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

(11) Publication number: **0 548 408 A1**

(12) **EUROPEAN PATENT APPLICATION**

(21) Application number: **91122338.6**

(51) Int. Cl.5: **B05B 3/04**, B08B 3/02

(22) Date of filing: **27.12.91**

(43) Date of publication of application:
**30.06.93 Bulletin 93/26**

(84) Designated Contracting States:
**AT BE CH DE DK ES FR GB GR IT LI LU NL SE**

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(54) **Jet-producing head for high-pressure cleaners.**

(57) In a jet-producing head for high-pressure cleaners, in which a rotating jet nozzle (11) set at an acute angle (29) to its axis of rotation (26) and hence able to produce a jet (not shown) describing a surface of a cone is driven by a turbine rotor (5) using the liquid supplied (through 1) from the pump of the high-pressure cleaner (not shown) as a power source, the new feature consists in the bearing arrangement shown for supporting the turbine rotor (5) and the jet nozzle (11) for rotation. Thus, the upstream end of the turbine rotor (5) is supported for rotation and limited axial movement by a radial bearing (6,7), whereas its nozzle end carries a bearing surface - in the embodiment shown a part-spherical surface - (28) cooperating with a complementary bearing surface (13) on a stationary bearing member (16) surrounding the jet exit opening. A high supply pressure will urge the turbine rotor (5) in the downstream direction and hence cause the bearing pressure between the bearing surfaces (28 and 13) to be high, thus preventing any leakage from the space (17) surrounding the turbine rotor (5), whilst a low pressure will cause the bearing pressure to be so low as to allow rotation of the turbine rotor, even if the energy available from the flowing liquid is considerably reduced.

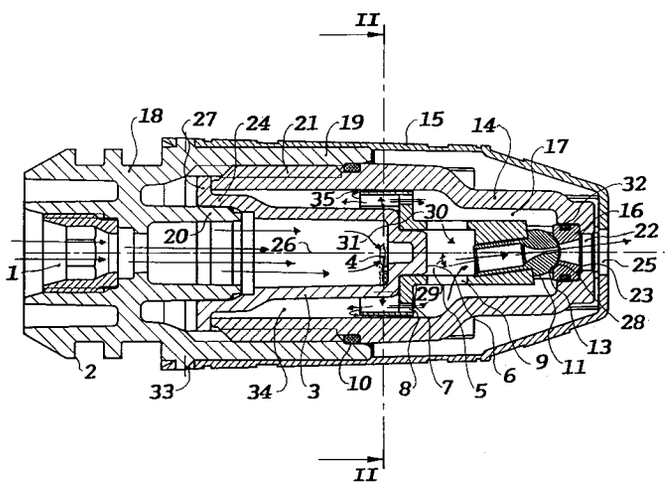


Fig.1

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## TECHNICAL FIELD

The present invention relates to a jet-producing head for high-pressure cleaners, said head being of the kind set forth in the preamble of claim 1.

## BACKGROUND ART

A jet-producing head of the kind referred to above is described in the specification of the German Patent No. 3,419,964. The head thus known is adapted to produce a rotating jet of cleaning liquid describing the surface of a cone having its apex in the bore of the jet nozzle, and on the background of the specification mentioned, this jet-producing head appears to be well suited to produce such a rotating jet. There is, however, a certain risk that a small quantity of liquid may leak out from the space surrounding the turbine rotor and the jet nozzle to the outside of the bearing surrounding the latter, especially after prolonged use and wear of this bearing. This means that in operation, the jet-producing head may "slobber", i.e. a small quantity of liquid flows down along the surface of the head, possibly landing on the hands of the operator. In the case of aggressive cleaning liquids, this is obviously a major disadvantage.

## DISCLOSURE OF THE INVENTION

It is the object of the present invention to provide a jet-producing head of the kind referred to initially, in which the risk of leakage of the kind referred to above is practically completely eliminiated, and this object is achieved with a jet-producing head, according to the present invention additionally exhibiting the features set forth in the characterizing clause of claim 1.

With this arrangement, the bearing pressure between the stationary and rotating bearing surfaces surrounding the jet-nozzle opening will adapt itself to the pressure of the liquid supplied to the head. Thus, a high supply pressure will cause a high bearing pressure and hence a high resistance towards leakage, whereas a low supply pressure, whilst still maintaining a sufficient bearing pressure to make the bearing leak-proof, will cause the bearing pressure to be so low as not to produce sufficient friction to prevent the turbine rotor from rotating, even when the reduced supply pressure has also caused a reduction in the energy available for turning the turbine.

Advantageous embodiments of the jet-producing head according to the present invention, the effects of which are explained in the following detailed portion of the present specification, are set forth in claims 2-5.

## BRIEF DESCRIPTION OF THE DRAWINGS

In the following detailed portion of the present specification, the present invention will be explained in more detail with reference to the drawings, in which

Figure 1 is a longitudinal sectional view through an exemplary embodiment of the jet-producing head, and

Figure 2 is a cross-sectional view taken along the line II-II in Figure 1.

## DESCRIPTION OF THE PREFERRED EMBODIMENT

The jet-producing head shown in the drawing comprises the following stationary parts, all substantially rotationally symmetrical about a common axis 26:

- a first housing part 18 comprising a through-going supply conduit 1 adapted to be connected to the liquid-output tube of a high-pressure cleaner by means of a coupling part 2, an internally-threaded outer tubular projection 19 directed in the downstream direction, and an inner tubular projection 20 likewise directed in the downstream direction,
- a second housing part 14, on its upstream end having an externally-threaded tubular projection 21 screwed into the internally-threaded tubular projection 19 on the first housing part 18, and at its downstream end having an opening 22 to allow for the passage of a liquid jet issuing from a jet nozzle 11 to be described below,
- a cover 15 secured to and surrounding the outer tubular projection 19 on the first housing part 18 and surrounding the second housing part 14, this cover also having a downstream opening 25 aligned with the opening 22 in the second housing part 14, and
- a liquid-guiding member 3, having at its upstream end a tubular part 24 embracing the inner tubular projection 20 on the first housing part 18, as well as a flange 27 cooperating with the free end of the

tubular projection 21 on the second housing part 14 so as to be held secure in the upstream direction, this liquid-guiding member 3 having at its downstream end a male bearing member 6 adapted to rotatably support a turbine rotor 5 to be described below.

In the exemplary embodiment shown, the stationary components also comprise an annular bearing member 16 placed upstream of and close to the opening 22 in the second housing part 14 and resting against an abutment surface 23 around the opening 22. The bearing member 16 has on its upstream side a part-spherical bearing surface 13 adapted to cooperate with a complementary bearing surface 28 on the jet nozzle 11 mentioned above.

The sole rotating component of the jet-producing head shown consists of two parts rotating together as one, viz.

- the above-mentioned turbine rotor 5 having at its upstream end a peripheral row of turbine vanes 12 adapted to turn the rotor 5 under the influence of liquid jets issuing from two tangential turbine nozzles 4 in the downstream end of the liquid-guiding member 3, this rotor 5 having both axial openings 8 and radial openings 9 to allow liquid having passed from the supply conduit 1 through the guiding member 3 and the turbine rotor 5 to flow to the upstream end of
- the likewise above-mentioned jet nozzle 11 inserted as shown at an acute angle 29 to the above-mentioned common axis 26.

The upstream end of the turbine rotor 5 comprises an annular bearing member 7 cooperating with the stationary bearing member 6 on the liquid-guiding member 3. A radial surface 30 on the turbine rotor 5 cooperates with a radial surface 31 surrounding the male bearing member 6 on the downstream end of the guiding member 3 so as to keep the bearing surface 28 on the jet nozzle 11 close to the bearing surface 13 on the stationary bearing member 16.

In operation, liquid delivered by the pump of the high-pressure cleaner flows through the supply conduit 1 and the liquid-guiding member 3, issuing in the form of powerful jets through the nozzles 4, thus causing the turbine rotor 5 and with it the jet nozzle 11 to rotate. The liquid having spent a small proportion of its energy in the turbine rotor 5 then flows through the axial openings 8 and the radial openings 9 into the jet nozzle 11, issuing from the latter in the form of a powerful jet, due to the rotation of the nozzle 11 describing the surface of a cone with its apex within the nozzle 11.

Especially during work with aggressive liquids it is important that no liquid leaves the downstream end of the jet-producing head except in the form of the above-mentioned jet. Thus, any leakage from the space 17 surrounding the rotating components 5 and 11 must be prevented. Leakage between the bearing member 16 and the surrounding part of the second housing part 14 may be prevented, e.g. in a conventional manner using a sealing ring 32. The question of preventing leakage between the rotating jet nozzle 11 and the stationary bearing member 16 is, however, not quite so simple. Thus, at high supply pressures, the bearing pressure between the cooperating bearing surfaces 13 and 28 on the stationary bearing member 16 and the jet nozzle 11 respectively must be sufficiently high to prevent liquid leaking from the space 17, while at low supply pressures, when the energy availably for driving the turbine rotor 5 is considerably less, this bearing pressure must not be so high as to prevent rotation of the turbine rotor 5.

In the jet-producing head according to the present invention this problem is solved by the construction shown, in which the bearing pressure between the rotating nozzle 11 and the stationary bearing member 16 is derived from the pressure differential between the upstream-facing and downstream-facing surfaces of the assembly constituted by the turbine rotor 5 and the nozzle 11. With this arrangement, a high delivery pressure will cause this bearing pressure to be high, whereas a low delivery pressure will result in a correspondingly reduced bearing pressure, thus allowing the turbine rotor to rotate despite the fact that the energy delivered by the liquid jets issuing through the turbine nozzles 4 is considerably reduced. This effect would be achieved to a certain degree solely by the pressure difference between the upstream and downstream parts of the jet nozzle 11, but is augmented in the exemplary embodiment shown by letting the turbine rotor 5 function as a piston dividing the space within the second housing part 14 into an upstream space 34 and the downstream space 17 mentioned above. All the liquid issuing as turbine jets through the turbine nozzles 4 must necessarily flow to the jet nozzle 11, but the flow restriction produced partly by the narrow gap 35 between the rotor 5 and the wall of the second housing part 14, partly by the axial openings 8 of limited flow cross-sectional area, will produce a pressure difference urging the rotor 5 and the jet nozzle 11 in the downstream direction. This flow restriction may be adjusted by varying the width of the gap 35 and/or the total cross-sectional area of the openings 8 - the latter may be omitted altogether - thus varying the bearing pressure at the downstream end of the jet nozzle 11.

In the preferred embodiment shown, both the jet nozzle 11 and the bearing member 16 are in the form of inserts fitted into the turbine rotor 5 and the second housing part 14 respectively with a light press fit. This makes its easy to remove or replace these parts when need arises. It does, however, lie within the

scope of the present invention to form the nozzle 11 as an integral part of the turbine rotor 5 and/or to form the stationary bearing member 16 as an integral part of the second housing part 14.

In addition to the salient advantage with regard to the bearing pressure explained above, the jet-producing head as shown according to the present invention also possesses the advantage of being very easy to dismantle and reassemble. Thus, to dismantle the head, the cover 15 is first removed, such as by opening a bayonet-type closure 33 not shown in detail, after which the second housing part 14 may be unscrewed from the first housing part 18, thus freeing both the liquid-guiding member 3 and the turbine rotor 5 with the jet nozzle 11. After any necessary maintenance or cleaning work, the head may be reassembled by repeating the procedure in the reverse order.

Leakage between the outer tubular projection 19 on the first housing part 18 and the tubular projection 21 on the second housing part 14 may be prevented in any conventional manner, such as by means of a sealing ring 10.

| LIST OF PARTS | | | |
|---|---|---|---|
| 1 | supply conduit | 18 | first housing part |
| 2<br>3 | coupling part<br>liquid-guiding member | 19 | outer tubular projection |
| 4<br>5 | turbine nozzle<br>turbine rotor | 20 | inner tubular projection |
| 6<br>7 | male bearing member<br>bearing member | 21 | tubular projection |
| 8<br>9<br>10<br>11<br>12<br>13<br>14<br>15<br>16<br>17 | axial openings<br>radial openings<br>sealing ring<br>jet nozzle<br>turbine vanes<br>bearing surface<br>second bearing part<br>cover<br>bearing member<br>space | 22<br>23<br>24<br>25<br>26<br>27<br>28<br>29<br>30<br>31<br>32<br>33<br>34<br>35 | opening<br>abutment surface<br>tubular part<br>opening<br>common axis<br>flange<br>bearing surface<br>acute angle<br>radial surface<br>radial surface<br>sealing ring<br>bayonet-type closure<br>upstream space<br>gap |

## Claims

**1.** Jet-producing head for high-pressure cleaners and of the kind comprising

a) a supply conduit (1) adapted to be connected to the liquid-output tube of a high-pressure cleaner,

b) a turbine (3,4,5) comprising

b1) a fixed liquid-guiding member (3,4), the inlet of which communicates with the supply conduit (1) and the outlet of which is constituted by at least one turbine nozzle (4) directed at least partly in the tangential direction towards

b2) turbine blades (12) integral with or secured to a turbine rotor (5) supported rotatably about a longitudinal axis (26) in the housing (14) of said jet-producing head and carrying

c) a jet nozzle (11), the nozzle of which forms an acute angle (29) with the rotational axis (26) of said turbine rotor (5), said jet nozzle (11) being surrounded by a bearing (28,13) communicating on its upstream side with a space (17) accommodating said rotor (5),

characterizing in

d) that said turbine rotor (5) at its end nearest to the supply conduit (1) is supported for rotation and limited axial movement by a radial bearing member (6) integral with or secured to said liquid-guiding member (3,4),

e) that said turbine rotor (5) at its end nearest to said nozzle (11) comprises a bearing surface (28) adapted to cooperate with a spherical or conical stationary bearing surface (13) on a bearing member (16) integral with or secured to said housing (14), and

f) that the arrangement is such that in operation, said turbine rotor (5) with its bearing surface (28) is urged against said stationary bearing surface (13) by the pressure difference between its upstream and downstream sides.

**2.** Head according to claim 1, characterized in that the turbine rotor (5) is closely surrounded by a stationary housing member (14) so as to divide the space inside the latter into an upstream part (34) in direct fluid communication with the space in the turbine rotor (5) comprising the latter's vanes (12) and a downstream Part (27) communicating with said upstream part (34) through the narrow gap (35) between the rotor (5) and said housing part (14), possibly also through openings (8) of limited flow cross-sectional area through the rotor (5).

**3.** Head according to claim 1 or 2, characterized in that said nozzle (11) is inserted into said turbine rotor (5) with a light press fit.

**4.** Head according to any one or any of the claims 1-3, characterized in that said bearing member (16), the bearing surface (13) of which cooperates with said bearing surface (28) on the nozzle (11), is inserted into the housing (14) against a downstream abutment (23) with a light press fit.

**5.** Head according to any one or any of the claims 1-4, characterized in that all its non-rotating parts are shaped substantially in the form of solids of revolution, viz.

a) a first housing part (18) comprising said supply conduit (1), an internally-threaded outer tubular prejection (19) and an inner tubular projection (20),

b) a second housing part (14), at its upstream end having an externally-threaded tubular projection (21) screwed into said internally-threaded tubular projection (19) on the first housing part (18), and at its downstream end having an opening (22) adjacent to the outlet opening of said jet nozzle (11), said opening being surrounded by an abutment surface (23) facing upstream for said bearing member (16), and

c) said fixed liquid-guiding member (3,4), having at its upstream end a tubular part (24) adapted to embrace said inner tubular projection (20) on said first housing part (18) and having a flange (27) cooperating with the free end of said externally threaded tubular projection (21) on said second housing part (14) to be held in the upstream direction, said liquid-guiding member (3,4) having at its downstream end said bearing member (6) for said turbine rotor (5) as well as said turbine nozzle or nozzles (4).

**6.** Head according to claim 5, characterized by a cover (15) surrounding at least all parts downstream of the upstream end of said outer tubular projection (19) on said housing part (18) and having an opening (25) aligned with said opening (22) in said bearing member (16).

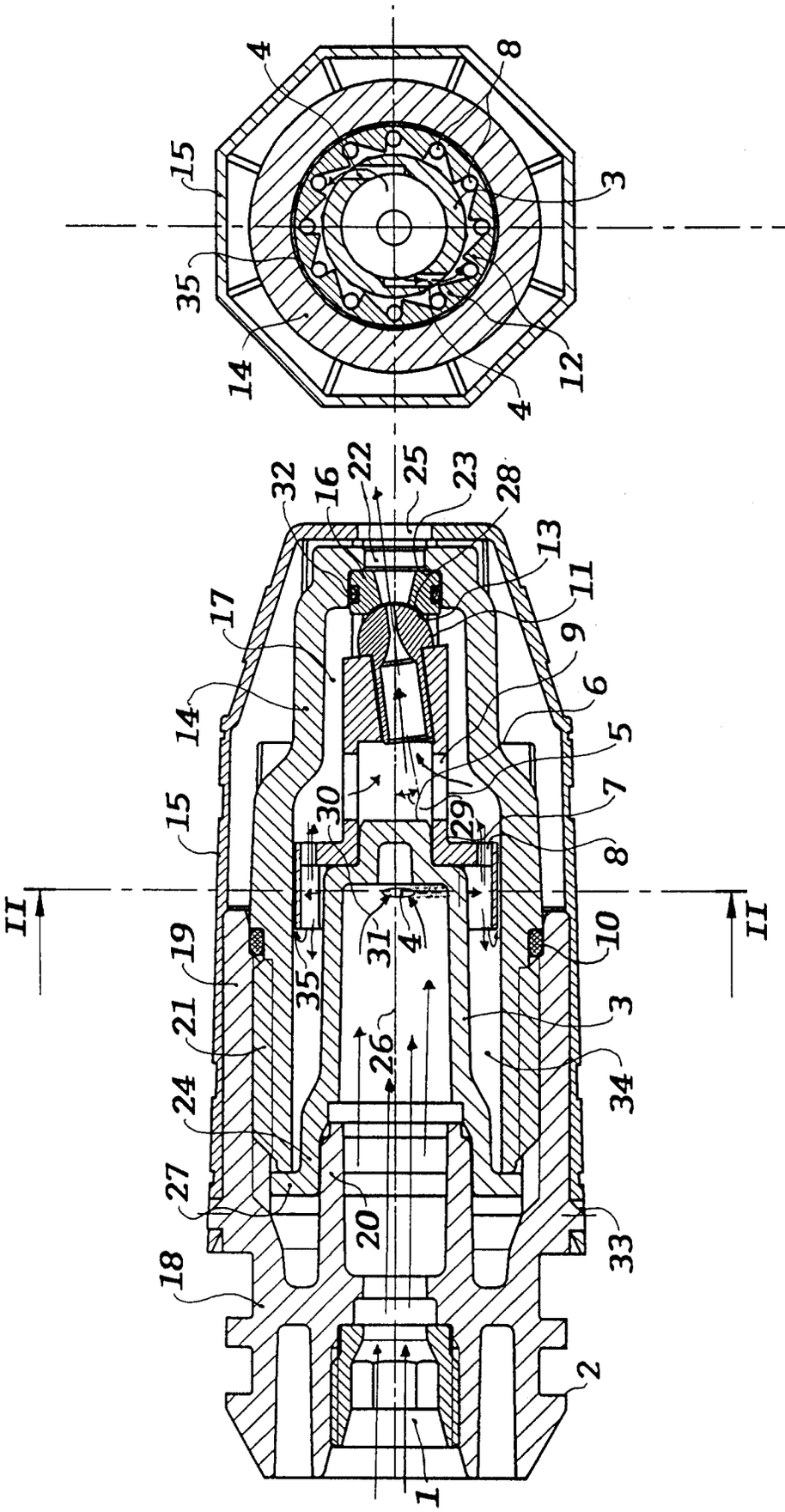
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Fig.1


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Fig.2

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# EUROPEAN SEARCH REPORT

Application Number

EP 91 12 2338

## DOCUMENTS CONSIDERED TO BE RELEVANT

| Category | Citation of document with indication, where appropriate, of relevant passages | Relevant to claim | CLASSIFICATION OF THE APPLICATION (Int. Cl.5 ) |
|---|---|---|---|
| D,A | DE-A-3 419 964 (KÄRCHER)<br>* abstract; figures * | 1-6 | B05B3/04<br>B08B3/02 |
| A | EP-A-0 379 654 (KRÄNZLE)<br>* abstract; figures * | 1,3,5,6 | |
| A | DE-U-8 801 793 (WESTERGAARD)<br>* page 3 - page 6; figures * | 1,3-6 | |
| A | DE-A-3 708 096 (SUTTNER)<br>* column 8, line 53 - column 9, line 15; figure 2 * | 1 | |
| A | EP-A-0 393 689 (FRIEDRICHS) | | |
| A | EP-A-0 252 261 (KÄRCHER) | | |

TECHNICAL FIELDS SEARCHED (Int. Cl.5 )

B05B
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The present search report has been drawn up for all claims

| Place of search | Date of completion of the search | Examiner |
|---|---|---|
| THE HAGUE | 28 SEPTEMBER 1992 | DE SCHEPPER H.P. |

CATEGORY OF CITED DOCUMENTS

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