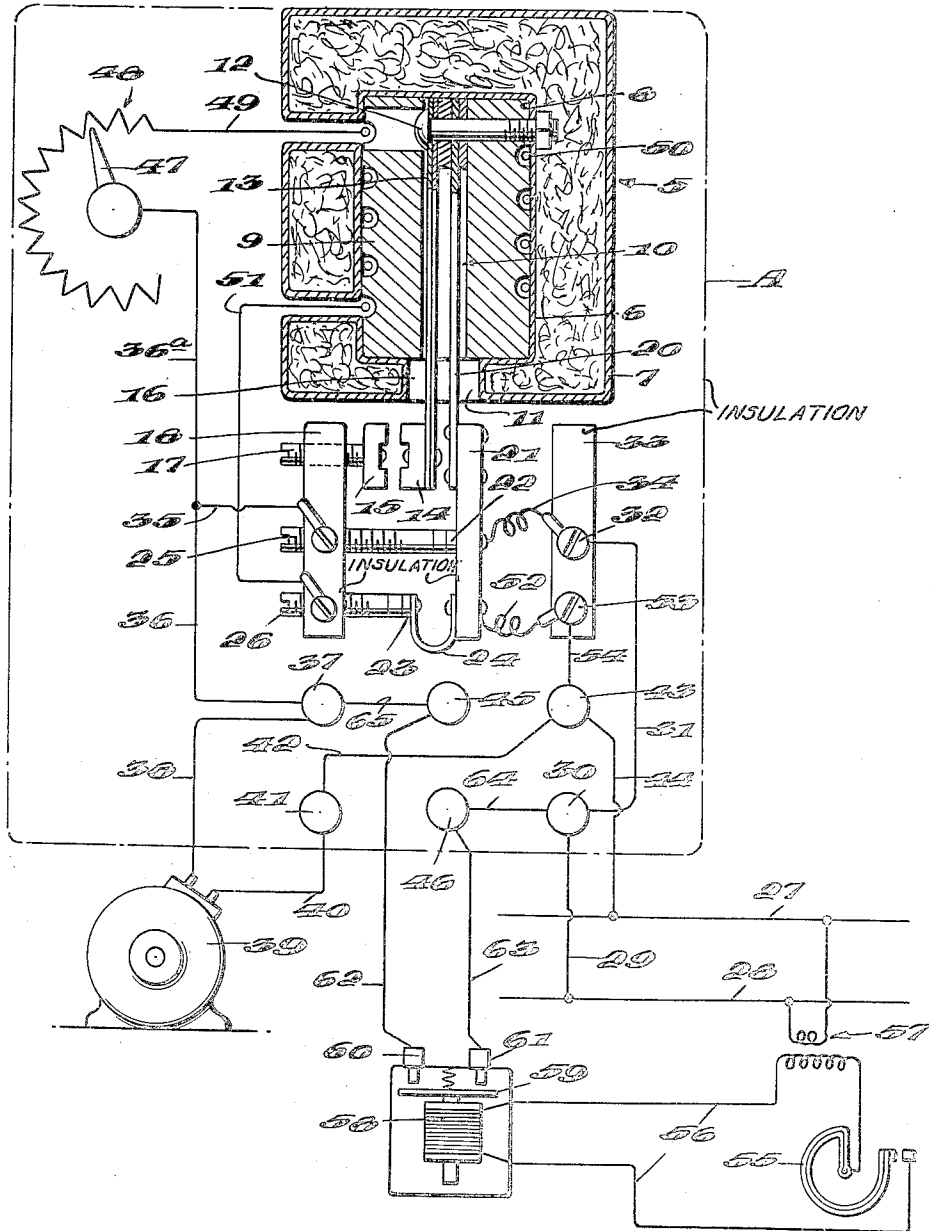


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COMPENSATING STOKER TIMER

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COMPENSATING STOKER TIMER

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1

The object of the present invention is to provide a simple, rugged and inexpensive timing mechanism for controlling the periodic operation of motor-driven coal stokers, whereby to maintain fuel combustion, created through the operation of such stokers, at a minimum heat value during mild weather and yet to prevent such combustion from reaching such a low value as to prevent it from being quickly intensified upon a demand for increased heat.

It is well known in the heating industry that coal stokers are generally operated at a constant rate of speed and fuel feed during their operating cycles, and that variation in heat requirements is met by intermittent operation of the stoker.

It is also recognized that the time interval between operating cycles in mild or warm weather is so great that the fire in the stoker tuyère or retort is apt to be completely extinguished unless means other than the room thermostat is provided to operate automatically the stoker for short periods at reasonable intervals.

In the past, this has been accomplished in most installations by utilizing a motor driven timer set arbitrarily to operate the stoker on a fixed schedule, as, for example, two minutes, such operation then being followed by a period of approximately one hour of inactivity, then for two minutes more, followed by a similar prolonged period of inactivity, and so on throughout the heating season. As more heat was needed, a separate room thermostat would close an electrical circuit and energize the electric motor controlling the operation of the stoker, which condition of operation would be maintained until sufficient heat had been generated to reach the thermostat, and warm it to a predetermined temperature. Upon attaining this temperature, the thermostat would break the circuit and the operation of the structure would cease unless it happened to be the period at which the separate and independent timer was operating, in which case the stoker would continue to run until the end of the timing interval.

Thus in such a prior installation, it commonly occurred that the timer would start to function but a short time following operation of the stoker under the regulation of the room thermostat, and this additional combustion of fuel in very mild weather particularly would result in substantial overheating and waste of fuel.

To eliminate this objectionable condition, the timing mechanism comprising the present invention is constructed so as to operate at a manually adjustable but definite period beginning from

2

the time of last stoker operation, rather than at a definite interval arbitrarily set with regard to time only. In addition, the mechanism forming the present invention is fully compensating, so that should the room thermostat only operate the stoker for a very short period, such as would be ineffective in sustaining the desired rate of combustion of the fuel, my improved timing mechanism will only delay the subsequent operating period of the stoker that additional part of its normal rest period which the increased fire would justify.

For a further understanding of the invention, reference is to be had to the following description and the accompanying drawing, wherein the figure is a diagrammatic view of the apparatus and circuits used in my improved stoker operation timing mechanism.

Referring more particularly to the drawing, my improved timing mechanism comprises a suitable panel A, or other base, on which is mounted a casing 5, the latter being formed with spaced inner and outer walls 6 and 7, respectively, between which walls is packed a body of thermal insulation, such as a mineral wool, granulated cork or the like. The inner walls of the casing define an internal chamber 8 in which is positioned a heat storage mandrel 9, preferably of metal. The mandrel is formed with an axially disposed opening 10 which registers with a similar opening 11 provided in the bottom of the casing 5.

Secured to the mandrel, as at 12, and disposed within the openings 10 and 11, is a bimetallic strip 13. This strip is formed with its high expanding side on the left, so that when heated, it will deflect to the right. The lower end of the strip 13 projects below the casing 5 and has secured thereto a permanent magnet 14 which, conveniently, is of disk-like form. When the strip 13 is cooled, the magnet 14 is disposed in immediately adjacent relationship to a complementary attracting magnet 15, the mutually attracting fields of the magnets serving to hold the same in closely adjoining but slightly spaced order, since the strip 13 engages a stop 16, formed with the casing 5, thereby preventing physical contact between the magnets. The magnet 15 is carried by a threaded stud 17, which is received within a threaded opening provided in a bar 18 mounted on the base panel A, said bar being formed from a suitable dielectric material. By rotating the stud 17, the spacing between the magnets 14 and 15 is subject to variation, for a purpose to be hereinafter set forth.

Also secured as at 12 to the mandrel 9 is the upper end of a resilient metallic reed 20. This reed, when the timer is cool, extends in parallel relationship, with but slightly spaced from the bimetallic strip 13. The lower end of the reed 20, which flexibly depends below the casing 5, is fastened to the upper end of a movable bar 21, also formed from a dielectric material. The bar 21 carries an inflexible headed contact 22 and a spaced resiliently movable contact 23. The contact 23 is carried by the free end of a substantially U-shaped spring 24, the opposite end of this spring being attached to the lower end of the reed-carried bar 21.

With the timer in a cool or unheated state, the contact 22 is disposed in positive resiliently urged engagement with one end of an adjustable contact-forming screw 25, which is mounted for adjustment in a threaded opening provided in the bar 18. The contact 23 under such conditions of timer operation is disposed in engagement with the outer end of a second contact-forming screw 26, also mounted for adjustment in a threaded opening provided in the bar 18. The screws 25 and 26 are supported in spaced parallel relationship and electrically insulated from each other by the material constituting the bar 18.

The leads of a standard current-supplying circuit are indicated at 27 and 28. From the lead 28, a conductor 29 extends to a line terminal post 30, preferably mounted on the timer base or panel. From this post, there extends a conductor 31 which is shown as leading to a terminal screw 32 threaded in a stationary insulating bar 33, carried by the timer base. A flexible conductor 34 extends from the screw 32 to the contact 22, so that current may be transmitted to the screw 25 and conducted from that screw by way of conductors 35 and 36 to a terminal post 37 on the timer base. From the post 37, a conductor 38 extends to one of the terminals of the electrical operating motor 39 of a solid fuel stoker, said motor being employed in operating the blower or fan of the stoker, and/or its fuel-conducting conveyor in a manner well understood in the art. From the other terminal of the motor, a conductor 40 extends to another base-mounted post shown at 41. From the post 41, a conductor 42 leads to a terminal post 43, and, from this last-named post, a conductor 44 leads to the power line 27. The posts 30 and 43 may be termed the "line" terminals of the timing mechanism, and the posts shown at 37 and 41, the "stoker" terminals. The intermediate set of terminal posts, indicated at 45 and 46, may be referred to as the "relay" posts or terminals. All these posts or terminals are advantageously mounted in mechanically and electrically spaced order on the timer base.

It will be seen that when the timer is in its cool or low-temperature state, current may flow from the line 28 through conductors 29, 31 and 34 to the contact 22, and thence through screw 25 and conductors 35, 36 and 38 to the stoker motor 39, the current returning by way of conductors 40, 42 and 44 to the return side 29 of the power line, thus energizing the stoker motor and causing the active operation of equipment driven thereby.

Simultaneously with the closing of this motor circuit, current will flow from the conductor 35 to a conductor 36a and thence by way of this latter conductor to the adjustable arm 47 of a rheostat 48. From the windings of this rheostat, current is conducted by the line 49 to a heating

coil 50 which surrounds the mandrel 9, so that during passage of current through the coil 50, the mandrel will be heated to govern the operation of the bimetallic strip 13. A conductor 51 conveys current from the coil 50 to the contact screw 26 and, with the timer still in a relative cool condition, current passes through the contact 23, the spring 24 and thence through a flexible conductor 52 to a contact screw 53 mounted on the bar 33. From the screw 53, a conductor 54 conveys current to the terminal posts 43, and thence by way of the conductor 44 to the return side 27 of the power line.

With this arrangement, it will be evident that when the timer switch cools to cause closing of the motor circuit, the mandrel 9 will be heated by the action of the coil 50. This heat is transmitted to the bimetallic strip 13 which, responding to the influence of the heat, tends to flex to the right. Initial flexure, however, is resisted by the attraction of the magnets 14 and 15 and, therefore, an appreciable amount of potential energy will be stored in the strip before reaching such magnitude as to overcome the attraction influence of the magnets. When, however, the attraction is overcome, the magnets separate with a sharp, snap action, which results in the lower end of the strip coming into forceable contact with the lower end of the reed 20, flexing said reed and causing movement of the bar 21 carried thereby to a position separating the contacts 22 and 25 and the contacts 23 and 26, thus breaking the motor circuit and discontinuing the application of heat to the mandrel 9. Due to the fact that the casing 5 is thoroughly insulated against heat loss, an appreciable period of time is required to permit of the cooling of the bimetallic strip 13 to cause it to flex sufficiently to bring the magnets 14 and 15 together and move the strip 13 rapidly to a position of contact closure. This period, however, is subject to variation through the manual adjustment of the stud 17 on which the magnet 15 is carried. By adjusting the screw 17 so that the magnet 15 is brought toward the magnet 14, the duration of the cooling period may be shortened, and vice versa if the magnet 15 is moved away from the magnet 14. Likewise, the period for heating the mandrel may be varied by adjusting the operating positions of the rheostat 48, so that more or less current may pass through the coil 50. The contact screws 25 and 26 are likewise adjustable toward and away from the contacts disclosed at 22 and 23. Due to the inclusion of the spring 24, the contacts 23 and 26 remain in relative engagement longer and engage sooner than the contacts 22 and 25, the operation of the latter set of contacts being synchronous with the operation of the magnets 14 and 15.

While the timer mechanisms thus far described may be used as a separate and independent instrumentality in governing the operation of electrical equipment, such as the operating motor 39 of a fuel-feeding stoker, yet it may be combined advantageously with a room thermostat controlled circuit in governing the operation of the stoker motor. In the drawing, the room thermostat has been indicated by the numeral 55. In the event the room thermostat is of low current capacity, its operating circuit 56 may be energized by a step-down transformer 57 which has its primary winding connected with the power lines 27 and 28. Included in the circuit 56, is a relay 58, the armature 59 of which, when attracted by the relay winding, is adapted to bridge spaced terminals 60 and 61. From the post 45, a conductor

62 extends to the terminal 60, and from the post 48, a parallel conductor 63 leads to the terminal 61.

With this arrangement, when a heat demand exists in the room in which a thermostat 55 is disposed, the latter responds to close the circuit 56 and thereby causes the armature 59 to electrically unit the terminals 60 and 61. Current passes from the power line 28 through conductor 29, a conductor 64 which unites terminals 30 and 46, conductor 63, terminal 61, armature 59, terminal 60 and conductor 62 to post 45. From the post 45, current passes by way of the conductor 65 to post 37, thence through conductor 38, motor 39, conductor 40, post 41, conductor 42, post 43, and conductor 44 to the return side 27 of the power line, thereby energizing the motor 39 and causing the operation of the stoker.

Simultaneously with the closing of the motor circuit through the operation of the relay 58, current will pass from the post 37 by way of the conductors 36 and 36a to the rheostat 48, heating the timer coil 50. In the event the timer mechanism is in a cool state, the bimetallic strip 13 will be positioned to close the contacts 23 and 26. Therefore, when the motor 39 is operated under the control of the thermostat 55, the timer mechanism is heated, so that when the operation of the motor 39 is discontinued by lack of heat demand around the thermostat 55, the timing mechanism will be in a heated state requiring a full cycle of operation on the part of the timing mechanism before the motor 39 is again re-energized, or until the thermostat 55 again responds to a heat demand. By this arrangement, it will be seen that under mild weather conditions, particularly the timing mechanism, in contrast with prior arrangements, cannot operate immediately following operation of the stoker through its room thermostat controls.

From the above, it will be obvious that the operation of the stoker, either by the room thermostat, or by the action of the timer itself, immediately reheats the mandrel 9 to a predetermined temperature, but not beyond such temperature. Slight cooling of the mandrel to a sufficient extent as to allow closure of contacts 23 and 26, adds additional heat which keeps the mandrel at a substantially high temperature as long as the stoker is in operation, and following which the mandrel cools at a uniform rate until the magnets 14 and 15 snap together, or until additional stoker operation is caused by the room thermostat, or other external means. Another advantage is found in the fact that if the external means should only call for short operation which would be insufficient to fully warm the mandrel 9 and open contacts 23 and 26, a shorter rest period would be required to re-cool the mandrel to its stoker operating temperature. In other words, short stoker operation only adds to the subsequent rest period the amount of time proportional to the actual operating period, but never extends such rest period beyond the safe limit as set for normal operation by the temperature differential screw or stud 17 and the temperature-limiting screw 26. Since the rheostat 48 is in series with the heating coil 50, any

reasonable heating-up speed can be secured, which is also the duration of the running cycle for the stoker or other load under its control.

I claim:

1. A timing switch comprising a base, a thermally insulated casing mounted on said base, a heat storing mandrel arranged within said casing, said mandrel being provided with an axial opening disposed for registration with an opening formed in the walls of said casing, a resilient heat deflectable bimetallic strip supported at one end within the axial opening of said mandrel and projecting exteriorly of the casing through the opening formed in the wall thereof, a resilient reed supported at one end in parallel and normally spaced relation from said bimetallic strip, a magnet carried by the free end of said bimetallic strip, a stationary magnet supported on said base in spaced relation from said strip-carried magnet, a stationary contact mounted on said base, a movable contact carried by said reed and normally disposed in engagement with said stationary contact, and electrically energized means for heating said mandrel, the heating of said mandrel and strip producing stresses in the latter sufficient to overcome the attraction between said magnets, whereby to produce a resilient release of said strip and cause the same to forcibly engage said reed to deflect the latter to a position separating said contacts.

2. A switch for periodically opening and closing associated circuits comprising a base, a thermally insulated casing mounted on said base, a heat storage mandrel positioned within said casing, said mandrel being provided with an axial opening arranged for registration with an opening formed in the walls of said casing, a resilient bimetallic strip secured at one end to said mandrel, said strip being positioned in the openings formed in said mandrel and casing and having its free end disposed exteriorly of the casing, a resilient reed coextensive with said strip, said reed being secured at one end to said mandrel and being disposed within the openings provided in said mandrel and casing in normally spaced coextensive order with said bimetallic strip, an electrically energized heating element for said mandrel, a circuit for said heating element, a magnet carried by the free end of said thermostatic strip, a second magnet arranged on said base in opposed and attracting relationship to said first-named magnet, said magnets opposing deflection of said strip in response to increased temperatures thereabout, an appliance-operating circuit, movable contacts for said heating and appliance circuits supported by the free end of said reed, and stationary contacts for said circuits supported by said base and normally disposed in engagement with said movable contacts, whereby when said thermostatic strip is heated to a deflecting temperature sufficient to overcome the attraction of said magnets, the resilient release of said thermostatic strip from the field of said magnets causes the free end of said strip to forcibly strike said reed to produce accelerated separation between said movable and stationary contacts.

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