

FORM P8(PCT)

(Lodge in Duplicate)

**REPUBLIC OF SOUTH AFRICA
PATENTS ACT, 1978****PUBLICATION PARTICULARS AND ABSTRACT**

[Section 32(3)(a) - Regulation 22(1)(g) and 31]

21	01	Official Application No. 2005/10070	DrG Ref.: 90526				
22	Lodging date: 2005-12-12						
43	Acceptance date: 30/08/06						
51	International Classification: F28G						
Not for publication. Classified by:			WIPO				
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Earliest priority claimed		33	Country	31	Number	32	Date
			DE		10 2004 014 822.8		24 March 2004
54	Title of invention METHOD FOR CLEANING THE PIPES OF A HEAT EXCHANGER BY MEANS OF AN ABRASIVE, AND CORRESPONDING DEVICE						
57	Abstract See next page.						
Number of sheets 25							

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REGISTRAR VAN PATENTE, MODELLE,
HANDELSMERKE EN OUFEBREKKE

(12) NACH DEM VERTRAG ÜBER DIE INTERNATIONALE ZUSAMMENARBEIT AUF DEM GEBIET DES
PATENTWESENS (PCT) VERÖFFENTLICHTE INTERNATIONALE ANMELDUNG

(19) Weltorganisation für geistiges Eigentum
Internationales Büro



(43) Internationales Veröffentlichungsdatum
6. Oktober 2005 (06.10.2005)

PCT

(10) Internationale Veröffentlichungsnummer
WO 2005/093360 A1

(51) Internationale Patentklassifikation⁷: F28G 1/16, 9/00

(21) Internationales Aktenzeichen: PCT/EP2005/002903

(22) Internationales Anmeldedatum:
18. März 2005 (18.03.2005)

(25) Einreichungssprache: Deutsch

(26) Veröffentlichungssprache: Deutsch

(30) Angaben zur Priorität:
10 2004 014 822.8 24. März 2004 (24.03.2004) DE

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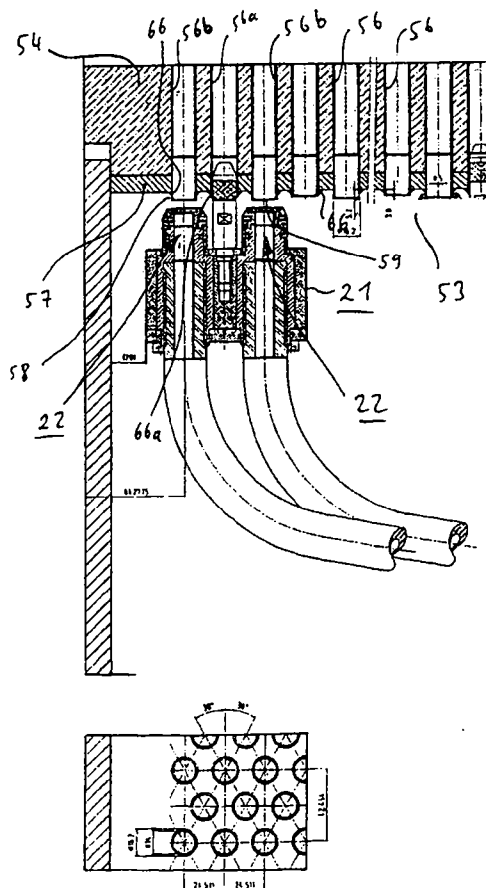
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(81) Bestimmungsstaaten (soweit nicht anders angegeben, für
jede verfügbare nationale Schutzrechtsart): AE, AG, AL,
AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH,
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MG, MK, MN, MW, MX, MZ, NA, NL, NO, NZ, OM, PG,

[Fortsetzung auf der nächsten Seite]

(54) Title: METHOD FOR CLEANING THE PIPES OF A HEAT EXCHANGER BY MEANS OF AN ABRASIVE, AND COR-
RESPONDING DEVICE

(54) Bezeichnung: VERFAHREN ZUM REINIGEN DER ROHRE EINES WÄRMETAUSCHERS MIT HILFE EINES STRAHL-
MITTELS UND DAFÜR GEEIGNETE VORRICHTUNG



(57) Abstract: The invention relates to a method for cleaning the pipes of a heat exchanger (54). According to said method, a jet nozzle is applied to one end of a pipe (56) and an air stream containing an abrasive is blown through the pipe. The invention is characterised in that a throttle-free jet nozzle (22) is used.

(57) Zusammenfassung: Verfahren zum Reinigen der Rohre eines Wärme-
tauschers (54) bei dem an das eine Ende eines Rohres (56) eine Strahldüse
angesetzt und ein ein Strahlmittel enthaltender Luftstrom durch das Rohr
geblasen wird, wobei eine drosselfreie Strahldüse (22) verwendet wird.

Description

Method for cleaning the pipes of a heat exchanger by means of an abrasive and device suitable for this
5 method

The invention relates to a method for cleaning a heat exchanger by means of an abrasive and to a device for carrying out the method. Heat exchanger pipes must be
10 cleaned of deposits from time to time. Although many chemical cleaning methods are available, the large number of heat exchanger pipes and corresponding number of openings mean that this is technically quite a demanding undertaking. Therefore, exchange pipes are
15 primarily cleaned mechanically. Apart from cleaning with brushes, blasting methods are often used, involving an abrasive being blasted through a pipe by means of a jet nozzle placed against an end of a pipe. Such a method is described for example in DE 195 46 788
20 A1. Particles of steel or corundum are used for example as the abrasive. The particles emerging from the other end of the pipe, respectively, are gathered by a collecting device and returned to the circulation of the abrasive. Such a collecting device is described
25 in DE 198 37 683 C2. In the case of a conventional cleaning method, as shown in Figure 1, two jet nozzles 2 fixed to a carrier 1 are placed for example against the inlet side 3 of a heat exchanger 4. The jet nozzles 2 are made narrower at their end pointing in
30 the blasting direction 5, to form a cylindrical connection piece 6, which is inserted into the end of the pipe 7. At its end pointing counter to the blasting direction 5, the jet nozzles 2 bear an inlet opening 9, connected to a feed tube 8. Arranged
35 between the outlet opening 10, which is enclosed by the front end of the connection piece 6, and the inlet opening 9 is a Venturi nozzle 12 with a throttling point 13.

The object of the invention is to provide an alternative method and an alternatively designed device for carrying out the method mentioned at the beginning, with which in particular more efficient cleaning of a heat exchanger is possible.

This object is achieved according to claim 1 and claim 6, respectively, by a throttle-free jet nozzle being used, preferably one in which the outlet opening is of the same size or slightly smaller than the inner cross-sectional area of the pipe. This configuration makes it possible to subject the pipe that is to be cleaned to a large stream of abrasive. In the case of conventional jet nozzles, this is not possible to the same extent. With said conventional nozzles, the velocity of the stream of abrasive in a feed tube connected to the jet nozzle is greatly increased by a relatively small constriction in a Venturi nozzle. The consequences are that abrasive particles are expelled with high kinetic energy. However, these particles are already retarded within a relatively short piece of pipe. Then only a stream of abrasive with a low particle concentration is available for the pipe cleaning. The situation is different with the invention. Here, because there is no throttling or constriction in the jet nozzle, a stream of abrasive with a very high particle concentration is obtained, accompanied by great abrasiveness. A configuration which allows large outlet openings provides that the jet nozzle is pressed against an end face of an end of a pipe with a contact area encompassing the outlet opening. By contrast with this, in the case of the prior art, a constricted connection piece is introduced into an end of a pipe, the outlet opening of the connection piece having to be reduced at least by an amount corresponding to its wall thickness in comparison with the cross-sectional area of the pipe.

The time spent on performing the cleaning method can be reduced by a number of pipes being cleaned simultaneously. This is accomplished by using a number
5 of jet nozzles which are held on a carrier in the same layout as the pipes of the heat exchanger. While in the case of conventional methods and devices positional fixing of the jet nozzles takes place by inserting them with a narrowed connection piece into an end of a pipe,
10 the invention provides a fixing bolt which protrudes in the blasting direction and, for cleaning, is inserted into an end of a pipe. This is possible without any problem if the fixing bolt is arranged on a carrier at a position corresponding to the layout of the pipes.

15 A throttle-free jet nozzle is accomplished by the jet nozzle being passed through by a flow channel delimited by an inlet opening and an outlet opening, the flow channel having a cross-sectional area that
20 substantially remains the same and corresponds approximately to the size of the outlet opening. As stated further above, the outlet opening of the jet nozzle is encompassed by a contact area which is pressed against the end face of the pipe to be cleaned
25 while the method is being carried out. This contact area is preferably encompassed by a collar arranged radially on the outside and projecting axially. The contact area and the collar thereby form a receptacle for an end of a pipe. This configuration on the one
30 hand makes better sealing of the end region of the pipe possible and on the other hand makes additional positional fixing of the device on the heat exchanger possible. This prevents a carrier carrying a number of jet nozzles from turning about the fixing bolt as an
35 axis of rotation. To increase the sealing between the end of the pipe and the jet nozzle, in a preferred configuration it is provided that the region comprising the receptacle and the outlet opening consists of an

elastomer. This also makes it possible to compensate for tolerances and unevenness in the region of the end face of an end of a pipe. As mechanical protection, and to prevent the collar encompassing the end face region of a pipe from being made to expand by the pressurized stream of abrasive, said collar is enclosed by a stiffening sleeve made of solid material, for example a metal. The elastomer region is preferably formed by an end piece that is in the form of a portion of pipe and is positively connected to the jet nozzle.

The invention is now explained in more detail on the basis of the accompanying drawings, in which:

- Figure 1 shows a conventional device, positioned on a heat exchanger, in a longitudinal sectional representation,
Figure 2 shows an illustration corresponding to Figure 1 of a device according to the invention,
Figure 3 shows the device as shown in Figure 2 in an enlarged representation of a detail,
Figure 4 shows a detail taken from Figure 3,
Figure 5 shows a perspective representation of the device from Figure 2.

25

The device shown in Figures 2 to 5 comprises a jet head with a carrier 21, in which two jet nozzles 22 are mounted. Of course, jet heads with only one jet nozzle or more than two jet nozzles are also conceivable. The carrier is substantially formed by a hollow-cuboidal housing 23. The housing 23 is passed through by two bores 24, which run parallel to each other and each receive a jet nozzle 22. A jet nozzle 22 is substantially configured as a housing 25 in the form of a portion of pipe. The housing 25 has three different longitudinal portions, a middle portion 26 having a larger diameter than the two other portions, that is a front portion 27 and a rear portion 28. The transition

35

between the middle portion 26 and the narrowed portions 27, 28 is in each case formed by a radial shoulder 29, 30. A stop flange 32 protrudes radially inward in each case from the wall of the bores 24. The side of this
5 stop flange that faces a middle portion 26 interacts with the radial shoulder 29 in the sense of an axial fixing of the housing 25. With the radial shoulder 30, the housing 25 bears against a cover part 33, which closes the carrier housing 23 on the rear side.
10 Arranged between the cover part 33 and the rear portion 28 of the jet nozzle 22 is an O-ring seal 31. Inserted in the region of the bore 24 extending away from the stop flange 32 and enclosing the portion 27 is an elastomer seal 34, encompassing the circumference of
15 the portion 27. Made in the front end face of the jet nozzle housing 25 is a cross-sectionally dovetailed groove 35, in which an end piece 36 made of elastomer material substantially in the form of a portion of pipe is positively fitted with its one end.
20
The front portion 27 is passed through by a flow channel 37. The center longitudinal axis 38 of the flow channel at the same time forms the center longitudinal axis of the jet nozzle housing 25. The
25 flow channel 27 is delimited on the front side by an outlet opening 39 and at its other end by an inlet opening 40. It has substantially a cross-sectional area that remains the same or diameter 42 that remains the same. The cross-sectional area or the diameter 42
30 corresponds to the cross-sectional area or the diameter 43 of a feed tube 46 screwed with an external thread 44 into an internal thread 45 of the middle portion 26. The feed tube 46 bears with its front end face 47 against a radial shoulder 48 that is present in the
35 transitional region between the portion 26 and the portion 27. Protruding from the radial shoulder 48 in the axial direction is a cross-sectionally wedge-shaped projection 49, which encompasses the inlet opening 40

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in an annular manner and digs itself into the material of the feed tube 46, an elastomer material. This improves the sealing between the feed tube 46 and the housing portion 26. The diameter 50 of the inlet opening 40 is slightly greater than the diameter 43 of the feed tube 46. The difference in diameter is in this case made for example to correspond to an expansion of the diameter 43 when the tube is subjected to a pressurized stream of abrasive. This ensures that a stream of abrasive does not impinge on an interfering housing edge protruding into the flow channel. The region 52 of the flow channel 37 adjoining the inlet opening 40 is made to narrow slightly conically, approximately as far as its middle, the region 52 being adjoined by a cylindrical channel region with the diameter 42.

To carry out a cleaning method, as shown in Figure 2, the carrier 21 is arranged on the inlet side 53 or the outlet side of a heat exchanger 54. If the heat exchanger is a nuclear power plant, the carrier 21 is generally held by a manipulator (not represented), on which the carrier 21 is fixed by a fastening device 55 (Figure 5). The pipes 56 of a heat exchanger are arranged in a regular layout and pass with their ends through a holding plate 57. They protrude from the latter with an overhang 58. The jet nozzles 22 are arranged spaced apart from one another on the carrier 21 to the extent that they can be placed on the end faces 59 of two pipes 56b separated from each other by a pipe 56a. For this purpose, the end piece 36 has a stop area 60, which interacts with the end face 59 and encompasses the outlet opening 39. The stop area 60 extends transversely in relation to the center longitudinal axis 38. The stop area 60 is in turn enclosed by a collar 62, which protrudes in the axial direction of the blasting direction or in the blasting direction 5. The collar 62 is formed in a cross-

sectionally wedge-shaped manner, having a radially inwardly directed sloping area 63 and a radially outwardly directed sloping area 61. The sloping area 63 serves as a guiding-in slope when the jet nozzle 22 is placed on an end of a pipe. During the cleaning, the latter lies in a recess 64 enclosed by the stop area 60 and the collar 62. The collar 62 thereby bears with a cylindrical edge portion 65 against the outer circumference of a pipe 56b. The sloping area 63 bears snugly against a weld 66, with which the pipes 56 are fixed on the holding plate 57. The collar 62 consequently acts like a sealing lip which interacts with the outer circumference and the weld 66 of a pipe 56b. In order that the collar cannot radially expand when it is subjected to pressure, it is encompassed around its full circumference by a stiffening sleeve 67. The stiffening sleeve 67 lies with a flange 68, protruding radially inward from its end facing the carrier 21, in a radial groove 71 of the end piece 36. The end face of the stiffening sleeve 67 that is facing the flange 68 is beveled and forms a sloping area 69 in line with the sloping area 61 of the collar 62. The beveling of the end piece in the form of the sloping areas 61 and 69 prevents it from coming into contact with a weld 66a of a neighboring pipe 56a and under some circumstances thereby preventing a sealing abutment of an end piece 3 against the pipe 56b that is to be cleaned. Between the portion 27 of the jet nozzle housing 25 and the stiffening sleeve 67 there is in the end piece 36 a further radial groove 70, which increases its elasticity in the axial direction.

For the positional fixing of the carrier 21 on the holding plate 57, there is on the front side of the carrier 21 from which the jet nozzles 22 also protrude with an overhang 72 a fixing bolt 73, which protrudes from the carrier 21 in the direction of the center longitudinal axis 38. The fixing bolt 73 is screwed

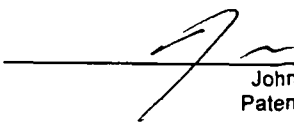
with a threaded portion 74 into a threaded bore 75 of the carrier 21. Its front end 76, facing away from the threaded portion 74, is conically narrowed. The longitudinal portion adjoining the narrowed region has
5 a diameter which is slightly smaller than the inside diameter of a pipe 56. During the cleaning operation, the fixing bolt 76 protrudes into a pipe 56a arranged between two pipes 56b that are to be cleaned. Turning of the carrier about the fixing bolt 73 as an axis of
10 rotation is prevented by the positively engaging interaction of the pipe ends with the end pieces 36.

Also arranged on the front side of the carrier 21 is a mechanical distance sensor 77. This ensures that the
15 carrier 21 can be moved into a predetermined position in relation to the holding plate 57 by means of a manipulator (not represented).

List of designations

1	carrier	38	center longitudinal axis
2	jet nozzle	39	outlet opening
3	inlet side	40	inlet opening
4	heat exchanger	42	diameter
5	blasting direction	43	diameter
6	connection piece	44	external thread
7	end of pipe	45	internal thread
8	feed tube	46	feed tube
9	inlet opening	47	end face
10	outlet opening	48	radial shoulder
12	Venturi nozzle	49	projection
13	throttling point	50	diameter
21	carrier	52	region
22	jet nozzle	53	inlet side
23	housing	54	heat exchanger
24	bore	56	pipe
25	housing	57	holding plate
26	middle portion	58	overhang
27	front portion	59	end face
28	rear portion	60	contact area
29	radial shoulder	61	sloping area
30	radial shoulder	62	collar
31	O-ring seal	63	sloping area
32	stop flange	64	recess
33	cover part	65	cylindrical wall portion
34	elastomer seal	66	weld
35	groove	67	stiffening sleeve
36	end piece	68	flange
37	flow channel	69	sloping area

- 70 radial groove
- 72 overhang
- 73 fixing bolt
- 74 threaded portion
- 75 threaded bore
- 76 front end
- 77 distance sensor


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Claims

1. A method for cleaning the pipes of a heat exchanger (54),
in which a jet nozzle is placed against one end of a pipe
(56) and a stream of air containing an abrasive is blown
through the pipe, characterized in that a throttle-free
jet nozzle (22) in which the outlet opening (39) is of the
same size or slightly smaller than the inner cross-
sectional area of the pipe (56) is used.
2. The method as claimed in claim 1, characterized in that
the jet nozzle (22) is pressed with a contact area (60)
encompassing the outlet opening (39) against the end face
(52) of an end of a pipe.
3. The method as claimed in one of the preceding claims,
characterized in that a number of pipes (56) are cleaned
simultaneously, a number of jet nozzles (22) held on a
carrier (21) in the same layout as the pipes of the heat
exchanger being placed against corresponding pipes (56b).
4. The method as claimed in claim 3, characterized in that
the carrier (21) is arrested on an end of a pipe, in that
a fixing bolt (73) protruding from it in the blasting
direction is introduced into the end of the pipe.
5. A blasting device for carrying out a method as claimed in
one of the preceding claims, characterized by an
unthrottled jet nozzle (22) with an outlet opening (39,
40), which is encompassed by a contact area (60) which
extends in the plane of the opening and interacts with the
end face (52) of a pipe (56).
6. The blasting device as claimed in claim 5, characterized
in that the jet nozzle (22) is passed through by a flow
channel (37) delimited by an inlet opening (39) and an
outlet opening (40), the flow channel (37) having a cross-
sectional area that substantially remains the same and

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corresponds approximately to the size of the outlet opening (39).

- 5 7. The device as claimed in claim 6, characterized in that the contact area (60) is delimited radially on the outside by an axially protruding collar (62), the stop area and the collar forming a receptacle (64) for an end of a pipe.
- 10 8. The blasting device as claimed in one of claims 5 to 7, characterized in that the region of the jet nozzle (22) comprising the receptacle (64) and the outlet opening (39) consists of an elastomer.
- 15 9. The blasting device as claimed in claim 8, characterized in that the elastomer region is formed by an end piece (36) that is in the form of a portion of pipe and is positively connected to the jet nozzle (22).
- 20 10. The blasting device as claimed in claim 8 or 9, characterized in that the longitudinal portion of the elastomer region that comprises the recess (64) is enclosed by a stiffening sleeve (67) made of solid material.
- 25 11. The blasting device as claimed in one of claims 5 to 10, characterized in that a number of jet nozzles (22) are arranged on the carrier (21) in the same layout as the pipes of the heat exchanger (54) to be cleaned.
- 30 12. The blasting device as claimed in one of claims 5 to 11, characterized in that on the carrier (21) there is a fixing bolt (73) which can be introduced into an end of a pipe.

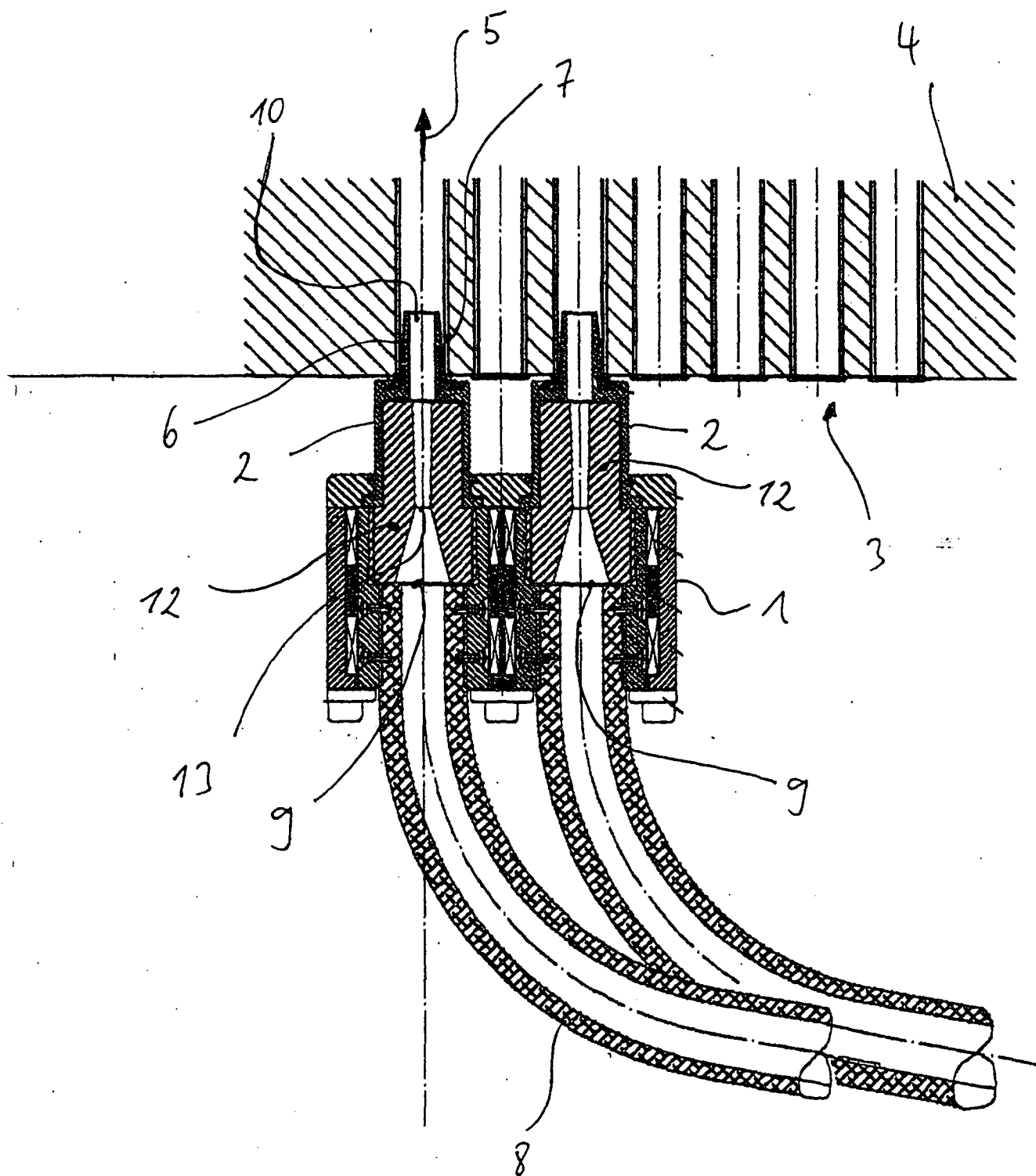


Fig. 1
stand der Technik

