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[54] **ANAESTHETIC APPARATUS**

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[58] **Field of Search** 128/188, 142, 142.2, 128/142.3, 145.6, 145.8; 137/88, 98, 100, 87, 89, 99; 417/395, 413

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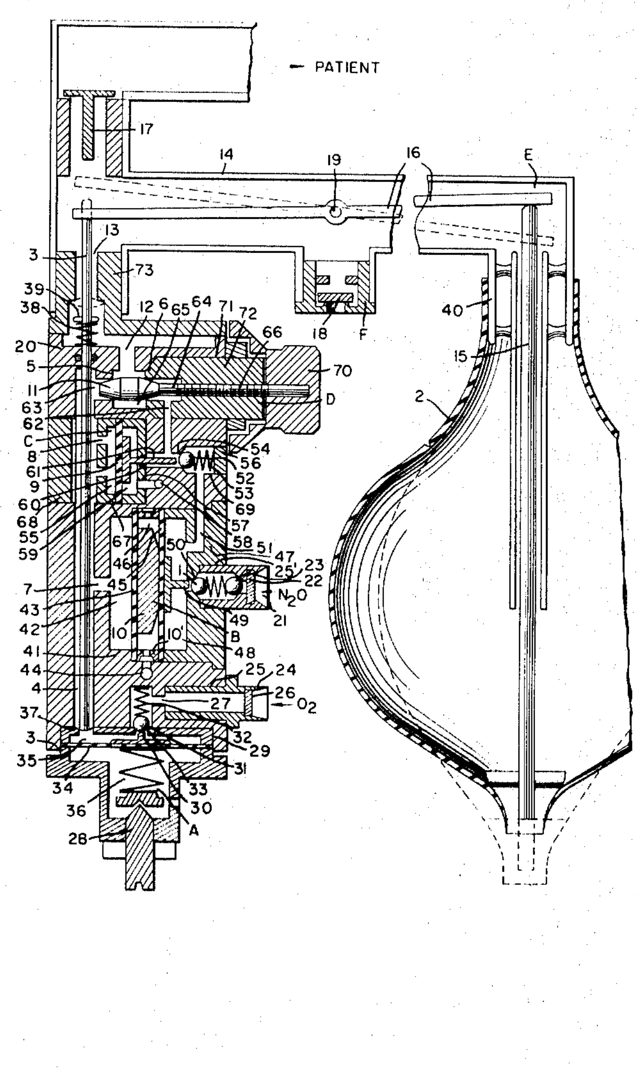
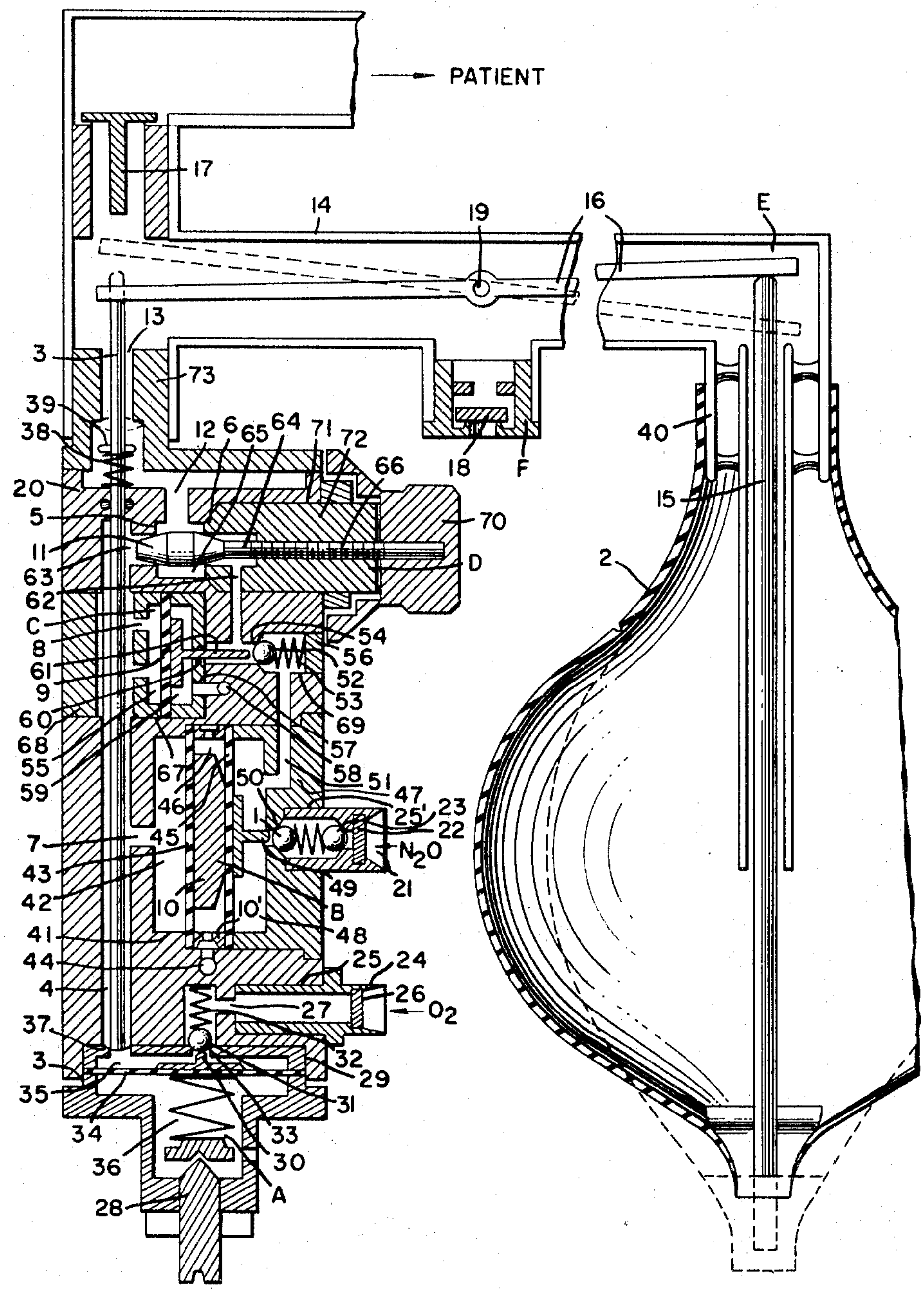
[57] **ABSTRACT**

An anaesthetic apparatus for analgesic narcosis using a mixture of oxygen gas and nitrous oxide gas, said apparatus being equipped with an inlet valve for the oxygen gas, a pressure regulator for same, a pressure-controlled balance regulator for the nitrous oxide gas and a proportioning valve for regulation of the oxygen nitrous gas mixture, which apparatus is executed as a homogenous block and in which the connections between the components are arranged as internal channels.

3 Claims, 1 Drawing Figure

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ANAESTHETIC APPARATUS

The invention applies to an anaesthetic apparatus for analgesic narcosis using a mixture of oxygen gas and nitrous oxide gas. Anaesthetic devices of this kind using a pressure regulator for the oxygen gas pressure, a membrane-influenced balance regulator, controlled by the oxygen gas pressure, for the nitrous oxide gas pressure, a proportioning valve for regulation of the nitrous oxide/oxygen gas mixture and an oxygen gas supply regulation valve are well-known.

Devices of this type are intended for connection either to a central gas supply, in which pressure is generally maintained at 4 ± 2 at overpressure, or, via a pressure regulator, to gas cylinders with a much higher pressure. These devices are adjustable for gas mixtures containing 30–100 percent oxygen gas by volume, the remainder being nitrous oxide gas. With a loss of nitrous oxide gas supply they only provide pure oxygen gas as long as the supply lasts.

In addition to connectors for oxygen and nitrous oxide gases there is generally a connection for a face mask and a connection for a reservoir bag.

Such anaesthetic devices are subject to stringent safety regulations. Thus, placing a check valve between the reservoir bag and the face mask to prevent rebreathing into the device is well-known. The provision of a fixed locking device to prevent any percentage setting less than 30 percent oxygen gas by volume so as to obviate the risk of suffocation is also well-known. With a 100 percent oxygen gas by volume setting, oxygen gas is generally supplied independently of the supply of nitrous oxide gas, thereby making oxygen gas therapy possible with anaesthetic devices of this kind. Quick-release connectors are good fittings for connecting oxygen gas and nitrous oxide gas to the apparatus. Non-interchangeable connectors are used which may also be colour coded and have engraved or similarly marked information on gas type. Moreover, such anaesthetic devices contain provisions to prevent the flow of nitrous oxide gas to the oxygen gas connection and vice versa through the use of check valves and/or balance regulators which reduce the pressure of inflowing nitrous oxide gas to a level not exceeding the oxygen gas inflow pressure or preferably somewhat less than said pressure.

Even though known anaesthetic devices satisfy existing safety regulations, there is still room for further improvement and improved safety measures.

The object of the present invention is to improve and reduce the cost and size of known anaesthetic devices and to provide increased security.

According to the invention, therefore, a design for anaesthetic devices is proposed having no moving or loose parts which might involuntarily rub against each other or which people or objects could catch on, thereby inducing leakages. Furthermore, according to the invention it is proposed to separate the gases via a pressureless chamber or the like, connected to the atmosphere, in cases where the components are touched by both oxygen and nitrous oxide gases under raised pressure.

An anaesthetic apparatus according to the present invention is, therefore, characterized by execution in one homogenous block made from e.g. aluminium, perspex or some other material, by connections between components being made of internal channels in the ma-

terial and by having components such as valves, regulators, membranes etc., mainly fitted into holes or recesses in the material.

According to a further characteristic feature of the invention, the balance regulator for nitrous oxide gas pressure displays a double membrane between a chamber for the nitrous oxide gas and a chamber for the oxygen gas, said membrane having an intermediate space connected to the atmosphere.

According to another characteristic feature of the invention, a throttle valve is fitted after the balance regulator, said valve being controlled by the oxygen gas pressure prevailing after said balance regulator and an oxygen gas supply regulation valve, said throttle valve controlling nitrous oxide gas flow from the balance regulator, an interspace connected to the atmosphere being further arranged between a chamber for the nitrous oxide gas and one for the oxygen gas.

An operative example of the invention will now be explained with references to the accompanying drawing which provides a schematic, vertical cross-section through an anaesthetic apparatus with a reservoir bag. The requisite, conventional sealing units are not shown.

By the lid **47** fitted to the recess **41** in a homogenous block **20** made of e.g. aluminium, perspex or other material, there is the connection **21** (only sketchily rendered in the drawing) in a recess **25'** for nitrous oxide gas with a filter **22** and check valve **23,** here in the form of a spring-loaded ball. In addition, there is a connection **24** for oxygen gas fitted to another recess **25** in the block **20,** the external shape of said connection differing from the connection **21** for nitrous oxide gas, here indicated with a fin-like ring of greater diameter than that of connection **24** in general. Another way to make the connections **21** and **24** is to supply one with a left-hand thread and the other with a right-hand thread. A channel **27** leads from the oxygen gas connection **24** to an oxygen gas pressure regulator A arranged in a hole **29** in the block **20.**

This pressure regulator A can be adjusted with an adjustment screw **28** which, via a tensioned spring and load sensor **30,** can raise a valve **31** from a valve seat **33** against the pressure of a spring **32.** The load sensor **30** is connected to a membrane **34,** which is located between an upper pressure space **35** and a lower open space **36,** preferably in connection with atmospheric pressure, in which the aforementioned spring and one end of the adjustment screw **28** are located.

Via an inlet valve **3, 37** the upper pressure space **35** is connected to an oxygen gas channel **4.** The inlet valve consists of a valve seat **37** and a valve body, here in the form of a valve rod **3** with a valve element shown near the bottom of the drawing . A spring **38,** which via a pin **39** in valve rod **3** strives to raise said rod **3** from its valve seat **37,** compensates for the weight of valve rod **3.**

One end of a double-arm lever **16,** which is swingably mounted on a pivot **19,** is actuated by the end of valve rod **3** away from valve seat **37**; the other end of this lever **16** is connected to a centre rod **15** of the reservoir bag **2** which mechanically senses the reservoir bag's degree of filling. This bag **2** is attached to a downward pointing pipe socket **40** on a lever tube **14** surrounding the lever **16.**

An air valve F with valve body **18** whose weight causes it to rest on the air valve's valve seat (not rendered in detail in the drawing) is affixed to lever tube

14. In addition, a "patient valve" with a valve body **17** seated only by virtue of its own weight, is connected to the lever tube **14**, thereby preventing re-breathing into the anaesthetic apparatus.

From the oxygen gas channel **4** there is a connecting channel **7** leading to a hole **41** for a balance regulator B provided in said hole **41**, thereby limiting a chamber **42** for the oxygen gas. This chamber **42** is formed by the walls of the hole **41** and, on one side, by a membrane **43** on the other side of which a spacer **10** and a coaxial spacer ring **10'** are affixed, followed by a further membrane **45**. A space **46** is formed between the membranes **43** and **45** which, via openings in the ring **10'** and a hole **44** in the block **20**, is in contact with the atmosphere. This makes it impossible for oxygen gas to intrude into the nitrous oxide gas line or for nitrons oxide gas to intrude into the oxygen gas line, even with punctures of both membranes **43** and **45**.

On the side of membrane **45** opposite the spacer a load sensor **49** is fitted into a chamber **48** for nitrous oxide gas. The aforementioned nitrous oxide gas connection **21**, the valve of the balance regulator B with its valve body **1** and valve seat **50** and a spring which loads the valve body **1** in the direction of closure are fitted into lid **47** of this chamber **48**. From chamber **48** there is also a nitrous oxide gas channel **51** leading to a throttle valve C for the nitrous oxide gas. This nitrous oxide gas channel **51** may consist of a radial hole in the lid **47** and an arc-shaped recess in the block **20**.

The throttle valve C is fitted into a hole **67** in the block **20** which is closed off with a plug **68**. Valve rod **3** and the oxygen gas channel **4** pass through a hole **67**. Two connecting channels **8** lead from oxygen gas channel **4** to an oxygen gas chamber **55**, one wall of which is formed by a membrane **9** which has a space **59** on one side which is connected to the atmosphere via a hole **58**. In this space **59** on the side of the membrane **9** turned away from the oxygen gas chamber **55** there is a load sensor **61** with a leak-proof introduction through the housing **57** of the throttle valve at **60**. The load sensor **61** is devised to lift a valve body **52** against the pressure of a spring **53** off the throttle valve seat via the membrane **9** when there is a certain over-pressure in the throttle valve's oxygen gas chamber **55** and, thus, even in the oxygen gas channel **4**. The valve body **52** is fitted into hole **69** in the block **20** which hole is closed off with a plug **56**.

A connecting channel **62** in the block **20** leads from the throttle valve's seat **54** to the anaesthetic device's proportioning valve D which is fitted into a hole **71** in the block **20**. This proportioning valve D displays, i.e., an oxygen gas chamber **63** connected to the channel **4**, a nitrous oxide gas chamber **64** connected to connecting channel **62**, and an intermediate mixing chamber **65**. Between the mixing chamber **65** and the oxygen gas chamber **63** there is an oxygen gas throttling slot **5**; further there is a corresponding nitrous oxide gas throttling slot **6** between mixing chamber **65** and nitrous oxide gas chamber **64**. The displaceable valve body **11** of proportioning valve D is fitted between said slots **5** and **6**.

Axial displacement of the valve body **11** is produced via a threaded valve spindle **66**, connected to valve body **11**, which spindle can be rotated in a threaded body **72** in a hole **71** via a setting knob **70** of the proportioning valve D.

A channel **12** in the block **20** and a further connecting channel **13** in an upper lid **73** in the block **20** lead from the mixing chamber **65** to the aforementioned lever tube **14** fixed to the lid **73** and thence to reservoir bag **2** and, via the "patient valve," to the patient.

The anaesthetic apparatus described above works as follows: oxygen gas and nitrous oxide gas from gas cylinders or a central supply are connected to the device's respective connections **21** and **24** and introduced at a pressure of ca 4 ± 2 at overpressure. The order in which the two gases are connected is unimportant. If nitrous oxide gas is connected first, it can go no further than to the valve **1, 50** of the balance regulator B. When oxygen gas is then also connected and introduced, the following takes place:

Oxygen gas pressure is reduced in the pressure regulator A to the pressure set with adjustment screw **28**, e.g. **2** at overpressure. If the reservoir bag is not filled at the time, the inlet valve **3, 37** is open and oxygen gas due to overpressure flows through channel **4** and is impeded in the throttling slot **5** of the proportion valve D, and an over-pressure, which in the present case is somewhat under **2** at overpressure, builds up in channel **4**. This pressure influences the membrane **43** of the balance regulator B, its spacer **10**, the membrane **45** and the load sensor **49** which lifts the balance regulator's valve body **1** from its seat **50**, permitting nitrous oxide gas to flow through to the throttle valve C.

Via the channels **8** the throttle valve C is, in turn, influenced by oxygen gas pressure developing in channel **4**, causing the membrane **9** of the throttle valve C via load sensor **61** to lift the valve body **52** from its seat **54**, permitting nitrous oxide gas to flow via the channel **62** to nitrous oxide gas chamber **64**. The inflowing nitrous oxide gas accordingly acquires a pressure which is somewhat lower than oxygen gas pressure in the channel **4** because of the spring by valve body **1** of the balance regulator B.

Axial displacement of valve body **11** of the proportioning valve D via the setting knob **70** and valve spindle **66** balances the flow-through areas of the slots **5** and **6** and, accordingly, the flow velocity of both gas components so that the desired percentage mixture or pure oxygen respectively is obtained. By virtue of a provision using a familiar technique but not shown in the drawing, oxygen gas content is not allowed to fall below a certain minimum value, primarily not below 30 percent by volume.

The gases so mixed or, where applicable, oxygen gas almost reduced to atmospheric pressure, flow from the mixing chamber **65** via channels **12** and **13** through the lever tube **14** to the reservoir bag **2**. The bag is shortened when filled and lifts its centre rod **15** upwards so that the valve rod **3** of the inlet valve is pressed downwards via the swinging lever **16** against the pressure of spring **38**, closing off the flow of oxygen gas. The pressure in the channels **4, 7** and **8** terminates and the flow of nitrous oxide gas is, thus, cut off. Throughout this procedure the system is kept elastically sealed by means of the valve body **17**.

When the patient takes a breath, this valve body **17** is lifted and the relatively mild over-pressure (e.g. 1,2 cm column of water) in the reservoir bag and the latter's volume decline. Thus, the bag is extended in length once again, inlet valve **3, 37** is opened and the entire procedure is repeated.

If the reservoir bag **2** is empty because there is no oxygen gas, sub-pressure develops in the system with patient inspiration, thereby lifting the valve washer **18** of an air valve F, thus providing the patient with plain air.

Nitrous oxide gas pressure does not influence oxygen gas flow. According to the invention, the anaesthetic apparatus may, thus, also be connected to oxygen gas alone and used in the oxygen gas treatment of patients.

No backflow of gas to any gas cylinder is possible because of the back-pressure valve between the gas cylinder and the anaesthetic apparatus. An overflow of oxygen gas from a central gas supply's oxygen gas connection to the nitrous oxide gas connection is prevented by the check valve **23** built into the anaesthetic apparatus. But even if this check valve **23** should fail, no oxygen gas could intrude into the nitrous oxide gas line and no nitrous oxide gas could intrude into the oxygen gas line via the proportioning valve, as this valve's mixing chamber **65** is practically connected to the atmosphere via channels **12** and **13**, lever tube **14** and reservoir bag **2**. However, both nitrous oxide gas and oxygen gas have a palpable over-pressure at the inlet valve **3, 37** and the balance valve **1, 50** respectively. Neither gas component could force the other out of the way; gas pressure would be reduced to about atmospheric pressure if there were a hypothetical flow from the oxygen gas throttling slot **5** through mixing chamber **65** to the nitrous oxide gas throttling slot **6** or vice versa. In other words, pressure in the connected oxygen and nitrous oxide gas lines is assumed to be greater than in the mixing chamber **65**, which is equivalent to a provision offering protection against overflow.

Since the throttle valve C only opens the nitrous oxide gas supply if a certain minimum oxygen gas pressure exists or is exceeded, further security is provided. Possible leakage in the throttle valve's membrane **9** cannot lead to gas overflow to another gas system because of the connection **58** with the atmosphere. Nor can leakage in the balance regulator B lead to gas overflow from one system to the other because of intermediate space **46** which is connected to the atmosphere via the hole **44**.

The invention also produces a very compact, lightweight version of an anaesthetic apparatus, e.g. 5 × 5 × 15 cm (ca 2 inches × 2 inches × 6 inches), (not including the reservoir bag and lever tube), with simple attachment either to a wall or a stand.

In conclusion, the anaesthetic apparatus, according to the invention, has no loose or moving parts which could involuntarily rub against one another or be torn loose by people or objects (e.g. an instrument trolley) passing, thereby obviating the development of leakages or other drawbacks.

Thus, the invention provides greater security, particularly against leakages, and reduced space requirements with lower production costs.

What I claim is:

1. Anaesthetic apparatus for analgesic narcosis using an oxygen-nitrous oxide gas mixture comprising a pressure regulator for the oxygen gas, a pressure-controlled balance regulator for the nitrous oxide gas "said balance regulator includes a pair of spaced-apart membranes positioned between a chamber for nitrous oxide gas and second chamber for oxygen gas, said pair of membranes being separated by an intermidiate space connected to the atmosphere," a proportioning valve for regulation of the oxygen-nitrous oxide gas mixture, and an inlet valve for the oxygen gas, and a one-piece homogenous block having a plurality of holes and recesses formed therein from the exterior surface of said block,each of said valves and regulators being mounted in one of said holes and recesses formed in the block, said block further including a plurality of internal connecting passages and channels formed therein, said internal passages and channels adapted for operatively interconnecting the components mounted in said recesses formed in the block.

2. Apparatus according to claim **1**, characterized by a throttle valve controlled by the oxygen gas pressure prevailing after the inlet valve, said throttle valve being arranged after the balance regulator in the direction of the nitrous oxide gas flow and adapted to cut off or admit the nitrous oxide gas flow from the balance regulator, an intermediate space connected to the atmosphere being arranged between a chamber containing the nitrous oxide gas and an oxygen gas chamber.

3. Apparatus according to claim **2**, wherein the proportioning valve is provided with an over-pressure chamber for the oxygen gas, an over-pressure chamber for the nitrous oxide gas, and an intermediate chamber which is connectable to both of said over-pressure chambers by adjustable throttle slots and is in further connection with the atmosphere through a reservoir bag means and with a connection for a face mask.

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