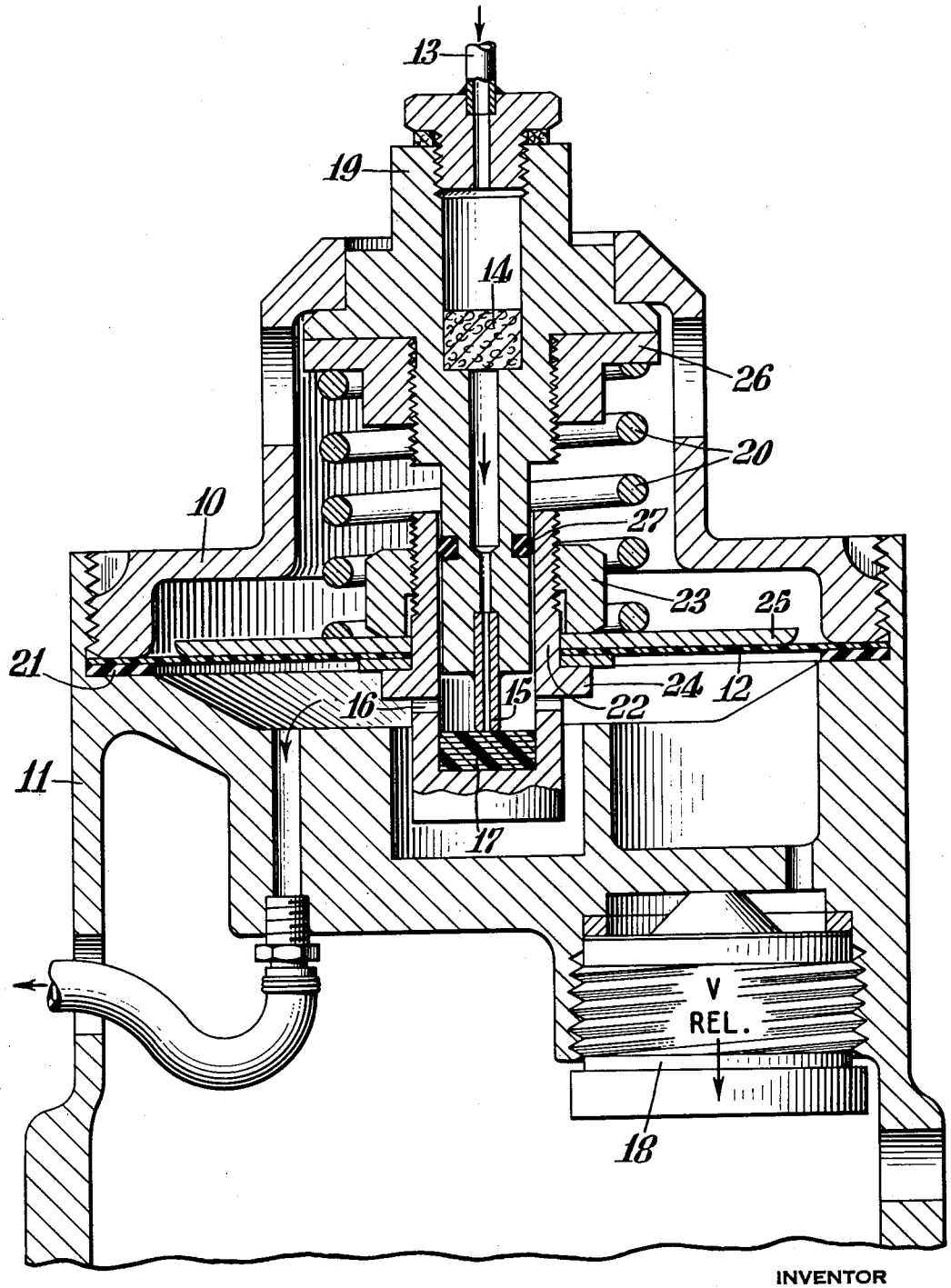
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NOZZLE TYPE REGULATOR

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NOZZLE TYPE REGULATOR

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Heretofore it has been difficult to make a small size regulator for a low quantity of gas flow and yet at the same time preserve a good discharge characteristic. Under the present invention, this has been accomplished by a number of features of construction which have been used together for the first time.

An object of this invention is to provide a fluid pressure regulator which is simple and compact, may be made inexpensively, and has a good flat discharge characteristic when operating with small quantities of gas, whereby such a regulator is well adapted for drink vending machines and other purposes.

Referring to the drawing:

The single figure gives a longitudinal section through one embodiment of this invention.

The regulator casing is comprised of two parts, **10** and **11**, between which is clamped the diaphragm **12** by the threaded cooperation of the casing parts. An inlet passage **13** leads through a filter **14** to a precision tube **15** for cooperation with a movable valve seat **17**. After the gas has passed through the stationary valve member **15**, it moves through the outlet passage **16** to its place of use. A relief valve **18** may be secured in the casing portion containing the outlet passage. The stationary member **19** receiving the major part of the inlet passage is insertable in the casting part **10** from the inside when the casing portions have been separated. A spring **20** engages the diaphragm **12** to oppose the outlet pressure acting on the opposite side of the diaphragm. A rubber washer **21** is insertable adjacent the periphery of the diaphragm where it is subjected to the clamping pressure of the casing parts.

The movable valve seat member is carried by and secured to the diaphram with the aid of a tubular holder **22** having a flange **24** which engages the diaphragm on one side. On the opposite side of the diaphragm a clamping nut **23** holds the diaphragm plate **25** against the diaphragm **12**, clamping it between the diaphragm plate and the flange **24**. A nut **26** may be adjustable to control the stress in the spring **20**. The pressure of the spring **20** against the diaphragm is sufficient to hold the inlet passage receiving member **19** tightly within the recess of the casing portion **10**, due to the shoulder illustrated on the member **19**.

A silicone rubber O ring **27** is carried by the member **19** and engages the inner wall of the tubular guide holder **22**. For very low flow conditions, the O ring may not slide but only be subject to a small amount of stress. For larger flow conditions with a larger valve opening, the O ring may slide. This regulator may be built in larger sizes for a larger quantity of gas being handled. Also in larger sizes the O ring may be secured to stationary member **19** and to the inner wall of the holder **22** for the purpose of opposing any tendency to hum without the presence of sliding friction between the holder **22** and the stationary member **19**.

The degree of regulation depends on the ratio of diaphragm area to the area of the inlet opening in the valve member which cooperates with the seat portion. In the present invention this ratio is many times greater than is found in many commercial regulators and still many more times greater than is found in any small size regulator.

Structural features contributing to the compactness of the present regulator include the elimination of a yoke heretofore customary in many regulators. The location of the spring **20** around the movable and stationary valve members contributes to axial shortness in the regulator. The pressure responsive diaphragm **12** is preferably either a film of polytetrafluoroethylene known under the brand name of "Teflon" about .005" thick or a glass fabric impregnated with this same plastic.

Another distinguishing characteristic of the present invention is its possession of a good flat discharge characteristic, especially with a small quantity of gas flow. The degree of regulation depends on the ratio of the diaphragm area to the area of the valve opening. In this regulator that ratio is close to 500 to 1, and a conspicuous structural feature contributing to this advantageous result is the use of the precision tubing **15** of stainless steel having an outside diameter of .045" and an inside diameter of .009", the inside diameter being within the range of sizes commonly designated capillary tubing. Such capillary openings are usually within the range of .005" to .015". With these good discharge characteristics, flows of 15 to 100 cubic feet per hour are possible. The regulator valve illustrated is of the general nozzle type, that is, having the discharge pressure tending to close the valve. It is believed that there is no sliding friction in this small type valve, that is, of the dimensions described and shown approximately in the drawing. The O ring **27** tends to stick to the inner surface of the holder **22** and thus be adhesively or otherwise secured thereto, as well as to the holder **19** for the stationary valve member and, due to the small movement of the movable valve element, the O ring may function as and take the place of a valve closing spring commonly found in fluid pressure regulators. This regulator, while described as a small one, may, nevertheless, be made in larger sizes for handling larger quantities of flow, and, when so made in larger sizes, the O ring may or may not have any sliding friction with the inner surface of the holder **22**. For maximum flow, that is, for maximum valve opening, the present regulator movable valve element has a movement of only .002". This silicone rubber O ring is flexible at —70° F. and possesses adequate strength at 150° F.

Another feature of the present invention is its simplicity and reduction in cost. This regulator is perhaps 40% more compact and probably 30% cheaper to produce than any comparable regulator available on the market today.

All parts are adapted to be made on a screw machine. The straight in-line construction contributes to simplicity of assembly. Before the casing portions are screwed together the member **19** is inserted in the casing portion **10** from the inside and held there by the spring **20** after being assembled. The valve seat is of nylon and the precision tube is a material which is available on the market generally of stainless steel. Having the movable valve seat **17** carried by the diaphragm eliminates the need for any valve yoke such as is customary in many types of fluid pressure regulators.

What is claimed is:

1. A pressure responsive valve comprising in combination a casing, a pressure responsive diaphragm carried by said casing, a supply passageway, an outlet passageway, a valve between said passageways, a movable seat element for said valve, means securing said seat element to

said diaphragm for movement therewith in each direction, including a guide tube enclosing said seat element, secured to and extending axially through said diaphragm, said inlet passageway being fixed with respect to said casing and telescoping within said guide tube, and resilient O ring type packing between said guide tube and a portion of the inlet passageway within said tube, carried by one of them and secured to the other one strongly enough for said packing ring to flex or to slide, depending on the degree of movement of said diaphragm, whereby said O-ring packing, when it does not slide, is adapted due to its resilience and internal stresses therein to assist in moving said valve, said guide tube having an outlet opening between said seat element and said O ring packing.

2. A valve according to claim 1 in which said inlet passageway terminates in a precision tube having a capillary bore and said valve seat has a movement of only a few thousandths of an inch for its full opening, whereby said valve is well adapted to control small flows.

3. In a fluid pressure regulator of the type having an inlet passageway, an outlet passageway, a valve between them, a diaphragm responsive to pressure in said outlet passageway, a casing, and a spring clamped in said casing and cooperating with said casing and diaphragm for opposing the outlet pressure against the diaphragm, the combination therewith of the improvement enabling said regulator to be made on a screw machine, said improvement comprising a spring receiving portion of said casing being provided with an axial bore, an inlet passage receiving member centered in said bore, carried by said casing portion, and extending through said diaphragm, said diaphragm being mounted for flexure along said inlet passageway receiving member and relative thereto at the diaphragm central portion and flexible packing between said diaphragm and inlet passage receiving member.

4. In a pressure responsive valve having a casing, a pressure responsive diaphragm clamped in said casing, an inlet passageway, an outlet passageway, a valve between said passageways, and a spring cooperating with said casing and diaphragm for opposing outlet pressure upon said diaphragm, the combination therewith of the improvement facilitating assembly of said valve, said improvement comprising an axial bore in a spring receiving portion of said casing, a complementary casing portion threaded to the first and clamping a peripheral portion of said diaphragm between them, an inlet passage receiving member centered in said bore, passing through said diaphragm, and adapted to be assembled therein from the inside when said casing portions have been separated, a movable valve seat secured to an inner edge portion of said diaphragm within a tubular member, a stationary end portion of said inlet passage member telescoping within said tubular member, and flexible packing between said telescoping members.

5. In a fluid pressure regulator having a casing, a pressure responsive diaphragm held in said casing, an inlet passageway, an outlet passageway, a valve between said passageways responsive to flexure of said diaphragm, and a spring cooperating with said casing and diaphragm, the side of said diaphragm opposite said spring being exposed to pressure of said outlet passageway, the combination therewith of the improvement for obtaining a generally flat discharge characteristic for small fluid flows and for eliminating any sliding friction in said valve, said improvement including said inlet passageway at said valve being of capillary inside diameter, said valve being of the nozzle type in which pressure in said outlet passageway tends to close said valve and said valve has a movable member and a stationary member, one of said valve members being said inlet passageway and the other a yieldable seat member fixed to and movable with an innermost portion of said diaphragm, a tube in which said seat member is mounted adjacent one end, said tube extending around said inlet passageway, close thereto but spaced therefrom, and projecting through said diaphragm, and a resilient packing between said tube and inlet passageway, adapted to yield with movement of the movable valve member in guiding its movement without sliding friction therebetween and also to provide a gas seal between opposite sides of said diaphragm, said tube having a vent between said seat member and packing.

6. A regulator according to claim 5 in which said resilient packing is an O ring carried by one of said valve members and secured to the other valve member.

7. In a fluid pressure regulator for small flow rates and of a type having a casing, an inlet passageway, an outlet passageway, a valve between said passageways, a diaphragm clamped in said casing and responsive to fluid pressure in said outlet passageway for actuating said valve, a spring between said diaphragm and a portion of said casing for opposing outlet pressure against said diaphragm, said valve being of the type having a stationary nozzle at an end of said inlet passageway, and a yieldable seat element movable away from said nozzle under flexure of said diaphragm due to said spring, the inlet passageway within said casing being substantially straight and extending axially through said diaphragm and spring, the combination therewith of the improvements including means securing said seat element to said diaphragm for movement thereby in both directions, and means associated with such securing means for providing sliding movement of the central portion of said diaphragm along the inlet passageway during flexure of the diaphragm, and a gas seal for preventing gas flow from one side to the other of the diaphragm along said inlet passageway, whereby the whole area of said diaphragm is responsive to outlet pressure and whereby with a given diameter of diaphragm the degree of regulation and the tendency for the valve to close tightly are enhanced.

8. A regulator according to claim 7 in which said gas seal is an O ring packing sealing a space between the inlet passageway and a central portion of said diaphragm and said packing is of a type tending to stick to the walls of any such space.

9. A regulator according to claim 7 in which said valve nozzle is a length of capillary tubing having an inside diameter no larger than .005 of an inch secured to said inlet passageway.

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