

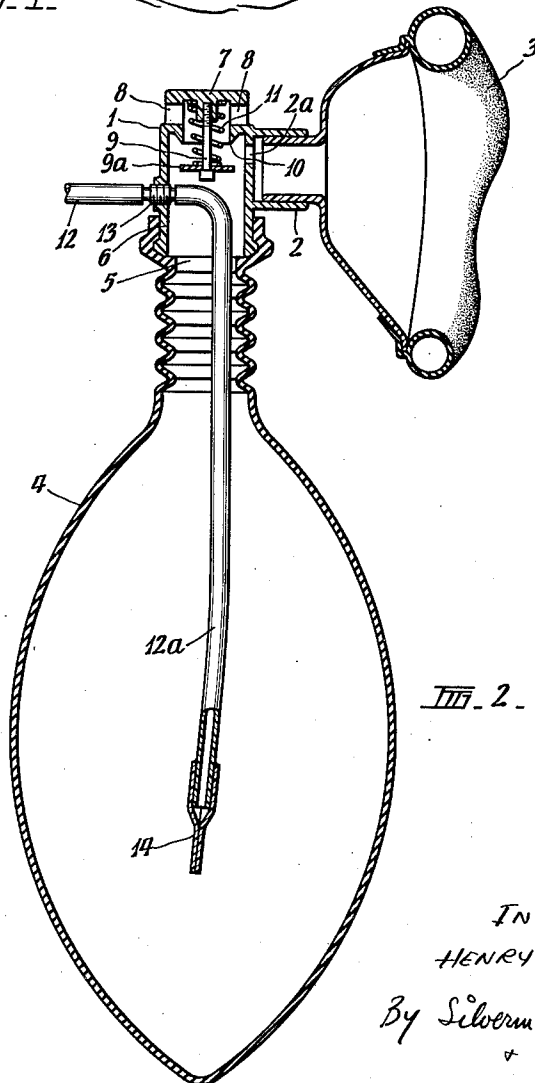
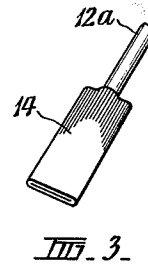
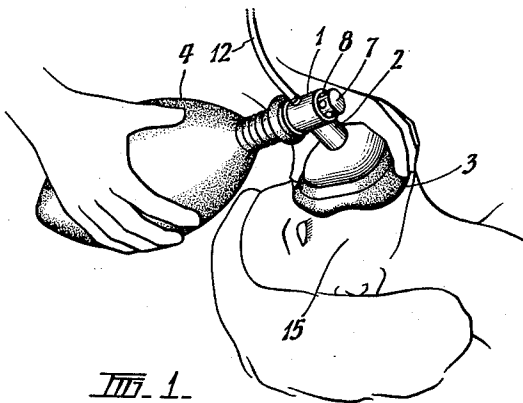
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RESUSCITATOR

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3,196,866 RESUSCITATOR

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This invention relates to devices for re-establishing normal breathing when that function has been halted or impaired by immersion or other suffocatory circumstance.

An object of the invention is to provide a resuscitator which is of simple, light-weight inexpensive construction, and which needs only one air valve whereas prior resuscitators have required at least two air valves, one for admitting fresh air, and the other for the exhalation of used air.

A further object of the invention is to provide a resuscitator which can be applied to the patient without obstructing or impeding the normal breathing of the patient to any noticeable extent. It should be noted here that presently known resuscitator devices are so constructed that the patient can breathe normally with the resuscitator still in position on his face only if his breath is strong enough to exert sufficient pressure to open, and maintain open, a series of valves of the device. This is of importance where, for example, under emergency or battle-field conditions there is a large number of patients awaiting attention, and not enough persons to give that attention, i.e. to operate the resuscitator devices. Under these conditions the resuscitator device of this invention may be applied to a patient by comparatively unskilled personnel and left in position on the patient's face without impairing any normal breathing ability which the patient may still have, while being immediately available for operation.

Another object of the invention is to provide a resuscitator having means whereby oxygen, or any other gas, may be added to the air supplied to a patient from the resuscitator. A more particular object is to provide an arrangement whereby the so-called "dead-space" air may be breathed by the patient. In this connection it will be understood that when a patient's lungs are filled with air (or oxygen, or oxygen-enriched air) from the resuscitator, some of that "air" does not reach the patient's lungs as it serves to fill the air passages from the mouth to the lungs. This dead-space air contains enough oxygen to be still breathable to advantage. The useful breathing of the dead-space air is of considerable importance where oxygen is added to the air which is administered through the resuscitator, as supplies of oxygen are often difficult to provide at the scene of an emergency.

A further object is to ensure that the carbon dioxide content of the air which is sent into the patient's lungs is not appreciably higher than the natural concentration of carbon dioxide in the air. A feature of the invention is that, although the dead-space air can be effectively breathed by using the resuscitator, this does not give rise to any substantial increase in the carbon dioxide content of the air which is actually sent into the patient's lungs upon operation of the resuscitator of the invention. This is of importance in improving the resuscitatory effect when compared, for example, with the mouth-to-mouth

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method of resuscitation, in which the air sent into the patient's lungs has, unavoidably, a carbon dioxide concentration which is higher than natural concentration of carbon dioxide in the air.

Still another feature related to the effective use of dead-space air is that such use permits relatively small oxygen containers to be used quite effectively: for example, the small ampoules of oxygen, which contain about 8 litres of that gas (when expanded to atmospheric pressure) and which are commercially available and readily refillable by the suppliers of oxygen. Alternatively the supply of oxygen may be derived from the usual commercial cylinders or bulk supply systems.

Still another object of the present invention is to provide a resuscitator which may be used in a completely satisfactory manner for resuscitation with atmospheric air only, should this be ever desirable, or in the event of oxygen being unavailable for the enrichment of the air.

According to this invention there is provided a resuscitator device of the type having a compressible self-distending reservoir with one opening, a tubular head member connected to the opening of the head member having a second opening for connection to a face mask or directly to the breathing organs of a patient, and a third opening leading to atmosphere, characterised in that the head member incorporates a resiliently loaded valve which is adapted to be displaced from its normal position to close the third opening whenever the reservoir is compressed, and remains in that position as long as the pressure within the reservoir is in excess of atmospheric pressure by an amount greater than the pressure exerted by the resilient load on the valve. Preferably the device is further provided with a supply tube through which oxygen or other gases can be supplied to the reservoir, characterised in that the supply tube is provided with a valve which is adapted to close whenever the reservoir is compressed.

A presently preferred embodiment of the invention will now be described by way of example with reference to the accompanying drawings, in which:

FIGURE 1 is a perspective view of the resuscitator in use, applied to the face of a patient;

FIGURE 2 is a cross-sectional view through the resuscitator; and

FIGURE 3 is a detailed perspective view of the valve at the end of the oxygen supply conduit.

The head member 1 may be moulded or otherwise formed out of any rigid material, such as a suitable plastic material. It is made in the form of a tubular T-piece, one of the branches 2 having a common type face mask 3 secured airtightly thereto. The reservoir is a generally oval bag 4 which is made from resilient rubber or like material, and has an opening 5 at one end, by means of which it is secured to one of the other branches 6 of the head member 1. The walls of the bag 4 are slightly thinner in the vicinity of both ends of the bag, whereby the self-distending characteristics of the bag are improved. The third branch 7 of the head member 1 has ports 8 formed therein which communicate with the atmosphere. A central valve stem 9 projects into the head member and provides a mounting support for an air "spill" valve which is in the form of a closure disc 9a. The disc 9a seats upon a circumferential valve seat 10 formed in the head member at the inner end of the third T-branch 7. The disc 9a is slightly loaded by a compression spring 11 which keeps the valve normally open. If desired, the

spill valve may be in the form of a resilient flap or a self-opening check valve or the like.

The head member 1 preferably has a fourth opening for attachment of an oxygen supply pipe 12 and this opening may be constituted by a short tube 13 to which the oxygen supply hose 12 may be connected. An extension hose 12a is joined to the tube 13, leading into the interior of the bag 4, and carries at its free end a one-way valve 14 which is able to open freely to allow gas under slight pressure to enter the bag through the tubes 12, 12a, but which closes whenever the bag 4 is compressed to prevent gas flow in the opposite direction.

In use of the resuscitator, the face mask is applied to the mouth and nostrils of the patient 15, being held there by the operator. Alternatively, the face mask may be furnished with harness-like straps, elastic head bands, suction caps, or the like by which the resuscitator may be attached to the patient's head with the face mask properly fitted and held in the required position. If the patient has any breathing ability, that ability may be exercised notwithstanding the presence of the resuscitator as the patient's nose and mouth have direct access to atmospheric air through the face mask 3, the opening 2a in the head member and the atmospheric air ports 8.

Where breathing is to be started or augmented by use of the resuscitator, it is only necessary for the operator to squeeze the reservoir bag 4, which will cause air to flow from the bag through the head member, closing the spill valve 9a on the way, and enter, through the opening 2a, into the patient's lungs. When hand pressure on the reservoir bag is relaxed, the self-distending property of the bag permits and encourages exhalation. At the start of exhalation the dead-space air which is still breathable, is exhaled into the bag 4. The valve 9a remains closed during this brief period, whilst the bag slowly expands or distends to its normal size. The internal capacity of the reservoir bag 4 and the strength of the spring 11 are so chosen that by the time the deoxygenated, or used, air is begun to be exhaled from the patient's lungs, the reservoir bag will be fully distended, and the air pressure therein reduced to below the normal exhalation pressure, so that the valve 9a will be opened by the spring 11. The remainder of the exhalation breath is discharged directly to atmosphere through the opening 2a and the air ports 8.

It will be clear that the loading effect of the spring 11 must be such as will keep the valve 9a open during the exhalation of deoxygenated air, and hence at all gas pressures within the head member and the reservoir bag which are slightly above atmospheric, i.e. which can be created therein by exhalation. When the bag is squeezed however, a gas pressure of approximately 0.25 inch of water will suffice to close the spill valve.

Where oxygen is to be used and a source thereof attached to the pipe 12, such source will, of course, be furnished with its own flow control means by which the rate at which oxygen is able to enter the head member may be controlled.

It will be appreciated that various changes may be made in resuscitators as herein described without departure from the essence of the invention: for example, the self-distending ability of the reservoir bag may be assisted by inclusion in the bag of a compression spring, or other means which will help the bag to return to its normal shape after it has been compressed. In this connection it will be apparent that the bag need not be made of resilient material, in that it may have a "concertina" or bellows shape, and may also incorporate springs or other expansion or distension aiding devices.

I claim:

1. A resuscitator comprising a compressible, self-distending reservoir having an opening which constitutes an air inlet to and an air outlet from the reservoir; a hollow head member connected to said opening, said head member having an inlet passage communicating with the reser-

voir, an outlet passage for connection to a face mask, and at least one aperture communicating with the atmosphere; and a resiliently biased valve movable between inlet and outlet controlling positions in the head member, said valve including a valve stem which projects into the interior of the head member and extends past said outlet passage from the head member in a direction toward said inlet passage, a transversely disposed disc on said valve stem, said disc being adapted to slide along said valve stem, a valve seat for the disc in the vicinity of said aperture in the head member, and a spring which extends along said valve stem, said spring being normally operative to maintain the disc away from said valve seat at the inner end of the valve stem; said valve being directly operative by air pressure to close said aperture in the head member whenever the reservoir is compressed, and is adapted to remain in the closed position as long as the pressure within the reservoir and head member exceeds normal human exhalation pressure.

2. A resuscitator comprising a compressible, self-distending reservoir having an opening which constitutes an air inlet to and an air outlet from the reservoir; a hollow head member connected to said opening, said head member having an inlet passage communicating with the reservoir, an outlet passage for connection to a face mask, and at least one aperture communicating with the atmosphere; and a resiliently biased valve in the head member, said valve including a valve stem which projects into the interior of the head member and extends past said outlet passage from the head member in a direction toward said inlet passage, a transversely disposed disc on said valve stem, said disc being adapted to slide along said valve stem, a valve seat for the disc in the vicinity of said aperture in the head member, and a spring which extends along said valve stem, said spring being normally operative to maintain the disc away from said valve seat at the inner end of the valve stem; said valve being directly operative by air pressure to close said aperture in the head member whenever the reservoir is compressed, and is adapted to remain in the closed position as long as the pressure within the reservoir and head member exceeds normal human exhalation pressure; and wherein there is a further inlet passage in the head member, said further inlet passage being adapted to be connected to a supply of oxygen, a tubular conduit connected to said further inlet passage and extending into the interior of the reservoir, and a one-way valve at the end of the conduit, said valve being adapted to admit oxygen to the reservoir and to prevent the oxygen-air mixture from flowing out of the reservoir through said conduit and said further inlet passage.

3. A resuscitator comprising a compressible, self-distending reservoir having an opening which constitutes an air inlet to and an air outlet from the reservoir; a hollow head member connected to said opening, said head member having an inlet passage communicating with the reservoir, an outlet passage for connection to a face mask, and at least one aperture communicating with the atmosphere; and a resiliently biased valve in the head member, said valve including a valve stem which projects into the interior of the head member and extends past said outlet passage from the head member in a direction toward said inlet passage, a transversely disposed disc on said valve stem, said disc being adapted to slide along said valve stem, a valve seat for the disc in the vicinity of said aperture in the head member, and a spring which extends along said valve stem, said spring being normally operative to maintain the disc away from said valve seat at the inner end of the valve stem; said valve being directly operative by air pressure to close said aperture in the head member whenever the reservoir is compressed, and is adapted to remain in the closed position as long as the pressure within the reservoir and head member exceeds normal human exhalation pressure; and wherein there is a further inlet passage in the head member, said further

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inlet passage being adapted to be connected to a supply of oxygen, a tubular conduit connected to said further inlet passage and extending into the interior of the reservoir, and a one-way valve at the end of the conduit, said valve being adapted to admit oxygen to the reservoir, and to prevent the oxygen-air mixture from flowing out of the reservoir through said conduit and said further inlet passage; and wherein said one-way valve is constituted by a folded sleeve which is fitted over the end of the conduit, said sleeve being adapted to open out to admit oxygen to the reservoir from the conduit, and being adapted to collapse, closing the conduit, whenever the reservoir is compressed.

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RICHARD A. GAUDET, *Primary Examiner.*