

**Dec. 6, 1949**

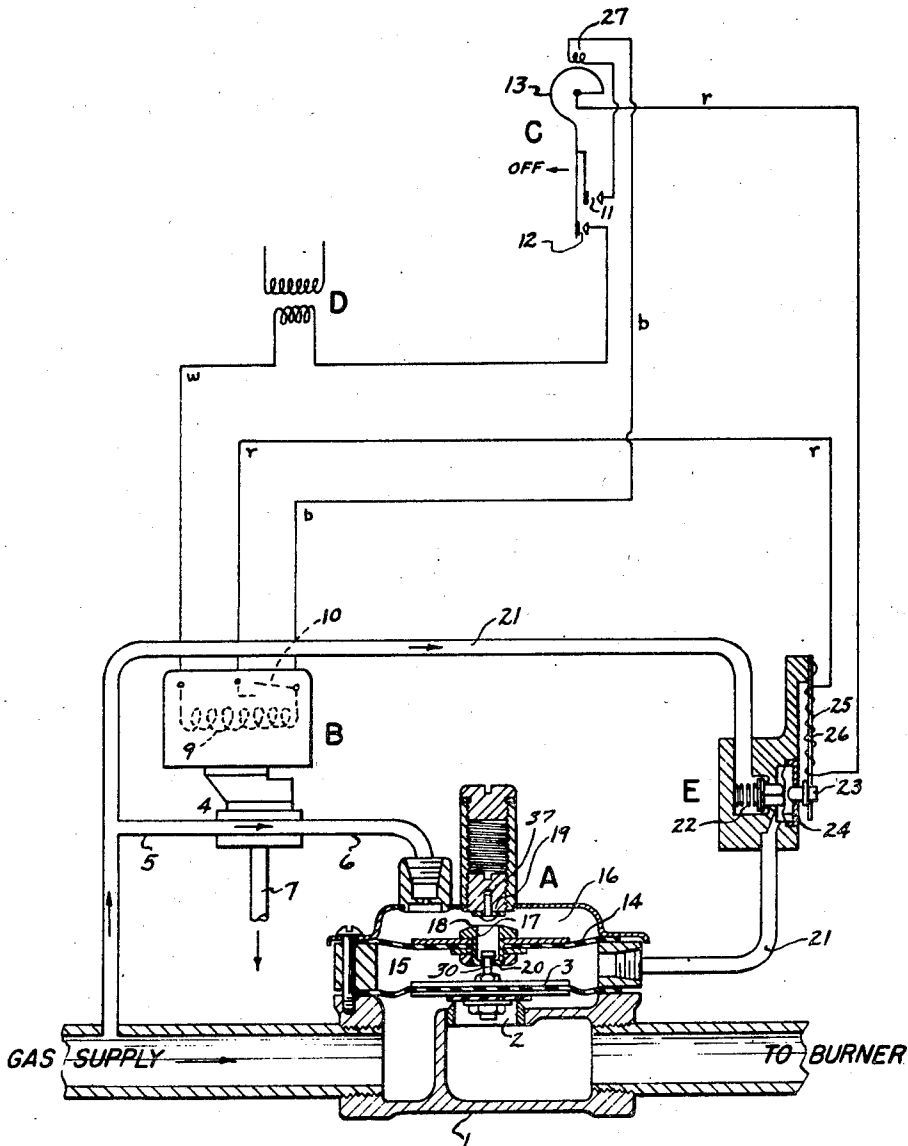
**K. T. DAVIS**

**2,490,420**

## GAS CONTROL MEANS

Filed Feb. 10, 1948

2 Sheets-Sheet 1



**INVENTOR.**

**KEITH T. DAVIS**

**BY**

Frank R. Higley

Dec. 6, 1949

K. T. DAVIS  
GAS CONTROL MEANS

2,490,420

Filed Feb. 10, 1948

2 Sheets-Sheet 2

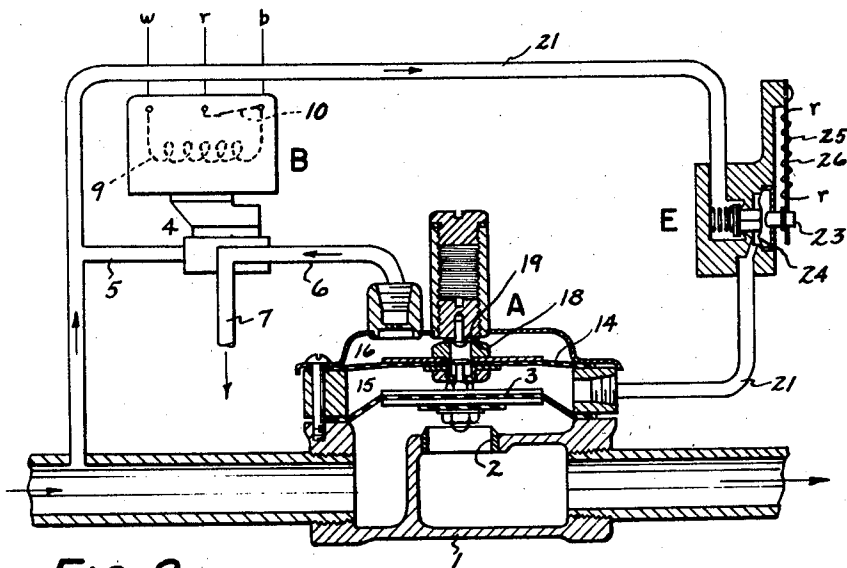


FIG. 2

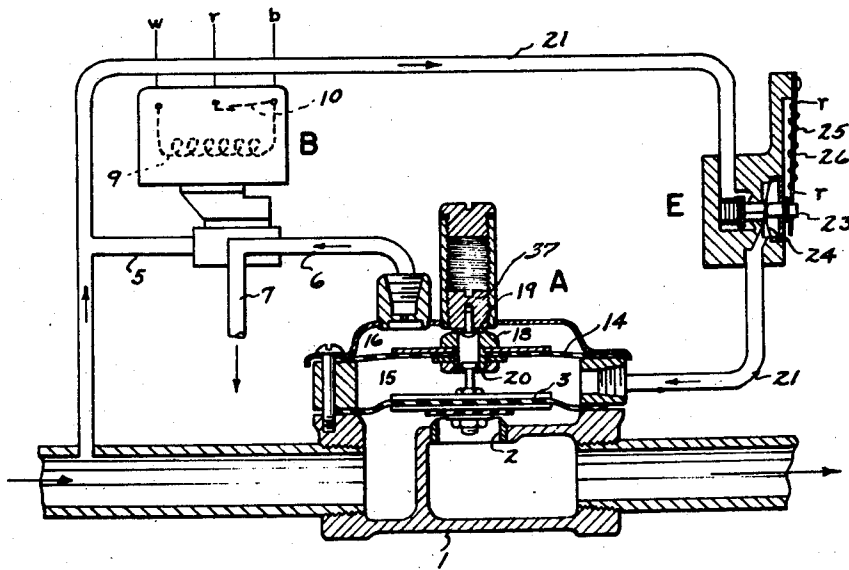


FIG. 3

INVENTOR.  
KEITH T. DAVIS  
BY  
Frank R. Higley

## UNITED STATES PATENT OFFICE

2,490,420

## GAS CONTROL MEANS

Keith T. Davis, Cleveland, Ohio, assignor, by  
mesne assignments, to Affiliated Gas Equip-  
ment, Inc., Cleveland, Ohio, a corporation of  
Delaware

Application February 10, 1948, Serial No. 7,462

5 Claims. (Cl. 137-153)

1

This invention relates to gas fuel control means for heating systems wherein a heating device burner has operation responsive to a condition such as temperature within a space to receive heat from operation of the burner.

An object of the invention is to arrange a single valve for immediate control of the burner operation, with provision that, in a heating cycle, the valve is first fully opened responsive to one condition such as a call for heat at a certain temperature, and thereafter the valve will partially close to provide throttling effect upon the burner, with consequent reduced rate of heat output therefrom until another condition such as a slightly higher temperature, is satisfied.

Other objects are to accomplish the above with the fewest and simplest parts, employing insofar as possible units which are well known in the art and readily obtainable as practically standardized units therein.

More particular objects are to provide a simple circuit employing such units for the purpose described, together with a main valve of simple novel construction for employment in such circuit to the ends described.

Further objects and advantages will be apparent from the following description taken in connection with the accompanying drawings, wherein

Fig. 1 is a conventionalized and diagrammatic view showing pertinent details of construction of certain units, together with an elementary circuit by which the units are interrelated; the parts being designed for control of a gas burner subject to room temperature, and appearing in the figure as in "off" position wherein the thermostat indicated is satisfied and gas supply is cut off from the burner by the main valve appearing;

Fig. 2 is a view including certain of the parts appearing in Fig. 1, but indicating its parts as in "on" position; and

Fig. 3 is a view similar to Fig. 2 but showing the parts as in throttling position.

In all of the drawings arrows indicate either flow or presence or direction of pressure.

With reference now to the drawings, A indicates generally main gas valve means, B motorized valve means, and C room thermostat means.

The main valve A includes a body 1 with inlet and outlet openings for connections from gas supply and to the burner means to be controlled, as indicated in the drawing. The body means has a port 2 effective between its inlet and outlet openings, and thereabove a chamber with a movable wall portion 3 here shown as in the form of a diaphragm and carrying the main valve ar-

2

ranged to close the port 2 responsive to pressure within the chamber.

The motorized valve means B includes a valve 4 having connection 5 from the gas supply line, a connection 6 to the diaphragm chamber of the main gas valve A, and an exhaust connection 7 which may lead to a vent or flare pilot not shown. The arrangement is such that when the valve 4 is in the "off" position indicated in Fig. 1, the chamber of the main valve A will be subject to line-gas pressure by way of the connections 5 and 6, and the vent connection 7 will be closed; whereas when the valve 4 is in "on" position as indicated in Figs. 2 and 3, gas supply will be cut off from the chamber of the main gas valve A, and the latter will be relieved of its pressure, by way of the connections 6 and 7 so that the main valve is permitted to open, as indicated Fig. 2, under line-gas pressure.

For motorization of the valve 4, any suitable device may be employed, here conventionally indicated as by the electrical coil 9, arranged for energization to position the valve 4 as in Figs. 2 and 3, and when de-energized to position the valve 4 as in Fig. 1. Motorized valves suitable for the purpose are well known in the art, one being shown at Fig. 5 in Patent No. 2,098,383, issued November 9, 1937, to Furlong.

The thermostat C is located in the space to be heated responsive to operation of the burner means which receives gas subject to the main valve A.

The thermostat is of the double contact type, being adapted to make contact at 11 at the temperature at which commencement of burner operation is desired, and to make contact at 12 at a slightly higher temperature at which burner operation is to be discontinued; both contactors being subject to a bimetallic or otherwise thermally-responsive electrically conductive element 13.

Switch means 10 is associated with the motorizing means 9 for the valve 4 to have closed or energizing position coincident with energization of the valve 4 to open position; such arrangement also being well known in the art and an example thereof illustrated in detail in the patent above identified.

The parts thus far described have circuit forming interconnections as follows: A line w, including a source of power such as the transformer D, interconnects the contactor 12 of the room thermostat C with one end of the motor 9 of the valve 4. A line b connects the other room thermostat contact 11 with the other end of the

3

motor 9 and one pole of the switch 10 has connection through a line *r* with the element 13 of the room thermostat C.

What has thus far been described is generally well known in the art as will be appreciated by one familiar therewith, and has operation as follows:

Commencing with the parts as in Fig. 1, the room thermostat C is satisfied, both its contacts 11 and 12 are open, the motorized valve B is de-energized, the chamber of the main gas valve A is at line-gas pressure to maintain the valve closed, and no flow of gas is had to the burner.

As the room temperature drops, the thermostat C will make contact first at 12 and then at 11. Contact made at 12 effects no immediate result, but upon contact at 11, the motor 9 of the motorized valve 4 will be energized by a circuit including the transformer D, contacts 12 and 11, line *b*, through the motor 9, and back to the transformer by line *w*.

Energization of the motorized valve B moves valve 4 to the position of Fig. 2, relieving pressure within the chamber of the main gas valve A and permitting the latter to open under main gas pressure and allow flow to the burner.

Continued operation of the burner eventually raises the temperature in the space to be heated until the thermostat C reopens contact at 11. However, main burner operation continues because of the switch 10, which closed coincidentally with energization of the motor 9, and the line *r* which provides alternate return connection to the thermostat, in holding circuit relation to the line *b* which is now dead.

On further rise in its temperature, the thermostat opens contact at 12, the motorized valve 4 is de-energized, and admission of gas to the chamber of the valve A closes the gas supply to the burner.

It may be observed that in the above operations the main gas valve A when closed, is so maintained because the total pressure within its chamber effective throughout the area of its diaphragm 3 is greater than the total pressure tending to open it, on the opposite face of the diaphragm 3 about the port 2. Similarly, when the valve is open it has effectively line-gas pressure throughout its area on its port side opposed only by atmospheric pressure on its chamber side. Thus the main gas valve, so far as hereinbefore described, has merely two positions: either fully closed as in Fig. 1 or fully open as in Fig. 2.

According to this invention I provide a third, partially open position for the main gas valve whereby throttling effect upon the burner is had, as indicated Fig. 3; and arrange further for control of the valve to such throttling position.

For the purpose, as to the main valve A, I arrange a movable partition wall or diaphragm 14 to divide its diaphragm chamber into a pair of subchambers including a near subchamber 15 partially bounded by the main diaphragm 3, and a far subchamber 16 separated from the diaphragm 3 by the partition 14.

The connection 6 from the motorized valve means 4 communicates immediately with the far subchamber 16, and in order to transmit closing gas pressure to the diaphragm 3, the partition wall 14 is provided with a central aperture 17 in a suitably arranged boss 18 carried by the partition wall:

To permit pressure within the near subchamber 15 without pressure in the far subchamber

4

16, I provide a seat 19 against which the boss 18 may bear to close the aperture 17.

To locate the diaphragm 3 in throttling position by means of the partition wall 14 when the boss 18 is seated to close the aperture 17, without preventing full valve opening movement of the diaphragm 3 when pressure is relieved within the subchamber 15, I provide a lost motion connection effective between the diaphragm 3 and the partition wall 14. Such lost motion connection is here shown as a central stud 30 on the diaphragm 3, having a head within the aperture 17 engageable with an internal flange 20 on the boss 18, these parts fitting loosely so as not to prevent gas flow between the two subchambers 15 and 16 by way of the aperture 17.

To supply pressure within the near subchamber 15 when the far subchamber 16 is relieved of pressure, the body means of the valve A is laterally apertured for a connection 21 leading back to the gas supply, by way of an auxiliary valve E.

The valve E, as indicated in the drawings, is maintained yieldably closed by a spring 22, against which it may be opened by a plunger 23 acting through a sealing diaphragm 24.

For opening of the valve E, subject to control of the room thermostat C, remotely controlled motor means are provided, here indicated as by a heating coil 25 effective upon a bimetallic blade 26 which in turn carries the plunger 23; the coil 25 being in circuit in the line *r*, which runs from the thermostatic element 13 to one side of the switch 10.

Operation of the described novel parts will be as follows: When the parts are in "off" position as in Fig. 1, the main valve will be closed, closing gas pressure being effective on the main valve diaphragm 3 by way of the subchamber 15, the aperture 17, subchamber 16, and line 6 from the motorized valve B; such pressure finding no escape from the subchamber 15 by way of the line 21, because the auxiliary valve E is closed. The heating coil 25 is de-energized, its line *r* being dead because the switch 10 is open.

Upon call for heat by the room thermostat C, making contact at both 11 and 12, the motorized valve B relieves main gas valve closing pressure, and the main gas valve A immediately fully opens.

After slight room temperature rise, the room thermostat breaks contact at 11 and the switch 10 being closed, the heating coil 25 is energized to energize the bimetallic blade 26, and the blade moves the plunger 23 to open the auxiliary valve E, admitting gas pressure to the subchamber 15. Such pressure raises the partition wall 14 to close the boss 18 against its seat 19, thus preventing escape by way of the aperture 17. Such pressure within the subchamber 15 also is effective upon the diaphragm 3, tending to close the main gas valve. However, the head of the stud 30 engages the flange 20, limiting the closing motion of the main gas valve and thus locating the latter by means of the partition wall 14, in throttling position. The parts are then positioned as in Fig. 3 and main gas flow to limited extent is admitted to the burner.

To predetermine the amount of such flow, I provide adjustment for the position of the seat 19 against which the boss 18 bears. As here shown for the purpose, the seat is carried by a nut 27 threadedly mounted in the cover portion of the main gas valve body means as indicated.

After such throttling operation for a sufficient

period of time, the room thermostat C breaks contact at 12, returning the motorized valve B to closed position and immediately closing the main gas valve A under line-gas pressure; and coincidentally de-energizing the heating coil 25 of the auxiliary valve E.

It will be noted that by this invention, although throttling operation of the burner may be had after a period of full operation in each complete burner cycle; nevertheless, when the burner comes on responsive to the thermostat, it is always initially at full line pressure so that ignition is assured. Also, the total "on" period relative to "off" period in the complete cycle, will be increased, although with graduated effect, so that a more even room temperature will be had, from the same thermostat, than before.

Under certain conditions the normal operating cycle may vary for considerable periods between throttling and full "on," with only occasional "off" periods; so that comfort is increased in the heated space, and burner noise, "on" and "off," as met in certain gases, is reduced.

For still more sensitive operation, the line b, which includes the thermostat contact 11, may be provided with a heating element 27 of slight heating capacity and properly slight electrical resistance relative to the motor 9 of the motorized valve B, effective on the element 13 of the thermostat C, to have heat anticipating effect upon the thermostat. Such coil will be energized upon making of contact at 11 and de-energized on breaking thereof, to decrease time lapsed before circuit is broken at such contact to initiate effectiveness of the auxiliary valve E.

While in the arrangement specifically shown, the described throttling effect is had responsive to the room thermostat C, the remotely controlled motor means of the auxiliary valve E having connection with the thermostat C for the purpose, as will be appreciated by one familiar with the art, throttling effect might be made responsive to conditions other than those of room temperature.

For example, throttling operation might be had responsive to temperature or pressure within a boiler subject to the main gas valve A. Thus to obtain throttling responsive to boiler pressure, the auxiliary valve E could be arranged for opening actuation by a diaphragm, having connection with the boiler, in place of the blade 26 and its coil 25 responsive to the room thermostat. Similarly, as for a water boiler, the motor means of the auxiliary valve E could be arranged to be responsive to temperature of the water within the boiler. Still similarly and within the scope of this invention, the auxiliary valve E and thus the throttling operation of the system, might be made responsive to humidity, by a suitable remotely controlled motor for it.

The general arrangement just described lends itself to boiler control of the so-called gas type, with slight modification as follows:

A slight leakage may be arranged effective at the check valve from the near subchamber 15 to the far subchamber 16 when the check valve is in checking position as in Figs. 2 and 3, the orifice effect of such leakage providing greater restriction at the check valve than the resistance from the subchamber 16 out through the exhaust connection 7. The auxiliary valve E is then arranged to have its effective opening modulated responsive to boiler temperature or pressure in any manner whereupon the main valve A will

have corresponding modulating effect upon main gas flow.

With the exception of the auxiliary valve E and its immediate connections, both installation and servicing will be practically as heretofore in the art, since the main gas valve A, as improved for throttling effect according to this invention, replaces but a single diaphragm valve unit in the prior art.

What I claim is:

1. In gas valve means comprising body means having gas inlet and outlet openings and a valve port effective therebetween, and having a chamber with a movable wall portion, said wall portion having associated main valve means arranged to close said port responsive to pressure within said chamber against said wall portion: a movable partition wall arranged to divide said chamber into a near subchamber partially bounded by said movable wall portion and a far subchamber separated from said movable wall portion by said near subchamber, said body means being apertured to provide separate inlets to said subchambers, and said partition wall being apertured to provide communication between said subchambers, check valve means associated with the aperture of said partition wall to check flow there-through from said near subchamber to said far subchamber, and lost motion means interassociating said movable wall portion and said partition wall, to locate said main valve means in throttling position responsive to pressure within said near subchamber.

2. In gas valve means comprising body means having gas inlet and outlet openings and a valve port effective therebetween, and having a chamber with a movable wall portion, said wall portion having associated main valve means arranged to close said port responsive to pressure within said chamber against said wall portion: a movable partition wall arranged to divide said chamber into a near subchamber partially bounded by said movable wall portion and a far subchamber separated from said movable wall portion by said near subchamber, said body means being apertured to provide separate inlets to said subchambers, and said partition wall being apertured to provide communication between said subchambers, said body means and said partition wall being arranged for cooperation to provide a closed position of the partition wall aperture against said body means responsive to pressure within said near subchamber, and lost motion means interassociating said movable wall portion and said partition wall, to locate said main valve means in throttling position when said partition wall aperture is closed.

3. In gas valve means comprising body means having gas inlet and outlet openings and a valve port effective therebetween, and having a chamber with a movable wall portion, said wall portion having associated main valve means arranged to close said port responsive to pressure within said chamber against said wall portion: a movable partition wall arranged to divide said chamber into a near subchamber partially bounded by said movable wall portion and a far subchamber separated from said movable wall portion by said near subchamber, said body means being apertured to provide separate inlets to said subchambers, and said partition wall being apertured to provide communication between said subchambers, a portion of said body means and of said partition wall being arranged for

7

cooperation to provide a closed position of the partition wall aperture against said body means portion responsive to pressure within said near subchamber, lost motion means interassociating said movable wall portion and said partition wall, to locate said main valve means in throttling position when said partition wall aperture is closed, and means for adjusting said body means portion to thereby adjust the amount of said throttling.

4. In gas valve means comprising body means having gas inlet and outlet openings and a valve port effective therebetween, and having a chamber with a movable wall portion, said wall portion having associated main valve means arranged to close said port responsive to pressure within said chamber against said wall portion: a movable partition wall arranged to divide said chamber into a near subchamber partially bounded by said movable wall portion and a far subchamber separated from said movable wall portion by said near subchamber, said body means being apertured to provide separate inlets to said subchambers, and said partition wall being apertured to provide communication between said subchambers, check valve means associated with the aperture of said partition wall to prevent flow therethrough from said near subchamber to said far subchamber but permit flow in the opposite direction, and lost motion means interassociating said movable wall portion and said partition wall, to locate said main valve means in throttling position responsive to pressure within said near subchamber.

5. In gas valve means comprising body means having gas inlet and outlet openings and a valve port effective therebetween, and having a

8

chamber with a movable wall portion, said wall portion having associated main valve means arranged to close said port responsive to pressure within said chamber against said wall portion: a movable partition wall arranged to divide said chamber into a near subchamber partially bounded by said movable wall portion and a far subchamber separated from said movable wall portion by said near subchamber, said body means being apertured to provide separate inlets to said subchambers, and said partition wall being apertured to provide communication between said subchambers, check valve means associated with the aperture of said partition wall to permit relatively free flow therethrough from said far subchamber to said near subchamber and relatively slight flow from said near subchamber to said far subchamber, and lost motion means interassociating said movable wall portion and said partition wall, to locate said main valve means in throttling position responsive to pressure within said near subchamber.

KEITH T. DAVIS.

#### REFERENCES CITED

The following references are of record in the file of this patent:

#### UNITED STATES PATENTS

| Number    | Name                  | Date          |
|-----------|-----------------------|---------------|
| 2,158,787 | Lorenz et al. ....    | May 16, 1939  |
| 2,164,511 | Furlong .....         | July 4, 1939  |
| 2,244,555 | Harris .....          | June 3, 1941  |
| 2,282,755 | Bondurant et al. .... | May 12, 1942  |
| 2,328,279 | Jones .....           | Aug. 31, 1943 |
| 2,377,517 | Ray .....             | June 5, 1945  |