

Dec. 30, 1969

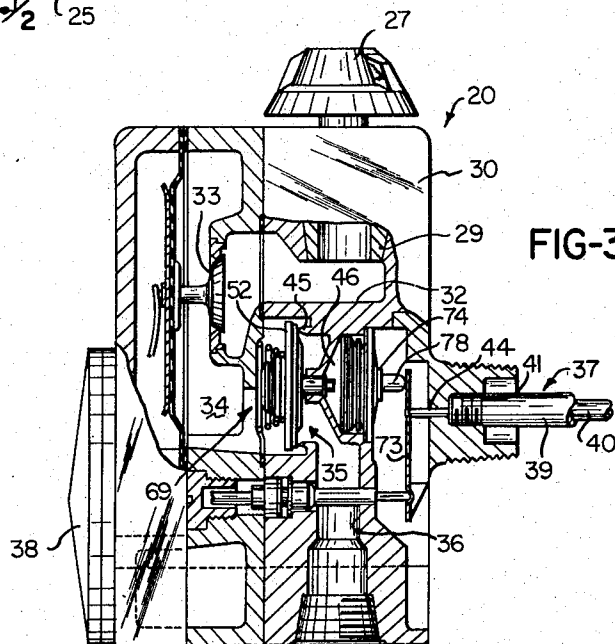
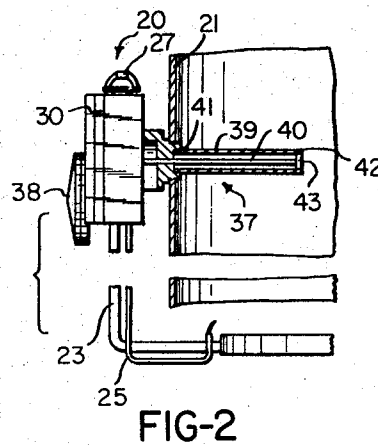
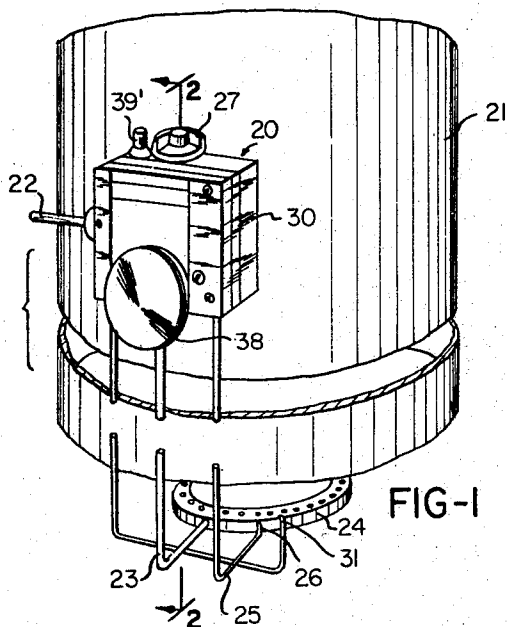
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3,486,732

DUAL SEATING VALVE

Original Filed Nov. 20, 1962

4 Sheets-Sheet 1



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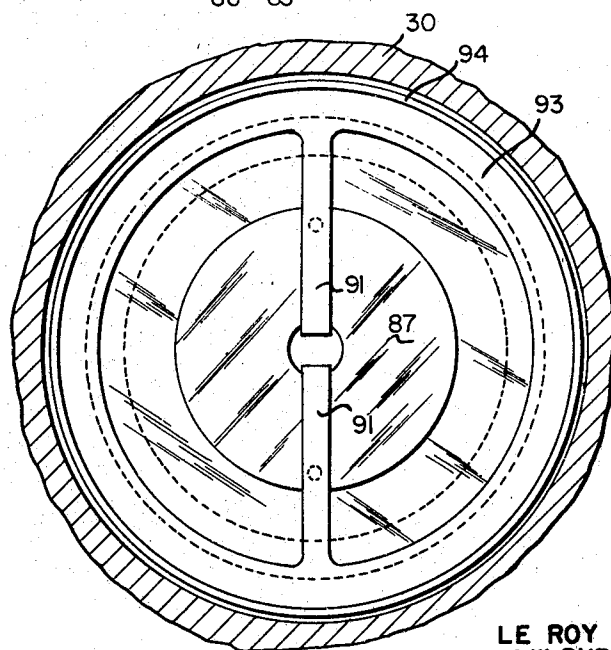
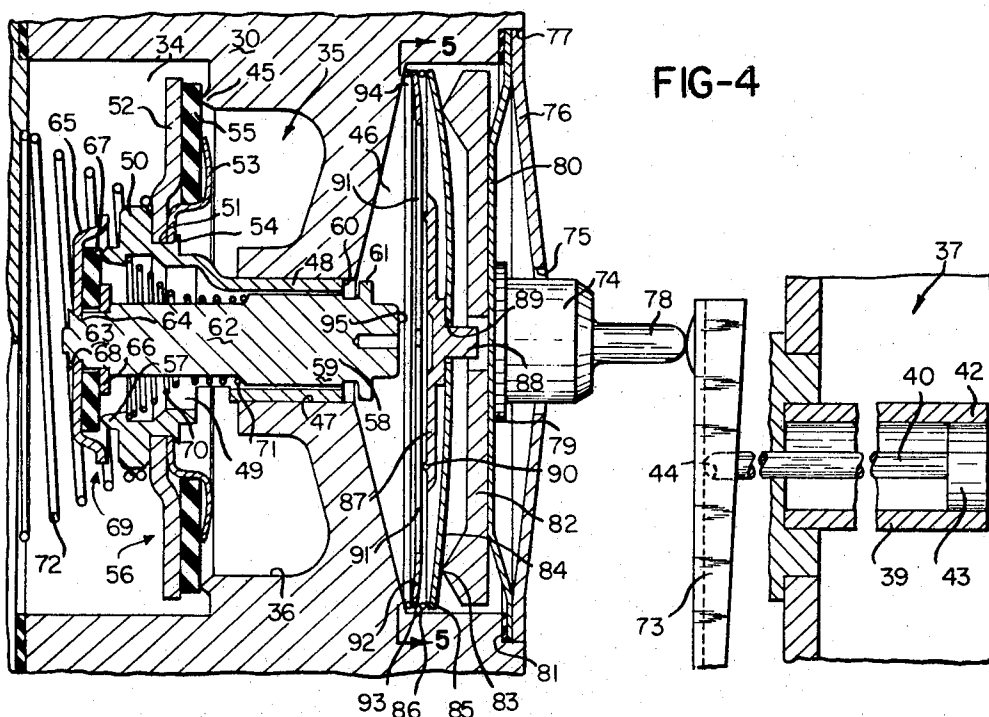
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DUAL SEATING VALVE

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4 Sheets-Sheet 2



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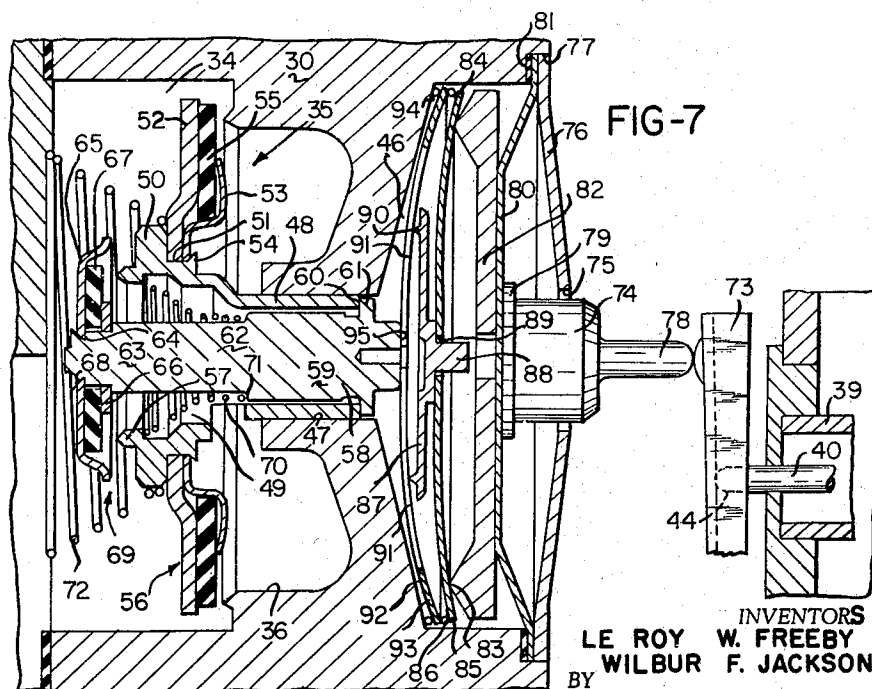
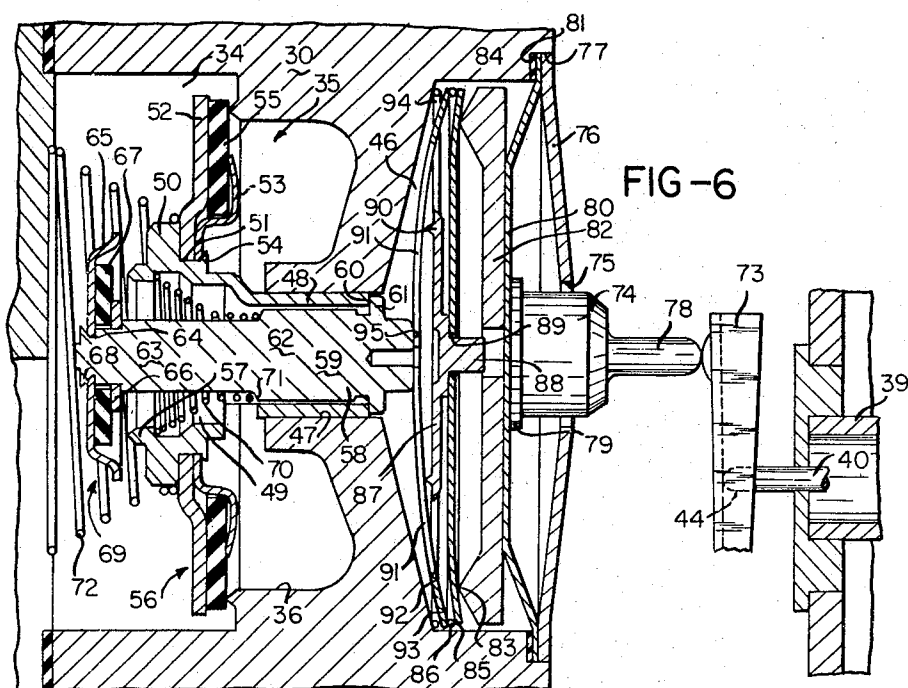
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DUAL SEATING VALVE

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4 Sheets-Sheet 3



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DUAL SEATING VALVE

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4 Sheets-Sheet 4

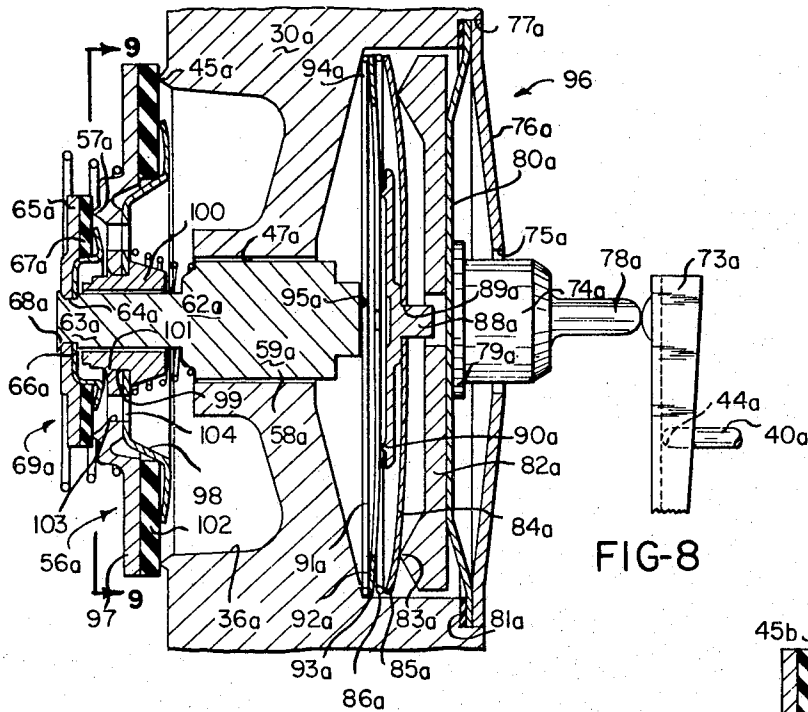


FIG-8

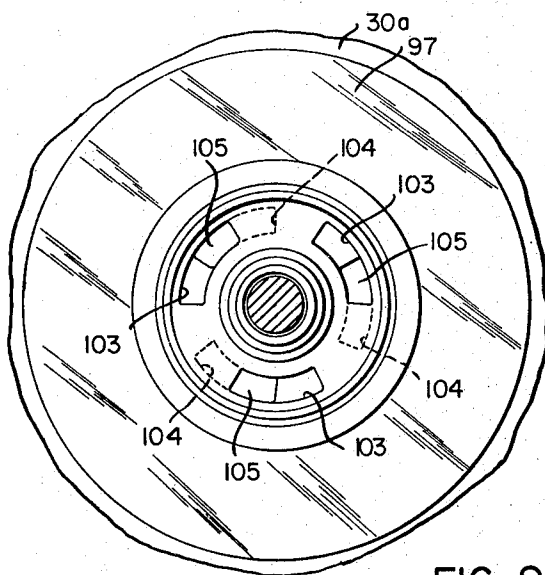


FIG-9

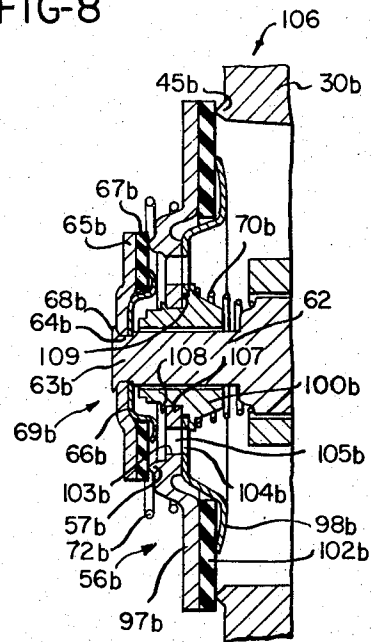


FIG-10

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3,486,732

DUAL SEATING VALVE

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Original application Nov. 20, 1962, Ser. No. 238,899, now Patent No. 3,275,035, dated Sept. 27, 1966. Divided and this application July 20, 1966, Ser. No. 566,555

Int. Cl. F16k 31/44, 25/00

U.S. Cl. 251—75

16 Claims

ABSTRACT OF THE DISCLOSURE

This disclosure relates to valve means for controlling the flow of fuel from an inlet of a housing means through a valve seat means thereof to an outlet thereof wherein a main valve member is adapted to be snap opened to permit a first flow of fuel to issue to the outlet means for normal use of a burner means and when an abnormal demand on such burner means is made, a supplemental valve member carried by the main valve member is initially snapped to an open position to add an additional flow of fuel to the outlet means to compensate for such abnormal demand on the burner means. Such snap action of the supplemental valve member is provided by an amplifying member disposed between a snap action member and the valve members to transmit movement of the snap action member to both valve members. The main valve member and supplemental valve member are so constructed and arranged that a spring means is operatively disposed therebetween to normally tend to maintain one of the valve members in its closed position and another spring means normally tends to maintain the other valve member in its closed position, the spring means permitting each valve member to be moved to its open position in opposition to only the force of a single spring means.

This application is a divisional patent application of its copending patent application, Ser. No. 238,899, filed Nov. 20, 1962 and now U.S. Patent No. 3,275,035 which is assigned to the same assignee to whom this application is assigned.

This invention relates to an improved control device for water heaters and the like, as well as to improved parts for such a control device or the like.

Heretofore, various control devices have been provided for domestic water tanks and the like to control the heating thereof.

For example, one prior known control device included a housing having means to receive fuel, such as gas or the like, from a source thereof and having means to selectively direct the fuel to a pilot burner and a main burner, the pilot burner having a continuously burning flame for igniting fuel issuing from the main burner in an intermittent operation thereof and the main burner being utilized to heat the water in the tank to tend to maintain the water at a constant temperature regardless of the amount of heated water drawn from the tank.

Such a control device has a thermostatically operated valve means interconnecting the source of fuel with the main burner whereby the thermostat means senses the temperature of the water in the tank and opens the valve means when the temperature of the water falls below a selected temperature setting to cause the main burner to heat the water tank up to the selected temperature whereby the thermostat means closes the valve means to terminate the operation of the main burner.

However, it has been found that in such a prior known control, the recovery rate of the temperature in the water heater tank remains the same whether small draws of hot water or large draws of hot water are made on the

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water heater tank whereby the control must be set at a recovery rate sufficient to supply hot water in a reasonable time after a large draw of hot water has been made.

In this manner, the control also supplies the same high recovery rate when small draws of hot water are made whereby not only does the temperature of the water in the water heater tank overshoot the selected temperature to provide a dangerous hot water condition for house use but also the larger burner flame required for the high recovery rate reduces the life of the water heater tank.

In order to overcome this problem of prior known water heater controls, one would have to use a larger capacity water heater tank whereby not only is the same uneconomical to operate during normal operation thereof but also the same requires more building space adding to the overall cost of such an installation.

However, the improved control device of this invention permits a normal amount of fuel to issue from the main burner when the temperature of the water in the water tank only falls below a selected temperature a predetermined amount during normal draws of hot water whereby a normal, relatively low recovery rate is utilized.

However, should the temperature of the water fall below the predetermined amount by having an excessive or abnormal draw thereon, the control device of this invention automatically effects a greater flow of fuel to the main burner to rapidly heat up the water in the tank at a relatively high recovery rate until the temperature of the water approaches the selected temperature whereby the control device reduces the amount of fuel issuing from the burner to a normal amount of fuel which will be effective to subsequently bring the temperature of the water in the tank to the selected temperature.

In this manner, not only is overshooting of the temperature of the water tank substantially eliminated or materially reduced over prior known control devices by the control device of this invention, but also the control device of this invention permits a relatively smaller water tank to be utilized in situations where excessive draws may be effected thereon because such excessive draws are compensated by the control device of this invention while still operating the main burner in a normal manner should normal draws be made on the water tank.

In this manner, prolonged tank life is effected by the control device of this invention because reduced recovery rates are utilized during periods of lesser demands on the hot water system and because temperature overshoot is eliminated by reducing the recovery rate prior to cycle shutoff.

Therefore, the control device of this invention is adapted to permit a small sized water tank to be utilized in applications wherein emergency excessive draws therefrom can readily be compensated for by the control device of this invention so that oversized water tank constructions need not be utilized in order to anticipate such emergency excessive draws.

Accordingly, it is an object of this invention to provide improved water heating system or the like.

Another object of this invention is to provide an improved control device for such a system or the like.

A further object of this invention is to provide an improved valve means for such a control device or the like.

Other objects, uses and advantages of this invention are apparent from a reading of this description which proceeds with reference to the accompanying drawings forming a part thereof and wherein:

FIGURE 1 is a fragmentary, schematic, perspective view illustrating one embodiment of the water tank heating system of this invention.

FIGURE 2 is a fragmentary, cross-sectional view of the system illustrating in FIGURE 1 and is taken on line 2—2 thereof.

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FIGURE 3 is an enlarged, fragmentary, axial, cross-sectional view of the control device of FIGURE 1.

FIGURE 4 is an enlarged, schematic, cross-sectional view illustrating one embodiment of the valve means of the control device illustrated in FIGURE 3.

FIGURE 5 is an enlarged view of the motion amplifying means of the device illustrated in FIGURE 4 and is taken on line 5—5 thereof.

FIGURE 6 is a view similar to FIGURE 4 illustrating the valve means in one operating position thereof.

FIGURE 7 is a view similar to FIGURE 4 illustrating the valve means in another operating position thereof.

FIGURE 8 is a view similar to FIGURE 4 illustrating another embodiment of the valve means of this invention.

FIGURE 9 is an end view taken on line 9—9 of FIGURE 8.

FIGURE 10 is a fragmentary view similar to FIGURE 8 and illustrates still another embodiment of the valve means of this invention.

While the various features of this invention are herein-after described and illustrated as being particularly adaptable for forming a control device for a domestic water tank or the like, the various features of this invention can be utilized singly or in any combination thereof to provide other constructions as desired.

Therefore, this invention is not to be limited to only the embodiments illustrated in the drawings, because the drawings are merely utilized to illustrate one of the wide variety of uses of this invention.

Referring now to FIGURES 1 and 2, the improved control device of this invention is generally indicated by the reference numeral 20 and is adapted to maintain the temperature of water contained in a tank 21, such as a conventional domestic water heater tank or the like, at a selected temperature regardless of the amount of hot water drawn therefrom, the water level in the tank 21 being maintained at a substantially constant level by conventional means (not shown) as hot water is drawn from the tank 21.

In particular, the control device 20 is interconnected to a source of fuel by an inlet conduit 22 and is adapted to interconnect the inlet conduit 22 to an outlet conduit 23 leading to a main burner 24 for heating the tank 21. The control device 20 is also adapted to interconnect the inlet conduit 22 to a conduit 25 leading to a pilot burner 26 utilized to ignite fuel issuing from the main burner 24 in a manner hereinafter described.

The general operation of the control device 20 will now be described and reference is made to FIGURES 1, 2 and 3.

When the water heater system of this invention is initially installed, the control knob 27 of the control device 20 is normally disposed in an "off" position thereof whereby a cock valve 29, disposed in the housing 30 of the control device 20 is disposed in such a position that communication between the inlet 22 and the conduits 23 and 25 is prevented.

However, a conventional safety valve is disposed upstream from the cock valve 29 whereby the safety valve must be opened before the cock valve 29 can interconnect fuel to either the pilot burner 26 or main burner 24.

To actuate the water heater system of this invention, the control knob 27 is first rotated to a "pilot" position thereof whereby a groove of the cock valve 29 is adapted to only interconnect the inlet 22 to the pilot burner 26.

With the control knob 27 disposed in the "pilot" position thereof, a button 39' is manually pressed downwardly to manually open the safety valve member upstream from the cock valve 29 whereby fuel can issue from the pilot burner 26 and can be ignited either manually or automatically, as desired.

When a flame appears at the pilot burner 26, the button 39' is manually held downwardly until the heat of

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the flame issuing at the pilot burner 26 is sufficient to cause a thermocouple 31 (FIGURE 1) to operate suitable mechanism to hold the safety valve open.

Thus, the safety valve member will always remain in the open position thereof as long as a flame appears at the pilot burner 26.

However, should the flame at the pilot burner 26 be terminated, suitable spring means returns the safety valve member to the closed position to prevent fuel from passing through the control device 20.

After the pilot burner 26 has been ignited and the safety valve member is held in the open position, the control knob 27 is rotated to the "on" position thereof as illustrated in FIGURE 3 whereby the cock valve 29 not only continues to interconnect the inlet 22 with the pilot burner 26 but also interconnects the inlet 22 with a chamber 32 in the housing 30.

Fuel issuing from the chamber 32 can pass through a suitable pressure regulator 33 or not, as desired, such main fuel pressure regulating means not forming a part of this invention. After the fuel from the chamber 32 has passed through the pressure regulator 33, the same enters a chamber or inlet 34 formed in the housing 30 as illustrated in FIGURE 3.

From chamber or inlet 34, the gas or fuel is adapted to pass through a valve means 35 of this invention that defines a passage means to an outlet or chamber 36 interconnected to the outlet conduit 23 which leads to the main burner 24.

The fuel is only adapted to pass through the valve means 35 in a manner hereinafter described when a water temperature sensing means 37, FIGURES 2 and 3, determines that the temperature of the water in the tank has fallen below a temperature selected by a control knob 38 of the control device 20 a predetermined amount.

The temperature sensing or thermostat means 37 comprises a conventional tube 39 and rod 40 arrangement, the tube 39 and rod 40 being disposed in the interior of the tank 21 in such a manner that the end 41 of the tube 39 is fixed relative to the tank 21 and the other end 42 of the tube 39 is free for movement relative to tank 21.

The rod 40 has an end 43 secured to the free end 42 of the tube 39 and is formed of a material having a lower coefficient of thermal expansion than the tube 39 whereby the free end 44 of the rod 40 is moved to the left as illustrated in FIGURE 2 when there is a decrease in temperature in the tank 21 because the tube 39 contracts. Conversely, the end 44 of the rod 40 is moved to the right as illustrated in FIGURE 2 when the temperature in the tank 21 increases because the tube 39 expands.

In this manner, the thermostat means 37, after the pilot burner 26 has been ignited and the control knob 27 is disposed in the "on" position thereof, opens the valve means 35 in a manner hereinafter described to allow fuel to issue from the burner 24 when the temperature of the water in the tank 21 is below a selected temperature so that the burner 24 will heat the water in the tank 21 to the temperature selected by the control knob 38 in a manner conventional in the art.

When the temperature of the water in the tank 21 has reached the desired temperature level, the thermostat means 37 permits the valve means 35 to close so that no fuel issues from the burner 24 until the temperature of the water in the tank 21 falls below the selected temperature.

Thus, the main burner 24 is intermittently operated by the thermostat means 37 to maintain the water in the tank 21 at a selected temperature regardless of the amount of hot water drawn from the tank 21.

While one type of a general control system for heating a water tank has been described, such a system is merely emblematic of the many different types of systems to which the following features of this invention can be utilized.

The particular details and operation of the valve means 37 of this invention will now be described and reference is made to FIGURES 4-7.

As illustrated in FIGURE 4, the inlet chamber 34 and outlet chamber 36 formed in the housing 30 are separated by an annular supplemental valve seat 45 formed on the housing 30, the housing 30 having an open ended cavity 46 formed therein and interconnected to the chamber 36 by a bore 47.

A hollow valve stem 48 is disposed in sealing and sliding relation in the bore 47 of the housing 30 and has a passage means 49 formed therein which is adapted to interconnect the interior of the valve stem 48 to the chamber 36.

The valve stem 48 has an enlarged head 50 provided with an annular recess 51 receiving a backing disc 52 and a retainer disc 53 therein which are adapted to be secured thereto by staking at 54, the valve disc 52 and retainer disc 53 cooperating to secure an annular resilient face valve member 55 therebetween, the members 48, 52, 53 and 54 comprising a supplemental valve member 56 which is adapted to cooperate with the supplemental valve seat 45 in the manner illustrated in FIGURE 4 to close the supplemental valve seat 45.

The enlarged head 50 of the valve stem 48 defines a main valve seat 57 adapted to interconnect the chamber 34 with the interior of the valve stem 48.

Another valve stem 58 has an enlarged end portion 59 disposed in sliding and sealing engagement with the interior peripheral surface of the valve stem 48, the enlarged end 59 of the valve stem 58 projecting beyond the end surface 60 of the valve stem 48 and having an outwardly directed annular shoulder 61 adapted to abut the end 60 of the valve stem 48 in a manner hereinafter described.

The valve stem 58 has a reduced portion 62 disposed in the valve stem 48 to permit communication between the main valve seat 57 and the passage 49 in the valve stem 48 for a purpose hereinafter described.

The valve stem 58 is provided with a head 63 having an annular recess 64 respectively receiving a backing valve disc 65, a retainer 66 and a resilient face valve disc 67 therebetween, the members 65-67 being staked in the recess 64 at 68 whereby the members 58 and 65-67 define a main valve member 69 which cooperates with the main valve seat 57.

Thus, the valve seats 45 and 57 define a valve seat means that interconnects the inlet 34 to the outlet 36 with the valve members 56 and 69 controlling and cooperating with that valve seat means.

A compression spring 70 is disposed between an inwardly directed annular shoulder 71 formed on the valve stem 58 and the enlarged end 50 of the valve stem 48 to tend to hold the main valve member 69 against the main valve seat 57 to close the same.

When the main valve member 69 is seated, the annular shoulder 61 of the valve stem 58 is disposed remote from the end 60 of the valve stem 48 whereby the main valve member 69 can be moved to the left to open the main valve seat 57 before the shoulder 61 of the valve stem 58 contacts the end 60 of the valve stem 48 for a purpose hereinafter described.

A compression spring 72 is disposed between the housing 30 and the supplemental valve member 56 whereby the compression spring 72 tends to maintain the supplemental valve member 56 in its closed position against the supplemental valve seat 45, the force of the compression spring 72 being stronger than the force of the compression spring 70 for a purpose hereinafter described.

The thermostatic means 37 is utilized to operate the valve means 35 in a desired sequence, the end 44 of the rod 40 of the thermostatic means 37 engaging a lever 73 which is adjusted in a manner well known in the art to select a desired temperature setting of the water in the tank 21 by the control knob 38, such temperature

selecting structure not forming a part of this invention.

Accordingly, it is sufficient to state that should it be desired to maintain the temperature of the water in the tank 21 at a selected temperature, the control knob 38 of the control device 20 is turned to that selected temperature to adjust the lever 73 so that the thermostat means 37 will operate the valve means 35 of this invention in a manner hereinafter described to maintain the temperature of the water in the tank 21 at the selected temperature.

The lever 73 is adapted to engage a button 74 projecting outwardly through an aperture 75 in a diaphragm retainer 76 disposed in an annular recess 77 of the housing 30.

The button 74 has an end 78 engageable by the lever 73 whereby a movement of the end 44 of the rod 40 of the thermostatic means 37 to the left moves the button 74 to the left upon a decrease in temperature of the water within the tank 21.

The button 74 has the other end 79 thereof disposed against a sealing disc 80 disposed in the recess 77 against a gasket 81.

A movable plunger 82 is disposed against the lefthand side of the sealing disc 80 and has an annular shoulder 83 adapted to be disposed against a snap-action disc or member 84 normally disposed in the bowed condition illustrated in FIGURE 4, the snap-action member 84 having the outer periphery 85 thereof held against a retainer ring 86.

A fulcrum member 87 has a central projection 88 passing through a central aperture 89 formed in the snap-action member 84 and is disposed on the left-hand side thereof, the fulcrum member 87 having an annular shoulder 90 disposed against opposed flexible legs 91 of a motion amplifying lever or member 92 having its outer periphery 93 held between the retainer ring 86 and another ring 94.

When the button 74 is moved from the position illustrated in FIGURE 4 to the left as illustrated in the drawings, the plunger 82 acts against the snap-action member 84 to move the same to its dead-center position. When the snap-action member 84 is moved beyond its dead-center position, the same snaps into the over-center bowed condition illustrated in FIGURE 6 whereby the snapped snap-action member 84 causes the fulcrum member 87 to push the lever legs 91 against the end 95 of the stem 58 of the main valve member 69 to move the main valve member 69 to the left in opposition to the force of compression spring 70 to open the main valve seat 57, the full travel of movement of the snapped snap-action member 84 only causing the shoulder 61 of the stem 58 to be disposed against or spaced from the end 60 of the stem 48 of the supplemental valve member 56 and not open the supplemental valve member 56 as illustrated in FIGURE 6.

Further movement of the end 44 of the rod 40 of the thermostat means 37 to the left from the position illustrated in FIGURE 6 causes the button 74 to move to the left and through the members 82, 84, 87 and 91 causing the valve stem 58 to move to the left and carry the valve stem 48 therewith in opposition to the force of the compression spring 72 to open the supplemental valve member 56.

However, it has been found that when the legs 91 of the amplifying member 92 are relatively resilient rather than stiff, such further leftward movement of the button 74 does not initially open the supplemental valve member 56 but stores up motion in the flexing of the legs 91 because of the pressure of the gas in chamber 34 acting to hold the valve member 56 closed whereby the supplemental valve member 56 initially opens with a snap-action movement to provide a more rapid recovery rate than if the same were opened in a true modulating manner as will be apparent hereinafter.

As the end 44 of the rod 40 of thermostat means 37 begins to move to the right upon sensing an increase in the temperature of the water in the tank 21, the button 74 moves to the right causing the supplemental valve member 56 to close while the main valve member 69 remains in its open position. Subsequently, further movement of the button 74 to the right permits the main valve member 69 to close under the force of the compression spring 70 even though the lever legs 91 move out of engagement with the stem 58 of the main valve member 69.

The operation of the valve means 35 of this invention is described in the aforementioned parent U.S. Patent No. 3,275,035.

Further, other means could be provided for selectively adjusting the amount of fuel which will flow through the open main valve member 69 of the valve means 35 of this invention.

In particular, reference is made to FIGURE 8 wherein another valve means of this invention is generally indicated by the reference numeral 96 and parts thereof similar to the valve means 35 of FIGURE 4 are indicated by like reference numerals followed by the reference letter *a*.

As illustrated in FIGURES 8 and 9, the supplemental valve member 56*a* includes a valve backing member 97 and a retainer 98 secured in a recess 99 of a valve stem 100 by staking at 101, the retainer 98 and backing member 97 holding a resilient valve face member 102 therebetween which cooperates with the supplemental seat 45*a* in the manner previously described.

The backing member 97 of the supplemental member 56*a* is provided with a plurality of circumferentially disposed angular slots 103 passing therethrough inboard of the main valve seat 57*a*. Similarly, the retainer 98 of the supplemental valve member 56*a* is provided with a plurality of circumferentially disposed arcuate slots 104 which are adapted to register with slots 103 in the backing member 97 in the manner illustrated in FIGURE 9 to provide flow passages 105 interconnecting the main valve seat 57*a* with the outlet chamber 36*a*.

Thus, by merely adjusting the members 97 and 98 relative to each other prior to the staking at 101, the desired degree or passage size between the main valve seat 57*a* and the outlet passage 36*a* can be selected to provide a desired flow of fuel to the main burner 24 when the main valve member 69*a* is disposed in the fully opened position thereof.

While the valve means 96 illustrated in FIGURE 8 merely discloses an initial setting adjustment for the passage size 105 before the staking 101, another valve means of this invention for providing adjustment after assembly thereof is generally indicated by the reference numeral 106 in FIGURE 10 and parts thereof similar to the valve means 35 and 96 are indicated by like reference numerals followed by the reference letter *b*.

In particular, the valve stem 100*b* of the supplemental valve member 56*b* is so constructed and arranged that only the backing member 97*b* is adapted to be received in a recess 107 and be secured thereto by staking 108, the retainer 98*b* being received in a recess 109 having a width greater than the cross-sectional thickness of the retainer 98*b* and a circumference smaller than the aperture passing through the retainer 98*b* so that the retainer 98*b* can be rotated relative to the valve stem 100*b* even though the backing member 97*b* is staked thereto.

The backing member 97*b* and retainer 98*b* are respectively provided with the arcuate slots 103*b* and 104*b* whereby the passage means 105*b* can be adjusted to any desired size by merely rotating the retainer 98*b* relative to the staked backing member 97*b*. The retainer 98*b* normally is held in the selected rotational position thereof by frictionally bearing against the valve face member 102*b* although being adapted to be moved therefrom by merely overcoming such frictional force.

Therefore, the passage size 105*b* of the valve means 106 illustrated in FIGURE 10 can be adjusted after the same is assembled together to vary the amount of fuel flow to the main burner when the main valve means 69*b* is moved to its fully opened position.

What is claimed is:

1. In combination, a housing having a passage means leading from an inlet to an outlet, first and second valve seat means disposed in said passage means and interconnecting said inlet with said outlet, a supplemental valve member cooperable with said first valve seat means and having passage means interconnecting said inlet with said outlet, a main valve member carried by said supplemental valve member and cooperable with said second valve seat means, a snap-action member for controlling opening movement of said valve members, said snap-action member when snapped over center in one direction having means opening only said main valve member relative to said second valve seat means to cause a flow of fluid from said inlet to pass through said passage means in said supplemental valve member into said outlet, said snap-action member when further moved in said one direction having means opening said supplemental valve member relative to said first valve seat means to add an additional flow of fluid from said inlet into said outlet, and a resilient amplifying member operatively disposed between said snap-action member and said valve members to transmit motion of said snap-action member respectively to said valve members when said snap-action member respectively opens said valve members, said resilient amplifying member causing said supplemental valve member to substantially snap open even though said snap-action member had previously been snapped over center.

2. A combination as set forth in claim 1 wherein said resilient amplifying member has a pair of opposed fulcrum legs.

3. A combination as set forth in claim 1 wherein said main valve member has a stem slidably passing through said supplemental valve member, and a spring disposed between said stem and said supplemental valve member to tend to maintain said main valve member in its closed position.

4. A combination as set forth in claim 3 wherein said stem has an outwardly directed shoulder disposed on the other side of said supplemental valve member and said spring is disposed between said shoulder and said supplemental valve member.

5. A combination as set forth in claim 1 wherein said passage means of said supplemental valve member comprises aperture means passing therethrough and means carried by said supplemental valve member for selectively controlling the size of said aperture means.

6. A combination as set forth in claim 5 wherein said means for selectively controlling the size of said aperture means comprises a disc structure rotatably carried by said supplemental valve member and having opening means registerable with said aperture means.

7. A combination as set forth in claim 5 wherein said aperture means include a plurality of circumferentially disposed arcuate slots.

8. A combination as set forth in claim 1 wherein said supplemental valve member has a stem portion, a pair of retainers carried by said stem portion, and a resilient member disposed between said retainers for cooperating with said second valve seat means.

9. A combination as set forth in claim 8 wherein said stem portion has an annular recess therein, said retainers being received in said recess and being staked therein.

10. A combination as set forth in claim 1 wherein said main valve member has a stem portion, a pair of retainers carried by said stem portion, and a resilient member disposed between said retainers and cooperating with said first valve seat means for opening and closing the same.

11. A combination as set forth in claim 1 wherein a first spring means is disposed between said housing and

one of said valve members to tend to hold that one valve member in its closed position, and a second spring means operatively disposed between said valve members to hold the other of said valve members in its closed position whereby said main valve member is adapted to be moved to its open position in opposition to only the force of one of said spring means and whereby said supplemental valve member is adapted to be moved to its open position only in opposition to the force of one of said spring means.

12. In combination, a housing having an inlet and an outlet separated by second and first valve seat means, a first movable valve member cooperable with said first valve seat means for controlling a first flow of fluid from said inlet to said outlet through said first valve seat means upon movement of said first valve member between a closed position thereof and a fully opened position thereof, a second valve member carrying said first valve member and being movable relative to said housing from a fully closed position to various open positions thereof, said second valve member only opening after said first valve member has moved to its said fully opened position thereof, said second valve member cooperating with said second valve seat means to add an increased flow of fluid from said inlet to said outlet over the flow provided by said fully opened first valve member as said second valve member is opened, said first valve member having abutment means for engaging said second valve member to move said second valve member from its closed position to its various open positions after said first valve member has moved to its fully opened position and is further moved away from said valve seat means, a first spring means disposed between said housing and one of said valve members to tend to hold that one valve member in its closed position, and a second spring means operatively disposed between said valve members to hold the other of said valve members in its closed position whereby said first valve member is adapted to be moved from its closed position to its fully opened position in opposition to only the force of one of said spring means whereby

the engagement of the abutment means thereof against said second valve member to move said second valve member from its closed position to its open position is only in opposition to the force of one of said spring means.

13. A combination as set forth in claim 12 wherein said second valve member has passage means therethrough for interconnecting said inlet to said outlet, said first valve member effectively closing said passage means when said first valve member is in its closed position.

14. A combination as set forth in claim 13 wherein said passage means comprises a plurality of openings passing through said second valve member.

15. A combination as set forth in claim 12 wherein said second spring means is a compression spring and is in its most compressed condition when said first valve member is in one of its fully opened and fully closed positions and is in its least compressed condition when said first valve member is in the other of its fully opened and fully closed positions.

16. A combination as set forth in claim 12 wherein said housing means carries motion transmitting means for opening said valve members, said motion transmitting means being engageable with said abutment means of said first valve member.

References Cited

UNITED STATES PATENTS

2,843,323	7/1958	Dobbin	251—75 X
2,991,012	7/1961	Wright et al.	236—48
3,052,264	9/1962	Graham et al.	251—75 X
3,159,346	12/1964	Caparone et al.	251—75 X
3,190,314	6/1965	Visos et al.	251—75 X
3,204,921	9/1965	Ages	251—75

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U.S. Cl. X.R.

137—630.14