Nov. 17, 1942. W. P. GALLAGHER ET AL 2,302,625

ELECTRICAL TIMING APPARATUS

Filed Feb. 15, 1940 4 Sheets-Sheet 1

Fig. 1.

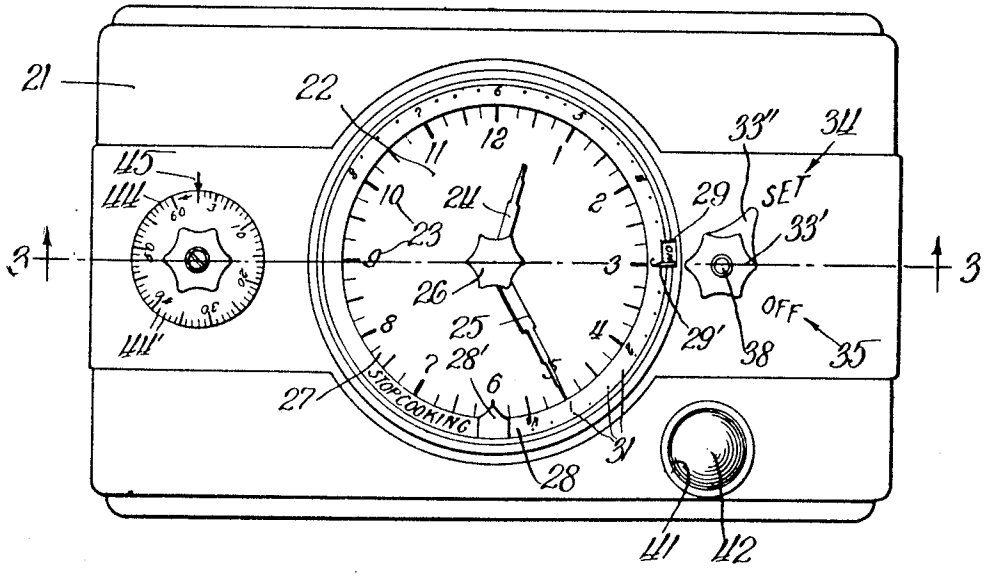
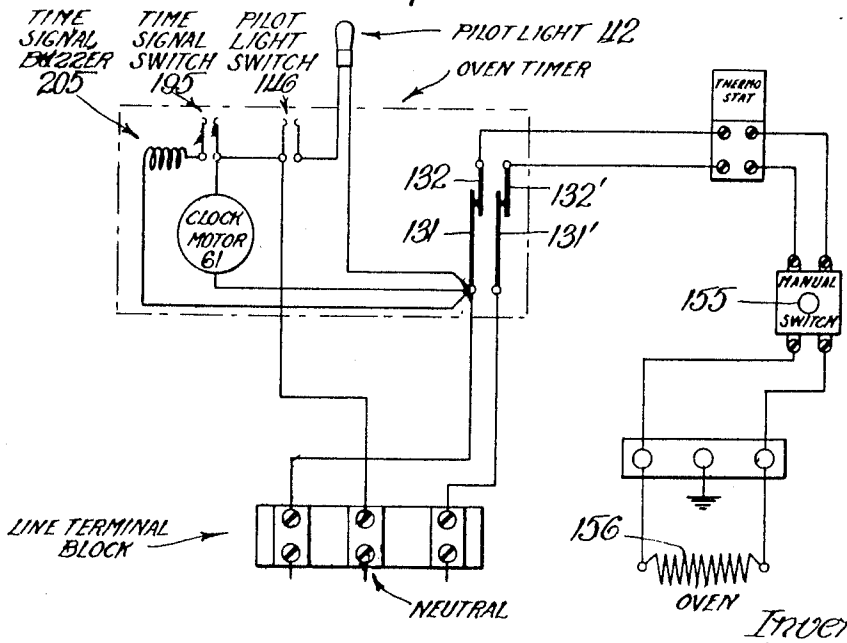


Fig. 2.



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ELECTRICAL TIMING APPARATUS

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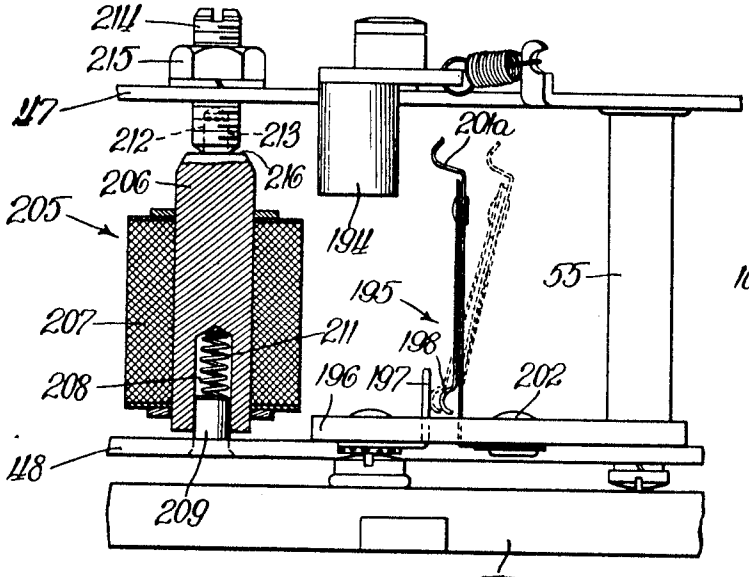


Fig. 8.

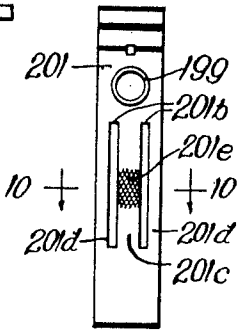


Fig. 9.

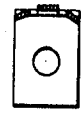


Fig. 10.

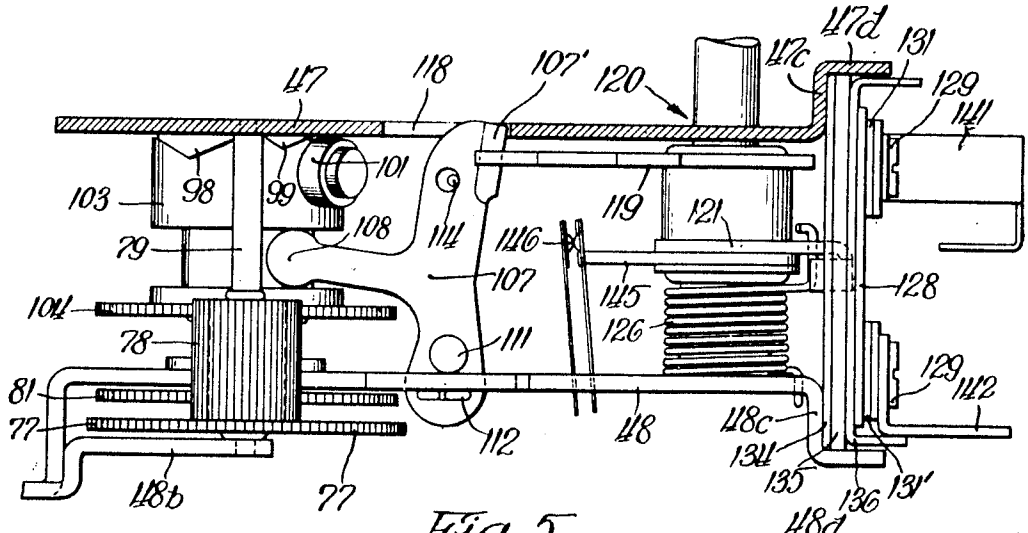


Fig. 5.

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ELECTRICAL TIMING APPARATUS

Filed Feb. 15, 1940 4 Sheets-Sheet 3

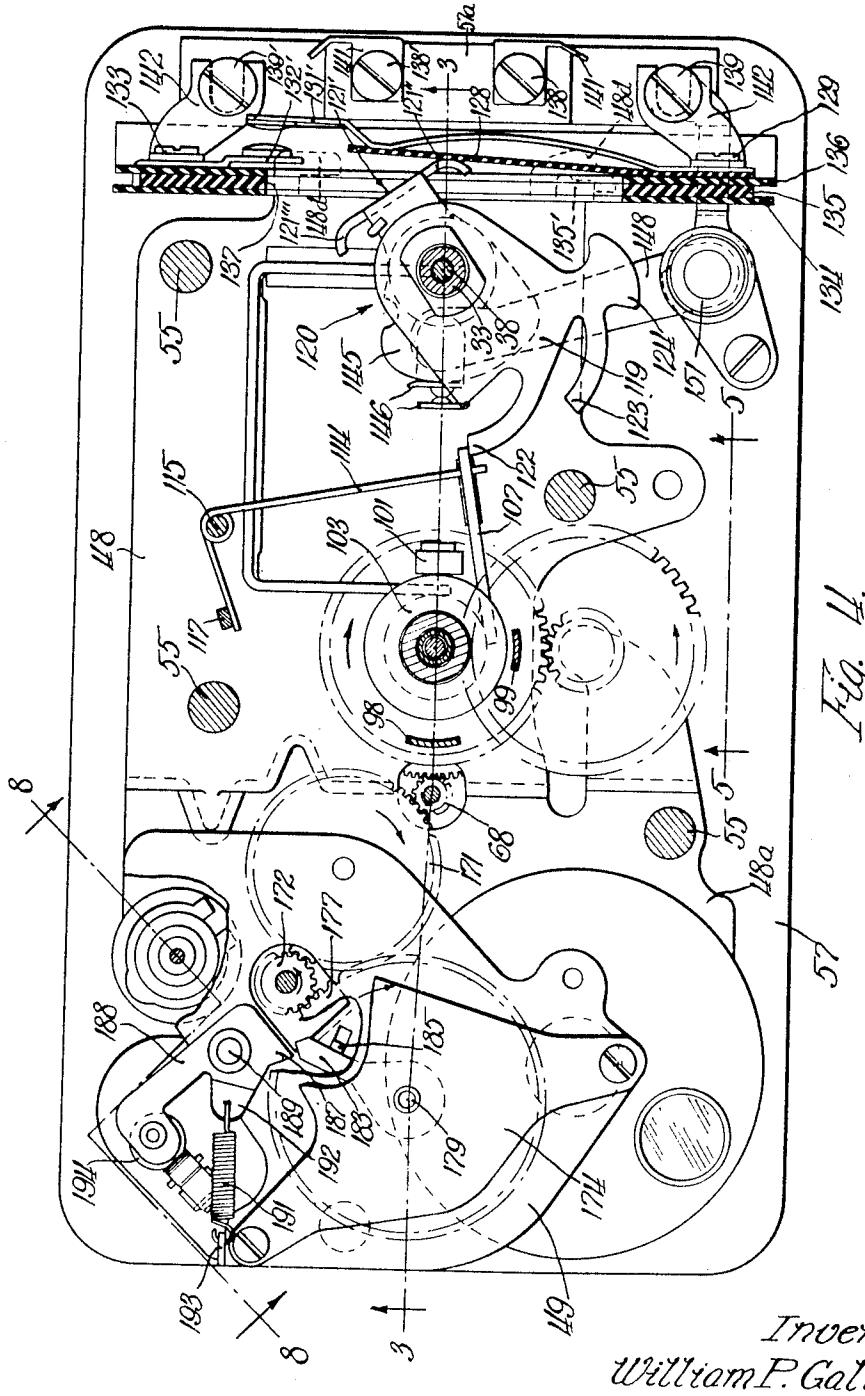


Fig. 4.

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ELECTRICAL TIMING APPARATUS

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Fig. 3.

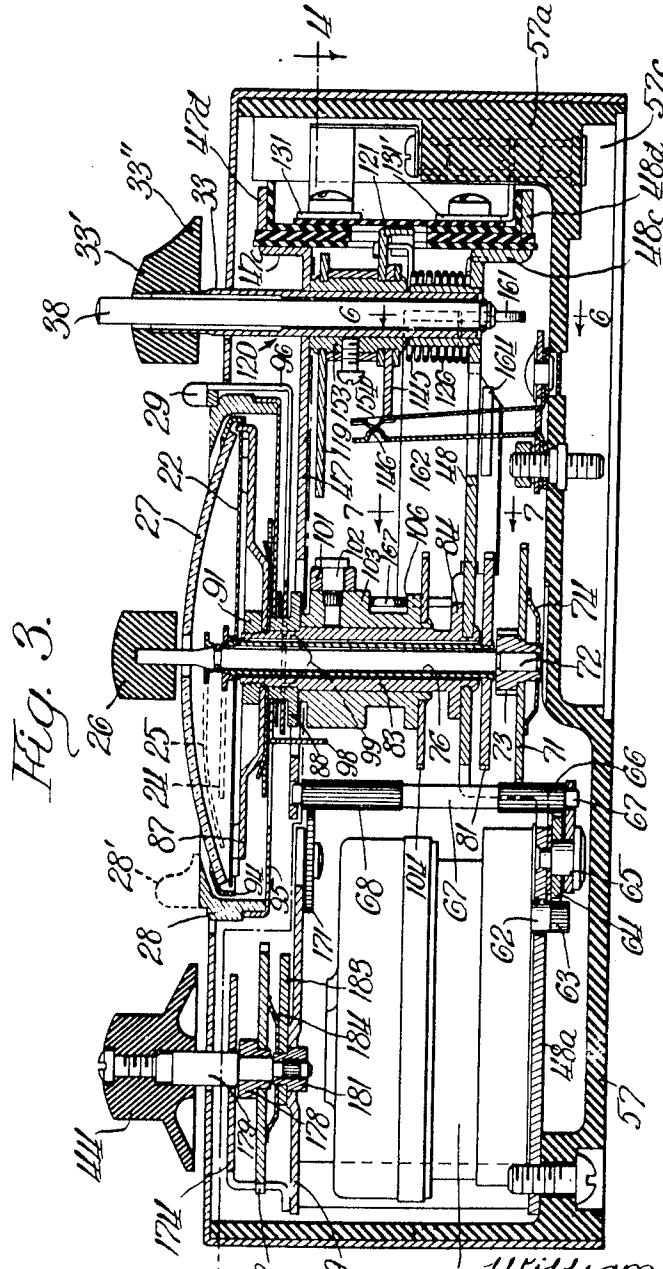


Fig. 7.

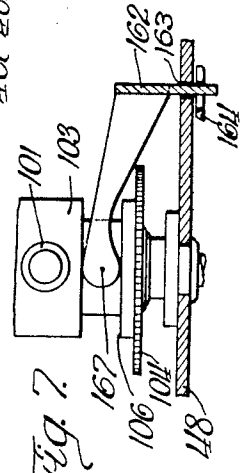
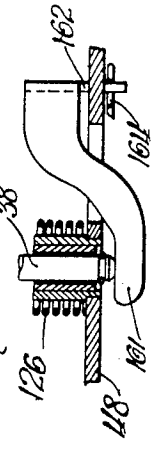


Fig. 6.



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UNITED STATES PATENT OFFICE

2,302,625

ELECTRICAL TIMING APPARATUS

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Application February 15, 1940, Serial No. 319,010

27 Claims. (Cl. 200—39)

The present invention relates to electrical timing apparatus, such as time switches, interval timers and the like.

One of the principal fields of utility for the invention is in that group of domestic or household time switches which are used on electric ranges or the like, and which are adapted to be set by the housewife to automatically control the starting and stopping of a cooking operation. Our improved time switch preferably has one adjustment which is set corresponding to the time when the cooking operation is to stop, and another adjustment which is set corresponding to the number of hours or fraction of an hour required for the performance of the cooking operation. This is the preferred arrangement because it requires no arithmetical computation by the housewife in order to insure that the cooking operation will be completed at a desired hour, since it is only necessary for her to set one adjustment corresponding to that hour, and to set the other adjustment corresponding to the prescribed length of time for cooking, and everything is then in readiness without her having to do any computing in making these settings. While this is the preferred relation of the adjustments, the invention is not necessarily limited thereto, but also includes other relations wherein the settings correspond to a definite hour for starting the cooking and a definite hour for stopping the cooking, or correspond to a definite hour for starting the cooking and an adjustable cooking time.

Another feature of the invention resides in the concentric grouping of these adjustments with respect to the clock dial of the electric switch. This simplifies the making of the adjustments because the two adjustments are thus directly related by such concentric grouping; also, because the setting of the stop cooking adjustment can then be made directly with reference to the hour and fractional hour markings on the clock dial. These clock dial markings are large and widely spaced, and the above adjustment can therefore be made more easily and more accurately than when small separate dials are used. The concentric grouping also results in a more compact structure, and in a decidedly better appearance, avoiding the impression of complicated manipulation.

Another feature of the invention pertains to an improved time responsive mechanism for controlling the electrical switch of the device. This comprises a stud or roller which is continuously moved at a predetermined rate through a closed path of travel by the clock mechanism of the time switch. For example, this roller is preferably continuously revolved in a circular path concurrently with the hour hand of the electric clock, whereby the roller completes one revolution through said path every twelve hours. Interposed in this path are two cams which, upon being encountered by the roller, cause the roller to be displaced in a direction axial of the circular path. Said cams are independently adjustable to any desired position in said circular path, and to any desired relative spacing in said path. One of the cams is adjusted by the aforementioned adjusting member which predetermines when the cooking operation is to stop, and the other cam is adjusted by the other adjusting member which predetermines the interval of the cooking operation. Such operating relation of adjustable cams and time driven roller affords a very simple, compact construction, and one which lends itself well to the concentric grouping of the adjusting members referred to above.

Another feature of the invention pertains to the manner in which the above described displacement of the time driven roller, upon successive engagement thereof with the adjustable cams, effects the tripping of the electric switch successively to different positions. This portion of the mechanism comprises a control shaft arranged to be spring impelled in one direction of rotation, and movable in successive steps to different angular positions, each of which effects an opening or a closing of the electric switch. Said control shaft carries a plurality of angularly spaced stop shoulders which project outwardly from the shaft to progressively larger radii. These stop shoulders engage successively against a tripping lever which is arranged to respond to the axial displacement of the time driven roller. The tripping lever is successively withdrawn from engagement with one stop shoulder, and then the next stop shoulder etc., resulting in a step-by-step rotative movement of the control shaft, this movement causing the electric switch to be closed and opened in timed sequence as established by the setting of the aforementioned adjustable members. At the completion of the automatic cycle, the switch is adapted to be restored to its normal closed position by a manual restoring operation performed through the medium of the tripping lever, so that the range is restored to its normal manual control.

Another feature of the invention pertains to an improved interval timer which is driven by

the electric clock of the time switch, and which can be set by the housewife to sound a buzzer upon the lapse of any desired time interval, ranging say from three minutes to sixty minutes or longer. This interval timer is advantageous for indicating to the housewife the termination of a certain time period that she wishes to be reminded of in connection with a cooking or other culinary operation. Said interval timer comprises an improved snap contact mechanism, an improved buzzer construction, and other improvements to be later described.

Other features, objects and advantages of the invention will hereinafter appear in the following detail description of one preferred embodiment of our invention. In the accompanying drawings illustrating such embodiment:

Figure 1 is a front elevational view of our improved electrical timing apparatus;

Figure 2 is a circuit diagram of the device;

Figure 3 is a vertical longitudinal sectional view through the mechanism, corresponding to a section taken approximately on the planes of the lines 3—3 of Figures 1 and 4;

Figure 4 is a horizontal sectional view taken approximately on the plane of the line 4—4 of Figure 3;

Figure 5 is a fragmentary vertical view taken approximately on the plane of the line 5—5 of Figure 4;

Figure 6 is a detail sectional view taken approximately on the plane of the line 6—6 of Figure 3;

Figure 7 is a detail sectional view taken approximately on the plane of the line 7—7 of Figure 3;

Figure 8 is a vertical sectional view through the buzzer and switch of the interval timer, corresponding to a view taken approximately on the plane of the line 8—8 og Figure 4;

Figure 9 is a detail elevational view of the movable switch element of the interval timer; and

Figure 10 is a transverse sectional view taken approximately on the plane of the line 10—10 of Figure 9.

Referring to Figure 1, the housing 21, which is preferably composed of a plastic or the like, is of box-like form comprising a front wall and four side walls extending rearwardly therefrom, this housing or cover being secured to a base, as will be presently described. The front wall of said housing has a large central opening therein through which appears the dial 22 of the electric clock, this dial having the usual hour and fractional hour markings 23, and the hour and minute hands 24 and 25 respectively. A resetting knob 26 extends forwardly from the front side of the cover glass 27, this knob being operative to reset the hands of the clock if the clock motor should stop by reason of current failure or any other cause.

Concentric with the clock dial are the two rotatable adjusting members 28 and 29 which are settable to different positions to predetermine the starting and stopping of the cooking operation. The adjustable member 28 is preferably in the form of a continuous ring surrounding the clock dial and bearing the notation "Stop cooking." The ring is formed with an index knob 28', preferably located adjacent to the above notation, and this knob has an inwardly extending pointer formation which is adapted to register with the hour and fractional hour markings 23 on the clock dial in the different angular positions to which the adjusting ring is moved. The other adjusting member 29 may likewise be in the form of a continuous ring, surrounding the ring 28. However, in the preferred construction shown, this member 29 is in the form of an arm having a knob or handle extremity which moves adjacent to or overlies a portion of the adjusting ring 28. This outer adjusting member 29 bears the notation "On," such indicating that the adjustments which are given this member correspond to the time that the cooking operation is "on." An index or pointer portion 29' projects inwardly from the adjusting member 29 in position to register with a second series of hour and fractional hour markings 31 provided on the adjusting ring 28. These latter marks designate the length of time that the cooking operation is to continue, the adjusting member 29 being movable to different ones of these marks for adjusting the length of the cooking time. In adjusting the members 28 and 29 to different times, the "stop cooking" ring 28 is first adjusted to the time when it is desired to have the cooking operation completed. In Figure 1 this is represented as six o'clock. After adjusting this member, the other adjusting member 29 is now moved into registration with the marking 31 which corresponds with the length of time that the cooking operation is to continue. In the drawings, this is represented as being 3 hours. Thus, the cooking operation will automatically start at three o'clock and stop at six o'clock.

Spaced to one side of the clock dial is a control knob 33' which is secured to the upper end of an oscillatable control shaft 33 (Figure 3). Projecting from said knob is a pointer portion 33'' which is adapted to coact with the "set" marking 34 and the "off" marking 35 to designate two of the four positions of the control knob 33''. The control shaft 33 and knob 33' are tubular, and a reciprocable plunger rod 38 extends downwardly therethrough, the upper end of this rod projecting above the knob or button 33' and being adapted to be depressed when the housewife desires to trip the control mechanism and restore the electric switch to its normal, closed circuit position, thereby placing the electrical heating element of the range back under manual control. The restoration of the electric switch to normal, closed circuit position results in the control knob 33' revolving downwardly to present its pointer portion 33'' to a lower or normal position, below the "off" position 35.

Also formed at any desired point in the front wall of the housing is an opening 41, into or through which entends the upper end of a pilot light 42. This pilot light is arranged to be illuminated so long as the control shaft 33 is either in its "set" position 34, its "off" position 35, or in its "on" position intermediate these two, thereby indicating to the housewife that the timing switch is functioning, or is still in control of the particular range circuit which leads from this timing switch. The pilot light is only extinguished when the control shaft 33 is restored to its normal, closed circuit position, to which position said shaft moves when the plunger rod 38 is depressed, as described above.

Disposed to the other side of the clock dial is the interval timer knob 44. The periphery of this knob is marked with minute graduations 44', ranging say from zero to sixty. These marks are adapted to be brought into registration with an index pointer 45 on the casing when it is desired that the interval timer shall sound an audible

signal upon the lapse of a selected time interval, as will be later described in detail.

Referring now to Figures 3, 4, 5, etc., the working parts of the mechanism are supported in a frame structure comprising upper and lower frame plates 47 and 48 and an extension plate 49, the latter extending from the left hand edge of the upper plate 47. The plates 47 and 48 are joined together in spaced relation by suitable screws and spacing posts 55 (Figure 4), and the plate assembly is suitably secured to a lower base member 57 composed of insulating material. The left hand part of the frame plate 48 has an extending portion 48a which is dropped to a lower plane, and mounted on this extending portion is the electric motor 61 which drives the clock and other driven parts of the mechanism. In almost all instances, this electric motor will be a synchronous alternating current motor of any preferred construction, such as are commonly employed in electric clocks and the like. It will of course be understood that if a frequency regulated alternating current is not available for operating such a motor, the latter might be substituted by conventional spring driven clock mechanism, or by an accurately regulated electric motor of another type. Extending downwardly from reduction gearing within the base of the motor unit 61 is a pinion shaft 62 carrying pinion teeth 63, which mesh with an idler gear 64 supported by a strap-like bracket 65. The idler gear meshes with teeth 66 formed on the lower end of a vertically disposed rotatable shaft 67, which has its lower end journaled in the bracket 65 and its upper end journaled in the upper frame plate 47. Gear teeth 68 formed in the upper portion of the shaft 67 are arranged to drive the interval timer, which will be later described.

The aforementioned teeth 66 in the lower portion of the shaft drive the large spur gear 71 which is disposed at the lower end of the clock assembly. Such gear is adapted to have a frictional clutch drive with the axial shaft or spindle 72 which carries the minute hand 25 at its upper end. The extremity of this minute hand shaft extends out through an opening in the cover glass 27 of the clock dial and has the resetting knob 26 secured thereto. A pinion 73 is fixedly staked to the minute hand shaft 72, and has a hub portion extending downwardly through the large gear 71, the lower end of this hub portion having a spring armed spider 74 fixedly secured thereto. The large gear 71 is capable of frictional rotation on the pinion hub, between the body of the pinion and the spider 74, the operating relation being such that the gear 71 normally transmits timed rotation to the minute hand shaft 72, but said minute hand shaft is capable of rotation relatively to said gear in the operation of setting the clock hands through manipulation of the resetting knob 26. The hour hand 24 of the clock is secured to the upper end of an hour hand sleeve 76 which surrounds the minute hand shaft 72. The appropriate speed reduction is transmitted from the minute hand shaft to the hour hand sleeve through laterally disposed reduction gearing illustrated in Figures 4 and 5. This comprises a large spur gear 77 which is driven by the spur pinion 73 on the minute hand shaft. Extending upwardly from the gear 77 in fixed relation thereto is a relatively long spur pinion 78. Said gears 77 and 78 are mounted on a vertical shaft 79 which has its lower end supported in a bracket portion 48b extending from the lower frame plate 48, and which has its upper end supported in the upper frame plate 47. The relatively long pinion 78 transmits rotation to a spur gear 81 which is fixed to the lower end of the hour hand sleeve 76 and which transmits one complete rotation to the hour hand every twelve hours. Said long spur gear 78 also transmits this same identical rate of rotation to a time driven roller which rotates through a circular path externally of the hour hand sleeve 76, as we shall presently describe.

The clock assembly comprising the dial, minute hand shaft, and hour hand sleeve, is supported by a vertical, stationary supporting sleeve 83 which is rigidly anchored to the lower frame plate 48. For example, a radial mounting flange 84 projects outwardly from the lower portion of the sleeve for abutment against the top surface of the frame plate, and a reduced lower portion of said sleeve extends through an aperture in the frame plate and is peened over to rigidly stake the supporting sleeve to the plate. The minute hand shaft 72 and the hour hand sleeve 76 extend upwardly through the supporting sleeve 83. For mounting the clock dial 22 on said supporting sleeve, the dial is carried by a plate 87 having a central aperture which fits down over the upper end of the sleeve. Below the plate 87 is a bushing or collar 88 formed with an outwardly extending lower flange, this bushing or collar having its lower face seating against an annular shoulder formed around the upper portion of the supporting sleeve 83. A nut 91 screws down over an external thread formed on the upper end of the supporting sleeve, the dial supporting plate 87 being clamped rigidly between the nut 91 and the bushing or collar 88. The cover glass 27 extending over the clock dial has any suitable attachment to the dial and to the plate 87 by a peripheral confining ring 94.

The adjustable "stop cooking" ring 28 is anchored within a peripherally flanged disk 95 which has a central bearing aperture engaging over the bearing bushing 88 for free rotation thereon. The other adjusting member 29, which predetermines the number of hours that the cooking operation is to continue, is carried by an arm 96 which extends downwardly and inwardly below the disk 95, and which has an apertured central portion rotatably engaging over the bearing bushing 88 below the rotatable disk 95. Extending downwardly from the disk 95 is a pointed cam 98 (best shown in Figures 3 and 5), it being evident that this cam will assume different positions of adjustment as the "stop cooking" ring 28 is moved to its different points of adjustment. In similar fashion, a pointed cam 99 projects downwardly from the arm 96, whereby this cam assumes different angular positions of adjustment as the outer adjusting member 29 is moved to different positions for adjusting the cooking interval. Both cams extend down through a relatively large circular opening formed within the upper frame plate 47 (Figure 3), and the cam 99 rotates in a path of movement which is just inside the path of movement of the cam 98. The cams are independently adjustable, but the arm 96 will engage against the cam 98 if the housewife should accidentally attempt to make an erroneous setting with the long cam 98 in position to be engaged by the time driven roller before said roller engages the short cam 99. In the normal operation, first the short cam 99 and then the long cam 98 are engaged in that sequence by the aforementioned roller 101, which revolves

continuously around the outer side of the supporting sleeve 83. Said roller is rotatably mounted on a stud 102 projecting radially outwardly from a time driven shifter sleeve 103 which is mounted for rotation and reciprocation on the outside of the supporting sleeve 83. A gear 104 is rigidly secured to the lower end of the sleeve 103, this gear having the same diametral pitch as the gear 81 and also meshing with the relatively long gear 78 which drives gear 81. Thus, sleeve 103 and roller 101 rotate at the same speed as the hour hand 24, i. e. one complete revolution in twelve hours, the gear 104 remaining in continuous mesh with the relatively long gear 78 during axial reciprocation of the sleeve 103 along the supporting sleeve 83. Downward reciprocation of the roller 101 and sleeve 103 occurs each time that the roller 101 encounters the cams 98 and 99. As clearly shown in Figure 5, the two cams are of unequal length in a downward direction, the cooking hours cam 99 being relatively short and causing the sleeve 103 to move down a relatively short distance, whereas the stop cooking cam 98 is relatively longer, and causes the sleeve 103 to move down a greater distance.

An annular groove 106 is formed in the lower portion of the shifter sleeve 103, whereby the shifting movement of the sleeve is transmitted to a time controlled tripping lever 107 (see Figure 5). A laterally extending arm of said lever is formed with a rounded end portion 108 which engages in the annular groove 106, for transmitting reciprocal motion of the shifter sleeve to the lever. The lower end of the lever 107 is pivotally supported by the lower frame plate 48 in any suitable manner; in the exemplary arrangement shown the pivot mounting is established by extending the lever down through a slot in the plate, and by having a stud or protuberance 111 projecting from the lever and engaging the top of the plate, and a cotter pin 112 passing through the lever and engaging the bottom of the plate. A spring bias is continuously exerted against the lever tending to swing it to the right (Figure 5), such being effected by a wire spring 114 having one end extending through a hole in the lever 107. The intermediate portion of the spring is given several turns around a stud 115 projecting downwardly from the top plate 47, and the other extremity of the spring is anchored against a lug 117 also projecting downwardly from the plate 47. The upper extremity of the bell crank tripping lever 107 is arranged to oscillate back and forth in a long narrow guide slot 118 punched in the upper frame plate 47 (Figure 5), this guide slot sustaining the lever against the lateral stresses exerted against the lever by the spring impelled control member to be now described.

This control member, designated 120 in its entirety, comprises the aforementioned control knob 33' and control shaft 33, together with the multiple stop plate 119 and switch actuating cam 121, both mounted on the tubular shaft 33 to have rotative movement therewith. Referring to Figure 4, the multiple stop plate 119 comprises three successive stop shoulders 122, 123 and 124 adapted to engage successively against the side surface of the tripping lever 107 as the control shaft 33 is angularly advanced, step by step, in a clockwise direction. The stop shoulder 123 projects outwardly to a larger radius than the stop shoulder 122, and the stop shoulder 124 projects outwardly to a larger radius than the stop shoulder 123, whereby as the tripping lever 107 is retracted in steps, it will successively release the stop shoulders 122 and then 123, for producing a step by step advancing movement of the control shaft 33. When the index pointer 33'' of the control knob 33' is in the "set" position 34, as shown in Figure 1, the stop plate 119 occupies the position illustrated in Figure 4, with its first stop shoulder 122 abutting against the side of the tripping lever 107. The continuous, time driven motion of the roller 101 brings it into engagement with the relatively short, cooking hours cam 99 for effecting the first tripping actuation of the lever 107, the lever being oscillated to a limited extent just sufficient to free the stop shoulder 122. Immediately, the control shaft is oscillated in a clockwise direction under the impetus of a torsion spring, to be later described, this bringing the next stop shoulder 123 up against the side of the tripping lever 107. Following this, at the conclusion of the cooking interval, the longer cam 98 is encountered by the continuously moving roller 101, and a further retractive movement is thereby imparted to the tripping lever 107. This frees the second stop shoulder 123, which permits the control member to rotate through its next step of movement, bringing the third stop shoulder 124 up against the side of the tripping lever 107. Referring to Figure 5, the stop surface on the side of the tripping lever 107 which is engaged by the successive stop shoulders 122—124 may be sloped or accurately machined, as indicated at 107' for insuring accurate tripping of the successive stop shoulders 122—124. The aforementioned torsion spring is indicated at 126, this spring being coiled around the lower portion of the control shaft with one end hooked to a shoulder on the switch actuating cam 121 and the other end hooked in an aperture in the lower frame plate 48, this spring tending constantly to rotate the control assembly in a clockwise direction, as viewed in Figure 4.

The switch actuating cam plate 121 comprises a shoe-like formation at one side (Figure 4), this shoe-like formation defining a flat cam spot 121' and two cam lobes or projections 121'' and 121''', located to each side of the flat spot. These cam surfaces engage successively against a strip 128 composed of fiber, vulcanite or other relatively stiff insulating material. One end of this strip is fixedly anchored by screws or rivets 129 (Figure 4) and the other end is free to flex inwardly and outwardly under the action of the cam surfaces 121'—121'''. This flexing motion of the insulating strip is imparted to a pair of parallel movable contact springs 131, 131'. Said contact springs have their fixed ends anchored under the screws or rivets 129, and carry contact buttons at their free ends which are adapted to engage with cooperating contact buttons on a pair of stationary contacts 132, 132'. These stationary contacts are likewise anchored by screws or rivets 133. The movable and stationary pairs of switch contacts are assembled upon an insulating panel structure built up of three strips of insulating material 134, 135 and 136, the screws or rivets 129, 133 passing through the two outer strips 135 and 136. As shown in Figure 4, a horizontal, slot-like opening 137 is provided in the three insulating laminations, through which opening the switch operating cam 121 moves in imparting switch actuating motion in the insulating strip 128. To provide a mounting for the insulating base structure 134—136 of the switch, the two frame plates 47 and 48 are formed with upwardly

and downwardly extending end flanges 47c and 48c respectively (Figure 3), and the base or panel structure of the switch is assembled up against these vertical flanges. Thereafter, hook-shaped lugs or tabs 47d and 48d, extending from the flanges 47c and 48c respectively, are bent horizontally to hook over lugs 135' which project from the upper and lower edges of the insulating plate 135. Figure 4 shows two of these hook-shaped lugs in dotted lines, and it will be noted that the lowermost lug 48d embraces the lower edge of the lug 135', so as to lock the panel structure against edgewise displacement from under the hook-shaped lugs. The insulating base 57 is formed with a terminal block portion 57a adjacent to the switch assembly, and mounted on a raised central portion of this block are two terminals 138, 138', and mounted on the outer lower portions of said block are two terminals 139, 139'. As shown in Figures 4 and 5, terminal clips 141 extend from the upper pair of switch contacts 131, 132 to the terminals 138, 138', and terminal clips 142 extend from the lower pair of switch contacts 131', 132' to the outer terminals 139, 139'. The four stationary terminals extend downwardly through said mounting block into a cavity 57c formed in the under side of the insulating base 57, the electrical conductors being led into this cavity for connection with the lower ends of said terminals.

The pilot light 42 is responsive to the angular position of the control shaft 33, and, to this end, a cam 145 is mounted on said control shaft and arranged to control a switch 146 which is connected in circuit with the pilot light 42. The cam 145 is indicated largely in dotted lines in Figure 4, and is of such configuration that it serves to hold the switch 146 closed for maintaining the pilot light illuminated during the entire time that the successive stop shoulders 122, 123, and 124 are engaging the tripping lever 107, the cam 145 only passing beyond the contact springs 146 and permitting them to separate after the stop shoulder 124 has been tripped beyond the tripping lever 107, such final position of the control member leaving the main power switch 131—132' in closed position. As shown in Figure 3, the pilot light switch contacts 146 have their lower ends suitably mounted on the insulating base 57, one of these switch elements being connected through a conducting strip 148 (Figure 4) with a terminal of the lamp socket 151 into which the pilot light 42 screws. Referring to Figure 3, the stop plate 119, main switch cam plate 121 and pilot switch cam plate 145 are all rigidly assembled in their proper angular relation on an assembly hub 153, which hub is thereafter adjustably secured to the tubular control shaft 33 by set screw 154.

Referring to the circuit diagram of Figure 2, it will be seen that the automatic timer switch 131—132' is connected in series with a conventional manually actuated switch 155 which is provided for each heating element of the range. Thus, the energization of the heating element 156, located in the oven or any other part of the range, requires that the automatic timer switch and the manual switch be both in their closed positions. However, when the automatic timer switch automatically stops the cooking operation it leaves the switch 131—132' in open circuit position, the stop shoulder 124 of the control member engaging at this time against the side of the trip lever 107. Accordingly, to place the heating element 156 back under the control of the manual switch 155, for manual starting and stopping of a cooking operation, it is necessary that the automatic switch 131—132' be restored to closed circuit position. This is effected by the housewife presing inwardly on the aforementioned plunger rod 38 that extends downwardly through the tubular control shaft 33. As shown in Figures 3 and 6, the lower end of this rod extends out of the lower end of the tubular shaft or sleeve 33, and is operative to impart rocking movement to an arm 161. This arm is an integral extension of a rocker plate 162 which has pivotal mounting within a slot 163 punched in the lower frame plate 48. The plate 162 has a tongue portion which extends down through the slot and receives a transverse cotter pin 164 at a point below the frame plate 48, such mounting affording inexpensive pivotal support for the rocking plate. An arm 167 extends forwardly from the other end of said plate, and is formed with a rounded extremity which engages within the annular groove 106 formed in the time driven shifter sleeve 103. As previously described, this shifter sleeve is normally urged upwardly toward its uppermost position by a spring 114 which acts through the tripping lever 107. The depressing of the plunger rod 38 acts through the arm 161, rocker plate 162 and arm 167 to depress the shifter sleeve 103 downwardly to the lower limit of its movement, thereby swinging the tripping lever 107 through a maximum range of retractive movement, and thus releasing the last stop shoulder 124 of the stop plate 119. This permits the control shaft to rotate through a final clockwise step, for moving the cam lobe 121''' out of engagement with the insulating plate 128, enabling the switch contacts 131, 131' to move to closed circuit position. The automatic timer is now reset to its normal closed circuit condition, so that further control of the heating element 156 is placed under the control of the manual switch 155, at least until it is desired to employ the timer for another automatic cycle. It will be noted that the resetting operation can be performed at any time by merely depressing the plunger rod 38, as for example to release either of the other stop shoulders 122, 123 in the event that the housewife has made a mistake in the setting of the adjustments 28, 29 and wishes to start over again.

Assuming now that it is desired to have the timer operate through an automatic cycle, say for starting a cooking operation which is to end at six o'clock and which is to be of three hours duration, as mentioned above, the stop cooking adjustment 28 is set at six o'clock on the clock dial 22, and the cooking hours adjustment 29 is set at the numeral "3" on the scale 31, both as indicated in Figure 1. Thereupon, the control knob 33' is rotated in a counterclockwise direction to bring the index pointer 33'' into the "set" position 34. The setting operation is now completed, and the timer is in readiness to go through its automatic cycle at the prescribed times. This setting operation can, of course be performed in the morning, noon or any hour in the afternoon, preceding the time when the cooking operation is to start. For example, the clock hands in Figure 1 illustrate that the set condition has been established in the timer at or before 12:25 o'clock. In this set condition of the parts, the multiple stop plate 119 will occupy the position illustrated in Figure 4, with its first stop shoulder 122 abutting against the trip lever 107. In this position of the control member, the main switch cam has its lobe 121'' bearing against the insulating strip 128 for holding the switch contacts 131, 131' in open circuit positions. The

pilot switch cam 145 is now holding the pilot switch 146 closed, so that the pilot light 42 is illuminated for indicating that the timer is in its set position. As the time approaches for starting the cooking operation, the continuously driven roller 101 encounters the short cam 99, which has an angular setting predetermined by the position of the cooking hours adjustment 29. The roller rides down the slope of said cam, thereby thrusting the sleeve 103 downwardly and imparting a retractive movement to the tripping lever 107. Substantially at the time when the roller reaches the peak of the cam 99, the tripping lever has been retracted just enough to clear the first stop shoulder 122 of the stop plate 119. Instantly upon the tripping of this first stop shoulder, the control assembly rotates quickly through a one step advancement, bringing the second stop shoulder 123 up against the tripping lever 107, said second stop shoulder projecting outwardly to a greater radius than the first stop shoulder, as previously described. The one step advancement of the control member brings the flat stop 121' of the main switch cam into substantial parallelism with the insulating strip 128, permitting said strip and the movable contacts 131, 131' to flex inwardly into circuit closing position. This completes the circuit to the heating element 156, the manually actuated switch 155 having been previously set in its on position. The pilot light cam 145 still maintains the pilot switch 146 in closed position, so that the pilot light 42 will remain illuminated for indicating that the heating element 156 is still under the control of the automatic timer. The continued time driven motion of the roller 101 finally brings it into engagement with the relatively long cam 98 as the time approaches for stopping the cooking operation. Substantially at the time that the roller 101 reaches the peak of the cam 98, the tripping lever 107 has been retracted sufficiently far to clear the second stop shoulder 123 of the stop plate 119. Hence, the control assembly is permitted to quickly rotate through a second step of advancing movement, this bringing the third stop shoulder 124 up against the side of the tripping lever 107. This second step of advancing movement of the main switch cam 121 brings the cam lobe 121''' up against the insulating strip 128, flexing this strip outwardly and moving the contacts 131, 131' to open circuit position. Thus, energization of the heating element 156 is interrupted at the time previously set for stopping the cooking operation. In this position of the parts, the pilot switch cam 145 is still holding the switch 146 closed for maintaining the pilot light 42 illuminated, this light serving to indicate to the housewife that the circuit to the heating element 156 is still under the control of the automatic timer, in the sense that the automatic timer is retaining the switch contacts 131, 131' in their open circuit position; and that a resetting operation must be performed for bringing the timer back to its normal condition with the switch contacts 131, 131' closed. Thus, the housewife is apprised of the fact that she must depress the plunger rod 38 for shifting the sleeve 103 down through a final depressing movement, the range of which movement causes the tripping lever 107 to clear the third stop shoulder 124. The clearing of this last stop shoulder permits the control assembly to advance through a third and final step of rotation, thereby moving the cam lobe 121''' away from the insulating strip 128 and permitting the switch contacts 131, 131' to move back to a normal, closed circuit position. Such third step of angular movement of the pilot switch cam 145 permitted the switch 146 to open, thereby extinguishing the pilot light 42, and indicating to the housewife that the timer is now restored to its normal position.

Referring now to the interval timer or time signal apparatus, this is driven from the gear teeth 68 in the upper end of the toothed drive shaft 67, the latter transmitting rotation to a gear wheel 171 which is journaled on the underside of the left hand frame plate 49. The gear wheel 171 meshes with the lower end of the relatively long idler pinion 172 which has its lower end journaled in a lug punched downwardly from the plate 49 and which has its upper end journaled in a small upper plate 174. The main body of this upper plate 174 is spaced upwardly from the plate 49, and mounted between these two plates is a relatively large spur gear 177 which is driven from the pinion 172. As best shown in Figure 3, the gear 177 is provided with a hub 178 which is capable of rotating freely on a vertical spindle 179. Fixedly secured to the lower end of said spindle is a bushing 181 which has a rotatable bearing support in the frame plate 49, the spindle also having a bearing support in the upper plate 174. Fixedly secured to the upper end of the spindle is the knob 44 which serves to set the interval timer. Rigidly secured to the bushing 181 is a time settable arm 183, disposed below the spur gear 177. A spring-arm spider 184 has its central portion rigidly secured to the bushing 181 and arm 183, and has its spring arms bearing with a resilient frictional contact against the bottom surface of the spur gear 177. The latter gear rotates continuously, and the gear ratio of the drive thereto is such that this gear makes one complete revolution each hour, the scale markings 44' on the knob 44 representing the sixty minutes of this hour. The spring-arm spider 184 functions as a friction slippage clutch for transmitting rotating torque from this continuously rotating gear 177 to the time settable arm 183 and spindle 179. The torque transmitted through this slippage clutch causes the arm 183 to revolve in the direction indicated by the arrow in Figure 4, until said arm encounters a stationary stop shoulder 185, this preferably consisting of a lug punched upwardly from the body of the plate 49. It will be seen from the foregoing that when the knob 44 is given a counterclockwise adjusting rotation to establish a time setting of 10 minutes, 20 minutes or any other desired time with respect to the index marker 45 (Figure 1), the settable arm 183 will be revolved a corresponding amount away from the stop lug 185. The knob and arm can be rotated in this direction, counter to the direction of rotation of the gear 177, by virtue of the slippage which is permitted to occur at the friction clutch 184. Immediately that the adjusting knob has been given this desired time adjustment, the knob and arm 183 start their return motion under the driving torque of the gear 177, the knob and arm continuing this return motion back to their normal position, defined by the arm engaging the stop lug 185.

The arm 183 has a pointed or wedge-shaped outer end which is adapted to cooperate with a corresponding wedge-shaped formation 187 on a tripper lever 188, this occurring just before the settable arm 183 arrives back in its normal position in engagement with the lug 185. The

tripper lever is pivoted on a pin 189 extending upwardly from the frame plate 49, and the lever is yieldingly held in the normal position illustrated by a tension spring 191 which has one end hooked to an apertured arm 192 extending from said lever, and which has its other end hooked to a lug 193 projecting up from the plate 49. The outwardly extending arm of said lever carries a downwardly extending roller 194 composed of insulating material. This roller is adapted to actuate a snap switch 195, best shown in Figures 8, 9 and 10. The switch is mounted on an insulating base 196, and comprises a stationary contact 197 and a movable contact 198 adapted to snap into and out of engagement with the stationary contact. The movable contact is in the form of a long strip of metal having its upper end secured by a rivet 199 to a biasing snap strip 201, and having an outwardly curved lower extremity which constitutes the contact surface adapted to engage with the stationary contact 197. The lower portion of the strip 201 has a laterally bent extremity which is attached by a connector rivet 202 to the insulating plate 196, and the upper end of said strip has a laterally curved end 201*a* against which the insulating roller 194 is adapted to engage for actuating the switch. Referring to Figures 10 and 11, that portion of the strip 201 disposed below the rivet 199 is provided with two parallel slots 201*b* which produce a central strip or ribbon portion 201*c*, and the two lateral strips or ribbons 201*d*—201*d*. These strips or ribbon portions are so treated and shaped that the middle strip or ribbon portion 201*c* has a greater effective length than the side portions 201*d*. For example, the median zone of the central ribbon, represented by the opposite lines of cross-hatching 201*e*, is given a tension stretch by a stamping or other shaping operation, whereby the metal is elongated so as to make the central ribbon portion 201*c* of greater length than the side ribbon portions 201*d*. Furthermore, the effective length of the side ribbon portions may be shortened relatively to the central portion by forming a slight kink or bend in each side ribbon portion, this bend being located intermediate the upper and lower ends of the ribbon portions and being in a direction toward the strip 198 which constitutes the movable contact. Such bending shortens the effective length of the side ribbon portions relatively to the central ribbon portion. Referring to Figure 11, the side portions are also given a forward slope or bend, to have their outer edges extend forwardly in a direction toward the movable contact strip 198. This adds stiffness to the side portions, so that the major portion of the snap flexure occurs in the central portion 201*c*. In the operation of this snap switch, when the insulating roller 194 engages the bent upper end 201*a* and starts flexing the switch structure toward the dotted line position shown in Figure 8, the member 201 is flexed laterally a substantial distance before the differential stresses in the central portion 201*c* and in the side portions 201*d* result in the over-center snap. Before the snap, the central portion occupies a position which curves or bows rearwardly (in a direction away from the movable contact strip 198) with respect to the side portions 201*d*, and these side portions extend or are disposed in a position forwardly of the central portion. As the asesmbly is flexed backwardly, the differential stress continues until the over-center snap occurs, by which the central portion 201*c* is snapped or bowed forwardly toward the movable contact strip 198. The action causes a quick movement of the contact strip 198 into engagement with the stationary contact 197. Having snapped into such a closed position, the movable contact remains in engagement with the stationary contact during any further motion of the insulating roller 194 in this same direction. In the retractive movement of the roller in the opposite direction, the switch assembly flexes back toward its normal position, and at a certain point the over-center snap action occurs in the reverse direction for quickly separating the movable contact strip 198 from the stationary contact 197.

As shown in Figure 2, this snap switch 195 controls the circuit of a signal buzzer 205. Referring to Figure 8, the buzzer comprises a core 206 and a winding 207 mounted thereon, this core and winding constituting the movable element of the buzzer. The core is composed of a magnetic metal, and formed in the lower end thereof is a guide bore 208 which has a sliding fit over a stud 209 projecting upwardly from the frame plate 48. The stud 209 is preferably composed of brass or other nonmagnetic metal. The frame plate 48 is composed of a magnetic metal so that when the core 206 is energized it tends to move downwardly toward the plate 48. A compression spring 211 interposed between the upper end of the stud 209 and the end of the bore 208 normally holds the core and winding in an elevated position, as shown. The upper end of the core 206 is formed with a guide pin 212 which has a slidable fit in a guide bore 213 formed in an adjustable guide screw 214. Said screw threads through a tapped hole in the upper frame plate 47, and is adapted to be locked in any vertical position of adjustment by a lock nut 215. The screw 214 is preferably composed of brass or other nonmagnetic metal. The pressure of the spring 211 normally holds the shouldered upper end 216 of the core against the lower end of the guide screw 214. The main body of the core 206 is disposed in closer proximity to the lower frame plate 48 than it is to the upper frame plate 47, and hence upon energization of the winding 207 the core and winding tend to move as a unit downwardly toward the plate 48. The lower end of the core striking this plate constitutes one end stop for the movable unit, and the shouldered upper end of the bore striking the guide screw 214 constitutes the other end stop for the movable unit. It will be understood that the winding 207 is energized by the alternating current which operates the synchronous electric motor 61. Hence, the movable buzzer unit 206—207 tends to vibrate with the same frequency as the alternating current. The degree of loudness resulting from the movable unit striking the aforementioned end stops can be increased or decreased by screwing the adjusting screw 214 upwardly or downwardly, thereby adjusting the distance between the end stops.

When the housewife desires to set the interval timer for a certain time period, as for example to call her attention to a particular cooking operation upon the expiration of say 20 minutes, she will turn the adjustable knob 44 in a counterclockwise direction to place the "20" minute marking of the knob in registration with the index pointer 45. This revolves the arm 183 a predetermined distance away from the stationary stop 185 in a counterclockwise direction. The continuously rotating gear 177, a revolving one revolution per hour, immediately starts to drive

the arm 183 back toward the stop 185 in a clockwise direction of motion, such drive being transmitted through the friction clutch 184. Referring to Figure 4, when the arm 183 arrives in proximity to the stop 185, the wedge-shaped outer end of said arm engages the wedge-shaped formation 187 on the lever 188, thereby rocking the lever 188 in a counterclockwise direction with the continuous motion of the arm 183. Such rocking movement of the lever 188 operates through the insulating roller 194 to close the snap switch 195, as described above. The snap switch is only held in its closed position for a brief time, say from 10 to 30 seconds or so, because of the small area of contact between the wedge-shaped end of the arm 183 and the wedge-shaped formation 187 on the lever 188, and also because of the adjusted position of the snap switch 195 relatively to the path of travel of the roller 194. During this closed condition of the snap switch, the buzzer device 205 sounds its signal by a continuous vibration. When the wedge-shaped outer end of the arm 183 slips past the wedge-shaped portion 187 of the lever 188, the lever 188 is immediately restored to normal position, and the arm 183 is thereafter brought to a stop against the shoulder 185.

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. In this regard, we wish to point out that our improved timer mechanism is not necessarily limited to the control of an electric switch, but may be employed for other purposes, such as for effecting the automatic time control of a gas valve governing the operation of a burner in a gas range, as fully disclosed in the copending application of William P. Gallagher, Serial No. 317,248, filed February 5, 1940, entitled "Burner control apparatus."

We claim:

1. In timing apparatus for governing the timed operation of a control device, clock mechanism comprising a clock dial, a first adjustable member for predetermining the time when said control device moves to one position, a second adjustable member for predetermining the time when said control device moves to another position, said two adjustable members having rotative movement substantially concentrically of said clock dial, and manual means operable separately from said adjustable members for placing said control device in a predetermined position.

2. In an electric time switch of the class described, the combination of a switch, an electrically driven clock comprising a clock dial having dial numerals and hour and minute hands cooperating therewith, mechanism responsive to said clock for controlling said switch comprising two relatively adjustable members for predetermining the time of opening of said switch and the length of time said switch is to remain closed, said members being mounted for rotation concentrically around the outside of said clock dial, the adjustable member which predetermines the time when said switch is to open being provided with an index pointer adapted to be placed in registration with the numerals on said clock dial, spaced time indicating marks carried by said latter adjustable member, and an index pointer carried by the other adjustable member and adapted to be set with respect to said time indicating marks for predetermining the length of time the switch is to remain closed.

3. In time switch apparatus for an electric cooking range, the combination of a switch governing a heating element in said range, a constantly running electric clock having a clock dial, and adjustable mechanism responsive to said clock for controlling said switch, comprising one adjustable member rotatable concentrically of said clock dial for predetermining the hour when said switch is automatically moved to one position, and another adjustable member also rotative concentrically of said clock dial and operative to give a direct reading designation of the number of hours the cooking operation is to continue.

4. In timing apparatus for governing the timed operation of a control device, an actuator therefor, spring means tending to move said actuator always in the same direction, the combination of clock mechanism comprising a clock dial, a time driven member moving in a predetermined path concentrically of said clock dial, an adjustable cam member movable to different positions along the length of said predetermined path corresponding to different times of operation, said cam member adapted to be engaged by said time driven member, and means responsive to the engagement between said members for governing said actuator.

5. In timing apparatus for governing the timed operation of an electric switch, the combination of a time driven member moving through a closed circular path at a timed rate, a plurality of adjustable cam members rotatively adjustable to different angular positions around said closed circular path and adapted to be engaged successively by said time driven member, the engagement between said members causing displacement of one of said members, said latter member being displaced in the same direction in each of said successive engagements and means responsive to such successive displacements in the same direction for causing successive timed operations of said electric switch.

6. In a time switch, the combination of an electric clock, a roller driven continuously through a closed circular path by said clock at a timed rate, a plurality of adjustable cam members rotatively adjustable to different angular positions around said path and adapted to be engaged by said roller in each revolution of the latter, such engagement causing displacement of said roller relatively to the cam member, an electric switch, and means responsive to the displacement of said roller for actuating said switch.

7. In timing apparatus for governing the timed operation of a control device, the combination of time actuated tripping means adapted to be actuated successive distances, and control means comprising a plurality of rotary stop shoulders having concurrent movement and adapted to be successively released by said tripping means for governing said control device.

8. In timing apparatus for governing the timed operation of a control device, the combination of a time actuated tripping member adapted to be actuated successive distances at different predetermined time intervals, a rotatable control member having a plurality of stop shoulders disposed at different radii and adapted to be successively released by said tripping member, and means responsive to said control member for actuating said control device.

9. In a time switch of the class described, the combination of an electric clock, a tripping lever adapted to be actuated by said clock through successive retractive movements, adjusting means for causing first one and then another of said retractive movements to occur at different preselected time intervals, a spring rotated control member having a plurality of stop shoulders adapted to engage said tripping lever, said shoulders being disposed at different radii and being adapted to be successively released by the successive retractive movements of said lever, and a switch responsive to the motion of said control member.

10. In timing apparatus for governing the timed operation of a control device, the combination of a time driven member moving in a predetermined path, an adjustable cam member movable to different relatively stationary positions along said predetermined path at which it is adapted to be engaged by said time driven member, tripping means responsive to the engagement between said members, and control means comprising a plurality of stop shoulders adapted to be successively released by said tripping means and governing said control device.

11. In timing apparatus for governing the timed operation of a control device, the combination of a time driven member moving through a closed path at a timed rate, an adjustable cam member adjustably movable to different positions along said closed path and adapted to be engaged by said time driven member, the engagement between said members causing displacement of one of said members, a tripping member responsive to such displacement and adapted to be actuated successive distances, a rotatable control member having a plurality of stop shoulders disposed at different radii and adapted to be successively released by said tripping member, and means responsive to said control member for actuating said control device.

12. In a time switch of the class described, the combination of an electric clock, a roller driven continuously through a closed circular path by said clock at a timed rate, a plurality of adjustable cam members independently adjustable to different positions along said path and adapted to be engaged by said roller in each revolution of the latter, such engagement causing displacement of said roller, a tripping lever adapted to be actuated by the displacement of said roller through successive retractive movements, a spring rotated control member having a plurality of stop shoulders adapted to engage said tripping lever, said shoulders being disposed at different radii and being adapted to be successively released by the successive retractive movements of said lever, and a switch moved successively between closed and open positions by said control member.

13. In an electric time switch of the class described, the combination of a switch, an electrically driven clock comprising a clock dial having dial numerals and hour and minute hands cooperating therewith, two relatively adjustable members for predetermining the time of closing and the time of opening of said switch, said members being mounted for rotation concentrically around the outside of said clock dial, one of said adjustment members having an index pointer adapted to be placed in registration with the numerals of said clock dial, cams carried by said relatively adjustable members and movable thereby to different positions of adjustment, a roller continuously driven by said clock through a closed circular path and adapted to encounter said cams, said roller being subjected to a lateral displacing movement when encountering one of said cams, a tripping lever responding to such movements of said roller and adapted to be actuated through successive retractive movements, a spring rotated control member having a plurality of stop shoulders adapted to engage said tripping lever, said shoulders being disposed at different radii and being adapted to be successively released by the successive retractive movements of said lever, and cam means rotating with said control member and operating to actuate said switch.

14. In timing apparatus for securing the timed operation of a device, the combination of a rotatable control member operatively arranged to govern said device, time responsive mechanism for causing automatic rotation of said control member, said time responsive mechanism comprising manually actuated adjusting means for adjusting the time of such automatic rotation, said control member having a set position where it is under the automatic control of said time responsive mechanism and also having a normal position where it is not under said automatic control, and manually operated means for effecting the rotation of said control member from said set position to said normal position and from said normal position to said set position without disturbing the adjustment given said manually actuated adjusting means.

15. In a time switch of the class described, the combination of a switch, a rotatable control member operatively arranged to govern said switch, time responsive mechanism for causing automatic operation of said switch, said time responsive mechanism comprising tripping means and a plurality of stop shoulders coacting therewith, said control member having rotary movement into different set positions where it is under the automatic control of said tripping means and said plurality of stop shoulders, and also having a normal, switch-closing position where it is not under such automatic control, and manually operated means for releasing said tripping means and all of said stop shoulders, whereby to effect the movement of said control member from any one of said set positions to said normal position.

16. In a time switch, the combination of an electric clock, a roller driven continuously through a closed circular path by said clock at a timed rate, a plurality of adjustable cam members independently adjustable to different positions along said path and adapted to be engaged by said roller in each revolution of the latter, such engagement causing displacement of said roller relatively to the cam member being engaged thereby, a tripping lever adapted to be actuated by the displacement of said roller through successive retractive movements, a spring rotated control member having a plurality of stop shoulders adapted to engage said tripping lever, said shoulders being disposed at different radii and being adapted to be successively released by the successive retractive movements of said lever, a switch responsive to the motion of said control member, a plunger rod mounted for reciprocation within said control member, and means actuated by said plunger rod for causing displacement movement of said roller such as to release all of said stop shoulders.

17. In timing apparatus for securing the timed operation of a device, the combination of an electric clock, tripping means actuated by said elec-

tric clock, a spring impelled rotary control member having a plurality of stop shoulders rotating therewith and adapted to be released by said tripping means for rotation in one direction, said control member governing the operation of said device, and manual means for rotating said control member in the other direction.

18. In timing apparatus of the class described, the combination of an electric clock, tripping means actuated by said electric clock, a spring impelled control member having a plurality of stop shoulders adapted to be released by said tripping means, an electric switch governed by said control member, a continuously rotating member driven by said electric clock, a friction clutch cooperating therewith, an adjustable tripping arm adapted to have driving energy transmitted thereto from said electric clock through said continuously rotating member and friction clutch, a stop, said driving energy tending to rotate said arm toward said stop and to maintain it in engagement therewith, means for manually adjusting said arm in a reverse direction to different positions away from said stop corresponding to different time intervals, and signal means adapted to be operated by said arm for a brief time interval as said arm is rotating back into normal position against said stop.

19. In an electric timer for cooking ranges and the like, the combination of clock mechanism comprising a clock dial, an electric switch, a spring impelled actuator for said switch normally remaining substantially stationary between switching operations, a time setting mechanism cooperating with said clock mechanism and comprising indicating means mounted for rotation concentrically of said clock dial, said indicating means remaining substantially stationary between different time setting operations, and means responsive to said time setting mechanism for tripping said spring impelled switch actuator at a predetermined time.

20. In an electric timer for cooking ranges and the like, the combination of clock mechanism, an electric switch, a spring impelled actuator for said switch arranged to be spring impelled in one direction and manually actuated in the reverse direction, two time-setting mechanisms cooperating with said clock mechanism and comprising two manually rotatable adjusting knobs mounted for concentric rotation, and means responsive to said two time-setting mechanisms for tripping said spring impelled switch actuator at different predetermined times.

21. In an electric timer for cooking ranges and the like, the combination of a control device for the range, a spring-impelled rotary actuator for actuating said control device, said rotary actuator comprising an impelling spring which tends to rotate said actuator in one direction at all times, manual means for rotating said actuator in the reverse direction against the action of said spring, a constantly operating electric motor running at a timed rate, time driven means rotated by said electric motor at a timed rate, two time-setting mechanisms cooperating with said time driven means and comprising two manually rotatable adjusting knobs mounted for concentric rotation, and means responsive to said two time-setting mechanisms for tripping said spring impelled rotary actuator at different predetermined times.

22. In timing apparatus for governing the timed operation of a control device, the combination of an electrically driven clock comprising a clock dial having dial characters and hour and minute hands cooperating therewith, a first adjusting member movable to different positions around said clock dial for predetermining when said control device moves to one position, said first adjusting member being set in its different adjusted positions with reference to the numerals on said clock dial, time indicating means on said first adjusting member, a second adjusting member movable to different positions around said clock dial for predetermining when said control device moves to another position, said second adjusting member being adapted to be set in different adjusted positions with reference to said time indicating means on said first adjusting member, and means responsive to the settings of said adjusting members for governing said control device.

23. In timing apparatus for governing the timed operation of a control device, the combination of clock mechanism comprising a clock dial, a first adjustable indicating member rotatable concentrically of said clock dial for designating the time when said control device is to move to one position, a second adjustable indicating member rotatable concentrically of said clock dial for designating the time when said control device is to move to another position, a time scale on one of said indicating members and a cooperating pointer on the other of said members for giving a direct reading designation of the interval that said control member is to remain in one position, mechanism responsive to said two indicating members for governing said control device, and manual means operable separately from said indicating members for placing said control device in a predetermined position.

24. In timing mechanism for governing the timed operation of a control device, the combination of clock mechanism comprising a clock dial, a first adjustable member rotatable concentrically of said clock dial for predetermining the time when said control device is to move to one position, a second adjustable member rotatable concentrically of said clock dial for predetermining the time when said control device is to move to another position, means on one of said adjustable members cooperating with the numerals on said clock dial, a time scale on one of said members cooperating with a pointer on the other of said members, and mechanism responsive to said two adjustable members for governing said control device.

25. In timing apparatus for governing the timed operation of a control device, the combination of clock mechanism comprising a clock dial, a first adjustable member for predetermining the time when said control device is to move to one position, a second adjustable member for predetermining the time when said control device is to move to another position, pointer means on one of said adjustable members cooperating with the numerals on said clock dial, a time scale on one of said adjustable members and pointer means on the other of said adjustable members cooperating therewith for giving a direct reading designation of the interval that said control member is to remain in one of its positions, and mechanism responsive to said adjustable members for governing said control device.

26. In an electric timer for cooking ranges and the like, the combination of clock mechanism comprising a clock dial, an electric switch, a spring impelled actuator for said switch normally remaining substantially stationary between

switching operations, a time setting mechanism cooperating with said clock mechanism and comprising indicating means mounted for rotation concentrically of said clock dial, said indicating means remaining substantially stationary between different time setting operations, means for giving a direct reading indication of the time that said switch is to remain in a predetermined position, and means responsive to said time setting mechanism for tripping said spring impelled switch actuator at a predetermined time.

27. In a time switch, the combination of timing mechanism, tripping means actuated by said timing mechanism through a first predetermined movement when the switch is to close and actuated through a second predetermined movement when the switch is to open, a switch actuator tending to move in a predetermined direction, and first and second stop means moving concurrently with said switch actuator and coacting with said tripping means, whereby said first stop means is released by the first predetermined movement of said tripping means and said second stop means is released by the second predetermined movement thereof.

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