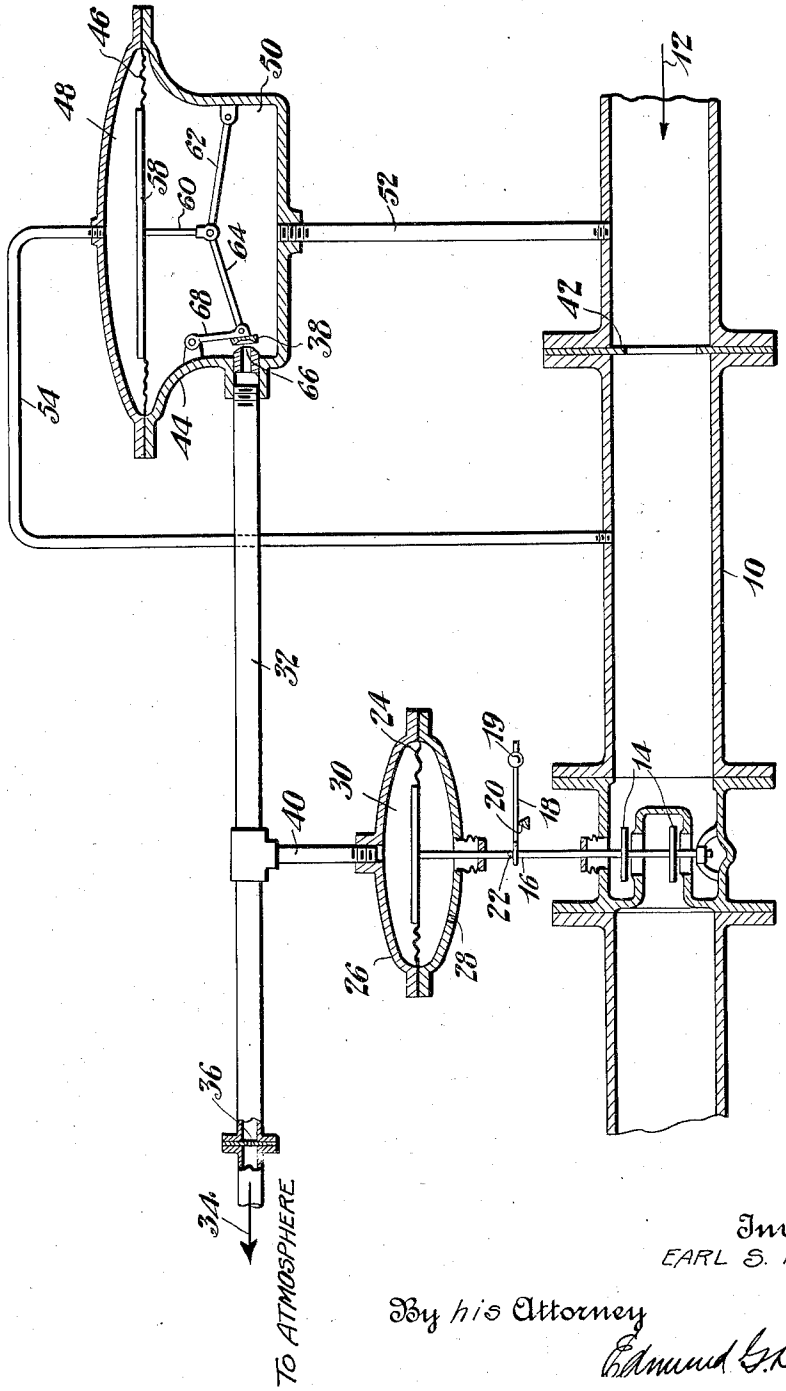
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PILOT CONTROLLED DEMAND METER

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PILOT-CONTROLLED DEMAND METER

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The present invention relates to the art of gas distribution.

It has been proposed to use flow limiting or demand limiting devices in the connections between gas mains and the burners of the individual consumer.

Moreover in my co-pending application Ser. No. 218,847 filed Sept. 10, 1927, I have disclosed a flow limiting apparatus adapted for use in gas mains or like conduits for limiting the rate of flow of fluid therein.

The principal object of the present invention is to provide a simple and efficient apparatus for limiting the flow of fluid in a gas or like main.

The novel features of the present invention are pointed out with particularity in the appended claims. The invention itself, however, together with further objects and advantages will best be understood from the following description taken in connection with the accompanying drawing in which

The figure is an elevation of an apparatus according to the present invention, parts being shown in section, parts being broken away for purposes of illustration.

In the apparatus illustrated in the drawing, gas is assumed to be flowing in the main 10 in the direction indicated by the arrow 12. For limiting the rate of flow in the main 10 a valve 14 is placed in the main. Any suitable type of valve may be used for this purpose, but in the particular embodiment of the invention disclosed, the valve 14 is of the double beat or balanced type. Valve 14 has a rod 16 by which the valve members are moved into either open or closed position to throttle the flow of gas in main 10 or permit it to flow free as desired. Suitable means are provided for normally holding valve 14 in open position. As illustrated said means comprises a weighted lever 18, or its equivalent having a weight 19 at one end. Lever 18 is pivoted intermediate its ends on fulcrum 20 and the end of lever 18 opposite the weight is in contact with a pin 22 fixed to the rod 16 whereby the weight on the lever tends to throw the rod 16 upwardly. For moving valve 14 in closing direction, the free end of rod 16 may be connected to a diaphragm 24 in a casing 26, the diaphragm 24 dividing casing 26 approximately in the middle. The lower half of the casing 26 is open to the atmosphere as indicated at 28, the upper half of casing 26 however forming a pressure chamber 30 above the diaphragm 24.

In order to overcome the effect of weighted lever 18 and so cause valve 14 to throttle when desired, pressure fluid is introduced into the chamber 30 to act on the upper face of diaphragm 24. In the particular embodiment of the invention disclosed, pressure fluid for this purpose is taken from an auxiliary pipe or conduit 32. Normally, pipe 32 is at atmospheric pressure, but when valve 14 is to be moved toward its closed position pressure fluid is admitted to pipe 32. Pressure fluid is assumed to flow in the conduit 32 in the direction indicated by the arrow 34. The pressure fluid for pipe 32 may be taken from any convenient source. However, pressure fluid for the pipe 32 may be conveniently taken from the pipe 10 at a point prior to the valve 14 so that the fluid in pipe 32 shall be of the same character as that in main 10. Pipe 32 has an uninterrupted discharge to the atmosphere and contains an orifice plate 36 near its discharge end, said plate acting as a flow restriction in the pipe 32 to maintain the pressure in pipe 32 at points prior to plate 36 in the direction of gas flow when pressure fluid has been introduced into the pipe. Pipe 32 contains a valve 38 which permits, when open, flow of pressure fluid in pipe 32. The valve 38 normally remains closed, or nearly so. The casing 26 of valve 14 is connected into pipe 32 by a pipe 40 at a point intermediate plate 36 and valve 38. The pressure in chamber 30 above the diaphragm 24 is therefore normally relatively low and the weighted lever 18 is so designed as to hold the valve 14 open against the normal pressure in chamber 30.

Automatic means are provided whereby valve 38 may be opened when the flow of fluid in main 10 reaches a predetermined maximum. When the valve 38 is open, the pressure fluid passing into the section of pipe 32 between plate 36 and valve 38 is to some extent, trapped in said section and

the pressure thereupon goes up in pipe 32 and in chamber 30 sufficiently to move the valve 14 against the action of weighted lever 18 so as to throttle the flow of fluid in the main 10. Valve 14, however, is not permitted to close entirely, the valve 38 being automatically controlled so as to maintain conditions in pipe 32 and chamber 30 permitting the flow through valve 14 in the main 10 of the given maximum amount for which the apparatus has been adjusted. In the arrangement illustrated the means for operating and controlling the value 38 to produce the results just described include an orifice plate 42 in the main 10. Plate 42 is illustrated as being placed ahead of the valve 14 in the main 10 but this relative arrangement is not essential. Plate 42 acts as a flow restriction causing a drop in pressure in the gas passing through the plate, said drop in pressure increasing with increase in flow in main 10. The drop in pressure at the plate 42, or pressure difference on opposite sides of plate 42, is utilized to operate the valve 38. In the particular arrangement illustrated for this purpose, valve 38 is enclosed in a casing 44, casing 44 being divided by a diaphragm 46 into an upper chamber 48 and a lower chamber 50. The pipe 32 enters the lower chamber 50 of casing 44, valve 38 being illustrated as controlling pipe 32 at the point of the discharge from chamber 50 into pipe 32. The chamber 50 is connected with the main 10 by a pipe 52 entering the main 10 at a point prior to the orifice plate 42. Chamber 50 and pipe 52 act not only to apply pressure to one side of diaphragm 48, but also to extend pipe or conduit 32 to a connection with pipe 10 whereby pressure fluid may be introduced into the section of conduit 32 between valve 38 and orifice plate 36. The chamber 48 is connected with the pipe 10 by a pipe 54 entering the pipe 10 at a point intermediate plate 42 and valve 14. In the arrangement illustrated, it will be seen that the diaphragm 46 is subjected to the pressure drop through the plate 42, the pressure on the low pressure side of plate 42 being applied to the upper face of diaphragm 46 through pipe 54 while the chamber 50 on the underside of diaphragm 46 is always maintained at the same pressure as that on the high pressure side of plate 42 by the pipe 52. The diaphragm 46 is weighted by plate 58 and certain connecting parts so that it is normally in its lower position holding the valve 38 closed. When the drop in pressure through plate 42 increases beyond a certain amount, determined by the weight on the diaphragm 46, and by the size of the orifice in plate 42, diaphragm 46 is raised to open the valve 38. The connections for operating valve 38 from diaphragm 46 include a rod 60 fixed to the plate 58 and a pair of links 62 and 64. Link 62 is pivoted to the casing 44 at one end and to the rod 60 and link 64 at the other, while link 64 is pivoted at one end to the valve 38 and to rod 60 and link 62 at the other. The links 62 and 64 incline downwardly from their points of connection with the rod 60 whereby members 60, 62 and 64 form a toggle acting to close valve 38 as the diaphragm 46 moves downwardly and to open the valve 38 as the diaphragm moves upwardly. Valve 38 may be mounted in any suitable manner so as to close and open the port 66 where the pipe 32 leaves casing 44. As illustrated valve 38 is suspended from the casing 44 by a link 68.

The operation of the apparatus above described will be obvious to those skilled in the art from the foregoing matter. For purposes of convenience, however, the operation of the apparatus herein disclosed may be described as follows:

Assuming the flow in main 10 to be below a given predetermined maximum, the valve 38 is closed and the pressure in pipe 32 is atmospheric. Consequently, the pressure in the chamber 30 is less than that required to move the valve 14 against the weighted lever 18 and valve 14 stands wide open. As the flow in main 10 increases, the pressure drop through plate 42 increases so that, at the rate of flow determined by the size of the orifice plate 42, and the weight connected to diaphragm 46, diaphragm 46 is raised, thereby opening valve 38, and introducing into pipe 32 and chamber 30 the pressure on the high pressure side of plate 42. The orifice in plate 36 being relatively small, the escape of gas from the pipe 32 to atmosphere is not rapid enough to materially reduce the pressure in line 32 below that in the main on the high pressure side of plate 42 and conducted through pipe 52 and casing 54 to the pipe 32. Therefore when valve 38 is opened pressure in chamber 30 builds up to a point such that valve 14 begins to close and moves far enough towards the closed position to maintain a certain pressure drop through the plate 42, said drop depending upon the weight carried by the diaphragm 46.

By maintaining a predetermined pressure drop through the orifice plate 42 the flow through the main 10 will be limited to a predetermined maximum flow, the operation of the valve 14 tending to cut down the flow through the line 10 as an increased pressure drop through the orifice plate tends to produce an increased flow. On the other hand, as the flow through the orifice plate 42 falls the pressure differential across the orifice falls and the valve opens. In any case in which the flow is below the predetermined maximum the valve 14 tends to move into open position. When the pressure drop through the orifice plate is slightly lower than the pressure drop for the predetermined

maximum flow, then the valve 38 closes and the pressure in the chamber 30 above the diaphragm 24 gradually decreases from the pressure in the line 12 to atmospheric pressure. At this time the valve 14 moves into wide open position. The movement of the valve by this means is gradual and slow so that there is not a quick action or hunting, or a rapid increase and decrease in the pressure. On the other hand, when the flow through the line tends to approach the maximum demand the valve 38 is opened slowly and the pressure in the line 32 and above the diaphragm 24 slowly builds up so that there is not a hunting or chatter of the valve 14 in regulating the flow.

While I have described and illustrated a particular embodiment of the present invention, it will be understood that I do not limit myself to details of the present disclosure, it being the intention to claim the novelty residing in the apparatus herein disclosed as broadly as the state of the art permits.

In particular, it will be understood that the apparatus according to the present invention is not limited to the control of flow in gas mains, but may be applied to control the flow of air or gas to oil wells for air lift pumping or for reestablishing rock pressure or applied to control of liquid in a main by a gaseous pressure in the pilot line.

The invention having been described, what I claim is:

1. The combination of a main, a flow limiting valve in said main, means for creating a pressure difference varying with the flow in said main, an auxiliary conduit, a flow restriction in said auxiliary conduit, operating means for said valve, connections whereby said operating means is subject to the pressure in said conduit, a source of pressure fluid for said conduit, a valve for controlling admission of said fluid to said auxiliary conduit, said connections entering said auxiliary conduit intermediate said flow restriction and said second valve, a diaphragm and connections for operating said second valve from said diaphragm, and means for applying to said diaphragm the pressure difference from said first means and in a direction to cause an increase in the pressure in said auxiliary conduit with increase in flow in said main.

2. The combination of a main, a flow limiting valve in said main, a restriction in series with said valve, an auxiliary conduit, a flow restriction in said auxiliary conduit, an operating means for said valve, means whereby said operating means is subjected to the pressure in said conduit at a point before said second flow restriction, a valve in said auxiliary conduit, the high pressure side of said second valve being connected to the high pressure side of the flow restriction in said main, a diaphragm, connections with the main leading to opposite sides of said diaphragm whereby said diaphragm is subjected to the pressures on opposite sides of the flow restriction in said main, and operating means connecting said diaphragm with said second valve.

3. The combination of a main, a flow limiting valve in said main, means in series with said valve for creating a pressure varying with the flow in said main, an auxiliary conduit, a flow restriction in said auxiliary conduit, an operating mechanism for said valve, means whereby said mechanism is operated in accordance with the pressure in said auxiliary conduit on the upstream side of said flow restriction, a valve in said auxiliary conduit arranged to control the operating pressure for said mechanism, and means subject to the pressure from said first means for operating said second valve.

4. The combination of a main, a flow limiting valve in said main, an auxiliary conduit, a flow restriction in said conduit, an automatic valve in said conduit, operating means for said first valve, means for applying to said operating means the pressure in said auxiliary conduit at a point intermediate said flow restriction and said automatic valve, a casing for said automatic valve, a diaphragm in said casing, a connection between said diaphragm and said automatic valve, and means including said diaphragm and said flow limiting valve for preventing an increase in flow in said main beyond a given value.

5. In a flow limiting apparatus the combination of a main, a conduit discharging to atmosphere and having a flow restriction therein, means for maintaining substantially atmospheric pressure in said conduit so long as the flow in said main remains below a given value, means for increasing the fluid pressure in said conduit when the flow in said main reaches said given value, and means operated by said fluid pressure for limiting the flow in said main substantially to said given value.

6. In a flow limiting apparatus, the combination of a casing, a diaphragm in said casing, means for introducing fluid into said casing on opposite sides of said diaphragm whereby the diaphragm may be moved, an outlet for fluid from the casing on one side of said diaphragm, a valve for controlling said outlet, and a connection between said diaphragm and said valve for operating the valve.

7. The combination of a main, a flow limiting valve in said main, an auxiliary conduit having an uninterrupted outlet, a flow restriction in said auxiliary conduit, a valve in said auxiliary conduit, operating means for said flow limiting valve, connections whereby said operating means is subject to the pressure in said auxiliary conduit at a point intermediate said flow restriction and said second valve, a diaphragm, a casing containing said

diaphragm and said second valve, means forming a toggle between said second valve, said diaphragm, and said casing for operating said second valve, and means including said diaphragm whereby said second valve admits pressure fluid to said auxiliary conduit when the flow in said main reaches a given value.

8. The combination in a flow limiting device of a conduit having an uninterrupted but restricted outlet, a source of pressure fluid connected to said conduit, a valve controlling the flow of pressure fluid in said conduit, a flow limiting valve, and means whereby the pressure in the said conduit at a point following said first valve operates said limiting valve.

9. A flow limiting apparatus comprising a main, a valve in the main for regulating the flow therein, an auxiliary conduit having an uninterrupted but restricted outlet to atmosphere, a valve controlling the introduction of pressure fluid to said conduit, automatic operating means for said second vlave arranged to substantially exclude pressure fluid from said conduit except when the flow in said main reaches a certain maximum. and throttling mechanism for said flow limiting valve subject to the pressure in said auxiliary conduit and operative to maintain said flow limiting valve in wide open position except when pressure fluid is admitted to said auxiliary conduit.

In testimony whereof I affix my signature.

EARL S. RUSH.