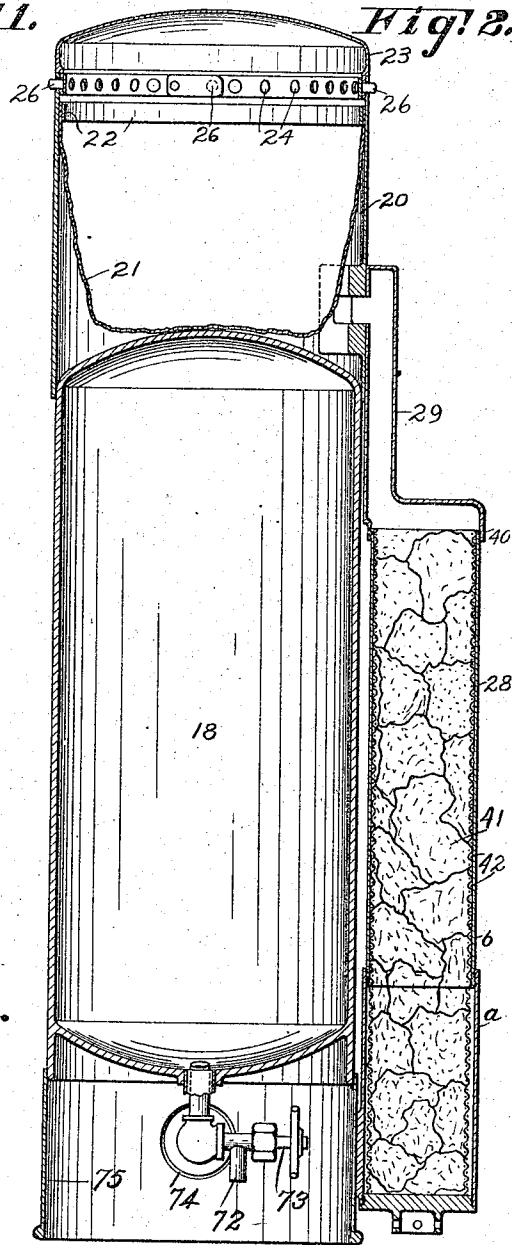
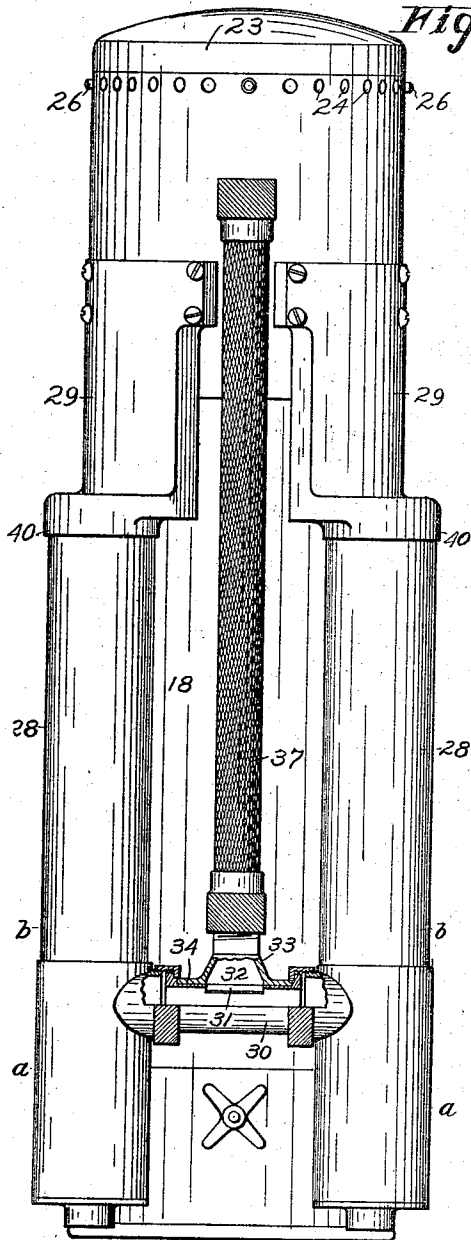


C. H. ACKERMAN.  
RESPIRATORY SYSTEM FOR SMOKE HELMETS.  
APPLICATION FILED SEPT. 28, 1914.

1,215,327.

Patented Feb. 13, 1917.

4 SHEETS—SHEET 1.



Inventor

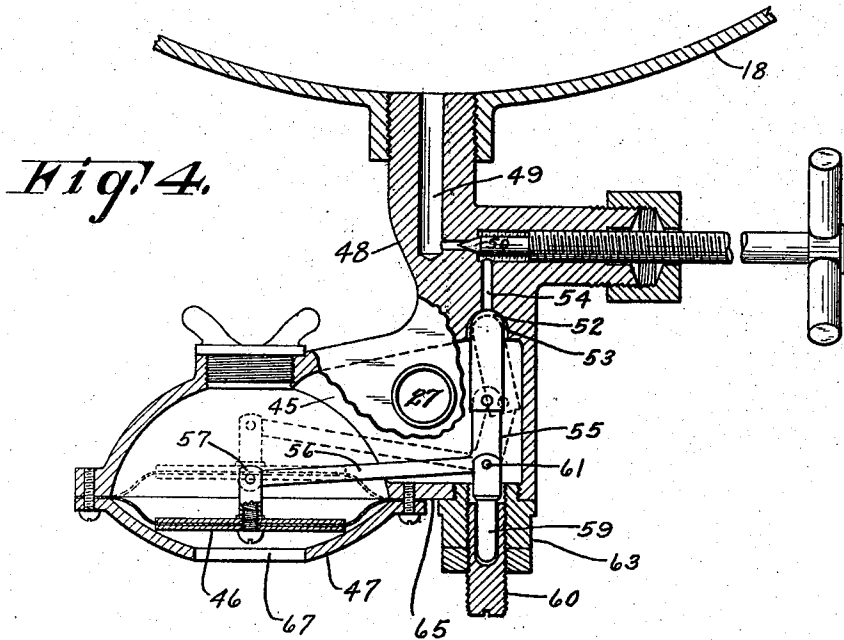
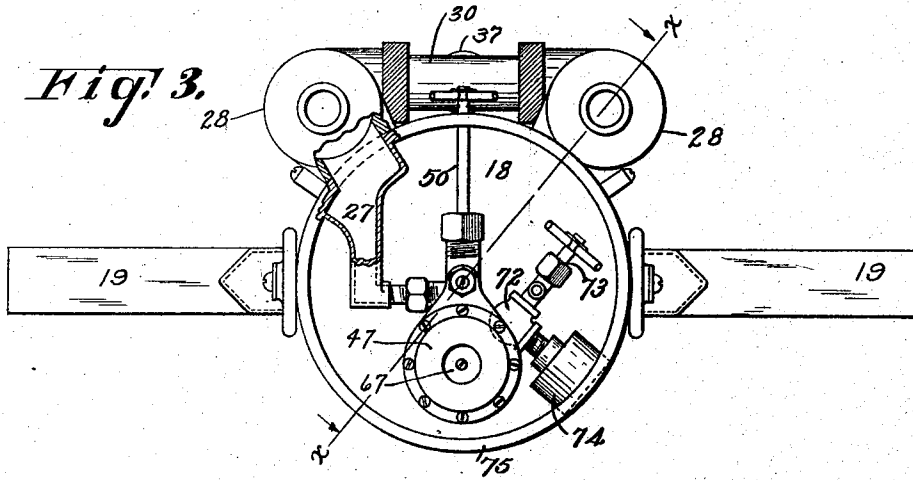
Witnesses  
*Photo.*  
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4 SHEETS—SHEET 2.



Witnesses  
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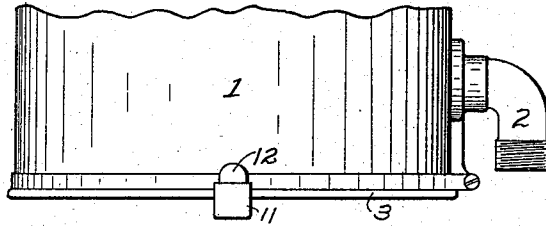
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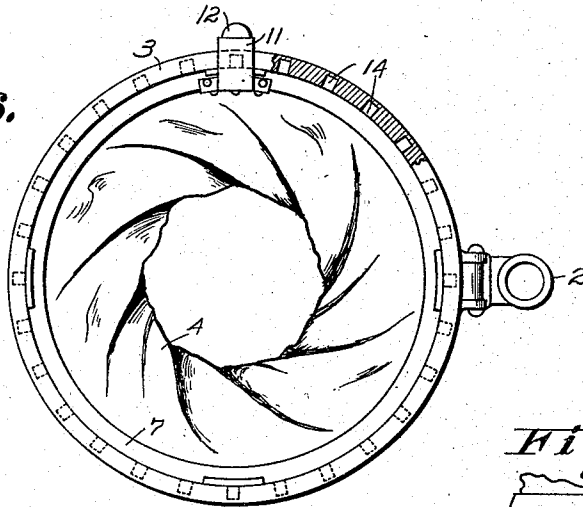
4 SHEETS—SHEET 3.

1,215,327.

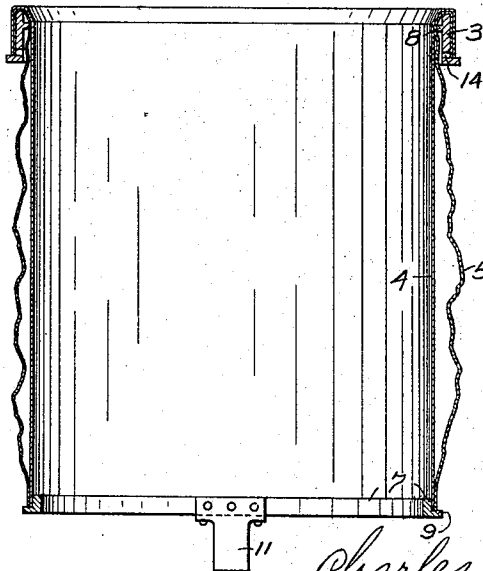
*Fig. 5.*



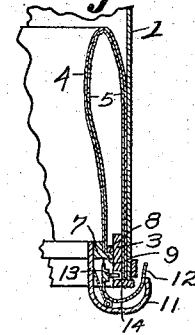
*Fig. 6.*



*Fig. 7.*



*Fig. 8.*



Inventor

Charles H. Ackerman  
By Edwin J. Wheeler

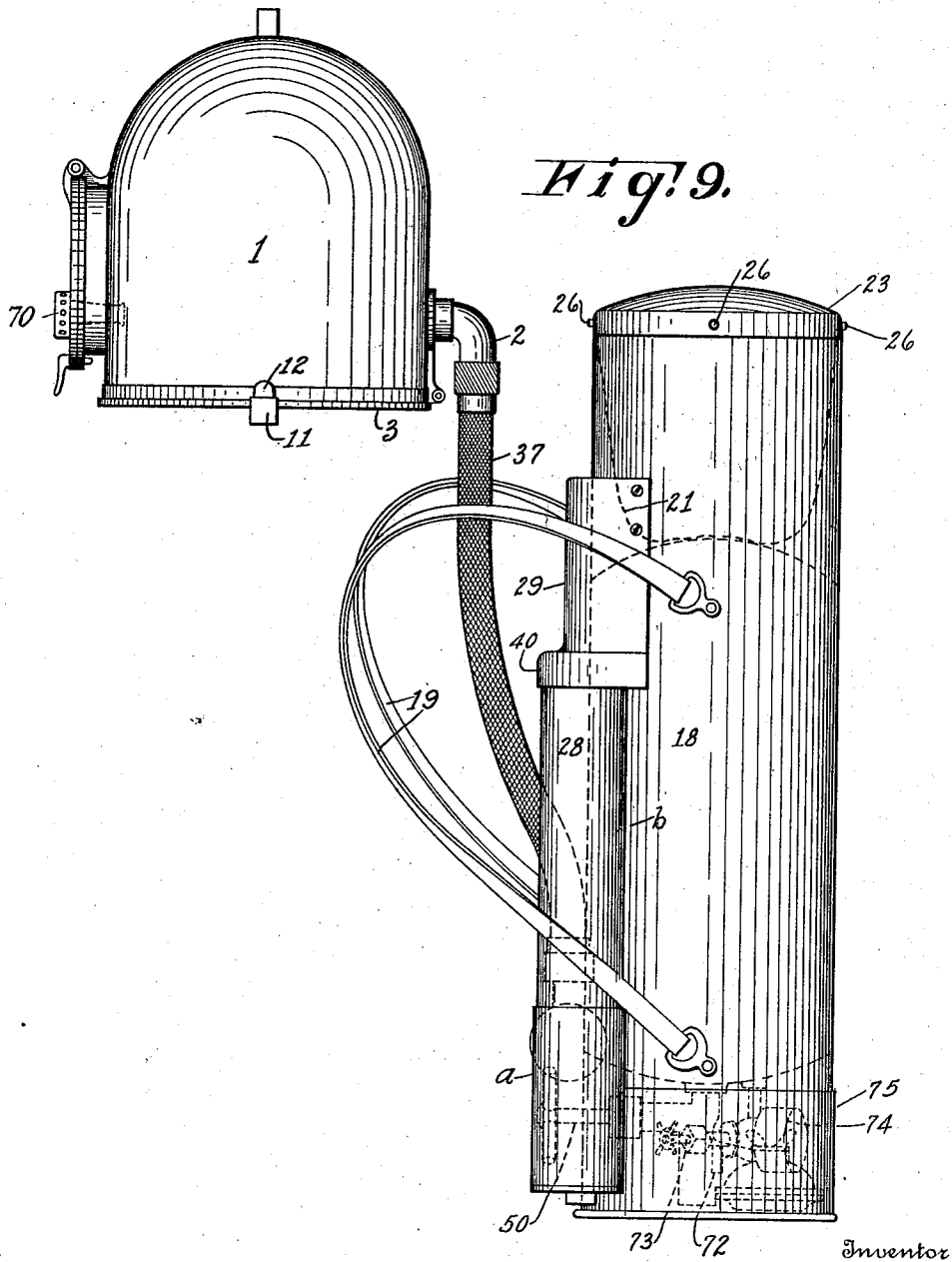
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4 SHEETS—SHEET 4.



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# UNITED STATES PATENT OFFICE.

CHARLES H. ACKERMAN, OF MILWAUKEE, WISCONSIN.

RESPIRATORY SYSTEM FOR SMOKE-HELMETS.

1,215,327.

Specification of Letters Patent.

Patented Feb. 13, 1917.

Application filed September 28, 1914. Serial No. 863,833.

*To all whom it may concern:*

Be it known that I, CHARLES H. ACKERMAN, a citizen of the United States, residing at Milwaukee, county of Milwaukee, and State of Wisconsin, have invented new and useful Improvements in Respiratory Systems for Smoke-Helmets, of which the following is a specification.

My invention relates to improvements in respiratory systems for smoke helmets.

The object of my invention is to provide a smoke helmet from which the external atmosphere may be absolutely excluded, the helmet being provided with an air circulatory system in which the circulating air may be purified and repeatedly inhaled without deleterious effects and to which fresh air or oxygen may be automatically admitted from a storage tank whenever respiration becomes labored and difficult owing to a deficient supply of oxygen.

In the drawings—

Figure 1 is a front elevation of my invention with the smoke helmet detached.

Fig. 2 is a sectional view of the same drawn on line  $x-x$  of Fig. 3.

Fig. 3 is a bottom plan of the device shown in Fig. 1.

Fig. 4 is a fragmentary sectional view of the diaphragm chamber and valves controlling the delivery of fresh air or oxygen from the reservoir.

Fig. 5 is a side elevation of the lower end of the smoke helmet.

Fig. 6 is a bottom plan view of the smoke helmet with the lower ring partially broken away on one side to show the interlocking recesses.

Fig. 7 is a detail sectional view of the neck webs and the rings to which these webs are connected.

Fig. 8 is a fragmentary view showing the web supporting rings and webs assembled, the same being illustrated partly in cross section and partly in interior elevation. The section is drawn to a plane cutting the adjusting and locking members.

Fig. 9 is a general view of the apparatus in side elevation.

Like parts are identified by the same reference characters throughout the several views.

The hood 1 of the smoke helmet may be of any ordinary construction in which an air tight shell is employed to cover the head of

the user. Near its lower end it is provided with a tubular fitting 2, through which air may be permitted to pass to and from the helmet. The lower end of the helmet is provided with a ring 3 to which a set of neck webs 4 and 5 are secured. The neck web 4 may be formed of fabric, while the neck web 5 is composed of rubber or other material adapted to prevent the passage of air through the webs. The web 5 is of greater width than the web 4, thereby avoiding any danger that the web 5 will become torn in use. Both webs are in the form of a circular band, the outer margins of which are secured to the ring 3. The inner margins are folded inwardly and secured to a ring 7, which is mounted to rotate within the ring 3, said rings having mutually engaging track flanges 8 and 9, whereby one ring may be relatively rotated with reference to the other. A rotation of the ring 7 relatively to the ring 3, causes the neck webs to draw with a winding movement about the neck of the user into air tight relation thereto. The ring 7 is provided with a downwardly and outwardly curved hook shaped lip 11 whereby it may be rotated. A spring latch 12 carries a locking pin 13 which is adapted to engage in any one of a series of recesses 14 formed in ring 3.

When the mask is in position covering the head of the user, the spring 12 is pushed inwardly to disengage locking pin 13 from one of the recesses 14. By pressing upon the lip or operating arm 11, the ring 7 may then be turned until webs 4 and 5 are wound about the neck sufficiently to prevent the entry of air to the hood from the exterior. It is not necessary that the pressure upon the neck be severe, owing to the fact that the soft folds of rubber and fabric composing the webs 4 and 5, will easily form an air tight packing capable of resisting the passage of air under such slight variations in pressure as may exist between the space within and without the helmet or hood 1. Ordinarily, also, the pressure within the helmet will be slightly greater than that of the exterior atmosphere.

The reservoir 18 is supported from the back of the user by suitable straps 19. A respiratory chamber 20 is mounted upon this reservoir. The upper wall of the chamber 20 comprises a flexible diaphragm 21, preferably formed of thin rubber, with

its margins secured to the side walls of chamber 20 by ring 22. A projecting cap 23 is fitted to the upwardly projecting walls of chamber 20 above the diaphragm 21 and is provided with a series of apertures 24, which permit air to escape from beneath the cap so that the diaphragm 21 may freely lift and may also descend with the same freedom, since the space above the diaphragm may be filled with air from the exterior through said holes 24. Spring actuated pins 26 are preferably employed to hold the cap 23 in position.

A set of purifying chambers 28 are mounted upon the sides of the reservoir 18. These purifying chambers are connected at their upper ends with the chamber 20 by ducts 29. At their lower ends these chambers are connected with each other by a tube 30, provided with a port 31 for registry with a port 32 in an upwardly projecting arm 33 of a rotary cylindrical valve 34. The arm 33 is adapted to be connected by a flexible tube 37 with the fitting 2 (Fig. 5) on the helmet 1. When the device is strapped upon the back of the user, the pipe 37 necessarily occupies a substantially vertical position, with ports 31 and 32 in registry with each other, thus affording communication between the interior of the helmet and the respiratory chamber 20 through the tube 37, ports 32 and 31, cross tube 30, the purifying chambers 28 and duct 29. Therefore, during exhalation, the air from the helmet will pass through the purifying chambers 28 and the chamber 20, raising the diaphragm 21 therein. During inhalation, the air will return from chamber 20 to the helmet with no tendency to form a vacuum in chamber 20, since diaphragm 21 descends freely as above explained. The capacity of chamber 20 is sufficient to satisfy the lung capacity of any user.

The purifying chambers 28 are preferably tubular in form and may be formed in sections *a* and *b*, the upper section *b* also having screw threaded connection at 40 with the ducts 29. Within these tubular purifying chambers, a purifying agent 41 may be placed. This purifying agent is preferably inclosed in cartridge form within a netted container 42 which may be easily removed and replaced by either separating the sections *a* or *b* or by unscrewing the container 40.

When the oxygen in the air becomes sufficiently exhausted so that it is desirable to draw upon the reservoir 18, fresh air may be delivered from said reservoir either under the influence of the labored breathing of the user or by the voluntary act of the user in drawing in his breath sharply or the vacuum caused by expelling air through the whistle opening or mouth piece of the helmet. In either case a partial vacuum

will be formed in the helmet which will extend to the purifying chambers 28. The purifying agent in these chambers affords sufficient resistance to the air so that when a partial vacuum is thus quickly established below chambers 28, it cannot be immediately satisfied from the respiratory chamber 20. The exterior pressure of the atmosphere may therefore be utilized to operate a valve, permitting delivery from reservoir 18. This valve and this operating mechanism are clearly illustrated in Figs. 3 and 4. The controlling chamber 45 is in communication with the bottom portions of the purifying chamber 28, being connected with the latter by duct 27. This chamber 45 is therefore subject to the partial vacuum which for any reason may be established in the helmet. The bottom of chamber 45 is composed of a diaphragm 46 which operates above an open protecting shell 47. The chamber 45 is provided with an upwardly projecting member 48 which is screwed into the bottom of reservoir 18 and provided with an elbowed duct 49, through which air or oxygen in the reservoir 18 may be delivered to chamber 45. A manually operated needle valve 50 may be used to prevent the escape of air through this duct when the apparatus is not in use. This valve 50 will, however, be opened by the user before adjusting the helmet over the head.

Another valve 52 is seated in a socket 53 which is adapted to close the lower portion 54 of the duct 49. This valve 52 has toggle-joint connection with the upwardly projecting arm 55 of an elbow lever, the other arm 56 of which is pivotally connected with an upwardly projecting post 57 carried by diaphragm 46. The elbowed lever is fulcrumed at the elbow to a post 59 loosely socketed in an adjusting screw 60 and connected with the elbow lever by a fulcrum pin 61. The adjusting screw 60 has threaded engagement in an aperture formed in a packing nut 63, which is screwed into the lower wall member 65 of chamber 45. By turning the adjusting screw 60, the valve 52 may be accurately seated to cover the lower end of duct 54 when the toggle-joint members are in alinement, this being the position of these members when diaphragm 46 is depressed.

But when a partial vacuum is developed in chamber 45, diaphragm 46 is lifted by atmospheric pressure exerted through the opening 67 in the protecting member 47. When diaphragm 46 is thus lifted, lever arm 55 is swung to the dotted line position illustrated in Fig. 4, thus withdrawing valve 52 from duct 54 sufficiently to permit the escape of air from reservoir 18 into the circulatory system of which chamber 45 is a part. As soon as the partial vacuum has

been satisfied by air delivery from chambers 18 and 20, diaphragm 46 will again descend by gravity to normal position, thereby seating valve 52 and preventing further delivery of air from the reservoir 18.

If desired, the parts may be so proportioned and adjusted that when valve 52 has once been opened, it will not be again closed until there is a slight excess pressure in the circulatory system over that in the external atmosphere. In such event, vitiated air will be expelled outwardly more readily than inwardly. Also the air may be permitted to escape through the usual whistle or mouth openings (70, Fig. 9) with which all smoke helmets are provided. The reservoir 18 may be filled from time to time through an ordinary inlet fitting 72 which is normally closed by a manually operated valve at 73. 74 is an ordinary pressure gage seated in the base flange 75.

In operation the reservoir is strapped to the back and the hood 1 adjusted over the head of the user, the neck web being rotatively adjusted about the neck to a sufficient extent to prevent air from entering the system from the exterior and also tight enough to permit the operation of the valves as above described through variations of the pressure in the interior of the system or in parts thereof. The cup shaped diaphragm 21 being composed of thin rubber as above explained, allows the user to breathe freely without materially increasing or decreasing the internal pressure since the variation in the capacity of the system due to the rise and fall of the diaphragm 21 is equal to the variation in the quantity of air withdrawn and restored to the system during breathing operations. This is accomplished without stretching the rubber of the diaphragm 21 which by reason of its cup shape is adapted to reverse its position within the outer shell or casing. The upward movement of the diaphragm is of course limited by the cap 23 and when valve 52 is open for delivery of air from the system to the reservoir, it is obvious that this delivery may continue until flexible diaphragm 21 is raised to the top of the cap 23, after which any further admission of air will increase the pressure within the system above that of the exterior atmosphere, thereby actuating valve controlling diaphragm 46 to close valve 52. I attach great importance to the use of a flexible diaphragm 21 located within a chamber having substantially rigid walls, the central portion of the diaphragm being free to move without resistance, substantially over one end of the chamber to the other, whereby extremely slight variations in pressure resulting from respiration will be sufficient to actuate the diaphragm without material effort on the part of the user. This is accomplished by making the diaphragm cup

shape, as shown, and forming it of thin rubber or equivalent material with sufficient stock to allow it to move upwardly and downwardly along the outer walls of the chamber without stretching.

I claim—

1. A smoke helmet, provided with a flexible impervious web secured to its neck portion, means for winding the same about the neck of the user, and latch means for holding the web in any desired position of adjustment.

2. A smoke helmet, provided with a plurality of rings secured to its neck portion, means for rotating one of said rings upon the other, and a flexible impervious webbing ring folded longitudinally upon itself and having its margins secured to the respective rings, with the folded portion projecting inwardly therefrom.

3. A smoke helmet, provided with a plurality of flexible neck bands, folded longitudinally, and means for actuating said bands with a winding motion about the neck of a user.

4. A smoke helmet, provided with a plurality of flexible neck bands, folded longitudinally, means for actuating said bands with a winding motion about the neck of a user, one of said bands being impervious to air and the other being of less width and composed of fabric.

5. A smoke helmet, provided with a plurality of flexible neck bands, folded longitudinally, means for actuating said bands with a winding motion about the neck of a user, together with a holding member secured to one margin of each of said bands, and an actuating member secured to the other margins thereof.

6. A smoke helmet, provided with a substantially air tight neck portion, in combination with a reservoir, a chamber having substantially rigid walls, an expansible respiratory chamber therein, and arranged in communication with said helmet, a purifying chamber interposed between the respiratory chamber and helmet, and means controlled by variation in air pressure in the helmet for controlling delivery from the reservoir to the helmet.

7. A smoke helmet provided with a substantially air tight neck portion, in combination with a reservoir provided with an outlet duct, an expansible chamber connected with the helmet, a purifying chamber interposed in the connections between the expansible chamber and the helmet, and means controlled by variations in air pressure originating in the helmet, for regulating deliveries to said system from the reservoir; said purifying chamber being adapted to afford sufficient resistance to the passage of air to and from the expansible chamber to allow sudden variations in air pressure in

the portion of the system on the helmet side of the purifying chamber independently of the pressure in the expansible chamber.

8. A smoke helmet, provided with a substantially air tight neck portion, in combination with a reservoir provided with an outlet duct, a purifying chamber in communication with said helmet, an expansible chamber in communication with the purifying chamber and adapted to receive and discharge air delivered through the purifying chamber from and to the helmet and having a movable wall permitting expansion and contraction of said chamber substantially in correspondence with the lung capacity of the user, a valve, controlling the reservoir outlet duct, a flexible wall exposed to pressures within the helmet on one side and to atmospheric pressure on the other side, and valve actuating connections between the valve and said flexible wall; said outlet duct being connected with the expansible chamber and helmet, for delivery of air from the reservoir thereto.

9. A smoke helmet provided with an expansible respiratory chamber connected with the helmet, in combination with a reservoir adapted for supplying air under pressure, a passage leading from the reservoir and communicating with the helmet, a valve controlling delivery of air through said passage, and a diaphragm operatively connected with said valve and adapted to transmit movement to open and close the same, said diaphragm being exposed on one side to pressure from within the helmet and on the other side to exterior pressure, and means for purifying air circulating between the helmet and the expansible chamber.

10. A smoke helmet in combination with a respiratory system including a chamber hav-

ing substantially rigid outer walls and provided with an internal cup shaped flexible diaphragm, having margins secured to the walls of the chamber at an intermediate point, said diaphragm being formed of thin material adapted to move without material resistance due to slight variations in the pressure within the system resulting from breathing operations.

11. A smoke helmet comprising a head inclosing hood, in combination with a reservoir having an outlet duct, a respiratory chamber provided with a diaphragm adapted to freely move within said chamber from one end to the other under slight variations in pressure due to respiration, a valve controlling deliveries from said reservoir to the helmet and respiration chamber, and means controlled by relative pressures within and without the system for actuating said valve.

12. A smoke helmet in combination with an expansible respiratory chamber, in combination with a reservoir adapted for storing air under pressure, a passage leading from the reservoir and communicating with the helmet, a rocking valve controlling delivery of air through said passage, and a diaphragm operatively connected with said valve and adapted to transmit movement to rock the same; said diaphragm being exposed on one side to pressure from within the helmet and on the other side to exterior pressure.

In testimony whereof I affix my signature in the presence of two witnesses.

CHARLES H. ACKERMAN.

Witnesses:

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IRMA D. BREMER.