NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
WASHINGTON, D.C. 20546

REPLY TO
ATTN OF: GP

October 12, 1970

TO: USI/Scientific & Technical Information Division
Attention: Miss Winnie M. Morgan

FROM: GP/Office of Assistant General
Counsel for Patent Matters

SUBJECT: Announcement of NASA-Owned
U.S. Patents in STAR

In accordance with the procedures contained in the Code GP to Code USI memorandum on this subject, dated June 8, 1970, the attached NASA-owned U.S. patent is being forwarded for abstracting and announcement in NASA STAR.

The following information is provided:

U.S. Patent No. : 3,229,689

Corporate Source : Manned Spacecraft Center

Supplementary
Corporate Source :

NASA Patent Case No.: XMS-01115

Gayle Parker

Enclosure:
Copy of Patent

Jan. 18, 1966 L. M. CHRISTMAN 3,229,689

RESUSCITATION APPARATUS

Filed May 1, 1963 2 Sheets-Sheet 1

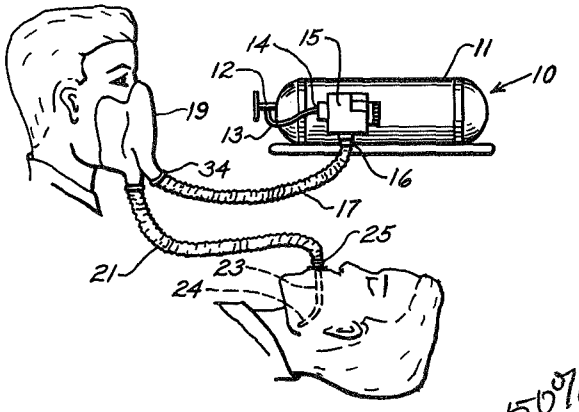

Fig. 1

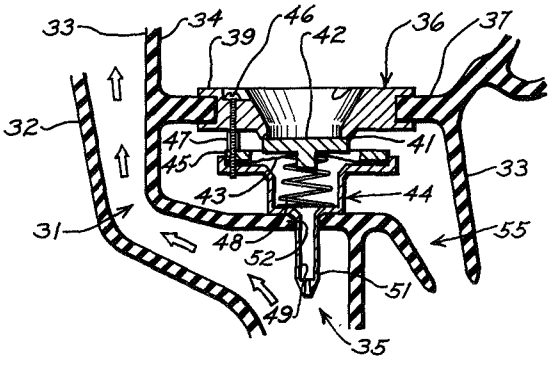

Fig. 2

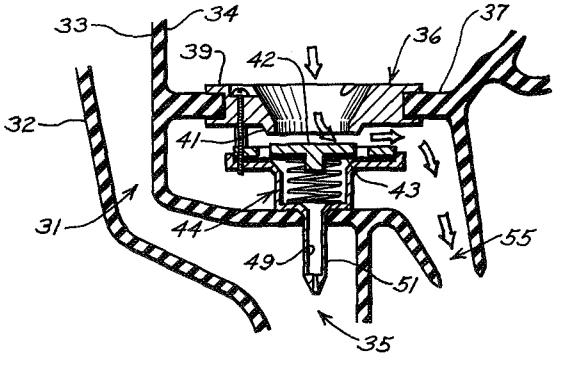

Fig. 3

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Jan. 18, 1966 L. M. CHRISTMAN 3,229,689

RESUSCITATION APPARATUS

Filed May 1, 1963 2 Sheets-Sheet 2

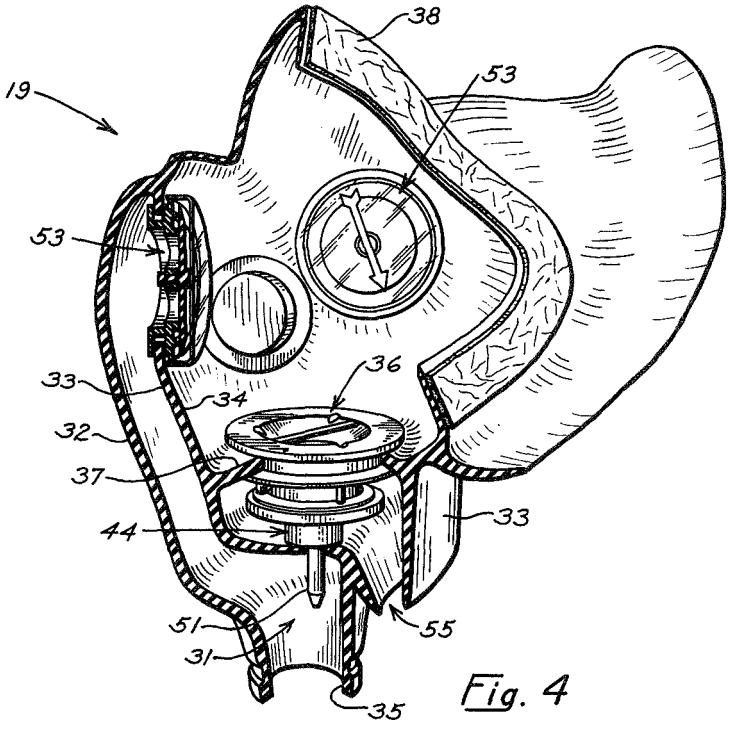

Fig. 4

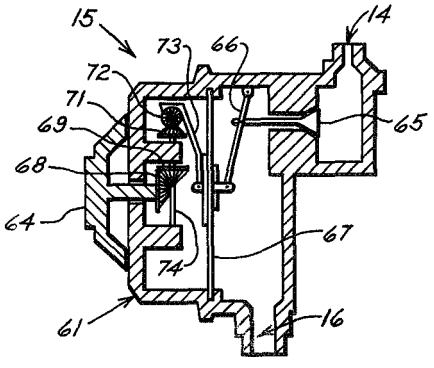

Fig. 5

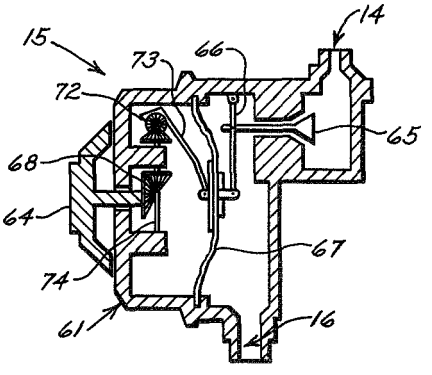

Fig. 6

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United States Patent Office 3,229,689 Patented Jan. 18, 1966

3,229,689

RESUSCITATION APPARATUS

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Filed May 1, 1963, Ser. No. 277,404
2 Claims. (Cl. 128—29)
(Granted under Title 35, U.S. Code (1952), sec. 266)

This invention relates to a pulmonary resuscitative method and apparatus, and more particularly to a method and apparatus for delivering oxygen intrapulmonically to a person through the intermittent intrapulmonic application of a selected positive pressure which is adjustable as desired.

A variety of resuscitative techniques and apparatuses for delivering oxygen to a person in labored respiration or respiratory arrest are in current use. In cases of acute dyspnea or respiratory arrest, the conventional apparatuses which are employed in mouth-to-mouth, mouth-to-mask, or mask-to-mask resuscitative techniques are generally inadequate in delivering oxygen to subjects in a manner to provide for an efficient oxygen and carbon-dioxide exchange in the vascular system of the subject. With these conventional techniques the subject receives only a negligible intrapulmonic positive pressure as represented by the intermittent force of exhalation of the person administering aid and therefore never receives more than eighteen percent (18%) oxygen during the tidal exchange in inhalation and exhalation. In cases of acute dyspnea, however, a far greater intermittent and intrapulmonic pressure and delivery of oxygen is required, although the required intermittent positive pressure may be decreased as the condition of the subject improves. Furthermore, these methods do not preclude the subject's swallowing his tongue nor do they compensate for nasal pharyngeal occlusion as would interfere with delivery of the life-sustaining oxygen to the subject. Also, due to the fluctuating exhalation pressures of the operator, a variable rate of oxygen exchange is induced instead of a controlled rate as is desirable. In addition, in these techniques the failure of intrapulmonic delivery is a distinct possibility and in techniques wherein a mask is used on the person receiving aid, there is the further possibility of leakage affecting the pressure and quantity of oxygen delivered.

Apparatuses such as the iron lung and the oxygen tent, while presenting one hundred percent (100%) oxygen environmentally, and which provide for satisfactory therapy in certain specific cases, present environments which are delivered externally to the body rather than internally and therefore do not provide for the degree of lung ventilation which is adequate and necessary in cases of acute dyspnea or respiratory arrest. These apparatuses, like the standard resuscitator and other pressure breathing apparatuses in current use, are of undesirably great mass and weight. In emergency type apparatus, humidification is either lacking or inadequate. One problem presented by the standard resuscitator in particular, is that it is provided with a regulator which is designed to cut off delivery whenever back-pressure is sensed. This, of course, may be induced by factors other than complete tidal quantity. Also the intricate valving arrangements in these devices frequently confound inexpert practitioners and even trained hospital corpsmen. They are also prone to malfunction because of their complexity.

Other techniques and devices which provide for a continuous flow of oxygen to the subject also induce severe cardiac deficiency and are to be avoided where apparatuses permitting an intermittent delivery of oxygen are available. On the other hand, more radical techniques in current practice, such as a tracheotomy or a technique involving the use of a nasal pharyngeal catheter, require professional guidance and a physician's skill to avoid the probability of serious and permanent injury to the subject.

To overcome the disadvantages attendant to the prior resuscitative techniques and devices, the apparatus and resuscitative method of this invention are devised such that adequate ventilation and displacement of nitrogen from the lungs with oxygen may be provided in cases of labored breathing or respiratory arrest with minimum danger to the subject by even an inexpert operator. With the intermittent application of positive pressure, a gaseous mixture comprising over 94.5% oxygen and from 2.7% to 4% carbon dioxide is delivered intrapulmonically to the subject on an intermittent basis. By judicious selction and control of the intermittent positive pressure as determined by the condition of the subject, the assimilation of oxygen into the subject's vascular system is accomplished in direct correspondence with his physical needs.

It is known that during respiration not all of the gas volume which enters the respiratory passages with each breath penetrates to the alveoli of the lungs, the regions where gas exchange actually takes place, and that it is the alveolar gases rather than the inspired gases which represent the effective gaseous environment of the body. Hence, the advantages of an intermittent application of intrapulmonic positive pressure during respiration which facilitates penetration of the inspired gaseous medium to the alveoli of the lungs and increases the absorption of oxygen by the blood are readily appreciated. Tests have shown that after only one minute of therapy by practicing the method of this invention the high percentage of inert nitrogen, approximately 80%, which is usually present in the lungs of a person, is largely replaced by oxygen and reduced proportionately to approximately two percent (2%) of the gaseous medium in the lungs.

The apparatus of this invention includes a soft rubber oro-pharyngeal tube or airway which is adapted for insertion into the throat of the subject so that oxygen may be delivered directly to the trachea and lungs. In addition to the airway the apparatus comprises a conventional oxygen supply cylinder, an adjustable pressure regulator for controlling pressure from the oxygen supply, and a conventional pressure breathing mask interposed in the oxygen supply line from the regulator. The mask is connected at its inlet port in communication with the outlet of the regulator and at its exhalation port to a flexible exhalation conduit, the distal end of which is equipped with the soft rubber airway.

As used in practicing the novel resuscitation method disclosed herein, the mask is placed over the face of the person practicing the method, hereinafter called the operator, who may then receive oxygen at a selected pressure by adjustment of the pressure selector dial of the regulator. When the operator exhales in the mask, oxygen at this selected pressure is delivered through the exhalation conduit and airway directly to the trachea and lungs of the subject. By pressure-loading of the exhalation valve of the mask in correspondence with the pressure output of the regulator, the operator is required to exhale with a force which is slightly in excess of the pressure of oxygen supplied by the regulator in order to open the exhalation conduit and permit oxygen flow to the subject. The operator therefore opens and closes

the oxygen supply line to the subject at spaced time intervals in accordance with his own exhalations and inhalations which are consciously spaced to prevent the possibility of his own hyperventilation and respiratory arrest.

The interposition of the operator in the oxygen supply line prevents the over-pressurization of the subject's lungs. In addition, the operator's breath humidifies the oxygen before delivery to the subject and thereby avoids the undersirable physical effects which generally result when humidification is lacking. By his exhalation, the operator assures delivery of oxygen intrapulmonically to the subject at a substantially uniform positive pressure on an intermittent basis and also provides for a suitable proportion of carbon dioxide within the medically acceptable range of 2.7% to 4% which is sufficiently high to serve as a respiratory stimulant for excitation of the subject's respiratory center but sufficiently low to avoid carbon dioxide toxicity and repression of breathing.

Control of the intermittent intrapulmonic pressure as delivered to the subject is made possible by the pressure regulator which is manually adjustable to selectively reduce or increase the outlet pressure of the regulator in accordance with the needs of the subject and his rate of recovery. Furthermore, pharyngeal blockage and tongue swallowing, which are ever present dangers in mouth-to-mouth resuscitative teachniques or techniques which involve placing a mask over the subject's face, are averted by the presence of the rubber airway in the subject's throat.

Other objects and many of the attendant advantages of this invention will be readily appreciated as the same become better understood by reference to the following detailed description when considered in connection with the accompanying drawings in which like reference numerals designate like parts throughout the figures thereof and wherein:

FIG. 1 is a view showing the arrangement of resuscitative apparatus for practicing the method of this invention;

FIG. 2 is a schematic sectional view through the pressure breathing mask in the apparatus of this invention which is worn by an operator when practicing the method of this invention, and showing the pressure loading of the exhalation valve of the mask during inhalation by the operator;

FIG. 3 is a schematic sectional view through the pressure breathing mask of this invention, showing the disposition of the exhalation valve of the mask during exhalation by the operator;

FIG. 4 is a perspective view of the mask in the apparatus of this invention with parts broken away to show the inspiratory valves and the exhalation valve in the mask and the flow paths in the mask for the oxygen from the regulator and the exhaled breath of the operator;

FIG. 5 is a schematic sectional view of the manually-controlled pressure regulator in the apparatus of this invention, showing the condition of the regulator when adjusted to provide for zero pressure at its outlet; and,

FIG. 6 is a view similar to FIGURE 5, but showing the operation of the pressure regulator when delivering a selected pressure of oxygen to its outlet.

Referring more particularly to the drawings, the resuscitative apparatus **10**, which is a preferred embodiment of the appartus of this invention, is shown in FIG. 1 as it is used in practicing the method of this invention. The apapratus **10** comprises a standard oxygen supply cylinder **11** which preferably has a capacity of at least 295 cubic inches volume but which is desirably small in size to provide for easy mobility. The oxygen cylinder is connected at its outlet **12** by a conduit, such as a copper tubing **13**, to the inlet **14** of a pressure breathing regulator **15**, illustrated schematically in FIGURES 5 and 6. The regulator outlet **16** is connected to one end

of a flexible oxygen hose **17**, the other end of which is connected to the inlet of a conventional pressure breathing mask **19**. A second oxygen hose **21** is connected to the outlet of the mask and is provided at its distal end with an airway **23** adapted for insertion into the subject's throat. The airway is fabricated of soft rubber instead of conventional plastic or metal to avoid injury and laceration to the throat of the subject, and is provided with an arcuate end portion **24** designed to extend to the subject's trachea when the airway is inserted into the throat. It is also provided with an imbedded metal bite-ring in the wall of the airway adjacent the lip-guard **25** to prevent the subject's teeth from clamping the airway to a closed condition.

As used in the resuscitative method of this invention, the airway is inserted into the throat of a person in labored respiration or respiratory arrest and the mask fitted to the face of an operator who may then receive oxygen at a selected pressure from the regulator by adjusting the pressure selector dial on the regulator to a predetermined outlet pressure. Preferably, the selector dial is graduated to indicate pressure in inches of water although other systems of measurement might satisfactorily be used.

In cases of acute dyspnea, the pressure initially selected is suitably high, ordinarily a pressure head of eight inches of H_2O, although pressures as high as sixteen inches of H_2O may safely be used. By means of the valving arrangement in the mask and pressure loading of the exhalation valve of the mask in corerspondence with the pressure output of the regulator, as hereinafter described, the operator is required to exhale with a force in excess of the pressure supplied by the regulator in order to open the exhalation conduit and permit oxygen flow to the subject. Hence, a suitable uniform pressure of oxygen, always above a predetermined value, is thereby delivered intrapulmonically to the subject.

To avoid the possibility of hyperventilating himself or the subject, the operator, after inhaling, waits a brief time before exhaling, such as a two to three second interval. He also waits a correspondingly brief time before inhaling so that a rate of ten breaths a minute is approximately and maintained during pressure breathing therapy until such time as the subject commences breathing on his own. In this manner a humidified mixture of oxygen and carbon dioxide is delivered to the subject at regularly spaced intervals corresponding in time of occurrence and duration to the exhalations of the operator and in a far greater amount than would be received by a person breathing 100% oxygen at normal pressure and rate of breathing.

As previously stated, a proportion of carbon dioxide in an amount up to 4% of the mixture delivered intrapulmonically is necessary for the excitation of the respiratory center of the subject as would induce his own breathing. Analyses which have been made of the gases delivered to the subject by practicing the resuscitative method disclosed herein have shown that after one minute of pressure breathing at a pressure selected within the range of 4 to 8 inches of H_2O, a mixture comprising approximately 3.2% carbon dioxide, 94.8% oxygen, and 2% nitrogen is deliverable to the subject. The 2% nitrogen represents a residual amount remaining in the lungs of the person administering aid from the high proportion of 80% nitrogen initially present when first commencing the pressure breathing therapy.

Further analysis has shown that after from one to thirteen minutes of pressure breathing, mixtures ranging from 2.7% to 3.2% carbon dioxide and 96.5% to 94.8% oxygen are deliverable. These mixtures, of course, are eminently satisfactory, particularly when compared with the mixture obtainable from exhalation during breathing of ambient air as would be deliverable by the mouth-to-mouth resuscitation technique and which would comprise approximately 80% nitrogen and about 18% oxygen.

Many other useful purposes, of course, in addition to attainment of a desirable oxygen and carbon-dioxide mixture, are served by the interposition of the operator in the oxygen supply line to the subject. The operator's breath, for instance, humidifies the oxygen before delivery to the subject and thereby avoids such undesirable effects as dehydration with scaling and peeling of membranous tissue, increased viscosity of bronchial mucous secretions, and the like, which generally result when humidification is lacking. The exhalation of the operator assures the delivery of oxygen to the subject at a uniform positive pressure on an intermittent basis with the pressure delivered being slightly greater, of course, than the pressure loading of the exhalation valve. Thus, it is assured that a pressure slightly greater than the selected dial pressure is delivered intrapulmonically to the subject with each exhalation of the operator. Experience has demonstrated that the exhalation pressure exerted by the operator in overcoming the total pressure loading on the diaphragm and to force the exhalation valve to open is slightly greater than the pressure loading by a value in the amount of 1 to 1½ inches of H_2O, and in practice never exceeds this amount. Hence, the interposition of the operator also serves as a safety factor to prevent over-pressurization of the subject's lungs as might occur in a mechanical mode of delivery.

The means by which pressure loading of the exhalation valve of the mask is achieved and the functioning of the valve during the inhalation and exhalation of the operator is illustrated schematically in FIGS. 2 and 3. A face mask which may be satisfactorily used in the apparatus of this invention is of the type produced by the Mine Safety Appliances Corporation of Philadelphia, Pennsylvania, model No. A13–A. The mask is provided with an inlet channel **31** as defined by the outer rubber wall **32** of the mask and the rubber wall **33**, the inner surface **34** of which forms the interior surface of the mask. The inlet **35** of the mask is adapted to be connected in communication with the outlet of the pressure regulator by means of the flexible hose **17**, as shown in FIG. 1, so that oxygen at a pressure corresponding to the outlet pressure of the regulator is delivered to the inlet channel. A valve assembly comprising a valve seating member **36** at the upper end thereof is connected to an inner wall **37** of the mask which is integrally formed with the wall **33** and depends substantially perpendicularly therefrom. The valve seating member, which is disposed such that it would be located slightly below the mouth of the mask-wearer when the mask is worn with the wearer's face disposed against the seal flap **38**, as shown in FIG. 4, comprises an annular top portion **39** with an annular flange section **41** depending downwardly from the center thereof and providing a seat, by its lower annular surface, against which the valve element **42** is adapted to engage when the valve is in closed condition, as shown in FIG. 2. The valve element which is in the form of a circular disc, is disposed centrally of a resilient diaphragm **43** to which it is attached in a flat position. The diaphragm in turn is seated in the upper end of a nipple member **44** and clamped therein by an annular ring **45** which is laid over the peripheral margin of the diaphragm and held in position by bolts **46** which join the valve seating member and the upper end of the nipple. Spacer members **47** sleeved about the shanks of the bolts **46** serve to clamp the annular ring and the diaphragm against the nipple and to space the upper end of the nipple member from the valve seating member. The valve element is biased upwardly to a normally closed position against the valve seat by a compressed spiral spring **48** which is seated in an enlarged bore section of the nipple and attached at its upper end to the under side of the diaphragm. The outlet pressure from the regulator is deliverable to the under side of the diaphragm through the axial bore **49** of the nipple which is installed in the mask such that the lower reduced end portion **51** of the nipple extends through an aperture **52** in the wall **33** with its open end disposed in the inlet flow channel of the mask.

The mask is preferably provided with a suitable attaching means, such as a strap (not shown) for holding the mask in sealing position against the face and thereby freeing the hands of the operator. During inhalation by the operator, oxygen is received through the inlet flow cha channel of the mask, as shown in FIG. 2, and through the inspiratory valves **53**, shown in FIG. 4, to the interior of the mask. Upon exhalation by the operator, the exhalation valve element and diaphragm are urged downwardly to open the valve whenever the operator exhales with a force which is sufficient to overcome the pressure-loading on the underside of the diaphragm, as represented by the total combined outlet pressure of the regulator and the small upwardly biasing force exerted by the coil spring. The inspiratory valves are forced closed and the expired breath of the operator, comprising pure oxygen and a small proportion of carbon dioxide constituting his own body elimination, is forced through the valve opening between the valve seat and valve element into the exhaust channel **55** of the mask, as is shown in FIG. 3, whereupon the mixture is delivered to the subject via the flexible exhalation conduit **21** and the airway.

The pressure regulation and control of the oxygen supply from the oxygen cylinder is achieved by adjustment of the pressure regulator which is illustrated schematically in FIGS. 5 and 6. A pressure regulator which has been satisfactorily used in this apparatus is one produced by the Aro Equipment Corp., of Cleveland, Ohio, model A–14. The regulator comprises a housing **61** having an inlet port **14** connected in communication with the outlet of the oxygen cylinder and an outlet port **16** connected in communication with the oxygen supply line. The oxygen is adapted to flow through the housing from the inlet to the outlet when the valve in the housing is in open position, as shown in FIG. 6, and is cut off when the valve is in closed position, as shown in FIG. 5. The oxygen flow and the pressure delivered to the outlet of the regulator is controlled by adjustment of a pressure selector dial **64** on the face of the regulator which is mechanically linked to the valve element **65**. One end of the valve element is pivotally connected to an arm **66** which, in turn, is pivotally connected at one end to the wall of the housing and at its other end to one side of a resilient diaphragm **67** which is disposed in the housing and forms one wall of the oxygen flow channel through the housing. The arm **66** is pivotally attached at the center of the diaphragm.

The other side of diaphragm is connected to rotatable dial by a mechanical linkage comprising two pairs of bevelled gears **68**, **69** and **71**, **72** in cooperation with a resilient arm **73** which is attached at one end to the bevelled gear **72** and at its other end to the center of the diaphragm. Rotary movement of the dial is transmitted through the first pair of gears to the second pair of gears by means of a shaft **74** which is rotatably journalled in the wall of the housing. Rotation of the dial therefore causes movement of the bevelled gears such that the arm **73** is swung to the right, as shown in FIG. 6, to cause the diaphragm to also move to the right. It will thus be apparent that this movement of the diaphragm is transmitted via the pivotal arm **66** to the valve element to unseat the valve element and open the flow channel through the housing. The pressure delivered at the outlet of the regulator is, of course, dependent on the movement of the diaphragm **67** and the loading of the resilient arm **73** as controlled by the setting of the rotatable dial.

It will therefore be seen that by practicing the method of this invention, a rich oxygen mixture may be delivered at a selected positive pressure to the lungs of a person in labored respiration or respiratory arrest, the particular pressure selected being of a level sufficient to insure assimilation of oxygen into the vascular system of the person in a desired amount. Since the need for additional oxygen

proportional to the amount of air inspired is great in cases of acute dyspnea, to increase the oxy-hemoglobin of the blood a high setting is therefore desirable to expedite oxygen absorption when thereby is first commenced. As the condition of the subject improves, the pressure setting may be correspondingly decreased and when the subject is able to breathe on his own the operator may remove the airway from the subject's throat and place his own mask over the face of the subject to permit him to breathe 100% oxygen direct from the pressure regulator of the oxygen supply on a demand basis without pressure. A zero setting for the selector dial would be required in this instance so the negative pressure induced in the flow channel through the regulator during inhalation would move the regulator diaphragm so as to open the regulator valve and admit oxygen only during the subject's inhalation. On the other hand, it might alternatively be desirable, as the subject improves, for the operator to breathe his own expired air into the lungs of the subject by disconnecting the oxygen supply from his mask. However, less than 18% oxygen is delivered to the subject in this manner.

It is to be understood of course, that other apparatus might be resorted to in practicing the method of this invention, particularly in instances where specified components are not readily available. In lieu of the pressure breathing mask, for example, the person administering aid might breathe from a source of oxygen under a fixed pressure and exhale into an exhalation conduit fitted with a spring-loaded valve, or the like, for delivering his exhalation under pressure to the person in distress. Such improvisations, aside from being extremely inefficient and cumbersome, would be very prone to failure.

In practicing the method of this invention, the operator, during his own exhalations, may hold the subject's nose closed with one hand so as to insure a closed system. After each exhalation of the operator, whereupon the flow of oxygen to the subject ceases, the elastic lungs of the subject will automatically retract and force his own exhalation so that his expired breath will pass out around the rubber airway. At this time, of course, the operator should release the subject's nose to assist the exhalation. If desired, an airway with a non-return flap valve, such as is disclosed in U.S. Patent No. 3,017,880, might be used to facilitate the subject's exhalation. It might also be desirable during the periods following the operator's exhalations for the operator to manually apply pressure to the subject's thorax to force the air from the subject's lungs. Also, in cases of cardiac arrest, cardiac stimulation might be applied during these periods by the closed chest cardiac massage method, which is, of course, far less hazardous than the open-thorax method of cardiac stimulation.

It will therefore be seen that a new and improved intermittent positive pressure breathing apparatus is disclosed herein which utilizes a conventional pressure breathing mask installed in the oxygen supply line to the subject in a manner so that oxygen is received in the mask from a pressure-controllable source of oxygen. The mask is provided with means for pressure loading the exhalation valve of the mask to closed position by a preselected pressure from the source of oxygen so that when the mask is worn by an operator practicing the method of this invention the oxygen is delivered intermittently to the subject in correspondence with the exhalations of the operator, and at a pressure corresponding to the preselected pressure, but is in excess thereof by a pressure difference of approximately 1 to 1½ inches of H_2O.

It will also be seen that an intermittent pressure breathing resuscitative apparatus is disclosed herein which possesses versatility and simplicity of operation. Because of its light weight and mobility it is also particularly desirable for use in limited confined areas.

It will also be seen that a new and improved pulmonary resuscitation method is disclosed herein which utilizes the step of intermittently flowing a mixture of oxygen and carbon dioxide at a pressure greater than a preselected value through an airway which is inserted into the throat of the subject so that the pressure is delivered intrapulmonically. The air flow is delivered during time intervals corresponding to the durations of the exhalations of an operator practicing the resuscitative method, and the pressure of the mixture delivered to the subject is determined by the force of the operator's exhalations which is always slightly greater than the preselected pressure. The moist expired breath of the operator, mixed with a supply of oxygen, provides for humidification of the mixture and supplies the proportion of carbon dioxide necessary for therapy.

Obviously, many modifications and variations of the present invention are possible in the light of the above teachings. It is therefore to be understood that within the scope of the appended claims the invention may be practiced otherwise than as specifically described.

What is claimed and desired to be secured by Letters Patent is:

1. A pulmonary resuscitation apparatus comprising:
a supply of oxygen under pressure;
a face-fitting pressure breathing mask adapted to be fitted to a person's face in airtight sealing relationship therewith, said mask having an inlet and inlet valve means whereby a gaseous medium may be flowed through said inlet into the interior of said mask when fitted to a person's face and said mask having an outlet channel with exhalation valve means installed in said outlet channel for controlling exhalation therethrough, said exhalation valve means being adapted to open only in response to a force of exhalation which exceeds the pressure of gaseous medium flowing into the mask;
means fluidly communicating oxygen from said oxygen supply to the inlet of said mask;
adjustable pressure regulator means selectively controlling the pressure of oxygen which is deliverable from said supply of oxygen;
a conduit connected in fluid communication with the outlet of said mask;
an oro-pharyngeal tube on the distal end of said conduit, said tube having an arcuate shaped free end portion whereby said tube is adapted to be inserted into the throat of a person in respiratory distress; and
means pressure loading said exhalation valve of the mask to a normally closed position in correspondence with the selected pressure of oxygen delivered to the mask whereby when the mask is worn in operative position by an operator administering aid to a person in respiratory distress, said exhalation valve is adapted to open and remain open during intervals when the force of exhalation by the operator exceeds the pressure loading on the exhalation valve to thereby deliver the exhalations of the operator intrapulmonically to the person in respiratory distress.

2. Pulmonary resuscitation apparatus for reviving a person in respiratory distress comprising:
adjustable regulator means adapted to be connected to a source of oxygen under pressure for selectively adjusting and controlling the pressure of oxygen obtainable from said source;
a face-fitting pressure breathing mask adapted to be fitted to a person's face in airtight sealing relationship therewith, said mask having an inlet whereby a gaseous medium may be flowed through said inlet into the interior of said mask when fitted to a person's face and said mask having an outlet with outlet valve means installed therein for controlling

exhalation therethrough, said outlet valve means adapted to open in response to a force of exhalation by the person wearing the mask which exceeds the pressure of gaseous medium flowing into the mask;

means fluidly communicating said regulator means with the inlet of said mask whereby when said regulator means is operatively connected to a source of oxygen under pressure oxygen at a preselected pressure is delivered to the interior of the mask to be breathed by a person wearing the mask; and

conduit means connected to the outlet of the mask and having an end portion adapted to be inserted into the throat of a person in respiratory distress whereby the exhalations of a person wearing the mask are communicated directly to the lungs of a person in respiratory distress whenever said exhalations are produced with a force which exceeds said preselected pressure to thereby deliver intrapulmonically to said person in distress a humidified gaseous mixture consisting essentially of pure oxygen and a proportion of carbon dioxide in an amount sufficient

to stimulate the respiratory center of a person in respiratory distress.

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