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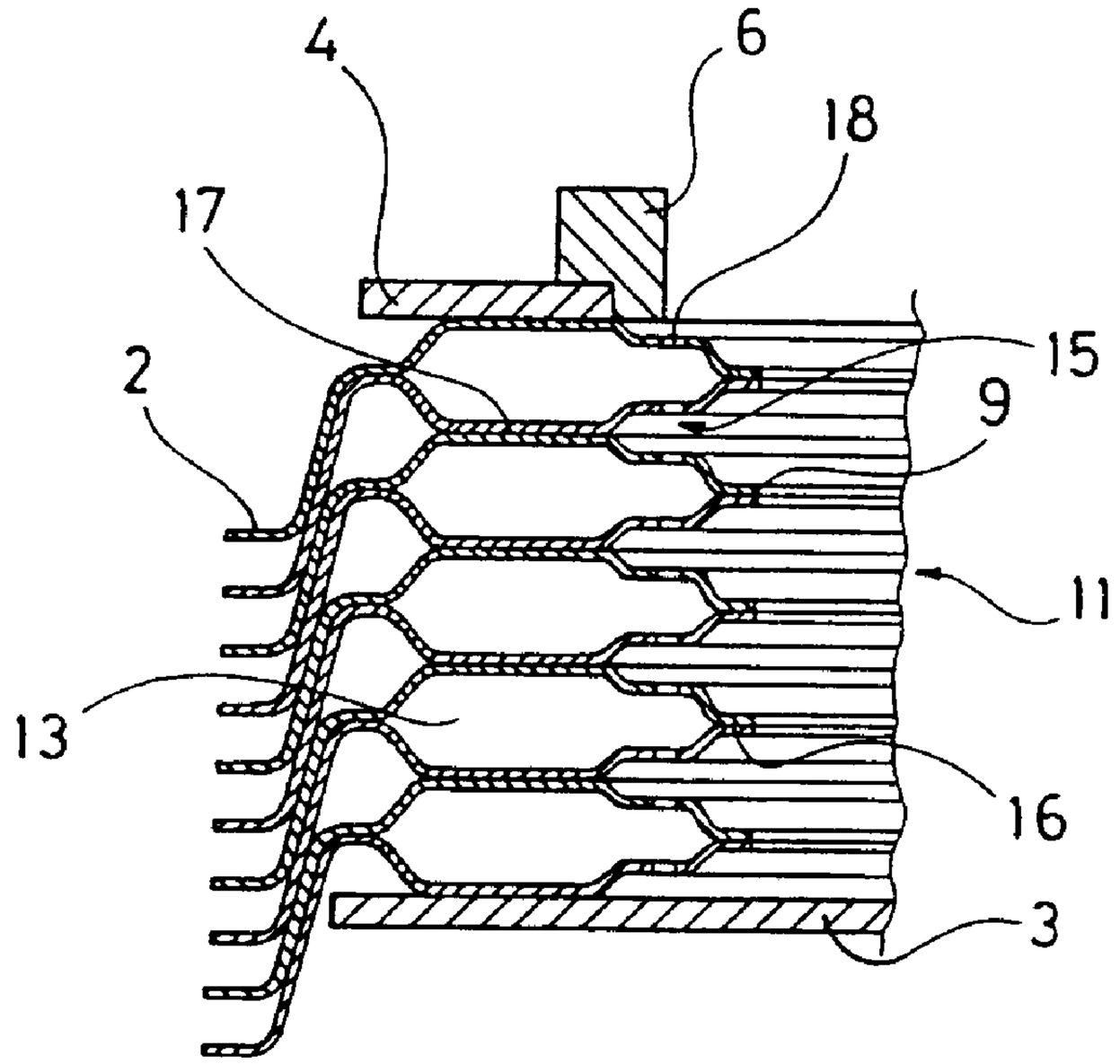

(57) Abrégé/Abstract:
A plate heat exchanger comprising a pack of heat transfer plates (2) provided with inlet ports (9) forming an inlet channel (11) and with sealing means co-operating with the plates to delimit first (13) and second flow passages in alternate plate interspaces. A first sealing area (17, 23) is located around the respective inlet part (9). The inlet channel (11) communicates with each first flow passage (13) by way of at least one inlet passage (15) while being blocked from the second flow passages by said first sealing area. The plates which form said first flow passage (13) have an essentially tight surface abutment against each other in a second sealing area (16) in connection to the respective inlet ports (9), and said inlet passage (15) is delimited by at least one of said heat transfer plates (2) between the first sealing area (17, 23) and the inlet port (9) of the heat transfer plate (2).

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(54) Title: PLATE HEAT EXCHANGER

(57) Abstract

A plate heat exchanger comprising a pack of heat transfer plates (2) provided with inlet ports (9) forming an inlet channel (11) and with sealing means co-operating with the plates to delimit first (13) and second flow passages in alternate plate interspaces. A first sealing area (17, 23) is located around the respective inlet port (9). The inlet channel (11) communicates with each first flow passage (13) by way of at least one inlet passage (15) while being blocked from the second flow passages by said first sealing area. The plates which form said first flow passage (13) have an essentially tight surface abutment against each other in a second sealing area (16) in connection to the respective inlet ports (9), and said inlet passage (15) is delimited by at least one of said heat transfer plates (2) between the first sealing area (17, 23) and the inlet port (9) of the heat transfer plate (2).

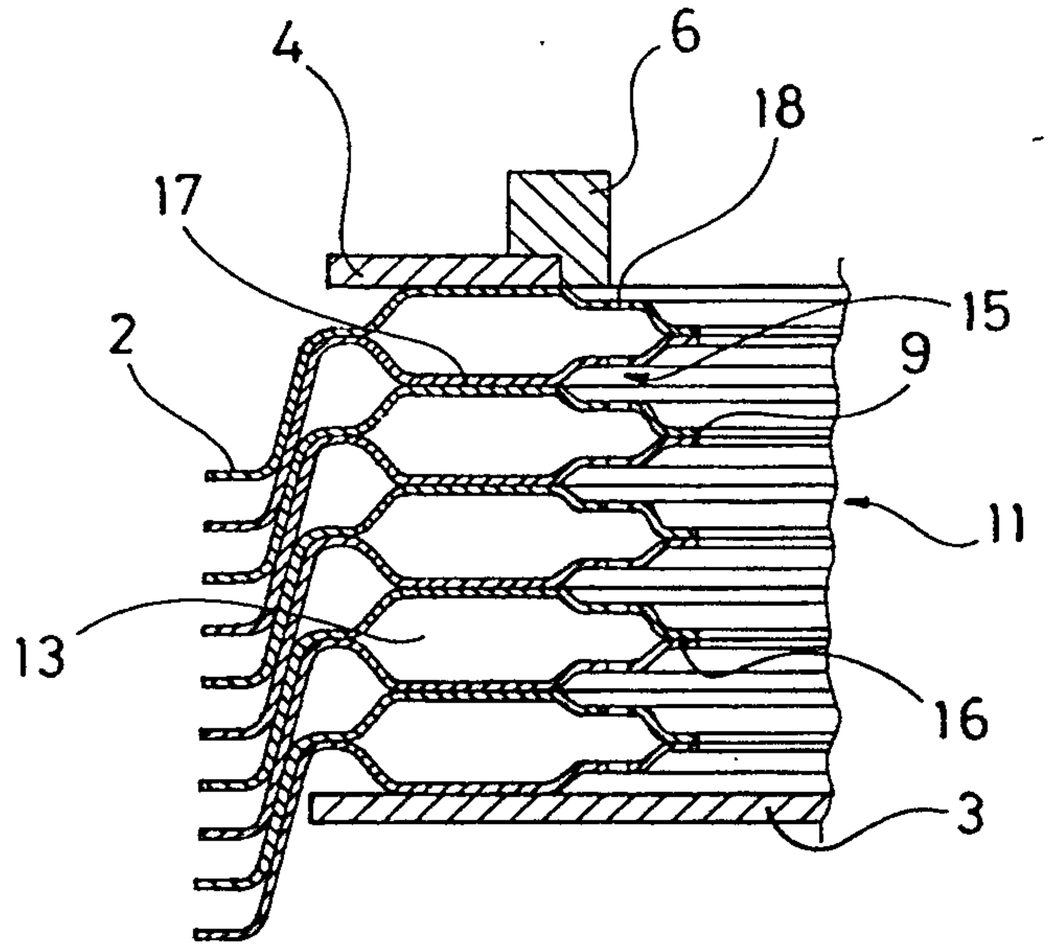

PLATE HEAT EXCHANGER

The present invention refers to a plate heat exchanger comprising a package of heat transfer plates, which is provided with through inlet ports, forming an inlet channel through the package, and between the heat transfer plates arranged sealing means, which together with the heat transfer plates in every other plate interspace delimit a first flow passage for one fluid and in each of the remaining plate interspaces delimit a second flow passage for a heating fluid, wherein the inlet channel communicates with each first flow passage by way of at least one inlet passage, and is blocked from each second flow passage by said sealing means, which is located in a first sealing area around respective inlet port.

Both openable and permanently joined conventional plate heat exchangers are normally constructed with equally sized inlets and outlets for respective heat transfer media. For one-phase heat transfer equally sized inlets and outlets are satisfactory regarding to flow velocity and pressure drop, since the specific volume for the media does not change considerably at the difference of temperature to which the media is exposed during the heat transfer.

In two-phase heat transfer, as during concentration or evaporation, the media is however supplied in liquid-phase and discharged in gas-phase, which has a considerably larger specific volume than the liquid-phase, wherein the flow velocity and the pressure drop in the outlet become larger than in the inlet. By equally sized inlets and outlets unbalance may thus appear between different ducts in the plate heat exchanger, when this is utilized for two-phase heat transfer.

To avoid this problem a plate heat exchanger of the above mentioned kind has been presented in the published Swedish patent application 8702608-4. Through this reference, it is previously known to provide a plate heat exchanger with a restriction means in respective inlet between two adjacent heat transfer plates to obtain an equal distribution of the incoming fluid. The restriction means may consist of a ring or a washer, which is provided with a through hole and which is arranged between each pair of adjacent heat transfer plates. The restriction means can also consist of a pipe, having several holes and is arranged in the inlet port of the plate heat exchanger. As an alternative it has also been proposed that the restriction means may be formed of the heat transfer plates themselves, whereby the edge of the ports of two adjacent heat transfer plates has been folded to abutment, edge to edge, towards each other with exception of a short distance, which is intended to form an opening.

The above mentioned restriction means have not proved to function satisfactorily. Problems have arisen by the production of the plate heat exchanger. The use of separate rings or washers has proved far too expensive and it has been difficult to locate the rings or the washers in correct position at the assembly of the same. A restriction means in shape of a pipe must be adapted to the number of heat transfer plates included in the plate heat exchanger and must also be located correctly related to the inlet passages between the heat transfer plates. This has resulted in that such pipes have not been used in serial production of plate heat exchangers. The proposed folding of the edge of the port has not proved practicable, depending on that the heat transfer plates are produced of thin plates and it has shown

difficult to obtain a well-defined opening to the plate interspaces.

The purpose of the present invention is to avoid the above mentioned disadvantages of previous known plate heat exchangers and to achieve a plate heat exchanger of the introductory described kind, in which a considerably well defined opening may be attained, to restrict the incoming fluid, and that the heat transfer plates of the plate heat exchanger are formed such that said restriction can be attained at a low cost regarding to production and assembly of the plate heat exchanger.

This purpose will be reached with the present invention, which principally is characterized in that the heat transfer plates, forming said first flow passage, have an essentially tight surface abutment towards each other in a second sealing area in connection to its respective inlet ports, and that said inlet passage is delimited by at least one of said heat transfer plates between the first sealing area and the inlet port of this heat transfer plate.

By the present invention the need of extra components is eliminated and by integrating the restriction means in the pattern of the plate, the shape may be altered depending on the need of restriction. One essential advantage with the present invention is that a heat transfer plate, designed according to the invention, can be used for purposes other than evaporation, i.e. by cutting a port with larger diameter of the port a conventional heat transfer plate is obtained, without any restriction means. It is thus possible to modify existing pressing tools, such that the major part of the heat transfer plates of known kind through a simple

cutting of the plates may be utilized either in connection with evaporation or in connection with conventional **one-phase heat transfer**. **It is not necessary to produce any** additional pressing tool for pressing of heat transfer plates intended for evaporation, and therefore the additional cost for production of such plates becomes **very low compared with known techniques**.

The invention will be described in more detail in the following with reference to the accompanying drawings, in which

figure 1 shows a perspective view of a plate heat exchanger,

figure 2 shows a cross-section through a conventional plate heat exchanger along the line A-A in figure 1,

figure 3 shows a partial cross-section through a plate heat exchanger according to a first embodiment of the invention along the line A-A in figure 1,

figure 4 shows a partial cross-section through a plate heat exchanger according to a second embodiment of the invention along the line A-A in figure 1,

figure 5 shows a part of a heat transfer plate included in the plate heat exchanger according to figure 4,

figure 6 shows a part of a heat transfer plate included in an additional embodiment of a plate heat exchanger according to the invention, and

figure 7 shows a cross-section along the line B-B in figure 6.

In figure 1 a plate heat exchanger 1 is shown, comprising a package of heat transfer plates 2 and outer cover plates 3 and 4, which are arranged on the under and the upper side, respectively, of the package. The plate heat exchanger 1 has a first and a second inlet and 6 and a first and a second outlet 7 and 8 for two heat transfer media.

In figure 2 a cross-section through the plate heat exchanger of figure 1 is shown, extending along the part of the heat exchanger comprising the second inlet pipe 6 and the first outlet pipe 7.

The plate heat exchanger 1 comprises ten heat transfer plates 2, which are arranged on top of each other between the upper, outer cover plate 4 and the lower, outer cover plate 3. The number of heat transfer plates 2 of the heat exchanger can be altered in respect to a desired capacity.

The heat transfer plates 2 are provided with through ports 9 and 10. The ports 9 and 10 are located in line with each other, such that the ports 9 form an inlet channel 11 through the package and the ports 10 form an outlet channel 12 through the package. Both of the ducts are downwards delimited by the cover plate 3. The inlet channel 11 is upwards connected to the inlet pipe 6 and the outlet channel 12 is connected to the outlet pipe 7.

The plate heat exchanger 1 is in conventional manner provided with sealing means between the heat transfer plates 2, which together with respective heat transfer plates in every other plate interspace delimit a first flow passage 13 for one fluid and in the remaining plate

interspaces delimit second flow passages for a heating fluid.

The heat transfer plates 2 are preferably provided with a corrugation pattern in shape of parallel ridges 14, which are arranged such that they in two adjacent heat transfer plates 2 are crossing each other.

The first the flow passage 13 is connected to the inlet channel 11 by way of at least an inlet passage 15 between the ports 9 of two towards each other abutting heat transfer plates 2.

The plate heat exchanger comprising preferably rectangular heat transfer plates 2, but also other shapes may be thinkable, such as rounded heat transfer plates.

The plate heat exchanger is provided with one inlet channel 11 and one outlet channel 12 for each of the two heat transfer media, which in- and outlet channels are located in the end portions of the heat transfer plates 2. Naturally, a plate heat exchanger may be provided with several inlet or outlet channels, whereas the shape and location of the channels may be freely chosen.

The plate heat exchanger can either be openable or permanently joined by means of soldering, gluing or welding. During joining by means of soldering a suitable number of heat transfer plates are piled on each other with a solder in shape of thin disc located between adjacent heat transfer plates, whereupon the whole package is heated in an oven until said solder melts.

During assembly of openable plate heat exchangers a suitable number of plates are piled on each other with sealing, in shape of rubber gaskets or similar, located between adjacent plates, whereupon the whole package is clamped together with aid of bolts (not shown) or similar.

In figure 3 a first embodiment of the invention is shown, the heat transfer plates 2 are provided with a contraction of the inlet channel 11 for the fluid compared with what is shown in figure 2. The port 9 has thus a smaller diameter and the plate material around the port 9 has been formed such that the heat transfer plates 2 abut closely towards each other along the edge of the port 9.

The heat transfer plates 2 thus have both a first outer sealing area 17 and a second inner sealing area 16, which close respective second and first flow passages. The second sealing area 16 has an extension around the inlet ports 9 and across of the inlet channel in the longitudinal direction. Naturally, this second sealing area 16 may also be directed along with the inlet channel 11. The essential of the invention is that the heat transfer plates 2 have one surface abutment towards each other in this second sealing area 16.

To achieve a communication between the first flow passage 13 and the inlet channel 11 respective inlet passages 15 have been formed as a hole 18 through the heat transfer plates 2. The number of holes 18 and their size can simply be adapted to a desired restriction of the inlet passage. The holes 18 may be arranged in one or in both of two adjacent heat transfer plates 2. The distribution of the holes 18 around the port 9 may be

altered depending on the desired flow properties, but also the distribution in different plate interspace along the plate heat exchanger can be varied.

By the present invention it is thus possible to optionally choose appropriate size for the holes 18 and by that achieve a well-defined inlet passage, for restriction of the incoming medium. Essential for the invention is that the inlet passage 15 is delimited by at least one of the heat transfer plates 2 between the first sealing area 17 and the inlet port 9 of the heat transfer plate 2.

By that the heat transfer plates 2 of the plate heat exchanger are formed such that said restriction is integrated with the plates the cost regarding production and assembly of the plate heat exchanger is low.

Figure 4 and 5 show a second embodiment of the invention, in which the heat transfer plates 2 likewise are provided with a contraction of the inlet channel 11 for the fluid, compared with what is shown in figure 2. Around the port 9 an essentially flat annular second sealing area 16 and a first sealing area 17 are provided, in which the heat transfer plates 2 abut closely towards each other.

Within the second sealing area 16 a number of projections 19 occur and outside this a number of projections 20 occur. The projections 19 and 20 extend from one lower end plane to an upper end plane of the heat transfer plates 2. The projections 19 and 20 of the one plate abut towards the projections 19 and 20 of the other plate. The projections abutting towards each other

form uniting means, holding the port portions of the two heat transfer plates together along the inlet channel 11.

Between the projections 19 and 20 at least one channel 21 is connected with the first flow passage 13 between the heat transfer plates 2. The channel 21 is formed through a projection of the plate in the second sealing area 16. This projection can be formed such that the channel 21 discharges into the projection 19, but it can also discharge between two adjacent each other located projections 19. Naturally, one such channel 21 may also be formed in the heat transfer plates of the kind appearing from figure 3, which lacks such projections 19.

The bottom of the channel 21 is located between the lower end plane and the upper end plane of the heat transfer plates 2. The size of the channel 21 can simply be adapted to a desired restriction of the inlet passage 15 by varying the position of its bottom or by varying its width.

The channel 21 can be arranged in one or in both of the two adjacent heat transfer plates 2. The number of ducts 21 and their distribution can be arranged in the same way as described above in connection with figure 3.

In figure 5 a dashed line 22 is also shown along which the port 9 of the heat transfer plate 2 may be cut or punched to obtain a conventional heat transfer plate.

In figure 6 and 7 a further embodiment of the invention is shown, which is intended for a partly openable plate heat exchanger comprising partly a welded joint along

the second sealing area 16 and partly a rubber gasket 23 between two adjacent pairs of welded heat transfer plates. The rubber gasket 23 is located in one gasket groove 24 round the port 9, corresponding to the above mentioned first sealing area.

The inlet passage 15 is provided by a combination of the holes 18 and a channel 25 between the projections 19. The welded pair of heat transfer plates have a further welded joint along a sealing area 26 located at the edge of the plates. Also these heat transfer plates can be cut or punched along the line 22 to obtain conventional heat transfer plates.

CLAIMS:

1. A plate heat exchanger comprising a package of heat transfer plates which are provided with inlet ports therethrough forming an inlet channel through the package, and sealing means arranged between the heat transfer plates and forming together with the heat transfer plates a first flow passage for one fluid in every second plate interspace and a second flow passage for a heating fluid in each of the remaining plate interspaces, wherein the inlet channel communicates with each first flow passage through at least one inlet passage for each first flow passage while being blocked from communication with each second flow passage by part of the sealing means located in a first sealing area that extends around the inlet channel, and further wherein every two adjacent heat transfer plates delimiting a first flow passage have an essentially tight surface abutment against each other in a second sealing area, that extends around the inlet channel and is situated between the inlet channel and the first sealing area as seen along one of said adjacent heat transfer plates, and wherein the inlet passage is delimited by at least one of the two adjacent heat transfer plates between its inlet port and the first sealing area.

2. A plate heat exchanger according to claim 1, wherein the inlet passage is formed as one or more holes through at least one of the two adjacent heat transfer plates delimiting the first flow passage.

3. A plate heat exchanger according to claim 1, wherein the inlet passage is formed as one or more ducts extending through the second sealing area between the two adjacent heat transfer plates delimiting the first flow passage.

4. A plate heat exchanger according to any one of claims 1 to 3, wherein the second sealing area has an extension around and across the inlet channel.

5. A plate heat exchanger according to claim 1, wherein inlet passage is located between the first sealing area and the second sealing area.

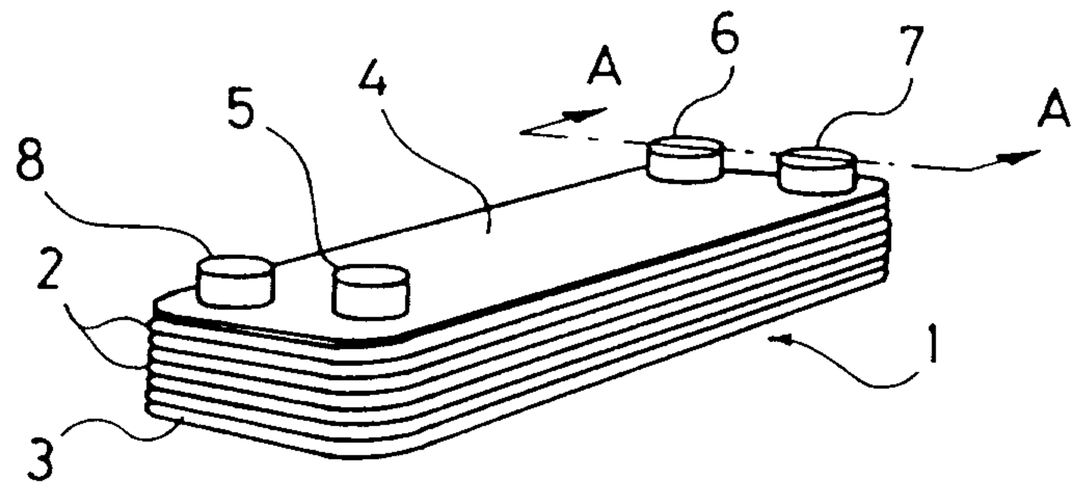

Fig.1 **PRIOR ART**

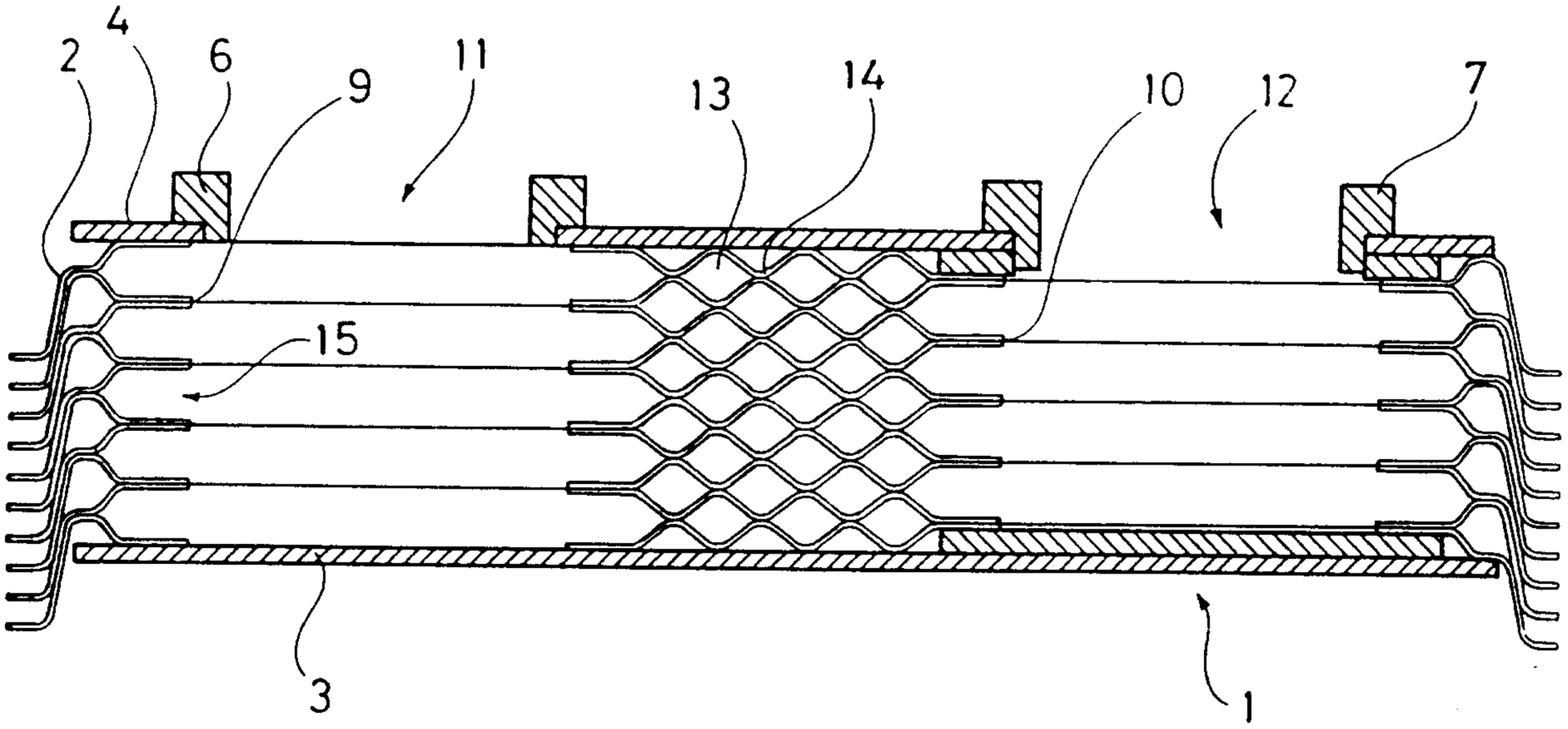

Fig.2 **PRIOR ART**

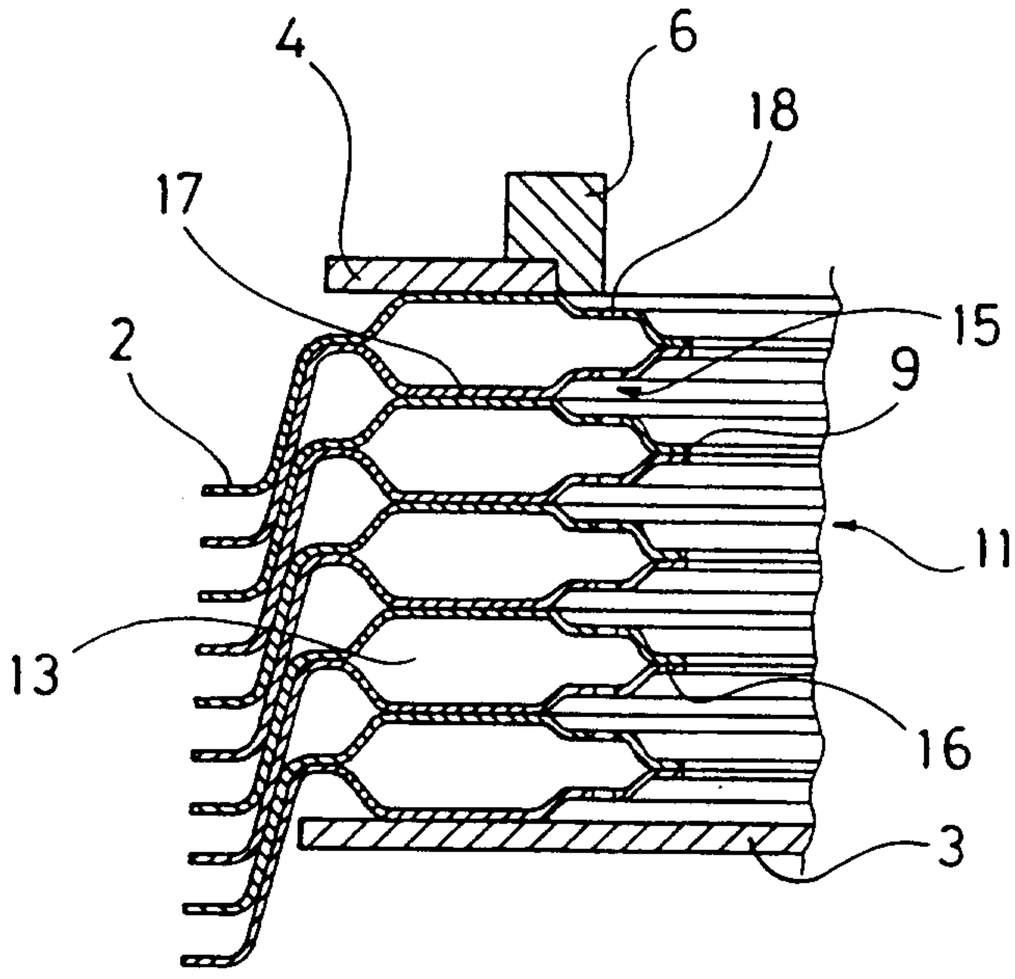

Fig.3

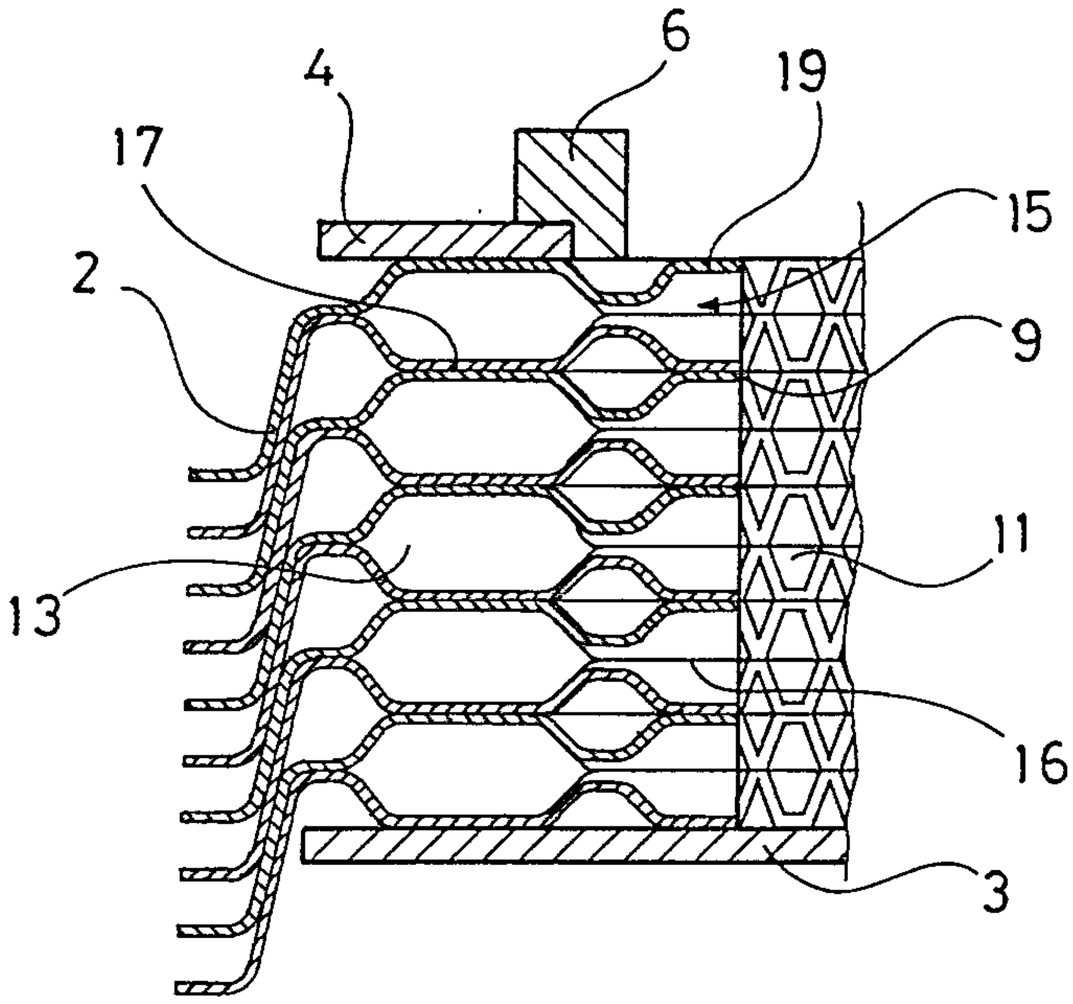

Fig.4

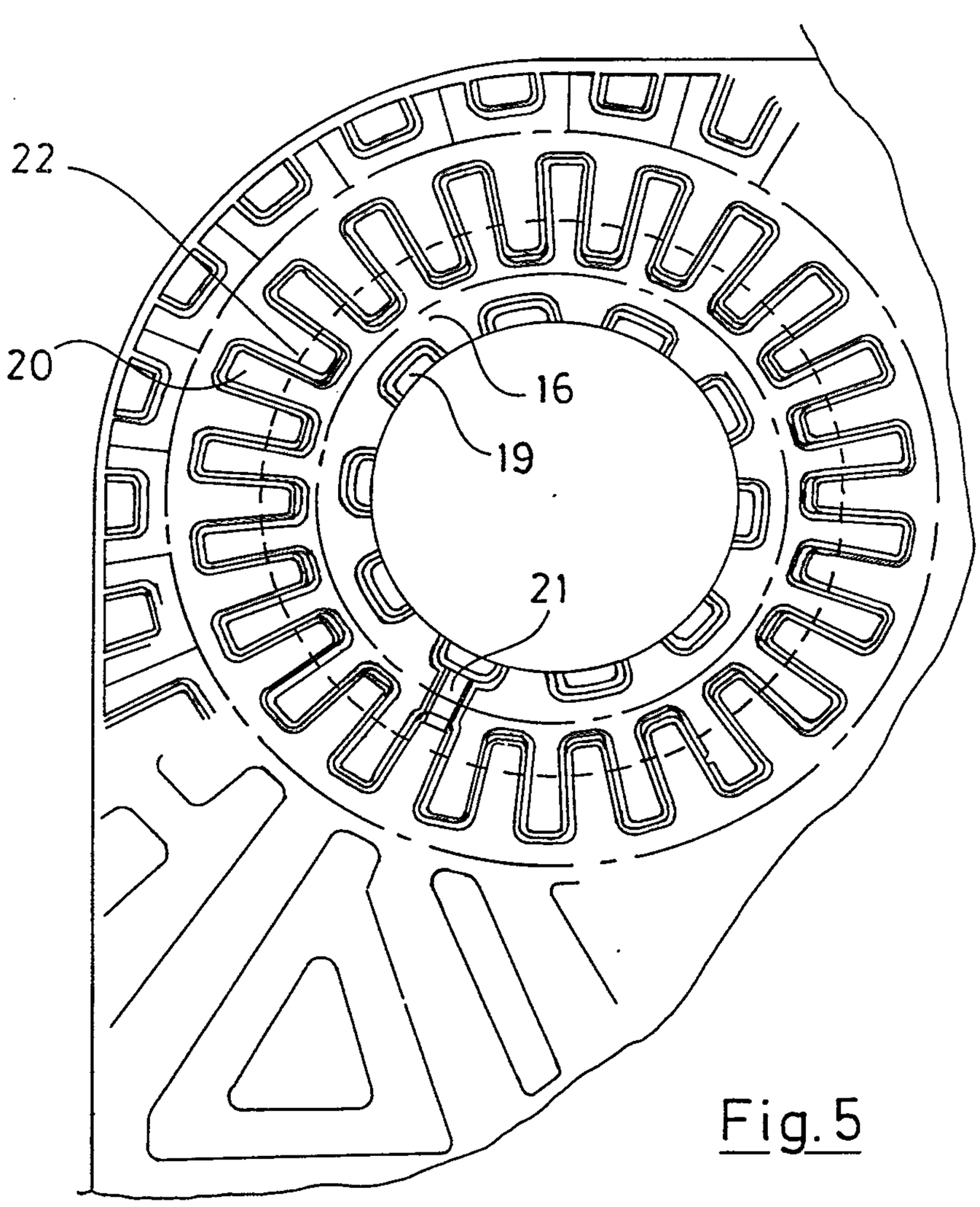

Fig.5

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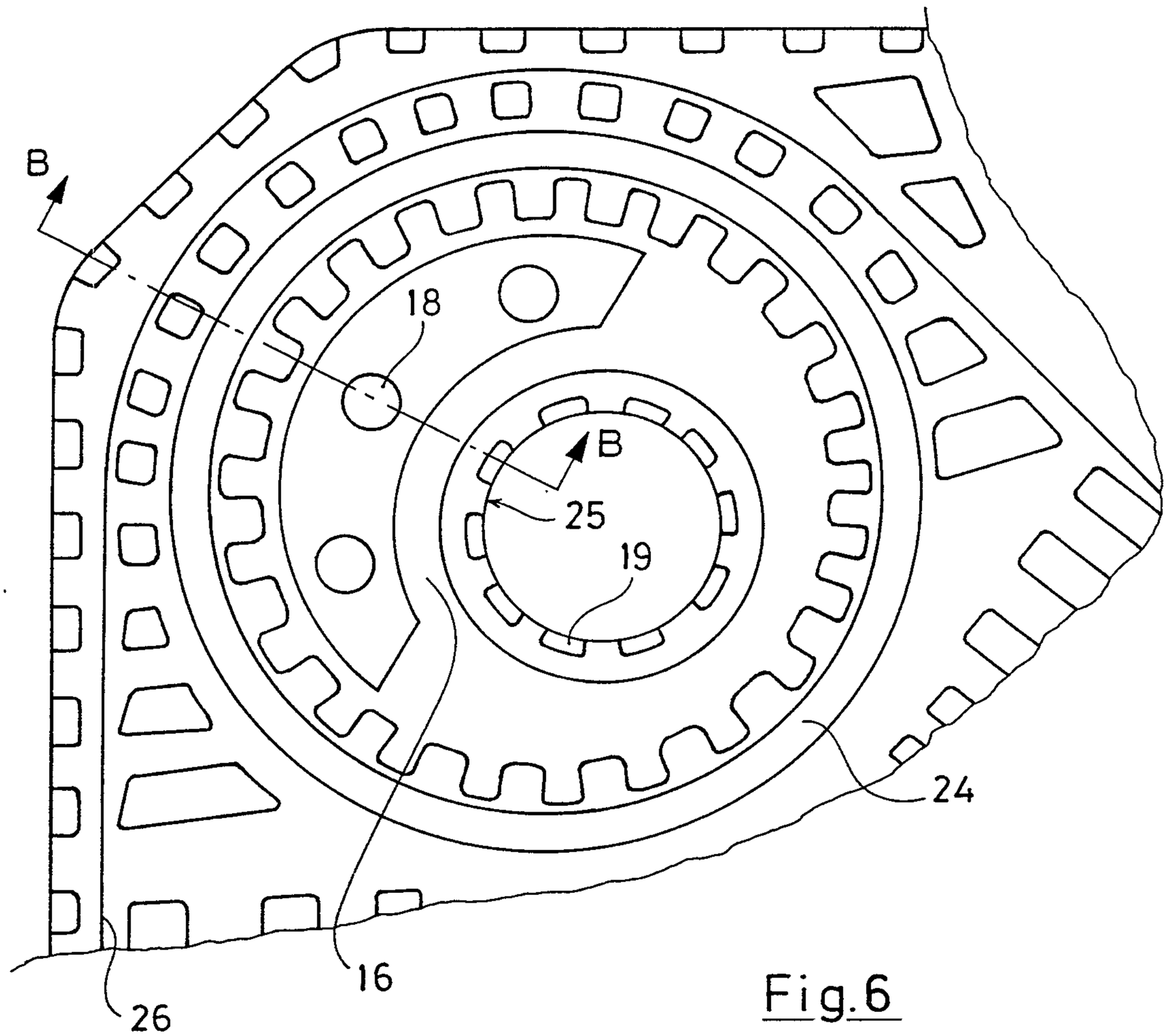


Fig.6

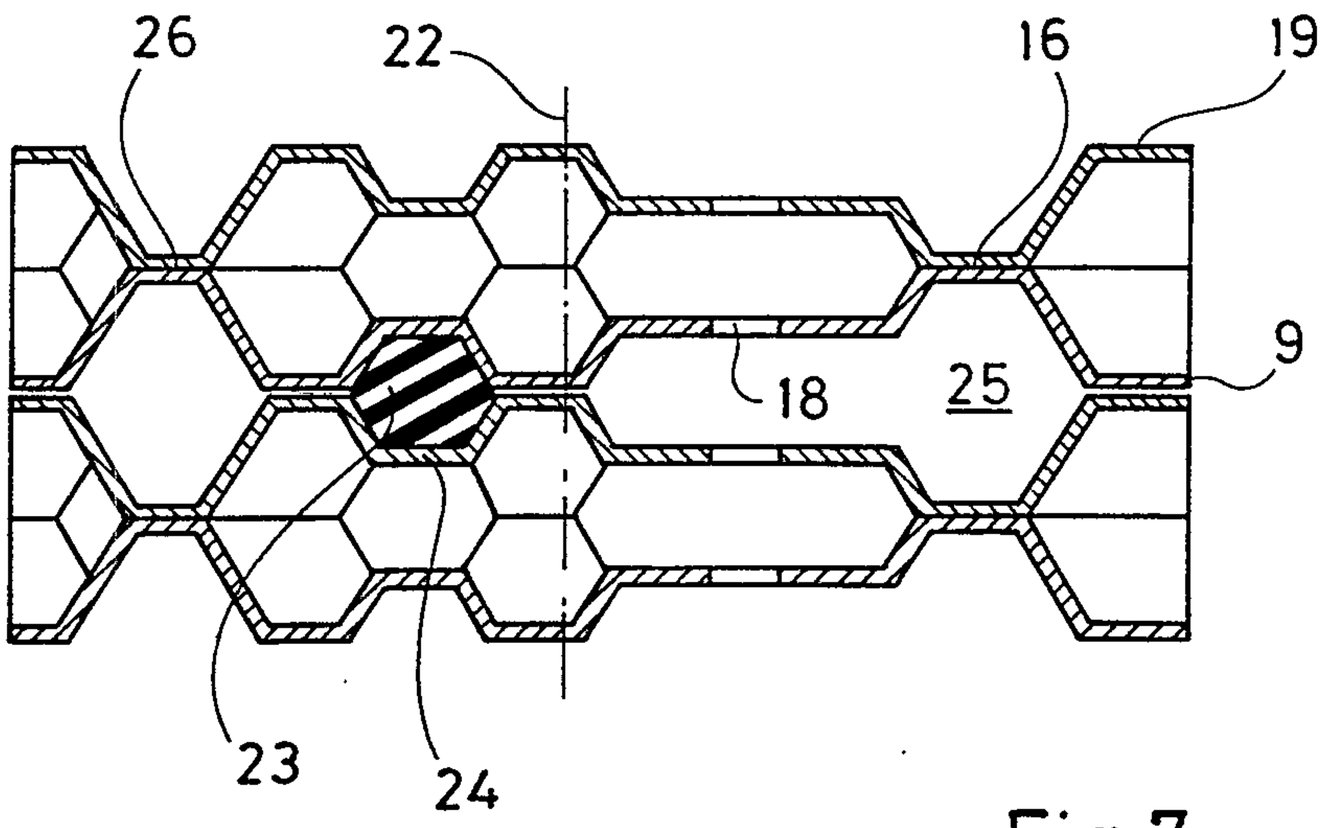
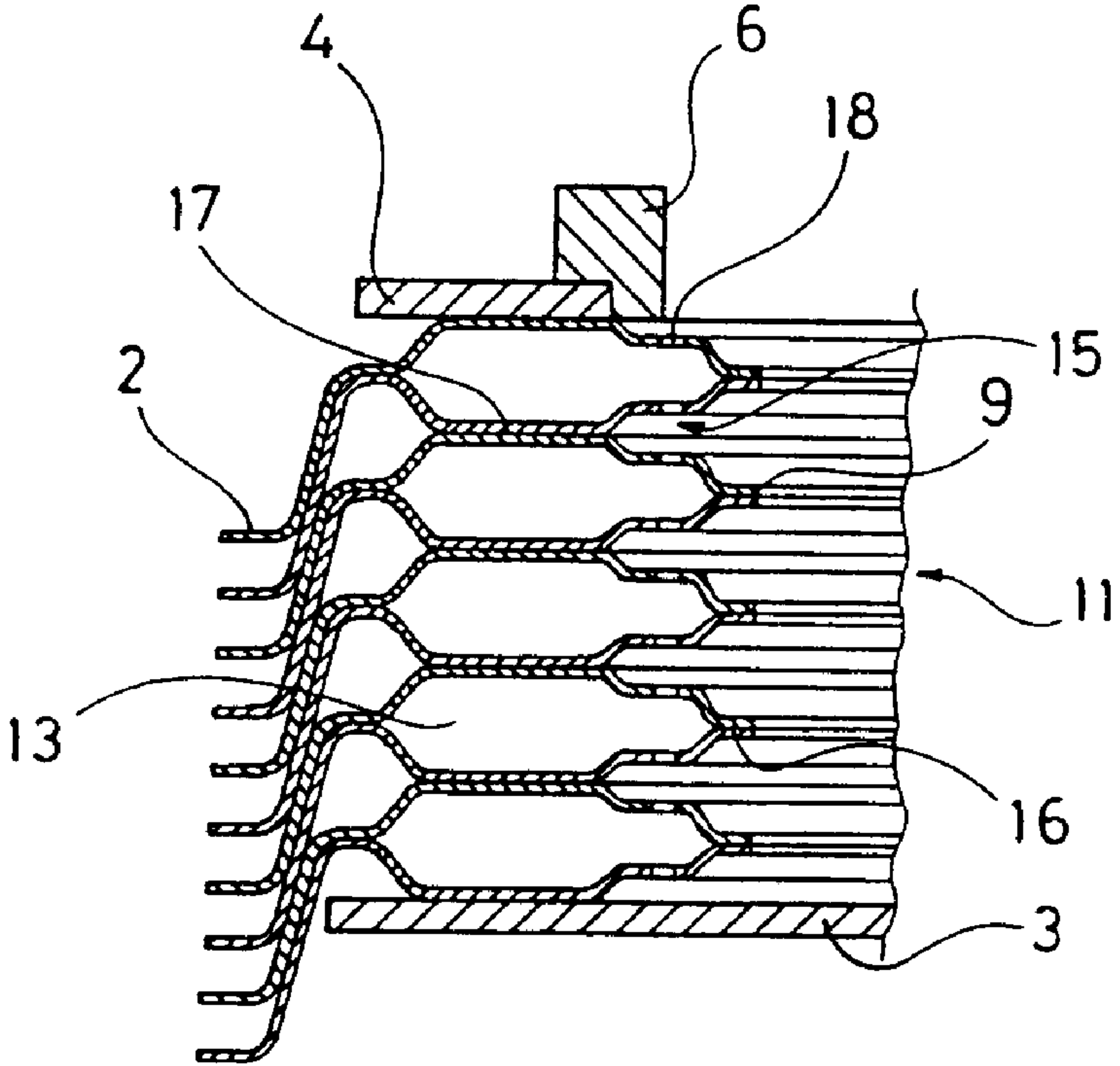


Fig.7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