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(72) Inventeurs/Inventors:
SCHNEIDER, WOLFGANG, DE;
LANGEN, MANFRED, DE;
INSTONE, STEPHEN, DE

(73) Propriétaire/Owner:
MAERZ-GAUTSCHI INDUSTRIEOFENANLAGEN GMBH, CH

(74) Agent: FETHERSTONHAUGH & CO.

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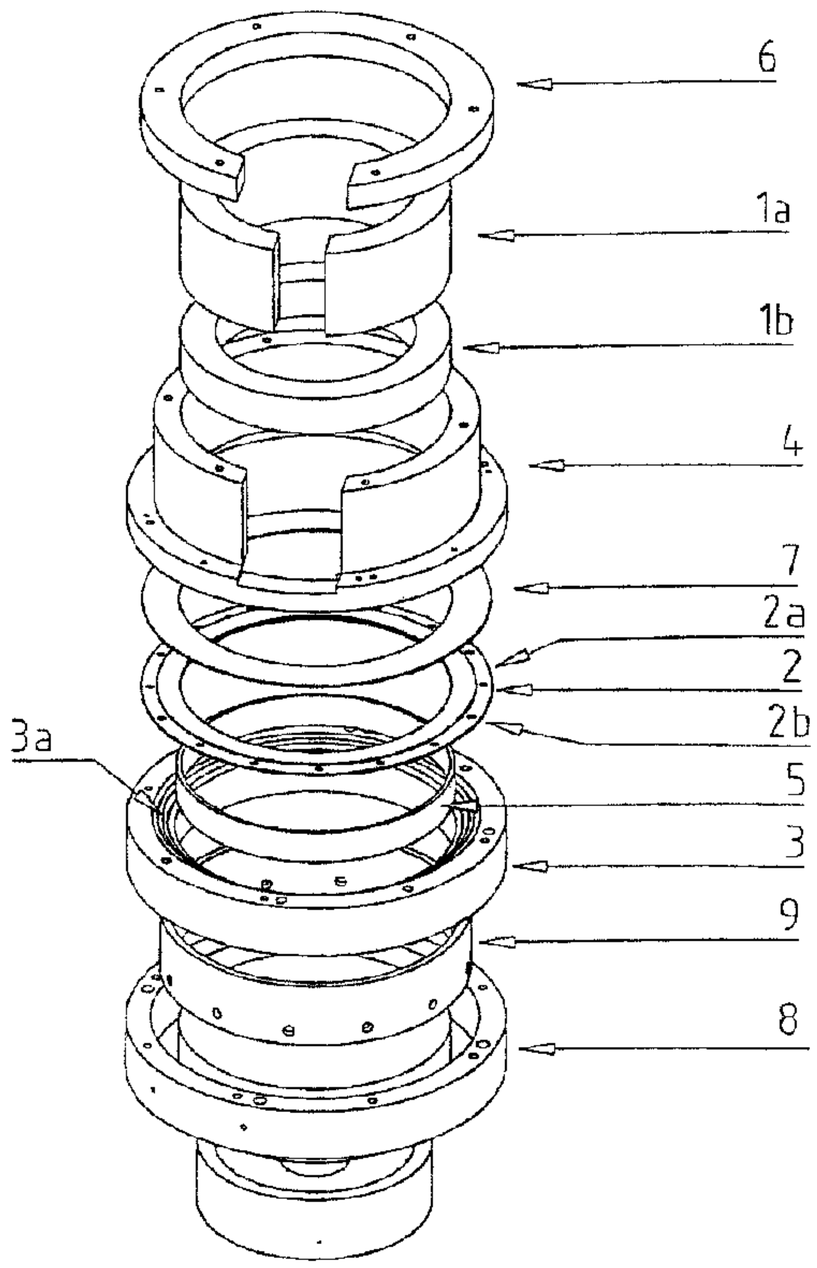

(57) Abrégé/Abstract:
The invention relates to a hot-top mold for a strand casting apparatus, consisting of a hot top, which lies on the upper side of a parting agent distributor and presses it with its underside against the surface of a mold, an overhang being formed on the radially inner surface of the hot top, which protrudes beyond the parting agent distributor in the direction of take off of the strand, the hot top being centered and held by an outer ring, which is releasably fastened to the mold. The mold surrounds a function ring toward the bearing surface of the mold which, together with the parting agent distributor, forms function surfaces with adjustable roughness on the surfaces. In the parting agent distributor, radial channels are formed at the upper side and the underside, the channel cross sections at the upper side and the underside being in a ratio of 1:3 to 1:5 to one another.

Abstract of the Disclosure

The invention relates to a hot-top mold for a strand casting apparatus, consisting of a hot top, which lies on the upper side of a parting agent distributor and presses it with its underside against the surface of a mold, an overhang being formed on the radially inner surface of the hot top, which protrudes beyond the parting agent distributor in the direction of take off of the strand, the hot top being centered and held by an outer ring, which is releasably fastened to the mold. The mold surrounds a function ring toward the bearing surface of the mold which, together with the parting agent distributor, forms function surfaces with adjustable roughness on the surfaces. In the parting agent distributor, radial channels are formed at the upper side and the underside, the channel cross sections at the upper side and the underside being in a ratio of 1 : 3 to 1 : 5 to one another.

MOLD WITH A FUNCTION RING

The invention relates to a hot-top mold for a strand casting apparatus, consisting of a hot top, which lies on the top of a parting agent distributor and presses the latter against it with its bottom against the surface of a mold, an overhang being formed on the radially inside surface of the hot top and reaching out beyond the parting agent distributor in the downward direction of the movement of the strand and forming an annular gap with the running surface of the mold.

A hot-top mold of the kind described above is disclosed in EP 0566 865 (VAW); by way of the parting agent distributor, parting or lubricant agent reaches the surface of the cast strand, and two different parting agents can also be fed separately or in a mixture of fluid parting oil and a gaseous parting or lubricant agent, for example. It has already been recognized that it is especially desirable if the oil-gas mixture is first formed close to the mold.

But problems still exist in regard to the castability of so-called hard-to-cast alloys since, in this case, the surface quality often is insufficient. This is especially true of aluminum alloys containing lead, zinc, tin and copper. Recently, these have been gaining importance in the production of special alloys and machining alloy stock, which are to be used at a high cutting speed.

Another problem is the precise control of the gas pressure, which is of decisive importance as to whether the parting agent reaches the entire surface of the metal strand. If pressure fluctuates, surface flaws can easily occur and, if the pressure is too high, there is the risk that gas might escape through the molten metal.

For the solution of this problem it is proposed in US patent 4,732,209 (Pechiney) to use a graphite ring on the inside of the mold, the porosity of which is

established so that a gas under pressure is forced from the outside through the open pores of the graphite material to the inside of the mold and there acts as a parting agent between the surface of the forming metal strand and the mold surface. In our experience, however, the problems involved in the production of hard-to-cast alloys cannot be solved in this manner.

The present invention is addressed to the problem of improving a hot-top mold of the kind described above, so that different types of alloy, especially hard-to-cast alloys, can be made with a satisfactory surface quality. For its solution, it is proposed that:

1) the hot top 1a, 1b be held by an outer ring 4, which is releasably fastened to the mold 3,
2) the mold 3 surrounds at its inside surface a function ring 5, whose upper side forms a function surface with the parting agent distributor 2,
3) and that the parting agent distributor 2 consists of a plate provided on both sides with radial channels, the cross sections of the channels are as 1 : 3 to 1 : 5 between top and bottom side.

According to feature a), the new hot-top mold is constructed of several rings, which are easy to assemble and disassemble. Thus, it is possible to quickly exchange different parting agent distributors and function rings according to the desired type of alloy.

According to feature b), the invention consists in the use of a function ring 5 with function surfaces toward the parting agent distributor and toward the mold surface. The function surfaces form wall faces with a defined roughness for the channels formed by the parting agent distributor and it is especially desirable if the function surface forms one wall face for the fluid-bearing channel cross section. It has

been found that, with a precisely adjusted surface roughness and temperature of the function surfaces, a defined change in the viscosity of the fluid parting agent can be achieved for producing a stable foam layer.

According to feature c), the ratio of the channel cross sections in the parting agent distributor is important for controlling the composition of the parting agent mixture. By combining features b) and c), a foaming can be achieved, which is especially effective as a highly viscous parting agent and, especially in the case of hard-to-cast alloys, it permits a very good surface quality.

It is proposed to provide a clamping ring 6 above the hot top 1a, 1b, by which the hot top 1a, 1b, the parting agent distributor 2 and the mold 3 can be clamped. When the clamping ring 6 and the outside ring 4 are loosened, the parting agent distributor 2 and function ring 5 are easy to replace. Thus, matching the surface and channel cross sections responsible for foam production is easily possible.

It is advantageous if a defined, tight porosity of the function ring 5 and a specific density is chosen within narrow limits. Additional improvements in the stability of the parting agent foam have been achieved by additional experiments, wherein a cooling of the function ring 5 was performed in order to keep the viscosity properties on the function surfaces constant. The construction and manner of operation of the function surfaces and the cooling is further explained in the following embodiments.

As already set forth above, the parting agent distributor 2 on the top end 2a is used preferably to form gas-carrying passages and, on the bottom 2b, is used for a fluid parting agent. The passages must be made with very

great precision, which can be achieved, for example, by laser machining or by a chemical etching method.

What is important for the air content in the parting agent foam is also the cross-sectional shape of the radial passages in the parting agent distributor, and the surface area ratio of the passages is important for the formation of a parting agent foam distributed uniformly over the circumference. Under these circumstances the parting agent is formed with especially fine cells and hence it is strong, so that the liquid component of the parting agent can be reduced.

The previously mentioned cooling of the function ring 5 is performed preferably by arranging cooling passages in the mold 3, which reach all the way into the area of the function ring. In this primary cooling zone, a temperature is established for the optimum action of the parting agent. In the adjoining secondary cooling zone, provision is made for a rapid removal of heat, since the cooling passages here run in the direction of the descent of the strand and lead into a slot nozzle. Here, the pressure of the coolant is lowered, so that the coolant is in contact with the aluminum strand and thus further cools it.

According to one aspect of the present invention, there is provided a hot-top mold for a strand casting apparatus consisting of a hot top, which lies on the top of a parting agent distributor and presses the latter with its bottom against the top surface of a mold, an overhang being formed at a radially interior surface of the hot top and protruding beyond the parting agent distributor in the withdrawal direction of the strand and forming an annular gap with the mold surface, wherein the hot top is centered

and held by an outer ring, which is releasably fastened to the mold, the mold surrounding a function ring toward the bearing surface of the mold and, together with the parting agent distributor, forms function surfaces with adjusted roughnesses on the surfaces, and radial passages are formed on the top and bottom sides, the passage cross sections between the upper and bottom side being in a ratio of 1:3 to 1:5.

Figure 1 shows an overall exploded view of an inventive hot-top mold.

Figure 2 shows a representation of the inventive hot-top mold in the case of strand casting.

In the general view in Figure 1, the following parts of the system [used] in strand casting are shown, which are assembled together:

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1a hot top

1b hot top

2 parting agent distributor

2a upper side

2b bottom side

3 mold

3a surface

4 outer ring

5 function ring

6 clamping ring

7 activator ring

8 bottom part

9 pressure plate

10 metal strand

11 annular gap

12 parting agent foam

13 -

14 annular gap

15 cooling passage

16 foam layer

It is apparent that the formation of certain function surfaces is of decisive importance for the

formation of a stable parting agent foam. The function surfaces are situated above and below the parting agent distributor as well as on the inside of the function ring 5. The latter is in direct contact with the passages of the parting agent distributor 3 and cooperates in the formation of the foam.

As an innovation and supplementation of the function surfaces, an activator ring 7 is introduced, which can be made of various materials. The activator ring 7 lies between the outer ring 4 and the top 3a of the parting agent distributor 2. It thus covers the top of the passages made in the parting agent distributor 2. Its roughness values differ from those of the hot top 1b and can be adjusted to the particular requirements of the parting agent. At the same time, the thermal gradient of the parting

agent distributor 2 underneath the hot top 1b can thereby be controlled.

A mold 3 is supplemented by an outside ring 4 and a function ring 5. By means of a clamping ring 6, the system parts are assembled together with the inclusion of an activator ring 7. The mold 3 is completed by a bottom part 8 and a pressure plate 9.

Figure 2 is intended to further explain the basic construction of the inventive hot-top mold and, in this case especially, the enlarged detail under the overhang of the hot top 1b will be discussed. An annular gap 11 can be seen underneath the overhang, the side walls of the annular gap being formed, on the one hand, by the hot-top overhang and, on the other, by the inside radius of the parting agent distributor 2 and by the function ring 5. Upon the introduction of gaseous and liquid parting agent within the volumetric ratio of the invention, a stable parting agent foam 12 is formed, which develops as a continuous layer of foam between the mold 3 and the strand 10.

To begin with, the viscosity of the parting agent is controlled by the surface roughness in the gas region as well as in the liquid region. The viscosity of the parting agent is the essential factor in the formation of the foam. Furthermore, the pressure and rate of flow of the delivered gaseous and liquid medium can be controlled, so that the composition of the parting agent foam can be regulated within wide limits.

In turn, a controlled heat removal can be performed, or else an insulating effect can be produced with the parting agent. This is advantageous especially in the case of alloys that are difficult to cast.

28346-1

CLAIMS:

1. A hot-top mold for a strand casting apparatus consisting of a hot top, which lies on the top of a parting agent distributor and presses the latter with its bottom against the top surface of a mold, an overhang being formed at a radially interior surface of the hot top and protruding beyond the parting agent distributor in the withdrawal direction of the strand and forming an annular gap with the mold surface, wherein the hot top is centered and held by an outer ring, which is releasably fastened to the mold, the mold surrounding a function ring toward the bearing surface of the mold and, together with the parting agent distributor, forms function surfaces with adjusted roughnesses on the surfaces, and radial passages are formed on the top and bottom sides, the passage cross sections between the upper and bottom side being in a ratio of 1:3 to 1:5.

2. The hot-top mold of claim 1, wherein the function ring consists of copper or copper alloys.

3. The hot-top mold of claim 1, wherein the function ring consists of ceramic or composite materials.

4. The hot-top mold of claim 1, wherein the function ring consists of graphite.

5. The hot-top mold of claim 1, wherein a clamping ring is disposes above the hot top, by which the hot top, the parting agent distributor, the function ring and the mold are clamped.

6. The hot-top mold of claim 5, wherein the function ring has a closed porosity of 0 - 20% and a density of 1.5 - 10 g/cc.

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7. The hot-top mold of claim 6, wherein the radial channels, incorporated into the upper side of the parting agent distributor, are connected to a pressurized gaseous medium and that radial passages are formed at the underside of the parting agent distributor and are connected to a pressurized liquid reservoir.

8. The hot-top mold of claim 7, wherein the lower radial passages of the parting agent distributor are configured in the manner of a diffuser, an approximately square cross section being given to the radially outward lying passage carrying the parting agent distributor and a rectangular cross section with a surface ratio of at least 1:2 being formed on the radially inward-lying exit side.

9. The hot-top mold of claim 8, wherein cooling passages are disposed in the mold, which reach all the way into the area underneath the parting agent distributor and the function ring, heat removal being performed in the annular gap through a foam layer produced by the gas and liquid medium and issuing in the descending direction of the strand.

10. The hot-top mold of claim 9, wherein the thermal conductivity of the bottom part of the hot top is 1.5 to 2.0 times greater than that of the upper part of the hot top.

11. The hot-top mold of claim 10, wherein the upper part of the parting agent distributor is covered with an activator ring.

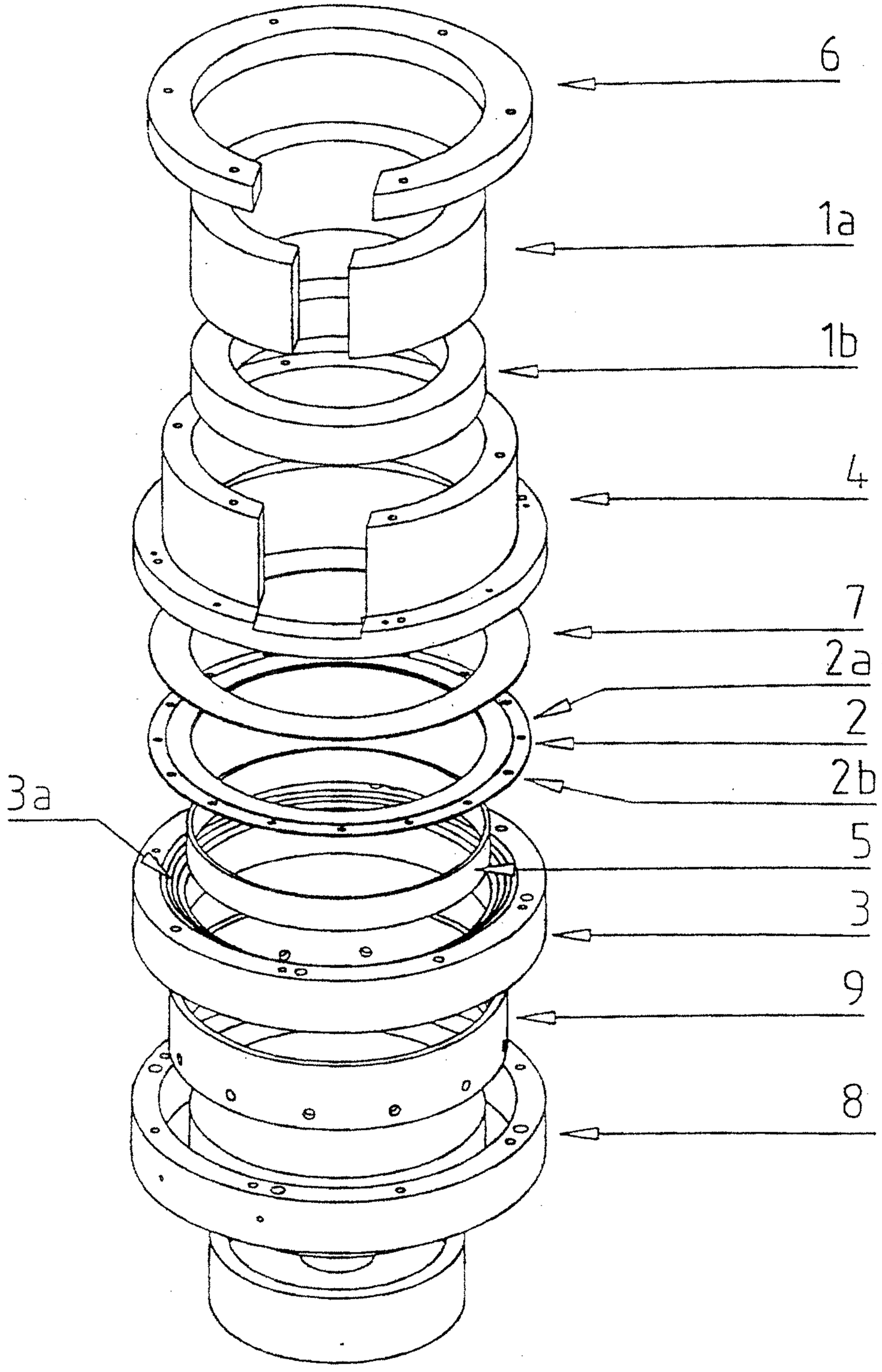


FIG. 1

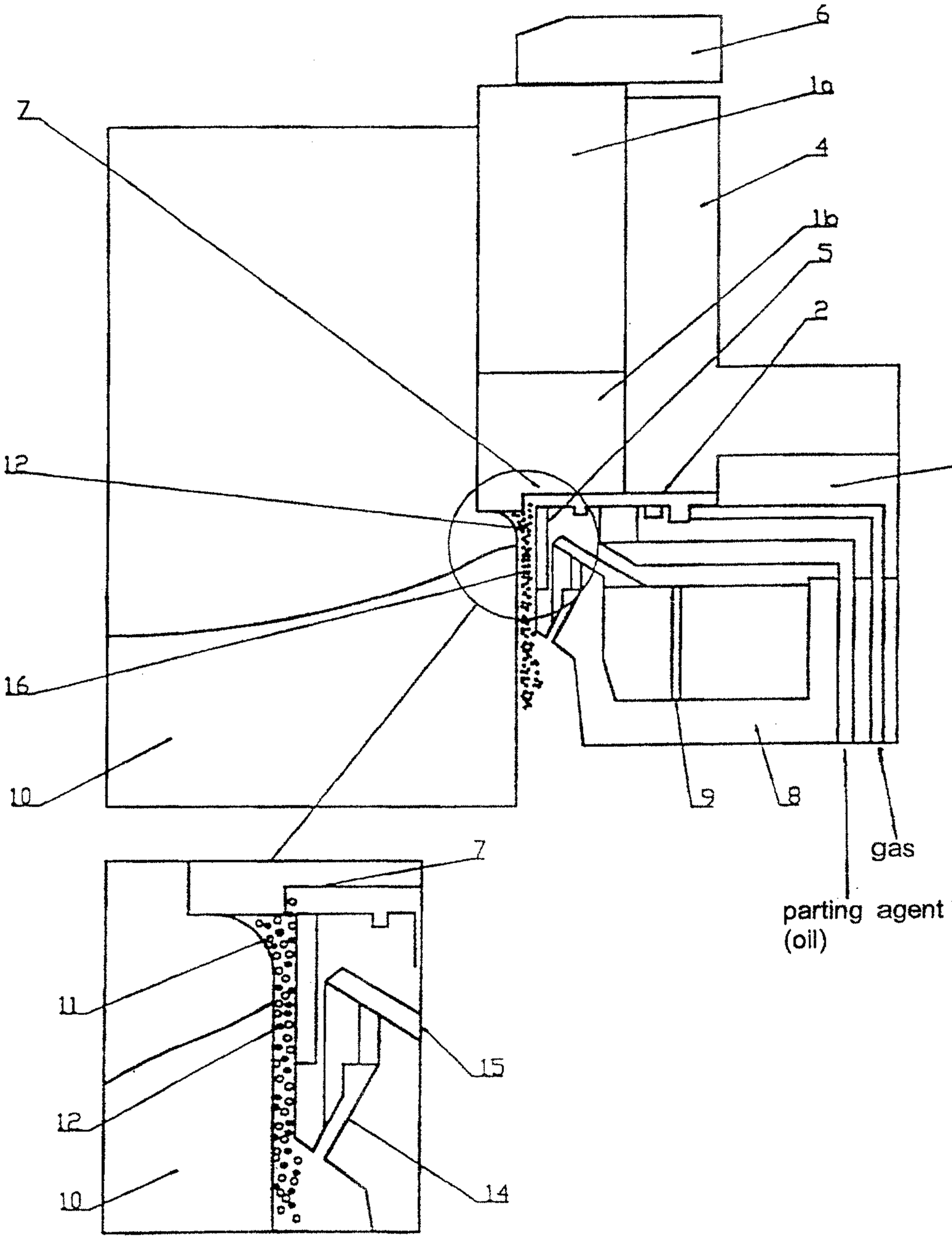
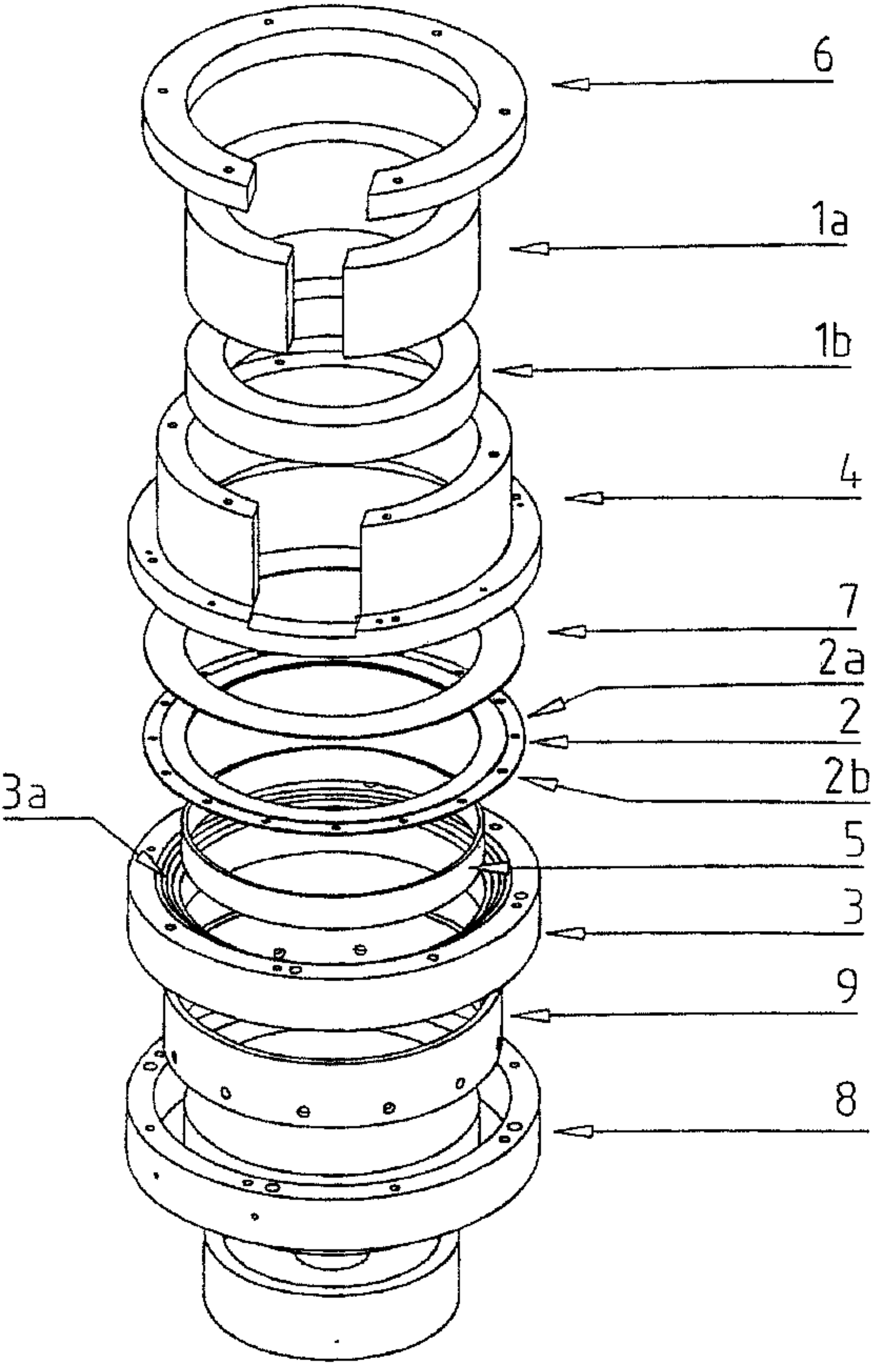


FIG. 2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1a
1b
4
7
2a
2
2b
3a
5
3
9
8