Aug. 5, 1952 H. N. BLISS 2,605,833

TIMER

Filed Jan. 25, 1951 4 Sheets-Sheet 1

Fig. 1

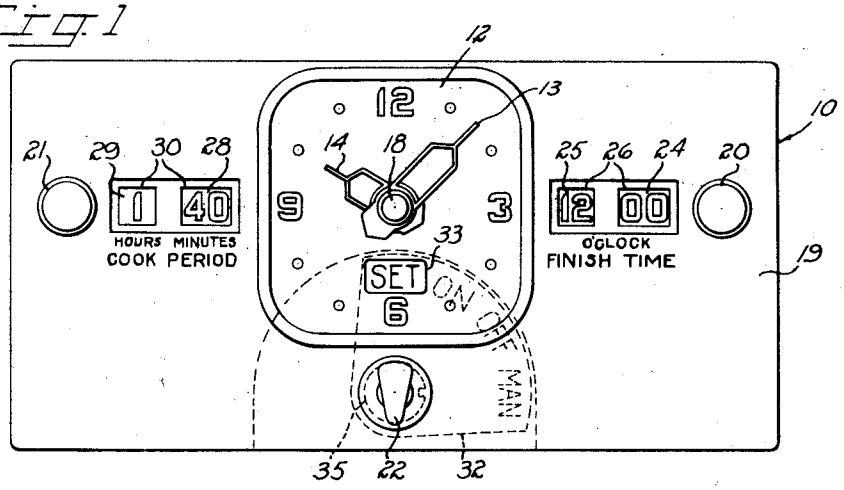
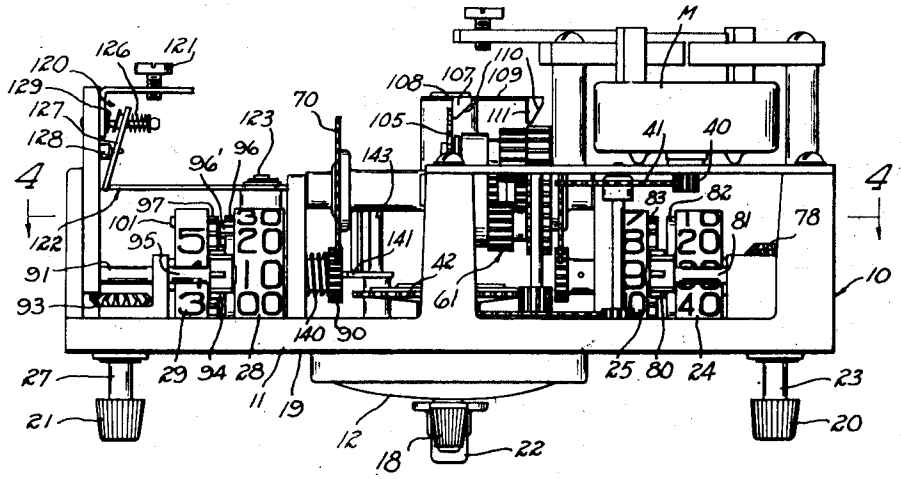


Fig. 2



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TIMER

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Fig. 3

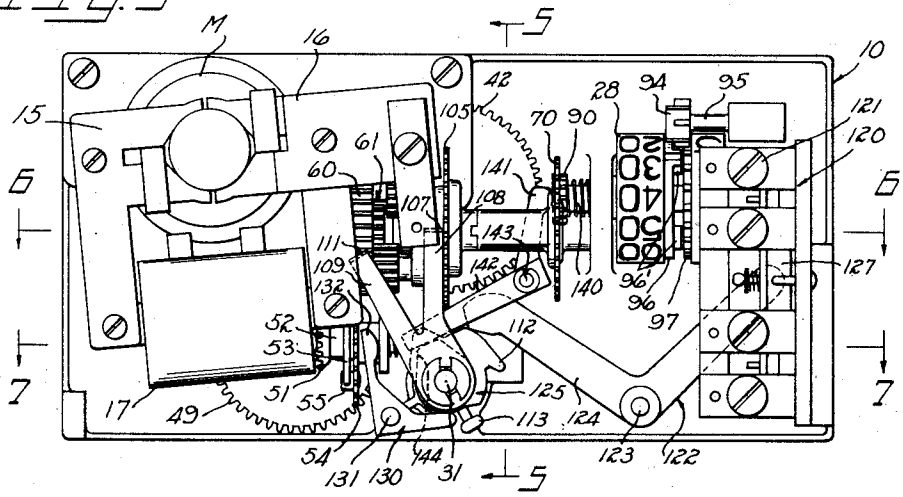
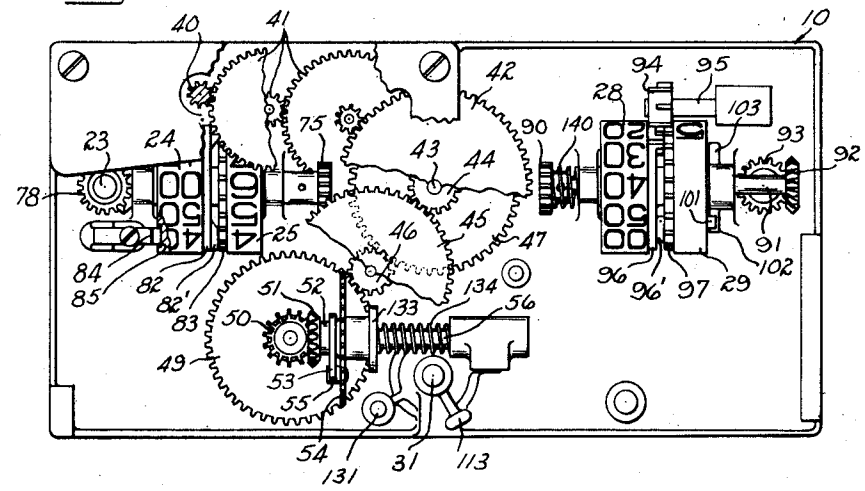


Fig. 4



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TIMER

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Fig. 5

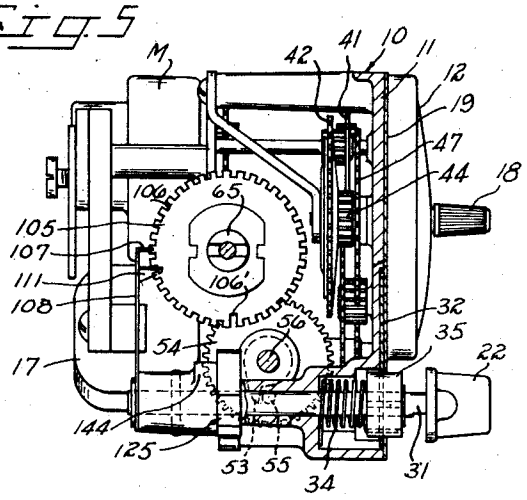


Fig. 6

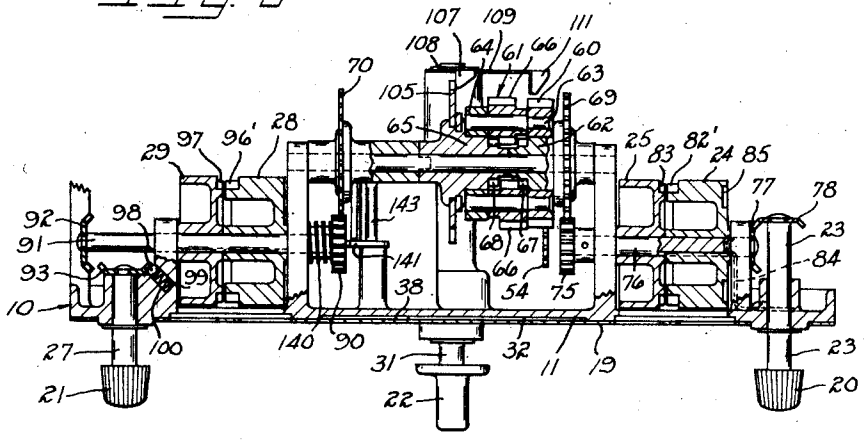
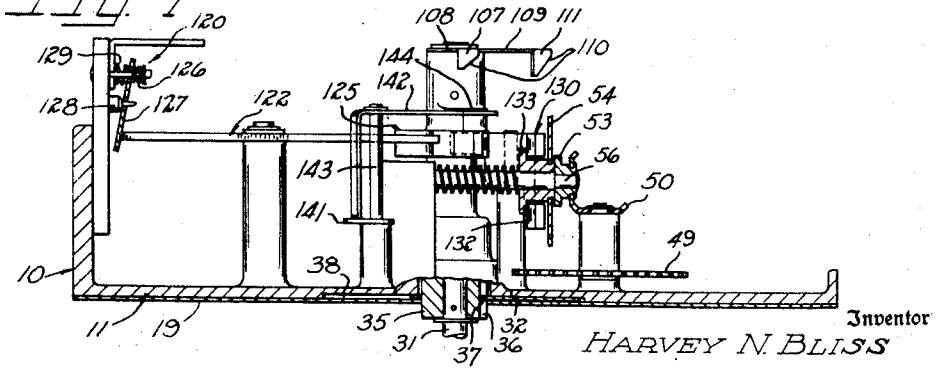


Fig. 7



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TIMER

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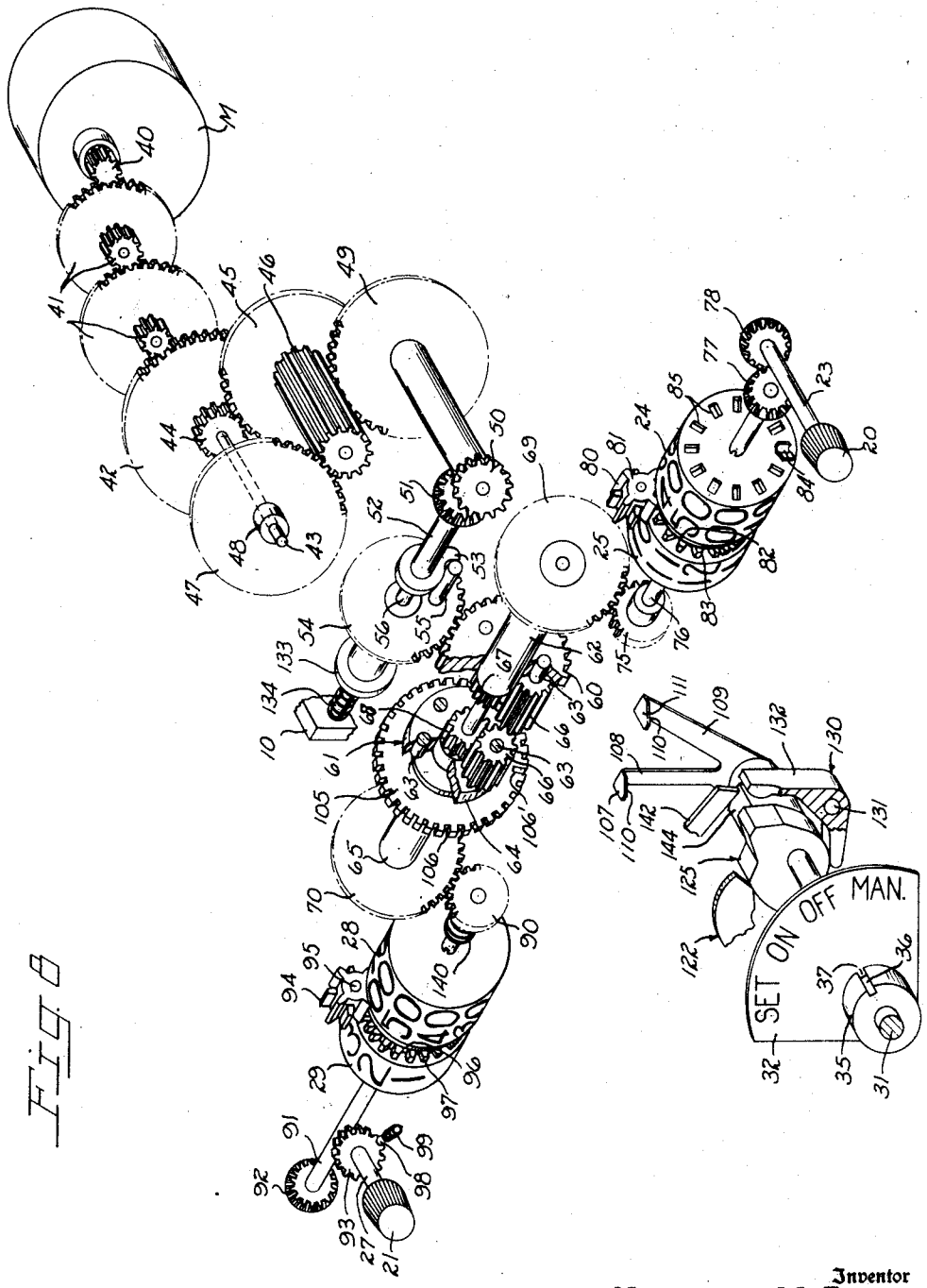


Fig. 8

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UNITED STATES PATENT OFFICE

2,605,833

TIMER

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Application January 25, 1951, Serial No. 207,707

24 Claims. (Cl. 161—1)

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This invention relates to timers, and more particularly to time responsive control mechanism which may be preset to sequentially perform a plurality of operations at preselected future times.

Although timers constructed in accordance with this invention may be utilized in many installations to perform various operations, the timer of this invention is particularly well adapted for use with kitchen ranges so as to enable the housewife to preset her range to automatically commence and complete a cooking operation at chosen future times, it being highly desirable that timers for kitchen ranges be provided with simplified control devices so that the housewife can set the range for automatic operation, under the control of the timer, without becoming involved in a series of complicated calculations or operations to arrive at the particular setting she desires.

It is a general object of the present invention to provide a timer for kitchen ranges and the like which may be preset to automatically control a cooking operation of preselected duration to be completed at a preselected time.

It is a more particular object of this invention to provide a timer for kitchen ranges and the like which has separate indicators and independent setting means therefor for directly indicating a selected finish time and for directly and separately indicating a cooking period thereby requiring no calculations in presetting.

It is another object of this invention to provide a timer for cooking ranges or the like with direct reading indicators showing a cooking period and a selected finish time with independent setting means for each indicator which may be preset simultaneously or in any desired sequence.

Still another object of this invention is to provide a timer for cooking ranges or the like which may be preset with facility to visibly indicate a selected automatic cooking period and to visibly indicate a selected finish time for the cooking period and which will indicate during the cooking period the time remaining to run.

A further object of the invention is to provide a new and improved system of combining and correlating a clock mechanism, a switch control mechanism, and manually settable devices having indicating means to show the selected positions of the clock mechanism at which the switch control mechanism will be functioned in terms of operating time and finish time, whereby the combined apparatus is rendered completely

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accurate and sensitive in operation, whereby the operation of either settable device is rendered entirely independent of the other, and whereby the correlation and cooperation of the said mechanisms and devices is fully automatic.

Another object of the present invention is to provide in a device of the character described an improved switch control mechanism which permits sensitive and accurate functioning of the switch and which is particularly adapted for use in the new and improved system of the invention.

Other objects will be in part obvious, and in part pointed out more in detail hereinafter.

The invention accordingly consists in the features of construction, combination of elements and arrangement of parts which will be exemplified in the construction hereafter set forth and the scope of the application of which will be indicated in the appended claims.

In the drawings—

Fig. 1 is a front elevational view of a timer constructed in accordance with this invention and which is particularly adapted for use with an electric kitchen range for automatically controlling a cooking operation of the range at preselected future times.

Fig. 2 is a top plan view of the timer shown in Fig. 1.

Fig. 3 is a rear elevational view of the timer shown in the first two figures.

Fig. 4 is a vertical cross-sectional view taken as indicated generally by the line 4—4 of Fig. 2 and viewed in the direction of the arrows thereon.

Fig. 5 is a transverse sectional view taken generally as indicated by the line 5—5 of Fig. 3 and viewed as indicated by the arrows thereon.

Fig. 6 is a fragmentary horizontal sectional view taken as indicated generally by the line 6—6 of Fig. 3 and viewed in the direction of the arrows thereon.

Fig. 7 is also a fragmentary horizontal cross-sectional view taken as indicated generally by the line 7—7 of Fig. 3 and viewed in the direction of the arrows thereon.

Fig. 8 is a diagrammatic view of the operating mechanism of the timer shown in oblique projection.

In the various views of the drawings, there is illustrated a specific embodiment of a timer constructed in accordance with the present invention which is particularly adapted for use in connection with an electric kitchen range for controlling the automatic operation of the range.

It will be apparent, however, that timers constructed in accordance with the present invention are not limited for use with kitchen ranges and may be advantageously utilized in many other installations for time responsive control of the various operations. For instance, the timer of the present invention may be utilized to open or close valves at preselected future times in any desired sequence or may be used to open or close electric switches to circuits which may incorporate various electrical appliances.

Referring now to the drawings in detail, the time controlled mechanism of this invention is disposed within a case indicated generally by the reference numeral 10 suitable for mounting in any desired manner upon an electric kitchen range (not shown). The case 10 has a front wall 11 provided with a face plate 19 and supporting a clock face 12 having conventional minute and hour hands 13 and 14, respectively, the clock being settable by means of a conventional knob 18. The clock operating mechanism shown in the drawings is of conventional construction driven by a synchronous electric motor M having conventional field elements 15 and 16 (Fig. 3) and a coil 17. The gear train 41 of the clock mechanism is also conventional and will be described in more detail later in connection with other operating parts of the timer mechanism. While an electric clock mechanism has been shown in the drawings, it will be apparent from the following description that the clock mechanism may be of the hand wound spring type or any other type which might be preferred in a particular installation.

The wall 11 journals three setting shafts which are associated with manually operable control knobs 20, 21 and 22. The righthand control knob 20 is connected to a setting shaft 23 for setting a minutes number wheel 24 and an hours number wheel 25 visible through windows 26 in the wall 11 and plate 19 adjacent the control knob 20. The visible indication on the number wheels 24 and 25 indicates the time at which the desired cooking operation will be completed. This may be identified by suitable indicia such as "O'Clock—Finish Time" imprinted on the face plate 19 adjacent and below the windows 26. When the knob 20 is manipulated to set the number wheels 24 and 25 to the desired indication other elements of the timer mechanism are also set in a manner to be described later.

The lefthand control knob 21 is connected to a setting shaft 27 for setting a minutes number wheel 28 and an hours number wheel 29 readily visible through windows 30 in the wall 11 and plate 19 adjacent the control knob 21. The number wheels 28 and 29 indicate the cook period in hours and minutes, which, in the specific embodiment, is shown by the indicia "Hours—Minutes—Cook Period" imprinted on the plate 19 adjacent and below the windows 30. When the control knob 21 is manipulated to indicate the desired cook period in the windows 30 other devices of the timer mechanism are set in a manner to be described later.

The centrally disposed control knob 22 is connected to a switch actuator shaft 31 (Fig. 5) which may be set in one position to place the electric range under the control of the timer mechanism for automatic operation and in another position to place the range in condition for manual operation. The shaft 31 carries a disk segment 32 which bears the indicia "Set On Off Man" which are separately visible, depending upon the rotated position of the switch actuator shaft 31, through a window 33 located in the clock face 12 adjacent and above the numeral 6. For normal operation of the range, the indicia "Man" is visible in the window 33 to indicate that the range may be manually operated. To set the range for automatic operation, the shaft 31 and control knob 22 is rotated until the indicia "Set" is visible in the window 33. Thereafter, the range is automatically controlled by the timing mechanism and is sequentially operated to the "On" and "Off" conditions which are indicated by the corresponding indicia visible in the window 33. As will be described more particularly hereinafter, all that the operator need do to set the timing mechanism for automatic operation of the range is to manipulate the control knobs 20 and 21 simultaneously or in any desired sequence to place the selected indications of the finish time and cook period in the windows 26 and 30, respectively, and then set the switch actuator shaft 31 by means of the control knob 22 to "Set" position as indicated in the window 33.

By way of illustration, there has been shown in Fig. 1 of the drawings a desired finish time of twelve o'clock and a cook period of 1 hr. 40 min. with the actuator shaft "Set." This means that at 10:20 the automatic cook period will commence and the actuator shaft 31 will rotate counterclockwise (as viewed in Fig. 1) so that the indicia "On" will be visible in the window 33. At twelve o'clock the 1 hr. 40 min. cook period will have been completed and the actuator shaft 31 will again rotate counterclockwise so that the "Off" indicia will be visible in the window 33.

A general description of the timing mechanism and its operation may be best understood with respect to Fig. 8 wherein the elements are diagrammatically illustrated. The synchronous motor M has a pinion drive shaft 40 driving the conventional gear train indicated generally by the reference numeral 41 which, in turn, drives a minute gear 42 having a minute hand shaft 43 and a drive pinion 44. The drive pinion 44 drives a gear 45 and associated pinion 46 which, in turn, drives an hour gear 47 and its associated hour hand shaft 48. It will be understood that the various gears and other elements of the timing mechanism are supported or journaled by the case or frame 10 in the manner shown in the various figures.

In accordance with the present invention the pinion 46, in addition to driving the hour gear 47 drives a power take-off gear 49 which carries a bevel gear 50 for rotation therewith. The bevel gear 50 meshes with a second bevel gear 51 which is freely rotatable on a shaft 56 secured by the frame or case 10. The gear 51 is provided with a sleevelike hub 52 which has fixed thereto a pawl-like pickup element or finger 53 for rotation therewith. As a result, the finger 53 is driven one complete rotation by the clock mechanism every twelve hours. Also disposed on the shaft 56 and therefore concentric with the hub 52 is a gear 54 hereinafter referred to as the "timing gear." The timing gear 54 is freely rotatable and axially slidable on the shaft 56. Extending outwardly from one side of the timing gear 54 is a pin 55 which may be engaged by the finger 53 whereby the timing gear 54 may be rotated by the clock mechanism. The timing gear 54 is urged in an axial direction toward the finger 53 by a spring 134 extending between the frame 10 and an annular hub member 133 fixed to the gear 54. As a result, the gear 54 is nor-

mally disposed so that the finger 55 is disposed in the path of rotation of the finger 53 and will be rotated by the finger 53 when the finger 53 is brought into contact with the pin 55 by the clock mechanism. On the other hand, the timing gear 54 may be slid axially away from the finger 53 to remove the pin 55 from the path of rotation of the finger 53.

The timing gear 54 is in mesh with a wide gear 60 which comprises one element of a differential indicated generally by the reference numeral 61. The gear 60 is made sufficiently wide so that the timing gear 54 remains in mesh therewith in either shifted position.

Turning now to the differential 61, gear 60 is freely rotatable about a shaft 62 and journals one end of a plurality of pinion shafts 63 equally radially spaced from the shaft 62. The other ends of the pinion shaft 63 are journaled in a disk 64 rotatably mounted on a shaft 65. The shafts 63 carry intermeshing pairs of pinion gears 66 arranged so that the outer extremities of the pinions of each pair in mesh respectively with concentric pinions 67 and 68 integrally formed on shafts 62 and 65, respectively. The pinions 67 and 68 are formed on the opposed inner ends of the shafts 62 and 65 which carry gears 69 and 70, respectively at their outer ends. As will be apparent, gear 60 may be driven through differential 61 by either drive gear 69 or 70, or both, and this may be accomplished either simultaneously or sequentially, as desired. Conversely, drive gear 69 or 70 may be driven by rotation of gear 60. As previously mentioned, gear 60 is in mesh with timing gear 54 and therefore the relative rotated position of timing gear 54 with respect to finger 53 can be varied by rotating either gear 69 or 70, or both. Since finger 53 is operated by the clock mechanism, the rotational distance between finger 53 and pin 55 on timing gear determines the amount of time which will elapse before the differential is actuated by the clock mechanism. When finger 53 engages with pin 55, the clock mechanism drives the differential through gear 60.

Differential driving gear 69 is connected with the finish time setting mechanism by a gear 75 mounted for rotation with and on one end of a shaft 76 which supports the finish time minutes number wheel 24 and hours number wheel 25. The other end of the shaft 76 secures a bevel gear 77 which is in mesh with a bevel gear 78 secured to the inner end of the finish time setting shaft 23. Thus, manipulation of the control knob 20 and finish time setting shaft 23 will drive the differential gearing 61 through the drive gear 69. At the same time the number wheels 24 and 25 are set to the selected position within the windows 26 in the timer face 11, this for the reason that the minutes number wheel 24 is fixed to the shaft 76 while the hours number wheel 25 is driven through conventional transfer mechanism by the minutes number wheel 24. In the embodiment shown, the minutes number wheel 24 bears two consecutive sets of indicia running from 00 to 50 in multiples of 10 consecutively. The hours number wheel 25 is provided with indicia running from numbers 1 to 12, inclusive. Also in the embodiment shown, the transfer mechanism comprises a mutilated pinion 80 rotatably mounted on a transfer pinion shaft 81 secured in the frame or case 10. The mutilated pinion 80 is engaged by a locking disk 82 having suitable transfer teeth 82' on the minutes wheel 24 and, in turn, drives the gear 83 on the hours wheel 25. The arrangement is such that one complete revolution of the minutes number wheel 24 will rotate the hours number wheel 25 by two hours as represented by two digits on the hours number wheel 25.

The gear ratios employed, including those in the differential 61, are such that when the shaft 76 is rotated one revolution corresponding to a period of two hours, as above mentioned, the time gear 54 will be rotated ⅙ revolution which is the distance traveled by finger 53 in the same period, i. e. two hours. The indicia on the number wheels 24 and 25 are arranged so that the finish time appearing in the windows 26 increases, i. e., indicate a later time when the shaft 76 is rotated clockwise, as viewed in Fig. 8 of the drawings. When the shaft 76 is rotated clockwise the time gear 54 also is rotated in a clockwise direction by the differential 61. Clockwise rotation of time gear 54 serves to advance the pin 55 ahead of the finger 53 thereby causing the differential 61 to be driven in a reverse direction by the clock mechanism commencing at a later time, depending upon the extent to which the number wheels 24 and 25 are advanced.

The finish time setting mechanism is provided with a detent comprising a spring arm 84 carried by the frame or case 10 and engageable in a plurality of cavities 85 in the outer side wall of the minutes number wheel 24. There is one cavity 85 provided for each of the digits appearing on the number wheel 24 so that the finish time indicator can be accurately set in selected ten-minute increments. The detent also serves to hold the differential drive gear 69 while the differential is being driven in either direction by the differential drive gear 70 or by the timing gear 54.

Differential drive gear 70 is connected with the cook period setting mechanism by a gear 90 which is secured to one end of a shaft 91 for rotation therewith. The other end of the shaft 91 secures a bevel gear 92 which is in mesh for setting purposes with a bevel gear 93 secured to the inner end of the cook period setting shaft 27. The shaft 91 is axially shiftably supported by the frame or case 10 so that the gears 92 and 93 may be brought into mesh when the selected cook period is being set, and may be disengaged after being set for purposes and by means to be described later. Spring 140 disposed between the frame and gear 90 normally urges the shaft 91 in a righthand direction (as viewed in Fig. 6) to intermesh gears 92 and 93. The gear 90 is sufficiently wide to remain in mesh with gear 70 regardless of the shifted position of shaft 91. Detent means comprising a ball 98 engageable in the teeth of the bevel gear 93 and a spring 99 disposed within a cavity 100 (Fig. 6) in the frame 10 provides for accurate setting of the Cook Period indicator in ten-minute increments.

The shaft 91 carries the minutes number wheel 28 and the hours number wheel 29 for indicating the selected cook period in the windows 30 of the face 11. The minutes number wheel is splined to the shaft 91 for rotation therewith and in the embodiment shown is provided with two consecutive sets of indicia ranging from 00 to 50 in steps of 10. The hours number wheel 29 of the cook period bears the hours indicia numbered from 1 to 5 and is driven by the minutes number wheel 28 through a mutilated transfer pinion 94 rotatably mounted on

a transfer pinion shaft 95 secured to the frame or case 10. The transfer pinion 94 is engaged by a locking disk 96 having suitable transfer teeth 96' carried by the minutes number wheel and by a driven gear 97 carried by the hours number wheel. The arrangement is such that the hours number wheel 29 is turned through two digits (hours) upon each complete revolution of the minutes number wheel 28. The desired cooking time can thus be preset on the number wheels 28 and 29 and be visible through the windows 30 by manipulation of the control knob 21. The side of the number wheel 29 is provided with a lug 101 which is adapted to engage stops 102 and 103 supported by the casing 10. The stops 102 and 103 are so located that the wheel 29 can be turned freely to display the numerals 0 through 5 but cannot be turned directly from 0 to 5 or vice versa. In other words, rotation of wheel 29 is limited to less than a full revolution in either direction.

The gear ratios employed between the cook period setting mechanism and the time gear 54 including the gear ratios of the differential 61, in the embodiment shown, are exactly the same as those between the finished time setting mechanism, i. e. for each revolution of the shaft 91 the time gear 54 is rotated ⅛ of a revolution which corresponds to a period of two hours in both cases.

The indicia on the number wheels 28 and 29 are arranged oppositely to that of the number wheels 24 and 25 with the result that the cook period is increased by rotating the shaft 91 in a counterclockwise direction, as viewed in Fig. 8 of the drawings. Counterclockwise rotation of shaft 91 drives the time gear 54 through differential 61 also in a counterclockwise direction. The result is that when the cook period is increased, as shown by a higher set of numbers appearing in the window 30, the time gear 54 is rotated so as to bring the pin 55 closer to the finger 53, thus conditioning the apparatus for operation in a reverse direction by the clock mechanism commencing at an earlier time depending upon the extent to which the number wheels 28 and 29 are advanced.

When the timer is assembled, the cook time setting mechanism, finish time setting mechanism, differential 61 and time gear 54 are connected so that, with the cook period indicators at zero and the pin 55 in engagement with the finger 53, the reading on the finished time indicators is the same as the setting of the clock hands 13 and 14. Thereafter, these devices remain fully coordinated and complete accuracy of the timer is assured.

As will be apparent from the above description, the rotated position of the time gear 54 will always depend upon the algebraic sum of the settings of the cook period setting mechanism and the finish time setting mechanism, i. e. the distance of the pin 55 from the finger 53 will always be equal (from a time standpoint) to the difference between the time indicated by the clock hands 14 and 13 which fixes the position of finger 53 and the finish time indicated by number wheels 24 and 25 minus the cook period indicated by number wheels 28 and 29.

When the device is set in operation for automatic control of the range or other instrumentality, the first operation which takes place is the advancement of the finger 53 by the clock mechanism until it engages the pin 55 on the time gear 54. Thereafter, the clock mechanism

drives the time gear 54 which, in turn, drives the gear 60 of the differential 61. Inasmuch as the shaft 76 is retained against rotation by the detent 84, the output of the differential is directed to shaft 91 of the cook time setting mechanism with the result that the number wheels 28 and 29 are returned to zero position in time with the clock mechanism. At the end of the operation, when the cook time period has been reduced to zero, the time gear 54 is shifted by mechanism to be described hereinafter so as to disengage the pin 55 from the finger 53.

Coming now to the manner in which the aforesaid relationship of the cook period setting mechanism, finish time setting mechanism, time gear 54, and finger 53 is utilized in accordance with the invention to control an associated mechanism such as an electric range, it will be observed that a notched control disk 105 is fixed to shaft 65 for rotation therewith. The ratio of gears 70 and 90 is such that the shaft 65 makes one-third of a revolution for each complete revolution of the shaft 91. In other words, the control disk 105 will make one complete revolution every six hours, this being also the maximum setting of the cook period indicating number wheels 28 and 29. The control disk 105 has thirty-six notches 106 cut in its outer periphery with the result that the disk 105 is rotated one notch for each ten-minute period shown on the cook time indicating wheels 28 and 29. One of the notches 106 which is indicated at 106' is cut relatively deep compared with the remaining notches 106 for the purpose hereinafter described.

As previously mentioned, the rotated position of the actuating shaft 31 is utilized to determine the condition of operation of the associated apparatus, such as a kitchen range. The shaft 31 is biased in a counterclockwise direction by the spring 34, which is secured at one end to the frame 10 and at the other end to a collar 35 fixed to the shaft 31. The spring 34 also serves to urge the shaft 31 outwardly, i. e. to the right as viewed in Fig. 5 of the drawings, to the axial position shown. The collar 35 is slotted at 36 to slidably receive a key 37 on the segment dial 32 to permit the shaft 31 to move axially without displacing the dial 32. The dial 32 is rotatably received in a recess 38 in the wall 11 which is covered by the face plate 19 and is thus restrained against movement in a direction axially of shaft 31.

Disposed on the internal end of the actuating shaft 31 are a pair of spaced apart arms 108 and 109 having ears 107 and 111, respectively, at the outer ends thereof and extending therefrom at an angle of approximately 90°. As best shown in Fig. 2 of the drawings, the arms 108 and 109 are so located when shaft 31 is in its normal axial position that the arms will have a path of rotation at right angles to the plane of disk 105 and just outside the periphery thereof. However, the ears 107 and 111, being turned inwardly toward the disk 105, will normally engage against the side of the timing disk 105 adjacent the periphery thereof. The arms 108 and 109 are preferably made of light spring material whereby they are relatively flexible in a plane axially of the shaft 31. Since the righthand edges of the ears 107 and 111 are beveled as indicated at 110, the engagement of the ear 107 or 111 with the disk 105 will not prevent turning of the shaft in a clockwise direction, this for the reason that the arm 108 or 109, as the case may be, will be cammed and thus flexed outwardly to cause dis-

engagement. However, upon the reverse rotation of shaft 31, the flat edges of the ears 107 and 111 are brought into engagement with the disk 105 and thus remain in holding engagement. In the "Set" position of shaft 31 the arms 108 and 109 are moved to the position shown in Figs. 2 and 6 of the drawing, i. e. with the ear 107 of arm 108 engaged against disk 105. Engagement of ear 107 with disk 105 retains shaft 31 in the "Set" position against the bias of spring 34.

The length of the ear 107 is such that, when it is brought into engagement with the edge of disk 105 and disk 105 is rotated to bring one of the notches 106 into registry therewith, the ear 107 will pass through the notch thereby releasing shaft 31 for rotary movement under the influence of spring 34.

The effective length of the arm 108 is such that the ear 107 will engage the disk 105 slightly in advance of one of the notches 106 when the cook time indicators 28 and 29 are accurately set in one of the selective ten-minute settings thereof. Accurate positioning of the number wheels 28 and 29 is insured, as previously mentioned, by the detent 98.

As soon as any driving force is transmitted to the differential 61 by reason of the pickup of the pin 55 by the finger 53 the disk 105 will begin to rotate. Slight movement of the control disk 105 causes a notch 106 to be brought into registry with the ear 107 on the arm 108 permitting the ear 107 to pass through the notch, thus permitting counterclockwise rotation of the actuating shaft 31 to the "On" position.

The ear 111 on the arm 109 is made somewhat longer than the ear 107 so that it cannot pass through any of the notches 106 except the deep notch 106'. Accordingly, when shaft 31 is released for counterclockwise movement by reason of ear 107 passing through one of the notches 106, rotation is thereafter halted by engagement of ear 111 with the side of disk 105, thus fixing the "On" position of shaft 31. The axial position of disk 105 on the shaft 65 is such that the deep notch 106' is brought into registry with the ear 111 when the cook time indicating wheels 28 and 29 have been returned to the zero position. When this condition occurs the ear 111 is free to pass through the notch 106', thus releasing the actuating shaft 31 for further rotation to the "Off" position. The "Off" position of shaft 31 is fixed by the engagement of finger 112 on stationary lug 113.

It thus will be seen that when the selected cook period is set on the number wheels 28 and 29 the relatively deep notch 106' will be rotated away from registry with the path of movement of the ear 111 by an amount which is equal from a time standpoint to the desired cook time. At the same time, as previously mentioned, the time gear 54 is rotated relative to the finger 53 in an amount depending upon the selected cook time and selected finish time. As a result, the pin 55 of the time gear 54 is picked up by the finger 53 to cause reverse driving of the differential 61 by the clock mechanism at the position of the clock which differs from the finish time by the amount of the cook period selected. Almost immediately upon engagement of the pin 55 by the finger 53 resulting in rotation of the disk 105, a notch 106 is brought into registry with the finger 107 permitting the actuating shaft to move to the "On" position. Then, as the differential 61 is further driven by the clock mechanism and the number wheels 28 and 29 are returned to zero, the deep notch 106' is brought into registry with the ear 111, thus releasing the shaft 31 for movement to the "Off" position. At this moment, of course, the finish time appearing on the number wheels 24 and 25 corresponds exactly with the clock time.

In order to utilize the movements of shaft 31 to control an associated apparatus, the shaft 31 has fixed thereto a cam 125. In the specific embodiment shown in the drawings, cam 125 is utilized to operate a switch 120 connected by means of terminals 121 for controlling the heating elements of the range with which the timer is being employed. The switch 120 is of conventional construction and may be provided, by way of example, with a pivotal contact arm 127 fulcrumed by a pin 128 intermediate its ends and adapted to cooperate with stationary contacts 129. A spring 126 is utilized to bias the arm 127 to closed position. The outer end of the terminal arm 127 engages one arm of a bell crank 122 which, in turn, engages the cam 125. The cam 125 is so designed that the switch 120 is held in open position at all times except when the shaft 31 is in the "On" or "Manual" positions.

The cam 125 also operates a second bell crank 130 which is pivotally mounted on a shaft 131 secured by the frame 10 and which has a bifurcated arm 132 embracing the hub 133 on the timing gear 54. The arrangement is such that upon rotation of the actuator shaft 31 to the "Off" or "Manual" positions the cam 125 will rotate the bell crank 130 to shift the timing gear 54 axially away from the finger 53 whereupon the pin 55 is removed from the path of rotation of the finger 53. This insures that there will be no interference of the finger 53 with the positioning of the time gear 54 in either rotated direction by the Finish Time and Cook Time setting mechanisms, nor will the position of the time gear 54 be operated by the finger 53 when the device is not in use.

Also fixed to the shaft 31 is a cam 144 for operating a bell crank having arms 141 and 142 and pivoted at 143. The arm 141 is adapted to engage against the side of the gear 90. The cam 144 is so designed that when the shaft 31 is turned to the "Set" or "On" positions, the shaft 91 is moved axially so as to disengage the gears 92 and 93. This removes the Cook Time setting mechanism from control by the knob 21 so that the knob 21 and its detent 98 will place no load on the driving mechanism during automatic operation of the range.

In order to move the shaft 31 from "Off" position to "Manual" position, it is necessary for the operator to thrust the shaft 31 inwardly against spring 34 to cause the finger 112 to clear the lug 113, whereupon the shaft 31 is released for the required additional turning movement to the "Manual" position. The "Manual" position is fixed by abutment of the finger 112 against a final stop which, for convenience, in the particular embodiment shown comprises the adjacent end of bell crank 130. As previously mentioned, turning the shaft 31 to "Manual" position closes the switch 120 and thus places the range under the sole control of the manually operated switches of the range.

It thus will be seen that there has been provided in accordance with the invention a time responsive control mechanism which is fully auto-

matic in operation, which can be preset with simplicity and ease, which is fully accurate and foolproof in operation, and which clearly and simply identifies the stages and conditions of operation at all times.

As many changes could be made in the above construction and many apparently widely different embodiments of this invention could be made without departing from the scope thereof, it is intended that all matter contained in the above description or shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

It is also to be understood that the language used in the following claims is intended to cover all of the generic and specific features of the invention herein described and all statements of the scope of the invention which, as a matter of language, might be said to fall therebetween.

I claim as my invention:

1. A timer comprising a plurality of setting means, a clock mechanism having a driving element, a driven element adapted to be advanced relative to said driving element, and differential gearing interconnecting said driven element and said setting means.

2. A timer comprising a plurality of setting means, a clock mechanism having a rotatable driving element, a rotatable driven element adapted to be driven by the driving element in predetermined relatively rotated positions thereof, and differential gearing interconnecting said driven element and said setting means.

3. A timer comprising a plurality of manually operable setting means, a control member connected to one of said setting means for movement therewith, a clock mechanism having a driving element, a driven element adapted to be driven by the driving element in predetermined relative positions thereof, and differential gearing interconnecting said driven element and said setting means.

4. A timer comprising a plurality of manually operable setting means, a control member connected to one of said setting means for movement therewith, a clock mechanism having a rotatable driving element, a driven element rotatably settable relative to said driving element and adapted to be driven by the driving element in predetermined relatively rotated positions thereof, and differential gearing interconnecting said driven element and said setting means.

5. A timer comprising a plurality of manually operable setting means, independent indicating means for each of said setting means to indicate the positions thereof, a control member connected to one of said setting means for movement therewith, a clock mechanism having a driving element, a driven element movable relative to said driving element and adapted to be driven by the driving element in predetermined relative positions thereof, and driving means including a differential between said driven element and said setting means.

6. A timer comprising a pair of aligned shafts, differential gearing connecting said shafts including a sun gear on each of said shafts, a planetary supporting gear, and planetary pinions carried on said supporting gear and meshing with said sun gears, manually operable setting means for said aligned shafts, a clock mechanism having a rotatable driving element, a gear meshing with said planetary supporting gear and rotatable coaxially with said driving element, and means forming a driving connection between the driving element and said coaxial gear in predetermined relatively rotated positions thereof.

7. A timer comprising a first indicator shaft, a second indicator shaft, a settable driven element, a continuously maintained positive driving connection between the indicator shafts and the driven element including a differential, a clock mechanism having a time responsive driving element, and means forming a driving connection between the driving and driven elements at a predetermined relatively rotated position thereof.

8. A timer comprising a plurality of manually operable setting means, independent indicating means for each of said setting means to indicate the positions thereof, a control member connected to one of said setting means for movement therewith, means for actuating an associated mechanism responsive to said control member, a clock mechanism having a rotatable driving element, a driven element rotatably settable relative to said driving element and adapted to be driven by the driving element in predetermined relatively rotated positions thereof, and differential gearing interconnecting said driven element and setting means.

9. In a time responsive switching device, a rotatable control disk, switch actuating means responsive to said rotatable control disk, first setting means for setting said control disk in selected rotated positions, time controlled driving means, a rotatable driven member, means forming a driving connection between said driven member and driving means in one relatively rotated position thereof, second setting means, means for rotating said driven member relative to said drive member selectively by said first and second setting means, and means for preventing movement of said second setting means while said control disk is rotated by said first setting means or said driven member.

10. In a time responsive switching device, a rotatable control disk, switch actuating means responsive to said rotatable control disk, an indicator for showing the position of said control disk, first setting means for setting said control disk in selected rotated positions, time controlled driving means, a rotatable driven member, said driving means having means engageable with said driven member in one rotated position relative to said driven member, second setting means, means for rotating said driven member relative to said drive member selectively by said first and second setting means, a second indicator for showing the rotated position of said driven member relative to said drive member, and means for preventing movement of said second setting means while said control disk is rotated by said first setting means or said driven member.

11. In a time responsive switching device, a rotatable control disk, switch actuating means responsive to said rotatable control disk, first setting means for setting said control disk in selected positions, time controlled driving means, a rotatable driven member, said driving means having means engageable with said driven member in one rotated position relative to said driven member, second setting means, differential gearing interconnecting said driven member with said first and second setting means whereby said driven member may be rotated relative to said drive member selectively by said first and second setting means, and means for preventing movement of said second setting means while said control disk is rotated by said first setting means or said driven member.

12. In a time controlled switch, switch actuating means comprising an actuating arm, means biasing said arm in one direction to cause sequential on and off operation of a switch, a rotatable control disk for controlling movement of said arm in said one direction, first setting means for setting said control disk in selected positions, clock mechanism, a timing gear, rotatable drive means on said clock mechanism engageable with said timing gear in one rotated position relative thereto, second setting means, differential gearing interconnecting said timing gear to said control disk and said second setting means whereby said timing gear may be rotated relative to said drive means selectively by said first and second setting means, and upon engagement of said timing gear by said drive means, said control disk will be rotated to permit movement of said actuating arm to on position, and means for preventing movement of said second setting means while said control disk is rotated by said first setting means or said timing gear.

13. In a time controlled switch, switch actuating means, a rotatable control disk for controlling the switching movements of said actuating means, said control disk having one rotated position relative to said actuating means permitting movement thereof to switch opening position, first setting means for setting said control disk in selected positions relative to said actuating means, an indicator for showing the position of said control disk, clock mechanism, a timing gear, rotatable drive means on said clock mechanism engageable with said timing gear in one rotated position relative thereto, second setting means, differential gearing interconnecting said timing gear to said control disk and said second setting means whereby said timing gear may be rotated relative to said drive means selectively by said first and second setting means and upon engagement of said timing gear by said drive means said control disk will be rotated to one of a plurality of positions relative to said actuating means permitting movement thereof to switch closing position, and means for preventing movement of said second setting means while said control disk is rotated by said first setting means or said timing gear.

14. In a timer, the combination comprising a clock mechanism provided with a rotatable driving element, a rotatable driven element mounted coaxially with the driving element, means forming a driving connection between the driven element and the driving element in a predetermined relatively rotated position of the driven and driving elements, a first indicator shaft, indicating means for selectively indicating a period of operating time operated by the first indicator shaft, a second indicator shaft, indicating means for selectively indicating a finish time operated by the second indicator shaft, and driving means including a differential between said driven element and said indicator shafts whereby the rotated position of the driven element relative to said driving element is determined by the difference between the clock time and the finish time minus the operating time.

15. A timer comprising a first setting means including an indicator shaft, indicating means on the shaft and a drive shaft, a second setting means including a second indicator shaft, second indicating means on the second shaft and a second shaft, a differential coupling including a sun gear on each of said drive shafts, and a drive gear on which are mounted planetary pinions in mesh with said sun gears, a clock mechanism provided with a rotatable driving element, a gear mounted coaxially with the driving element and in mesh with the drive gear of said differential coupling, means forming a driving connection between the last-named gear and the driving element in one relatively rotated position thereof, a switch operating mechanism and a rotatable control member operatively connected for rotation with the first setting means, having means for functioning the switch operating mechanism at an initial and final rotated position thereof.

16. A timer comprising a clock mechanism provided with a driving element, a driven element mounted coaxially with the driving element, means forming a driving connection between the driving element and the driven element in a predetermined relatively rotated position of the driving and driven elements, a first indicator shaft, indicating means operated by said shaft, gear means between said driven element and said first indicator shaft including a differential arranged so that the indicating means may be operated in a subtracting direction as the driven element is turned in the driving direction of the driving element, a second indicator shaft, indicating means operated by the second indicator shaft, means connecting the second indicator shaft to the differential whereby the said driven element may be turned in the driving direction of the driving element as the last-named indicating means is advanced, rotatable control means operated in response to turning of the first indicator shaft, and means settable for a first movement responsive to initial movement of the control means and a second movement responsive to movement of the control means to a position corresponding to zero position of the first indicating means.

17. A timer comprising a clock mechanism provided with a rotatable driving element, a driven element mounted coaxially with the driving element, means forming a driving connection between the driven element and the driving element in a predetermined relatively rotated position of the driving and driven elements, a first indicator shaft, indicating means operated by the first indicator shaft for selectively indicating a period of operating time, a second indicator shaft, indicating means operated by the second indicator shaft for selectively indicating a finish time, driving means including a differential between said driven element and said indicator shafts whereby the rotated position of the driven element relative to said driving element is determined by the difference between the clock time and the finish time minus the operating time, rotatable control means operated in response to turning of the first indicator shaft, and means settable for a first movement responsive to initial movement of the control means and a second movement responsive to movement of the control means to a position corresponding to zero operating time.

18. A timer comprising a clock mechanism provided with a rotatable driving element, a driven element mounted coaxially with the driving element, engageable means adapted to engage and form a driving connection between the driven element and the driving element in a predetermined relatively rotated position of the driving and driven elements, a first indicator shaft, indicating means operated by the first indicator shaft for selectively indicating a period of operating time, a second indicator shaft, indicating

means operated by the second indicator shaft for selectively indicating a finish time, driving means including a differential between said driven element and said indicator shafts whereby the rotated position of the driven element relative to the driving element is determined by the difference between the clock time and the finish time minus the operating time, said operating time being zero when the driven and driving elements are interengaged and the finish time is equal to the clock time, means for preventing turning of the second indicator shaft through said differential, means for preventing operation of the first indicator shaft during rotation of the second indicator shaft, means for releasing said engageable means between the driven and driving elements during manual operation of said first and second indicator shafts, rotatable control means operated in response to turning of the first indicator shaft, and means settable for a first movement responsive to initial movement of the control means and a second movement responsive to movement of the control means to a position corresponding to zero operating time.

19. A timer comprising a clock mechanism provided with a rotatable driving element, a driven element mounted coaxially with the driving element, engageable means adapted to engage and form a driving connection between the driven element and the driving element in a predetermined relatively rotated position of the driving and driven elements, a manually operable first indicator shaft, indicating means operated by the first indicator shaft for selectively indicating a period of operating time, a manually operable second indicator shaft, indicating means operated by the second indicator shaft for selectively indicating a finish time, driving means including a differential between said driven element and said indicator shafts whereby the rotated position of the driven element relative to the driving element is determined by the difference between the clock time and the finish time minus the operating time, said operating time being zero when the driven and driving elements are interengaged and the finish time is equal to the clock time, means for preventing turning of the second indicator shaft through said differential, means for preventing operation of the first indicator shaft during rotation of the second indicator shaft, a rotatable control disk operatively connected to the first indicator shaft, switch actuating means movable in one direction to sequentially perform a plurality of switching operations, means biasing the actuating means in said one direction, a plurality of stops on said actuating means sequentially engageable with said control disk during movement of the actuating means in said one direction, means on said control disk defining a plurality of escapements for the first of said stops and means on said control disk defining an escapement for the second of said stops, said last-named escapement being located for registry with the second of said stops when the operating time is zero.

20. In a time responsive switching device, switch actuating means movable in one direction to sequentially perform a plurality of switching operations, means biasing the actuating means in said one direction, a rotatable control disk, a plurality of stops on said actuating means sequentially engageable with said control disk during movement of the actuating means in said one direction, means on said control disk defining a plurality of escapements for the first of said stops, means on said control disk defining an escapement for the second of said stops, time controlled driving means for said contol disk, and means for setting the control disk whereby upon initial rotation thereof the first of said stops will escape said control disk to effect one switching operation of said actuating means and upon further rotation of said control disk for a preselected period the second of said stops will escape said control disk to effect another switching operation of said actuating means.

21. In a time responsive switching device, switch actuating means movable in one direction to sequentially perform a plurality of switching operations, means biasing the actuating means in said one direction, a rotatable control disk, a plurality of stops of varying form on said actuating means sequentially engageable with said control disk, means on said control disk defining a plurality of notches to provide escapement for the first of said stops only, means on said control disk defining a notch to provide escapement for the second of said stops, manually operable means for setting the rotated position of said control disk, time controlled driving means, and means for having an adjustable time delay for interconnecting said driving means and said control disk whereby upon interconnection thereof the first of said stops will escape said control disk to effect one switching operation and upon further rotation of said control disk for a preselected period the second of said stops will escape said control disk to effect another switching operation of said actuating means.

22. In a time responsive switching device, switch actuating means rotatable in one direction to sequentially perform a plurality of switching operations, means biasing the actuating means in said one direction, a rotatable control disk having an axis of rotation transverse of the axis of rotation of said actuating means, a plurality of radially disposed and angularly related stops on said actuating means sequentially engageable with the peripheral portion of said control disk, said stops being of different length, means on said control disk defining a plurality of relatively shallow notches about the periphery thereof providing an escapement for the first of said stops, means on said control disk defining a relatively deep notch on the periphery thereof providing an escapement for the second of said stops, manually operable means for setting the rotated position of said control disk relative to said actuating means, time controlled driving means, and means for interconnecting said driving means and said control disk at a selected future time whereby upon interconnection at said future time the first of said stops will escape said control disk to effect one switching operation and upon further rotation of said control disk for a preselected period the second of said stops will escape said control disk to effect another switching operation of said actuating means.

23. In a time responsive switching device, switch actuating means movable in one direction to sequentially perform a plurality of switching operations, means biasing the actuating means in said one direction, a rotatable control disk, a plurality of stops on said actuating means sequentially engageable with the peripheral portion of said control disk during movement of the actuating means in said one direction, means on said control disk defining a plurality of escapements about the periphery thereof for the first of said stops, means on said control disk defining an escapement on the periphery thereof for the

second of said stops, manually operable means for setting the rotated position of said control disk, time controlled driving means, means having an adjustable time delay for interconnecting said driving means and said control disk, and manually operable means for adjusting the last-named means whereby interconnection of said drive means and said control disk may be effected at a preselected future time to immediately release the first of said stops to effect one switching operation of said actuating means and upon further rotation of said control disk for a preselected period the second of said stops will be released to effect another switching operation of said actuating means.

24. A timer for automatically controlling electric ranges or the like comprising a switch, a switch actuator, a rotatable control disk for controlling the movements of said actuator, said control disk having a plurality of rotated positions relative to said actuator permitting switch closing movement thereof and one position permitting switch opening movement, first setting means for setting said control disk in selected positions relative to said actuator, an indicator for showing the relative position of said control disk, clock mechanism, a driven timing gear, rotatable drive means on said clock mechanism engageable with said timing gear in one rotated position relative thereto, differential gearing interconnecting said timing gear to said control disk and said second setting means whereby said timing gear may be rotated relative to said drive

means selectively by said first and second setting means, manually operable means for placing said actuator in a set position for sequential movements to switch closing and opening positions under the control of said control disk, whereby upon engagement of said timing gear by said drive means said control disk will permit movement of said actuator to switch closing position, a second indicator operable by said second setting means and showing the time when said actuator will move to switch opening position, and means for preventing movement of said second setting means while said control disk is rotated by said first setting means or said timing gear.

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