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(54) **Muffler device for an air intake conduit**

(57) A muffler device (10) for an air intake conduit, in particular for an intake conduit of a whirlpool bath. The muffler device (10) comprises an essentially cylindrical main body (11). Furthermore, the main body (11) is provided with a plurality of peripheral air intakes (BI1, BI2,

BI3, BI4, BI5) equally distributed on at least one portion of its external surface (SUPE). What is more, the main body (11) consists of a plurality of fitted plates (11a, 11b), which in use are "sandwiched" between two fitted terminal elements (12, 13).

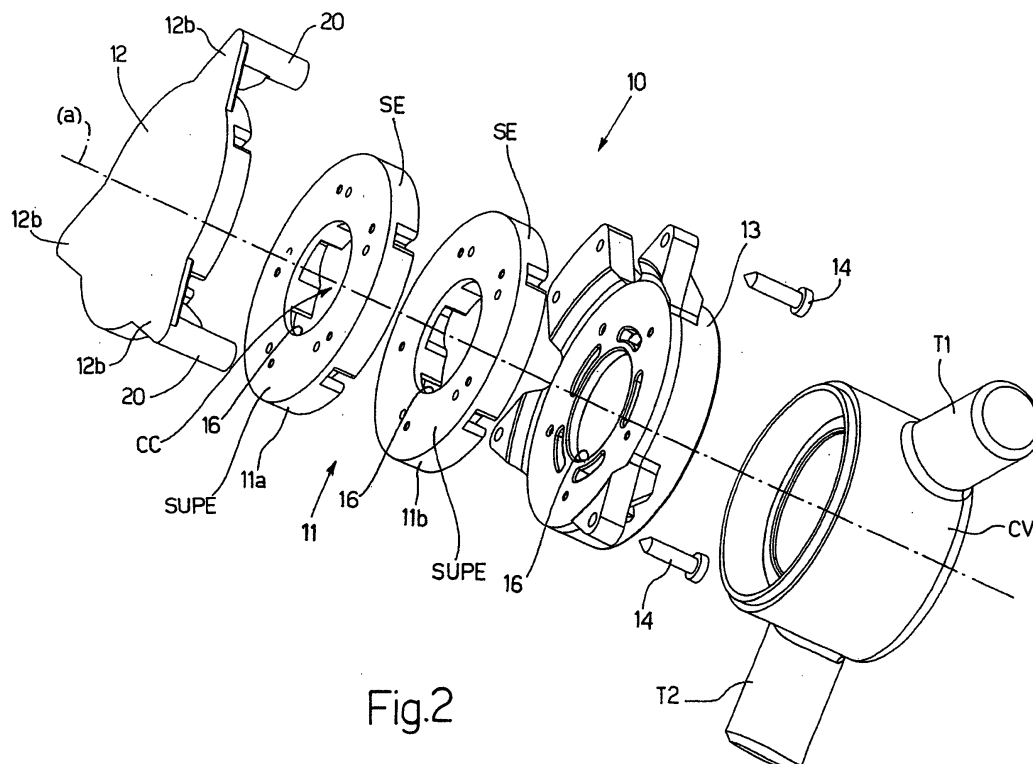


Fig.2

Description

[0001] The present invention relates to a muffler device for an air intake conduit, in particular an intake conduit of a whirlpool bath.

[0002] Indeed, the present invention finds advantageous, but not exclusive, application in a whirlpool bath, to which explicit reference will be made in the following description without for this losing in generality.

[0003] As known, all whirlpool baths comprise, among other things, an electrical motor associated to a pump, which takes in water from the tub and re-introduces it into the tub itself, immediately after appropriately mixing the water with a certain amount of air (in the form of air bubbles).

[0004] In a known way, the water/air mixture is introduced by means of a plurality of nozzles which are distributed on the entire edge of the tub, and which, in use, are positioned under the surface of the water in the tub itself.

[0005] It is also known that the air for the water/air mixture is taken from the environment in which the whirlpool bath is found by means of an intake conduit which carries the plurality of nozzles for re-injecting recirculation water. Since each nozzle is provided with a corresponding "venturi tube", the intake of external air, which is mixed in form of bubbles with the recirculation water during the tub re-injection operation, is determined by the injection of recirculation water itself in the tub. This results in the desired release of water/air mixture into the tub to obtain the required massaging effect on the body of the user immersed in the tub water.

[0006] Regretfully, the air which is taken in from the environment into the intake conduit generates noise, whose annoyingness increases when level of noise of the other components (electrical motor, pump, injection nozzles, etc.) is low.

[0007] In other words, in a noisy whirlpool bath, the noise due to air intake in the intake conduit is irrelevant, because covered by other noises, but in a muffled tub (and this is the current trend of new products), in which there is a careful selection of components (electrical motor, pump, injection nozzles, etc.) for containing noise, fractions of decibels are also audible, and this creates annoyance.

[0008] We therefore sought to attenuate the level of noise caused by the intake of air by equipping the air intake itself in the intake conduit with a muffler device.

[0009] In the past, various attempts to design *ad hoc* muffler devices has been made, but none have achieved in ensuring acceptable levels of noise for the current applications.

[0010] Therefore, it is the object of the present invention to make a muffler device suitable adapted to ensure an acceptable level of noise due to the introduction of external air in the air intake conduit of a whirlpool bath.

[0011] Moreover, the construction of a working prototype has required considerable theoretical fluid-dynamic

considerations and many experimental tests.

[0012] In particular, the air intakes in the muffler device and in the labyrinths in which the air flows must be carefully designed to obtain the best noise attenuation effects.

5 [0013] Initial studies led to determine the optimal number of peripheral intakes of the air into the labyrinths.

[0014] Therefore, attempts were firstly made with five intakes, then with six and then with only four intakes.

10 [0015] However, we reached the conclusion that the "five intake" choice was the best, because this number ensures optimal air flow and low noise.

[0016] Having understood the optimal number of air intakes, we started to modify the routes of the air itself within a labyrinth.

15 [0017] Furthermore, during the tests, we understood that the various input flows in the labyrinth needed to be separated, creating not a single labyrinth with five intakes, but three separate labyrinths with five intakes each, thus obtaining an air flow with fifteen autonomous intakes.

[0018] Immediately after, we started to define the optimal profile of the labyrinth, attempting to mitigate as much as possible the course that the air needs to follow in order to connect to the air intake tube.

25 [0019] Mitigating the air trajectory means creating wide curves, eliminating angles, adopting broadening flow sections, etc., while continuing to keep into consideration the dimensions of the muffler device.

30 [0020] By rounding the corners, we obtained the current profile, resulting the best after a numerous series of experimental tests.

[0021] This profile shows a narrow input intake, followed by a straight route which broadens out, a 180° curve, immediately followed by another, this time 90°, curve; the latter curve introduces air into the conduit through which it reaches the valve body union. The 90° curve was designed with a particularly wide bend, to allow the air to slow down and stand, to then mix with other air from the other fitted plates.

40 [0022] According to the present invention, it is therefore made a muffler device for an air intake conduit, in particular an intake conduit of a whirlpool bath, according to the features contained in the attached claims.

45 [0023] The present invention will now be described with reference to the accompanying drawings illustrating a non-limitative embodiment example thereof, in which:

- figure 1 shows a three-dimensional overview of a muffler device according to the present invention;
- 50 - figure 2 shows an exploded three-dimensional view of the muffler device shown in figure 1;
- figure 3A shows a first three-dimensional view of a first element comprised in the muffler device shown in figure 1, 2;
- 55 - figure 3B shows a second three-dimensional view of the first element in figure 3A;
- figure 3C shows an enlarged view of a portion of the first element shown in figures 3A and 3B;

- figure 4 shows a frontal view of the first element in figures 3A, 3B;
- figure 5 shows a section A-A taken on the frontal view of the first element in figure 4;
- figure 6 shows a three-dimensional view of a second element comprised in the muffler device shown in figure 1, 2;
- figure 7 shows a frontal view of the second element in figure 6;
- figure 8 shows a side view of the second element in figures 6 and 7;
- figure 9 shows a three-dimensional view of a third element comprised in the muffler device shown in figure 1, 2;
- figure 10 is a frontal view of the third element in figure 9; and
- figure 11 shows a section B-B taken on the frontal view of the second element in figure 10.

[0024] Incidentally, only the details indispensable for understanding the present invention will be described in the following.

[0025] In figures 1, 2, it is indicated as a whole by 10 a muffler device for an air intake conduit (not shown) according to the present invention.

[0026] As previously mentioned, the muffler device 10 is validly employed at the beginning of an air intake conduit of a whirlpool bath (not shown).

[0027] As shown in particular in figures 1, 2, the muffler device 10 comprises a central body 11, in the present case comprising, in turn, two fitted plates 11a, 11b.

[0028] The muffler device 10 presents a longitudinal axis of symmetry (a).

[0029] Incidentally, in the present context, the word "fitted" defines an element (plate, lid, union flange with the valve body) in which air baffles and/or openings for the passage of the air itself are envisaged.

[0030] In use, the main body 11 is "sandwiched" by a lid 12 on one side, and by a union flange 13 of device 10 with a valve body CV on the other. Furthermore, the valve body CV presents two tube holders T1 and T2 to which, in use, are connected the flexible tubes (not shown) which carry air to the water injection nozzles.

[0031] Indeed, the two flexible tubes constitute that which in the present context is defined as "air intake conduit".

[0032] As shown again in figure 2, the elements are tightly secured by means of a plurality of bolts 14 (only two bolts 14 are shown in figure 2), which, as will be seen in better detail in the following, in use, are inserted in through holes envisaged on different elements which compose the device 10.

[0033] The valve body CV (a component well known in whirlpool bath manufacturing and, therefore, not described in detail) contains, in known manner, a "check valve" (not shown) and possibly a choking device (not shown) of the air flow rate.

[0034] Indeed, since the feeding system of the air to

the tank, in particular conditions, may be flooded by the water from the tub, the "check valve" prevents the release of water by means of the air system itself.

[0035] In the embodiment shown in figure 2, the fitted plates 11a, 11b are identical and therefore one will be described by describing the other.

[0036] Indeed, as shown in greater detail in figures 3A, 3B, 3C, 4, 5, the fitted plate 11a (or 11b) comprises a ring element 15 provided with a central hole 16.

[0037] On an internal surface SUP1 of the fitted plate 11a are envisaged five labyrinths LB1, LB2, LB3, LB4, LB5, pitched about the external circumference CIR of the fitted plate 11a itself.

[0038] Furthermore, each labyrinth LB1, LB2, LB3, LB4, LB5 envisages a respective intake BI1, BI2, BI3, BI4, BI5 of the ambient air into the device 10.

[0039] Since the labyrinths LB1, LB2, LB3, LB4, LB5 are all reciprocally the same, it will suffice to describe one for all.

[0040] With reference to figure 3C, labyrinth LB2 also comprises the previously mentioned environment air intake BI2, as well as a first baffle 17, whose portion essentially lays on the circumference CIR. Furthermore, the terminal part of the first baffle 17 is curved to form a bend 18.

[0041] Labyrinth LB2 also comprises a second baffle 19 essentially parallel to the first baffle 17 which lays on the circumference CIR. What is more, the second baffle 19 insinuates within the bend 18.

[0042] Therefore, the air entering intake BI2 firstly flows along a first course PR1 which progressively broadens out, is deviated by a 180° meeting bend 18, deviates towards a second route PR2, to immediately find another curve, this time at 90°.

[0043] The latter curve forces the air to enter a respective outlet BU2 leading to the central hole 16.

[0044] From the central hole 16, as we will see in greater detail below, the air flows towards the valve body CV and therefore to the air intake conduit and to the release nozzles (not shown) of the recirculated water.

[0045] As shown in figures 3a, 3C, the terminal portion of the second route PR2 which ends with outlet BU2 broadens out to let the air slow down and stand, and then mix with more air from the other intakes BI1, BI3, BI4, BI5 (see below).

[0046] By observing the embodiment shown in figures 3A, 3B, 3C, 4, 5 it may be observed that, advantageously, the second baffle 19 of the labyrinth LB2 is integrally obtained with the first baffle 17 of the adjoining labyrinth LB3, and so on.

[0047] In other words, the same element which protrudes from the surface SUP1 acts both as the second baffle 19 of labyrinth LB2, and as the first baffle 17 of the adjoining labyrinth LB3. And so on.

[0048] Again as shown in figures 3A, 3B, labyrinths LB1, LB2, LB3, LB4, LB5 are provided with respective centring pins C1, C2, C3, C4, C5, each of which, in use (when all the elements are "sandwiched", see figure 2),

engages with a respective seat S1, S2, S3, S4, S5 made on the external surface SUPE of the adjoining fitted plate 11b (see figure 3B).

[0049] In reality, since the fitted plate 11a is made of plastic material by means of a single moulding operation, the ring element 15, the labyrinths LB1, LB2, LB3, LB4, LB5, the respective centring pins C1, C2, C3, C4, C5 and the respective seats S1, S2, S3, S4, S5 are all integral.

[0050] Evidently, the same considerations apply to the fitted plate 11b.

[0051] As shown in figure 2, in use, the external surface SUPE of the fitted plate 11b along with the routes PR1, PR2 of each labyrinth LB1, LB2, LB3, LB4, LB5 (when the two fitted plates 11a, 11b are "sandwiched") define proper "hook-shaped" channels, which start, respectively with intakes BI1, BI2, BI3, BI4, BI5, from the outside, and end with outlets BU1, BU2, BU3, BU4, BU5 in the central hole 16, through which the air is conveyed towards the air intake conduit of the whirlpool bath (see below).

[0052] As shown in figures 2, 6, 7, 8, the lid 12 presents a central body 12a similar to that of the two fitted plates 11a, 11b, and which therefore will not be illustrated in detail.

[0053] Indeed, the only essential difference between the central body 12a and the ring element 15 of the fitted plates 11a, 11b is that, in order to fulfil the closing function of an end of the device 10, the central body 12a does not present any through holes similar to the through hole 16 of the fitted plates 11a, 11b.

[0054] The circumference CIR1 of the lid 12 is provided with three protuberances 12b, reciprocally distanced by an angle of 120°, and radially extending.

[0055] Each protuberance 12b, in turn, envisages a respective foot 20 which extends in a direction essentially parallel to the longitudinal symmetry axis (a) in the entire muffler device 10.

[0056] Each foot 20 presents, in turn, a threaded seat 21 in which is fastened a corresponding bolt 14 when the different components are "sandwiched" (figure 2).

[0057] Furthermore, as mentioned, the device 10 comprises a union flange 13 with the valve body CV.

[0058] As shown in detail in figures 2, 9, 10, 11, the flange 13 presents an essentially ring-shaped central body 13a, therefore provided with a through hole 22 whose centre, in use, lays on axis (a).

[0059] The circumference CIR2 of the central body 13a is provided with three protuberances 13b, reciprocally distanced by an angle of 120°, and radially extending.

[0060] Each protuberance 12b is provided with a respective through hole 23 in which the mentioned bolts 14 are inserted.

[0061] Furthermore, from circumference CIR2 also protrudes an overhang 12c provided with two through holes 24, 25 in which are inserted two bolts which are used to fix the device 10 to an appropriate support (not shown).

[0062] As shown in figure 10, the central body 13a envisages a series of seats 26 arranged in a circle adapted

to receive corresponding centring pins C1, C2, C3, C4, C5 of the fitted plate 11b.

[0063] What is more, on the central plate 13a are obtained through arc-of-a-circle slots F1, F2, F3, F4, F5, each of which, in use, corresponds to a corresponding labyrinth LB1, LB2, LB3, LB4, LB5.

[0064] For the aforesaid reasons, the air which is issued from the outlets BU1, BU2, BU3, BU4, BU5 is conveyed towards the valve body CV through a central channel CC (again with axis (a); see figure 2) given by the sum of the through holes 16 of the plates 11a, 11b and the through hole 22 of the flange 13 in series.

[0065] A further portion of air which is issued from the labyrinths LB1, LB2, LB3, LB4, LB5 of the last fitted plate (in the case in point, the fitted plate 11b) is issued again to the valve body CV through respective arc-of-a-circle clefts F1, F2, F3, F4, F5.

[0066] The various intakes BI1, BI2, BI3, BI4, BI5 of the fitted plates 11a, 11b and of the fitted lid 12 may either be aligned in directions parallel to axis (a), or may be staggered, as in the embodiment shown in figure 1.

[0067] In other words, intakes BI1", BI2", BI3", BI4", BI5" e BI1'", BI2'", BI3'", BI4'", BI5'" of fitted plates 11a, 11b, and intakes BI1', BI2', BI3', BI4', BI5' of the closing element 12, may be reciprocally staggered (figure 1).

[0068] One of the main advantages of the muffler device 10 object of the present invention consists in that, since plates 11a, 11b are modular, muffler devices 10 of the required flow rate can be made simply by stacking the required number of plates 11a, 11b and "sandwiching" them with a lid 12 and with a flange 13 (always the same for all muffler devices of any flow rate). Evidently, to increase the length of the devices, appropriate shims may be arranged on the end of the each resting foot on the respective protuberance 13b.

Claims

1. A muffler device (10) for an air intake conduit, in particular for an intake conduit of a whirlpool bath; muffler device (10) **characterised in that** it comprises an essentially cylindrical main body (11), said main body (11) being provided with a plurality of peripheral air intakes (BI1, BI2, BI3, BI4, BI5) equally distributed on at least one portion of the external surface (SUPE) of said main body (11) itself.
2. A muffler device (10) as claimed in claim 1, **characterised in that** a respective labyrinth (LAB1, LAB2, LAB3, LAB4, LAB5) is associated to each intake (BI1, BI2, BI3, BI4, BIS).
3. A muffler device (10) as claimed in any of the preceding claims, **characterised in that** said main body (11) comprises at least one fitted element (11a, 11b) which, in use, is "sandwiched" by two terminal ele-

ments (12, 13).

4. A muffler device (10) as claimed in claim 2, **characterised in that** each labyrinth (LAB1, LAB2, LAB3, LAB4, LAB5) is provided with a respective outlet (BU1, BU2, BU3, BU4, BU5) through which the intake air enters a central conduit (CC) from which it flows towards the air intake conduit.
5. A muffler device (10) as claimed in claim 2, **characterised in that** the labyrinths (LAB1, LAB2, LAB3, LAB4, LAB5) are five.
6. A muffler device (10) as claimed in claim 2, **characterised in that** each labyrinth (LAB1, LAB2, LAB3, LAB4, LAB5) comprises a first baffle (17) whose terminal part forms a bend (18).
7. A muffler device (10) as claimed in claim 6, **characterised in that** each labyrinth (LAB1, LAB2, LAB3, LAB4, LAB5) further comprises a second baffle (19) which insinuates within said bend (18).
8. A muffler device (10) as claimed in claim 7, **characterised in that** the second baffle (19) of the labyrinth (LB2) is integrally obtained with the first baffle (17) of the adjoining labyrinth (LB3), and so on.
9. A muffler device (10) as claimed in claim 2, **characterised in that** said labyrinths (LB1, LB2, LB3, LB4, LB5) are provided with respective centring pins (C1, C2, C3, C4, C5), each of which, in use, engages with a respective seat (S1, S2, S3, S4, S5; 26) made on an external surface (SUPE) of an adjoining fitted element (11b; 13).
10. A muffler device (10) as claimed in claims 3 and 9, **characterised in that** each fitted element (11a, 11b) is made of plastic material by means of a single moulding operation integrally with said labyrinths (LB1, LB2, LB3, LB4, LB5), said centring pins (C1, C2, C3, C4, C5), and said seats (S1, S2, S3, S4, S5).
11. A muffler device (10) as claimed in claim 10, **characterised in that** each fitted element (11a, 11b) is ring-shaped.
12. A muffler device (10) as claimed in claim 3, **characterised in that** said terminal elements (12, 13) present respective means (12b, 20, 21; 13b, 23) adapted to allow to "sandwich" at least one fitted element (11a, 11b).
13. A muffler device (10) as claimed in claim 3, **characterised in that** the intakes (BI1", BI2", BI3", BI4", BI5"; BI1'", BI2'", BI3'", BI4'", BI5'") of said fitted elements (11a, 11b) and the closing element 12 (BI1', BI2', BI3', BI4', BI5') are reciprocally staggered.

14. A whirlpool bath provided with a muffler device (10) as claimed in any of the preceding claims.

5 Amended claims in accordance with Rule 86(2) EPC.

1. A muffler device (10) for an air intake conduit, in particular for an intake conduit of a whirlpool bath; muffler device (10) comprising an essentially cylindrical main body (11), said main body (11) being provided with a plurality of peripheral air intakes (BI1, BI2, BI3, BI4, BI5) equally distributed on at least one portion of the external surface (SUPE) of said main body (11) itself;
the muffler device (10) being **characterised in that** a respective labyrinth (LAB1, LAB2, LAB3, LAB4, LAB5) is associated to each intake (BI1, BI2, BI3, BI4, BI5) ;

in that said main body (11) comprises at least one fitted element (11a, 11b) which, in use, is "sandwiched" by two terminal elements (12, 13); and **in that** said labyrinths (LB1, LB2, LB3, LB4, LB5) are provided with respective centring pins (C1, C2, C3, C4, C5), each of which, in use, engages with a respective seat (S1, S2, S3, S4, S5; 26) made on an external surface (SUPE) of an adjoining fitted element (11b, 13).

2. A muffler device (10) as claimed in claim 1, **characterised in that** each labyrinth (LAB1, LAB2, LAB3, LAB4, LAB5) is provided with a respective outlet (BU1, BU2, BU3, BU4, BU5) through which the intake air enters a central conduit (CC) from which it flows towards the air intake conduit.

3. A muffler device (10) as claimed in claim 1, **characterised in that** the labyrinths (LAB1, LAB2, LAB3, LAB4, LAB5) are five.

4. A muffler device (10) as claimed in claim 1, **characterised in that** each labyrinth (LAB1, LAB2, LAB3, LAB4, LAB5) comprises a first baffle (17) whose terminal part forms a bend (18).

5. A muffler device (10) as claimed in claim 4, **characterised in that** each labyrinth (LAB1, LAB2, LAB3, LAB4, LAB5) further comprises a second baffle (19) which insinuates within said bend (18).

6. A muffler device (10) as claimed in claim 5, **characterised in that** the second baffle (19) of the labyrinth (LB2) is integrally obtained with the first baffle (17) of the adjoining labyrinth (LB3), and so on.

7. A muffler device (10) as claimed in claim 1, **characterised in that** each fitted element (11a, 11b) is made of plastic material by means of a single moulding operation integrally with said labyrinths (LB1,

LB2, LB3, LB4, LB5), said centring pins (C1, C2, C3, C4, C5), and said seats (S1, S2, S3, S4, S5).

8. A muffler device (10) as claimed in claim 7, **characterised in that** each fitted element (11a, 11b) is ring-shaped. 5

9. A muffler device (10) as claimed in claim 1, **characterised in that** said terminal elements (12, 13) present respective means (12b, 20, 21; 13b, 23) adapted to allow to "sandwich" at least one fitted element (11a, 11b). 10

10. A muffler device (10) as claimed in claim 1, **characterised in that** the intakes (BI1", BI2", BI3", BI4", BI5"; BI1'", BI2'", BI3'", BI4'", BI5'") of said fitted elements (11a, 11b) and the closing element 12 (BI1', BI2', BI3', BI4', BI5') are reciprocally staggered. 15

11. A whirlpool bath provided with a muffler device (10) as claimed in any of the preceding claims. 20

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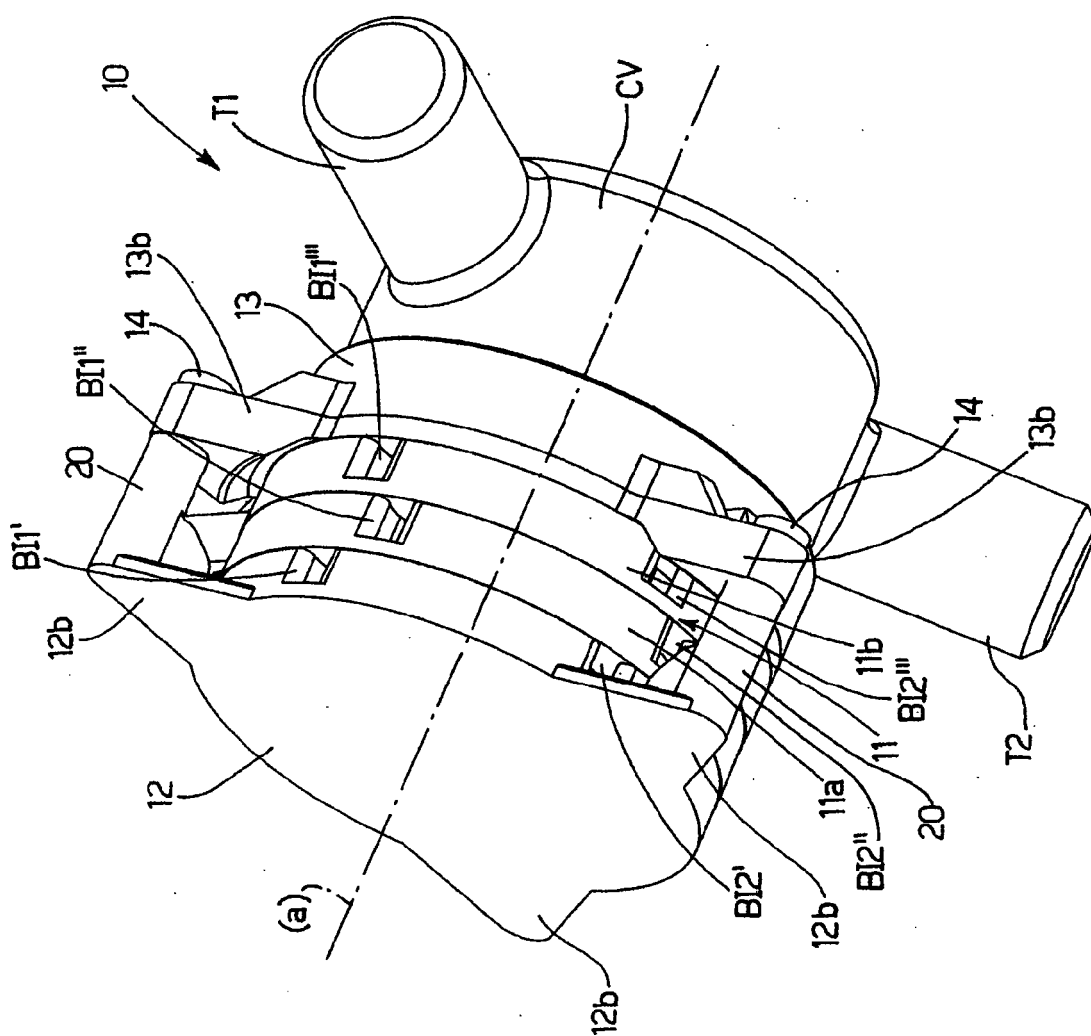
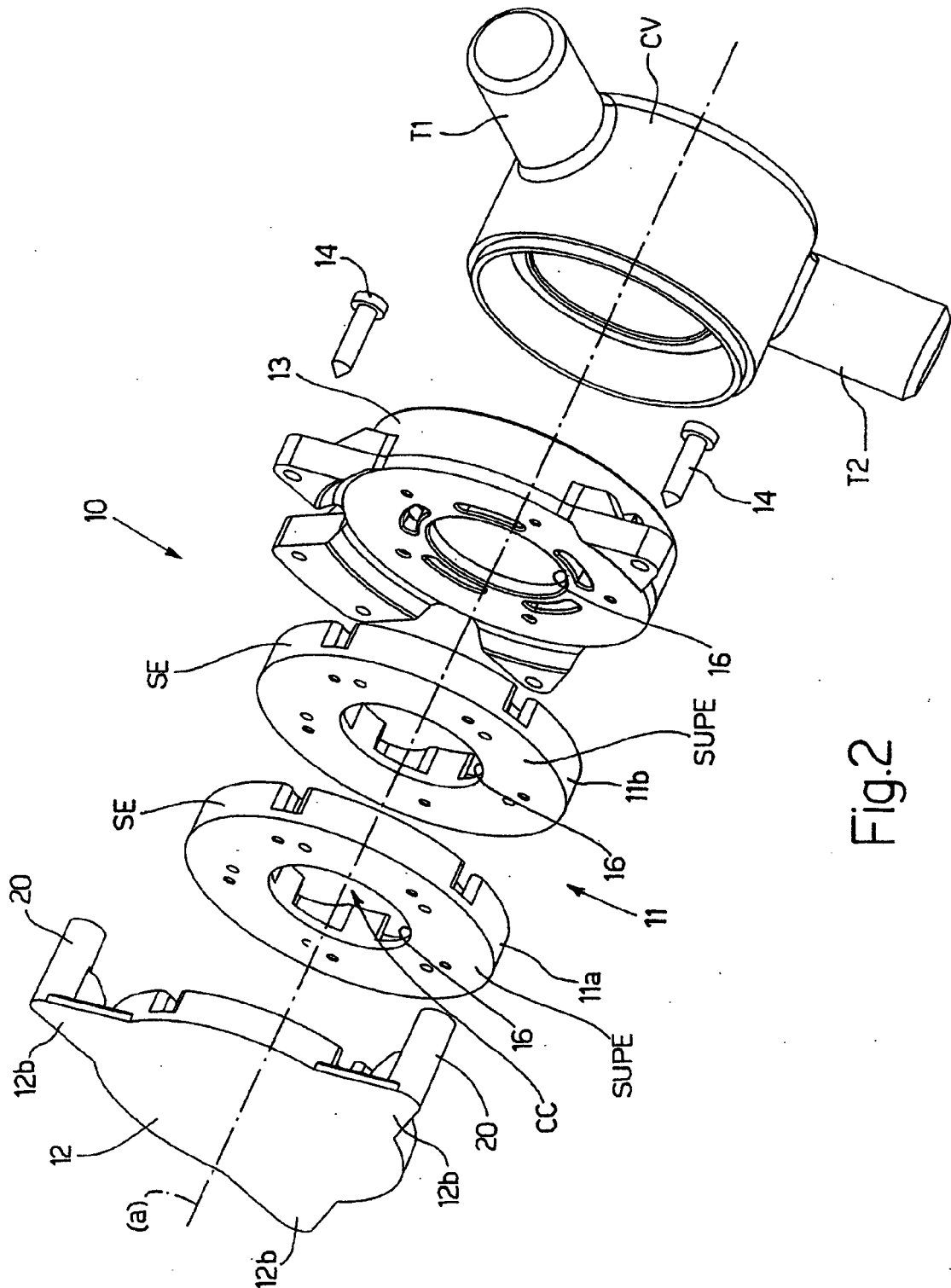
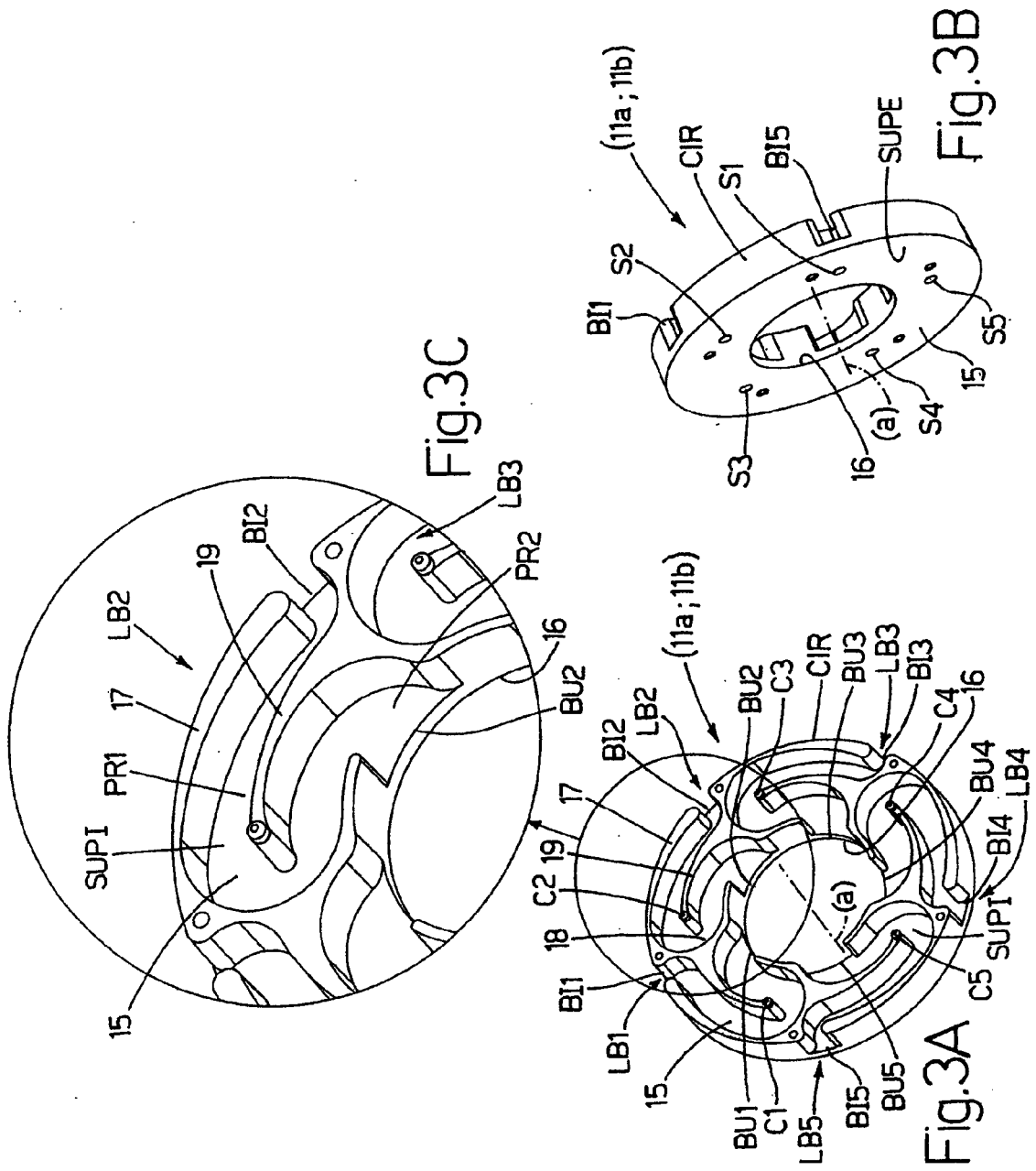
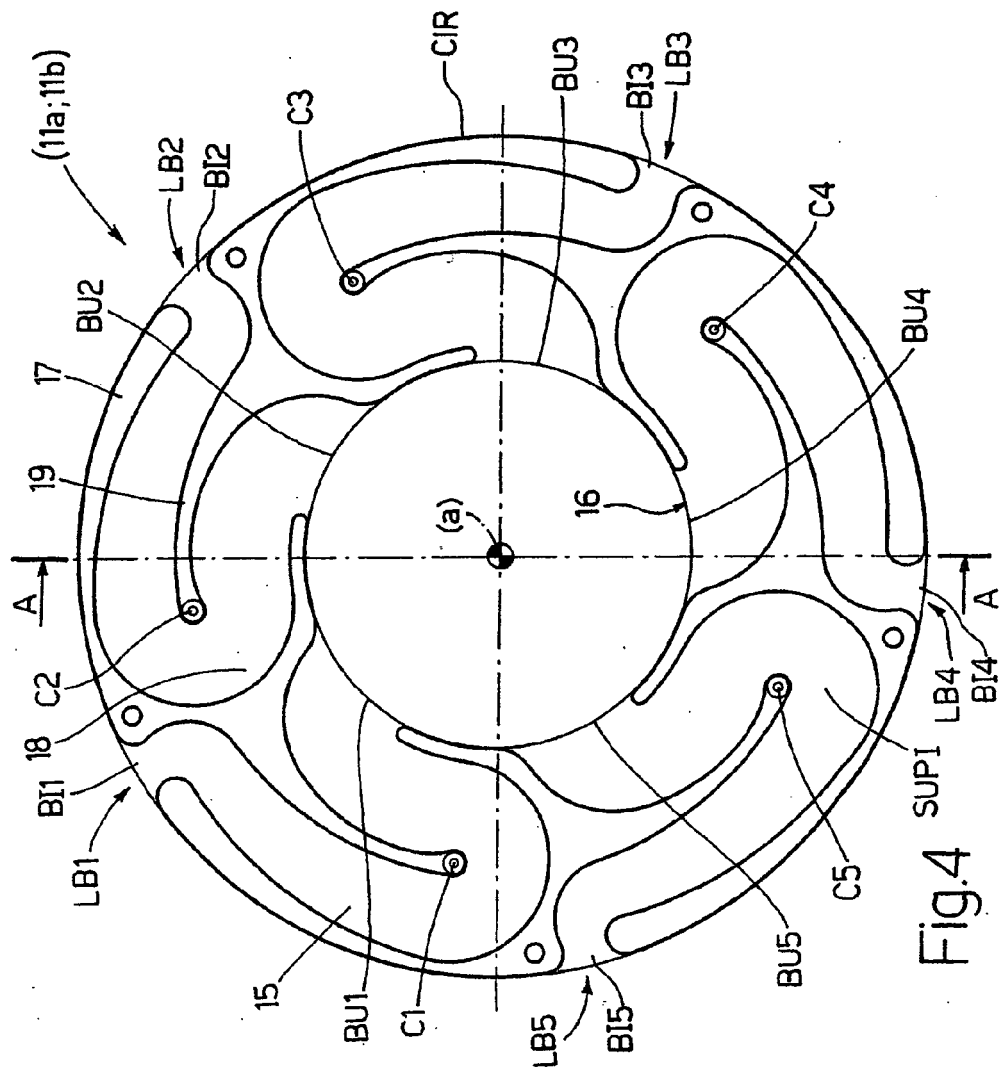
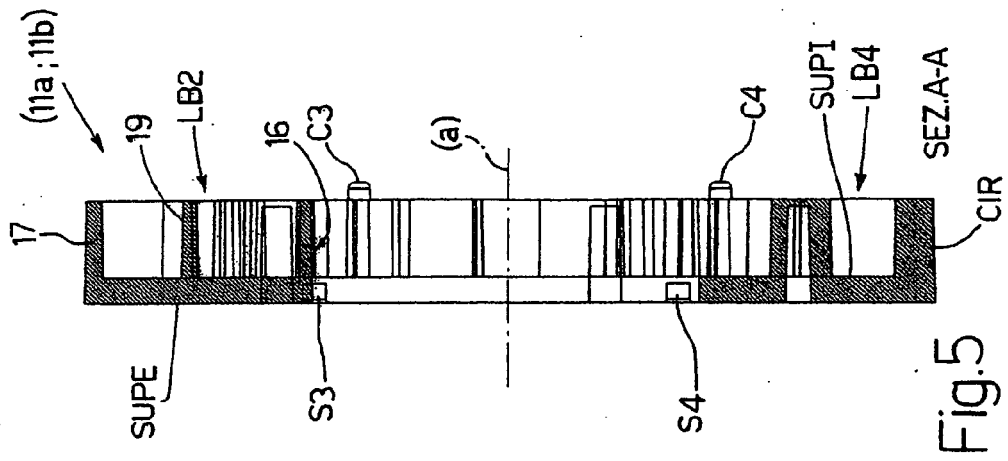


Fig.1







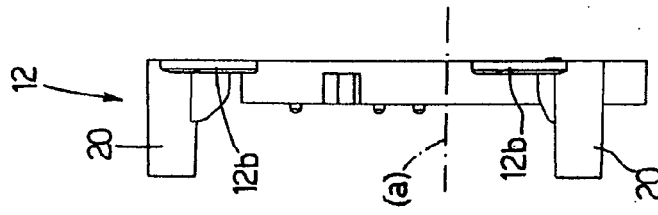


Fig.8

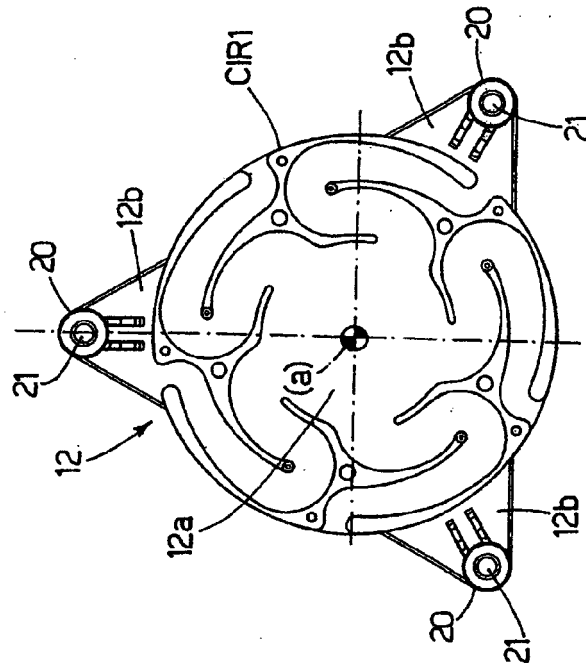


Fig.7

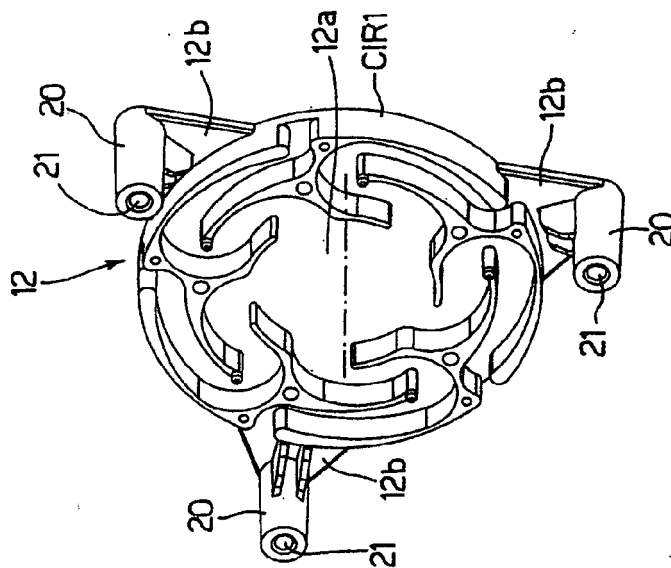


Fig.6

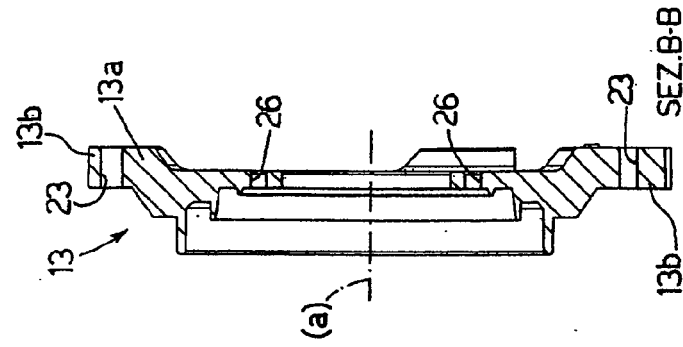


Fig.11

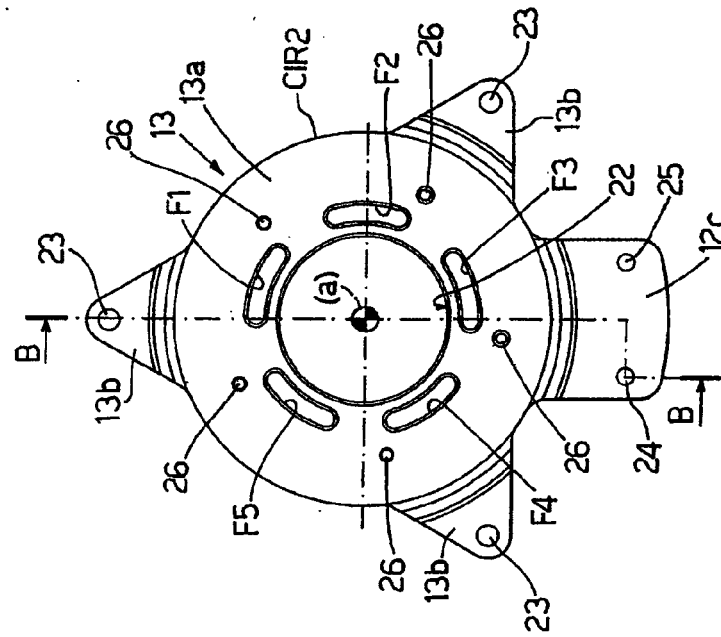


Fig.10

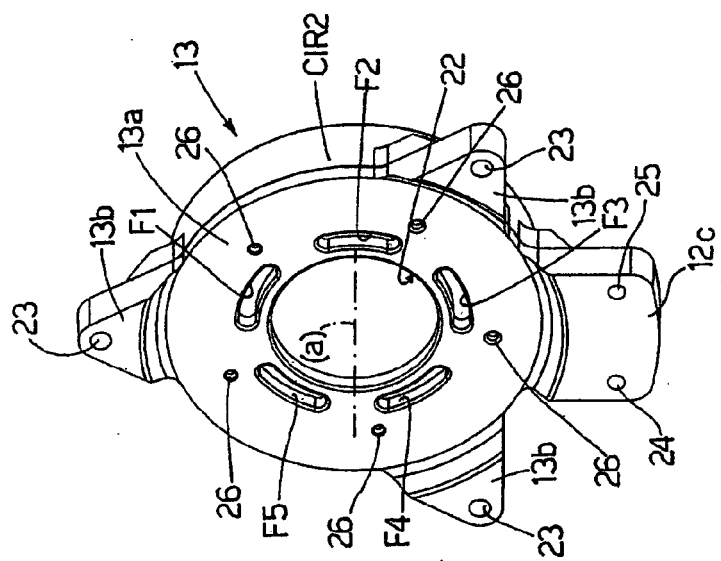


Fig.9



European Patent
Office

EUROPEAN SEARCH REPORT

Application Number
EP 06 42 5211

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 22 November 2006	Examiner Oelschläger, Holger
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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ON EUROPEAN PATENT APPLICATION NO.**

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This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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