July 2, 1963 J. L. McCLURE 3,096,407

TIMED SWITCH ACTUATION MEANS

Filed Aug. 16, 1960

3 Sheets-Sheet 1

FIG. 1

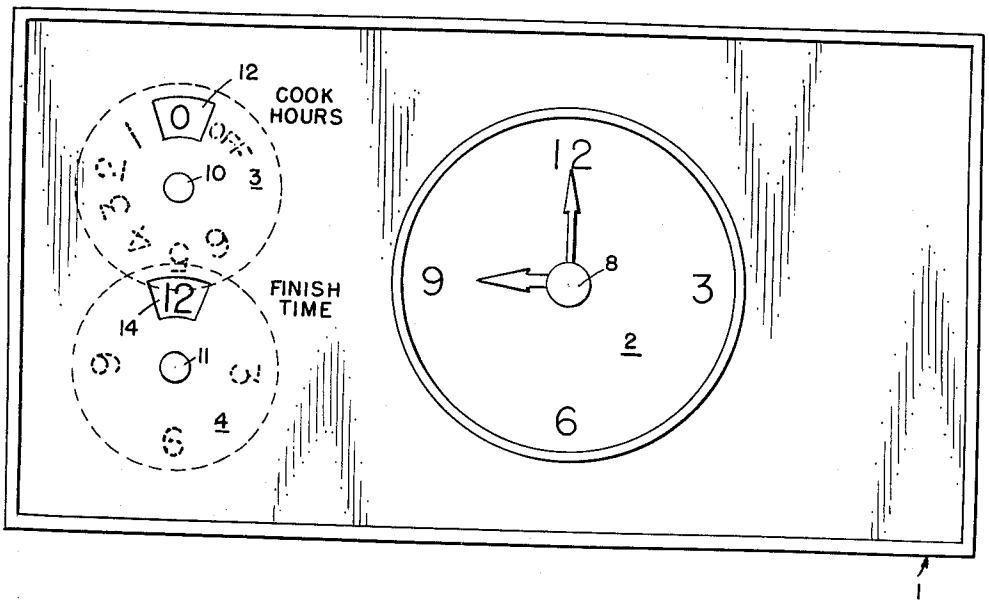
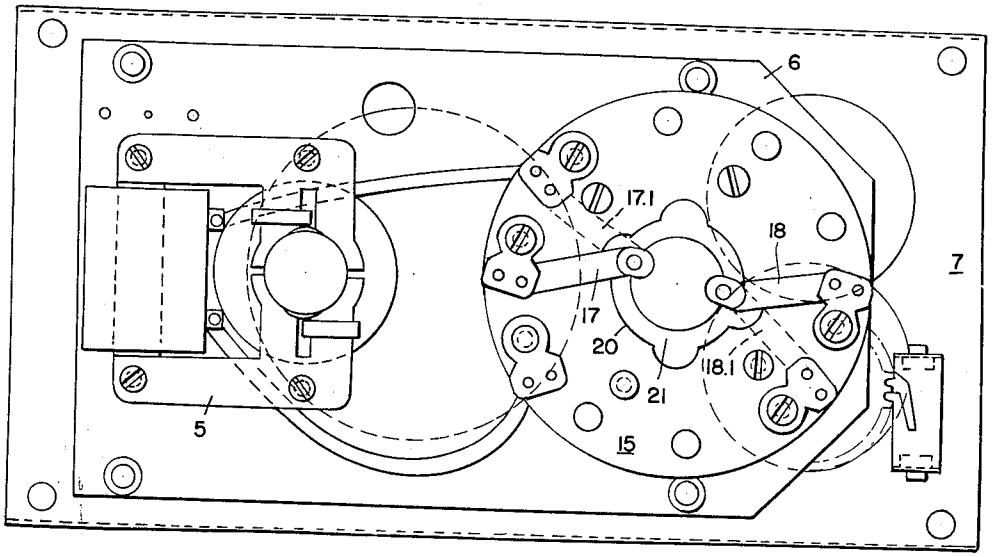


FIG. 2



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TIMED SWITCH ACTUATION MEANS

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FIG. 3

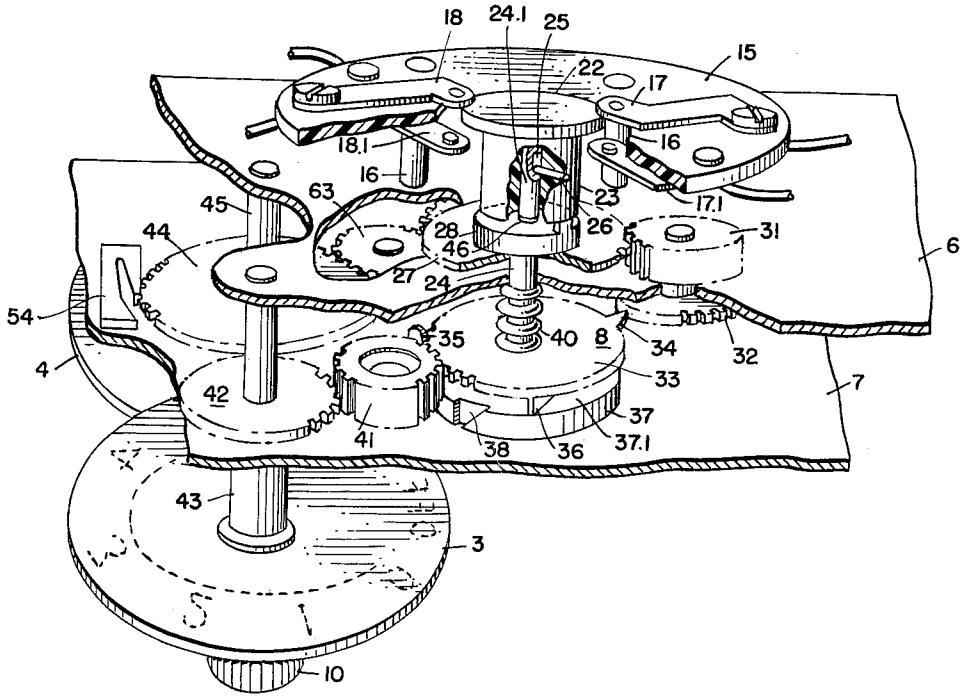


FIG. 5

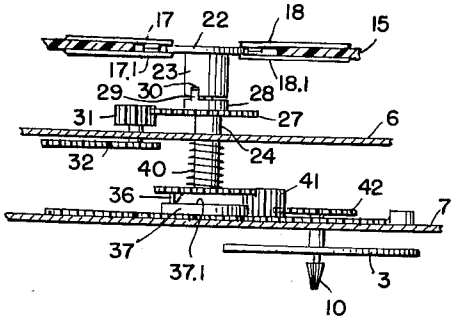
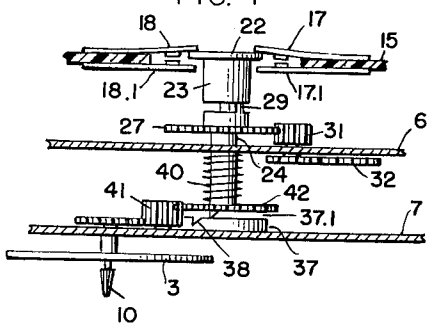


FIG. 4



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FIG. 6

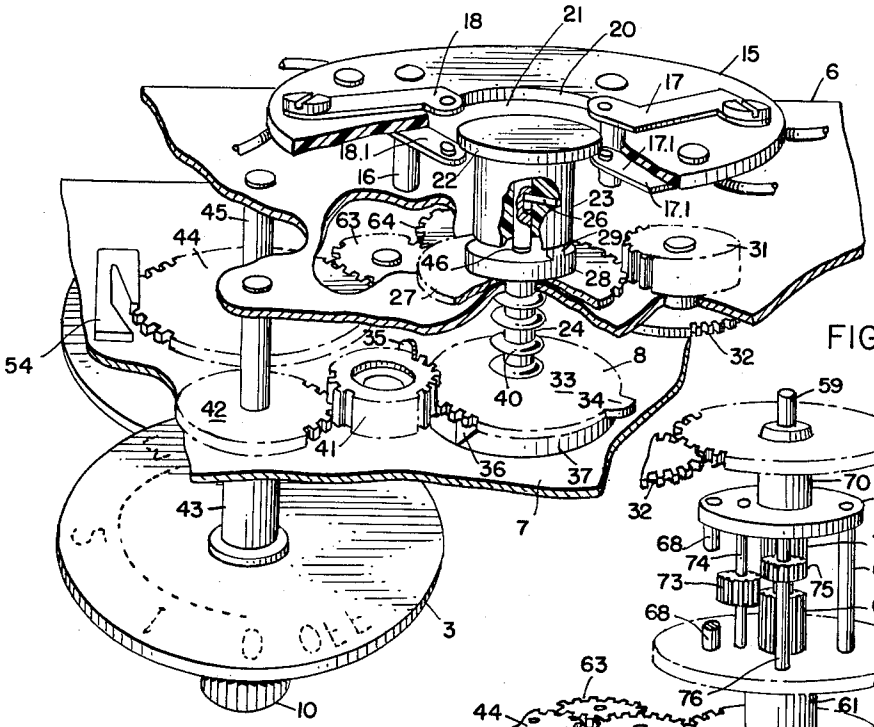


FIG. 8

FIG. 9

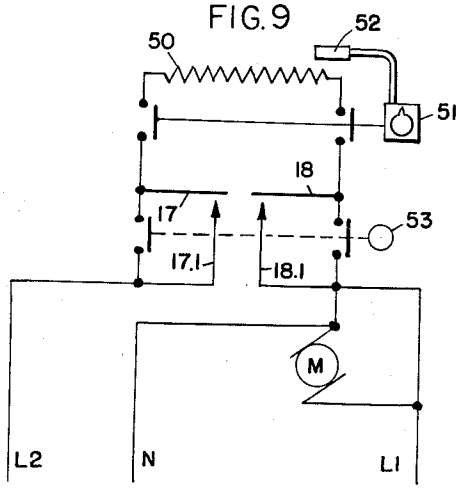
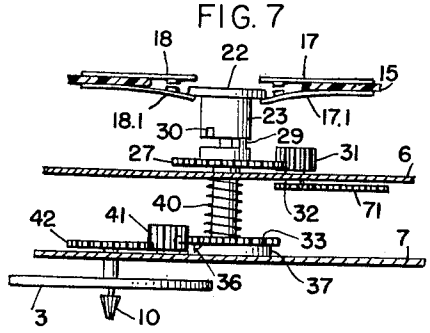


FIG. 7



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3,096,407

TIMED SWITCH ACTUATION MEANS

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Filed Aug. 16, 1960, Ser. No. 49,890
8 Claims. (Cl. 200—38)

This invention relates to switch actuation mechanisms for timing devices and the like, and although not restricted to such use, is particularly suitable in timers used for starting and terminating a cooking process in a range or other cooking appliance.

Timed cooking operations which came into use in domestic ranges for oven cookery a number of years ago, are now being made available for surface cooking operations. It becomes a practical necessity to construct the timing devices so that their operation is easily understood by the housewife and easily manipulated to carry out the desired cooking program with a high degree of accuracy. From the point of view of service, the timer must be sufficiently simple in its operating components to insure its continued operation with minimum service expense. It is an object of the present invention to provide a switch mechanism for a timing apparatus which will be easy to set, will be reliable in operation, and will function for a long period of time without repairing or adjustment.

It is a further object of the invention to provide a timing apparatus in which the switch actuator mechanism is simple and positive in its operation.

These and other advantages are accomplished in the present invention by means of a switching mechanism comprising a pair of leaf spring contacts in stacked relation and opposingly biased to assume a normally closed position. These contacts control the energy source of the cooking appliance. A contact actuator has means extending between the tip ends of the contacts in a manner not disturbing the normal closed circuit position thereof. Said actuator is movable normal to the plane of the contacts to three positions, determined by the initial setting and subsequent timed operation of the device. In the first position, the actuator lifts the upper of the contact pair to separate the contacts. This actuator position is established when the cook sets the device to the hour at which the cooking operation is to be completed. The second of the actuator positions returns the contacts to closed circuit relationship; this position occurs at the time the cooking operation is to begin. The third position is one in which the actuator draws downwardly the lower of the contact pair to separate the contacts and thus open the circuit at the termination of the cooking operation.

These positions result from the axial displacement of the contact actuator. Such displacement is accomplished by a camming mechanism jointly associated with setting dials respectively establishing the time at which the cooking operation is to be completed, and the actual time of the cooking process. Manually setting one of these dials actuates a first camming device which mechanically lifts the contact actuator to the first of its positions and also establishes the "hours to cook" period. Manually setting the other of the dials positions a time-operated actuating mechanism in suitable relation to the actuator to cause the actuator to assume an intermediate position returning the contacts to closed position at the necessary time in advance of the "finish cooking" time to allow for proper cooking. This contact actuation begins the cooking operation. Upon the attainment of this intermediate position the actuator mechanism couples the first camming device to the clock train, whereby, at the completion of the cooking period the contact actuator moves to its third

position to open the cooking circuit. It is a feature of the invention that the fundamental operating movements of the actuator are both axial and rotative, whereby its timed action relative to the associated contacts is rotational, derived from a simple geared mechanism, and its contact operation is axial, providing for the positive actuation thereof. It is a further feature of the invention that the commencement of the cooking operation initiates the reverse rotation of the "hours to cook" dial, whereby the cook may at a glance determine the cooking period which remains and by experience or observation of the foodstuff at that stage, advance or retard the cooking period. It is a further feature of the invention that at the end of the cooking operation the electrical switching system is automatically restored for operation at a future time without the necessity of manually clearing or resetting the apparatus.

Other features and advantages of the invention will be understood from the following detailed description of a preferred embodiment thereof read in connection with the accompanying drawings in which:

FIG. 1 is a front view of timing apparatus embodying the present invention;

FIG. 2 is a rear view thereof;

FIG. 3 is a fragmentary perspective view to illustrate the operational position of the switching mechanism at the first setting of the device;

FIG. 4 is a simplified representation of the switch actuator at the stage of operation represented in FIG. 3;

FIG. 5 is similar to FIG. 4, but taken from another vantage point to show the relation of the parts when the cooking operation commences;

FIG. 6 is a view similar to FIG. 3 in which the parts are shown in their relationship at the completion of the cooking operation;

FIG. 7 is a simplified view showing the part relationship under the FIG. 6 position;

FIG. 8 is an exploded perspective view of the planetary transmission; and

FIG. 9 is a schematic wiring diagram.

FIGS. 1 and 2 which are respectively front and rear views of a timer embodying the invention, indicate a frame **1** which forms general support for the mechanism comprising the clock **2**, the "cook hours" dial **3**, and the "finish time" dial **4**. The clock is in all respects conventional and consists of the usual synchronous motor **5** of the type manufactured and sold by applicant's assignee under the trademark "Telechron." Said clock motor is mounted on the rear of a plate **6** which is suitably spaced from the front frame plate **7** so as to accommodate the conventional clock gear train (not shown) and the timer actuating mechanism presently described. It is, of course, understood that the clock includes a conventional setting knob **8** and that the usual slip clutch (not shown) or equivalent is employed in connection with the setting mechanism of the clock and within the driving components between the clock mechanism and the timing mechanism, so that the manual setting of either the clock or the timing mechanism does not impose mechanical strains on the clockwork per se. The "cook hours" mechanism has its setting knob **10** and the "finish time" mechanism has its setting knob **11**. The face of the frame **1** is desirably opaque, at least in the areas behind which the respective time control dials are mounted, and there are provided the respective windows **12** and **14** so that the markings on the dials may be observed. The "cooking hours" dial is graduated over a six-hour period in view of the fact that almost no cooking operations require cooking for more than six hours. The "finish time" dial is graduated to provide a twelve-hour scale for obvious reasons.

As shown in FIG. 3, a disk **15** of insulation material

is fixed in spaced relation to the plate 6 by means of any suitable number of posts 16. Said disk 15 comprises the terminal block from which as indicated in FIG. 2 the power connections for the motor and switching circuits may be made, and also serves to mount the contacts which are controlled by the timing device. For the reason that the precise electrical circuit of which the contacts are a part is not important to an understanding of the present invention, the schematic circuit shown in FIG. 9, later explained, should not be interpreted in any limiting sense. As indicated in FIG. 3, the disk 15 mounts two pairs of switch elements, each of which comprises a flexible bronze strip of leaf spring quality. Specifically, to the right of the disk as shown in FIG. 3, one of the switch pairs comprises an upper strip 17 and a lower strip 17.1, each having suitable terminal provisions for connection into the electric circuit. The left-hand contact pair comprises the upper strip 18 and the lower strip 18.1 similarly arranged for electrical connection. Each of the switch elements has a free end to which a silver contact is affixed pursuant to conventional practice and although the switch elements themselves may be in any offset relationship appropriate to the geometry of the disk and other structure, the free ends of each pair are arranged so that they are in a stacked relationship—that is to say, one above the other in mutual alignment. The free end of each switch element projects over a rim 20 which defines a central opening 21 of the disk. As best shown in FIG. 5, the pairs of switch elements are biased in an opposing relationship so that they will normally assume a closed circuit condition. Also, the free ends of the respective elements are spaced one above the other so that even in the closed circuit condition they will accommodate the flange 22 which comprises the operating projection of a contact actuator 23. It is this actuator 23 which moves axially and rotationally with respect to the contact pairs to establish the three contact conditions presently described.

The actuator 23 is axially movable on a reduced diameter portion 24.1 of a gear shaft 24 appropriately journalled in the plate 6 for rotational and axial movement. The axial movement on said shaft portion 24 is limited by a slot 25 therein, and a pin 26 which extends diametrically across the actuator 23 to ride within the slot. It should be noted that the actuator 23 is advantageously a cylindrical structure formed of an insulating material such as nylon. Mounted on the step or shoulder portion (not shown) which forms the base of the reduced portion 24.1 of shaft 24, and freely rotatable on said shaft 24 is a gear 27. Said gear has an enlarged hub 28 (which may be substantially the same diameter as the barrel portion of the actuator 23). Hub 28 has a key 29 extending upwardly from its rim. Said key rides upon the bottom surface of the actuator 23 until it comes into registry with an axially extending keyway 30 formed in actuator 23 whereupon as later described, said actuator will move downwardly under the influence of the spring bias of the elements 17 and 18. The slot 25 is preferably longer than the axial length of the key 29. Gear 27 is driven at a timed rate by a gear train including the meshing pinion 31 and a gear 32 which is driven by the clock mechanism through any conventional transmission (not shown) having suitable slip-clutch components and a conventional planetary gearing system permitting rotation of gear 32 relative to the timer-driven transmission.

A gear 33 is affixed to the lower end of shaft 24. Said gear has a projecting stop 34 which limits the rotation of the gear to a six hour interval by engagement with a finger 35. The gear 33 is, in effect, part of a camming device and is, therefore, equipped with a cam follower 36 which is arranged to ride upon the surface of a plate cam 37 fixed to plate 7. The lower end of shaft 24 is journalled within cam 37 for rotation and reciprocation. This cam has a notch 38 conforming generally to the slope of the cam element 36; that is, both the cam element and the notch have a vertical wall and a matching sloping wall. Preferably, there are two cam elements 37, in diametrically opposite relationship. A coil spring 40 on shaft 24 between plate 6 and gear 33 tends to drive the shaft 24 in a downward direction viewed in FIG. 3, whereupon when the cam follower 36 comes into registry the notch 38, the gear and its shaft and associated actuator will be downwardly propelled. As later described, the surface 37.1 provides a first cam level at which the actuator operates the contacts to a first open position, and the base of the notch 38 comprises a second cam level at which the actuator operates the contacts to a second open position. Gear 33 is arranged for manual rotation by means of a gear train comprising a pinion 41 meshing with a gear 42 which is fixed upon the shaft 43 directly associated with the setting knob of the disk 3. The pinions 31 and 41 are sufficiently long to permit the axial shaft movements without disengagement from their meshing gears. It will be obvious that rotation of the setting knob to any position indicating the desired cooking time will rotate gear 33 so as to space the cam element 36 a predetermined angular distance from the notch 38.

A gear 44 fixed on a shaft 45 to which the setting knob 11 of disk 4 is attached, is arranged by appropriate intermediate gearing to mesh with the gear 32 whereupon rotation of the disk 4 to a position representing the hour at which the cooking operation is to terminate will rotate gear 32 and by means of said gear and the pinion 31 will rotate the gear 27 and its associated hub 28. With respect to said hub it should be noted that it is incapable of axial displacement along the shaft 24; its associated gear 27 rests upon a shoulder on said shaft as previously noted and a snap ring 46 on said shaft prevents the hub from moving upwardly along the reduced portion 24.1.

FIG. 6 represents the mechanism at the termination of a previous cooking operation, and FIG. 7 schematically shows the relationship at some time thereafter. The "cook hours" dial 3 has returned to the position at which the "0" index appears at the window 12; the designation at window 14 (FIG. 1) shows that the previous cooking operation terminated at 12:00. It will be assumed that the next operation of the timer will be in connection with the preparation of an evening meal. For example, the cook may wish to prepare a roast to be completed at 6:00 p.m. This presumes, of course, that the timing mechanism is arranged in circuit with an oven heating element as schematically shown in FIG. 9. The oven heating unit 50 is under direct control of a combination switch and thermostat 51 which, when manually operated to any temperature setting, closes a double pole, single throw switch to prepare the oven control circuit. During operation the thermostat will cycle the heating unit 50 as the temperature-sensitive bulb 52 responds to temperature changes within the oven (not shown). To provide for the operation of the oven on a manual or nontimed basis, the circuit schematically illustrates a double pole, single throw switch 53, bypassing the timer mechanism contacts 17, 17.1 and 18, 18.1. The schematic representation of the time switch circuits shows them at the completion of a timed cooking operation and as they will be when the time switch is set for the next cooking operation. In using the oven under nontimed conditions, the cook sets the thermostat 51 to the desired oven temperature and operates the "normal bake" switch 53 to complete the circuit. On the other hand, when the cook wishes to conduct a time-bake operation, she sets the thermostat to the desired temperature setting which, while closing the indicated switch, merely prepares the oven circuit for completion as the timing mechanism closes its contact at the proper time to begin the cooking operation. In this circumstance, switch 53 remains open.

Referring to FIG. 6, it will be noted that the cam follower 36 on gear 33 has dropped into the notch 38 and the gear 33 and its shaft 24 have been driven downwardly under the effort of spring 40. The downward drive of shaft 24 causes the downward movement of the actuator

23, with which it is associated by way of the pin and slot connection. The flange 22 has moved the lower element of each contact pair downwardly away from their associated upper contacts whereupon the oven circuit is in open position. Because of the relative length of slot 25 and key 29, the key has disengaged from the keyway 30, and is in an idling position relative to the actuator 23.

In resetting the mechanism for the next operation the cook first rotates the dial 4 in a clockwise direction as viewed in FIG. 1 to the hour at which the cooking operation is to be completed—for example, "6." It will be recalled that gear 44 on shaft 45 was noted as being operatively associated with the gear 32 by intermediate gear trains and it will be understood that the gear 32 is also operatively associated with the gear train (not shown) of the time clock.

The mechanism for effecting such association may be of various conventional types, although it is advantageous to employ a planetary transmission as schematically shown in FIG. 8. A shaft 59 extends between and is secured to the plates 6 and 7. A gear 60 having a large hub 61 and a relatively smaller diameter pinion 62 formed thereon is freely rotatable on the shaft. Gear 60 is arranged for manual rotation by way of the "finish time" gear 44 and the idler gears 63 and 64. A gear 65 is freely rotatable on a reduced diameter portion of hub 61 and is, therefore, rotatable about pinion 62. A gear 66 provides for driving gear 65 from the clockwork (not shown). Gear 65 supports a plate 67 by means of spaced posts 68; said plate is rotatable with respect to the enlarged hub 70 of a gear 71 rotatable on shaft 59. Gear 71 is meshed with gear 32. Hub 70 is formed with a pinion 72 which is concentric with pinion 62 but axially spaced with respect thereto on shaft 59. Pinions 62 and 72 provide the sun gears for a planetary system which includes two sets of planet gears respectively rotatable on shafts supported by plate 67 and gear 65. The planet gears are symmetrically arranged and for simplicity, only one set has been shown in FIG. 8. Planet gear 73 is rotatable on shaft 74 and is in mesh with sun gear 62. Planet gear 75 is rotatable on shaft 76 and is in mesh with sun gear 72 and planet gear 73. Now it is obvious that gear 71 is the ultimate driven gear of this system, for its purpose is to drive the gear 27 on which key 29 is mounted, and said gear must be rotated manually by the setting gear 44 and by the clockwork gear 66, each of the latter gears being independent of the other and operable without conflict with each other. It is also obvious that while gear 60 is being operated by the setting mechanism, gear 65 may be considered to be fixed for the gear 66 holds it so; and when gear 65 is in its usual driven condition, gear 60 is fixed, for the detent 54 associated with gear 44 holds it so. Thus, the conditions are fulfilled for an effective planetary system. During the setting operation, gear 60 and its pinion 62 are rotated. Plate 67 is stationary because it is mounted on gear 65 whereupon the sun gear 62 drives the sun gear 72 and its associated gear 71 by way of the planet gears 73 and 75. This accomplishes the rotation of key 29 relative to the actuator keyway 30. On the other hand, when gear 60 is held stationary, the planet gears 73 and 75 provide a driving connection between gear 65 and the sun gear 72 of gear 71 whereupon said gear 71 and the gear 32 are driven at a timed rate from the clock mechanism. It will be understood that in FIG. 8, no attempt has been made to show proper sizes and gear ratios for the planetary system.

During the setting operation, therefore, rotation of the dial 4 will cause the rotation of gear 27 and the key 29 thereon relative to the actuator 23. Said actuator at this point is immobilized because the cam follower 36 is seated within the slot 38. The detent 54 engaging with the teeth of gear 44 permits the time setting to be accomplished with precision. The cook then rotates dial 3 in a clockwise direction to establish the proper length of the cooking operation which, of course, depends upon the nature and the size of the roast. This operation rotates gear 33 in a direction which causes the follower 36 to climb out of the notch 38. This vertical movement causes the shaft 24 to rise and thus to lift the actuator to the FIG. 3 position in which the flange 22 has raised the contacts into an open circuit position. At the same time the rotation of dial 3 and gear 33 rotates the actuator relative to the key 29 so that there is a predetermined angular relationship between the keyway 30 on the actuator and the key 29 on gear 27. Also, the rotation of gear 33 positions follower 36 at such location relative to notch 38 that it will not reseat in the notch until the completion of the cooking period. The operator then sets the thermostat 50 to the desired cooking temperature whereupon the oven circuit is then prepared for operation at the time cooking is to begin.

By means of the transmission between the time clock and gear 32 this gear begins its rotation and drives the gear 27 relative to the actuator 23. Said actuator remains stationary for there is no driving power applied to gear 33 and the friction of the gear train between it and the dial 3 is higher than the friction resulting from the travel of the key 29 along the underside of the actuator 23. Said actuator is desirably of nylon or other material having a low coefficient of friction. The respective gear trains are now so related that the key 29 will travel into registry with the keyway 30 at the time the actual cooking operation is to begin. For example, if as shown in FIG. 1 it was 9:00 a.m. when the cook placed the roast in the oven, it is obvious that the cooking operation must not begin until 4:00 p.m. assuming a cooking time of two hours. Therefore, the key 29 will have rotated into registry with the keyway 30 at 4:00 p.m. When this occurs, the bias of the upper switch springs 17 and 18 will drive the actuator downwardly from the FIGS. 3 and 4 position to the FIG. 5 position. The pin and slot device by means of which actuator 23 is mounted on the shaft extension 24.1 permits this movement. The timer contacts are then closed and the oven heating unit is energized. The pin 26 will then be intermediate the ends of the slot 25.

At this time, the mechanical engagement between the gear 27 and the actuator 23 and between the actuator and the shaft extension 24.1 completes a driving relationship between the clock mechanism and gear 33 which rotates the gear in a clockwise direction as viewed in FIG. 3. At the end of two hours the follower 36 will reach the notch 38. The spring 40 will drive the gear and its shaft downwardly. Because the pin 26 had not been at the upper limit of slot 25, the initial downward drive of shaft 24 and gear 27 will withdraw the key 29 from the keyway, following which pin 26 strikes the bottom of slot 25 and actuator 23 is moved downwardly in a positive manner to establish the switch elements in the open circuit position represented in FIGS. 6 and 7. The upward bias of elements 17.1 and 18.1 maintains actuator 23 above key 29, so that gear 27 may rotate idly. At this time, the hours-to-cook dial 3 will have reached the "0" designation signifying that the cooking has been completed. Actually, the slope of the cam slot 38 and the follower 36 cooperate so that the downward drive of spring 40 causes an additional fractional rotation of the gear 33 during the instant at which the oven contacts are opened. This additional movement can be utilized to move dial 3 through a further rotation sufficient to expose the word "Off" behind the window 12. This designation may be more meaningful to the cook than the "0" designation, although the significance is precisely the same.

As previously stated, the time switch mechanism is then in a ready position for another timed operation, or for the cook to conduct a "normal" nontimed baking operation without having to reset or reestablish any particular oven condition.

While there has been described what is at present considered to be the preferred embodiment of the invention, it will be understood that various modifications may be

made therein, and it is intended to cover in the appended claims all such modifications as fall within the scope of the invention.

I claim:

1. A switching device, comprising a plate; first and second switch elements of leaf spring quality insulatedly secured to opposite sides of said plate with free ends projecting beyond an edge of said plate in mutual vertical alignment, said switch elements being biased in opposing directions to assume a closed circuit condition; a shaft disposed normal to said plate; means for mounting said shaft for axial and rotational movement relative to said switch elements; a switch actuator; means for mounting said actuator on said shaft for rotation therewith and axial movement relative thereto, said actuator comprising a cylindrical body portion having a circular flange extending between said switch elements without interference with the closed circuit condition thereof; a keyway extending axially along said actuator body; a gear freely rotatable on said shaft and axially movable therewith, said gear having a key disposed beneath said body for seating within said keyway to establish said actuator flange at a level at which said switch elements are closed, manually operable means including a plate cam fixed relative to said shaft and a cam follower on said shaft for moving said shaft and actuator axially to a first position sufficient to disengage said key and keyway and for rotating said shaft and actuator body relative to said key, said actuator flange thereby engaging said first switch element in opposition to the bias thereof to disengage said switch elements; timed means for rotating said gear in an opposite direction to return the key to registry with said keyway whereby the bias of said switch element axially displaces said actuator to a second position to close said switch elements, said gear and said actuator being then in mechanically coupled relation for rotation of said shaft by said gear; means effective upon a predetermined extent of said rotation to position said cam follower relative to said cam to restore said shaft to its first position and move said actuator to a third position wherein said actuator flange separates said switch elements and said key disengages from said keyway; and spring means for effecting said movement.

2. A switching device, comprising an insulated plate; upper and lower switch elements of leaf spring quality secured to opposite sides of said plate with free ends projecting beyond an edge of said plate in mutual vertical alignment, said upper and lower elements being respectively biased in opposing directions to assume a closed circuit condition; a shaft disposed normal to the plane of said plate; means for mounting said shaft for axial and rotational movement relative to said switch elements; a switch actuator; means comprising a pin and slot mechanism for mounting said actuator on said shaft for rotation therewith and axial movement relative thereto, said actuator comprising a body portion having a flange of insulation material extending between said switch elements while maintaining the closed circuit condition thereof; a keyway extending axially along said actuator body; a gear freely rotatable on said shaft and axially movable therewith, said gear having a key disposed beneath said body for seating within said keyway to establish said actuator flange at a level at which said switch elements are closed, manually operable means for effecting an elevation of said shaft and actuator an amount sufficient to disengage said key and keyway and for rotating said actuator body relative to said key, said actuator flange lifting the upper switch element in opposition to the bias thereof to disengage said upper and lower elements; timed means for rotating said gear to place the key in registry with said keyway whereby the said bias of said switch element drives said body downwardly into mating relation with said key to close said switch elements, said gear and actuator thereby being in mechanically coupled relation for rotation of said shaft by said gear; and means effective upon a predetermined rotation thereof to drive said shaft and said actuator body downwardly to a position whereby said actuator flange separates said lower switch element from said upper element.

3. A switching device comprising a plate, first and second switch elements of leaf spring quality insulatedly mounted on said plate with free ends projecting beyond an edge of said plate in mutual vertical alignment, said switch elements being opposingly biased to assume a closed circuit condition; a shaft; means for mounting said shaft for axial and rotational movement relative to said switch elements; a switch actuator; means including a pin and slot mechanism for mounting said switch actuator on said shaft for axial movement and rotation therewith and axial movement independent thereof, said actuator having means engageable with each of said switch elements independently; means for manually displacing said shaft and actuator in an axial and rotational direction to establish said actuator in a first position displacing one of said switch elements to open circuit relationship with the other; timing mechanism operable at a predetermined time following the displacement of said switch element to effect an independent axial movement of said actuator to a position restoring said switch elements to closed circuit condition; means operable upon the last named movement of the actuator to clutch said actuator to said timing mechanism to effect a rotation of said shaft and actuator; means effective upon a predetermined timed rotation thereof to axially displace said shaft and said actuator to a further position whereby said actuator urges said second switch element to open circuit position, and means effective upon movement of said actuator to said further position to disengage the same from said timing mechanism whereby said actuator maintains the open circuit position of said elements.

4. The switching device according to claim 3, in which said clutching mechanism comprises a keyway on said actuator and a key on said timing mechanism.

5. The switching device according to claim 4, in which means are provided for manually angularly displacing said key relative to said keyway to establish a desired time interval before the engagement of said key with said keyway.

6. The switching device according to claim 3, in which the means for effecting the first noted rotational and axial displacement of said shaft comprises a two-level plate cam fixed relative to said shaft and a cam follower fixed on said shaft.

7. The switching device according to claim 6, in which said plate cam and cam follower cooperate to urge said shaft into further rotation during the last noted axial displacement of said shaft.

8. A switching device comprising first and second switch elements of leaf spring quality mounted in insulated relationship with the free ends thereof in vertical alignment, said elements being oppositely biased to assume a normal closed-contact condition; a shaft; means for mounting said shaft for axial and rotatable movement relative to said switch elements; a switch actuator; said shaft having an axial slot for mounting said actuator on said shaft for rotation therewith and limited axial displacement thereon, said actuator having means projecting between the free ends of said elements for selective engagement therewith; means for manually effecting a rotation and an axial displacement of said shaft and actuator from a first position to a second position in which said actuator is at one limit of its permitted axial movement on said shaft and engages the first of said switch elements to separate it from the second; a timer-driven clutch member concentric with said shaft for rotation relative thereto and axial movement therewith; means following a predetermined timed rotation of said clutch member for moving

said actuator axially to a position intermediate said shaft slot to effect a reengagement of said contact elements while mechanically engaging said clutch member to enforce timed rotation of said actuator shaft thereby; and means effective upon further timed rotation of said clutch member to displace said actuator for a distance in which it engages said second contact element to separate it from the first while displacing said shaft and clutch member a further distance effecting a disengagement of said actuator from said clutch member.

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