Feb. 18, 1958 J. H. THORNBERY 2,823,741

MULTIPLE BURNER CONTROL

Filed March 26, 1953 2 Sheets-Sheet 1

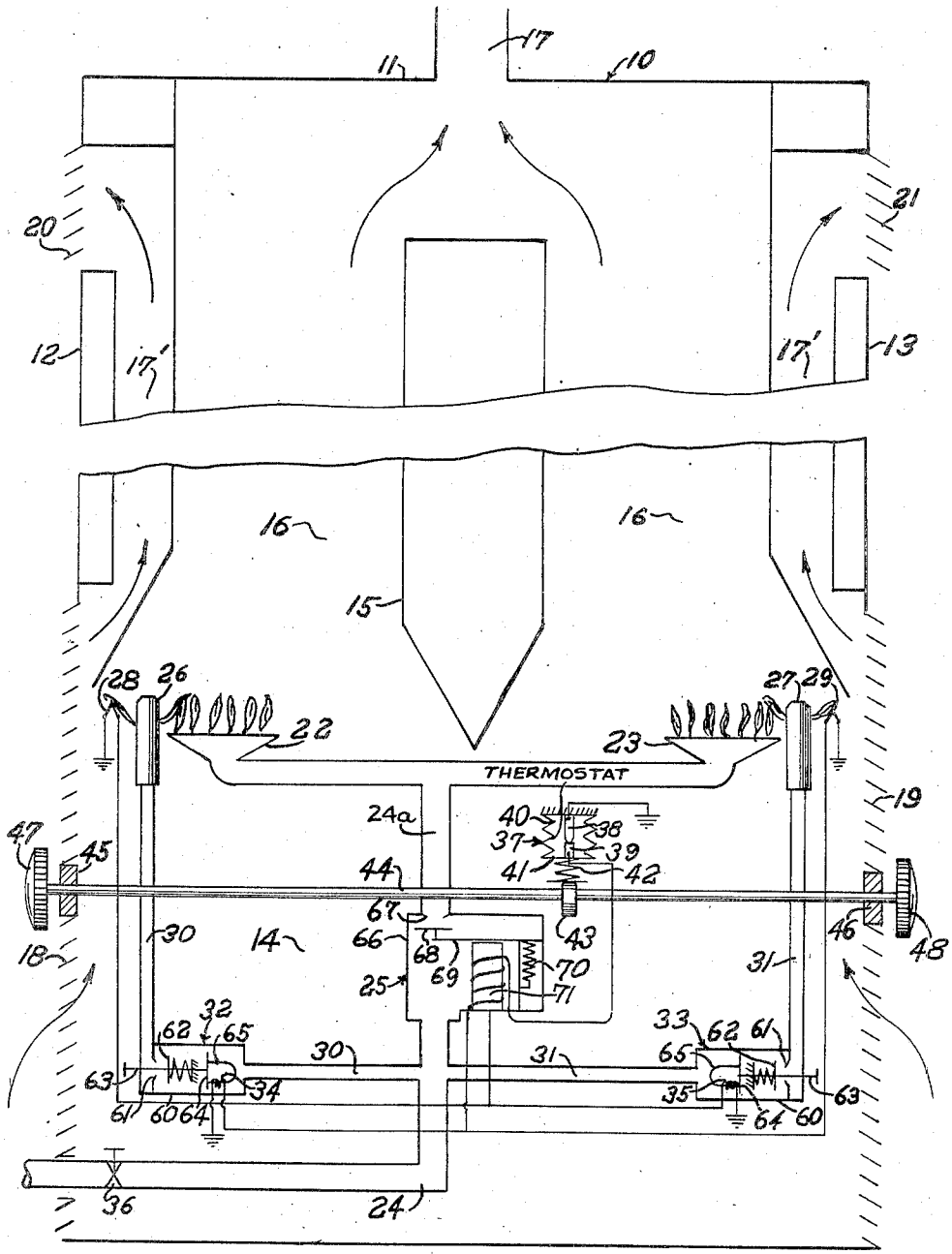

Fig. 1.

INVENTOR.
John H. Thornbery
BY
Brown, Jackson, Boettcher & Dienner
Attys.

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MULTIPLE BURNER CONTROL

Filed March 26, 1953 2 Sheets-Sheet 2

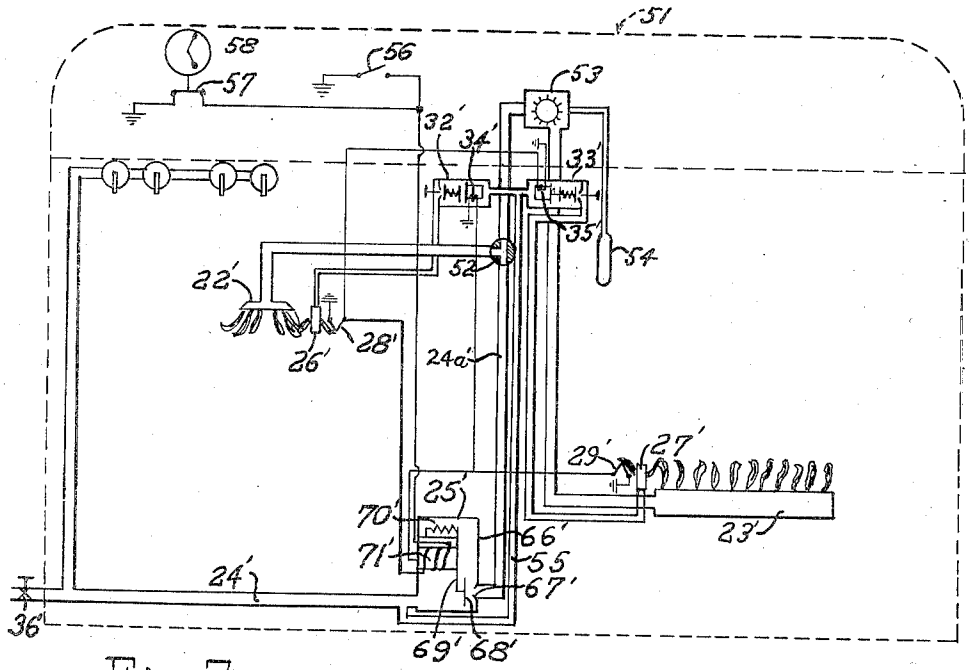

Fig 3.

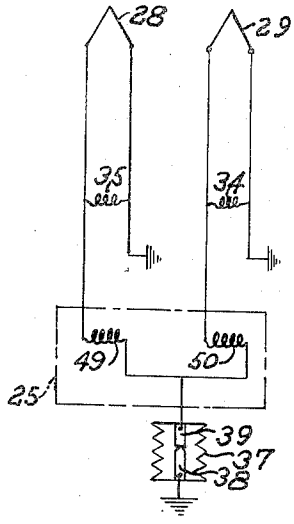

Fig. 2.

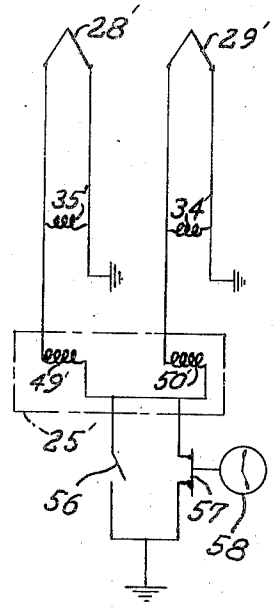

Fig. 4.

INVENTOR.

John H. Thornbery.

BY

Brown, Jackson, Boettcher & Dixon

Attys.

United States Patent Office 2,823,741
Patented Feb. 18, 1958

2,823,741

MULTIPLE BURNER CONTROL

John H. Thornbery, Whitefish Bay, Wis., assignor to Baso Inc., Milwaukee, Wis., a corporation of Wisconsin

Application March 26, 1953, Serial No. 344,758

20 Claims. (Cl. 158—123)

This invention relates to improvements in multiple burner control systems.

It is a general object of the present invention to provide an improved multiple burner control system wherein a plurality of main burners are supplied from a single main fuel supply line through a thermoelectrically operated fuel control valve, there being a pilot burner for each main burner and thermoelectrically operated means responsive to extinguishment of one of the pilot burners for providing one hundred percent shut-off of the flow of fuel to all of the burners.

Another object of the invention is to provide an improved multiple burner control system provided with a thermoelectrically operated fuel shut-off valve for each pilot burner and a thermoelectric generator at each pilot burner, the shut-off valve for each pilot burner being powered by the thermoelectric generator at another pilot burner, and the main burner fuel control valve also being powered by said thermoelectric generators, so that extinguishment of one pilot burner causes sequential shut-off of all pilot burner valves as well as closure of the main fuel control valve.

Another object of the invention is to provide an improved control system of the character described in which the main burner fuel control valve is one of the cycling type which opens and closes in response to variations in the flow of thermoelectric current therethrough, there being condition responsive means in circuit with said valve for controlling the flow of thermoelectric current through said valve and thereby controlling the flow of fuel to the main burners.

A more specific object of the invention is to provide, in a control system of the character described, a main fuel control valve having a pair of coils each connected in parallel circuit relationship with a separate thermoelectric generator, as well as with one of the pilot burner fuel shut-off valves, the connections to said pair of coils being such that flow of thermoelectric current therethrough from said generators provides magnetic fields which complement each other to actuate said main burner fuel control valve.

Another object of the invention is to provide an improved control system of the character described which is operated solely by thermoelectric power and which is adapted for operation under the control of either timing and/or temperature responsive devices.

With these and other objects in view, the invention consists of the improved multiple burner control system and all of the parts and combinations set forth in the claims and all equivalents thereof.

In the accompanying drawings illustrating two forms of the invention:

Figure 1 is a fragmentary semi-diagrammatic elevational view of the invention embodied in a wall type space heater;

Figure 2 is a schematic diagram of the electrical circuit for the form of the invention shown in Figure 1;

Figure 3 is a semi-diagrammatic elevational view of the invention embodied in a kitchen range; and

Figure 4 is a schematic diagram of the electrical circuit for the form of the invention shown in Figure 3.

Referring now to Figure 1 of the drawings illustrating one application of the invention, the numeral **10** indicates a wall type space heater having a casing **11** provided with opposite side walls **12** and **13**. The illustrated heater **10** is adapted to be mounted within an interior wall of a building so that the casing side walls **12** and **13** are contiguous with the opposite sides of said wall. The lower portion of the casing **11** forms a cold air return and combustion chamber **14**, above which is a heat exchanger **15**. The heat exchanger **15** has passages **16** for hot gases of combustion, said passages communicating with a vent **17** at the upper end of the casing **11**. Outwardly of the passages **16**, there are fresh air passages **17'** which communicate at their upper ends with louvered openings **20** and **21**. Louvered openings **18** and **19** provide for the admission of fresh air into both the chamber **14** and the lower ends of the passages **17'** as shown.

Main burners **22** and **23** are mounted in the upper portion of the chamber **14** below the passages **16**, said burners being fed through supply lines **24** and **24***a*. Line **24** may be provided with a manually operated shut-off valve **36**. A main burner fuel control valve **25** is interposed between supply lines **24** and **24***a* as shown. A pair of pilot burners **26** and **27** are mounted adjacent the main burners **22** and **23**, respectively, and mounted in coacting relationship with said pilot burners are thermoelectric generators **28** and **29**, respectively, which generators may take the form of thermocouples. The pilot burners **26** and **27** are fed through fuel supply pipes **30** and **31** which connect with the main fuel supply line **24** ahead of the control valve **25** as shown.

A pair of manually resettable thermoelectrically actuated shut-off valves **32** and **33** are located in pilot fuel lines **30** and **31** respectively. Valves **32** and **33** may be identical and are preferably of the type shown and described in the copending patent application of Gerald E. Dietz, Serial No. 296,831, filed July 2, 1952, and assigned to the assignee of the present application. A detailed description of the structure and operation of the valves **32** and **33** will not be included herein, reference being had to the above cited patent for this purpose. For the purposes of this application, it will be sufficient to state the valves **32** and **33** each have a casing **60** provided with a fuel inlet connection and a fuel outlet connection, between which is interposed a valve seat **61**. A valve member **62** is positioned within each casing **60** and is spring urged into sealing engagement with the adjacent valve seat **61**. Each valve **62** is carried by an axially slidably mounted stem **63** which has one end projecting through the casing end wall to permit manual actuation thereof. At their inner ends the stems **63** are each fixed to an armature **64**. An electromagnet **65** is mounted within each valve casing **60** and coacts with the adjacent armature **64** to hold open the valve **62** connected to said armature when said electromagnet is energized. The electromagnet **65** of the valve **32** is provided with a coil **34**, and the valve **33** is provided with a similar electromagnet coil **35**.

A thermostat **37** may be suitably mounted in the chamber **14** in a position to sense the temperature of the cold air entering the chamber through the openings **18** and **19**. The thermostat **37** is preferably of the type shown and described in the copending application for patent of Adolph J. Hilgert, Serial No. 291,047, filed May 31, 1952, and assigned to the assignee of the present application, now Patent No. 2,724,030. This type of thermostat has extremely high sensitivity and very low differential, and it is well adapted for the control of thermoelectric cir-

cuits by reason of the low contact resistance of said thermostat.

Suffice it to state, for the purposes of this application, that the thermostat **37** has a pair of coacting electrical contacts **38** and **39** which are mounted within an expansible and contractible bellows **40** having a movable wall **41** and an opposite fixed end wall. A compression spring **42** is interposed between the movable bellows wall **41** and an eccentric cam **43** which is fixedly mounted on a transverse shaft **44**. The shaft **44** is rotatably mounted in suitable bearings, such as the bearings **45** and **46**, and is provided with handles **47** and **48** outwardly of the casing walls **12** and **13** respectively.

The thermostat **37** preferably contains a volatile fill which expands and contracts in response to temperature changes and causes corresponding expansion or contraction of the bellows and movement of the bellows wall **41**. The contact **39** moves with the wall **41** toward and away from the contact **38**, which is fixed to the opposite wall of the bellows. The temperature control point of the thermostat **37** can be readily varied by turning handles **47** and **48** to vary the compressive force exerted on the bellows by the spring **42**.

The main burner fuel control valve **25** is preferably of the type shown and described in the copending application for patent of Gerald E. Dietz and Adolph J. Hilgert, Serial No. 292,488, filed June 9, 1952, and assigned to the assignee of the present application. This type of valve can be operated on thermoelectric power exclusively, said valve being normally closed, and being movable to open position in response to the flow therethrough of a predetermined thermoelectric current. Thus, the valve **25** can not only provide safety shut-off on pilot failure, but can also operate under the control of the thermostat **37** to provide highly sensitive temperature responsive main burner control.

The structure of the valve will not be described in detail herein, reference to the application Serial No. 292,488 being had for this purpose. Suffice it to state for the purposes of this application that the valve **25** has a casing **66** provided with a fluid inlet and a fluid outlet connection, there being an annular valve seat **67** at the outlet connection. A valve member **68** normally sealingly engages the valve seat **67** to prevent the flow of fuel to the burners **22** and **23**, said valve being movable to a retracted open position. The valve member **68** is carried by a pivotally mounted arm **69** which is urged by a spring **70** in a direction to move the valve member **68** toward the seat **67**. The arm **69** and spring **70** form a part of an electromagnetic valve operator which also includes an electromagnet **71** having a pair of coils **49** and **50** (see Figure 2). The valve operator also includes an armature (not shown) having a resilient connection with the arm **69**, said connection providing an energy storing means, the structure and operation of which is more specifically described in the referred to copending application, Serial No. 292,488.

The coils **49** and **50** preferably surround separate pole pieces of the electromagnet **71** and are interconnected at one end and connected in circuit with the contact **39** of the thermostat. The contact **38** of the thermostat is suitably grounded, as is one side of each of the thermoelectric generators **28** and **29** and one side of each of the pilot fuel shut-off valve coils **34** and **35**. The ungrounded side of the generator **28** is connected to the ungrounded side of the coil **35** and to free end of the coil **49**, as shown, whereas the ungrounded side of the generator **29** is connected to the ungrounded side of the coil **34** and to the free end of the coil **50**.

It is apparent that the coils **35** and **49** are connected in parallel circuit relationship with the generator **28**, and that the coils **34** and **50** are in parallel circuit relationship with the generator **29**. The connections to the coils **49** and **50** are preferably such that when thermoelectric current flows therethrough from the generators **28** and **29**, magnetic fields are provided which complement each other to cause actuation of the valve **25**. It is also apparent that the pilot fuel shut-off valve **32** is under the control of the pilot burner **27**, and that the pilot fuel shut-off valve **33** is under the control of the pilot burner **26**.

During operation of the improved burner control system the pilot burners **26** and **27** normally burn continuously and heat the thermoelectric generators **28** and **29**. Thermoelectric current from the generators **28** and **29** flows through the coils **34**, **35** to hold the normally closed pilot burner fuel shut-off valves **32** and **33** in open position. Thermoelectric current from the generators **28** and **29** also flows through the coils **49** and **50** under the control of the thermostat **37**, so that the valve **25** is opened and closed in accordance with the temperature of the air entering the chamber **14** through the openings **18** and **19** so long as the pilot burners **26** and **27** are functioning properly.

The thermostat **37** may function as a variable resistance device wherein a decrease in contact pressure increases the contact resistance, and when the contact resistance increases to a predetermined point where the thermoelectric current can no longer flow therethrough in sufficient quantity to maintain the electromagnetic operator of valve **25** energized, said operator closes said valve. Conversely, an increase in contact pressure decreases the contact resistance, and when this resistance decreases to a predetermined point, the thermoelectric current can flow therethrough in sufficient quantity to energize the operator of the valve **25**, whereupon said operator opens said valve.

A highly sensitive automatic control of the thermoelectric current in the circuit can be effected in response to changes in temperature by merely varying the contact pressure of the contact **39** against the contact **38**. The inherent differential required to open and close the valve **25** is very small, and, neglecting thermal lag of the thermostat **37**, is dependent upon the electrical constants of the apparatus as determined by the relationship of the current values which will cause opening and closing of the valve **25** in relation to the contact pressure in the thermostat. This inherent differential is so minimal as to be within the thermal lag range of the thermostat **37**. It is apparent, therefore, that the thermostat **37** serves as a very sensitive condition responsive means which cycles the valve **25** in response to predetermined relatively low temperature differentials.

The copending application for patent of Adolph J. Hilgert and Russell B. Matthews, Serial No. 289,242, filed May 22, 1952, and assigned to the assignee of the present application, now Patent No. 2,717,123, shows and describes a thermoelectric control circuit incorporating an encapsulated thermostat and an electromagnetically operated valve similar in structure and operation to the thermostat **37** and valve **25**. Reference may be had to this copending application for additional specific structural details.

When one of the pilot burners is extinguished, for example, the burner **26**, the adjacent generator **28** cools and deenergizes the coil **35** of the shut-off valve **33** for the other pilot burner (burner **27**), closing valve **33** and extinguishing said other pilot burner. This, of course, causes cooling of the generator **29**, which deenergizes the coil **34** of the shut-off valve **32** for the pilot burner **26**, closing the latter valve. With both generators in a cooling state, coils **49** and **50** of the valve **25** are both deenergized, and the valve member **68** of valve **25** moves to closed position, if open, to provide one hundred percent shut-off of the fuel. The valve member **68** will remain in closed position until after the pilot burners **26** and **27** are relighted to cause generation of current by the generators **28** and **29**.

In Figure 3 the improved burner control system is shown embodied in a range **51** having a broiler burner

22' and an oven burner 23', both supplied with fuel through supply lines 24' and 24a'. A three-way valve 52 may be interposed in the line 24', as shown, to provide for selective operation of either or both of the burners 22' and 23'. A thermostatically operated valve 53 of any well known type is located in the branch of the line 24a' connected to the burner 23' and has a sensing bulb 54 located in the range oven.

A cycling type of thermoelectrically operated shut-off valve 25', which may be identical with the valve 25 of Figure 1, is interposed between supply lines 24' and 24a', said valve having an electromagnetic operator provided with two coils 49' and 50' (see Figure 4). Parts of the valve 25' corresponding to parts of the valve 25 in Figure 2 are indicated by the same numerals primed. A pair of pilot burners 26' and 27' are mounted adjacent the main burners 22' and 23' respectively, and a pair of thermoelectric generators 28' and 29' are mounted in coacting relationship with the pilot burners 26' and 27' respectively. The pilot burners 26' and 27' are supplied with fuel through a branched line 55 which communicates with the main fuel supply line 24' ahead of the valve 25' as shown. The main fuel supply line 24' may also be provided with a manual shut-off valve 36'.

The flow of fuel to the pilot burner 26' is controlled by a thermoelectrically operated shut-off valve 32' which may be identical with the valves 32 and 33 and has a coil 34' corresponding to the coil 34 of valve 32. The flow of fuel to the pilot burner 27' is controlled by a thermoelectrically operated shut-off valve 33' which may be identical with valves 32, 32' and 33 and has a coil 35' corresponding to the coil 35 of valve 33. As shown in Figure 4, the coil 35' is connected in parallel circuit relationship with the generator 28', and the coil 34' is similarly connected to the generator 29'. The coils 49' and 50' are interconnected at one end, and the interconnected ends are also connected in circuit with one side of a manual switch 56, as well as with one side of a switch 57 which is actuated by an oven clock control 58. The other side of each switch 56 and 57 is grounded.

One side of each of the generators 28' and 29' and of coils 34' and 35' is grounded, the ungrounded side of the generator 28' and of the coil 35' being connected in circuit with the free end of the coil 49'. The ungrounded side of the generator 29' and of the coil 34' is connected to the free end of the coil 50'. The connection to the coils 49' and 50' are such that the flow of current therethrough from the generators 28' and 29' provides magnetic fields which complement each other to actuate the valve 25'.

The pilot burners 26' and 27' normally burn continuously and heat the generators 28' and 29' to cause current to flow therefrom through the coils 34' and 35'. This holds open the normally closed pilot burner shut-off valves 32' and 33'. Upon closure of either of the switches 56 and 57, the current from the generators flows through the coils 49' and 50' to thereby move the valve member 68' of the valve 25' to open position. With the valve 52 positioned as shown, fuel flows to the main burners 22' and 23', the flow to the latter being under the control of the thermostatic valve 53.

When one of the pilot burners, for example, the burner 26', becomes extinguished, the adjacent generator 28' cools and deenergizes the coil 35' of the shut-off valve 33' for the pilot burner 27', closing said valve extinguishing the latter burner. This cools the generator 29' and deenergizes the coil 34' of the pilot burner shut-off valve 32', closing said valve. With both generators 28' and 29' in a cooling state, the coils 49' and 50' of the valve 25' are deenergized and the valve member 68' of said valve closes, if open, to provide one hundred percent shut-off of the fuel. The valve member 68' remains closed until after the pilot burners 26' and 27' are relighted to cause generation of current by the generators 28' and 29'.

It is apparent that whenever both of the switches 56 and 57 are open, the flow of current through the coils 49' and 50' is interrupted, and the valve 25' is therefore closed. The clock control 58 may be set to close the switch 57 at any predetermined time, thereby opening the valve 25' and placing the selected main burner in operation at the selected hour. The clock control 58 may also be set to close the valve 57 after a predetermined period of burner operation. When it is desired to operate the oven or broiler without the clock control, the manual switch 56 is closed and the range is operated in the conventional manner.

In both of the illustrated forms of the invention a multiple burner control system is provided in which one hundred percent shut-off of fuel flow to the main burners, as well as to the pilot burners is automatically effected in response to extinguishment of one of the pilot burners. The improved system operates entirely on thermoelectric power generated within the system.

The illustrated embodiments of the invention are for the purpose of disclosure only, and are not to be construed as in any way defining the limits or scope of the invention. Various other changes and modifications may be made without departing from the spirit of the invention, and all of such changes are contemplated as may come within the scope of the appended claims.

What I claim as the invention is:

1. Apparatus for controlling the flow of fuel in a fluid fuel burning unit, comprising: a plurality of ignition burners; an electromagnetically operated fuel shut-off valve for each of said burners; a separate thermoelectric generator at each of said burners, each of said generators being connected to and powering the fuel shut-off valve of one of said burners other than the one associated with the respective generator, whereby extinguishment of one of said burners causes sequential closure of the fuel shut-off valves of all of said burners.

2. In apparatus for controlling the flow of fuel in a fluid fuel burning unit; a pair of pilot burners; a thermoelectric generator at each pilot burner; an electromagnetically operated shut-off valve for each pilot burner, said valves each having a coil connected in circuit with the generator at the other pilot burner; and an electromagnetically operated main burner fuel shut-off valve having a pair of coils each connected in parallel circuit relationship with a separate one of said generators, the connections to said pair of coils being such that the flow of a predetermined thermoelectric current from said generators through said coils provides magnetic fields which complement each other and cause actuation of said main burner fuel shut-off valve.

3. In apparatus for controlling the flow of fuel in a fluid fuel burning unit: a pair of pilot burners; a thermoelectric generator at each pilot burner; an electromagnetically operated shut-off valve for each pilot burner, said valves each having a coil connected in circuit with the generator at the other pilot burner; an electromagnetically operated main burner fuel shut-off valve having a pair of coils each connected in parallel circuit relationship with a separate one of said generators, the connections to said pair of coils being such that the flow of a predetermined thermoelectric current from said generators through said coils provides magnetic fields which complement each other and cause actuation of said main burner fuel shut-off valve; and a condition responsive circuit controlling device in circuit with said pair of coils and controlling the flow of current thereto from said generators.

4. In apparatus for controlling the flow of fuel in a fluid fuel burning unit: a pair of pilot burners; a thermoelectric generator at each pilot burner; an electromagnetically operated shut-off valve for each pilot burner, said valves each having a coil connected in circuit with

the generator at the other pilot burner; an electromagnetically operated main burner fuel shut-off valve having a pair of coils each connected in parallel circuit relationship with a separate one of said generators, the connections to said pair of coils being such that the flow of a predetermined thermoelectric current from said generators through said coils provides magnetic fields which complement each other and cause actuation of said main burner fuel shut-off valve; and a switch in circuit with said pair of coils controlling the flow of thermoelectric current thereto from said generators.

5. In apparatus for controlling the flow of fuel in a fluid fuel burning unit: a pair of pilot burners; a thermoelectric generator at each pilot burner; an electromagnetically operated shut-off valve for each pilot burner, said valves each having a coil connected in circuit with the generator at the other pilot burner; an electromagnetically operated main burner fuel shut-off valve having a pair of coils each connected in parallel circuit relationship with a separate one of said generators, the connections to said pair of coils being such that the flow of a predetermined thermoelectric current from said generators through said coils provides magnetic fields which complement each other and cause actuation of said main burner fuel shut-off valve; and a temperature responsive variable resistance device in circuit with said pair of coils controlling the flow of thermoelectric current thereto from said generators, said device comprising coacting electrical contacts encapsulated within an expansible and contractible bellows.

6. In apparatus for controlling the flow of fuel in a fluid fuel burning unit: a pair of pilot burners; a thermoelectric generator at each pilot burner, each generator having one side grounded; an electromagnetically operated shut-off valve for each pilot burner, said valves each having a coil with one side connected to the ungrounded side of the generator at the other pilot burner, the other side of said coils being grounded; and an electromagnetically operated main burner fuel shut-off valve having a pair of coils which are interconnected at one end and grounded, said coils having their other ends respectively connected to the ungrounded sides of said generators, the connections to said pair of coils being such that the flow of a predetermined thermoelectric current from the generators through said coils provides magnetic fields which complement each other and cause actuation of the main burner fuel shut-off valve.

7. In apparatus for controlling the flow of fuel in a fluid fuel burning unit: a pair of pilot burners; a thermoelectric generator at each pilot burner, each generator having one side grounded; an electromagnetically operated shut-off valve for each pilot burner, said valves each having a coil with one side connected to the ungrounded side of the generator at the other pilot burner, the other side of said coils being grounded; an electromagnetically operated main burner fuel shut-off valve having a pair of coils which are interconnected at one end and grounded, said coils having their other ends respectively connected to the ungrounded sides of said generators, the connections to said pair of coils being such that the flow of a predetermined thermoelectric current from the generators through said coils provides magnetic fields which complement each other and cause actuation of the main burner fuel shut-off valve; and a condition responsive circuit controlling device connected in the circuit between the interconnected ends of the pair of coils and the ground, said device controlling the flow of thermoelectric current to said coils from said generators.

8. In apparatus for controlling the flow of fuel in a fluid fuel burning unit: a pair of pilot burners; a thermoelectric generator at each pilot burner, each generator having one side grounded; an electromagnetically operated shut-off valve for each pilot burner, said valves each having a coil with one side connected to the ungrounded side of the generator at the other pilot burner, the other side of said coils being grounded; an electromagnetically operated main burner fuel shut-off valve having a pair of coils which are interconnected at one end and grounded, said coils having their other ends respectively connected to the ungrounded sides of said generators, the connections to said pair of coils being such that the flow of a predetermined thermoelectric current from the generators through said coils provides magnetic fields which complement each other and cause actuation of the main burner fuel shut-off valve; and a switch connected in the circuit between the interconnected ends of the pair of coils and the ground, said switch controlling the flow of thermoelectric current to said coils from said generators.

9. In apparatus for controlling the flow of fuel in a fluid fuel burning unit: a pair of pilot burners; a thermoelectric generator at each pilot burner, each generator having one side grounded; an electromagnetically operated shut-off valve for each pilot burner, said valves each having a coil with one side connected to the ungrounded side of the generator at the other pilot burner, the other side of said coils being grounded; an electromagnetically operated main burner fuel shut-off valve having a pair of coils which are interconnected at one end and grounded, said coils having their other ends respectively connected to the ungrounded sides of said generators, the connections to said pair of coils being such that the flow of a predetermined thermoelectric current from the generators through said coils provides magnetic fields which complement each other and cause actuation of the main burner fuel shut-off valve; and a temperature responsive variable resistance device connected in the circuit between the interconnected ends of the pair of coils and the ground, said device controlling the flow of thermoelectric current to said coils from said generators and comprising coacting electrical contacts encapsulated within an expansible and contractible bellows.

10. Apparatus for controlling the flow of fuel in a fluid fuel burning unit, comprising, a plurality of fuel burners having individual fuel supply conduits, an electrically operated fuel shut-off valve in each of said conduits for control of fuel supply to its respective burner, a thermoelectric generator for each of said burners to be heated respectively thereby, each of said generators being in circuit with one of said shut-off valves other than the one controlling fuel supply to its respective burner, extinguishment of any one of said burners effecting successive closure of the valves of all of said burners.

11. Apparatus for controlling the flow of fuel in a fluid fuel burning unit, comprising, a plurality of fuel burners having individual fuel supply conduits, an electrically controlled fuel shut-off valve in each of said conduits for control of fuel supply to its respective burner, thermoelectric generators for said shut-off valves heated by said burners, each of said generators having individual connection with one of said valves other than the one controlling the fuel supply to the burner affording heat for the respective generator while at least one of said generators has an additional connection with another of said valves, and condition responsive means controlling said last-mentioned valve for control of the fuel supplied thereby to its respective burner in response to variations in the condition, extinguishment of any one of said burners other than the burner controlled by said last-mentioned valve effecting closure of all of said valves.

12. Apparatus for controlling the flow of fuel in a fluid fuel burning unit, comprising, at least three fuel burners having individual fuel supply conduits, an electrically controlled fuel shut-off valve in each of said conduits for control of fuel supply to its respective burner, and a thermoelectric generator for each of two of said three burners to be heated respectively thereby, each of said generators having operating connection with the valve controlling fuel supplied to the burner affording heat for the other generator, at least one of said generators also having operative connection with the valve

controlling fuel supply to the burner lacking heat-affording relation with either of said generators, extinguishment of either of said burners affording heat for one of said generators effecting closure of all of said valves.

13. Apparatus for controlling the flow of fuel in a fluid fuel burning unit, comprising, at least three fuel burners having individual fuel supply conduits, an electrically controlled fuel shut-off valve in each of said conduits for control of fuel supply to its respective burner, a thermoelectric generator for each of two of said three burners to be heated respectively thereby, each of said generators having operative connection with the valve controlling fuel supply to the burner affording heat for the other generator, at least one of said generators also having operative connection with the valve controlling fuel supply to the burner lacking heat-affording relation with said generators, and condition responsive means controlling said last-mentioned valve to control the fuel supplied thereby to its respective burner in response to variations in the condition, extinguishment of either of said burners affording heat for said generators effecting closure of all of said valves.

14. Apparatus for controlling the flow of fuel in a fluid fuel burning unit, comprising, at least three fuel burners having individual fuel supply conduits, an electrically controlled fuel shut-off valve in each of said conduits for control of fuel supply to its respective burner, a thermoelectric generator for each of two of said three burners to be heated respectively thereby, each of said generators having operative connection with the valve controlling fuel supply to the burner affording heat for the other generator, at least one of said generators also having operative connection with the valve controlling fuel supply to the burner lacking heat-affording relation with said generators, and temperature responsive means having connection with said last-mentioned valve to thermostatically control the fuel supplied thereby to its respective burner, extinguishment of either of said burners affording heat for said generators effecting closure of all of said valves.

15. Apparatus for controlling the flow of fuel in a fluid fuel burning unit, comprising, a plurality of fuel burners having individual fuel supply conduits, an electrically operated fuel shut-off valve in each of said conduits for control of fuel supply to its respective burner, a thermoelectric generator for each of said burners to be heated respectively thereby, each of said generators being in circuit with one of said shut-off valves other than the one controlling fuel supply to its respective burner, extinguishment of any one of said burners effecting successive closure of the valves of all of said burners, and at least one additional burner having an electrically operative cycling valve for control of fuel supplied thereto, said cycling valve being in circuit with at least one of said generators, whereby said cycling valve shuts off supply of fuel to said additional burner upon extinguishment of any of said first-mentioned burners.

16. Apparatus for controlling the flow of fuel in a fluid fuel burning unit, comprising, a main fuel burner and main fuel supply line therefor, an electrically operated main shut-off valve in said fuel supply line, a plurality of pilot burners having individual fuel supply conduits having connection with said main fuel supply line upstream of said main valve, an electrically operated auxiliary fuel shut-off valve in each of said conduits for control of fuel supply to its respective pilot burner, a thermoelectric generator for each of said pilot burners to be heated respectively thereby, each of said generators being in circuit with one of said auxiliary shut-off valves other than the one controlling fuel supply to its respective pilot burner, and with said main shut-off valve, whereby extinguishment of any one of said pilot burners effects successive closure of the auxiliary valves of all of said pilot burners and closure of said main shut-off valve.

17. Apparatus for controlling the flow of fuel in a fluid fuel burning unit, comprising, at least one main burner and main fuel supply line therefore, an electrically operated main shut-off valve in said main supply line, said main shut-off valve having a flow control member and condition responsive means associated therewith for controlling said flow control member in response to a given condition, a plurality of pilot burners having individual fuel supply conduits independent of said main valve, an electrically operated auxiliary fuel shut-off valve in each of said conduits for control of fuel supply to its respective pilot burner, a thermoelectric generator for each of said pilot burners to be heated respectively thereby, each of said generators being in circuit with one of said auxiliary shut-off valves other than the one controlling fuel supply to its respective pilot burner and with said main shut-off valve, whereby extinguishment of any one of said pilot burners effects successive closure of the auxiliary valves of all of said pilot burners, and renders said condition responsive means ineffective to control said main valve.

18. Apparatus for controlling the flow of fuel in a fluid fuel burning unit, comprising, a plurality of main burners, a main fuel supply line and electrically operated main shut-off valve therein for supply of fuel to said main burners, thermostat means comprising a pair of cooperating electric contacts positioned within an expansible and contractible enclosure in circuit with said main shut-off valve to render said valve responsive to predetermined temperature variations, a pilot burner for each of said main burners in heating relation respectively therewith, said pilot burners having individual fuel supply conduits independent of said main supply line, an electrically operated auxiliary fuel shut-off valve in each of said conduits for control of fuel supply to its respective pilot burner, a thermoelectric generator for each of said pilot burners to be heated respectively thereby, each of said generators being in circuit with one of said auxiliary shut-off valves other than the one controlling fuel supply to its respective pilot burner, at least one of said generators also having electrical connection with said main shut-off valve whereby extinguishment of any one of said pilot burners effects successive closure of the auxiliary valves of all of said pilot burners and closure of said main valve to thereby provide one hundred percent shut-off.

19. Apparatus for controlling the flow of fuel in a fluid fuel burning unit comprising, a plurality of main burners, a main fuel supply line and electrically operated main shut-off valve therein for supply of fuel to said main burners, a pilot burner for each of said main burners in heating relation respectively therewith, said pilot burners having individual fuel supply conduits independent of said main supply line, an electrically operated auxiliary fuel shut-off valve in each of said conduits for control of fuel supply to its respective pilot burner, a thermoelectric generator for each of said pilot burners to be heated respectively thereby, each of said generators being in circuit with one of said auxiliary shut-off valves other than the one controlling fuel supply to its respective pilot burner, said main shut-off valve having a coil and at least one of said generators being also in circuit with said coil of said main shut-off valve, a switch also in circuit with said coil controlling the flow of thermoelectric current therethrough from said one of said generators, and thermostatic means controlling flow of fuel to at least one of said main burners, extinguishment of any one of said pilot burners effecting successive closure of the auxiliary valves of all of said pilot burners and closure of said main valve to thereby provide one hundred percent shut-off, interruption of flow of fuel to said main burners being effected also by opening of the circuit to the coil of said main valve at said switch and by operation of said thermostatic means even though fuel is being supplied to said pilot burners and said generators are heated.

20. Apparatus for controlling the flow of fuel in a fluid fuel burning unit, comprising: a plurality of ignition burners, an electromagnetically operated fuel shut-off valve operatively associated with each burner, a separate thermoelectric generator at each of said burners, each of said generators being connected to and powering the fuel shut-off valve directly controlling another burner whereby extinguishment of one of said burners causes sequential closure of the fuel shut-off valves of all the said burners.

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