Jan. 19, 1932. E. J. TE PAS 1,842,337

GASEOUS FUEL CONTROL SYSTEM

Filed Jan. 12. 1927 2 Sheets-Sheet 1

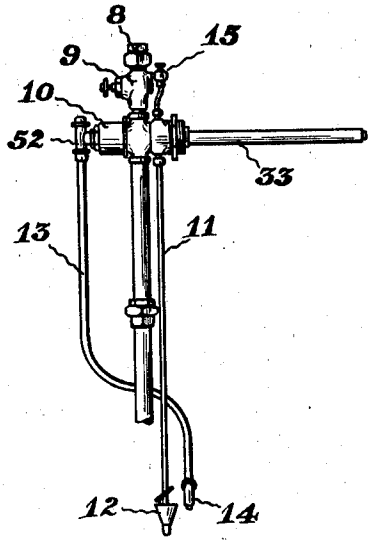

FIG. 2

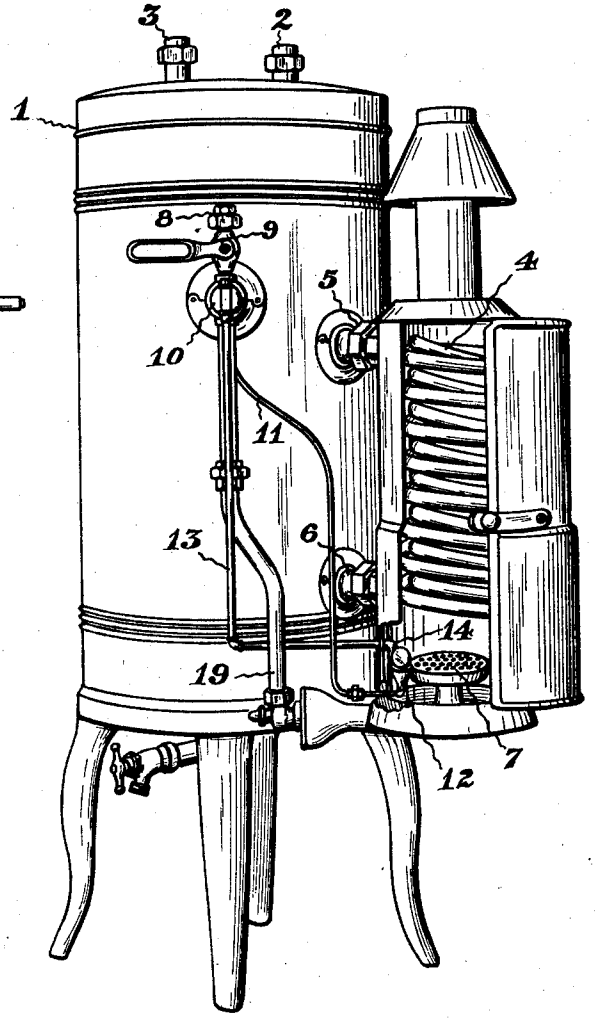

FIG. 1

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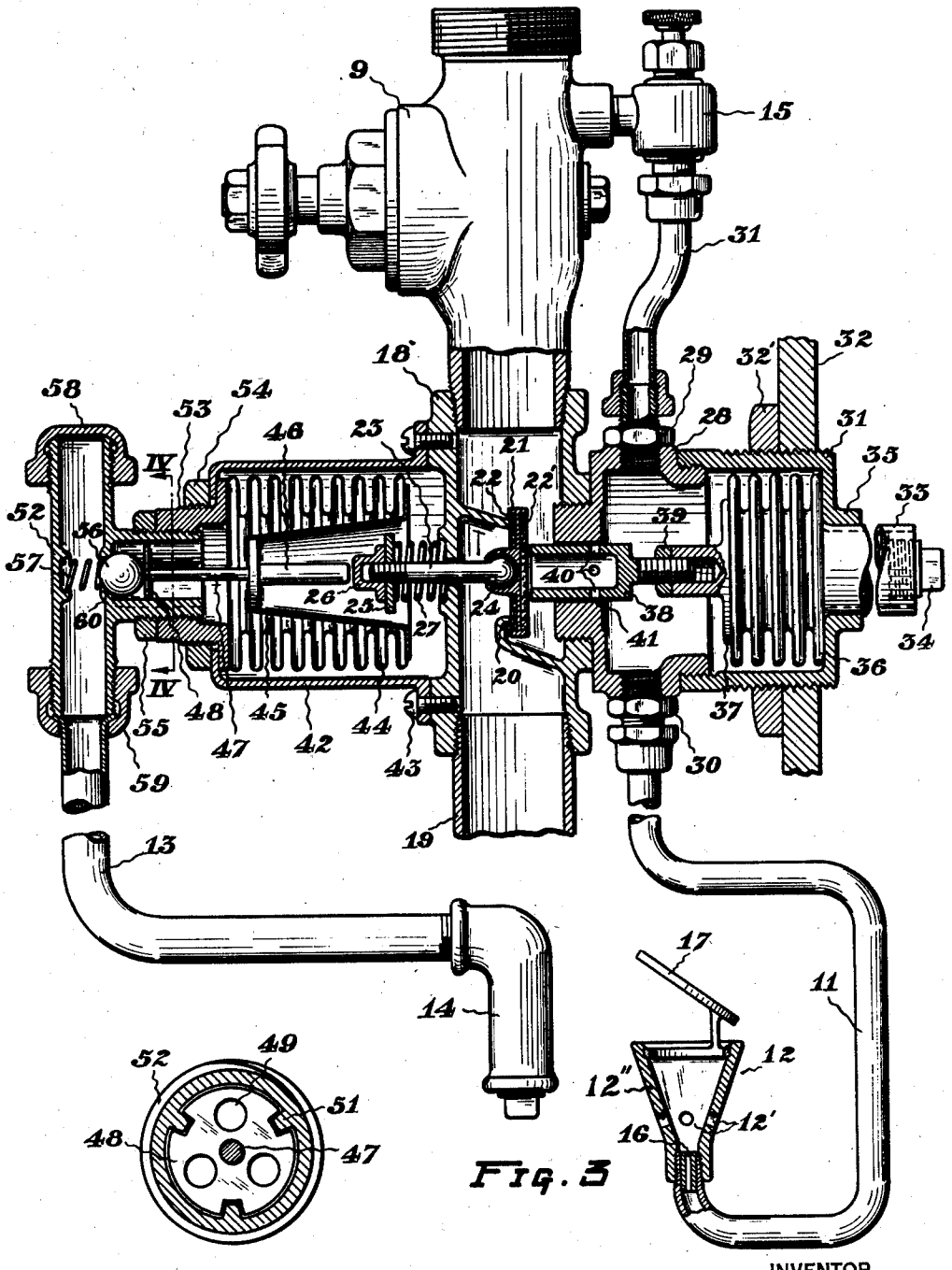

Fig. 3

Fig. 4

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Patented Jan. 19, 1932

1,842,337

UNITED STATES PATENT OFFICE

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GASEOUS FUEL CONTROL SYSTEM

Application filed January 12, 1927. Serial No. 160,747.

This invention relates to improvements in fluid heaters and in particular to storage automatic gas fired water heaters.

Heaters of the latter type comprise in general a storage tank with water circulating elements connected thereto and a gas burner to furnish the heat for the water circulating elements. The gas supply of the heating burner is ordinarily controlled by a thermostat responsive to the temperature of the water of either the graduating or snap-acting type. Heaters using a snap-acting thermostat in which the gas valve is either in a fully open or fully closed position require a constantly burning pilot light for ignition of the burner. Due to the possibility of extinguishment of the pilot light, it is becoming common practice to equip water heaters of the above type with some sort of a safety device under the control of the pilot light to insure the presence of the pilot light when the gas is turned on by the thermostat. These safety devices as a rule consist of a thermostatic valve which is held open by the heat of the pilot flame and in the absence of such flame are supposed to close and prevent the admission of gas to the main burner. Valves of this type operate only when a dangerous condition occurs and are open to the objection that they may get out of order without affecting the normal operation of the fuel control system and then when they are called upon to function they fail in their mission. Another objection to a separate safety device of this sort is the added expense of manufacture and installation.

The objects of this invention are to provide in a single unitary structure a thermostatic safety gaseous fuel control valve; that is relatively simple in construction and inexpensive to manufacture, that will function over a long period of time without attention or adjustment, that can be simply and easily installed in substantially any type of gas fired water heater or boiler, that will never turn on the gas if the ignition pilot light of the main burner is extinguished, that will shut off the gas upon extinguishment of the pilot light, that can be opened only by the heat from the main burner ignition pilot, that opens with a quick motion, that regulates and controls the gas required to keep it open, and that closes itself and stays closed upon failure of its operating elements.

This invention accomplishes in a single unit that which has previously required the use of two separate valves together with their actuating mechanism.

A structure which is the preferred embodiment of my invention is clearly illustrated in the accompanying drawings, in which:

Fig. 1 is perspective view of a storage automatic water heater equipped with my improved thermostatic safety fuel control valve.

Fig. 2 is a side elevation of the control valve removed from the heater tank.

Fig. 3 is an enlarged side elevation partly in section of the structure shown in Fig. 2 and Fig. 4 is a section taken on line IV—IV of Fig. 3.

Referring to Fig. 1 which shows a storage automatic water heater of the conventional type equipped with my improved fuel control, the numeral 1 indicates the outer casing of a storage tank. Water inlets and outlets are indicated by 2 and 3 respectively. The usual coil type water circulating elements 4 are connected to the tank by couplings 5 and 6. Heat is supplied to the circulating elements by a gas burner 7. Gas for this burner is supplied by a feed line to be connected to the system by means of the union coupling 8 which is provided therefor.

A manually operable cock 9 is positioned below this union 8 and just above the control valve the end of which is indicated by 10 in Fig. 1. A needle valve 15 connected to the cock 9 above its shutoff plug, controls the flow of gas to a constantly burning pilot 12 in communication with the feed line 11. Conduit 13 at one end is provided with a fitting 14 which serves as a closure and is connected at its other end to the control valve 10 by the T 52.

The pilot burner 12 which is not specifically claimed in this case forming part of a separate application for Letters Patent filed by L. F. Doen, April 15, 1927, Serial No. 184,085 and comprises a conical shaped member 12''

provided with primary air inlet holes 12' and a gas orifice or spud 16. A deflector plate 17 is positioned on the top of this burner. Normally the pilot flame does not burn high enough to be deflected to any great extent by the deflector plate but when the pilot is provided with an increased gas supply the gas impinges upon the plate 17 and is deflected to one side of the burner. The reason for deflecting the flame is to cause it to impinge upon and heat the fitting 14 the purpose of which will be explained in detail in the latter part of this specification.

The valve casing 18 is adapted to threadably receive at its inlet end the manually operable cock 9 and at its outlet end the conduit 19. The valve casing 18 has formed within it a valve seat 20 which cooperates with a disc shaped valve head 21 to control fluid flow between its inlet and outlet ends. The valve head 21 is provided with facings 22 and 22' of a yielding material such as leather and is mounted upon a valve stem 23 by means of a ball and socket joint 24. The valve defined by the seat 20 and head 21 is normally held in a closed position by means of a spring 27 which is retained in position by a nut 25 and a lock nut 26. These nuts serve as an adjusting means for the tension of the spring 27 as well as for the clearance under the valve tappet 46. The valve casing 18 is detachably secured to and carried by a coupling member 28. This coupling member is provided with fittings 29 and 30 which are connected to the pilot burner feed lines 31 and 11 respectively, providing a continuous passageway between the needle valve 15 and the pilot burner 12. The coupling member 28 is in turn carried by a housing member 31 which is adapted to be screwed into the water tank 32 of the heater. A lock nut 32' serves to hold the member 33 in the desired position. The housing member 31 supports in its interior a thermostat of the fluid expansion type.

The thermostat is made up of a tube 33 connected in a suitable and fluid tight manner to an expansible-contractible member or bellows 36. The tube 33 is provided with a removable plug 34 at the end opposite the bellows. This thermostat has confined within it under less than atmospheric pressure, a small amount of liquid such as acetone so that normally the bellows is in a partially contracted state by reason of the different pressures its interior and exterior are subjected to. An internally threaded member 37 is secured to the end of the bellows. This member 37 carries a sleeve valve 38 which is adjustably secured thereto by the lock nut 39. The sleeve valve 38 is centrally bored and open at the end adjacent the valve head 21. Four holes 40 communicate with the central bore and provide the passageway through the valve when it is in its retracted position in the bore 41 of a coupling member 28.

A bellows housing 42 is secured to the valve casing 18 on the side opposite the aforementioned thermostat by means of screws 43. A bellows 44 similar in design to the bellows 36 is carried in this housing. The bellows 44 has secured to its inner end a conical member 45 which serves as a closure for one end of the bellows and also carries a valve tappet 46 adapted to make contact with the nut 26 to actuate the valve head 21 carried by valve stem 23. The member 45 constitutes a core insert for the bellows 44 and occupies the major portion of the interior area of the bellows so that a smaller amount of fluid is required to effect the initial movement of the bellows 44 upon the unseating of the ball valve 56. The valve tappet is provided with an internal extention 47 which carries a crosshead 48. This crosshead reciprocates in a suitable guide in the T 52. In order to permit the free passage of gas past the crosshead there are provided three holes 49 in the crosshead.

A ball check valve 56 provided with a spring 57 is in contact with the extension 47 and is adapted to ride upon the guide fins 51 of the T 52. The ball check valve is under control of the bellows 44 which is normally in a partially expanded condition serving as a spring to hold the ball 56 in contact with a suitable valve seat 60 formed in the T fitting 52. The reason for having the bellows 44 normally expanded or extended is further taken advantage of for safety purposes as will be hereinafter set forth. The bellows 44 in this case acts as a spring pushing the extension 47 of the valve tappet against the sphere 56 as viewed in Fig. 3. An externally and internally threaded member 53 is secured to the bellows 44 in a fluid tight manner. The element 53 serves to carry the bellows 44 and is secured to the bellows housing 42 by means of a lock nut 54. The member 53 also receives one of the branches of the T fitting 52 which is locked in position by means of a nut 55. The T fitting is provided with a closure cap 58 for another of its branches and upon the branch opposite thereto the conduit 13 is secured by means of an apertured cap 59. The bellows 44, T 52, conduit 13 and fitting 14 combine to form a sealed chamber which contains a small amount of low boiling point liquid such as alcohol.

The operation of the device is substantially as follows: With the parts in the position shown in Fig. 3, the contents of the storage tank should be in a heated condition. Upon cooling of the water in the tank which is in contact with the tube 33 of the thermostat, the pressure inside of the thermostat will decrease with the temperature of the water. This reduction in pressure will cause the bellows 36 to gradually contract and at the same

time shift the sleeve valve 38 to the right. When the sleeve valve has shifted sufficiently to the right to uncover the ports 40 the gas supply to the pilot 13 which has been provided for up to now only by the needle valve 15, is now increased and the enlarged flame of the burner 12 impinges upon the plate 17 and is deflected against the fitting 14. The fitting 14 is now heated until the vapor pressure of the liquid inside of this fitting and the conduit 13 is sufficiently great to unseat the ball check valve 56 thus defining a source of fluid pressure responsive to the heat of the burner 12 for effecting the operation of the bellows 44. When this condition is reached the pressure caused by the deflected pilot flame first builds up a pressure in the chamber defined by the bellows 44 and ball check 56 until the pressure in this chamber is great enough to expand the bellows and draw the crosshead 48 and stem 47 away from the ball 56. The fluid pressure now is not restrained by the throttling action of the ball 56 and the total pressure in the system acts upon the relatively large piston area provided by the bellows 44. This serves to quickly expand the bellows 44 moving the tappet 46 against the adjusting nut 26 of the valve stem 23 which carries the valve head 21 opening the valve defined by the valve head 21 and the valve seat 20 with a quick action. By this action, gas is admitted to the conduit 19 and thence to the burner 7 which in turn is ignited by the flame of the pilot 12. The flame of the burner 7 now causes the liquid contents of the tank 32 to become heated and upon reaching a temperature determined by the adjustment of the thermostat and its sleeve valve, the sleeve valve is pushed against the face 22′ of the valve head 21 cutting off the increased supply of gas to the pilot burner 12 and at the same time urging the valve head 21 towards its seat 22. Upon the cutting off of this increased supply of gas to the pilot burner 12, the source of heat supply is taken away from the valve actuating mechanism, the pressure drops therein and the bellows 44 collapses allowing the valve head 21 by means of its spring 27 to shift to its closed position. Due to the fact that the fluid pressure within the tank thermostat is directly proportional to the temperature of the liquid contents of storage tank of the heater, continued operation of the burner 7, for any reason after the time when it should have been extinguished, causes further expansion of the thermostatic bellows 36. This expansion pushes the sleeve 38 against the valve head 21 with sufficient force to close this valve and cut off the gas supply to the burner 7 when the contents of the storage tank have reached a predetermined excessive temperature. It will be noted in connection with the operation of this control that the size of the flame required to maintain the valve open is controlled by the valve head 21 which working in combination with the valve seat formed by the open end of the sleeve valve 38 regulates the increased supply of gas to the burner 12. As an example of this action if the pilot 12 furnishes more heat than is needed the pressure required in the bellows 44 increases to the point where the valve head 21 entirely closes the open end of the sleeve 38 shutting off the impinging flame of the pilot burner 12 allowing the pressure to decrease until equilibrium is reached between the pressure necessary to hold the valve open and the heat necessary to maintain this pressure. Due to the fact that the bellows 36 is under reduced pressure and consequently in a normally contracted condition, in the event that a leak should develop in this bellows or the tube 33 the bellows will tend to expand closing off the additional supply of gas to the burner 12 by forcing the sleeve valve 38 against the valve face 22′ and at the same time urging the valve head 21 against its seat 20. The bellows 44 being at all times in a partially expanded condition will assume in the event of leakage of the bellows or of the system of which it forms a part, the position shown in Fig. 3 allowing the spring 27 to close the valve.

The invention of using a movable valve seat to shift a valve head is broadly claimed in my copending applications Serial Nos. 271,802 and 271,803 and the present invention contemplates among other things the provision of novel operating means for such valve seat as well as the elimination of a supplemental burner to heat the thermostat as shown in my above refered to copending application.

Furthermore, it is to be understood that the particular forms of apparatus shown and described, and the particular procedure set forth, are presented for purposes of explanation and illustration and that various modifications of said apparatus and procedure can be made without departing from my invention as defined in the appended claims.

Having now fully described my said invention, what I claim and desire to secure by Letters Patent, is:

1. In a quick acting pressure operated valve, a normally closed valve, a pressure chamber adapted to contain a fluid under pressure, an expansible-contractible chamber having a movable wall adapted to be placed in communication with said pressure chamber to open said normally closed valve, and a check valve engaged by the movable wall of said chamber for controlling communication between said chambers, said check valve opening when the pressure in the pressure chamber is at a predetermined point allowing the pressure to act upon the relatively large piston face of the expansible-contractible chamber quickly expanding this chamber and opening the said normally closed valve.

2. In a thermostatic valve, a thermostat,

a ported sleeve valve open at one end carried by said thermostat and adapted to provide a fluid passageway through said sleeve valve upon a predetermined movement of said thermostat, a valve seat formed on the open end of said sleeve valve, and a valve head cooperating therewith to control fluid flow through said sleeve valve.

3. A fluid fuel control valve, means to normally maintain said valve closed, sealed pressure responsive means to open said valve and sealed pressure responsive means to close said valve, both of said pressure responsive means being so arranged that failure of the seal of either one or both of said means will cause said valve to close if open and prevent it from opening again so long as said seal or seals are broken.

4. In a storage automatic water heater, a main heating gas burner, a main supply valve therefor, a constantly burning ignition pilot burner adjacent said main burner, a thermostatic valve, means to increase the flow of gas to said ignition pilot burner when the temperature of the water in the heater drops below a predetermined point, a source of fluid pressure maintained by the heat from said ignition pilot burner the pressure thereof varying directly as the flame of said pilot burner varies, pressure responsive means to open said main supply valve and supply gas to the main burner, and means connecting said pressure responsive means to said sources of fluid pressure when the pressure of said source of fluid pressure exceeds a predetermined value.

5. In a pressure operated device, a valve, a pressure responsive expansion element to open said valve, a source of fluid pressure, and means directly responsive thereto under control of said element for controlling communication between said source of fluid pressure and said pressure responsive element.

6. In a pressure operated device, a valve, pressure responsive means to open said valve, a source of fluid pressure, means to vary the pressure in said source of fluid pressure, and means engaged by said pressure responsive means and movable therewith for controlling communication between said source of fluid pressure and said pressure responsive means.

7. In a pressure operated device, a valve, pressure responsive means to open said valve, a source of heat, a source of fluid pressure associated therewith comprising a chamber for the reception of a thermo-sensitive fluid, and means responsive to said fluid pressure for controlling communication between said source of fluid pressure and said pressure responsive means.

8. In a gaseous fuel valve, a valve head, thermally responsive means to actuate said valve head, a constantly burning ignition burner constituting the source of heat energy for said thermally responsive means, and means directly associated with said valve head to vary the flow of gas to said ignition pilot burner and to effect the opening movement of said valve head, said last named means being further adapted to engage and shift said valve head to its closed position.

9. In a gaseous fuel valve, a valve head, a constantly burning ignition pilot burner adapted to support a flame of varying size, pressure responsive means associated with said ignition pilot burner and responsive in its operation to the heat emitted thereby to actuate said valve head in accordance with the size of the flame of said ignition pilot burner, and means directly associated with said valve head to vary the size of the flame of said ignition pilot burner to effect the opening movement of said valve head, said last named means being further adapted to engage and shift said valve head to its closed position.

10. In a valve, a valve head normally maintained in its closed valve position, a sealed chamber comprising a metallic bellows normally maintained in an expanded condition by fluid pressure within said bellows and adapted to further expand and to shift said valve head to its open position upon a predetermined increase in said fluid pressure, and a second sealed chamber comprising a second metallic bellows normally maintained in a contracted condition by a sub-atmospheric pressure within said bellows and adapted to expand and to urge said valve head to its closed position upon a predetermined increase in pressure within said second bellows, both of said bellows and said valve head cooperating to provide a normally closed valve upon equalization of the internal and external pressure acting on either or both of said bellows.

11. In a fluid fuel control, a pilot burner adapted to support a flame of varying size, a main burner in lighting proximity thereto, thermostatic means to increase or decrease the size of the flame of said pilot burner, and means directly responsive to the heat supplied by said pilot burner when its flame is increased in size for supplying fuel to said main burner, said last named means being further adapted to regulate the size of the flame of said pilot burner in accordance with the thermal condition of said means.

12. An automatic gas burner control comprising, a gas burner, a source of gas supply therefor, a valve to control the flow of gas to said gas burner, a continuously operating pilot burner to ignite the gas supplied to said gas burner, means secured to said valve controlling a passageway therein to vary the size of the flame of said pilot burner, and means responsive to the heat emitted by said pilot burner secured to said valve to actuate the same and control a second passageway therein in accordance with and in response

to the variations in the size of the flame of said pilot burner.

13. An automatic gas burner control comprising, a gas burner, a source of gas supply therefor, a single valve having a ported valve body and associated valve head to control the flow of gas to said gas burner, a conduit connecting said valve to said gas burner, a pilot burner to ignite the gas supplied to said gas burner, thermostatic means carried by the body of said valve to control the flow of gas from an outlet passageway thereof and to vary the size of the flame to said pilot burner, and means responsive to the heat emitted by said pilot burner carried by the body of said valve to actuate its valve head in accordance with the variations in the size of the flame of said pilot burner and thus control the flow of gas to said gas burner.

14. An automatic gas burner control comprising, a gas burner, a source of gas supply therefor, a single valve having a ported valve body and associated valve head to control the flow of gas to said gas burner, a conduit connecting said valve to said gas burner, a pilot burner to ignite the gas supplied to said gas burner, thermostatic means carried by the body of said valve to control the flow of gas from an outlet passageway thereof to vary the size of the flame of said pilot burner, and pressure responsive means responsive to the heat emitted by said pilot burner carried by the body of said valve and having a portion extending therefrom to a point adjacent said pilot burner to actuate said valve head in accordance with the variations in the size of the flame of said pilot burner and thus control the flow of gas to said gas burner.

15. In a water heater fuel control, a hot water storage tank therefor, a gas burner, a gas valve, a pair of opposed expansible-contractible elements, a valve head for said valve positioned between said elements and responsive in its movements to said elements, thermo-responsive fluid pressure means to expand and contract one of said elements in accordance with the temperature of the water in said tank, a source of heat controlled thereby, and additional thermo-responsive fluid pressure means responsive to said source of heat to expand and contract the other of said elements in accordance with the operation of said first named element to effect the operation of said valve and control the gas supply of said burner.

16. In a water heater fuel control, a hot water storage tank therefor, a gas burner, a pilot burner therefore, a gas valve, a pair of opposed expansible-contractible elements, a valve head for said valve positioned between said elements and responsive in its movements to said elements, thermo-responsive fluid pressure means to expand one of said elements to shift said valve head to its open position and supply gas to said gas burner, and thermo-responsive fluid pressure means to expand the other of said elements to shift said valve head to its closed position and cut off the gas supply of said gas burner in accordance with the temperature of the water in said tank.

17. In a gas appliance control, a gas burner, a valve, a pair of opposed expansible-contractible elements, a valve head for said valve positioned between said elements and responsive in its movements to said elements, a source of heat, thermostatic means to expand and contract one of said elements for controlling said source of heat in accordance with the thermal conditions of the appliance, and thermostatic means responsive to said source of heat to expand and contract the other of said elements in accordance with the operation of said first named element to effect the operation of said valve and control the fuel supply of said gas burner.

18. In a gas valve, a pair of opposed expansible-contractible elements defining in part a pair of sealed chambers for the confinement of a thermo-sensitive fluid, a valve head for said valve positioned between said elements and responsive in its movements to said elements, a pilot burner adapted to supply heat for the operation of one of said elements, and supplemental valve means associated with the other of said elements for controlling the operation of said pilot burner, first named element and gas valve.

19. In a valve, a valve body having a main valve port and a supplemental outlet passage formed therein, a valve head operatively associated with said main valve port to control fluid flow therethrough, temperature responsive means secured to said valve body, supplemental valve means for controlling fluid flow from the supplemental outlet passage of said body operatively associated with said temperature responsive means for effecting the operation of said valve head, said supplemental valve means being adapted under predetermined conditions to engage and force said valve head into closing relation with the main port of said valve body.

20. In a valve, a valve body having a valve port and a bypass outlet formed therein, a valve head operatively associated with said valve port to control fluid flow therethrough, thermostatic means to effect the operation of said valve head, temperature responsive means secured to said valve body, valve means operatively associated with said temperature responsive means to control fluid flow from said bypass outlet, said valve means being further adapted at times to engage said valve head to force it into closing engagement with said valve port, and a constantly burning pilot burner adapted to support a flame varying in size and controlled

by said temperature responsive means for supplying heat to said thermostatic means and for controlling the operation thereof.

21. In a thermostatic burner control, a source of fuel supply, a fuel valve, a valve body therefor having a valve port and a bypass outlet formed therein, a single valve head operatively associated with said valve port and said bypass outlet to control fluid flow therethrough, a main burner communicating with said valve port, thermostatic means to effect the operation of said valve head for controlling the gas supply of said main burner, a pilot burner associated therewith for constant communication with said source of fuel supply, temperature responsive means secured to said valve body, and valve means operatively associated with said temperature responsive means and said valve head to control fluid flow from the bypass outlet of said valve body to increase at times the fuel supply of said pilot burner and thereby heat said thermostatic means for the purpose of effecting the opening movement of said valve head, said valve means being further adapted to engage said valve head to decrease the fuel supply of said pilot burner and to force said valve head into closing relation with said valve port.

22. In a valve, a valve body having a valve port and a bypass outlet formed therein, a valve head operatively associated with said valve port to control fluid flow therethrough, temperature responsive means secured to said valve body, a sleeve valve operatively associated with said temperature responsive means to control fluid flow from said bypass outlet, and a pilot burner adapted to normally maintain a minimum flame that is increased in size when said sleeve valve is in open position, and means responsive to the heat emitted by said pilot burner when its flame is increased in size to shift said valve head to open position with respect to said valve port.

23. In a valve, a valve body having a valve port and a bypass outlet formed therein, a valve head operatively associated with said valve port to control fluid flow therethrough, temperature responsive means secured to said valve body, an open ended hollow sleeve valve operatively associated with said temperature responsive means to control fluid flow from said bypass outlet, and a pilot burner adapted to normally maintain a minimum flame that is increased in size when said sleeve valve is in open position, and means responsive to the heat emitted by said pilot burner when its flame is increased in size to shift said valve head to open position with respect to said valve port and into closing engagement with the open end of said sleeve valve.

24. In a gas valve, a valve body having a valve port and an auxiliary outlet formed therein, a valve head operatively associated with said valve port to control fluid flow therethrough, a sleeve valve positioned opposite said valve head and adapted to control fluid flow from said auxiliary outlet, means to actuate said sleeve valve, a pilot burner supplied with a fixed flow of gas that is increased when said sleeve is opened, means responsive to the heat of said pilot burner when its fuel supply is increased to shift said valve head to open position with respect to said valve port and into cooperative engagement with said sleeve valve to control and regulate the operation of said pilot burner.

25. In a hydrocarbon fuel fired appliance, a main burner and an ignition burner therefor in combination with a unitary structure comprising, a valve body connected to a source of fuel supply and having a main and an auxiliary outlet passage adapted for communication with said main burner and said ignition burner respectively, means for regulating the flow of fuel from the auxiliary outlet passage of said body to said ignition burner to control the flame size thereof, and means associated with the main outlet passage of said valve body solely responsive in its operation to the heat emitted by said ignition burner for connecting said main burner to the source of fuel supply and for regulating the fuel supply of said ignition burner.

26. In a hydrocarbon fuel fired appliance, a main burner and an ignition burner therefor in combination with a unitary structure comprising, a valve body connected to a source of fuel supply and having a main and an auxiliary outlet passage adapted for communication with said main burner and said ignition burner respectively, means for regulating the flow of fuel from the auxiliary outlet passage of said body to said ignition burner to control the flame size thereof, and means controlling the flow of fuel from the main outlet passage of said valve body responsive in its operation to the heat emitted by said ignition burner for connecting said main burner to a source of fuel supply and cooperating with said ignition burner regulating means to regulate at times the fuel supply of said ignition burner.

27. In a thermostatic valve, a valve member, an expansible chamber having a movable wall operatively associated with said valve member, a chamber of fixed volume adapted for communication therewith, said chambers being adapted for the confinement of a thermo-sensitive fluid, means for controlling communication between said chambers, and means for supplying heat to the thermo-sensitive fluid to effect the operation of said valve member.

28. In a pressure operated device, a valve member, a valve seat controlled thereby, an expansible chamber having a movable wall

operatively associated with said member and a port or passageway communicating with the interior thereof, said port or passageway having a smaller cross-sectional area than the area of the movable wall of said chamber, a source of fluid pressure communicating with said port, and a valve for controlling communication between said source of fluid pressure and the interior of said chamber adapted to open in response to fluid pressures acting upon the portion of the valve exposed thereto and to close in response to fluid pressures acting upon the movable wall of said chamber.

29. In a pressure operated device, a valve member, a valve seat controlled thereby, an expansible chamber having a movable wall operatively associated with said member and a port or passageway communicating with the interior thereof, said port or passageway having a smaller cross-sectional area than the area of the movable wall of said chamber, a source of fluid pressure communicating with said port, and a check valve engaged by the movable wall of said chamber for controlling communication between said source of fluid pressure and the interior of said chamber, said check valve being further adapted to open in response to fluid pressures acting upon the portion of the valve exposed thereto and to close in response to fluid pressures acting upon the movable wall of said chamber.

30. In a pressure operated thermostatic device, a valve member, a valve seat controlled thereby, an expansible chamber having a movable wall operatively associated with said member and a port or passageway communicating with the interior thereof, said port or passageway having a smaller cross-sectional area than the area of the movable wall of said chamber, a container for a thermo-sensitive fluid communicating with said port providing a source of fluid pressure, means for heating said container to vary the pressure therein, and a valve for controlling communication between said source of fluid pressure and the interior of said chamber adapted to open in response to fluid pressures acting upon the portion of the valve exposed thereto and to close in response to fluid pressures acting upon the movable wall of said chamber.

31. In a gas burning appliance, a gas valve having a pair of outlet ports, a main heating burner, a valve head to control the flow of gas from one of the outlet ports of said valve to said main heating burner, a continuously burning ignition pilot burner adapted to light said main burner, and thermo-sensitive fluid pressure means associated with said valve head and responsive to the heat produced by said pilot burner to regulate at times the flow of gas to said pilot burner from the other outlet port of said valve.

32. In a safety control for gas fired liquid heaters, the combination of a storage tank, a main heating gas burner, an ignition pilot burner adjacent thereto, and a unitary control device adapted for installation in the wall of said tank comprising a valve casing, thermostatic valve means associated therewith responsive to the temperature of the liquid being heated to control the operation of said pilot burner, and additional valve means associated with said casing forming a part of said unitary control device, said last named valve means being responsive in its operation to the heat emitted by said pilot burner and having a portion extending therefrom to a point adjacent said pilot burner whereby to control the flow of gas to said main burner and to regulate at times the flow of gas to said pilot burner, and a conduit connecting said valve casing with said main burner.

33. A liquid heater comprising, a storage vessel, a main gas burner to heat the contents of said storage vessel, a thermostatic valve to control the flow of gas to said main burner, an ignition pilot burner adapted to provide a source of energy for the operation of said thermostatic valve, and means controlled by the temperature of liquid in said container to control the flow of gas to said ignition pilot burner and to positively move said thermostatic valve to its closed position.

34. A thermostatic valve comprising, a body having a bypass outlet formed therein, a thermostatic actuating element, valve means in said body operatively engaged by said element, a gas burner adjacent said element adapted to supply heat thereto, and means comprising a graduating thermostat having a sleeve valve connected thereto and carried in the bypass outlet of said body to control the flow of gas to said gas burner.

35. In a thermostatic valve, a body having a main outlet and an auxiliary outlet, a thermostatic actuating element, valve means in said body operatively engaged by said element, a gas burner adjacent said element and adapted to supply heat thereto, and a thermostatically actuated sleeve valve carried in the auxiliary outlet of said body to control the flow of gas to said gas burner.

36. In a safety control for liquid heaters, thermostatic means controlled by the temperature of the liquid which is being heated, a gas burner to heat the liquid, a valve body having a main outlet and an auxiliary outlet, valve means in said body to control the flow of gas from the main outlet of said body to said gas burner, a thermostatic actuator therefor, a pilot gas burner to supply heat energy to said actuator to operate said valve means, and means comprising a supplemental valve carried in the auxiliary outlet of said valve body operatively associated with said first named thermostatic means to control the operation of said pilot burner.

In testimony whereof I affix my signature.

EDMUND J. TE PAS.