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(54) **Titre : DEFLECTEUR INSTALLE DANS UN ECHANGEUR DE CHALEUR**
(54) **Title: BAFFLE PLATE IN A HEAT EXCHANGER**

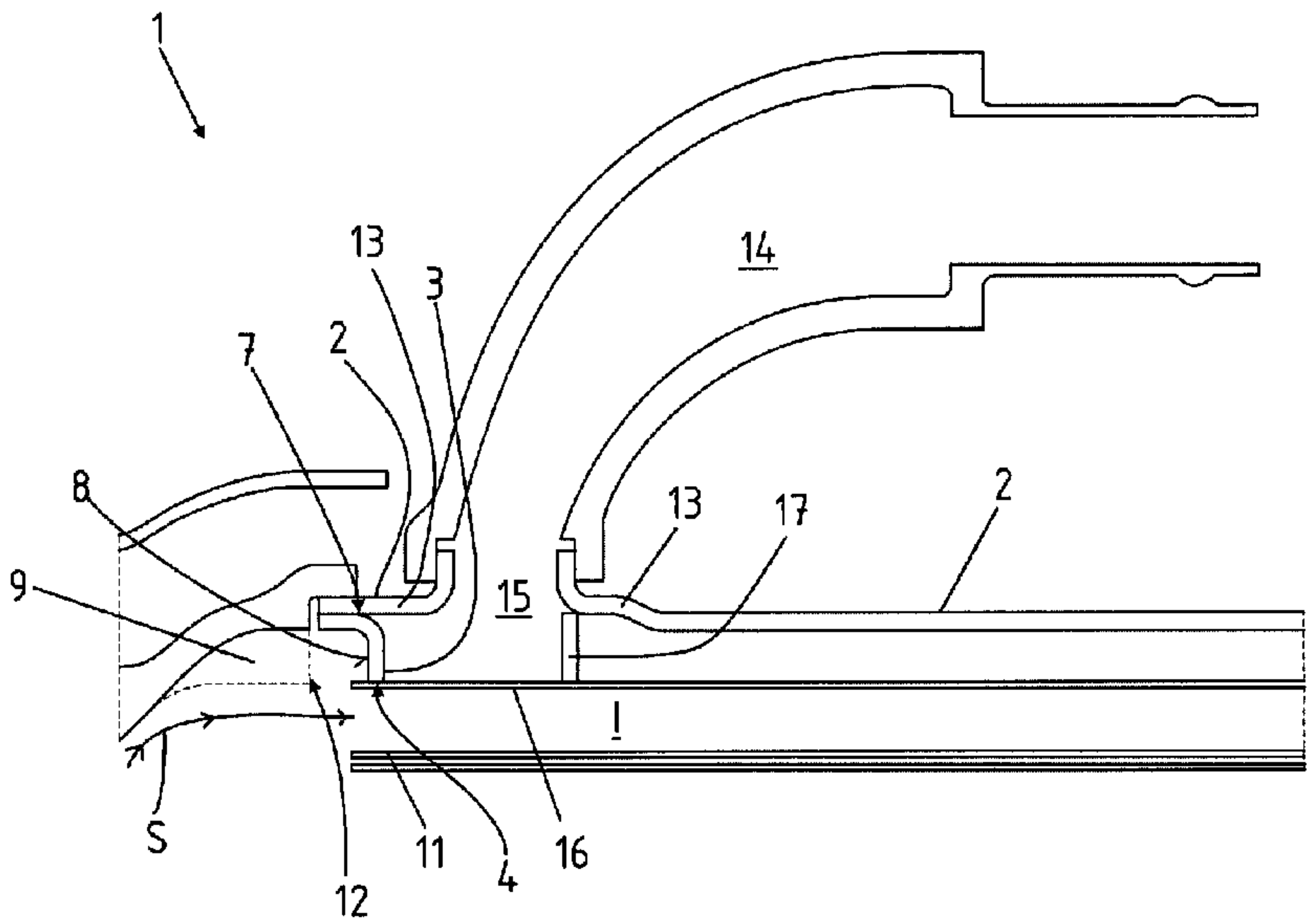

Fig. 2

(57) **Abrégé/Abstract:**
The present invention relates to a heat exchanger (1) for a motor vehicle, in particular exhaust gas heat exchanger, wherein the heat exchanger (1) has an outer covering (2) and heat exchanger tubes (11) are arranged in the outer covering (2) and a medium is feedable into the covering (2) on the front side and is removable on the opposite side, wherein a front plate (3) is arranged in each case on the end side of the covering (2), wherein the front plate (3) has openings (4) through which the medium is transferrable into the heat exchanger tubes (11), and, in particular, the heat exchanger tubes (11) at least partially reach through the openings (4), which heat exchanger is characterized in that flat surfaces (8) are formed on the front plate (3) on the border side between the openings (4), wherein directing elements (9) are arranged indirectly or directly in front of the flat surfaces (8) in the direction of flow (S), wherein the transverse clamping surfaces of the directing elements (9) overlap at least the flat surfaces (8) in the direction of flow (S).

Abstract

The present invention relates to a heat exchanger (1) for a motor vehicle, in particular exhaust gas heat exchanger, wherein the heat exchanger (1) has an outer covering (2) and heat exchanger tubes (11) are arranged in the outer covering (2) and a medium is feedable into the covering (2) on the front side and is removable on the opposite side, wherein a front plate (3) is arranged in each case on the end side of the covering (2), wherein the front plate (3) has openings (4) through which the medium is transferrable into the heat exchanger tubes (11), and, in particular, the heat exchanger tubes (11) at least partially reach through the openings (4), which heat exchanger is characterized in that flat surfaces (8) are formed on the front plate (3) on the border side between the openings (4), wherein directing elements (9) are arranged indirectly or directly in front of the flat surfaces (8) in the direction of flow (S), wherein the transverse clamping surfaces of the directing elements (9) overlap at least the flat surfaces (8) in the direction of flow (S).

Baffle Plate in a Heat Exchanger

The present invention relates to a heat exchanger according to the features in the preamble of Claim 1.

From the prior art it is known to use heat exchangers, in particular in motor vehicles, in order to cool components by means of a medium and/or in order to remove heat from a medium in a controlled manner. In this way it is possible, for example, to cool the cooling water of an internal combustion engine of a motor vehicle in a controlled manner by means of a second medium, in particular air. However, it is also possible to cool the exhaust gas of a motor vehicle, for example, in order to feed the cooled exhaust gas itself back into the combustion process.

From DE 434 34 05 A1, for example, a tube cluster heat exchanger is known, in which at one end a medium is introduced, which strikes a tube sheet and accumulates at the tube sheet, and then is led through heat exchanger tubes located in the tube sheet. In the cross flow principle, a second medium is then introduced on the outside onto a covering of the heat exchanger, it flows through the heat exchanger and it exits the heat exchanger again at an outlet side on the opposite side from the inlet of the second medium.

The disadvantage here is that, in the case of the use of such a tube cluster heat exchanger as exhaust gas heat exchanger, the tube sheet in particular is exposed at least locally to the high temperatures of the flowing exhaust gas.

The problem of the invention is to reduce the thermal effects of a medium flowing through a heat exchanger on the construction components within the heat exchanger.

The above-mentioned problem is solved according to the invention with a heat exchanger for a motor vehicle, in particular with an exhaust gas heat exchanger, according to the features in Claim 1.

Advantageous embodiment variants of the present invention are the subject matter of the dependent claims.

The heat exchanger according to the invention for a motor vehicle is formed in particular as exhaust gas heat exchanger, wherein the heat exchanger comprises an outer covering, and heat exchanger tubes are arranged in the outer covering, and a medium can be fed on the front side into the covering and removed from the opposite side, wherein the medium then flows through the heat exchanger tubes. In each case, on the terminal side, on the covering, a front plate is arranged, wherein the front plate itself has openings and the medium which flows through the heat exchanger tube passes through the openings heat exchanger tubes and exits the heat exchanger tubes again on the terminal side through the openings. In particular, the heat exchanger tubes here pass through the openings in some sections. According to the invention, the heat exchanger is characterized in that, on the front plate, on the border side between the openings, flat surfaces are formed, wherein, in the flow direction in front of the flat surfaces, indirectly or directly, directing elements are arranged, wherein the transverse clamping surface of a directing element in the flow direction overlaps at least one flat surface.

In the context of the invention, the covering, in particular an outer covering, refers most particularly preferably to a heat exchanger cartridge, in which the heat exchanger tubes are arranged in particular to form a tube cluster. The covering can here be formed preferably from a metal material, for example, in a tubular design or also in a plate design, wherein the covering is then welded with longitudinal seam. In the context of the invention, the covering is formed in particular from a steel material, most particularly preferably from a material that is resistant to the corrosive properties of the exhaust gas. However, in the context of the invention it is also possible for the covering to be formed from a light metal material, for example, aluminum or the like.

In the covering itself, the heat exchanger tubes are then arranged to form a tube cluster, wherein the individual heat exchanger tubes are held in particular by a front plate, most particularly preferably by a front plate arranged in each case in the area of an end of the covering. The front plates themselves are also known as tube sheet or else tube collar. For this purpose, the front plates comprise cutouts, wherein the heat exchanger tubes are coupled either to the cutouts or else they pass at least partially, and in particular completely, through the cutouts. As a result, it becomes possible for a medium, which enters the covering on the front side and which also exits the covering again on the front side, to first strike the front plate arranged on the inlet side and then flow through the openings into the heat exchanger tubes. In particular, this medium here is an exhaust gas, which is then led through the heat exchanger tubes. However, in the context of the invention, any other medium can also be led in the fluid and/or gaseous state through the heat exchanger.

On the front plate itself, as a result of the medium striking the front plate, a locally elevated temperature occurs in each case, in particular in the form of heat accumulation. As a result of the exhaust gas flowing through the heat exchanger tubes, the heat is then entrained again or else dissipated. However, in particular in the border area of the front plate, the portions of the front plate that are formed as a flat surface are always exposed to the impacting exhaust gas flow, since, under some circumstances, if the openings are in a staggered arrangement, the openings are not formed here or are only partially formed, and therefore these portions are heated considerably more. As a result, a thermal distortion of the front plate can occur, which leads to leaks of the heat exchanger, particularly in the case of intensive use over several years. This can, on the one hand, be compensated by only using front plates of higher quality, particularly front plates having a thicker wall design, which, however, entails increased production costs. However, the solution according to the invention provides for arranging corresponding directing elements in such a manner in the flow direction indirectly in front of the front plate, that is to say with a spacing, or, on the other hand, directly, that is to say in direct contact with the front plate itself, so that the flowing medium, in particular the flowing exhaust gas, is directed by the directing elements in a controlled manner in the direction of the front plate center and/or of the openings into the heat exchanger tubes, and thus does not strike the planar or flat surfaces. As a result, increased heating of the flat surfaces in comparison to the rest of the front plate is avoided, which allows, in particular, heat resistance and longevity of the heat exchanger, with conventional materials and optimized material use, that is to say minimized wall thickness. As a result, it is possible to form a thermally resistant heat exchanger with improved life expectancy, without using higher-quality materials and/or more materials.

In the context of the invention, the directing elements are formed, in particular as curvatures protruding into the inner space of the heat exchanger. Moreover, in the context of the invention, the directing elements can also be formed as a shaping protruding into the inner space of the heat exchanger. Consequently, the directing elements arise in the form of a curvature from the inner lateral surface of the covering and/or of a flange in the direction of the inner space of the heat exchanger. Most particularly preferably, the directing elements for this purpose have a tip which then becomes larger in the flow direction of the medium. In particular the transverse clamping surface of the respective directing element becomes larger. In the context of the invention in particular, the transverse clamping surface here becomes decreasingly larger. As a result, it is first ensured that the tip, which protrudes opposite the flow direction of the medium, in particular of the exhaust gas, with the transverse clamping surface of the directing element, which increases in size thereafter, presents an optimal flow resistance.

In particular, the directing elements are at least partially in the form of a rocket tip and/or of a water drop, in particular a mixed form of the above-mentioned flow-optimized shapes. The directing elements moreover can have the shape of a conical, at least semi-conical, cross section, of a triangular prism or else of a cubic cross section.

In the context of the invention, it is also possible to use the directing elements as separate component in the inflow funnel. For example, the directing elements are then coupled in an inner lateral surface of the inflow funnel by thermal joining, for example, by a soldering process or else by a welding process. In the context of the invention, it is also conceivable to form several directing elements on a directing element plate, for example, using reforming technology, and to insert the directing element plate then in the inner space of the inflow funnel and arrange it in accordance with the front plate which is arranged behind with respect to the flow direction, so that the flat surfaces are not exposed to the hot exhaust gas flow and thus to increased heat development.

However, it is important that the directing elements be formed so that they extend from the border into the inner space, and therefore the above-mentioned examples also should be considered to have been halved. In particular, the degressive increase in size of the transverse clamping surface refers to the fact that the extent of this surface at first increases more strongly and subsequently more weakly, but still always has a design presenting an increase.

In particular, a back side, viewed in the flow direction, of the directing element is then barely sloping, so that no suction effect is produced due to a surface that again slowly comes closer to the inner lateral surface of the heat exchanger. This would then result in the advantage, according to the invention, of the directing of the flowing medium over the flat surfaces not occurring.

In particular, several directing elements are in a radially peripheral arrangement with mutual spacing. A directing element is preferably always associated with or positioned in front of a flat surface in the border area of the heat exchanger. The heat exchanger itself can here be formed so that it is square in cross section, for example, or else rectangular. However, in the context of the invention, it is also possible for the heat exchanger to be formed so that it is round and/or oval in cross section, wherein in that case flat surfaces remain also in the border area of the front plate, due to the openings.

Moreover, it is preferable for the covering of the heat exchanger to be coupled to a flange. In the context of the invention, the flange can also be a pipe connection, wherein the flange or pipe connection is then coupled to the covering. In particular, the pipe connection is shifted at least partially in the flow direction into the covering and/or slipped onto the covering. In the context of the invention, the directing elements are then arranged again particularly preferably in the flange itself.

To achieve a particularly cost effective manufacturing, the flange is formed in particular as a cast component, wherein the directing elements are coupled to the flange so as to form a single part and be made of the same material; in particular, in the case of a flange implemented as a cast component, they are cast directly on said flange or else the directing elements are coupled as external components to the flange. It is preferable for the directing elements then to be welded and/or soldered in the flange. It is also possible, in the context of the invention, to bond the directing elements into the flange. In the context of the invention, it is also possible to incorporate an additional frame component that is peripheral on the outside on the inner lateral surface, wherein the directing elements are then formed in the frame component itself or else formed on the frame component.

Moreover, in the context of the invention, it is preferable for the inner lateral surface of the flange and/or the surface of the directing elements to be coated. The coating is, in particular, a thermally resistant coating and/or a flow-optimized coating. As a result, an increase in the useful life, in particular of the directing elements, is produced, and at the same time, inside the heat exchanger, the counter pressure generated by the directing elements in particular is minimized due to the flow-optimized surface.

Additional advantages, features, properties and aspects of the present invention are the subject matter of the dependent claims. Preferred embodiment variants are represented in the diagrammatic figures. The figures are used to facilitate the understanding of the invention.

Figures 1a and b show a perspective cutaway view and a cross-sectional view through a heat exchanger according to the invention,

Figure 2 shows a longitudinal section through a heat exchanger according to the invention with inserted heat exchanger tube, and

Figure 3 shows a front view of a heat exchanger with front plate.

In the figures, the same reference numerals are used for identical or similar components, even when a repeated description is omitted for the sake of simplification.

Figure 1a shows a heat exchanger 1 according to the invention in a perspective partial cutaway view. The heat exchanger 1 here has a covering 2 with an inserted front plate 3. At one end 5 of the covering 2, a flange 6 with inflow nozzle 6a is provided. In the inflow nozzle 6a itself, directing elements 9 are formed, which, as explained in Figure 1b below, are connected upstream of the flat surfaces 8 in flow direction S of the fluid. The directing elements 9 here can be designed so as to form a single part and be made of one material in the inflow nozzle 6a itself, or alternatively they can also be attached as external components in the inflow nozzle 6a. In the context of the invention, it is also possible for the directing elements 9 to be formed in each case on one side of the inflow nozzle 6a by a baffle plate or for the entire baffle plate to be introduced into the inflow nozzle 6a.

Furthermore, the end 5 of the covering 2 is designed with enlargement, so that a peripheral lip 13 here receives at least partially the inflow nozzle 6a with positive lock. Furthermore, a connection nozzle 14 is arranged on the lip 13, which conveys a cooling medium not shown in further detail into a cooling channel 15 represented according to Figure 2 and formed on a back side of the front plate 3, thus additionally cooling the front plate 3. The lip 13 and the inflow nozzle 6a here are preferably coupled to one another in a bonding manner, in particular soldered or welded.

Figure 1b shows a cross-sectional view of a heat exchanger 1 according to the invention, wherein the heat exchanger 1 comprises a covering 2 with inserted front plate 3. The front plate 3 itself in turn has openings 4, wherein heat exchanger tubes not represented further in Figure 1 can be inserted in the openings 4. Also represented is the flow direction S of a medium flowing through the heat exchanger 1. On one end 5 of the covering 2, a flange 6 is connected upstream of said covering. Through the flange 6, the medium flows in the direction of covering 2 and it first strikes the front plate 3. Here, the medium flows through the openings 4, wherein flat surfaces 8 are arranged in the border area 7 of the front plate 3 itself. In the flow direction S, in each case a directing element 9 is connected upstream of the flat surfaces 8. The directing element 9 itself has a tip 10, wherein the directing element 9 becomes then enlarged in flow direction S from the tip 10 on, in particular in the form of a curvature protruding into the inner space of the flange 6.

In Figure 2, the heat exchanger 1 is shown in a longitudinal section, wherein the front plate 3 is arranged at the end of the covering 2. Here, in the border area 7, the front plate 3 has a flat surface 8, wherein a heat exchanger tube 11 passes through the front plate 3 itself in the opening 4. Included in the drawing is the flow direction S of the medium through the heat exchanger tube 11. The directing element 9 is connected upstream of front plate 3 in the flow direction, wherein, in Figure 2, one can clearly see that the flow direction S thus flows from a rear end 12 of the directing element 9 in the direction toward the heat exchanger tube 11 and as a result any flowing in front of the flat surface 8 in the border area of the front plate 3 is prevented. Also shown is a cooling channel 15 which directs a cooling medium, which is not further represented, through the connection nozzle 14 to the back side of the front plate 3 and the tubes 16 arranged partially in the heat exchanger 1, thus cooling in particular the front plate. Also shown is a separation wall 17 which also borders the cooling channel 15. As represented here, the connection nozzle 14 itself can here be placed with positive lock on the lip 13, but it can also be formed as a single part with said lip and be made of the same material. It can also be seen clearly in Figure 2 that the flow direction S and consequently the exhaust gases flowing through the tube 16 would not strike in front of the flat surface 8 and generate an increased heat development here, but are directed instead directly into an inner space I of the tube 16.

This can also be seen very well in Figure 3, wherein the individual openings 4 can be seen here each in staggered arrangement in the front plate 3. In the border area 7, the flat surfaces

8 are formed which are overlapped, however, by the respective directing elements 9 in flow direction S, which in Figure 3 extends into the image plane. The directing elements 9 are indicated diagrammatically in the drawing here, since they are located, relative to the image plane, above the front plate 3. Consequently, the transverse clamping surface of the directing element 9 is larger than the flat surface 8, located behind relative to the image plane, of the border area of the front plate 3, which is thus overlapped by the transverse clamping surface of the directing element 9. The exhaust gas flowing into the image plane together with the inflowing medium is thus prevented from flowing, in particular accumulating, in front of the flat surfaces 8 of the directing element 9 and it is directed in a controlled manner into the openings 4.

Reference numerals:

1 - Heat exchanger

2 - Covering

3 - Front plate

4 - Opening of 3

5 - End of 2

6 - Flange

6a - Inflow nozzle

7 - Border area

8 - Flat surface

9 - Directing element

10 - Tip of 9

11 - Heat exchanger tube

12 - Rear end of 9

13 - Lip of 2

14 - Connection nozzle

15 - Cooling channel

16 - Tube

17 - Separation wall

S - Flow direction

I - Inner space

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Reference: **PCT/EP2013/001281**

Applicant: **Benteler Automobiltechnik GmbH**

Our file: **BENT1835WO**

December 11, 2013 XO/Bo

ANNEX

Newly Submitted Claims

1. Heat exchanger (1) for a motor vehicle, particularly an exhaust gas heat exchanger, wherein the heat exchanger (1) comprises an outer covering (2), and heat exchanger tubes (11) are arranged in the outer covering (2), and a medium can be fed on the front side into the covering (2) and discharged on the opposite side, wherein on the terminal side in the covering (2) a front plate (3) is arranged, wherein the front plate (3) has openings (4) through which the medium can be transferred into the heat exchanger tubes (11), and in particular the heat exchanger tubes (11) pass at least in some sections through the openings (4), wherein the openings (4) are formed in the front plate (3) as circular holes, and the holes are in a mutually staggered arrangement, characterized in that, on the front plate (3), on border side (7), between the openings (4), flat surfaces (8) are formed, wherein, in the flow direction (S) before the flat

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surfaces (8), directing elements (9) are arranged indirectly or directly, wherein the transverse clamping surface of the directing elements (9) in the flow direction (S) overlaps at least the flat surfaces (8).

2. Heat exchanger according to Claim 1, characterized in that the directing elements (9) are formed as a curvature protruding into the inner space (I) of the heat exchanger (1).

3. Heat exchanger according to one of Claims 1 to 2, characterized in that the directing elements (9) have a tip (10) and increase in size in flow direction (S) of the medium, and

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in particular the transverse clamping surface of the directing element (9) increases in size.

4. Heat exchanger according to the previous claim, characterized in that the transverse clamping surface increases in size degressively.

5. Heat exchanger according to one of the previous claims, characterized in that several directing elements (9) are arranged radially peripherally with mutual spacing.

6. Heat exchanger according to one of the previous claims, characterized in that a flange (6) is coupled to the covering (2), wherein the directing elements (9) are arranged in the flange (6).

7. Heat exchanger according to the previous claim, characterized in that the flange (6) is formed as a cast component, wherein the directing elements (9) are arranged so as to form a single part and be made of the same material in the flange (6), or that the directing element elements (9) are coupled as external components in the flange (6).

8. Heat exchanger according to one of the previous claims, characterized in that the inner lateral surface of the flange (6) and/or the surface of the directing elements (9) is/are coated, in particular with a heat resistant and/or flow-optimized coating.

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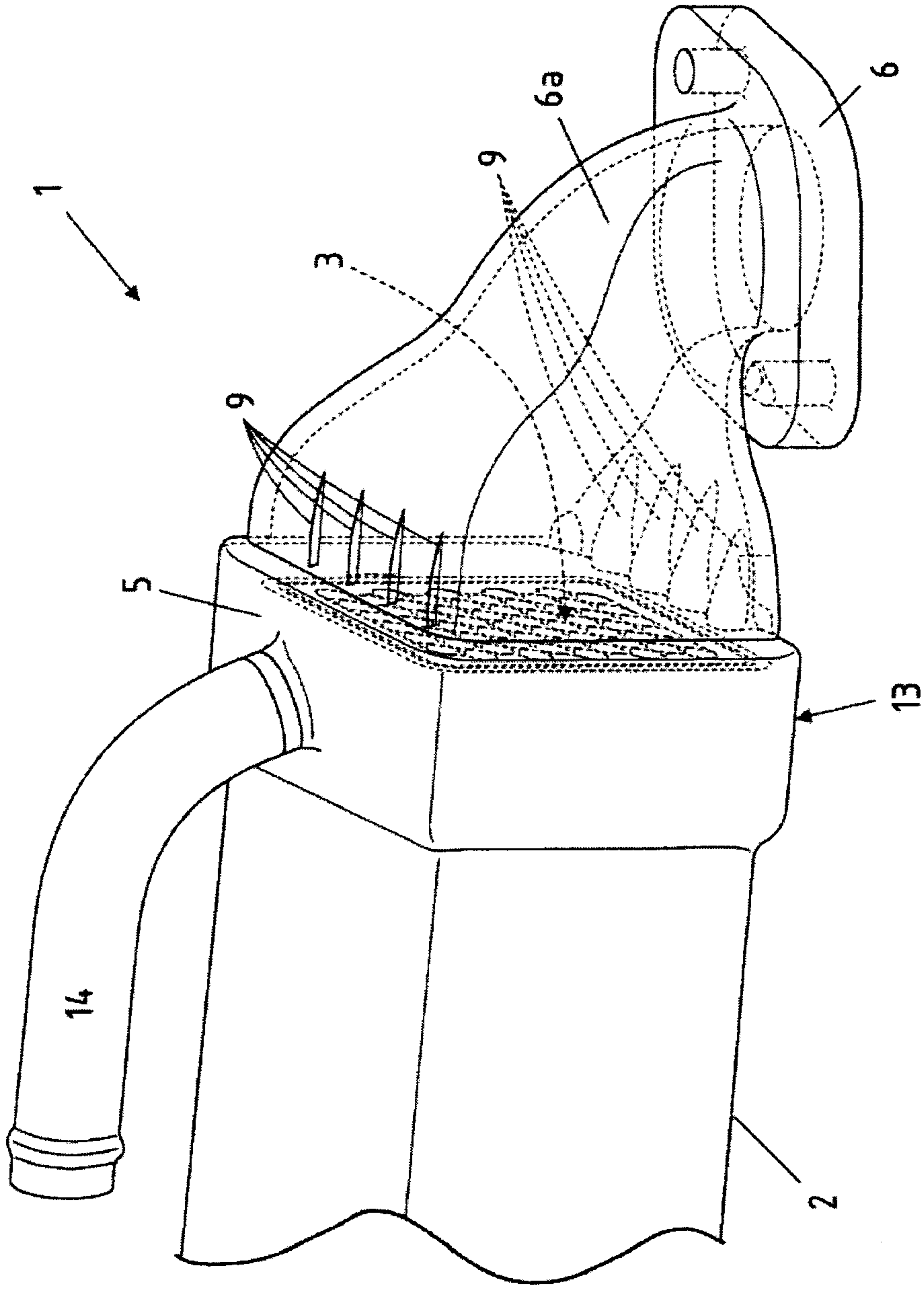

a)

Fig. 1A

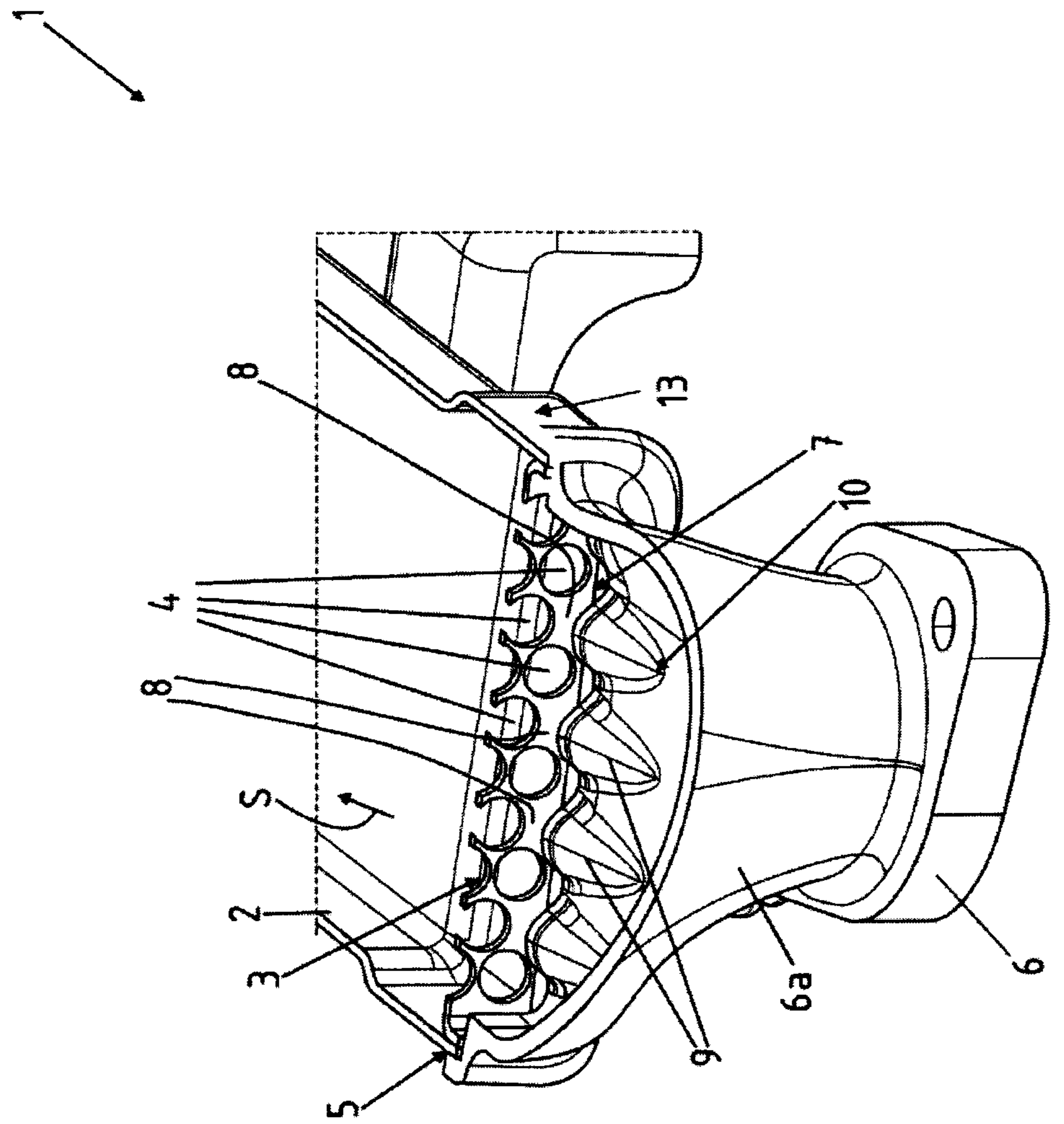

Fig. 1B

b)

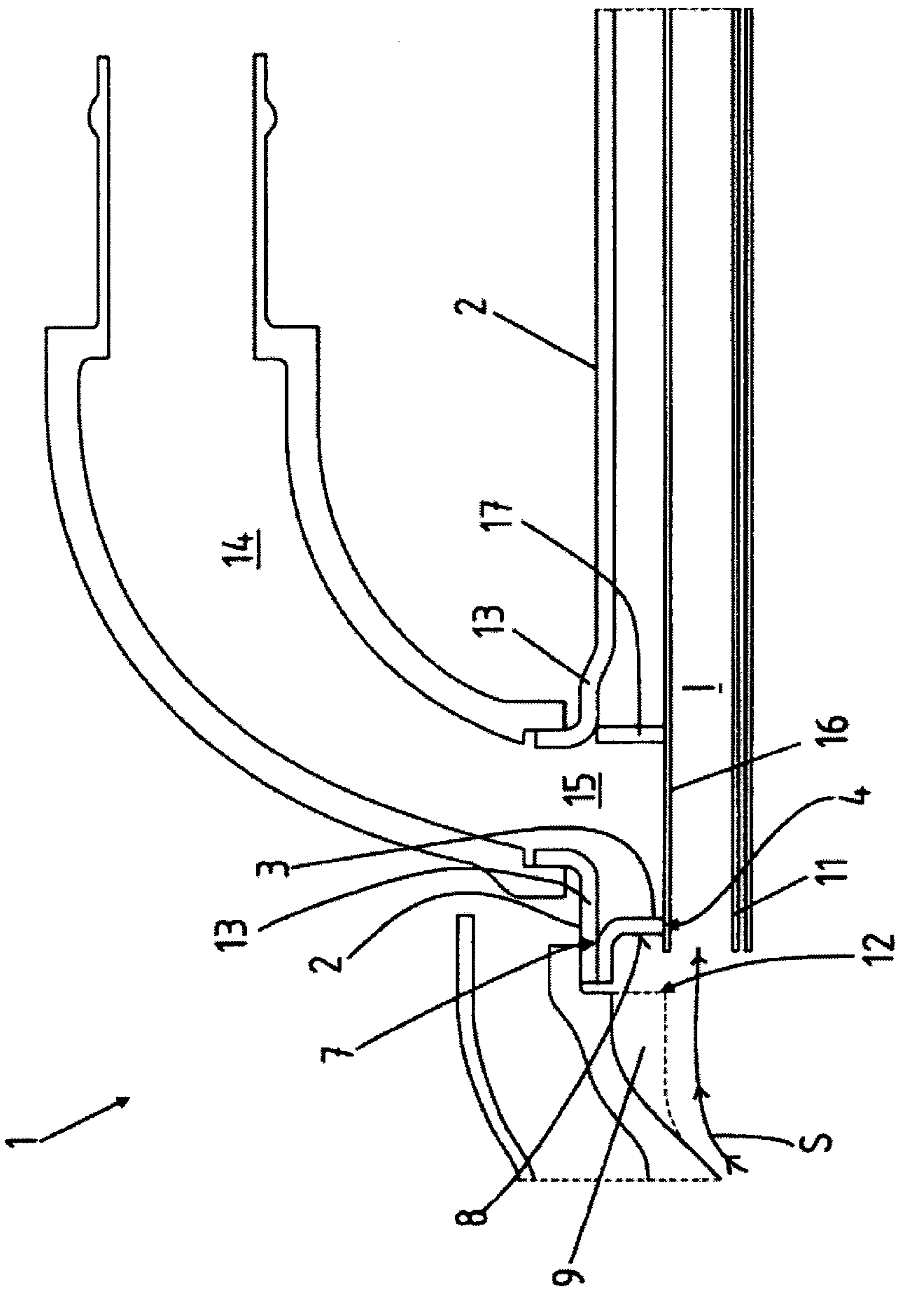

Fig. 2

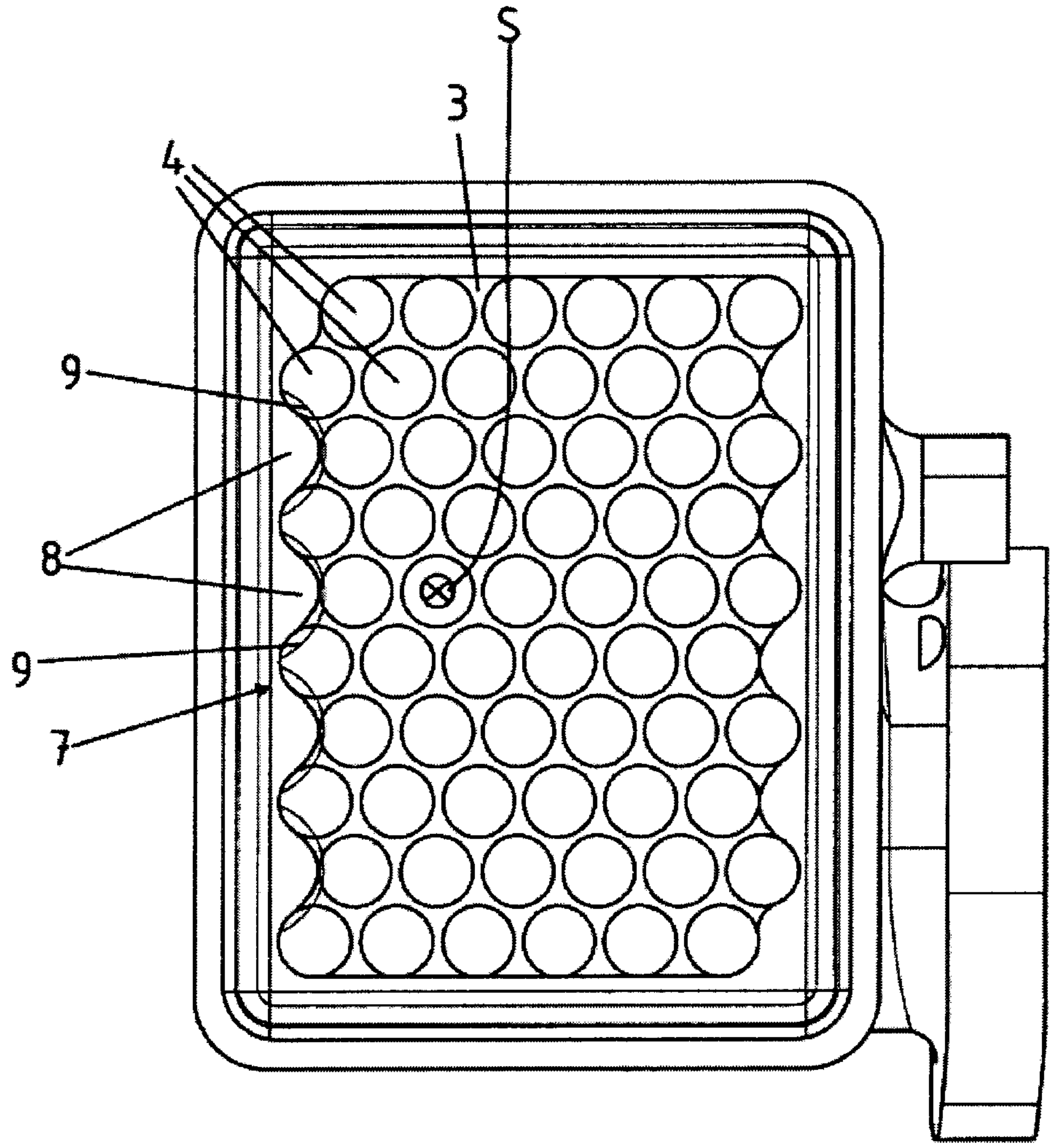

Fig. 3

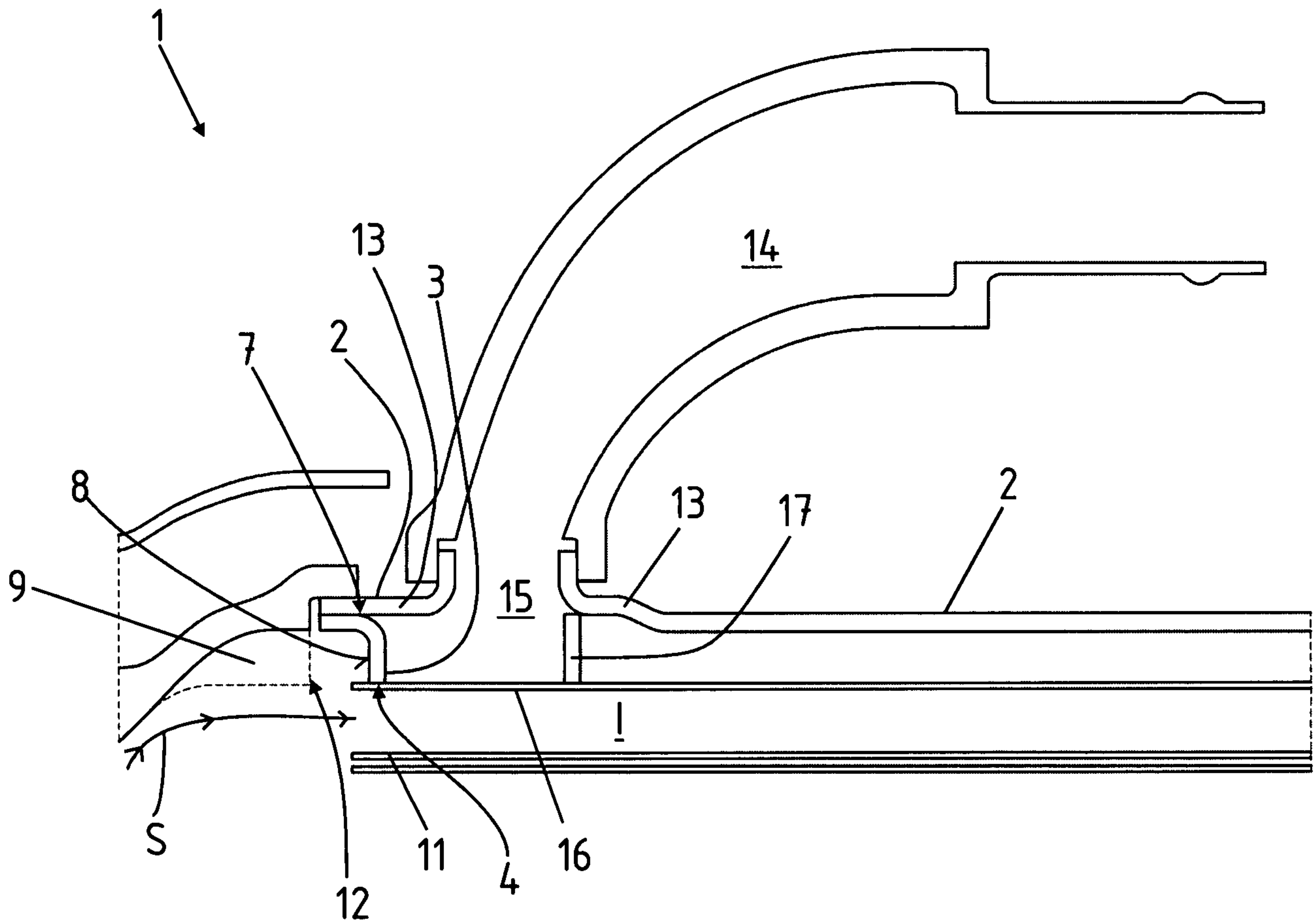

Fig. 2