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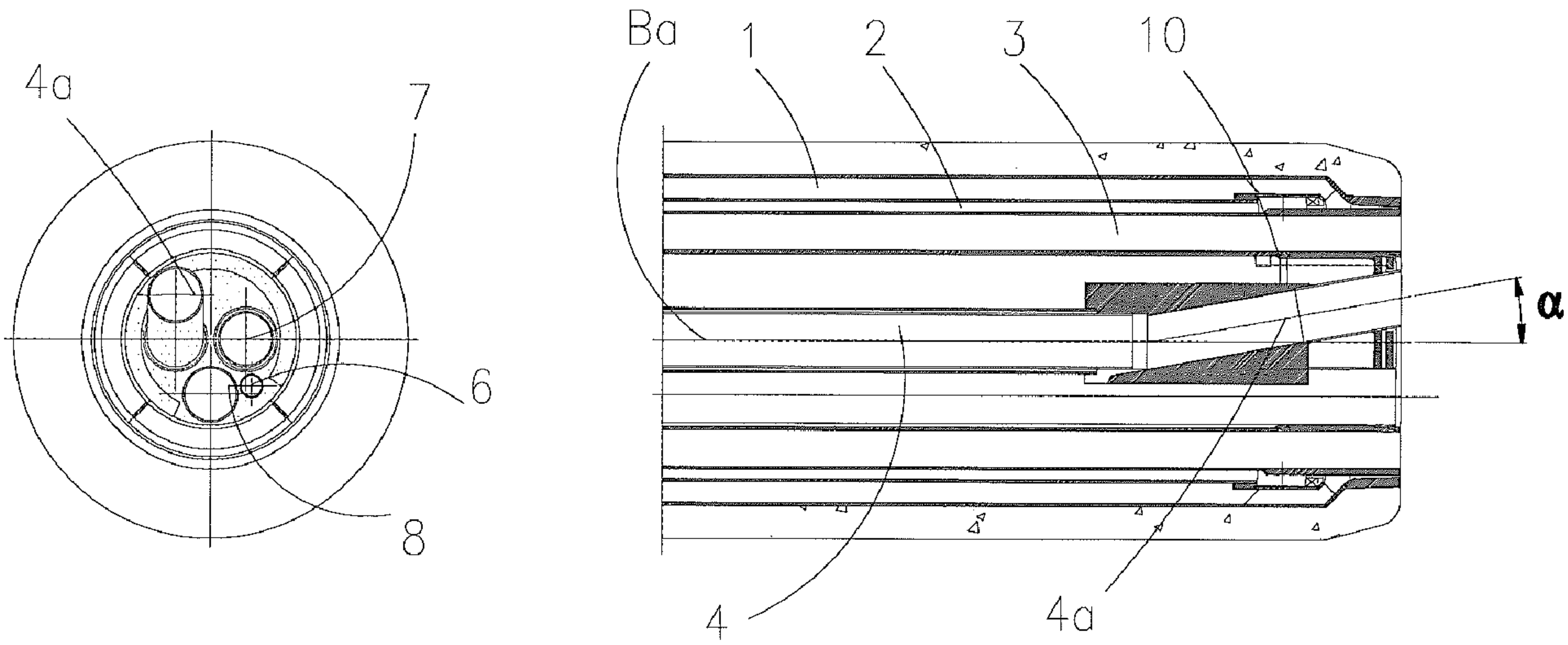
(54) **Titre :** BRULEUR EQUIPE DE MOYENS DE CHANGEMENT DE LA DIRECTION D'ECOULEMENT D'UN COMBUSTIBLE
(54) **Title:** BURNER WITH MEANS FOR CHANGING THE DIRECTION OF FUEL FLOW



(57) **Abrégé/Abstract:**
A description is given of a burner for introducing solid, liquid or gaseous fuel to a burning zone of a kiln, such as a rotary kiln for manufacturing cement clinker or the like, said burner comprising a number of substantially concentric ducts (1, 2, 3), being parallel to the main axis B3 of the burner, for conveying fuel and primary air to nozzle openings, as well as a number of additional ducts (4, 6, 7, 8) for conveying solid, fluid or gaseous fuel to separate nozzle openings, said additional ducts being located in the central part (10) of the burner. The burner is characterized in that it comprises means (4a, 5) for changing the flow direction of the fuel which is introduced via at least one of the additional ducts in the central part (10) of the burner, relative to the main axis B3 of the burner, at least in an ascending direction. This will allow the individual fuel particles to travel in a curved, approximately ballistic path, thereby extending the time they can be maintained in the flame. Another advantage of this configuration of the burner is that the large particles will attain the highest, and hence the longest, path, since the path of the smaller particles will to a greater extent than is the case for the large ones be deflected by the primary air which is injected via the outer annular primary air nozzle which is parallel to the main axis of the burner. Hence it will be possible to achieve a more uniform combustion of all particles, regardless of their size. It will be possible to change the path of the particles by altering the velocity or direction of injection.

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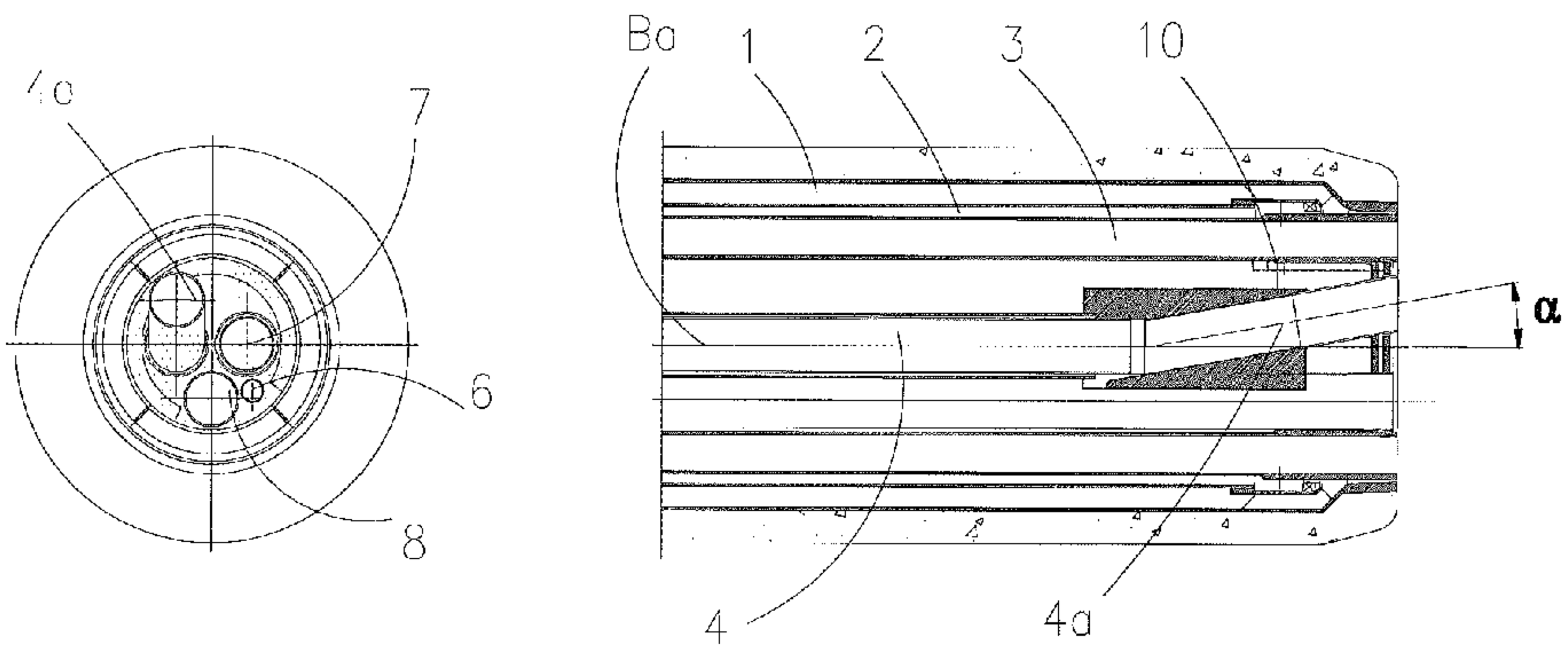
(54) Title: BURNER WITH MEANS FOR CHANGING THE DIRECTION OF FUEL FLOW



(57) Abstract: A description is given of a burner for introducing solid, liquid or gaseous fuel to a burning zone of a kiln, such as a rotary kiln for manufacturing cement clinker or the like, said burner comprising a number of substantially concentric ducts (1, 2, 3), being parallel to the main axis B3 of the burner, for conveying fuel and primary air to nozzle openings, as well as a number of additional ducts (4, 6, 7, 8) for conveying solid, fluid or gaseous fuel to separate nozzle openings, said additional ducts being located in the central part (10) of the burner. The burner is characterized in that it comprises means (4a, 5) for changing the flow direction of the fuel which is introduced via at least one of the additional ducts in the central part (10) of the burner, relative to the main axis B3 of the burner, at least in an ascending direction. This will allow the individual fuel particles to travel in a curved, approximately ballistic path, thereby extending the time they can be maintained in the flame. Another advantage of this configuration of the burner is that the large particles will attain the highest, and hence the longest, path, since the path of the smaller particles will to a greater extent than is the case for the large ones be deflected by the primary air which is injected via the outer annular primary air nozzle which is parallel to the main axis of the burner. Hence it will be possible to achieve a more uniform combustion of all particles, regardless of their size. It will be possible to change the path of the particles by altering the velocity or direction of injection.

WO 2008/065554 A1

Burner with means for changing the direction of fuel flow

The present invention relates to a burner for introducing solid, liquid or gaseous fuel to a burning zone of a kiln, such as a rotary kiln for manufacturing cement clinker or the like, said burner comprising a number of substantially concentric ducts, which are parallel to the main axis of the burner, for conveying fuel and primary air to nozzle openings, and a number of additional ducts for conveying solid, fluid or gaseous fuel to separate nozzle openings, with said additional ducts being located in the central part of the burner.

Burners of the aforementioned kind are known for example from EP 965 019 and EP 967 434. These known burners comprise in the central part one or several ducts for conveying fuel, said ducts being surrounded by annular, concentric channels for introducing primary air. These centrally located channels are often used for introducing alternative fuels such as solid fuels comprising for example plastics, paper, rubber and wood chips or liquid fuels such as for example oil or mixtures of solid and/or liquid fuels.

When for example solid fuel is injected via a fuel duct into a flame in a rotary kiln for cement manufacturing, it is essential to ensure that the individual fuel particles are kept suspended for as long as possible in order to achieve complete combustion of the majority of the particles before they drop into the material charge. However, it will rarely be possible to achieve complete combustion of the largest fuel particles which will drop into the material charge, with a continuation of the combustion process at this location. In such cases, it would be advantageous for these particles to be led so far into the kiln as is practicably possible in order to achieve full combustion of the particles prior to the discharge of the material from the kiln, always providing that the material, as is the case in a typical rotary kiln for manufacturing of cement, is transported in direction which is opposite to that in which the fuel is injected. If this is not the case, unburned particles may cause damage to the material charge in the rotary kiln. Quite often, solid alternative fuels will have a highly variable particle size and, as a rule, they will be less finely comminuted than solid fossil fuels. Also, the comminution of alternative fuels may be a relatively complex and expensive process. Therefore, many burners are configured so that a small amount of the primary air is injected through annular, concentric ducts surrounding the individual ducts for alternative fuel. Such a configuration will allow even relatively large particles to remain suspended until complete combustion has been achieved. In EP 967 434, a description is given of separate annular ducts for primary air which are concentrically positioned around the ducts for solid fuel. Such a configuration would make it possible to increase the time the fuel particles can be maintained in a state of suspension, thereby leading to improved combustion efficiency. It is also proposed in this patent application that the primary air is injected subject to rotation causing the fuel particles to be scattered further outwards in the cross-sectional area of the flame, thereby improving combustion efficiency. However, disadvantages may be associated with the injection of air subject to rotation since it may cause large particles to be thrust outward all the way to the point of the flame before complete combustion of these particles has been achieved. This may entail risk of the fuel particles dropping through, with attendant risk of the quality of the material in the kiln being impaired. Also, it is a common characteristic of the known burners that the fuel is introduced to the kiln in a flow of direction which is substantially parallel to the main axis of the burner. In this context, the expression "flow direction" is taken to mean the direction described, on average, by the fuel particles in a fuel stream. In cases where the fuel is introduced subject to rotation, the flow direction of the fuel will thus coincide approximately with the line of symmetry for the fuel stream.

It is the objective of the present invention to provide a burner by means of which the alternative fuel can be maintained in the flame for a longer period of time without any of the aforementioned disadvantages.

According to the invention this is achieved by a method of the kind mentioned in the introduction and being characterized in that the burner comprises means for changing the flow direction of the fuel which is introduced via at least one of the additional ducts in the central part of the burner, relative to the main axis of the burner, at least partially in an ascending direction.

Hence it will be possible for the individual fuel particles to travel in a curved, approximately ballistic path, thereby extending the time they can be maintained in the flame. Another advantage of this configuration of the burner is that the large particles will attain the highest, and hence the longest, path, since the path of the smaller particles will to a greater extent than is the case for the large ones be deflected by the primary air which is injected via the outer annular primary air nozzle which is parallel to the main axis of the burner. Hence it will be possible to achieve a more uniform combustion of all particles, regardless of their size. It will be possible to change the path of the particles by altering the velocity or direction of injection.

In principle, the means for changing the flow direction of the fuel may be made up of any suitable means.

In one embodiment of the invention the means for changing the flow direction of the fuel which is introduced via at least one of the additional ducts in the central part of the burner comprises an injection duct which is located at the outlet point of the duct in question in immediate extension hereof, with its centreline forming an angle relative to the main axis of the burner. It is preferred that the injection duct is located so that it points upward in relation to the main axis of the burner at an angle between 1° and 25°, preferentially between 5° and 15° and most preferentially between 7° and 10°. It is further preferred that the lowest point of the outlet of the injection duct is located at a level above the upper part of the pipes of the duct in question. The injection duct may in a special embodiment have an oval cross-section or may otherwise be configured so that the height/width ratio is less than 1. If this is the case, the injection velocity may be varied either by changing the cross-sectional area of the injection duct or by changing the airflow rate which is injected simultaneously with the fuel.

In a second embodiment of the invention, the fuel is introduced in parallel to the main axis of the burner. In this embodiment of the invention the means for changing the flow direction of the fuel which is introduced via at least one of the additional ducts in the central part of the burner comprises an air duct, the outlet of which is located immediately at or at least partially enclosing the duct in question in such a way that the centre of gravity of the outlet cross-section of the air duct is displaced in relation to the centre of gravity of the outlet cross-section of the duct in question. In this embodiment according to the invention, the change in the flow direction of the fuel is effected according to a method which involves that the cross-section of the outlet, or in other words the flow-through area of the air duct outlet is not uniformly distributed across the outlet of the fuel duct in question, entailing also that the quantity of air flowing through the air duct outlet is not uniformly distributed across the circumference of the fuel duct outlet in question. Since the greatest movement quantity of the air will occur in the area or areas of the air duct outlet where the highest air passage rates occur, the airflow in this area or these areas will physically impact the fuel so that this flow direction is changed in direction toward this area or these areas. This second embodiment of the invention may be combined with the aforementioned first embodiment.

In a third embodiment of the invention the fuel is also introduced in parallel to the main axis of the burner. In this third embodiment of the invention the means for changing the flow direction of the fuel which is introduced via at least one of the additional ducts in the central part of the burner comprises a separate air duct, the outlet of which is located immediately at or at least partially enclosing the duct in question, and forming an angle relative to the main axis of the burner. In this embodiment the flow direction of the fuel is changed according to a method whereby the air being injected via the separate air duct forces the fuel in a different direction determined as a function of the angle formed by the air duct in relation to the main axis of the burner. It is preferred that the air duct is fitted so that it points upward relative to the main axis of the burner at an angle of between 8° and 80°, preferentially between 35° and 60°. In this embodiment the direction and velocity of injection will be changed by varying the airflow rate. This third embodiment of the invention may be combined with one or both of the embodiments described above.

The duct 4a, 4 may be configured with an outlet cross-section which forms an angle which is different from 90° relative to the centreline through the duct. Such a configuration can be used to effect a change in the direction of the fuel stream exclusively or in combination with the above-mentioned embodiments.

The invention will now be described in further details with reference to the drawing, being diagrammatical, and where

Fig. 1 shows a first embodiment of the burner according to the invention,

Fig. 2 shows a second embodiment of the burner according to the invention, and

Fig. 3 shows a third embodiment of the burner according to the invention.

The Figs. 1-3 show front views as well as sectional views of three different embodiments of the burner according to the invention, and they all comprise two substantially concentric ducts 1 and 2 for conveying primary air which are parallel to the main axis B_a, and a herewith concentric duct 3 for pneumatic conveyance of coal dust and a central part 10 which comprises a duct 4 for conveying solid alternative fuel, and a number of additional ducts or pipes 6, 7 and 8 for ignition gas burner, oil burner and gas burner, respectively. The burners shown in Figs. 2 and 3 also comprise an air duct 5 which encloses the duct 4.

According to the first embodiment of the invention which is shown in Fig. 1 the burner comprises an introduction duct 4a which is fitted in extension of the duct 4 for conveying solid alternative fuel. The introduction duct 4a is arranged so that it points upward relative to the main axis of the burner at an angle α of approximately 8° relative to its centreline. As previously mentioned, the injection velocity of the fuel can be varied by changing the cross-sectional area of the introduction duct 4a or by varying the airflow rate which is injected simultaneously with the fuel.

According to the second embodiment of the invention which is shown in Fig. 2, the burner comprises, as mentioned, an air duct 5, the outlet of which is located so that it encloses the duct 4 for conveying solid alternative fuel. In this embodiment, the air duct 5 is arranged so that the centre of gravity of the outlet cross-section of the air duct 5 is displaced upwards relative to the centre of gravity of the outlet cross-section of the duct 4. Hence the largest quantity of air will flow through the upper part of the air duct 5, thereby impacting the fuel stream in upward direction, hence changing the flow of direction of the fuel in the upward direction. This is due to the fact that the movement quantity of the air in the shown embodiment will be greatest in the upper area of the outlet of the air duct 5. As mentioned in the introduction, this second embodiment of the invention may be combined with the first embodiment described above, although this is not shown in the drawing.

According to the third embodiment of the invention, which is shown in Fig. 3, the burner comprises, as mentioned, an air duct 5 the outlet of which is located so that it encloses the duct 4 for conveying solid alternative fuel. In the shown embodiment the air duct 5 is arranged so that it points upwards, forming an angle β of approximately 65° relative to the main axis of the burner. This will cause the flow direction of the fuel to be changed in the upward direction due to the fact that the airflow being injected via the air duct 5 will force the fuel in the upward direction. As previously mentioned, the direction and velocity of injection can be changed by varying the airflow rate. This third embodiment of the invention may as previously mentioned be combined with one or both of the aforementioned embodiments.

CLAIMS

1. A burner for introducing solid, liquid or gaseous fuel to a burning zone of a kiln, said burner comprising:

a number of substantially concentric ducts, which ducts are parallel to a main axis of the burner, for conveying fuel and primary air to nozzle openings; and

a number of additional ducts for conveying solid, fluid or gaseous fuel to separate nozzle openings, said additional ducts being located in a central part of the burner and at least one of the additional ducts being angled in relation to a plane passing through the main axis to convey a solid fuel in a direction toward a point located in a radially outward direction away from the main axis, the point being along an outermost peripheral edge of the concentric ducts and the additional duct being connected to a source of solid fuel so that all of the solid fuel flowing through the additional duct during use flows in the direction towards the point.

2. A burner according to claim 1, wherein at least one of the additional ducts comprises an introduction duct which is located at an outlet of the at least one additional duct in immediate extension thereof, with a centreline of the introduction duct forming an angle relative to the plane.

3. A burner according to claim 2, wherein the centreline of the introduction duct forms an angle between 1° and 25° relative to the plane.

4. A burner according to claim 2, wherein the centreline of the introduction duct forms an angle between 7° and 10° relative to the plane.

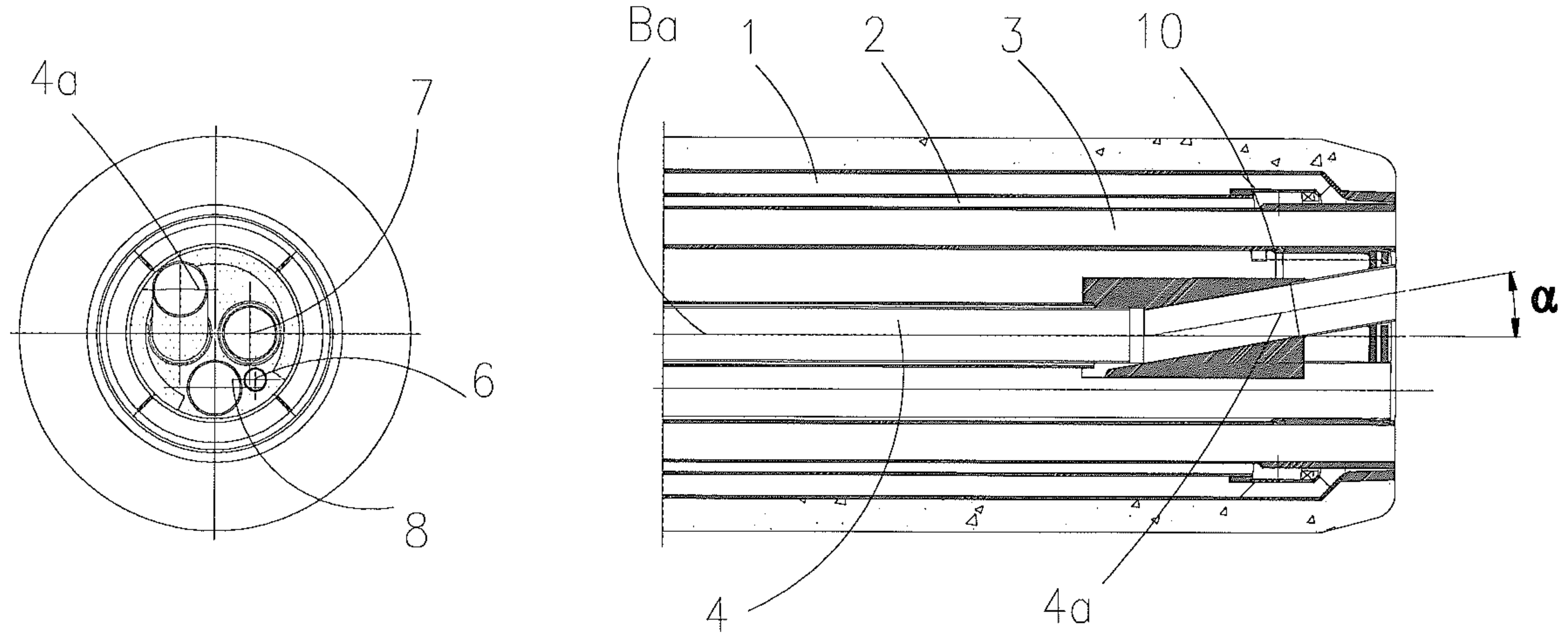


Fig. 1

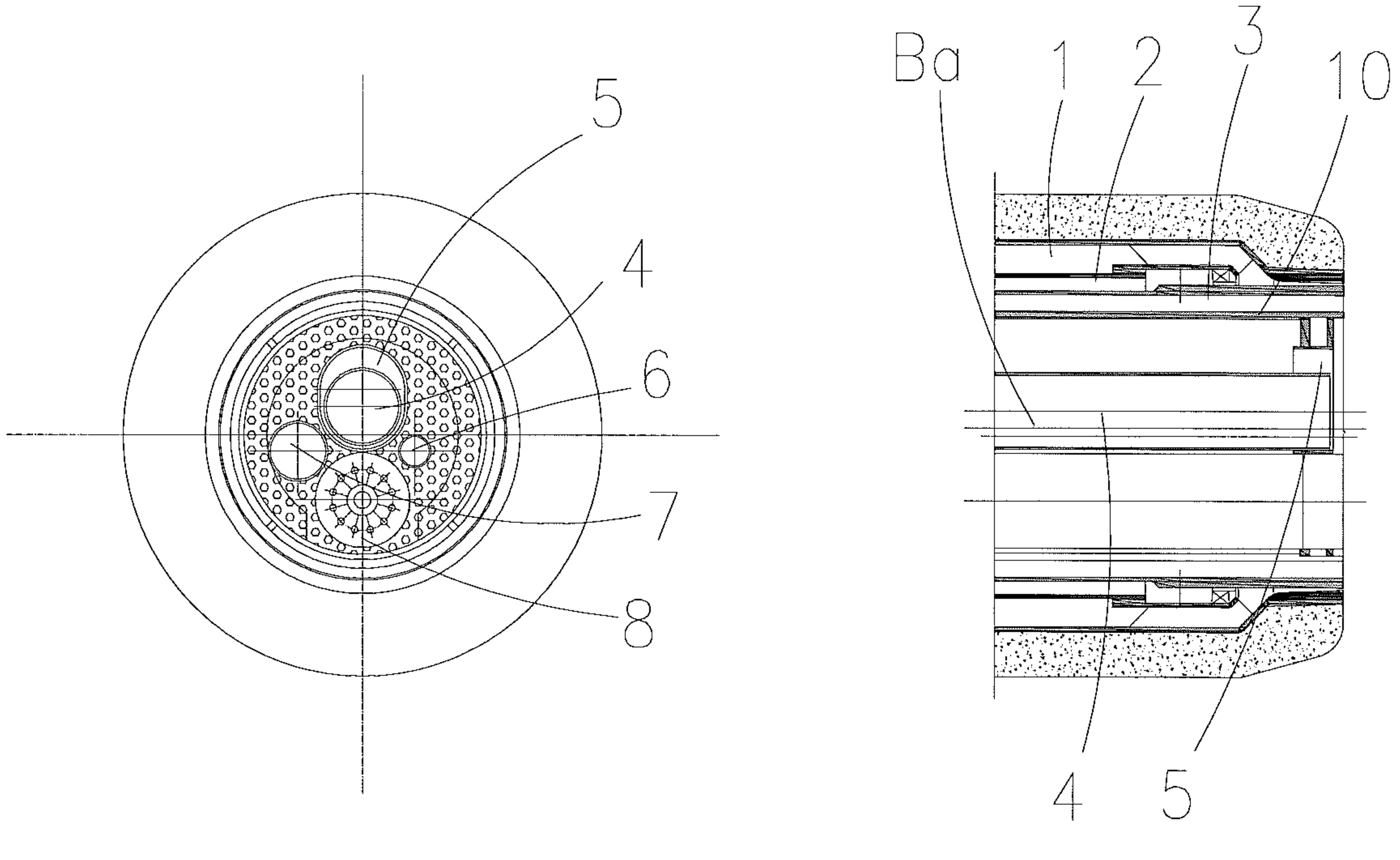


Fig. 2

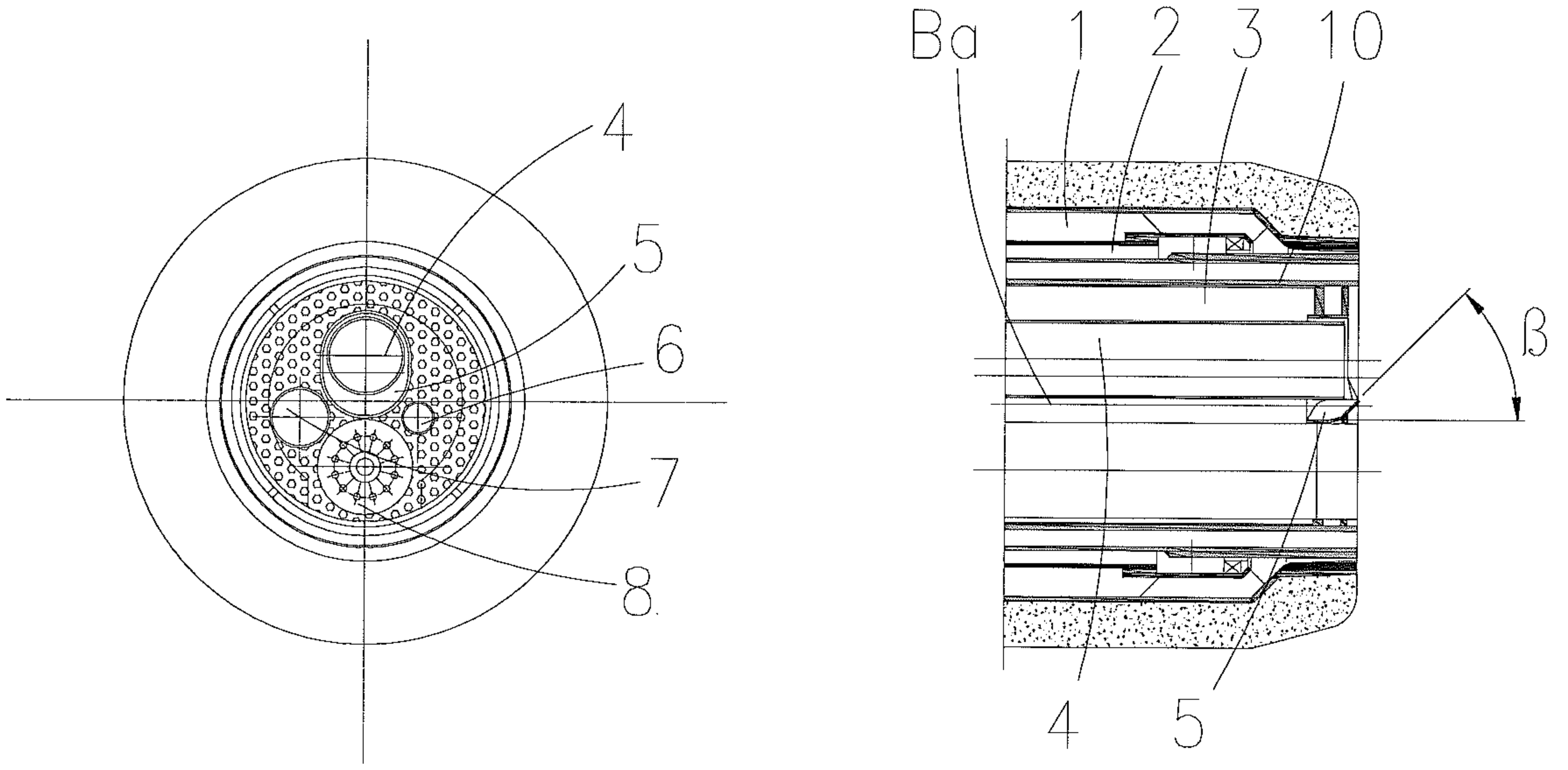
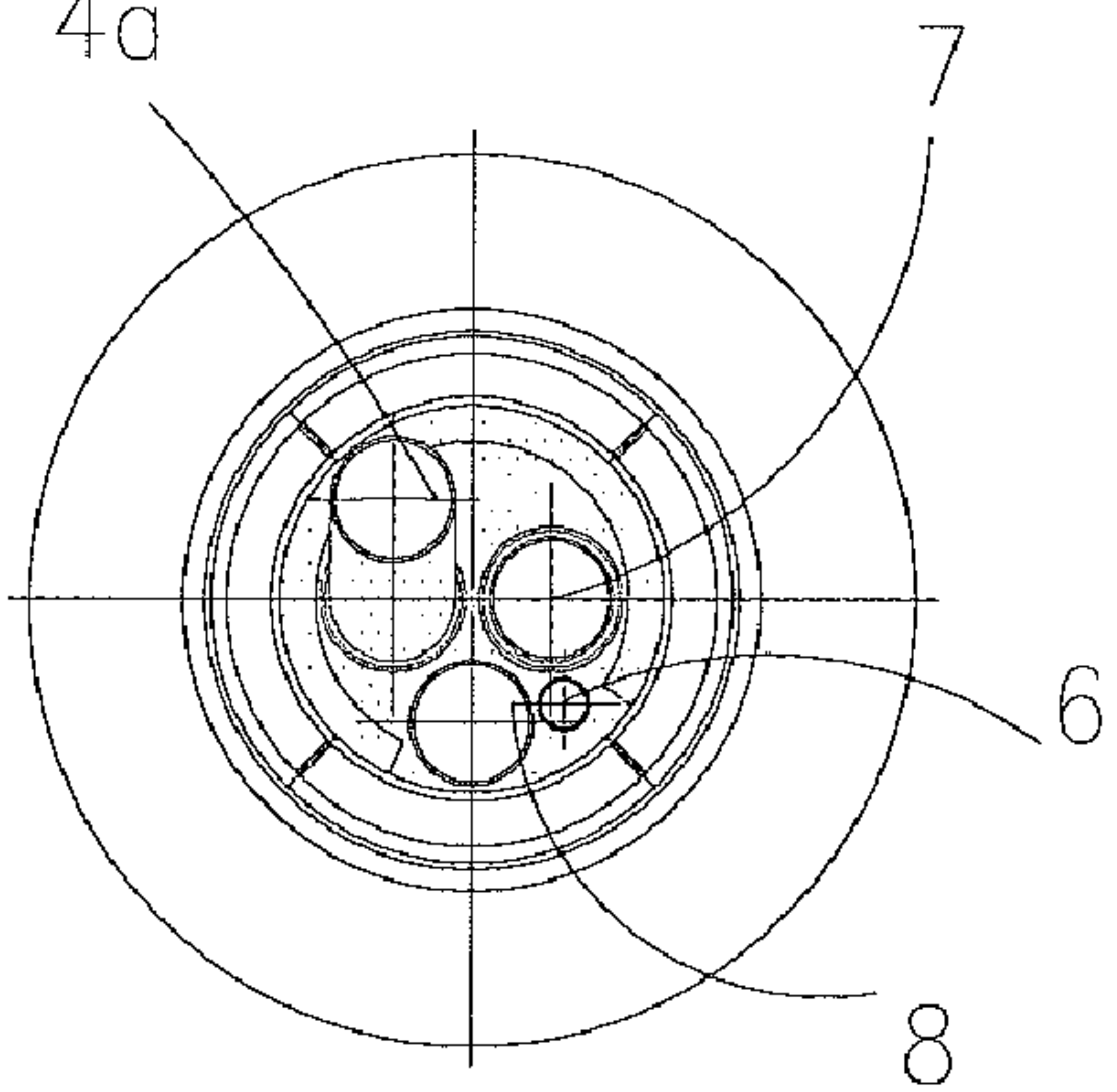


Fig. 3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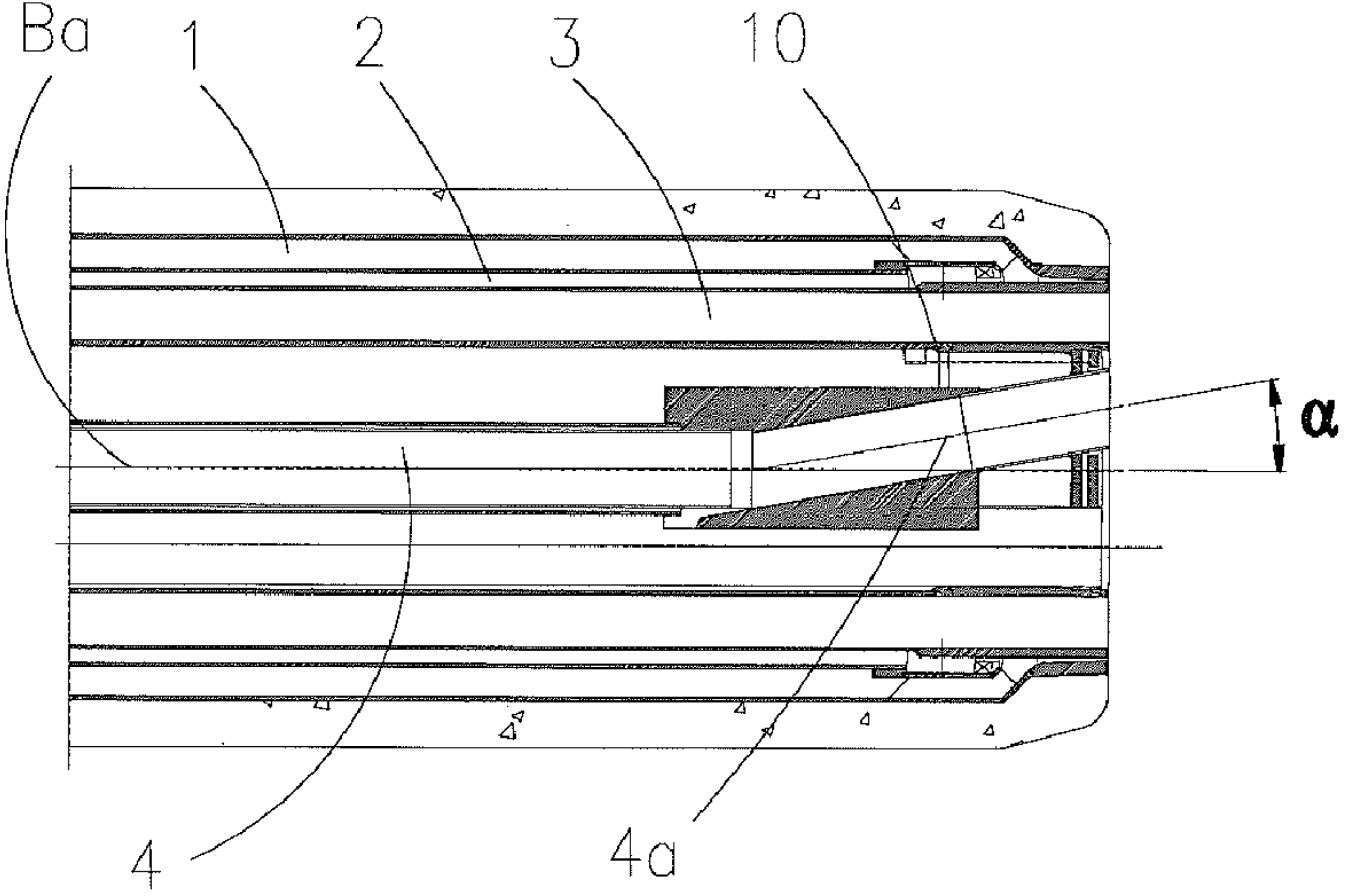
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