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

(11) Publication number: **0 013 700**
A1

(12) EUROPEAN PATENT APPLICATION

(21) Application number: **79104298.9**

(51) Int. Cl.³: **F 28 D 7/00**

(22) Date of filing: **05.11.79**

(30) Priority: **22.01.79 IT 1949879**

(43) Date of publication of application: **06.08.80 Bulletin 80/16**

(84) Designated Contracting States: **AT BE CH DE FR GB LU NL SE**

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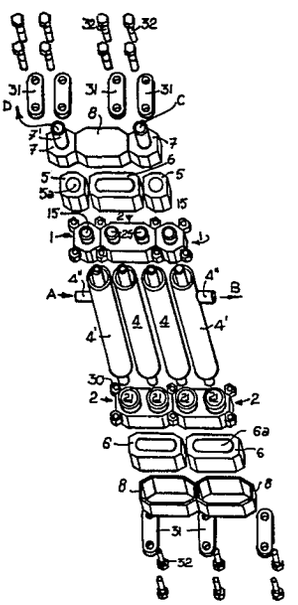
(54) Modules for heat exchanger or the like and heat exchanger thus obtained.

(57) Modules for heat exchanger, condenser, evaporator, tank or reservoir and the like, characterized by being formed of a hollow box (1, 2) comprising openings (11, 15; 21, 25) for receiving tubes (3, 4) on two opposite facing surfaces, referred to as outer and inner surfaces, one of the modules being provided with only one opening (11, 15) on each of said surfaces, and a second module being provided with two openings (21, 25) still on each of said surfaces.



EP 0 013 700 A1

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MODULES FOR HEAT EXCHANGER OR THE LIKE AND HEAT EXCHANGER THUS OBTAINED.

This invention relates to a novel modular structure for the production of heat exchangers, condensers, evaporators or reservoirs which are used separately or along with one of the above mentioned devices. For simplicity, in the following the term "heat exchanger" will be referred to as any of the above mentioned devices.

Structures of this type have been hitherto made by gas or autogeneous welding of tubes against separately made heads. This causes the heads to which said tubes are welded to be brought up to the smelting temperature of the alloy (about 600-800°C). Should these heads be of a considerable size, the required increase in temperature would cause deformations therein. It is therefore necessary to provide heat exchangers or the like with heads of a reduced size.

Further, these conventional heat exchangers have the disadvantage that specific heads have to be made for each required size of the heat exchanger, which involves high costs in manufacturing and storing said heads. Moreover, the assembling of a specific heat exchanger is time wasting and complicated.

Another conventional approach contemplates a coil comprising two continuous coaxial tubes which are spirally wound up. This approach is restricted to the length of the commercially available tubes. It is also difficult and cumbersome to provide for parallel arrangement between a plurality of coils.

It is the primary object of the present invention to provide a heat exchanger formed of standard modules, by which heat exchangers or the like of any size can be made.

It is another object of the present invention to provide, particularly in the refrigeration art, the construction in a single block of condenser, also including an evaporator, or a condenser with the addition of an evaporator for the liquid cooling and a tank or reservoir.

The above mentioned objects have been accomplished by the provision of making two base modules, substantially formed of a hollow box comprising openings for receiving the tubes on two opposite facing surfaces, which will be referred to as

outer and inner surfaces, respectively, one of the modules being provided with only one opening on each of said surfaces, and the second of said modules being provided with two openings, still on each of said surfaces.

A first embodiment of the invention enables to provide a not inspectable type of heat exchanger by connecting the inner tubes of the heat exchanger with fixed curves or bendings.

On the other hand, a second embodiment according to the invention contemplates the provision of an inspectable type of heat exchanger with the addition of modular gaskets or seals and covers or lids also of modular type. These covers or lids are preferably made by the same equipment used for the modules. According to a particular embodiment of the invention such lids and modules are secured in place by bolts and nuts housed on the periphery of the modules forming the head.

Further, by using modules closed at the ends with only outer tubes, high pressure resisting tanks or reservoirs can be readily provided as comprising a number of series and parallel tubes.

The modules according to the present invention are preferably made by pressing and can be provided in all of the ferrous materials or alloys of non-ferrous metals, and therefore can be used also with fluids requiring the use of particular materials.

In order to improve heat exchange, the inner tubes intended for heat exchange may be smooth, finned, rolled, extruded, etc.

The invention will now be more clearly explained with reference to some exemplary embodiments which have been shown in the accompanying drawings, in which:

Fig. 1 is an exploded view showing a series or rank for an inspectable type of heat exchanger;

Fig. 2 is a view similar to that of Fig. 1, but comprising a series or rank for a not inspectable type of heat exchanger;

Fig. 3 is a view similar to that of Fig. 2, but having a tank or reservoir acting portion;

Fig. 4a is a plan view of a module according to the present invention;

Fig. 4b is a sectional view taken along line B-B of Fig. 4a;

Fig. 5a is a plan view of a second module according to the present invention; and

Fig. 5b is a sectional view taken along line B-B of Fig. 5a.

As shown in Fig. 1, reference numeral 1 denotes the head module having only one opening for a tube on each of its major surfaces, which will be respectively referred to as inner and outer surfaces. Reference numeral 2 denotes a module similar to the former, but of a larger size and having two openings for tubes on each of its major inner and outer surfaces.

These two modules will be described in further detail with reference to Figs. 4a and 4b as to module 1 and with reference to Figs. 5a and 5b as to module 2.

Module 1 comprises a socket 10 of a square shape with beveled angles or corners, having an opening 11 on its inner surface and an opening 12 on its outer surface, into which a closure wall 13 is caused to penetrate and at the rear bears on some impressions 14 formed on at least two side walls of said socket 10. Said closure wall 13 has a central hole 15 projecting from the body of socket 10 and is located on the opposite side relative to hole or opening 11, that is in the surface which is outside to the heat exchanger. Opening 15 is smaller than opening 11. The first one will receive the inner tube of a heat exchanger and the second one the outer tube.

Generally, module 1 is provided by pressing out a socket which initially does not comprise either said opening 11 or impressions 14, then these operations are carried out thereon, and finally said wall 13 is assembled by causing it to bear against impressions 14. This bearing is useful during brazing operation which is effected throughout the contact periphery between said socket and wall 13, as shown at 16 of Fig. 4b.

Module 2, as shown in detail in Figs. 5a and 5b, is similarly made as module 1. Particularly, it is formed of a socket 20

of about rectangular cross-section, having impressions 24 and two openings 21 on its inner surface (instead of one as in module 1). The openings 21 have the same diameter as openings 11. At the front said socket 20 is closed by a wall 23 abutting against impressions 24 and also having two holes 25 of the same diameter as holes 15. Also this wall is brazed at locations 26 throughout its periphery of contact with socket 20. This module 2 is of rectangular shape with beveled corners, in a plan view, as clearly shown in Fig. 5a. The distance between the holes 21 or 25 of module 2 is the same as the distance between holes 11 and 15 of two adjacent modules 1.

The explanation will now be given for the assembling of the various components, so as to provide a heat exchanger, evaporator and possible tank or reservoir, and so on. Hereinafter it will be described how to provide a "rank or series" for heat exchanger, that is an assembly of tubes which are series connected to one another. Each rank or series will then be parallel connected with other ranks, to which they will be possibly juxtaposed. This connection is per se well known and will not be here described in further detail.

The heat exchanger comprises a set of inner tubes 3, externally of which outer tubes coaxial with the former and denoted by reference numeral 4 are mounted. At the upper and lower ends, the outer tube is formed by a tube 4' having

an inlet or outlet sleeve 4". Tubes 3 are longer than tubes 4 and 4', so as to penetrate into holes 21 or 11, clearing the gap between the respective tubes 3 and the side walls of sockets 20 or 10, while the end of the tubes is precisely inserted in holes 15 and 25, then sealing is provided, for example by means of welding or other similar operation. The outer tube 4 or 4' is of such a diameter that it is exactly inserted on the side walls of openings 21 or 11; also in this case, sealing is provided for example by welding or other similar operation. The heads are formed of modules 1 and 2 arranged in adjoining relationship or alternate, as desired, so as to provide a continuous water circuit, in which tubes 4 and 4' are all in series to one another, the connection thereof being obtained within modules 1 or 2. For each head, these modules 1 and 2 are joined to one another, for example by welding.

The circuit connection between the inner tubes 3 is provided by means of seals 5 having only one hole 5a of nearly circular shape, or by means of seals 6 provided with an oval hole 6a connecting the two openings 25 of module 2 and covers 7, corresponding to the size of module 1, or covers 8, corresponding to the size of module 2. These covers 7 and 8 and seals 5 and 6 are retained against modules 1 and 2 by means of bars 31, screws 32 and nuts 30 that are secured, for example, by welding to modules 1 and 2.

The circulation of the fluids is as follows. The admittance of a first external fluid is along arrow A, the fluid

traveling through the gap between tubes 3 and 4, penetrating into the inner space in module 2, traveling again through the gap between tubes 3 and 4, then again through the space or cavity in module 2, and so on for several times until issuing in the direction of arrow B. The circuit for the inner fluid is provided by causing it to enter from C, travel throughout the inner tubes 3 passing in the hollow empty spaces 5a and 6a within the seals 5 and 6 and issuing from tube 7' on cover 7 in the direction of arrow D.

In the approach of Fig. 2, there is shown an embodiment of simplified design relative to that of Fig. 1. Therein, the connection between inner tubes 3 is provided by means of bendings 33 and sleeves 34 which will be respectively welded to the ends 25 of modules 2, or to the ends 15 of modules 1.

The embodiment of Fig. 3 shows an approach similar to that of Fig. 2, in which part of the rank is used as a tank or reservoir. Use is made in this case of a module 2' having only one outlet 25, on which a sleeve 34 is mounted for the entry of the inner fluid circulating in tubes 3 in the direction of arrow C. This fluid will issue in the direction of arrow D. The outer fluid circulating in the gap between tubes 3 and 4 or 4' will enter in the direction of arrow A and issue from sleeve 34. In this embodiment the two lower tubes 4 are no longer effective as a heat exchanger, but merely as a tank or reservoir.

Of course, rather than with bendings 33 and sleeves 34, this approach comprising a tank or reservoir could be realized with an inspectable system of the type shown in Fig. 1.

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C L A I M S

1. Modules for heat exchanger, condenser, evaporator, tank or reservoir and the like, characterized by being formed of a hollow box (1,2) comprising openings (11,15; 21,25) for accepting tubes (3,4) on two opposite facing surfaces, which will be referred to as outer and inner surfaces, one of the modules being provided with only one opening (11,15) on each of said surfaces, and a second module being provided with two openings (21,25) still on each of said surfaces.

2. Modules according to Claim 1, characterized by being of square and rectangular shape, respectively, wherein the corners are beveled or hollowed out for receiving a nut (30) or other fastening device.

3. A heat exchanger, condenser, evaporator, tank or reservoir or the like, characterized by comprising a series of tubes (4) interconnected by means of modules according to Claim 1 or 2.

4. A heat exchanger, condenser, evaporator, tank or reservoir or the like according to Claim 3, characterized in that the circuit for the inner fluid is provided through seals (5,6) retained by covers or lids and having cavities (5a,6a) in which said fluid can circulate.

5. A heat exchanger, condenser, evaporator, tank or reservoir or the like according to Claim 3, characterized in that the circuit for the inner fluid is provided by means of bendings (33) and sleeves (34) sealingly mounted on the modules (1,2).

6. A heat exchanger, condenser, evaporator, tank or reservoir or the like according to Claim 4, characterized in that fastening means (30), particularly nuts for the fastening of the sealing covers or lids (7,8) are secured in the zones cleared by the bevels or notches provided between the corners of the modules.

7. A heat exchanger, condenser, evaporator, tank or reservoir or the like according to Claim 4 or 6, characterized in that the sealing covers or lids (7,8) are of the same shape is the modules (1,2), while not having any openings (11,15; 21,25), so that they can be made by a single initial pressing operation by means of a single tool.

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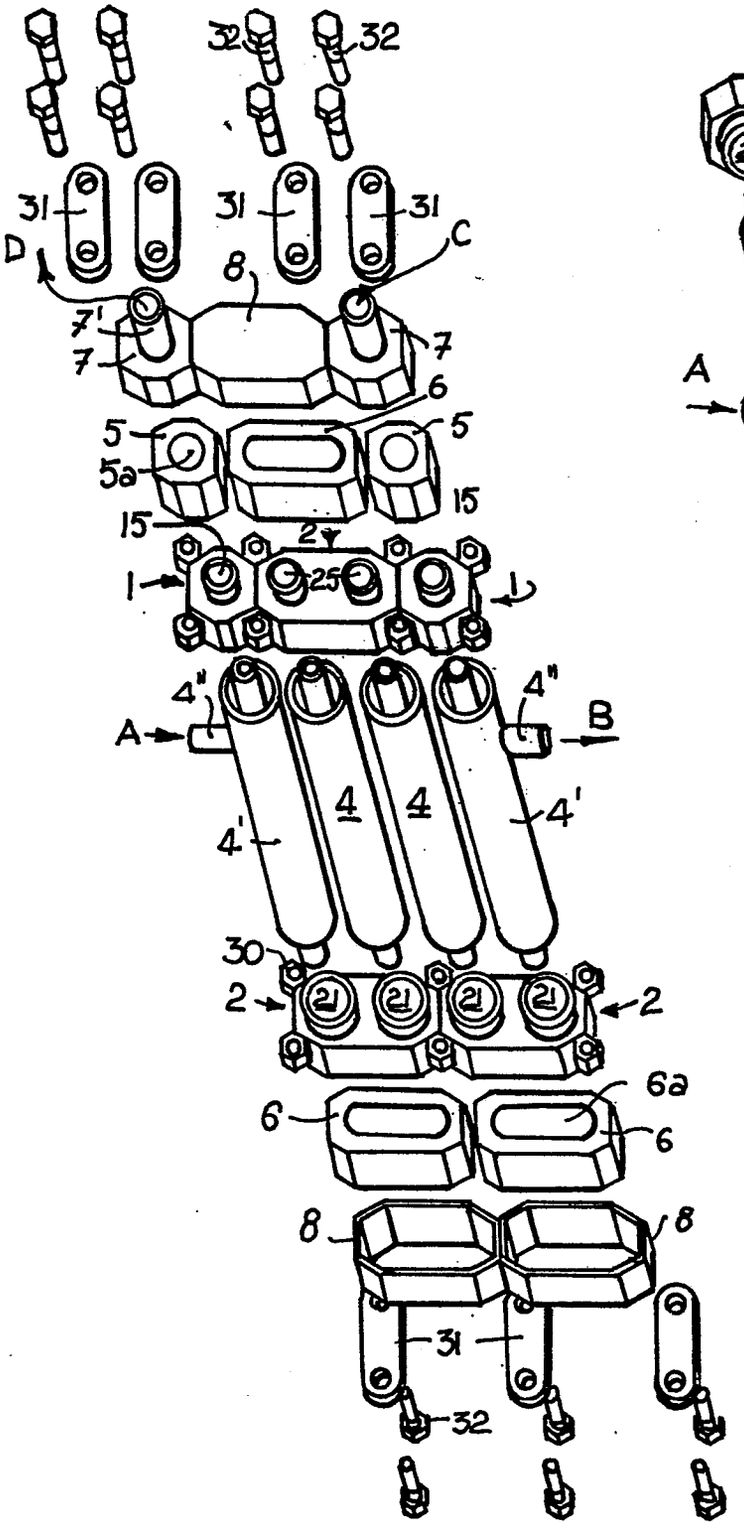

Fig. 1

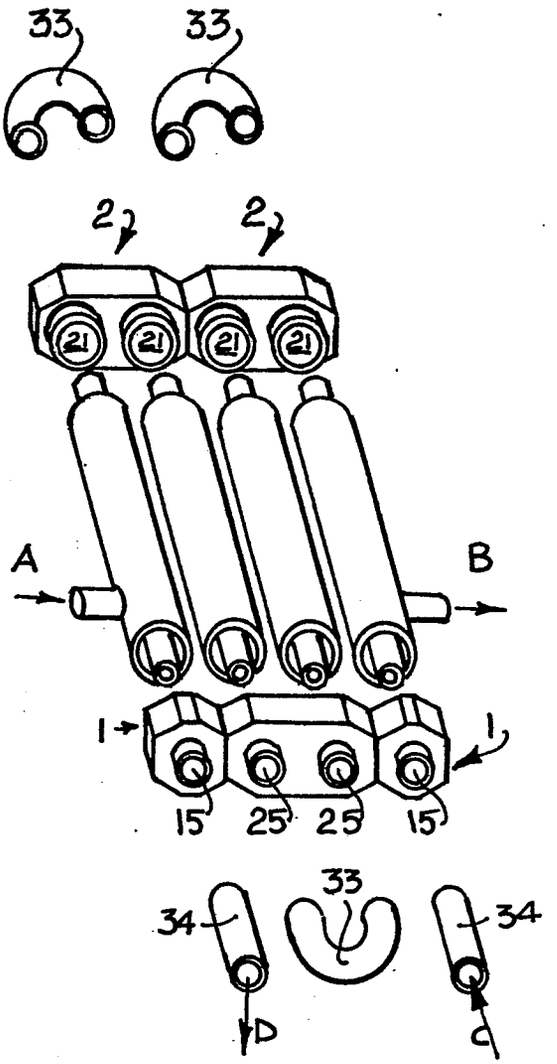

Fig. 2

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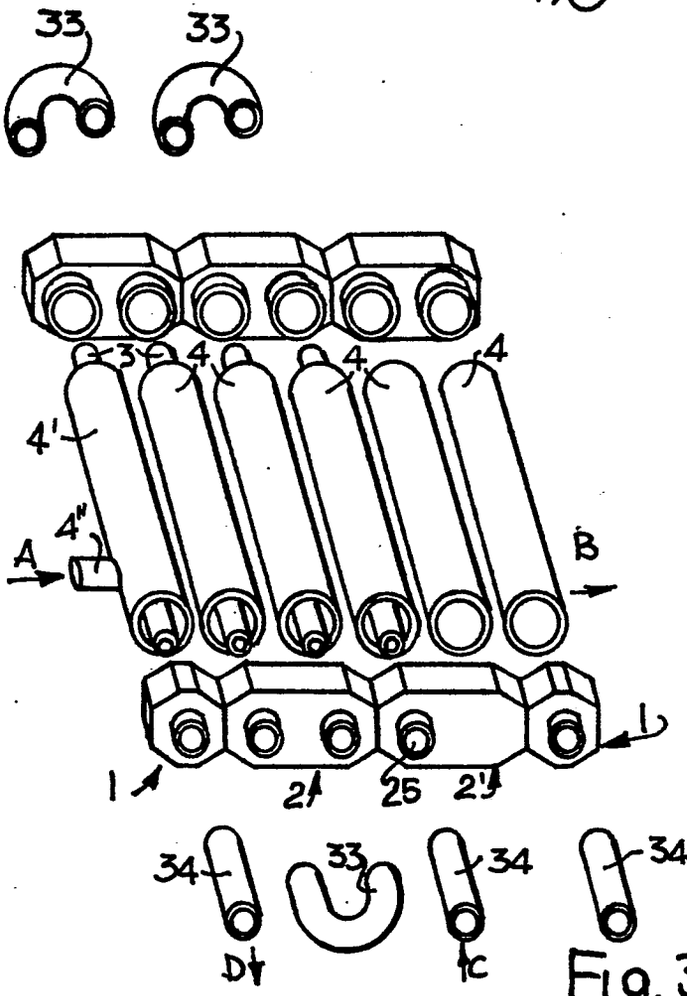

Fig. 3

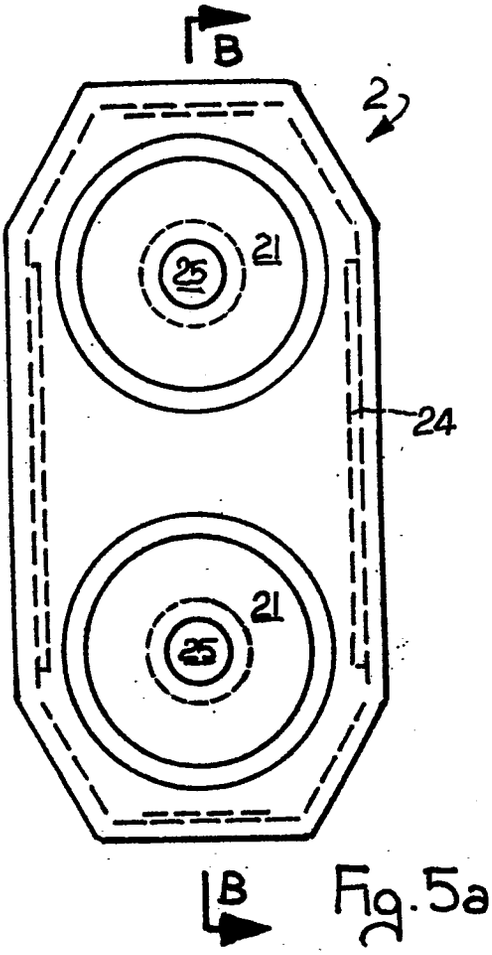

Fig. 5a

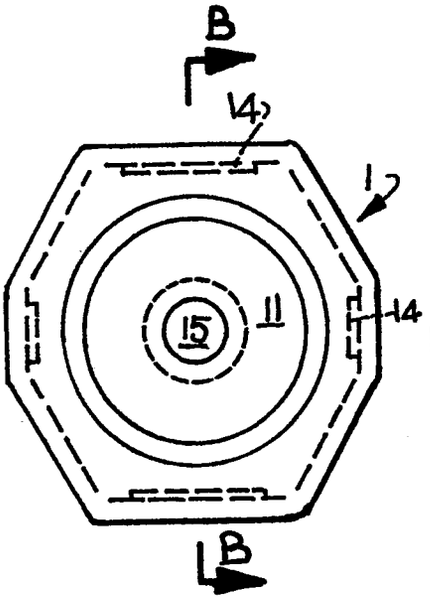

Fig. 4a

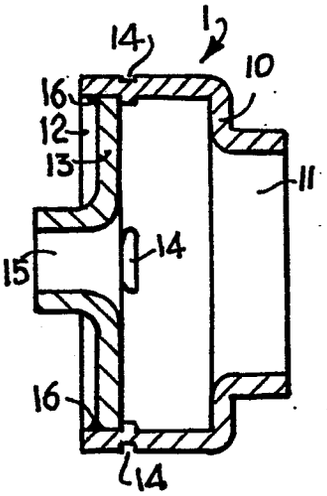

Fig. 4b

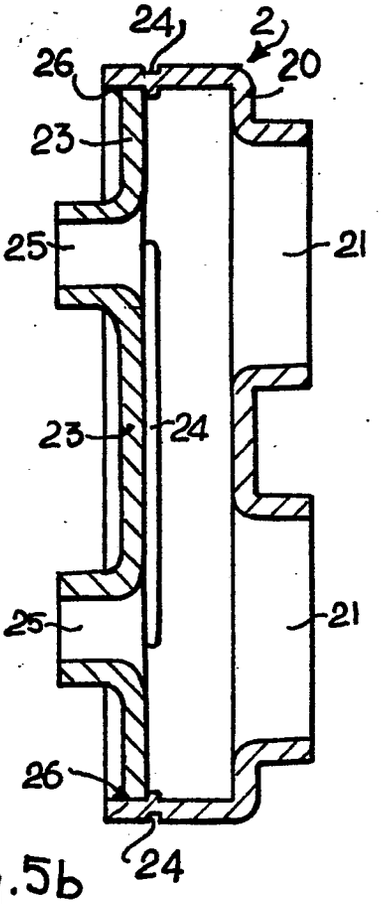

Fig. 5b

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EUROPEAN SEARCH REPORT

Application number
0013700
EP 79 10 4298

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim
X	US - A - 1 605 987 (RICHEY) * Page 1, line 41 - page 2, line 34; figures 1-3 *	1-6
X	US - A - 1 826 253 (MARSHALL) * Page 1, lines 41-85; figure 1 *	1,3-6
X	US - A - 1 742 833 (THOMAS) * Page 1, lines 84-96; page 2, lines 3-17; figures 1-3 *	1,3
A	FR - A - 980 414 (LIAGRE)	1
A	US - A - 2 713 996 (POTTHARST)	1
A	US - A - 3 171 478 (WEIKS)	1
A	US - A - 3 791 326 (SCHWARZ)	1

CLASSIFICATION OF THE APPLICATION (Int. Cl. 3)

F 28 D 7/00

TECHNICAL FIELDS SEARCHED (Int.Cl. 3)

F 28 D
F 28 F

CATEGORY OF CITED DOCUMENTS

X: particularly relevant
A: technological background
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P: intermediate document
T: theory or principle underlying the invention
E: conflicting application
D: document cited in the application
L: citation for other reasons

&: member of the same patent family, corresponding document

X The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	28-04-1980	JOHANSSON

EPO Form 1503.1 06.78