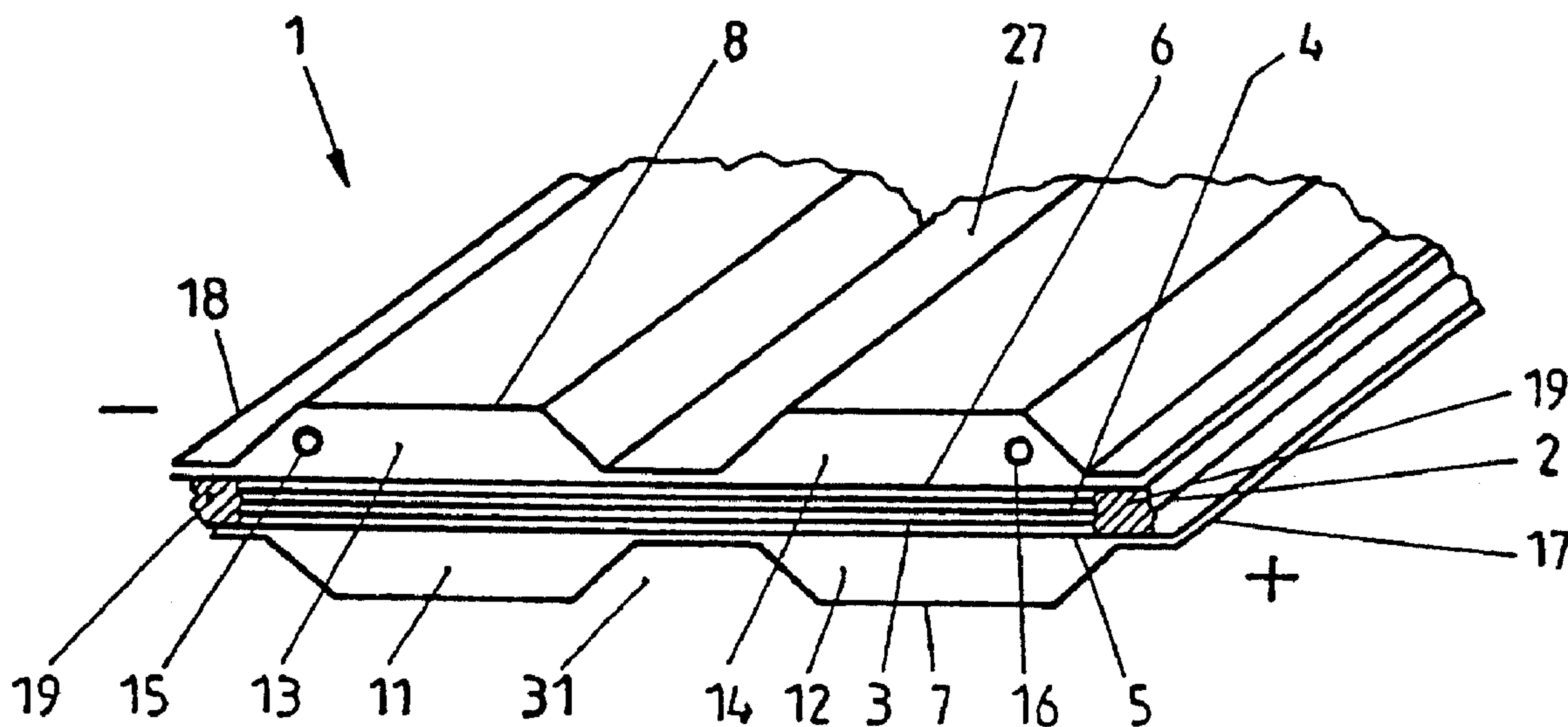




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(57) Abrégé/Abstract:

A fuel cell (1) is provided with a central polymer membrane (2) that is provided with diffusion layers (3, 4) covering both sides and having plane electrodes (5, 6) supporting the back surface of said layers. The electrodes (5, 6) are provided with openings (15, 16) and rear covers (7, 8) with gas supplies (9, 10) for at least one of the plane electrodes (5, 6). At least two parallel extending gas flow channels (11, 12; 13, 14) sealed against each other are configured between at least one plane electrode (5, 6) and the cover (7, 8) pertaining thereto. Openings (15) in the plane electrode (6) extend from one gas flow channel (13) into the adjacent diffusion layer (4) and from the diffusion layer (4) into the other gas flow channel (14). The fuel cell (1) is provided with a greater dimension lengthwise in the main extension direction of the gas flow channels (11, 13) than vertical thereto.



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<p>(57) Abstract</p>		
<p>A fuel cell (1) is provided with a central polymer membrane (2) that is provided with diffusion layers (3, 4) covering both sides and having plane electrodes (5, 6) supporting the back surface of said layers. The electrodes (5, 6) are provided with openings (15, 16) and rear covers (7, 8) with gas supplies (9, 10) for at least one of the plane electrodes (5, 6). At least two parallel extending gas flow channels (11, 12; 13, 14) sealed against each other are configured between at least one plane electrode (5, 6) and the cover (7, 8) pertaining thereto. Openings (15) in the plane electrode (6) extend from one gas flow channel (13) into the adjacent diffusion layer (4) and from the diffusion layer (4) into the other gas flow channel (14). The fuel cell (1) is provided with a greater dimension lengthwise in the main extension direction of the gas flow channels (11, 13) than vertical thereto.</p>		

FUEL CELL WITH POLYMER ELECTROLYTE

The invention relates to a fuel cell having a central polymer membrane, diffusion layers covering the polymer membrane on both sides, plane electrodes supporting the diffusion layers at their backside and provided with openings, and a rear cover for at least one of the plane electrodes provided with at least one gas port.

Fuel cells having a central polymer membrane to which the invention is particularly related are also called PEM fuel cells. The abbreviation PEM stands for Polymer Electrolyte Membrane or Proton Exchange Membrane. Within PEM fuel cells oxygen or an oxygen containing gas reaches the polymer membrane via one of the diffusions layers, whereas hydrogen gas or another fuel gas diffuses through the other diffusion layer up to the polymer membrane. The water resulting from the oxygenation of the fuel gas occurs in the oxygen diffusion layer and must be removed out of the oxygen diffusions layer. The current produced by the fuel cell is taken from the plane electrodes, which must be in close contact with the diffusion layers to keep the inner resistance of the fuel cell low; in turn, the diffusion layers must be in close contact with the polymer membrane.

A PEM-fuel cell of the type described at the beginning is, for example, known from DE 298 03 325 U1. Here, the cover provided for the plane electrode on the side of the fuel gas diffusion layer is formed by a housing of the fuel cell made of plastic. The housing does not only enclose the polymer membrane, the diffusion layers and the plane electrodes on their backside but also laterally. A support which is open to the surroundings is provided for the adjacent plane electrode on the side of the oxygen diffuser layer. In the known fuel cell, both plane electrodes are made as fine mesh screen sheets to provide for a large access area of the respective gas to the diffuser layer being arranged in front of the plane electrode. The known fuel cell is very well suited as a demonstration object of the general construction and the general performance of fuel cells. It is however not provided for producing higher currents. For producing higher voltages, PEM fuel cells providing an output voltage of, depending of their working point, about 0,3 to 1 Volt have always to be connected in series.

A further fuel cell is known from US 5,879,826. The fuel cell has a central membrane and porous electrodes surrounding the membrane on both sides. The porous electrodes are in turn surrounded on both sides by electrically conducting plates. These plates each have a gas inlet and a gas outlet, which are connected to each other via a plurality of parallel gas leading channels, which are open in the direction towards the porous electrodes.

The invention is based on the problem to provide a construction of a fuel cell, which enables a simple large-scale industrial production of high power fuel cells.

According to the invention this problem is solved by a fuel cell having the features of claim 1.

The new fuel cell solves the problem of gas supply over great constructional units which are necessary for providing high power. The fuel gas and/or the oxygen can be brought into the respective diffuser layer via the gas leading channels by means of an overpressure, the overpressure suitably only existing in one of two gas leading channels, whereas the other gas leading channel being kept on a low pressure or adjusted to an under pressure. Thus, the fuel gas or the oxygen is pressed from the one gas leading channel through the diffusion layer within the plane of main extension of the diffusion layer into the other gas leading channel, and thus, it is always provided at the polymer membrane to a sufficient extent. Additionally, water which is produced by the reaction within the fuel cell can be removed out of the oxygen diffuser layer, and other substances can be brought to the polymer membrane like, for example, water at the side of the fuel gas diffusion layer. The cross section of the gas leading channels, the number of which may also be greater than two and which may not only be arranged in pairs but also as a trio of two outer gas leading channels with overpressure and of one inner gas leading channel with normal pressure, can be selected quite great as compared to the thickness of the diffusion layers. Thus, even with a very great constructional length of the fuel cell in the direction of main extension of the gas leading channels, a sufficient supply to the fuel cell can be ensured over its entire constructional length. Preferably in the new fuel cell, the openings in the plane electrodes are arranged in those areas of both gas leading channels which are as far away from each other as possible so that the pressure difference between both gas leading channels can be used over the entire diffusion layer arranged under the plane electrodes. To build up a pressure difference between both gas-leading channels, the gas leading channels have to be sealed against each other and against the surroundings. In the new fuel cell, a separation wall between both gas-leading channels is also used for building up a compression force for the adjacent plane electrode against the diffusion layer lying behind the plane electrode.

Whereas the plane electrodes of the new fuel cell may be simple stamped out metal sheet ribbon sections or other stamped out ribbon or stripe materials, the covers are preferably formed using endless profile sections. These endless profile sections can, for example, be formed from rolled metal sheet profile sections. Generally, however, it is also considerable to make the covers of or at least using endless extruded plastic profiles.

In case of making the covers and the plane electrodes of metal, they can in an advantageous manner be welded or soldered with a laser, for example. In case of covers and/or plane electrodes on the basis of plastic profiles, a sealed connection can probably also be achieved by locally melting up; in this case however, bonding by adhesive and/or casting in the relevant portions are better suited. A weld or bonding and/or casting in can also be used for sealing the endless profile sections for the covers at the ends of the sections. The gas ports can be integrated here.

For forming the plane electrodes from a non-metallic material, mainly graphite may be used as the conductive component of the plane electrodes. The graphite may have a reinforcement of elastic and/or flexible plastic and/or of a metal foil, which also enhances the conductivity of the graphite. In this case, the covers can be formed from composite materials which are already commercially available.

A double hat profile is particularly well suited as a profile form for an endless profile section for the covers, the outer and the inner hat rims being provided to be connected to the respective plane electrode in a sealing manner. Generally, it may also be considered to form the cover from two separate hat profile sections running in parallel which are each arranged over a row of openings in one plane electrode and which are connected to the plane electrode in a sealing manner. In this case however, no stabilisation of the fuel cell is achieved over its entire width by the covers as the covers are divided and shown an interruption. The stabilization, however, is important for the close contact of the plane electrodes with the diffusion layers lying there below to keep the inner resistance of the fuel cell as small as possible.

The new fuel cell is particularly well suited for such arrangements in which itself has or its diffusion layers have a length in the direction of main extension of the gas leading channels, which is by a multitude greater than its width running in perpendicular. The opposing electrical poles can be provided at the long edges of the fuel cell opposing each other for simply taking the current from the fuel cell. This means that means a connection to the one plane electrode is possible at the one long edge, and a connection to the other plane electrode is possible at the other long edge. Concretely, the opposing electrical poles can be formed by single protruding rims of the plane electrodes and/or of the covers which are electrically connected to the plane electrodes.

If such a fuel cell is rolled up lengthwise with regard to the gas leading channels, contacting of the electrical poles at the fuel cell can be effected by two opposing contact plates leaning against the long edges. By means of rolling up the new fuel cell, a contact force of the plane electrodes onto the diffusion layers laying there below can be voluntarily effected, which is an advantage in limiting the inner electrical resistance of the fuel cell as already mentioned. A principal advantage of a rolled up fuel cell is its small dimensions as compared to its active area.

In the rolled arrangement of the fuel cell, at least one spiral cooling water channel can be formed between the covers leaning against each other back to back. This can be particularly simply realized in the region of an isolation layer which is rolled in between the covers of the two opposed plane electrodes leaning against each other back to back.

In an enhanced embodiment of the new rolled up fuel cell, a further polymer membrane with two adjacent diffusion layers and with plane electrodes supporting these diffusion layers can, as a pair or instead of a pair of covers, be rolled in between two plane electrodes of opposing poles so that always plane electrodes of the same pole are positioned adjacent to each other while enclosing the gas leading channels. From another point of view there are two fuel cells rolled into each other and connected in parallel, no further construction elements being necessary for the covers besides distant pieces between the plane electrodes for forming the gas leading channels. Especially, there is no separate isolation layer between any covers in this embodiment of the new fuel cell.

The rolled up fuel cells are suited for a compact arrangement in series by forming stacks while arranging circle or ring-shaped contact plates between the fuel cells.

Especially in forming a rolled arrangement, particular high forces perpendicular to the plane of main extension of the diffusion layers can act on the outer covers, resulting in a danger of the gas leading channels being compressed. In this case, it can be an advantage, if stabilizing bodies are arranged in the gas leading channels for stabilizing the free cross section of the gas leading channels. The stabilizing bodies can, for example, be extruded material having a very large free volume which limits the gas flow through the gas leading channels as little as possible.

In the following, the invention is further explained and described by means of embodiment examples. Here,

Fig. 1 shows an exploded view of the layer arrangement of a first embodiment of the new fuel cell having plane electrodes and covers made of metal sheet material,

Fig. 2 is a perspective view of a cross section through the embodiment of the new fuel cell of Fig. 1,

Fig. 3 is a longitudinal cross section through the embodiment of the new fuel cell according to Fig. 1 in the region between a plane electrode and a cover,

Fig. 4 shows the embodiment of the new fuel cell of Fig. 1 rolled up lengthwise,

Fig. 5 is a series connection of a plurality of new fuel cells according to Fig. 4,

Fig. 6 is a second embodiment of the new fuel cell having plane electrodes and covers made of metal sheet material in a cross sectional view,

Fig. 7 is a cross sectional view of an embodiment of the new fuel cell which is modified as compared to Fig. 6,

Fig. 8 is a cross sectional view of a further embodiment of the new fuel cell which is modified as compared to Fig. 6,

Fig. 9 is yet a further embodiment of the new fuel cell which is modified as compared to Fig. 6 and rolled up lengthwise, and

Fig. 10 is a further embodiment of the new fuel cell having plane electrodes and covers made of graphite embedded in plastic in a cross sectional view.

The fuel cell 1 which is shown in Fig. 1 in form of its parts comprises a polymer membrane as its central layer 2, the composition and structure of which is principally known for so called PEM-fuel cells. Diffusion layers 3 and 4 are provided adjacent to the polymer membrane 2, the diffusion layer 3 here being a hydrogen diffusion layer for leading hydrogen to the polymer membrane 2, and the diffusion layer 4 being an oxygen diffusion layer 4 for leading oxygen 2 to and for removing water from the polymer layer 2. Plane electrodes 5 and 6 are arranged adjacent to the diffusion layers 3 and 4 on their backsides and are in close contact with the respective diffusion layer in the assembled fuel cell. The plane electrodes 5 and 6 are formed as stamped out metal sheet ribbon sections, here. Covers 7 and 8, which are here each formed from a form rolled metal sheet profile section provided with gas ports 9 and 10, are arranged at the backsides of the plane electrodes 5 and 6. The gas ports are only visible at the upper cover 8. They can be provided at one or at both ends of the fuel cell. In Fig. 1, only one end of the fuel cell 1 is depicted. In the assembled fuel cell 1, two gas leading channels 1 and 12, and 13 and 14 are formed between each cover 7 and 8 and the plane electrode 5 or 6, respectively, arranged in front thereof. The gas leading channels are sealed against each other by means of welding the covers 7 and 8 and the plane electrodes 5 and 6 together in their edge regions as well in their middles. A sealing, which is not depicted here, is also provided in the end regions of the fuel cell 1. However, openings 15, 16 are provided in the plane electrodes 5 and 6, which are only visible in the plane electrode 6 here and through which the gas leading channels 13 and 14 communicate with the diffusion layer lying in front of the plane electrode 6. If the fuel cell 1 is connected to a gas supply, there is an overpressure in the gas-leading channel 13, which presses oxygen via the openings 15 into the diffusion layer 4. Oxygen and water to be removed from the diffusion layer 4 are pressed out through the opening 16 into the gas leading channel 14 which, to this end, can additionally be subjected to an under pressure. On the hydrogen side of the fuel cell 1 the conditions are similar only differing in that water is not removed here but may have potentially to be supplied together with the hydrogen as a fuel gas via the gas leading channel 11 to keep the fuel cell 1 in function even in case of a high output power per area. Because the flow cross section of the gas leading channels 13 and 14 is very large as compared to the flow resistance within the diffusion layer 4, very uniform conditions can be adjusted over the tire length of the fuel cell 1 with regard to the pressure difference between the openings 15 and 16 even in case of a very long fuel cell 1. Thus, very huge fuel cells can be provided with gas in all regions, and therefore, very high currents can be produced in a fuel cell. Sealing the fuel cell between the plane electrodes 5 and 6 in a

lateral direction, i. e. in the edge regions of the polymer membrane and the diffusion layers 3 and 4 is preferably effected by casting in with an adhesive or with any other plastic material. Welding the plane electrodes to the covers in a sealing manner can be effected by means of a laser. The openings 15 and 16 can, for example, be provided in the plane electrodes by means of stamping out. Preferably, the openings are in the furthest side region of the gas leading channel 13 or 14 arranged above the openings. An electrical contact to the fuel cell 1 for taking off the current produced in the fuel cell is, in the embodiment according to Fig. 1, provided by a long edges 17 of the plane electrode 5 and the cover 7 protruding to the right hand side and by long edges 18 of the plane electrode 6 and the cover 8 protruding to the left hand side. As such, the plane electrodes 5 and 6 and the covers 7 and 8 are formed identically.

Fig. 2 shows a slightly modified embodiment of the fuel cell 1 in a perspective cross sectional view. Here, the fuel cell is assembled, and the lateral cast-in regions 19 are visible. The modification of the fuel cell 1 according to Fig. 2 with regard to that according to Fig. 1 relates to the covers 8 having no differently shaped longer edges here but being laterally set off with regard to the longitudinal middle plane of the fuel cell 1 so that for this reason, the long edges 17 of the lower cover 7 protrude to the right hand side, and the long edges 18 of the upper cover 8 protrude to the left hand side.

In a top view onto the plane electrode 6, the longitudinal cross section according to Fig. 3 shows the contact regions 20 to the cover arranged there above and the openings 15 and 16 which lead to the diffusion layer arranged there below.

Fig. 4 shows a rolled up fuel cell 1 in which the gas ports 9 und 10 which lead to a pair of gas leading channels 13, 14 and 11, 12, respectively, are provided at opposing ends of the fuel cell 1. Because of being rolled up, the fuel cell 1 has particular compact dimensions so that within a small space a comparatively great current can be produced. In the rolled arrangement according to Fig. 4 or 6, it is important that the covers 7 and 8 leaning against each other are isolated against each other. To this end, an isolation layer 21 is rolled in. In the rolled arrangement according to Fig. 4, the beads 31 at the backside of the covers 7 and 8 shown in Fig. 2 can be used for forming cooling water channels. These cooling water channels run in the middle of the fuel cell where cooling is most important. The heat removed with the cooling water can in turn be used in a combined power-heat-system. Contacting the fuel cell 1 according to Fig. 4 can be effected by lateral contact plates not shown here which lean against

the long edges 17 and 18. The large contact area at the long edges avoids an undesired increase in the contact resistance to the fuel cell 1. For increasing the produced voltage it is necessary to connect a plurality of fuel cells 1 in series as it is indicated in Fig. 5. I. e., the fuel cells 1 are arranged in a row side by side and are electrically connected so that a positive pole of one fuel cell is always connected to a negative pole of the neighbouring fuel cell. Thus, the voltages of the single fuel cells add up. With the fuel cell 1 having protruding long edges 17 and 18, series connection can be effected easily by connecting one long edge 17 with one long edge 18 via a contact plate 22 arranged there between. At the outmost long edges 17 and 18 which remain free the increased voltage can be taken from the fuel cell. In Fig. 5 this is depicted for a plurality of rolled up fuel cells 1 according to Fig. 4, the diagram of the series connection of the fuel cells being broken off in the region of the third fuel cell. The massive contact plates 22 may, for example, be made of copper and be firmly pressed against the long edges 17 and 18.

The embodiment of the fuel cell 1 depicted in Fig. 6 differs from the embodiments according to Figures 1 to 5 by a multiple part construction of the covers 7 and 8. The covers 7 and 8 each consist of profiled metal sheet sections 23 which are arranged at a distance to the plane electrodes 5 and 6 by means of distance pieces 24. The profile of the profiled metal sheet sections 23 includes beads 25, which fix the distance pieces 24 laterally and which serve for supporting guiding threads 26 gripping the diffusion layers 3 and 4 and fixing them laterally. The distance pieces 24 may be made of plastic. Preferably however, they are conductive to also use the profiled metal sheet sections 23 for leading away the current produced in the fuel cell 1. Further beads 25 are also provided in the plane electrodes 5 and 6, which are formed, as stamped out profiled metal sheet sections 4. The beads 25 in the plane electrodes are opposed to the beads 25 in the profiled metal sheet sections 23. Further, the cast-in regions 19 extend over the entire height of the fuel cell 1. The long edges 17 and 18 of the electrodes 5 and 6 as well as the associated metal sheet sections 23 of the covers 7 and 8 are ground flat together with the cast-in region 19 so that a flat contact area 27 results, from which the long edges 17 and 18 are slightly protruding, if, for example, the material in the cast-in region 19 slightly shrinks or is placed under a lateral pressure. The fuel cell 1 according to Fig. 6 can be particularly easily rolled up, as there is no part, which develops a high resistance against the flexional forces exerted in rolling. Because of the relative movements of the single materials with regard to each other which occur in rolling up, it is suitable to assemble the materials for the first time during rolling up and to first seal them against each other upon rolling or even

later, i. e. in the rolled state. This is a particular argument for self-sealing materials to be used for the distance pieces 24.

The embodiment of the fuel cell 1 according to 7 differs from that one according to Fig. 6 in that a guiding thread 26 is not arranged in every single bead within the plane electrodes 5 and 6. Instead only in one of two beads 25 facing each other a guiding thread 26 is arranged. This results in a suitable lateral tension of the diffusion layers 3 and 4 and of the polymer membrane 2 arranged there between. The main difference between these two embodiments, however, has to be seen in that in the embodiment according to Fig. 7 three gas leading channels 11, 12 and 12', and 13, 14 and 14', respectively, are provided on the side of each plane electrode 5 and 6. Thus, the gas leading channel 11 or 13 which is under overpressure is arranged in a central position and is surrounded by two gas leading channels 12 and 12' or 14 and 14' being under a lower pressure or under under pressure. The openings 15 in the central gas leading channels 11 and 13 are themselves arranged centrally, whereas the openings 16 are in the furthest side region of the fuel cell 1 like in the other embodiments.

The embodiment of the fuel cell 1 according to Fig. 8 is in another way modified over that one according to Fig. 6. At first, all beads 25 have a uniform direction here. I. e., they are not orientated in opposing directions between the plane electrodes 5 and 6 and the associated profiled metal sheet sections 23 of the covers 7 and 8. As a result, there is no necessity of guiding threads 26, and upon rolling up the fuel cells 1 according to Fig. 8 the single layers are guided laterally with regard to each other by the layers of the fuel cell 1 engaging each other in the area of the beads 25 via an isolation layer 21 arranged there between. The particular feature of the fuel cell 1 according to Fig. 8, however, is that the gas leading channels 11 to 14 are filled up with stabilizing bodies 28. The stabilizing bodies 28 have a low through flow resistance for the fuel gas, i. e. hydrogen here, and the oxygen in the main extension direction of the gas leading channels 11 to 14. At the same time, they are pressure resistant in a direction perpendicular to the polymer membrane. Thus, on the one hand, they avoid compression of the gas leading channels 11 to 14, which would result in a breakdown of the gas supply. On the other hand, they care for a uniform transmission of a pressing force which acts between the outer profiled metal sheet sections 23 to the transition region between the plane electrodes 5 and 6 and the diffusion layers 3 and 4 arranged in front thereof. This is particularly suitable for a rolled arrangement of the fuel cell 1, if such pressing forces are applied by means of the rolling itself and have to be distributed uniformly and without

destructions. Besides applying the contact pressure by means of rolling, a contact pressure necessary for contacting the plane electrodes can, for example, also be applied by a gas pressure in the gas leading channels 11 to 14 supported at the single rolled layers and/or by an expandable core in the middle of the rolled arrangement in combination with a pressure resistant sleeve surrounding and supporting the rolled arrangement and/or via an sleeve around the rolled arrangement reducing its inner diameter in combination with a core in the middle of the rolled arrangement supporting the rolled arrangement, these latter measures not being explicitly depicted in the drawings but being directly understood as such. The sleeve, for example, can be formed by winding ribbon material around the rolled arrangement, and decrease its inner diameter by means of a longitudinal shrinking process of this ribbon material.

The embodiment of the new fuel cell according to Fig. 9 is a rolled arrangement which does without an isolation layer between the single courses, and in which the respective covers 7 and 8 within the rolled arrangement are at the same time used as additional plane electrodes 5' and 6, an additional polymer membrane 2' with adjacent diffusion layers 3' and 4' being arranged there between. As a result, there are two fuel cells connected in parallel in which the gas leading channels 11 to 14 are formed without additional covers only by using the distance pieces 24. For the reason of simplicity, the cast-in regions 19 are not depicted in Fig. 9.

The embodiment of the fuel cell 1 according to Fig. 10 has plane electrodes 5 and 6 and covers 7 and 8 made of graphite reinforced with plastic. The covers 7 and 8 are formed by distance pieces 24 and cover layers 29, here. Graphite reinforced with plastics is known as ribbon or our band material. It can be provided with an embedded metal foil for a further reinforcement. The known material has a quite good electrical conductivity in its direction of main intension whereas the conductivity in perpendicular to the direction of main extension is relatively low. This distribution of the electrical conductivities is explored in the fuel cell 1 according to Fig. 10 in that the current produced in the fuel cell 1 is taken off laterally, i. e. in the plane of main extension of the plane electrodes 5 and 6 and the cover layers 29. The fuel cell 1 according to Fig. 10 can be particularly easily produced by rolling up, as upon firmly rolling up no further sealing materials are necessary. Even in the edge regions of the diffusion layers 3 and 4 and the polymer membrane 2 sealing distant pieces 30 are sufficient which may even be made of the same graphite/plastic-material like the distance pieces 24, if the polymer membrane 2 avoids a direct contact between the distance pieces 30 on both sides of the

polymer membrane 2. In the fuel cell 1 according to Fig. 10, it is also intended to take off the current produced in the fuel cell 1 via the long edges 17 and 18 of the plane electrodes 5 and 6 and the covers 7 and 8 protruding laterally.

LIST OF REFERENCE NUMERALS

- 1 - fuel cell
- 2 - polymer membrane
- 3 - (hydrogen-) diffusion layer
- 4 - (oxygen-) diffusion layer
- 5 - plane electrode
- 6 - plane electrode
- 7 - cover
- 8 - cover
- 9 - gas port
- 10 - gas port
- 11 - gas leading channel
- 12 - gas leading channel
- 13 - gas leading channel
- 14 - gas leading channel
- 15 - opening
- 16 - opening
- 17 - long edge
- 18 - long edge
- 19 - cast-in region
- 20 - contact region
- 21 - isolation layer
- 22 - contact plate
- 23 - profiled metal sheet section
- 24 - distance piece
- 25 - bead
- 26 - guiding thread
- 27 - supporting area
- 28 - stabilizing body
- 29 - cover layer
- 30 - distance piece
- 31 - bead

CLAIMS:

1. Fuel cell (1) comprising a central polymer membrane (2), diffusion layers (3, 4) covering the polymer membrane (2) on both sides, plane electrodes (5, 6) supporting the diffusion layers (3, 4) on their backsides and provided with openings (15, 16), and a rear cover (7, 8) for at least one of the plane electrodes (5, 6) having at least one gas port (9, 10); at least two gas leading channels (11, 12; 13, 14) being formed between at least one of the plane electrode (5, 6) and the associated cover (7, 8), and running in parallel to each other, and being sealed against each other; openings (15, 16) in the plane electrodes leading from the one gas leading channel (11, 13) into the adjacent diffusion layer (3, 4), and from the diffusion layer (3, 4) into the other gas leading channel (12, 14); and the fuel cell (1) having a greater constructional length in the direction of main extension of the gas leading channels (11, 13) than in a direction perpendicular thereto.
2. Fuel cell (1) according to claim 1, characterized in that the cover (7, 8) is formed from one or more endless profile sections.
3. Fuel cell (1) according to claim 2, characterized in that the endless profile sections include at least one form rolled profiled metal sheet section.
4. Fuel cell (1) according to any of the claims 1 to 3, characterized in that at least one of the plane electrodes (5, 6) is formed from a stamped or metal sheet section.
5. Fuel cell (1) according to any of the claims 1 to 3, characterized in that at least one of the plane electrodes (5, 6) comprises graphite as an electrically conducting component.
6. Fuel cell (1) according to any of the claims 1 to 5, characterized in that opposing electrical poles for taking off current from the fuel cell (1) are formed at its opposing long edges (17, 18) running in parallel to the gas leading channels (11, 12; 13, 14) by single rims of the plane electrodes (5, 6) and/or the covers (7, 8) electrically connected to the plane electrodes (5, 6).

7. Fuel cell (1) according to any of the claims 1 to 7, characterized in that it is rolled up in the direction of the length of the gas leading channels (11, 12; 13, 14).
8. Fuel cell (1) according to claim 7, characterized in that an isolating layer is rolled in between the covers (7, 8) of two plane electrodes (5, 6) leaning against each other back to back.
9. Fuel cell (1) according to claim 7, characterized in that a further polymer membrane (2') together with adjacent diffusion layers (4', 3') and with plane electrode (6', 5') supporting these diffusion layers (4', 3') are rolled in as a pair of covers between two plane electrodes (5, 6) of opposing poles; electrodes (5', 5; 6, 6') of the same pole arranged adjacent each other forming the gas leading channels (11, 12; 13, 14) there between.
10. Fuel cell (1) according to any of the claims 7 to 9, characterized in that it is arranged side by side with a plurality of further identical fuel cells 1 with massive contact plates arranged there between.

New Claim 1 filed on March 28, 2001 and forming the basis of the International Preliminary Examination Report:

C L A I M S:

1. Fuel cell (1) comprising a central polymer membrane (2), diffusion layers (3, 4) covering the polymer membrane (2) on both sides, plane electrodes (5, 6) supporting the diffusion layers (3, 4) on their backsides and provided with openings (15, 16), and a rear cover (7, 8) for at least one of the plane electrodes (5, 6) having at least one gas port (9, 10); at least two gas leading channels (11, 12; 13, 14) being formed between at least one of the plane electrode (5, 6) and the associated cover (7, 8), and running in parallel to each other, and being sealed against each other and against the surroundings for building up a pressure difference; openings (15, 16) in the plane electrodes leading from the one gas leading channel (11, 13) into the adjacent diffusion layer (3, 4), and from the diffusion layer (3, 4) into the other gas leading channel (12, 14); and the fuel cell (1) having a greater constructional length in the direction of main extension of the gas leading channels (11, 13) than in a direction perpendicular thereto.

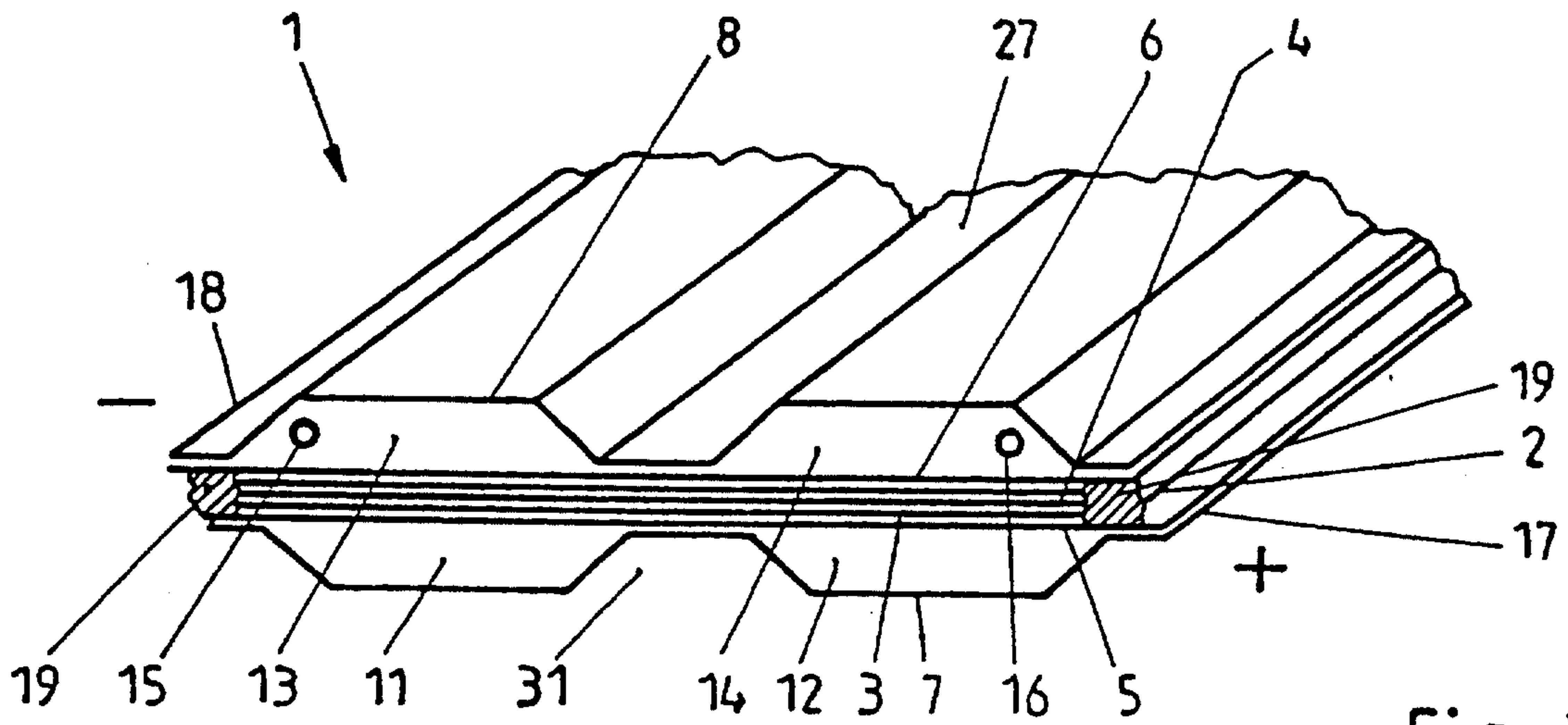


Fig. 2

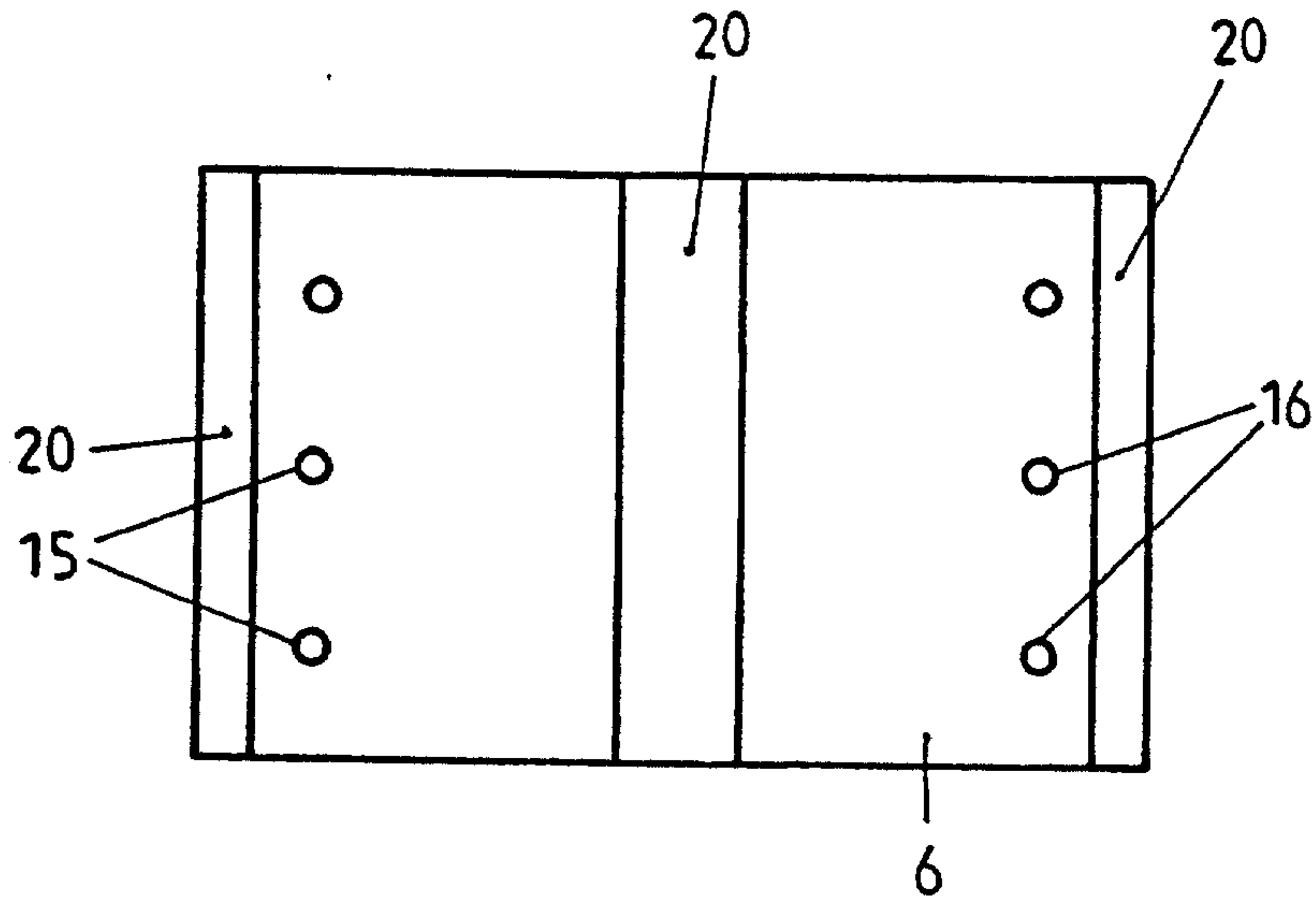


Fig. 3

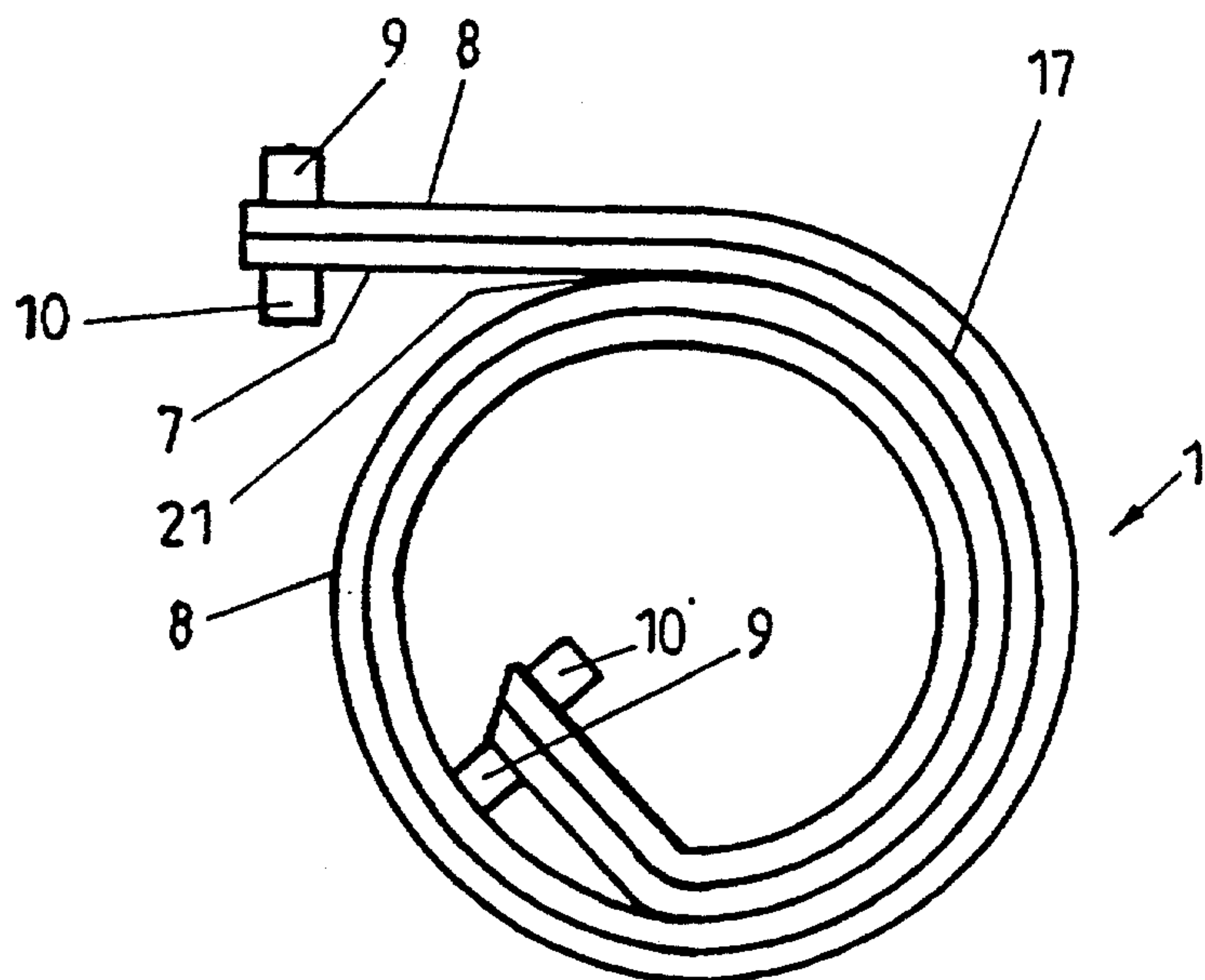


Fig. 4

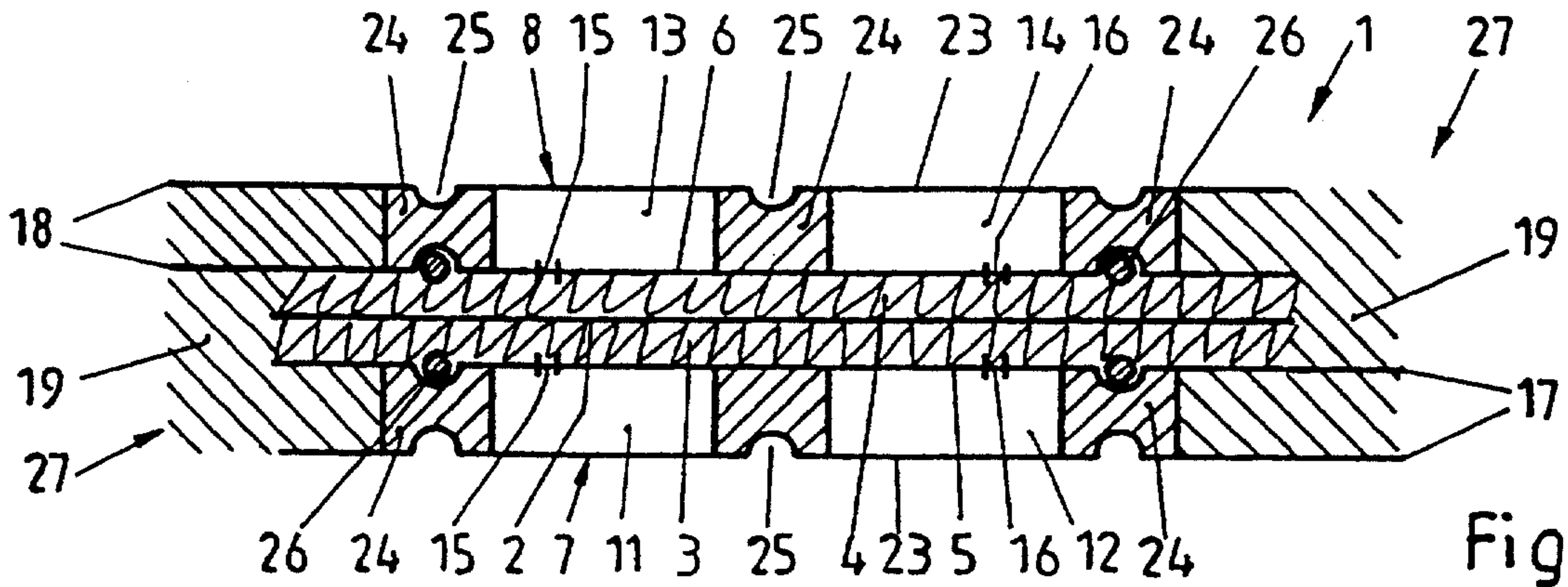


Fig. 6

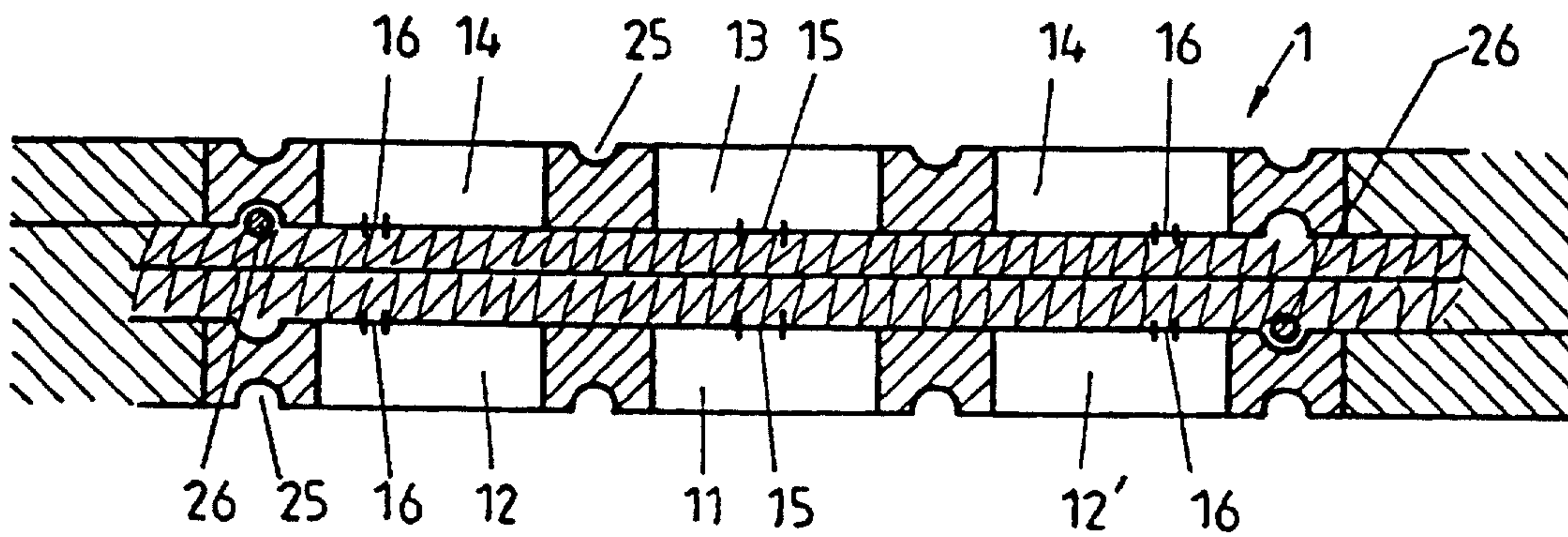


Fig. 7

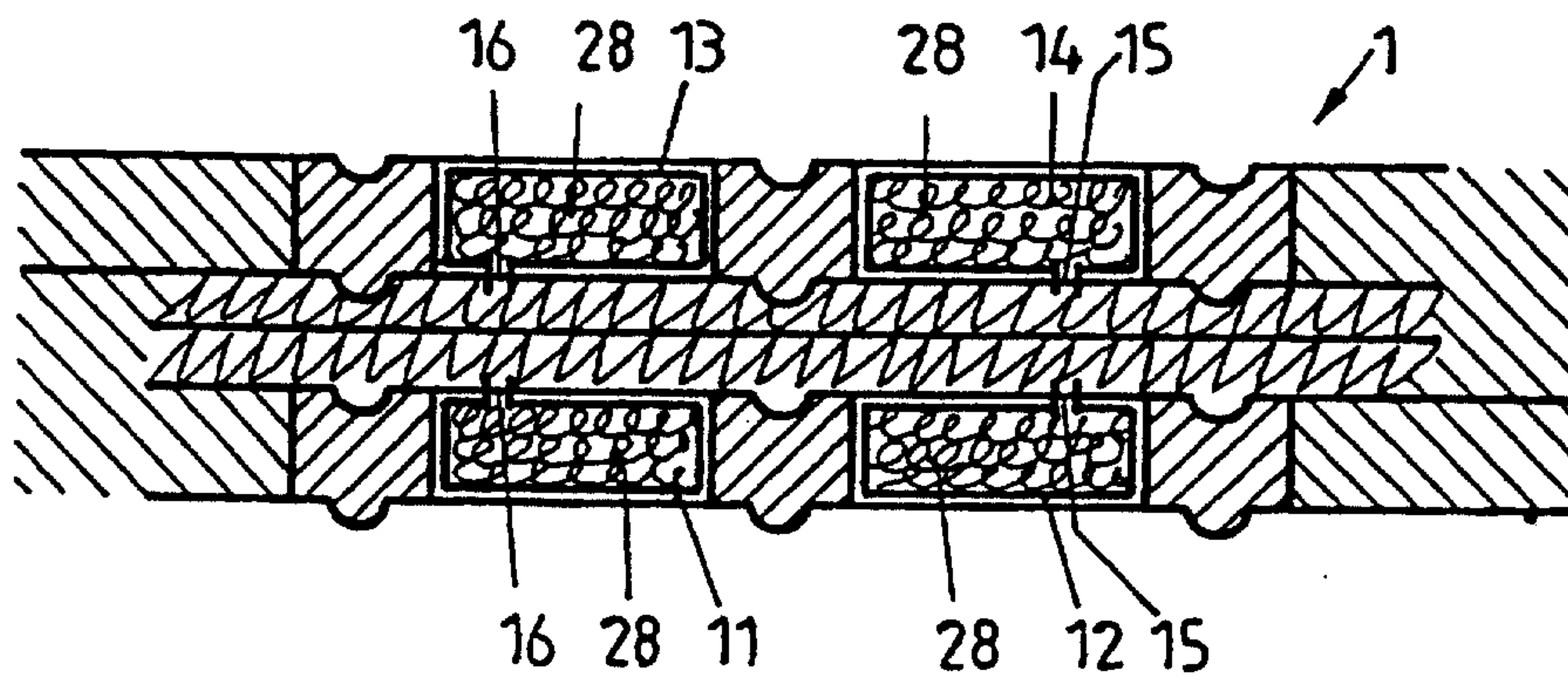


Fig. 8

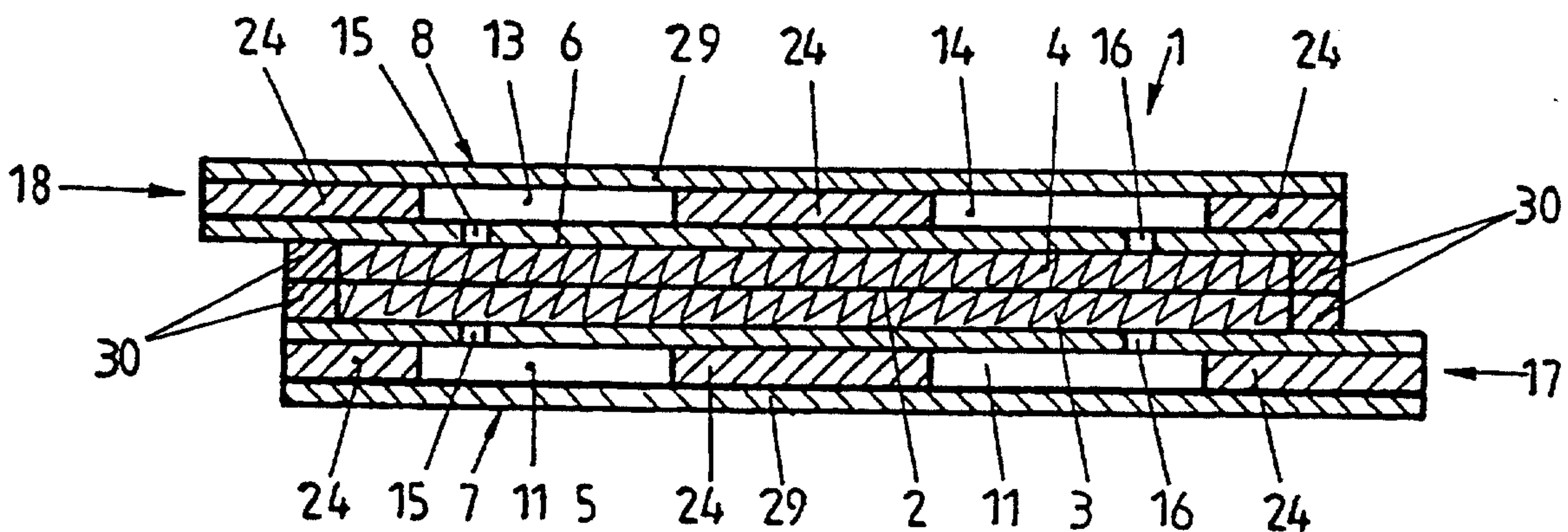


Fig. 10

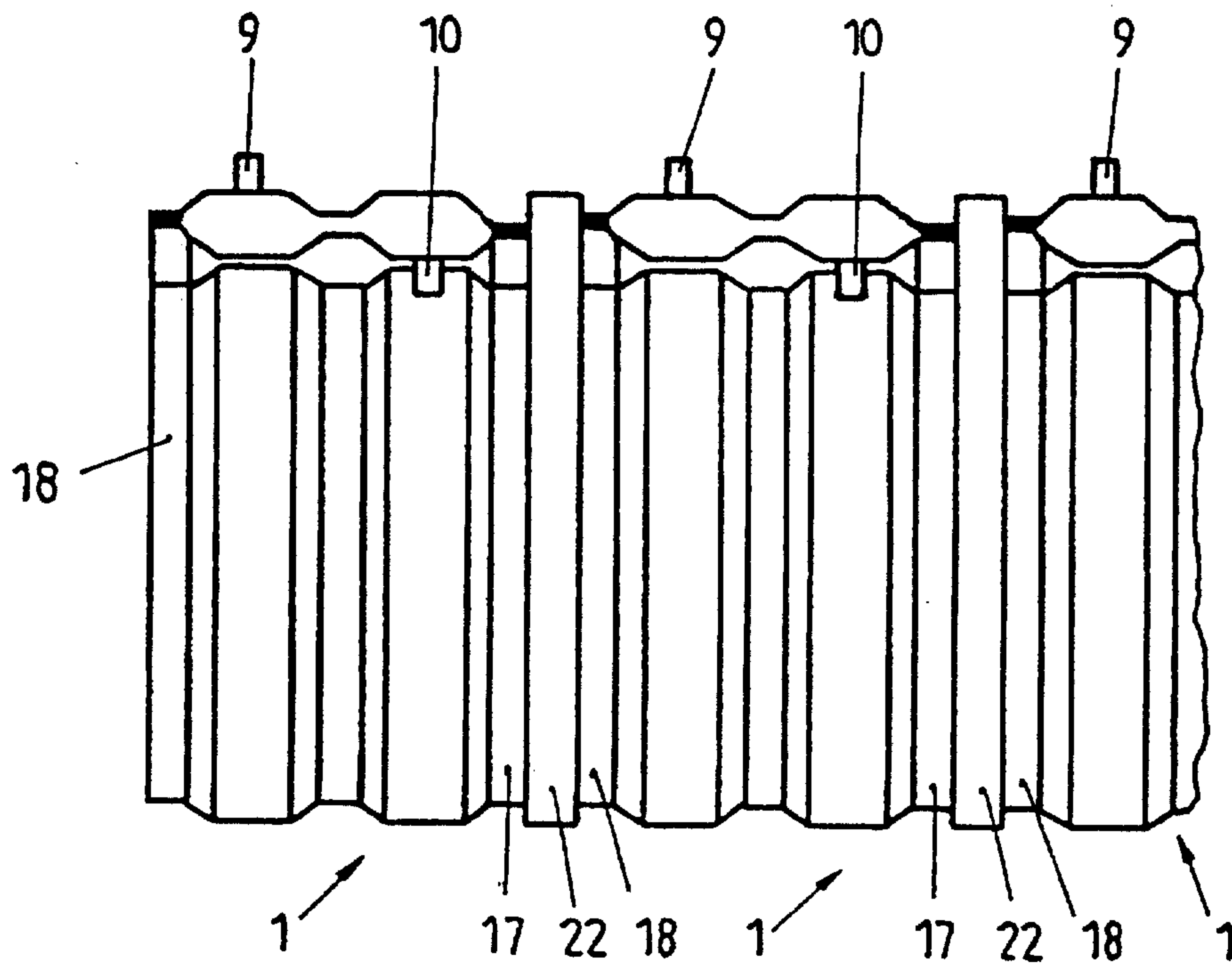


Fig. 5

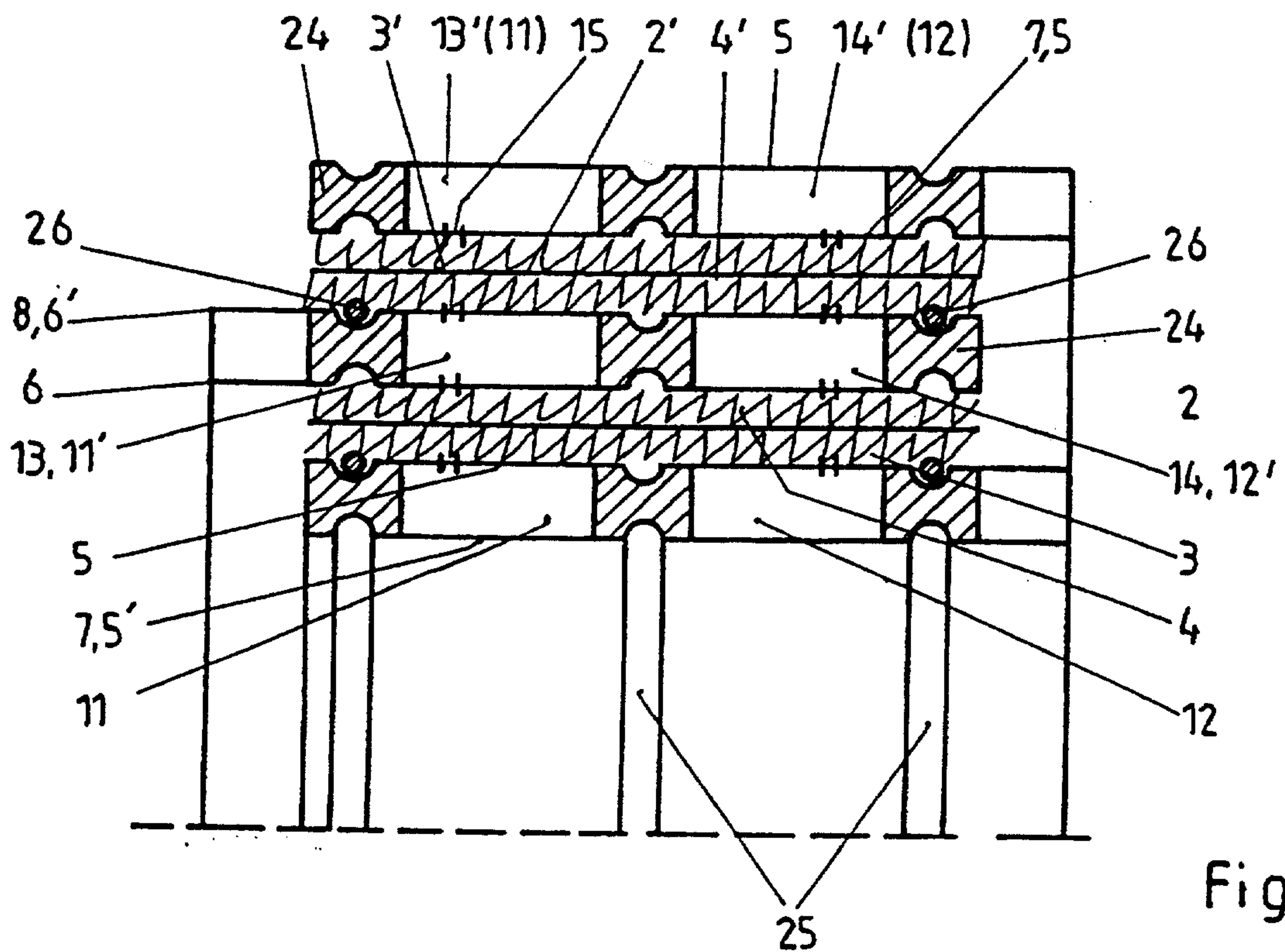


Fig. 9

