May 8, 1934. W. GAERTNER 1,957,951

OXYGEN REGULATOR

Filed Nov. 6, 1931 4 Sheets-Sheet 1

Fig.1

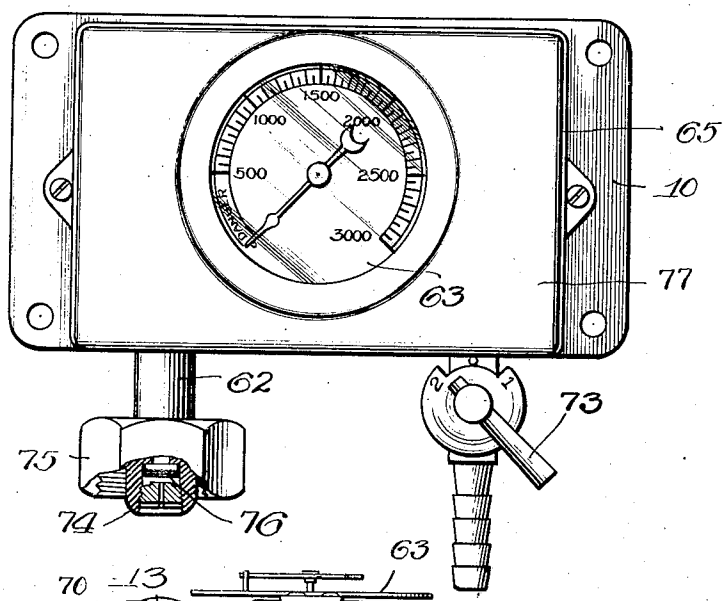


Fig.2

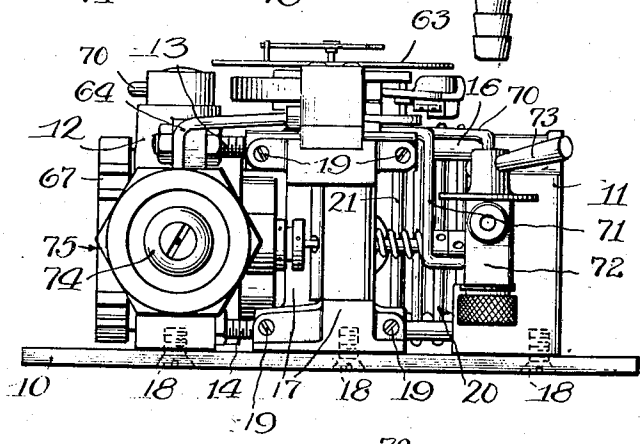
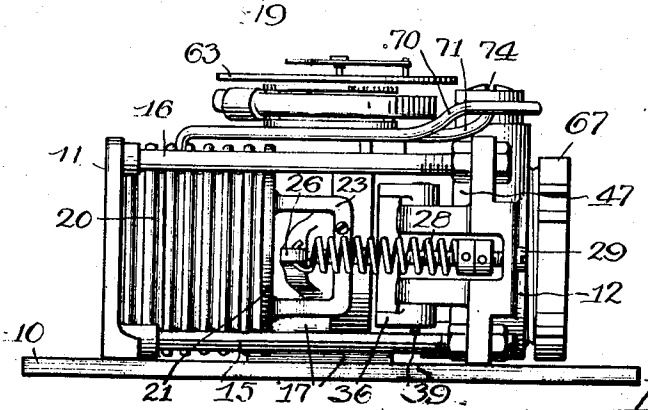


Fig.3



Witness:
Chas. R. Kourse.

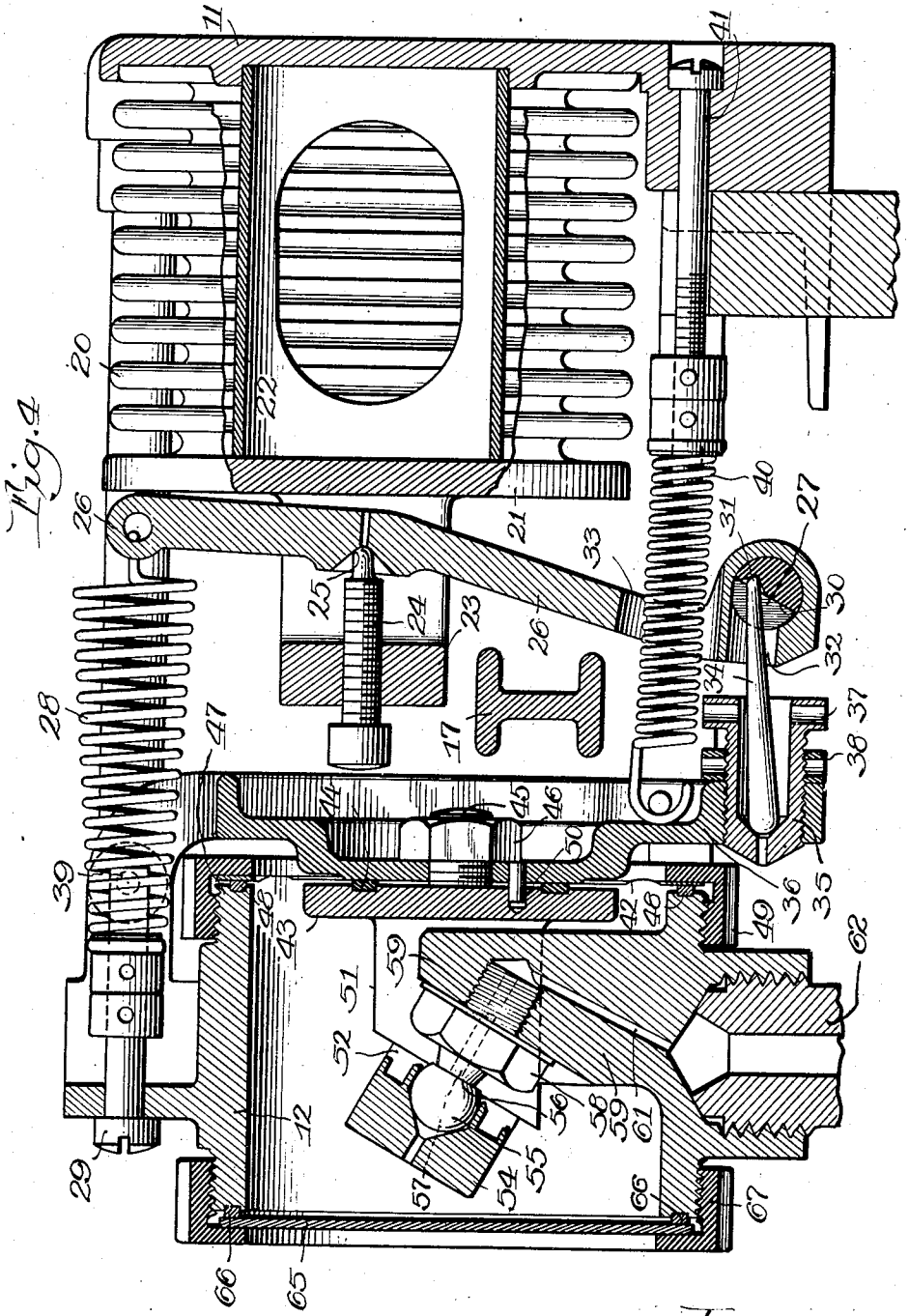
Inventor
William Gaertner,
George Bayard Jones Atty.

May 8, 1934. W. GAERTNER 1,957,951

OXYGEN REGULATOR

Filed Nov. 6, 1931 4 Sheets-Sheet 2

Fig. 4



Witness:
Chas. L. Kousek.

Inventor,
William Gaertner,
George Bayard Jones & Kitty.

May 8, 1934. W. GAERTNER 1,957,951

OXYGEN REGULATOR

Filed Nov. 6, 1931 4 Sheets-Sheet 3

Fig. 6

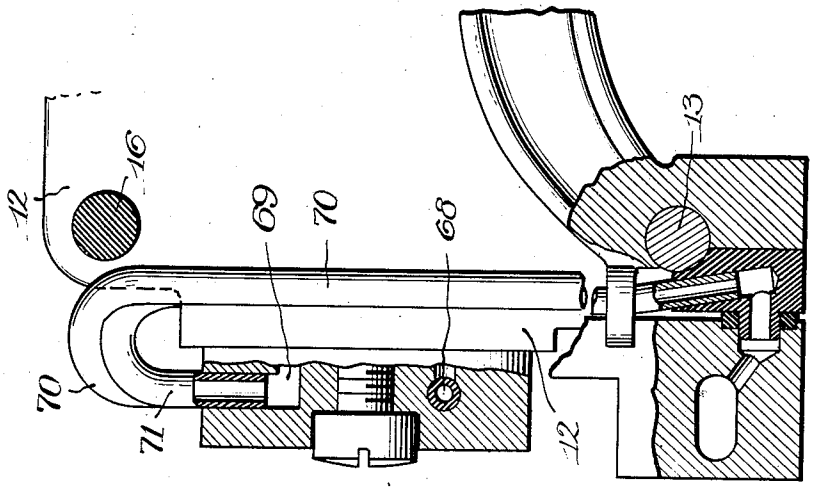
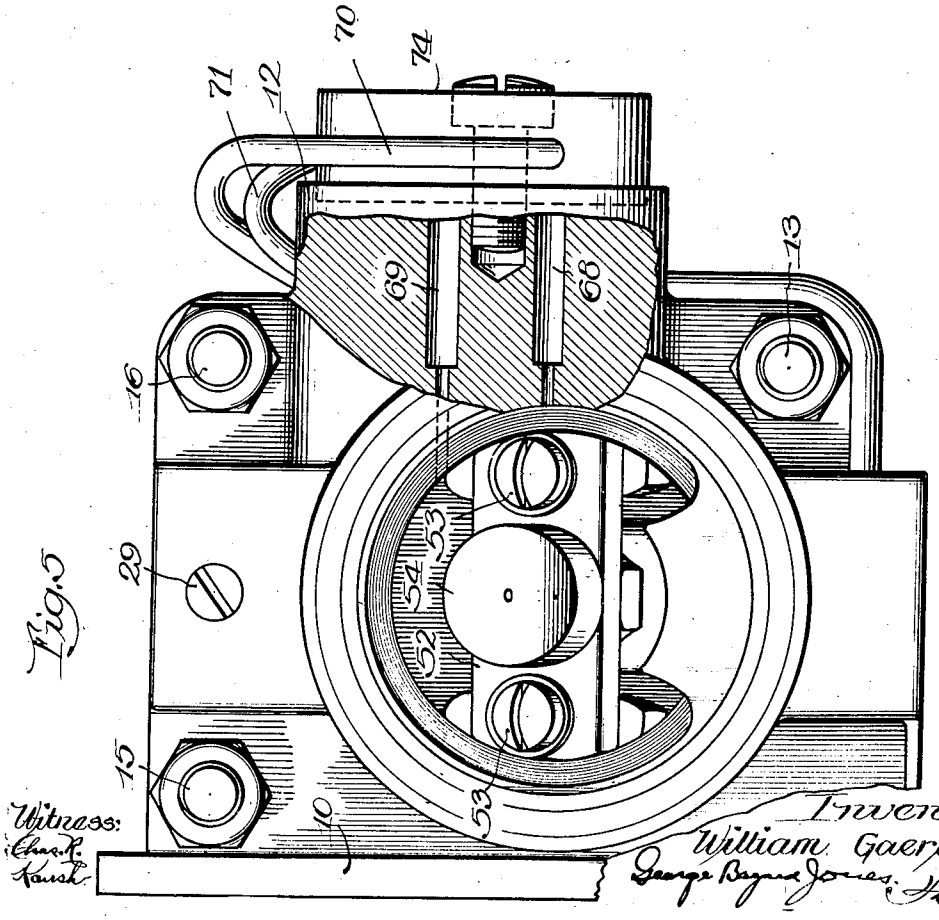


Fig. 5



Witness:
Chas. R. Kausk

Inventor,
William Gaertner,
George Bryan Jones, Atty.

May 8, 1934. W. GAERTNER 1,957,951

OXYGEN REGULATOR

Filed Nov. 6, 1931 4 Sheets-Sheet 4

Fig. 7

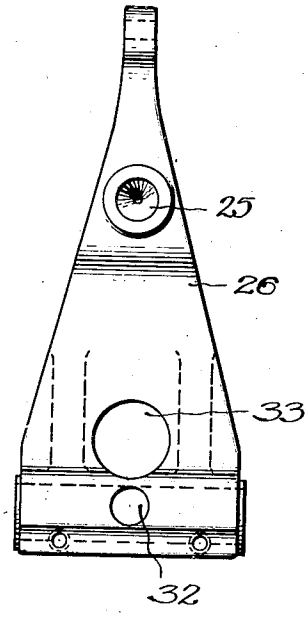


Fig. 8

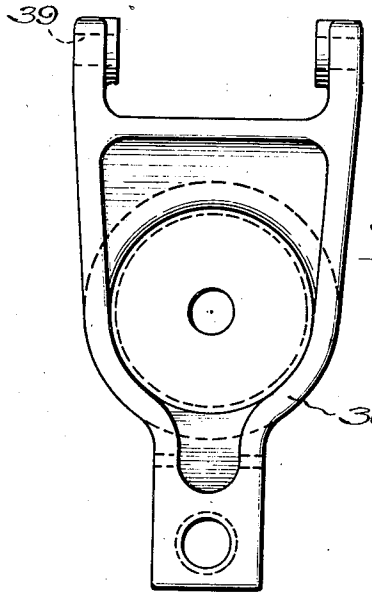


Fig. 9

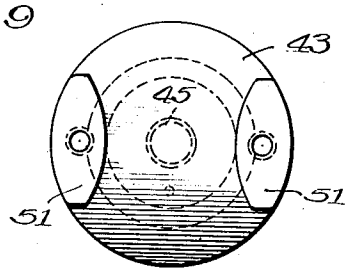


Fig. 10

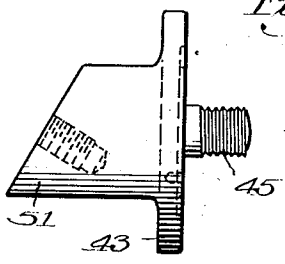


Fig. 11

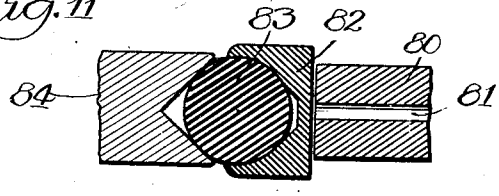
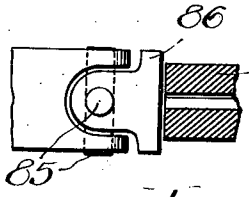


Fig. 12



Witness:
Chas. L. Fourse.

Inventor,
William Gaertner,
George Bagard Jones Atty.

Patented May 8, 1934 1,957,951

UNITED STATES PATENT OFFICE

1,957,951

OXYGEN REGULATOR

William Gaertner, Chicago, Ill., assignor to The Gaertner Scientific Corporation, a corporation of Illinois

Application November 6, 1931, Serial No. 573,363

13 Claims. (137—153)

This invention relates to improvements in oxygen regulators, such as are used by aviators and other individuals in need of an artificial supply of oxygen or of a mixture of oxygen and other gases, and in which there is employed a "sylphon" or cylindrical, corrugated tube or bellows of thin metal from which the air has been exhausted to a point corresponding to about two inches of mercury. The tendency of the sylphon to collapse at ordinary atmospheric pressure is offset in part by a spring which tends to hold the movable end of the sylphon away from the fixed end. Complete collapse is prevented by a stop inside the sylphon. The spring is so adjusted that the free end of the sylphon is in equilibrium when subjected to a predetermined atmospheric pressure of about fifty-three (53) centimeters of mercury corresponding to an altitude of ten thousand (10,000) feet. As the atmospheric pressure decreases due to increased altitude, outward movement of the sylphon end is communicated to a valve by means of a lever and linkage system. Said valve is thus opened more and more as the altitude increases, permitting more oxygen to flow from the supply tank to the low pressure outlet, the other end of which is carried by the aviator to compensate for the decreasing oxygen supply. The operation of such a valve is very delicate, the maximum opening being only a few thousandths of an inch. With such instruments it is very important to maintain the proper flow of oxygen at all altitudes and pressures and temperatures within the available range, and to this end the instrument must not only be sensitive and consistent in its action, but must also be rugged, unaffected by vibration, compact in form, light in weight, and durable. Those instruments heretofore used for the purpose have not fulfilled these exacting requirements during continued service, due to the fact that a needle valve was employed, which it was difficult to make self-alining, and in which the successive impressions made by the needle in the softer seat, caused undesirable inaccuracies in the flow of oxygen. Also it proved difficult, if not impossible, to adjust the valve accurately and permanently.

The general object of the present invention is to provide an improved instrument, which is sturdy, durable and compact in construction and able to withstand continued vibration and to maintain predetermined flows of oxygen at various different altitudes or pressures, and temperatures.

A contributory object is to provide a valve, the relatively movable engaging parts of which consist of two accurately formed, flat, polished, hard surfaces, one of which is self-aligning to insure perfect contact of said surfaces.

Another object is to provide an improved lever and link mechanism which is positive and uniform in its actions, which is protected from dust and other foreign matter, but which may, nevertheless, be readily adjusted to insure the proper operation over the entire predetermined range of altitudes or pressures.

Other objects and advantages will be apparent from the description hereinafter given of a commercial embodiment of the invention.

In the drawings:

Fig. 1 is a top plan view of the instrument selected to illustrate the invention.

Fig. 2 is a front elevation thereof with the cover removed.

Fig. 3 is a rear elevation thereof.

Fig. 4 is an enlarged sectional view on a horizontal plane.

Fig. 5 is an end view with certain parts removed.

Fig. 6 is a vertical section through the coupling block connecting the low pressure pipes with the valve chamber.

Fig. 7 is an elevation of the sylphon lever.

Fig. 8 is an elevation of a lever actuated thereby.

Fig. 9 is a front elevation of the movable valve plate yoke.

Fig. 10 is a side elevation thereof.

Fig. 11 is a section of a modified form of a valve.

Fig. 12 is an elevation partly in section of a further modification.

The instrument, which in the preferred form illustrated, is only a few inches long, is provided with a suitable base plate 10, and may be said to consist of three units; the sylphon unit, the lever and linkage unit, and the valve unit. The sylphon unit has an end piece or casting 11 (see Figs. 2, 3 and 4) mounted on the base plate near one end, and the valve unit consists of a casting 12 mounted on the other end. These castings are connected by four metal rods 13, 14, 15, and 16. The lever and linkage unit or supporting bracket 17 therefor, is mounted on the base between the two end castings, all three of said castings being secured to the base by screws 18 or other suitable fastening means. The bracket 17 is also secured to the rods 13 and 14 by small set screws 19.

The sylphon unit consists essentially of a structure having certain walls thin and flexible so that it may respond readily to relative variations in pressure within and without the same. In the

preferred form shown, designated as a "sylphon" it consists of a cylindrical, corrugated tube, one end being closed by the end casting 11 and the other by a plate 21, the latter being free to move in and out under variations in pressure. Other forms of pressure responsive devices may, however, be used. The air is exhausted from the sylphon to a point within two inches of mercury, and to prevent collapsing, a tube 22 is located inside the same, against which the free end 21 is normally held by atmospheric pressure. Said free end has a yoke 23 thereon, through which passes a screw 24, the reduced end of which seats in a conical recess 25 in a lever 26, shown also in Fig. 7. Said lever pivots about alined vertical pins 27 in the upper and lower ends of the bracket 17.

The spring 28 engages the free end of said lever 26, and has its other end adjustably secured at 29, said spring tending to enlarge the sylphon against the action of the atmosphere, which tends to collapse it.

The lever 26 has a semi-cylindrical member 30 therein concentric with the axis of rotation, said member having a recess 31 in line with an opening 32 therein. Another opening 33 in said lever is provided to accommodate a spring hereinafter described.

A link or pin 34 is arranged with one end within recess 31 and the other end within an adjustable thimble 35 received in an opening near one end of a lever 36 and adjustable therein by means of a flange 37 and capable of being locked in adjusted position by lock nut 38.

The lever 36, which is shown also in Fig. 8, is pivoted at one end about the vertical pins 39, and is normally drawn towards the sylphon by a spring 40, one end of which is secured to the adjustable member 41 for regulating the tension. The pin 34, normally held under compression by spring 40, is almost completely enclosed by the adjacent parts, shown in Fig. 4. When the lever 26 rocks about its pivotal support, pin 34 is given a slight longitudinal movement which communicates to the lever 36. Said lever carries a flexible diaphragm 42 which is clamped between it and the circular base 43 of a yoke with a lead washer 44 interposed between said base 43 and said diaphragm. A screw threaded extension 45 on said base 43 (see Fig. 10) projects through an opening in said lever, the parts being clamped in place by nut 46. Said diaphragm is clamped at its periphery against the threaded end 47 of the casting 12, with a lead washer 48 interposed, by means of the nut 49. A pin 50 on the lever 36 enters a hole in the base 43 to properly position the latter in assembling the parts.

The yoke, in addition to the circular base 43, consists of a pair of extensions 51, shown in Figs. 9 and 10, the ends thereof being finished in a plane inclined with reference to the plane of the base. A bridging member 52 (Fig. 5) is secured to the uprights 51 by suitable screws 53, and has a central boss 54 thereon with a recess (Fig. 4) which receives a ball 55 which is made preferably of stainless steel, and has an accurate, flat, polished surface cut thereon or made of the same or of other suitable material, fastened thereto. Said ball, while confined within said recess, is free to turn with reference thereto and thus seat itself accurately against the polished flat surface 56, having a central opening 57 therethrough constituting a port. This flat surface may be cut directly on the head of the stud 58, or it may be made of the same or of other suitable material fastened thereto, said stud being mounted in a part 59, integral with the casting 12. In order to assure continuous and accurate operation of the valve the flat surface 56 is made of a material somewhat softer than the surface on the ball, and is also slightly smaller in order to prevent the possibility of indentation or deformation of either surface of such a character as might cause leakage. The relative arrangement of the surfaces may also be reversed, but in general the larger polished area should be the harder.

The opening 57 in screw 58 permits communication thru channel 61 to oxygen or gas pressure connection 62. The pressure gauge with dial 63 is also in communication with the oxygen supply connection 62 thru the connecting pipe 64. See Fig. 2.

The flexible diaphragm 42 (Fig. 4) insures a gas-tight connection at one end of the chamber in casting 12, the other end being closed by a disc 65 held against a gasket 66 by a nut 67. Said chamber containing the oxygen under reduced pressure connects through the two orifices 68 and 69 shown in Fig. 5, with the pipes 70 and 71 leading to the feed cock 72, which allows the proper supply of oxygen for either one or two men. Tube 71 may be opened or closed by the rotation of the handle 73, leaving the tube 70 always open. Thus the proper amount of oxygen may be emitted for either one or two persons through a flexible tube which fits on the end of said feed cock.

A coupling 74 including nut 75 connects directly to the high pressure line, said coupling containing a wire mesh strainer 76 to prevent foreign particles from passing through the valve. The parts are enclosed in a suitable casing 77, which, with the base plate, forms a dust and weather proof enclosure.

The instrument is so adjusted that when it is subjected to at atmospheric pressure of about fifty-three (53) centimeters of mercury or at an altitude of ten thousand (10,000) feet, the free end of the sylphon is in equilibrium. Any decrease in atmospheric pressure due to an altitude higher than ten thousand (10,000) feet will result in an elongation of the sylphon due to the pressure in the sylphon and the action of spring 28 which will move the link mechanism heretofore described in such a way as to permit the valve ball 55 to be lifted slightly from its seat by the pressure of the oxygen in the central opening 57 beneath it.

The oxygen flowing through the valve between the closely adjacent parallel surfaces thereof is confined within said chamber, thus building up a pressure and tending to force the diaphragm 42 outwardly. This pressure disturbs the equilibrium between the sylphon and the spring controlled lever 26 and associated parts, with the result that said sylphon tends to compress slightly and the ball 55 tends to decrease the size of the opening, thus decreasing the internal pressure.

The result of these opposing forces is that a constant low pressure is maintained in said chamber. The valve works with great exactitude and without the possibility of being affected by dust or other foreign particles, as the gas escapes radially at high velocity from the end of the opening 57 beneath the ball, and thus maintains the adjacent surfaces clean and bright.

Fig. 11 illustrates a modified form of valve in which the stationary member 80 may be similar to that previously described, the port 81 being

closed normally by a block of metal 82 having a flat, hard surface such as previously described, and having a spherical recess within which the ball 83 is gripped. Said ball is backed by a movable member 84 having a conical recess therein, which permits the movable valve member to be self-aligning.

In the further modified form of valve shown in Fig. 12, a universal joint 85 is provided whereby the movable valve part 86 may seat itself properly against the end of the stationary member 87.

All the forms of valves described herein consist of two perfectly flat, polished surfaces, either of a hard metal such as steel or stellite, or a soft metal with a hard plated surface, or a metal surface and a jewel, or a combination of any or similar ones. These valves operate with extreme accuracy and with great refinement of regulation, as will be appreciated from the fact that the movable surface has, in the commercial form of the instrument, a maximum clearance from the stationary valve member of less than two thousandths (.002) of an inch.

Although the instrument is described as an oxygen regulator, it may of course be used for regulating the flow of other gases. Furthermore, various changes may be made in the form and arrangement of the parts described, without departing from the spirit of the invention as expressed in the appended claims.

I claim as my invention:

1. An oxygen regulator comprising a chamber having a flexible wall, a valve within said chamber having a stationary part with a flat face and a port therein communicating with an opening through another wall of said chamber, a movable part having a flat face, a backing for said movable part, mounted on said flexible wall and providing a universal connection whereby said movable part is self aligning with reference to said stationary part, and a pressure responsive device outside of said chamber, having link connections with said flexible wall.

2. An oxygen regulator comprising a valve having a stationary part with a flat face and a port therein, a movable part having a flat face, a backing providing a universal connection for said movable part whereby the latter is self aligning with reference to said stationary part, a pressure responsive device, a lever actuated thereby, a spring to modify the action of said pressure responsive device at varying altitudes, a second lever mechanically connected to said movable valve part, a spring tending to hold said valve closed, and a link between said levers.

3. An oxygen regulator comprising a valve having a stationary part with a flat face and a port therein, a movable part having a flat face, a backing providing a universal connection for said movable part whereby the latter is self aligning with reference to said stationary part, an enclosure for said valve, one wall of which is flexible, mechanical connections from said wall to said self aligning valve part, an adjustable socket associated with said wall, a spring biasing said flexible wall in a direction to close said valve, a lever, a loose link therefrom to said adjustable socket, a spring associated with said lever and a sylphon controlling the action of said lever.

4. In an oxygen regulator, a chamber having inlet and outlet ports, a valve in said chamber having a minute range of movement for accurately controlling the flow of oxygen through said ports, a pressure responsive device outside of said chamber and mechanical connections between said device and said valve, including two levers normally impelled toward each other, a socket associated with each lever, and a pin having its ends enclosed in said sockets and maintained under compression.

5. In an oxygen regulator, a chamber having inlet and outlet ports, a valve in said chamber having a minute range of movement for accurately controlling the flow of oxygen through said ports, a pressure responsive device outside of said chamber and mechanical connections between said device and said valve, including two levers normally impelled toward each other, an adjustable thimble near the free end of one lever, a member coincident with the axis of rotation of said other lever and having a socket therein, and a pin confined at its ends in said socket and said thimble.

6. Means for regulating the flow of oxygen and other gases, comprising a stationary member having an opening therein with a hard flat surface surrounding said opening, a ball having a flat surface thereon adjacent said other surface and of a size sufficient to extend beyond the periphery of the same and made of material harder than said other surface, a transverse member having a conical recess for said ball, a yoke having projections on which said transverse member is supported and a chamber in which said parts are enclosed, said chamber having a flexible wall on which said yoke is mounted.

7. In a device of the class described, a chamber having a flexible wall, a plate secured to said wall and having arms thereon, a bridging member secured to said projection and having a recess therein, a member projecting inwardly from another wall of said chamber to a point between said arms, having an opening therethrough constituting an inlet port and which connects at the inner end thereof with a flat surface constituting a valve seat, and a ball in said recess with a flat surface engaging said other flat surface whereby inward movement of said flexible wall will enable said ball to be lifted from its seat to permit the escape into said chamber of fluid under pressure from between said surfaces.

8. In a device of the class described, a chamber having a flexible wall, a plate secured to said wall and having arms thereon with end surfaces inclined with respect to said wall, a bridging member secured to said projections and having a recess therein and a ball in said recess, a stationary member in said chamber with a duct therethrough, a hard flat surface on said member surrounding the end of said duct, constituting a valve seat and in a plane parallel to said inclined end surfaces, said ball having a hard flat surface normally pressed against said other hard flat surfaces and being movable in said recess to make it self aligning with respect to said seat.

9. Apparatus for regulating the flow of gases comprising a chamber having a flexible wall, a valve within said chamber comprising a stationary part having a flat face and mounted on another wall of said chamber, with a port therein communicating with a supply of gas through an opening in said wall, a movable part having a flat face to engage a corresponding face on said stationary part and having a rounded rear portion, means mounted wholly on said flexible wall and having a recess therein in alignment with said port to receive said rounded portion and render said valve parts self aligning, a lever connected to the outside of said flexible wall for moving the latter and thus separating said valve faces for

regulating the flow of gas into said chamber, an outlet for said gas through a wall of said chamber and a pressure responsive device outside of said chamber for causing movement of said lever.

10. Apparatus for regulating the flow of gases comprising a chamber having a flexible wall, a valve within said chamber comprising a stationary part having a flat face and mounted on another wall of said chamber, with a port therein communicating with a supply of gas through an opening in said wall, a movable part having a flat face to engage a corresponding face on said stationary part and having a rounded rear portion, means mounted wholly on said flexible wall and having a recess therein in alignment with said port to receive said rounded portion and render said valve parts self aligning, a lever connected to the outside of said flexible wall for moving the latter and thus separating said valve faces for regulating the flow of gas into said chamber, an outlet for said gas through a wall of said chamber, a closure outside of said chamber having flexible airtight walls to maintain a partial vacuum in said closure and mechanical connections from a wall of said closure to said flexible wall, whereby variations in air pressure on said closure will cause said flexible wall to vary the clearance between said valve faces.

11. Apparatus as in claim 10 in which said mechanical connections reduce the movement transmitted to said flexible wall, to insure a very close regulation of said valve.

12. Apparatus for regulating the flow of gases comprising a chamber having a flexible wall, a valve within said chamber comprising a stationary part having a flat face and mounted on another wall of said chamber, with a port therein communicating with a supply of gas through an opening in said wall, a movable part having a flat face to engage a corresponding face on said stationary part and having a rounded rear portion, means mounted wholly on said flexible wall and having a recess therein in alignment with said port to receive said rounded portion and render said valve parts self aligning, a lever pivoted outside of said chamber and connected to said flexible wall to move the latter and thus separate said engaging valve faces, the plane of said engaging faces being at an angle to the plane of said flexible wall and passing through the pivotal support for said lever.

13. Apparatus as in claim 12 with the addition of a pressure responsive device and a motion reducing linkage connecting the same to said flexible wall.

WILLIAM GAERTNER.