United States Patent

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[73] Assignee **By mesne assignments, to Abbott Laboratories, a corporation of Illinois**

[54] RESUSCITATOR MASK

8 Claims, 5 Drawing Figs.

[52] **U.S. Cl.** **128/145.8,** 128/145.7, 128/142.3
[51] **Int. Cl.** **A62b 7/02**
[50] **Field of Search** 128/145.7, 145.8, 203, 205

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ABSTRACT: This specification describes an oxygen breathing mask device, suitable either for incorporation in a single package with a small pressure vessel, or which may alternatively be used with only minor modifications in conjunction with a separate somewhat larger source of oxygen, or other gas, the mask assembly being formed with concertina side walls to permit the same to be collapsed when not in use, and to be expanded to provide a relatively substantial container for oxygen at low pressure, and which incorporates a face mask at one end of the container and which also incorporates means for attaching conduits thereto so as to permit the container to be used as a pump, the oxygen or other gas being delivered through such conduits to a further mask and further describes the use of a particularly advantageous tubular pressure vessel and pressure reducing outlet means and quick release sealing means.

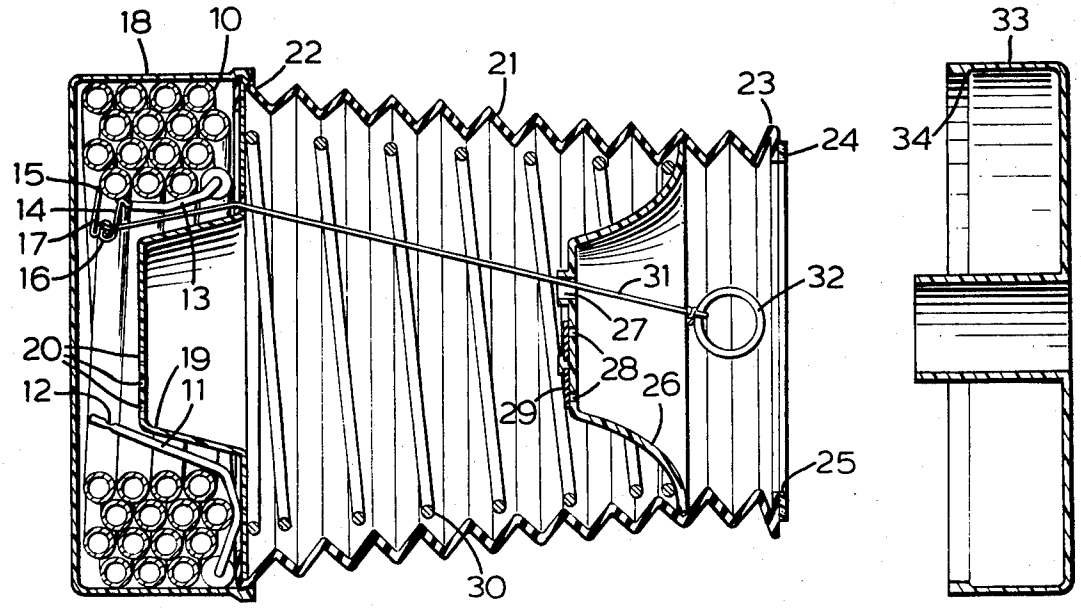

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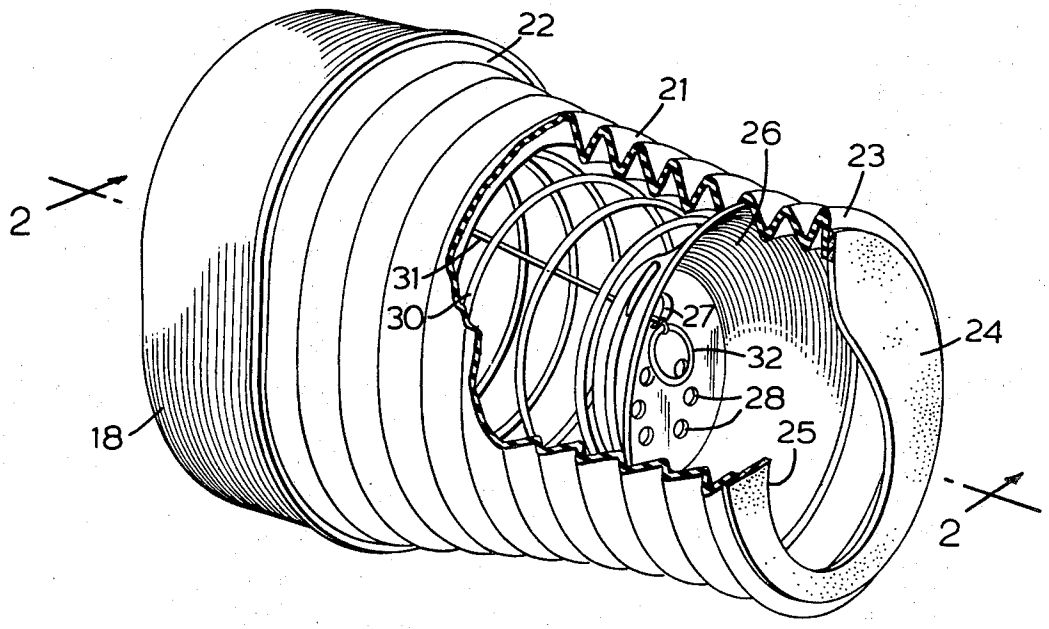
FIG. 1



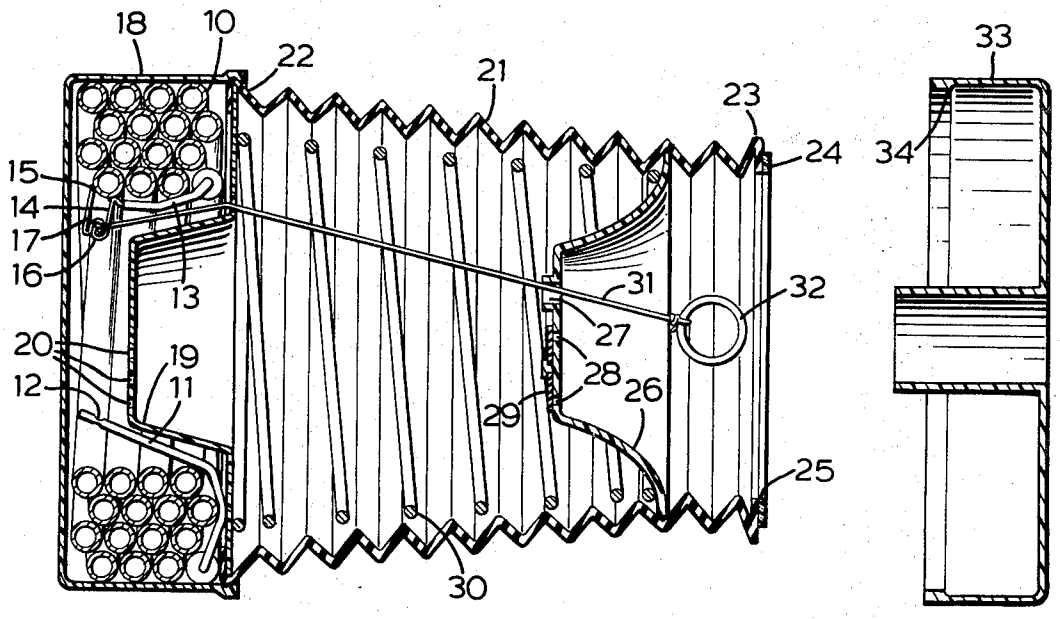


FIG. 2

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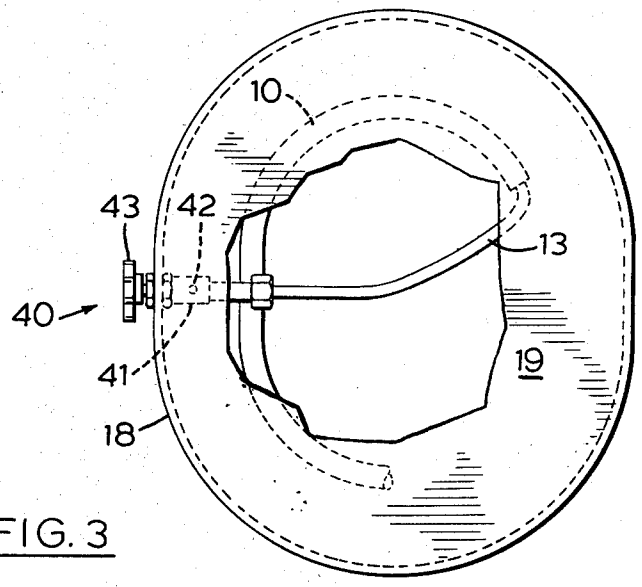
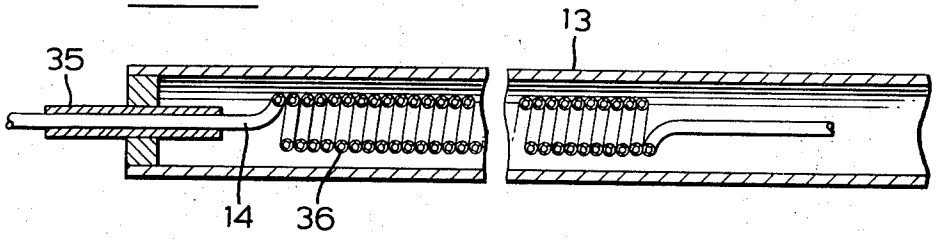


FIG. 3

FIG. 4



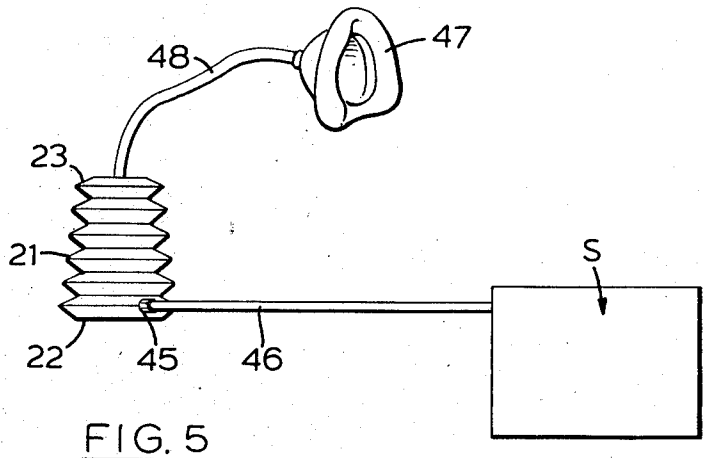


FIG. 5

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RESUSCITATOR MASK

This invention relates to a breathing mask for resuscitators and the like of the type which are used for injured or sick persons who are unconscious and either breathing only with difficulty or who have stopped breathing altogether. Various forms of apparatus are available for use by doctors, nurses, emergency workers, and others for attempting to revive injured or sick persons by resuscitation. Such equipment is usually of great complexity and high cost with the result that it is only available in such locations as hospitals, ambulances and the like, and has not achieved wide distribution with individual doctors or in other emergency locations such as swimming pools and public parks on the one hand, or in industrial locations where accidental electrical shock or other form of injury where resuscitation techniques may be beneficial. In addition, the equipment available up to the present time has been difficult to use, requiring a certain amount of training and skill.

It has been proposed to provide portable hand-held oxygen dispensing devices providing both resuscitator and inhalator action, incorporating a tubular pressure vessel comprising a length of tubing wound upon itself, and having easily breakable means sealing one end of the tube and incorporating flow-metering means, and a mask which fits around the face of the user. A somewhat larger version of a similar device is carried in a small carrying case and incorporates gauges and flow-regulating means, and a flexible hose having a mask connectable at its free end, permitting the same to be used over a greater length of time in the case of a patient who is totally incapacitated. Such devices are described in U.S. Pat. No. 3,392,724 assigned to Therapeutic Research Corporation Limited.

In the case of both types of apparatus however, it is desirable to provide a face mask which can be compressed into a small space for storage and which is instantly ready for use, on the one hand, and on the other hand, and oxygen accumulator bag, for accumulating low pressure oxygen as it escapes from the pressure vessel in sufficient volume to permit the patient to completely fill his lungs at one breath. In addition, for the sake of economy, it is desirable that the face mask and oxygen accumulator should be combined into a single unit, and should preferably be such that a large number of parts thereof will be substantially interchangeable for use on either unit. Furthermore, in some cases, it is desirable to provide for a resuscitator action of the unit, whereby a patient who is unconscious may be supplied with oxygen at a low positive pressure whereby to force the oxygen into his lungs. According to the present invention, such resuscitator action may advantageously be incorporated in the design of the mask and oxygen accumulator so that it may also serve as a pump if required.

It is therefore an objective of the present invention to provide a mask for use with an oxygen breathing system which is of simple, reliable construction, which is collapsible for storage and is instantly ready for use at any time, and which defines a substantial storage volume for accumulation of oxygen at breathing pressures, and which may also in some circumstances be used to provide a pumping action.

More particularly, it is an objective of the present invention to provide a mask having the foregoing advantages which is formed with a bellows system and wherein the bellows are arranged in a tapering configuration so as to permit the same to be stored flat.

More particularly, it is an objective of the present invention to provide a mask device incorporating a spring means there within expanding the same and permitting the same to be used as a pump if required.

More particularly, it is an objective of the present invention to provide a mask member which is adapted for free inhalation by a patient who is conscious, and is also provided with inlet and outlet valve means permitting the same to be used with a pumping action, and means for attaching the same to an oxygen hose if desired.

More particularly, it is an objective of the present invention to provide a mask member having the foregoing advantages in which the several parts thereof are adaptable for use both as a mask and oxygen accumulator and also as a pump, without substantial alteration.

The foregoing and other advantages will become apparent from the following description of a preferred embodiment of the invention which is now given by way of example only and with reference to the following drawings in which like reference devices refer to like parts thereof throughout the various views and diagrams in which:

FIG. 1 is a perspective illustration partially cut away to reveal the construction, showing an oxygen inhalator incorporating a mask member according to the invention;

FIG. 2 is a sectional side elevation along the line 2–2 of FIG. 1;

FIG. 3 is an end view of the mask member showing the portion adapted to engage the face, and also showing a further modification of the inhalator device which may be incorporated in some cases;

FIG. 4 is a greatly enlarged sectional view of a portion of the inhalator as shown in FIGS. 1 and 2 along the line 4–4 of FIG. 2; and

FIG. 5 is a schematic illustration showing the use of the mask as a pumping unit.

Referring now to FIGS. 1 and 2, it will be seen that the invention comprises an oxygen high pressure storage vessel consisting of a length of tube **10** wound upon itself into a doughnut-shaped configuration to provide a sufficient volume for storage of oxygen at approximately 5,000 p.s.i. so as to insure delivery of an adequate volume for a period of about 20 minutes in the preferred case. Filling of the tube **10** is accomplished through pipe **11** which, after filling, is sealed at **12**, a sufficient length of pipe **11** being exposed from one end of tube **10** to permit the same to be refilled and resealed several times. At the other end of tube **10** there is provided a further pipe **13** for permitting metered release of oxygen from tube **10**. The metering means consists of a capillary tube identified as reference **14** (shown in more detail in FIG. 4). Capillary tube **14** is sealed with solder at **15** and is provided with a looped portion **16** and adjacent weakened neck portion **17** to permit the same to be readily broken thereby releasing the oxygen at a metered flow rate. Coiled tube **10** is contained within a plastic housing **18** closed by a recessed closure member **19** provided with a series of perforations **20** therein permitting oxygen to pass therethrough.

The face mask portion of the invention consists essentially of the bellows-like member **21** having an enlarged end **22** of a diameter corresponding to that of housing **18** and attached thereto, and a reduced end **23** of a size appropriate for use as a face mask. The bellows member **21** tapers from end **22** to end **23** in cross-sectional size, and in this way, when compressed for storage, it occupies a very much smaller space than if the bellows' folds fell one on top of the other. It will be noted that when made of this construction, the member **21** may readily be formed by, for example, "below moulding" techniques at very low cost. When used in the embodiment of FIG. **1** and **2**, openings will be cut both at end **22** and end **23** since, in the below moulding process, both ends would normally be completely sealed. However, in the embodiment of FIG. **5**, the larger end **22** will be left sealed for reasons to be described below.

At the reduced end **23** of member **21**, a resilient padded disc **24** is attached, preferably formed, for example, of flexible foam plastic or foam rubber, and having a mouth-opening **25** cut therein to accommodate the mouth and nose of a patient. Within member **21** there is provided a recessed partition member **26** formed of moulded plastic and having a moulded plastic socket **27** formed therein, to permit flow of oxygen therethrough. In addition, a plurality of perforations or small passageways **28** are formed in partition **26** and provided with a flexible thin rubber diaphragm **29** on the inner side thereof to provide a one-way valve action.

In order to extend the bellows member **21**, a spring **30** is provided extending between closer member **19** and partition member **26**.

A cord **31** is attached to looped portions **16** of capillary tube **14** and extends within member **21** and passes through socket **27**. A ring **32** is attached to the free end of cord **31** for pulling the same to break capillary tube **14**.

A cover portion **33** having an inwardly directed peripheral lip **34** thereon is provided to make snap engagement with plastic housing **18** and hold bellows member **21** in its collapsed, compressed condition.

With particular reference to FIG. **4**, it will be noted that this is a greatly enlarged sectional illustration of pipe **13** and capillary tube **14**. It will be noted that capillary tube **14** where it extends outwardly from pipe **13** is contained within an outer sleeve **35** the function of which is to protect and strengthen capillary tube **14** which might outherwise become accidentally flattened or cracked during assembly. Capillary tube **14** extends within pipe **13** and is formed into an elongated tight coil **36**. The purpose of capillary tube **14**, which may be in the region of from one to four-thousandths of an inch internal diameter, is to provide a metered flow rate of gas escaping from vessel **10** which is not of massive construction, and also which, being contained within pipe **13**, is not subjected to the pressure difference stressing the vessel **10** and pipe **13**. However, as is well known, if there is any moisture present in the oxygen or other gas compressed within the vessel **10**, and that gas is then permitted to pass through a very fine orifice, the orifice will tend to become blocked with frozen particles and will eventually ice-up completely. It has been found that this problem can be overcome by providing a considerable length of capillary tube **14** wound into tight coils **36** as shown and located within pipe **13**. In this way, the bore of capillary tube **14** can be slightly enlarged, that is to say it can be made slightly larger than the size of a mere orifice which would provide the equivalant flow rate. In addition, it is found that there is considerably less tendency for the very fine passage way defined by capillary tube **14** to become iced up, because the heat stored within the walls of capillary tube **14**, and the very efficient transfer of heat from its surroundings, due to the very thin walls of tube **14**, make it much more difficult for local cold spots to develop at which ice particles will accumulate. This function of what may be termed a reverse heat sink is of course greatly enhanced where capillary tube **14** is made of copper. The tight coil **36** of capillary tube **14** by forcing the high pressure gas to follow a tortuous path provides a labyrinth which considerably slows down the rate of flow, and the combination of this effect with the heat exchange effect, provide a very satisfactory answer to the problem of icing up, which of course is greatly aggravated by the very high pressures stored within vessel **10**.

According to a further embodiment of the invention as shown in FIGS. **1** and **2**, the invention may be further modified as shown in FIG. **3**, by the addition of an on/off control valve indicated by the general reference **40**. In this case, the capillary tube **14** is connected directly to the body **41** of valve **40**, and the capillary tube **14** is left unsealed, the pressure being held by means of any suitable needle valve mechanism (not shown) contained within body **41** of valve **40**. A gas outlet hole **42** is drilled in body **41** to permit escape of gas into the interior of housing **18** from where it will pass through openings **20** into bellows member **21**. Body portion **41** is arranged to extend transversely through one side of housing **18** and is provided with a handle **43** for switching the same on and off.

According to a further embodiment of the invention illustrated in FIG. **5**, the bellows member **21** with minor modifications may be employed in association with a separate oxygen source both as a breathing mask and also as a bellows pump for use as a resuscitator.

In this further embodiment, bellows member **21** is of identical construction to the bellows member shown in FIGS. **1** and **2** with the exception that the larger end **22** is left closed, and spring **30** bears against the interior of the closed end **22**. The other features of bellows member **21** as described in FIGS. **1** and **2** are identical, that is to say it is provided with a smaller end **23** opened and provided with a foam plastic face piece **24** and with an interior partition **26** having a socket **27** and a one-way inlet **28** therethrough.

The only addition to these features, is the provision of a socket **45** formed in the side of bellows member **21** adjacent to closed end **22** for connection to a source of oxygen, indicated generally as the reference S. It will be understood that the oxygen source S may simply be any form of pressure vessel having suitable outlet and flow control valves (not shown). However, one particularly preferred form of oxygen source is disclosed in co-pending application Ser. No. 618,636, filed Feb. 27, 1967, now U.S. Pat. No. 3,502,075 and assigned to Therapeutic Research Corporation Limited.

When using this form of the invention, a flexible hose **46** is connected between source S of oxygen and socket **45**. Oxygen will be supplied continuously at substantially atmospheric pressure to the interior of bellows member **21**. From there, oxygen will flow continuously through socket **27** for breathing where a simple inhalator function is required. When a resuscitator action is required, then a separate oxygen mask of any suitable design indicated as **47** may be connected to socket **27** by a further hose **48**. The bellows member **21** may then be placed on any suitable secure surface, and hand pressure is applied to the smaller end **23** to compress the bellows. Such compression will force oxygen through socket **27** and into mask **47** at a somewhat elevated pressure. It will be understood that when hand pressure is removed from such smaller end **23**, the spring within the bellows will cause rapid recovery of the bellows to their original shape. Such recovery will probably take place at a greater rate than the incoming low pressure oxygen can effectively replace. As a result, a somewhat reduced pressure will momentarily occur within the bellows member **21**, and such reduced pressure will cause atmospheric air to be drawn into the interior of such bellows member **21** through the one-way inlet valve **28**, until a pressure equilibrium is reached. In this way, upon the next downward stroke of bellows **21**, under hand pressure, a mixture of air and oxygen will be delivered into mask **47** to the patient. Such a mixture is generally to be preferred rather than delivering pure oxygen for any length of time to an unconscious patient, and it is intended that this mixing effect will take place continuously, both for the beneficial effect on the patient, and also because it will reduce the volume of oxygen being consumed. In this way, a high pressure source of oxygen, which may for example have a rated capacity equal to continuous delivery of low pressure oxygen for about 90 minutes or so, to in fact last for two or three times that length of time. An additional benefit which occurs from the use of the invention, is that if and when the supply of oxygen becomes exhausted, the bellows member **21** will continue to be fully effective for the purposes of delivering pure atmospheric air for resuscitation purposes without any change in the apparatus whatever, atmospheric air being alternately drawn in through inlet valve **28** and forced upwardly through socket **27** into mask **47**. In this way, it is possible with no changes in the apparatus whatever to provide for continuous manual resuscitation of a patient for many hours, if such should be necessary.

As stated above, the only change in the bellows member **21** for use in this way, is that the larger end **22** is left sealed. As stated, this is in any event a necessary result of the most economical mode of manufacturing bellows member **21**, namely plastic blow moulding, which would in fact normally leave both ends **22** and **23** closed. Thus, in the manufacturing of the modified form of bellows member **21**, all that is required is to omit one step in the manufacture, namely the removal of the larger end **22**. It will be understood that this modified form of bellows member **21**, is nonetheless entirely suitable as an emergency oxygen mask in itself, notwithstanding such modification. In this way, the oxygen source S is connected to bellows member **21** by means of socket **45** precisely as described above. However, the additional conventional mask **47** and hose **48** is omitted, and the face mask constituted by the added disk **24** at the smaller end **23** of bellows member **21** is applied to the face of the patient. In this case, if necessary, an assistant can apply manual pressure to the larger end **22** of bellows member **21** thereby forcing some oxygen into

the lungs of the patient. As hand pressure is relieved, so also is pressure relieved as between the padded disc **24** and the face of the patient. Thus, fresh atmospheric air can enter around padded disc **24** and through inlet valve **28**. Alternatively, if the assistant holds padded disc **24** firmly in contact with the face of the patient, then a suction effect can be applied to the lungs of the patient as hand pressure is removed from large end **22**, bellows member **21**, thereby assisting in the resuscitation effect.

It will therefore be seen that by the practice of the invention, a combined breathing mask and low pressure gas accumulator may be provided having many different uses, and being applicable with only minor modifications either to a small emergency oxygen inhalator, or to a larger professional care unit at a low cost and with a high degree of reliability and effectiveness.

The foregoing description of a preferred embodiment of the invention is given here by way of example only.

I claim:

1. A portable oxygen mask assembly having both resuscitator and inhalator capability, and comprising:

a long tubular pressure vessel wound upon itself for containing oxygen gas under high pressure;

manually operably gas release means connected to said vessel for permitting the discharge of gas therefrom;

housing means for said pressure vessel, said gas release means discharging into said housing means;

a compressible container of generally tubular construction for accumulating gas at lower pressures, discharged from said gas release means;

concertina folds formed in side walls of said container around a central axis of said container whereby to lie flat one over the other when folded and compressed and to permit said container to be extended for a pumping action, said container being attached around one end thereof to said housing;

opening means at one end of said container communicating between said housing and said compressible container permitting gas discharged by said gas release means to pass into and fill said container;

face mask means arranged around the other end of said container;

partition means separating said mask means from the interior of said container;

outlet means in said partition means for continuous flow of gas through said partition means to said mask means;

spring means within said container arranged to normally extend the same, and being compressible to permit said container to be collapsed; and

removable cover means for said housing shaped and dimensioned to fit over said mask means and said container when in its compressed condition and retain same to form a substantially closed package together with said housing.

2. A portable oxygen mask assembly as claimed in claim **1** including one way air inlet valve means in said partition means communicating between the exterior and the interior of said container whereby to permit mixing of air and gas therein.

3. A portable oxygen mask assembly as claimed in claim **1** wherein said concertina folds are formed in said container around a central axis thereof, said folds being of a continuously decreasing size among a major portion of the length of said container whereby to provide an overall generally frusto-conical tapering effect along the said major partition thereof, permitting said folds to lie at least partially one inside the other when folded and compressed.

4. A portable oxygen mask assembly as claimed in claim **1** including restricted orifice means connected to said pressure vessel for permitting escape of gas therefrom under reduced flow conditions, said orifice means being connected for delivery of gas to said container at about atmospheric pressure.

5. A portable oxygen mask assembly as claimed in claim **1** wherein said release means comprises one end of a thin walled tube of breakable material, and including a sealed end on the free end of said tube normally retaining said gas therein under high pressure, and a reduced neck adjacent said sealed end, and manually operable means attached to said sealed end for manually moving the same and causing the same to break at said reduced neck thereby permitting flow of gas therefrom into said container.

6. A portable oxygen mask assembly as claimed in claim **1** wherein said housing is formed around said tubular pressure vessel and enclosing the same on at least three sides thereof leaving one side thereof open; means attaching one end of said compressible container around said open side of said housing, restricted orifice means located within a portion of said tubular pressure vessel, and communicating with the interior thereof; tubular conduit means extending from said orifice means exteriorally of said tubular pressure vessel thereby establishing a gas flow outlet path through said orifice means, the outer end of said tubular conduit means being located to deliver gas from said tubular pressure vessel to said compressible container.

7. A portable oxygen mask assembly as claimed in claim **1** wherein said housing is formed around said tubular pressure vessel and encloses the same on at least three sides thereof leaving one side thereof open; means attaching one end of said compressible container around said open side of said housing; a closure member for said open side of said housing extending thereacross and separating said container from the interior of said housing; opening means through said closure member for passage of gas therethrough; manually operable valve means connected to said tubular pressure vessel, and operable to release gas therefrom slowly, said valve means being located within said housing, and discharging said gas into said housing for passage through said opening means in said housing closure member, and, valve handle means extending outwardly from said housing for manual operation of said valve means.

8. A portable oxygen mask assembly as claimed in claim **1** wherein said concertina folds are formed in said container around a central axis thereof, said folds being of a continuously decreasing size along a major portion of the length of said container, the largest said fold being at that end of said container adjacent said housing, and decreasing in size towards the opposite end of said container, and concertina folds formed in the remaining minor portion of said container, adjacent said outer end, to define the face mask portion of said container; said partition means being of generally well shaped construction and fastened within said container at approximately the transition between said major portion and said minor portion thereof, and, a soft flexible face engaging member attached around said outer end of said container, and defining an opening therethrough for reception of the nose and mouth of a user.