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SAFETY CONTROL SYSTEM FOR FUEL BURNERS

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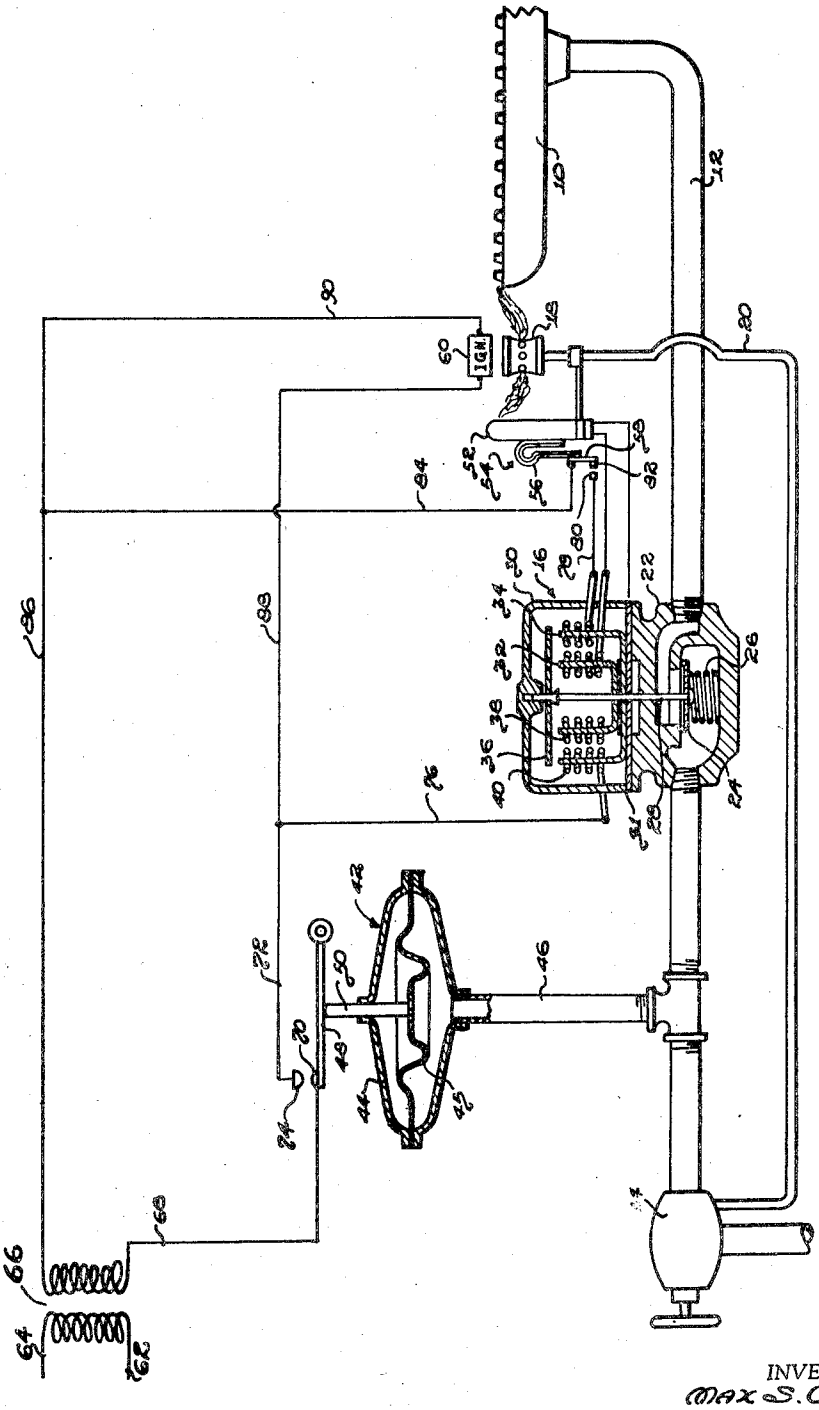

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SAFETY CONTROL SYSTEM FOR FUEL BURNERS

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This invention relates to safety controls for fuel burners and, more particularly, to thermoelectric controls therefor.

Fuel burners employing thermoelectric safety control apparatus may be arranged so that the thermocouple or thermopile, which is responsive to the heat of a flame at the pilot burner, controls the energization of an electromagnetic safety device for shutting off the fuel supply to the main burner upon extinguishment of the pilot burner flame. In such devices the electric current generated by the thermoelectric device, even where this comprises a thermopile, is usually insufficient to attract the armature of the electromagnet but is sufficient only to hold the armature in attracted position after it has been otherwise moved to such position. Manually operated devices have been employed for the purpose of resetting the armature but are subject to various disadvantages which this invention seeks to overcome.

An object of this invention is to eliminate the necessity for a manual reset operation on an electromagnetic device by automatically operated means.

Another object of the invention is to continue operation of the automatically operated means until a thermoelectric current is available for controlling the electromagnetic safety device.

Another object of the invention is to render the automatically operated means inoperative during the period that the electromagnetic safety means is under thermoelectric control.

Another object of the invention is to secure prompt recycling of the control upon extinguishment of the flame at the pilot burner.

parent from the following description taken in

Other objects and advantages will become ap-

connection with the accompanying drawing wherein is shown a schematic embodiment of the safety control apparatus of this invention in conjunction with the main and pilot burners of a gaseous fuel burning apparatus.

Referring more particularly to the drawing, a main burner 10 is supplied with fuel by a main fuel pipe 12 and the flow of fuel therein is under separate control of a main valve 14 which may be manually operated and a safety valve 16 which may be electrically operated. A pilot burner 18 is positioned adjacent the main burner 10 and is supplied with fuel by a conduit 20 in which the flow of fuel is controlled by the main valve 14 only.

The safety valve 16 may be arranged for electromagnetic operation and, to this end, comprises a valve body 22 containing a valve member 24 intercepting the flow of fuel in the pipe 12 and being biased by a coil spring 26 to closed position. The valve member 24 carries a valve stem 28 which projects from the valve body 22

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into a housing 30 which is attached thereto and sealed against entrance of fuel by the gasket 31. The housing 30 contains a pair of horseshoe magnets 32 and 34 which may be conveniently nested one within the other with their pole faces lying substantially in the same plane. Surmounting the magnets 32 and 34 and supported by the valve stem 28 is a single armature 36 of sufficient area to extend across the pole faces of both magnets 32 and 34. The valve stem 28 is of such length that when the valve member 24 is biased to the closed position shown, the armature 36 is disengaged from the pole faces of the magnets 32 and 34 leaving the usual air gap therebetween. The valve stem 28 is adapted for reciprocable movement within the valve body 22 and the cover 30 and may be guided in suitably spaced bearings formed in the cover 30 and the valve body 22. The magnets 32 and 34 are provided with windings or coils 38 and 40, respectively, which are separately wound and electrically unconnected with each other.

As will be more clearly apparent hereinafter, the electromagnetic device in housing 30 is adapted both to attract and hold the armature 36 against the pole faces of the magnets 32 and 34. It is not essential that two such magnets be used as in certain instances a single magnet having separate coils thereon would serve the purpose. However, where one coil is energized from a thermocouple generating direct current and the other coil is energized from a separate source it is preferable to utilize separate magnets. Otherwise, if the separate source should be an alternating current source, the coil energized thereby would act as a tripping coil serving to demagnetize the single magnet by producing lines of force opposed to those produced by the thermoelectric current. The provision of two magnets renders the device applicable for use with either direct or alternating current in addition to that generated by the thermocouple.

Interposed in the fuel supply pipe 12 ahead of the safety valve 22 is a pressure switch 42 comprising a diaphragm housing 44 connected on one side of the diaphragm 45 by the nipple 46 with the fuel supply pipe 12 and on the other side with a movable switch arm 48 by means of a plunger 50. Variations in pressure of the fuel conveyed through nipple 46 to the diaphragm housing 44 will cause corresponding variations in the position of the diaphragm 45 to operate the switch arm 48.

Suitable flame responsive means which will serve to generate electric current in the presence of a flame at the pilot burner are provided. In this embodiment thermoelectric means in the form of a thermopile or thermocouple 52 is arranged adjacent the pilot burner 18 in position to be heated by the flame thereof. Time delay

means in the form of a thermally operable switch 54 is positioned adjacent the thermocouple 52 and comprises a bimetal strip 56 positioned to be heated by conduction of heat along the thermocouple 52 and carrying a movable switch arm 58. The fuel flowing from the pilot burner 18 is adapted to be ignited by an electrical igniting means 60 of any suitable type including either the incandescent coil or spark plug type.

The electrical connections for energizing one coil of the electromagnetic safety valve 16 and also the igniting means 60 are shown as comprising line wires 62 and 64 connected to the primary of transformer 66, a wire 68 connected to one terminal of the secondary of the transformer 66, a contact 70 carried on the movable switch arm 48 of the pressure switch 42, a wire 72 connected at one end to a fixed contact 74 of pressure switch 42, a wire 76 connected with one end of the coil 40, a wire 78 connecting the other end of coil 40 to a fixed contact 80 of the thermally operable switch 54, a movable contact 82 carried by the movable switch arm 58, and wires 84 and 86 connected to the other terminal of the secondary of the transformer 66.

The electrical igniter 60 is connected in a parallel circuit with the coil 40 and the contacts 80 and 82 of the thermally operable switch 54 which circuit may be traced by a wire 88 connected at one end to the wire 76, the igniter 60, and a wire 90 connected to the wire 86 at its junction with the wire 84. The thermocouple 52 has one of its leads connected directly to one end of the coil 38 and the other lead grounded on the valve body 22, the other end of the coil 38 being likewise grounded on the valve body 22. This circuit is entirely separate from the secondary circuit of the other coil 40 and the igniter 60.

In the operation of the apparatus it may be assumed that the main valve 14 is closed, the transformer 66 energized by the line wires from an alternating current source and the various elements in the position shown in the drawing. In this condition of the apparatus it will be noted that the valve 24 is biased closed, the contacts 70 and 74 of the pressure switch 42 are opened and the contacts 80 and 82 of the thermally operable switch 54 are likewise opened. In such position of the valve 24 the armature 36 is disengaged from the pole faces of the magnets 32 and 34 and the electrical igniter 60 is deenergized due to the open condition of the contacts 70 and 74.

The system may be placed in operation by opening the main valve 14 which will allow fuel to flow in the main fuel pipe 12 as far as the safety valve 16 and in the conduit 20 to the pilot burner 18. The fuel in the main fuel pipe 12 also enters the nipple 46 and the pressure thereof exerted against the underside of the diaphragm 45 causes the plunger 50 to be raised and move the switch arm 48 to close the contacts 70 and 74. The igniter 60 now becomes energized and serves to ignite the fuel issuing from the pilot burner 18. The heat of the flame at the pilot burner 18 causes the thermocouple 52 to become heated and to generate electric current which is conducted to the coil 38 through the connections previously described.

The heat conducted along the thermocouple 52 will cause the temperature of the bimetal strip 56 to be raised sufficiently to flex the strip and cause closure of the contacts 80 and 82 by movement of the switch arm 58. Thus, after a time delay period fixed by the time it requires for the bimetal strip 56 to warp, the circuit through the

coil 40 of the electromagnet is completed, it being apparent that one coil 40 is energized from the source 62—64 of alternating current and the other coil 38 is energized from the source of direct current from the thermocouple 52. It will further be apparent that the relatively weak current generated by the thermocouple 52 is not relied upon to attract the armature 36 against the pole faces of the magnets 32 and 34 and it may be assumed for the purposes of this invention that such current is insufficient to cause this attracting operation. However, the alternating current which energizes the coil 40 is of sufficient value to overcome the bias of the spring 26 and to attract the magnet 36 against the pole faces of the magnets 32 and 34.

The attracting of the armature 36 is accompanied by opening of the valve 24 as these elements are connected together by the valve stem 28. The fuel in the main fuel pipe 12 now flows from the main burner 10 and is ignited by the flame of the pilot burner 18. The opening of the valve 24 serves to relieve the pressure in the diaphragm housing 44 to cause movement of the plunger 50 downwardly thus separating contacts 70 and 74. The opening of the pressure switch 42 causes deenergization of the igniter 60 and also causes deenergization of the magnet coil 40. The armature 36 is retained against the pole faces of the magnet 32 as the coil 38 thereof remains energized by the thermocouple generated current which is sufficient for this holding action.

It is thus apparent that while the value of the current generated by the thermocouple 52 is insufficient to attract the armature 36 against the pole faces of the magnets 32 and 34 such current value is sufficient to hold the armature 36 in engagement with the magnets when it has once been moved to such position by energization of the coil 40 connected to the source of alternating current. While the pole faces of the magnets are described as being in substantially the same plane it would be entirely feasible to extend the pole face of magnet 32 beyond that of magnet 34 so that close contact between the armature 36 and the magnet 32 would be assured. That is, the magnetizing force arising from the current which energizes the coil 40 can be of sufficient magnitude so that the magnetic flux through an air gap between the pole faces of magnet 34 and the armature 36 will cause retention of the armature whereas the magnetizing force arising from the thermocouple current is generally so weak that close engagement between the pole faces of magnet 32 and the armature is essential in order that the armature be retained. The electromagnet which is energized from the source of alternating current is rendered inoperative after the armature has been attracted and, as previously pointed out, this source could equally well be direct current.

The main burner 10 will continue to operate until the flame of the pilot burner 18 becomes extinguished assuming that the main valve 14 remains open. Such failure at the pilot burner will cause the thermocouple 52 to cool and the current generated thereby will cease or become insufficient to permit the coil 38 to retain the armature 36 against the pole faces of the magnets 32 and 34. The valve 24 will then close under the bias of the spring 26 and shut off the flow of fuel to the main burner 10. Such action will, however, again create the pressure in the pressure switch 42 causing the contacts 70 and 74 to close to energize the electrical igniter 60 and the coil 40 of

the electromagnet. Thus, the system is recycling upon failure of the pilot burner and no attention on the part of the operator is required to set the system in operation after flame failure.

It will be apparent that many changes can be made in the arrangement and combination of parts and in the details of construction herein disclosed within the scope of the appended claims without departing from the spirit of the invention.

I claim:

1. Safety control apparatus for fuel burners having main and pilot burners comprising in combination, control means operable for controlling the supply of fuel to the main burner and being biased to one controlling position, electromagnetic means including a plurality of coil means and a single armature movable relatively to said coil means between attracted and released positions, said electromagnetic means being operatively associated with said control means for overcoming said bias when at least one of said coil means is energized sufficiently to hold said armature in said attracted position and said control means in another controlling position, means responsive to the presence of a flame at the pilot burner for energizing said one coil means sufficiently to hold said armature in said attracted position but insufficiently to cause said relative movement from released position, a source of current supply, means for energizing another one of said coil means from said source sufficiently to cause said relative movement of said armature from released to said attracted position, and means responsive to the said positioning of said control means and said armature upon said relative movement for rendering said last means inoperative while said armature remains held in said attracted position by energization of said one coil means.

2. Safety control apparatus for fuel burners having main and pilot burners comprising in combination, control means operable for controlling the supply of fuel to the main burner and being biased to one controlling position, electromagnetic means positioned on one side of said control means and including coil means and armature means movable relatively between attracted and released positions, said armature means having a stem connected to said control means and being operable for overcoming said bias when said coil means is energized sufficiently to hold said armature means in said attracted position and said control means in another controlling position, means responsive to the presence of a flame at the pilot burner for energizing said coil means sufficiently to hold said armature means in said attracted position but insufficiently to cause said relative movement from released position, a source of current supply, means for energizing said coil means from said source sufficiently to cause said relative movement of said armature means to said attracted position, and means responsive to the said positioning of said control means and said armature means upon said relative movement for rendering said last means inoperative while said armature means remains held in said attracted position by energization of said coil means by said flame responsive means.

3. Safety control apparatus for fuel burners having main and pilot burners comprising in combination, means for supplying fuel to the burners, an electromagnet having an armature, a valve connected to said armature and being adapted to control the supply of fuel in said fuel supplying means to the main burner, said valve being biased to closed position for preventing flow of said fuel supply when said armature is disengaged from said magnet and being movable to open position for permitting flow of said fuel supply when said armature is in engagement therewith, means responsive to the presence of a flame at the pilot burner and operable for energizing said electromagnet sufficiently to hold said armature in engagement therewith but being incapable of energizing said electromagnet sufficiently to attract said armature into engagement therewith, a source of current supply, an energizing circuit connecting said electromagnet to said source and being effective for attracting said armature into engagement therewith, a pressure switch responsive to pressure in said fuel supplying means and having contacts in said circuit movable between opened and closed positions for controlling energization of said circuit, said switch being operable for opening its contacts when said valve is opened and for closing its contacts when said valve is closed, and time delay means operable upon expiration of a predetermined period during which said flame responsive means has time to become operable for maintaining said circuit deenergized and said valve closed until after said flame responsive means becomes operable.

4. Safety control apparatus for fuel burners having main and pilot burners comprising in combination, means for supplying fuel to the burners, an electromagnet having an armature, a valve connected to said armature and being adapted to control the supply of fuel in said fuel supplying means to the main burner, said valve being biased to closed position for preventing flow of said fuel supply when said armature is disengaged from said magnet and being movable to open position for permitting flow of said fuel supply when said armature is in engagement therewith, thermoelectric means exposed to the heat of a flame at the pilot burner and operable for energizing said electromagnet sufficiently to hold said armature in engagement therewith but being incapable of energizing said electromagnet sufficiently to attract said armature into engagement therewith, a source of current supply, an energizing circuit connecting said electromagnet to said source and being effective for attracting said armature into engagement therewith, a pressure switch responsive to pressure in said fuel supplying means and having contacts in said circuit movable between opened and closed positions for controlling energization of said circuit, said switch being operable for opening its contacts when said valve is opened and for closing its contacts when said valve is closed, and a thermal switch having contacts in said circuit also movable between opened and closed positions for controlling energization of said circuit, said thermal switch being responsive to heating of said thermoelectric means for closing its contacts so as to delay energization of said circuit until said thermoelectric means becomes operable.

5. Safety control apparatus for fuel burners having main and pilot burners comprising in combination means for supplying fuel to the burners, an electromagnet, means operable upon energization of said electromagnet for controlling supply of fuel from the fuel supply means to the main burner and being biased to a position where fuel supply is prevented, an electric igniter for the pilot burner, thermoelectric means exposed to the heat of a flame at the pilot burner and operable

for energizing said electromagnet but insufficiently to overcome the bias of said fuel controlling means, a source of current supply for said electromagnet separate from that generated by said thermocouple and sufficient to overcome the bias of said fuel controlling means, a pressure switch connected to the fuel supplying means ahead of said fuel controlling means and responsive to pressure in said fuel supplying means for controlling said separate current supply according to the position of said fuel controlling means, and a thermally operable switch connected in series circuit with said pressure switch and responsive to heating of said thermoelectric means for controlling said separate current supply according to the heated or unheated condition of said thermoelectric means, said igniter being connected to be energized from said source according to the position of said fuel controlling means.

6. Safety control apparatus for fuel burners having main and pilot burners comprising in combination, means for supplying fuel to the burners, control means operable for controlling the supply of fuel from said fuel supplying means to the main burner and being biased to one controlling position, electromagnetic means including coil means and armature means movable relatively between attracted and released positions, said electromagnetic means being operatively associated with said control means for overcoming said bias when said coil means is energized sufficiently to hold said armature means in said attracted position and said control means in another controlling position, means responsive to the presence of a flame at the pilot burner for energizing said coil means sufficiently to hold said armature means in said attracted position but insufficiently to cause said relative movement from released position, a source of current supply, a circuit connecting said coil means to said source for energizing the same sufficiently to cause said relative movement of said armature means to said attracted position, time delay means operable for maintaining said circuit open until after said flame responsive means becomes responsive, and a pressure switch in said circuit responsive to the pressure in said fuel supplying means to the main burner for opening said circuit after said relative movement has occurred and while said armature means remains in said attracted position by energization of said coil means by said flame responsive means.

7. A safety control apparatus for fuel burners comprising control means operable for controlling the fuel supply to a burner and being biased to one controlling position, a pair of electromagnets including a pair of coil means and a single armature movable relatively to said coil means between attracted and released positions, said electromagnets being operatively associated with said control means for overcoming said bias when at least one of said coil means is energized sufficiently to hold said armature in said attracted position and said control means in another controlling position, an electric igniter, a circuit including said igniter and one of said electromagnets in parallel, a source of current supply for energizing said one electromagnet and igniter and effective to cause said armature to assume attracted position relative to said electromagnets, thermoelectric means responsive to operation of said igniter and connected in circuit with the other of said electromagnets, said thermoelectric means being capable of generating sufficient current for energizing said other electromagnet to retain said armature in said attracted position but insufficient to cause said armature to assume said attracted position, and means responsive to said control means assuming said other controlling position and said armature assuming said attracted position for opening the first said circuit.

8. A safety and ignition system for fuel burners having main and pilot burners comprising in combination means for supplying fuel to the burners, an electromagnet having a pair of magnet elements and separate coils therefor, a single armature movable relatively to said magnet elements between released and attracted positions, controlling means connected to said armature and biased to a position where fuel supply to the main burner is prevented by said controlling means and said armature is held in released position, a source of current supply for energizing one of said coils sufficiently to overcome said bias and cause said armature to be moved to attracted position relative to said one coil and associated magnet, an electric igniter for the pilot burner connected in parallel circuit with said one coil, thermoelectric means exposed to the heat of a flame at the pilot burner and connected for energizing the other of said coils sufficiently to hold said armature in said attracted position with the associated magnet, a pressure switch connected to the fuel supplying means ahead of said controlling means and responsive to pressure in said fuel supplying means to close its contacts in said biased position of said controlling means, said pressure switch contacts being connected in series circuit with said one coil and said igniter for deenergizing said igniter and one coil upon said armature being held in said attracted position by said other coil and magnet, and a thermally operable switch responsive to heating of said thermoelectric means for closing its contacts, said thermal switch contacts being connected in series circuit with said one coil and said pressure switch contacts for delaying energization of said one coil until said thermoelectric means has become heated.

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