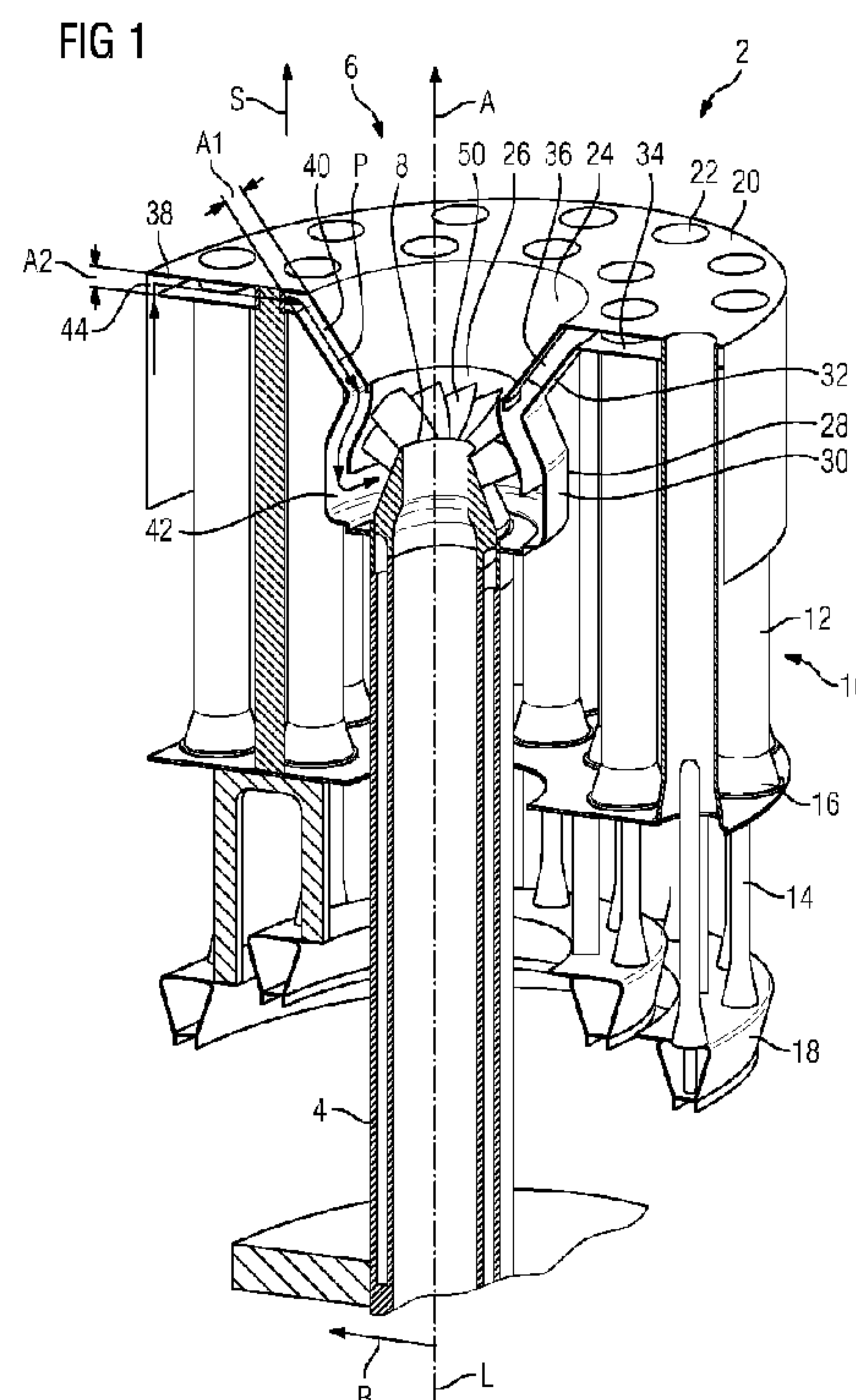




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(54) Title: BURNER FOR A COMBUSTION MACHINE, AND COMBUSTION MACHINE



(57) **Abrégé/Abstract:**

The invention relates to a burner (2) for a combustion machine, having a pilot burner (4), which extends in the axial direction (A), having a nozzle chamber (10), having a burner region (6) and having a cover plate (20) which is arranged between the nozzle chamber (10) and the burner region (6) and which has an inlet opening (26), wherein an adapter (28) is arranged, in order to guide air out of the nozzle chamber (10) along a specified flow path (P) in the direction of the combustion region (6), wherein a flow channel (36) is formed as part of the flow path (P) between the adapter (28) and the cover plate (20) and the adapter (28) has a radially extending, annular section (34) which, together with the cover plate (20), forms a radial section (38) of the flow channel (36), in order to cool the cover plate (20) by means of the air. The invention further relates to a combustion machine having such a burner (2).



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Abstract

The invention relates to a burner (2) for a combustion machine, having a pilot burner (4), which extends in the axial direction (A), having a nozzle chamber (10), having a burner region (6) and having a cover plate (20) which is arranged between the nozzle chamber (10) and the burner region (6) and which has an inlet opening (26), wherein an adapter (28) is arranged, in order to guide air out of the nozzle chamber (10) along a specified flow path (P) in the direction of the combustion region (6), wherein a flow channel (36) is formed as part of the flow path (P) between the adapter (28) and the cover plate (20) and the adapter (28) has a radially extending, annular section (34) which, together with the cover plate (20), forms a radial section (38) of the flow channel (36), in order to cool the cover plate (20) by means of the air. The invention further relates to a combustion machine having such a burner (2).

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Description

Burner for a combustion machine, and combustion machine

The invention relates to a burner for a combustion machine, and also to a combustion machine.

The combustion machine is especially a gas turbine in the megawatt power range, preferably for a power plant for power generation with an output of several hundred megawatts. The combustion machine in this case typically comprises a plurality of burners, for example in an annular arrangement, and a compressor which is connected upstream of the burners and also a turbine which is connected downstream to the burners. Here, each of the burners comprises a combustion region which is arranged in the interior of a combustion chamber of the combustion machine. In this case, each of the combustion regions is a part of a combustion space which in the main corresponds to the interior of the combustion chamber. This combustion chamber is for example of annular design, that is to say designed as an annular combustion chamber, along which are arranged the burners. A suitable fuel/air mixture is first of all injected into the combustion chamber and then combusted. The fuel in this case is natural gas, for example.

In this case, it is known to operate the combustion machine using a number of so-called premixed jet flames. For this, provision is typically made for a plurality of nozzles which extend parallel to each other and in which the fuel/air mixture is formed in each case before this is injected into the combustion chamber, that is to say especially into the combustion region. The nozzles here are frequently arranged in a ring-like manner, sometimes along a plurality of concentric rings. The nozzles have in each case an outlet which opens into

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the combustion chamber. In addition, the nozzles are connected close to the nozzle outlets to a nozzle carrier which at the same time constitutes the upstream disposed end of the combustion chamber and especially separates the combustion chamber from a nozzle chamber which lies on the other side of the nozzle carrier. The nozzle carrier therefore also serves as a cover plate.

As part of a generally intended power increase and an increase in the number of nozzles, which is especially related as a result, on the one hand a cost increase ensues, especially in the case of the auxiliary systems which are used for operating the combustion machine, for example cooling systems, and on the other hand an enlargement of the system results, especially of the nozzle carrier. In the case of the nozzle carrier, moreover, as a result of the typically solid design of this, the installation is made more difficult or, in the case of specific combustion machines, wholly prevented on account of their design. In addition to this, cooling of the nozzle carrier in its function as a cover plate is made increasingly difficult in the case of greater output.

It is therefore an object of the invention to specify a burner which on the one hand is more cost-effective to produce and on the other hand is simpler to install. Furthermore, a combustion machine having such a burner is to be specified.

The object is achieved according to the invention by means of a burner having the features of claim 1, and by means of a combustion machine having the features of claim 13. Advantageous embodiments, developments and variants are subject matter of the dependent claims. In this case, the developments and advantages which are referred to in relation to the burner correspondingly also apply to the combustion machine.

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The burner is designed for use in a combustion machine, especially in a gas turbine in the megawatt power range, and comprises a pilot burner, which extends in the axial direction, a nozzle chamber and a combustion region. Furthermore, the burner comprises a cover plate which is arranged between the nozzle chamber and the combustion region and has an inlet opening. Additionally arranged is an adapter for guiding air from the nozzle chamber along a predetermined flow path in the direction of the combustion region.

The advantages which are achieved using the invention especially lie in the fact that a design of the burner in a lightweight construction is enabled since as a result of the adapter a solid nozzle carrier is dispensed with, as a result of which the burner is to be produced cost-effectively, moreover. In addition to this, the burner is especially simple to install, in particular it is advantageously possible to install the components of the burner through the combustion chamber of the combustion machine. A further advantage is especially that by means of the adapter at least some of the air can be fed back to the pilot burner as combustion air in a particularly efficient manner. Moreover, the cover plate advantageously prevents smoke and/or exhaust gases from the combustion region reaching the nozzle chamber. This is especially also achieved by means of the air which flows along the flow path into the combustion region. In other words, although a fluidic connection exists between nozzle chamber and combustion region, penetration of exhaust gases into the nozzle chamber is especially prevented by air flowing from the nozzle chamber into the combustion region.

The combustion machine has a general flow direction which points from the compressor in the direction of the burner in

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the direction of the turbine. The terms upstream and downstream which are used below are especially to be understood in relation to this general flow direction.

The pilot burner extends along a longitudinal axis and is especially arranged centrally in the burner. The pilot burner serves for feed of a fuel, especially oil, into the combustion region. Arranged around the pilot burner are a number of nozzles which in each case extend parallel to the longitudinal axis, that is to say also in the axial direction. The nozzles are arranged in the nozzle chamber and have in each case an outlet downstream which corresponds to a recess which is introduced in each case into the cover plate. In other words, the nozzles open out into the combustion region in each case. The nozzles are especially arranged on a number of rings, the middle point of which lies on the longitudinal axis in each case. Each ring of nozzles is also referred to as a stage. In the case of a plurality of stages, the rings are preferably arranged concentrically.

Upstream, the nozzles are especially designed for receiving air from the nozzle chamber, that is to say have a suitable nozzle inlet into which a burner lance especially also projects in each case for the feed of fuel. The air which is made available in the nozzle chamber is especially compressed air which is directed into the nozzle chamber from a compressor of the combustion machine which is connected upstream to the burner. The nozzle chamber therefore especially serves as a reservoir for compressed air.

The nozzle chamber is fluidically connected to the combustion region, as a result of which a supply of the pilot burner with air as combustion air is enabled. The adapter serves in this case especially for the suitable guiding of air, that is to say

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especially for guiding an air flow along a suitable flow path. The air in this case has a flow direction which is generally oriented from the nozzle chamber in the direction of the combustion region. In this case, the flow direction does not generally correspond to the axial direction but can alter along the flow path. To this end, the adapter enables a deflection of the air in a particularly suitable manner.

According to the invention, a flow passage is formed between the adapter and the cover plate, as a result of which a suitable flow path is realized in a particularly simple manner. The flow passage is therefore bounded by the adapter and the cover plate, that is to say the adapter and the cover plate form in each case a boundary of the flow passage. In this case, the flow passage is especially a flow space which extends around the inlet opening in such a way that the air at a predetermined position in the flow space flows in each case basically in the direction of the inlet opening.

For cooling the cover plate by means of the air, the adapter has a radially extending annular section which with the cover plate forms a radial section of the flow passage. The radial section of the flow passage is also referred to as radial section. By means of this, a particularly effective cooling of the cover plate is especially enabled. The annular section of the adapter and the cover plate especially include an annular flow space through which the air flows basically in the radial direction and in the direction of the diagonal section. In this case, the nozzles which extend in the axial direction in the flow passage especially form a break in each case. In other words, the nozzles have an end section in each case which is arranged in the flow space, that is to say in the radial section, and consequently is advantageously exposed to a circumflow of air which flows from there. As a result, it is

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especially possible to also cool the nozzle ends, that is to say the end sections of the nozzles, by means of the air, in addition to the cover plate.

The adapter is especially formed in the style of a bell, wherein the head region forms an upper bell part and the diagonal section forms a lower part of the bell to which in turn is connected the radial section. In this case, the three sections are formed either in one piece or the radial section and the bell are separate interconnected parts. The air which flows out of the nozzle chamber is then drawn in via the outer edge of the radial section and flows along the nozzle chamber-side wall of the cover plate into the lower part of the bell. In the process, the cover plate is cooled by means of the air. In the lower part of the bell, the air flows along an axial cone and especially also cools this. The flow direction on the diagonal section is in this case in the main opposite to the general flow direction in the combustion machine. The air then flows into the head region and is deflected there in such a way that the flow direction of the air corresponds in the main to the general flow direction. The air is guided in this case along the downstream disposed end of the pilot burner and is finally made available in the combustion region as combustion air for the pilot burner. The air therefore flows generally from the outside inward along the inner wall of the adapter.

Especially for improved feed of the air as combustion air for the pilot burner the adapter, in a preferred embodiment, has a head region into which the pilot burner projects. In other words, the head region encompasses the downstream disposed end of the pilot burner and especially also the outlet opening. As a result, during operation a particularly advantageous deflection of the air and a subsequent mixing of this with fuel is achieved.

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For guiding the air, an annular passage is expediently formed between the pilot burner and the head region. As a result, the air is especially introduced in a particularly uniform manner. The pilot burner, or at least its end, especially has in this case a circular edge. By the same token, the inlet opening is also circular.

In order to especially improve the mixing of air by means of the fuel which is ejected out by means of the pilot burner, a part of the cover plate is designed as an axial cone, on the upstream disposed end of which is arranged the inlet opening. The axial cone is especially arranged in the center of the cover plate and widens out in the opposite direction to the pilot burner, that is to say downstream. The axial cone therefore especially forms a conical shell-like extension of the combustion chamber in the direction of the burner. The axial cone is especially also referred to here as an axial lattice cone and correspondingly serves for improving guiding or directing of the fuel/air mixture in the direction of the combustion chamber.

In an expedient development, the adapter has a diagonally extending section which extends at a distance from the axial cone and consequently forms a conical shell-like section of the flow passage. The conical shell-like section is also referred to as a diagonal section. As a result of this development, it is especially possible to advantageously use the air from the nozzle chamber for cooling the axial cone.

An axial swirler is preferably arranged between the inlet opening of the axial cone and the outlet opening of the pilot burner for improved mixing of air which is fed by means of the annular passage and fuel which is fed by means of the pilot

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burner. The axial swirler especially extends at least partially past the end of the pilot burner and into the annular passage. The axial swirler is expediently encompassed or enringed by a collar which is especially formed on the axial cone. In this case, the axial swirler is arranged inside the collar and the outer disposed side of the collar, in combination with the adapter, forms an advantageous extension of the diagonal section of the flow passage.

The flow passage is expediently designed as an annulus. As a result, the air can be altogether guided over a particularly large area and therefore can be used in a particularly efficient manner for cooling the cover plate. Especially understood in this case by annulus is that the flow passage is a space which is enclosed by suitable sidewalls and which in at least one direction transversely to the flow direction has an extension which is comparable with the length of the flow passage in the flow direction of the air. In comparison to for example flow passages which are introduced into a solid part by means of holes, the flow passage which is designed as an annulus can be produced in a particularly material-saving manner and, moreover, is lighter with regard to its weight. In the case of the annulus, the contact surface between air and elements to be cooled, here especially the cover plate, is furthermore advantageously enlarged.

For the inflow of air into the flow passage, this preferably has an air inlet which lies on the outside in the radial direction. As a result, an air flow from the outside inward is especially formed and cools a particularly large part of the cover plate by means of the air which flows past it. The air inlet is especially annular and is then referred to as an annular inlet. This has a radius which is especially larger than the radial distances of the nozzles to the longitudinal

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axis of the burner. The air is therefore also drawn in from an outer region of the nozzle chamber with regard to the nozzles. As a result of the outer position of the air inlet, a particularly larger flow cross section can be achieved, moreover. Therefore, a corresponding quantity of air for cooling and then for introduction into the combustion region is made available.

In an advantageous development, an annular gap, into which a sealing ring is inserted, is formed in the radial direction between the pilot burner and the adapter. This especially serves for avoiding or at least reducing an inflow of air from the nozzle chamber through the gap, that is to say past the pilot burner into the head interior which is enclosed by the head region of the adapter.

In a preferred embodiment, the sealing ring is fastened on one of the two parts, specifically on the pilot burner or on the adapter, and is displaceable relative to the other of these two parts. The sealing ring is consequently either fastened on the pilot burner and displaceable relative to the adapter or is fastened on the adapter and is displaceable relative to the pilot burner. On account of the customarily existing thermal load of the various parts of the burner during operation, a thermal expansion occurs and is possibly also of different magnitude for different parts or is oriented in different directions. The displaceability of the sealing ring then especially enables avoidance of clamping of the pilot burner against the adapter and damage which possibly results therefrom.

In order to especially improve the sealing effect, in addition to the displaceability which is described above, the sealing ring has at least one bridge which extends in the axial

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direction and encompasses the sealing ring, wherein the bridge forms a sealing face which is seated on the adapter. The sealing ring especially therefore has an approximately H-shaped cross section and consequently can be produced in a particularly material-saving manner, with suitable sealing effect at the same time.

The problem with the thermal expansion which is described above especially also applies to the adapter and to the cover plate. In order to avoid jamming or displacement of these two in relation to each other and deformation of the flow passage which possibly results from this, the adapter has at least one spacer which is seated on the cover plate. The spacer is preferably attached on the diagonally extending section of the adapter and butts against the axial cone, as a result of which a suitable spacing in the radial and in the axial directions especially ensues at the same time. In addition, as a result of the spacer the installation of the burner is simplified to the effect that during assembly a suitable spacing and alignment, especially centering of the cover plate, the adapter and the pilot burner, automatically ensues.

In an expedient embodiment, the spacer is designed as a deformation of the adapter. As a result, a suitable spacer can be produced in a particularly simple manner. The spacer is especially designed as a dimple, knob or cam and constitutes a protrusion or recess along the surface of the adapter. Provision is expediently made for a plurality of spacers, especially for improving spacing during installation and for improved centering with regard to the longitudinal axis of the burner.

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In the case of a plurality of spacers, these are distributed especially uniformly in the circumferential direction of the adapter.

The adapter and the cover plate are preferably produced from metal sheets in each case, that is to say with lower material thickness, as a result of which the burner can be produced in an advantageous lightweight construction. The material thickness in this case is especially about 1 - 4mm in the case of both the adapter and the cover plate.

Exemplary embodiments of the invention are explained in more detail below with reference to a drawing. In the drawing:

FIG 1 shows a burner in a longitudinal sectional view, having a nozzle chamber and having an adapter,

FIG 2 shows a detail of the nozzle chamber according to FIG 1 and an alternative adapter,

FIG 3 shows a detail of the arrangement according to FIG 1,

FIG 4 shows a detail of the arrangement according to FIG 1 with an alternative sealing ring, and

FIG 5 shows the adapter according to FIG 2 in a perspective view.

Shown schematically in FIG 1 is a burner 2 in a sectional view along a longitudinal axis L of the burner 2. Extending along the longitudinal axis L, that is to say in the axial direction A, is a pilot burner 4 for delivering fuel into a combustion region 6 which is arranged downstream of the pilot burner 4. The fuel is injected via an outlet opening 8 of the pilot

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burner 4 into the combustion region 6. The combustion region 6 corresponds in this case to the interior of a combustion chamber, not shown in more detail here, which is connected downstream to the burner 2.

Arranged around the pilot burner 4 in a nozzle chamber 10 are a number of nozzles 12 which also extend in each case in the axial direction A and extend parallel to each other. The nozzles 12 serve for providing a fuel/air mixture in the combustion region 6. To this end, for each nozzle 12 a fuel lance 14 is arranged in each case in such a way that this projects at least partially on the rear side, that is to say on the upstream disposed nozzle end 16, into the nozzle 12. Consequently, an annular nozzle inlet is especially formed in each case, by means of which air can flow from, or be drawn out of, the nozzle chamber 10 into the nozzle 12 in order to be mixed there with the fuel which is ejected out of the respective burner lance 14. The air which is present in the nozzle chamber 10 is in this case especially provided by a compressor, not shown here, which is connected upstream to the burner 2, and therefore the air is compressed air. The fuel is provided upstream of the fuel lances 14 via a number of annular fuel passages 18, in this case two. The nozzles 12 are correspondingly arranged along a number of rings, in this case two, and form in FIG 1 an inner and an outer stage.

The nozzle chamber 10 is separated from the combustion region 6, that is to say from the combustion chamber, by means of a cover plate 20. This extends in the main in the radial direction R and has a number of recesses which are associated in each case with an outlet 22 of a nozzle 12 for admitting the fuel/air mixture, which is formed in the nozzles 12, into the combustion region 6. In the region of the longitudinal axis L, the cover plate 20 has an axial cone 24 which is widened out in

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the flow direction S. On the upstream disposed end, the axial cone 24 has an inlet opening 26 which in the exemplary embodiment which is shown here is arranged downstream of the outlet opening 8 of the pilot burner 4.

Arranged in the nozzle chamber 10 is an adapter 28 which has a head region 30, which encompasses the end of the pilot burner 4, and a diagonal section 32 which extends and widens out downstream of this head region.

In this case, the adapter 28 is formed in the style of a bell, wherein the head region 30 is an upper part of the bell and the diagonal section 32 is a truncated cone-like lower part. A radial section 34 extends from the downstream disposed end of the diagonal section 32 in the radial direction R. The diagonal and the radial sections 32, 34 are in this case each arranged at a suitable distance A1, A2, for example about 2 - 5mm, with regard to the axial cone 24 or to the cover plate 20 respectively. In FIG 1, the adapter 28 is constructed in one piece, but alternatively a multi-piece construction is possible, as shown in FIG 2.

The cover plate 20 and the adapter 28 form an intermediate space, which serves as a flow passage 36, in order to admit air from the nozzle chamber 10 into the combustion region 6 and to cool the cover plate 20 in the process. The flow passage 36 comprises a plurality of sections 38, 40, 42 for this, specifically a radial section 38 along the cover plate 20, also referred to as a radial section 38, a diagonal section 40 along the axial cone 24, also referred to as a diagonal section 40, and an annular passage 42 in the head region 30 between the adapter 28 and the pilot burner 4. A ring-form inlet, which is also referred to as an annular inlet, serves as an air inlet 44. This annular inlet encompasses the radial section 34 of

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the adapter 28, as FIG 2 shows particularly clearly. Moreover, a number of positioning flanges 46 are formed there on the radial section 34 of the adapter 28 in order to achieve suitable positioning. Moreover, it can be seen from FIG 2 in combination with FIG 1 that the nozzles 12 project in each case by their nozzle ends 16 into the radial section 38 and in this way form cylindrical recesses 48 in said radial section 38.

In FIG 1, the flow path P of the air is illustrated by a number of arrows. The air is first of all admitted via the air inlet 44 into the flow passage 36 and then follows the radial section 38 from the outside inward as far as the diagonal section 40. On this, a deflection along the axial cone 24 into the interior of the head region 30 takes place. There, the air is deflected again in the direction of the inlet opening 26. Additionally arranged between inlet and outlet openings 26, 8, in the exemplary embodiment shown here, is an axial swirler 50 into which the air is directed before mixing with the fuel from the pilot burner 4. The axial swirler 50 is in this case encompassed by a collar 52 which is attached on the axial cone 24 as an extension.

As FIG 1 and FIG 3 show in an enlargement, a gap 54, into which a sealing ring 56 is inserted, is formed between the pilot burner 4 and the upstream disposed end of the adapter 28. This sealing ring, in the exemplary embodiment shown here, is fastened on the pilot burner 4 and is displaceable relative to the adapter 28. Shown in FIG 4 is a variant of the sealing ring 56 with an axially extending bridge 58 which extends round this radially on the outside and forms a sealing face 60 on the outside which butts against a mating face 62 of the adapter 28.

FIG 4 furthermore shows that the adapter 28 has a number of spacers 64 in order to suitably space the adapter 28 away from

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the cover plate 20 and during installation of the burner 2 to achieve a suitable alignment of the cover plate 20, the adapter 28 and the pilot burner 4 in relation to each other. The adapter 28 which is shown in FIG 4 is also shown in FIG 5 in a perspective view. Clearly visible are the spacers 64 which are formed as recesses with regard to the outer side of the adapter 28 and designed in each case in the style of a dimple, a knob or a cam. The spacers 64 project into the flow passage 36 and are seated on the cover plate 20. In the embodiment which is shown here, the spacers 64 are arranged on the diagonal section 32 of the adapter 28 and are seated on the axial cone 24 on the outer side.

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Patent claims

1. A burner (2) for a combustion machine, with a pilot burner (4) which extends in the axial direction (A), with a nozzle chamber (10), with a combustion region (6) and with a cover plate (20) which is arranged between the nozzle chamber (10) and the combustion region (6) and which has an inlet opening (26), and also nozzles (12) which are arranged around the pilot burner (4) in the nozzle chamber (10) and which extend in each case in the axial direction (A) and which have in each case a nozzle outlet (22) which corresponds in each case to a recess which is introduced into the cover plate (20), wherein an adapter (28) is arranged for guiding air from the nozzle chamber (10) along a predetermined flow path (P) in the direction of the combustion region (6), wherein between the adapter (28) and the cover plate (20) a flow passage (36) is formed as part of the flow path (P), and the adapter (28) has a radially extending annular section (34) which with the cover plate (20) forms a radial section (38) of the flow passage (36) for cooling the cover plate (20) by means of the air, characterized in that the nozzles (12) have in each case an end section which is arranged in the radial section (38).

2. The burner (2) as claimed in claim 1, characterized in that the adapter (28) has a head region (30) into which the pilot burner (4) projects.

3. The burner (2) as claimed in the preceding claim, characterized in that between the pilot burner (4) and the head region (30) an annular passage (42) is formed as part of the flow path (P).

4. The burner (2) as claimed in one of the preceding claims,

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characterized in that a part of the cover plate (20) is designed as an axial cone (24), on the upstream disposed end of which the inlet opening (26) is arranged.

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5. The burner (2) as claimed in the preceding claim, characterized in that the adapter (28) has a diagonally extending section (32) which extends at a distance from the axial cone (24) and consequently forms a conical shell-like diagonal section (40) of the flow passage (36).

6. The burner (2) as claimed in one of the preceding claims, characterized in that the flow passage (36) is designed as an annulus.

7. The burner (2) as claimed in one of the preceding claims, characterized in that the flow passage (36) has an air inlet (44) which lies on the outside in the radial direction (R).

8. The burner (2) as claimed in one of the preceding claims, characterized in that an annular gap (54), into which a sealing ring (56) is inserted, is formed in the radial direction (R) between the pilot burner (4) and the adapter (28).

9. The burner (2) as claimed in the preceding claim, characterized in that the sealing ring (56) is fastened on one of the two parts, specifically on the pilot burner (4) or on the adapter (28), and is displaceable relative to the other of these two parts.

10. The burner (2) as claimed in one of the two preceding claims, characterized in that the sealing ring (56) has at least one bridge (58) which extends in the axial direction (A) and encompasses the sealing ring (56), wherein the bridge (58) forms a sealing face (60) which is seated on the adapter (28).

11. The burner (2) as claimed in one of the preceding claims,

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characterized in that the adapter (28) has at least one spacer (64) which is seated on the cover plate (20).

12. The burner (2) as claimed in the preceding claim, characterized in that the spacer (64) is designed as a deformation of the adapter (28).

13. A combustion machine, especially a gas turbine, having a burner (2) as claimed in one of the preceding claims.

FIG 1

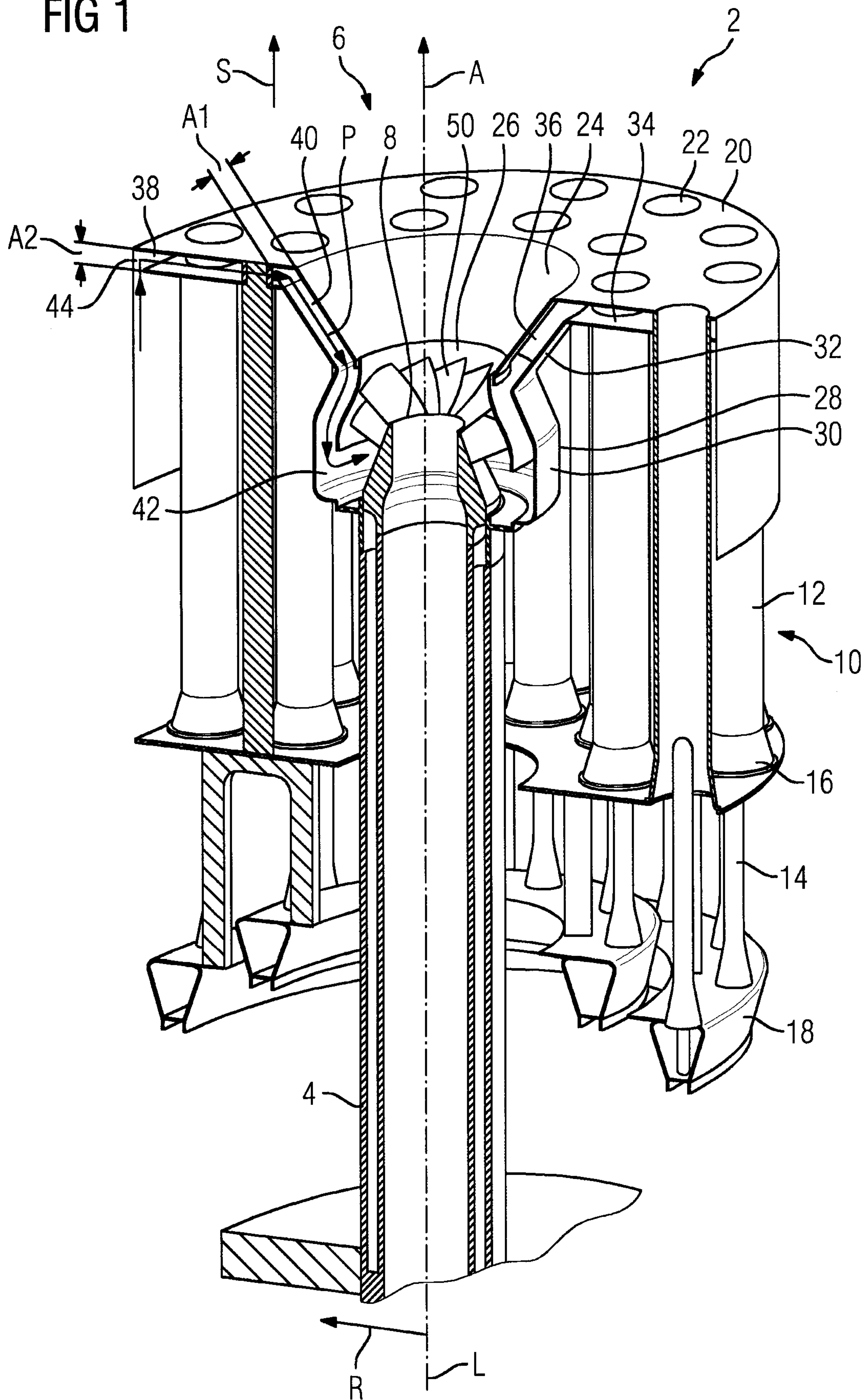


FIG 2

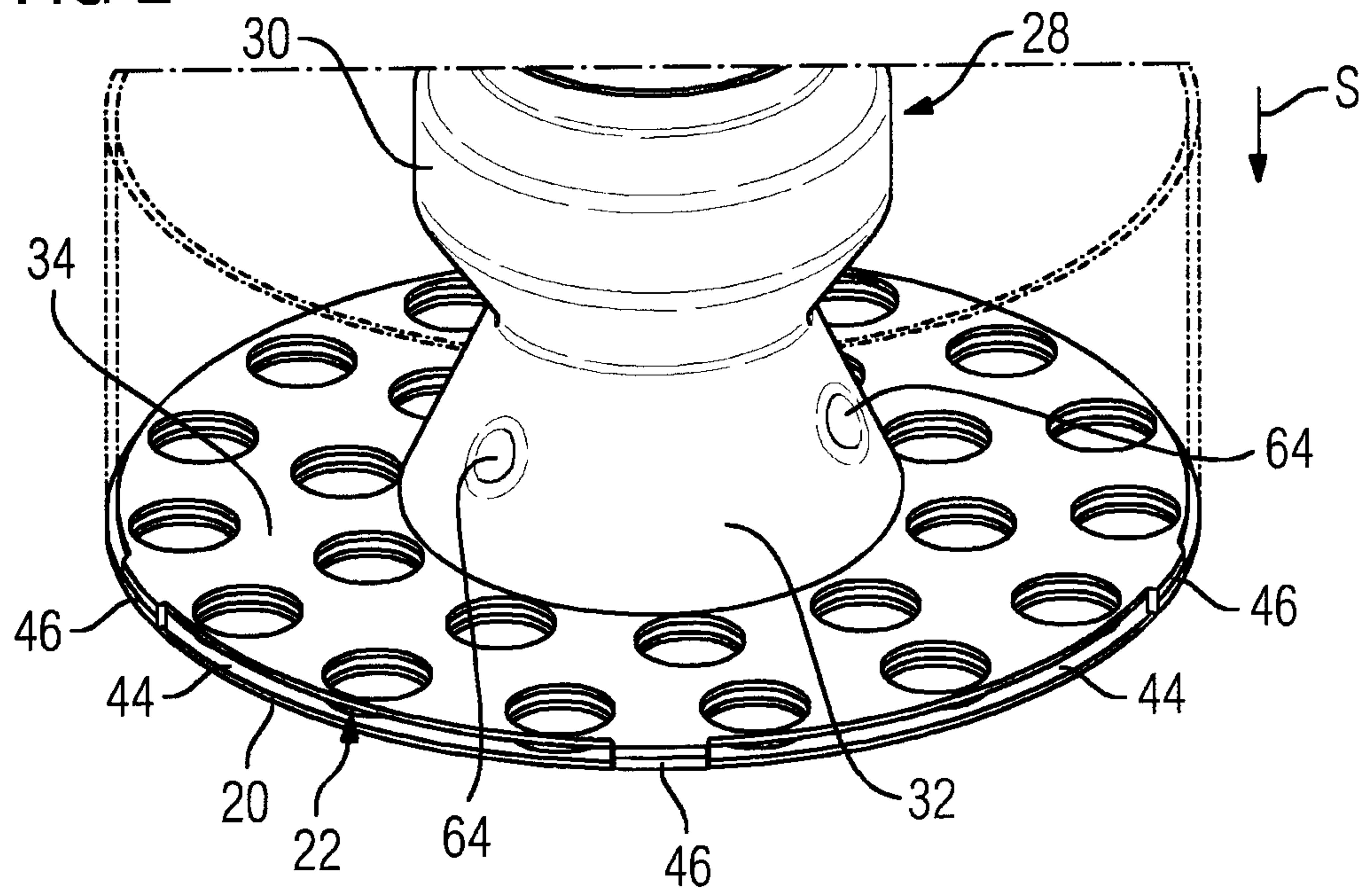


FIG 3

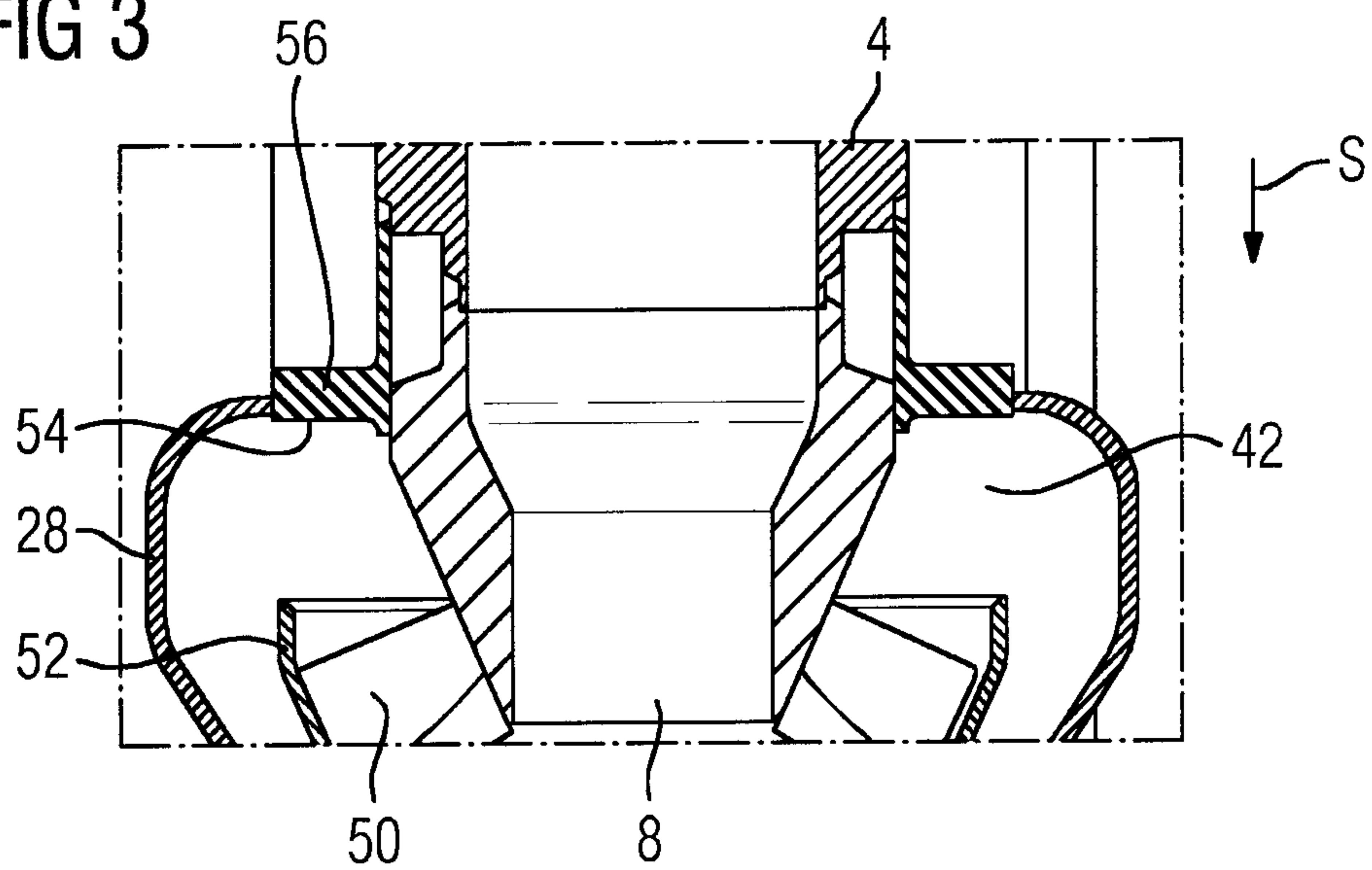


FIG 4

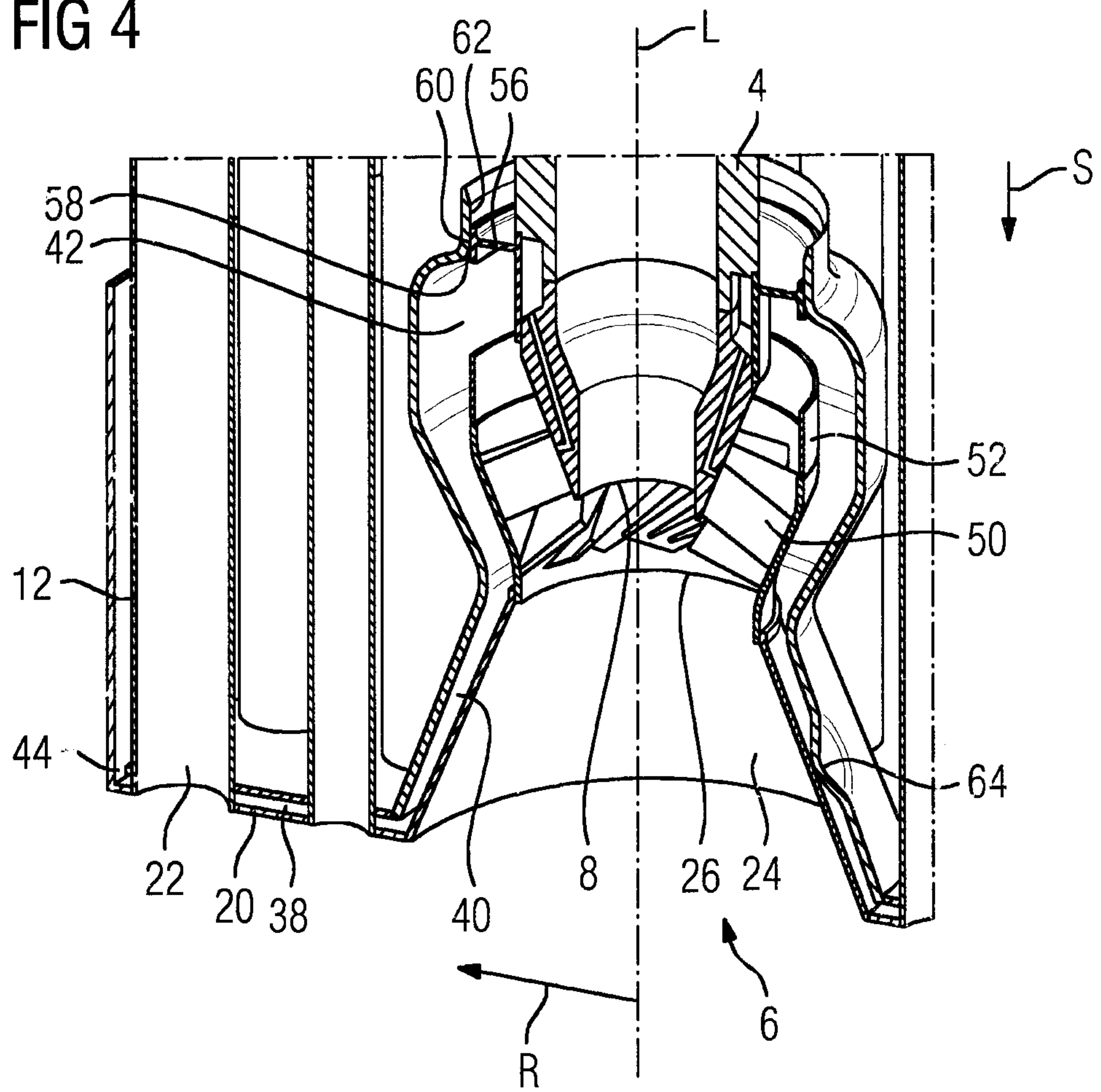


FIG 5

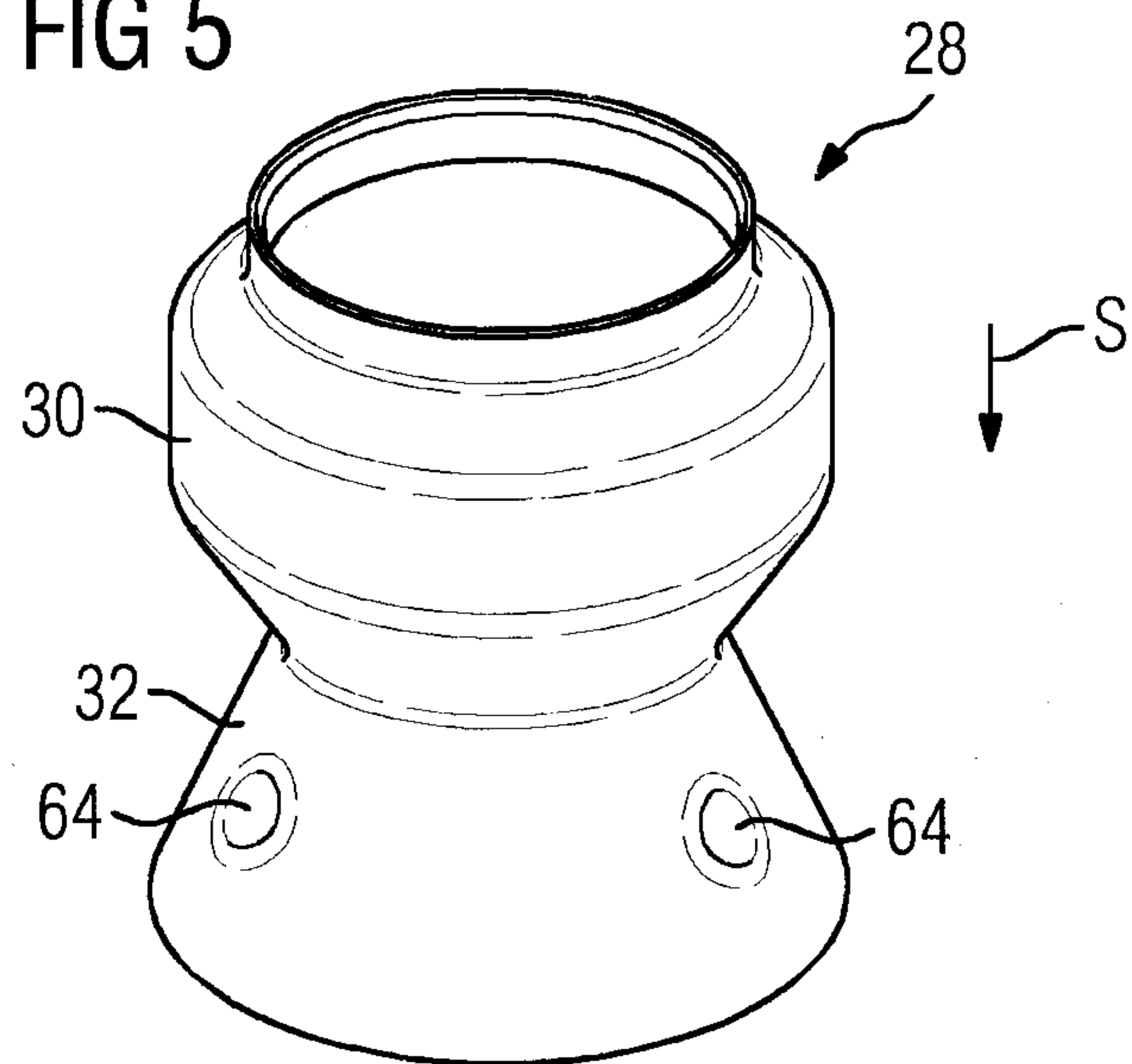


FIG 1

