

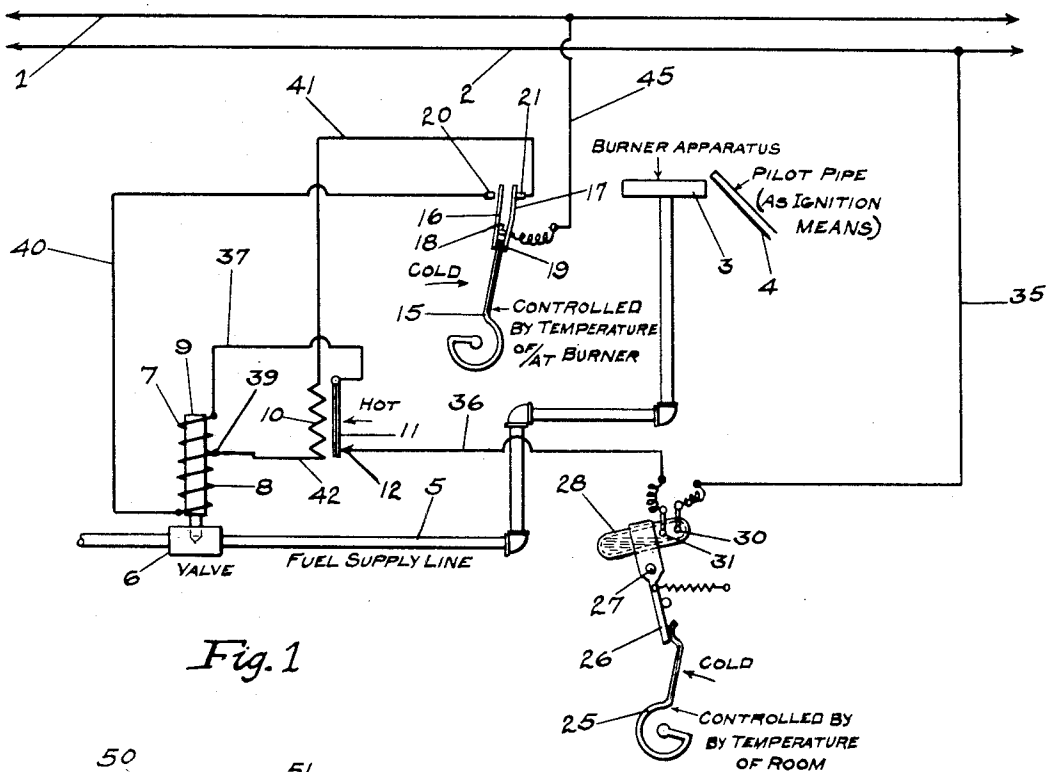
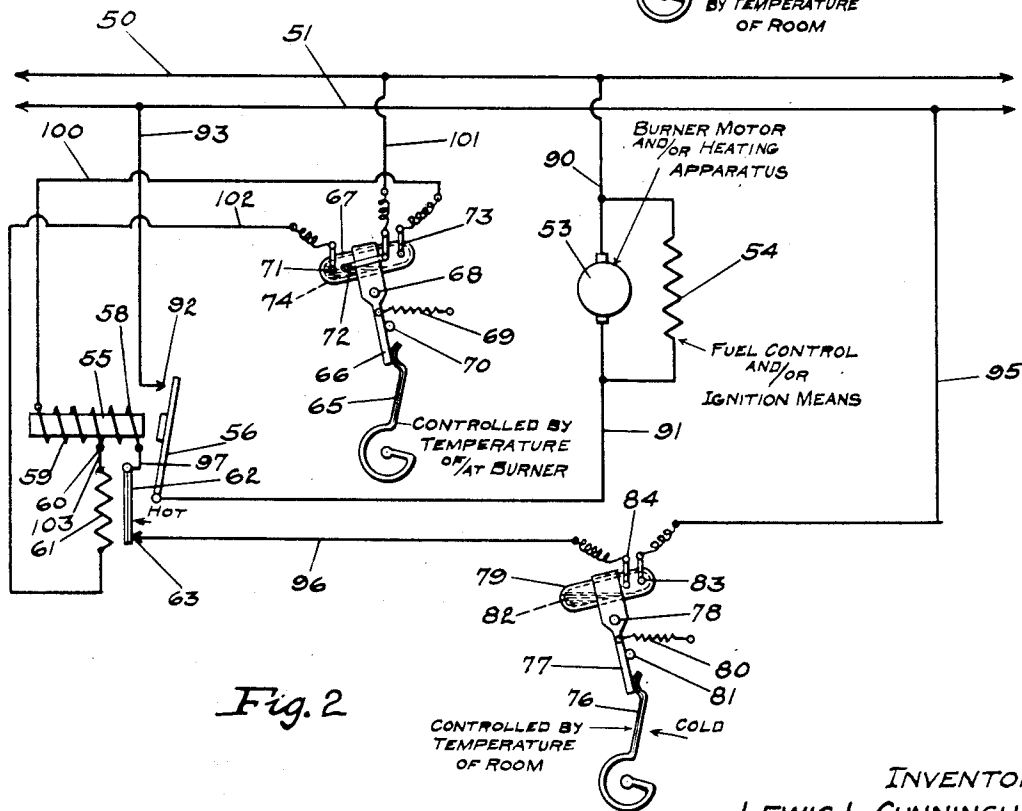
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HEAT REGULATING DEVICE

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HEAT REGULATING DEVICE

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This invention relates to improvements in heat regulating devices, and has for general and broad objects to provide an electro-magnetically operable means for controlling a heating apparatus and an electro-thermal timing device in such manner that temperature changes at or in the heating apparatus will operate a control switch so that a maximum degree of energization of the electro-magnetic device and/or timer can be obtained when the temperature of the burner reaches a predetermined minimum, and such that a minimum energization of the electromagnetic device and/or timer will take place when the temperature of the burner apparatus reaches a predetermined maximum.

Specific objects are to provide a double coil electro-magnetically operable device and so arrange a circuit that the magnetic force can be varied according to the temperature of the heating apparatus, and so that a warp switch as a timing device can be operated to continue operation of the burner apparatus when flame is obtained or, in other words, when ignition is successful, and such that this device can be made inoperative when ignition is successful. Another object is to so control the magnetic force that under some conditions the magnetic device has sufficient energy to control the heating apparatus in a certain manner, and under some conditions does not have sufficient magnetic energy to control the burner apparatus, in that manner. Another object is to use an electro-magnetic device in a manner to cause a thermally operable switch, for example a warp switch as a timer device to be energized or de-energized respectively to perform or not perform its operation according to the temperature condition at the burner of the heating apparatus. Another object is to control the electro-magnetic means and the burner apparatus by means of switches which are either magnetically or thermally operable.

Features of the invention include the broad idea of using a magnetically operable device and varying its magnetic force for the purposes above mentioned, along with all details of construction and arrangement of the apparatus per se, and the electrical connections or circuits.

Features of the invention will be set forth in the description of the drawing forming a part of this application, and in said drawing:

Figure 1 is a diagrammatic view showing an application of the invention in which the electro-magnetic means is applied to operate an oil valve;

Figure 2 is a diagram showing a modification in which the electro-magnetic means is applied to operate a relay.

A very simple application of the invention is shown in Figure 1 of the drawing, in which the power lines are indicated respectively at 1 and 2. The burner is indicated at 3. It will be understood that the term "burner apparatus" as used herein includes all those parts such as a blower motor, pilot pipe, ignition means, and oil means etc., needed to supply heat. In this instance, the burner apparatus may be viewed as including the burner 3, pilot pipe 4 and fuel supply line 5. The control of the fluid through the supply pipe is obtained by electro-magnetic means designated 6, in this instance, an electro-magnetically operable valve. It is conceivable that the electro-magnetic control may have many forms and may be connected mechanically or electrically to control the operation of the burner apparatus. Nevertheless the specific form and arrangements are also claimed. This electro-magnetically operable means is therefore connected to control the burner apparatus and the said means herein includes two coils, designated respectively 7 and 8. These coils may be arranged in other ways, but the specific arrangement is also a feature of the invention. The coil 7 may have less resistance than the coil 8. In any event, when both coils are in circuit the magnetic pull is reduced to such a degree that the core 9 cannot be caused to open the valve, but if the valve is once open it can be held open when both coils are in circuit. The coil 7 is capable of opening the valve.

A warp switch as one form of electro-mechanical timing device includes the heating coil 10, and the bimetallic element 11, in this instance closing against a contact 12 when cold. As shown in the drawing, the heating of this device is in series with the electro-magnetic means. The circuit will be described herebelow.

A double contact switch (in this case thermally operable) is arranged to be controlled by burner temperatures, and in practice is quickly responsive to presence or absence of flame. This device includes a bimetallic element 15, two spaced spring arms respectively 16—17, electrically connected at 18 and insulated as at 19 from the element 15. The spring arms operate between contacts 20—21. In this instance, the arrangement is such that the contacts are alternately made, and each engages its contact before the other disengages. The reason for this will be explained. A third switch in this case thermally operable in-

cludes the thermal element 25 operating against a lever arm 26, pivoted as at 27 and carrying at the opposite side of its pivot a mercury switch 28, having terminals 30—31. The following circuit connections are provided. Conductor 35 connects on side 2 of the main line and with the terminal 30. The terminal 31 is connected by conductor 36 with contact 12. The opposite side of the circuit controlling member 11 is connected by conductor 37 with one terminal of coil 7. In this instance, coils 7 and 8 are connected together as at 39. It will be understood that the coils can be differently arranged. The opposite terminal of coil 8 is connected by conductor 40 with contact 20. Contact 21 is connected by conductor 41 with one terminal of the heating coil 10, and the opposite terminal of the heating coil is connected by conductor 42 with the junction point 39 of coils 7 and 8. Both spring arms 16—17 are electrically connected with the opposite side of the main line by conductor 45.

It will thus be seen the circuit connections are such that when the mercury switch closes (as when heat is desired) at 30—31 and when the thermally operable device 15 is cold (no flame), and is closed at 17—21, the electro-magnetic means is energized to start the burner apparatus, in this instance, by raising core 9 to open the valve and at the same time the heating coil 10 is energized. Suppose the burner apparatus effective to supply the heat, so that contacts 16—20 are closed. Then the heating coil 10 is shunted out and therefore further operation of the timing device is prevented. That this is so may be seen by tracing the circuit as follows: Main line 2, 35, 30, 31, 36, 12, 11, 37, 7, 39, 42, 10, 41, 21, 17, 45 to line 1. It will be noted that in this instance the warp switch blade 11, coil 7 and coil 10, are all in series across the line. On energization of the coil 7, the valve is opened.

Let it be supposed that there is an ignition failure (no flame produced). At the end of a predetermined time (because heat is being supplied at the coil 10) switch 11 will be opened, the coil 7 will be de-energized and the valve will close. Under these conditions an inspection of the apparatus and repair of the same will be in order. However, suppose that ignition is successful, and that therefore heat is produced by the burner apparatus. The double contact switch moves, in this instance, to the left, closes at 16, 20 and then opens at 17, 21. The valve remains open, and that this is true can be seen by tracing the circuit as follows: Main line 2, 35, 30, 31, 36, 12, 11, 37, 7, 8, 40, 20, 16, 45 to line 1. Under these conditions, it will be noticed that no current will pass through the heating coil and the magnetic pull upon core 9 is weakened, but is still sufficient to hold it so that fuel is supplied. In practice, the response of the element 15 to temperature conditions at the burner apparatus is prompt. The magnetic characteristic and arrangement of the coils is such that if when the contacts 16, 20 are making contact, they are de-energized, the core 9 will cause a closure of the valve and on reenergization, the valve cannot again be opened while 16 and 20 are making circuit. However, the element 15 by cooling will shortly make contact at 17, 21, in which instance, only the coil 7 will be in circuit and the valve can be opened, if 31, 30 are closed. If this occurs, and if ignition is not successful, the coil 10 will eventually heat sufficiently to open the switch 11, as in the first case.

Therefore, the arrangement is such that when one contact of the double contact switch is closed,

(in this instance when no heat is being supplied) a comparatively large current passes to operate the electro-magnetic device, as well as to furnish heat for the coil of the timer. On the other hand, after heat has been furnished, the other contact of the double contact switch is closed and both coils are in circuit. Under these conditions there is sufficient magnetic force to hold the movable core in its previous position, but the timer can receive a very small current or no current at all, and therefore is not operative after heat is supplied by the burner apparatus. By the use of the present invention an alternating current can be used, and the warp switch or timer coil can be put in series with the coils of the magnetic device or relay or similar device, without danger of over-heating and destruction of the coil.

Moreover, a burner regulating device is provided which complies with one of the most important requirements of an oil burner control circuit, namely that an electrical failure of any of the contacts or conductor in the safety or timer circuit, will result in a shut-down of the oil burner due in some instances to the stopping of the motor or interruption of the fuel supply or both.

Another valuable application of the invention is illustrated in Figure 2, in which the magnetically operable means includes a relay having two coils, or which is operable by two coils. The broader features of the device herein shown are identical with those of Figure 1. The main lines are shown at 50, 51. The burner apparatus in this instance includes a motor 53, a fuel control or ignition means 54, which is energizable whenever the motor is energized. The motor, the fuel control and/or ignition means may be considered as constituting a burner apparatus, which apparatus as before stated, must have all the parts necessary to supply and maintain flame. The motor 53 will be considered the burner motor. The relay, (as an electro-magnetic means) includes the core 55, armature 56, coil 58 and coil 59, the coils being, in this instance, connected at 60. The warp switch, as a timer device, includes the heating coil 61 and the bimetallic warp member 62 cooperative with contact 63 and closing it when cold. The double contact switch, operable as a result of heat furnished by the burner apparatus, is of the mercury type and is moved by a thermally operable means indicated at 65, engaging against a lever 66 of the tube 67. The lever is pivoted at 68 and has a spring 69 urging it against a stop 70. The mercury switch has a terminal 71, an L-shaped terminal 72, and a third terminal 73. The mercury is indicated at 74. There is also herein provided, as in the first form of the invention, a thermally operable device (which may be manually operable) comprising a thermal element 76 operative against a lever 77, pivoted at 78, carrying its upper end tube 79, and having a spring 80 urging the lever against a stop 81. The mercury is indicated at 82. The terminals are indicated at 83, 84. Circuit connections are arranged, so that when the switch 82 as well as one of the contacts of the double contact switch are closed, the electro-magnetic means is energized to start the burner apparatus and the heating coil is also energized, so that if the burner apparatus is effective to supply heat, said double contact switch closes its other contact to prevent operation of the timing device.

The circuit connections are as follows: Line 50 is connected by conductor 90 to one side of the motor 53, and the other side of the motor is con-

connected by conductor 91 and relay armature 56 which operates against a contact 92, in turn connected by conductor 93 with line 51. The ignition coil 54 of the magnetically operable fuel device is connected as shown so as to be energized when the motor is energized. Contact 83 is connected by conductor 95 with main line 51, and terminal 84 is connected by conductor 96 with contact 63. Warp switch blade 62 is connected by conductor 97 with terminal of the coil 58. The terminal of the coil 59 is connected by conductor 100 with terminal 73 of the double-contact switch. Terminal 72 is connected by conductor 101 with line 50. Terminal 71 is connected by conductor 102 with one end of the heating coil 61, and the opposite end of the heating coil is connected to the junction point of coils 59, 58 by conductor 103.

The operation of this device is substantially the same as above described for the construction of Figure 1. Assuming the switch 82 to close and beginning at line 51, the current takes the following course: 95, 83, 84, 96, 63, 62, 97, 58, 60, 103, 61, 102, 71, 72, 101 to line 50. As the result, coil 58 is energized, armature 56 is closed and current to the motor or burner apparatus is supplied. Simultaneously heating current is supplied to the coil 61. If ignition is unsuccessful, switch 62 will open at the end of a predetermined period, which is the safety timing, or trial ignition period. If ignition is successful, the mercury switch will close contacts 72, 73, coil 59 will be put in circuit with coil 58 and coil 61 will be inoperative to open switch 62. Armature 56 will be held closed, and therefore the burner apparatus will continue to operate.

The arrangement is therefore such that if the burner apparatus is effected to supply heat, the double contact switch closes one contact before opening the other to prevent operation of the timing device, and the arrangement is further such that the magnetic effect of the electro-magnetic means is so modified that although the burner apparatus remains operative after closure of the second contact, or, in this instance, of contact 72, 73, yet if the magnetic means is once de-energized or momentarily de-energized, re-energization is impotent to close the relay (the armature of which will have fallen open), to obtain operation of the burner apparatus to supply heat (because the armature 56 cannot close with its contact 92). This is a valuable feature of the invention, and is shown for both forms of the invention.

It will be understood that in all instances, the arrangement of the double contact switch will be such that in changing from one contact to the other the circuit cannot be momentarily broken or one circuit cannot be broken before the other is made to allow de-energization of the electro-magnetic means.

The circuit arrangement including the coils is such that when a flame is present, and when both coils are energized, the magnetic pull is so reduced that no operation of the electro-magnetic means to start the ignition apparatus can take place, and no current to the heating coil can be had, sufficient to obtain a safety timing operation of the warp switch to shut down the heating apparatus. The circuit and coil arrangement is also such that if the magnetic device has been energized and its movable core moved to that position which supplies fuel or starts operation of the ignition apparatus, on presence of flame the core will be held in this position.

If a flame responsive double-contact switch device is used, which acts quickly to change from one contact to another, as compared with the speed of drop of the plunger of the electro-magnetic valve for example, so that the change is made before the plunger can close the valve, or before it can move, after release, no overlapping switch arrangement is necessary, as above described for both applications of the invention. However, if this is not so, then contacts must be arranged so that one contact is made before the other opens. This overlapping contact can be obtained either by the spring arrangement of Figure 1 or by using the mercury tube of Figure 2. However, it will be conceivable that a single switch arm operating between two contacts can be used if the speed of travel between the contacts sufficiently exceeds that of the rate of motion of the electro-magnetic means.

In all instances, the coils of the electro-magnetic means, for example the relay or magnetic valve, can be put in series in such manner that the timer coil can receive sufficient heat to eventually cause opening of its switch to shut down the motor, or in another instance cannot receive sufficient heat for that purpose. Broadly, in both instances, there is an arrangement for the fuel supply or motor control means whereby a coil or coils can be controlled to vary the magnetic effects and increase these effects, for example, when the flame responsive device is making on the cold side, and decrease them when making on the hot side.

Another valuable feature of the invention is that it provides means whereby increased heating effects can be had at the warp switch when one contact is making, in order to obtain a trial ignition period or timing cycle to shut down the motor if all is not working properly, or when the other contact is making to decrease the heating effects and prevent a shut-down if all is operating properly. These are considered important broad features of the invention, and there is no intention to be limited to details of construction although such details are in all cases considered features of the invention.

I claim as my invention:

1. A system of the class described comprising, in combination, an electrically actuated fuel feeding means, a switch in circuit with and for controlling energization of said fuel feeding means, combustion responsive switching mechanism having first contacts which are closed in the absence of combustion, and second contacts which are closed in the presence of combustion prior to the opening of said first contacts, a thermal time switch, a heater element for actuating said switch upon energization for a time period, a main control switch, and a single high impedance solenoid having a portion of its turns connected in series with said first contacts, said heater element, said time switch, and said main switch and operable when so energized to close said fuel feeding control switch, and having all of its turns connected in series with said second contacts, said time switch and said main switch, and when so energized it is operable to hold said fuel feeding control switch closed, but is incapable of closing said switch.

2. A system of the class described comprising, in combination, an electrically actuated fuel feeding means, a normally open switch in circuit with and for controlling energization of said fuel feed-

ing means, combustion responsive switching mechanism having first contacts which are closed in the absence of combustion, and second contacts which are closed in the presence of combustion prior to the opening of said first contacts, a normally closed thermal time switch, a heater element for actuating said switch to open position upon energization for a time period, a main control switch, and a single high impedance solenoid having a portion of its turns connected in series with said first contacts, said heater element, said time switch, and said main switch and operable when so energized to close said fuel feeding control switch, and having all of its turns connected in series with said second contacts, said time switch and said main switch, and when so energized it is operable to hold said fuel feeding control switch closed, but is incapable of closing said switch.

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