be closed and an indicator extend-

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ing from the rear disk member through said sector opening to indicate on the clock dial the switch operating time for which the rear disk is set, means for manually adjusting the rotary position of one of said disk members to set the time for the corresponding switch operation, the indicator on the rear disk member by reason of its extension through the sector opening in the front disk member comprising a lost motion during connection between said disk members whereby both disk members may be rotatively adjusted by said manual operating means to set the times for the corresponding automatic switch operations.

JOHN R. MACINTYRE.

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