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(54) **STEAM CLEANING APPARATUS WITH SUCTION**

(57) A steam cleaning apparatus with suction comprises generator means (2) of pressurized steam (S); out-flow and suction means (3) provided with at least one outflow opening (7), which is connected to the generator means (2) for supplying the steam (S) on a surface (100) to be cleaned, and with at least one suction opening (8) for sucking a waste fluid (W), in particular containing material that is removed from the surface (100); a storage

tank (4), which is connected to the suction opening (8) for receiving the waste fluid (W); and ejector means (5), which is interposed between the suction opening (8) and the storage tank (4) and is supplied by the generator means (2) with said pressurized steam (S) so as to create a depression at the suction opening (8) for sucking the waste fluid (W) and conveying the latter into the storage tank (4).

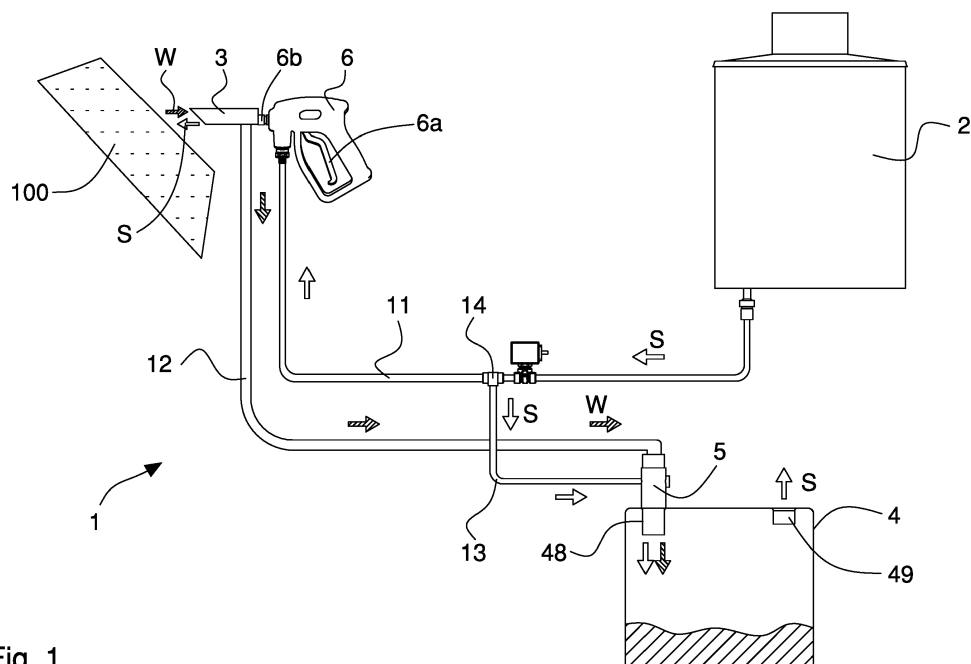


Fig. 1

Description

[0001] The invention relates to apparatuses for cleaning surfaces by means of steam and suction, and in particular relates to a cleaning apparatus suitable to generate steam and, at the same time, to suck liquids and/or solids, which are generated by cleaning.

[0002] Apparatuses for domestic, professional and industrial use are known that allow cleaning and washing surfaces by using steam and thus removing the dirt by sucking the latter. As is known, the steam is suitable to wash, clean and sanitize in optimal way dirty surfaces, such as floors, pavings, furniture, vehicles, etc. without using chemical detergents and maintaining a limited water consumption. The suction allows to effectively remove from the surfaces the dirt detached by the steam, in particular allows to suck and convey a waste fluid containing condensed steam and material that has been removed from the surfaces.

[0003] The known cleaning apparatuses comprise a steam generator capable to generate steam, typically dry saturated steam at a temperature comprised between 120 and 160 °C, at a suitable pressure of use and a suction pump that is capable to create a depression (pressure reduction) for sucking the solids and/or liquids containing the dirt.

[0004] The steam generator and the suction pump are powered by electric current, typically electric system current, and are generally housed inside a body of the apparatus and connected to a brush or cleaning terminal element by a flow hose (of the steam) and suction hose (of the waste or return fluid). Inside the apparatus body there are also housed a container for storing the waste fluid and suitable filtering means that prevents the solids and/or liquids and/or steam that are sucked to reach the suction pump, in order to avoid the latter to be damaged.

[0005] A drawback of the known cleaning apparatuses consists in the high cost and in the size and weight since two distinct operating units, namely the steam generator and the suction pump, are necessary for the operation that are both to be inserted into the apparatus body. Furthermore, said electric operating units consume a considerable amount of electrical energy during the operation, with a consequent increase of the operating costs.

[0006] Another drawback of the known cleaning systems is that the suction pump, especially in the case of prolonged and intense use, is subject to failure and breakages that make the cleaning apparatus unusable.

[0007] WO 2009/133243 discloses an equipment for washing carpets that is provided with a frame that comprises a conveyor for transferring a carpet between the different operating units, a control unit for controlling the operation of the equipment, at least one washing unit and at least one drying unit, which is downstream of the washing unit along a transport direction. The washing unit comprises a wet or dry cleaning unit with at least one brush and means for transferring the carpet; the drying unit has an air fan that supplies compressed air on the carpet at

a pressure that is comprised between 2 and 15 bar and dependent on the carpet type.

[0008] An object of the present invention is to improve the known cleaning apparatuses with steam generation and dirt suction.

[0009] Another object is to provide a compact and economic cleaning apparatus that allows performing an optimal steam cleaning and an efficient suction and storage of dirt, reducing energy consumption, in particular electrical energy consumption, and thus the operating costs.

[0010] A further object is to obtain a reliable and robust cleaning apparatus that allows a prolonged and intense use also for professional and industrial use.

[0011] These objects and others are achieved by a cleaning apparatus according to one or more of the following claims.

[0012] The steam cleaning apparatus with suction according to the invention comprises pressurized steam generator means, outflow and suction means provided with at least one outflow opening, which is connected to the generator means for supplying the steam on a surface to be cleaned, and at least one suction opening for sucking a waste fluid containing material that is removed from the surface, and a storage tank that is connected to the suction opening for receiving the waste fluid. The apparatus further includes ejector means that is interposed between the suction opening and the storage tank and is supplied by the generator means with the pressurized steam so as to create a depression (pressure reduction) at the suction opening for sucking the waste fluid and conveying the latter to the storage tank. The ejector means comprises a Coanda ejector having a passage duct, provided with an inlet portion that is convergent and in connection with the suction opening, an outlet portion that is divergent and in connection with the storage tank, and a central portion with narrow section that is interposed between the inlet portion and the outlet portion. The ejector also comprises an annular chamber that is external to the passage duct, connected through a plurality of holes to the central portion and supplied by the pressurized steam, which, coming out through the holes at high speed and sliding along an inner wall of the passage duct generates a depression in the latter by means of dragging action, in particular by dragging toward the outlet portion the waste fluid entering from the inlet portion.

[0013] Therefore, thanks to the cleaning apparatus of the invention it is possible to optimally wash and clean by steam surfaces to be cleaned, such as floors, pavings, furniture, objects, vehicles and, at the same time, effectively suck dirt that is removed by using only the pressurized steam generated by the generator means, i.e. without the need to have an electric suction pump for such purpose. In fact, the ejector means allows using the energy and the pressure of the steam for creating the depression that is necessary for an effective suction.

[0014] The cleaning apparatus of the invention, requiring only the steam generator means, is more compact

and economic than the known apparatuses and allows reducing the energy consumption, in particular the consumption of electricity, and the operating costs.

[0015] The cleaning apparatus, devoid of suction pump, is also more reliable and robust and allows a prolonged and intense use also for professional and industrial uses.

[0016] The invention will be better understood and implemented with reference to the attached drawings, which illustrate an exemplifying and not limiting embodiments thereof, in which:

- figure 1 is a schematic front view of the cleaning apparatus of the invention;
- figure 2 is an enlarged and partial view of the apparatus of figure 1, which illustrates outflow and suction means fixed to supplying means, partially shown;
- figure 3 is an enlarged and partial view of the apparatus of figure 1, which illustrates ejector means associated to a storage tank, partially illustrated;
- figure 4 is a plan view of the outflow and suction means of figure 2;
- figure 5 is a section according to line V-V of figure 4;
- figure 6 is a section according to line VI-VI of figure 4;
- figure 7 is an enlarged side view of the ejector means of figure 3;
- figure 8 is a section according to line VIII-VIII of figure 7;
- figure 9 is an exploded and section view of the ejector means of figure 7;
- figure 10 is an enlarged perspective view of an element of the ejectors means of figure 7.

[0017] With reference to figures 1 to 6, a steam cleaning apparatus 1 with suction is shown that comprises pressurized steam generator means 2 and outflow and suction means 3 that is provided with an outflow opening 7, which is connected to the generator means 2 for supplying pressurized steam S on a surface 100 to be cleaned, and an suction opening 8 for sucking a waste fluid W, containing material that is removed from the surface 100. The apparatus 1 also comprises a storage tank 4, which is connected to the suction opening 8 in order to receive and contain the waste fluid W, and ejector means 5, which is interposed between the suction opening 8 and the tank 4 and supplied by the generator means 2 with pressurized steam so as to create, at the suction opening 8, a depression (pressure reduction) that allows sucking the waste fluid W and conveying the latter into the storage tank 4, as better explained in the following description.

[0018] The waste fluid W comprises condensed steam and particles, residues, elements, material in solid and or liquid form that is removed by the steam from the surface 100.

[0019] The steam generator means 2 includes, for example, a boiler provided with a fuel powered burner, which is capable to heat the water coming from an accu-

mulation tank and generate pressurized saturated steam, for example at a temperature comprised between 120 and 180°C. Alternatively, the steam generator means 2 can comprise a boiler provided with electric resistors for heating the water.

[0020] The cleaning apparatus 1 includes a first duct 11, which connects the steam means generator 2 to the outflow and suction means 3, in particular to the outflow opening 7, a second duct 12, which connects the storage tank 4 to the outflow and suction means 3, in particular to the suction opening 8, and a third duct 13, which connects the steam generator means 2 to the ejector means 5.

[0021] In the illustrated embodiment, the third duct 13 is connected to the first duct 11, for example by means of a "T" connection 14, for receiving from the first duct the pressurized steam coming from the generator means 2.

[0022] The ducts 11, 12, 13 comprise respective flexible tubes or hoses, which are for example made of plastic and/or elastomeric material that is resistant to operating temperatures of the steam S.

[0023] The apparatus further includes supplying means 6 that is interposed between the generator means 2 and the outflow and suction means 3 for controlling and adjusting a flow rate of the pressurized steam S that is supplied to the outflow and suction means 3.

[0024] In the illustrated embodiment, the supplying means comprises a supplying gun 6, which can be grasped by an operator and is provided with a driving lever 6a for the steam adjustable outflow. The supplying gun 6 is fixed to, and supports, the outflow and suction means 3 that can be easily moved and oriented by the operator with the gun 6.

[0025] With particular reference to figures 4 to 6, the outflow and suction means comprises an operating element 3 that is provided with a body 40, having a prismatic shape, for example having a substantially trapezoidal plan shape, provided with a working wall 41, which is arranged for interacting with the surface 100 and on which the outflow opening 7 of steam and the suction opening 8 of waste fluid W are carried out.

[0026] The body 40 includes an outflow chamber 42 that comprises the outflow opening 7 and an outflow duct 43, which connects the outflow chamber 42 to a steam inlet opening 44 that is connectable to the generator means 2. The body 40 further includes a suction chamber 45 having the suction opening 8 and a suction duct 46 that connects the suction chamber 45 to an outlet opening 47 of the removed material that is connectable to the storage tank 4.

[0027] The outflow chamber 42 and the suction chamber 45 have section that is divergent in the direction of the outflow opening 7 and suction opening 8, respectively.

[0028] In the illustrated embodiment, the steam inlet opening 44 of the operating element 3 is connected to a supplying connection 6b of the gun 6, while the outlet

opening 47 is connected to the storage tank 4 through the second duct 12.

[0029] With reference to figure 3, the ejector means includes in the illustrated embodiment a Coanda ejector 5. The Coanda ejector 5 comprises a passage duct 20, which is provided with an inlet portion 21 of substantially convergent shape and in flow connection with the suction opening 8 of the outflow and suction means 3, an outlet portion 22, having a substantially divergent shape and in flow connection with the storage tank 4, and a central portion 23 with narrow section so as to form a narrowing, interposed between the inlet portion 21 and outlet portion 22.

[0030] The ejector 5 also comprises an annular chamber 24, which is external to the passage duct 20, is connected through a plurality of holes 25 to the central portion 23 of the passage duct 20 and is supplied by the pressurized steam S coming from the generator means 2 through the third duct 13. The holes 25 are oblique with respect to a longitudinal axis X of the passage duct 20 in order to give a cyclonic or vortex motion to the steam S along the inner wall of said passage duct 20.

[0031] In the operation, the pressurized steam that is injected through the holes 25 flows at high speed (due to the section narrowing in the central portion 23 and to the cyclonic motion given by the oblique holes) along an inner wall of the passage duct 20 and generates a depression (pressure reduction) in the latter by means of dragging action. More precisely, the waste fluid W that is sucked into the passage duct 20 through the inlet portion 21 comes into contact with the steam, which flows at high speed and with cyclonic motion along the inner wall of the passage duct 20, and is dragged out of the passage duct 20 according to the fluid dynamic phenomenon that is known as Coanda effect.

[0032] With particular reference to figures 7 to 10, in the illustrated embodiment the ejector 5 includes a first element 16 comprising a first housing 26, having at least one first side opening 36, in particular two first side openings 36 facing each other, and the divergent outlet portion 22 of the passage duct 20 in flow connection with the first housing 26.

[0033] A second element 17 of the ejector 5 is inserted into the first housing 26 of the first element 16 and comprises a second housing 27, having at least one second side opening 37 facing the first side opening 36 of the first housing 26, in particular two second side openings 37 facing each other and the respective first side openings 36. The second element 17 of the ejector also comprises the convergent inlet portion 21 of the passage duct 20 that is connected to the second housing 27.

[0034] The ejector 5 includes a third element 18 that is inserted into the second housing 27 of the second element 17 and comprises a third housing 28 having at least one third side opening 38 facing the second side opening 37 of the second housing 27, in particular having two third side openings 38 facing each other and the respective second side openings 37.

[0035] A fourth element 19 of the ejector 5 is inserted into the third housing 28 of the third element 18 and comprises an outer annular groove 24a, which faces the third side openings 38 and forms the annular chamber 24 with an internal wall of the third housing 28. The fourth element 19 includes the central portion 23 of the passage duct 20, which is connected to the outer annular groove 24a through the plurality of holes 25. The holes 25 are carried out inclined with respect to the longitudinal axis X of the passage duct 20 and angularly spaced out around said axis X.

[0036] In an assembled configuration, at least one of the first side openings 36 (the remaining one being closed by a plug) is connected to the third duct 13 for receiving the pressurized steam, while the inlet portion 21 of the passage duct 20 is connected with the second duct 12 for receiving the waste fluid W coming from the outflow and suction means 3. The outlet portion 22 of the passage duct 20 is directly connected to the storage tank 4 through a respective inlet opening 48 thereof. The storage tank 4 further comprises a venting opening 49 for the steam that is dragged with the waste fluid W.

[0037] In a variant of the apparatus that is not illustrated in the figures, the ejector means 5 comprises a Venturi ejector, of known type. In this case, the ejector comprises a Venturi duct provided with an inlet portion, which is connected to the generator means 2 and is supplied with pressurized steam, an outlet portion, which is connected to the storage tank 4, and a central portion, which has a narrow section and is interposed between the inlet portion and the outlet portion. An annular chamber, which is external to the Venturi duct, is connected at one side to the suction opening and at the other side to the central portion. In this manner, the pressurized steam, by passing through the central portion of the Venturi duct, accelerates so as to generate, by Venturi effect, a depression (pressure reduction) inside the annular chamber that draws the waste fluid W.

[0038] In the operation of the cleaning apparatus of the invention, the pressurized steam S generated by the generator means 2 is supplied by the outflow and suction means 3 on the surface 100 to be cleaned. For this purpose, the user activates the supplying gun 6 by acting on the driving lever 6a.

[0039] The pressurized steam S comes out from the outflow opening 7 of the outflow and suction means 3 and hits the surface 100 for cleaning and washing the latter.

[0040] At the same time, part of the pressurized steam generated by the generator means 2 reaches the ejector means 5 through the third duct 13, generating a depression (pressure reduction) inside the passage duct 20 of said ejector means 5 by virtue of the fluid dynamic phenomenon described above (Coanda effect). The depression extends along the second duct 12 up to the suction opening 8 of the outflow and suction means 3. In this manner, the outflow and suction means 3 is capable to suck effectively a waste fluid W generated by cleaning

and washing the surface 100. Along the second duct 12, the waste fluid W is dragged by depression and then conveyed inside the storage tank 4. The steam (cleaned), which is eventually present in the waste fluid W arrived in the storage tank 4, can come out in the environment through the venting opening 49.

[0041] Therefore, thanks to the cleaning apparatus of the invention it is possible to wash and clean by steam in optimal way surfaces to be cleaned, such as floors, pavings, furniture, objects, vehicles, and at the same time to suck in effective way dirt that is removed by using only the pressurized steam generated by the generator means, i.e. without the need to have an electric suction pump for this purpose. In fact, the ejector means allows using the energy and pressure of steam for generating the depression required for an effective suction.

[0042] The cleaning apparatus of the invention, requiring only the steam generator means, is particularly compact and economic and allows reducing the energy consumption, in particular the consumption of electricity, and the operating costs.

[0043] The cleaning apparatus, devoid of suction pump, is also more reliable and robust and allows a prolonged and intense use also for professional and industrial uses, for such uses the boiler of the generator means to be sized accordingly.

Claims

1. Steam cleaning apparatus with suction comprising:

- generator means (2) of pressurized steam;
- outflow and suction means (3) provided with at least one outflow opening (7), which is connected to said generator means (2) for supplying said pressurized steam (S) on a surface (100) to be cleaned, and at least one suction opening (8) for sucking a waste fluid (W), in particular containing material removed from said surface (100);
- a storage tank (4) connected to said suction opening (8) for receiving said waste fluid (W);

characterized in that it comprises ejector means (5) interposed between said suction opening (8) and said storage tank (4) and supplied with said pressurized steam (S) by said generator means (2) so as to create a depression at said suction opening (8) for sucking said waste fluid (W) and conveying the latter into said storage tank (4).

2. Apparatus according to claim 1, comprising supplying means (6) interposed between said generator means (2) and said outflow and suction means (3) for controlling and adjusting a flow of said pressurized steam (S) directed to said outflow and suction means (3).

3. Apparatus according to claim 2, wherein said outflow and suction means (3) is fixed to, and in flow connection with, said supplying means (6).

4. Apparatus according to any preceding claim, comprising a first duct (11) for connecting said generator means (2) to said outflow and suction means (3), in particular to said outflow opening (7), a second duct (12) for connecting said storage tank (4) to said outflow and suction means (3), in particular to said suction opening (8), and a third duct (13) for connecting said generator means (2) to said ejector means (5).

5. Apparatus according to claim 4, wherein said third duct (13) is connected to said first duct (11) for receiving from the latter said pressurized steam.

6. Apparatus according to any preceding claim, wherein said ejector means includes at least one Coanda ejector (5).

7. Apparatus according to claim 6, wherein said ejector (5) comprises:

- a passage duct (20) provided with an inlet portion (21) which is convergent and in connection with said suction opening (8), an outlet portion (22) which is divergent and in connection with said storage tank (4) and a central portion (23) with a narrow section, which is interposed between said inlet portion (21) and said outlet portion (22);
- an annular chamber (24) external to said passage duct (20), connected to said central portion (23) through a plurality of holes (25) and supplied by said pressurized steam (S);

wherein said steam by outflowing at high speed through said holes (25) and flowing along an inner wall of said passage duct (20) generates a depression in the latter by dragging action, in particular dragging toward the outlet portion (22) the waste fluid (W) entering from the inlet portion (21).

8. Apparatus according to claim 7, wherein said holes (25) are inclined with respect to a longitudinal axis (X) of said passage duct (20) in order to give a cyclonic or vortex motion to said steam inside said passage duct (20).

9. Apparatus according to claim 7 or 8, wherein said ejector (5) includes:

- a first element (16) comprising a first housing (26), which has at least one first side opening (36), and said divergent outlet portion (22) of said passage duct (20) connected to said first housing (26),

- a second element (17) inserted into said first housing (26) and comprising a second housing (27), which has at least one second side opening (37) facing said first side opening (36), and said convergent inlet portion (21) of said passage duct (20) connected to said second housing (27), 5

- a third element (18) inserted into said second housing (27) and comprising a third housing (28), which has at least one third side opening (38) facing said second side opening (37), and 10

- a fourth element (19) inserted into said third housing (28) and comprising an outer annular groove (24a), facing said third side opening (38) and defining with an internal wall of said third housing (28) said annular chamber (24), and said central portion (23) of said passage duct (20), which is connected to said outer annular groove (24a) through said plurality of holes (25). 15

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10. Apparatus according to any of claims 1 to 5, wherein said ejector means includes a Venturi ejector.

11. Apparatus according to any preceding claim, wherein said outflow and suction means comprises an operating element (3) provided with a body (40) having a working wall (41) arranged for interacting with said surface (100) and on which said outflow opening (7) and said suction opening (8) are carried out. 25

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12. Apparatus according to claim 11, wherein said body (40) includes an outflow chamber (42) having said outflow opening (7), an outflow duct (43) for connecting said outflow chamber (42) to a steam inlet opening (44) connectable to said generator means (2), a suction chamber (45) having said suction opening (8) and a suction duct (46) for connecting said suction chamber (45) to an outlet opening (47) of the waste fluid (W) that is connectable to said storage tank (4). 35

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13. Apparatus according to any preceding claim, wherein said ejector means (5) is fixed to a respective inlet opening (48) of said storage tank (4), which further comprises a venting opening (49) for the steam. 45

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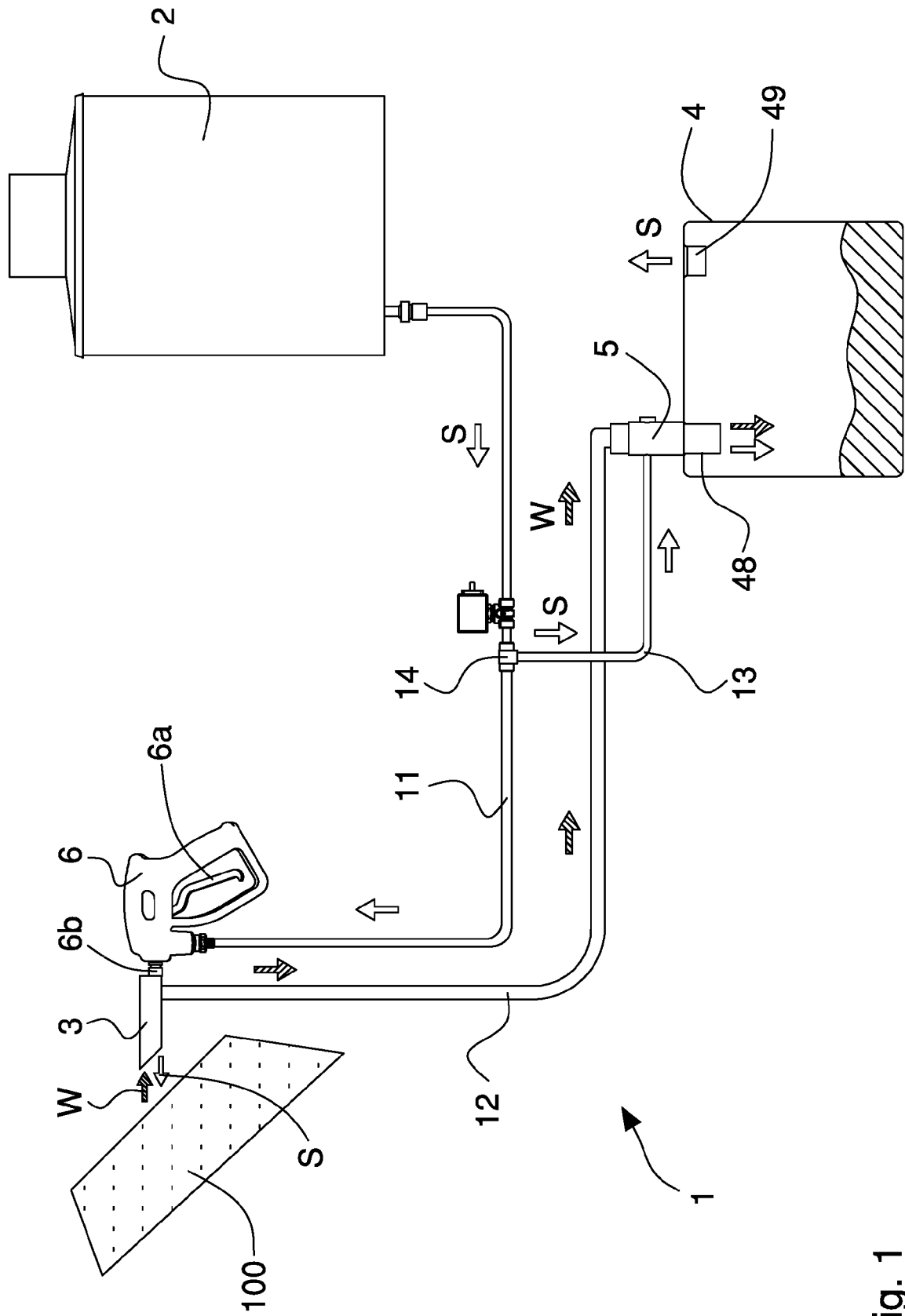


Fig. 1

Fig. 2

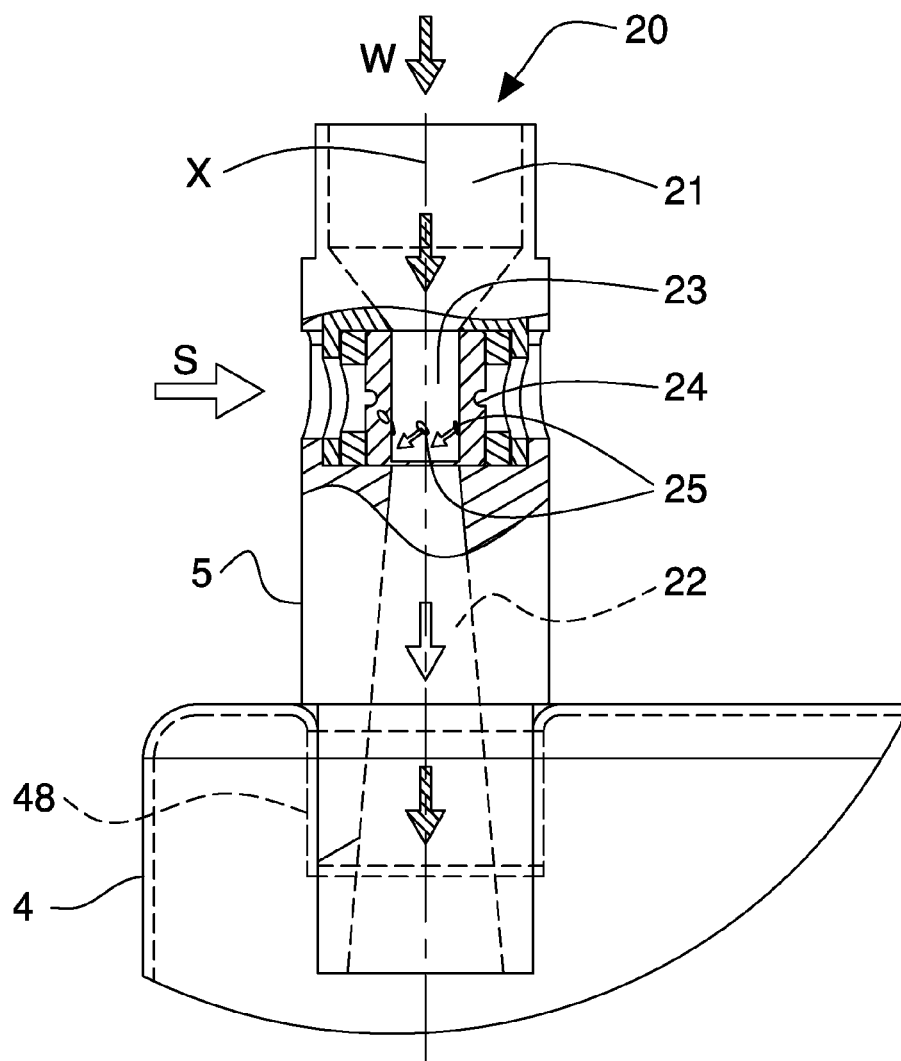
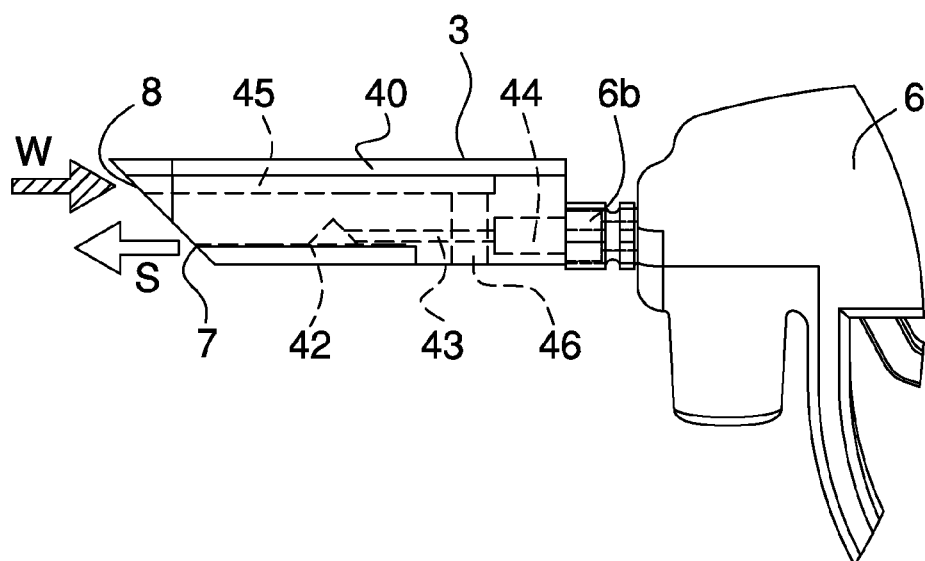


Fig. 3

Fig. 4

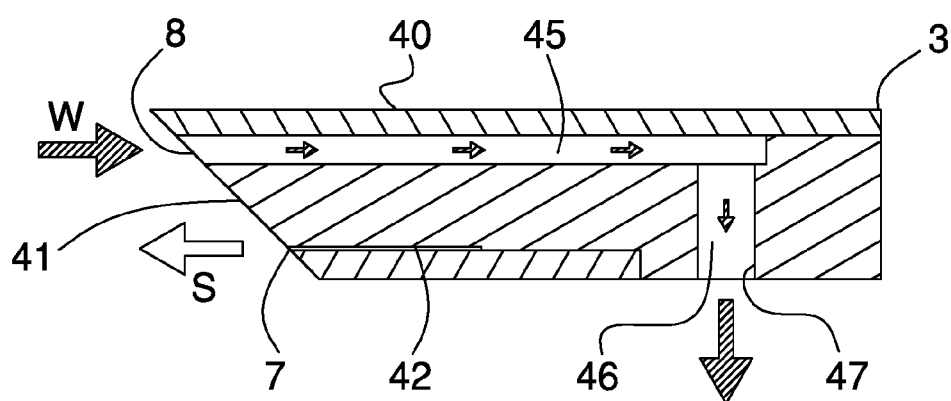
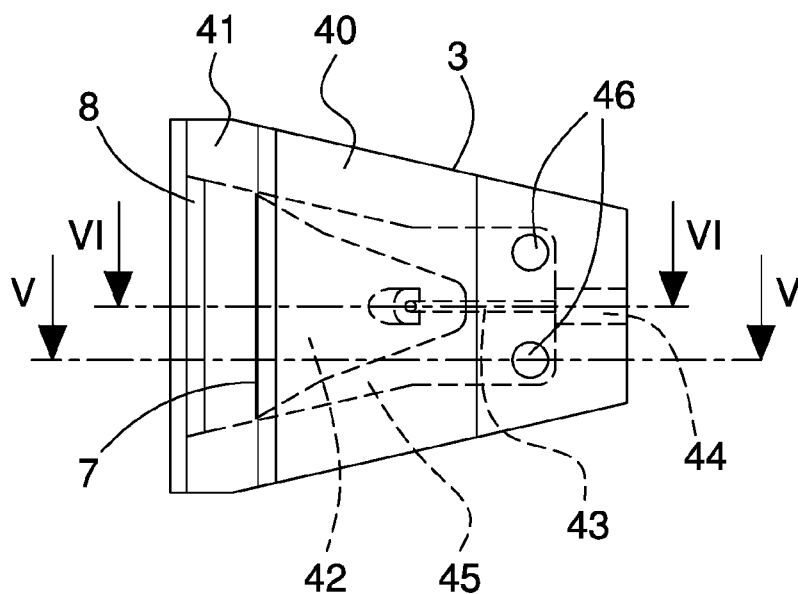


Fig. 5

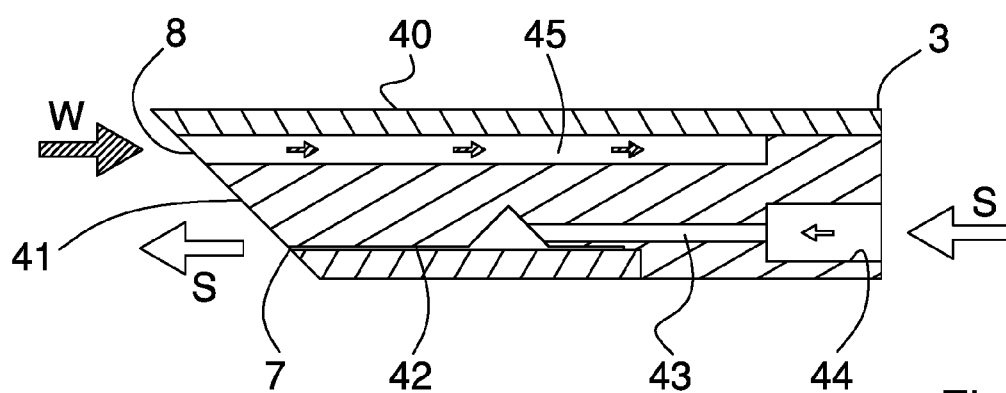


Fig. 6

Fig. 7

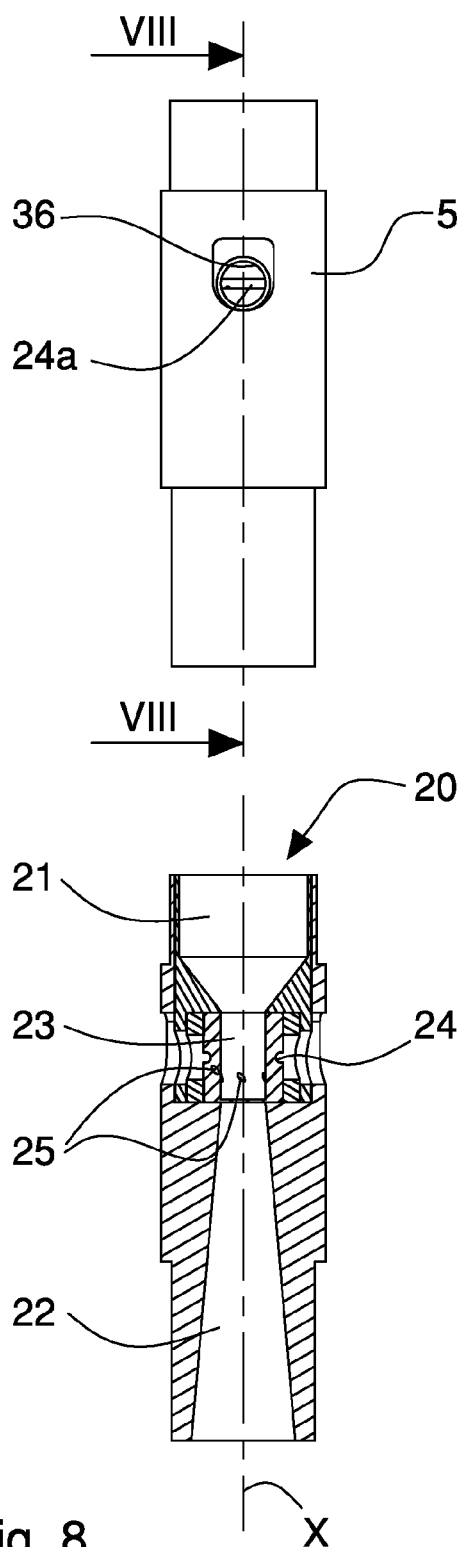


Fig. 8

Fig. 9

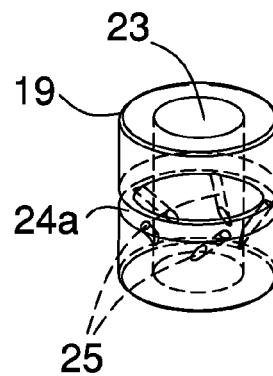
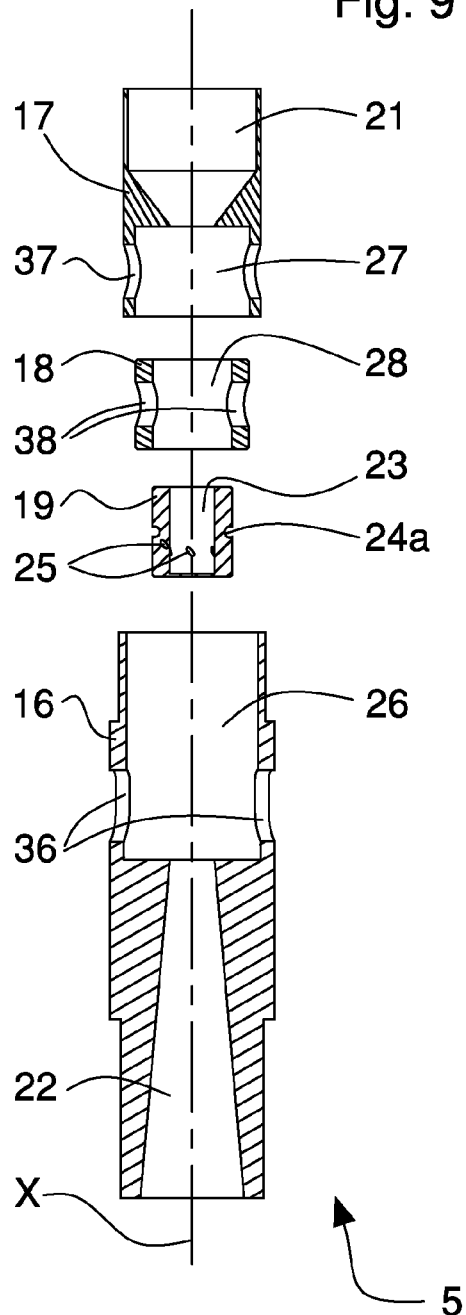


Fig. 10



EUROPEAN SEARCH REPORT

Application Number
EP 16 16 6616

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DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	WO 2009/133243 A1 (WEST HEAT RAUMA OY) 5 November 2009 (2009-11-05) * abstract * * page 2, line 36 - page 3, line 8 * * page 5, line 34 - page 6, line 10 * * page 9, line 1 - line 3 * * figure 1 * -----	1	INV. A47L7/00 A47L11/30 A47L11/40 B08B3/02
			TECHNICAL FIELDS SEARCHED (IPC)
			A47L B08B
The present search report has been drawn up for all claims			
Place of search		Date of completion of the search	Examiner
Munich		12 July 2016	Baumgärtner, Ruth
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