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(54) Title: AN ARRANGEMENT FOR MEASURING TWO-WAY RESPIRATION GAS FLOWS WITHOUT INCREASING THE DEAD SPACE

(57) Abstract

An arrangement for measuring bidirectional respiration flow, including a hose (1) which is connected to the breathing passages of a patient in which, via a Y-piece (2) is also connected to a tube (3) for inspiration gas and to a tube (4) for expiration gas. The tubes (3, 4) are connected to a breathing apparatus. Each tube has a venturi means arranged therein. According to the invention a pressure differential meter (8) having two inlets is connected with one inlet to each venturi means. A magnet valve (7) is arranged to periodically connect both inlets together, and there is provided an electronic means (9) for calculating the valve measured and for controlling the zero-setting, to which end the control means is connected electrically to the pressure differential meter (8) and to the magnet valve (7).
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AN ARRANGEMENT FOR MEASURING TWO-WAY RESPIRATION
GAS FLOWS WITHOUT INCREASING THE DEAD SPACE

The present invention relates to an arrangement for measuring
two-way or bidirectional respiration gas flows without increasing
the dead space. Such an arrangement includes a hose which is
connected to the breathing passages of a patient and which, via a
Y-piece, is connected to a tube for inspiration gas and a tube for
expiration gas, said tubes being connected in turn to a respirator,
or breathing apparatus; and further includes a venturi device
arranged in each of said tubes.

The known art will be described with reference to Figure 1 of
the drawing, while the invention will be described with reference
to Figure 2 thereof.

Background Art

Patients under intensive care and anaesthetized patients are often
connected to equipment which assists with their breathing. This
is illustrated in Figure 1.

A hose 1 is connected to the breathing passages of the patient.
That end of the hose 1 which extends away from the patient is
connected to a Y-piece 2, to which is connected two tubes 3 and
4. Unidirectional flow for alternating inspiration gas is effected
through the one tube 3 and for expiration gas through the other
tube 4. The tubes are, in turn, connected to a respirator or breathing
apparatus not shown.

It is of great clinical interest to be able to measure the respiration
flows as close to the patients as possible. Alternative solutions
include the insertion of a flow meter for bidirectional flows between
the hose and Y-piece, or to insert two flow meters for unidirectional
flows between said Y-piece and the apparatus tubes (B).

The known technique employs various kinds of flow meter, for example:

1) Respiration flow meters according to Fleisch, incorporating inserts having narrow, mutually parallel channels. The pressure drop across the inserts is proportional to the flow. The flow meter is symmetrical, and measures in both directions.

2) Vortex meters in which a rod is placed perpendicular to the gas flow, so as to generate vortices. The vortices move as swiftly as the gas and can be detected with the aid of ultrasonic devices. The vortex meter is intended for flow in one direction only.

3) Venturi tubes, which are provided with a constriction, such that the gas moves at a faster rate and the lateral pressure falls. Downstream of the constriction there is an elongate gradual transition to the "general" diameter of the gas tube. The difference is lateral pressure between a location immediately upstream of the constriction to the narrowest location thereof is proportional to the square of the flow. The total drop in pressure over the whole of the venturi tube is much lower than the pressure difference measured in the first instance. Thus, the lateral pressure in the constricted area of the tube is lower than the lateral pressure upstream and downstream of the constriction. Consequently, the flow can be measured by determining the difference is lateral pressure between the narrowest part of the constriction and the lateral pressure downstream of the venturi tube. The differential pressure thus measured is 20-30% lower than the difference in pressure which prevails simultaneously between an upstream location and the narrowest location of the constriction. The venturi tube is intended for flow in one direction.

The above described apparatus possess various properties, which are summarized below.
The flow meter to Fleisch is highly sensitive to condensation and particles of foreign matter, while this particular sensitivity is low in the case of vortex and venturi type flow meters. When a transducer is positioned in the flow meter according to Fleisch, at A in Figure 1, the dead space is greatly increased, while the inclusion of two transducers at B in Figure 1 does not result in this undesirable effect. This latter is also true of transducers placed at B in the vortex and venturi methods. The measuring area becomes insufficient with the vortex meter, but is sufficient with the Fleisch and venturi meters. All three meters have a small resistance to flow, their resistance being smallest with the venturi device. The degree of sensitivity to the configuration of the supply lines is high in the vortex apparatus, but low in the other two.

Routines for setting the arrangement to zero are necessary in all methods, except for the vortex method.

The object of the present invention is to improve the aforementioned techniques for measuring the bidirectional respiration flows of anaesthetized patients or patients under intensive care.

To this end the invention is mainly characterized in that a pressure-differential meter having two inlets or inputs is connected to the inlet of each venturi's device, that a magnet valve is arranged to connect the two inlets together periodically; and that an electronic means is arranged to calculate the measured value and to control setting of the arrangement to zero, said electronic means to this end being electrically connected to the pressure-differential meter and to the magnet values.
Preferred embodiment

The invention is illustrated schematically in Figure 2 and relates to a venturi-tube meter, which offers many advantages when used as a respiration flow meter, as will be gathered from the resume above. In order to reduce the noxious clearance, it is necessary to use separate meters for the inspiration and expiration flows. As illustrated in said Figure, a tube 1 connected to the breathing passages of a patient is connected to an inspiration tube 3 and an expiration tube 4, via a Y-piece 2. In each of these tubes there is arranged a venturi means, the latter being arranged to co-act with a common transducer means in the form of a pressure differential meter 8 and to indicate the flow electrically. The meter 8 is connected to the venturi means in the tube 3 via a first line 5, and to the venturi means in the tube 4 via a second line 6. An annular chamber 5 'and 6' connects the lateral orifices together at the narrowest location of the venturi means. Connected across the two inputs of the meter 8 is a short line 10. Zero-setting of the transducer is essential for obtaining a correct measurement.

In the illustrated embodiment, simple zero-balancing of the pressure differential meter 8 is effected by intermittently (e.g. each hour) connecting both inlets of the meter to the same pressure, by means of a magnet valve 7 (by rotating the valve body 90°, as shown by the arrow in Figure 2).

An electronic means 9 (a microprocessor) for calculating the measured value and for controlling the zero-setting of the transducers is arranged to control the setting of the valve 7 and to lineate the measured pressure-differential signal, so that it can be presented as a calibrated flow signal. Flow will be present alternately in either the inspiration tubes 3 or the expiration tube 4. The pressure signal will have different characteristics, depending upon which of the two tubes 3, 4 is through-passed by gas.
CLAIM

1. An arrangement for measuring bidirectional respiration flows, including a hose (1) connected to the breathing passages of the patient, said tube being connected via a Y-piece (2) to a tube (3) for inspiration gas and a tube (4) for expiration gas, said tubes (3,4) being in turn connected to a breathing apparatus, and further including a venturi means arranged in each tube, characterized in that a pressure differential meter (8) having two inlets is connected with one inlet to each of the venturi means; that a magnet valve (7) is arranged to periodically connect both inlets one to the other; and that an electronic means (9) is arranged for calculating the measured valve and for controlling zero-setting, said control means to this end being electronically connected to the pressure differential meter (8) and to the magnet valve (7).
# INTERNATIONAL SEARCH REPORT

International Application No PCT/SE83/00370

## I. CLASSIFICATION OF SUBJECT MATTER
According to International Patent Classification (IPC) or to both National Classification and IPC

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Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched:

SE, NO, DK, FI classes as above

## II. FIELDS SEARCHED
Minimum Documentation Searched

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## III. DOCUMENTS CONSIDERED TO BE RELEVANT

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## IV. CERTIFICATION
Date of the Actual Completion of the International Search:

1984-02-06

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