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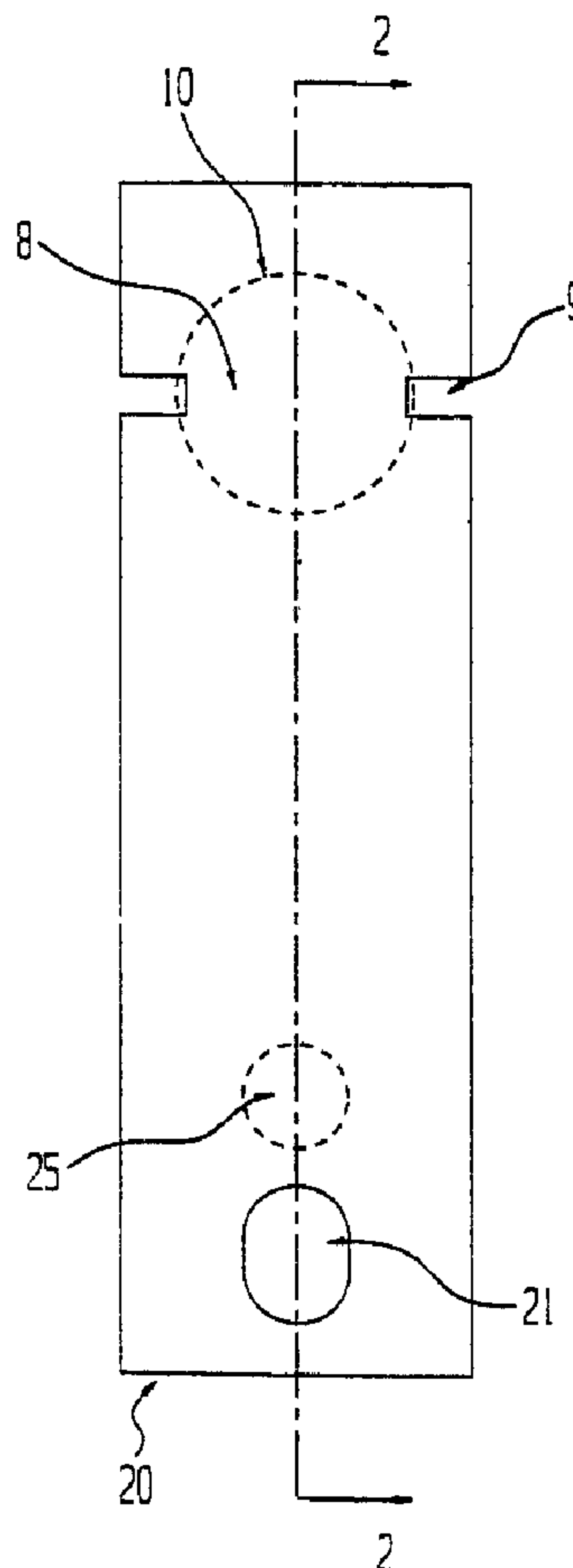
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(54) Title: SENSOR CONNECTION MEANS



(57) Abrégé/Abstract:

The invention relates to a sensor adapted for electrical connection to a power source having an electrical contact means (3). The sensor has a first insulating substrate (1) carrying a first electrode (2) and a second insulating substrate (7) carrying a second

(57) **Abrégé(suite)/Abstract(continued):**

electrode (6). The electrodes are disposed to face each other in spaced apart relationship, sandwiching a spacer (4) therebetween. A first cut-out portion extends through the first insulating substrate (1) and a spacer (4) to expose a first contact area (23) on the second insulating substrate (7). This permits the electrical contact means (31) to effect electrical connection with the first contact (23) which in turn is in electrically conductive connection with the second electrode (6). A similar contact arrangement may be disposed on the opposite side of the sensor.

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ABSTRACT

The invention relates to a sensor adapted for electrical connection to a power source having an electrical contact means (3). The sensor has a first insulating substrate (1) carrying a first electrode (2) and a second insulating substrate (7) carrying a second electrode (6). The electrodes are disposed to face each other in spaced apart relationship, sandwiching a spacer (4) therebetween. A first cut-out portion extends through the first insulating substrate (1) and a spacer (4) to expose a first contact area (23) on the second insulating substrate (7). This permits the electrical contact means (31) to effect electrical connection with the first contact (23) which in turn is in electrically conductive connection with the second electrode (6). A similar contact arrangement may be disposed on the opposite side of the sensor.

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TITLE: "SENSOR CONNECTION MEANS"**TECHNICAL FIELD**

This invention relates to disposable electrochemical sensors of the type used for
5 quantitative analysis, for example, of glucose levels in blood, for pH measurement, or the
like. More particularly the invention relates to means for electrical connection of such
sensors to a measuring apparatus.

BACKGROUND ART

US Patent 5,437,999 discloses an electrochemical sensor of the kind which in use is
10 electrically connected with a power source. The sensor is constructed from two spaced
apart printed circuit boards each having a metal layer on one side and disposed so that the
metal layers are facing each other in spaced apart relationship. The metal layers are
photolithographically treated to define electrode areas which form part of a cell. At one
end of the assembly the electrode substrates are cut to provide laterally spaced protruding
15 tabs bearing the metal layer. The exposed metal surfaces of the tabs act as contact pads,
each contact pad being electrically connected with a corresponding electrode. The contact
pads in turn engage contact prongs connected to a power source and provide electrical
connection between the sensor and a power source.

The arrangement of US Patent 5,437,999 suffers from the disadvantages that the
20 substrate is required to be of considerable rigidity in order to ensure satisfactory and
reliable electrical contact. Moreover the user is often left uncertain as to whether a sensor
has satisfactorily been connected with the power source.

In co-pending applications WO 96/32635, WO 97/0041, WO 97/18465 and
WO 97/18464 there are described various very thin electrochemical cells. Each

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cell is defined between facing spaced apart electrodes which are formed as thin metal coatings (for example sputter coatings) deposited on thin inert plastic film (for example 100 micron thick PET). The electrodes are separated one from the other by a spacer of thickness of for example 500 μm or less.

5 The connection arrangement of US 5,437,999 is not suitable for use with the extremely thin sensor devices of the kind discussed in our co-pending applications in view of the flexibility of the insulating electrode carriers. In general, it is desirable that the disposable sensor be capable of simple, quick, reliable and effective connection with the power source in the measuring device by unskilled users. It is an object of the present
10 invention to overcome or ameliorate at least one of the disadvantages of the prior art, or to provide a useful alternative.

DESCRIPTION OF THE INVENTION

According to a first aspect, the invention provides a sensor adapted for electrical connection with a power source having first contact means, the sensor comprising:

15 a first insulating substrate carrying a first electrode and a second insulating substrate carrying a second electrode, said electrodes being disposed to face each other in spaced apart relationship,

 a first cut-out portion extending through said first insulating substrate and a spacer to expose a first contact area on the second insulating substrate to permit a first contact means
20 to effect electrical connection with the first contact area disposed on the second insulating substrate, the first contact area being in electrically conductive connection with the second electrode.

 The first contact area may be maintained at a predetermined depth from the first insulating substrate..

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According to a second aspect, the invention provides a sensor according to the first aspect further comprising a second cut-out portion extending through said second insulating substrate and the, or another, spacer to expose a second contact area on the first insulating substrate to permit a second contact means to effect electrical connection with a second contact area disposed on the first insulating substrate, the second contact area being in electrically conductive connection with the first electrode.

The second contact area may be maintained at a predetermined depth from the second insulating substrate.

According to a third aspect, the invention also provides a sensing system comprising a sensor according to the first or second aspects and a sensing apparatus including a first contact means and/or second contact means adapted to effect electrical contact with the first and second contact areas respectively.

"Comprising" as herein used is used in an inclusive sense, that is to say in the sense of "including" or "containing". The term is not intended in an exclusive sense ("consisting of" or "composed of").

In preferred embodiments the insulating substrate is made of a flexible insulating material. The second electrode and the first contact area are formed from a unified layer of metal deposited on the first substrate, and more preferably deposited by being sputter coated thereon. Suitable metals include, but are not limited to palladium, gold, platinum, iridium, and silver. Carbon may also be used. Desirably the contactor is a metal contactor which is resiliently biased to extend through the first cut-out portion to make contact with the metal first contact area on the second substrate. In highly preferred embodiments the contactor is adapted for click engagement with the cut-out portion which extends through the first insulating substrate and the spacer.

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With a connector according to the current invention the spacer layer provides extra strength. A rigid connector can therefore be formed using flexible materials. This allows a wider range of materials to be utilised. An audible confirmation of connection can also be simply provided by the current invention unlike the connector described in US 5,437,999.

5 **BRIEF DESCRIPTION OF THE DRAWINGS**

The invention will now be described by way of example only with reference to the accompanying drawings in which:

Figure 1 shows a first embodiment of a sensor according to the invention in plan view.

10 Figure 2 shows a scrap side elevation of the sensor of Figure 1 in cross-section on line 10-10.

Figure 3 is a diagrammatic enlargement showing a part of the sensor of Figure 2 in engagement with contacts.

Figure 4 shows an end elevation of the sensor of Figure 3 in section on line A-A.

15 Figure 5 shows a second embodiment of the invention in plan view.

Figure 6 shows a cross-section of the embodiment of Figure 5 in end elevation when viewed on line C-C.

Figure 7 shows a cross-section of the embodiment of Figure 5 in side elevation on line D-D.

20 Figure 8 shows a third embodiment of the invention in plan view.

BEST MODES FOR CARRYING OUT THE INVENTION

With reference to Figures 1 to 3 there is shown a first embodiment of an electrochemical sensor. The sensor comprises a polyester spacer 4 approximately 25 mm x 5 mm and 100 microns thick and having a circular aperture 8 of 3.4 mm diameter.

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Aperture 8 defines a cylindrical cell wall 10. Adhered to one side of spacer 4 is a first insulating substrate polyester sheet 1 having a first coating of palladium 2. The palladium was sputter coated on sheet 1 at between 4 and 5 millibar pressure in an atmosphere of argon gas to give a uniform coating thickness of about 100-1000 angstroms. Sheet 1 is
5 adhered by means of adhesive 3 to spacer 4 with palladium coating 2 adjacent spacer 4 and covering one side of aperture 8.

A second insulating substrate 7 consists of a polyester sheet having a second sputter coating 6 of palladium adhered by means of contact adhesive 5 to the other side of spacer 4 and covering the opposite side of aperture 8. There is thereby defined a cell having
10 cylindrical side wall 10 and closed at one cylinder end by a first electrode of palladium metal 2. The other cylinder end wall is a second electrode formed from palladium 6. The assembly is notched at 9 to provide a means for admission of a solution to the cell, and to allow air to escape.

Adjacent one end 20 a cut-out aperture 21 pierces first insulating layer 1 and first
15 metal layer 2. In the present example cut-out 21 is oval-shaped. A corresponding cut-out portion 22 in spacer 4 is in registration with cut-out 21. Figure 3 shows a side elevation cross-section of sensor 1 inserted into a receiving slot formed in part 30 of measuring apparatus and to which is mounted a first resilient contactor 31 and a second resilient contactor 32. Upon insertion of sensor end 20 into the slot, contactor 31 rides over the
20 outer surface of insulating layer 1 and clicks into the well formed by apertures 21 and 22 to engage a first contact area portion 23 of metal layer 6. First contact area 23 is a portion of the same metal layer 6 deposited on insulating layer 7 from which the second electrode is formed and is therefore in electrically conductive communication with the second electrode

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area of cell 8. Contact area 23 is in effect defined by the diameter of cut-out 20 of spacer 4 in the present example.

In the embodiment shown in Figure 1 a second circular cut-out portion 25 spaced further from edge 20 than aperture 21 extends through second insulating layer 7 and second metal layer 6. A cut-out portion 26 (see Figure 2) of spacer 4 corresponds with and registers with cut-out portion 25 of insulating layer 7. Referring again to Figure 3, in use the sensor is configured to permit a second resiliently biased contactor 32 to extend through the well defined by cut-out portions 25 and 26 whereby resilient contactor 32 engages and makes electrical contact with metal layer 2 at 27 and thereby with the first electrode 2 of cell 8.

Resilient connectors 31 and 32 are arranged in a slot 30 of the measuring device and are electrically connected in a measuring circuit. In use, the sensor is inserted into slot 30 with edge 20 leading. The first resilient contactor 31 rides over the end margin of the sensor 1 until it encounters first aperture 21, 22 whereupon it click engages with the opening and makes electrical contact with the first contact area 23 of metal layer 6. Slight additional insertion of sensor 1 in slot 30 causes the second contactor 32 to click engage with the second aperture 25, 26 and make contact with second contact area 27 of metal layer 2.

Spacer 4 surrounds both apertures and ensures that, despite the intrinsic flexibility of the insulating layers and the thinness of the sensor, electrical contact can be made with reliable precision.

A second embodiment of the invention is shown in Figures 5, 6 and 7 wherein parts corresponding in function to corresponding parts of the embodiment of Figures 1 and 2 are identified by corresponding numerals. The major difference between the second

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embodiment and the first is that in the second embodiment cut-out portions 21, 22 are cut from one side edge of sensor 1 while cut-out portions 25, 26 are cut out from the opposite side edge of the sensor 1. In this case contactors 31 and 32 are spaced laterally and click substantially simultaneously into their respective cut-out opening. The cut-out openings
5 are surrounded on three sides by spacer 4, the fourth side being exposed at respective edges of the sensor.

Although in the embodiment shown in Figures 5, 6 and 7 the openings are at a corresponding distance from end 20 in other embodiments they could be spaced in the longitudinal direction as is the case in the first described embodiment. This ensures that
10 contact is only made when the sensor is inserted in a correct orientation and ensures correct polarity.

A third embodiment is shown schematically in Figure 8. In this case the openings take the form of slots 21, 25 extending longitudinally from edge 20. For preference spacer 4 extends around all edges of openings 21 and 25 of Figure 8 but in a less preferred
15 embodiment spacer 4 only extends on three sides of slots 21 and 25 in which case click engagement is not obtained or is obtained only if the contacts extend from the opposite direction. However, the advantage that the contact pad area of the sensor is at a predetermined dimension from the opposite face is maintained. If desired the slots can differ in length and co-operation with contacts spaced longitudinally so that contact with
20 both contacts requires correctly orientated insertion of the sensor.

It will be understood that both construction materials and dimensions are given merely by way of example and that sensors of a differing design or construction may utilise the invention. One, two or more than two contacts may be provided by the means shown.

The invention extends to include a power source or measuring device when connected to a

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sensor by the means described. Any suitable form of contactor may be used with sensors according to the invention.

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CLAIMS:

1. A method of making a sensor adapted for electrical connection with a power source having a contactor, the method comprising the steps of:

5 providing a first insulating substrate carrying a first electrode and having an aperture, a spacer having an aperture, and a second insulating substrate carrying a second electrode;

adhering the first insulating substrate to one side of the spacer, whereby the first electrode defines a first end wall of an electrochemical cell;

10 adhering the second insulating substrate to an opposite side of the spacer, whereby the second electrode defines a second end wall of the cell;

wherein the aperture of the first insulating substrate defines a first cut-out aperture that provides a first contact area on the second insulating substrate that is adapted to permit electrical contact with the second electrode.

15 2. A method according to claim 1, wherein each insulating substrate is formed from a flexible insulating material.

3. A method according to claim 2, wherein the flexible insulating material is polyester.

4. A method according to claim 1, further comprising the step of depositing metal on
20 the first and second insulating substrates to form the first and second electrodes and the first contact area.

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5. A method according to claim 4, wherein the metal is selected from the group consisting of palladium, gold, platinum, iridium and silver.
6. A method according to claim 4, wherein the metal is 10-1000 nanometers thick.
7. A method according to claim 4, further comprising the step of depositing the layer
5 of metal is on the insulating substrate by sputter coating.
8. A method according to claim 1, wherein each electrode and the first contact area are formed from carbon.
9. A method according to claim 1, wherein the first cut-out aperture is spaced adjacent
10 one end of the sensor.
10. A method according to claim 1, wherein the first cut-out aperture is cut from an edge of the sensor such that the first cut-out aperture is open on at least one edge of the sensor.
11. A method according to claim 1, wherein at least one of the insulating substrates or
15 the spacer extends around the entire periphery of the first cut-out aperture.
12. A method according to claim 1, wherein the spacer comprises a cut-out aperture that corresponds to the first cut-out aperture of the first insulating substrate.

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13. A method according to claim 12, wherein the cut-out aperture of the spacer is in registration with the first cut-out aperture of the first insulating substrate.
14. A method according to claim 1, wherein the first cut-out aperture is adapted for click engagement with a contactor.
- 5 15. A method according to claim 1, further providing that the second insulating substrate have an aperture, wherein the aperture defines a second cut-out aperture that provides a second contact area on the first insulating substrate that is adapted to permit electrical contact with the first electrode.
16. A method according to claim 15, wherein the first and second contact areas are
10 laterally spaced apart relative to the longitudinal axis of the sensor.
17. A method according to claim 15, wherein the first and second contact areas are longitudinally spaced apart relative to the longitudinal axis of the sensor.
18. A method according to claim 15, wherein the first and second contact areas are laterally and longitudinally spaced relative to the longitudinal axis of the sensor.

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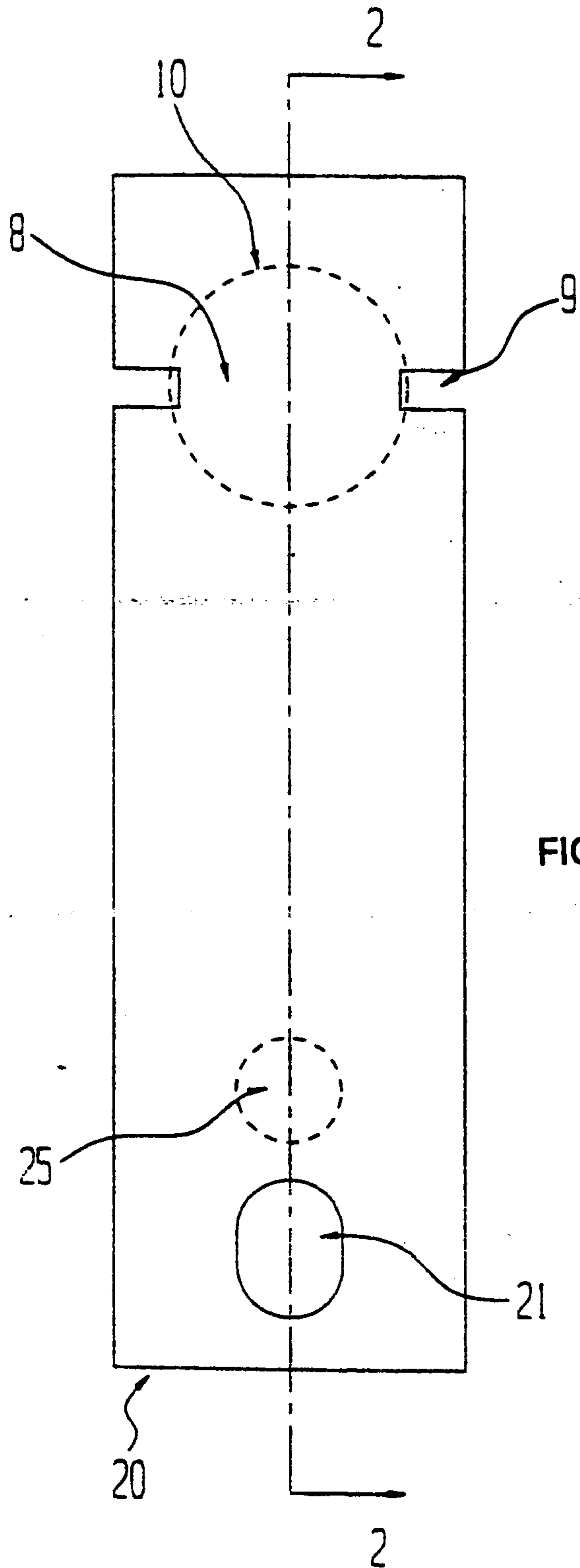


FIG 1

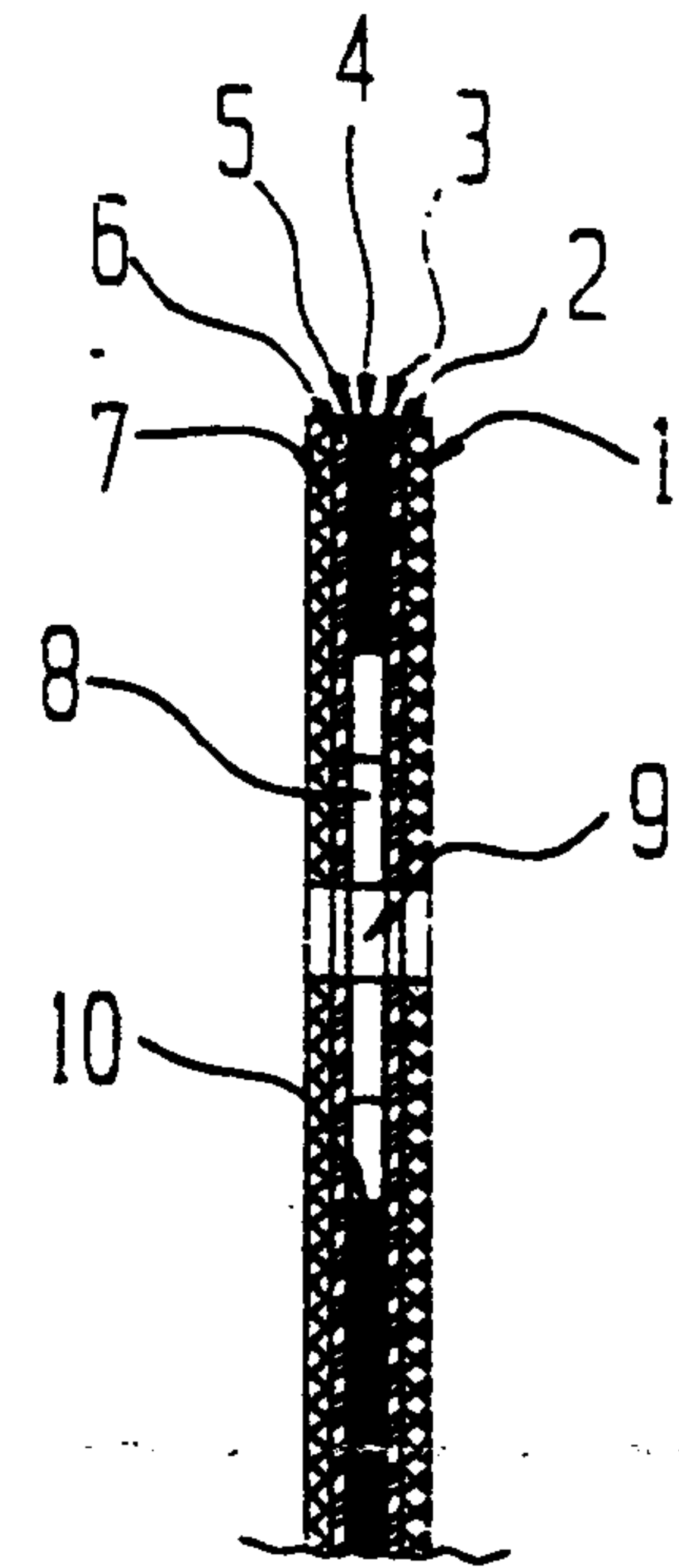
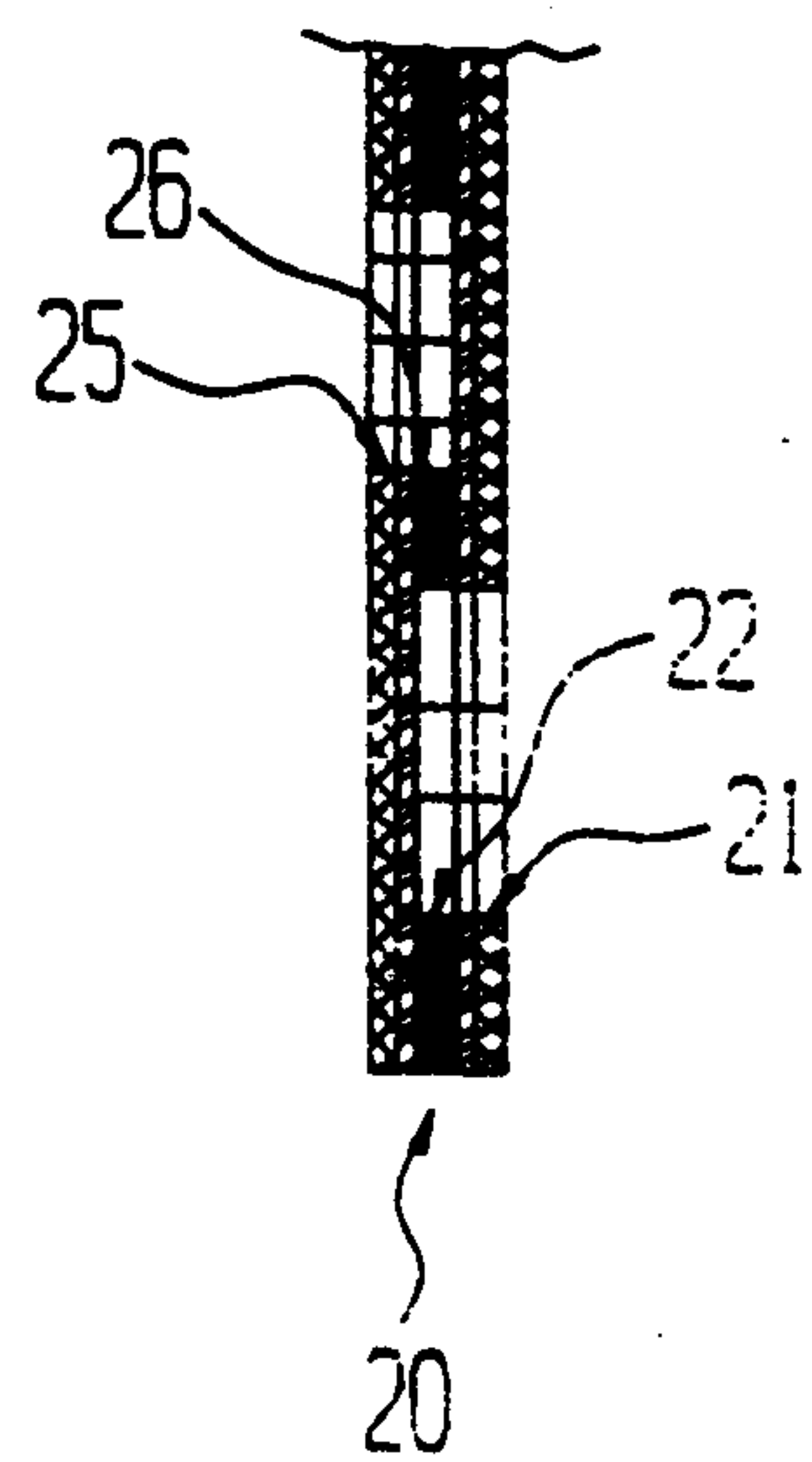


FIG 2



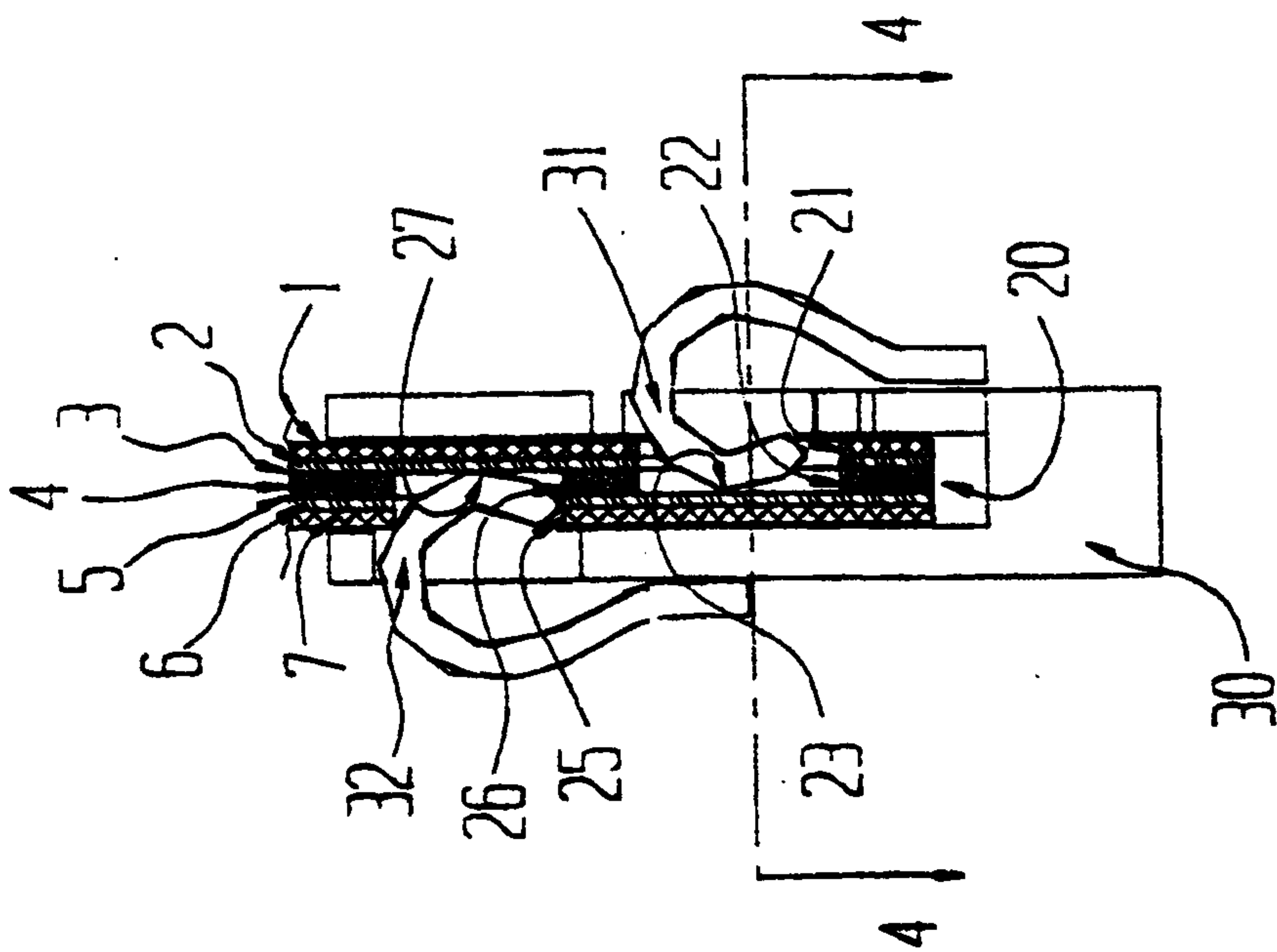


FIG 3

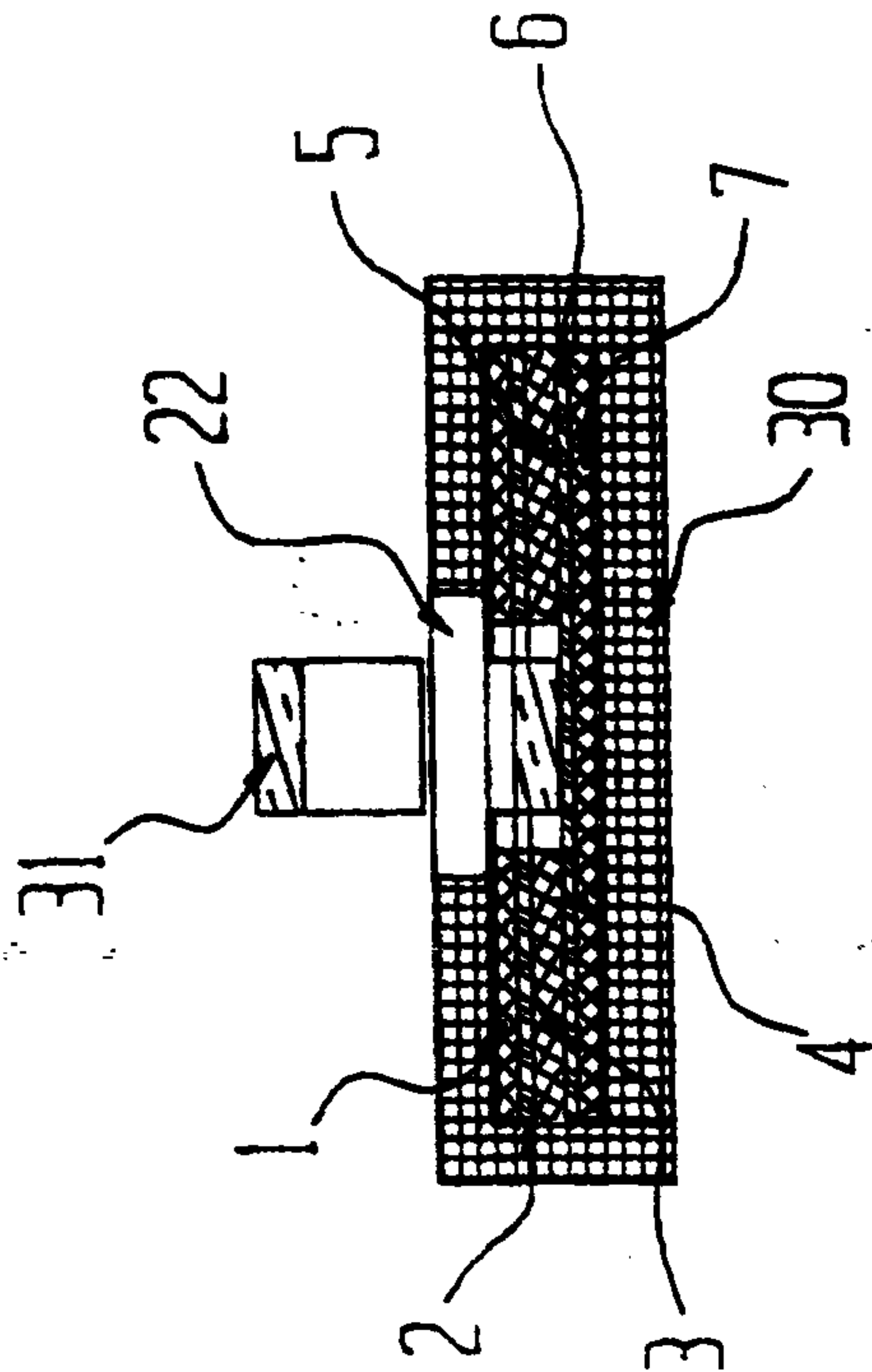


FIG 4

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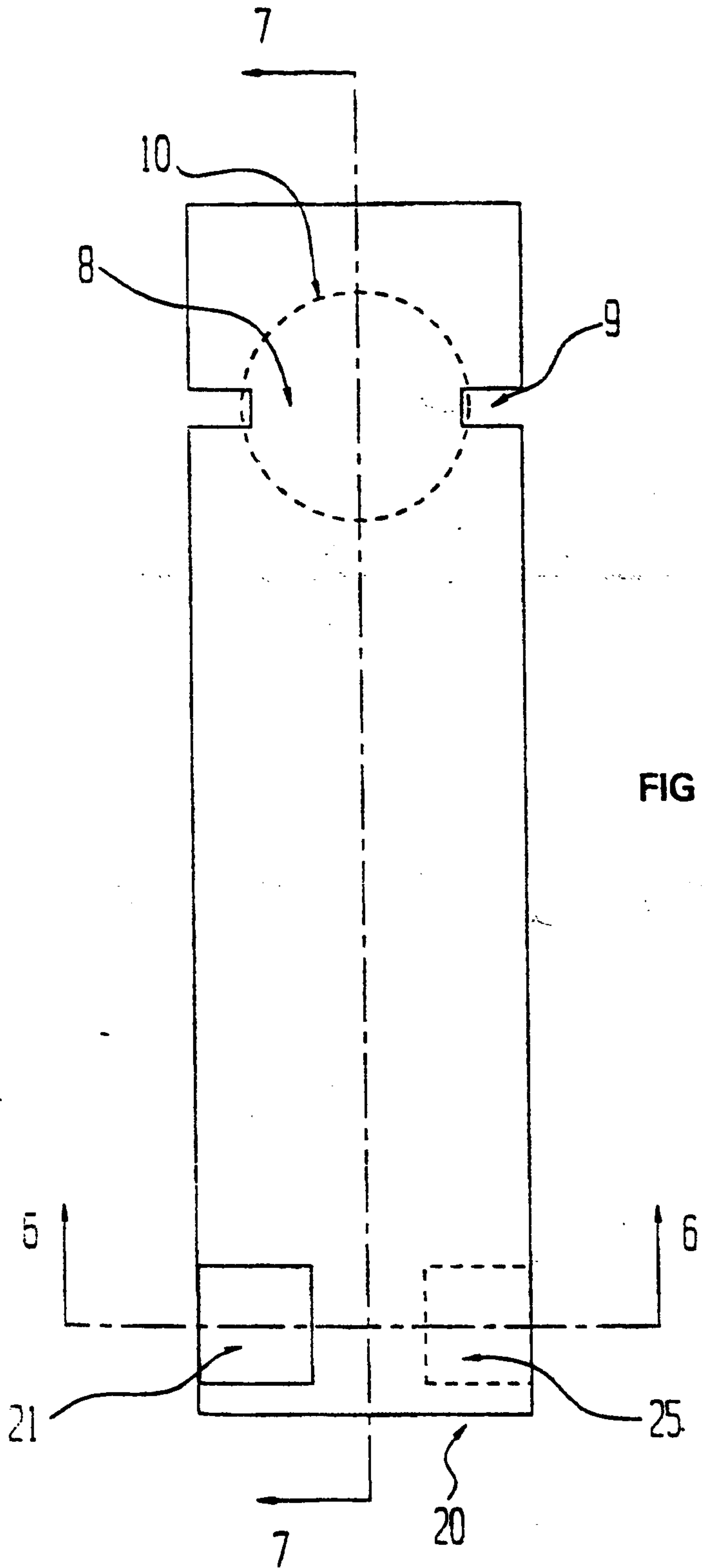


FIG 5

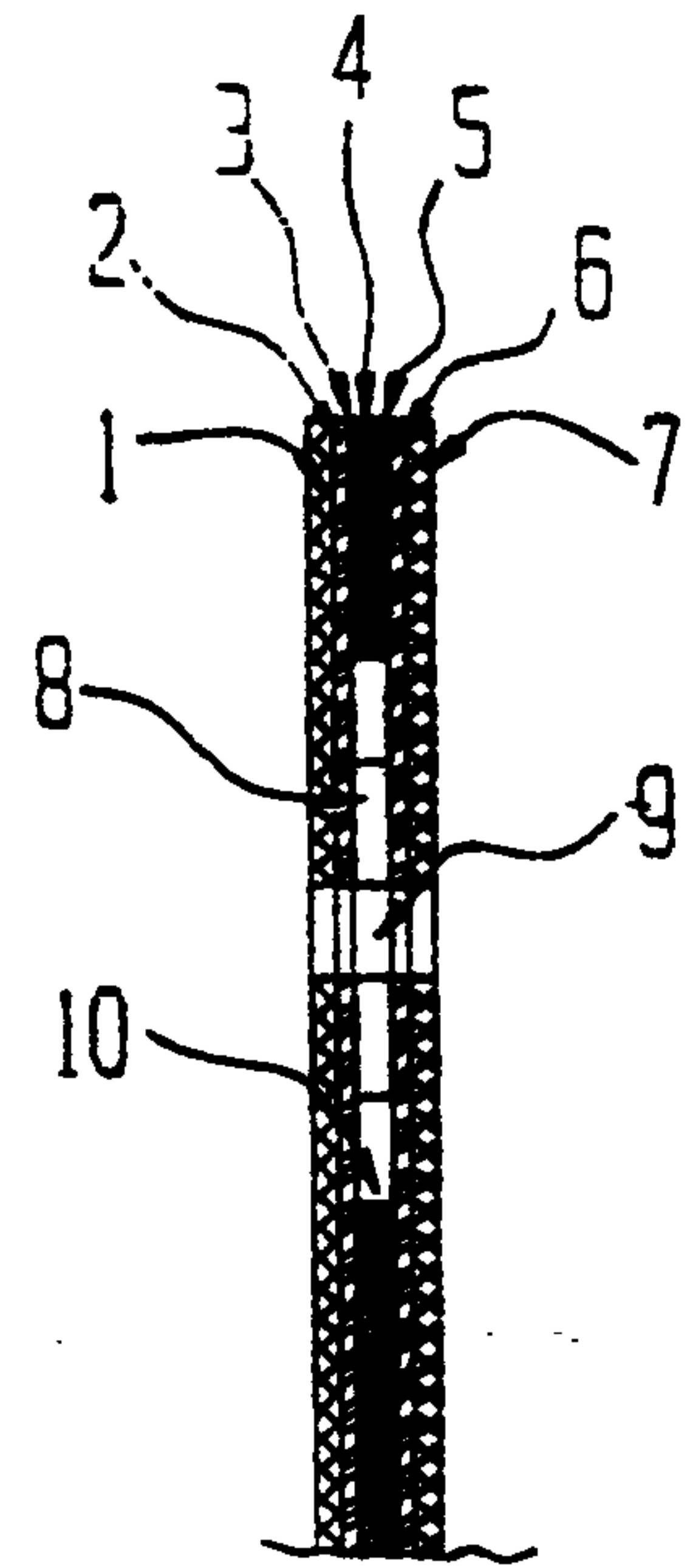
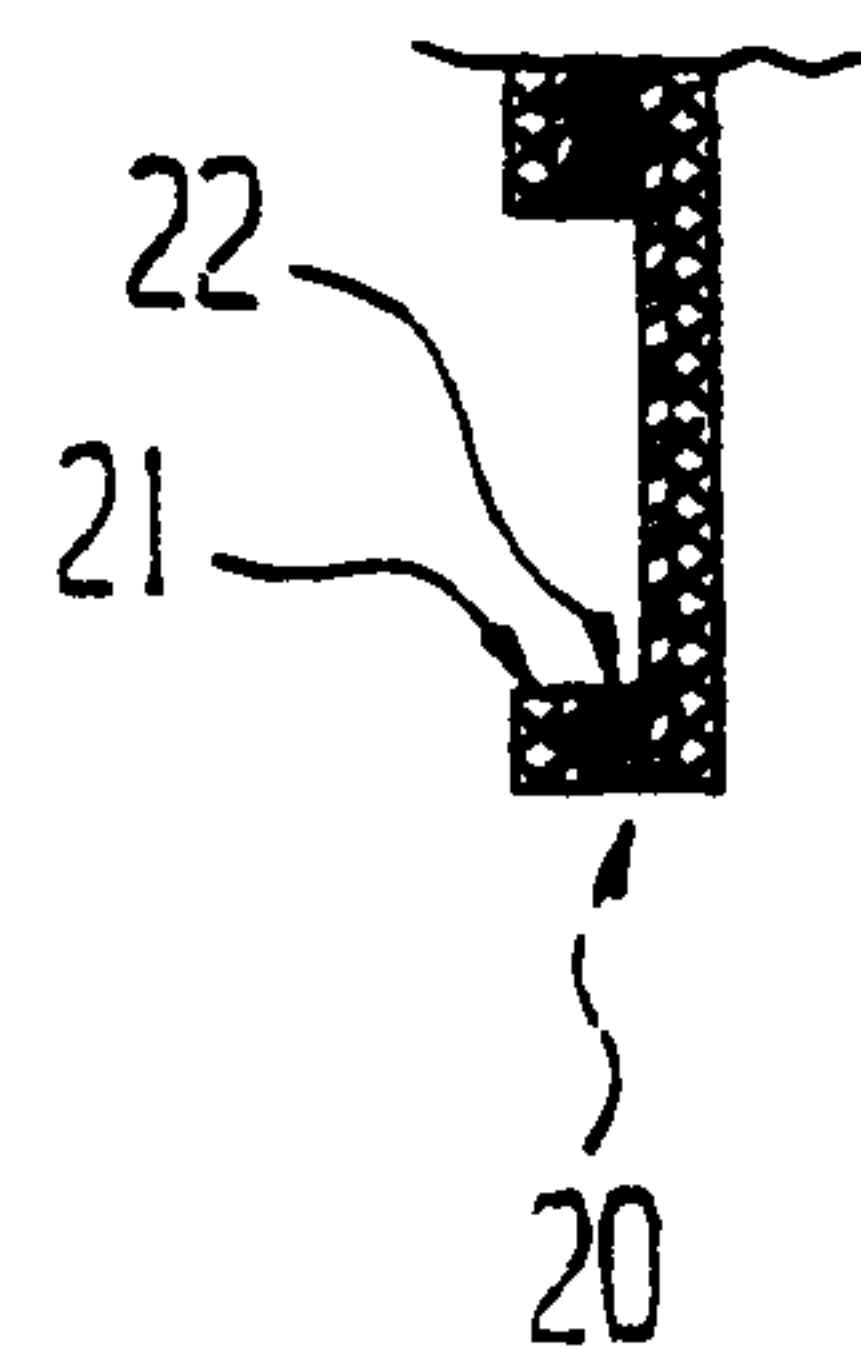


FIG 7



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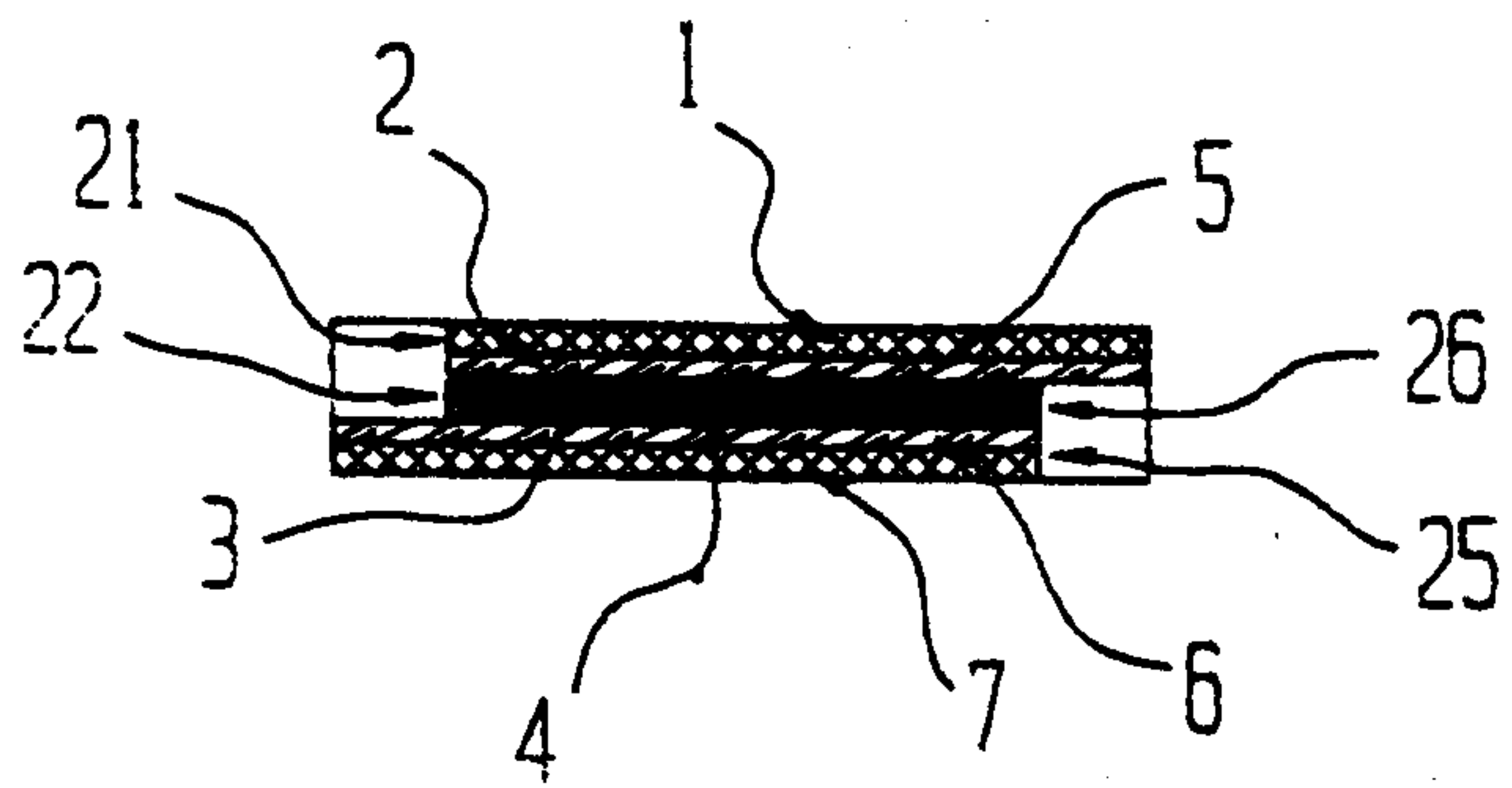


FIG 6

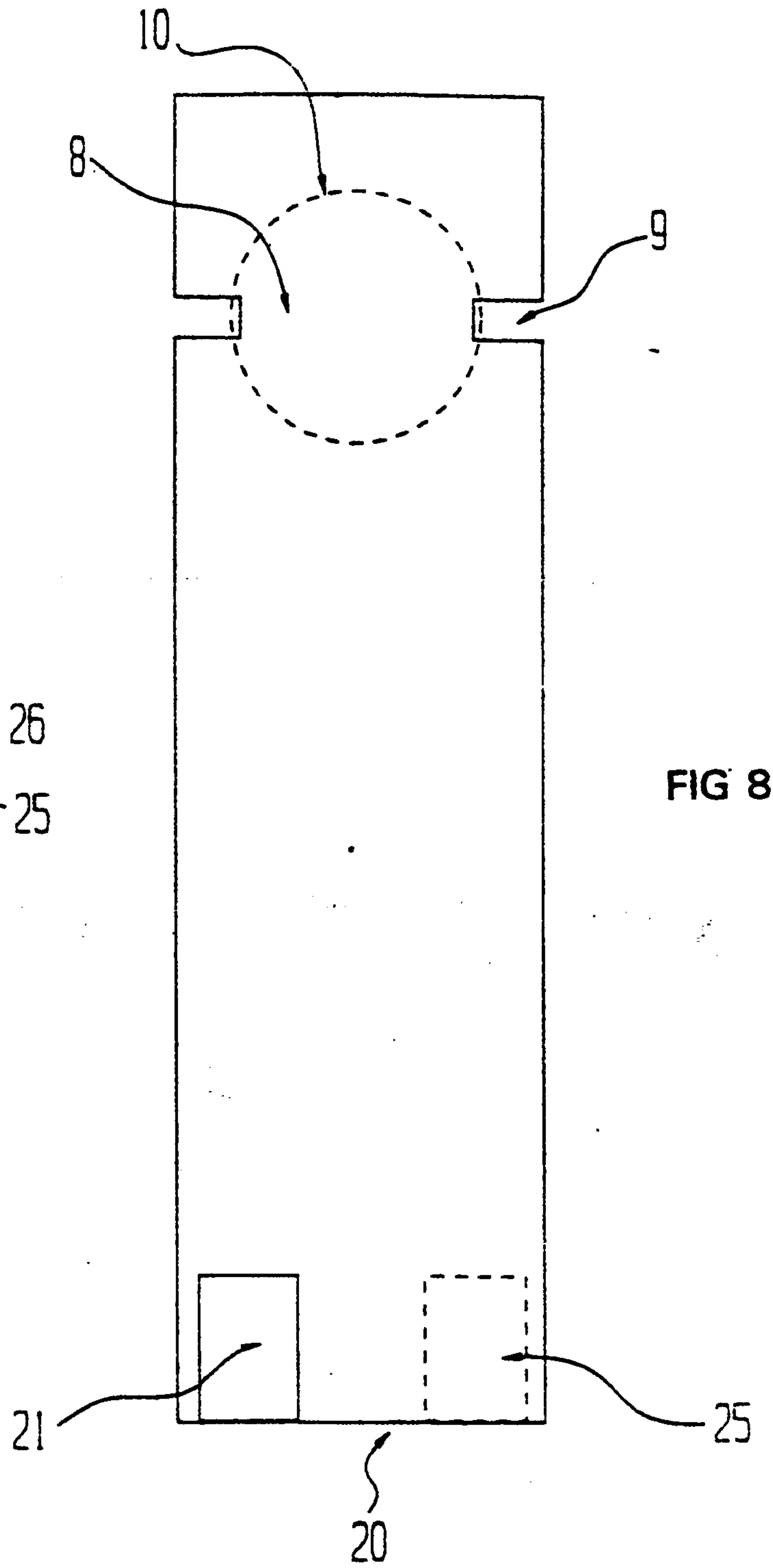


FIG 8

