(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
16 July 2009 (16.07.2009)

PCT

(10) International Publication Number
WO 2009/087480 A2

(51) International Patent Classification:
F28F 19/00 (2006.01) *F28D 9/00* (2006.01)
F28D 7/00 (2006.01)

(21) International Application Number:
PCT/IB2008/003814

(22) International Filing Date:
22 December 2008 (22.12.2008)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
PV 2007-900 27 December 2007 (27.12.2007) CZ

(71) Applicant and
(72) Inventor: **DINULESCU, Mircea** [NL/NL]; Groen van Prinstererlann 37, NL-2271 Voorburg (NL).

(74) Agent: **ZÁK, Vitezslav**; Lidická 51, 60200 Brno (CZ).

(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MT, NL, NO, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Declaration under Rule 4.17:
— *of inventorship (Rule 4.17(iv))*

Published:
— *without international search report and to be republished upon receipt of that report*

(54) Title: HEAT EXCHANGER

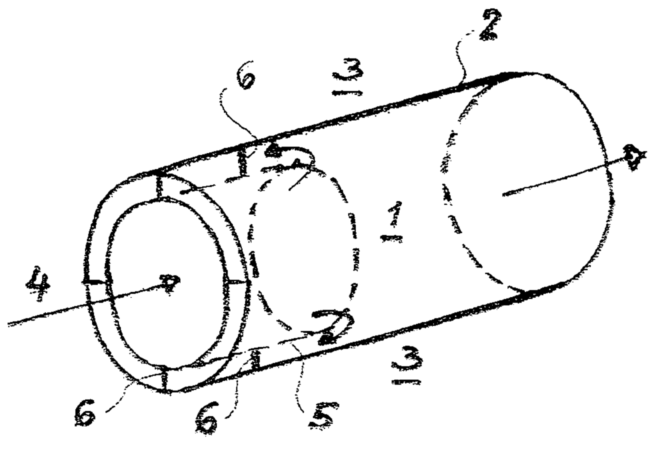

Fig. 1

(57) **Abstract:** To eliminate corrosion of inside walls of channels for hot media flow the heat exchanger is provided with means for creating layers of heated media separating at least a part of space for the cold media flow from the hot media energy transfer surface.

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HEAT EXCHANGER

Technical Field

The invention relates to a heat exchanger having systems of first channels for cold media flow and a second channels for hot media flow.

Background of the Invention

Heat exchangers comprise evenly spaced and mutually parallel arranged desks defining channels for hot and cold media flows. In principle there exist two basic designs, the first one featuring media cross flow and the other one media counter-flow, the inlet and outlet of the media being arranged either at the same side of the exchanger or at its opposite sides. The exchanger with media counter-flow having inlet and outlet of the media being arranged at the same side is often named as U-type exchanger while the one with inlet and outlet of the media on opposite sides is called a Z-type exchanger. Typical constructions are known from the paper WO 92/09859 describing an exchanger with a media cross-flow and from the paper WO 96/19708 dealing with an exchanger having a media counter-flow. When entering conventional type exchangers the cold media flow comes to a contact with exchanger walls which are from the opposite side heated by the hot media flow. In this area the cold media cools inside surfaces of channels for hot media flow down to temperature which is below the condensation point of the hot gas. Therefore vapours inside the channels for hot media flow condensate and this feature results in a corrosion of inside surfaces of the channels.

It is an object of the invention to eliminate vapour condensation inside channels for hot media flow and the resulting corrosion by application of up to the present time unknown means.

Disclosure of the Invention

The above object has been achieved by a heat exchanger having systems of first channels for cold media flow and a second channels for hot media flow designed in accordance with the present invention, the exchanger being provided with means for creating layers of heated media separating at least a part of space for the cold media flow from the hot media energy transfer surface. Further according to the invention the said means for creating a layer of warm media are arranged within the area of cold media inlet. In one preferred embodiment the means for creating a layer of warm media comprise inserts located in each of the first channels, the inserts being spaced apart from the first channel walls, while at the cold media inlet side the interjacent space between the first channel wall and the insert is closed. In another preferred embodiment the means for creating a layer of warm media comprise inserts located in each of the first channels, the inserts being spaced apart from the first channel walls and at the cold media inlet side the interjacent space between the first channel wall and the insert is interconnected with the first channel inside space, while the cold media inlet consists of jets opening into the inside space of the first channels. Still according to the invention the means for creating a layer of warm media are provided for by paths for a return flow of pre-heated media, the paths having their inlets at the side of heated media output and outputs leading into a common space at the side of cold media inlet through which there are extending the jets for input of the cold media, the jets opening into the inside space of the first channels.

According to the substantive aspect of the invention a layer of pre-heated media is created within the cold media inlet area. Such a layer provides for thermal conditions allowing no vapour condensation and corrosion of inside surfaces of channels hot media flow.

Brief Description of the Drawings

The invention is further illustrated by way of examples of embodiments presented in the accompanying drawings.

Fig. 1 shows design of one tube of a channel for cold media flow by a tube type exchanger with a static protective layer of pre-heated media. Fig.2 presents a similar embodiment by a desk type exchanger.

Fig. 3 illustrates a longitudinal section through one tube of the channel for cold media flow of a tube type exchanger having a dynamic protective layer of pre-heated media and on Fig. 4 there is a partial vertical longitudinal section through a similar embodiment.

Fig. 5 shows a vertical longitudinal section through a channel for cold media flow by a tube type exchanger, the protective layer being provided for by a return flow of a part of the heated media and the Fig. 6 shows a horizontal section through a the channel for cold media flow by a desk type exchanger being of a similar embodiment as on Fig. 5

Description of Preferred Embodiments

In further presented descriptions of heat exchangers comprising the invention, the term heat-exchanging media means cold medium and hot medium which flow into the exchanger and flow out as heated and cooled media resp. The term warm medium describes originally cold medium partially heated during transport through an exchanger. The heat-exchanging media may be represented by water or gas, the term cold medium applies for any matter which is to be heated. As a typical hot medium we can take waste heat, the energy of which an exchanger transfers to another medium.

Basic embodiment of the new solution is presented on Fig. 1, representing a section of a tube type heat exchanger. Cold media flow channels 1 are provided for by tubes 2 passing through a hot media flow channel 3. Within a section adjacent to a cold media inlet 4 each tube 2 is furnished with a tubular insert 5 which is by means of spacers 6 spaced apart from the tube 2 inside surface. The space between the tube 2 and the tubular insert 5 is closed at the side of the cold media inlet 4. When entering the exchanger the cold media flow contacts only the tubular insert 5, while within the space between the tubular insert 5 and the tube 2 inside surface there is an air cushion of warmed media. Thus the cold media flow does not act directly upon the wall of the hot media flow channel 3 and within a section running along the tubular insert 5 an outside surface of tubes 2 is cooled less intensive. Therefore no condensation of vapours within the hot media flow channel 3 occurs.

Similarly there is constructed a plate type heat exchanger, the embodiment of the one with a heat-exchanging media cross flow is schematically presented on Fig. 2. Spaced apart plates 7 define first channels 1 for cold media flow and second channels 2 for hot media flow. Each channel 1 for cold media flow is provided with flat inserts 8 located adjacent to a cold media inlet 4. The flat inserts 8 are my means of spacers spaced apart from the first channel 1 inside surface. The space between the plate 7 and the adjacent flat insert 8 is closed at the side of the cold media inlet 4. When entering the exchanger the cold medium contacts only the flat insert 8. In a space between the flat insert 8 and the plate 7 there are created protective layers, cushions of heated media and therefore the cold media does not act directly upon the plates 7 and walls of the hot media flow channels 3. The said layers of heated media separating parts of cold media flow channels 1 from surfaces for transfer of hot media energy prevent extensive cooling of walls of the hot media flow channels 3.

The above described feature gives an effective protection against vapour condensation in the hot media flow channels 3 at the cold media inlet 4 sides. The protective layers of heated media by the above described embodiments practically do not move, their possible movement is negligible and has no influence upon the effect of the layer. Therefore such a protective layer can be described as a static protective cushion. To prevent movements of the layer mechanical barriers could be installed. It is not necessary to prevent any movement of the layer, it is sufficient to minimize it to negligible extent.

It is also possible to provide for a dynamic protective layer as described below.

Fig. 3 illustrates a design providing for the dynamic protective layer by a tube heat exchanger. The basic construction of the exchanger is the same as the one presented on Fig. 1. The .cold media flow channels 1 are provided for by tubes 2 passing through a hot media flow channel 3. Within a section adjacent to a cold media inlet 4 each tube 2 is furnished with a tubular insert 5 which is by means of spacers 6 spaced apart from the tube 2 inside surface and arranged spaced apart from an outside seal 9 at the cold media inlet 4.side of the cold media flow channel 1. A cone-like jet 10 protrudes through the seal 9 and opens into the inside of the tubular insert 5. The cold media flow running into the first channel 1 produces suction effect resulting into back-flow of a part of already heated media through a gap between the tubular insert 5 and the tube 2 into the entry part of the cold media flow channel 1. A pre-heated medium thus flows around the tubular insert 5 and increases the effect of the warm protective cushion. In its entry part the tube 2 has no direct contact with the cold media flow and the tube 2 outside surface inside the hot media flow channel 3 is not excessively cooled and no vapour condensation and consequent undesired corrosion may occur.

The above described design with jets 10 can be applied also by plate-type heat exchangers, as shown on Fig. 4. The cone-like shape of the jets is here replaced by elongated shape occupying full width of each of the cold media flow channels 1. Such jets 10 offer the same effect and temperature behaviour as described above for the tube-type heat exchanger.

Apart from the above discussed inserts the dynamic protective layer can be introduced also by means of separate paths for a return flow of warm or heated medium. Fig. 5 shows a corresponding construction by a heat exchanger of the tube type. The cold media flow channels 1 comprise two systems of tubes. Cold medium enters the exchanger through funnel-type jets 10 directly only into primary tubes 21, while a system of intermediate tubes 22 serves for return flow of a part of already warmed media. By a suitable ratio between primary tubes 21and intermediate tubes 22 one can obtain desired rate of a return flow of originally cold, now already warmed medium.

The cold medium entering through the jets 10 into the primary tubes 21 produces at the inlet suction effect. Static pressure at an outlet 15 of the system of primary tubes 21 is higher than pressure in a common space 16 of both tube systems at the cold media inlet 4. This fact results in a return flow of a part of warmed medium from the outlet side back towards the inlet side.

During the return flow the warm medium is further heated by the hot medium surrounding the system of intermediate tubes 22. Therefore temperature inside the common space 16 of both tube systems is significantly higher than the entering cold medium temperature. The cold medium flow running through the jet 10 sucks the warmed medium from the common space 16 of both tube systems into the primary tubes 21 the flow of sucked medium having a form of a ring-shaped flow. Within the inlet part of the system of primary tube the ring-shaped flow of the warmed medium creates the protective layer preventing direct contact of the cold medium with walls of the hot medium flow channel 3. As discussed above also in this case no excessive cooling of the walls occurs and therefore no undesired vapour condensation inside the hot medium flow channel 3 appears.

Similarly as in the above discussed constructions the double system of the cold media flow channel 1 of the tube-type heat exchanger can be applied also by the plate-type heat exchanger as shown on Fig. 6.

Each cold media flow channel 1 is again divided into two systems. The first system consists of primary channels 31 arranged in parallels, the second system comprise intermediate channels 32. Each primary channel 31 has its own jet 10 providing for inlet of the cold medium flow. The cold medium entering through the jets 10 into the primary channels 31 produces at the inlet suction effect allowing for draw of a flow of the already warmed medium from the intermediate channels 32 into the primary channels 31. Heat energy of this flow warms hot medium flow channel 3 walls located over and below the respective cold medium flow channel 1 and prevents creation of conditions for vapour condensation and consequent wall corrosion in the adjacent hot medium flow channel 3

Industrial applications

The present invention is designed for heat exchangers of tube or plate construction.

CLAIMS

1. Heat exchanger having systems of first channels for cold media flow and second channels for hot media flow, **characterised in**, that it is provided with means for creating layers of heated media separating at least a part of space for the cold media flow from the hot media energy transfer surface.

2. Heat exchanger according to claim 1, **characterised in**, that the means for creating a layer of warm media are arranged at the area of cold media inlet (4)

3. Heat exchanger according to claim 1 or 2, **characterised in**, that the means for creating a layer of warm media comprise inserts (5,8) located in each of the first channels (1), the inserts (5,8) being spaced apart from the first channel walls, while at the cold media inlet (4) side the interjacent space between the first channel (1) wall and the insert (5,8) is closed.

4. Heat exchanger according to claim 1 or 2, **characterised in**, that the means for creating a layer of warm media comprise inserts (5,8) located in each of the first channels (1), the inserts (5,8) being spaced apart from the first channel walls and at the cold media inlet (4) side the interjacent space between the first channel wall (1) and the insert (5,8) is interconnected with the first channel (1) inside space, while the cold media inlet (4) consists of jets (10) opening into the inside space of the first channels (1).

5. Heat exchanger according to claim 1 or 2, **characterised in**, that the means for creating a layer of warm media are provided for by paths for a return flow of pre-heated media, the paths having their inlets at the side of heated media output and outputs leading into a common space (16) at the side of cold media inlet (4) through which there are extending the jets (10) for input of the cold media, the jets (10) opening into the inside space of the first channels (1).

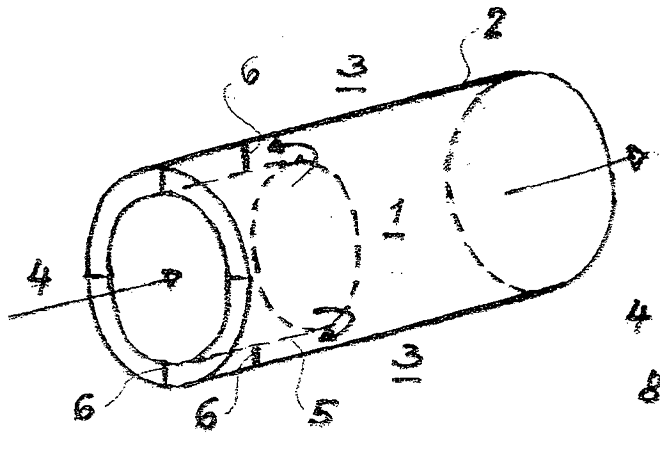

Fig. 1

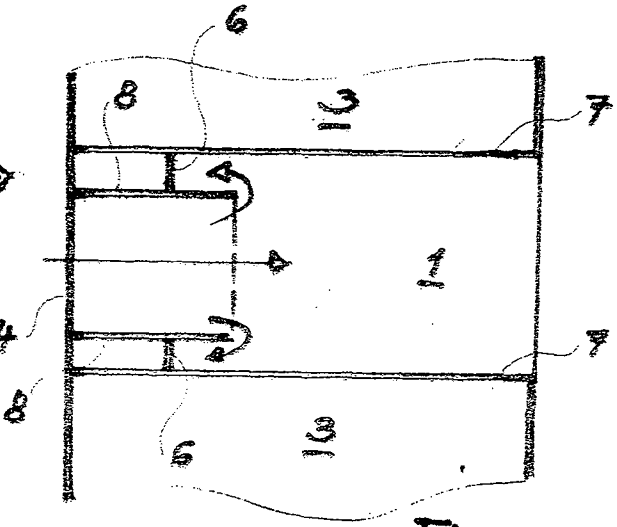

Fig. 2

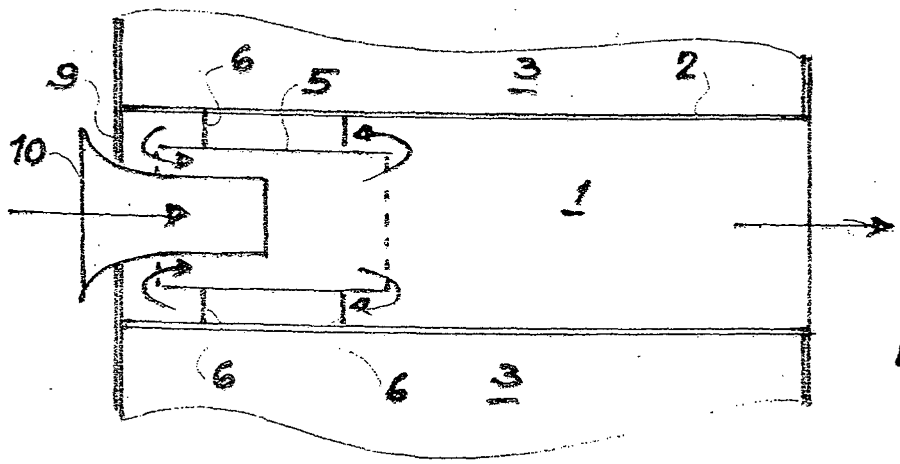

Fig. 3

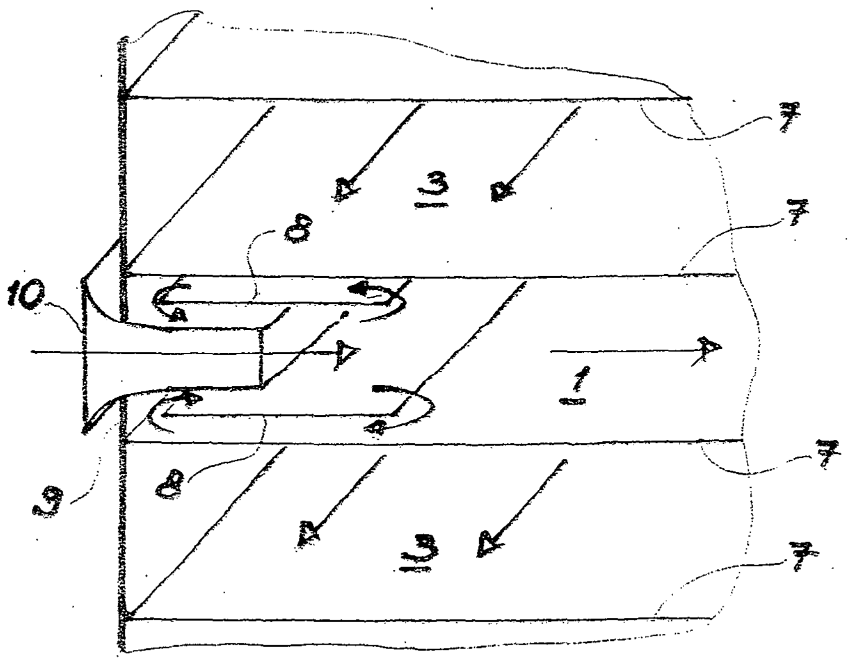

Fig. 4

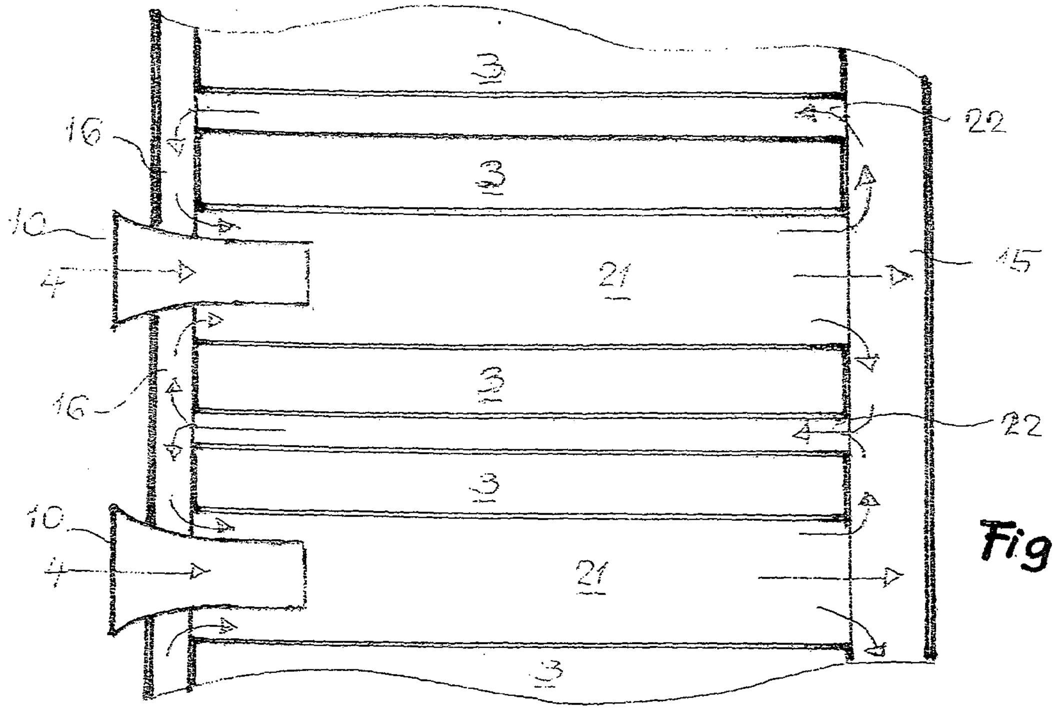
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Fig: 5

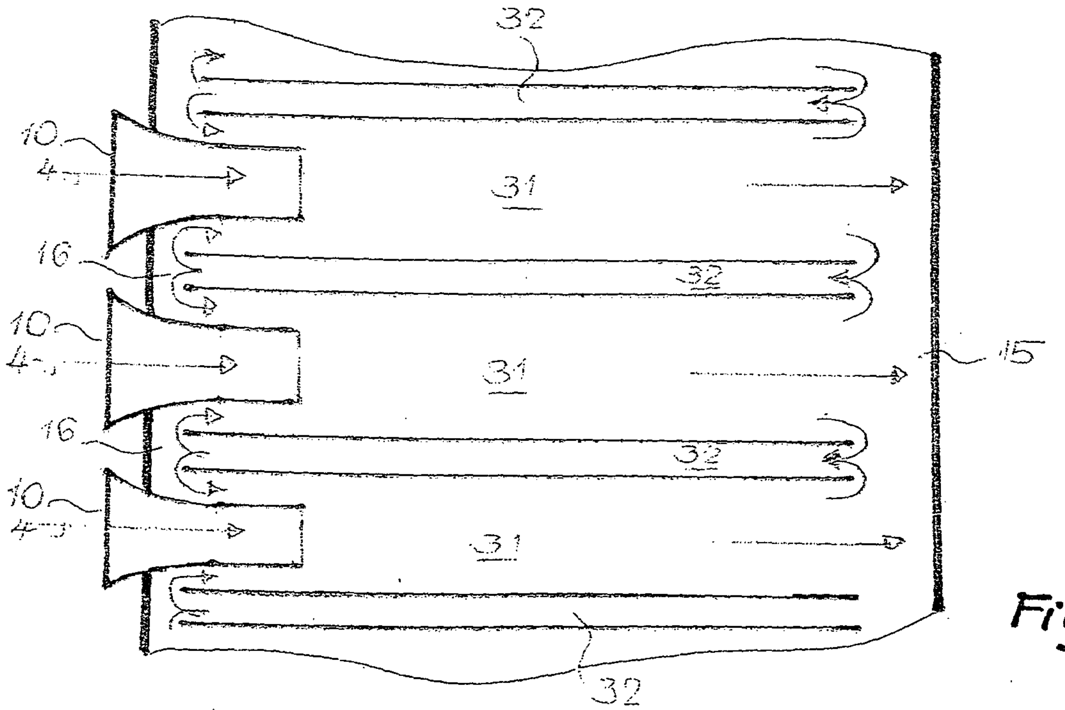
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Fig. 6