W. SODERLING.

RESPIRATOR.

APPLICATION FILED FEB. 23, 1916. RENEWED JUNE 17, 1918.

1,292,115. Patented Jan. 21, 1919.

2 SHEETS—SHEET 1.

Fig. 1.

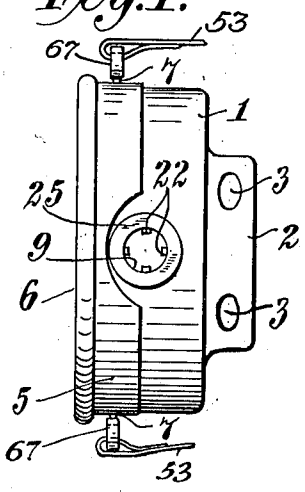


Fig. 2.

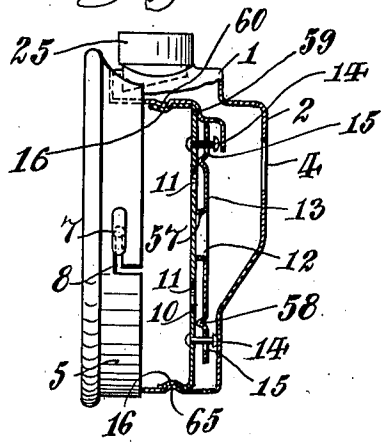


Fig. 3.

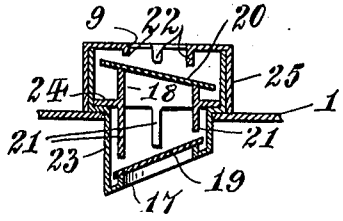


Fig. 5.

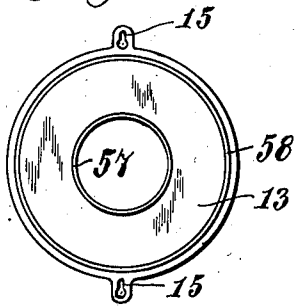
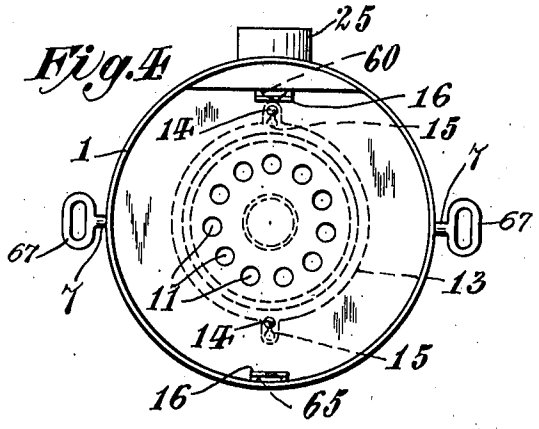


Fig. 4



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2 SHEETS—SHEET 2.

Fig. 6.

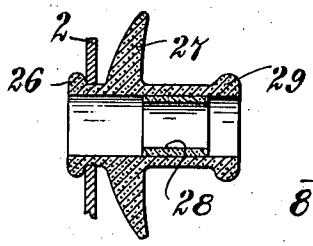


Fig. 7.

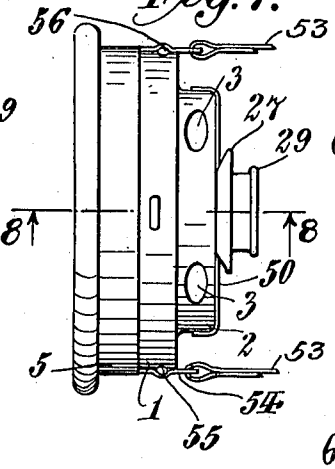


Fig. 8.

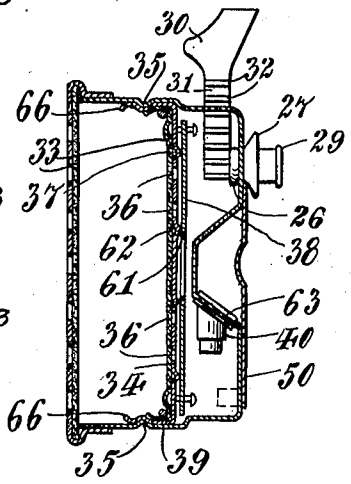


Fig. 9.

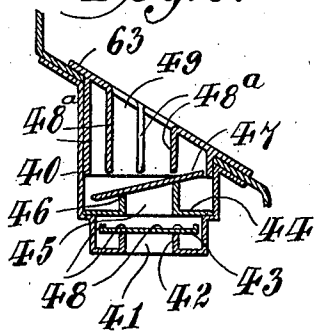


Fig. 10.

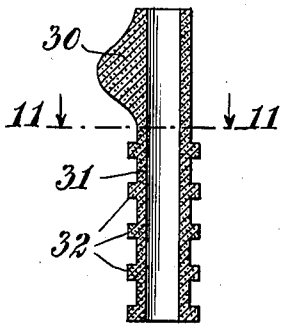


Fig. 11.

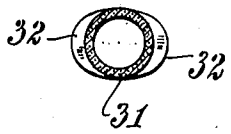


Fig. 12.

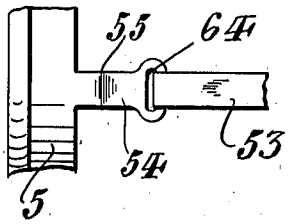
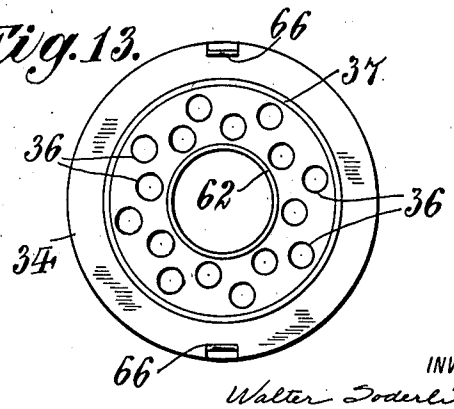


Fig. 13.



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WALTER SODERLING, OF NEW YORK, N. Y.

RESPIRATOR.

1,292,115. Specification of Letters Patent. Patented Jan. 21, 1919.

Application filed February 23, 1916, Serial No. 79,850. Renewed June 17, 1918. Serial No. 240,522.

To all whom it may concern:

Be it known that I, WALTER SODERLING, a citizen of the United States, and a resident of the borough of Manhattan of the city of New York, in the county and State of New York, have invented an Improvement in Respirators, of which the following is a specification.

The present invention relates to improvements in respirators, the object being to provide a standard apparatus which may be adaptable for use under a great variety of conditions. Preferred embodiments of my invention are illustrated in the drawings which accompany this specification, and in which—

Figure 1 is a top view of a respirator having an upwardly directed discharge opening located on top of the device;

Fig. 2 is a side view of the same type of respirator, a part of the outer shell being broken away to show clearly the construction of the intake valve;

Fig. 3 is a central vertical section of the discharge valve indicated in Figs. 1 and 2;

Fig. 4 is a front view of the device illustrated in Fig. 1 with the cover removed to show the partitions and means for retaining the removable partition;

Fig. 5 is a detail view showing the valve indicated in Fig. 2;

Fig. 6 shows in longitudinal vertical section a preferred type of mouth-piece which may be used conveniently with either of the respirators illustrated;

Fig. 7 is a top view of a modified form of my improved respirator in which the discharge opening is located in the rear of the device;

Fig. 8 is a view in section substantially along the line 8—8 of Fig. 7, showing in addition a nostril engaging member;

Fig. 9 is a central vertical section showing in detail the type of valve adapted for use with the form of device illustrated in Figs. 7 and 8;

Fig. 10 is a transverse vertical section illustrating the construction of a preferred type of nostril engaging member;

Fig. 11 is a cross section of the nostril engaging member taken at the line 11—11 of Fig. 10;

Fig. 12 is an enlarged view of a portion of the cover of the device shown in Fig. 4 showing a modified form of cover fastening device with means for engaging a retaining strap; and

Fig. 13 is a detail view of the removable partition indicated in Fig. 8.

Referring now to Figs. 1 to 3, the type of respirator there illustrated comprises a main body portion or casing 1 which may conveniently be stamped out of a single piece of thin sheet metal into a substantially cylindrical form with a rearwardly projecting compartment 2 having openings 3 to accommodate nostril engaging means and another opening 4 to accommodate suitable mouth engaging means, preferably of the type shown in Figs. 6, 7 and 8. The body portion or casing may be closed by means of a cover or cap 5 having a perforated front 6 to permit the passage of air into the interior of the respirator. This cap may be detachably connected to the casing by any suitable means, shown in Figs. 1 and 2, as a pin-and-slot locking device provided by a pair of pins 7 fixed at opposite sides of the casing and slots 8 formed in the flanges of the cover, the said pins and slots coöperating in a well known manner to lock the cover in position. Another form of cover locking device is shown in Figs. 7 and 12 which show a spring clip 54 provided with a corrugated portion 55 adapted to engage a projection 56 extending upwardly from the casing to hold the cover in secure engagement therewith and a terminal eyelet or slot 64 adapted to receive a head engaging strap 52 or the like.

The rearwardly projecting compartment 2 of the casing provides in effect an air conducting chamber adapted to receive filtered or modified air from the forward or main body portion of the respirator, said air being then in position to be drawn into the lungs of the wearer of the device through suitable nostril and mouth engaging members. This air conducting chamber also is adapted to receive the exhaled air which is dis-

charged therefrom through a conveniently located opening.

The front part of the casing provides a convenient container for holding an air filtering or modifying agent, preferably a sponge saturated with a neutralizing chemical in case the device is intended to be equipped for use in the presence of poisonous gases. This sponge may be confined rearwardly by a partition 10, Fig. 2, having valve controlled openings 11 arranged to permit the passage of air to chamber 2. The admission of purified air through and the exclusion of vitiated air from the openings 11 is controlled by means of a valve 13 sustained loosely on pins 14 fixed in position on the partition 10, said valve being provided with a central opening 12 having an edge 57 turned forwardly to engage the partition 10 and a partition engaging rib 58 also contacting with said partition, the edge 57 and the rib 58 being adapted to provide seating contact with the partition to obstruct the passage of exhaled air through the openings 11. The valve may be made readily removable by providing it with slotted openings 15, see Fig. 5, enlarged at one end to receive the head of the pin 14 and adapted to engage the shank of said pin for holding the valve in operative position. The valve carrying partition may be held in operative position by any suitable means. In the form of my invention illustrated in Figs. 1 and 2, I have shown for this purpose resilient locking members or spring clips 16 in yielding engagement with a projecting portion 60 extending downwardly from a partition 59, and a projecting portion 65 extending inwardly from casing 1 respectively, said partition otherwise serving more particularly to separate the upper portion of the air conducting chamber from that portion of the casing which holds the air filtering or modifying element.

The discharge opening may be controlled by suitable valves, as illustrated in Fig. 3, including a port 17 formed in a conduit 23 and having an upturned edge to provide substantially a line contact with valve member 19; another valve 20 is preferably disposed at an angle to valve 19 and both are associated with means to limit the extent of their opening, downwardly projecting lugs 21 being adapted to engage the valve 19 to limit its upward movement, and downwardly projecting lugs 22 being adapted to limit the upward movement of the valve 20. In order that these interiorly located valves may be readily accessible, I have arranged them in the conduit 23 which is so proportioned that the valve parts may be inserted and removed from the exterior. The valve 20 is preferably mounted within said conduit in connection with a partition member 24 which, while separate from the conduit 23, is adapted to be fitted snugly therein and provides the valve engaging lugs 21 and the air passage or port 18. The partition 24 being thus removable provides easy access to the valve 19. To hold these parts securely in operative position the conduit 23 is closed at the top by a snug fitting cap 25 having the opening 9 and the downwardly projecting members 22 for limiting the upward movement of the valve 20, said cap 25 being removable for the purpose of permitting access to the valve 20.

Although no mouth or nostril engaging members are shown in Figs. 1 and 2, it is contemplated that a suitable mouth-piece, preferably like that illustrated in Figs. 6 and 7, may conveniently be inserted in the opening 4 of the chamber 2. This mouth-piece comprises a tube preferably made of rubber and having a relatively stiff flange portion 26 adapted to engage the inner surface of the casing 1 immediately adjacent to the opening 4. The mouth-piece is further provided with a flange-like portion 27 adapted to lie between the teeth and the lips of the wearer, thus affording a more secure closure against the possible accidental admission of poisonous air to the mouth. In order that the resilient rubber tube comprising the normal conduit portion of the mouth-piece may be held open for the free passage of air, I insert a suitable distending member or supplementary tube 28 which serves to prevent the conduit from collapsing either by reason of suction or by reason of pressure thereon by the wearer's teeth. The inner end of the conduit or mouth-piece may be reinforced by a thickened resilient portion 29.

A suitable nostril engaging member is shown in Figs. 8, 10 and 11. This member provides a graduated upper portion 30 which is designed to fit nostrils of different sizes and shapes and to provide a secure and air-tight connection between the interior of the respirator and the nose passages of the wearer. The normal conduit portion 31 of the nostril engaging member is relatively resilient and may conveniently be formed of a suitable grade of rubber. In order that the nostril engaging member may be made universally adjustable, I have provided means whereby it may be moved up or down relatively to the mouth-piece so as to be accommodated to various facial proportions. To insure an air tight joint between the casing and the nostril engaging member and to retain the nostril engaging member securely in any desired position, I have provided laterally projecting ribs 32 which engage the interior surface of the chamber 2 immediately adjacent the edge of the openings 3. When inserting the nostril engaging

member into the opening 3, or when changing its vertical position, these ridges are pressed inwardly so that they readily pass through said openings. However, the resiliency of the material of which the nostril engaging member is formed, distends the conduit sufficiently to completely close the opening 3 and to hold the ridges 32 in position to engage the interior surface adjacent to the openings 3 thus preventing slipping of the nostril engaging member up or down.

In Figs. 7 and 8, I have illustrated a modified form of my invention which differs from the first form described mainly in that the discharge opening is located in the rear instead of on top of the casing. This provides in some cases a distinct advantage as well as an improved and more compact appearing design. Referring to Fig. 8, I have illustrated the modified form of respirator equipped with air filtering means 33 consisting of woven pads of lint or other filtering material. One piece may be held in position immediately underneath the perforated front 6, being secured peripherally between the front edge of the casing 1 and the inside surface of the cover 5 while a similar piece 33 may be positioned adjacent to a partition 34. This partition, see Fig. 13, is conveniently held in operative position by spring clips 66 adapted to engage inwardly extending projections 35 in the casing 1, and is provided with perforations 36 for permitting the passage of air from the front of the casing to the rear or air conducting portion. Rearwardly projecting ridges 37 and 62 are formed in the surface of said partition to provide substantially line contact with a flat valve member 38 attached to the partition 34 by suitable means which may be similar to the means employed in connection with the form of my invention illustrated in Fig. 2 and may have a central opening 61. The additional filtering pad 33, utilized in connection with the partition 34, may be held in secure engagement therewith by a circular spring 39 or other suitable pad retaining means. Thus, in this form of the device, it may be convenient to use two separate and disconnected filtering members as well as either one alone, or an air modifying agent of any desired character such as might conveniently be used with the first form of my invention described.

The discharge opening in the modified form of respirator may be controlled by valves inclosed in a conduit 40 illustrated in detail in Fig. 9. This conduit has a port 41 provided with an upturned edge 42 which furnishes an effective seat for a valve 43. A removable partition 44 is interposed in the conduit 40 and is provided with an opening 45 and an upturned edge 46 adapted to provide a seat for a valve 47. The valve 43 may be provided with upwardly extending projections 48 adapted to engage the under surface of the partition 44 to limit the upward movement of the valve 43 and at the same time to permit the passage of air through the opening 45. The extent of upward movement of the valve 47 may be limited by means of projections 48^a extending downwardly from a conduit closing cap 63, said projection being arranged to prevent the valve 47 from falling out through a discharge opening 49 in the cap 63, with which the conduit 40 registers to permit the discharge of air. This opening 49 may be protected from interference by means of a vertically disposed removable plate 50 detachably secured to the rear of the device by suitable means. It will be obvious that the valves 43 and 47 will be readily accessible and removable by removing the closing cap 63, being similar in this respect to the valves shown in Fig. 3.

In operation it is contemplated that either form of respirator may be equipped with a sponge or other absorbent element adapted to hold chemical means for modifying the character of air admitted through the openings in the front. This form of air modifying means is indicated where the user is required to breathe air containing an injurious amount of poisonous gas. It is contemplated that the gas laden air entering the openings in the front, will pass through a sponge carrying a chemical solution adapted to neutralize the particular kind of poisonous gas with which the air may be mixed. This action takes place coincident with inhalation by the force of which, the valve 13 or 38 as the case may be is lifted from the partition, thus permitting the purified air to flow into the chamber 2 and thence to the mouth or nostrils of the wearer of the apparatus.

Among the advantages residing in the structure which I have described, is that of being operative in practically any position in which the wearer of the device may ordinarily find himself. This advantage follows partly from the fact that the device is designed to carry a liquid neutralizer suspended in an absorbent element, thus making it immaterial at what angle the apparatus may be tilted. This does away with the difficulty heretofore experienced in connection with some types of respirators in which gas laden air was delivered into a chamber containing freely movable liquid, the liquid sealing the intake opening. Obviously, unless such a device were held in a certain position, it is probable that the intake opening would become uncovered, thus permitting the gas laden atmosphere to penetrate direct to the nostril engaging portions of the device.

It has been found in practice that the valves controlling the inlet and discharge openings of a respirator are not satisfactory if they depend upon spring pressure for being held in normal closed position. The introduction of a fine spring of any sort for this purpose in this kind of a device introduces a weak element which very often becomes detached and lost or wears out at a critical time. Furthermore, the use of rubber or leather valves is also unsatisfactory inasmuch as these materials deteriorate and are therefore not always dependable. In order to overcome difficulties of this sort, I have sought to eliminate spring-controlled valves and to provide valves of such construction that all the parts may be made of simple forms of metal. Thus, in the case of the intake valve illustrated in Fig. 2, the partition 10 may be made of thin sheet metal and the edges of the air passage in the valve may be turned to form with said partition a seat for the valve 13 which in this case is preferably a thin metal disk freely hung upon the pins 14 so that it may readily swing free from the partition 1 upon inhalation and may also readily seat thereon upon exhalation, thus forcing the exhaled air out through the discharge opening in the top of the casing.

The certainty of operation of the valves controlling the discharge openings is exceedingly important. That is, it is essential that the discharge port shall be securely sealed during the operation of inhaling and that it shall open readily during exhalation. Otherwise, the gas laden atmosphere would be drawn through this port directly into the lungs of the user of the device instead of through the air modifying portion heretofore referred to. While it is a more or less obvious thing to provide a valve which will accomplish this result under some conditions, it has been found very difficult to devise a valve which will be operative under all conditions and in a great variety of positions. The objection to spring-controlled valves has been referred to. The question, therefore, of providing a non-spring-pressed valve which will be operative even in an unusual position then presents itself. I have met this difficulty by interposing in the discharge opening, a multiple valve having the valve portions disposed at an angle to each other so that although one valve may fail to seat by reason of the force of gravity acting upon it to draw it away from its seat, the other valve, being disposed at a different angle will act normally and effectively to seal the opening. Such an arrangement is illustrated in Figs. 3 and 9.

A further difficulty which has presented itself in connection with the use of valves and respirators is that wherein the area of contact between the valve and its seat is so broad as to effect a too secure connection with the parts after they become covered with moisture condensed from the breath. To obviate this difficulty, I have provided valve ports in which the valves seat upon edges or ridges in substantially line contact, thus not only insuring effective closing of the port, but also preventing the unnecessary adhesion of the valve to the seat by reason of the presence of moisture intervening between the two contacting surfaces. I have applied this principle to the valve structures shown in Figs. 3 and 9. The intake valves illustrated in Figs. 2 and 8 also embody the same principle but with some modification made necessary by the decentralized position of the air passages or openings in the respective partitions.

Where the respirator is intended to be used for the purpose of filtering air, that is, to modify the physical character by removing particles of dust or solid matter as distinguished from effecting a chemical change therein, I prefer the form of filtering elements shown in Fig. 8. As heretofore pointed out, these elements may be composed of circular pieces of woven or matted fabric adapted to fit substantially inside the cap 5 and against the front face thereof. Where additional filtering action is necessary, as many layers as necessary may be interposed between the inlet openings in the cover of the device and the partition which closes off the chamber for carrying purified air.

Among other advantages residing in the structure hereinabove described, I may point out the comparative simplicity of the several portions, which permits the device to be made in large part out of thin sheet metal by means of suitable dies, thereby insuring not only low cost of production but precision in the finished product. Where the openings are of uniform size, as they would ordinarily be if the casings were all made by the same set of dies, the nostril and mouth engaging portions may be standardized as to shape and size and thus be interchangeable so that if one or more of these portions becomes lost or destroyed, another can readily be supplied.

The improved mouth piece presents several advantages, one being that the inner flange 26 tends to eliminate the danger of the mouth-piece becoming detached from the respirator. Furthermore, the flange 27 provides an effective seal against entrance of gas laden atmosphere between the mouth-piece and the lips, and the resilient distending member 28 not only provides against collapse of the air conduits but also affords an effective resisting means whereby a more secure grip may be had upon the device.

Where the position of the mouth-piece is fixed relatively to the purified air conducting portion of the casing, as in my improved

respirators, it is advisable to provide means for adjusting the position of the nostril engaging member. The form of nostril engaging member which I have heretofore described allows of this adjustment and at the same time affords the additional advantage of providing means in the lateral ribs 32 for preventing accidental displacement from operative position.

To further insure dependability of operation, I have provided means for attaching the respirator to the head of the wearer said means being quickly and easily adjusted and applied securely in position. I refer to a pair of eyelets 67, Figs. 1 and 2, mounted on the end of the pins 7 and adapted to receive the looped portion of the strap 53 which may be passed around the head of the wearer of the device and fastened thereto as tightly as may be desired. In Figs. 7 and 12 a slightly modified form of attaching apparatus is shown, the strap receiving slot 64 being formed at the end of a spring clip extending from the cover portion, thus holding the cover in secure engagement with chamber 1 and also providing means for retaining the device in position for use.

I claim as my invention:

1. A respirator comprising an air chamber provided with an outlet opening and air actuated valves having seats arranged in the path of air currents passing through said opening and disposed at an angle to each other.

2. A respirator comprising an air chamber having an outlet opening provided with valve seats disposed at an angle to each other, valves entirely detached from said seats and free to change position relatively thereto, said valves being adapted to engage said seats in sealing contact during inhalation through the inlet opening.

3. A respirator comprising an air chamber having an outlet opening provided with a valve seat, a valve entirely detached from said seat and said chamber and mounted for free transverse movement relative to said seat, said valve being adapted to engage said seat in sealing contact, and means on the valve to limit the extent of movement of said valve away from said seat.

4. A respirator comprising an air chamber having an outlet opening, a valve seat in said outlet opening, a valve freely movable relatively to said seat and having peripherally disposed means for limiting its movement away from said seat.

5. A respirator comprising a casing adapted to form a forwardly located air modifying or filtering chamber and a rearwardly located air conducting chamber, openings in said air conducting chamber to receive nostril and mouth engaging members, and a rearwardly directed valve controlled outlet opening in said air conducting chamber whereby the discharge controlling valve may be protected forwardly by the body of the respirator and rearwardly by the face of the wearer.

6. A respirator comprising a chamber adapted to receive an air modifying or filtering agent, a chamber for receiving filtered or modified air, a removable perforated partition interposed between said chambers and having a portion adapted to serve as a line contact valve seat, a valve slidably supported adjacent to said valve seat by oppositely disposed supporting means, said valve being adapted to admit filtered or modified air through the perforations in the partition upon inhalation and to prevent the escape of exhaled air through said perforations upon exhalation.

7. A respirator having an air chamber and collapsible nostril and mouth engaging members adapted to be applied from outside said chamber and having laterally projecting means adapted to engage portions of the inner surface of the air chamber whereby said members may be retained in operative position.

8. A respirator having a chamber for holding air filtering or modifiying means, a chamber for filtered or modified air and removable nostril engaging members each having a plurality of projections along its length adapted to engage inner portions of said air receiving chamber to hold the nostril engaging members in operative position.

9. A respirator comprising an air chamber having a valve controlled outlet opening rearwardly directed, whereby said opening and said valve may be protected rearwardly by the face of the wearer.

10. A respirator comprising an air chamber and nostril engaging members removably attached to said air chamber and having laterally projecting means coöperating with the chamber to retain said nostril engaging members in operative position.

11. A respirator comprising an air chamber, an outlet opening in said chamber, and a valve to control the passage of air through said opening, said valve having projecting means for limiting the extent of movement away from its seat.

12. A respirator comprising an air chamber, an outlet opening in said chamber, and a valve to control the passage of air through said opening, said valve having peripherally disposed means for limiting its extent of opening.

13. In a respirator, the combination of an air chamber, a removable cap for said chamber, means for retaining said cap in operative position, and head engaging means attachable to said cap retaining means whereby the respirator may be held on the wearer's head in position for use.

14. A respirator comprising an air cham-

ber having openings to receive nostril engaging members and collapsible nostril engaging air conducting members provided with a plurality of laterally projecting means adapted to be inserted through said openings to engage the chamber to hold said members in operative position and whereby said nostril engaging members may be effectively secured to said chamber at substantially any desired position along their length.

15. A respirator comprising an air chamber, a discharge opening in a rearwardly disposed wall of said chamber and means supported at the rear of said chamber to protect said opening without interfering with the free passage of air therethrough.

In testimony whereof, I have signed my name to this specification this 8th day of February, 1916.

WALTER SODERLING.