

Nov. 25, 1952

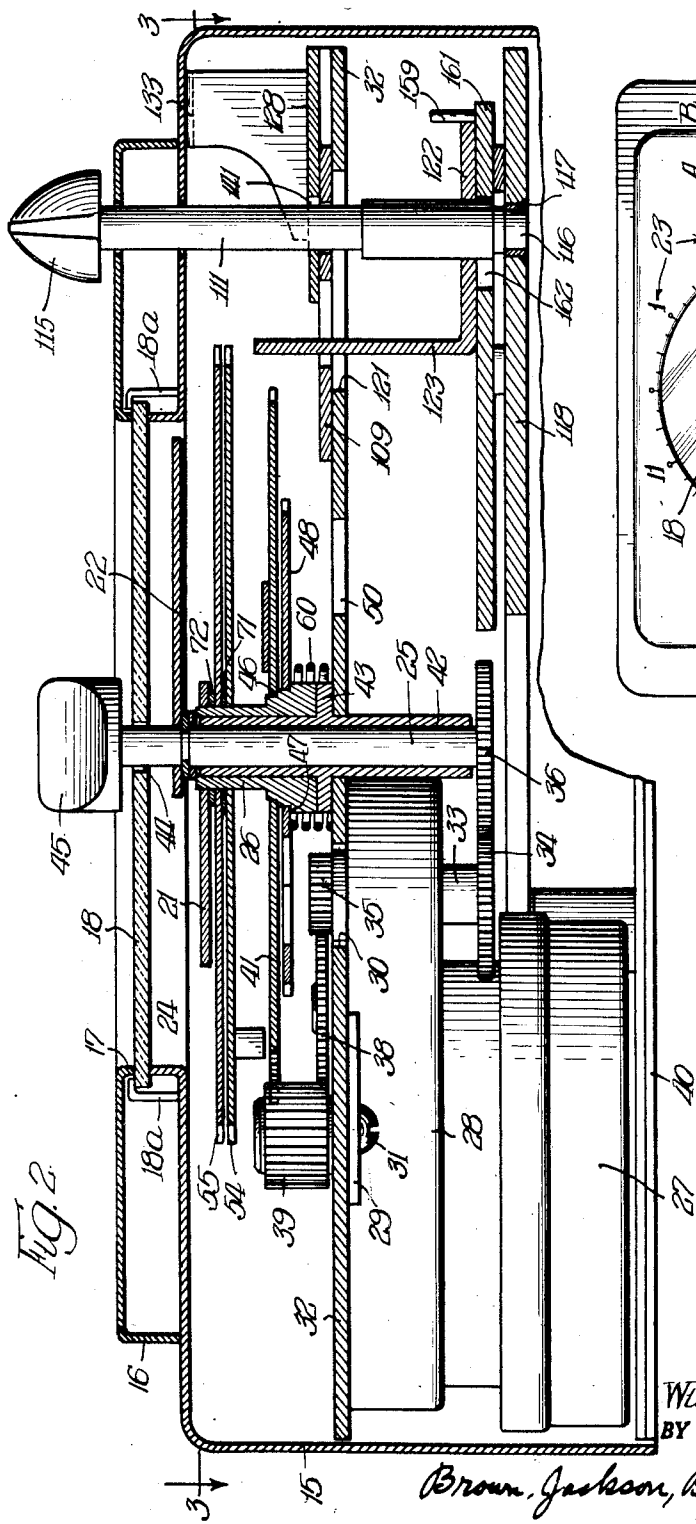
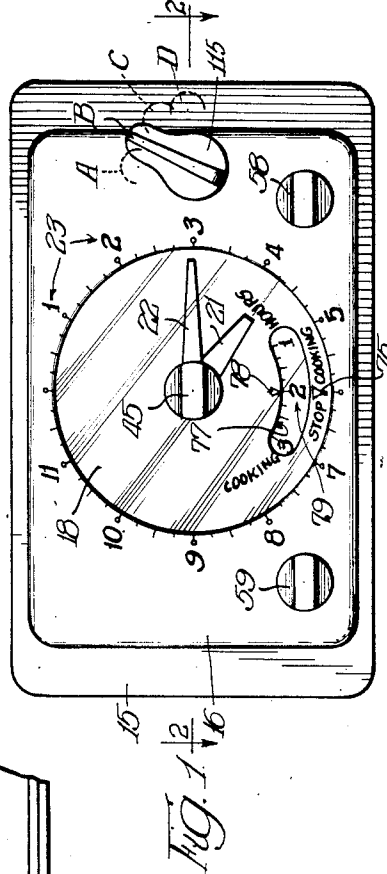
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2,619,558

TIMING MECHANISM

Filed Oct. 6, 1947

4 Sheets-Sheet 1



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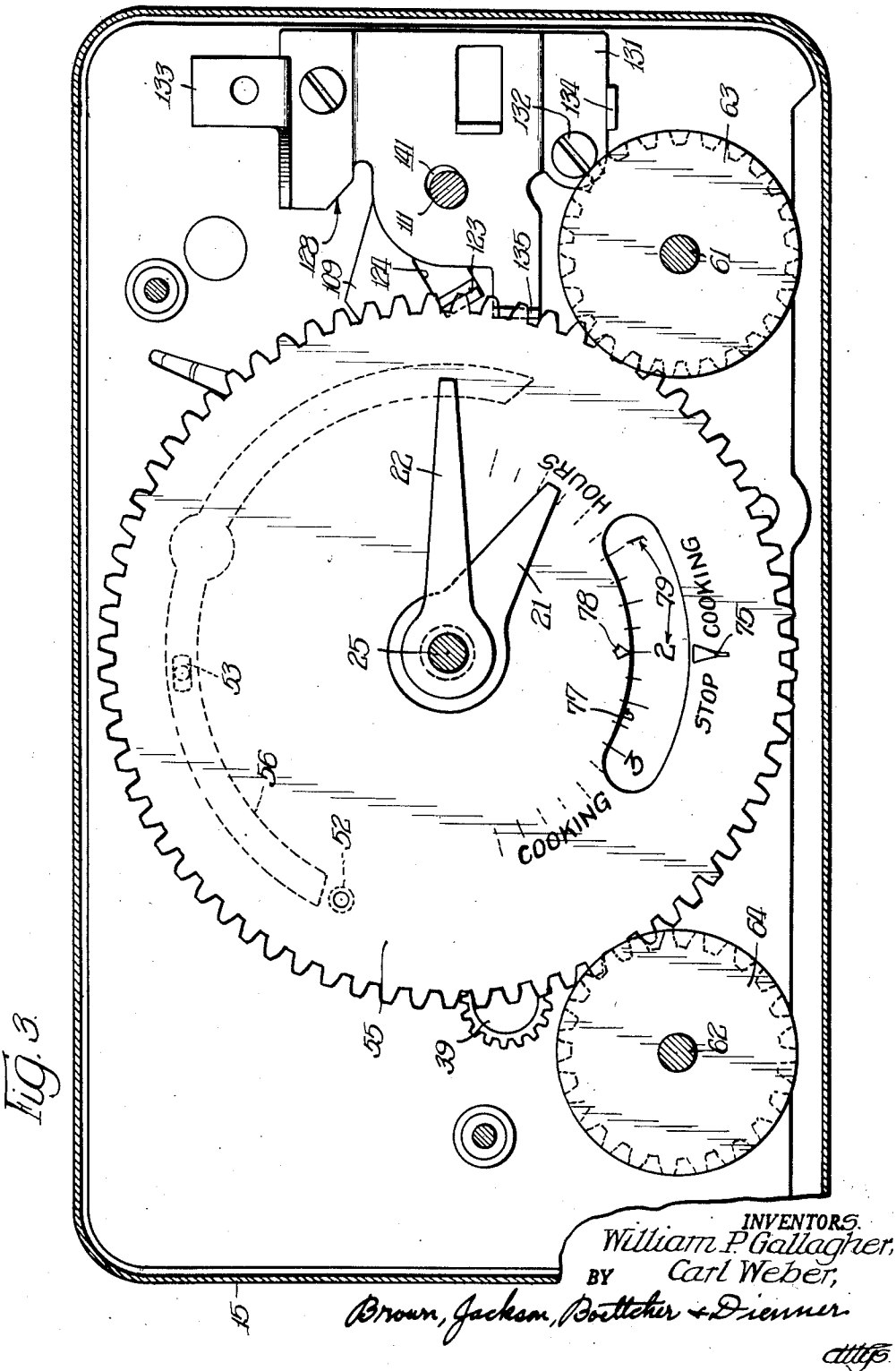
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TIMING MECHANISM

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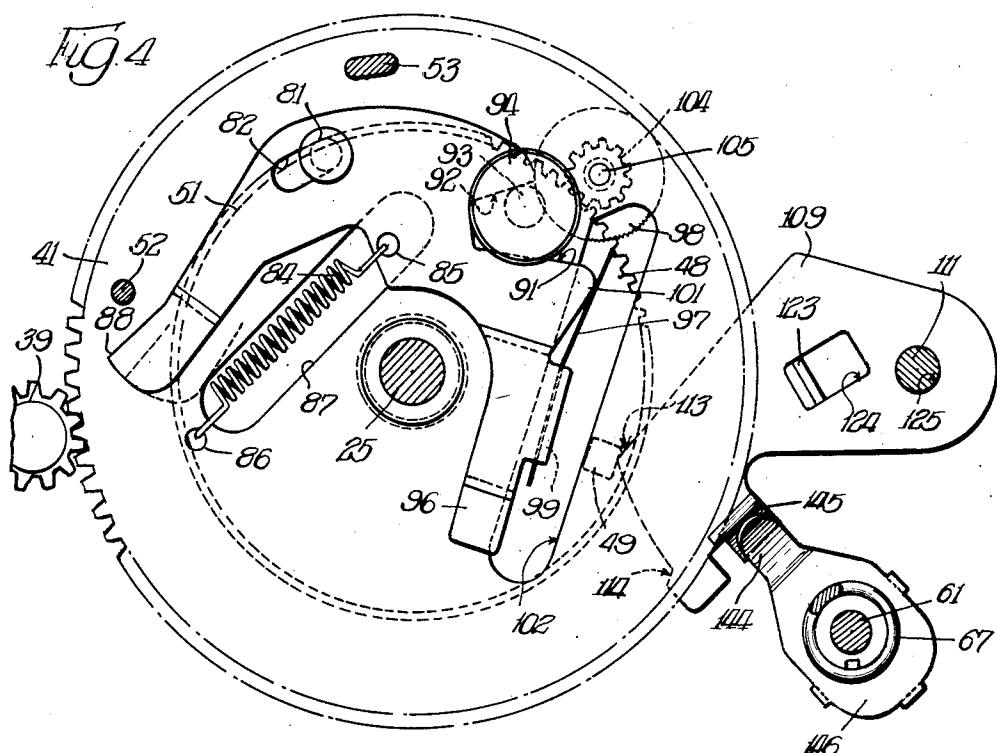
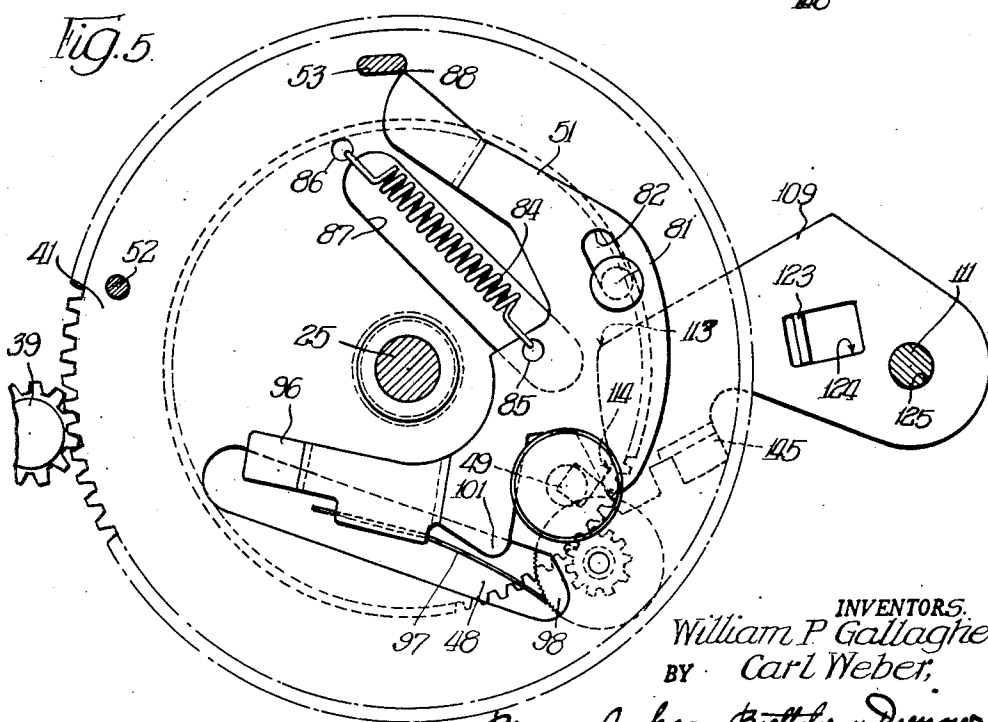
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TIMING MECHANISM

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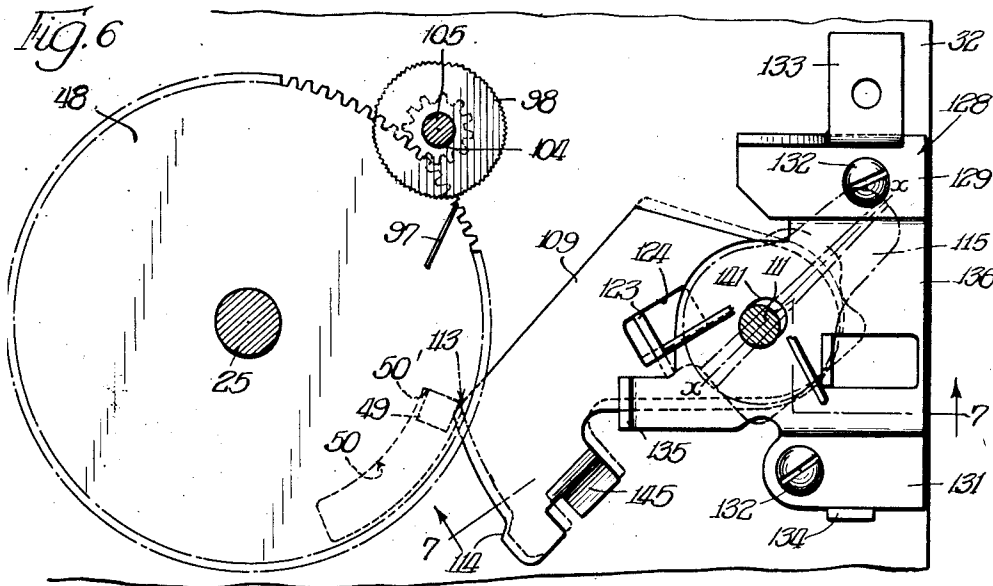
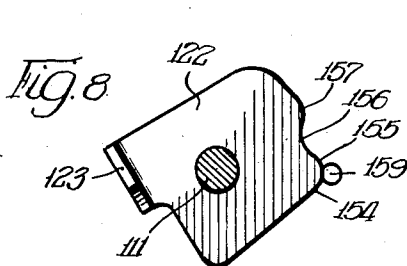
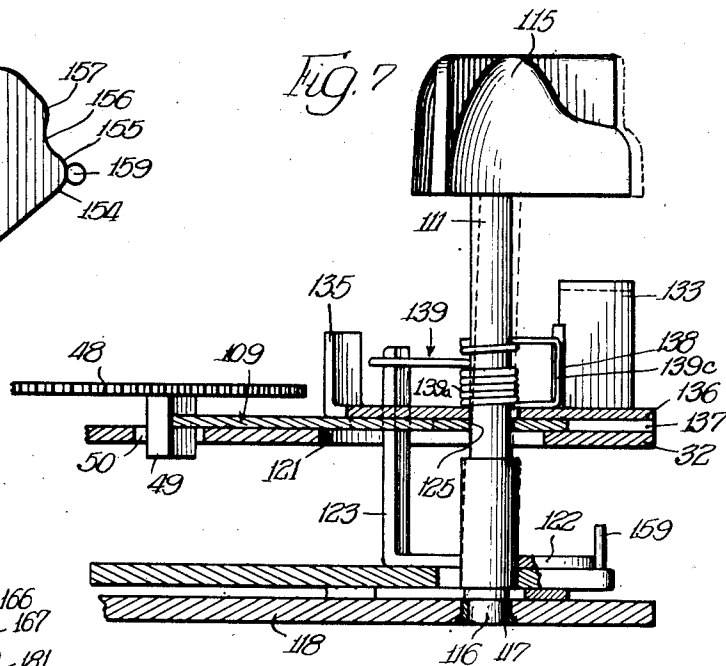
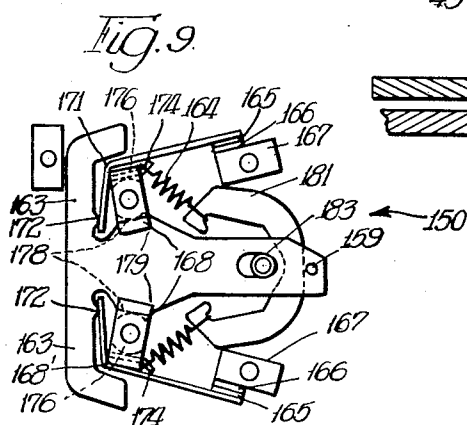
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TIMING MECHANISM

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4 Sheets-Sheet 4



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UNITED STATES PATENT OFFICE

2,619,558

TIMING MECHANISM

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Application October 6, 1947, Serial No. 778,104

19 Claims. (Cl. 200—38)

1

The present invention relates to timing mechanisms, such as time switches, interval timers, and the like. More particularly, the main features of the invention pertain to that type of timing mechanism which can be re-set so as to cause one or more desired operations to occur at a certain pre-selected hour or hours of the day or night. For example, the device might be employed to open or close an electrical switch at a predetermined time or times of the day or night, or to open or close a valve at a predetermined hour of the day or night. In the exemplary embodiment herein disclosed we have shown the invention in the form of an automatic time switch for electric stoves, electric ovens and the like, whereby the housewife can set the time switch to automatically start and stop a cooking operation at predetermined hours, or can set the device to result in a cooking operation of predetermined duration and to have this operation stop at a preselected time.

The timing mechanism herein disclosed is an improvement upon the automatic timing mechanism constituting the subject matter of our copending application, Serial No. 643,599, filed January 26, 1946. The timing mechanism of the present application is also similar in many respects to the automatic timing mechanisms disclosed in the prior patents of William P. Gallagher and Alfred W. Gardes, No. 2,302,625 and No. 2,301,942, both issued November 17, 1942.

One of the features of the timing mechanism disclosed in the present application is the greater accuracy of timing in the automatic operation of the device. That is to say, the automatic closing of the switch to start the cooking operation and the automatic opening of the switch to stop the cooking operation are more accurately related to the start-cooking and stop-cooking times which are actually set up on the automatic timer. In some of the automatic timers of the prior art there may be errors as large as a quarter-hour or half-hour, either in the closing of the switch or in the opening of the switch, or both, and if the particular cooking operation taking place at that time happens to be one of normally short duration such error or errors may result in a faulty cooking operation, particularly if such errors happen to be cumulative. In the construction herein disclosed, the timing accuracy of the device is approximately as accurate or possibly more accurate than the human element in the setting of the device, i. e., the timer performs just about as accurately as a human being can set the indicating elements on the timer. This great-

2

er accuracy of automatic operation is obtained largely through the use of an improved accelerating type of motion transmitting mechanism operative between the time driven parts and the switch tripping parts. The time driven parts or mechanisms have an extremely slow rate of rotation, such, for example, as one revolution in twelve hours, which slow rate of rotation makes it difficult to obtain relatively accurate tripping time for tripping the electric switch to start and stop the cooking operation at the pre-selected times. However, our improved accelerating type of motion transmitting mechanism transmits a sufficiently accelerated motion from the time driven parts to the switch tripping parts, so that a much greater degree of timing accuracy can be obtained. In its preferred embodiment, this accelerating type of motion transmitting mechanism comprises a planetary gear arrangement wherein a planetary pinion normally has a planetary idling motion around the perimeter of a normally stationary gear. This planetary idling motion causes the planetary pinion to have a rotary motion around its own axis in one direction. At the pre-selected time of tripping, a rotary motion is imparted to this planetary pinion to cause it to rotate in the opposite direction around its own axis, whereby an accelerated motion is transmitted from the planetary pinion to the normally stationary central gear, which latter gear then actuates the switch tripping parts. This improved construction of motion transmitting mechanism affords greater facility and simplicity of assembly of the timer. More particularly, this improved construction minimizes or eliminates the possibility of faulty operation or inaccurate timing arising because of assembly variations occurring between one unit and the next in the assembling operations.

Another feature of our improved timer herein disclosed is the safeguarding of the timer against mistakes made by the housewife in the setting of the timer, particularly mistakes which might leave the timer in closed circuit position indefinitely or for a time interval beyond the automatic control of the timer. In the absence of this safeguarding feature, such mistakes by the housewife may result in a burned meal or in the continuous heating of the heating element and the unnecessary use of electricity beyond the desired cooking interval. Such mistakes in setting the timer most frequently arise when the housewife sets the timer for a longer cooking interval than time permits. For example, let us say that

3

it is 4:15 o'clock in the afternoon, and the housewife either carelessly or without observing the clock sets the timer for a two-hour cooking interval to be completed at 6:00 p. m. Since there is not sufficient time for a two-hour cooking interval between 4:15 and 6:00 p. m., the timer may malfunction with regard to the switch closing or switch opening operation. What usually happens is that the manually set tripping pin which normally functions to start the cooking operation is overtraveled or passed by in this faulty setting operation performed by the housewife, so that this start-cooking pin is no longer in a position where it can perform a switch controlling function. Hence, the second manually set tripping pin, which normally functions to stop the cooking operation, is the only pin remaining to perform a switch controlling operation; and if this pin is incapable of distinguishing between a switch closing operation and a switch opening operation, or is not correlated to a switch opening operation, it will perform whatever switch operation is next in sequence. In the normal cycle of the timer when the housewife places the timer under automatic control, the switch closing operation is the next switch operation in sequence. Therefore, this stop-cooking pin, in not being correlated to a switch opening operation, actually performs a start-cooking operation. Inasmuch as there is no other tripping pin or other automatic instrumentality beyond this stop-cooking pin for controlling switch operation, then there is nothing which will automatically stop the cooking operation at the end of the pre-selected two-hour interval. The result is that the cooking operation continues indefinitely or until the housewife shuts off the range manually. The improved safeguarding feature of our present invention resides in establishing a positive correlation between the second or stop-cooking pin and the stop-cooking operation, so that whenever this latter pin performs a switch controlling function, it will always result in the switch moving to its open circuit position irrespective of whether or not there has been any switch controlling function performed by the first or start-cooking pin.

Another feature of the invention resides in an improved and simplified form of manually actuated start-cooking control. This control enables the housewife to start the cooking operation immediately by performing a very simple manual control operation, while still leaving the stop-cooking operation subject to pre-selected automatic time control. For example, the housewife may desire to have the cooking operation start immediately and to stop automatically at a predetermined hour of the day, such as 6:00 p. m. For this type of operation she would set the stop-cooking dial at the 6:00 p. m. marking of the clock dial and would then perform the manually actuated, start-cooking control which starts the cooking operation immediately. The housewife performs this manually actuated start-cooking operation by rotating the setting knob or lever to the set position and then merely tilting this setting knob slightly to one side. This sidewise tilting of the knob performs the first switch tripping operation immediately, so that the cooking operation begins at once, but the timer still remains subject to the automatic control of the second tripping operation, which has been pre-set to stop the cooking operation a predetermined hour of the day.

This manually actuated start-cooking control extends the utility of the timer and simplifies

4

the procedure when the housewife desires to have the cooking operation start immediately.

Other features, objects and advantages of the invention will appear from the following detailed description of one preferred embodiment thereof. In the accompanying drawings illustrating such embodiment:

Figure 1 is a front elevational view of our improved timer;

Figure 2 is a transverse sectional view through the axis of the clock dial, minute and hour hands and rotative assembly, corresponding to a section taken approximately on the plane of the line 2—2 of Figure 1;

Figure 3 is a sectional view taken on a plane at right angles to Figure 2, corresponding to a section taken approximately on the plane of the line 3—3 of Figure 2;

Figures 4 and 5 are similar detailed plan views showing in two different positions of operation the motion transmitting release mechanism which responds to the setting of the manually-settable trip pins to trip the switch actuating shaft;

Figure 6 is a fragmentary detail view illustrating the slidable releasing motion of the swinging stop plate.

Figure 7 is a sectional view taken approximately on the plane of the line 7—7 of Figure 6.

Figure 8 is a detail plan view of the switch operating cam; and

Figure 9 is a detail plan view, on a smaller scale, of one form of switch which we may use.

Many of the details of the automatic timer herein disclosed are similar to or identical with details disclosed in our aforementioned copending application, Serial No. 643,599, filed January 26, 1946, and attention is directed thereto for these similar details.

Figure 1 illustrates the automatic timer as viewed from the front of the electric range, the clock face being disposed substantially vertically so that it is readily visible from the front of the range. The mechanism is enclosed within a rectangular main housing 15, from the front of which extends a small rectangular supplemental cover or housing 16. Formed centrally of the supplemental cover 16 is a depressed circular opening 17 behind which is set the cover glass 18 (Figure 2) constituting the transparent front of the clock dial. The supplemental cover 16 is detachably secured to the main housing 15 by readily releasable attachment posts which are disclosed in our aforementioned copending application. This readily releasable mounting enables the cover 16 to be readily snapped off the main housing 15 to replace a broken cover glass 18, and then snapped back into place again. The cover glass may be rectangular or circular as desired, and it is held against sidewise shifting movement by a plurality of lugs 18a which are punched forwardly from the front wall of the main housing. The hour hand 21 and minute hand 22 rotate behind this glass 18 and cooperate with the clock dial numerals 23. The numerals 23 are shown as being marked on the outer surface of the supplemental housing 16, but it will be understood that they might also be marked upon a dial card disposed in back of the cover glass 18. As shown in Figure 2, the main housing 15 is formed with a forwardly extending circular flange 24 which aligns with the rearwardly extending circular flange 17 projecting inwardly from the supplemental housing 16, and the cover glass 18 is confined between these two matching circular flanges 17 and 24. The minute hand

5

22 is driven from the central minute hand spindle 25, and the hour hand 21 is driven from the surrounding hour hand sleeve 26. These clock hands are shown as being driven from the synchronous alternating current motor 27, although it will be understood that they might be driven from a conventional clock spring. The electric motor assembly includes a self-contained speed reducing gear train enclosed within a gear train housing 28. Tongues 29 (Figure 2) projecting laterally from the housing 28 receive fastening screws 31 which thread into tapped holes in an assembly plate 32 for attaching the motor 27 and housing 28 to said plate 32, the latter constituting the main frame element of the entire assembly. The power take-off from the gear housing 28 is in the form of a shaft 33 which has its rear end projecting rearwardly from the housing 28 for mounting a rear drive gear 34, this shaft also having its front end projecting forwardly through a hole 30 in the mounting plate 32 for mounting a front driving gear 35; these two gears rotating at the same speed. The front driving gear 35 can pass freely through the hole 30, which enables the electric motor assembly to be readily removed from the timer as a unit by simply removing the mounting screws 31, this motor assembly including the electric motor 27, gear housing 28, shaft 33 and back and front gears 34 and 35, all being removable as a unit. This can be readily accomplished by merely removing the back housing plate 40 and then releasing the screws 31, from which it will be seen that the motor unit can be very easily substituted if its operation becomes faulty.

The rear gear 34 of the motor assembly meshes directly with a gear 36 which is secured to the inner end of the minute hand spindle 25, whereby the minute hand is driven at a rate to make one complete revolution every hour. The front driving gear 35 meshes with a first idler gear 38 which in turn meshes with a second idler gear 39, and the latter transmits rotation to a relatively large spur wheel or time wheel 41 which is secured to the hour hand sleeve 26, the ratio of the gears 35, 38, 39 and 41 being such as to rotate the time wheel 41 and hour hand 21 through one complete revolution every twelve hours. The minute hand spindle 25 rotates within a stationary mounting sleeve 42, and the hour hand spindle rotates around the outside of this mounting sleeve. Said mounting sleeve is formed with a staking collar or flange 43 which is adapted to be pinned or staked to the front side of the frame plate 32, the rear portion of this mounting sleeve extending through the plate 32 to provide a long length of bearing support for the minute hand spindle. The front end of the minute hand spindle extends outwardly through a central aperture 44 in the cover glass 18, and has secured thereto an adjusting knob 45 which enables the clock hands to be set by rotating the minute hand spindle through the instrumentality of the knob 45. The knob 45 can be rotated in either direction for manually setting the clock hands in either direction, such manual setting being accommodated by a friction slippage clutch or the like, which is preferably embodied directly within the speed reducing gear housing 28 for enabling the gears 34, 35 to be manually rotated forwardly or backwardly independently of the rotation of the rotor of motor 27.

Referring to Figure 2, the continuously rotating time driven wheel 41 (which makes one revolution every twelve hours) is assembled over a shouldered step 46 on the hour hand sleeve 26,

6

this time driven wheel being staked or otherwise secured to the sleeve 26 for continuously driving the hour hand through the medium of the sleeve 26. Formed on said sleeve, back of the time driven wheel 41, is another shouldered step 47 on which is mounted a relatively large spur wheel or gear 48 which normally stands stationary while the time driven wheel 41 proceeds with its continuous rotation. This spur wheel 48 is, however, capable of being rotated forwardly and backwardly relatively to the time driven wheel through a limited arc of movement. Such limited arc of movement of spur wheel 48 is defined by a rectangularly shaped stop pin 49 which is riveted and brazed to the underside of the spur wheel to project downwardly therefrom into an arcuate slot 50 which is punched out in the frame plate 32 (Figure 7). The rectangular stop pin 49 normally tends to swing upwardly into a position of abutment against the upper end 50' of the arcuate slot 50. The spur wheel and stop pin are normally biased in this direction by a torsion spring 60 (Figure 2) which is coiled around the inner portion of the sleeve 26 and has one end bearing against the lower side of the stop pin 49 and the other end hooked against the lower end of the slot 50. The spur wheel 48 functions as a normally stationary sun gear around which the aforementioned planetary pinion of the accelerated motion transmitting mechanism revolves. At the pre-selected switch tripping times when motion is transmitted through this accelerated motion transmitting mechanism, an oscillatory movement is imparted to the spur wheel 48 for causing it to revolve in a clockwise direction (Figure 5) in opposition to the pressure of the spring 60, thereby moving the square shaped stop pin 49 through a short distance in a clockwise direction to effect a switch tripping operation, as will be later described.

The motion transmitting mechanism is adapted to be actuated by a pivotally swinging actuating member or lever 51 which is pivotally mounted on the time driven wheel 41 so as to rotate continuously therewith (Figures 4 and 5). This actuating lever 51 is adapted to be actuated at the pre-selected times by coming into contact with two manually settable tripping pins indicated at 52 and 53 in Figure 3. This arrangement of the manually settable tripping pins will be described before describing the planetary pinion motion transmitting mechanism. The tripping pins 52 and 53 can be set in different angular positions around the center of the rotative assembly 21, 22, 41. The tripping pin 52 is a "start-cooking" pin and can be manually set to start the cooking operation at any pre-selected time. On the other hand, the other tripping pin 53 is a "stop-cooking" pin and can be manually set to stop the cooking operation at any pre-selected time. It follows from this that the angular distance between these two pins 52 and 53 can be manually set to establish a certain number of cooking hours therebetween. These two tripping pins are carried by two concentric indicator discs 54 and 55 which are mounted for free rotation around the outside of the hour hand sleeve 26. The start-cooking or switch closing pin 52 is carried by the rear disc 54, and the stop-cooking or switch opening pin 53 is carried by the front disc 55. The rear disc 54 is formed with a relatively long arcuate slot 56 therein, and the tripping pin 53 which is carried by the front disc projects rearwardly through this slot 56, so that by rotating either disc relatively to the other the angular distance between the two tripping pins

can be adjusted as desired, and the angular positions of the tripping pins around the clock dial can be shifted to occupy positions at any desired points around the dial. The two indicator discs have gear teeth around their peripheries, and the front disc 55 is adapted to be rotated by manual rotation of a right hand adjusting knob 58, and the rear indicator disc 54 is adapted to be adjusted by rotation of a left hand adjusting knob 59. These two adjusting knobs are mounted on adjusting shafts 61 and 62, respectively, which carry spur pinions 63 and 64, the pinion 63 meshing with the front indicator disc 55 and the pinion 64 meshing with the rear indicator disc 54. The pinions 63 and 64 are preferably of the shrouded type comprising front and rear flanges with the spur teeth disposed therebetween, these shrouding flanges maintaining each pinion exactly in the plane of its respective indicator disc, or possibly causing the indicator disc to flex slightly in its rotative movement into mesh with its respective pinion, these indicator discs being relatively thin and hence being capable of flexing freely. A friction drag is imposed upon each of the pinions 63 and 64 by any suitable arrangement of friction drag apparatus, such as friction washers forced together by compression springs or the like. A suitable construction of friction drag apparatus is disclosed in our aforementioned copending application, to which attention is directed for the details thereof. This friction drag imposed upon the pinions 63 and 64 must be sufficient to hold the tripping pins 52 and 53 in each of their respective set positions, so as to prevent either of these pins being picked up and dragged along by the rotating actuating lever 51 which rotates continuously with the time driven wheel 41. The adjusting shafts 61 and 62 have bearing support in the main frame plate 32 and also have bearing support in aligned holes in the housings 15 and 16. Referring to Figure 2, the two indicator discs or dials 54 and 55 are loosely assembled over the hour hand sleeve 26, and are maintained in spaced relation on this sleeve by an intervening spacing washer 71. The outer indicator disc abuts a washer 72 under the hub of the hour hand 21 and the rear indicator disc 54 is held against shifting inwardly along the sleeve 26 by a plurality of angularly spaced supporting pins which project forwardly from the supporting plate and abut the under side of the disc.

Referring now to the cooking indicia which is marked on the indicator dials 54 and 55, it will be seen from Figure 3 that the front dial 55 carries a marking arrow or pointer 75 which is designated "Stop Cooking." Rotation of the right hand manually actuated knob 58 rotates this front dial 55 to place the "Stop Cooking" pointer 75 in registration with any desired time numeral 23 on the clock dial. For example, Figure 1 shows this front indicator dial as having been adjusted through the manual knob 58 so as to place the "Stop Cooking" pointer 75 in registration with the 6:00 o'clock marking of the clock dial. It will be understood that this setting which has thus been given to the dial 55 has placed the second tripping pin 53 at a predetermined angular position (Figure 3) which will cause the electrical switch to be opened at 6:00 o'clock. This front dial 55 is also provided with an arcuate slot or sight window 77 which is preferably located just inside of the "Stop Cooking" marker 75. This slot 77 is provided along its inner margin with a central marking pointer 78, and the slot

and pointer have associated therewith the indicia "Cooking Hours." The "Cooking Hours" pointer 78 is adapted to register with a series of dial numerals 79 and associated dial markings which are printed on the rear dial 54 so as to appear in the sight window 77. Rotation of the left hand manual knob 59 rotates the back dial plate 54 for presenting any one of the "Cooking Hours" numerals 79 in registration with the marking pointer 78 for setting up a cooking interval of predetermined duration on the automatic timer. It will be noted that any such setting given to the rear dial disc 54 places the first tripping pin 52 at a predetermined angular point around the clock dial, whereby to cause tripping of the electric switch at such point as to insure that there will be a cooking interval of the desired duration.

Referring now to the motion transmitting release mechanism which responds to the first and second tripping pins 52 and 53 for swinging the square stop pin 49 to its successive releasing positions, the actuating lever 51 of this mechanism is of bell-crank or U-shaped outline and is pivotally supported upon the front side of the time driven wheel 41 on a pivot stud 81. The stud 81 is riveted to the wheel 41 and extends up through a relatively long slot 82 in the lever 51 and is provided with a head which overlies the margins of the slot 82. A tension spring 84 has one end connected to the lever at 85 and has its other end connected to the gear wheel at 86, this tension spring being recessed into a long slot 87 which is punched out in the gear wheel 41. The action of this tension spring is to hold the lever in the position shown in Figure 4 with the inner end of the slot 82 pressed up against the pivot stud 81 and with the nose portion 88 of the lever in position to engage the first and second tripping pins 52 and 53 as the lever is slowly carried by the time driven wheel 41 into successive engagement with the tripping pins.

The other arm of the lever 51 is formed with a relatively wide notch 91 therein, one edge 92 of which is adapted to function as a guide edge in collaboration with a guide stud 93. This guide stud has its inner end riveted or staked to the gear wheel 41 and extends up into the notch 91 and has a large head portion 94 which overlies the edges of the notch 91. The straight guide edge 92 of the notch is adapted to have sliding guided engagement in contact with the shank portion of the guide stud 93. When the nose 88 of the actuating lever 51 encounters one of the settable tripping pins 52 or 53 in the normal forward rotation of the time driven wheel and actuating lever the lever is caused to rock around the pivot stud 81 in a counterclockwise direction, as shown in Figure 5. In this normal counterclockwise pivoting of the lever 51 the guide surface 92 of the notch 91 separates from the guide stud 93, the notch 91 being sufficiently wide to accommodate the necessary range of pivotal movement of the lever. The purpose of the slot 82 and of the guide surface 92 is to permit of a retractive sliding movement of the lever 51 in the event that the tripping end 88 of the lever and one of the tripping pins 52 or 53 should come together in a reverse direction of rotation. This can arise during the setting operation if one of the tripping pins 52 or 53 is being rotated in a forward clockwise direction past the tripping end 88 of the lever; or it may arise in setting the clock hands of the clock if the clock hands should be rotated backwardly and carry the tripping end 88 of the lever against one of the tripping pins 52 or 53. In

either of these situations, the lever 51 can have a sliding retractive movement along an inward path defined by the slot 82 and guide surface 92, the spring 84 snapping the lever 51 back to its normal position as soon as the tripping pin and the tripping end of the lever have cleared each other. This pin-clearing retractive movement of the lever does not impart switch tripping movement to the stop block 49 through the planetary pinion.

Referring now to the manner in which the normal counterclockwise pivoting of the lever 51 imparts movement through the planetary pinion to the stop block 49, it will be seen that the other extremity of the lever is formed with an arm 96 which carries a thin-leaf spring 97 that is adapted to act as a ratchet pawl or nose for coaction with ratchet teeth around the periphery of a ratchet wheel 98. The anchored end of the leaf spring is welded or riveted to the inner side of a rearwardly projecting flange 99 extending from the arm 96. The ratcheting end of the spring 97 is flexed slightly in an outward direction with its inner side abutting against a stop shoulder 101 formed on the lever 51. This stop shoulder predetermines the normal position of the ratcheting end of the spring, but as the spring enters the ratchet teeth on the wheel 98 and starts to follow the rotating path of the teeth the spring can flex away from the stop shoulder 101. The ratcheting spring is set in a long rectangular recess 102 punched out of the gear wheel 41 so that this spring can act on the teeth of the ratchet wheel 98 even though this wheel is mounted on the opposite side of the spur wheel 41. As best shown in Figure 6, the ratchet wheel 98 is secured directly to the aforementioned planetary pinion 104 which meshes continuously with the central sun gear 48 which carries the stop block 49. This concentric assembly of ratchet wheel 98 and planetary pinion 104 is pivotally mounted on a pivot stud 105 secured to the time driven wheel 41. In order to utilize as much of the effective working stroke of the ratchet spring 97 as possible the ratchet wheel 98 is preferably formed with very fine ratchet teeth approximately in the order of 100 teeth or so for a wheel diameter of approximately one-half inch.

During the normal non-tripping part of the cycle, the time driven wheel 41 slowly rotates at the rate of one revolution in twelve hours and carries the tripping lever 51 and planetary pinion 104 with it. Since the sun wheel 48 is normally held in a stationary position by its torsion spring 60 the planetary pinion 104 idly revolves around the sun gear, with a concurrent planetary rotation occurring in a clockwise direction around the planetary axis 105. At this time the ratchet spring 97 stands clear of the teeth on the ratchet wheel 98. As soon as the nose 88 of the lever 51 encounters the manually set tripping pin 52 (or 53) the lever starts to oscillate in a counterclockwise direction around the axis of the pivot stud 81. This immediately swings the ratchet spring 97 outwardly into the teeth of the ratchet wheel 98 so that further idling rotation of the planetary pinion 104 and ratchet wheel 98 in a clockwise direction around planetary axis 105 is immediately stopped. The continued counterclockwise swinging movement of the lever 51, with progressive movement of the nose 88 along the tripping pin 52 causes continued outward motion of the ratchet spring 97 and continued counterclockwise rotation of the ratchet wheel 98 and planetary pinion 104. The blocking of the clock-

wise rotation of the ratchet wheel and planetary pinion immediately started to impart clockwise movement to the sun gear 48, and the next succeeding action of immediately imparting counterclockwise rotation to the ratchet wheel and planetary pinion around the planetary axis 105 accelerates this clockwise rotation of the sun gear 48. This accelerated rotation transmitted to the sun gear through the planetary pinion imparts a more rapid tripping movement to the stop block 49. Such accelerated tripping movement is advantageous in obtaining greater accuracy in the tripping operation, as previously described. The degree of clockwise tripping rotation imparted to the sun gear 48 and stop block 49 through the planetary pinion 104 depends upon the angular span of the manually settable tripping pins 52 and 53. The start-cooking tripping pin 52 is relatively narrow or of short angular span and hence this pin only causes the stop block 49 to be actuated through a distance sufficient to release the first stop shoulder of the switch controlling stop plate, to be later described. On the other hand, the stop-cooking tripping pin 53 is relatively wide or of long angular span, and hence this pin is operative to swing the stop block 49 through a distance sufficient to release both of the stop shoulders on the switch actuating stop plate, as we shall now describe.

The square stop block 49 is adapted to cooperate with a multiple stop plate 109 which is mounted for rotative movement on a switch actuating shaft 111. This multiple stop plate is formed with an arcuate swinging edge on which are formed two angularly spaced stop shoulders 113 and 114. The stop plate 109 has swinging movement across the front surface of the frame plate 32 so that the stop shoulders 113 and 114 move in arcuate paths where they can be intercepted by the square stop stud 49, as clearly shown in Figures 4, 5 and 6. The stop plate 109 is spring impelled in a clockwise direction by a biasing spring to be later described. When the stop shoulder 113 is bearing against the stop block 49, as shown in Figure 4, the electric switch which responds to shaft 111 is in its open position, awaiting downward tripping movement of the stop block 49 away from the shoulder 113. When this tripping operation occurs, the stop plate 109 swings in a clockwise direction to bring the second stop shoulder 114 up against the stop block 49. In this position of the stop plate 109 the electric switch is in its start-cooking closed position. This position of the parts is illustrated approximately in Figure 5, except that Figure 5 illustrates that point in the cycle where the stop block 49 has moved just to the point where it is clearing the stop shoulder 114 for permitting the stop plate 109 to swing through its next step of movement. In swinging through this final step of clockwise movement after the stop block 49 has freed the stop shoulder 114 the electric switch is caused to move to its stop-cooking open circuit position, such corresponding to a completion of the cooking operation and a completion of the automatic operating cycle of the timer.

The switch actuating shaft 111 projects forwardly through enlarged openings in the main housing 15 and supplemental housing 16, these openings being constructed to permit a small degree of lateral tipping or cocking motion of the shaft 111, as will be presently described. The front end of the shaft carries a suitable knob or lever 115 through which the housewife can impart turning motion to the shaft and also the

11

latter tilting motion. Referring to Figure 7, the lower end of the shaft 111 has a reduced portion 116 which is seated in a bearing ferrule 117 set into the insulating base plate 118 of the electric switch. The shaft can rotate and tilt slightly in this bearing ferrule 117. The switch actuating shaft passes through a relatively large opening 121 in the frame plate 32. Secured to the shaft below the plate 32 is a cam plate 122 which is adapted to actuate the electric switch. Bent forwardly from this cam plate 122 is an arm 123 which projects forwardly through the opening 121 and also extends forwardly through a slotted opening 124 formed in the swinging stop plate 109 (Figure 6). The stop plate 109 has a circular opening 125 (Figure 4) which has a free rotative fit on the switch actuating shaft 111, the torque transmitting connection between the stop plate and shaft being established through the cam plate 122, arm 123 and the tip of said arm bearing against the side edges of the slotted opening 124.

Assembled down over the swinging stop plate 109 is a guide bracket 128 which holds the stop plate 109 in its proper position against the frame plate 32 during the rotating and tipping movements of the switch shaft 111. As shown in Figure 6, the guide bracket 128 is formed with depressed end portions 129 and 131 which are secured to the front side of the frame plate 32 by screws 132 threading into tapped holes in the frame plate. Projecting forwardly and laterally from the edge of the depressed portion 129 is an apertured lug 133 which serves to secure or support the main casing in proper position. Another spacing lug 134 projects forwardly from the other depressed portion 131 for a similar purpose, and a third lug 135 projects forwardly from the other edge of the bracket to serve as a support bearing against the under side of dial disk 54. Intermediate the depressed portions 129 and 131 the bracket 128 is formed with a raised portion 136 which defines a guide space 137 in which moves the stop plate 109 (Figure 7). Punched out of the raised portion 136 is an upwardly projecting tongue 138 which serves as a stationary stop against which one end of the spring 139 bears. This spring 139 is a dual purpose spring serving the two-fold function of applying torsion to the arm 123 in a clockwise direction and also applying lateral deflection pressure against the switch actuating shaft 111 tending to press this shaft diagonally inwardly and downwardly, as viewed in Figure 6. The shaft 111 extends through a hole 141 provided in the raised portion 136 of guide bracket 128, which hole is elongated in slot-like formation along the diagonal line $x-x$ of Figure 6. The elongated form of this hole 141 permits the shaft 111 to be tilted or cocked sidewise in a direction along this line $x-x$, and in said tilting movement the first stop shoulder 113 of stop plate 109 is moved to a point where it can clear stop block 49. Normally, the shaft 111 is maintained in a perpendicular position at the inner end of slot 141 by the deflecting action of the spring 139. As shown in Figure 7, the spring comprises a helical coil 139a which wraps around the shaft 111. The outer end of the coil extends laterally at 139b to seat in a notch in swinging arm 123. The inner end of the helical coil extends laterally and forwardly to form a U-shaped portion 139c which abuts against the adjacent edge of the lug 138. The other end of this U-shaped portion is then given one or more

12

wrapped turns around the shaft 111. By having points of reaction against the arm 123 and lug 138, the spring can exert a constant deflection pressure against the shaft 111 tending to hold it at the inner end of the slot-like opening 141. Concurrently therewith, the torsion stored in the helical coil of the spring tends constantly to swing the arm 123 in a clockwise direction, which torsion is transmitted through the side margins of slot 124 to the stop plate 109 and is also transmitted through cam plate 122 to the switch actuating shaft 111.

The lower edge of the stop plate 109 is formed with a raised hump 145 having forward and rearward surfaces sloping down each way from the ridge of the hump. Adapted for cooperation with this raised hump is a spring detent finger 144 adapted to snap down over the hump. This finger is formed integral with an apertured base or clip 146 through which passes the right hand adjusting shaft 61 which adjusts the stop cooking dial 55. A compression spring 67 which is mounted on this shaft to act on the friction drag surfaces associated with the shaft is also utilized to exert rearward pressure against the base clip 146. The construction and arrangement is such that the detent finger 144 has a spring pressed up and down rocking action as it snaps up and down over the hump 145. A similar or equivalent arrangement of spring detent is disclosed in our copending application Serial No. 643,599, to which attention is directed for details. When the stop plate 109 is swung down into detent engagement with the spring detent 144 by counterclockwise rotation of the knob 115 it is placed in a position where it is out from under the automatic control of the timer. This is the normal switch closed position designated A in Figure 1, as will now be described.

Referring to Figure 1, the control knob 115 has four rotative switch controlling positions indicated at A, B, C and D. Position A is the normal position of the timer, representing that condition where the timer is not operating and the electrical switch thereof is closed and is not subject to automatic control. In this closed position of the switch, the circuit is completed through the automatic timer, so that the control of the range or oven is now made responsive to a manual switch which the housewife can turn on and off as desired. This manual control switch is a separate switch, independent of the timer, and is typically shown in the aforementioned prior Patents 2,302,625 and 2,301,942. Position B (the full line position in Figure 1) is the "set" position where the electrical switch of the timer is now under the automatic control of the timer. The housewife turns the control knob 115 to this set position B when she desires to put the timer into operation. In this position of the knob 115 the electrical switch is open. Position C is the start-cooking position to which the switch controlling shaft 111 is tripped when the stop block 49 releases the stop shoulder 113 on the stop plate. In this position the stop shoulder 114 is in engagement with the stop block 49, and the switch is closed. Position D is the final or stop-cooking position which represents the completion of the timer cycle. In this position, the stop shoulder 114 has been tripped past the stop block 49 and the switch is in the open position. Figure 6 illustrates the control knob in "set" position B. When the knob is in this position it can be readily pushed diagonally upwardly and outwardly along the line $x-x$ to start the cooking

operation immediately. It will be seen from Figure 6 that when the knob is given this lateral tilting motion the stop plate 109 is caused to slide in this upward and outward diagonal direction, whereby the plate is caused to shift from the position indicated in full lines in Figure 6 to the position indicated in dotted lines. This shifting movement is limited by the length of the slot 141, which is so proportioned that the movement will be sufficient to trip the shoulder 113 from the stop block 49, thereby permitting the knob 115 to swing into position C (the start-cooking position), but the degree of such shifting movement is not sufficient to clear the shoulder 114 from the stop block. Thus, when the housewife performs the lateral tilting control operation upon the knob 115, the stop plate swings sufficiently far to close the electric switch and start the cooking operation immediately, but not sufficiently far to open the switch, whereby the opening operation still remains subject to the automatic control of the timer.

Referring now to the correlation which is established between the relatively wide stop-cooking tripping pin 53 and the tripping release of the second stop shoulder 114 on stop plate 109, it will be seen that the greater angular span of the stop-cooking pin 53 over the angular span of the start-cooking pin 52 will result in the gear 48 and stop block 49 being rotated through a longer interval of time in response to pin 53 than in response to pin 52. This means that the stop block will be moved a further distance in its clockwise releasing motion by the pin 53 than it will be by the pin 52. The parts are so proportioned that the releasing movement of block 49 effected by the start-cooking pin 52 will just be sufficient to enable the block to clear the stop shoulder 113, but not enough to clear the stop shoulder 114. On the other hand, the stop-cooking pin 53 will cause the block 49 to move sufficiently far to clear both stop shoulders 113 and 114 on the stop plate 109, see Figure 5. Accordingly, if the housewife has carelessly attempted to set the timer for a longer cooking interval than time permits, and has therefore overtraveled or gone past the start-cooking pin 52, the action of the stop-cooking pin 53 will be to swing the stop block 49 clear of both stop shoulders 113 and 114, so that the stop plate 109 will be tripped entirely through to its final switch open position D. Hence, there will be no burning of the meal or indefinite heating of the range heating element.

The electric switch which is actuated by the shaft 111 is indicated at 150 in its entirety. This switch can be of the same identical construction disclosed in our copending application Serial No. 643,599, or it can be of the construction diagrammatically illustrated in Figure 9 herein, or it can be of any other desired construction. Such a switch is preferably actuated by cam humps and valleys formed on the cam plate 122, as shown in Figure 8. This cam is shown as having four switch actuating positions formed in its periphery, viz: a cam valley 154 for closing the switch, a cam hump 155 for opening the switch, a cam valley 156 for closing the switch, and a cam hump 157 for opening the switch. Riding on these cam formations is a cam following pin 159 which projects upwardly from the end of a switch operating plate 161. This switch operating plate is composed of insulation. The switch actuating shaft 111 passes down through a longitudinal slot 162 in the plate 161 and establishes a point of guidance for guiding the to and fro motion of

the plate 161. The plate 161 has T-shaped cross arms 163 projecting outwardly to the sides and overlying the movable switch blades. These switch blades, designated 164, are of angular formation carrying movable contacts 165 on the inner sides of their outwardly diverging ends. These movable contacts 165 are adapted to engage with stationary contacts 166 carried by stationary terminals 167 secured to the insulating base plate of the switch. The switch blades are adapted to have rocking movement about the outer corners 168' of terminal blocks 168. The inner corner 171 at the angle bend of each blade has rocking movement on such shoulder edge 168' of its companion terminal block 168. Current is conducted to the movable switch blade through this terminal block 168 and through this rocking edge contact established at 168'-171. The inwardly bent arms of the blades bear against a hump 172 projecting from the cross arms 163. When the switch plate 161 is shifted to the right, motion is transmitted through the projections 172 to the inwardly extending arms 164b of the switch blades for rocking the blades to open circuit positions.

Tongues 174 punched inwardly from the outer arms 164a of the switch blades serve as attachment hooks to which the outer ends of tension springs 175 are connected. These tongues also function as guiding and retaining elements for the switch blades by extending into U-shaped guide spaces 176 formed in the outer surfaces of the terminal blocks 168. Similar U-shaped guide ways 178 are formed in the inner sides or edges of the terminal blocks 168 for receiving guide wings 179 projecting from the plate 161. This arrangement establishes lateral guidance for the left hand end of the plate 161. The inner ends of the tension springs 175 are hooked to hook ends on an insulating yoke 181 which has rockable bearing contact against the bushing 183 mounted in the insulating base plate of the switch. The switch actuating shaft 111 extends down through this bushing 183. This electrical switch has been made the subject matter of our copending application Serial No. 86,324, filed April 8, 1949, and attention is directed thereto for any further details as to the construction and operation of said switch.

While we have illustrated and described what we regard to be the preferred embodiment of our invention, nevertheless it will be understood that such is merely exemplary and that numerous modifications and rearrangements may be made therein without departing from the essence of the invention.

We claim:

1. In switch apparatus, the combination of a time driven wheel, a toothed wheel disposed substantially concentrically of said time driven wheel, motion transmitting means comprising a planetary pinion carried by said time driven wheel adapted to impart intermittent movement to said toothed wheel, tripping means disposable at different points around said time driven wheel for causing actuation of said motion transmitting means at different times, and switch means responsive to intermittent movement of said toothed wheel.

2. In switch apparatus, the combination of a continuously rotating wheel, means for driving said wheel at a timed rate, a normally stationary wheel disposed substantially concentrically of said continuously rotating wheel, motion transmitting means comprising a planetary pinion

carried by said continuously rotating wheel adapted to impart movement to said normally stationary wheel, settable means for causing actuation of said motion transmitting means at a predetermined time, and switch means responsive to movement of said normally stationary wheel.

3. In switch apparatus, the combination of a time driven wheel, a toothed wheel associated therewith, motion transmitting means comprising a planetary pinion carried by said time driven wheel and ratchet means for actuating said planetary pinion, said pinion being operative to impart movement to said toothed wheel when actuated by said ratchet means, tripping means disposable at different points around said time driven wheel for causing actuation of said ratchet means, and switch means responsive to intermittent movement of said toothed wheel.

4. In switch apparatus, the combination of a continuously rotating wheel, means for driving said wheel at a timed rate, a normally stationary wheel disposed substantially concentrically of said continuously rotating wheel, motion transmitting means comprising a planetary pinion carried by said continuously rotating wheel and ratchet means for actuating said planetary pinion, said pinion being operative to impart intermittent movement to said normally stationary wheel when actuated by said ratchet means, settable means for causing actuation of said ratchet means at a predetermined time and switch means responsive to movement of said normally stationary wheel.

5. In switch apparatus, the combination of a time driven wheel, a sun gear disposed substantially concentrically of said time driven wheel, a planetary pinion carried by said time driven wheel normally having idling planetary rotation around said sun gear, ratchet means carried by said time driven wheel adapted to impart rotary movement to said planetary pinion in such direction as to transmit an accelerated rotary movement to said sun gear, manually settable means for causing actuation of said ratchet means at a predetermined time, and switch means responsive to movement of said sun gear.

6. In switch apparatus, the combination of a time driven wheel, a toothed wheel associated therewith, motion transmitting means comprising a planetary pinion carried by said time driven wheel adapted to impart intermittent movement to said toothed wheel, a stop pin actuated by said toothed wheel, a movable stop member having successive stop shoulders thereon adapted to be successively blocked and cleared by said stop pin, an electric switch responsive to said movable stop member, and a plurality of settable tripping pins controlling said motion transmitting mechanism, one of said pins being constructed or arranged to cause said stop member to clear all stop shoulders on said movable stop member.

7. In switch apparatus, the combination of a time driven wheel, a toothed wheel disposed substantially concentrically of said time driven wheel, motion transmitting means comprising a planetary pinion carried by said time driven wheel adapted to impart intermittent movement to said toothed wheel, a stop block actuated by said toothed wheel, a swinging stop plate having successive stop shoulders thereon adapted to be successively blocked and cleared by said stop block, an electric switch responsive to said swinging stop plate, and a plurality of settable tripping pins controlling said motion transmitting mechanism, one of said tripping pins having a relatively long

angular span whereby to cause said stop block to clear all stop shoulders on said swinging stop plate.

8. In switch apparatus, the combination of a time driven wheel and a toothed wheel concentrically disposed, a planetary pinion carried by said time driven wheel adapted to have planetary meshing movement around said toothed wheel, ratchet means for actuating said planetary pinion to impart movement to said toothed wheel, a stop block actuated by said toothed wheel, a pivotally swinging stop plate having first and second stop shoulders thereon adapted to be successively blocked and cleared by said stop block, an electric switch responsive to said swinging stop plate, and first and second manually settable tripping pins controlling said ratchet mechanism, said first tripping pin being adapted to cause said stop block to clear said first stop shoulder and said second tripping pin being adapted to cause said stop block to clear said second stop shoulder, said second tripping pin being of wider angular span than said first tripping pin so as to be operative to cause said stop block to clear both stop shoulders.

9. In switch apparatus, the combination of a time driven member, a normally stationary member associated therewith, motion transmitting mechanism for transmitting movement to said normally stationary member, stop means actuated by said normally stationary member, a switch actuating shaft, stop means associated therewith adapted to be released by said first recited stop means, a switch responsive to said switch actuating shaft, and means mounting said shaft for rotative movement in one plane and for a secondary movement at an angle to said plane, said second stop means being operatively connected with said shaft whereby said secondary movement of said shaft actuates said second stop means to perform a control function on said switch.

10. In switch apparatus, the combination of a time driven wheel, a normally stationary wheel disposed concentrically of said time driven wheel, motion transmitting mechanism carried by said time driven wheel for transmitting intermittent movement to said normally stationary wheel, settable means disposable at different points around said time driven wheel for causing actuation of said motion transmitting mechanism at different times, stop means actuated by said normally stationary wheel, a switch actuating shaft, stop means associated with said shaft adapted to be released by said first recited stop means, a switch responsive to said switch actuating shaft, means mounting said shaft for rotative movement and for lateral movement, and means operatively connecting said second stop means with said shaft whereby said lateral movement of said shaft is operative to perform a control function on said switch.

11. In switch apparatus of the class described, the combination of a time driven wheel and a toothed wheel concentrically disposed, motion transmitting means for imparting movement from said time driven wheel to said toothed wheel, means coacting with said motion transmitting means for causing the latter to operate at a predetermined time, a switch actuating shaft having rotary movement responsive to movement of said toothed wheel, a switch responsive to said shaft, means mounting said shaft for rotary movement and for sidewise tilting movement, and means responsive to said sidewise tilting

movement for causing said switch to move to closed position.

12. In switch apparatus, the combination of a time driven wheel and a normally stationary wheel, motion transmitting mechanism for imparting movement from said time driven wheel to said normally stationary wheel, means coacting with said motion transmitting mechanism for causing the latter to operate at a predetermined time, a rotatable switch actuating shaft, spring means normally tending to impell said shaft in one direction of rotation, stop means responsive to said toothed wheel for controlling such spring impelled rotation, means mounting said shaft for a separate sidewise tilting movement, and means responsive to said sidewise tilting movement whereby said stop means can be released by such sidewise tilting movement to cause the closing of said switch.

13. In a time switch, the combination of contact apparatus, a control member governing said contact apparatus, said control member being mounted for rotational and lateral movement, means tending to rotate said control member in one direction for performing control functions on said contact apparatus, time controlled stop means governing the rotation of said control member in said latter direction, and means for causing said control member to perform a control function on said contact apparatus when said control member is moved laterally.

14. In a time switch, the combination of contact apparatus, a control member governing said contact apparatus, said control member being adapted to be moved from an end position to a starting position, means normally tending to cause a unidirectional return motion of said control member from said starting position back to said end position, a movable stop biased to a stopping position at a point in the path of such return movement, time responsive driving means for actuating said stop to release said control member, said driving means including a normally idling planetary gear, motion transmitting means for causing counter-rotation of said planetary gear to effect motion multiplication in the actuation of said stop, and settable means for causing actuation of said motion transmitting means at a predetermined time.

15. In switch apparatus of the class described, the combination of a switch, a control element adapted to control said switch, time driven means, manually adjustable switch closing means cooperating with said control element and with said time driven means and adapted to be set manually for predetermining the time of closing of said switch, and manually adjustable switch opening means cooperating with said time driven means and adapted to be set manually for predetermining the time of opening of said switch, said switch opening means being constructed to have a longer interval of cooperative engagement with said time driven means than said switch closing means for insuring that said control element will be actuated to open said switch in the event that the device is set for a switch closed interval of longer duration than the available time permits.

16. In switch apparatus of the class described, the combination of a switch, a control element adapted to control said switch, time driven means, manually adjustable switch closing means cooperating with said control element and with said time driven means and adapted to be set manually for predetermining the time of closing of said switch, manually adjustable switch opening

means cooperating with said control element and with said time driven means and adapted to be set manually for predetermining the time of opening of said switch, a rotatable and laterally movable control shaft responding to said manually adjustable switch closing means and to said manually adjustable switch opening means, and means responsive to lateral movement of said control shaft for causing said control element to move to its switch closing position.

17. In a time switch, the combination of a continuously driven time wheel, a normally stationary driven wheel disposed substantially concentrically of said time wheel, motion transmitting means carried by said time wheel operative to transmit brief rotary motion from said time wheel to said driven wheel, switch means, means responsive to said brief rotary motion of said driven wheel for causing said switch means to move between open and closed positions, manually adjustable switch closing means operative to cause actuation of said motion transmitting means at a desired time for transmitting brief rotary motion to said driven wheel for closing said switch and then interrupting said rotary motion of said driven wheel while said switch means remains closed, and manually adjustable switch opening means operative to cause actuation of said same motion transmitting means at a desired time for transmitting brief rotary motion to said same driven wheel for opening said switch and then interrupting said rotary motion of said driven wheel while said switch remains open, said manually adjustable switch opening means comprising means operative to transmit a greater degree of rotary motion to said driven wheel than said manually adjustable switch closing means, whereby said switch means will not be moved to closed position and allowed to remain there if the operator should erroneously set the time switch for a switch closed interval of longer duration than the available time permits.

18. In switch apparatus of the class described, the combination of a switch, control means adapted to control said switch, a continuously rotating time driven wheel, a normally stationary driven wheel, motion transmitting means for transmitting motion from said time wheel to said driven wheel, means responsive to said driven wheel for controlling said control means, adjustable switch closing means cooperating with said motion transmitting means and adapted to be set manually for predetermining the time of closing of said switch, and adjustable switch opening means cooperating with said motion transmitting means and adapted to be set manually for predetermining the time of opening of said switch, said switch opening means comprising means for insuring that said control means will be actuated to open said switch in the event that the switch apparatus is set for a switch closed interval of longer duration than the available time permits.

19. In an electric timer of the class described, the combination of a switch, a control element adapted to control said switch, a continuously driven time wheel, a normally stationary driven wheel, motion transmitting means for transmitting motion from said time wheel to said driven wheel, means responsive to said driven wheel for controlling said control element, manually adjustable switch closing means operative to cause actuation of said motion transmitting means for closing said switch, manually adjustable switch opening means operative to cause actuation of said motion transmitting means for opening said

switch, said switch closing means and said switch opening means enabling the timer to be normally set for a chosen length of switch closed interval and for a chosen time of termination of the switch closed interval, and means for preventing the switch from remaining in its closed position if a switch closed interval has been chosen which is longer than the time then remaining to the chosen time of termination of the switch closed interval.

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