

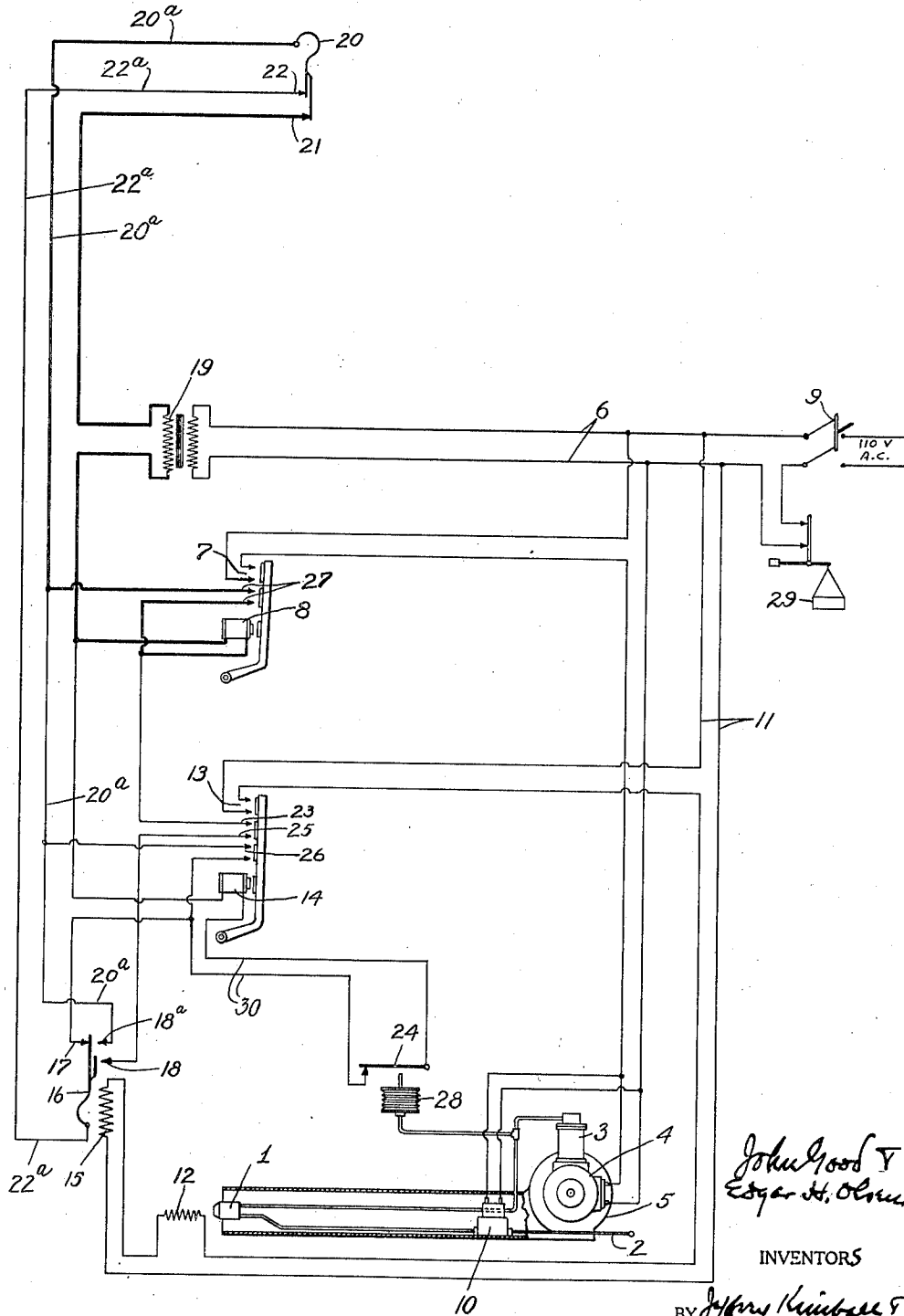
April 9, 1929.

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1,708,918

OIL BURNER SYSTEM

Filed July 8, 1925



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OIL-BURNER SYSTEM.

Application filed July 8, 1925. Serial No. 42,147.

The invention relates to control systems for oil burners of the general type used for house heating purposes, although not limited to such use, and its object is to provide an organization of inter-related controlling elements which is proof against possibility of explosive accident and, among other things, to provide in such a system means whereby, on the resumption of the supply of operating current following a momentary interruption, no explosive effect is possible from the re-delivery of fuel into the combustion space or by re-energization of the ignition means, and a further object is to provide such a system in which the stopping of the burner is not dependent on the making of any circuit, but is always produced by opening or breaking a circuit, at the room thermostat or otherwise, thereby further guarding against accident in the event of failure of the main current supply. A still further use is the accomplishment of these and other results which will hereinafter become apparent, by the aid of simple, inexpensive mechanism least subject to derangement and extremely reliable in operation.

The invention consists in an organization of circuits and translating devices which is susceptible of considerable variation and modification of design, but which is shown in the preferred form in the figure of the drawing, which will suffice to illustrate the principles of the invention.

In the drawing, which is entirely diagrammatic, the burner is assumed to comprise an atomizing spray nozzle 1 supplied with fuel oil by a pipe 2 from any suitable source and with high pressure atomizing air from a small pump 3, the latter being driven by an electric motor 4 which also drives a fan blower 5 to supply combustion supporting air to the sprayed fuel as will be understood. The design of the burner structure forms no part of this invention and may be according to preference. The motor is connected to the main leads 6 by means of the motor switch contacts 7 adapted to be closed by the electro-magnet 8, which will be hereinafter referred to as the motor switch magnet. The supply leads 6 are connected to the ordinary 110 volt house wiring system through a main shut-off switch 9, and the burner-operating motor accordingly may be a 110 motor. Bridged across the motor circuit is an electro-

magnetic oil valve 10, the function of which is to open the oil line to the burner whenever the motor is in operation and close it whenever motor current ceases, this being no part of the present invention and well known to the art. The igniter circuit 11 is also connected to the same leads 6, and includes, in the present case, a resistance element, or hot wire igniter 12 placed in igniting relation to the fuel spray of the burner and controlled at the circuit gap 13 which is adapted to be closed by the electro-magnet 14, which magnet is herein termed the ignition magnet.

In series with the resistance igniter 12 is a second resistance heating element 15, associated with a thermostat element 16, the function of which is to dominate the action of all parts of the system, second only to the room thermostat or other primary control member, as later explained. Inasmuch as this resistance element is in series with the igniter 12 it can only function when the igniter functions, and rupture or burning out of the latter will thus preclude the operation of any part of the system beyond the room thermostat. The said heater 15 is closely associated with its thermostat element 16, which is adapted to move in one direction or the other according as it is heated by the heater 15 or allowed to cool. Conveniently this member may take the form of a bi-metallic strip usual in thermostats and moves away from the heater element as it cools and towards it as it warms and is so designed as to consume four or five minutes in changing its position from one extreme to the other; when cool, it rests in engagement with a cold side contact 17 and is only moved from this normal position when the igniter circuit is energized, as will now be apparent. When subject to the heat of the igniter circuit, it moves to its hot side position wherein it closes contact, first by its attached flexible finger, with the hot side contact 18 and, second or simultaneously by the end of the element itself, with the auxiliary hot side contact 18^a, both of which will be later referred to. Inasmuch as the circuit-closing function of this lag element requires a considerable period of time, it is herein termed the lag element or thermostat, and the resistance 15, the lag heater.

The two electro-magnets 8 and 14 are both operated by low voltage current derived from a transformer 19 connected, as indicated, to

the high voltage leads 6 and arranged to be controlled in a definite sequence by the room thermostat 20, or whatever kind of primary control device is employed. In some systems it is preferred that the control shall be exercised by a thermostat situated in the room heated and in others by a pressurestat connected to the boiler and set for maintaining pre-determined steam pressure; in either case the term "room thermostat" is herein used as applying to such a primary responsive control member whether heat or pressure operated. In the present case the room thermostat consists of an ordinary bimetallic strip, but is provided with two contact-making arms adapted for making a double contact, one contact with the contact point 21, and the other with the contact point 22. It closes these contacts successively or simultaneously and for this purpose the arm to engage point 21 is a very flexible finger extended from the bimetallic strip. The armatures of the two magnets 8 and 14 are normally arranged to lie away from their circuit-closing positions, by gravity, spring or otherwise.

When, on a cooling room temperature, the flexible thermostat finger closes the gap at contact 21, the effect is to establish a conducting path from the room thermostat through the transformer and motor switch magnet 8 to a contact 23, which latter is under control of the igniter switch magnet 14, but no current flows through this path because contact 23 is open, the effect is also to establish a path from contact 21 through the transformer to the igniter switch magnet 14, and through the latter to the pneumatically-controlled switch 24, and thence to the cold side contact 17 of the lag thermostat. If the lag thermostat is cold, as for example after a period of burner inaction, the cold side gap at 17 is closed and then the conducting path established by the room thermostat becomes extended through the lag thermostat and wire 22^a to contact 22, and if the room thermostat has engaged with this latter contact the path becomes a complete circuit back to the transformer, thereby energizing the igniter switch magnet. This closes the gap 13 in the igniter circuit thereby starting 110 volt current through the igniter and the lag thermostat heater 15. Magnet 14 connects contact 23 to the contact 25, thereby extending the conducting path already established, by thermostat finger 21 to the hot side contact 18, which is of course open if cold side gap 17 is closed. The magnet 14 also closes the gap 26 of what may be called a holding circuit, since its function is merely to maintain a path for current through the igniter switch magnet 14 to the room thermostat and transformer independent of, or around, the cold side gap 17 of the lag thermostat, so that the subsequent opening by heat of the cold side gap will not have the effect of de-energizing

the igniter switch magnet. This circuit may be traced as follows from the transformer to magnet 14, to pneumatic switch 24, to gap 26, to wire 20^a, to room thermostat, contact 21, back to transformer. By the closure of gap 26 the said magnet thus closes its own circuit so that it must continue energized until that circuit is interrupted at some point other than contact 17.

On the growing warmth of the lag heater 15 the lag element 16 opens the cold side gap at 17 and in the course of several minutes engages the hot side contact 18, which occurs slightly before or coincidentally with the engagement with the auxiliary hot side contact 18^a. Closure of the gap at contact 18 completes the already partially established current path through the motor switch magnet 8, making a closed circuit, which may be traced as follows: from transformer to magnet 8, closed gap at 23—25, contact 18, lag element 16, wire 22^a contacts 22 and 21 back to transformer. The motor switch magnet is thus energized, which accordingly sets the burner in operation. The armature of the motor switch magnet at the same time closes a circuit gap at 27, the effect of which is to close another circuit for maintaining current through the magnet 8, independently of the lag thermostat, so that this magnet cannot become deenergized save by the opening of gap 21 by the room thermostat, or by cessation of the current supply. This circuit is thus a holding circuit; it is shown in heavy lines in the diagram.

As already stated, it has taken several minutes for the lag thermostat to move from its cold to its hot side position and during this time the resistance igniter 12 has become incandescent and the motor has started in operation, the fuel spray becoming ignited immediately on contact with the hot igniter. As air pressure is developed by the air pump 3 and builds up in the flexible metallic bellows 28, the distension of the latter opens switch 24, which, it will be seen, interrupts the current flow through the igniter switch magnet allowing its armature to drop back, thus opening the igniter circuit and allowing both heating elements therein to cool down. The lag thermostat now recedes from its hot side contact 18, but this is without effect on the motor switch magnet, because of the holding circuit of the latter, which keeps that magnet energized as already described. The subsequent closure by the lag thermostat of its cold side contact 17, is also without effect, because said contact has been made dead by the opening of the switch 24 which, like the oil valve 10, remains open for as long as the burner motor is in operation. The only magnet remaining energized during burner operation is the motor switch magnet 8 which is kept energized for as long as the room thermostat maintains contact with point 21.

As the room temperature rises the contact just referred to is broken, the motor switch armature drops back and the burner stops and cannot again be put in operation without repeating the same cycle of operation as above described, involving in each case a period of time delay at least sufficient to enable the lag thermostat to move from its cold to its hot position, because, as will be seen, said thermostat must be engaged with its hot side contact before the motor switch magnet can be again energized and the heavy line holding circuit again completed. This can only occur from the effect of the heat on the lag thermostat heater 15. The result of this arrangement is that any momentary interruption of the main supply of current and subsequent resumption cannot result in the delivery of fuel into a hot furnace, hot enough to ignite it; the time period of the lag thermostat 16 is made long enough to insure this effect; five minutes is ordinarily considered ample. Should the main current supply cease and resume again while the lag thermostat 16 is still hot and engaged with its hot side contact 18, no untoward result can occur because enough time would not then have elapsed to produce an explosive condition in the furnace combustion space. Should the interruption and resumption occur during the warming up period of the igniter, no combustion could occur because no fuel has yet been supplied. In such event, the igniter switch armature drops back and cannot be closed again until the lag heater has cooled and closed its cold side gap 17, when the normal cycle will be started over again.

It will be observed that the pneumatic switch 24 is merely for the purpose of discontinuing the igniter circuit after it is no longer needed, this being for the purpose of conserving the integrity of the resistance wire of which the igniter is composed; the igniter is discontinued very promptly on the starting of the burner motor, the overlap being no greater than is required for the distension of the bellows 28.

The auxiliary hot side contact 18^a serves an important purpose. It is connected through wire 20^a to the supported end of the room thermostat. When the lag thermostat engages 18^a, the effect is merely to close another conducting path from hot side contact 18 back to the transformer. This path is through the lag thermostat element to auxiliary contact 18^a (instead of to wire 22^a) and thence, by wire 20^a, to the fixed end of the room thermostat, thereby guarding against the possibility of de-energization of the motor switch magnet 8, in the event that the room thermostat should have moved to the right and parted from point 22 in the lag interval. The lag thermostat 16 requires about 1½ minutes to close contact 18 when warming; but 4 or 5 minutes to close con-

tact 17 when cooling. An auxiliary path is thus provided for the current which operates the motor switch magnet.

The usual bucket trip switch 29 is provided in the main supply leads 6, the purpose of which, as well understood in this art, is to disconnect the entire apparatus from the source of power in the event of oil leakage.

It will be understood that the burner apparatus and the igniter and also the pneumatic bellows 28 and its switch 24, as well as the trip switch just referred to, are all located adjacent the boiler or furnace and that the room thermostat is or may be located at any remote place. The rest of the apparatus, including the transformer, lag thermostat and lag heater, can be compactly housed in a small box or chamber situated near the furnace or at any point desired. The two electromagnets and their armatures may be of identical construction and of the same size, their armatures being gravity opened as described. It will be apparent, however, that the lag thermostat can be arranged to be influenced by the heat of the igniter 12 itself, if desired, the provision of a separate lag heater being principally for convenience in locating the lag thermostat; the lag thermostat is in either case heated by the ignition means, or circuit, and when subject to the igniter heat it may also be subject to the heat in the burner itself, which will keep it in its hot side position for as long as the burner operates and afterwards, until the burner gets cold, but the arrangement shown is easier on the thermostat and is preferred on that account.

We claim:

1. In a burner control system, a burner motor circuit including a source of high voltage current, an electromagnetic switch to control it operated by a lower voltage current, an igniter circuit, a low voltage electromagnetic switch to control the latter, a room thermostat adapted to close a gap in the circuit of each of said switches and a timing device controlling the transmission of the current to each of said switches.

2. In a burner control system, high voltage burner motor and igniter circuits, a low voltage electromagnetic switch for each, a room thermostat and connections therefrom whereby it closes a gap in the circuit of each of said switches, and a timing device controlling said connections and adapted to cause the energization first of the igniter switch and later of the motor switch.

3. In a burner control system, a high voltage motor circuit, a low voltage motor switch circuit, a room thermostat controlling a gap in said motor switch circuit, a timing device also controlling a gap in said motor switch circuit, and an ignition controlling circuit containing an electromagnet also controlling a gap in said motor switch circuit.

4. In a burner control system, the combination with the burner motor and an electric igniter, of a slow-moving member adapted to move to an extreme position when the igniter is active and to an opposite position when inactive, a double-contact room thermostat, wires connecting the two contacts thereof respectively one to lag contacts engaged by said member in each of its said positions and the other to said member, and circuits controlled by said lag contacts for controlling the current to said igniter and burner motor respectively.
5. In a burner control system, the combination with a burner motor circuit and an igniter circuit and high potential leads to supply current to both said circuits, an electromagnet for closing each of said circuits, a transformer and a room thermostat controlling the transmission of low voltage transformer current to operate said electromagnets, and means for establishing a predetermined sequence in the closure of the circuits of said magnets whenever said room thermostat moves to initiate the activity of the system.
6. In a burner control system, a burner motor circuit and an igniter circuit, an electromagnet to close a gap in each circuit, a room thermostat adapted to control a gap in a circuit through each magnet and a second thermostat operative in each active cycle of the burner to control the sequence of completing such circuits.
7. In a burner control system, a burner motor circuit, an electromagnet to control it, an igniter and a circuit therefor, an electromagnet to control the latter, a room thermostat and connections whereby it may energize both magnets, a lag thermostat controlling the transmission of the current to both said magnets, and a resistance heater in series with the igniter for heating said thermostatic element.
8. In a burner control system, a burner motor circuit, an electromagnetic switch therefor, an igniter circuit and an electromagnetic switch for the latter adapted also to control a gap in the circuit of the motor circuit switch, a room thermostat and connections therefrom whereby it may call both switches into action, a timing device active at each starting of the burner to produce a lag between the operations of said switches, and a holding circuit for said burner motor switch adapted to be closed coincidently with the motor circuit and maintaining current flow through said motor switch independently of the other switch and said timing device.
9. In a burner control system, a burner motor circuit, an electromagnet to close it, an igniter circuit, and an electromagnet controlling the latter circuit, a room thermostat and connections therefrom to said magnets and a timing device producing a sequence in the energization of said magnets upon the initiation of each period of activity of the burner.
10. In a burner control system, a burner motor circuit, an electromagnet to close it, an igniter circuit and an electromagnet to control the latter circuit, a room thermostat and connections therefrom to said magnets, a timing device producing a sequence in the energization of said magnets upon the initiation of each period of activity of the burner, and a holding circuit for each magnet closed by the action of such magnet and adapted to maintain current flow through said magnets independently of the action of said timing device.
11. In a burner control system, the combination with a burner motor and an igniter, a room thermostat having control connections to both, said connections including a circuit having an electromagnet and a normally closed gap in it, in series relation, a device controlled in accordance with the condition of the igniter for opening said gap when the igniter is operative, a holding circuit forming a path around said gap and closed by the action of said magnet, and means active after the motor is active for interrupting current flow in said holding circuit.
12. In a burner control system, motor and igniter circuits for the burner, a circuit containing a magnet to close the motor circuit and including a gap controlled by the room thermostat and also including two other gaps, means whereby the latter gaps are closed seriatim, one when the igniter circuit is closed and the other by means set in action by said circuit and means whereby the energization of said magnet establishes a holding circuit through itself and the room thermostat gap in series, and independent of both other gaps.
13. In a burner control system, a motor circuit, a double-contact room thermostat, a motor switch circuit including a magnet to close the motor circuit and also including the gap at one of the contacts of the room thermostat and a lag gap, a second circuit containing the gap at the other room thermostat contact and adapted when closed to cause the closing of said lag gap and means whereby the energization of said magnet establishes a holding circuit through itself and said first mentioned room thermostat gap in series and independent of said second circuit and lag gap.
14. In a burner control system, a burner motor circuit, an electromagnet to control it, an igniter circuit independent of the motor circuit, and an electromagnet to control said igniter circuit, a room thermostat adapted to control the operating current in both magnets, a resistance heater in the igniter circuit, a thermostat heated thereby and controlling gaps in the circuits of said magnets.
15. In a burner control system, a burner

motor circuit, an electromagnetic closing switch therefor, an igniter circuit and an electromagnetic closing switch for the latter, a room thermostat and connections therefrom whereby it closes a gap in the circuit of each of said switches, a timing device controlling said connections to effect the energization first of the igniter switch magnet and later on the motor switch magnet, and a means rendered active by the motor circuit for discontinuing current through the igniter switch magnet.

16. In a burner control system, the combination with a burner motor circuit and an igniter circuit and high voltage leads to supply current to both, an electric magnetic switch for closing each of said circuits, a transformer, a room thermostat controlling the transmission of low voltage current from the transformer to operate said electromagnets and a heat-operated element for establishing the circuits through said magnets.

17. In a burner control system, the combination with a burner motor circuit and an igniter circuit and high voltage leads to supply current thereto, an electromagnetic switch for closing each of said circuits, a transformer, a room thermostat controlling the transmission of low voltage transformer current to the electromagnets of said switches and slow-moving means adapted for alternately establishing the circuit for each magnet.

18. In a burner control system, the combination with a burner motor circuit, and an igniter circuit, both connected to high volt-

age leads, electromagnetic means for closing said circuits, a transformer connected to said high voltage leads, a room thermostat controlling the transmission of low voltage transformer current to said electromagnetic means and an electrically heated thermostat for establishing a pre-determined sequence in the closure of said circuits.

19. In a burner control system, the combination with a burner motor circuit and an igniter circuit, both connected to high voltage leads, an electromagnetic switch for closing each of said circuits, a transformer connected to said high voltage leads, a room thermostat controlling the transmission of low voltage transformer current to said electromagnetic switches, means whereby the operation of one of said switches establishes part of the circuit for the magnet of the other switch and a slow moving means for completing said circuit.

20. In a burner control system and burner and a motor circuit therefor, a room thermostat, a second thermostat arranged to be heated when heat is in the burner and adapted to close a gap in one circuit when cold and a gap in another circuit when warm, an electromagnet in each circuit, one of said magnets controlling the circuit of the other and also controlling ignition means for the burner.

In testimony whereof, we have signed this specification.

JOHN GOOD.
EDGAR H. OLSEN.