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(54) **SEAL IN A SCROLL FLUID MACHINE**

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(57) **ABSTRACT**

In a scroll fluid machine, an orbiting scroll comprises an orbiting end plate having an orbiting wrap and a fixed scroll comprises a fixed end plate having a fixed wrap. An engagement groove is formed at the tip ends of the orbiting wrap and fixed wrap, and/or the fixed or orbiting end plate. A seal is fitted in the engagement groove in sliding contact with a counter member. The seal comprises a sealing material and a backup material between the sealing material and the bottom of the engagement groove. The backup material has a plurality of projections which elastically stretch to press the inner circumferential surface of the engagement groove when the seal is pressed.

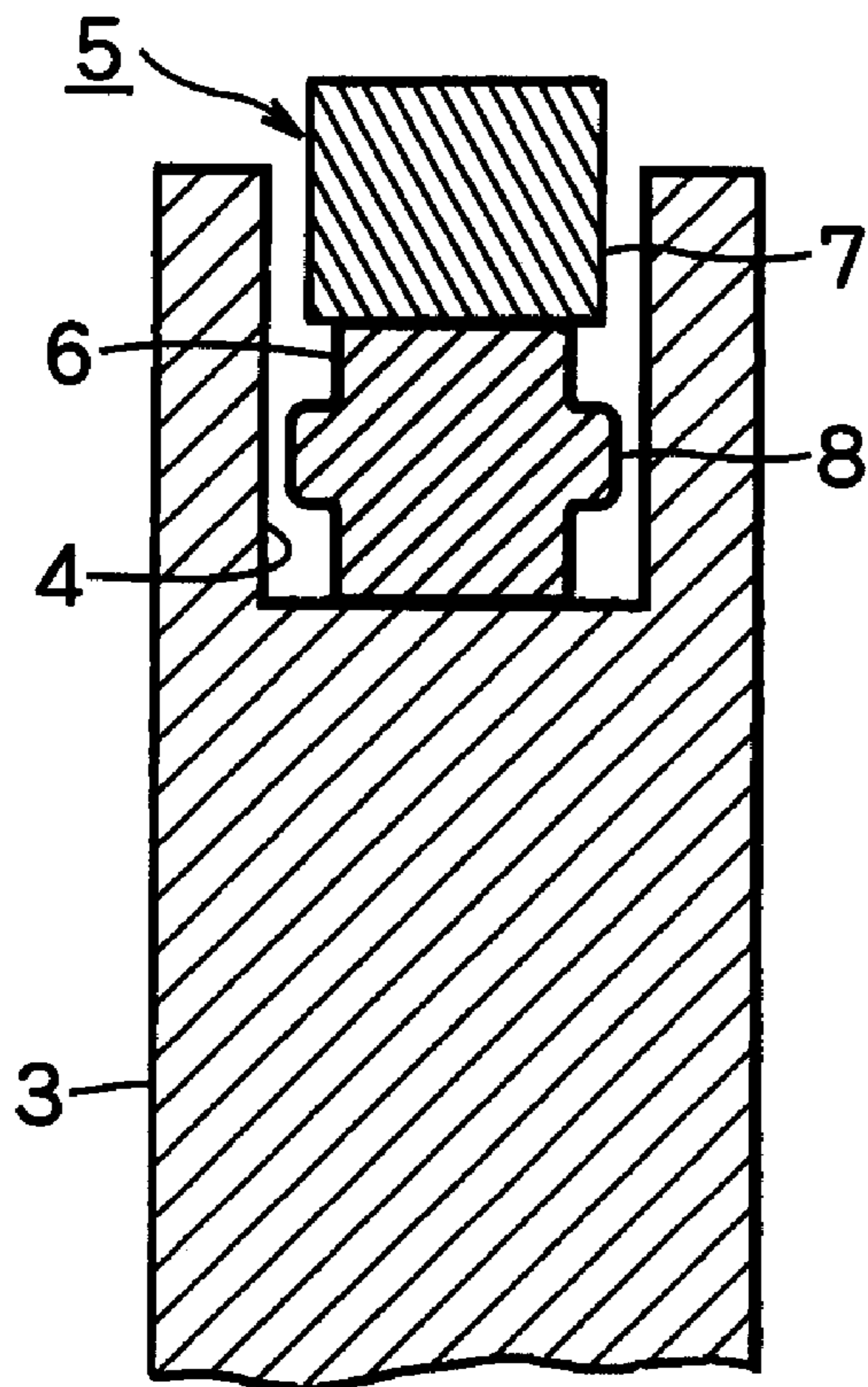
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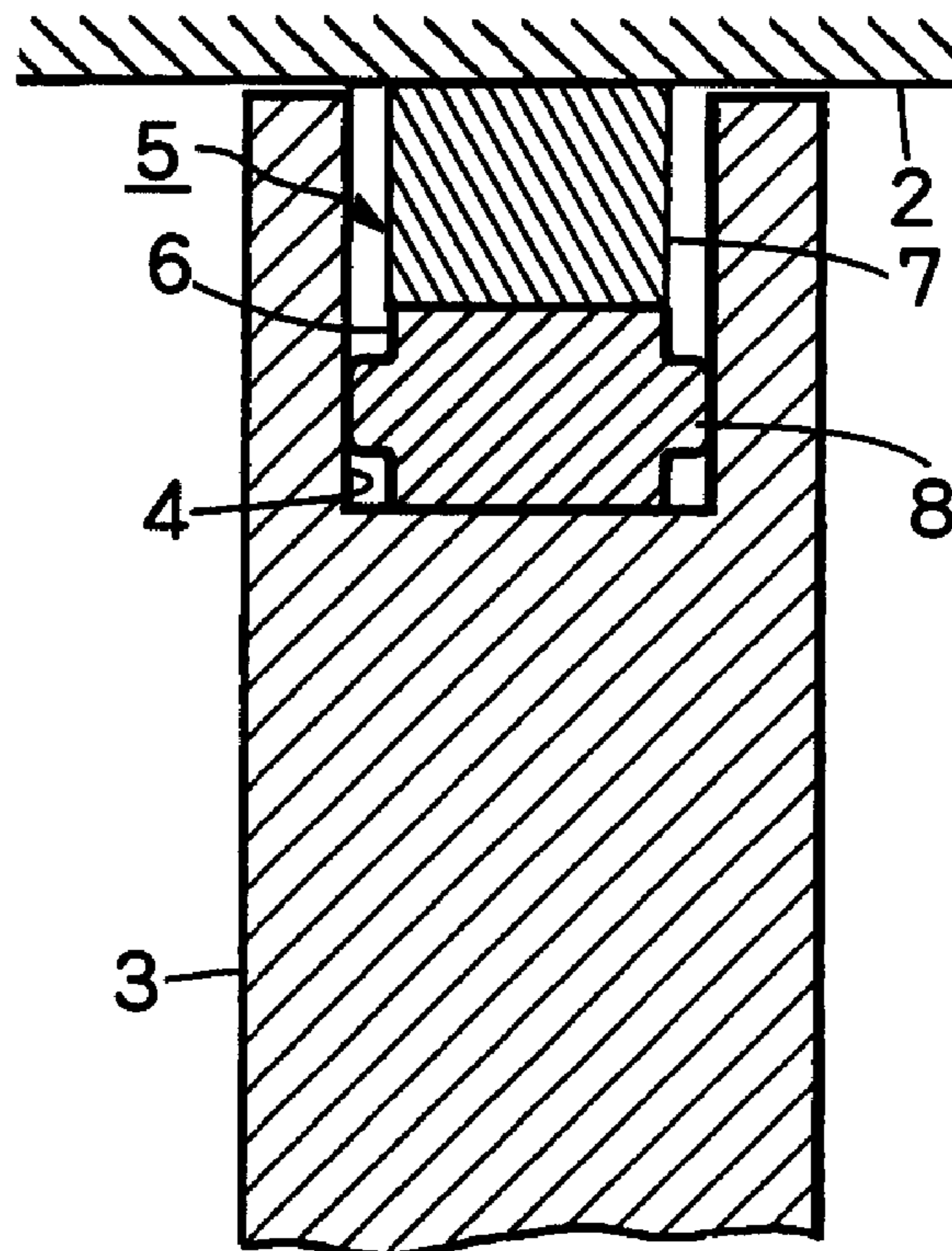
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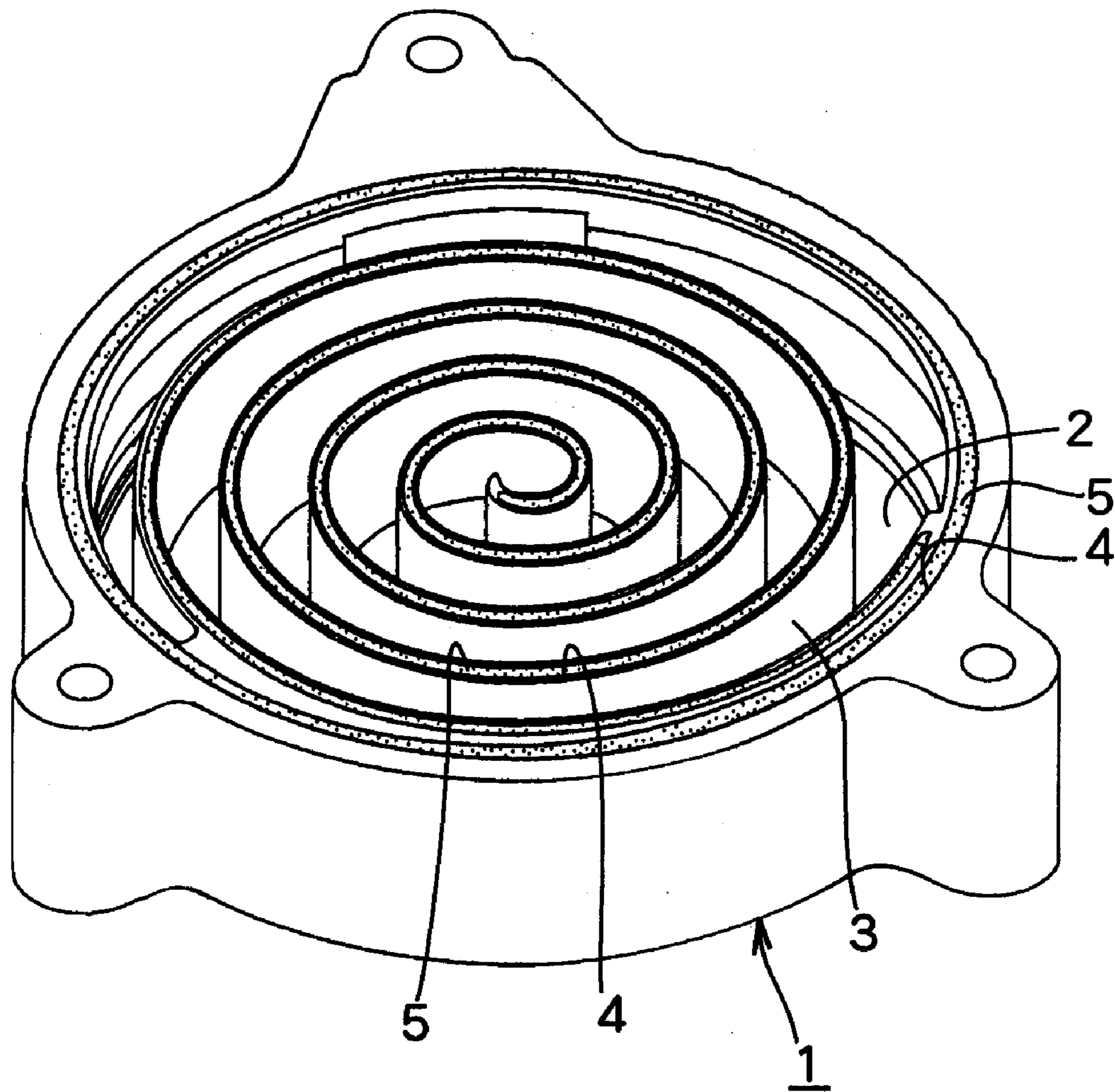


(a)

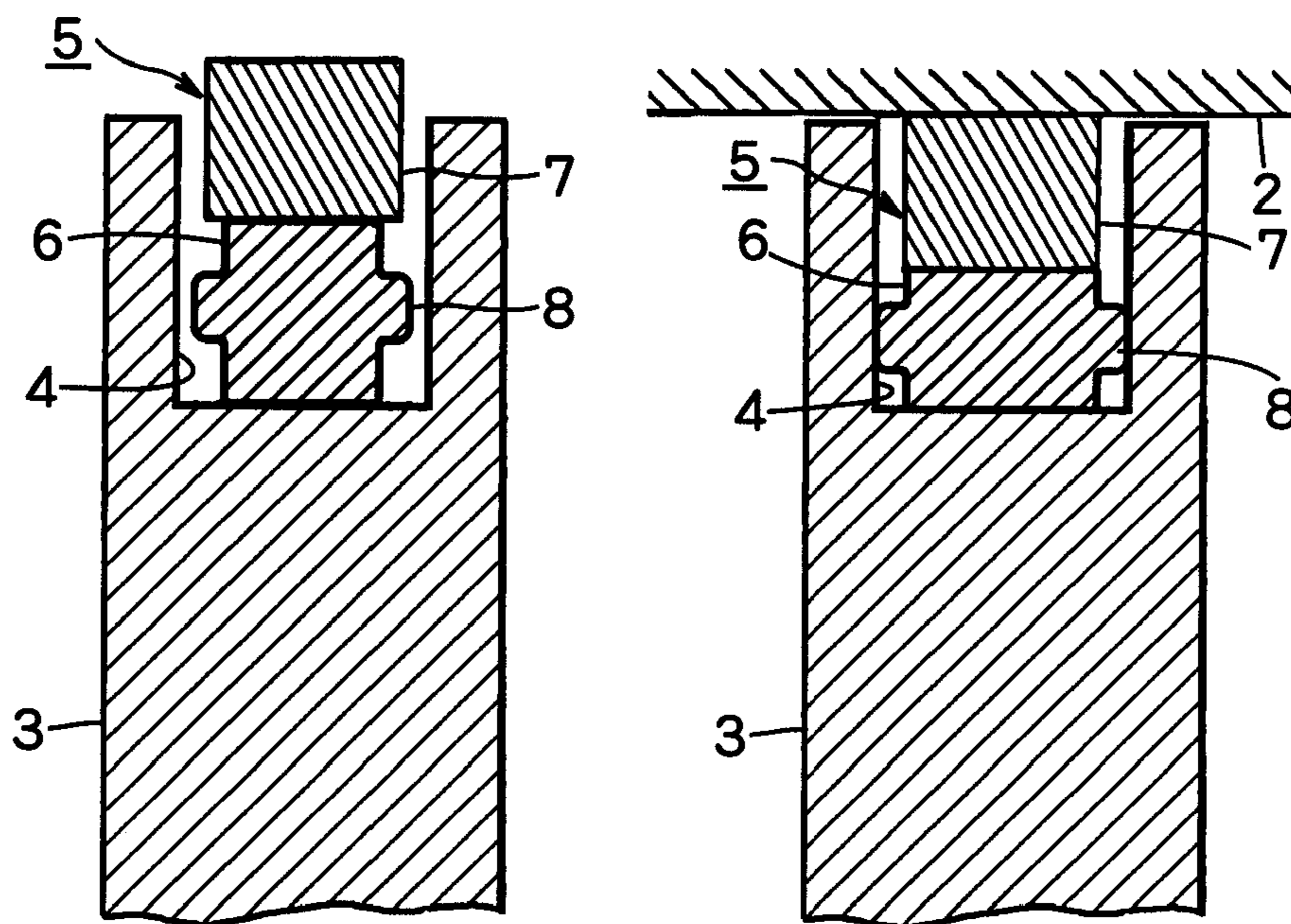


(b)

*FIG. 1*



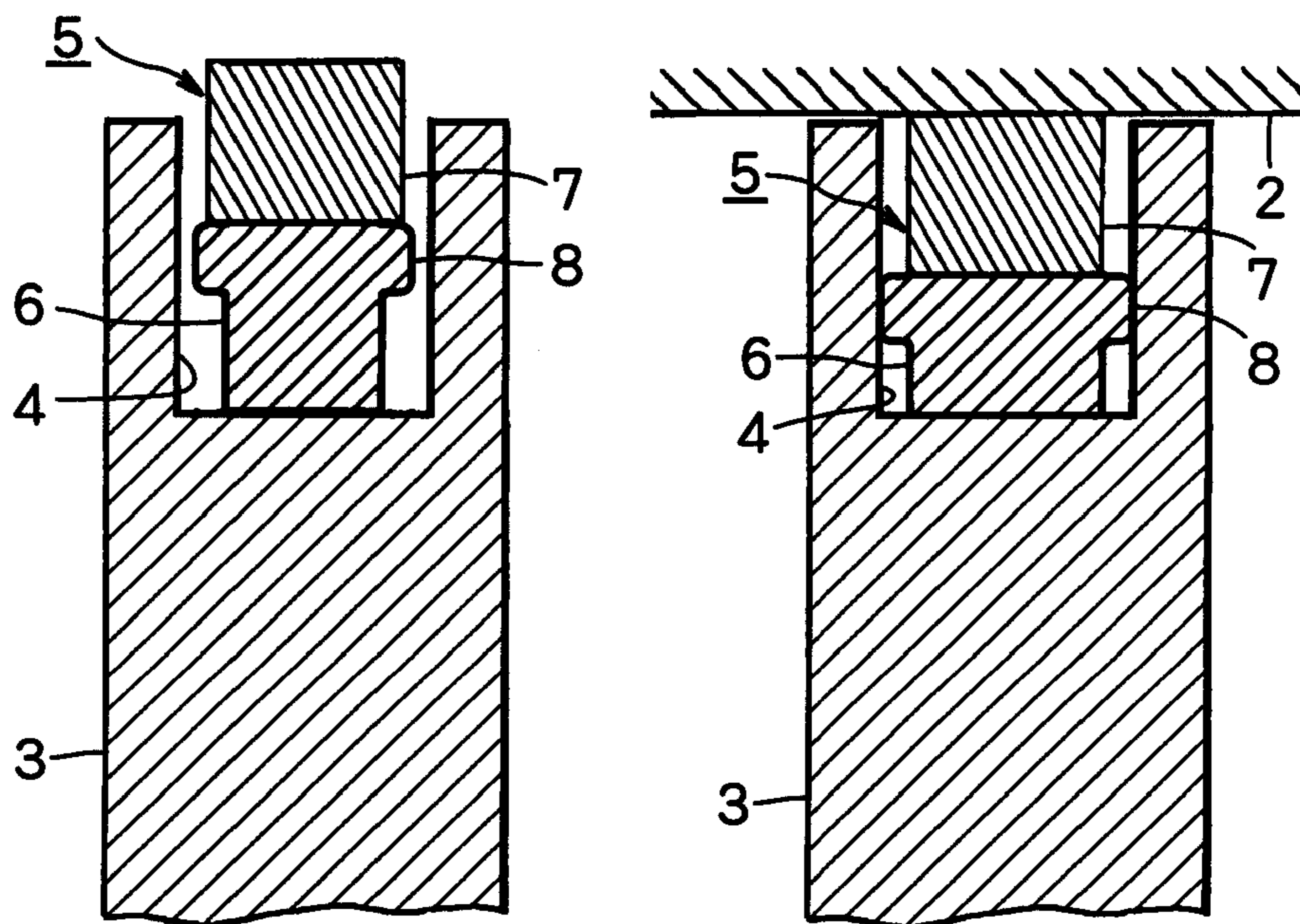
**FIG.2**



(a)

(b)

**FIG.3**



(a)

(b)

FIG. 4

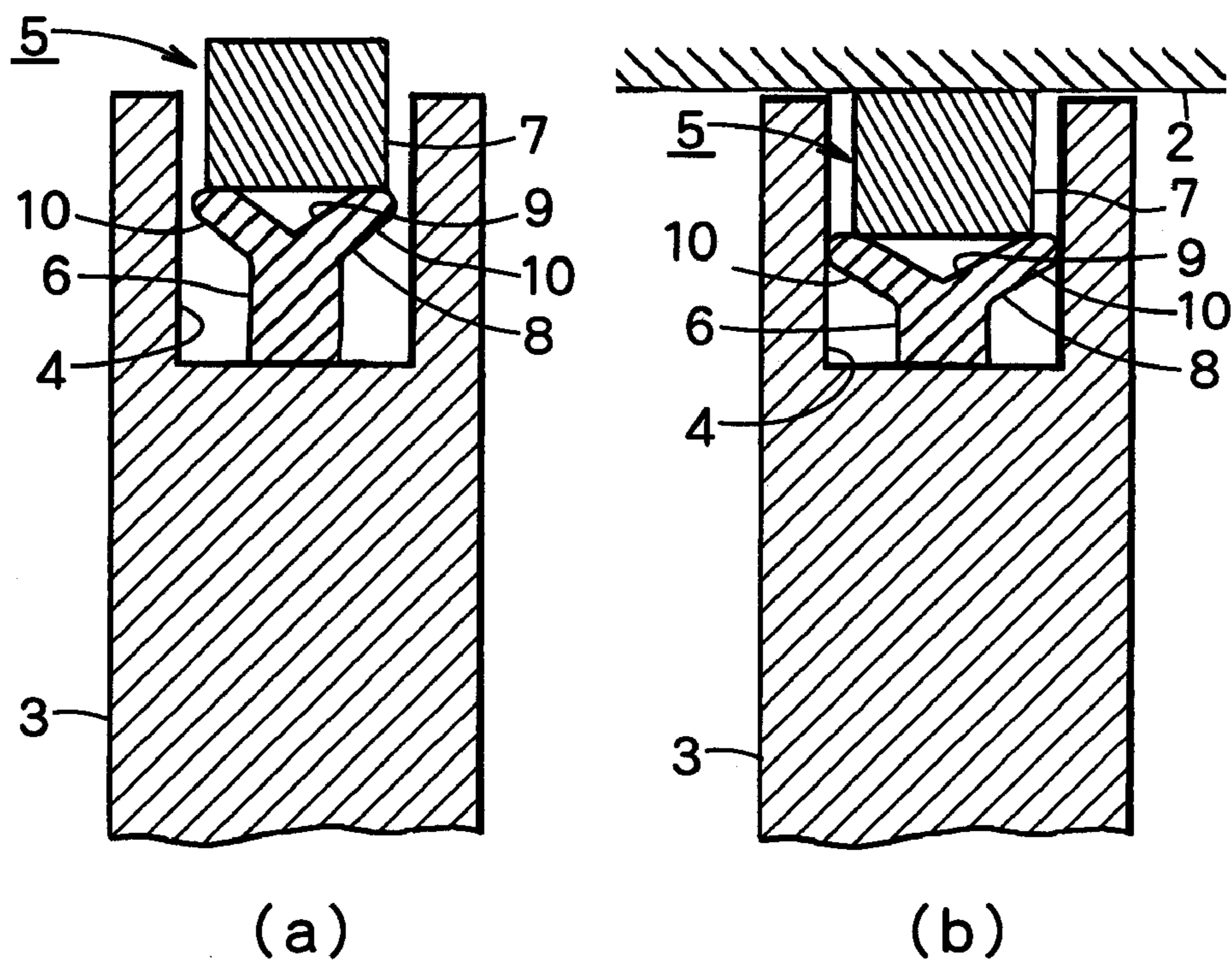
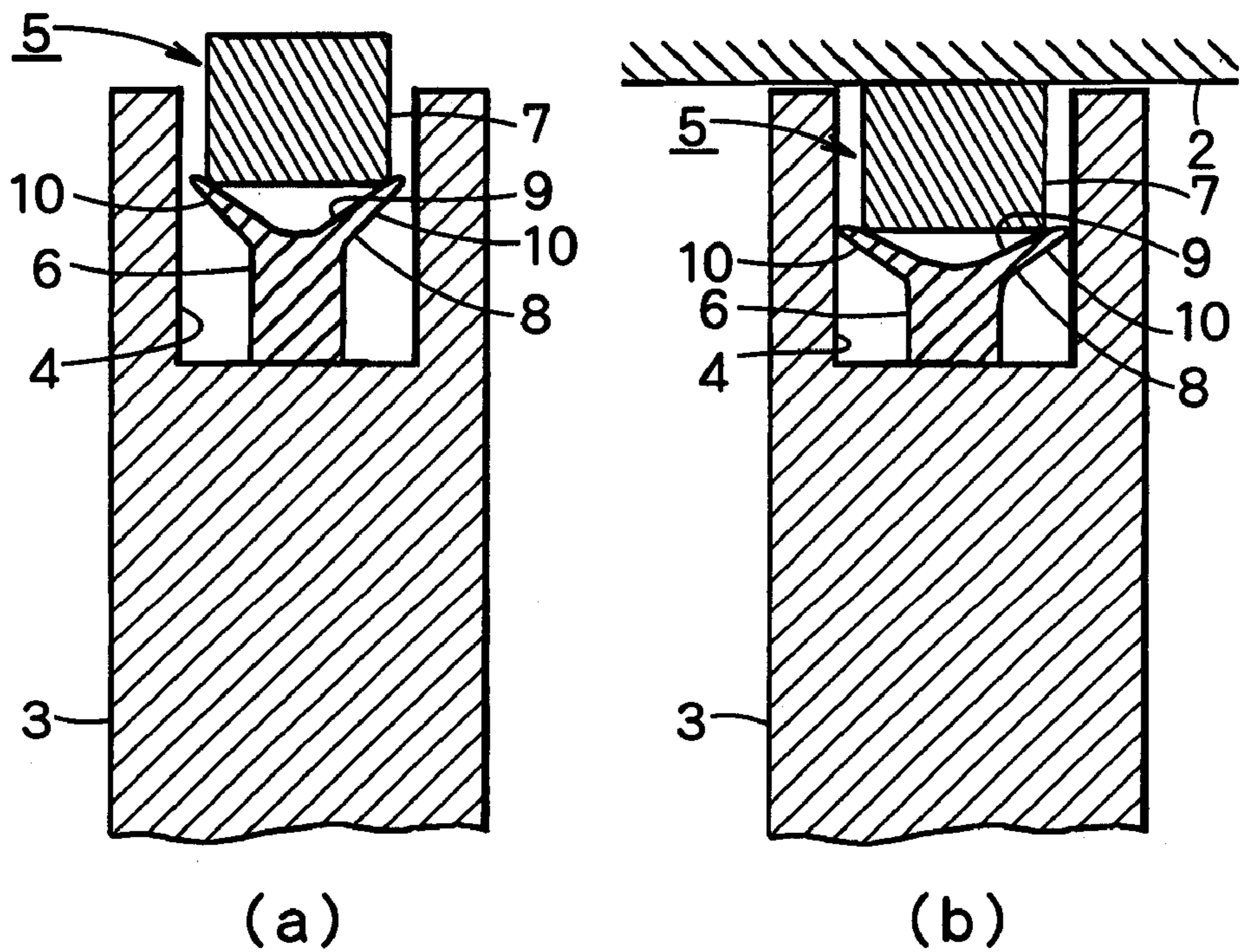
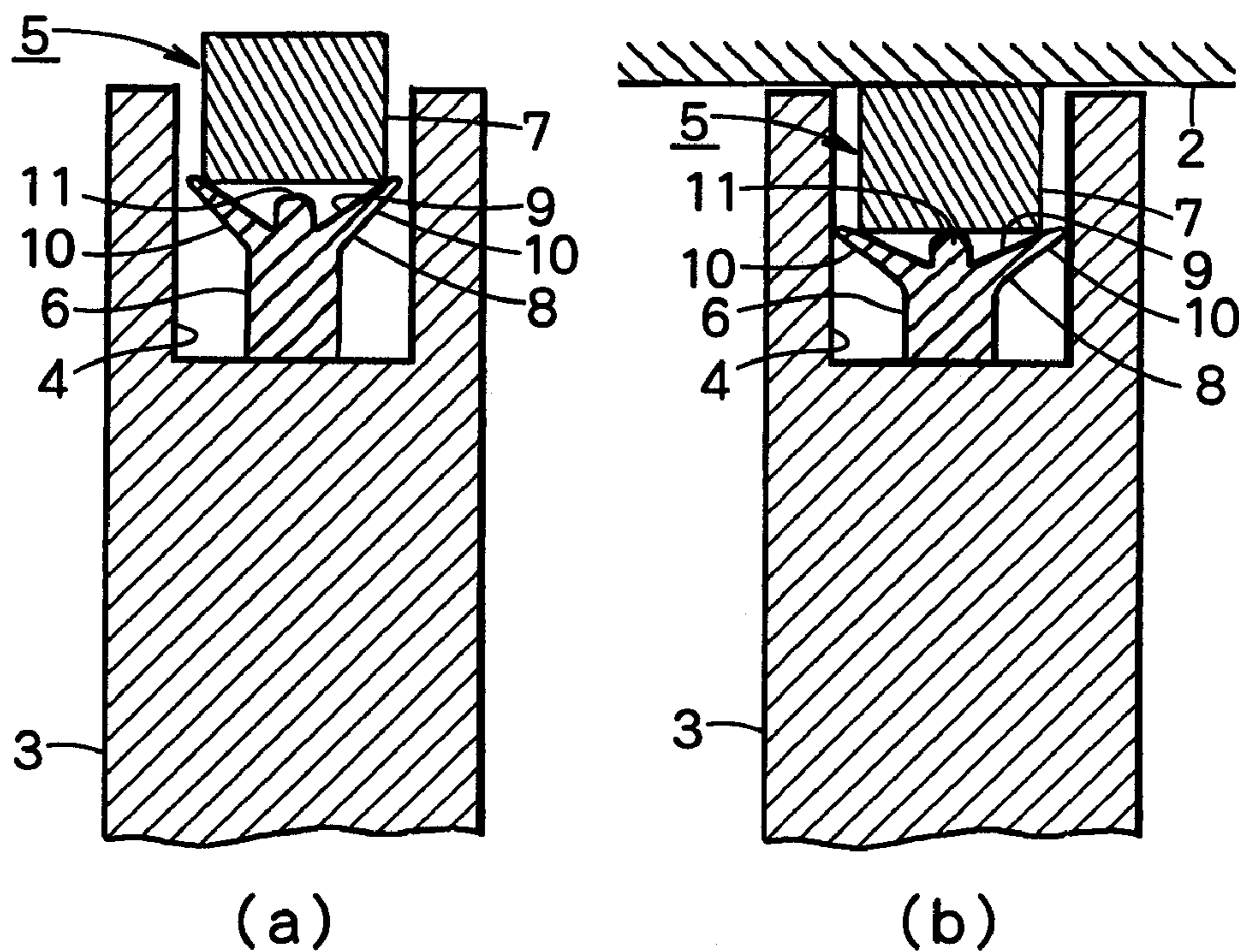


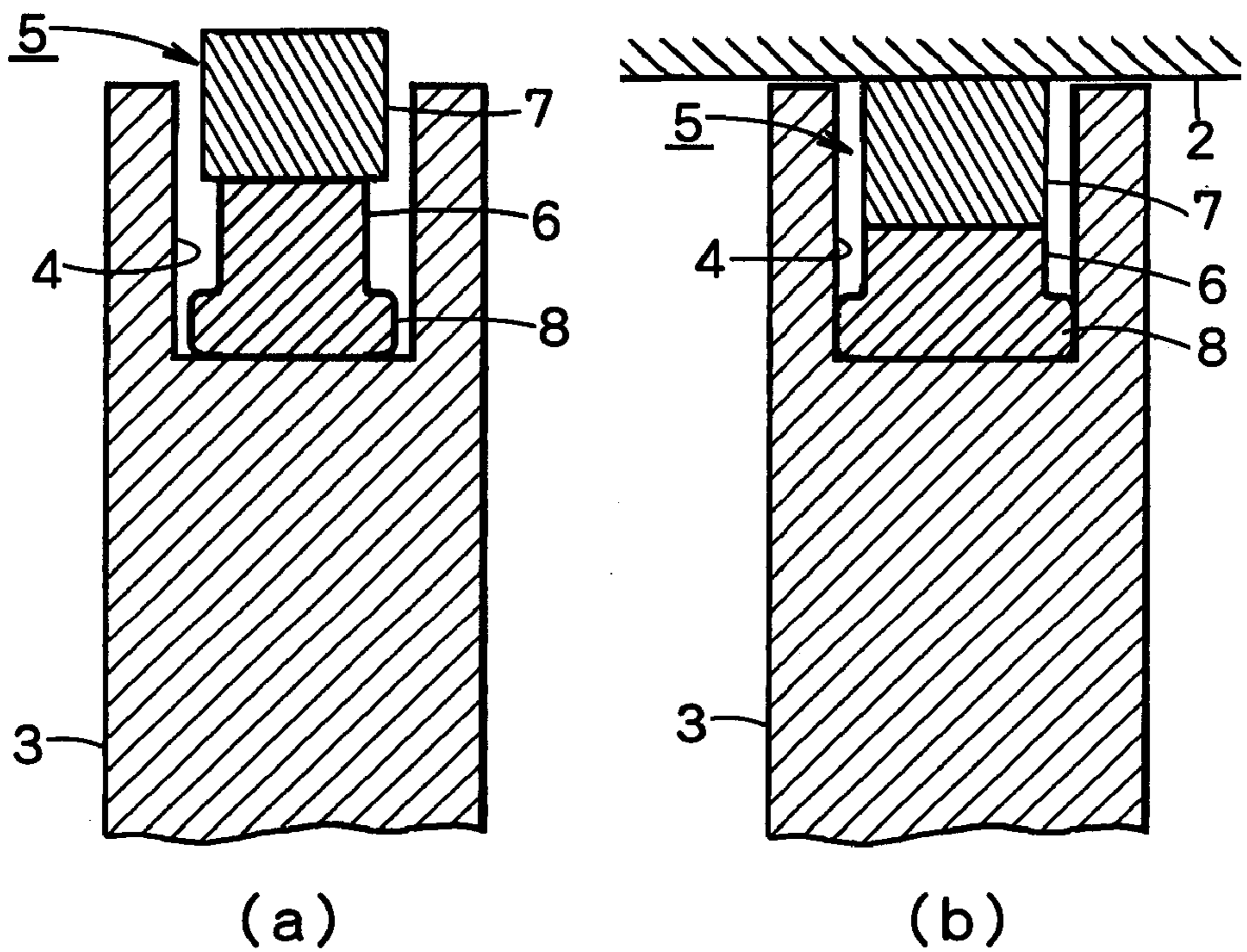
FIG. 5



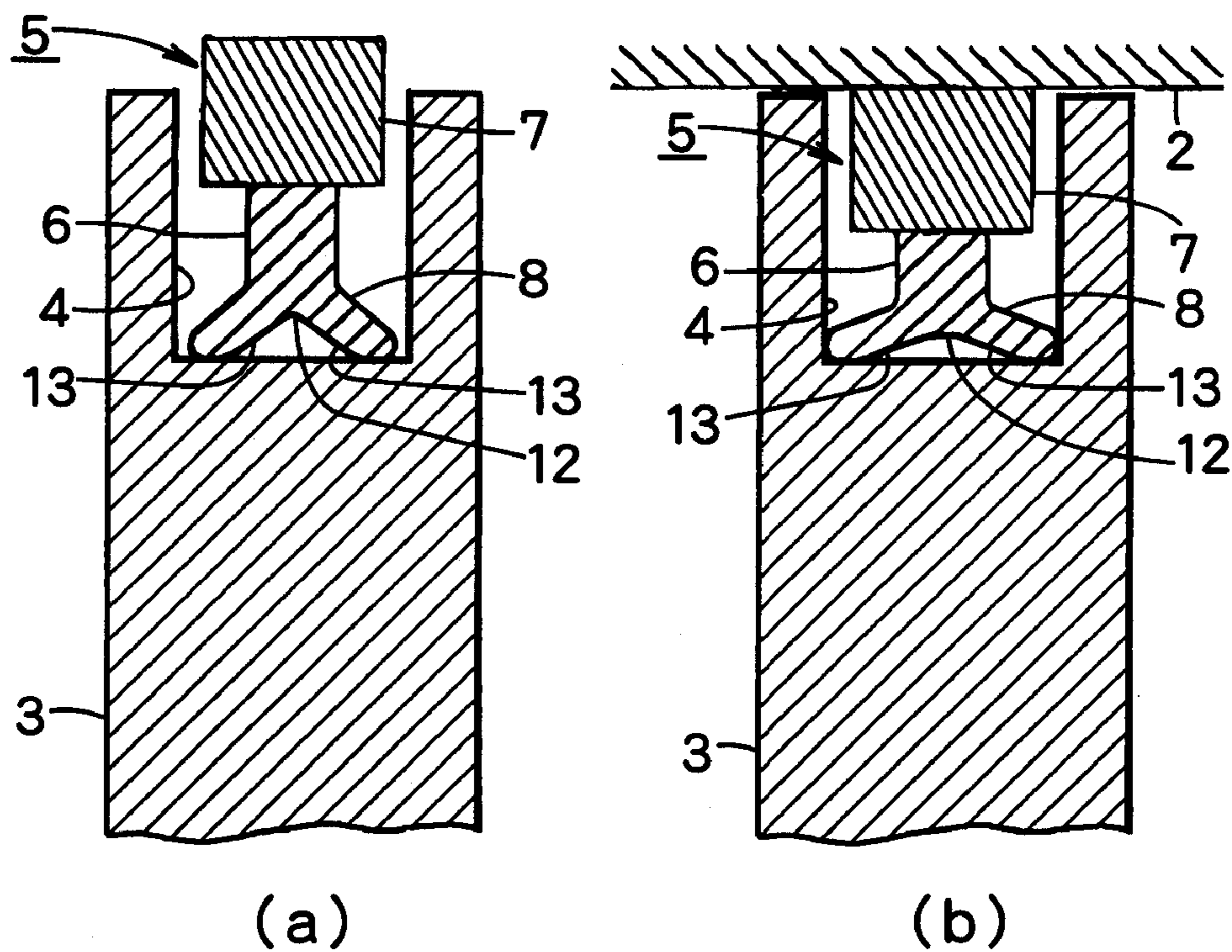
**FIG. 6**



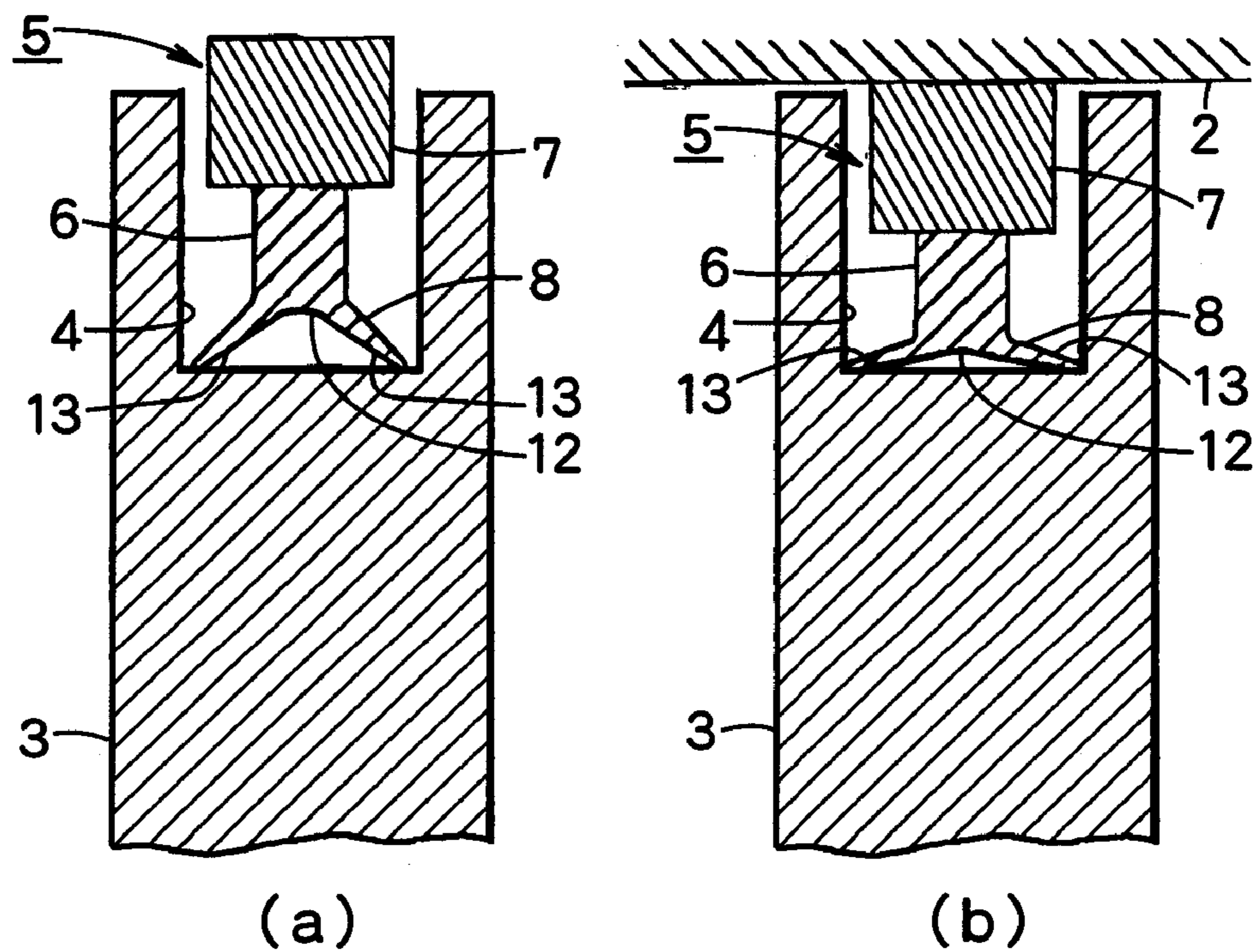
**FIG. 7**



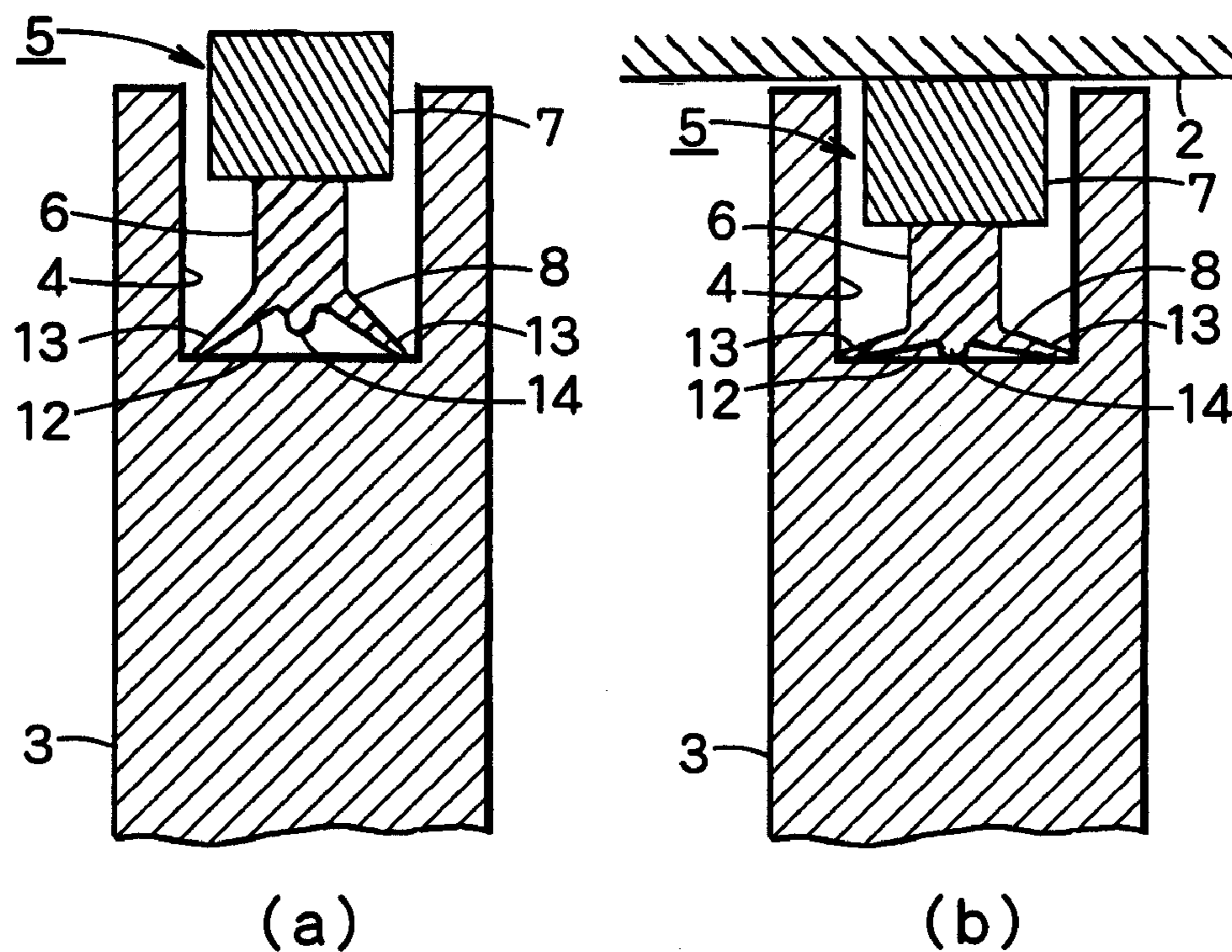
**FIG. 8**



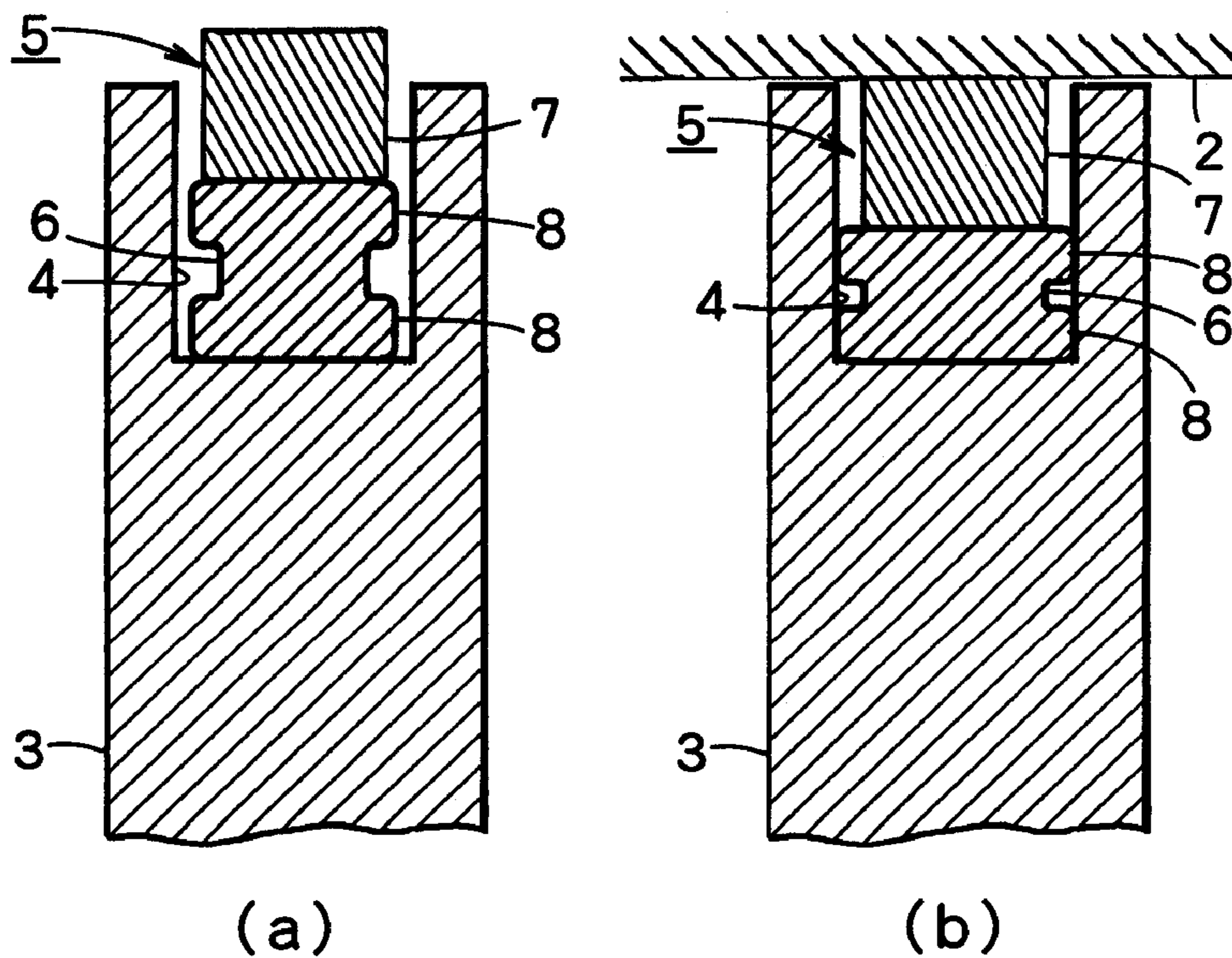
**FIG. 9**



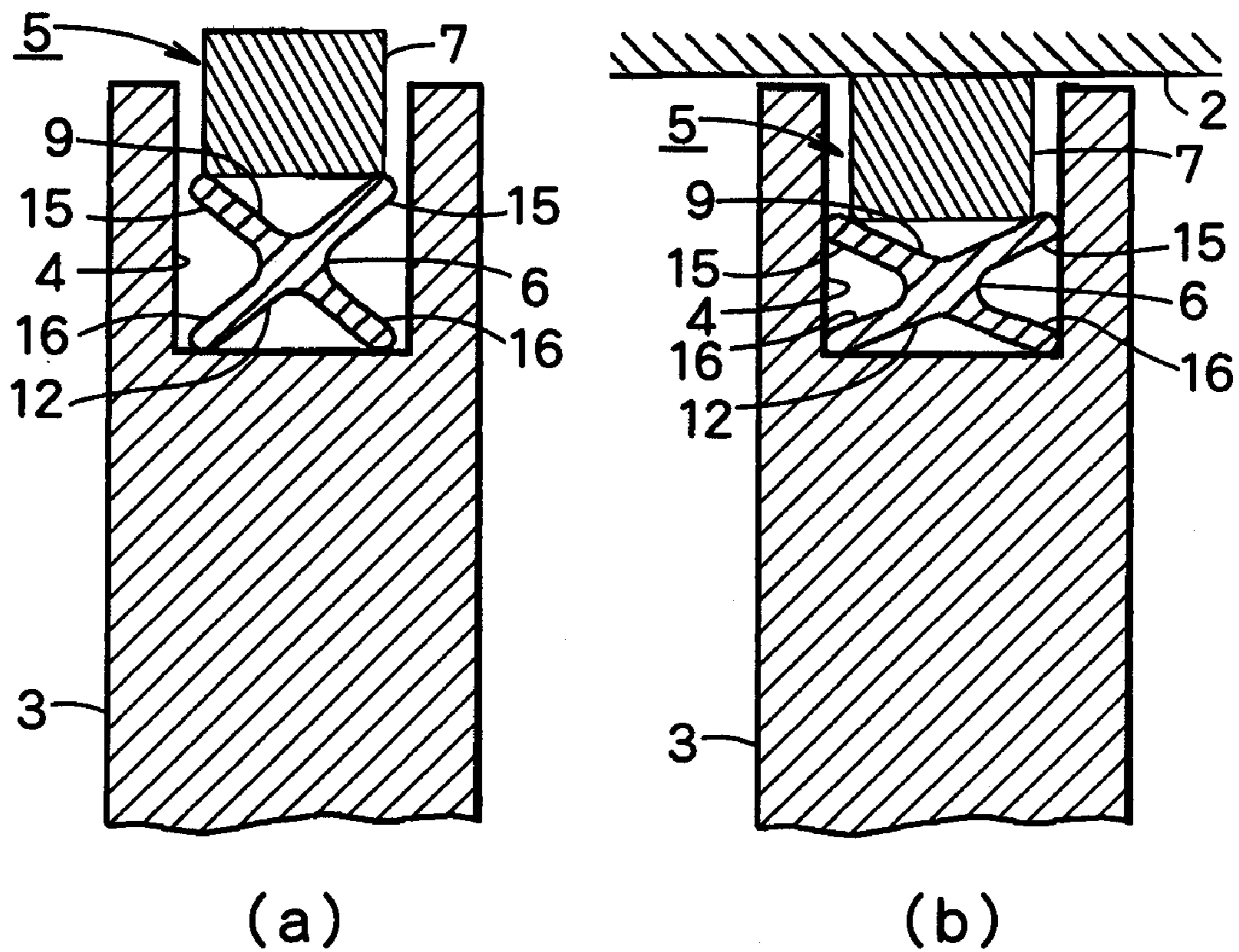
**FIG. 10**



**FIG. 11**



**FIG. 12**





## SEAL IN A SCROLL FLUID MACHINE

### BACKGROUND OF THE INVENTION

[0001] The present invention relates to a seal in a scroll fluid machine and particularly to a seal which is fitted in an engagement groove of an end plate, an orbiting wrap and/or a fixed wrap in a scroll compressor or a scroll vacuum pump.

[0002] In this specification, “upper” and “lower” mean an entrance and the bottom of an engagement groove respectively in which a seal is fitted.

[0003] A scroll fluid machine such as a scroll compressor or a vacuum pump is well-known among persons skilled in the art and comprises an orbiting scroll rotatably mounted on an eccentric end portion of a drive shaft and a fixed scroll. The orbiting scroll comprises an orbiting end plate having an orbiting wrap, and the fixed scroll comprises a fixed end plate having a fixed wrap. The orbiting wrap engages with the fixed wrap to allow a sealed chamber to be formed between the fixed and orbiting wraps. The scroll fluid machine also comprises a plurality of self-rotation preventing devices for preventing the orbiting scroll from rotating on its own axis. Such a scroll fluid machine is disclosed in JP6-207588A and JP3248618B.

[0004] With the axial end portion of the drive shaft and the self-rotation preventing devices, the orbiting scroll is eccentrically revolved to decrease the volume of the sealed chamber towards the center or to increase it away from the center thereby compressing a gas sucked from the outer circumference towards the center or decompressing a gas sucked from the center away from the center.

[0005] The orbiting and fixed wraps comprise an involute curve increasing a diameter gradually in a direction of rotation around the center; a curve comprising very short curves combined in a circumferential direction; or the combination of the curves above. A gap between the orbiting and fixed wraps is exactly determined not to excessively contact the wraps to each other and not to become too wide.

[0006] An engagement groove is formed in the end plate or tip ends of the orbiting and fixed wraps, and a dust seal or a tip seal is fitted in the engagement groove to slide hermetically with the opposing end plate.

[0007] The dust seal or tip seal comprises a backup material on the bottom of the engagement groove to improve gas-tightness with the counter end plate and a sealing material made of resin on the upper surface of the backup material.

[0008] The backup material comprises a porous material softer than the sealing material in FIG. 4 of JP3248618B and a band-like tube made of heat-resistant rubber in FIG. 1 of JP2-145686U.

[0009] The backup materials in the tip seal in the prior art involve the following disadvantages.

[0010] The elastic material 10 as backup material in JP6-207588A is made of heat-resistant porous elastic material such as sponge rubber having a rectangular cross-section to allow axial or sideward deformation of the scroll 2 to become smaller.

[0011] Depending on the width of the tooth grooves 5 of the teeth 3 in the elastic material 10 and scroll 3, the elastic

material 10 excessively engages in the tooth grooves 5 to solidify the elastic material 10 thereby failing to exhibit sufficient elasticity. On the contrary, the elastic material 10 loosely engages in the tooth grooves 5 to reduce gas-tightness around it or not to exhibit sufficient pressing force onto the tip seal 9.

[0012] The tip seal 9 in JP3248618B is integrally formed with the porous rectangular cross-sectioned backup material 41 made of softer material than the self-lubricating sealing material 92 such as polytetrafluoroethylene resin. Under high temperature or radioactivity, an adhesive is deteriorated to lose adherence or makes the sealing material 92 peeling off the backup material 91 involving poor sealing capability.

[0013] The backup material 5 in JP2-145686U is made of band-like fluorine rubber to make it difficult for the ends to be bound to form a circle. Gas-tightness in the bound ends becomes poor making it impossible to keep gas-tightness from the one side to the other side of the sealing groove 1a. Thus, the backup material 5 employed in a scroll fluid machine such as a vacuum pump causes its performance to become worse to make its use impossible.

### SUMMARY OF THE INVENTION

[0014] In view of the disadvantages, it is an object of the invention to provide a seal in a scroll fluid machine in which a backup material and a sealing material are fitted in an engagement groove at the end of an orbiting wrap or a fixed wrap without an adhesive which is likely to deteriorate or to powder, thereby positioning the backup material in the engagement groove properly and applying suitable repulsive force to the sealing material to improve the performance of the scroll fluid machine.

### BRIEF DESCRIPTION OF THE DRAWINGS

[0015] The features and advantages of the invention will become more apparent from the following description with respect to embodiments as shown in accompanying drawings wherein:

[0016] FIG. 1 is a perspective view of an orbiting scroll in which a seal according to the present invention is applied;

[0017] FIG. 2 is an enlarged vertical sectional view of the first embodiment of a seal according to the present invention;

[0018] FIG. 3 is an enlarged vertical sectional view of the second embodiment of a seal according to the present invention;

[0019] FIG. 4 is an enlarged vertical sectional view of the third embodiment of a seal according to the present invention;

[0020] FIG. 5 is an enlarged vertical sectional view of the fourth embodiment of a seal according to the present invention;

[0021] FIG. 6 is an enlarged vertical sectional view of the fifth embodiment of a seal according to the present invention;

[0022] FIG. 7 is an enlarged vertical sectional view of the sixth embodiment of a seal according to the present invention;

[0023] FIG. 8 is an enlarged vertical sectional view of the seventh embodiment of a seal according to the present invention;

[0024] FIG. 9 is an enlarged vertical sectional view of the eighth embodiment of a seal according to the present invention;

[0025] FIG. 10 is an enlarged vertical sectional view of the ninth embodiment of a seal according to the present invention;

[0026] FIG. 11 is an enlarged vertical sectional view of the tenth embodiment of a seal according to the present invention; and

[0027] FIG. 12 is an enlarged vertical sectional view of the eleventh embodiment of a seal according to the present invention.

#### DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

[0028] FIG. 1 is a perspective view of an orbiting scroll 1 to which a seal 5 according to the present invention is applied in an engagement groove 4 in the outer circumference of an orbiting end plate 2 as dust seal. The dust seal may be used in an engagement groove of the outer circumference of a fixed end plate of a fixed scroll which is not driven by power.

[0029] A seal 5 according to the present invention is also fitted in an engagement groove 4 of the tip end of a spiral orbiting wrap 3 standing on the orbiting end plate 2 as tip seal. A seal is fitted in an engagement groove of the tip end of a fixed wrap standing on the fixed end plate of the fixed scroll.

[0030] FIG. 2 is an enlarged vertical sectional view of the first embodiment in which the seal 5 is fitted in the engagement groove 4.

[0031] In FIGS. 2-12, the left parts (a) show the seal 5 on which downward force is not applied, while the right parts (b) show the seal 5 onto which certain downward force is applied.

[0032] In FIG. 2, the seal 5 comprises a sealing material 7 made of polyimide resin and overlapped on the upper surface of a sintered carbon backup material 5 putting on the bottom of the engagement groove 4. A horizontal protuberance 8 is formed in the middle of each side of a backup material 6 made of heat-resistant elastic material.

[0033] In the second embodiment in FIG. 3, a protuberance 8 is horizontally formed from each side of the upper end of a backup material 6.

[0034] In FIG. 4, a vertical groove 9 is formed in the middle of the upper surface of protuberances 8 of a backup material 6 to form arms 10,10.

[0035] FIG. 5 shows the fourth embodiment in which arms 10,10 gradually become thinner outwards.

[0036] FIG. 6 shows that the fifth embodiment in which a head 11 or a support protrusion contacts the lower surface of a sealing material 7 to prevent arms 10,10 from collapsing if more than certain pressing force is exerted onto the middle of a groove 9 by a sealing material 7.

[0037] FIG. 7 shows the sixth embodiment in which a protuberance 8 is horizontally formed from each side of the lower end of a backup material 6. When downward load is exerted, the whole lower surface of the backup material 6 including protuberances 8 contacts the bottom surface of a groove 6 and the side surfaces of the protuberances 8 press the inner circumferential surface of an engagement groove 4.

[0038] FIG. 8 shows the seventh embodiment in which a groove 12 is formed in the middle of the lower surface of a backup material 6 to form legs 13,13 inclined downwards from the lower end of the backup material 6.

[0039] FIG. 9 shows the eighth embodiment in which legs 13,13 becomes thinner outwards to allow the lower ends of the legs 13,13 to engage with inner corners of the bottom of an engagement groove 4.

[0040] FIG. 10 shows the ninth embodiment in which there is formed a downward protrusion 14 which contacts the bottom surface of an engagement groove 4 to prevent legs 13,13 from collapsing if more than certain force is applied to the middle of a groove 12 on the lower surface of a backup material 6.

[0041] FIG. 11 shows the tenth embodiment where protuberances 8,8 are horizontally formed from each side of the upper and lower ends of a backup material 6.

[0042] FIG. 12 shows the eleventh embodiment in which a groove 9 is formed in the upper surface of a backup material 6 and a groove 12 is formed in the lower surface of the backup material 6 to form upward-inclined arms 15,15 and downward-inclined legs 16,16.

[0043] The backup material 6 is annular when it is used as a dust seal in a vacuum pump to prevent dust from invading into a pump chamber, while it is band-like to reduce a compressed gas from leaking through the end of a wrap when it is used as a tip seal.

[0044] The foregoing merely relate to embodiments of this invention. Various changes and modifications may be made by a person skilled in the art without departing from the scope of claims wherein:

What is claimed is:

1. A seal in a scroll fluid machine comprising an orbiting scroll and a fixed scroll, said orbiting scroll comprising an orbiting end plate having an orbiting wrap, said fixed scroll comprising a fixed end plate having a fixed wrap, said seal being fitted in an engagement groove of an outer circumference of a fixed end plate or an orbiting end plate, and/or a tip end of the orbiting wrap and a tip end of the fixed wrap, said seal comprising:

a backup material made of elastic material and having a plurality of projections which elastically stretch, when said seal is pressed, to press on an inner circumferential surface to enable the seal to be positioned in the engagement groove exactly and to enable gas-tightness to be kept in the engagement groove; and

a sealing material putting on an upper surface of the backup material and being in sliding contact with a counter member.

2. A seal according to claim 1 wherein said plurality of projections comprise a plurality of protuberances extending sideward from each side of a middle of the backup material.

3. A seal according to claim 1 wherein said plurality of projections comprise a plurality of protuberances extending sideward from each side of an upper end of the backup material.

4. A seal according to claim 1 wherein said plurality of projections comprise a plurality of arms formed obliquely from an upper end of the backup material to support the sealing material.

5. A seal according to claim 4 wherein said plurality of arms gradually become thinner outwards.

6. A seal according to claim 4 wherein a head is provided in a middle of an upper surface of the backup material to support the sealing material.

7. A seal according to claim 1 wherein a plurality of projections comprises a plurality of protuberances extending sideward from each side of a lower end of the backup material.

8. A seal according to claim 1 wherein said plurality of projections comprise a plurality of legs extending from a lower end of the backup material.

9. A seal according to claim 8 wherein said plurality of legs gradually become thinner outward.

10. A seal according to claim 8 wherein a downward protrusion is formed from a middle of the lower end of backup material.

11. A seal according to claim 1 wherein said plurality of projections comprise a plurality of protuberances extending sideward from each side of upper and lower ends of the backup material.

12. A seal according to claim 1 wherein said plurality of projections comprise a plurality of upward-inclined arms to support the sealing material and a plurality of downward-inclined legs supported by a bottom of the engagement groove.

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