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(54) **A washing machine, in particular a laundry washing machine**

Waschmaschine, insbesondere eine Wäschewaschmaschine

Machine à laver, notamment une machine à laver le linge

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Description

[0001] The present invention relates to a washing machine, in particular a laundry washing machine, fitted with at least conventional and ultrasonic washing systems.

[0002] Ultrasonic cavitation is the phenomenon through which it is possible to comprehend the ultrasonic washing principle, which allows removing very small dirt particles.

[0003] As known from patents FR 2614325 to Blasutti and DE 38 43 110 to Grünbeck Wasseraufbereitung, washing cloth by means of one or more ultrasonic transducers requires also an action exerted by conventional washing means, such as a rotary drum. In fact, textile cloths would get damaged by the use of ultrasonic systems alone, in that a persistent action exerted by cavitation bubbles generated by ultrasonic transducers would cause the cloth structure to break up.

[0004] In order to prevent damaging said cloths, it is necessary that they are kept continually in motion, so that the cavitation bubbles can exert their action in as many directions as possible.

[0005] In this manner, the cavitation bubbles can vary the geometry of the cloth, thus promoting dirt detachment and creating a washing effect.

[0006] This washing effect is mostly mechanical, and can be increased by using a detergent, which may have an acid pH.

[0007] The action of the detergent is further enhanced by the presence of ultrasounds, which help activate the chemical components within the detergent dissolved in water, thus pre-activating the detergent; this advantageously reduces the quantity of detergent required, compared to a traditional washing system.

[0008] It is also generally known to those skilled in the art that an ultrasonic washing process using detergents having an acid pH is highly corrosive for metals.

[0009] In fact, in addition to a chemical action due to the large quantity of oxonium ions in the watery solution, a prevalently mechanical action is also exerted by the cavitation bubbles, which can wear metals.

[0010] The tubs of most washing machines currently on the market are made of plastic material, which is less subject to corrosion.

[0011] However, this type of tub, when used along with ultrasonic transducers, is easily subject to cracking caused by the vibrations generated both by the implosion of the cavitation bubbles (the pressure of which is of the order of hundreds of atmospheres) and by the operation of said transducers.

[0012] It is therefore apparent that the sealing of such tub types may be jeopardized after a limited number of wash cycles.

[0013] This limit is even more apparent when the tub includes one or more holes for the installation of one or more ultrasonic transducers, since the regions surrounding the hole are more subject to cracking. A possible solution to this problem is disclosed in the european patent

application EP 1 837 432 to Miele & Cie, in which a hole of a tub is delimited by a flange in order to reduce the possibility of cracking.

[0014] The present invention aims at solving these and other problems by providing a washing machine, in particular a laundry washing machine, which comprises a tub fitted with at least conventional and ultrasonic washing systems, as set forth in the appended claim 1. The present invention is based on the idea of providing a laundry washing machine comprising a tub fitted with at least conventional and ultrasonic washing systems, and equipped with holes for securing the ultrasonic transducers; each hole comprises a suitably shaped and thick flange which, in combination with reinforcement ribs (typically provided on the tub) and other parts of the tub, limits the amplitude of the vibrations of the latter's structure, thus reducing the risk of cracking.

[0015] Further advantageous features of the present invention will be set out in the appended claims.

[0016] These features as well as further advantages of the present invention will become more apparent from the following description of an embodiment thereof as shown in the annexed drawings, which are supplied by way of non-limiting example, wherein:

Fig. 1 is an exploded perspective view of the tub of the laundry washing machine according to the present invention;

Fig. 2 is an exploded view of the ultrasonic transducer of Fig. 1;

Fig. 3 is a sectional view along the plane A-A shown in Fig. 2 of the ultrasonic transducer according to the invention;

Fig. 4 shows a detail of the ultrasonic transducer of the preceding figures, when installed on the washing machine.

[0017] With reference to Figs. 1 and 2, there is shown a tub of a laundry washing machine 1 which comprises an ultrasonic transducer 2 and a cylindrical skirt 3.

[0018] The term "cylindrical skirt" refers herein to the side wall of the tub 1, which is substantially cylindrical.

[0019] A hole 20 is present in the lower portion of the tub 1, which in this case, for room reasons, is advantageously obtained in the cylindrical skirt 3, with a flange 4 inside of it; said hole 20 is adapted to house the ultrasonic transducer 2.

[0020] The ultrasonic transducer 2 is thus connected to the tub 1, preferably to the cylindrical skirt 3 thereof, by means of the flange 4 that comprises holes 5 for fastening a counterflange 6. The latter comprises through holes 7 for fastening means, preferably self-tapping screws for plastic (not shown in the drawings). In the assembled condition, the fastening holes 5 are aligned with the through holes 7.

[0021] The ultrasonic transducer 2 thus rests between the flange 4 and the counterflange 6, and comprises a piezoelectric resonator 8 and a metallic diaphragm 10,

which is preferably made of aluminium.

[0022] Within the space between the flange 4 and the counterflange 6 there are the following components, starting from the outermost one: the piezoelectric resonator 8, a vibration insulator 9, the metallic diaphragm 10, and a sealing element 11.

[0023] As shown in Fig. 3, the piezoelectric resonator 8 is installed in the cavity of the counterflange 6 and is glued to the metallic diaphragm 10, preferably by means of an epoxy glue.

[0024] The piezoelectric resonator 8, which is typically made of piezoelectric ceramic material, is supplied by at least one pair of wires (not shown in the drawings) with an alternating current having a frequency between 20 kHz and 300 kHz, preferably between 40 kHz and 80 kHz, more preferably between 40 kHz and 50 kHz (the piezoelectric resonator 8 receiving a power of approx. 70 Watts).

[0025] The piezoelectric resonator 8 may be operationally connected to a control oscillator circuit (not shown in the drawings), whose task is to modulate the vibration frequency in order to reach the maximum power transmitted to a wash liquid (the term "wash liquid" referring to water with a washing agent dissolved therein) by the ultrasonic wave.

[0026] The diameter of the piezoelectric resonator 8 is preferably at least ten times greater than its thickness, the latter being advantageously greater than or equal to the thickness of the metallic diaphragm 10, so as to effectively spread the pressure wave into the wash liquid; as a reminder, the resonance frequency of said piezoelectric resonator 8 is inversely proportional to its diameter, and therefore a relatively great diameter of the metallic diaphragm 10 will increase the effectiveness of penetration of the ultrasonic wave into the cloths to remove dirt therefrom.

[0027] When the piezoelectric resonator 8 is subjected to a variable potential difference, said resonator 8 can generate diaphragm stresses which theoretically remain within the plane of the resonator 8, propagating outwards in every radial direction B from the centre of the resonator 8.

[0028] This rapid motion of the piezoelectric resonator 8 causes a diaphragm vibration having a frequency between 20 kHz and 300 kHz, preferably between 40 kHz and 80 kHz, more preferably between 40 kHz and 50 kHz, said vibration being then transmitted to the metallic diaphragm 10.

[0029] Said diaphragm 10 transmits the vibration to the wash liquid present in the tub 1; it is important that the ultrasonic transducer 2, when in operation, is always underneath the surface of the wash liquid.

[0030] In order to avoid a direct transmission of diaphragm vibrations from the metallic diaphragm 10 to the flange 4 and the counterflange 6, and then to the cylindrical skirt 3 of the tub 1, a vibration insulator 9 is used which is similar in shape to a circular sealing element such as an O-ring, and which is arranged between the

counterflange 6 and the metallic diaphragm 10. The insulator 9 may, for example, be made of silicone-based material.

[0031] In addition to the vibration insulator 9, the thickness of said flange 4 can be increased compared to the thickness of the cylindrical skirt 3, so as to further improve its vibration insulation capability.

[0032] The flange 4 juts out from the cylindrical skirt 3, and is made in one piece therewith, i.e. it is obtained during the same moulding operation carried out to manufacture the tub portion where it is located. In the example shown in the drawings annexed to the present description, the tub 1 is obtained by welding together two plastic half-shells, and the flange 4 is made in one piece with the rear half-shell. Advantageously, then, the flange 4 is connected to reinforcement ribs 12 for the purpose of increasing the rigidity of said flange 4, to which the ultrasonic transducer 2 is connected.

[0033] In order to further improve the rigidity of a region of the cylindrical skirt 3 where the ultrasonic transducer 2 is installed, the flange 4 is positioned near a bracket 13 that secures the tub 1 to the frame of the washing machine (not shown in the drawings), and that advantageously contributes to stiffening said region, thus reducing the transmission of ultrasonic vibrations from the ultrasonic transducer 2 to the tub 1.

[0034] To ensure a proper seal, the sealing element 11 is positioned between the metallic diaphragm 10 and the tub 1; said element 11 has a circular shape and is preferably of the O-ring type. In addition to the sealing function, it also provides further insulation from vibrations that would otherwise be transmitted to the tub 1.

[0035] In this way, the vibrations transmitted from the ultrasonic transducer 2 to the tub 1 are negligible; it follows that there is a negligible risk of cracking due to direct transmission of ultrasounds generated by said transducer 2.

[0036] The ribs 12 jutting out from the outer surface of the cylindrical skirt 3 are made in one piece therewith; in other words, the thickness of the tub material at the ribs 12 is greater than the thickness of the cylindrical skirt 3.

[0037] Preferably, the flange 4 is made in one piece with said ribs 12.

[0038] For the purpose of fulfilling the design requirements, the man skilled in the art may increase at will the number of ultrasonic transducers 2 (one, or two arranged on opposite sides of the cylindrical skirt 3, or four evenly positioned on the cylindrical skirt 3), and may likewise vary the operating frequency thereof; in fact, said ultrasonic transducers may operate either at a fixed frequency or at a variable frequency ("sweep mode").

[0039] By varying the frequency it is possible to vary the diameter of the cavitation bubbles, thereby allowing for the removal of differently sized dirt particles.

[0040] For the purpose of fulfilling the design requirements, the man skilled in the art may vary the position of said transducers 2 by installing them in any position on the tub 1, so long as they remain underneath the surface

of the wash liquid, taking into account that the tub 1 may be mounted inclined to make loading easier for a human operator. Furthermore, at least one transducer 2 may advantageously be arranged near a heating resistor (not shown in the drawings) in order to promote the detachment of any calcareous deposits.

[0041] Finally, it should be pointed out in this regard that the hole 20 with the respective flange 4 and ultrasonic transducer 2 may be arranged in other areas of the tub 1, other than the skirt 3: for example, they may be arranged on the back wall of the tub 1.

[0042] According to an alternative embodiment of the present invention (not shown in the drawings), the tub 1 (or at least that portion thereof which encloses the ultrasonic transducer 2, said at least one portion being preferably the lower half-shell of the tub 1) is made in one piece with the metallic diaphragm 10. In particular, the portion of the tub 1 that encloses the transducer 2 is obtained through a process of co-moulding plastic over the metal (in particular, aluminium) of the metallic diaphragm 10. After co-moulding, the transducer 2 is completed by gluing (advantageously by means of an epoxy glue) the piezoelectric resonator 8 onto the metallic diaphragm 10. Such an embodiment proves to be particularly advantageous in terms of easiness of assembly of the tub 1, since the counterflange 6, the vibration insulator 9 and the sealing element 11 are eliminated, as well as in terms of position accuracy of the metallic diaphragm 10 and of effectiveness of the hydraulic seal of the area that houses the transducer 2.

40 kHz and 80 kHz, more preferably between 40 kHz and 50 kHz.

4. A washing machine according to one of claims 2 to 3, wherein the ultrasonic transducer (2) comprises a vibration insulator (9), preferably having a circular shape, arranged between the counterflange (6) and the metallic diaphragm (10).
5. A washing machine according to one of claims 2 to 4, wherein a sealing element (11), preferably having a circular shape, is positioned between the metallic diaphragm (10) and the tub (1).
6. A washing machine according to any one of the preceding claims, wherein at least one ultrasonic transducer (2) is arranged close to a heating resistor for the purpose of promoting the detachment of calcareous deposits from said resistor.
7. A washing machine according to any one of the preceding claims, wherein said counterflange (6) comprises a plurality of through holes (7) adapted to house screws for securing said counterflange (6) to said flange (4).
8. A washing machine according to any one of the preceding claims, wherein said flange (4) is obtained during the same step of moulding the tub portion where said flange (4) is located.

Claims

1. A washing machine, in particular a laundry washing machine, comprising ultrasonic cloth washing means, a wash tub (1) having at least one hole (20) for housing an ultrasonic transducer (2),
characterised in that
said hole (20) is delimited by a flange (4) jutting out from the tub (1) and cooperating with a separate counterflange (6) for securing the ultrasonic transducer (2) to the tub (1), wherein the flange is made in one piece with the tub (1) or with a portion of said tub (1), and wherein the flange (4) is connected to reinforcement ribs (12) jutting out from the surface of said tub (3).
2. A washing machine according to claim 1, wherein the ultrasonic transducer (2) comprises a piezoelectric resonator (8) and a metallic diaphragm (10), said piezoelectric resonator (8) being preferably glued to said metallic diaphragm (10).
3. A washing machine according to claim 2, wherein the piezoelectric resonator (8) is adapted to be powered by an alternating current having a frequency between 20 kHz and 300 kHz, preferably between

Patentansprüche

1. Waschmaschine, insbesondere Wäschewaschmaschine, mit einem Ultraschallkleidungswaschmittel, einer Waschwanne (1) mit mindestens einem Loch (20) zum Aufnehmen eines Ultraschallwandlers (2),
dadurch gekennzeichnet, dass
das Loch (20) durch einen Flansch (4) begrenzt ist, der aus der Wanne (1) herausragt und mit einem separaten Gegenflansch (6) zusammenwirkt, um den Ultraschallwandler (2) an der Wanne (1) zu sichern, wobei der Flansch in einem Stück mit der Wanne (1) oder mit einem Teil der Wanne (1) hergestellt ist und
wobei der Flansch (4) mit Verstärkungsrippen (12), die aus der Oberfläche der Wanne (3) herausragen, verbunden ist.
2. Waschmaschinen nach Anspruch 1, wobei der Ultraschallwandler (2) einen piezoelektrischen Resonator (8) und eine metallische Membran (10) aufweist, wobei der piezoelektrische Resonator (8) vorzugsweise mit der metallischen Membran (10) verklebt ist.
3. Waschmaschine nach Anspruch 2, wobei der piezo-

elektrische Resonator (8) derart ausgebildet ist, dass er durch Wechselstrom versorgbar ist, der eine Frequenz zwischen 20 kHz und 300 kHz, vorzugsweise zwischen 40 kHz und 80 kHz, besonders bevorzugt zwischen 40 kHz und 50 kHz, aufweist.

4. Waschmaschine nach einem der Ansprüche 2 bis 3, wobei der Ultraschallwandler (2) einen Schwingungsisolator (9) aufweist, der vorzugsweise eine kreisförmige Form aufweist und zwischen dem Gegenflansch (6) und der metallischen Membran (10) angeordnet ist.
5. Waschmaschine nach einem der Ansprüche 2 bis 4, wobei ein Dichtungselement (11), das vorzugsweise eine kreisförmige Form aufweist, zwischen der metallischen Membran (10) und der Wanne (1) angeordnet ist.
6. Waschmaschine nach einem der vorgehergehenden Ansprüche, wobei mindestens ein Ultraschallwandler (2) in der Nähe eines Heizwiderstandes angeordnet ist, um die Ablösung von kalkhaltigen Ablagerungen von dem Widerstand zu fördern.
7. Waschmaschine nach einem der vorhergehenden Ansprüche, wobei der Gegenflansch (6) mehrere Durchgangslöcher (7) aufweist, die zur Aufnahme von Schrauben zum Sichern des Gegenflansches (6) an dem Flansch (4) angepasst sind.
8. Waschmaschine nach einem der vorhergehenden Ansprüche, wobei der Flansch (4) während des gleichen Schritts des Formens des Wannenabschnitts, in dem sich der Flansch (4) befindet, erhalten wird.

Revendications

1. Machine à laver, en particulier machine à laver le linge, comprenant un moyen de lavage d'étoffe ultrasonique, une cuve de lavage (1) ayant au moins un trou (20) pour loger un transducteur ultrasonique (2),
caractérisée en ce que
ledit trou (20) est délimité par une bride (4) faisant saillie de la cuve (1) et coopérant avec une contre-bride séparée (6) pour arrimer le transducteur ultrasonique (2) à la cuve (1), dans laquelle la bride est fabriquée d'une seule pièce avec la cuve (1) ou avec une portion de ladite cuve (1), et dans laquelle la bride (4) est raccordée à des nervures de renforcement (12) faisant saillie de la surface de ladite cuve (3).
2. Machine à laver selon la revendication 1, dans laquelle le transducteur ultrasonique (2) comprend un résonateur piézoélectrique (8) et un diaphragme mé-

tallique (10), ledit résonateur piézoélectrique (8) étant de préférence collé audit diaphragme métallique (10).

3. Machine à laver selon la revendication 2, dans laquelle le résonateur piézoélectrique (8) est adapté pour être alimenté par un courant alternatif ayant une fréquence entre 20 kHz et 300 kHz, de préférence entre 40 kHz et 80 kHz, de manière davantage préférée entre 40 kHz et 50 kHz.
4. Machine à laver selon l'une des revendications 2 et 3, dans laquelle le transducteur ultrasonique (2) comprend un amortisseur de vibrations (9), ayant de préférence une forme circulaire, agencé entre la contre-bride (6) et le diaphragme métallique (10).
5. Machine à laver selon l'une des revendications 2 à 4, dans laquelle un élément d'étanchéité (11), ayant de préférence une forme circulaire, est positionné entre le diaphragme métallique (10) et la cuve (1).
6. Machine à laver selon l'une quelconque des revendications précédentes, dans laquelle au moins un transducteur ultrasonique (2) est agencé près d'une résistance chauffante dans le but de favoriser le décollement de dépôts calcaires de ladite résistance.
7. Machine à laver selon l'une quelconque des revendications précédentes, dans laquelle ladite contre-bride (6) comprend une pluralité de trous traversants (7) adaptés pour loger des vis pour arrimer ladite contre-bride (6) à ladite bride (4).
8. Machine à laver selon l'une quelconque des revendications précédentes, dans laquelle ladite bride (4) est obtenue pendant la même étape de moulage de la portion de cuve où est située ladite bride (4).

1

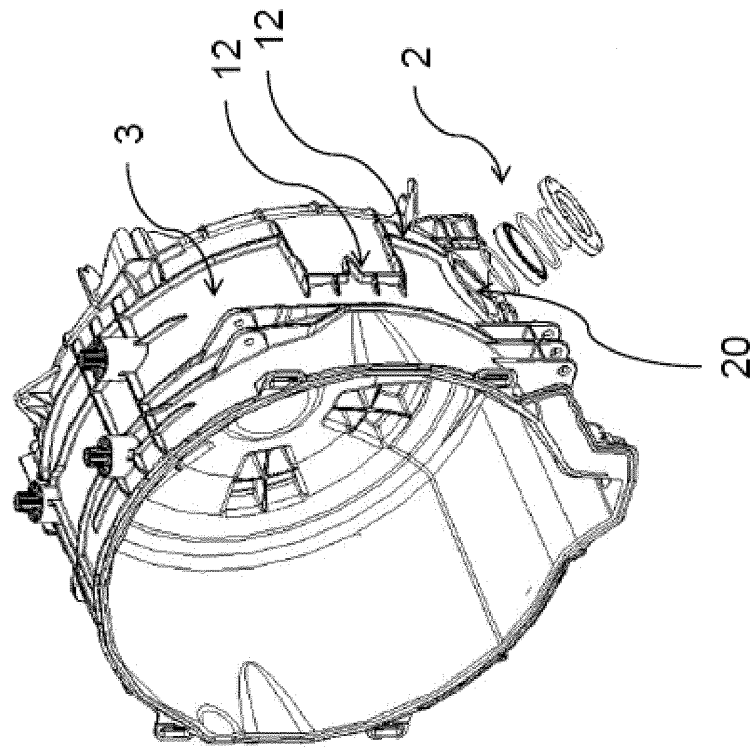


Fig. 1

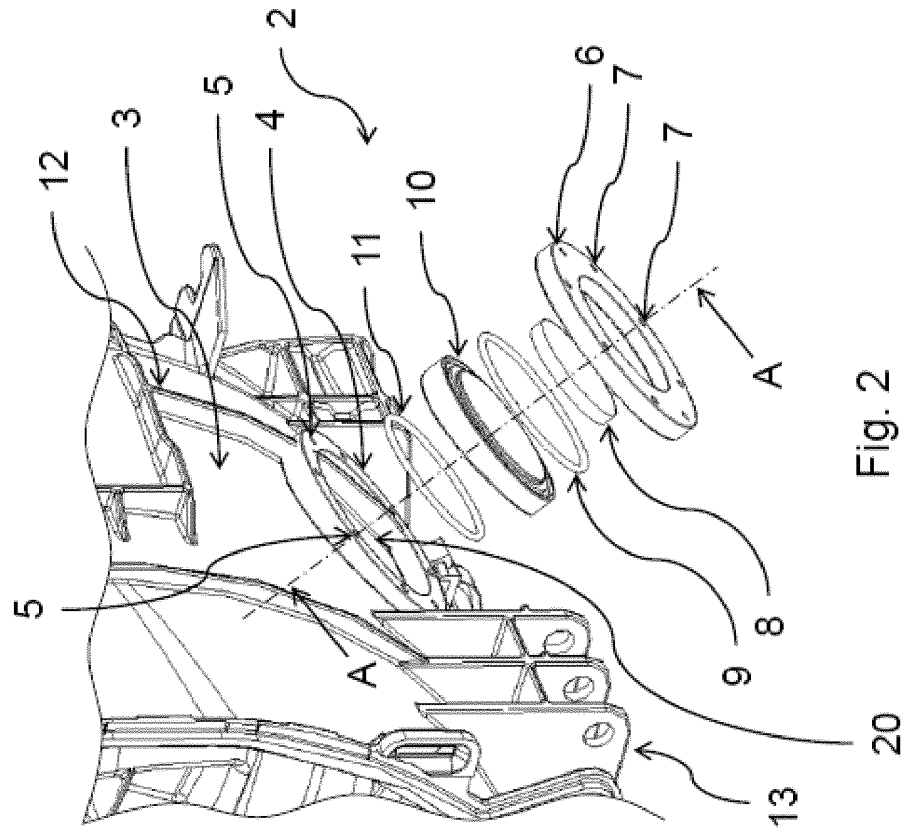
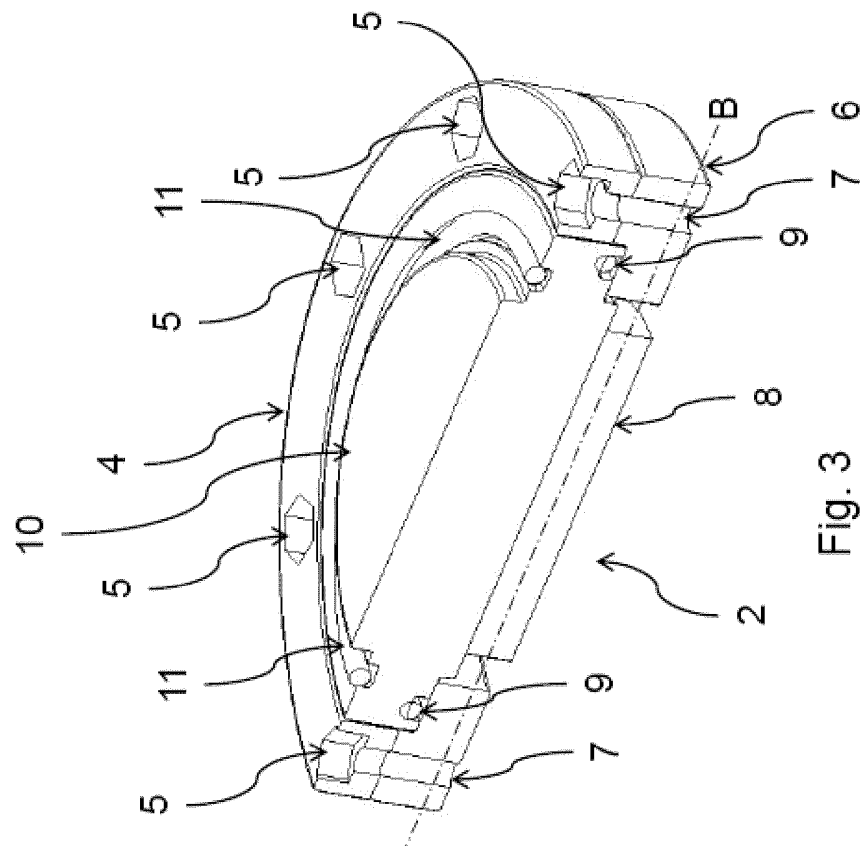
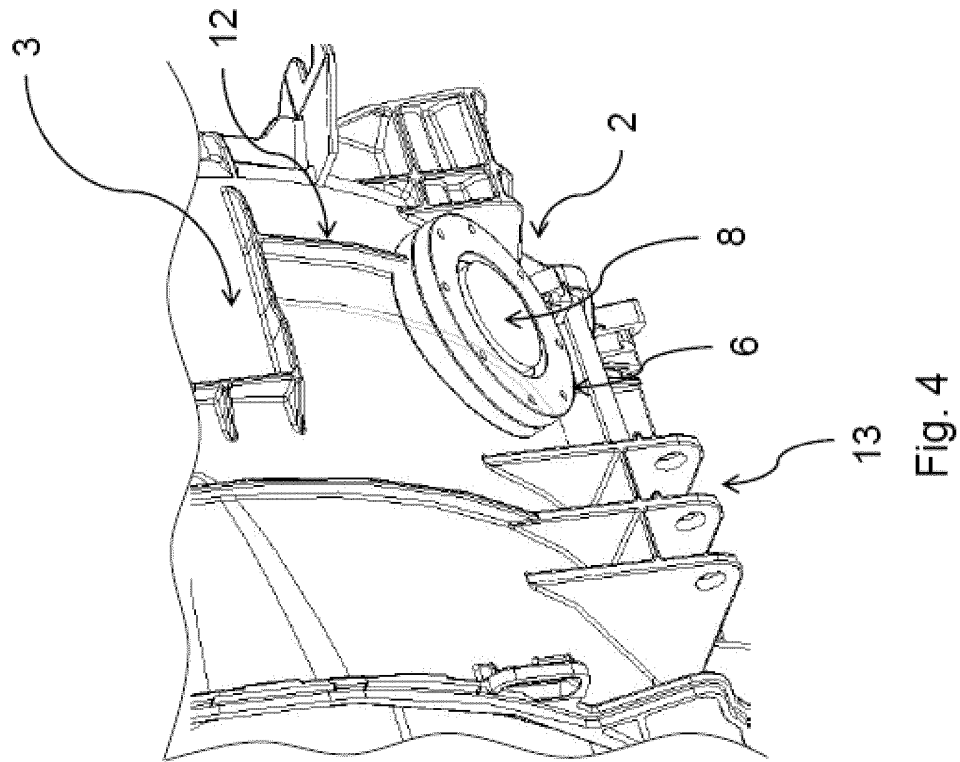


Fig. 2



REFERENCES CITED IN THE DESCRIPTION

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