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(54) Heating apparatus for combined clothes washing and drying machine.

(57) Heating apparatus (15) for a combined clothes washing and drying machine, including a housing (14) removably joined with an opening (13) in the upper part of the wash tub (5) and forming part of the wall of the tub. The heating apparatus (15) is formed by at least one electrical resistance heating element (21) embedded in a mass (23) of heat-radiating material and is provided with means capable of conveying drying air toward the drum (6) containing the clothes.

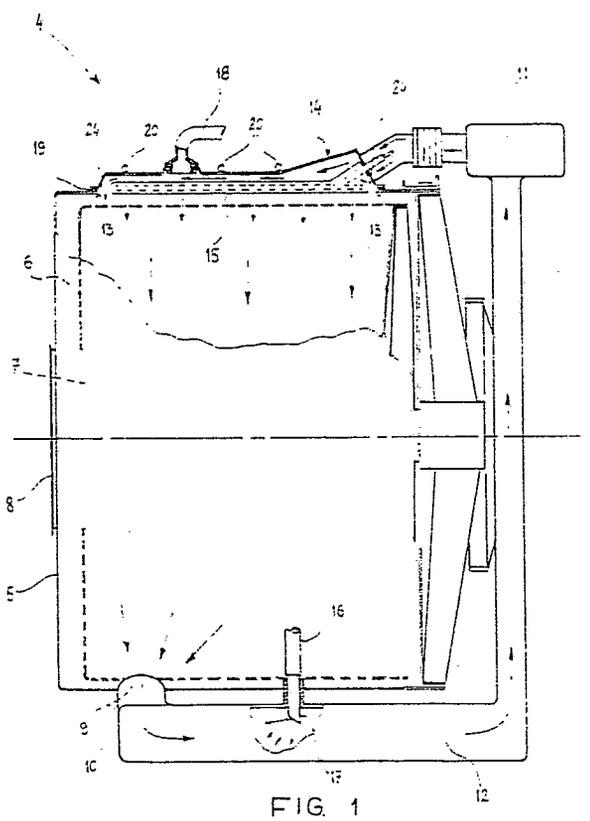

FIG. 1

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HEATING APPARATUS FOR COMBINED CLOTHES WASHING AND DRYING MACHINE

The present invention relates to a heating apparatus for a combined laundering machine for washing and drying clothes, which is apt to both improve the efficiency of the machine during the clothes drying process and enhance the construction and the assemblability of the machine itself.

In particular, the present invention relates to a front-loading domestic washing machine, which is equipped with a wash tub within which a clothes drum is able to rotate about a horizontal axis and to accomodate the washload during both the washing and the drying process.

Combined washing and drying machines are known, which wash the clothes either by soaking them into the wash liquor or by spraying them with a reduced amount of wash liquor being properly circulated in the wash tub, and them dry the washload by a hot-air process.

Said drying process can be implemented either by means of a closed-loop air circulation system, where the air is forced to successively flow through a heating apparatus, the drum containing the clothes, a dehumidifying apparatus, and is finally returned to the circuit where the cycle starts again, or by means of an open-loop system which takes in the air from the room, heats it up, sends it through the clothes and finally blows it outside the machine under moist and hot conditions.

In view of obtaining a higher efficiency of the machine during the drying operation, the heating elements provided to heat up the drying air are preferably placed into a box-like housing which is fixed by welding in the area where the air intake opening lies in the upper part of the wash tub.

The main disadvantage arising in connection with this solution, however, lies in the problems which are encountered in getting at the heating elements for maintenance and repair purposes, since access to them can be only gained by first taking the tub-drum assembly apart.

A further disadvantage lies in the corrosion initiation effects induced by the welding operation performed to attach the heating-element housing onto the wash tub.

Furthermore, heating elements are usually employed in this type of machines to heat up the drying air, which are designed to operate at as high temperatures as 600 °C in order to ensure a favourable heat-exchange interaction with the drying air and, as such, shall necessarily be sheathed with special-alloy materials having high nickel-chromium contents for increased corrosion strength.

Such heating elements require manufacturing processes which are quite complex and imply high defect rates.

A metal screen is furthermore arranged above the body of said heating elements in view of both increasing the heat-exchange surface area and minimizing heat radiation losses towards the outside of the appliance, while at the same time reducing the temperature values which the electrical and other functional parts housed in the upper part of the machine may become exposed to.

As a consequence, heating elements of this type are both intensively power-consuming and expensive, and they also require the use of thermal screening arrangements which not only contribute to the construction complexity of the machine, but can also give rise to disturbing noise and vibration problems during certain operation cycles (eg., spin extraction) of the machine.

Under these circumstances it would therefore be desirable, and is in fact the main object of the present invention, to provide a heating apparatus for a combined clothes washing and drying machine capable of eliminating all above described disadvantages, while ensuring the same or possibly a better efficiency of the machine during the clothes drying process.

These and other objects are attained according to the present invention by a heating apparatus for a combined clothes washing and drying machine, particularly a front-loading washer-dryer machine for home use comprising a wash tub within which a drum is rotatable about a horizontal axis and is capable of accomodating the clothes to be both washed and dried, a drying pneumatic circuit equipped with a blower forcing the drying air to successively flow through a housing containing heating elements and communicating with an opening in the upper part of the wash tub, and the drum containing the clothes, to finally expel it out of the tub of the machine, characterized in that the housing of the heating apparatus is joined in a removable way with the opening in the upper part of the wash tub and forms a part of the wall of said wash tub, said heating apparatus being formed by one or more electrical resistance heating elements embedded in a mass of heat-radiating material and being further provided with means capable of conveying the drying air toward the drum containing the clothes.

The characteristics and advantages of the invention will become more clearly apparent from the following description, given by way of non-limiting example with reference to the accompanying drawings, wherein:

Figure 1 is a partial cut-away, side view of a clothes washing and drying machine equipped with a preferred embodiment of the apparatus according to the invention;

Figures 2 and 3 respectively show a longitudinal cut-away view along the II-II line of Fig. 3 and a partial top view of the apparatus according to Fig. 2.

The clothes washing and drying machine 4 shown in Fig. 1 is essentially formed by a wash tub 5 in which a drum 6 is mounted in such a way as to be capable of rotating about a horizontal axis and accomodating the clothes to be washed and dried.

The drum 6 is driven rotationally by an electric motor and belt-type driving means in a per se known, not shown way, and it features a front loading opening 7 which is in a line with both the front opening 8 in the wash tub and the front opening in the outer cabinet (not shown) of the washing and drying machine.

The wash tub 5 has a lower opening 9 connected via a conduit 10 with a filtering device, a pump and a drain conduit (not shown) which are provided to duly discharge the wash liquor or the water from the machine at the end of the various washing and rinsing cycles.

After completion of a washing process, the machine 4 can in a per se know way perform also the drying of the washed clothes by means of a heated-up air flow which is circulated through the drum 6 containing the wet drying load, and which is then expelled from the tub 5, dehumidified, heated up and blown again into the tub 5.

To this purpose, a blower 11 is provided, the suction side of which is connected with the drain conduit 10 of the wash tub 5 through a water-cooled condensing device 12, while the delivery side of said blower 11 is connected with an opening 13 in the upper part of the wash tub 5 through a housing 14 containing a heating apparatus 15 formed by electrical resistance heating elements.

The condensing device 12 is connected to the water mains through a conduit 16 and a water inlet solenoid value (not shown) which deliver to a spray nozzle 17 the water needed to form the cooling curtain for condensing the moisture out of the air expelled from the tub 5.

Both cooling water and condensate are then conveyed to the discharge pump and. from there, to the drain.

The machine equipped with the heating apparatus according to the invention is capable, in a per se known way, of either traditionally washing the clothes by soaking them in the wash liquor or washing the clothes by spraying a reduced quantity of continuously circulated wash liquor on them.

To this purpose, the filtering apparatus (not shown) of the machine is connected, via a collecting manifold and a circulation pump (not shown), with a conduit 18 which penetrates into the top part of the tub 5, just above the heating apparatus 15, so that it can spray heated-up wash liquor onto the clothes contained in the drum 6.

The housing 14 of the heating apparatus 15 is in a preferred way made of stainless steel and is attached in a removable way to the opening 13 in the upper part of the wash tub 5 with the interposition of suitable sealing means 19 (eg., rubber sealing gaskets) therebetween.

The connection of the housing 14 of the heating apparatus 15 with the wash tub 5 is made through the use of tie-rods 20 connected to the ends of a circular strap (not shown) which is capable of being applied in a removable way against the circumference of the wash tub 5 as described in European Patent Application No. 0 214 510.

Instead of or together with said tie-rods, traditional screw-and-nut fastening means can also be used.

The heating apparatus 15 (Fig. 2) is fixed in a removable way to the housing 14, eg. by screw-and-nut or similar fastening means 21, and includes one or more electrical resistance heating elements 22 made of conventional stainless steel material and embedded in a plate 23 of heat-radiating material.

Said heat-radiating plate 23 has a rectangular shape extending transversally so as to cover almost the whole surface of the opening 13 in the wash tub 5, except for a narrow passage gap 24 all along the perimeter (Fig. 1).

The plate 23 is further provided with a number of through holes 25 (Fig. 3) which are so designed as to enable both the drying air and the wash liquor issuing from the circulation conduit 18 during spray washing of the clothes to freely flow through them.

The upper surface of the plate 23 is provided with fins 26 (Fig. 3) which feature a diverging pattern along the direction in which the drying air flows into the tub 5, in view of enabling the drying air to be distributed over the largest possible surface area of the plate 23.

The plate 23 may for example be formed by a cast slab of aluminium in all those cases in which the heating elements 22 are required to operate at medium-to-low temperature values which would therefore exclude the occurrence of problems arising from the difference in the thermal expansion coefficients of the stainless steel, of which the heating elements 22 are made and the aliminium forming the plate 23.

Should on the contrary heating elements for higher operating temperatures be required, the plate 23 may advantageously be made of a ce-

ramic material enabling also normal heating elements, ie. not specially sheathed, to be embedded therein.

It is to be noticed that the heating apparatus as described herein is connected in a removable way with the wash tub 5, thereby eliminating all disadvantages deriving from a welded attachment and simplifying maintenance of the housing 14 as well as the possible replacement of the heating apparatus 15.

Furthermore, the heating apparatus 15 is such as to make it unnecessary to use expensive heating elements sheathed with high-grade steel claddings, since the heat-radiating plate 23 enables the actually available heat-exchange surface, and as a consequence the efficiency of normal heating elements, to be increased and, at the same time, the heating elements themselves to be effectively protected against corrosion.

As a consequence, the heating apparatus 15 may be made to operate at lower temperatures and makes it unnecessary to provide for the arrangement of such heat shielding means as usually required by traditional solutions.

In the above-described embodiment, the heating apparatus is used in a closed-loop condensing-type combined clothes washing and drying machine. However, it is quite apparent that the same advantages would also derive from its use in washing and drying machines provided with an open-loop drying circuit.

The heating apparatus according to the present invention can of course be further modified or differently made as compared to the described embodiment without departing from the scope of the invention.

For example, the heating plate 23 could also be given different shapes (eg. oval or arched) or be made of materials other than those previously mentioned (eg., special ceramics).

Claims

1. Heating apparatus for a combined clothes washing and drying machine, particularly a front-loading washer-dryer machine for home use comprising a wash tub within which a drum is rotatable about a horizontal axis and is capable of accomodating the clothes to be washed and dried, a drying pneumatic circuit equipped with a blower forcing the drying air to successively flow through a housing containing heating elements and communicating with an opening in the upper part of the wash tub, and the drum containing the clothes, to finally expel it out of the tub of the machine, characterized in that the housing (14) of the heating apparatus (15) is joined in a removable way with the opening (13) in the upper part of the wash tub (5) and forms a part of the wall of said wash tub (5), said heating apparatus (15) being formed by one or more electrical resistance heating elements (21) embedded in a mass (23) of heat-radiating material and being further provided with means (25, 26) capable of conveying the drying air toward the drum (6) containing the clothes.

2. Apparatus according to claim 1, characterized in that said mass of heat-radiating material is shaped as a rectangular plate (23) extending transversally so as to cover almost the whole surface of the opening (13) through which the drying air flows into the tub (5), and that said drying air conveying means are formed by fins (26) and through holes (25) showing a diverging pattern along the direction in which the drying air is made to flow intp the tub (5).

3. Apparatus according to claims 1 and 2 for a clothes washing and drying machine provided with a wash tub and a circular strap of plastic material capable of being applied in a removable way and fitted against the outside circumference of said tub as described in European Patent Application No. 0 214 510, characterized in that said housing (14) is kept in its position over the opening (13) in the upper part of said tub (5) by means of tie-rods (20) connected to the ends of said circular strap on the tub (5).

4. Combined clothes washing and drying machine provided with an apparatus according to claim 1, comprising a system for circulating the wash liquor from the lower part to the upper part of the tub in view of spraying the clothes with a reduced quantity of wash liquor, characterized in that the conduit (18) for circulating the wash liquor ends into the tub (5) above the heating apparatus (15).

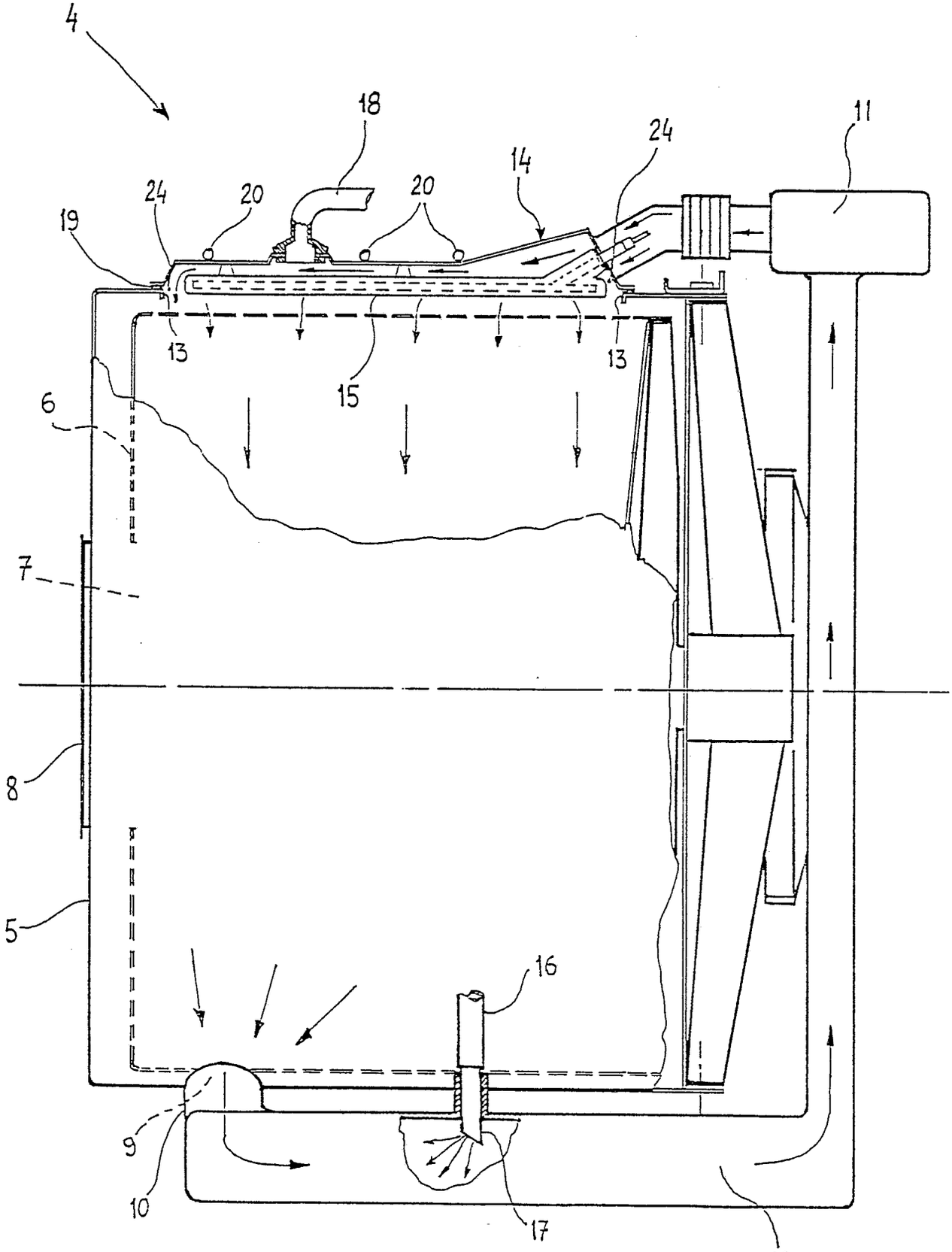

FIG. 1

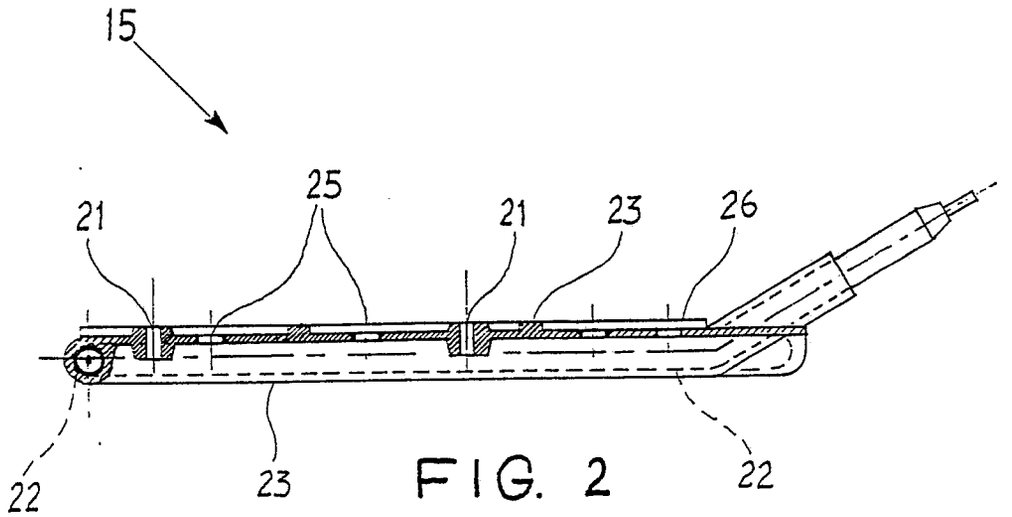
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FIG. 2

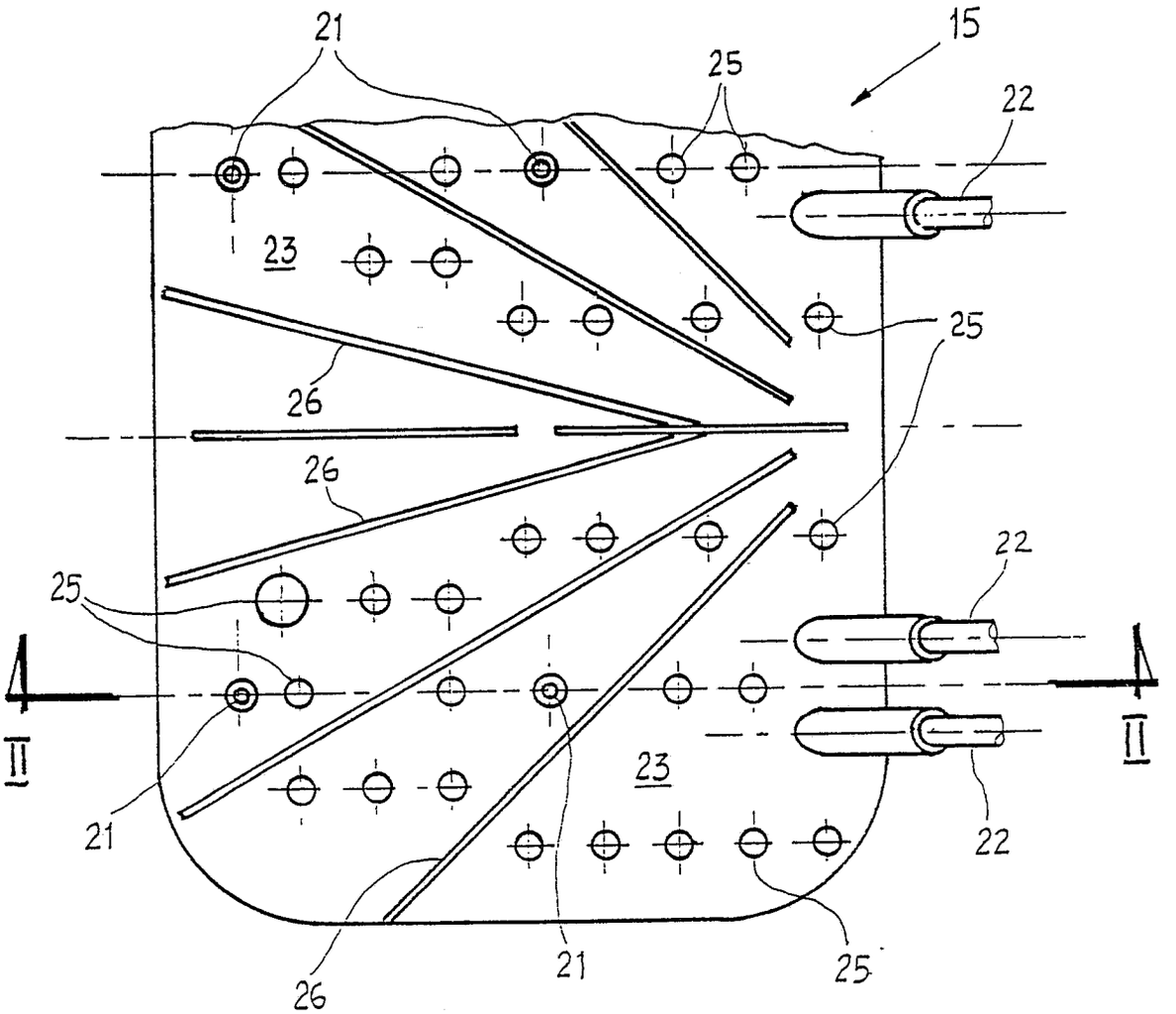
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FIG. 3

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EUROPEAN SEARCH REPORT

Application Number

EP 89 10 9099

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)
A	DE-A-3340313 (LICENTIA PATENT-VERWALTUNGS-GMBH) * page 4, line 33 - page 5, line 28 * * page 6, lines 1 - 18 * * claims 1, 2, 4-9; figures 2, 3 *	1, 2	D06F58/26 D06F39/04 D06F25/00
A	EP-A-0240910 (ZANUSSI ELETTRODOMESTICI S.P.A.) * column 4, line 32 - column 5, line 26 * * claims 1, 2, 5-7; figures 3, 4 *	1, 4	
A	EP-A-0252323 (INDUSTRIE ZANUSSI S.P.A.) * column 3, line 20 - column 4, line 20 * * column 5, line 51 - column 6, line 7 * * claim 3; figure 1 *	1, 4	
A	US-A-2867430 (H. E. HULLAR) * column 2, lines 34 - 43 * * column 3, lines 29 - 46 * * column 8, lines 13 - 58 * * figures 1, 2, 10, 11 *	1	
A	GB-A-2044297 (DOMAR S.A.) * page 1, lines 78 - 87 * * figures 1-5, 7, 8 *	1	TECHNICAL FIELDS SEARCHED (Int. Cl.4) D06F
D,A	EP-A-0214510 (ZANUSSI ELETTRODOMESTICI S.P.A.)		
A	US-A-2682599 (T. R. SMITH)		
A	US-A-2607209 (A. R. CONSTANTINE)		
A	FR-A-1160079 (COMPAGNIE FRANÇAISE THOMSON-HOUSTON)		

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	15 SEPTEMBER 1989	BOURSEAU A.M.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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