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(54) **Washing machine with compact drum driving system**

(57) A washing machine comprises a tub in which a drum is rotatably mounted and driven by transmission means provided between two bearings supporting a shaft of the drum, and an electric motor driving such transmission means. The motor is mounted in a space comprised between a rear end of the tub and a supporting dish-shaped element carrying one of the bearing, a second bearing being supported by the rear end of the tub.

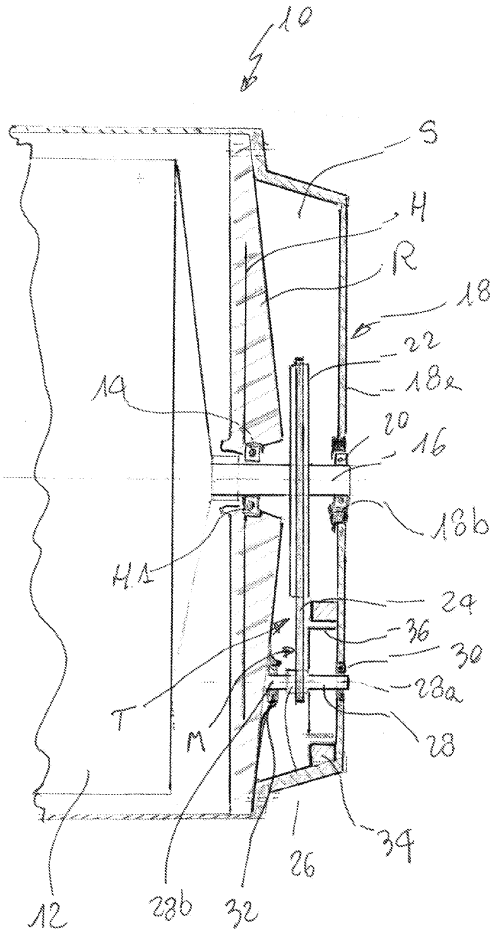

Fig. 1

EP 2 436 826 A1

Description

[0001] The present invention relates to a washing machine comprising a tub in which a drum is rotatably mounted and driven by transmission means provided between two bearings supporting a shaft of the drum, and a motor driving such transmission means.

[0002] A washing machine of this kind is disclosed by JP 2004-105267. In this known solution it is provided a sort of integrated drive system which has some advantages compared to the direct drive system. On the other hand the way in which the motor and the pulley or gear transmission system is mounted on the tub does not allow reducing the overall space of the suspended mass (tub + motor), particularly for washers having a horizontal axis.

[0003] It is therefore an object of the present invention to provide a washing machine of the above type which does not present the above drawback and which presents much reduced dimensions of the system tub + motor.

[0004] A further object of the present invention is to increase the overall stiffness of the mounting system of the cantilevered suspension of the rotating drum. A further object is to provide a washing machine in which the noise is very low compared to known machine. A further object is to provide a washing machine in which the integrated drive system is very easy to be installed on the machine.

[0005] These and further objects are obtained thanks to the features listed in the appended claims.

[0006] One of the main advantages of the present invention, in which the motor is totally installed in a substantially closed space on one end of the tub, is the absence of protruding components, for instance the motor, which necessarily reduce the overall dimension of the tub, and therefore reduce the load of the washer. By enclosing the motor in a closed space does reduce the noise of the transmission system.

[0007] The closed space between the rear face of the tub and a cover can be used also for housing the electronic diving circuit of the motor. Moreover, if the cover is made of metal, it can be used as a heat sink for such electronic driving circuit. Further advantages and features of the present invention will become clear from the following detailed description, with reference to the attached drawings, in which:

- figure 1 is a cross sectional view of one rear part of the tub of a washing machine according to the invention;
- figure 2 is a view similar to figure 1 and refers to a second embodiment of the invention;
- figure 3 is a view similar to figure 1 and refers to a third embodiment of the invention;
- figure 4 is a view similar to figure 1 and refers to a fourth embodiment of the invention;
- figure 5 is a view similar to figure 1 and refers to a fifth embodiment of the invention; and
- figure 6 is a perspective exploded view of a motor used in any of the above embodiment, and particularly in the embodiments of figures 1 and 2.

[0008] With reference to the drawings, a washing machine comprises a tub 10 and a drum 12 rotatably mounted in the tub 10. A rear wall R of the tub 10 is made of polymeric material and present a co-injected disc-shaped metal stiffener H. Such stiffener H present a central aperture H1 on which an external ring of an internal bearing 14 supporting a shaft 16 of the drum 12 is mounted. On the rear wall R of the tub 10 it is mounted, by means of screws or similar fastening means, a cup-shaped supporting element or cover 18 preferably made of metal. A flat portion 18a of the supporting element 18 presents a central hole 18b which support an external bearing 20 for the drum shaft 16. On this latter is mounted a driven pulley 22 of a transmission system T including a belt 24 and a drive pulley 26. Instead of a pulleys-belt transmission system T, a gear transmission system can be used as well. The supporting element 18 may be provided with stiffening ribs (not shown).

[0009] The above construction of a transmission system T in a closed space, identified with reference S in the drawings, facing the tub is common to all the embodiments of the present invention.

[0010] With reference to figure 1 the motor M present a shaft 28, to which the pulley 26 is coupled, which is supported on a first end 28a by a first motor bearing 30 mounted on the supporting element 18, and on a second end 28b by a second motor bearing 32 mounted in a seat of the rear wall R of the tub 10. A stator 34 is fixed to an inner wall of the supporting element 18, while a rotor 36 is coupled to the shaft 28. If the rear wall R of the tub is assembled as a separate component of the tub (installed thereto by means of friction welding), the solution according to the invention presents the advantage that the overall driving system can be easily mounted, as a whole component, to the tub.

[0011] In the second embodiment of the present invention (figure 2), in which identical or similar components are identified with the same reference numerals of figure 1, the motor M is supported in a cantilevered way by the supporting element 18. The shaft 28 of the motor is rotatably supported by the supporting element 18 by means of bearings 40. In both embodiments according to figures 1 and 2 the stator 34 can be integral with the flat portion 18a of the supporting element 18, in a way described in connection with figure 6. The embodiment of figure 2 can be assembled in a very easy way, mainly due to the fact that the motor M is a built- in component already installed in the supporting element 18. Therefore, by using an intermediate removable shaft (not shown), it is possible to have an assembly comprising the supporting element or cover 18, the motor M, the pulley 22 and the belt 24. By coupling such assembly with the tub, the shaft 16 of the drum abuts one end of the removable shaft and replaces

it. According to an alternative solution, the intermediate shaft can be coupled (and therefore not removed) with the drum shaft 16 by using one of the well known shaft coupling systems.

[0012] The embodiment of figure 3 is very close to the embodiment of figure 2, with the difference of presenting a supporting element 18 which is open in the lower part thereof (with reference to the working configuration of the washing machine). In figure 3 such lower aperture is identified with the reference K. This solution has the advantage of a better heat dissipation and it allows also having enough space to reach a certain pulley dimension in case a high transmission ratio is needed.

[0013] The solution shown in figure 4 presents a motor shaft supporting system substantially identical to the first embodiment, but in which the stator 34a is supported in a seat 42 of the rear wall R of the tub 10.

[0014] The solution according to figure 5 is close to the solution of figure 4, but in this case the motor shaft 28 is supported in a cantilevered way by bearings 40a whose outside rings are supported by a seat 44 of the rear wall R of the tub 10. In both solutions according to figures 4 and 5, for increasing the stiffness and the assembly precision, the stiffener H can match the stator 34 or can be integral therewith. In the assembly process of the embodiment of figure 5, the first step is to fix the motor M to the tub. Then the shaft 16 of the drum is inserted in the bearing 14 and the pulley 22 is coupled to such shaft 16. The next step is to put the belt on the driven pulley 22 and on the driving pulley 26 of the motor. The last step is to fix the supporting or cover 18.

[0015] Figure 6 shows one of the preferred flat motor M which can be used in the washing machine according to the invention. Such motor is already disclosed by EP 2228481 with reference to a direct drive motor. With reference to figure 6, the motor comprises a metal portion P which is integral with the supporting element 18 (figures 1, 2 and 3) or with the stiffener H (figures 4, 5) A shaped central aperture Pa of the portion P acts as the housing of a motor bearing 30. In the bearing 30 the shaft 28 is rotatably mounted. The rotor assembly 36 present a central tubular portion 36a keyed on the shaft 28, an inner crown 36b and an outer crown 36c, each crown being provided with magnets (not shown) secured along a circumferential direction. The inner crown 36b of the rotor assembly 36 is obtained by providing C-shaped cutting 52 on the flat central portion of a cup-shaped element and then by bending the so obtained tongues. By this process a dual rotor is produced in a quick way by simple metal bending, the outer crown 36c being connected to the rest of the rotor by spokes 54 between the cutting 52.

[0016] In this preferred embodiment of the motor M, the portion P presents an annular zone where a plurality of L-shaped tongues 56 or flaps are punched along a C-shaped profile and then shaped so that each tongue has a fist portion 56a substantially parallel to the shaft 28 and a second portion 56b which is projecting outward in a radial direction. The second portions 56b of each tongue 56 has a shape corresponding to the shape of single partition core 58 made of stacked lamination.

[0017] In the assembly process of the motor M of figure 6 the single cores 58 are frontally assembled to the second portions 56b of the flap 56 by known techniques, preferably by tacking, tack-welding, or spot-welding. Then two crown shaped plastic insulators 60 are mounted on the two front faces of the cores 58 fixed to the tongues 56, and then a coil is wound around each core 58 and tongue 56.

[0018] The plurality of holes 70 obtained through the punching process of the tongues 56 allows a good air flow in the motor and therefore a good cooling thereof.

[0019] From the above description it is clear that the solution to fix the stator active material (i.e. magnet steel and copper winding) is very simple and cheap. This can be implemented by using a finger-shaped tongue for each motor core 58 or just a proper subset of punched tongues integrated in some of the stator slots. In order to increase the stiffness of the stator, the metal portion P is preferably provided with a plurality of stiffening ribs (not shown) obtained in the forming of the metal cover. Of course other kind of motors can be used, without the finger-shaped tongues.

[0020] Even if on the above embodiments the supporting element 18 is described as a flat cup-shaped element, there can be provided bumps thereon in order to house bigger version of the motor M. As al alternative solution, a cut-out can be provided in the cover matching the motor.

[0021] Moreover, according to the invention the motor M can be placed in different positions in the rear space S; if it is housed in the upper portion of the space S, it is possible to avoid problems to the motor in case of water leakage from the tub.

Claims

1. Washing machine comprising a tub (10) in which a drum (12) is rotatably mounted and driven by transmission means (T) provided between two bearings (14, 20) supporting a shaft (16) of the drum (12), and a motor (M) driving such transmission means (T), **characterized in that** such motor (M) is mounted in a space (S) comprised between a rear end (R) of the tub (10) and a supporting element (18) carrying one of the bearing (20), a second bearing (14) being supported by the rear end (R) of the tub (10).

2. Washing machine according to claim 1, wherein the motor (M) presents a motor shaft (28) having a first end (28a) supported by a first motor bearing (30) mounted on the supporting element (18) and a second end (28b) supported by a second motor bearing (32) mounted on the rear end (R) of the tub (10).

3. Washing machine according to claim 2, wherein the

motor (M) presents a stator (34) fixed or integral to the supporting element (18)

4. Washing machine according to claim 2, wherein the motor (M) presents a stator (34) fixed or integral to the rear end (R) of the tub (10).

5. Washing machine according to claim 1, wherein the motor (M) is supported by the supporting element (18).

6. Washing machine according to claim 1, wherein the motor (M) is supported by the rear end (R) of the tub (10).

7. Washing machine according to any of the preceding claims, wherein the supporting element (18) is a cup-shaped cover fixed on the frontal edge of the rear end (R) of the tub (10).

8. Washing machine according to any of the preceding claims, wherein the rear end (R) of the tub (10) is made of polymeric material co-molded with a disc-shaped stiffening element (H) adapted to cooperate with an external ring of the second bearing (14).

9. Washing machine according to claim 3 or 4, wherein the motor (M) comprises a rotor assembly (36) fastened to the shaft (28) and provided with magnets secured along a circumferential direction and a stator comprising a plurality of magnetic cores (58) of stacked laminations, insulators (60) for surrounding said cores and coils wound on the outer surface of the insulators, the stator comprising a flat metal element (P) integral to the supporting element (18) or to the rear end (R, H) of the tub (10) supporting a plurality of finger-shaped portions (56) on which said magnetic cores (58) are fastened.

10. A washing machine according to claim 9, wherein said finger-shaped portions (56) project in a radial direction.

11. A washing machine according to any of the claim 9 or 10, wherein said finger-shaped portions (56) projected in a radial direction are obtained by punching the supporting element (18) or a metal stiffening element (H) or the rear end (H) of the tub (10) in order to form L-shaped tongues (56) integral with the flat metal element (P).

12. A washing machine according to claim 11, wherein the stiffening element (H) is a co-molded metal insert.

13. A washing machine according to claim 11 or 12, wherein each tongue (56) presents a flat portion (56b) having a contour corresponding to the shape of the stacked laminations of the magnetic cores (58).

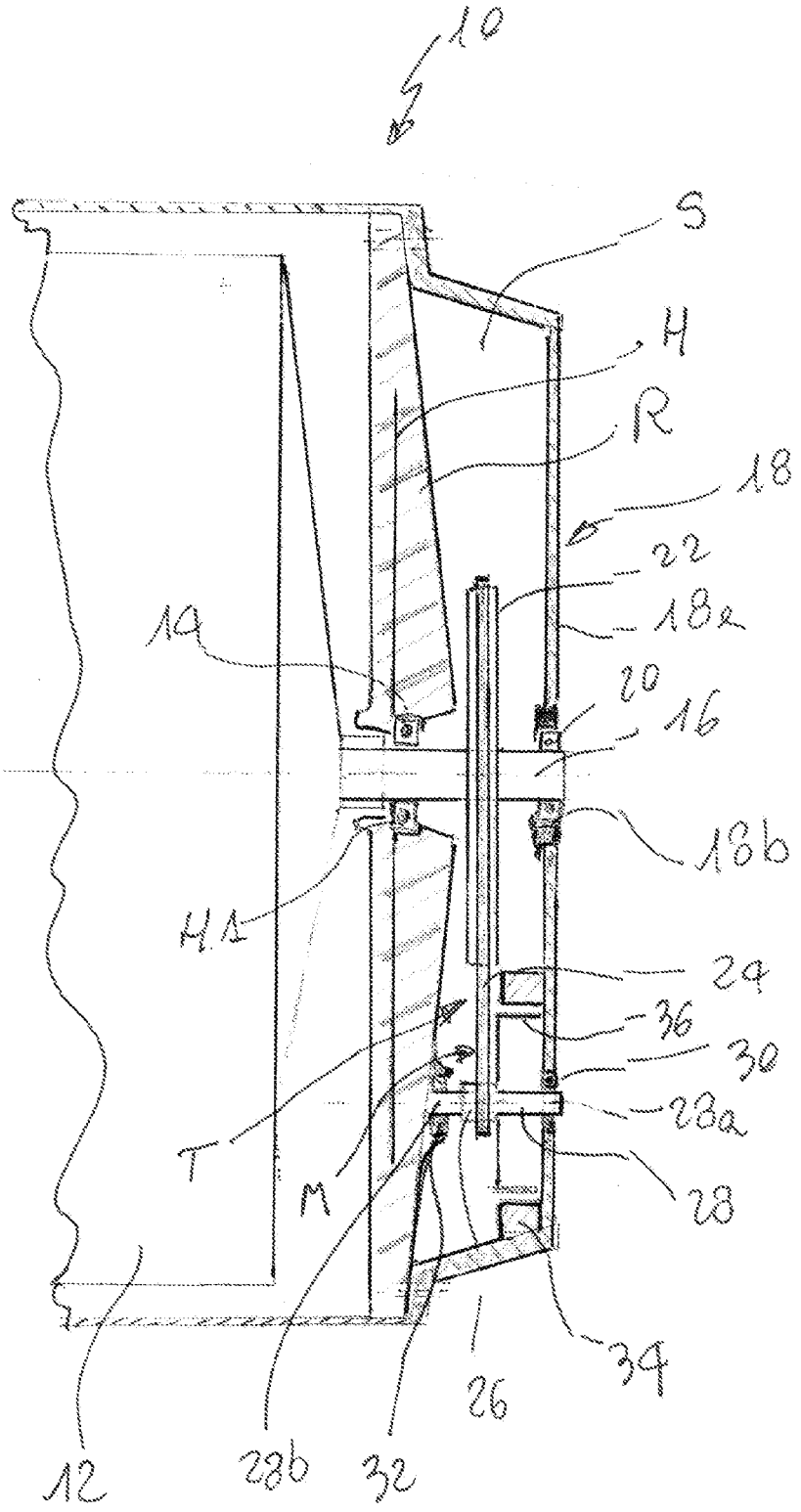

Fig. 1

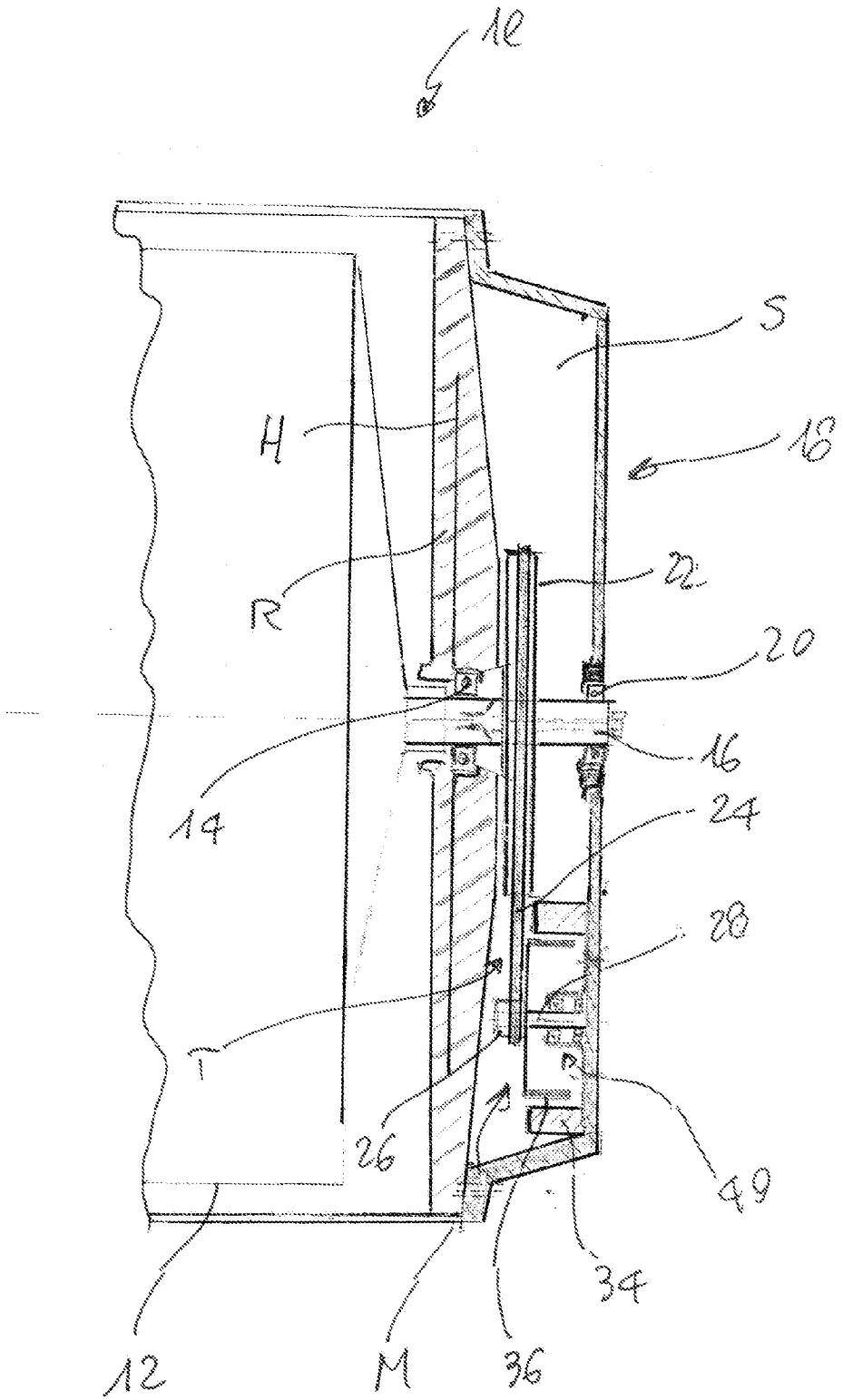

Fig. 2

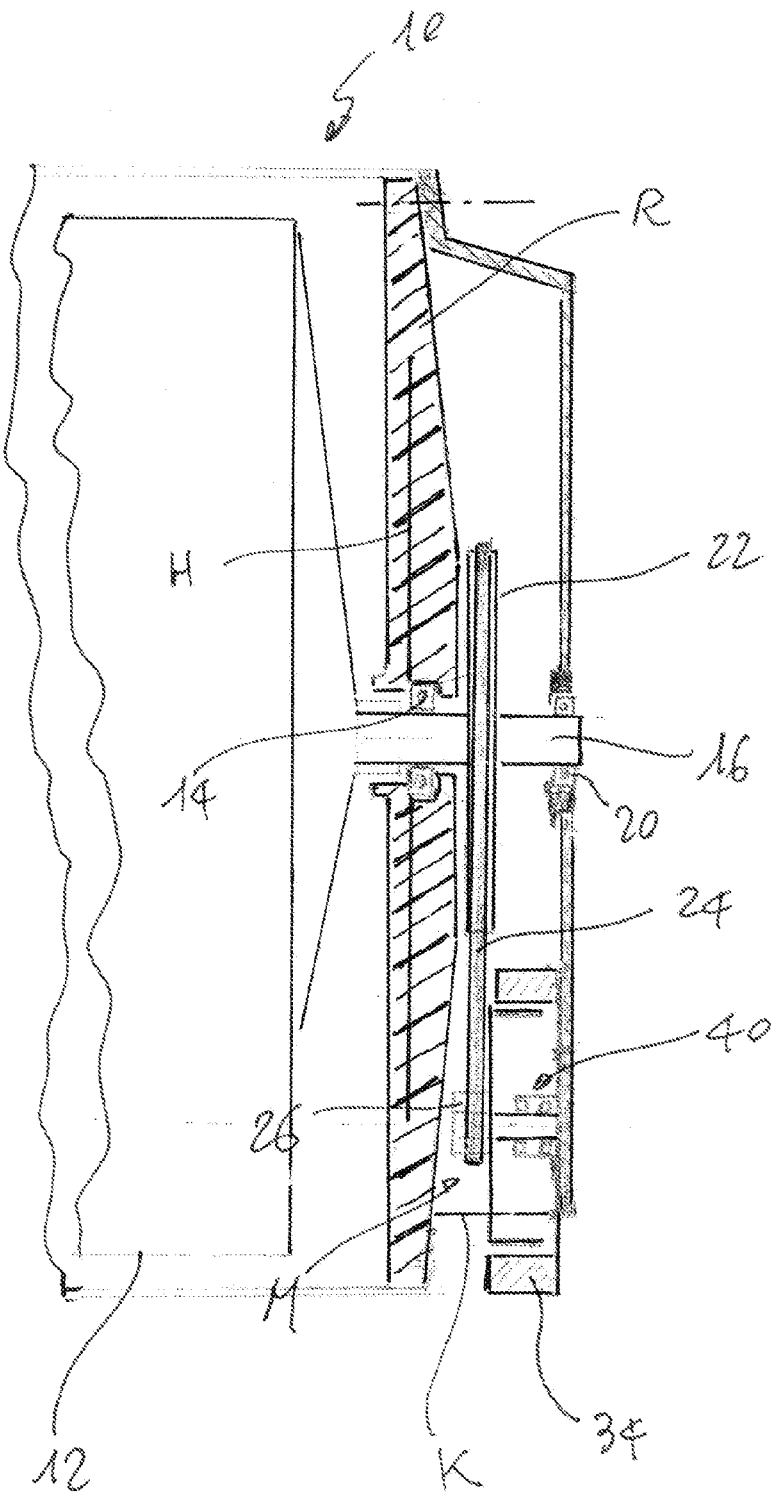

Fig. 3

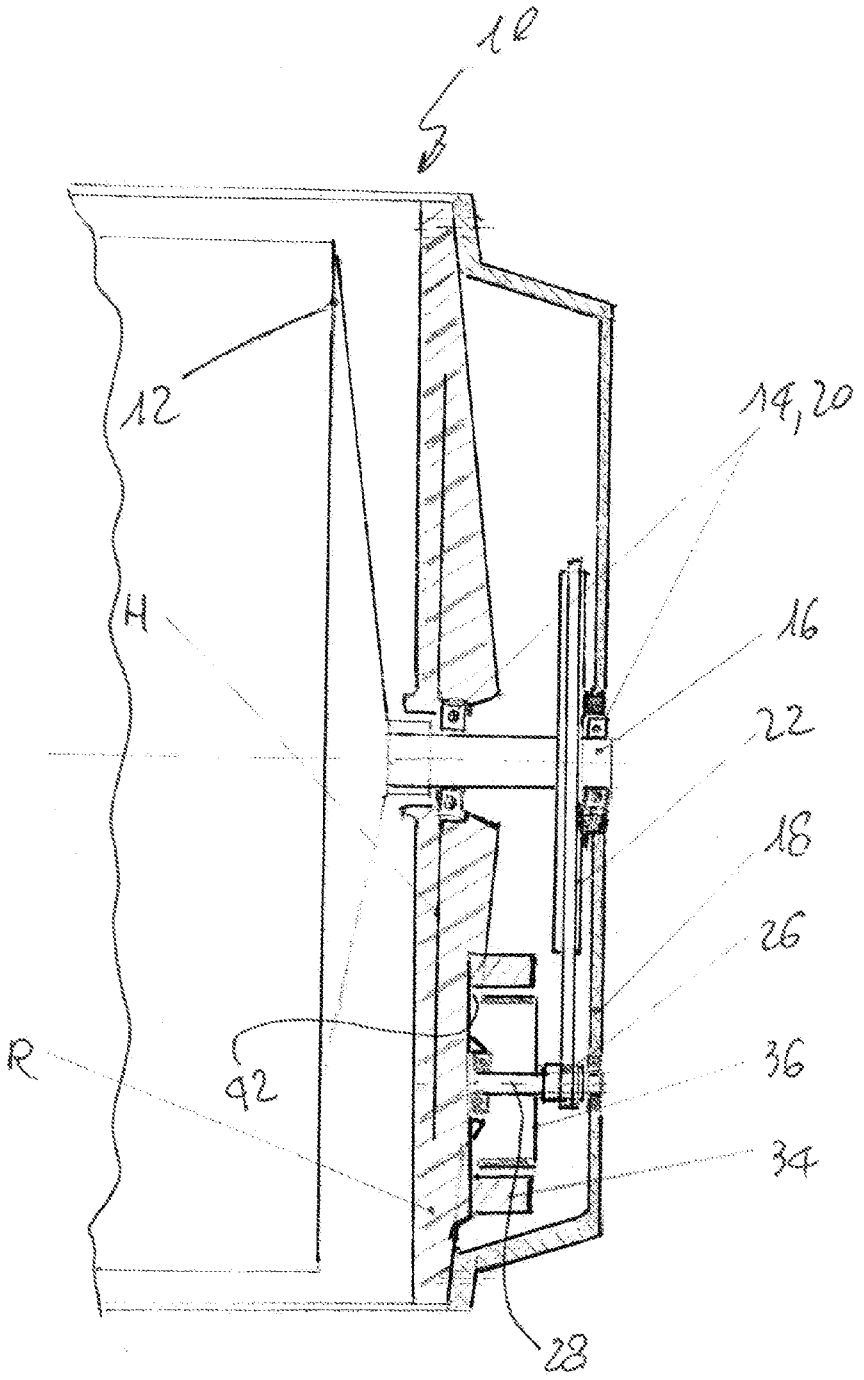

Fig. 4

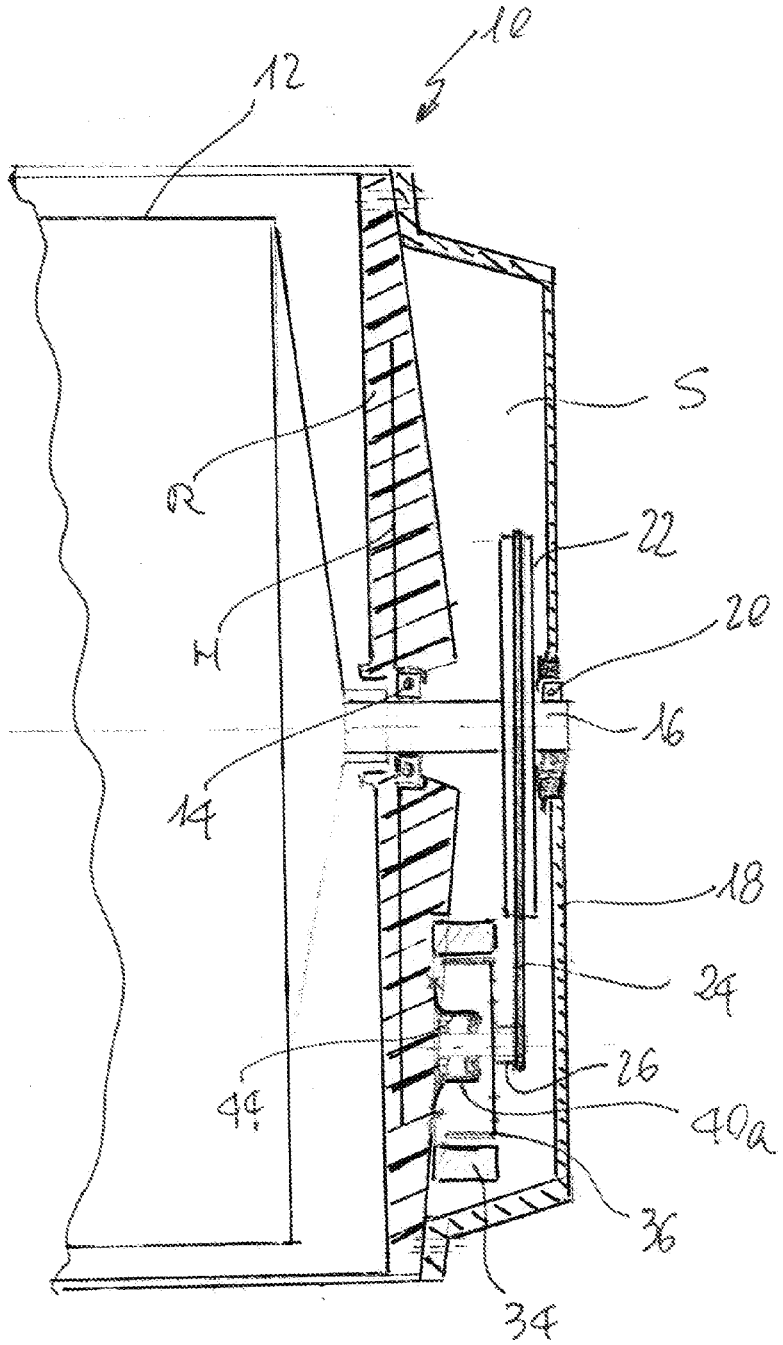

Fig. 5

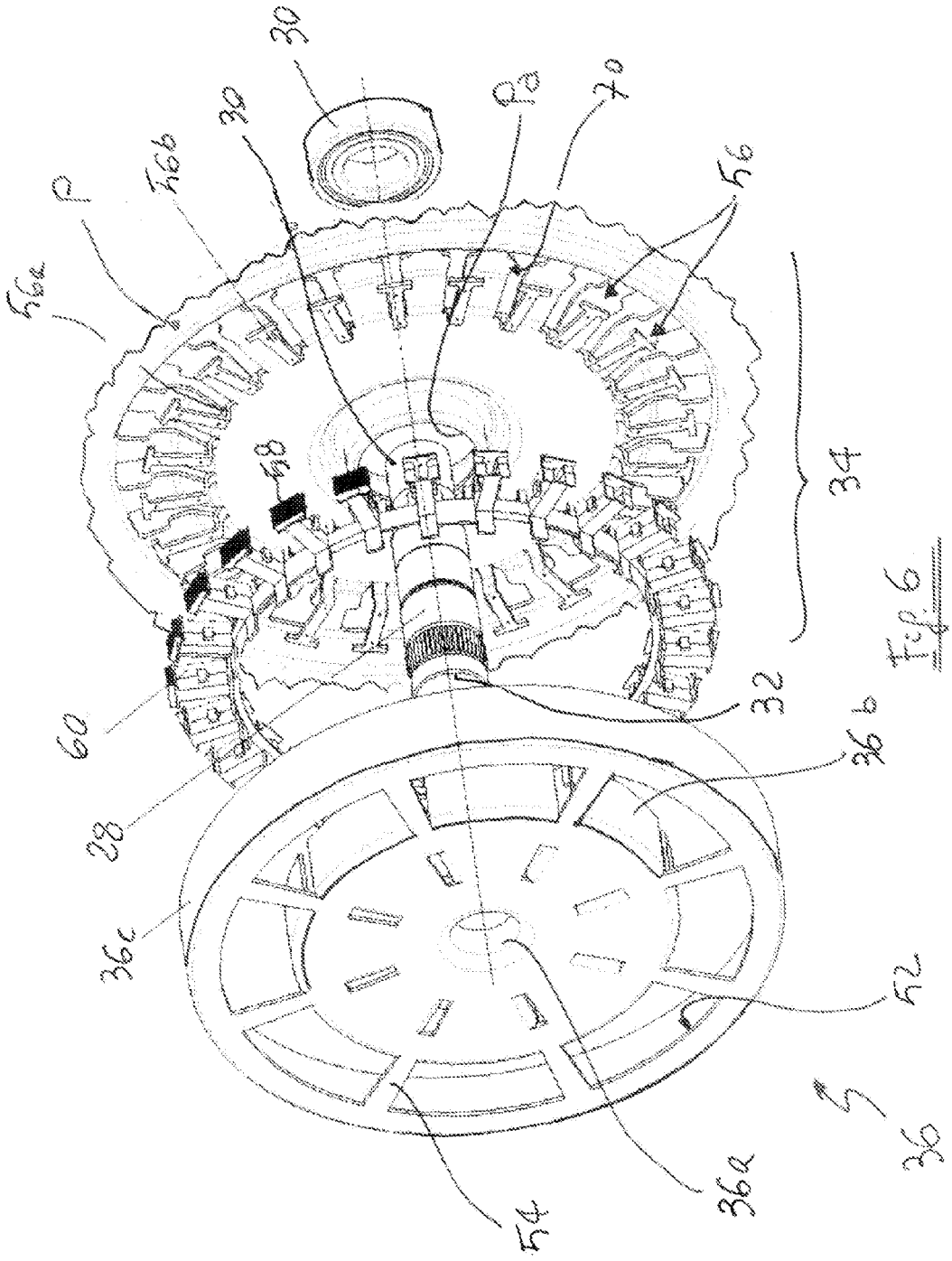

Fig. 6

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EUROPEAN SEARCH REPORT

Application Number
EP 10 18 3966

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TECHNICAL FIELDS SEARCHED (IPC)

D06F

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	28 December 2010	Stroppa, Giovanni

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