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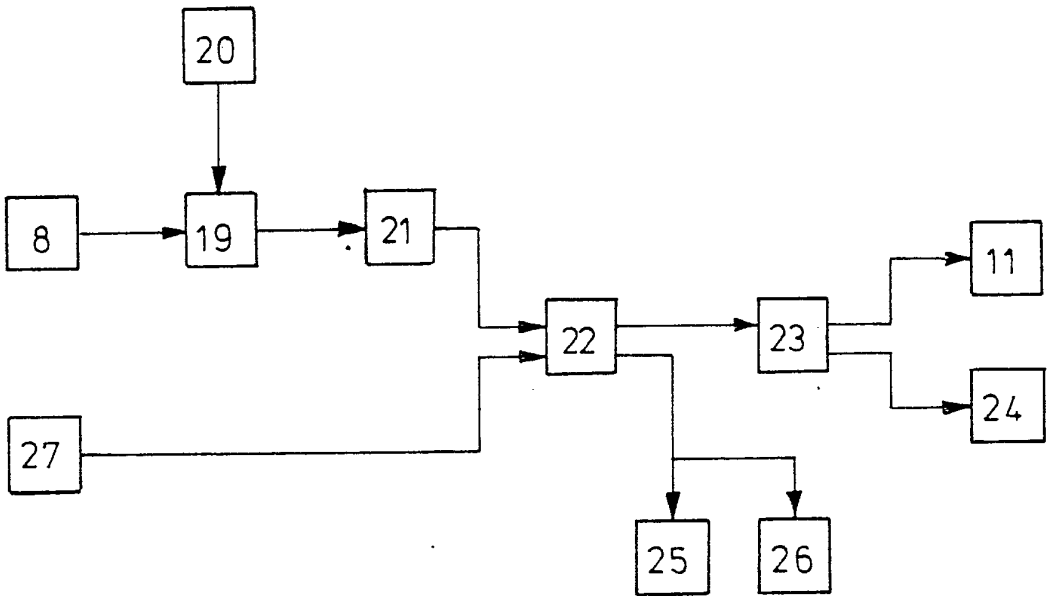
(54) Title: MEASURING AND CONTROLLING THE MOISTURE CONTENT OF HAIR



(57) Abstract

Mean values of the humidity of air in a return air duct (9) of a drying hood (1) are formed at equal measurement intervals by means of a differential measurement process in a measurement (19). A first stop signal is transmitted from the measuring device (19) to a hair drying programme device (22) when a predetermined differential value of the measured air humidity mean values is not achieved.

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Measuring and controlling the moisture content of hair.

TECHNICAL FIELD

The invention relates to a method of measuring and controlling the moisture content of hair using a hair-drying hood with an air humidity sensor in the return air duct, and to a hood for use in such a method.

BACKGROUND ART

A drying process is known from the European Patent Application EP-A-0 073 944, in which the heating capacity is controlled automatically as a function of the relative air humidity measured by means of an air humidity sensor arranged in the return air duct. The disadvantage here is that the degree of moisture in the hair is not compared with the relative humidity of the outside air, so that a process of this type is extremely inaccurate and may lead to overdrying. In this connection a remedial measure is said to be provided in the form of a second air humidity sensor, which includes the relative humidity of the outside air in the drying process. The disadvantage here is still a large degree of measurement inaccuracy, since it is necessary to work from the fact that a comparative relative air humidity measurement is only possible when the temperatures of the return air and the outside air are the same; another disadvantage is the use of two sensors with characteristics which are not identical. An improvement in the accuracy of measurement is possible by means of a

selected (expensive) pair (extensive correlation of the characteristics), but this also makes the device for performing the method expensive as a result of large circuit costs.

German Auslegeschrift DE-A2-10 79 801 discloses a drying process with two air humidity sensors. The relative humidity of the return air and the outside air is detected; the return air temperature is said to be brought to the temperature of the outside air by means of cooling fins and the application of outside air, in order that a comparative measurement of the relative air humidity can be made at equal temperatures. As a result of the strong return air flow an adjustment to the outside air temperature is not possible. In addition, the already mentioned disadvantages are present.

What is desired is a hair drying method which does not have the disadvantages or which makes exact measurement and control of the moisture content of the hair possible and prevents overdrying.

DISCLOSURE OF INVENTION

The present invention provides a method of measuring and controlling the moisture content of hair using a hair drying hood with an air humidity sensor in the return air duct, in which when the drying phase commences, a measuring device connected to the air humidity sensor produces mean values at equal measurement intervals, a first stop signal being transmitted from the measuring device to a hair drying programme device in order to introduce an automatic programme stop when a predetermined differential value of the measured air humidity mean values is not reached.

Proceding from the concept that the hair is considered to be dry when there is no longer any significant change in the moisture content of the exhaust air, this state and thus the end of the drying process can be determined using the method according to the invention.

In order to adapt the treated hair to the temperature and humidity of the surroundings and in order to reduce the excess remaining moisture of the hair without overdrying the hair, once a predetermined differential value (e.g. 0.1) of the measured mean values of the air humidity has been reached, the drying processing continue to operate at a reduced heat capacity and also a reduced fresh air capacity until a predetermined period of time has elapsed (e.g. 5 min).

To signal a warning for the end of the drying process a stop signal can advantagsously be used which, after a predetermined period of time and after a predetermined period of time of the reduced drying phase (reduction of the heat capacity/fresh air flow), also indicates by means of a timer the time which remains until the drying hood switches off. This device enables the operating personnel to adapt themselves optimally to the operation cycle.

Since the sensitivity of air humidity sensors is particularly high in the region of greater air humidity, it is easier with measuring means to detect return air which has been cooled by means of a heat exchanger chamber, since the relative air humidity is thereby increased.

It is also advantageous if the heat exchanger,

preferably provided with cooling fins, is arranged in the fresh air flow of the ventilator.

A the hollow ring-shaped mixing chamber (preferably having cooling fins) provides for a good mixing of the return air and a good constructional adaptation in respect of the fresh air fan or the interior of the drying hood.

Similarly, a hollow ring-shaped heat exchanger chamber provides a good constructional adaptation and a good circulation of fresh air from the fan blower.

Drawing off of the return air via one or more return air ducts can be effected via a separate fan or by means of a fresh air fan, the underpressure being used for the drawing off.

An individualised drying programme is possible when a hair drying programme device is used. It is thus possible for example at full heat capacity in the first phase of drying to reduce the capacity according to a predetermined characteristic, by monitoring a temperature sensor. A correspondingly determined reduction in the fresh air flow leads to a drying process which protects the hair and is pleasant for the person undergoing the drying process.

A further advantage of the invention is seen in that air humidity sensors can be used which need no pronounced linearity on account of the differential measurement and consequently sensors can be used which are economical.

The invention is explained further, by way of example, with reference to the accompanying drawings.

BRIEF DESCRIPTION OF DRAWINGS

Fig. 1 shows a drying curve with the measurement intervals illustrated;

Fig. 2 is a block diagram illustrating a method according to the invention,

Fig. 3 is an axial section through a drying hood;

Fig. 4 is a section through the mixing chamber, taken along line A - A in Fig. 3; and

Fig. 5 is a section through the heat exchanger chamber, taken along line B - B in Fig. 3.

BEST MODE FOR CARRYING OUT THE INVENTION

Fig. 1 is a graph of relative air humidity versus time, showing the measurement intervals. Six equal measurements per measurement interval (J) of t = 2 minutes have been found be meet the requirements. From these first six measurement values in the measuring interval J_1 the mean value is derived and stored. Then the mean value from the measurement interval J_2 is derived from a further six measurements and stored. The mean value from interval J_2 is then subtracted from the mean value from interval J_1. If the difference between the two mean values is for example less then $\pm$ 0.1, then a first stop signal is produced.

A further mean value is derived from the interval J_3. If the substraction of the mean values derived from the intervals J_2 and J_3 results in a difference

which is again less than $\pm$ 0.1 for example, then the operating automatic programme is stopped by means of a second stop signal and switched over to a fixed time programme of for example 5 minutes length. This procedure prevents the operating automatic programme from being stopped in the event of erronous measurements. A first stop signal must therefore be confirmed by an immediately following second stop signal, for example $(J_1 - J_2)$ less than $\pm$ 0.1 and $(J_2 - J_3)$ less than $\pm$ 0.1.

If the first stop signal does not have an immediately following confirmation in the form of the immediately following differential measurement, if the differential value is for example greater than $\pm$ 0.1, then the interval measurements and the automatic programme continue. If a predetermined differential value is not reached within an overall drying period, for example 60 minutes, then the drying hood switches off automatically.

The block diagram represented in Fig. 2 illustrates in addition the measurement process in a method according to the invention. A mean value measuring device 19 detects the air humidity measurements of a air humidity sensor 8 at equal measurement intervals $(J_1....J_n)$, which are time-controlled by means of an impulse generator 20. At the end of each interval $(J_1.....J_n)$, timed by the impulse generator 20, the mean value is fed into a differential value measuring device 21 and stored here, a first stop signal then being produced when a predetermined difference of successive values has been reached. Differential value formation is activated in each case by the input of a new mean value. Only a second successive stop signal is effective to cause the hair drying programme device to

allow heating means 24 and a fan or blower motor 11 to continue to operate at a reduced capacity at the end of a predetermined period of time via the hair drying control device 23 in the case of automatic operation of the hair drying hood 1. It may advantageously be provided that the second successive stop signal effects an optical and/or acoustic warning signal 25 indicating that the end of the drying process can shortly be expected, possibly with a time delay. A remaining time indicator 26 indicating the predetermined fixed time can be provided parallel thereto, the drying hood 1 being switched off when the remaining period "O" has been reached.

By means of a temperature sensor 27 connected to the hair drying programme device 22 the temperature of the exhaust air 3 can be monitored and/or controlled.

Furthermore, the hair drying programme device 22 can be equipped so that it can be adjusted for predetermined parameters (e.g. time, temperature, fan motor speed) in the non-automatic programme area.

The drying hood 1 with air circulation shown in axial section in Fig. 3 comprises at least two return air ducts 2, which partly receive the drying exhaust air circulating around the hair through one or more openings 4 in the region of the lower parts of the hair and the exhaust air is guided back via a mixing chamber 5 and a heat exchanger chamber 6 into the fresh air flow. The return air 7 flowing through the mixing chamber 5 and the heat exchanger chamber 6 acts upon an air humidity sensor 8 in an adjoining return air suction duct 9. The outlet of the mixing chamber 5 and the inlet of the heat exchanger chamber 6 are connected by means of a connecting duct 10. The fan impellor 12, which is driven

by means of a motor 11, drives the fresh air 13 and the return air 7 emerging from the return air suction duct 9 for heating by a heating element 14, and the heated air passes through air outlet openings 15 into the drying space 16.

For improved heat exchange, cooling fins 17 are arranged on the heat exchanger chamber 6 such that optimum circulation of fresh air is ensured, the cooling fins being arranged around all or part of the periphery of the hollow tube of the heat exchanger chamber 6.

The outlet opening of the return air outlet duct 9 is arranged at a slight distance from the impellor 12, the rotating impellor 12 creating an underpressure at the outlet opening, which effects the return air flow through the return air ducts 2, mixing chamber 5, connecting duct 10, heat exchanger chamber 6, and return air section duct 9.

Fig. 4 is a section through the hollow ring-shaped mixing chamber 5 taken along line A - A (Fig. 3). In the preferred embodiment shown here, four return air ducts 2 open collectively into the mixing chamber 5, the return air 7 from two return air ducts 2 in each case being mixed thoroughly in each mixing chamber half and flowing through the oppositely disposed outlet opening 18 into the connecting duct 10. This arrangement ensures that the distances covered by the mixed return air 7 in the mixing chamber 5 are approximately equal and the test reading falsifies less often.

Fig. 5 is a section taken along line B - B (Fig. 3) through the hollow ring-shaped heat exchanger chamber 6. The return air 7 which passes through the connecting duct 10 into the heat exchanger chamber 6 divides into

two partial currents, which each flow through one half of the heat exchanger chamber and flow into the return air outlet duct 9 on the oppositely disposed side. Cooling fins 17 are arranged around the heat exchanger chamber 6 for increased heat exchange.

Claims

1. A method of measuring and controlling the moisture content of hair using a hair drying hood (1) with an air humidity sensor (8) in a return air duct (9), characterised that, from the beginning of the drying phase, a measuring device (19) connected to the air humidity sensor (8) produces mean values of the air humidity at equal measurement intervals, a first stop signal being transmitted from the measuring device to a hair drying programme device in order to introduce an automatic programme stop when a predetermined differential value of the said mean values is not achieved.

2. A method as claimed in claim 2, in which programme device (22) switches from an automatic programme to a predetermined fixed time programme as a result of an immediately following second stop signal.

3. A method as claimed in claim 2, in which, at the end of the fixed time programme, the hair drying hood (1) continues to operate at a reduced heat capacity and a reduced speed of a fresh air fan (11) until it is switched off manually.

4. A method as claimed in claim 2, in which the end of the fixed time programme is indicated optically and/or acoustically.

5. A method as claimed in claim 1, in which the stop signal actuates a remaining time indicator (26).

6. A hair drying hood for use in a method according to claim 1, comprising at least two, preferably four,

return air ducts (2) which open into a mixing chamber (5), and an air humidity sensor (8) acted upon by the mixed return air (7).

7. A hair drying hood as claimed in claim 6, in which the outlet (18) of the mixing chamber (5) is connected to a heat exchanger (6), the air humidity sensor (8) being acted upon by the mixed, cooled return air (7).

8. A hair drying hood as claimed in claim 6 or 7, in which the mixing chamber (5) and/or the heat exchanger chamber (6) comprises cooling fins (17) and is arranged in a fresh air flow (13).

9. A hair drying hood as claimed in claim 6 in which the mixing chamber (5) is designed as a hollow ring and comprises an outlet opening (18) on the side opposite the return air inlet.

10. A hair drying hood as claimed in claim 7, in which the heat exchanger (6) is designed as a hollow ring and an outlet opening (18') is arranged on the side opposite the inlet opening for the mixed return air (7).

11. A hair drying hood as claimed in claim 6, further comprising a fresh air fan (11) which also draws in the return air (7).

12. A hair drying hood as claimed in claim 6, in which the air humidity sensor (8) is connected to a hair drying programme device (22) via a mean value measuring device (19) which measures the relative air humidity

13. Hair drying hood according to claims 1 to 12, characterised in that the hair drying programme device (22) is connected to a temperature sensor (27).

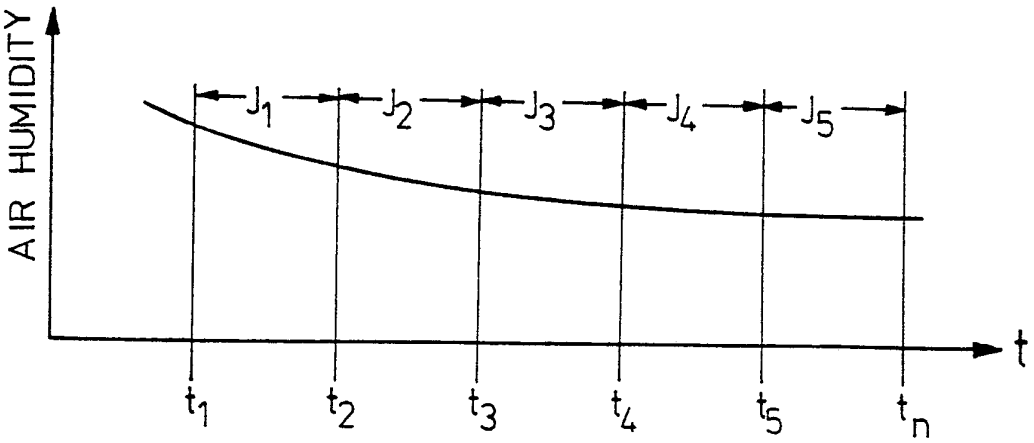
AIR HUMIDITY
J1
J2
J3
J4
J5
t
t1
t2
t3
t4
t5
tn

FIG.1

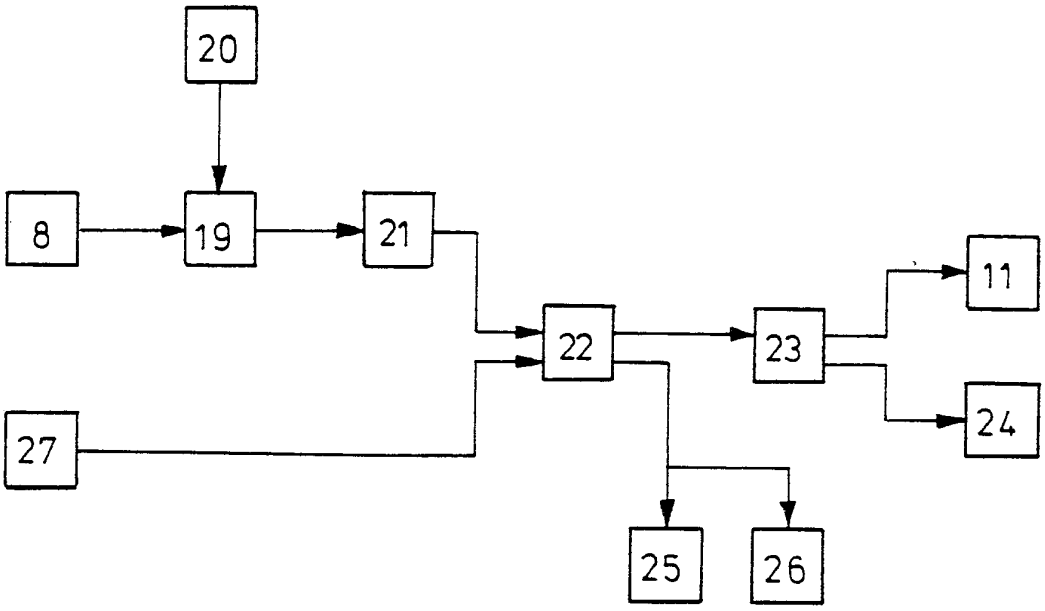
20
8
19
21
22
23
11
24
27
25
26

FIG.2

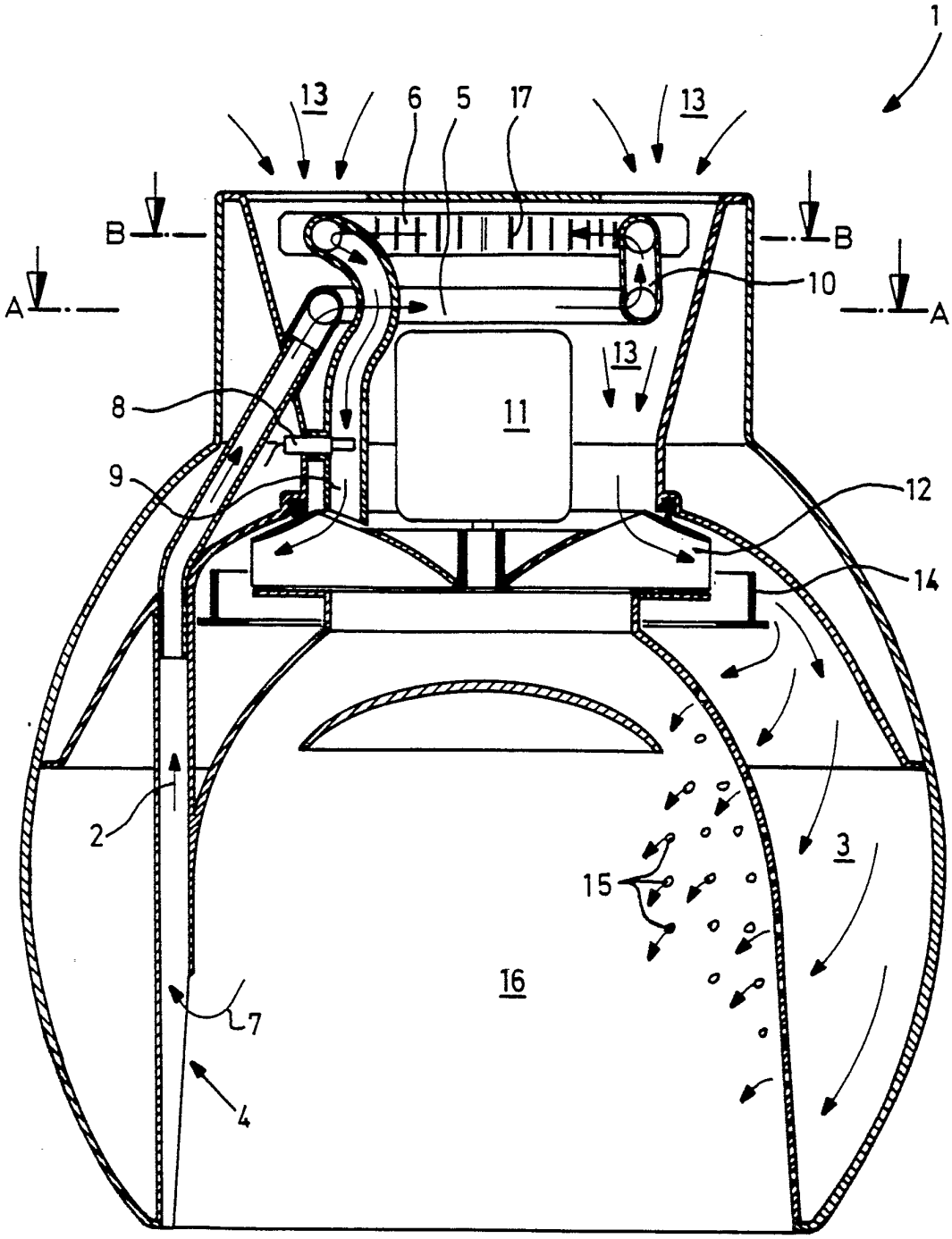

FIG. 3

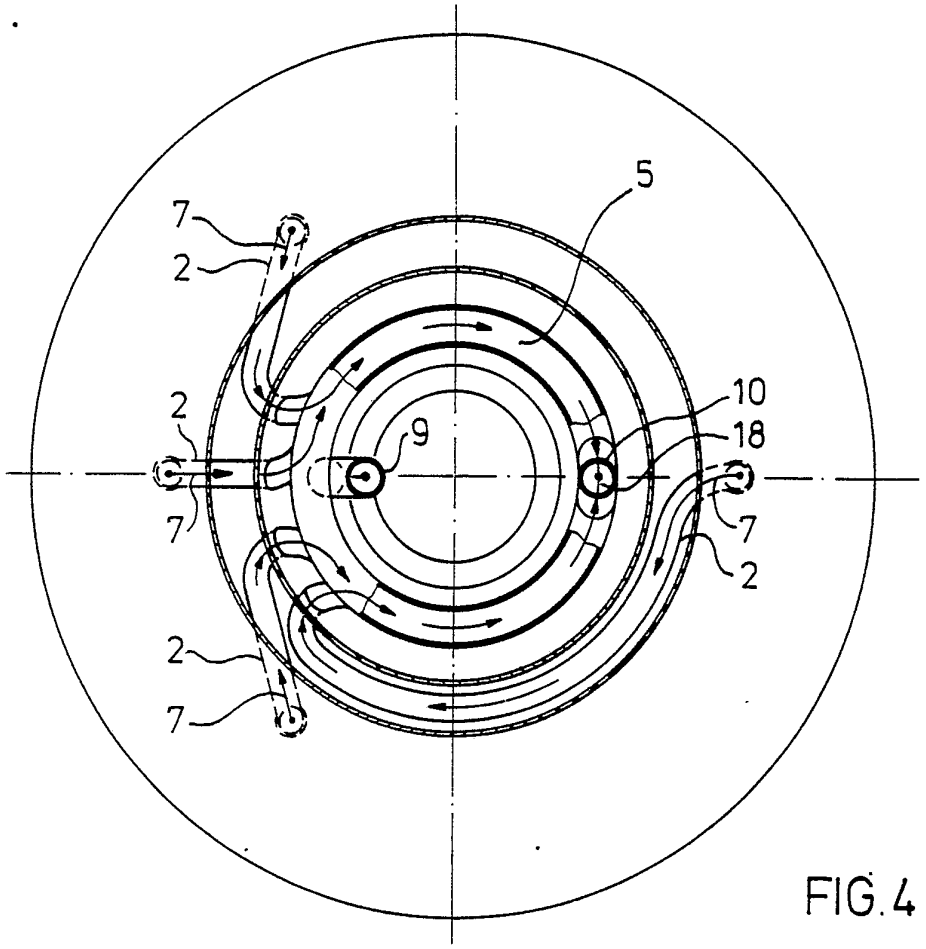

FIG.4

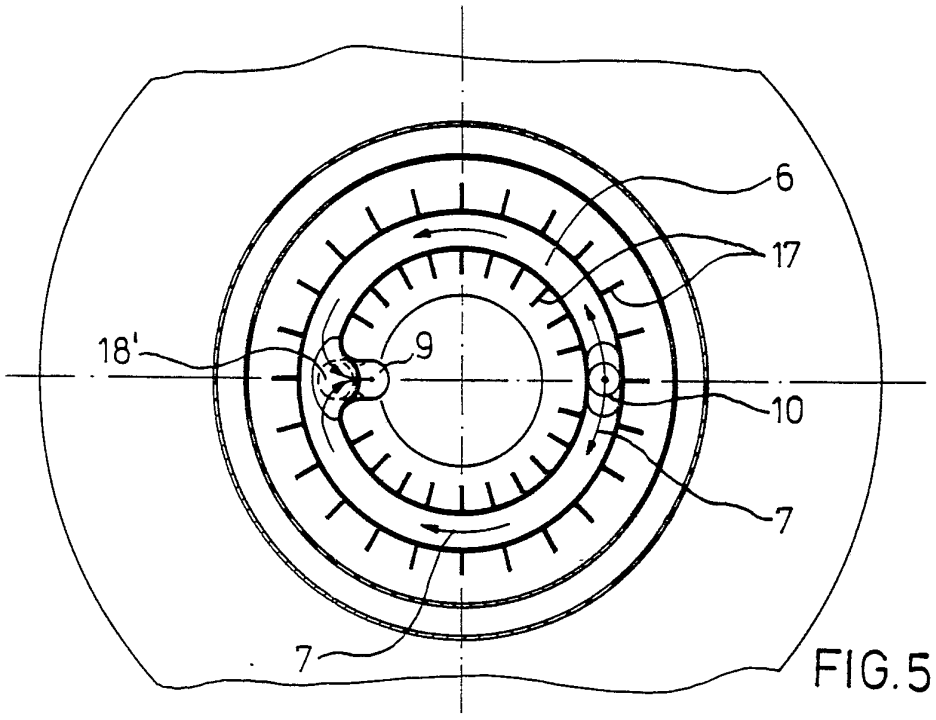

FIG.5

INTERNATIONAL SEARCH REPORT

International Application No PCT/EP 85/00457

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

IPC[4]: A 45 D 20/30; F 26 B 25/22; G 05 D 22/02

II. FIELDS SEARCHED

Minimum Documentation Searched [7]

Classification System	Classification Symbols
IPC[4]	A 45 D; F 26 B; G 05 D

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

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]
A	FR, A, 2424352 (MALLORY) 23 November 1979, see page 3, lines 27-36; page 13, line 21 - page 14, line 14; page 17, line 3 - page 19, line 5, lines 32-36; page 21, lines 8-15; figure 3 --	1
A	EP, A, 0074108 (MATSUSHITA ELECTRIC INDUSTRIAL) 16 March 1983, see page 2, lines 16-25; page 10, lines 1-24 --	1
A	US, A, 3327403 (HOOD) 27 June 1967, see column 1, lines 26-30 --	2
A	US, A, 3304621 (NELSON) 21 February 1967, see column 1, lines 17-26 --	2
A	DE, B, 1079801 (VELECTA) 14 April 1960, see column 4, lines 10-32; figures 4-6 (cited in the application) --	6-8,11

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* Special categories of cited documents: [14]

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IV. CERTIFICATION

Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
4th December 1985	16 JAN. 1986
International Searching Authority	**Signature of Authorized Officer**
EUROPEAN PATENT OFFICE	G.L.M. Kruydenberg

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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A	DE, A, 3112384 (MÜHOLOS-WERK) 11 November 1982	
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A	CH, A, 569943 (FELBER) 28 November 1975	

ANNEX TO THE INTERNATIONAL SEARCH REPORT ON

INTERNATIONAL APPLICATION NO. PCT/EP 85/00457 (SA 10723)

This Annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report. The members are as contained in the European Patent Office EDP file on 08/01/86

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Patent document cited in search report	Publication date	Patent family member(s)		Publication date
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CH-A- 569943	28/11/75	None		