Feb. 19, 1952 W. A. RAY 2,586,257

INTERLOCKING SAFETY SWITCH SYSTEM

Original Filed Nov. 13, 1944

Fig. 2

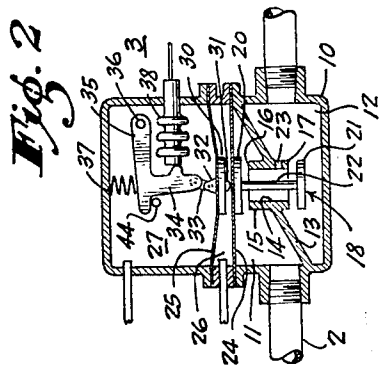
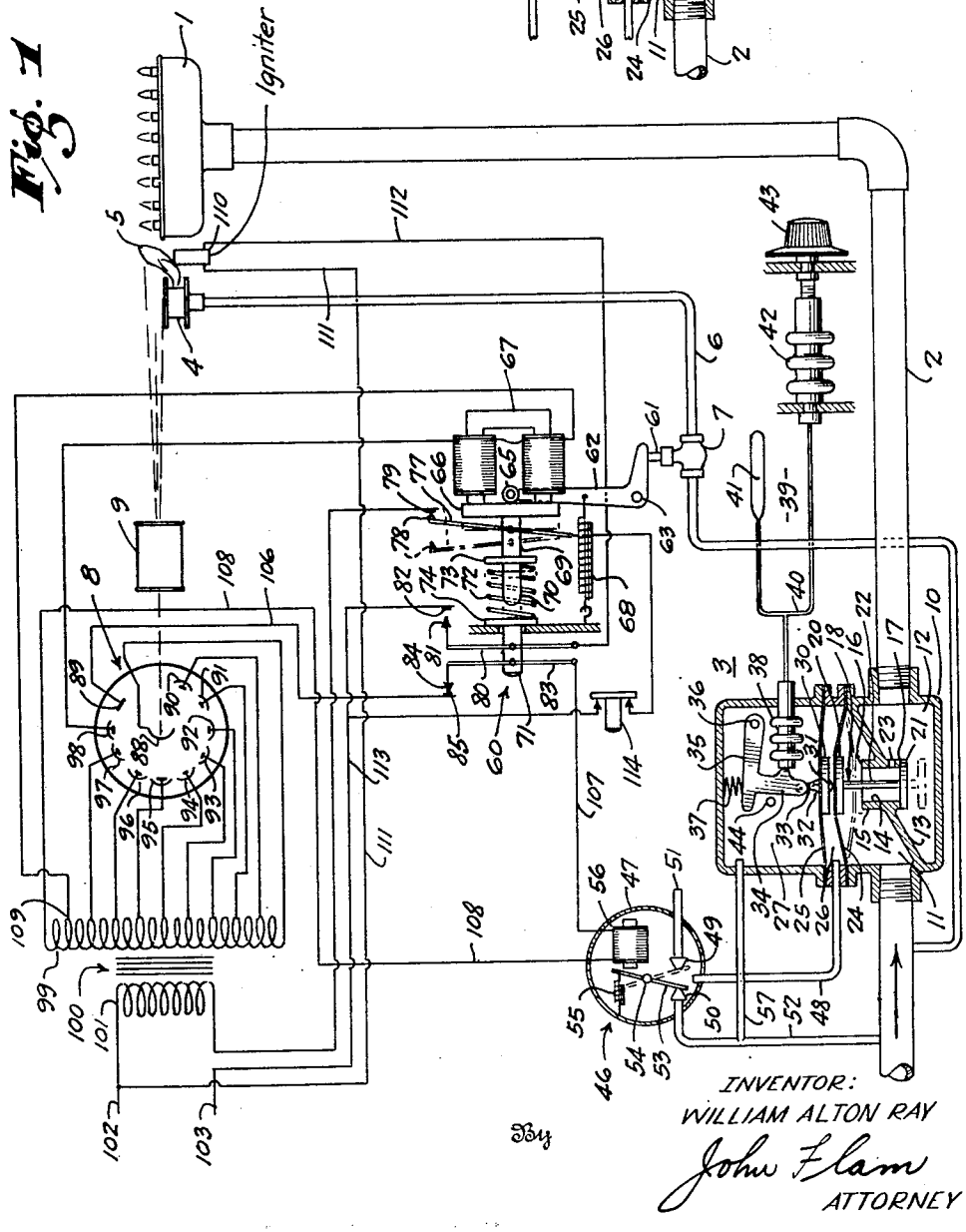


Fig. 1



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INTERLOCKING SAFETY SWITCH SYSTEM

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2 Claims. (Cl. 175—375)

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This invention relates to the control of burners, such as in domestic gas ranges, and particularly to the control of the oven or broiler burners.

This application is a division of an application filed May 13, 1944, in the name of William A. Ray, now Patent No. 2,446,718, and entitled Fuel Igniting System.

It is an object of this invention to provide a safety switch system, especially in connection with fluid fuel burners. It is thereby assured that the burners may be safely operated without danger of explosions due to an undesired accumulated fuel.

This invention possesses many other advantages, and has other objects which may be made more clearly apparent from a consideration of one embodiment of the invention. For this purpose there is shown a form in the drawings accompanying and forming part of the present specification. This form will now be described in detail, illustrating the general principles of the invention; but it is to be understood that this detailed description is not to be taken in a limiting sense, since the scope of this invention is best defined by the appended claims.

In the drawings:

Figure 1 is a schematic showing of a system incorporating the invention, and

Fig. 2 is a view showing a different operating position of one of the valves employed in the system illustrated in Fig. 1.

The system of the invention contemplates the use of a photo-emissive electronic device which is energized by a suitable source, and operated to supply current for the system by the light of the pilot flame. The response of such a device is substantially instantaneous. Thus, it is proposed to energize the device to actuate an igniter, and to open the valve controlling the pilot burner, as by pressing a push button. Release of the push button serves to open the control valve for the main burner, but only if the pilot flame is burning. If the pilot flame is not burning, such release will not open the control valve and, further, will cause return of the pilot valve to closed position. Thus, the need of a constantly burning pilot flame is obviated. Further, by lighting the pilot burner first and causing the control valve for the main burner to open only if the pilot flame is burning, escape of any considerable amount of unignited fuel, such as might occur if it were attempted to light the main burner directly, is prevented.

The system may be utilized for the control of fuels generally, either gaseous or liquid. As

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shown, it is particularly adapted for controlling a main burner 1 which may be used, for example, to heat the oven or for broiling in a conventional cooking stove which utilizes gaseous fuel. The main burner 1 is adapted to be supplied with fuel from an appropriate source by means of a pipe 2, the flow of fuel to the burner being controlled by a main or control valve 3. A pilot burner 4 provides a flame 5 for lighting the burner 1 when valve 3 is opened, and is supplied with fuel by a conduit 6 connected to pipe 2 between the control valve 3 and the source of fuel supply. In this way, the supply of fuel to the pilot burner is not affected by closing of the control valve 3. A pilot burner valve 7 is interposed in the conduit 6 for controlling the supply of fuel to the pilot burner 4.

The arrangement is such that the pilot flame does not burn continuously, but is extinguished when the main burner is extinguished, and lighted only when the main burner is to be lighted. Further, unless the pilot flame is burning, the control valve 3 cannot be opened; and, should the pilot flame 5 fail at any time, the control valve 3 will immediately close.

The control circuit includes a light sensitive device 8, such as a photo-tube, that responds to the light produced by the pilot flame 5, appropriate shields (not shown) being provided to exclude light from any other source. Thus, although the main burner 1, the pilot burner 4, and the light sensitive device 8 are shown for illustrative purposes as lying in the plane of the drawing, it is preferred that the device 8 and the pilot burner 4 lie in a plane normal to the plane of burner 4 and the main burner 1. In this way, the light sensitive device 8 is not exposed to the light of the main burner flame. A focusing device 9 may be used to project light from the flame 5 into the light sensitive electrode of the tube 8.

The control valve 3 is shown diagrammatically and is of a novel type, being adapted when open to supply either a large quantity of fuel (high fire) or a small quantity (low fire) to the main burner 1 in accordance with the amount of heat required from the burner 1. Such a valve is disclosed and claimed in a co-pending application filed in the name of William A. Ray on October 28, 1944, under Serial No. 560,793, now Patent No. 2,526,972, and entitled "Fluid Control System."

The valve 3 is shown as having a body 10 with an inlet chamber 11 and an outlet chamber 12 separated by a wall 13. The chambers 11 and 12 are adapted to be in communication by a

port 14 extending through the wall 13 and defined by a vertically extending tube 15 providing valve seats 16 and 17 at its upper and lower ends respectively. A valve member 18 is provided for controlling the port 14 and includes closure members 20 and 21, secured together in spaced relationship by a stem 22, which cooperate respectively with seats 16 and 17 to close the port 14. When the valve member 18 is in its lowest position, the closure 20 is on its cooperating valve seat 16, closing the port 14 and preventing any communication between the chambers 11 and 12. This is of course the closed position of the valve 3, and is indicated by broken lines in Fig. 1. When the valve member 18 is in its upper position, closure member 21 is on its cooperating valve seat 17, also closing port 14 but communication between chambers 11 and 12 is maintained by a reduced port 23 between port 14 and the outlet chamber 12. This is the low fire position of the valve and is shown in Fig. 1. With the valve member 18 is an intermediate position both closure members 20 and 21 are sufficiently spaced from their respective seats 16 and 17 to allow free communication between the chambers 11 and 12 via port 14. This is the high fire position of the valve and is shown in Fig. 2.

Means are provided whereby the valve 3 is caused to open and to close in accordance with energization or de-energization of a controlling circuit. Further means are provided by which valve 3 assumes the low fire or high fire position in accordance with the heat requirements of the system. Thus the upper wall of the inlet chamber 11 is formed by a flexible diaphragm 24 to which is secured the valve member 18. A similar diaphragm 25 is secured in body 10 above the diaphragm 24 and cooperates with the body 10 and the diaphragm 24 to form a pressure chamber 26. The diaphragm 25 forms the lower wall of a working chamber 27 in the body 10.

The diaphragms 24 and 25 are maintained in spaced relation by a member 30 fixed on the under side of diaphragm 25 in axial alinement with the valve member 18 and having a projection 31 adapted to engage the top of diaphragm 24. The member 30 also has an extension 32 projecting upwardly through the diaphragm 25 and forming a clevis to which is pivoted one end of a link 33. The other end of the link 33 is pivoted to a depending arm 34 of the operating lever 35, pivotally supported at 36 in the body 10, and urged downwardly about its pivot 36 by a compression spring 37.

A charged Sylphon or expansible chamber 38 supported in body 10 serves by engagement with arm 34 to determine the position of lever 35 about its pivot. The Sylphon 38 forms one element of a conventional pressure responsive system 39 and for this purpose is connected by means of capillary tube 40 with a feeler bulb 41 in thermal relation with the space or object arranged to be heated by fuel passed by the valve 3 and the temperature of which it is desired to control. A second expansible chamber or Sylphon 42 is also connected to the capillary tube 40 and is adjusted to a desired volume by an adjusting knob 43. By adjustment of the volume of chamber 42, the position of lever 35 for any given temperature at the feeler bulb 41 may be altered. The knob 43 may be provided with an appropriate scale to assist in such adjustment, and may be marked in temperature degrees. A stop pin 44 serves to limit movement of lever 35 in response to a lowered temperature, that causes Sylphon 38 to contract and pull lever 35 downwardly.

An operating or pilot valve 46 is provided for controlling the pressures in chambers 26 and 27 and causing the valve 3 to open and to close. Valve 46 includes a fluidtight casing 47 in continuous communication with pressure chamber 26 as by a conduit 48. Casing 47 is arranged to be vented to the atmosphere or provided with fluid under pressure from the pipe 2 by a pair of spaced oppositely directed nozzles 49 and 50. Nozzle 49 communicates with the exterior of casing 47 as by a vent tube 51, while the nozzle 50 communicates with the pipe 2 by tube 52.

A member 53 is pivotally supported at 54 in casing 47 for angular motion between the nozzles 49 and 50, being biased as by a tension spring 55 to a position in which it closes the vent nozzle 49 and opens the inlet nozzle 50. An electromagnet 56 is provided to act on member 53 in opposition to the spring 55. For this purpose, member 53 is a magnetic armature. Thus upon energization, magnet 56 swings member 53 to a position in which the vent nozzle 51 is open and inlet nozzle 50 is closed. The working chamber 27 is under fluid pressure at all times through the connection 57 to the tube 52.

The operation of the control valve 3 may now be set forth. The position of diaphragm 25 is determined by lever 35 in accordance with the temperature requirements of the system independently of pressure conditions in the valve 3. With magnet 56 de-energized, vent 49 is closed and fluid pressure from the pipe 2 is present in casing 47 and pressure chamber 26, where it serves to maintain diaphragm 24 in its lower position with closure 20 of valve member 18 on seat 16, thus preventing passage of fuel through valve 3. Upon energization of magnet 56, member 53 swings to vent casing 47 and chamber 26 to the atmosphere, so that the pressure of the fuel below diaphragm 24 urges the diaphragm and valve member 18 upwardly until stopped by engaging the projection 31 carried by diaphragm 25. If the temperature requirements of the system are such that a low fire is all that is required, lever 35 will be so positioned that projections 31 does not engage the diaphragm 24, hence the diaphragm and valve member 18 can move to their upper position allowing member 21 to seat. Thus fuel is supplied to burner 1 only by the reduced port 23, as shown in Fig. 1. If, however, a high fire is required, lever 35 will be so positioned that projection 31 stops diaphragm 24 and valve member 18 at an intermediate position in which both closures 20 and 21 are unseated, giving a full valve opening. Upon de-energization of magnet 56, pressure will be re-established in chamber 26. Pressures on opposite sides of diaphragm 24 are thus equalized and the diaphragm 24 is moved downwardly by the weight of valve member 18 to cause closure 20 to seat and prevent passage of fuel to the burner 1. The transition of the valve member 18 from high fire to low fire position, or vice versa can, of course, occur at any time while the valve is open and the main burner 1 in operation.

The main burner 1 is arranged to be lighted by the actuation of a switch mechanism 60 and through the intermediary of a pilot burner. Thus, when the push button is pressed, the pilot burner is lighted. When the push button is released, if the pilot burner is burning, the control valve 3 will be opened. If the pilot burner has

failed to light, the control valve 3 will remain closed and the pilot burner valve will close.

The pilot burner valve 7 comprises a spring pressed closure member having a projection or stem 61 which when pressed opens the valve. A bell crank 62 pivoted at 63 serves by clockwise movement about its pivot to open the valve 7. The upper end of bell crank 62 carries a roller 65 which engages the face of a magnetic armature 66. The armature 66 is adapted to be moved to and from engagement with the polar faces of an electromagnet 67. When armature 66 is in engagement with the magnet 67 as shown, or in attracted position, valve 7 will be open. If no force is present to maintain armature 66 in this position, armature 66 and arm 62 will be returned to the broken line position and valve 7 will close, in response to force exerted by the spring in the valve, supplemented if desired by a tension spring 68.

The armature 66 has a push rod 69 with a convex outer end 70 adapted to be engaged by the inner end of a push button or actuating member 71. A light compression spring 72 is confined between flanges 73 and 74 respectively on push rod 69 and push button 71 for urging the push rod and the push button axially apart. However, it is to be understood that spring 72 does not have sufficient strength to move rod 69 and armature 66 toward magnet 67 in opposition to the force exerted by spring 68. Spring 72 is merely for the purpose of returning the push button 71 to its initial position when released, if the armature 66 is retained in its attracted position by magnet 67.

A switch arm 77 is attached to push rod 69 and carries a contact 78 adapted to engage a stationary contact 79 when armature 66 is in engagement with magnet 67. A similar switch arm 80 carrying a contact 81 is arranged to be moved to engage a stationary contact 82 when push button 71 is depressed to move armature 66 to engage the magnet 67. Contacts 81 and 82 are separated upon return of push button 71 to its initial position. Similarly contacts 78 and 79 separate upon movement of armature out of engagement with magnet 67. Another arm 83 carries a contact 84 which engages a fixed contact 85 when the push button 71 is in its initial or normal position, contacts 84 and 85 separating when push button 71 is depressed. The operation of the push button mechanism will be explained after a discussion of the control circuit.

The control circuit includes the phototube 8 which is energized by an alternating current source and is operative to supply current to the circuit only as long as the pilot flame 5 is burning. The phototube 8 serves, in addition, as an electronic emission rectifier for supplying unidirectional current to the electromagnet 67 for maintaining the pilot burner valve 7 open and to magnet 56 which serves to open and maintain open the control valve 3. If the pilot flame is not burning, no current is delivered by the phototube 8 and valves 3 and 7 are not maintained open. Accordingly the phototube 8 performs a plurality of functions: it not only serves as a control device, but also provides rectified current for the system.

The phototube 8 preferably supplies sufficient current for the electromagnets 56 and 67 without the use of an amplifier. Accordingly, the tube 8 is shown as of the electron multiplier type, for example of the type known as 931-A. Such a tube includes a photo-sensitive cathode 88 which emits electrons when its active surface is

illuminated, as by the flame 5. The anode 89 finally receives the electrons produced in the tube by successive action of the electrons upon a number of dynodes or secondary emitters 90, 91, 92, 93, 94, 95, 96, 97 and 98, nine being shown in the present instance. In order that these electrodes serve effectively to reinforce, by secondary emission, the original electronic stream emanating from the cathode 88, they are connected to taps on the secondary winding 99 of a step up transformer 100. The primary winding 101 is adapted to be connected to a commercial source of alternating current by leads 102 and 103.

The operation of a tube of this character is well known. A relatively weak stream of electrons is dislodged from the photo-sensitive surface of the cathode 88, which stream is greatly reinforced by secondary emission successively from the auxiliary electrodes 90 and 98 inclusive, which are successively encountered by the electron stream. The output current between the anode 89 and the last dynode 98 is unidirectional, and the maximum of which the device is capable.

Accordingly, the coil of the electromagnet 56 of valve 46 is connected between anode 89 and dynode 97, since this magnet is required to move member 53, to attracted position as well as to retain it in such position. This circuit includes the normally closed contacts 84 and 85, so that it is broken if the push button 71 is not in its normal position, and may be traced as follows: from anode 89, lead 106 to contact 85, contact 84, switch arm 83, lead 107, through coil 56, lead 108, to the upper terminal of the transformer secondary 99; thence through a section of the secondary winding 99 to dynode 97. Since the electromagnet 67 is called upon to perform only a holding function, less than the maximum current from the tube 8 will suffice. Accordingly, it may be connected between the two dynodes 97 and 98. Thus the coil or magnet 67 is interposed in a circuit including dynode 98, dynode 97, and tap 109.

Means are provided for opening the circuit to the transformer primary 101 when the main burner 1 is extinguished. For this purpose the contacts 78 and 79 are interposed in one of the leads as 103 which supplies the transformer primary. Thus the transformer 100 and tube 8 are energized only when armature 66 is in its attracted position.

Further, since the pilot flame 5 is extinguished whenever the main burner 1 is extinguished, means are provided for lighting the pilot burner 4 when it is desired to open the control valve 3. For this purpose, an igniter 110 is provided, which may be of any preferred type, as spark or hot wire, and is arranged to be activated upon opening the pilot burner valve 7. Thus the igniter 110 is connected across leads 102 and 103 by a circuit including the normally open contacts 81 and 82 so that the igniter 110 is operated only when the push button 71 is depressed. This circuit may be traced as follows: from lead 102, lead 111, igniter 110, lead 112, contact 81, contact 82, lead 113 to lead 103.

The operation of the system as a whole will now be discussed. Assuming that the system is not operating, armature 66 will be in its retracted position indicated by the broken lines and switch contacts 78, 79 will be open, pilot burner valve 7 will be closed, member 53 will be in the broken line position, and the closure 18 of the main valve 3 will be in its closed, broken line position (Fig. 1). Push button 71 is now depressed to move armature 66 to its attracted full line posi-

tion. This opens the pilot burner valve 7, closes contacts 78—79 energizing the phototube 8, closes contacts 81—82, energizing the igniter 110, and opens contacts 84—85. The pilot burner 4 lights very soon thereafter, causing tube 8 to energize the control circuit including the electromagnet 67 thus maintaining armature 66 in attracted position and holding the pilot burner valve 7 open and contacts 78—79 closed. However, the valve 3 controlling the main burner cannot open due to contacts 84—85 being separated.

The response of the phototube is practically instantaneous. Hence as soon as the pilot burner 4 lights, the control circuit is energized and push button 71 may be released. It is then returned to its initial position by spring 72 leaving armature 66 in its attracted position. This opens contacts 81—82 de-energizing the igniter, and closes contacts 84—85 energizing coil 56, which opens the main valve 3 as previously explained.

When it is desired to extinguish the main burner 1, the entire control circuit is de-energized by opening the circuit of the transformer primary 101. This may conveniently be done operating a normally closed push button actuating switch 114.

If the pilot burner 4 fails to light, the phototube 8 cannot energize the control circuit. Hence, when push button 71 is released, armature 66 returns to its retracted position, allowing the pilot burner valve 7 to close and de-energizing phototube 8 by opening contacts 78—79.

In view of the fact that the system utilizes an electronic emission device 8 for supplying current to the manual reset electromagnet 67 and the valve operating electromagnet 56, the automatic process of checking the safety circuits upon pressing button 71 is very rapid. Accordingly, the button need be held down only for a short period, usually less than a second, and under no circumstances more than two or three seconds. This checking period is considerably less than the period of time that the ordinary person would be expected to hold down a button.

The inventor claims:

1. In combination: an electrical energy translator; means for passing energy to said translator; and a switch controlling said translator, comprising: an actuator; means urging the actuator to initial position; a member moved by the actuator; means capable of being electrically energized by said translator for holding said member in the position to which it is moved; a first circuit controller operated by said member for energizing said energy passing means, when the member is in its held position, a circuit deriving energy from said translator; and a second circuit controller for controlling said circuit and operated by return of the actuator to its initial position for permitting energization of said circuit.

2. In combination: an electrical energy translator; means for passing energy to said translator; and a switch controlling said translator, comprising: an actuator; means urging the actuator to initial position; a member moved by the actuator; means capable of being electrically energized by said translator for holding said member in the position to which it is moved; a first circuit controller operated by said member for energizing said energy passing means, when the member is in its held position, a circuit deriving energy from said translator; means urging said member away from its held position; and a second circuit controller for controlling said circuit and operated by return of the actuator to its initial position for permitting energization of said circuit.

WILLIAM ALTON RAY.

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