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(54) Household-type clothes washing machine with compact drive motor

(57) Household clothes washing machine comprising: a rotating drum (1), a washing tub (3) mounted on to the outer casing of said washing machine, a synchronous motor comprising a stator (6) and a rotor (7), arranged coaxially with the axis of rotation (X) of said drum, and mounted externally to said tub (3) on the rear side thereof, said rotor (7) being shrink-fitted on to the rotary drive shaft (8) of said drum, a hub (9) supported by a central rear portion of said tub and accommodating said rotary drive shaft of the drum thereinside, two bearings (10,11) arranged coaxially with said rotary drive shaft (8), at least one of which being accommodated between said hub (9) and said rotary drive shaft in respective positions situated at a different distance from said drum, and adapted to rotatably support said rotary drive shaft, wherein said motor is mounted in a recessed arrangement included within the outer rear contour of said tub; in a preferred manner, the rotor (7) or the stator (6) are mounted substantially on a plane (m) corresponding to the orthogonal plane passing through the bearing arranged externally relative to the axis of rotation (X). In the case that the stator is mounted internally relative to the rotor, an advantageous improvement consists in having the outer bearing (11) supported by the inner surface of the stator (6).

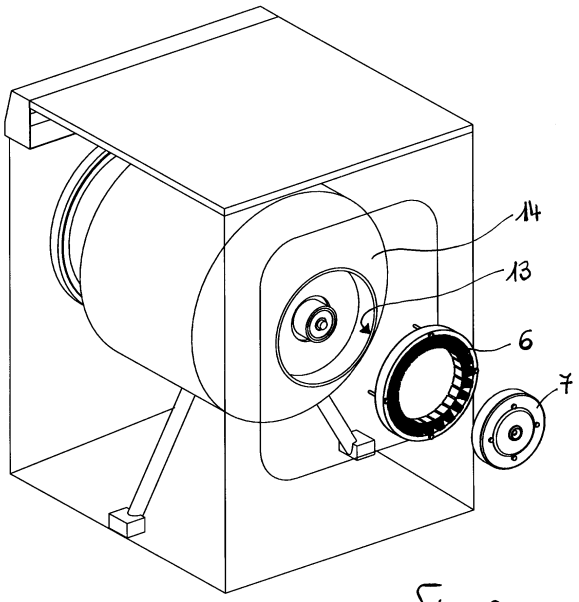

Fig. 2

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Description

[0001] The present invention refers to an improved kind of both front-loading and top-loading clothes washing machine that is provided with a washing tub and a drive motor for rotatably driving a rotating drum housed within said washing tub, wherein said clothes washing machine is particularly compact in the depth dimension, i.e. in the direction from the front side to the rear side thereof, and wherein said drive motor is adapted to be easily replaced or repaired.

[0002] Clothes washing machines are generally known to have an inner drum, which is rotatably driven by means of the rotary drive shaft thereof that is caused to pass through a central aperture provided in the rear wall of the washing tub accommodating said drum, from which said shaft therefore protrudes. This rotary drive shaft of the drum is shrink-fitted onto a pulley, or driven pulley, that is connected to the motor or drive pulley by means of an appropriate belt engaging both of them.

[0003] As an alternative to such solution, more recently there have been developed drive motors of the synchronous type fitted for use in household-type clothes washing machines, wherein such motors are provided with a stator and a rotor that may be arranged either externally or internally relative to the stator which it is associated to.

[0004] Thanks to them being capable of being manufactured and even controlled in a quite easy, uncomplicated manner, these synchronous motors are advantageously press-fitted or shrink-fitted directly on to said rotary drive shaft of the drum, i.e. exactly behind the rear side of the washing tub. This configuration is generally referred to as "direct-drive" system in the art.

[0005] Direct drives of this kind actually bring about a number of advantages, especially of an economic and space-saving nature, since they do away with any need for an adequate space to be made available within the volume of the outer casing of a washing machine for the installation of a full-size motor and the pulley on the protruding rotary drive shaft of the drum.

[0006] Anyway, the above-described constructions and solutions are generally known to all those skilled in the art, so that they shall not be described or explained any further here.

[0007] However, the solution based on the use of a synchronous motor installed in a direct-drive configuration, while being certainly more efficient than traditional solutions, still has a drawback in that the space required for installing the synchronous motor, which is mounted exactly on the rear wall of the washing tub, implies a certain volume to be kept free behind said tub and, as a result, the depth and, therefore, the useful volume of the same tub to be reduced accordingly.

[0008] In addition, synchronous motors used in such direct-drive configurations have a further drawback in that they cannot be repaired in the machine, i.e. in the assembled condition thereof. Should they be repaired or replaced for any reason whatsoever, these motors must therefore be fully removed from the machine and replaced in their entirety. It can be readily appreciated that this entails costs that could be at least partly avoided in the case that a motor failure occurs either only in the rotor or only in the stator.

[0009] It would therefore be desirable, and it is actually an object of the present invention, to provide a clothes washing machine fitted out with a synchronous motor mounted directly on to the rotary drive shaft of the rotating drum in a so-called direct-drive configuration, which does not involve any substantial increase in space requirements due to the motor being installed behind the rear wall of the washing tub accommodating said drum, and which allows for convenient maintenance further to ensuring the possibility for the rotor and/or the stator to be replaced independently of each other.

[0010] According to the present invention, these aims are reached in a particular kind of clothes washing machine provided with a drum, a washing tub and a synchronous motor of the direct-drive type, so as this is described in greater detail below by way of non-limiting example with reference to the accompanying drawings, in which:

- Figure 1 is a view of a washing tub provided with a synchronous motor of a kind according to the prior art;
- Figure 2 is an exploded view of the washing tub, the drum, the hub supporting the drive shaft of the drum, the stator and the rotor of the motor according to a first embodiment of the present invention;
- Figure 3 is a median cross-sectional view, through the axis of the drum, of the washing tub shown in Figure 2, with the various component parts in the assembled state thereof;
- Figure 4 is an exploded view of the washing tub, the drum, the hub supporting the drive shaft of the drum, the stator and the rotor of the motor according to a second embodiment of the present invention;
- Figure 5 is a median cross-sectional view, through the axis of the drum, of the washing tub shown in Figure 4, with the various component parts in the assembled state thereof;
- Figure 6 is an exploded view of the washing tub, the drum, the hub supporting the drive shaft of the drum, the stator and the rotor of the motor according to a third embodiment of the present invention;
- Figure 7 is an enlarged median cross-sectional view, through the axis of the drum, of the washing tub shown in Figure 6, with the various component parts in the assembled state thereof.

[0011] A clothes washing machine according to the prior art comprises a perforated rotating drum 1 for holding and handling the clothes to be washed, a loading door 2 ensuring access into said drum, a washing tub 3 mounted on - even in a suspended or oscillating manner - to the outer casing of said washing machine and accommodating said drum 1, which is therefore housed rotatably inside said tub. It further comprises a synchronous motor comprising a stator 6 and a rotor 7, arranged coaxially with the axis of rotation X of said drum and mounted externally to said tub on the rear side thereof, wherein said rotor 7 is shrink-fitted on to the rotary drive shaft 8 of said drum, a hub 9 being applied axially on to a central rear portion of said tub and accommodating said rotary drive shaft of the drum thereinside.

[0012] Provided to support said drive shaft 8 there are two bearings 10, 11 arranged coaxially with said rotary drive shaft 8 and accommodated between said hub 9 and said rotary drive shaft. The inner bearing 10 and the outer bearing 11 are situated at different distances "a" and "b", respectively, from a common plane K passing through the drum inside the tub.

[0013] According to the present invention, said motor is not positioned behind the rear wall of the tub, but rather within an appropriate cylindrical recess 13 provided in said rear wall 14 of the tub.

[0014] This is obtained by providing said accommodation or recess 13 in the space that is generally occupied by the thickness of said rear wall 14 and the reinforcing ribs 15 provided thereon, without of course affecting the strength and robustness of the same rear wall, which can on the other hand be most easily kept unaltered by sizing said ribs 15 accordingly as far as the number and the thickness thereof are concerned.

[0015] The tub itself can be manufactured using any technique and material, or combination thereof, as are generally known as such and used in the art. It will however be most readily appreciated that the present invention can best be applied to a moulded plastic tub, since such tub is by itself provided with a significant thickness on its rear side enabling said recessed accommodation 13 to be conveniently provided there.

[0016] With reference to Figures 2 and 3, these may be noticed to illustrate a first embodiment of the present invention, in which the stator 6 is arranged externally, i.e. adhering against the inner surface of said recessed accommodation, whereas the rotor 7 is arranged internally, i.e. inside the stator.

[0017] With reference to Figures 4 and 5, these may be noticed to illustrate a second embodiment of the present invention, in which the stator 6 is on the contrary arranged internally, whereas the rotor 7 is arranged externally, i.e. adhering against the inner surface of said recessed accommodation 13.

[0018] In particular - and advantageously - the rotor and the stator, and preferably both of them, are aligned with the outer bearing 11, in the sense that their symmetry or median plane m, which lies orthogonal to the axis X, passes through the median plane of the outer bearing 11 or quite close thereto.

[0019] In fact, since the position of the outer bearing 11 is practically dictated by mechanical considerations and constraints, an alignment of the synchronous motor with the outer bearing enables the in-depth space taken up by the same motor relative to the tub to be minimized.

[0020] With reference to Figures 6 and 7, these illustrate a further improved embodiment of the present invention. This calls for the stator 6 to be mounted internally and the rotor 7 to be mounted externally, while the outer bearing 11, instead of being mounted inside the hub 9, is mounted directly inside the stator 6, the hub 9 terminating before reaching, i.e. in advance of the position of said outer bearing 11.

[0021] This embodiment has in fact the advantage of enabling the stator to be assembled in an integrated manner with the rear wall of the tub in an operation that is fully independent of the assembly of the rotor, which can therefore be mounted separately in a subsequent, again fully independent operation.

[0022] It can therefore be readily appreciated that such solution is effective in enabling the rotor to be replaced without having to also disassemble the stator. On the other hand, in the case of the configuration illustrated in Figures 2 and 3, such possibility is given for the stator, which can in fact be replaced without any need arising for also the rotor to be disassembled.

[0023] A further advantage of this particular embodiment lies in a clear improvement that can be achieved in terms of production standardization, since the possibility is given here for washing tubs provided with a same stator to be mass-produced, all of them duly provided with a same stator, to which different rotors may then be each time associated to cope with different functional or operating specifications which the various washing machine models are required to comply with.

[0024] Referring again to Figures 6 and 7, the stator 6 is secured to the rear wall 14 of the tub with the help of fastening means that are largely known as such in the art, e.g. by means of bolts 17 extending axially through the stator to eventually engage the same rear wall 14 or, preferably, the annular rear wall 18 of the hub 9, as this is allowed for by the very circumstance that said hub does not reach out to the axial position occupied by the related stator 6.

Claims

1. Household clothes washing machine, either of the front-loading or the top-loading type, comprising:

   - a perforated rotating drum (1),
   - a loading door (2) ensuring access into said drum,
   - a washing tub (3) mounted on to the outer casing of said washing machine and accommodat-

ing said drum (1), which is therefore housed rotatably thereinside,
- a synchronous motor comprising a stator (6) and a rotor (7), arranged coaxially with the axis of rotation (X) of said drum, and mounted externally to said tub on the rear side thereof, said rotor (7) being shrink-fitted on to the rotary drive shaft (8) of said drum,
- a hub (9) supported by a central rear portion of said tub and accommodating said rotary drive shaft of the drum thereinside,
- two bearings (10, 11) arranged coaxially with said rotary drive shaft (8), which are accommodated between said hub (9) and said rotary drive shaft in respective positions situated at a different distance from said drum, and are adapted to rotatably support said rotary drive shaft (8),
characterized in that said motor is mounted in a recessed arrangement included within the outer rear contour of said tub in an appropriate accommodation (13) provided substantially within the body of the rear wall (14) of the tub.

2. Clothes washing machine according to claim 1, **characterized in that** said rotor (7), or said stator (6), or even both of them, are mounted so that the median plane (m) thereof passes substantially through the median plane of the outer bearing (11), which lies orthogonal to the axis of rotation (X).

3. Clothes washing machine according to claim 1 or 2, **characterized in that** said rotor (7) is mounted either externally or internally relative to said stator (6).

4. Household clothes washing machine, either of the front-loading or the top-loading type, comprising:

- a perforated rotating drum (1) provided to hold and agitate the clothes to be washed,
- a loading door (2) ensuring access into said drum,
- a washing tub (3) mounted on to the outer casing of said washing machine and accommodating said drum (1), which is therefore housed rotatably thereinside,
- a synchronous motor comprising a stator (6) and a rotor (7), arranged coaxially with the axis of rotation (X) of said drum, and mounted externally to said tub on the rear side thereof, said rotor (7) being shrink-fitted on to the rotary drive shaft (8) of said drum,
- a hub (9) supported by a central rear portion of said tub and accommodating said rotary drive shaft of the drum thereinside,
- an inner bearing (10) and an outer bearing (11) arranged coaxially with said rotary drive shaft (8) and adapted to rotatably support said rotary drive shaft (8),

characterized in that

- said motor is mounted in a recessed arrangement included within the outer rear contour of said tub in an appropriate accommodation (13) provided substantially within the body of the rear wall (14) of the tub,
- said rotor (7), or said stator (6), or even both of them, are mounted so that the median plane (m) thereof passes substantially through the median plane of the outer bearing (11), which lies orthogonal to the axis of rotation (X),
- the inner bearing (10) is supported by the inner surface of said hub (9),
- the outer bearing (11) is supported by the inner surface of said stator (6).

5. Clothes washing machine according to claim 4, **characterized in that** said rotor (7) is arranged on the radially outer surface of said stator (6).

6. Clothes washing machine according to claim 5, **characterized in that** said stator (6) is secured to the rear wall (14) of the tub with the help of removable fastening means (17) applied axially through the stator and adapted to engage said rear wall (14) or even the annular rear wall (18) of said hub (9).

7. Clothes washing machine according to any of the preceding claims, **characterized in that** said tub, or said rear wall (14) thereof, is made of plastics.

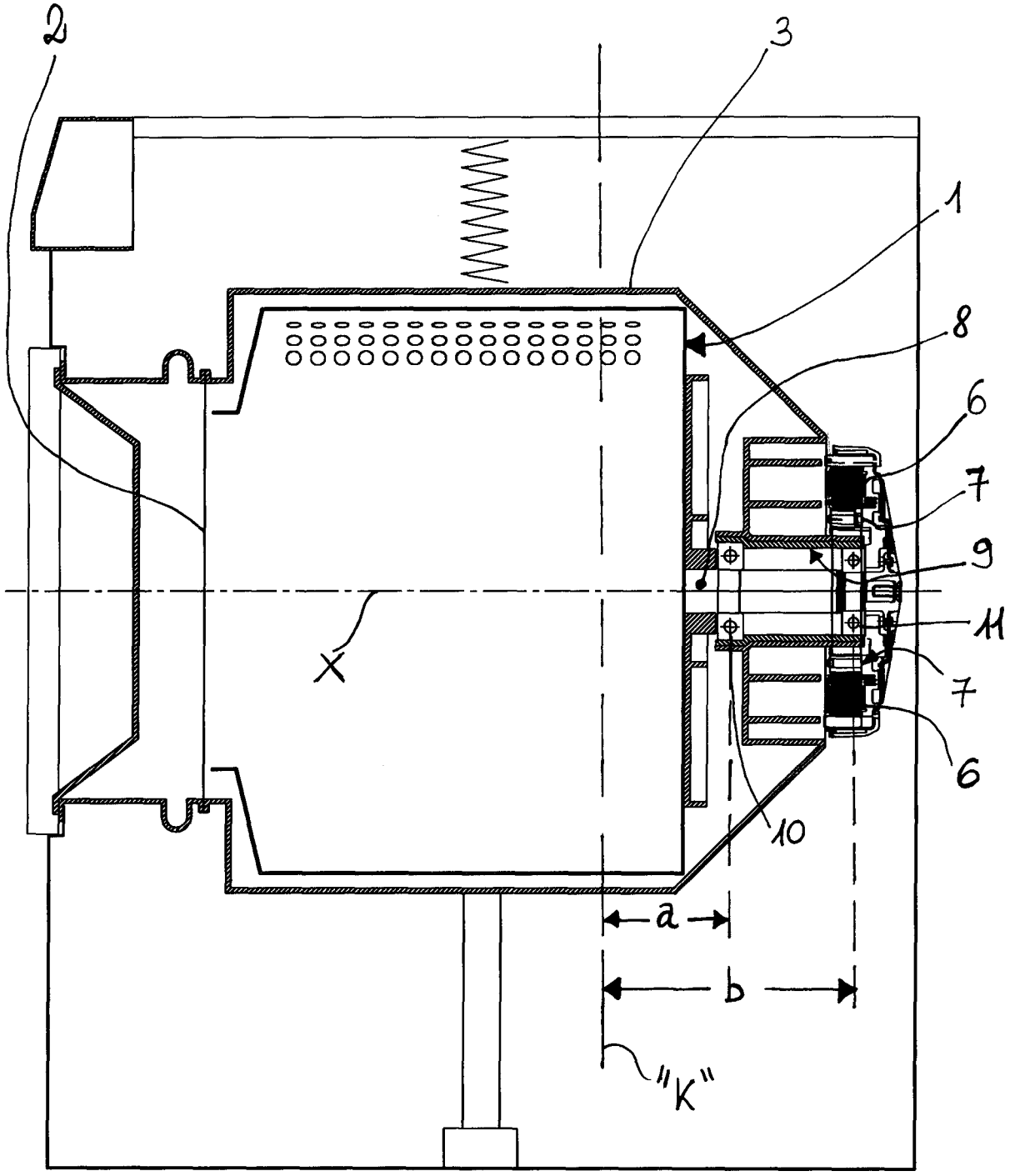

fig. 1

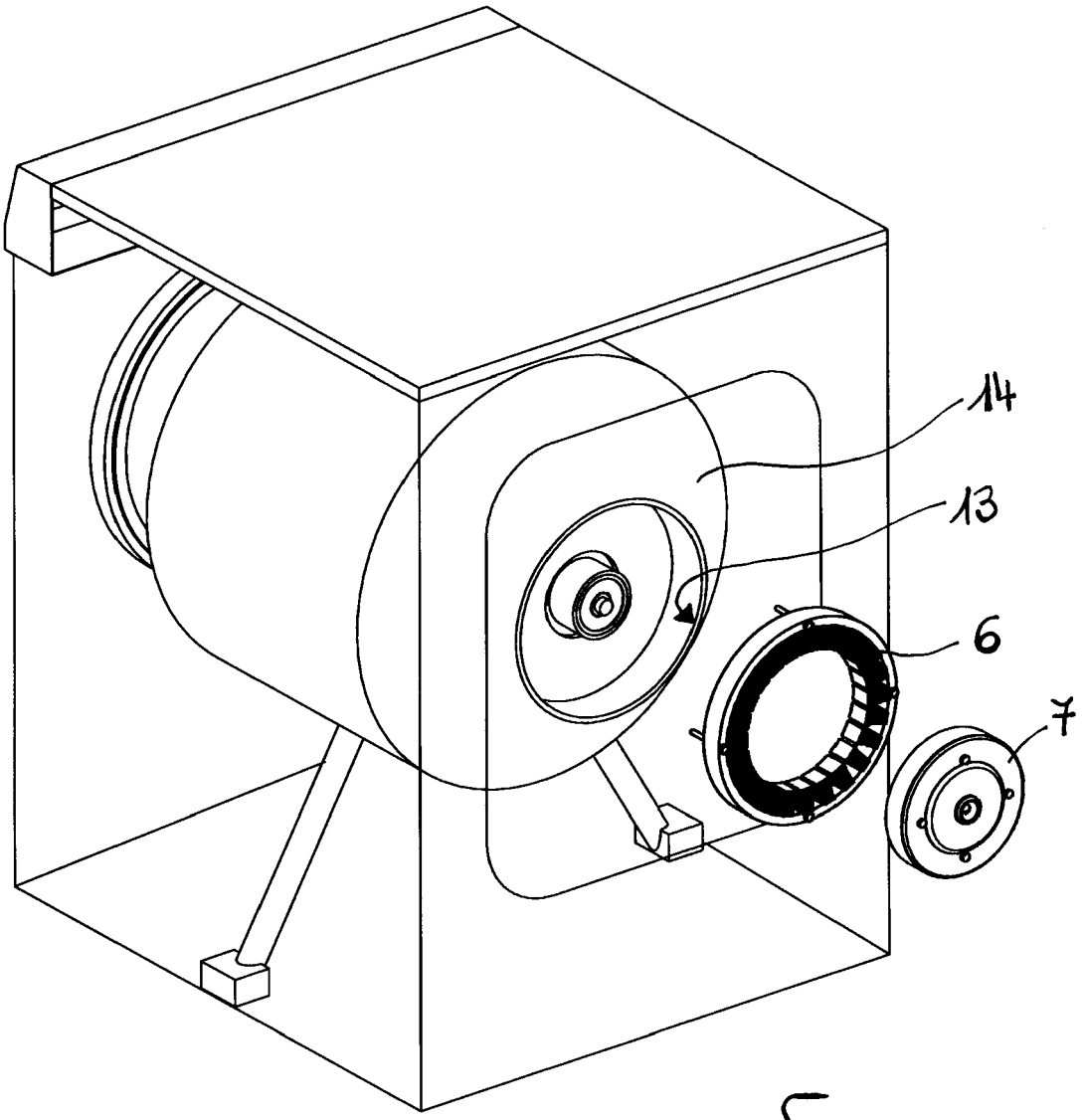

Fig. 2

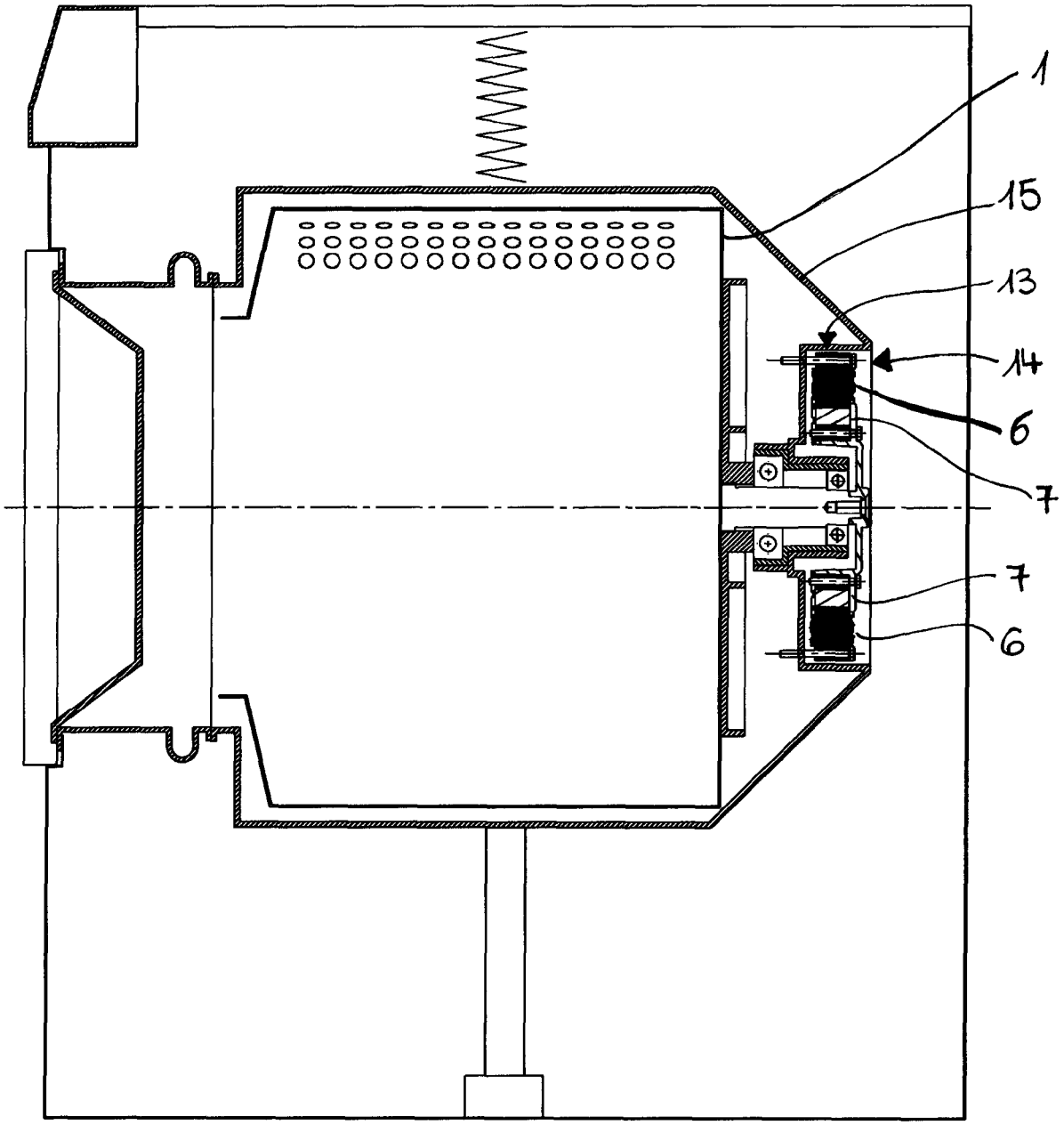

fig. 3

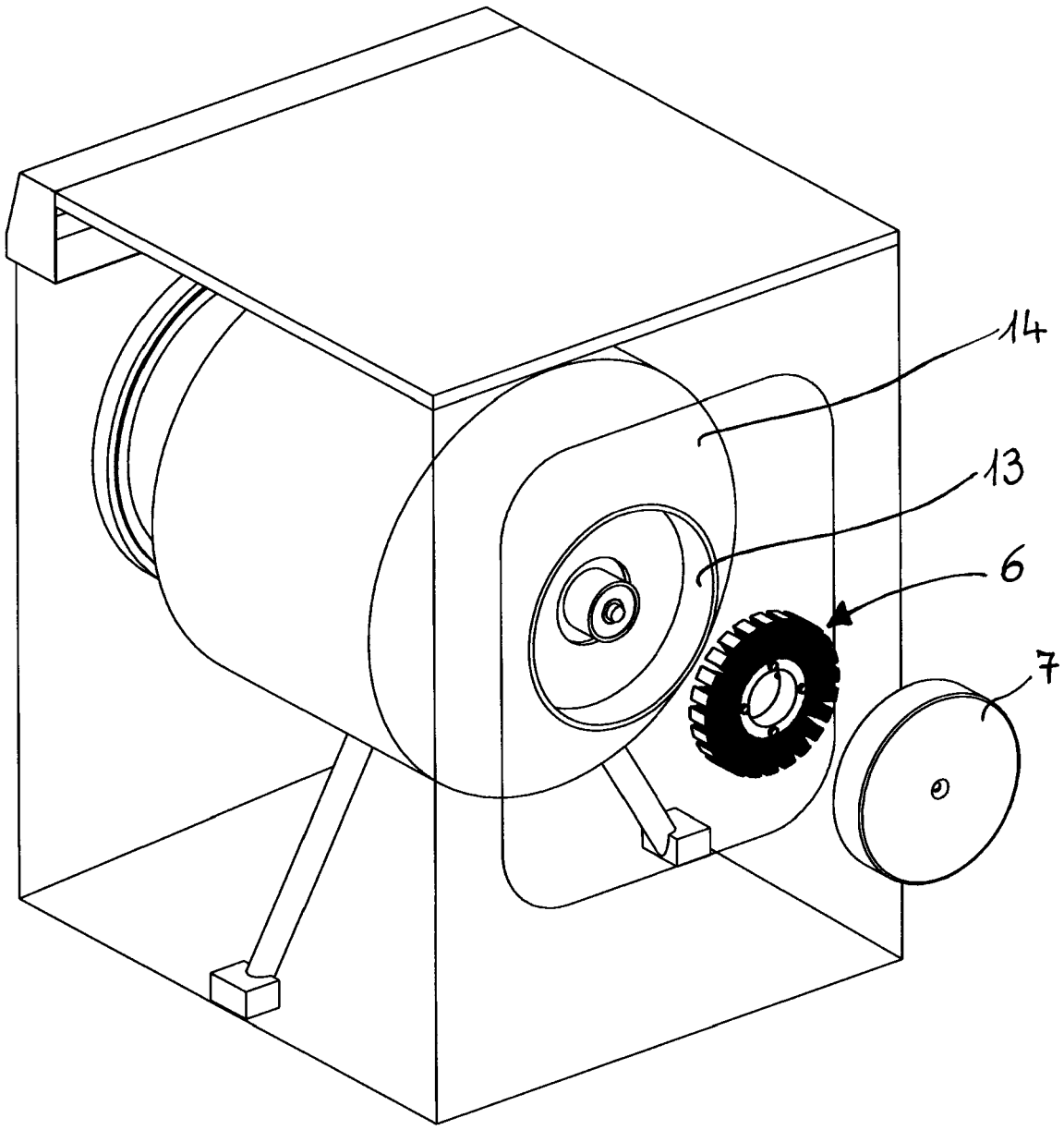

fig. 4

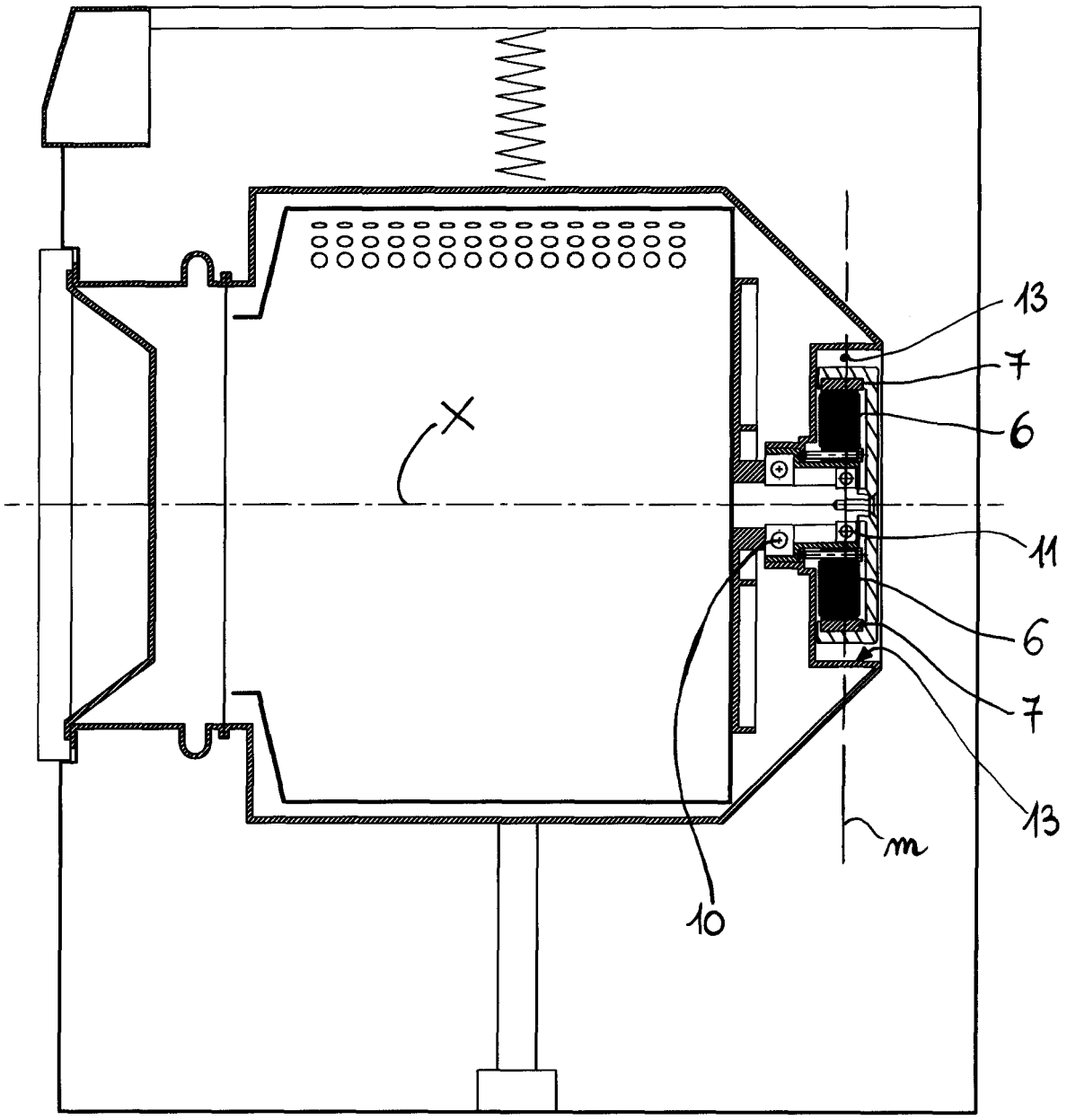

fig. 5

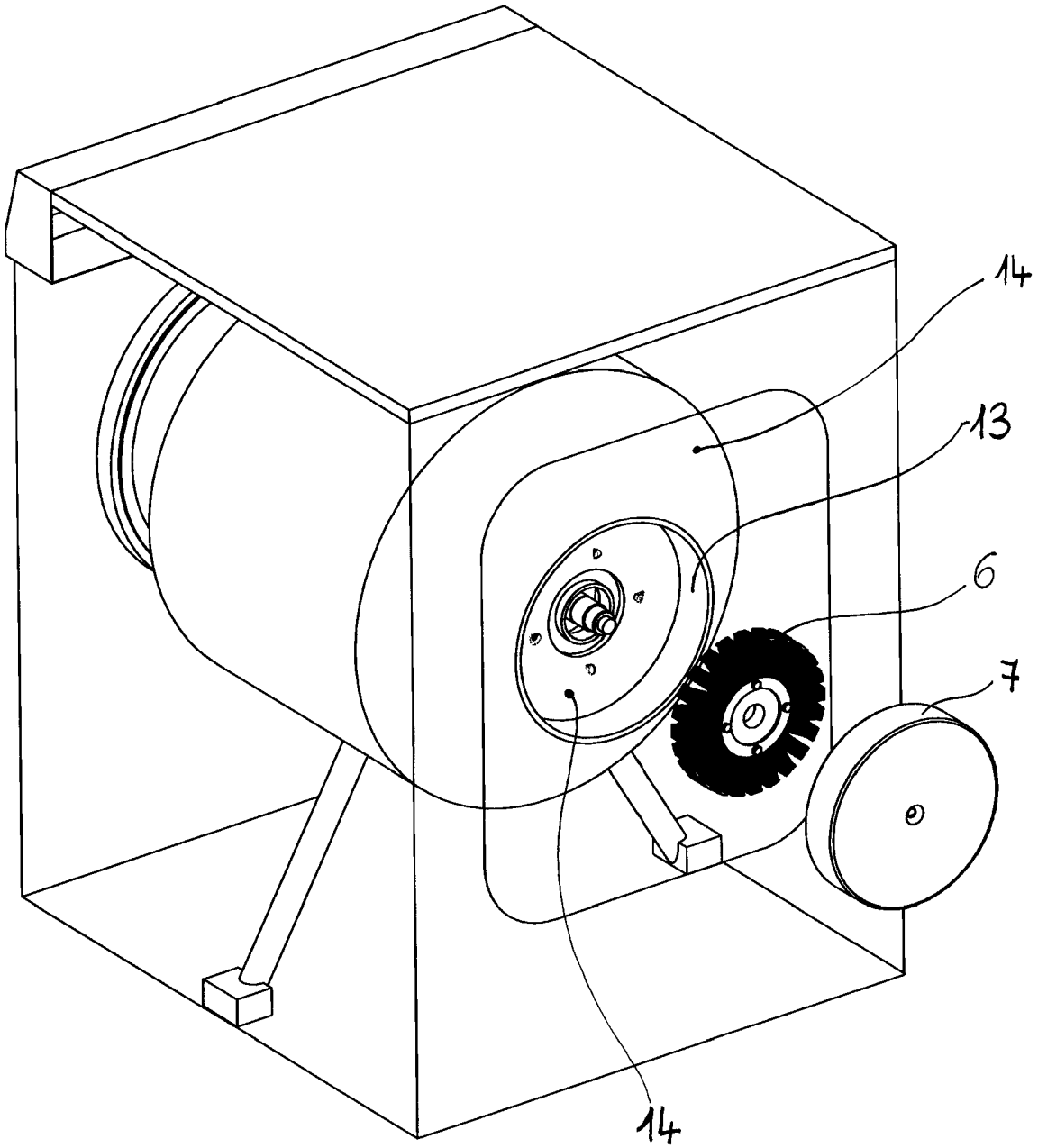

fig. 6

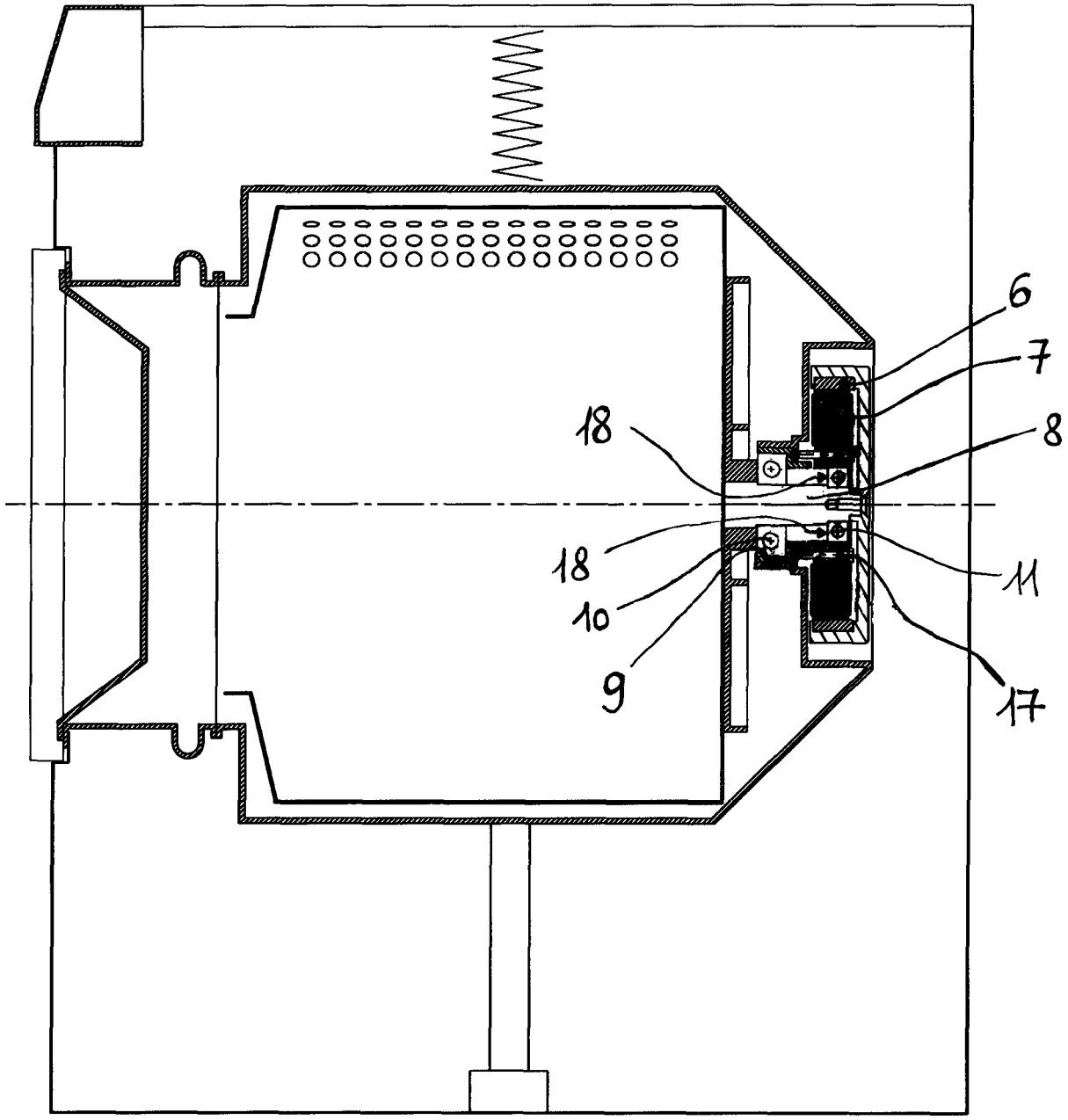

fig. 7

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Application Number
EP 05 11 1751

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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	24 August 2006	Falkentoft, C

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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