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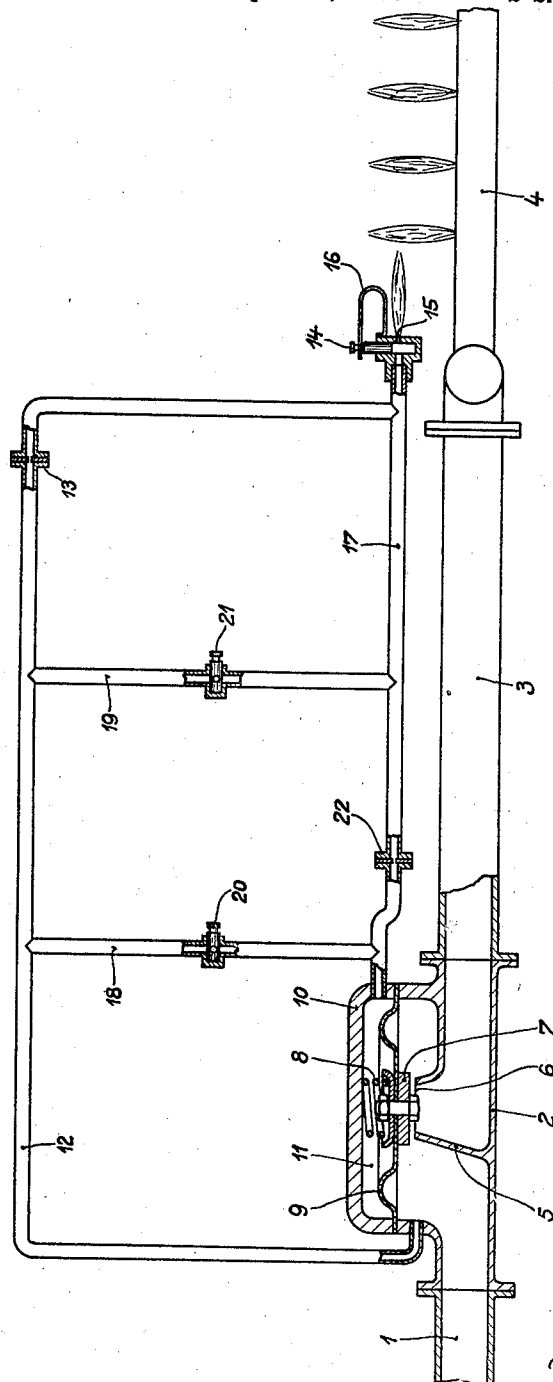
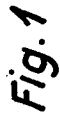
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GAS BURNING APPARATUS

Filed Sept. 15, 1930

2 Sheets-Sheet 1



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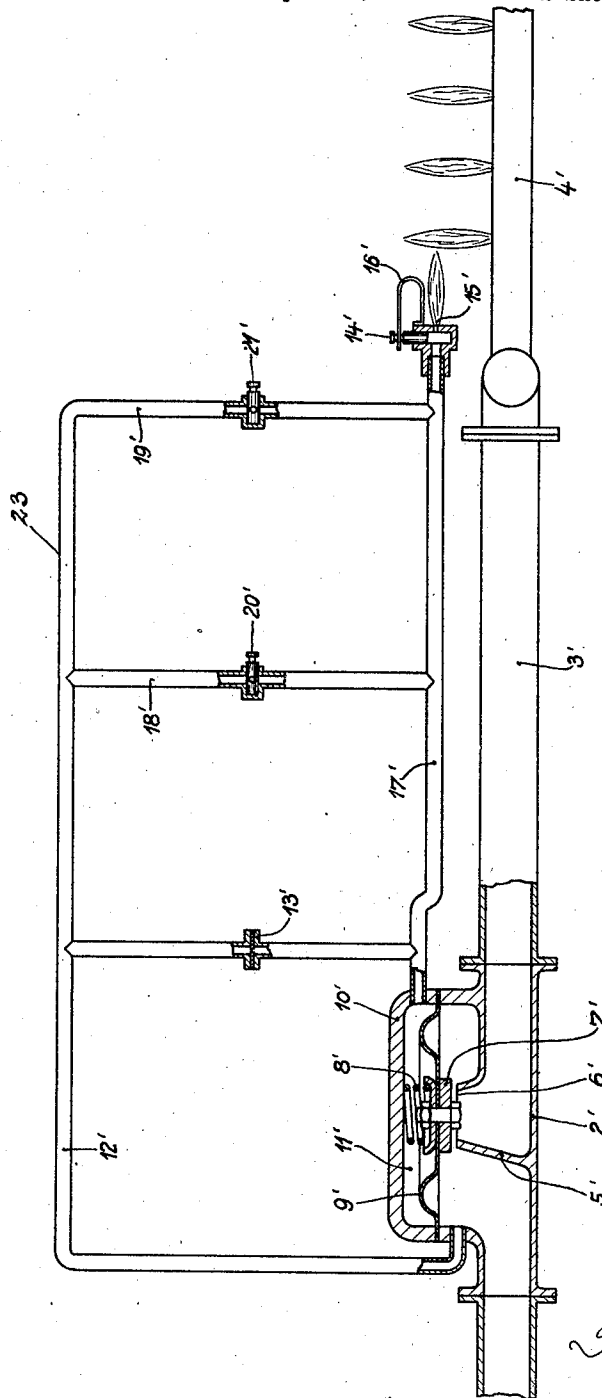
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Fig. 2



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UNITED STATES PATENT OFFICE

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GAS BURNING APPARATUS

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8 Claims. (Cl. 158—117.1)

The present invention relates to gas burning apparatus.

Gas burning apparatus, such for example as gas burning apparatus for domestic hot water supply, are already known in which a main gas valve is controlled by variations of gas pressure produced by regulators or governors in one or more controlling pipes. In these known devices, however, the controlling gas is generally led off from the main gas pipe separately from the pilot burner gas in such a manner that the controlling gas continues to flow off through an auxiliary outlet when the main valve and the pilot burner valve are closed. Such devices are therefore disadvantageous in the possibilities they present of the collection of gas, in the room in which the device is used, to a sufficient extent to lead to gas poisoning or explosion. In other known gas burning apparatus, the controlling gas is led off from the main gas line through a pilot burner, and the pilot burner is provided with a thermostat-operated valve to ensure the complete and automatic closing of the pilot orifice when the pilot flame is extinguished so as to prevent the escape of gas exteriorly of the apparatus.

My invention pertains to a gas burning apparatus of the last-mentioned type and has for its general object the provision in such an apparatus of a control system comprising controlling-gas pipes, a pilot-burner and a thermostat-operated pilot-burner valve automatically actuating upon extinguishment of the pilot flame to effect the closure of the main gas valve as well as all the controlling-gas pipes against the escape of gas exteriorly of the apparatus and additional control means operable to close the main gas valve without extinguishment of the pilot flame.

The foregoing objects of the invention and other objects and principles thereof will more fully appear from the detailed description of two constructional forms of the invention hereinafter described and illustrated in the accompanying drawings forming a part of this specification. It is to be understood, however, that the invention is not limited to the precise forms shown but may include other constructions within the scope of the appended claims.

In the drawings:

Fig. 1 is a more or less diagrammatical view, partly in vertical side elevation and partly in vertical section, of one form of construction the invention may take; and

Fig. 2 is a like view of a form of construction similar to that of Fig. 1 but with certain modifi-

cations in the arrangement of the controlling-gas pipes.

The form of apparatus of the invention shown in Fig. 1 comprises a main gas valve, generally indicated at 2, having its housing or valve chamber divided by a wall 5 into a gas-receiving or pressure-side, at the left of the wall 5 as the parts are viewed in Fig. 1, and a gas-discharge side, at the right of the wall 5, which are connected through the opening 6 at the top of the division wall. The gas-receiving or pressure side of the valve chamber is connected to the main gas pipe 1 while the discharge side of that chamber is connected, through the pipe 3, with the main burner 4 of the apparatus. The flow of gas through the valve chamber, from its pressure to its discharge side through the opening 6, is controlled by the valve disc 7 which has a downward closing movement against the upper rim of the division wall 5 and an upward opening movement. The valve disc 7 operates in its closing movement under the influence of a spring 8 and its own weight and in its opening movement under the influence of a diaphragm 9 to which it is attached, depending upon the gas pressures on the opposite faces of the diaphragm, the diaphragm being clamped between the lower part of the housing of the valve and its cover 10 which is recessed above the diaphragm to form a pressure-control chamber 11. Thus the bottom face of the diaphragm is exposed to the gas pressure in the high-pressure side of the valve chamber and its top face is exposed to the gas pressure in the control chamber 11, so that upward movement of the diaphragm and consequent opening movement of the valve disc may be effected by reductions of the gas pressure in the chamber 11 below the gas pressure on the opposite side of the diaphragm and downward or closing movement of the valve disc may be effected under the influence of the spring 8 and the weight of the valve disc by restoring the gas pressure in the chamber 11 to that of the gas on the opposite side of the diaphragm.

The means in the form of construction shown in Fig. 1 for controllably varying the gas pressure in the pressure-control chamber 11 comprises a pipe 17 leading from the chamber 11 to a pilot burner having a valve 14 controlling the pilot orifice 15 and a U-shaped gas pipe 12 leading from the high-pressure side of the valve chamber of the main-burner valve 2 through a throttling nozzle 13 to a point of connection with the pipe 17 closely adjacent the pilot burner. The pilot-burner valve is arranged to be opened

by a heat-expansion element, when this is heated, and to be closed by the contraction of this element when it is cooled. Any suitable form of valve and heat expansion element may be employed, but, in the present instance, the valve is of the sliding cylindrical plug type as indicated at 14 and the heat-expansion element is a U-shaped thermostat member, preferably of the bi-metallic type, mounted closely adjacent the pilot jet and having its free arm attached to the head of the plug valve.

Pipes 18 and 19 connect the pipes 12 and 17 at points between the pressure-control chamber 11 of the main-burner valve 2 and the pilot burner, and these pipes 18 and 19 are provided with turn-plug valves 20 and 21 having heads adapted for operating connections designed to operate the valves from some remote point as remote controls for purposes hereinafter mentioned. A throttling restriction or nozzle 22 is provided in the pipe 17 between the points of connection therewith of the pipes 18 and 19.

The relative sizes and proportions of the various gas pipes, nozzles, valve apertures, etc. may be varied somewhat but in general it may be said that the throttle 13 should be of slightly smaller size than the pilot burner aperture or jet 15 so that the latter can readily pass off, without any rise in pressure, the gas passed by throttle 13. Also, throttle 22 should be smaller than the openings in the valves 20 and 21 of the remote controls, and these openings should be larger than the pilot-burner aperture or jet 15.

While the relative proportions of the various parts need not vary, their sizes will vary according to the designed capacity of the apparatus and particularly of the main gas pipes. Those pipes, indicated at 1 and 3 on Fig. 1, may, for example, vary from 0.25 of an inch to 4 inches in diameter. For an apparatus employing a main gas pipe of one inch diameter, the other parts may advantageously be of the following sizes:

Pipes 12, 17, 18 and 19	0.25 inch diameter
Throttle 13	0.02 inch diameter
Jet aperture 15 of the pilot burner	0.08 inch diameter
Aperture of each of the control valves 20 and 21	0.25 inch diameter
Throttle 22	0.01 inch diameter

While the foregoing dimensions of the various parts of the apparatus are exemplary and not restrictive, and the principles of operation would be the same with the parts of other relatively proportionate sizes, for convenience of describing its operation the apparatus shown in Fig. 1 will be assumed to be of those dimensions.

Before starting up the apparatus, with the pilot burner valve 14 in closed position, the valve disc 7, under the influence of its own weight and the spring 8, will be in its lowermost position closing the main burner valve because of the equalization of gas pressures on the opposite sides of the diaphragm through the open connection afforded by the pipes 12 and 17 between the high pressure side of the main valve chamber and the pressure control chamber 11. The main burner valve will be thus closed whether or not the valves 20 and 21 of the remote controls are open or closed. If they are closed, then the pipes 12 and 17 alone provide the open connection between the high pressure side of the main valve chamber and the chamber 11, and if either or both of these valves 20 and 21 are open, then they provide simply an additional connection through the cross

pipes 18 and 19 in which these valves are located.

As will later more fully appear, however, if the valves 20 and 21 of the remote controls are closed when the pilot burner is started and begins to function, the gas pressure is so reduced in the pressure-control chamber 11 as to cause the diaphragm 9 to immediately move upwardly and open the main burner valve whereas, if either or both of the valves 20 or 21 are open, the starting up of the pilot burner does not cause the opening of the main burner valve and that valve is not opened until the valves 20 and 21 are closed. Where it is not desired to have the main burner put in operation immediately following the lighting of the pilot burner, one or both of the valves 20 and 21 will, therefore, be kept in open position while the pilot burner is started; and this will be assumed to be the starting condition in the following further description of the operation of the apparatus in use.

With either or both of the valves 20 and 21 open, the quickly heated expansion element 16 may be heated, for example by a match flame, so that this element quickly expands and opens the pilot burner valve 14, and the gas issuing from the pilot orifice or jet 15 is ignited by the flame applied to the expansion element. With the pilot burner valve thus opened and the pilot flame on, and either or both of the valves 20 and 21 open, the following conditions of gas flow are created:

Gas will flow from the pressure side of the main valve chamber 2 through the pipe 12, the throttle restriction 13 therein and to the pilot orifice 15 to feed the pilot flame. But the gas may also flow from the pipe 12 into one or both of the cross pipes 18 and 19 and through the apertures of the valves 20 and 21 therein, which in the illustrative example are of 0.25 of an inch diameter, and into the pipe 17. As a consequence of this additional flow of gas, the gas pressure within the pipe 17 and within the connected control chamber 11 above the diaphragm will not drop below that of the pressure in the main valve chamber on the opposite side of the diaphragm. This is so because the volume of gas escaping through the pilot orifice (of 0.08 of an inch diameter in the illustrated example) is less than the volume of gas flowing through the valves 20 or 21. Consequently, the gas pressure above and below the diaphragm 9 of the main valve will remain equalized and consequently the spring 8 and the weight of the valve disc 7 will keep that disc in the closed position.

With the pilot burner thus started, if both valves 20 and 21 of the remote controls are closed, the following conditions of gas flow are created in the control system. Gas may flow in the pipe 12 only through the throttle 13 (of 0.02 of an inch diameter in the present example) to the pipe 17 and through the remaining short portion of that pipe to the pilot burner; and as the volume of gas passing through said throttle is less than the capacity of the pilot orifice 15 (of 0.08 of an inch diameter in the present example), the gas pressure in the pipe 17 and in the connected control chamber 11 will drop below the gas pressure in the main valve chamber below the diaphragm. Consequently, the greater gas pressure in the main valve chamber on the bottom face of the diaphragm will lift that diaphragm and with it the valve disc 7 of the main gas valve and thus open that valve. Thereupon, the gas will flow through the main gas pipe 3 to the main burner where it is ignited by the pilot flame. That pilot flame, it is to be noted, continues to be fed by

the gas passing through the throttle 13, that throttle being of a designed capacity to limit the volume of gas passed therethrough to that sufficient to maintain the pilot flame burning but insufficient to build up a pressure in the pipe 17, and consequently in the connected control chamber 11, which might close the main valve.

With the last mentioned condition of operation obtaining, if the pilot burner flame becomes extinguished, intentionally or otherwise, the expansion element 16 cools very quickly and closes the pilot burner valve 14 in a few seconds. As no more gas then issues from the pilot orifice or jet 15, the pressures in the pipes 12 and 17 on the opposite sides of the throttle 13 quickly equalize and, as a result, the gas pressure in the chamber 11 above the diaphragm becomes equal to the gas pressure in the main valve chamber below the diaphragm, and consequently the valve disc 7 is forced back on its seat by its own weight and the spring 8. The main gas valve 2 is thus closed and the flow of gas to the burner 4 shut off.

It is therefore clear that with the pilot burner lit, as long as one or both of the valves 20 and 21 of the remote controls are kept open, the main gas valve is closed and the gas consequently shut off from the main burner, and that closing the valves 20 and 21 of the remote controls has the effect of opening the main gas valve for flow of gas to the main burner. It is also apparent that with the valves 20 and 21 closed, the control system keeps the main gas valve open as long as the pilot flame is on and that when the flame is extinguished the pilot burner valve closes and the resulting rise in gas pressure in the control system causes the immediate closing of the main gas valve.

Referring now more specifically to the difference in effectual action of the controls 20 and 21 on the closing of the main gas valve, if the remote control 20 be opened while remote control 21 is kept closed, there will be a flow of gas from pipe 12 through the control 20 into pipe 17; and as the aperture of the control 20, in the given example, is 0.25 of an inch in diameter and there is a throttle 22 of 0.01 of an inch diameter in the pipe 17 between the control chamber 11 and the pilot orifice 15, a sudden accumulation of gas will be effected within pipe 17 on the control-chamber side of the throttle 22 and of course within the control chamber itself, so that the pressure within that chamber is substantially instantly raised to the pressure in the gas main on the other side of the diaphragm. With the resulting equalization of pressures above and below the diaphragm, the valve disc 7 will at once be forced down by the spring 8 to closed position.

On the other hand, if the control 21 is opened and 20 closed, there will be a flow of gas through the aperture of 0.25 of an inch diameter of the control 21 into pipe 17, and as the volume of gas passing through control 21 is greater than the capacity of the 0.08 of an inch escape orifice 15 of the pilot burner, the gas pressure in pipe 17 will rise abruptly. But this increase in gas pressure in pipe 17 cannot directly and immediately affect the pressure within the control chamber 11 as in the case of the control 20, because the 0.01 of an inch throttle 22 in pipe 17 on the chamber side of pipe 19 prevents the gas from immediately entering the control chamber 11. Instead of such substantially immediate entry as in the operation of the control 20, in the operation of the control 21 the gas must pass through the throttle 22 and consequently the gas pressure builds up more

slowly in chamber 11. The insertion of the throttle 22 in the pipe 17 in the position shown in Fig. 1, therefore, renders the control 21 an ordinary or time lag control, while the control 20 is useful as a quick or emergency control.

As already stated, if the pilot flame becomes extinguished, either intentionally or otherwise, the expansion element 16 cools very quickly and closes the valve 14 in a few seconds; and as there is no other escape for the gas from the control system than through the pilot burner, the pressure in the pipe 17 and in the connected control chamber 11 quickly rises to that on the lower side of the diaphragm by continued flow of gas from the gas main out through the pipe 12 to and through the pipe 17 to the control chamber. In consequence of the equalization of pressures on the opposite sides of the diaphragm, the spring 8 is free to force the main burner valve to closed position.

It is also to be noted that, with the form of construction shown in Fig. 1, the main gas burner cannot be put into communication with the gas supply when the pilot burner flame is not burning. This is because of the fact that with the pilot burner valve closed, there is a constantly open gas connection between the pressure side of the chamber of the main valve beneath the diaphragm 9 and the chamber 11 above that diaphragm through the pipes 12 and 17 which connection equalizes the gas pressures on the opposite sides of the diaphragm and thereby enables the valve disc 7 to close under its own weight and the influence of the spring 8, and no manipulation of the valves 20 and 21 of the remote controls, whether to open or close them, interrupts that connection. Therefore, while the opening of the valves 20 and 21 from their closed positions, when the pilot flame is on and the main gas valve open, is effective in closing the main gas valve, when the pilot flame is extinguished the main gas valve at once closes without the necessity of manipulating the valves 20 and 21.

In the apparatus shown in Fig. 2, the main burner 4' and the gas pipes leading thereto and the main gas valve, with its division wall 5' apertured at 6', the valve disc 7' with its spring 8' and the diaphragm 9' with the pressure control chamber 11' within the cover 10' above the diaphragm, are all identical with the corresponding apparatus parts in Fig. 1.

After the manner of the Fig. 1 apparatus, in the Fig. 2 apparatus, a pipe 17' leads from the pressure control chamber 11' to the pilot burner. Also, the pilot burner, the valve 14' controlling the jet orifice 15' and the thermostat element 16', operating the valve, are identical with the pilot burner and its component parts of the Fig. 1 apparatus. But the arrangement of the remaining gas pipes of the control system differ somewhat in the Fig. 2 apparatus from the arrangement in the Fig. 1 apparatus.

In the Fig. 2 apparatus, the pipe 12' leads off from the high pressure or supply side of the main valve 2', through the throttle 13', to a point of connection with the pipe 17 closely adjacent the pressure-control chamber 11', instead of closely adjacent the pilot burner as in the case of the corresponding pipe 12 in the Fig. 1 apparatus.

Also, in the Fig. 2 apparatus, the valves 20' and 21' of the remote controls are disposed with their pipes 18' and 19' between a branch 23 of the pipe 12' and the pipe 17', with the branch pipe 23 terminating in the pipe 19' which

contains the valve 21'. With this arrangement, the pipes 18' and 19' containing the control valves 20' and 21' are disposed between the throttle 13' and the pilot burner instead of between the corresponding throttle 13 and the pressure-control chamber 11 as in the Fig. 1 apparatus. Also, the Fig. 2 apparatus omits the throttle such as shown at 22 in the pipe 17 in the Fig. 1 apparatus.

The relative sizes of the pipes and throttle and valve apertures of the Fig. 2 apparatus are the same as in the Fig. 1 apparatus, and the principles of operation are substantially the same in the two forms.

As with the Fig. 1 apparatus, the Fig. 2 apparatus is started by heating the thermostat 16' to open the pilot burner valve 14' and by igniting the gas thereupon issuing from the pilot jet 15'. At this time, the control valves 20' and 21' may be closed or opened as desired and, as in the case of the Fig. 1 apparatus, if these valves are closed, the lighting of the pilot burner will immediately be followed by such a reduction of gas pressure in the control chamber 11' as to cause an upward movement of the diaphragm 9' and an opening of the main gas valve 2' whereas, if either or both of these valves are open, the gas pressure will still remain high enough in the chamber 11 to equalize the pressures on the opposite sides of the diaphragm and cause the valve disc 7' of the main gas valve to close under the influence of its weight and the spring 8'.

Referring more particularly to these operations as they occur in the use of the Fig. 2 apparatus, and assuming that one or both of the valves 20' and 21' are open, when the pilot burner is lighted the gas to feed the flame is drawn from the pipe 12' in part through the nozzle 13' and in greater part through the pipe 23 and into one or both of the cross-pipes 18', 19', through the open valve 20' or 21' therein, and through the connected portions of the pipe 17' to the burner. And since the aperture in each of the valves 20', 21' is larger than the jet aperture 15' of the pilot burner, the gas pressure in the pipe 17' remains sufficiently high to maintain the gas pressure in the connected pressure-controlled chamber 11' above the diaphragm 9' substantially equal to the gas pressure on the bottom face of that diaphragm. In consequence, the disc valve 7' is maintained in downward position by its weight and the spring 8' to shut off the supply of gas to the main burner while at the same time the pilot burner continues in operation.

If the valves 20', 21' are closed, however, the gas to feed the pilot burner is then drawn from the pipe 12' solely through the nozzle 13' and the pipe 17' to the burner. Due to the greater capacity of the pilot jet 15' than the nozzle 13' to pass the gas, a drop in gas pressure in the gas pipe on the advance side of the throttle occurs and a consequent withdrawal of gas from the pressure-control chamber 11' which reduces the pressure therein sufficiently below the gas pressure on the bottom face of the diaphragm 9' to cause an upward movement of that diaphragm carrying with it the valve disc 7' and thereby opening the flow of gas to the main burner.

If, during the foregoing conditions of operation, the pilot flame should be extinguished, the resulting rapid cooling of the thermostat 16' quickly closes the pilot burner valve 14', and the gas pressure in the pipes 12' and 17' on the advance side of the throttle 13' quickly rises to that of the gas pressure in the pipe 12' on the rear side of the throttle. In consequence, the gas

pressure in the pressure-control chamber 11' above the diaphragm 9' is restored to substantially that of the pressure on the bottom face of the diaphragm so that the valve disc 7' moves downwardly under its weight and the spring 8' to shut off the supply of gas to the main burner.

Or, if the pilot flame is not extinguished, the main gas valve can be closed and the supply of gas to the main burner thus cut off simply by opening one or both of the valves 20', 21' of the remote controls, for with either of those valves open, as above pointed out, not only is the pilot burner so fed with gas as to continue in operation but the gas pressure remains sufficiently high in the pipe 17' and in the connected pressure-control chamber 11' to equalize the pressures on the opposite sides of the diaphragm 9' and bring the valve disc 7' into operation under the influence of its spring to close the main gas valve.

It is therefore apparent that, in both forms of apparatus shown in Figs. 1 and 2, the pressure chamber above the diaphragm, the pilot burner with its thermostat-operated valve, the pipes connected with that chamber and burner, and the throttles and valves in those pipes all cooperate to constitute a control system for controlling the main gas valve, and that the only escape for gas from that system is through the pilot burner. It is also apparent that the thermostat-operated valve of the pilot burner constitutes a means for not only securing all the gas pipes of the control system in closed position against the escape of gas exteriorly of the apparatus but also for securing the closure of the main gas valve when the pilot flame is extinguished.

I claim:

1. A gas burning apparatus comprising a main burner and a pilot burner, passages for gas leading to both burners, a valve in each passage, a restriction in the pilot burner passage, the pilot burner passage extending to the pressure supply side of the main burner valve whereby the closing of the latter will not interrupt the flow of gas to the pilot burner, a diaphragm operable to open the main burner valve whenever the pressure difference on the two sides of the diaphragm exceeds a predetermined value, a casing enclosing said diaphragm, exposing one side of said diaphragm to the pressure of the gas supply and forming with the diaphragm a pressure chamber on the opposite side thereof, gas connections between said chamber and the pilot burner passage whereby said chamber may receive gas from said passage at a point between the restriction therein and the pilot burner or from said passage at a point between the restriction and the supply side of the main gas valve, alternatively, and whereby in the first instance, when the pilot burner valve is opened, the resultant drop in pressure at such point produces a pressure difference on said diaphragm sufficient to open the main burner valve and in the second instance the pressure difference is insufficient to open the main burner valve.

2. A gas burning apparatus comprising a main burner and a pilot burner, passages for gas leading to both burners, a valve in each passage, the pilot burner passage extending to the pressure side of the main burner, a restriction in the last mentioned passage, a diaphragm operable to open the main burner valve whenever the pressure difference on the two sides of the diaphragm exceeds a predetermined value, a casing enclosing said diaphragm, exposing one side of said diaphragm to the pressure of the gas supply and

forming with said diaphragm a pressure chamber on the opposite side thereof, a gas connection between said chamber and the pilot burner passage on the low pressure side of said restriction, a by-pass between said pilot burner passage and said gas connection around said restriction and a valve in said by-pass operable to control the flow of gas through said by-pass and thereby the pressure difference on said diaphragm when the pilot valve is open, and thereby control the opening of the main valve.

3. A gas burning apparatus comprising a main burner and a pilot burner, passages for gas leading to both burners, a valve in each passage, the pilot burner passage extending to the pressure side of the main burner valve, a restriction in the last-mentioned passage, a diaphragm operable to open the main burner valve whenever the pressure difference on the two sides of the diaphragm exceeds a predetermined value, a casing enclosing said diaphragm, exposing one side of said diaphragm to the pressure of the gas supply and forming with said diaphragm a pressure chamber on the other side thereof, two gas connections between said chamber and the pilot burner passage, one on the low pressure side of said restriction and the other on the high pressure side, and means for controlling the flow of gas through the last mentioned connection when the pilot valve is opened, to vary the pressure difference on the diaphragm and thereby the opening of the main valve.

4. Apparatus as in claim 1 in which the pilot burner provides the only outlet for escape of gas from the connections between the two sides of the diaphragm.

5. Apparatus as in claim 1 comprising a thermostat responsive to the heat of the pilot flame and operable to control the valve in the pilot burner passage.

6. A safety device for gas burning apparatus, comprising the combination with a gas main feeding a main burner, of a main valve controlling said gas main, actuating means for said valve comprising a diaphragm and a mounting therefor exposing said diaphragm on one side to the gas pressure in said gas main on the supply side of said valve and forming with said diaphragm a control chamber on the other side thereof whereby said valve may be actuated by variations of the gas pressure in said control chamber, a pilot burner and a pilot line leading from the main gas side of the diaphragm to said pilot burner, a valve for said pilot burner, a thermostat responsive to the heat of the pilot flame and operable upon said pilot-burner valve to close the pilot line upon extinction of the pilot flame, a throttle in said pilot line functioning to pass the gas at the minimum pressure required for feeding the pilot burner, a main control gas line connecting the control chamber of the main valve to said pilot line at a point between said throttle and said pilot burner, an additional control line connecting said main control line to said pilot line at a point therein on the high-pressure side of said throttle, and a valve in said additional control line operable to control the flow of gas therethrough.

7. A safety device for gas burning apparatus, comprising the combination with a gas main feeding a main burner, of a main valve controlling said gas main, actuating means for said valve comprising a diaphragm and a mounting therefor exposing said diaphragm on one side to the

pressure in said gas main on the supply side of said valve and forming with said diaphragm a control chamber on the other side thereof whereby said valve may be actuated by variations of the gas pressure in said control chamber, a pilot burner and a pilot line leading from the main gas side of the diaphragm to said pilot burner, a valve for said pilot burner, a thermostat responsive to the heat of the pilot flame and operable upon said pilot-burner valve to close the pilot line upon extinction of the pilot flame, a throttle in said pilot line functioning to pass the gas at the minimum pressure required for feeding the pilot burner, a main control gas line connecting the control chamber of the main valve to said pilot line at a point between said throttle and said pilot burner, additional control lines connecting said main control line to said pilot line at points therein on the high-pressure side of said throttle, a valve in each of said additional control lines operable to control the flow of gas therethrough, and an additional throttle arranged in said main control line between the points of connection thereto of said additional control lines.

8. A gas burning apparatus comprising a main burner, a gas line for supplying gas thereto, a main gas valve in said line, differential-pressure operated means comprising a diaphragm and a mounting therefor exposing said diaphragm on one side to the gas pressure in said line on the pressure side of said valve and forming with said diaphragm a pressure-control chamber on the opposite side thereof for opening said valve by reduction in pressure in said chamber below the pressure on the opposite side of said diaphragm, said valve being formed to automatically close upon equalization of pressures on the opposite sides of said diaphragm, a pilot burner and a valve therefor, means automatically operating to close said pilot burner valve upon extinguishment of the pilot flame, conduit means connecting said gas line on the pressure side of said main gas valve with said control chamber and said pilot burner, additional conduit means in communication with said gas line and said control chamber and a control valve therein operable between closed and open positions for controlling the flow of gas through said additional conduit means, said first-mentioned conduit means and said additional conduit means being so formed and cooperatively arranged as to produce when said control valve and said pilot-burner valve are both open a gas flow to said control chamber and said pilot burner feeding the pilot flame and maintaining the gas pressure in said control chamber equal to the gas pressure on the opposite face of said diaphragm and thereby maintaining said main gas valve in closed position, to produce when said control valve is closed and said pilot-burner valve is open such a flow of gas to said pilot burner and withdrawal of gas from said control chamber as to feed the pilot flame and reduce the pressure in said control chamber sufficiently to effect the opening of said main gas valve and to produce when said pilot-burner valve is closed upon extinguishment of the pilot flame such a rise in the gas pressure in said control chamber as to maintain said main gas valve in closed position until said pilot burner valve is again opened, both of said conduit means having an outlet to atmosphere only through said pilot burner.

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