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APPARATUS FOR CONTROLLING THE VOLUME OF FLOW OF FLUIDS

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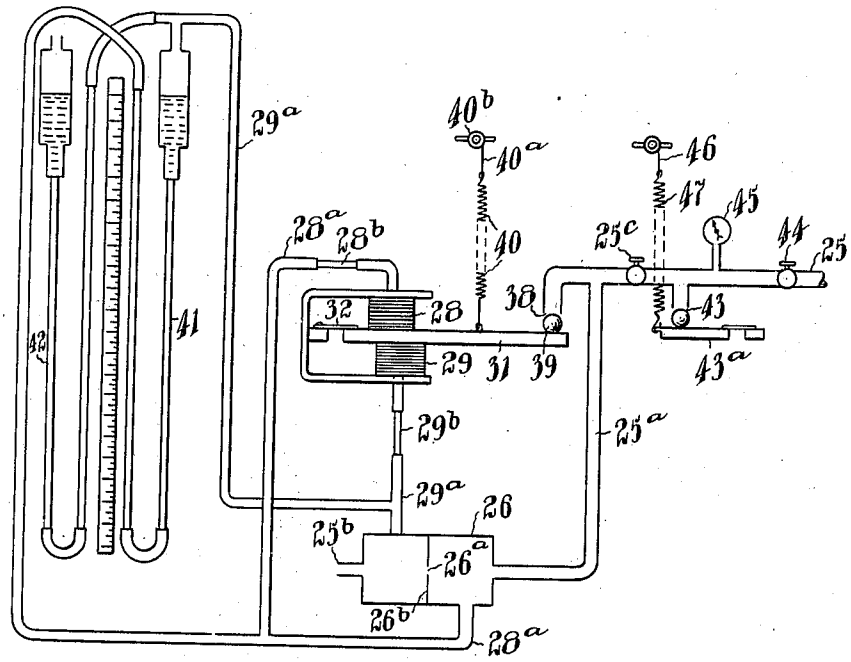


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## APPARATUS FOR CONTROLLING THE VOLUME OF FLOW OF FLUIDS

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2 Claims. (Cl. 137—152.5)

This application is in part a continuation of my co-pending application Serial No. 80,947, filed May 21, 1936, which matured into Patent No. 2,168,207 issued Aug. 1, 1939.

This invention relates to apparatus for obtaining a constant volume of flow of a fluid and is particularly adapted for use with classifying tubes such as shown in the above mentioned parent application and my object is to devise simple automatic apparatus of this character which is inexpensive to manufacture and yet attains excellent results.

I attain my object by the constructions which may be briefly described as follows. A fluid supply pipe or line is provided with a relief opening and an apertured partition. The difference of pressure on opposite sides of the partition is maintained substantially constant by utilizing any variations in said difference to vary the leakage through the relief opening, and thus the volume of the flow of fluid through the outlet end of the supply pipe is maintained substantially constant.

The constructions are hereinafter more fully described and are illustrated in the accompanying drawing which is a diagrammatic view of my volume control apparatus.

In the drawing like numerals of reference indicate corresponding parts in the figure.

A fluid supply pipe which may be formed of pieces of tubing 25, 25a and 25b is connected with a suitable source (not shown) of compressed air. The piece of tubing 25 is provided with a relief opening 38 at the end of the stem thereof. The leakage through said opening is varied by a valve plug or ball 39 carried by an arm 31. The ball rests on the upper surface of the arm which is provided with any suitable means, lying flat on said surface, adapted to limit the movement of the ball relative to its seat formed by the opening 38 so that as the ball is raised by the arm it will center itself relative to the relief opening. When the apparatus is in operation, there is a continuous leakage past the ball.

The arm 31 is pivoted at 32 on any suitable stationary part and is actuated by expansible devices, which in the drawing are shown as bellows 28, 29. These devices are carried one above the other on a suitable stationary frame and each engages a side of the arm 31. The pivoted arm 31 is thus passed between the devices. The sides of the devices remote from the arm engage the upper and lower sides of the frame. One end of each device 28, 29 is closed and the other ends of the devices are connected by flexible tubing 28a and 29a with the fluid supply pipe at opposite sides of a partition 26b therein. The partition may be located in an expanded passage 26 of the supply pipe and has a small aperture or orifice 26a therein. Normally the pressure in the supply pipe at one side of the partition is greater than that at the other side thereof. The normally high pressure side of the passage 26 is connected with the upper device 28, and the normally low pressure side of the passage is connected with the lower device 29 whereby the ball 39 is normally positioned, as set, to effect the desired leakage under normal condition.

The initial setting of the ball relative to the relief opening is effected by turning a spindle 40b on which one end of a flexible cord 40a is wound. Intermediate the ends of the cord is connected a spring 40 and the other end of the cord is secured to the arm 31. The weight of the latter and of the ball is thus counterbalanced. The inflow to the tubing 25a and the relief opening 38 must be just sufficiently to provide a leak at the relief opening when approximately sufficient fluid is flowing through the outlet tubing 25b before the tension of the spring 40 is adjusted to obtain the desired normal working leakage at the relief opening. Preferably I provide a valve 25c for varying the above mentioned inflow so that it may be limited whereby a slight variation in the leakage past the ball 39 will have a materially greater effect in varying the pressure in the tubing 25a than if the said inflow were unrestricted.

It is obvious that by varying the tension of the spring 40, the volume of the flow of the fluid escaping through the outlet 38 may be varied to thus vary the difference of pressure at opposite sides of the orifice 26a to any predetermined amount.

Any variation in the back pressure in the low pressure end of the passage 26 which will cause a variation in the differential pressure at opposite sides of the partition 26b will result in the ball 39 being moved closer to or further from the relief opening 38 to vary the leakage. Thus the greater the back pressure in the low pressure end of the passage 26, the less the leakage at the relief opening 38, and thus the more the pressure in the high pressure end of the passage will be increased to maintain a substantially constant difference of pressure at opposite sides of the partition. Immediately the back pressure is reduced the pressure at the high pressure end

of the passage 26 is also reduced, to maintain the difference of pressures at opposite sides of the orifice substantially constant and thus maintain the volume of the flow of the fluid through the outlet $25^b$ substantially constant.

Preferably the pieces of flexible tubing $28^a$, $29^a$ are provided with short lengths of glass tubes $28^b$, $29^b$ having small bores which tend to dampen any sudden flow of air through the pieces of tubing and thus smoothly effect the movements of the arm 31 by the expansion and contraction of the devices 28, 29.

The orifice meter referred to in the above mentioned application is shown complete with two indicators 41, 42, and the supply pipe 25 is provided with a pressure regulating and safety valve 43 and with a shut-off valve 44.

A pressure gauge 45 may also be connected with the supply pipe between the shut-off valve 44 and the regulating valve 43. All these parts 43, 44 and 45 are positioned betwen the valve $25^c$ and the source of supply. The regulating and safety valve 43 is preferably of the same type as the relief valve 39 and it permits a continuous leak past the ball of the valve 43 to maintain a substantially constant pressure of the fluid between the valve 44 and the valve $25^c$. The ball of the valve 43 is carried on a pivoted arm $43^a$ similar to that of arm 31 and is adjusted in the same manner as arm 31. A cord 46, spring 47 and spindle for winding the cord is provided for this purpose.

It will be noted that the bellows 29 is located farther from the pivot 32 than the bellows 28 to compensate for the pressure of the fluid on the ball 39.

The indicators 41 and 42 are shown as manometers connected with the tubing $28^a$, $29^a$ respectively to indicate the pressures on the opposite sides of the orifice partition $26^b$. The manometer 41 may be used as a guide during the adjustment of the valves 43 and $25^c$ and of the spring 40 to set the valve 39 in its initial position.

The volume control apparatus may be used in connection with a device for classifying finely granulated solids according to size. The construction and operation of such device is clearly disclosed in my above mentioned application and in my U. S. Patent No. 2,034,185 issued March 17, 1936, and therefore it is not necessary to describe the classifying apparatus here except to state that it is most important to have the fluid flowing therethrough maintained at a substantially constant volume.

What I claim as my invention is:

1. Apparatus for controlling the volume of flow of a fluid including a fluid supply pipe having a relief opening and a valve for controlling the flow through said pipe; a valve for varying the leakage through the relief opening, the pipe being provided with an apertured partition; a pivoted arm for actuating the leakage varying valve; means controlled by the difference in pressure on opposite sides of the partition for actuating the arm, the said means including expansible devices engaging opposite sides of the arm, the expansible device for moving the arm and thus the leakage varying valve towards the relief opening being positioned farther from the pivot of the pivoted arm than the other expansible device; and an automatic pressure regulating valve having a continuous leak positioned in the supply pipe at the side of the said flow controlling valve remote from the apertured partition and the relief opening.

2. A differential pressure operated device comprising a valve member for varying leakage through a relief opening; a pivoted arm for moving the valve member towards and away from the opening, the pressure of fluid on the valve member tending to move the latter to an open position; and hollow expansible devices connectible with sources of different pressures engaging opposite sides of the arm, one of said devices being adapted when expanded to cause the valve member to move in a direction away from the relief opening, the other of said devices being adapted when expanded to cause the valve member to move in the opposite direction, the last mentioned device being positioned farther from the pivot of the pivoted arm than the first device.

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