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(54) **SPRAYER FOR APPLYING A FLUID ON THE INNER SURFACE OF A TUBULAR ELEMENT**

(57) The present invention relates to a sprayer (10) for applying a fluid on the inner surface of a tubular element.

In particular, this sprayer (10) comprises:
- a substantially tubular supporting body (16a, 16b);
- a diffusion bell (11);
- rotation means (12) interposed between the supporting body (16a, 16b) and the diffusion bell (11) and connected to the base (11a) of the diffusion bell (11); more precisely, these rotation means (12) are configured to rotate the diffusion bell (11) around its axis of symmetry (X) with respect to the supporting body (16a, 16b);
- a pipe (13) configured to convey the aforesaid fluid to the inner surface of the diffusion bell (11), the pipe (13) being substantially rectilinear and passing through the base (11a) of the diffusion bell (11) coaxially to the aforesaid axis of symmetry (X);
- rotation detecting means (20) configured to detect the instantaneous rotation speed of the rotation means (12) and operationally connected to the circuit (18) so as to define a feedback control of the flow of compressed air towards the turbine (17).

The detecting means (20) comprise at least one winding coupled with at least one permanent magnet and adapted to convert a portion of the mechanical power associated with the rotation means (12) into electrical power to power the electronics of the detecting means (20).

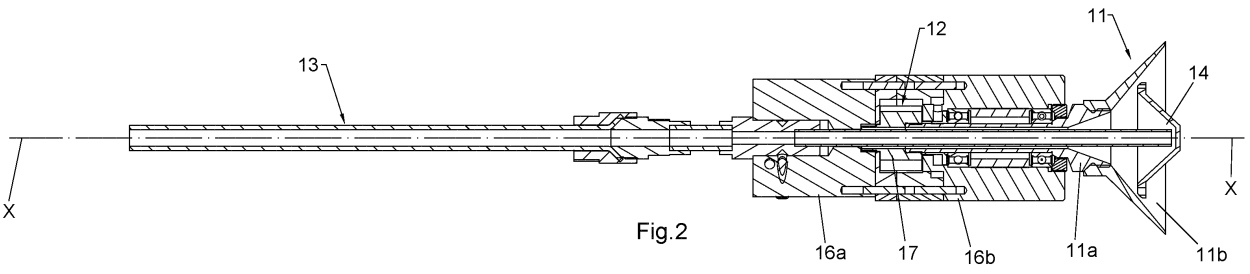

Fig.2

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Description

[0001] The invention relates to a sprayer for applying a fluid on the inner surface of a tubular element.

[0002] Nowadays, sprayers capable of applying a fluid to the inner surface of tubular elements are known.

[0003] Such a sprayer of the known-type comprises:

- a supporting body;
- a diffusion bell;
- rotation means interposed between said supporting body and said diffusion bell, where such rotation means are configured to rotate the diffusion bell about its axis of symmetry with respect to the supporting body;
- a pipe configured to convey the aforesaid fluid to the inner surface of the diffusion bell.

[0004] Such a sprayer, although well known and appreciated, however has some important limitations.

[0005] In particular, a first limitation is related to the impossibility of using this sprayer, due to its size, on the inner surfaces of tubular elements with a diameter lower than a certain threshold value.

[0006] A second limitation is instead related to the application of the fluid on the inner surfaces of tubular elements, which is not sufficiently homogeneous in some technical contexts requiring precision.

[0007] The task of the present invention is to develop a sprayer capable of obviating the aforementioned drawbacks and limitations of the prior art.

[0008] In particular, the object of the present invention is to realise a sprayer whose size is smaller than similar sprayers of the known type.

[0009] Further, an object of the invention is to develop a sprayer whose application of the fluid on the inner surfaces of tubular elements is more homogeneous than similar sprayers of the known type.

[0010] The above-mentioned task and objects are achieved by a sprayer according to claim 1.

[0011] Further characteristics of the sprayer according to claim 1 are described in the dependent claims.

[0012] The aforesaid task and objects, together with the advantages that will be mentioned hereinafter, are indicated by the description of an embodiment of the invention, which is given by way of non-limiting example with reference to the attached drawings, where:

- Figure 1 represents a side view of a sprayer according to the invention;
- Figure 2 represents a first section side view of the sprayer of Figure 1;
- Figure 3 represents a perspective view of a first detail of the sprayer of Figure 1;
- Figure 4 represents a section perspective view of a second detail of the sprayer of Figure 1;
- Figure 5 represents a second section side view of the sprayer of Figure 1.

[0013] With reference to the above-mentioned figures, a sprayer according to the invention, adapted to apply a fluid to an inner surface of a tubular element, is indicated as a whole with the number 10 and is clearly visible in Figures 1, 2 and 5.

[0014] This sprayer **10** comprises:

- a substantially tubular supporting body **16a** and **16b,** clearly visible in Figures 1, 2, 3, 4 and 5;
- a diffusion bell 11, clearly visible in Figures 1, 2, 3, 4 and 5;
- rotation means **12,** clearly visible in Figures 2, 4 and 5, interposed between the supporting body **16a** and **16b** and the diffusion bell **11,** wherein said rotation means **12** are connected to the base **11a** of the diffusion bell **11;** in particular, these rotation means **12** are configured to rotate the diffusion bell 11 about its axis of symmetry X with respect to the supporting body **16a** and **16b;**
- a pipe **13,** clearly represented in Figures 1 and 2, configured to convey the aforesaid fluid to the inner surface of the diffusion bell 11.

[0015] It is important to emphasise that this pipe **13** is substantially rectilinear and crosses the base **11a** of the diffusion bell 11 coaxially to the axis of symmetry **X,** as represented in Figure 2.

[0016] This advantageously results in a sprayer **10** which is less bulky than similar sprayers of the known type, as the pipe 13 for conveying the aforementioned fluid towards the diffusion bell 11 is completely contained within the supporting body **16a** and **16b** of the sprayer 10.

[0017] Equally advantageously, the coaxial positioning of the pipe **13** in relation to the diffusion bell **11,** still as represented in Figure 2, allows for a more homogeneous application of the aforesaid fluid on the inner surfaces of tubular elements than is the case with similar sprayers of the known type.

[0018] From the present embodiment of the invention, it can be easily inferred that the diffusion bell **11** has its concavity in a position distal to the supporting body **16a** and **16b.**

[0019] This makes it possible to diffuse the fluid in the direction opposite to the supporting body **16a** and **16b,** ensuring less collateral deposition of the aforesaid fluid on the outer surface of said supporting body **16a** and **16b.**

[0020] It cannot, however, be ruled out that the diffusion bell **11** has its own concavity oriented in the direction of the supporting body **16a** and **16b,** still falling within the protective scope of the present invention.

[0021] It is also noted that the diffusion bell **11** comprises a truncated-cone body **11b** and a containment element **14** attached to said inner surface of the diffusion bell **11** so as to form a fluid storage compartment, as it can be inferred from the Figures 1, 2, 3 and 5.

[0022] More specifically, the pipe **13** faces the inner surface of the containment element **14** and the diffusion bell **11** shows at least one slit **15** defined between the

truncated-cone body **11b** and the containment element **14** to allow the diffusion of said fluid when the diffusion bell **11** is placed in rotation by the rotation means **12.**

[0023] This containment element **14** and these three slits **15** make it advantageously possible to obtain a better atomisation of the aforesaid fluid.

[0024] Moreover, as it can be seen in Figures 1, 2, 3 and 5, this containment element **14** is convex with respect to said inner surface of said truncated-cone body **11b,** but it cannot be excluded that the containment element **14** is flat in various embodiments of the invention.

[0025] It can neither be ruled out that the slits **15** are in a number other than the one described in the present embodiment of the invention.

[0026] The rotation means **12** comprise a turbine **17,** clearly visible in Figures 2, 4 and 5, which is rotatably constrained within the supporting body **16a** and **16b** coaxially to the axis of symmetry **X** of the diffusion bell **11.**

[0027] Even more precisely, the aforesaid turbine **17** is operatively connected to the base **11a** of the diffusion bell **11** and is configured to be rotated by a compressed air circuit **18,** where the use of the turbine **17** and of the circuit **18** advantageously allow the structure of the sprayer **10** to be made even more compact.

[0028] The supporting body **16a** and **16b** comprises an inlet channel **18a** and an outlet channel **18b** of the circuit **18,** both visible in Figures 1 and 5.

[0029] In addition, the supporting body **16a** and **16b** has an inlet groove **19a,** clearly shown in Figure 4, connected to the inlet channel **18a** and defined at the plane in which the turbine **17** lies orthogonally to the axis of symmetry **X.**

[0030] More precisely, this inlet groove **19a** is configured to make the air flow tangentially to the turbine **17** and then towards the aforementioned outlet channel **18b.**

[0031] This inlet groove **19a** allows the compressed air conveyed by the inlet channel **18a** to be accelerated, causing the turbine **17** to rotate at high speeds much faster than similar known-type sprayers.

[0032] In this embodiment of the invention, the supporting body **16a** and **16b** also has an outlet groove **19b,** also shown in Figure 4, connected to the outlet channel **18b** and defined in the same plane as the inlet groove **19a.**

[0033] As shown in Figure 4, the inlet groove **19a** has an angle of curvature greater than 90°.

[0034] Even more precisely, this inlet groove **19a** has a substantially C-shaped profile. The sprayer **10** also comprises rotation detecting means **20,** clearly visible in Figure 5, configured to detect the instantaneous rotation speed of the rotation means **12** and operationally connected to the circuit **18** so as to define a feedback control of the flow of compressed air towards the turbine **17.**

[0035] In particular, the detecting means **20** comprise at least one permanent magnet fixed integrally to the rotation means **12** and configured to generate a magnetic field in a substantially radial direction with respect to the longitudinal development of said rotation means **12.**

[0036] In this configuration, the aforementioned detecting means **20** comprise a magnetic detector **20a,** clearly visible in Figure 5, coupled with the aforesaid permanent magnet and configured to detect the rotational speed of the rotation means **12.**

[0037] Also according to said embodiment of the invention, the detecting means **20** comprise at least one winding coupled with the aforesaid permanent magnet and adapted to convert a portion of the mechanical power associated with the rotation means **12** into electrical power for powering the electronics of the detecting means **20.**

[0038] Furthermore, the detecting means **20** according to the present embodiment of the invention still comprise a wireless transmission module configured to transmit to an external receiving device data related to the rotation speed.

[0039] It is emphasised that, in the present embodiment of the invention, the wireless transmission module is also powered by the aforesaid winding. Advantageously, in this configuration, no wiring is required to power the electronics of the detecting means **20** and to transmit the aforesaid data related to the rotation speed, which is typically difficult in the context of spraying tubular elements with particularly long longitudinal development.

[0040] In addition, the sprayer **10** comprises an electromechanical unit to adjust the aforesaid flow of compressed air towards the turbine **17.**

[0041] Specifically, this electromechanical adjustment unit comprises an electric motor and an adjustment valve configured to act on the flow of compressed air towards the turbine **17** based on the data related to the rotation speed.

[0042] This allows to circumscribe the feedback control of the flow of compressed air within the sprayer **10,** making it advantageously unnecessary to transmit to an external receiving device the data related to the rotation speed and thus to control the amount of flow of compressed air applied to the inlet channel **18a** of the circuit **18.**

[0043] Therefore, the sprayer **10** according to the present embodiment is autonomous in the implementation of the aforesaid feedback control of the flow of compressed air towards the turbine **17.**

[0044] Practically, it has been established that the invention achieves the intended task and objects.

[0045] In particular, with the invention, a sprayer has been developed that is less bulky than similar sprayers of the known type.

[0046] In addition, a sprayer has been developed whose application of the fluid on the inner surfaces of tubular elements is more homogeneous than similar sprayers of the known type.

[0047] The invention thus conceived is susceptible of numerous modifications and variations, all of which are within the scope of the inventive concept; moreover, all the details may be replaced by other technically equivalent elements.

[0048] In practice, the components and materials

used, as long as they are compatible with the specific use, as well as the dimensions and the contingent shapes can be anyone according to requirements and the prior art.

[0049] If the characteristics and techniques mentioned in any claim are followed by reference signs, these reference signs are to be intended for the sole purpose of increasing the intelligibility of the claims and, consequently, such reference signs have no limiting effect on the interpretation of each element identified by way of example by these reference signs.

Claims

1. Sprayer (10) for applying a fluid on the inner surface of a tubular element, said sprayer (10) comprising:

- a substantially tubular supporting body (16a, 16b);
- a diffusion bell (11);
- rotation means (12) interposed between said supporting body (16a, 16b) and said diffusion bell (11) and connected to the base (11a) of said diffusion bell (11), said rotation means (12) being configured to rotate said diffusion bell (11) about its axis of symmetry (X) with respect to said supporting body (16a, 16b), said rotation means (12) comprising a turbine (17) rotatably constrained within said supporting body (16a, 16b) coaxially to said axis of symmetry (X) of said diffusion bell (11), said turbine (17) being operatively connected to said base (11a) of said diffusion bell (11) and being configured to be rotated by a compressed air circuit (18);
- a pipe (13) configured to convey said fluid to the inner surface of said diffusion bell (11),

said pipe (13) being substantially rectilinear and passing through said base (11a) of said diffusion bell (11) coaxially to said axis of symmetry (X);

- rotation detecting means (20) configured to detect the instantaneous rotation speed of said rotation means (12) and operatively connected to said circuit (18) so as to define a feedback control of the flow of compressed air towards said turbine (17), said detecting means (20) comprising at least one permanent magnet integrally fixed to said rotation means (12) and configured to generate a magnetic field in a substantially radial direction with respect to the longitudinal development of said rotation means (12), said detecting means (20) comprising a magnetic detector coupled with said at least one permanent magnet and configured to detect said rotation speed of said rotation means (12);

characterised in that said detecting means (20) comprise at least one winding coupled with said at least one permanent magnet and adapted to convert a portion of the mechanical power associated with said rotation means (12) into electrical power for powering the electronics of said detecting means (20).

2. Sprayer (10) according to claim 1, **characterised in that** said detecting means (20) comprise a wireless transmission module powered by said winding and configured for transmitting to an external receiving device data related to said rotation speed.

3. Sprayer (10) according to claim 1 or 2, **characterised in that** said diffusion bell (11) has its concavity in a position distal to said supporting body (16a, 16b).

4. Sprayer (10) according to claim 3, **characterised in that** said diffusion bell (11) comprises a truncated-cone body (11b) and a containment element (14) fixed to said inner surface of said diffusion bell (11) so as to form an accumulation compartment for said fluid, said pipe (13) facing the inner surface of said containment element (14), said diffusion bell (11) having at least one slit (15) defined between said truncated-cone body (11b) and said containment element (14) to allow the diffusion of said fluid when said diffusion bell (11) is rotated by said rotation means (12).

5. Sprayer (10) according to claim 4, **characterised in that** said containment element (14) is substantially convex with respect to said inner surface of said truncated-cone body (11b).

6. Sprayer (10) according to any one of the preceding claims, **characterised in that** said supporting body (16a, 16b) comprises an inlet channel (18a) and an outlet channel (18b) of said circuit (18), said supporting body (16a, 16b) having an inlet groove (19a) connected to said inlet channel (18a) and defined at the plane in which said turbine (17) lies orthogonally to said axis of symmetry (X), said inlet groove (19a) being configured to make the air flow tangentially to said turbine (17) and subsequently towards said outlet channel (18b).

7. Sprayer (10) according to claim 6, **characterised in that** said inlet groove (19a) has an angle of curvature greater than 90°.

8. Sprayer (10) according to claim 7, **characterised in that** said inlet groove (19a) has a substantially C-shaped profile.

9. Sprayer (10) according to any one of the preceding claims, **characterised in that** it comprises an elec-

tromechanical adjustment unit for adjusting said flow of compressed air towards said turbine (17), said electromechanical adjustment unit comprising an electric motor and an adjustment valve configured to act on said flow of compressed air towards said turbine (17) based on said data related to said rotation speed.

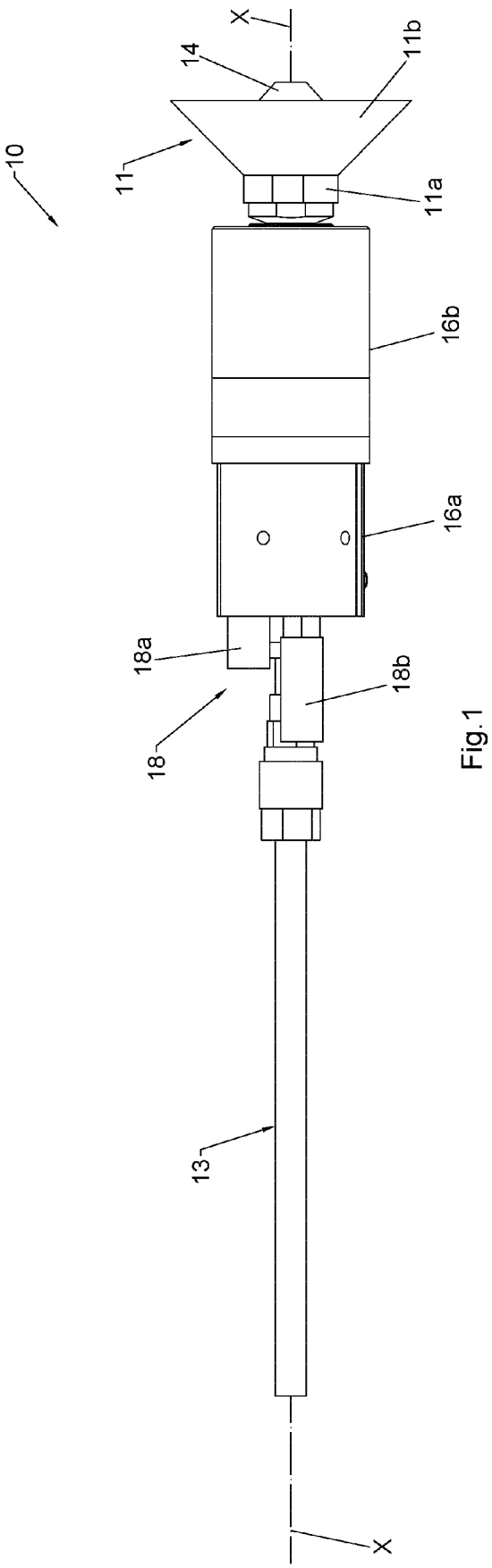
10
11
14
11b
11a
16b
16a
18a
18b
18
13
X
X

Fig.1

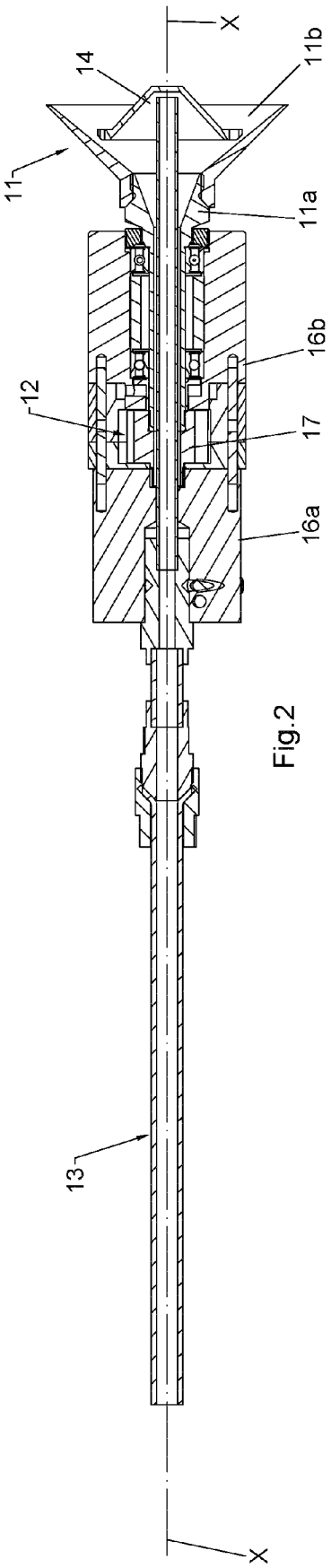
11
14
11b
11a
16b
12
17
16a
13
X
X

Fig.2

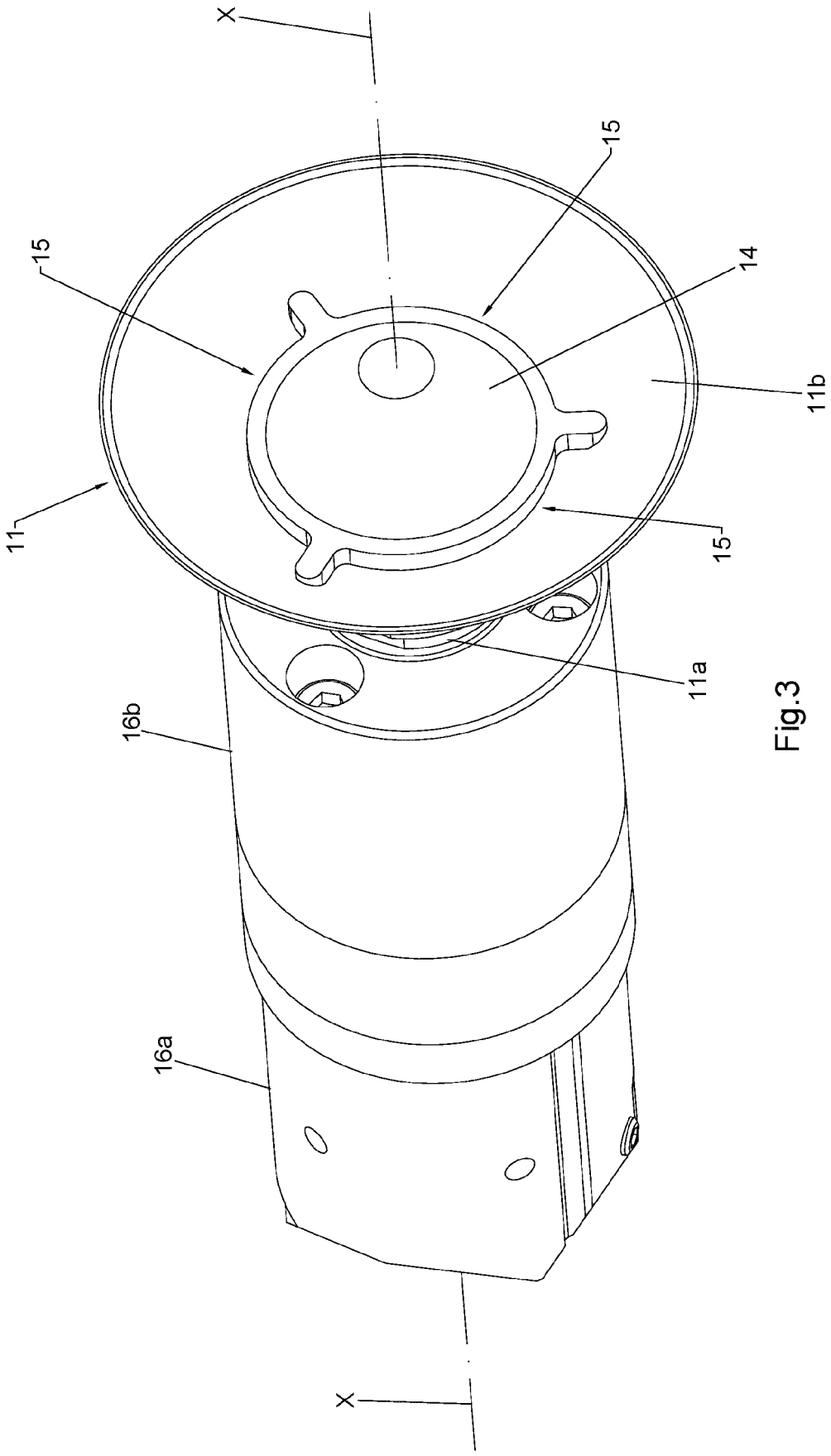

Fig.3

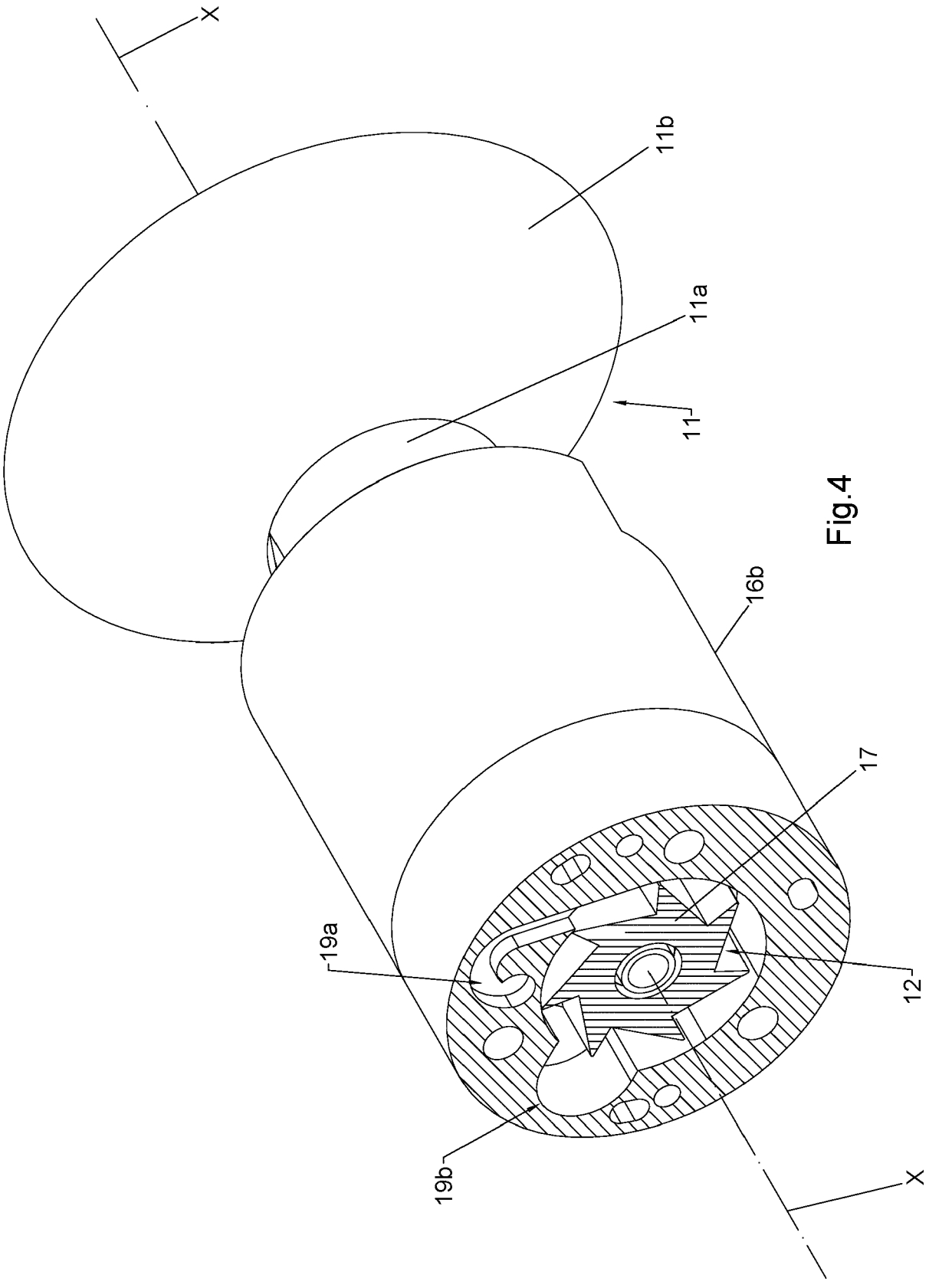

Fig.4

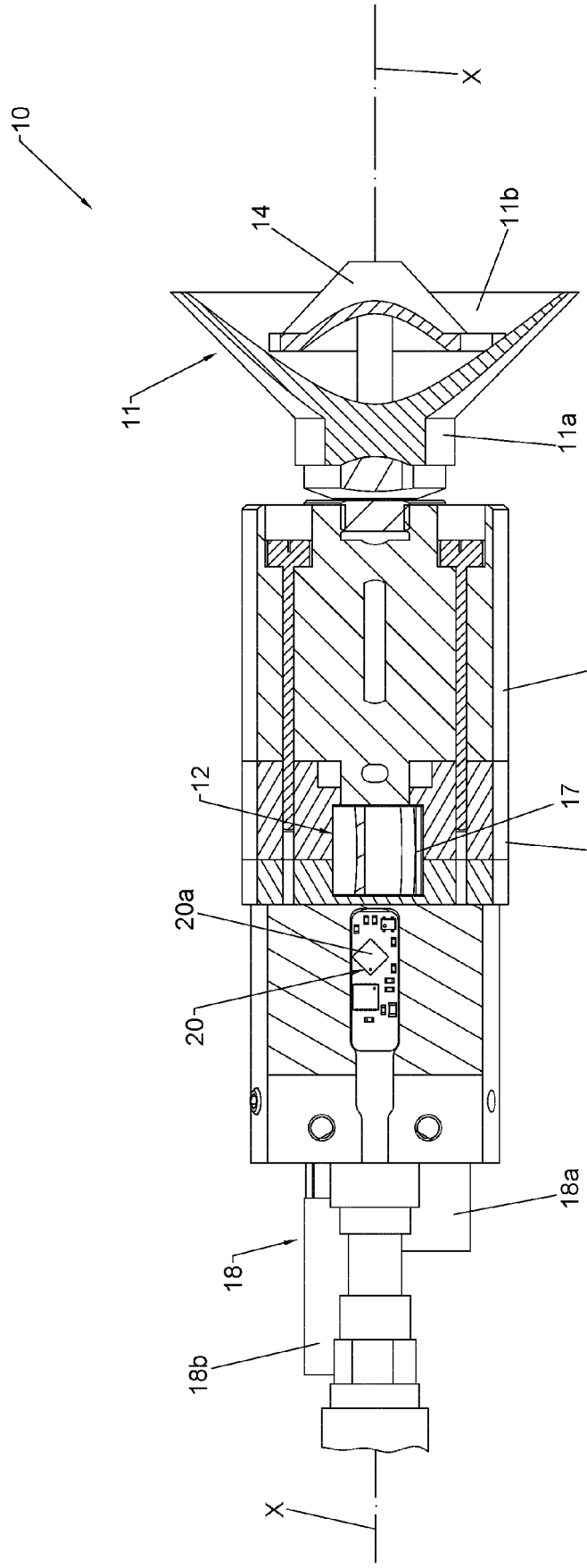

Fig.5

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EUROPEAN SEARCH REPORT

Application Number
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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
Munich	15 October 2024	Verger, Paul

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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