(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 1 201 810 A1

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
02.05.2002 Bulletin 2002/18

(51) Int Cl.[7]: **D06F 37/22**, D06F 23/06

(21) Application number: **00830716.7**

(22) Date of filing: **31.10.2000**

(84) Designated Contracting States:
AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU MC NL PT SE
Designated Extension States:
AL LT LV MK RO SI

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(54) Inclined washing machine with shock absorbing device

(57) A washing machine (1) comprises a basic structure (2) inside which is mounted a tub (5) having a substantially axially symmetrical shape with respect to an axis (6) inclined to a horizontal axis (8). A drum (10) for holding the laundry is mounted coaxially inside the tub (5) and is rotatable about the axis (6). The tub (5) and the drum (10) define an oscillating unit (3) mounted inside the basic structure (2), suspended between two shock-absorbers (13) operatively connected to a base (14) of the basic structure (2) and two resilient suspension components (18) which restrain the tub (5) at the top. Both the shock-absorbers (13) and the resilient suspension components (18) are mounted on the tub (5) at points lying in a vertical plane (15) perpendicular to the horizontal axis (8) and extending through the centre of gravity of the oscillating unit (3).

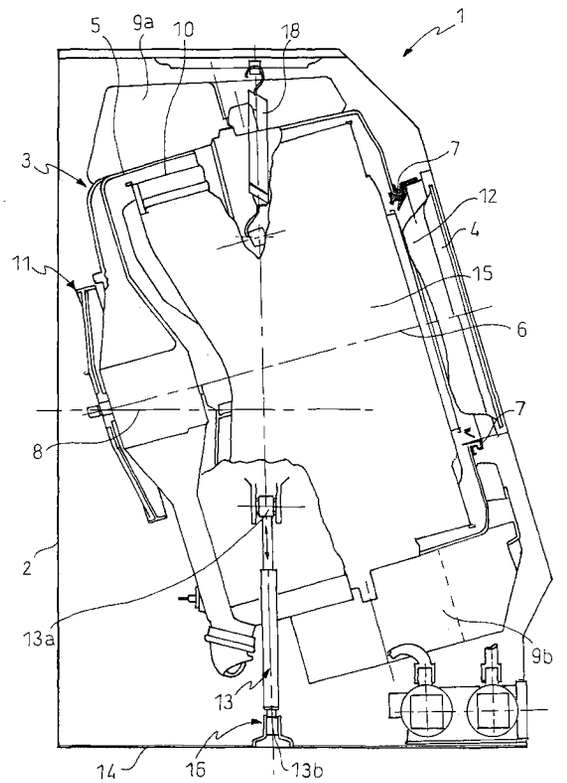

FIG. 1

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Description

[0001] The subject of the present invention is a washing machine comprising a basic structure, a tub having a substantially axially symmetrical shape with respect to an axis and mounted inside the basic structure with the axis inclined to a horizontal axis, a drum for holding the laundry, mounted coaxially inside the tub and rotatable about the axis of symmetry, the tub and the drum defining a unit which oscillates inside the basic structure, and shock-absorbers operatively connected to a base of the basic structure and to the tub to limit the oscillations of the tub in operation.

[0002] More particularly, the invention relates to a washing machine for domestic use.

[0003] As is known, in washing machines of the type indicated above, the oscillating unit, which is constituted by the tub with its counterweights, and by the drum, is suspended inside the basic structure which constitutes the outer casing of the washing machine. In particular, the tub is suspended on the basic structure by means of resilient springs and at the same time is supported on the base of the basic structure with the interposition of the shock-absorbers.

[0004] Moreover, to limit consumption, the oscillating unit is arranged with its axis inclined to a horizontal plane.

[0005] In particular, the inclined axis permits the use of optimal water-column levels in a limited position in the drum, even in the presence of a small quantity of water. However, as a result of this inclination, the washing machine as described above has some disadvantages particularly connected with the problem of limiting the loads acting on the springs and on the shock-absorbers and of limiting the oscillations of the oscillating unit inside the basic structure.

[0006] In particular, there is a great need to achieve a configuration of the unit which oscillates relative to the basic structure, that can limit the oscillations, the forces to which the entire structure is subjected, and the noise of the washing machine.

[0007] It is clear from the foregoing description that, particularly for a washing machine with an oscillating unit having an inclined axis, there is a need to have an optimal configuration of the oscillating unit itself, of the shock-absorbers which support it from below, and of the resilient springs which support it from above.

[0008] The problem upon which the present invention is based is therefore to devise and to define a washing machine which has structural and functional characteristics such as to satisfy the above-mentioned requirements and at the same time to overcome the disadvantages mentioned with reference to the prior art.

[0009] This problem is solved by means of a washing machine of the type specified above, characterized in that the shock-absorbers are mounted on the tub at points lying in a vertical plane perpendicular to the horizontal axis and extending through the centre of gravity of the oscillating unit.

[0010] Further characteristics and the advantages of the washing machine according to the invention will become clear from the following description of a preferred embodiment thereof, provided by way of non-limiting example, with reference to the appended drawings, in which:

Figure 1 is a partially-sectioned side view of a washing machine according to the present invention,
Figure 2 is a partially-sectioned front view of the washing machine of Figure 1, and
Figure 3 is an enlarged detail of Figure 1 showing the connection between one of the shock-absorbers and the base of the basic structure.

[0011] With reference to the above-mentioned drawings, a washing machine, particularly for domestic use, is generally indicated 1.

[0012] The machine is composed of a basic structure 2 which constitutes the housing for an oscillating unit 3. As shown in Figure 1, access to the interior of the basic structure 2 is through a porthole 4.

[0013] The oscillating unit 3 is composed of a tub 5 having a substantially axially symmetrical shape with respect to an axis 6. The front portion of the tub has an opening which faces the porthole 4 and the edges of the opening are connected to the basic structure by means of resilient couplings 7.

[0014] The axis 6 of the tub 5 is inclined to a horizontal axis 8 and this inclination, measured anticlockwise from the horizontal axis 8, may vary within a range of between 10° and 15°. In particular, the inclination of the tub preferably adopts a value of 12° when the washing machine 1 is in the operating condition.

[0015] The tub 5 also comprises counterweights 9a and 9b disposed on the upper portion and on the lower portion of the tub, respectively.

[0016] Inside the tub 5, the oscillating unit 3 comprises a drum 10 for holding the laundry. The drum is coaxial with the tub and is driven by a motor and by transmission means, shown partially and indicated 11, so as to be rotatable about the axis 6.

[0017] In the front portion of the drum there is an opening 12 which faces the corresponding opening of the tub 5 and the porthole 4 so as to afford access to the interior of the drum.

[0018] The counterweights 9a and 9b constitute parts of the oscillating unit 3 and are formed in a manner such that the centre of gravity of the oscillating unit is kept within the vertical projection of the oscillating unit in a horizontal plane, once the tub is inclined by the desired amount. The counterweights 9a and 9b are also such as to shift the centre of gravity of the drum alone rearwardly relative to the baricentric plane of the unit as a whole and such that the centre of gravity of the fully-loaded drum is also shifted slightly from the vertical baricentric plane.

[0019] From the side, that is, in the plane of Figure 1, the counterweight 9a disposed on the upper portion of the oscillating unit advantageously has a substantially trapezoidal cross-section or, in any case, such as to have a greater height in the rear portion, whilst the upper surface of the counterweight is kept substantially parallel to the basic structure and the lower surface of the counterweight is kept in contact with the tub. This configuration enables approximately 80% of the weight to be kept in the rear portion of the oscillating unit.

[0020] From the front, that is, in the plane of Figure 2, the counterweight 9a is arranged symmetrically with respect to the vertical axis a-a, that is, to the line of the vertical plane containing the horizontal axis 8, and its lower surface preferably follows the external profile of the tub.

[0021] The counterweight 9b is arranged below and entirely in a position at the front of the oscillating unit. Moreover, considering the two portions into which it is divided by the axis a-a, a first portion corresponding to the right-hand portion including the motor will consequently have less weight than a second portion corresponding to the left-hand portion which does not include the motor. In particular, the weight of the left-hand portion is greater than the weight of the right-hand portion by a value calculated in dependence on the weight of the motor and of its eccentricity and is preferably greater than or equal to twice the weight of the right-hand portion.

[0022] According to one embodiment, the weights of the two counterweights 9a and 9b are preferably interdependent. In particular, if the weight of the upper counterweight 9a is indicated P and the weight of the lower counterweight 9b is indicated p, the following is preferably true: $21/15 \leq P/p \leq 43/27$. This proportion is obtained owing to the fact that the percentage variation in the angle of the tub when it is empty and when it is fully loaded is preferably between 0.1 and 0.2 for the corresponding initial angle values of between 12° and 15°.

[0023] The entire oscillating unit 3 is suspended inside the basic structure 2. In particular, the tub 5 is supported from below by two shock-absorbers 13 each having an end 13a connected to the tub and an end 13b connected to a base 14 of the basic structure 2.

[0024] These shock-absorbers 13 have the purpose of limiting the oscillations of the oscillating unit 3, and particularly of the tub 5, when the washing machine 1 is in operation.

[0025] As shown in Figure 1, the shock-absorbers 13 are mounted on the tub in an original manner at points lying in a vertical plane 15 perpendicular to the horizontal axis 8 and extending through the theoretical centre of gravity of the tub 5 and of the drum 10, that is, of the oscillating unit 3 including the counterweights 9a and 9b.

[0026] In Figure 1, the vertical plane 15 is illustrated by its line in the plane of the drawing and, in particular, the shock-absorbers 13 are aligned along this line, that is, they have axes which lie in the vertical plane 15.

[0027] Moreover, in the vertical plane 15 perpendicular to the horizontal axis 8, that is, in the plane of Figure 2, the shock-absorbers 13 are arranged on opposite sides of a vertical axis of symmetry and each is preferably inclined at approximately 10°-12° to a vertical line 15a when unloaded.

[0028] As shown in Figure 2, the two shock-absorbers are inclined in a manner such that the distance between the two is greater at the points at which they are connected to the base of the basic structure than at the point at which the shock-absorbers are connected to the tub. If the distance between the points at which the two shock-absorbers are connected to the base of the basic structure is indicated A and the distance between the two points at which the shock-absorbers are connected to the tub is indicated B, A is therefore greater than B and, in particular, is advantageously greater by 20-22%.

[0029] For example, in an advantageous configuration A=521 mm and B=410 mm and the ratio between the difference A-B and the length of the shock-absorbers is between 0.35 and 0.6.

[0030] Moreover, the point at which each shock-absorber 13 is connected to the tub 5 is arranged 45° from the vertical axis extending through the centre line of the tub.

[0031] Each shock-absorber 13 and, in particular, each of its ends 13a and 13b, is connected to the tub 5 or to the base 14, respectively, by an articulated connection 16 with the interposition of at least one resilient vibration-damping element 17 of known type.

[0032] The resilient element 17 which is present in the lower connection, that is, that between the shock-absorber 13 and the base 14 of the basic structure 2, is compressed between the respective shock-absorber 13 and a bracket fixed firmly to the basic structure 2. In particular, the resilient element 17 may be compressed axially relative to the articulated connection 16, or radially, or in both directions.

[0033] Moreover, the resilient element 17 may advantageously be made of a material having a hardness value of about 63° Shore, insofar as production tolerances allow.

[0034] In particular, the inclination of the tub 5 allows the deformability of the resilient element 17 to be utilized fully so that it is always working not only in response to a vertical force component but also in response to oscillations of the oscillating unit relative to the horizontal axis 8, in the plane of Figure 1.

[0035] The oscillating unit 3 and, in particular, the tub 5 is also suspended inside the basic structure 2 by means of resilient components 18 fastened to the upper portion of the tub 5. Like the shock-absorbers 13, the resilient components 18 are also fastened to the tub at points lying in the vertical plane 15 perpendicular to the horizontal axis 8 and extending through the centre of gravity of the oscillating unit 3.

[0036] In particular, as shown in Figure 1, the resilient components 18 have axes which lie in the vertical plane

15 and which are therefore aligned with the respective shock-absorbers disposed at the bottom.

[0037] As shown in Figure 2, which corresponds to the vertical plane 15 perpendicular to the horizontal axis 8, each resilient component 18 is inclined to a vertical line 15a. Each component is preferably inclined at 15° to the vertical line.

[0038] Like the shock-absorbers 13, the two resilient components 18 also have opposite inclinations. In particular, as shown in Figure 2, the two resilient components 18 are inclined in a manner such that the distance between the two is greater at the level of the connection to the basic structure than at the points at which the resilient components are connected to the tub. If the distance between the points at which the two resilient components are connected to the basic structure is indicated C and the distance between the two points at which the resilient components are connected to the tub is indicated D, D is therefore less than C and, in particular, is advantageously less by about 14%.

[0039] For example, in an advantageous configuration, C=590 mm and D=487 mm and the ratio between the difference C-D and the lengths of the shock-absorbers is between 0.45 and 0.55.

[0040] It can be appreciated from the foregoing that the provision of a front washing-machine structure with an inclined axis permits optimal water-column levels whilst the quantity of water inside the tub is nevertheless kept small. In particular, this condition is achieved in a limited portion of the drum in the vicinity of the lower inside corner of the drum. The characteristic that the axis is inclined at 15° (12° in operation) enables consumption to be reduced and permits an improvement both in the structure of the drum and of the tub, and in terms of the fatigue strength of the entire oscillating unit. In fact the average pressure produced by the load is shifted appreciably towards the rear region of the drum support, thus ensuring greater strength of the structure.

[0041] This is also ensured by the original and advantageous arrangement both of the shock-absorbers and of the upper resilient components. This arrangement not only limits the oscillations to an acceptable value but also enables a faster spin speed to be achieved for a given load.

[0042] The oscillating unit and the respective resilient suspension components and shock-absorbers are substantially in line vertically. As a result, the oscillating unit is extremely free and can oscillate, hinged on the resilient suspension components, loading both the shock-absorbers and the resilient vibration-damping elements 17 in a symmetrically oriented manner so that the particular configuration described above enables, in particular, a damping oscillatory motion to be achieved.

[0043] In order to satisfy contingent and specific requirements, an expert in the art may apply to the above-described preferred embodiment of the washing machine many modifications, adaptations and replacements of elements with other functionally equivalent elements without, however, departing from the scope of the following claims.

Claims

1. A washing machine (1) comprising:

a basic structure (2),
a tub (5) having a substantially axially symmetrical shape with respect to an axis (6) and mounted inside the basic structure (2) with the axis (6) inclined to a horizontal axis (8),
a drum (10) for holding the laundry, mounted coaxially inside the tub (5) and rotatable about the axis (6), the tub (5) and the drum (10) defining a unit (3) which oscillates inside the basic structure (2), and
shock-absorbers (13) operatively connected to a base (14) of the basic structure (2) and to the tub (5) to limit the oscillations of the tub in operation,

characterized in that the shock-absorbers (13) are mounted on the tub (5) at points lying in a vertical plane (15) perpendicular to the horizontal axis (8) and extending through the centre of gravity of the oscillating unit (3).

2. A washing machine according to Claim 1 in which the axes of the shock-absorbers lie in the said vertical plane (15).

3. A washing machine according to any one of the preceding claims in which the tub (5) comprises counterweights (9a, 9b) fixed firmly to the tub, and in which the shock-absorbers (13) are mounted on the tub (5) at points lying in a vertical plane (15) perpendicular to the horizontal axis (8) and extending through the centre of gravity of the tub (5) including the counterweights (9a, 9b) and the drum (10).

4. A washing machine according to any one of the preceding claims in which the tub (5) and the respective drum (10) are disposed inside the basic structure (2) with the axis (6) inclined at between 10° and 15° to the horizontal axis (8).

5. A washing machine according to Claim 4 in which, in the operating condition, the tub (5) and the respective drum (10) have the axis (6) inclined at 12° to the horizontal axis (8).

6. A washing machine according to Claim 3 in which, if the weight of the upper counterweight (9a) is indicated P and the weight of the lower counterweight (9b) is indicated p, the ratio between P and p is such that the percentage variation in the angle of the tub

when it is empty and when it is fully loaded is kept between 0.1 and 0.2.

7. A washing machine according to Claim 3 or Claim 6 in which, if the weight of the upper counterweight (9a) is indicated P and the weight of the lower counterweight (9b) is indicated p, $21/15 \leq P/p \leq 43/27$.

8. A washing machine according to one or more of the preceding claims in which, in the vertical plane perpendicular to the horizontal axis (8) and extending through the centre of gravity of the oscillating unit (3), each shock-absorber (13) is inclined to a vertical line (15a).

9. A machine according to Claim 8 in which each shock-absorber (13) is inclined at 10-12° to the vertical line (15a).

10. A machine according to Claim 8 or Claim 9 in which each shock-absorber (13) is connected to the tub (5) at a point arranged 45° from a vertical axis (a-a) extending through the centre line of the tub.

11. A washing machine according to any one of the preceding claims in which, if the distance between the points at which the two shock-absorbers (13) are connected to a base of the basic structure (2) is indicated A and the distance between the points at which the shock-absorbers (13) are connected to the tub (5) is indicated B, A is greater than B by 20-22%.

12. A washing machine according to any one of the preceding claims in which, if the distance between the points at which the two shock-absorbers (13) are connected to a base of the basic structure (2) is indicated A and the distance between the points at which the shock-absorbers (13) are connected to the tub (5) is indicated B, the ratio between the difference A-B and the lengths of the shock-absorbers (13) is between 0.35 and 0.6.

13. A washing machine according to one or more of the preceding claims in which the shock-absorbers (13) are connected to the basic structure (2) by means of an articulated connection (16) with the interposition of at least one resilient, vibration-damping element (17), the at least one resilient element (17) being compressed between the shock-absorber (13) and a bracket fixed firmly to the basic structure (2).

14. A washing machine according to Claim 13 in which the resilient damping element (17) has a hardness of 63° Shore.

15. A washing machine according to one or more of the preceding claims in which the upper portion of the tub (5) is operatively connected to the basic structure (2) by means of resilient suspension components (18) mounted on the tub (5) at points lying in a vertical plane (15) perpendicular to the horizontal axis (8) and extending through the centre of gravity of the oscillating unit (3).

16. A washing machine according to Claim 15 in which the axes of the resilient components (18) lie in the vertical plane (15).

17. A washing machine according to Claim 15 or Claim 16 in which, in the vertical plane (15) perpendicular to the horizontal axis (8), each resilient suspension component (18) is inclined to a vertical line (15a).

18. A washing machine according to Claim 17 in which each resilient suspension component (18) is inclined at 15° to the vertical line (15a).

19. A washing machine according to any one of Claims 15 to 18 in which, if the distance between the points at which the resilient components (18) are connected to the basic structure (2) is indicated C and the distance between the points at which the resilient components (18) are connected to the tub (5) is indicated D, D is less than C by about 14%.

20. A washing machine according to any one of Claims 15 to 19 in which, if the distance between the points at which the resilient components (18) are connected to the basic structure (2) is indicated C and the distance between the points at which the resilient components (18) are connected to the tub (5) is indicated D, the ratio between the difference C-D and the lengths of the shock-absorbers is between 0.45 and 0.55.

21. A washing machine according to Claim 3 in which the upper counterweight (9a) has a frontal cross-section which is symmetrical with respect to a vertical plane including the horizontal axis (8).

22. A washing machine according to Claim 21 in which the upper counterweight (9a) has a lateral cross-section having a greater height in the rear portion than in the front portion of the oscillating unit (3).

23. A washing machine according to Claim 22 in which the upper counterweight (9a) comprises an upper surface parallel to the basic structure (2) and a lower surface in contact with the tub (5).

24. A washing machine according to Claim 22 in which the upper counterweight (9a) has about 80% of its weight in the rear portion of the oscillating unit (3).

25. A washing machine according to Claim 3 in which

the lower counterweight (9b) is disposed entirely in a position at the front of the oscillating unit (3).

26. A machine according to Claim 25 in which a vertical plane comprising the horizontal axis (8) divides the lower counterweight (9b) into a first portion comprising a motor and a second portion the weight of which is greater than that of the first portion by an amount depending on the weight of the motor and on its eccentricity.

27. A machine according to Claim 26 in which the weight of the second portion is greater than or equal to twice the weight of the first portion.

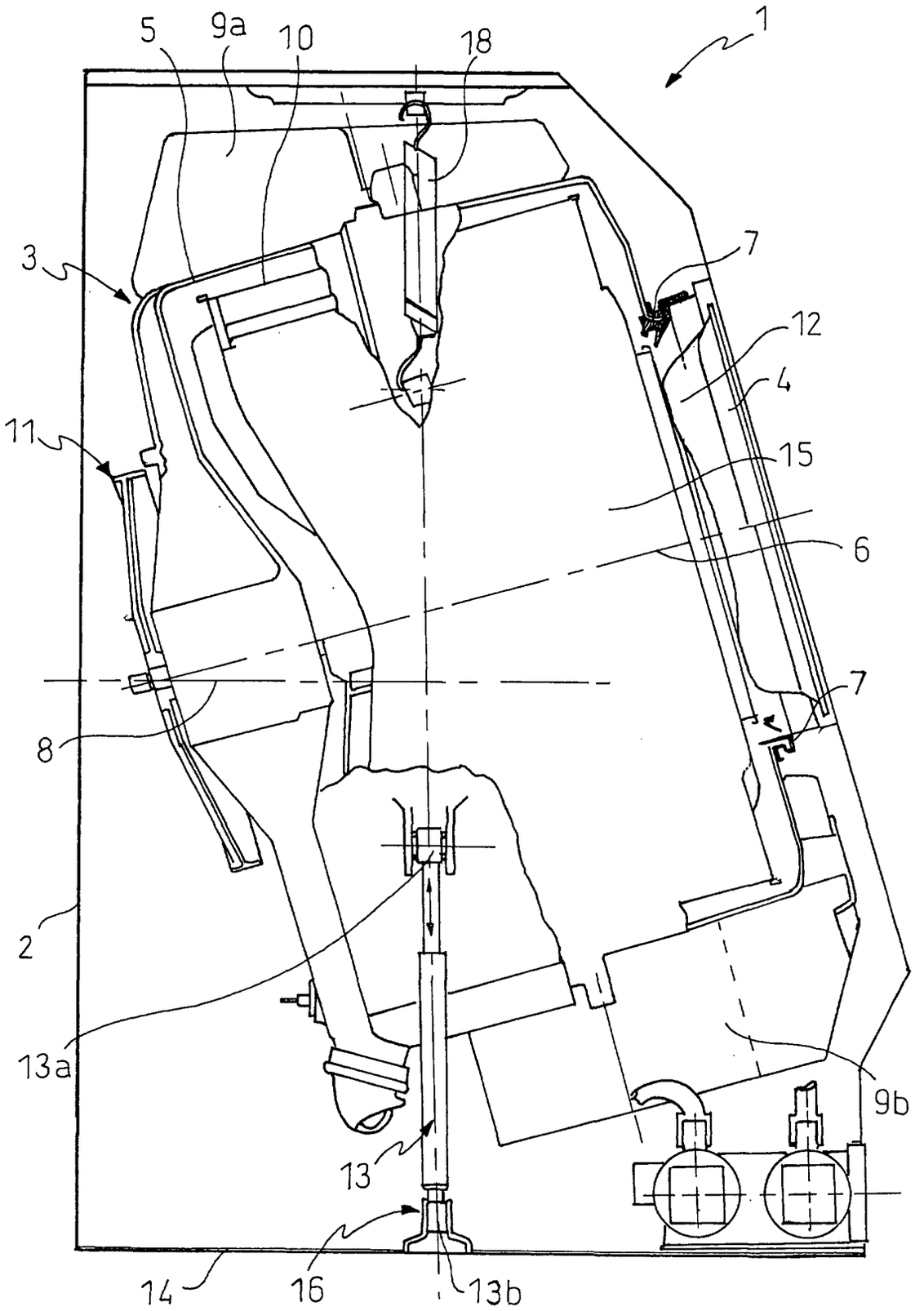

FIG. 1

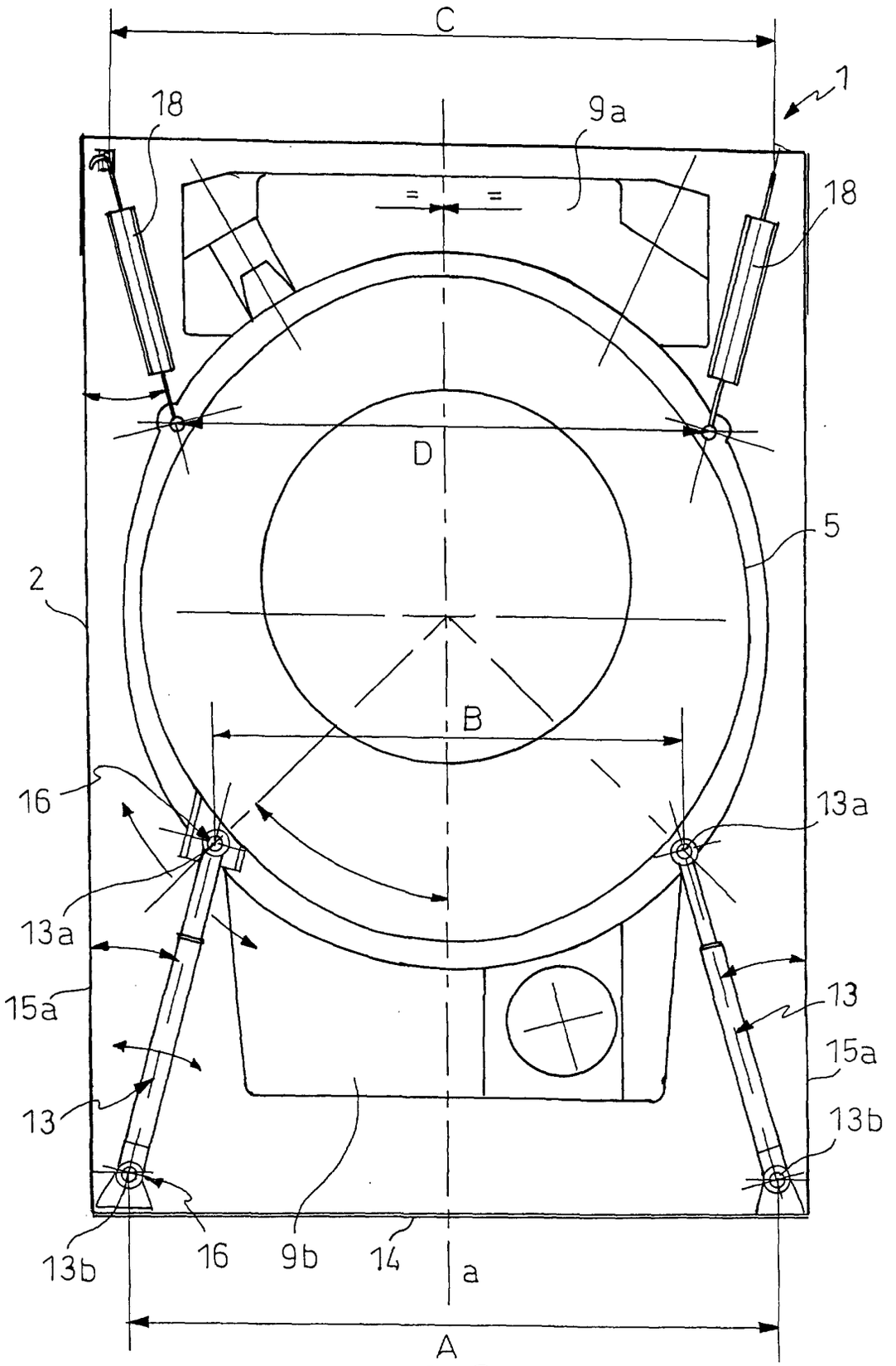

FIG.2

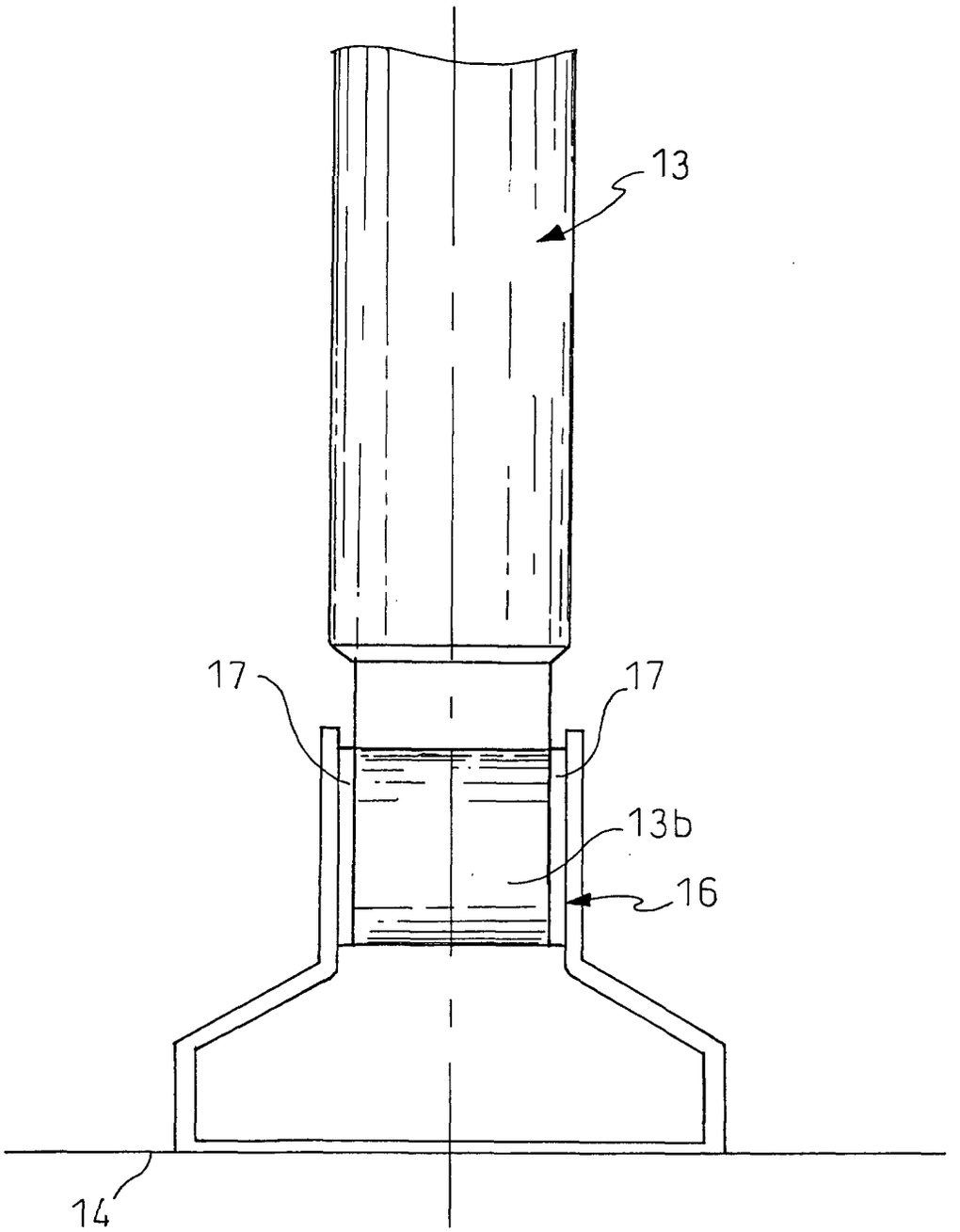

FIG. 3

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EUROPEAN SEARCH REPORT

Application Number
EP 00 83 0716

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
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TECHNICAL FIELDS SEARCHED (Int.Cl.7)

D06F

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	10 May 2001	Norman, P

CATEGORY OF CITED DOCUMENTS

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