June 4, 1963 E. H. WRIGHT 3,092,070

PILOT VALVE AND A SYSTEM OPERABLE IN CONNECTION THEREWITH

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Fig. 3.

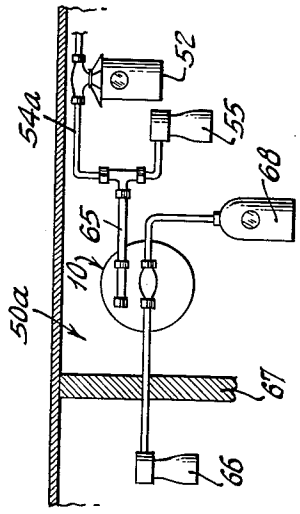


Fig. 2.

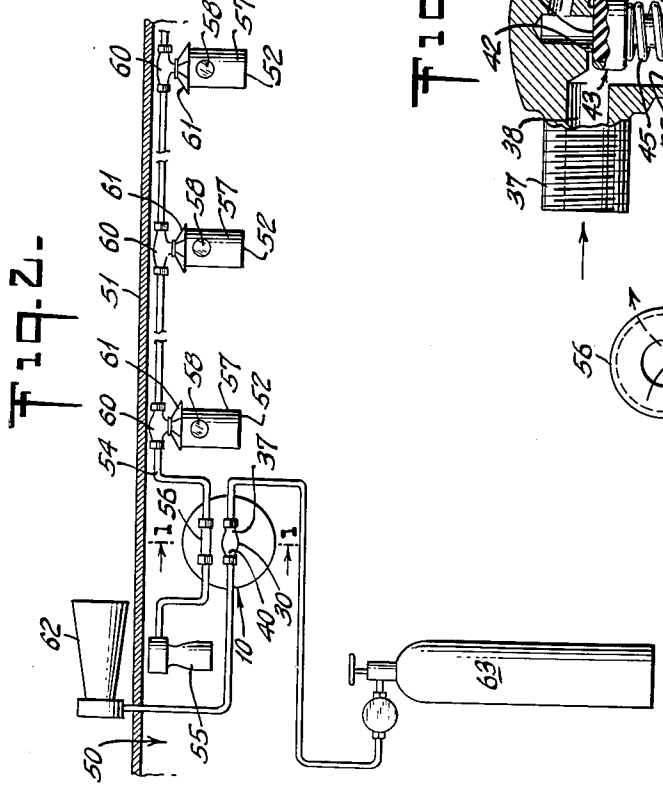
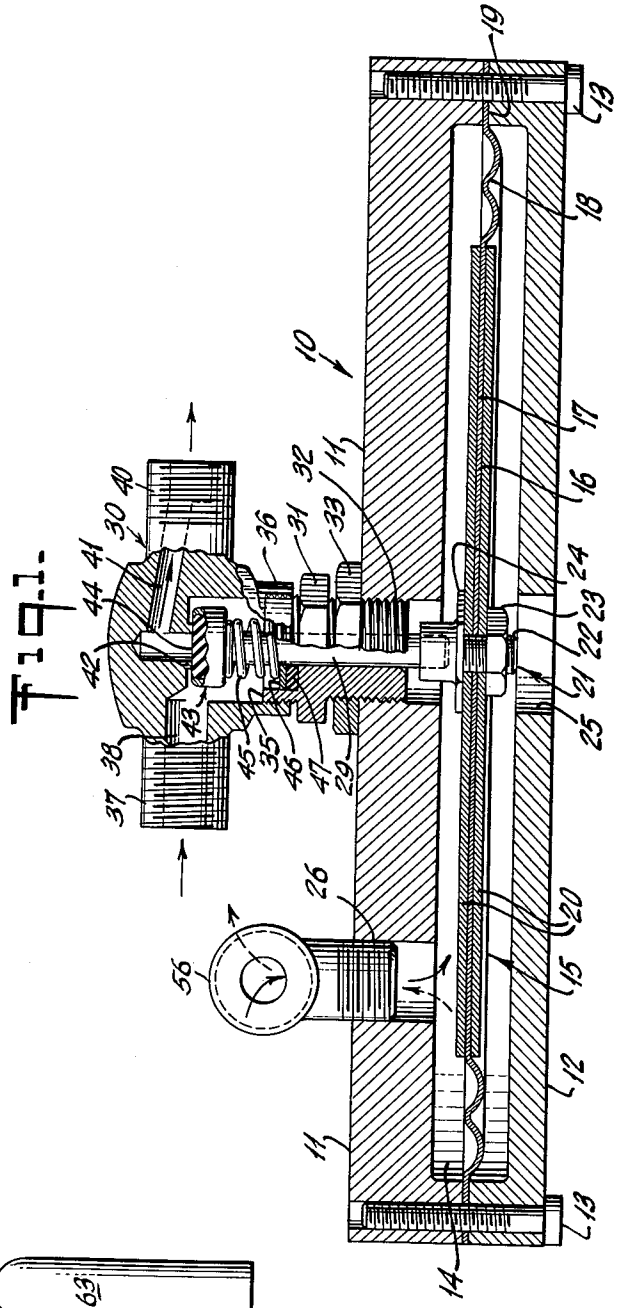


Fig. 1.



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PILOT VALVE AND A SYSTEM OPERABLE IN CONNECTION THEREWITH

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The present invention relates to a pilot valve operable by means of pressure fluid from one source to open a passage for pressure fluid from another source, and to a fluid controlled system operable in connection therewith, and although the invention has a wide range of utility, it is particularly useful in connection with fire alarm systems.

One object of the present invention is to provide a new and improved pilot valve.

Another object of the present invention is to provide a new and improved pilot valve, which is designed for use in connection with a fire alarm system, and which is adapted to withstand the high temperature incident to a fire.

Another object of the present invention is to provide a new and improved system controlled by fluid pressure through a pilot valve.

A further object of the present invention is to provide a fire alarm system controlled by fluid pressure through a pilot valve.

Another object of the present invention is to provide a new and improved fire alarm system, in which a plurality of fire alarm devices responsive to the same detector system are automatically operated from different sources of pressure fluid without the use of such electrical contrivances as electrical pressure switches and solenoid valves.

In accordance with certain features of the present invention, there is provided a fluid-controlled system including a first device automatically operable by means of pressure fluid, which is derived from one source, and which is releasable for such operation when certain conditions occur. The system also includes a second device operable by means of pressure fluid from another source, and a pilot valve operable by the fluid released for the operation of the first device for releasing the fluid from said other source for operation of said second device. This system is particularly useful in connection with a fire alarm system, since it permits the system to be controlled entirely by fluid and thereby permits the elimination of electrical control devices which are liable to fail in case of fire.

In connection with a fire alarm system, an audible alarm device, such as a horn, operated by fluid under pressure, is connected to one or more fire detector devices, each having a container for a supply of vaporizable fluid under pressure, such as dichlorodifluoromethane and a fusible plug for controlling the flow of the fluid to the horn. In the case of a fire, the fusing of the plug releases the fluid for the actuation of the horn. A second audible alarm device, such as a horn, is provided, which is also operable by fluid under pressure, and which may be placed at a site remote from the first horn. This second alarm device may either require greater pressure to operate or the pressure from the container of the fire detector device may not be sufficient to operate at the same time the remote horn. The system of the present invention, therefore, includes a pilot valve, having a connection on the primary side to receive the fluid released from the fire detector device and a valve on the secondary side controlling flow between a source of pressure fluid other than the fluid released from the first detector device and the second fire alarm device. This valve on the secondary

side of the pilot valve is automatically opened when the fluid is released from the detector device to permit passage of the fluid from the other source to the second alarm device to operate the latter device. This pilot valve is designed to open the valve on the secondary side to a source of fluid having a pressure much greater than that operating the first alarm device, thereby permitting the second alarm device to sound a louder alarm. It is seen, therefore, that the system of the present invention, although entirely gas-controlled, may be primarily regulated from a source of fluid under low pressure to operate secondarily a device by fluid under higher pressure.

Various other objects, features and advantages of the invention are apparent from the following description and from the accompanying drawings, in which

FIG. 1 is radial section of a pilot valve embodying the present invention;

FIG. 2 is a form of fire alarm system having a pilot valve of the character shown in FIG. 1 and constituting one embodiment of the present invention; and

FIG. 3 is a form of fire alarm system having a pilot valve of the character shown in FIG. 1 and constituting another embodiment of the present invention.

Referring to FIG. 1 of the drawings, there is shown a pilot valve **10** comprising a circular body **11** and a circular back **12** sealably secured together face to face at their peripheries by means of screw studs **13** to form a housing defining a chamber **14**. In the chamber **14** is a circular vibratile diaphragm **15** comprising a thin disk **16** having a main flat center section **17**, an annular corrugated section **18** encompassing said center section to permit flexing of the diaphragm in this latter section and a flat peripheral section **19** clamped between the body **11** and the back **12** and held fixedly in position by means of the studs **13**. The diaphragm disk **16** is of metal which is thin enough to flex at its corrugated annular section **18** and which has a melting point high enough to withstand high temperatures, such as would be encountered in case of a fire. A diaphragm disk **16** of brass would be suitable for the purpose.

The flat center section **17** of the diaphragm disk **16** is supported between two rigid circular backing plates **20** terminating at their outer peripheries near the inner periphery of the annular corrugated section **18** of the diaphragm disk **16** and forming part of the diaphragm **15**. For holding the plates **20** in flanking engagement with the center section **17** of the diaphragm disk **16** and for connecting the diaphragm **15** to a valve to be described, there is provided an adapter bolt **21** having a threaded pin section **22** passing through aligned center holes in the diaphragm **15** to receive a nut **23** on one side of said assembly and having a head **24** bearing against the other side of said assembly. The center sections of these plates **20** around the bolt **21** may be adhesively secured to the diaphragm disk **16**.

The housing back **12** has a hole **25** to expose one side of the diaphragm **15** to the atmosphere, while the housing body **11** has a tapped inlet hole **26** for a primary connection leading from a source of primary pressure fluid to the other side of the diaphragm. This pressure fluid enters the pilot valve **10** through the inlet **26** to one side of the diaphragm **15** at a certain pressure per unit of area and this pressure applied over the effective area of the diaphragm produces a force at the center of the diaphragm according to the effective area of the diaphragm. In a specific embodiment of the invention, the pilot valve **10** has an effective area of about 20 square inches i.e. a ratio of 20 to 1, so that fluid at a pressure of one pound per square inch admitted into the diaphragm chamber **14** through the opening **26** will produce at the center of the diaphragm a force for opening a valve equal to about

twenty pounds. With this construction and ratio, it is possible, for example, with a fluid of one-half pound per square inch, to open a valve in a line carrying fluid at a pressure of as much as two hundred and fifty pounds per square inch.

The movement of the center of the diaphragm 15 is transmitted through the adapter bolt 21 to the valve stem 29 of a pressure valve 30. This valve 30 is connected to the diaphragm housing body 11 by means of a bushing 31 threaded into a hole 32 in the center of said housing body and locked in position by a lock nut 33. This bushing 31 serves as a guide for the valve stem 29 and has a tubular extension 35 threaded into the casing 36 of the valve 30.

The valve 30, as far as certain aspects of the invention are concerned, may be of any suitable form. In the specific form of the invention shown, the valve 30 is of the plug type and the casing 36 has a threaded tubular extension 37 defining an inlet passage 38 for connection to a pipe leading from a source of secondary pressure fluid and a threaded tubular extension 40 defining an outlet passage 41 for connection to a pipe leading to a fluid pressure actuated device. Inside the valve casing 36 between the valve passages 38 and 41 is a circular valve seat 42 and bearing against said valve seat is a valve member 43 shown in the form of a plug having a resilient insert 44 for sealing engagement with said seat. This plug 43 is connected to one end of the valve stem 29, the other end being threaded into the head 24 of the adapter bolt 21 and is yieldably pressed against the valve seat 42 by means of a coil spring 45 encircling said valve stem and bearing at one end against said plug and bearing at its other end against a washer 46. This washer 46 is seated against a packing ring 47 encircling the valve stem 29 with a fluid-tight fit and located in the tubular extension 35 of the bushing 31. This packing ring 47 is of the type which will withstand high temperatures, such as those encountered by a fire.

With the pilot valve construction described, primary pressure fluid admitted through the primary connection hole 26 and applied to one side of the diaphragm 15 causes said diaphragm to flex outwardly from the housing body 11, and thereby pulls on the valve stem 29 by a pressure substantially equal to the pressure of the primary fluid per square inches multiplied by the effective fluid pressure area of the diaphragm. Since the pressure of the secondary fluid on the valve plug 43 urging it into closed position is the difference between the areas on the inner and outer end faces of the plug exposed to this pressure, the pull on the valve 29 by the action of the diaphragm 15 subjected to primary fluid, although at low pressure, is sufficient to pull the valve plug 43 into open position against the spring 45 and against the pressure action of the secondary fluid, although the secondary fluid may be at high pressure.

All of the parts of the pilot valve 10, except perhaps for the packing ring 47 and valve member insert 44 are made of metal of high melting point such as ferrous metal and/or brass, and the packing ring and valve member insert, if not of metal, at least are of a material that will withstand high temperatures, such as Teflon (polytetrafluoroethylene). The pilot valve 10 can be used, therefore, in places where high temperatures might be encountered, as for example, those encountered at a fire.

FIG. 2 shows a fire alarm system which includes a pilot valve 10 similar to that described hereinbefore. This system is shown installed in a building 50 with a roof 51 and includes a series of fire detectors 52 dispersed strategically in various parts of the building and connected together in series. The series of fire detectors 52 is joined by means of a detector line 54 to an audible fire alarm device 55, such as a horn, through a T-connection 56 having a body connection into the primary hole 26 of the pilot valve 10.

The fire detectors 52 may be of the type shown and described in U.S. Patents 2,777,416, except that instead of having a horn attached to each detector, there is provided the single horn 55 for the whole series of detectors. Each of these detectors 52 includes a pressurized cylinder 57 charged with a fluid that will create pressure in the detector line 54 when the detector is activated by an unusual high temperature in the vicinity of said detector. An example of such a fluid is a group of halogenated hydrocarbons containing one or more fluorine atoms, which are known commercially as "Freon" and in particular dichlorodifluoromethane or "Freon 12." A window 58 permits ready inspection of the amount of the fluid inside the cylinder 57.

The top of the cylinder 57 has a temperature head which contains a fusible plug in a hole normally closing communication between the interior of the cylinder and the detector line 54 through a T-connection 60, and which carries a heat conducting hood 61 for the conduction of heat to said temperature head. The fusible plug is of a metal which will melt or fuse when the temperature head is heated to a selected temperature, such as an eutectic metal melting at a temperature of 136° F.

The horn 55 is also of the type shown in the aforesaid patent, except that instead of being directly connected to a respective detector unit, it is connected to the whole series of detector units. This horn 55 has a vibratile reed, which when subjected to pressure fluid sounds the horn and thereby gives the alarm.

In the operation of the fire alarm system so far described, an elevated temperature in the region of any one of the detectors 52 in the series will fuse the plug therein and open up communication between its pressurized cylinder 57 and its detector line 54. The pressure in the detector line 54 in a specific embodiment of the invention, may be about 2 lbs. per square inch. This low pressure is sufficient to operate the single horn 55 but could not operate another horn. The horn 55, may for example, be located inside the building 50 as shown in FIG. 2, but it may be desirable to provide an additional fire alarm device 62, such as a horn, of much greater volume and intensity, located on the roof of the building, as shown, or anywhere else outside the building, so that it may be heard for a considerable distance outside. The low pressure available in the detector line 54 is not sufficient to operate directly the horn 62 but a secondary source of pressure fluid shown in the form of a tank 63 containing, for example, compressed nitrogen or air, at a pressure, for example, of 100 lbs. per square inch, is connected to the horn through the valve 30 forming part of the pilot valve 10. The low pressure in the detector line 54 applied to the primary side of the pilot valve 10 will open the valve 30 and establish flow from the tank 63 to the horn 62 causing said horn to operate at the same time as the horn 55.

FIG. 3 shows another example of the use of the pilot valve 10 of the present invention in a fire alarm system. In this system, a series of detectors 52 similar to those in the system of FIG. 2 are connected together in series to the alarm device 55 inside a building 50*a* through a detector line 54*a* and a branch line 65 connects this detector line to the primary side of the pilot valve 10. It is desirable in this case to have an additional alarm device 66 in the form of a horn located some distance away in the building and separated from the horn 55 by a wall 67. In this case, the horn 66 may be similar in size and volume as the horn 55, but the fluid pressure released for the activation of the horn 55 is not sufficient to sound the horn 66. For that reason, a pressurized cylinder 68 is provided, which may contain "Freon" (dichlorodifluoromethane) and which is connected to the inlet side of the valve 30, the outlet side being connected to the horn 55.

With the system of FIG. 3, pressure fluid released for actuation of the horn 55 opens at the same time the valve

30 and thereby admits pressure fluid from the cylinder 68 into the horn 66 to sound the latter horn.

It should be noted that the systems of FIGS. 2 and 3, although operating two alarm devices actuated from different sources of fluid pressure are controlled from the same detector system without the use of any electrical devices whatever. The system, therefore, is not susceptible to failure due to damage to electrical installations or devices in case of a fire.

While the invention has been described with particular reference to specific embodiments, it is to be understood that it is not to be limited thereto but is to be construed broadly and restricted solely by the scope of the appended claims.

What is claimed is:

1. A fluid-controlled fire alarm system comprising a fire detector responsive to high temperatures incident to a fire, a first fluid-responsive audible fire alarm device, a source of pressure fluid, a fluid connection between said source of pressure fluid and said fire alarm device, means operable in response to the action of high temperature on said detector for releasing pressure fluid from said source into said connection for actuation of said fire alarm device, a second audible fire alarm device responsive to a fluid under a pressure greater than that available from the released pressure fluid while said released pressure fluid is being utilized to actuate said first fire alarm device, a source of fluid under pressure sufficient to operate said second fire alarm device, a fluid connection between the latter source and said second fire alarm device, a pilot valve having an inlet, and means for delivering the released fluid to said inlet while said released fluid is operating said first fire alarm device, said pilot valve also comprising a normally closed pressure valve in the connection between the latter source and said second fire alarm device, and means responsive to the pressure of the fluid admitted to said pilot valve through said inlet for opening said pressure valve and for admitting thereby fluid from the latter source to said second alarm device through the last mentioned connection at a pressure greater than that available from the released pressure fluid and admitted into said inlet.

2. A fluid-controlled fire alarm system as described in claim 1, comprising in addition to said fire detector, one or more fire detectors, said fire detectors being located in different parts of a region to be protected against fire, each of said fire detectors being responsive to high temperature incident to a fire in the regions of the respective detectors, said second fire alarm device being located remote from said first alarm device.

3. A fluid-controlled fire alarm system as described in claim 1, said detector comprising a pressurized fluid container constituting said first mentioned source of pressure fluid and a fusible plug controlling the flow of the fluid from said container to said first alarm device, said plug being melted by the temperature resulting from a fire to cause flow of the fluid from said container to said first alarm device, said pilot valve having a diaphram for operating said pressure valve, said inlet delivering fluid to one side of said diaphragm.

4. A fluid-controlled fire alarm system as described in claim 1, wherein the second fire alarm device is of greater volume than the first alarm device requiring for actuation fluid of substantially greater pressure than that of the fluid which actuates the first alarm device, the fluid in said second mentioned source having the necessary higher pressure to actuate said second alarm device.

5. A fluid-controlled fire alarm system as described in claim 1, wherein the second fire alarm device is substantially of the same volume as that of the first alarm device requiring for actuation fluid of substantially the same pressure as that of the fluid which actuates the first alarm device, the fluid in said second mentioned source having substantially the same pressure as the fluid which actuates said first alarm device.

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