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(54) **Oil-filled column radiator**

(57) An oil-filled column radiator has columns (2) made of pressed sheet metal panels (5). Oil passageways (6) extend between upper and lower bosses (3,4). The oil level is reduced and is further from the top of the radiator than in conventional designs. Less heat is therefore transferred to upper regions. Thermal breaks in the form of slanting slots (9) are provided in non-oil containing portions (8) of each column. Due to the more efficient column design, the outer surface temperature of the radiator is substantially uniform and less columns can be used for the same thermal output, without exceeding safety limits for the outer surface temperature.

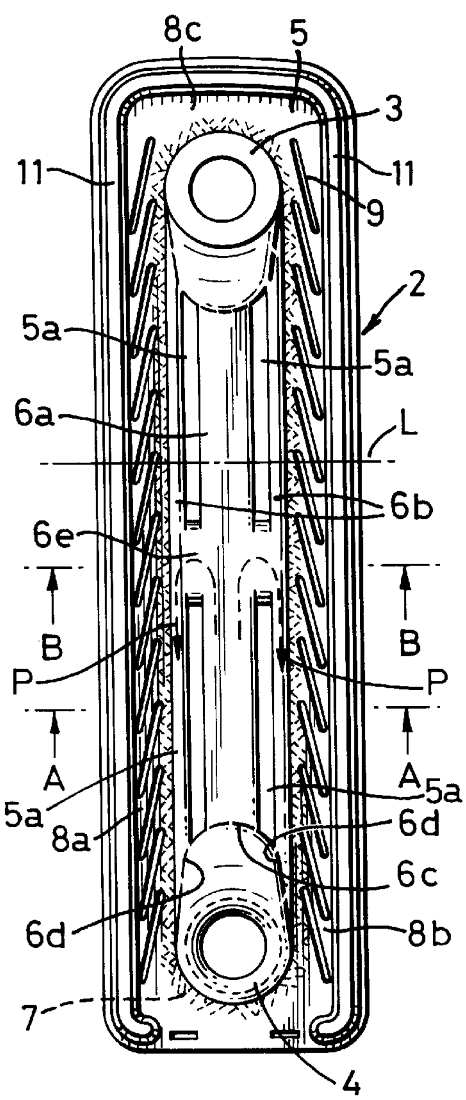

FIG.1

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Description

This invention relates to an oil-filled column radiator.

Oil-filled column radiators are well-known in the art and generally comprise a plurality of columns which are joined at upper and lower bosses to form a column array. Each column has oil passageways extending between the upper and lower bosses. An electrical heating element passes through the lower bosses and is immersed in the oil which is contained by the columns.

In earlier designs of radiator, the oil passageways extended to peripheral edges of the columns, and hence outer surfaces of the radiator could reach high temperatures when the radiator was giving its maximum heat output.

In the past, less stringent surface temperature limits applied to oil-filled radiators. Such limits were set by standards which applied to the temperature reached by accessible outer or peripheral surfaces or edges when the radiator is operating at maximum controlled outputs. However, these edge or surface temperatures could be reduced by adding more columns to an array, i.e. without increasing the power rating of the electrical element used to heat the oil. The additional columns increased both the surface area of the radiator, and the volume of oil in the radiator, thereby helping to reduce its outer surface temperature. If the power rating of the heating element were increased to raise the thermal output of the radiator, even more columns were then needed to reduce the temperature. Another problem encountered with these prior art radiators was uneven temperature distribution. Generally, they were cooler at the bottom and hotter at the top, because of the tendency for heat to rise. (Typically, there can be a temperature difference of say 70°C between the outer surface temperatures at the bottom and the top.)

The latter prior art radiators were therefore cumbersome, heavy, expensive to produce and to package, a problem to transport and incapable of dissipating heat uniformly.

More recent limits imposed on maximum outer surface temperature, such as those in current European standards, mean that the surface temperature of outer parts of the radiator should not exceed a temperature lower than previous requirements. Whilst more columns could be added to deal with this, it would lead to an even more cumbersome and heavy design of radiator, which would be more expensive to produce and hence commercially unattractive.

The more stringent outer surface temperature requirements are also more difficult to meet with regard to upper regions of oil-filled radiators. As heat naturally rises and the hottest parts of the radiator are usually at the top of the column array, adding further columns does not deal satisfactorily with this problem. The top of the column array of a conventional radiator will still reach far higher temperatures than the lower regions.

An important market for oil-filled column radiators is that which relates to the use of DIN (German) Standard shaped columns (or fins), which are in accordance with a Standard (DIN 4703) for water-filled columns. Whilst the latter Standard does not specifically apply to electrical column radiators, it is recognised as a de facto Standard for the shape of the column. These columns have a rectangular format (600 mm x 160 mm). Known electrical column radiators of this form designed to dissipate a nominal 2 kW of electrical energy as heat, require at least 12-14 fins in order to avoid exceeding European standard requirements for outer surface temperature.

The problems facing the invention are thus to re-design an oil-filled column radiator so that (a) it will comply with existing outer surface temperature requirements, particularly with regard to the upper regions of the radiator, (b) it will need fewer columns for a given thermal output, without exceeding the outer surface temperature requirements, and (c) its outer surface temperature distribution will be more uniform, i.e. the outer surface temperature at the bottom will be similar to the outer surface temperature at the top.

EP-A-0 556 433 discloses an oil-filled column radiator in which each column is formed by a pair of confronting pressed metal panels. The confronting panels of each column define triangular shaped oil passageways which extend between upper and lower bosses. Non-oil containing portions of the columns extend laterally from the outer edges of the oil passageways and these portions conduct heat between the oil passageways and peripheral surfaces of the columns. The panels are first welded together, by automatic machines equipped with welding rollers, following a path around the upper and lower bosses and alongside the oil passageways, the path being in the shape of a racetrack. Peripheral lateral portions of each panel are then folded so as to define vertical air channels having flat outer surfaces. These air channels draw cold air from below the body of the radiator, so as to increase the loss of heat by convection, and this has the effect of reducing surface temperature at the sides of the radiator. In a modification, two rows of staggered slots are also provided in side walls of the vertical channels to allow air to pass between the interior of the radiator and the channels. The upper peripheral portions of the plates also appear to be extended and perforated to allow the escape of hot air. This does not deal effectively with outer surface temperature requirements in the upper regions of the radiator. Nor does this reference address the problem of a uniform outer surface temperature distribution in the radiator.

US-A-2 651 506 discloses a similar arrangement i.e. which employs folded peripheral extensions forming air ascent shafts for cooling the sides of a column radiator. This radiator also employs a separate cap as a hot air outlet, thereby providing an air gap between the top of the column array and the cap. This reduces conduction between the columns and the top of the radiator. However, this does not address the problem of a uniform surface temperature.

The radiators disclosed in EP-A-0 556 433 and US-A-2 651 506 also have a complex construction, because complicated folds need to be made in peripheral portions of the confronting panels. In EP-A-0 556 433 these folds are made after the panels have been automatically welded together. This leads to higher manufacturing expense.

The invention solves the above-mentioned problems by reducing the level of oil in the oil passageway or passageways, so as to reduce the flow of heat to the top of the radiator. Hence, heat is transferred from the oil (near the top of the radiator) to the tops of the columns mainly or solely by conduction through upper non-oil containing portions of panels forming the columns, whereby the temperature of outer surfaces of the tops of the columns can be maintained below a predetermined limit. In addition, the thermal breaks in the lateral non-oil containing portions of the columns, are selectively located so as to reduce conduction of heat between the oil passageway or passageways and the peripheral side surfaces of the columns. The net effect of these two features is to confine more heat to the lower part of the radiator so that the temperature at the bottom of each column is similar to that at the sides and top of each column, thereby creating a substantially even temperature distribution around outer or the peripheral surfaces of the radiator. Because more efficient use is therefore made of the radiating surfaces of the radiator, by using the invention, the oil can be heated to a higher temperature, thereby allowing fewer columns and less oil to be used for dissipating the same amount of heat. Typically, the oil is heated to a temperature some 50°C higher than in conventional radiators (when the radiator is giving its maximum heat output). For example, the temperature measured on the top of the lower boss of the central column may be 200°C compared with 150°C (measured in the same spot) on a conventional radiator.

By way of example, a conventional 2 kW oil radiator of earlier manufacture would require 18 active columns, to meet current surface temperature requirements, the radiator containing some 9 litres of oil. In contrast, the invention can be embodied in a 2 kW oil radiator using 8 active DIN type columns and containing only 2.8 litres of oil.

The level of the oil in the columns will (in practice) depend on the design of the radiator, but it can be ascertained either by experiment, or by calculation, or both. The general aim is to reduce the outer surface temperature below the requirements or recommendations currently in force (in the respective country). For example, there are presently standard requirements for Europe in accordance with European Norm EN6 0335-2-30, which require that the temperature rise of an accessible outer surface of a radiator should not exceed 85°C above ambient (e..g it should not exceed 105°C if ambient is considered to be 20°C).

The size and position of bosses in the columns may also vary with different designs of radiator. For example, the centre of an upper boss may be close to, or distant from the upper surface of the radiator. Whilst this may not have any significant effect on performance, it will change the relative distance between the oil level and the centre of the upper boss. (The oil level relative to the upper surface of the radiator will generally remain the same.) For example, it may always be below upper bosses, taking account of oil expansion when the radiator is hot, or it may reach the upper bosses, at least when the oil expands where the bosses are lower, i.e. not near the top. (Upper bosses are usually present but they are not essential to the operation of the invention. When present, they provide a more rigid structure.)

In the case of using columns which have been designed largely in accordance with the current DIN 4703 Standard for radiators with water-filled columns, the oil level in conventional radiators of this type would usually be much closer to the top of the radiator. In an embodiment of the invention, which uses columns designed largely in accordance with the current DIN 4703, the oil level is further from the top of the radiator. For example, it can be not less than about 100 mm, and preferably 120 mm, from the top of the radiator (whereas it may be about 30-40 mm from the top of the conventional radiators, or even higher). In such embodiments of the invention, the upper bosses have centres of about 80 mm from the upper surface of the radiator. In contrast, the upper boss centres in conventional radiators are at about 40 mm from the upper surface.

In some embodiments of the invention, the oil level is typically level with, or below the lowest part of the upper bosses when the oil is at its maximum operating temperature, so that little or no heat is transferred directly from the oil to the upper bosses and upper parts of the radiator.

The size and disposition of the thermal breaks can be selected so that (in conjunction with the effect achieved by the oil level), the overall surface temperature of the radiator is substantially uniform.

In one embodiment of the invention, each column has at least two oil passageways extending between upper and lower bosses, the oil passageways communicating, via a by-pass, at a level between the upper and lower bosses.

Radiators embodying the invention are easier to manufacture, because the complicated folds and channels of EP-A-0 556 433 are not required in order not to exceed outer surface temperature limits. Moreover, less columns are required and there is hence a further saving in manufacturing costs, as well as an improvement in portability.

Embodiments of the invention will now be described with reference to the accompanying drawings in which:

Fig. 1 is a side elevation of a column used in a radiator embodying the invention;

Fig. 2 is a front elevation showing two columns forming part of an array of columns in the radiator of Fig. 1;

Figs. 3 and 4 are sections on AA and BB respectively;

Fig. 5 illustrates one example of how the lower boss can be enlarged, compared with a standard boss; and

Fig. 6 illustrates a heating element in the radiator.

Referring to the drawings, the column array 1 is made up of a series of parallel fins or hollow columns 2, each having outwardly facing upper and lower bosses 3,4. These bosses are secured together, e.g. by welding, in order to build-up the column array. More or less columns are added so as to provide the required thermal output. Only two columns are shown in Fig. 2, but there will usually be more, as shown in Fig. 6.

Each column 2 is made of confronting, pressed sheet metal panels 5, which are formed into the shapes shown in the drawing. Three vertical passageways 6a,6b, partly filled with oil, communicate between the upper and lower bosses 3,4. The lateral passageways 6b are spaced apart from the central passageway 6a by webs 5a in the panels 5, which webs may be spot-welded. These webs 5a are non-oil containing portions of the column. The central passageway 6a is elongated in horizontal cross-section, whereas the lateral vertical passageways 6b are oval or circular in cross-section. At the foot of the central passageway 6a, the entrance 6c is higher up in the column than the entrances 6d to the lateral passageways 6b; this promotes oil circulation within each column 2 (indicated by arrows P) because hot oil tends to rise in the central passageways 6a and to return to the lower bosses 4 (via a by-pass 6e) through the lateral passageways 6b. By-pass 6e is optional, but preferred.

A continuous seam weld is made around the peripheries of the passageways 6 and bosses 3,4 (as represented by the dotted shading 7 shown in Fig. 1 of the drawings). Also, although not shown, confronting faces of the respective bosses 3,4 are welded together, so that the upper and lower bosses respectively define coaxially extending chambers in the column array, which chambers communicate with the oil passageways 6a,6b. The lower bosses also contain an electrical heating element 10 which extends through the entire width of the radiator. In some prior art radiators, "short" heating elements are used to save expense. However, this leads to uneven temperature distribution along the column array, because columns not over the element will receive less thermal input than those over the element. Therefore, it is preferable, to use an element extending through each and every lower boss (except at the ends whereby dummy panels or columns may be used).

Non-oil containing portions or webs 8a,8b extend between the outer oil passageways 6b and peripheral side edges of the column 2. Non-oil containing portions 8c extend between the upper boss 3 and the peripheral upper edge of the column 2. The panels 5 are usually made of steel and the non-oil containing portions 8a,8b,8c thereby provide a conductive path for heat flowing towards the peripheral surfaces and edges of the columns 2. Thermal breaks, in the form of slanting slots 9, are provided in the side portions 8a,8c in order to reduce the amount of heat conducted from a central region of the column 2 to peripheral side edges of the column 2. This helps to reduce surface temperatures to comply with European standards as well as to distribute heat more uniformly to the outer surfaces of the radiator as a whole.

Referring to Fig. 1 the oil level in each column 2 is preferably and approximately 2/3 of the height between the upper and lower bosses (when the oil is hot, i.e. when the radiator is operating), with this particular design of panel. The oil level L is typically level with or below the lowest part of the upper boss in this design of panel and it is selected (when the radiator is made) so that little or no oil enters the upper boss, due to expansion, when the radiator is heated. By-pass 6e enables thermal currents to circulate in the individual column. (In alternative designs, the oil level is the same with respect to the top of the radiator, but it can flow over the upper bosses, which are lower down the column, when the oil is hot, thereby providing thermal circulation, but from column to column, via the upper bosses.

The by-pass 6e extends between the vertical oil passageways 6, at about the mid-point between the upper and lower bosses 3,4, when the radiator is operating normally. This by-pass 6e enables the oil levels in each vertical passageway to equalise and the oil to circulate and thereby assist in maintaining a more uniform temperature distribution throughout the radiator.

In Fig. 5, it can be seen that the lower boss 4 has been enlarged so as to increase its oil capacity. This enlargement is manifest in the upper generally sloping and partially conical surface above the usual boss. The lower boss volume may thereby be greater than the volume of the upper boss 3 (although the upper boss 3 does not contain oil). By providing more oil in the lower bosses, the temperature rise in the oil can be kept lower (although the oil is heated to a higher temperature than usual, as mentioned above). The upper boss may be similarly enlarged, in an oppositely directed sense, but this is just for appearance or styling.

A sheathed wire electrical heating element 10 is coaxially located in a lower oil-containing chamber, defined by the lower bosses 4, i.e. so that the element extends from one side of the radiator to the other. The element 10 is totally immersed in oil at all times. As the heating element and its manner of location in the lower bosses 4 is of known construction, no further detailed description will be given. Its power rating will, of course, be selected to achieve the required operation temperature (which is higher than in a conventional radiator, as explained above).

A region 11 bounding the thermal break region, defines a hollow bead, which may be either of an inverted U-shape (as shown in Fig. 1), or extend continuously around the periphery of the column. This hollow bead provides a more pleasing finish, besides helping to distribute heat more evenly over the radiator body. It does not, however, induce any flow of convected air because it does not form, e.g. an open vertical shaft.

The approximate oil content of each column 2 is reduced compared with prior art radiators of other manufacture. For example, the oil content for a single column in such a known prior art radiator may be 0.5 litres, whereas the oil content in each column of a radiator in accordance with embodiments of the invention is 0.2 - 0.35 litres.

Peripheral edges of the panels forming the columns may be bonded with heat resistant adhesive, which is more cost effective than welding, because no attempt needs to be made to provide an hermetic seal for oil. The adhesive provides a neat finish to the edge, because it prevents the two halves of the panels from opening up to due continued thermal cycling. Adhesive is not necessary to seal the bottom edge, because this is not visible.

In a radiator according to the preferred embodiment of the invention, only eight columns need be used which use the DIN design of panel, in order to dissipate 2 kW of energy. As shown in Fig. 6 cover 13 is provided at one end (in which controls for the radiator can be mounted in a known way) and a dummy end column 12 is provided at the other end. The cover and dummy end column prevent contact with hot oil ways on the end columns. The end cover and dummy end column are not part of the eight columns mentioned above.

Some of the features in the radiator of the preferred embodiment of the invention are as follows.

(a) Compared with traditional oil-filled radiators, the oil level, with respect to the top of the radiator is much lower.

(b) No thermal breaks are required in the upper non-oil containing portions 8c and these portions can be relatively short, i.e. because less heat is conveyed to the upper regions. In the radiator embodying the invention, heat is transferred to the upper regions mainly by conduction through the (e.g.) steel from which the panels are made.

(c) The design, i.e. including the shape of the panels 5, the shape and location of the thermal breaks 9, the oil level L, and the heating element used, is such that heat is distributed generally uniformly around the peripheral surfaces of the columns. The required balance is achieved by experiment, calculation, or both. As the heat is distributed more uniformly, without exceeding the more stringent surface temperature requirements, the oil can be heated to higher temperatures, in the centralised oil passageways. The net result is that the a radiator needs fewer columns for the same thermal output, compared with prior art radiators. In fact, the design is such that it enables the production of an oil-filled radiator with the fewest columns for an equivalent thermal output of any presently known radiator.

(d) The lower oil level (and enlarged lower bosses) provide a lower centre-of-gravity in the radiator, hence making it more stable and less likely to fall over, if it is struck.

(e) The slanting slots 9, which impede the flow of conducted heat, overlap in the lateral direction, whichever horizontal direction is traced between the oil passageways and the peripheral edge of a column. Conducted heat is therefore forced to take a longer path (than just horizontally straight across).

(f) The heating element is long enough to extend through the lower bosses of all thermally active columns of the radiator.

Claims

1. An oil-filled column radiator comprising:

a plurality of columns, joined together at least by lower bosses to form a column array, each column having an oil passageway or passageways extending upwardly from the lower bosses and having non-oil containing portions extending laterally from the oil passageways, said portions conducting heat between the oil passageways and outer or peripheral side surfaces of the column,

an electrical heating element or elements located in the oil in the lower bosses, and

thermal breaks in said non-oil containing regions to reduce conduction of heat from the oil passageways towards the outer or peripheral side surfaces of the radiator,

characterised in that the level of oil in the oil passageways is reduced so that heat transfer to the tops of the columns is mainly by conduction through upper non-oil containing portions of the columns, whereby the temperature of outer surfaces of the tops of the columns does not exceed a predetermined limit; and that the thermal breaks are selectively located in the lateral non-oil containing portions of the columns, so as to reduce conduction of heat between said passageway or passageways and the outer or peripheral side surfaces of the columns; the net effect of the reduced oil level and selective location of the thermal breaks creating a substantially even temperature distribution around outer or peripheral surfaces of the radiator.

2. A radiator according to Claim 1 in which the lower bosses are enlarged to increase their oil capacity.

3. A radiator according to Claim 1 or 2 in which the thermal breaks are slanted and overlap in the horizontal direction.

4. A radiator according to any of Claims 1 to 3 in which each column has at least two of said oil passageways and in which said passageways communicate at a level between the tops of the columns and the lower bosses.

5. A radiator according to Claim 4 in which said passageways communicate via a by-pass.

6. A radiator according to Claim 5 in which the by-pass is located at about a mid-point between upper and lower bosses in each column.

7. A radiator according to any of the preceding Claims, wherein a central oil passageway is flanked, on each side, by lateral oil passageways, the oil passageways extending vertically in each column; the central oil passageway having an entrance to its lower end which is higher than entrances to lower ends of the lateral oil passageways.

8. A radiator according to any of the preceding Claims in which the level of oil in the columns is about 100 mm below the top of the radiator, when the oil is at its operating temperature.

9. A radiator according to any of the preceding Claims in which the columns are substantially in accordance with the DIN (German) Standard for water-filled column radiators.

10. A radiator according to any of the preceding claims in which peripheral edges of panels forming the columns are secured together by adhesive.

11. A radiator according to any preceding Claim including either a cover, or a dummy column at both ends of the column array.

12. A method of making an oil-filled column radiator, the method including the steps of:

pressing panels to form column halves having at least lower bosses, grooves which define an oil passageway or passageways, and non-oil containing portions extending laterally from the oil passageway or passageways;

joining pairs of the panels to form a plurality of columns;

joining at least the respective lower bosses of the columns to form a column array;

introducing an amount of oil to the column array;

locating an electrical heating element or elements in the lower bosses; and

characterised by forming thermal breaks in the non-oil containing lateral portions of the panels to reduce thermal conduction between said passageway or passageways and the peripheral surfaces of the columns, and by introducing only that amount of oil which will provide a required surface temperature at the tops of the columns, the net effect being to achieve a substantially uniform temperature distribution around outer surfaces of the radiator.

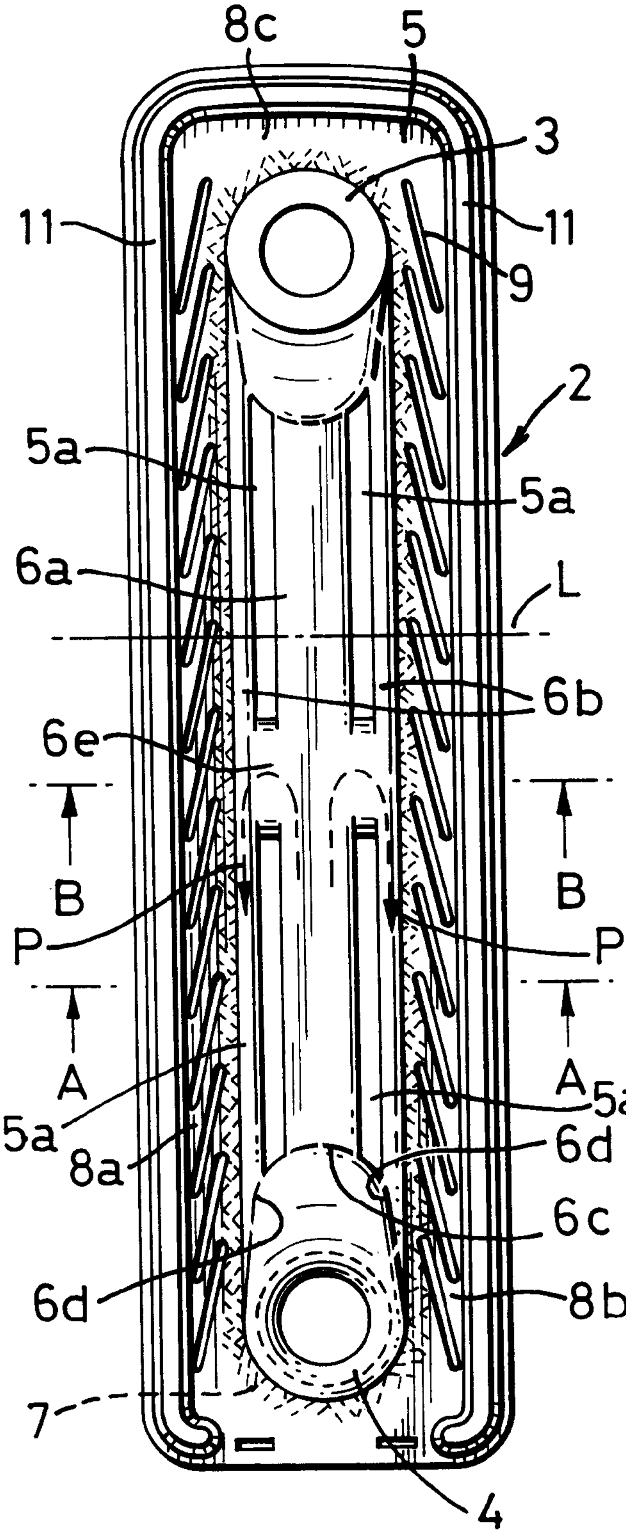


FIG.1

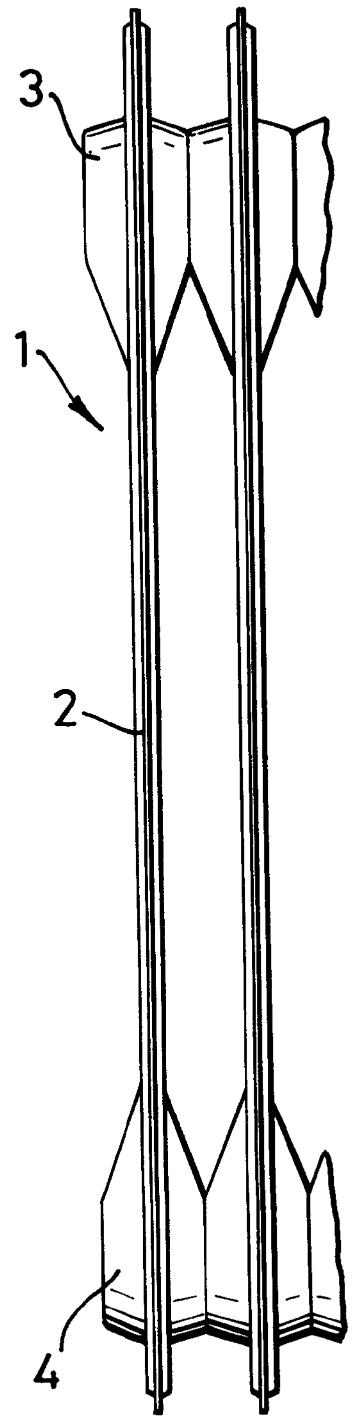


FIG.2

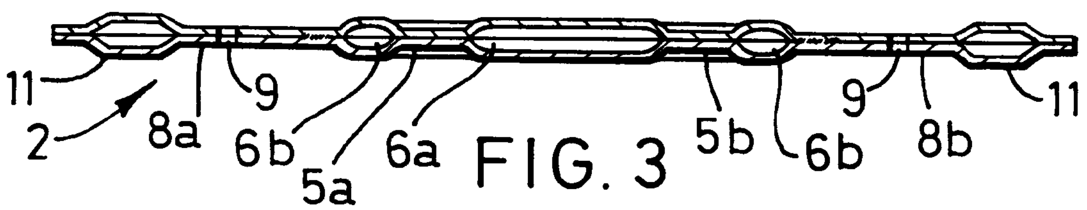


FIG. 3

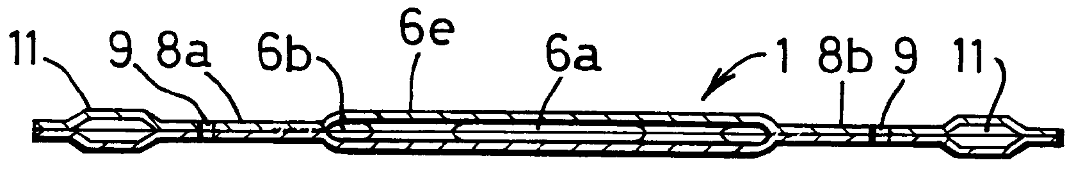


FIG. 4

FIG.5

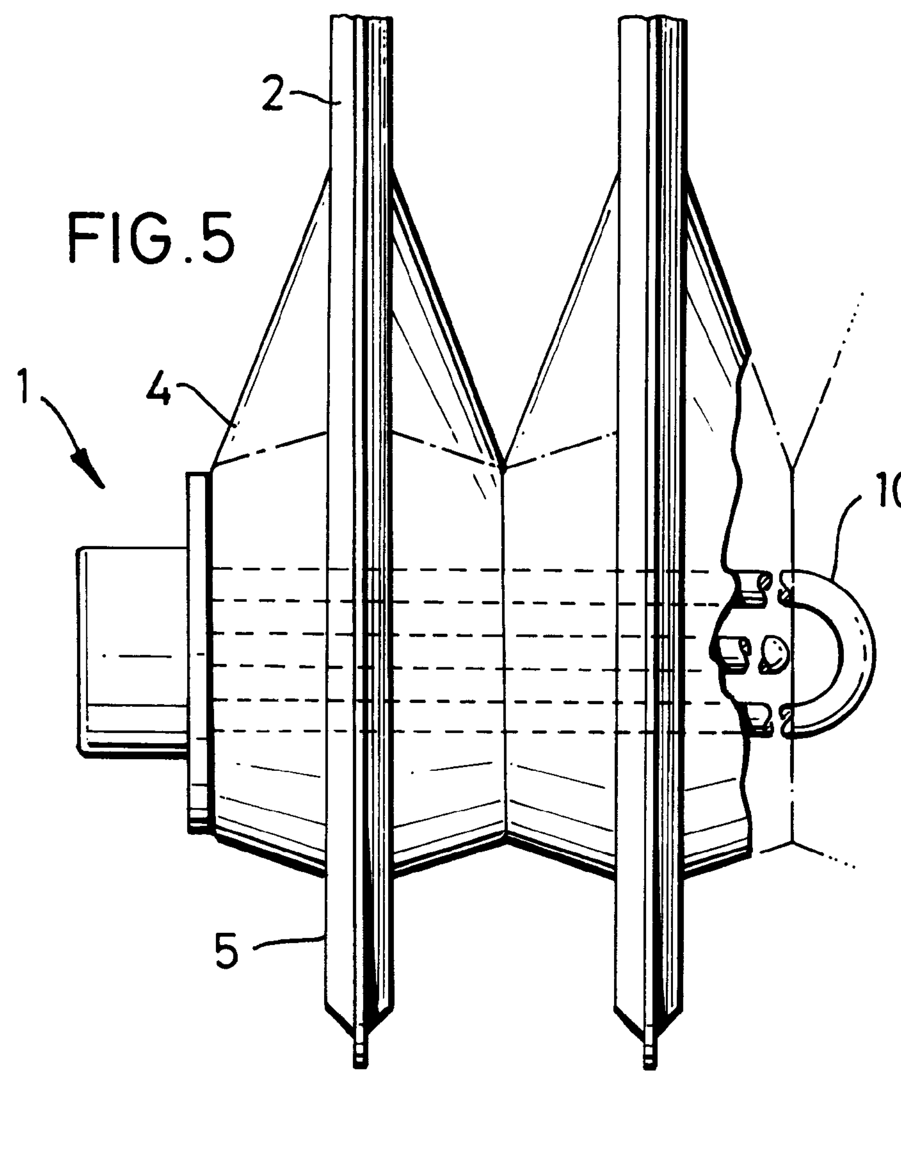
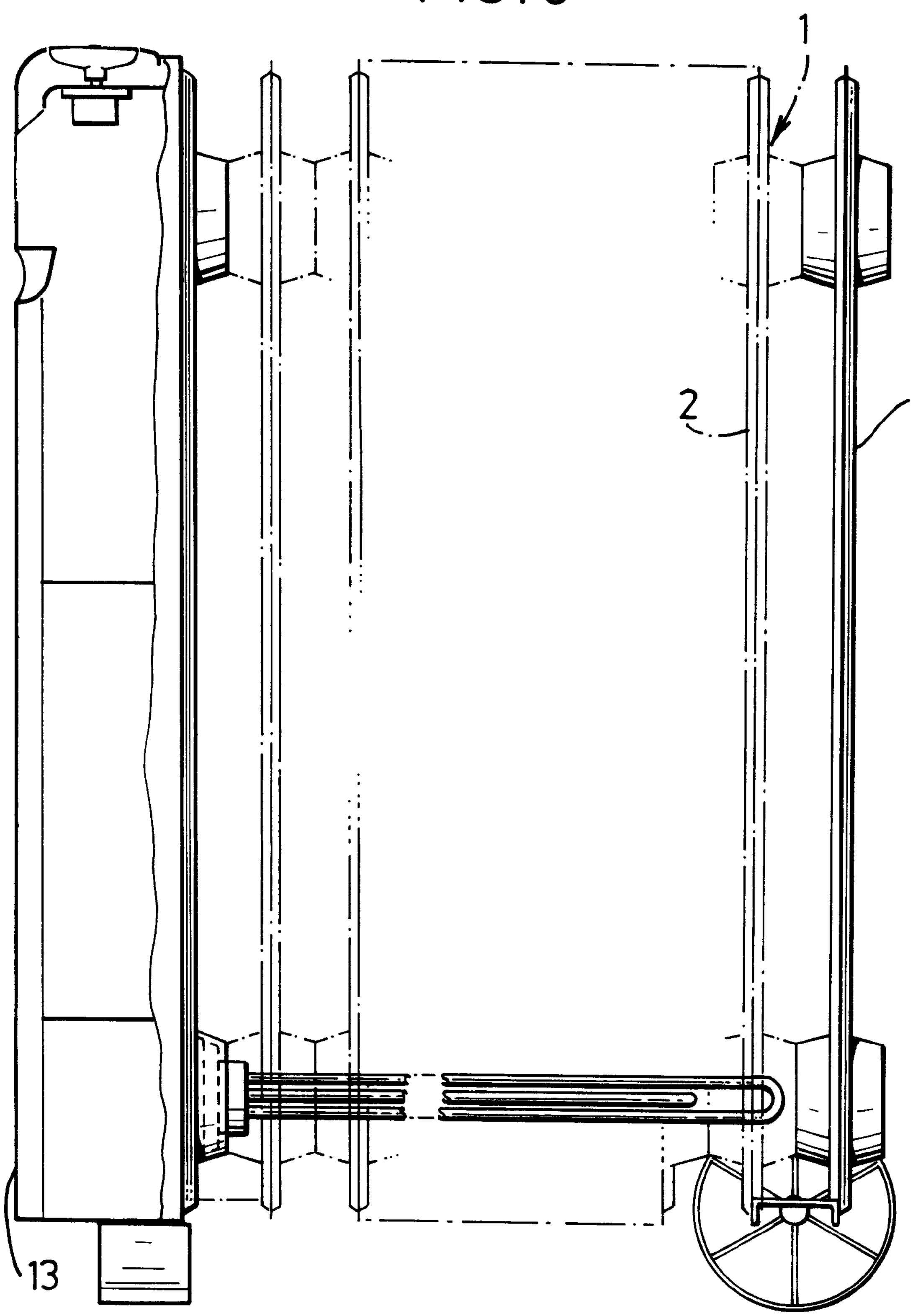


FIG. 6



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EUROPEAN SEARCH REPORT

Application Number
EP 95 30 5066

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.6)
A	FR-A-1 394 844 (LOISY) * figures * ---	1	F24H3/00
A	US-A-2 060 795 (BURKE) * figures * ---	1	
A	GB-A-730 976 (HARVEY) * figure 1 * ---	1,11	
A	AU-D-6 530 674 (MARTIN PERR & CO. PRESS-UND ZIEHWERK GMBH) * figure 2 * ---	1,11	
A	FR-E-75 621 (DENIS) * the whole document * -----	1	
			TECHNICAL FIELDS SEARCHED (Int.Cl.6)
			F24H

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	5 October 1995	Van Gestel, H

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