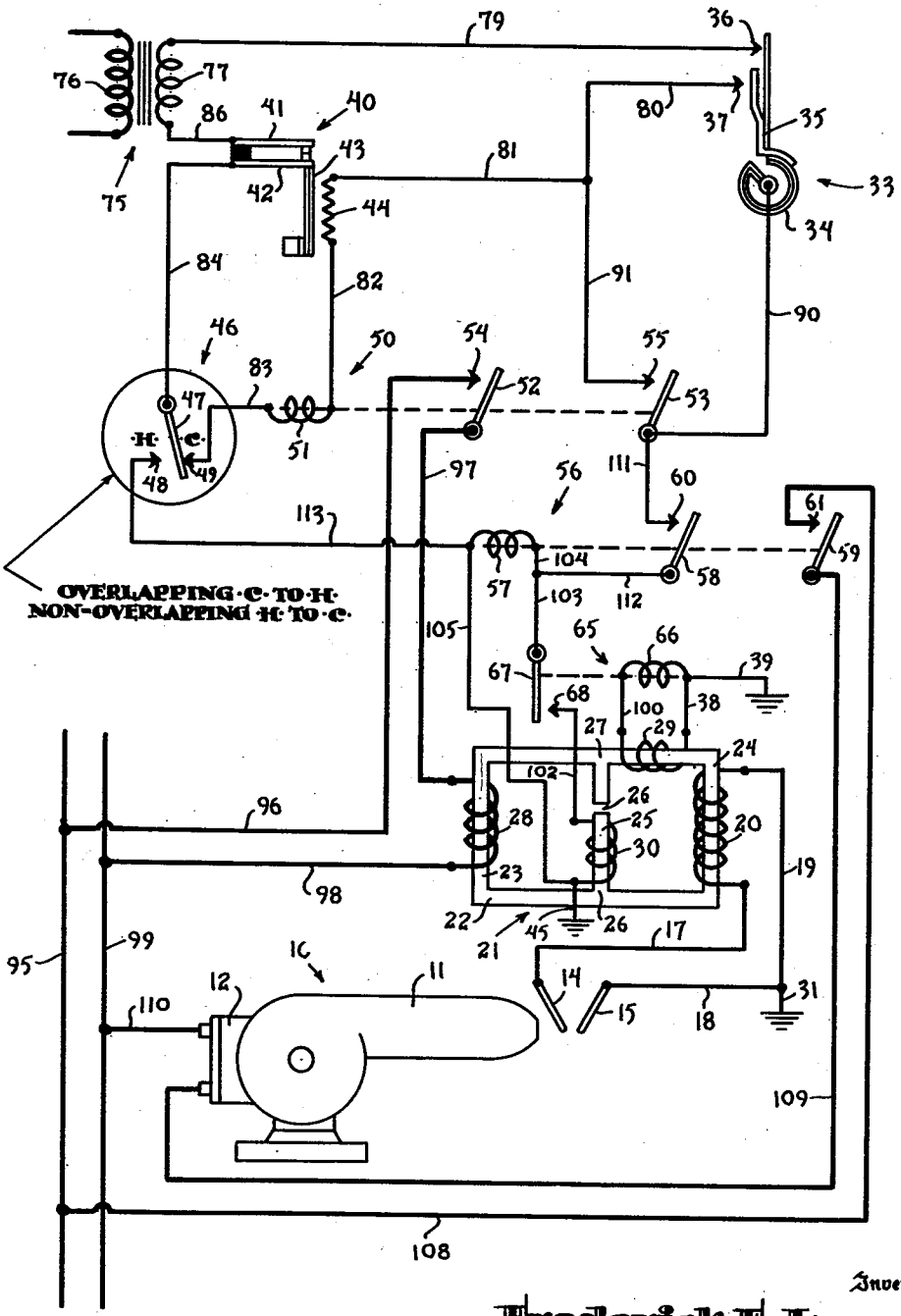
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FLUID FUEL BURNER CONTROL SYSTEM

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FLUID FUEL BURNER CONTROL SYSTEM

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5 Claims. (Cl. 158—28)

The present invention relates to a fluid fuel burner control system and more particularly to one of the type having intermittent ignition and means for checking the condition of such ignition before starting operation of the burner.

In Patent No. 2,143,076 issued to Allan M. Koerner on January 10, 1939, there is disclosed a spark checking system for a fluid fuel burner control system of the intermittent ignition type. The present invention is concerned with improvements in the type of system shown in this application.

An object of the present invention is to provide a spark checking system for an intermittent ignition fluid fuel burner control system in which the operation of the fuel feeding means is controlled by an electrically operated device initially energized by means responsive to the presence of a spark and after the ignition is deenergized, by independent means.

A further object of the invention is to provide such a system in which the electrically operated device is initially energized by an auxiliary winding on the ignition transformer and after the ignition is deenergized by a different source of power.

A still further object of the invention is to provide such a system in which the electrically operated device is an electromagnetic relay.

A still further object of the invention is to provide such a system as set forth in the last object in which a main control switch and a starting relay are employed and in which the relay initially energized by the auxiliary winding on the transformer is connected to the thermostat in lieu of the starting relay upon the establishment of combustion and the consequent deenergization of the ignition means.

Other objects of the present invention will be apparent from a consideration of the accompanying specification, claims, and drawing, in which is shown a schematic form of the present invention.

Referring to the drawing for a more detailed understanding of the invention, an oil burner is generally designated by the reference numeral 10. This burner comprises a nozzle 11 through which a mixture of fuel and air is forced by a blower driven by a motor 12.

Adjacent the nozzle 11 is a pair of ignition electrodes 14 and 15, which electrodes are connected by conductors 17, 18 and 19 to the secondary 20 of an ignition transformer generally indicated by the reference numeral 21. The ignition transformer 21 comprises a rectangular core 22 which is provided with end legs 23 and 24 and an intermediate leg 25 having an air gap 26 therein. The transformer core also comprises the side legs 26 and 27. The main secondary winding 20 is located on the end leg 24. Located upon the end leg 23 is the primary winding 28. Located on the side leg 27 between the intermediate leg 25 and the end leg 24 is an auxiliary secondary winding 29. A second auxiliary secondary winding 30 is located on the intermediate leg 25. The intermediate leg 25 constitutes the leakage leg of the transformer. One end of the secondary 20 is connected to ground by conductors 19 and 31 in accordance with the usual practice. One end of the auxiliary secondary 29 is connected by conductors 38 and 39 to ground. Similarly, one end of the auxiliary secondary 30 is connected to ground by conductor 45.

The operation of the system is controlled by a room thermostat generally designated by the reference numeral 33. This thermostat comprises a bimetallic element 34 to which is secured a composite contact arm 35. The contact arm 35 has a flexible portion adapted to engage a fixed contact 36 and a second portion adapted to engage a fixed contact 37. The contact arm 35 is more widely spaced from contact 37 than from contact 36. The bimetallic element 34 is adapted to move the contact arm 35 to the left upon a drop in temperature.

A thermal safety switch is generally indicated by the reference numeral 40. This switch may take the form of the switch shown in the patent to Frederick S. Denison No. 1,958,081 issued May 8, 1934. As shown in the drawing for purposes of illustration, the switch comprises a pair of switch blades 41 and 42. Switch blade 42 is biased downwardly away from switch blade 41 but is normally held in engagement therewith by a bimetallic element 43 rigidly secured at its lower end. Located adjacent the bimetallic element 43 is a heater 44 which upon energization thereof is adapted to heat the bimetal. The bimetallic element 43 is so arranged that upon being heated it deflects to the right so that the upper end thereof moves from under blade 42 allowing the two blades to move apart. It will be obvious that if the heating effect of heater 44 is allowed to continue a sufficiently long time, this will occur. After the switch blades have once separated, it is impossible for the switch to close automatically.

A stack switch is indicated by the reference numeral 46. This stack switch comprises a bimetallic element (not shown) which extends

into the stack and which is connected to a switch blade 47 adapted to cooperate with contacts 48 and 49. The bimetallic element is adapted to rotate switch arm 47, being connected thereto through a slip friction connection. The contact structure including switch blade 47 and contacts 48 and 49 is designed so that upon the switch blade 47 moving from engagement with contact 49, which is its cold position, into engagement with contact 48, as occurs upon a rise in temperature, the switch blade 47 engages contact 48 before it leaves contact 49. Upon a fall in temperature, however, the switch blade 47 leaves contact 48 before it engages contact 49. Such a switch is shown in the patent to F. S. Denison et al., No. 1,941,540, issued January 2, 1934.

The thermostat 33 and the stack switch 46 control the energization of relay 50. This relay comprises a relay coil 51 and a pair of switch blades 52 and 53. The switch blades 52 and 53 are adapted to engage with contacts 54 and 55. The switch blades are normally biased out of engagement with these contacts and are moved into engagement therewith upon energization of relay coil 51.

The second relay is designated by the reference numeral 56. This relay comprises a relay coil 57 and a pair of switch blades 58 and 59. The switch blades 58 and 59 are adapted to be moved into engagement with contacts 60 and 61 upon energization of relay coil 57. Upon deenergization of the relay coil, the switch blades are moved out of engagement with their contacts and associated biasing means (not shown).

A third relay is designated by the reference numeral 65. This relay comprises a relay coil 66 and a switch blade 67 adapted to be moved into engagement with contact 68 upon energization of the relay coil 66. The switch blade 67 is normally biased out of engagement with the contact.

Power is supplied to the system by a step-down transformer 75. This transformer comprises a line voltage primary 76 and a low voltage secondary 77. The line voltage primary 76 is connected to any suitable source of power (not shown).

Operation

The various elements of the system are shown in the position which they assume when the temperature to which thermostat 33 is connected is at or above the desired value. Let it be assumed now that this temperature drops so that contacts 36 and 37 are successively engaged by the contact arm 35. Nothing happens until engagement of both of these contacts is effected. Upon such engagement occurring, a circuit is established to relay coil 51 as follows: from the upper terminal of secondary 77 through conductor 79, contact 36, contact arm 35, conductors 80 and 81, heating element 44, conductor 82, relay coil 51, conductor 83, contact 49, switch blade 47, conductor 84, switch blades 42 and 41, and conductor 86 to the other terminal of secondary 77. The establishment of this circuit results in relay coil 51 being energized so as to cause the engagement of switch blades 52 and 53 with contacts 54 and 55.

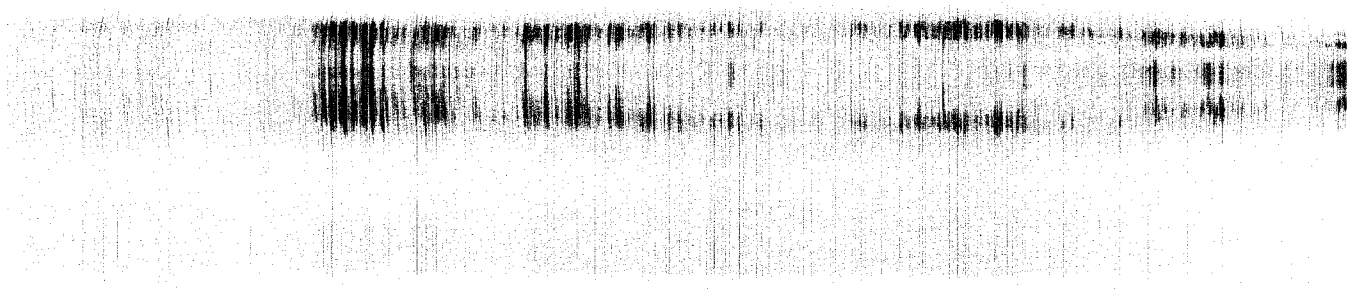
The engagement of switch blade 53 with contact 55 results in a holding circuit being established to relay coil 51 independent of contact 37. This circuit is as follows: from the upper terminal of secondary 77 through conductor 79, contact 36, contact arm 35, bimetallic element 34, conductor 90, relay switch blade 53, contact 55, conductors 91 and 81, heating element 44, conductor 82, relay coil 51, conductor 83, contact 49, switch blade 47, conductor 84, switch blades 42 and 41, and conductor 86 to the other terminal of secondary 77. This new circuit, as previously pointed out, is independent of contact 37 so that the relay will not be deenergized until the thermostat contact blade 35 moves away from contact 36. Thus a differential is required for operation of the thermostat so as to avoid any tendency towards chattering.

The engagement of switch blade 52 with contact 54 results in the following circuit being established to the primary 20 of the ignition transformer 21: from line wire 95 through conductor 96, contact 54, switch blade 52, conductor 97, primary winding 20, and conductor 98 to the other line wire 99. It will be understood that the two line wires 95 and 99 lead to any suitable source of power (not shown) which may be the same source as that to which transformer primary 76 is connected.

The energization of the primary winding of the ignition transformer will result in a spark being produced across the spark electrodes 14 and 15 if the apparatus is functioning properly. If a short circuit condition does not exist or if the resistance of the secondary circuit is not abnormally low, sufficient flux will flow through winding 29 to cause that winding to energize relay coil 66 through the following circuit: from the auxiliary winding 29 through conductor 100, relay coil 66 and conductor 38 back to winding 29. If the resistance in the secondary circuit is much lower than that accompanying a proper spark, the flow of heavy current through the secondary circuit will be so heavy that the flux flowing through the portion upon which both secondary 20 and auxiliary winding 29 are located will be relatively small so that the relay coil 66 is not sufficiently energized. In this way, relay coil 66 provides a check against short circuit conditions.

If the resistance in the secondary circuit is not unduly low, the relay coil 66 will be sufficiently energized to move switch blade 67 into engagement with contact 68. When this happens, a circuit will be established between auxiliary winding 30 and relay coil 57 as follows: from auxiliary winding 30 through conductor 102, contact 68, switch blade 67, conductors 103 and 104, relay winding 57, and conductor 105 to the other terminal of the auxiliary winding 30. The auxiliary winding 30 is provided for the purpose of checking an open circuit condition. If the main secondary circuit is open due to either a break in the conductors or to the electrodes 14 and 15 being too widely spaced, the flux will all flow through the portion of the transformer core upon which secondary winding 20 is located. This will result in very little flux flowing through the leakage leg 25 and consequently in the auxiliary winding 30 being subjected to relatively little flux. Under these conditions, relay coil 57 will be unable to move switch blades 58 and 59 into engagement with their contacts. If, however, the normal condititon exists, switch blades 58 and 59 will be so moved.

The movement of switch blade 59 into engagement with contact 61 results in an energizing circuit being established to the burner motor 12 as follows: from line wire 95 through conductor 108, contact 61, switch blade 59, conductor 109, burner motor 12, and conductor 110 to the other line wire 99. The energization of the oil burner



circuits constituting the only means for energizing said actuating means whereby the energization of said actuating means is dependent upon the existence of a proper spark until combustion has been established.

3. In a fluid fuel burner control system, a fluid fuel burner, electrically operated means for controlling the flow of fuel to said burner, a high voltage circuit including a spark gap for igniting the fuel, an ignition transformer comprising a core, a primary winding, and a secondary winding connected in said high voltage circuit, an energizing circuit for said fuel feed controlling means, a switch controlling said circuit, electrically operated actuating means for said switch, an auxiliary winding on said transformer connected to said actuating means for energizing the same, means for terminating energization of said ignition transformer, means responsive to a condition accompanying ignition for disconnecting said auxiliary winding from said actuating means upon deenergization of the ignition transformer, and means for independently energizing said actuating means incidental to such termination of the energization of said ignition transformer, said auxiliary winding constituting the only means for energizing said electrically operable means until said previously named means is so effective whereby the energization of said actuating means is dependent during the entire ignition period upon the existence of a proper spark.

4. In a fluid fuel burner control system, electrically operated fuel feed controlling means, a high voltage circuit including a spark gap for igniting the fuel, a leakage transformer comprising a core, a primary winding, and a secondary winding connected in said high voltage circuit, said core having a portion constituting a leakage path around that portion of the core on which the secondary winding is located, a plurality of auxiliary windings on said core, a switch controlling said fuel feed controlling means and operated by actuating means energized by one of said auxiliary windings through a connecting circuit, a second switch in said connecting circuit and operated by means energized by the other of said auxiliary windings, said windings being so located with respect to said leakage path that only upon a flow of current through said high voltage circuit of the magnitude accompanying a proper spark will both of said windings be energized sufficiently to hold their respective switches closed, means for terminating energization of said ignition means, and means operative incidental to such termination for connecting said actuating means to an independent source of energy, said first named auxiliary winding constituting the only means for energizing said actuating means until said previously named means is so effective whereby the energization of said actuating means is dependent during the entire ignition period upon the existence of a proper spark.

5. In a fluid fuel burner control system, a fluid fuel burner, an electrically operated fuel feed controlling means, a relay including a relay coil and a switch, an energizing circuit for said fuel feed controlling means controlled by said switch, ignition means including a spark gap for igniting the fuel and an ignition transformer having a primary and a secondary winding, said secondary winding being connected to said spark gap, means for energizing said relay coil solely from said ignition transformer upon the establishment of a condition indicating the existence of a proper spark, means for terminating operation of said ignition means, and means for energizing said relay coil independently of said ignition transformer upon the establishment of combustion, said ignition transformer constituting the only means for energizing said relay coil until said previously named means is so effective whereby the energization of said relay coil is dependent during the entire period prior to combustion upon the existence of a proper spark.

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