This invention relates to an ignition control, and while primarily designed and intended for controlling the intermittent ignition of a fluid or gas burner of the conventional type used in connection with water heating systems, heating furnaces, and analogous heating apparatus, it will be obvious that the invention may be employed for any other purposes wherein it is found to be applicable.

Important objects and advantages of the invention are to provide an ignition control of the character described, which is electrically operated and controlled and automatic in its operation, which will function to ignite the pilot burner only at the time that the ignition of the main burner is to be effected, and in consequence obviating the employment of the usual continuously ignited pilot flame, which may be readily installed and connected with an installed burner as well as form a component part of a new burner structure, which will operate to prevent the supply of fuel to the main burner in the event the pilot burner is not ignited, which is simple in its construction and arrangement, compact, positive in its action, durable, highly efficient and absolutely safe in its use, and comparatively economical in its manufacture, operation, and maintenance.

With the foregoing and other objects which will appear as the description proceeds, the invention resides in the novel construction, combination, and arrangement of parts herein specifically described and illustrated in the accompanying drawings, but it is to be understood that the latter is merely illustrative of an embodiment of the invention, and that changes in the form, proportions and details of construction may be resorted to that come within the scope of the claims hereunto appended.

In the drawing wherein like numerals of reference designate corresponding parts through the several views:

Figure 1 is a diagrammatic view of an embodiment of electrical conductors and appliances involved and arranged for carrying out the functions of the present invention.

Figure 2 is a similar, fragmentary view of a modified type of safety appliance embodied in the invention.

Referring in detail to the drawing 1 and 2 respectively, denote the main conductors carrying the electric current from a suitable source of supply. A main switch 3 is connected in the conductor 1 and is of any suitable construction and type to close automatically by either mechanical or thermostatic controlled means upon a call or requirement for heat in the apparatus with which the device is associated, in the manner well known in the art to which the invention appertains.

The invention embodies three electro-magnetic devices hereinafter termed “solenoids,” ni mely, the burner solenoid 4, the pilot solenoid 5, and the switch solenoid 6. The burner solenoid is operatively joined with the main gas control valve 7 to open the latter when energized. In like manner, the pilot solenoid 5 is operatively connected with the pilot gas control valve 8 to open the latter when energized. The main valve 9 is connected in the gas supply pipe 9, which connects with the main burner 10, and the pilot control valve 8 is connected in a pipe 11 that joins with the supply pipe 9 and is connected with the pilot burner 12.

The position of the pilot burner 12 with respect to the main burner 10 is such that the latter may be ignited by flame issuing from the former.

The ignition control includes the following electric appliances; two thermostatic units 13, 14; an ignition element 15, and a heating element 16; four normally closed switches 21, 22, 23, 24, which comprise respective contacts 16, 17, 18, 19, 20, one normally open switches 21, 22, 23, 24, which comprise respective contacts 16, 17, 18, 20; a resistor 22, and a transformer 30 including the primary and secondary coils 31 and 32.

The pilot solenoid 5 engages the contact arm 17 and when energized will shift the latter to open the normally closed switch 21. The switch solenoid 6 is connected with the contact arms 18 and 19 and when energized will shift said arms 18 and 19 to respectively open said normally closed switch 24 and close said normally open switches 25 and 26. The energization of the ignition element 15 ignites the pilot burner 12, and the heat from operation of the latter will actuate the thermostatic unit 14 to open the normally closed switch 23 and to close the normally open switch 27. A stop member 33 is provided to limit the movement of the contact arm 20 carrying the normally closed switch 23. The energization of the heating element 16 will actuate the thermostatic unit 13 to open the normally closed switch 22 and, under certain conditions, to close the normally open switch 28. The latter is insulated from the thermostatic unit 13 by an insulating element 34.

The electrical conductors embodied in the improved ignition control are respectively indicated at 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47.
The connected arrangement of these conductors, relatively to each other and with respective appliances of the control are clearly illustrated in Figure 1, and may be readily followed in the various electrical circuits and functions now to be described.

Because the equipped heating apparatus calls for or requires heat, the main switch 3 is automatically closed, as stated, and remains closed until the required heat has been provided.

Each time the main switch 3 is closed, the improved control exhibits its cycle of functions to ignite the main burner 10 to provide the required heat, as follows: An initial circuit is first completed through the conductor 1, main switch 3, conductor 35, conductor 36, solenoid 6, conductor 90, conductor 37, switch 21, contact arm 17, initial circuit 38, thermostatic unit 13, switch 22, conductor 39, conductor 40, conductor 61, and conductor 2. The initial circuit energizes the switch solenoid 6, whereby the normally closed switch 24 is opened and the normally open switches 25 and 26 are closed.

Cycling of the switch 25 completes a transformer circuit, comprising the conductor 1, main switch 3, conductor 35, conductor 58, conductor 95, transformer primary 31, conductor 42, switch 25, contact arm 16, conductor 43, conductor 41, resister 29, conductor 53, conductor 49, conductor 61, and conductor 1, and energizes the transformer 30. The energization of the latter completes a transformer secondary circuit, comprising the transformer secondary 32, conductor 44, thermostatic unit 14, switch 23, contact arm 20, conductor 45, ignition element 15, conductor 46, heating element 16, and conductor 47, and energizes the ignition element 15 and the heating element 16. The energization of the heating element 16 will actuate the thermostatic unit 13 to open the normally closed switch 22 and thereby open the initial circuit 38. Until the latter is opened, the energization of the switch solenoid 6 continues through the initial circuit, after which the energization of said solenoid 6 is continued through a sustaining circuit.

The closing of the switch 26 completes the sustaining circuit, comprising the conductor 1, main switch 3, conductor 35, conductor 36, solenoid 6, conductor 90, contact arm 19, switch 26, conductor 48, solenoid 5, conductor 49, conductor 62, conductor 61, and conductor 2. The completed sustaining circuit functions to maintain the energization of the switch solenoid 6 after the initial circuit is broken by the opening of the normally closed switch 22, and, subsequent to such breaking of said initial circuit, energizes the pilot solenoid 5 to open the pilot control valve 8, thereby supplying gas to the pilot burner 12, to be ignited by the energized ignition element 15. The energization of the pilot solenoid 5 further actuates the contact arm 17 to open the normally closed switch 21 for opening the initial circuit at a point remote from the normally closed switch 22. It should be noted that the prior opening of the switch 22 has previously opened the initial circuit, but it is possible that said switch 22 may close in the normal cycle of the control, and therefore the purpose of the switch 21 is to assure the open initial circuit until the normal cycle of the control is completed.

Heat from the ignited pilot burner 12 will actuate the thermostatic unit 14 to open the normally closed switch 23 for opening the transformer secondary circuit and thereby discontinue the energization of the ignition element 15 and of the heating element 16. The actuation of said thermostatic unit subsequently closes the normally open switch 27 to complete an operating circuit. In the meantime the thermostatic unit 13 has begun to cool and may eventually again allow the closing of the switch 22 during the operation of the improved control.

The operating circuit comprises the conductor 1, main switch 3, conductor 35, conductor 58, conductor 90, conductor 57, conductor 44, thermostatic unit 14, switch 27, conductor 63, conductor 60, solenoid 4, conductor 51, conductor 52, conductor 51, and conductor 58. The energizing circuit energizes the burner solenoid 4 to open the main gas valve 7, thereby supplying gas to the main burner 10 to be ignited from the ignited pilot burner 12. Supply of gas to the main burner 10 is so continued until the requirement for heat to the apparatus heating has been achieved causing the opening of the main switch 3, and thereby completing a normal cycle of the improved ignition control.

It will be noted that in the operation of the ignition control the solenoids 6, 5, and 4, will be energized in the sequence enumerated, and will remain energized throughout the function cycle of each heating operation, and that the pilot burner 12 will remain ignited until the normal cycle of the control is completed.

Should a burner fail to open, due to sticking or any other reason, when the main switch 3 is opened, an emergency shunt circuit is set up comprising conductor 1, main switch 3, conductor 35, conductor 58, conductor 90, conductor 44, thermostatic unit 14, switch 27, conductor 63, switch 24, conductor 18, conductor 43, conductor 41, resister 29, conductor 53, conductor 40, conductor 61, and conductor 2. Under this condition the closing of the main switch 3 will complete the emergency shunt circuit and shunt out the transformer 30 and the solenoids 4, 5, and 6, whereby the ignition control would not function to ignite the burners 12 and 10, until the switch 27 is repaired for proper operation.

If for any reason the energized ignition element 15 fails to ignite the pilot burner 12, the continuous energization of the heating element 16 will further actuate the thermostatic unit 13 to close the normally open switch 28 to complete a safety shunt circuit. The latter comprises the conductor 1, main switch 3, conductor 35, conductor 58, conductor 52, switch 28, conductor 41, resistor 29, conductor 53, conductor 40, conductor 61, and conductor 2, and will shunt out the transformer 30 and the solenoids 4, 5, and 6, thereby causing the closing of the pilot control valve 8.

The resister 29 in the emergency and safety shunt circuits comprises a suitable resistance coil necessary to prevent the short-circuiting of the line upon closing of the switch 28 when said circuits are employed for the purposes stated.

While the resister 29 is shown as common to both of the shunt circuits, as well as being embodied in the transformer circuit, it will be obvious that a separate resister may be placed in each of the shunt circuits so as to eliminate such resister from the transformer circuit. However, its inclusion in the latter does not affect the successful operation of the improved ignition control.

The stop member 35 may be adjustable to allow the opening of the normally open switch 27 in the operating circuit prior to the opening of the
normally closed switch 23 in the transformer secondary circuit, instead of subsequent thereto and actuating the energizing the ignition element 15 is continued until gas is being actually supplied to the main burner 10.

To minimize the sticking of the switch 27 in the operating circuit, a separated contact member 54, suitably supported as at 55, may be interposed in the switch 27, as clearly illustrated in Figure 2. The embodiment of such separated contact member 54, could, of course, be employed with or without the emergency shunt circuit.

The present invention provides a durable and most efficient device of its kind, which eliminates entirely all potential hazards ordinarily concomitant with the operation of analogous ignition control mechanisms, and which may be successfully and economically employed in the manner and for the purposes herein set forth.

What I claim is:

1. In an electric control for a heating apparatus including a gas burner and gas supply means, energizing circuit means, a thermostatically controlled normally closed switch connected in said energizing circuit means, sustaining circuit means, a normally open switch connected in said switch means, an electromagnet switch element connected in said energizing circuit means and in said sustaining circuit means, electro-magnetic valve means connected in said sustaining circuit means to control the gas flow to the burner, said electro-magnetic switch element being operable through said energizing circuit means to close said normally open switch to control the gas flow to the burner, said electro-magnetic switch means being operable to control the gas flow to the burner, said electro-magnetic switch element being operable through said energizing circuit means to close said normally open switch to control the gas flow to the burner, a thermostatically actuated unit including an electric heating element to control the operation of one of said normally closed switches in said energizing circuit means, and to operate said electro-magnetic valve means to supply gas flow to the burner, said electro-magnetic means being further operable to open the other of said pair of normally closed switches in said energizing circuit means to maintain the latter open upon re-closure of said thermostatically actuated normally closed switch in said energizing circuit means.

2. In an electric control for a heating apparatus including a gas burner and gas supply means, energizing circuit means, a normally closed switch connected in said energizing circuit means, sustaining circuit means, a normally open switch connected in said switch means, an electromagnet switch element connected in said energizing circuit means and in said sustaining circuit means, electro-magnetic valve means connected in said sustaining circuit means to control the gas flow to the burner, said electro-magnetic switch element being operable through said energizing circuit means to close said normally open switch to control the gas flow to the burner, said electro-magnetic switch means being operable to control the gas flow to the burner, said electromagnet means being further operable to open the other of said pair of normally closed switches in said energizing circuit means to maintain the latter open upon re-closure of said thermostatically actuated normally closed switch in said energizing circuit means.

3. In an electric control for a heating apparatus including a gas burner and gas supply means, energizing circuit means, a pair of normally closed switches connected in said energizing circuit means, sustaining circuit means, a normally open switch connected in said switch means, an electromagnet switch element connected in said energizing circuit means and in said sustaining circuit means, an electromagnet switch element connected in said energizing circuit means and in said sustaining circuit means, electro-magnetic valve means connected in said sustaining circuit means to control the gas flow to the burner, a thermostatically actuated unit including an electric heating element to control the operation of one of said normally closed switches in said energizing circuit means, and to operate said electro-magnetic valve means to supply gas flow to the burner, the other of said pair of normally closed switches in said energizing circuit means being operatively joined with said electro-magnetic valve means to open upon energization of the latter to maintain the energizing circuit means open upon the re-closure of said thermostatically actuated normally closed switch in said energizing circuit means, and circuit means for said heating element.

4. In an electric control including energizing circuit means, a normally closed switch connected in the energizing circuit means, a thermostatically actuated unit including an electrically heated heating element to control the operation of said normally closed switch, an electro-magnetic switch element connected in the energizing circuit means, a normally open switch operatively connected with said electric heating element to control the energizing circuit means and closed by the energization of the latter, circuits means for said heating element including said normally open switch to energize said heating element to open said thermostatically controlled normally closed switch to break the energizing circuit means.

5. In an electric control including energizing circuit means, an electro-magnetic switch element connected in the energizing circuit means, a normally open switch operatively connected with said electro-magnetic switch element and closed by the energization of the latter, electrical ignition means, a normally closed switch connected in the energizing circuit means, a thermostatically actuated unit including an electrically heated heating element to control the
operation of said normally closed switch, and circuit means including said ignition means and including said normally open switch to control the energization of said heating element to open said thermostatically actuated normally closed switch to break the energizing circuit means and to control the energization of said ignition means.

7. In an electric ignition control for a heating apparatus including a gas burner and gas supply means for the latter, energizing circuit means, an electro-magnetic switch element connected in said energizing circuit means, a pair of normally open switches operatively joined with said electro-magnetic switch element to close upon energization of the latter, a normally closed switch connected in said energizing circuit means, a thermostatically actuated unit including an electrically heated heating element to control the operation of said normally closed switch, electric ignition means, circuit means including one of said pair of normally open switches and including said heating element and said ignition means to energize said heating element and said ignition means, sustaining circuit means, electro-magnetic valve means operable to control the gas flow to the burner, said electro-magnetic valve means and said electro-magnetic switch element and the other of said pair of normally open switches being connected in said sustaining circuit means, and a normally closed switch connected in said energizing circuit means and being operatively joined with said electro-magnetic valve means to open upon energization of said electro-magnetic valve means through said sustaining circuit means to supply gas flow to the burner after said thermostatically actuated switch has reclosed.

RAYMOND M. KAUFMANN.