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(54) Improved finned-pack heat exchanger construction for refrigerating, air conditioning and heating apparatus

(57) An improved finned-pack heat exchanger construction for refrigerating, air conditioning and heating apparatus comprises a plurality of longitudinal parallel tubes and cross fins including corresponding holes housing said tubes and forming a fin pack, and being characterized in that the connection of the fins to form fin groups, on bearing edge portions, to one another and between the fins and rigid elements, is performed by using structural glue materials.

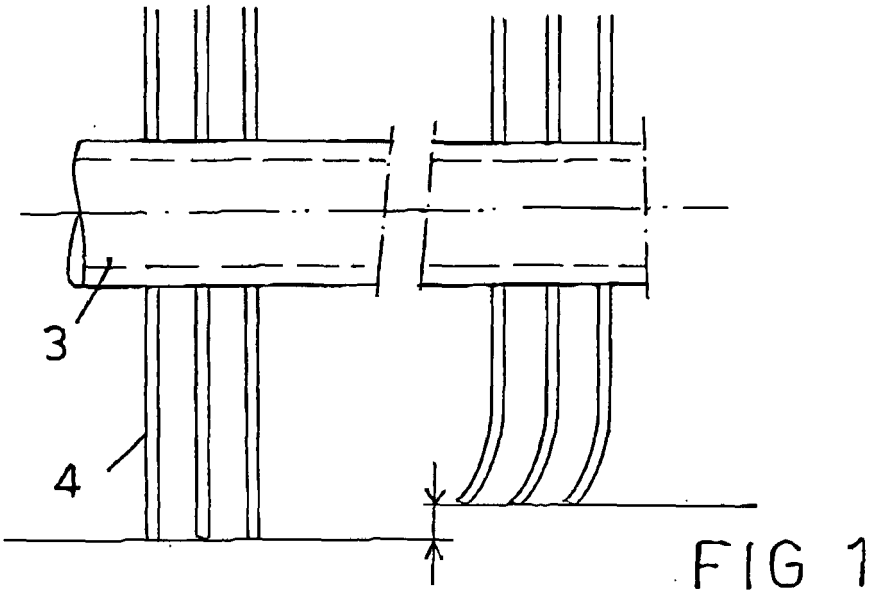

FIG 1

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Description

BACKGROUND OF THE INVENTION

[0001] The present invention relates to an improved finned-pack heat exchanger construction for refrigerating, air conditioning and heating apparatus.

[0002] Prior heat exchangers have been made by using tubes, fins, manifolds and a supporting frame therefor.

[0003] As is known, through said tubes a heat exchanger fluid is conveyed which, depending on the heat exchanger use, can comprise hot water, cold water or an evaporating or condensing fluid, such as in ventilated condensers.

[0004] Through said fins air is conventionally conveyed, whereas the manifold operates to evenly distribute the fluid through the head exchanger tubes.

[0005] The supporting frame is made of side and middle supporting plates, including corresponding calibrated holes, therethrough the heat exchanger tubes are threaded.

[0006] The finned pack, which can comprise respective cover elements, is essentially supported by the tubes passing through the side and middle plates of the supporting frame.

[0007] Said supporting frame also operates to allow the heat exchanger to be mounted in more complex apparatus, conventionally also provided with ventilating assemblies or sets.

[0008] Depending on their use, said apparatus are called conditioners, air evaporating devices, ventilated condensers and liquid coolers.

[0009] In prior bearing constructions of "air exchanger" apparatus made of fluid circulating tubes interconnected by heat exchange fins having a larger radiating surface, which are conventionally called "battery assemblies", it is difficult and expensive to support said assemblies, because of two main reasons.

[0010] In fact, both said fins and tubes comprise materials, such as copper and aluminium, having a high thermal conductivity coefficient, but a low mechanical strength.

[0011] Moreover, both said tubes and fins have a small thickness and, accordingly, they cannot resist against high static and dynamic loads due to their weights'.

[0012] In addition, as said batteries, during their use, are subjected to thermal stresses, they thermally expand, thereby generating mechanical stresses which must be properly neutralized.

[0013] Also known is the fact that other conventional supporting systems comprise perforated walls having the same geometrical configurations as said fins, and which are called "shoulders", arranged at the end portions of the tube sheet and at middle positions.

[0014] The tubes passing through said shoulders are properly supported but, because of friction generated by the thermal expansions and contractions, they are affected by breakage and pressurized fluid losses, thereby decreasing the operating life of the apparatus.

[0015] In some applications supporting elements for replacing the tubes and providing an auxiliary load supporting function have been also used, in view, in which the loads, also in this case, are offset or transferred to the mentioned "shoulders".

[0016] In this connection it should be pointed out that the same Applicant has designed a novel patented system allowing to support the battery not by supporting tubes or optional replacement elements, but by suitably coupled fins, to provide a homogeneous assembly reinforced by C section members made of a strong material clamped to bearing edge portions.

[0017] Said bearing edge portions, rigid with the main construction of the apparatus, operate as skid members, permitting thermal dilatations and not generating stresses, even in heat exchangers having a comparatively large length, greater than twelve meters.

SUMMARY OF THE INVENTION

[0018] Accordingly, the aim of the present invention is to provide an improved construction for making heat exchangers, even of a comparatively large size.

[0019] In this connection it should be apparent that if such a large-size heat exchanger would be conventionally constructed, then the high extension of the radiating surfaces and weight of the components, tubes and fins, would apply high stresses on conventional supporting elements.

[0020] Moreover, the constructional tolerances of the apparatus parts would not provide the desired compactness, stiffness and control of the coupling clearance of the components to be assembled, with very high consequent constructional difficulties.

[0021] Within the scope of the above mentioned aim, a main object of the invention is to provide, by novel constructional elements, both from a structural and design standpoint, a novel system for connecting fins and C section members for properly coupling the section members and the elements of the bearing construction of the overall apparatus.

[0022] Another object of the invention is to provide such a constructional solution which can be adopted for any desired types of heat exchanger apparatus, to be assembled or transported either in a horizontal or vertical position and, in particular, for comparatively large size heat exchanger apparatus, in which weight and thermal dilatation effects have hindered up to now a possibility of obtaining a high quality and reliability industrial production.

[0023] The above mentioned aim and objects, as well as yet other objects, which will become more apparent hereinafter, are achieved by an improved finned-pack heat exchanger, construction for refrigerating, air conditioning and heating apparatus, comprising a plurality of longitudinal parallel tubes and cross fins including a cor-

responding plurality of holes housing said pack forming tubes, characterized in that the coupling of said fins into groups, on bearing edge portions, with respect to one another and between said fins and corresponding rigid elements, is performed by using structural glue materials.

[0024] Said structural glue materials represent a very important feature of the invention since they comprise a silane rubber based single component resilient sealing element, polymerize under atmospheric moisture and form a soft and resilient sealing.

[0025] Thus, they provide a bearing element adapted to support the glued fins and cooperate to provide a proper load distribution.

BRIEF DESCRIPTION OF THE DRAWINGS

[0026] Further characteristics and advantages of the present invention will become more apparent hereinafter from the following detailed disclosure of a preferred, though not exclusive, embodiment of the invention which is illustrated, by way of an indicative, but not limitative, example in the accompanying drawings, where:

Figure 1 shows, by two cross-sectioned partial views, the deformations the fins of a conventional heat exchanger construction are subjected to;

Figure 2 is a partially cross-sectioned view illustrating the coupling system for coupling the heat exchanger fins according to the invention;

Figure 3 is a further partially cross-sectioned view illustrating the coupling of another portion of fins, according to the present invention;

Figure 4 shows, by three front cross-sectioned views, the coupling' system for connecting to the bearing construction of the overall apparatus, the supporting elements and C section members glued to the fins, according to the present invention;

Figure 5 is a front cross-sectional view illustrating the connecting or coupling system for coupling to the bearing construction of the overall apparatus, the C section members coupled to the fins according to the present invention; and

Figure 6 is a further front cross-sectional view illustrating the coupling system, for coupling to the bearing construction of the overall apparatus, the supporting. elements glued to the fins, according to the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0027] With reference to the number references of the above mentioned figures, the improved finned-pack heat exchanger construction for refrigerating, air conditioning and heating apparatus according to the invention, which has been generally indicated by the reference number 1, essentially comprises a plurality of longitudinal parallel tubes 3, therethrough heat exchanger fluid is conveyed, and a plurality of cross cooling fins 4 including respective fin holes housing said tubes 3 to form a pack.

[0028] In a conventional construction, the fins 4, of small thickness, as individually considered, do not provide under pressure or flexure loads a sufficient stiffness: thus, they are collapsed and permanently deformed, as shown in figure 1.

[0029] The fins arranged close to the heavy loaded region are not able of properly operating and transferring to other fins their load, thereby causing a "chain-type" deformation of the overall supported region.

[0030] According to the present invention, the solution of the above mentioned problem is that of coupling to one another the groups of fins 4 and connecting said groups to a supporting element 5 designed for evenly distributing the operating load, as is schematically shown in figure 2.

[0031] Moreover, according to the invention, a main feature is to also connect that fin portion 6, previously not used, which would be loaded by pulling forces, as it is schematically shown in figure 3.

[0032] Actually, as is known, elongated bodies of small cross-sections, subjected to a pressure force, are easily bended and collapsed, whereas they properly operate if subjected to pulling forces, thereby holding their performance to a target level.

[0033] According to the present invention, the loads, comprising the weight and other stress of the batteries, are supported by cooperating tensioned fins pressed fins.

[0034] This result is achieved, according to a further feature of the present invention, by connecting to the overall apparatus bearing construction, the supporting elements 7 or C section members 8 glued to the fins, as is clearly shown in figures 4-6.

[0035] This connection is also performed by a constructional glue material applied during the assembling operation.

[0036] This provides two great advantages: to provide the disclosed connection, as shown in figure 4, and overcome the component piece constructional errors, as shown in figure 5, by properly eliminating the clearances between the component parts and providing a small resilient coupling, adapted to cushion any vibrations in operating or transporting conditions.

[0037] The coupling system between the fins and constructional parts also comprises the battery zones either central or intermediate with respect to the zone contours, as clearly shown in figure 6, where any deflection due to a resilient flexure yielding would be maximum.

[0038] This allows to make large size batteries, of reliable operation, both in a regimen condition and in transporting the apparatus, owing to the supporting and cushioning of dynamic forces susceptible to deteriorate the operating performance.

[0039] It has been found that the invention fully achieves the intended aim and objects.

[0040] In fact, the invention provides an improved heat exchanger construction allowing to make comparatively

large size heat exchanger apparatus, without generating the problems affecting prior constructions in which the extension of radiating surfaces and component element weight, such as tubes and fins, generate very high stresses.

[0041] Actually, the constructional tolerances of prior apparatus do allow to obtain the desired compactness, stiffness and control of the coupling clearances on the components to be assembled.

[0042] The construction according to the invention, on the contrary, provides a novel system using structural glue materials for coupling fins and C section members and further coupling the bearing elements of the bearing construction of the overall apparatus.

[0043] Such a solution can be adopted for any apparatus, independently from the assembling or transporting direction, either horizontal or vertical, and, in particular for large size apparatus in which the weights and thermal dilatations have prevented up devices of high quality performance and functional reliability from being easily made.

[0044] Thus, the improved construction according to the invention provides a lot of very important advantages such to eliminate the constructional clearances, a properly support the battery intermediate regions, greatly reduce the construction movements to thermal dilatations, and properly distribute the loads through the fins, between the pressed side and tensioned side in a vertical assembling.

[0045] Yet another important advantage is that the dynamic forces can be properly cushioned, during handling and transporting operations, to prevent functional properties from being negatively affected because of fatigue, breakage and other phenomena.

[0046] Moreover, the improved construction according to the present invention allows to properly exploit the overall radiating surface and the tube sections provided for circulating the heat exchanger fluid.

[0047] In practicing the invention, the used materials, as well as the contingent size and shapes, can be any, depending to requirements.

Claims

1. An improved finned-pack heat exchanger construction for refrigerating, air conditioning and heating apparatus, comprising a plurality of longitudinal parallel tubes and cross fins including corresponding fin holes, housing said tubes and forming a pack, **characterized in that** the coupling of said fins into groups, on bearing edge portions, to one another and to rigid elements is performed by using structural glue materials.

2. An improved finned-pack heat exchanger construction, according to claim 1, **characterized in that** it comprises a connection of said fins into groups, on bearing edge portion subjected to pulling loads, from a side, and pressure loads, from the opposite side, by structural glue materials.

3. An improved finned-pack heat exchanger construction, according to claim 1 or 2, **characterized in that** said coupled fins are connected to supporting or section elements, cross extending with respect to said fins, by using structural glue materials.

4. An improved finned-pack heat exchanger construction, according to one or more of the preceding claims, **characterized in that** it comprises a supporting system for supporting the fin batteries, said supporting system using, at said battery and bearing construction coupling zones, structural glue materials.

5. An improved finned-pack heat exchanger construction, according to one or more of the preceding claims, **characterized in that** it comprises a compensating system for compensating for clearances and geometrical defects between said batteries and bearing construction.

6. An improved finned-pack heat exchanger construction, according to one or more of the preceding claims, **characterized in that** said compensating system, comprises structural glue materials applied to the defective regions as a multiple direction connecting filling and coupling means.

7. An improved finned-pack heat exchanger construction, according to one or more of the preceding claims, **characterized in that** it comprises a vibration cushioning system.

8. An improved finned-pack heat exchanger construction, according to one or more of the preceding claims, **characterized in that** said vibration cushioning system comprises structural glue material layers arranged between component parts subjected to variable loads or impacts, to compensate for any clearances by a weakly resilient material.

9. An improved finned-pack heat exchanger construction, according to claim 8, **characterized in that** said structural glue materials comprise a silane rubber based single component resilient sealing material polymerizing under atmospheric moisture thereby providing a soft and resilient sealing.

10. An improved finned-pack heat exchanger construction, according to one or more of the preceding claims, **characterized in that** it further comprises a system for controlling any flexural deflections at central or intermediate regions of said batteries, said system comprising a connection, at said regions, of

fin groups to bearing elements of said apparatus, by using structural glue materials.

11. A method for making an improved finned-pack heat exchanger construction, for refrigerating, air conditioning and heating apparatus comprising a plurality of parallel longitudinal tubes and cross fins including corresponding fin holes housing said tubes to form a pack, **characterized in that** said method comprises the step of coupling said fins into groups, on bearing edge portions thereof, to one another, and to rigid elements by using a structural glue material.

12. A method according to claims 11, **characterized in that** said structural glue material is applied as said fins are assembled to form batteries and as said batteries are assembled on said bearing constructions.

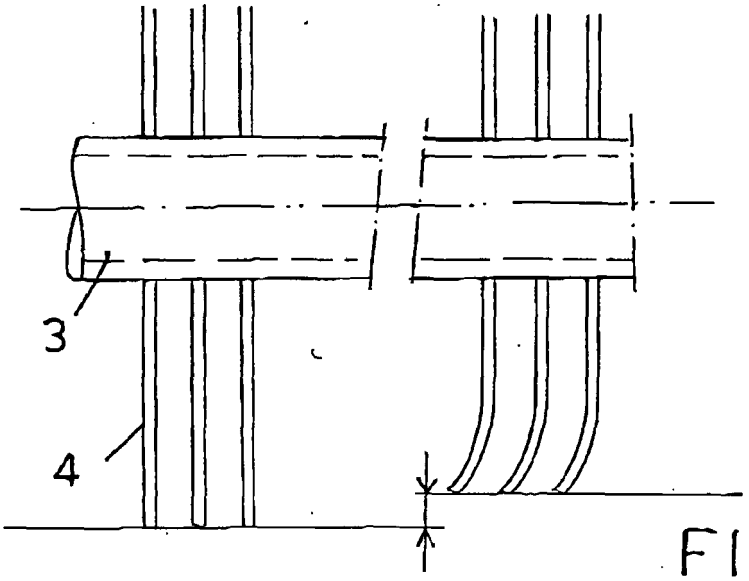


FIG 1

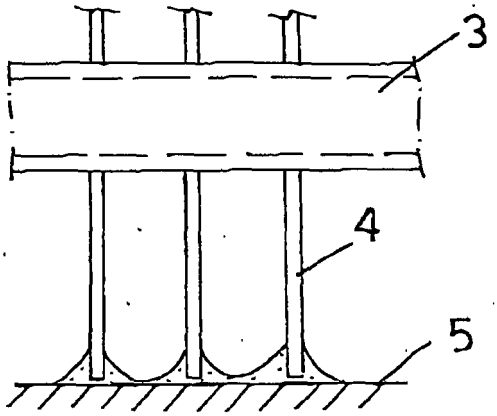


FIG 2

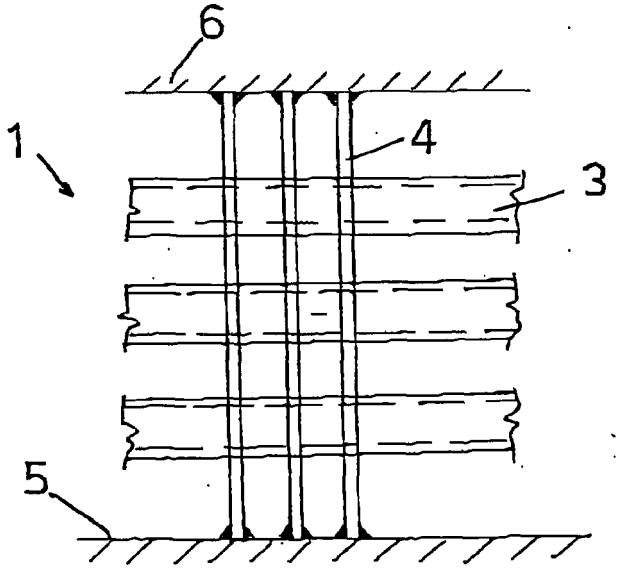
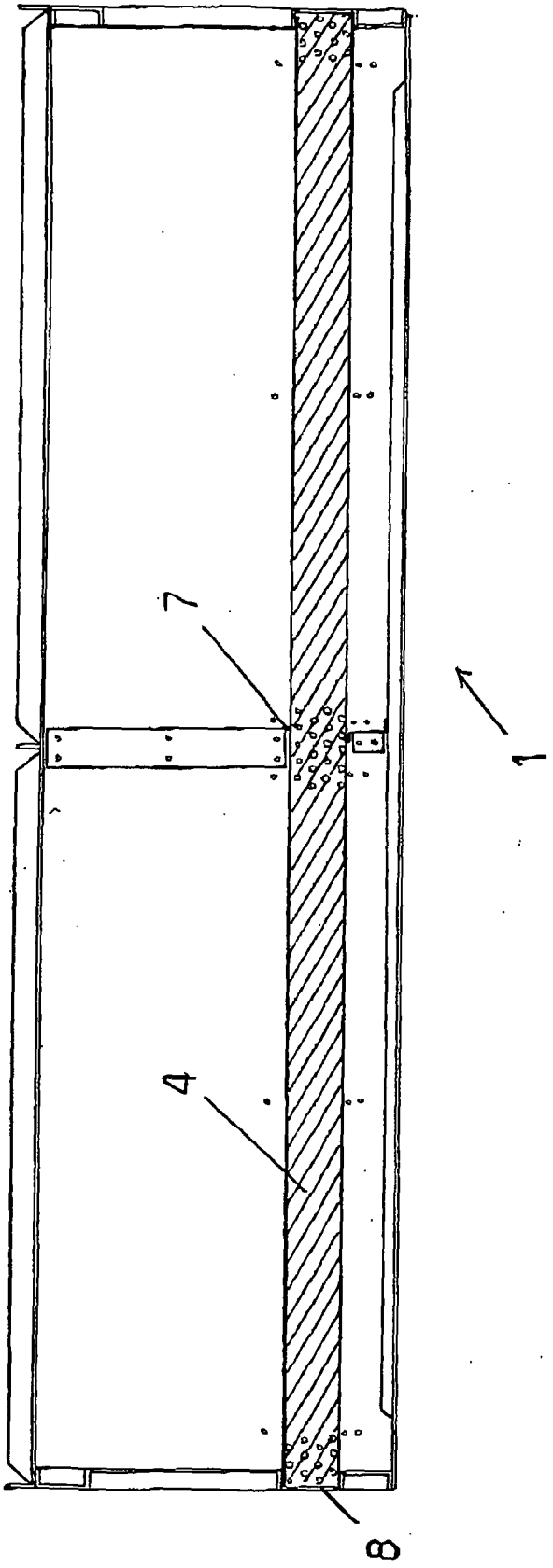


FIG 3

FIG 4



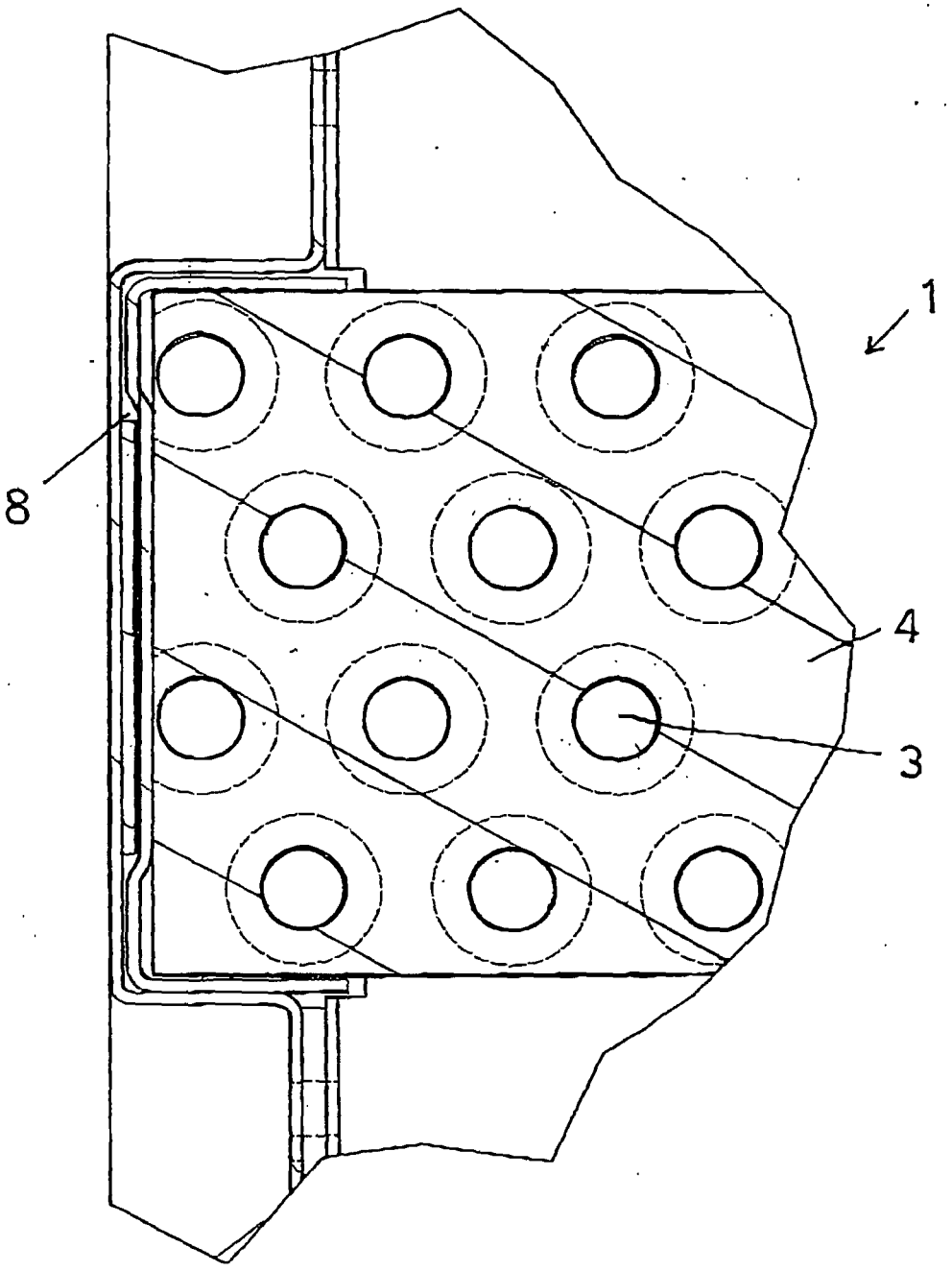


FIG 5

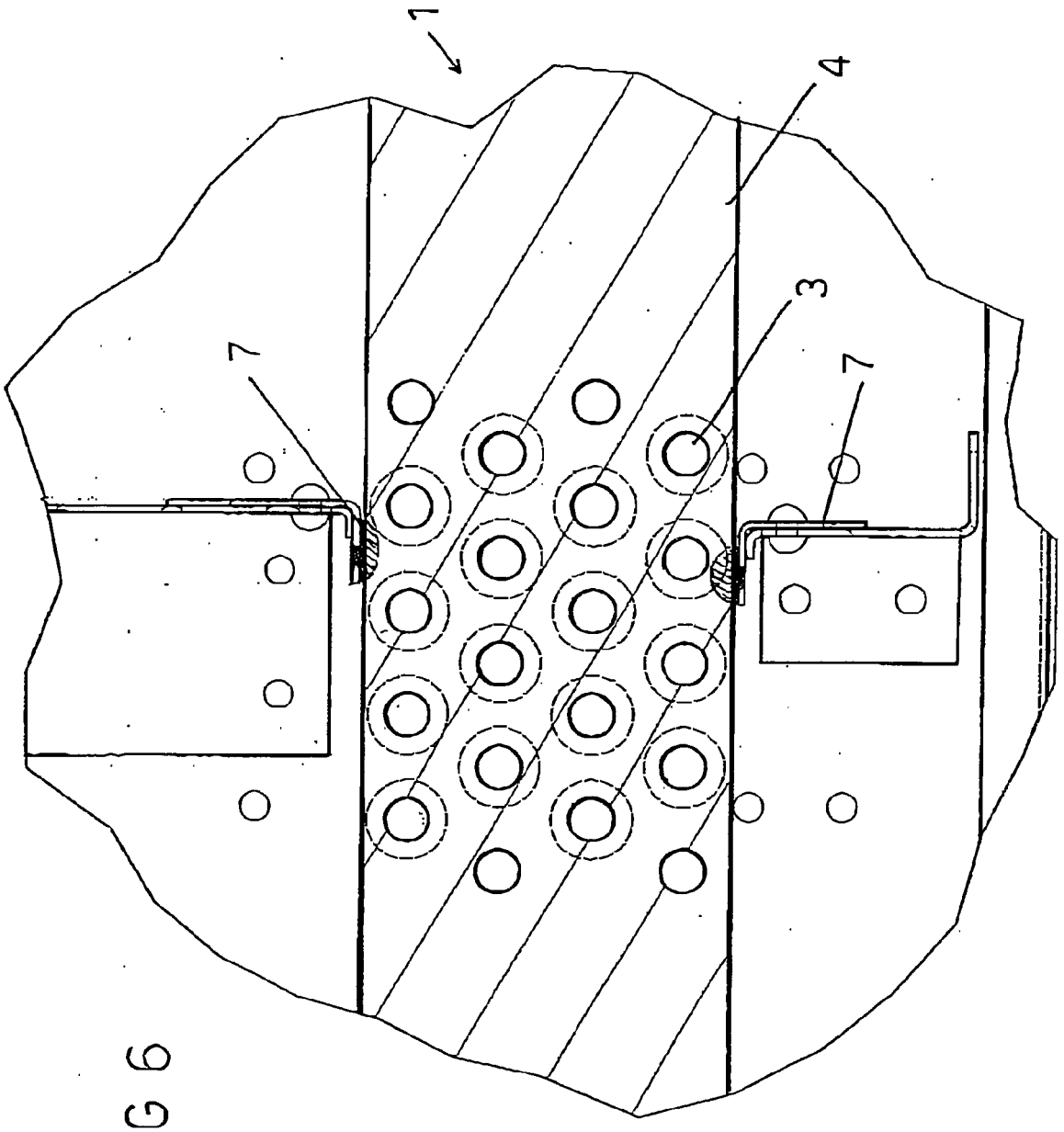


FIG 6