United States Patent [19]

Caviar

[11] **3,736,391**

[45] **May 29, 1973**

[54] **TIMING DEVICE WITH ADJUSTABLE CAM OPERATED MICROSWITCH ASSEMBLY**

[76] Inventor: **Lee Caviar,** 705 E. 31st St., Kansas City, Mo. 64109

[22] Filed: **May 1, 1972**

[21] Appl. No.: **249,201**

[52] **U.S. Cl.** .....**200/38 R,** 200/33 B, 307/141, 307/141.8

[51] **Int. Cl.**.....**H01h 43/10**

[58] **Field of Search**.....200/33 R, 37 A, 38 R, 200/38 D, 38 DA, 38 DB, 38 DC, 18; 307/141, 141.4, 141.8

[56] **References Cited**

UNITED STATES PATENTS

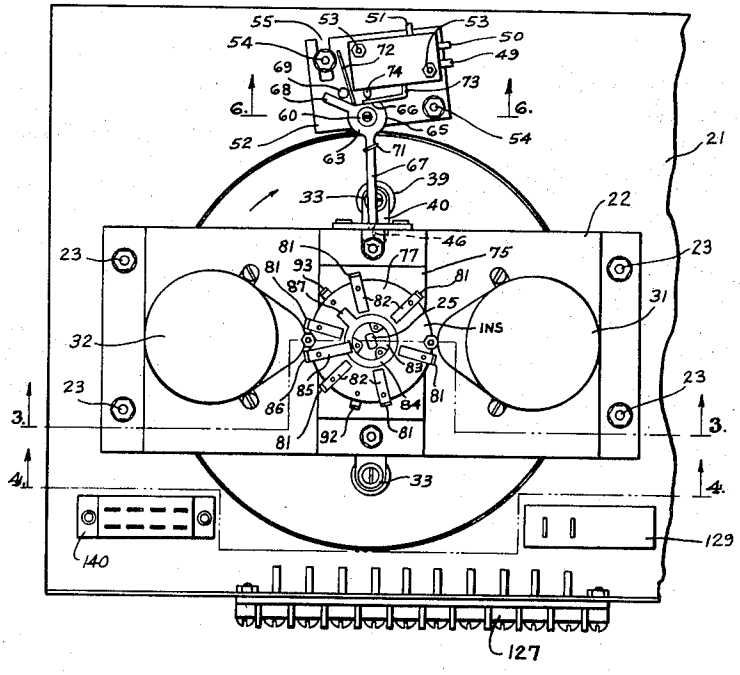
3,227,821	1/1966	Hauser	200/33 B X
3,359,382	12/1967	Hendry	307/141 X
3,379,894	4/1968	Carsten	307/141.8 X

Primary Examiner—J. R. Scott
Attorney—Alfred R. Fuchs

[57] **ABSTRACT**

A timing disk has switch controlling members mounted in a circular series about its axis of rotation and independently rotatable about their axes to adjust the position of a pin projecting latterly from a radially outwardly extending arm on each controlling member. The movable contact of a micro-switch, biased toward a first position controlling a first motor for driving the disk, is movable into a second position controlling a second motor, driving the disk at a much slower speed than the first motor. A cam having an arcuate high portion is rotatable about an axis out of the pin path and has a finger movable with it projecting into this path to rotate the cam through an arc dependent on how long the pin contacts the finger. A switch operating member holds the movable contact in its second position as long as a follower engaging the operating member engages the cam high portion. A spring rotates the cam to engage its low portion with the follower upon disengagement of the pin from the finger. A contact moving with the disk successively engages a circular series of stationary contacts concentric with the disk, each corresponding to a controlling member and each in the circuit of a different electrically operated valve. A ring contact concentric with and rotating with the disk has a gap and cooperates with a stationary contact to open both motor circuits upon completion of a rotation of the disk.

6 Claims, 10 Drawing Figures



4 Sheets-Sheet 1

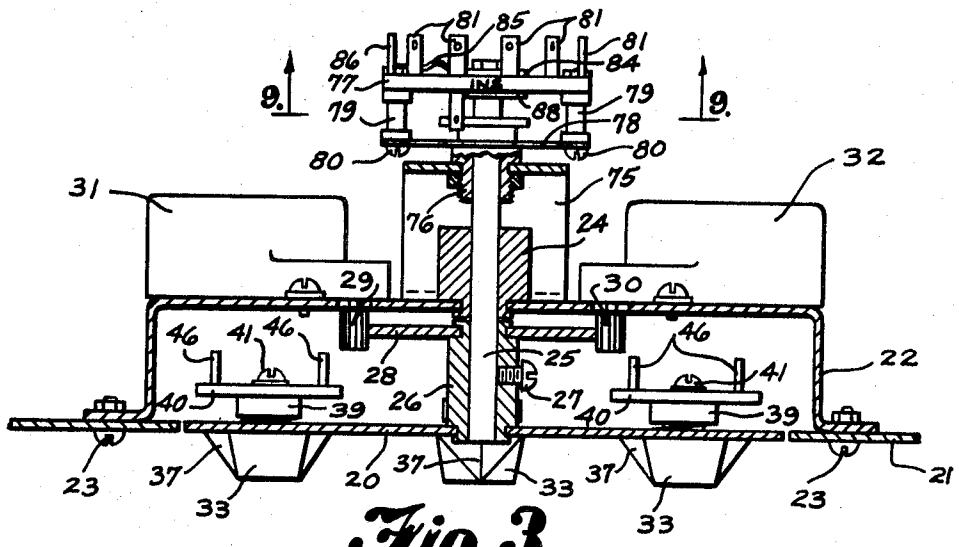


Fig. 3.

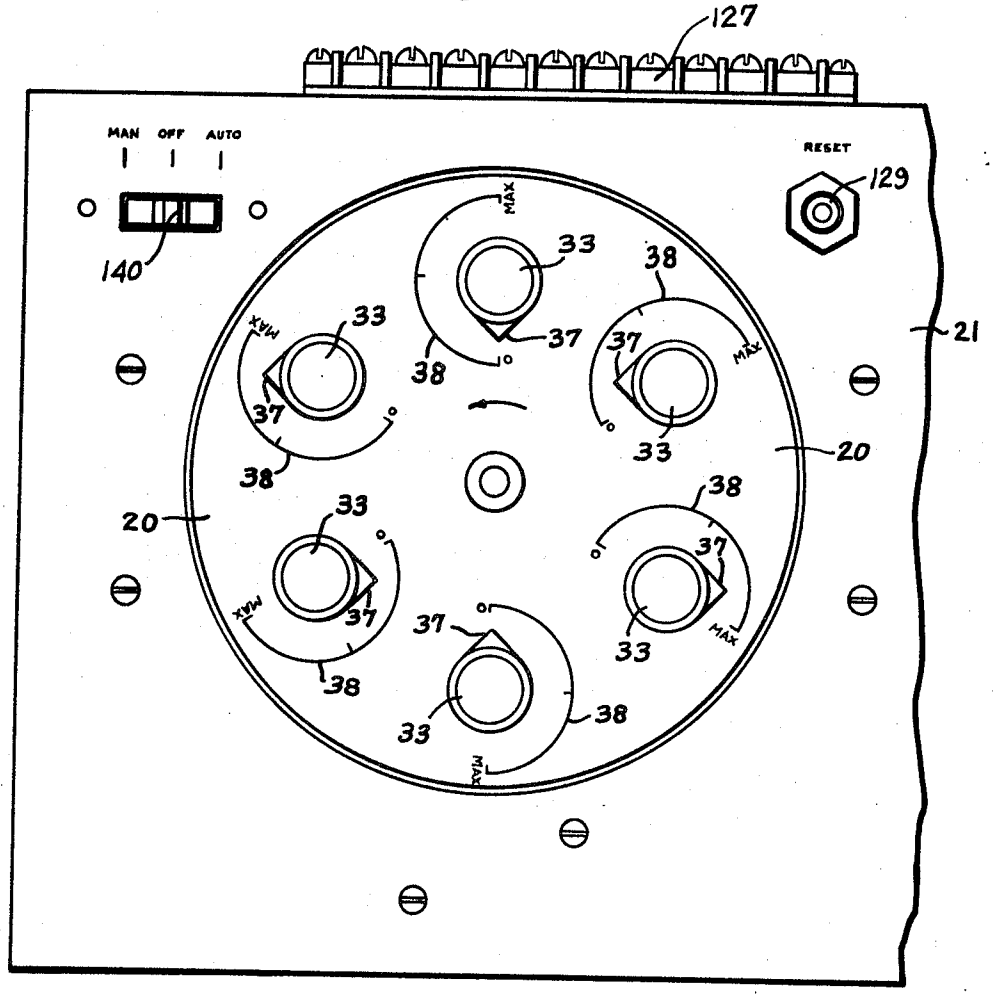


Fig. 1.

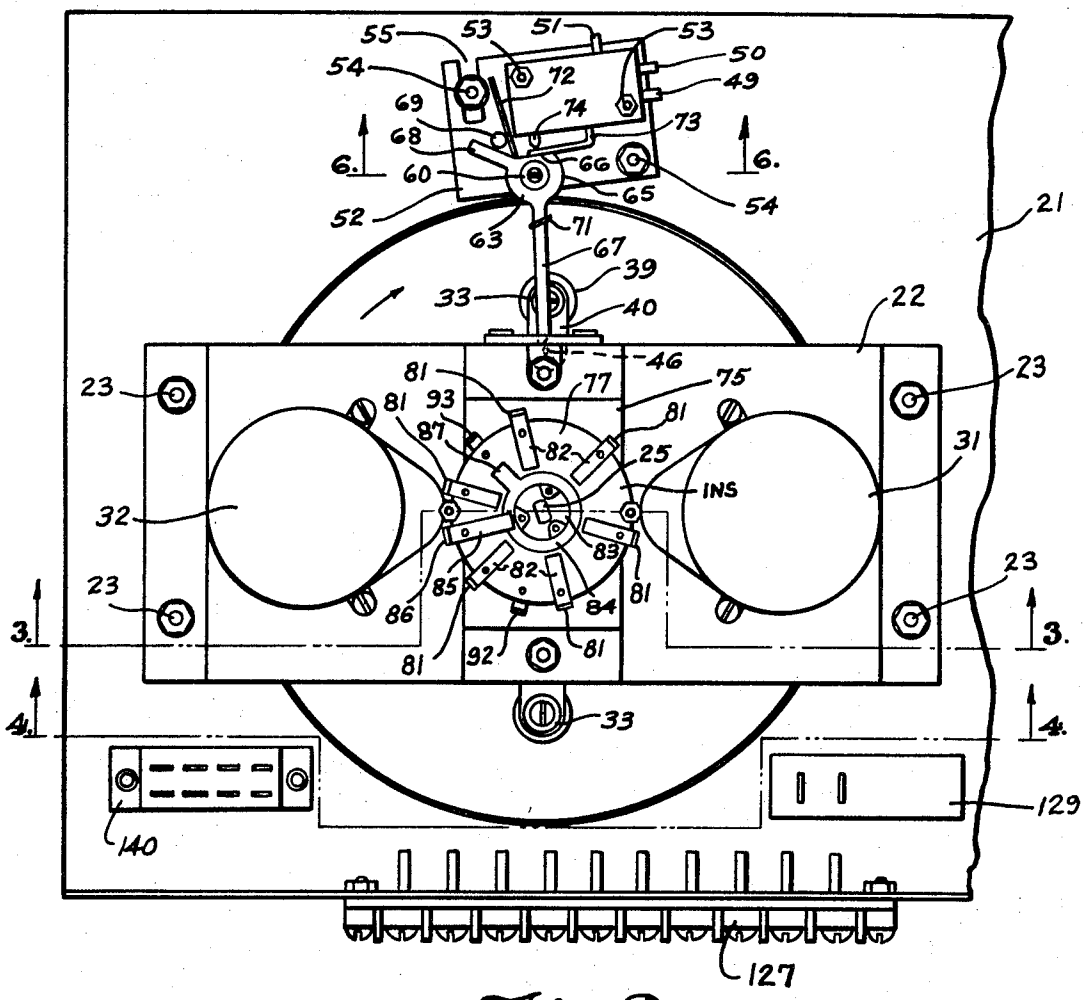


Fig. 2.

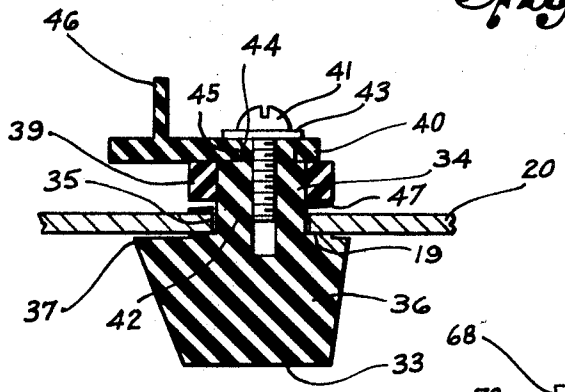


Fig. 5.

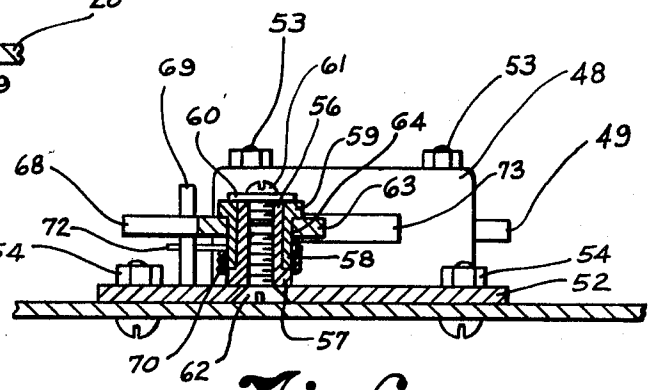


Fig. 6.

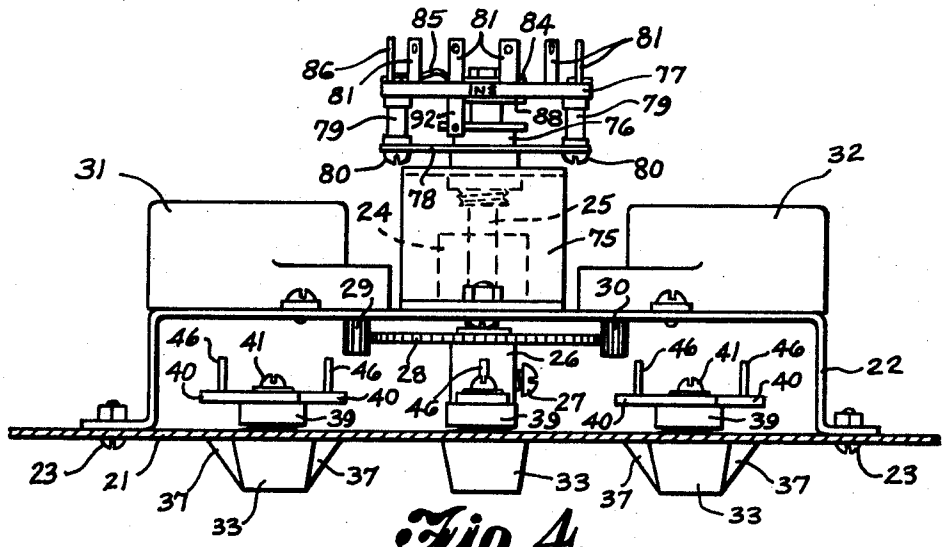

85
81
84
81
86
81
77
79
92
88
79
76
80
80
78
31
32
24
25
75
29
30
46
41
40
46
28
26
27
39
22
23
21
37
33

Fig. 4.

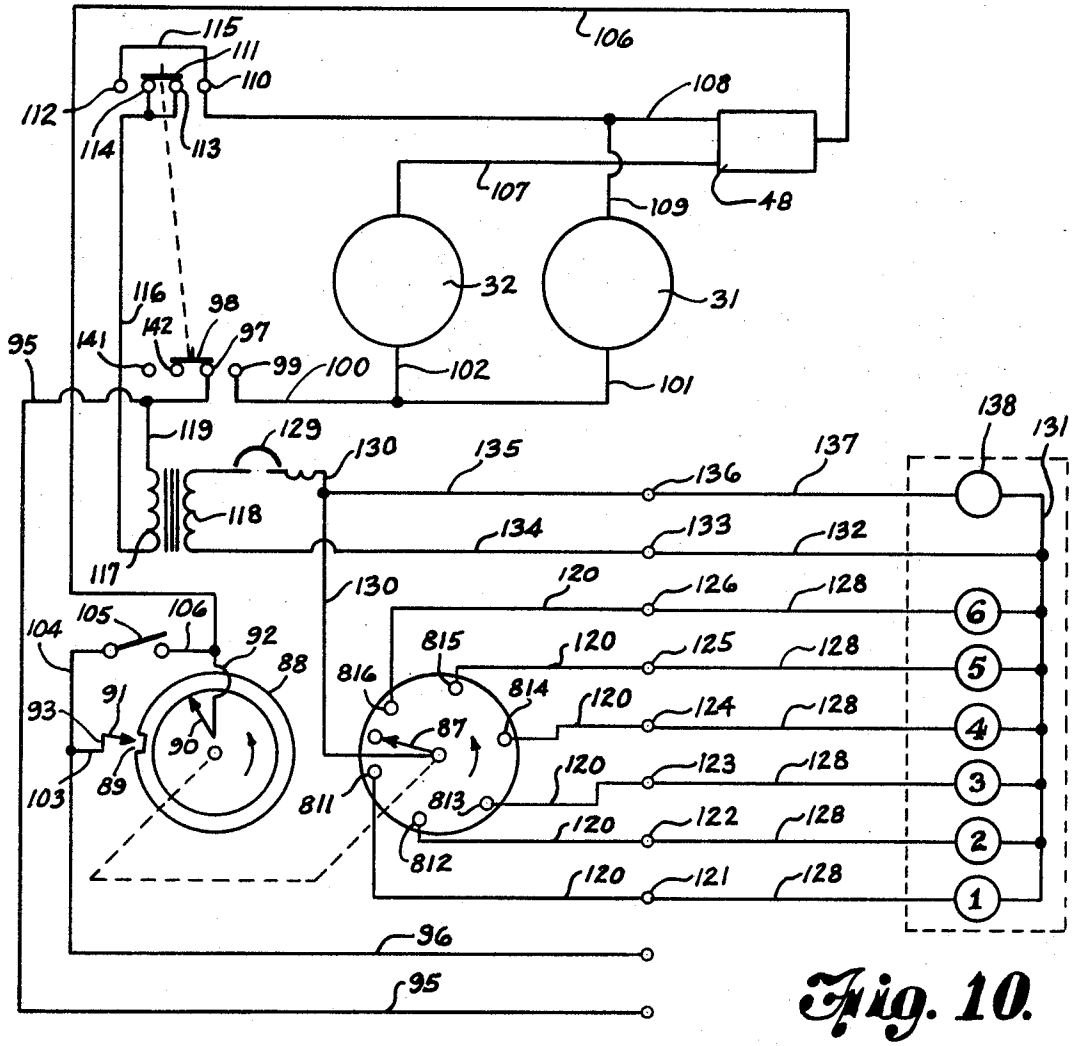

115
111
110
106
112
108
114
113
107
109
48
32
31
116
98
95
141
142
97
99
100
102
101
119
129
130
135
136
137
138
131
118
134
133
132
117
130
120
126
128
104
105
106
92
88
815
120
125
128
816
91
814
120
124
128
93
90
87
120
123
128
103
89
811
813
120
122
128
812
120
121
128
96
95

Fig. 10.

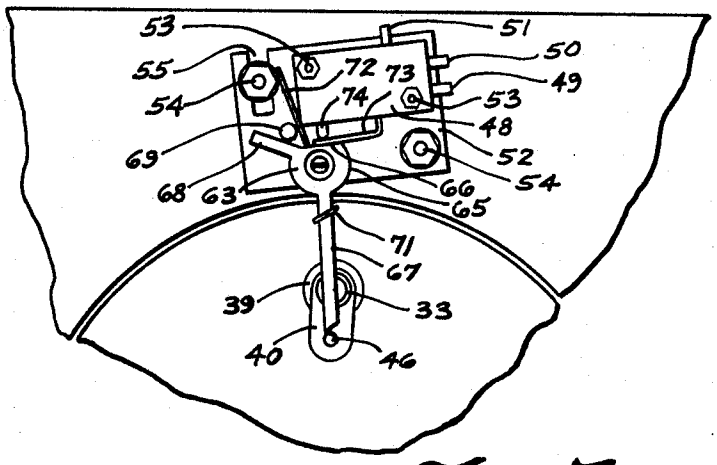


Fig. 7.

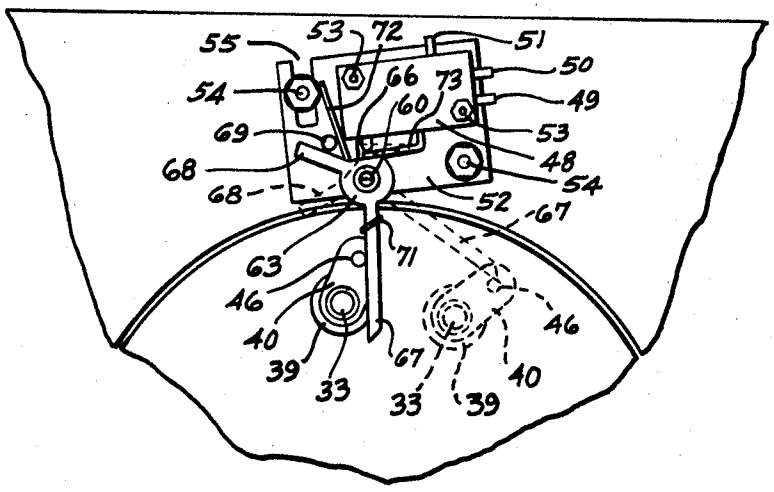


Fig. 8.

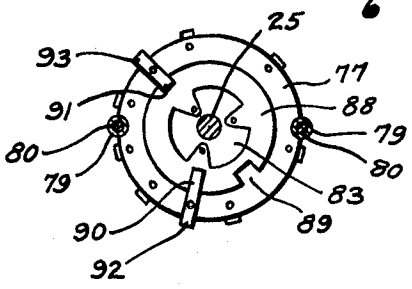


Fig. 9.

TIMING DEVICE WITH ADJUSTABLE CAM OPERATED MICROSWITCH ASSEMBLY

BACKGROUND OF THE INVENTION

Timing devices of the general character of the present invention have included a timing disk that had a circular series of openings in it for controlling members that were rotatably adjustable independently of each other in the openings in the disk about their own axes, which had body portions from which pins extended axially in spaced relation to the axis of rotation of the controlling member. As the disk rotated the controlling members actuated a micro-switch whenever the pins engaged an operating member which had means for operating it that extended into the path of the pins. The disk was rotated by either of a pair of motors that had a driving connection with the shaft of the disk, one of said motors driving said disk at a predetermined rate and the other of said motors driving the disk at an extremely slow rate compared with rate of the first mentioned motor. The micro-switch had a movable contact member that was mounted so as to engage either a contact in the circuit of the first mentioned motor or a contact in the circuit of the extremely slow motor. The movable contact member of the micro-switch was biased to engage the stationary contact in the circuit of the first motor and movable by means of one of the controlling members on the disk into engagement with the contact in the circuit of the extremely slow rotating motor, the means moving the movable contact holding the movable contact member out of engagement with the first mentioned stationary contact and in engagement with the second mentioned stationary contact. The length of time that the slow motor operated determined the length of time an apparatus, controlled by the particular controlling member of the timer, was supplied with electrical energy, one of the uses being to keep an electrically operated valve in a lawn sprinkler system in opened position during the interval that the slow motor was operating. The particular valve or other apparatus that was being operated was determined by a movable contact member rotating with the disk engaging a stationary contact that was connected with the particular apparatus, such as the above referred to valve, that was to be opened. The position of the movable contact member of the micro-switch was controlled by a member that extended into the path of the pins on the controlling members when these were so adjusted that when these reached a certain point in their path during the rotation of the disk they would engage the member that operated the switch member. The length of time that a pin on a particular controlling member was in engagement with the member that operated the switch was dependent upon the distance the pin was located from the axis of rotation of the disk and it in turn was dependent upon the adjustment of the particular controlling member about its axis. The variation in the amount that the pin could be spaced from the axis of rotation of the disk was very small because the distance of the pin from the axis of rotation of the controlling member was limited by the size of the body portion of the controlling member which was also limited as spaces had to be provided between the holes in the disk in which the body portion of the controlling members turned. Also, the range of the length of time that the slow motor could be operated was limited because the pins could have only a limited period of contact with the member that operated the micro-switch, and was directly dependent upon the travel of this operating member. In order to prevent the disk from continuing to operate after it had made one complete revolution, a micro-switch was provided for opening the circuit to both motors which was operated by a projecting post on the disk.

It is the purpose of my invention to provide a timer in which a very much larger variation in the length of time that the apparatus controlled by the timer can be obtained, and in which the micro-switch for terminating the rotation of the disk after one revolution is eliminated.

In order to accomplish this the means for determining the position of the movable contact of the micro-switch that controls the operation of the two motors selectively is operated by a circular series of controlling members that are mounted on the disk for indepednet rotation, with respect to the disk, which each have a radially extending arm thereon from which one of said pins projects in spaced relation to and parallel to the axis of rotation of the controlling member, so that said pin is much more widely spaced from the axis of rotation of the controlling member than if it were projecting directly from the body portion of the controlling member. Each controlling member is adapted to be moved through nearly one hundred eighty degrees between a zero position, in which the pin on the contact member will avoid the operating means for the micro-switch, and a maximum position in which the micro-switch can be held in position to operate the apparatus controlled thereby for an hour, positions in between said zero position and maximum position providing for any time interval of operation between zero and an hour, which may be found desirable.

The micro-switch operating means is also of such a character that it permits the same to be operated by the pin from minimum to maximum position thereof, by providing a cam having operating means for it in the form of a finger projecting into the path of the pins on the controlling members, the cam having a high portion extending around the major portion thereof. When such high portion is in engagement with a follower that operates the micro-switch, contact is made and maintained by the movable contact member with the stationary contact that serves to control the circuit condition of the extremely slow motor in order to energize it during the entire time that the high portion of the cam is in engagement with the follower. Such position of the cam is maintained as long as the pin on a controlling member is in engagement with the finger that projects from the cam to rotate the cam about its axis, and this can vary from a position in which the pin does not engage the finger at all up to a period of time of an hour or any designated time that said pin is in engagement with the finger depending upon the speed of the slow motor. The cam is provided with means for rotating it to a position in which the low portion engages the follower when no pin is in engagement with the finger.

Instead of providing a projection on the timing disk operating a micro-switch to open the circuit of both motors to halt rotation of the disk when a rotation of the disk has been completed, a switch having an arcuate contact having a gap therein is provided with which a pair of stationary contact members engage, which is mounted to turn about the axis of rotation of the disk along with the disk, one contact member being so posi-

tioned that it will be at the gap when a complete rotation of the disk has taken place.

Other objects and advantages of my invention will appear as the description of the drawings proceeds. I desire to have it understood, however, that I do not intend to limit myself to the particular details shown or described except as defined in the claims.

In the drawings:

FIG. 1 is a face view partly broken away of my improved timer.

FIG. 2 is a rear view thereof partly broken away.

FIG. 3 is a fragmentary section taken on the line 3—3 of FIG. 2.

FIG. 4 is a fragmentary section taken on the line 4—4 of FIG. 2.

FIG. 5 is a fragmentary detail section view on an enlarged scal through one of the controlling members.

FIG. 6 is a fragmentary view on an enlarged scale of the mounting of the cam for controlling the micro-switch, partly in section.

FIG. 7 is a fragmentary detail plan view of the micro-switch and operating means showing the position of said operating means when the pin on a controlling member is in its zero position.

FIG. 8 is a view similar to FIG. 7 of the micro-switch and the operating means therefor, showing the position thereof when a pin first engages the finger in full lines, and in the position in which the pin has traveled along the finger on the switch operating means to the end thereof and is about to leave the finger, in dotted lines.

FIG. 9 is a fragmentary section taken on the line 9-9 of FIG. 3, and

FIG. 10 is a diagram of the circuit connections for the timer.

Referring in detail to the drawings, a timing disk 20 is shown in FIG. 1 which is mounted for rotation in a housing 21 which is provided with a bracket 22 secured to the housing 21 in a suitable manner as by means of the bolts 23, a bearing 24 (see FIG. 3) being provided on the bracket 22 for the shaft 25, which is mounted on the axis of rotation of the timing disk 20 (see FIG. 3). Fixed on the disk 20 is a hub 26 which is secured to the shaft 25 by means of a set screw 27. A gear 28 is fixed to the hub 26 and meshes with the pinions 29 and 30, provided on the output shafts of the motors 31 and 32. The disk 20 will be rotated about its axis with the shaft 25 by either the motor 31 or 32, dependent upon which is being energized. The motors are of a type in which the dirve is through one way clutch means so that when the pinion 29 is driving the gear 28, the pinion 30, which will be rotated in a reverse direction to that in which it will be driven by the motor 32, will not rotate the motor 32 because slippage in the one way clutch will occur. The same will be true with respect to the motor 31 when the motor 32 is driving the gear 28 through the pinion 30.

Mounted on the disk 20 is a circular series of controlling members 33 which are shown more in detail in FIG. 5. While only six controlling members 33 are shown in the drawings, the number shown in only illustrative. As many controlling members can be provided on the disk as the size of the disk and the spacing of the openings for the controlling members in the disk will permit. The controlling members each have a body portion 34 which is cylindrical and is mounted for rotation in a circular opening 35 in the disk 20. A head portion 36 is provided on the body portion 34 forming an operating knob which has an indicating member 37 projecting therefrom, each of which is adapted to cooperate with a scale 38 provided on the disk 20 for showing the adjusted position of the controlling member. A collar 39 is provided on the controlling member spacing an arm 40 from the face of the disk 20, a headed threaded fastening element 41 engaging in a screwthreaded opening 42 in the body portion 34 and a washer 43 being provided for securing the arm 40 and the collar 39 in assembled relation with respect to the body portion 34 of the controlling member. The body portion has a reduced end portion 44 which has a flattened portion 45 and the arm 40 has a correspondingly shaped opening therein so that when the parts are assembled the arm will project laterally radially outwardly from the controlling member in fixed position to rotate with the controlling member 33 about its axis. A pin 46 projects laterally from the arm 40 at the portion thereof that projects outwardly beyond the body portion 34 so as to extend parallel to the axis of rotation of the controlling member in greater spaced relation from the axis thereof than the outer surface of the body portion 34, thus providing an arc of much greater radius through which the pin 46 can be adjusted relative to the axis of rotation of the disk 20 than is possible, if the pin is provided directly on the body portion 34. The pin 46 is in transverse alignment with the indicator 37 and a spring 47 is provided between the collar 39 and the disk 20, which is compressed when the parts of the controlling member are assembled with the disk, to provide frictional means for holding the controlling member 33 in adjusted position by frictional engagement of the shoulder 19 with the disk 20.

Mounted on the housing 21 is a micro-switch 48 (see FIGS. 2,7 and 8). The micro-switch is mounted out of the path of the pins 46 as the disk 20 rotates about its axis, no matter what the adjustment of the pins 46 may be. Terminals 49 and 50 are provided on the micro-switch which are connected with stationary contacts, and a terminal 51 is provided thereon which is connected with a movable contact member. The micro-switch 48 is mounted on a plate 52 by means of bolts 53 and the plate 52 is mounted on the housing 21 by means of bolts 54, for limited adjustment relative to the body portion, one of said bolts being mounted in a slot 55 in the plate 52.

Mounted on the plate 52 is a sleeve 56 (FIG. 6) which is provided with a flange 57 that engages the plate 52. Mounted on the sleeve 56 is a sleeve 58 which has a flange 59 engaged by the washer 60 which is mounted under the head of the bolt 61 which screw-threadedly engages with the threaded opening in the sleeve 56. A bolt 62 screw-threadedly engages said threaded opening in the sleeve 56 to secure the sleeve 56 to the plate 52. The bolt 61 secures the sleeve 58 on the sleeve 56 for rotation on the sleeve 56. The sleeve 56 thus forms a bearing member for the sleeve 58. The cam 63 has an opening 64 therein through which the sleeve 58 extends, the sleeve being secured to the cam 63 to rotate therewith.

The cam 63 has a high portion 65 and a low portion 66 and has an elongated finger 67 projecting therefrom which is adapted to be engaged by a pin 46 to turn the cam on the axis of its bearing. A stop finger 68 also projects from the cam, which is adapted to engage a stationary stop member 69 on the plate 52. The cam has the position shown in FIGS. 2 and 7 when no pin

46 is engaging with the finger 67. The cam is held in this position by a coil spring 70, one end of which is connected at 71 with the cam 63, and the other end engages the stop member 69, as shown at 72 in FIG. 6. When the cam is in position with the stop finger 68, in engagement with the stop member 69, the follower 73 will be in engagement with the cam low portion 66. The end 17 of finger 67 is beveled for quick disengagement of pin 46 therefrom after passing sharp edge 18. The follower 73 is preferably made of a spring material so that it will yieldingly engage the surface of the cam and is located between a switch operating member 74 and the surface of the cam so that the follower 73 will actuate the switch operating member 74 in accordance with the portion of the cam with which it is engaging. The operating member 74 determines the position of the movable contact member of the micro-switch 48.

The movable contact member of the micro-switch is normally biased so that it will engage with the stationary contact connected with the terminal 49, and when the operating member 74 is moving upwardly, (as viewed in FIG. 2), the movable contact member is moved away from the stationary contact connected with the terminal 49 and into engagement with the stationary contact that is connected with the terminal 50, and will be held there as long as the operating member 74 is in an upward position, as shown in dotted lines in FIG. 8. This will be during the entire time that the follower 73 is in engagement with the high portion 65 of the cam. When in engagement with the low portion 66 of the cam, the follower will permit the operating member 74 to return to its normal position and the movable contact member of the micro-switch will return to engagement with the stationary contact connected with the terminal 49 and out of contact with the stationary contact connected with the terminal 50. The high portion 65 extends from the low portion 66 to the finger 68. The movement of the finger 67 is through a much larger angle than the follower 73 would have if the pin 46 engaged directly therewith, thus providing for a greater variation in the time interval that the movable contact member of the micro-switch will be in engagement with the stationary contact connected with the terminal 59 than if the cam were not provided for actuating the same, and thus providing for greater range of adjustment of the apparatus controlled by the micro-switch than if the cam were not provided.

In FIGS. 2 and 7 the controlling member having the pin 46 thereon is adjusted to such a position that it will not engage with the finger 67 during its path of movement along with the disk 20. In FIG. 8 the controlling member having the pin 46 is shown as having been adjusted to a position in which it engages the finger 67, the adjustment being such that it approaches the position in which it would have maximum length of contact with the finger 67. It is shown in full lines in FIG. 8 as it first engages the finger 67, and in dotted lines when about ready to leave the finger 67. The finger 67 will disengage from the pin 46 upon any further movement in a clockwise direction, as viewed in FIG. 8, of the disk 20. When this occurs then the spring 70 will return the cam to the full line position shown in FIG. 8, which is the position thereof shown in FIG. 7 with the stop finger 68 in engagement with the stop member 69.

Referring now to FIGS. 2, 3 and 4, a bracket 75 is mounted on the bracket 22, said bracket having a bearing 76 for the shaft 25. A plate of insulating material 77 is mounted on the bearing 76 by means of a metal plate 78 and is spaced from said metal plate by means of spacing sleeves 79 that are mounted on the bolts 80 that secure the insulating plate 77 to the metal plate 78. Mounted on the insulating plate 77 is a circular series of stationary contacts each of which is provided with a terminal 81 with which a conductor can be connected, each conductor leading to a different piece of apparatus that is controlled by the timer. While only six terminals are shown in the drawings, as many as twelve can be provided on the insulating disc 77, if desired. The number shown is for purposes of illustration only and has been reduced in order to simplify this drawing.

Extending from each terminal inwardly toward the shaft 25 is a stationary contact member 82. Mounted rotatably within an opening in the insulating disk 77 is a rotatable insulating member 83 on which a ring contact 84 is mounted, which is engaged by a contact member 85 that has a terminal 86 extending therefrom. The rotatable insulating member 83 is mounted on the shaft 25 to rotate therewith and, accordingly, the ring contact 84 will make one rotation with each rotation of the disk 20. Extending outwardly radially from the ring contact 84 is a contact projection 87 which is adapted to successively engage with the contacts 82 as the ring contact 84 rotates with the shaft 25. The contacts 82 are so arranged that each will correspond to one of the controlling members on the disk 20, so that contact will be made by the contact projection 87 with the contact member 82 that controls a circuit leading to apparatus that is controlled by a particular controlling member on the disk 20.

The opposite side of the insulating plate 77 to that shown in FIG. 2 is shown in FIG. 9. A ring contact 88, having a gap therein at 89, is provided on the rotatable insulating member 83, being secured therein by means extending through the insulating member 83. A pair of stationary contacts 90 and 91 having terminals 92 and 93, are mounted on the insulating plate 77, and it will be noted that the contact 91 is shorter than the contact 90 so that it will pass into the gap 89 to disconnect the contact 91 from the ring contact 88, while the contact 90 will continue to engage with the ring 88, as it will extend inwardly beyong the gap 89, when passing the same.

Referring now to FIG. 10, the conductors 95 and 96 extend from a source of alternating current, the conductor 95 being connected with a contact 97 of a slide switch having a movable switching member 98 adapted to bridge the contacts 97 and 99. The contact 99 has a conductor 100 connected therewith which has branches 101 and 102 leading to the motors 31 and 32 respectively.

The conductor 96 has branches 103 and 104 leading to the terminal 93 and switch 105 which is interposed between the conductors 104 and 106 extending from the terminal 92. The conductor 106 extends to the micro-switch 48 being connected with the terminal 51 leading to the movable contact member thereof. Conductors 107 and 108 extend respectively from the terminals 49 and 50 on said switch 48, a conductor 109 extending from the conductor 108 to the motor 31 and the conductor 107 extending to the motor 32.

The conductor 108 extends to a stationary contact 110 of a slide switch having the movable contact 111 and stationary contacts 112, 113 and 114, the contacts 110 and 112 being connected by a conductor 115 and

the movable contact 111 being adapted to bridge either the contacts 110 and 113 or 112 and 114. A conductor 116 extends from the contacts 113 and 114 to the one end of the primary winding 117 of a transformer having a secondary winding 118, the other end of the primary winding 117 being connected with the conductor 95 by means of conductor 119. The slide switches having the movable contact members 98 and 111 are mounted on the member 140 (FIG. 2) and have a common operating member for the movable contact members 111 and 98 so that the movable contact member 111 will bridge the contacts 110 and 113 at the same time that the contact 98 will bridge the contacts 97 and 99.

The terminals 81 previously referred to are designated 811,812,813,814,815 and 816 in FIG. 10 to distinguish between them. Conductors 120 extend from each of said terminals to corresponding terminals 121,122,123,124,125 and 126 on a terminal strip 127 mounted on the housing 21 and conductors 128 connect the terminals 121,122,123,124,125 and 126 with the corresponding devices 1,2,3,4,5 and 6 controlled by the timer, such as electrically actuated valves.

The secondary 118 of the transformer has a circuit breaker 129 connected with one end thereof, a conductor 130 extending from the circuit breaker to the movable contact 87 (through terminal 86 FIG. 2). The other end of the secondary 118 is connected with a conductor 131 common to the electrical devices 1,2,3,4,5 and 6 by a conductor 132 connected with terminal 133 provided on the terminal strip 127 and a conductor 134 extending between said terminal 133 and said other end of the secondary. A branch conductor 135 may be provided extending to a terminal 136 from the conductor and a conductor 137 may extend from the terminal 136 to a master valve 138 if desired, the master valve controlling the supply of water to the valves 1,2,3,4,5 and 6.

In FIG. 10 the movable switching members 98,105 and 111 are shown in open circuit condition and the apparatus would be halted in its operation. In order to start the rotation of the disk 20 and the controlled operation of the valves 1 to 6 inclusive by means of the timer, the switch 105 is closed to connect the conductor 104 with the conductor 106. The circuit is then completed from the conductor 96 through the conductor 104, switch 105, conductor 106 through the micro-switch 48, the conductor 107, through the motor 32, conductor 102, conductor 100, contact 99, switching member 98, contact 97 to the conductor 95. The reason the circuit will be through the motor 32, which operates more rapidly than the motor 31, is because when the rotation of the disk 20 was halted, the gap 89 in the movable contact 88 will be in position to break the circuit to both motors. This would take place after disengagement of one of the pins 46 from the finger 67 and after the micro-switch will have moved to a position such that the movable contact member connected with the terminal 51 will be in engagement with the contact connected with the terminal 49 which controls the operation of the motor 32. While the switch 105, which may be either timer operated or manually operated, is of a type that would remain closed only momentarily, the period during which it is closed would be sufficient for the disk 20 to move sufficiently that the gap 89 of the ring contact 88 will be out of alignment with the contact member 91.

The circuit will then be from conductor 96 through conductor 103, contact 91, contact 88, conductor 106, micro-switch 48, conductor 107, motor 32, conductor 102, conductor 100, contact 99, switching member 98, and contact 97 to conductor 95. Rotation of the disk by motor 32 would continue until a pin 46 moves the finger 67 to a position such as to connect the motor 31 in this circuit instead of the motor 32. The slow motor 31 then being in operation, the circuit will be completed from the conductor 96, through the conductor 106, to the micro-switch 48, through the micro-switch to the conductor 108 and from the conductor 108 through the contact 110, movable switching member 111, contact 113, and conductor 116 to one end of the primary winding 117 and from the other end of the primary winding 117 through the conductor 119 to the conductor 95. At the same time the circuit is completed from the micro-switch 48 through the conductors 108 and 109 and motor 31 and conductors 101 and 100, contacts 99 and 97 and movable switching member 98 to the conductor 95.

The secondary circuit is energized. The movable contact member 88, having been moved along with the disk 20, will be in engagement with the contact member 82 connected with the terminal 811 and the secondary circuit will be completed from one end of the secondary winding 118, circuit breaker 129, conductor 130, movable contact member 87, terminal 811, conductor 120, terminal 121, conductor 128, valve operating member 1, conductor 132, terminal 133 to the other end of the secondary winding 118. In a similar manner, as the movable contact member 87 moves successively into engagement with the stationary contacts 82, provided with the terminals 812,813,814,815 and 816, the circuit will be completed successively to the valve operating members 2,3,4,5 and 6. At the same time the master valve operating means 138 will be energized by completion of the circuit through the conductor 135, terminal 136, conductor 137, conductors 131 and 132, terminal 133 and conductor 134. The slow moving rotor 31 will be actuated for a length of time dependent upon the adjustment of the pin 46 on each of the controlling members 33, the proportion of parts being such that the contact between any one of the contact members 82 and the movable contact 87 will be maintained for the maximum time adjustment of any of the controlling members 33. The circuit controlling the particular valve being operated will remain closed as long as the slow motor 31 is operating. As soon as the pin 46 of a controlling member 33 leaves the finger 67, the fast motor 32 will move the disk 20 sufficiently for the next controlling member to be in position to operate the finger 67 to again close the circuit to the slow motor 31 and to the valve controlled by that particular controlling member. After all of the controlling members have in succession operated the valve operating members, the gap 89 will become aligned with the contact member 91 and the rotation of the disk 20 and operation of the controlling means will be halted until the switch 105 is again closed.

If it is desired to manually operate any of the valves, the movable switching members 98 and 111 can be moved into position to bridge the contacts 112 and 114 and the contacts 141 and 142, the contact 141 being a dead contact. This will put the motors 31 and 32 out of operation, but will complete the circuit to the primary of the transformer 117 whereupon the disk 20 can be

rotated manually to move the movable contact **87** into engagement with any one of the contacts that are connected with the terminals **811,812,813,814,815** and **816** to actuate the corresponding valve operating member **1,2,3,4,5** and **6.**

What I claim is:

1. In a timer having a rotatable timing disk, a pair of motors alternately rotating said disk, each at a different speed, a switch having a pair of stationary contacts each in a circuit of one of said motors, and a movable contact biased toward a first position in engagement with only one of said stationary contacts and movable into a second position in engagement with only the other stationary contact, means for determining the position of said movable contact comprising controlling members mounted on said disk in a circular series, each for independent rotatable adjustment about its axis, a pin projecting from each of said controlling members in spaced relation to said controlling member axis, a cam mounted for rotation about a fixed axis out of the path of said pins, said cam having a high portion extending over the major portion thereof concentric with said fixed axis, a finger projecting from said cam into the path of said pins for engagement therewith, a cam follower, means biasing said cam toward a position with said follower engaging the low portion thereof, said cam having the high portion thereof in engagement with said follower during engagement of a pin with said finger, and a switch operating member engaged by said follower to move into and hold said movable contact in said second position during engagement of said cam high portion with said follower.

2. In the timer claimed in claim **1** providing said disk with a circular series of openings, said controlling members each mounted in one of said openings, each having a radially extending arm thereon and one of said pins projecting laterally from each of said arms.

3. In the timer claimed in claim **1** in which a conductor common to the circuits of both said motors has a switch interposed therein comprising a ring contact concentric with the axis of said disk having a gap therein mounted to move with said disk about said axis and a pair of stationary contacts engaged by said disk, one of said stationary contacts being in the path of said gap.

4. In the timer claimed in claim **1** said cam has a body portion rotatably mounted on a bearing and said finger is integral with said body portion and projects radially with respect to the axis of rotation of said cam.

5. In the timer claimed in claim **1** said cam has a body portion rotatably mounted on a bearing and a stop member integral therewith, a fixed stop member in the path thereof and spring means tending to rotate said body portion in a direction to engage said integral stop member with said fixed stop member.

6. In the timer claimed in claim **1** in which the finger has a beveled end portion, providing a sharp edge thereon.

* * * * *