

[54] **INTERVAL TIMING MECHANISM
WITH IMPROVED CAM AND CAM
FOLLOWER STRUCTURE**

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200/38 F, 38 FA, 38 FB, 38 B, 38 BA, 38 C,
38 CA, 153 LB; 74/568 T, 3.5, 3.52, 3.54,
3.56

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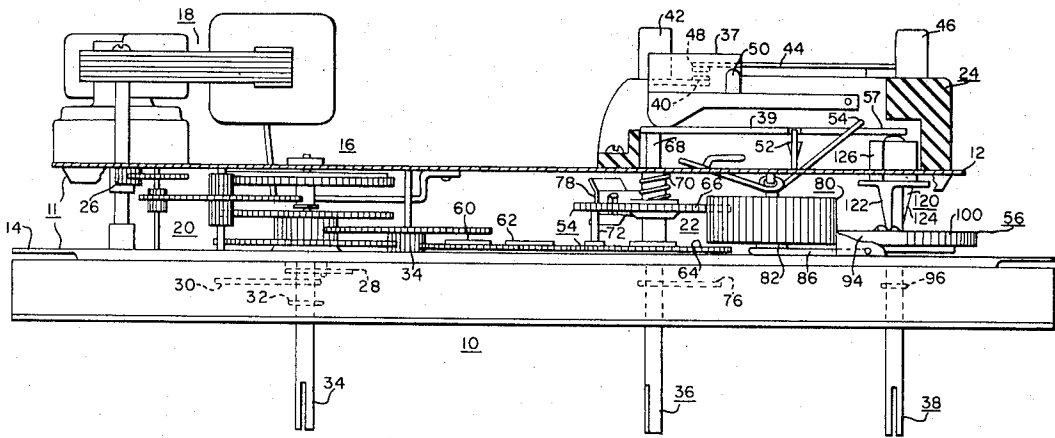
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[57] **ABSTRACT**

A timing device including a switch for automatically controlling the energizing time of an appliance. The timing device includes a rotor disc having a face which defines a predetermined cam profile. Rotary motion of the rotor disc in response to a motive device, provides axial motion of a cam follower for operating the switch.

9 Claims, 8 Drawing Figures



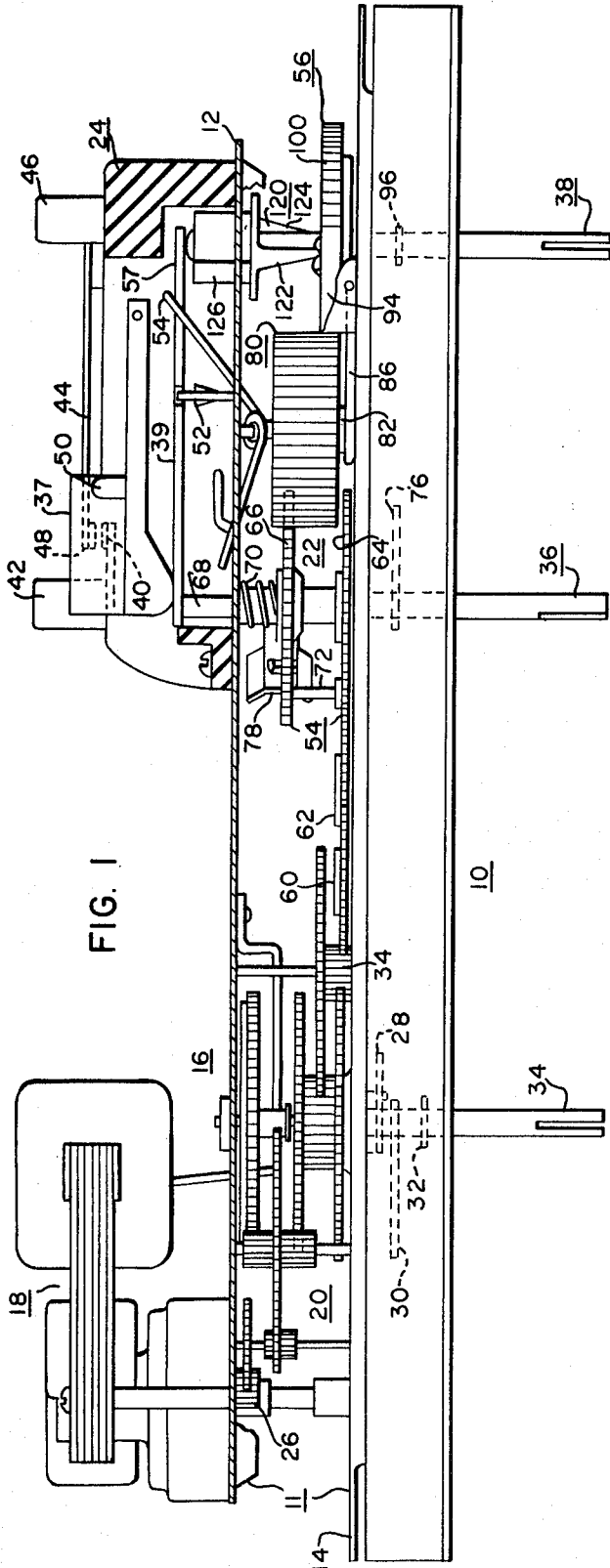


FIG. 1

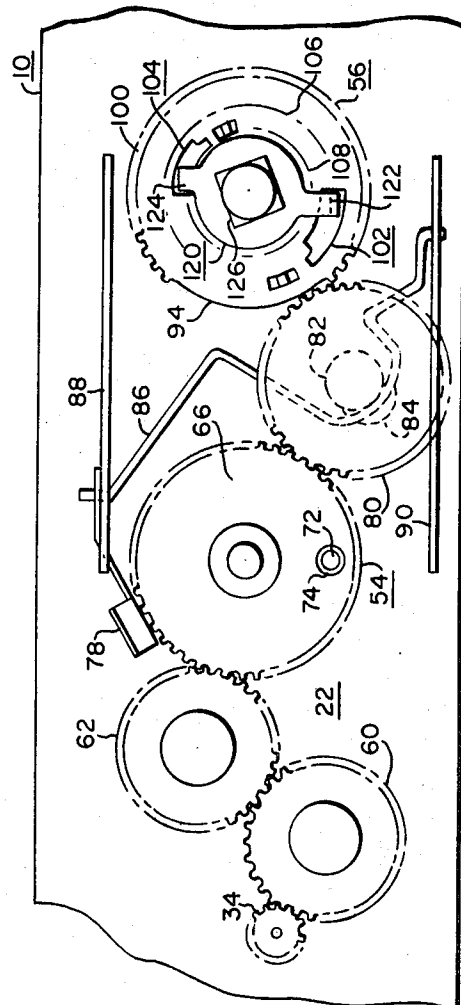
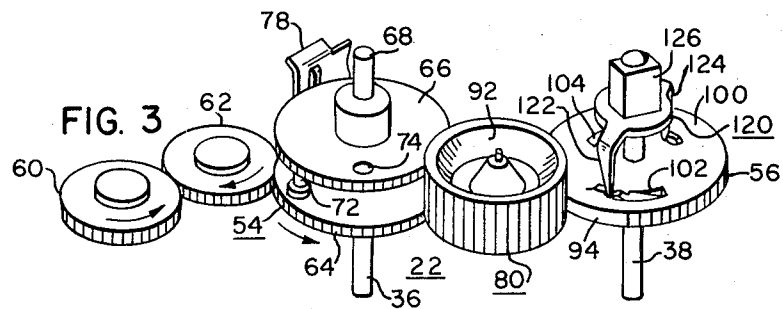
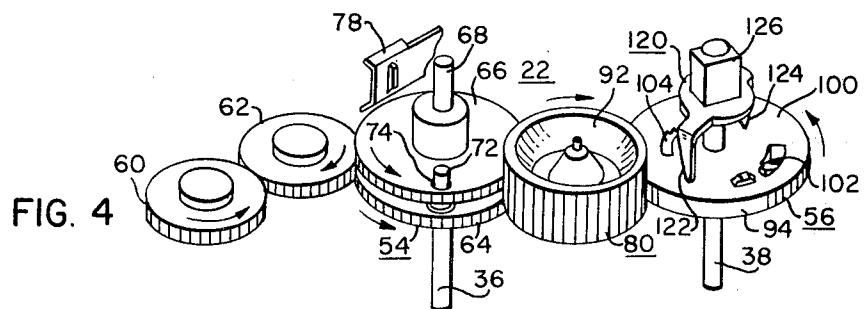
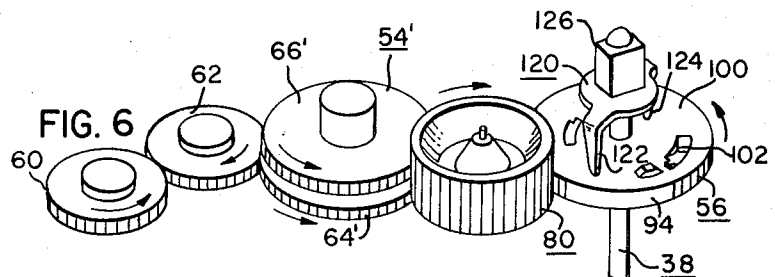
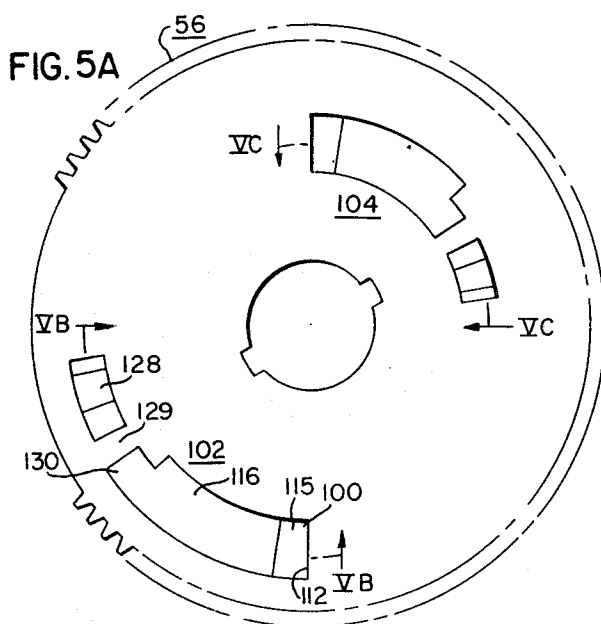
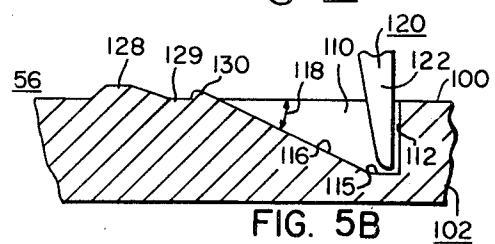
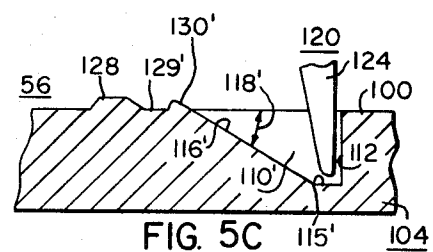


FIG. 2



INTERVAL TIMING MECHANISM WITH IMPROVED CAM AND CAM FOLLOWER STRUCTURE

BACKGROUND OF THE INVENTION

1. Field of the Invention

The invention relates in general to interval timers, and more specifically to interval timers suitable for controlling the operating time of cooking ranges.

2. Description of the Prior Art

Certain appliances, such as electric and gas ranges, often include means for automatically controlling the stopping time thereof, i.e., the time at which the appliance is deenergized. Still others include means for automatically delaying the energization of the appliance for a preselected period of time, at the end of which the preselected energization time commences. The controls for providing these automatic features should be uncomplicated, both from a manufacturing viewpoint, and from the users viewpoint, and they should be operable with a relatively low turning torque on the shaft.

In the prior art, it is common to control the energization time of an appliance by a control shaft which has a first axial position during a timing interval, and a second axial position at the end of the timing interval, with the axial movement of the shaft being used to actuate an associated switch. It would be desirable to provide a new and improved "stop" control for an electrical appliance which may be operated by a simple rotary motion, eliminating the usual prior art requirement of first pushing the shaft axially inwardly to establish the first axial position thereof, prior to rotating the shaft to select the interval to be timed.

SUMMARY OF THE INVENTION

Briefly, the present invention is a new and improved interval timer having a clock shaft and a stop shaft, with the latter actuating a switch to automatically control the energization time of the associated appliance, when it is desired to place the operation of the appliance under automatic control. The stop shaft requires only rotary motion to effect its operation, i.e., the shaft is rotated until an associated pointer selects the desired interval to be timed. The rotary motion of the stop shaft is transformed into mechanical motion which has a direction substantially parallel with the axis of the stop shaft, by providing a predetermined cam surface on one face of a rotor disc fixed to the stop shaft. A cam follower is biased to the face of the rotor disc, with the motion of the cam follower coacting with means for changing the electrical condition of a switch.

The rotor disc is a mutilated gear, which is rotated by motive means, such as a synchronous motor and a gear train. The gear of the gear train which coacts with the mutilated gear is yieldably biased towards the mutilated gear, to enable their teeth to demesh while the interval to be timed is being manually selected by rotation of the stop shaft.

The start of the timing interval may be delayed for a predetermined period of time by adding a start shaft connected to a gear assembly in the motive means, which delays the application of the motive means to the rotor disc by a preselected interval of time.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention may be better understood, and further advantages and uses thereof more readily apparent, when considered in view of the following detailed description of exemplary embodiments, taken with the accompanying drawings, in which:

FIG. 1 is a view in side elevation of an interval timer embodying the teachings of the invention;

FIG. 2 is a fragmentary plan view, partially cut away, of the interval timer shown in FIG. 1, illustrating a spring biasing arrangement used in the interval timer;

FIG. 3 is a perspective view of the gears of the interval timer shown in FIG. 1 which perform "start" and "stop" functions according to the teachings of the invention, with the "start" gearing shown in the delay mode and the "stop" gear shown in the manual mode;

FIG. 4 is a perspective view similar to that of FIG. 3, except with the "stop" gear shown in an angular position which indicates that an interval is being timed;

FIG. 5A is an enlarged view of the "stop" gear shown in FIG. 2;

FIGS. 5B and 5C are cross sectional views of the rotor disc shown in FIG. 5A, taken in the direction of arrows VB—VB and VC—VC, respectively; and

FIG. 6 is a perspective view similar to FIG. 4, except with the "start" gearing and start shaft replaced with an idler gear assembly.

DESCRIPTION OF PREFERRED EMBODIMENTS

Referring now to the drawings, and FIG. 1 in particular, there is shown, in side elevation, an interval timer 10 constructed according to the teachings of the invention. Interval timer 10 includes a stator structure or frame 11 having two spaced support plates 12 and 14, and motive means 16 including a synchronous motor 18 and a clock time mechanism 20. This portion of the interval timer 10 may be of conventional construction, with a motive force being initiated by gear 26 associated with the synchronous motor 18, which drives gearing for operating hour and minute hands 28 and 30 of a time clock, and a minute timer hand 32, all of which are disposed about a clock shaft 34. The clock time mechanism 20 is disclosed and described in detail in my co-pending application Ser. No. 774,940, filed Nov. 12, 1968, now U.S. Pat. No. 3,564,310.

The clock time mechanism 20 provides motive force, such as from pinion gear 34, to a gear train 22, which, as set by start and stop shafts 36 and 38, respectively, perform the functions of actuating a switch 24 at preselected times.

Switch 24 is sectioned to clearly illustrate a pivotable switch operator 37 which, in response to lever 39, controls the electrical condition of switch 24. Switch 24 includes a fixed contact 40 connected to terminal 42, and a resilient electrically conductive finger 44 connected to terminal 46. Finger 44 is biased such that a contact 48 at its free end engages the fixed contact 40. The switch operator 37, when pivoted upwardly in response to lever 39, contacts the resilient finger 44 and moves its contact 48 away from the fixed contact 40. Switch 24 may include a similar contact arrangement on the portion thereof cut away, with the resilient finger of this additional contact arrangement being actuated by protuberance 50 on the switch operator. A similar

protuberance on the switch operator is also used to actuate the finger 44 associated with the first contact arrangement described.

Lever 39 is pivotally mounted on frame 11, such as by providing two spaced projections on support plate 12, which establish a fulcrum 52. A substantially U-shaped spring member 54 biases end 57 of lever 39 toward the support plate 12. The angular position of lever 39 about its fulcrum 52, and thus the electrical condition of switch 24, is responsive to the setting and operation of gear train 22. Gear train 22, in the embodiment of the invention shown in FIG. 1, includes both a delayed start feature, as controlled by start shaft 36 and gear assembly 54, and a controlled energized time feature, such as "cooking hours" if the appliance is an electrical or gas range. The latter feature is controlled by stop shaft 38 and rotor disc 56. More specifically, gear train 22 includes idler gears 60 and 62 which receive motive force from pinion 34 and transmit it to gear 64, which is the lower gear of the gear assembly 54. Gear assembly 54 also includes an upper gear 66. The lower gear is disposed about start shaft 36, but it is free to rotate relative thereto, in response to the constant rotation of idler gears 60 and 62. The upper gear 66 is fixed to the start shaft 36, and the start shaft 36 extends beyond gear 66, through the upper support plate 12, to form an operating rod portion 68 for lever 39, as will be hereinafter explained.

Start shaft 36 is axially movable, with the gear 66 and start shaft 36 being biased axially downward as viewed in FIG. 1, by a spring 70 disposed about start shaft 36, between gear 66 and the upper support plate 12.

The lower gear 64 includes an upstanding nose 72 fixed to the uppermost face of the gear, and the upper gear 66 includes an aperture 74, best shown in FIG. 2, which is a fragmentary plan view of the gear train 22, as well as in FIGS. 3 and 4, which are perspective views of the gear train 22. The nose 72 and aperture 74 are disposed on like radii of their respective gears.

When it is desired to automatically control the energized time of the associated electrical appliance, and to delay the start of the energized time, shaft 36 is manually pressed inwardly to overcome the urging of spring 70, and the start shaft 36 is then rotated, in either circumferential direction, until pointer 76, which is secured to the shaft 36, points to the desired time delay interval. The depressing of the start shaft 36 frees the nose 72 from the aperture 74, allowing the shaft 36 and gear 66 to then be rotated to the desired time delay setting, in which the nose 72 rests against the inner face of gear 66 and holds the shaft and gear in this depressed axial position. In this position, the actuating rod portion 68 of shaft 36 is fully extended, lifting the end of lever 39 which rests thereon, as well as the switch operator 37, to change the electrical condition of the associated switch contact. Movement of gear 66 to the depressed axial position of shaft 36 moves the gear 66 against a ratchet spring 78 which is fixed to the stator assembly 11. Ratchet spring 78 provides a slight resistance to turning torque applied to shaft 36, and thus provides the function of retaining the gear 66 and shaft 36 in the selected angular position while the delayed start interval is being timed out.

During the selected delayed start time interval, gear 64 of the gear assembly 54 is rotating, while gear 66 is

held in the selected position by ratchet spring 78. Since gear 64 does not directly mesh with any gear further along in the gear train, the motive force provided by the clock mechanism 20 terminates at gear 64. When gear 64 rotates to the point where its nose 72 is in alignment with the aperture 74 in gear 66, signalling the end of the delayed start time interval, spring 70 snaps the gear 66 and start shaft 36 to a new or second axial position, retracting the actuating rod portion 68 of shaft 36, enabling switch 24 to change its electrical condition.

When the nose 72 enters the aperture 74 in gear 66, gears 64 and 66 are locked together, and gear 66 is no longer restrained by the ratchet spring 78. Thus, gears 64 and 66 rotate together under the influence of the motive force provided by the clock mechanism 20. FIGS. 1 and 3 illustrate the gear assembly 54 set for a predetermined time delay, while FIGS. 2 and 4 illustrate gear assembly 54 after the delay period has terminated.

Gear 66 has its teeth engaged with the teeth of an idler gear 80 in both of the axial positions of shaft 36. In the set or depressed position of gear 66 it imparts no rotation to the idler gear 80, since gear 66 does not rotate in this mode. Once gear 66 is locked to gear 64, however, idler gear 80 starts to rotate, providing motive force to the rotor disc 56, which is fixed to stop shaft 38.

Idler gear 80, as best illustrated in FIG. 2, is yieldably biased towards rotor disc 56, for purposes which will be hereinafter explained. Idler gear 80 includes a support shaft 82, with the support shaft 82 being slidably fixed to support plate 14 in an elongated opening 84 disposed in the support plate. A spring member 86, which has its ends fixed to vertical support members 88 and 90, urges the idler gear 80 towards the end of slot 84 which is adjacent to rotor disc 56. The upper portion of idler gear 80 may be slightly dished, as illustrated at 92 in FIGS. 3 and 4, to eliminate the possibility of interference between the idler gear and the U-shaped spring member 54 which is used to bias lever 39.

Rotor disc 56 and stop shaft 38 control the energized time of the associated appliance by actuating lever 39 to change the electrical condition of switch 24 at the end of a preselected timing interval. This function is provided in response to a setting step which requires only rotary motion of the stop shaft 38, and yet an actuating force for lever 39 is provided which is parallel with the axis of the stop shaft 38. Thus, the energized time setting is simplified, and the desirable feature of having the unexpired time of the preselected interval continuously indicated is provided.

Rotor disc 56 is a mutilated gear, having a pre-determined portion 94 free of teeth, in order to provide an inoperative position for the stop shaft, which in the case of an electric or gas range timer is usually labeled "manual," indicating that the range is set for completely manual control. In the "manual" position, the teeth of the idler gear 80 do not engage the mutilated gear 56, and thus no rotation is imparted to the mutilated gear 56.

As hereinbefore stated, the stop shaft 38 and rotor disc or mutilated gear 56 may be set to the desired time or energized interval without depressing the shaft axially. The stop shaft 38 is rotated until the indicator 96

attached to shaft points to the desired time interval on an associated dial. As soon as shaft 38 and mutilated gear 56 are moved from the "manual" position, the portion 94 of the mutilated gear 56 which has no teeth is advanced past the idler gear 80, and the teeth of the mutilated gear engage the teeth of the idler gear 80. The yieldable spring loaded arrangement for idler gear 80 now becomes important, as it allows rotation of the rotor disc 56 to a preselected time interval without rotation of idler gear 80, which is locked into the gear train driving the idler gear 80. Rotation of the mutilated gear 56 pushes the idler gear 80 away from the mutilated gear, enabling the coacting teeth of the two gears to mesh and demesh as the mutilated gear 56 is rotated to the desired angular position. Thus, the yieldable spring loading of idler gear 80 is critical to the invention, enabling the stop shaft 38 and mutilated gear 56 to be set with only a rotary motion of the stop shaft. Once set to a preselected time interval, mutilated gear 56 will rotate under the influence of idler gear 80, assuming of course that any time delay interval set by the start shaft 36 has expired. The mutilated gear 56 will rotate until the portion 94 without teeth reaches the idler gear 80.

Rotation of the mutilated gear 56 is transformed to pivotal movement of lever 39, by providing a predetermined cam profile on the face 100 of mutilated gear 56, which face is adjacent to the lever 39.

In order to provide a balanced axial movement for actuating lever 39, as well as providing an arrangement which exhibits a relatively low turning torque on stop shaft 38, first and second similar cam arrangements 102 and 104 are provided, which are disposed on opposite sides of the mounting shaft axis of the mutilated gear 56. In other words, the two cam arrangements are 180° apart on the surface or face 100 of the mutilated gear 56. Further, in order to provide one time interval for a complete revolution of the mutilated gear 56, instead of two operations for one revolution, the two cam profiles are placed on different diameters, as illustrated in FIG. 2. For example, the cam profile 102 is placed on the larger of the two diameters, indicated by the dotted circle 106, and the cam profile 104 is placed on the smaller of the two diameters, indicated by the dotted circle 108.

An enlarged plan view of mutilated gear 56 is shown in FIG. 5A, and cam profiles 102 and 104 are illustrated in FIGS. 5B and 5C, which are fragmentary views of mutilated gear 56 taken in the direction of arrows VB—VB, and VC—VC, respectively.

More specifically, cam profile 102, shown in FIG. 5B, includes a trough or depression 110 formed in the face of the mutilated gear 56, which has a wall 112 at one end of the depression which is substantially perpendicular to the face 100 of the mutilated gear 56, and which extends downwardly towards the bottom 115 of the depression. The depression 110 slopes upwardly from the bottom 115, away from the wall 112, providing a ramp 116 which continues beyond the surface 100 of the mutilated gear by a predetermined small dimension, as will be hereinafter explained. The ramp 116 slopes away from the surface 100 at a predetermined angle 118, such as 25½°.

Cam profile 104, shown in FIG. 5C, is substantially similar to cam profile 102, differing only because the

cam follower 124, while being lifted by the same dimension as cam follower 122 by their associated cam profiles, is required to make its vertical lift over a shorter circumferential dimension than cam follower 122. Thus, angle 118 in cam profile 104 is about 30°. Like reference numerals are used in FIGS. 5B and 5C, with a prime mark added to the elements of FIG. 5C which may be dimensioned differently than similar elements in FIG. 5B.

A cam follower assembly 120 is biased to the face 100 of mutilated gear 56, with the cam follower assembly 120 having first and second cam follower members 122 and 124, respectively, oriented to follow the diameters 106 and 108, respectively, on the face of the mutilated gear 56. The cam follower assembly 120 is biased against face 100 of the mutilated gear 56 by the U-shaped spring member 54 via the lever 39, and thus the lever 39 pivots about its fulcrum 52 in response to the profile of the cam arrangements 102 and 104.

A suitable arrangement for coupling the cam follower assembly 120 with the lever 39 is to provide an upper extension on shaft 38 over which the cam follower assembly 120 is telescoped. The cam follower assembly 120 may thus include a hollow, upwardly extending portion 126 sized to slidably receive the upper extension of shaft 38. Portion 126 of the cam follower assembly 120 extends through the upper support plate 12 and is free to move relative thereto. The cam follower assembly 120 may be properly oriented and prevented from rotating by providing portion 126 with a rectangular or square cross section configuration, and sizing the opening in the support plate 12 to snugly but slidably receive the selected configuration.

In the "manual" position of the mutilated gear 56, the cam follower members 122 and 124 are biased to the face 100 of the mutilated gear 56, as illustrated in FIG. 1. In this position, portion 126 of the cam follower assembly 120 is in its uppermost or extended position, and it overcomes the bias provided by spring 54 to pivot lever 39 about its fulcrum. If the delayed start is set, as illustrated in FIG. 1, the lever 39 at this point will be substantially horizontal, as it will be supported at opposite ends by portions 68 and 126 of the start shaft and cam follower, respectively. The cam followers 122 and 124 are positioned in the manual position of the stop shaft 39 by spaced protuberances disposed adjacent to each cam profile, such as protuberances 128 and 130 illustrated relative to cam profile 102 in FIG. 5B, which are separated by space 129. Protuberance 130 may be a continuation of ramp 116, as illustrated. Rotating the stop shaft 38 clockwise, when viewing the knob end of the shaft, to cause the cam follower members 122 and 124 to rise over both of the protuberances adjacent thereto, engages the teeth of the mutilated gear 56 with those of the idler gear 80, and rotation of shaft 38 may then be continued until the pointer 96 associated with shaft 38 selects the desired time interval the associated electrical apparatus is to be energized. When any delay interval, set by start shaft 36 times out and idler gear 80 is driven, the mutilated gear 56 is then rotated until the cam follower members 122 and 124 reach the depressions or troughs associated with the cam profiles 102 and 104, and the biased lever 39 then pivots about its fulcrum under the influence of spring 54 to advance the cam follower members into

their associated depressions. The pivoting lever 39 actuates the switch operator 37 and changes the electrical condition of the switch 24.

Resetting the stop shaft to the "manual" position requires that the stop shaft 38 be rotated a few degrees in a clockwise direction, when facing the knob end of the shaft, to force the cam follower up the ramp 116 and the shaft rotation is terminated when the cam follower members 122 and 124 are located in the space between their associated protuberances. As illustrated in FIG. 5, the protuberances are formed such that the first protuberance 130 has a smaller height dimension than the second protuberance 128, in order to quickly and accurately turn the stop shaft to its manual position. The rotation of the stop shaft 38 to force the cam followers out of the trough or depression positions of the cam profile to knob manual position of the stop shaft is insufficient to engage the teeth of the mutilated gear 56 with the idler gear 80, retaining the stop shaft and mutilated gear 56 in a deenergized position. This movement of the stop shaft, however, changes the electrical condition of the switch 24, due to the rising of the cam followers out of the depressions, with the resulting electrical condition of the switch 24 permitting manual control of the associated appliance. This also enables the delayed start function to be used without setting a predetermined stop time, by setting the delayed start shaft and leaving the stop shaft in its manual setting.

In the event that the delayed start feature is not required, the gear assembly 54 is simply replaced by an idler gear assembly 54', as illustrated in FIG. 6, and the start shaft 36 is not required. The other gears and their functions shown in FIG. 6 are the same as hereinbefore described, with like reference numerals in FIG. 6 and the other figures indicating like components.

In the operation of interval timer 10, it will be assumed that the timer is being used with a range. To use the automatic features, the housewife simply sets the oven thermostat to the desired oven temperature, pushes the start shaft 36 and rotates it in either circumferential direction to the desired delay interval and rotates the stop shaft 38 clockwise to the cooking time desired. The clock mechanism 20 drives the lower gear 64 to gear assembly 54 until the nose 72 thereon is aligned with the aperture 74 in the upper gear 66, at which time the complete assembly 54 rotates, imparting rotation to the idler gear 80 and the mutilated gear 56. The mutilated gear 56 turns until its cam follower drops into depressed portions of the cam profiles, actuating the switch to terminate the cooking time.

In summary, there has been disclosed a new and improved interval timer for an appliance, having an improved and simplified control for automatically terminating the energized time of the appliance. The control for selecting the energizing time interval need only be rotated to the selected time, without requiring that the shaft be depressed. This feature is made possible by a yieldable spring biased arrangement for the gear which coacts with the gear associated with the stop shaft, and by providing a cam profile on one face of this gear which changes the rotary motion of the gear to an axial motion for changing the electrical condition of the associated switch.

I claim as my invention:

1. A timing device, comprising:
a stator structure,

a rotor disc mounted for rotation about an axis relative to said stator structure,
a control shaft disposed to control the angular position of said rotor disc,

a predetermined continuous portion on a face of said rotor disc defining a first arcuate path including a predetermined cam profile spaced from said face and extending arcuately from one end of said first arcuate path, and further defining a second arcuate path extending between said one end and the other end of said first arcuate path,

a rotating motive means having a regular rate of rotation,

a switch operable between open and closed conditions,

means for actuating said switch including a cam follower biased against the predetermined face portion of said rotor disc, said cam follower being oriented to be responsive to the face portion and to the cam profile thereon such that when positioned at said one end of said first arcuate path said switch is placed in one of said conditions and when positioned along said second arcuate path said switch is placed in the other of said conditions,

and means selectively coupling and decoupling said motive means to said rotor disc in response to the rotational positions of said rotor disc, wherein said motive means is coupled to said rotor disc when said cam follower is located against said second arcuate path so as to rotate said rotor disc and drive said one end of said first arcuate path directly toward said cam follower and wherein said motive means is decoupled from said rotor disc when said cam follower is located against said one end of said first arcuate path, whereby said control shaft is positionable to set said rotor disc so that when said cam follower is located on said second arcuate path at variable arcuate distances from said one end of said first arcuate path corresponding variable time intervals are established for actuating said switch from said one condition to said other condition.

2. The timing device of claim 1 wherein the rotor disc includes a mutilated gear, and the selective coupling and decoupling means includes an idler gear disposed to engage the teeth of the mutilated gear when the mutilated gear is set between two predetermined angular positions corresponding to the location of said cam follower at opposite ends of said second arcuate path.

3. The timing device of claim 2 including means yieldably biasing said idler gear toward the mutilated gear for enabling the teeth of the idler gear and mutilated gear to demesh when the control shaft is actuated to rotate the mutilated gear to a position intermediate said two predetermined angular positions.

4. The timing device of claim 1 wherein the face of the rotor disc includes a further predetermined continuous portion with the latter and first named predetermined face portions being concentric to each other with the latter face portion having first and second arcuate paths corresponding to said first and second arcuate paths of the first named face portion, and wherein first and second depressions disposed on opposite sides of the axis form the cam profiles said

first arcuate paths of each predetermined face portion, with the first and second depressions being on first and second different radii relative to the axis, respectively, and the cam follower includes first and second spaced members, oriented to contact each of the predetermined face portions of the rotor disc at said first and second different radii, respectively.

5. The timing device of claim 1 wherein the means for actuating the switch includes a lever mechanism pivotally mounted to the stator structure, and means biasing the lever mechanism in a predetermined direction about its pivot point such that the lever mechanism pivots in response to the cam follower and cam profile on the rotor disc.

6. The timing device of claim 1 wherein the motive means includes a start member mounted for rotation about an axis relative to the stator structure intermediate said motive means and the selective coupling and decoupling means which has a first axial position effective to disconnect said motive means from the selective coupling and decoupling means and upon approaching a preselected interval starting time the motive means is effectively decoupled from the rotor disc, and said start member having a second axial position in

response to arrival at said preselected starting time, which position is effective to enable the rotor disc to be coupled with the motive means.

7. The timing device of claim 6 wherein the rotor disc is a mutilated gear and the motive means includes an idler gear disposed to couple the start member and the mutilated gear, and said device includes means yieldably biasing said idler gear toward said mutilated gear for enabling the idler gear and mutilated gear to demesh while the angular position of the mutilated gear is being changed.

8. The timing device of claim 6 wherein the means for actuating the switch includes a lever mechanism pivotally mounted relative to the stator structure, with the cam follower and the start member being disposed to actuate said lever mechanism from opposite ends thereof.

9. The timing device of claim 3 wherein said other end of said first arcuate path is coextensive with said face of said face of said rotor disc such that when said cam follower is located on said other end said switch is placed in the other of said conditions while the idler gear and mutilated gear are demeshed.

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