Nov. 14, 1933. R. D. SMITH 1,935,232

CONVERSIONAL TIMING MECHANISM

Filed July 26, 1927 4 Sheets-Sheet 1

FIG. 1

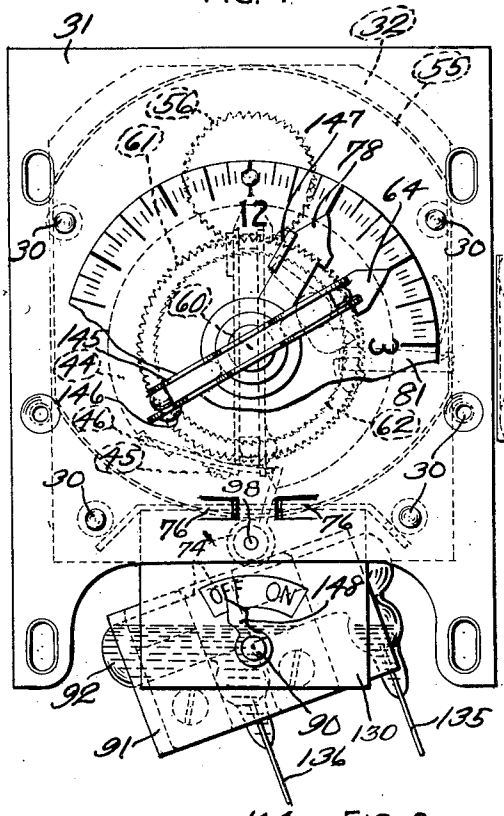


FIG. 2

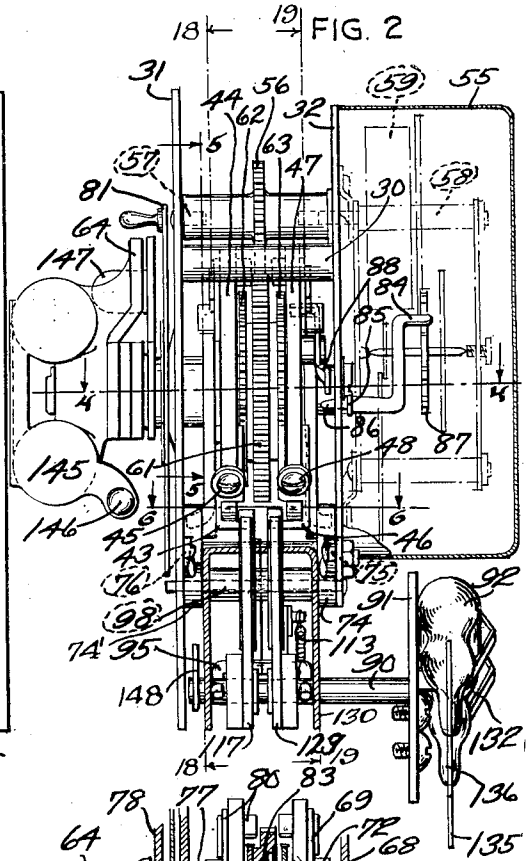


FIG. 3

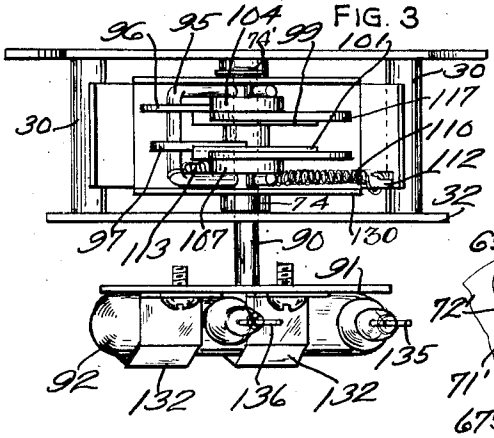


FIG. 4

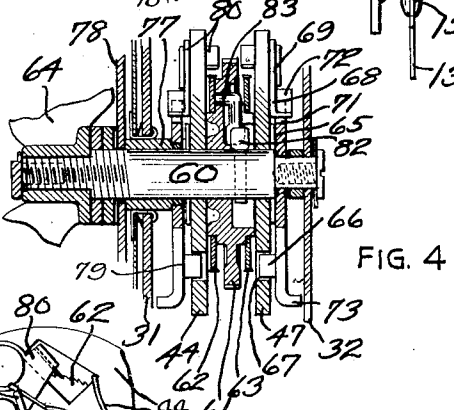
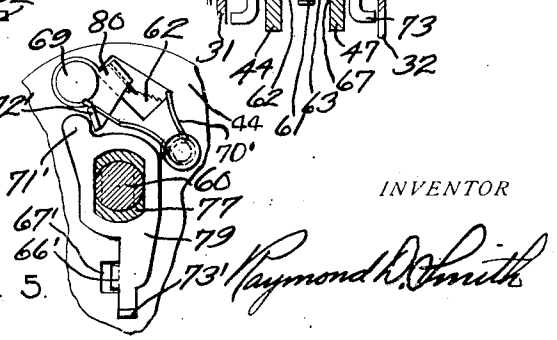


FIG. 5.



INVENTOR

Raymond D. Smith

Nov. 14, 1933. R. D. SMITH 1,935,232

CONVERSIONAL TIMING MECHANISM

Filed July 26, 1927 4 Sheets-Sheet 2

FIG. 6

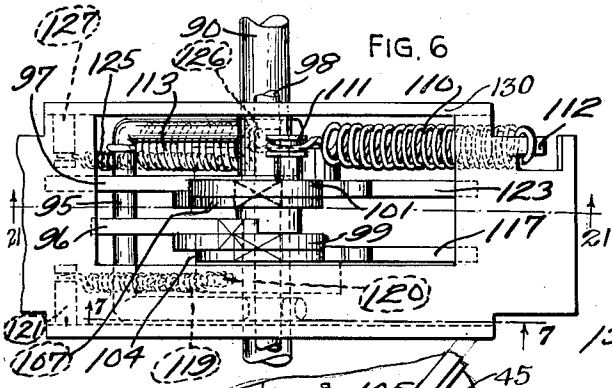


FIG. 9.

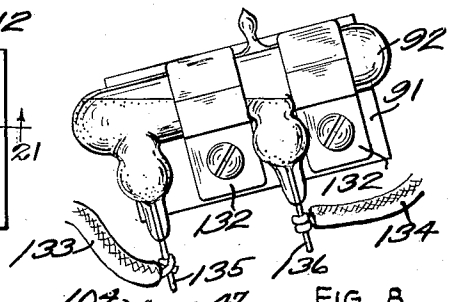
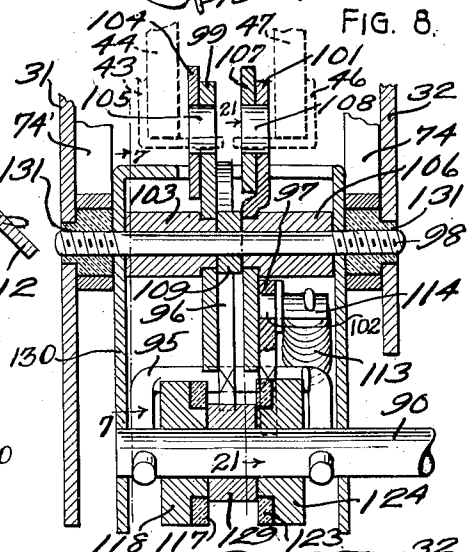


FIG. 8.



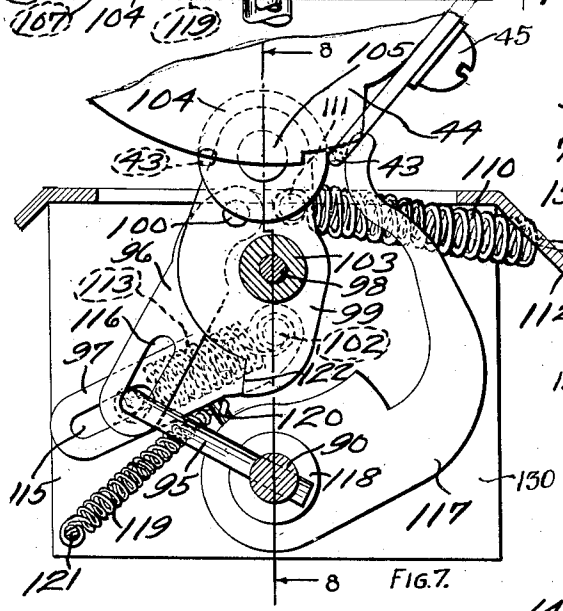


FIG. 7.

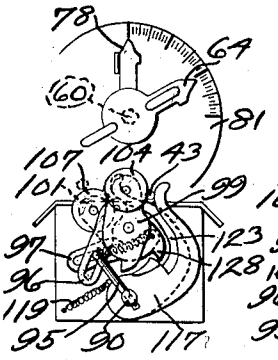


FIG. 10

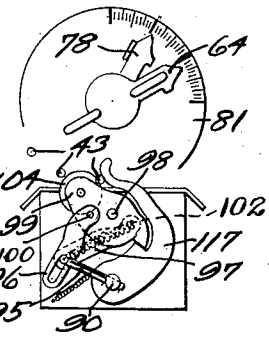


FIG. 11

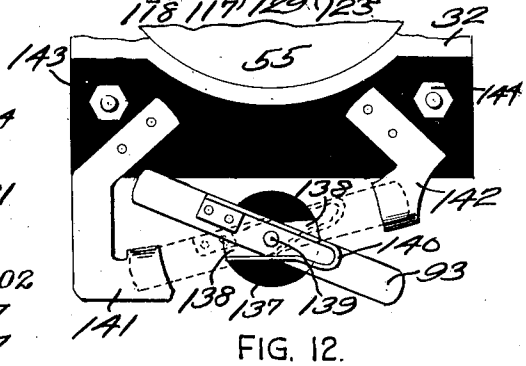


FIG. 12.

INVENTOR

Raymond D. Smith

Nov. 14, 1933. R. D. SMITH 1,935,232

CONVERSIONAL TIMING MECHANISM

Filed July 26, 1927 4 Sheets-Sheet 3

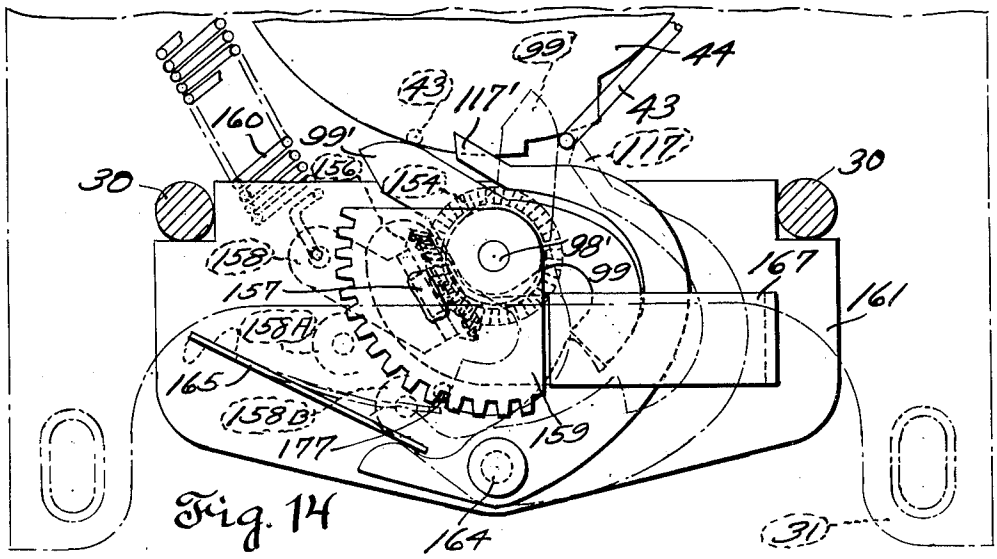


Fig. 14

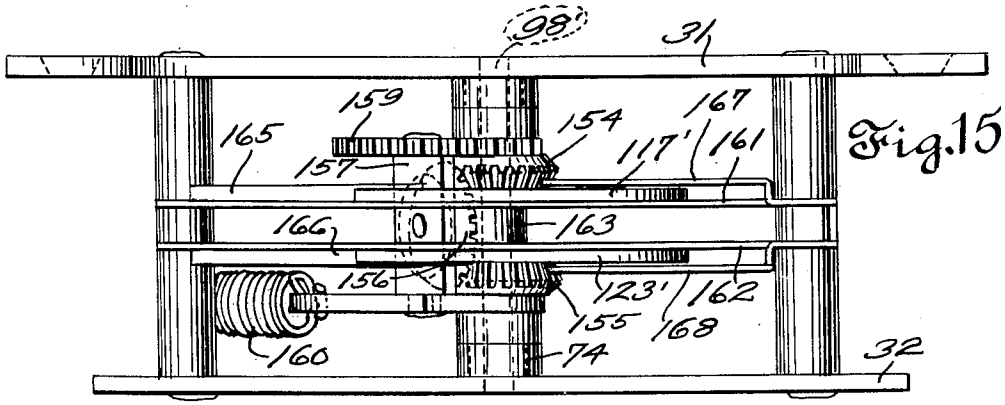


Fig. 15

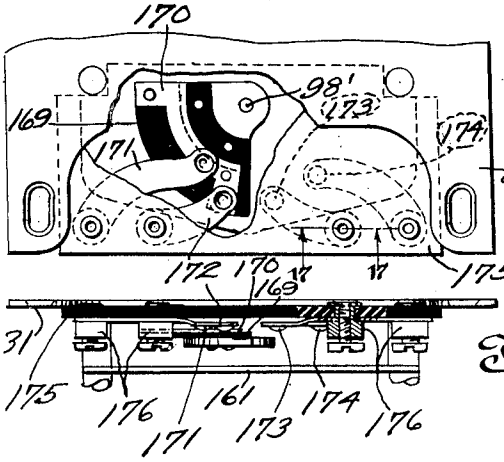


Fig. 16

Fig. 17

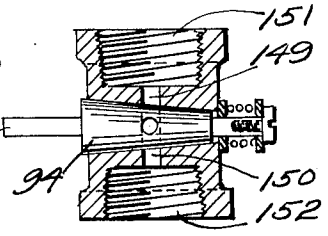


Fig. 13

INVENTOR

Raymond D. Smith

Nov. 14, 1933. R. D. SMITH 1,935,232

CONVERSIONAL TIMING MECHANISM

Filed July 26, 1927 4 Sheets-Sheet 4

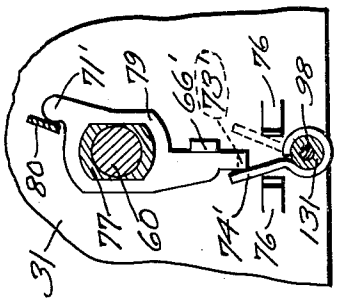


FIG 18

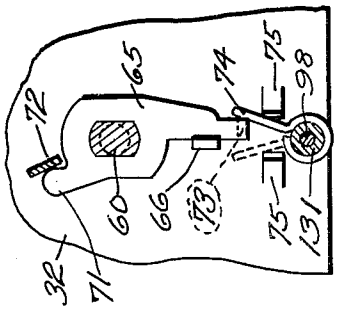


FIG. 19

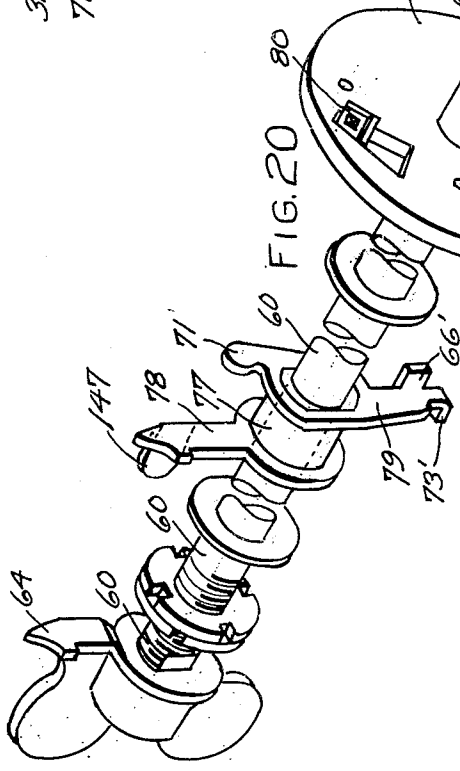


FIG. 20

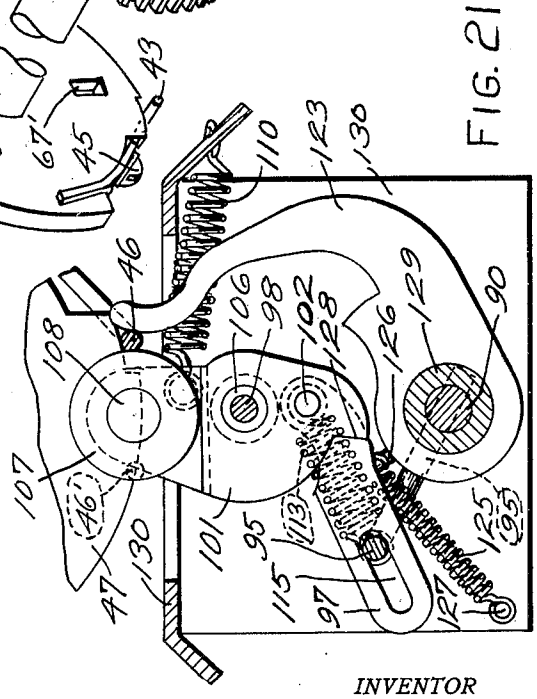


FIG. 21

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Patented Nov. 14, 1933 1,935,232

UNITED STATES PATENT OFFICE

1,935,232

CONVERSIONAL TIMING MECHANISM

Raymond D. Smith, Pleasantville, N. Y., assignor to Tremont Products Corporation, Boston, Mass., a corporation of Massachusetts

Application July 26, 1927. Serial No. 208,547

13 Claims. (Cl. 161—1)

This invention relates to a mechanism for accomplishing one or all of the circuit controlling effects possible to my circuit switching timer disclosed in my co-pending application Serial No. 183,838, with resort to a single, ultimate actuator for the circuit controlling contacts or other device such as a gas valve to be actuated through the medium of time setting controls.

A particular species of the present improvement contemplates the tilting by means of such mechanism of a mercury container in which the movement of the mercury acts to make and break an electric circuit.

The invention will be fully understood from the following description and accompanying drawings in which:

Fig. 1 is a front view of a complete mechanism illustrative of the present improvements, the upper or time actuating parts of which may be identical with those pictured and described in my said co-pending application, Serial No. 183,838.

Fig. 2 is a side elevation looking at the right of Fig. 1, certain parts being broken away more clearly to show the construction.

Fig. 3 is a bottom plan view looking upwardly at Fig. 1.

Fig. 4 is a fragmentary cross sectional view taken on the plane 4—4 in Fig. 2.

Fig. 5 is a fragmentary view taken in section on the plane 5—5 in Fig. 2 looking in the direction of the arrows.

Fig. 6 is an enlarged view of the differential actuating mechanism looking downward on the plane 6—6 in Fig. 2.

Fig. 7 is an enlarged front view taken in section on the plane 7—7 in Fig. 6 looking in the direction of the arrows; the parts being shown as they are positioned when both time pointers are at zero.

Fig. 8 is a sectional view taken on the plane 8—8 in Fig. 7 looking in the direction of the arrows.

Fig. 9 is a rear view of the mercury tube switch looking from the right at Fig. 2.

Fig. 10 is an outline view of reduced size showing the position taken by the parts in Fig. 7 when one time pointer only is removed from zero.

Fig. 11 is a view similar to Fig. 10 with the parts positioned in the condition they assume when both time pointers are set away from zero.

Fig. 12 illustrates how a simple metallic contact may be substituted for the mercury tube to produce an equivalent circuit controlling effect.

Fig. 13 indicates a gas valve that may be operated in the same manner to cut off or permit the flow of gas.

Fig. 14 is an enlarged view of the lower portion of Fig. 1 showing a modified form of mechanism that may be substituted for that mechanism shown in Fig. 7.

Fig. 15 is a bottom plan view looking upwardly at Fig. 14.

Fig. 16 shows electric current switching contacts adapted to the actuating mechanism of Figs. 14 and 15, certain parts being broken away more clearly to show the contacts and this figure is on the same scale as Fig. 1.

Fig. 17 is a partial bottom plan view looking upwardly at Fig. 16 with certain parts sectioned on the plane 17—17 in Fig. 16.

Fig. 18 is a fragmentary view taken in section on the vertical plane 18—18 in Fig. 2 looking in the direction of the arrows.

Fig. 19 is a fragmentary view taken in section on the vertical plane 19—19 in Fig. 2 looking in the direction of the arrows.

Fig. 20 is an isometric view of the parts carried by shaft 60 shown in separated relation on said shaft looking from the rear, right side of Fig. 1 to the front, left side of Fig. 1.

Fig. 21 is a view on the same scale as Fig. 7 taken in section on the vertical plane 21—21 in Fig. 6 and in Fig. 8.

Throughout the drawings different views of each part are designated by a common reference numeral.

I will first describe the timer and actuating mechanism that may be identical with that disclosed in my hereinbefore mentioned co-pending application although it will be understood that any other kind of timing mechanism of equivalent characteristics may be employed and for a more particular understanding of some of the details reference may be had to another of my co-pending applications Serial No. 675,419.

Supported between front plate 31 and rear plate 32 which are spaced and connected by posts 30, is a system of rotary mechanism shown sectioned in Fig. 4 and in edgewise elevation in Fig. 2 and isometrically in Fig. 20 and which includes the time determining means and has operated, as well as operating, connection with the time movement (shown in main by broken lines inside the casing 55) by means of a pinion 56 recessed at the forward end of its hub to bear on the stud 57 and having its rear hub journaled in the rear frame plate 32 and provided with a square hole fitting the square terminus of winding spindle 58 of the time movement which is

impelled in a clockwise direction in Fig. 1 by the power spring 59. In the present improvement power spring 59 is not called upon to supply the power that operates the switch or gas valve as is required of it in my co-pending application Serial No. 183,838.

The time setting mechanism shown more particularly in Figs. 4 and 5 and in Figs. 18, 19 and 20 is comprised of two concentric and quite similar sets of parts turnable both with and upon, or relative to, the main shaft 60. Each of these sets of parts derives its timing movement from a variable and releasable drive connection to a central gear 61 loose upon shaft 60 except for abutment of a pin 82 in said shaft against a flip stop 83 pivoted in said gear, and gear 61 is constantly in mesh with pinion 56 and is flanked by two ratchet toothed wheels 62 and 63 fixed to gear 61.

There are two rotary sets of similarly co-acting parts designated in the drawings by the same numerals respectively primed and not primed so a description of either of these sets of parts will also fully describe the other by reference to Fig. 5. One of these two sets of parts turning upon the axis of shaft 60 comprises as part of a common rotor with said shaft, a time pointer 64 at the forward end and the release dog 65 at the rear end. Impelled positively by release dog 65 is the timer disc 47 by means of the engagement of a forwardly bent tongue 66 with an opening 67 in the disc 47 permitting a degree of lost motion, or limited relative movement, between release dog 65 and the disc 47. Disc 47 further carries pivoted thereon a pawl 68 (see 80) that falls into engagement with the ratchet teeth on wheel 63, being yieldingly urged into such engagement by the spring 70 (see 70') and displaceable therefrom through the limited relative movement between disc 47 and release dog 65 which movement permits the finger portion 71 (see 71') of dog 65 to urge the operating ear 72 (see 72') of pawl 68 (see 80) to the right in Fig. 5. This permits disc 47 to be rotated freely in either direction by turning pointer 64 and yet renders it positively impellable, when undisturbed, by pressure of finger 71 upon ear 72, in the contraclockwise direction in Fig. 1 by the running of the time movement and until something occurs to resist the free travel in such direction of release dog 65 in which event even if said dog be positively arrested, gear 61 with its ratchet wheel 63 may continue contraclockwise rotation because as each tooth of the ratchet wheel comes to bear pressure upon pawl 68 the increment of rotative travel of disc 47 resulting will press finger 71 against the stationary operating ear 72 and lift the pawl to permit free passage of the ratchet tooth.

Release dog 65 is so arrested in its travel contra clockwise when pointer 64 reaches its vertically upward or zero position through interception of the lower bent terminus 73 by the swing stop 74 limited in its swing by abutments 75 and 75 struck forwardly from the rear frame plate 32, the stop 74 being pivoted on the mounting bushing 131.

A similar co-action and relation of parts is provided in a rotor comprising bearing hub 77 carrying fixed on its forward end the time pointer 78 exterior of the frame plate 31 and carrying interior of said frame plate the release dog 79 also fixed thereto, said dog 79 co-acting with the timer disc 44 and its pawl 80 in the same manner as release dog 65 with timer disc 47 and its pawl 68 above described, the ratchet wheel 62 in this case co-acting with pawl 80 just as ratchet wheel 63 has been described to co-act with pawl 68. Two abutments 76, 76 struck rearwardly from front plate 31 act to limit the travel of release dog 79 through the instrumentality of stop lever 74' as do the abutments 75, 75 act upon release dog 65 through the medium of stop lever 74.

The time dial 81 may have any markings consistent with its purpose and may be mounted on the front face of frame plate 31 to be fixed or rotatively adjustable for computing time in terms of the time of day. When this dial is made rotatable I may provide a zero marker on frame plate 31 as a fixed point from which to compute the time setting. The winding of power spring 59 is effected through the engagement of the pin 82 in shaft 60 with the flip stop 83 in gear 61 before referred to. To insure starting of the movement an agitator 84 may be pivoted to the movement frame at 85 and have a projection 86 for operating the same extending forwardly through the rear frame plate 32 to be thrown against the balance wheel 87 or other sensitive part of the movement by the starter finger 88 carried by disc 47 and spring-positioned to actuate the agitator 84 when time pointer 64 is being manually displaced from zero.

Timer disc 47 carries the operating finger 46 adjustably mounted thereon by the screw 48 and timer disc 44 carries a corresponding operating finger 43 held by screw 45; the travel and performance of these two operating fingers being similar in all respects and in their relation to that part of the time actuating mechanism so far described, to the travel and performance of similar parts in my co-pending application 183,838.

The improvements consituting the present invention reside per se and in combination with the foregoing described mechanism of the immediate actuating mechanism for the switch, valve or other device to be operated, next to be described. The object of the following mechanism is to convert the similar automatic movements of operating fingers 43 and 46 which take place in a common direction, into respectively reciprocative movements of an ultimate actuator such as the shaft 90, in Figs. 1, 2 and 3 shown as carrying rigidly mounted at its rear end the vertically disposed plate 91 as convenient mounting means for any common form of mercury tube switch 92. In Fig. 12 shaft 90 is shown fitted at its rear end 139 with a conductive, metallic, switch contact bridging member 93. In Fig. 13 this same shaft 90 is adapted to turn the port control plug 94 of a valve by means of any suitable operating connection to the plug stem 153.

The mechanism immediately acting to operate shaft 90 consists of a bail crank 95 connected to be operated in opposite directions respectively by the front link 96 and rear link 97 through the pivoting of said two links on diametrically opposite sides respectively of the spindle 98 serving as pivot for the front rocker 99 to which link 96 is pivoted at 100, and for rear rocker 101 to which link 97 is pivoted at 102. Rocker 99 is fixed to its hub 103 and carries the wheel 104 pivoted thereon at 105 to be actuated by the operating finger 43. Rocker 101 is fixed to its hub 106 and carries mounted thereon the wheel 107 pivoted at 108 to be actuated by the operating finger 46. Hubs 103 and 106 are separated by the spacer washer 109. Spring 110 connects a spring stud 111 with a frame projection 112 urging rocker 101 in a clockwise direction in Figs. 7, 10 and

11. Spring 113 connects a stud 114 (constructed as the terminus of pivot 102) with the bail crank 95, stud 114 being carried by rocker 101 also and spring 113 thereby urging bail crank 95 to remain seated at the inner end of the elongated slot 115 in link 97. A corresponding slot 116 is the means by which link 96 engages bail crank 95.

A latch member 117 loosely pivoted on shaft 90 at its hub 118 has a spring 119 connecting a pin 120 with frame stud 121 to urge latch 117 into engagement with a spur 122 on rocker 99. A corresponding latch member 123 loosely pivoted on shaft 90 at its hub 124 has a spring 125 connecting a pin 126 with frame stud 127 to urge latch 123 into engagement with spur 128 on rocker 101. Hubs 118 and 124 are separated by the spacer collar 129. Shaft 90 and spindle 98 have a common mounting in a retaining frame 130 and spindle 98 is further mounted at its extreme ends in the front plate 31 and rear plate 32 by means of bushings 131 thus insuring accurate positioning of wheels 104 and 107 and of latch members 117 and 123 for correct operating relation to fingers 43 and 46.

The operation of the foregoing parts is as follows. Having in mind that pointers 64 and 78 are ultimately and finally returned by the time movement in a contraclockwise direction to their common top center position indicated by broken lines in Fig. 1, it is first to be understood that Figs. 7 and 21 indicate the corresponding position of both operating fingers 43 and 46 and of the parts actuated thereby, bail crank 95 occupying its lower extreme position. Manual displacement of pointer 64, alone, by turning to the right as indicated in Fig. 10 causes operating finger 46 to swing rocker 101 contraclockwise until latch 123 is snapped into engagement with spur 128 by spring 125 to hold rocker 101 thus positioned, or "cocked", against the tension of spring 110. This action of rocker 101 is fully accomplished by that part of the movement of operating finger 46 represented between the full line and broken line showing of finger 46 in Fig. 21, and through the tension in spring 113 pulls bail crank 95 into its uppermost position as shown in Fig. 10, this movement being accommodated without corresponding movement of rocker 99 because of the elongated slot 116 in link 96. Now if pointer 64 be manually or under time control returned to its top center, or zero position finger 46 will freely pass wheel 107 and force latch member 123 from its dotted line position to its full line position in Fig. 10 thus releasing spur 128 to the pull of spring 110 which will snap rocker 101 back to the position of all parts as shown in Fig. 7. The usefulness of the wheel or roller 104 as an anti-friction device comes into play when the cam finger 43 attempts to pass in its contraclockwise return (Fig. 11) for tripping the latch 117. Owing to the settling back of the rocker 99 in a clockwise direction until held by the latch 117 after being cocked by the passing of cam finger 43 in its clockwise travel, the roller 104 is lifted slightly into the path of travel of cam finger 43 and by its ability to turn greatly eases the effort which finger 43 must exert against the rocker spring 113 in order to slightly depress the roller 104 in returning past same. The same is true of the other roller 107.

If, however, starting from the position of parts as in Fig. 10, time pointer 78 be likewise displaced from its top center, or zero position by turning to the right, operating finger 43 through engagement with wheel 104 throws rocker 99 contraclockwise into alignment with rocker 101, whereupon its spur portion 122 is caught and held by latch member 117, and the consequent downward thrust of link 96 overcoming the tension in spring 113 has forced bail crank 95 back to its original or lowermost position, this movement being permitted in the absence of corresponding movement of rocker 101, by means of the elongated slot 115 in link 97. The parts are now positioned as shown in Fig. 11.

From the foregoing description, it will be plain that no further action of either rocker 99 or rocker 101, and therefore no further movement of bail crank 95, will take place until one or both of pointers 78 and 64 have been returned to their top center or zero position. Upon the return of pointer 78 to zero, parts will restore themselves to the position in Fig. 10, and upon the later return of time pointer 64 to zero, the parts will restore themselves to the position in Fig. 7, it being seen that each departure and arrival of either pointer 78 or 64, singly from zero, results in alternately upward and downward movement of bail crank 95 through a mechanism that thus converts successive uni-directional travel of operating fingers 43 and 46 into respectively reverse movements of an ultimate actuator such as bail crank 95 and shaft 90 which may be put to useful purposes that will next be described.

The mercury tube switch of Figs. 1, 2, 3, and 9 comprises a hermetically sealed, cartridge shaped, glass container 92 hereinbefore mentioned, depending from which are two pockets both of which contain pools of mercury at all times. In the position shown in Fig. 9 tube 92 held against plate 91 by clips 132 is tipped at such an angle that the said pools of mercury are electrically connected by the superabundance of mercury in the tube, but, on the other hand, tipping of the tube to its position in Fig. 1 throws the entire body of mercury into the nose of the tube thereby isolating the pool of mercury in the heel of the tube and breaking the circuit between lead wires 133 and 134 which connect respectively to conductive terminals 135 and 136 sealed into the glass wall of the tube and communicating respectively with the two pools of mercury. Any other form of fluid level switch may of course be substituted for the particular mercury tube 92 herein disclosed merely for purposes of illustration.

In Fig. 12 the shaft 90 carries at its rear end 139 an insulating block 137 formed with a diametrical cut out or recess 138 of sufficient angular extent to permit a limited swing from side to side of said recess of a conductive bar 93 pivoted at 139 concentrically with shaft 90 and urged to the side of recess 138 indicated in full lines in Fig. 12 by the leaf spring 140. Contraclockwise movement of shaft 90 causes block 137 positively to impel blade 93 into its broken line position conductively bridging stationary contact clips 141 and 142 mounted on an insulating plate 143 secured to the frame plate 32 by nuts 144. As this is the direction of movement effected by the time release snap action of shaft 90 the circuit making is quick. The reverse movement of shaft 90 normally taking place no faster than the pointer 78 is manually turned away from zero, effects a correspondingly quick action of blade 93 to break contact with clips 141 and 142 because the initial part of the clockwise movement of block

137 in Fig. 12 does not immediately move blade 93 the latter being retained by the friction thereon of contact clips 141 and 142 thus storing tension in spring 140 until the shoulder of recess 138 positively disengages blade 93 from the clips at which time the tension in spring 140 snaps the blade away from the clips causing a quick breaking of the circuit. Thus it will be seen that the metallic switch of Fig. 12 is truly a quick make and break switch in its actions both to make and to break the circuit.

A removable stop piece may be applied to the handle of pointer 64 such as the part 145 in Fig. 2 having the depending stop finger 146, the function of which is to engage with the upstanding ear 147 on pointer 78 when pointer 64 is at bottom center position whereby if desired the switch may be left in the reverse condition from that it assumes when both pointers are at top center position and the timing movement therefore kept from ultimately making or breaking the circuit as desired.

In order not to depend on inspection of the relative and absolute position of the time pointers in order to know whether the switch is on or off I may provide shaft 90 with an indicator 148 preferably visible from the front of the device.

It will be plain that by introducing the equivalent of recess 138 and spring 140 for the actuation of mercury tube 92 I may cause the tilting of the latter to be abrupt, or snap acting, in both directions at all times.

Or I may substitute for any kind of electric switch device any sort of gas cock or valve for any purpose whatever exemplified by any port control member such as the valve plug 94 shown in Fig. 13 as governing the communication of conduit 149 and conduit 150 connectible into a pipe line by the threaded outlets 151 and 152 respectively, shaft 90 being connected directly, or by gears, or in any suitable way whatever to actuate spindle 153. Nor do I limit myself to the type of valve shown, as an axially acting, or tappet, or plunger type of valve can as easily be operated by the movement of shaft 90 through the instrumentality of a crank, eccentric cam, rack and gear, or other suitable mechanism.

The modification shown in Figs. 14 and 15 contemplates a different resultant movement from the latching and unlocking of rocker 99' by latch 117' analogous to the co-action of rocker 99 and latch 117 in Fig. 7 and of rocker 101' by latch 123' analogous to the co-action of rocker 101 and latch 123 in Fig. 7. To produce the above said different resultant movement of a shaft 98' taking the operative place of shaft 90 in Fig. 7, I may resort to a differential gear system similar to that described in my co-pending application Serial No. 150,278 wherein rocker 99' carries fixed thereto the bevel gear 154 and rocker 101' carries a similar bevel gear 155; the floating bevel gear 156 being constantly in mesh with both gear 154 and 155 and itself being pivoted on the cross bar 157 riveted at its rear end to the spring lever 158 and at its forward end to the gear segment 159, the said cross bar, spring lever, and segment, thereby comprising a rigid yoke-like structure loosely pivoted upon shaft 98' concentric with the rockers 99' and 101' and constantly urged into the position shown in Fig. 14 by the power spring 160 connecting spring lever 158 with any convenient portion of the frame. Two similar plates 161 and 162 are spaced by the collar 163 and afford a convenient pivot for latches 117' and 123' normally urged into their full line or locking position by two leaf springs 165 and 166. The tongues 167 and 168 may be struck out of the metal of plates 161 and 162 respectively to retain the rockers and the latches in their common plane of operating alignment. Stops 177 may separately limit the throw of each rocker 99' and 101' against the pull of spring 160.

The operation of the mechanism in Figs. 14 and 15 is as follows. Normally, when both time pointers are at top center or zero position both rockers and both latches occupy their broken line position in Fig. 14 permitting power spring 160 to position the segment as shown. Upon turning time pointer 64 to the right away from zero, front rocker 99' and front latch 117' move to the full line position in Fig. 14 and the approximately 60 degree swing of rocker 99' through the differential action of the bevel gears swings spring arm 158 downwardly to its position 158A which is about one half the angular movement of rocker 99' inasmuch as rocker 101' and its bevel gear 155 performs no movement, the floating bevel gear 156 merely rolling in mesh with same. As segment 159 travels in unison with spring lever 158, it also will be swung about 30 degrees contraclockwise or one half the angular swing of rocker 99'. Now if time pointer 78 be also turned to the right away from zero, rear rocker 101' and rear latch 123' also assume the full line position represented in Fig. 14, bevel gear 154 this time remaining stationary and the resulting throw of spring lever 158 and segment 159 being about 30 degrees farther in the same contraclockwise direction or spring lever 158 moving to its position 158B. Obviously, when pointer 78 is returned to zero either by running of the time movement or directly by hand actuation, spring lever 158 is restored to its position 158A and upon the subsequent return of pointer 64 to zero latch 123' is tripped and all parts are restored to correspond with the position of the segment 159 in Fig. 14.

It will thus be seen that shaft 98' of Fig. 14 swings in two increments of travel in the same direction upon setting of the time and reverses these increments of travel upon the running out of the time as differing from Figs. 7, 10 and 11 where each arrival or departure of each pointer from zero position causes consecutively reverse movements of the shaft 98. There are many useful purposes to which this different characteristic of movement of shaft 98' in Fig. 14 may be put having to do with the actuation of electric switches, valves and the like, one example of which I show in Figs. 16 and 17 wherein is substituted for the toothed segment 159 an insulative segment 169 carrying the conductive distributor plate 170. For co-operating with such a distributor plate I may arrange a series of stationary spring contacts in any number and for a great variety of purposes and I may shape the distributor plate 170 in many different ways to produce a variety of circuit controlling effects.

Herein I show one spring contact 171 which may, for instance, be connected to a source of current and designed to be constantly in contact with distributor plate 170 in all three positions of segment 169 whereas three other spring contacts 172, 173 and 174 may be singly furnished with current by the distributor plate 170 in each of its respective three positions. Or, by connecting contacts 172 and 174 to the same load such as the opening magnet of a relay switch

and by connecting contact 173 to a different load such as the closing magnet of this same relay switch I may cause each successive arrival and departure of either time pointer to result in the alternate opening and closing of the relay switch, for obviously every distinct movement of segment 169 will shift the current from the opening magnet to the closing magnet or vice versa. Thus I devise a different way of effecting the circuit control represented in Fig. 13 of my co-pending application Serial No. 150,278 and the similar type of circuit control represented in Figs. 30 to 33 inclusive of my co-pending application, Serial No. 183,838.

Each of the spring contacts 171 to 174 inclusive may be provided with a binding post 176 of common construction as shown in section in Fig. 17 the insulating plate 175 serving as a rigid mounting for all of these electrically alive parts.

Referring to Figs. 14 and 16, as the movements of segment 159 will be seen to be analogous to the movements of segment numbered 57 in Figs. 7 to 21 inclusive, of my co-pending application Serial No. 150,278, all of the useful applications of this movement suggested with respect to the said segment of my co-pending application will be understood as contemplated and available to the present improvements.

In addition to the hook-up of a reciprocating or toggle type of switch with a time controlled segment such as 159 of the present improvement having two stages of movement in one direction and corresponding reverse actions, such as the switch 94 shown in Figs. 19 to 21 inclusive, of my co-pending application Serial No. 150,278, I may, to good advantage substitute for such reciprocating, or toggle, type of switch, a rotary switch of the type well known as a 3-heat switch in which the contacts are often arranged so that at each successive quarter-turn of the switch handle respectively different circuits are established to produce high, low, medium or no heat, and in which type of rotary switch the contacts can as well be arranged so that a quarter-turn of the switch handle in either direction always makes or breaks the circuit with a snap action due to the particular type of spring and detent mechanism designed to snap the contacts in quarter-turn stages of rotation in either direction. Obviously to produce the current switching effect characteristic of Fig. 13 and of Figs. 17 and 21 of my said co-pending application, all I would need to do with a reverse acting rotary snap switch such as mentioned, is to mount the gear 79 in Fig. 17 in the co-pending application to turn the spindle of such rotary switch just as the latter is designed to be turned by hand in either direction.

Also a valve of any kind, as for instance that pictured in Fig. 13, may be operated for multiple and various functions of flow control by suitable connections to shaft 98'.

Whereas I have shown a tilting mechanism including a shaft 90 having a fixed axis in certain figures of the present drawings, I may effect the tilting of the mercury container 92 in different ways. For instance, I may support it in a cradle tilted by the action thereupon of two elements moving in opposite directions on each of which the container depends for its support and said elements may derive their movements for tilting the container through actuation respectively by cams 44, 47 or suitable means carried thereby. I may also, if preferred, tilt a shaft such as 90 by the action of bell crank levers pivoted to be rocked in relatively opposite directions at opportune times by any desired conformation of the periphery of cams 44 and 47 in which case I preferably introduce a compensating element to permit free action at any time such bell crank levers might be acted upon by cams 44 and 47 with opposing effect upon shaft 90.

Without, therefore, intention of limiting the present improvements as herein claimed to a narrower scope than is involved in the novel combinations and principles specified, I claim as my invention:

1. In combination, timing mechanism, two actuators, means to tension said actuators for release by said timing mechanism, a device pivoted to be rocked by movement of each of said actuators, a connecting member between one of said actuators and said device acting to rock the latter in the same rotational direction as said actuator, and a separate connecting member between the other actuator and said device acting to rock the latter in an opposite rotational direction from the movement of the said other actuator.

2. In mechanism of the class described, a swingable element to be motivated, two rockers for motivating said element, a movement transmitting link so connecting one of said rockers to said element that said element is motivated thereby in the same direction as said rocker, and another movement transmitting link so connecting the other of said rockers to said element that said element is motivated thereby in the opposite direction from said other rocker, one of said links having lost motion connections permitting one of said rockers to move independently of the position of the other rocker.

3. In mechanism of the class described, a swingable element to be motivated, two rockers for motivating said element, a movement transmitting link so connecting one of said rockers to said element that said element is motivated thereby in the same direction as said rocker, and another movement transmitting link so connecting the other of said rockers to said element that said element is motivated thereby in the opposite direction from said other rocker, each of said links having lost motion connection permitting each of said rockers to move independently of the position of the other rocker.

4. In mechanism of the class described, a swingable element to be motivated, two rockers for motivating said element, a movement transmitting link so connecting one of said rockers to said element that said element is motivated thereby in the same direction as said rocker, and another movement transmitting link so connecting the other of said rockers to said element that said element is motivated thereby in the opposite direction from said other rocker, one of said links having lost motion connections permitting one of said rockers to move independently of the other rocker, together with a spring connected to normally take up the said lost motion but yieldable to permit same.

5. In mechanism of the class described, a swingable element to be motivated, two rockers for motivating said element, a movement transmitting link so connecting one of said rockers to said element that said element is motivated thereby in the same direction as said rocker, and another movement transmitting link so connecting the other of said rockers to said element that said element is motivated thereby in the opposite direction from said other rocker, one of said links having lost motion connections permitting one

of said rockers to move independently of the position of the other rocker, together with a spring connecting said element to its rocker so as normally to take up the said lost motion and establish a normally maintained relationship between said element and its spring connected rocker, said spring yielding to permit relative displacement between said element and its spring connected rocker.

6. In mechanism of the class described, a swingable element to be motivated, two rockers for motivating said element, a movement transmitting link so connecting one of said rockers to said element that said element is motivated thereby in the same direction as said rocker, and another movement transmitting link so connecting the other of said rockers to said element that said element is motivated thereby in the opposite direction from said other rocker, one of said links having lost motion connection permitting one of said rockers to move independently of the other rocker, together with a spring connected to normally take up the said lost motion but yieldable to permit same, and so connected that said element is motivated in one direction by the rocker acting through the tension in said spring.

7. In combination, a swingable element to be motivated, a rocker, a connection for transmitting movement between said element and said rocker and arranged to provide lost motion whereby said rocker can move without corresponding movement of said element, a spring connected to urge said element to move when said rocker moves, a second rocker, a second connection for transmitting movement between said element and said second rocker and arranged to provide lost motion whereby said second rocker can move without corresponding movement of said element.

8. In timing mechanism, a reciprocatory element to be motivated, two separately movable rockers for motivating said element, a spring urging one of said rockers to a definite absolute position, a second spring urging said element into a definite position relative to said rocker, a second rocker connected to cause relative movement between said element and the first said rocker against the resistance of said second spring, and connections affording lost motion so that one rocker can be moved without moving the other rocker.

9. In timing mechanism, a reciprocatory element to be motivated, two separately movable rockers for motivating said element, a spring urging one of said rockers to a definite absolute position, a second spring urging said element into a definite position relative to said rocker, a second rocker connected to cause relative movement between said element and the first said rocker against the resistance of said second spring, and connections affording lost motion so that one rocker can be moved without moving the other rocker, together with means to retain the first said rocker displaced from its said absolute position against the action of the first said spring, and means to retain the second rocker and element displaced from their said definite relative position against the action of said second spring, and control instrumentalities for discharging said rockers from the control of their said respective retaining means to the action of their said respective springs.

10. In combination, timing mechanism, a time setting handle adapted to rotate with the automatic running of the mechanism and formed as a key handle to be grasped by the hand of the operator, and a removable stop clip formed as a U-shaped resilient part to slip over and cling to said handle, said clip having a portion at one end projecting outside the limits of the shape of the handle structure, whereby said clip may readily be removed from said handle and reversed in its end-to-end relation for selectively determining the position in which said handle shall be stopped, and a stop member adapted to engage said clip portion.

11. In combination, timing mechanism, two spring-tensioned actuators, means separately to cock each of said actuators in tensioned position, means operable by said timing mechanism separately to fire said actuators from their tensioned positions, a device pivoted to be rocked by the firing movement of each of said actuators, a connecting member between one of said actuators and said device acting to rock the latter in the same rotational direction as the movement of said actuator when fired, and a separate connecting member between the other actuator and said device acting to rock the latter in an opposite rotational direction from the movement of the said other actuator when fired.

12. In a time switch, timing mechanism including its prime mover (59), a switch arm (95), an operating rocker (101), a spring (113) connecting said rocker and said switch arm whereby said rocker and arm are separable but tend to move in unison, cocking and firing means (123) controlled by said timing mechanism and operable to hold said rocker in a cocked position, a second rocker (99) operatively associated with said switch arm, cocking and firing means (117) controlled by said timing mechanism and operable to hold said second rocker (99) and thereby said switch arm in a cocked position against the tension of said spring while said operating rocker (101) is held in its said cocked position, and another spring (110) connected to cause the movement of said rocker (101) and thereby of said switch arm when said rocker (101) is released from its cocked position.

13. In a time switch, timing mechanism including its prime mover (59), a switch arm (95), an operating rocker (101), a spring (113) connecting said rocker and said switch arm whereby said rocker and arm are separable but tend to move in unison, a separator (96) having lost motion impelling engagement with said switch arm thereby to permit said arm to move with said rocker and also for moving said arm relative to said rocker against the action of said spring, cocking and firing means (123) controlled by said timing mechanism and operable to hold said rocker in a cocked position, a second rocker (99) operatively connected to said separator, cocking and firing means (117) controlled by said timing mechanism and operable to hold said second rocker (99) and through the instrumentality of said separator thereby to hold said switch arm in a cocked position separated from said rocker (101) against the tension of said spring while said operating rocker (101) is held in its said cocked position, and another spring (110) connected to cause the movement of said rocker (101) and thereby of said switch arm when said rocker (101) is released from its cocked position.

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