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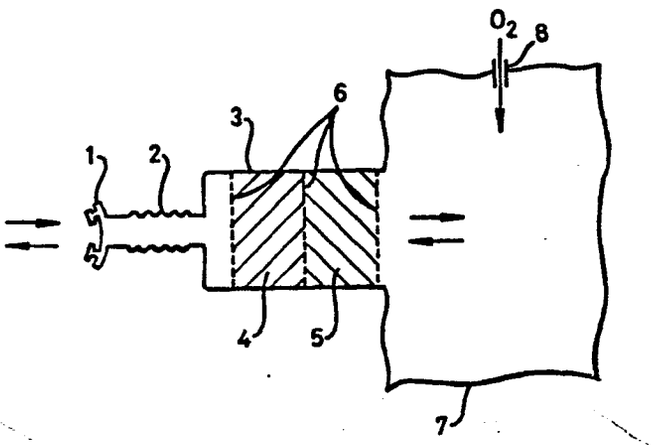
(54) Improvements in closed circuit breathing apparatus.

(57) A closed circuit breathing apparatus comprising a mouthpiece coupled to a counterlung to which oxygen is admitted on demand by the wearer, a medium provided between the mouthpiece and the counterlung to absorb the exhaled carbon dioxide and a chemical heat exchanger in the form of activated carbon to reduce the temperature and relative humidity of the exhaled purified air resulting from the exothermic reaction in the carbon dioxide absorbing medium.



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IMPROVEMENTS IN CLOSED CIRCUIT BREATHING APPARATUS

This invention relates to closed circuit breathing apparatus incorporating means for removing carbon dioxide exhaled by the user.

In some forms of conventional closed circuit breathing apparatus it is usual to employ a material such as caustic soda or soda lime to absorb the carbon dioxide, the chemical being held in a replaceable container. However the exothermic reaction produced by absorption of carbon dioxide results in an increase in temperature of the exhaled air and an increase in relative humidity. Typical values for the temperature and relative humidity of the purified exhaled air are 55°C and 100% respectively. Such values make the inhalation of the recycled exhaled air extremely uncomfortable for the user. In an endeavour to reduce both the temperature and relative humidity heat exchangers have been utilised, one example being that disclosed in UK Patent Specification No. 1057155 in which a liquid or liquified cooling medium is used to cool the purified exhaled air.

Whilst such heat exchangers have often produced the required result in making the recylced air more comfortable for the user to inhale the addition of a heat exchanger has increased the total weight of the apparatus to a value which makes it tiring for the user to wear particularly when engaged in fairly strenuous physical exertion, for example when fire fighting or escaping from a dangerous toxic environment.

Most of the heat exchangers used in known types of closed circuit breathing apparatus rely on an efficient heat conductor in the form of a coolant or a heat radiating medium to conduct rapidly the heat produced by the exothermic reaction to the environment to reduce the

temperature of the exhaled air. In contrast to this and surprisingly we have found that using a poor heat conductor in a heat exchanger not only produces the desired results of decreasing the temperature and relative humidity of the purified exhaled air but, in the form used in this invention, does not add signficantly to the total weight of the closed circuit breathing apparatus.

In accordance with this invention therefore we provide a closed circuit breathing apparatus incorporating a carbon dioxide absorbing medium characterized in that a chemical heat exchanger in the form of activated carbon is located in a position relative to the carbon dioxide absorbing medium to reduce the temperature and relative humidity of the exhaled purified air resulting from the exothermic reaction thereof.

In a pendulum type closed circuit breathing apparatus, the activated carbon in the form of granules may be contained in a housing immediately adjacent to a housing containing the carbon dioxide absorbing medium in the form of soda lime whilst in a unidirectional type of closed circuit breathing apparatus, a housing containing soda lime can be sandwiched between two housings each containing activated carbon.

Two embodiments of the invention will now be described with reference to the accompanying drawings in which:-

Figure 1 shows a pendulum type closed circuit breathing apparatus in accordance with this inventon; and

Figure 2 shows a unidirectional closed circuit breathing apparatus in accordance with this invention.

The pendulum type breathing apparatus shown in Figure 1 comprises a mouthpiece 1 connected via a breathing tube 2 to a canister 3 having

therein a chemical heat exchanger 4 in the form of an activated carbon granule pack and a pack of soda lime 5, the canister 3 being attached to a counterlung 7 having an oxygen intake valve 8 therein.

Metal screens 6 covered with a fine filter paper are positioned one between the packs 4 and 5 and one at each end thereof to prevent dust from entering the breathing tube and counterlung. Both packs 4 and 5 are preferably replaceable within the canister 3 or alternatively the canister itself may be replaced by a new one having fresh activated carbon granule and soda lime packs 4 and 5 respectively.

In operation air exhaled by the user passes through the activated carbon pack 4 and the soda lime pack 5 in which the carbon dioxide content of the exhaled air is absorbed, the exothermic reaction causing the temperature of the purified exhaled air to rise, typically, to 65°C and the relative humidity to 100%. The insertion of the chemical heat exchanger 4 between the breathing tube 2 and the carbon dioxide absorbent soda lime pack 5 traps the moisture from the the users exhaled breath. As a result of the exothermic reaction in the pack 5 the temperature of the activated carbon granule pack 4 rises. Since the activated carbon is a poor conductor of heat a large amount of heat and moisture is stored therein thus resulting in inhaled temperature levels significantly lower than those referred to above, for example between 42° and 48°C at a relative humidity of 70% or less. Such levels of temperature and relative humidity are very much more acceptable to the user. The activated carbon may be in granular form but other forms such as extrudate are also suitable.

The chemical heat exchanger can also be used in a closed circuit breathing apparatus of the unidirectional type as shown in Figure 2. This apparatus comprises a mouthpiece 1 coupled by breathing tubes 2

and 9 having non-return valves 22 and 21 to a canister 3 and a counterlung 7 respectivaly. The canister 3 has a soda lime pack 5 sandwiched between two activated carbon granule packs 4 and a tube 10 connecting the canister 3 to the counterlung 7 which has an oxygen inlet valve 11 therein. Here the breath exhaled through the mouthpiece 1 via the non-return valve 22 passes into the canister containing the activated carbon packs 4 and soda lime pack 5 into the tube 10 and thence to the counterlung 7 into which oxygen is admitted through the inlet valve 11, the mixture then passing through the breathing tube 9, non-return valve 21 and into the mouthpiece 1 on inhalation. Again heat and moisture are trapped in the activated carbon granule packs 4 to reduce the temperature and relative humidity of the inhaled air to acceptable levels. As in the apparatus described with reference to Figure 1, the apparatus of Figure 2 may also incorporate metal screens 6 between the soda lime pack 5 and the activated carbon granule packs 4 and also at the inlet and outlet of the canister 3.

CLAIMS

1. A closed circuit breathing apparatus incorporating a carbon dioxide absorbing medium, characterized in that a chemical heat exchanger in the form of activated carbon is located in a position relative to the carbon dioxide absorbing medium to reduce the temperature and relative humidity of the exhaled purified air resulting from the exothermic reaction thereof.

2. A closed circuit breathing apparatus comprising a mouthpiece, a counterlung, means for admitting oxygen into said counterlung, and a carbon dioxide absorbing medium located between said mouthpiece and said counterlung, characterized in that a chemical heat exchanger in the form of activated carbon is located in a position relative to the carbon dioxide absorbing medium to reduce the temperature and relative humidity of the exhaled purified air resulting from the exothermic reaction thereof.

3. A closed circuit breathing apparatus according to Claim 2, including a breathing tube coupled to said mouthpiece and a canister having an inlet connected to said breathing tube and an outlet connected to said counterlung, in which said carbon dioxide absorbing medium and said chemical heat exchanger are housed within said canister.

4. A closed circuit breathing apparatus according to Claim 3, wherein said carbon dioxide absorbing medium and said chemical heat exchanger are each in the form of replaceable packs located within said canister with the chemical heat exchanger pack between said inlet and said carbon dioxide absorbing medium pack.

5. A closed circuit breathing apparatus according to Claim 4 wherein said carbon dioxide absorbing medium is sodalime.

6. A closed circuit breathing apparatus according to any one of Claims 4 or 5, including filters positioned one between said packs and one at each end thereof to prevent dust from entering the breathing tube and counterlung.

7. A closed circuit breathing apparatus according to Claim 3, including a first non-return valve in said breathing tube, a second breathing tube coupled to said mouthpiece, and a second non-return valve in said second breathing tube; and wherein said counterlung has an inlet coupled to the outlet of said canister and an outlet coupled to said second breathing tube so that exhaled air passes through said first mentioned breathing tube via said first non-return valve to said canister where the temperature and relative humidity of said exhaled air is reduced and passes into said counterlung which combines with oxygen admitted by said means into said counterlung to pass via said second non-return valve in said second breathing tube to said mouthpiece upon inhalation by the wearer of said apparatus.

8. A closed circuit breathing apparatus according to Claim 7, wherein said carbon dioxide absorbing medium is in the form of a replaceable pack and said chemical heat exchanger comprises two replaceable packs of activated carbon between which is located said pack of carbon dioxide absorbing medium.

9. A closed circuit breathing apparatus according to Claim 8, including filters positioned between said packs and at each end of said canister to prevent dust from entering the counterlung.

10. A closed circuited breathing apparatus as claimed in any one of Claims 7, 8, or 9, wherein said carbon dioxide absorbing medium is sodalime.

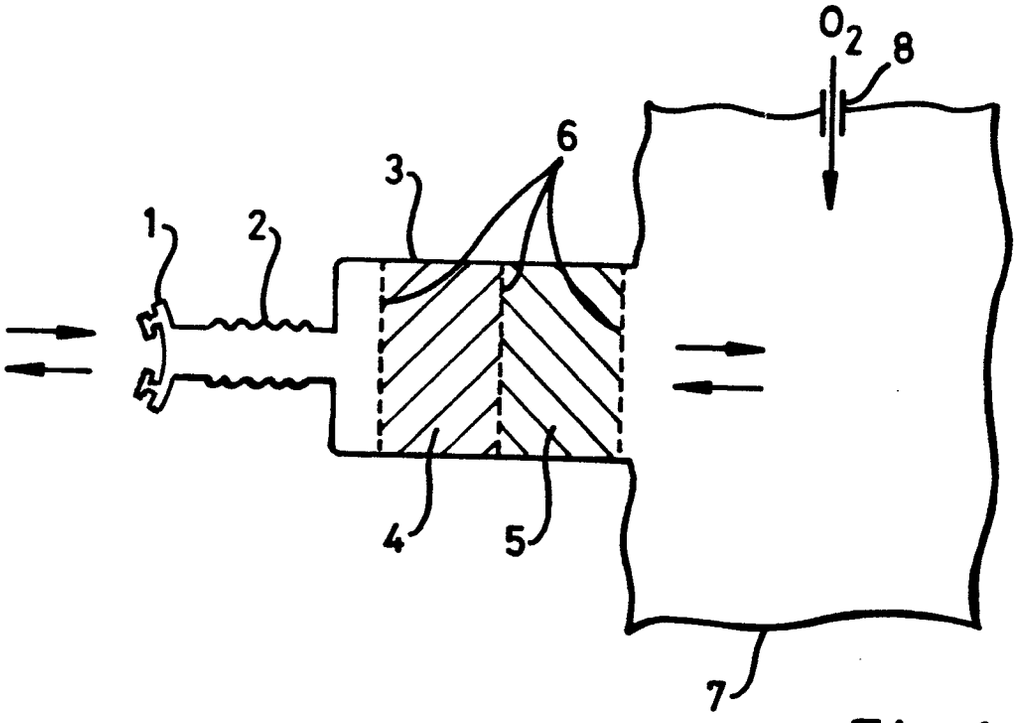

Fig 1

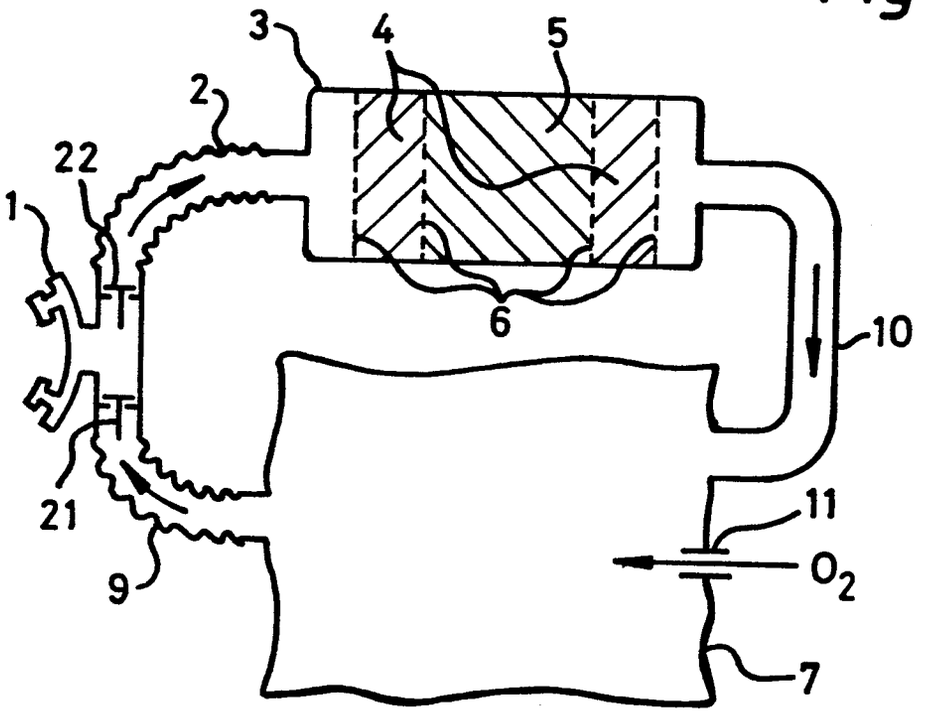

Fig.2