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(54) **Washing machine**

(57) Washing machine comprising a washing tub (2) containing a drum (1) comprising a base (3) and a lateral surface (5) with one or more first regions (200) provided with apertures (6) adapted for allowing a washing liquid contained in the tub (2) to flow into and out of the drum (1), the lateral surface (5) comprises one or more second regions (100) which are not provided with the apertures adapted for allowing the washing liquid contained in the tub (2) to flow into and out of the drum (1), furthermore, the drum (1) comprises one or more hollow lifters (8), protruding from the lateral surface (5) towards the internal part of the drum (1) and provided with one or more outlet openings (9) adapted to fluidly connect the internal part of the one or more lifters (8) to the internal part of the drum (1) in order to allow the release of a liquid contained in the one or more lifters (8) inside the drum (1) when the one or more lifters (8) are in an upper region of the tub (2); the one or more lifters (8) are associated with the one or more second regions (100) of the lateral surface (5), the base (3) of the drum (1) being provided with one or more inlet apertures (17) fluidly connecting the one or more lifters (8) to the external of the drum (1), so as to allow, during the rotation of the drum (1), the washing liquid present in a rear and bottom region (2a) of the tub (2) to enter the one or more lifters (8).

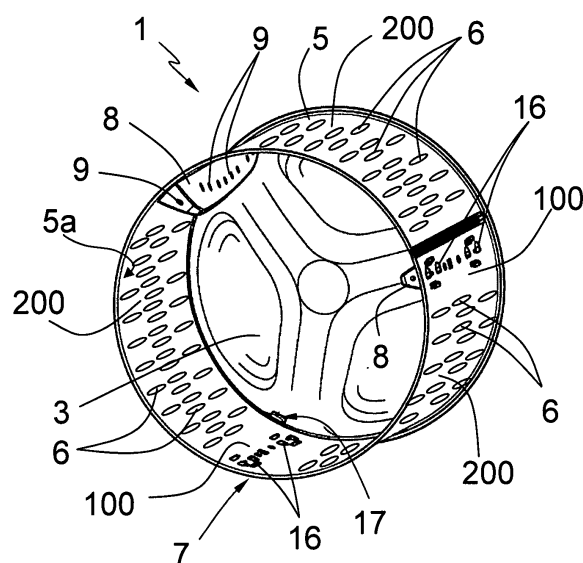


Fig. 3

Description

[0001] The present invention refers to a washing machine, particularly a laundry washing machine.

[0002] While reference will be generally made to a "single-duty" laundry washing machine, i.e. a machine designed to only wash the laundry, throughout the following description, it shall be understood that the considerations and explanations set forth and given hereinbelow equally apply to combined clothes washing and drying machines, i.e. the so-called washer-driers.

[0003] Usually laundry washing machines comprises an external casing containing a washing tub in which a rotary perforated drum is placed, adapted for loading the laundry to be washed.

[0004] Usually the drum is provided with some lifters (called also elevators, or ribs, or diverter), adapted to improve the stirring of the laundry during the rotation of the drum; the lifters are substantially prismatic elements fixed to the inner face of the lateral surface of the drum, and positioned with their longitudinal axis substantially parallel to the rotation axis of the drum.

[0005] One of the parameters which affect the quality of the wash in a washing machine is the wetting of the laundry; in fact, in order to obtain an optimal wash of the laundry, it is important that its wetting is as uniform as possible.

[0006] Another parameter which affects the quality of the wash, is the temperature of the washing liquid (i.e. water, or water mixed with washing/rinsing products) in contact with the laundry; the temperature of the washing liquid in contact with the laundry should be also in this case as uniform as possible in order to obtain an optimal wash.

[0007] However both the wetting of the laundry and the temperature of the washing liquid in contact with the laundry are typically higher at the periphery of the drum, and lower in the middle of the latter, particularly in the full load condition, which results in worse washing performances, in a longer wash cycle, and in higher water and energy consumptions.

[0008] In order to overcome this drawback, nowadays some washing machines are provided with re-circulating means that are adapted to lift up the washing liquid from the bottom of the tub and to pour it again and again into the drum, preferably into and through the washload itself, in view of enhancing the effectiveness of the washing action, while reducing both energy and water usage.

[0009] Machines of this kind are particularly efficient and their diffusion and popularity on the marketplace are indicative of them being largely accepted by the consumers, actually. However, these machines, generally referred to as "re-circulating type" machines in the art, have an obvious major drawback in that they are significantly more expensive than traditional designs, since they require the construction of a re-circulating circuit, along with the pump and the various devices and arrangements associated thereto.

[0010] In view of at least partly doing away with such drawback, a solution that has been largely adopted in the art lies in sizing and shaping in a particular manner the above mentioned lifters that are usually applied on the inner face of the lateral surface of the drum.

[0011] This solution provides that the lifters are hollow and that they are provided, on their surface, of some apertures or holes; in this solution the internal of the lifters fluidly communicates with the external of the drum via the openings provided on the lateral surface of the drum in order to allow the washing liquid contained in the tub to flow into and out of the drum.

[0012] During the rotation of the drum, when a lifter passes by the bottom of the tub, in which the washing liquid is collected, the washing liquid enters the lifter via the openings present in the lateral cylindrical surface of the drum, and, while the lifter is taken aloft by the rotation of the drum, the washing liquid is discharged inside the drum through the apertures or holes provided on the lifter.

[0013] However this solution allows achieving only a small recirculation of the washing liquid, and therefore its effect on the uniformity of the wetting of the laundry and of the temperature of the washing liquid is modest.

[0014] Other solutions have been developed in order to try to obtain a more uniform wetting of the laundry contained in the drum of a washing machine; for example US 6,386,004 discloses a laundry drum, comprising a liquid diverter (i.e. a lifter or elevator) including a driver having a driver interior and a run-off ramp therein. The driver interior receives liquid scooped and lifted by the drum during its rotation. The driver discharges the scooped liquid, in its lifted position, into the drum interior.

[0015] The run-off ramp is oriented horizontally or has a descending gradient when the drum rotation axis is orientated in a direction deviating from horizontal, and when the drum is in a rotary position in which the driver is in its highest position, and thereby permits, in all of the drum's rotation directions, a flow of scooped liquid on the run-off ramp in a direction of a rising part of the rotation axis when in the driver's lifted position. The liquid is conducted into only part of the drivers in a case of low liquid level as a result of the inclination.

[0016] This solution has however the drawback that the driver interior fluidly communicates with the external of the drum also via some orifices obtained in the lateral cylindrical surface of the drum, and therefore during the rotation of the drum some of the scooped liquid exits from the drum through these orifices, returning in the bottom of the tub, and reducing in this way the quantity of scooped liquid which reaches the laundry contained in the drum, and therefore reducing the equalizing effect on the wetting of the laundry.

[0017] EP 0 360 059 discloses a water-saving apparatus comprising a drum, contained in a tub, possessing a scooping ring of a relatively large diameter, mounted on a drum end wall (i.e. a base of the drum), with radially disposed scooping compartments; these scooping compartments dip into the liquor level underneath the drum,

and with the aid of a laterally disposed scooping compartment, feed openings, and drum inlet openings, convey the washing liquor from the bottom of the tub to the textile goods by virtue of the rotation of the drum.

[0018] This solution allows washing with an extremely low liquor fill level, and therefore shortens the fabric wetting times and the water consumption.

[0019] Also this solution has however a drawback; in fact the washing liquor is introduced into the tub from drum inlet openings provided in proximity of the drum end wall (or base), and therefore such washing liquor wets mainly the portion of the laundry placed near to these openings, while the wetting is reduced in the portion of the laundry which is farther from the end wall (or base) of the drum.

[0020] Therefore this solution has only a very low effect on the uniformity of the laundry wetting.

[0021] DE 43 26 496 discloses a washing machine comprising a tub containing a drum provided, on its rear base, with a supporting star (i.e. the so called "spider"), the arms of which, when passing through lye (i.e. the washing liquid) located in the tub bottom, scoop up some of this lye and, during the further rotation of the drum, lift it and guide it to perforations which are arranged in the rear base of the drum in the vicinity of the hub of the supporting star.

[0022] Also this solution has a drawback; in fact the washing liquid is introduced into the tub from perforations arranged in the rear base of the drum, in the vicinity of the hub of the supporting star, and therefore such washing liquid wets mainly the portion of the laundry placed near to these perforations, while the wetting is reduced in the portion of the laundry which is farther from the rear base of the drum.

[0023] Therefore also this solution has only a very low effect on the uniformity of the laundry wetting.

[0024] EP 0 304 391 discloses a washing machine comprising a drum, on which scoop-shaped water-inlet orifices are arranged underneath the drum ribs (i.e. lifters); the drum ribs fill with washing fluid from the free liquor during the washing operation. In the drum ribs there are also water-outlet orifices, through which the fluid can trickle onto the laundry again during the further drum rotation. The water-inlet orifices are effective in both directions of rotation of the drum. To assist the scooping effect, the water-inlet orifices are designed as scoop elements shaped out from the drum casing. The water-inlet orifices are aligned alternately in order to take effect in both directions of rotation of the drum.

[0025] In this solution, however, the washing fluid is scooped mainly in correspondence of the lateral cylindrical surface of the drum, and the mixing of the washing fluid, and therefore the equalizing effect on the temperature of the washing fluid in contact with the laundry, is very low.

[0026] The aim of the present invention is therefore to improve the uniformity of the wetting of the laundry and of the temperature of the water in contact with the laundry

contained in the drum of a washing machine, so as to increase the washing performances.

[0027] Within this aim, another object of the invention is to reduce the duration, the water consumption, and the power consumption of the washing cycles.

[0028] Another object of the invention is the possibility to improve the wetting of the laundry and of the temperature of the water in contact with the laundry also in a standard washing machine, by modifying only the drum of the latter, and not the tub.

[0029] It is therefore an object of the present invention to solve the above-noted problems, thereby doing away with the drawbacks of the cited prior art.

[0030] The Applicant has found that by placing the lifters of a drum of a washing machine (such lifter being hollows and provided with one or more outlet openings adapted to fluidly connect the internal of the lifters to the internal of the drum in order to allow the release of the washing liquid inside the drum when the more lifters are in the upper region of the tub), in a region of the lateral surface of such a drum which is not provided with apertures adapted for allowing a washing liquid contained in a tub to flow into and out of the drum, and by providing inlet apertures on a base of such drum, fluidly connecting the lifters to the external of the drum so as to allow, during the rotation of the drum, the washing liquid present in a rear and bottom region of the tub to enter the lifters, it is possible to obtain a recirculation of the washing liquid which ensures an uniform wetting of the laundry and of the temperature of the washing liquid in contact with the laundry.

[0031] In particular, the above-mentioned aim and objects, as well as others that will become better apparent hereinafter, are achieved by a washing machine comprising a washing tub containing a drum comprising a base and a lateral surface with one or more first regions provided with apertures adapted for allowing a washing liquid contained in the tub to flow into and out of the drum, the lateral surface comprising one or more second regions which are not provided with the apertures adapted for allowing a washing liquid contained in the tub to flow into and out of the drum, the drum comprising one or more lifters, hollow, protruding from the lateral surface towards the internal of the drum and provided with one or more outlet openings adapted to fluidly connect the internal of the one or more lifters to the internal of the drum in order to allow the release of a liquid contained in the one or more lifters inside the drum when the one or more lifters are in an upper region of the tub; the one or more lifters are associated with the one or more second regions of the lateral surface, the base of the drum being provided with one or more inlet apertures fluidly connecting the one or more lifters to the external of the drum, so as to allow, during the rotation of the drum, the washing liquid present in a rear and bottom region of the tub to enter the one or more lifters.

[0032] The above-mentioned aim and objects are also achieved by a washing machine comprising a washing

tub containing a drum comprising a lateral surface and a base connected to a spider member comprising a central region from which a plurality of arms radially protrudes, the drum comprising one or more lifters, hollow, protruding from the lateral surface towards the internal of the drum, and provided with one or more outlet openings adapted to fluidly connect the internal of the lifter to the internal of the drum in order to allow the release of a liquid contained in the one or more lifters inside the drum when the one or more lifters are in an upper region of the tub; the spider member is provided with scooping means adapted, during the rotation of the drum, to collect the washing liquid from the rear and bottom region of the tub and to guide the washing liquid into the internal of the lifter.

[0033] Features and advantages of the present invention will anyway be more readily understood from the description that is given below by way of nonlimiting example with reference to the accompanying drawings, in which:

- **Figure 1** is a schematic, lateral and partially sectioned view, of a tub and a drum of a washing machine according to the invention;
- **Figure 2** is a schematic, lateral and partially sectioned view, of the drum of Figure 1;
- **Figure 3** is a frontal and prospective view of the drum of Figure 2, in which one of the lifters has been removed;
- **Figure 4** is a rear and prospective view of the drum of Figures 2 and 3;
- **Figure 5** is a prospective view of the spider of the drum of Figure 4;
- **Figure 6** is a rear and prospective view of the drum of Figures 2 and 3, in which the spider has been removed;
- **Figure 7** is a first prospective view of a lifter of the drum of Figure 2;
- **Figure 8** is a lateral view of the lifter of Figure 7;
- **Figure 9** is a second prospective view of the lifter of Figures 7 and 8;
- **Figure 10** is a plan view from the bottom of the lifter of Figures 7 to 9;
- **Figure 11** is a rear and prospective view of the drum of a further embodiment of a washing machine according to the invention;
- **Figure 12** is a frontal and prospective view of the drum of Figure 11, in which two of the lifters have been removed;
- **Figure 13** is a first prospective view of a lifter of the drum of Figure 12;
- **Figure 14** is a lateral view of the lifter of Figure 13;
- **Figure 15** is a rear view of the lifter of Figures 13 and 14;
- **Figure 16** is a plan view from the bottom of the lifter of Figures 13 to 15;
- **Figure 17** is a rear and prospective view of the drum of Figures 11 and 12, in which the spider has been

removed;

- **Figure 18** is a prospective view of the spider of the drum of Figure 11.

[0034] With reference to Figures 1 to 10 a washing machine, not illustrated, according to the invention, comprises a tub 2 containing a drum 1 comprising a base 3 (i.e. a end wall or surface), which is advantageously substantially perpendicular to the rotational axis 4 of the drum 1, and a lateral surface 5 (substantially cylindrical) provided with one or more first regions 200 provided with apertures 6 adapted for allowing a washing liquid (e.g. water, or water mixed with washing/rinsing products) contained in the tub 2 to flow into and out of the drum 1.

[0035] Advantageously the drum 1 comprises also one or more second regions 100 which are not provided with apertures adapted for allowing a washing liquid contained in the tub 2 to flow into and out of the drum 1.

[0036] The drum 1 illustrated in the enclosed Figures is of the type adapted to be used in a front-loading washing machine, that is a washing machine, not illustrated, provided with and external casing, typically parallelepiped-shaped, on which frontal wall an opening is provided, facing a further opening obtained in the tub 2; the drum 1 is placed into the tub 2 in such a way that its opened end 7 (that is the end of the drum 1 opposite to the base 3) faces the opening of the tub 2, so that the laundry can be loaded in the drum 1 via its opened end 7. In the case of a front-loading washing machine, the first openings of the external casing and of the tub 2 are closable by an external lid, not illustrated, hinged to the upper surface of the external casing.

[0037] However it is clear that the invention can be applied, substantially without any crucial modification, also in order to obtain a washing machine of the so-called top-loading type, that is a washing machines comprising a casing, typically parallelepiped-shaped on the upper surface of which an opening is obtained, facing a further opening obtained in the lateral surface of the tub; these openings are closable by an external lid, hinged to the upper surface of the external casing.

[0038] In the case of a top-loading washing machine the drum 1 is also provided with a further base, not illustrated, substantially equal to the base 3, which closes also the opened end 7 of the drum 1; in this case, therefore, the drum 1 is closed in correspondence of both its bases, and the laundry can be loaded into the drum 1 via a suitable opening, not illustrated, obtained in the lateral surface 5 of the drum 1, an closable by one or more internal lids, also not illustrated, which, when closed, substantially constitute a portion of the lateral surface 5 of the drum 1.

[0039] Advantageously (both in the case of a front-loading washing machine and in the case of a top-loading washing machine) the drum 1 comprises one or more lifters 8 (or elevators, or ribs, or diverter), hollow (i.e. box-shaped end empty), protruding from inner face 5a of the lateral surface 5 towards the internal of the drum 1, and

provided with one or more outlet openings 9 adapted to fluidly connect the internal of the lifters 8 to the internal of the drum 1 in order to allow the release of a liquid contained in such one or more lifters 8 inside the drum 1 when the one or more lifters 8 are in an upper region 2b of the tub 2.

[0040] Preferably, each lifter 8 is associated with one of the one or more second regions 100 of the lateral surface 5 of the drum 1 which are not provided with the apertures 6; this means that the washing liquid can't flow into (and therefore nor flow out of) a lifter 8 through the lateral surface 5 of the drum 1.

[0041] In a further embodiment, not illustrated, the lifters 8 may be associated with the first regions 200 of the lateral surface 5 of the drum 1 provided with the apertures 6, so that the washing liquid can also flow into/out of these lifters through the lateral surface 5.

[0042] Advantageously, but not necessarily, the lifters 8 are distributed in an orderly arrangement along the inner face 5a of the lateral surface 5 of the drum 1; in the embodiment illustrated in Figures 1 to 10 there are three lifters 8, but it is clear that, according to the invention, any number of lifters (even only one) can be used. Clearly, the lifters 8 could be also distributed in a non-orderly arrangement along the inner face 5a of the lateral surface 5 of the drum 1.

[0043] Advantageously, the lifters 8 are "box-shaped" (or "sell-shaped" or "doomed-shaped"), so that a liquid can be collected in their inside.

[0044] For example, with reference to the embodiment illustrated in Figures 1 to 10, each lifter 8 is, in a plan view, substantially trapezoidal, and it is provided with two lateral walls 10a and 10b, inclined relative to each other, and connected, respectively in correspondence of a frontal end 11a and of a rear end 11b of the lifter 8, by a frontal wall 12a and by a rear wall 12b.

[0045] The lateral walls 10a and 10b, the frontal wall 12a and the rear wall 12b are connected by a flowing surface 13, adapted to guide a washing liquid contained in the lifter 8 towards the outlet openings 9; preferably the flowing surface 13 is inclined in such a way to guide a washing liquid contained in the lifter 8 towards the frontal end 11a of the lifter 8 when, during the rotation of the drum 1, the lifter 8 is in the upper region 2b of the tub 2.

[0046] In the embodiment illustrated in Figures 1 to 10, the above mentioned outlet openings 9 are advantageously provided on the lateral walls 10a, 10b, on the frontal wall 12a, and on the flowing surface 13 of the lifters 8.

[0047] The lifters 8 are fixed to the inner face 5a of the lateral surface 5 of the drum 1 with their opened border, numbered 14 in the enclosed figures, opposite to the flowing surface 13.

[0048] Advantageously, the lifters 8 are fixed to the inner face 5a of the lateral surface 5 of the drum 1 by suitable fixing means, comprising, for example, suitable screw or rivets, not illustrated, and/or by gluing, and/or by welding, and/or by snap-fittings means, comprising,

for example, suitable pawls (or pins or hooks) 15 protruding from the lifters 8 and adapted to snap fit with suitable seats 16 provided on the lateral surface 5 of the drum 1.

[0049] Clearly, once the pawls 15 have engaged the seats 16, these pawls 15 substantially obstruct the respective seats 16, and therefore at most a very small quantity of the washing liquid can flow into and out of the drum 2 through the clearances which should be present between the seats 16 and the pawls 15; in other words the seats 16 aren't intended for allowing the washing liquid contained in the tub 2 to flow into and out of the drum 1, even if a small quantity of such a liquid should flow through the possible clearances between the seats 16 and the pawls 15.

[0050] Advantageously, but not necessarily, the lifters 8 are fixed to the drum 1 in such a way that their lateral surface engages (i.e. touches or is in contact with) the base 3 of the drum 1.

[0051] In another embodiment, not illustrated, in which the washing machine is of the top-loading type, and the drum 1 comprises a further base, not illustrated, which closes also the opened end 7 of the drum 1, the lifters 8 could engage (i.e. touch or be in contact with) one or both the base 3 and the further base of the drum 1.

[0052] In another embodiment thereof, also not illustrated, the lifters 8 are separated from the base 3 of the drum 1 (and also from the further base in the case of a top-loading washing machine).

[0053] Advantageously, the base 3 is provided with one or more inlet apertures 17 fluidly connecting the lifters 8 to the external of the drum 1, so as to allow, during the rotation of the drum 1, the washing liquid present in a rear and bottom region 2a of the tub 2 to enter one lifter 8, in order to allow the release of the washing liquid inside the drum 1, when such a lifter 8 is in the upper region 2b of the tub 2, advantageously through the one or more outlet openings 9.

[0054] In the embodiment illustrated in Figures 1 to 10, in which the rear wall 12b of the lifters 8 engages (i.e. touches or is in contact with) the base 3, an inlet aperture 17 is obtained in each region of the base 3 which engages the rear wall 12b of a lifter 8; in this case, in the rear wall 12b of each lifter 8, a inlet hole 18 is obtained, facing the corresponding inlet aperture 17, so that a liquid can flow into the lifter 8 through the inlet aperture 17 and the inlet hole 18 facing this inlet aperture 17.

[0055] Advantageously one or more inlet apertures 17 may be associated to a single lifter 8.

[0056] In a further embodiment, not illustrated, the lifters 8 aren't provided with a rear wall, and they are connected to the base 3 in correspondence of the border of the lateral walls 10a, 10b and of the flowing surface 13; in this case each inlet aperture 17 is arranged in such a way that it directly communicates with the internal of one lifter 8.

[0057] In a further embodiment, not illustrated, the lifters 8 doesn't engage the base 3, and the internal of each lifter 8 is fluidly connected to one or more inlet apertures

17 obtained in the base 3 by connecting means comprising, for example, a pipe or a duct, not illustrated, connecting these one or more inlet apertures 17 to the internal of the lifter 8.

[0058] In another embodiment, not illustrated, in which the washing machine is of the top-loading type and the drum comprises a further base, not illustrated, which closes also the opened end 7 of the drum 1, and in which the lifters 8 engage (i.e. touch or be in contact with) both the base 3 and the further base of the drum 1, one or more inlet apertures 17 may be obtained in the base 3 and/or in the further base closing the drum 1, and such apertures 17 can communicate with the internal of the lifters 8, for example via suitable inlet holes obtained in the lifters 8 and facing the corresponding inlet aperture 17. Alternatively, if a lifter 8 isn't provided with the frontal and/or the rear walls 12a, 12b, and is connected to the base 3 and/or to the further base in correspondence of the border of the lateral walls 10a, 10b and of the flowing surface 13, the one or more inlet apertures 17 can be arranged in such a way that they directly communicate with the internal of the lifter 8.

[0059] In another embodiment thereof, also not illustrated, in which the washing machine is of the top-loading type, and the drum 1 comprises a further base, not illustrated, which closes also the opened end 7 of the drum 1, the lifters 8 may also be separated from the base 3 and/or from the further base of the drum 1; in this case one or more inlet apertures 17 may be obtained in the base 3 and/or in the further base closing the drum 1, and such apertures 17 may communicate with the internal of the lifters 8 also by connecting means comprising, for example, a pipe or a duct, not illustrated, connecting these one or more inlet apertures 17 to the internal of the lifters 8.

[0060] In the embodiment illustrated in Figures 1 to 10, a liquid may therefore flow into a lifter 8, from the rear and bottom region 2a of the tub 2 only via one or more inlet apertures 17, and therefore not through the lateral (cylindrical) surface 5 of the drum 1; in fact each lifter 8 is associated to the drum 1 in correspondence of a second region 100 of the latter which is not provided with apertures adapted for allowing a washing liquid contained in the tub 2 to flow into and out of the drum 1, and therefore the washing liquid may flow into such lifter 8 only via the one or more inlet apertures 17 associated to said lifter 8.

[0061] Advantageously, the drum 1 comprises scooping means adapted, during the rotation of the drum 1, to collect the washing liquid from the rear and bottom region 2a of the tub 2 and to guide the washing liquid into the internal of the lifter 8 through the one or more apertures 17.

[0062] In the embodiment illustrated in Figures 1 to 10, the base 3 of the drum 1 is connected to a spider member 19 (or supporting star) comprising a central region 20 from which a plurality of arms 21 radially protrudes, fixed to the outer face 3a of the base 3.

[0063] The central region 20 of the spider member 19 is fixed to a shaft 32, adapted to cross the tub 2, so as to be connected, directly or by a suitable belt pulley, to a motor, not illustrated, for allowing the rotation of the drum 1.

[0064] In the embodiment illustrated in Figures 1 to 10, the above mentioned scooping means are provided in/at the spider 19, particularly in/at the arms 21 of the latter; in this case the number of the arms 21 is advantageously equal to the number of the lifters 8, and the free end of each arm 21 is fixed to the base 3 in proximity of the one or more inlet apertures 17 (only one in the embodiment illustrated in Figures 1 to 10) associated to one lifter 8.

[0065] Advantageously, in this case the scooping means comprises, for each arm 21, a conveyor element 22 (i.e. a blade, or paddle, or bucket) protruding laterally from the free end of this arm 21, and arranged to cover the one or more inlet apertures 17, in such a way to define a guide or a duct 122a which, during the rotation of the drum 1 in one of the directions of rotation, as will be explained in the following, guides the liquid contained in the rear and bottom region 2a of the tub 2 towards the one or more inlet apertures 17 covered by the conveyor element 22, and therefore into the respective lifter 8.

[0066] Advantageously, in the embodiments illustrated in Figures 1 to 10, all the conveyor elements 22 protrude from a same lateral side (i.e. the right side or the left side) of the arms 21, in order to scoop the liquid contained in the rear and bottom region 2a of the tub 2 only during the rotation of the drum 1 in a specific direction of rotation (called scooping direction), and not in the other direction of rotation.

[0067] For example, with reference to Figure 4, all the conveyor elements 22 protrude from the left side of the respective arm 21, and therefore they are able to scoop the liquid only when the drum is rotating, with reference to Figure 4, in the counter-clock direction (corresponding in this case to the scooping direction).

[0068] It is therefore possible to arrange a washing machine in which during the spin phase the drum 1 rotates only in the scooping direction, so that the conveyor elements 22 don't scoop potential liquid which could collect in the bottom 2a of the tub during this spin phase, ensuring in this way a better spin phase.

[0069] The conveyor elements 22 are advantageously paddle-shaped, and comprise a curved surface 23 adapted to guide a liquid towards the inlet apertures 17 while the conveyor element 22 moves in this liquid in a prefixed direction.

[0070] In another embodiment, not illustrated, the scooping means aren't associated to the spider 19; in this case one or more conveyor elements, not associated to the spider 19, are provided on the base 3 in proximity of the one or more inlet apertures 17; these one or more conveyor elements are adapted to guide, during the rotation of the drum 1 in the scooping direction, the liquid contained in the rear and bottom region 2a of the tub 2 towards the one or more inlet apertures 17, and therefore

into the lifters 8 fluidly communicating with these one or more inlet apertures 17.

[0071] In a further embodiment, also not illustrated, some of the scooping means are associated to the spider 19, and other scooping means aren't associated to the spider 19.

[0072] The functioning of the invention is the following: Figure 1 schematically illustrates part of the tub 2 and of the drum 1 of a washing machine according to the invention.

[0073] During the rotation of the drum 1, the scooping means (in this case the conveyor elements 22 associated to the arms 21 of the spider 19), cyclically immerse in the liquid contained in the rear and bottom region 2a of the tub 2; if the drum 1 rotates in the scooping direction (for example, with reference to Figure 4, the scooping direction is counter-clock), the conveyor elements, while moving through the washing liquid contained in the rear and bottom region 2a of the tub, scoop the washing liquid and convey it towards the inlet apertures 17 covered by such conveyor elements 22, and therefore into the lifters 8 associated to these inlet apertures 17.

[0074] When a conveyor element 22 passes in correspondence of the rear and bottom region 2a of the tub in the scooping direction, the washing liquid contained in such rear and bottom region 2a enters the guide or duct 122a defined by the conveyor element 22, and is guided by the curved surface 23 towards the one or more inlet apertures 17 covered by the conveyor element 22.

[0075] Therefore, during the rotation of the drum 1 in the scooping direction, when a conveyor element 22 passes in correspondence of the rear and bottom region 2a of the tub 2, such a conveyor element 22 scoops some of the liquid contained therein and flows it into the lifter 8 fluidly connected to the one or more inlet apertures 17 covered by the conveyor element 22.

[0076] Because of the rotation of the drum 1, this lifter 8 is lifted and taken in an upper position (which is for example the position of the lifter numbered 8a in enclosed Figure 1), in which it is placed in the upper region 2b of the tub 2.

[0077] When a lifter 8 is in the upper position, the liquid contained in this lifter 8 flows on the flowing surface 13, because of the inclination of the latter, towards the frontal end 11a of the lifter 8, and flows out of the latter through the outlet openings 9.

[0078] In this way the liquid contained in the rear and bottom region 2a of the tub 2 is released over the laundry, not illustrated, from a position close to the upper region 2b of the tub 2; during the rotation of the drum 1 in the scooping direction, the washing liquid is therefore drawn from the rear and bottom region 2b of the drum and is flown into the drum 1 from an upper region of the tub 2, improving the uniformity of the wetting of the laundry and also the temperature of the washing liquid in contact with the laundry.

[0079] The particular inclination of the flowing surface 13, flowing the washing liquid towards the end of the drum

opposite to the base 3, further improves the uniformity of the wetting and of the temperature.

[0080] Figures 11 to 18 illustrate a further embodiment of the invention, which, as will be explained in the following, differs from the embodiment illustrated in Figures 1 to 10 because of the shape of the lifters 8 and of the spider 19, and because of number and position of the inlet apertures obtained in the base 3, and of the scooping means.

[0081] In fact, in the embodiment illustrated in Figures 11 to 18, the lifters 8 comprises two lateral walls 10a and 10b, inclined relative to each other, so as to join each other along a common side and to define a flowing surface 13, adapted to guide a washing liquid contained in the lifter 8 towards the outlet openings 9 during the rotation of the drum 1; preferably the flowing surface 13 is inclined in such a way to guide a washing liquid contained in the lifter 8 towards the frontal end 11a of the lifter 8 when, during the rotation of the drum 1, the lifter 8 is in the upper region 2b of the tub 2.

[0082] The lateral walls 10a and 10b are also connected each other, respectively in correspondence of a frontal end 11a and of a rear end 11b of the lifter 8, by a frontal wall 12a and by a rear wall 12b.

[0083] In the embodiment illustrated in Figures 11 to 18, the outlet openings 9, adapted to fluidly connect the internal of the lifters 8 to the internal of the drum 1, are advantageously provided on the lateral walls 10a, 10b and on the frontal wall 12a of the lifters 8.

[0084] Inside each lifter 8 there is situated a partition wall 24, which bisects the lifter 8 lengthwise, thereby creating two chambers 25a, 25b.

[0085] Advantageously the partition wall 24 is arranged in such a way that each chamber 25a, 25b fluidly communicates with the internal of the drum 1 via one or more of the outlet openings 9.

[0086] Advantageously the partition wall 24 is arranged in such a way that the chambers 25a and 25b are fluidly separated one another; in another embodiment, not illustrated, the partition wall 24 is arranged in such a way that the chambers 25a and 25b are fluidly connected one another.

[0087] Advantageously the partition wall 24 is a planar, rectangular member, which is arranged with the major side thereof joining with the flowing surface 13; preferably the partition wall 24, in proximity of the rear wall 12b of the lifter 8, divides in two curved arms 24a, 24b, diverging each other and connected to the second wall 12b.

[0088] Also in this case the lifters 8 are fixed to the inner face 5a of the lateral surface 5 of the drum 1 by suitable fixing means, comprising, for example, suitable screw or rivets, not illustrated, and/or by snap-fittings means, also not illustrated.

[0089] Advantageously the lifters 8 are fixed to the drum 1 in such a way that their rear wall 12b engages (i.e. touches or is in contact with) the base 3 of the drum 1.

[0090] In the embodiment illustrated in Figures 11 to 18, the base 3 is advantageously provided, for each lifter

8, with at least one inlet aperture 17a, and at least one inlet aperture 17b, fluidly communicating respectively with the two chambers 25a, 25b defined inside the lifter 8.

[0091] In the rear wall 12b of each lifter 8 two inlet holes 18a, 18b are obtained, facing the corresponding inlet apertures 17a, 17b, so that a liquid can flow into the two chambers 25a, 25b defined inside the lifter 8, respectively through the inlet apertures 17a, 17b and the inlet holes 18a, 18b facing these inlet apertures 17a, 17b.

[0092] In a further embodiment, not illustrated, the lifters 8 doesn't engage the base 3, and the two chambers 25a, 25b of a lifter 8 are fluidly connected, respectively to one or more inlet apertures 17a, 17b obtained in the base 3, by connecting means comprising, for example, pipes or a ducts, not illustrated, connecting these one or more inlet apertures 17a, 17b respectively to the internal of the two chambers 25a, 25b.

[0093] In another embodiment, not illustrated, in which the washing machine is of the top-loading type and the drum 1 comprises a further base, not illustrated, which closes also the opened end 7 of the drum 1, and in which the lifters 8 engage (i.e. touch or be in contact with) both the base 3 and the further base of the drum 1, for each lifter 8 one or more inlet apertures 17a, 17b may be obtained in the base 3 and/or in the further base closing the drum 1, and such apertures 17a, 17b may communicate respectively with the internal of the two chambers 25a, 25b defined inside the lifter 8 via suitable inlet holes obtained in the lifters 8 and facing the corresponding inlet aperture 17a, 17b.

[0094] In another embodiment thereof, also not illustrated, in which the washing machine is of the top-loading type and the drum 1 comprises a further base, not illustrated, which closes also the opened end 7 of the drum 1, the lifters 8 may also be separated from the base 3 and/or from the further base of the drum 1; in this case, for each lifter 8, one or more inlet apertures 17a, 17b may be obtained in the base 3 and/or in the further base closing the drum 1, and such apertures 17a, 17b may communicate respectively with the two chambers 25a, 25b defined inside the lifter 8 also by connecting means comprising, for example, pipes or ducts, not illustrated, connecting these one or more inlet apertures 17a, 17b respectively to the internal of the two chambers 25a, 25b.

[0095] Also in the embodiment illustrated in Figures 11 to 18, a liquid may flow into a lifter 8 only via one or more inlet apertures 17a, 17b, and therefore not through the lateral surface 5 of the drum 1; in fact each lifter 8 is associated to the drum 1 in correspondence of a second region 100 of the latter which is not provided with apertures adapted for allowing a washing liquid contained in the tub 2 to flow into and out of the drum 1, and therefore the washing liquid may flow into such lifter 8 only via the one or more inlet apertures 17a, 17b associated to said lifter 8.

[0096] Moreover a liquid contained in a lifter 8 can exit the latter only via the outlet openings 9.

[0097] In a further embodiment, not illustrated, the lift-

ers 8 are associated with the one or more first regions 200 of the lateral surface 5 of the drum 1 provided with the apertures 6, so that the washing liquid can also flow into/out of these lifters 8 through the lateral surface 5.

[0098] Also in the embodiment illustrated in Figures 11 to 18, the base 3 of the drum 1 is connected to a spider member 19 (or supporting star) comprising a central region 20 from which a plurality of arms 21 radially protrudes, fixed to the outer face 3a of the base 3; the central region 20 of the spider member 19 is fixed to a shaft 32, adapted to cross the tub 2 and to be connected, directly or by a suitable belt pulley, to a motor, not illustrated, for allowing the rotation of the drum 1.

[0099] The scoping means are advantageously provided in/at the spider 19, particularly in/at the arms 21 of the latter; also in this case the number of the arms 21 is equal to the number of the lifters 8, and the free end of each arm 21 is fixed to the base 3 in proximity of the one or more inlet apertures 17a, 17b associated to each lifter 8.

[0100] Advantageously, in this case the scoping means comprises, for each arm 21, two conveyor elements 22a, 22b (i.e. two blades, or paddles, or buckets) protruding laterally from the free end of this arm 21, and arranged to cover the one or more inlet apertures 17a, 17b, in such a way to define two guides or ducts 222a, 222b which, during the rotation of the drum 1, depending on the direction of rotation of the drum 1, guides the liquid contained in the rear and bottom region 2a of the tub 2 towards one or the other inlet apertures 17a, 17b, and therefore into one or the other of the two chambers 25a, 25b defined inside each lifter 8.

[0101] In this embodiment, therefore, the liquid can be scooped from the rear and bottom region 2a of the tub 2 during the rotation of the drum in both the directions of rotation, which consequently are both scooping directions.

[0102] In a further embodiment, not illustrated, the partition wall 24 isn't provided, and the washing liquid, flowing through the one or more inlet apertures 17a or 17b associated to a lifter 8, collects inside this lifter 8.

[0103] In the embodiment illustrated in Figures 11 to 18, the conveyor elements 22a, 22b are advantageously paddle-shaped, and comprise a curved surface 23 adapted to guide a liquid towards the respective inlet opening 17a or 17b, depending on the direction of rotation of the drum 1.

[0104] In another embodiment, not illustrated, the scooping means aren't associated to the spider 19; in this case the inlet apertures 17a, 17b associated to each lifter 8 may be provided with one or more conveyor elements, not associated to the spider 19, adapted to guide, during the rotation of the drum 1, depending on the direction of rotation, the liquid contained in the bottom 2a of the tub 2, towards one or the other inlet apertures 17a, 17b associated to the same lifter 8.

[0105] The functioning of the embodiment illustrated in Figures 11 to 18 is substantially the same of the one

illustrated with reference to Figures 1 to 10, with the only differences that in the embodiment of Figures 11 to 18 the scooping means scoop the liquid contained in the rear and bottom region 2a of the tub 2 while the drum 1 rotates in both the directions of rotation, and that this liquid is flown into one or the other of two chambers 25a, 25b, from which it is released over the laundry, not illustrated, when the lifter 8 is in the upper region 2b of the tub 2, through the outlet openings 9 fluidly connecting the respective chamber 25a or 25b to the internal of the drum 1.

[0106] It is seen therefore how the invention achieves the proposed aim and objects, there being provided a washing machine which, thanks to the recirculation of the the washing liquid actuated by the scooping means, and by the inlet means, allows to improve the uniformity of the wetting of the laundry and of the temperature of the water in contact with the laundry contained in the drum of such a washing machine, increasing in this way the washing performances.

[0107] Moreover, the recirculation of the the washing liquid allows to reduce the water consumption and the power consumption of the washing cycles, without using an expensive re-circulating circuit.

[0108] Furthermore a washing machine according to the invention may be also obtained, starting from a "standard" washing machine, by replacing the drum of the latter with a drum obtained according to the invention, substantially without any modification of the tub and of the rest of the washing machine.

Claims

1. Washing machine comprising a washing tub (2) containing a drum (1) comprising a base (3) and a lateral surface (5) with one or more first regions (200) provided with apertures (6) adapted for allowing a washing liquid contained in said tub (2) to flow into and out of said drum (1), said lateral surface (5) comprising one or more second regions (100) which are not provided with said apertures (6) adapted for allowing a washing liquid contained in said tub (2) to flow into and out of said drum (1), said drum (1) comprising one or more lifters (8), hollow, protruding from said lateral surface (5) towards the internal of said drum (1) and provided with one or more outlet openings (9) adapted to fluidly connect the internal of said one or more lifters (8) to the internal of said drum (1) in order to allow the release of a liquid contained in said one or more lifters (8) inside the drum (1) when said one or more lifters (8) are in an upper region (2b) of said tub (2),
characterized in that
said one or more lifters (8) are associated with said one or more second regions (100) of said lateral surface (5), said base (3) of said drum (1) being provided with one or more inlet apertures (17, 17a, 17b) fluidly

connecting said one or more lifters (8) to the external of said drum (1), so as to allow, during the rotation of said drum (1), the washing liquid present in a rear and bottom region (2a) of said tub (2) to enter said one or more lifters (8).

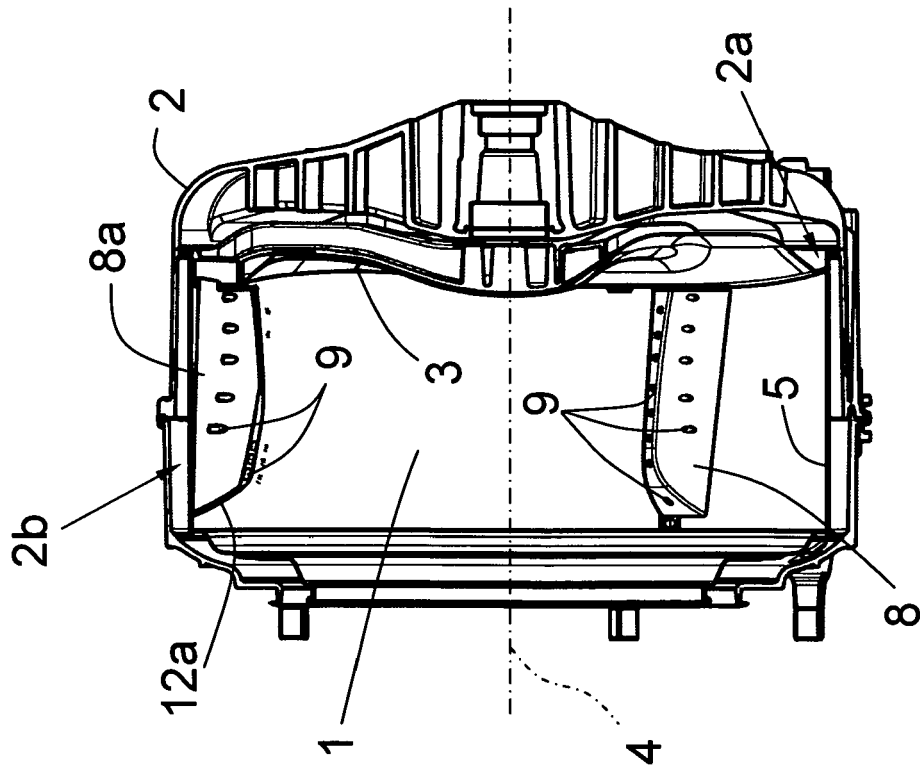
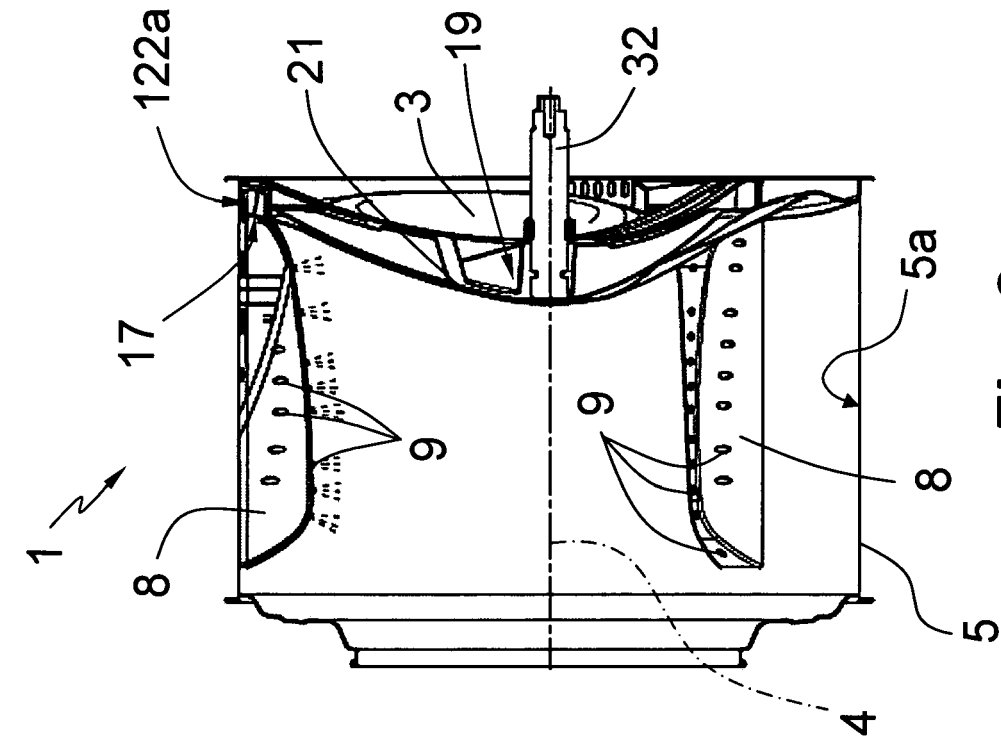
2. Washing machine, according to claim 1, **characterized in that** it comprises scooping means adapted, during the rotation of said drum (1), to collect a washing liquid from the rear and bottom region (2a) of said tub (2) and to guide said washing liquid into the internal of said lifters (8) via said one or more inlet apertures (17, 17a, 17b).
3. Washing machine, according to claim 2, **characterized in that** said scooping means are provided on said base (3) in proximity of said one or more inlet apertures (17, 17a, 17b).
4. Washing machine, according to claim 2, comprising a spider member (19), associated to said base (3), comprising a central region (20) from which a plurality of arms (21) radially protrudes, said spider member (19) comprising said scooping means.
5. Washing machine comprising a washing tub (2) containing a drum (1) comprising a lateral surface (5) and a base (3) connected to a spider member (19) comprising a central region (20) from which a plurality of arms (21) radially protrudes, said drum (1) comprising one or more lifters (8), hollow, protruding from said lateral surface (5) towards the internal of said drum (1), and provided with one or more outlet openings (9) adapted to fluidly connect the internal of said lifters (8) to the internal of said drum (1) in order to allow the release of a liquid contained in said one or more lifters (8) inside the drum (1) when said one or more lifters (8) are in an upper region (2b) of said tub (2),
characterized in that
said spider member (19) is provided with scooping means adapted, during the rotation of said drum (1), to collect the washing liquid from the rear and bottom region (2a) of said tub (2) and to guide said washing liquid into the internal of said lifter (8).
6. Washing machine, according to claim 4 or 5, **characterized in that** said scooping means comprises at least a conveyor element (22, 22a, 22b) provided at/on at least one arm (21) of said spider member (19) and defining a guide or a duct (122a, 222a, 222b) which, during the rotation of said drum (1) in at least one of the directions of rotation, guides the liquid contained in the rear and bottom region (2a) of said tub (2) towards one or more of said one or more inlet apertures (17, 17a, 17b).
7. Washing machine, according to claim 6, **character-**

ized in that said conveyor elements (22, 22a, 22b) are paddle-shaped, and comprise a curved surface (23) adapted to guide a liquid towards one or more of said inlet apertures (17, 1a, 17b) while said conveyor element (22, 22a, 22b) moves in said liquid during the rotation of said drum (1) in a prefixed direction of rotation.

8. Washing machine, according to one or more of the previous claims, **characterized in that** said one or more lifters (8) are directly fluidly connected to said one or more inlet apertures (17, 17a, 17b).
9. Washing machine, according to one or more of the previous claims, **characterized in that** said one or more lifters (8) are fluidly connected to said one or more inlet apertures (17, 17a, 17b) via one or more inlet holes (18, 18a, 18b) provided in/at said lifters (8) and arranged to face said one or more inlet apertures (17, 17a, 17b).
10. Washing machine, according to one or more of the previous claims, **characterized in that** said one or more lifters (8) are fluidly connected to said one or more inlet apertures (17, 17a, 17b) by connecting means connecting said one or more inlet apertures (17, 17a, 17b) to the internal of said lifters (8).
11. Washing machine, according to one or more of the previous claims, **characterized in that** said one or more lifters (8) comprises a flowing surface (13) adapted, during the rotation of said drum (1), to guide a washing liquid contained in the respective lifter (8) towards the outlet openings (9) of said lifter (8), said flowing surface (13) being inclined in such a way to guide said washing liquid towards a frontal end (11a) of the respective lifter (8), opposite to said base (3), when, during the rotation of said drum (1), said lifter (8) is in the upper region (2b) of said tub (2).
12. Washing machine, according to one or more of the previous claims, **characterized in that** in at least one of said one or more lifters (8) is provided with two chambers (25a, 25b) fluidly connected to the internal of said drum (1) via one or more of said outlet openings (9), each chamber (25a, 25b) being fluidly connected to the external of said drum (1) via at least one of said one or more inlet apertures (17a, 17b), so as to allow, during the rotation of said drum (1), the washing liquid present in a rear and bottom region (2a) of said tub (2) to enter said one or more lifters (8).
13. Washing machine, according to one or more of the previous claims, **characterized in that** said scooping means are adapted to collect a washing liquid from the rear and bottom region (2a) of said tub (2) and to guide said washing liquid into the internal of

said lifters (8), via said one or more inlet apertures (17, 17a, 17b), during the rotation of said drum (1) in both the directions of rotation.

14. Washing machine, according to one or more of the previous claims, **characterized in that** said scooping means are adapted to collect a washing liquid from the rear and bottom region (2a) of said tub (2) and to guide said washing liquid into the internal of said lifters (8), via said one or more inlet apertures (17, 17a, 17b), during the rotation of said drum (1) in only one direction of rotation, while they are adapted not to collect said washing liquid during the rotation of said drum (1) in the other direction of rotation.



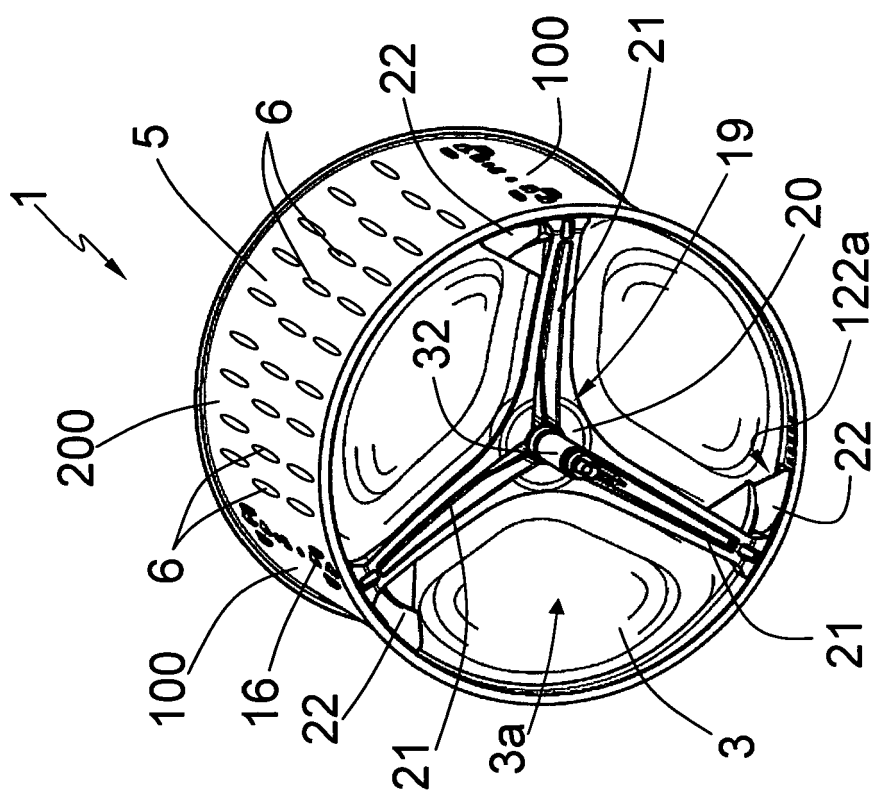


Fig. 3

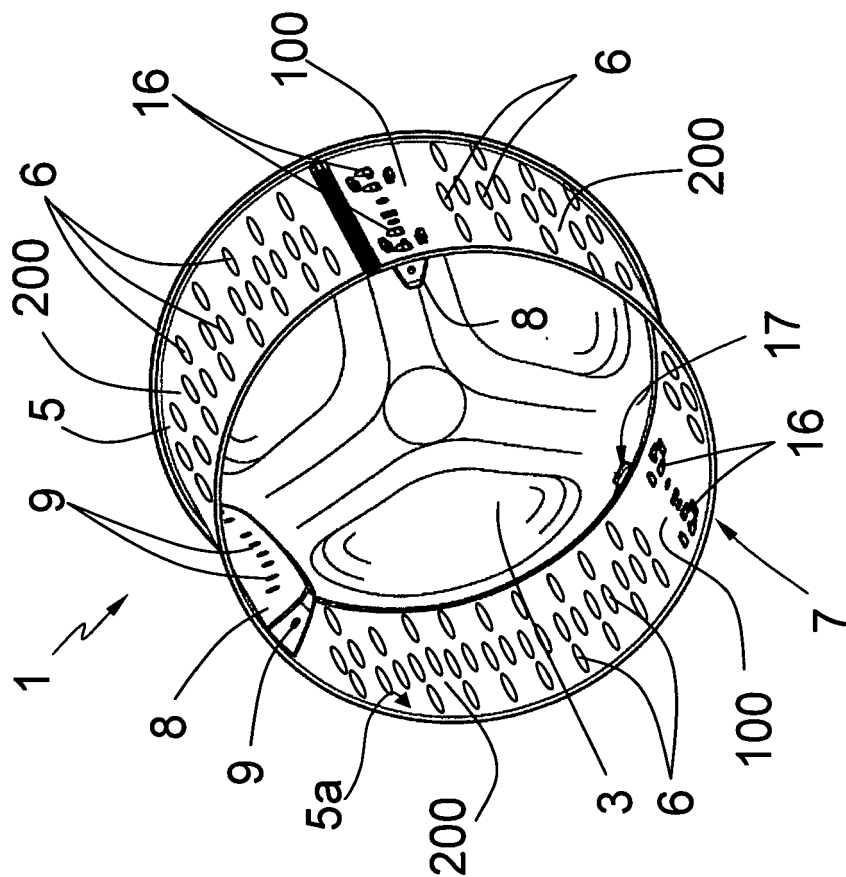


Fig. 4

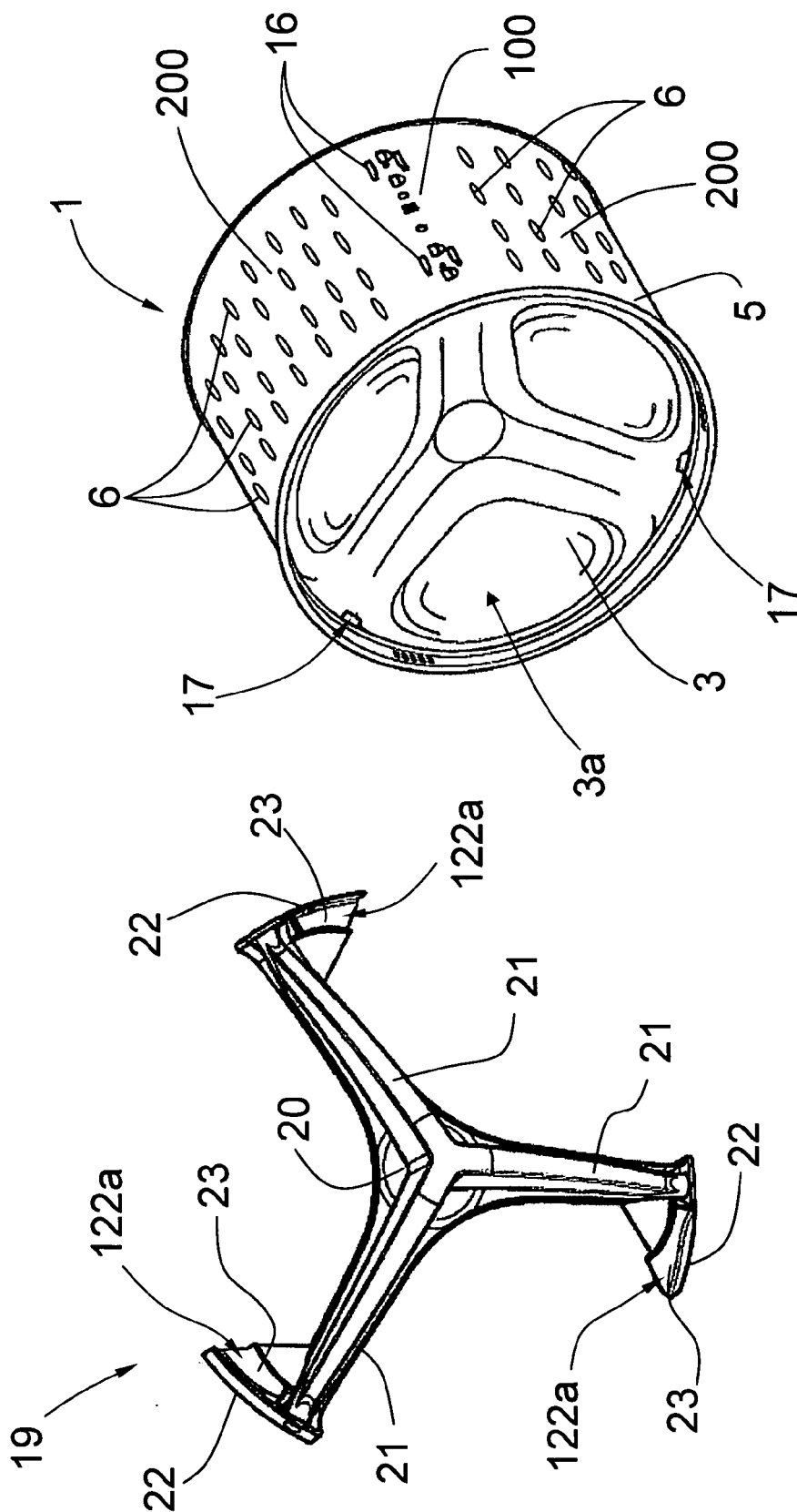


Fig. 6

Fig. 5

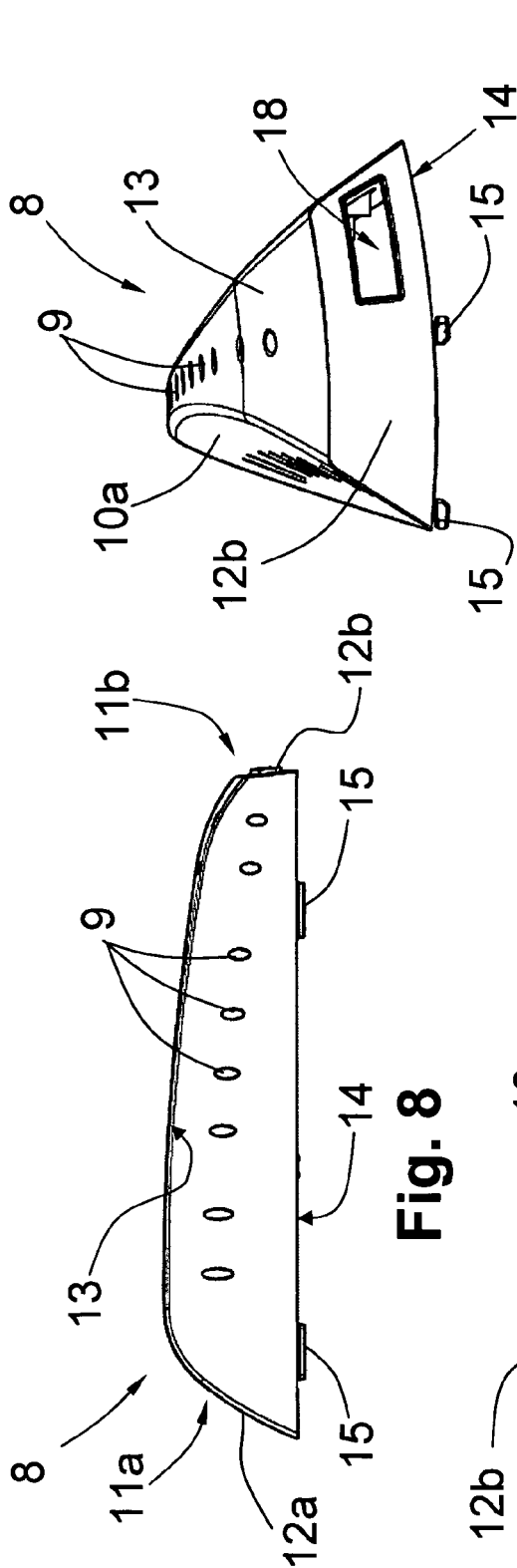


Fig. 9

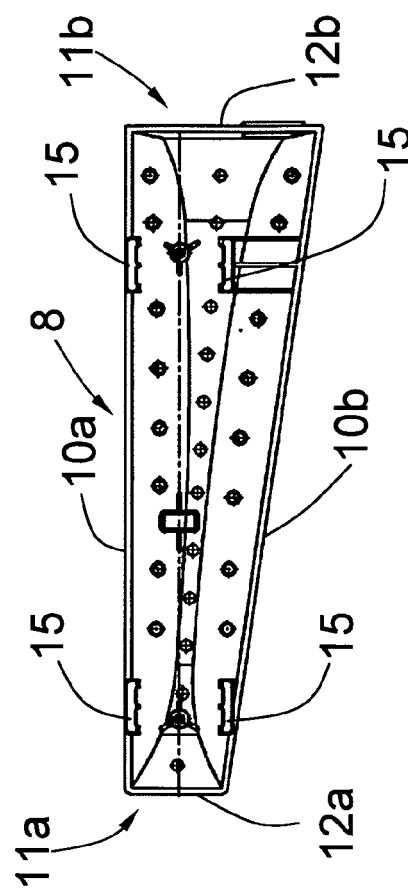


Fig. 10

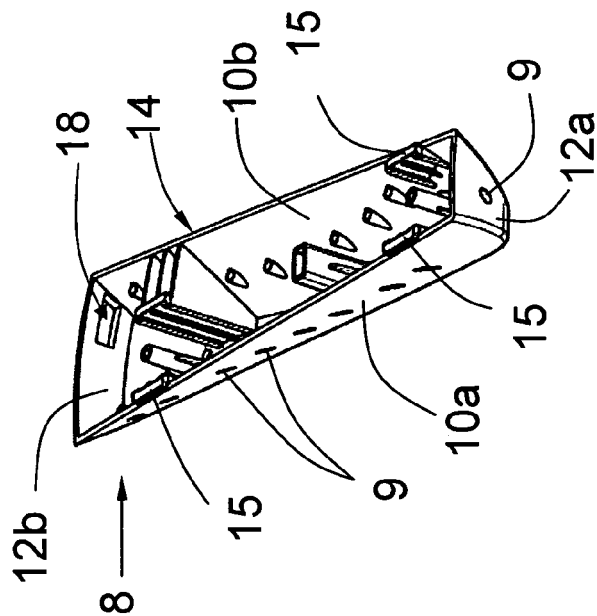


Fig. 7

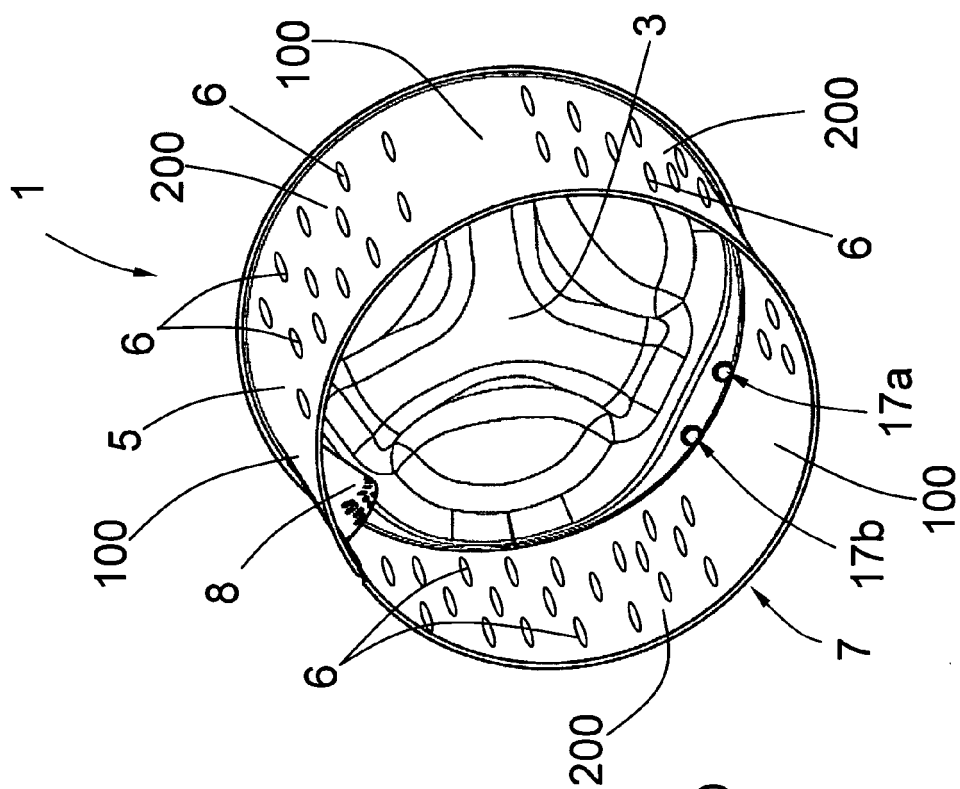


Fig. 12

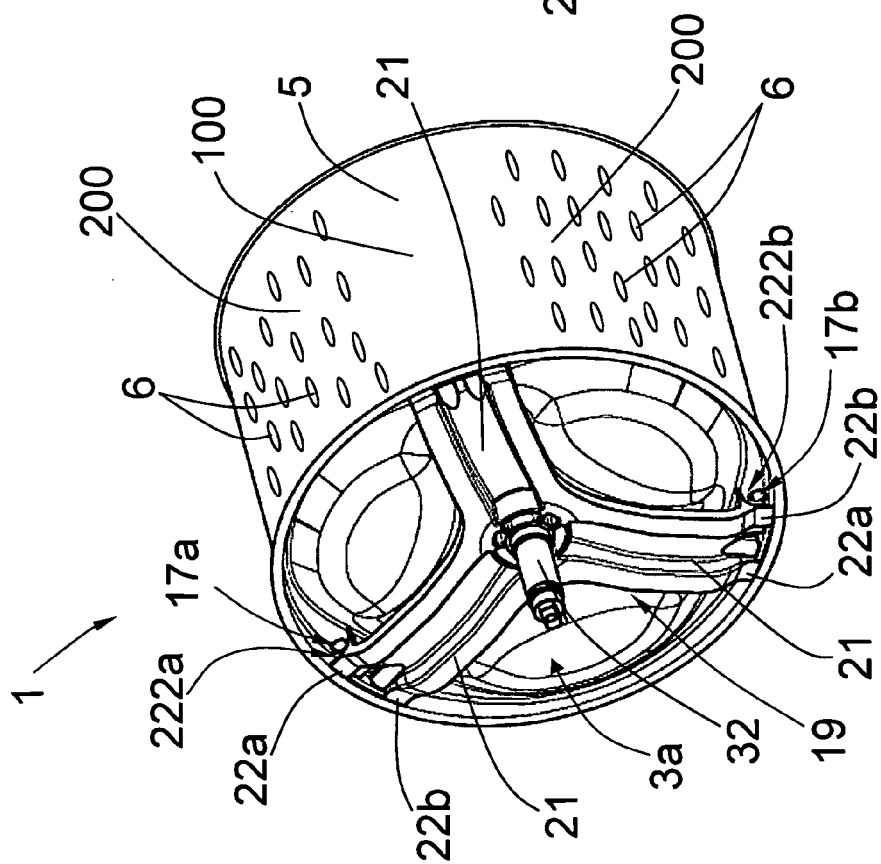


Fig. 11

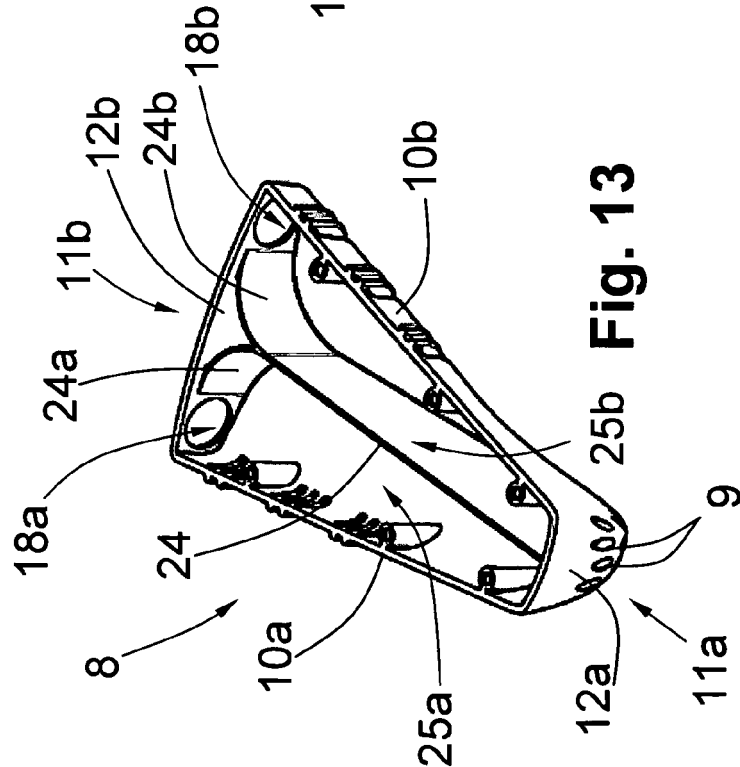


Fig. 13

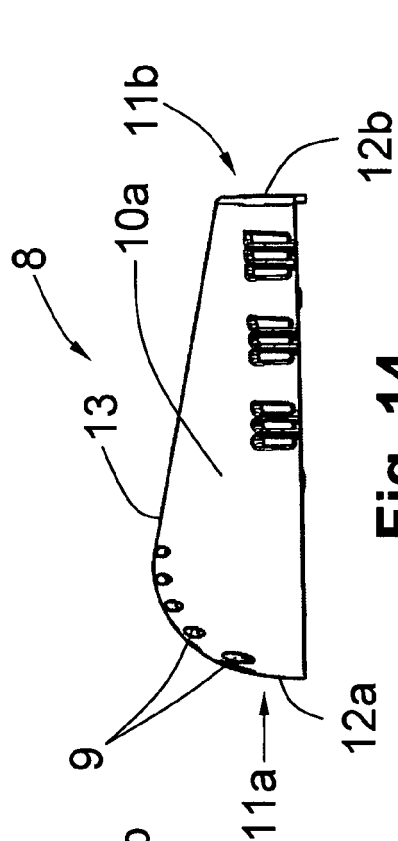


Fig. 14

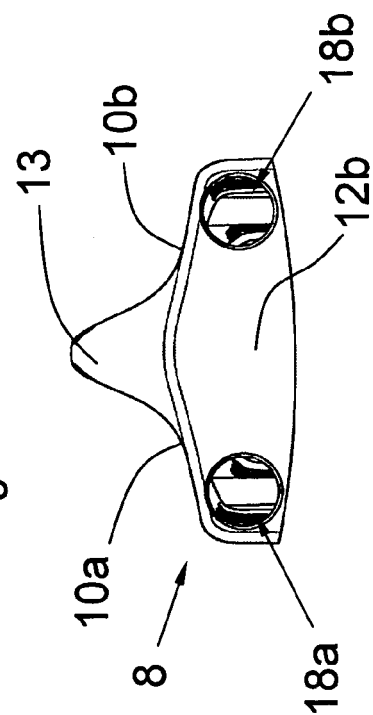


Fig. 15

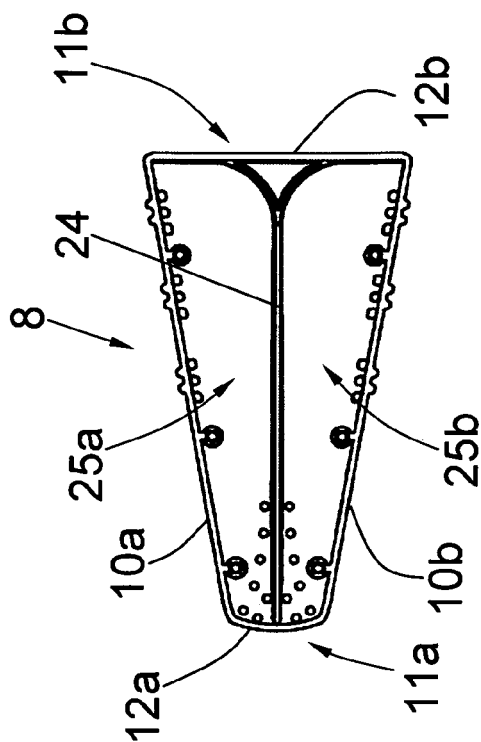


Fig. 16

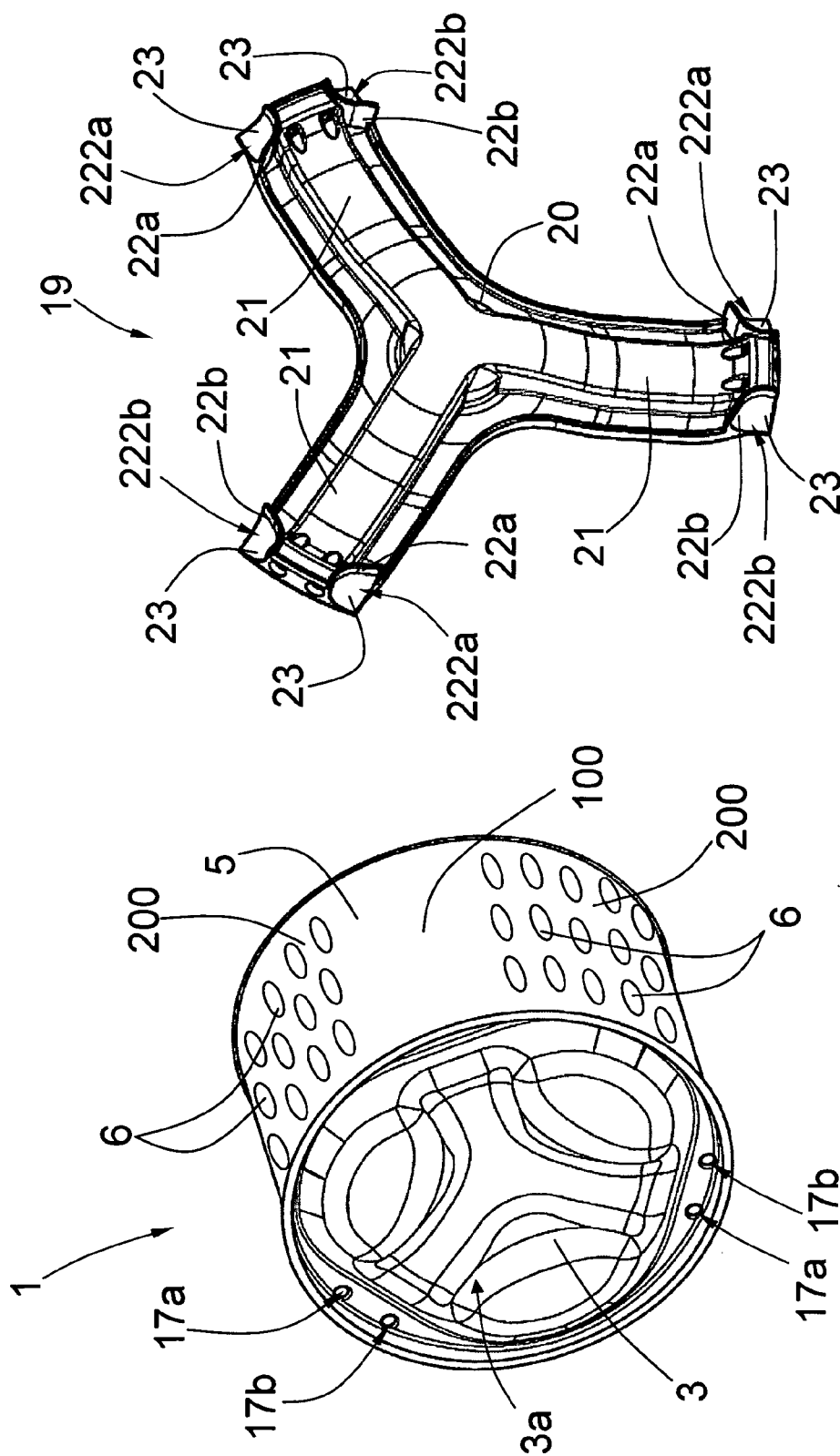


Fig. 18

Fig. 17



EUROPEAN SEARCH REPORT

Application Number
EP 09 00 8485

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	DE 200 23 048 U1 (BSH BOSCH SIEMENS HAUSGERAETE [DE]) 26 September 2002 (2002-09-26) * claims; figures *	1-14	INV. D06F23/02 D06F37/20
A,D	US 6 386 004 B2 (SALEIN MATTHIAS [DE]) 14 May 2002 (2002-05-14) * column 1, lines 10-17; column 4, line 33 - column 5, line 40claims; figures *	1-14	
A	US 2007/006618 A1 (CHOI DONG H [KR] ET AL) CHOI DONG HYUN [KR] ET AL) 11 January 2007 (2007-01-11) * the whole document *	1-14	
A	EP 1 947 229 A2 (MIELE & CIE [DE]) 23 July 2008 (2008-07-23) * the whole document *	1-14	
A	FR 993 216 A (FRITSCHMANN RENÉ) 29 October 1951 (1951-10-29) * the whole document *	1-14	
The present search report has been drawn up for all claims			TECHNICAL FIELDS SEARCHED (IPC)
			D06F
Place of search		Date of completion of the search	Examiner
Munich		13 January 2010	Clivio, Eugenio
CATEGORY OF CITED DOCUMENTS			
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 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			

EPO FORM 1503 03.02 (P04C01)



Application Number

EP 09 00 8485

CLAIMS INCURRING FEES

The present European patent application comprised at the time of filing claims for which payment was due.

☐ Only part of the claims have been paid within the prescribed time limit. The present European search report has been drawn up for those claims for which no payment was due and for those claims for which claims fees have been paid, namely claim(s):

☐ No claims fees have been paid within the prescribed time limit. The present European search report has been drawn up for those claims for which no payment was due.

LACK OF UNITY OF INVENTION

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

see sheet B

☐ All further search fees have been paid within the fixed time limit. The present European search report has been drawn up for all claims.

☒ As all searchable claims could be searched without effort justifying an additional fee, the Search Division did not invite payment of any additional fee.

☐ Only part of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the inventions in respect of which search fees have been paid, namely claims:

☐ None of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims, namely claims:

☐ The present supplementary European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims (Rule 164 (1) EPC).

**LACK OF UNITY OF INVENTION
SHEET B**

Application Number

EP 09 00 8485

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

1. claims: 1-3, 8-14

A washing machine comprising a washing tub containing a drum comprising a base and one or more hollow lifters adapted to release a liquid inside the drum, wherein the base of said drum is provided with apertures fluidly connecting said hollow lifters to the washing liquid present in a rear and bottom region of said washing tub.

1.1. claims: 4-7

A washing machine comprising a washing tub containing a drum comprising a base, one or more hollow lifters adapted to release a liquid inside the drum and a spider provided with scooping means adapted to collect the washing liquid and to guide said liquid inside said hollow lifters.

Please note that all inventions mentioned under item 1, although not necessarily linked by a common inventive concept, could be searched without effort justifying an additional fee.

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 09 00 8485

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
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13-01-2010

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