

Oct. 21, 1969

J. E. TATHAM

3,473,531

RESERVOIR BAG FOR BREATHING CIRCUITS

Filed July 26, 1965

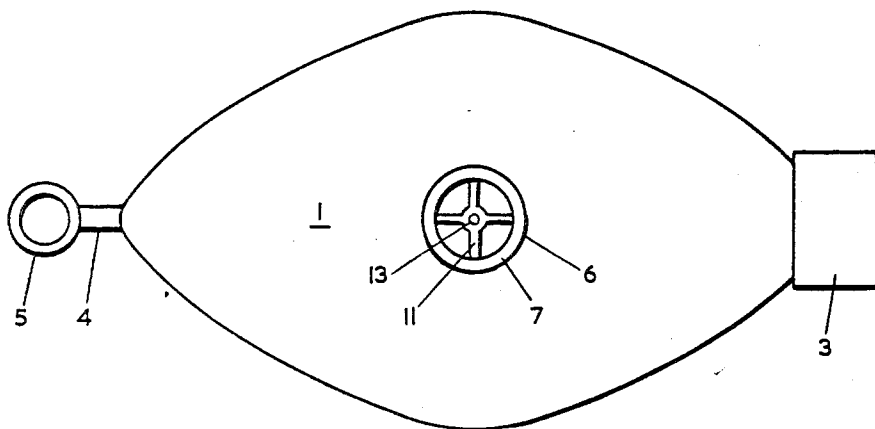


FIG. 1

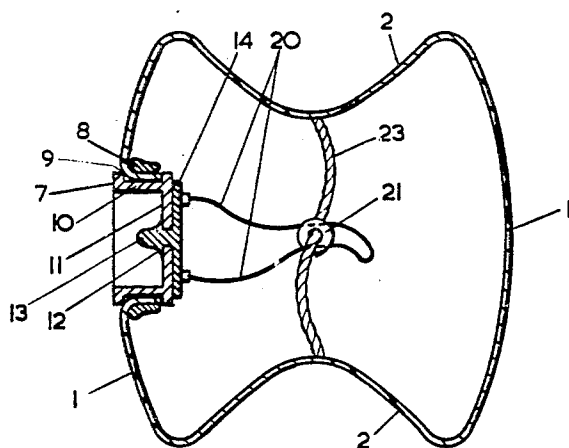


FIG. 2

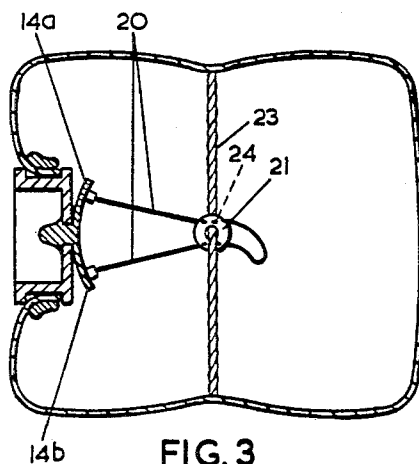


FIG. 3

INVENTOR
JOHN EDWARD TATHAM

BY *Townsend & Speers*
ATTORNEYS

1

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3,473,531

RESERVOIR BAG FOR BREATHING CIRCUITS
John Edward Tatham, Harpenden, England, assignor to
The British Oxygen Company Limited, a British
company

Filed July 26, 1965, Ser. No. 474,784
Claims priority, application Great Britain, July 29, 1964,
30,140/64

Int. Cl. A61m 15/00

U.S. Cl. 123—202

3 Claims

ABSTRACT OF THE DISCLOSURE

A self-venting elongated rebreathing bag which operates irrespective of the direction in which the equatorial zone of the bag is squeezed has a vent valve in one side wall. This is connected to at least two points spaced-apart in the equatorial zone from both the valve, each other, and the flow port. Thus the vent valve is opened only when the bag is distended to a chosen extent, and not by manual pressure on the walls of the bag.

This invention relates to reservoir bags such as are used in breathing circuits for treating human or animal patients.

In breathing circuits to which an inhalant gas is supplied under pressure, it is usual to include a reservoir bag from which gas is delivered to the patient. Such bags commonly consist of a bladder of rubber or like elastic material, which in the expanded condition is generally ellipsoidal, and which has a port at one or both of the extremities of its major axis for normal gas flow into and out of the bag.

One particular form of such a bag may be described as being defined by four walls, all of elliptical form, joining along their peripheries. Two of the walls, facing one another, assume a flat position when the bag is collapsed, and will be referred to as the end walls, and the other two walls fold inwardly along their major axis when the bag is collapsed and will be referred to as the side walls. The minor axes of the elliptical walls define an equator around the bag, and the general region of the bag surface around this equator will be referred to as the equatorial zone. The plane including this equator will be referred to as the equatorial plane.

When a reservoir bag is used in anaesthesia circuits, assisted or controlled ventilation of the patient may be carried out by manual squeezing of the bag, the gas being delivered through an inflating valve. Pressure is applied manually about the equatorial zone of the bag.

Certain inflating valves have the property that if, due to excessive gas flow from the anaesthetic machine during exhalation, the reservoir bag becomes distended, the inflating valve will change to the inflating phase before exhalation is complete and remain in this state until action is taken to rectify the condition.

When a reservoir bag is included in the circuit of an automatic lung ventilating machine, it is essential to prevent excessive pressure being generated at the inlet of the machine, whilst at the same time ensuring that the reservoir bag has reached an optimum capacity before any venting occurs through the over-spill valve which is usually incorporated in such circuits.

In order to prevent excessive distension of the bag, it has been proposed by Professor E. A. Pask of Durham University, England, to provide in the equatorial zone of the bag a vent valve which is connected by a substantially non-elastic thread to the corresponding point on the opposite side of the bag, the arrangement being such that when the bag reaches a predetermined degree of expansion, the thread becomes taut and any further expansion of the bag causes the valve to open and release the contents. A bag fitted with a valve of this kind has come to be known as a self venting bag and will hereinafter be so referred to.

A disadvantage of such a self venting bag is that if manual pressure is applied to the equatorial zone in a direction normal to the axis of the thread, the gas will be vented through the valve to atmosphere instead of being delivered to the patient.

It is an object of this invention to provide a self venting bag in which the vent valve remains closed when the bag is only partially inflated irrespective of the direction in which pressure is applied manually about the equatorial zone.

Another object of this invention is to provide a self venting bag in which the degree of expansion of the bag which can occur before the valve opens is adjustable.

A further object of this invention is to provide a self-venting bag, the contents of which can be readily dumped should the need arise.

According to the present invention, in a reservoir bag of the self venting type as herein defined, for use in breathing circuits, the movable valve element of the vent valve is connected to the bag by traction means at points spaced apart around the equatorial zone, whereby when, upon inflow of gas, the bag expands in excess of a predetermined extent in any direction in the equatorial plane the traction means exerts a force on the movable valve element to open the vent valve and permit discharge of gas therethrough.

Where the bag is defined by two end walls and two side walls, all of elliptical form and joining along their peripheries, and the vent valve is disposed in one end wall, the traction means may be connected between the movable valve element of the vent valve and the side walls of the bag.

The traction means may comprise an anchor thread connected between the side walls, and a traction thread connected between the movable valve element of the vent valve and the anchor thread.

Preferably the traction means, and in particular the traction thread, is adjustable in effective length so that the permissible degree of expansion of the bag may be adjusted.

The traction thread may be connected to the anchor thread by a coupling member which frictionally grips the traction member at a desired position along its length.

The traction thread may be looped around the anchor thread, but in a preferred arrangement the traction thread is secured by friction coupling means to a rider which is slidable along the anchor thread, said friction coupling means permitting the effective length of the traction thread to be altered whereby the permissible degree of expansion of the bag may be adjusted.

The valve element may comprise a centrally fixed flexible disc overlying a discharge port, and the traction thread may consist of two strands which are secured to diametrically opposite points on the disc.

A particular embodiment of the invention will now be described with reference to the accompanying drawings, in which:

FIGURE 1 shows a plan view of a self venting bag in the collapsed state;

FIGURE 2 shows a lateral cross-section, in the equatorial plane, of the bag in the partially expanded state; and

FIGURE 3 shows a similar cross-section of the bag in the state of maximum expansion.

The body of the self venting bag is in the form of a moulded bladder defined by two end walls 1 and two side walls 2 of sheet rubber, the walls joining along their edges to form a sealed enclosure. The walls are elliptical

3

in form, and in the collapsed state of the bag the end walls lie flat and the side walls fold in along the lines of their major axes. At one extremity of the bag is a port defined by a stiff rubber collar 3, which is adapted to seal onto a conduit (not shown) of a breathing circuit for normal gas flow into and out of the bag. At the other extremity, in accordance with known practice, the interior of the bag communicates with a tube 4 closed at its outer end which may be severed to provide a second port. For hanging up the bag a loop 5 is provided.

One of the end walls 1 has a central port 6 in which is secured a plug 7 of rigid plastic material by means which include a resilient ring 8 holding a lip 9 of the port 6 in sealing engagement with the cylindrical flanges 10 of the plug 7. Discharge ports are provided between cross arms 11 joining the cylindrical flanges 10. At the intersection of the arms 11 is a hole 12, in which is fitted the spigot 13 of a resilient valve member, the main portion of which is in the form of a flexible disc 14. The valve member is centrally fixed by the spigot 13, the disc providing radially movable valve elements in the form of two flaps 14a and 14b which cover the discharge ports.

To each of the flaps 14a and 14b is attached a strand 20 of a traction thread which may be pulled to move the flaps 14a and 14b radially of the bag and so open the vent valve formed by the combination of the plug 7 and the flexible disc 14. Each strand 20 passes through a small hole 24 in a washer-like rubber rider 21 which constitutes an adjustable coupling member frictionally gripping the traction thread at a desired position along its length. The small holes 24 extend transversely and non-axially through the rider 21 and are of such a size that each strand is normally held in the rider 21 by friction. However, when it is desired to adjust the effective length of traction thread between the rider 21 and the valve flaps 14a and 14b it is possible at any time to overcome this frictional force and to slide the rider 21 along these strands 20 to the required position.

In addition to the strands 20 the traction means for the vent valve includes an anchor thread 23 which extends across the bag and has its ends secured to the centres of the side walls 2. This anchor thread passes through the central orifice of the rider 21, and it will be seen that the valve flaps 14a and 14b are thereby connected to the centres of the side walls 2.

It is not necessary that the anchor thread be connected to the centre points of the side walls, nor that these points are disposed accurately in the equatorial plane so long as the traction means can respond to excessive expansion of the bag in the equatorial plane.

The operation of the invention may be understood from FIGURES 2 and 3. As shown in FIGURE 2 the bag is only partially inflated by gas supplied through the port defined by the rubber collar 3, and the strands 20 of the traction thread and the anchor thread 23 are slack. In this state the vent valve remains closed by virtue of the resilience of the disc 14, which normally assumes the flat position, and the pressure of gas within the bag against the disc 14.

In normal use, the partially inflated bag is squeezed about its equatorial zone to cause flow of gas from the bag into the breathing circuit, and the pressure in the bag then increases. The vent valve cannot open under

4

these conditions, irrespective of the direction in the equatorial plane in which the bag is squeezed, since the traction thread remains slack. However, if an excessive quantity of gas is supplied to the bag an expansion to the state shown in FIGURE 3 may take place, with resultant tautening of the strands 20 of the traction thread and of the anchor thread 23. As shown, the traction means has opened the vent valve and excess pressure is being vented.

In this design the operation of the vent valve is not dependent on whether it is the end walls or the side walls which are squeezed. If however the bag is compressed lengthwise, the expansion of the bag in the equatorial plane opens the valve and this allows the contents to be rapidly dumped.

It will be noted that the vent valve is, by nature, a one-way valve. In consequence when the bag is in the collapsed condition so that no gas is stored in the bag for inhalation, the patient can continue to inhale by drawing air in through the vent valve.

In an alternative form not shown in the drawings, no anchor thread is used and instead the strands of the traction thread are joined directly between the vent valve flaps and the centres of the side walls.

I claim:

1. A reservoir bag for use in a breathing circuit, comprising an inflatable bag defined by two side walls and two end walls, all elliptical form, joining along their peripheries, the bag being generally ellipsoidal in expanded condition and having a flow port at one extremity of its major axis and a vent port in one end wall, a vent valve in the vent port having a movable valve element, and traction means within the bag connecting the movable valve element to the said side walls, whereby when, upon inflow of gas through the flow port, the bag expands in excess of a predetermined extent in the equatorial plane a traction force is exerted on the movable valve element to open the vent valve and permit discharge of gas there-through; said traction means comprising an anchor thread secured at its ends to the said side walls, and a traction thread connected to the anchor thread and extending to the movable valve element.

2. A reservoir bag as claimed in claim 1, and including a coupling member connecting the traction thread to the anchor thread, the coupling member being adapted to frictionally grip the traction thread at a desired position along its length.

3. A reservoir bag as claimed in claim 2, wherein the traction thread comprises two strands extending from the coupling member to the movable valve element, and wherein the movable valve element comprises a centrally fixed disc overlying a discharge port in the vent valve, the said two strands being connected respectively to two diametrically opposed points on the disc.

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WILLIAM E. KAMM, Primary Examiner

U.S. Cl. X.R.

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