

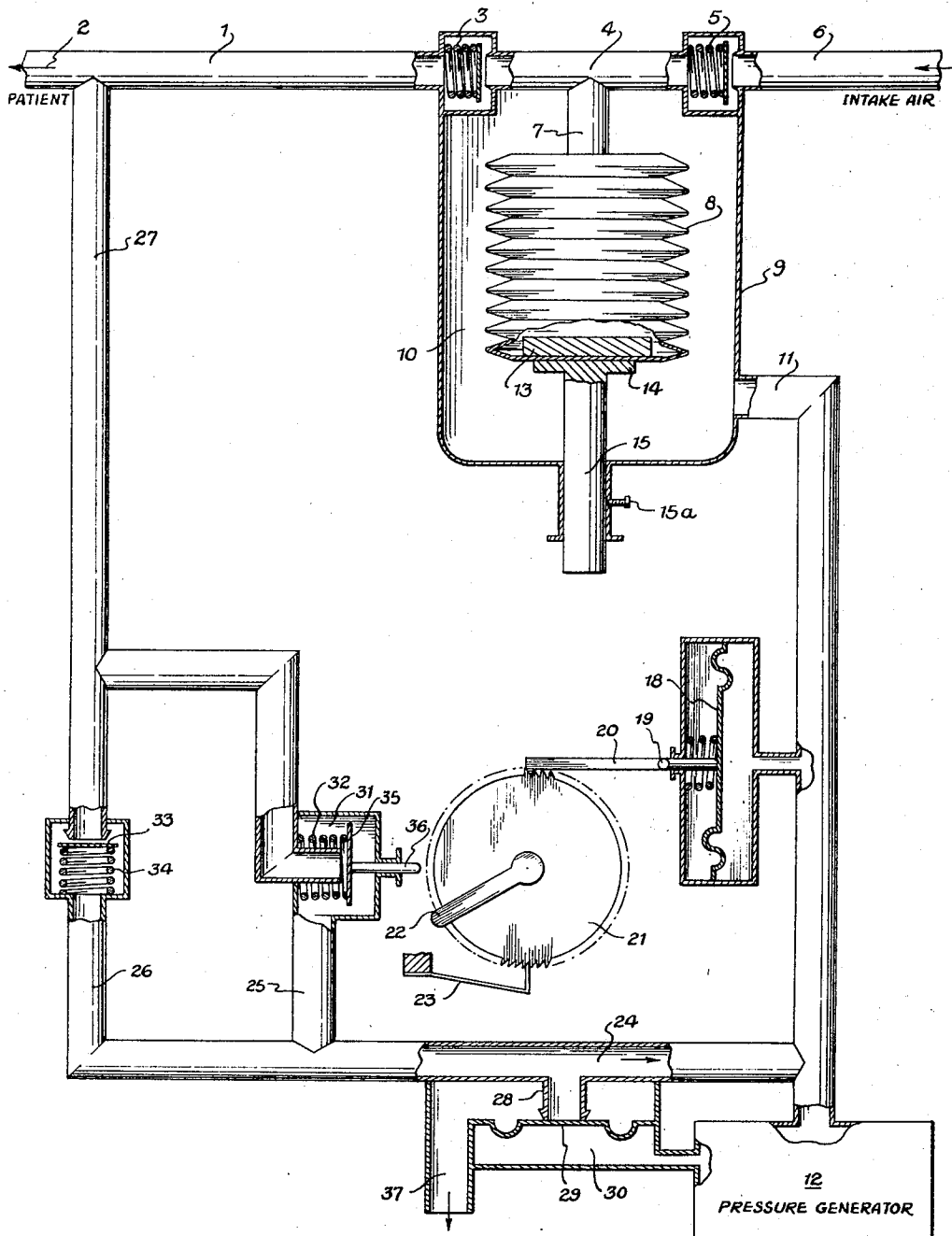
Aug. 13, 1968

K. FREYTAG

3,396,724

BREATHING APPARATUS WITH PERIODIC VOLUME CHANGE

Filed April 25, 1966



INVENTOR

Klaus Freytag

BY

Bailey, Stephens and Huetting
ATTORNEYS

1

3,396,724

BREATHING APPARATUS WITH PERIODIC VOLUME CHANGE

Klaus Freytag, Lubeck, Germany, assignor to Otto H. Drager, Lubeck, Germany

Filed Apr. 25, 1966, Ser. No. 544,789

Claims priority, application Germany, May 8, 1965, D 47,204

5 Claims. (Cl. 128—145.6)

This invention relates to a breathing apparatus and in particular to a breathing apparatus for forcing a deep breath into the lungs of a person.

A conventional breathing apparatus is used to force air into the lungs of a patient at predetermined intervals and for drawing air out of the lungs during intervening intervals. Such an apparatus has a housing containing a breathing bag and the pressure in the housing is alternately changed from greater than to less than atmospheric pressure in order to compress and expand the bag. An adjustable stop is used to limit the maximum expansion of the bag.

Atelectasis, that is lung collapse, can occur during the continuous breathing with such apparatus because the breathing cycle is very uniform.

The object of this invention is to avoid the disadvantages of the heretofore described apparatus. In this invention, the breathing apparatus has an air inhaling tube to intermittently supply the patient with compressed air and an exhale tube having an exhaust valve. Furthermore, in this invention, the exhaust valve is engageable with the valve closing mechanism which is operated by an adjustable automatic means for counting the cycles greater than and less than atmospheric pressures in the inhaling tube. Thus this closure mechanism, after a predetermined number of greater than atmospheric pressure cycles, keeps the exhaust valve closed during a period of air exhalation, that is during a period of greater than atmospheric pressure in the inhaling tube and also is provided with a second exhaust valve having a higher resistance than the first exhaust valve and which is connected in parallel with the first exhaust valve. Consequently, after a predetermined number of breaths taken in by the patient, the exhalation pressure is increased by blocking the first exhaust valve so that all of the air is not exhaled by the patient. Consequently, on the next inhaling of air, the patient's lungs become filled with a larger amount of air which, in effect, means that the patient has taken a deeper breath.

The means by which the objects of the invention are obtained are described more fully with reference to the accompanying schematic drawing.

The drawing illustrates a breathing apparatus in which the air forced into the lungs is spontaneously exhaled. However, the invention can be applied to a breathing apparatus which not only forces the air into the lungs but also withdraws the air from the lungs.

The drawing also shows the invention applied to a breathing apparatus in which pressure cycles are produced on a breathing bag mounted in a housing and connected to the inhaling tube leading to the patient.

Inhaling tube 1 leads to a patient in the direction of the arrows 2, this tube containing a check valve 3 which opens in the direction of the arrow 2. Tube 1 is connected to a T-pipe 4 whose other leg contains a check valve 5 in communication with the intake air tube 6. Valve 5 opens in the direction of the arrow 2. Tube 6 is open to the atmosphere. Pipe 7 leads from pipe 4 into a bellows breathing bag 8 which is mounted in a housing 9 forming a chamber around bellows 8. Chamber 10 is connected by way of pipe 11 to a gas pressure generator 12, not shown in detail. This generator produces alternately greater than and less than atmospheric gas pressures, these pres-

2

ures being cyclically applied to chamber 10. The bottom of bellows 8 is closed by a heavy plate 13 which rests on a stop plate 14 but is not joined thereto. This stop plate is connected to a guide rod 15 which can be adjusted to various heights by a set screw 15a so as to limit the expansion of the breathing bag 8.

When the generator 12 produces a greater than atmospheric pressure, the breathing bag 8 is contracted and in so doing forces the air present in the bag through tube 1 into the lungs of the patient. A following less than atmospheric pressure produced by generator 12 then expands bag 8. In so doing, valve 3 closes, valve 5 opens, and air is drawn into the bag through tube 6 and pipe 7.

The flexible diaphragm 18 is connected to pipe 11 and this diaphragm is attached by a pivot joint 19 to a pawl 20 which engages ratchet 21. Ratchet 21 carries a cam 22 and is kept from freely rotating by a leaf spring 23 which engages the ratchet teeth.

Generator 12 is further connected to a pipe 24 which extends into connection with parallel pipes 25 and 26, which pipes lead to the common pipe 27 extending to tube 1. Pipe 24 is joined to a valve port 28 which is opened and closed by a flexible diaphragm 29. Chamber 30 opposite port 28 communicates with generator 12. When the port 28 is open, pipe 24 communicates through pipe 27 to the atmosphere.

A greater than atmospheric pressure produced by generator 12 forces diaphragm 29 to close port 28. This also closes a first exhaust valve 31 mounted in pipe 25, which valve is normally held open by spring 32. A second exhaust valve 33 mounted in pipe 26 is also closed.

While second exhaust valve 33 is normally held closed by its spring 34, first valve 31 is normally held open by spring 32. The valve head 35 of valve 31 is connected to a stud 36 which is engageable by cam 22 to close valve 31.

When generator 12 produces a less than atmospheric pressure, the diaphragm 29 is released from port 28 so that pipes 11, 24, 25 and 26 communicate with the atmosphere through pipe 27. A less than atmospheric pressure is produced in chamber 10. The weight of bottom plate 13 causes bag 8 to expand downwardly until stopped by plate 14 which results in the drawing in of air through valve 5 while valve 3 is closed. This less than atmospheric pressure also pulls against diaphragm 18 so that pawl 20 indexes ratchet 21. In the ratchet position shown in the drawing, the patient can exhale air through pipe 27 and open first exhaust valve 31.

When generator 12 has gone through a predetermined number of pressure cycles, cam 22 engages stud 36 of valve 31 so that the valve is held closed during one exhaling of air by the patient. Thus during this exhaling period, the air can be exhaled only through second exhaust valve 33 which will open under the greater pressure thereagainst. However, the exhalation of the air of the patient is incomplete because of the resistance of valve 33 so that, during the next inhalation that the lungs are filled from bag 8, the lungs will be filled more than during the other breaths so that the patient receives in effect a deeper breath.

The next following less than atmospheric pressure from generator 12 again indexes ratchet 21 so that cam 22 is disengaged from stud 36 and valve 31 opened and normal exhalation resumed.

The predetermined number of cycles for closing valve 31 can be easily adjusted by, for example, changing the ratchet 21.

Having now described the means by which the objects of the invention are obtained, I claim:

1. A breathing apparatus comprising a housing, a breathing bag in said housing, pressure means for putting said bag under greater than or less than atmospheric

3

pressure to expand or contract said bag, first tube means joined to said bag for supplying air to a patient, second tube means joined to said first tube means for removing air exhaled by the patient, first exhaust valve means in said second tube means in normally opened position for the release of exhaled air, pressure counting means engageable with said first exhaust valve means for closing said first exhaust valve means after a predetermined number of greater than atmospheric pressures applied to said bag, and second exhaust valve means in said second tube means having a greater resistance to opening than said first exhaust valve means for releasing a portion only of the air being exhaled by the patient.

2. A breathing apparatus as in claim 1, said pressure counting means being mechanically engageable with said first exhaust valve means.

3. A breathing apparatus as in claim 2, said pressure counting means including flexible diaphragm means movable in response to said pressure means for mechanically operating said first valve means.

4. A breathing apparatus as in claim 3, said pressure

4

counting means further including a pawl and ratchet actuatable by said diaphragm and engageable with said first exhaust valve means.

5. A breathing apparatus as in claim 4, further comprising a cam carried by the ratchet and engageable with a stud on said first exhaust valve means.

References Cited

UNITED STATES PATENTS

10	2,414,747	1/1947	Kirschbaum	128—172.1
	2,770,231	11/1956	Falk	128—145.6
	2,969,789	1/1961	Mörch	128—145.8
	2,972,345	2/1961	Spigel	128—145.6
15	3,033,195	5/1962	Gilroy et al.	128—145.8
	3,033,196	5/1962	Hay	128—145.8
	3,068,857	12/1962	Black	128—145.8
	3,251,359	5/1966	Ismach	128—145.8

20 RICHARD A. GAUDET, *Primary Examiner*.
K. L. HOWELL, *Assistant Examiner*.