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A. E. ENGELDER

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GAS FLOW CONTROL UNIT

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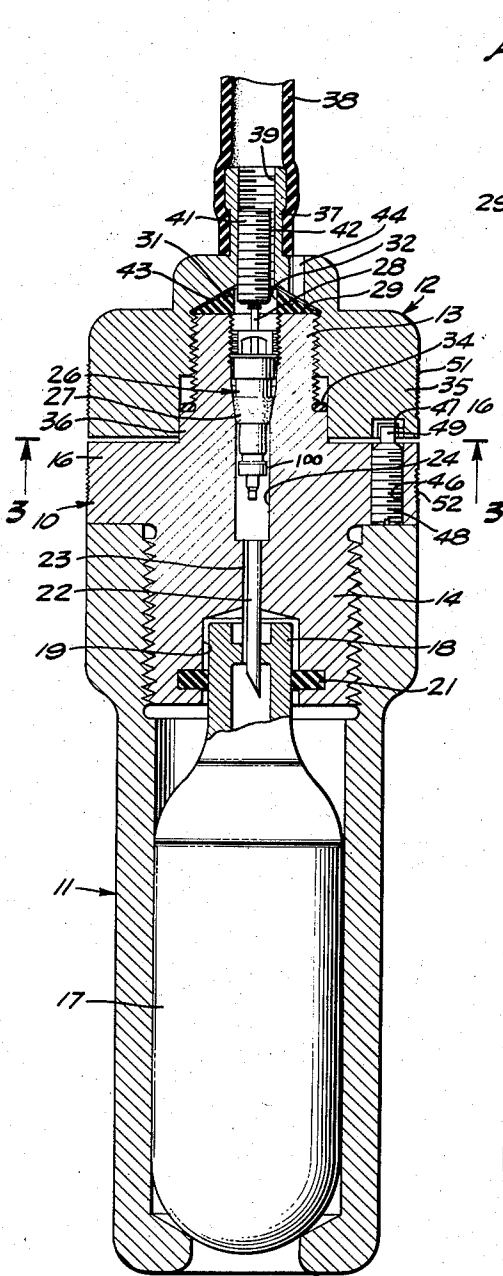


FIG. 1.

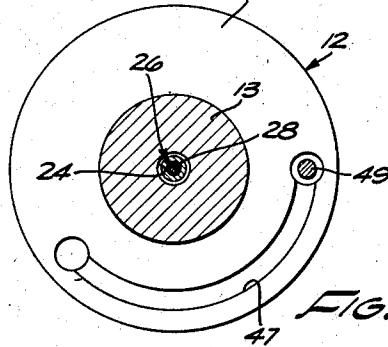
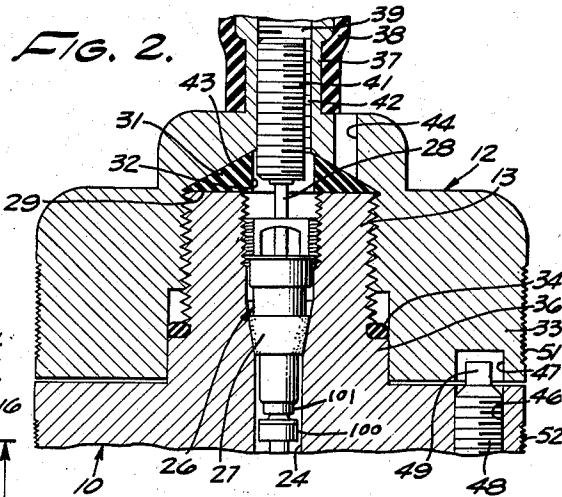
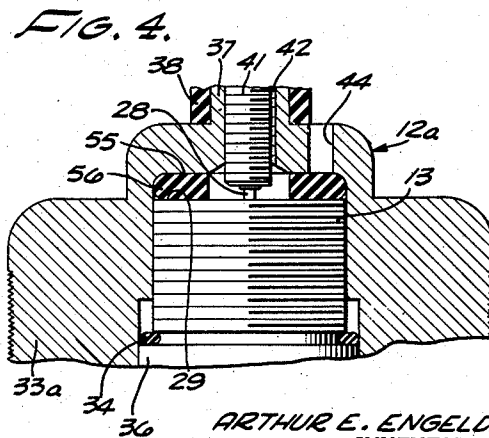


FIG. 3.



ARTHUR E. ENGELDER
INVENTOR.

BY

W. T. Allen
ATTORNEY

1

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GAS FLOW CONTROL UNIT

Arthur E. Engelder, Warren, Ariz.

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14 Claims. (Cl. 222-5)

This invention relates to a gas flow control unit, and more particularly to a two-way valve means for sequentially inflating and deflating such medical equipment as the cuffs of sphygmomanometers (blood pressure instruments). The present device constitutes an improvement of the structure described and claimed in my copending application, Serial No. 248,929, filed September 29, 1951, for a Gas Flow Control Unit, now patent No. 2,717,100, issued September 6, 1955.

While the gas flow control unit described in the above-cited co-pending application was completely operative for the specified purpose, it was characterized by a substantial number of parts and required a substantial amount of machining and off-center boring operations. In particular, the valve means for controlling the venting of gas from the inflatable cuff to the atmosphere were somewhat difficult to form in that a relatively long angular passage and a large diameter ported collar were employed. In addition, the vent valve means of the previous unit did not operate as the result of longitudinal or axial shifting of the cap or head, but instead operated as the result of rotation thereof. This necessarily resulted in certain adverse effects both as regards sealing effectiveness and as regards frictional resistance to cap rotation.

In view of the above factors characteristic of gas flow control units, it is an object of the present invention to provide an improved gas flow control unit which has only a small number of readily manufactured parts, so that the production cost of the over-all unit is greatly reduced.

A further object is to provide a gas flow control unit in which the vent-control portion of the valve means, i. e., the portion of the valve means which controls the venting of fluid from a chamber to the atmosphere, is extremely simple to form and operate yet is adapted to provide a perfect seal preventing venting of gas at undesired times.

A further object is to provide a gas flow control unit embodying inflow and outflow valves which operate reciprocally and along the same line of motion.

These and other more specific objects will appear upon reading the following specification and claims and upon considering in connection therewith the attached drawing to which they relate.

In the drawing:

Figure 1 is a longitudinal central sectional view illustrating the gas flow control unit of the invention, the parts being shown in the vent or outflow position;

Figure 2 is an enlarged fragmentary longitudinal central section corresponding to the upper portion of Figure 1, but showing the components in their inflow position at which gas is permitted to flow from the gas cartridge to the inflatable cuff or other device with which the gas flow control unit is associated;

Figure 3 is a transverse sectional view taken along line 3-3 of Figure 1 and as viewed in the direction of the arrows; and

Figure 4 is a fragmentary view of a modified form of the invention in which the vent or outflow washer is gen-

2

erally cylindrical instead of conical as shown in Figures 1 and 2, the cap portion of the unit being shown in section and the illustrated portion of the body being shown in elevation.

Referring now to the drawing, and particularly to the form of the invention illustrated in Figures 1-3, the gas flow control unit may be seen to comprise a body 10, a hollow casing or cartridge holder 11, and a head or cap 12. Body 10 is formed with upper and lower exteriorly threaded cylindrical extensions 13 and 14, and with a central collar portion 16 having the same outer diameter as the cartridge holder 11 and head 12 at that point.

The cartridge holder 11 is adapted, after reception of a conventional pressurized gas cartridge 17 containing carbon dioxide, oxygen or other desired gas, to be threaded over body extension 14 until its upper end comes into abutment with the undersurface of collar 16. During this threading operation, the neck 18 of cartridge 17 is inserted into a cylindrical recess 19 in the lower end of body 10, there being an elastomeric or plastic seal 21 provided between neck 18 and the valve body so as to prevent leakage of gas therebetween. The threading of the cartridge holder onto the valve body also effects piercing of the cartridge by a cylindrical piercing pin 22 which is mounted axially of body extension 14 and protrudes into the recess 19 as illustrated. One side of piercing pin 22 is made flat to provide a small diameter passage 23 permitting discharge of gas from cartridge 17 into a generally cylindrical valve chamber 24 which is formed axially of body 10 above the piercing pin 22.

A high-pressure poppet valve core 26 is mounted in valve chamber 24, the core being in the nature of a tire valve core but being adapted to withstand much greater pressure and shock. A "Dill" valve core, made by the Dill Mfg. Co. of Cleveland, Ohio, such as their Model 302D, is highly satisfactory. Such valves are formed with a conical sealing seat 27 which rests sealingly on a corresponding conical portion of the wall of valve chamber 24, and with an upper threaded end which is threaded into an interiorly threaded portion of extension 13 at the upper end of the chamber 24. The axial actuating stem or pin 28 of the poppet valve core projects upwardly therefrom and above the body extension 13 for actuation as will be described subsequently. Stem 28 connects to a poppet head 100, the latter being urged toward its seat 101 by an internal spring, not shown. Although it is preferred that core 26 be employed in the flow control unit, it would be possible to use instead the poppet valve described in the cited co-pending application.

The upper end of body extension 13 is provided with a washer seat 29, preferably lying in a plane transverse to the axis of the unit, and on which is mounted the base surface of a conical washer 31 formed of rubber or similar elastomeric or plastic material. Preferably, the washer is secured to seat 29 by means of a suitable adhesive in order to insure that the washer will remain closely adjacent seat 29 despite movement of cap 12 as will be described. The washer is formed with a central aperture 32 of substantial diameter, and into which the valve actuating pin 28 extends.

The head or cap 12 is interiorly recessed and threaded, so that it may be threadedly mounted over body extension 13 until its lower rim portion 33 comes into close proximity with the upper surface of body collar 16. A seal 34, such as an elastomeric or plastic O-ring, is mounted between rim portion 33 and a shoulder 36 on body extension 13 in order to prevent gas leakage between the cap and body. Provided axially at the upper end of cap 12 is a tubular extension 37 adapted to sealingly seat the end of a rubber hose 38 leading to the device with which the gas flow control unit is associated, for example the cuff portion of a blood pressure instrument. The passage 39

3

through tubular extension 37 communicates with the interiorly threaded recess within cap 12, and is itself interiorly threaded for reception of a set screw 41. Set screw 41 extends into the washer aperture 32, and is ground flat on one side in order to form a path 42 through which gas may flow from valve core 26 into hose 38. It is to be understood that thread friction causes screw 41 to turn with cap 12 except when the screw is adjusted by means of a screwdriver.

The bottom wall of the recess within head 12, that is to say the upper wall of the recess as viewed in the drawing, is formed as a conical valve seat 43 the angle of which corresponds to the conical angle of washer 31 so that valve seat 43 and washer 31 may come into surface contact as illustrated in Figure 2. An offset vent passage 44 is formed through head 12 from a central point on valve seat 43 to the ambient atmosphere. Preferably, vent passage 44 extends parallel to the axis of the flow control unit.

In assembling the gas flow control unit, piercing pin 22 is first press-fit into its passage in body 10, and valve core 26 is threaded into valve chamber 24 until its sealing portion 27 closely engages the corresponding wall portion of chamber 24. Seals 21 and 34 are then mounted in place, and washer 31 is adhesively secured to its seat 29. The head 12 is then threaded over body extension 13 until the conical valve seat 43 comes into close sealing engagement with washer 31 so as to block flow of gas through vent passage 44. At this time, an interiorly threaded longitudinal bore 46 in body collar 16 is registered with one end of an arcuate groove 47 (Figure 3) in cap rim portion 33, and a set screw 48 is threaded through bore 46 so that a stop portion 49 at the upper set screw end is inserted into the one end of groove 47. Stop portion 49 of the set screw limits rotation of the cap 12, relative to body 10, to an arc having the length of groove 47, and the length of this arc is calculated to permit disengagement of valve seat 43 from washer 31 until a vent space is formed therebetween as shown in Figure 1.

The set screw 41 is then threaded into passage 39 and into engagement with pin 28, and is adjusted in such manner that upon rotation of cap 12 through its permitted arc of rotation the poppet valve core 26 will be opened at approximately the same time that valve seat 43 comes into sealing engagement with washer 31. Thus, when stop portion 49 of set screw 48 is at one end of groove 47, valve 26 will be closed and a vent space will be provided between valve seat 43 and washer 31 as shown in Figure 1. When, however, cap 12 is rotated so that stop 49 is at the other end of groove 47, valve core 26 is open and valve seat 43 is in close sealing engagement with washer 31 (Figure 2) to block the flow of gas through passage 44 to the atmosphere.

It is to be understood that the above assembly operations are carried on at the factory. In order to insert a gas cartridge into the flow control unit, the physician or other operator of the unit merely unthreads the cartridge holder 11 from body 10, inserts a fresh cartridge 17 therein, and rethreads the cartridge holder onto the body. During the rethreading, and as above described, the neck 18 of the cartridge is pierced by pin 22 and sealing contact is provided between seal 21 and the cartridge neck.

In using the device, for example with a blood pressure cuff, the physician merely connects tube 38 to the cuff and then turns the valve to the position shown in Figure 2. When in this position, as above described, the inflow valve means comprising valve core 26 is open, and the outflow or vent valve means comprising washer 31 and valve seat 43 is closed. Gas may then flow from cartridge 17 through passage 23, valve chamber 24, valve core 26, central washer opening 32, path 42, and tube 38 to the blood pressure cuff in order to inflate the latter. After the cuff is sufficiently inflated, the physician merely rotates head 12 within the limits permitted by stop portion

4

49 and groove 47. The parts then assume the position shown in Figure 1, in which the inflow valve (core 26) is closed and the outflow valve is open. Gas is then vented from the cuff through tube 38, path 42, the vent space between washer 31 and its seat 43, and passage 44 to the ambient atmosphere so as to effect slow deflation of the blood pressure cuff as desired. The physician is thus saved the labor of pumping up the blood pressure cuff with a conventional squeeze-ball pumping device.

It is to be understood that the entire flow control unit is relatively small, and is adapted to be held within one hand of the physician. The physician may, with the fingers of one hand, rotate cap 12 at the same time that he is holding cartridge holder 11 in the palm of the same hand, so that his remaining hand is free to hold a stethoscope, for example. To facilitate rotation of the cap 12, and to facilitate rotation of valve body 10 during piercing of a cartridge 17, cap 12 and body collar 16 are knurled as indicated at 51 and 52, respectively.

Referring next to Figure 4, a second embodiment of the invention is illustrated and in which all parts are identical to the previously described embodiment except for the washer and the valve seat therefor. This being the case, all parts have been given like reference numerals except where they differ from the parts shown in Figures 1 and 2.

In the embodiment shown in Figure 4, the valve seat 55 of cap 12a is not conical but instead lies in a plane which is perpendicular to the axis of the gas flow control unit. Similarly, the washer 56 is generally cylindrical, so that its upper surface lies in the plane perpendicular to the axis of the unit and is adapted to engage seat 55 in order to block vent passage 44. Washer 56 is adhesively secured to washer seat 29 as in the case of the previous embodiment, and all parts operate substantially the same as described heretofore.

It is an important feature of both forms of the invention that the inflow and outflow valves operate reciprocally, and along the same line of motion. Stated otherwise, the axial shifting of cap or head 12 in opposite directions effects alternate opening and closing of the inflow and outflow valves. Neither valve depends for its operation directly upon the rotation of cap 12, as was the case with the vent valve described in the copending application. Instead, both valves are operated by axial shifting of cap 12 resulting from its rotation.

It is emphasized that during shifting of cap 12 to its position causing inflow of gas from cartridge 17 to the blood pressure cuff, as shown in Figures 2 and 4, the washer 31 or 56 does not tend to frictionally impede rotation of cap 12 until the seating or sealing position has been substantially achieved. Furthermore, continued rotation of the cap 12 results in an increase in sealing pressure between the washer 31 or 56 and the seat 43 or 55 therefor, which insures that no undesired venting of gas from the cuff will be effected. These functions are to be contrasted with the function of the device shown in the cited co-pending application, in which the cap is always in rubbing contact with the ported vent collar, and in which the degree of rotation of the cap has nothing to do with the amount of sealing pressure which prevents undesired gas venting.

It is emphasized that the components of the present gas flow control unit may be readily formed on a lathe since substantially all of the openings and bores are axially located. This fact, together with the fact that only a small number of relatively simple parts are involved, means that the over-all cost of production of the gas flow control unit will be relatively small.

While the particular device herein shown and disclosed in detail is fully capable of attaining the objects and providing the advantages hereinbefore stated, it is to be understood that it is merely illustrative of the presently preferred embodiments of the invention and that no limitations are intended to the details of construction or de-

sign herein shown other than as defined in the appended claims.

I claim:

1. A gas flow control unit for use with a pressurized gas cartridge, which comprises a cartridge holder adapted to hold said cartridge, means to release the gas from said cartridge, passage means to conduct released gas from said cartridge to a device which it is desired to alternately fill with gas and to vent, vent means communicating with said passage means and with the ambient atmosphere, first valve means to control the flow of gas through said passage means, second valve means to control the flow of gas through said vent means, and valve actuating means common to both said first valve means and said second valve means, said valve actuating means being adapted to be manually shifted along a given straight line path of motion and to operate said first and second valve means solely as a result of shifting along said straight line path of motion, said valve means and valve actuating means being adapted to operate reciprocally so that one is open when the other is closed and vice versa.

2. A gas flow control unit, which comprises a body, means to hold a pressurized gas cartridge on said body, a cap threadably mounted on said body for rotational movement and consequent axial shifting, first port means through said cap and leading to an object to be alternately inflated and vented, second port means through said cap and leading to the ambient atmosphere, passage means to conduct released gas from said cartridge to the interior of said cap, first valve means to control the flow of gas through said passage means to said first port means, and second valve means to control the flow of gas from said first port means to said second port means, said first and second valve means being adapted to be alternately opened and closed by said cap due solely to said axial shifting thereof.

3. The invention as claimed in claim 2, in which said first valve means comprises a poppet valve mounted in said passage means and having a stem adapted to be engaged by a portion of said cap in order to shift the poppet valve to open position, and in which said second valve means comprises a sealing element adapted to be compressed between said cap and body and to block said second port means upon axial shifting of said cap toward said body sufficiently to open said poppet valve.

4. The invention as claimed in claim 3, in which said portion of said cap is a set screw adjustably threaded therein.

5. The invention as claimed in claim 3, in which said sealing element is an elastomeric or plastic washer mounted interiorly of said cap and secured to said body.

6. In a gas flow control unit, a two-way valve mechanism which comprises an exteriorly threaded valve body, a cap having a recess which in interiorly threaded to receive said body, a resilient seal washer mounted between the bottom wall of said recess and the adjacent end of said body, a normally closed valve core mounted in a valve chamber in said body and having an actuating portion aligned with the central opening in said washer, a first port through said cap and registered with said washer opening, a second port through said cap and extending from said bottom wall adjacent the body of said washer to the ambient atmosphere, and an actuating element mounted on said cap and adapted to engage said actuating portion of said core, said actuating element being so adjusted that said valve core is open when said second port is blocked by said washer body, and said valve core is closed when said cap is shifted away from said body sufficiently to shift said bottom wall away from said washer and permit flow of gas between said first and second ports.

7. The invention as claimed in claim 6, in which said actuating element is a set screw threaded into said first port, said set screw being formed flat along one side so as to permit flow of gas through said first port.

8. The invention as claimed in claim 6, in which said washer is adhesively secured to said end of said body.

9. The invention as claimed in claim 6, in which said bottom wall of said recess and said washer have corresponding surfaces which are surfaces of revolution about the axis of said washer.

10. The invention as claimed in claim 9, in which said bottom wall of said recess and the adjacent wall of said washer are correspondingly conical.

11. The invention as claimed in claim 6, in which said bottom wall of said recess and the adjacent wall of said seal washer are perpendicular to the axis of said washer.

12. A gas flow control unit, which comprises a valve body having a central collar portion and upper and lower exteriorly threaded extensions, a hollow casing having one end threadably mounted over said lower extension, said casing being adapted to receive a pressurized gas cartridge so that the neck of the latter will be sealingly inserted into a recess in said lower extension, a piercing pin mounted axially in said body to pierce said cartridge upon threading of said casing over said lower extension, said piercing pin being adapted to permit flow of gas from said cartridge to a valve chamber formed axially of said body above said pin, a high pressure valve core mounted in said valve chamber and having an actuating stem which extends axially of said body to adjacent the upper end of said upper end of said upper extension, a sealing washer secured to said upper end and having a central opening registered with said stem, a cap threadably mounted over said upper extension and having a valve seat shaped correspondingly to the wall of said washer remote from said upper end, a tubular extension formed axially on said cap and adapted to be associated with a tube leading to a blood pressure cuff or the like, a set screw threadably mounted in said tubular extension and extending downwardly therethrough for actuating engagement with said stem, said set screw being shaped to permit passage of gas from said valve core through said tubular extension to said tube, and a vent passage extending through said cap from the ambient atmosphere to said valve seat adjacent the body of said washer, said set screw being adjusted so that said valve core is open when said valve seat engages said washer, and said valve core is closed when said valve seat is disengaged from said washer to permit the flow of gas from said tubular extension to said vent passage.

13. The invention as claimed in claim 12, in which said cap is formed adjacent said collar portion of said valve body with an arcuate groove, and in which a stop element is threaded through said collar portion and projects into said groove, whereby rotation of said cap relative to said body is limited to the length of said groove.

14. The invention as claimed in claim 12, in which said piercing pin and said set screw are both solid in construction and are formed flat along one surface to permit passage of gas therealong.

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