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1,522,988

H. E. WARREN

TIME SWITCH

Filed Oct. 27, 1920

Fig. 1

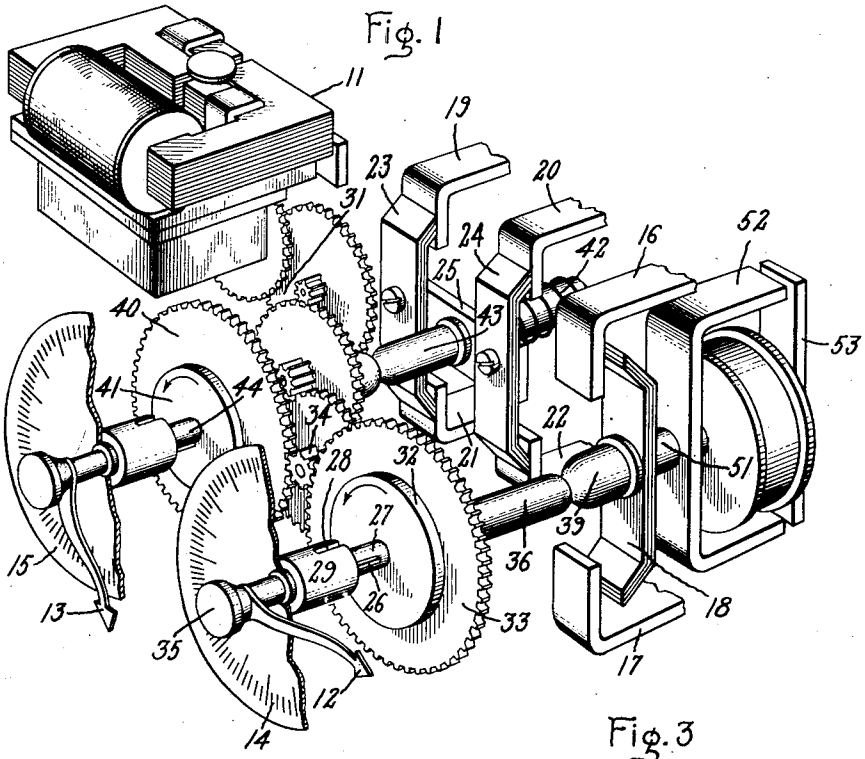


Fig. 3

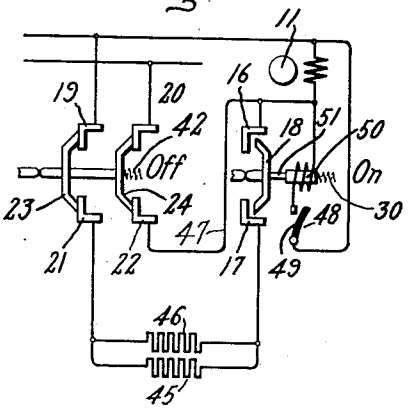
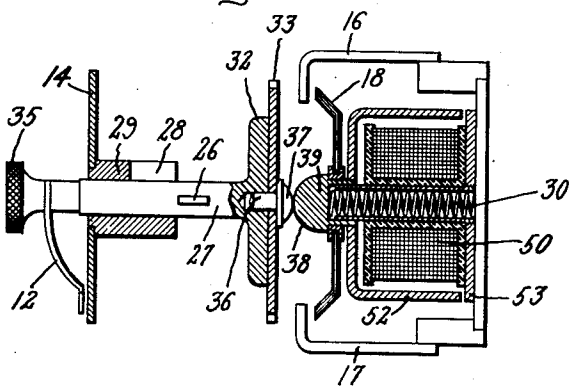


Fig. 2



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UNITED STATES PATENT OFFICE.

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TIME SWITCH.

Application filed October 27, 1920. Serial No. 419,989.

To all whom it may concern:

Be it known that I, HENRY E. WARREN, a citizen of the United States, residing at Ashland, in the county of Middlesex, State of Massachusetts, have invented certain new and useful Improvements in Time Switches, of which the following is a specification.

This invention relates to time switches, and more particularly to time switches for turning on and off such translating devices as the heating coils for electric ranges.

The main object of my invention is to produce such a device having as few parts as possible, thus rendering it inexpensive to manufacture as well as reliable in operation. Another object of my invention is to prevent too great a rise in temperature when the switch is used to control a heating circuit as in an electric range; and thus make it possible to set the time switch and to have it operate automatically upon a predetermined temperature rise even before the time when the current is to be turned off. Various other advantages and objects will become apparent as the description proceeds, and will be hereinafter more fully described and claimed.

My invention may be better understood from the following description taken in connection with the accompanying drawings, in which Fig. 1 is a distorted perspective of the time switch as a whole, showing how the various operating elements are associated; Fig. 2 is a sectional view taken through that switching element which is adapted to complete the circuit at a predetermined time; and Fig. 3 is a wiring diagram indicating how the device may be used in an electrical circuit.

Referring now more in detail to the drawings, in which like reference characters refer to like parts throughout, I show a constant speed mechanism 11 such as a small self-starting synchronous motor adapted to be supplied from a commercial source and to perform the timing function for the switch. It is evident that part 11 may be replaced by any other well known constant speed mechanism such as a clock-work or the like. The kind of synchronous motor illustrated is described in several Letters Patent granted in my name, Nos. 1,283,432, patented October 29, 1918, and 1,283,435, patented October 29, 1918.

It is possible to set the time switch so as to determine when the circuit will be completed and when at a later time it will be again interrupted by means of pointers 12 and 13 cooperating with the stationary dials 14 and 15. At the time the switch is set, the pointer 12 indicates on dial 14 how long a time must elapse before the "on" switch will operate, that is, when the controlled circuit will be completed; while pointer 13 indicates on dial 15 how long a time must elapse before the "off" switch will operate, that is, when the circuit will be interrupted. The switching operations described depend upon various features of construction that I shall now describe.

The elements of the "on" switch comprise the stationary contact pieces 16 and 17 adapted to be bridged by the movable contact piece 18, shown in this instance as made of laminated conducting material such as copper. The relative position of the movable contact piece 18 as regards the stationary contact piece 16 or 17 before the "on" switch operates is shown clearly in Fig. 2. The "off" switch has a construction somewhat similar to that of the "on" switch, but in this case the elements comprise a plurality of stationary contact pieces 19, 20, 21 and 22 forming two pairs of contacts adapted to be bridged by the movable contact pieces 23 and 24 insulated from a short strap 25 forming their common support. When the "off" switch operates, the support 25 moves so as to break the continuity of the circuit between the stationary contact pieces 19 and 21 as well as that between 20 and 22. Although I show a plurality of "off" switches and but one "on" switch, so far as the actual operation of my device is concerned, any number of "off" or "on" switches may be used.

In order to operate the "off" and the "on" switches, use is made of a construction whereby the supports for the movable contact pieces 18, 23 and 24 are allowed to move a short distance relative to the stationary contact pieces at a predetermined time and

thus perform their switching operations. For this purpose, the "on" switch operating means comprises a spline 26 carried by a member 27 rotated at a constant speed from the constant speed mechanism 11, said spline being adapted to enter a slot 28 located in a stationary member 29, which also serves as a bearing for the rotatable member 27. Spring pressure is made use of to push the spline 26 into the slot 28 when the member 27 rotated in the direction of the arrow at constant speed moves sufficiently to align the slot and spline. The initial relative angular position of the slot and spline determines the length of time before they will be aligned. The pointer 12 serves to indicate this angular position when the switch is set. When the slot and spline are in alignment, the member 27 moves axially and is prevented from rotating further, its axial movement allowing the movable contact piece 18 to move in the same direction and to bridge the stationary contact pieces 16 and 17, and thus completing the circuit. The spring pressure tending to push the spline 26 into the slot 28 also serves to push the contact piece 18 up against the stationary contact pieces 16 and 17. I utilize a compression spring 30 for this purpose, although any other means for positively urging the spline 26 to enter the slot 28 may be used. The mechanical connection between the movable contact piece 18 and the rotatable member 27 will be later described.

The constant speed mechanism 11 drives the rotating member 27 at a constant rate through the gearing designated in general by the reference character 31. One of the elements in the transmission is a clutch, shown in this case as a friction clutch. One of the cooperating faces of the clutch is carried by the flange 32, made in this instance integral with the rotating member 27. The other cooperating face of the friction clutch is a surface of one of the gears 33 transmitting the motion of the constant speed mechanism 11. Thus the axial movement of the rotating member 27 upon the alignment of the spline 26 with the slot 28 has several effects. One is to restrain positively the member 27 from further rotation. Another effect is to permit the contact piece 18 to engage the stationary contact pieces 16 and 17. Another effect is to lessen the spring pressure between the two faces of the friction clutch, due to the expansion of spring 30. Another effect is to disengage the gear 33 from its driving pinion 34 so that the faces of the friction clutch do not need to have any relative slipping when the member 27 is restrained, since the constant speed mechanism 11 is mechanically disengaged from the clutch member. Such a disengagement however is not essential since the friction clutch may be designed so as to permit relative movement of its members when one of them is restrained. The parts 32 and 33 may thus be designated a pair of clutch members, upon which the spring 30 exerts a pressure for causing them to be engaged frictionally. When this spring 30 expands, the pressure is relieved.

The clutch members 32 and 33 are axially guided in each other's path by a pin 36 which enters into an aperture located in the rotatable member 27, and through an aperture in the center of gear member 33. This pin has a rounded head 37 cooperating with a rounded surface 38 on the button 39 carrying the movable contact piece 18, but insulated therefrom, as shown in Fig. 2. In this way, while the movable member 27 is being rotated, there is but a very small surface at which any friction may be developed between the non-rotating button 39 serving as a support for the contact piece 18 and the rotating friction clutch. The "on" switch may be set by pushing backward on the button 35 carried by member 27 so as to disengage spline 26 from slot 28 and then rotating it clockwise. The relative angular position of the spline 26 and slot 28 determines the time which it will take before the switch can operate. The clockwise rotation of the member 27 is opposed only by the friction between the faces of the friction clutch, which may easily be overcome for this purpose.

Precisely the same means are utilized for operating the "off" switches, as has been described in connection with the "on" switch. The driving pinion 34 also drives a gear 40 which acts as one of the members of a friction clutch, the other member of which is formed on the flange 41 corresponding to the flange 32 of the "on" switch operating mechanism. The spring 42 acts in this case on the short strap 25 forming the support carrying a button 43 similar to the button 39 of the "on" switch. In this case the positions of the movable contact pieces 23 and 24 are reversed as regards the stationary contact pieces 19, 20, 21 and 22, so that upon axial movement of the member 44, which is rotated at constant speed, these movable contact pieces are moved away from their cooperating stationary contacts, and thus cause the opening of the circuit.

In Fig. 3 I show a wiring diagram of my switch. This diagram shows the condition of affairs just after the switches are set and before any of them have operated. The load is designated as a pair of resistances, such as heating coils 45 and 46, used for example in an electric range. The circuit when the "on" switch operates would be completed from the mains through the stationary contact piece 19, movable contact piece 23, stationary contact piece 21, coils 45 and 46, stationary contact piece 17, mov-

able contact piece 18, stationary contact piece 16, wire 47, stationary contact piece 22, movable contact piece 24, stationary contact piece 20, to the other side of the line. It is evident that when the "off" switch operates, both terminals of the heating coils are disconnected from the mains. This is made so as to conform to the code requirements in certain localities. The small synchronous motor 11 is shown as connected across the line, through one of the "off" switches thus: stationary contact piece 20, movable contact piece 24, stationary contact piece 22, wire 47, motor 11, to the other main. Thus the motor 11 is in operation only while the "off" switch has not operated and it is energized only long enough to operate both switches. If, after the time switch has been set, there should be a failure of the supply before or during the heating period, it will be evident that the motor 11 will stop and start up again as soon as the power comes back on, consequently, the total heating period will be the same as that for which the device was originally set even though in the meantime there has occurred a failure in the supply for any length of time.

An auxiliary contact opening means designated in general by the numeral 48 in Fig. 3 is made use of to prevent too great a rise in temperature in the oven, or any other place the temperature of which is controlled by the heating circuit. This means 48 comprises a bi-metallic element 49 adapted to control a circuit when the temperature where it is located reaches a predetermined value. The circuit which this thermostat operates is adapted to energize an electromagnet 50 adapted to operate upon the movable contact 18 of the "on" switch. This is effected by means of a mechanical connection shown diagrammatically at 51 between the armature of the electromagnet 50 and the movable contact piece 18. The armature of the electromagnet is shown more clearly in Figs. 1 and 2 and comprises a U-shaped strap 52 of magnetic material. The stationary portion 53 also made of magnetic material, is adapted to serve as the pole piece of the electromagnet which attracts the movable armature 52. When the electromagnet is energized the movable contact piece 18 is pulled away from the pieces 16 and 17. It is thus evident that the position of the "on" switch, after its mechanism has operated, is dependent solely upon the temperature controlled. If the temperature is below the predetermined limit, the member 49, responsive to this temperature, is in such a position as to allow the contact piece 18 to remain in contact with the cooperating stationary contact pieces 16 and 17. On the other hand, should the temperature rise above the predetermined limit, the electromagnet 50 operates to pull this contact piece 18 away from the stationary contact pieces. After this pulling away, should the temperature fall again, the electromagnet 50 is deenergized and the circuit is again reestablished. This cycle of operations may be repeated time and again, until the "off" switch operates. Thus there is provided means for independently operating the switching elements in response to a rise in temperature.

While I have shown in the accompanying description the preferred embodiment of my invention, I do not wish to be limited thereto, but aim to cover in the appended claims all modifications falling fairly within the scope of my invention.

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

1. In a time switch, in combination, a member rotated at constant speed, means for determining the amount of rotation of said member, a stationary contact piece, a cooperating movable contact piece, and means whereby said movable contact piece is moved to perform a switching operation when said rotated member stops.

2. In a time switch, in combination, a rotatable member, a constant speed mechanism, means for transmitting the motion of said mechanism to said member including a friction clutch, means for restraining the movement of said member after a set time, and cooperating contact pieces so constructed and arranged that they perform a switching operation when the rotatable member stops.

3. In a time switch, in combination, a rotatable member, a constant speed mechanism, means for transmitting the motion of said mechanism to said member including a friction clutch, a stationary member, means for stopping the rotating member comprising a spline adapted to enter a slot, said slot and spline being carried one by the rotatable member and the other by the stationary member, means for setting the relative angular positions of the slot and the spline whereby said rotatable member is stopped after a definite time interval, and contacts operated upon the stopping of said rotatable member.

4. In a time switch, in combination, a rotatable member, a constant speed mechanism, means for transmitting the motion of said mechanism to said member including a pair of clutch members, means for relieving the pressure on the clutch members at a predetermined time, and a contact piece mechanically arranged to move when the pressure is released to perform a switching operation.

5. In a time switch, in combination, a rotatable member, a constant speed mechanism, means for transmitting the motion of said mechanism to said member including

a pair of clutch members, a spring for exerting a pressure between said clutch members, means for releasing the spring pressure at a predetermined time, and a contact performing a switching function upon the release of said spring pressure.

6. In a time switch for controlling a heating circuit, in combination, a pair of contact pieces, mechanical means for moving said contact pieces for turning on the current in said circuit at a predetermined time, and means for preventing too great a rise in temperature created by the heating circuit, comprising an electromagnet responsive to the temperature for independently operating the contact pieces so as to open the heating circuit, whereby the operation of said contact pieces after they cause the heating circuit to be closed, is dependent solely upon the temperature controlled.

7. In a time switch for controlling a heating circuit, in combination, a stationary contact piece, a movable contact piece, means for operating said movable contact piece so as to close the heating circuit at a predetermined time, an electromagnet adapted when energized to operate said contact pieces to cause the opening of the heating circuit, and means operated only by a rise in temperature above that desired for energizing said electromagnet

8. In a time switch, in combination, a rotatable member, a constant speed mechanism, means for transmitting the motion of said mechanism to said member including a pair of clutch members, one of said clutch members being carried by said rotatable member, a spring for pressing the other of said clutch members toward the former, means for permitting axial movement of the rotatable member at a predetermined time in a direction to lessen the spring pressure, and a pair of contact pieces arranged to perform a switching operation in response to said axial movement.

9. In a time switch, in combination, a rotatable member, a constant speed mechanism, means for transmitting the motion of said mechanism to said member including a gear and its driving pinion, said gear being mechanically coupled to the rotatable member, means for permitting axial movement of the rotatable member at a predetermined time whereby the gear and pinion are disengaged, and a pair of contact pieces arranged to perform a switching operation in response to said axial movement.

10. In a time switch, in combination, a rotatable member, a constant speed mechanism, means for trnasmitting the motion of said mechanism to said member including a pair of clutch members, one of said clutch members being carried by said rotatable member, a spring for pressing the other of said clutch members toward the former, means for permitting axial movement of the rotatable member at a predetermined time in a direction to lessen the spring pressure, a pair of contact pieces arranged to perform a switching operation in response to said axial movement, and an electromagnet adapted when energized to move one of said contact pieces to perform the reverse switching operation.

11. A time switch for controlling a heating circuit as set forth in claim 10 in combination with a member responsive to a temperature greater than desired for causing the electromagnet to be energized.

12. In a time switch, in combination, a rotatable member, a constant speed mechanism, means for transmitting the motion of said mechanism to said member including a gear and its driving pinion, said gear being mechanically coupled with the rotatable member, means for permititng axial movement of the rotatable member at a predetermined time whereby the gear and pinion are disengaged, a pair of contact pieces arranged to perform a switching operation in response to said axial movement, and an electromagnet adapted when energized to move one of said contact pieces to perform the reverse switching operation.

13. A time switch for controlling a heating circuit as set forth in claim 12, in combination with means responsive to a temperature greater than desired for energizing the electromagnet.

14. A time switch including a rotatable member, a constant speed mechanism, means for stopping the rotation of said rotatable member by an axial movement thereof, and a pair of contact pieces, characterized by the fact that the contact pieces are made to perform a switching operation when the axial movement takes place.

15. A switch of the type adapted to control the circuit of a translating device supplied from a source of electric energy and to be normally automatially opened in response to a timing device at a predetermined time, characterized by the provision of a timing mechanism the action of which is suspended during a failure of the source of supply.

16. In combination, a source of electric energy, a circuit supplied thereby, a time switch adapted to be set for operation at predetermined adjustable times for controlling said circuit and timing means for operating said switch the action of which is suspended by a failure in said source of supply and stopped by the opening operation of said switch.

17. In combination, a source of electric energy, a translating device supplied thereby, a switch for controlling the circuit of said translating device, means for setting said switch to operate at a predetermined

time and an electrically driven timing device supplied from said source for actuating said setting means.

18. In combination, a source of electric energy, a translating device supplied thereby, a switch for closing the circuit of said translating device, a switch for opening said circuit, means for setting said switches to operate at predetermined adjustable times and an electrically driven timing device supplied from said source for actuating said setting means.

19. In combination, a source of electric energy, a heating device supplied thereby, a time switch for controlling the circuit of said heating device, means for suspending the heating operation when said heating device is above a predetermined temperature, and a timing device, the operation of which is suspended during a failure of said source, for timing the operation of said switch.

In witness whereof, I have hereunto set my hand this 21st day of Sept. 1920.

HENRY E. WARREN.