(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 2 014 982 A2

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
14.01.2009 Bulletin 2009/03

(51) Int Cl.:
F23D 14/62 *(2006.01)*

(21) Application number: **08075581.2**

(22) Date of filing: **20.06.2008**

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MT NL NO PL PT RO SE SI SK TR
Designated Extension States:
AL BA MK RS

(30) Priority: **13.07.2007 IT MO20070235**

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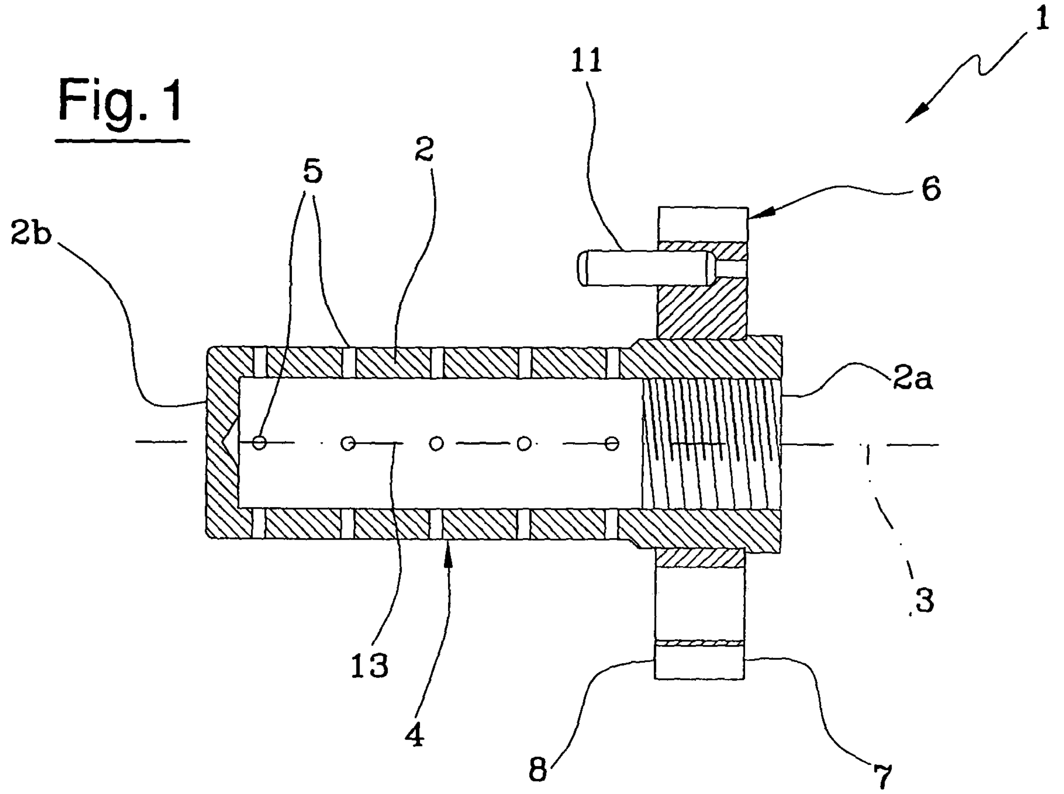
(54) **A mixing head and a burner comprising the mixing head**

(57) A mixing head for burners comprises a cylindrical, internally hollow, main body (2), extending around an axis (3) and comprising a cylindrical lateral surface (4) delimited by an open end (2a) for allowing an input of a gas into the cylindrical body (2), and by a closed end (2b), which is opposite the first end (2a). The cylindrical surface (4) exhibits a flame-ignition zone (4a) comprising a plurality of nozzles (5) through which the gas exits. In proximity of the open end (2a) of the main body (2) there is a diffuser disc (6) comprising a plurality of slits (9) which allow an air flow to pass through the disc (6) and to reach the nozzles (5). The nozzles (5) are arranged along a plurality of mutually parallel circumferences (12) which are axially aligned along the entire flame zone (4a).

Fig. 1



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Description

[0001] The object of this invention is a mixing head, in particular for gas burners. A further object of the invention is a gas burner for industrial kilns comprising the mixing head. The mixing head of the invention is used in burners in kilns for a wide range of applications, in particular for firing ceramic materials.

[0002] Mixing heads in the prior art exhibit a cylindrical main body which is internally hollow, an axial extension of which is limited to between 20 and 30 mm.

[0003] Through a first open end, the inside of the main body fluidly communicates with a conduit of the burner, through which gas flows.

The opposite end of the main body is closed off.

[0004] There are nozzles or holes on the lateral surface of the main body, arranged along a single circumference.

Gas exits through these nozzles or holes.

[0005] A diffuser disc is located between the circumference containing the nozzles and the first end of the main body, which diffuser disc affords a plurality of slits axially crossing the diffuser disc in such a way that the two opposite base surfaces of the disc fluidly communicate. In other words, the diffuser disc has a plurality of blades, between which air flows. The diffuser disc is in fluid communication with a second conduit of the burner, which is preferably concentric to the conduit containing gas, through which second conduit air flows. The air passes from the second conduit, through the slits between the blades, to the base surface of the diffusor disc facing the nozzles or holes. Here the air mixes with the gas which is coming out of the nozzles.

[0006] To improve the mixture, the slits are generally inclined in relation to the axis of the main body, in such a way as to confer a swirling motion on the air.

[0007] The burner conduits, inside which gas and air flow, are generally positioned outside the kiln. The mixing head is however contained within a portion of the burner which is inserted in the wall of the kiln. In particular, the portion of the main body containing the nozzles faces internally of the kiln.

[0008] The present applicant has noted that combustion heads of this type have a number of drawbacks. In particular, the positioning of the nozzles, which are situated along a single circumference located at the base of the main body and very close to the diffuser disc, gives rise to problems during the air-gas mixing phase.

[0009] In fact, gas flowing inside the main body exits radially from the nozzles at a considerable speed, thus giving rise to a sort of annular barrier to the axial flow of air travelling through the flange.

[0010] Therefore to improve mixing, a greater intensity of air flow than would in effect be necessary must often be used in order to overcome the counter-pressure created by the flow of gas exiting from the nozzles. The prior-art mixing head also entails high gas consumption.

[0011] This invention therefore aims to design a mixing head which obviates the drawbacks found in the prior art.

[0012] The aim of the invention is to provide a mixing head which enables improved air-gas mixing to be achieved, with a consequent saving of energy.

[0013] A further aim is to provide a mixing head which, since it improves combustion, also reduces gas consumption and pollutant emissions.

[0014] A still further aim of this invention is to provide a mixing head which distributes the temperature at the mixer outlet more uniformly and provides a steadier and better circumscribed flame.

[0015] Use of the invention allows combustion to be improved overall, thus reducing both heat dispersion and any likelihood that the combustion chambers and connected elements will break.

[0016] These aims, together with other advantages, are achieved by the invention as it is described in one or more of the claims listed below.

[0017] Further characteristics and advantages of the invention will emerge more clearly from the following non-limiting description of a preferred but not exclusive embodiment of a mixing head, as shown in the appended figures of the drawings, in which:

- figure 1 shows a schematic axial section view of a mixing head in a first embodiment, in accordance with the invention;
- figure 2 shows a schematic side view of a mixing head in a second embodiment, in accordance with the invention;
- figure 3 shows a side view from the left of the heads shown in figures 1 and 2;
- figure 4 shows an axial section of a burner for industrial kilns comprising a mixing head in accordance with the invention;
- figures 5 and 6 show schematic perspective views of the embodiments of figures 1 and 2.

[0018] In the above-mentioned figures, the reference number 1 denotes a mixing head in accordance with the invention.

[0019] The mixing head 1 for burners comprises a preferably cylindrical main body 2 which is internally hollow and prevalently extends along an axis 3.

[0020] The main body 2 comprises a first end 2a, which is open to allow the supply of a gas, and a second closed end 2b, which is opposite the first end 2a.

[0021] The main body 2 further comprises a lateral surface 4, which is delimited by the two ends 2a, 2b and exhibits a flame-ignition zone comprising a plurality of nozzles or holes 5 through which gas exits.

[0022] The diameter of the nozzles or holes 5 varies between 1 mm and 3 mm, preferably between 1.5 mm and 2.5 mm, and the nozzles or holes 5 are distributed on the lateral surface 4, the extension of which lateral surface 4 is greater in an axial direction than a transversal dimension of the main body 2.

[0023] Near the first end 2a of the main body 2, in particular between the nozzles or holes 5 and the first end 2a, the head 1 exhibits a diffuser disc. The diffuser disc 6, which is coaxial with the main body 2, comprises a first base surface 7 which faces the open end 2a of the central body 2, and a second base surface 8, which is situated opposite the first base surface 7, and faces the closed end 2b of the main body 2.

[0024] The diffuser disc 6 normally has a diameter of between 50 mm and 60 mm, preferably 57 mm, and is between 5 mm and 15 mm thick.

[0025] An annular peripheral portion of the diffuser disc 6 exhibits a plurality of slits 9, which place the first base surface 7 fluidly in communication with the second base surface 8 of the flange 6. In other words, the diffuser disc 6 exhibits a sort of plurality of blades 10 which alternate with a plurality of slits 9, between which air flows.

[0026] Advantageously, the slits 9 are inclined relative to the longitudinal axis 3 of the main body 2, in such a way as to impart a swirling motion on the air, which improves air-gas mixing.

[0027] Preferably the slits 9 are inclined with respect to the axis 3 by an angle a comprised between 20° and 40°, preferably 30°. On the second surface 8 of the diffuser disc 6, which extends towards the flame-ignition zone, there is a ignition element 11.

[0028] The element 11 comprises, for example, a metallic electrode which can be electrically excited, in such a way as to create a spark which ignites the mixture to initiate combustion thereof. The mixing head further comprises a flame detector, which is not shown in the appended figures, and which detects and signals a presence of a flame in the burner.

[0029] The main body 2 has an axial extension of between 50 mm and 80 mm, preferably between 60 mm and 70 mm. The length of the flame-ignition zone, along which the nozzles 5 are distributed, can vary between 30 mm and 70 mm, and is preferably between 50 mm and 60 mm.

[0030] According to a first embodiment, shown in figure 1, the nozzles or holes 5 are aligned along at least one generatrix line 13, which is parallel to the axis 3 of the main body 2. Preferably there are from two to eight generatrix lines 13 along which the nozzles or holes 5 are aligned, each including an aligned number of nozzles which can vary from two to six.

[0031] Alternatively, as illustrated in figure 2, the nozzles 5 are arranged along at least one spiral line 14 which winds around the cylindrical surface 4 of the main body 2.

[0032] The spiral lines 14 can vary in number from two to six spiral lines, preferably four. The spiral lines 14 can be wound rightwards or leftwards and be inclined in a same direction as, or in an opposite direction to, the inclination of the slits 9 of the flange 6. Among possible configurations, the configurations where the nozzles or holes 5 are arranged along spiral lines 14 which are inclined differently to the inclination of the slits 9 are favourable for improving the air-gas mixture.

[0033] A further arrangement which favours improved mixing is a configuration having a staggered distribution of the nozzles or holes 5 along the generatrix lines of the first embodiment shown, or along the spiral lines of the second embodiment, thanks to which distribution, in any one section which is perpendicular to the axis 3 there is only one nozzle or hole 5, (or there is a smaller number thereof than the number of rows or generatrix lines).

[0034] A burner 15 for industrial kilns comprises a first portion 16 which can be positioned externally of an oven, in particular constrained to an external surface 17 of a wall 18 of the oven. The burner 15 further comprises a second portion 19, which is coaxially aligned to the first portion 16 and which can be positioned internally of the wall 18 of the oven.

[0035] The above-described mixing head 1 is situated inside the second portion, with the flame zone 4a facing towards the inside of the kiln. The first portion 16 and the second portion 19 are preferably cylindrical and axially aligned.

[0036] The first portion 16 comprises a first conduit 20 and a second conduit 21, which are concentric and are supplied with gas and air respectively. The first conduit 20 fluidly communicates with the open end 2a of the main body 2 of the mixing head 1, in such a way that the gas, after going through the first conduit 20 and entering the main body 2, exits from the nozzles or holes 5. The second conduit 21 fluidly communicates with the diffuser disc 6 of the mixing head 1; in particular the air which goes through the second conduit 21 flows from the first surface 7 of the diffuser disc 6 to the second surface 8 of the disc 6 through the slits 9.

[0037] The slits confer a swirling motion to the air in order to improve mixing with the gas exiting from the nozzles 5.

[0038] The invention provides important advantages.

[0039] At a given intensity of gas input flow, the presence of a high number of nozzles spread over a wide area extending coaxially to the flow means that the gas spreads more uniformly along the flame-ignition zone and to exit from each nozzle or hole at a relatively low speed. In this way, the jets of gas do not give rise to a "barrier" to air flow, thus enabling improved gas-air mixing to take place, and reducing by approximately 15% the quantity of combustion air which is at present required by prior-art burners installed in kilns. At present, in fact, 20-30% of air in excess is needed to overcome the counter-pressure created by the gas which exits at a relatively high speed from a small number of nozzles concentrated in a limited flame zone, giving rise a sort of barrier to the air arriving from the diffuser disc.

[0040] Further, gas and air mix more uniformly in a zone which is dimensionally well controlled. This contributes to improving combustion, consequently reducing consumption and the volume of smoke in the exhaust by at least 10%. The mixing head of the invention further allows gas to be saved when the kiln is empty. In other words, during the materials firing stage, there may be periods of time during which there is no material to be fired inside the kilns. During this time, however, the burner remains lighted, with nothing inside the kiln to absorb the produced heat. Consequently heat accumulates inside the kiln, thus shifting the temperature profile away from the desired curve. The mixing head of the invention makes regulation possible, since it allows the burner to be kept alight even with gas pressure at a minimum value of 2/3 mm H_20 (400 kcal/h), thus delivering savings of 3-5% per day. Finally, the combustion chamber has a longer working life, since the external wall of the kiln heats up less owing to the fact that the nozzles or holes, and thus the flame zone, exhibit a uniform and controlled (longitudinal) distribution inside the combustion chamber.

Claims

1. A mixing head for burners comprising:

   an internally-hollow cylindrical main body (2) which develops around an axis (3) thereof and comprises an open end (2a) which allows a gas to enter, a closed end (2b) which faces the first end (2a), and a lateral surface (4), delimited by the first end (2a) and the second end (2b), which main body (2) exhibits a flame-ignition zone comprising a plurality of nozzles or holes (5) through which the gas exits,
   a diffuser disc (6), which is coaxial with the main body (2) and positioned near the open end (2a) of the main body (2), comprising an annular peripheral portion provided with a plurality of slits (9) which place a first base surface (7) of the diffuser disc (6) in fluid communication with a second base surface (8) thereof, which second base surface (8) is opposite the first base surface (7), such as to allow passage of air through the diffuser disc (6); the plurality of slits (9) are inclined relative to the axis (3) in such a way as to confer a swirling motion to the air,
   an ignition element (11),
   characterised in that the nozzles or holes (5) are distributed on the lateral surface (4) the extension of which is greater in an axial direction than in a transversal dimension of the main body (2).

2. The combustion head of claim 1, **characterised in that** the nozzles or holes (5) are axially aligned along a plurality of generatrix lines (13) of the cylindrical lateral surface (4) of the main body (2).

3. The mixing head of claim 1, **characterised in that** the nozzles or holes (5) are aligned along a plurality of lines (14) which wrap spirally around the axis (3) of the main body (2).

4. The burner head of claim 3, **characterised in that** a direction in which the spiral lines (14) wrap matches an inclination of the slits (9) on the diffuser disc (6).

5. The mixing head of claim 3, **characterised in that** a direction in which the spiral lines (14) wrap does not match an inclination of the slits (9) on the diffuser disc (6).

6. The mixing head of any one of the previous claims, **characterised in that** the slits (9) are inclined by an angle of between 20° and 40°, preferably 30°, relative to the axis (3) of the main body (2).

7. The mixing head of any of the previous claims, **characterised in that** a flame-ignition zone of the cylindrical lateral surface (4) is between 30 mm and 70 mm long, preferably 50 mm.

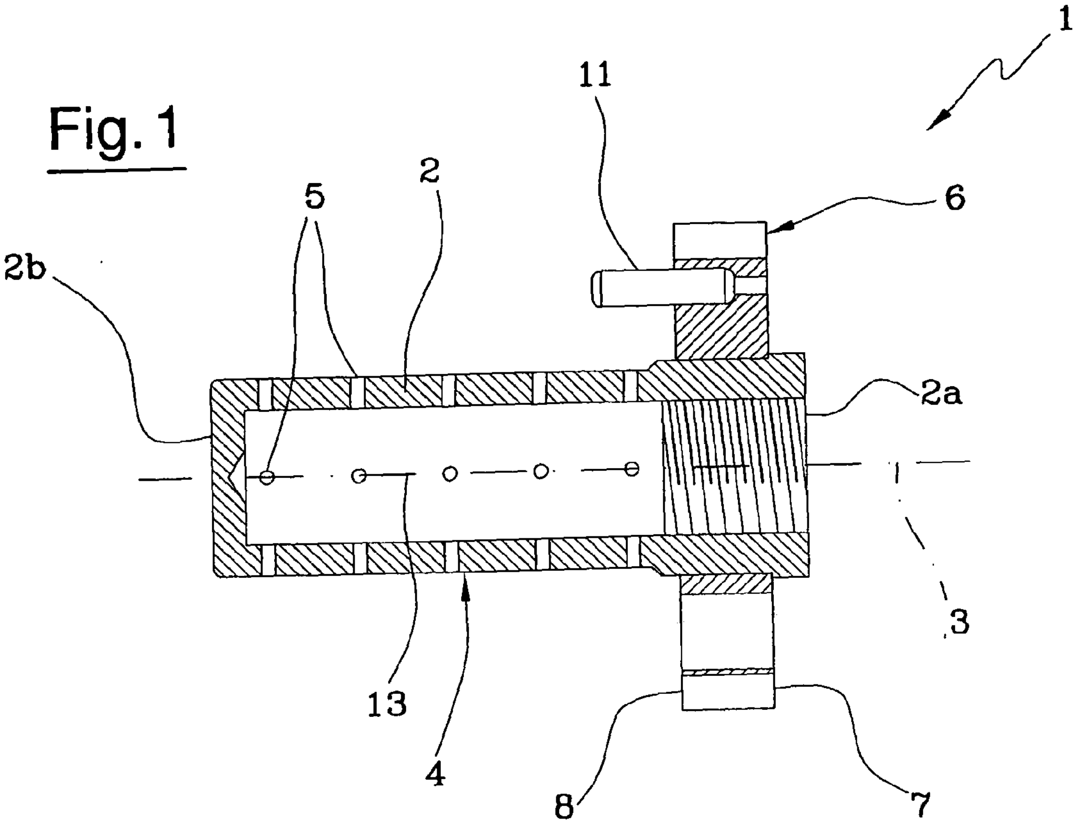
8. A burner for industrial kilns comprising a first portion (16) which can be positioned externally of an kiln and a second portion (19), which is coaxially aligned with the first portion (16), and can be positioned inside a wall (18) of the kiln, **characterised in that** the second portion (19) internally comprises the mixing head (1) of one or more of claims from 1 to 7.

9. The burner of claim 8, **characterised in that** the first portion (16) comprises a first conduit (20) and a second conduit (21) which are reciprocally concentric, and which are respectively supplied with gas and air.

10. The burner of claim 9, **characterised in that** the first conduit (20) is in fluid communication with the open end (2a) of the main body (2) of the mixing head (1), in such a way that gas flows from the first conduit (20) into the main body (2) of the mixing head (1), exiting through the nozzles (5).

11. The burner of claim 10, **characterised in that** the second conduit (19) fluidly communicates with the diffuser disc (6) of the mixing head (1), in such a way that the air flows from the second conduit (19) to the second surface (8) of the flange (6) through the slits (9), in order to mix with the gas exiting from the nozzles or holes (5).

Fig. 1



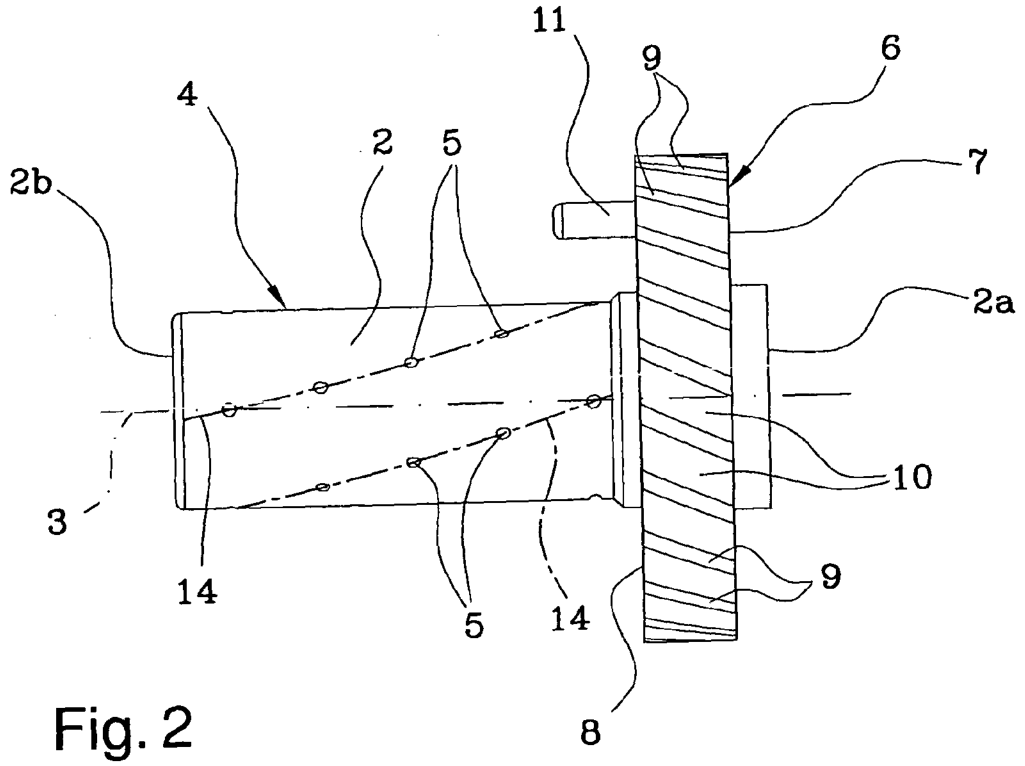
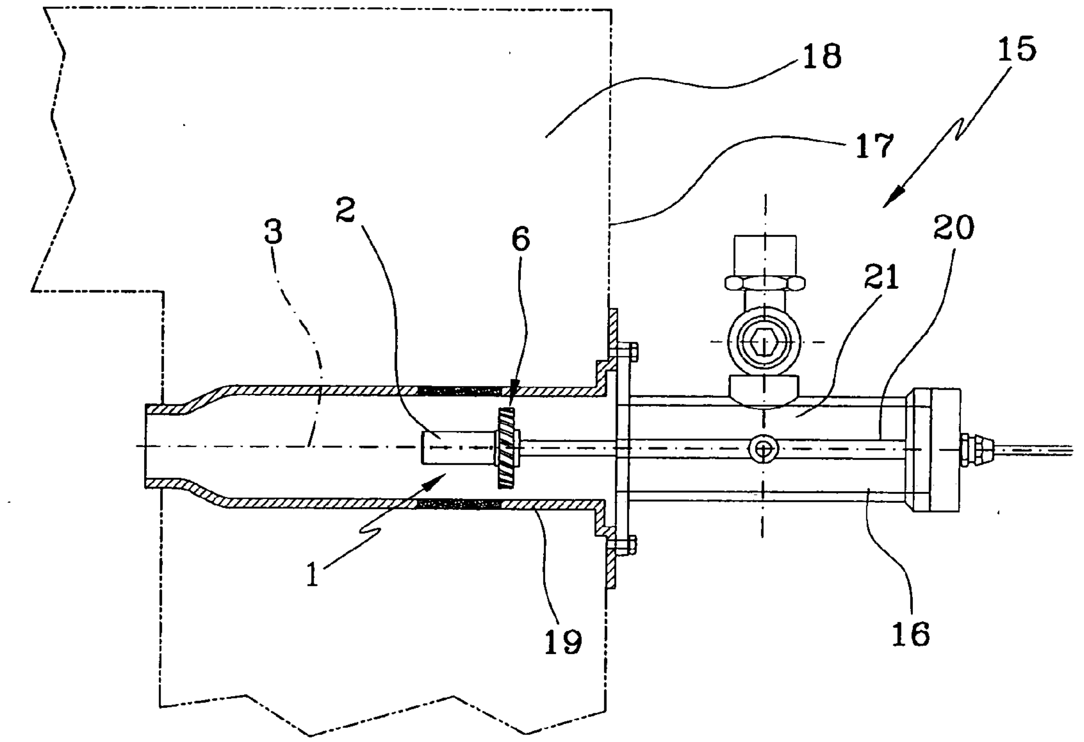


Fig. 2

Fig. 4



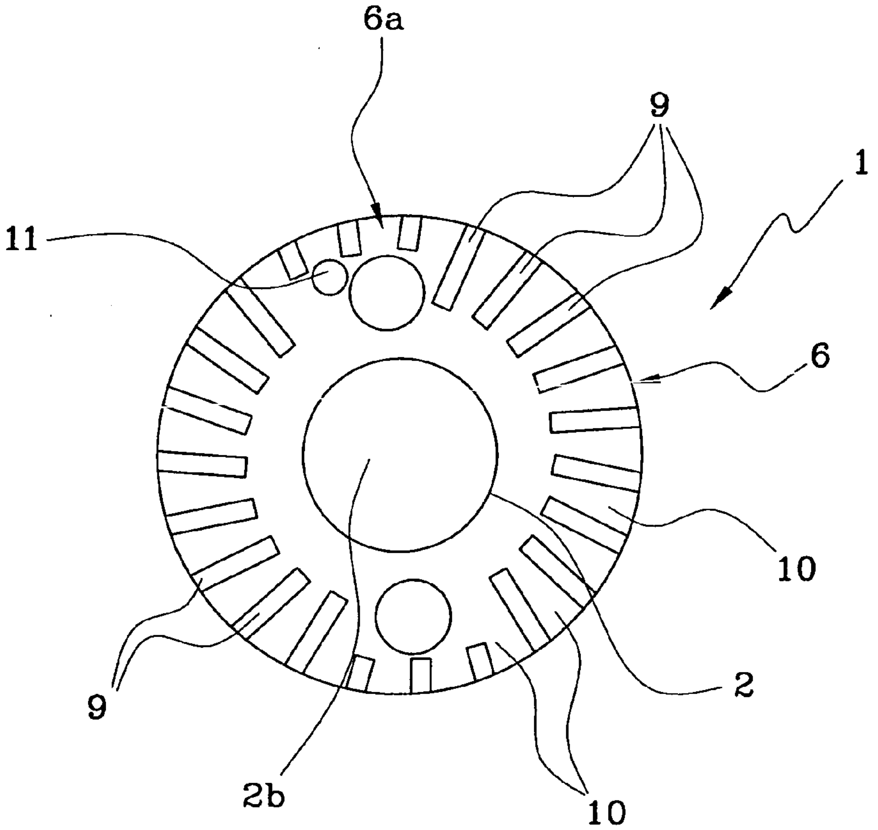


Fig. 3

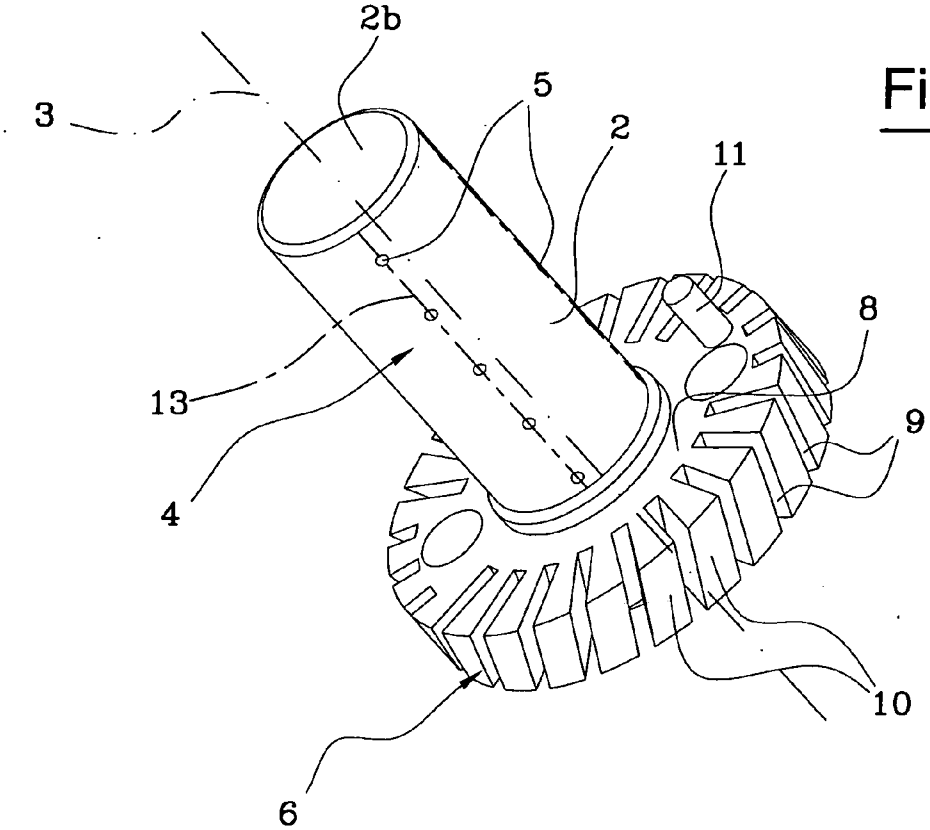


Fig. 5

Fig. 6