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(54) **Combustion head for gas burners**

(57) A combustion head for gas burners comprising an outer tubular pipe (1) for conveying combustion air, an inner tubular pipe (2) with nozzles (5) for injecting

gaseous fuel, a disc (3) provided with means (6) for the passage of combustion air and a flame shaping device (4).

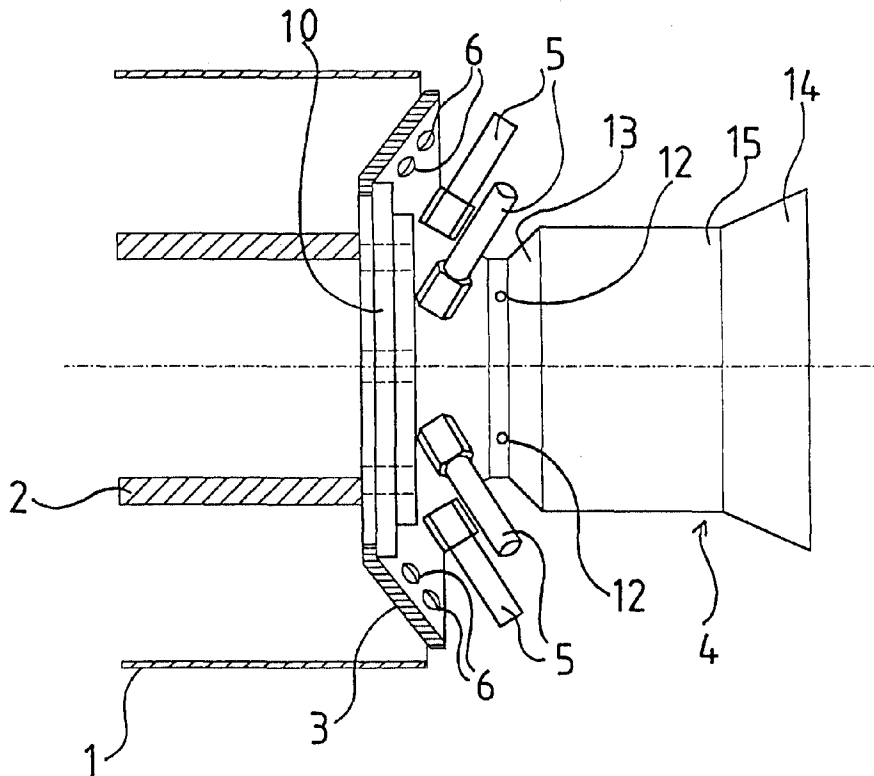


FIG. 1

Description

The present invention concerns a combustion head for burners, in particular boilers, stoves, ovens, dryers and similar fed with combustible gas.

It is well known that the front part of the burners consists of a combustion head that is introduced inside the combustion chamber, and the functions whereof are to optimize the mixture of combustible and burning air so as to obtain the best management of the flame in any point thereof, thus reducing the emission of polluting substances, in particular of nitrogen oxide, usually shown with NO_x.

The most restrictive European rules in force at present determine the maximum allowable NO_x level in the fumes in 82 mg/kWh, corresponding to 40 p.p.m.

The gas burners known until now face these limits by using combustion heads mainly comprising an outer tubular case; an inner tubular pipe for the gas feeding, fixed at the back of the burner's body, and ending up in the front part with a gas distributor; an air conveyor applied to a collar placed on said gas feeder; and an outer nozzle of tubular shape, which is a prolongation of said outer tubular case, ending up in the front part with an end in the shape of a converging truncated cone.

On the gas distributor, openings are provided for the emission of the combustible gas, or tubular nozzles for the emission of said gas are applied in sunburst. In some cases, said nozzles may be slightly frontwards inclined relating to the direction of emission of the burning air. Usually, also small holes are provided on the gas distributor, for the emission of the so-called root gas which prevents the detachment of the flame from the combustion head, assures the stability of the flame and favours the ignition of the burner.

The air conveyor usually has the shape of a cylinder, is open on the front side and is provided with holes (or openings) for the passage of the air, which are uniformly distributed onto its annular plane bottom fixed to the collar, also provided with holes, of the gas feeder. Said openings allow the burning air to pass in the area determined for the mixing with the combustible and for the ignition of the flame.

The outer tubular case leads the burning air blown by a fan provided on the burner, by means of its cylindrical body. The nozzle with its end part converging in the shape of a truncated cone, favours the forming and burning of the air-gas mixture and shapes the flame in the combustion chamber.

Said technical solutions as applied to the combustion heads known until now, do however not allow to remain below the further limits of NO_x emission provided with the rules that will be in force within short time and that reduce the actual limits to 70 mg/kWh;

It is the main aim of the present invention to gain the respect of the most restrictive emission limits without therefore increasing the value of other polluting substances (like e.g. carbon monoxide) in boilers with com-

bustion chambers with passing flame as well as in boilers with combustion chambers with flame reversal, i.e. with re-circulating of flame and fumes.

A further aim is the one of shaping the flame, so as to reduce the length thereof in use in boilers with combustion chambers with passing flame, or for increasing said length in use in boilers with combustion chambers with flame reversal, when it is requested that the flame has a greater penetration power.

The aims set forth are reached by means of the present invention as it is characterized in the enclosed claims, consisting of a combustion head for gas burners, comprising a tubular outer case for canalizing the burning air, an inner tubular pipe for feeding the combustible provided with nozzles for the emission of the same, characterized in that it comprises a disc air conveyor provided with means for the passage of the burning air, and a shaped flame conveyor.

The edge of the disc air conveyor is placed near the end part of the outer tubular case, for obtaining a better post-mixture of the gas and the burning air, and the outlet opening of the nozzles is provided on the combustion front of the head with respect to said air conveyor, so that the plane passing through the outlet opening of each nozzle meets that plane with the greatest circumference of said air conveyor disc, at a distance from the axis of the combustion head which is not less than the radius of said circumference.

For obtaining a substantial reduction of the flame's length, which is advantageous in boilers with combustion chambers with passing flame, the disc air conveyor has the shape of a diverging truncated cone, and the shaped flame conveyor stretches far beyond the section of the nozzle's mouth, also having a diverging shape.

On the other hand, for obtaining a greater length of the flame, which may be advantageous in boilers with combustion chambers with flame inversion, the disc air conveyor is plane and has the shape of circular crown, and the flame conveyor stretches little beyond the section of the nozzle's mouth, with a mainly cylindrical shape.

The flame conveyor is connected with a coaxial piping internal to the gas piping for favouring the cooling down of the same; in said piping, air from the burner's fan flows and it comprises at least one outlet hole for said air.

The advantages obtained by means of the present invention mainly consist in that the emission levels of the NO_x compounds are comprised between 15 and 20 p.p.m.; in that extremely low levels of carbon monoxide are maintained, i.e. equal to those obtained by means of the actually known combustion heads; in that an optimal ignition of the flame is obtained even in conditions of strong air excess, and a good stability of said flame; in that the flame may be shaped in such a way as to reduce or increase the length thereof, so as to improve the combustion efficiency in boilers with combustion chambers of small dimensions with passing flame as well as in combustion chambers with flame inversion;

and in that the combined action of the disc air conveyor and of the shaped flame conveyor allows to obtain a recirculating effect of the burned gases without ducting the flame, as it is necessary in the conventional burners, and without increasing the electric power of the fan's engine inserted in the burner.

Further features and advantages according to the present invention will be more evident from the detailed specification hereinbelow relating to the enclosed drawings, in which some embodiments are shown.

Figure 1 shows a lateral and partially section view of a combustion head for gas burners, in particular for boilers with combustion chambers with passing flame, according to the present invention.

Figure 2 shows a longitudinal and partially exploded view of said combustion head.

Figures 3 and 4 respectively show a longitudinal section and a front view of an air conveyor of the combustion head of figures 1 and 2.

Figure 5 shows a longitudinal section and partially exploded view of a variant of the combustion head, provided with additional piping for the adduction of air to the flame conveyor.

Figure 6 shows a front view of the flame conveyor of figure 5.

Figure 7 shows a front view of the front part of a combustion head for gas burners, in particular for boilers with combustion chambers with flame inversion.

Figure 8 shows a longitudinal axial view according to line VII-VII of figure 7, of said combustion head.

Figure 9 shows a lateral view of a burner provided with a combustion head, in particular for boilers with combustion chambers with passing flame, according to the present invention.

Relating to the details shown in the figures, the combustion head for gas burners according to the present invention mainly comprises an outer tubular case 1, and inner tubular pipe 2, an air conveyor 3, a flame conveyor 4 and gas emission nozzles 5.

The outer tubular case 1 has a mainly cylindrical shape and has the function of canalizing piping for burning air which flows between the inner tubular piping 2 and said case, blown by a fan of known kind provided in the back part 8 of said burner.

Said case 1 begins near a flange 7 for the connection of the burner to the boiler, and ends near the edge of said air conveyor 3.

The inner diameter of said case 1 is greater, in each section, than the one of the inner tubular piping 2 as well as than the edge circumference of said air conveyor 3.

Said inner air pipe 2 mainly consists of a piping for supplying combustible gas, which at the rear end is connected to the mouth 9 for the gas inlet and at the front end to a flame conveyor 4.

Near its front end portion, said pipe 2 is provided with a collar 10 for fixing said air conveyor 3.

Said collar 10 is also provided with holes 11 for the passage of the burning air.

Downstream of said air conveyor 3, nozzles 5 for the emission of the combustible are screwed to said pipe 2.

Said nozzles 5 are arranged in sunburst to the axis of said pipe 2.

The outlet mouth of said nozzles 5 is provided on the combustion front of the head with respect to the air conveyor 3 disc, and the plane passing through the outlet mouth of each nozzle meets the plane with the greatest circumference of said air conveyor 3 at a distance from the axis of the combustion head not inferior to the radius of said circumference.

A small hole 12 is performed on said pipe 2 in correspondence with each nozzle 5, for the emission of root gas.

The air conveyor 3 is realized by means of a disc provided with means for the passage of the burning air, advantageously consisting of holes 6 or openings of appropriate shape, regularly distributed on the surface of said conveyor and regularly spaced out with said nozzles 5.

The flame conveyor 4 comprises a shaped element, internally hollow, that stretches coaxially to said pipe 2 beyond the end section of said nozzles 5.

The end of said flame conveyor 4 consists of a plane surface of circular shape.

The combustion head is finished with an ignition and a survey electrode of the known kind, not shown in the figures.

In a first embodiment of the combustion head, as shown in figures 1, 2, 3, 4 and 9, particularly suitable for boilers with combustion chamber with passing flame, the air conveyor 3 disc is advantageously folded in the shape of a truncated cone, diverging in the advancing sense of the burning air flow, and the nozzles 5 are consequently forward inclined of about 30° with respect to the plane normal to the axis of the combustion head, for mainly following the inclination of said disc 3.

The shape of the flame conveyor 4 is advantageously realized by means of two diverging surfaces 13 and 14 in the shape of a truncated cone, connected by a cylindrical portion 15.

The angles obtained by the conical surfaces 13 and 14 with the combustion head's axis are respectively about 45° and 25°.

In a variant of the first embodiment of the combustion head, shown in figures 5 and 6, the same is provided with a further pipe 16 internal to the gas pipe, in which air blown by said fan of the burner is flown, for preventing the flame conveyor 4 from overheating due to the nearness to said flame.

Said pipe 16 ends up in the hollow body of the flame conveyor 4, which in this case is provided with pipes 17 and emission holes 18.

Therefore, in this variant the cooling air supplied through pipe 16 comes out from pipe 17 through holes 18, so as to prevent the overheating of the flame conveyor 4 and to supply further oxygen for the combustion.

In a second embodiment of the combustion head according to the present invention, shown in figures 7 and 8, and particularly suitable for boilers with combustion chambers with flame inversion, the air conveyor disc 3 is advantageously plane, in the shape of a circular crown and arranged perpendicularly to the combustion head's axis in correspondence with the end portion of the outer tubular case 1, which is shaped with a converging lip 19.

Consequently, nozzles 5 are normal to the combustion head's axis.

Inside said tubular case 1, small plates 20 are applied that rest on the edge of said conveyor 3 and that have the function of spacer, so as to allow a correct concentricity between the outer tubular case 1 and the edge of the air conveyor disc 3.

At the front end of the tubular pipe 2 the flame conveyor 4 is applied.

Said flame conveyor 4 has a mainly cylindrical shape, with an outer diameter equal to the one of said pipe 2, and stretches little beyond the end front section of said pipe 2. Such stumpy shape of the flame conveyor allows the flame to extend more in length.

The combustion head is advantageously provided with a further pipe 16, coaxial and internal to the gas pipe, in which air blown from the burner's fan flows, for preventing the flame conveyor 4 from excessively overheating and for assuring a further oxygen supply for the combustion.

Pipe 16 ends up in the flame conveyor 4 which is provided with at least one hole 18 for the emission of said air.

According to the first embodiment of the present invention, the combustible gas is led to nozzles 5 and to holes 12 through pipe 2, while the burning air, blown by the fan in the back portion 8 of the burner, passes through the annular duct with decreasing section that is obtained between the case 1, the pipe 2 and the air conveyor 3, as well as through holes 11 and 6 respectively on said collar 10 and on said air conveyor 3.

The flame obtained by the ignition of the air-combustible mixture, and which is forced to lick up the flame conveyor 4 which shapes it and favours the reduction of the nitrogen oxides, also due to the particular turbulence caused by the shape of the air conveyor 3 and of the case 1.

According to the second embodiment of the present invention, the combustible gas is fed to nozzles 5 and to holes 12 through the inner tubular pipe 2. The burning air blown by said fan of mainly known kind in the burner, passes through the annular duct that is obtained between the outer case 1 and the inner pipe 2, as well as through pipe 16.

Therefore, the main flow of burning air comes out from the circular crown with variable section, obtained between the shaped end portion with the converging lip 19 of said outer case 1 and the edge of said air conveyor 3, as well as from the openings 6 on said air conveyor.

The secondary air flow fed by pipe 16 comes out directly from hole 18 present on the flame conveyor 4.

The fluid dynamics effect caused by the way of mixing gas and air, obtained by the disposition of the outlet plane of said nozzles 5 with respect to the edge of the air conveyor disc 3 and by the position of the edge of said disc with respect to the outer tubular case, as well as to the shape of the flame conveyor 4, allows to obtain a considerable reduction of the NO_x compounds also in boilers with combustion chamber with flame inversion.

Claims

1. A combustion head for gas burners, comprising an outer tubular case (1) for canalizing the burning air, an inner tubular pipe (2) for feeding the combustible, provided with nozzles (5) for the emission of the same, characterized in that it comprises a disc air conveyor (3) provided with means for the passage of the burning air, and a shaped flame conveyor (4).
2. A combustion head according to claim 1, characterized in that the edge of the disc air conveyor (3) is placed near the end part of the outer tubular case (1), for obtaining a better post-mixture of the gas and the burning air, and the outlet opening of the nozzles (5) is provided on the combustion front of the head with respect to said air conveyor (3) so that the plane passing through the outlet opening of each nozzle (5) meets that plane with the greatest circumference of said air conveyor (3) disc, at a distance from the axis of the combustion head which is not less than the radius of said circumference.
3. A combustion head according to claim 1, characterized in that said means for the passage of the burning air provided on said air conveyor (3), comprise holes (6) appropriately shaped and arranged on said air conveyor.
4. A combustion head according to claim 1, characterized in that the disc air conveyor (3) has the shape of a diverging truncated cone and that the shaped flame conveyor (4) stretches far beyond the section of the nozzles' (5) mouth, also with a diverging shape.
5. A combustion head according to claim 4, characterized in that the shape of the flame conveyor (4) is conveniently realized by means of the diverging surfaces (13, 14) in the shape of a truncated cone, linked by a cylindrical section (15).
6. A combustion head according to claim 5, characterized in that the angles formed by the conical surfaces (13, 14) with the axis of the combustion head are respectively of about 45° and 25°.

7. A combustion head according to claim 1, characterized in that the flame conveyor (4) comprises at least one pipe (17) and one hole (18) for the air emission.
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8. A combustion head according to claim 1, characterized in that the combustion head comprises a further pipe (16) inside the gas pipe, in which the air is fed, blown by the fan of the burner.
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9. A combustion head according to claim 1, characterized in that the air conveyor (3) disc is conveniently plane, in the shape of a circular crown.
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10. A combustion head according to claim 1, characterized in that the end portion of the outer tubular case (1) is shaped with a converging lip (19).
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11. A combustion head according to claim 1, characterized in that said shaped flame conveyor (4) has a substantially cylindrical shape and stretches little beyond the front end section of the pipe (2).

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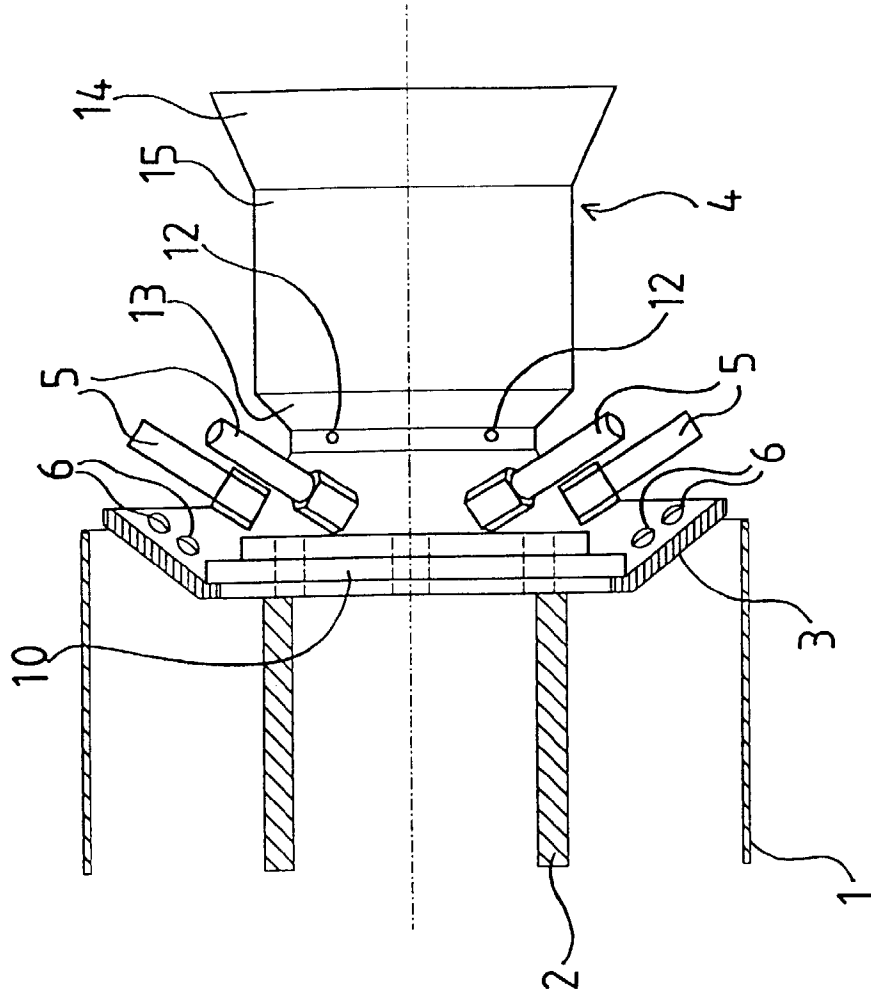
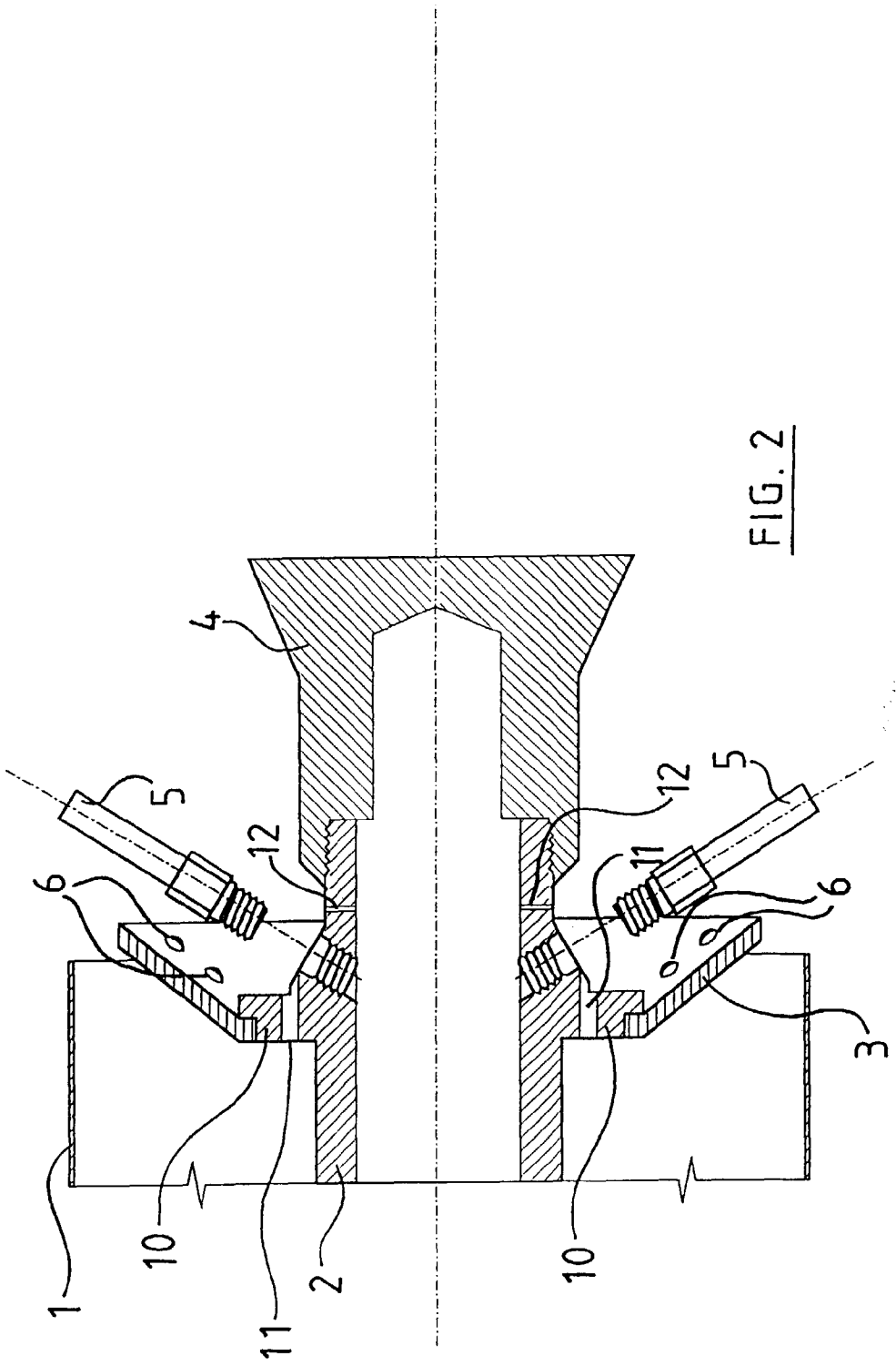


FIG. 1



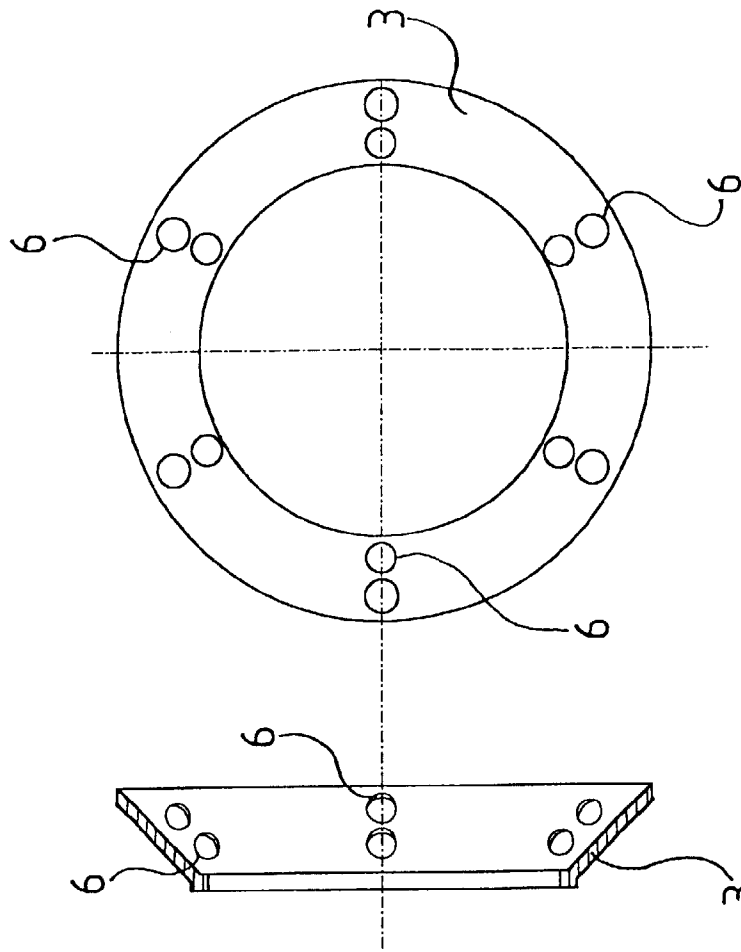


FIG. 3

FIG. 4

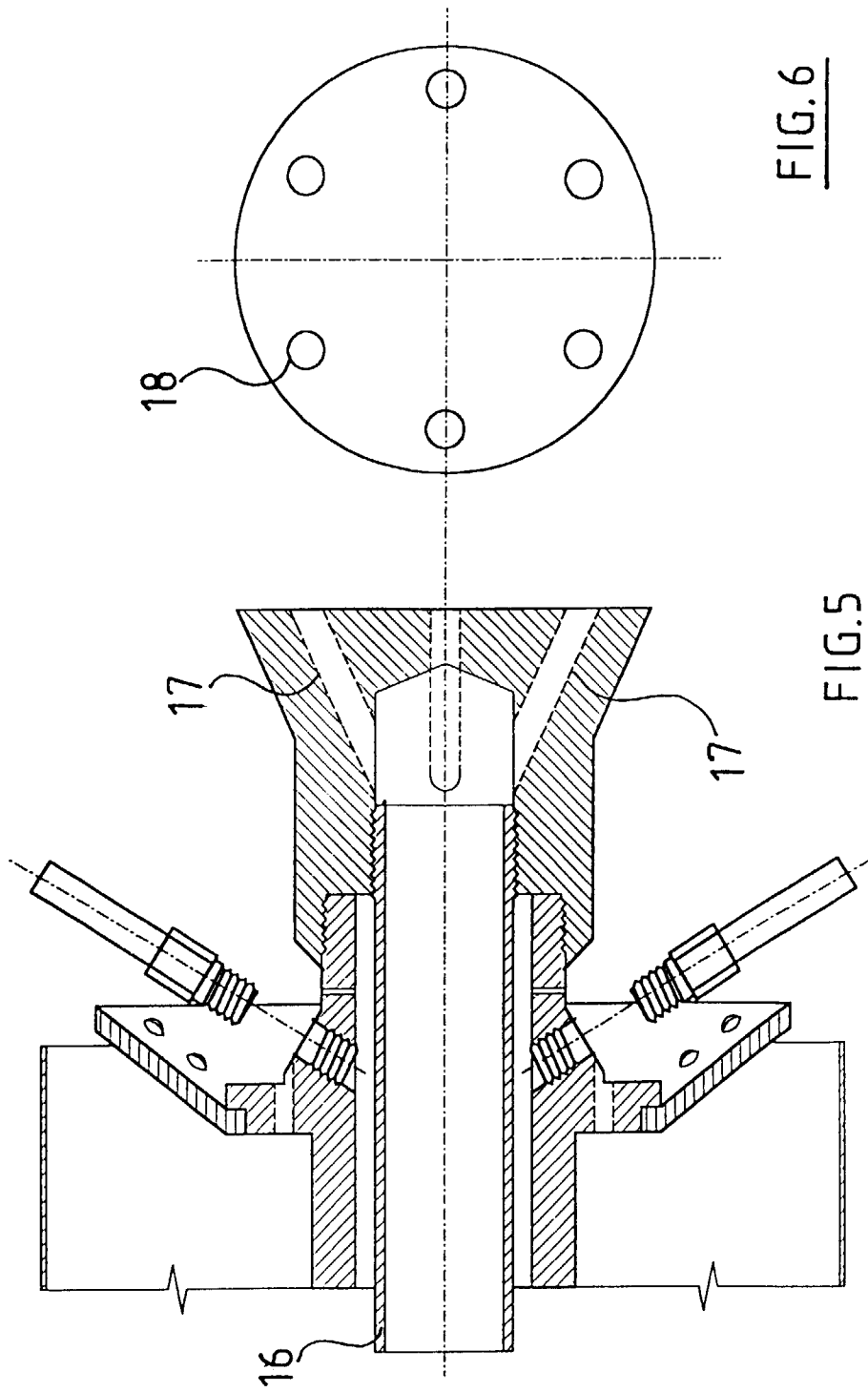
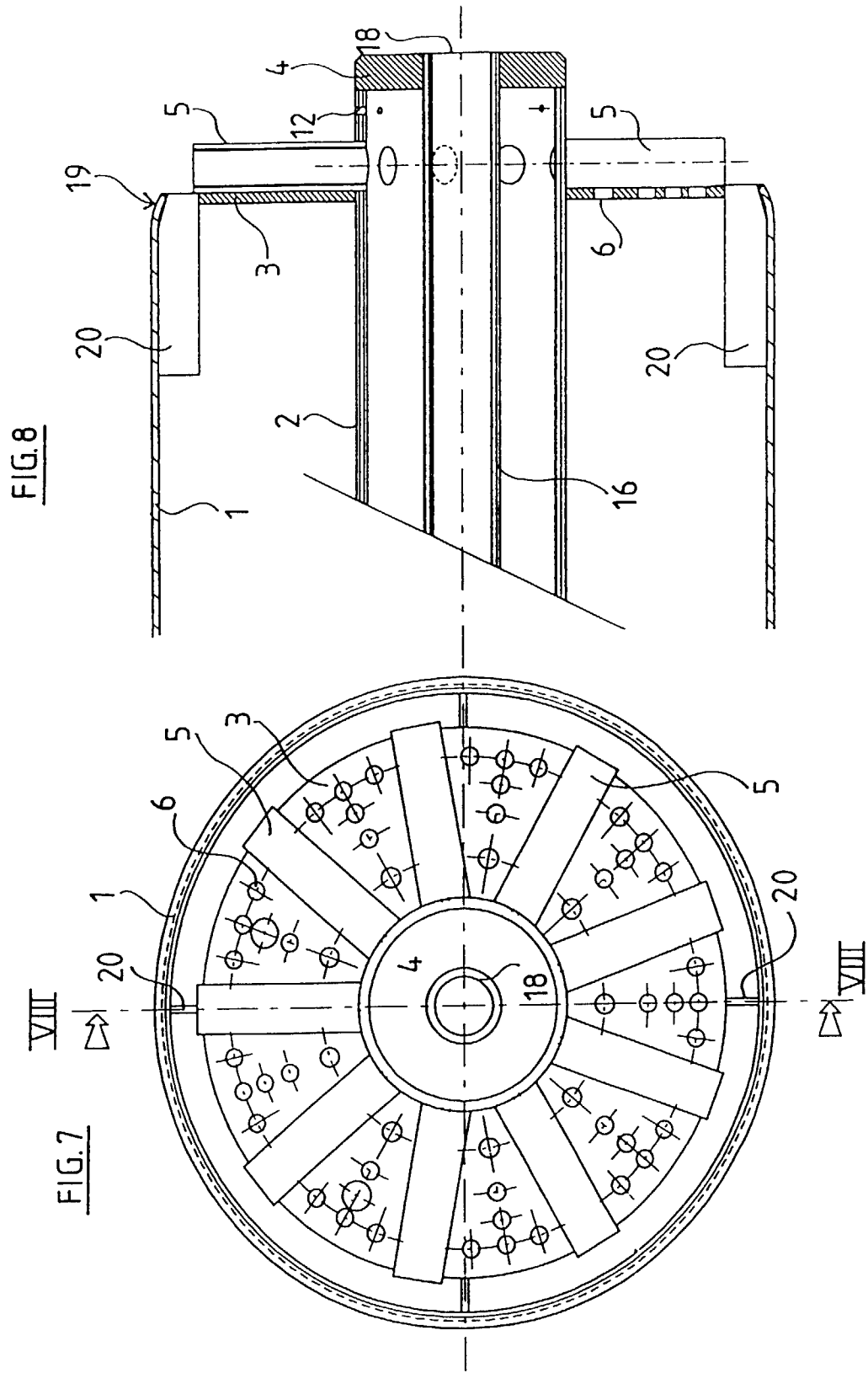


FIG. 6

FIG. 5



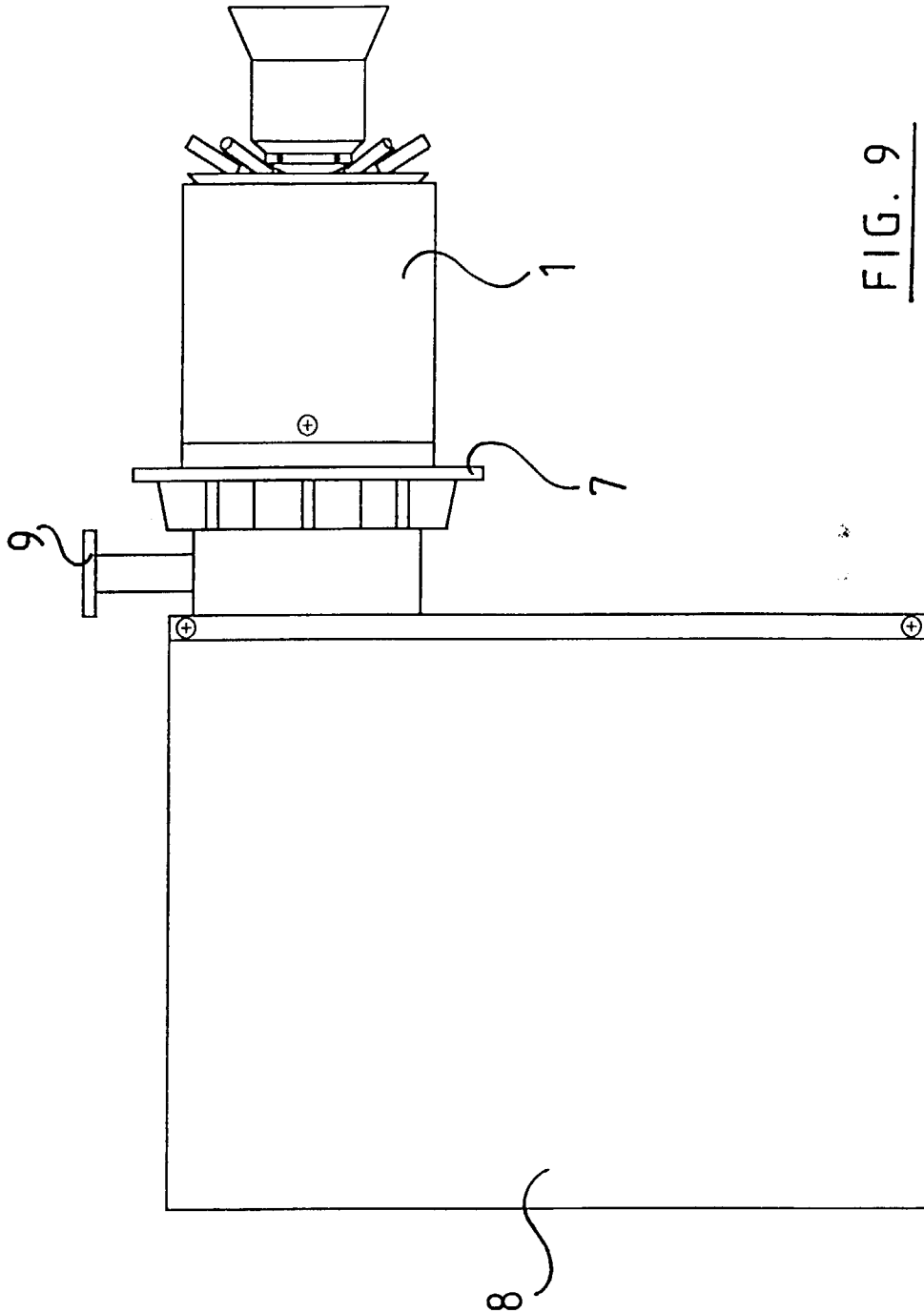


FIG. 9