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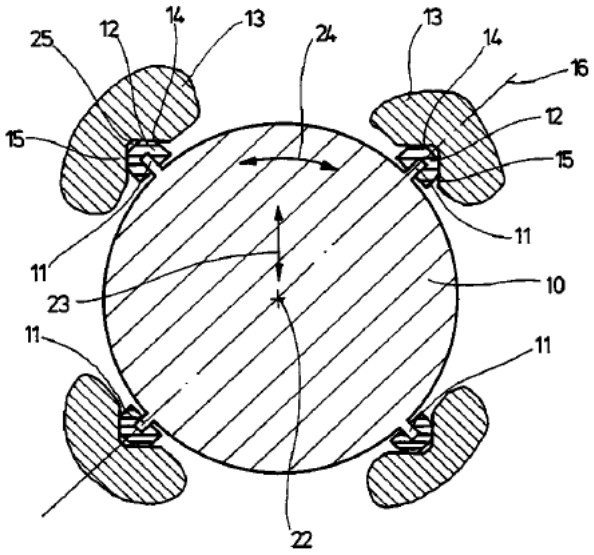
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(54) Vibration damping mounting for electric motors, integrated into a blower.

(57) a) The invention concerns a vibration-damping mounting for electric motors, integrated into a blower.

b) The invention is characterized in that each damper element (12) is supported in the radial direction on two support surfaces (14, 15) located on the side of the motor mounting, which are each at an acute angle with respect to the radii (16)



Stoneridge Control Devices, Inc. - Exhibit 2003
ZF North America, Inc. et al vs. Stroneridge Control Devices, Inc.
IPR2023-00273

"Vibration damping mounting for electric motors, integrated into a blower".

The invention relates to a vibration-damping mounting for electric motors, with mounting ribs projecting radially from the motor housing and offset from each other by an angle and with damping elements mounted on the mounting ribs made of a flexible material for flexibly decoupling the motor housing from a motor mounting.

In a known mounting of this type for an electric motor, integrated into a blower, the damping elements, made of rubber, for flexibly decoupling the motor housing from a motor mounting on the side of the blower receiving the motor housing, are accommodated up to the end in recesses in the motor mounting, i.e., are surrounded on all sides by the motor mounting. With this mounting, the damping properties of the rubber remain largely unused, and the mounting remains largely rigid, as the rubber can only deform and expand in the recesses to a very small extent.

The vibration-damping mounting for electric motors according to the invention is characterized in that each damping element is supported in the radial direction on two support surfaces located on the side of the motor mounting, each of which surfaces forms an acute angle α with respect to the radii. The advantage of the mounting according to this invention is that due to the support of the damping elements on the support surfaces placed obliquely on the side of the motor mounting, the flexible material of the damping elements is loaded in a favorable way consisting of a combination of pressure and thrust. This applies equally to radial vibrations occurring perpendicular to the motor axis (e.g., due to a balancing defect) and to torsional vibrations occurring tangentially to the motor axis (e.g., as a result of standstill torques). Since the damping elements are held on only the two support surfaces, the flexible material can be deformed in a suitable manner. Due to the low thrust stiffness compared to the pressure stiffness of the flexible material, a soft motor mounting, i.e., good vibration damping, is achieved in this case with a small overall volume.

Advantageous developments and refinements of the above-mentioned mounting are made possible by the fact that:

- the damping elements are approximately rectangular or trapezoidal in cross-section with a slot

open towards the side facing the mounting ribs to rest upon the mounting rib, and on their rear sides facing the motor mounting, there are two chamfers forming the same acute angle α as the surfaces, on the motor mounting side, with respect to the radii,

- the angle between the two support surfaces is approximately 90°,
- the mounting ribs have a substantial expansion in the axial direction, which is preferably greater than their expansion in the radial direction, and that each damping element engages the corresponding mounting rib on five sides in a form-fit manner,
- the damping elements have a slightly mitered shape in the axial direction so that their radial height increases slightly as the axial length increases,
- the damping elements rest with their front surfaces extending perpendicularly in the direction of the axis on the boundary surfaces located on the mounting side of the motor,
- the arrangement of the support surfaces is stopped, and the radial height of the mounting ribs surrounded by the damping elements is dimensioned in such a way that the barrier ribs do not penetrate into the area between the support surfaces,
- the support surfaces are formed within a receiving pocket, extending in an axial direction to the motor mounting, on the motor mounting, and a number of receiving pockets corresponding to the number of mounting ribs is arranged to be offset from each other by the same angle as the mounting ribs,
- the slope of the support surfaces with respect to the radii is determined in such a way that the distance between the support surfaces and the bottom of the receiving pocket decreases, and the two support surfaces are formed by the lateral flanks of the receiving pocket,
- the damping elements resting on the mounting ribs extend radially from the bases of the ribs to the bottom of the receiving pockets and completely fill the latter, and in that the radial height of the mounting rib is such that it ends before the opening of the receiving pockets,
- the slope of the support surfaces to the radii is determined in such a way that their clearance increases with respect to the bottom of the receiving pockets, and the two support surfaces

are each arranged at a certain distance from the opening of the receiving pockets,

- each of the damping elements resting on the mounting ribs has a ribbed head at their free end, which completely fills the area between the support surfaces and the bottom of the receiving pockets and rests on the support surfaces and the bottom of the pocket under prestress,
- the damping elements resting on the mounting ribs extend radially from the bases of the ribs to the bottom of the receiving pockets, and in that the region of the damping elements projecting into the receiving pockets contains an undercut up to the top towards the lateral flanks of the receiving pockets.

In order to make assembly simple, in a preferred embodiment of the invention, the damping elements are given a slightly mitered shape in the axial direction. The support surfaces on the motor mounting adapt to this mitered shape in their axial extent.

In a preferred embodiment of the invention, the damping elements rest with their front surfaces extending perpendicularly to the axial direction on boundary surfaces on the mounting side of the motor. In this way, the motor is also axially locked and is held together exclusively by the damping elements. Other mounting elements, in particular on the end surfaces of the motor housing, can be omitted.

According to a preferred embodiment of the invention, the support surfaces are arranged, and the mounting ribs, which are surrounded by the damping elements, are dimensioned on the motor mounting in the radial direction in such a way that the mounting ribs do not penetrate into the area between the support surfaces. This constructive measure ensures that, in the event of tangential vibration of the motor, there is no material area of the damping element between the mounting rib and the support surface that is subject to pressure. Due to the significantly lower thrust stiffness of the damping element, the motor's ability to vibrate tangentially is improved, and the tangential motor loads caused by the rotor and the magnetic circuit are not transmitted to the motor mounting or are only transmitted in a very strongly damped manner.

In another embodiment of the invention, the support surfaces are preferably in the form of

receiving pockets, which are arranged on the motor mounting in a number corresponding to the number of mounting elements and are offset at the same angle as the mounting ribs with respect to each other.

The two support surfaces in each receiving pocket can, in this case, be arranged in such a way that their transverse clearance, or in relation to the radii, decreases towards the bottom of the receiving pocket. Appropriately, the support surfaces are then formed by the obliquely extending side flanks of the receiving pockets extending in the axial direction of the motor mounting. The receiving pockets are completely filled by the damping elements resting on the mounting ribs, which extend from the bases of the mounting ribs to the bottom of the receiving pockets.

In an alternative embodiment of the invention, the slope of the support surfaces to the radii is determined such that the clearance of the support surfaces from each other increases towards the bottom of the receiving pockets. In this case, the support surfaces are arranged at a certain distance from the opening of the receiving pocket facing the motor. The damping elements each carry a ribbed head at their free end, which completely fills the area between the support surfaces and the bottom of the receiving pocket and rests on the support surfaces and on the bottom of the pocket under prestressing. In this way, an improved axial mounting of the damping element in the receiving pocket is achieved without compressing the damping element too strongly.

In this case, one is assured that the axial oscillations of the motor can be improved by the fact that the damping elements resting on the mounting ribs and extending radially from the bases of the ribs to the bottom of the receiving pockets contains a clearance in the area penetrating the receiving pockets up to their top towards the lateral sides of the receiving pockets

Drawings:

The following description will explain the invention in more detail by using an example of an embodiment shown in the drawings.

- Figure 1 is a longitudinal section of the motor housing of the mounting and a partial view of the motor support according to a schematic representation.

- Figure 2 is a cross-section along line II-II in Figure 1.
- Figure 3 shows a partial section along line III-III of Figure 1.
- Figure 4 is a cross-section of the motor housing, mounting, and motor support of an example build.
- Figure 5 is a cross-section along line V-V of Figure 4.
- Figure 6 is a representation identical to that of the Figure showing another embodiment.

The vibration-damping electric motor mounting, shown schematically in Figure 1 in a longitudinal section and in Figure 2 in cross-section, the housing of which is designated by reference 10, has a total of four mounting ribs 11, which are offset from each other at the same angle, and damping elements 12, made of a resilient material, in this case, rubber, which are placed on mounting ribs 11 which flexibly decouple motor housing 10 with respect to a mounting shown only schematically. For this purpose, each damping element 12 is supported in the radial direction upon two support surfaces 14, 15 formed on motor support 13, which form an acute angle α (Figure 3) with respect to the radii 16. In the example of an embodiment shown, angle 2α between the two support surfaces 14, 15 is approximately 90°. The two support surfaces 14, 15, are arranged in a respective pocket 25 formed on motor support 13. The four receiving pockets 25 are offset from each other by the same angle as mounting ribs 11 on motor housing 10.

As can be seen from Figure 2 and Figure 3, each damping element is approximately rectangular or slightly trapezoidal in cross-section with a slot 17 open towards side-facing mounting ribs 11, and these elements have two chamfers 18, 19 on their rear side facing motor support 13, which forms the same acute angle α as support surfaces 14, 15 on the side of the motor support with respect to radii 16. As can be seen in Figure 1, the extension of mounting ribs 11 is in an axial direction that is greater than their radial height. Each mounting rib 11 is pressed into slot 17 of a damping element 12 and is surrounded on five sides by damping element 12 in a form-fit manner. Each damping element 12 also rests with its end surfaces extending perpendicularly in an axial direction on boundary surfaces 20,

21 on the motor support side. These surfaces are shown in part in Figure 1. In this way, motor housing 10 is locked in the axial direction by damping elements 12, and other mounting means can be dispensed with for this purpose.

For ease of assembly, damping elements 12 have a slightly mitered shape as they rise in the axial direction, i.e., their radial height increases slightly in relation to motor housing 10 as the length increases. Support surfaces 14, 15 also increase with a corresponding mitered shape on motor support 13 in relation to the support axis.

Motor housing 10 is essentially vibrated by radial vibrations occurring perpendicular to the axis of the motor 22. These vibrations are symbolized in Figure 2 by reference 23 and by torsional vibrations occurring tangentially to the axis of motor 22. These vibrations are symbolized in Figure 2 by arrow 24. Radial vibrations occur, for example, as a result of balancing errors. Torsional vibrations are produced, for example, by sudden standstill torques. Damping elements 12 are subjected to the same amount of pressure and thrust from both radial and torsional vibrations, as the pressure and thrust deformation properties of the flexible material, i.e., rubber, are related to each other.

Due to the low thrust stiffness of the rubber compared to the pressure stiffness, good shock absorption for the engine is achieved via a soft mounting when a small footprint is required.

In the embodiment of the vibration-damping mounting shown in Figure 4 and Figure 5, the two support surfaces 14, 15 are arranged between motor housing 10 and motor support 13, corresponding to each other in a receiving pocket 25, which extends in the axial direction of the motor support 13. The number of receiving pockets 25 distributed around the circumference of motor support 13 at the same angle is in turn four. Support surfaces 14, 15 are formed on side flanks 251 and 252 of receiving pocket 25 in such a way that their clearance increases from the bottom of pocket 253 towards the opening of pocket 253 facing motor housing 10. Damping element 12 resting on mounting rib 22 extends radially from the base of mounting rib 11 to the bottom of receiving pocket 253 and completely fills receiving pocket 25. The radial height of mounting rib 11 is dimensioned in such a

way that mounting rib 11 ends at a certain distance before opening 254 of receiving pocket 25 and thus does not penetrate into receiving pocket 25 as in the embodiment according to Figures 2 and 3. In this way, motor housing 19 is able to more freely vibrate tangentially in a substantial manner, and due to the lower thrust stiffness of the rubber, the material from which damping elements 12 are in turn made, the tangential vibrations caused by the rotor and magnetic circuit are not transmitted to motor support 13. By improving the tangential possibility of vibration of the motor housing 10, there is a much lower transmission of so-called motor gear frequency noise.

In Figure 6, a cross-sectional view of the vibration-damping mounting between engine housing 10 and engine mounting 13 is shown, modified from that shown in Figure 4. Here too, as in the embodiment shown in Figure 4 and Figure 5, the arrangement of support surfaces 14', 15' in receiving pockets 25 was selected, and the radial height of the mounting ribs surrounded by damping elements 12' was dimensioned in such a way that mounting ribs 11 do not project into the area between support surfaces 14', 15' and that in this way the mounting has an equally good tangential vibration possibility, which contributes to the reduction of slot-frequency transmission noise. Support surfaces 14', 15' in receiving pockets 25' are each arranged at a distance from pocket opening 254', and their slope with respect to the radii is determined such that the clearance of support surfaces 14', 15' increases in the direction of the pocket bottom 253'. Damping elements 12' resting on mounting ribs 11 extend radially from mounting rib base 11 to the bottom of the receiving pockets 25' and carry at the free end, in each case, a ribbed head 121', which completely fills the area between the support surfaces 14', 15' and pocket bottom 253' and rests on the latter and on support surfaces 14', 15' under prestressing. Area 122' of cushioning element 12'' connecting to the top 121', entering the receiving pocket 25' maintains a clearance up to the head 121’ from side flanks 251', 252' of receiving pocket 25' parallel to each other and to the radius. Due to damping element's 12' recess in the area of receiving pocket 25, the barrier rib 11 can penetrate into receiving pocket 25, and in this way, in the case of a small distance between the motor housing 10 and the motor support, it can be produced to have sufficient height without impairing the tangential vibration capability of the damping element 12'.

The role of head 121' of damping element 12', which rests under prestressing on support surfaces 14' and 15' and on the bottom 254' of the pocket, is to ensure additional axial mounting without the entire damping element 12' being too strongly compressed. In this case, it is not necessary to surround the mounting rib 11 on the front side with the damping elements 12', as can be seen in Figure 1 and Figure 5.

CLAIMS

1.) A vibration-damping mounting for electric motors with mounting ribs projecting radially from the motor housing and offset at an angle to each other and with damping elements mounted on the mounting ribs made of a flexible material for flexibly decoupling the motor housing from a motor mounting, characterized in that each damping element (12) is supported in the radial direction on two support surfaces (14, 15) located on the mounting side of the motor, each at an acute angle (α) with respect to the radii (16).

2.) The mounting according to claim 1, characterized in that the damping elements (12) are approximately rectangular or trapezoidal in cross-section with an open slot (17) towards the side facing the mounting ribs (11) for resting on the mounting rib (11) and have, on their rear sides facing the motor mounting (13), two chamfers (18, 19) forming the same acute angle (α) as the surfaces (14, 15) on the motor mounting side with respect to the radii (16).

3.) The mounting according to claim 1 or 2, characterized in that the angle (2α) between the two support surfaces (14, 15) is approximately 90°.

4.) The mounting according to any of claims 1-3, characterized in that the mounting ribs (11) have a substantial expansion in the axial direction, which is preferably greater than their expansion in the radial direction, and that each damping element (12) engages on the corresponding mounting rib (11) on five sides in a form-fit manner.

5.) The mounting according to claim 4, characterized in that the damping elements (12) have a slightly mitered shape in the axial direction so that their radial height increases slightly as the axial length increases.

6.) The mounting according to claim 4 or 5, characterized in that the damping elements (12) rest with their end surfaces extending perpendicularly to the direction of the axis on the boundary surfaces (20, 11) on the motor mounting side.

7.) The mounting according to any of claims 1-6, characterized in that the arrangement of the support surfaces (14, 15*;* 14', 15') is locked and the radial height of the mounting ribs (11) surrounded

by the damping elements (12; 12') is dimensioned in such a way that the barrier ribs (11) do not penetrate into the area between the support surfaces (14, 15; 14', 15').

8.) The mounting according to any of claims 1-7, characterized in that the support surfaces (14, 15*;* 14', 15') are formed in a receiving pocket (25*;* 25'), extending in the axial direction of the motor mounting (13), on the motor mounting (13), and that a number of receiving pockets (25*;* 25') corresponding to the number of mounting ribs (11) is arranged offset from each other by the same angle as the mounting ribs (11).

9) The mounting according to claim 8, characterized in that the slope of the support surfaces (14, 15) with respect to the radii is determined in such a way that the distance between the support surfaces (14, 15) and the bottom (254) of the receiving pocket (25) decreases, and that the two support surfaces (14, 15) are formed by the lateral flanks (251, 252) of the receiving pocket (25).

10.) The mounting according to claim 9, characterized in that the damping elements (12) resting on the mounting ribs (11) extend radially from the bases of the ribs to the bottom (253) of the receiving pockets (25) and completely fill the latter, and in that the radial height of the mounting rib (11) is such that it ends before the opening (254) of the receiving pockets (25).

11.) The mounting according to claim 8, characterized in that the slope of the support surfaces (14', 15') with respect to the radii is determined in such a way that their clearance increases with respect to the bottom (253') of the receiving pockets (25), and in that the two support surfaces (14', 15') are each arranged at a distance from the opening (254') of the receiving pockets (25').

12.) The mounting according to claim 11, characterized in that the damping elements (12') resting on the mounting ribs (11) each have at their free end a ribbed head (121') that completely fills the area between the support surfaces (14', 15') and the bottom (253') of the receiving pockets (25') and rests on the support surfaces (14', 15') and the pocket bottom (253') under prestressing.

13.) The mounting according to claim 12, characterized in that the damping elements (12') resting on the mounting ribs (11) extend radially from the bases of the ribs to the bottom (253') of the receiving pockets (25'), and in that the region of the damping elements (12') projecting into the

receiving pockets (25') contains, up to the head (121'), an undercut to the lateral flanks (251', 252') of the receiving pockets (25').

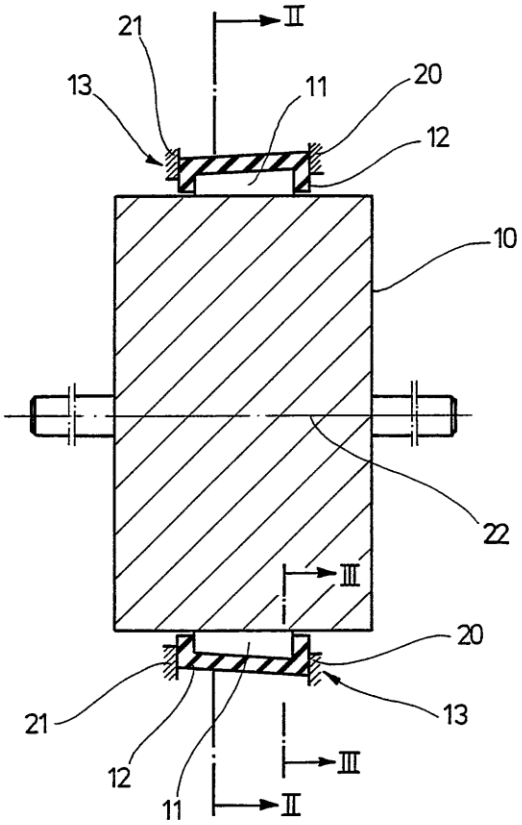


Fig. 1

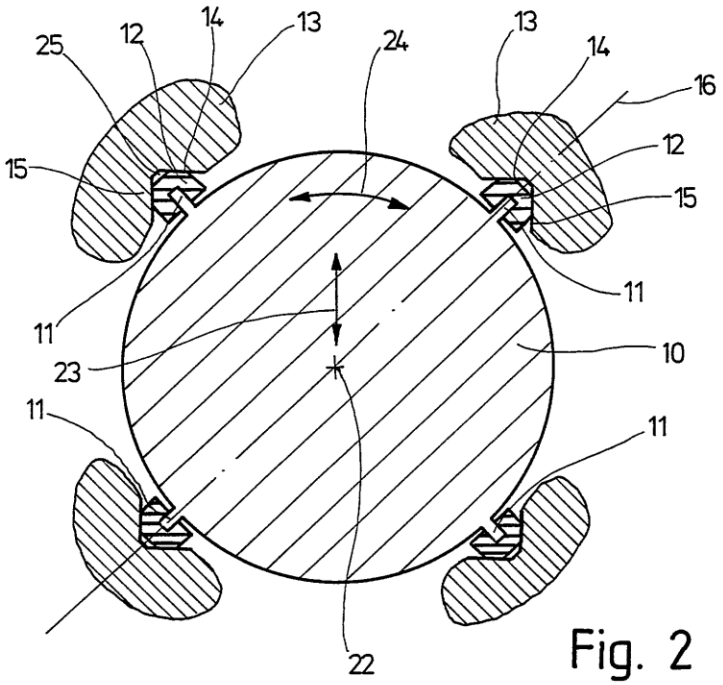

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Fig. 2

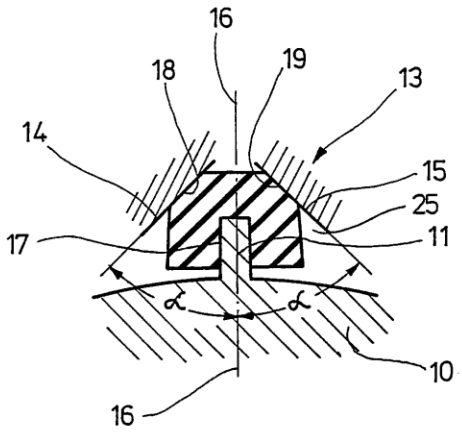

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Fig. 3

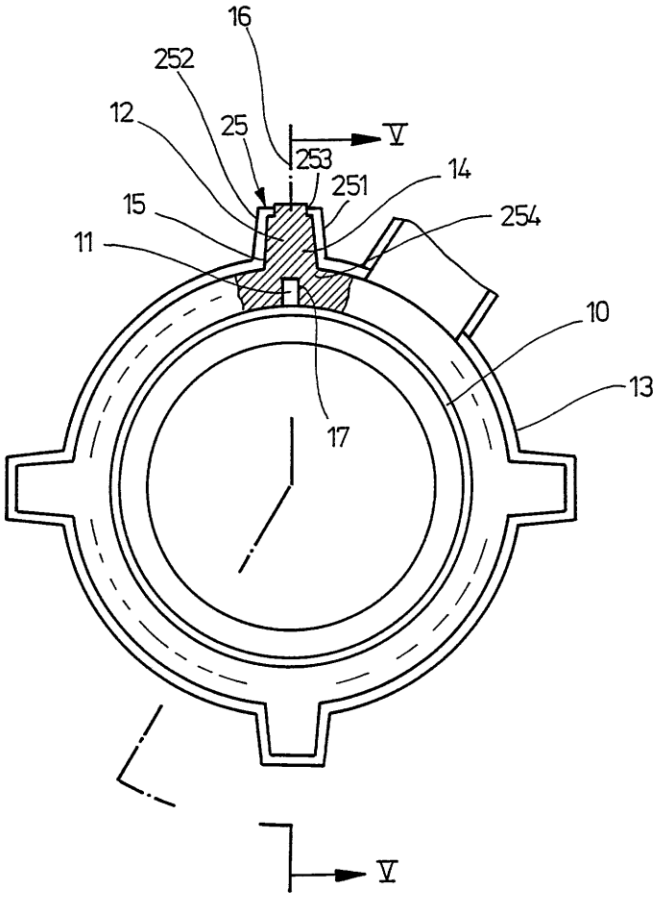


Fig. 4

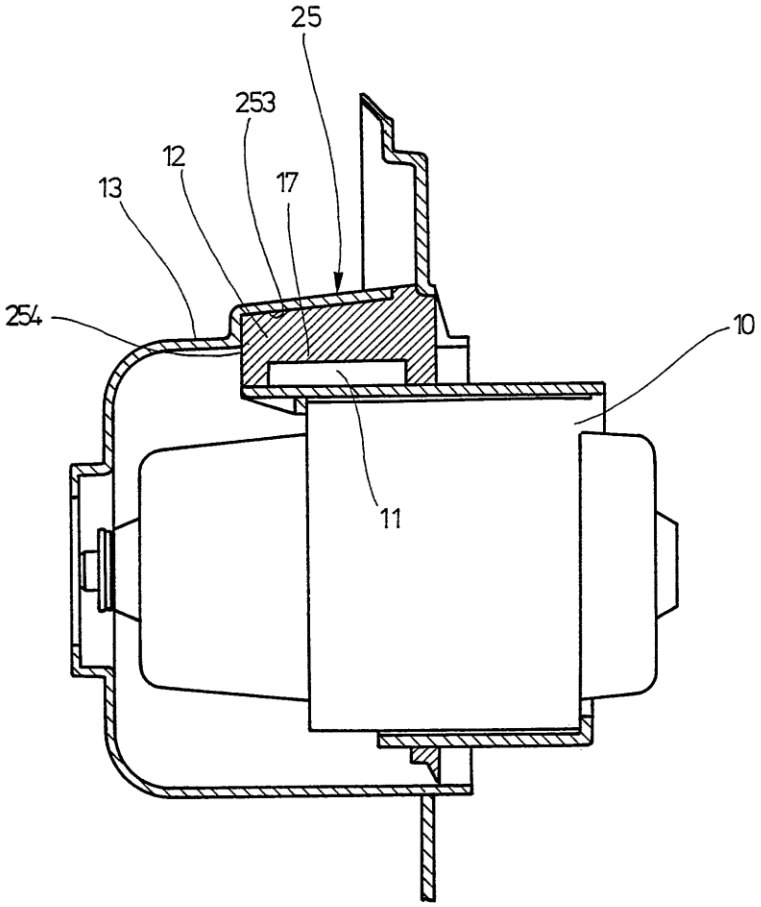


Fig. 5

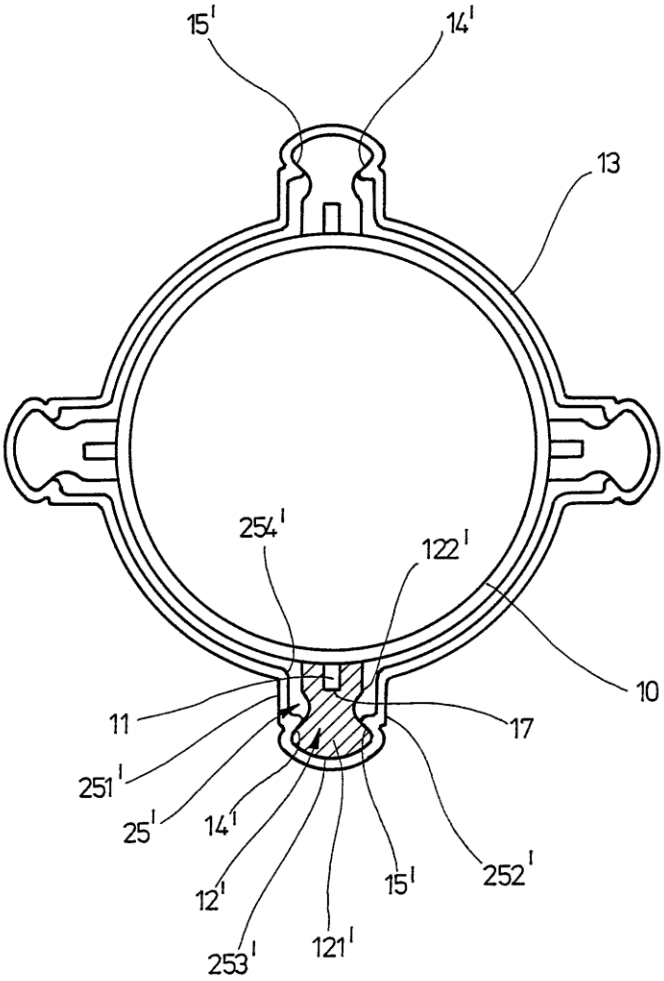


Fig. 6

February 10, 2023

Certification

Welocalize Translations

TRANSLATOR'S DECLARATION:

I, Laura H. Hastings-Brownstein, hereby declare:

That I possess advanced knowledge of the French and English languages. The attached French into English translation has been translated by me and to the best of my knowledge and belief, it is a true and accurate translation of: FR2693779A3.pdf.

All statements made in this declaration of my own knowledge are true, and all statements made on information and belief are believed to be true. I certify these statements under the understanding that willful false statements and the like are punishable by fine or imprisonment, or both (18 U.S.C. 1001). To the best of my knowledge, the aforementioned documents are a true, full, and accurate translation into English of the specified document.

Laura H. Hastings-Brownstein

Laura H. Hastings-Brownstein

Project Number: CGO_2302_P0001

STATE OF Arizona
COUNTY OF Pima

The foregoing instrument was acknowledged before me this 10 day of 2, 2023, by Laura Hasting

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