June 26, 1951 W. A. RAY 2,558,267

GAS BURNER SYSTEM WITH AUTOMATIC PILOT BURNER CONTROL

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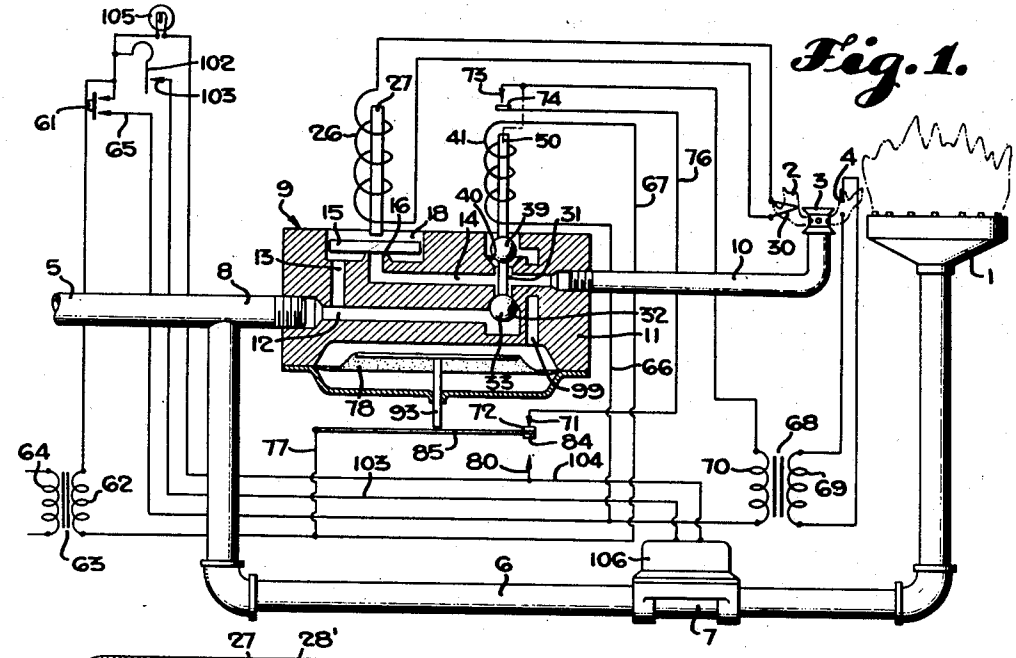
Fig. 1.



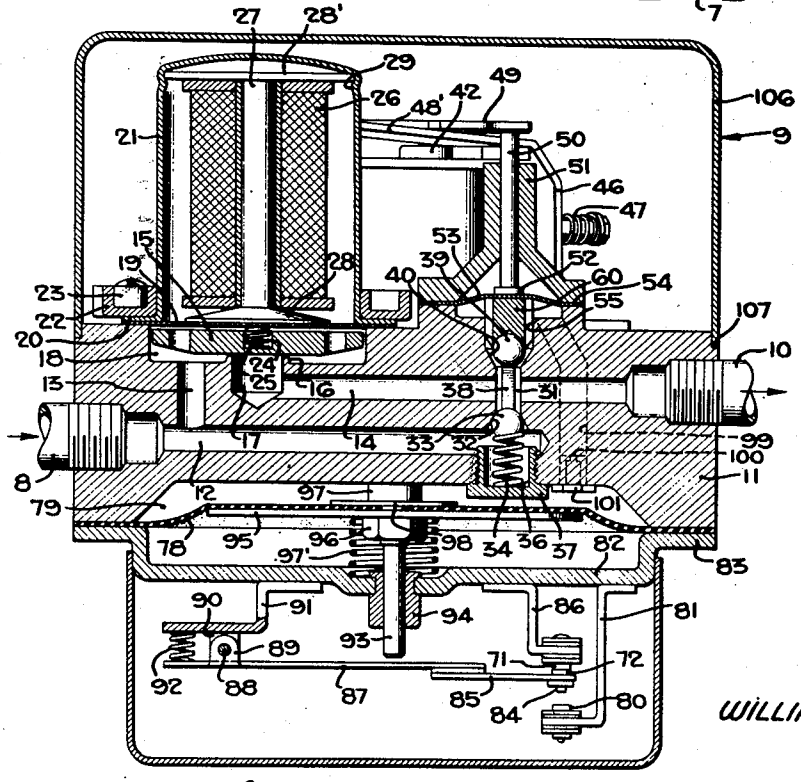


Fig. 2.

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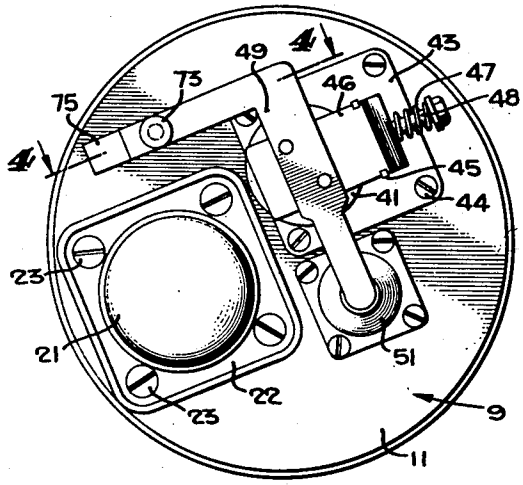


Fig. 3.

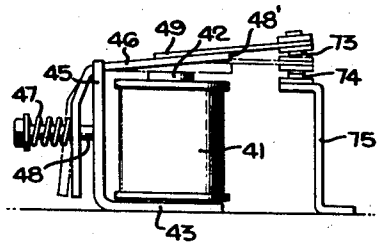


Fig. 4.

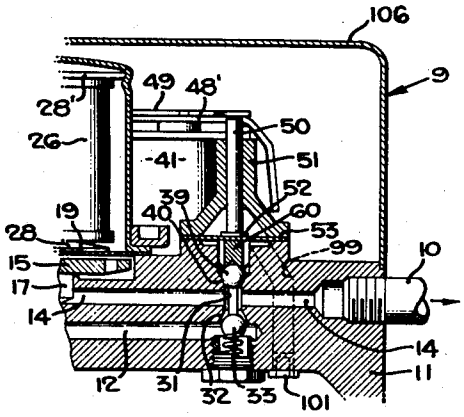
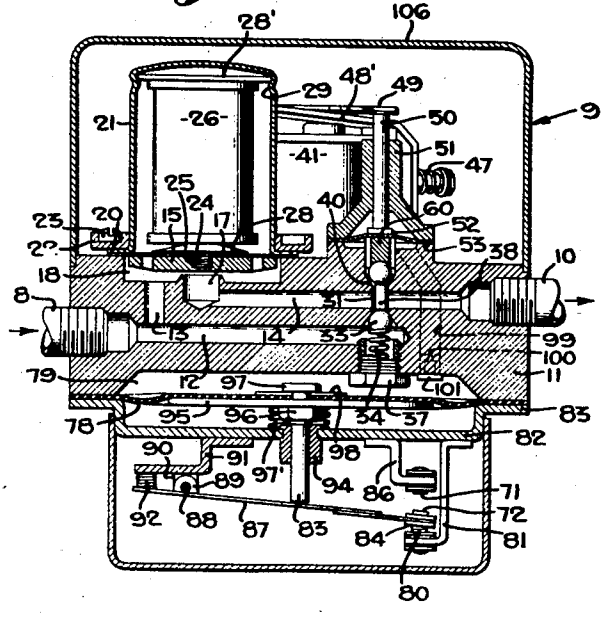


Fig. 5.

Fig. 6.



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GAS BURNER SYSTEM WITH AUTOMATIC PILOT BURNER CONTROL

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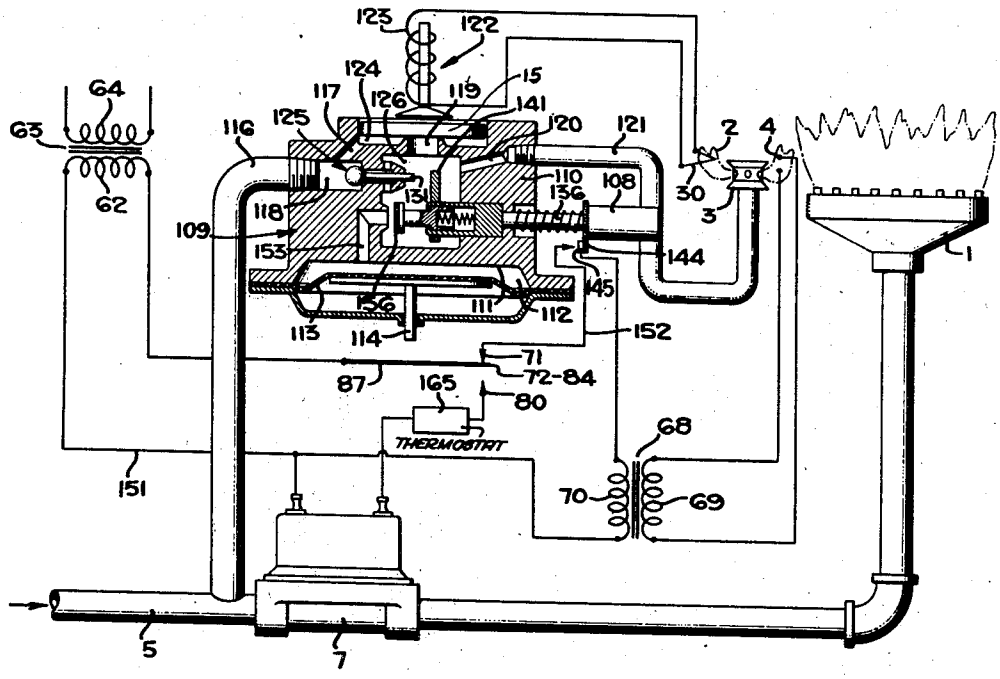

Fig. 7.

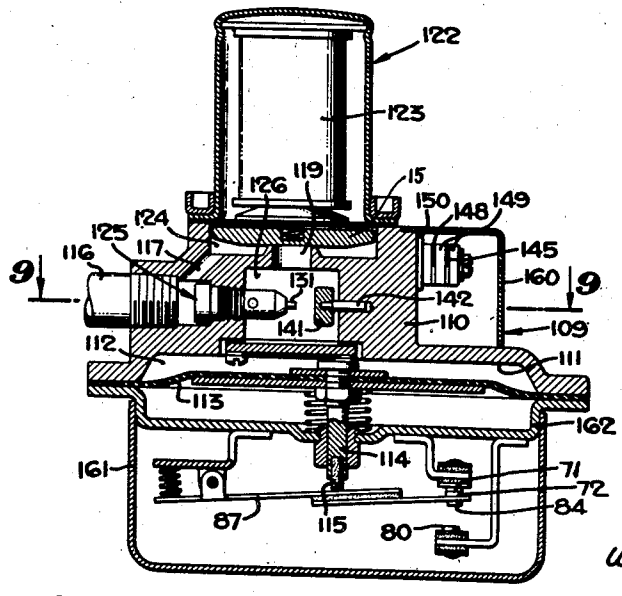

Fig. 8.

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GAS BURNER SYSTEM WITH AUTOMATIC PILOT BURNER CONTROL

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Fig. 9.

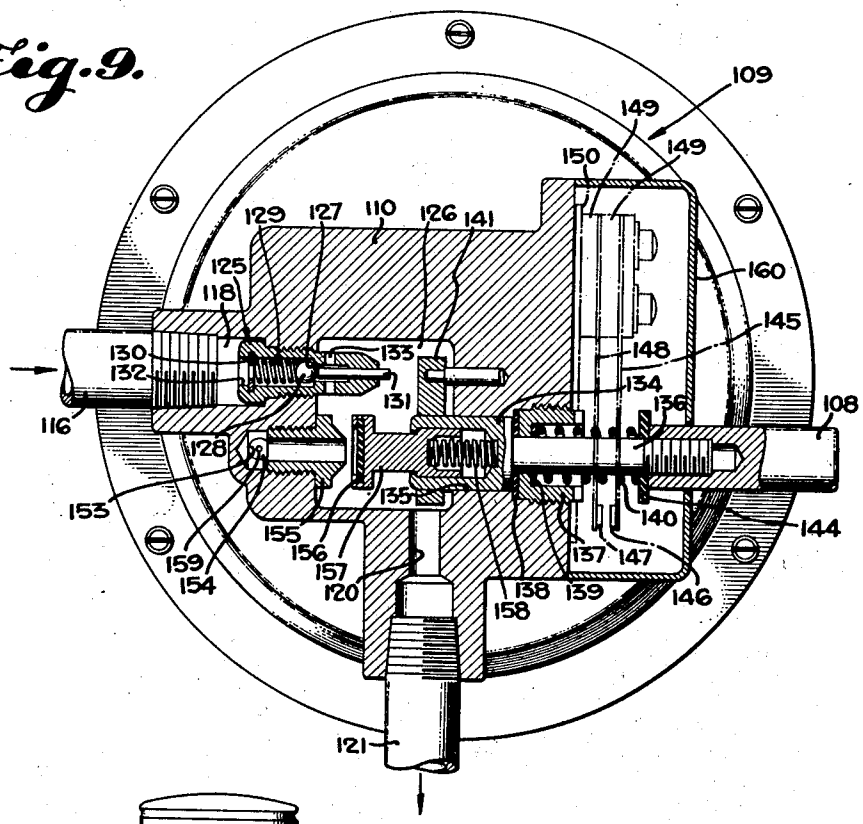
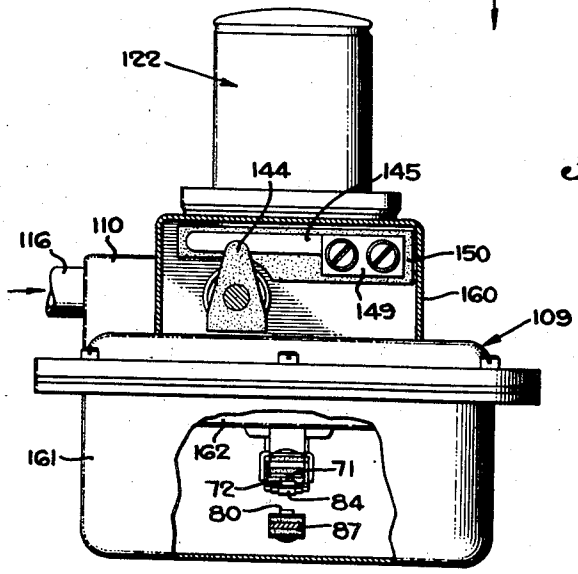


Fig. 10.



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GAS BURNER SYSTEM WITH AUTOMATIC PILOT BURNER CONTROL

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Fig. 12.

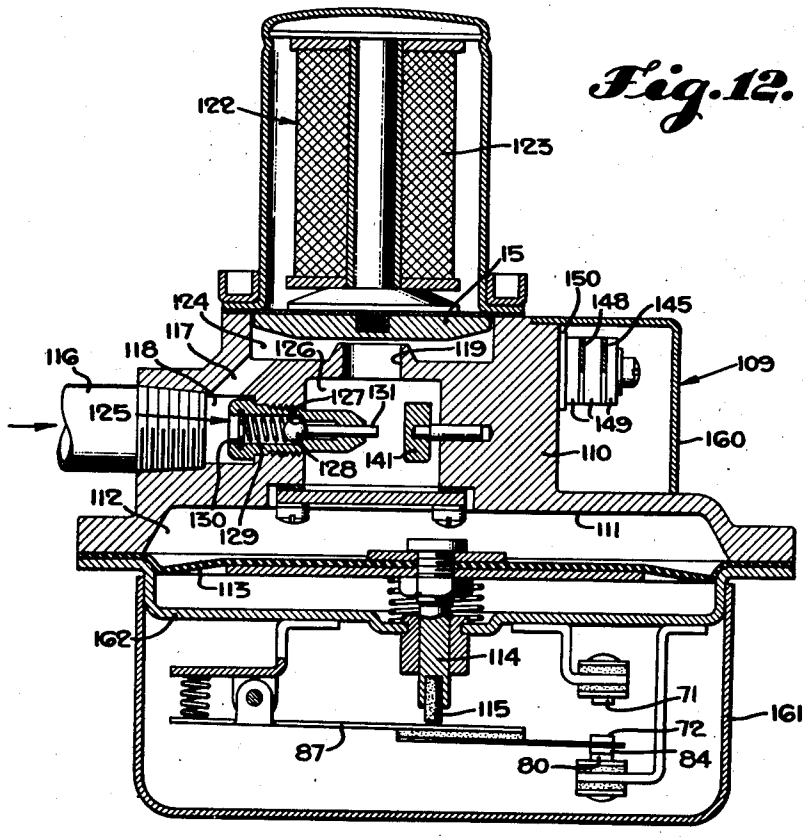
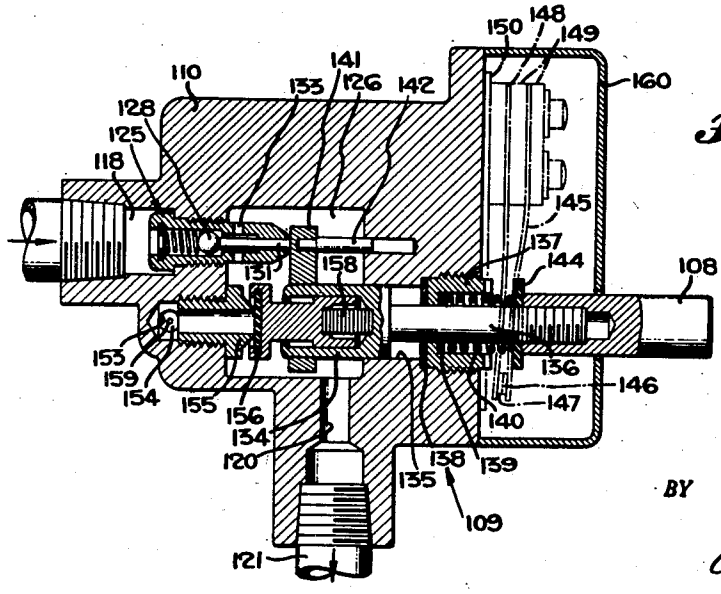


Fig. 11.



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Patented June 26, 1951

2,558,267

UNITED STATES PATENT OFFICE

2,558,267

GAS BURNER SYSTEM WITH AUTOMATIC PILOT BURNER CONTROL

William A. Ray, North Hollywood, Calif., assignor to General Controls Co., a corporation of California

Application May 26, 1948, Serial No. 29,233

22 Claims. (Cl. 158—117.1)

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This invention relates to gas burner systems, and particularly of the type utilizing a pilot burner and safety devices ensuring against operation of the burner in the event the pilot flame is extinguished.

This application is a continuation in part of application Serial No. 566,662, filed December 5, 1944, for "Burner Control System," now Patent No. 2,456,147, patented December 14, 1948.

Systems of this character often employ a thermocouple or thermopile that are operative to generate electrical power in response to the heat of the pilot flame. This relatively minute power is then utilized, as by the aid of relays, or the like, to permit passage of gas to the burner. When the pilot flame is extinguished, the supply of gas to the system is interrupted; and the pilot flame must again be ignited before any gas can flow.

It is one of the objects of this invention to improve, in general, systems of this character.

Burners are commonly used for space heating, such as in homes or auditoriums. The use of the heating equipment is seasonal, and the system is inactive for a considerable period at a time. During these inactive periods the pilot burner flame is extinguished, and no gas is consumed.

It is another object of this invention to facilitate the initiation of the operation after a shutdown, as by a single act, which causes an igniter to be effective until the pilot flame is established.

It is essential that the main burner be prevented from operating until the pilot flame is in existence for a short time. Accordingly, it is still another object of this invention to provide a simple and effective system that ensures against opening of the valve for the main burner until after the period of ignition has been completed.

Upon establishment of operating conditions, the igniter is rendered inactive, the pilot flame is established and, when more heat is required (for example, as determined by a thermostat switch), the main burner valve is opened. Thus, the thermostat may cause the main burner to burn or to be burned off, as required.

Now, in the event of pilot flame failure, the system being shut down, the re-establishment of operation may be attempted immediately thereafter. However, it is very important to ensure that there be a time delay before the igniter is operated, for otherwise serious explosions may occur. It is still another object of this invention to insure that the igniter cannot be energized until a short period has elapsed after the main burner valve is closed.

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

Referring to the drawings:

Figure 1 is a diagrammatic representation of a system incorporating the invention;

Fig. 2 is a sectional view of an apparatus employed in the system shown in Fig. 1;

Fig. 3 is a top plan view of the apparatus;

Fig. 4 is a view taken along a plane corresponding to line 4—4 of Fig. 3;

Fig. 5 is a fragmentary, sectional view of a portion of the apparatus illustrated in Fig. 2, and showing an alternate position of some of the parts;

Fig. 6 is a view, similar to Fig. 2, on a reduced scale, illustrating the running or operating condition of the system;

Fig. 7 is a diagram of a modified form of the system illustrated in Figs. 1 to 6 inclusive;

Fig. 8 is a sectional view of the apparatus incorporated in the system of Fig. 7;

Fig. 9 is an enlarged sectional view, taken along a plane corresponding to line 9—9 of Fig. 8.

Fig. 10 is a side view, partly broken away, of the apparatus illustrated in Figs. 8 and 9;

Fig. 11 is a fragmentary enlarged sectional view similar to Fig. 9, but illustrating an alternate position of the apparatus; and

Fig. 12 is a view similar to Fig. 8, showing the position of the apparatus when the system is in operation.

In the form shown in Figs. 1 to 6, a main burner 1 is shown adapted to be placed in operation by the flame 2 of the pilot burner 3. An electric spark igniter 4 is arranged to light the pilot burner to start the system in operation after a prolonged period of inactivity, as, for example, during the warmer months of the year, or after accidental failure of the pilot flame 2.

A source of gaseous fuel supply is connected to the conduit 5. One branch 6 of this conduit passes through an electromagnetically operated

valve 7 to the main burner 1. The branch conduit 8 leads to a burner control apparatus 9, shown in detail in Figs. 2 to 5 inclusive. An outlet conduit 10 leads to the pilot burner 3.

The control apparatus 9 includes a main body 11 which may be in the form of a casting, and which has a number of gaseous fuel passageways.

During the seasonal inactive period of the system, fuel to the pilot burner 3 is entirely shut off. This inactive position of the apparatus is illustrated in Fig. 2. Thus, conduit 8 leads into a passageway 12 in the body 11. This passageway connects to a short upright extension 13. Another passageway 14, parallel with and above passageway 12, is shown extending to the right to pass gaseous fuel to the conduit 10.

In the inactive position, however, the passage of fuel through conduits 12, 13, and 14 is prevented by a valve closure 15. This valve closure is shown as resting on an annular valve seat 16 surrounding the port 17, which leads to the passage 14. The passage 13 leads to the space 18 surrounding the seat 16. This space is defined by a thin, metallic sealing diaphragm 19 which overlies the open upper end of the space 18. It is held in sealing position by aid of the flange 20 of a housing 21. Disposed over this flange is the clamping ring 22 through which one or more screws 23 extend into the top of the body 11 (see Fig. 3).

The closure member 15 is in the form of a disc made of magnetic material which is urged to seated position by the aid of a light compression spring 24. This compression spring is disposed in a recess 25 in the closure 15. Disc 15 may be provided with a number of through apertures for ready passage of fuel to the top of the disc 15 for providing a further force to hold the disc seated.

Electromagnetic means are used to lift the armature or disc 15 to the open position indicated in Fig. 6. For this purpose a coil 26 is utilized, extending over a core 27. The lower end of this core 27 has an enlarged pole piece 28, which has a circular polar area immediately above the diaphragm 19 and disposed centrally of the axis of the disc 15. The lift of the armature 15 is quite small. A relatively minute electric power can lift the valve closure to pass fuel to the pilot burner 3. This is effected by making the polar area very much greater than the cross sectional area of core 27. In order to complete the magnetic circuit, the core 27 is joined to a magnetic member 28' attached to the top of the core 27 and held in place by a clamp 29 in the housing 21. This housing 21 is also made of magnetic material in order to form an iron-clad electromagnet.

The electric energy to operate the valve closure 15 is supplied in this instance by the aid of thermocouple 30, having its hot junction in the pilot flame 2. Thus, the electromagnetic operator for the armature 15 is made responsive to the existence of a pilot flame. When the pilot flame is extinguished, as in the position of Fig. 1, the armature 15 interrupts the flow of fuel to the pilot burner.

In initiating the operation of the system from the quiescent or inactive stage illustrated in Fig. 1, it is necessary to provide a by-pass for the passageways 13 and 14. This by-pass is partly formed by the passageway 12. This pasageway 12 connects to an upright passageway 31 which intersects the passage 14. The lower end of this passage connects to a tapered seat 32 in which a ball closure 33 is seated. This ball closure 33 is normally held in closed position by a compression spring 34. The lower end of the compression spring abuts the bottom of a recess 36 of a hollow screw 37 threaded into the lower portion of the body 11.

When it is desired to ignite the pilot burner 3 the ball 33 is urged downwardly against the force of spring 36 by a stem or strut 38 of square cross section which extends through the passage 31. This stem or strut is disposed between the ball 33 and another ball 39 that is adapted to cooperate with a tapered seat 40 at the upper end of the pasageway 31.

In order to urge the ball 33 downwardly to the position illustrated in Fig. 5, use is made of an electromagnetic device mounted on the top of the body 11. This electromagnet includes a coil 41 placed somewhat back of the housing 21, as shown most clearly in Fig. 3. This coil 41 has a core 42 which is supported upon the lower leg of bracket 43. This bracket, in turn, is fastened as by the screws 44 to the top of the body 11. This bracket is made of magnetic material and has an upright leg 45. This upright leg provides a support for the tilting armature 46. This armature 46 is urged to the upward position illustrated in Fig. 4 by the aid of a compression spring 47 surrounding a post 48. This post 48 is attached to the leg 45. The substantially horizontal portion 48' of the armature 46 is adapted to be attracted by the core 42 to assume the dot-and-dash position of Fig. 4 when the coil 41 is energized.

The armature 46 carries an actuator arm 49 that cooperates with and contacts the upper end of a stem 50. When the electromagnet is energized, the stem 50 is urged downwardly to cause unseating of the ball 43.

To guide the stem 50 use is made of a standard 51 fastened to the top of the body 11. Its lower enlarged end 52 rests on a flexible sealing diaphragm 53 extending between the standard 51 and the upright surface of a boss 54 surrounding the opening 55 leading to the passage 31. Carried by the lower surface of diaphragm 53 is a strut member 60 that has a tapered seat at its bottom engaging the ball 39. This strut member 60 is appropriately guided in the passage 55.

When the electromagnetic coil 41 is energized, the stem 50 is urged downwardly, as shown in Fig. 5, and the ball 33 is unseated. Fuel can then flow directly to the pilot burner through passages 12 and 31, passage 14, and conduit 10, to the burner 3.

In the form illustrated in Figs. 1 to 6, energization of the electromagnet coil 41 is obtained by a remote control push button. This remote control may include a push button switch 61. This push button may be kept manually depressed until the system is in the active operating position of Fig. 6.

Power for operating the electromagnet 41 may be derived from a transformer 63 having a primary coil 64 that may be connected to an appropriate commercial source.

This transformer 63 is a step-down transformer having a secondary coil or winding 62.

The circuit for energizing the coil 41 may now be traced as follows: from the secondary coil 62, push button 61, connection 65, connection 66, coil 41, and connection 67 to the lower terminal of winding 62.

Energization of this circuit simultaneously causes energization of the igniter 4. This igniter 4 is supplied through a transformer 68. This

transformer has a secondary winding 69 for energizing the igniter 4, and a primary coil 70, the circuit of which is established only upon energization of the coil 41, and only when a pair of contacts 71 and 72 are in engagement. The manner of operating these contacts will be described hereinafter. It is sufficient for the present to note that, when the system is in the inactive position of Fig. 1, these contacts 71 and 72 are established.

When coil 41 is energized, the armature 46 also causes closing of another pair of contacts 73 and 74. Contact 73 is supported upon the member 49, as shown most clearly in Figs. 3 and 4. When the coil 41 is energized, the contact 73 is brought into engagement with the contact 74 mounted on a bracket 75. The contacts 73 and 74 are appropriately insulated from members 49 and 75. With the electromagnet coil 41 energized, the circuit for the primary coil 70 energizing the igniter 4 may be traced as follows: from secondary winding 62 of transformer 63, push button 61, connection 65, primary winding 70, contacts 73 and 74, connection 76, contacts 71 and 72, connection 77, to the lower terminal of the secondary winding 62.

Soon after the pilot burner 3 is lighted by the igniter 4, the thermocouple 30 energizes the coil 26 and the button 61 may be released, de-energizing coil 41 and causing ball 33 to reseat. Under such circumstances gas can flow to the pilot burner 3, since armature 15 is in the energized position of Fig. 6. Gas will flow from conduit 8, passageways 12, 13, and 14, to the conduit 10 and the pilot burner 3.

Contacts 71 and 72 are maintained in closed position until gaseous pressure is developed above a flexible diaphragm 78. This diaphragm 78 defines a pressure space or chamber 79 between the diaphragm 78 and the lower surface of the body 11. This chamber or space 79 with the diaphragm 78 forms a pressure responsive device to condition the valve 7, so that it may be opened when heat is desired by the system.

The urging of the diaphragm 78 downwardly by gas pressure in chamber 79 makes it possible to open the main burner valve 7. However, since the flow of gas to the space 79 is restrained, in a manner to be hereinafter described, an appreciable time must elapse before this valve 7 may be opened, thereby ensuring that the pilot flame 2 is fully established and the system in condition to be fully active.

For this purpose use is made of a stationary contact 80 supported on a bracket 81 joined to the bottom of a cover member 82. This cover member has a flange 83 that overlies the diaphragm 78 and holds it securely in place.

Contact 80 is appropriately insulated from the bracket 81. It cooperates with the movable contact 84 carried by the arm 85 that carries the contact 72 controlling the energization of the igniter 4. Stationary contact 71 for the igniter circuit is insulatedly supported on a bracket 86 attached to the lower side of cover member 82. Of course, contacts 72 and 84 are both electrically joined to the arm 85. This arm, in turn, is insulatedly supported on a pivoted arm 87.

Arm 87 is pivoted by the aid of a pin 88 joining the ears 89 on arm 87 and the ears 90 mounted on the lower side of a bracket 91. This bracket is also mounted on the lower cover member 82. A compression spring 92, extending between the bracket 91 and the lefthand extension of arm 87, urges the arm 87 upwardly to cause engagement

between contacts 72 and 71 while the diaphragm 78 is in its uppermost position.

However, when gaseous fuel is admitted to the chamber 79, the diaphragm 78 is urged downwardly to the position illustrated in Fig. 6. When this position is reached, the arm 87 is in engagement between contacts 84 and 80. Motion of the diaphragm is transmitted to the arm 87 by a push rod 93 which is guided by the bushing 94. This bushing 94 is appropriately supported in cover member 82. The rod 93 is held in place on diaphragm 78 by the aid of a wide washer 95 overlying the diaphragm 78 and a nut 96 that is threaded on the rod 93. Rod 93 has a head 97 disposed over a washer 98 above the diaphragm 78. A threaded portion of the rod 93 extends through the diaphragm 78. The head 97 serves to limit the upward movement of the diaphragm toward the lower surface of the port 11. A compression spring 97' below the diaphragm 78 urges the diaphragm upwardly, but it is capable of being compressed to the position shown in Fig. 6 when gas pressure is effective in chamber 79.

In order to supply the chamber 79 with gaseous fuel after the pilot flame 2 is established, use is made of a passageway 99 that extends from the space below the diaphragm 53 to the space 79. The gaseous fuel, however, must pass through a restricted opening 100 in a hollow screw 101 threaded into the lower portion of the body 11. Accordingly, there is a time delay that elapses before the diaphragm 78 is urged downwardly to the active position of Fig. 6.

With the electromagnet coil 41 deenergized and the stem 50 urged upwardly by the force of the spring 34, fuel can flow through passageway 99 only when the armature 15 is attracted. This position is illustrated in Fig. 6 in which the fuel flow to the chamber 79 is effected through passageways 12, 31 and 99, and the aperture 100. Accordingly, the contacts 80 and 84 cannot be established until the pilot flame 2 is established. In order to ensure that, in the starting period illustrated in Fig. 5 (the coil 41 being energized) no fuel can pass through passageway 99, the ball 39 cooperates with the tapered seat 40 to prevent upward movement of gas through the passageway 31. This starting position is illustrated in Fig. 5, the ball 39 being seated and interrupting the flow of fuel to the chamber 79.

However, as soon as the pilot burner 3 is ignited and the push button 61 released, the coil 41 is de-energized and the coil 26 is energized This raises the armature 15 to the position of Fig. 6, and gas can now flow through passageways 12, 31, and 99 to the chamber 79.

Thereupon, the arm 87 is gradually brought to the position of Fig. 6. In that position, the valve 7 may be operated whenever the thermostat 102 (Fig. 1) requires more heat. This thermostat may be placed in the space to be heated to respond to the existing temperature. When the thermostat 102 closes contacts 103, and the apparatus is in the active position of Fig. 6, the circuit for electromagnetically operating the valve 7 is completed through secondary winding 62, contacts 103, valve 7, connection 104, a pilot light 105, back to the upper trminal of the secondary winding 62.

While the system is active, therefore, the pilot flame 2 being in existence, this valve 7 may be energized and closed as desired by the system. However, should the pilot flame 2 become accidentally extinguished, the coil 26 is de-energized and the system returns to the inactive

position of Fig. 2. The gaseous fuel exerting pressure in the chamber 79 is then free to flow from aperture 100, passageway 99, downwardly through port 31 and out through conduit 10, leading to the pilot burner 3. As soon as this chamber 79 is thus vented, the stem 93 retracts to the inactive position of Fig. 2 and contacts 80 and 84 are ultimately disengaged. Thereafter the thermostat 102 is ineffective to open the valve Nor can this valve be opened until after it is placed in operation by operating the igniter 4 and opening the by-pass 12 to the pilot burner.

A substantial delay occurs between the extinguishment of the pilot flame 2 and the closing of contacts 71 and 72. This occurs since it takes an appreciable time for the diaphragm 78 to move to its uppermost position of Fig. 2.

This time delay is of considerable importance. It delays the re-energizing of the ignition circuit after a pilot flame failure, and thereby ensures against igniting the pilot burner until after there is an opportunity for the accumulated unconsumed gas to escape from the burner.

A résumé of the operation of the system may now be set forth.

Assuming that the system has been shut down, as illustrated in Fig. 1, the flow of gas to the pilot burner is interrupted by the armature 15. The main valve 7 cannot be opened by operation of thermostat 102, since contacts 80 and 84 are out of engagement.

Now, when push button 61 is operated, the coil 41 is energized. This causes the ball 33 to be unseated and the ball 39 to be seated. Ball 33 opens the by-pass 12 to the pilot burner 3, and ball 39 simultaneously closes off the conduit 99, preventing passage of fuel to the chamber 79. At the same time contacts 73 and 74 are closed, causing energization of the igniter 4 through contacts 71 and 72. Shortly after the pilot flame 2 is established, coil 26 is energized. The push button 61 may now be released, de-energizing the coil 41 which, in turn, causes opening of the igniter circuit through the contacts 73 and 74. Fuel can now pass slowly through by-pass 12, and passageways 31 and 99, to the chamber 79. The push rod 93 opens contacts 71 and 72 and after an appreciable time establishes contacts 80 and 84. This position is shown in Fig. 6. Thereafter the thermostat 102 can control the opening of valve 7.

Upon flame failure, the electromagnet coil 26 is de-energized, and the flow of fuel to the pilot burner 3 is interrupted by the closure armature 15, the chamber 79 is slowly vented through the aperture 100, and the system returns slowly to the inactive position of Figs. 1 and 2.

The pilot light 105 indicates when the main burner is conditioned for operation.

A dust-proof cover 106 can be placed over the upper portion of the body 11, and can be held in place by the aid of the shoulder 107 formed on this body.

In the form just disclosed, the initiation of operation is effected by remote control push button 61, which may be placed in any convenient location. In the form shown in Figs. 7 to 12, the operation is rendered simple by the elimination of the electromagnet coil 41. Instead, a reset button 108 is utilized to perform the function of the electromagnet 41—42—43.

The control apparatus 109 of this form includes a body member 110. The lower surface 111 of this body defines a pressure chamber 112 with the diaphragm 113. This diaphragm 113 operates a push rod 114 in a manner similar to the operation of push rod 93 in the first form. In this case the push rod 114 carries an insulation extension 115 to contact the arm 87 which, as before, carries the contacts 72 and 84. These contacts respectively cooperate with the contacts 71 and 80, and are utilized in a similar manner.

The inlet to the body 110 is obtained by the aid of the conduit 116 which leads, as by passageways 117 and 118, and chamber 126, to the port 119. From this port gaseous fuel can pass through passage 120 to the outlet conduit 121, supplying gas to the pilot burner 3. The electromagnet structure 122, similar to the structure of the first form, and having an energizing coil 123, is mounted above the chamber 124 in communication with the passage 116 and the port 119. The armature 15 is arranged to be attracted as in the first form, when the pilot flame 2 is in existence, for opening the port 119 and thereby to pass fuel to the pilot burner 3.

In the inactive position illustrated in Fig. 8, the port 119 is closed and, therefore, the pilot flame is extinguished. In order to by-pass the port 119, a valve arrangement is provided within the body 110. This valve arrangement is operated by the push button 108.

Thus, as shown most clearly in Fig. 9, the passage 118 serves to support a valve structure that controls the by-pass. This valve structure is enclosed in a valve body 125 threaded into the main body 110 and into the chamber 126.

The valve body 125 is hollow and has a valve seat 127 adapted to be closed by a ball 128. This ball 128 is urged to its seat by the aid of a compression spring 129. The left-hand end of this spring 129 is retained within the valve body 125, as by the spring ring 130.

A stem 131 is guided in the inner end of the valve body 125, and is adapted to unseat the ball 128 as shown in Fig. 11. When the ball is unseated, fuel can pass from passage 118 through the aperture 132 in the valve body 125, and thence around the ball 128 through the passages 133 into chamber 126. Thence gas can flow through the passage 120 and to the pilot burner 2.

The stem 131 is pushed inwardly to the position of Fig. 11 by operation of the push button 108. This push button 108, as shown most clearly in Figs. 9, 11, and 12, may be made of insulating material, and may be threaded on a stem 136. This stem 136 projects inwardly and terminates in the large hollow portion 134. This portion 134 is guided in the aperture 135 in the body 110. A packing is shown for the push button, including a hollow screw 137 threaded into the body 110 and having a packing washer 138. Its left-hand side is seated on a shoulder around the aperture 135. Another packing washer 139 is disposed on the inside of the screw 137. Both the washers 138 and 139 closely contact the stem 136.

A compression spring 140, having its left-hand end disposed in screw 137, urges the push button 108 toward the right, to the inactive position illustrated in Fig. 9.

The enlarged portion 134 carries an actuator 141 within the chamber 126. This actuator urges the stem 131 inwardly when the push button is pushed to the left, to the position shown in Fig. 11. In order further to guide the push button, a guide pin 142 is attached to the actuator 141 and is guided in the recess 143 in the body member 110.

When the button is pushed inwardly to the

position shown in Fig. 11, the pilot burner 2 is supplied with fuel and, at the same time, the ignition system is energized through the primary winding 70 of the ignition transformer 68. For this purpose the push button 108 carries an insulation arm 144. This arm 144 operates to urge the spring contact arm 145 inwardly. This contact arm carries the contact member 146, cooperating with the contact 147 mounted on another spring arm 148. These spring arms are insulated from each other and are mounted upon the right-hand wall of the body 110, as seen in Figs. 11 and 12. For this purpose, insulation blocks and spacers 149 are provided, mounted on the base 150.

Accordingly, when the push button 108 is actuated, the ignition circuit is completed through the secondary winding 62 of the power transformer 63 as follows: from the left-hand terminal of the secondary winding 62, connection 151, primary winding 70, contacts 146 and 147, connection 152, contacts 71 and 72, arm 87, back to the right-hand terminal of the secondary winding 62.

The push button 108 is kept urged inwardly until the pilot flame 2 is established. When this occurs, the electromagnet 122 is energized and closure member 15 uncovers the port 119. The fuel from the pilot burner can proceed through passageways 116 and 117, through port 119 to chamber 126, and thence through passage 120 to conduit 121.

A gaseous fuel pressure-responsive device is formed, as before, to urge contact 84 into engagement with contact 80. The chamber 112 of this device is in communication with chamber 126 through a passage 153, shown most clearly in Figs. 7 and 11. A hollow screw member 154 is threaded into the body 110 to communicate with the passageway 153. This screw has a small opening 159 to retard the flow of gas to and from chamber 112.

Passage 153 has an annular valve seat 155. Normally, the gas finds its way from chamber 126 to the pressure chamber 112 through the aperture 159. However, when the push button 108 is actuated, this communication is interrupted by aid of a resilient valve closure 156. This valve closure is carried on a stem 157 slidably mounted in the hollow enlarged portion 134. It is urged outwardly of this hollow portion by a compression spring 158. The outer edge of the hollow portion 134 is turned inwardly to restrain the stem 157. However, when the push button 108 is operated, the compression spring 158 is compressed, as shown in Fig. 11, and the passage 153 is closed by the closure member 156. Accordingly, during the period of ignition, no gas pressure can be exerted in chamber 112.

The spring fingers 145 and 148 are covered by housing 160 appropriately fastened to the body 110. Furthermore, a housing 161 may be provided to cover the contact mechanism disposed below the cover plate 162.

The mode of operation of this form of the invention is substantially the same as that of the form illustrated in Figs. 1 to 6.

When the system is in the inactive position of Fig. 7, gaseous fuel is completely turned off both at the main burner valve 7 and the pilot valve closure 115. The push button 108 is inactive, and the circuit for the igniter 4 is de-energized at contacts 146 and 147.

When the push button 108 is urged inwardly, the passage 153 is closed by the closure 156 and the by-pass through the valve body 125 is opened to the pilot burner 3. At the same time, the circuit for the igniter is energized through contacts 146, 147, 71, and 72, since the arm 87 is in the upper position.

Shortly after the pilot flame 2 is in existence, the electromagnet 122 operates and the fuel can be supplied to the pilot burner 3 through port 119 and the chamber 126. This position is illustrated in Fig. 12. The push button 108 can now be released. This opens the passage 153 and gas slowly passes to the chamber 112. First, contacts 72 and 71 separate and, after an interval, the main burner valve contacts 80 and 84 are engaged. The main burner valve 7 can then be opened whenever the thermostat 165 demands more heat.

Upon accidental failure of the pilot flame 2, the ignition circuit cannot be re-established until after the diaphragm 113 assumes its uppermost position, as indicated in Fig. 8. Upon this occurring, the ignition circuit contacts 72 and 71 are re-established, and button 108 can be operated. The travel of the diaphragm 113 to the inactive position of Fig. 8 is delayed by the slow passage of the fuel as it is vented through the opening 159, chamber 126, passage 120, through the pilot burner 3.

The inventor claims:

1. In a gaseous fuel control system having a main burner, a valve for the main burner, and a pilot burner: means operated by the fluid pressure of the fuel for controlling the main valve; means responsive to the existence of a pilot flame at the pilot burner for passing fuel to the pilot burner as well as for passing fuel to said fluid pressure-operated means; and valve means to by-pass fuel to the pilot burner and simultaneously to prevent passage of fuel to the fluid pressure-operated means.

2. In a gaseous fuel control system having a main burner, a valve for the main burner, and a pilot burner: means operated by the fluid pressure of the fuel for controlling the main valve; means responsive to the existence of a pilot flame at the pilot burner for passing fuel to the pilot burner as well as for passing fuel to said fluid pressure-operated means; means in the fluid fuel path to the fluid pressure-operated means for reducing the rate of flow to said fluid pressure-operated means; and valve means to by-pass fuel to the pilot burner and simultaneously to prevent passage of fuel to the fluid pressure-operated means.

3. In a gaseous fuel control system having a main burner, fuel supply means for the main burner, a valve for the main burner, a pilot burner, fuel supply means for the pilot burner, and an igniter for the pilot burner: means operated by the fluid pressure of the fuel passing to the pilot burner for controlling the main valve; means operating upon pilot burner flame failure to prevent the passage of fuel to the pilot burner, relieving pressure on said pressure operated means; normally open valve means for controlling the passage of fuel to the fluid pressure operated means; and means for energizing the igniter and for operating said valve means for preventing passage of fuel to the fluid pressure operated means.

4. In a gaseous fuel control system having a main burner, fuel supply means for the main burner, a valve for the main burner, a pilot burner, fuel supply means for the pilot burner, and an igniter for the pilot burner: means op-

erated by the fluid pressure of the fuel passing to the pilot burner for controlling the main valve; means operating upon pilot burner flame failure to prevent the passage of fuel to the pilot burner, relieving pressure on said pressure operated means; normally open valve means for controlling the passage of fuel to the fluid pressure operated means; means for energizing the igniter and for operating said valve means for preventing passage of fuel to the fluid pressure operated means; and means in the path of flow of fuel to the fluid pressure operated means for retarding the rate of flow to said fluid pressure operated means.

5. In a gaseous fuel control system having a main burner, a valve for the main burner, a pilot burner, and an igniter for the pilot burner: means operated by the fluid pressure of the fuel for controlling the main valve; means responsive to the existence of a pilot flame at the pilot burner for passing fuel to the pilot burner as well as for passing fuel to said fuel pressure operated means; valve means for by-passing fuel to the pilot burner and simultaneously to prevent passage of fuel to the fluid pressure operated means; and means for energizing the igniter and for simultaneously operating said valve means.

6. In a gaseous fuel control system having a main burner, a valve for the main burner, a pilot burner, and an igniter for the pilot burner: means operated by the fluid pressure of the fuel for controlling the main valve; means responsive to the existence of a pilot flame at the pilot burner for passing fuel to the pilot burner as well as for passing fuel to said fuel pressure operated means; valve means for by-passing fuel to the pilot burner and simultaneously to prevent passage of fuel to the fluid pressure operated means; means for energizing the igniter and for simultaneously operating said valve means; and means in the fluid fuel path to the fluid pressure operated means for reducing the rate of flow to said fluid pressure operated means.

7. In a gaseous fuel control system having a main burner, a valve for the main burner, a pilot burner, and an igniter for the pilot burner: means operated by the fluid pressure of the fuel for controlling the main valve; means responsive to the existence of a pilot flame at the pilot burner for passing fuel to the pilot burner as well as for passing fuel to said fuel pressure operated means; said pilot burner operating as a vent for the fuel from the fluid pressure operated means when said responsive means interrupts the flow of fuel due to failure of the pilot flame; valve means for by-passing fuel to the pilot burner and simultaneously to prevent passage of fuel to the fluid pressure operated means; means for energizing the igniter and for simultaneously operating said valve means; means in the fluid fuel path from the fluid pressure operated means to the pilot burner to reduce the rate of flow from said fluid pressure operated means when said responsive means interrupts the flow of fuel.

8. In a gaseous fuel control system having a main burner, a valve for the main burner, a pilot burner, and an igniter for the pilot burner: means operated by the fluid pressure of the fuel for controlling the main valve so that the main valve cannot be opened until the said fluid pressure operated means attains an active position due to exertion of fluid pressure thereon; means responsive to the existence of a pilot flame for passing fuel to the fluid pressure operated means as well as to the pilot burner; normally open valve means for controlling the passage of fuel to the fluid pressure means; means for energizing the igniter; and means preventing energization of the igniter until the fluid pressure operated means attains a position in which the main valve is prevented from opening.

9. In a gaseous fuel control system having a main burner, a valve for the main burner, a pilot burner, and an igniter for the pilot burner: means operated by the fluid pressure of the fuel for controlling the main valve so that the main valve cannot be opened until the said fluid pressure operated means attains an active position due to exertion of fluid pressure thereon; means responsive to the existence of a pilot flame for passing fuel to the fluid pressure operated means as well as to the pilot burner; normally open valve means for controlling the passage of fuel to the fluid pressure means; means for energizing the igniter; means preventing energization of the igniter until the fluid pressure operated means attains a position in which the main valve is prevented from opening; and means delaying the return of said fluid pressure operated means to said position upon pilot flame failure.

10. In a gaseous fuel control system having a main burner, a valve for the main burner, a pilot burner, and an igniter for the pilot burner: means operated by the fluid pressure of the fuel for controlling the main valve so that the main valve cannot be opened until the said fluid pressure operated means attains an active position due to exertion of fluid pressure thereon; means responsive to the existence of a pilot flame for passing fuel to the fluid pressure operated means as well as to the pilot burner; valve means for by-passing fuel to the pilot burner and for preventing passage of fuel to the fluid pressure operated means; means for energizing the igniter and for simultaneously operating said valve means; and means preventing energization of the igniter until the fluid pressure operated means attains a position in which the main valve is prevented from opening by outward flow of fuel from said fluid pressure operated means through the pilot burner upon pilot flame failure.

11. In a gaseous fuel control system having a main burner, a valve for the main burner, a pilot burner, and an igniter for the pilot burner; means operated by the fluid pressure of the fuel for controlling the main valve so that the main valve cannot be opened until the said fluid pressure operated means attains an active position due to exertion of fluid pressure thereon; means responsive to the existence of a pilot flame for passing fuel to the fluid pressure operated means as well as to the pilot burner; valve means for by-passing fuel to the pilot burner and for preventing passage of fuel to the fluid pressure operated means; means for energizing the igniter and for simultaneously operating said valve means; means preventing energization of the igniter until the fluid pressure operated means attains a position in which the main valve is prevented from opening by outward flow of fuel from said fluid pressure operated means through the pilot burner upon pilot flame failure; and means delaying the said outward flow of fuel.

12. In a gaseous fuel control system having a main burner, a valve for the main burner, a pilot burner, and an electrically energized igniter for the pilot burner: means operated by the exertion of pressure by the gaseous fuel for condi-

tioning the main valve so that the main valve may be opened said pressure operated means having active and inactive positions; means responsive to the existence of a pilot flame for passing fuel to said gaseous fuel pressure operated means; means for by-passing fuel to the pilot burner and for preventing passage of fuel to said gaseous fuel pressure operated means, said by-passing means having an active and an inactive position, the gaseous fuel pressure operated means being vented when the pilot flame is extinguished through the pilot burner; and a circuit for energizing the igniter, said circuit including two circuit controllers, both of which must be active to energize the igniter, one of the circuit controllers being operated by said by-passing means, and said gaseous fuel pressure operated means, when inactive operating the other circuit controller.

13. In a gaseous fuel control system having a main burner, a valve for the main burner, a pilot burner, and an electrically energized igniter for the pilot burner: means operated by the exertion of pressure by the gaseous fuel for conditioning the main valve so that the main valve may be opened said pressure operated means having active and inactive positions; means responsive to the existence of a pilot flame for passing fuel to said gaseous fuel pressure operated means; means for by-passing fuel to the pilot burner and for preventing passage of fuel to said gaseous fuel pressure operated means, said by-passing means having an active and an inactive position, the gaseous fuel pressure operated means being vented when the pilot flame is extinguished through the pilot burner; means for reducing the rate of gaseous fuel flow to or from said gaseous fuel pressure operated means; and a circuit for energizing the igniter, said circuit including two circuit controllers, both of which must be active to energize the igniter, one of the circuit controllers being operated by said by-passing means, and said gaseous fuel pressure operated means, when inactive, operating the other circuit controller.

14. In a gaseous fuel control system having a main burner, a valve for the main burner, a pilot burner, and an electrically energized igniter for the pilot burner: means operated by the exertion of pressure by the gaseous fuel for conditioning the main valve so that the main valve may be opened said pressure operated means having active and inactive positions; means responsive to the existence of a pilot flame for passing fuel to said gaseous fuel pressure operated means; electrically operated means for by-passing fuel to the pilot burner and for preventing passage of fuel to said gaseous fuel pressure operated means, said by-passing means having an active and an inactive position, the gaseous fuel pressure operated means being vented when the pilot flame is extinguished through the pilot burner; a remote control switch for operating said by-passing means; means for retarding the rate of passing fuel to or from the said gaseous fuel pressure operated means; and a circuit for energizing the igniter, said circuit including two circuit controllers, both of which must be active to energize the igniter, one of the circuit controllers being operated by said by-passing means, and said gaseous fuel pressure operated means, when inactive, operating the other circuit controler.

15. In a gaseous fuel control system having a main burner, a valve for the main burner, a pilot burner, and an electrically energized igniter for the pilot burner: means operated by the exertion of pressure by the gaseous fuel for conditioning the main valve so that the main valve may be opened said pressure operated means having active and inactive positions; means responsive to the existence of a pilot flame for passing fuel to said gaseous fuel pressure operated means; electrically operated means for by-passing fuel to the pilot burner and for preventing passage of fuel to said gaseous fuel pressure operated means, said by-passing means having an active and an inactive position, the gaseous fuel pressure operated means being vented when the pilot flame is extinguished through the pilot burner; a remote control switch for operating said by-passing means; and a circuit for energizing the igniter, said circuit including two circuit controllers, both of which must be active to energize the igniter, one of the circuit controllers being operated by said by-passing means, and said gaseous fuel pressure operated means, when inactive, operating the other circuit controller.

16. In a gaseous fuel control system having a main burner, a valve for the main burner, a pilot burner, and an electrically energized igniter for the pilot burner: means operated by the exertion of pressure by the gaseous fuel for conditioning the main valve so that the main valve may be opened said pressure operated means having active and inactive positions; means responsive to the existence of a pilot flame for passing fuel to said gaseous fuel pressure operated means; means for by-passing fuel to the pilot burner and for preventing passage of fuel to said gaseous fuel pressure operated means, said by-passing means having an active and an inactive position, the gaseous fuel pressure operated means being vented when the pilot flame is extinguished through the pilot burner; a push button having a normally inactive position, for mechanically operating said by-passing means; and a circuit for energizing the igniter, said circuit including two circuit controllers, both of which must be active to energize the igniter, one of the circuit controllers being operated by said by-passing means, and said gaseous fuel pressure operated means, when inactive, operating the other circuit controller.

17. In a gaseous fuel control system having a main burner, a valve for the main burner, a pilot burner, and an electrically energized igniter for the pilot burner: means forming alternate passageways for supplying fuel to the pilot burner; means responsive to the existence of a pilot flame for opening one of the passageways; means dependent upon the opening of said one passageway conditioning the main burner valve so that it may be opened, said conditioning means having an active and an inactive position; means for initiating operation of the system including means for opening the other passageway; and a circuit for energizing the igniter, said circuit including a pair of circuit controllers for jointly controlling the energization of the igniter, one of the circuit controllers being operated by the means for opening the other passageway, and the other circuit controller being operated by the said conditioning means when said conditioning means is in inactive position.

18. In a gaseous fuel control system having a main burner, a valve for the main burner, a pilot burner, and an electrically energized igniter for the pilot burner: means forming alternate passageways for supplying fuel to the

pilot burner; means responsive to the existence of a pilot flame for opening one of the passageways; means operated by the pressure of the fuel passing through said one passageway conditioning the main burner valve so that it may be opened, said conditioning means having an active and an inactive position; means for initiating operation of the system including means for opening the other passageway; a circuit for energizing the igniter, said circuit including a pair of circuit controllers for jointly controlling the energization of the igniter, one of the circuit controllers being operated by the means for opening the other passageway, and the other circuit controller being operated by the said conditioning means when said conditioning means is in inactive position; and means for reducing the flow of fuel to the said fuel pressure operated means.

19. In a gaseous fuel control system having a main burner, a valve for the main burner, a pilot burner, and an electrically energized igniter for the pilot burner: means forming alternate passageways for supplying fuel to the pilot burner; means responsive to the existence of a pilot flame for opening one of the passageways; means dependent upon the opening of said one passageway conditioning the main burner valve so that it may be opened, said conditioning means having an active and an inactive position; electrically operated means for opening the other passageway, and for ensuring against operation of the means for conditioning the main burner valve; a circuit controlling said electrically operated means including a remote control switch; and a circuit for energizing the igniter, including two circuit controllers in series, one of the circuit controllers being operated by the operation of the electrically operated means for opening the other passageway, and the other circuit controller being operated by the said conditioning means when said conditioning means is in inactive position.

20. In a control apparatus for a gaseous fuel system having a pilot burner: a body having a gas inlet and a gas outlet; there being a pair of conduits between the inlet and the outlet providing alternate fuel passageways to said pilot burner, as well as a branch conduit connected with each of the pair of conduits; means forming a fluid pressure chamber having a movable wall and connected to the branch conduit; a valve controlling one of said pair of conduits according to the operating conditions of said pilot burner; and valve means for interrupting flow to the chamber through the branch conduit and for connecting the other of said pair of conduits with the outlet.

21. In a control apparatus for a gaseous fuel system having a pilot burner: a body having a gas inlet and a gas outlet; there being a pair of conduits between the inlet and the outlet providing alternate fuel passageways to said pilot burner, as well as a branch conduit connected with each of the pair of conduits; means forming a fluid pressure chamber having a movable wall and connected to the branch conduit; a valve controlling one of said pair of conduits according to the operating conditions of said pilot burner; and valve means for interrupting flow to the chamber through the branch conduit and for connecting the other of said pair of conduits with the outlet, comprising a valve stem extending through the branch conduit and a pair of valve closure means connected to the stem.

22. In a control apparatus for a gaseous fuel system having a pilot burner: a body having a gas inlet and a gas outlet; there being a pair of conduits between the inlet and the outlet providing alternate fuel passageways to said pilot burner, as well as a branch conduit connected with each of the pair of conduits; means forming a fluid pressure chamber having a movable wall and connected to the branch conduit; a valve controlling one of said pair of conduits according to the operating conditions of said pilot burner; and valve means for interrupting flow to the chamber through the branch conduit and for connecting the other of said pair of conduits with the outlet, comprising a push button having means urging the push button to inactive position, a valve closure for interrupting flow of gas to the chamber and carried by the button, and valve means in the other of said conduits and operated to open position by the push button.

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