

Sept. 19, 1944.

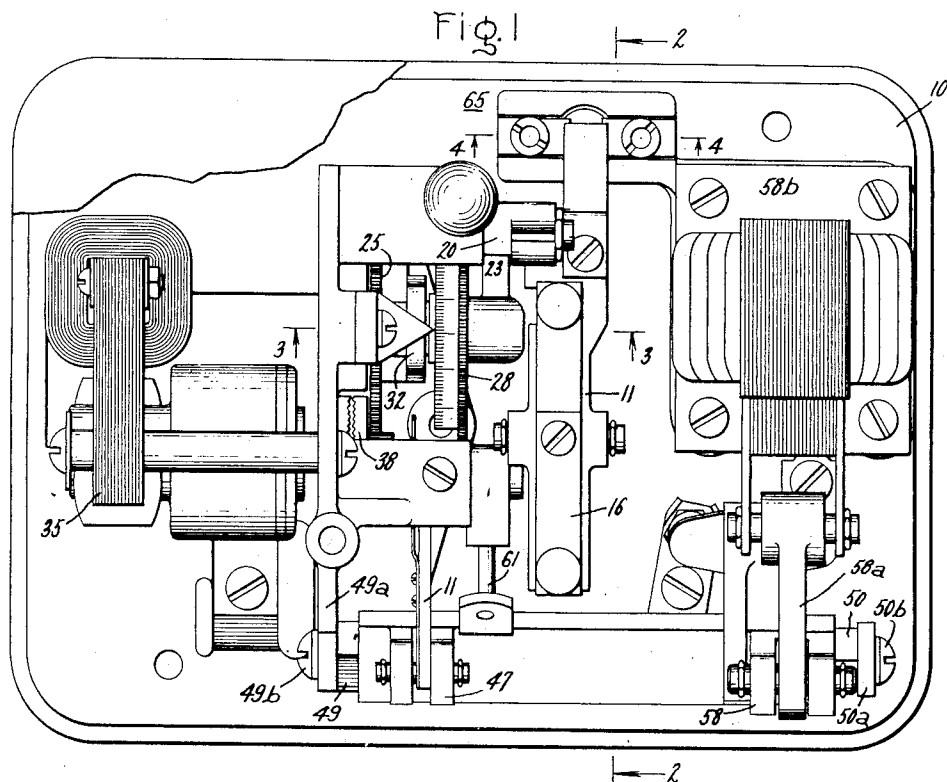
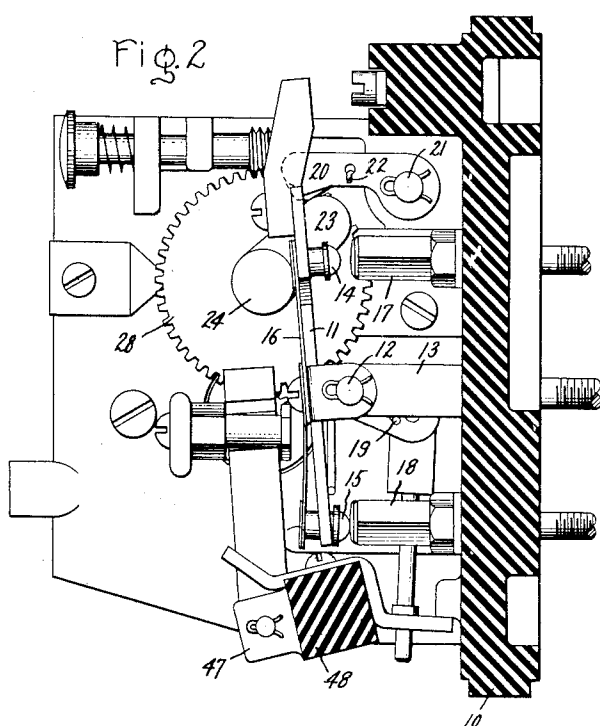
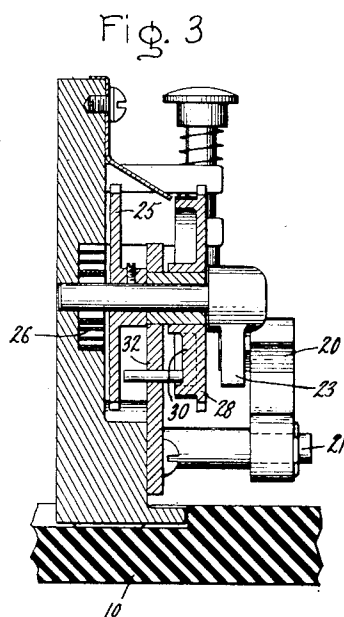
R. W. GOFF

2,358,633

TIMING MECHANISM

Filed Feb. 26, 1943

2 Sheets-Sheet 1



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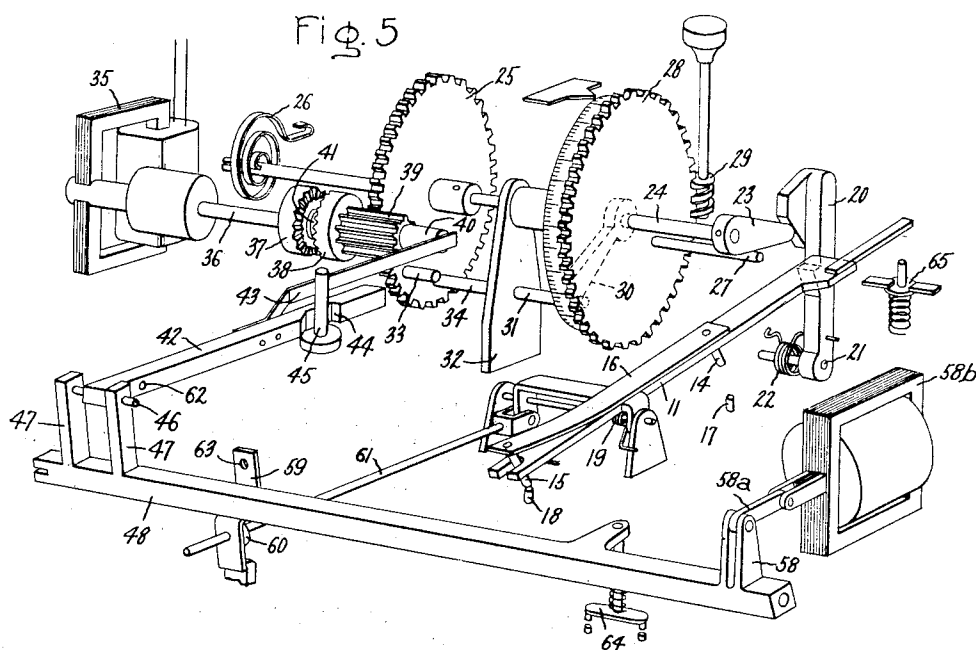
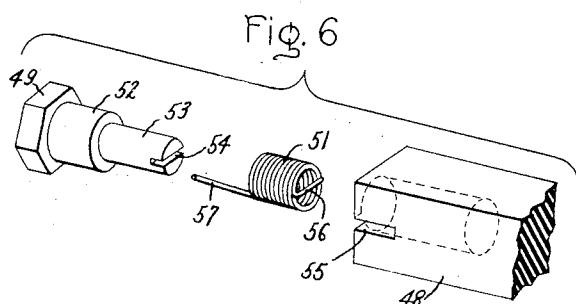
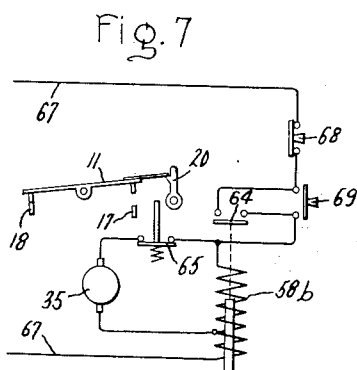
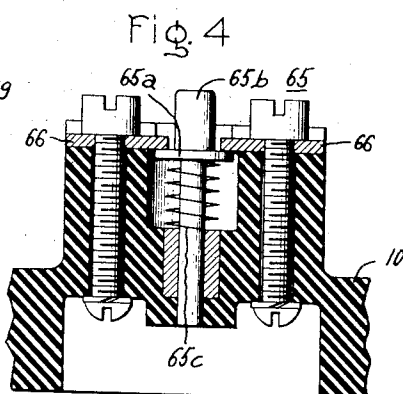
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TIMING MECHANISM

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2 Sheets-Sheet 2



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UNITED STATES PATENT OFFICE

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TIMING MECHANISM

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6 Claims. (Cl. 200—97)

My invention relates to timing mechanism, more particularly to motor driven electric circuit controllers for performing a switching operation after a predetermined time interval, and has for its object the provision of a new and improved device of this character which is simple and inexpensive in construction and durable and dependable in operation and which affords precision of adjustment and accuracy of operation over a wide range of time intervals.

It is a further object of my invention to provide a new and improved arrangement for interchanging the control of a device of the above character selectably to permit initiation of a timing interval either by the closing or the opening of a control circuit.

In carrying out my invention in one form I provide a pivoted contact arm biased to a released position to effect a circuit controlling function and a latch member biased to a latching position for retaining said contact arm in a latched position against its bias. To time an interval terminated by release of the contact arm I provide a driven shaft carrying a cam or lever operable upon rotation of the driven shaft in one direction to a predetermined position to actuate the latch member to release the contact arm. Spring means are provided for biasing the driven shaft for rotation in the opposite direction to an initial position determined by the position of an adjustable stop. An electric motor of the constant speed type is arranged to be connected by means of a clutch to the driven shaft so that the position of the adjustable stop and thus the extent of rotation of the driven shaft prior to actuation of the latching member determines the length of a timed interval.

For controlling the operation of the timer I provide a rocker shaft connected to an electromagnetic actuator such as a solenoid. The rocker shaft is biased by means of a spring to one limiting position and is movable by the solenoid against its bias to a second limiting position. Selectable connection is provided between the rocker shaft and the clutch so that the clutch may be either engaged or disengaged as desired when the solenoid is energized, that is, solenoid may be selectably connected for normal energization or normal deenergization, the clutch being engaged upon an appropriate change in solenoid energization. A connecting link capable of transmitting force in only one direction is provided between the rocker shaft and the switch arm. The link is selectably connectable to the rocker shaft in accordance with the clutch

connection so that the switch arm is reset to its latched position by clutch disengaging movement of the rocker shaft. Thus the rocker arm when in its clutch disengaging position retains the switch arm in its latched position independently of the latch member and when moved to its clutch engaging position by a change in the energization of the solenoid it releases the switch arm for response to actuation of the latch member.

Preferably the driving motor is arranged to be energized substantially simultaneously with the initiation of a timing operation by the controlling solenoid. Thus the timing interval is initiated by a suitable change in the energization of the solenoid to engage the clutch, release the switch arm and energize the driving motor. The timing interval is terminated by actuation of the latch member to release the switch arm. Preferably an interlock contact is provided for deenergizing the driving motor upon release of the switch arm. In order positively to ensure stoppage of the driven shaft after release of the latch, a mechanical stop is provided in such a position that it will stall the motor in the event that the motor interlock contact fails to disable the motor.

For a more complete understanding of my invention reference should now be had to the following detailed specification taken in conjunction with the accompanying drawings in which Fig. 1 is a front view of a relay embodying my invention; Fig. 2 is a sectional view thereof taken along the line 2—2 of Fig. 1; Fig. 3 is a fragmentary sectional view taken along the line 3—3 of Fig. 1; Fig. 4 is a fragmentary sectional view taken along the line 4—4 of Fig. 1; Fig. 5 is a simplified perspective view of the relay; Fig. 6 is an exploded perspective view of a detail of the relay rocker shaft; and Fig. 7 is a simplified circuit diagram of connections for the relay.

Referring now to the drawings, the preferred embodiment of my invention illustrated comprises a unitary relay structure compactly mounted upon a suitably formed insulating base plate 10. The relay itself comprises a movable switch arm 11 pivotally mounted intermediate its ends upon a fixed pivot pin 12 carried by a support 13 extending from the base 10. The switch arm 11 carries at opposite ends a pair of movable contacts 14 and 15 mounted upon a suitable wipe spring 16 for cooperation with a pair of fixed contact studs 17 and 18 respectively mounted upon the base 10. The switch arm 11 is biased for rotation in a clockwise

direction, as viewed in the drawings, by means of a helical spring 19 (Fig. 5) coiled about the pin 12 and engaging a portion of the support 13. In order releasably to retain the switch arm 11 in the latched position shown in the drawings I provide a pivoted latch member 20 mounted upon a fixed pivot pin 21 and biased by means of a helical spring 22 to a latch engaging position.

The latch member 20 is arranged to be actuated by means of a rotatable cam or arm 23 to release the switch arm 11. The cam 23 is rotatably mounted upon a driven shaft 24 which is fixedly attached to a driven spur gear 25. The driven shaft 24 is biased for rotation in a counterclockwise direction, as viewed in the drawings, by means of a spiral spring 26 connected between the shaft 24 and a fixed point on the base 10. The spring 26 biases the driven shaft 24 for counterclockwise rotation against an adjustable stop 27 carried by a time setting drum 28 which is loosely mounted upon the shaft 24 for rotation with respect thereto. Conveniently a portion of the periphery of the setting drum 28 is formed as a spur gear for cooperation with a manually operable worm gear 29 to set the drum 28 to a desired position. In the form illustrated in the drawings the drum 28 is hollow and open at one side and has formed internally thereof a radial arm 30 for cooperation with a fixed stop 31 mounted upon a supporting bracket 32 extending from the base 10. The purpose of the arm 30 and the stop 31 is to limit rotation of the setting drum 28 to a single revolution and to stop counterclockwise rotation of the drum 28 in the minimum time setting position of the apparatus, as illustrated in the drawings.

The driven gear 25 is also provided with a stop pin 33 arranged for cooperation with a fixed stop pin 34 in the bracket 32 positively to stop rotation of the driven shaft 24 shortly after the cam 23 has actuated the latch member 20 in timing operation. The purpose of the stop pins 33 and 34 will be described more fully hereinafter in connection with the mode of operation of the timing mechanism as a whole.

The driven shaft 24 is arranged to be rotated in a clockwise direction against the bias of the spring 26 by means of a constant speed electric motor 35 connected through a driving shaft 36, a pair of separable clutch members 37, 38, and a pinion 39 to the gear 25. The pinion 39 and the clutch member 38 are mounted upon an axially movable jack shaft 40, which is biased to a position of clutch disengagement by a helical compression spring 41 disposed between the clutch members 37 and 38. A longitudinally movable clutch actuating bar 42 carries in parallel spaced relation thereto a cantilever spring 43 engaging one end of the jack shaft 40. The bar 42 is recessed at 44 for camming engagement of the inclined walls of the recess with a fixed pin 45 extending from the base 10 to move the actuating bar 42 laterally and thereby to control engagement and disengagement of the clutch members 37 and 38.

The clutch actuating rod 42 is slidably and pivotally connected to a pin 46 carried at the ends of a pair of arms 47 upon a rocker shaft 48. The rocker shaft 48 is rotatably mounted at its ends upon suitable bearings, such as bearing pins 49 and 50 mounted upon the base 10. The bearing pin 50 fits loosely into a bored end of the shaft 48 and is attached to a fixed bracket 50a by a bolt 50b. As illustrated at Fig. 6 the bearing pin 49 is fitted with a helical spring 51

adjustably to bias the rocker shaft 48 in a counterclockwise direction as viewed in the drawings. For this purpose the bearing pin 49 comprises a head portion adjustably connectable to a fixed bracket 49a by means of a bolt 49b, a bearing portion 52 fitting loosely into a counterbore in the end of the shaft 48, and a section 53 of reduced diameter having at its end a diametrical slot 54. The rocker shaft 48 is slotted at its end as at 55. The spring 51 has one end bent diametrically as at 56 for interfittingly engaging the slot 54 in the pin 49 and has its other end extending tangentially as at 57. The bearing is assembled by slipping the spring 51 onto the reduced section of the bearing pin 49 until the end 56 of the pin lies in the slot 54. The pin and spring are then inserted into the bored shaft 48 so that the end 57 of the spring passes through the slot 55 in the shaft. The pin 49 may then be turned with respect to the shaft 48 to tension the spring 51 in the direction and to the extent desired. The bolt 49b is then tightened to fasten the pin 49 to the fixed bracket 49a in the desired position. The spring 51 thus extends between the fixed bearing pin 49 and the rocker shaft 48, and is arranged to bias the rocker shaft in one direction with an adjustable force determined by the position of the bearing pin 49 with respect to the rocker shaft. In the relay shown in the drawings the spring 51 is arranged to bias the rocker shaft 48 for counterclockwise rotation. The shaft 48 carries an arm 58 connected by a link 58a to an actuating solenoid 58b. The solenoid 58b is arranged when energized to rotate the rocker shaft in a clockwise direction against the bias of the spring 51.

The rocker shaft 48 is also provided intermediate its ends with a crossarm 59 arranged for cooperation with a collar 60 upon a reset rod 61. The reset rod 61 is connected at one end with the switch arm 11 and is selectably connectable for thrusting engagement only with the cross arm 59 to reset the switch arm 11 to its latched position upon clutch disengaging movement of the rocker shaft 48. The connection of the reset rod 61 to the rocker shaft is dependent upon the selected connection of the clutch bar 42 to the shaft. As shown in the drawings the bar 42 is connected for clutch disengagement upon counterclockwise rotation of the shaft 48 and the rod 61 is connected so that such counterclockwise movement exerts a thrust upon the collar 60 to reset the switch arm and to hold the arm non-responsive to actuation of the latch member 20. Clockwise movement of the shaft 48 to engage the clutch merely moves the crossarm 59 away from the collar 60 thereby to render the arm 11 responsive to actuation of the latch member 20.

With the above described connection of the rocker shaft 48 a timing interval is initiated by energizing the solenoid 58b to rotate the rocker arm 48 clockwise and thereby to engage the clutch members 37 and 38 and to release the switch arm 11 to the control of the latch member 20. To provide for initiation of a timing operation by deenergization rather than energization of the solenoid 51 the clutch actuating bar 42 is bored at 62 and the cross-arm 59 is drilled at 63 to provide for selectable connection of the clutch bar 42 and the reset rod 61 to the rocker shaft 48. The holes 62 and 63 are so arranged that when the pin 46 is in the hole 62 and the reset rod 61 is in the hole 63 the clutch members 37 and 38 will be engaged and the

collar 60 on the rod 61 will be free from the cross-arm 59 in the deenergized position of the solenoid 58b. With this latter arrangement of parts the solenoid 58b is normally energized and a timing interval is initiated by deenergization of the solenoid.

For suitable control of my timing relay I provide a normally open solenoid holding interlock contact 64 connected to the rocker shaft 48 for closure upon energization of the solenoid 58b. I also provide a normally closed motor interlock contact 65 mounted upon the base 10 for actuation to its open circuit position upon release of the switch arm 11 by the latch member 20. The motor interlock contact 65 is shown in detail at Fig. 4 and comprises a contact member 65a mounted upon a slidable rod 65b and biased by means of a spring 65c into engagement with a pair of fixed contacts 66 mounted upon the base 10. The rod 65b is arranged to be depressed by the switch arm 11 in its released position.

At Fig. 7 I have shown a schematic circuit diagram of connections for my timing relay in which elements corresponding to those described in connection with Figs. 1 to 6 of the drawings have been assigned like reference numerals. Fig. 7 shows that the solenoid 58b is connected to a source of electric current supply 67 through a normally closed "stop" pushbutton 68 and a normally open "start" pushbutton 69. The start pushbutton 69 is arranged to be shunted upon actuation of the solenoid 58b by the solenoid holding interlock contact 64. The motor 35 is connected for energization across a portion of the winding of the solenoid 58b through the normally closed motor interlock contact 65.

Assuming now that the rocker shaft 48 is connected in the manner shown in the drawings and that all the other parts of the device are in the positions shown in the drawings, the mode of operation of my relay will be more fully understood from the following brief description.

Referring particularly to the perspective view of Fig. 5, it will be observed that the setting drum 28 is positioned for minimum time operation of the relay. If it is desired to set the relay for timing a longer interval the manually operable worm gear 29 may be rotated in a direction to turn the setting drum 28 in a clockwise direction as viewed in the drawings. The drum 28, being loosely mounted upon the shaft 24, will turn freely and carry the stop pin 27 clockwise to the desired position. Since the clutch members 37 and 38 are now disengaged and since the spring 26 biases the shaft 24 for clockwise rotation, the cam 23 will be retained in following engagement with the stop pin 27 and the shaft 24 will turn clockwise with the drum 28. Thus the position of the stop pin 27 determines the initial position of the cam 23.

With the relay thus set for timing the desired interval operation may be initiated by depressing the start button 69 thereby to complete an energizing circuit for the solenoid 58b and the driving motor 35. When the solenoid 58b picks up it rotates the rocker shaft 48 clockwise from the position shown in the drawings thereby to release the crossarm 59 from engagement with the collar 60 on the reset rod 61 and to close the solenoid holding interlock switch 64. Clockwise rotation of the rocker shaft 48 also shifts the clutch actuating rod 42 longitudinally and into camming engagement with the fixed pin 45. When the inclined surface of the recess 44 engages the pin 45 the clutch rod 42 is shifted

laterally to the left, as viewed at Fig. 5, and moves the clutch member 38 into engagement with the clutch member 37 against the bias of the spring 41.

Since the driving motor 35 has now been energized, the driving shaft 36 rotates the driven shaft 24 in a counterclockwise direction against the bias of the spring 26. The driven shaft 24 now moves relative to the setting drum 28 so that the cam 23 leaves the stop pin 27 and moves toward its position of engagement with the latch member 20. Since the motor 35 is a constant speed motor, the length of the timing interval depends upon the distance through which the shaft 24 must move from its initial position in engagement with the stop pin 27 to its position of engagement with the latch member 20. It will thus be evident that the position of the adjustable stop 27 and thus the initial position of the shaft 24 determines the length of the timed interval.

When the cam 23 engages the latch member 20 it moves the member 20 against its bias to release the switch arm 11. Upon release of the switch arm 11 the arm moves from its latched position to a released position under the influence of its biasing spring 19. By this movement the collar 60 on the reset rod 61 is thrust toward the crossarm 59 on the rocker arm 48, but, due to prior clockwise rotation of the rocker arm 48, this movement of the reset arm 61 does not interfere with operation of the switch arm 11. In moving from its latched position to its released position the switch arm 11 opens the normally closed contacts 15 and 18 and closes the normally open contacts 14 and 17 to effect any desired circuit controlling function or functions. In its released position the switch arm 11 also opens the motor interlock contact 65 thereby to deenergize the motor and stop rotation of the driving and driven shaft 36 and 24 respectively. Thus at the termination of the timing period, as determined by release of the switch arm 11, the motor 35 is deenergized but the solenoid 51 remains energized.

In the normal timing operation described above, the motor 35 is deenergized before the stop pin 33 on the gear 25 engages the fixed stop pin 34. If, however, the motor interlock contact 65 should be shortcircuited or should fail to open for any reason upon release of the switch arm 11, the motor 35 will continue to run until the driven gear 25 brings the pin 33 into engagement with the pin 34. The fixed pin 34 now acts as an emergency stop positively to prevent further rotation of the driven shaft 24 and to stall the motor 35.

After completion of the timing operation described above the relay may be reset by pressing the "stop" button 68 of Fig. 7. The pushbutton 68 disables the energizing circuit for the solenoid 58b and permits the biasing spring 51 to rotate the rocker arm 48 counterclockwise to the position shown in the drawings. It will be clear from the foregoing description that counterclockwise rotation of the rocker arm 48 will move the clutch rod 42 to such a position that the pin 45 falls within the recess 44 thereby to permit separation of the clutch members 37 and 38 by the spring 41. In rotating counterclockwise the rocker shaft 48 also moves the crossarm 59 in a direction to exert a thrust upon the reset rod 61 thereby to raise the switch arm 11 from its released position to its latched position. Raising of the switch arm 11 permits the latch member 20 to

move into latching position under the influence of its biasing spring 22. As previously noted, so long as the clutch is disengaged, the crossarm 59 and the reset rod 61 are effective to retain the switch arm 11 in its latched position independently of the position of the latching member 20.

While I have described only one preferred embodiment of my invention by way of illustration, many modifications will occur to those skilled in the art, and it will therefore be understood that I intend by the appended claims to cover all such modifications as fall within the true spirit and scope of my invention.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. A timing mechanism comprising a driven shaft, a constant speed driving motor arranged to be operatively connected to said driven shaft, means actuated by said driven shaft upon rotation of said shaft in one direction to a predetermined position to initiate a control function, means for biasing said shaft for rotation in the opposite direction to an initial position, adjustable stop means for determining the initial position of said driven shaft thereby to determine the length of a timed interval, means for energizing said motor to initiate a timing operation, electric circuit control means actuated by said driven shaft at said predetermined position to deenergize said motor and terminate said timing operation, and mechanical stop means operable in conjunction with said driven shaft after said shaft has passed said predetermined position in said one direction of rotation positively to stall said motor in the event of failure of said electric circuit control means.

2. A timing mechanism comprising a driving shaft, a driven shaft, separable clutch means for drivingly connecting said driving shaft to said driven shaft for rotation of said driven shaft in one direction, a constant speed electric motor connected to drive said driving shaft, means actuated by said driven shaft upon rotation of said shaft in said one direction to a predetermined position to initiate a control function, means for biasing said driven shaft for rotation in the opposite direction to an initial position, adjustable stop means for determining the initial position of said driven shaft thereby to determine the length of a timed interval, means for simultaneously energizing said electric motor and engaging said clutch means to initiate a timing operation, electric circuit control means actuated by said driven shaft at said predetermined position for deenergizing said electric motor thereby to terminate said timing operation, and mechanical stop means operable in conjunction with said driven shaft beyond said predetermined condition in said one direction of rotation positively to stall said motor in the event of failure of said electric circuit control means.

3. A timing mechanism comprising a driving shaft, means for rotating said driving shaft at a constant speed, a driven shaft, clutch means for connecting said driving shaft to rotate said driven shaft in one direction, a control member movable from a latched position to a released position to initiate a control function, latch means actuated by said driven shaft upon rotation of said driven shaft in said one direction to a predetermined position to release said control member, means for biasing said driven shaft for rotation in the opposite direction to an initial position, adjustable stop means for determining the initial position of said driven shaft thereby

to determine the length of a timed interval, a rocker shaft operatively connected to said control member and to said clutch means, said rocker shaft being normally biased to a position to disengage said clutch and to hold said control member in said latched position independently of said latch means, and means for actuating said rocker shaft to a second position simultaneously to engage said clutch means and to render said control member responsive to actuation of said latch means thereby to initiate a timing operation.

4. A timing mechanism comprising a driving shaft, means for rotating said driving shaft at a substantially constant speed, a driven shaft, clutch means for connecting said driving shaft to rotate said driven shaft in one direction, a control member movable from a latched position to a released position to initiate a control function, latch means actuated by said driven shaft upon rotation of said driven shaft in said one direction to a predetermined position to release said control member, means for biasing said driven shaft for rotation in the opposite direction to an initial position, adjustable stop means for determining the initial position of said driven shaft thereby to determine the length of the timed interval, a rocker shaft movable between two limiting positions for controlling said clutch means and said control member, means for biasing said rocker shaft to a first position, electromagnetic means for moving said rocker shaft against its bias to a second position, and selectable connecting means between said rocker shaft and said control member and between said rocker shaft and said clutch means for resetting said control member and disengaging said clutch means when said rocker shaft is moved to a desired one of said positions, said rocker shaft being operable upon a change in the energization of said electromagnetic means substantially simultaneously to engage said clutch means and to render said control member responsive to actuation of said latch means thereby to initiate a timing operation.

5. A circuit timer comprising a driving shaft, a substantially constant-speed driving motor for rotating said driving shaft, a driven shaft, clutch means for connecting said driving shaft to rotate said driven shaft in one direction, a pivoted switch arm movable from a latched position to a released position to initiate a control function, said switch arm being biased to said released position, latch means for releasably retaining said switch arm in said latched position, means actuated by said driven shaft upon rotation of said shaft in said one direction to a predetermined position for actuating said latch means to release said switch arm, means for biasing said driven shaft for rotation in the opposite direction to an initial position, manually adjustable stop means operable in conjunction with said driven shaft to determine said initial position thereby to determine the length of a timed interval, a rocker shaft movable between two limiting positions to control said clutch means, means for biasing said rocker shaft to a first position, connecting means between said clutch means and said rocker shaft for selectably connecting said clutch means either for engagement or disengagement in the biased position of said rocker shaft, and connecting means between said rocker shaft and said switch arm operable only upon movement of said rocker arm to its clutch disengaging position to reset said switch arm in said latched position.

6. A circuit timer comprising a driving shaft, a substantially constant speed driving motor connected to said driving shaft, a driven shaft, clutch means including a pair of relatively movable clutch members for connecting said driving shaft to rotate said driven shaft in one direction, said clutch members being biased to a first operable position, a pivoted switch arm movable from a latched position to a released position to initiate a control function, said switch arm being biased to said released position, latch means for releasably retaining said switch arm in said latched position, means actuated by said driven shaft upon rotation of said shaft in said one direction to a predetermined position for actuating said latch means to release said switch arm, means for biasing said driven shaft for rotation in the opposite direction to an initial position, manually adjustable stop means operable in conjunction with said driven shaft to deter-

mine said initial position thereby to determine the length of a timed interval, a rocker shaft movable between two limiting positions to control said clutch members, means for biasing said rocker shaft to a first position, a clutch bar connected to be moved longitudinally by said rocker arm, said bar being movable laterally to actuate at least one of said clutch members against its bias to a second operable position, and cam means operable in conjunction with said clutch bar upon longitudinal movement thereof to control lateral clutch engaging and disengaging movement of said bar, the connection between said bar and said rocker shaft being adjustable to permit connection of said bar selectably for engagement or disengagement with said clutch members when said rocker shaft is in its biased position.

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