March 29, 1955 P. M. WORKINGER 2,705,052

VOICE TRANSMITTING GAS MASK

Filed Dec. 17, 1951

2 Sheets-Sheet 1

Fig. 1

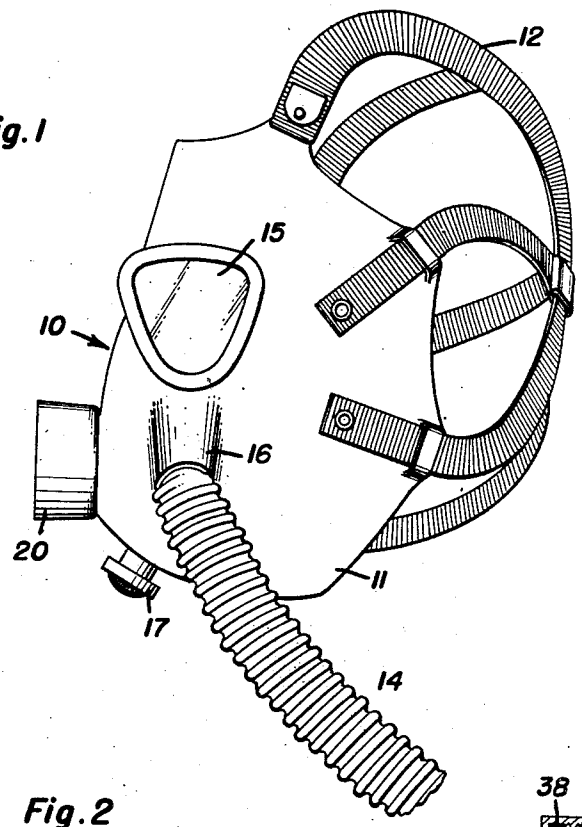


Fig. 2

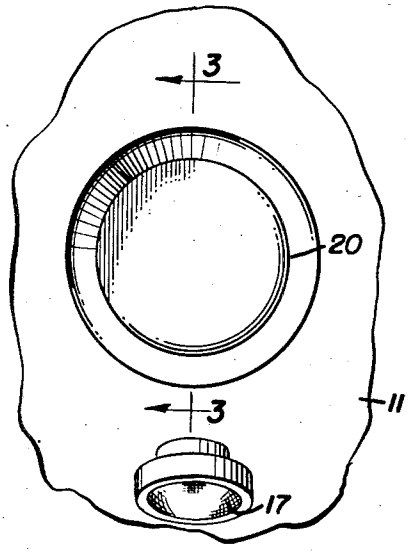
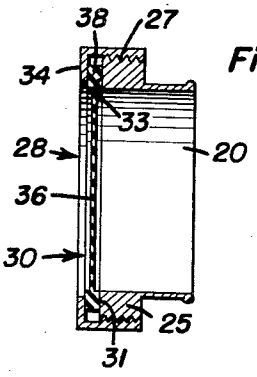


Fig. 3



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Fig.4

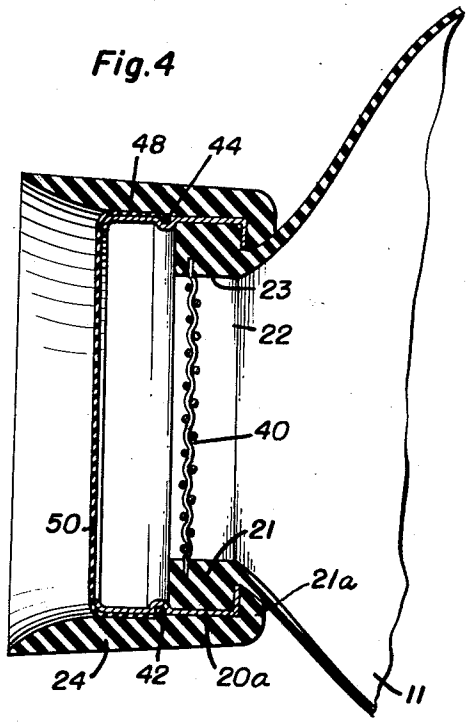


Fig.5

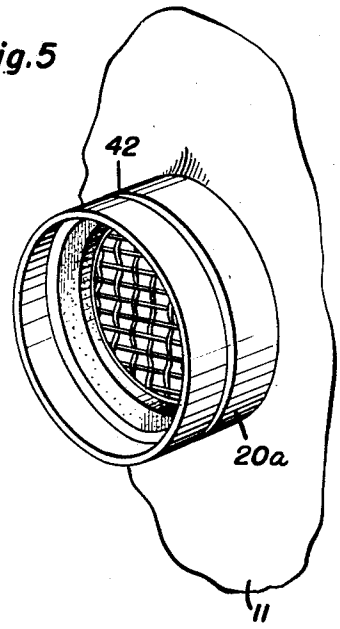


Fig.6

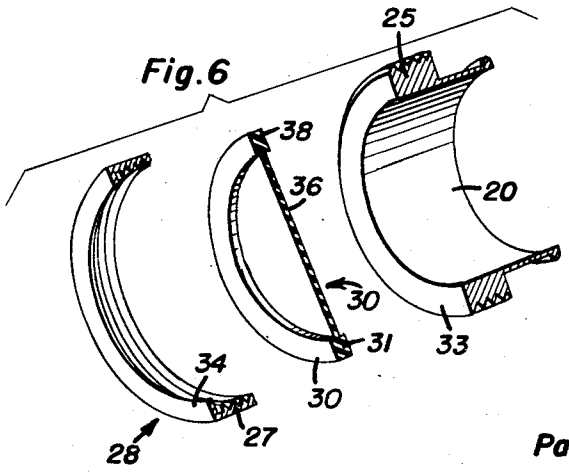
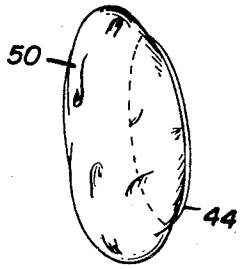


Fig.7



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United States Patent Office 2,705,052 Patented Mar. 29, 1955

2,705,052

VOICE TRANSMITTING GAS MASK

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Application December 17, 1951, Serial No. 262,105

4 Claims. (Cl. 181—18)

This invention relates to voice transmitting gas masks and other breathing apparatus, including a face piece tightly covering the entire face of the wearer of the gas mask or a substantial portion thereof, including the mouth and nose, and it has for its general object to provide improved means for the transmission of the wearer's voice, enabling the wearer of the mask to make himself heard to the extent that the speech may be understood without undue effort in speaking.

Certain difficulties are experienced in connection with the transmission of voice through a gas mask or through another face covering breathing apparatus. It is inadvisable to use speaking apparatus operated electrically, because dry cell batteries and the like remain operative only through a very limited time and constant renewal of the batteries also during periods fo non-use of the gas mask would be necessary to keep the gas mask or a breathing apparatus in good condition for an emergency. Moreover, the battery cannot be held by the gas mask itself and thus constitutes a second unit which must be worn by the wearer of the gas mask.

Voice transmission through the usual type of metallic diaphragm which is not excited electromagnetically has however its difficulties as the diaphragm must be responsive to a wide range of voice frequencies to reproduce voice with sufficient fidelity for intelligible and effortless communication. The natural oscillation frequency of metallic diaphragms, selected within the frequency range to be covered or close to the limits of this range, interferes with intelligible speech on account of the preference accorded to the reproduction of certain frequencies. If however the natural frequency of a metallic diaphragm is entirely outside the frequency range of the human voice the energy necessary to move the diaphragm is at the highest level. As the energy produced by the human voice is very low it is necessary to use light weight diaphragms which are movable by the low voice energy. This condition is however at variance with the condition imposed on the diaphragm to be impervious to gas which condition requires a minimum thickness. Therefore a direct transmission merely by means of a diaphragm is usually not feasible and other expedients, such as acoustical chambers associated with the diaphragm and the like have been recommended which however produce a complication of the gas mask construction.

It has been found by experiment that a satisfactory voice reproduction under the circumstances which have been described above can be obtained with thin rubber diaphragms or membranes closing tightly a speaking tube inserted into the face piece of the gas mask which membranes must be resiliently held at the rim of the speaking tube.

Such diaphragms do not have a natural oscillation frequency which they tend to adopt and moreover they are impervious to gases even when of very moderate thickness and they make large excursions even when driven with low energy. The kinetic energy of the membrane, returning from an excursion, which has to be overcome at each cycle is very low so that the weight of such a diaphragm is not limited to the same extent as in other rigid diaphragms such as the metallic diaphragm. Further sounds may partly pass through a rubber diaphragm member and this passage may even be promoted by a suitable fixation of the membrane.

It has been found that large excursions of the membrane are possible with two modes of holding the rubber diaphragm or membrane one mode permitting to hold the marginal portion of the membrane more rigidly and another mode which gives the most perfect results and in which the diaphragm is not held positively along the margin of the opening but is held along a cylindrical part of the tube which it closes by means of an elastic band or cord.

The invention is illustrated in the accompanying drawing showing two embodiments thereof. It is however to be understood that the embodiments shown do not represent the sole embodiments of the invention which are hereinafter described and that the illustrated embodiments therefore are only examples intended to facilitate the explanation of the principle of the invention and the best mode of applying said principle. A departure from the examples which have been illustrated does therefore not necessarily involve a departure from the principle of the invention.

In the drawing:

Figure 1 is a perspective view of a gas mask.

Figure 2 is a perspective fragmentary view on a larger scale of the speaking tube seen from the front.

Figure 3 is an elevational sectional view through part of the gas mask carrying the speaking and voice transmission device.

Figure 4 is an elevational sectional fragmentary view of a second embodiment of the voice transmission device.

Figure 5 is a perspective fragmentary view of the embodiment of the voice transmission device shown in Figure 4 with the rubber membrane removed.

Figure 6 is an exploded perspective and sectional view of the speaking tube and membrane illustrated in Figure 3, and

Figure 7 is a perspective view of the membrane as used in the modification illustrated in Figure 4.

Figure 1 illustrates a gas mask **10** of conventional design which is provided with the customary face mask piece **11** of a flexible and impervious material which is provided with the customary head straps **12** and with openings which are surrounded by the eye pieces or lenses **15**. On a lateral part of the lower section of the gas mask a tubular fitting **16** is arranged to which a flexible air hose **14** is attached which leads to the customary canister (not shown). On the lower portion of the face piece of the mask an exhalation opening with an exhalation valve **17** is provided.

Above the exhalation opening and preferably facing the region occupied by the mouth of the wearer of the gas mask a speaking tube **20** is mounted which forms the voice transmission device and which is preferably seated on or within a flange or sleeve-like projection **21** surrounding a tubular trunk piece **23** slightly projecting from the face mask piece which surrounds the speaking opening **22**. On the outside the speaking tube may be surrounded with a sound guiding megaphone tube **24**. However the use of the megaphone tube is optional and it does not form a necessary accessory.

The speaking tube holds the speaking membrane and two different modifications of this membrane have been shown in the figures.

In the modification shown in Figure 3 the speaking tube **20** is provided with a threaded flange **25** projecting outwardly from the tube over which a cap **28** may be screwed by means of internal screw threads **27** provided on the same. The flange **25** ends in a flat surface **33** while the cap **28** is provided with an inwardly projecting flange **34** facing this flat surface. Between the surface **33** and the inwardly projecting flange **34** the membrane **30** may be held. The membrane consists entirely of rubber and comprises a central and thin flat portion **36** and an outer, reinforced and thicker annular flange or rim portion **38**. This thicker rim portion **38** is clamped between the surface **33** of the flange **25** and the inwardly projecting flange **34**. As the membrane **30** is entirely made of thin rubber a clamping of the outer annular flange portion **38** does not prevent the inner portion **36** from moving freely making relatively large excursions.

Partly the sound produced by the wearer of the gas mask traverses the rubber and thus penetrates directly to the outside but partly the pressure increases on the inside and produces a vibration of the membrane. The

opening 22 of the face piece 11 remains tightly closed on account of the tight holding of the annular flange 38 of the membrane 30 between the two members 25 and 28 of the speaking tube.

The tubular trunk piece 23 of the face piece 11 of the gas mask may hold an angle tube 20*a* as shown in Figure 4 with an inner cylindrical face which is seated on the outwardly projecting flange 21 of the trunk piece 23. The rear edge of the angle tube 20*a* may be bent inwardly and it thus surrounds the flange 21 of the trunk piece 23 on its periphery and covers its back. The front edge of the angle tube 20*a* may also be bent inwardly and may be rounded. This angle tube is provided with a small groove 42 in its cylindrical section which groove is arranged at some distance from the front opening of the angle tube 20*a*. A membrane 50 consisting merely of a piece of thin rubber is fastened over the front opening and also covers part of the peripheral cylindrical portion over which it is fitted snugly and it is fastened on the angle tube 20*a* by means of an elastic band or cord which by virtue of its elasticity snaps into the groove on top of the membrane. The elastic band or cord must be so dimensioned that its peripheral length is in fact somewhat smaller than the periphery of the speaking tube so that when held in the groove the band or cord is under elastic tension.

This elastic band 44 may also be cemented or otherwise held on the outer portion of the membrane as shown in Figure 7.

When the elastic band 44 holds the membrane 50 in the groove 42 the said membrane is tensioned so that it is held stretched in front of the opening of the angle tube 20*a*. The angle tube 20*a* is held in the trunk piece 23 by holding and sound guiding member 24 which fits snugly over the angle tube 20*a* so that the latter is firmly clamped between the holding and sound guiding tube 24 and the flange 21 of the trunk piece 23. The holding and sound guiding member 24 may be provided at one of its ends with an inwardly turned flange fitting over and gripping the back portion of the angle tube 20*a*.

As above stated the angle tube 20*a* has its front portion covered by the membrane 50 and this portion fits snugly into the holding and sound guiding tube 24 which therefore not only holds the angle tube and membrane but which also projects beyond the membrane. This projecting portion has a flaring inside which serves as a horn or megaphone. The membrane then closes tightly the front opening of the speaking tube and it may also vibrate when sounds are produced on the inside. The excursions of the membrane find less resistance when the membrane is held in the manner shown in Figure 4 because the point of fixation is in this case located between the rim of the angle tube and the holding and sound guiding tube and the membrane is held along a cylindrical surface rather than in the manner shown in the modification illustrated in Figures 3 and 6. Moreover the membrane is held on the rounded inwardly bent end of the angle tube 20*a* and it is pressed against the rounded end of the angle tube only on one of its sides.

The angle tube 20*a*, if properly mounted, is held on the flange 21 of the trunk piece 23 between the groove 42, which produces a protruding ridge on the inside of the angle tube, and the bent flange of the same, thus securing a firm and stable seating of the angle tube.

The tubular trunk piece 23 of the face piece 11 of the mask may hold a wire mesh plate or disk 40 which is provided for the purpose of preventing the membrane from being drawn inwardly during the testing of the gas mask.

Preferably the rubber membrane has a thickness varying between .002 inch to .030 inch. As such a membrane will deteriorate in the course of a long time it will be necessary to mark it by color, by a date stamp, or the like in order to facilitate the locating of membranes which are due for replacement on account of age, climatic conditions or other reasons.

The described construction of a rubber membrane and especially the use of a membrane in the manner illustrated in Figures 4 and 5 of the drawings according to which the membrane is fixed on the cylindrical part of the speaking tube near the front end and held there by an elastic band or cord has been found to be superior to other membrane constructions mainly by experimentation which showed that the transmission of sound was much clearer and more intelligible with membranes of the above mentioned type and was much preferable to constructions in which a rigid membrane, such as a metal membrane, or another membrane of rigid material was used. Among various means of fixation of the membrane the fixation by means of an elastic band was found to produce the best results.

It will be clear that non-essential parts of the construction as above shown may be changed without in any way departing from the essence of the invention as defined in the annexed claims.

Having described the invention, what is claimed as new is:

1. A voice transmitting gas mask with a face piece tightly fitting over the face of the wearer, comprising a speech transmission unit mounted on a trunk piece surrounding an opening of the face piece, said unit including an angle tube provided with a groove, firmly seated on and surrounding said trunk piece, a membrane covering the cylindrical portion of the angle tube in front of the groove and the frontal cross-section of the angle tube, a holding and sound guiding tube with a cylindrical inner surface fitting snugly over the angle tube and projecting on the front side beyond the angle tube and the membrane, the inner surface of the projecting portion of the holding and sound guiding tube being flared to act as a sound amplifier, and elastic means on said membrane for holding the end of the membrane tightly within the groove of the angle tube, while the adjacent portion of the membrane is clamped between the cylindrical portion of the angle tube and the holding and sound guiding tube surrounding it.

2. A voice transmitting gas mask as claimed in claim 1, wherein the front end of the angle tube is rounded and the rubber membrane covers the opening, the rounded end portion and a cylindrical portion and is stretched over the end portion by elastic means pressing on its marginal portion forcing it into the groove.

3. A voice transmitting gas mask as claimed in claim 1, wherein the elastic means comprises an elastic band fixedly carried by the edge of the rubber membrane, and contracting the same, so that said edge is normally contracted when the rubber membrane is not mounted on the speaking tube and is held under elastic tension when mounted on the speaking tube.

4. A voice transmitting gas mask as claimed in claim 1, wherein the speaking opening is provided with a wire mesh for preventing the rubber membrane from being stretched beyond a predetermined limit during tests.

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