

Oct. 20, 1942.

R. E. HARTLINE

2,299,540

VALVE

Filed Oct. 19, 1940

Fig. 1.

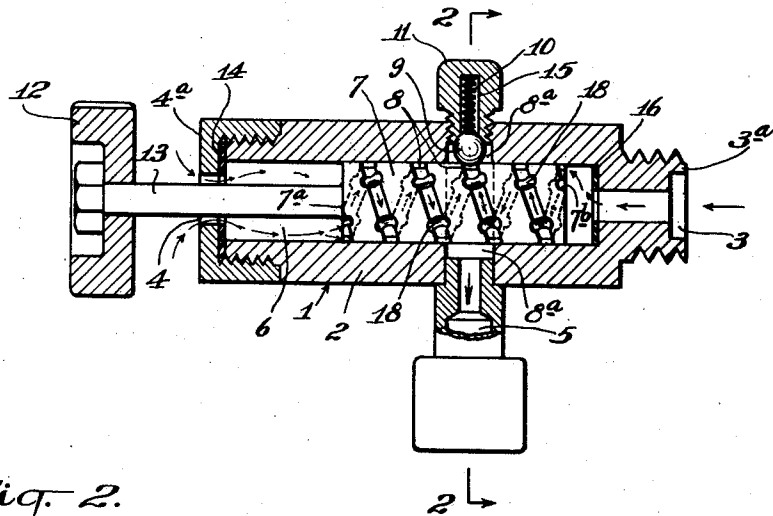


Fig. 2.

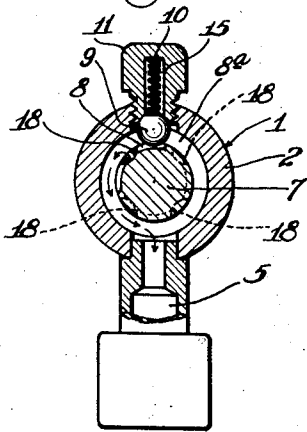


Fig. 3.

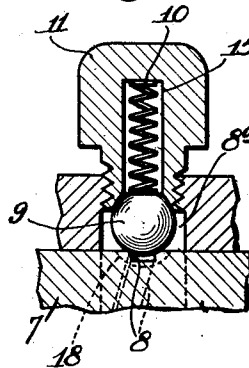
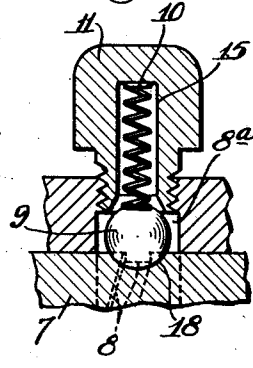


Fig. 4.



BY

INVENTOR.
RALPH E. HARTLINE

Frank E. Fook
ATTORNEY.

UNITED STATES PATENT OFFICE

2,299,540
VALVE

Ralph E. Hartline, Swissvale, Pa., assignor to
Mine Safety Appliances Company, Pitts-
burgh, Pa.

Application October 19, 1940, Serial No. 361,926

6 Claims. (Cl. 137-69)

This invention relates to an improvement in a valve adaptable to accommodate two independent sources of fluid and to be discharged from a common outlet, and more particularly, to a valve suitable for use in connection with gas testing apparatus in which it is desired in some instances to introduce another fluid into the sample to dilute or treat the sample to be tested and by which the ratio of the fluid and the sample in a mixture formed may be varied as desired and controlled within very small limits.

To provide a valve for controlling the introduction of a gas sample to a gas testing apparatus, it becomes necessary in some cases to introduce additional air to the sample before passing into the apparatus. As an example, when the concentration of combustibles in a sample is above the range of the instrument, air is added to the sample so that the concentration is reduced to within the range of the instrument and the results can be interpreted by knowing the extent of dilution to give the true extent of combustibles in the original sample. Also, when the sample is deficient in oxygen to support complete combustion, it is necessary because of the nature of the apparatus and its operation to add sufficient oxygen to the sample before it enters the apparatus to obtain complete combustion. Because of the nature of the instrument for testing gas mixtures and the relatively low pressures of available samples and the pressures at which the samples are tested and the effect of dilution in altering the results of the apparatus, it is required that any means of control of the sample and the diluent must be operative under such conditions and to provide a wide range of adjustment operable within very small limits of deviation from the adjustment selected.

An object of this invention is to provide a valve means which is easily operated, simple and inexpensive in construction, durable, adaptable to provide small increments of adjustment of flow and operable as a three-way valve and effective to simultaneously control the flow of fluid from each of two sources to form a mixture and operative in such control over a wide range of mixture.

A more specific object of this invention is to provide a valve adaptable as a supply valve to gas detecting apparatus and in which the sample to be supplied can be diluted or treated during passage through the valve and operable to provide small increments of adjustment in varying the extent of dilution or treatment and the extent of dilution or treatment can be readily and

directly determined from the position of the valve.

Other objects of this invention will become apparent from the description of what I now consider to be a preferred embodiment and which is illustrated in the drawing in which:

Fig. 1 is a sectional view of the preferred embodiment;

Fig. 2 is an end view taken along the line 2-2 of Fig. 1;

Fig. 3 is a fragmentary sectional view representing one position of the valve moving mechanism; and

Fig. 4 is a similar fragmentary sectional view representing another position of the valve moving mechanism.

For the purpose of illustration and explanation of my invention, it is described as a valve means for controlling the supply of a sample to a gas testing apparatus. In the preferred embodiment and referring to the drawing, the valve 1 comprises a valve body 2 having an inlet opening 3 in one end 3a and another inlet opening 4 in the other end 4a of the body and an outlet opening 5 in the wall of the body and intermediate the inlet openings. The openings of the body are connected by means of a central passage 6 which extends the full length of the body and of a length depending upon the increments and extent of adjustment desired as will be more fully hereinafter understood. The valve is arranged to be connected to the atmosphere so that air may pass through the inlet opening 4 to the central passage 6, this being the fluid used ordinarily in diluting a sample for gas testing apparatus and for purposes such as heretofore mentioned. The opposite end 3a of the body is threaded and is to be connected to a duct carrying the sample and enters the passage through the inlet opening 3.

In order to control the flow of fluid from each of the inlet openings, an obstruction or valve member 7, which is cylindrical in shape and is to fit snugly to form a fluid tight seal between the engageable surface of the member 7 and to the wall of the valve body defining the passage 6. The fit must not be too secure so that the member 7 may move longitudinally along the passage. Normally positioned the member 7 is arranged to overlie the outlet opening and in such a position obstructs the movement of fluid through the body and from each of the inlet openings. To allow the passage of fluid from the inlet opening to the outlet opening and to control the extent of flow from each of the openings, a passage 8

is provided in the peripheral portion, of the member 7. For the purpose of illustration the passage 8 is represented as being spirally or helically arranged around the periphery of the member and extends from the one end 7a of the member 7 to the opposite end 7b. An annular duct or channel 8a is formed in the valve body to connect the spiral passage to the outlet opening.

A feature of this invention is that by movement of the control or obstruction member 7 in relation to the outlet opening to vary the length of orifice or passage from each of the inlet openings to the outlet, a means of control of the extent of flow of the fluid from each of the openings is obtained and this control is of such a nature that simultaneous and small increments of adjustment of the flow from each inlet opening are possible. The increments and range of control will depend upon the construction and size of the parts of which the valve is constituted.

To move the control or obstruction member 7 relative to the valve body, a rotatable bearing member 9 is supported in a fixed location and positioned between the valve body and the obstruction member 7. The rotatable bearing member 9, Fig. 3, is positioned between the valve body and the obstruction member and rides in the fluid passage or race 8 of the member 7. By rotating the member 7, the bearing member moves the member longitudinally in the valve body in either direction depending upon the direction of rotation. In the embodiment illustrated, the bearing member 9 is held in place onto the valve body by fitting into a flared end of an opening 15 of cap 11 which is threaded to the valve body above the annular channel 8a.

It has been found advisable to enlarge the spiral fluid passage at intervals to provide some means by which known or indicating increments of adjustment can be made quickly. A spring 10 within the opening 15 presses against the bearing member 9 and holds it in contact with the obstruction member 7 when the member 9 moves into an enlargement or recess 18, Fig. 4. Due to the pressure exerted on the bearing member 9 by the spring 10, the passage of the member into or out of one of these recesses is noticeably indicated during rotation of the obstruction member by affecting the normal resistance to movement. Obviously, this action in manual control makes it possible to readily determine the extent of change in an adjustment from a previous setting. A wheel 12, which may be indexed, is connected to the member 7 by means of a stem 13 and by which the valve member 7 can be easily rotated and moved to a desired position.

Since the valve body in this illustration is connected to the atmosphere, it passes into the passage 6 between the valve stem and the inlet opening 4. Should it be necessary to connect the opening 4 to a confined source of fluid, it is apparent that changes can be made for connecting the opening to the source and provide means to rotate the member 7. As an example, the valve body could be sealed to the valve stem as arranged in the drawing and an inlet opening provided in the side wall of the valve body such as the outlet opening but near the end thereof.

For some conditions it may be necessary to close off the passages of fluid from one of the inlet openings and for this purpose sealing washers 14 and 16 are provided at each end of the passage 6 and to which the end of the mem-

ber 7 abuts when moved to these extreme positions, and sufficiently to seal off the passage 6 from the opening in the end engaged. Such a position frees the passage of fluid from the other inlet opening into the passage. The length of the passage 6 and valve member 7 should be arranged so that when the valve is in an extreme position it is capable of holding the bearing member 9 in position.

The principle involved in the operation of my valve is to simultaneously adjust the length of travel of each of the components of a mixture in passing through the valve and thus control the resistance to movement of flow of each of the components and consequently the ratio of the components existing in the mixture. If it is desired to increase the extent of one component in the mixture, such is accomplished by decreasing the extent of passage or the length of the orifice through which this component is to travel and lower the resistance to movement of this component. By this adjustment, the extent of passage or the length of the orifice through which the other component is to travel is increased and thereby the resistance to movement is increased with the result that the extent of this component is decreased. This is accomplished simply by movement of the valve member 7 in the direction of the inlet opening through which the extent of fluid flow is to be reduced and this simultaneously moves the valve member away from the inlet opening through which fluid flow is to be increased.

An advantage of this construction is that the total resistance offered by the valve is comparatively constant and independent of the valve position but the flow of the components is adjusted by means of proportioning this total resistance among the components and by this the extent of each component passing through the valve is controlled with the result that any desired ratio of components in the mixture can be accomplished. For practical purposes, it has been found advantageous to provide positive increments of adjustments of values sufficiently small and to accommodate the requirements of testing the extent of combustible constituents in a gas sample.

An advantage of the simultaneous adjustment of the orifice or passages from each of the inlet openings is that it allows a relatively large suction head to be applied to the sample line connected to the valve when high dilution ratios are used and this accomplishes some reduction in the deviations often encountered by the use of available equipment at relatively high dilution ratios.

A further advantage of this improvement is that by the proper arrangement of the length of the obstruction member in a certain valve body passage and the controllable passage in the peripheral portion of the member, the results produced in a gas testing apparatus for a given sample concentration can be made approximately a simple function of the linear movement of the wheel attached to the valve or obstruction member.

Although it has been found for the purpose of testing apparatus to use a passage of a spiral form, it is apparent that other shapes or designs of passage can be used by which the length of the orifice from each of the inlet openings to the common outlet opening can be varied and in a simultaneous manner in order to control

the flow of the components in the mixture discharged from the valve.

Although the invention has been described in connection with a control of two sources of fluid and the mixture discharged through a common outlet, the apparatus might well be utilized in providing different supply pressures of a single fluid from a single source. In this application the opening 5 designated as the outlet opening would be used as the inlet opening while openings 3 and 4 would function as outlet openings. A change in opening 4 to connect it directly to a confined source has been disclosed and this same arrangement can be used in the application considered.

While the construction as illustrated and described is what I now consider to be the preferred embodiment of my invention and which incorporates the principle involved, it is to be understood that the invention is to be restricted only by the scope of the appended claims.

I claim:

1. A valve comprising a body member, the body having a passage and inlet openings at each end thereof connectable to a source of fluid, the body having an outlet opening connected to the passage and intermediate the inlet openings, a unitary obstruction member in the passage movable in the direction of either inlet opening and adaptable to overlie the outlet opening, and one of said members being provided with a duct in its surface coacting with the surface of said other member to form a passage of uniform resistance throughout its length and establishing communication between the inlet openings and the outlet openings whereby movement of the obstruction member in either direction simultaneously changes resistance to movement of fluid passing from each of the inlet openings to the outlet opening.

2. A valve comprising a valve body, the valve body having a tubular passage therein and inlet openings at each end thereof, the body having an outlet opening connected to the passage intermediate its ends, a cylindrical unitary member in the passage and in sliding engagement with the body to obstruct the passage of fluid through the valve body and arranged to overlie the outlet opening, said member having a spiral shaped passage in its peripheral portion, the outlet opening being arranged to be continually connected to the passage, and means to move the member along the passage in the direction of either inlet opening to change simultaneously the resistance to movement of fluid from either opening to the outlet opening.

3. A gas analyzing valve comprising a valve body, the valve body having a tubular passage therein and inlet openings at each end thereof, the body having an outlet opening connected to the passage intermediate its ends, a cylindrical member in the passage and in sliding engagement with the surface of the body defining the passage to obstruct the flow of fluid through the valve body and arranged to overlie the outlet opening, said member having a spiral shaped passage in its peripheral portion and extending from one end of the member to the other, the outlet opening being arranged to be continually connected to the passage, means to move the member along the passage in the direction of either inlet opening to change simultaneously the resistance to movement of fluid from either opening to the outlet opening and the member being movable to an extreme position in either direction to close

off the flow of fluid from one of the inlet openings.

4. A valve to be connected to two sources of fluid and to discharge from a single outlet comprising a valve body, the body having a tubular shaped passage and connected at each end to an inlet opening formed in the body, the body having an outlet opening connected to the passage and intermediate its ends, a cylindrical member fitted to the inner surface of the body defining the passage to provide fluid tight sliding engagement and arranged normally to overlie the outlet opening to obstruct the flow of fluid through the body and being movable longitudinally of the passage, a fluid passage in the peripheral portion of the member and spirally formed and extending the length of the member to provide openings in each end thereof to connect the inlet openings to the outlet opening, means supported by the valve body and engageable with the cylindrical member to move along the spiral passage by relative movement of the cylindrical member to move the cylindrical member in the direction of either of the inlet openings, the length of the cylindrical member and the fluid passage therein being in such relation to provide a desired resistance to movement of fluid passing there-through to provide the necessary increments of adjustment of flow of fluid from each of the inlet openings relative to the flow from the other inlet opening, and a means operative to close off the flow of fluid from one of the inlet openings when the cylindrical member is moved to an extreme position in either direction.

5. A three-way valve comprising a valve body, the body having a tubular shaped passage and connected at each end to an inlet opening formed in the body, the body having an outlet opening connected to the passage and intermediate its ends, a cylindrical member fitted to the surface of the body defining the passage to provide a fluid tight sliding engagement and arranged normally to overlie the outlet opening and being movable longitudinally of the passage, a fluid passage cut into the peripheral portion of the member and spirally formed along the length of the member and defining an opening in each end of the member and arranged to connect the inlet openings to the outlet opening and a ball means resiliently supported by the valve body and adaptable with the cylindrical member to move in the passage and move the member in the direction of either of the inlet openings, the passage of the cylindrical member having enlarged sections at intervals to define fixed increments of adjustment, the length of the cylindrical member and the size of the fluid passage therein being in such relation to provide the desired total resistance to movement of fluid moving through the passage whereby positioning of the member relative to the outlet opening determines the fraction of the total resistance to movement interposed against the movement of fluid from each of the inlet openings to the outlet opening and thus produce the desired ratio of components in the mixture discharged from the outlet opening, and a means connected to the valve body and disposed in the passage at each end and operative to close off the flow of fluid from one opening when the cylindrical member is moved to an extreme position in either direction.

6. A valve comprising a valve body having a passage and an opening at each end, the body having further an intermediate opening connected to the passage, a plug obstruction member fitted to the inner surface of the body defining

the passage to provide fluid-tight sliding engagement and arranged normally to overlie the intermediate opening to obstruct the flow of fluid through the body and being movable longitudinally of the passage, a fluid passage in the peripheral portion of the plug member and spirally formed and extending the length of the member to provide openings in each end thereof to connect the openings in the end of the body to the

intermediate opening, means supported by the valve body and engageable with the plug member to move along the spiral passage by a relative movement of the plug member to move the member in the direction of either of the openings in the end of the body to provide increments of adjustment of flow of fluid relative to the openings in the end of the valve body.

RALPH E. HARTLINE.