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(54) **IMPROVEMENT IN THE DYNAMIC BALANCING ARRANGEMENT OF A CLOTHES WASHING MACHINE**

DYNAMISCHE AUSWUCHTVORRICHTUNG EINER WÄSCHEWASCHMASCHINE

AMELIORATION APPORTEE A L'AGENCEMENT D'EQUILIBRAGE DYNAMIQUE D'UN LAVE-LINGE

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(73) Proprietor: **Electrolux Zanussi S.p.A.**
33170 Pordenone (IT)

(72) Inventors:
• **CIMETTA, Silvano**
I-31100 Treviso (IT)

• **HABERL, Ingo**
I-33170 Pordenone (IT)

(74) Representative: **Giugni, Valter et al**
PROPRIA
Protezione Proprietà Industriale S.r.L.
Via Mazzini 13
33170 Pordenone (IT)

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Description

The present invention refers to clothes washing machine, in particular of the household type, provided with an improved arrangement for dynamically balancing its rotating drum.

Although the present invention refers specially to a washing machine of the front-loading type, and for greater convenience of exemplification the following description is actually referred to such a type of washing machine, it can in an advantageous manner be applied also to other types of washing machines, in particular to the ones that are loaded from the top or even to the machines that have their drum rotating about a vertical axis.

It is a widely known fact that one of the most critical problems that design engineers have to cope with in designing clothes washing machines, in particular those intended for household application, refers to the need of balancing the washload containing drum as it rotates at a high speed during the spin-extraction phase provided for removing in a quick manner the rinse water from the clothes. Such a problem is particularly felt when the washload being handled is in an out-of-balance condition in the drum. In fact, such a condition is most likely to cause the drum to undesirably and, quite often, unacceptably oscillate and give rise to vibrations that are transmitted to the tub assembly and, ultimately, to the whole outer casing of the machine.

This is a commonly known problem, so that it shall not be described here any farther.

Among the various solutions devised to cope with this problem, some have been based on the proposal of a dynamic-type arrangement consisting in letting an out-of-balance force of a similar extent, but of an opposite vector, oppose the centrifugal force generated by the unbalanced washload in the drum. Such solutions are for instance described in the French, patent specification no. 1.213.067, Swiss priority 8.11.1957, the Italian patent specification no. 1108367, Japanese priority 12.1.1978, and in the patent specification FR-A-2 393 097.

The above specifications disclose dynamic balance arrangements provided for application to rotating drums of clothes washing machines, in particular of the household type, such arrangements being essentially constituted by annular hollow bodies that are firmly associated to the drum and contain balancing weights capable of sliding within said hollow bodies, said balancing weights being further capable of placing themselves into such an arrangement as to be able to oppose the unbalancing motion of the drum as brought about by the out-of-balance condition of the washload in the same drum.

However, such a solution, although generally effective, failed to find practical implementation in current applications owing to a number of reasons, among which the following ones can in particular be cited:

a) In the presence of washloads that are initially

quite well distributed and, hence, quite well balanced in the drum, said balancing weights tend to distribute along the periphery of the annular hollow bodies to take any substantially haphazard, but mutually opposing position, so as to keep the whole structure in a balanced condition. However, owing just to said fact that such a position taken by the balancing weights is substantially haphazard, it has been observed that, due to irregularities in the motion, unavoidable tolerances in installing the annular hollow body containing the balancing weights, as well as the deformation of said body, the vibrations that are produced owing to even a very slight out-of-balance condition of the washload are such as to bring about an immediate balancing response of said weights that start rotating until they find a new balanced position.

During their pursuit of a new balancing position, said weights happen to even violently strike against each other, thereby giving rise to a lot of noise. Then, when they eventually succeed in finding said new balancing position, the latter is not going to be kept for a long time, since it just takes the washload to be caused to slightly increase or modify its out-of-balance condition for any reason whatsoever for the above described unbalancing/re-balancing cycle of the balancing weights to start again.

A substantially unstable situation therefore occurs, in which the machine gets unbalanced and then automatically re-balances itself in a practically continuous manner. This leads to a particularly disturbing condition, since, while vibrations fail to be suppressed to any definitive manner, the machine keeps generating a remarkable noise periodically.

b) The need arises for the drum design to be modified accordingly in view of making them stronger and adapted to accomodate said hollow bodies, which press against the walls of the drum with a considerable centrifugal force owing to the action exerted by said balancing weights.

c) The annular hollow bodies that have been used up to now are made of a rather light-weight material, which is therefore most likely to get deformed to a certain extent under a centrifugal force as may be exerted by said balancing weights. The consequence of such a deformation of the hollow bodies is that the balancing weights contained therein are practically prevented from getting arranged in the position that is each time required to optimally balance the out-of-balance condition of the washload in the drum, with the ultimate result that such a balancing effect is only achieved in an imperfect, partial manner.

It therefore would be desirable, and it is in fact a purpose of the present invention, to provide an improved construction of said drums, by providing

them with arrangements that are adapted to constrain the balancing weights into well-defined positions when any out-of-balance condition prevails which is below a pre-determined level, while on the contrary enabling said balancing weights to move freely into a balancing position when in the presence of any out-of-balance condition above said pre-determined level. Such arrangements are made with the features and according to the characteristics as defined in the appended claims, which are such as to enable the afore described drawbacks to be eliminated without any need for any major modification or any other measure to be taken in the construction of the machines themselves.

The invention will be more readily understood from the description which is given below by way of non-limiting example with reference to the accompanying drawings, in which:

- Figure 1 is a cross-sectional view showing schematically an annular hollow body according to the present invention;
- Figures 2a and 2b are views of two distinct shapes of the perimeter of the hollow bodies according to the present invention;
- Figure 3 is a view illustrating the operation conditions of an embodiment of the present invention;
- Figure 4 is a view illustrating a particular operation condition;
- Figure 5 is a view of an improved embodiment of the present invention;
- Figures 6, 7 and 7a are views illustrating various possibilities of application of a plurality of hollow bodies according to the present invention;
- Figure 8 is a view of different shapes of the movable balancing weights in said hollow bodies;
- Figure 9 is a view of an improved shape of the hollow bodies provided with prominent lobes according to the present invention;
- Figures 10 and 10a are views illustrating a particular case with reference to the shape and the arrangement of the hollow bodies;
- Figure 11 is a view showing an improved embodiment as an alternative to the embodiment shown in Figure 10.

Since the actual problem lies in finding a means that is effective in preventing the balancing weights from

moving in the presence of out-of-balance conditions to a limited extent of the washload holding drum, various configurations of the hollow bodies containing movable balancing weights have been devised and tested. The results of such experiments have by large shown that the afore cited instability and noise problems are practically eliminated if said hollow bodies are shaped so as to meet following conditions:

- 1) Each hollow body shall have a sealed peripheral contour that is convex along its whole extension, in such a way that the segment joining any two points situated on the perimeter of the hollow body is wholly contained in the surface being delimited by such a perimeter.
- 2) Each hollow body shall feature a plurality of "lobes", ie. portions of perimeter being evenly distributed along said perimeter and situated outside the circle inscribed within said perimeter.

For reasons of improved manufacturability and operational simmetricalness it is highly preferable, although not strictly necessary, that said lobes are arranged so as to be regularly distributed along a single circumference that has its center coinciding with the center of gravity of the respective hollow body, even if the perimeter of said hollow body does not of course coincide with said circumference, and that said center of gravity of the hollow body is situated on the axis of rotation and symmetry of the drum.

Figure 1 illustrates a preferred embodiment of such a hollow body, which is provided with three lobes arranged at regular intervals along the perimeter.

When looking at Figure 1, it can be noticed that the perimeter p of the hollow body associated to the drum (not shown), and having its center situated on the axis of rotation and symmetry of said drum, features said three lobes regularly spaced along the circumference 2 having its center at O.

The perimeter of the hollow body is formed by three curvilinear sections 3, which are represented in the Figure as three arcs of three respective circumferences having a radius R which is greater than the radius r of the circumference 2.

The arrangement of said circumferences, as well as the full regularity in their distribution and arrangement, can be clearly seen in the same Figure 1. It should be noticed that the bisecting line g, which cuts the angle formed by two radii r between the center O and two lobes, intersects first the perimeter of the hollow body at the point 4 and then the circumference 2 at the point 5.

If f is considered to be the distance between the center and said point 4, the distance (r-f) between the point 4 and the point 5 represents the difference in height which a movable weight being positioned on a lobe should overcome to reach said point 5 by opposing the centrifugal force generated by the rotation of the

drum.

In order to reach intermediate points 6 situated along said perimeter, the balancing weight has to overcome a smaller, but in any case positive difference in height ($r-f'$).

Said differences in height are not only geometrical definitions, but also, and above all, actual physical situations considering that, if the drum, and the hollow body with it, are caused to rotate at a given rotational speed, the centrifugal force acting on the movable balancing weights causes the same movable balancing weights to move into a position that lies in correspondence of the lobes, and not of the intermediate points of the hollow body between a lobe and the adjacent one, owing exactly to the difference in height that they should surmount by overcoming the centrifugal force.

As a result, in a situation in which the drum is not in an out-of-balance condition, or is just slightly unbalanced, the same drum rotates substantially about its center O, while the movable balancing weights take a stable position in correspondence of the lobes, from which they do not get displaced if they are not urged to by such forces as to compel them to overcome the centrifugal force generated solely by the rotation of the drum.

Referring now in particular to Figure 3, it can be noticed that it shows a perimeter of a hollow body according to the present invention, wherein said three lobes 1 are joined by the three arcs of a circle A, B and C, which are centered at the points OA, OB and OC, respectively.

For a greater simplicity, said three arcs may now be assumed to be identical, so that also their respective radii and angles of curvature will be the same. If the radii a and a' are now drawn between the center OA and both ends of the corresponding arc A, and if the same thing is done as far as the radii b and b' , as well as the radii c and c' are concerned, it can be noticed that said six radii will intersect each other, while the intersection points, along with the afore cited centers OA, OB and OC, will define the vertices of a hexagon H which is shown with dotted lines in the Figure.

Each inner point in said hexagon is more distant from a generic point P situated within any of said three arcs A, B and C than the radii of equal length a , a' , b , b' , c and c' , for any position of said generic point P except for the extreme points of the three lobes 1.

As a result, if the center of rotation C of the corresponding hollow body lies within such a hexagon, the movable balancing weights contained in said hollow body will be urged by the centrifugal force to position themselves in the farthest points with respect to the center of rotation and, therefore, to get positioned in the cuspidal points 1.

Generally, this will not bring about an unbalance effect such as to oppose the out-of-balance condition of the center of rotation C with respect to the center of gravity O. However, in this assumption in which the center of

rotation C is lying relatively close to the center of gravity O, this means also that such an out-of-balance condition is limited in its extent, so that no particularly great balancing force is actually required.

If, on the contrary, such out-of-balance condition is greater than that, ie. occurs to sufficiently large extent, so as to cause the drum and the related hollow body to rotate about a center of rotation C1 lying outside said hexagon, points P' will be determined along the perimeter formed by the three circle arcs that lie at a distance d from said center of rotation C1 which is greater than the above cited radii. Under these conditions, the movable balancing weights will be compelled to move naturally towards said points P', until they succeed to re-balance the drum, ie. to eliminate said out-of-balance condition thereof, since the new center of rotation will be displaced to lie again within the afore cited hexagon H.

A situation substantially occurs, which is fully similar to the one described by the afore cited prior-art patents, so that the known solutions may be applied, since these are in no way impaired or affected by the particular configuration of the hollow bodies as described above.

Anyone skilled in the art should at this point be able to appreciate that, by appropriately adjusting the shape of the hollow body, the number of the lobes, the shape thereof (cuspidated or free of arrises) and the type of movable balancing weights used (as it will be explained in greater detail later on), it is possible to determine, also experimentally, a combination of factors so that the movable balancing weights are enabled to distribute themselves in correspondence of the lobes, thereby ensuring the desired balancing effect also as a function of the actual rotational speed.

The present invention admits a great number of improvements. So, for instance, a first improvement, which is rather an optimization, relates to the possibility of providing hollow bodies provided with a more or less large number of lobes, wherein the sections between contiguous lobes are more or less curved or straight. This allows for a wide range of options that may be appropriately selected in view of optimizing, on the one hand, the minimum rotational speed at which the movable balancing weight are supposed to intervene and, on the other hand, their actual capacity of balancing the unbalanced drum (Figures 2a, 2b).

In selecting an option, anyone skilled in the art shall of course aim at reaching the best possible compromise in accordance to the scale of priority of the defined objectives to be reached. Therefore, the circumstance will in any case be duly considered that the less curved are the arcs between said lobes, the more will the perimeter of the hollow body look like a circumference, so that it will have an unstable behaviour as described above. However, such a configuration will prove to be the best one from the standpoint of the balancing properties, since, for the same speed of rotation of the drum, there will be a smaller difference in height which said balancing weights shall surmount in order to reach an optimum

balancing arrangement and, hence, the balancing response of said weights will occur much more readily and, furthermore, at a lower rotational speed.

In the opposite case, ie. in the case of lobes being joined by very curved sections, an effect will be obtained which is the opposite with respect to the just described one and which, for reasons of brevity, will not be explained here any longer, since readily appreciable by anyone skilled in the art.

A second improvement consists in the possibility of introducing a considerable plurality of movable balancing weights, such as for instance metal balls, in said hollow body. This is effective in increasing the balancing mass, and hence the balancing capacity even in front of markedly unbalanced loads, accordingly. However, this has also the drawback that, in such a case, said balls tend, under the action of the centrifugal force, to form a single row of nonoverlapping balls.

It is quite obvious to infer that such a solution gives rise to a drawback due to the fact that, in this case, the distribution of the balancing weights along too wide an arc reduces the actual balancing capacity, since the balancing components of the centrifugal force relating to the most distant balls with respect to the center of the lobe compensate each other in part, as this is shown in Figure 4, where F_1 opposes F_2 .

In order to overcome this further drawback, it appears advantageous to provide a plurality of distinct hollow bodies, which do not necessarily need to have similar characteristics, in a side-by-side arrangement (in this connection, see the two sections of Figure 5, wherein the left-side section is the one being identified as A-A in the right-side section) in order to increase the overall balancing mass without running into the risk of giving rise to the afore cited drawbacks of a balancing mass that covers too wide an arc of the hollow body.

Such a provision and arrangement of a plurality of hollow bodies open up a new, interesting possibility (Figure 6). As a matter of fact, said hollow bodies, which for a greater simplicity in the description are assumed to be identical, can be oriented in such a way as to form any angle other than a null one between contiguous lobes and hence, in the assumption illustrated in Figure 6 of a certain number of identical hollow bodies arranged with respect to each other at a same angle which is equal to the round angle divided by the product of the number of hollow bodies multiplied by the number of lobes of each hollow body (an example with two hollow bodies is shown in the cited illustration, wherein each of said hollow bodies is provided with three lobes, which therefore gives a total of 6 lobes that get positioned at regular intervals of $360^\circ/6$), the advantageous configuration is obtained of an arrangement having good balancing capabilities thanks to both the quantity of its balancing mass and the well-centered alignment of the same mass, wherein said balancing capability is further enhanced in that said balancing mass is subdivisible among a plurality of distinct hollow bodies which are ar-

ranged in such a manner that their aggregate action may deliver an optimum balancing effect whichever the position of the out-of-balance washload in the drum may also be.

A further improvement that is achieved thanks to said provision of a plurality of hollow bodies lies in the possibility of arranging said hollow bodies in contact with the side walls, ie. the front and/or back walls of the drum (Figure 7), instead of having them arranged on the cylindrical surface thereof, where they would bring about the drawback of occupying a large portion of the space that is usually reserved to the inlet/outlet perforations provided for the passage of the wash liquor. In such a case, in order to create the possibility for all of a plurality of hollow bodies to be in contact with said side walls of the drum, the need arises for the same hollow bodies to be sized so as to be able to be fitted within each other.

Figure 7 illustrates an embodiment provided with only two hollow bodies, but it will be appreciated that such an architecture may obviously be extended to include a greater number of hollow bodies arranged on the same side wall of the drum. Such an improvement extends to include both the case in which the hollow bodies have their lobes arranged on common radii, as this is shown in Figure 7, and the case in which said hollow bodies have their lobes arranged on different radii, as this is shown in Figure 7a.

It has also been demonstrated experimentally that a configuration equivalent to the hitherto proposed arrangements consists in providing hollow bodies that, instead of such lobed shape, have a circular shape and the same diameter, wherein said hollow bodies are arranged in such a way that their respective centers D1, D2, D3 come to lie slightly offset with respect to the axis of the drum, as this is shown schematically in Figure 10.

It has been found that such a configuration is effective in ensuring a balancing action which is very much similar to the one supplied by a lobed hollow body having the same perimeter of the outer portions (when seen in a front projection) of the circular hollow bodies, as indicated with a darker line in Figure 10a, where the inner portions of the individual circular hollow bodies are indicated with a dotted line.

As a result, as anyone skilled in the art may well appreciate, all afore illustrated variants and improvements referred to lobed hollow bodies similarly apply also to the case in which one or more lobed hollow bodies are replaced, for each one of said hollow bodies, with a corresponding plurality of circular hollow bodies which may be either coplanar, and therefore provided with a different radius and fitted within each other, or arranged laterally in a side-by-side disposition, with their respective centers D1, D2, D3 in an off-center alignment with respect to the axis of the drum.

In particular, the solution of a lobed hollow body constituted by a plurality of circular hollow bodies in an off-center, coplanar arrangement, and hence fitted within each other, is illustrated in Figure 11, which shows a

said plurality of circular hollow bodies 11, 12, 13 having differing radii S1, S2, S3, respectively, wherein said circular hollow bodies have the same depth size H, and said radii are selected and the respective centers D1, D2, D3 are offset with respect to the axis O of the drum and are rotated in relation to each other with respect to said axis by a same angle α° (in the case of Figure 11, $\alpha^\circ = 120^\circ$) so that said hollow bodies can be perfectly fitted within each other in a combination of the "Chinese box" type.

In an advantageous manner from a construction point of view, said combination of hollow bodies is manufactured as a single piece and, therefore, forms a cylinder, as it is shown by way of example in Figure 11, where also the cylindrical outer surface T of said piece comprising said hollow bodies is shown along with the projection on the exposed base of said cylinder of the three thicknesses $\underline{d}$ that delimitate said hollow bodies from each other.

A further advantageous improvement of the present invention consists also in the use of movable balancing weights that have the shape of a thick disk and are capable of being rotated inside said hollow bodies having a cross-section that is substantially similar to the cross-section of said disk D (Figure 8). It is in fact widely appreciated that, as can be easily demonstrated, for an equal total volume occupied by the portion of hollow body filled with movable balancing weights, the weight of said movable balancing weights is greater if the latter are actually given such a disk-like shape than if they are given a ball-like shape, the most appropriate shapes and sizes being used in both cases in connection with the cross-section of the respective hollow bodies.

Said improvement is further enhanced if the substantially rectangular cross-section of said hollow body is given an increased width size, for instance through inclined walls p (Figure 9a) or rounded corners (Figure 9b), with respect to the width of the thick disks, wherein the outer edge of the hollow body is tapering until it reaches a width which is similar to the width of the thick disk.

This enables the thick disks to more freely and smoothly rotate within the hollow bodies, since the contact and, therefore, friction possibilities between said elements are thereby minimized. Furthermore, in view of both promoting the slidability of said movable balancing weights within the respective hollow bodies and reducing the noise generated by such sliding of said weights, it may be advantageous to fill some lubricant medium into said hollow bodies, preferably a lubricating oil having a low viscosity in the range of temperatures at which the drum operates.

Finally, a further improvement consists in the use of movable balancing weights which, instead of being constituted by a plurality of separate, distinct solids, are formed by a thick fluid mass, preferably a liquid which has the purpose of sustaining the movement of and in which there are borne a high quantity of very small, high

specific-gravity particles, such as sand, metal chips or powder, etc. Such a combination would have the advantage of simplifying the construction of the movable balancing weights, while further improving the balancing capability, not only for the fact that a balancing mass provided in this way would not suffer from the discontinuities of distinct movable weights, but also for the fact that, under certain conditions, the ratio of the produced mass to the occupied volume may turn out to be still better than the one achievable in the afore illustrated case of the movable balancing weights being shaped as thick disks.

Although the invention has been described on the basis of the example represented by some preferred embodiments thereof, and using a generally known terminology, it cannot be considered as been limited by these, since anyone skilled in the art will appreciate that a number of variations and modifications can be further made involving both construction and shape. The appended claims shall therefore be understood to include such possible modifications as anyone skilled in the art is capable of appreciating, and which do not depart from the scope and the real meaning of the present invention.

Claims

1. Washing machine, particularly of the household type, comprising an outer casing, a washing tub, a perforated drum of a cylindrical form contained in said tub and capable of rotating therein about the axis of the cylinder during washing and spin-extraction, said drum being provided with a dynamic balancing arrangement consisting of a plurality of annular, sealed hollow bodies (P) integrally provided on said cylindrical drum, and a plurality of movable balancing weights (P) that are capable of sliding freely within said hollow bodies, **characterized in that** :

1) Each hollow body (P) shall have a sealed peripheral contour that is convex along its whole extension, in such a way that the segment joining any two points situated on the perimeter of the hollow body is wholly contained in the surface being delimited by such a perimeter.

2) Each hollow body shall feature a plurality of "lobes" (1), i.e. portions of perimeter being evenly distributed along said perimeter and situated outside the circle inscribed within said perimeter.

2. Washing machine according to claim 1, **characterized in that** said annular hollow bodies (P) are arranged on one and the same plane and are centered coaxially with the axis (O) of the drum, the respective annular outlines of said annular hollow

bodies having such greatest and smallest dimensions that they do not interfere with one another.

3. Washing machine according to claim 1, **characterized in that** said annular hollow bodies are arranged so that at least two of them are located side-by-side.

4. Washing machine according to any preceding claim, **characterized in that** said hollow bodies are rotated in relation to each other, with respect to the axis of the drum, by an angle of $360^\circ/(m \cdot n)$, wherein m is the number of hollow bodies and n is the number of lobes of each hollow body.

5. Washing machine, particularly of the household type, comprising an outer casing, a washing tub, a perforated drum of a cylindrical form contained in said tub and capable of rotating therein about the axis of the cylinder during washing and spin-extraction, said drum being provided with a dynamic balancing arrangement consisting of a plurality of annular, sealed hollow bodies (P) integrally provided on said cylindrical drum, and a plurality of movable balancing weights (P) that are capable of sliding freely within said hollow bodies, **characterized in that:**

- at least one of said annular hollow bodies consists of at least a plurality "s" of circular hollow bodies (11, 12, 13), each having its respective center (D1, D2, D3) rotated in relation to the center of another one of said hollow bodies, with respect to the axis of the drum, by an angle of $360^\circ/s$,
- and said hollow bodies (11, 12, 13) are arranged in such a way that they respective centers (C1, C2, C3) be slightly offset with respect to the axis of the drum.

6. Washing machine according to claim 5, **characterized in that** said circular annular hollow bodies axially misaligned with respect to each other (11, 12, 13) have different radii (S1, S2, S3) and are fitted within each other coplanarily.

7. Washing machine according to claim 6, **characterized in that** said circular annular hollow bodies axially offset with respect to each other have the same thickness (H) and are formed of a single piece.

8. Washing machine according to any preceding claim, **characterized in that** said movable balancing weights are in the shape of a thick disk (D), the cross-section of said hollow bodies being rectangular and sized so as to enable said movable balancing weights in the shape of thick disks to rotatably slide thereinto.

9. Washing machine according to any one of claims 1 to 7, **characterized in that** the cross-section of said hollow bodies is rectangular and slightly tapered towards the outer edge,

a clearance being provided between the inner wall of said hollow bodies and the side surfaces of said movable balancing weights.

10. Washing machine according to any one of claims 1 to 7, **characterized in that** said movable balancing weights consist of heavy fluid substances.

Patentansprüche

1. Wäschewaschmaschine, insbesondere für den Haushalt, umfassend ein Außengehäuse, einen Waschbehälter, eine perforierte Trommel mit zylindrischer Form, die in dem Behälter angeordnet ist, und sich darin während des Waschens und Schleuderns um die Zylinderachse drehen kann, wobei die Trommel mit einer dynamischen Auswuchtungseinrichtung versehen ist, die eine Anzahl von ringförmigen, abgedichteten, Hohlkörpern (P) umfaßt, welche integral an der zylindrischen Trommel angeordnet sind, sowie einer Anzahl von bewegbaren Ausgleichsgewichten (P), welche innerhalb der Hohlkörper frei gleiten können, **gekennzeichnet durch:**

1) Jeder Hohlkörper (P) soll eine geschlossene periphere Kontur aufweisen, die in der Weise entlang ihrer gesamten Ausdehnung konvex ist, daß das Segment, welches jeweils zwei Punkte, die auf dem Umriß des Hohlkörpers liegen, verbindet, vollkommen von der Fläche umschlossen ist, die durch einen solchen Umriß begrenzt wird,

2) Jeder Hohlkörper zeichnet sich durch eine Anzahl von "Lappen", d. h. von Umrißbereichen aus, die über den Umriß gleichmäßig verteilt und außerhalb eines Kreises, welcher innerhalb dieses Umrisses einbeschrieben ist, angeordnet sind.

2. Wäschewaschmaschine nach Anspruch 1, **dadurch gekennzeichnet, daß** die ringförmigen Hohlkörper (P) in ein und derselben Ebene angeordnet und koaxial zur Achse (O) der Trommel zentriert sind, wobei die entsprechenden ringförmigen Umrisse der ringförmigen Hohlkörper solche größte und kleinste Abmessungen aufweisen, daß sich diese nicht überlagern.

3. Wäschewaschmaschine nach Anspruch 1, **dadurch gekennzeichnet, daß** die ringförmigen Hohlkörper so angeordnet sind, daß mindestens zwei von diesen sich nebeneinander befinden.

4. Wäschewaschmaschine nach einem oder mehreren der vorhergehenden Ansprüche, **dadurch gekennzeichnet, daß** die Hohlkörper relativ zueinander und in bezug zur Trommelachse um einem Winkel von $360^\circ/(m \cdot n)$ versetzt sind, wobei m die Anzahl der Hohlkörper und n die Anzahl der Lappen jedes Hohlkörpers bezeichnen.

5. Wäschewaschmaschine, insbesondere für den Haushalt, umfassend ein Außengehäuse, einen Waschbehälter, eine perforierte Trommel mit zylindrischer Form, die in dem Behälter angeordnet ist, und sich darin während des Waschens und Schleuderns um die Zylinderachse drehen kann, wobei die Trommel mit einer dynamischen Auswuchtungseinrichtung versehen ist, die eine Anzahl von ringförmigen, abgedichteten, Hohlkörpern (P) umfaßt, welche integral an der zylindrischen Trommel angeordnet sind, sowie einer Anzahl von bewegbaren Ausgleichsgewichten (P), welche innerhalb der Hohlkörper frei gleiten können, **dadurch gekennzeichnet, daß:**

- mindestens einer der ringförmigen Hohlkörper mindestens eine Anzahl "s" von runden Hohlkörpern (11, 12, 13) umfaßt, wobei deren entsprechender Mittelpunkt (D1, D2, D3) relativ zum Mittelpunkt eines anderen der Hohlkörper in bezug zur Trommelachse um einen Winkel von $360^\circ/s$ versetzt ist,
- und die Hohlkörper (11, 12, 13) in solcher Weise angeordnet sind, daß die entsprechenden Mittelpunkte (C1, C2, C3) in bezug zur Trommelachse geringfügig versetzt sind.

6. Wäschewaschmaschine nach Anspruch 5, **dadurch gekennzeichnet, daß** die ringförmigen Hohlkörper (11, 12, 13) in bezug zueinander axial versetzt sind, unterschiedliche Radien (S1, S2, S3) besitzen und ineinander koplanar befestigt sind.

7. Wäschewaschmaschine nach Anspruch 6, **dadurch gekennzeichnet, daß** die runden ringförmigen Hohlkörper, die zueinander axial versetzt sind, dieselbe Dicke (H) aufweisen und einstückig geformt sind.

8. Wäschewaschmaschine nach einem oder mehreren der vorhergehenden Ansprüche, **dadurch gekennzeichnet, daß** die beweglichen Ausgleichsgewichte die Form einer dicken Scheibe (D) haben, und der Querschnitt dieser Hohlkörper rechteckig und so bemessen ist, daß die als dicke Scheiben ausgebildeten Ausgleichsgewichte darin eine drehende Gleitbewegung ausführen können.

9. Wäschewaschmaschine nach einem oder mehreren der Ansprüche 1 bis 7, **dadurch gekennzeichnet,**

net, daß der Querschnitt der Hohlkörper rechteckig und zur Außenkante hin leicht verjüngt ist, und daß ein Zwischenraum zwischen den Innenwänden der Hohlkörper und den Seitenflächen der beweglichen Ausgleichsgewichte vorgesehen ist.

10. Wäschewaschmaschine nach einem oder mehreren der Ansprüche 1 bis 7, **dadurch gekennzeichnet, daß** die beweglichen Ausgleichsgewichte aus schweren Fluiden gebildet sind.

Revendications

1. Lave-linge, en particulier du type ménager, comprenant un boîtier externe, un bac de lavage, un tambour perforé de forme cylindrique contenue dans ledit bac et capable de tourner dedans autour de l'axe du cylindre pendant le lavage et l'essorage centrifuge, ledit tambour étant fourni avec un dispositif d'équilibrage dynamique composé d'une pluralité de corps creux étanches annulaires (P) faisant corps avec ledit tambour cylindrique, et une pluralité de masses d'équilibrage mobiles (P) qui sont capables de glisser librement dans lesdits corps creux, caractérisé en ce que:

1) chaque corps creux (P) devra avoir un contour périphérique étanche qui est convexe le long de toute son extension, d'une façon telle que le segment joignant tout couple de points situé sur le périmètre du corps creux est entièrement contenu dans la surface délimitée par un tel périmètre;

2) chaque corps creux devra représenter une pluralité de "lobes" (1), à savoir des portions de périmètre étant régulièrement distribuées le long dudit périmètre et situées à l'extérieur du cercle inscrit dans ledit périmètre.

2. Lave-linge selon la revendication 1, caractérisé en ce que lesdits corps creux annulaires (P) sont disposés sur un plan et ce même plan et sont centrés coaxialement avec l'axe (O) du tambour, les profils annulaires respectifs dasdits corps creux annulaires ayant les dimensions les plus grandes et les plus petites telles qu'elles n'interfèrent pas ensemble.

3. Lave-linge selon la revendication 1, caractérisé en ce que lesdits corps creux annulaires sont disposés de sorte qu'au moins deux d'entre eux sont situés côte à côte.

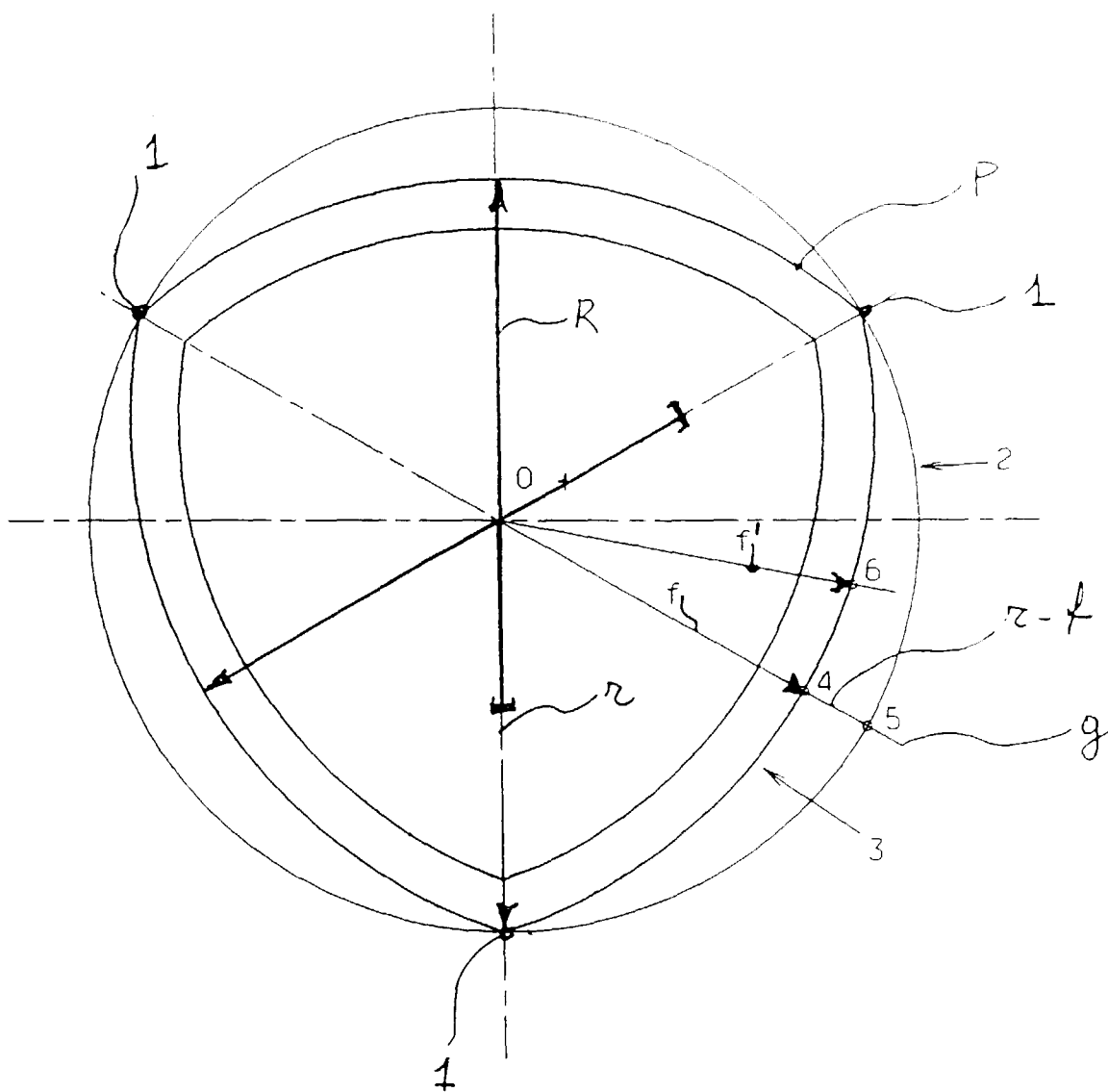
4. Lave-linge selon l'une quelconque des revendications précédentes, caractérisé en ce que lesdits corps creux tournent en relation les uns avec les autres, par rapport à l'axe du tambour, par un angle

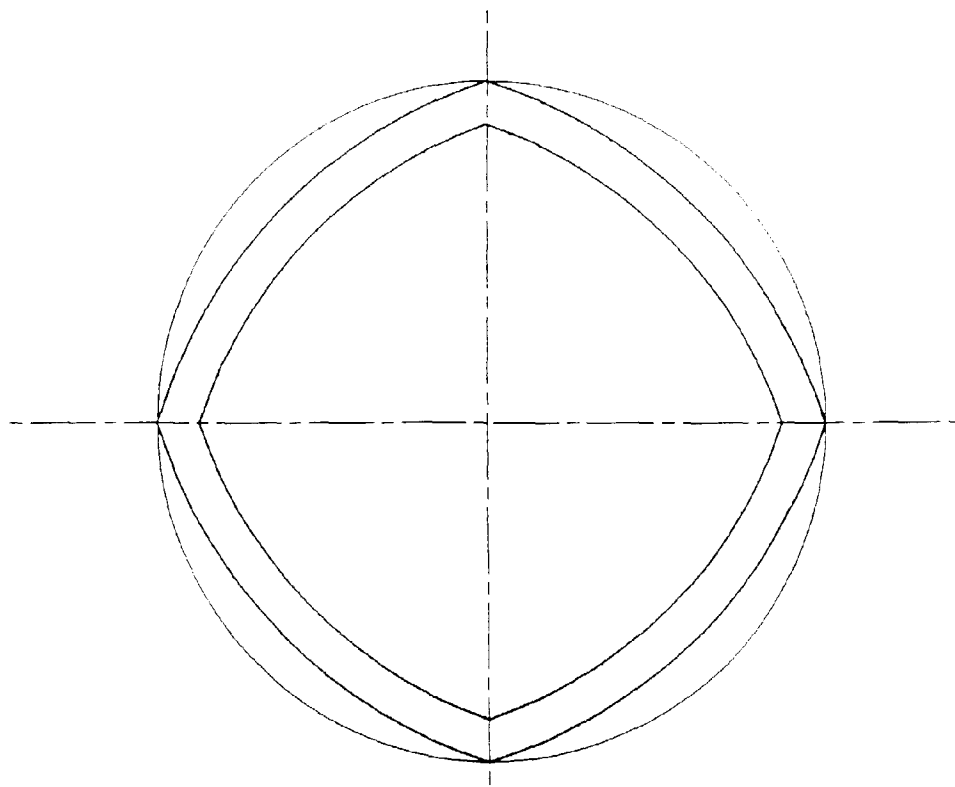
de $360^\circ/(m.n)$, dans lequel m est le nombre de corps creux et n est le nombre de lobes de chaque corps creux.

5. Lave-linge, en particulier du type ménager, comprenant un boîtier externe, un bac de lavage, un tambour perforé de forme cylindrique contenu dans ledit bac et capable de tourner à l'intérieur autour de l'axe du cylindre pendant le lavage et l'essorage centrifuge, ledit tambour étant fourni avec un dispositif d'équilibrage dynamique composé d'une pluralité de corps creux étanches annulaires (P) faisant corps avec ledit tambour cylindrique, et une pluralité de masses d'équilibrage mobiles (P) qui sont capables de glisser librement dans lesdits corps creux, caractérisé en ce que:
 - au moins un desdits corps creux annulaires se compose d'au moins une pluralité "S" de corps creux circulaires (11, 12, 13), chacun ayant son centre respectif (D1, D2, D3) tournant en relation avec le centre de chaque autre desdits corps creux, par rapport à l'axe du tambour, d'un angle de $360^\circ/S$; 20
 - et lesdits corps creux (11, 12, 13) sont disposés d'une façon telle que leurs centres respectifs (C1, C2, C3) sont légèrement décentrés par rapport à l'axe du tambour. 25
6. Lave-linge selon la revendication 5, caractérisé en ce que lesdits corps creux annulaires circulaires axialement décentrés les uns par rapport aux autres (11, 12, 13) ont des rayons différents (S1, S2, S3) et sont ajustés les uns dans les autres de façon coplanaire. 30 35
7. Lave-linge selon la revendication 6, caractérisé en ce que lesdits corps creux annulaires circulaires axialement décentrés les uns par rapport aux autres ont la même épaisseur (H) et sont formés d'une seule pièce. 40
8. Lave-linge selon l'une quelconque des revendications précédentes, caractérisé en ce que lesdites masses d'équilibrage mobiles sont sous la forme d'un disque épais (D), la coupe transversale desdits corps creux étant rectangulaire et de dimensions telles que lesdites masses d'équilibrage mobiles sous la forme de disques épais peuvent y glisser en rotation. 45 50
9. Lave-linge selon l'une quelconque des revendications 1 à 7, caractérisé en ce que la coupe desdits corps creux est rectangulaire et légèrement effilée vers le bord externe, un dégagement étant prévu entre la paroi interne desdits corps creux et les surfaces latérales desdites masses d'équilibrage mobiles. 55

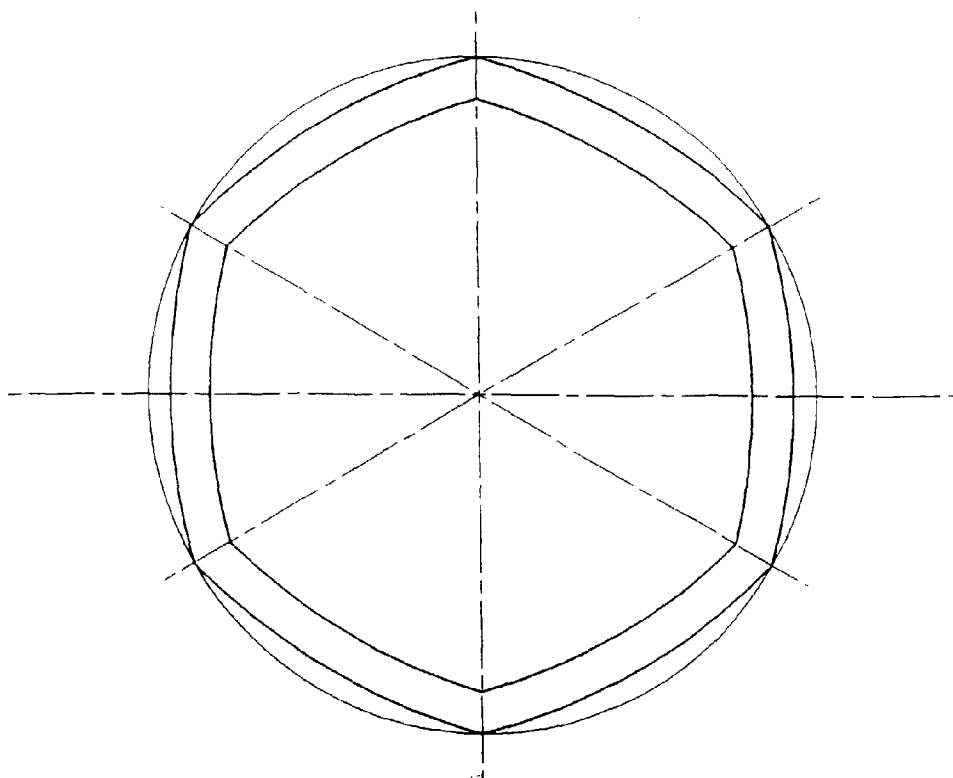
10. Lave-linge selon l'une quelconque des revendications 1 à 7, caractérisé en ce que lesdites masses d'équilibrage mobiles se composent de substances fluides denses.

- fig. 1 -



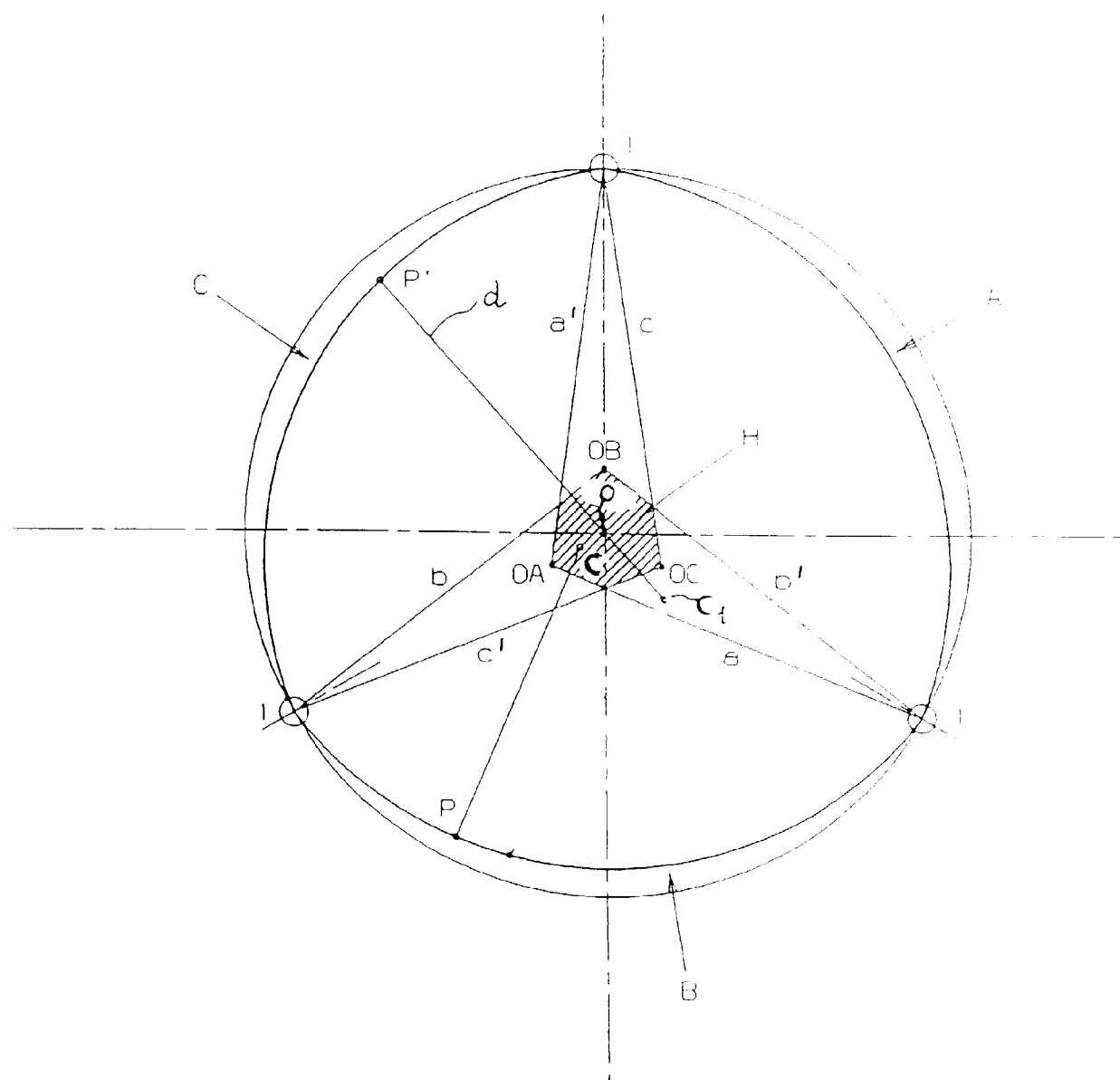


- fig. 2a -

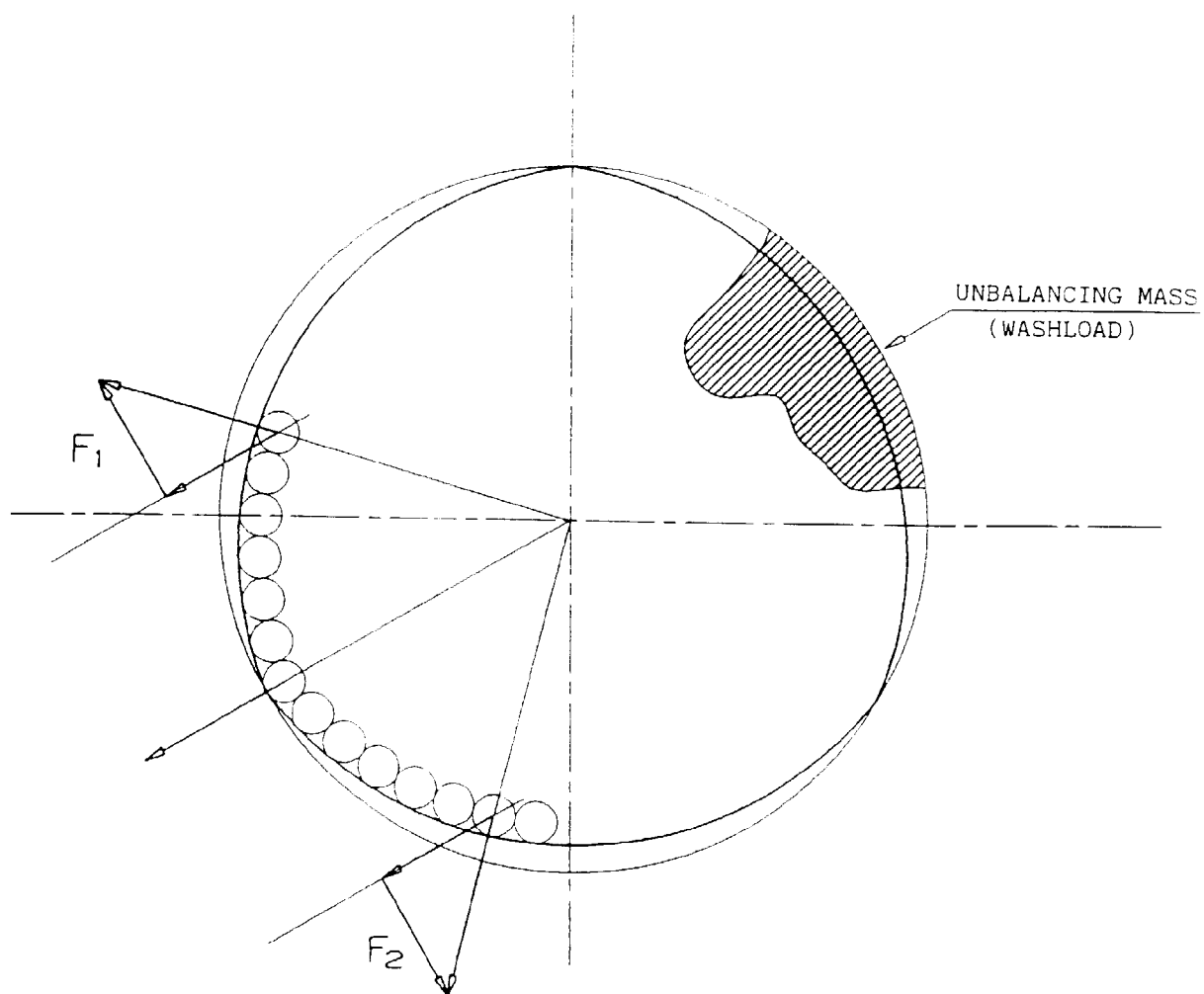


- fig. 2b -

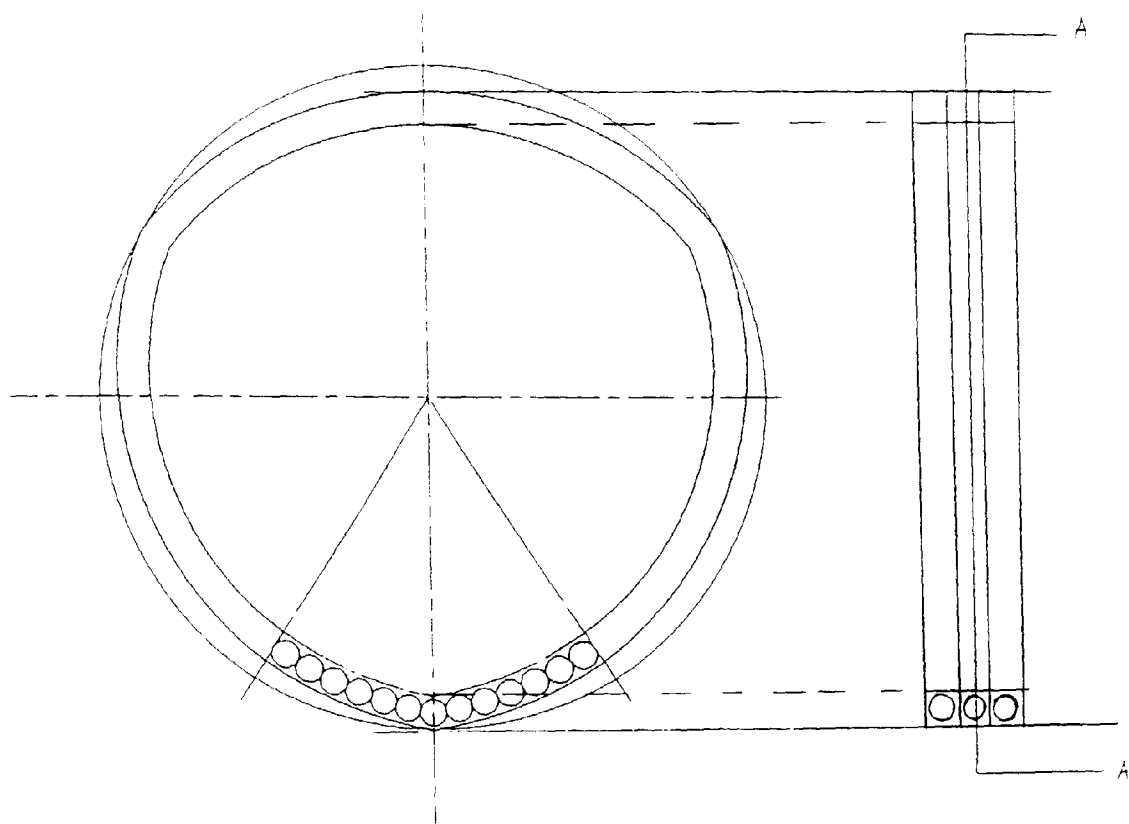
- fig. 3 -



- fig.4 -



- fig.5 -



- fig.6 -

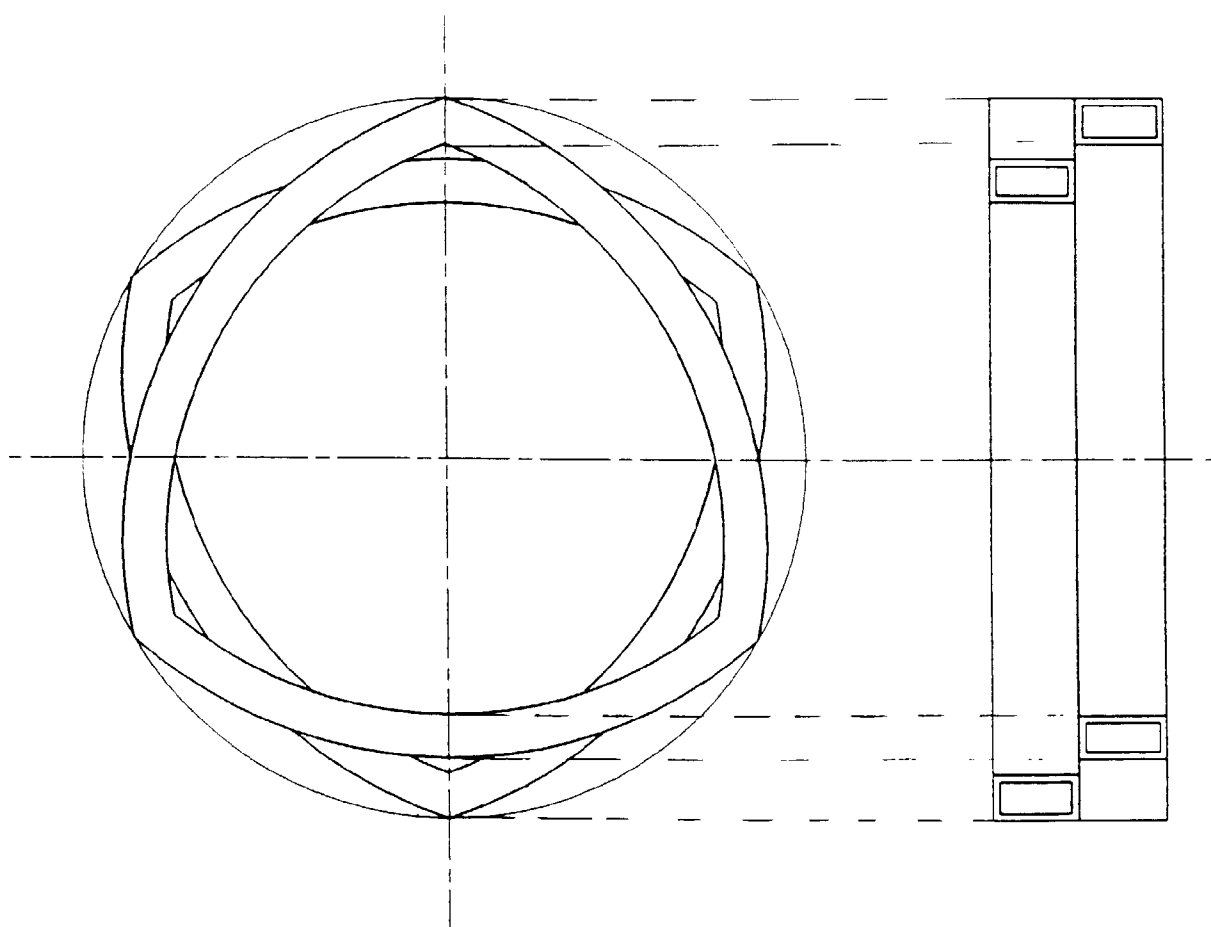
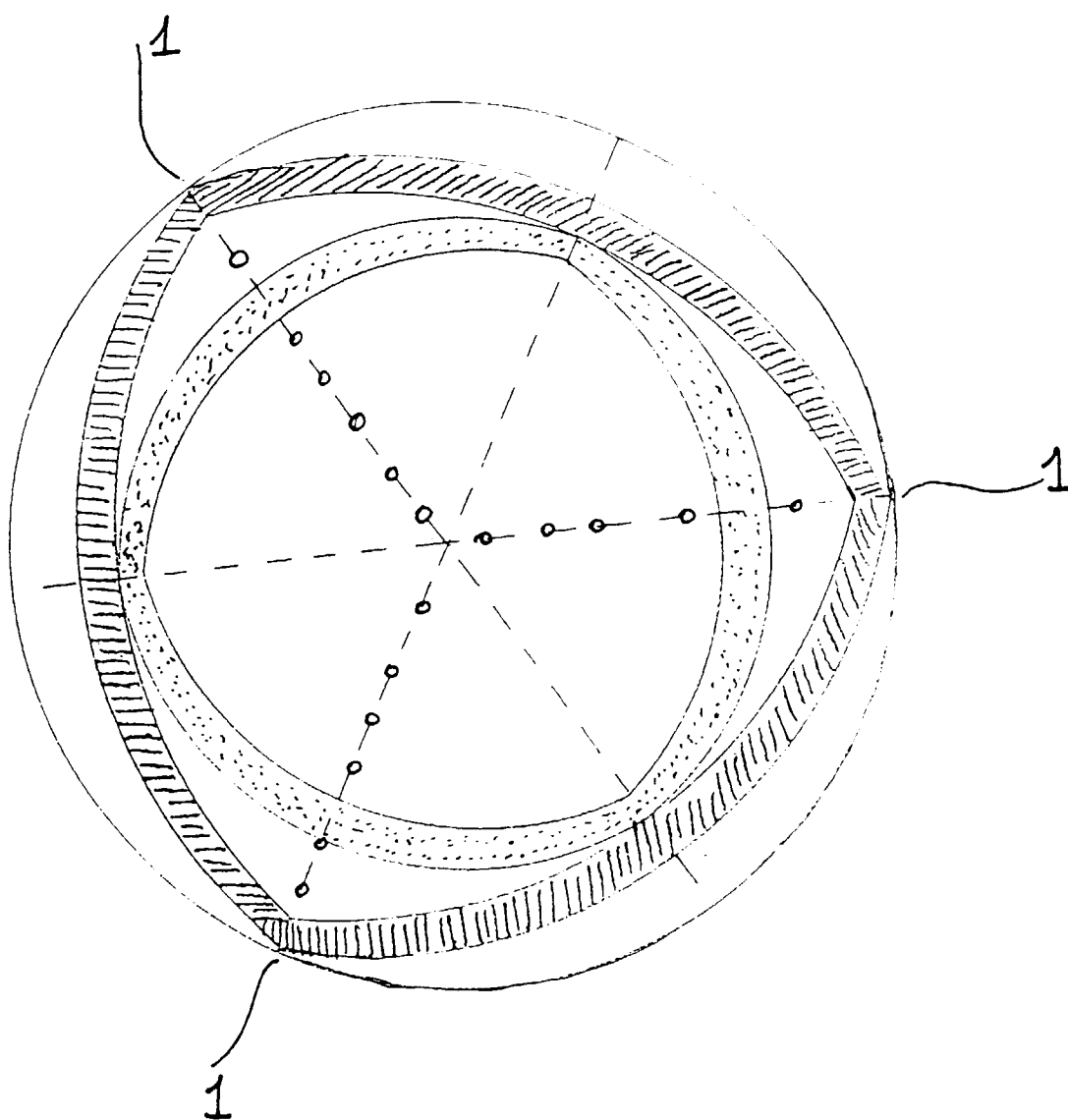
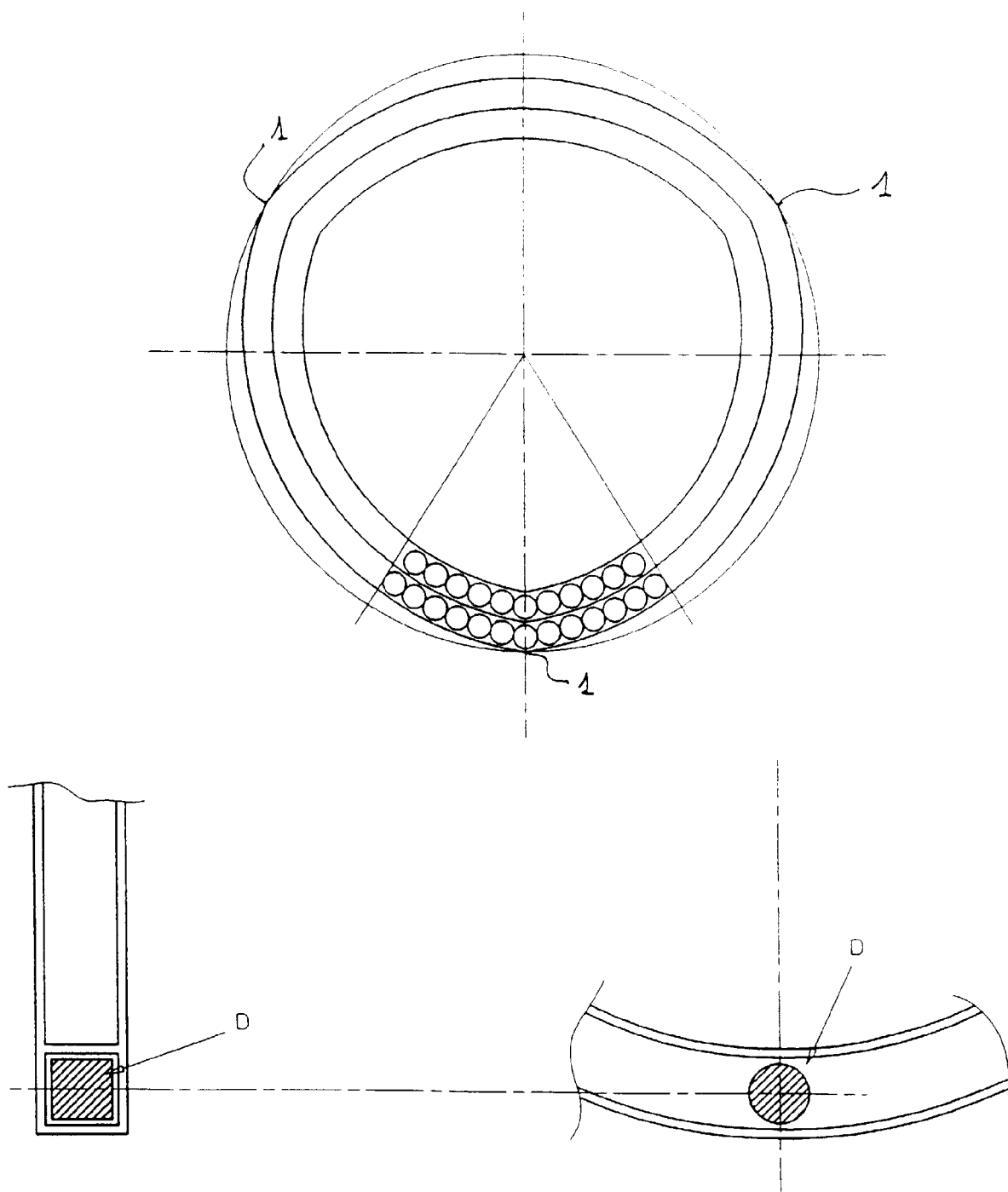


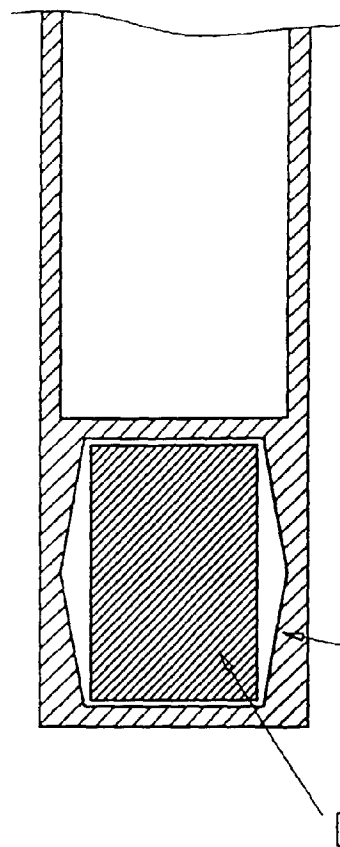
fig 7a



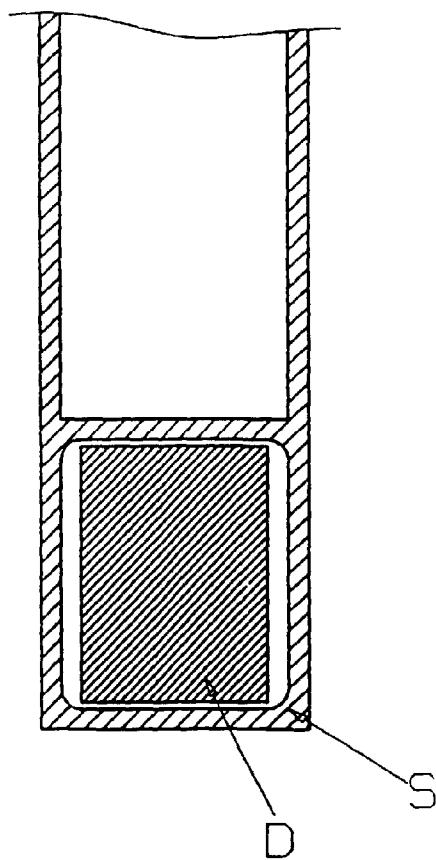
- fig. 7 -



- fig. 8 -

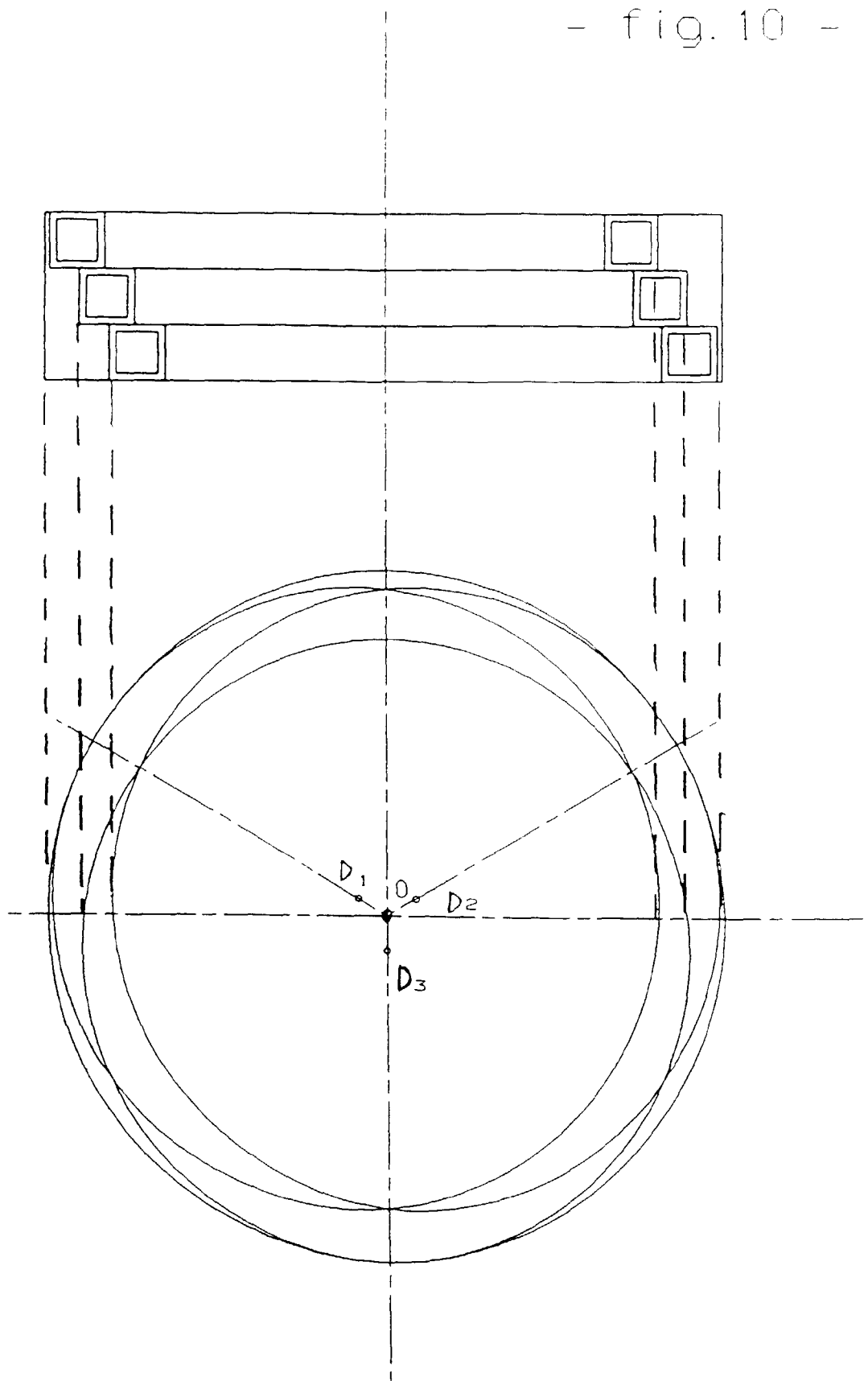


- fig. 9a -

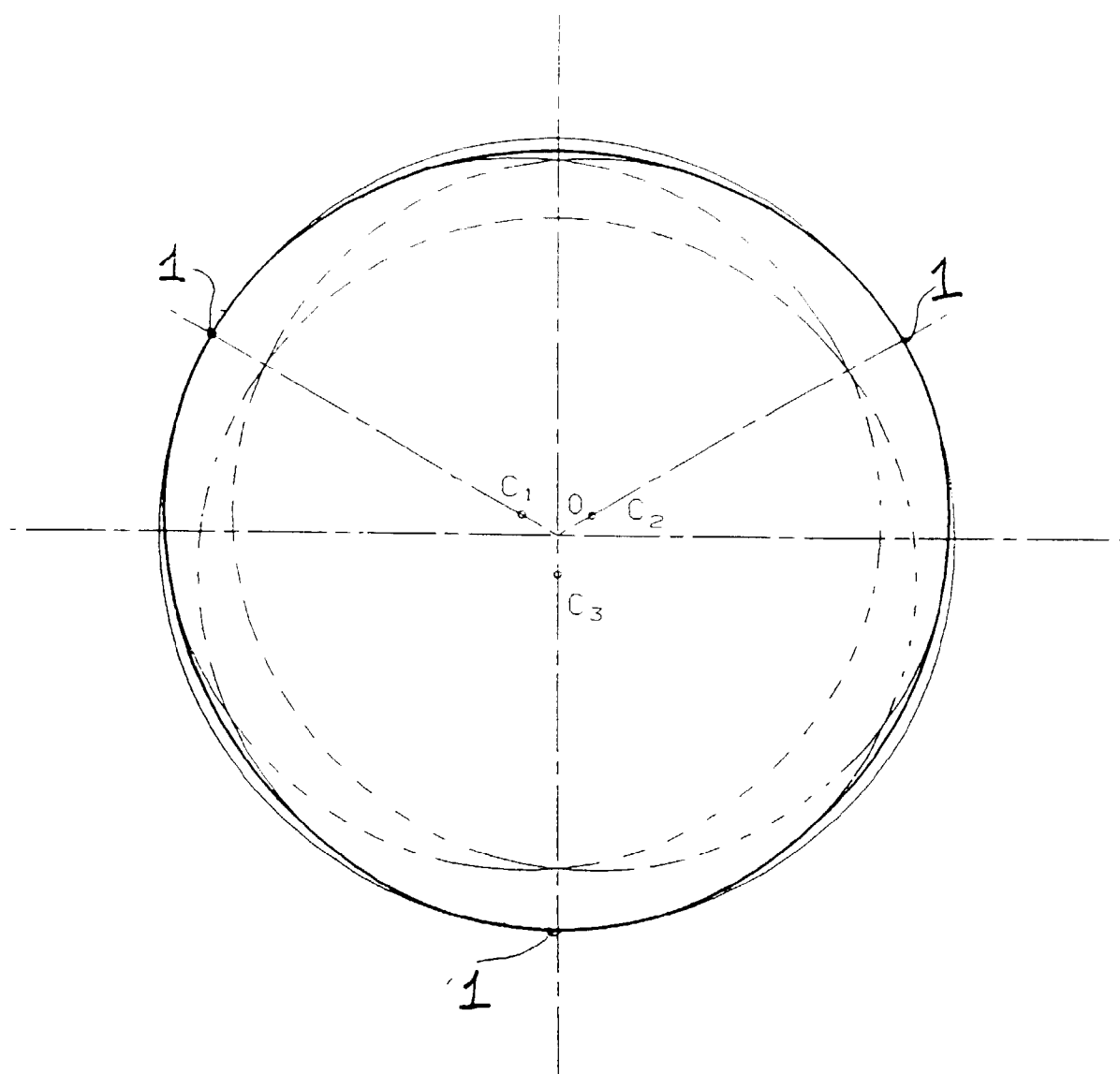


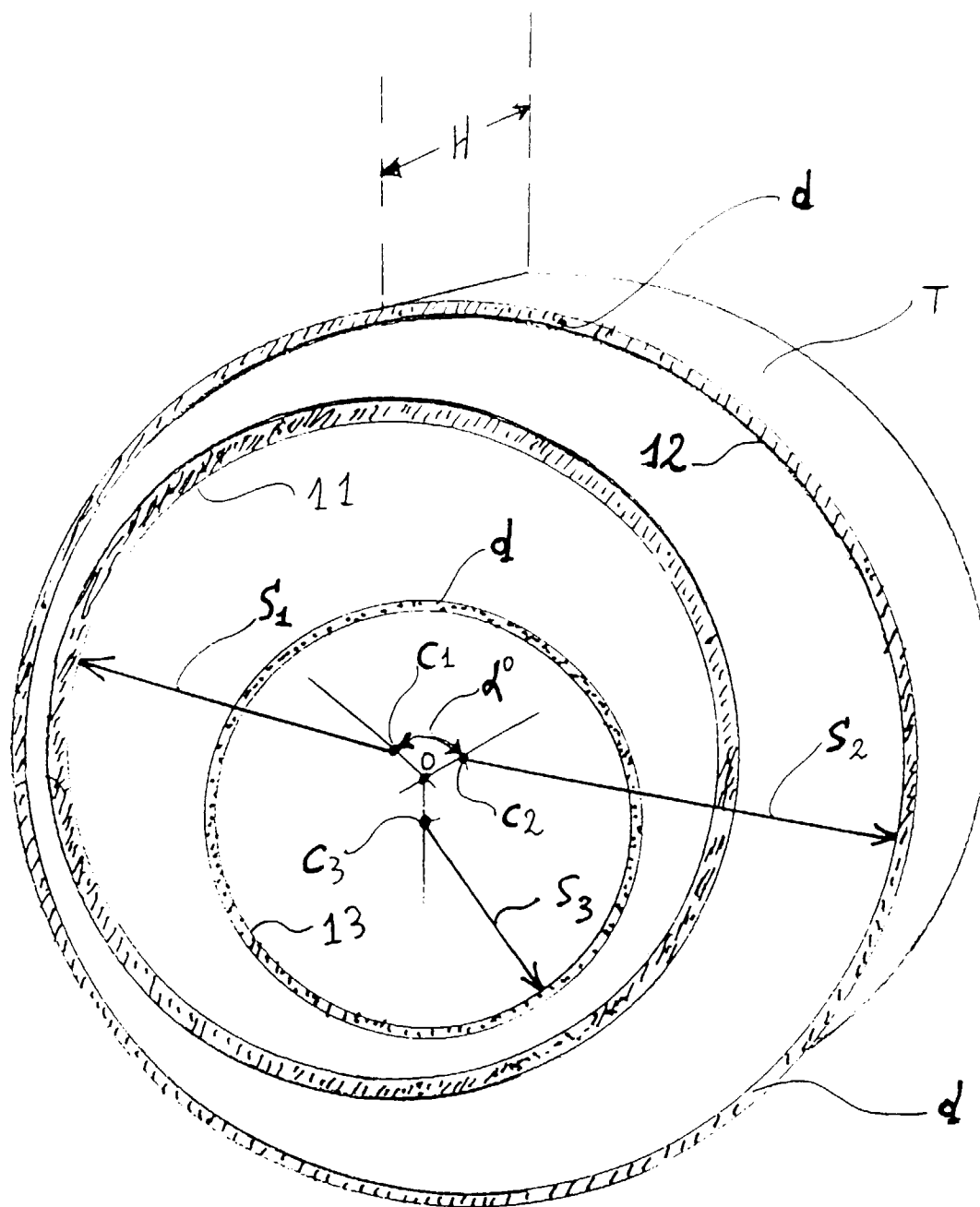
- fig. 9b -

- fig. 10 -



- fig. 10a -





- fig. 11 -