United States Patent [19]

Cox

[11] **3,830,256**

[45] **Aug. 20, 1974**

[54] **FLUID MIXING**

[75] Inventor: **Lawrence Alfred Cox,** London, England

[73] Assignee: **The British Oxygen Company Limited,** London, England

[22] Filed: **Nov. 14, 1972**

[21] Appl. No.: **306,184**

[52] **U.S. Cl.** **137/599,** 137/606

[51] **Int. Cl.** **F16k 19/00**

[58] **Field of Search** 137/599, 607, 606

[56] **References Cited**

UNITED STATES PATENTS

3,032,053	5/1962	Ross et al.	137/607 X
3,308,619	3/1967	Richardson et al.	137/599 X
3,542,064	11/1970	Garrahan	137/599 X
3,603,349	9/1971	Botnick	137/599 X
3,677,296	7/1972	Berger	137/606

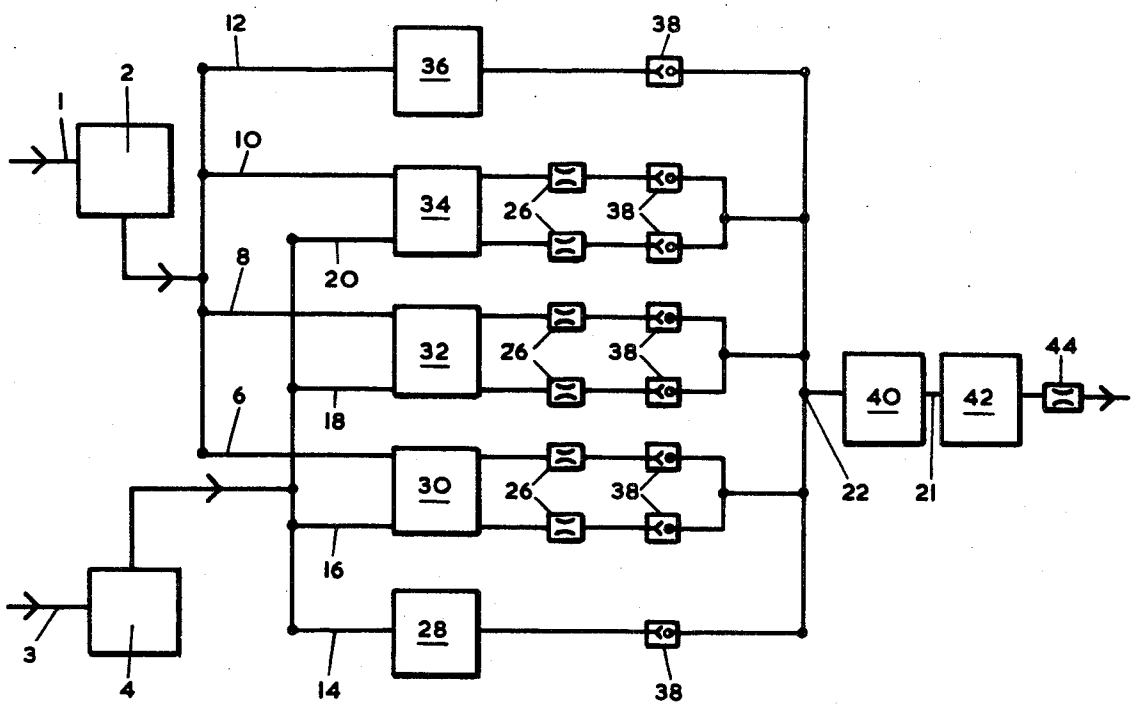
Primary Examiner—Robert G. Nilson

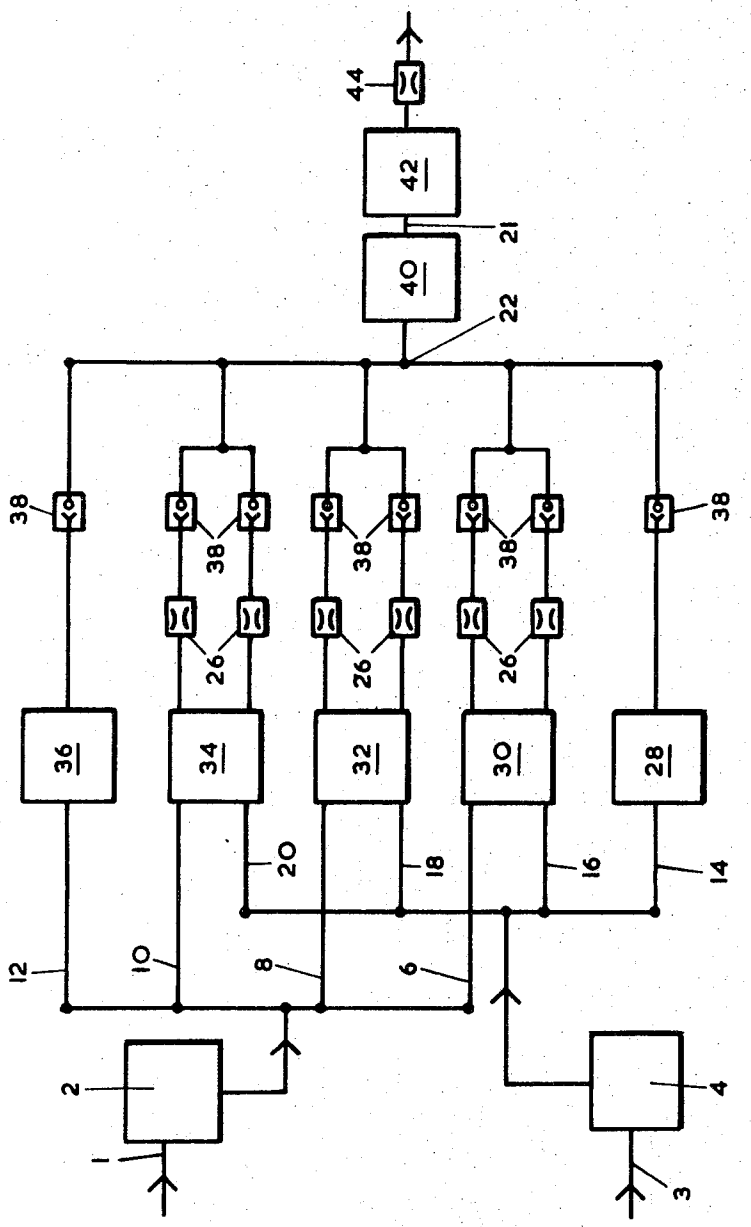
Attorney, Agent, or Firm—Dennison, Dennison, Townshend & Meserole

[57] **ABSTRACT**

An apparatus for mixing two or more fluids including a series of passages into each of which each fluid to be mixed can be passed at a chosen rate so that each passage can supply a chosen mixture, and valve means operable to select which of the passages is used to supply the mixture.

8 Claims, 1 Drawing Figure




44
42
21
40
22
38
38
38
38
38
26
26
26
36
34
32
30
28
20
18
16
14
12
10
8
6
2
4
3

FLUID MIXING

The present invention relates to fluid mixing, and particularly to apparatus for mixing gases for medical purposes.

In order to provide a comprehensive gas supply service for respiratory purposes it is necessary to be able to provide a mixture of two different gases in which the constituent gases may be present in any one of several different ratios. It has been customary to provide such a mixture by using a gas mixing apparatus which can provide continuous variation in the composition ratio of the mixture over a considerable range. This apparatus is relatively complex, and hence, expensive.

It is an aim of the invention to provide a fluid mixing apparatus which is relatively simple in construction. Accordingly the present invention provides an apparatus for mixing two or more different fluids which is as claimed in the appended claims.

The present invention will now be described by way of example with reference to the accompanying drawing which is a schematic flow diagram of apparatus for producing an air-oxygen mixture for a lung ventilator.

Referring to the drawing, oxygen and air are passed along their respective inlet lines **1** and **3** to regulators **2** and **4** respectively at a pressure of 0.4N/mm^2. These regulators are designed and fluid loaded to ensure that the oxygen and air leave their respective regulators at a constant pressure of 0.28N/mm^2.

The oxygen passes from regulator **2** along the inlet line and is directed into four separate flow lines, **6, 8, 10** and **12.** The air leaves the regulator **4** and is directed along the inlet line **3** into four flow lines **14, 16, 18** and **20.** All the flow lines are connected to an outlet line **21** at a common outlet point **22.**

Before reaching the outlet point **22,** the oxygen lines **6, 8,** and **10** are joined to the air lines **16, 18** and **20** respectively. Flow impedances in the form of calibrated orifices **26** are located in the flow lines **6, 8, 10, 16, 18** and **20.** These orifices (or throttles) are dimensioned so that their flow impedances have such relative magnitudes as to be able to give from the pairs of flow lines **6** and **16, 8** and **18** and **10** and **20,** mixtures containing 25 percent, 35 percent and 60 percent by volume of oxygen, respectively. It will be appreciated that there will be 100 percent and approximately 20 percent of oxygen in the flow lines **12** and **14** respectively because the line **12** is an oxygen line and the line **14** is an air line.

Push button on/off switches **28, 30, 32, 34** and **36** are located in the flow lines as shown in the drawing. The switches **30, 32** and **34** control the mixed pairs of flow lines **6** and **16, 8** and **18,** and **10** and **20** respectively.

Non-return valves **38** are located in all the flow lines downstream of the on/off switches to prevent reversed gas flow.

The outlet line **21** leads from the outlet point **22** to the lung ventilator (not shown). An outlet regulator **40** is located in the outlet line **21.** An off/on switch **42** and a calibrated orifice **44** are located in the outlet line **21** downstream of the outlet regulator **40.** The bore of the orifice **44** defines the gas flow rate to the ventilator.

The operation of the apparatus is as follows:

The oxygen and air supplies are turned on, and the switch **42** is switched off. The appropriate one of the

on/off switches **28** to **36** is pressed to select a gas of the required composition.

At the start of each inspiratory phase of the ventilator, the switch **42** is switched on by the flow mechanism of the ventilator. This allows the selected gas to pass through the orifice **44** to the ventilator.

At the end of each inspiratory phase, the switch **42** is switched off by the ventilator flow mechanism thereby shutting off the inspiratory gas supply to the ventilator until the start of the next inspiratory phase.

The composition of the gas being fed to the ventilator can be changed simply by pressing the appropriate one of the switches **28** to **36** so as to open the required flow line or pair of flow lines. The action of pressing one of these on/off switches automatically releases a previously pressed switch so as to close the previously opened flow line or pair of flow lines. This prevents two flow lines or pairs of flow lines from being open at the same time so as to pass a gas of incorrect composition.

In this particular apparatus, the gas is fed from the outlet regulator **40** at a pressure of 0.2N/mm^2. Although non-return valves **38** are included in this described apparatus, it is to be understood that apparatus according to the invention may operate efficiently without non-return valves.

The orifices **26** and **44** may be replaced by orifices of adjustable cross-sectional area. The calibrated orifice **44** may be replaced by either a demand valve, or a fine adjustment valve which allows a preset adjustable gas flow. The fine adjustment valve may be used either with or without a flowmeter.

In a modified apparatus provision may be made for two or more of the on/off switches to remain on at the same time. This increases the number of gas composition ratios which can be selected by an operator.

I claim:

1. A gas mixing apparatus including:

a. at least two gas inlet passages for the gases to be mixed;

b. a gas pressure regulator in each inlet passage;

c. a plurality of gas mixture distribution passages;

d. a plurality of flow rate control passages, each flow rate control passage being connected between an inlet passage and a gas mixture distribution passage, and each gas mixture distribution passage being connected by flow rate control passages to both of said at least two gas inlet passages;

e. a calibrated flow impedance in each flow rate control passage, for passing gas at a chosen flow rate to the gas mixture distribution passage downstream thereof, whereby gas mixtures of different chosen compositions are able to be formed in the gas mixture distribution passages;

f. a common outlet to which all the gas mixture distribution passages are connected, and from which a gas mixture can be supplied; and

g. valve means operable to close selected gas mixture distribution passages, whereby the composition of the gas mixture supplied from the common outlet depends on which of the gas distribution passages is left open to the passage of gas therethrough.

2. Apparatus as claimed in claim **1,** in which each flow impedance is in the form of an orifice.

3. Apparatus as claimed in claim 1, in which each flow impedance has associated with it a non-return valve for each of the fluids passed to it.

4. Apparatus as claimed in claim 1, in which the cross-sectional area of at least one of the orifices is adjustable.

5. Apparatus as claimed in claim 1 including a pressure regulator located in the outlet line.

6. Apparatus as claimed in claim 5, including an outlet switch in the outlet line downstream of the pressure regulator.

7. Apparatus as claimed in claim 5, including an orifice of reduced cross-sectional area downstream of the pressure regulator in the outlet line.

8. Apparatus as claimed in claim 5, including a demand valve downstream of the pressure regulator in the outlet line.

* * * * *