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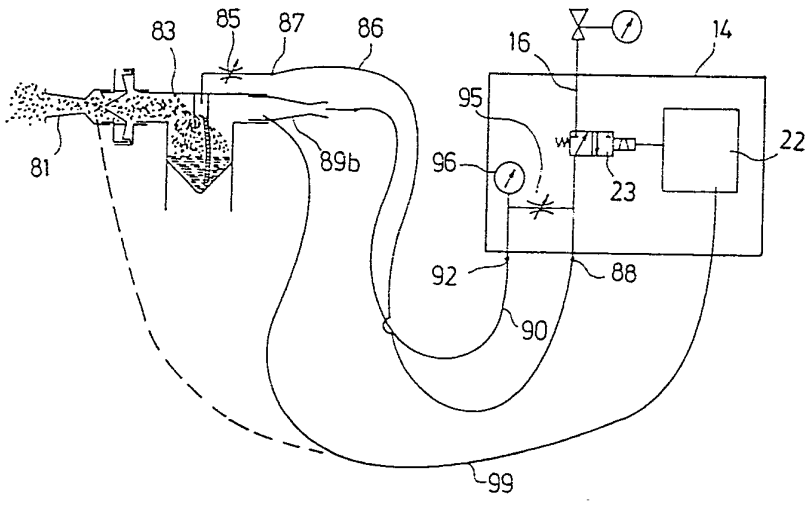

(57) Abstract

A respiration therapy apparatus used as a drug atomizer means and/or as a so-called respirator and/or as an oxygen dispensing means. In the apparatus of the invention, administration to the patient of oxygen or air is discontinued, at the latest, when the exhalation phase starts. This has been implemented in the apparatus of the invention by employing a pressure pick-up (22) observing the differential pressure of the flow and which further provides control of an electromagnetic valve (23) which has been disposed to close and to open a pressure line (16). At commencement of the inspiration phase, the differential pressure is transmitted over a signal connection (99) to the pressure pick-up (22). The pressure pick-up (22) further controls the electromagnetic valve (23), opening the pressure line (16). The pressure pick-up (22) measuring differential pressure has been connected, as taught by the invention, over a signal connection (19, 39, 59 or 99) either to an oxygen mask, to oxygen whiskers (30), to an atomizing means (50) or to a respirator (80).

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Respiration therapy apparatus

The present invention concerns a respiration therapy apparatus intended for persons suffering from respiratory diseases, for indisposed persons or for unconscious persons and employed as a respirator and/or as a drug atomizing apparatus and/or as an oxygen dispensing apparatus conforming to the patient's respiration, said respiration therapy apparatus comprising an oxygen or air supply tube connected to a regulating means, to this regulation means being further connected an air or oxygen line coming from an oxygen mask or from oxygen whiskers, and to said regulating means being connected an air or oxygen line coming from a drug atomizer or to said regulating means being connected air or oxygen lines coming from a respirator means comprising a mouthpiece, an exhalation valve, a drug atomizer and an injector, the second of said lines being directly connected to the injector and the first line being connected to the drug atomizer, advantageously over a regulating valve, for adding drug spray to the oxygen or air flow.

In prior art are known various kinds of respiration therapy apparatus intended for persons suffering from respiratory diseases, for indisposed persons or for unconscious persons, the respiration therapy apparatus then comprising a drug atomizer, a supply pressure source communicating with the drug atomizer for conducting air or oxygen, an injector communicating with the drug atomizer, and separate regulating valves for controlling the atomizing rate of the drug atomizer, respectively the respiration pressure. In drug atomizers of prior art, the flow rate of the flowing air or oxygen is controllable. Regulating valves are known in the art through which the air or oxygen can be conducted. It is possible with the aid of electrically controlled magnetic valves, or of a magnetic valve controlling means, to effect control of the operating period of the respiration therapy apparatus in conformity with the patient's breathing rhythm; similarly, it is possible with the aid of separate timer means to effect regulation of the resting period

of the respiration therapy apparatus to conform to the patient's breathing rhythm.

Respiration therapy apparatus of prior art can be controlled with the aid of press buttons or equivalent in such manner that the operation of the respirator is paced to be appropriate for the patient, for instance specifically be pressing a button.

Likewise known in the art are respirators e.g. through the present applicant's earlier Finnish patent application No. 830059, where the respirator is used as an atomizing means. The period of operation and period of rest of the drug atomizer can be controlled with a timer means, or by pacing with finger pressure on a press button, to conform to a breathing rhythm appropriate for the particular patient, and by regulating the atomizing rate of the drug atomizer with the aid of a pressure regulator, provided with pressure gauge, inserted in the supply pressure line.

It is also previously known that an inhalation dispenser is provided with atomizing commencement time control to the purpose of selecting the time of commencement of atomizing to be advantageous for each individual patient, at the beginning of the inspiration period. This apparatus arrangement is known through the same applicant's earlier Finnish patent application No. 843769. Through the same Finnish patent application of the present applicant is also known an inhalation dispenser incorporating an inspiration flow rate control for setting at desired magnitude the inspiration flow rate advantageous for each individual patient.

The apparatus just discussed cannot be used in conjunction with oxygen whiskers or masks as an oxygen supplying means, nor can it serve, in this simple design, as an atomizer and respirator apparatus.

The drawback of oxygen supplying means of prior art, again, can be seen in the circumstance that in said oxygen also flows during the

exhalation period, causing unnecessary irritation of the patient's nostrils. It is thus understood that the patient is disturbed by the continuous oxygen flow, and it is understood that the detriment consequent on this continuous oxygen or air flow is high wasted consumption. Drug substance is also wasted, and the patient's environment becomes polluted.

The respirator design of the invention eliminates all drawbacks which have been mentioned. They have been avoided by implementing the respirator of the invention with a pressure pick-up, and so that to the pressure pick-up there is a signal connection. The signal connection has further been taken out through a connector from the regulating means. This pick-up indicating the pressure of the respiration flow is further applied to control a control valve which governs the oxygen or air flow going to the patient. The pick-up observes the pressure change arriving through the signal connection and it observes the moment when the patient commences his inspiration. The pick-up then acts on the control valve and opens the oxygen or air flow passage. Likewise, said pick-up observes, through the signal connection, the commencement of the patient's exhalation phase, at which time the pressure pick-up further acts on said control valve, whereby the valve closes the oxygen or air passages. With this apparatus arrangement one avoids supply of oxygen or air or drugs to the patient during the patient's exhalation phase.

The apparatus design of the invention, which may expressly be used both as atomizer means, as oxygen administration means and as respirator, may operate at different pressure levels. It is this which enables the signal connection of the invention to be taken out from the control units and carried to different targets. Hereby the use of this apparatus design as a multi-purpose means, in operation at low and high pressure levels, is rendered feasible.

The invention is mainly characterized in that the respiration therapy apparatus comprises a pressure pick-up and a separate

connection going to the pressure pick-up arranged to close and open the air or oxygen supply pressure line, which over a valve communicates with the oxygen or air line so that when the patient's inspiration is taking place the pressure pick-up observes the pressure change in the inspiration air caused by the commencement of this inspiration phase, the pick-up having been arranged thereupon to open the valve similarly at commencement of the patient's exhalation the pressure pick-up has been arranged to control the valve so that the air or oxygen pressure line is closed.

The invention is described in greater detail in the following with reference to the enclosed figures.

In Fig. 1 is depicted a respirator according to the invention, in schematical presentation, and the oxygen or air tube, and the signal connection going to the pressure pick-up, this connection being attached to a face mask. Moreover, separate oxygen whiskers have been depicted in this figure.

In Fig. 2 is shown the face mask, seen from the front and in the direction X indicated in Fig. 1.

In Fig. 3 are shown the oxygen whiskers, attached to the patient. The connection to be carried to the pressure pick-up is incorporated in this figure.

In Fig. 4 is presented a respirator according to the invention, provided with pressure pick-up and signal connection and used as an atomizing means.

In Fig. 5 is presented a respiration therapy apparatus according to the invention which is used as a respirator (IPPB). The presentation is an elevational view of the apparatus.

In Fig. 6 is shown the apparatus of Fig. 5, in schematical presentation. The alternative placements of the other end of the signal

connection have been shown in this figure.

In Fig. 7 is schematically presented the connecting of a computer to the respiration therapy apparatus. Furthermore, a design is presented in which two valves have been employed.

In Fig. 1, a respiration therapy apparatus is depicted. In the figure, reference numeral 10 is used to indicate a face mask; numeral 11, to indicate the part of the mask to be placed against the face, this part being connected through an air or oxygen tube 12 to the control unit 14. The air or oxygen tube 12 is connected over a connector 13 on the mask 11 to the mask part proper, 11. The connector 15 similarly connects the tube 12 with the control unit proper, 14. The supply pressure tube, supplying oxygen or air, is indicated by reference numeral 16. This tube 16 has been connected to the control unit 14 with the connector 17. The control unit 14 comprises the oxygen or air flow operating time control 18. The apparatus of the invention comprises a signal connection 19 leading to a pressure pick-up, this connection being carried from the control unit 14 along with the tube 12 to the mask part proper 11, through the connector 20. The connector 21 connects said signal connection 19, leading to the pressure pick-up, with the control unit proper, 14. Reference numeral 22 represents schematically the pressure pick-up, or differential pressure transducer, located in the control unit 14. The current supply to the apparatus can be interrupted by operating the switch 23.

The current to the respiration therapy apparatus, and suitably also to its control unit 14, may be conveyed either from a storage battery, from a dry cell battery or from the electric mains.

The oxygen whiskers carry the reference numeral 30. These whiskers may conduct air or oxygen into the patient. The oxygen line or air line 32 branches into two lines 32a and 32b. These branches 32a and 32b are further connected to a nostril connector 31, comprising parts 33 entering the nostrils. The connection of the air or oxygen

line 32 to the control unit 14 is indicated with reference numeral 35. Reference numeral 39 indicates the signal connector leading to the pressure pick-up. The connection of the branches 32a and 32b of the air or oxygen line with the nostril connector 31 is represented by reference numeral 40. Connector 41 is the connection with the control unit 14 of the signal connection 39 leading to the pressure pick-up.

Fig. 3 illustrates the oxygen whiskers 30, attached to a patient.

In Fig. 4 is schematically shown the use of the respiration therapy apparatus 10 as an atomizing means from drug dispensing. Reference numeral 50 indicates a drug atomizing means. To the drug atomizer 51 is connected a supply pressure tube 52 leading to the drug atomizer. Control of atomizing rate takes place through the valve 53. Reference numeral 59 represents the connection going to the pressure pick-up 22. The pick-up 22 in its turn controls an electromagnetic valve 23, its opening and closing. Through this valve 23, the oxygen or air is carried along the supply pressure tube 52. The conical connector 60 of the signal connection attaches to the drug atomizer 51. The air or oxygen supply pressure line 16 goes to the valve 23. In this line 16 is incorporated a supply pressure valve 16a and, in association therewith, a supply pressure gauge 16b. The drug atomizer 51 is provided with a mouthpiece 24, through which the flow enters the patient. The signal connection 59 leading to the pressure pick-up has been connected to the conical connector 60 on the drug atomizer 51. The operation of the unit is such that when the patient is inhaling through the mouthpiece 24, there is a flow through the conical connector 60, whereby the pressure falls in this connector 60. This pressure drop is observed by the pressure pick-up 22, and the pressure drop is transmitted through the signal connection 59 to the pick-up 22. The signal connection is appropriately a length of plastic tubing. The pick-up 22 transmits the information, controlling the electromagnetic valve 23 and opening a connection from the supply pressure line 16 to the supply pressure tube 52 going to the drug atomizer 51.

Hereby an atomized drug spray will in the course of the patient's inspiration be admixed to the air entering through the conical connector 60, said atomized spray being produced by the air or oxygen flow to the drug atomizer 51 taking place along the supply pressure tube 52. The control unit 14 may furthermore comprise a means by which the maximum time of drug atomizing is regulated. If the inspiration phase exceeds this maximum time, said maximum time controller shuts off the communication from the pressure line 16 to the supply pressure tube 52 and the atomizing process is interrupted. In any other case, when the patient commences exhalation through the mouthpiece 24, the pressure in 59 increases, and this pressure rise is observed by the pressure pick-up 22, which then controls the electromagnetic valve 23 and shuts off the connection between the supply passage 16 and the supply pressure tube 52, the atomizing process ceasing forthwith.

In Fig. 5 is illustrated, in elevational view, the use of respiration therapy apparatus as a true respirator. The respirator, now indicated with reference numeral 80, comprises a mouthpiece 81, an exhalation valve 82, an atomizer 83. From the control unit 14, a supply pressure line 86 for oxygen or air runs over the connector 87 to the atomizer 85. The supply pressure line 86 is connected over the connector 88 with the control unit 14. The flow connector 90 is connected over the connector 92 with the control unit 14, and over the connector 91 with the injector 89, i.e., with its injector nozzle 89a. The injector 89 is further joined with the body of the atomizer 83. The control arrangement of the invention is furthermore composed of a pressure pick-up 22, appropriately located in the control unit 14. From the pressure pick-up 22 and from the control valve 14, the signal connection 99 leads either to the mouthpiece 81 or to the atomizing means 83, and in that case suitably to its conical connector. The control unit 14 moreover comprises a timer means 94 for the time of operation of the atomizer and a respiration pressure regulator, suitably a regulating valve 95. The control unit 14 further comprises a gauge 96 indicating the respiration pressure. The gauge 96 indicating the respiration

pressure is connected, as shown in Fig. 6, to the flow connector 90. The respiration pressure regulating valve 95 may be connected either directly to the flow connector 90 or to the line leading to said connector 90. When the patient's inspiration is taking place, the pressure pick-up 22 through the signal connection 99 observes the change of pressure and controls the electromagnetic valve 23, as in the embodiment of Fig. 4. When the patient's exhalation commences, the pressure rises at the signal connector 99. The pressure pick-up 22 observes this change and controls the electromagnetic valve 23, shutting the pressure line off. The signal connection 99 may be connected either to the conical connector 89b of the atomizer 83 or directly to the mouthpiece 81 going to the patient.

The pressure pick-up 22 may also be disposed so that it is located directly in the oxygen or air flow entering the patient. In that case, an electrical signal is conducted from the pressure pick-up 22 along the signal connection to the control unit 14 and further to the electromagnetic valve 23. Most appropriately, however, the signal connection is a flexible tube and the pressure pick-up has been disposed to be located expressly in the control unit 14. The changes of pressure are then transmitted along the hollow tube to the pressure pick-up 22. The oxygen and air lines, or connectors, are suitably pieces of plastic tubing consisting of some plastic material.

In Fig. 7 is presented a design in which in addition to the valve 23 also another valve 98 is employed, this valve too, appropriately, an electromagnetic valve. The valse 98 has been placed in the flow connector 90 or in the control unit 14 in such manner that it communicates with the line 90. The pressure pick-up 22 controls the valve 98, either directly or over electronic circuitry 97; the latter may suitably consist of a timer means. In that case it becomes possible to time the opening of the line 90 and the opening of the line 86 to the pressure line 16 to be as desired, and favourable from the therapeutic point of view.

In Fig. 7 has also been shown the connecting of a computer, suitably a micro-processor, to the respiration therapy apparatus of the invention. The computer or equivalent has been indicated with reference numeral 100. The computer is by one or several cables connected to the respiration therapy apparatus of the invention. This signal line between the computer and the respiration therapy apparatus has been denoted, in general, with reference numeral 110. The computer has been arranged, with the aid of a programme stored therein, to place the respiration therapy apparatus of the invention into operation and out of operation. The computer 100 may simultaneously control one or several respiration therapy apparatuses. In the latter case one person is enabled to program the therapy schedules individually for each patient. The computer may equally be programmed to operate the respiration therapy apparatus of the invention in such manner that with the aid of a programme stored in the computer's memory are controlled the therapeutic variables of the respiration therapy apparatus, such as respiration pressure, drug atomizing, etc. A data line, or data lines, carried in a suitable manner from the computer, and which have been denoted in general with reference numeral 110, are connected to the control unit 14. In the figure has been depicted a computer 100, connected over a data line, or data lines, 110 to a respiration therapy apparatus 80 according to the invention.

The computer 100 may be arranged to control the valve 98, which is suitably an electromagnetic valve. The computer 100 may be arranged to control either separately the valves 23 and 98, or to control both in dependence of each other, as specified in each case in the programme that has been stored. The computer 100 may be made to control the valve 98 over supply electronics 97, suitably a timer means. The computer 100 has been disposed to control the valve 98 and/or the valve 23 so that the connection from the supply pressure line 16 to the flow connector 90 and/or the flow connector 86 is opened.

Claims

1. A respiration therapy apparatus intended for persons suffering from respiratory diseases, for indisposed persons or for unconscious persons and which is used as a respirator (IPPB) and/or as a drug atomizing means and/or as an oxygen dispensing means conforming to the patient's respiration, said respiration therapy apparatus comprising an air or oxygen supply pressure tube (16) connected to a control unit (14), to said control unit (14) being further connected an air or oxygen line (12,32) coming from an oxygen mask (10) or from oxygen whiskers (30), or to said control unit (14) being connected an oxygen or air line (52) coming from a drug atomizer (51), or to said control unit (14) being associated oxygen or air lines (86,90) coming from a respirator (80) comprising a mouthpiece (81), an exhalation valve (82), a drug atomizer (83) and an injector (89), whereof the second line (90) is connected directly to the injector (89) and the first line (86) is connected to the drug atomizer (83), preferentially over a regulating valve (85), for adding atomized drug spray to the oxygen or air flow; the respiration therapy apparatus comprises a pressure pick-up (22) and a separate connection leading to the pressure pick-up and arranged to close and open the air or oxygen supply pressure line (16), which over a valve communicates with the oxygen or air line (12 or 32 or 52 or 90 and 86) so that when the patient's inspiration is taking place the pressure pick-up (22) observes the change of pressure in the inspiration air caused by the commencement of this inspiration phase, whereat the pressure pick-up (22) has been arranged to open the valve and, respectively, at commencement of the patient's exhalation the pressure pick-up (22) has been arranged to control the valve so that the air or oxygen pressure line (16) is closed, characterized in that the control unit (14) comprises a timing means (94) which regulates the oxygen or air flow coming to the atomizer (83,51), to the oxygen whiskers (30) or to the oxygen mask (10), and that the signal or control variable coming from the pressure pick-up (22) has been arranged, counted from commencement of the inspiration phase, to start the count of a timing means

(94) provided in the control unit (14), in said timing means (94) having been pre-set that maximum time during which the valve is open and admits the air or oxygen flow to the oxygen whiskers (30) or to the oxygen mask (10) or to the atomizer means (50) or to the respirator (80).

2. Respiration therapy apparatus according to claim 1, characterized in that the control unit (14) comprises, in addition to a first valve (23), also a second valve (98), which is advantageously an electromagnetic valve, and which communicates with the oxygen or air line, and that the pressure pick-up (22) is arranged either directly or over electronic circuitry, most preferably a timing means (97), to control the valve (98), whereby the opening of the oxygen and/or air line going to the patient from the control unit (14) to communicate with the pressure line (16) can be timed to be as desired and appropriate from a therapeutic point of view.

3. Apparatus according to claim 1 or 2, characterized in that a signal connection has been carried out from the control unit (14) and has by one end been connected to the pressure pick-up (22) and by its other end connected to a therapy apparatus consistent with each therapeutic measure.

4. Apparatus according to claim 1,2 or 3, characterized in that the pressure pick-up (22) has been disposed to be located in the control unit (14).

5. Apparatus according to any one of claims 1-4, characterized in that to the pressure pick-up (22) leads a connection (19) which is connected to an oxygen mask (10) at its other end.

6. Apparatus according to any one of claims 1-4, characterized in that to the pressure pick-up (22) has been connected a connector (39) which is further connected to oxygen whiskers (30).

7. Apparatus according to any one of claims 1-4, characterized in

that with the pressure pick-up (22) is connected a connector (59) which has further been connected to a conical connector (60) on an atomizer (51).

8. Apparatus according to any one claims 1-4, characterized in that with the pressure pick-up (22) is associated a connector (92) which is by one end connected to the end adjacent to the atomizing means (83) of the injector (89) in a respirator (80) or in the vicinity of the mouthpiece (89) of the respirator (89) or to the mouthpiece (81) itself.

9. Apparatus according to any one of the preceding claims, characterized in that the pressure pick-up (22) has been disposed to control a valve (23), which is an electromagnetic valve.

10. Apparatus according to any one of the preceding claims, characterized in that the connection (99,59) coming from the pressure pick-up (22) connects by its other end with a part (89,60) having conical cross-section.

11. Apparatus according to claim 1 or 2, characterized in that the pressure pick-up (22) has been disposed to be located directly in the oxygen or air flow entering the patient, and that from the pressure pick-up (22) an electrical signal has been conducted along a signal connection to the control unit (14) and further to the electromagnetic valve (23).

12. Apparatus according to any one of the preceding claims, characterized in that the pressure pick-up (22) has been disposed to control either directly a valve (98) placed in a flow connector (90) or a valve (98) disposed in the control unit (14) and connected to the flow connector (90).

13. Apparatus according to any one of the preceding claims, characterized in that a computer (100) has been disposed over a data line, or data lines, (110) to control the respiration therapy

apparatus.

14. Apparatus according to the preceding claim, characterized in that the data line, or data lines (110) has/have been connected directly to the control unit (14).

15. Apparatus according to any one of the preceding claims, characterized in that the computer (100) has been disposed to control the valve (98) and/or the valve (23) so that a connection is opened or closed from the supply pressure line (16) to the flow connector (90) and/or to the flow connector (86).

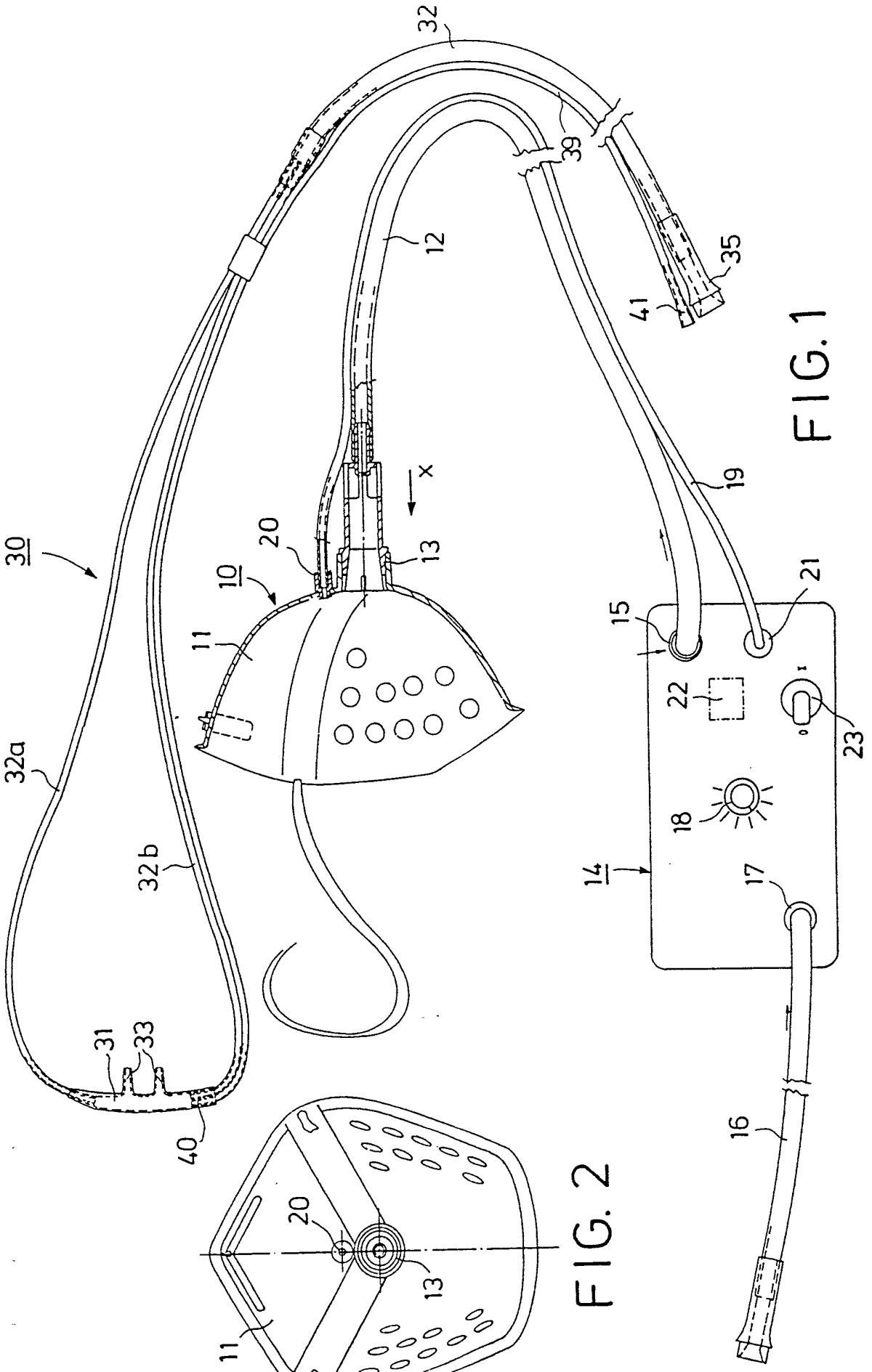
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FIG. 1

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FIG. 2

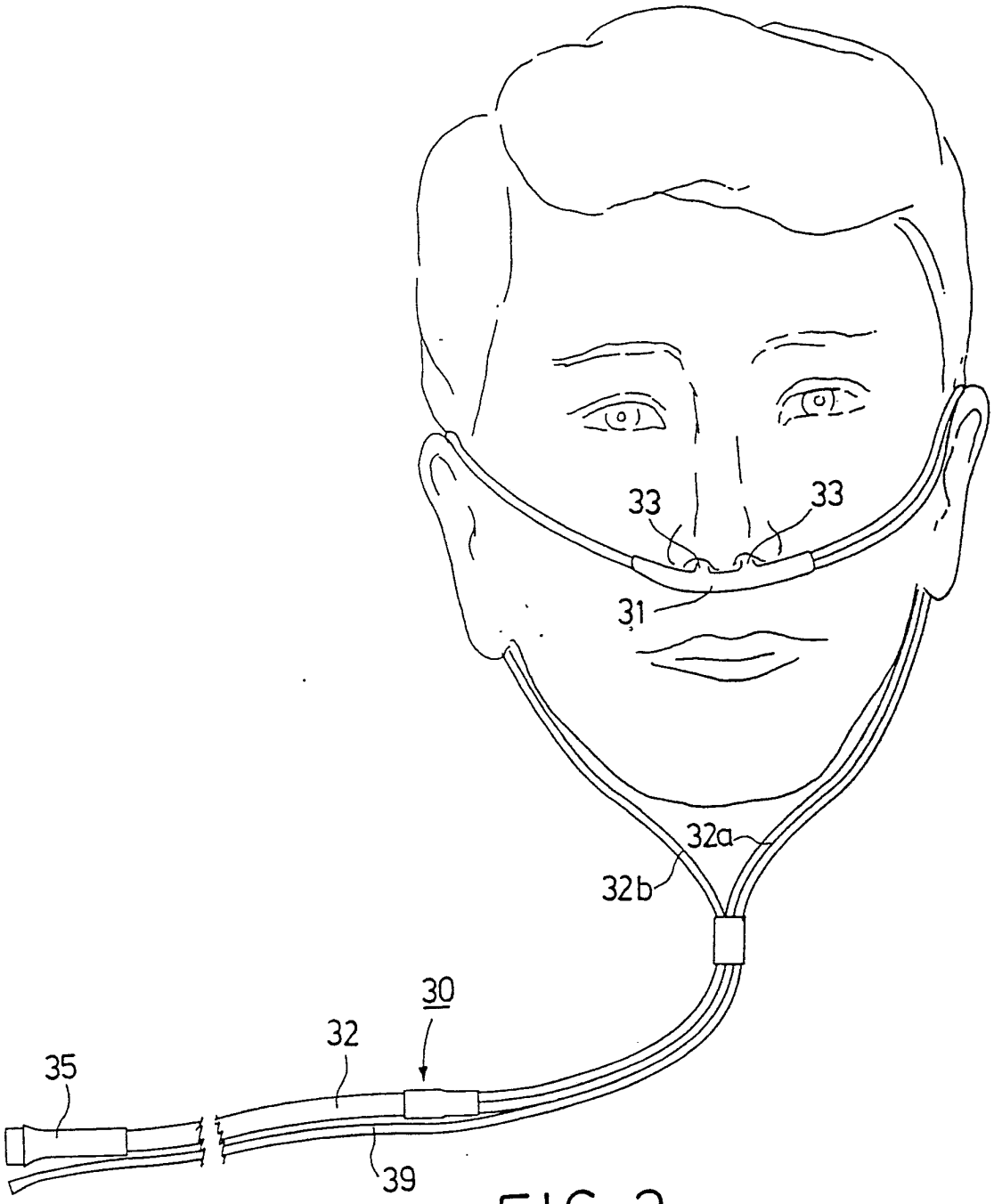
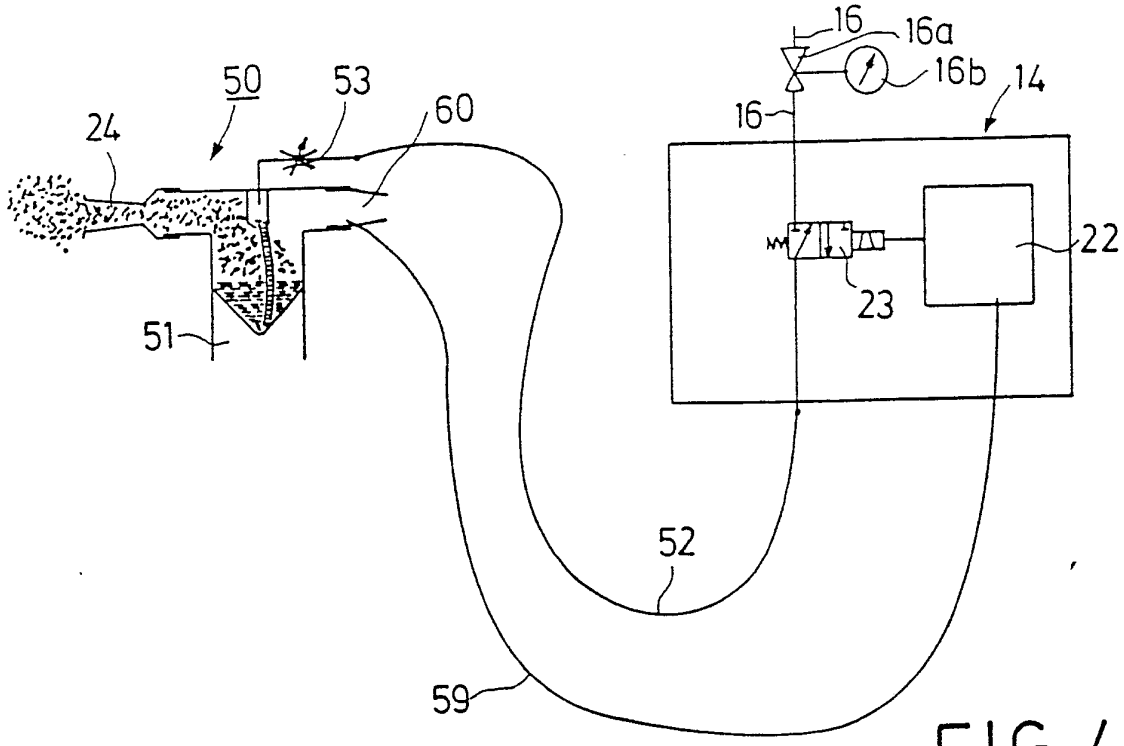


FIG. 3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16b
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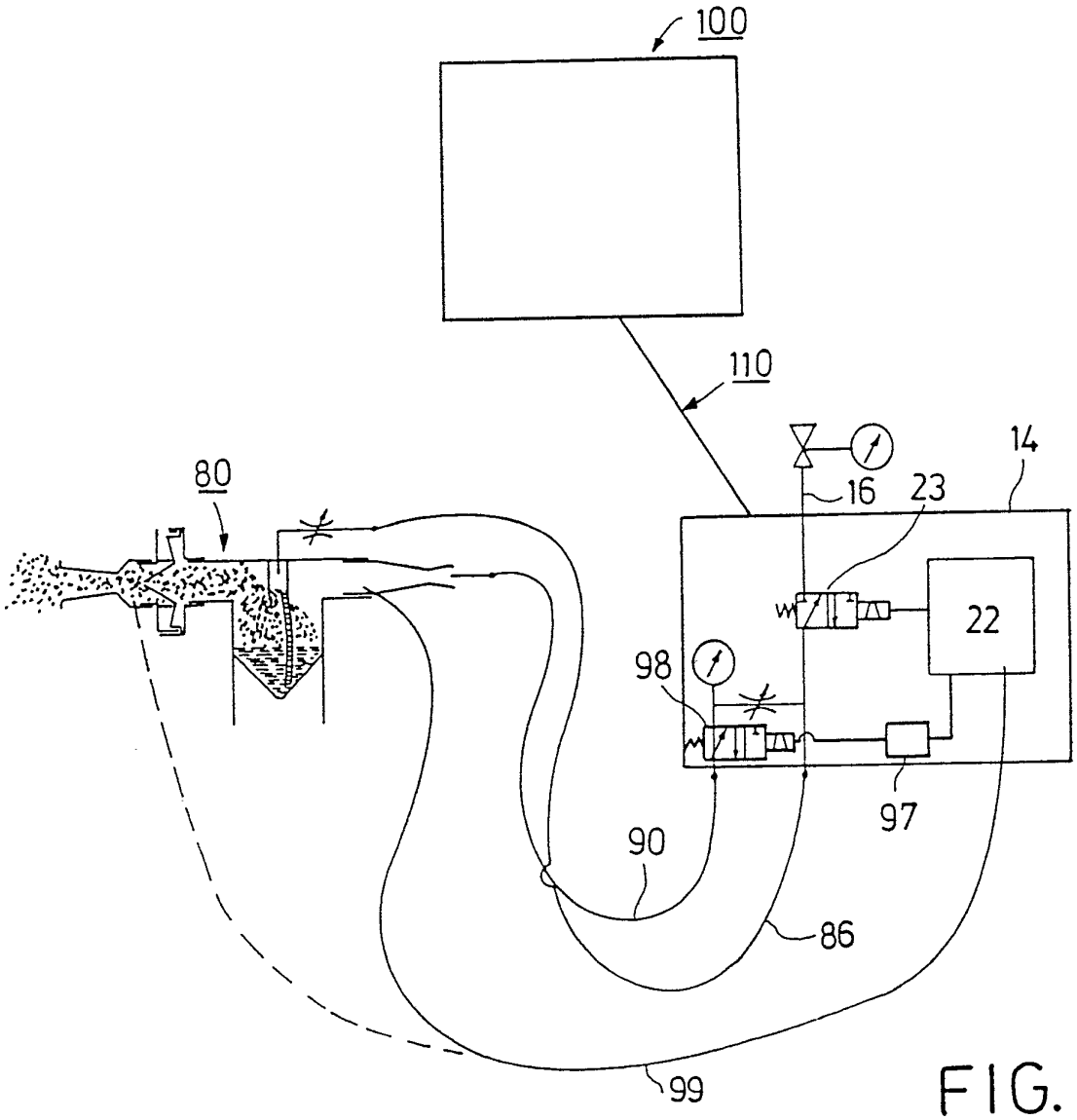
FIG. 4


100
110
14
80
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98
97
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86
99

FIG. 7

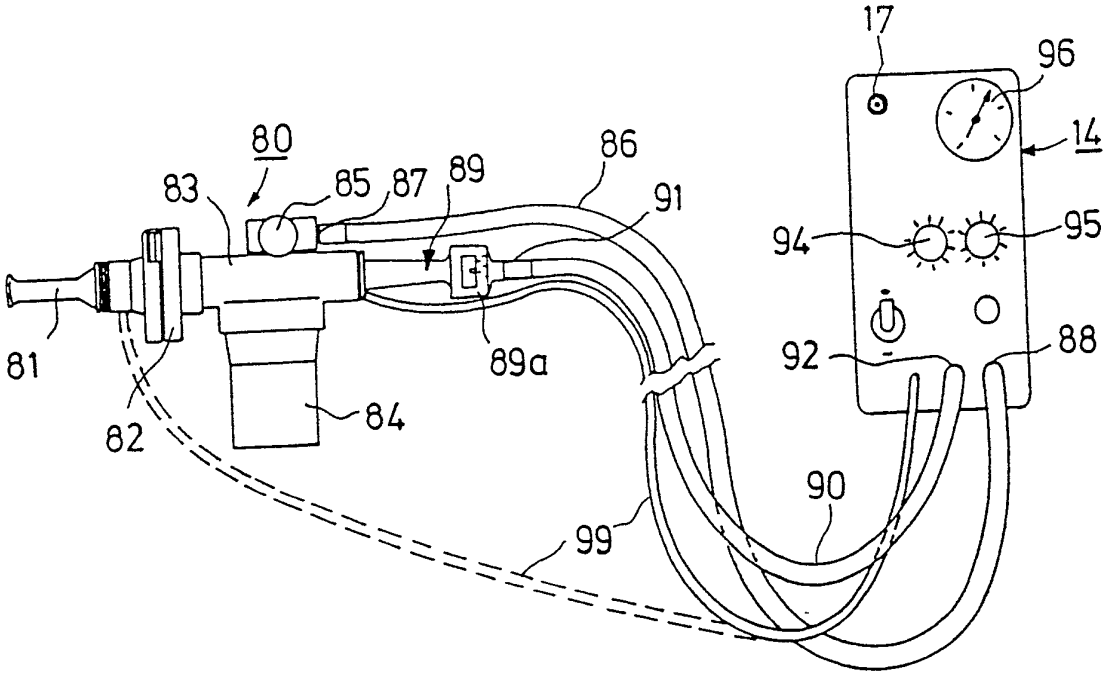
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FIG. 5

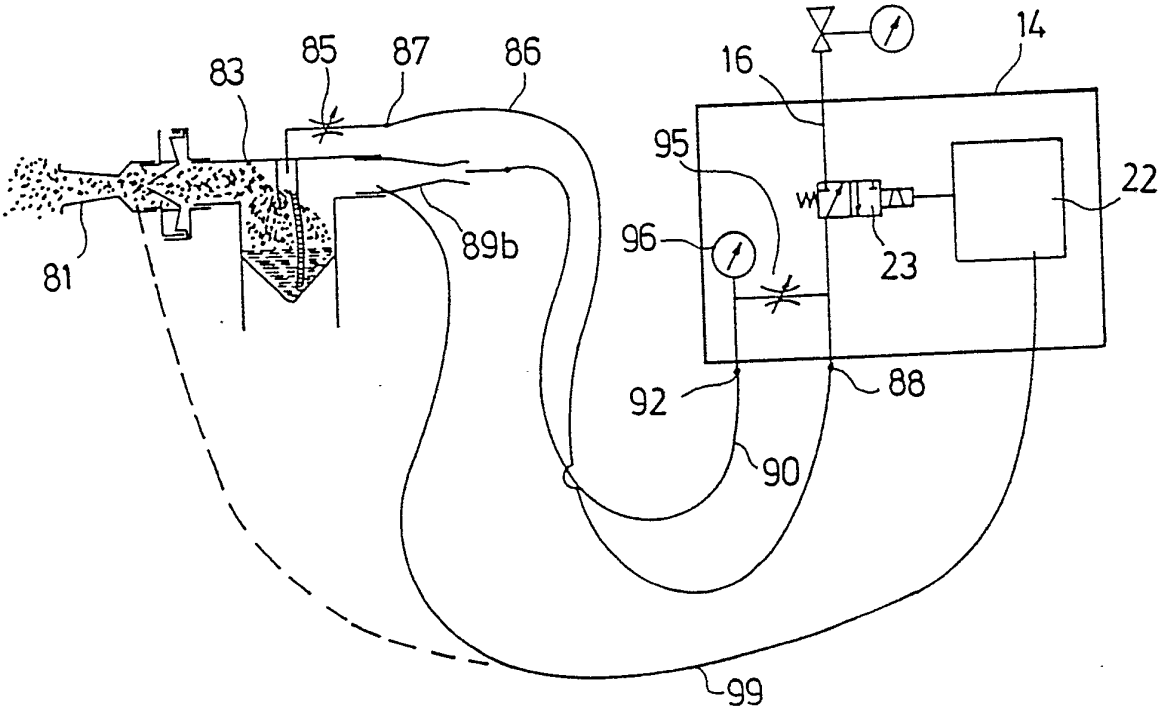
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FIG. 6

INTERNATIONAL SEARCH REPORT

International Application No PCT/FI86/00053

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) [6]

According to International Patent Classification (IPC) or to both National Classification and IPC [4]

A 61 M 16/00 // A 61 H 31/00

II. FIELDS SEARCHED

Minimum Documentation Searched [7]

Classification System	Classification Symbols
IPC 4	A 61 H 31/00-/02; A 61 M 16/00, /10-/20
US Cl	128:145.5-145.8, 198-205

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched [8]

SE, NO, DK, FI classes as above

III. DOCUMENTS CONSIDERED TO BE RELEVANT [9]

Category [10]	Citation of Document, [11] with indication, where appropriate, of the relevant passages [12]	Relevant to Claim No. [13]
X	SE, B, 386 366 (G.E. SMYTHE ET AL) 9 August 1976 & NL, 7211141 GB, 1288019 FR, 2149580 DE, 2238928 US, 3921628	1-5, 9-12
X	SE, B, 434 597 (E. SCHWANBOM ET AL) 6 August 1984 & NL, 7807874 FR, 2406436 GB, 2007101 DE, 2746924 JP, 54068095 US, 4211221 CH, 635246 SE, 7810852	1-5, 9-12
A	DE, A, 2 124 446 (L. HELM ET AL) 23 December 1971	1-4, 7-12

.../...

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"&" document member of the same patent family

IV. CERTIFICATION

Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
1986-09-15	1986 -09- 16
International Searching Authority	**Signature of Authorized Officer**
Swedish Patent Office	Leif Karnsäter

Form PCT/ISA/210 (second sheet) (January 1985)

III. DOCUMENTS CONSIDERED TO BE RELEVANT (CONTINUED FROM THE SECOND SHEET)

Category *	Citation of Document, with indication, where appropriate, of the relevant passages	Relevant to Claim No
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