May 19, 1959 E. S. BROWN ET AL 2,887,105

MASK TO MASK RESUSCITATOR

Filed March 12, 1958 2 Sheets-Sheet 1

Fig. 1

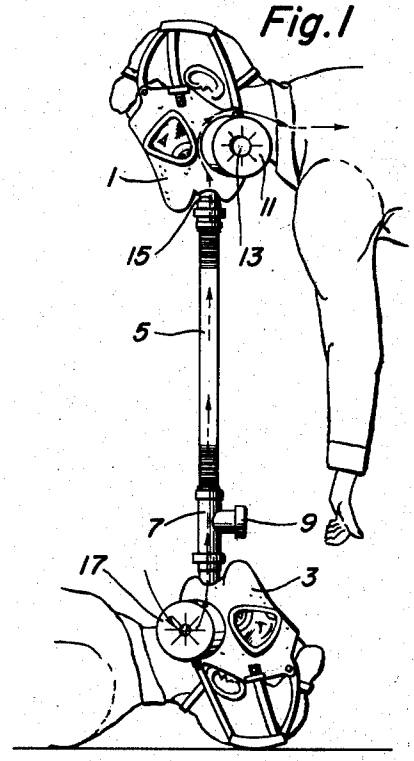


Fig. 2

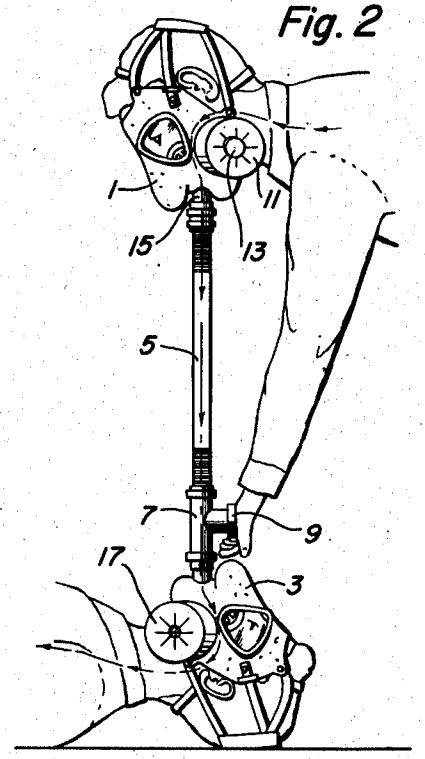
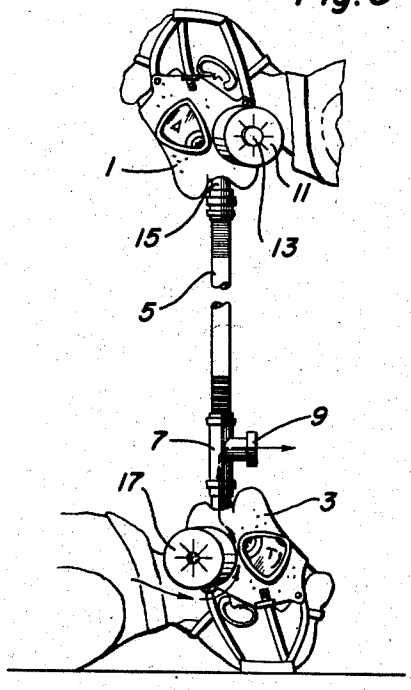


Fig. 3



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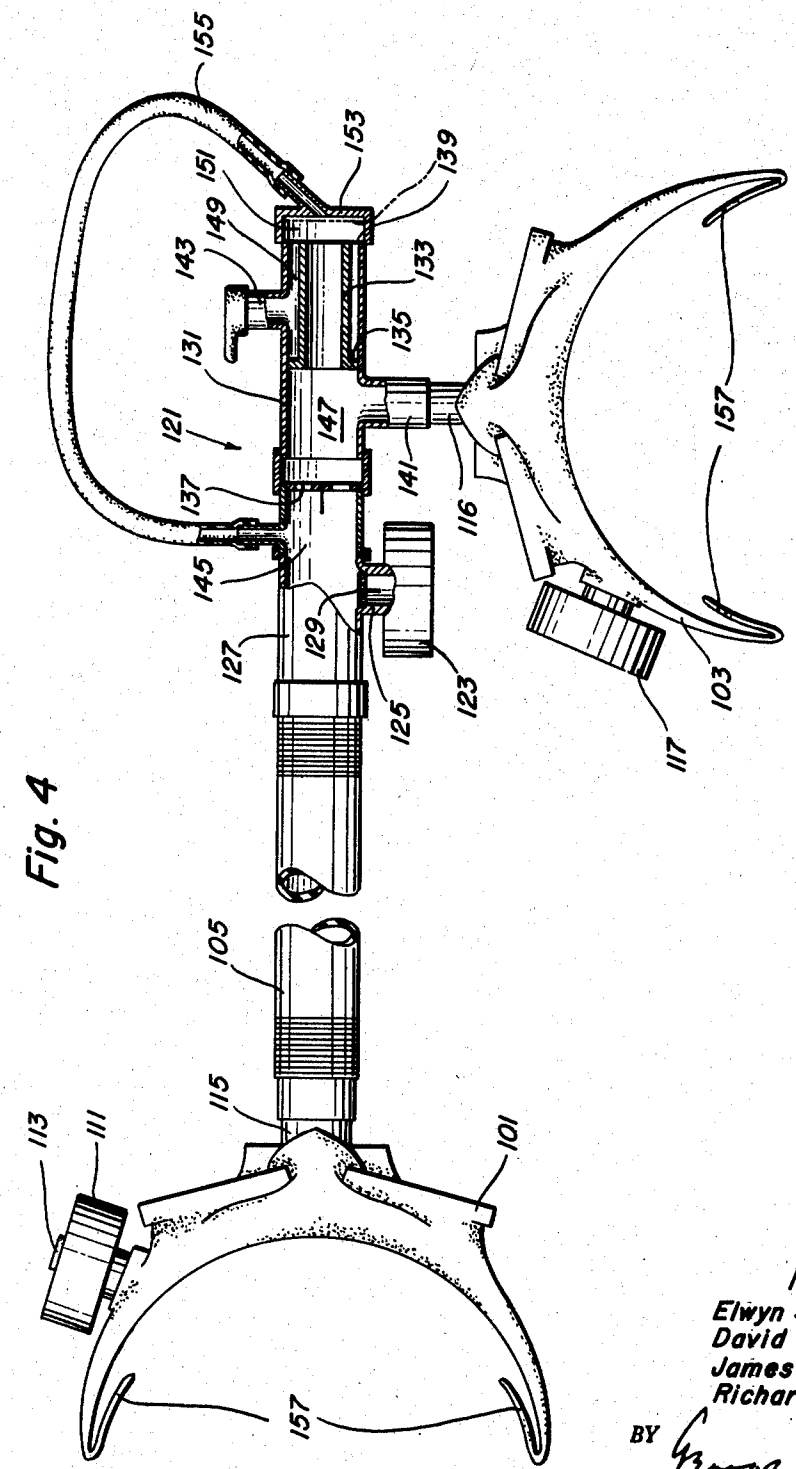


Fig. 4

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MASK TO MASK RESUSCITATOR

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2 Claims. (Cl. 128—29)

The invention herein described may be manufactured and used by or for the Government of the United States of America for governmental purposes without the payment to us of any royalty thereon.

This invention relates to a resuscitator particularly adapted for use in a contaminated atmosphere.

In the treatment of victims of poison gases, particularly to so-called "nerve gases," it is frequently necessary to resort to some type of artificial respiration or resuscitation. Since the resuscitation must be carried out promptly, the method must be such that it can be carried out in a contaminated atmosphere while both the casualty and the operator are protected. The apparatus employed should be light, simple, and easily transported.

One previously known method is termed "mouth-to-mouth resuscitation." It consists in the operator blowing exhaled air into the mouth of the casualty. Our apparatus makes possible a variation of this method, which we term "mask-to-mask" resuscitation. The operator inhales through a canister and gas mask. He then exhales into the lungs of the patient. Finally, the patient exhales to the atmosphere. Our apparatus makes it possible for the operator to carry out this cycle for extended periods of time and ensures that the casualty receives air of adequate oxygen content.

In the drawing, Figs. 1, 2, and 3 are external views, schematic in character, showing the three steps of a cycle employing a simple embodiment of our invention.

Fig. 4 is a view partially in plan and partially in section, showing another embodiment of our invention.

The apparatus of Figs 1–3 comprises an operator's mask **1**, a casualty's mask **3** and a flexible connecting tube **5**. Between the tube **5** and the casualty's mask **3** is a T-connection **7** having an outlet **9**, which contains a conventional one-way outlet valve of the type normally used in gas masks.

The operator's mask **1** is a standard gas mask including the usual canister **11** which is, however, closed by a plug **13**. It also includes the usual outlet tube **15**. The usual outlet valve is, however, removed and the tube **5** connected in its place. The casualty's mask **3** is likewise a standard gas mask from which the outlet valve has been removed and replaced by the T-connection **7**. Mask **3** includes the usual canister **17**, which is left open. Canisters **3** and **11** are associated with the usual one-way inlet valves, which may either be part of the canister or part of the mask.

Figure 1 shows the first step of a cycle of operation. The operator inhales deeply through canister **17**, casualty's mask **3**, T-connection **7**, tube **5** and operator's mask **1**. The valve in outlet **9** closes. At the end of this step the entire system is filled with fresh, purified air.

In the second step, shown in Fig. 2, the operator closes outlet **9** with his hand and exhales. This forces the fresh air filling the system into the casualty's lungs, followed by a part of the air exhaled by the operator. At the end of this step, the system is filled with the operator's exhaled air and the casualty's lungs are inflated.

In the third step, shown in Fig. 3, the operator removes his hand from outlet **9** and holds his breath. The elasticity of the casualty's lungs causes him to exhale through outline **9**.

The step of Fig. 1 is then repeated. It will be noted that the operator first rebreathes the exhaled air, which fills the system, followed by fresh air, and the cycle continues as before.

An important feature of our invention is the fact that the operative canister, **17**, is at the casualty's mask. One of the problems involved in mouth-to-mouth or mask-to-mask resuscitation is hyperventilation of the operator, who must breath much more deeply than normal.

If the canister **11** is used as the source of the operator's air, so that only fresh air is inhaled, the carbon dioxide content of the lungs is lowered to the point where dizziness and other symptoms of hyperventilation occur, making it difficult or impossible for the operator to continue the resuscitation for the requisite length of time. When the operative canister is at the casualty's mask, the resultant rebreathing of exhaled air by the operator serves to keep the carbon dioxide concentration in his lungs at a value such that the effects of hyperventilation are minimised, making it possible to maintain the resuscitation for long periods.

The location of the operative canister also benefits the casualty, whose breathing has stopped and who is suffering from suffocation. It is desirable that he receive as much oxygen as possible. If canister **11** were the operative canister, the casualty would receive only exhaled air. With our arrangement, he receives fresh air as well.

The T-connection **7** with its outlet **9** is located adjacent to the casualty's mask in order that the resistance may be as small as possible when the casualty exhales and also in order to cause the operator to inhale a minimum quantity of the casualty's exhaled air.

While the canister **11** is inoperative in the combination described, it is desirable that it be present. The flexible tube **5** can be disconnected from outlet tube **15** and the conventional outlet valve replaced. The operator can then remove plug **11** and utilize mask **1** as a conventional gas mask until it is necessary to treat another casualty.

Figure 4 shows second embodiment of our invention which employs an automatic valve instead of the T connection **7** of Figures 1–3, which has only an outlet valve.

This second embodiment includes an operator's mask **101** and a casualty's mask **103**. Between the masks is flexible connecting tube **105**. The operator's mask **101** includes the canister **111** which is closed during the resuscitation cycle by a plug **113**. The casualty's mask includes a canister **117** which is inoperative during the resuscitation cycle but which is preferably left open for reasons which will be explained later. The operator's mask **101** includes the usual outlet tube **115** from which the usual outlet valve has been removed. The flexible tube **105** is preferably connected to outlet tube **115** by a quick-disconnect coupling. The mask **103** also includes outlet tube **116** from which the outlet valve has been removed.

The apparatus thus far defined is the same as that of Figures 1–3. In this embodiment, however, we include an automatic valve indicated at **121** and a resuscitator canister **123** which provide a more convenient means of carrying out the resuscitation cycle. Resuscitator canister **123** is mounted on a side arm **125** of a T-connection **127**, which is connected to flexible tube **105** and automatic valve **121**. One way inlet valve **129** may be located either in the T-connection as shown or in canister **123**.

Valve **121** will now be described. This valve per se is not our invention but was obtained from the J. H. Emerson Resuscitator Company.

The valve includes an outer housing **131** and an inner tube **133**. The inner tube is provided with an annular shoulder **135** which fits inside outer housing **131**. Within outer housing is a one-way inlet valve **137** and a valve leaflet **139** which is movable between the positions shown in solid and broken lines. Casualty's side arm connection **141** and outlet side arm connection **143** are also joined to outer housing **131**. The various elements of valve **131** define several chambers, as follows: An inlet chamber **145** to the left of inlet valve **137**, a central chamber **147** formed by inlet tube **133**, inlet valve **137** and outer housing **131**, outlet chamber **149** formed by inner tube **133**, shoulder **135**, outer housing **131** and outlet side arm connection **143**, and a control chamber **151** lying between the right hand end of inner tube **133** and the end closure **153**. A pressure equalizing tube **155** connects inlet chamber **145** with end closure **153**.

The masks **101** and **103** are preferably provided with inwardly folded edges **157** which serve to prevent leakage around the edges when superatmospheric pressure prevails in the masks.

The cycle of operations is as follows:

A. *The operator inhales.*—Valve **137** closes and valve **129** opens. Outside air is drawn in through canister **123** and thus purified. The purified air fills tube **105** and mask **101** and enters the operator's lungs. At the end of this step the tube **105** is filled with freshly purified air.

B. *The operator exhales.*—Valve **129** closes and valve **137** opens. Also, air flows through pressure equalizing tube **155**, thus equalizing the pressure in inlet chamber **145** and control chamber **151**. This pressure is above atmospheric. The pressure in outlet chamber **149** is atmospheric. Only a portion of the left face of valve leaflet **139** is exposed to the pressure of central chamber **147** while the entire right face is exposed to the pressure of control chamber **151**. Valve disk **139** is therefore held in the full line position, closing the end of inner tube **133**. As the operator continues to exhale, air is forced through casualty side arm connection **141** into mask **103**, inflating the casualty's lungs.

C. *The operator again inhales.*—This lowers the pressure in inlet chamber **145** below atmospheric. The valve **137** closes. The casualty exhales due to the elasticity of his lungs. Due to tube **155** the pressure on the right hand face of valve leaflet **139** is less than that on the left face. Valve leaflet **139** therefore moves to the right toward the broken lines position, so that control chamber **151** connects central chamber **147** with outlet chamber **149**. The casualty therefore exhales to the atmosphere.

At the end of step "B," hose **105** was filled with air exhaled by the operator. During step "C" he therefore first inhales this exhaled air, followed by fresh purified air.

The cycle of steps A, B, and C is then repeated until the casualty begins to breath again. Canister **117** now provides a second source of air for the casualty regardless of whether or not his breathing is synchronized with that of the operator. When the casualty is sufficiently revived side arm **141** may be disconnected and the outlet valve replaced in mask **103**, which will function in the usual manner.

The operator may continue to inhale through the canister **123** and exhale through valve **121**, or he may remove plug **113** from canister **111**. Flexible tube **105** may be disconnected from outlet tube **115** and the outlet valve replaced. Mask **101** will then function in the normal manner.

While we have shown two embodiment of our invention, it will be apparent that further modifications are possible. In particular, other valves performing the same function may be substituted for valve **121**. For example, that shown in Reissue Patent No. 24,193 (reissue of Patent No. 2,428,451) may be employed.

We therefore wish our invention to be limited solely by the scope of the appended claims.

We claim:

1. A mask-to-mask resuscitator comprising an operator's gas mask having no operative inlet for air, a casualty's gas mask having an air inlet adjacent thereto, a tube connecting said masks, and an outlet to the atmosphere connected to said tube adjacent said casualty's mask.

2. A mask-to-mask resuscitator comprising an operator's gas mask having no operative inlet for air, a casualty's gas mask, air inlet means adjacent said casualty's mask and comprising an air-purifying canister, a tube connecting said masks, and an outlet connected to said tube adjacent said casualty's mask, said outlet being so constructed and arranged that it may be closed when the operator exhales and opened when the casualty exhales.

References Cited in the file of this patent

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