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(54) **SCROLL FLUID MACHINE**

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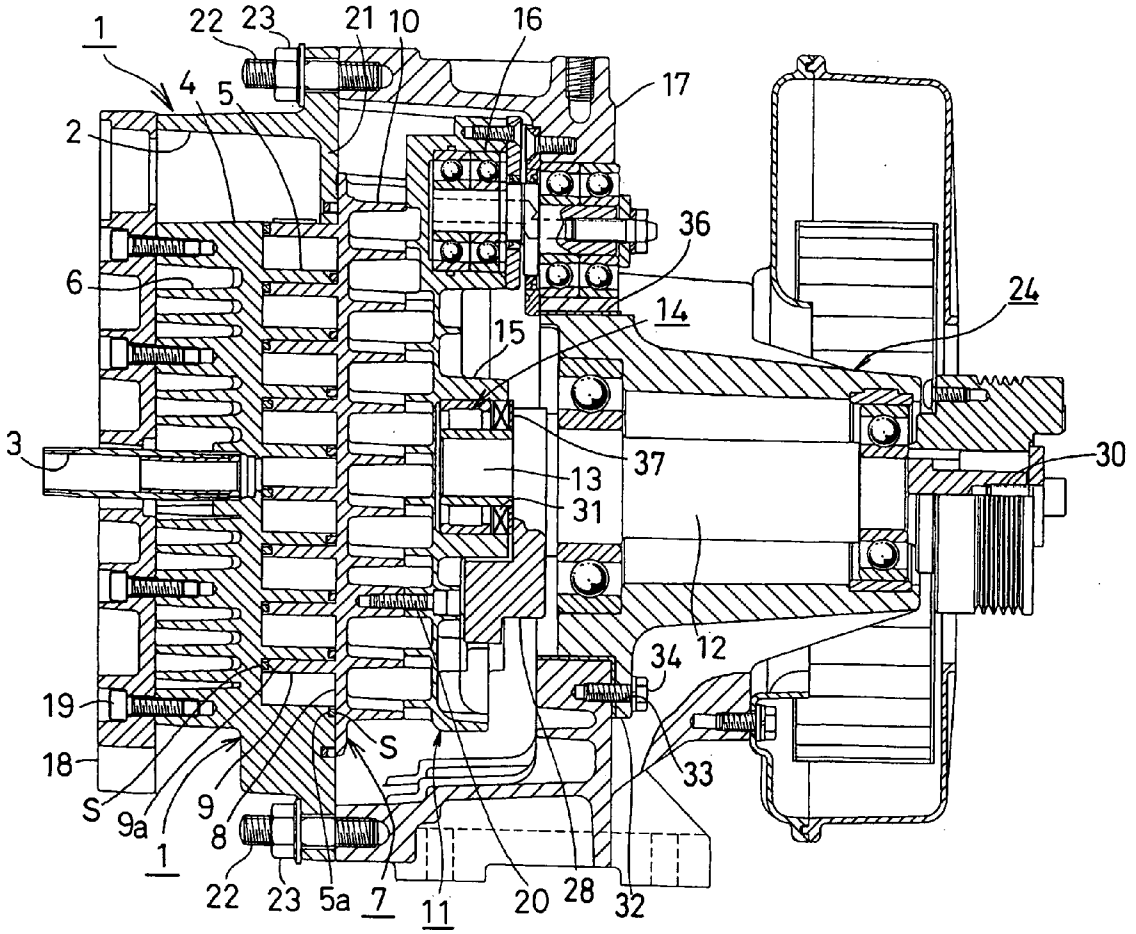
(57) **ABSTRACT**

A scroll fluid machine comprises an orbiting scroll and a stationary scroll. The orbiting scroll comprises an orbiting end plate having an orbiting wrap, and the stationary scroll comprises a stationary end plate having a stationary wrap. The orbiting scroll is supported to turn on an eccentric shaft portion of a drive shaft. The orbiting wrap engages with the stationary wrap to form a sealed chamber therebetween. A bearing tube is detachably disposed in a housing. The drive shaft is supported to turn in the bearing tube.



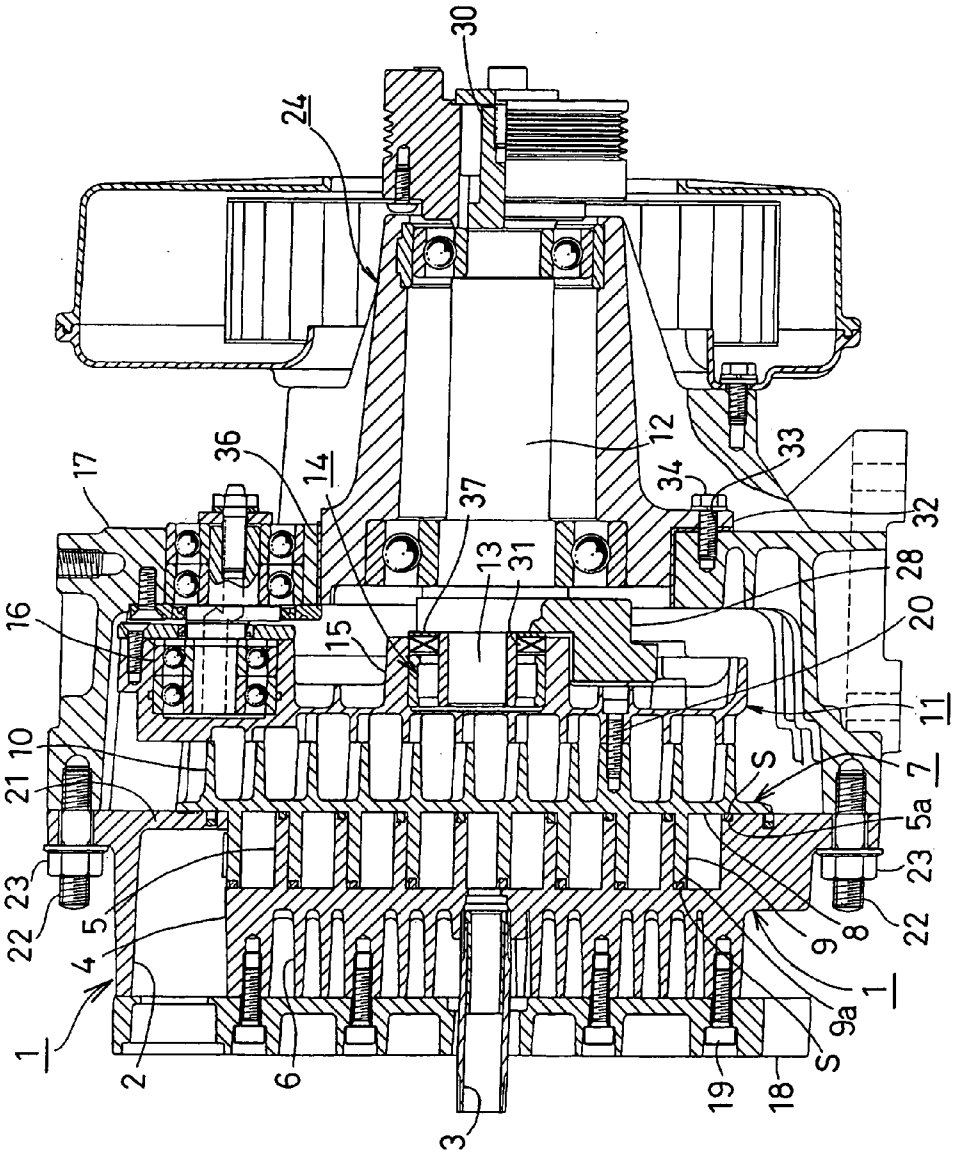

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FIG.1

FIG.2

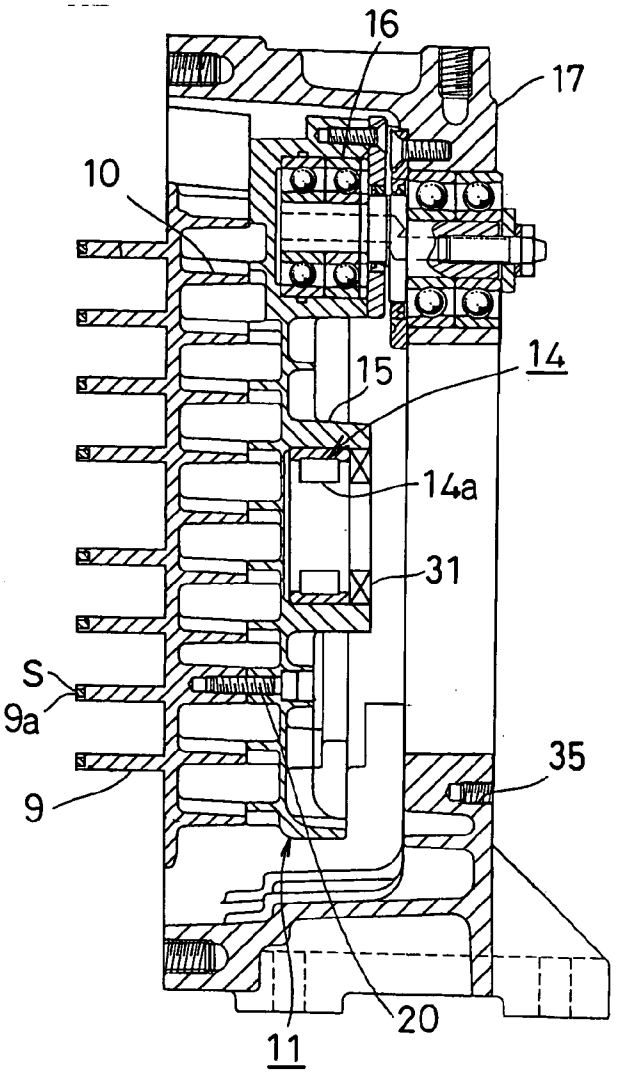
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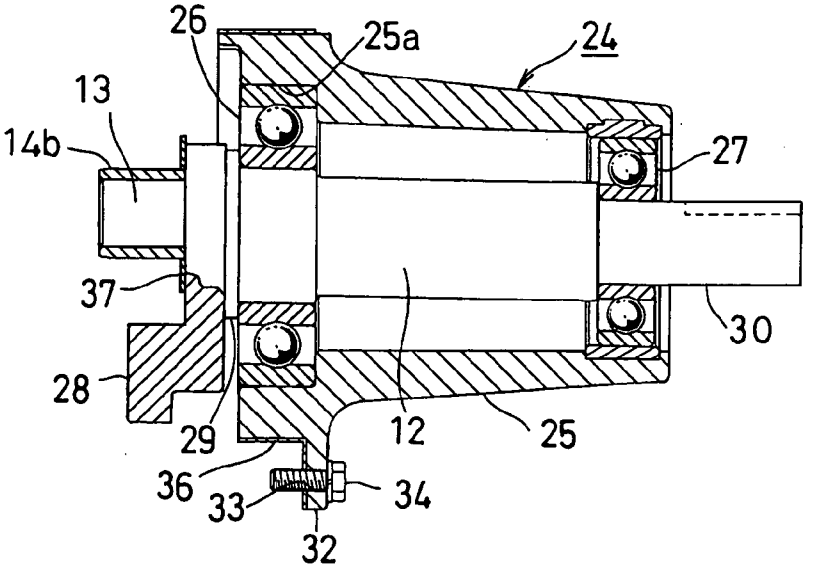
FIG.3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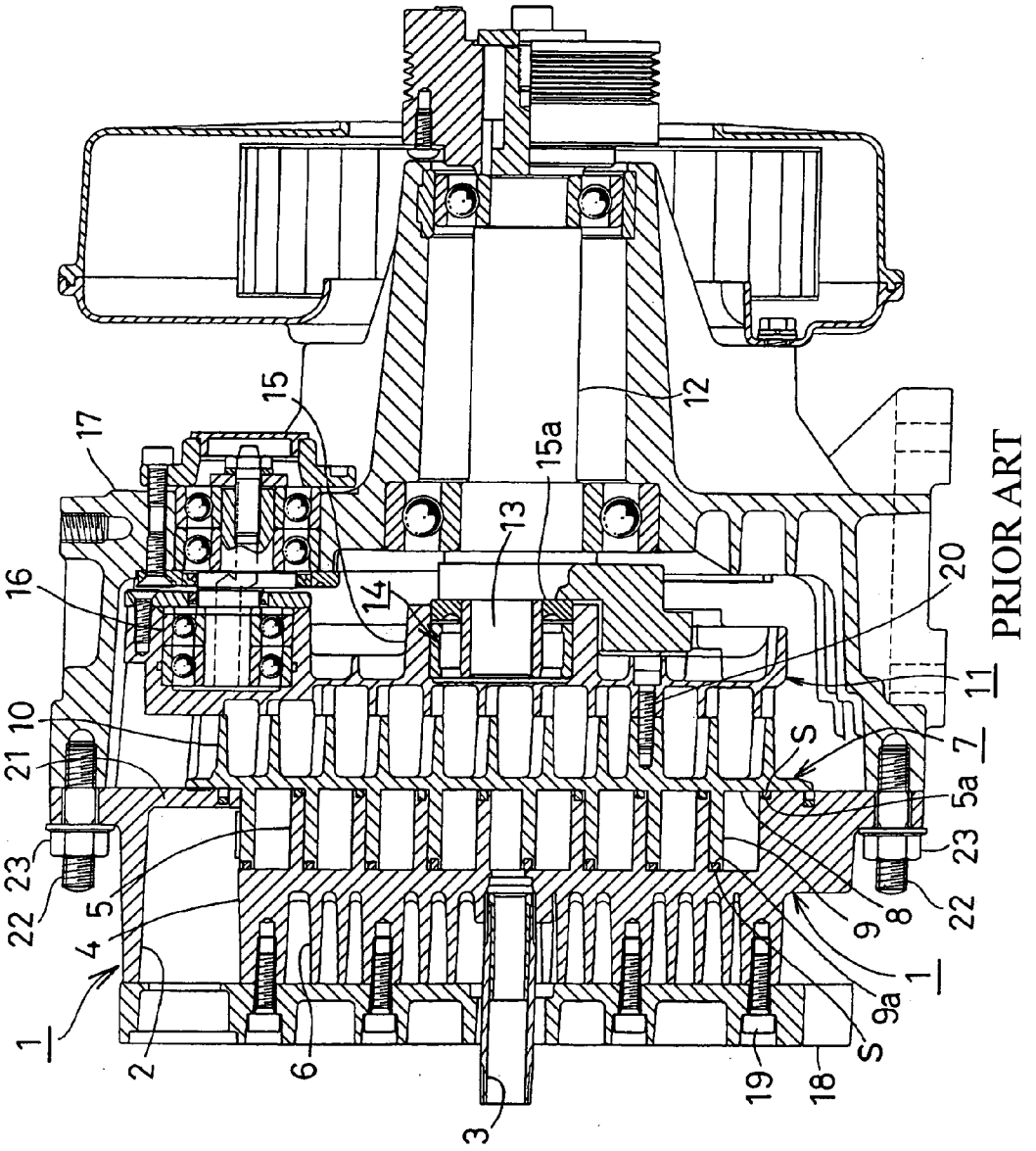
PRIOR ART
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FIG.4

SCROLL FLUID MACHINE

BACKGROUND OF THE INVENTION

[0001] The present invention relates to a scroll fluid machine such as a scroll compressor, a scroll vacuum pump, a scroll expander or a scroll blower.

[0002] Such a scroll fluid machine comprises an orbiting scroll having an orbiting end plate and supported to turn on an eccentric shaft portion of a drive shaft via a bearing, and a stationary scroll having a stationary end plate. An orbiting wrap of the orbiting end plate engages with a stationary wrap of the stationary end plate to form a sealed chamber between the orbiting and stationary wraps. The scroll fluid machine has a self-rotation preventing mechanism for preventing rotation of the orbiting scroll.

[0003] By the eccentric shaft portion of the drive shaft and the self-rotation preventing mechanism, the orbiting scroll is eccentrically revolved. Depending on a revolving direction, the volume in the sealed chamber gradually decreases toward a center or increase away from the center, thereby compressing fluid sucked from the outer circumference toward the center or depressurizing fluid sucked from the center to discharge it through the outer circumference.

[0004] A housing of the scroll fluid machine is generally manufactured by die casting of Al alloy. During operation, a support portion for a ball bearing thermally expands to decrease holding force of the support portion, so that the ball bearing is likely to rotate in the support portion.

[0005] To prevent it, a cast iron reinforcement ring is cast into the support portion to restrain thermal expansion of the support portion and to increase strength thereof. However, the whole housing is made by die casting of Al alloy to limit restraint of thermal expansion of the support portion and not to achieve it sufficiently.

[0006] Furthermore, the reinforcement ring separately made of different material must be cast surely and firmly during die casting of Al alloy to obtain suitable product, which requires excellent technique and the increased number of steps to increase a total cost.

SUMMARY OF THE INVENTION

[0007] To overcome the disadvantages in the prior art, it is an object of the present invention to provide a scroll fluid machine in which a housing is made of Al alloy by die casting, to fit with different bearings or a drive shaft having different length of a bearing support portion, having a drive-shaft support portion that can be replaced if it is damaged or inoperative to assure long-time operation suitably.

BRIEF DESCRIPTION OF THE DRAWINGS

[0008] The above and other features and advantages of the invention will become more apparent from the following description of embodiments as shown in appended drawings wherein:

[0009] **FIG. 1** is a vertical sectional side view of a scroll fluid machine according to the present invention;

[0010] **FIG. 2** is a vertical sectional side view of a housing of the scroll fluid machine in **FIG. 1**;

[0011] **FIG. 3** is a vertical sectional side view of a bearing unit of the scroll fluid machine in **FIG. 1**; and

[0012] **FIG. 4** is a vertical sectional side view of a known scroll fluid machine.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENT

[0013] **FIG. 4** shows an example of a known scroll compressor.

[0014] The basic structure in **FIG. 4** is known and will simply be described. In **FIG. 4**, the left side is front, and the right side is rear.

[0015] In a stationary scroll **1** at the left or front side in **FIG. 4**, a circular stationary end plate **4** has a sucking bore **2** on the outer circumference and a discharge bore **3** at the center. A spiral stationary wrap **5** is provided on the rear surface of the stationary end plate **4** and a plurality of horizontal corrugated cooling fins **10** are provided at regular intervals on the front surface.

[0016] An orbiting scroll **7** behind the stationary scroll **1** has a circular orbiting end plate **8** which has a spiral orbiting wrap **9** on the front surface opposite to the stationary scroll **1** and a plurality of corrugated cooling fins **10** at regular intervals on the rear surface.

[0017] Behind the orbiting scroll **7**, a bearing plate **11** is provided. In the central portion of the rear surface of the bearing plate **11**, there is provided a tubular boss **15** in which an eccentric shaft portion **13** of a drive shaft **12** is supported to turn on a roller bearing **14**. At three points on the outer circumference of the bearing plate **11**, there is a known crank-pin-type self-rotation preventing mechanisms **16** so that the orbiting scroll **7** may eccentrically revolve around the drive shaft **12** in a housing **17**.

[0018] A cover plate **18** contacts the front surface of the stationary scroll **1** and is fixed by a screw **20**.

[0019] The orbiting scroll **7** is fixed to the bearing plate **11** by a screw on the rear side of the orbiting scroll **7**. A rear plate **21** of the stationary scroll **1** contacts the front surface of the housing **17** and is fixed to the housing **17** by a bolt **22** and a nut **23**.

[0020] Engagement grooves **5***a* and **9***a* are formed on the ends of the stationary wrap **5** and the orbiting wrap **9** respectively. In the engagement grooves **5***a* and **9***a*, seal members "S" in sliding contact with the orbiting end plate **8** of the orbiting scroll **7** and the stationary end plate **4** of the stationary scroll **1** are provided respectively. The orbiting wrap **9** is similar thereto in structure.

[0021] The stationary scroll **1**, the orbiting scroll **7**, the housing **17** and the cover plate **18** are all made of Al alloy by die casting.

[0022] The foregoing structure is general as a scroll fluid machine,

[0023] The present invention will be described with respect to FIGS. **1** to **3**, and a bearing unit **24** that supports an eccentric shaft portion **13** of a drive shaft **12** to turn thereon is separately made of different material from that of a housing **17**.

[0024] A bearing tube **25** of the bearing unit **24** is made of material such as cast iron providing higher strength and lower thermal expansion coefficient than that of the housing. The bearing tube **25** is detachable from the rear of the housing **17** and has ball bearings **26**,**27** at the front and rear ends of the bearing tube **25**. The drive shaft **12** is supported by the ball bearings **26**,**27** to turn thereon.

[0025] Between the eccentric shaft portion **13** and the drive shaft **12**, a balance weight **28** is provided. The drive shaft **12** is provided via a collar **29** behind the balance weight **28** and has a smaller-diameter portion **30** at the rear end.

[0026] An oil seal **31** is provided on the eccentric shaft portion **13** in front of the balance weight **28**. The front ball bearing **26** engages on the drive shaft **12** right behind the collar **29** and is supported in an engagement groove **25***a* at the front end of the bearing tube **25**. The rear ball bearing **27** engages on the front end of the smaller-diameter portion **30** and is supported on the rear end of the bearing tube **25**. Thus, the drive shaft **12** is prevented from going out of the bearing tube **25** rearward.

[0027] The eccentric shaft portion **13** of the drive shaft **12** projects from the front surface of the bearing tube **25**. A plurality of rollers **14***a* of a roller bearing **14** engage in a tubular boss **15** of the housing **17**. An inner race **14***b* in the plurality of rollers **14***a* contacts the eccentric shaft portion **13**. An oil seal **31** is provided on an opening end of the tubular boss **15**.

[0028] The smaller-diameter portion **30** at the rear end of the drive shaft **12** projects from the rear end of bearing tube **25**. On the projected smaller-diameter portion **30**, a rotation drive for transmitting driving force such as a key, an engagement joint or a pulley is provided.

[0029] At the front end of the bearing tube **25**, a plurality of ears **32** are formed. A screw **34** goes through a thread bore **33** of each of the ears **32** and is threaded in a female bore **35** of the housing **17**, so that the bearing unit **24** is detachably mounted to the rear surface of the housing **17**. The eccentric shaft portion **13** is supported to turn in the roller bearing **14**.

[0030] The shape, the number and location of the bearings for supporting the drive shaft **12** in the bearing tube **25** are optional.

[0031] At contacting portion of the bearing unit **24** and the housing **17**, such as between the ear **32** and the housing **17** and between the drive shaft **12** and the tubular boss **15**, thermal insulation packings **36**,**37** are inserted to prevent transfer of heat. Thermal insulation coating may be applied instead of the thermal insulation packing.

[0032] The foregoing merely relates to an embodiment of the invention. Various modifications and changes may be made by persons skilled in the art without departing from the scope of claims wherein:

What is claimed is:

1. A scroll fluid machine comprising:

a housing;

a drive shaft having an eccentric shaft portion at one end in the housing;

an orbiting scroll supported on the eccentric shaft portion to turn via a bearing in the housing and comprising an orbiting end plate having an orbiting wrap;

a stationary scroll comprising a stationary end plate having a stationary wrap that forms a sealed chamber with the orbiting wrap;

a self-rotation preventing mechanism for preventing rotation of the orbiting scroll in the housing; and

a bearing tube in which the drive shaft is supported to turn, the bearing tube being detachably secured to the housing.

2. A scroll fluid machine as claimed in claim 1 wherein the drive shaft is disposed in the bearing tube via a ball bearing.

3. A scroll fluid machine as claimed in claim 1 wherein the bearing tube is fixed by threading a bolt into the housing.

4. A scroll fluid machine as claimed in claim 1 wherein the bearing tube is made of material having thermal expansion coefficient lower than that of the housing.

5. A scroll fluid material as claimed in claim 1 wherein the bearing tube is made of material having mechanical strength higher than that of the housing.

6. A scroll fluid machine as claimed in claim 1 wherein the housing is made of Al alloy while the bearing tube is made of cast iron.

7. A scroll fluid machine as claimed in claim 1 wherein a thermal insulation packing is put between the bearing tube and the housing.

8. A scroll fluid machine as claimed in claim 1 wherein a thermal insulation coating is put between the bearing tube and the housing.

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