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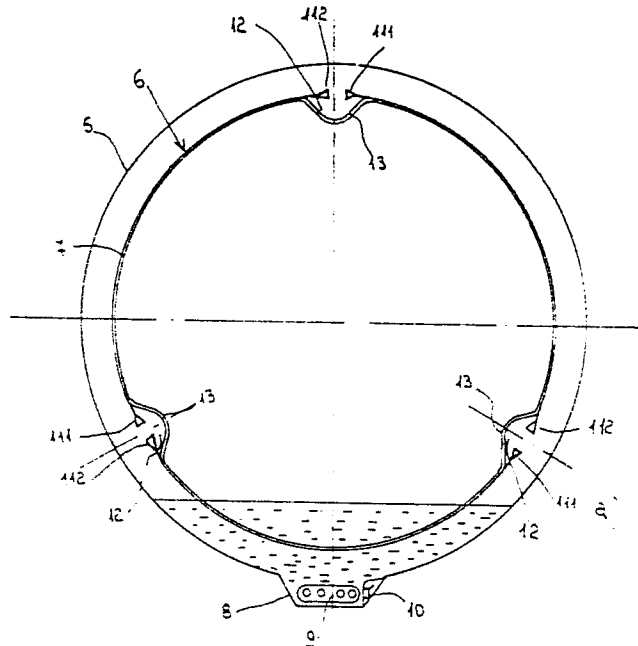
Laundry washing machine.

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A laundry washing machine comprises a tub (5), a washing liquid collector receptacle (8) with a heater element (9) disposed therein, and a number of containers (111-117) associated to the entrainment ridges (13) of the drum (6) and adapted to pick up amounts of the washing liquid at the lower portion of the tub (5) for lifting the liquid to a maximum height with respect to the laundry by rotation of the drum, and for subsequently releasing the liquid to drop onto the laundry.

The liquid subsequently returns to the tub (5) so that the washing of the laundry is accomplished by repeated recirculation of the washing liquid between the tub (5) and the drum (6).

The present laundry washing machine is capable of carrying out "intensive" washing programmes with normal or reduced washing liquid levels in the tub (5), as well as "delicate" washing programmes with normal liquid levels in the tub.



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Laundry Washing Machine

The invention relates to a laundry washing machine of the washing liquid recirculation type adapted to efficiently launder laundry of different nature at charges of different magnitude in the drum of the machine, and with different washing liquid levels in the laundering tub.

In Italian Patent Application No. 45734 - A/83, filed on December 6, 1983 in the name of Industrie Zanussi S.p.A., there is described a laundry washing machine of the type specified above, comprising a laundering tub, a washing liquid collecting receptacle communicating with a lower portion of the tub, and an electric pump communicating with a top portion of the tub through a recirculation conduit for irrigating the laundry by repeated recirculation of the washing liquid from the collecting receptacle to the tub.

This machine is capable of carrying out "intensive" and "delicate" laundry washing programmes for laundering variable quantities of cotton fabrics and/or of mixed cotton and synthetics fabrics capable of withstanding high temperatures of the washing liquid, as well as delicate fabrics and/or woolsens.

In particular, the "intensive" laundering programmes may selectively be carried out with normal or reduced levels of the washing liquid in the tub, resulting respectively in complete immersion of the laundry in the washing liquid, and in irrigation of the laundry with the liquid.

In the course of these programmes, the drum of the machine is rotated at respective laundering speeds and at the spindrying speed, the electric recirculation pump being kept in the energized state only in the presence of reduced washing liquid levels in the laundering tub.

Although a laundry washing machine of the type described permits the consumption of water, detergents and electric power to be considerably reduced, it suffers from the disadvantage of a rather complicated construction due to the employ of the recirculation pump and conduit, and to the necessity of providing at least one filtering element of conventional type in the collecting receptacle for retaining impurities and any foreign bodies possibly entrained by the washing liquid.

In another laundry washing machine of the washing liquid recirculation type, described in German Patent Application No. 3,320,177, the recirculation of the washing liquid is accomplished in a more simple manner, eliminating the electric pump, the recirculation conduit and the filter element provided in the embodiment described above.

In particular, this machine comprises a rotatable drum of conventional type, formed with perforations in its lateral walls, the drum being housed in a laundering tub and so dimensioned that its circumferential wall extends closely adjacent the corresponding circumferential wall of the tub.

The tub is filled with a washing liquid to a predetermined reduced level, the liquid being heated by a heater element disposed in the bottom of the tub at a spaced location from the circumferential wall of the drum.

During rotation of the drum the liquid is lifted to a predetermined level, entering the drum through the perforations in the respective lateral walls, so as to soak the laundry contained in the drum to thus carry out the washing operation. The liquid subsequently returns to the tub through a passage or a suitable opening formed in the drum. A laundry washing machine of this construction permits the laundry to be washed with a reduced consumption of water, detergents and electric energy, while still presenting certain shortcomings.

In the first place, the soaking of the laundry in a machine of this type is rather difficult and uncertain because of the reduced dimensions of the perforations formed in the lateral walls of the drum, which permit the entry of only reduced amounts of the washing liquid into the drum. This limitation is not conducive to obtaining satisfactory results of the washing operation.

Another critical aspect in a laundry washing machine of this type is the extremely small distance between the respective walls of the drum and the tub. On the one hand this distance has to be sufficiently small for ensuring an efficient lifting action on the washing liquid contained in the drum during rotation of the drum, while on the other hand this distance may not be too small for avoiding any contact of the drum with the heater element disposed in the bottom portion of the tub.

It is an object of the invention to overcome the shortcomings and limitations of the known washing machines described above by the provision of a laundry washing machine capable of efficiently washing the laundry by repeated circulation of the washing liquid between the tub and the drum of the machine without the employ of the recirculation pump and conduit and of the filter described above.

These and other objects are attained according to the invention in a laundry washing machine comprising a laundering tub, a rotatable drum mounted in the tub, adapted to contain the laundry and composed of a perforate peripheral wall and two lateral closure walls, and a washing liquid col-

lecting receptacle formed directly in the lower portion of the tub, the machine further comprising means for heating the washing liquid preferably disposed within said collecting receptacle, and entrainment means adapted to cause the washing liquid to be repeatedly recirculated between the tub and the drum.

According to the invention, a machine of this type is characterized in that said entrainment means comprises a plurality of containers located at regular spacings about the peripheral wall of said drum and adapted on rotation of said drum in both directions to collect a volume of the washing liquid from the lower portion of said tub for lifting it to a predetermined maximum height for subsequently dropping it into said drum, from where said liquid returns to said tub through the perforations of said peripheral wall.

The characteristics of the invention will become more clearly evident from the following description, given by way of example with reference to the accompanying drawings, wherein:

figs. 1 to 4 show diagrammatical illustrations of the laundering tub and the drum of a laundry washing machine according to four different embodiments of the invention.

With reference to fig. 1a, wherein the laundry washing machine according to the invention is shown in a diagrammatical front view, the machine is shown to comprise a laundering tub 5 supported in a known manner in a housing of the machine, a rotatable drum 6 mounted in tub 5 for containing the laundry to be washed and having a perforate peripheral wall 7 connected to two lateral closure walls (not shown), and a collector receptacle 8 for collecting the washing liquid supplied to tub 5, said receptacle 8 being integrally formed with tub 5 at the lower portion thereof and adapted to contain an electric heater element 9 of conventional construction.

The laundry washing machine further comprises at least one thermostatic sensor 10 of conventional type associated to collector receptacle 8 and electrically connected to heater element 9 for controlling the temperature of the washing liquid contained in receptacle 8 by successively energizing and deenergizing heater element 9.

The described laundry washing machine finally comprises a number of pressure switches or similar level control means (not shown) for controlling the supply of the washing liquid to tub 5 up to a normal or a reduced level, depending on the amount and type of laundry to be washed.

In particular, heater element 9, thermostat sensor 10, said pressure switches and the remaining electromechanical components of the machine are connected in the electric circuit thereof in the same manner as in the laundry washing machine de-

scribed in the cited Italian Patent Application No. 45734 - A/83. In contrast to this machine, however, the machine according to the invention lacks the recirculation pump and conduit as well as a filter for the washing liquid, while still permitting the washing liquid to be recirculated between tub 5 and drum 6 in the manner to be described.

To this purpose drum 6 is provided with a plurality of containers 111, 112 supported in corresponding recesses 12 formed at regular intervals along the outer surface of peripheral wall 7 of drum 6.

In particular, each recess 12 is formed by deforming peripheral wall 7 of drum 6 inwards so as to obtain a corresponding ridge 13 for entraining the laundry at the inner surface of peripheral wall 7.

Recesses 12 may of course also be formed in peripheral wall with different shapes and at different locations not corresponding to those of ridges 13 without thereby leaving the scope of the present invention.

Shown in fig 1b is a perspective view on an enlarged scale of a detail of one of the recesses 12 described above. The recess shown has an arcuate bottom 14 connected to peripheral wall 7 of drum 6 by two curved portions 15, 16. Disposed in recess 12 at symmetric positions are two containers 111, 112 each comprising two slightly curved imperforate walls 17, 18 extending over the full width of the respective ridge 13 and converging towards a common terminal portion 19, whereat the two walls are connected to one another and to peripheral wall 7 of drum 7 by a narrow sheet metal strip 20. The two walls 17, 18 of each container are closed off laterally by respective end walls 21 (only front end wall 21 being shown in fig. 1b), so that each container defines a chamber 22 the bottom of which is formed by terminal portion 19, while the side opposite the bottom is open.

The thus formed containers are dimensioned so that on rotation of drum 6 they do not come into contact with the peripheral wall of tub 5, and so as to permit them to collect determined volumes from the lower portion of tub 5 and to lift the thus collected washing liquid to a predetermined maximum height, from which the liquid drops back into drum 6 through the perforations of the respective portion of peripheral wall 7 to thereby soak the laundry contained in drum 6.

In the example under discussion, the washing liquid is lifted by the containers to a maximum height corresponding to the diameter of drum 6 as each pair of containers is displaced to a position opposite to the liquid contained in the lower portion of tub 5.

As containers 11, 112 of each pair are disposed at symmetric positions facing one another, it is ensured that the washing liquid is lifted in the described manner on rotation of drum 6 in both directions, i.e. container 112 acts to lift the liquid on clockwise rotation of drum 6, while container 111 lifts the liquid during counterclockwise rotation.

The part of the liquid thus supplied to the interior of drum 6 and not absorbed by the laundry therein returns to the lower portion of tub 5 through the perforations of peripheral wall 7 of drum 6.

The described laundry washing machine thus permits washing programmes to be efficiently carried out by repeated recirculation of the washing liquid between tub 5 and drum 6 in the described manner, without the employ of an electric recirculation pump and conduit and a filter as formerly employed in the machine described in patent application No. 45734 - A/83.

The recirculation is in particular obtained on the base of a functional principle of the machine which is different from that of the machine described in German Patent Application No. 3,320,177.

This aspect permits the shortcomings of the latter machine to be eliminated, thanks to the fact that in the present case a satisfactory soaking of the laundry is achieved and that the lifting of the washing liquid is not dependent on the positioning of the drum in close proximity to the tub, as in the former case, the lifting of the washing liquid being advantageously accomplished by the use of the described containers.

The laundry washing machine according to the invention is moreover capable of carrying out the same washing programmes as described in patent application No. 45734 - A/83, i.e. "intensive" washing programmes with normal or reduced levels of the washing liquid in the laundering tub, for in the latter case obtaining reduced consumption of water, detergents and electric energy, and "delicate" washing programmes with normal washing liquid levels in the tub.

With reference finally to figs. 2, 3 and 4, there are shown three possible embodiments of containers in a laundry washing machine according to the invention adapted to cause the washing liquid to be recirculated in substantially the same manner as described above.

The laundry washing machines shown in these figures are designed to operate in the same manner, and composed of the same structural components as the machine shown in fig. 1, the respective components being therefore designated by the same reference numerals.

In the embodiment of figs. 2a and 2b, showing respectively a front view and a perspective partial view of the drum of the present machine, a pair of containers 113, 114 is likewise mounted in a respective recess 12 of drum 6. Containers 113, 114 are of a construction similar to that shown in fig. 1, comprising a pair of slightly curved imperforate walls 17, 18 extending over the full width of the respective ridge 13 of drum 6, and two lateral end walls 21 cooperating with walls 17, 18 to define a chamber 22 of the respective container.

In contrast to the construction shown in fig. 1, the slightly curved walls of each container converge in the opposite direction, so that the two containers 113, 114 disposed in each recess 12 are symmetric to one another and interconnected at a common terminal portion 23, the pair of containers being secured to peripheral wall 7 of drum 6 by respective narrow sheet metal strips 24.

This structural solution likewise permits the washing liquid to be lifted from the lower portion of tub 5 on rotation of drum 6 in both directions, container 113 acting to lift the liquid on clockwise rotation of drum 6, while container 114 is effective to lift the liquid on counterclockwise rotation.

In the embodiment of figs. 3a and 3b, showing the tub and drum of a washing machine in the same views as above, each container 115 is no longer housed in a corresponding recess in the peripheral wall of the drum, its construction being also different from that of the embodiments described above.

Each container 115 comprises an elongate channel member 25 extending over the full width of peripheral wall 7 of drum 6, and a pair of lateral end walls (not shown).

Connected to the open side of channel member 25 are two planar wall portions 26, 27 at offset positions relative to one another, wall portions 26, 27 being formed with suitable bores 28, permitting them to be secured as by means of screws or the like to the interior surface of peripheral wall 7 which in this embodiment is of a continuous circular shape.

In this embodiment each container 115 thus additionally acts as a ridge for entraining the laundry.

The interior of each container 115 is longitudinally divided by a transverse partition 29 into two identical chambers 30, 31 each provided with openings 32, 33 and 34, 35, respectively, for the admission to and discharge of the washing liquid from the respective chamber.

In particular, openings 32 and 33 are of identical shape and disposed at offset positions, being defined by the free edges of respective planar walls 26, 27 and the free edge of channel member 25, all of said free edges being seated on the

interior surface of peripheral wall 7. In a modified embodiment the free edge of channel member 25 may also be recessed with respect to peripheral wall 7.

The discharge openings 34, 35 are formed at locations permitting the respective chamber on rotation of drum 6 to lift the washing liquid from the lower portion of the tub to a predetermined maximum height with respect to the liquid level in the tub, and to release the liquid at this height to drop onto the laundry in the drum.

In particular, chamber 30 of each container acts to thus lift the washing liquid on clockwise rotation of the drum, while chamber 31 is effective to lift the liquid on counterclockwise rotation.

The view shown in figs. 4a and 4b are similar to the ones shown in the preceding figures and depict a further embodiment of the containers different from the ones described.

In this embodiment drum 6 is formed with the same recesses as in figs. 1 and 2, each recess 12 being divided into two identical chambers 116, 117 or containers by a central partition 36 extending within recess 12 over the full width of peripheral wall 7 of drum 6 and releasably secured to peripheral wall 7 by means of per se known fasteners.

Partition 36 is relatively thin-walled adjacent its connection to peripheral wall 7 and terminates in an enlarged portion at its free end.

The presence of the enlarged portion 37 at the free end of partition 36 permits a sufficient volume of the washing liquid to be picked up at the lower portion of tub 5 on rotation of drum 6, and to be lifted to a determined maximum height from which it drops onto the laundry contained in drum 6 through discharge openings 38, 39 formed in the bottom portions of containers 116, 117, respectively.

In this embodiment containers 117 act to lift the washing liquid on clockwise rotation of drum 6, while containers 116 are effective to lift the liquid on counterclockwise rotation.

Claims

1. A laundry washing machine comprising a laundering tub, a rotatable drum mounted within said tub, adapted to contain the laundry and composed of a perforate peripheral wall and two lateral end closure walls, and a washing liquid collecting receptacle formed integrally with the lower portion of said tub, the machine further comprising means for heating the washing liquid preferably disposed in said collecting receptacle, and entrainment means adapted to cause said liquid to be repeatedly recirculated between said tub and said drum, characterized in that said entrainment means com-

prises a plurality of containers (111, 112; 113, 114; 115; 116, 117) provided at regular intervals around said peripheral wall (7) of said drum (6) and adapted on rotation of said drum (6) in both directions to pick up amounts of the washing liquid at the lower portion of said tub (5) to lift said liquid to a predetermined maximum height for subsequently releasing said liquid to drop into said drum (6) and to return to said tub (5) through the perforations of said peripheral wall (7).

2. A laundry washing machine according to claim 1, characterized in that said containers (11,112; 113,114) are disposed at symmetric positions relative to one another in corresponding recesses (12) formed in the outer surface of said peripheral wall (7) and at the same time forming respective internal ridges (13) of said drum (6).

3. A laundry washing machine according to claim 2, characterized in that each container of each pair of said containers (111,112; 113,114) is composed of two slightly curved imperforate walls (17, 18) extending over the full width of the respective ridge (13) and converging towards a respective terminal portion (19, 23), and two lateral end closure walls (21) cooperating with said walls to define a container chamber (22) open at one side and closed at the other side by a bottom formed by the respective end portion (19, 23).

4. A laundry washing machine according to claim 3, characterized in that each of said containers (111,112) is connected adjacent its respective terminal portion (19) to said peripheral wall (7) by means of a metallic member (20).

5. A laundry washing machine according to claim 3, characterized in that each of said containers (113,114) is connected to the other container adjacent the respective terminal portion (23), and secured to said peripheral wall (7) by a respective metallic member (24).

6. A laundry washing machine according to claim 1, characterized in that each container (115), while also forming a respective inner ridge (13) of said drum (6), is releasably secured to the interior surface of said peripheral wall (7) and comprises a concave channel member (25) extending over the full width of said peripheral wall, and two lateral end closure walls, the interior of said container (115) being longitudinally divided by a transverse partition (29) into two identical chambers (30, 31) each provided with inlet openings (32, 33) and discharge openings (34, 35) for said washing liquid.

7. A laundry washing machine according to claim 6, characterized in that the open side of said channel member (25) is connected to two planar walls (26, 27) of identical dimensions disposed at mutually offset positions and associated to respective ones of said inlet openings (32,33), said planar

walls (26, 27) being formed with bores (28) for securing them to said peripheral wall (7) by means of per se known fasteners.

8. A laundry washing machine according to claim 7, characterized in that each of said inlet openings (32,33) is defined by the space between the free edge of a respective one of said planar walls (26, 27) in contact with said peripheral wall (7) and the free edge of said channel member (25) disposed in contact with said peripheral wall (7) or recessed therefrom.

9. A laundry washing machine according to claim 1, characterized in that said containers (116,117) are formed by respective chambers separated from one another by a partition (36) dividing the respective recess (12) formed on the outer surface of said peripheral wall (7), said recess (12) additionally forming a respective entrainment ridge (13) of said drum (6), said partition extending over the full width of said peripheral wall (7) and being releasably secured to said peripheral wall by means of per se known components.

10. A laundry washing machine according to claim 9, characterized in that said partition (36) has a reduced wall thickness adjacent the location whereat it is secured to said peripheral wall (7), and is provided with an enlarged portion (37) adjacent its free end.

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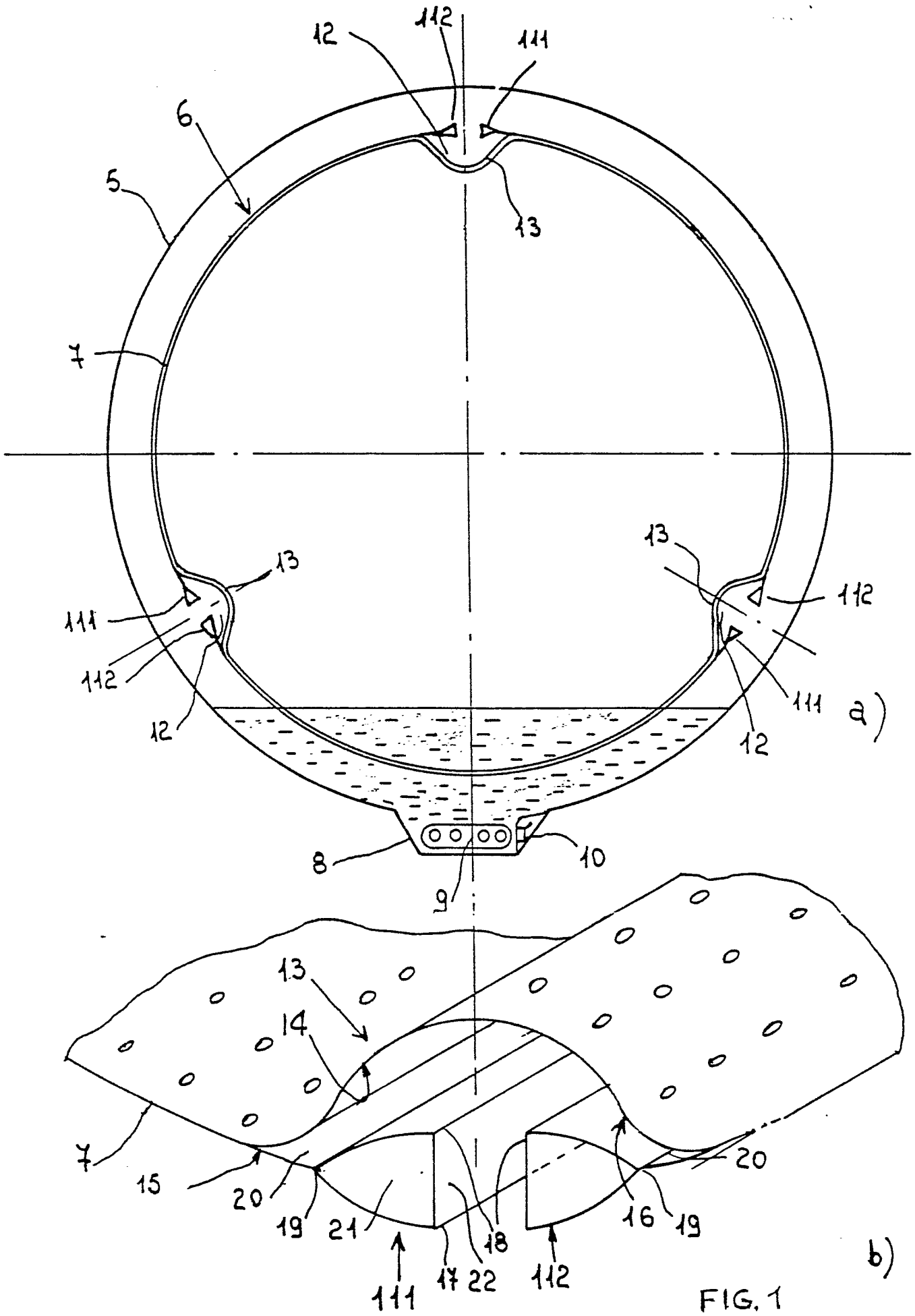


FIG. 1

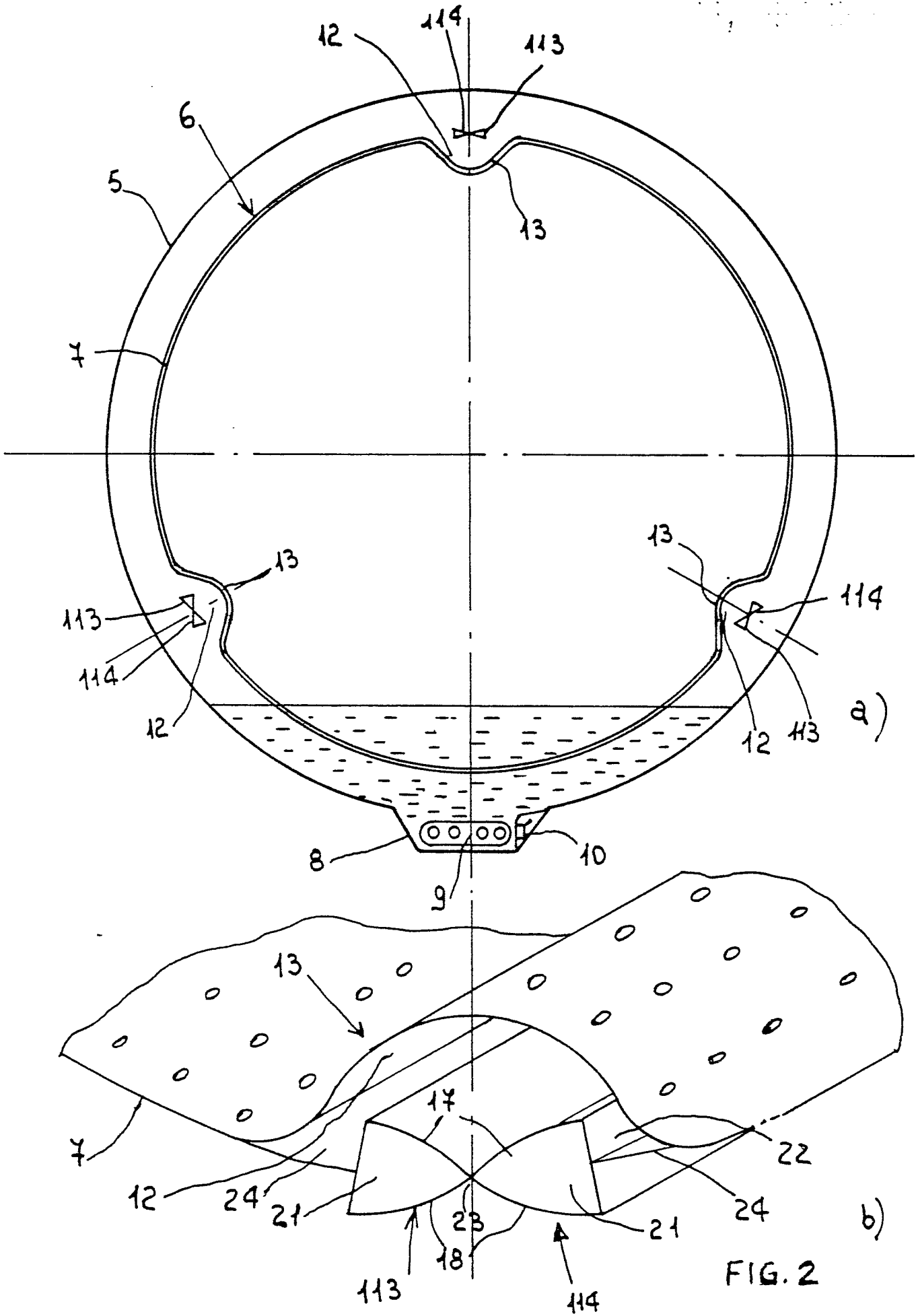
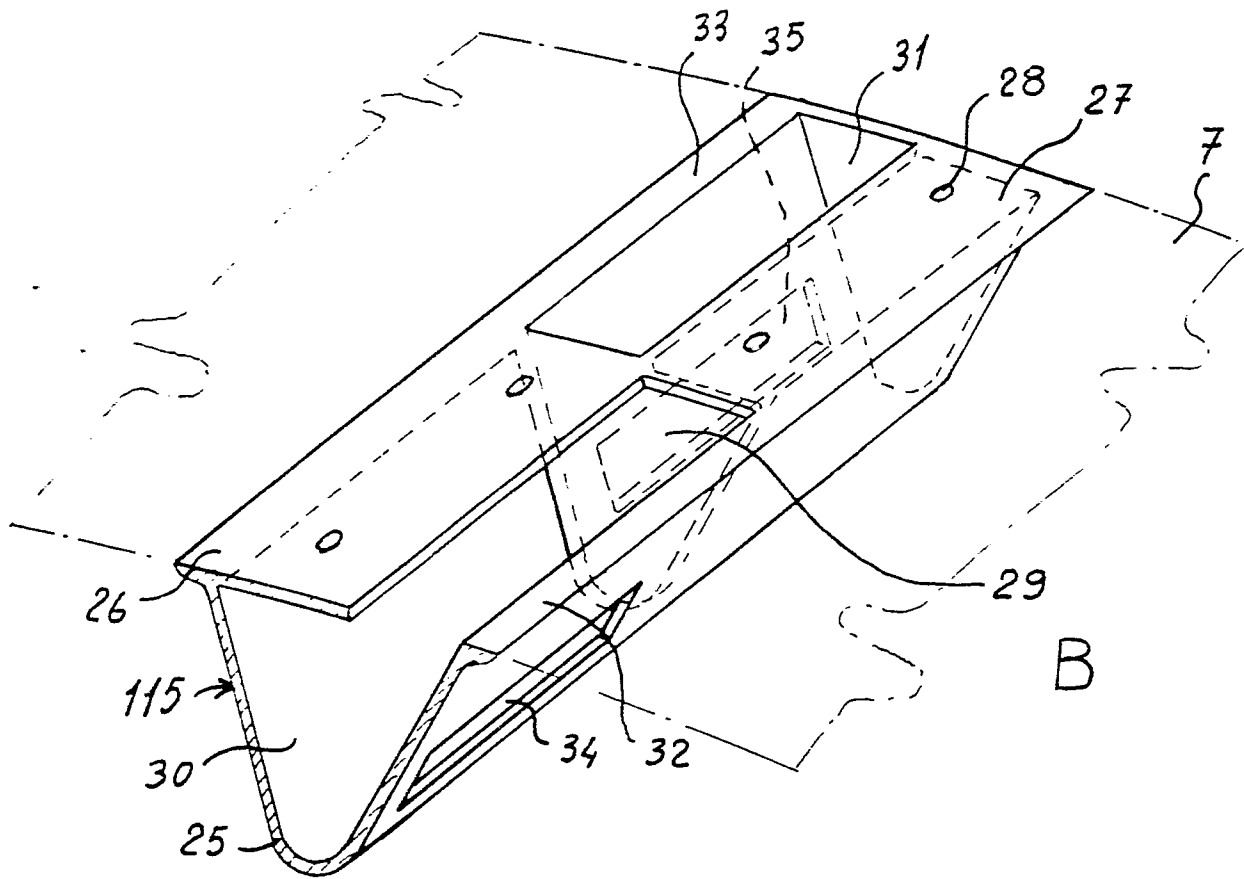
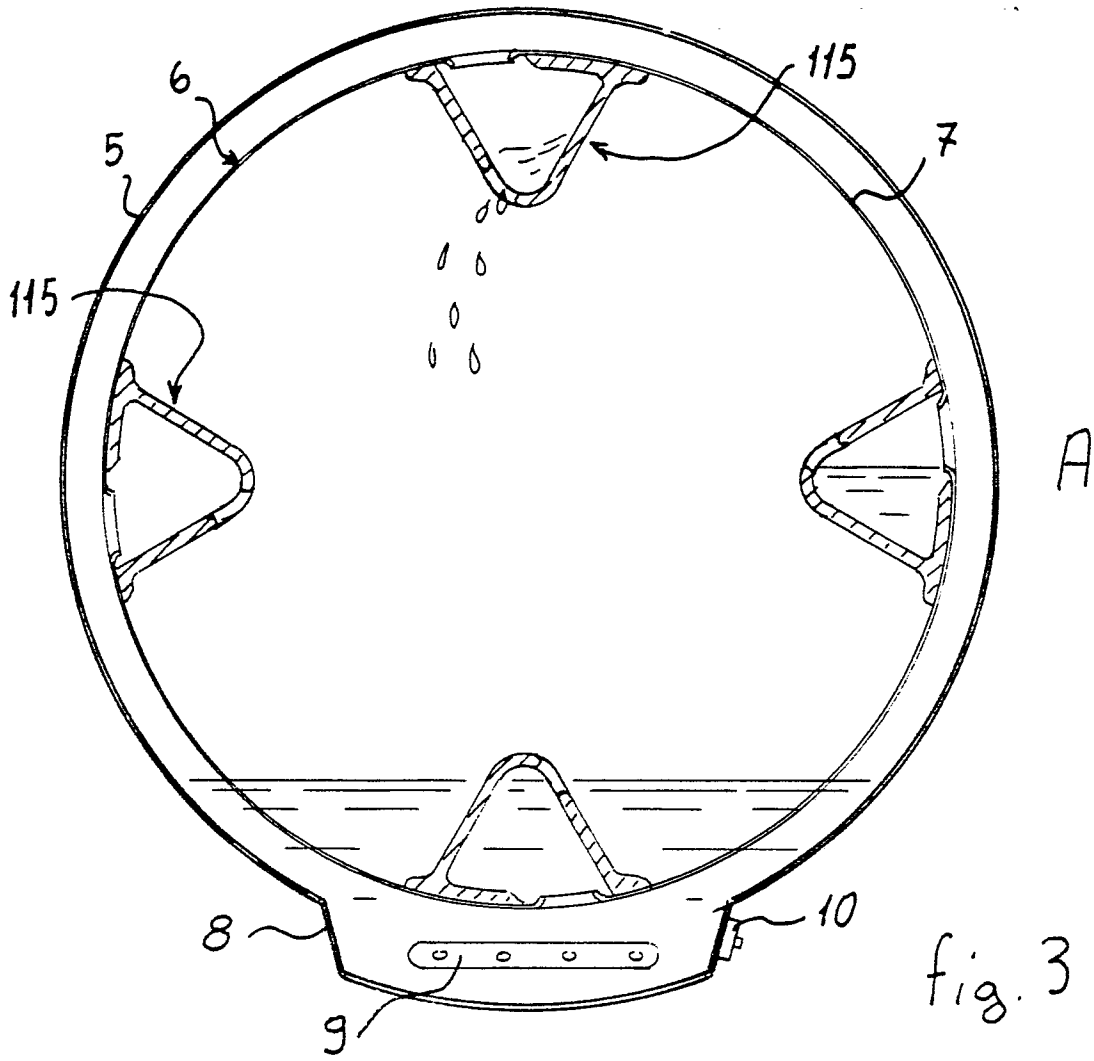
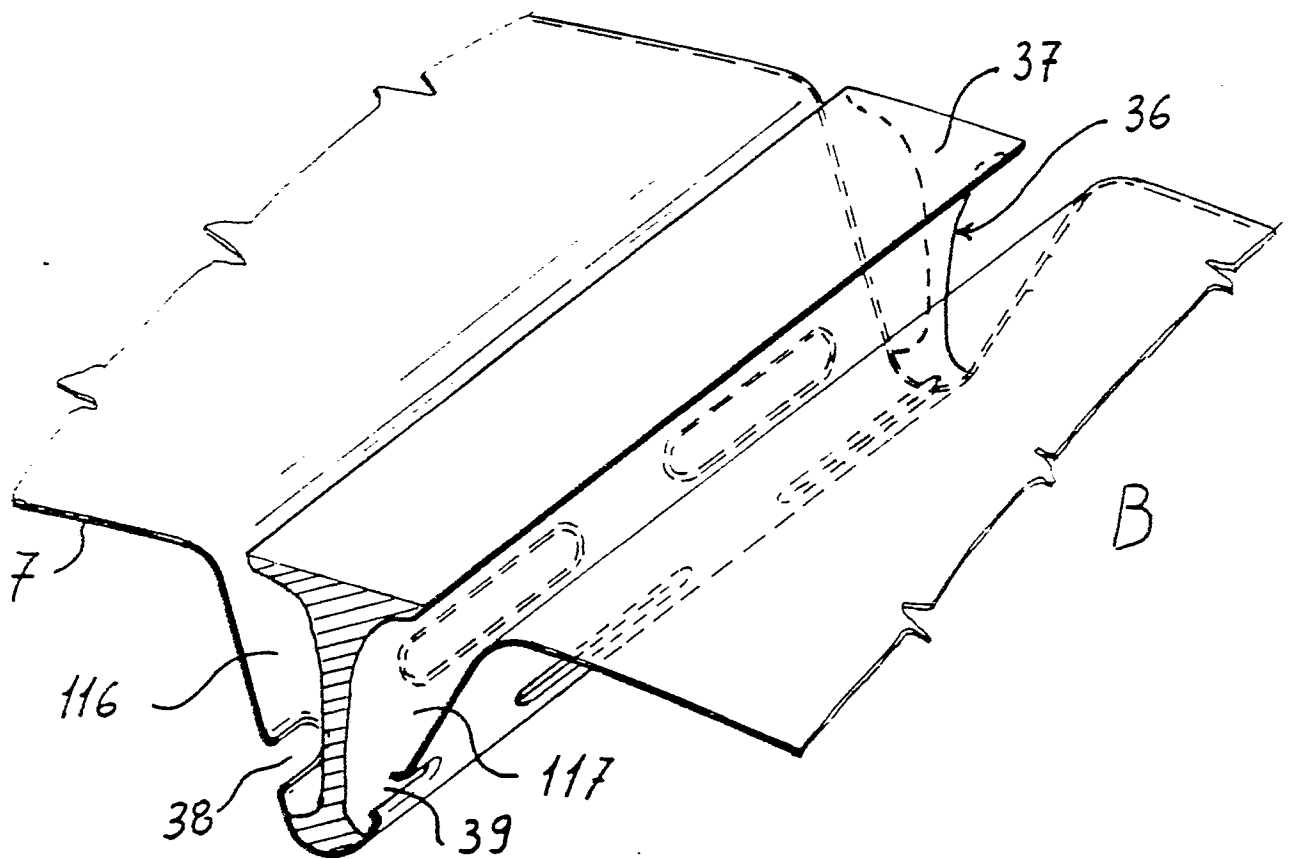
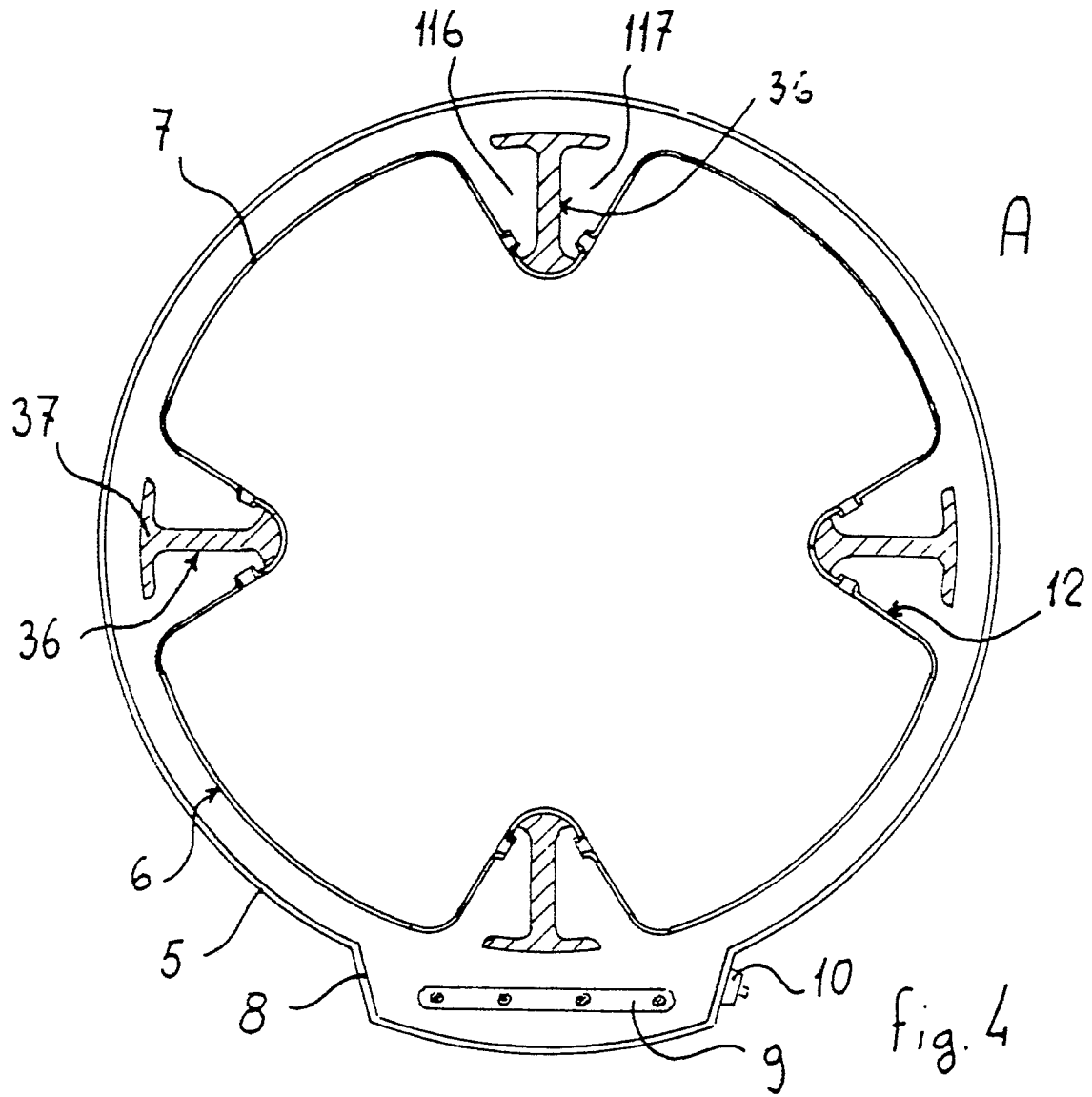


FIG. 2







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)
X	GB-A- 819 251 (THE CHERRY TREE MACHINE CO. LTD) * Figure 2; claims *	1,2,9,10	D 06 F 23/02
X	US-A-3 201 958 (POLYMARK) * Figures 2,3; claim *	1,2,9,10	
X	DE-C- 163 464 (MÜLLER) * Whole document *	1,2	
A		3,4,5	
X	GB-A- 640 974 (BRAITHWAITE & SON ENGINEERS LTD) * Figures 2,3; claims *	1,2	
X	FR-A- 458 768 (CAISSO) * Figure; claim *	1	
A		2	
X	FR-A- 377 638 (BECKMANN) * Figures 1,2; claim; page 1, lines 59,60 *	1	
X	FR-A-1 299 679 (JESUS) * Figures 2,3 *	1	D 06 F
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 03-06-1987	Examiner COURRIER, G. L. A.
CATEGORY OF CITED DOCUMENTS		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	
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DOCUMENTS CONSIDERED TO BE RELEVANT			Page 2
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.4)
A	GB-A- 22 944 (HENRICI) * Figures 2,7 * -----	1,2,6, 7,8	
			TECHNICAL FIELDS SEARCHED (Int. Cl.4)
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 03-06-1987	Examiner COURRIER, G. L. A.
<p>CATEGORY OF CITED DOCUMENTS</p> <p>X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document</p> <p>T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons</p> <p>& : member of the same patent family, corresponding document</p>			