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Doe et al.

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[54] **SAFETY CUT-OFF VALVES FOR GAS SUPPLY SYSTEMS**

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[30] **Foreign Application Priority Data**

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[52] **U.S. Cl.** **137/494,** 137/458, 137/463, 251/65

[51] **Int. Cl.** **F16k 17/64**

[58] **Field of Search** 137/458, 463, 466, 494; 251/65

[56] **References Cited**

UNITED STATES PATENTS

2,327,055	8/1943	McMahon	137/458
2,426,364	8/1947	Massecar	137/458
2,701,580	2/1955	Sullivan	137/458
2,881,787	4/1959	Sullivan	137/458 X
3,021,866	2/1962	Handley	137/458
3,306,317	2/1967	Brown	137/463 X
3,422,841	1/1969	Farrer	137/463 X
3,635,239	1/1972	Farrer	137/463

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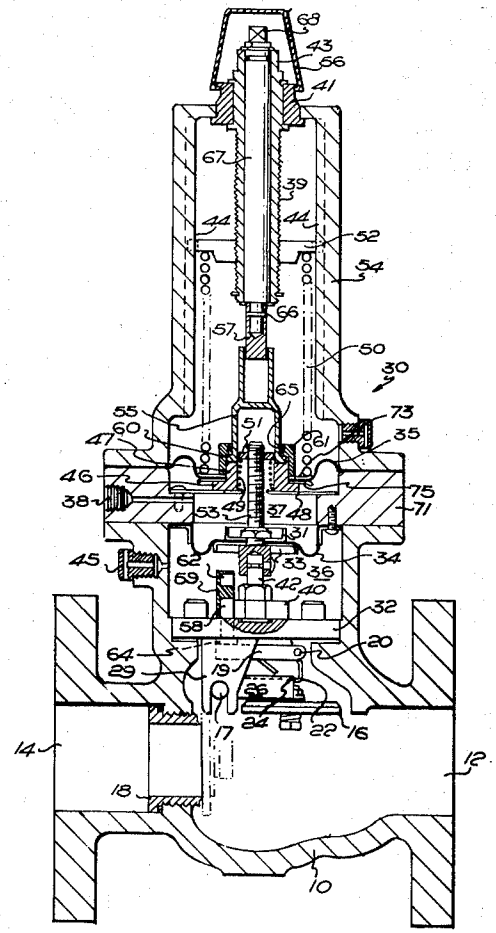
[57] **ABSTRACT**

A safety cut-off valve for a gas supply system a control unit of which is responsive both to a rise above a pre-determined maximum pressure and to a fall below a pre-determined minimum pressure to cause closure of the valve.

7 Claims, 5 Drawing Figures



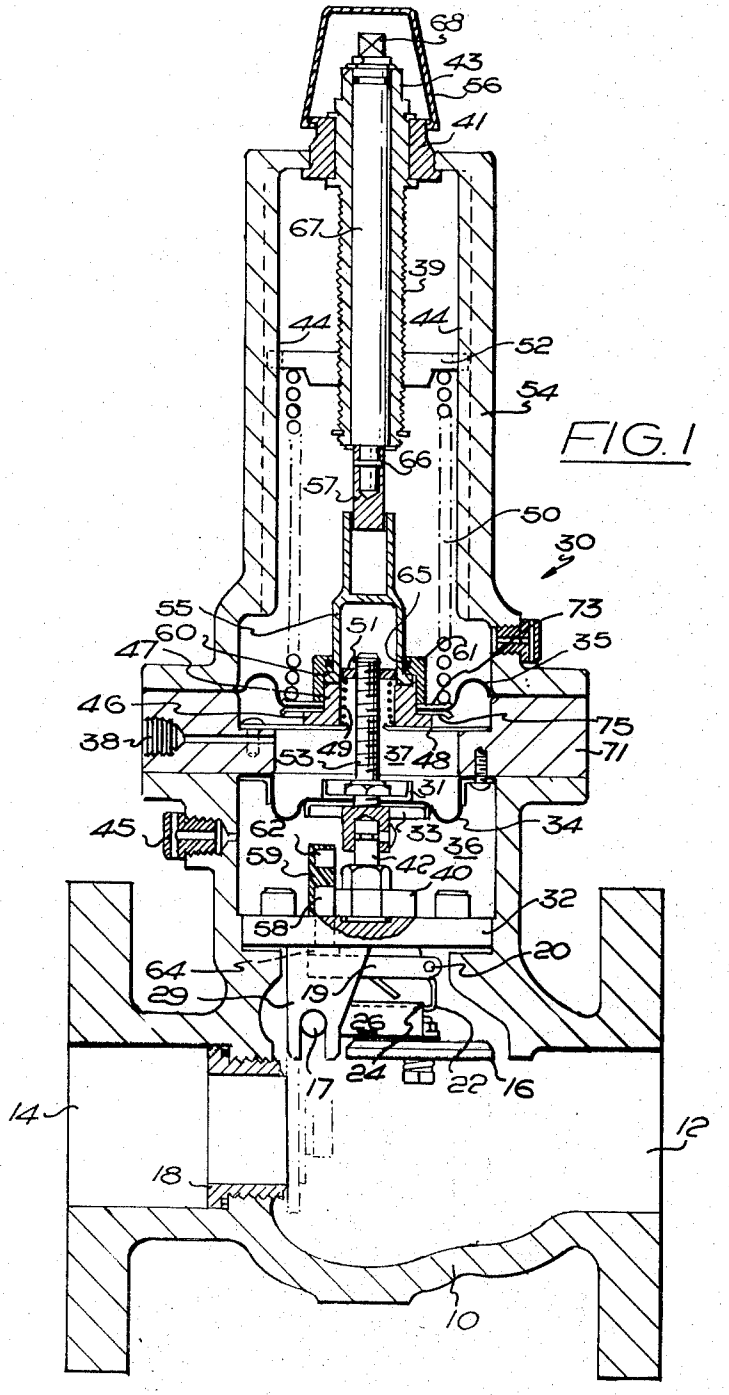

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FIG. 1

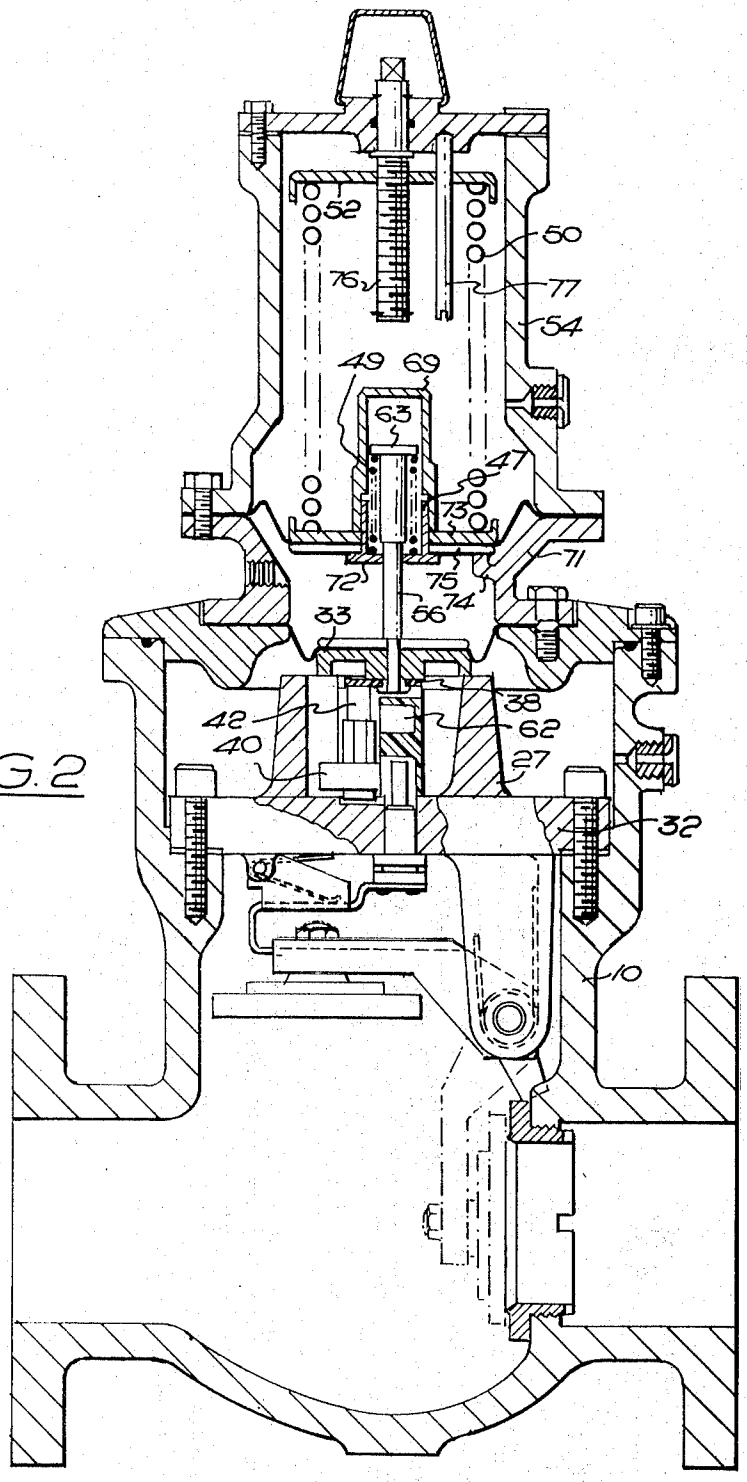

FIG. 2

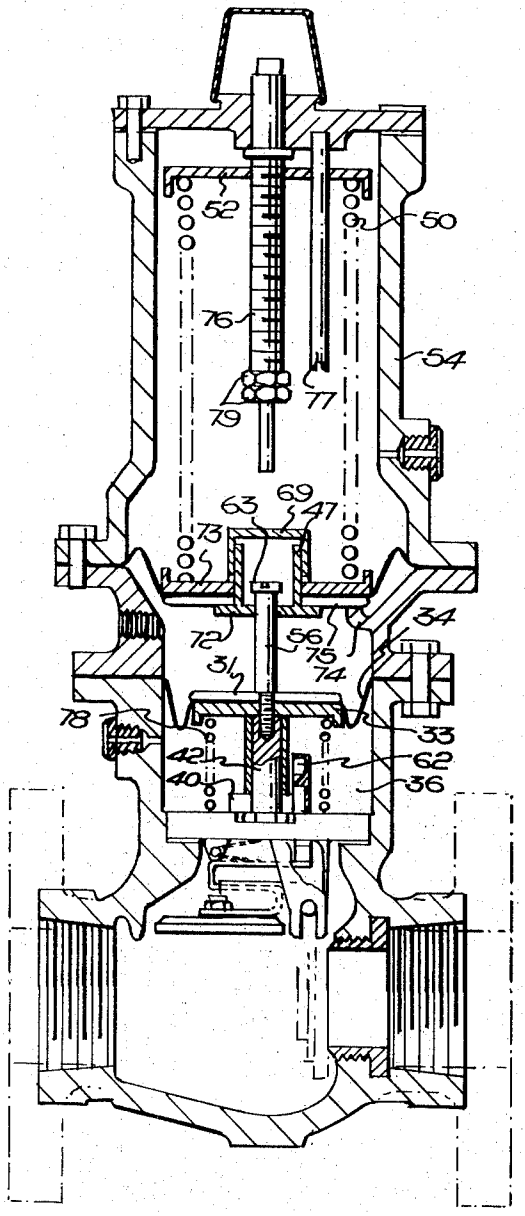

FIG. 3

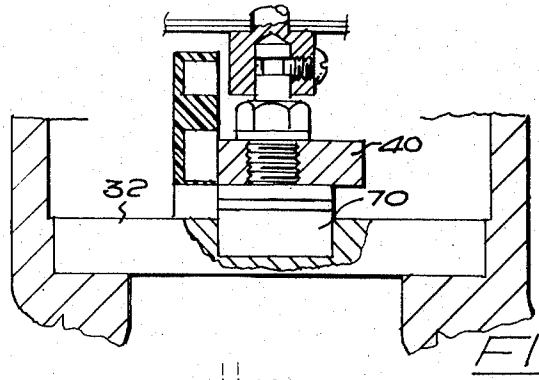
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FIG. 4

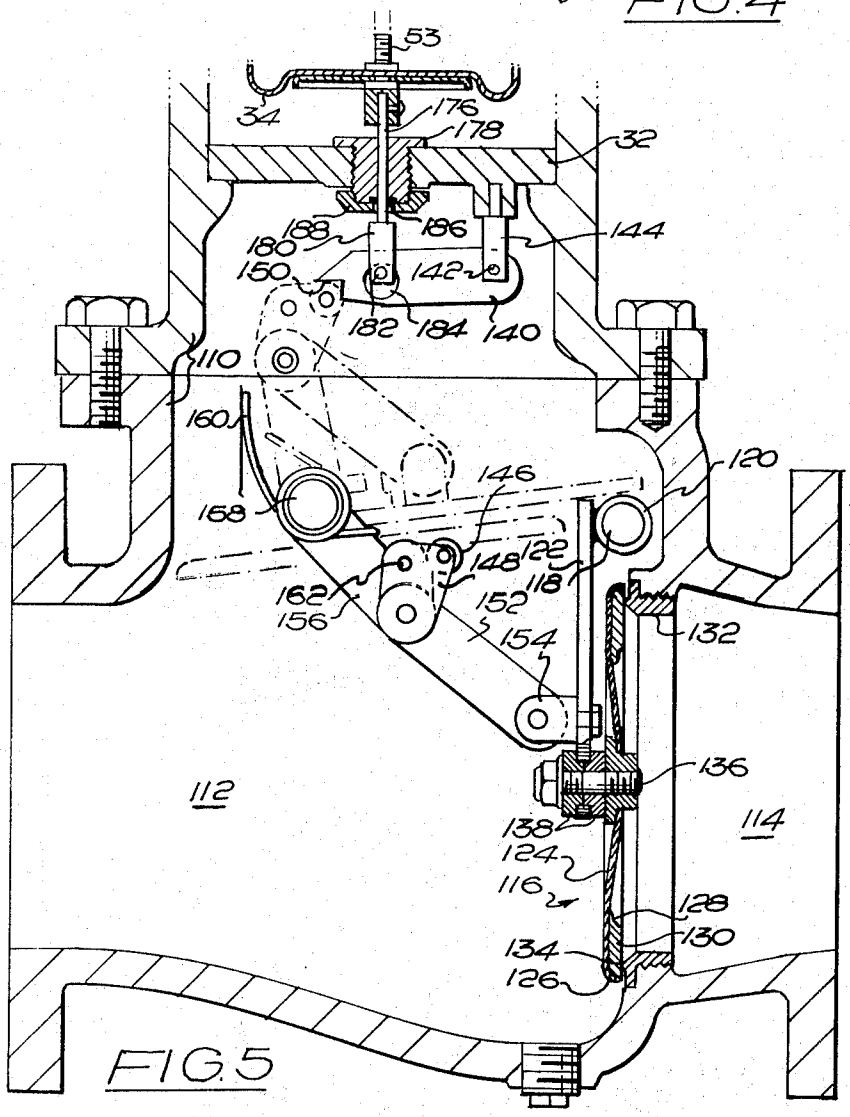
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FIG. 5

SAFETY CUT-OFF VALVES FOR GAS SUPPLY SYSTEMS

The invention relates to safety cut-off valves for gas supply systems.

Safety cut-off valves are known in which a valve member is released from an inoperative position to close a flow passage through the valve when the gas pressure at some gauge point rises above a pre-determined maximum pressure. It is an object of the invention to provide an improvement in or relating to such a valve.

According to the invention, a safety cut-off valve for a gas supply system includes a valve member mounted for movement towards or away from a valve seat; detent means for retaining said valve member in an inoperative position off said seat during normal operation; and a control unit co-operating with said detent means to effect the release of said valve member in response to the gas pressure at some gauge point rising above a pre-determined maximum pressure or falling below a pre-determined minimum pressure.

The control unit preferably includes a pair of flexible diaphragms of different effective areas urged in opposite directions by gauge pressure, first spring means acting against the larger of the two flexible diaphragms, second spring means acting against the smaller of said two diaphragms, lost motion means connecting said two diaphragms, and a control spindle connected to the smaller of said two diaphragms, the arrangement being such that when the gauge pressure is maintained within permissible limits the control spindle is held by the smaller of the two diaphragms against the force of said second spring means in a position in which the detent means act to retain the valve member in its inoperative position, and when the gauge pressure exceeds a pre-determined maximum pressure said gauge pressure acting against the larger of the two diaphragms overcomes the force of said first spring means to cause the control spindle to be displaced in a direction causing the detent means to release the valve member, and when the gauge pressure falls below a pre-determined minimum pressure the second spring means acting against the smaller of the two flexible diaphragms displace the latter against the force of said gauge pressure, again in a direction causing the detent means to release the valve member. The gauge pressure preferably acts in a space between the two diaphragms. Means may be provided whereby the force of the first spring means acting against the larger of the two flexible diaphragms and the force of the second spring means acting against the smaller of the two diaphragms can be adjusted.

The valve member will preferably be pivotally mounted and will preferably be arranged to move towards the valve seat under the force of a spring when released by the detent means, preferably assisted by gravity. The detent means may be such that a mechanical advantage is obtained in retaining the valve member in its inoperative position.

The detent means with which the control unit co-operates for retaining the valve member in an inoperative position off its seat or to effect the release of said valve member may include magnetisable means arranged to retain the valve member in its inoperative position when magnetically activated. In this case said detent means will also include a magnet movable under the control of said control unit from a first position in

which during normal operation it activates said magnetisable means to a second position in which the magnetisable means are magnetically de-activated. Such magnetisable means may be constituted by a pair of fixed pole pieces extending through an impermeable wall between a part of the valve in which the magnet is disposed and a flow passage in which the valve member is located. A lever which constitutes a part of the detent means within said flow passage preferably acts as a "keeper" when the pole pieces are magnetically activated. A further "keeper" will preferably be arranged to be contacted by the magnet just before the pole pieces are magnetically de-activated consequent upon the magnet being slid off them.

On the other hand the detent means with which the control unit co-operates for retaining the valve member in an inoperative position off its seat or to effect the release of said valve member may be constituted by a mechanical latch mechanism capable of being released by means of a rod connected at one end to the control unit, said rod preferably extending into the flow passage and being connected to the detent means in this case wholly disposed within said flow passage.

In order that the invention may be fully understood and readily carried into effect, the same will now be described, by way of example only, with reference to the accompanying drawings, of which:

FIG. **1** is a sectional view through a safety cut-off valve embodying the invention,

FIGS. **2** and **3** are views similar to FIG. **1** and illustrating possible modifications which will be referred to,

FIG. **4** is a scrap view showing a further possible modification thereof, and

FIG. **5** is a sectional view through a rather different construction of cut-off valve to which the invention may be applied,

Referring now to FIG. **1** of the drawings, a safety cut-off valve for installation in a gas supply system includes a main body part **10** with co-axial inlet and outlet passages indicated **12** and **14** respectively. A valve member **16** is pivotally mounted within the body part as shown for movement towards or away from a valve seat which is constituted by one end of a liner **18** screwed into the outlet passage. A detent mechanism is also provided within the main body and co-operates with the valve member **16** when the latter has been raised to an inoperative position off the valve seat, as shown in full lines in the drawing. Said detent mechanism is constituted by a lever **19** pivotally mounted on a pivot pin **20,** and said lever is provided with a latch portion **22** which co-operates with a tail piece **24** of an arm **26** on which the valve member is carried, to retain the latter in its inoperative position against the action of a torsion spring not shown which acts to close the valve. A soft iron "keeper" **64** is mounted at the free end of the lever **19** and extends transversely thereof for a purpose which will be presently explained.

The valve member **16** is pivotally mounted within the body **10** on a spindle **17** which extends between a pair of brackets **29** (only one of which can be seen in the drawing) depending from an aluminum insert **32** which forms an impermeable wall between upper and lower parts of the valve body. Means for retaining the lever **19** in the position in which it is shown in the drawing during normal operation of the valve are constituted by a permanent magnet **40** located above the insert **32** at

the lower end of a carrier spindle **42.** During normal operation of the valve, that is to say when a certain gauge pressure is maintained within a predetermined permissible range, the poles of said magnet contact from an exposed side the upper ends of a pair of soft iron plugs **58** which are moulded in a block of synthetic plastics material **59.** The soft iron plugs extend through the aluminum insert, providing an abutment surface for the soft iron keeper **64** mounted at the free end of the lever **19,** and when magnetically activated by the magnet they retain the lever in its raised position. In an upper position to which it is moved in circumstances which will presently be described, the magnet is disconnected from the soft iron plugs and contacts a soft iron "keeper" **62** which is disposed some distance above the upper ends of said plugs. Said plugs are thus magnetically open circuited, allowing the keeper **64** together with the lever **19** to fall so that immediate closure of the valve results.

A control unit generally indicated **30** is provided for causing the release of the valve member **16** in response to a rise above a predetermined maximum or a fall below a predetermined minimum of the gauge pressure referred to above. The control unit includes an annular spacer member **71** disposed between flanges on the main body part **10** and on an upstanding cover **54.** An outer peripheral edge portion of a flexible diaphragm **34** is secured to a lower face of the spacer member to enclose a cavity **36** immediately overlying the insert **32,** said cavity communicating to atmosphere by way of a breather **45.** The head of a screwthreaded control spindle **53,** clamped to said diaphragm by upper and lower disc members **31** and **33** respectively, is connected to the carrier spindle **42** to lift and lower the magnet **40.** A further flexible diaphragm **35** is clamped around its outer periphery between the spacer member and the flange of the upstanding cover **54** and encloses a space **37** between the two diaphragms. It will be seen that the flexible diaphragm **35** has a larger effective area than the flexible diaphragm **34.** A screwthreaded aperture **38** is provided in the side of the spacer member for the reception of a pipe connection (not shown) by means of whiqh the gauge pressure referred to above, conveyed from some convenient source, can be caused to act in the space **37.** A further breather **45** is provided to vent the space overlying the diaphragm **35.**

A coil spring **50** (which may be referred to as first spring means) overlies the diaphragm **35** and acts to urge said diaphragm downwardly. The spring re-acts against an abutment member **52** which can be adjustably positioned within the cover **54** to pre-load the spring to a required degree. The means provided for adjusting the abutment member within the cover are constituted by a screw-threaded sleeve **39** extending downwards from an upper end of the cover. Said sleeve is rotatably mounted but axially fixed in a bush **41** which is located at the upper end of the cover. An extraneous tool (not shown) can be applied to a squared upper end **43** of the sleeve when a cap **56** has been removed. The abutment member **52,** being held against rotation in the cover **54** by guideways generally indicated **44,** is caused to move upwards or downwards depending on the direction in which the sleeve **39** is turned.

During normal operation of the valve, that is to say as shown in the drawing, the spring **50** holds a flange **46** of a sleeve **47** which extends through a central aperture in the diaphragm **35** in contact with an annular abutment plate **48** which extends across the space **37.** In this condition also, a relatively light coil spring **49** (which may be referred to as second spring means) acts against a nut **51** carried by the screwthreaded spindle **53** (and thus acts indirectly against the diaphragm **34**) and reacts against said abutment plate, although in fact it is not sufficiently powerful to lift the magnet from its lower position against the gauge pressure acting on the diaphragm **34.** Means which are provided for adjusting the position of the nut **51** on the spindle **53,** to adjust the force of the spring **49,** include a socket member **55** having a hexagonal opening in which said nut is axially slidable but non-rotational and a driving key **57** of square cross-section which engages a square opening in the upper end of the socket member so that it drivingly engages said socket member whilst being axially slidable relative thereto. The socket member is provided with a peripheral flange **60** at its lower end which is held loosely in contact with the upper end of the sleeve **47** by means of a screwthreaded collar **61** which engages said sleeve. The screwthreaded collar **61** is also employed to clamp the flexible diaphragm **35,** a central part of which is located between upper and lower disc members **73** and **75,** against the flange of the sleeve **47.** An O-ring seal **65** is provided between the collar **61** and a cylindrical external portion of the socket member to prevent the leakage of gas from the space **37.** The driving key **57** on the other hand is secured by means of a pin **66** at the lower end of an adjusting spindle **67** which extends rotatably through the screw-threaded sleeve **39.** The adjusting spindle is secured against axial movement in said sleeve and has a squared upper end **68** to which an extraneous tool (not shown) can be connected when it is desired to turn it to adjust the force of the spring **49.**

In operation, when the valve is open as shown in the drawing, and the gauge pressure in the space **37** is within the permissible operating range, the soft iron plugs are magnetically activated and cause the detent mechanism to retain the valve member in its inoperative position as previously described. If the gauge pressure becomes higher than the predetermined maximum, however, the upward force produced against the diaphragm **35** is sufficient to overcome the force of the spring **50** acting downwards and the diaphragm **35** together with the sleeve **47** and socket member **55** are displaced upwardly. When this occurs, the sleeve **47** abuts against the underside of the nut **51** and lifts the magnet together with the diaphragm **34** (which it can do by virtue of the fact that the effective area of the diaphragm **35** is greater than that of the diaphragm **34**). Consequently, as previously described the soft iron plugs are magnetically de-activated and the valve is caused to close. On the other hand if the gauge pressure drops below the predetermined minimum, the force of the spring **49** is sufficient to lift the diaphragm **34** against the force of said gauge pressure and to lift the magnet so that once again the soft iron plugs are magnetically de-activated to allow the valve to close.

Thus there is provided a safety cut-off valve of relatively simple construction which is responsive to either a rise above a predetermined maximum or a fall below a predetermined minimum in a certain gauge pressure. It is also "fail-safe" in the sense that if over a long period of time the magnet **40** looses its strength the valve will shut and, being unable to be held open despite the

gauge pressure being within the prescribed limits, will give an indication that the magnet should be replaced.

Referring now to FIG. **2**, in a modified and somewhat simplified version of the valve just described, no special provision is made for the force of the spring **49**, i.e., the second spring means, to be adjusted and consequently the predetermined minimum gauge pressure at which the release of the valve member is effected is pre-set according to the strength of the spring (although it will be understood that the effective length of the spring, and thus its strength, could be slightly adjusted by shimming between the spacer member **71** and the main body part). As a result of this it has been possible to omit the adjusting spindle **67** and the mechanism associated with it, and the screwthreaded sleeve for adjusting the position of the abutment member has been replaced by an axially fixed adjusting spindle **76.** In addition, the means now provided for preventing rotation of the abutment member **52** are constituted by a spindle **77** which depends from an upper end of the upstanding cover and extends freely through a hole in said abutment member.

The control spindle **56** is not screwthreaded, except at its lower end, and is provided with a head **63** against which the spring **49** acts, the head of the spindle being located within a screwthreaded cap **69** which takes the place of the socket member **55** and screwthreaded collar **61** of the first described embodiment. It will be seen that in this case the abutment plate **48** has been omitted and that, in effect, the lower one of the disc members **73** and **75,** between which the flexible diaphragm **34** is claimed, takes the place of said abutment plate by virtue of the fact that at normal and low gauge pressure it seats itself upon abutment members **74** which are provided within the spacer member **71.** It will also be seen that at normal and high gauge pressures the lower one of the disc members **31** and **33,** between which the flexible diaphragm **34** is clamped, seats itself upon an upstanding annular part **27** of the insert **32.** The carrier spindle **42** will also be seen to be offset from the axis of the control spindle **56** on a bracket **38** secured to the lower end of the latter.

It will be understood however that despite these various differences just described the valve operates in a very similar manner to that previously described. The overall length of the adjusting spindle **76** is such that it acts as a stop against which the screwthreaded cap **69** can abut to locate the magnet **40** in alignment with the "keeper" **62** whatever the rise in the gauge pressure above the high trip pressure might be. Similarly, the distance between the head of the control spindle and the upper surface of the interior of the screwthreaded cap is such that the magnet **40** is again located in alignment with the "keeper" **62** whatever the drop in the gauge pressure below the low trip pressure might be.

Referring now to FIG. **3**, in a further modified form of the valve (in many ways similar to that just described) the spring **49** has been omitted from beneath the head of the control spindle **56** and a spring **78** (which again can be referred to as second spring means) has been located within the cavity **36** to act upwardly against the lower one of the disc members **31** and **33** between which the central part of the flexible diaphragm **34** is clamped. In this case, an excessive gauge pressure causes the collar **72** of the sleeve **47** to act directly against the head **63** of the control spindle and to lift the magnet **40.** As in the case of the valve illustrated in FIG. **2,** the abutment of the screwthreaded cap **69** against the lower end of the adjusting spindle **76** limits the upward movement of the magnet due to an excessive gauge pressure so that said magnet is aligned with the "keeper" **62** (but in this case said adjusting spindle is provided with a pair of locknuts **79** to limit the extent by which the spring **50,** i.e., the first spring means, can be pre-loaded by the abutment member **52**). Similarly, the abutment of the head **63** of the control spindle against the upper surface of the interior surface of the screwthreaded cap limits the upward movement of the magnet due to a fall in the gauge pressure below the pre-determined minimum so that said magnet is again aligned with the keeper **62.**

Referring now to FIG. **4** there is illustrated a simple modification which can be made to any of the safety cut-off valves previously described but which for the sake of illustration has been shown applied to the valve illustrated in FIG. **1.** In this modification a so-called "pot" magnet **70** has been located in a depression formed in the aluminium insert **32.** Said "pot" magnet acts to hold the carrier spindle **42** in its lower position so that the magnet **40** remains in contact with the soft iron plugs **58** until the hold of the pot magnet is overcome by the force by the force tending to lift the magnet **40** as a result of the gauge pressure being outside the permissible limits. A decisive "trip" action then results.

Referring now to FIG. **5** of the drawings, in a somewhat different kind of safety cut-off valve to which the invention has been applied, a main body part **110** is provided with co-axial inlet and outlet passages indicated **112** and **114** respectively. A valve member generally indicated **116** is pivotally mounted within the body part about the axes of oppositely disposed spigots **118** of screwed plugs (not shown) which are screwed in alignment from opposite sides of the body part, said spigots engaging the opposite ends of a tube **120** which is welded to one end of an arm **122.** The tube **120** and arm **122,** together with spigots **118,** constitute a hinge mounting for the valve member **116.**

The valve member **116** is provided with a sheet metal pressing **124** with an annular lip **126** formed integrally with it. An annular disc **128** is welded to the inwardly dished surface of the pressing **124** to form an annular space **130** which is filled with a resilient material. A seating ring **132** is screwthreaded into the upstream end of the outlet passage as shown and is provided with an annular projection **134** constituting a valve seat arranged to bite into the resilient material filling the space **130** in the door, thereby providing a good gas-tight seal when the valve member has been closed. A screwthreaded spindle **136** is provided for securing the valve member to the arm **122,** and said spindle is surrounded by a pair of abutting rubber bushes **138** where it extends through a hole in said arm. This improves still further the seal which is made when the valve member has been closed, since the valve member is able to adjust its position upon the valve seat.

A detent mechanism arranged to retain the valve member in the raised inoperative position in which it is shown in chain-dotted lines in FIG. **5,** is constituted by a mechanical latch mechanism including a trip lever **140** pivotally mounted at **142** in a bracket **144** depending from the insert **32** located between upper and lower parts of the valve body; a roller **146** abutting a notched

part **150** of the trip lever when the valve member is inoperative; a roller carrier assembly comprising a link **152** secured at one end to a pair of plates **148**; a bracket **154** projecting from the arm **122** and pivotally connected to the other end of the link **152**; and a further link **156** pivotally mounted at one end to the roller carrier assembly and pivotally mounted at its other end about the axis of a spindle **158.** A spring **160** encircles the spindle **158** and acts against the link **156,** the arrangement being such that when the detent mechanism is tripped, that is to say released, the spring acts to cause the valve member to be slammed shut upon its seat, being assisted in this of course by gravity and by any flow of gas which there may be through the valve as the valve member approaches its seat. It will be seen that, in slamming shut, the valve member causes the linking arrangement constituted by the links **152** and **156** to move "over-centre" and a pin **162** which is also mounted between the plates **148** abuts against the link **156** to retain the links in a near straight condition so that the valve member is held hard upon its seat with the annular projection **134** biting into the resilient material which fills the space **130** in the door.

Means for tripping the detent mechanism in response to a rise above a predetermined maximum or a fall below a predetermined minimum of a certain gauge pressure include a control unit as any of those previously described with reference to FIGS. **1, 2** and **3** but for the sake of illustration the control unit described with reference to FIG. **1** is shown to have been adapted for fitment to the safety cut-off valve illustrated in FIG. **5.** Consequently, a rod **176** which is connected at its upper end to the head of the spindle **53** (which is connected to diaphragm **34**) extends slidably through a bush **178** which extends through the insert **32.** At its lower end the rod is connected to a fork member **180** between the arms of which a roller **182** is mounted. The arms of the fork member straddle the trip lever and the roller bears against an upper part of the surface of an aperture **184** which is considerably larger than the roller as shown. The bush **178** is recessed as shown for the reception of a rubber O-ring **186** which surrounds the rod **176** and forms a seal against the leakage of gas along the rod. The O-ring is retained in position by means of a cap **188** screwed on the lower end of the bush.

During normal operation, the valve member **116** is latched up in its inoperative position out of the main gas stream by the detent mechanism. However, if the pressure in the space **37** of the control unit exceeds a pre-determined maximum, or becomes less than a predetermined minimum, the detent mechanism is tripped by the control unit so that the valve member is immediately slammed shut by the spring **160.** As previously described, the links **152** and **156** more "over-centre" as the valve is shut, but the valve can be re-opened and the mechanism re-set when normal operating conditions have been re-established by turning the spindle **158** in an anti-clockwise direction when viewed as in FIG. **5.** For this purpose an end of the spindle which extends through the wall of the main body part has a square portion (not shown) for the connection of an extraneous key (not shown).

Various other modifications may be made without departing from the scope of the invention, particularly in the manner in which the valve member is suspended within the main body part of the valve and in the details of the detent mechanism for retaining it in its raised inoperative position. Furthermore, the exposed surfaces of the parts which constitute the magnetic circuits of the control units illustrated in FIGS. **1** to **4** of the drawings may be coated with lacquer to prevent corrosion or, instead of this, the side surfaces of the soft iron plugs and of the keeper **62** may lie just beneath the surface of the synthetic plastics material. The gauge pressure need not necessarily act in a space between the pair of flexible diaphragms; it could act in separate chambers on opposite sides of the diaphragms, the space between them then being vented to atmosphere.

What we claim and desire to secure by Letters Patent is:

1. In a safety cut-off valve for a gas supply system, a valve member mounted in a flow passage for movement towards and away from a valve seat; detent means for retaining said valve member in an inoperative position off said seat during normal operation; and a control unit controlling said detent means and effective to release said valve member in response to the gas pressure at some gauge point rising above a predetermined maximum pressure and in response to said gas pressure falling below a pre-determined minimum pressure, the improvement wherein said control unit includes a pair of flexible diaphragms of different effective areas urged in opposite directions by gauge pressure acting in a space therebetween, first spring means for acting with sufficient force against the larger of said two flexible diaphragms to hold it in a pre-set position dictated by the presence of an abutment plate when the gauge pressure is below a pre-determined maximum pressure reached, second spring means for acting against the smaller of said two flexible diaphragms with sufficient force to hold it in a pre-set position when the gauge pressure is above a pre-determined minimum pressure and for urging said smaller of the two diaphragms towards the larger of the two diaphragms, lost motion means connecting said two diaphragms for causing said smaller diaphragm to be displaced in response to the displacement of said larger diaphragm, and a control spindle connected to the smaller of said two diaphragms and movable in one direction to release the valve member, the arrangement being such that when the gauge pressure acting in a space between the two diaphragms is within the pre-determined limits, said control spindle is held by the smaller of the two diaphragms against the force of said second spring means in a position in which it causes said detent means to retain said valve member in its inoperative position but when said gauge pressure exceeds the pre-determined maximum pressure it acts against the larger of the two diaphragms to overcome the force of said first spring means and to move said control spindle in said one direction, by means of said lost motion means, to a position in which it causes said detent means to release said valve member, and when said gauge pressure falls below the predetermined minimum pressure said second spring means acting against the smaller of the two diaphragms displace the control spindle against the force of said gauge pressure, again in said one direction, to cause said detent means to release said valve member.

2. A safety cut-off valve as claimed in claim **1,** in which adjusting means are provided for adjusting the force of said first spring means.

3. A safety cut-off valve as claimed in claim 1, in which adjusting means are provided for adjusting the force of said second spring means.

4. A safety cut-off valve as claimed in claim 1, in which said valve member is pivotally mounted and a spring is provided for moving said valve member towards said valve seat when it has been released by the control spindle having been displaced in said one direction to cause the release of said detent means.

5. A safety cut-off valve as claimed in claim 1, in which said detent means controlled by said control unit for retaining said valve member in an inoperative position off its seat during normal operation and to effect the release of said valve member in response to the gas pressure at said gauge point rising above said pre-determined maximum pressure and in response to said gas pressure falling below said pre-determined minimum pressure includes a magnet movable in said one direction by said control spindle in response to changes of gas pressure at said gauge point and magnetizable means arranged to retain said valve member in its inoperative position when magnetically activated by the proximity of said magnet.

6. A safety cut-off valve as claimed in claim 5, in which said detent means includes a lever which acts as a keeper when said magnetizable means are magnetically activated.

7. A safety cut-off valve as claimed in claim 1, in which said detent means controlled by said control unit for retaining said valve member in an inoperative position off its seat during normal operation and to effect the release of said valve member in response to the gas pressure at said gauge point rising above said pre-determined maximum pressure and in response to said gas pressure falling below said pre-determined minimum pressure includes a mechanical latch mechanism and a rod extending into said flow passage and connected to the control spindle of said control unit, said rod being capable of releasing said latch mechanism when moved in said one direction in response to the gas pressure at said gauge point rising above said pre-determined maximum pressure and in response to said gas pressure falling below said pre-determined minimum.

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