

[54] **PRESSURE SENSITIVE CONTROL
APPARATUS WITH MAGNET ACTUATED
SWITCH AND VALVE**

[75] Inventors: **Richard Davis Grayson**, Arcadia;
Reed Albert Palmer, Glendale, both
of Calif.; **Raymond John Fox**, Irwin,
Pa.

[73] Assignee: **International Telephone and
Telegraph Corporation**, New York,
N.Y.

[22] Filed: **Jan. 22, 1971**

[21] Appl. No.: **108,873**

Related U.S. Application Data

[63] Continuation of Ser. No. 796,051, Feb. 3, 1969.

[52] U.S. Cl. **200/83 Q; 200/83 L; 251/63.4;
137/503**

[51] Int. Cl.² **H01H 35/34**

[58] Field of Search **200/83 Q, 83 L, 83 T;
251/61.4, 63.4, 77; 137/503**

[56] **References Cited**

UNITED STATES PATENTS

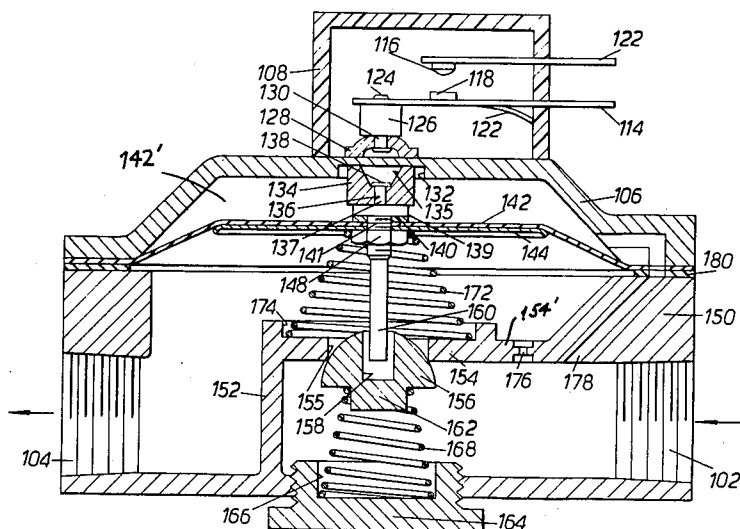
1,938,327	12/1933	Green	200/83 Q
2,601,321	6/1952	Ray	200/83 Q X
3,238,323	3/1966	Stonich et al.	200/83 L X

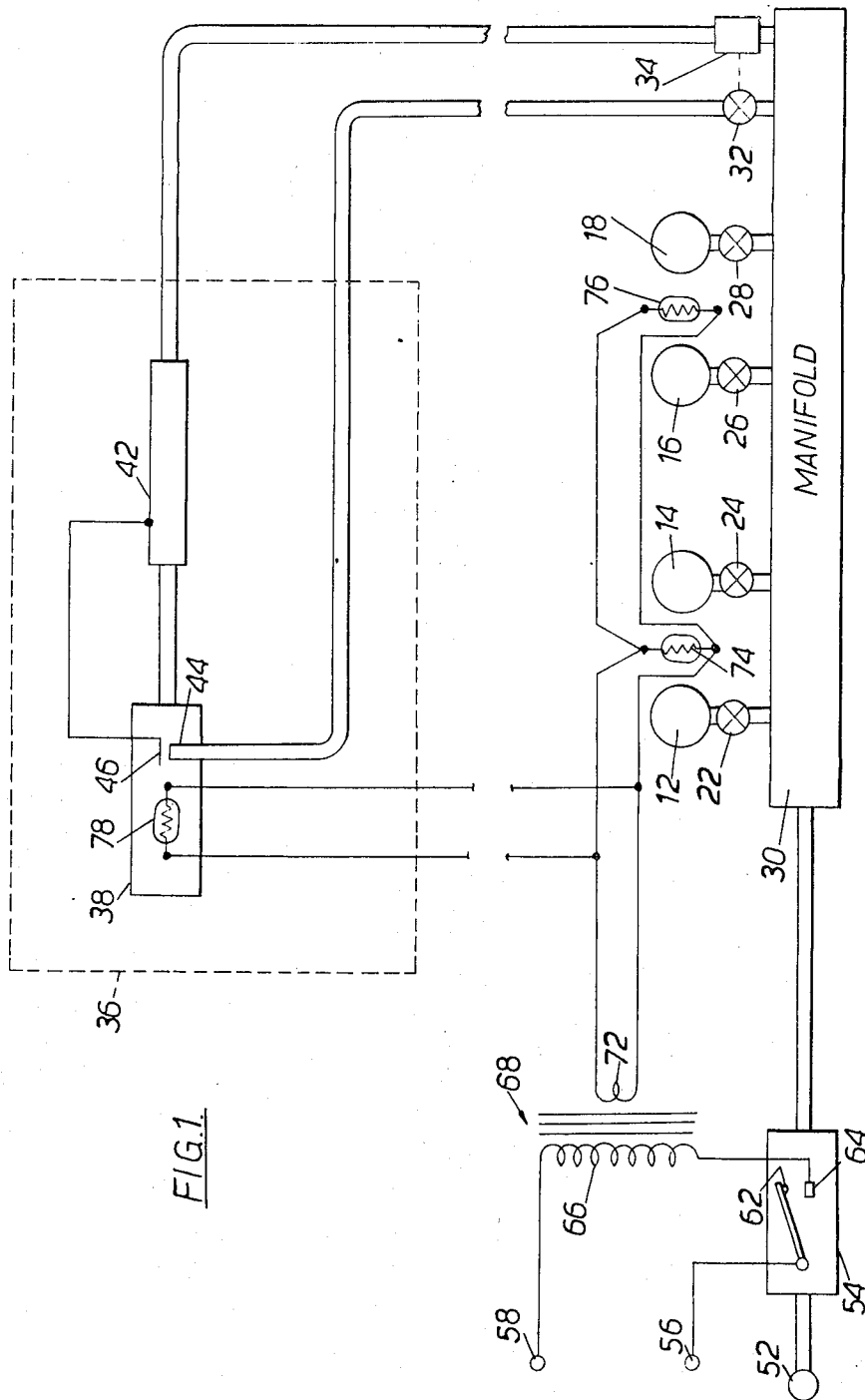
Primary Examiner—Gerald P. Tolin
Attorney, Agent, or Firm—A. Donald Stolzy

[57] **ABSTRACT**

A fuel ignition system and a flow switch therefor which can be used for leak detection and otherwise. Upon detection of the flow, ignitor elements in the system are heated to cause combustion of the fuel at the point of release of the fuel in the system. The flow switch includes a diaphragm which separates a pressure chamber from the outlet side of the system. The inlet side is connected to the pressure chamber to cause the chamber pressure to be the same as that on the inlet side. A permanent magnet is connected to the diaphragm and is responsive to a pressure differential between the inlet side and the outlet side to actuate the switch when there is a very small inlet-to-outlet flow of fuel. Also connected to the diaphragm is a stem for actuating the main valve connecting the inlet side of the system to the outlet. The main valve permits fuel to flow through the switch with a very small pressure drop across the switch. The stem and main valve have a lost motion connection therebetween to insure positive closing of the valve and positive engagement of the permanent magnet with the switch casing.

16 Claims, 2 Drawing Figures





Inventors

Inventors
RICHARD D. GRAYSON

REED A. PALMER

RAYMOND J. Fox

By: Donald J. [Signature]
Attorney

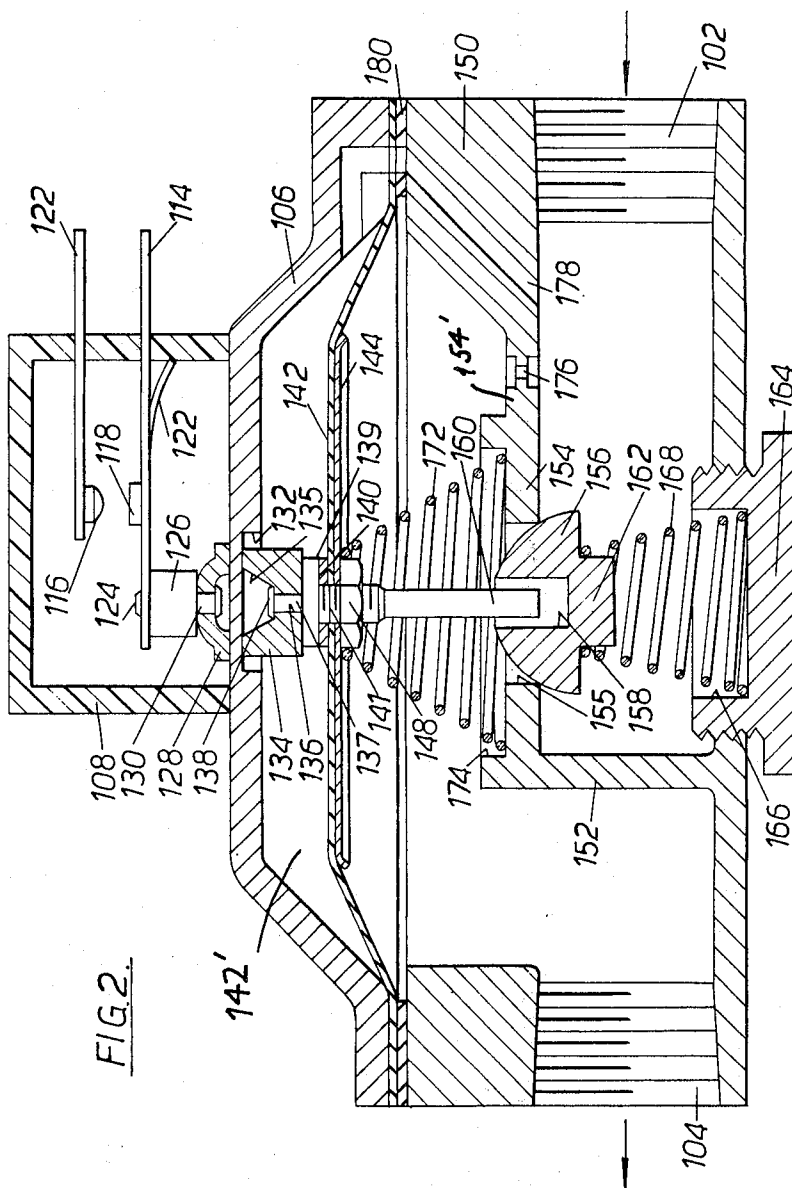


FIG. 2.

Inventors
 RICHARD D. GRAYSON
 REED A. PALMER
 RAYMOND J. FOX
 By: *[Signature]*
 Attorney

PRESSURE SENSITIVE CONTROL APPARATUS WITH MAGNET ACTUATED SWITCH AND VALVE

BACKGROUND OF THE INVENTION

This application is a continuation of copending application Ser. No. 796,051 filed Feb. 3, 1969. The benefit of the filing date of said copending application is, therefore, hereby claimed for this application. Attention is also hereby called to the prior art in said copending application made of record both by applicants and the Examiner in charge thereof.

The invention relates in general to fluid pressure responsive systems and, more particularly, to an ignition system or the like and a flow switch for use in a variety of ways.

Conventional home ranges which utilize fuel have for many years included the "pilot light" concept of ignition. One innovation which eliminated the continuous burning pilot light, has been the use of high tension spark igniter. The spark igniter delivers a pulsating high voltage charge for 15 to 30 seconds which is triggered by a switch on the control shaft of each burner. The wiring harness and switches for the spark igniter are very cumbersome and costly to make and install. Further, high tension wires are needed to connect the source of pulsating high voltage to spare electrodes which cause the fuel to ignite. A major drawback, in addition to the high expense of the high tension spark igniter, has been the problem of fear of the range operator caused by the unusual sparking noise required to ignite the fuel.

SUMMARY OF THE INVENTION

The invention comprises a fuel ignition system or the like and switch means to detect a flow of fuel in such a system or in other systems. Upon detection of the flow, a flow switch turns on an igniter element which is heated to cause combustion of the fuel at the point of release of the fuel in the system. All fuel to the system passes through the flow switch which is actuated equally in response to a very low or a very high flow rate while imposing a pressure drop of insignificant magnitude which is relatively constant at all flow rates.

Advantages of the invention, both as to its construction and mode of operation, will be readily appreciated as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawings in which like reference numerals designate like parts throughout the figures.

BRIEF DESCRIPTION OF THE DRAWINGS

In the drawings which are to be regarded as merely illustrative:

FIG. 1 is a schematic view of a preferred embodiment of a fuel ignition system in accordance with the invention; and

FIG. 2 is a sectional view of a preferred embodiment of the flow switch of the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to the drawings, there is shown in FIG. 1 a fuel ignition system in accordance with the invention. The fuel, which may be natural gas, for example, is supplied to a plurality of top burners 12, 14, 16 and 18, each having a valve 22, 24, 26 and 28, respectively,

associated therewith, for connecting a manifold 30 to the burners. Also connected to the manifold is an oven pilot valve 32 and an oven thermostat control 34. An oven 36, whose temperature is controlled by the thermostat control 34, contains a burner 38 to which gas is supplied from the thermostat control through a flame sensing safety valve 42. An oven pilot 44 heats a temperature sensitive element 46 which is connected to the safety valve 42 so that the valve 42 will not open unless the pilot 44 is on. Fuel for the system is supplied to an inlet 52 which is connected to the manifold 30 through the flow switch 54 of the present invention.

A source of A.C. voltage is connected across a pair of terminals 56 and 58. The terminal 56 is connected to a contact 62 in the flow switch. The contact 62 is associated with a second contact 64 in the flow switch. The contacts are normally closed except when held open by a magnet when no flow exists. The contact 64 is connected to one side of a primary winding 66 of a transformer 68. The other side of the primary winding is coupled to the terminal 58. The secondary winding 72 of the transformer has coupled thereacross a plurality of electrical igniters 74, 76 and 78. Each of these igniters may be of the form described in the above-mentioned copending application, although they need not necessarily be so. The igniter 74 is positioned so that upon heating, fuel emitted from either burner 12 or 14 would be ignited and the igniter 76 is positioned so that fuel emitted from the burner 16 or 18 would be ignited. Alternatively, separate igniters may be provided each burner.

The flow switch 54 which is shown in greater detail in FIG. 2, is of the type that when the output pressure is slightly less than the input pressure thereacross, the terminals 62 and 64 close, causing the igniters 74, 76 and 78 to heat up as fuel passes from the inlet 52 to the manifold 30. Thus, for example, should the operator open the valve 22 associated with the burner 12, the flow switch will cause igniters 74, 76 and 78 to heat up and the igniter element 74 will cause the fuel to ignite and light burner element 12.

In the oven portion of the system, the thermostat control 34 is set to a predetermined temperature and fuel flows through the pilot valve 32 and to the pilot 44. The pilot valve may be part of the thermostat control or may be separated therefrom and mechanically coupled thereto.

Fuel is momentarily prevented from flowing to the main burner 38 by the flame sensing safety valve 42. Flow through the pilot valve 32 causes the flow switch 54 to energize all igniters and pilot 44 is ignited by igniter 78.

When the pilot 44 is ignited, the heat therefrom heats up the pilot flame sensing element which is connected to the flame sensing safety valve. When element 46 reaches a predetermined temperature, the safety valve allows fuel from the manifold to flow to the oven burner where it is ignited by the pilot. The thermostat control 34 determines the cyclic variations in the oven temperature so that the oven burner is maintained at a relatively constant temperature. The operation of the oven is conventional and forms no part of this invention other than the use of the igniter element 78 to ignite the pilot 44.

With the description of the system so far, as can be readily seen, should an operator use one of the top burners, or the oven burner, all three igniter elements

are heated although they may not be used, since all the elements are connected in parallel and a flow of fuel detected by the flow switch 54 causes the terminals 62 and 64 to close. However, the elements may be connected in series, if desired. All the igniter elements remain heated as long as there is a fuel flow in the system.

Referring now to FIG. 2, a preferred embodiment of the flow switch 54 of FIG. 1 is shown in greater detail and comprises an inlet chamber 102 and an outlet chamber 104, formed in a main body 105, which are threaded for connection to inlet and outlet devices. The switch contains a cover 106 upon which a switch body 108 is mounted. Extending out of the switch body 108 are a pair of terminals 112 and 114, for connection to a system as depicted in FIG. 1. Mounted at the internal end of the terminal 112 is a contact 116, and opposite the contact 116 is contact 118 secured to the terminal 114 at approximately the center of the terminal in that portion of the terminal 114 mounted within the switch body 108. The terminal 114 further comprises a cantilever spring member 122 which is secured to the side wall of the switch body 108 and biases the portion of the terminal 114 within the body 108 upward towards the contact 118. The end of the terminal 114 within the switch body 108 is cold headed by means of element 124 to an insulating spacer 126, the other end of the insulating spacer being attached to an armature 128 by means of element 130, the bottom of the armature being adjacent the cover 106.

The underside of the cover opposite the armature 128 contains a cavity 132 into which a permanent magnet 134 is positioned. The top portion of the magnet 134 contains a substantially V-shaped opening 135, the bottom of the opening having an opening 136 into which a vertical stem 137 is riveted, the end of the stem having a head 138 positioned at the bottom of the opening 135. Integral with the stem 137 is a flange 139 whose top surface abuts the bottom of the magnet. The bottom surface of the flange abuts a gasket 140 which surrounds a threaded portion 141 of the stem 137. The threaded portion 141 also passes through a diaphragm 142 and a plate 144. A nut 148 on the threaded portion 141 seals the gasket 140 between the flange 139 and diaphragm 142 and the plate 144 to the diaphragm.

The inlet chamber 102 and outlet chamber 104 are divided by means of a side wall 152 which is made integral with a horizontal wall 154'. The valve seat 154 has an opening 155 therethrough for mating with a valve sealing element 156 positioned in the inlet chamber 102. The valve sealing element has an opening in its top 158 into which the bottom portion 160 of the stem 137 protrudes, a lost motion connection thus being formed between stem 160 and valve 156. A reduced diameter bottom portion 162 of the element 156 is positioned opposite a plug 164 mounted in the bottom wall of the inlet chamber 102 having a cup-shaped opening 166 of a diameter larger than the bottom portion 162. A valve spring 168 is positioned between the cup-shaped opening 166 and the bottom portion 162 so as to normally bias the valve sealing element 156 upwardly against the valve seat 154. Further, a diaphragm spring 172 is mounted between a cup-shaped opening 174 on the top portion of the valve seat 154 and the plate 144. The diaphragm spring 172 causes the diaphragm 142 and plate 144 to be biased upwardly which, in turn, causes the stem 137 to move outwardly from the opening 158 in the element 156. Moreover, an orifice 176 is formed

in the wall 154' between the inlet and the outlet to allow the pressure in the inlet and outlet to stabilize after the valve sealing element is closed. A passageway 178 extends between the inlet 102 to the diaphragm chamber 142' to allow the pressure above the gasket to remain equalized with the inlet pressure. The diaphragm 142 is secured with a gasket 180 between the cover 106 and the main body 105. Thus, the diaphragm chamber 142' between the cover 106 and the diaphragm 142 may be considered to be a pressure chamber which allows the diaphragm 142 to detect pressure changes between the inlet and the outlet chambers 102 and 104, respectively.

With the inlet chamber 102 connected to a gas supply line and the outlet chamber 104 connected to a conventional manifold, such as depicted in FIG. 1, with no valve connected to the manifold open, gas from the inlet passes through the orifice 176 and through the passageway 178 until the pressures in the inlet and outlet chambers 102 and 104, respectively, are equal to each other and to the pressure in the diaphragm chamber 142'. The spring 168 biases the valve sealing element 156 upwardly, closing off the area between the inlet chamber 102 and the outlet chamber 104. Further, the spring 172 biases the diaphragm 142 and plate 144 upwardly causing the magnet 134 to rest in the cavity 132, thus attracting the armature 128 and causing the switch contacts 116 and 118 to remain in an open position.

When one of the valves connected to the manifold is opened, the pressure decreases in the outlet chamber 104 and causes the diaphragm 142 and plate 144 to move downwardly, moving the magnet 134 away from the cavity 132. When the magnet is in this position, the armature 128 is no longer attracted to the magnet 134 and the switch contacts 116 and 118 close, causing igniters 74, 76 and 78 to be heated. If flow is very small, so that sufficient fuel passes through orifice 176 without a significant pressure drop between inlet chamber 102 and outlet chamber 104, the diaphragm will remain in this position. If flow is larger, diaphragm 142 and plate 144 will continue to move downwardly so as to allow stem 160 to open valve 156 a sufficient amount necessary to keep a minimal constant pressure drop between the inlet chamber 102 and the outlet chamber 104. Thus, should only one downstream burner or should all the downstream burners be on, the flow switch senses flow through a pressure drop in the outlet passage, resulting from the opening from one or more of the downstream valves and the valve 156 is opened sufficiently to allow whatever flow is in demand at a minimal pressure drop. When gas is no longer being used in the system, the pressure in the inlet chamber 102 and the outlet chamber 104 will equalize through the orifice 176 and the armature 128 will return to the position shown in FIG. 2, thus, re-opening contacts 116 and 118.

Thus, as can readily be seen, the flow switch depicted in FIG. 2 allows a pair of contacts to be closed when a flow of gas is detected, so as to heat up the igniter elements and cause the fuel to be ignited.

To summarize:

The pressure in the inlet chamber 102 is equalized with that of the diaphragm chamber 142' through unrestricted passage 178.

The pressure in the outlet chamber 104 is equalized with that of the inlet chamber 102 through orifice 176 restriction, when no fuel is flowing.

Flow of fuel causes pressure in outlet chamber 104 to drop below that of the diaphragm and inlet chambers 142' and 102, respectively, causing diaphragm 142 to move downward causing in sequence:

a. Closure of switch contacts 116 and 118.

b. Opening of valve 156 a sufficient amount to hold the pressure drop to a minimal and constant level.

In the event of only a small flow demand, flow through the orifice 176 may sufficiently minimize the pressure drop that the diaphragm 142 moves only to close switch contacts 116 and 118, but not to open the valve 156.

It is another outstanding advantage of the present invention that the device of FIG. 2 may have the outlet of another valve connected to inlet chamber 102, and outlet chamber 104 vented to, for example, the atmosphere. A lamp may then be illuminated upon the closure of contacts 116 and 118. The device of FIG. 2 may thus be employed as a leak indicator.

It is an advantage of the device of FIG. 2 that it can detect extremely small leaks, yet have a very small pressure drop across it under maximum flow conditions.

Although the magnetic operation of the flow switch of FIG. 2 and other features of the invention are advantageous, any one feature may be employed by itself or in combination with any one or more or all of the other features without departing from the true scope of the invention.

Note will be taken that the magnetically operated switch may be replaced with a mercury switch or any other utilization device inside or outside the fluid housing. For example, if the mercury switch is inside the housing, pigtail electrical leads may extend completely through the housing in sealed relation thereto.

What is claimed is:

1. In fluid pressure responsive apparatus, the combination comprising: a non-magnetic housing; a diaphragm mounted across the interior of, and fixed to, said housing, said diaphragm defining an auxiliary inlet chamber and a main outlet chamber with said housing, said housing including an outlet port in free and open communication with said outlet chamber; said housing having a main inlet chamber, said housing having an inlet port in free and open communication with said main inlet chamber, said housing having a passageway providing for free and open communication between said main and auxiliary inlet chambers; said housing including a web partially defining said main inlet chamber, said web having a hole therethrough and a valve seat therearound on the main inlet chamber side thereof; a valve in said main inlet chamber to rest on said valve seat; a first spring in said main inlet chamber in compression between said valve and said housing when said valve is closed to hold said valve tightly against said seat, said web having a constricted opening therethrough spaced from said hole and providing for communication between said main inlet and outlet chambers; an assembly fixed approximately to the center of said diaphragm having one projection extending toward said housing in said auxiliary inlet chamber and another projection extending toward said valve, said other projection having a lost motion connection with said valve, said one projection being a first magnetic

body; a second magnetic body outside said housing; a switch; means connected to said body for operating said switch when said one projection moves inside said housing, at least one of said bodies being a permanent magnet; and a second spring in said main outlet chamber in compression between said housing and said diaphragm when said first body contacts said housing.

2. The invention as defined in claim 1, wherein said switch includes a pair of conductive cantilever leaf springs with electrical contacts conductively bonded thereto, said second body being fixed to one of said leaf springs, said contacts being spring biased closed when said first body is located in a first position spaced a predetermined distance from said housing, the magnetic force of attraction of said bodies causing said contacts to open when said first body moves to a second position, said first body being closer to said housing in said second position than in said first position.

3. The invention as defined in claim 2, wherein said other projection is spaced from, and of contact with, said valve when said first body contacts said housing.

4. The invention as defined in claim 3, wherein said other projection and said valve are movable relative to each other along the axes thereof.

5. The invention as defined in claim 4, wherein said valve has a cylindrical recess on the axis of said hole, said other projection including a cylindrical pin to move coaxially inside said recess, said pin having an axis the same as that of said hole, said recess being open to said main outlet chamber when said valve is closed.

6. The invention as defined in claim 1, wherein said other projection is spaced from, and of contact with, said valve when said first body contacts said housing.

7. In fluid pressure responsive apparatus, the combination comprising: a housing having a first fluid inlet and a first fluid outlet; a first valve movable to one position to allow fluid to flow from said first inlet to said first outlet and movable to another position to shut off flow from said first inlet to said first outlet; first means mounted on said housing to move said first valve to said one position when the difference between the first inlet and first outlet pressures rises to at least a predetermined magnitude and to move said first valve to said other position when said difference falls below said predetermined magnitude; second means providing a first passageway open at both of its ends and connecting said first inlet and said first means to cause said first means to be responsive to the first inlet pressure, said passageway providing free and open communication from said first inlet to said first means; third means providing a second passageway open at both of its ends and connecting said first outlet and said first means to cause said first means to also be responsive to the first outlet pressure, said second passageway providing free and open communication from said first outlet to said first means; a utilization device, said device having a base fixed relative to said housing and a body movably mounted relative to said base, said first means including a member to move said first valve; and fourth means including fifth means connected to said first means in a manner to move said body during at least a portion of the movement of said member; and a lost motion connection between said member and said first valve.

8. The invention as defined in claim 7, wherein said first valve is moved when said member abuts the same,

said lost motion connection enabling positive movement of said body over a portion of the travel of said member which is unhampered by engagement of said member with said first valve.

9. In fluid pressure responsive apparatus, the combination comprising: a housing having a first fluid inlet and a first fluid outlet; a first valve movable to one position to allow fluid to flow from said first inlet to said first outlet and movable to another position to shut off flow from said first inlet to said first outlet; first means mounted on said housing to move said first valve to said one position when the difference between the first inlet and first outlet pressures rises to at least a predetermined magnitude and to move said first valve to said other position when said difference falls below said predetermined magnitude; second means providing a first passageway open at both of its ends and connecting said first inlet and said first means to cause said first means to be responsive to the first inlet pressure, said first passageway providing free and open communication from said first inlet to said first means; third means providing a second passageway open at both of its ends and connecting said first outlet and said first means to cause said first means to also be responsive to the first outlet pressure, said second passageway providing free and open communication from said first outlet to said first means; a utilization device, said device having a base fixed relative to said housing and a body movably mounted relative to said base, said first means including a member to move said first valve; and fourth means including fifth means connected to said first means in a manner to move said body during at least a portion of the movement of said member; and sixth means providing a third passageway connecting said first inlet and said first outlet, said third passageway being open at both ends and providing free and open communication between said first inlet and said first outlet, said third passageway, however, having a small cross-sectional opening to provide a constriction.

10. The invention as defined in claim 9, including a second valve having a second inlet connected from said first outlet, said third passageway equalizing the pressures in said first inlet and outlet when said second valve is closed and fluid flow out of said first outlet is thereby prevented.

11. In fluid pressure responsive apparatus, the combination comprising: a housing; a diaphragm mounted across the interior of, and fixed relative to, said housing, said diaphragm defining an auxiliary inlet chamber and a main outlet chamber with said housing, said housing including an outlet port in free and open communication with said outlet chamber, said housing having a main inlet chamber, said housing having an inlet port in free and open communication with said main inlet chamber, said housing having a passageway providing for free and open communication between said main and auxiliary inlet chambers, said housing including a web partially defining said main inlet chamber, said web having a hole therethrough and a valve seat around said hole on the main inlet chamber side thereof; a valve in said main inlet chamber to rest on said valve seat; a first spring in said main inlet chamber in compression between said valve and said housing when said valve is closed to hold said valve tightly against said seat; an electrical switch fixed relative to said housing; and second means including third means fixed relative to said diaphragm to actuate said switch,

said second means including a projection extending toward said valve, said projection having a lost motion connection with said valve.

12. The invention as defined in claim 11, including a second spring in said main outlet chamber in compression between said housing and said diaphragm.

13. The invention as defined in claim 11, including a second spring in said main outlet chamber in compression between said housing and said diaphragm.

14. In fluid pressure responsive apparatus, the combination comprising: a housing; a diaphragm mounted across the interior of, and fixed relative to, said housing, said diaphragm defining an auxiliary inlet chamber and a main outlet chamber with said housing, said housing including an outlet port in free and open communication with said outlet chamber, said housing having a main inlet chamber, said housing having an inlet port in free and open communication with said main inlet chamber, said housing having a passageway providing for free and open communication between said main and auxiliary inlet chambers, said housing including a web partially defining said main inlet chamber, said web having a hole therethrough and a valve seat around said hole on the main inlet chamber side thereof; a valve in said main inlet chamber to rest on said valve seat; a first spring in said main inlet chamber in compression between said valve and said housing when said valve is closed to hold said valve tightly against said seat; means providing a constricted opening spaced from said hole providing for communication between said main inlet and outlet chambers; an electrical switch fixed relative to said housing; and second means including third means fixed relative to said diaphragm to actuate said switch, said second means including a projection to move said valve.

15. The invention as defined in claim 14, including a second spring in said main outlet chamber in compression between said housing and said diaphragm.

16. In fluid pressure responsive apparatus, the combination comprising: a housing; a diaphragm mounted across the interior of, and fixed relative to, said housing, said diaphragm defining an auxiliary inlet chamber and a main outlet chamber with said housing, said housing including an outlet port in free and open communication with said outlet chamber, said housing having a main inlet chamber, said housing having an inlet port in free and open communication with said main inlet chamber, said housing having a passageway providing for free and open communication between said main and auxiliary inlet chambers, said housing including a web partially defining said main inlet chamber, said web having a hole therethrough and a valve seat around said hole on the main inlet chamber side thereof; a valve in said main inlet chamber to rest on said valve seat; a first spring in said main inlet chamber in compression between said valve and said housing when said valve is closed to hold said valve tightly against said seat; an electrical switch fixed relative to said housing; second means including third means fixed relative to said diaphragm to actuate said switch, said second means including a projection extending toward said valve, said projection having a lost motion connection with said valve; means providing a constricted opening which, in turn, provides communication between said main inlet and outlet chambers, said opening being spaced from said hole.

* * * * *