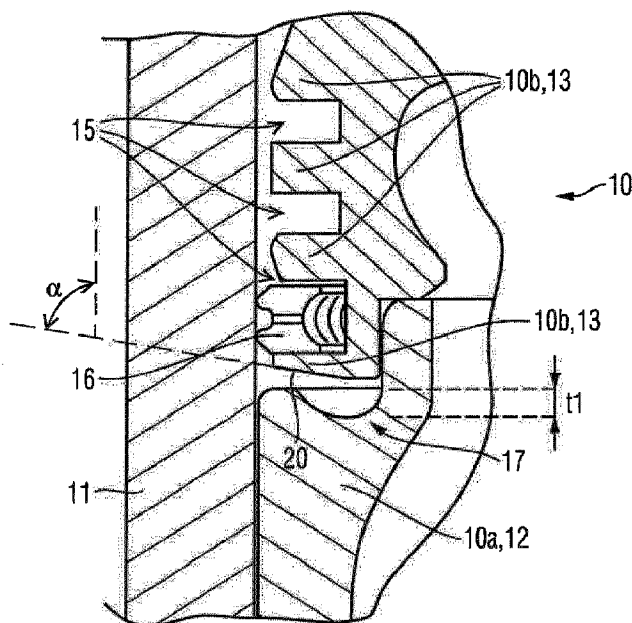




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(54) **Titre : PISTON ET CYLINDRE D'UN MOTEUR A COMBUSTION INTERNE**
(54) **Title: PISTON AND CYLINDER OF AN INTERNAL COMBUSTION ENGINE**



(57) **Abrégé/Abstract:**

A piston (10) of a cylinder of an internal combustion engine, with a piston skirt (12), with a ring belt (13) which is positioned on a first axial side of the piston skirt (12) and has a plurality of ring grooves (15) which are delimited by ring lands (14) and which are

(57) Abrégé(suite)/Abstract(continued):

separated from one another by the ring lands (14), wherein each of the ring grooves (15) receives a piston ring (16) which is configured as a compression ring or as an oil scraper ring, and with an oil collector channel (17) which is positioned between the piston skirt (12) and the ring belt (13) as viewed in the axial direction of the piston. As viewed in the axial direction of the piston, the oil collector channel (17) has a greater depth at the circumferential position of the pressure side of the piston and/or at the circumferential position of the counterpressure side of the piston than at the circumferential position of the coupling side of the piston and/or at the circumferential position of the coupling opposite side of the piston. As viewed in the circumferential direction of the piston, the oil collector channel (17) has a slope, namely starting from the axial depth in the region of the coupling side and/or the coupling opposite side of the piston in the direction of the axial depth in the region of the pressure side and/or the counterpressure side of the piston.

ABSTRACT

A piston (10) of a cylinder of an internal combustion engine, having a piston skirt (12), having a ring belt (13) positioned on a first axial side of the piston skirt (12), which comprises multiple ring grooves (15) that are limited by ring lands (14) and separated from one another by the ring lands (14), wherein each of the ring grooves (15) receives a piston ring (16) formed as compression ring or as oil scraper ring, and have an oil collection channel (17) positioned seen in the axial direction of the piston between the piston skirt (12) and the ring belt (13). In the circumferential position of the pressure side of the piston and/or in the circumferential position of the pressure opposite side of the piston, the oil collection channel (17), seen in the axial direction of the piston, has a greater depth than in the circumferential position of the coupling side of the piston and/or in the circumferential position of the coupling opposite side of the piston. Seen in the circumferential direction of the piston, the oil collection channel (17) has a gradient, namely emanating from the axial depth in the region of the coupling side and/or of the coupling opposite side of the piston in the direction of the axial depth in the region of the pressure side and/or of the pressure opposite side of the piston. (Fig. 1)

PISTON AND CYLINDER OF AN INTERNAL COMBUSTION ENGINE

The invention relates to a piston of an internal combustion engine. The invention, furthermore, relates to a cylinder of an internal combustion engine.

A cylinder of an internal combustion engine comprises a piston, which is moveably guided up and down in a cylinder liner. The fundamental construction of a piston, which via a connecting rod is coupled to a crankshaft of the internal combustion engine is familiar to the person skilled in the art addressed here. Accordingly, a piston comprises a piston skirt through which a piston pin for attaching the piston to the respective connecting rod extends. On a side of the piston skirt, a ring belt of the piston is positioned, wherein the ring assembly of the piston comprises multiple ring grooves limited by ring lands and separated from one another by the ring lands for receiving piston rings.

Seen in the circumferential direction of the piston, the piston has defined circumferential positions, namely a so-called pressure side and a so-called pressure opposite side. During the movement of the piston in the cylinder liner, the piston is pressed via the gas pressure near a top dead centre against a cylinder wall of the cylinder liner, wherein this circumferential position is referred to as pressure side. On the side located diametrically opposite, the so-called pressure opposite side is formed. A straight line can be drawn through the pressure side and pressure opposite side, wherein a straight line running perpendicularly to the said straight line extends parallel to the piston pin, which serves for connecting the piston to the respective connecting rod. On this straight line, which extends parallel to the piston

pin, a so-called coupling side and a so-called coupling opposite side of the piston is located, which is located diametrically opposite the coupling side.

DE 884 586 B discloses a piston of an internal combustion engine in monobloc design. Here, piston skirt and ring belt are embodied integrally in a monolithic assembly. Between the piston skirt and the ring belt an oil collection channel is formed according to this prior art seen in the axial direction, in which scraped-off oil can be collected. Seen in the axial direction, this oil collection channel has an axial depth that is constant in the circumferential direction and a width that is constant seen in the radial direction.

By way of the piston lateral forces acting on the piston during the operation, the piston is pressed against the cylinder liner with great force in the region of the top dead centre, i.e. in the region of the pressure side of the piston. In particular when for the lubrication or cooling of the piston insufficient oil is present, a metallic contact between the piston and the cylinder liner can occur, as a result of which so-called seizures can be caused. This can damage the cylinder. There is a need for a piston or a cylinder of an internal combustion engine having a piston with which the risk of damage is reduced.

Starting out from this, the invention is based on the object of creating a new type of piston and cylinder of an internal combustion engine. According to the invention, the oil collection channel in the circumferential position of the pressure side of the piston and/or in the circumferential position of the pressure opposite side

of the piston seen in the axial direction of the piston has a greater depth than in the circumferential position of the coupling side of the piston and/or in the circumferential position of the coupling opposite side of the piston. Furthermore, the oil collection channel seen in the circumferential direction of the piston has a gradient, namely originating from the axial depth in the region of the coupling side and/or of the coupling opposite side in the direction of the axial depth in the region of the pressure side and/or of the pressure opposite side.

By way of the oil collection channel designed according to the invention with different depths defined in the axial direction on pressure opposite side, pressure side, coupling side and/or coupling opposite side, oil can be collected during a downward stroke of the piston approximately from the middle of the downward movement of the piston in the direction of the bottom dead centre, namely in the region of the coupling side and coupling opposite side of the oil collection channel. Because of the gradient in the oil collection channel, this accumulated oil flows in the direction of the pressure side and preferentially pressure opposite side of the piston, wherein this collected oil, during an upward movement of the piston from the middle of the upward movement up to the top dead centre, is then splashed through inertia forces in the direction of the ring belt of the piston and the cylinder liner where it is then available for the lubrication. Accordingly, the cylinder is supplied with lubricating oil in the region of its top dead centre in the region of the pressure side and preferentially pressure opposite side so that the risk of a so-called seizure is reduced. Accordingly, the risk of damage to the piston is reduced.

Preferentially, the axial depth of the oil collection channel in the circumferential position of the pressure side and preferentially in the circumferential position of the pressure opposite side amounts to between 4 mm and 30 mm, preferably between 6 mm and 20 mm. The axial depth of the oil collection channel in the circumferential position of the coupling opposite side and preferentially in the circumferential position of the coupling side, which is always smaller than the axial depth in the circumferential position of the pressure side and preferentially pressure opposite side amounts to between 2 mm and 15 mm, preferably between 3 mm and 10 mm. Such a dimensioning of the oil collection channel is particularly preferred in order to collect oil during the downward movement of the piston in the region of the oil collection channel and dispense it again in the region of the upward movement.

Preferentially, a control edge facing the oil collection channel is formed seen in the axial direction of the piston between the oil collection channel and the ring belt, which includes an angle with the axial direction. By way of the control edge, the collecting of the oil and dispensing of the oil can be specifically influenced.

Preferentially, the angle included with the axial direction by the control edge changes in the circumferential direction of the piston. By way of this, individual angles can then be adjusted in the region of pressure opposite side, pressure side, coupling side and/or coupling opposite side in order to individually influence the collecting of the oil and dispensing of the oil.

Preferred further developments of the invention are obtained from the subclaims and the following

description. Exemplary embodiments of the invention are explained in more detail by way of the drawing without being restricted to this. There it shows:

- Fig. 1 a cross section by way of an extract through a piston according to the invention in a sectional direction extending through coupling side and coupling opposite side with built embodiment of the piston;
- Fig. 2 an extract from Fig. 1 during the downward stroke of the piston;
- Fig. 3 a cross section by way of an extract through the piston according to the invention of Figs. 1, 2 in a sectional direction extending through pressure side and pressure opposite side;
- Fig. 4 an extract from Fig. 3 during the upward stroke of the piston;
- Fig. 5 a detail of the piston;
- Fig. 6 a further detail of the piston;
- Fig. 7 a cross section by way of an extract through a piston according to the invention in a sectional direction extending through coupling side and coupling opposite side with a monobloc embodiment of the piston;
- Fig. 8 a cross section by way of an extract through the piston according to the invention of Fig. 7 in a sectional direction extending through pressure side and pressure opposite side.

The invention relates to a piston of a cylinder of an internal combustion engine and to a cylinder of an internal combustion engine having a piston.

Figs. 1 to 6 show different cross sections and details of a piston 10 of a cylinder of an internal combustion engine according to the invention, which is moveably guided up and down in a liner 11. The piston 10 of the exemplary embodiment of Figs. 1 to 6 is a so-called built piston consisting of two piston portions 10a and 10b, which are formed as separate assemblies 10a and 10b and joined to one another.

The piston 10 of the exemplary embodiment of Figs. 1 to 6 has a piston skirt 12, which is provided by the assembly 10a of the piston. A piston pin which is not shown for connecting the piston 10 to a connecting rod of the respective cylinder which is not shown extends through the piston skirt 12.

The piston 10, furthermore, comprises a ring belt 13 which is provided by the assembly 10b of the piston 10. The ring belt 13 is arranged on an axial side of the piston skirt 12 located opposite the connecting rod.

The ring belt 13 comprises multiple ring grooves that are limited by ring lands 14 and spaced from one another by the ring lands 14. In the ring grooves 15, piston rings 16 are arranged which are either formed as compression ring or as oil scraper ring. Such a piston ring 16 is shown for the piston 10 of Figs. 1 to 6.

The piston comprises an oil collection channel 17. The oil collection channel 17 is formed seen in the axial direction of the piston 10 between the piston skirt 12 and the ring belt 13, i.e. positioned seen in the axial

direction between the piston skirt 12 and the ring belt 13.

In the circumferential direction of the piston 10, the oil collection channel 17 circulates about the piston 10 and in the shown exemplary embodiment is formed by the assembly 10a of the piston 10.

As is evident from a comparison of Figs. 1, 2 with Figs. 3, 4, the axial depth t of this oil collection channel 17 seen in the circumferential direction is not constant, the oil collection channel 17, seen in the axial direction of the piston 10, rather has a greater axial depth t_2 in the circumferential position of the pressure side of the piston 10 and preferentially also in the circumferential position of the pressure opposite side of the piston (see Figs. 3 and 4) than the piston has a depth t_1 in the circumferential position of the coupling side of the same and in the circumferential position of the coupling opposite side of the same (see Figs. 1, 2).

As already explained, coupling side and coupling opposite side of the piston lie on a straight line which extends parallel to the axis of the piston pin. Pressure side and pressure opposite side of the piston 10 lie on a straight line which extends perpendicularly to the piston pin.

The 90° offset between the relatively low depth t_1 of the oil collection channel 17 in the circumferential position of the coupling side and in the circumferential position of the coupling opposite side to the relatively large depth t_2 of the oil collection channel 17 in the circumferential position of the pressure side and in the circumferential position of the pressure opposite side is also evident from Fig. 5.

While the axial depth t of the oil collection channel 17 changes in the circumferential direction of the piston, the radial width b of the oil collection channel 17 is preferentially constant in the circumferential direction.

The oil collection channel 17 not only has the different depths on the pressure side, pressure opposite side and coupling side, coupling opposite side, but the oil collection channel 17 also has a gradient namely emanating from the relatively low axial depth t_1 in the region of the coupling side and counter-coupling side in the direction of the relatively large axial depth t_2 in the region of the pressure side and pressure opposite side. By way of this it can be ensured that oil, which is accumulated in the region of the coupling side and counter-coupling side in the region of the oil collection channel 17, can drain in the direction of the pressure side and pressure opposite side of the piston 10 or the oil collection channel 17 and collect there.

Fig. 2 shows a detail of the piston 10 during a downward movement of the same, i.e. during a downward stroke (arrow X1), emanating from the top dead centre in the direction of the bottom dead centre, wherein approximately from the middle of this downward movement to the bottom dead centre, oil in the region of the coupling side and counter-coupling side is collected and enters the oil collection channel 17. An arrow 18 visualises this oil collecting during the downward movement of the piston 10 from the middle of the downward movement to the bottom dead centre.

As already explained, the oil, emanating from the coupling side and coupling opposite side, flows as a

consequence of the gradient of the oil collection channel 17 in the oil collection channel 17 in the direction of the pressure side and pressure opposite side. The gradient of the oil collection channel 17, emanating from the coupling side and coupling opposite side in the direction of the pressure side and pressure opposite side is preferentially continuous, i.e. without steps or shoulders.

Fig. 4 visualises a detail of the oil collection channel 17 in the region of the pressure side during an upward stroke (arrow X2) of the piston 10, i.e. during a movement of the same emanating from the bottom dead centre into the region of the top dead centre, wherein approximately from the middle of this upward stroke up to the top dead centre according to the arrows 19 of Fig. 4, oil from the oil collection channel 17 in the region of the pressure side and pressure opposite side is directed in the direction of the cylinder liner 11.

By way of this, an optimum lubrication of the piston in the region of the top dead centre can be realised even in the presence of major coupling lateral forces, so that a metallic contact between piston 10 and liner 11 can be avoided and the risk of a piston seizure reduced or eliminated.

As already explained, the axial depth t_2 of the oil collection channel 17 in the region of the pressure side and pressure opposite side of the piston 10 is greater than the axial depth t_1 of the oil collection channel 17 in the region of the coupling side and coupling opposite side of the piston 10. In the circumferential position of the coupling side and coupling opposite side of the piston 10, the axial depth t_1 of the oil collection channel 17 preferably amounts to between 2 mm and 15 mm, particularly

preferably between 3 mm and 10 mm. The axial depth t_2 of the oil collection channel in the circumferential position of the pressure side and the pressure opposite side, which is greater than the axial depth t_1 , preferably amounts to between 4 mm and 30 mm, particularly preferably between 6 mm and 20 mm. The width b in the radial direction of the oil collection channel 17 preferably amounts to between 2 mm and 25 mm, particularly preferably between 5 mm and 20 mm.

In the shown exemplary embodiment, a control edge 20 is formed seen in the axial direction of the piston 10 between the oil collection channel 17 and the ring belt 13, which with the axial direction includes an angle α (see Fig. 1). This control edge 20 can be formed circumferentially in the circumferential direction and circumferentially in the circumferential direction be configured with a constant angle α . It is also possible to configure this control edge 20 with an angle α that's variable in the circumferential direction, which can be formed differently in the region of pressure side, pressure opposite side and in the region of coupling side, coupling opposite side. This is advantageous in order to individually influence the collecting of the oil and the dispensing of the oil.

The angle α , which the control edge 20 includes with the axial direction, is preferentially greater than 0° and smaller than 90° , preferably, this angle lies between 45° and 90° , particularly preferably between 60° and 75° .

The oil, which during an upward stroke of the piston 10 flies or is splashed out of the oil collection channel 17 in the region of the pressure side and pressure opposite side in the direction of the cylinder liner, first reaches the control edge 20 (see Fig. 4) and

flies or is splashed from the control edge 20 in the direction of the cylinder liner 11.

Figs. 7 and 8 show cross sections through a piston 10 according to a second exemplary embodiment of the invention, which substantially differs from the piston 10 of the exemplary embodiment of Figs. 1 to 6 only in that the piston 10 of Figs. 7 and 8 is not formed as a built piston consisting of two assembled assemblies 10a, 10b joined to one another, but is rather embodied as a monobloc piston, the ring belt 13 and piston skirt 12 of which are formed by a monolithic assembly. With regard to the design embodiment details, reference for the piston 10 of Fig. 7 and 8 can be made to the explanations regarding the piston 10 of Figs. 1 to 6, wherein in the case of a monobloc piston the angle β , which the control edge 20 includes with the axial direction, is likewise greater than 0° and smaller than 90° and preferably amounts to between 30° and 70° .

With the invention present here, the lubrication of the piston 10 for the cylinder liner 11 can be improved, in particular in the region subjected to thermal and mechanical load shortly before and after the top dead centre on the pressure side and pressure opposite side of the piston 10. The risk of the piston seizing up can be prevented. Here, the configuration of the oil collection channel with different depths and the gradient is significant according to the invention.

During the downward stroke, oil can be collected in the oil collection channel 17 in the region of coupling side and coupling opposite side, flow within the oil collection channel 17 based on the gradient in the direction of the pressure side and pressure opposite side, be collected there and during the upward stroke be directed to the lubricating region between piston 10

and cylinder liner 11. The oil collection behaviour and oil dispensing behaviour can be coordinated via the angle of the control edge 20.

CLAIMS

1. A piston for a cylinder of an internal combustion engine, the piston comprising:

a piston skirt,

a ring belt positioned on a first axial side of the piston skirt, which comprises multiple ring grooves that are limited by ring lands and separated from one another by the ring lands, wherein each of the ring grooves receives a piston ring formed as compression ring or as oil scraper ring,

an oil collection channel positioned, seen in an axial direction of the piston, between the piston skirt and the ring belt,

wherein the oil collection channel, seen in a circumferential position of at least one of a pressure side of the piston and a pressure opposite side of the piston in the axial direction of the piston, has a greater depth than in the circumferential position of at least one of a coupling side of the piston and a coupling opposite side of the piston, and

wherein the oil collection channel, seen in a circumferential direction of the piston, has a gradient emanating from an axial depth in a region of at least one of the coupling side and the coupling opposite side in a direction of the axial depth in a region of at least one of the pressure side and the pressure opposite side.

2. The piston according to claim 1, wherein, seen in the circumferential direction, the circumferential position of the pressure opposite side is located opposite the circumferential position of the pressure side by 180° .
3. The piston according to claim 1 or 2, wherein the circumferential position of the coupling opposite side is located opposite the circumferential position of the coupling side seen in the circumferential direction by 180° .
4. The piston according to any one of the claims 1 to 3, wherein seen in the circumferential direction the circumferential position of the coupling opposite side and the circumferential position of the coupling side, are offset by 90° relative to the circumferential position of the pressure opposite side and the circumferential position of the pressure side.
5. The piston according to any one of the claims 1 to 3, wherein

the axial depth of the oil collection channel in the circumferential position of the pressure side and in the circumferential position of the pressure opposite side is between 4 mm and 30 mm, the axial depth of the oil collection channel in the circumferential position of the coupling opposite side and in the circumferential position of the coupling side is between 2 mm and 15 mm.
6. The piston according to claim 5, wherein the axial depth of the oil collection channel in the circumferential position of the pressure side and

in the circumferential position of the pressure opposite side is between 6 mm and 20 mm.

7. The piston according to claim 5 or 6, wherein the axial depth of the oil collection channel in the circumferential position of the coupling opposite side and in the circumferential position of the coupling side is between 3 mm and 10 mm.
8. The piston according to any one of the claims 1 to 7, wherein, seen in a radial direction, a width of the oil collection channel is between 2 mm and 25 mm.
9. The piston according to claim 8, wherein, seen in the radial direction, the width of the oil collection channel is between 5 mm and 20 mm.
10. The piston according to any one of the claims 1 to 9, wherein, seen in the axial direction of the piston, a control edge is formed between the oil collection channel and the ring belt facing the oil collection channel, which with the axial direction includes an angle.
11. The piston according to claim 10, wherein with a monobloc piston, the ring belt and piston skirt of which are formed by a monolithic assembly, the angle is between 30° and 70°.
12. The piston according to claim 10, wherein with a built piston, the ring belt and piston skirt of which are formed by assemblies that are separate from one another and joined to one another, the angle is between 60° and 75°.

13. The piston according to any one of the claims 10 to 12, wherein the angle which the control edge includes with the axial direction changes in the circumferential direction.
14. A cylinder of an internal combustion engine, comprising

a cylinder liner,

a piston according to any one of the claims 1 to 13, the piston being moveably guided up and down in the cylinder liner.

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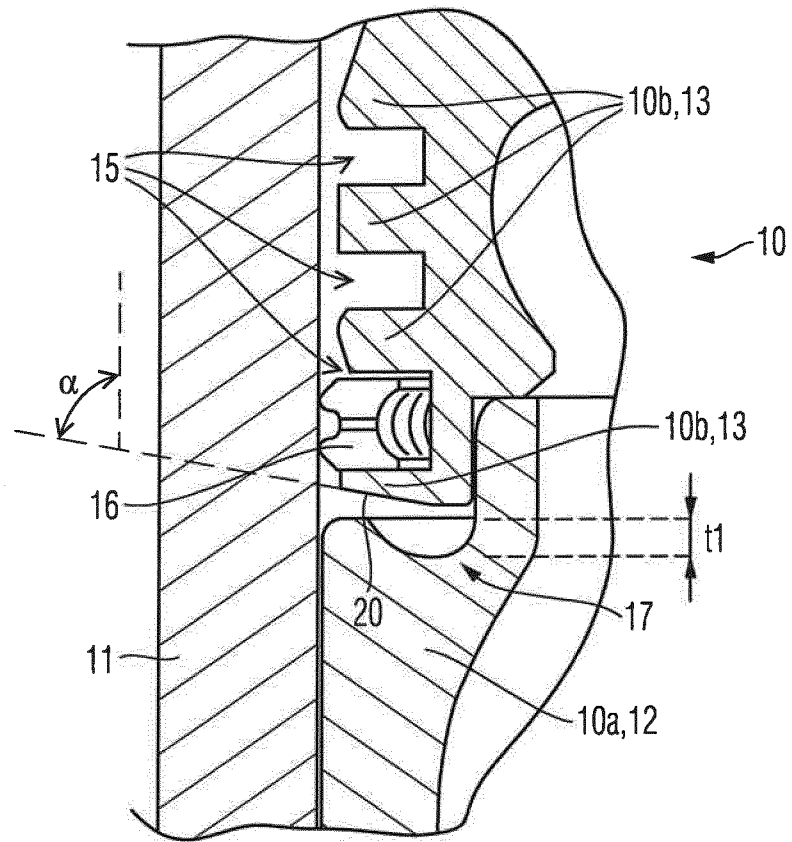


Fig. 1

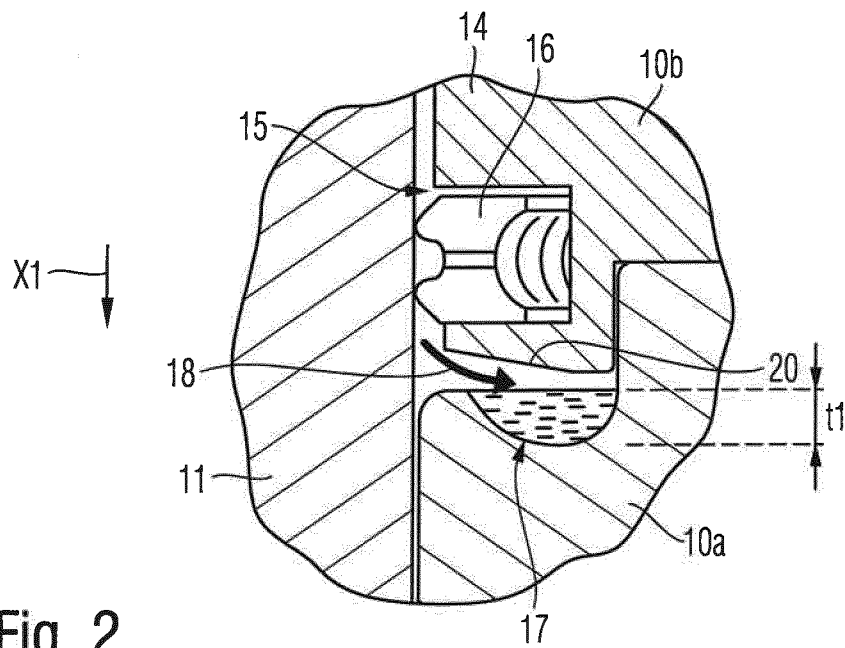


Fig. 2

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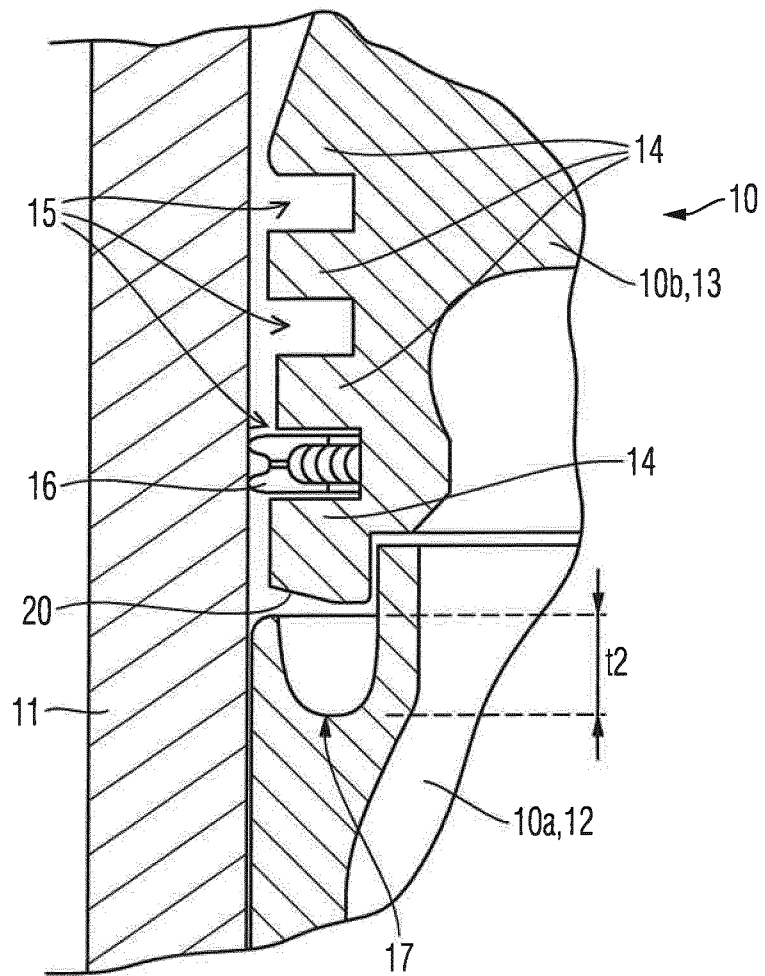


Fig. 3

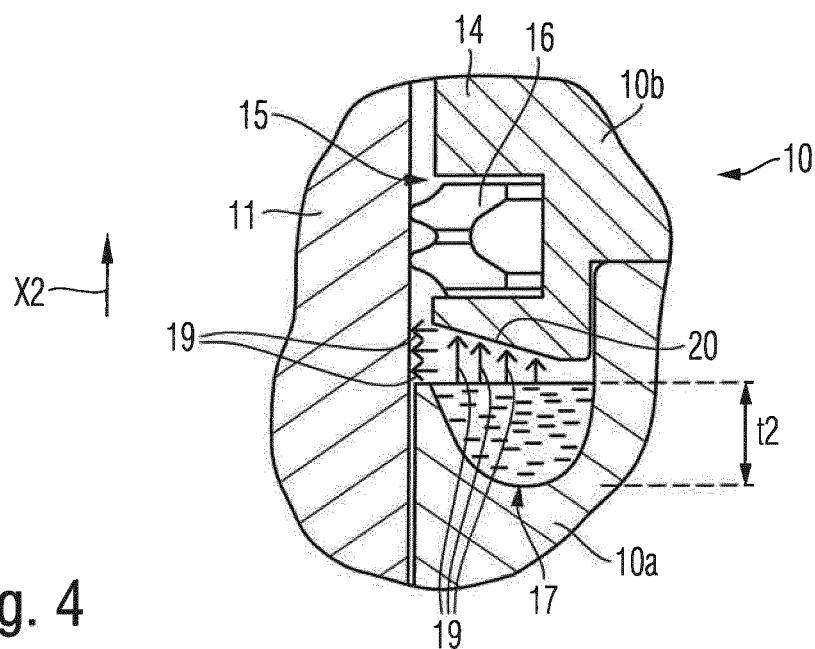


Fig. 4

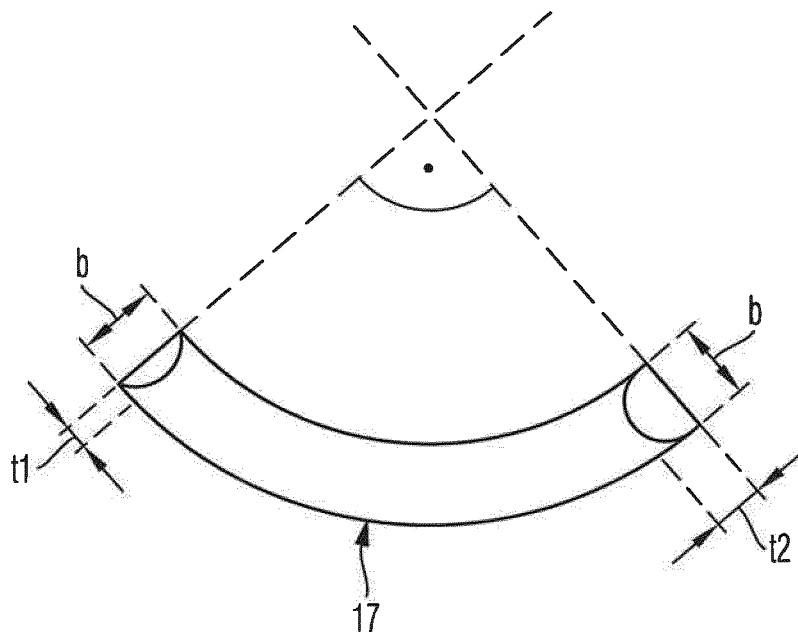


Fig. 5

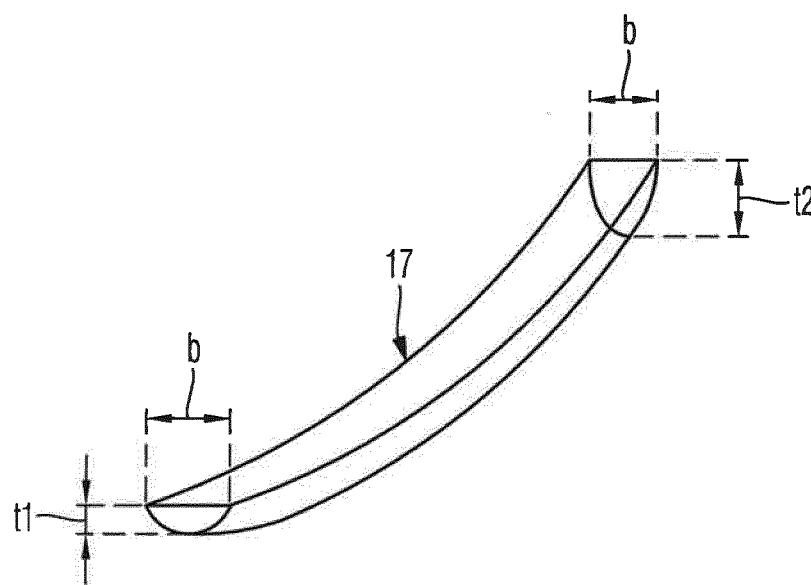


Fig. 6

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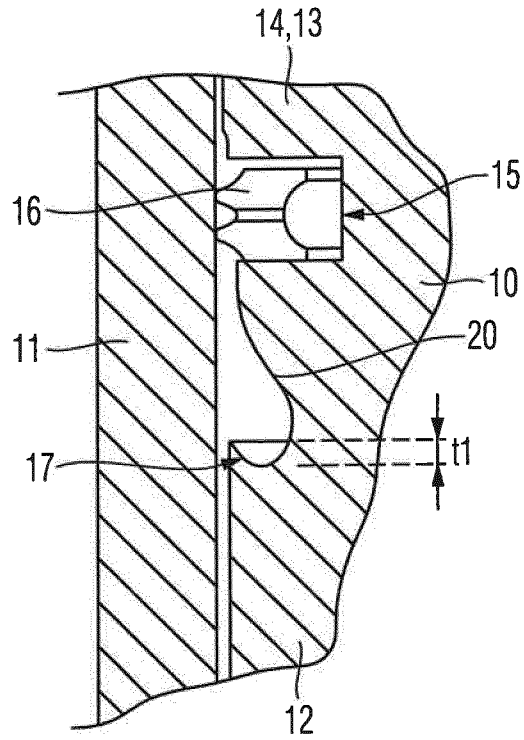


Fig. 7

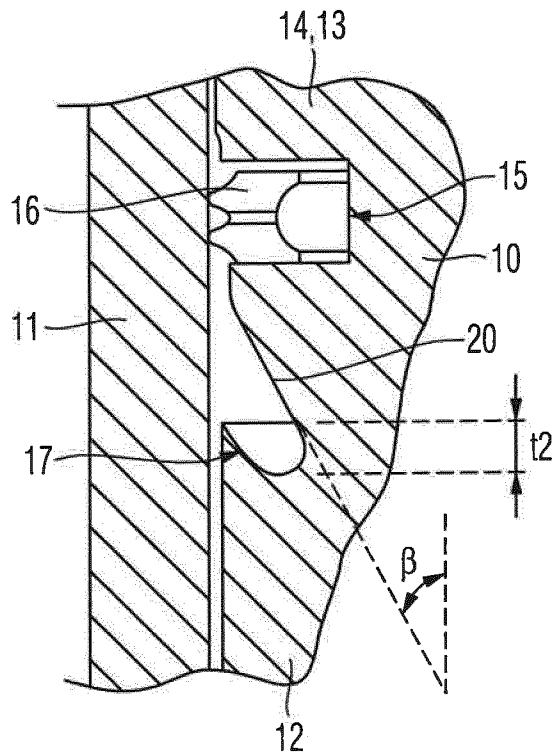


Fig. 8

