(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 191 956**
A1

(12) EUROPEAN PATENT APPLICATION

(21) Application number: 85201608.8

(22) Date of filing: 04.10.85

(51) Int. Cl.⁴: F 28 F 9/02
F 28 F 21/06, F 28 F 1/02

(30) Priority: 24.12.84 NL 8403934

(43) Date of publication of application:
27.08.86 Bulletin 86/35

(84) Designated Contracting States:
BE CH DE FR GB IT NL SE

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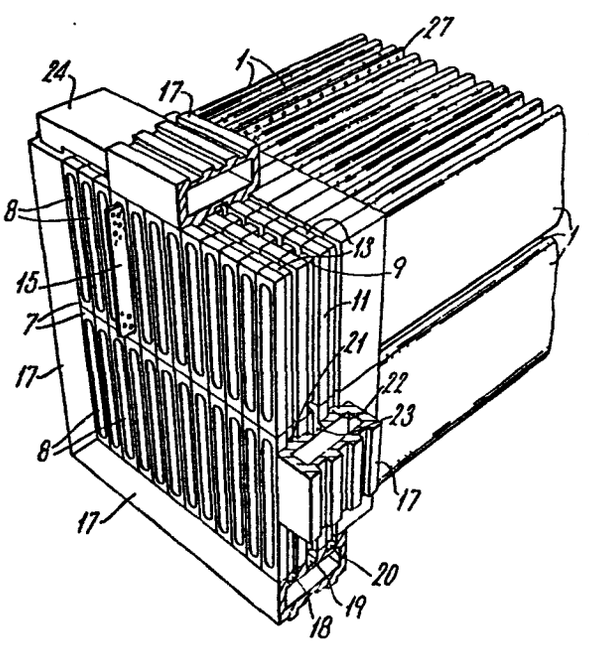
(54) Heat exchanger.

(57) A heat exchanger comprising tubular members (1) which comprise at their ends sleeves (7) which are slid on the tubular members and which have an at least substantially rectangular cross-section and on their outside comprise circumferential grooves (9) for receiving gaskets (10). The tubular members (1) are stacked in a substantially rectangular pack, the sleeves being situated on and beside each other. The sleeves (7) are clamped in a frame (17,24) surrounding the sleeves.

Fig.8.



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Heat exchanger.

The invention relates to a heat exchanger comprising tubular members fixed near its ends.

The tubular members usually formed by round tubes in conventional heat exchangers are fixed with their ends in so-called tube plates which have to be made to size for every heat exchanger.

Netherlands Patent Application 6903607 discloses a heat exchanger in which the ends of the tubes are clamped between frame-like parts placed one on top of the other, in which a semicircular recess has been formed in each of the frame-like parts in such manner that two of these recesses constitute a hole for receiving one end of a tube. These frame-like parts which for each heat exchanger have to be made to the desired size again will be difficult to manufacture with the required accurate design of the holes.

It is the object of the invention to provide a heat exchanger of the above-mentioned type which can be manufactured economically in any desired size by means of parts which are simple to manufacture.

According to the invention this can be achieved in that each of the tubular members comprises

at one end a sleeve which is slid on the tubular member in question and which has an at least substantially rectangular cross-section and on its outside comprises a circumferential groove for receiving a gasket, the sleeves of the tubular members forming part of the heat exchanger being clamped in a frame surrounding the sleeves.

When using the construction according to the invention the tubular members may be constructed in any desired length and be provided at their ends with sleeves of equal construction. The sleeves which have a rectangular cross-section of tubular members forming part of the heat exchanger can be arranged in an rectangular pattern beside and above each other and then be clamped in a simple manner, and by using the construction according to the invention heat exchangers of any desired size can thus be built while using a small number of standard components. Extruded profiled members, in particular profiled members manufactured from synthetic resin, may advantageously be used for the tubular members. High-grade thermoplastic synthetic resins, for example, aromatic polycarbonate, modified polyphenylene ether, polybutylene terephtalate and polyetherimides are preferably used as synthetic resin materials.

The invention will now be described in greater detail with reference to an embodiment of the construction according to the invention shown in the accompanying Figures.

Figure 1 is a perspective elevation of a tubular member to be used in the heat exchanger according to the invention.

Figure 2 is a perspective elevation of a sleeve to be provided on a tubular member.

Figure 3 is a perspective elevation of a gasket.

Figure 4 is an elevation of a plate-shaped member which, if desired, may be inserted into the tubular member or, as is shown in Figure 7, may be provided between the tubular members.

Figure 5 is a perspective view of a profiled beam which may be used to form a part of a frame forming part of the heat exchanger.

Figure 6 is a perspective view of an angular member which may be used for the construction of the frame forming part of the heat exchanger.

Figure 7 is a diagrammatic perspective exploded view of the components showing the way in which the components can be united in a heat exchanger.

Figure 8 is a perspective view of a heat exchanger according to the invention partly constructed.

Figure 9 is a perspective view of a heat exchanger having connected thereto tubes for the inlet and outlet of fluids between which heat exchange is to take place.

As shown in the Figure 1 embodiment, tubular members 1 are used for constructing a heat exchanger formed by tubes which are formed from two parallel extending walls 2 and 3 which are connected at their ends by semicircular connectors 4 and 5. As shown in Figure 1, the height of a tube is a multiple of the width of the said tube. Such tubes can simply be extruded in any desired length from a suitable synthetic resin or a suitable metal and, if desired after extrusion, be cut to the desired lengths.

For assembling the tubes shown in Figure 1 in a heat exchanger, a sleeve 7 (Figure 2) is slid on each end of the tube.

Said sleeve comprises a passage 8 which is adapted to the interior passage of the tube 1 and which has a stepped shape in such manner that, viewed in Figure 2, said passage, in the right-hand end portion of the sleeve 7, has a cross-section which is suitable for receiving with a force fit the end of a tube 1, while the remaining part of the passage 8 has a slightly smaller cross-section so that in the interior of the sleeve a shoulder (not further shown) is formed at the transition between the parts of the passage 8 having diferent sizes, against which shoulder the end of the tube 1 will engage when inserting said end of the tube 1 into the sleeve 7. If desired, a suitable adhesive may be used to obtain a rigid and tight connection between the sleeve 7 and the end of the tube 1.

As shown in Figure 2, the sleeve 7 also comprises a circumferential groove 9 provided in the outer circumference. This groove is destined to receive a corespondingly shaped gasket 10 shown in Figure 3 and manufactured from a suitable elastic material.

On each side of the groove 9 on one long side of the sleeve, grooves 11 are provided, while the oppositely located side comprises complementary projections 12. Similarly, viewed in Figure 2, grooves 13 adjoining the projections 12 are provided in the upper short end wall of the sleeve 7, while viewed in Figure 2 complementary projections 14 are provided in the lower short side wall.

The sleeves may be manufactured by injection moulding. They are preferably manufactured from high-grade thermoplastic synthetic resins as mentioned hereinbefore.

Figure 4 shows a plate-shaped member 15 which throughout its surface comprises on each side regularly divided studs 16 only a few of which are shown in Figure 4.

Viewed in the longitudinal direction of the plate-shaped member 15, the studs provided in a first row extending at right angles to the longitudinal direction of the plate-shape member are staggered with respect to the studs in the row situated therebehind.

For forming a frame holding the tubular members together in a heat exchanger, profiled, hollow beams 17 substantially rectangular in cross-section as shown in Figure 5 may be used. As appears from this Figure, the beam at its one wide rectangular side is provided, by way of example, with three grooves 18, 19 and 20 extending in the longitudinal direction of the beam 17, while on the oppositely located rectangular side opposite to the grooves 18 and 20, ribs 21 and 22 extending in the longitudinal direction of the beam are provided, while centrally between said ribs a groove 23 is present. Such a profiled beam 17 can also be manufactured efficaciously by extrusion from a suitable synthetic resin or a suitable metal or the like.

For interconnecting two such profiled beams 17 provided at right angles to each other, an L-shaped connector 24 as shown in Figure 6 may efficaciously be used. Holes 25 and 26, respectively, extending in the longitudinal direction of the two limbs of said L-

shaped connector are provided in the two limbs in such manner that the holes 25 present in one limb do not intersect the holes 26 present in the other limb. The function of the holes 25 and 26 will be explained in detail hereinafter.

As shown in Figure 7, plate-shaped members 15 may be inserted into the tubular members 1 so that on the one hand the fluid passed through the tubular members will flow closer along the walls of the tubular members, while a zig-zag flow of the fluid in the tubular members will be generated by means of the studs 16 provided on the plate-shaped members 15, said flow also promoting the heat transfer.

As is furthermore shown in Figure 7, the tubular members may be provided beside and above each other and plate-shaped parts 27 may be provided between two columns of tubular members placed above each other, said parts, although not further shown in Figure 7, comprising studs on each side similarly to the plate-shaped members 15. A good guiding of the fluid bypassing the tubular members along said tubular members in a zig-zag-like path of flow is also effected by means of such plate-shaped members.

As further appears from Figures 7 and 8, in which to avoid complexity of the drawing the gaskets 10 provided in the grooves 9 of the sleeves upon assembly are not shown, in order to form a heat exchanger, a desired number of tubular members comprising sleeves are provided beside and above each other, the projecting parts 12 and 14 of one sleeve entering into corresponding recesses 11 and 13 of sleeves situated therebeside and thereunder.

An at least substantially rectangular assembly of sleeves thus obtained and situated beside and above each other may then be combined to form a firm unit while using profiled beams 17 the ends of which will preferably have been mitre sawn. In the adjacent ends of two profiled beams adjoining each other at right angles, the limbs of an L-shaped connector 24 are inserted and the assembly may then be firmly connected together by means of clamping bolts which are passed through holes formed in the boundary walls of the profiled beams 17 and situated in the elongation of the holes 25 and 26, respectively, said clamping bolts extending through the hollow profiled beams 17 from one side of the assembly to the oppositely located side. The arrangement is such that, as is also shown in Figure 8, on certain sides of the assembly formed by the sleeves the projecting parts 21 and 22 engage in recesses 11 or 13 of sleeves 7 placed above or beside each other which recesses are situated in the elongation of each other while on other sides the projecting parts 12 or 14 of the sleeves are incorporated in recesses 18 and 20 of the profiled beams. It will be obvious that in this manner a firm connection is obtained between the sleeves mutually and between the sleeves and the frame formed by the profiled beams 17 and surrounding the sleeves, the tubular members being effectively locked against movement in the longitudinal direction.

As is further shown in Figure 9, channel connectors 28 and 29 may be connected to a heat exchanger thus obtained for the inlet and outlet, respectively, of a first medium to be passed through the tubular members, while further connectors 30 and 31 can be connected to the heat exchanger for the inlet and outlet,

respectively, of a second fluid which bypasses the tubular members to thus produce an exchange of heat between the first and the second fluid. The remaining side walls of the heat exchanger are closed by means of cover plates 32.

It will be obvious from the above that, by means of a number of simple components which can easily be manufactured by extrusion and injection moulding, a heat exchanger can be built up having any desired number of tubular members which may be constructed in any desired length.

CLAIMS:

1. A heat exchanger comprising tubular members fixed near its ends, characterized in that each of the tubular members comprises at one end a sleeve which is slid on the tubular member in question and which has an at least substantially rectangular cross-section and on its outside comprises a circumferential groove for receiving a gasket, the sleeves of the tubular members forming part of the heat exchanger being clamped in a frame surrounding the sleeves.

2. A heat exchanger as claimed in Claim 1, characterized in that the tubular members, viewed in cross-section, have an at least substantially rectangular cross-section.

3. A heat exchanger as claimed in Claim 2, characterized in that a tubular member comprises two long parallel extending side walls which are connected together by short walls which are curved in cross-section.

4. A heat exchanger as claimed in any of the preceding Claims, characterized in that a sleeve has a stepped passage, the cross-section of a first part of said passage corresponding to the external cross-section of a tubular member and the remaining part of the passage corresponding at least substantially to the inner cross-section of a tubular member.

5. A heat exchanger as claimed in any of the preceding Claims, characterized in that the sleeve comprises grooves over a part of its circumference and comprises projecting parts formed complementarily with said grooves over the remaining part of its circumference.

6. A heat exchanger as claimed in any of the preceding Claims, characterized in that a sleeve comprises a circumferential groove for receiving a gasket.

7. A heat exchanger as claimed in any of the preceding Claims, characterized in that the frame is constructed from hollow profiled beams which are coupled together by means of L-shaped connectors.

8. A heat exchanger as claimed in any of the Claims 6-8, characterized in that a profiled beam has an at least substantially rectangular cross-section, comprises on one side grooves which extend in the longitudinal direction of the beam and serve for accommodating projecting parts of the sleeves, and comprises on the oppositely located side ribs which extend in the longitudinal direction and fit in recesses provided in the sleeves.

9. A heat exchanger as claimed in any of the claims 6-8, characterized in that the profiled beams near the centres of their long rectangular sides comprise continuous grooves which are present at the level of the grooves in the sleeves destined to receive gaskets.

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Fig.1.

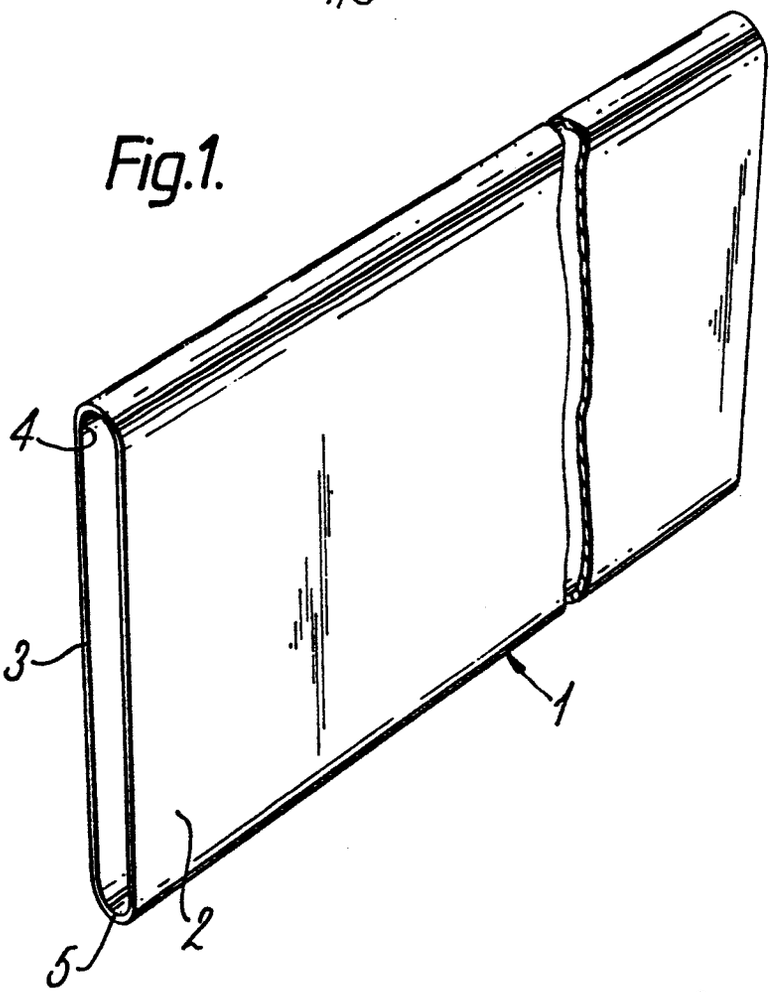

Fig.2.

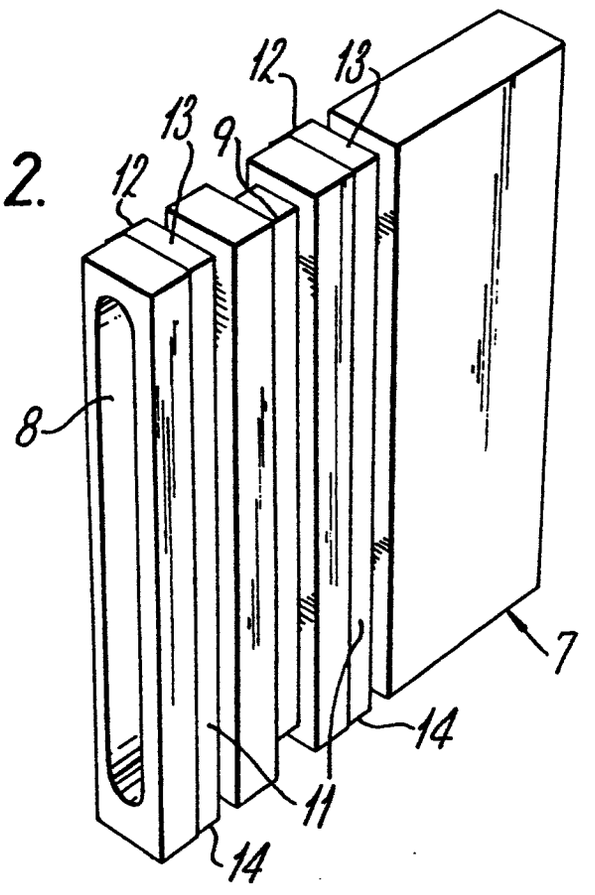

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Fig.3.

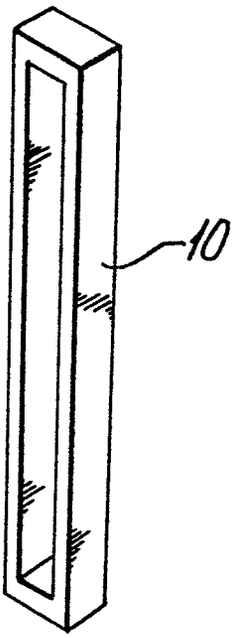

Fig.4.

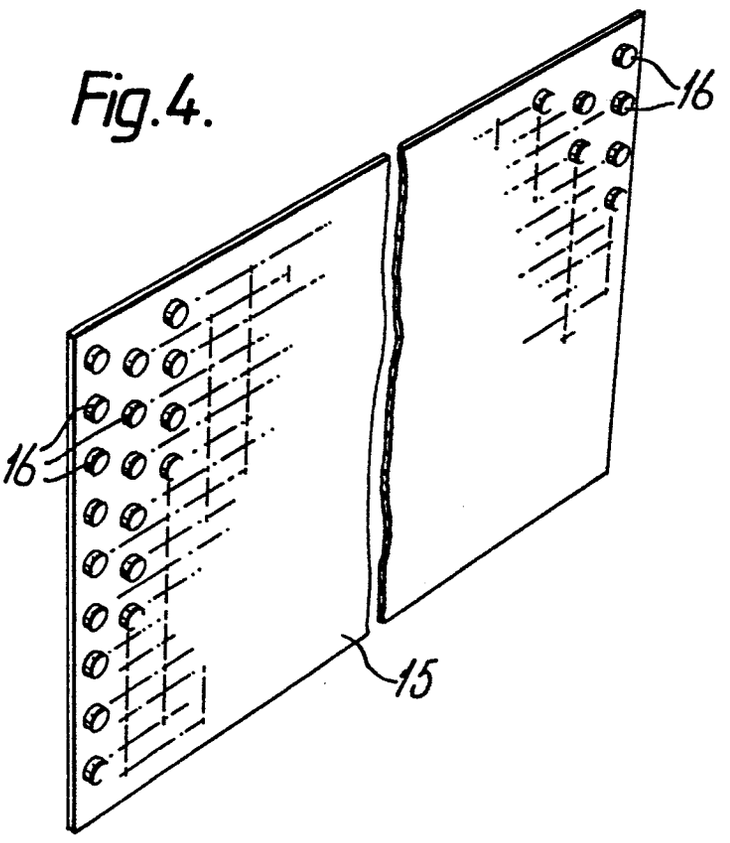

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Fig.5.

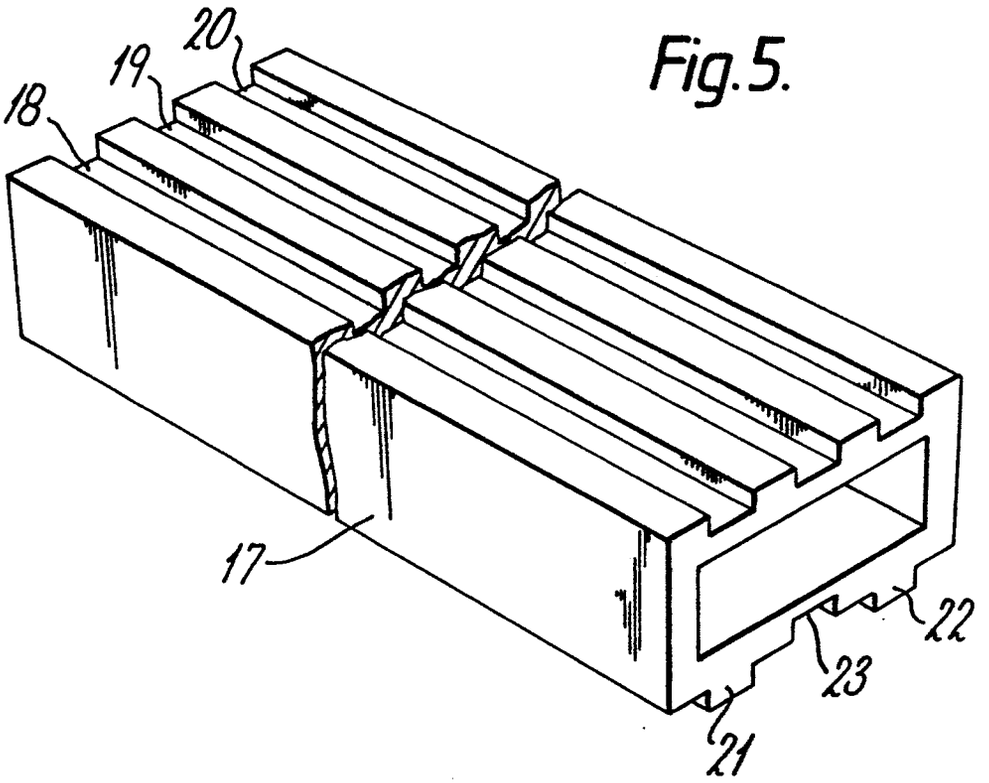

Fig.6.

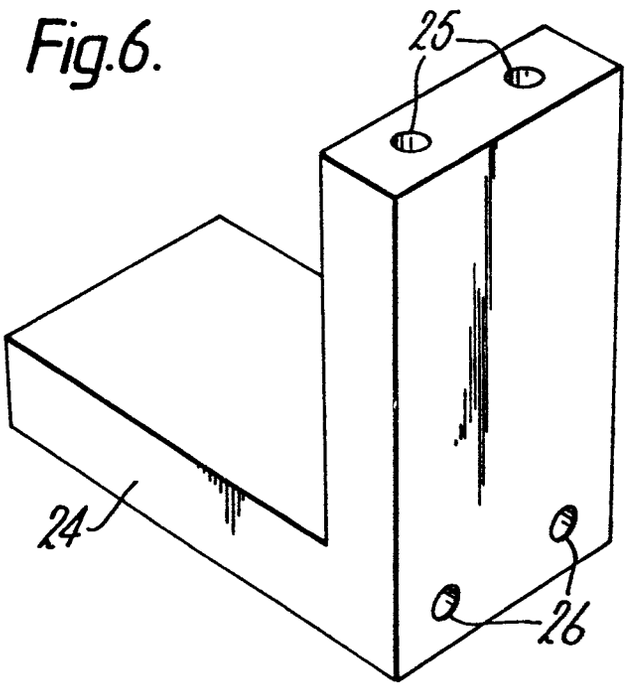

Fig.7.

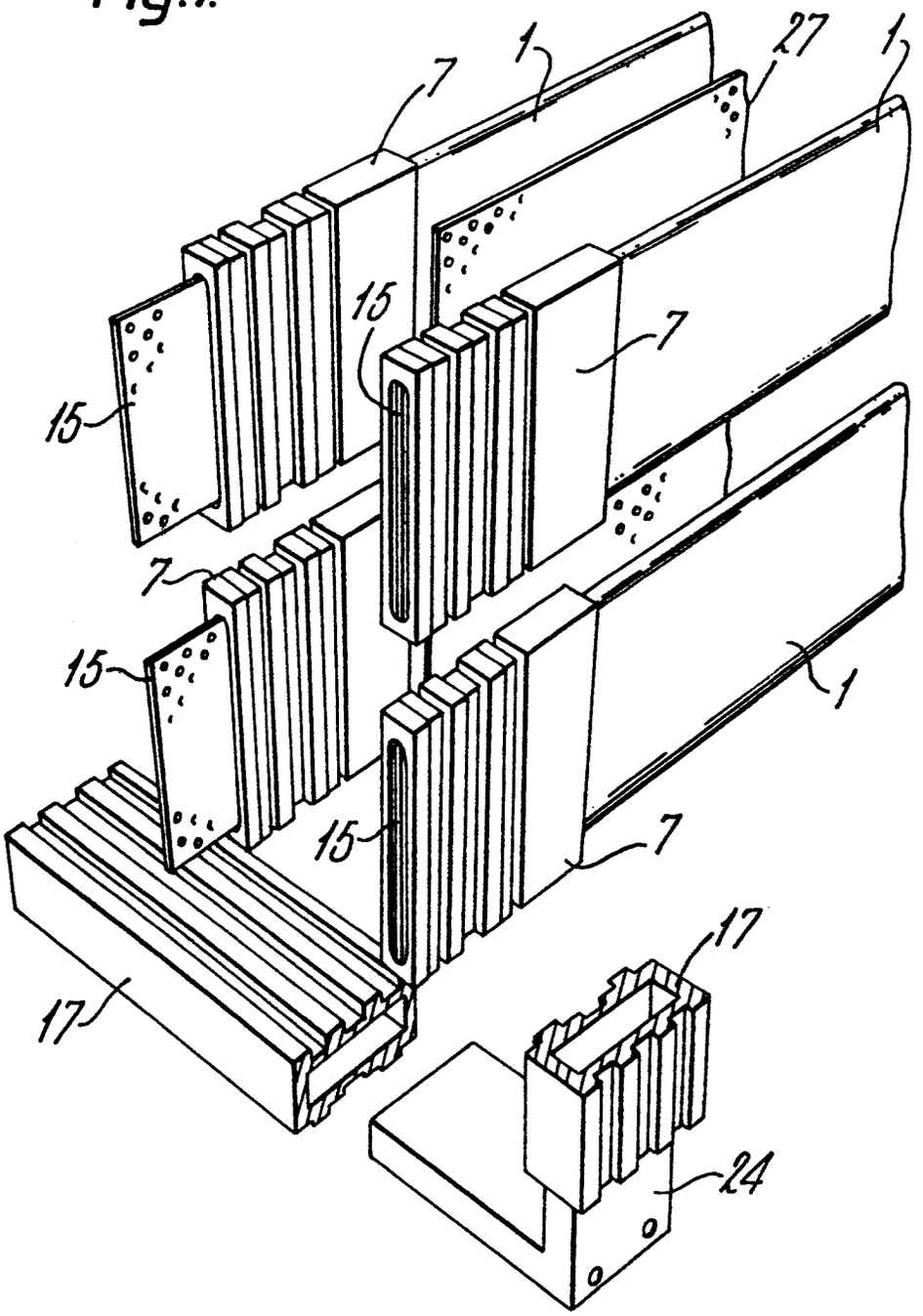

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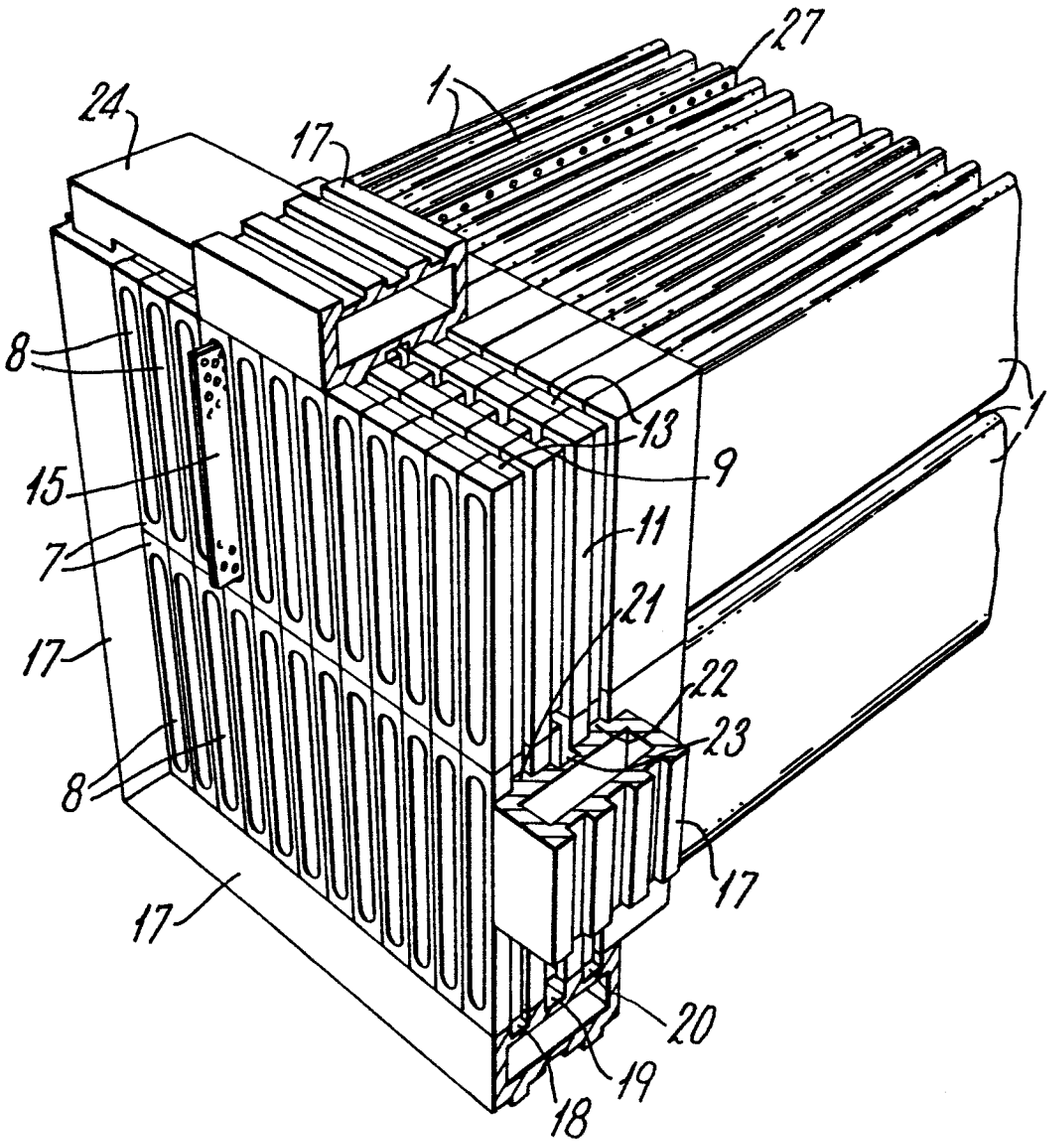
Fig.8.



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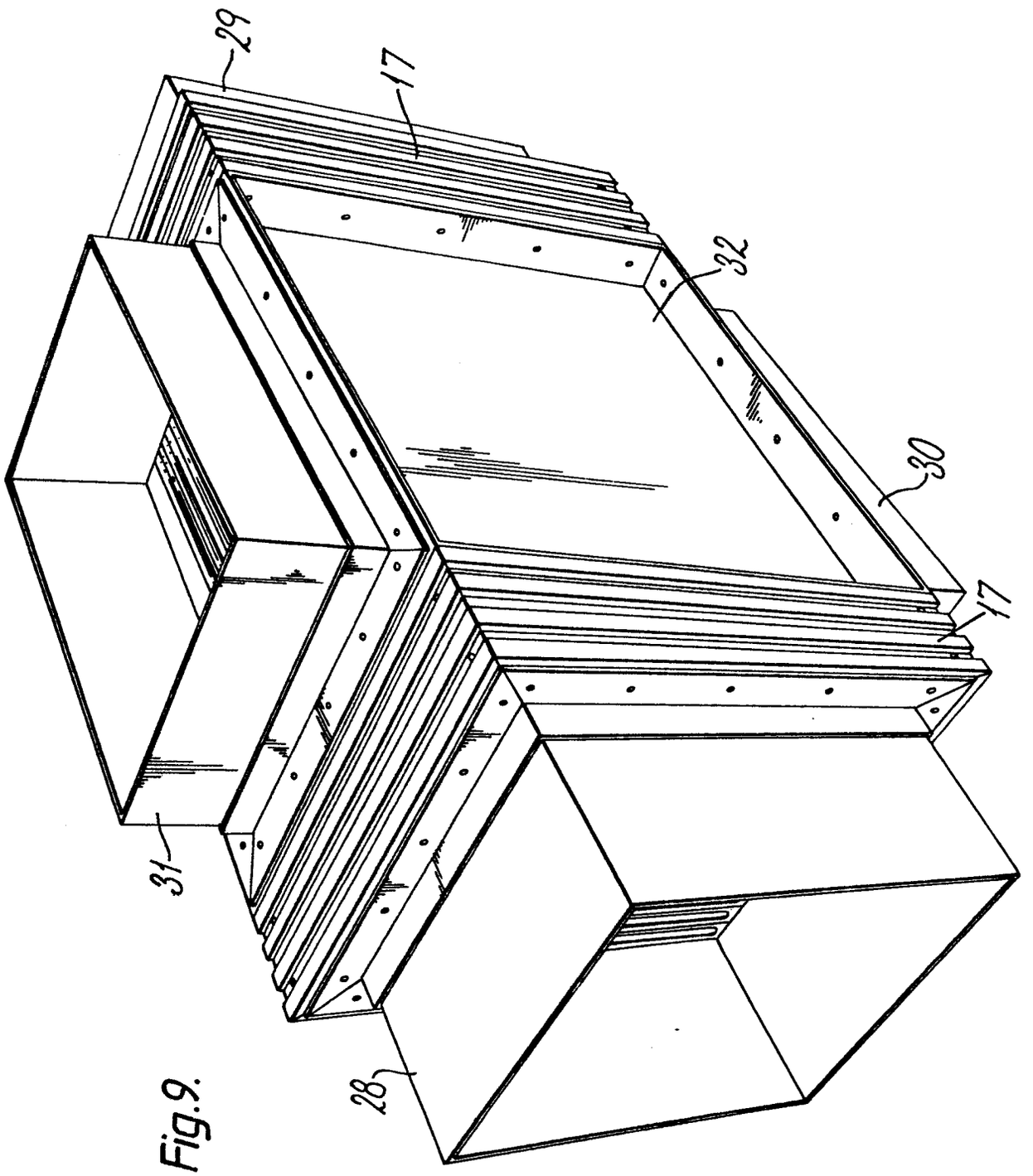

Fig.9.

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EUROPEAN SEARCH REPORT

Application number 0191956

EP 85 20 1608

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.4)
Y	GB-A- 815 842 (SENIOR ECONOMISERS LTD.) * Whole document *	1,2,6	F 28 F 9/02 F 28 F 21/06 F 28 F 1/02
Y	DE-A-2 910 005 (SIEMENS AG) * Whole document *	1,2,6	
A	GB-A-2 012 406 (S.A. DES USINES CHAUSSON) * Whole document *	1-3	
A	DE-A-3 200 525 (POWILLEIT) * Whole document *	2,3,7	
A	FR-A-2 304 885 (TOGASHI)		TECHNICAL FIELDS SEARCHED (Int. Cl.4)
A	FR-A- 833 347 (LAMBOT)		F 28 F F 28 D

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	01-04-1986	SILVIS H.

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