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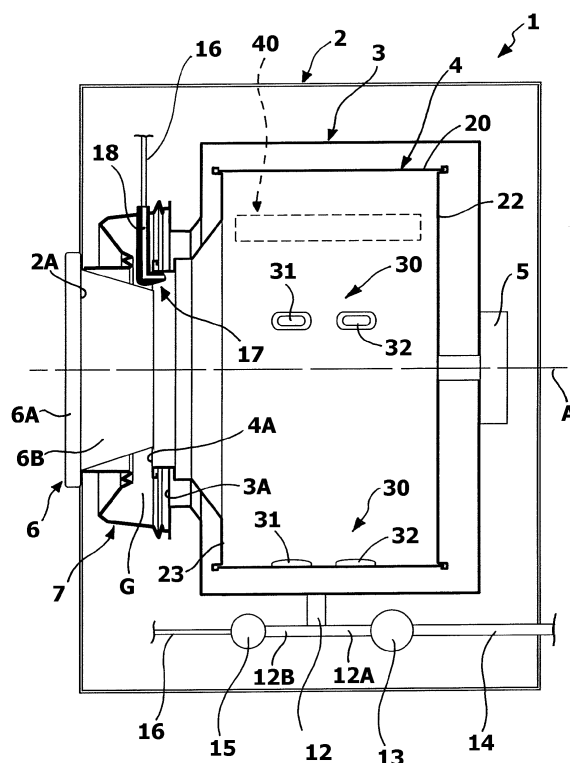
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(54) **Front-loading laundry washing machine**

(57) Front-loading laundry washing machine (1) having a drum (4) with a substantially cylindrical skirt (20) having one or more arrays of holes (21), a rear wall (22), and a front wall (23), formed in which is the front opening (4A) of the drum (4). The skirt (20) has a plurality of lifter elements (30,40) that extend in length in a direction of depth of the drum (4), among which at least one first lifter element (30) formed integrally with the skirt (20) and comprising at least one drawn indentation (31,32) of the skirt itself, and one second lifter element (40), each lifter element (30,40) having a front end region and a rear end region. The at least one first lifter element (30) and the second lifter element (40) have different heights, understood as the distance between the top of the lifter element (30,40) and the skirt (20), the height of the at least one first lifter element (30) being less than the height of the second lifter element (40). The front end region of the at least one first lifter element (30) is further away from the front wall (23) of the drum (4) than from the front end region of the second lifter element (40).

Fig. 2



Description

Field of the invention

[0001] The present invention relates to a front-loading laundry washing machine.

Background of the invention

[0002] Machines of the type referred to comprise a laundry drum mounted in a washing tub, which is in turn housed in a cabinet. The cabinet has a front opening for loading laundry, where a hatch is mounted, and this opening is substantially aligned to a front opening of the tub, which is in turn substantially aligned to a front opening of the drum. The drum is mounted so that it can rotate about a substantially horizontal or slightly inclined axis, which is in a fixed position with respect to the tub. The tub is suspended elastically within the cabinet so as to be able to perform given oscillations as a result of the loads acting on the drum during rotation thereof, said loads being due to the weight of the laundry being treated.

[0003] Between the front wall of the tub and the front wall of the cabinet there extends a substantially tubular gasket, which defines a water-tight passage. Giving out into a first end of said passage is the opening of the cabinet, whilst giving out into the other end is the opening of the tub and that of the drum. The presence of the aforesaid gasket prevents part of the washing liquid or of the laundry from possibly coming out of the tub and drum and penetrating into the gap between the tub and the cabinet. The gasket must enable a certain relative movement between the cabinet and the tub, given that the latter is subject to oscillation during rotation of the drum: for this reason, the gasket, and hence the tubular passage defined thereby, must have a certain axial length and be elastic, preferably shaped at least in part in bellows fashion. In the tubular passage defined by the gasket there usually extends also an internal or rear portion of the hatch, which is shaped in a way in itself known to provide a sort of barrier to prevent exit of the laundry at least from the bottom part of the mouth of the drum, during rotation of the latter. Between the aforesaid internal portion of the hatch, the gasket, and the mouth of the drum there must exist an annular space or gap in order to enable both oscillations of the tub and rotation of the drum.

[0004] During rotation of the drum it may happen that a flap of a item of laundry penetrates into an area of the aforesaid gap, and this can cause scuffing of the item itself, particularly when the speed of rotation of the drum is relatively high, for example in the course of the steps of centrifugation of the laundry.

[0005] In order to solve the aforesaid problem some machines of a known type are provided with a device, referred to as «laundry rejector», basically constituted by a deflector member, usually made of resilient material. The deflector member traverses a limited area of the aforesaid gap and is shaped so as to project towards the

inside of the front opening of the drum, in the proximity of its rim. In this way, following upon rotation of the drum, any items of laundry that might get partially caught in the gap at a certain point reach the deflector member, which physically pushes the item of laundry towards the inside of the drum, releasing it from the gap. A machine of this type is known, for example, from the document WO 02/12612, where a laundry rejector has a body basically constituted by a pocket made integral with the gasket; said pocket-like body is relatively yielding, so that inside it there projects a stiffening element, defined by a metal ring for fixing the gasket.

[0006] The laundry drum is usually constituted by a peripheral wall or skirt, defining a substantially cylindrical shape, closed at the two ends by a front wall and a rear wall. The peripheral wall of the drum is prevalently perforated, i.e., the majority of its angular development presents arrays of holes in such a way that, in the course of rotation of the drum, a partial and temporary immersion of the items of laundry is obtained in the bath of washing or rinsing liquid present in the bottom area of the tub. The front wall of the drum is provided with the corresponding opening for loading, whilst fixed to the rear wall is the shaft used for setting the drum in rotation via a motor and possible transmission means.

[0007] In order to favour agitation and mixing of the laundry within the drum, the latter is provided inside with lifter elements or lifters, which project from the skirt of the drum itself in the direction of its centre. Said lifter elements, which can be made via shaping of the skirt or else configured as components fixed to the latter, are hollow and have an approximately triangular section. Usually, provided inside the drum are at least three lifters, having a height, understood as the distance between the skirt and the top of the lifter element, of approximately 40-50 mm.

[0008] In order to improve the effectiveness of the steps of washing and/or rinsing, certain washing machines are also equipped with a system for recirculation of the treatment liquid. In some solutions, part of the liquid present in the tub is drawn in by a pump and sprayed towards the inside of the drum, for example via nozzle means mounted in the top part of the tub or else in a position corresponding to the bellows-shaped gasket. A solution of this sort is described, for example, in the already cited document WO 02/12612, where mounted within the pocket-like body of the laundry rejector is a tubular nozzle, connected to which is the outlet end of a duct for recirculation of the liquid.

[0009] In other solutions, which are less costly, the effect of circulation is instead obtained by exploiting the lifter elements provided within the drum. In an area corresponding to the lifter element, the circumferential wall of the drum has inlet passages, via which part of the liquid constituting the bath of washing or rinsing liquid present on the bottom of the tub can penetrate within the lifter element, when the latter substantially comes to occupy the area of the bottom dead centre of the drum. The lifter

element is also equipped with outlet passages in its part facing the inside of the drum, usually in a position corresponding to the cusp of the lifter element. In this way, following upon rotation of the drum, when the lifter element moves towards the area of the top dead centre, the water contained in the lifter element itself can be sprayed into the drum, through the aforesaid outlet holes, onto the underlying laundry. In this way, a certain effect of recirculation of the washing or rinsing liquid is obtained. A solution of this type is described, for example, in the document EP-A-0244365.

Summary and object of the invention

[0010] In the perspective of the prior art previously referred to, the object of the present invention is to provide a front-loading laundry washing machine that presents improved and reliable operation, as well as being simple and inexpensive to produce.

[0011] The above and other purposes, which will emerge more clearly hereinafter, are achieved according to the present invention by a front-loading laundry washing machine having the characteristics specified in the attached Claim 1. Preferred characteristics of the machine forming the subject of the invention are specified in the sub-claims. The claims form an integral part of the technical teaching provided herein in relation to the invention.

Brief description of the drawings

[0012] The purposes, characteristics and advantages of the present invention will emerge clearly from the ensuing description, with reference to the annexed drawings, which is provided purely by way of non-limiting example, and in which:

- Figure 1 is a schematic perspective view of a laundry washing machine according to the present invention;
- Figure 2 is a schematic cross-sectional view of the laundry washing machine of Figure 1;
- Figure 3 is a schematic perspective view of a laundry drum of the machine of Figure 1;
- Figure 4 is a schematic representation of a portion of the drum of Figure 3, viewed from outside;
- Figure 5 is a schematic top plan view of a drawn indentation belonging to the drum of Figures 2-3.

Description of preferred embodiments of the invention

[0013] With particular reference to Figures 1 and 2, the reference number 1 designates as a whole a front-loading laundry washing machine according to the invention. The machine 1 comprises a load-bearing structure or cabinet 2, elastically supported in which in a known way is a tub 3. Rotatably mounted inside the tub 3 is a perforated drum 4 for the laundry, which can be driven in rotation about an axis A, via an electric motor 5. The tub 3

and the drum 4 have respective front openings, designated by 3A and 4A, respectively, and the drum 4 is accessible to the user through an opening 2A made in the front wall of the cabinet 2. The openings 2A, 3A and 4A are substantially coaxial or in any case aligned, preferably according to the axis A.

[0014] Provided in a position corresponding to the opening 2A is a hatch 6 (represented only in Figure 2), which has a frame 6A, hinged in a known way to the cabinet 2, associated to which is a containment body 6B, preferably transparent, for example made of glass. Preferably, as may be seen in Figure 2, the containment body 6B is shaped so as to project towards the inside of the cabinet 2 as far as in the proximity of the loading mouth of the drum 4, namely, its slightly projecting front part that delimits the opening 4A. It should be noted that the internal part of the body 6B could possibly extend as far as within the opening 4A, it remaining understood that between the rim that delimits said opening and the body 6B there must in any case be provided a certain gap, given that - during operation of the machine 1 - the assembly that includes the tub 3 and the drum 4 is able to oscillate within the cabinet 2, whilst the hatch 6 remains in a fixed position.

[0015] Once again from Figure 2 it emerges how, mounted between the cabinet 2 and the tub 3, is a gasket 7, which is as a whole tubular in shape. The gasket 7, which is preferably made of resilient elastomer material and is at least in part bellows shaped, has a first end connected in a water-tight way to the front part of the cabinet 2 so as to circumscribe the opening 2A. The opposite end of the gasket 7 is instead connected in a water-tight way to a front flange-like part of the tub 3 so as to circumscribe the corresponding opening 3A thereof, with the opening 4A of the drum that gives out into the generally tubular duct defined by the gasket 7. In order to enable oscillations of the tub-drum assembly and rotation of the drum, the gasket 7 must have a certain axial extension and between the body 6B, the mouth of the drum 4, and the gasket itself must have a certain free space or annular gap, designated by G in Figure 2.

[0016] The machine 1 comprises all the components necessary for its normal operation, which are not represented and described herein in so far as they are not of immediate interest for the purposes of the present invention, among which level-sensor means, means for heating the water, filters, safety devices, suspensions, a dispenser of washing agents, supply means for connection to a domestic water supply, a user interface, and a control unit, comprising, for example, a microcontroller with associated memory means, encoded in which are the instructions regarding general functions of the machine and the corresponding operating programs.

[0017] In Figure 2, the reference number 12 designates a discharge union, connected to an opening present in the bottom region of the tub 3, which branches into two ducts 12A and 12B. The duct 12A is connected to the intake of a discharge pump 13, there being con-

nected to the delivery of the pump itself a discharge pipe 14. The duct 12B is, instead, connected to the intake of a recirculation pump 15, there being connected to the delivery of the pump itself a recirculation pipe 16. The pump 15 and the duct 16 form part of a system for recirculation of the washing or rinsing liquid, aimed at improving wetting of the laundry present in the drum 4.

[0018] The machine 1 is further equipped with laundry-rejector means, aimed at preventing the risks deriving from any possible imprisoning of flaps of laundry in the gap G. For this purpose, designated by 17 is a laundry rejector, the body of which is made of a single piece with the gasket 7; in the example, the laundry rejector 17 is located substantially in the region of the top dead centre of the opening of the drum 4, but said positioning is not to be understood as limiting.

[0019] Once again with reference to the embodiment illustrated, the system for recirculation of the washing or rinsing liquid comprises an ejector or nozzle, configured for directing a jet of liquid into the drum 4 through the corresponding opening. In the preferred embodiment of the invention, the ejector of liquid is formed directly in the laundry rejector 17, which is for this reason provided with an internal channelling 18, the inlet end of which is connected to the recirculation pipe 16, whilst the outlet end faces the inside of the drum 4.

[0020] It should be noted that the presence of the laundry rejector 17 and of the corresponding internal duct 18 is to be understood as preferred, but not essential for the purposes of implementation of the invention.

[0021] With reference also to Figures 3 and 4, the drum 4 has a peripheral skirt 20 having one or more arrays of holes 21, a rear wall 22, and a front wall 23, formed in which is the front opening 4A of the drum. In accordance with the known art, the skirt 20 has a plurality of lifter elements, which extend in length in the direction of depth of the drum 4, i.e., substantially parallel to the axis A of Figure 2. In accordance with the known art, said lifters are configured as elements projecting towards the inside of the drum 4, present in which is the laundry to be treated.

[0022] According to the invention, the lifter elements of the drum are of types different from one another, both as regards their height and in terms of distance of the lifter element from the front wall 23.

[0023] More in particular, according to the invention, the drum 4 envisages at least one lifter element of a first type, designated as a whole by 30, having a height appreciably lower than the height of a lifter element of the second type, designated by 40. Once again according to the invention, the at least one lifter element 30 is formed integrally with the skirt 20 and comprises at least one drawn indentation or recess in the skirt itself.

[0024] The at least one lifter element 30 has a height, understood as the distance between its top and the skirt 20 that is appreciably less than the height of the lifter element 40. Furthermore, the front end region of the at least one lifter element 30 is at a greater distance from the front wall 4A of the drum than from the front end region

of the lifter element 40.

[0025] In the embodiment currently deemed preferential, the drum 4 is provided with two lifter elements 30 and one lifter element 40, as represented in the figures, located at approximately 120° from one another.

[0026] Practical tests conducted by the present Applicant have enabled ascertainment of the advantages of the invention, described hereinafter, that can be achieved with a lifter element 40 of a height at least twice, in particular at least three times, the height of the lifter elements 30. The preferred heights are, for the lifter element 40, comprised between 35 and 50 mm, in particular approximately 40 mm, whilst for the lifter elements 30 they are between 5 and 15 mm, in particular approximately 10 mm. On the machines tested by the present Applicant the best results have been obtained with a height of the lifters 40 of approximately 40 mm and a height of the lifters 30 of approximately 10 mm (i.e., approximately four times less).

[0027] Once again with reference to the currently preferred embodiment, illustrated in the figures, each lifter element 30 comprises at least two drawn indentations or recesses. In the example illustrated, each lifter element 30 consists of two drawn indentations or recesses, of which one (designated by 31) is closer to the front wall 23 of the drum and the other (designated by 32) is closer to the rear wall 22 of the drum. As emerges in particular from Figure 4, the two indentations 31, 32 are located in an intermediate part of the depth of the skirt 20 and are aligned to one another in the direction of depth of the drum 4, with the distance between the two indentations 31, 32 that is smaller than the distance of the indentation 31 from the front wall 23 and the distance of the second indentation 32 from the rear wall 22 of the drum 4. Preferably, moreover, the length of each indentation 31, 32 is greater than the distance between them.

[0028] This relative positioning between the indentations 31, 32, in addition to determining a lesser tendency of the laundry to penetrate into the gap G defined by the gasket 7, enables improvement of wetting of the laundry and circulation of the water within the drum. Once again from Figure 4 it emerges in fact how each first lifter element 30, i.e., each of the indentations 31, 32, is formed in a respective non-perforated region of the skirt 20; in the space that separates the two indentations 31, 32, delimited by a non-perforated portion of the skirt 20, part of the washing or rinsing liquid can hence freely penetrate into the drum and be temporarily withheld therein the course of its rotation.

[0029] From the figures it should moreover be noted how each indentation 31, 32 has a shape longitudinally extended in the direction of depth of the drum 4. The profile of the indentations 31, 32 is radial, except for the top surface or wall, which is preferably substantially plane. This enables reduction of the risks of wear on the laundry being washed.

[0030] As may be seen in Figure 5, this plane top, designated by 31A, is joined to the cylindrical part of the skirt

20 by two portions of spherical surface, designated by 31A, at the longitudinal end portions of the indentation, and by two portions of cylindrical surface 31C, at the longitudinal sides of the indentation 31. The indentation 32 is preferably of identical conformation.

[0031] In the embodiment illustrated in the figures, the lifter element 40 is configured as a component distinct from the skirt 20, for example made of moulded plastic material, and fixed to the latter with modalities in themselves known in the field, for example in positions corresponding to sheared passages made in the skirt. This embodiment is, however, to be considered as preferred, though not essential, in so far as also the lifter element 40 could be obtained by deformation, in particular drawing, of the cylindrical wall of the drum.

[0032] Practical tests conducted by the present applicant have shown that the use of lifter elements of contained height and set at a distance from the front wall of the drum enables important practical advantages to be obtained, first amongst which is the reduction of the risks of scuffing of the laundry.

[0033] More in particular, and given the same washing result as compared to a machine provided with lifters of a traditional type, in the machine according to the invention there has been found a lesser tendency of the items of laundry to get drawn into the gap G delimited by the gasket 7. The consequence of this is that the items of laundry are less likely to get caught and pulled along in the gap G, with consequent reduced risks of wear or damage. The fact that only one lifter element 40 is closer to the front wall 23 of the drum than are the lifters 30 does not reduce this advantageous effect substantially. On the other hand, the larger sizing of the lifter element 40, both in terms of height and in terms of length, is necessary to guarantee in each condition of use an efficient agitation of the laundry. It should be noted that the front end or rear end of the lifter element 40 could also be in contact with, or be formed by, the front wall or rear wall of the drum, respectively.

[0034] Another advantage is linked to the possible presence of a laundry rejector in the washing machine. The effect described above, i.e., a reduced tendency of the items of laundry to penetrate into the gap G, has as consequence a reduction also of the mechanical stresses exerted by the laundry on the laundry rejector 17; the body of said laundry rejector can thus be made integral with the gasket 7, but without any need for additional reinforcements, such as an internal metal, or in any case rigid, core, as in the solution described in the document WO 02/12612.

[0035] A further advantage, deriving from the aforesaid reduced stress that is exerted on the laundry rejector 17, is that a channelling 18 forming the terminal nozzle of the recirculation circuit 15-16 can be easily made in its body, without the need to provide, within said body, additional components, such as a purposely designed tubular element or plastic nozzle, as is, instead, the case in the document WO 02/12612.

[0036] A further advantage of the invention is that the presence of a single lifter element of a traditional type (such as the lifter 40), i.e., having a height between approximately 35 mm and 50 mm, instead of the three traditional lifters provided in the machines according to the known art, enables an increase in the useful space within the drum. Said advantage may be particularly appreciated in laundry washing machines provided with drums of relatively small size.

[0037] From the foregoing description, the characteristics of the present invention, as likewise its advantages, emerge clearly.

[0038] Of course, without prejudice to the principle of the invention, the details of construction and the embodiments may vary widely with respect to what has been described and illustrated herein purely by way of example, without thereby departing from the scope of the present invention as defined in the annexed claims. Previously, reference was made to lifter elements 30 formed by two distinct drawn indentations 31, 32. It is, however, clear that the effects of the invention can be achieved, albeit with lesser benefits, also with lifter elements obtained from a single indentation, obviously longer than the ones exemplified in the annexed drawings, and with due respect of the constraints specified in the annexed claims.

Claims

1. A front-loading laundry washing machine, comprising a cabinet (2) housing a washing tub (3), in which a drum (4) for a laundry load is mounted, the drum (4) being rotatably operable by motor means (5), the cabinet (2), the tub (3), and the drum (4) having respective front openings (2A, 3A, 4A) substantially aligned to each other, the machine (1) having a gasket (7) defining a sealed passage for connecting the front opening (2A) of the cabinet (2) to the front opening (3A) of the tub (3), the front opening (4A) of the drum (4) giving out into the sealed passage, wherein the drum (4) has a substantially cylindrical skirt (20) having one or more arrays of holes (21), a rear wall (22), and a front wall (23), in which the front opening (4A) of the drum (4) is formed, and wherein the skirt (20) has a plurality of lifter elements (30, 40) extending in length in a direction of depth of the drum (4), among which at least one first lifter element (30), integrally formed in the skirt (20) and comprising at least one drawn indentation (31, 32) of the skirt itself, and one second lifter element (40), each lifter element (30, 40) having a front end region and a rear end region, said laundry washing machine being **characterized in that** the at least one first lifter element (30) and the second lifter element (40) have different height, understood as the distance between the top of the lifter element and the skirt (20), the height of the at least one first lifter element (30) being

- less than the height of the second lifter element (40), and **in that** the distance between the front end region of the at least one first lifter element (30) and the front wall (23) of the drum (4) is greater than the distance between the front end region of the second lifter element (40) and the front wall (23) of the drum (4).
2. The laundry washing machine according to Claim 1, wherein the height of the at least one lifter element (30) is less than one-half, preferably less than one-third, much more preferably approximately one-quarter, of the height of the second lifter element (40).
 3. The laundry washing machine according to Claim 2, wherein the second lifter element (40) has a height comprised between approximately 35 and 50 mm, in particular approximately 40 mm, and the at least one first lifter element (30) has a height comprised between approximately 5 and 15 mm, in particular approximately 10 mm.
 4. The laundry washing machine according to any of the preceding claims, wherein the at least one first lifter element (30), or each first lifter element (30), is formed by at least two of said drawn indentations (31, 32).
 5. The laundry washing machine according to Claim 4, wherein the at least one first lifter element (30), or each first lifter element (30), is formed by one first said drawn indentation (31), having a respective end facing the front wall (23) of the drum (4), and one second said drawn indentation (32), having a respective end facing the rear wall (22) of the drum (4), the first and the second drawn indentations (31, 32) being mutually aligned in the direction of depth of the drum (4), i.e. in a direction which is substantially parallel to the axis of rotation (A) of the drum (4), the distance between the two drawn indentations (31, 32) in said direction being less than the distance between the first drawn indentation (31) and the front wall (23) of the drum (4) and than the distance between the second drawn indentation (32) and the rear wall (22) of the drum (4).
 6. The laundry washing machine according to any of the preceding claims, wherein the lifter elements (30, 40) of the drum (4) consist of two said first lifter elements (30) and one said second lifter element (40).
 7. The laundry washing machine according to one or more of the preceding claims, wherein each drawn indentation (31, 32) has a shape which is elongated longitudinally in the direction of depth of the drum (4) and has a profile that includes a substantially plane top surface (31A) which is joined to the skirt (20) of the drum (4) by two portions of spherical surface (31 B), at the longitudinal end portions of the indentation (31), and by two portions of cylindrical surface (31C), at the longitudinal sides of the indentation (31).
 8. The laundry washing machine according to one or more of the preceding claims, wherein the at least one first lifter element (30), or each first lifter element (30), is formed in a respective non-perforated region of the skirt (20) of the drum (4).
 9. The laundry washing machine according to one or more of the preceding claims, wherein the second lifter element (40) is configured as a component distinct from the skirt (20) of the drum (4) and fixed thereto.
 10. The laundry washing machine according to Claim 1, comprising a laundry rejector (17), for pushing or in any case forcing towards the inside of the drum (4) parts of the laundry load that, during rotation of the drum (4), possibly come out or tend to come out of the front opening (4A) of the drum and penetrate into said sealed passage.
 11. The laundry washing machine according to Claim 1, further comprising a system for re-circulation of the washing or rinsing liquid, including one pump (15) and a duct (16), which has an inlet connected to a delivery of the pump (15) and an outlet connected to an ejector or nozzle (18) configured for directing a jet of liquid towards the inside of the drum (4).
 12. The laundry washing machine according to Claims 10 and 11, wherein the ejector or nozzle (18) is at least partly integrated in the laundry rejector (17).
 13. The laundry washing machine according to Claim 10 or Claim 12, wherein the laundry rejector (17) has a body formed integrally in the gasket (7).

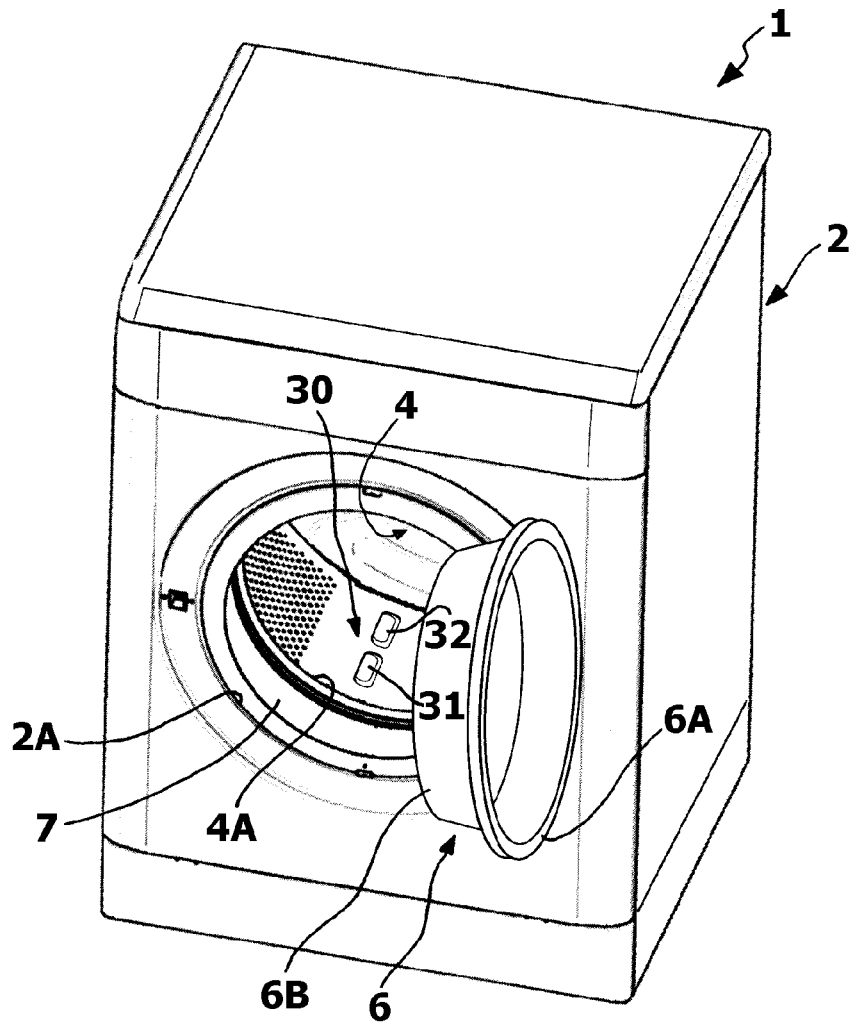


Fig. 1

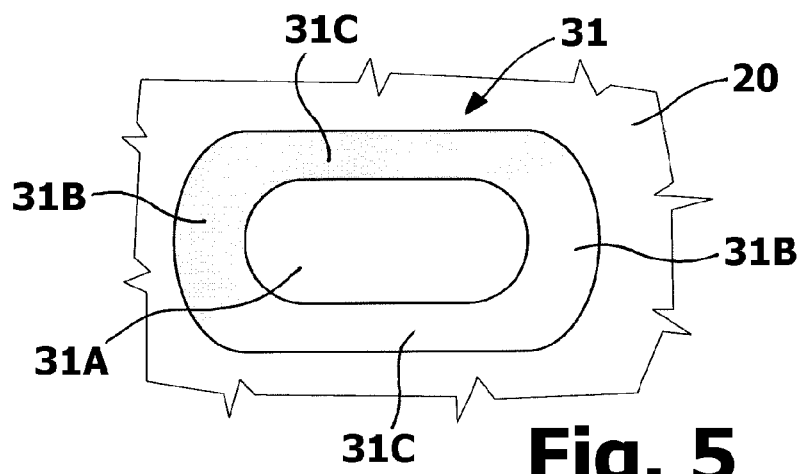


Fig. 5

Fig. 2

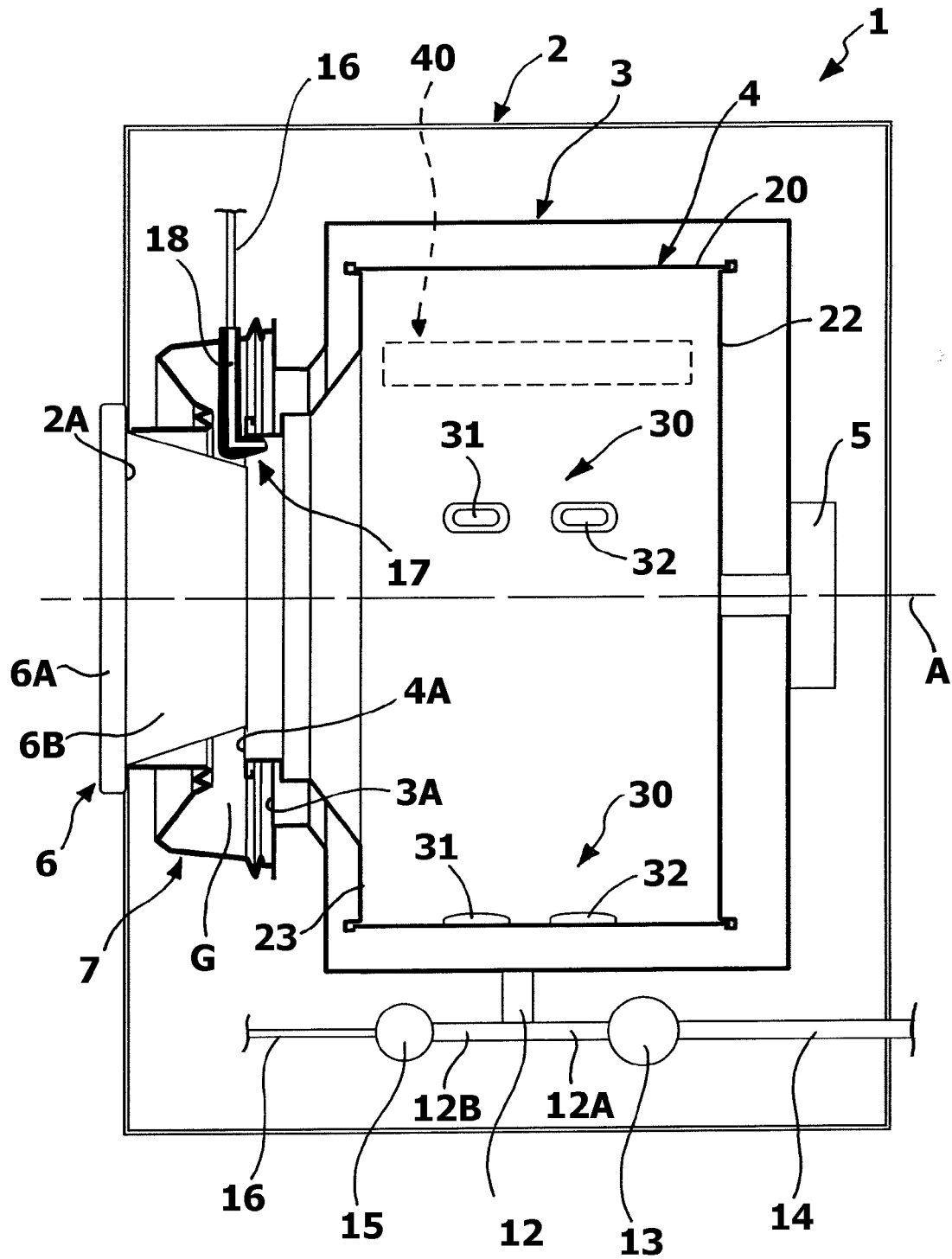


Fig. 3

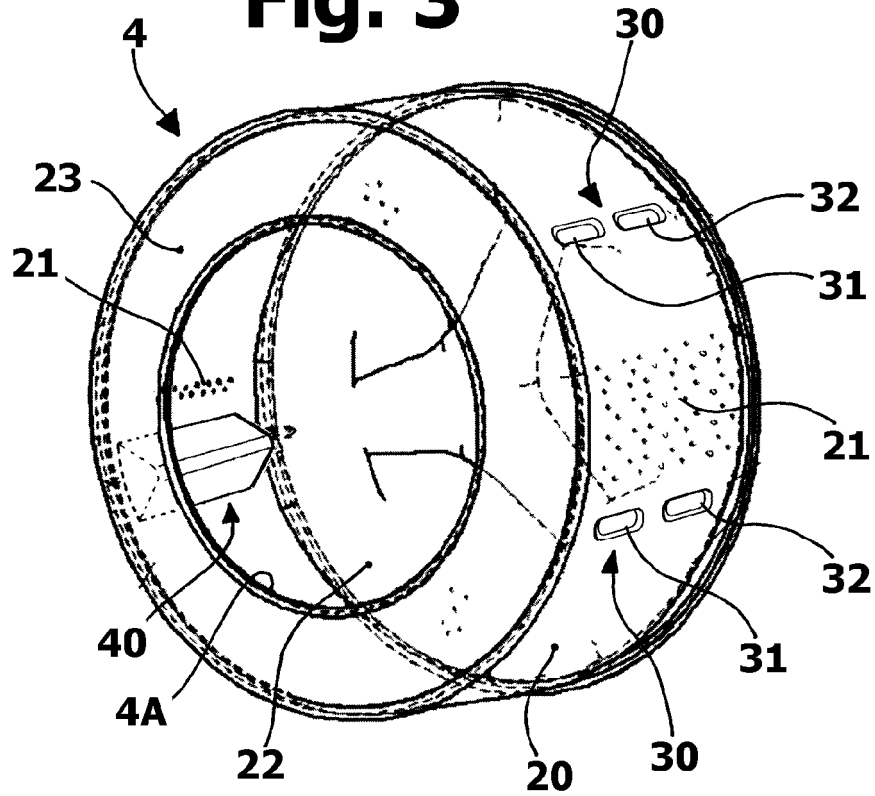
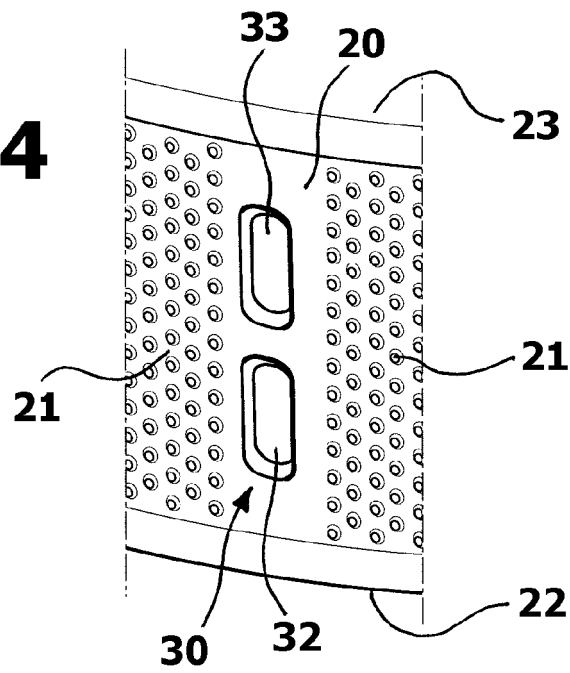


Fig. 4





EUROPEAN SEARCH REPORT

Application Number
EP 10 17 0437

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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The present search report has been drawn up for all claims			TECHNICAL FIELDS SEARCHED (IPC) D06F
Place of search Munich		Date of completion of the search 4 November 2010	Examiner 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	

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EPO FORM 1503 03.82 (P04C01)

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

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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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