PATENT SPECIFICATION

733,473

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COMPLETE SPECIFICATION

Improvements relating to Breathing Apparatus

We, NATIONAL RESEARCH DEVELOPMENT CORPORATION, a British Corporation established by statute, of 1, Tilney Street, London, W.1, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to breathing apparatus of the closed cycle type including an air or passage.

Also according to the invention, the cooling agent is conducted in gaseous form through a passage or tube in the cooler, contiguous with the passage or tube through which the gas mixture to be breathed passes on its way from the breathing bag to the face mask of the apparatus.

A great part of the heat of metabolism of

in the design of the unit to provide capacity for the moisture which condenses from the expired air, which may provide several hundred cubic centimetres of ice in an apparatus designed to last for two hours. The liquid air or solid carbon dioxide may be contained in tubes almost entirely surrounded by the gas mixture breathed which is in turn preferably thermally insulated from the ambient atmosphere. While it is found that the additional weight of the apparatus somewhat reduces the capacity of the wearer to do work under favourable climatic conditions, his capacity for work under conditions of high temperature and humidity is greatly increased.

In a second form of the invention, liquid air or liquid oxygen is used not only for cooling the gas mixture breathed by the wearer of the apparatus by means of a heat exchange unit, but is also used to provide the oxygen needed by the wearer for respiration. Breathing apparatus employing liquid air to provide the oxygen for respiration is already known to the art, but liquid air has not been used simultaneously in a heat exchange unit for the purposes of cooling and drying the gas mixture as in this invention.

In a third form of the invention, the gas mixture cooled in the heat exchange unit is not only used for respiration but is allowed to flow over the face of the wearer of breathing apparatus fitted with a full-face mask. [illegible]

tus and

Figure 7 is a sectional view illustrating details of the said face mask.

The apparatus shown in Figure 1 is of the closed circuit type comprising a breathing bag 1 fed with oxygen from a cylinder 2 communicating with the said bag through a pressure reducing valve 3. The gas mixture to be breathed passes from the bag 1 through a short pipe 4 into a cooler or heat exchanger 5 hereinafter more particularly described, and thence through a flexible pipe 6 to the face mask of the apparatus (not shown in Figure 1). The gas mixture expired passes through a flexible pipe 7 to a purifier 8 containing a suitable agent for the removal of carbon dioxide and thence through a short pipe 9 to the breathing bag 1. An automatic pressure release valve 10 is provided on the bag 1. The bag 1, cylinder 2, the cooler or heat exchanger 5 and purifier 8 together with their associated parts are disposed in a suitable case 11 adapted to be carried on the wearer's back.

In the example shown in Figure 2 the heat exchanger (5, Figure 1) comprises a casing 12 of synthetic resin having insulating properties for example, foamed "Bakelite" (Registered Trademark) through the top of which casing there extends inwardly a cooling device in the form of a cylinder 13 containing solid carbon dioxide 14. The said cylinder 13 is closed by a cap 15 which may [illegible]

escapes through an opening 24.

The example of heat exchanger shown in Figure 3 is similar externally to that previ-

adjusted in position so that its edges fit the head of the wearer whilst an air space is left between the inner surface of the mask and

21, and an outlet 24 for the escape of the cooling agent. In this example however use is made of liquid air instead of solid carbon dioxide as the cooling agent. The liquid air is contained in a bottle 25 containing absorbent material 26 such as calcined asbestos, the said bottle 25 having a tube 27 with a perforated wall extending into the absorbent material as shown so that the cold gaseous air may escape as the liquid evaporates. The bottle 25 is supported by a tube 28 extending through the top of the heat exchanger and closed by a suitable cap or stopper, the tube 28 serving as a means for permitting the bottle 25 to be recharged with liquid air when exhausted. The interior of the heat exchanger is divided by a partition 29 into inner and outer chambers, the inner chamber containing baffle members arranged as shown to increase the length of the path of the evaporated air on its way from the bottle 25 to the outlet 24. The gas mixture to be breathed passes through the outer chamber as shown by the solid arrows in the drawing and is cooled and dried in the process. Condensed moisture collects in the sump 30 and may be drained therefrom by the removal of the plug 31.

In the alternative form of breathing appa-

securing straps 42 are provided at the back of the mask and a microphone 43 may be arranged in the front thereof.

The flexible pipes 6 and 7 previously referred to are connected respectively to the inlet and outlet branches 44 and 45 of a T-pipe junction 46 which is attached to the face mask 41 in front of the wearer's mouth. This portion of the face mask is formed with a double wall, namely an inner wall 47 and an outer wall 48 with an intermediate space 49 (Figure 7). The T-pipe junction 46 is provided with an inner tube 50 which extends through the inner wall 47 and is open to the wearer's mouth whilst the other end of the said tube 50 communicates with the outlet branch 45 of the T-junction 46. Suitable valves 51 and 52 are provided in the branches 44 and 45 of the said T-junction. With this arrangement the gas mixture to be breathed enters the space 49 from the pipe 6 whilst the expired air passes through the tube 50 to the flexible pipe 7.

Extending from the space 49 are channels 53 moulded in the cheek portion of the mask 41. The said channels terminate above the glass eye pieces of the mask and serve to conduct the cold, dried, gas mixture over the face and forehead of the wearer and over the

3. Breathing apparatus as claimed in Claim 1 or Claim 2 wherein the cooling agent is derived from liquid air, liquid oxygen or solid carbon dioxide.

4. Breathing apparatus as claimed in Claim 1, 2 or 3 wherein the cooler comprises a casing housing a container for the solidified or liquified cooling agent, through which casing the gas mixture to be breathed and the cooling agent in gaseous form circulate, the said casing being provided with internal partitions separating the gaseous streams and serving also as heat exchange members.

5. Breathing apparatus as claimed in Claim 1 wherein the cooler comprises a heat exchanger to which cold air or oxygen coming from an air or oxygen supply bottle is supplied before entering the breathing bag.

6. Breathing apparatus as claimed in any of the preceding claims wherein the face mask of the apparatus is constructed so that the cool mixture to be breathed is caused to flow over the face of the wearer before inspiration.

7. Breathing apparatus substantially as hereinbefore described with reference to the accompanying drawing.

C. E. BELL,
Chartered Patent Agent,
Agent for the Applicants.

PROVISIONAL SPECIFICATION

Improvements relating to Breathing Apparatus

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change unit for the purposes of cooling and drying the gas mixture as in this invention.

In a third form of the invention, the gas mixture cooled in the heat exchange unit is not only used for respiration but is allowed to flow over the face of the wearer of breathing apparatus fitted with a full-face mask. Further heat is extracted by this means from the body of the wearer but this is found to be small in amount compared with the heat lost by respiration. The flow of cooled gas mixture over the face does however inhibit the intense sweating of the face which is otherwise inevitable under unfavourable climatic conditions, greatly increases the comfort of the wearer and makes a full-face mask more acceptable to the wearer, thus permitting the incorporation of a microphone where necessary for the purpose of communication.

C. E. BELL,
Chartered Patent Agent

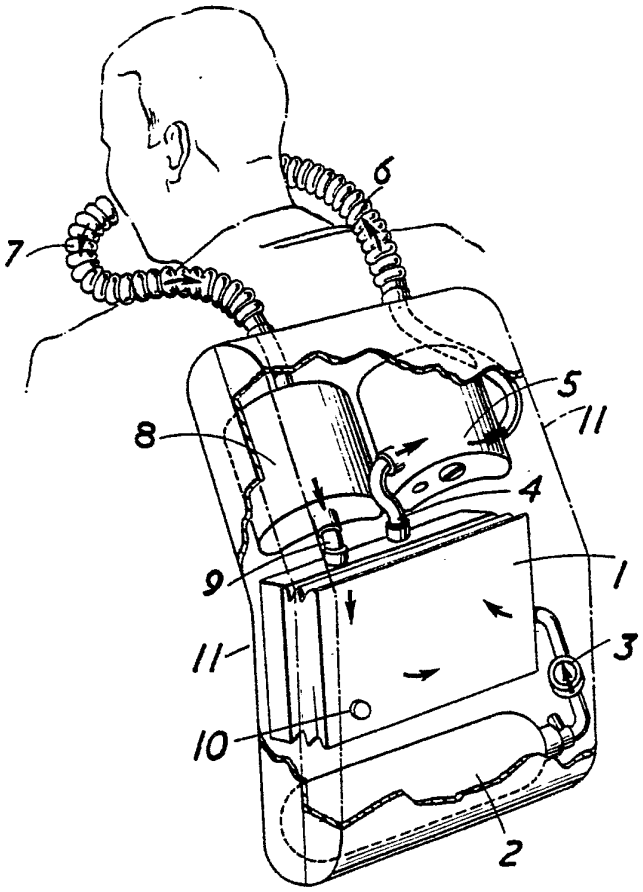
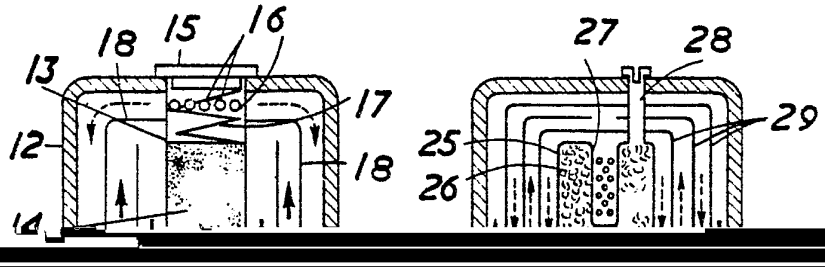


Fig. 1.



733,473 COMPLETE SPECIFICATION
2 SHEETS This drawing is a reproduction of the Original on a reduced scale.
SHEETS 1 & 2

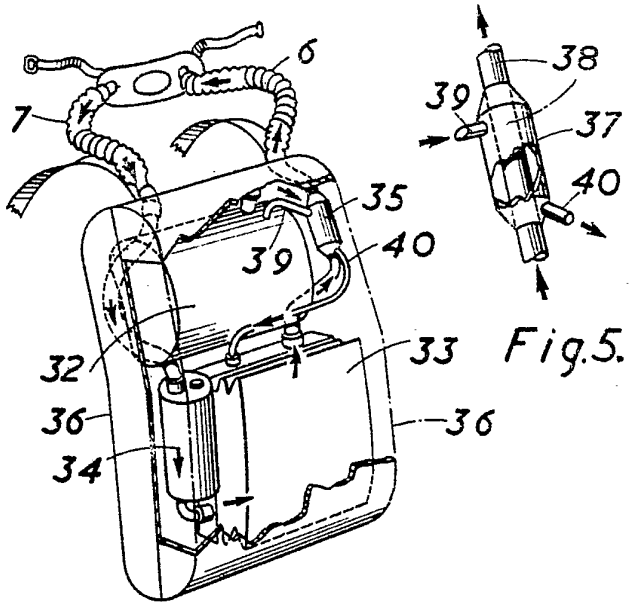


Fig. 4.

Fig. 5.

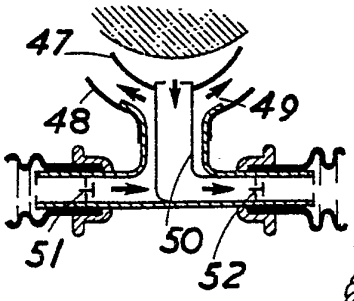


Fig. 7.

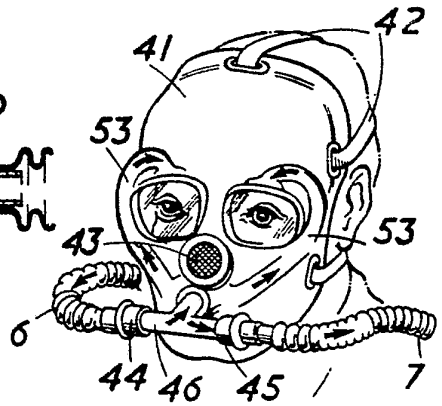


Fig. 6.

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SHEETS 1 & 2

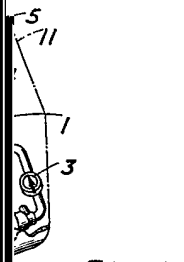

Fig. 1.

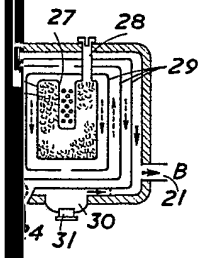

Fig. 3.

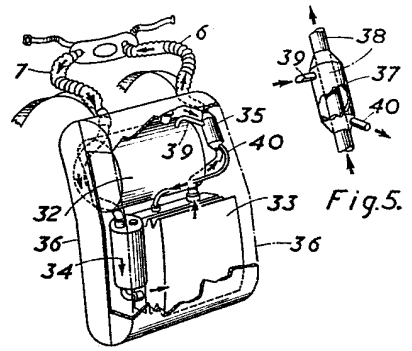

Fig. 4.

Fig. 5.

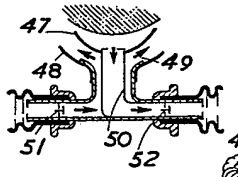

Fig. 7.

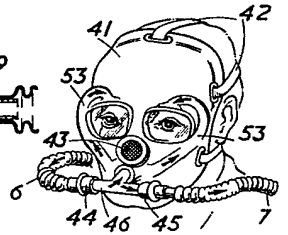

Fig. 6.