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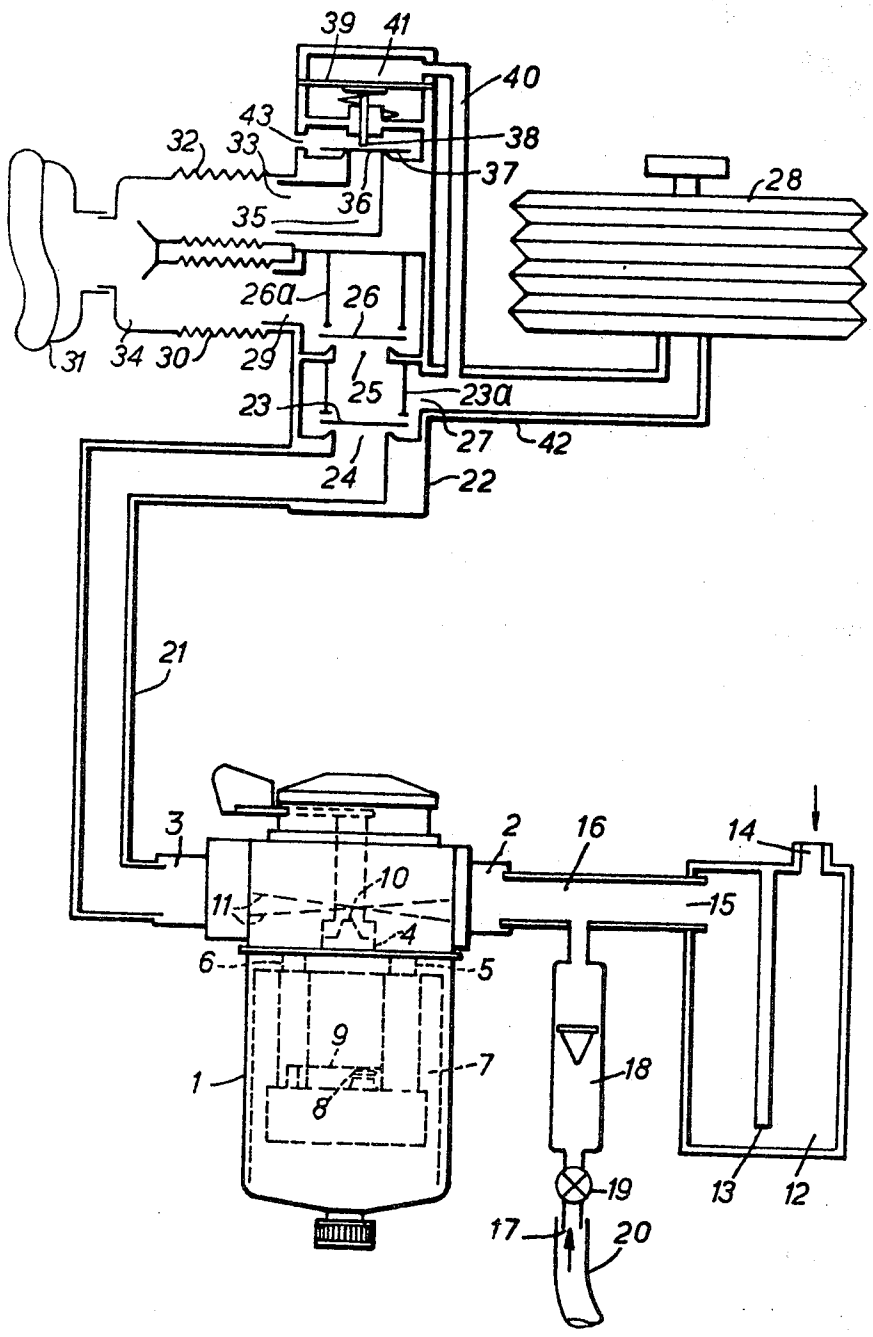

INVENTORS

Wilfred Jones

William Edmondson

by Pierce, Scheffler & Parker

attys

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VOLATILE ANAESTHETIC VAPORISING APPARATUS

Wilfred Jones, Long Lee, Keighley, and William Edmondson, Keighley, England, assignors to Cyprane Limited, Haworth, near Keighley, England, a British company

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ABSTRACT OF THE DISCLOSURE

A portable anaesthetic apparatus comprises a valve-controllable volatile anaesthetic vaporiser having a connection from its inlet to a high region outlet from an oxygen economiser reservoir furnished with a high region air inlet-exhaust port, a pendant partly dividing plate in said reservoir between said inlet and said outlet, an oxygen supply inlet to the connection between the vaporiser and the reservoir, a connection between the outlet from said vaporiser and a flow control valve unit, twin vertically spaced-apart light-weight plate valve members controlling two flow passage ports leading to a connection to a face mask, a third inlet port between said two ports with an inlet connection from a bellows unit, and a passage from the bellows inlet connection to a pressure chamber in said valve unit behind a diaphragm, said diaphragm controlling a valve which normally closes an expiration port from the face mask to atmosphere.

This invention relates to apparatus capable of mixing the vapour of a volatile liquid anaesthetic with a gaseous fluid, such as air or oxygen, or a combination thereof.

There are occasions when a portable anaesthetic apparatus could be an advantage for the administration of a volatile anaesthetic in air to which oxygen could be added economically. Such an apparatus may be of a type to be used almost anywhere an operation could be carried out and thus it would be ideal for emergency work. Said apparatus could be such that it would not include an oxygen cylinder, as such cylinders may be available on the site of an accident, although an oxygen cylinder could be included and the unit be more of a transportable type.

According to the present invention there is provided anaesthetic apparatus, including a valve controlled volatile anaesthetic vaporiser, a reservoir providing an air inlet to the vaporiser, oxygen supply means connected to the vaporiser and reservoir, a valve control unit connected to said vaporiser and a bellows unit and controlling an inspiration outlet to and an expiration outlet from connection means for a patient's mask, said unit having nonreturn valve means between said inspiration outlet the bellows unit and the vaporiser for controlling the flow of air/oxygen and anaesthetic vapour mixture and a patient's expiration.

The invention will now be more particularly described with reference to the diagrammatic view in the accompanying drawing.

According to the drawing the improved apparatus, which may be constructed to be portable or otherwise, includes a liquid anaesthetic containing vaporising unit **1** for air and/or oxygen to pass thereinto and become admixed with a percentage of anaesthetic vapour according to a predetermined setting of the unit. This vaporising unit is preferably of a nonspillable type, such as is disclosed in our prior British Patent Specification No. 968,-054, dated Feb. 4, 1963, where there is an inlet **2** and an outlet **3** on opposite sides of the unit for a through flow of air and/or oxygen and a rotatable plate valve **4**,

which normally closes an inlet **5** to and an outlet **6** from a vaporising chamber **7** or chambers. The latter also includes a valve **8** carried by a temperature responsive element **9** and this valve or another valve controls the outflow of anaesthetic vapour. When the plate valve **4** is turned it initially opens the aforesaid inlet to and outlet from the vaporising chamber or chambers. The said plate valve has an upstanding rib **10** which is rotated in relation to superposed inclined facings **11** which causes the through passage for air and/or oxygen to be variable.

The vaporising unit **1** is connected to an oxygen economiser receptacle **12** which has a pendant partly dividing plate **13** between an air inlet **14** (which may be controllable) and an outlet **15** connected by pipe **16** to the inlet to the vaporiser unit. An inlet **17** for oxygen is linked to the said connection pipe **16** and a flow meter **18** is provided to give visible indication of the inlet of oxygen from a supply source. This inflow of oxygen is controlled by a fine control valve **19** and a feed pipe **20** is provided for connection to a cylinder and fitted with an oxygen reducing valve.

The vaporiser unit **1** is connected by pipe **21** from its outlet **3** to a connection unit **22** embodying a direction flap valve **23** for controlling the inflow of air-oxygen-anaesthetic-vapour through an inlet port **24** with a further inlet port **25** spaced away therefrom and controlled by a nonreturn flap valve **26**. The two valves are thin plates or discs resting by gravity on the port seatings to be raised by a patient's inspiration or bellows induced pressure. Stop means **23***a* and **26***a* restrict the opening movements of the valves. Between these two valves there is a third port **27** connected to a manually operated bellows unit **28**. From this connection unit there is an outlet **29** to which can be attached a flexible connection tube **30** to a facepiece **31** which has a second flexible tube **32** also connected to the said connection unit at an inlet **33**. The two flexible tubes are conveniently connected to the facepiece by a Y-coupling **34**. The unit **22** has a passageway **35** leading from the second flexible tube inlet **33** to a port **36** normally closed by an expiratory valve **37** over which there is mounted a spring returned plunger **38** connected to a flexible diaphragm **39**. A passage **40** leads from a chamber **41** above the diaphragm to the connection **42** between the said unit **22** and the bellows **28** and there is an expiratory port **43** in the wall of the connection unit from the region where the expiratory valve mounted.

With the above type of apparatus a patient can have normal breathing and draw in air and/or oxygen, or anaesthetic vapour mixed with air and/or oxygen. Expiration can take place normally through the second flexible tume **32** to the expiratory port **43** by expired air pressure opening the expiratory valve **37**. Should it be necessary, breathing can be assisted by operation of the bellows unit **28**. It will be appreciated that as a patient inspires air can be drawn through the oxygen economiser **12**, through the vaporiser unit **1** and the two nonreturn spaced apart valves **23**, **26**, and thence through the first flexible tube **30** to the facepiece **31**. As the patient expires the second nonreturn valve **26** will close and thus all expiration will pass out through the aforesaid valve **37** to the expiratory port **43**. If it is desired to supplement the air with oxygen the fine control valve **19** is opened to admit oxygen from a supply source at a desired rate. By providing an economising unit **12**, while a patient is expiring or not breathing, the oxygen flow will be charging the economiser unit itself, and this will discharge any existing air in the economiser through the air inlet **14**. Thus as the patient next inspires he will firstly draw in pure oxygen from the economiser and then air or an admixture of air and oxygen. The percentage of oxygen received by the patient will be dependent on the

rate of flow of oxygen according to the setting of its inlet control valve **19** and the patient's minute volume. By the expression "minute volume" is meant lung capacity per one minute. It will be understood that the percentage of oxygen a patient receives will vary according to the patient's own minute volume which of course differs with different patients.

If it is necessary to assist a patient's breathing then the bellows **28** can be operated and this will draw air and/or oxygen and/or vaporised anaesthetic into it and then cause it to be forced through the second of the nonreturn valves **26** and the first flexible tube **30** to the facepiece **31**. The said second nonreturn valve **26** prevents any air being drawn from the patient's lung. Operation of the bellows which causes the pressure in a patient's lungs to be raised causes a pressure to be transmitted to the aforesaid chamber **41** in the connection unit **22** behind the flexible diaphragm **39**. Pressure on the diaphragm causes the plunger **38** to be forced down on to the expiratory valve **37** to hold it closed against any escape to atmosphere during the period when there is ejection into the patient's lungs. As the bellows are expanded pressure on the said diaphragm will be immediately released to release the expiratory valve and thus allow passive expiration to atmosphere from the patient's lungs.

It will be understood that during spontaneous breathing there will be some movement of the bellows which will give some indication of the patient's breathing. On the other hand, a more precise measurement of tidal volume may be obtained by fitting a respirometer to the air inlet to the economiser unit, although this will not give entirely accurate indication under all conditions.

The above apparatus may be mounted on a base plate which may have gripping means and rubber feet. A carrier case may be provided. Alternatively, the apparatus may be on a trolley or be otherwise movable. The vaporising unit may be of the nonspillable type and include a drainage outlet.

It is considered the invention provides at least two important features, i.e., automatic loading and unloading of the expiratory valve by the bellows created pressure, and economy in or full benefit of pure oxygen provided in the system through the flowmeter.

We claim:

1. A portable anaesthetic apparatus, including in combination:

a valve-controllable volatile anaesthetic vaporiser having an inlet and an outlet;

an oxygen economiser reservoir having a high region air inlet-exhaust port and a high region outlet;

a connection from said vaporiser inlet to said high region outlet of said reservoir;

a pendant partly dividing plate in said reservoir between said inlet and said outlet;

an oxygen supply inlet to the connection between the vaporiser and the reservoir;

a flow control valve unit having two sequential flow passage ports;

a connection between the outlet from said vaporiser and said flow control valve unit;

a face mask;

twin vertically spaced-apart lightweight plate valve members controlling said two flow passage ports in said valve control unit and leading to said face mask;

a bellows unit;

a third inlet port in said valve control unit between said two sequential flow passage ports, said third inlet port having an inlet connection from said bellows unit;

a diaphragm in said valve control unit;

a pressure chamber in said control valve unit behind said diaphragm;

a passage from said bellows inlet connection to said pressure chamber;

an expiration port leading from said face mask to atmosphere; and

an expiration valve which normally closes said expiration port, said diaphragm controlling said expiration valve.

2. Anaesthetic apparatus according to claim **1**, wherein the valve members are gravity closed flap valves resting on said ports with stop means to restrict their opening movements.

3. Anaesthetic apparatus according to claim **1**, wherein said valve control unit includes two tubular connection elements, one of said elements being an outlet for valve controlled air/oxygen and anaesthetic vapour and the other element leading to said valve controlled expiration port, and a pair of flexible tubes adapted to be removably attached to said connection elements, said tubes being joined together at their other ends and to a patient's face mask.

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RICHARD A. GAUDET, *Primary Examiner.*

W. E. KAMM, *Assistant Examiner.*