March 27, 1945. S. G. ISSERSTEDT 2,372,276

FLUID FUEL BURNER CONTROL APPARATUS

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Fig. 1.

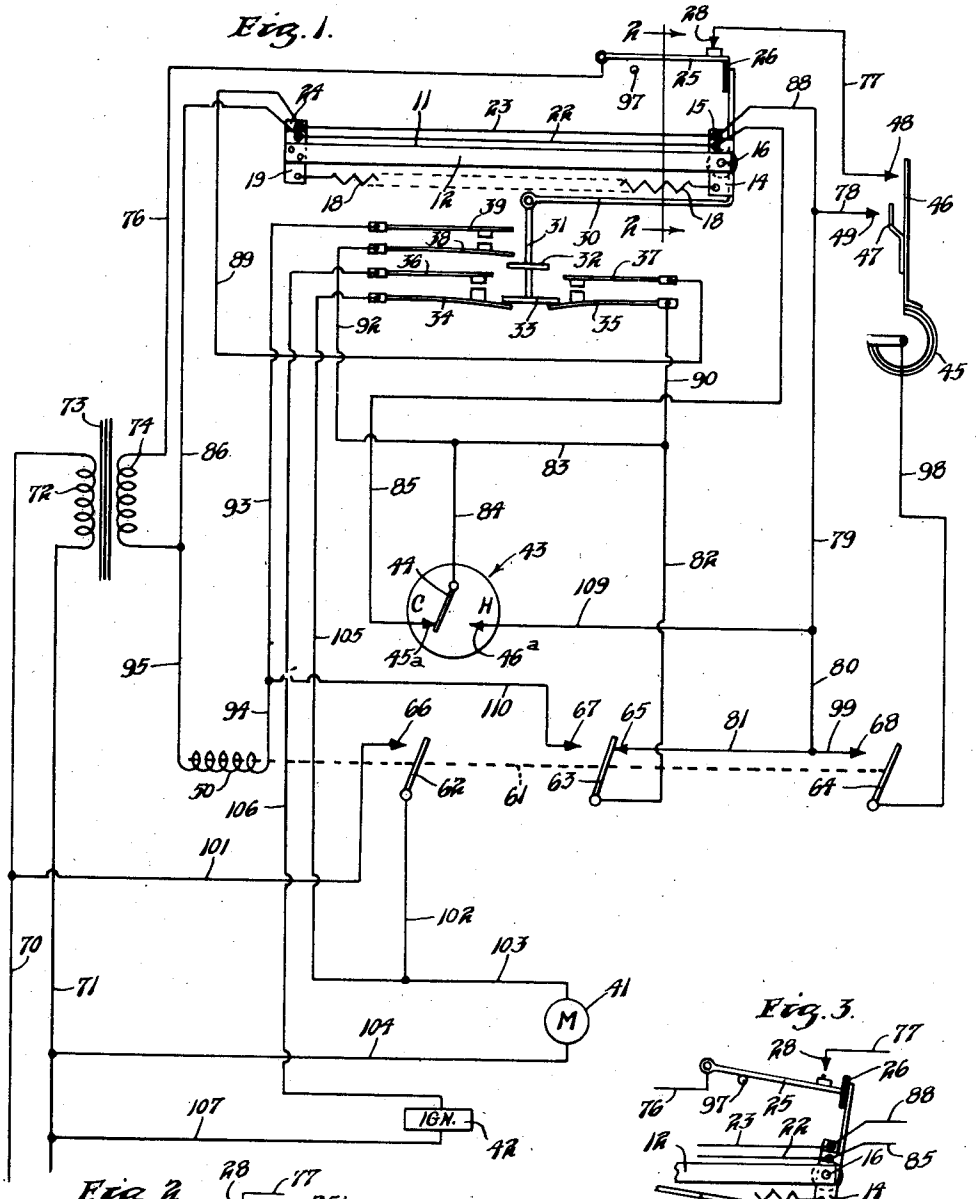

Fig. 2.

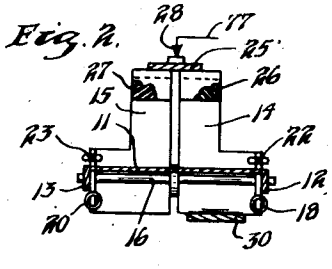

Fig. 3.

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UNITED STATES PATENT OFFICE

2,372,276

FLUID FUEL BURNER CONTROL APPARATUS

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15 Claims. (Cl. 158—28)

The present invention is directed to automatic control apparatus for the burners of fluid fuel, and is more particularly concerned with apparatus for that type of system which incorporates separate timing means for placing the system in operation, and for terminating operation of the ignition means in the case of an intermittent ignition system.

In systems where fluid fuel is burned, and particularly where this fuel is oil, it is desirable to interpose a certain predetermined minimum period of inaction between successive energizations or operations of the burner for the purpose of allowing the vapors of unburned fuel to pass out of the combustion chamber and up the stack. In many prior art control systems this timing is obtained by means of a device which is responsive to the presence or the absence of combustion within the combustion chamber. Thus when operation of the burner is terminated the combustion responsive device will require a certain predetermined time to return to its cold position and the control system is so arranged that the burner cannot be reenergized until such action has taken place.

The control apparatus of the present invention however was designed to be used in combination with a combustion responsive device which is extremely sensitive and which passes from its hot to its cold position so rapidly that it cannot be used for timing the delay between successive burner energizations. When such a combustion responsive device is used it is necessary to provide some additional means for preventing the reenergization of the burner until a certain predetermined minimum of time has elapsed.

In the case of intermittent ignition systems it has been the practice in many prior art control systems to time the post ignition period by means of the combustion responsive device. Thus upon the establishment of combustion the combustion responsive device starts to heat and after a certain length of time will deenergize the ignition. Where an extremely sensitive combustion responsive device is used however, some additional means must be provided for timing the post ignition period in view of the fact that it is not desirable to deenergize the ignition device immediately upon the establishment of combustion.

It is therefore a prime object of the present invention to design a control apparatus for a system which utilizes an extremely sensitive combustion responsive device and which has thermal timing means for interposing a proper time delay between successive burner energizations, and where an intermittent ignition system is desired, to time the post ignition period following the establishment of combustion.

A further object of the invention is to design a system of the above type in which the timing means is energized upon a demand for burner operation for producing the proper timing functions and is deenergized during the normal operation of the burner. The above feature is particularly important where the timing means is in the form of a thermal timer in view of the fact that where the thermal timer is heated during the entire time that the burner is in operation it absorbs such a large quantity of heat that it is apt to require an excessive time period to cool off and return to its cold position following the termination of burner operation.

A further object of the invention is to provide a control system having a biased open safety switch and a pair of thermal actuators normally holding the safety switch in closed position, one of said actuators being heated upon a call for burner operation to energize the burner and to close a heating circuit for the second actuator, the arrangement being such that when both the thermal actuators are hot the safety switch is tripped to open position. A combustion responsive device is provided for the purpose of deenergizing both actuators in the event that combustion is established before the safety switch has been opened.

Other objects will readily become apparent to those who are skilled in the art when the following specification is read in the light of the accompanying drawing in which:

Figure 1 is a more or less diagrammatic showing of a control system embodying my invention,

Figure 2 is a detail view of the safety switch and two latches taken along the line 2—2 of Figure 1, and

Figure 3 is a detailed view of the safety switch in its tripped position.

Referring to the drawing, the reference numeral 11 indicates a frame member having a pair of stiffening flanges 12 and 13 extending longitudinally of the member 11. A pair of latches 14 and 15 are mounted upon a rod 16 carried by the flanges 12 and 13 at one end of the same member 11, the arrangement being such that the latches 14 and 15 are adapted to rotate about the rod 16. See Figure 2. A biasing spring 18 is connected at one end to the latch 14 below the frame 11 and at the other end to a member 19 which is fixed to the opposite end of the frame 11. A second biasing spring 20 is con-

nected to the latch 15 below the frame 11 and also to a second fixed member 24 connected to frame 11 directly in back of member 19 as seen in Figure 1. A portion of spring 20 may be seen in the detail view shown in Figure 2. The two springs 18 and 20 therefore bias the latches 14 and 15 for rotation in a clockwise direction as seen in Figure 1. The latch 15 is actually directly behind the latch 14 as seen in Figure 1. The latch 15 and member 24 are shown to extend slightly above latch 14 and member 19 respectively in Figure 1. They have been shown this way for the sake of clarity only, as they are preferably of the same size.

A thermally expansible wire 22 is connected at one end to the latch 14 just above the frame 11, and at its other end to the fixed member 19. Thus it can readily be seen that the biasing spring 18 maintains the expansible wire 22 under tension and that upon expansion of the wire 22 the latch 14 will rotate in a clockwise direction and upon contraction of this wire the latch will be rotated in a counter-clockwise direction. A second expansible wire 23 is connected at one end to the latch 15 just above the frame 11 and at its opposite end to the second fixed member 24. The biasing spring 20 will maintain the expansible wire 23 under tension, and as in the case of the wire 22, expansion of the wire 23 will cause a rotation of latch 15 in a clockwise direction whereas a contraction of the wire 23 will cause rotation of the latch 15 in a counter-clockwise direction. The two wires 22 and 23 preferably, although not necessarily, rotate the two latches 14 and 15 respectively through the same effective lever arm as shown in Figure 2.

The safety switch has been disclosed as comprising a pivoted switch arm 25 which may be biased downwardly by gravity or by means of a spring not shown. When the two expansible wires 22 and 23 are cold the latches 14 and 15 will be in the position shown in Figure 1 and the safety switch blade 25 will be resting upon the tip of the insulating portions 26 and 27 which are carried by the two latches 14 and 15 respectively. When the switch blade 25 is in this position it will be in engagement with its stationary contact 28, or in other words the safety switch will be latched in closed position.

The latch 14 is provided with a portion 30 which extends horizontally beneath the frame 11 and which carries pivotally a rod 31 having two switch actuating portions 32 and 33. When the expansible wire 22 is cold as shown in Figure 1 the rod 31 will be in its lowermost position at which time the switch actuating member 33 will engage the two resilient switch blades 34 and 35 and hold them out of engagement with the switch blades 36 and 37. When the wire 22 expands and permits clockwise rotation of the latch 14 the rod 31 will be raised and will first permit the two switch blades 34 and 35 to move as a result of their own bias into engagement with the switch blades 36 and 37 respectively. Further upward movement of the rod 31 will cause the switch actuating member 32 to engage the resilient switch blade 38 and move it into engagement with the switch blade 39. The function of these various switches will be explained in detail later in connection with the operation of the system as a whole.

The present control system may be adapted to control various types of fluid fuel burners, but for the purposes of this description it will be assumed that it is in control of the usual oil burner. Therefore the reference numeral 41 indicates the usual oil burner motor and the reference numeral 42 indicates any of the usual types of electric ignition devices for igniting the oil delivered to the burner by the motor 41.

The combustion responsive device has been indicated diagrammatically at 43 as comprising a switch arm 44 which is adapted to engage a cold contact 45a in the absence of combustion and at a hot contact 46a in the presence of combustion. Although various types of condition responsive devices may be utilized successfully in this invention, I prefer to utilize the device which is illustrated and described in my copending application Serial Number 423,989 entitled "Radiant heat responsive device" and filed December 22, 1941, now Patent No. 2,336,399, issued December 7, 1943.

This system may be controlled manually or may be controlled by any automatic control device which responds to a demand for burner operation. However for the purposes of the present disclosure I have shown the usual type of room thermostat in the form of a bimetallic element 45 which is fixed at one end and which carries at its free end a resilient contact blade 46 and a second contact blade 47, the arrangement being such that on a decrease in temperature the resilient contact blade 46 first engages its stationary contact 48 and then at a slightly lower temperature the contact blade 47 engages its stationary contact 49.

The control system includes an electric relay which is shown as comprising a winding 50 and an armature indicated by the dotted line 61 which, when the winding 50 is deenergized, occupies the position shown in Figure 1 in which the two switch arms 62 and 64 are in open circuit position and the switch arm 63 is in engagement with its "out" contact 65. Upon energization of the winding 50 the armature 61 will move to the left at which time the switch arms 62, 63, and 64 will be in engagement with their stationary contacts 66, 67 and 68 respectively.

The electrical power is supplied to the system from the supply lines 70 and 71 which feed the primary winding 72 of a step-down transformer 73 having a low voltage secondary winding 74.

Operation

The parts are shown in Figure 1 in the position which they will occupy when the room thermostat 45 is satisfied, or in other words is holding its switches in open circuit position. Under these conditions the two expansible wires 22 and 23 will be cold and the latches 14 and 15 will maintain the safety switch arm 25 in closed circuit position and all of the switches controlled by the actuating rod 31 will be in open circuit position. The relay winding 50 will be deenergized and the combustion responsive switch arm 44 will be in engagement with its cold contact 45a. Inasmuch as the relay winding 50 is deenergized the burner motor and ignition devices will also be deenergized.

Inasmuch as no heat is being supplied by the burner at this time, the temperature at the thermostat 45 will begin to decrease and the thermostat 45 will begin to decrease and the thermostat will cause the flexible switch arm 46 to move into engagement with the stationary contact 48. No circuit will be established at this time in view of the fact that the relay arm 64 is in its "out" position. The temperature at the thermostat 45 will therefore continue to decrease until the blade 47

is moved into engagement with the stationary contact 49. This will establish an energizing circuit for the expansible wire 22 which extends from one side of the secondary winding 74 of the transformer 73 through conductor 76, safety switch arm 25, contact 28, conductor 77, contact 48, switch blades 46 and 47, contact 49, conductors 78, 79, 80 and 81, contact 65, switch arm 63, conductors 82, 83 and 84, combustion responsive switch arm 44, cold contact 45a, conductor 85, expansible wire 22 and conductor 86 back to the other side of the secondary winding 74.

The establishment of the above circuit causes sufficient heating of the wire 22, due to its own resistance, to cause it to expand and permit rotation of the latch 14 in a clockwise direction as seen in Figure 1. Such rotation causes the actuating rod 31 to move upwardly and permit movement of the resilient contact blades 34 and 35 to closed circuit position. The switch blade 34 is in circuit with the ignition device 42 and in view of the fact that the switch arm 62 is still in open circuit position the movement of the switch blade 34 into engagement with the switch blade 36 will not result in the establishment of a circuit at this time. The movement of the switch blade 35 to closed circuit position will have no effect at this time either. Although this switch blade does close a circuit to the expansible wire 23 the expansible wire 23 is effectively shunted out by means of the switch arm 63 and contact 65. Thus no control action will take place until the actuating member 31 causes a movement of the resilient contact blade 38 into engagement with the contact blade 39. This establishes a circuit for the relay winding 50 which extends from one side of the secondary winding 74 through conductor 76, safety switch arm 25, contact 28, conductor 77, contact 48, switch blades 46 and 47, contact 49, conductors 78 and 88, expansible wire 23, conductor 89, switch blades 37 and 35, conductors 90, 83 and 92, switch blades 38 and 39, conductors 93 and 94, relay winding 50, and conductor 95 back to the other side of the secondary winding 74.

Closure of the above circuit accomplishes two important results. In the first place it energizes relay 50 and breaks the shunt around the expansible wire 23 and starts this wire heating and expanding. It will be noted that the expansible wire 22 is already in its heated state and therefore it has rotated the latch 14 from beneath the safety switch arm 25, but this arm remains in its latched position due to the latch 15. Heating of the wire 23, however will cause the latch 15 to start to rotate in a clockwise direction and if this action is permitted to continue for a predetermined length of time, usually about 90 seconds, the latch 15 will move from beneath the safety switch arm 25 and permit it to move to open circuit position as shown in Figure 3. At this time the arm 25 drops down out of engagement with its contact 28 and into engagement with a stop 97. The opening of the safety switch removes the power from the entire low voltage portion of the system and therefore deenergizes both of the expansible wires 22 and 23 as well as the relay winding 50. The safety switch must be reset manually and if desired may be provided with the usual trip free reset which is now common in the art. In actual practice some strain release means would probably be provided between the latches 14 and 15 and the safety switch arm 25 to permit the expansible wires 22 and 23 to cool off and contract following the opening of the safety switch without putting undue strain upon the operating mechanism of the switch. These details have not been illustrated in this application which has been limited more or less to a diagrammatic showing.

The second result is accomplished by the movement of the relay switch arms 62, 63 and 64 into engagement with their stationary contacts 66, 67 and 68 respectively. Movement of the switch arm 64 into engagement with contact 68 establishes a shunt circuit around the switch formed by the contact blade 47 and contact 49. This circuit extends through the switch blade 46, bimetal 45, conductor 98, switch arm 64, contact 68 and conductors 99, 80 and 79. Thus when the switch arm 64 has been moved to closed circuit position a holding circuit is set up to maintain operation of the system even though the temperature at the thermostat 45 may rise sufficiently to cause the switch blade 47 to separate from contact 49.

Movement of the switch arm 63 into its attracted position first causes it to separate from the contact 65 thereby breaking the original energizing circuit for the expansible wire 22. This wire however remains energized at this time by a circuit which extends from one side of the secondary winding 74 through conductor 76, safety switch arm 25, contact 28, conductor 77, contact 48, switch blade 46, bimetal thermostat 45, conductor 98, switch arm 64, contact 68, conductors 99, 80, 79 and 88, expansible wire 23, conductor 89, switch blades 37 and 35, conductors 90, 83, 84, combustion responsive arm 44, cold contact 45a, conductor 85, expansible wire 22 and conductor 86 back to the other side of the secondary winding 74. Therefore after the relay winding 50 has been energized the expansible wire 22 and the relay winding 50 are connected in parallel and they are each connected in series with the expansible wire 23. Note there is less current flowing through the expansible wire 22 at this time, however this current is sufficient to maintain this wire in its heated condition so that the latch 14 will be rotated sufficiently to permit the safety switch arm 25 to drop to the position shown in Figure 3 should the expansible wire 23 heat for a sufficient period of time to rotate the latch 15 from beneath the switch arm 25.

Movement of the relay switch arm 62 into engagement with contact 66 will result in the establishment of a circuit for energizing both the burner motor 41 and the ignition device 42. This circuit extends from the supply line 70 through conductor 101, contact 66, switch arm 62, conductors 102 and 103, burner motor 41 and conductor 104 back to the other supply line 71. The ignition device 42 is energized by means of a circuit extending from the supply line 70 through conductor 101, contact 66, switch arm 62, conductors 102 and 105, switch blades 34 and 36, conductor 106, ignition device 42 and conductor 107 back to the other supply line 71.

If combustion is not established within a predetermined period of time the expansible wire 23 will heat sufficiently to release the safety switch arm 25 as described above. This will cut off the power to the low voltage portion of the system and the safety switch will have to be manually reset in order to restart the system. Normally, however, the energization of the burner motor 41 and ignition device 42 will result in the establishment of combustion which will cause the combustion responsive switch arm 44 to move from engagement with its cold contact 45a into engagement with its hot contact

46a. This action will break the circuit through the expansible wire 22 and will establish a holding circuit for the relay winding 50 which is independent of any of the switches operated by the expansible wire 22. This circuit extends from one side of the secondary winding 74 through conductor 76, safety switch arm 25, contact 28, conductor 77, contact 48, switch blade 46, bimetallic element 45, conductor 98, switch arm 64, contact 68, conductors 99, 80 and 109, hot contact 46a, combustion responsive switch arm 44, conductors 84, 83, 82, switch arm 63, contact 67, conductors 110 and 94, relay winding 50 and conductor 95 back to the other side of the secondary winding 74.

The expansible wire 22 will now start cooling and contracting in view of the fact that the circuit therethrough has been broken. This will cause the switch actuating rod 31 to move downwardly first permitting the switch blade 38 to move out of engagement with the switch blade 39. This will have no effect upon the system in view of the fact that a holding circuit for the relay winding 50 has been established independently of this switch. Further movement of the actuating rod 31 will cause the switch blade 35 to move out of engagement with the switch blade 37. This action will break the circuit through the expansible wire 23. It is pointed out however that this wire was effectively deenergized at the time that the combustion responsive switch arm 44 engaged the hot contact 46a because the closure of this switch established a shunt around the expansible wire 23 which extends from one side thereof through conductors 88, 79, and 109, hot contact 46a, combustion responsive switch arm 44, conductors 84, 83 and 90, switch blades 35 and 37, and conductor 89 to the other side of hot wire 23. Thus the separation of the switch blade 35 from the blade 37 has no effect upon the system.

The lowering of the actuating rod 31 also causes the switch blade 34 to separate from the switch blade 36. It will be noted that these two blades are in the circuit to the ignition device 42 and therefore their separation will terminate operation of the ignition device. The circuit to the burner motor 41 however is independent of this switch and therefore will continue in operation as long as the relay winding 50 is energized.

The above is the running condition of the system. It will be noted that as soon as combustion is established both of the expansible wires 22 and 23 are effectively deenergized and will start contracting to prevent the opening of the safety switch. However the ignition switch 34, 36 will remain closed and the ignition device energized until the expansible wire 22 has cooled sufficiently to open the switch 34, 36. This provides for a proper post ignition period which is very desirable in the usual oil burner control system. It will be noted that the running circuit for the system passes serially through the thermostatic switch 48, 46, the combustion responsive switch 46, 44 and a holding switch which was closed by the relay 64, 68 as well as 63, 67. Thus either a momentary power failure, a flame failure, or an increase in temperature of the room thermostat 45 will cause the relay to be deenergized. In the event of a flame failure or a momentary power failure the original energizing circuit for the expansible wire 22 will be substantially immediately reclosed by engagement of the relay switch arm 63 with its "out" contact 65 and engagement of the combustion responsive switch arm 44 with its cold contact 45a, if the temperature at the thermostat 45 is sufficiently low to cause the contact blade 47 to be in engagement with the stationary contact 49. However, the relay winding 50 cannot be reenergized to start the burner motor 41 and ignition device 42 until the expansible wire 22 has heated sufficiently to cause movement of the switch blade 38 into engagement with the switch blade 39. The time required for the expansible wire 22 to produce this action is sufficient to permit any unburned vapors which might cause an explosion to pass out of the combustion chamber and up the stack. In other words the expansible wire 22 times the delay between successive burner energizations.

As many changes and modifications of this invention will undoubtedly occur to those who are skilled in the art I wish it to be understood that I intend to be limited, not by the specific disclosure embodied herein, but only by the scope of the accompanying claims.

I claim as my invention:

1. A fluid fuel burner control system comprising in combination, fuel delivery means, means for igniting said fuel, a timer, a main switch, a safety switch in control of said fuel delivery and said igniting means, electrical timing means for opening said safety switch at the end of a timed interval, an energizing circuit for said timer controlled by said main switch, means operated by said timer when energized for rendering said fuel delivery means operative to deliver fuel and for energizing said igniting means and electrical timing means for said safety switch, and means operating in response to combustion for deenergizing said timer and electrical timing means and maintaining said fuel delivery means operative independently of said timer.

2. A fluid fuel burner control system comprising in combination, fuel delivery means, means for igniting said fuel, a timer, a main switch, a safety switch in control of said fuel delivery and said igniting means, electrical timing means for opening said safety switch at the end of a timed interval, an energizing circuit for said timer controlled by said main switch, means operated by said timer when energized for rendering said fuel delivery means operative to deliver fuel and for energizing said igniting means and electrical timing means for said safety switch, means operating in response to combustion for deenergizing said timer and electrical timing means and maintaining said fuel delivery means operative independently of said timer, and means operated by said timer upon cooling for deenergizing said igniting means.

3. A fluid fuel burner control system comprising in combination, fuel delivery means, means for igniting said fuel, a timer, a main switch, a safety switch in control of said fuel delivery and said igniting means, electrical timing means for opening said safety switch at the end of a timed interval, hot and cold combustion responsive switches, an energizing circuit for said timer including said main switch and cold combustion responsive switch, a first switch closed by said timer when energized, a relay, an energizing circuit for said relay including said main switch electrical timing means and first switch, means operated by said relay for rendering said fuel delivery means operative and for energizing said igniting means, a relay switch closed by said relay when energized, said cold combustion responsive switch opening upon the establishment o

combustion to deenergize said timer, a holding circuit for said relay comprising said main switch, relay switch, and hot combustion responsive switch, and means including said hot combustion responsive switch for deenergizing said electrical timing means.

4. A fluid fuel burner control system comprising in combination, fuel delivery means, means for igniting said fuel, a timer, a main switch, a safety switch in control of said fuel delivery and said igniting means, electrical timing means for opening said safety switch at the end of a timed interval, hot and cold combustion responsive switches, an energizing circuit for said timer including said main switch and cold combustion responsive switch, a first switch closed by said timer when energized, a relay, an energizing circuit for said relay including said main switch, electrical timing means and first switch, means operated by said relay for rendering said fuel delivery means operative and for energizing said igniting means, a relay switch closed by said relay when energized, said cold combustion responsive switch opening upon the establishment of combustion to deenergize said timer, a holding circuit for said relay comprising said main switch, relay switch, and hot combustion responsive switch, and switch means in series with said electrical timing means opened by said timer upon deenergization thereof for breaking the circuit through said electrical timing means.

5. A fluid fuel burner control system comprising in combination, fuel delivery means, means for igniting said fuel, a timer, a main switch, a safety switch in control of said fuel delivery and said igniting means, electrical timing means for opening said safety switch at the end of a timed interval, hot and cold combustion responsive switches, an energizing circuit for said timer including said main switch and cold combustion responsive switch, a first switch closed by said timer when energized, a relay, an energizing circuit for said relay including said main switch, electrical timing means and first switch, means operated by said relay for rendering said fuel delivery means operative and for energizing said igniting means, a relay switch closed by said relay when energized, said cold combustion responsive switch opening upon the establishment of combustion to deenergize said timer, a holding circuit for said relay comprising said main switch, relay switch, and hot combustion responsive switch, means including said hot combustion responsive switch for deenergizing said electrical timing means and means operated by said timer upon deenergization thereof for deenergizing said igniting means.

6. A fluid fuel burner control system comprising in combination, fuel delivery means, means for igniting said fuel, a timer, a main switch, a safety switch in control of said fuel delivery and said igniting means, electrical timing means for opening said safety switch at the end of a timed interval, hot and cold combustion responsive switches, an energizing circuit for said timer including said main switch and cold combustion responsive switch, a first switch closed by said timer when energized, a relay, an energizing circuit for said relay including said main switch, electrical timing means and first switch, means operated by said relay for rendering said fuel delivery means operative and for energizing said igniting means, a relay switch closed by said relay when energized, said cold combustion responsive switch opening upon the establishment of combustion to deenergize said timer, a holding circuit for said relay comprising said main switch, relay switch, and hot combustion responsive switch, switch means in series with said electrical timing means opened by said timer upon deenergization thereof for breaking the circuit through said electrical timing means, and means operated by said timer upon deenergization thereof for deenergizing said igniting means.

7. A fluid fuel burner control system comprising in combination, fuel delivery means, means for igniting said fuel, a timer, a main switch, a safety switch in control of said fuel delivery and said igniting means, electrical timing means for opening said safety switch at the end of a timed interval, hot and cold combustion responsive switches, a relay, a first relay switch which is closed when said relay is deenergized, an energizing circuit for said timer including said main switch, first relay switch, and cold combustion responsive switch, a first timer switch which is closed by said timer when energized, an energizing circuit for said relay including said main switch, electrical timing means, and first timer switch, means operated by said relay for rendering said fuel delivery means operative and for energizing said igniting means, means for opening said cold combustion responsive switch and closing said hot combustion responsive switch upon the establishment of combustion, a second relay switch which is closed by said relay when energized, and a holding circuit for said relay including said main switch, hot combustion responsive switch and second relay switch, said last named holding circuit being connected in shunt with said electrical timing means for effectively deenergizing the same.

8. A fluid fuel burner control system comprising in combination, fuel delivery means, means for igniting said fuel, a timer, a main switch, a safety switch in control of said fuel delivery and said igniting means, electrical timing means for opening said safety switch at the end of a timed interval, hot and cold combustion responsive switches, a relay, a first relay switch which is closed when said relay is deenergized, an energizing circuit for said timer including said main switch, first relay switch, and cold combustion responsive switch, a first timer switch which is closed by said timer when energized, an energizing circuit for said relay including said main switch, electrical timing means, and first timer switch, means operated by said relay for rendering said fuel delivery means operative and for energizing said igniting means, means for opening said cold combustion responsive switch and closing said hot combustion responsive switch upon the establishment of combustion, a second relay switch which is closed by said relay when energized, and a holding circuit for said relay including said main switch, hot combustion responsive switch and second relay switch, said last named holding circuit being connected in shunt with said electrical timing means for effectively deenergizing the same, and switch means in series with said electrical timing means opened by said timer upon deenergization thereof for breaking the circuit through said electrical timing means.

9. A fluid fuel burner control system comprising in combination, fuel delivery means, means for igniting said fuel, a timer, a main switch, a safety switch in control of said fuel delivery and said igniting means, electrical timing means for opening said safety switch at the end of a timed interval, hot and cold combustion responsive

switches, a relay, a first relay switch which is closed when said relay is deenergized, an energizing circuit for said timer including said main switch, first relay switch, and cold combustion responsive switch, a first timer switch which is closed by said timer when energized, an energizing circuit for said relay including said main switch, electrical timing means, and first timer switch, means operated by said relay for rendering said fuel delivery means operative and for energizing said igniting means, means for opening said cold combustion responsive switch and closing said hot combustion responsive switch upon the establishment of combustion, a second relay switch which is closed by said relay when energized, a holding circuit for said relay including said main switch, hot combustion responsive switch and second relay switch, said last named holding circuit being connected in shunt with said electrical timing means for effectively deenergizing the same, and means operated by said timer upon deenergization thereof for deenergizing said igniting means.

10. A fluid fuel burner control system comprising in combination, fuel delivery means, means for igniting said fuel, a timer, a main switch, a safety switch in control of said fuel delivery and said igniting means, electrical timing means for opening said safety switch at the end of a timed interval, hot and cold combustion responsive switches, a relay, a first relay switch which is closed when said relay is deenergized, an energizing circuit for said timer including said main switch, first relay switch, and cold combustion responsive switch, a first timer switch which is closed by said timer when energized, an energizing circuit for said relay including said main switch, electrical timing means, and first timer switch, means operated by said relay for rendering said fuel delivery means operative and for energizing said igniting means, means for opening said cold combustion responsive switch and closing said hot combustion responsive switch upon the establishment of combustion, a second relay switch which is closed by said relay when energized, a holding circuit for said relay including said main switch, hot combustion responsive switch and second relay switch, said last named holding circuit being connected in shunt with said electrical timing means for effectively deenergizing the same, switch means in series with said electrical timing means opened by said timer upon deenergization thereof for breaking the circuit through said electrical timing means, and means operated by said timer upon deenergization thereof for deenergizing said igniting means.

11. A fluid burner control system comprising in combination, fuel delivery means, a biased open safety switch in control of said fuel delivery means, first and second latches for maintaining said safety switch closed, first and second thermal actuators for said latches, said actuators, when heated, moving said latches in a direction to release said safety switch for movement to open position, means for closing a heating circuit for said first actuator in response to a demand for burner operation, means controlled by said first actuator and effective when said actuator is hot to render said fuel delivery means operative to deliver fuel and to establish a heating circuit for said second actuator, and means operating in response to the establishment of combustion for opening both of said heating circuits while maintaining operation of said fuel delivery means.

12. In a fluid fuel burner control system comprising in combination; fuel delivery means; a safety switch in control of said fuel delivery means; means including a pair of heaters effective only when both of said heaters are energized to cause opening of said safety switch; a further switch means; means for energizing one of said heaters; means for closing said further switch means upon energization of said one heater; means effective upon closure of said further switch means to establish energizing circuits to said fuel delivery means and said other heater; and means including a combustion responsive device for deenergizing both of said heaters while establishing a running circuit to said fuel delivery means independent of said further switch means so that upon the cooling of said heaters and the resultant opening of said further switch means, said fuel delivery means remains in operation.

13. In a fluid fuel burner control system comprising in combination; fuel delivery means; means for igniting said fuel; a safety switch in control of said fuel delivery means; means including a pair of heaters effective only when both of said heaters are energized to cause opening of said safety switch; a further switch means; means for energizing one of said heaters; means for closing said further switch means upon energization of said one heater; means effective upon closure of said further switch means to establish energizing circuits to said fuel delivery means, said igniting means, and said other heater; and means including a combustion responsive device for deenergizing both of said heaters while establishing a running circuit to said fuel delivery means independent of said further switch means so that upon the cooling of said heaters and the resultant opening of said further switch means, only said fuel delivery means remains in operation.

14. In fluid fuel burner control apparatus for controlling a fuel delivery means; a safety switch adapted to control said fuel delivery means; means including a pair of heaters effective only when both of said heaters are energized to cause opening of said safety switch; a further switch means; means for closing said further switch means upon energization of said one heater; circuit means including said switch means and said other heater and adapted to be associated with a fuel delivery controlling means in such a manner as to establish, upon closure of said further switch means, energizing circuits to said fuel delivery means and said other heater; and further circuit means adapted to be connected to a combustion responsive device and to said fuel delivery controlling means for deenergizing both of said heaters upon the establishment of combustion while establishing a running circuit to said fuel delivery means independent of said further switch means.

15. Fluid fuel burner control apparatus for a fuel delivery means and means for igniting said fuel, a timer, means including a safety switch adapted to be connected to said fuel delivery means and said igniting means for controlling the same, electrical timing means for opening said safety switch at the end of a timed interval, circuit means adapted to be connected to a main switch and to constitute when so connected an energizing circuit for said timer controlled by said main switch, further circuit means including said electrical timing means for said safety switch and a switch operated by said timer, said further circuit means being adapted to be connected to

said fuel delivery means and said igniting means and effective when so connected to render said fuel delivery means operative to deliver fuel and to energize said ignition means and electrical timing means for said safety switch, and means including said timer and electrical timing means and adapted to be connected to a device responsive to combustion and to said fuel delivery means for deenergizing said timer and electrical timing means upon the establishment of combustion and for maintaining said fuel delivery means operative independently of said timer.

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