

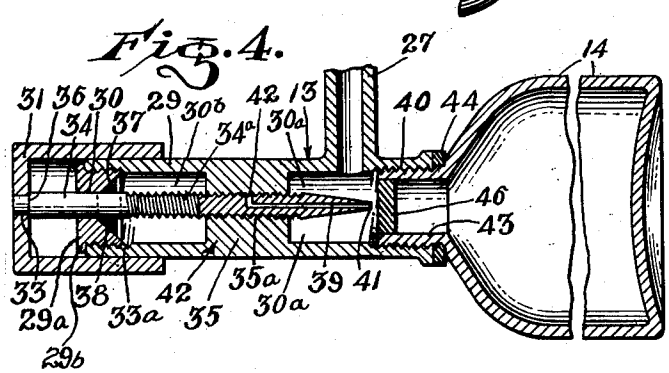
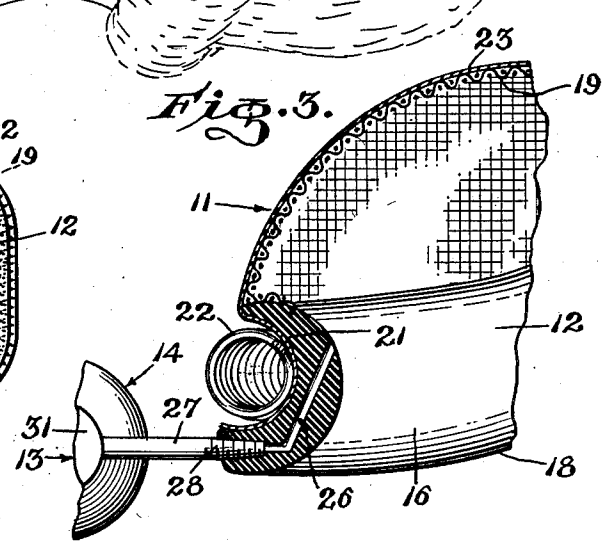
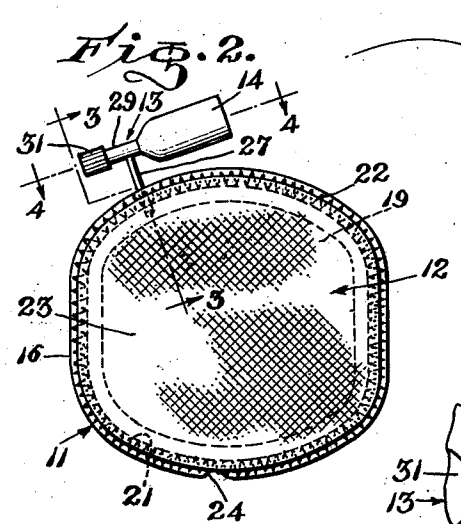
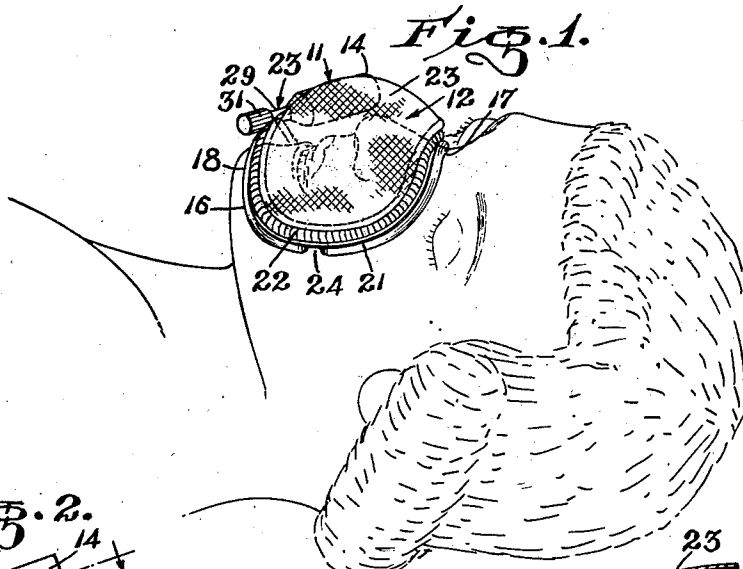
June 9, 1953

A. E. ENGELDER
ANESTHESIA APPARATUS

2,641,253

Filed Aug. 7, 1951

2 Sheets-Sheet 1



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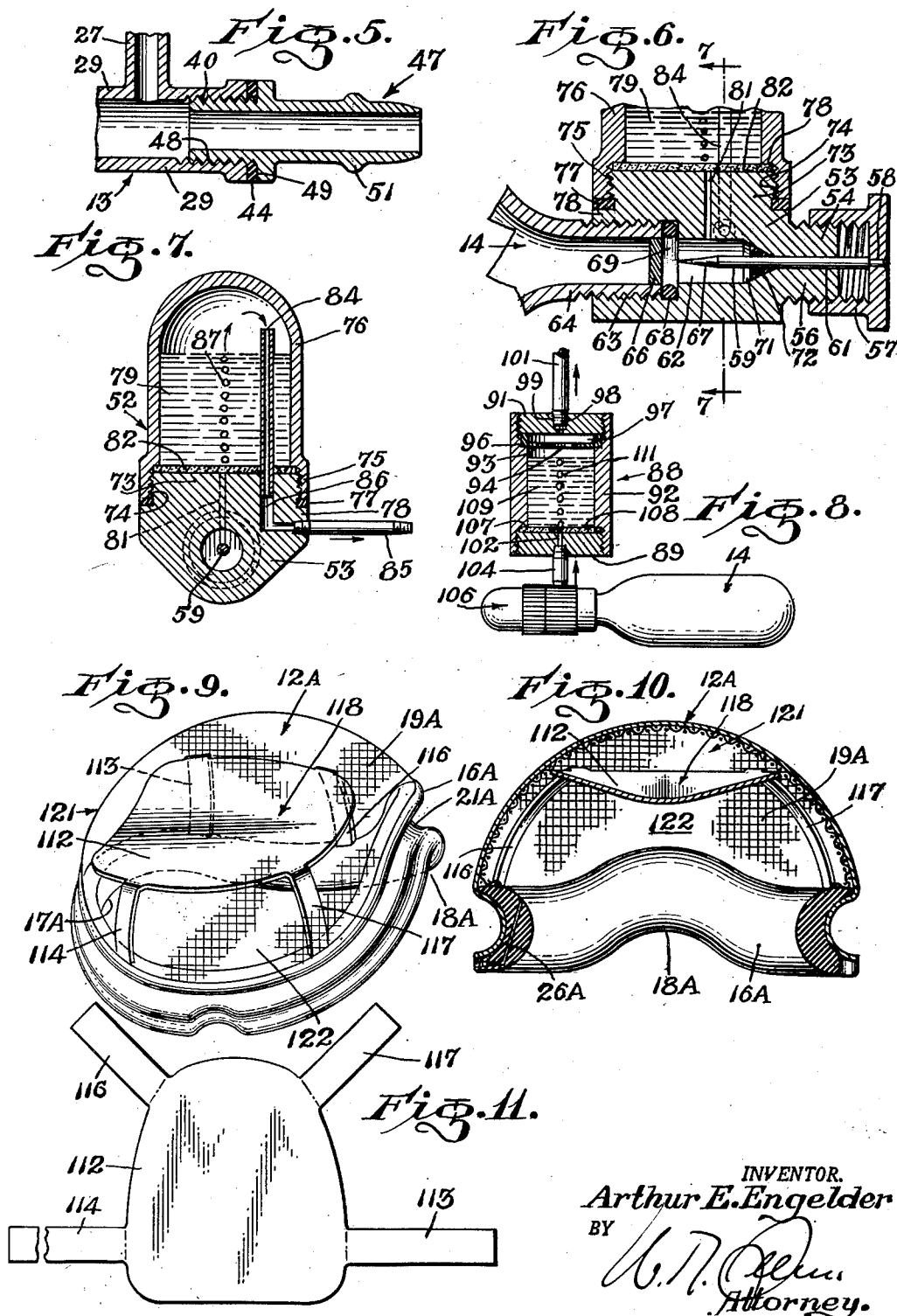
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2 Sheets-Sheet 2



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UNITED STATES PATENT OFFICE

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ANESTHESIA APPARATUS

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Application August 7, 1951, Serial No. 240,657

26 Claims. (Cl. 128—188)

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This invention relates generally to anesthesia apparatus of the inhalator type and in particular to an open-drop mask of improved construction for volatile anesthetics.

A primary purpose of the present invention is to overcome a particular disadvantage of the open-drop equipment, viz., the lack of means to introduce oxygen to the patient at critical stages of the anesthesia process.

A brief statement concerning the critical aspects and various stages of anesthesia must be made fully to appreciate the invention embodied in the construction disclosed herein. During the induction of anesthesia the most highly developed functions of the nervous system are affected first by the anesthetic while the oldest and most primitive functions, including respiration and circulation vital to life, are depressed last. The stages of anesthesia have been listed as follows:

1. The stage of altered consciousness.
2. The stage of excitement.
3. The stage of surgical anesthesia during which breathing is deep and regular and circulation entirely adequate.
4. The stage of medullary paralysis in which vital functions are greatly depressed and death is imminent.

Absorption of anesthetic sufficient to induce the first stage effectively abolishes pain. However, to eliminate involuntary muscular activity in the surgical patient it is necessary to administer anesthetic in sufficient quantities to attain the third stage of anesthesia. To reach stage 3 successful passage through stage 2 is essential.

Stage 2, the stage of excitement, is the most dangerous in the anesthesia process. This stage is characterized by involuntary muscular movement, in some cases so intense as to amount to excitement. The patient is totally unaware of his surrounding and of his inability to cooperate. Respiration is rapidly impaired to a point of extreme oxygen depletion. The impairment of respiration is due to the reduction of blood oxygen and high concentration of the anesthetic in the blood. This reduction is caused in part by the fact that the air under the mask is inhaled and exhaled effecting a consumption of oxygen and a decrease in its partial pressure under the mask.

The present invention is designed to correct this deficiency of the open-drop ether masks by making available an adequate supply of pure oxygen for intermittent administration during stage 2. Supplementary oxygen is not ordinarily necessary in stage 3 in using open-drop masks,

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since breathing is regular and deep and the patient is completely relaxed and room air is adequate.

It is an object of this invention to provide an improved apparatus for the administration of anesthesia to surgical patients.

Another object of this invention is to provide an open-drop ether mask capable of supplying oxygen intermittently to the patient as necessary to preserve life during the administration of volatile anesthetics.

Still a further object of this invention is to provide an open-drop ether mask having an attachment thereon adaptable to direct pure oxygen under the mask to the patient without removal of the mask.

Another object of this invention is to provide an open-drop ether mask having a source of oxygen as an integral part thereof.

A further object of the invention is to provide a safe, reliable anesthesia apparatus of open-drop mask type of light weight and portable character and especially useful for emergency purposes having a self-contained oxygen source.

A further object of the invention is to provide an open-drop ether mask with a baffle therein to prevent the exhalation of the patient's lungs from interfering with the administration of anesthesia.

Another object of the invention is to provide a flow indicator to be used in conjunction with an open-drop face mask to indicate the rate of oxygen flow.

These and other more specific objects will appear upon reading the following specification and claims and upon considering in connection therewith the attached drawings to which they relate.

Referring now to the drawings in which a preferred embodiment of the invention is illustrated:

Figure 1 is a view in perspective of the mask constructed in accordance with the present invention positioned on the patient's face in correct position for the administration of an anesthetic;

Figure 2 is a top plan view of the mask per se; Figure 3 is a partial section of the mask taken on line 3—3 of Figure 2;

Figure 4 is a transverse sectional view taken on line 4—4 of Figure 2 showing in detail the needle valve controlling the flow of oxygen to the mask;

Figure 5 is a cross-sectional view through an adapter the use of which enables the open-drop mask constructed in accordance with the present

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invention to be used with a bulk oxygen source;

Figure 6 is a partial sectional view through an oxygen metering valve and flow indicator unit suitable for use in open-drop ether masks constructed in accordance with the present invention;

Figure 7 is a sectional view through the flow indicator being taken on line 7-7 of Figure 6;

Figure 8 is a sectional view through another embodiment of the flow indicator;

Figure 9 is a perspective view of an improved open-drop ether mask embodying an interior gas-directing baffle;

Figure 10 is a transverse cross-section through the mask illustrated in Figure 9; and

Figure 11 illustrates the baffle incorporated in the embodiment of the mask illustrated in Figures 9 and 10 but in a flattened condition.

Referring again to the drawings, and to Figure 1 in particular, the mask constructed in accordance with the present invention is indicated generally by the reference character 11 and is seen to comprise a contoured open-drop ether mask proper 12, an oxygen container 14, and a T-shaped member 13 connecting container 14 to the mask proper for the purpose of conveying oxygen therebetween. The mask proper 12 includes a metallic peripheral ring 16 contoured on its lower surface to conform to the anatomical features of the human face, being curved at 17 and 18 to fit the curvatures of the nose and chin, respectively. Seated upon the inner edge of ring 16 is a hemispherical wire gauze dome 19 curving outwardly from the face.

Referring to Figures 2 and 3, ring 16 is seen to have a groove 21 in its peripheral surface shaped to receive and seat an endless coil spring ring 22. In condition for use several layers of cotton gauze 23 are placed over dome 19 and are held firmly in place by the spring 22 which clamps their edges in the groove 21. A small finger indentation 24 is formed in ring 16 at the bottom of groove 21 so that the operator may slip his finger under the spring 22 for easy removal of the spring.

A passage 26 extends through ring 16 at the chin sector, its inner end being positioned above the line of contact of the ring with the face and being directed toward the oral and nasal passages. The outer end of passages 26 is interiorly threaded and seats the threaded end 28 of arm 27 of the T-shaped attachment member 13. Arm 27 extends at right angles from body 29 which forms the other arm of attachment member 13, both arms being interiorly bored along their respective axes as shown.

Referring to Figure 4, it is seen that body 29 is interiorly threaded at 33a to seat a centrally bored guide plug 29a formed with an end flange 29b to abut the end of the attachment member. An elongated rigid piercing needle 34 projects through bore 30 of guide plug 29a and is exteriorly threaded along part of its length at 34a to seat in threaded seat 35a of interior abutment 35 in body 29, dividing the latter into two chambers 30a and 30b. A cup-shaped control cap 31 telescopically enclosing one end of body 29 has its end wall formed with a small bore 33 seating the end of needle 34. A shoulder 36 on the needle abuts the inside face of the cap end wall and fixes the relative positions. The inner end of guide plug 29a is recessed to form a frusto conical seat 37 surrounding the inner end of bore 30. A conforming resilient seal 38 is seated in seat 37 and is centrally apertured to receive needle

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34 as it extends inwardly and to seal the bore 30. The internal pressure in body 29 acting on the face of seal 38 will cause the seal to seat firmly in seat 37 and around needle 34. Piercing needle 34 is formed for a part of its length with an axial bore 39 and is tapered to a sharp point 41 at its end spaced from the cap 31. A small radial port 42 is positioned in needle 34 at a distance from its tapered end and connects to its interior bore 39. Port 42 is so located as to open within the threaded seat 35a.

Body 29 is interiorly threaded at 40 at its end spaced from the cap 31 to receive and seat an exteriorly threaded nipple 43 of the disposable container 14 filled with oxygen under pressure. An annular rubber washer 44 on nipple 43 compressed between the end of member 29 and the neck of container 14 forms a seal to prevent gas leakage. In its new unused condition the cartridge is sealed by a lead sealing element 46 at the end of nipple 43 adapted to be pierced by needle 34. Small disposable oxygen cartridges of this type normally carry oxygen under pressures ranging from 2000 to 4000 pounds per square inch.

Rotation of control cap 31 rotates needle 34 in its threaded seat 35a to advance or retract the needle toward or from lead sealing element 46. When the needle has fully pierced sealing element 46 oxygen flows through needle bore 39 and through port 42. The high pressure of the oxygen in the cartridge forces it through threaded seat 35a and into chamber 30a of member 29 leading to interiorly bored arm 27 and the face mask. Threaded seat 35a and the close fitting needle 34 act as a throttling valve and as oxygen passes therethrough its pressure is greatly reduced. Some of the oxygen will pass in the opposite direction and into chamber 30b where it is retained by resilient seal 38. The resultant back pressure formed in chamber 30b and the fact that port 42 is in nearer proximity to chamber 30a tends to reduce the amount of oxygen flowing to chamber 30b relative to that flowing to the mask.

A bulk oxygen source may be utilized rather than the cartridge with the improved open-drop ether mask constructed in accordance with the present invention. With bulk oxygen utilized as a source the cartridge 14 is removed and an adapter suitable for connection to a conventional oxygen delivery tube replaces it. In Figure 5 such an adapter 47 is illustrated and is seen to comprise a tube exteriorly threaded at one end at 48, beyond an encircling peripheral shoulder 49, as to be capable of engaging the threads 40 of body 29. The opposite end of the adapter is formed with an exterior circumferential bead 51 but is otherwise smooth. When in position the shoulder 49 of the adapter clamps the seal 44 against the end of body 29 forming a sealed joint. The oxygen delivery tube is adapted to slip over the unthreaded end of the adapter and is resistingly retained by bead 51. The flow of oxygen through delivery tube and adapter to the face mask would be controlled by conventional means forming no part of the present invention.

In its preferred form the open-drop ether mask unit constructed in accordance with the present invention embodies a flow meter to indicate the flow of oxygen to the mask and to measure roughly its rate. Figures 6, 7 and 8 are illustrative of preferred embodiments of such a device. Figures 6 and 7 also illustrate a modified form of metering valve and piercing means which

may be utilized in conjunction with such an indicating device.

Referring now to Figures 6 and 7 in particular, a combination metering valve and flow indicator assembly is indicated generally by reference character 52. The assembly includes a body 53 which is suitably affixed to contour ring 16. Body 53 is formed with a laterally extending cylindrical stub exteriorly threaded at 56 to seat control cap 57 of a solid piercing needle 59. The end wall of cap 57 is formed with a small bore 58 into which the shouldered end of piercing needle 59 extends. The latter extends from cap 57 through a passage 61 centrally bored in stub 54 and into oxygen chamber 62 formed in body 53. Chamber 62 extends from the face of body 53 opposite stub 54 and is counterbored and interiorly threaded at 63 to receive the exteriorly threaded neck 34 of a disposable oxygen cartridge 14. Such cartridges are conventionally provided with a soft lead seal positioned in the end of its neck to seal the contents and a typical seal is indicated by reference character 66. With the oxygen cylinder in place in body 53 seal 66 can be pierced by the tapered end 67 of needle 59 as the latter advances into chamber 62, a movement accomplished by rotating its carrying cap 57. With seal 66 pierced and needle 59 backed off slightly the contents of cylinder 14 are released to chamber 62. Leakage from chamber 62 and between the threads of neck 34 and its seat 33 is prevented by a resilient annular seal 68 positioned in the seat 33 and abutting the end of the neck.

A frusto conical seat 71 is formed in the wall of chamber 62 at the inner end of passage 61 and a frusto conical seal 72 is positioned therein being centrally apertured to receive needle 59. The pressure of the oxygen in chamber 62 on the face of seal 72 presses the latter against its seat and around the needle to form a gas-imperious seal.

In Figures 6 and 7 in addition to the piercing needle assembly above described there is embodied an oxygen flow indicator. Body 53 is formed with a second laterally extending cylindrical stub 73 exteriorly threaded at 74 and extended at right angles to stub 54. A transparent cylindrical housing 76 enclosed at one end by a hemispherical wall is formed interiorly at its opposite open end with threads 75 adapted to engage threads 74 of stub 73. An annular washer 77 of resilient material is seated between the seated end of body 76 and a peripheral shoulder 78 on stub 73 at the inner end of threads 74 and when compressed in place provides a fluid-imperious joint. The chamber formed by housing 76 is partially filled with water, indicated at 79, to a point somewhat below the housing top. It is important that the indicator be kept in a substantially vertical position.

A very small diameter passage 81 connects chamber 62 to the interior of housing 76 below the water level through which oxygen may pass. To prevent the water in the chamber 76 from traveling into the chamber 62 a gas-porous felt or ceramic disc 82 is positioned over the end of passage 81 in chamber 76, being clamped between a shoulder 83 of the body or chamber 76 and the stub 73.

A vertical standpipe 84 in the chamber has its upper end extended above the surface of water 79 and its lower end extended into abutment 73 where it connects to a lateral passage 86 in body 53. A short pipe 85 seats in the threaded outer end of passage 86 its own opposite threaded end

being adapted to engage the passage 26 of the connected face mask 11 in the manner illustrated by the pipe 27 in Figure 3.

Oxygen from chamber 62 enters the indicator through passage 81, passing through the gas-pervious but liquid-imperious wafer 82, and travels in bubbles, as indicated at 87, to the surface of water 79. The oxygen exits from above the water level in the indicator chamber downwardly through standpipe 84, passage 86 and pipe 85 to the interior of the connected face mask. Wafer 82 overlying the end of oxygen passage 81 serves not only to retain the indicator liquid 79 but also to reduce the size of the bubbles passing upwardly through the liquid. The size and number of those bubbles, which may be viewed readily through the transparent shell 76, indicate the rate of oxygen flow to the mask.

There is some advantage in using a solid piercing needle, as illustrated in Figure 6, rather than one constructed with an axial bore, as illustrated in Figure 4. In the former the needle 59 is advanced to pierce the lead seal 66 positioned across neck 34 of container 14. After piercing, the needle may be backed out as desired to permit the oxygen to flow between its tapered end 67 and the hole it has formed in the seal. The flow of oxygen may be metered obviously by varying the position of the tapered needle end with respect to the seal 66. The flow of oxygen cannot be varied when using a needle of the hollow type.

Flow indicators of the bubble type disclosed may be utilized with other types of metering valve units. Referring to Figure 8 in particular, a flow indicator of this type is indicated generally by reference character 88. In this form it includes a bottom wall 89 and a top wall 91 both of which are threaded into the ends of a transparent cylindrical side wall 92. A flat splash plate 93, formed centrally with a gas escape aperture 94, extends parallel to and below the top wall 91 being seated in a circumferential shoulder 95 in side wall 92. A retaining ring 97 preferably is positioned between the marginal edge of plate 93 and wall 91.

Top wall 91 is formed centrally with a minute gas passage 98 enlarged and threaded at 99 to seat a threaded nipple 101 which leads to the face mask of the type shown in Figures 1, 2 and 3. Bottom wall 89 also is centrally formed with a small gas passage 102 enlarged and threaded at 103 to seat connecting nipple 104. The latter connects to and conveys the oxygen from the metering unit 106 and connected oxygen cartridge 14. As in the embodiment of Figures 6 and 7 a shouldered inside wall 92, adjacent its lower threads, here indicated by the reference character 107, seats the peripheral edge of a gas-pervious felt or ceramic wafer 108 which is retained in place by threaded bottom plate 89. The indicator 88 is partially filled with a suitable fluid, such as water 109, to a level below splash plate 93. The latter functions to prevent fluid 109 from entering nipple 101 and the face mask connected thereto.

In this embodiment oxygen is released from cartridge 14 by the piercing metering unit 106 and flows through nipple 104 to entrance passage 102 of the indicator. The wafer 108 functions to retain the indicating fluid 109 in the indicator and to reduce the size of the oxygen bubbles 111 which rise vertically from passage 102 through the fluid. The rate of flow is indicated as in the embodiment of Figures 6 and 7 by the number and size of the bubbles passing through the fluid. After reaching the surface of the indicating fluid 109 the oxygen passes

through aperture 94 in splash plate 93 to passage 98 and then through nipple 101 to the attached face mask.

The flow indicators serve to convey intelligence that the seal of the cartridge 14 has been pierced and that oxygen is actually flowing to the face mask. In addition it indicates the rate of oxygen flow. An increase in the size and number of the oxygen bubbles indicates an increase in rate of oxygen flow. Conversely a reduction in their size and number indicates a decrease in oxygen flow. If no bubbles are visible in the indicator there is no flow of oxygen.

It may also be viewed as desirable to modify the interior of the face mask to minimize the interference of exhaled gas with the administration of anesthetic and oxygen by the incorporation of a baffle, as illustrated in Figures 9, 10 and 11.

Referring to Figures 9 and 10 in particular, a baffle 112, constructed as illustrated in Figure 11, is shown positioned in a face mask 12A constructed in accordance with the present invention. The wire gauze dome 19A is contoured as to curve farther from the patient's face to provide for the baffle. In other respects the mask proper may be viewed as identical to the embodiment illustrated in Figures 1, 2 and 3, its face ring 16A being contoured at 17A and 18A, respectively, to conform with the patient's chin and nose.

The baffle 112 in a preferred form is constructed of a small gauge sheet metal plate resistant, of course, to corrosion by fluids and gases. Referring to Figure 11, the baffle is seen to be formed with four laterally extending tabs or legs, indicated by reference characters 113, 114, 116 and 117, which are adapted to be bent down at their point of juncture with the baffle main body. The latter is shaped to form a shallow channel 118 along its longitudinal center line. The baffle tabs should be sufficiently long to position the baffle well above the patient's nose.

Referring to Figures 9 and 10, it is seen that the baffle tabs lie along the inside of dome 19A with their lower ends resting on the mask ring 16A adjacent the line of connection of the wire dome 19A. The stress induced in the tabs when they are bent to conform to the curvature of the dome retains them in place in the mask. The peripheral edge of the baffle abuts the dome 19A of the mask in the chin and cheek areas dividing the dome into upper and lower spaces. The surface of the dome above the baffle, indicated by reference character 121, is denominated the vaporizing surface; while its surface below the baffle, indicated by reference character 122, is identified as the peripheral or expiration zone. The anesthetic is applied by the operator only to the vaporizing surface 121 by allowing liquid anesthetic to drip thereon.

The anesthetic vaporizes at the vaporizing surface 121 and the vapor descends toward the patient's face. In the absence of the baffle the exhaled gas from the patient's lungs would be directed against the vaporizing surface and vaporized anesthetic would be blown into the ambient atmosphere. With the baffle in place, however, the expired gases are directed laterally outwardly through the expiration zone 122.

Anesthetic vapor descends from the vaporizing surface 121 and is deflected along the upper surface of baffle 112 to the end thereof which will normally be positioned above the narrow portion of the patient's nose where its periphery is

wire gauze dome 19A. As the patient inhales the vapor is drawn over this edge to the space below the baffle and so into the patient's lungs. Oxygen port 26A in ring 16A is positioned below the baffle and if oxygen is needed it enters through port 26A at a point under the baffle adjacent the mouth and chin of the patient.

It should be noted that a baffle constructed in accordance with the teaching of the present invention can be utilized in conventional open-drip ether masks.

In the operation of the face mask constructed in accordance with the present invention, reference being made particularly to the first embodiment of Figures 1 to 4, inclusive, the unit is first prepared for use. Coil spring ring 22 is removed from groove 21 in metal ring 16 by grasping the spring 22 at indentation 24 in face ring 16. The layers of cotton gauze 23 are laid over wire dome 19, the edges extending into the ring groove 21. Coil spring 22 is then repositioned in groove 21 over the edge of the cotton gauze layers to clamp the latter firmly in place. If the oxygen container 14 is discharged it may readily be replaced by unthreading its threaded nipple 43 from attachment member 29, accomplished by rotating the entire container and threading a new container in place. Before installing a new container care must be taken to see that cup member 31 is turned back to its extreme outer position so that the sharpened end 41 of piercing needle 34 is spaced from the sealing element 46 in nipple 43 of the new container. After installation of a fresh oxygen container the mask is ready for operation.

To prepare the flow indicator illustrated in Figures 6 and 7 for use the indicator and metering valve assembly 52 is unthreaded from nipple 85 which threadedly connects the assembly to the contour ring at its threaded channel 28. Transparent shell 76 is threaded off its cooperating threads 74 on body 53, inverted and partially filled with indicating fluid, and then is threaded back onto the shell.

The indicator and metering valve assembly 52 is then reconnected to the contour ring 16 by threading nipple 85 in channel 26 of the ring. The level of the fluid 79 in the indicator should be substantially below the upper end of stand-pipe 84.

To prepare the flow indicator illustrated in Figure 8 for use the metering valve means is first disconnected at nipple 101 from contour ring 16. The flow indicator 88, if empty, is disassembled by removing top wall 91, retaining ring 97 and splash plate 93, and fluid, which may be water, is poured into the indicator which is then reassembled. The water level should be just below splash plate 93. Nipple 101 is again threadedly seated in seat 28 of the contour ring and the flow indicator 88 is threaded on its opposite end. Then connecting nipple 104 of metering valve and piercing means 106 is threaded in its seat 103 in bottom plate 89 to affix the metering valve and cartridge-piercing means to the flow indicator. A fresh oxygen container 14 may then be threaded into the cartridge-piercing means 106, care being taken to see first that the piercing needle is backed away so that it will not pierce the cartridge seal, and the unit is ready for use.

In preparing for use a mask employing a gas-directing baffle the baffle 112 is positioned in the interior of the mask by flexing it centrally to give the curvature shown in the drawings and then

it is manually placed in the mask with its legs 113, 114, 116 and 117 positioned over the junction of the dome 19A with the face ring 16A. When the baffle is released the ends of legs 113, 114, 116 and 117 spring downwardly into the line of juncture of dome and the ring as the baffle tends to flatten out and retain the baffle rigidly in the mask.

In the event disposable oxygen cartridges of the character described are not available, bulk oxygen may be utilized with the mask so that it will perform its oxygenating function. If the use of bulk oxygen is necessary the adapter 47, illustrated in Figure 5, may be used. Cartridge 14 is first removed from its seat in the metering valve and piercing needle assembly body 13 and the threaded end of adapter 47 is seated therein. A flexible oxygen tube is then slipped over the free end of the adapter and is resistingly retained thereon by circumferential bead 51 and oxygen from a bulk source flows through the tube to the mask. Obviously the piercing needle and metering valve means in the body 13 cannot perform their flow-controlling functions and supplemental valve means are required. Such supplemental valve means could comprise a valve or clamp in the flexible tube.

In an example of the actual use of the present invention the patient is first prepared for surgery and placed in a reclining position, face upward. The mask is then fitted on the patient's face and anesthetic applied by permitting drops of ether to fall on the cotton gauze fabric 23 stretched over the dome 19 of the mask. The anesthetic in the saturated fabric vaporizes and passes through the fabric to the patient's mouth and nose beneath the mask where it is inhaled. At the critical stage of the anesthesia process, and when oxygen is desired for the patient, cap 31 is threaded on cross-member 23 to advance the piercing needle 34 longitudinally in the bore of cross-member 29. The needle penetrates the sealing element 46 and enters the interior of the container 14. Immediately the oxygen therein, being under pressure, rushes through the needle bore 33 and port 42 into the interior of member 29. From the interior of member 29 the oxygen flows through nipple 27 to the port 26 to raise the partial pressure of oxygen under the mask.

If a flow indicator of the type illustrated in Figures 6 and 7 or 8 is utilized, the oxygen, after being released by the piercing needle and metering valve means, passes through the indicator and then to the interior of the face mask. The size and number of bubbles of oxygen in the indicating fluid, as viewed through the transparent wall of the indicator, indicate the presence of and the rate of flow of oxygen to the face mask.

If a mask embodying a gas-directing baffle is being used, the anesthetic is allowed to drop on the cotton gauze fabric covering the foraminous dome where it vaporizes. Two distinct non-interfering gas flow patterns are created. The vaporized anesthetic induced by the patient's inhalation passes through the mask and is directed by the baffle toward the upper narrow part of the patient's nose where the baffle is spaced from the gauze-covered dome. The vapor then passes over the edge of the baffle and may be drawn into the nose or mouth upon the patient inhaling. During the exhalation phase the flow of vapor along the baffle slows down, while the expired gases from the patient's lungs are directed by the baffle laterally through the peripheral zone

122 of the mask to the ambient atmosphere. It is seen that the baffle decreases the interference normally presented by exhalation of the patient's lungs to the descending flow of ether.

When the partial pressure of the oxygen in the patient's arterial blood has returned to normal, as indicated by the return of normal respiration and normal skin color, the supply of oxygen may be terminated by further threading end member 31 in the same direction of rotation so that ports 42 are covered by the sealing element 46. When desired the flow of oxygen may be renewed by threading end member 31 in a reverse direction until such time as ports 42 are advanced out of sealing element 46.

In the use of a metering valve employing a solid piercing needle of the type shown in Figure 3 the flow of oxygen may be varied by adjusting the position of needle 59 in the aperture initially pierced by the needle in seal 66. The flow may be decreased by advancing the tapered end of the needle into its hole and may be cut off entirely by seating the needle firmly in the hole.

While the particular apparatus herein shown and described in detail is fully capable of attaining the objects and providing the advantages hereinbefore stated, it is to be understood that it is merely illustrative of the presently preferred embodiments of the invention and that no limitations are intended to the details of construction or design herein shown other than as defined in the appended claims.

I claim:

1. In an open-drop type ether mask, a mask proper including a porous absorbent surface, a pressurized oxygen container mounted on and portably carried by said mask proper and connected interiorly by a fluid-conducting passage to a point opening interiorly of said porous absorbent surface, and a manually controlled valve to control the flow of oxygen from said container and through said passage.

2. In an open-drop type ether mask, a ring contoured to conform to the anatomical features of the human face and to surround the oral and nasal areas thereof, a perforated dome seated on said ring curving outwardly from said oral and nasal areas and adapted to support covering absorbent material, said ring being formed with a channel to receive the marginal edge of said material, a coil spring seated in said channel to affix said absorbent material to said dome, a tubular member connected to said ring and interiorly connected therethrough to the space under said dome, a supply of pure oxygen connected to said tubular member, and a valve to control the flow of oxygen from said supply.

3. In an open-drop type ether mask, a ring contoured to conform to the anatomical features of the human face around the oral and nasal passages thereof and to provide a substantially airtight seat with the face, a perforated dome attached to said ring and curving outwardly from the oral and nasal areas of the face, absorbent material overlying the entire exterior surface of said perforated dome, and means to affix said absorbent material to said dome, a container of oxygen, a tubular member mounting said container on said ring, a passage in said ring connecting said tubular member with the space beneath said dome, and valve means to control the flow of oxygen from said container to said dome.

4. In an open-drop type ether mask, a ring contoured to conform with the anatomical features of the human face surrounding the oral

and nasal passages thereof and adapted to provide a substantially air-tight seal with the face, a perforated dome curving outwardly from the oral and nasal areas of the face and attached to said ring, absorbent material covering the entire exterior surface of said perforated dome, means to hold said absorbent material against said dome, a disposable pressurized container of oxygen, a tubular member affixing said container rigidly to said ring and adapted to convey oxygen from said container to the space underneath said dome, and valve means adaptable to control the flow of oxygen from said container to said dome.

5. In an open-drop type ether mask, a ring contoured to conform to the anatomical features of the human face surrounding the oral and nasal areas thereof, the lower surface of said ring being adapted to provide a substantially air-tight seal with the face, a continuous groove in the peripheral surface, a perforated dome curving outwardly from the oral and nasal areas of the face and attached to said ring, layers of absorbent material covering the entire exterior surface of said perforated dome, the edge thereof lying in said groove in said ring, a coil spring ring seating in said groove in said ring and overlying the edge of said material to affix said material to said dome, a pressurized container of oxygen, a tubular member affixing said container rigidly to said ring and adapted to convey oxygen therefrom to the space underneath said dome, and valve means to control the flow of oxygen to said dome.

6. In an open-drop type ether mask, a ring contoured to conform to the anatomical features of the human face surrounding the oral and nasal areas thereof, the lower surface of said ring being adapted to seat in air-tight relationship with the face, said ring being formed with a continuous groove in its outer surface, a foraminous dome curving outwardly from the oral and nasal areas of the face and attached to the inner and upper edge of said ring, layers of absorbent material lying on and covering the entire exterior surface of said dome with their edges extended in said groove, a coil spring ring resiliently retaining the edges of said layers in said groove to affix said absorbent material relative to said dome, a disposable pressurized container of oxygen having threaded nipple filled with a closure element, a T-shaped tubular attachment member removably seating the threaded nipple of said container and mounted rigidly on said ring, said attachment being formed with a passage to direct oxygen from said container to said ring, said ring being formed with a passage extended from its exterior to its interior, a hollow needle adjustably seated in said attachment member and mounted for movement toward and from said nipple, said needle being adapted to penetrate said closure element to release said oxygen from said container into said attachment.

7. In an open-drop type face mask, a ring contoured to conform to the anatomical features of the human face surrounding the oral and nasal areas thereof, the lower surface of said ring being adapted to seat in air-tight relationship with the face, a passage constructed from the outer radial surface of said face ring to the inner radial surface thereof, the outer end of said passage being threaded to receive the threaded end of the conduit arm of a hollow attachment member, a disposable pressurized oxygen container having a threaded nipple thereon removably seated on said attachment member and supported thereby with

respect to said ring, said nipple being sealed by a displaceable closure element, a manually adjustable hollow needle movably carried by said attachment member toward and from penetrating relationship with said closure element to release oxygen from the said pressurized container into said attachment member and therethrough into said passage in said ring, a foraminous dome curving outwardly from the oral and nasal areas of the face and attached to the inner and upper edge of said ring, absorbent material covering the entire surface of said foraminous dome, a circular groove constructed in the outer surface of said ring seating the marginal edges of said material, and a coil spring ring cooperating with said circular groove to affix said absorbent layers to said ring and dome.

8. In an open-drop type face mask, a rigid body contoured to seat on the patient's face around the oral and nasal areas and including a support to retain absorbent material to form a vaporizing surface above said areas, an oxygen cartridge, an attachment member fixed to said body and formed with a seat supporting the mouth of said cartridge, said attachment member and said body being formed with oxygen-conducting connecting passages extended from the mouth of said cartridge to a point inside said body and its connected vaporizing surface and adjacent said oral and nasal areas, and a manually adjustable valve carried by said attachment member controlling the flow of oxygen through said passages.

9. The construction recited in claim 8 characterized in that said cartridge includes a sealing element in its mouth, and in that said valve comprises a hollow needle, a rotatable cap rigidly supporting said hollow needle, said cap adjustably mounted on said attachment member for movement between a position in which said needle penetrates said sealing element and extends into said cartridge to release oxygen from said cartridge through said passages to a point under said vaporizing surface and a position in which said needle is positioned entirely exteriorly of said cartridge.

10. In an open-drop type ether mask, a mask proper, a pressurized oxygen container mounted on and portably carried by said mask proper and connected interiorly by a fluid-conducting passage to a bubble-type flow indicator portably carried by said mask, a fluid-conducting passage connecting said flow indicator to the interior of said mask, and a manually controlled valve portably carried by said mask to control the flow of oxygen from said container and through said passages and flow indicator.

11. In an open-drop ether mask, a mask proper with a gas-directing baffle positioned therein, a pressurized oxygen container mounted on and portably carried by said mask proper and connected interiorly through a fluid-conducting passage to a point opening interiorly thereof, and a manually controlled valve portably carried on said mask proper to control the flow of oxygen from said container and through said passage.

12. In an open-drop ether mask, a ring contoured to conform to the anatomical features of the human face and to surround the oral and nasal areas thereof, a perforated dome seated on said ring curving outwardly from said oral and nasal areas, and adapted to support covering absorbent material, said ring being formed with a channel to receive the marginal edge of said material, a coil spring seated in said channel to affix said absorbent material to said dome, a gas-

directing baffle positioned within said dome, a tubular member connected to said ring and interiorly connected therethrough to the space under said dome, a liquid type flow indicator connected to said tube to indicate the presence and rate of flow of gas therethrough, a supply of oxygen connected to said flow indicator, and a valve to control the flow of oxygen from said supply through said indicator.

13. In an open-drop type mask, a body contoured to seat on the patient's face around the oral and nasal areas, including a support to retain absorbent material above said areas, an attachment member including manually controlled valve means secured to said body, a flow indicating device having a transparent housing adapted to be partially filled with liquid mounted on said attachment member, an oxygen cartridge seated in said attachment member, connecting interior passages in said cartridge, said attachment member, said indicator and said body arranged to direct and convey oxygen from said cartridge through said attachment member, said indicator, and said body to a point within said face mask, said valve means being positioned to control the flow of oxygen.

14. An anesthesia mask of the open-drop type including a face-contacting ring and a porous dome positioned thereon to support absorbent material, means to supply oxygen to the interior of said mask comprising a disposable pressurized container of oxygen having a nipple and a displaceable sealing element positioned in said nipple closing said container, a T-shaped tubular attachment member removably seating the nipple of said container and mounted rigidly on said face-contacting ring, said attachment being formed with a passage to direct oxygen from said container to said ring, said ring being formed with a seat for said attachment member and with a passage extending therethrough, a needle adjustably seated in said attachment member and mounted for movement toward and from said nipple, said needle being adapted to penetrate said sealing element and to be backed therefrom to release said oxygen from said container through said punctured sealing element to pass through said attachment member and through said ring passage to the interior of said mask.

15. An anesthesia mask of the open-drop type including a face-contacting ring and a porous dome positioned thereon to support absorbent material, a gas-directing baffle comprising a plate positioned beneath said dome and a plurality of legs connected to said plate and supported at their lower ends by said face ring to space said plate from the patient's face, said baffle directing the air exhaled from the patient's lungs laterally and away from anesthesia vapor descending downwardly from the surface of said dome.

16. In an anesthesia mask of the open-drop type, a face-contacting ring adapted to carry a porous dome to support absorbent material and formed with a gas conduit connecting its interior and exterior surfaces, means to supply oxygen to the interior of said mask below said dome comprising a disposable cartridge having a nipple and a displaceable sealing element positioned in said nipple to close said cartridge, a tubular attachment member mounting said cartridge and including valve means to control the flow of oxygen from said cartridge through said nipple, an oxygen flow indicator comprising a transparent side wall and top and bottom walls threadedly seated in said side wall to form a fluid container adapted

to be partially filled with indicating fluid, said indicator being rigidly mounted at its bottom wall to said attachment member, said bottom wall being formed with a gas inlet connecting said container interiorly to said attachment member, said top wall being formed with gas outlet, a threaded nipple interiorly connecting said gas outlet with said conduit in said face-contacting ring, characterized in that said valve means are manually operable to control the flow of oxygen from said pressurized container through said tubular member to said indicator and thence to said face ring, the size and number of bubbles appearing in said indicator when containing fluid and upon oxygen passing therethrough indicating the presence and rate of flow.

17. In an open-drop type ether mask, a ring contoured to conform in substantially air-tight relationship to the anatomical features of the human face around the oral and nasal passages, a perforated dome attached to said ring contoured to curve outwardly from the oral and nasal areas of the face upon which said ring is positioned, absorbent material overlying the exterior surface of said dome, indicating means comprising a transparent hollow cylinder interiorly threaded at its opposite ends, first and second circular end walls seated in said cylinder and forming therewith an enclosed chamber adapted to be partially filled with gas flow indicating fluid, said first end wall being formed with a minute fluid passage which extends therethrough and is enlarged and threaded at its outer end, a tubular member seating in said enlargement and affixing said indicator vertically on said face ring, a passage in said ring connecting said tubular member with the space beneath said dome, a splash plate positioned in said hollow cylinder above the normal fluid level, said second end wall being centrally formed with a minute fluid passage enlarged at its outer end, a wafer of felt overlying said second end wall within said indicator to retain said indicating liquid therein, a second tubular member connected to the fluid passage in said second end wall, a container of oxygen connected to said indicating device through said second tubular member, and a valve to control the flow of oxygen from said container, through said indicating device to said dome, the presence and rate of oxygen flow being indicated by the appearance and quantity of oxygen bubbles appearing within said indicator.

18. In an open-drop type ether mask, a ring contoured to conform to the anatomical features of the human face and to surround the oral and nasal areas thereof, a laterally projecting body connected to said ring, said body including a first projecting abutment formed with exterior threads, an interiorly threaded cap rotatably seated on said first abutment, a piercing needle carried by said cap extended through said first abutment and adapted to be advanced and retracted by the rotation of said cap, an elongated chamber in said body to receive said needle, said chamber being interiorly threaded opposite said needle, a conventional oxygen container seated in the interior threads of said chamber and including a threaded neck having a closure wall positioned to be pierced by said needle to release contained oxygen, a second abutment formed on said body, a transparent housing seated rigidly on said second abutment and formed with a closure wall spaced therefrom, said housing forming with said second abutment an indicator chamber adapted to be partially filled with an indicating liquid, an

inlet passage formed in said body connecting said chamber to the interior of said indicator and adapted to convey gas therebetween, a standpipe rigidly seated in said second abutment and projecting into said indicator to a point above the surface of said indicating liquid, a duct in said body interiorly connecting said standpipe at its seat in said second abutment to the said ring, said standpipe and said duct being adapted to convey oxygen from the interior of said indicator to said ring, a perforated dome seated on said ring curving outwardly from said oral and nasal areas, said ring being formed with an encircling channel to receive the marginal edge of absorbent material overlying said dome, and a removable coil spring seated in said channel to secure said absorbent material to said dome.

19. In combination in an open-drop ether mask unit; a mask proper including a ring contoured to seat in gas-sealing relationship upon the human face around the nasal and oral passages, a convex dome carried by said ring, and absorbent material overlying said dome; an oxygen-providing unit including a body mounted on said ring and formed interiorly as a valve chamber, an oxygen cartridge including a sealed mouth carried by said body with its mouth exposed to said valve chamber, an adjustable cartridge-piercing element carried by said body and movable to pierce said cartridge to permit the oxygen therein to enter said valve cylinder, a manually operable member carried by said body to adjust said piercing element; and gas conduits connecting said valve chamber to a position on said ring below said dome.

20. The construction recited in claim 19 characterized in that said gas conduits include an oxygen flow indicator.

21. A valve of the type adapted to control the flow of oxygen from a pressurized container having a penetrable sealing element to an open-drop anesthesia mask comprising a hollow tubular member interiorly threaded at one end to seat the neck of a pressurized oxygen container, said tubular member being exteriorly threaded at its opposite end, an axially bored piercing needle formed with a lateral port, said needle projecting into said hollow tubular member and toward an oxygen container seated in said hollow tubular member, said needle threadedly seating in said hollow tubular member in a seat formed therein, a manually rotatable cap fixed on said needle opposite its piercing end, said needle having an exteriorly threaded shank and said tubular member being provided with an interiorly threaded shoulder to seat the threaded shank of said needle, said lateral post of said needle opening to said threaded connection of said shank and said shoulder, said needle being advanced in said tubular member to and from piercing relationship with the sealing element of said container upon the rotation of said cap, characterized in that oxygen flows from said container through said needle and out of its lateral port to and through said threads and into said attachment member in certain adjustable positions, and characterized further in that the passage of oxygen through said threads tends to reduce the pressure of the oxygen.

22. In an open-drop ether mask a face-contacting ring, a convex dome carried by said ring to support absorbent material in spaced relationship to the oral and nasal areas of the human face, and a baffle underlying said dome and dividing its interior into upper and lower chambers connected only at one end of said baffle whereby exhaled gases are directed laterally through the walls of

said dome forming the lower chamber and vaporized anesthetic is free to pass from said upper chamber to said lower chamber at said one end.

23. The construction recited in claim 22 characterized in that said baffle includes integral supporting legs seated on said face-contacting ring.

24. In an open-drop type ether mask, a ring contoured to conform in substantially air-tight relationship to the anatomical features of the human face around the oral and nasal passages, a perforated dome attached to said ring contoured to curve outwardly from the oral and nasal areas of the face upon which said ring is positioned, absorbent material overlying the exterior surface of said dome, a gas-directing baffle positioned within said dome, indicating means comprising a transparent hollow cylinder interiorly threaded at its opposite ends, first and second circular end walls seated in said cylinder and forming therewith an enclosed chamber adapted to be partially filled with gas flow indicating fluid, said first end wall being formed with a minute fluid passage which extends therethrough and is enlarged and threaded at its outer end, a tubular member seating in said enlargement and affixing said indicator vertically on said face ring, a passage in said ring connecting said tubular member with the space beneath said dome, a splash plate positioned in said hollow cylinder above the normal fluid level, said second end wall being centrally formed with a minute fluid passage enlarged at its outer end, a wafer of felt overlying said second end wall within said indicator to retain said indicating liquid therein, a second tubular member connected to the fluid passage in said second end wall, a container of oxygen connected to said indicating device through said second tubular member, and a valve to control the flow of oxygen from said container, through said indicating device to said dome, the presence and rate of oxygen flow being indicated by the appearance and quantity of oxygen bubbles appearing within said indicator.

25. In an open-drop type ether mask, a ring contoured to conform to the anatomical features of the human face and to surround the oral and nasal areas thereof, a laterally projecting body connected to said ring, said body including a first projecting abutment formed with exterior threads, an interiorly threaded cap rotatably seated on said first abutment, a piercing needle carried by said cap extended through said first abutment and adapted to be advanced and retracted by the rotation of said cap, an elongated chamber in said body to receive said needle, said chamber being interiorly threaded opposite said needle, a conventional oxygen container seated in the interior threads of said chamber and including a threaded neck having a closure wall positioned to be pierced by said needle to release contained oxygen, a second abutment formed on said body, a transparent housing seated rigidly on said second abutment and formed with a closure wall spaced therefrom, said housing forming with said second abutment an indicator chamber adapted to be partially filled with an indicating liquid, an inlet passage formed in said body connecting said chamber to the interior of said indicator and adapted to convey gas therebetween, a standpipe rigidly seated in said second abutment and projecting into said indicator to a point above the surface of said indicating liquid, a duct in said body interiorly connecting said standpipe at its seat in said second abutment to the said ring, said standpipe and said duct being

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adapted to convey oxygen from the interior of said indicator to said ring, a perforated dome seated on said ring curving outwardly from said oral and nasal areas, said ring being formed with an encircling channel to receive the marginal edge of absorbent material overlying said dome, a removable coil spring seated in said channel to secure said absorbent material to said dome, and a gas-directing baffle positioned within said perforated dome.

26. In an open-drop type ether mask, a ring contoured to conform to the anatomical features of the human face surrounding the oral and nasal areas thereof, the lower surface of said ring being adapted to seat in air-tight relationship with the face, said ring being formed with a continuous groove in its outer surface, a foraminous dome curving outwardly from the oral and nasal areas of the face and attached to the inner and upper edge of said ring, layers of absorbent material lying on and covering the entire exterior surface of said dome with their edges extended in said groove, a coil spring ring resiliently retaining the edges of said layers in said groove to affix said absorbent material relative to said dome, a gas-directing baffle positioned within said perforated dome, a disposable

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pressurized container of oxygen having threaded nipple filled with a closure element, a T-shaped tubular attachment member removably seating the threaded nipple of said container and mounted rigidly on said ring, said attachment being formed with a passage to direct oxygen from said container to said ring, said ring being formed with a passage extended from its exterior to its interior, and a hollow needle adjustably seated in said attachment member and mounted for movement toward and from said nipple, said needle being adapted to penetrate said closure element to release said oxygen from said container into said attachment.

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