

June 2, 1959

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2,889,419

ELECTRICAL TIMING DEVICE AND IMPROVED SWITCH MEANS THEREFOR

Filed Oct. 29, 1957

3 Sheets-Sheet 1

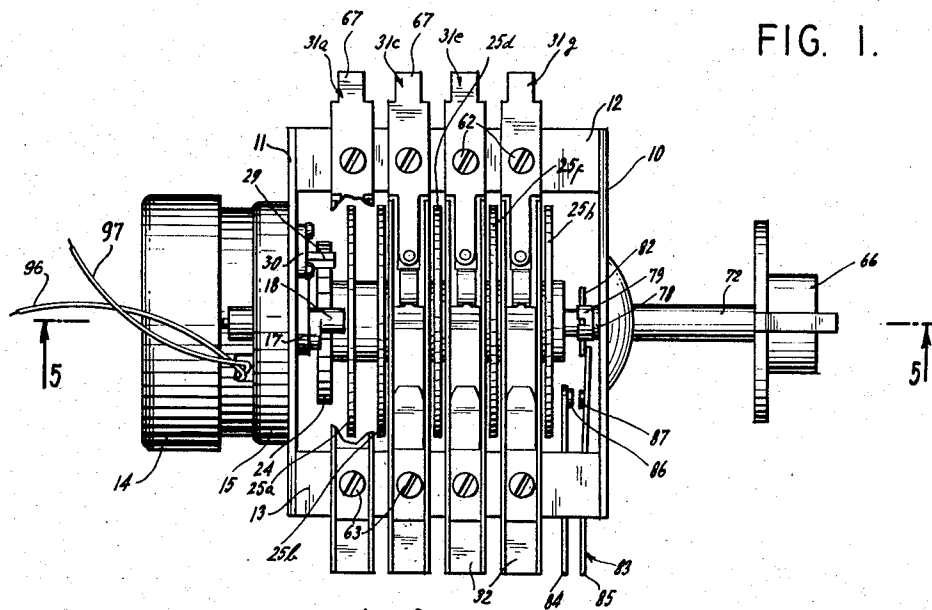


FIG. 1.

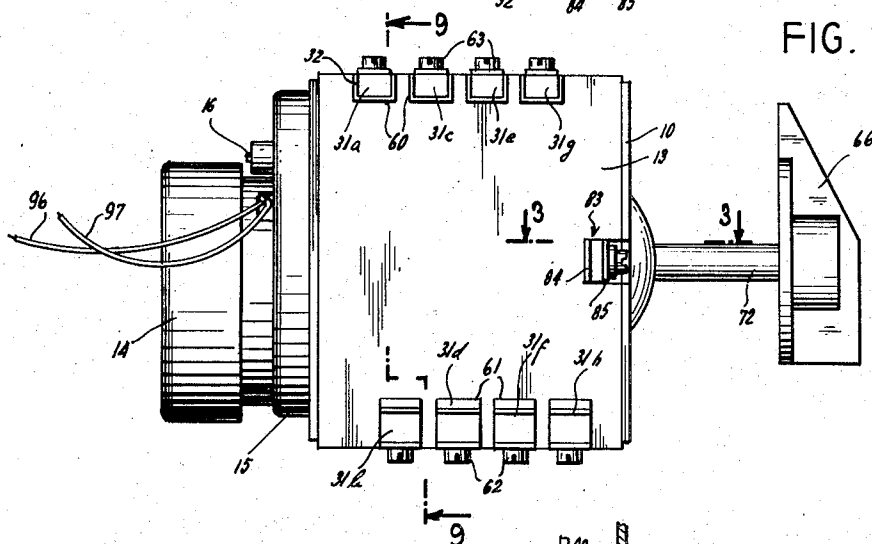


FIG. 2.

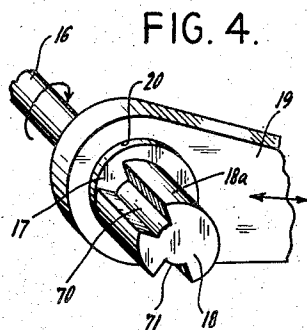


FIG. 4.

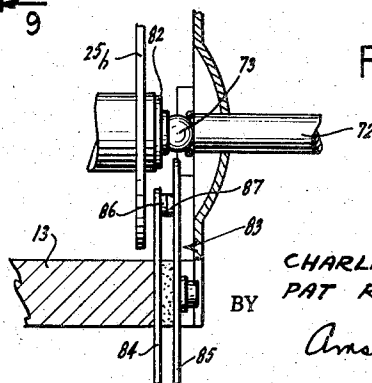


FIG. 3

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3 Sheets-Sheet 2

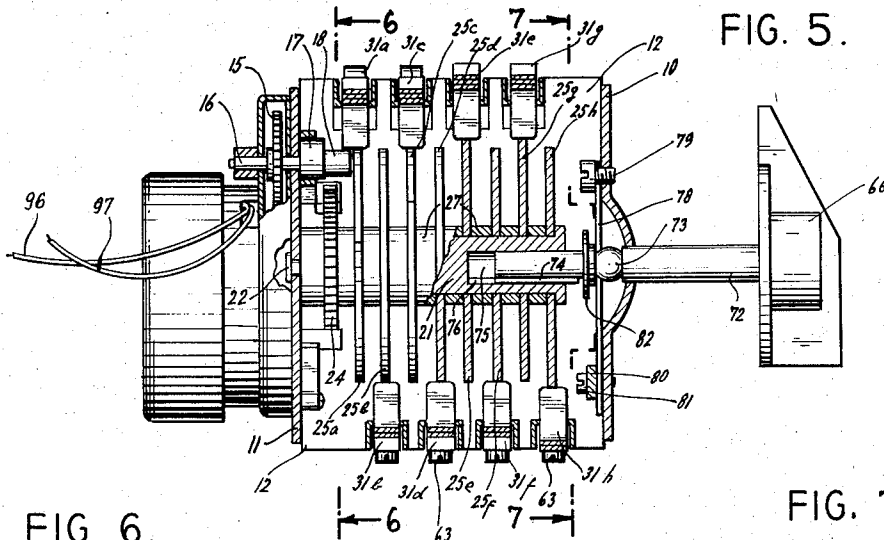


FIG. 5.

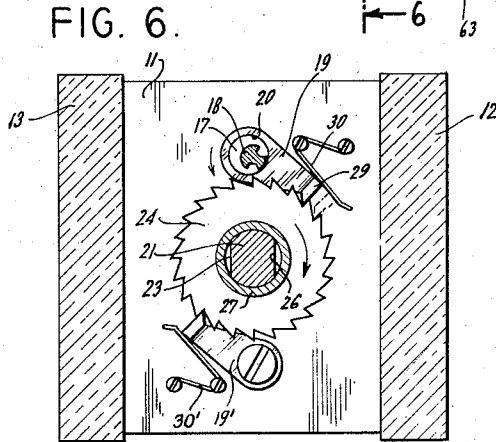


FIG. 6.

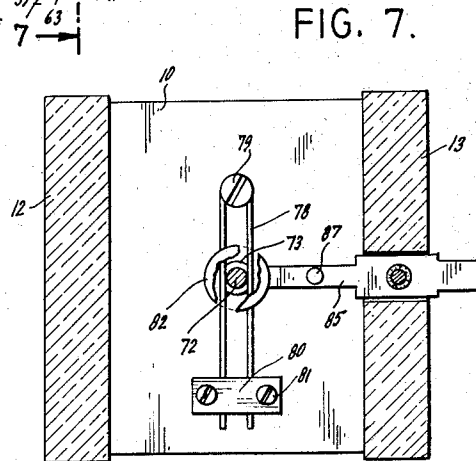


FIG. 7.

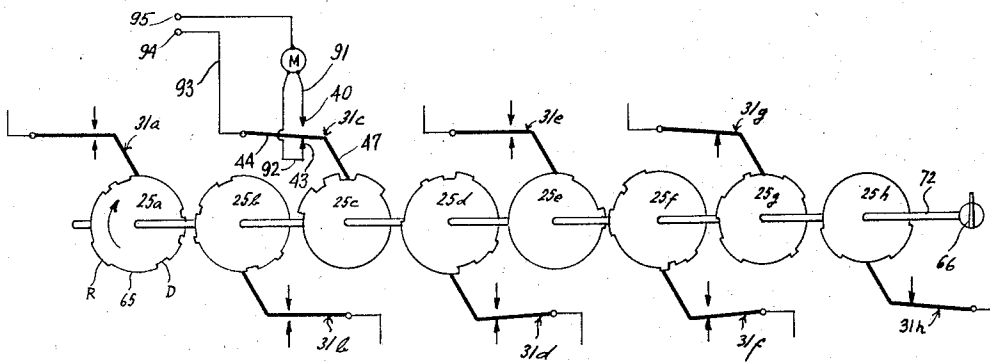


FIG. 8.

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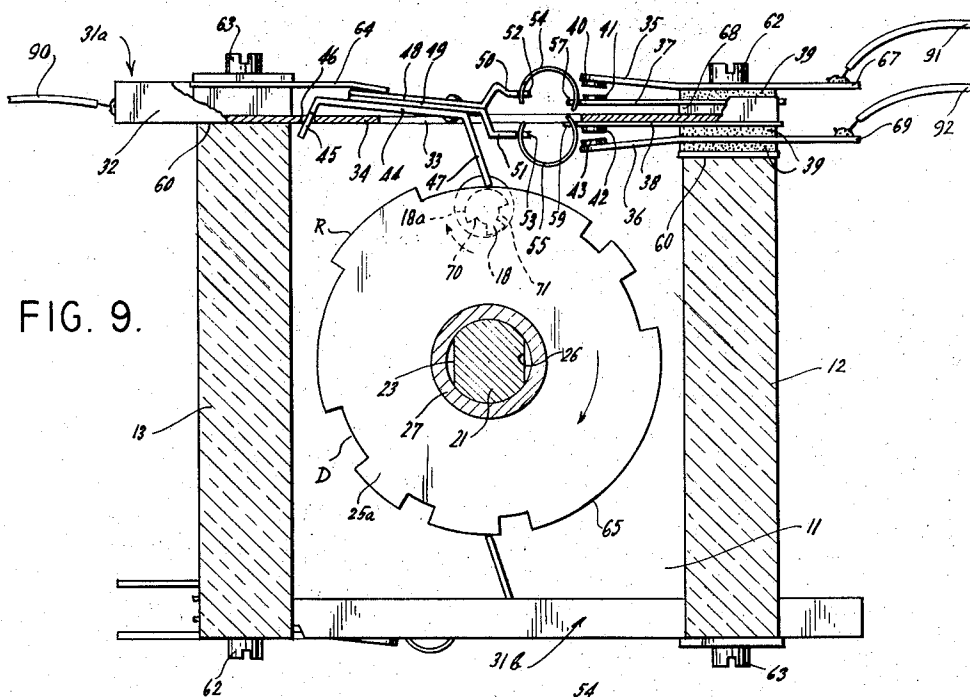


FIG. 9.

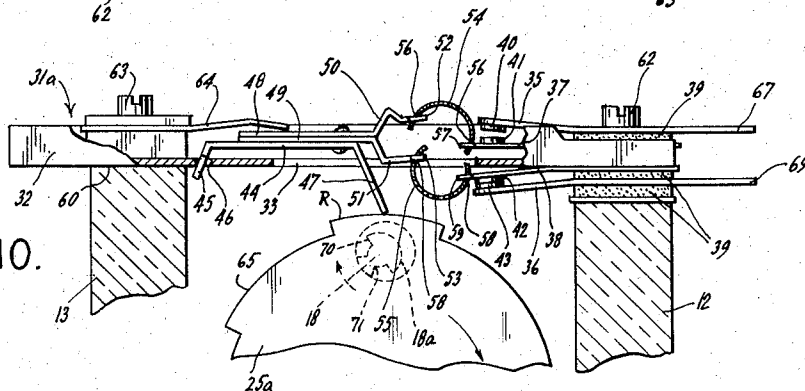


FIG. 10.

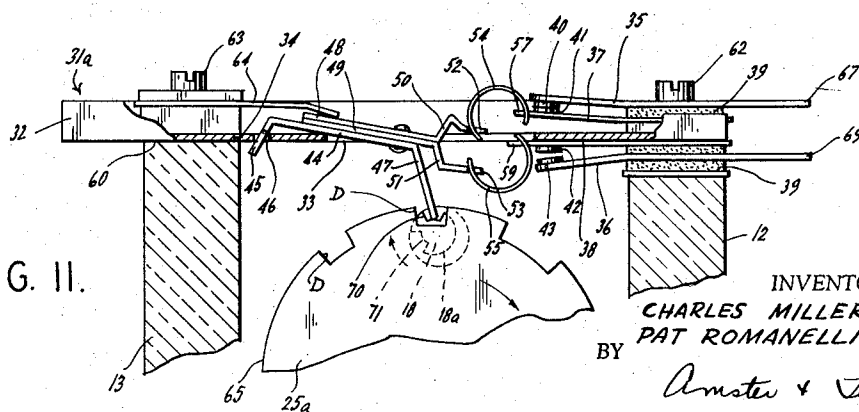


FIG. 11.

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## ELECTRICAL TIMING DEVICE AND IMPROVED SWITCH MEANS THEREFOR

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Application October 29, 1957, Serial No. 693,055

16 Claims. (Cl. 200—38)

This invention relates to improvements in electrical timing mechanisms, and in particular to an interval timer for automatically regulating the operating cycles of washing machines and the like.

Automatic electrical appliances such as dish-washing and clothes-washing machines are customarily provided with electrical timer units which operate the various switches, motors, solenoids, etc. of the machine in such a manner as to cause the machine to follow pre-selected cycles of operation such as filling, agitating, rinsing, draining and spin-drying cycles. Such conventional timers usually consist of an electric motor driving a plurality of cams, the cams being associated with electrical switches for controlling the various motor and solenoid circuits of the washing machine. In such timers, it is essential to insure rapid making and breaking of the switch contacts in order to prevent the contacts from arcing and fouling and therefore interfering with the efficient operation of the machine.

In order to effect rapid opening and closing of the switches, conventional washing machine timers are usually provided with a coiled torsion spring connecting the electric motor with the switch-regulating cams. As the motor runs continuously, the coil spring is tensioned while the cams are held immovably. At a designated time, the cams are released and the tensioned spring snaps the cams quickly and with considerable force to their next position, thereby providing fast opening and closing of the switches. A disadvantage of such construction is that the tension of the torsion spring turns the switch cams with considerable force, causing considerable wear and often damage to the cams and switches. In addition, the snap movement of the cams is unreliable, and it often happens that the cams pass their next proper positions, resulting in the skipping over of an entire operational cycle.

It is an object of the present invention to provide an interval timer which will eliminate the aforementioned disadvantages, the timer being constructed for continuous movement of the cams without snap-action, and including a plurality of micro-switches to provide rapid opening and closing of the switch contacts.

Another object of the invention is the provision of an interval timer of the character described in which the micro-switches are of a novel and improved type, having a neutral or null position in which the electrical circuits associated therewith are interrupted.

A further object of the invention is the provision of an interval timer of the character described in which the switches and the timer body are of such construction that the switches are conveniently mounted at the top and bottom of the timer in an exposed position in which they are accessible for repair and in such a manner that they can be easily removed and replaced if they become defective.

Additional objects and advantages of the invention will become apparent during the course of the following

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specification when taken in connection with the accompanying drawings in which:

Fig. 1 is a top plan view of an interval timer made in accordance with the invention, with portions thereof broken away to reveal inner constructional details;

Fig. 2 is a side elevational view of the timer shown in Fig. 1;

Fig. 3 is a partial section taken along line 3—3 of Fig. 2;

Fig. 4 is an enlarged perspective view of a portion of the timer mechanism including the motor drive shaft, and its attached parts;

Fig. 5 is a section taken along line 5—5 of Fig. 1, with portions of the timer being shown in elevation for clarity of illustration;

Fig. 6 is a section taken along line 6—6 of Fig. 5;

Fig. 7 is a section taken along line 7—7 of Fig. 5, with portions broken away for clarity of illustration;

Fig. 8 is a schematic diagram of the cam disc assembly of the timer, showing the relationship of the cam discs to each other and to the timer switches, with a portion of the electrical circuit associated with the switches also illustrated;

Fig. 9 is an enlarged section taken along line 9—9 of Fig. 2, and showing one of the timer micro-switches in its neutral or null position;

Fig. 10 is a partial section similar to Fig. 9, but showing the micro-switch in a position in which one of its pairs of contacts is closed; and

Fig. 11 is a partial section similar to Fig. 10 but showing the micro-switch in a position in which its other pair of contacts is closed.

The drawings show, by way of illustration, a timer unit especially adapted for use in an automatic clothes-washing machine which operates through a plurality of successive cycles, for example, an agitate cycle, a rinse cycle, and a spin cycle.

The timer unit has a housing formed by plate-like front and rear walls 10 and 11, and relatively thick side walls 12 and 13. The housing is open at its top and bottom.

Mounted on the outer surface of the rear wall 10 is a synchronous motor 14 of the well-known and conventional type having an internal gear assembly 15 (Fig. 5) connected to a projecting drive shaft 16. The motor 14 and its gearing 15 are such that the drive shaft 16 is rotated one full revolution per minute. The motor has lead wires 96, 97 for attachment to a power source.

The motor drive shaft 16 projects through the housing rear wall 11 and has a circular disc 17 fixed thereto adjacent said rear wall. Also fixed to the end of shaft 16 is a cam member 18, the function of which will be presently described. The circular disc 17 is mounted off-center on shaft 16 in such a manner that when the drive shaft 16 is rotated, the disc 17 is given an eccentric turning movement. The disc 17 extends snugly and slidably through an aperture 20 in a ratchet arm 19, as shown in Figs. 5 and 6, in such a manner that the eccentric rotation of the disc 17 will cause the ratchet arm 19 to reciprocate back and forth.

As shown in Fig. 5, a shaft 21 is fixed to the housing rear wall 11 by a rivet 22 and extends longitudinally through the center of the housing to a point spaced inwardly from the front wall 10. As shown in Fig. 6, the shaft 21 is non-circular in cross-section, having planar side edges 23. Alternately, the shaft 21 may be made rectangular in cross-section, or of any other suitable non-circular shape.

A ratchet wheel 24 and eight circular cam discs 25a, 25b, 25c, 25d, 25e, 25f, 25g and 25h are mounted on the shaft 21. Each of the cam discs 25a—h and the ratchet wheel 24 has a central aperture 26 conforming

in shape to the non-circular cross-section of the shaft 21, so that the cam discs and ratchet wheel rotate in unison with said shaft. A plurality of spacer rings 27 separate the cam discs 25a-25h from each other and separate the ratchet wheel 24 from the cam disc 25a 5 and from the rear wall 11.

The ratchet wheel 24 is provided with a plurality of ratchet teeth 28. In Fig. 6, the size of the ratchet teeth 28 is exaggeratedly enlarged for convenience of illustration; the ratchet wheel 24 in the illustrated embodiment actually being provided with sixty teeth. The ratchet arm 19 has a front claw 29 which is held in engagement with one of the ratchet wheel teeth 28 by a leaf spring 30 affixed to the housing rear wall 11. As viewed in Fig. 6, when the motor drive shaft 16 is rotated in a counter-clockwise direction, the eccentric disc 17 moves the ratchet arm 19 to the right, as indicated in broken line, by the length of one ratchet wheel tooth 28. The ratchet arm 19 thus drives the ratchet wheel 24 in a clockwise direction through  $\frac{1}{60}$  of a revolution. It will thus be apparent that since the motor drive shaft 16 is rotated at a speed of one revolution per minute, the ratchet wheel 24, shaft 21, and cam discs 25a-25h are driven at a speed of one revolution per hour. A second ratchet arm 19' held in contact with the ratchet wheel 24 by a spring 30' prevents the ratchet wheel from being turned in a counter-clockwise direction.

The timer is also provided with eight snap-acting switches or micro-switches 31a-31h which are individually engaged and actuated by the respective cam discs 25a-25h. Each micro-switch is of identical construction so that a detailed description of the micro-switch 31a illustrated in Figs. 9, 10 and 11, will apply as well to the micro-switches 31b to 31h.

The micro-switch 31a is of unique construction in that it has a neutral or null position in which neither of its pairs of contacts is closed. The switch 31a includes a U-shaped conductive casing 32 which is open at its top end and has a central opening 33 in its bottom wall 34. At one end of the switch two fixed contact arms 35 and 36 and two movable contact arms 37 and 38 are mounted, the contact arms being separated by insulating strips 39. The contact arms 35 and 37 carry a first pair of facing contacts 40 and 41, while the contact arms 36 and 38 carry a second pair of facing contacts 42 and 43. Movable contact arms 37 and 38 are made of resilient metal so that they can be flexed upwardly and downwardly.

At the other end of the micro-switch 31a, an actuator member 44 is mounted. The actuator member 44 has a downwardly bent terminal portion 45 which extends through a slot 46 in the bottom wall 34, and provides a fulcrum about which the actuator member 44 may pivot. The opposite end of the actuator member 44 has a downwardly-bent finger 47 which abuts and rides along the surface of the cam disc 25a.

A pair of metal strips 48 and 49 are rigidly mounted on the actuator member 44, these strips having respective bent free end portions 50 and 51 provided with tongues 52 and 53. These bent end portions 50 and 51 of strips 48 and 49 are coupled to the ends of the movable contact arms 37 and 38 by respective spring elements 54 and 55. The spring elements 54 and 55 comprise strips of flexible metal and are held compressed in the semi-circular form shown in Figs. 9-11 when mounted between the metal strips 48, 49 and the contact arms 37, 38. For such mounting, the spring element 54 has a slot 56 at each end, which slots 56 receive the tongue 52 of the strip 48 and a tongue 57 at the end of contact arm 37. Similarly, spring element 55 has a slot 58 at each end, which slots receive the tongue 53 of strip 49 and a tongue 59 at the end of contact arm 38.

The side walls 12 and 13 of the timer housing are formed with rectangular recesses or slots 60 in their top edges and recesses or slots 61 in their bottom edges.

The slots 60 and 61 serve as seats for receiving the U-shaped micro-switch body members 32, whereby the micro-switches may be conveniently mounted in the timer housing with four micro-switches extending transversely across the top of the timer housing and four micro-switches extending across the bottom thereof. The slots 60 are staggered from the slots 61 so that the top micro-switches 31a, 31c, 31e and 31g are mounted in staggered relationship to the bottom micro-switches 31b, 31d, 31f and 31h, in positions in which each micro-switch may be independently associated with one of the cam discs 25a to 25h.

Each micro-switch 31a-31h is secured in its mounted position by a pair of screws 62 and 63 shown in Figs. 1 and 2, in such a manner that the individual micro-switches may be easily and conveniently removed and replaced should they become defective. Each screw 63 also fixedly mounts a flat leaf spring 64 on the timer housing, the springs 64 bearing against the top surfaces of the metal strips 48 of the micro-switches. Each spring 64 therefore urges the actuator member of an individual micro-switch downwardly.

Each of the cam discs 25a-25h has a circular circumferential cam surface 65 which is provided with selected rise portions R and dwell portions D. The cams are so sized that when the switch fingers 47 are in contact with the circumferential cam surface 65, as shown in Fig. 9, the switch is in a neutral or null position. In this position, the actuator tongue 52 is substantially aligned with the contact arm tongue 56 and both pairs of switches 40, 41 and 42, 43 are open. In this neutral position, the springs 54 and 55 exert only a longitudinal force upon the movable contact arms 37 and 38, and do not exert any lateral biasing force upon the contact arms.

When the cam discs are turned until a rise portion R of one of the cam discs engages the switch finger 47, as shown in Fig. 10, the rise portion R raises the finger 47 and its associated actuator member 44 from their neutral positions, causing the actuator member to pivot upwardly. In this position, the actuator tongue 53 is raised above the level of the contact arm tongue 59 and past the dead-center position, causing spring 55 to tilt downward and exert a sudden biasing force in a downward lateral direction upon the contact arm 58. The flexible contact arm 58 is thus urged rapidly downward, causing the contact 42 to engage with contact 43 in a snap action.

Upon continued rotation of the cam disc, the finger 47 will leave the rise portion R and again ride along the normal circumferential cam surface 65, at which time the micro-switch parts are again brought to their dead-center position and the micro-switch again assumes its neutral position of Fig. 9 in which both pairs of switch contacts are open.

When the cam disc rotates to a position in which a dwell portion D comes into registry with the finger 47, the leaf spring 64 becomes effective to press the finger 47 downwardly into said dwell portion. The actuator member 44 then pivots downwardly, lowering the tongue 52 above the level of the contact arm tongue 57 and past the dead center position. The spring 54 is thereby tilted, urging the flexible contact arm 37 rapidly upward, and closing the pair of contacts 40, 41 with a snap action.

Each micro-switch 31a-31h therefore has three operative positions regulated by its associated cam disc; a position in which the first pair of contacts 40 and 41 is closed and the second pair open, a position in which the second pair of contacts 42 and 43 is closed and the first pair open, and a null or neutral position in which both pairs of contacts are open. The springs 54 and 55 move the flexible contact arms 37 and 38 instantaneously from one operative position to another, and the resulting snap-action opening and closing of the contact pairs 40, 41 and 42, 43 reduce arcing between the contacts to a minimum.

As was previously described, each cam disc 25a to 25h

is turned in one minute intervals through an angle of  $6^\circ$  ( $\frac{1}{60}$  of its circumference), at a rate of one revolution per hour. The rise and dwell portions of each cam disc are made of selected lengths so that the associated micro-switch is retained in its proper operative positions for predetermined intervals of time. As an example, one type of clothes-washing machine requires the following successive operating cycles: filling with water and agitating, ten minutes; agitating (washing), seven minutes; rinsing, eight minutes; spin-drying, eight minutes; and two seven-second warning buzzer signals at the end of the spin-drying period. Thus the complete washing cycle occupies a total period of thirty-three minutes, and the rise and dwell portions of the cam discs to regulate the various cycles of this washing period are contained on slightly more than one-half of the cam surface of the cam discs 25a—25h. The machine also has a faster washing period for certain fabrics in which the various operational cycles are performed during a total period of twelve minutes. The rise and dwell portions for this shorter washing period are contained on the other half of the cam discs. A selector knob 66, connected to the shaft 21 in a manner to be presently described, is provided for manual operation whereby the cams may be turned to their proper settings prior to the commencement of the washing operation.

Each micro-switch 31a to 31h has a pair of terminals 67 and 69 connected through the respective fixed contact arms 35 and 36 to the contacts 40 and 43. The U-shaped body member 32 is made of conductive metal and makes electrical contact with both flexible contact arms 37 and 38 through a conductive strip 68 which separates the ends of said contact arms 37 and 38. The U-shaped body member 32 therefore serves as a common terminal of both contact pairs 40, 41 and 42, 43, and a lead wire 90 (shown in Fig. 9) may be attached to the body member 32 at any point thereon, but preferably at the end of the body member opposite the terminals 67 and 69. The terminals 67 and 69 may be connected by lead wires 91 and 92 to respective electrical circuits of the washing machine. In the schematic view of Fig. 8, for example, the movable contacts of the micro-switch 31c are shown carried by the actuator member 44, and connected by wire 93 to one terminal 94 of a power source. The fixed contacts 40 and 43 are shown connected to the other terminal 95 of the power source through a motor M by the respective lead wires 91 and 92.

Each pair of contacts 40, 41 and 42, 43 of each micro-switch is thus adapted to be connected to a different electrical circuit for performing a different operation depending upon whether the micro-switch actuator member 44 is raised or lowered. For example, the micro-switch 31c in Fig. 8 is shown connected to a two-speed electrical motor M. When the upper pair of contacts is closed, the motor M is driven at one regulated speed, and when the lower pair of contacts is closed, the motor is driven at a different speed. In the neutral position of the micro-switch 31c the motor M is, of course, rendered inactive. The other micro-switches and their associated cams may regulate, for example, the following washing machine components: main power supply and accessories, timer motor, two-way valve control solenoid, extractor control solenoid, agitator control solenoid, buzzer, water valve and intermittent spray system.

The cam member 18 is mounted on the end of the motor drive shaft 16 to turn with said shaft 16 at the rate of one revolution per minute. The cam member 18 is positioned with its circumferential surface 18a normally abutting the finger 47 of the first micro-switch 31a, as shown in Figs. 5 and 9, together with the circumferential surface 65 of the cam 25a. The cam member 18 has two cut-out segments 70 and 71 forming dwell portions therein, each constituting  $\frac{7}{60}$  of the circumference of the cam member 18. Each dwell portion therefore represents a period of seven seconds.

While the cam member 18 rotates continuously, its cam

action does not become effective while the micro-switch finger 47 is in contact with the circumferential surface 65 of the first cam disc 25a. In this position, shown in Fig. 9, the engagement of the finger 47 with the circumferential surface of cam 25a, maintains the micro-switch 31a in its neutral position. When the cam disc 25 has turned until one of its dwell portions D has turned into registry with the switch finger 47, the circumferential surface 18a of the cam member 18 is at first in contact with the finger 47, so that the micro-switch 25a remains in its neutral position. The cam member 18 then rotates until its dwell portion 70 comes into registry with the finger 47, at which time, the contacts 40, 41 are closed for a period of seven seconds. The contact terminals 67 and 68 of contact switch 31a may be connected to a spray device within the washing machine to provide seven-second intermittent sprays during the rinsing cycle, and the switch 31a may be interconnected with switch 31c, the latter being connected to a warning signal buzzer, in such a manner as to provide two seven-second warning signals at the end of the operational cycles of the machine.

The selector knob 66 is affixed to the end of a cylindrical shaft 72 which is journaled in the timer housing.

The shaft 72 has an integral ball-shaped portion 73 intermediate its ends, and the free end portion of said shaft 72 has a longitudinally-extending key 74. Said free end of the shaft 72 extends within a longitudinal bore 75 in the front end of the shaft 21, the bore 75 having a communicating slot 76 sized to receive the key 74. It will be apparent that the key 74 and slot 76 cooperate to cause the shaft 21 to be turned by turning movement of the shaft 72, but at the same time to permit the shaft 72 to be moved axially relative to the shaft 21.

The front wall 10 of the timer housing has a central semi-spherical pressed-out portion 77 forming an inwardly-facing concavity. The shaft 72 extends rotatably and slidably through the center of this semi-spherical portion 77.

A U-shaped wire spring 78, having parallel legs, is mounted against the inner surface of the front wall 10 in a position to extend across the concavity formed by the semi-spherical portion 77. For this purpose, the top end of the spring 78 is secured to the front wall 10 by a clamping screw 79, while the free ends of the spring legs extend between the front wall 10 and a plate 80 which is mounted parallel to and spaced from the front wall inner surface by screws 81. The plate 80 holds the free ends of the legs of spring 78 against the inner surface of the front wall 10, and at the same time permits the legs to spread apart laterally.

The shaft 72 carries an electrically-insulated disc 82 positioned to engage and actuate an on-off switch 83 for the main electrical circuit of the washing machine. The switch 83 comprises a fixed arm 84 and a flexible spring arm 85 mounted spaced from each other on the housing side wall 13. The arms 84 and 85 carry respective contacts 86 and 87 which are normally held in engagement with each other by the flexible spring arm 85, as shown in Fig. 3. The bottom ends of the switch arms 84 and 85 project exteriorly of the timer housing and constitute respective terminals 86 and 87 which are wired within the electric circuit connecting the washing machine electrical system to a power source. Thus, when the switch 83 is closed, the washing machine is electrically energized, and when the switch is open, the washing machine is de-energized.

The selector knob 66 and its shaft 72 have an extended position, shown in Fig. 5, in which the ball portion 73 is located forwardly of the spring 78 and within the cavity formed by the semi-spherical front wall portion 77. The legs of the U-shaped spring 78 are spaced apart a distance which is less than the diameter of the ball portion 73, so that the spring 78 releasably holds the shaft

72 in said extended position. In this position, the insulated disc 86 engages and presses the flexible spring arm 85 away from the fixed arm 84, as shown in Fig. 1, the switch contacts 86 and 87 being separated and the on-off switch 83 held open.

When it is desired to operate the washing machine, the selector knob 66 is pressed inwardly with sufficient force to enable the shaft ball portion 73 to spread apart the legs of the U-shaped spring 78 and to move to the rear of said spring 78 to the inserted position shown in Fig. 3. The spring legs again move together to hold the ball portion 73 of shaft 72 in the inserted position. In this position, the insulated disc 86 has moved forwardly with shaft 72, out of contact with the flexible switch arm 85, and the flexible arm 85 is released to move to its normal position, bringing the switch contact 87 into engagement with contact 86 and closing the on-off switch 83. The selector knob 66 may now be turned manually to a selected position, turning the shaft 27 and all the cam discs 25a—25h to a position for commencement of the selected operational cycle.

The cam 25h shown in Fig. 8 is designed to shut off the washing machine electrical circuit automatically after completion of either of the operational cycles of the machine. If the user, however, desires to change the setting of the selector knob 66 while the machine is in operation, the selector knob 66 may be withdrawn to its extended position, opening the on-off switch 83 and thus preventing the various machine components from being rapidly and successively energized during the change in position of the selector knob. The selector knob 66 may, of course, also be withdrawn to stop operation of the machine at any desired time.

During operation of the timer motor 14, the ratchet arm 19 is advanced and retracted once each minute to turn the ratchet wheel 24 through a distance equal to the length of one ratchet tooth 28 or  $\frac{1}{60}$  of the circumference of the ratchet wheel. It will thus be appreciated that for one-half of each minute, the ratchet arm 19 is pressing against the ratchet tooth 28 and the ratchet wheel is moving. During the second half of the minute period, the ratchet arm 19 is being retracted, and the ratchet wheel 24 is immovable. During the time that the ratchet wheel 24 and its associated cam discs 25a—25h are immovable, the cam member 18 can provide its seven-second switch-actuation periods if it is in registry with one of the dwell portions of the cam disc 25a.

While the timer cam discs can be manually set by means of the selector knob 66 in any desired position, the provision of the micro-switches insure that the switch contacts are either fully opened or fully closed. The contacts can never, under any circumstances, be partially open so that even under manual operation the switch contacts cannot be brought to a position in which arcing can occur.

By the provision of the micro-switches 31a to 31c having two independent pairs of contacts and a central neutral position, the eight switches can be made to perform sixteen separate operations in the washing machine cycle. While it is desirable to employ micro-switches because of their rapid opening and closing without arcing, if conventional micro-switches were used, it would be necessary to employ sixteen micro-switches and sixteen associated cam discs to perform the same number of operations, resulting in greatly increased costs in manufacture, and, of course, a great increase in the length of the timer.

It will be further appreciated that the timer illustrated herein is so constructed as to afford ready access to its internal parts for repair or replacement. Normally, the switch contacts of a timer of this type are the first portions of the timer to wear out or to require cleaning. In conventional timers, the switch contacts are difficult to reach for cleaning or replacement. In the timer shown

herein, however, the micro-switches 31a—31h are mounted at the top and bottom of the timer housing and can be easily removed individually for convenient replacement.

It will be understood that the timer illustrated in the drawings and previously described, is shown by way of example only. Washing machine operations are constantly changing as new models are introduced each year. To comply with new operational requirements, the cam discs 25a to 25h may, of course, be changed with regard to the location and size of their rise and dwell portions.

While a preferred embodiment of the invention has been shown and described herein, it is obvious that numerous additions, changes, and omissions may be made in the invention without departing from the spirit and scope thereof.

What is claimed is:

1. An electrical timing device comprising an electric motor having a drive shaft, a plurality of cam members, coupling means connecting said cam members to said drive shaft for movement of the former when said motor is operated, a plurality of snap-acting switches each associated with a respective cam member and controlled thereby, each switch having two pairs of switch contacts, each pair comprising a movable contact and a fixed contact, an actuator member spaced from said switch contacts, and a pair of springs respectively connecting said actuator member to the movable contact of both pairs of contacts for movement of said actuator to a first operative position in which one of said pairs of contacts is closed, a second operative position in which the other pair of contacts is closed, and a neutral position in which both pairs of contacts are open, each actuator member being positioned to engage one of said cam members, at least some of said cam members having a cam surface sized to hold the associated actuator member in its neutral position, a rise portion sized to bring said actuator member to its first operative position, and a dwell portion sized to bring said actuator member to its second operative position.

2. An electrical timing device comprising an electric motor having a drive shaft, a plurality of cam members, coupling means connecting said cam members to said drive shaft for movement of the former when said motor is operated, a plurality of snap-acting switches each associated with a respective cam member and controlled thereby, each switch having two pairs of switch contacts, each pair comprising a movable contact and a fixed contact, an actuating member remote from said switch contacts, and a pair of springs respectively connecting said actuator member to the movable contacts of both pairs of contacts for movement of said actuator to a first operative position in which one of said springs closes one of said pairs of contacts, a second operative position in which the other spring closes the other pair of contacts, and a neutral position in which both springs are in a dead-center position with both movable contact arms and in which both pairs of contacts are open, biasing means urging each actuator member into pressing engagement with one of said cam members, at least some of said cam members having a cam surface sized to hold the associated actuator member in its neutral position, a rise portion sized to bring said actuator member to its first operative position, and a dwell portion sized to permit said biasing means to bring said actuator member to its second operative position.

3. An electrical timing device comprising a housing, an electric motor mounted on said housing and having a drive shaft, a plurality of cam discs mounted for simultaneous rotation within said housing and coupled to said motor drive shaft, a plurality of micro-switches mounted on said housing for cooperative association with the respective cam discs, each of said micro-switches comprising two pairs of switch contacts, an actuator member, and

a pair of springs connecting said actuator member to said pairs of contacts for alternate opening and closing thereof, said actuator being movable to a raised first operative position in which one of said springs closes one of said pairs of contacts, a lowered second operative position in which the other spring closes the other pair of contacts, and an intermediate neutral position in which the springs are positioned to hold open both pairs of contacts, each of said cams having a circumferential cam surface and at least some of said cams having rise and dwell portions, each micro-switch including spring means pressing said actuator member into engagement with the cam surface of a respective cam disc, each circumferential cam surface being sized to hold its respective actuator member in its neutral position, each rise portion being sized to raise said actuator member to its first operative position, each dwell portion being sized to permit said actuator member to be lowered to its second operative position under tension of said spring means.

4. An electrical timing device according to claim 3 in which said cam discs are mounted on a shaft extending through said housing, said shaft carrying a ratchet wheel, said drive shaft having a ratchet arm mounted eccentrically thereupon and positioned to engage said ratchet wheel for turning said cam disc shaft in successive periodic increments when said motor drive shaft is rotated.

5. An electrical timing device according to claim 3 in which said cam discs are mounted on a shaft extending through said housing, and said coupling means comprises a ratchet assembly for driving said cam disc shaft at a lesser speed than the rotational speed of the motor drive shaft, said motor drive shaft having a cam member fixed thereto and rotatable therewith, said cam member having a plurality of dwell portions and being located proximate to one of said cam discs and in a position for its dwell portions to register with the dwell portions of the cam disc and in a position to be engaged by the associated micro-switch for rapid actuation of the micro-switch associated with said cam disc when the dwell portions of said cam disc are in registry with the cam member.

6. An electrical timing device according to claim 3 in which said housing has slots at its top and bottom ends sized to receive the casings of the respective micro-switches.

7. An electrical timing device comprising a housing, an electric motor mounted on said housing and having a drive shaft, a plurality of cam discs mounted at the center of said housing for simultaneous rotation, means coupling said cam discs with said drive shaft, a plurality of micro-switches in cooperative association with the respective cam discs, and means removably mounting said micro-switches at the top and bottom of said housing, each of said micro-switches comprising two pairs of switch contacts, an actuator member, and a pair of springs connecting said actuator member to both said pairs of contacts for alternate opening and closing thereof, said actuator being movable to a raised first operative position in which one of said springs closes one of said pairs of contacts, a lowered second operative position in which the other spring closes the other pair of contacts, and an intermediate neutral position in which the springs are positioned to hold open both pairs of contacts, each of said cams having a circumferential cam surface and at least some of said cams having rise and dwell portions, each micro-switch including spring means pressing said actuator member into engagement with the cam surface of a respective cam disc, each circumferential cam surface being sized to hold its respective actuator member in its neutral position, each rise portion being sized to raise said actuator member to its first operative position, each dwell portion being sized to permit said actuator member to be lower to its second operative position under tension of said spring means.

8. In an electric timing device, the combination of a cam disc, a micro-switch associated with and controlled by said cam disc, and means for rotating said cam disc, said cam disc having a continuous cam surface containing at least one rise portion and one dwell portion, said micro-switch comprising a body portion, an actuator member pivotally mounted on one end of said body portion for upward and downward pivoting movement, a pair of switch units, each switch unit comprising a contact element immovably fixed to the body portion and a movable contact element, a pair of springs respectively connecting the movable contact element of each of said switch units to the free end of the actuator member for snap action closing of one of the switch units when the actuator member is pivoted upwardly to a first operative position and snap action closing of the other switch unit when the actuator member is pivoted downwardly to a second operative position, the actuator member having a neutral position in which both switch units are open, and biasing means urging a portion of the actuator member against the cam disc, the cam surface of the cam disc being sized to hold the actuator member in its neutral position, the rise portion being sized to bring the actuator member to its first operative position, and the dwell portion being sized to permit the biasing means to urge the actuator member to its second operative position.

9. In an electric timing device, the combination of a cam disc, a micro-switch associated with and controlled by said cam disc, and means for rotating said cam disc, said cam disc having a continuous cam surface containing at least one rise portion and one dwell portion, said micro-switch comprising a body portion, an actuator member pivotally mounted on one end of said body portion for upward and downward pivoting movement and having a cam follower engaging said cam disc, a pair of switch units, each switch unit comprising a first switch contact rigidly connected to the body portion, a second switch contact, and a movable arm carrying said second switch contact, a pair of springs connecting the respective movable arm of each of said switch units to the free end of the actuator member for snap action closing of one of the switch units when the actuator member is pivoted upwardly to a first operative position and snap action closing of the other switch unit when the actuator member is pivoted downwardly to a second operative position, the actuator member having a neutral position in which both switch units are open, and biasing means urging said cam follower of the actuator member against the cam disc, the cam surface of the cam disc being sized to hold the actuator member in its neutral position, the rise portion being sized to bring the actuator member to its first operative position and the dwell portion being sized to permit the biasing means to urge the actuator member to its second operative position.

10. A switching device comprising a first switch pair, a second switch pair, each of said switch pairs including a stationary contact element and a movable contact element, a common actuator for said first and second switch pairs, means mounting said common actuator for movement between a neutral position and first and second limit positions, and coupling means connected to said common actuator and having respective springs operatively connected to the movable contact elements of said first and second switch pairs, both switch pairs being open when said actuator is in said neutral position, said coupling means being arranged to cause said first switch pair to close in response to movement of said common actuator into one limit position, and to cause said second switch pair to close in response to movement of said common actuator into the other limit position.

11. A switching device comprising a first switch pair, a second switch pair, each of said switch pairs including a stationary contact element and a movable contact element, a common actuator for said first and second switch

pairs, means mounting said common actuator at a point remote from said switch pairs for movement between a neutral position and first and second limit positions coupling means connected to said common actuator and having respective springs operatively connected to the movable contact element of said first and second switch pairs and means including a control cam and a cam follower operatively connected to said common actuator for periodically urging the same into said neutral and limit positions in a prescribed time sequence.

12. For use in an electrical timing device, a micro-switch comprising a body portion, an actuator member pivotally mounted on said body portion, a first and second switch unit, each comprising a fixed contact element and a movable contact element, a pair of springs connecting the actuator member to the flexible contact arms of the respective switch units, the actuator member having a neutral position in which both switch units are open, a first operative position in which one of the switch units is closed, and a second operative position in which the other switch unit is closed.

13. For use in an electrical timing device, a micro-switch comprising a body portion, an actuator member pivotally mounted on said body portion and having a pair of terminal arms, a first and second switch unit each comprising a fixed contact arm and a movable flexible contact arm, an arcuately-bent spring connecting one of the terminal arms of the actuator member to the flexible contact arm of the first switch unit, a second arcuately-bent spring connecting the other arm of the actuator member to the flexible contact arm of the second switch unit, the actuator member having a neutral position in which both switch units are open, a lowered position in which the first switch unit is closed, and a raised position in which the second switch unit is closed.

14. For use in an electrical timing device, a micro-switch comprising a body portion, a first and second switch unit each comprising a fixed contact arm and a movable flexible contact arm, an actuator member pivotally mounted on said body portion at a point remote from the switch units and having a pair of spaced arms at its free end facing said switch units, an arcuately-bent spring connecting one of the arms of the actuator member to the flexible contact arm of the first switch unit, a second arcuately-bent spring connecting the other arm of the actuator member to the flexible contact arm of the second switch unit, the actuator member having a neutral position in which both arms are in substantially the same axial plane with the respective flexible contact arms and both pairs of switch units are open, a raised position in which one of the switch units is closed, and a lowered position in which the other switch unit is closed.

15. For use in an electrical timing device, a micro-switch comprising a body portion, a first and second switch

unit each comprising a fixed contact arm and a movable flexible contact arm, an actuator member pivotally mounted at one end on said body portion and having a free end facing said switch units, a first arcuately-bent spring connecting the free end of the actuator member to the flexible contact arm of the first switch unit, a second arcuately-bent spring connecting the free end of the actuator member to the flexible contact arm of the second switch unit, the actuator member having a neutral position in which both switch units are open, a lowered position in which the first switch unit is closed, and a raised position in which the second switch unit is closed.

16. For use in an electrical timing device, a micro-switch comprising a body portion, a first and second switch unit, the first switch unit comprising an upper fixed contact arm and a lower movable flexible contact arm, the second switch unit comprising a lower fixed contact arm and an upper movable flexible contact arm, an actuator member pivotally mounted on said body portion for upward and downward pivoting movement at a point remote from the switch units and having a pair of vertically-spaced arms at its free end facing said switch units, an arcuately-bent spring connecting the upper arm of the actuator member to the flexible contact arm of the first switch unit, a second arcuately-bent spring connecting the lower arm of the actuator member to the flexible contact arm of the second switch unit, the actuator member having a neutral position in which both arms are in substantially the same plane with the respective flexible contact arms and both pairs of switch units are open, a raised position in which the lower arm of the actuator member is above the plane of the flexible contact arm of the second switch unit and the latter is closed, and a lowered position in which the upper arm of the actuator member is below the plane of the flexible contact arm of the first switch unit and the latter is closed.

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