Dec. 10, 1946. T. F. VAN DENBERG ET AL 2,412,235

SAFETY VALVE MECHANISM

Filed Oct. 13, 1944 2 Sheets-Sheet 1

FIG. 1.

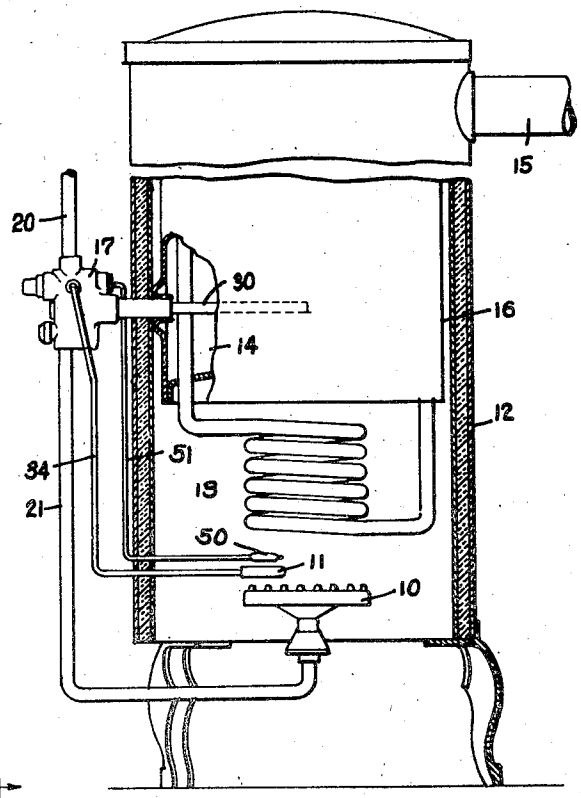

FIG. 2.

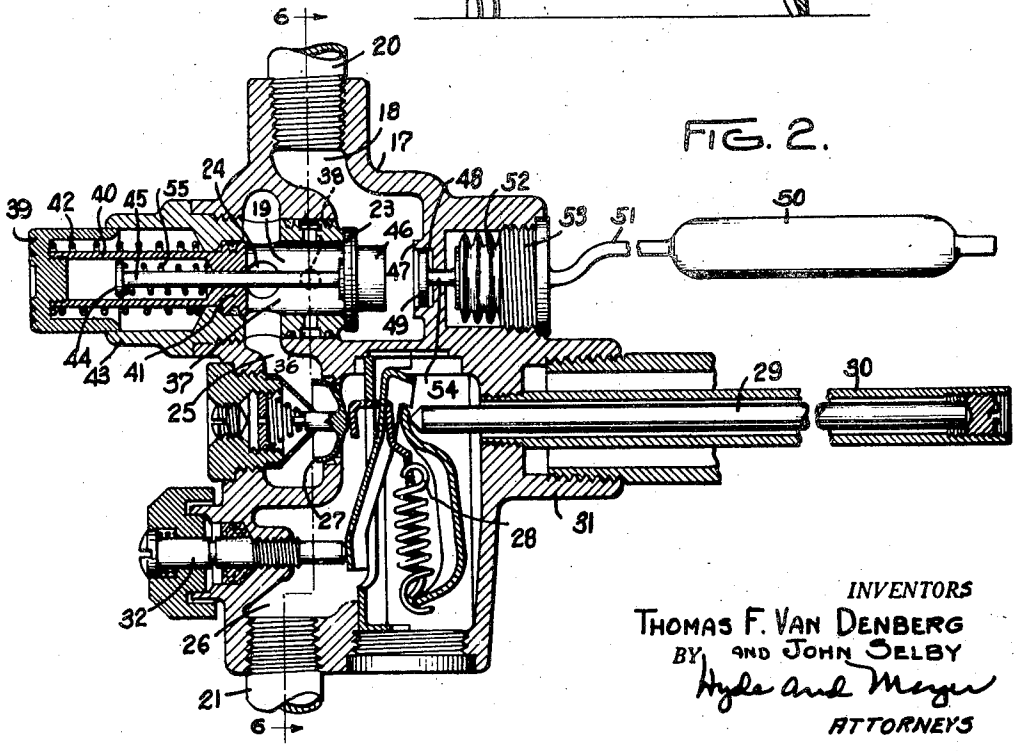

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FIG. 3.

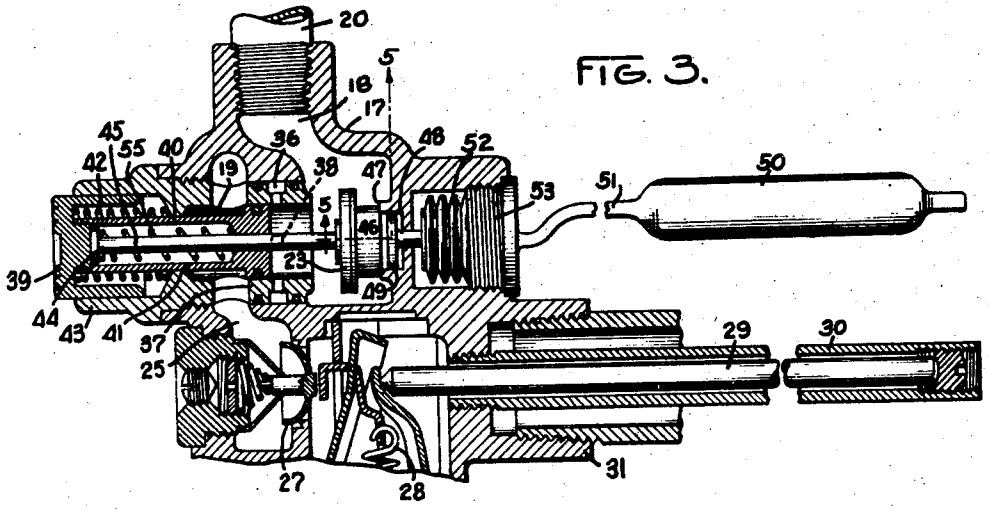
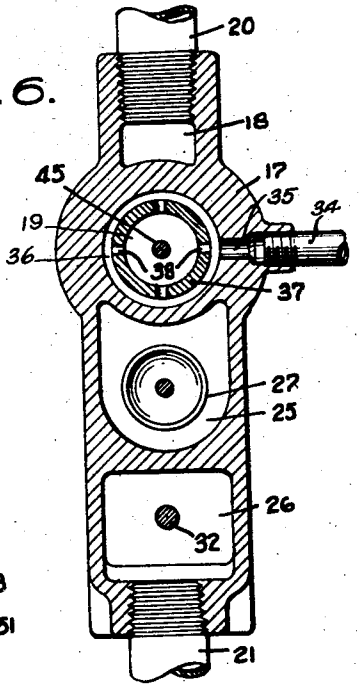


FIG. 6.



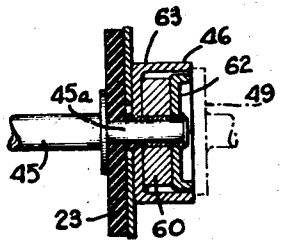
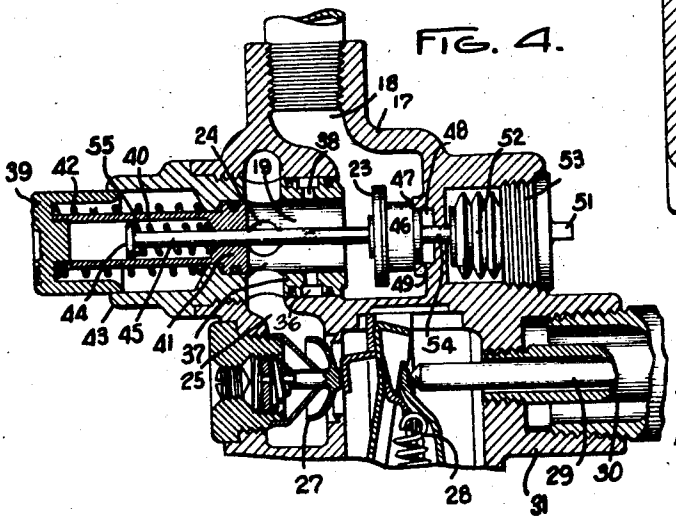


FIG. 5.

FIG. 4.



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SAFETY VALVE MECHANISM

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Application October 13, 1944, Serial No. 558,514

9 Claims. (Cl. 158—117.1)

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This invention relates to safety valve mechanism such as is used for controlling the supply of fuel gas to the burner of a hot water heating device or the like. The invention is an improvement upon the valve mechanism forming the subject matter of our prior application for Thermo-magnetic safety pilot mechanism, filed August 19, 1944, Serial No. 550,214, to which reference may be had if desirable or necessary.

One object of the invention is to provide improved magnetic couple maintaining means for the control valve or device, in which the magnet, rather than the keeper or armature, is associated with the movable valve member for movement therewith to the maintaining position, and in which, also, the armature or keeper is also movable to produce or to terminate the maintaining effect.

Still another object of the invention is to improve the thermally responsive maintaining means for the controlling valve by utilizing therefor relatively movable cooperating mated keeper and permanent magnet members together with stationary stop means for preventing them from reaching contact during a resetting operation, one of said members being bodily movable with reference to the stop means to approach and contact with the other member when the pilot burner is ignited, and being bodily movable away from its mate and said stop means to release the maintaining means when the flame is extinguished.

Still another object of the invention is to provide a combination valve mechanism of this kind including, as a part of the same unit, a regulating valve and thermostat sensitive to water temperature to maintain the same at any desirable normal value, thermally responsive means sensitive to the presence of flame at a burner located remotely from the unit for permitting gas flow only during the presence of flame, a single controlling valve controlling the flow of gas both to the main and to the pilot burner, and a supplementary valve actuated by a resetting device for temporarily shutting off the flow of gas to the main burner during ignition of the pilot flame.

Further objects of the invention in part are obvious and in part will appear more in detail hereinafter.

In the drawings, which represent one suitable embodiment of the invention,

Fig. 1 is an elevation, partly broken out and in section illustrating the valve mechanism applied to a hot water heating device;

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Fig. 2 is a sectional elevation, showing the valve mechanism in normal or inoperative position;

Fig. 3 is a similar sectional elevation, showing the reset device in advance position;

Fig. 4 is a similar view, showing the parts in final position;

Fig. 5 is a detail section view on the line 5—5, Fig. 3; and

Fig. 6 is a cross-section, on the line 6—6, Fig. 2.

Referring to the drawings, the valve mechanism is shown, for convenience of illustration and in no sense of limitation, for use in controlling the flow of fuel gas to the main and pilot burners 10, 11 of a domestic hot water heater, which is shown conventionally as including an outer casing or jacket 12 enclosing the combustion chamber 13 in which the burners operate and above them a water reservoir having a chamber 14. The products of combustion may be carried away to the stack pipe 15 in any suitable manner, as by a channel or channels 16 as is usual.

The valve mechanism forming the subject matter of the present invention is of unitary form, consisting of a single hollow body or casing 17 provided with supply and discharge chambers 18, 19 adapted for connection to or communication with a source of gas supply, such as the supply pipe 20 and a pipe or conduit 21 communicating with the main burner 10, in the usual manner.

Communication between the supply chamber 18 and discharge chamber 19 is controlled by an adjustable valve 23. Assuming that valve to be open, gas flows from the discharge chamber 19 to the main burner pipe 21 by way of ports 24, a passage 25 and a chamber 26 communicating with said passage and with pipe 21. Flow from passage 25 to chamber 26 is controlled by a regulating valve 27 operated, to open and close it, by snap action mechanism, marked generally 28 and actuated by the relatively non-expansible rod 29 of a thermostat including expansible copper tube 30 which extends through a hub 31 of casing 17 designed for attachment to the wall 12 of the heater casing, so that the thermostatic elements, 29, 30 extend into the water and are sensitive to variations in temperature therein. This arrangement, by automatic operation of valve 27 in accordance with variations in water temperature, controls the gas supply to maintain the water at uniform temperature. The temperature to be maintained may be varied by an adjustable screw 32. The details of the thermostat 29, 30, snap action mechanism 28, valve 27 and adjust-

ing device 32 form no part of the invention, except as the regulating control is included in the unitary structure, but, for example, may be of the same form and arrangement shown in the patent to Green and Bondurant, No. 2,328,642, granted September 7, 1943, for Combined safety pilot and control valve mechanism, to which reference may be had if desirable or necessary.

The pilot burner 11, shown more or less conventionally, is of course rather remote from the casing 17, which is attached to the wall of the casing 12 usually at a level considerably above that of the pilot burner. Therefore, the pilot burner is supplied with gas by way of a small diameter pipe or conduit 34 made, for example, of copper tubing, and which communicates with the discharge chamber 19 by way of a port or opening 35 through the wall of the casing 17, an annular channel 36 in a cylindrical shell 37, and ports or openings 38 opening through said shell into the discharge chamber 19 at a point spaced longitudinally from the main burner ports 24 and between ports 24 and valve 23.

Means is provided for resetting the controlling valve 23 to open position, by manual operation, as well as means for releasably maintaining said valve in open position when the pilot flame is ignited.

The reset means includes a manually operable button or head 39 on the outer end of a tube 40 provided at its inner end with an operable piston-form supplementary valve 41 movable longitudinally in the cylindrical discharge chamber 19. Said valve is normally biased to move to its inoperative position, shown in full lines Fig. 2, by a compression spring 42 surrounding tube 40 and housed within the chamber of a plug 43 screwed into the casing and integral with the sleeve 37 before referred to, the inner end of which sleeve provides the seat for valve 23. In the inoperative position of the supplementary valve the inner surface of button 39 is spaced from the head 44 of the stem 45 which supports valve 23, so that it is necessary to push the button in and take up the lost motion between said head and the valve stem, before the valve 23 begins to move. When that lost motion has been taken up the supplementary valve occupies a position beyond all of the ports 24 communicating with the passage 25 and shutting off the flow of gas to the main burner, but leaving port 38 open, so that flow to the pilot burner is not shut off. Further advance motion of the reset button moves valve 23 from its seat to open position, the motion continuing until one of the members 46 of a permanent magnet couple engages a fixed stop or shoulder, carried by the casing 17, and shown as an annular projection 47 surrounding a cylindrical recess 48 in the casing wall. In said recess is enclosed the other member 49 of said permanent magnet couple.

The two members of the permanent magnet couple are of such form as to have a strong tendency to adhere when they are in contact. In other words, one of them (either one) is a permanent magnet and the other (either one) is an armature or keeper for the permanent magnet. In the drawings, member 46 is the permanent magnet and member 49 is the keeper, although the reverse arrangement may be employed.

Member 49 of the couple, i. e., the one lying in the recess 48, is operatively associated with or connected to thermally responsive means sensitive to the presence or absence of flame at the pilot burner. Further, since the pilot burner is somewhat remote from casing 17, this means is made somewhat long and flexible, from the mechanical standpoint. It must include at the operating end which actuates couple member 49 a suitable servomotor to actuate said member, and at its opposite end, where it is sensitive to the pilot flame, it must include some means capable of producing actuation of the servomotor and thermally responsive to pilot flame. In the arrangement shown the thermally responsive means includes a bulb 50, the chamber in which communicates by the channel in a small diameter bendable copper or other tube 51 with a chamber in a suitable expansible and contractible servomotor 52 carried by a plug 53 screwed into the outer end of a chamber in the wall of casing 17 and in which chamber the servomotor 52 is located. The servomotor, for example, may be an ordinary Sylphon bellows. The movable abutment at the end of said bellows is connected by a stem 54 to couple member 49. As is usual, the closed or sealed system, including the chambers in bulb 50 and bellows 52 and the channel connecting them, contains an appropriate quantity of a fluid expansible and contractible by variations in temperature.

The parts are so designed, constructed and arranged that when the parts are cold, in the sense that neither burner is ignited, the servomotor is contracted and couple member 49 lies entirely within the recess 48, being spaced from the face of the stop ring 47 by a small distance, such as thirty thousandths of an inch.

The device operates as follows: Let us assume that the valve mechanism is installed upon a domestic water heater in the manner illustrated in Fig. 1, with the valve mechanism attached to the side wall of the casing, the thermostatic elements 29, 30 extending through the wall thereof into the water space, the main burner supply pipe 21 connecting the unit to the main burner, the small copper tube 34 providing gas supply for the pilot burner 33, and the servomotor 52 connected to bulb 50 by the pipe 51.

It may be further assumed that the valve parts occupy the position shown in Fig. 2. That is to say, the water temperature is above the critical value, so that the thermostatic tube 30 is extended, and because there is no demand for heat, regulating snap valve 27 is closed and main burner 10 is out. But the pilot burner is also out, as the result of an assumed back draft or other incident. It is desired to set the system into operation, which is accomplished as follows:

Button 39 is first pressed in, the parts moving to the positions shown in Fig. 3. When the lost motion between said button and valve stem 45 is taken up, valve 41 has moved beyond the ports 24, flow to which from chamber 19 is thereby cut off. Further inward motion of said button advances the valve 23 against the effect of its returning or biasing compression spring 55 until the magnet 46 engages the stop 47 on the casing wall, which is made, of course, of non-magnetic material such as brass or copper. In this position of the parts ports 38, leading to the pilot burner supply conduit, of course are still open. Since there is no flame existing, the fluid within the sealed bulb system is contracted and couple member 49 is separated from its mate by a distance such that the strength of the magnetic flux is relatively weak. Therefore, if neither burner is ignited and the finger is taken off from the button 39, the parts return to their initial positions and nothing occurs. However, if a lighted match

is applied to the pilot flame it will ignite, but the main burner does not ignite because the flow of gas to it is temporarily shut off by the supplementary valve 41. Play of the pilot flame upon bulb 50 expands the fluid therein and causes the movable abutment of the servomotor 52 to move over, advancing couple member 49 in the recess 48 until it contacts with its mate 46. When the couple members are in contact the strength of the magnetic flux between them, causing them to adhere, is considerably greater than the strength of the valve biasing spring 55. If the finger is now removed from button 39, valve 23 remains in its open position, where it is releasably held by the effect of the two couple members, and sleeve 40 and supplementary valve 41 return to their original positions. This reestablishes communication from the discharge chamber 19 by way of port 24 to the main burner, but subject however to the operation of the regulating valve 27. That is to say, the main burner channel is open when the water temperature is low and imposes upon the thermostatic elements 29, 30 a demand for heat, causing them to open valve 27. But if the water temperature is high valve 27 will be closed, in the usual manner.

All parts remain in the operative or valve opened position so long as the thermally sensitive device is affected by the pilot flame, but if the pilot flame is extinguished for any reason, such as on account of a failure in the gas supply, the thermally sensitive device 50 cools and the servomotor contracts, its end abutment moving to the right in Fig. 4 and carrying with it the magnet couple member attached to it, which in the form shown is the keeper member 49. Movement to the right of the magnet 46, however, is prevented by the stop shoulder or abutment on the casing wall. Consequently, cooling of the thermally sensitive device causes operation of the two couple members by bodily movement of one thereof (member 49) relative to the other member 46. Under the influence of its biasing spring 42 the control valve promptly snaps to its inoperative or closed position, shutting off the flow of all gas through the valve device, both to the pilot burner and to the main burner. The parts are now in their original normal or inoperative positions, requiring a complete resetting operation, when gas flow is resumed, as before.

Thus, the system described combines in one unit not only a regulating valve, sensitive to water temperature and always tending to maintain that temperature uniform, but also a single valve for controlling the supply of gas to both the main and pilot burners. That control valve is sensitive thermally to the presence or absence of flame playing upon the control bulb 50, and therefore constitutes a safety valve which fully shuts off the flow of any gas through the valve mechanism, if the pilot flame goes out. In addition, the valve mechanism includes a supplementary valve serving as a temporary shut-off valve for the main burner supply, but it automatically opens and remains open when the pilot burner is ignited and the reset device is released, so that it does away entirely with any necessity for the usual manually operated control valve for the main burner supply.

The permanent magnet of the magnet couple may be of any suitable form, but preferably is of a form producing high magnetic flux for a given size and weight of metal. An Alnico magnet is suitable for the purpose. The drawings show a special magnet illustrated in detail in

Fig. 5. This consists of a generally cylindrical body member 60 suitably secured on the reduced end portion 45a of the valve stem 45, and housed within two cup-shaped members 62, 63 made of magnetic material, the edges of the skirts of said cups being faced off in the same plane. The body member 60 is magnetized so that the lines of flux, from N to S, span the gap between the skirts of the two members 62, 63. Consequently the keeper or armature 49, when in contact with the magnet, includes two sets of lines of force, one on each side of the central axis, instead of a single set, as is usual with the ordinary horseshoe type of magnet. However, the special form of magnet, while of considerable value in the present construction, is not essential for its operation.

Other advantages of the invention will be apparent to those skilled in the art.

What we claim is:

1. Controlling mechanism of the character described, comprising movable control means having idle and operating positions, a magnet couple including cooperating mated permanent magnet and keeper members, both of which are movable and one of which is operatively associated with said control means, means biasing said control means toward one of its positions, reset means for advancing said control means against said bias toward its other position and its associated couple member to a position neighboring its mate, stop means for limiting advance motion of said associated couple member, and condition responsive means for adjusting the other couple member toward or from its mate, to produce contact or separation between the couple members with consequent holding or release of the associated control means.

2. Controlling mechanism of the character described, comprising a movable control device having idle and operating positions, a magnet couple including cooperating mated permanent magnet and keeper members, both of which are movable and one of which is operatively associated with said control device, means for advancing said one member of the couple and its associated control device, stop means limiting motion of the advanced couple member to a position neighboring its mate, and means for advancing the second couple member into contact with the first.

3. In combination, a hollow valve casing provided with gas supply and discharge chambers, a valve controlling the flow of gas from the supply chamber to the discharge chamber, means biasing said valve to move toward closed position, reset means for advancing said valve to open position, a magnet couple including cooperating relatively movable mated permanent magnet and keeper members, both of which are movable and one of which is operatively associated with the valve to move therewith, thermally responsive means affected by the heat produced by gas flowing past said valve for adjusting the other member toward and from its mate, and stationary abutment means in the path of movement of said one member for limiting its advance motion to thereby prevent or permit contact between said members dependent upon the temperature to which said thermally responsive means is subjected.

4. Valve mechanism of the character described comprising a hollow casing provided with gas supply and discharge chambers, a movable valve controlling the flow of gas between said chambers, said valve being biased toward closed position,

means for advancing said valve in the opening direction, a magnet couple including cooperating relatively movable mated permanent magnet and keeper members, both of which are movable, one of said members being operatively associated with said valve to move therewith, a wall of the casing being provided with a recess housing the second member and with a shoulder located anterior to said recess and lying in the path of movement of said first member and adapted to limit the movement thereof, an actuator operatively associated with said second member, and an operating device operatively associated with said servomotor and located to be affected by the heat produced by fuel flowing past said valve, said second member, said actuator, and said operating device being so constructed and arranged that when said operating device is at one temperature the second member lies within said recess and spaced from said shoulder and out of contact with the first member, and when the valve is advanced, and the operating device is subjected to another temperature, the actuator moves the second couple member in said recess to a position in contact with the first couple member, thereby to maintain the valve open.

5. Valve mechanism of the character described, comprising a hollow casing provided with gas supply and discharge chambers, a valve movable back and forth between idle and operative positions for controlling the flow of gas between said chambers, a magnet couple for controlling said valve, said couple including cooperating relatively movable mated permanent magnet and keeper members, both of which are movable and one of which is operatively associated with the valve, reset means for advancing said one member and said valve from inoperative to operative position, thermally responsive means affected by the heat produced by fuel flowing past the valve, the other couple member being operatively associated with said thermally responsive means and adapted to be moved thereby to either of two positions relative to its mate, one position in contact therewith and the other position separated therefrom, according to the temperature to which the thermally responsive means is subjected, and stationary abutment means lying in the path of movement of said one couple member to limit its advance and thereby prevent or permit actual contact between said couple members upon operation of the reset means dependent upon the temperature to which said thermally responsive means is subjected.

6. Fuel flow controlling mechanism, comprising a chambered valve casing, a control valve therein having open and closed positions, means biasing said valve toward closed position, reset means for advancing said valve toward open position, stop means limiting such advance, a magnet couple including cooperating mated permanent magnet and keeper members, both of which are movable and one of which is movable with the valve and the other of which normally occupies a position spaced from its mate when the valve has been advanced to its limit as determined by said stop means, and thermally responsive means affected by the heat produced by fuel passing said valve and operatively associated with the second of said couple members and adapted when heated to adjust said second couple member into contact with its mate, to thereby releasably maintain the valve open.

7. Fuel flow controlling mechanism, comprising a chambered valve casing, a control valve therein having open and closed positions, means biasing said valve toward closed position, reset means for advancing said valve toward open position, stop means limiting such advance, thermally responsive means affected by the heat produced by fuel passing said valve, and a magnet couple including cooperating mated permanent magnet and keeper members, both of which are movable and one of which is movable with the valve and the other of which is operatively associated with said thermally responsive means and when said means is heated occupies a position in which it engages its mate and thereby releasably maintains the valve open, whereby upon cooling of said thermally responsive means the couple member associated therewith is withdrawn and said stop means serves as an abutment compelling separation of the mated couple members and release of the valve for biased movement to closed position.

8. Controlling mechanism of the character described, comprising a movable control device having idle and operating positions, a magnet couple including cooperating mated permanent magnet and keeper members, both of which are movable and one of which is operatively associated with said control device to move therewith, means for advancing said one member of the couple and its associated control device to a position in which the advanced couple member neighbors its mate, and variable condition responsive means operatively associated with the second couple member to actuate the same and adapted upon variation of the condition in one direction beyond a given value to advance the second couple member to a position in which it may contact with the first and upon variation of the condition in the opposite direction beyond the given value to retract the second couple member and bodily separate it from its mate.

9. Controlling mechanism of the character described, comprising a movable control means having idle and operating positions, a magnet couple including cooperating mated permanent magnet and keeper members, both of which are movable and one of which is operatively associated with said control means, means biasing said control means toward one of its positions, reset means for advancing said control means against said bias toward its other position, and its associated couple member toward a position neighboring its mate, stop means for limiting advance motion of said associated couple member, and condition responsive means for adjusting the other couple member toward or from its mate, said condition responsive means being of such form and so related to the couple member which it operates as to prevent contact between said couple members at low temperature and to produce holding contact between them when the temperature is raised.

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