Sept. 23, 1941. B. E. SHAW 2,256,766

BURNER CONTROL SYSTEM

Filed Sept. 18, 1940 2 Sheets-Sheet 1

Fig. 1. - Idle Position

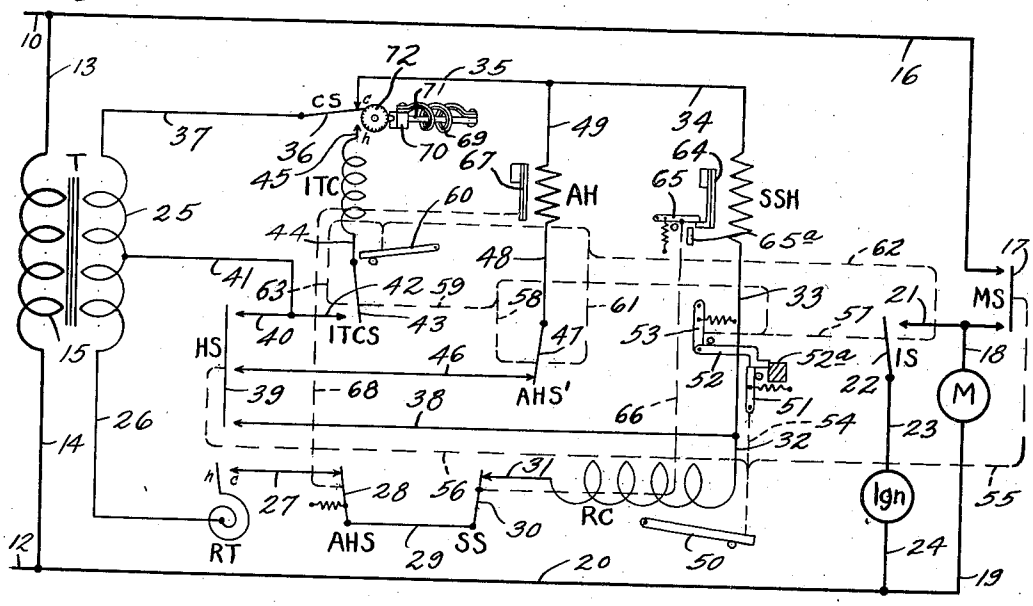
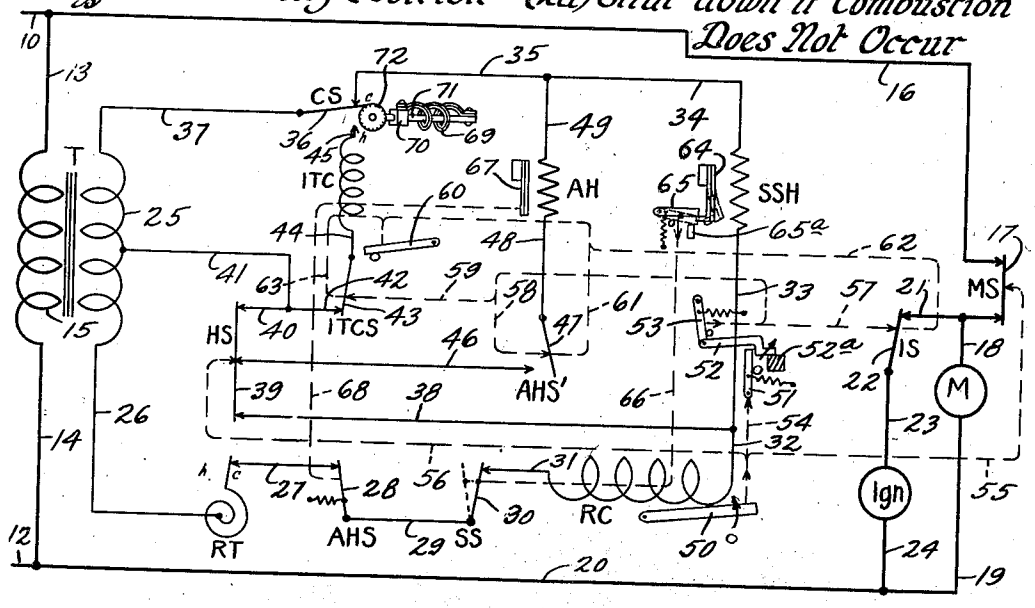


Fig. 2. - Starting Position - (2a) Shut-down if Combustion Does Not Occur



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BURNER CONTROL SYSTEM

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Fig. 3. ~ Running Position

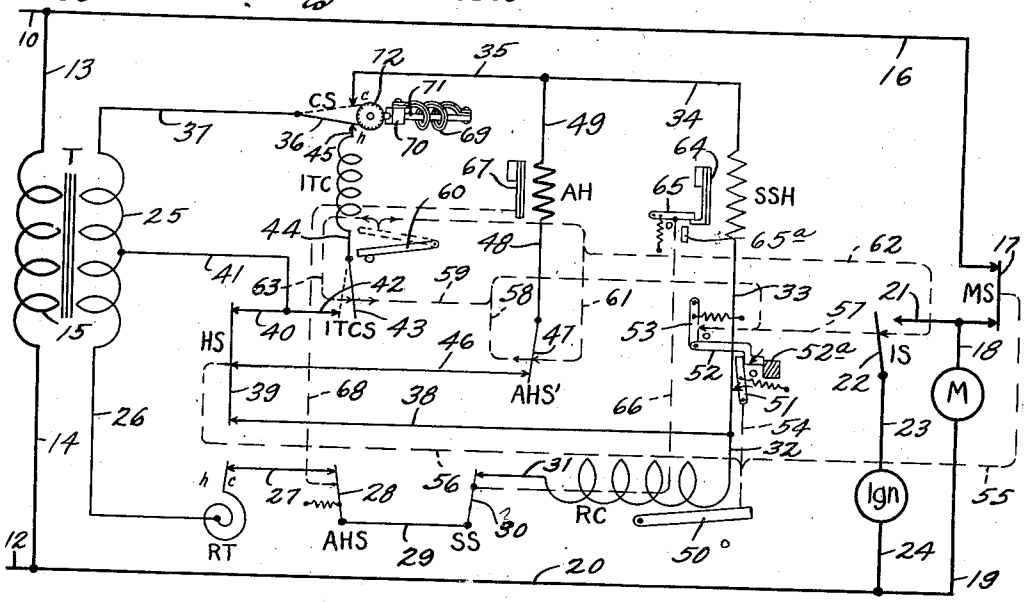
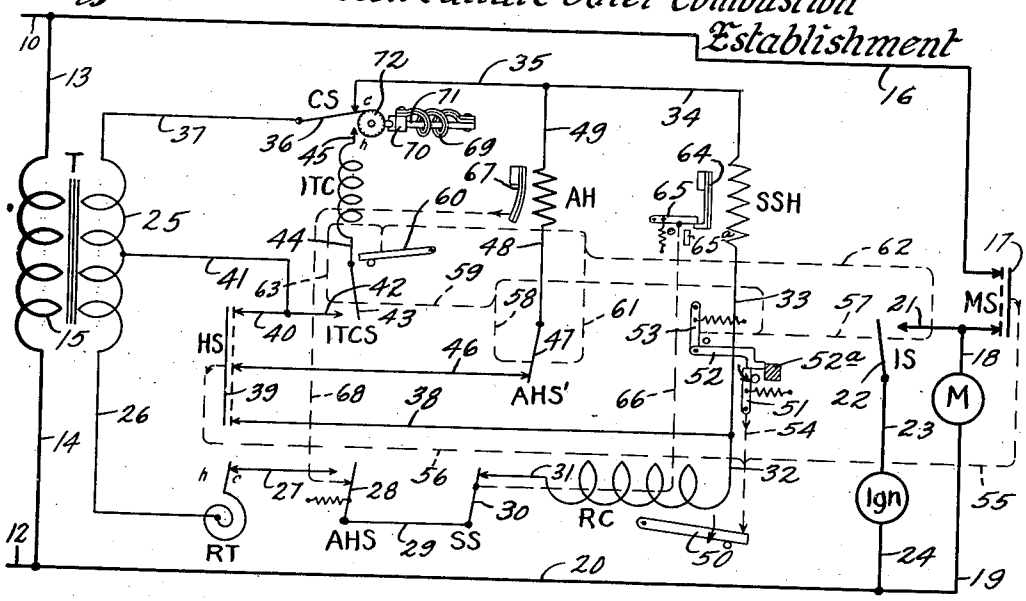


Fig. 4. ~ Combustion Failure After Combustion Establishment



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UNITED STATES PATENT OFFICE

2,256,766

BURNER CONTROL SYSTEM

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Application September 18, 1940, Serial No. 357,278

17 Claims. (Cl. 158—28)

My present invention relates to a burner control system particularly adaptable for oil burner installations wherein the burner motor and the ignition mechanism for the burner are electrically energized and controlled in response to a room thermostat or the like.

One object of the invention is to provide a control system wherein combustion failure from a hot position quickly shuts down the burner and recycling occurs after an elapsed period of time, the recycling operations being repeated indefinitely.

Another object is to provide for shut-down instead of recycling upon combustion failing to occur, the system being thereupon placed back into operation only by a manual resetting operation.

Another object is to provide a burner system of the general character shown in my Patent No. 2,080,580, to which has been added an auxiliary heater and associated mechanism effective to shut off the burner in less time than it is ordinarily shut down as a result of operation of a safety switch, the auxiliary heater effecting a recycling of the burner upon shutoff thereof after a predetermined period of time during which conditions that caused operation of the auxiliary heater may have time to clear up and permit restarting of the burner in the normal manner.

More specifically, it is an object of my invention to provide a system of interconnected control devices operated by a relay coil and an ignition trip coil so as to effect the desired circuit connections, making it possible to energize a safety switch heater for shutting down the burner by operation of a safety switch when combustion fails to occur and on the other hand to operate an auxiliary heater for quick shutoff of the burner and subsequent recycling thereof when combustion failure occurs after combustion has once been established.

Although my burner system is susceptible of various embodiments, it is unnecessary to fully describe and illustrate more than one such embodiment in a diagrammatic manner in order to give a full understanding of the invention and its operation. Accordingly, I have illustrated diagrammatically the various switches and wiring together with the control elements and the controlled elements comprising my system in a series of figures showing different positions and circuit connections of the parts. In said illustrations:

Figure 1 is a diagrammatic view of my burner control system showing the various parts thereof in idle position;

Figure 2 is a similar view showing the parts in starting position as a result of room thermostat closure, with a dotted position of the safety switch mechanism assumed after a time period if combustion does not occur;

Figure 3 is a similar view showing the running positions of the parts, and

Figure 4 is a similar view showing the position which the parts assume as a result of combustion failure after combustion establishment, with resultant positioning of the parts for a recycling operation.

On the accompanying drawings, a transformer T is illustrated having a primary coil **15** and a secondary coil **25**. The primary coil **15** is connected across line wires **10** and **12**, whereby the secondary coil **25** furnishes a low voltage current for the control circuits.

The line wire **10** is connected with a wire **16** leading to a motor switch MS. The motor switch has a bridging contact **17** and is connected by a wire **18** to one side of the burner motor M, the other side of which is connected by wires **19** and **20** to the line wire **12**. The motor side of the motor switch MS is connected by a wire **21** to an ignition switch IS, the switch blade of which is indicated at **22**. Wires **23** and **24** connect the ignition mechanism *Ign* of the burner with the switch **22** and the wire **20**.

One circuit of the transformer secondary **25** includes a wire **26**, a room thermostat RT, a wire **27**, a switch blade **28** of an auxiliary heater switch AHS, a wire **29**, a switch blade **30** of a safety switch SS, a wire **31**, a relay coil RC, wires **32** and **33**, a safety switch heater SSH, wires **34** and **35**, a switch blade **36** of a combustion switch CS, and a wire **37**. Another circuit of the transformer secondary **25** includes a wire **38**, a switch blade **39** of a holding switch HS, and wires **40** and **41**. A third circuit of the transformer secondary **25** through the holding switch HS includes a wire **38**.

The holding switch HS when closed also establishes a fourth circuit including a wire **42**, a switch blade **43** of an ignition trip coil switch ITCS, a wire **44**, an ignition trip coil ITC, and a wire **45**. A fifth circuit includes a wire **46**, a switch blade **47** of a second auxiliary heater switch AHS', a wire **48**, an auxiliary heater AH, and a wire **49**.

The relay coil RC includes an armature **50** normally in the lowered position of Figure 1, which when the relay coil RC is energized will

effect tripping of a trip mechanism 51—52—52a—53 by means of a thrust connection 54. Closure of the relay coil RC also, through thrust connections 55 and 56, closes the motor switch MS and the holding switch HS respectively. Dash lines have been used to show diagrammatically the thrust connections. Where the thrust connections have just operated, arrow heads are shown to indicate the direction of such operation.

The trip mechanism above referred to consists of the thrust rod 51 pivotally mounted relative to the thrust element 54 and operable to release a catch 52 from an abutment 52a. Thereupon the lever 53 swings from the position of Figure 1 to the position of Figure 2 to close the ignition switch IS through a thrust element 57, open the second auxiliary heater switch AHS' through a thrust connection 58 and close the ignition trip coil switch ITCS through a thrust element 59.

The ignition trip coil ITC when energized attracts an armature 60 which is normally in lowered position. The armature 60, through thrust elements 61, 62 and 63, respectively, closes the second auxiliary heater switch AHS', opens the ignition switch IS and opens the ignition trip coil switch ITCS. At the same time, the ignition trip coil ITC de-energizes itself by opening of the ignition trip coil switch ITCS and, reversely, through the thrust connections 58 and 59, resets the trip mechanism 51—52—52a—53 from the position of Figure 2 to the position of Figure 3.

The safety switch heater SSH is adapted to warp a bimetal latch 64 toward the right for unlatching a lever 65 which thereupon through an operative connection 66 opens the safety switch SS to the position shown by dotted lines in Figure 2. In order to reclose the safety switch, the lever 65 must be manually relatched on the bimetal latch 64 as by pressing inwardly on a pin 65a. The auxiliary heater AH is adapted to warp a bimetal bar 67 to the left, which thereupon through a thrust connection at 68 opens the auxiliary heater switch AHS. When the bar 67 cools down, the auxiliary heater switch AHS is reclosed.

Practical Operation

1. *Idle position*

In the operation of my burner control system, the parts are normally in the idle position of Figure 1. The transformer primary 15, it will be noted, is continuously energized so that a secondary current is always available, but there are no secondary circuits when the system is in idle position.

2. *Starting position*

Referring to Figure 2, the room thermostat RT has closed because of lowered room temperature, thus establishing a starting circuit through the following elements: 26—RT—27—28—29—30—31—RC—32—33—SSH—34—35—36 and 37. Thus the relay coil is energized from the entire secondary coil 25 which may have a potential of 24 volts, for instance. This insures a positive closure of the relay which results in attraction of the armature 50 even when the line voltage is relatively low.

The armature 50 directly closes the motor switch and the holding switch through the thrust connections 55 and 56, whereby further circuits are established as follows: A motor circuit is established through elements 16—17—18—M—19 and 20. This is a line voltage circuit for operating the burner motor M. Control circuits are established by the holding switch HS from the relay coil wire 32 as follows, under (a) and (b):

(a) A holding circuit through 38—39—40 and 41, whereby the relay coil is retained energized by the lower half only of the secondary coil 25, since it takes less current to hold the relay closed than to close it. With such an arrangement, a single relay is operable to cut in at as low as 80% of the full line voltage, and to cut out at a point not lower than approximately 65% of the full line voltage.

(b) A safety switch heater circuit through 41—40—39—38—33—SSH—34—35—36 and 37. The safety switch heater circuit is accordingly energized independently of the relay coil RC since the safety switch heater receives its current from the upper half only of the transformer secondary 25.

The attraction of the armature 50 by the relay coil RC also actuates the trip mechanism 51—52—52a—53 to the position of Figure 2 by the thrust element 54 pushing upwardly on the thrust rod 51, thereby lifting the catch 52 from the abutment 52a and permitting the lever 53 to swing the catch to the right past the abutment, which also results in the offset of the catch dropping over the edge of the rod 51. Movement of the lever 53 toward the right results in (a), closure of the ignition switch IS through the thrust connection 57; (b), opening of the second auxiliary heater switch AHS' through the thrust connection 58, and (c), closure of the ignition trip coil switch ITCS through the thrust connection 59. Thus the ignition mechanism *Ign* is energized through elements 21—22—23—*Ign* and 24 from the motor switch MS in one side to the line wire 12 through wire 20 on the other side. Opening of the switch AHS' eliminates the auxiliary heater AH from the circuit, whereas closure of the switch ITCS partially completes a circuit for the ignition trip coil ITC which is subsequently fully completed through the combustion switch CS, as will hereinafter be described.

2a. *Shut-down position if combustion does not occur*

Further referring to Figure 2, if combustion does not occur the combustion switch CS will not move from its position illustrated, so that after a time period, for instance forty seconds, the safety switch heater SSH will have radiated enough heat to the bimetal element 64 to cause it to warp toward the right, thereby unlatching the lever 65 and permitting it through the thrust connection 66 to open the safety switch SS. Opening of the safety switch cuts off the current to the relay coil so that the motor switch and the holding switch are opened and the thrust rod 51 is retracted to the dotted position. The system is now shut down until such time as a service man determines the cause of the trouble and resets the safety switch mechanism by pressing the resetting pin 65a.

3. *Running position*

If combustion does occur, the switch blade 36 of the combustion switch CS will be moved from circuit relation with the wire 35 to circuit relation with the wire 45. Such movement is effected through a slip friction or notched disc slipping connection between a temperature responsive element, such as a helical bimetal element 69, responsive to temperature in the stack

and the switch blade **36**. By way of example, one end of the element **69** is illustrated as attached to a stationary support **70** and the other end attached to a rod **71** rotatable in the support **70**. The rod carries a notched disc **72**, the periphery of which engages the end of the switch blade **36**, thereby swinging the switch blade from the position of Figure 2 to the position of Figure 3, substantially immediately upon a rise in stack temperature. After the switch blade **36** assumes the position of Figure 3, then upon further rise in stack temperature the notched disc **72** will slip past the switch blade **36** and retain it in circuit relation to the wire **45**.

Reversely, upon a subsequent lowering in stack temperature the switch blade **36** will subsequently immediately return from the position of Figure 3 to the position of Figure 2, and thereafter the disc **72** will slip past the blade **36**, keeping the blade in circuit relation to the wire **35**.

Closure of the combustion switch CS to the hot position of Figure 3 causes energization of the ignition trip coil ITC through elements **41**—**42**—**43**—**44**—ITC—**45**—**36** and **37** (the switch blade **43** of the switch ITCS being still in the position of Figure 2, or the dotted position of Figure 3).

Movement of the switch blade **36** of the combustion switch CS from circuit relation to the wire **35** de-energizes the safety switch heater SSH so that there will be no shut-down, as in the case of combustion failing to occur, as described under subheading *2a*. Energization of the ignition trip coil ITC primarily opens the ignition switch IS through the thrust connection **62**. Two secondary functions are performed by the ignition trip coil, consisting of (*a*) closure of the switch AHS' through the thrust connection **61**, and (*b*) opening of the ignition trip coil switch ITCS through the thrust connection **63**, so that current will not continue to flow through the ignition trip coil ITC. The mechanical relation of the parts is such that when the armature **60** is attracted by the coil ITC, it will have sufficient momentum to open the ignition trip coil switch ITCS and relatch the trip mechanism **51**—**52**—**52***a*—**53** reversely through the thrust connections **58** and **59**, in addition to opening the ignition switch IS and closing the auxiliary heater switch AHS' and even though the coil ITC is de-energized by the switch ITCS.

4. *Combustion failure after combustion establishment*

Figure 4 shows the position of the parts assumed as a result of combustion failing after it has once been established. First of all the combustion switch blade **36** will return from the position of Figure 3 to the position of Figure 4 due to a falling stack temperature. This establishes a circuit for the auxiliary heater AH through the following elements: **41**—**40**—**39**—**46**—**47**—**48**—AH—**49**—**35**—**36** and **37**. The upper half of the transformer secondary **25** is therefore the source of current for the auxiliary heater AH.

The heater AH has less resistance than the safety switch heater SSH, so that it can cause a shut-down relatively soon after combustion failure. For instance, it may be of sufficient heat radiating power to warp the bimetal element **67** to the position of Figure 4 within a space of some twenty seconds. Thus the time it takes for the combustion switch to return from the position of Figure 3 to the position of Figure 4 plus these twenty seconds is the shutoff time for the burner as a result of combustion failure after combustion establishment.

Warping of the bimetal element **67** to the full line position of Figure 4 causes opening of the auxiliary heater switch AHS directly through the thrust connection **68**. The elements AH—**67**—**68** and AHS are of recycling type, whereby cooling of the element **67** back to the position of Figure 3 will result in retraction of the thrust connection **68** and reclosure of the auxiliary heater switch blade **28**. Closure of the blade **28** re-establishes the starting circuit (and the running circuit, if combustion occurs), but if it again fails after establishment the recycling or purging period is repeated. If, however, combustion fails to be established after being established and then failing, the shut-down under subheading *2a* will occur.

The purging period is preferably of two or three minutes' duration and the major portion of this period is determined by the time it takes the bimetal element **67** to cool from the position of Figure 4 to the position of Figure 3. The relatively fast heating auxiliary heater radiates so much heat to the bimetal element **67** that it takes some two minutes or so for it to cool down, thereby giving a purging period of two minutes plus twenty seconds, plus whatever time it takes for the combustion switch **36** to move from hot to its opposite position. In Figure 4, the relay coil RC has been de-energized by opening of its holding circuit through **38**—**39**—**40** and **41**, and accordingly the holding switch and motor switch are open for the purging period, the dotted positions of **17** and **39** being the positions of these parts before the switch AHS opens.

I have shown my system in connection with intermittent ignition, whereas for continuous ignition the wires **21** and **23** can be connected together and the ignition switch IS, together with thrust connections **57** and **62**, can be eliminated. In such event the trip coil ITC would then serve as an actuator for only the switches AHS' and ITCS.

From the foregoing disclosure, it is obvious that I have provided a system wherein positive shut-down is provided for failure of combustion to occur. For the more frequently occurring failure of combustion after it has once been established, I provide a recycling or purging operation which permits the burner to recycle an infinite number of times, providing combustion failure occurs after the combustion has been established to a sufficient degree to move the stack switch from closed cold position to closed hot position and then back to closed cold position. Thus I have both the positive shut-down feature for certain conditions, and the recycling feature for certain other conditions, which other conditions occur more frequently than initial failure of combustion to take place. The arrangement is such that a purging period is started in less time through operation of the auxiliary heater AH than a shut-down operation through the safety switch heater SSH, which is a further desirable feature of the purging or recycling operation.

The characteristic of the auxiliary heater switch AHS and its associated mechanism **67** and AH whereby the element **67** heats up quickly to open the auxiliary heater switch AHS and then cools down slowly to provide the purging period, is particularly the feature which gives the desirable quick shut-down upon flame failure after combustion, together with a sufficient purging

period to clear away accumulated bases so that restarting can be accomplished wtih safety. Also, this insures that the auxiliary heater switch AHS will be opened instead of the safety switch SS, as the heaters AH and SSH are connected in parallel during the auxiliary heater operation.

In accordance with the provisions of the patent statutes, I have described my system together with its principle of operation, and have illustrated the various steps of such operation. The form of system shown is one which I consider to represent the best embodiment thereof, but I desire to have it understood that the disclosure is illustrative only and that the invention may be carried out by other means within the scope of the appended claims.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. In a burner system, a transformer, an initial room thermostat circuit including a room thermostat, an auxiliary heater switch, means operable upon energization by the secondary of said transformer to initiate operation of the burner, a safety switch heater and combustion switch contacts, said combustion switch contacts being closed in the absence and open in the presence of combustion, a second set of combustion switch contacts open in the absence and closed in the presence of combustion, a safety switch normally closed but opened by said safety switch heater upon energization thereof for a predetermined period of time, a second circuit energized by a portion only of said secondary of said transformer and including said room thermostat, said auxiliary heater switch, and said means, a holding switch for establishing said second circuit and for maintaining it when said first combustion switch contacts are separated, said holding switch being closed by energization of said means, a third circuit energized by the remaining portion of said secondary and including said holding switch, said safety switch heater and said first combustion switch contacts, said second and third circuits being established and said initial room thermostat being altered as to current supplied thereto by closure of said holding contacts, said first combustion switch contacts failing to open in the event that combustion fails to occur and thereby maintaining said third circuit energized until said safety switch heater opens said safety switch, a fourth circuit energized by said remaining portion of said secondary and including said second combustion switch contacts, an ignition trip coil and an ignition trip coil switch, an ignition switch for the burner closed by said means when energized and opened by said ignition trip coil when it is energized, said ignition trip coil switch being also opened by said ignition trip coil to de-energize the trip coil subsequent to opening of the ignition switch thereby, and a fifth circuit through said holding switch energized by said remaining portion of said secondary and including an auxiliary heater and a second auxiliary heater switch, said second auxiliary heater switch being closed by energization of said ignition trip coil and opened by energization of said relay coil, said auxiliary heater being operable upon energization to open said first auxiliary heater switch in a period of time shorter than the period of time required to open said safety switch upon energization of said safety switch heater, said auxiliary heater being energized by closure of said first combustion switch contacts as a result of combustion failure after combustion establishment, said auxiliary heater switch being reclosed after a purging period determined by the time required for said first auxiliary heater switch to cool back to normal position.

2. In a burner system, a transformer, an initial room thermostat circuit including a room thermostat, an auxiliary heater switch, a relay operable upon energization by the secondary of said transformer to initiate operation of the burner, a safety switch heater and combustion switch contacts, said combustion switch contacts being closed in the absence and open in the presence of combustion, a second set of combustion switch contacts open in the absence and closed in the presence of combustion, a safety switch normally closed but opened by said safety switch heater upon energization thereof for a predetermined period of time, a second circuit energized by a portion only of said secondary of said transformer and including said room thermostat, said auxiliary heater switch, and said means, a holding switch for establishing said second circuit and for maintaining it when said first combustion switch contacts are separated, said holding switch being closed by energization of said relay, a third circuit energized by the remaining portion of said secondary and including said holding switch, said safety switch heater and said first combustion switch contacts, said second and third circuits being established and said initial room thermostat being altered as to current supplied thereto by closure of said holding contacts, said first combustion switch contacts failing to open in the event that combustion fails to occur and thereby maintaining said third circuit energized until said safety switch heater opens said safety switch, a fourth circuit energized by said remaining portion of said secondary and including said second combustion switch contacts and a trip coil, and a fifth circuit through said holding switch energized by said remaining portion of said secondary and including an auxiliary heater and a second auxiliary heater switch, said second auxiliary heater switch being closed by energization of said trip coil and opened by energization of said relay coil, said auxiliary heater being energized by closure of said first combustion switch contacts as a result of combustion failure after combustion establishment, said auxiliary heater switch being reclosed after a purging period determined by the time required for said first auxiliary heater switch to cool back to normal position.

3. In a burner system, a source of current supply, an initial room thermostat circuit including a room thermostat, an auxiliary heater switch, means operable upon energization from said source of current supply to initiate operation of the burner, a safety switch heater and combustion switch contacts, said combustion switch contacts being closed in the absence and open in the presence of combustion, a second set of combustion switch contacts open in the absence and closed in the presence of combustion, a safety switch normally closed but opened by said safety switch heater upon energization thereof for a predetermined period of time, a second circuit including said room thermostat, said auxiliary heater switch, and said means, a holding switch for establishing said second circuit and for maintaining it when said first combustion switch contacts are separated, said holding switch being closed by energization of said means, a third circuit including said holding switch, said safety switch heater and said first combustion switch contacts, said first combustion switch contacts failing to open in the event that combustion

fails to occur and thereby maintaining said third circuit energized until said safety switch heater opens said safety switch, a fourth circuit including said second combustion switch contacts and an ignition trip coil, an ignition switch for the burner closed by said means when energized and opened by said ignition trip coil when it is energized, and a fifth circuit through said holding switch including an auxiliary heater and a second auxiliary heater switch, said second auxiliary heater switch being closed by energization of said ignition trip coil and opened by energization of said relay coil, said auxiliary heater being operable upon energization to open said first auxiliary heater switch in a period of time shorter than the period of time required to open said safety switch upon energization of said safety switch heater, said auxiliary heater being energized by closure of said first combustion switch contacts as a result of combustion failure after combustion establishment, said auxiliary heater switch being reclosed after a purging period determined by the time required for said first auxiliary heater switch to cool back to normal position.

4. In a burner system, a transformer, an initial room thermostat circuit including a room thermostat, an auxiliary heater switch, means operable upon energization by the secondary of said transformer to initiate operation of the burner, a first set of combustion switch contacts closed in the absence and open in the presence of combustion, a second set of combustion switch contacts open in the absence and closed in the presence of combustion, a second circuit energized by a portion only of said secondary of said transformer and including said room thermostat, said auxiliary heater switch, and said means, a holding switch for establishing said second circuit and for maintaining it when said first combustion switch contacts are separated, said holding switch being closed by energization of said means, a third circuit energized by the remaining portion of said secondary and including said holding switch, and said first combustion switch contacts, said second and third circuits being established and said initial room thermostat being altered as to current supplied thereto by closure of said holding contacts, a fourth circuit energized by said remaining portion of said secondary and including said second combustion switch contacts and a trip coil, and a fifth circuit through said holding switch energized by said remaining portion of said secondary and including an auxiliary heater and a secondary auxiliary heater switch, said second auxiliary heater switch being closed by energization of said trip coil and opened by energization of said relay coil, said auxiliary heater being operable upon energization to open said first auxiliary heater switch in a period of time corresponding to movement of said combustion switch from hot to cold position and said first auxiliary heater switch from cold to hot position, said auxiliary heater being energized by closure of said first combustion switch contacts as a result of combustion failure after combustion establishment, said auxiliary heater switch being reclosed after a purging period determined by the time required for said first auxiliary heater switch to move from hot to cold position.

5. In a burner system, a transformer, an initial room thermostat circuit including a room thermostat, a heater element, means operable upon energization by the secondary of said transformer to initiate operation of the burner, a safety switch actuator and combustion switch contacts, said combustion switch contacts being closed in the absence and open in the presence of combustion, a second set of combustion switch contacts open in the absence and closed in the presence of combustion, a safety switch normally closed but opened by said safety switch actuator upon energization thereof for a predetermined period of time, a second circuit energized by a portion only of said secondary of said transformer and including said room thermostat, said heater element switch, and said means, a holding switch for establishing said second circuit and for maintaining it when said first combustion switch contacts are separated, said holding switch being closed by energization of said means, a third circuit energized by the remaining portion of said secondary and including said holding switch, said safety switch actuator and said first combustion switch contacts, said second and third circuits being established and said initial room thermostat being altered as to current supplied thereto by closure of said holding contacts, said first combustion switch contacts failing to open in the event that combustion fails to occur and thereby maintaining said third circuit energized until said safety switch actuator opens said safety switch, a fourth circuit energized by said remaining portion of said secondary and including said second combustion switch contacts and a trip coil, and a fifth circuit through said holding switch energized by said remaining portion of said secondary and including a heater element and a second heater element switch, said second heater element switch being closed by energization of said trip coil and opened by energization of said relay coil, said heater element being energized by closure of said first combustion switch contacts as a result of combustion failure after combustion establishment, said first heater element switch being reclosed after a purging period determined by the time required for said first auxiliary element switch to cool back to normal position.

6. In a burner system, a transformer, an initial room thermostat circuit including a room thermostat, a circuit opener, a relay operable upon energization by the secondary of said transformer to initiate operation of the burner, a safety switch actuator and combustion switch contacts, said combustion switch contacts being closed in the absence and open in the presence of combustion, a second set of combustion switch contacts open in the absence and closed in the presence of combustion, a safety switch normally closed but opened by said safety switch actuator upon energization thereof for a predetermined period of time, a second circuit energized by a portion only of said secondary of said transformer and including said room thermostat, said circuit opener, and said means, a holding switch for establishing said second circuit and for maintaining it when said first combustion switch contacts are separated, said holding switch being closed by energization of said relay, a third circuit energized by the remaining portion of said secondary and including said holding switch, said safety switch actuator and said first combustion switch contacts, said first combustion switch contacts failing to open in the event that combustion fails to occur and thereby maintaining said third circuit energized until said safety switch actuator opens said safety switch, a fourth circuit energized by said remaining portion of said secondary and including said second combustion switch contacts and a trip coil, and

a fifth circuit through said holding switch energized by said remaining portion of said secondary and including a thermally operable actuator for said circuit opener and a second circuit opener, said second circuit opener being closed by energization of said trip coil and opened by energization of said relay coil, said thermally operable actuator being energized by closure of said first combustion switch contacts as a result of combustion failure after combustion establishment, said first circuit opener being reclosed after a purging period determined by the time required for said thermally operable actuator for said first circuit opener to return to cold position.

7. An electric control system for oil burners and the like including an initial room thermostat circuit through a room thermostat, an auxiliary heater switch, a relay operable upon energization to initiate operation of the burner, a safety switch heater and closed cold combustion switch contacts, a safety switch normally closed but opened by said safety switch heater upon energization thereof for a predetermined period of time, a second circuit including said room thermostat, said auxiliary heater switch, said safety switch and said relay, a holding switch for establishing said second circuit and for maintaining it when said combustion switch contacts are separated, said holding switch being closed by energization of said means, a third circuit including said holding switch, said safety switch heater and said combustion switch contacts, said combustion switch contacts upon opening due to combustion establishment discontinuing said third circuit and upon failure to open due to failure of combustion to occur causing said third circuit to continue to be energized and thereby said safety switch heater to open said safety switch, a fourth circuit including a second set of combustion switch contacts which close hot and means to close a second auxiliary heater switch, and a fifth circuit through said holding switch and including said auxiliary heater and a second auxiliary heater switch, said second auxiliary heater switch being closed by energization of said means and opened by energization of said relay, said auxiliary heater being operable upon energization to open said auxiliary heater switch in a period of time shorter than the period of time required to open said safety switch upon energization of said safety switch heater, said auxiliary heater being energized by closure of said first combustion switch contacts as a result of combustion failure after combustion has once been established, said auxiliary heater switch being reclosed after a purging period determined by the time required for said auxiliary heater switch to cool back to normal position.

8. In a control system for oil burners and the like, a transformer, an initial room thermostat circuit including a room thermostat, an auxiliary heater switch, means operable upon energization by the secondary of said transformer to initiate operation of the burner, closed cold combustion switch contacts, a second circuit energized by a portion only of said secondary of said transformer and including said room thermostat, said auxiliary heater switch and said means, a holding switch for establishing said second circuit and for maintaining it when said combustion switch contacts are separated, said holding switch being closed by energization of said means, a third circuit energized by the remaining portion of said secondary and including said holding switch and said combustion switch contacts, said combustion switch contacts upon opening due to combustion establishment discontinuing said third circuit, a fourth circuit energized by said remaining portion of said secondary and including a second set of combustion switch contacts which close hot and means to close a second auxiliary heater switch, and a fifth circuit through said holding switch and energized by said remaining portion of said secondary and including said auxiliary heater and a second auxiliary heater switch, said second auxiliary heater switch being closed by energization of said last means and opened by energization of said first means, said auxiliary heater being energized by closure of said first combustion switch contacts as a result of combustion failure after combustion has once been established, said auxiliary heater switch being reclosed after a purging period determined by the time required for said auxiliary heater switch to return to normal position.

9. In an electric control system for oil burners, an initial room thermostat circuit including a room thermostat, a heater switch, means operable upon energization to initiate operation of the burner, closed cold combustion switch contacts including said room thermostat, said heater switch and said means, a holding switch for establishing said second circuit and for maintaining it established when said combustion switch contacts are separated, said holding switch being closed by energization of said means, a third circuit including said holding switch and said combustion switch contacts, said second and third circuits being established by closure of said holding switch, said combustion switch contacts upon opening due to combustion establishment discontinuing said third circuit, a fourth circuit established by combustion occurring and including means to close a second heater switch, and a fifth circuit through said holding switch and including said heater and a second heater switch, said second heater switch being closed by energization of said last means and opened by energization of said first means, said heater being operable upon energization to open said heater switch and being energized by closure of said combustion switch contacts as a result of combustion failure after combustion has once been established, said first heater switch being reclosed after a purging period determined by the time required for said first heater switch to cool back to normal position.

10. In an oil burner system, a transformer having an intermediate tap for furnishing two sources of current supply, an initial room thermostat circuit connected across said transformer and including a room thermostat, an auxiliary heater switch, means operable upon energization by closure of the room thermostat to initiate operation of the burner, a safety switch heater, and combustion switch contacts in said initial room thermostat circuit, said combustion switch contacts being closed in the absence and open in the presence of combustion, a second set of combustion switch contacts open in the absence and closed in the presence of combustion, a safety switch normally closed but opened by said safety switch heater upon predetermined energization thereof, a holding switch closed by energization of said means and connected with said initial room thermostat circuit for dividing it so that upon closure of the holding switch a sec-

ond circuit is established through said room thermostat, said auxiliary heater switch and said means, and a third circuit is established through said safety switch heater and said first combustion switch contacts, said first combustion switch contacts upon failure to open due to failure of combustion to be established effecting opening of said safety switch, a fourth circuit including said second combustion switch contacts, an ignition trip coil and an ignition trip coil switch, an ignition switch for the burner closed by said means when energized and opened by said ignition trip coil when it is energized, said ignition trip coil switch being also opened by said ignition trip coil to de-energze the trip coil subsequent to opening of the ignition switch thereby, and a fifth circuit through said holding switch including an auxiliary heater and a second auxiliary heater switch, said second auxiliary heater switch being closed by energization of said ignition trip coil and opened by energization of said means, said auxiliary heater being energized by closure of said first combustion switch contacts as a result of combustion failure after combustion establishment, said auxiliary heater switch being reclosed after a purging period determined by the time required for said auxiliary heater switch to cool back to normal position.

11. In an oil burner system, a transformer having an intermediate tap for furnishing two sources of current supply, an initial room thermostat circuit connected across said transformer and including a room thermostat, an auxiliary heater switch, means operable upon energization by closure of the room thermostat to initiate operation of the burner, a safety switch heater, and combustion switch contacts in said initial room thermostat circuit, said combustion switch contacts being closed in the absence and open in the presence of combustion, a second set of combustion switch contacts open in the absence and closed in the presence of combustion, a safety switch normally closed but opened by said safety switch heater upon predetermined energization thereof, a holding switch closed by energization of said means and connected with said initial room thermostat circuit for dividing it so that upon closure of the holding switch a second circuit is established through said room thermostat, said auxiliary heater switch and said means, and a third circuit is established through said safety switch heater and said first combustion switch contacts, said second and third circuits being thereby established and said initial room thermostat being altered as to current supplied thereto, said first combustion switch contacts upon failure to open due to failure of combustion to be established effecting opening of said safety switch, a fourth circuit including said second combustion switch contacts, an ignition trip coil, an ignition switch for the burner closed by said means when energized and opened by said ignition trip coil when it is energized, and a fifth circuit through said holding switch including an auxiliary heater and a second auxiliary heater switch, said second auxiliary heater switch being closed by energization of said ignition trip coil and opened by energization of said means, said auxiliary heater being operable upon energization to open said auxiliary heater switch in a period of time shorter than the period of time required to open said safety switch upon energization of said safety switch heater, said auxiliary heater being energized by closure of said first combustion switch contacts as a result of combustion failure after combustion establishment, said auxiliary heater switch being reclosed after a purging period determined by the time required for said auxiliary heater switch to cool back to normal position.

12. In an oil burner system, a transformer having an intermediate tap for furnishing two sources of current supply, an initial room thermostat circuit connected across said transformer and including a room thermostat, a heater switch, a relay coil operable upon energization of closure of the room thermostat to initiate operation of the burner, and combustion switch contacts in said initial room thermostat circuit, said combustion switch contacts being closed in the absence and open in the presence of combustion, a second set of combustion switch contacts open in the absence and closed in the presence of combustion, a holding switch closed by energization of said relay coil and connected with said initial room thermostat circuit for dividing it so that upon closure of the holding switch a second circuit is established through said room thermostat, said auxiliary heater switch and said relay coil, and a third circuit is established through said first combustion switch contacts, a fourth circuit including said second combustion switch contacts and a trip coil, and a fifth circuit through said holding switch and including a heater and a second heater switch, said second heater switch being closed by energization of said trip coil and opened by energization of said relay coil, said heater being operable upon energization to open said first heater switch, said heater being energized by closure of said first combustion switch contacts as a result of combustion failure after combustion establishment, said first heater switch being reclosed after a purging period determined by the time required for said heater switch to cool back to its cold position.

13. In a control system for oil burners, a transformer, a room thermostat, a relay operable upon energization to cause operation of the burner, a circuit including the secondary of said transformer and said relay and controlled by said room thermostat, said room thermostat establishing said circuit upon closure of the room thermostat, means thereafter operable to maintain said relay energized from a portion only of said secondary, combustion switch contacts and a safety switch actuator in the other portion of said secondary circuit, said combustion switch contacts being normally closed but opened upon the presence of combustion, a heater, a heater switch in circuit with said room thermostat and opened by said heater to open said room thermostat circuit and thereby de-energize said relay, said heater being controlled by said combustion switch contacts and having a second heater switch opened by said relay, said means being also in circuit with said second heater switch, means responsive to combustion establishment to effect closure of said second heater switch whereby upon combustion failure subsequent to combustion establishment closure of said combustion switch contacts will effect completion of said heater circuit through said first means, said second heater switch and said second means, to energize said heater and thereby effect opening of said heater switch and shutting off of the system by de-energization of said relay, the system subsequently recycling after a time period upon reclosure of said heater switch as a result of cooling thereof, the cooling of said

heater switch requiring sufficient time to provide a purging period for the burner.

14. In a control system for burners, a source of current supply, a safety switch for shutting down the burner in case of failure of combustion to occur, a room thermostat, a relay operable upon energization to cause operation of the burner, a circuit including a safety switch heater for said safety switch and said relay and controlled by said room thermostat, said room thermostat establishing said circuit upon closure of the room thermostat, means thereafter operable to maintain said relay energized through a holding circuit from said source of current supply, combustion switch contacts and a safety switch actuator in another circuit from said source of current supply, said combustion switch contacts being normally closed but opened upon the presence of combustion, an auxiliary heater, an auxiliary heater switch in circuit with said room thermostat and opened by said auxiliary heater to open said room thermostat circuit and thereby de-energize said relay, said auxiliary heater being controlled by said combustion switch contacts and having a second auxiliary heater switch opened by said relay, another holding circuit in which said second auxiliary heater switch is located, said last circuit including means responsive to combustion establishment to effect closure of said second auxiliary heater switch whereby upon combustion failure subsequent to combustion establishment closure of said combustion switch contacts will effect completion of said auxiliary heater circuit through said second auxiliary heater switch and said second means, to energize said auxiliary heater and thereby effect opening of said auxiliary heater switch and shutting off of the system by de-energization of said relay, the system subsequently recycling after a time period upon reclosure of said auxiliary heater switch as a result of cooling thereof (said auxiliary heater effecting opening of said auxiliary heater switch more quickly than opening of said safety switch as a result of energization of said safety switch heater and the cooling of said auxiliary switch requiring sufficient time to provide a purging period for the burner).

15. In a control system of the character described, a transformer, a room thermostat, a relay operable upon energization to cause operation of a burner or the like, a circuit including the secondary of said transformer and said relay and controlled by said room thermostat, said room thermostat establishing said circuit upon closure of the room thermostat, means thereafter operable to maintain said relay energized from a portion only of said secondary, combustion switch contacts and a safety switch actuator in the other portion of said secondary circuit, said combustion switch contacts being normally closed but opened upon the presence of combustion, a thermally operable recycling actuator, an actuator switch in circuit with said room thermostat and opened by said recycling actuator to open said room thermostat circuit and thereby de-energize said recycling relay, said actuator being controlled by said combustion switch contacts and having a second actuator switch opened by said relay, said means being also in circuit with said second actuator switch, means responsive to combustion establishment to effect closure of said second actuator switch whereby upon combustion failure subsequent to combustion establishment closure of said combustion switch contacts will effect completion of said actuator circuit through said first means, said second actuator switch and said second means, to energize said actuator and thereby effect opening of said actuator switch and shutting off of the system by de-energization of said relay, the system subsequently recycling after a time period upon reclosure of said recycling actuator switch as a result of cooling of said thermally operable recycling actuator, the cooling of said recyling actuator requiring sufficient time to provide a purging period.

16. In a burner control system, a relay circuit including a room thermostat, a recycling actuator switch and closed cold contacts of a combustion switch, a recycling actuator, said actuator switch being opened by energization thereof and closed after a time period of de-energization thereof, a second actuator switch in circuit with said actuator, said second actuator switch being opened by said relay, and means responsive to closed hot contacts of said combustion switch to close said second actuator switch whereby, upon combustion failure following combustion establishment and resulting closure of said closed cold contacts of said combustion switch, said actuator will be energized and effect a purging period of non-operation of said burner followed by a recycling of the system.

17. In an oil burner control system, a relay circuit including a room thermostat, an auxiliary heater switch, a safety switch heater and closed cold contacts of a combustion switch, an auxiliary heater, an auxiliary heater switch opened by energization thereof and closed after a time period by de-energization thereof, a second auxiliary heater switch in circuit with said auxiliary heater, said second auxiliary heater switch being opened by said relay, means responsive to closed hot contacts of said combustion switch to close said second auxiliary heater switch whereby, upon combustion failure following combustion establishment and resulting closure of said closed cold contacts of said combustion switch, said auxiliary heater will be energized and effect a purging period of non-operation of said burner followed by a recycling of the system, and a safety switch controlled by said safety switch heater and operable to shut down the system in the event combustion fails to be established.

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