

June 16, 1953

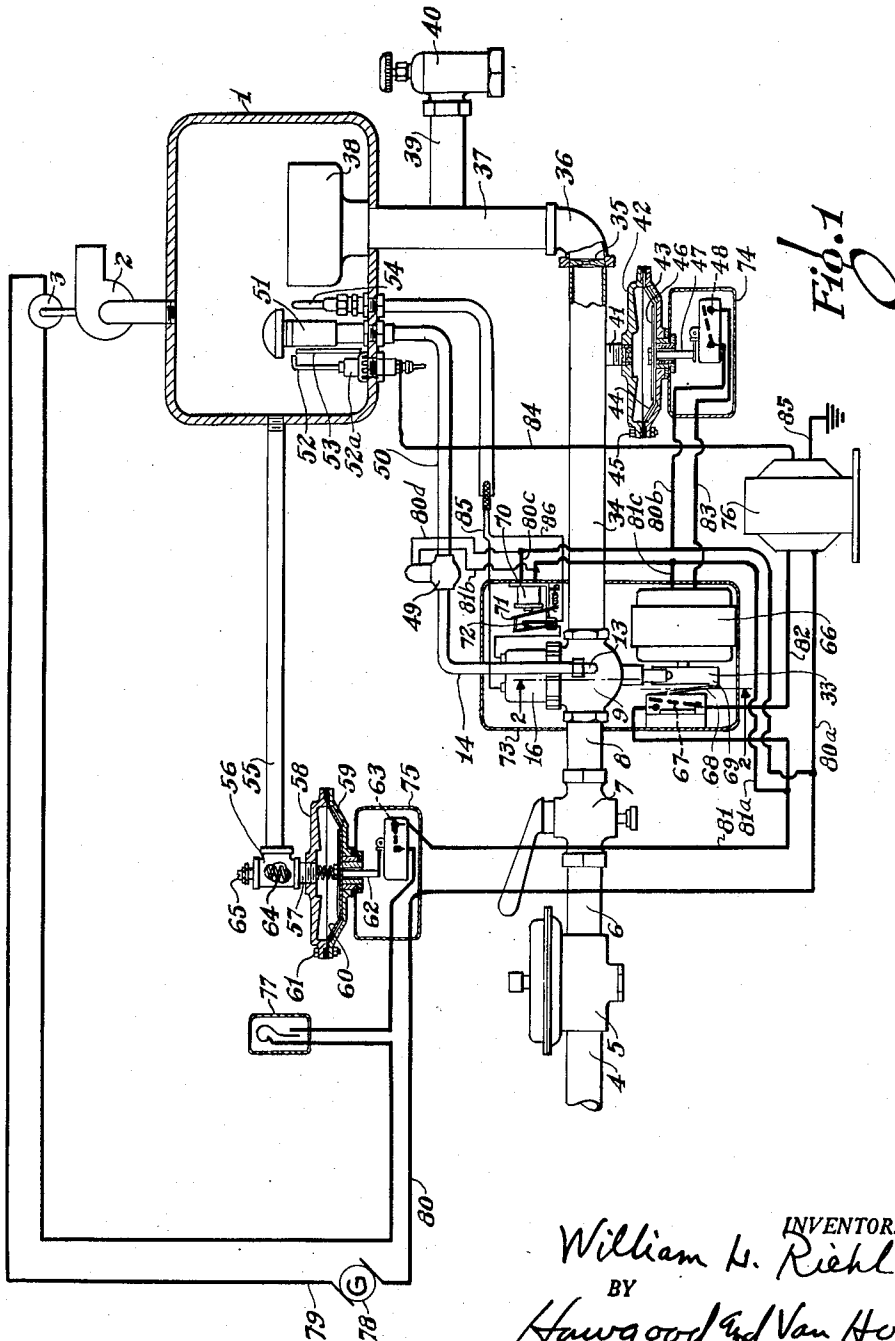
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2,642,128

PRESSURE RESPONSIVE COMBUSTION CONTROL APPARATUS

Filed Sept. 13, 1946

4 Sheets-Sheet 1



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4 Sheets-Sheet 2

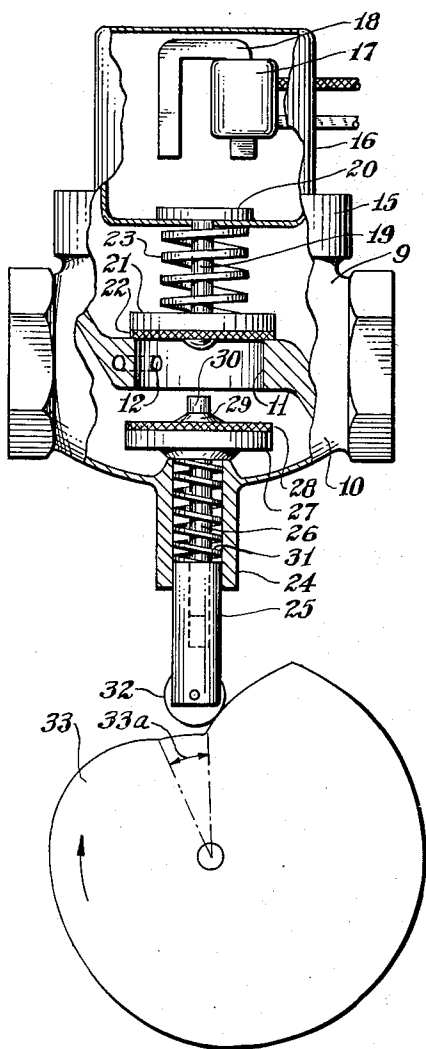


Fig. 2

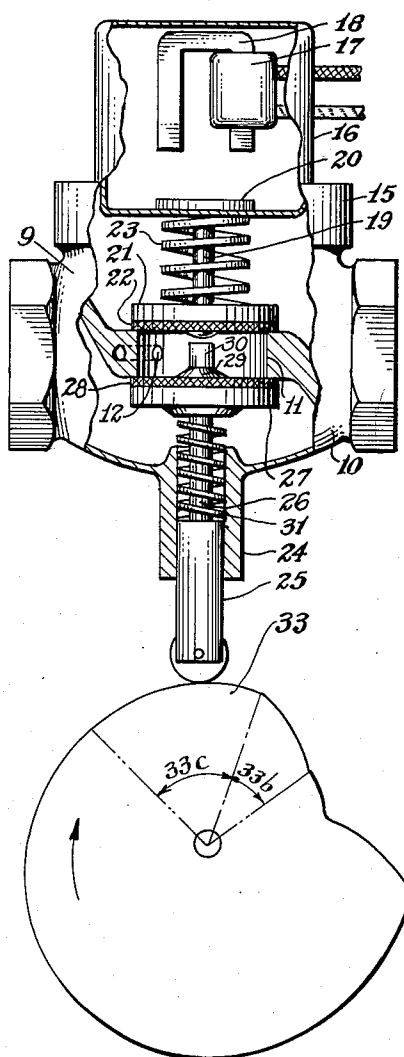


Fig. 3

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4 Sheets-Sheet 3

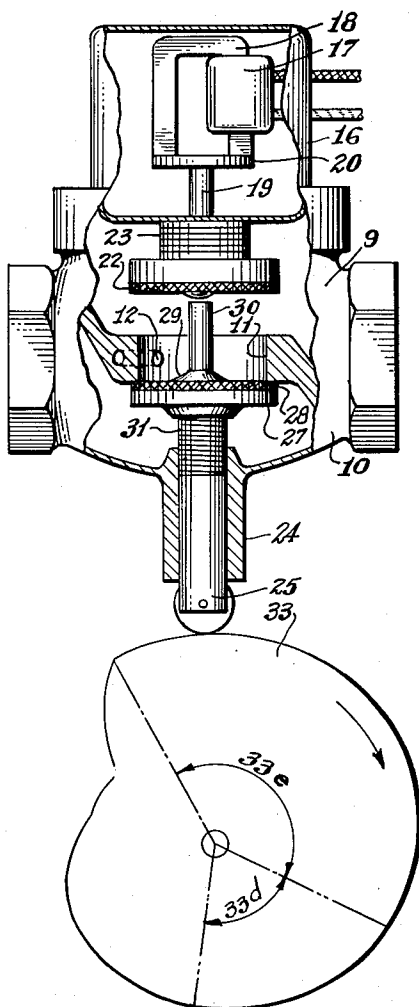


Fig. 4

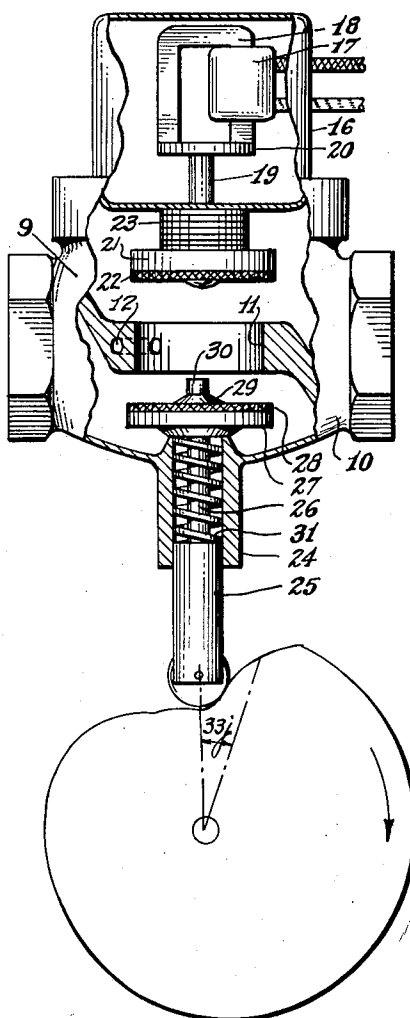


Fig. 5

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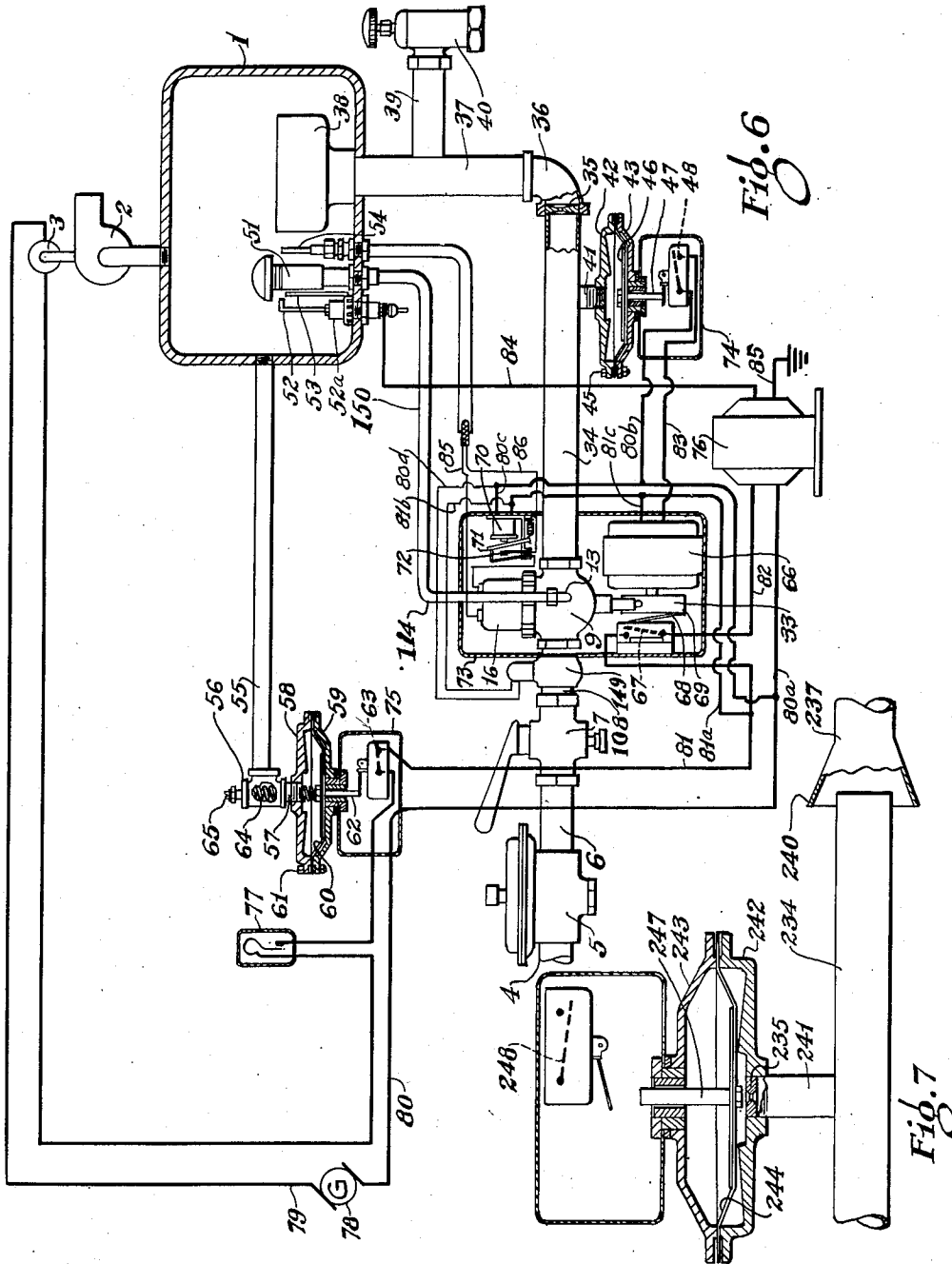
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PRESSURE RESPONSIVE COMBUSTION CONTROL APPARATUS

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4 Sheets-Sheet 4



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2,642,128

PRESSURE RESPONSIVE COMBUSTION
CONTROL APPARATUS

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This invention relates to combustion control and is particularly applicable to the burning of fluid fuel under automatic control.

An object of the invention is to provide an improved combustion control which will be extremely safe in operation.

Another object of the invention is to provide an improved combustion control which will accurately supply fuel in accordance with the heat requirements of the apparatus.

Another object of the invention is to provide an improved combustion control which will insure automatic ignition of fuel.

Another object of the invention is to provide an improved combustion control which will prevent the supply of undesirable quantities of fuel under any of a number of adverse fuel burning conditions.

Another object of the invention is to provide an improved combustion control which will be extremely reliable.

Another object of the invention is to provide an improved combustion control which will be composed of few and simple parts.

Another object of the invention is to provide an improved combustion control which will require a minimum amount of servicing.

Another object of the invention is to provide an improved combustion control which will be compact.

Another object of the invention is to provide an improved combustion control which may be easily and economically manufactured.

Another object of the invention is to provide an improved combustion control which will be extremely positive in its operation.

Other objects will hereinafter appear.

The invention will be better understood from the description of several practical embodiments thereof, illustrated in the accompanying drawings, in which:

Figure 1 is a somewhat diagrammatic view, partly in elevation and partly in section, of one form of control intended for the burning of fluid, and preferably gaseous, fuels at subatmospheric pressures;

Figures 2, 3, 4 and 5 are fragmentary sectional views to an enlarged scale taken on the line 2—2 of Figure 1, the valve top part of these views, however, having been rotated through 90° for clarity of illustration, and showing the parts in positions they occupy during various phases of the cycle of operation of the apparatus;

Figure 6 is a view similar to Figure 1 showing a second embodiment of the invention; and

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Figure 7 is a view similar to a portion of Figure 1 showing a third embodiment intended for the burning of fuel at atmospheric pressures.

Referring first to the embodiment, namely, that of Figures 1 to 5, I have shown a combustion system in which fuel is burned within a sealed combustion chamber 1, fuel and air being supplied to this chamber by the control apparatus to be described. The products of combustion are exhausted from the combustion chamber by a pump or blower 2, driven by a motor 3, so that the pressure within the combustion chamber is maintained at all times below that of the atmosphere.

Fuel is supplied from any source of fuel fluid under a pressure greater than atmospheric, such as the pipe or conduit 4, which, for the purpose of my present description, may be considered as connected to an ordinary city gas line.

The fuel passes through a gas pressure regulator at 5, which may be of any well known or desired type, and from the pressure regulator the fuel passes through the pipe or conduit 6, a manually operable shut-off cock 7, and pipe 8 to the control valve indicated generally at 9.

This valve, as most clearly seen from Figures 2 to 5 inclusive, consists of a body 10 resembling in its general form the ordinary globe valve, but having a thickened central partition 11 formed to constitute valve seats at both its upper and lower sides and having a perforation 12 extending to the exterior of the valve, beyond which it is provided with a fitting 13 connecting it to a pipe or tube 14.

The top of the valve body is provided with an enlarged boss 15 into which is received the lower end of a casing 16 carrying an electromagnet 17 provided with a U-shaped core 18.

Through the bottom of the casing 16 extends a valve stem 19 having its upper end, head or armature 20 in alignment with the poles of the core 18, while the lower end of the stem is provided with valve 21 carrying packing 22.

A spring 23 is interposed between the valve at 22 and the casing 16.

It will be understood that the casing 16 is fixed to and seals the top of the valve body against the passage of fuel therethrough.

The bottom of the valve body has a depending boss 24 which is bored for the reception of a plunger 25 which has an upper end of reduced diameter shown as carrying a valve head 27 provided with packing 28. The valve stem 26 is slidable through the valve head 27 and is provided with a flange or collar 29 adjacent its

upper end 30 which limits the upward motion of the valve relative to the stem.

Normally holding the valve head against the flange 29 is a spring 31 between the upper end of the larger diametric part of plunger 25 and the lower side of the valve head.

The lower end of the plunger is provided with a roller 32 which travels on a cam 33, which will be described more fully hereinafter.

From the valve 9 the fuel passes through a pipe or conduit 34 to an orifice plate 35 secured at the end of pipe 34 as by an elbow or other fitting 36 and constituting the main burner orifice of the apparatus.

From the fitting 36 a pipe or conduit 37 extends to the main burner 38 within the combustion chamber. A branch 39 connected to conduit 37 is provided with a manually adjustable regulating valve 40 which controls the admission of air to support combustion, this air being drawn in through the valve by the sub-atmospheric pressure within the pipe 37.

Connected to pipe 34, as by a nipple 41, is a casing consisting of a top 42 and bottom 43 between which is clamped a diaphragm 44, the two parts of the casing being secured together in any desired manner, as by bolts 45.

The diaphragm is provided with a plate 46 having a depending stem or pin 47 arranged to actuate a normally open switch 48.

Tube 14 ends at an electrically operated valve 49, from which a tube 50 passes to a pilot burner 51 within the combustion chamber adjacent the outlet of main burner 38.

Arranged adjacent the pilot burner is an igniting spark gap, consisting of an electrode 52 insulated from but passing through the combustion chamber wall, as by means of insulating bushings 52a, and a grounded electrode 53.

Also positioned adjacent the pilot burner and the main burner, where it will be subjected to flame from either or both, is a thermocouple 54.

A pipe 55 communicates with the interior of the combustion chamber and is connected by fittings, such as a T 56 and nipple 57, to a casing consisting of a cover 58 and a bottom 59 between the edges of which is clamped the edge of a diaphragm 60, the casing sections being held together by bolts 61. The diaphragm 60 has a pressure plate 61 on its upper surface having a depending pin 62 by which it may actuate a switch 63.

Passing upwardly from the pressure plate within the T 56 is a compression spring 64, the tension of which may be adjusted by a screw plug 65 threaded in the upper branch of the T.

Connected to rotate the cam 33 is a motor 66, and positioned adjacent the cam is a switch 67, having an arm 68, which may be moved to operate the switch by a projecting cam 69 formed on the side of cam 33.

A relay comprising a coil 70, an armature 71 and contacts 72 is positioned adjacent the casing 16 and valve 9 and motor 66, so that these parts, together with switch 67, may all conveniently be enclosed in a box or cover 73.

Covers or boxes 74 and 75 also conveniently may be provided for enclosing and protecting switches 48 and 63, respectively.

A transformer is shown at 76 to furnish current at suitable potential for the spark gap.

At 77 is shown a thermostat, which is positioned in the room or other space which it is desired to maintain at a uniform temperature.

Passing now to the description of the electri-

cal circuits which are associated with the mechanical parts above described, power is supplied by any suitable source such as a central power house generator 78 through line 79 and 80.

Line 79 includes motor 3 and thermostat 77 and terminates at switch 63.

Line 80 has four branches, one of which 80a terminates at transformer 76, another 80b at switch 48, a third 80c at relay coil 70 and a fourth 80d at electro-magnetic switch 49.

From the opposite side of switch 63, a conductor 81 extends to switch 67, and from switch 67 a conductor 82 extends to transformer 76.

Branching from conductor 81 is a conductor 81a which connects with the other end of coil 70 of the relay, and which has a branch 81b connected to the other side of valve 49.

Another branch 81c connects with motor 66, while the opposite side of the motor is connected by a conductor 83 to switch 48.

Switch 48 is normally open, and is closed only when the vacuum within pipe 34 is sufficient to raise diaphragm 44.

Switch 63 is normally closed, and is opened only in the event of an extremely high vacuum which causes the diaphragm 60 to overcome the pressure of spring 64.

From the secondary of transformer 76, conductors 84 and 85 pass, respectively, to electrode 52 and to the ground.

With the parts as above described, and the apparatus at rest, let it be assumed that the temperature at thermostat 77 falls below the setting of this thermostat.

This, of course, closes the contacts of the thermostat and permits current to be supplied through line 79 to motor 3, driving blower 2, the current flowing through switch 63, conductors 81, 81a, 80c, 81b, 80d, and 80 back to the generator, thus energizing the coil 70 of the relay to close contacts 72 and opening valve 49, current to the valve being supplied to it through conductors 81d and 81b which connect it in parallel with the coil 70.

The closing of the contacts 72 establishes communication through conductors 85 and 86 between the thermo-couple 54 and coil 17, while the opening of the valve 49 permits pilot gas to pass through pipes 14 and 50 to the pilot burner 51.

At the time this is taking place, the cam 33 is in the position shown in Figures 1 and 2, where the roller 32 is at its lowermost position with valve 27 open and valve 21 closed.

As soon as pump 2 has exhausted the contents of combustion chamber 1 sufficiently to raise diaphragm 44, switch 48 closes and current can now pass through this switch between conductors 83 and 80b, thus supplying current to motor 66 which starts to rotate and to move cam 33.

This cam rotates in a clockwise direction, as seen in Figures 2 to 5, so that the roller for a short period is free of the cam while the latter passes through the sector marked 33a, and thereafter climbs upon the sector 33b to the position shown in Figure 3 where both valves 21 and 27 are closed. The succeeding sector of the cam is a dwell, indicated at 33c, which may be for a substantial period, such as about a quarter of a minute, permitting the blower to completely purge the combustion chamber of any unburned fuel.

Passing beyond the dwell of sector 33c, sector 33d of the cam again raises plunger 25, as shown in Figure 4, so that valve 21 is opened while valve

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27 is held closed. This permits gas to flow from the intake side of valve body 10 to port 12, and thence through tubes 14 and 15 to the pilot burner.

While cam 33 is moving its sector 33d under the roller 32, its cam lug 69 engages switch arm 68 and as this lug extends axially a sufficient distance to actuate switch 67 this engagement closes the switch 67, permitting current to flow through 82 to the primary of transformer 76, and thus inducing a high tension current in conductors 84 and 85 producing a spark between electrodes 52 and 53.

This spark is of sufficient intensity to ignite the pilot gas, which is now entering through the pilot burner 51.

Continued rotation of motor 66 carries cam 33 beyond the dwell 33e, allowing the plunger to slide down the last sector 33f to the position shown in Figure 5.

Of course, when the parts are brought into the position shown in Figure 4, armature 20 is brought into contact with the poles of core 18, and if ignition of the gas has taken place within the combustion chamber, coil 17 is energized by the thermocouple and holds this armature in a raised position as shown in Figure 5, keeping valve 21 above its seat.

The dropping of plunger 25, of course, moves valve 27 below its seat so that valve 9 is fully opened and gas can flow freely throughout.

This condition will obtain as long as flame exists at either burner 38 or 51, and the thermostat 77 calls for heat by keeping its contacts closed.

In actual practice motor 66 has been so geared that it rotates cam 33 at about 1 R. P. M., thus making one cycle of the above steps per minute.

It will be observed that the control above described operates automatically to render the apparatus safe against the undesired supply of fuel in the event of various types of failure.

Pressure in pipe 34 opens switch 48 preventing the motor 66 from causing the parts to go through their cycle until a proper vacuum has been produced.

Interruption of electric current, whether by operation of thermostat 77 or from other causes, causes magnetic valve 49 to snap shut instantly stopping any supply of pilot gas.

Immediately upon exhaustion of the gas burning at the main burner, de-energization of coil 17 permits valve 21 to snap shut, cutting off all fuel to the main burner as well as to the pilot burner.

Absence of flame in the combustion chamber for any reason de-energizes coil 17 and closes valve 21.

Failure of vacuum-like pressure in pipe 34 breaks the motor circuit at switch 48.

If the pilot burner is not lit on the first cycle of the apparatus, but proper conditions of vacuum continue, the apparatus will re-cycle until ignition takes place.

Thus the control illustrated will guard against many types of failure and dangerous conditions which might arise as pointed out above.

In Figure 6, the electrically operated valve 149 has been inserted in conduit 108 instead of between tube parts 114 and 150. The operation of the device is otherwise just as above described.

Of course with valve 149 as shown in this figure, deenergization thereof shuts off the entire gas supply, not merely that to the pilot burner.

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In Figure 7 the apparatus is shown as adapted to burning fuel at atmospheric pressure.

In this form, the pipe 234 terminates at the frustro-conical end 240 of the pipe 237 leading to the main burner, the two pipes forming an inspirator or injector-like structure for drawing in air to support combustion at the burner.

The branch 241 is provided with an apertured plate 235, through which the extension communicates with the interior of the casing consisting of halves 242 and 243.

Within the casing is a diaphragm 244 having a rod or pin 247 arranged, when the diaphragm is raised, to contact the arm of switch 248, this switch being normally open and closed only when engaged by the shank 247.

It will be seen that the actuation of this switch is precisely the same as that of switch 48 of Figure 1, excepting that in the first figure the switch is controlled by vacuum created by the blower 2, while in the pressure operated system of Figure 7, the diaphragm is moved to operate the switch 248 by fuel pressure within the conduit 234.

While I have described the illustrated embodiments of my invention in some particularity, obviously many other embodiments, variations, and modifications will readily occur to those skilled in this art, and I do not, therefore, limit myself to the precise details shown and described herein, but claim as my invention all embodiments, modifications and variations coming within the scope of the appended claims.

I claim:

1. Combustion control apparatus comprising a combustion chamber, a burner in the chamber, a fuel supply line leading to the burner, a valve in said line, a restricting member in the line between the valve and burner, and valve control means operably associated with the valve and controlled by the pressure in the line between the valve and restricting member.

2. Combustion control apparatus comprising a combustion chamber, a burner in the chamber, a fuel supply line leading to the burner and including a valve, a restricting member in said supply line between the valve and burner, actuating means connected to said valve, control means for said valve connected to and responsive to the pressure in the chamber, and retaining means for said valve controlled by the existence or absence of a flame at the burner.

3. Combustion control apparatus comprising a combustion chamber, a burner therein, a fuel supply line leading to the burner and including a valve, a restricting member in said supply line between the valve and burner, actuating means for said valve connected to and responsive to the pressure in the chamber, and retaining means for said actuating means controlled by the existence or absence of a flame at the burner, and operating means for said valve controlled by the pressure in the conduit between the valve and the restricting member.

4. In a combustion apparatus comprising a combustion chamber, gas exhausting means connected with said chamber, a main burner and a pilot burner within the chamber adjacent each other, a source of fluid fuel under pressure, conduit means leading from said source of fuel to said main burner and having successively interposed therein a valve and a conduit restricting member and an air inlet, the valve being closest the source of fuel and the air inlet closest the main burner, electrical actuating means con-

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ected to said valve, and a pressure operated control connected to said actuating means controlled by the pressure in said conduit between the valve and the combustion chamber.

5. Combustion control apparatus comprising a combustion chamber, a burner therein, a source of fuel under pressure, a conduit leading from said source of fuel to said burner, a valve in the conduit, a restricting member in the conduit between the valve and the burner, an electric motor, power transmission means connected thereto and arranged to open said valve, resilient valve closing means, electro-magnetic valve retaining means arranged to hold the valve open, a pressure responsive control connected to and actuated by the pressure in the conduit between the valve and the restricting member and controlling said valve retaining means, a pressure responsive controlling means connected to and responsive to the pressure in the combustion chamber controlling the motor, and a thermocouple adjacent the burner controlling the valve retaining means.

6. Combustion control apparatus comprising a combustion chamber, a burner therein, a source of fuel under pressure, a conduit leading from said source of fuel to said burner, a valve in the conduit, a restricting member in the conduit between the valve and the burner, an electric motor, power transmission means connected thereto and arranged to open said valve, resilient valve closing means, electro-magnetic valve retaining means arranged to hold the valve open, a pressure responsive control connected to and actuated by the pressure in the conduit between the valve and the restricting member and controlling said valve retaining means, a pressure responsive controlling means connected to and responsive to the pressure in the combustion chamber controlling the motor, and a thermocouple adjacent the burner controlling the valve retaining means, a second conduit from the fuel supply conduit terminating in a pilot burner ad-

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jacent the first mentioned burner, and a valve in said second mentioned conduit actuated by said motor.

7. In a combustion apparatus comprising a combustion chamber, gas exhausting means connected with said chamber, a main burner and a pilot burner within the chamber adjacent each other, a source of fluid fuel under pressure, conduit means leading from said source of fuel to said main burner and having successively interposed therein a valve and a conduit restricting member and an air inlet, the valve being closest the source of fuel and the air inlet closest the main burner, electrical actuating means connected to said valve, and a pressure operated control connected to said actuating means controlled by the pressure in said conduit between the valve and the conduit restricting member.

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References Cited in the file of this patent

UNITED STATES PATENTS

Number	Name	Date
1,814,947	McGuinness	July 14, 1931
1,954,405	Dotterweich	Apr. 10, 1934
2,062,605	Peters	Dec. 1, 1936
2,125,473	Vaughan	Aug. 2, 1938
2,240,163	Pick	Apr. 29, 1941
2,259,299	Dewey	Oct. 14, 1941
2,290,048	Hildebrecht	July 14, 1942
2,297,854	Alfery	Oct. 6, 1942
2,335,471	Ashcraft	Nov. 30, 1943
2,363,073	Mantz	Nov. 21, 1944
2,369,746	Miller	Feb. 20, 1945
2,373,326	Miller	Apr. 10, 1945
2,403,611	Ray	July 9, 1946
2,412,990	Kruse	Dec. 24, 1946
2,424,154	Dunham et al.	July 15, 1947

FOREIGN PATENTS

Number	Country	Date
474,271	Great Britain	Oct. 28, 1937