Dec. 6, 1938. I. E. McCABE 2,139,454

TIMER MECHANISM

Filed July 26, 1937 4 Sheets-Sheet 1

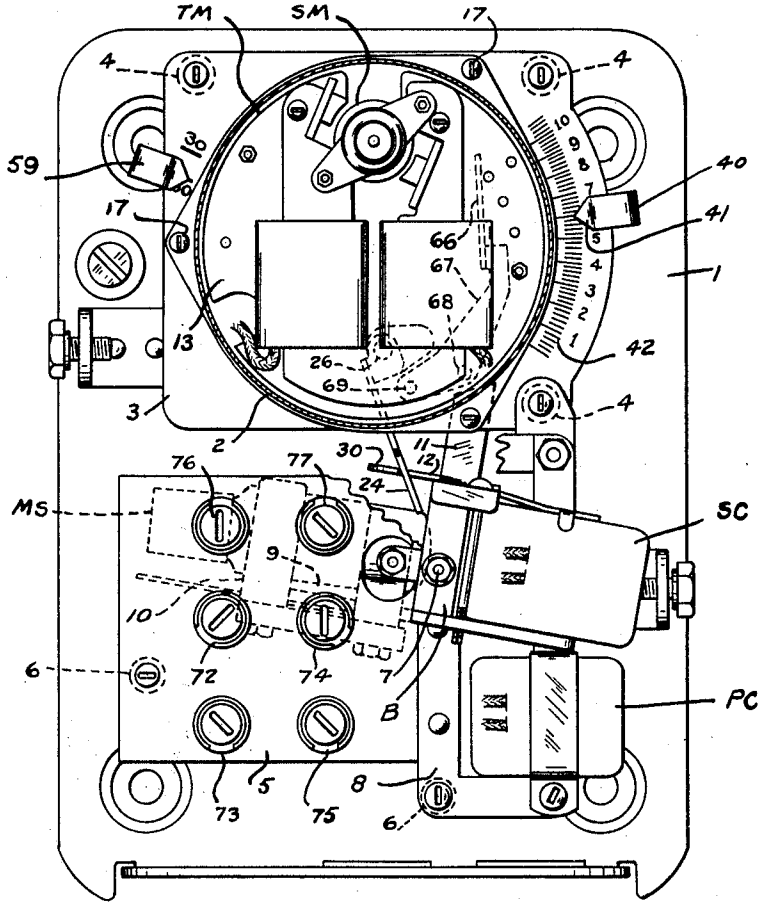

FIG. 1

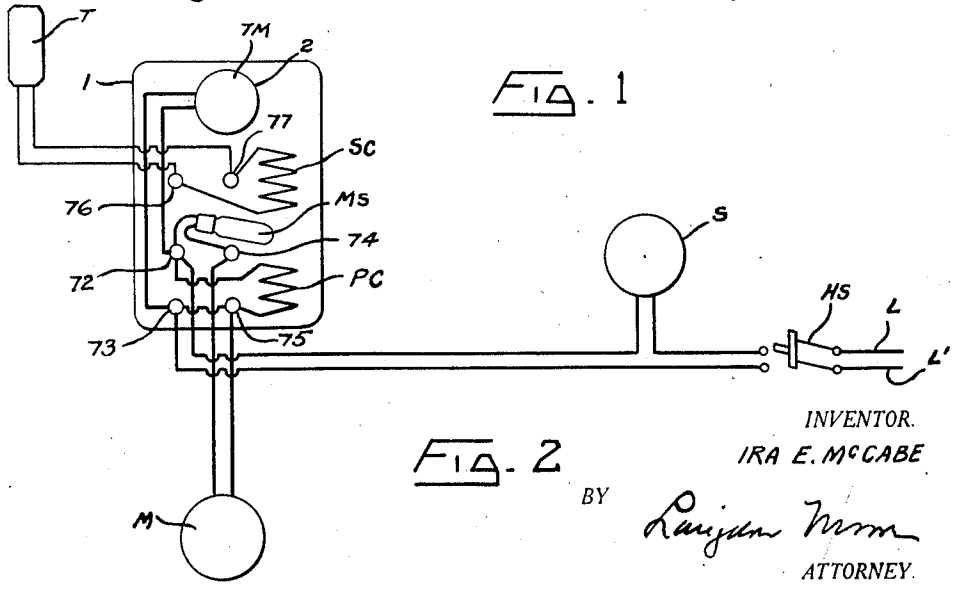

FIG. 2

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TIMER MECHANISM

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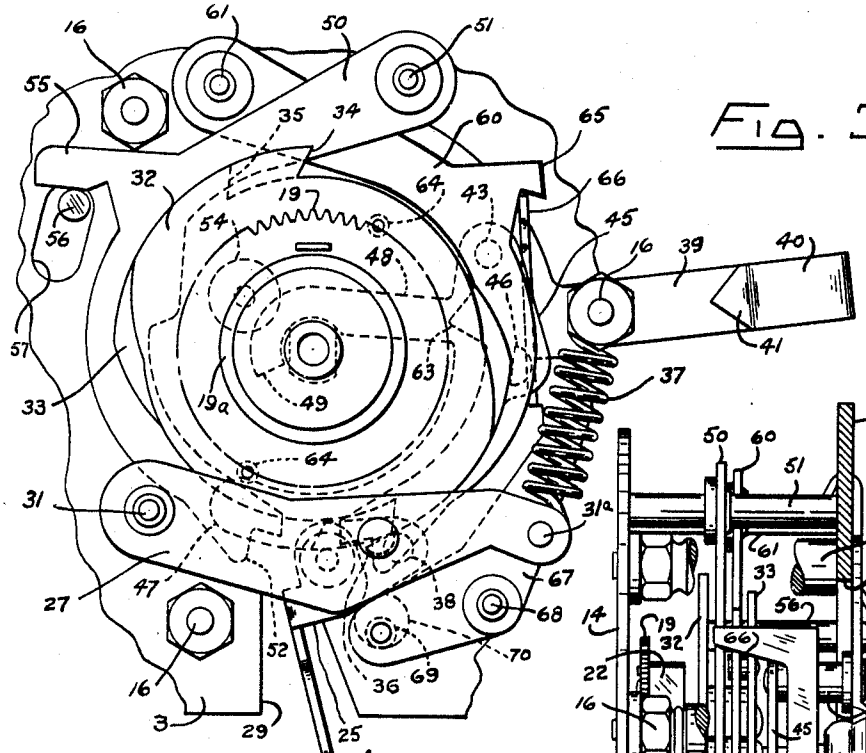

Fig. 3

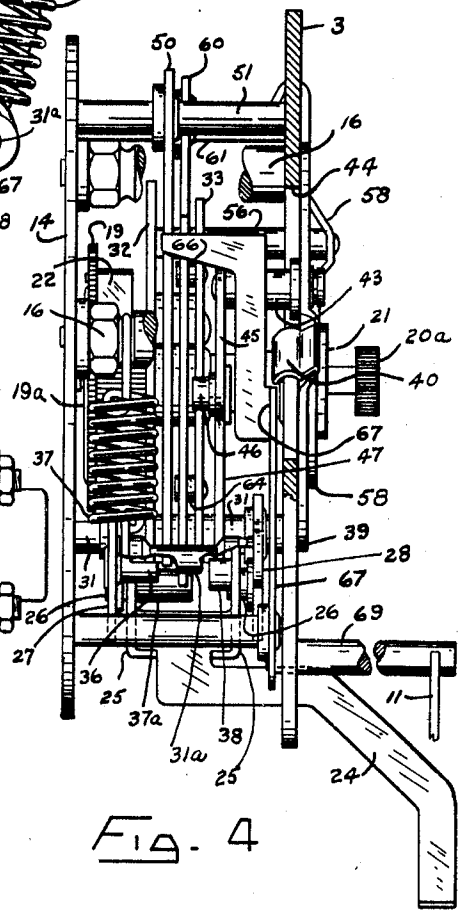

Fig. 4

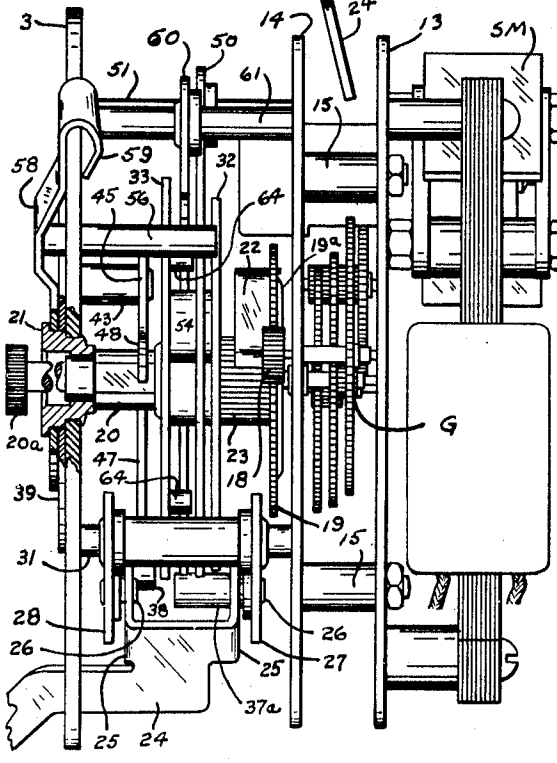

Fig. 5

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TIMER MECHANISM

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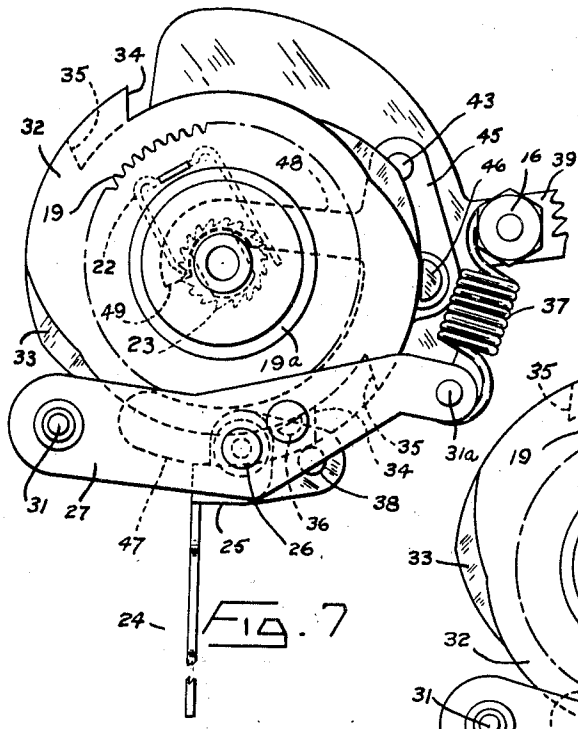

FIG. 7

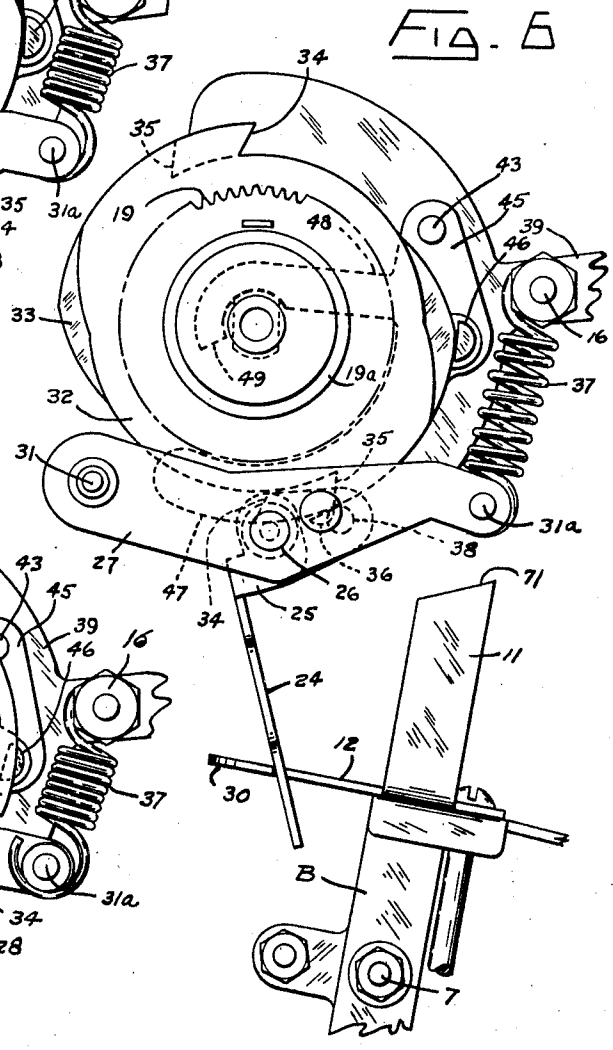

FIG. 6

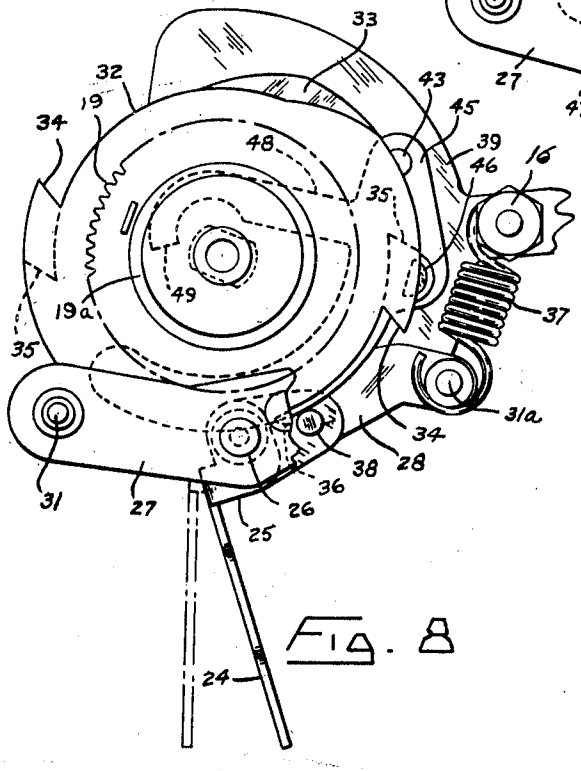

FIG. 8

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TIMER MECHANISM

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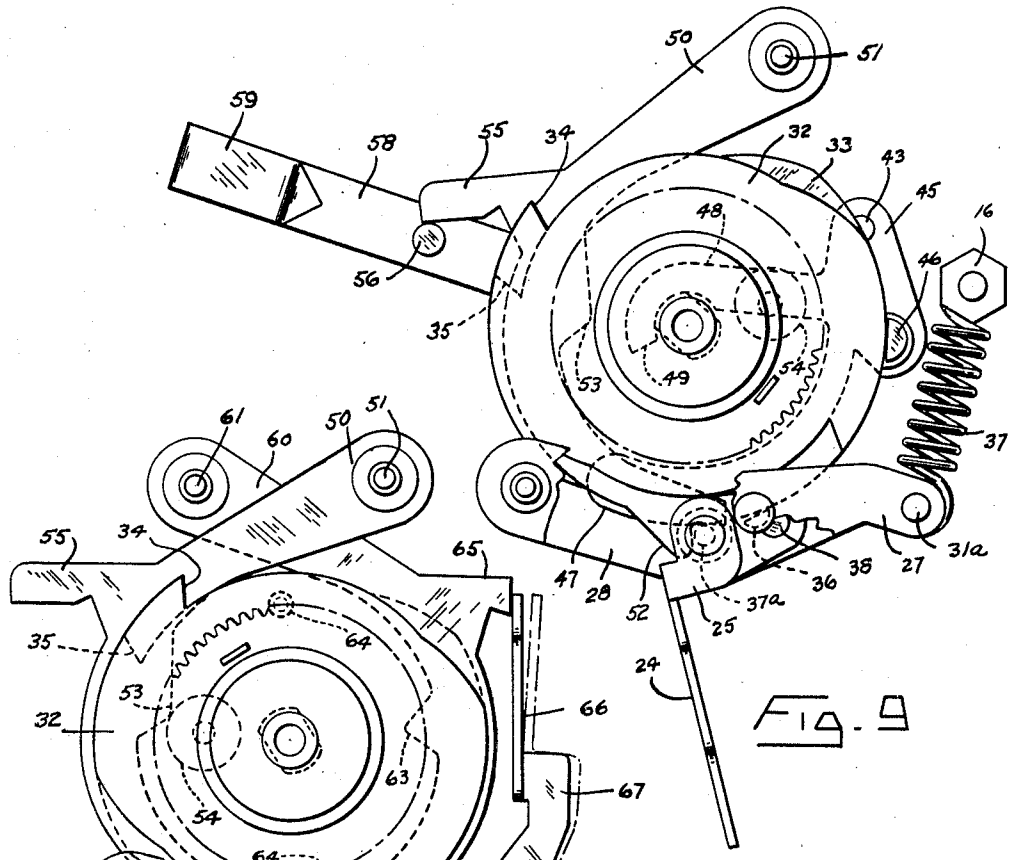

FIG. 9

FIG. 10

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Patented Dec. 6, 1938 2,139,454

UNITED STATES PATENT OFFICE

2,139,454

TIMER MECHANISM

Ira E. McCabe, Chicago, Ill.

Application July 26, 1937, Serial No. 155,649

14 Claims. (Cl. 200—38)

This invention relates to improvements in timer mechanisms and more particularly to a timing device for use in connection with other devices for controlling the operation of an electrically operated and controlled coal stoking mechanism for domestic and industrial heating plants.

It is an object of this invention to so construct and connect this improved timer mechanism that it will operate the stoker to feed fuel at periodic intervals to prevent the fire from becoming extinguished when otherwise the stoker mechanism would be idle.

Other objects of this invention include the construction of a mechanism operated by a synchronous electric motor to periodically operate means to close a circuit; to provide means to select the number of times the circuit closing means may be operated each hour; to provide means to determine the duration of such closed circuit periods; to provide a relay in the timer actuated circuit closing means responsive to other control devices to close the said circuit independent of the timer mechanism; and to include in the timer mechanism means actuated by the said independent operation of the relay to delay the first timer operation of the relay following a completed independent operation thereof.

With these and others objects in view, reference is made to the accompanying sheets of drawings, which illustrate an embodiment of this invention with the understanding that detail changes may be made therein without departing from the scope thereof.

In the drawings:

Figure 1 is a view in front elevation of a preferred form of this invention with the timer mechanism cover shown in sections.

Figure 2 is a view in diagram illustrating the electrical connections and a wiring diagram thereof.

Figure 3 is a fragmentary enlarged detail view in front elevation of the timer mechanism with the intermediate plate and other parts removed.

Figure 4 is a view in side elevation of Figure 3, looking at the right side thereof, with parts removed.

Figure 5 is a view similar to Figure 4 looking at the left side of Figure 3.

Figure 6 is a view similar to Figure 3, with parts removed, illustrating the means for determining the length of "on" periods and showing the positions assumed by said parts in the "off" position.

Figure 7 is a view similar to Figure 6 showing the positions assumed by these parts at the initiation of the "on" period.

Figure 8 is a view similar to Figure 6 showing the positions assumed preparatory to moving to the "off" position at the termination of the "on" period.

Figure 9 is a view similar to Figure 3, with parts removed, illustrating the means for selecting the number of "on" periods per hour.

Figure 10 is a view similar to Figure 3, with parts removed and additional parts included, illustrating the means to prevent initiation of timer operations at the termination of an independent operation of the relay.

The timer mechanism constructed in accordance with this invention includes a motor switch MS operated by a repulsion relay having a stationary primary coil PC and a movable secondary coil SC connected in circuit with a room thermostat T, to close the motor switch when the circuit is completed through the room thermostat and to open the motor switch when the room thermostat opens the circuit, and a timing mechanism TM actuated by a self-starting synchronous electric motor adapted under certain conditions to operate an arm to close and open the motor switch during the periods when the room thermostat maintains the secondary circuit open. The entire mechanism is mounted upon a panel 1, with the timing mechanism TM mounted within a cylindrical cover 2 upon a base plate 3 spaced apart from the upper portion of the panel 1 by posts 4 and a relay of the general type as disclosed in this applicant's prior Patent No. 1,973,925 dated September 18, 1934, mounted upon a plate of insulating material 5 spaced apart by posts 6 from the panel 1 below and in line with the base plate 3.

The movable secondary coil SC is mounted in a bracket B to oscillate about a pivot 7 upon the inner leg 8 of the rectangular core of the relay. The bracket B is provided upon the rear of the supporting plate 5 with an extension 9 which carries the motor switch support 10 so that when the secondary coil SC rests upon the stationary primary coil PC the bracket B will be rotated about its pivot 7 to open the motor switch MS, preferably a mercury tube switch as shown. The bracket B, is also provided with a vertical extension 11 above the pivot 7 and a horizontal extension 12 to the left of the extension 11 adapted to cooperate with the operating arm of the timing mechanism under certain conditions to tilt the bracket about its pivot 7 to close the motor switch MS as shown in Figures 1 and 10.

The timing mechanism includes a self-starting synchronous electric motor SM mounted upon a circular face plate 13. The synchronous motor SM operates a train of gears G mounted between the face plate 13 and a similar intermediate plate 14 spaced apart therefrom by posts 15. The intermediate plate 14, is spaced apart from the base plate 3 by posts 16 as shown in Figure 4. The cover 2 is secured to the base plate by screws 17. The train of gears G operate a pinion 18 upon the under side of the intermediate plate 14 meshing with a gear wheel 19 freely mounted upon one end of a driving shaft 20 having a bearing therefor in the intermediate plate 14, and a bearing 21 therefor in the base plate 3. The gear wheel 19, as shown in Figures 5 and 7, is held upon the shaft by means of a spring washer 19a and also mounts a flat U shaped spring 22 one end of which terminates in the form of a pawl adapted to engage the teeth upon a pinion 23 secured to the driving shaft 20 to impart movement thereto in a counter-clockwise direction as the gear is rotated in that direction. Screw threaded into the end of the shaft 20 opposite that mounting the gear wheel 19 is an operating stem terminating in a knurled head 20a to permit a manual rotation of the shaft to operate the mechanism, if desired. When manually operating the shaft in one direction no movement is imparted to the gear wheel 19 as it is not fixed to the shaft and the tension of the spring washer 19a is such that the spring 22 will wipe over the pinion 23. If the operating head 20a is rotated in the opposite direction it unscrews itself from its threaded connection to the shaft so that manual operation of the mechanism is possible by rotation of the operating stem in only one direction.

The relay operaing arm of the timing mechanism is an off-set flat arm 24 depending from a U-shaped bracket the sides 25 of which are pivotally mounted upon studs 26 secured upon and intermediate the length of similar shaped plates 27 and 28, on each side thereof. The arm 24 is offset to pass through a cut out portion 29 of the base plate 3, Figure 3, and is then extended downwardly to engage behind the off-set extremity 30 of the horizontal extension 12 of the movable coil bracket B. The left extremities of the spaced apart plates 27 and 28, are mounted on a stud 31 pivotally supported between the intermediate plate 14 and base plate 3, as shown in Figures 4 and 5.

Fixed upon the shaft 20, are two similar spaced cam plates 32 and 33, each having two diametrically opposite shoulders 34 and 35 with the shoulders of the plate 33 in a fixed relation in advance to the shoulders of the plate 32. The cam plates 32 and 33 rotate between the sides 25 of the U-shaped bracket supporting the relay operating arm 24. The bracket supporting plate 27 adjacent the intermediate plate 14 mounts a stud 36 having a flattened surface extending in the path of the cam plate 32 and over which the cam plate rides. The stud 36, is resiliently held against the periphery of the cam plate 32 by a coil spring 37 connected to one of the posts 16 and to a post 31a connecting free ends of the bracket supporting plates 27 and 28. The cam engaging stud 36 is arranged to the right of the bracket pivot stud 26 on the plate 27.

The cam plates 32 and 33 rotate in a counter-clockwise direction and as the shoulder 34 of the plate 32 rides over the stud 36 the spring 37 causes it to engage the off-set periphery of the plate therebelow allowing the spring 37 to impart an upward movement to the operating arm supporting plates 27 and 28 about their pivot 31. To utilize this action to impart a movement of the arm 24 to the left end of its oscillatory movement to tilt the motor switch MS to closed position by tilting the bracket B, the side 25 of the operating arm bracket adjacent the base plate 3 is extended beyond the other side 25 and mounts upon its inner side, a stud 38, to the right of the stud 36 on the opposite bracket supporting plate 27.

A lever 39 arranged upon the rear of the base plate 3 is provided with an enlarged end mounted for rotation upon the bearing 21 of the shaft 20 and at the other end with a bent-back portion 40 embracing an arcuate edge of the base plate 3 concentric with the shaft 20 terminating in a pointer 41 adapted to travel over a calibrated scale 42 as shown in Figures 1 and 3. The lever 39 mounts a stud 43 passing through an aperture 44 in the base plate 3 which pivotally mounts on its free end an actuating plate 45 adjacent the cam plate 33. The plate 45 mounts a stud 46 extending in the path of travel of said cam plate 33 having a flat surface to be wiped over by the periphery of said cam plate and is provided with an arcuate extension 47 curved about the under side of the shaft 20 and a horizontal extension 48 projecting over the operating shaft 20 terminating in a hook portion 49 adapted to engage the shaft 20 to limit the movement of the actuating plate 45 away from said shaft. When the stud 46 engages the outermost periphery of the cam plate 33 it is held against movement toward the shaft 20. The fixed relationship of the cams are such that with the stud 46 placed in any position, as determined by the position of the lever 39, said stud will be in engagement with the outermost periphery of cam 33 before the stud 36 rides over the shoulder 34 of cam 32. The arcuate depending portion 47 of plate 45 extends beyond and to the left of the stud 38 upon the elongated side 25 of the operating arm bracket, as shown in Figures 6, 7 and 8.

The spring 37 causes the stud 36 to ride over the shoulder 34 of cam 32, as the cam is rotated to that point, and imparts an upward movement to the support plates 27 and 28 but as the operating arm stud 38 is engaging the arcuate portion 47 of plate 45, which is held against movement inwardly at this time, the operating arm is caused to rotate around the stud 38 thus swinging the offset arm extension 24 to the left, as shown in Figure 7, which action tilts the bracket B. Figure 6 illustrates the position of the parts as the cam shoulder 34 approaches the stud 36 to impart the operation which causes the parts to assume the positions shown in Figure 7 and normally results in closing the motor switch MS. The motor switch remains closed until the shoulder 35 passes over the stud 46 whereupon the plate 45 is freed and the weight of the secondary coil swings the bracket B about its pivot to open the motor switch and at the same time swings the operating arm 24 to the right as the stud 38 is no longer held by the arcuate portion 47, as shown in Figure 8. Whenever the timer mechanism operates to close the motor switch the switch will stay closed as long as the stud 46 engages the cam 33. It is therefore evident that by moving the pointer 41, the lever 39 will shift the pin 46 to a position closer or farther from its operating cam shoulder 35 thus limiting the closed switch period to the time indi-

cated by the position of the pointer upon the scale 42.

If the train of gears operated by the synchronous motor are so arranged to impart one complete rotation of the operating shaft each hour, then the motor switch is closed, independently of the room thermostat T, each half hour as long as the room thermostat remains open, since the cam plate 32 is provided with diametrically opposed shoulders which allows the spring 37 to rotate the bracket supporting plates 27 and 28 each time they wipe over the stud 36.

To limit the closing of the motor switch to one period for each complete cam revolution, if desired, a lock-out latch 50 is mounted upon a post 51 pivotally supported between the base plate 3 and intermediate plate 14 to the right of the vertical center line and above cam plates 32 and 33, as shown in Figures 5 and 9. This latch is curved about the left of the shaft 20 between cam plates 32 and 33 and terminates in a notched end 52 so arranged that the weight of the latch normally causes the notched end 52 to engage an extended portion 37a of the stud 26 in the bracket supporting plate 27. As the shoulder 34 of cam plate 32 passes over the stud 36 the latch 50 will hold it against the tension of the spring 37, as shown in Figure 9. The latch 50 is provided with an angularly inclined extension 53 upon its side adjacent the shaft 20 adapted to be engaged by a roller 54 mounted between the cam plates 32 and 33 to move the end 52 out of engagement with the stud extension 37a as the roller 54 rides thereunder during each revolution of the cam plates so that the operating arm 24 is free to be actuated but once during each complete revolution of the shaft 20 or once an hour. In order to allow the operating arm to be actuated twice during each revolution of the shaft 20, or every half hour, the latch 50 is provided with an out-standing projection 55 adapted to be engaged by a stud 56 passing through an elongated slot 57 in the base plate 3 as shown in Figure 3, and carried on a lever 58 mounted at one end to rotate about the bearing 21 and having its free end 59 bent back upon itself to embrace the left edge of the plate 3, as shown in Figure 9, whereby upon an upward movement of the lever 59 the stud 56 will withdraw the latch to allow of two operations of the motor switch MS by the two cam shoulders 34 during each complete revolution of the shaft 20.

When it is desired to employ this invention for the control of coal stokers for the purpose of periodically causing the operation of the stoker, during periods when the stoker is not otherwise operated, for the purpose of maintaining the fire, it is desirable to prevent the operation of the stoker immediately following the termination of a stoker operation caused by other controls, such as a room thermostat. It is a purpose of this invention to prevent a timer operation of the stoker occurring for a minimum period, after a thermostat operation preferably fifteen minutes. This period may be longer, however, depending upon the position of the timer mechanism. When lever 58 is set for half hour operations the maximum delay period after the thermostat shuts off or opens the secondary circuit, may be forty-five minutes. When set for one hour operations, the maximum delay may be one hour and fifteen minutes. For this purpose, it is preferable to provide the timer mechanism with an additional lock-out latch 60 mounted upon a post 61 pivotally supported between the base plate 3 and intermediate plate 14 on the side of the vertical center line opposite the post 51, as shown in Figure 10. The lock latch 60 is curved about the right of the shaft 20 and terminates in a notched extremity 62 adapted at times to engage and hold the stud extension 37a in the same manner as the latch 50.

The latch 60 is provided with an outstanding hooked member 65 adapted normally to hold the latch 60 in its withdrawn position by engaging over a locking arm 66 extending from a plate 67 mounting intermediate its ends a post 68 pivotally supported between the base plate 3 and intermediate plate 14 and mounting at its other end a pin 69 passing through a slot 70 provided therefor in the base plate 3, as shown in Figures 3 and 10. To prevent the closing of the motor switch by the timer mechanism immediately after the termination of a closed period of the motor switch actuated by the room thermostat T or other control, the free end of the vertical extension 11 of the bracket B carrying the movable secondary coil SC terminates in an angular surface 71 which when the relay is energized by the room thermostat T, or other control, upon the tilting of the bracket by the repulsion of the coil SC wipes under the pin 69 and lifts it to rotate the locking arm 66 from the position shown in Figure 3 to free the latch 60, as shown in Figure 10, to engage the stud extension 37a.

The side of the lever 60 towards the shaft 20 is also provided with an angular inclined extension 63 adapted to extend into the path of two diametrically arranged studs 64 upon the cam plate 33 adapted to ride over the extension 63 to withdraw the notched end 62 from engagement with the roller 37a twice during each complete revolution of the shaft 20. When the cams are operated one complete revolution each hour it is preferable to arrange the pins 64 to actuate the latch 60 fifteen minutes prior to the time when the cam shoulder 34 passes under the stud 36 which normally results in the closing of the motor switch MS. The purpose of the pins, it may be stated, is to check the position of the motor switch each fifteen minutes prior to each timer operation. If the motor switch is open when the pins 64 operate the latch 60 the mechanism is placed in condition to be operated to close the motor switch at the next timer operation unless the thermostat should cause a stoker operation in the meantime. If a thermostat operation has been completed before the engagement of pin 64 with the latch extension 63 the locking arm 66, freed when the relay opens the motor switch, assumes the full line position shown in Figure 10. When the arm 66 is in this position and the motor switch is open, the engagement of pin 64 with the extension 63 will raise the latch 60 permitting the locking arm to fall in under the latch hook member 65 whereby the notched extremity of the latch is removed from possible interference with the timer operations, as shown in Figure 3. However, if a thermostat operation is in effect when the pin 64 passes the extension 63 or is begun thereafter the arm 66 will free the latch 60 and the notched extremity will engage the stud extension 37a to prevent the next timer operation of the relay operating arm 24.

Figure 2 is a diagrammatical view of a practical application of this improved timing mechanism to the motor M of a coal stoker mechanism. The wire L is connected to the commercial line and carries the commercial current through the usual boiler or furnace safety control S to the binding post 72 upon the panel 1. The current

then follows through the wire connected to the timing mechanism to energize the synchronous motor SM and from there to the binding post 73 and back through line L' to the commercial line. The current also passes from binding post 72 through the winding of the primary coil PC and through binding post 75 to binding post 73 and thence by line L' to the commercial source. The motor switch MS being in the open position the motor is not energized. The windings of the secondary coil SC are connected to the binding posts 76 and 77 and to the room thermostat T. When the circuit is closed through the room thermostat to energize the secondary winding SC it is repelled from the stationary primary coil PC and tilts the motor switch MS to closed position. This establishes a circuit from binding post 72 through motor switch MS binding post 74 through the stoker motor M to binding post 75 and from there through binding post 73 to the return line L'. It is seen from the above that whenever the house switch HS is closed to the commercial source, the primary winding PC is always in circuit and the synchronous motor of the timing mechanism TM is always in circuit and the motor circuit is closed whenever the room thermostat closes the secondary circuit or whenever the timing mechanism operates to tilt the bracket B.

What I claim is:

1. An electrically operated timer mechanism for opening and closing an electric switch periodically, including an electric motor, a pivoted switch operating arm, spring operated reciprocable means for mounting the pivot of the switch operating arm, cam means operated by the motor cooperating therewith to reciprocate periodically said reciprocable means against the tension of the spring and a predetermined time thereafter to free said means to the action of the spring to close the switch, said switch arm having a prolongation at one side of its pivot coacting with cam actuated means when engaged thereby to cause the arm to be rotated about its pivot to close the switch as the spring is freed to reciprocate its pivot.

2. The structure of claim 1 wherein means is included in the cam means to allow two normal operations of the switch arm during each complete rotation of the cam and wherein means is provided to prevent every other normal operation thereof.

3. The structure of claim 1 wherein means is provided to adjust the relation of the cam actuated means and the prolongation of the operating arm to determine the duration of the period the switch remains closed.

4. The structure of claim 1 in combination with means adapted to close and open the switch independent of the timer mechanism, and wherein the timer mechanism is provided with means operable after the switch has been closed and opened by said independent means to delay the next normal operation of the timer mechanism to close the switch.

5. An electrically operated timer mechanism for opening and closing an electric switch periodically, including an electric motor, cam actuating means operated by the motor, an oscillating switch operating arm, a bracket at one end thereof mounting a pivot and a stud spaced apart from the pivot, a support pivoted at one end mounting the bracket pivot intermediate its ends and engaging a spring at its other end to cause the bracket pivot to wipe over a cam of the actuating means, and a pivoted switch arm actuator coacting with a cam of the actuating means adapted to engage the stud on the arm bracket as the cam frees the support to the action of the spring to cause the lifting of the bracket pivot to oscillate the operating arm.

6. The structure of claim 5 wherein said last mentioned cam at a predetermined interval thereafter releases the switch arm actuator.

7. The structure of claim 5 wherein said last mentioned cam at a predetermined interval thereafter releases the switch arm actuator and wherein the switch arm actuator mounts a stud to be wiped over by the coacting cam and wherein the pivot of the switch arm actuator is mounted for manual adjustment to alter the relation of the arm actuator stud to the cam release to predetermine the duration of the period the switch remains closed.

8. The structure of claim 5 wherein means is included in the cam means to allow two normal operations of the switch arm during each complete rotation of the cam and wherein means is provided to prevent every other normal operation thereof, including a pivoted latch provided with its free end normally engaging the bracket pivot to hold the bracket support against the tension of the spring, said latch provided with a member coacting with a stud on the cam actuating means to move the end of the latch to free the pivot stud at each rotation of the cam to allow the lifting of the bracket support.

9. The structure of claim 5 wherein the cam actuating means is formed to free the bracket support to respond to the action of the spring at each half revolution of the cam thereof, and a pivoted latch provided with its free end normally engaging the bracket pivot to hold the bracket support against the tension of the spring, said latch provided with a member coacting with a stud on the cam actuating means to move the end of the latch to free the pivot stud at each rotation of the cam, and wherein the latch is provided with manual means to withdraw the free end from engagement with the bracket pivot and hold it in the withdrawn position.

10. The structure of claim 5 in combination with means to close and open the switch independent of the timer mechanism, a pivoted latch normally engaging the bracket pivot to hold the bracket support against the tension of the spring, a pivoted locking arm having one end engaged normally with a lock member on the latch to hold the latch inoperative and operable by the independent closing of the switch to disengage the latch, and a member on the latch adapted to be engaged by means on a cam actuator intermediate the normal closing of the switch by said actuator to reengage the latch locking member with the locking arm after it has been freed by the opening of the switch.

11. A switching device for an electric circuit, a switch interposed in said circuit, operating means for opening and closing said switch, electrically controlled means for actuating the operating means, motor operated means for normally operating mechanical means for actuating the switch operating means to close the switch for periodic intervals, and means actuated by the electrically controlled means upon closing the switch within a predetermined time before the next normal switch closing operation of the mechanical means to render said mechanical means inoperative for the duration of that period.

12. The structure of claim 11, including locking

means normally adapted to render the mechanical means inoperative, and means controlled by said motor operated means at selected intervals prior to normal switch closing periods to render the locking means ineffective.

13. The structure of claim 11, including locking means normally adapted to render the mechanical means inoperative, and means controlled by said motor operated means at selected intervals prior to normal switch closing periods to render the locking means ineffective, and manually operated means independent and exterior of said motor controlled means for permanently rendering the locking means ineffective until manually restored to operative position.

14. The structure of claim 11, wherein the mechanical means includes holding means actuated by the motor operated means to determine the duration the switch is closed by said mechanical means, and means to adjust said holding means exterior of the motor operated means.

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