(12) UK Patent Application (19) GB (11) 2 220 572 (13) A

(43) Date of A publication 17.01.1990

(21) Application No 8910149.7

(22) Date of filing 03.05.1989

(30) Priority data
(31) 3819988 (32) 11.06.1988 (33) DE

(51) INT CL⁴
A61M 16/00

(52) UK CL (Edition J)
A5T TDB

(56) Documents cited
None

(58) Field of search
UK CL (Edition J) A5T TDB
INT CL⁴ A61M

(71) Applicant
Drägerwerk Aktiengesellschaft

(Incorporated in the Federal Republic of Germany)

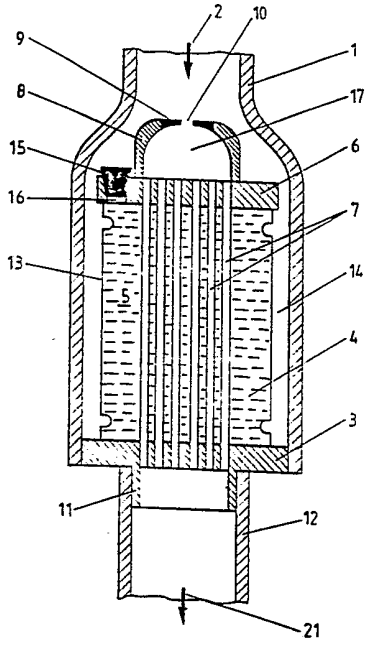
Moislinger Allee 53-55, D-2400 Lübeck,
Federal Republic of Germany

(72) Inventor
Adalbert Pasternack

(74) Agent and/or Address for Service
Haseltine Lake & Co
Hazlitt House, 28 Southampton Buildings,
Chancery Lane, London, WC2A 1AT, United Kingdom

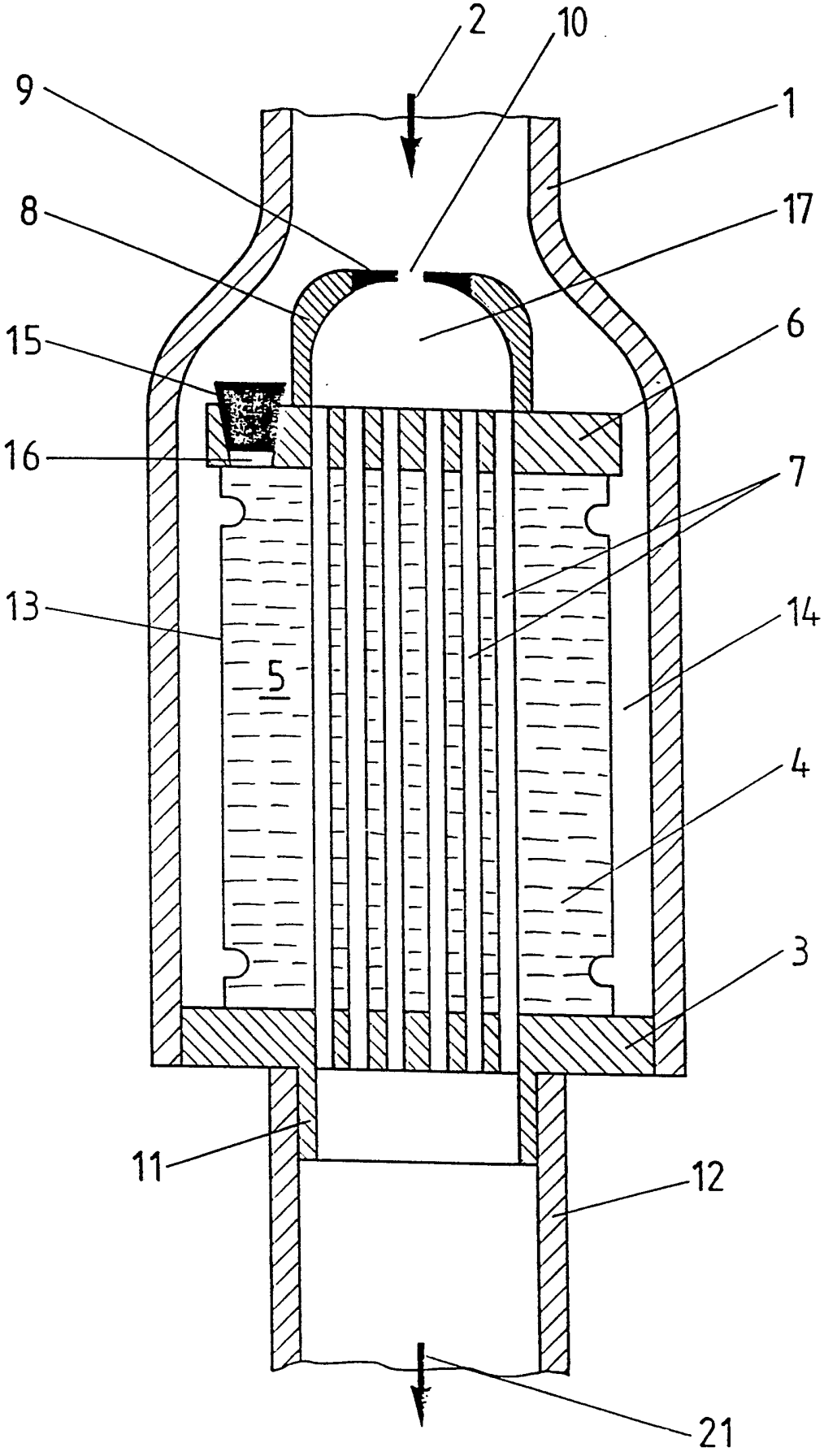
(54) Respiratory air humidifier for a respirator

(57) A respiratory air humidifier for a respirator, which humidifier is fitted in the path of a respiratory tube (12) leading from a respiratory gas source to a respiratory connector and which is formed from a multi-layer evaporation separating membrane (7) made of a waterproof but water-vapour-permeable semi-permeable material, whose first separating face is enclosed by humidifying chamber (4) filled with water (5) and having a resilient outer wall (13) which can be placed under overpressure, and whose other separating face opens into a respiratory air chamber (17) conveying the air to be breathed, is improved in that its humidification capacity is independent of the pressure in the interior of the hollow tubes (7) and the humidification of the air to be breathed is adapted to the requirements of the user of the device. To this end, in order to produce an overpressure independent of breathing, the outer wall (13) of the humidifying chamber (4) is surrounded by a prechamber (14), which can be filled with respiratory air and which is flow-connected with the respiratory air chamber (17) via a throttle (9, 10).



GB 2 220 572 A

2220572



RESPIRATORY AIR HUMIDIFIER FOR A RESPIRATOR

This invention relates to a respiratory air humidifier for a respirator.

A respiratory air humidifier is known from DE-B-2900484. This known respiratory air humidifier comprises a multi-layer evaporation separating membrane in the form of a bundle of hollow tubes through the individual tubes of which respiratory air can flow. Each hollow tube is surrounded by humidifying liquid water, which is contained in a humidifying chamber, whose resilient outer surface is acted upon by a pressure spring. As a result of the overpressure produced, an increasing amount of water vapour is forced through the semi-permeable membrane into the respiratory air chamber, so that the inhaled air is enriched in water vapour.

The disadvantage of the known respiratory air humidifier is that the degree of humidification is dependent upon the pressure existing in the respiratory tube, which in turn is dependent upon the breathing of the user of the device. For example, if in the case of the known respiratory air humidifier, the respiratory pressure increases inside the hollow tubes, then the overpressure exerted by the spring on the humidifying chamber is reduced, which means that less water vapour can be released from the water supply into the respiratory air. On the other hand, since the humidifying chamber is permanently under overpressure as a result of the pressure of the spring, the transfer of water vapour into the inner chamber of the hollow tubes takes place even when there is no air flow. Since there is then no removal of water vapour from the respiratory air, this leads to the formation of condensation on the inner surfaces of the hollow tubes. This results in blockage of individual tubes or even of all the tubes. The resulting increased flow resistance

in the respiratory tube is a hinderance to the person wearing the device and can even make breathing totally impossible.

It is therefore the object of the present invention to improve a respiratory air humidifier of the above type in such a manner that its humidification capacity is independent of the pressure in the inner chamber of the hollow tubes and the humidification of the respiratory air is adapted to the requirements of the person wearing the device.

According to the present invention, there is provided a respiratory air humidifier for a respirator, which humidifier is adapted to be fitted in the path of a respiratory tube leading from a respiratory gas source to a respiratory connector, and which comprises a plurality of membranes permeable to water vapour but non-permeable to water, the one faces of the membranes partially defining a humidifying chamber that in use is filled with water and that has a resilient outer wall that can be placed under overpressure, and the other faces of the membranes partially defining a respiratory air chamber through which in use respiratory air is conveyed; wherein, in order to produce an overpressure independent of respiration, the outer wall of the humidifying chamber is surrounded by a preliminary chamber which can be filled with respiratory air and which is flow-connected to the respiratory air chamber via a throttle.

The present invention also provides a respiratory air humidifier for a respirator, which humidifier is adapted to be fitted in the path of a respiratory tube leading from a respiratory gas source to a respiratory connector, and which comprises a multi-layer evaporation separating membrane made of a waterproof but water-vapour-permeable semi-permeable material, whose first separating face is enclosed by a

humidifying chamber that in use is filled with water and that has a resilient outer-wall that can be placed under overpressure, and whose other separating face opens into a respiratory air chamber through which in use respiratory air is conveyed; wherein, in order to produce an overpressure independent of respiration, the outer wall of the humidifying chamber is surrounded by a preliminary chamber which can be filled with respiratory air and which is flow-connected to the respiratory air chamber via a throttle.

The advantage of the invention essentially lies in the fact that the pressure exerted upon the humidifying chamber, and consequently the pressure difference produced over the outer face of the membrane, follows the respiratory pressure in the respirator. When the respiratory air is stationary, the same pressure exists on both faces of the membrane and a transfer of water vapour from the humidifying chamber into the respiratory air chamber is prevented. Only upon inhalation, as a result of the consequent fall in pressure in the respiratory air chamber relative to the humidifying chamber, does water vapour pass through the membrane into the respiratory air chamber as a result of the difference in pressure. The humidification of the respiratory air therefore increases as more air is required by the person wearing the device, which greater demand for air produces a relatively high pressure drop in the respiratory air chamber.

Preferably, the plurality of membranes are in the form of a plurality of tubes. Preferably, the one ends of the plurality of tubes are held in a top plate and the other ends of the plurality of tubes are held in a base, the ends held in the top plate opening into an upper chamber provided with said throttle, and the ends held in the base opening into the respiratory tube. In the latter case, the humidifier can be easily fitted at

a desired location in a respiratory line.

If the respiratory air humidifier is fitted in the medium pressure portion of the respirator, the pressure drop produced between the prechamber and the respiratory air chamber during inhalation increases, thereby raising the humidification capacity and the efficiency. By setting a higher medium pressure, a sufficient drop in pressure can be obtained even in the case of an increased air requirement.

Further adjustment between the respiratory pressure and the pressure drop across the membrane can be obtained by a suitable variation of the throttle opening.

An embodiment of the invention will now be described, by way of example, with reference to the drawing.

The single drawing shows a respiratory air humidifier which comprises an outer housing 1 which is designed as part of a respiratory tube 12 for supplying respiratory air from an air source (not shown) to a respiratory connector of a respirator (also not shown). The respiratory air flows during inhalation in the direction of the arrow 2. The housing 1 has a base 3 to which a humidifying chamber 4 is secured, which chamber contains water 5 used for humidification. The top of the humidifying chamber 4 is closed by a top plate 6. A plurality of hollow tubes 7 surrounded by the water 5 pass through the base and the top plate 6. The ends of the tubes 7 in the top plate 6 are covered by an upper chamber 8 having a throttle 9 which defines a throttle opening 10. The upper chamber 8 forms a respiratory air chamber 17. The ends of the tubes in the base 3 are connected via a socket 11 to the continuation of the respiratory tube 12. Air flow, in the direction of the arrow 21, continues inside the respiratory tube 12 to the respiratory connector of the

respirator (not shown).

The housing 1 encloses the outer wall 13 of the humidifying chamber 4 at a distance so that a prechamber 14 is formed, which prechamber, depending upon the direction of flow, is connected on the one hand to the respiratory air being supplied, which is under medium pressure, and on the other to the ends of the tubes 7 in the top plate 6.

The top plate 6 has an opening 16 which can be closed by a plug 15 and through which the water 5 can be introduced.

When there is no flow, i.e. when the person wearing the device is not breathing, the same pressure exists in the prechamber 14 and in the respiratory air chamber 17 and in the tubes 7. In this case, humidification of the respiratory air does not take place, since the transfer of water vapour from the water 5 into the interior of the tubes 7 is prevented on account of the lack of a pressure drop. If, on the other hand, the respiratory air flows in the direction of the arrows 2 and 21, then there is a pressure drop between the prechamber 14 and the interior of the tubes 7, so that the pressure exerted over the resilient outer wall 13 of the humidifying chamber 4 conveys water vapour from the water 5 into the interior of the tubes 7 and moistens the air to be breathed. The pressure drop which is produced upon inhalation can be varied by adjusting the pressure in the respiratory tube 1, and therefore in the prechamber 14 as well, by appropriate variation of the size of the throttle opening 10.

The tubes 7 act as a plurality of membranes that separate liquid phase (i.e. the water 5) from vapour phase (i.e. the water vapour generated by evaporation of water through the tubes 7).

A plurality of tubes 7, acting as multi-layer

membranes, are used because it is sometimes necessary to cause the evaporation of large amounts of water, e.g. when the user is breathing large amounts of water. This is achieved by the use of the plurality of tubes 7.

The tubes 7 forming the membranes are permeable to water vapour but not to water. Examples of suitable materials for forming the tubes 7 are polytetrafluoroethylene and polyethylene.

CLAIMS

1. A respiratory air humidifier for a respirator, which humidifier is adapted to be fitted in the path of a respiratory tube leading from a respiratory gas source to a respiratory connector, and which comprises a plurality of membranes permeable to water vapour but non-permeable to water, the one faces of the membranes partially defining a humidifying chamber that in use is filled with water and that has a resilient outer wall that can be placed under overpressure, and the other faces of the membranes partially defining a respiratory air chamber through which in use respiratory air is conveyed; wherein, in order to produce an overpressure independent of respiration, the outer wall of the humidifying chamber is surrounded by a preliminary chamber which can be filled with respiratory air and which is flow-connected to the respiratory air chamber via a throttle.

2. A humidifier according to claim 1, wherein the plurality of membranes are in the form of a plurality of tubes.

3. A humidifier according to claim 2, wherein the one ends of the plurality of tubes are held in a top plate and the other ends of the plurality of tubes are held in a base, the ends held in the top plate opening into an upper chamber provided with said throttle, and the ends held in the base opening into the respiratory tube.

4. A humidifier according to any of claims 1 to 3, when arranged in the medium pressure portion of the respirator.

5. A humidifier according to any of claims 1 to 4, wherein the throttle is adjustable.

6. A humidifier according to any of claims 1 to 5, wherein the membranes comprise polytetrafluoroethylene or polyethylene.

7. A humidifier according to claim 1, substantially as hereinbefore described with reference to, and as shown in, the drawing.

8. A respiratory air humidifier for a respirator, which humidifier is adapted to be fitted in the path of a respiratory tube leading from a respiratory gas source to a respiratory connector, and which comprises a multi-layer evaporation separating membrane made of a waterproof but water-vapour-permeable semi-permeable material, whose first separating face is enclosed by a humidifying chamber that in use is filled with water and that has a resilient outer-wall that can be placed under overpressure, and whose other separating face opens into a respiratory air chamber through which in use respiratory air is conveyed; wherein, in order to produce an overpressure independent of respiration, the outer wall of the humidifying chamber is surrounded by a preliminary chamber which can be filled with respiratory air and which is flow-connected to the respiratory air chamber via a throttle.

Published 1989 at The Patent Office, State House, 66/71 High Holborn, London WC1R 4TP. Further copies may be obtained from The Patent Office. Sales Branch, St Mary Cray, Orpington, Kent BR5 3RD. Printed by Multiplex techniques ltd, St Mary Cray, Kent, Con. 1/87