

Measuring system and measuring sensor for measuring a quantity of urine

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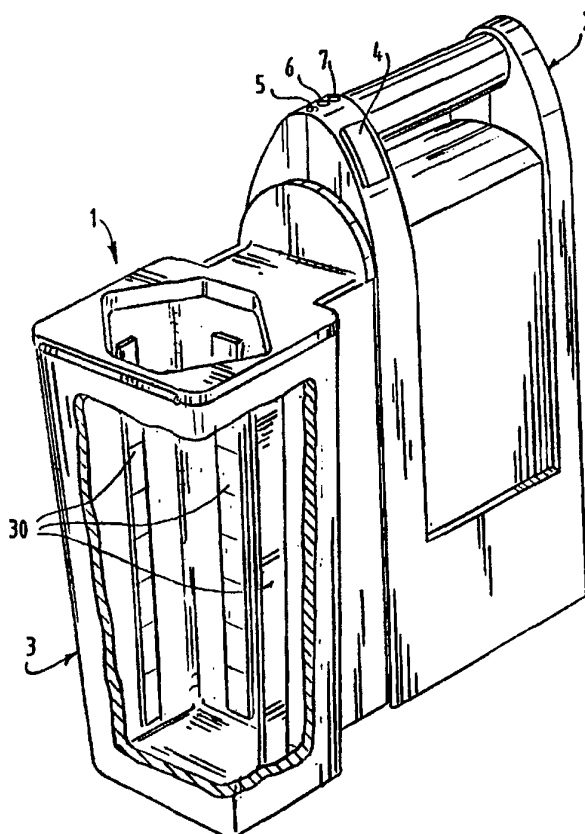
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(54) Title: MEASURING SYSTEM AND MEASURING SENSOR FOR MEASURING A QUANTITY OF URINE

(57) Abstract

The present invention provides a measuring sensor (30) for measuring the presence of liquid having a relatively low electrical resistance (of the order of 0-1000 Ω) comprising one or more conductors with high electrical resistance (of the order of 100 k Ω or more) which are maintained between connecting contacts on a carrier element made of synthetic material, cardboard or paper and which has a substantially meandering shape, wherein the resistance between the connecting contacts is notably reduced in the presence of the conducting liquid.



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**MEASURING SYSTEM AND MEASURING SENSOR
FOR MEASURING A QUANTITY OF URINE**

An accurate measuring sensor for measuring the quantity or flowrate, of released urine, occurring incontinent patients with micturition problems is sought after on a large scale.

5 The present invention provides a measuring sensor for measuring the presence of liquid with a relatively low electrical resistance, in the order of 0-1000 Ω , comprising one or more conductors with high electrical resistance, in the order of 100 k Ω or more, which are maintained between
10 connecting contacts on a carrier element made of synthetic material, cardboard or paper and which has a substantially meander shape wherein the resistance between the connecting contacts is notably reduced in the presence of the conducting liquid.

For diagnosing urination or micturition problems the rate of flow of urine released by a patient is measured. For this a patient usually has to urinate in a hospital. Due to unfamiliar surroundings and/or the fact that the patient
5 is a day patient, urination is often difficult or does not take place at all. Aberrations in the urination pattern can cause problems in making a correct diagnosis, especially in the case of scientific research. In some cases the patient has to remain in the hospital for many hours and drink as
10 much liquid as possible in order for trustworthy results with repeated measurements to be obtained. Existing flow meters are expensive and are mainly found, in practice, in hospitals.

Existing systems for registering micturition on
15 the one hand concern direct flow measurement and on the other hand volume measurement, differentiation of which reveals a flow rate. An existing direct flow measuring system comprises a rotating disc which is broken by the

urine stream. Such an apparatus is transportable with difficulty.

Volume measuring systems make use of, for instance, a pipe in a beaker which measures the pressure
5 therein. Another volume measuring system makes use of two plates in a beaker and in so doing, determines the volume due to capacity or resistance changes between these plates. The results of this measurement are greatly influenced by variations in the electrical conducting qualities of urine.
10 These known volume measuring systems are extremely sensitive to movement and are likewise susceptible to displacement.

Furthermore a portable flow meter exists which comprises a large pot and an above mentioned flow meter, which at the utmost can be called transportable.

15 The present invention provides a system for measuring the quantity of urine or other conducting liquid, for instance per unit time, such as released by an individual, wherein the system comprises:

- one or more carrier elements provided with a
20 measuring sensor for measuring the rise rate per unit time of urine in a collecting beaker wherein the measuring sensor is placeable; and

- measuring means coupled to the measuring sensor and which are provided with a timer, a memory for storing
25 the measured data and a control member for controlling the measuring sensor, the timer and the memory.

Preferably the measuring system is able to be carried so that the patient can personally carry out the measurements in familiar surrounding, mostly at home. A
30 first application of the portable flow meter can concern study and treatment of prostate enlargement (BPH), i.e. in men.

From the hygiene point of view the receiving beakers and/or carrier elements are preferably made of
35 plastified paper, cardboard or another disposable material wherein a printed sensor, for instance, is mounted on the wall of the receiving beaker. To compensate for a possible tilted position and possible movements of the receiving

beaker, which by use at home could obviously occur, preferably three, or in the case of a beaker with a rectangular form, preferably four measuring sensors are mounted with the aid of a number of carrying elements 5 equidistant along the circumference against the upstanding walls of the receiving beaker.

A related aspect according to the present invention concerns a measuring sensor, carrier element and/or receiving beaker.

10 Furthermore the present invention provides a measuring sensor wherein a number of meander shaped conducting lines are mounted parallel between conducting connecting contacts on a carrier element and wherein an absorption element is mounted for absorbing urine and the 15 even distribution thereof over the conducting lines, against the side on which the high resistivity conducting lines are mounted, which is especially suitable for use in incontinence nappies and/or training of a baby or a small child.

20 Further advantages, characteristics and details of the present invention will become clear with respect to the following description which refers to the accompanying drawings which show:

fig. 1 a partly cut away perspective view of a 25 preferred embodiment of a system according to the present invention; and

fig. 2 a block diagram of the embodiment from fig. 1;

30 fig. 3 a frontal view of a folded out inner beaker, provided with a number of measuring sensors according to the present invention;

fig. 4 a frontal view of a second preferred embodiment of an inner beaker when folded out, provided with a number of measuring sensors according to the present 35 invention;

fig. 5 an exploded perspective view of a measuring system according to the present invention provided with the inner beaker from fig. 3 or 4;

fig. 6 a perspective view of the device from fig. 5 by use thereof;

fig. 7 an exploded perspective view of a further preferred embodiment of a beaker to use with the measuring system from fig. 1;

fig. 8 a perspective view of a measuring sensor according to the present invention;

fig. 9 a block diagram of a measuring system for use with the measuring sensor of fig. 6; and

fig. 10 a graph of a measured result obtained with the measuring system from fig. 7.

A preferred embodiment 1 (fig. 1) comprises a portable case 2 and one or a number of receiving beakers 3 which are able to be coupled thereto. The patient releases urine into a receiving beaker 3, from which release the rate is measured and stored in the measuring means in the case. At the start of the measurement a switch 4 is operated whereafter it can be read on two (or three) coloured lamps 5, 6 and 7 respectively that the patient can commence urine release.

The receiving beaker is provided on the inside with three, four (or more), measuring sensors, mounted on carrying elements such as those in fig. 2 which are reproduced schematically with 8. A microprocessor 10 is housed in the portable case 2, which is provided with a schematically reproduced RS232 driving element for coupling with a personal computer PC, for reading out and/or printing of the measured data. Furthermore a crystal 12, which makes up part of the timer, is connected to the microprocessor 10. Via a bus structure 13 which comprises a data bus 14, an address bus 15 and a control bus 16, the microprocessor 10 is connected to a memory part 17, 18, 19 respectively, wherein the measured data is stored in memory part 18, for instance, whilst the program memory is formed, for instance, by part 17. The control bus 16 is connected to the address bus via an address decoding element 20. The time is noted by the main timer 21 with respect to the data provided from the

crystal 12 via the microprocessor 10 on the databus 14. Furthermore the microprocessor 10 is coupled with a programmable current source 22 and a programmable analogue switch unit 23 on which the measuring element unit 8 is
5 connected. A supply source 24 takes care of the electrical supply voltage V for the diverse components.

A measuring sensor 30, such as that comprised within the broken lines in fig. 2, comprises a thin conducting path 31 and a wide return path 32 which are
10 mutually connected near the bottom of the receiving beaker via a cross connection and which are printed in high resistivity carbon, for instance, as well as a path 33 lain there between which alternately consists of relatively stretched out broad lengths 34 and thin conducting
15 connecting lengths 35.

In the absence of urine in the receiving beaker, a high resistance in the order of 100 k Ω to 1 M Ω will be measured both between the connections 36, 37 respectively as well as between the connections 38 on the one side and 36 or
20 37 on the other side. The urine will only show a resistance in the order of 100 Ω and thus causes a relative short circuiting between the conducting paths whereby the resistance between the paths will be determined by the height of the urine level.

25 Because for instance, due to differing fabrication circumstances the resistance of the conducting paths 31, 32 and 33 can mutually differ, the conducting path 33 is provided with relatively wide areas 34 and thin conducting paths 35 mounted there between, so that the resistance
30 between the connection 38 and one of the other connections 36 or 37 will greatly reduce the moment the urine level reaches a new wide part of the conducting path. In this way it is possible to allow an accurate calibration of the changing resistance between the connections 36 and 37 to
35 take place simultaneously with the carrying out of the measurement. Due to the correct processing of the obtained measurement data with the aid of the measuring system, or later with the aid of a personal computer, an accurate

measurement of the rate of increase of the urine level in the beaker can take place, and thus doing, due to the known inner dimensions of the receiving beaker, the quantity of urine in the time produced.

5 The diverse measurements are sent to the diverse measuring sensors from the control member 10 and the registrations are stored in the correct manner in RAM, whether or not having being changed from analogue to digital form, with the correct time and date of the measurement.

10 Because in the shown preferred embodiment the possibility exists of connecting to an external computer, such as a personal computer, measured data can be further processed outside of the measuring system itself and, apart from this, a desired adjustment in the software of the measuring system

15 can be carried out. As will be clear to an expert, a large number of possibilities are available for the carrying out of diverse measurements and the filtering out of interference signals and such like with the help of a microprocessor.

20 In the shown and described preferred embodiment a patient or another individual can hold the flow meter in the hand during urine release because movement and/or a tilted position thereof has no influence on the results. The measuring sensor can be mounted on a disposable carrying

25 element which is placed in a re-usable beaker or in completely disposable beakers provided with such carrying elements with sensor elements.

 It is important to note concerning the measuring sensor, particularly due to the high resistance of the

30 conducting paths, that due to the large difference thereof with the conductance of the urine, differences in the conductance of the urine have a neglectable influence on the measured results. However it is also conceivable to fit the printed measuring sensor partly in material with a high

35 resistance and partly in material with a lower resistance.

 An inner beaker 40 (fig. 3, 4, 5, and 6) for a measuring system 41 according to the present invention, comprises a plate of material 42, for example made of

synthetic material, whereon a number of connecting contacts 43, 44, 45, 46 are mounted which are connected via low resistivity conducting paths 47-55 with broadened connecting terminals 56-64. High resistivity conducting paths project 5 out from the connecting contacts 43-46, such as the high resistivity conducting paths 65 and 66 with connecting contact 43, each of which are connected with low resistivity paths 67, 68, 69, 70, 71, 72, 73, 74 and 75 so that on connecting one of the good conducting path parts 67-75 with 10 the conducting path 66 a clearly reproducible signal is given off to the measuring system.

A second preferred embodiment of a round, foldable beaker according to the present invention (fig. 4) differs from the preferred embodiment shown in fig. 3, in that two 15 return conducting paths 55', 55" respectively are connected to connecting contacts 64', 64" respectively in order to reduce the total length of the conducting paths to be printed and to prevent a large number of conducting paths next to each other near the upper edge of the inner beaker 20 from projecting out, such as in the embodiment of fig. 3.

The plates of material 40 and 40' are preferably made from cardboard with a synthetic material layer, such as polypropylene, associated thereon.

Such a measuring sensor 76 is preferably mounted 25 on the outside of the measuring beaker 40 (see fig. 5 and 6) which is placed in its roundfolded form in a beaker 77 and connected to connecting terminals 78 and 79 of the measuring system 41 so that the urine arrives in the beaker according to arrow A and rises along the outside of the 30 inner beaker 40 according to arrow B between the inner wall of the beaker 77 and the outerwall of the inner beaker 40, and direct contact of the urine, has no influence on the measured results if the urine comes into contact with the innerwall of the inner beaker.

35 The conducting paths are preferably placed on the inner beaker with the aid of printing techniques.

A further preferred embodiment of an inner beaker 101 (fig. 7) is equipped with two walls wherein a number of

measuring sensors project between the walls thereof (not shown). A beaker 101 is preferably provided with a clickable thereon ring like lid 102 with an outer diameter D1 of about 110 mm. The height D2 of the beaker 101 is preferably 200 mm
5 so that the whole complete measuring system, with these dimensions according to fig. 1, can be held in the hand by the patient during urine release. The beaker 101 is preferably produced from polypropylene with a wall thickness of 0.7-0.9 mm.

10 A further application of of the measuring sensor according to the present invention concerns a so called leak detecting system for incontinence or for the training of children.

The cause of incontinence is to blame on the
15 disruption of the bladder function and/or on the disruption of the function of the closing mechanism of the bladder. This can be blamed on uncontrollable bladder contractions or external stress factors such as coughing, laughing or physical exertion. The diagnosis of incontinence and
20 especially the gravity of the complaint is difficult to pin down. A known technique consists of following a patient for a period of time and carrying out measurement on the bladder function and/or the closing mechanism, for example by measuring pressure. The gravity of incontinence and the
25 correlation with bladder functions measurements and the closing mechanism can be determined by detecting the moment and the extent of urine loss.

A new method for quantifying urine loss concerns pre-dry-weighing of a nappylike band and, after a certain
30 period has elapsed, the wet weighing thereof. The weight-difference yields the extent of urine release. With this, the amount of urine can only be measured, not the moment of urine release. It is not possible to determine the correlation between the bladder function and the closing
35 mechanism and the moment of urine release, and the amount of urine per function thereof can also not be determined.

It is also known to make use of fitting a thin pipe into the urethra. Two electrodes are usually mounted on

this pipe for carrying out impedance measurement. Also with this the amount of urine loss per urine release can not be determined. Furthermore the fitting and carrying of the pipe is uncomfortable for the patient.

5 Measuring systems are also known wherein strips of silver paper are associated with nappies, for example with press studs. It is also not possible to measure the amount of urine loss with this known system, and such a urine loss can only be determined once. After the system has become
10 wet, further urine loss will yield no significant lowering of the conductance and will also yield no measurement result.

 Finally there is a known method wherein a heat sensor is placed in a nappie. On contact of urine with the
15 body temperature, a temperature increase of the sensor is caused which is measured. After a little while the temperature of the sensor will drop back to a level beneath the bodytemperature of the urine. This known method can indeed determine the time of urine loss, but not the amount
20 of urine loss.

 A measuring sensor 80 (fig. 8, 9) according to the present invention comprises a carrier 81 of for example polyester or paper or a combination thereof, whereon, with the help of electric conducting ink, for example with the
25 help of print technique, a number of high resistivity meander shaped conducting paths 82, 83 to 90 is mounted. The high resistivity conducting paths 82 to 90 are furthermore connected with the conducting connecting contacts 91 and 92. Against the side of the carrier material 81 whereon the
30 conducting paths are mounted, an absorption element of damp absorbing material, preferably of a synthetic material, is secured, for example glued thereon. This absorption element ensures that the released urine is well distributed whereby a determined length of the different paths are
35 shortcircuited due to the total resistance decreasing. This decrease is directly propotional to the total length of the paths which have come into contact with the urine and is proportional to the surface and hence to the total quantity

of released urine. With a new release of urine, even at the same location, the surface of the absorption element will become larger which leads to a further decrease in resistance. The dimensions of the sensor can be chosen so
5 that no urine loss goes unmeasured. The first tests have shown that it is possible to detect a volume of one to a few hundred ml with the material now used. It is also possible to mount a sensor with a relatively thin absorption element on the upper side and a sensor element provided with a
10 relatively thick absorption element on the under side whereby an extremely sensitive sensor with a large measuring range is obtained.

This sensor makes it possible to determine the exact time of urine loss as well as various detections of
15 urine loss, while in an extremely sensitive manner a large measuring range is measured. Furthermore it appears that the position of the sensor in the nappyband is not critical and is not influenced to a great extent by the qualities of urine while, due to the relatively low costs, the sensor can
20 be made disposable.

A heat sensor is preferably used in the measuring system which makes use of the above mentioned sensor, which is used to determine the time when the patient goes to the toilet which can also be important for diagnoses, especially
25 with simultaneous measuring of the bladder pressure.

A measuring system 100 (fig. 9) making use of a measuring sensor 80 according to the present invention, preferably comprises a microprocessor 101 on which a schematically shown timer 102 is mounted and which is
30 connected to a periphery apparatus such as a personal computer 104 via a driving element 103. A read only memory (ROM) 109 and a writeable memory 110 are connected to the microprocessor 101 via a busstructure 105 which comprises a databus 106, an adressbus 107 and a controlbus 108.
35 Furthermore an energy source 111, a programmable current source 112 and a programmable switch element 113 are connected thereon. The sensor 80 is connected to the programmable switch element 113, the exits of which are

connected to an analog/digital-converter via amplifiers 114 which make up part of the microprocessor 101. Furthermore a schematically shown keyboard control panel 115 for the patient and a sound element for giving off of a sound signal 5 116 are connected to the microprocessor 101, the sound element being of importance for example for training goals for a patient, baby or small child.

Fig. 10 shows a measured result of measurements obtained with the help of the measuring system from the 10 blockdiagram of fig. 9. The time t is plotted along the horizontal axis and the conductance C along the vertical axis on a relative scale of 0 to 100. Apart from irregularities which can be easily filtered out with the aid of known filter technics, it is clear from the graph in fig. 15 10 that urine release occurs with the strongly rising flanks of curve A, while the extent of urine release can be determined from the difference in the conductance with the hardly rising or dipping parts of curve A. The time and extent of urine release can also be determined in successive 20 urine releases with the aid of the measuring system of fig. 9.

The present invention is not limited to the preferred embodiment described and shown above. The requested rights are rather determined by the following 25 claims.

CLAIMS

1. Measuring sensor for measuring the presence of liquid with a relatively low electrical resistance, in the order of 0-1000 Ω , comprising one or more conductors of high electrical resistance, in the order of 100 k Ω or more, which
5 are mounted between connecting contacts on a carrier element made of synthetic material, cardboard or paper and which are substantially meander shaped wherein the resistance between the connecting contacts is notably lowered by the presence of the conducting liquid.
- 10 2. System for measuring the quantity of body fluid for instance urine per unit time such as, for instance, released by an individual, wherein the system comprises:
- one or more carrier elements provided with a measuring sensor for measuring the rise amount per unit time
15 of the urine in a collecting beaker wherein the measuring sensor is placeable; and
 - measuring means coupled to the collecting beaker(s) and with the measuring sensor and which are provided with a timer, a memory for storing the measured
20 data and a control member for controlling the measuring sensor, the timer and the memory.
3. Measuring system according to claim 2, wherein the measuring means comprise a case of such dimensions, in which the control element, the timer and the memory are
25 housed, that it can be held in the hand during urine release.
4. Measuring system according to claims 2 or 3, wherein the steering element comprises a micro-processor the memory comprises a memory part for storing programs, and
30 wherein the busstructure, which comprises a databus, an adressbus, and a controlbus, is housed.
5. Measuring system according to one of the claims 2 to 4 provided with a driving element for connecting the

measuring means to a personal computer and/or possible other peripheral equipment.

6. Measuring system according to one of the claims 2 to 6 provided with a collecting beaker wherein a carrier 5 element and a measuring sensor are securable.

7. Measuring system according to one of the claims 2 to 6 wherein the collecting beakers are made of cardboard with a synthetic material layer or synthetic material such as polypropylene.

10 8. Measuring system according claims 6 or 7 wherein at least one measuring sensor is mounted along the upstanding wall of the collecting beaker.

9. Measuring system according to claim 8 wherein three or four measuring sensors project from various 15 locations along the circumference along the upstanding wall.

10. Measuring system according to claim 7 or 8 wherein the sensors are mounted on the outside of an inner beaker to be placed in the collecting beaker.

11. Measuring system according to one of the 20 claims 2 to 9, provided with a double walled beaker wherein one or more measuring sensors project upwards from between the inner and outer wall thereof.

12. Measuring sensor according to claim 1 and/or for use with the system according one of the claims 2 to 11.

25 13. Measuring sensor according to claim 1 provided with a number of relatively broad conducting paths of predetermined dimensions which are mutually connected with the aid of a relatively thin conducting part of even greater resistance.

30 14. Measuring sensor according to claims 1, 12 or 13 wherein a number of meander shaped conducting paths are mounted parallel between conducting connecting contacts on a carrier element and wherein against the side on which the high resistivity conducting paths are mounted, an absorption 35 element for absorbing urine and evenly distributing the urine over the conducting paths is mounted.

15. Measuring sensor according to claim 14 for use in a nappy for incontinence and/or for training of a baby or small child.

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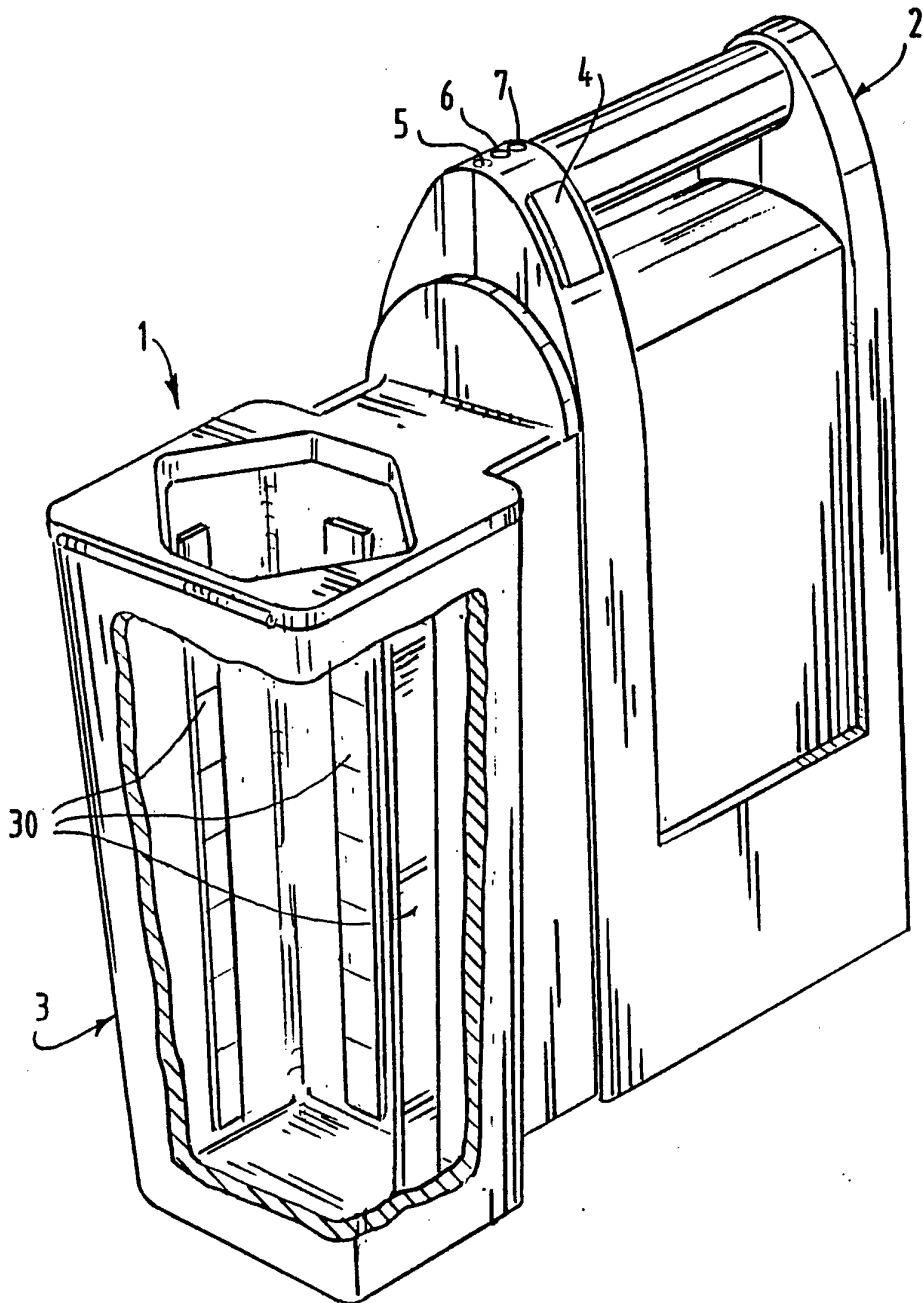


FIG.1

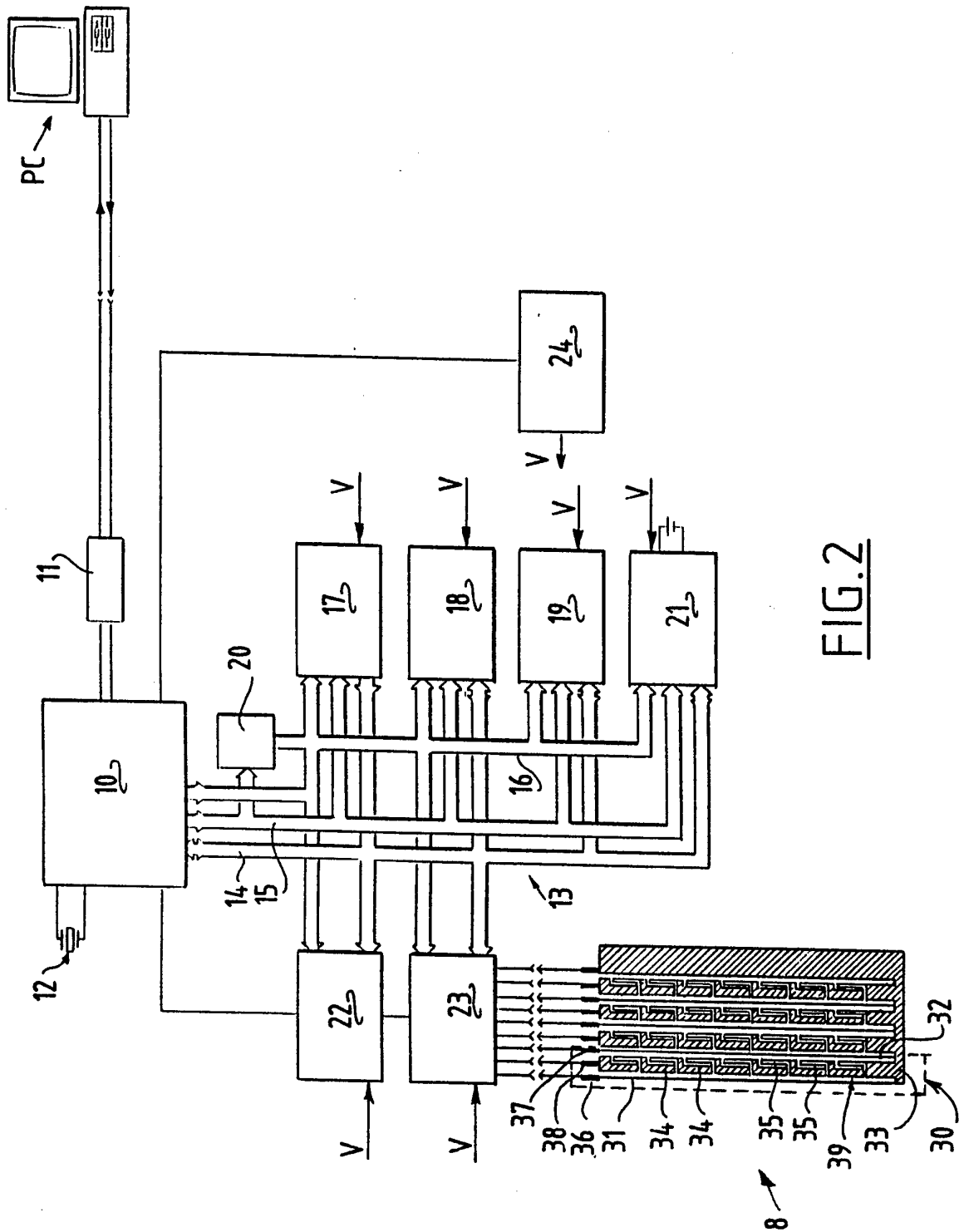


FIG.2

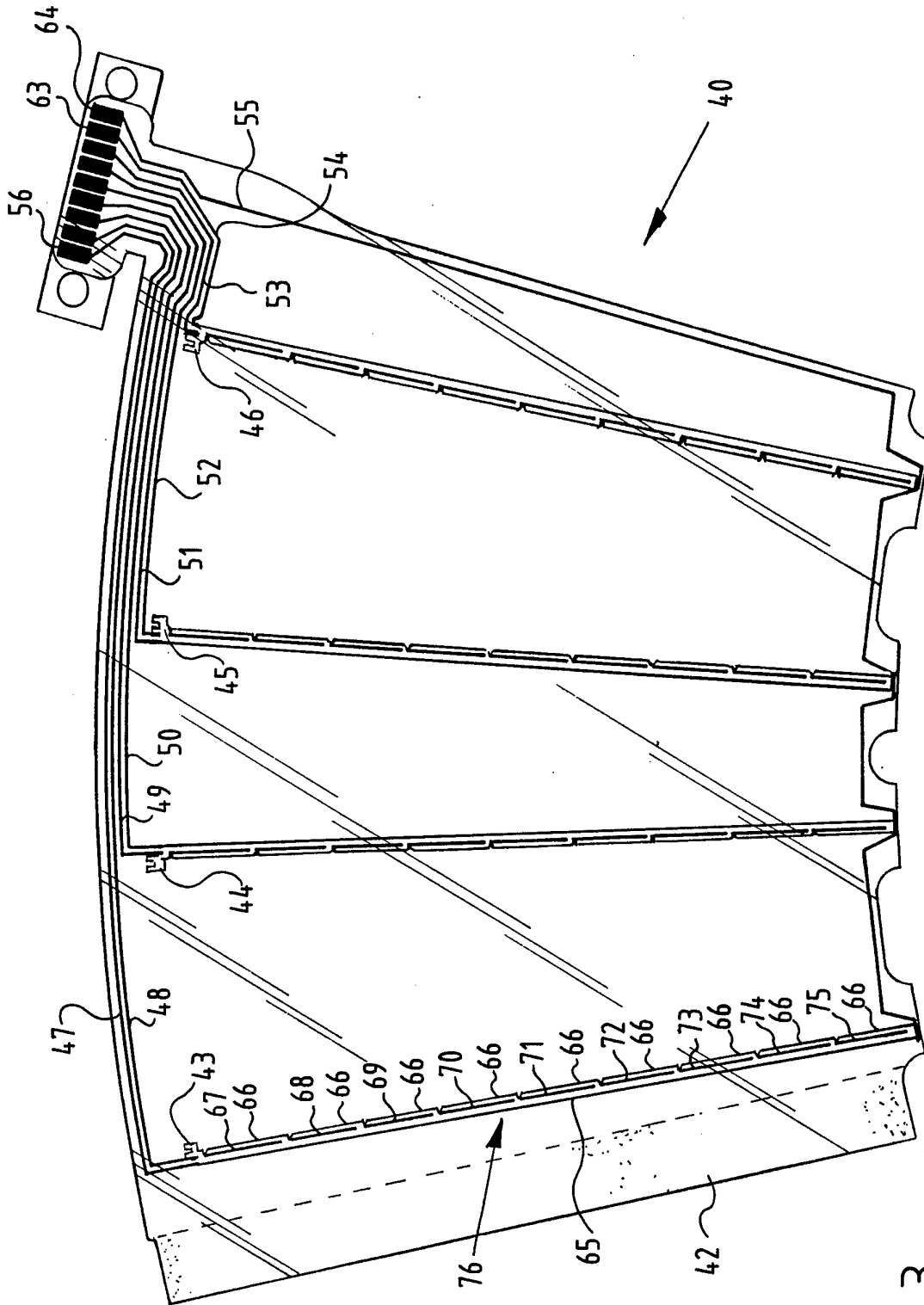


FIG. 3

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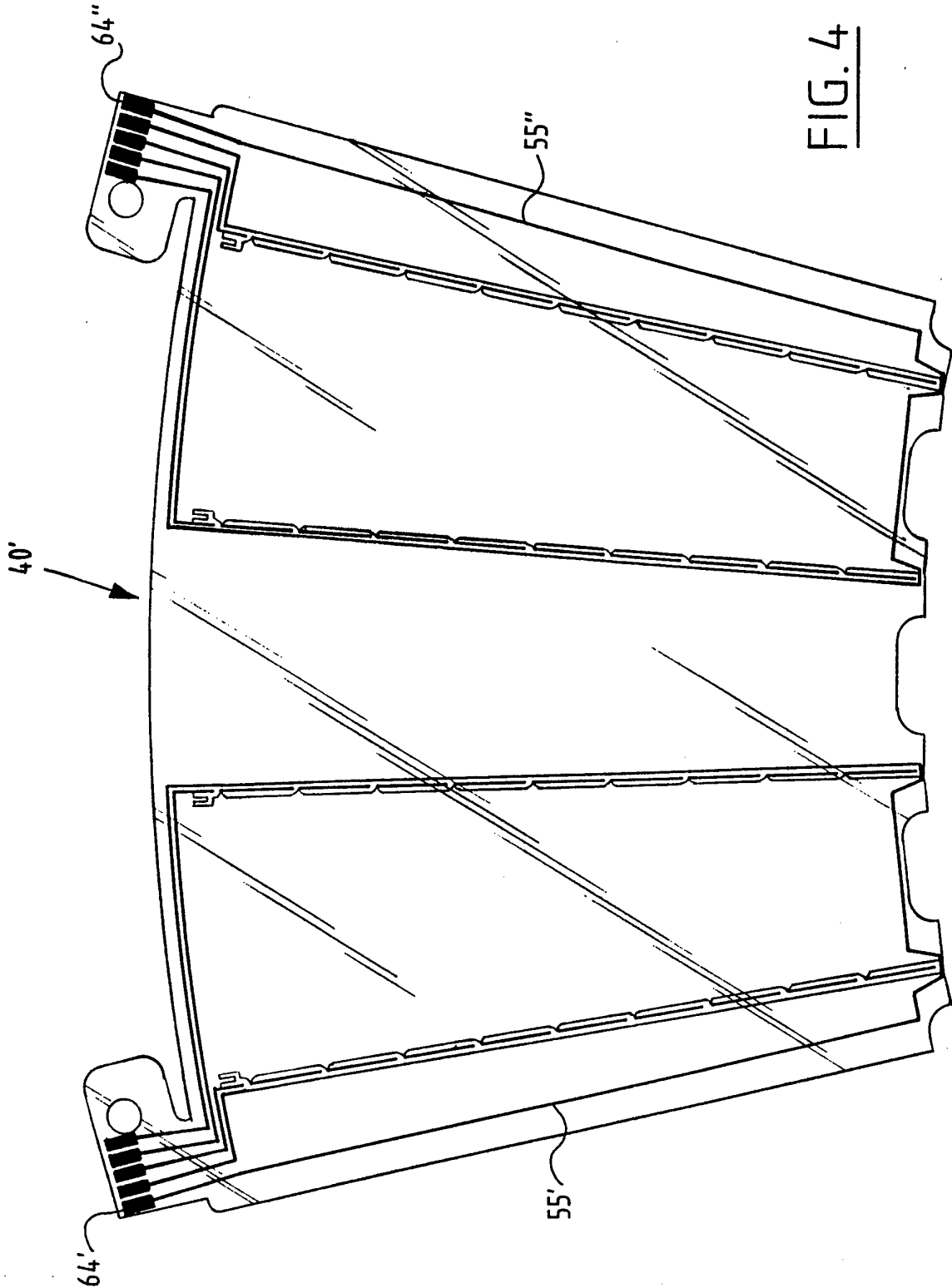


FIG. 4

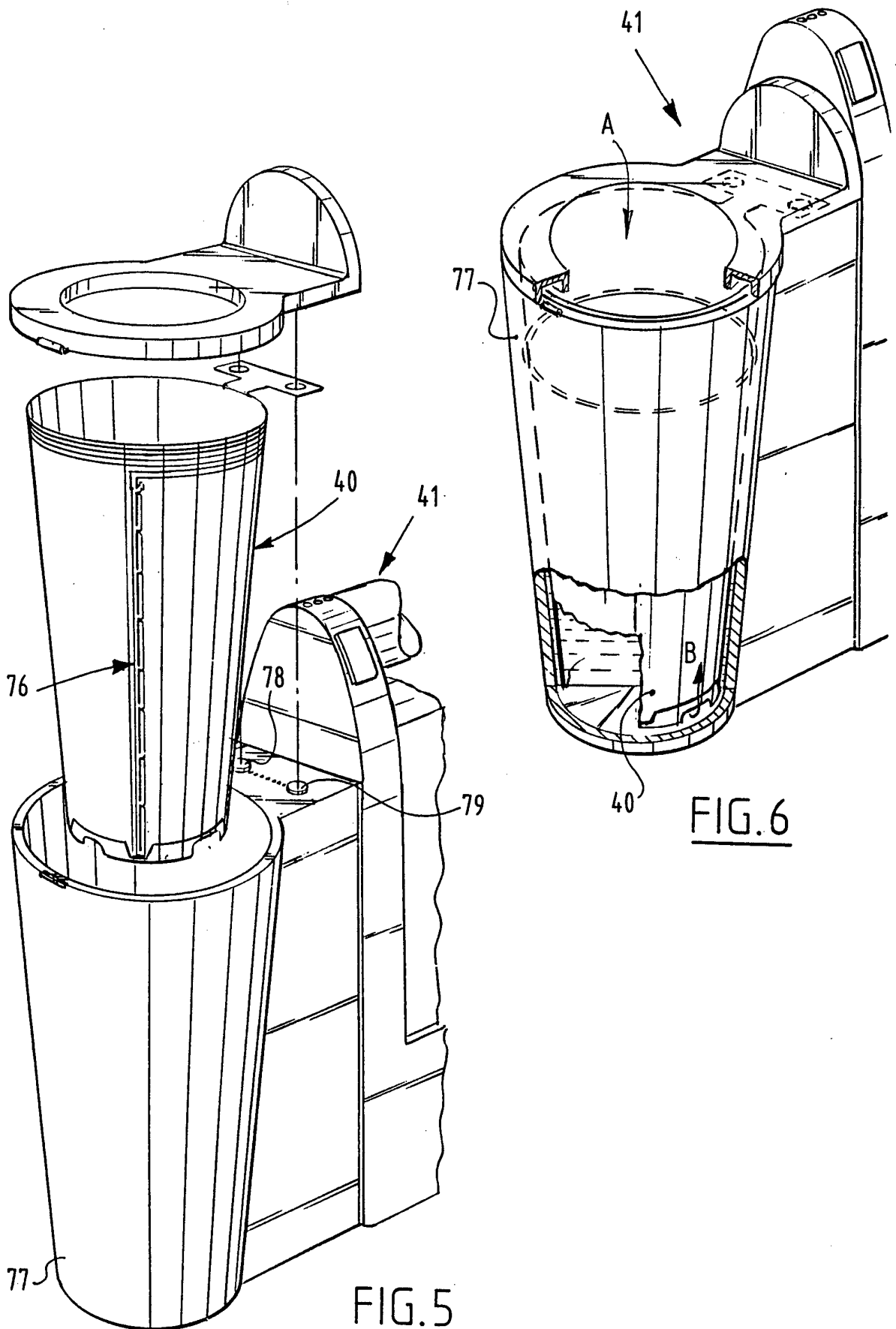


FIG. 5

FIG. 6

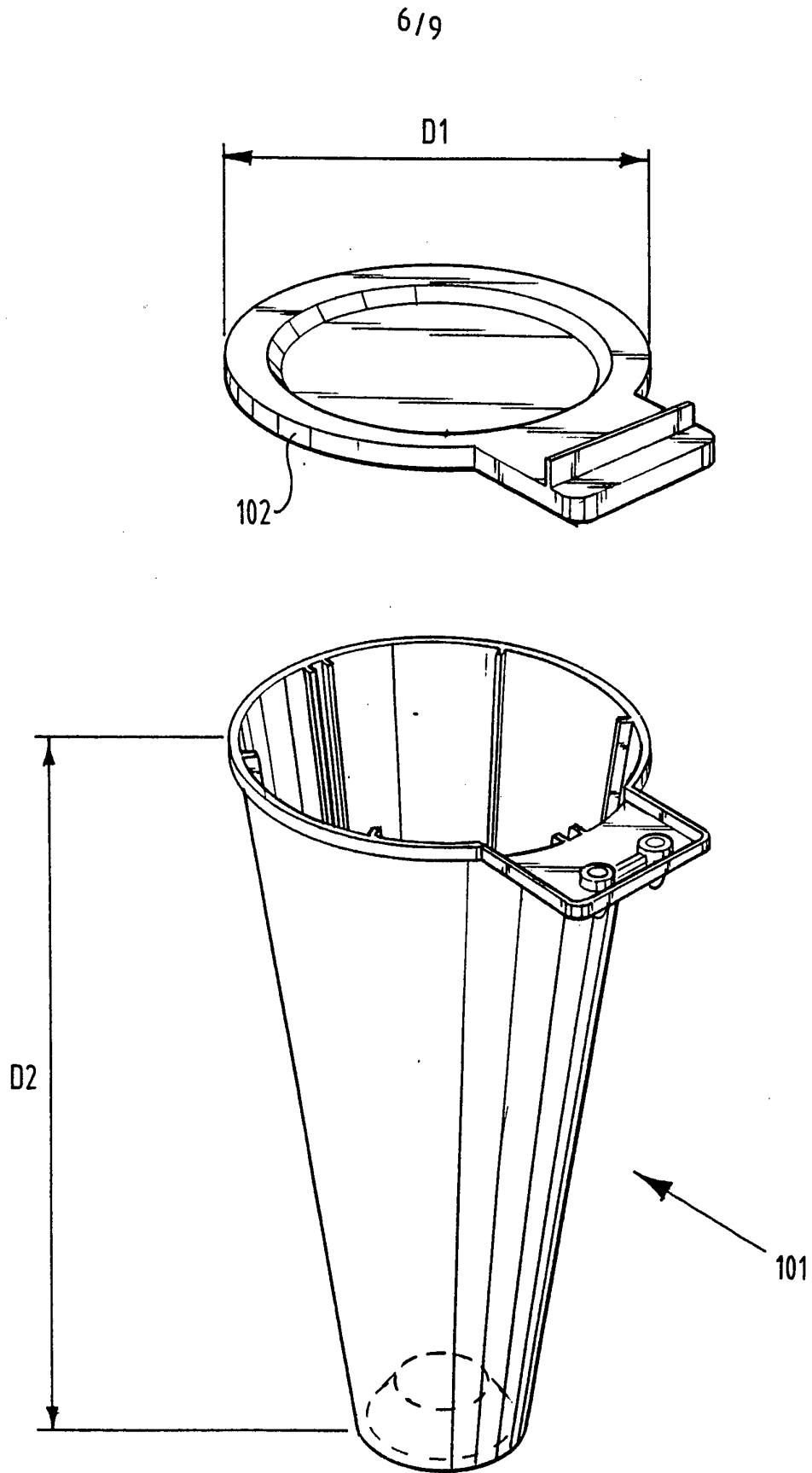
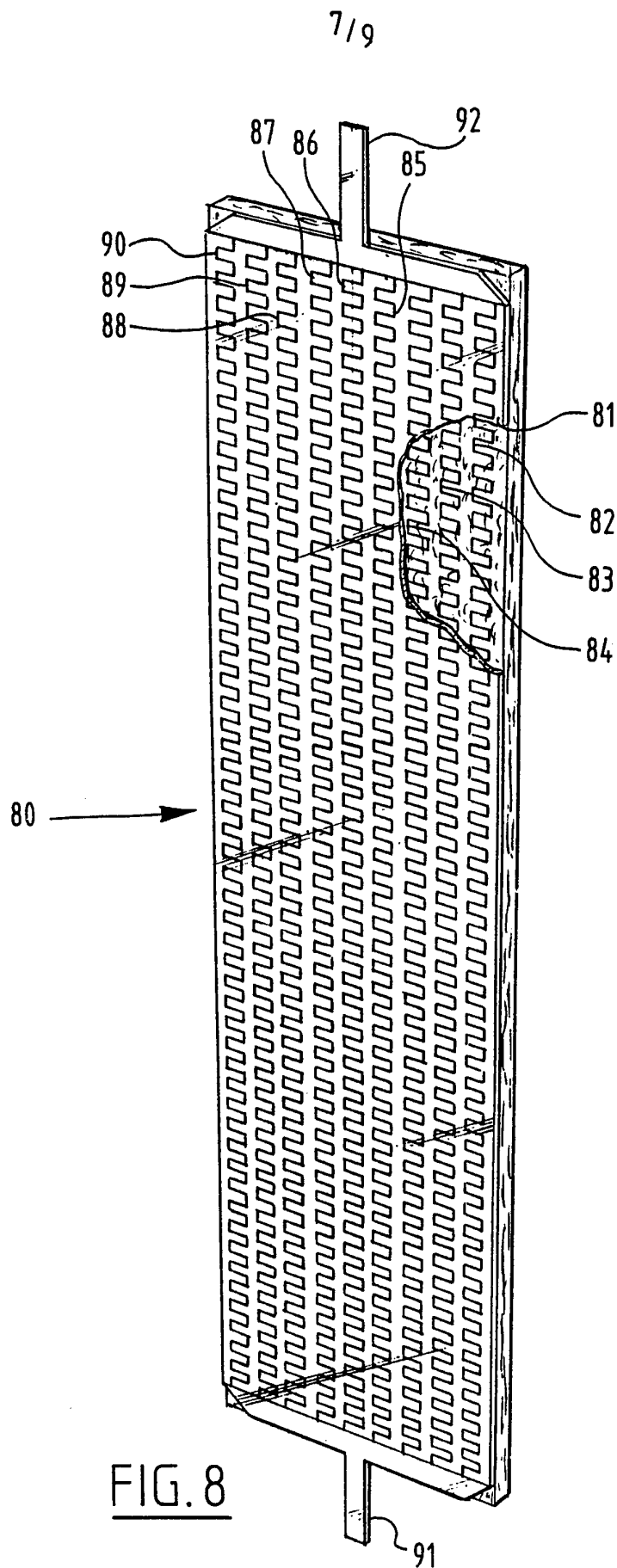


FIG. 7



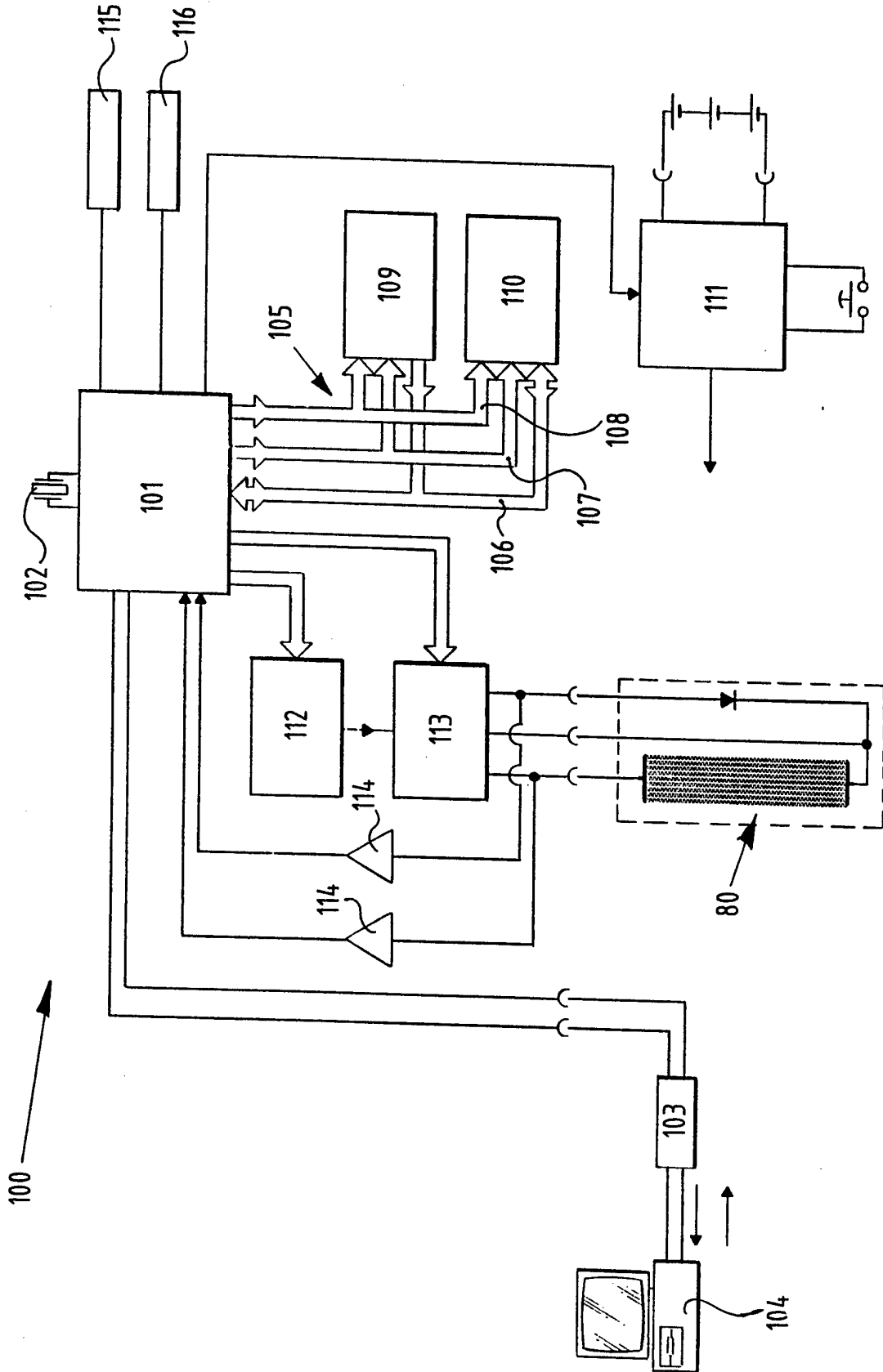


FIG. 9

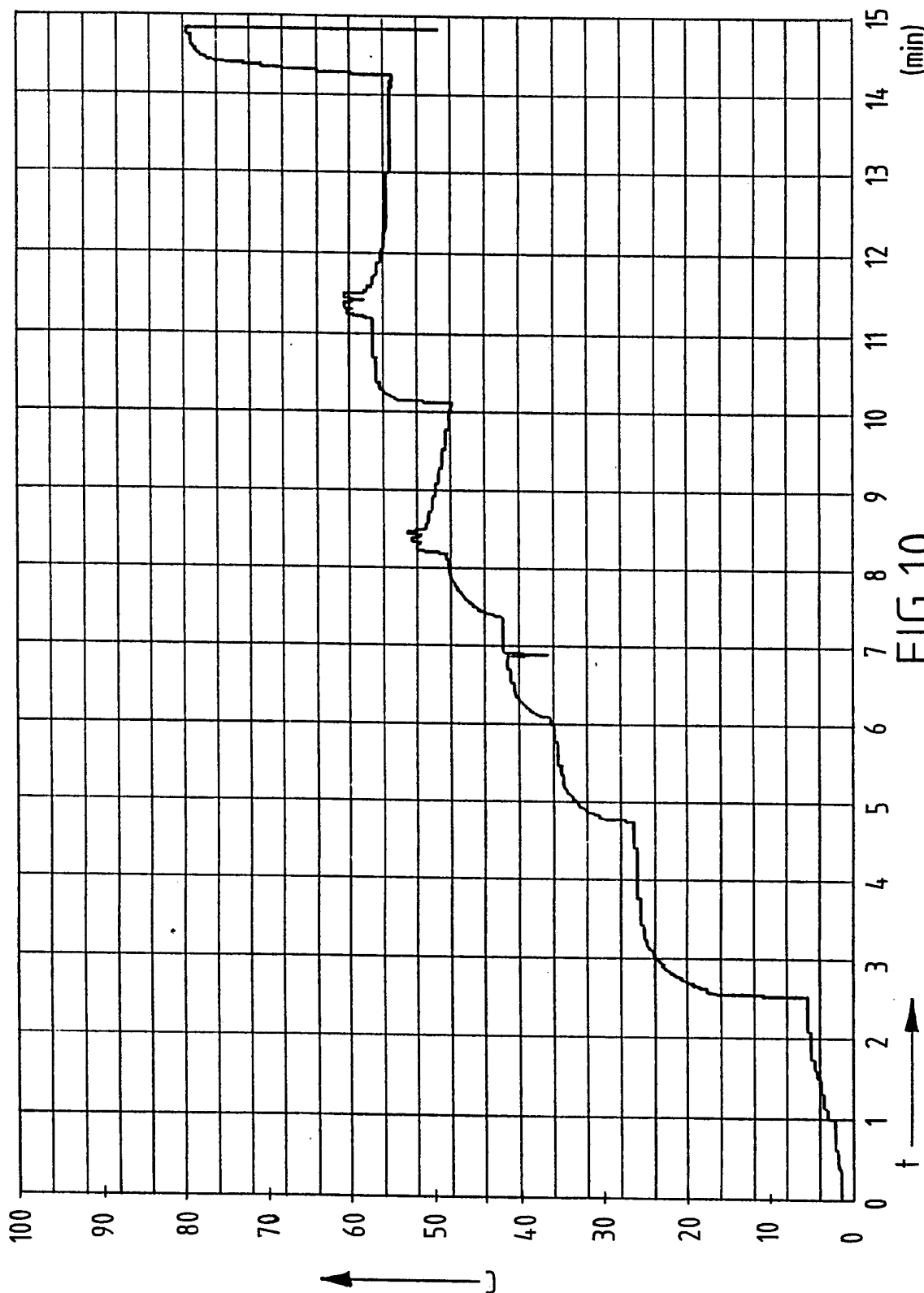


FIG.10

INTERNATIONAL SEARCH REPORT

International Application No

PCT/NL 94/00200

A. CLASSIFICATION OF SUBJECT MATTER
 IPC 6 A61B5/20 G01F23/24 A61F13/42

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
 IPC 6 A61B G01F A61F

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C. DOCUMENTS CONSIDERED TO BE RELEVANT

| Category * | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
|------------|---|-----------------------|
| X | WO,A,90 13797 (ENDOTHERAPEUTICS) 15 November 1990 | 2,4,5,7 |
| Y | see abstract; figures 1-7 | 8,9 |
| A | --- | 6 |
| Y | DE,A,26 23 557 (J. PÖRTENER) 8 December 1977 see the whole document | 8 |
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Name and mailing address of the ISA

European Patent Office, P.B. 5818 Patentlaan 2
 NL - 2280 HV Rijswijk
 Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,
 Fax: (+31-70) 340-3016

Authorized officer

Hunt, B

INTERNATIONAL SEARCH REPORT

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