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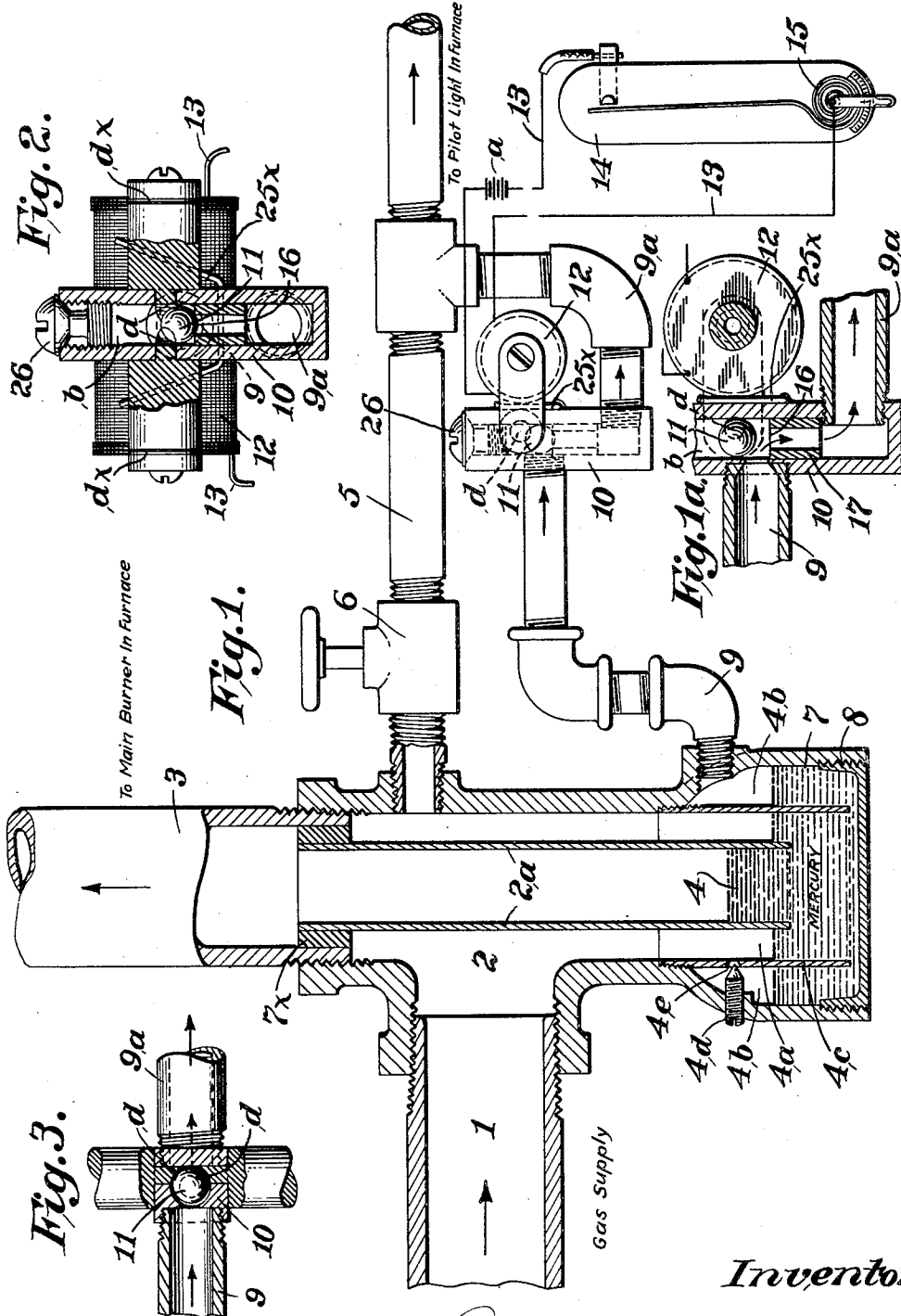
E. S. HALSEY

1,910,012

VALVE MECHANISM FOR CONTROLLING HEATING BURNERS

Filed Jan. 19, 1929

2 Sheets-Sheet 1



Inventor:

Edward S. Halsey,
by *Spencer Middleman* Attorney

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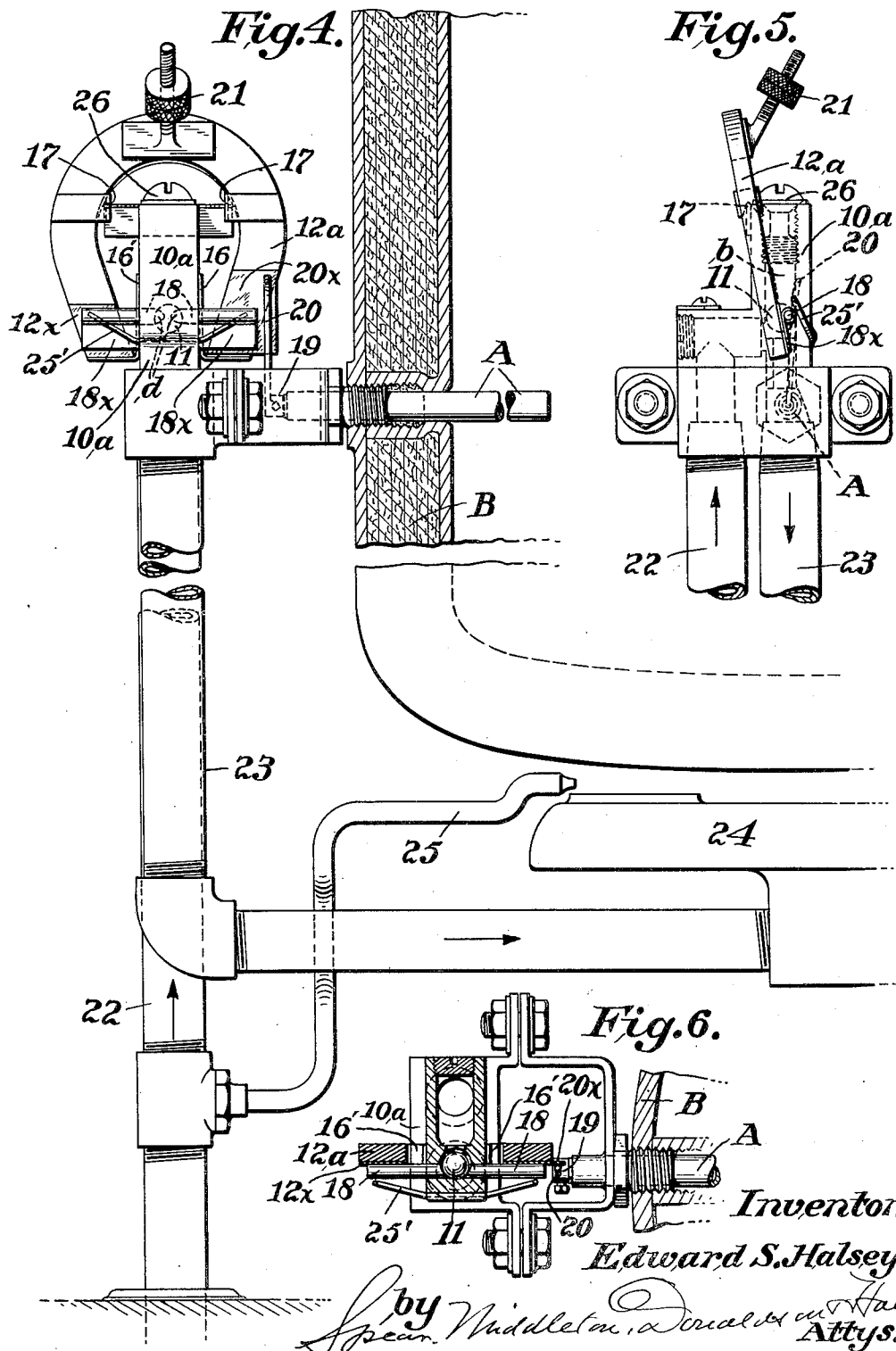
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UNITED STATES PATENT OFFICE

EDWARD S. HALSEY, OF WASHINGTON, DISTRICT OF COLUMBIA

VALVE MECHANISM FOR CONTROLLING HEATING BURNERS

Application filed January 19, 1929. Serial No. 333,673.

The invention relates to a controlled heating system and consists in the features and combination and arrangement of parts hereinafter described and particularly pointed out in the claims.

In the drawings:

Figure 1 is a diagrammatic view of one embodiment of the invention, parts being in section.

Fig. 1a is a vertical view of a part of the valve casing of the magnetic valve shown in Fig. 1.

Fig. 2 is a vertical sectional view of the magnetic ball valve mechanism in a plane a quarter turn from the plane of section in Fig. 1.

Fig. 3 is a plan view of a horizontal section through the controlling valve with the magnetic ball rolled off of its seat against the wall of the runway along which it moves vertically.

Fig. 4 is a diagrammatic view of another arrangement of ball valve and thermostat mechanism.

Fig. 5 is a view of the ball valve mechanism a quarter turn from that in Fig. 4.

Fig. 6 is a plan view partly in section.

The main gas supply pipe 1 is connected with a distributing chamber 2, from which the gas is supplied to a main burner through a pipe 3, under control of a mercury valve 4. From this chamber 2 a connection is made by way of pipe 5 to a pilot burner which is associated with the main burner for lighting the same in accordance with the demands of the system.

The pipe 5 has a hand valve 6 to regulate or cut off the supply of gas to the pilot burner, but this remains open during the operation of the system. The distributing chamber 2 has a well 7 at its enlarged lower end holding a body of mercury.

This mercury well is divided into an inner compartment 4a and an outer annular compartment 4b by a circular wall member 4c which however leaves these chambers in communication at its lower edge. Extending vertically at the center of the chamber 2 is the partition member 2a in the form of a tube,

the lower open end of which extends into the well.

The upper end of this pipe is seated in a bearing 7a forming a partition closing the upper end of the chamber 2. This upper end of the pipe 2a opens into the pipe 3 leading to the main burner. The bottom member of the mercury well is screw threaded at 8 into the wall of the well. From the outer annular chamber 4b a pipe 9 leads off and connects with the casing 10 of an automatic magnetic valve, and from the lower end of this valve casing a pipe 9a extends to the pipe 5 which supplies the pilot burner. The magnetic valve 11 within the casing 10 is in the form of a steel ball.

This ball is controlled by a magnet and in the particular form of the invention now being described the magnet is of the electro magnetic type as shown at 12, which is energized through a circuit 13 representative of any circuit suitable for the purpose, for instance, such as that shown supplied with current from a battery a. The circuit 13 includes a circuit breaker 14 which in turn is controlled by a thermostat 15, the one shown being representative as suitable for the purpose. The magnetic ball valve rests upon a seat 16 consisting of the upper annular end of a sleeve or cylindrical section 17 mounted in the bore of the casing 10, below the inlet from pipe 9. This ball valve will be referred to more at length hereinafter.

There is a regulated communication between the annular chamber 4b through a port 4e controlled by an adjustable needle valve 4d mounted in the outer wall of the mercury well.

During operation of the apparatus the pilot burner is constantly supplied with gas through the pipe 5 which is in communication with the main chamber 2. When there is no demand for the main burner the supply of gas thereto is cut off by the mercury in the well rising up into the central pipe 2a. This is due to the pressure of gas on the body of the mercury in the annular chambers or channels 4a and 4b, which at all times are in open communication with the main cham-

ber 2 and the main supply pipe 1, the chamber 4a by direct communication and the annular channel or chamber 4b being in communication with the said main gas supply through the port 4e in the wall 4c.

The body of mercury is so proportioned to the full pressure of the gas as to maintain a closure between the main chamber 2 and the pipe 2a and prevent the passage of gas to the main burner. When, however, the demand for heat is manifested by the thermostat closing the circuit at 14, then the electro-magnet 12 will be energized the ball valve 11 will be raised from its seat and gas will then pass from the chamber 4b through pipe 9 to the pilot burner.

The flow of gas from the chamber 4b reduces the pressure therein, it being noted that the flow of gas to said chamber is through the restricted port 4e, and as a result the pressure in chamber 4b is reduced and the mercury therefor rises therein and consequently falls in the chamber 4a and in the pipe 2a to a level below the lower open end of the said pipe 2a whereupon gas will flow from the main supply pipe 1 through chamber 2, past the lower end of pipe 2a and up through said pipe to the pipe 3 leading to the main burner which will then be lighted by the pilot. The pilot, as before stated, during the operation of the apparatus, is constantly lighted. The effect of the opening of valve 11 besides reducing pressure in the chamber 4b adds an increment to the gas supply of the pilot burner so that this flame will be enlarged or strengthened against the possibility of being blown out when the main burner bursts into flame.

This pilot burner continues under this augmented supply of gas as long as the thermostat keeps the circuit closed at 14, and during this period the pressure of gas in chamber 4b will remain reduced due to the flow of gas therefrom through pipe 9 as against the small accession of gas to this chamber through the restricted port 4e.

When the temperature in the furnace or boiler or other member to which the heat is being applied rises above that for which the apparatus is adjusted, the thermostat will break the circuit at 14, the magnetic ball valve will fall owing to the de-magnetizing of the electro-magnet. This cutting off of the flow of gas from chamber 4b, will allow pressure to build up therein by the gas passing through the restricted port 4e and this pressure acting on the body of mercury will depress the level in chamber 4b which will cause the level to rise in chamber 4a and into the central tube 2a thus cutting off the flow of gas to the main burner which therefore goes out, and remains so until the thermostat again closes the circuit at 14 whereupon the magnetic ball valve 11 will open again

and the above described operation will be repeated.

In Figs. 4, 5 and 6 I show another form of apparatus in which the ball valve is controlled by a permanent magnet 12a of horse-shoe type, having its arms embracing the valve casing 10a, said arms having pole pieces of thin flat metal 16' extending parallel with and close to the sides of the valve casing.

The magnet is poised at 17 upon a knife edge bearing. Its arms or poles cooperate with pole pieces 18 inserted in and held by the casing 10a. The horse-shoe magnet is operated by a thermostatic element A extending into the furnace, boiler, or the like, the shaft or rotatable rod 19 of which thermostat has a finger 20 to bear on the side of the horse-shoe magnet to tip it on its knife edge bearing. An adjustable weight 21 serves to determine the poise of the magnet, its responsiveness and its cooperative action in connection with the poles 18, which extend from the bore of the casing outwardly to lie opposite the side faces of the poles of the permanent magnet.

The ball valve in this form controls the supply of gas coming through main pipe 22 to a main burner 24 by way of pipe 23, the magnetic ball valve and its casing being interposed between said pipes.

A pilot burner is shown at 25 for lighting the main burner.

I employ a small depolarizing magnet 25' supported on the valve casing and having its ends adjacent the outer ends of the pole pieces 18. This magnet is preferably of mild tempered steel, so that it may become magnetized each time the horse-shoe magnet swings close to it. The pole pieces 18 are of soft iron. The effect of this is that when the horse-shoe magnet swings away the magnetism in the small magnet 25' will overbalance the residual magnetism of the pole pieces 18, reversing the same so that the inner ends of the pole pieces 18 which up to now have been attracting the ball valve, will become neutral or repellent to said ball, thus bringing on a quick and certain closing of the ball valve upon its seat.

This repellent action gives a positive closing action to the ball and takes place when the pole pieces 18 are no longer borne upon or contacted by the arms of the horse shoe magnet. The thin extension pieces of the poles of the magnet, as shown at 16', lie, as before stated, close to the valve casing. They afford a short parallel path for the lines of force to reduce the scattering lines of force that may reach the fixed pole pieces 18 and 18, when the horse-shoe magnet swings away from them into position to drop the ball and close said valve. In this form of the invention the thermostat is shown as extending through the wall of the member being heat-

ed, the wall of which is indicated in part at B.

Reverting to the novel characteristics of the magnetic ball valve mechanism, it will be noticed that the ball in closing moves in the direction of the flow of fluid, i. e., downwardly. The ball is slightly less in diameter than the diameter of the bore *b* of the casing in which it moves. The seat for the valve may be provided in various ways, one of which may be as shown by inserting a tubular member 17 in the bore of the valve casing and the upper rim or edge of this tube provides the seat for the valve. The poles of the electromagnet 12 in the form shown in Fig. 1 or the pole pieces 18 in the form shown in Figs. 4, 5, and 6 extend through the valve casing with their axes off to one side of the vertical axis of the valve seat and the bore of the valve casing. The faces of these pole pieces at their inner ends conform to the curve of the bore of the casing and form sections or continuations of said curved face.

The effect of this off-center disposition of the pole faces *d*, *d* in respect to the vertical axis of the valve seat and bore of the casing is that when the pole pieces are energized they will first draw or roll the ball valve (which is spaced but a few thousandths of an inch away) laterally off from its seat and against the vertical wall of the bore up which wall or runway the ball will then roll under the attraction of the pole pieces until the ball's horizontal axis nearly reaches the axial level of these pole pieces which is its full open position. In this action the ball moves counter to the direction of flow of the gas or other fluid.

When the pole pieces are de-energized the ball valve will roll vertically down along the wall of the casing and when its descent is arrested it will roll in a direction radially inward and will thereby find and rest upon its seat and in position with its vertical axis coinciding with the vertical axis of the casing. The closing of the ball is materially assisted by the pressure of the fluid.

In the act of opening, the ball valve does not immediately rise, in its initial movement vertically, but on the contrary its initial movement is radially or a rolling movement laterally in respect to the valve seat and the vertical axis of the valve mechanism, and this lateral movement is followed by a rolling movement vertically along and in contact with the smooth inner wall of the casing which thus provides a runway for the ball. This magnetic ball valve with the off-center pole piece or pole pieces lend themselves to the use of a minimum amount of current. The ball is not directly lifted but as stated is rolled laterally off from its seat to open the port through the valve and the opening movement is continued by an upward rolling movement of the ball along the runway formed by the bore of the casing.

Only one of the pole pieces of the magnet may pierce the wall of the casing to be exposed at and conform to the wall of the bore of the casing. Both pole pieces may be arranged at the same elevation, but I do not limit myself in this particular. In application No. 208,850, filed July 27, 1927, I show two pole pieces which are arranged at different levels in respect to each other and the pole pieces of the present application may be likewise arranged at two levels.

It will be observed that the outermost sides of the pole pieces are tangential to the curve of the wall of the bore. These pole pieces are first inserted without having their inner ends curved, but of cylindrical form throughout and with their end faces abutting.

The coring tool which forms the bore of the valve casing cuts away the inner ends of these pole pieces at the same time the bore of the casing is cut so that the end faces of the pole pieces form sections of the curved wall of the bore and therefore these faces are flush with the face or wall of the runway along which the ball rolls vertically.

Because the outermost sides of the pole pieces are tangential to the curved wall of the bore the pole pieces are of maximum extent and reach towards each other as closely as possible, thus providing maximum exposure to the side of the ball.

In making the arrangement shown in Figs. 4, 5 and 6 I may use a single bar or rod, and after this is inserted the coring tool in forming the bore will cut through the rod, form its curved faces and divide the rod into the two pole pieces.

Figs. 1 and 3 show the position of the ball in the open position of the valve when it is drawn laterally off from its seat against the wall of the bore of the valve chamber.

Fig. 2 shows the ball valve seated.

The valve casing is closed at its upper end by a screw plug 26.

12*x* and 20*x*, Fig. 4, are thin brass spacers permanently secured to the poles of the magnet, functioning to prevent actual contact of the magnet poles, with the expanded pole piece faces 18*x* of the pole pieces 18.

20*x* has an extended surface which may be entirely flat with a slightly curved face to cooperate with the rocker lever 20 whose movement applies the force of the torsion thermostat A with a rapidly changing ratio to the rocking of the magnet when the thermostat is slightly heated, thus compensating effectively for the rapid decrease in the drag of the magnet as it is forced away from the pole pieces 18 by the thermostatic action.

In Fig. 2 I show at *dx* non-magnetic spacer discs to facilitate depolarization of the poles *d*, *d*, when the electric circuit is broken. To further enhance said depolarization in some cases I use a small depolarizing magnet 25*x* preferably of mild tempered steel perform-

ing in a similar manner to that above described in connection with the depolarizing magnet 25.

To facilitate the effective operation of the ball valve both in its rising and falling movements, I have designed the relation of the gas inflow port in respect to the normal travel of the ball, so that when the pole pieces are magnetized to move the ball from its seat, the entering flow of gas to the valve casing impinges on the ball in such direction and with force as to supplement and assist the initial magnetic pull in unseating the valve. Furthermore, the intake port is preferably so related to the ball when suspended as to strike the lower half of the ball only. Upon demagnetization of the pole pieces, if a slight residual magnetism continues under the above described condition, the flow of gas impinging on the ball causes a trembling movement thereof, assuring its dislodgement and positive seating.

While I have shown the bore of the valve casing vertical, I do not limit myself to this exact relation, as it may be at various angles so long as the wall or runway for the ball extends in an upward direction from the ball seat.

Features concerning this invention are disclosed in my Patent 1,744,631, dated Jan. 21, 1930, for Temperature regulating attachment for linotype machines, and my Patent 1,744,632, dated Jan. 21, 1930, for Heating systems, applications for which were copending with the present case.

I claim:

1. In apparatus of the class described, a magnetic ball valve comprising a casing having a smooth upwardly extending runway wall with an apertured valve seat arranged at the bottom thereof on which the ball rests to close the aperture against the passage of fluid, a magnetic pole piece piercing said valve casing above the level of the center of the ball when resting on said seat, and acting to roll the ball laterally off of its seat into contact with and up along said wall, substantially as described.

2. A magnetic ball valve mechanism according to claim 1 in which the pole piece pierces the valve casing with its axis off to one side of the axis of the vertical bore or runway of said casing, substantially as described.

3. In apparatus according to claim 1 in which the pole piece pierces the valve casing tangentially in respect to the wall of the bore of said casing, substantially as described.

4. In apparatus according to claim 1 in which two pole pieces extend through the casing from opposite sides thereof, and with the outer sides of said pole pieces tangential to the wall of the bore of said casing, the faces of said pole pieces conforming to the curve of the wall of the bore and forming

sections of said wall, substantially as described.

5. In apparatus of the class described a valve casing having a cylindrical bore with a valve seat at the bottom thereof concentric with said cylindrical bore, a spherical ball of slightly less diameter than said cylindrical bore, a magnetic pole piece extending through the wall of the casing and above the level of the ball center when the ball is seated, said pole piece when energized rolling the ball laterally off from its seat and vertically up along the wall of the bore, substantially as described.

6. In combination, a ball valve, a magnet, a pole piece energized thereby and extending into position to raise the ball from its seat, and a depolarizing magnet to influence the pole piece to drop the ball valve, when the magnet first mentioned is out of service said depolarizing magnet being energized by the magnet first mentioned, substantially as described.

7. A magnetic ball valve according to claim 1 in which the pole piece extends with its outermost side tangentially to the runway wall of the bore of the valve casing and with its face curved to conform to the curve of the said bore, substantially as described.

8. A magnetic ball valve according to claim 1 in which a second piece pierces the wall of the casing axially in line with the first pole piece and with the outermost sides of said pole pieces tangential to the runway wall of the bore of the casing, the curved faces of the pole pieces conforming to and forming sections of the wall of the bore and thus being separated slightly by the runway for the ball.

9. A magnetic ball valve according to claim 1 in which the inlet for the gas to said casing is axially at right angles to the axis of the bore of said casing to impinge upon the ball and assist its initial lateral unseating by the pole piece.

10. A magnetic ball valve according to claim 1 in which the inlet for the gas to the casing is axially at right angles to the axis of the bore of said casing and substantially on the opposite side thereof from that upon which the pole piece is located so as to tend to force the ball laterally off its seat towards the said pole piece and assist in lifting the ball along its runway, substantially as described.

11. A magnetic valve according to claim 1 in which the inlet for the gas to the valve casing is axially at right angles to the axis of the bore of the casing, and on the opposite side of the casing from the pole piece, and adapted to make the inflowing gas impinge upon the ball when raised from its seat to insure its dislodgement and reseating when the pole piece is demagnetized, substantially as described.

12. In combination with a magnetic ball valve, a movable permanent magnet with operating means therefor to position it with its poles disposed to raise the ball valve from its seat, or to withdraw said magnet to allow the ball to fall to closed position, said movable magnet being poised to swing its poles to and from the valve casing, and means for adjustably counter-weighting the said magnet.

13. Apparatus according to claim 1, a second pole piece axially in line with the first mentioned pole piece and having its inner end face conforming to the curved wall of the runway, substantially as described.

14. In apparatus of the class described, a casing having a bore constituting a smooth upwardly extending runway with a valve seat arranged at the bottom thereof, a pair of pole pieces extending from opposite sides of the casing through the wall thereof and having their inner ends at a level above that of the center of the ball valve on its seat, said ball under the attraction of said pole pieces rolling laterally off from its seat and rolling up along the runway wall, substantially as described.

15. In apparatus of the class described, a magnetic ball valve comprising a casing having a bore with a smooth upwardly extending runway wall with an apertured valve seat arranged at the bottom thereof on which the ball rests to close the aperture against the passage of fluid, a magnetic pole piece piercing said valve casing above the level of the center of the ball when resting on said seat, the inner end of the pole piece having a face conforming to and forming an imperforate section of the runway wall, and acting to roll the ball laterally off of its seat into contact with and up along said wall, substantially as described.

16. In apparatus of the class described, a valve casing having a smooth perpendicular runway, a magnetic ball valve working freely up and down in said runway, a seat-port at the bottom of said runway closed by said ball while resting thereon, a concentrated opposing pair of horizontally disposed pole pieces so adapted and fixed to said casing above the transverse center of said seated ball as to establish a dense magnetic flux crosswise through said runway to raise and suspend said ball above said seat when energized the faces of the pole pieces having their axes coincident and located off to one side of the center of the ball, said axes being in a horizontal plane cutting the ball above its center.

17. In apparatus of the class described, a valve casing having a smooth perpendicular runway, a magnetic ball valve element freely rolling up and down one side of said runway, a seat-port at the bottom of said runway closed by said ball when seated thereon, a fluid admission duct into said runway above

said seat port, and a concentrated opposed pair of horizontally disposed pole pieces fixed to said casing above the transverse center line of said seated ball, establishing a dense elevated magnet field crosswise through said runway to raise and suspend said ball above said seat when energized.

18. In apparatus of the class described, a magnetic ball valve element, a valve casing therefor with a smooth vertical bore slightly larger than said ball, acting as a runway therefor, a concentric port seat at the bottom of said bore for said ball, a fluid admission duct into said runway above said seat port, an opposing pair of pole pieces fixed to said casing and extending in a direction transverse of said bore and in a plane above the center of said ball when seated to first draw the ball sidewise off its seat, and then roll it up the inner wall of said casing runway when energized.

In testimony whereof, I affix my signature.
EDWARD S. HALSEY.

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