April 5, 1949. T. F. VAN DENBERG ET AL 2,466,515

THERMOMAGNETIC SAFETY PILOT MECHANISM

Filed Aug. 19, 1944 2 Sheets-Sheet 1

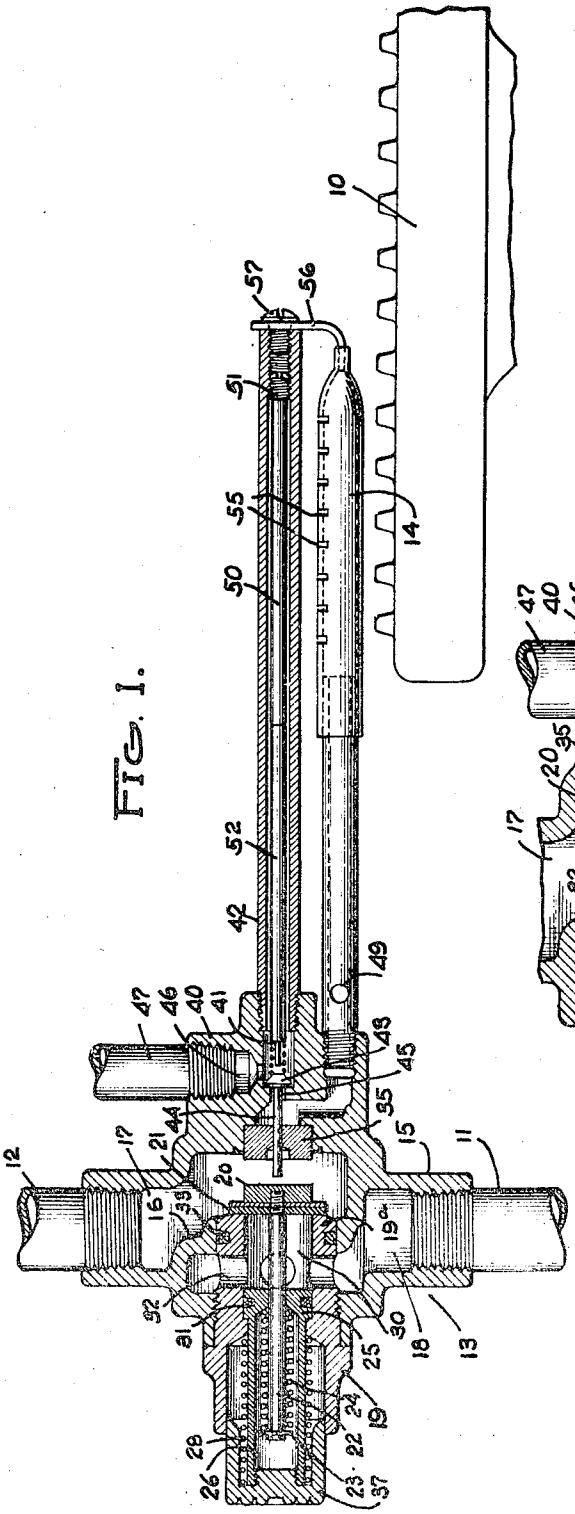


FIG. 1.

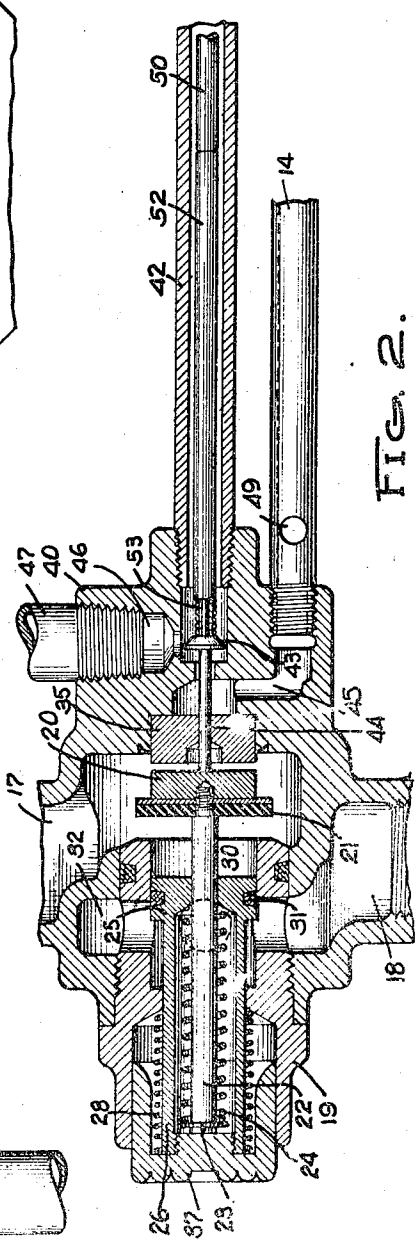


FIG. 2.

INVENTOR.
THOMAS F. VAN DENBERG
JOHN SELBY
BY Hyde and Meyer
ATTORNEYS

April 5, 1949. T. F. VAN DENBERG ET AL 2,466,515

THERMOMAGNETIC SAFETY PILOT MECHANISM

Filed Aug. 19, 1944 2 Sheets-Sheet 2

FIG. 4.

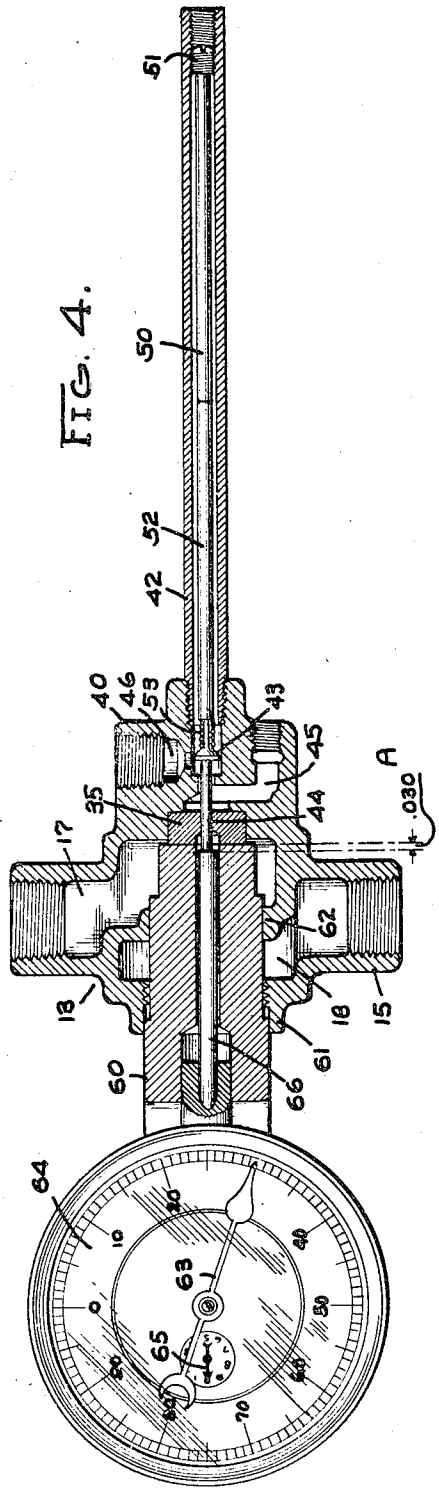
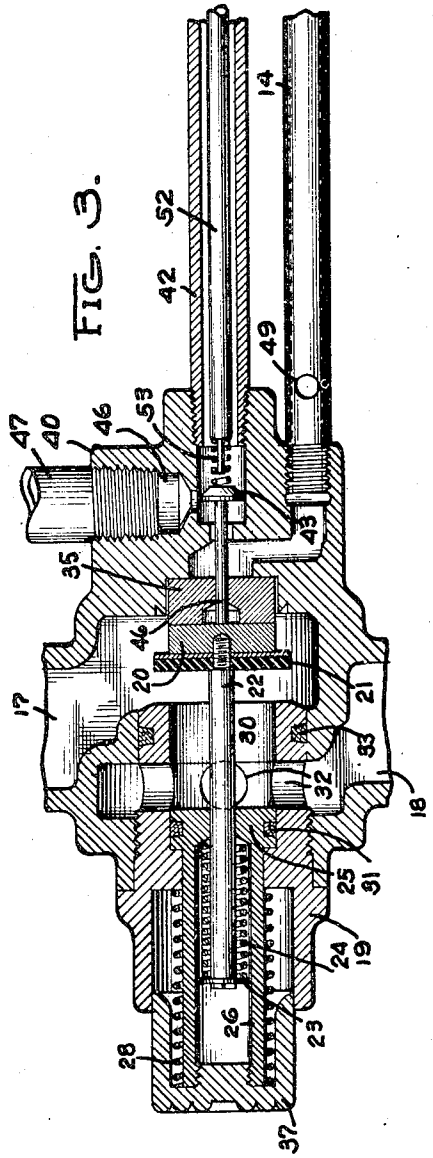


FIG. 3.



INVENTOR.
THOMAS F. VAN DENBERG
JOHN SELBY
BY Hyde and Meyer
ATTORNEYS.

Patented Apr. 5, 1949

2,466,515

UNITED STATES PATENT OFFICE

2,466,515

THERMOMAGNETIC SAFETY PILOT MECHANISM

Thomas F. Van Denberg, Cleveland Heights, and John Selby, Euclid, Ohio, assignors to The Titan Valve and Manufacturing Company, Cleveland, Ohio, a corporation of Ohio

Application August 19, 1944, Serial No. 550,214

19 Claims. (Cl. 158—117.1)

1

This invention relates to thermo-magnetic safety control mechanism for heaters, such as electric heaters or gas burners used for heating purposes in various places, for example, gas or electric stoves, hot water heaters or like devices.

One object of the invention is to provide an improved safety pilot mechanism which controls the flow of current to the heater or of gas both to the pilot and to the main burners, and which is dependent upon existence of heat or flame in order to maintain the heat supply route open.

Another object is to provide improved safety pilot mechanism of the character described, which dispenses with mechanical latch or lock mechanism and with electric control wiring, and is therefore simple, inexpensive and delicate in operation.

Still another object is to provide improved control mechanism of the character described, including a permanent magnet which holds the controlling device in operative position, but only when the temperature exceeds a given minimum, and hence only during existence of flame.

Still another object of the invention is to provide safety control mechanism, including a permanent magnet for holding the valve or other control mechanism open, the parts being so arranged that upon manual operation to reset the valve or other parts to operative position, the existence of flame or heat is necessary in order to maintain the parts in such position.

Another object of the invention is to provide valve mechanism including a self-contained unit which includes both the controlling valve and the seat therefor, to the end that upon any desire or necessity for repair or replacement purposes, such as on account of a worn valve seat, the parts may be quickly removed or exchanged without special tools or appliances for the purpose.

A further object is to provide improved thermo-magnetic safety control mechanism, in which the holding or maintaining means for the control device includes a permanent magnetic couple, the members of which are advanced toward maintaining position by two stages of motion, the second of which is thermostatically controlled and sensitive to variations in temperature resulting from heat supplied by a source under control of the control device.

Still another object is to provide improved thermo-magnetic safety control mechanism including a permanent magnet couple, the members of which, when in close neighboring holding relation, hold the control device in operative position, and which members, upon reduction in temperature at the thermostat, are mechanically separated to enable the control device to return to the inoperative or safe position.

2

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 a longitudinal sectional elevation, showing the valve parts in closed position:

Fig. 2 is a similar view, on a larger scale, showing certain of the valve parts in the positions to which they are manually adjusted in re-setting the mechanism:

Fig. 3 is a similar view, showing the parts in the valve open position; and

Fig. 4 is a detail view illustrating calibration of the device during initial assembly.

The present invention is capable of use for controlling the supply of heat to any heater, either electric or gas. It does so by operation and control of a control device, such as a switch for an electric heater or a valve for a gas heater, sensitive to variations in temperature. Such variations may occur in the temperature of the heating element itself, or the circumambient temperature in its vicinity, or may be variations in temperature at some other more remote point where heat is produced from some other source than the one being controlled. Also controlling effects may be produced either by rise or by fall in temperature in the controlling area or space, as will later appear.

The drawings, for purposes of illustration and in no sense of limitation, show the invention applied for controlling a valve or valves in the gas supply to a gas heater by variations in temperature in the temperature of a combustion chamber of the same heater.

Referring to the drawings, 10 indicates, more or less conventionally, a main burner to which fuel gas is supplied from the supply pipe 12 by way of the pipe or conduit 11 and a controlling valve mechanism generally indicated at 13. 14 indicates a pilot burner, located fairly close to the main burner, as is usual. The main burner is usually located in a combustion chamber, such as the combustion chamber within the jacket of a domestic hot water heater (not shown).

The valve mechanism shown includes a hollow brass casing or housing 15 provided interiorly with a cross wall 16 dividing the space therein into inlet and outlet chambers 17, 18 respectively, communicating with the supply pipe 12 and dis-

charge pipe 11. The outer casing wall and said cross wall are provided with concentric or alined openings, the opening in the casing wall being threaded, as shown, to receive the body or shell 19 of a main valve unit. The advance or inner end 19a of said shell or body, when the latter is screwed to its home position, as shown, extends through the chamber 18 and through the opening in the wall 16, and into chamber 17, where it carries one of the members 20 of a magnetic couple. Member 20 is provided with a main valve disc or ring 21, made of fiber, more or less dense rubber or rubber like material, or any other material suitable for the purpose. Members 20 and 21 are mounted upon a stem 22 slidable in a longitudinal opening of the body and provided on its outer end with a suitable shoulder 23 forming a perch for a light compression spring 24, which surrounds said stem and at its opposite end engages a piston like valve member 25 on the inner end of a tubular member 26. Stem 22, connected to the main valve member, slides longitudinally within said tube 26, its outward movement being limited by engagement of the main valve 21 in inoperative position with its seat on the end of the body part 19a. The outer end of tube 26 is closed by a cap 27 screwed into said tube and having a skirt which surrounds and encloses a compression spring 28. The advance nose or inner end of the body 19 is hollowed out to provide a cylindrical chamber 30 in which slides the piston valve member 25 referred to, said member preferably having a tight joint with the wall of said chamber, such as by having an annular groove in which is mounted a ring 31 made of rubber or rubber like material, preferably impervious to gas or oil. Communication is provided between piston chamber 30 and the discharge chamber 18, by way of one or more, four being shown, of small ports or openings 32, through the wall of the advance nose referred to, and a tight seal between the valve unit and the valve housing is provided, such as by the sealing ring 33, similar to ring 31 and mounted in an external groove of said nose.

In a recess of the opposite wall of the valve casing, and in alinement with the stem 22, we mount the other member 35 of the magnetic couple before referred to. Of the two couple members 20, 35, one is a permanent magnet and the other is an armature for cooperation therewith. Either one may be the magnet, but in the particular form shown the part 35 is the magnet and the part 20 is the armature.

Magnet 35, as shown, is a thick disc or cylinder having a central opening and more or less permanently anchored in place, such as by being a press fit, or by being beaded into the recess of the body wall in which it is seated. It is a very strong magnet with high efficiency, such as an Alnico magnet. It cooperates with its associated couple member 20, which is made of iron or other magnetic material, so that in addition to its use as a support for the valve disc 21, it can serve as an armature for the magnet, for a purpose which will appear hereinafter.

The casing wall, in the region of said magnet, is enlarged to form a boss 40 pierced to form a small chamber 41, into the open outer end of which is screwed a tube 42, and the bottom or inner end of which chamber forms a seat for a small pilot valve member 43 mounted on a stem 44 extending through an opening in the valve seat, through a channel 45 communicating therewith, and through a central opening in the magnet 35, the inner end of said stem projecting into the supply chamber 17 when the valves are closed, or in inoperative position, as shown in Fig. 1. Chamber 41 communicates with a threaded supply passage 46 adapted for connection thereto of a small pilot gas supply pipe 47, and the outer end of the channel 45 is threaded to receive the end of the tubular shank 48 of pilot burner 14. Usually said shank is provided with one or more small air supply ports 49.

Control of the control device or devices, which in the particular form shown of course are the main valve 21 and the pilot valve 43, is effected by the operation of suitable thermostatic means arranged when the temperature to which such means is subject varies beyond a predetermined critical value, either by rise or by fall, to become effective upon a movable member of the magnetic couple, either to permit it to advance toward holding relation with its mate or to cause it to move away from its mate and thereby release the control device and permit it to move to inoperative position. Any form of thermostat may be used which produces motion as the result of expansion or contraction, such as a bimetallic strip, a slotted metal strip distorted edgewise by heat, a sealed system including an expansible fluid and operating a Sylphon bellows, or equivalents for any of them. The particular thermostatic means shown includes tube 42 and an internal rod 50 made of materials having different coefficients of expansion under heat. Either may be the more expansible, depending upon whether the device shall operate upon rise or upon fall in temperature.

In the form shown, thermostatic tube 42 is made of any suitable material expansible by heat, such as stainless steel. It cooperates, thermostatically, with a relatively non-expansible member 50 enclosed within the tube, and made, for example, of silica, or a silica composition. Porcelain or carbon may be suitable. Rod 50 is shorter than said tube, say about half its length. Its outer end engages an adjusting screw 51 and its inner end loosely abuts against the end of a pressure rod 52. To reduce the effect of ambient temperature on that section of the tube in which rod 52 is enclosed, said rod may be made of material similar to that of tube 42, and expansible to the same extent, such as stainless steel. The inner end of rod 52 is provided with a reduced extension forming a pilot for a light compression spring 53 seated at one end against the shoulder of said rod, its opposite end seating against pilot valve member 43.

Pressure rod 52, of course, may be made of any suitable length, depending upon how far the main burner 10 is spaced or separated from the wall of the casing enclosing the combustion chamber, and through which wall the thermostatic elements and pilot burner tube extend. Usually, of course, it is of substantial length. Its purpose, of course, is to render impotent or inoperative, from the standpoint of differential thermal expansion, that portion of the thermostatic tube which encloses rod 52 or is in its zone. In other words, both rod 52 and that portion of the tube enclosing it are inoperative thermostatically. Consequently they are entirely unaffected by the ambient temperature of the air or gas surrounding them, or of variations in that temperature, enabling the instrument as a whole to be calibrated at the factory without consideration either of ambient temperature in which it will be used or of variations in the ambient tem-

perature. The device, in use therefore is sensitive only to such variations in temperature of the operating rod **50** and that portion of the tube **42** in its zone as cause differential expansion or contraction sufficient to separate the members of the magnet couple and release the main valve for closing movement.

If desired the outer end of the pilot burner, which has one or more burner openings **55** adjacent to thermostatic tube **42**, may be physically supported from said tube, such as by a supporting arm **56**, through an opening in which a closing screw **57** can be threaded into the outer end of tube **42**.

Fig. 1 illustrates the positions of the parts when cold or at the normal temperature within the combustion chamber, with both valves closed. Valve **21** is held in inoperative position against its seat on the end of the body **19** by the spring **24**. Pilot valve **43** is held to its seat by the spring **53**. Both are relatively light compression springs. The tube **26**, and operating push button, cap **37**, are in their outermost positions, to which they are urged by the spring **28**, outward motion being limited by engagement of the piston **25** with the outer end of the wall of chamber **30**. Adjusting screw **51** has been set so that under such conditions the pin **44** projects beyond magnet **35** into chamber **17**. No gas is flowing either to the main burner or to the pilot burner.

If the operator now presses his thumb upon the button **37**, moving it inwardly as far as it will go, the first effect is to advance the piston **25** along chamber **30**, first lapping the ports **32** and then moving beyond them in chamber **30** until finally, just before said piston engages the valve member **21**, the inner surface of the button **37** engages the outer end of stem **22**, so that further motion of the operating button moves the main valve off from its seat, or to the right in Fig. 1. But such motion does not permit a flow of gas from the supply pipe **12** to chamber **18**, because the piston **25** forms a barrier between chamber **17** and the ports **32**.

Continuing to push the operating button **37** inwardly, the disc or armature member **20** engages the end of pin **44** and moves the pilot valve **43** away from its seat, its motion being limited by engagement of the pilot valve with the end of the reduced portion **53** of rod **52**, the latter backed up, of course, by the rods **50**, **52** and the adjusting screw **51**, which has been pre-set to a definite position. The setting of this screw has been such that under the normal temperature condition existing at the thermostat and pilot burner, initial motion of the parts to the right stops when the armature **20** has not reached contact with the magnet **35**, but has stopped just short of the magnet, being spaced therefrom by a small gap or distance, such as twenty or thirty thousandths of an inch. This is the intermediate or blocking position of the parts shown in Fig. 2.

The pilot valve being open, gas now flows from the pilot gas pipe **47** to passage **46**, thence through the pilot opening to passage **45**, and to and through the pilot tube **48** to the pilot burner **14**. So long as the pressure of the finger is maintained upon the operating button, gas will continue to flow to the pilot burner. But no gas flows to the main burner, on account of the barrier before referred to.

If the finger is taken off from the starting button all parts return to their original positions, shown in Fig. 1, with both valves closed and all gas flow cut off. But, if the pilot burner is ignited,

the flame thus produced plays upon the outer end portion of the thermostatic tube **42**, expanding said tube lengthwise, carrying with it non-expansible rod **50** and the metal rod **52**, which always tend to move outwardly, during a setting operation, by reason of the continuing finger pressure exerted through stems **22** and **44**. The parts are so proportioned and adjusted that thermostatic expansion, such as is caused by flame, permits valve stem **44** to recede to the right sufficiently to permit the armature to reach holding contact with the magnet. But it need not go all the way into actual contact therewith, so long as it passes an intermediate point where magnetic flux and the combined biasing effect of springs **24** and **41** are equal. When that point is passed, the increasing and now preponderating magnetic attraction prevents the armature from retracting or receding, its tendency to stay put being considerably enhanced by the use of the unusually powerful permanent magnet before referred to.

Springs **24** and **41**, it has been said, are relatively light springs. As a matter of fact those springs are carefully selected and calibrated as to strength, so that their combined effects upon armature **20**, tending to separate the latter from the permanent magnet **35**, are insufficient to overcome the powerful magnetic flux when the armature contacts with the magnet. Consequently, when the operating button has been pushed in all the way, and the pilot burner has been ignited and permitted to remain lighted for a few seconds while the button is held depressed, the armature is maintained in holding position with relation to the magnet, when the finger is taken off from the operating button, even if dirt particles or any other nonmagnetic obstruction prevent metal to metal contact between magnetic material portions of the armature and magnet. When holding position is reached, the button is released and is moved to the left by the expansion of spring **28**, and the piston valve member **24** retraces its path across the ports **32**, so that in the final position of the parts, shown in Fig. 3, the piston **24** has returned to its original position. However, the main valve remains open, providing a path through its seat from chamber **17** to chamber **30** and thence through the ports **32** to pipe **11** and thence to the main burner, where the gas is ignited from the pilot flame.

The parts remain in the operating position, shown in Fig. 3, so long as the temperature at the thermostat remains above the critical value, which means, in the form shown, so long as a flame exists at the pilot burner, or flame plays upon the outer end of the thermostatic tube. But, should the flames go out or be extinguished for any reason, such as a momentary failure of gas supply, the thermostatic tube and rod cool down to the circumambient temperature of the combustion chamber in which they operate. For example, the maximum temperature at the tube in said chamber may reach say 1500° F. and when the flames are extinguished the circumambient temperature around the tube within said chamber may drop to 1200° F. The parts are so proportioned that the drop in temperature of 300° F., from 1500° F. to 1200° F., is sufficient to so contract the thermostat as to cause the inner end of valve stem **44** to emerge from the cavity in the permanent magnet and forcibly push the armature away from the permanent magnet a small distance, to a position beyond the aforesaid intermediate point, when the magnetic flux

is reduced to a value less than the opposing spring forces, which forces now preponderate over the magnetic attraction, thus retracting the armature. Thereupon the main valve is also released and is instantaneously closed by its spring 24. Pressure upon the stem 44 is also relieved and the pilot valve is released and moves fully to its seat. All gas flow is now cut off, both to the main burner and to the pilot burner. This necessitates a new starting or resetting operation by application of manual pressure to the starting button, with ignition of the pilot flame, as before, in order to put the main burner into operating condition.

Thus it will be observed that the resetting operation is performed by two stage relative approach of the members of a permanent magnet couple, one stage to a blocking position where the pilot valve is open but in which the couple members are sufficiently spaced to insure their safe separation and valve closure if the fuel is not ignited, and a second stage, thermostatically controlled and sensitive to the presence of flame, to a holding position, in which the couple members remain with the valves open so long as flame persists.

In this device one dimension is quite critical, requiring very accurate adjustment of the parts to insure satisfactory operation. This is the distance between the face of permanent magnet 35 and the end of valve stem 44 during the initial setting operation and prior to ignition when the parts occupy the positions shown in Fig. 2. This distance is critical because here the biasing spring forces must definitely preponderate over the magnetic force to insure safe return of the parts should ignition not occur, just as the magnetic flux must definitely preponderate over spring force when the parts reach holding position. Fig. 4 illustrates suitable calibrating means for so adjusting the parts.

The means shown comprises a suitable dial indicator, including a body 60 of tubular forms, shaped externally to closely fit cylindrical portions 61, 62 of the valve body when inserted therein to a position with the end of the indicator body engaging the face of the magnet 35. The magnet face, of course, is accurately surfaced and lies in a plane truly normal to the central axis. Body 60 supports the indicating mechanism, including a pointer 63 moving over a dial 64 indicating thousandths of an inch. Another pointer 65, geared to the first on a 10 to 1 ratio, may indicate ten thousandths of an inch. Connected to the pointers by suitable operating mechanism (not shown) is a stem 66 slidable in an axial opening of the body with its end opposite the end of valve stem 44.

In the zero position of the indicator the end of stem 66 is in the same transverse plane with the end of body 60 and the magnet face with which said body contacts. A spring (not shown) in the indicator mechanism biases the stem 66 to the right in Fig. 4. This spring of course is much stronger than spring 53 beyond the valve stem 44.

The critical dimension before referred to, indicated at A, Fig. 4, is predetermined from empirical data and calculation. Having thus determined it for any given thermostatic valve mechanism being assembled, the indicator is inserted to the position shown in Fig. 4 and screw 51 is adjusted until the dial reading corresponds with the predetermined dimension, say .030 inch. All parts, of course, are at normal temperature. Screw 51 then may be sealed in its position with a drop of solder, or assembly of the instrument may be completed, including insertion of the closing screw 57, concealing screw 51 and making unlikely any further adjustment thereof by a user.

The mechanism described is accurate, delicate and satisfactory in operation. It dispenses with electric circuits or wiring, and with unreliable mechanical latches or like devices. It also is simple to control and operate and provides full protection in case all flames are extinguished, cutting off the gas flow, both to the main and to the pilot burners.

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

What we claim is:

1. Apparatus of the character described, comprising a magnet couple including cooperating relatively movable mated permanent magnet and keeper members biased for movement toward retracted position out of holding relation with each other, means for producing relative motion of approach between said members, a control device mounted to move with a couple member toward an operating position upon relative approach movement of the couple members, stop means effective upon the couple for normally restraining the members thereof from reaching holding relation with each other, and means responsive to a variable condition for rendering said stop means ineffective and permitting additional relative approach between said couple members to holding relation with each other when the condition to which said means is responsive varies beyond a predetermined value, the magnetic flux between the couple members being insufficient to overcome their bias when the couple members are thus restrained but being sufficient to do so when they reach holding relation.

2. Controlling mechanism of the character described, comprising movable control means having idle and operating positions and biased toward idle position, a magnet couple including cooperating relatively movable mated permanent magnet and keeper members, one of which is operatively associated with said control means and approaches its mate as the control means advances to operating position, means biasing said control means toward idle position, reset means for advancing said control means and its associated couple member against said bias to an intermediate blocking position in which the couple members are close to but short of holding relation with each other, and condition responsive means effective upon the control means and its associated couple member for controlling further advance of said one couple member beyond said blocking position into a holding position with respect to its mate, the magnetic flux between the couple members being weaker than said bias when the advanced couple member is in said blocking position and stronger than said bias when it is advanced to and lies in said holding position.

3. Control mechanism of the character described, comprising a control device biased toward idle position, means for advancing said device toward operating position, cooperating magnet and keeper members having sufficient magnetic attraction to overcome said bias and cause them to remain stationary when in holding relation with each other but insufficient to that end when they are closely spaced but out of holding relation with each other, said members normally being relatively widely spaced apart and being so opera-

tively associated with said control device as to approach and recede from each other as said device moves toward operating and idle positions, respectively, means which under normal conditions limits relative approach motion of said members to a position in which they are closely spaced from but are out of holding relation with each other, and condition responsive means effective when an operating condition is reached for rendering said approach limiting means ineffective.

4. Control mechanism of the character described, comprising cooperating relatively movable permanent magnet and keeper members, means normally biasing said members to move apart, means for causing approach of said members toward holding relation, condition responsive means operatively associated with said members and adapted under normal conditions to prevent and under operating conditions to move to permit the production of holding relation between them, and a movable control device operatively associated with said members and arranged to lie in operating or idle position as they are in holding relation with or are separated from each other, the magnetic flux between said members being insufficient to maintain them stationary against the biasing effect when holding relation between them is thus prevented but being sufficient to that end when holding relation between them is permitted and effected.

5. Controlling mechanism of the character described, comprising movable control means having idle and operating positions and biased toward idle position, a magnet couple including cooperating relatively movable mated magnet and keeper members, one of which is operatively connected to move with said control means, means for advancing said control means from its idle toward its operating position and for simultaneously causing relative approach of said couple members, and variable condition responsive means for either preventing or permitting relative approach of the couple members into holding relation between them according to what is the existing condition, the magnetic flux between said members being insufficient to maintain them stationary against the biasing effect when holding relation between them is thus prevented but being sufficient to that end when holding relation is permitted and effected.

6. Safety gas control mechanism of the character described, comprising a burner, a magnetic couple including relatively movable mated armature and permanent magnet members having a strong tendency to approach each other and at least one of which is movable, reset means for advancing the movable member, a gas control valve for said burner biased toward closed position and operatively associated with said movable member of the couple for movement therewith toward valve open position, stop means initially limiting relative approach movement between the couple members to a position short of holding relation between them, and thermally responsive means sensitive to flame produced by said burner and operative to render said stop means ineffective upon said couple, whereby upon gas ignition additional relative approach movement of said couple members may be produced by actuation of the reset means to cause said members to advance into holding relation with each other and thereby maintain said control valve open.

7. Valve control mechanism for a gas burner of the character described, comprising a hollow valve body provided with a cross wall forming supply and discharge chambers communicating through an opening in said wall, a main valve controlling flow to the burner through said opening and operable from the exterior of the body, a magnetic couple including mated permanent magnet and armature members one of which is attached to said valve, the other being mounted in the body opposite its mate and having an opening, a pilot valve for controlling a pilot flame for said burner, said pilot valve having a stem extending through the opening in the last named couple member and adapted for engagement with its mate, and thermostatic means arranged when the temperature to which it is subject is on one side of a critical value to be effective upon said pilot valve and maintain its stem in a position in which it prevents contact between the mated couple members and when said temperature varies beyond said value to move said valve stem to a position in which it is ineffective upon the couple members and permits them to be moved into holding relation.

8. Thermostatic valve mechanism of the character described, comprising a burner, a movable valve device therefor biased toward closed position, thermally responsive means sensitive to variations in temperature due to the presence or absence of heat produced by said burner, cooperating relatively movable mated permanent magnet and keeper members, one of which is operatively connected with said valve device for motion therewith, and means for advancing the valve device and thereby producing relative approach motion between said members to a position in which said valve device is open, said thermally responsive means including a movable part lying adjacent to and in the path of movement of the movable member and which advances and recedes as the temperature to which the thermally responsive means is sensitive varies, the arrangement being such that when the temperature falls below a critical value said part advances and serves as a stop to limit relative approach motion between said members to an intermediate position short of holding relation between them and when the temperature rises above a critical value said part recedes and permits said members to be relatively advanced into holding relation with each other.

9. Control mechanism of the character described, comprising a control device movable back and forth between operating and inoperative positions and biased toward inoperative position, a couple including relatively movable mated armature and permanent magnet members, at least one of which is movable and to which said control device is connected for movement toward operating position as said movable couple member approaches its mate, the magnetic flux between said members being sufficient to overcome the bias between them and maintain the control device in operating position when said members are in holding relation but being insufficient to overcome such bias when they are close to but out of holding relation with each other, manual reset means for advancing the movable member of the couple and the control device connected thereto toward operating position, and thermostatic means sensitive to variations in temperature and arranged upon fall in temperature to bodily move a movable member to the couple away from its mate to a position in

which the control device responds to its bias and moves to inoperative position.

10. Thermostatic valve mechanism, comprising a hollow body having gas supply and discharge channels communicating through a valve opening, a valve controlling flow through said opening, yielding means biasing said valve toward closed position, a permanent magnet couple including a first member mounted in the valve body and a second member mounted to move with the valve and to advance toward its mate as the valve moves toward open position, and thermostatic means including a heat sensitive part and also an abutment located in the path of advance of said second member and movable along said path toward and away from said second member upon variations in temperature at the heat sensitive part, the parts being so constructed and arranged that when the temperature is above a critical value the abutment is out of contact with the second member and when it drops below said critical value said abutment engages and becomes effective upon said second member and mechanically moves it bodily away from the first member to a position in which the magnetic flux is sufficiently reduced to permit the valve to move under its bias to closed position.

11. Apparatus of the character described, including a gas burner, a supply conduit therefor including a control valve having open and closed positions and biased toward closed position, thermostatic means sensitive to variations in temperature at the burner, and a magnetic couple including relatively movable armature and permanent magnet members one of which is operatively associated with said control valve to move therewith, means for advancing said one member to bring the two members into holding relation with each other, thereby to maintain the valve open when the temperature at the thermostat rises above a critical value, said thermostatic means including a movable part operated by variations in temperature at the thermostat and arranged when the temperature is reduced below a critical value to retract one couple member from its mate, and means effective to prevent corresponding movement of said mate, thereby effecting separation of the couple members and consequent reduction of the magnetic flux sufficiently to release the control valve for movement to closed position.

12. Control mechanism for a gas burner, comprising a valve movable back and forth and controlling the gas supply to the burner, a magnetic couple controlling said valve and including mated armature and permanent magnet members relatively movable into and out of holding relation and one of which is operatively associated to move with the valve, said members when in holding relation serving to maintain the valve open, means biasing said one member and the valve associated therewith to move in the valve closing direction, and valve release means, including thermostatic means sensitive to variations in the burner temperature and arranged when said temperature is reduced below a critical value to become effective upon and move one couple member away from its mate, and means for preventing like movement of said mate, thereby to separate the couple members by an amount sufficient to reduce the magnetic flux to a value which permits valve closing movement responsive to its bias.

13. Valve mechanism for a gas burner of the character described, comprising a hollow valve body provided with a cross wall forming supply and discharge chambers communicating through an opening in said wall, a main valve controlling flow to the burner through said opening and operable from the exterior of the body, a magnetic couple including mated permanent magnet and armature members one of which is attached to said valve, the other being supported in the body opposite its mate and having an opening, a pilot valve for controlling a pilot flame for said burner, said pilot valve having a stem extending through the opening in the body-supported couple member, and thermostatic means responsive to reduction in temperature and then effective upon said pilot valve to actuate the same and cause its stem to advance through said opening and bodily move the valve carried couple member away from its mate.

14. Thermostatic valve mechanism of the character described, comprising burner means, a main valve and a pilot valve therefor, both thereof being normally biased toward closed position, thermostatic means sensitive to the presence or absence of flame produced by said burner means, cooperating relatively movable armature and permanent magnet members, one of which is connected to said valves to move therewith, means for producing relative advance motion between said members to cause them to come into holding relation with each other and said valves to open, an operating device actuated by said thermostatic means and effective upon one of said members to retract it from its mate, and holding means for the mate, whereby the open valves close upon operation of said thermostatic means when the flame is extinguished.

15. Thermostatic valve mechanism of the character described, comprising a burner, a movable valve therefor biased toward closed position, means for releasably maintaining said valve open, comprising cooperating relatively movable mated permanent magnet and keeper members, one of which is operatively connected with said valve for motion therewith, means for producing relative approach motion between said members into a holding position in which they adhere and said valve is held open, and valve release means including a movable part sensitive to variations in temperature due to the heat produced by said burner and operative upon a reduction in temperature to overcome the magnetic flux and bodily separate said members and thereby release the biased valve for movement to closed position.

16. Controlling mechanism of the character described, comprising movable control means having first and second positions and biased toward said first position, and means for releasably maintaining said control means in said second position, comprising a magnet couple including relatively movable mated magnet and keeper members at least one of which is operatively associated with said control means to move therewith, and variable condition responsive means effective upon a movable member of the couple and arranged upon variation of the condition in one direction beyond a given value to permit and control relative movement between said couple members in opposition to said bias into holding relation between them and upon variation of said condition in the opposite direction beyond the given value to move them apart for the consequent release of the control means for return under bias to its said first position.

17. Control mechanism of the character described, comprising a magnetic couple includ-

ing mated armature and permanent magnet members mounted for relative movement into and out of contact with each other, manually operatable means for relatively moving them toward contact, a control device connected for travel with one movable member of the couple and movable back and forth between first and second positions and biased to move with its connected couple member toward said first position, and thermostatic means including a movable abutment mounted in operative relation of said couple and normally lying in a blocking position in which it prevents contact between said members, said abutment being arranged when the temperature at the thermostat rises above a critical value to move to a retracted position in which it is ineffective upon said couple members, permitting them to be relatively moved into contact and said control device to be moved to its second position and when said temperature falls below the critical value to return to its said blocking position and thereby become effective upon the couple and bodily move one member thereof away from its mate, the magnetic flux between the couple members being weaker than said bias when the abutment holds the couple members apart and stronger than said bias when they are in contact, whereby return of the abutment to its blocking position reduces the magnetic flux sufficiently to release the control device for biased return to its first position.

18. Controlling mechanism of the character described, comprising movable control means having first and second control positions, a magnet couple including cooperating relatively movable mated permanent magnet and keeper means, one of which is mounted to move with said control means, means biasing said control means and its associated member toward its first control position, reset means for advancing said control means against said bias toward its second control position and its associated couple member toward its mate, movable stop means normally limiting advance of the movable couple member to an intermediate position short of contact with its mate, and condition responsive means effective upon said stop means and arranged upon variation in the condition in one direction beyond a given value to withdraw said stop means and condition the movable couple member for movement into holding contact with its mate and upon variation of the condition in the opposite direction beyond the given value to advance the stop means and thereby become effective upon and separate the couple members and thus release the control means for return by its biasing means to its first control position, the magnetic flux between said members being weaker than the bias when the movable couple member is in said intermediate position and stronger than the bias when it is in holding contact with its mate.

19. Thermostatic valve mechanism of the character described, comprising a burner, a movable

valve device biased toward closed position, thermally responsive means sensitive to variations in temperature due to the presence or absence of heat produced by said burner, cooperating relatively movable mated permanent magnet and keeper members, one of which is operatively connected with said valve device for motion therewith, and means for producing relative approach motion between said members to a position short of holding relation between them, in which position said valve device is open, said thermally responsive means including a movable part operatively associated with one of said members to move it relative to its mate as the temperature to which the thermally responsive means is sensitive varies, and holding means for the mate, the arrangement being such that when the temperature rises above a critical value said part recedes and permits said members to be relatively moved into holding relation, and when said temperature falls below said critical value said part advances and overcomes the magnetic flux and bodily separates its associated member from its mate and thereby permits the biased valve to close.

THOMAS F. VAN DENBERG.
JOHN SELBY.

REFERENCES CITED

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

UNITED STATES PATENTS

Number	Name	Date
130,895	Brown	Aug. 27, 1872
654,522	Cowey	July 24, 1900
1,520,549	Otto et al.	Dec. 23, 1924
1,678,658	Thomas et al.	July 31, 1928
1,804,849	Thompson	May 12, 1931
1,886,876	Gauger	Nov. 8, 1932
1,908,765	Kay	May 16, 1933
1,934,548	Kellogg	Nov. 7, 1933
1,998,913	Wheaton	Apr. 23, 1935
2,013,713	Hamilton	Sept. 10, 1935
2,023,276	Lovekin et al.	Dec. 3, 1935
2,085,581	Green	June 29, 1937
2,098,181	Dillman	Nov. 2, 1937
2,126,587	Thornbery et al.	Aug. 9, 1938
2,132,749	Morrow	Oct. 11, 1938
2,133,073	Beck	Oct. 11, 1938
2,170,341	Shaw	Aug. 22, 1939
2,210,526	Burling	Aug. 6, 1940
2,214,375	Jackson	Sept. 10, 1940
2,250,738	Wittmann	July 29, 1941
2,275,962	Herbster	Mar. 10, 1942
2,290,047	Hildebrecht	July 14, 1942
2,303,700	Mantz	Dec. 1, 1942
2,303,702	Mantz	Dec. 1, 1942
2,357,215	Maronek	Aug. 29, 1944
2,383,401	Mantz	Aug. 21, 1945
2,412,235	Van Denberg	Dec. 10, 1946
2,417,577	Van Denberg	Mar. 18, 1947