A NEW OXYGEN THERAPY APPARATUS

Preliminary Report

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In breathing 100 per cent oxygen, the expired air must necessarily contain a large percentage of oxygen which is wasted. It had occurred to us that if we could capture part of the expired air into a bag after it had been purified by passing through a carbon dioxide absorbent, and allow this bag when inflated to shut off the original supply during expiration when this is not utilized, we would have an efficient and economical means of administering pure oxygen. Hence, a description of our appliance.

The hospital type may contain two canisters containing CO_2 absorbent which may be used successively at the earliest signs of absorbent exhaustion, or even before. The portable type is contained in a box 14 x 9 x 27 inches which may contain two units for the simultaneous administration to two persons. With the apparatus at open position, the oxygen enters through valve 1 and to the patient through hose 16 under slightly increased pressure. The expired air passes through hose 17 to CO_2 absorbent canister 18, where it is purified, and then into rubber bag Y. When this bag becomes inflated with purified expired air, it raises, lifting rod 20, which in turn opens valve 2 and allows the expired air minus CO_2 to return to hose 16 and to the patient. As the lifting rod is raised it also raises its end of the lever 22 which is pivoted at P and lowers the opposite end of the lever closing inlet valve 1. This occurs chiefly during expiration, thus allowing some of the purified expired air to cut off the oxygen flow when it is not needed, and conserve the oxygen cylinder. When the bag is sufficiently deflated to allow the lifting rod 20 to drop and close valve 2, it automatically opens valve 1, allowing a fresh supply of oxygen under increased pressure to reach the patient in time for the next inspiratory phase.

Oxygen is permitted to enter the apparatus through a reducing valve which registers about two pounds. This corresponds to 15 liters per minute using the type of gage which registers up to 25 liters per minute (because the bore here is larger than that gage which registers only to 15 liters per minute). Due to the fact that the flow is intermittent and not continuous, the number of liters per minute is probably halved. When it is realized that a further reduction in the amount of fresh oxygen is used, because of a small amount of rebreathing of purified expired air,

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it will be seen at once that we have an economical means of oxygen administration without sacrificing strength.

The mask is a small triangular rubber one reinforced with malleable metal, neatly fitting over nose and mouth, and adjustable to the shape of the face. It contains a Y inlet tube and outlet tube. The former is connected with a corrugated hose to the inlet of apparatus and contains a valve which opens only during inspiration and shuts during expiration, thus preventing expired air from contaminating the fresh oxygen in the inlet hose. The latter outlet tube connects with the CO_2 absorbent and

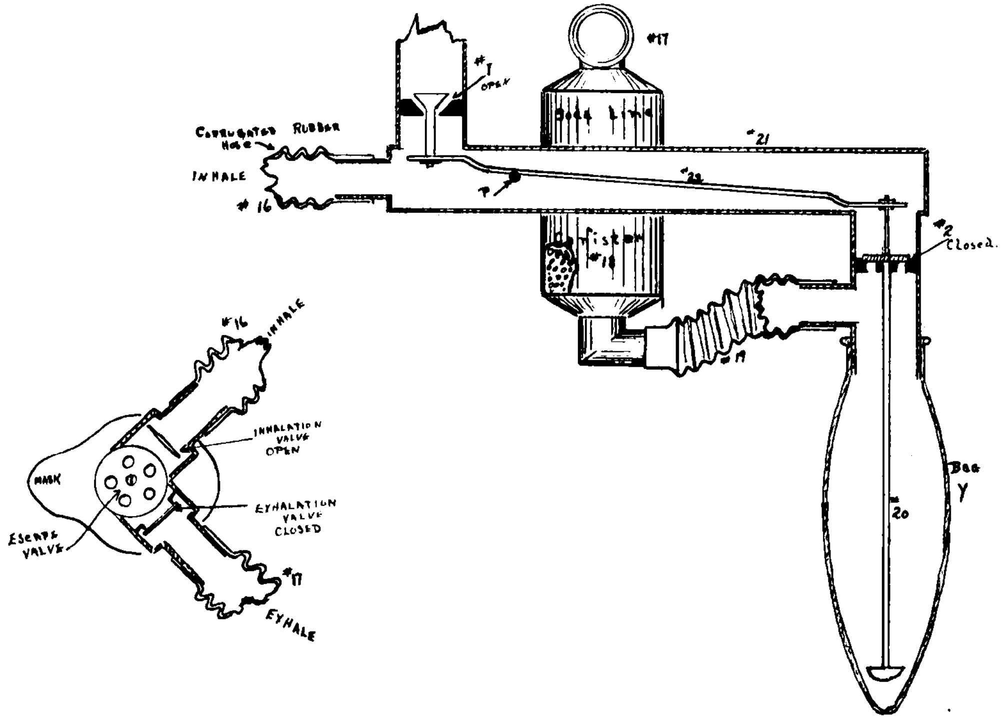

FIG. 1. 1, open valve at oxygen inlet. 16, corrugated hose to mask, where valve is open during inhalation. 17, expiratory hose. Valve is closed during inspiration. 18, canister of CO_2 absorbent. Hose 19 leads to bag Y, which contains lifting rod 20. Valve 2 is closed. Lever 22 is pivoted at P and regulates the opening and closing of valve 1 and 2. Diagram shows position of valves during inspiration. 21 is outside cylinder enclosing the mechanism.

contains a valve which opens only during expiration when the pressure in the mask is greater than in the expiratory hose. In order to reduce resistance to expiration, which tends to develop in any closed system, an expiratory vent is present at the top of the mask. This vent possesses a valve which opens only during expiration, allowing nitrogen to be expired, along with part of the expired air not used in the apparatus. During inspiration, this valve is closed and does not permit the inspiring of common air during the flow of fresh oxygen during the inspiratory phase. With the expiratory valve wide open, the resistance in the mask during expiration is practically nil as it does not register on a water manometer. When the expiratory valve is completely closed so that all of the expired air is utilized after purification, there is about 2 cm. of water resistance in the mask during expiration.

At the under surface of the mask, a metal connecting piece has been added with a window shutter which remains closed during active treatment. When it is desired to give liquid nourishment, or when suction of mucus or blood is indicated, the window is swung aside to permit these operations without interruption. Or, a Levene tube may be passed

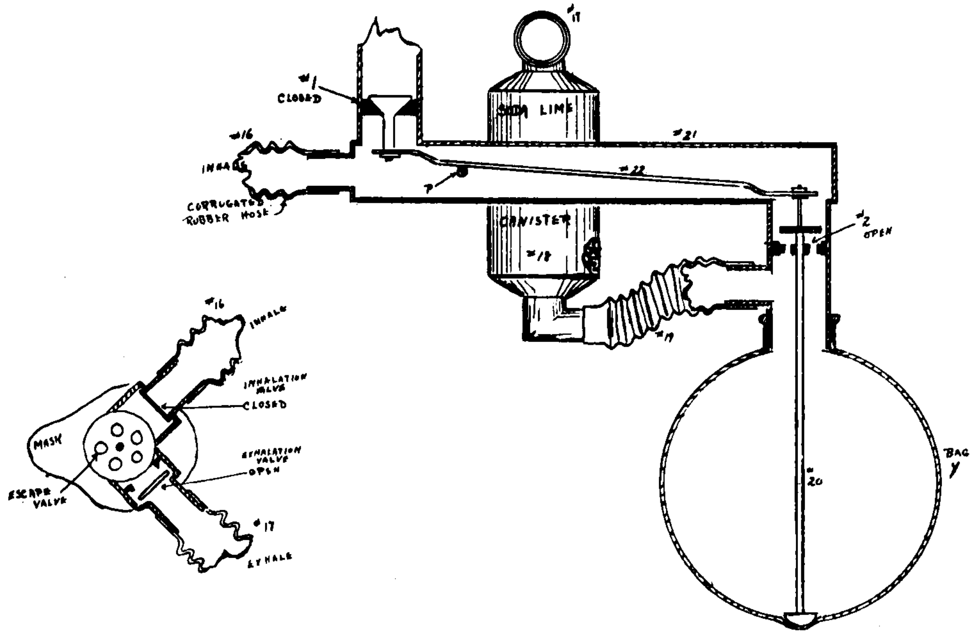

FIG. 2. Shows position of valves during expiration. Bag Y is inflated by expired air leaving mask through hose 17 where valve is now open. Air enters CO_2 absorbent (18) canister at 17 where it becomes purified; it passes along hose 19 to bag Y. When inflation takes place rod 20 is raised, opening valve 2 which permits purified air to pass through 21 into hose 16 to be rebreathed. At the same time, in lifting the rod, lever 22 which pivots at P brings the valve at 1 down, shutting off fresh supply of oxygen. Valve at mask end of hose 16 is now closed, preventing expired air from mixing with oxygen supply.

through the nose with the distal end protruding from the window at the time that oxygen therapy is instituted.

Preliminary tests * on the apparatus indicate the following: At the end of fifteen minutes' breathing the bag contains 85 per cent oxygen, and .1 per cent CO_2; at the end of thirty minutes, oxygen 90 per cent, CO_2 .15 per cent; after two hours, oxygen 92 per cent, CO_2 1.6 per cent. These figures do not represent inspired air; a small amount of the contents of the bag and a major portion of fresh pure oxygen make up the contents of the mask during inspiration. Further analyses and experiments will

* Courtesy of Department of Anesthesia, Bellevue Hospital, New York City.

be carried out to affirm this view, as well as the percentage of oxygen (alveolar) at various speeds of flow.

The box contains compartments on its inner side for the storage of plasma, glucose or saline infusions, ampules for intravenous anesthesia, as well as stimulants, narcotics, etc., for either emergency surgery or treatment of shock, with simultaneous oxygen administration.

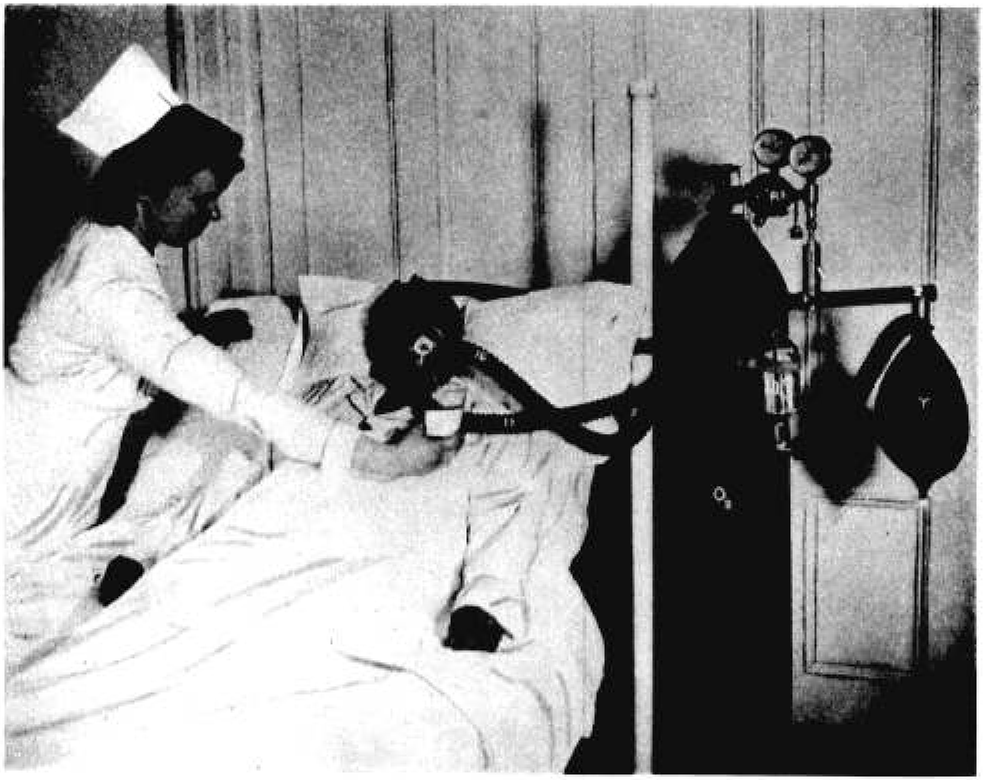

FIG. 3. R, reducing value on O_2, cylinder of oxygen; 1, location of valve within (inlet). 16, hose bringing pure oxygen to mask. Expired air returns through 17 to CO_2 absorbent canister 18, thence to bag Y, containing vertical lifting rod within. When bag is sufficiently inflated with purified expired air, it lifts performing two operations simultaneously. It opens valve 2, permitting purified air to return to hose 16, and by means of a lever within pivoting at P (not shown), shuts valve 1 during expiration. Illustration also shows patient fed by glass tube through window shutter at inferior surface of mask.

CONCLUSIONS

A new apparatus for the administration of 100 per cent oxygen is described which should prove more economical and more available than heretofore. A carrying case containing two units for multiple administration is described, consisting of compartments which can accommodate paraphernalia used in the treatment of shock and emergency operations in the field.

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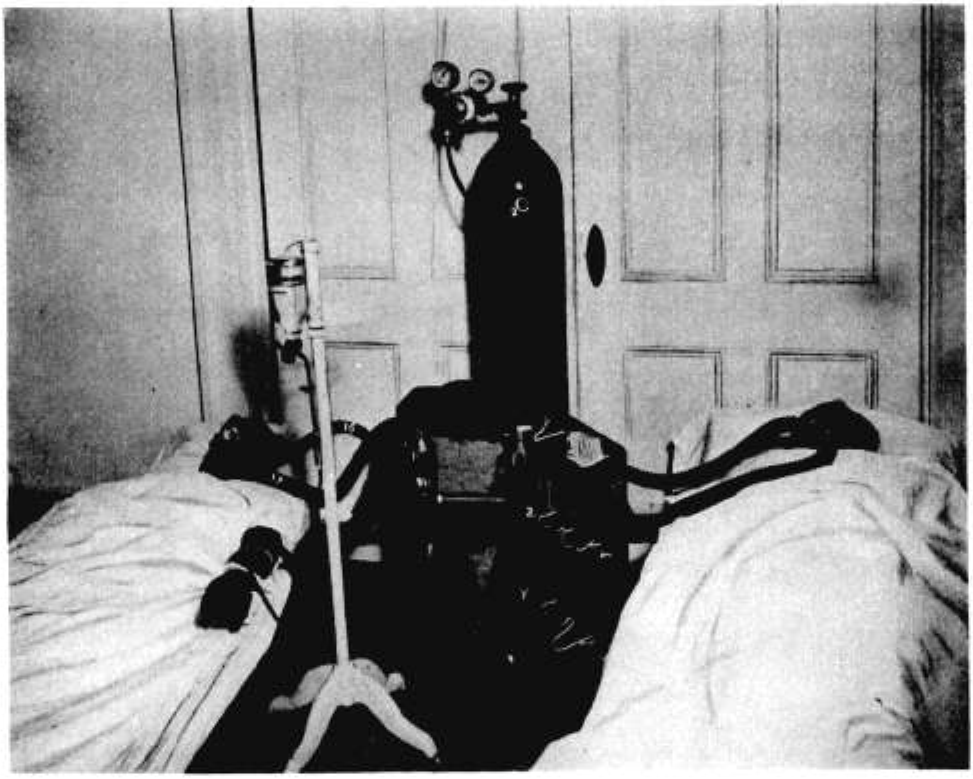

FIG. 4. Shows the simultaneous administration to two persons in the emergency room for treatment of shock, with plasma transfusion or intravenous anesthesia for emergency operations. Oxygen enters through valve 1, to hose 16 to patient. Expired air returns through hose 17 to CO_2 canister to open bag Y, which soon inflates sufficiently to open valve 2, permitting purified air to return to the system and automatically shuts valve 1 thus prolonging life of tank. E is expiratory vent.

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