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(54) **Improved shock absorber**

(57) Shock absorber to damp through a friction action the swinging of a first body, for example a tub of an household washing machine, with respect to a second body, for example a cabinet portion of the same appliance, comprising an outer cylinder (2) connected with one (22) of its ends to said first body, an inner shank (1) able of sliding inside said outer cylinder, and connected through respective end (21) to said second body, a damping assembly placed between said outer cylinder and said inner shank, and able of causing a differentiated damping force

which shows a weak damping force when the swinging transferred from said first to said second body is limited, and which offers a higher damping force when said swinging is wider, whereby said damping assembly also comprises a first friction element (4) engaged between said shank and a defined first portion of the inner surface of said outer cylinder, a second friction element (5) engaged between said first friction element (4) and a second defined portion of the inner surface of said outer cylinder, said second portion being other than said first portion.

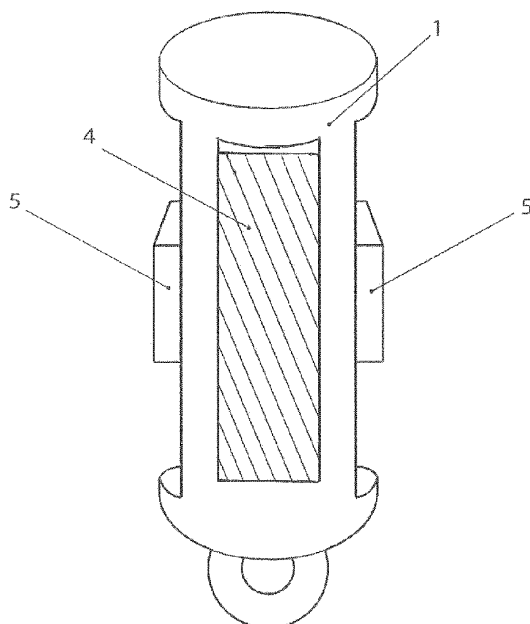


FIG. 8A

Description

DESCRIPTION

[0001] The present invention is related to an improved shock absorber which makes it possible to damp the swinging between two distinct bodies, for ex. and in particular it allows the damping of the swinging originated between the tub of a washing machine for domestic use, and the related frame or cabinet, due to the rotation of the basket rotating inside said tub.

[0002] The characteristics and the functioning of such shock absorber are universally known to the skilled person in the field, and, therefore, a detailed description is omitted for brevity sake.

[0003] Herewith patents EP 1 584 730 - US 2004/0144137 EP 0 407 755 and EP 1220961 are quoted for exemplification only.

[0004] One of the characteristics in the use of such shock absorbers in the washing machines lies in the fact that the swingings between the tub and the cabinet, which have to be damped, can vary from very low values to very high values and this requirement arises within a very limited time.

[0005] Moreover, it has to be considered that the damping action is not peremptorily the same for any swinging type or width, as small swingings are allowed because intrinsic, especially during the spin-drying phases, due to the rotation of a basket whose load is normally unbalanced, but often a little unbalanced.

[0006] In fact, if it were desired to forcibly damp any small swinging of the tub, as a consequence it would result that a good part of such small swingings would be transmitted to the structural elements of the machine, such as the base or the cabinet; as the skilled person in the field knows, such situation would cause a considerable and almost continuous swinging of the same machine, with consequences both on the machine structure and on its noisiness, which are completely undesirable.

[0007] On the contrary, if the shock absorbers were sized and made so as to damp all the impressed swingings in a much less forceful way, it would derive, as an undesirable consequence, that the tub would be effectively damped only for small swingings, while wide swingings would not be damped adequately and the tub would risk to swing excessively, bumping violently against other parts of the machine with even catastrophic risks, as it is well known.

[0008] In order to reduce such inconvenience as far as possible, other solutions have been devised which carry out the principle of the "differentiated damping", which consists in providing a type of shock absorber that damps, by a limited value, the swinging comprised in a given range and that outside said range it exerts a much more forceful damping action.

[0009] From patent US 2004/0144137 it is known, in particular, as it can be seen from the related figures from 14 to 18, the realization of two distinct damping elements,

wherein one is made of an element which operates exclusively due to elastic reaction and which acts exclusively on a second element which operates exclusively due to friction against a cylindrical surface, such as the inner wall of the outer cylinder of the shock absorber.

[0010] Anyway, such solution actually does not make a shock absorber have a differentiated effect, in the normal and traditional meaning of the term, as small swingings are only temporarily absorbed but not damped by means of an energy drawing by the elastic element which of course gives them back where they have been originated.

[0011] In the case in which the swinging increase their force, and therefore their value, they are transferred through said elastic element, to a means which, due to friction, works on the inner surface of the outer cylinder (see figures 14 and 17), which damps them according to a known effect.

[0012] As it is easily conceivable, such solution shows the intrinsic inconvenience that small swingings are not damped at all, but they are only temporarily absorbed and soon after they are given back to the bodies by which they have been originated.

[0013] From patent EP 1 220 961 it is known a shock absorber for washing-machines, wherein the damping action takes place with a differentiated effect, and, that is with swinging of limited width there is only the friction force between two defined and constant surfaces in contact with each other, while with a greater swinging the motion of the inner rod drags a second friction element which acts on the same inner surface of the outer rod, and that, therefore, damps the motion of the inner rod, providing, in this way, said differential damping action.

[0014] On the other hand such solution, though effective in principle, anyway shows the inconveniences of complex and expensive manufacturing for the various components, which have to be singularly made, and assembled one with the other; such limit is absolutely unacceptable in a highly competitive product field such as the one under consideration.

[0015] Further, once assembled, the friction elements cannot be dismantled anymore, without dismantling the entire shock absorber, since said second friction elements are annular and basically imprisoned among the other devices/organs of the shock absorber; and, therefore, once worn out they cannot be economically restored.

[0016] Therefore, it would be desirable and it is the main object of the present invention, to provide a type of shock absorber which overcomes the described inconveniences, which is compact and can be produced in a simple way with known materials and techniques, and easily and economically available.

[0017] Such object is achieved by means of a shock absorber realized according to the appended claims.

[0018] Characteristics and advantages of the invention will be apparent by the following description, for exemplification only but not excluding, with reference to the

appended figures, wherein:

- Figure 1 shows a perspective and transparent view of a general shock absorber according to the known technique,
- Figure 2 shows a plan and front view of a first friction element comprised in the invention,
- Figure 2A shows a perspective view of the element in figure 2,
- Figure 3 shows a second friction element in a plan front view,
- Figure 3A shows a perspective of the element in figure 3,
- Figures 4A, 4B and 4C show a plan front view, similar to figure 2, wherein the second friction element is inserted inside the first friction element in three respective distinct positions,
- Figures 5A and 5B show two perspective views of the assembly of the elements in figures 2 and 3 in respective different working arrangements,
- Figure 6 shows a plan projection of the rod according to the invention, projected on a plane parallel to the axis of the same rod,
- Figure 7 shows the view according to section A-A of figure 5,
- Figure 8 shows a view similar to figure 6 after assembling the two friction elements in the rod, but before introducing it in the outer cylinder,
- Figure 8A shows a perspective view of the assembly in figure 8,
- Figure 9 shows the rod of figure 8 after its insertion in the related cylinder,
- Figure 10 shows the view according section B-B of figure 9,
- Figure 11 shows the plane development of the rod outer surface of figure 6, according to a generatrix of the basically cylindrical surface of the rod, after providing the through openings,
- Figures 12A, 12B, 12C and 12D show respective symbolic and transparent views of the shock absorber of the invention, with the rod of figure 6 after assembling the two distinct friction elements, and after inserting the rod inside the outer cylinder in four respective operating assemblies.

[0019] Later in the description there could be used words such as "on", "under", "above", "below", "lower"; those skilled in the field will not have any difficulties in understanding that such words refer to the orientation of the shock absorber in its normal working assembly and as shown in the appended figures, and, therefore, these words, which do not give origin to any misunderstandings in those skilled in the field, on the contrary, are used to explain and define the content of the invention more clearly and more simply.

[0020] With reference to figure 1, a shock absorber, according to the known art, comprises an inner rod 1 and an outer cylinder 2 inside which the rod slides.

[0021] Between the rod and the cylinder it is usually interposed and connected to the rod, a damping or a friction element 3; further, both the rod 1 and the cylinder 2 are connected through respective engaging means 21 and 22, to the related bodies, not shown, and whose reciprocal motion and swinging are to be damped.

[0022] According to the invention it is provided a damping assembly comprising:

- Two distinct friction elements 4 and 5,
- A first through opening passing through said rod in the "Y" direction orthogonal to the axis "X" of the rod, that in the appended figures is made to coincide also with the axis of the outer cylinder, and which opens with two corresponding openings 11A, 11B on the rod surface,
- A second through opening passing through said rod in the "Z" direction orthogonal to axis "X" of the rod, but also orthogonal to the previous direction "Y", and which opens with two corresponding openings 10A, 10B on the rod surface.

[0023] To clearly understand the shaping of the rod 1, figure 11 gives a symbolic and schematic illustration which shows the development of the outer surface of the rod 1 on a plane, whereon it is supposed said development is obtained by means of a section of the outer surface of the rod along a generatrix parallel to the axis "X" of the rod.

[0024] With reference to figure 2 and 2A, the first friction element 4 is a parallelepiped-shaped body with two pairs of opposed fronts separated one from the other by an inner through groove 12, also having a parallelepiped shape and basically centred inside element 4; two pairs of the parallelepiped fronts forming said through groove 12 are parallel to the respective pairs of the outer fronts of the friction element 4.

[0025] Besides, and to exemplify, and apart from its sizes and its proportions, said element 4 is like, in the principle, to the frame of a painting where said inner through groove 12 is meant to be occupied by the painted portion of the same painting.

[0026] On the other hand, figures 2 and 2A do not allow any ambiguities.

[0027] With reference to figures 3 and 3A, the second friction element 5 is a pure parallelepiped body, without inner openings, and whose inner sizes are such that it can be inserted inside said groove 12 as shown in figures from 4B to 5B.

[0028] In particular:

- Height "f" of the second friction element 5 is smaller than height "b" of the groove 12, so that said second element 5 is able to slide inside the groove 12 according to axis "X", taking, therefore, a plurality of different positions, as shown in figures from 4A to 5B,
- And, further, the size of the thickness "g" (Fig. 3A) of the second friction element 5 is substantially the

same as the width "a" of the groove 12, so that said second element 5, even being able to slide inside the groove 12 according to axis "X", as shown in figure from 4A to 5B, anyway cannot move along axis "Y" since the opposite fronts of the groove 12 and of the element 5 are actually in reciprocal contact.

[0029] Ultimately, the second friction element 5 can be introduced in the groove 12 wherein it can slide upward and downward along axis "X" but not along axis "Y".

[0030] As for axis "Z", it will be specified as follows.

[0031] Let us consider now figures 6, 7, 8 and 8A; figure 6 shows a side view of the rod only as projected on a plane parallel to axis "X", from such a position that the two openings 10A and 10B are seen superimposed and, hence, not singularly identifiable; in fact, only the through opening related to said two openings is visible.

[0032] If now:

- The first element 4 is inserted through the first through opening represented by the two openings 11A and 11B,
- And then said second friction element 5 is inserted through the second through opening represented by the two openings 10A and 10B so that it also and naturally crosses the groove 12 of the first friction element 4 as in figure 5A, it will be obtained the construction shown in figures 8 and 8A.

[0033] For this purpose, it is to be provided that the first friction element 4 has dimensions both on axis "X" and on axis "Z" in order to be exactly housed in said first opening, without any slack or backlash between the walls facing each other.

[0034] Practically, height "c" of the element 4, as shown in figure 2, has to be exactly the same as height "c" of the two opening 11A and 11B, as shown in figure 6 and in figure 11.

[0035] Furthermore, it has to be also observed that the second through opening 10A, 10B and said groove 12 determine a path or a completely free passage along axis "Z" wherein said second friction element 5 can be freely inserted.

[0036] The dimensions along axis "X" of the groove 12, of course, have to be compatible at least partially, with the dimension along the same axis of the second opening 10A, 10B so that the second friction element can freely slide inside the groove along axis "X" without being hampered by the relative second opening 10A, 10B.

[0037] Now said rod has to be inserted inside the relative cylinder 2 and the assembly shown in figures 9 and 10 is obtained.

[0038] In particular, it has to be observed that the first friction element 4 slightly protrudes out of the rod, and, that is, out of the relative openings 11A and 11B, and, hence, after appropriate reciprocal dimensionings and known *per se*, said first friction element 4 exerts a friction

action against the inner surface of the cylinder 2, and, since said element 4 is blocked, by means of said first opening 11A, 11B, to the rod 1, a first damping action between the rod and the cylinder is carried out.

[0039] As shown in figure 3 and 10, also the cross dimension "I" of the second friction element 5 has to be such that, it can be inserted inside the cylinder 2 but that it can exert, with its lateral faces 30 and 31 (see figure 3, 3A and 5A), and against the inner surface of the cylinder 2, a damping action completely similar, in principle, to the one of the first element 4.

[0040] In conclusion, it is obtained an assembly in which the rod is integral with the first friction element 4 and wherein the second friction element 5 crosses both the rod and the first friction element, and can move with respect to these ones along only axis "X", but not along the other axes "Y" and "Z", as shown in figure 10.

[0041] However, and with reference to figures from 12A to 12D, it is determined a working method that is the result of the present invention and which can be explained as follows:

- With reference to fig. 12A, in an initial and resting situation, the rod 1 and the cylinder 2 are in a determined position wherein the lower edge 14 of the second friction element 5 is aligned with the reference line "S".

[0042] When the shock absorber has to work and, for example, the rod 1 further inserts inside the cylinder 2, as in Fig. 12B, so the first friction element 4 exerts its damping function according to known ways, it derives that it remains in the initial position as it can slide inside the groove 12 and at the same time, in the second opening 10A, 10B, and therefore it is not stimulated by any force which causes it to vary its position with respect to the cylinder 2, since said second friction element 5 is anyway compressed against the inner surface of cylinder 2.

[0043] Such situation is maintained until said second element 5 can slide inside groove 12, and that is until distance "K" of said lower edge 14 of the second friction element 5 from the lower edge 14 of the relative through opening, or from the lower edge of groove 12 (which of the two is touched first) is not higher than the run of the rod in the cylinder.

[0044] Such circumstance happens, as shown in Fig. 12B, when the rod passes from level "p" to the higher level "q" covering said run "K".

[0045] Continuing the run of the rod for a further run "H", therefore from level "q" to a further higher level "r", as shown in Fig. 12C, then said second friction element 5 is forcibly dragged, from the relative opening or from the lower edge of the first friction element 4, for an identical run and in the same direction.

[0046] Of course, in such motion it is kept compressed laterally against the inner surface of cylinder 2, and therefore it exerts there, by friction, its own damping action,

independent from the one exerted by the first element 4 and which therefore adds up to it.

[0047] Basically, it is caused the working of the shock absorber wherein the damping force is step-like, where the first level is the damping force up to a determined run between the rod and the cylinder, and where, besides said run, there is an additional force which overlaps to the first one and which ultimately determines, together with it, a higher damping force.

[0048] It has also to be observed that, in this way, it is obtained the advantage that the two friction elements 4 and 5 work on two respective cylindrical portions (here the meaning of the word cylindrical is meant as a ruled surface with the generatrix always parallel to itself) which never interfere with each other and which work on two separate and distinct portions of the inner surface of the cylinder, with undeniable advantages of operating regularity and reliability.

[0049] Figure 12D shows the situation opposed to the one shown in figure 12B, that is the situation wherein the rod 1, instead of further inserting itself in the cylinder 2, it is partially extracted from it, passing from level "p" to level "t".

[0050] In that case the second element 5 will acquire the higher position in the opening 10A, 10B, and, hence, the line of reasoning and the conclusions of the previous case apply, only of course inverted, also to the present case, therefore they will not be repeated for brevity sake.

Claims

1. Shock absorber to damp through a friction action the swinging of a first body, for example a tub of an household washing machine, with respect to a second body, for example a cabinet portion of the same appliance, comprising:

- an outer cylinder (2) connected with one (22) of its ends to said first body,
 - an inner shank (1) able of sliding inside said outer cylinder, and connected through respective end (21) to said second body,
 - a damping assembly placed between said outer cylinder and said inner shank, and able of causing a differentiated damping force which shows a weak damping force when the swinging transferred from said first to said second body is limited, and which offers a higher damping force when said swinging is wider,
- characterized in that** said damping assembly also comprises:
- a first friction element (4) engaged between said shank and a defined first portion of the inner surface of said outer cylinder,
 - a second friction element (5) engaged between said first friction element (4) and a second defined portion of the inner surface of said outer

cylinder, said second portion being other than said first portion.

2. Shock absorber according to claim 1, **characterized in that** said inner shank (1) is passed across:

- by a first through opening (11A, 11B) which is substantially orthogonal to the axis (X) of said shank and extended for a first length (c) along said axis (X),
 - and by a second through opening (10A, 10B) substantially orthogonal to the shank axis (X), and to said first through opening (11A, 11B), and extended for a second length along said axis (X), and at least partially placed in correspondence to said first length (c),
- and **in that** said first friction element (4) is wholly blocked across said first through opening (11A, 11B) so that it forms a solid assembly with said shank, and protrudes on both the opposite sides of said first through opening,
- and **in that** said second friction element (5) shows a size (f), along said axis (X), which is smaller of the size of said second through opening (10A, 10B).

3. Shock absorber according to claim 2, **characterized in that** said first friction element (4) is provided with a trough groove (12) lodging said second friction element (5) and **in that** said groove (12) is longer (b), along said axis (X), than said second friction element (5, b), so that said second friction element is able of sliding along said through groove (12) in the same axis (X).

4. Shock absorber according to claim 3, **characterized in that** said groove (12) of said first friction element (4) and said second friction element (5) show respective sizes so that the two opposite side faces of said second friction element (5) are apt of sliding basically contacting the corresponding inner faces of said first friction element (4).

5. Shock absorber according to claim 1, **characterized in that** said second friction element (5) shows a size (f) along said axis (X) smaller both than the size of said groove and the size of said second opening (10A, 10B), and crosses said second opening on both the relevant opposite fronts, so that said second friction element (5) is able to be moved with respect to the solid assembly formed by said shank (1) and by said first friction element (4).

6. Shock absorber according to any of the preceding claims, **characterized in that** said first friction element (4) is constantly working in the friction working with respect to a relevant portion of the inner surface of said outer cylinder, during the motion of said shank

(1) inside said outer cylinder (2), and said second friction element (5):

- is kept compressed against a corresponding portion of the inner surface of said outer cylinder, and 5
- for a defined initial run of said shank it does not cause any actual friction,
- and successively to said initial run, it causes a respective friction, able to be added to the friction 10 between said first friction element and said outer cylinder.

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FIG. 1

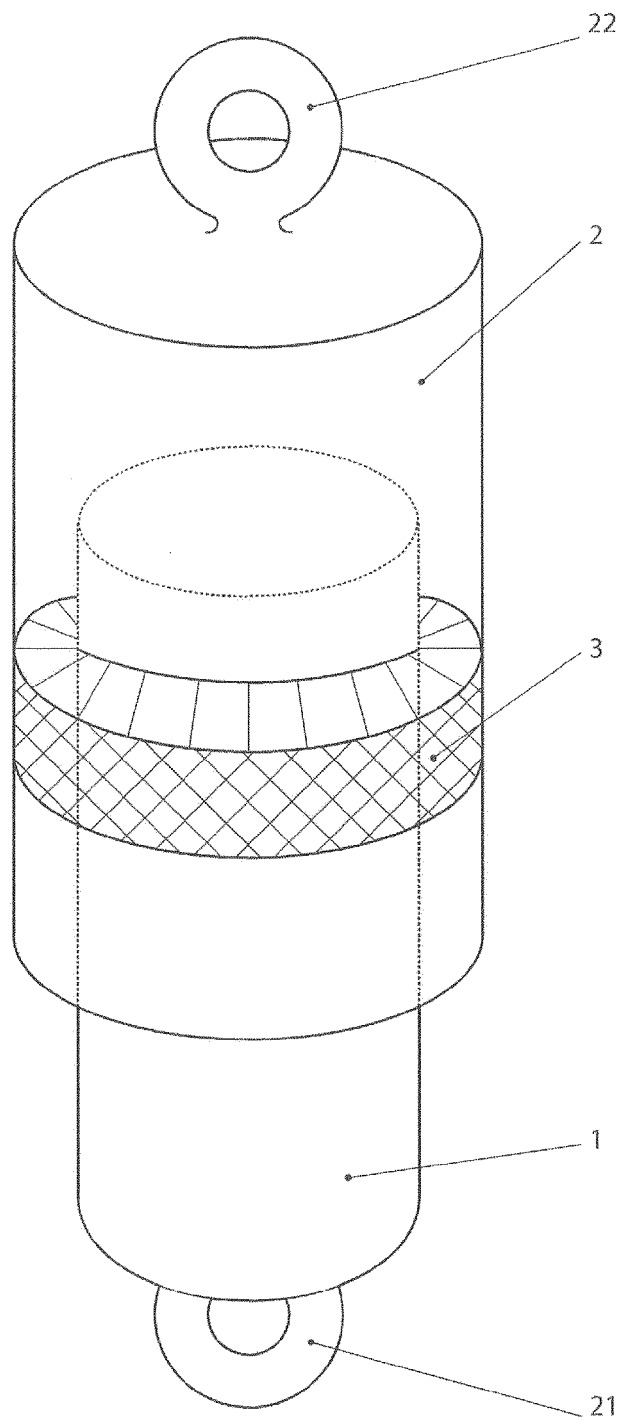


FIG. 2

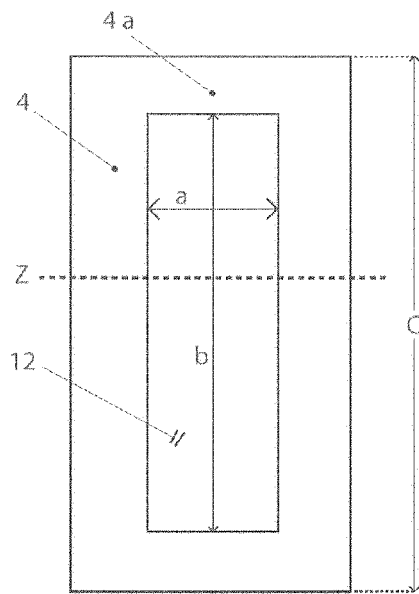


FIG. 3

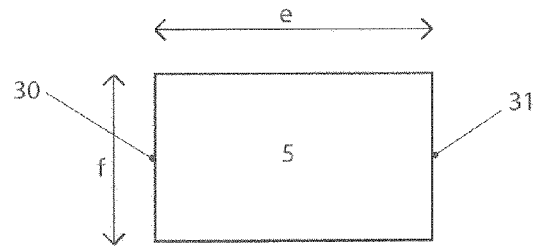


FIG. 2 A

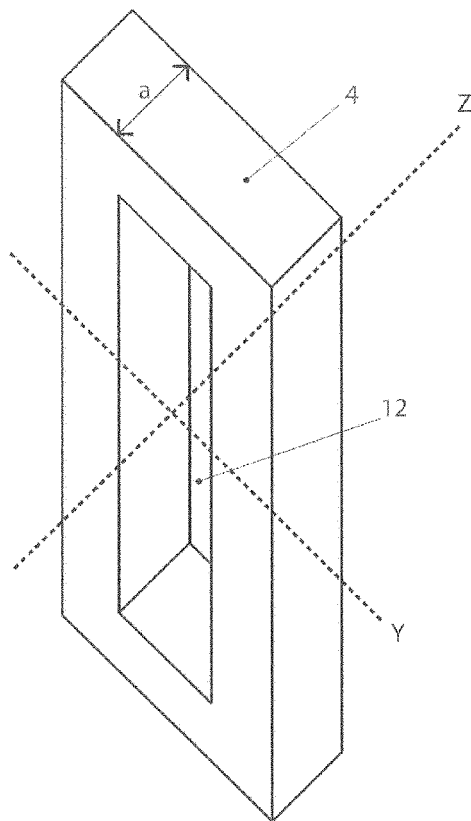
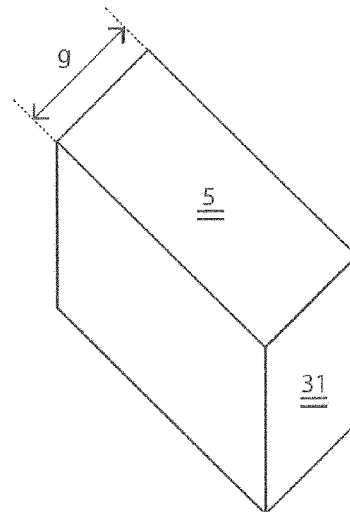
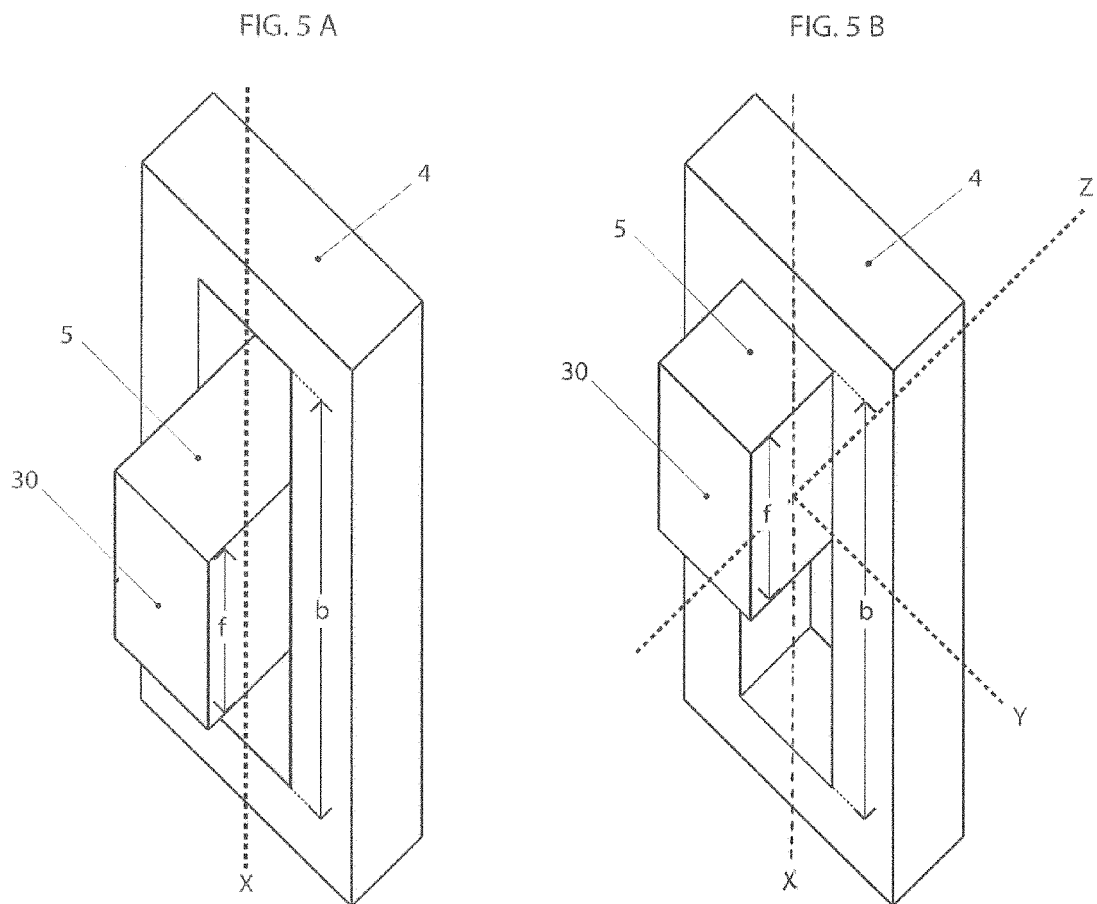
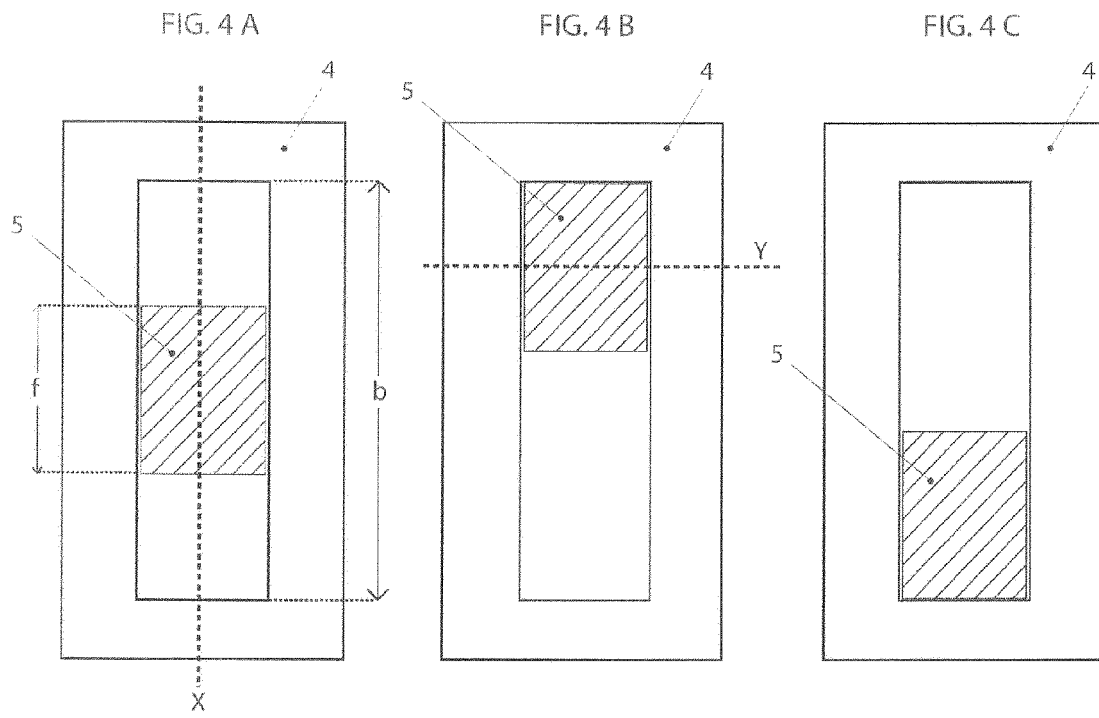


FIG. 3 A





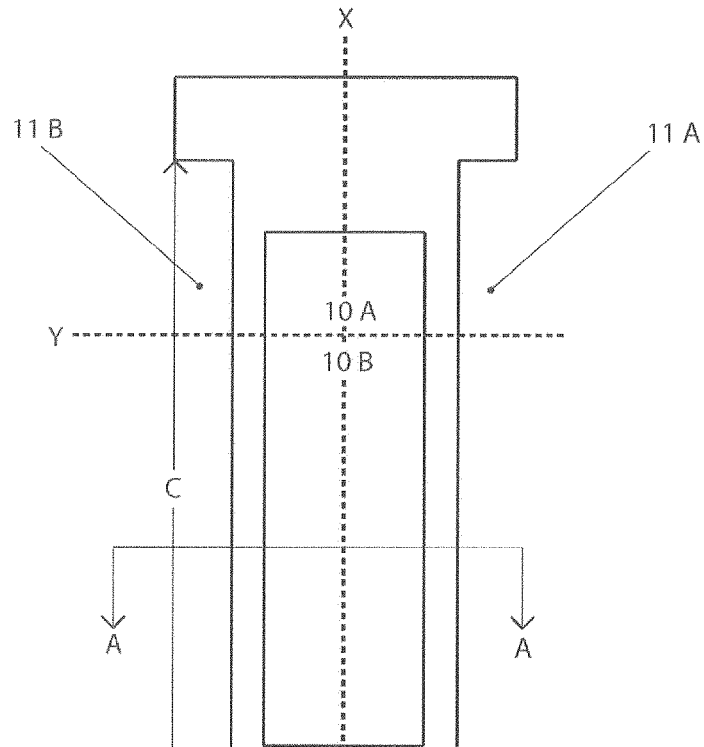


FIG. 6

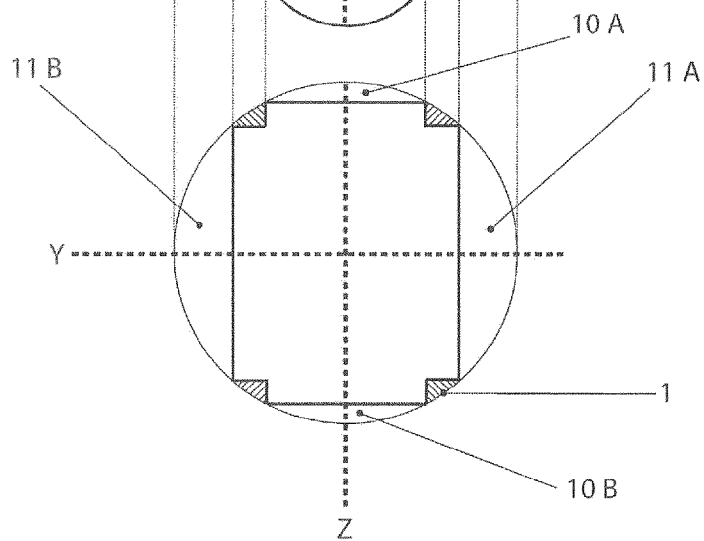


FIG. 7

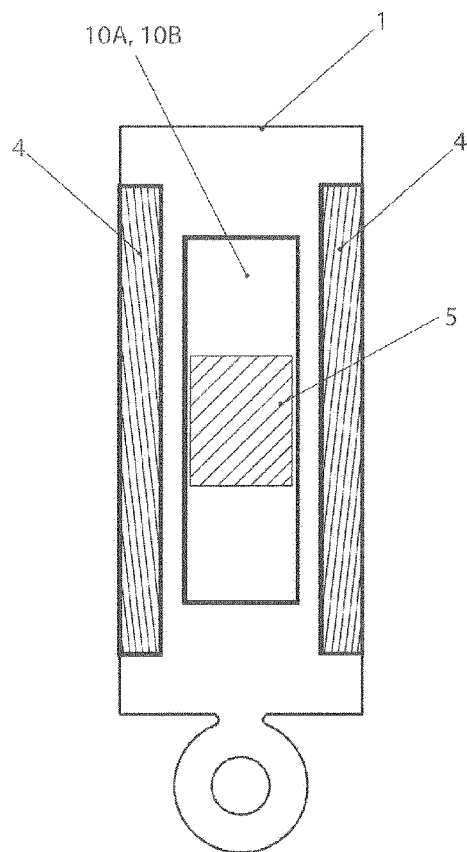


FIG. 8

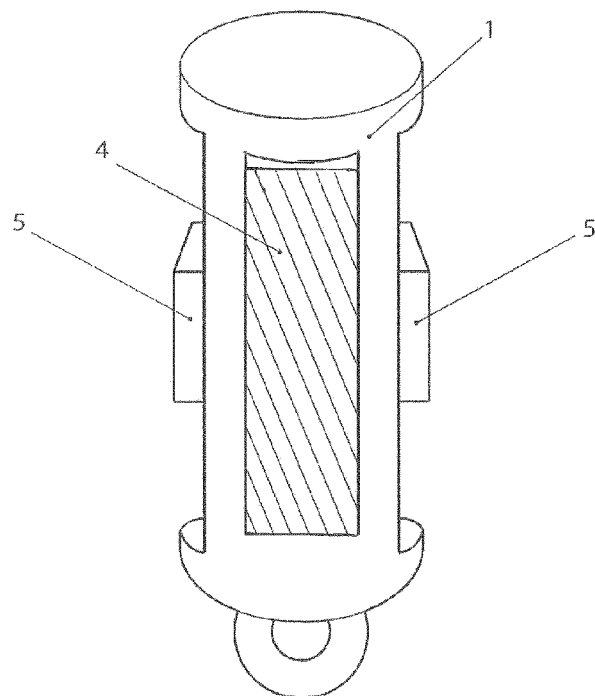


FIG. 8A

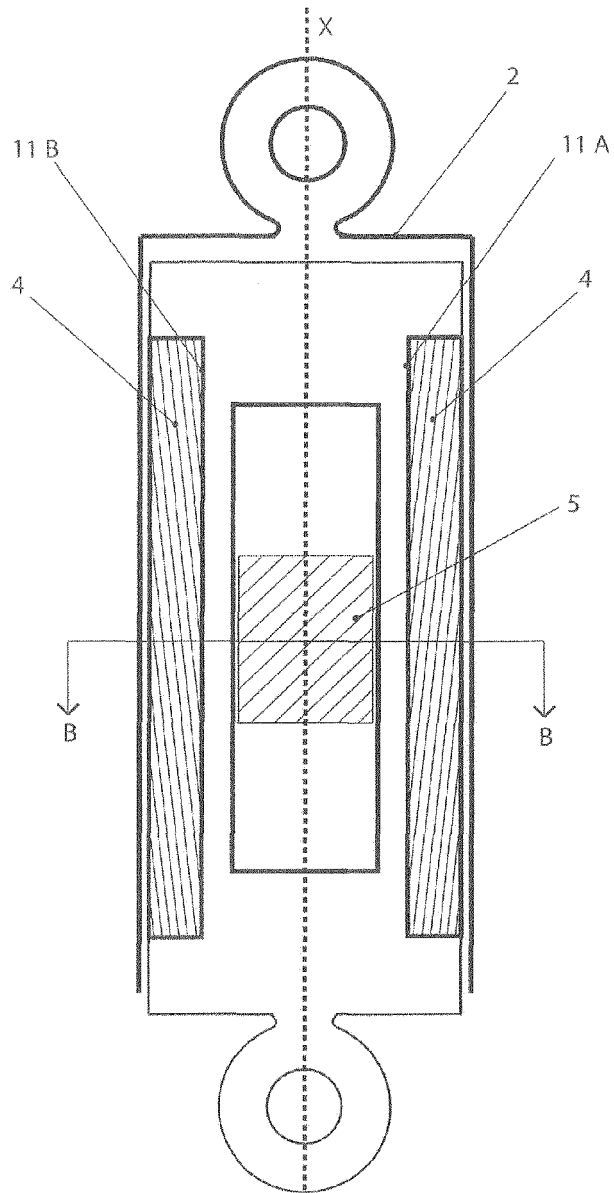


FIG. 9

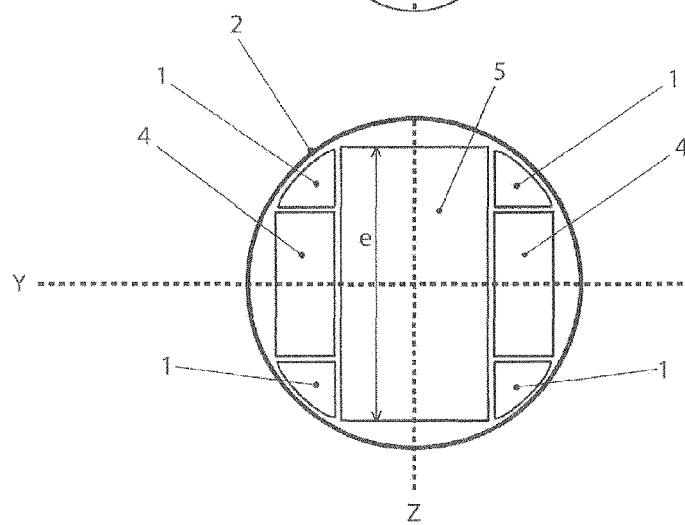
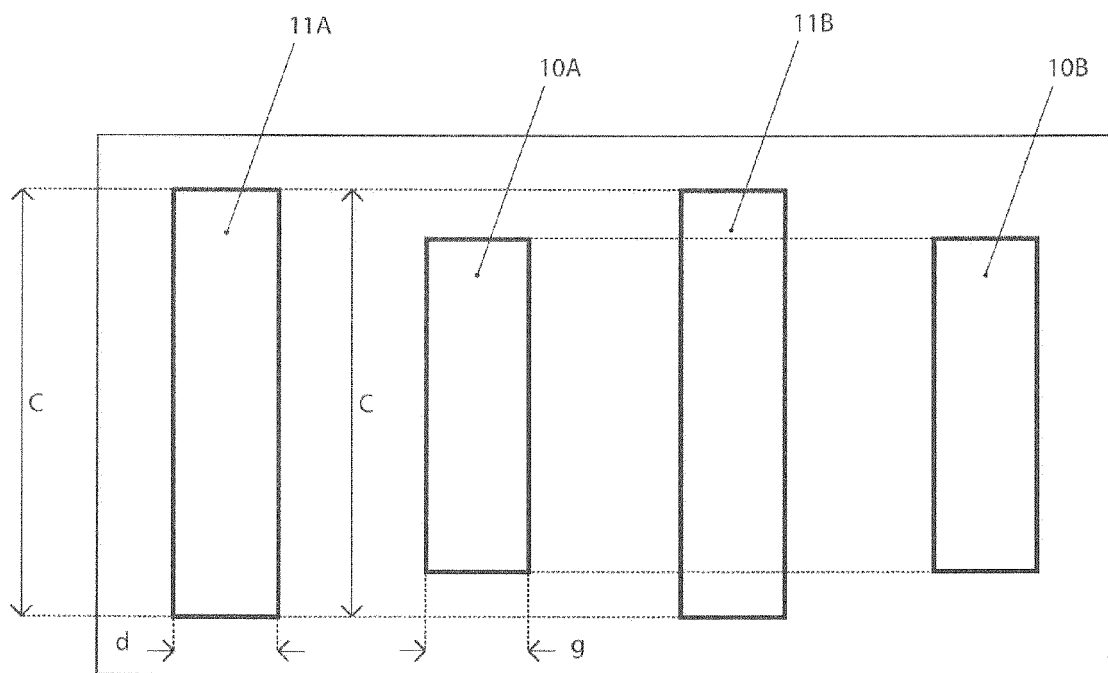
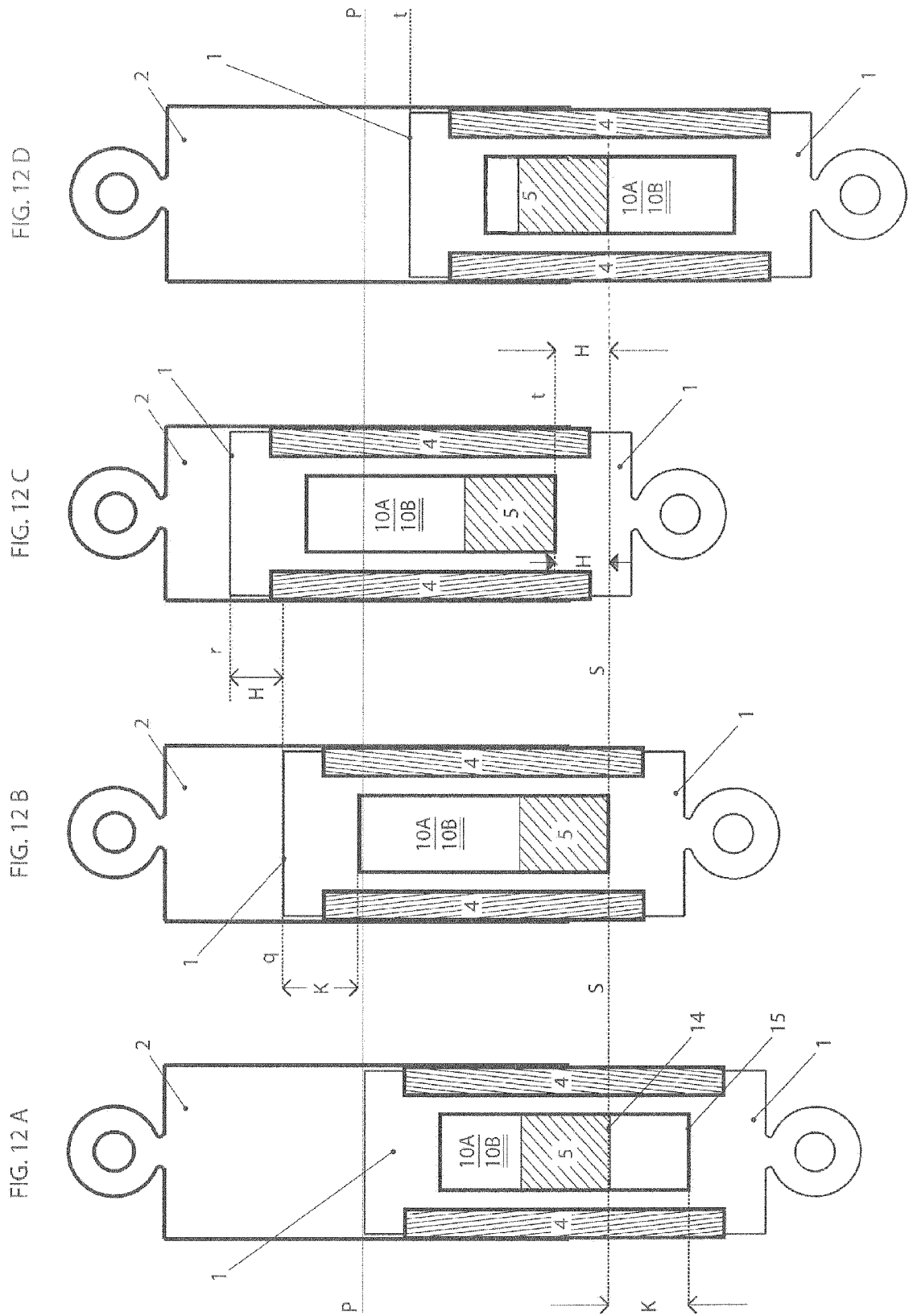


FIG. 10







EUROPEAN SEARCH REPORT

Application Number
EP 13 17 9738

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A,D	US 2004/144137 A1 (PARK GWAN-RYONG [KR] ET AL) 29 July 2004 (2004-07-29) * the whole document *	1-6	INV. D06F37/20
A	DE 32 16 152 A1 (SCHWARZENBERG WASCHGERAETE [DD]) 30 December 1982 (1982-12-30) * line 3 - page 4, line 22; figure 2 *	1-6	
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			TECHNICAL FIELDS SEARCHED (IPC)
			D06F
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 28 November 2013	Examiner Stroppa, Giovanni
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EPO FORM 1503 03.82 (P04C01)

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

EP 13 17 9738

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28-11-2013

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