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Eross

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[54] **FRACTIONAL INSPIRATORY OXYGEN MONITORING VALVE APPARATUS**

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[52] **U.S. Cl.** **137/322,** 251/149.7, 285/156, 128/274

[51] **Int. Cl.** **F16l 37/28,** F16l 47/00

[58] **Field of Search** 251/149.6, 149.7; 137/561, 137/320, 317, 322, 230, 231; 73/420; 285/156, 238, 240, 332; 128/140, 247, 274

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[57] **ABSTRACT**

The specification discloses a fractional inspiratory oxygen monitoring valve apparatus, adapted for insertion in respiratory systems used in hospitals for administering oxygen to patients. The monitoring valve apparatus enables withdrawal of a sample of the oxygenated air stream to the patient for purposes of supply to the oxygen analyzer, and insures against leakage of oxygen from the system when the sampling withdrawal is terminated. The apparatus is simple in construction, of relatively low cost, and readily installable and operable by persons of minimal skill or special training.

7 Claims, 2 Drawing Figures

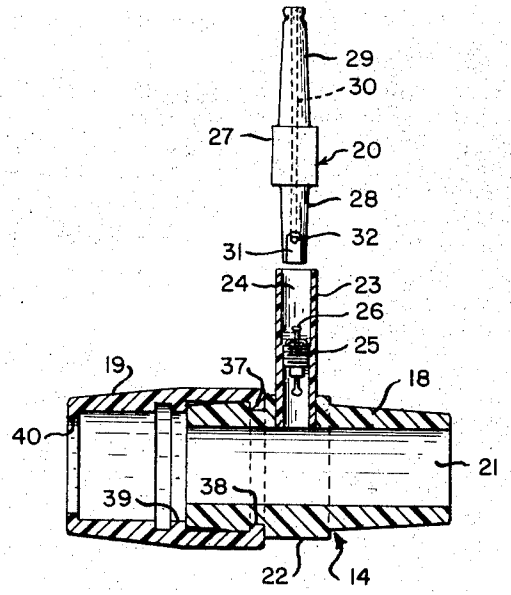


Fig. 1.

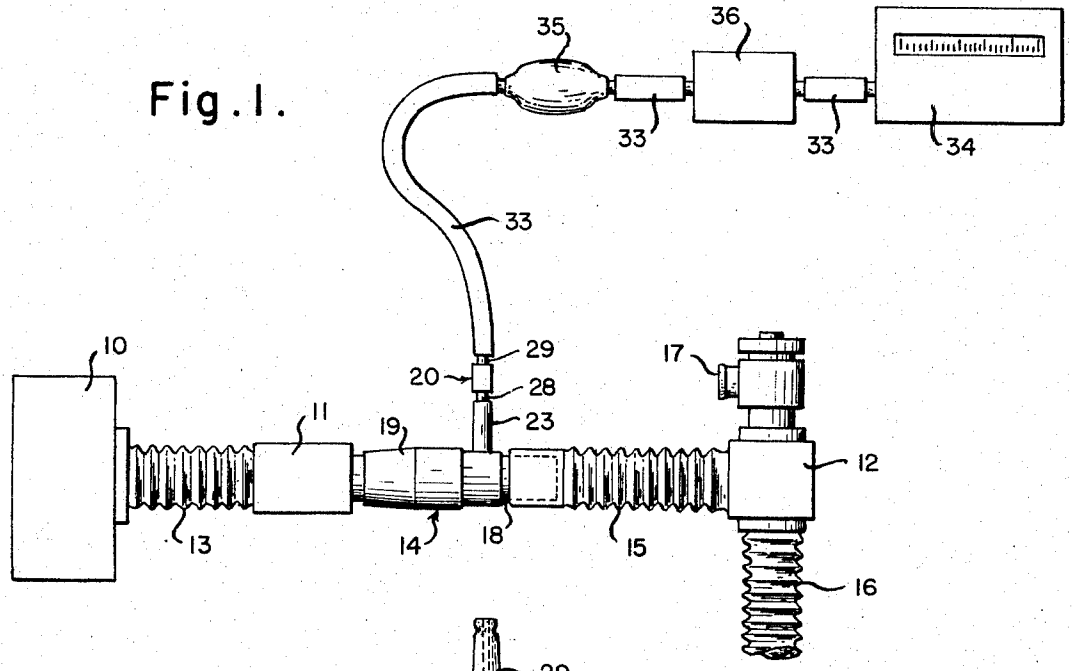
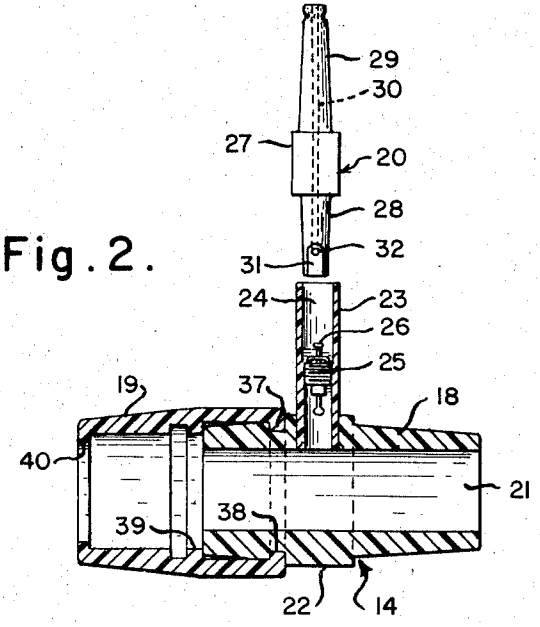


Fig. 2.



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FRACTIONAL INSPIRATORY OXYGEN MONITORING VALVE APPARATUS

This invention relates to monitoring valve apparatus adapted for insertion in respiratory systems, such as are used in hospitals for administering a controlled supply of oxygenated air to patients, for the purpose of diverting a sample from the controlled air stream to an analyzer. The analyzer functions to determine the appropriateness of the oxygen content and other factors in the air supplied to the patient.

In the administration of a controlled air supply from a respirator to a patient, it is highly important that the appropriate oxygen and other factors be monitored quickly and readily without elaborate equipment and without the necessity for utilizing highly skilled personnel. It has heretofore been necessary to employ technicians of considerable experience and skill to obtain a sample of the controlled air supply to the patient for delivery to the analyzer. In order to withdraw a supply of the controlled air being supplied to the patient, it has been the practice to inject a needle, similar to a hypodermic needle, into one of the flexible hose connections through which the air stream to the patient flows and by means of a resilient bulb induce a vacuum on the needle for purposes of withdrawing a sample of the controlled air and then, in turn, delivering the sample so withdrawn to the analyzer by compression of the bulb.

This type of operation is relatively slow and tedious and requires skilled personnel. Moreover, leakage of controlled air from the flexible hose is likely to occur upon withdrawal of the needle.

I propose to provide a monitoring valve apparatus by which a sample supply from the stream of controlled air to the patient may be diverted directly to the analyzer under the pressure existing in the system and without the necessity for utilizing a bulb to pressurize the sample withdrawn. Moreover, the monitoring valve apparatus is adapted to provide for cut off of the diverted sample supplied to the analyzer without danger of causing leakage from the system. Also, the monitoring valve apparatus is of relatively simple construction and low cost and capable of use by persons who are relatively unskilled.

The monitoring valve apparatus which I provide is essentially a fitting of T-shape readily insertable in existing respiratory systems and having a normally closed valve in the stem portion of the fitting. A hollow stem is insertable in the stem portion of the fitting to unseat the valve and bleed off a sample of controlled air supply to an analyzer. Removal of the hollow stem automatically returns the valve in the valve stem to closed position.

Details of the monitoring valve apparatus constituting my invention will be described hereinafter in connection with the accompanying drawings, wherein:

FIG. 1 is a simplified diagrammatic view of a respiratory system, illustrative of those used in hospitals, embodying my novel monitoring valve apparatus, and

FIG. 2 is an enlarged elevational view, mainly in section, showing details of my monitoring valve apparatus, and in which the valve activating stem portion is shown separated from the valve body itself.

Referring to FIG. 1 of the drawings, the illustrative respiratory system shown therein comprises a respirator 10, a nebulizer 11, and an exhalation valve 12.

Respirator 10, which for simplicity is shown in block form, comprises conventional equipment for supplying a controlled oxygenated air supply. The controlled air supply is conducted via a flexible hose 13 to a nebulizer 11 which functions to inject any additional element or elements, in vaporized form, into the air stream. For reasons which will become apparent later, the monitoring valve apparatus 14 which I provide, is desirably interposed at this point in the system between the output of the nebulizer and a flexible hose 15 connected to the input of exhalation valve 12. For the present it will suffice to understand that the controlled air supply flows through the body of the monitoring valve apparatus and thence via the exhalation valve and a flexible hose 16 to the patient. Air exhaled by the patient is blocked against back flow and diverted to the atmosphere via an exhaust or exhalation port 17.

Referring now to FIG. 2, the monitoring valve apparatus 14 shown is essentially a T-fitting in three parts, namely a body portion 18, a connection portion 19, and a valve activating stem 20, shown separated from the body portion.

The body portion is cylindrical in form and has a central longitudinal through passage 21. The body portion has an external circumferential rib 22 of enlarged diameter, the rib having a radial hole therein opening into the passage 21. A hollow tubular sleeve 23 is suitably cemented in the radial hole and extends substantially at a right-angle to the body portion. Sleeve 23 has a through bore 24 which is tapped to receive the body of a valve 25. Valve 25 is similar to the type of valve in an automotive tire valve stem. It is normally biased to a seated or closed position blocking escape of air or gas from the passage 21 but is unseated, that is opened, by pressure applied inwardly on a valve stem 26.

Valve activating stem 20 is a tubular element, having a central portion 27 of uniform diameter and oppositely extending circularly tapered end portions 28 and 29. A through bore or passage 30 extends longitudinally through the stem 20 from the outer extremity of tapered portion 29, through the central portion 27 and through the tapered portion 28 up to a point near the extremity thereof. The blocked end of the passage 30 provides a seat for engaging the end of valve stem 26 upon insertion of the valve activating stem 20 into the outer end of the tapped bore 24 in sleeve 23. The end portion 28 of the stem 20 is so tapered that the blocked end of the stem engages the valve stem 26 and holds the valve 25 unseated concurrently with engagement of the tapered end portion with the rim of the bore 24 in sleeve 23. By exerting a slight pressure on the stem 20, friction will hold stem 20 within the sleeve 23 in a position to hold the valve 25 unseated. Moreover, with a slight twisting pull the stem 20 may be readily removed from the sleeve 23.

For the purpose of allowing flow of air or gas from the passage 21 into the passage 30 in the valve activating stem 20, while the stem is frictionally held in sleeve 23, the end of the tapered portion 28 is provided with diametrically located flats 31 and a transverse bore or hole 32 through the flats 31 intersecting the passage 30. The end portion 29 of valve activating stem 20 is circularly tapered so as to receive a rubber or plastic hose 33 thereon, which, as shown in FIG. 1, leads to a so-called

oxygen (O_2) analyzer **34**. In hose **33** is interposed a resilient bulb **35** and a dryer unit **36**.

The body portion **18**, the sleeve **23** and the valve activating stem **20** are preferably of the same material, which may be any suitable clear, transparent and relatively hard plastic material. The slightly tapered end of the body portion **18** is of suitable diameter to engage sealingly in the end bore of hose **15** when pressed therein.

The connecting portion **19** is a sleeve of flexible resilient material having an interior sealing rib **37** at one end which expands over the cylindrical end of the body portion **18** and engages in a corresponding external groove **38** in the body portion **18** and a second interior sealing rib **39** which engages the end face of the body portion **18**. The sleeve tapers externally in diameter away from the body portion and has an internal sealing rib **40**. As shown in FIG. **1**, the tapered end of the connecting portion **19** thus sealingly expands over a projecting fitting (not shown) in the nebulizer **11**, or any other device correspondingly located.

In operation, let it be assumed that the monitoring valve apparatus **14** is installed in a respiratory system, such as shown in FIG. **1**, as previously described, and that the valve activating stem **20** is not connected to the sleeve **23**. In such case, of course, the valve **25** is closed and the controlled air supply flows from the respirator **10** and through passage **21** of the monitoring valve apparatus **14**, tube **15**, exhalation valve **12**, and tube **16** to the patient.

In order to obtain a sample of the controlled air being supplied to the patient and without interrupting the supply to the patient, for supply to the analyzer **34**, the operator simply inserts the end portion **28** of the activating stem **20** into the sleeve **23** of the body portion **18** with a slight twisting motion to thus frictionally hold the stem **20** in the sleeve **23**.

Valve stem **26** is thus engaged by the extremity of the tapered end portion **28** of the stem **20** and pressed in so as to hold valve **25** unseated. Controlled air under pressure is thus allowed to flow from passage **21** past the valve **25** and into the passage **30** of the stem **20**, whence it continues via hose **33**, the bulb **35** and dryer **36** to the analyzer **34**. It should be understood that bulb **35** is not required, as it has been in heretofore known practice, for pressurizing the sample to supply it to the analyzer. However, it may serve a useful purpose, as when calibrating the analyzer.

When the period of sample withdrawal has been completed, termination of the supply to the analyzer may be effected readily and quickly by simply removing the valve activating stem **20** from the sleeve **23**. Upon removal of the stem **20**, pressure on the valve stem **26** is automatically removed and the valve **25** is thus restored to its seated or closed position, sealing the bore **24** against leakage of controlled air from the passage **21**.

It will thus be seen that the monitoring valve apparatus which I have provided may be readily installed and operated by personnel with minimal training or skill. Moreover, the possibility of leakage of controlled air under pressure from the respiratory system is avoided because of the tight closure of valve **25**. Also, the non-metallic character of the apparatus is a safety factor, as it avoids possible sparks due to clash of metal parts — a dangerous situation where oxygen or traces thereof may be present in the ambient atmosphere.

While a specific embodiment of the monitoring valve apparatus has been shown and a particular use thereof described, it should be apparent that variations in the apparatus and its use are possible within the scope of the appended claims.

I claim:

1. Monitoring valve apparatus for use in respiratory systems and the like, comprising a tubular body member having a through passage adapted for connection in a communication through which a controlled gas is delivered to a patient, a tubular sleeve member generally radially on said body member having a branch passage opening out of said through passage, a normally closed valve in said branch passage; and a tubular activating stem insertable in the open end of said branch passage having means for opening said valve to bleed controlled gas under pressure from said through passage through said activating stem for a desired purpose, one of said sleeve and stem being of resilient plastic dimensioned to resiliently interfit and engage the other in frictionally held sealing relationship upon a predetermined amount of engagement.

2. Monitoring valve apparatus according to claim **1**, wherein said valve has a valve stem projecting outwardly of said branch passage and engaged by the inner end of said activating stem, when inserted inwardly from the outer end of said branch passage, to effect unseating of said valve.

3. Monitoring valve apparatus according to claim **2**, wherein said activating stem has a tapered end portion frictionally held in the outer end of said branch passage upon a predetermined amount of insertion thereinto, in which position the inner end of said activating stem engages said valve stem to hold said valve unseated.

4. Monitoring valve apparatus according to claim **1**, wherein one end of said tubular body portion is circularly tapered toward the outer end thereof to sealingly engage in the end bore of a hose.

5. Monitoring valve apparatus according to claim **1**, wherein the end of said tubular body portion opposite said one end is cylindrical and has in spaced relation to the outer end of said cylindrical end an external peripheral groove, and wherein a tubular connecting member of resilient material is provided having at one end an interior sealing rib which is expandible over said cylindrical end for engagement in said peripheral groove and having at its opposite end an expandible interior sealing rib for connection to another member in said system.

6. Monitoring valve apparatus according to claim **1**, wherein said activating stem has a longitudinal passage therein and a transverse passage therethrough intersecting said longitudinal passage, through which controlled gas under pressure is bled from said through passage in said fitting when said valve is unseated by said activating stem.

7. Monitoring valve apparatus for use in respiratory systems and the like, comprising a fitting having a through passage adapted for connection in a communication through which a controlled gas is delivered to a patient, a branch passage opening out of said through passage, and a normally closed valve in said branch passage; and a tubular activating stem insertable in the

open end of said branch passage for opening said valve to bleed controlled gas under pressure from said through passage through said activating stem for a desired purpose, said fitting comprising a tubular body portion containing said through passage, a transverse opening through the wall of said tubular portion, and a sleeve sealingly secured in said opening and providing said branch passage, wherein the end of said tubular body portion opposite said one end is cylindrical and has in spaced relation to the outer end of said end portion an external peripheral groove, and wherein a tubular connecting member of resilient material is provided with a pair of axially spaced interior sealing ribs, one of which is expandible over the cylindrical end of said tubular body portion to engage in said peripheral groove and the other of which sealingly engages the outer end face of said cylindrical end of the tubular body portion.

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