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(54) HIGH EFFICIENCY INJECTION HEAD FOR INJECTING CONSOLIDATING FLUID MIXTURES UNDER PRESSURE INTO THE SOIL

(57) An injection unit (10) for injecting consolidating fluid mixtures under pressure into the soil (T), comprising:
- an outer cylindrical body (11);
- at least one outlet lateral nozzle (12) defining an injection hole (12a) substantially perpendicular to the axis of the central longitudinal outer cylindrical body (11) and
- a conduit (13), for connecting the upper inlet (11a) to the outlet nozzle (12);
wherein the conduit (13) has along its axial extent a section progressively decreasing from the upper entrance to the nozzle, so that the fluid mixture (M) which flows along the conduit (13) acquires a progressively increasing speed, and
wherein the conduit (13) and the injection hole (12a) of the outlet lateral nozzle (12) have one or more stabiliser ridges or fins (14) which are formed and extend along their surface, from the area of the upper entrance to the outlet of the injection hole, and have the function of stabilising and making laminar the flow of the fluid mixture (M) to enable a high efficiency to the injection head (10) and a high power to the jet emitted by the outlet lateral nozzle (12).

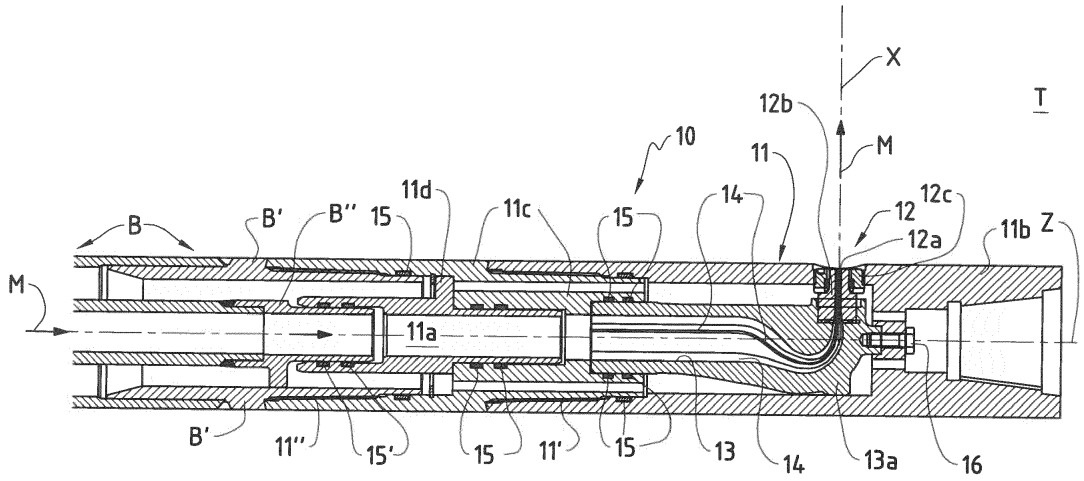

FIG. 1

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Description

Field of the invention

[0001] The present invention relates to an injection head for injecting a fluid mixture under pressure into the soil to consolidate it, as part of the technology known under the term "jet grouting", wherein this injection head provides significant improvements and in particular, a high efficiency with respect to the injection heads presently known and available on the market.

Technical background of the invention

[0002] The techniques known in general by the expression "jet grouting" are normally used to form columnar structures of artificial conglomerate in the soil, in order to consolidate it.

[0003] These techniques are based on the mixing of soil particles with binders, typically consisting of cement mixtures or grouts, which are injected in the form of jets at high pressure by means of nozzles, generally radially oriented and provided in an injection head commonly referred to with the term "monitor". The latter is normally attached to the lower end of a series or battery of tubular rods and is driven in rotation and moves so as to penetrate and then be extracted from the soil.

[0004] The binders disintegrate and are mixed with the surrounding soil, creating a conglomerate block, generally cylindrical in shape, which, once hardened, consolidates the soil.

[0005] The batteries of rods most commonly currently used in the area of foundations and soil consolidation provide a conduit of large cross section through which the mixture of water and cement is fed to a corresponding conduit, formed in the monitor, which in turn feeds the cement mixture under pressure, received from the battery of rods, to the zone of the monitor where the nozzles are present, with the latter housed in radially oriented holes, i.e. perpendicularly to the longitudinal axis of the monitor.

[0006] The conduit, formed in the monitor, which extends from the end region of the battery of rods to the nozzle area in order to feed to the latter the pressurised cementitious mixture, usually has a cylindrical configuration and thus a constant section along its axial extension, so that the cement mixture, which flows into this conduit, assumes a substantially constant speed.

[0007] Therefore the cement mixture, when flowing along the conduit and reaching the area of the nozzles, the latter being oriented in the direction normal to the longitudinal axis of the monitor and therefore of the cylindrical conduit, is subject to a sudden orthogonal deviation with respect to this axis.

[0008] It follows that, in the region of the nozzles, in which this orthogonal deviation occurs, the flow of cement mixture is usually subject to free irregular movements, in particular characterised by large turbulences, which in turn lead to a high loss of load and efficiency in the area of the nozzles. Since these turbulences prevent a regular and ordered ejection of part of the cement mixture by the nozzles, that is, with the velocity vector of the individual ejected fluid streams of cement mixture oriented along the main axis of each nozzle.

[0009] It is therefore clear that the mode and the conditions in which the cementitious mixture passes from inside to outside of the monitor through the nozzles, are a critical and fundamental point in the operation of the monitor. This being, as mentioned above, the cause of considerable losses of load, which entail not only an increased energy consumption for feeding under pressure the cementitious mixture, but also a smaller and reduced diameter of the column of cementitious material aimed at consolidating the soil.

[0010] Therefore, there is a strong need in the field for improving and increasing the efficiency of the monitor, or for reducing and limiting the load losses that are generated in the flow of cement mixture inside the monitor and in particular in the nozzle area.

[0011] For completeness of information, it is also noted that in recent years, also because of these needs, the technology of "jet grouting" has evolved and has been the subject in its whole of significant improvements and advances. This happened both as regards to some of its specific and particular aspects, such as "single jet grouting", "double jet grouting" and "triple jet grouting", in which the crushing of the soil and its consolidation are performed only with the injection of cementitious mixture, with the injection of cementitious mixture plus compressed air, and with the injection of cementitious mixture plus water and compressed air respectively, and as regards to the equipment or "tools" used in the "jet grouting" technology. These tools include of course the monitor, mounted on the tip of the battery of rods, for the injection of the cement mixture into the soil to be consolidated.

[0012] In the above-outlined context, patent literature offers several documents that describe different embodiments of monitors, for the "jet grouting" sector, which reflect these continuous improvements. These documents describe in particular various configurations of the conduit inside the monitor, which connects the battery of rods for supplying the fluid, i.e. the cementitious mixture, to the nozzles that eventually eject this mixture into the soil to be consolidated.

[0013] Among these documents mention is made here, for example, of the European patent EP 1 231 326 B1. This patent describes a monitor, for injecting a liquid under pressure into the soil, comprising a conduit apt to receive the pressurised liquid from a battery of rods and to convey it to an injection nozzle apt to inject the liquid outside of the monitor. This conduit, unlike conventional ones that have a constant section, exhibits along its extension towards the injection nozzle a progressively decreasing cross section.

[0014] This known monitor, with a conduit characterised by a progressively decreasing section, regularises

the flow of liquid through the conduit and improves the quality and the effectiveness of the jet of liquid that is emitted from the nozzle and injected into the soil. However, this is achieved at the cost of a non-negligible loss of load and energy in the flow of liquid in the conduit, presumably because residues and significant turbulent motions continue to be created in such a flow, with consequent load and energy losses.

[0015] The monitor or injection head for injecting consolidating fluid mixtures into the soil, as described by the European patent EP 2 407 598 B1, has the same limitation and disadvantage of a non-negligible loss of load and energy in the flow of consolidating mixture.

[0016] Other examples of monitors are known from patent documents US 5,228,809 and EP 1 396 585 A1. These monitors are characterised by specific configurations of the respective conduits, connecting an inlet zone of the monitor to an outlet nozzle apt to inject a fluid or consolidating mixture into the soil. They also have the same or similar problem of a loss of pressure and energy, in any way significant, in the consolidating mixture flow.

[0017] Therefore, there is still a need for further improving the features and performances of the known monitors and solutions currently offered and in use in the "jet grouting" sector. In particular, a solution is needed to eliminate altogether or at least reduce further, with respect to what has been achieved by the known monitors, the load losses suffered by the liquid, due to residual turbulent motions. This solution shall render more effective and powerful the jets of the consolidating mixture emitted by the nozzles and injected into the soil to consolidate it.

Summary of the invention

[0018] Therefore, the primary object of the invention is to provide a monitor or injection head for injecting consolidating mixtures under pressure into the soil, exhibiting significantly improved performances compared to the known monitors currently in use. In particular, this monitor or injection head has a high efficiency in terms of capability and penetrating power of the ejected jets, so as to obtain a greater and more effective disintegration effect of the soil to be treated and consolidated, for the same consumed energy.

[0019] A further object of the invention is to provide a monitor or injection head for injecting consolidating mixtures under pressure into the soil, which has a compact and optimised structure therefore suitable to be realised at a low and competitive cost.

[0020] The above objects can be considered fully achieved by the injection head for injecting pressurised consolidating fluid mixtures into the soil, having the features defined by the independent claim 1.

[0021] Particular embodiments of the present invention are defined by the dependent claims.

[0022] There are numerous advantages, some in part at least implicitly previously mentioned, which are associated with the new injection head or monitor, proposed by the present invention, such as those listed below, purely as a matter of example:

- high performance and efficiency, for the same consumed energy for the supply under pressure of the consolidating mixture to the monitor, for the formation of the jets of consolidating mixture injected into the soil to disintegrate it and consolidate it;
- a compact structure apt to facilitate mounting of the monitor at the battery of rods that feed the consolidating mixture to the same monitor;
- an optimised general configuration, consisting of a limited number of parts, in particular implying a low cost of manufacturing;
- capability of the monitor to operate effectively in various operational conditions and as a function of the characteristics of the soil to be disintegrated and consolidated with the jets of the consolidating mixture, injected into the soil by the same monitor.

Brief description of the drawings

[0023] These and other objects, features and advantages of the present invention will be made clear and evident by the following description of one of its preferred embodiments, given by way of a non-limiting example, with reference to the accompanying drawings, in which:

Fig. 1 is a longitudinal section of an injection head or monitor, as a whole, in accordance with the present invention, for injecting pressurised consolidating fluid mixtures into the soil;

Figs. 2A, 2B, 2C are sectional and normal views of a body, included in the injection head of Fig. 1, defining a conduit, with decreasing section, for conveying the flow of a consolidating fluid mixture through the injection head of the invention;

Figs. 3A-3D are sectional views from various viewpoints of a nozzle, comprised in the injection head of Fig. 1, apt to receive and eject outwards the consolidating fluid mixture fed to the injection head; and

Description of a preferred embodiment of the injection head or monitor of the invention

[0024] Referring to the drawings, an injection head for injecting pressurised consolidating fluid mixtures into the soil, also commonly called in the art "monitor", according to the present invention, is denoted as a whole by 10.

[0025] In detail, the injection head 10 of the invention comprises:

- an outer cylindrical body 11, exhibiting an elongated shape, which extends along a central longitudinal axis Z of the injection head 10 and defines an upper inlet 11a, coaxial to the central longitudinal axis Z, apt to receive a consolidating fluid mixture under pressure , also called cementitious mixture, shown schematically in the drawings by an arrow M, from a battery of tubular rods, generally denoted by B on which an upper end of the injection head 10 can be mounted;

- at least one outlet lateral nozzle 12, in turn defining an injection hole 12a, extending along a respective axis X substantially perpendicular to the central longitudinal axis Z, apt to inject into the soil T the fluid mixture M fed under pressure to the injection head 10 by the battery B of tubular rods; and

- at least one conduit 13, provided inside the outer cylindrical body 11, which connects the upper inlet 11a to the outlet lateral nozzle 12 so as to be apt to feed the fluid mixture M that the injection head 10 receives from the battery B of tubular rods, to the injection hole 12a of the same outlet lateral nozzle 12;

wherein the conduit 13 exhibits a structure extending, inside the outer cylindrical body 11, and evolving along a respective axis 13c, from an upper straight region, coaxial to the central axis Z of the upper inlet 11a, into a lower curved region where the axis 13c becomes eventually tangential to the axis X of the injection hole 12a of the outlet lateral nozzle 12 at the lower end of the conduit 13.

[0026] As described in greater detail below, both the conduit 13, which connects the upper inlet 11a of the outer cylindrical body 11 to the outlet lateral nozzle 12, and also the injection hole 12a, of the outlet lateral nozzle 12, which injects the fluid mixture M in to the soil T, exhibit an innovative configuration with respect to the one revealed by the injection holes and by the conduits of the injection heads according to the prior art. This innovative configuration is characterised by one or more stabilising ridges or fins, each one denoted by 14, which are formed on the surface of the conduit 13 and of the injection hole 12a. The stabilising ridges or fins extend along the axial development of the conduit 13 and of the injection hole 12a, i.e. from the area of the upper inlet 11a to the outlet area of the injection hole 12a and have the function of stabilising the flow of fluid or cementitious mixture M, which flows through the conduit 13 and the injection hole 12a.

[0027] The fluid mixture M that is fed to the injection head 10 by the battery B of tubular rods, is typically constituted by a cementitious binder or similar material, sometimes called in jargon "grout", suitable for being injected at high pressure into the soil T to disintegrate it and form, once solidified, hard columns apt to consolidate it.

[0028] The outer cylindrical body 11 that extends along the central longitudinal axis Z of the injection head 10 has a composite structure composed of a plurality of parts, in particular:

- an outer lower body 11b, located in a lower region of the injection head 10 and of the respective outer cylindrical body 11; and

- an adapter, in turn consisting of:

- an external adapter body 11 c; and

- an internal adapter body 11d defining a rectilinear conduit, in turn corresponding to the upper inlet 11a, extending along the central axis Z of the outer cylindrical body 11 and apt to feed the fluid mixture M received from the battery B, to the conduit 13;

wherein the adapter has the function of adapting the injection head 10 to the tip of the battery B of tubular rods, on which it is mounted, in the area of the upper inlet 11a of the outer cylindrical body 11 of the injection head 10.

[0029] The different parts of the outer cylindrical body 11 are firmly assembled and attached one to the other so as to form the outer cylindrical body 11.

[0030] In particular, as shown in the drawings, the outer lower body 11b and the adapter outer body 11c are provided with threads 11' so as to be able to be firmly screwed one in the other to form the outer cylindrical body 11.

[0031] Moreover, the adapter outer body 11c is provided with a further thread 11" so as to be apt to be screwed to a corresponding part, denoted by B' in Fig. 1, of the tip of the battery B of tubular rods, when the injection head 10 is mounted on this battery B.

[0032] The conduit 13, which connects the upper inlet 11a of the outer cylindrical body 11 to the outlet lateral nozzle 12, is formed in a connection block 13a, in turn housed inside the outer cylindrical body 11 of the injection head 10, between the upper inlet area 11a and the outlet lateral nozzle 12, and is attached to the outer lower body 11b of the outer cylindrical body 11 by means of an attachment screw 16.

[0033] The conduit 13 has along its axial extension a section progressively decreasing from the upper inlet 11a to the outlet lateral nozzle 12, so that the fluid mixture M, that flows in the conduit 13 to feed the outlet lateral nozzle 12, acquires a progressively increasing speed v, as shown schematically in Fig. 2A by arrows v exhibiting larger dimensions the closer they are to the outlet lateral nozzle 12.

[0034] As shown in the drawings, the axis 13c along which the conduit 13 extends from the upper inlet 11a to the outlet lateral nozzle 12, develops and lies completely in a longitudinal plane, denoted by Z-X, containing the central longitudinal axis Z of the outer cylindrical body 11

of the injection head 10 and the X axis of the outlet lateral nozzle 12.

[0035] While the conduit 13 shown in the drawings comprises a straight and a curved parts, the conduit 13 can also have different configuration, for instance a curved shape along its entire axial extension. The exact configuration of the conduit 13, while not being the salient feature of the present invention, has been the subject of complex and sophisticated mathematical calculations that take into account various factors and parameters and in particular are based on formulas that reflect fluid dynamic laws that govern the flow of the fluid mixture M in the conduit 13.

[0036] Based on these complex calculations, without entering into their respective details and mathematical formulas, it was possible to calculate and determine that one optimal configuration of the curved axis 13c, along which the curved conduit 13 extends and develops, corresponds to a clothoid, i.e. it is defined by a curve whose curvature varies linearly along its length.

[0037] Thanks to the particular clothoid form, which, as mentioned, characterises one optimal shape of the curved axis 13c of the conduit 13, the fluid mixture M, that flows in the conduit 13 and into the injection hole 12a, is subject to direction variations and therefore to accelerations and corresponding inertia forces that vary regularly and continuously, without abrupt changes, so as to limit to the maximum the onset and activation of turbulent motions that can reduce the efficiency and yield of the injection head 10.

[0038] For clarity, Figs. 2A-2C show, on a larger scale with respect to Fig. 1, details of the conduit 13 and of the respective connection block 13a.

[0039] In particular, Figure 2A is a sectional view of the conduit 13 along the plane Z-X containing the axis 13c, Fig. 2B is a view in the direction defined by the arrow IIB of Fig. 2A, and Fig. 2C is a sectional view along the plane defined by the line IIC-IIC of Fig. 2A.

[0040] The outlet lateral nozzle 12 is constituted, as shown in Figs. 3A-3D, by an outer body 12b in which the injection hole 12a extends along the respective X axis.

[0041] The outer body 12b in turn is housed in a corresponding seat 13b formed in the connection block 13a, which is accommodated inside the outer cylindrical body 11 and in which the conduit 13 extends to connect the upper inlet 11a to the outlet lateral nozzle 12.

[0042] As shown in Fig 1, a threaded sleeve 12c, which can be screwed into a hole formed in the outer lower body 11b of the outer cylindrical body 11, has the function of securely attaching the outer body 12b of the outlet lateral nozzle 12 in the corresponding seat 13b formed in the connection block 13a. The advantage of the indirect fixation mechanism of the nozzle 12 in the seat 13b, i.e. by the intermediate of the threaded sleeve 12c, is that it permits the precise orientation of the stabilizing ridges formed on the surface of the injection hole 12a towards those formed on the surface of the conduit 13.

[0043] A plurality of gaskets, denoted by 15, are inserted between the various parts which compose the outer cylindrical body 11 of the injection head 10, and between these parts and the connection block 13a through which the conduit 13 extends, for the purpose of ensuring an airtight seal between these parts and therefore preventing any seepage of the fluid mixture M under pressure out of the injection head 10.

[0044] In addition, a set of gaskets denoted by 15' are also inserted, in the area of the upper inlet 11a, between the inner adapter body 11d and a part, denoted by B", which is part of the tip of the battery B, in order to ensure the seal in the passage area of the fluid mixture M from the battery B to the injection head 10.

[0045] As anticipated, according to a salient feature of the present invention, both the conduit 13, which connects the upper inlet 11a of the outer cylindrical body 11 to the outlet lateral nozzle 12, and the injection hole 12a, of the outlet lateral nozzle 12, which injects the fluid mixture M into the soil T, have along their axial development, i.e. from the area of the upper inlet 11a to the area of the outlet of the injection hole 12a, one or more stabilising ridges or fins, each one denoted by 14. These are formed on the surface of the conduit 13 and of the injection hole 12a and are turned towards the centre of the same conduit 13 and of the same injection hole 12a. These stabilising ridges 14 have the function of stabilising the flow of the fluid mixture M that flows along the conduit 13 and the injection hole 12a so as to provide high efficiency to the injection head 10 and a high disintegrating power to the jet of fluid mixture M, which is emitted from the outlet lateral nozzle 12 and injected into the soil T.

[0046] Preferably, as shown in the drawings, these one or more stabilising ridges 14 formed along the surface of the conduit 13 and of the injection hole 12a each have a triangular or cusp shape section. The height of the stabilizing ridges 14 diminishes in the same manner as the section of the conduct 13.

[0047] Moreover, again preferably, these one or more stabilising ridges 14 are three in number and, viewed in section, are distributed evenly and equally distanced one from the other on the surface of the conduit 13 and of the injection hole 12a.

[0048] Further, these one or more stabilising ridges 14 can extend along the entire axial extension of the conduit 13 and of the injection hole 12a, hence from the upper inlet area 11a to the outlet section of the injection hole 12a, or they can extend only along portions of the conduit 13 and of the injection hole 12a.

Experimental tests

[0049] Several prototypes of the injection head of the invention have been subjected to numerous and specific experimental tests aimed at verifying the innovative performances and the significant advantages of this injection head.

[0050] In particular, the tests and trials carried out on these prototypes under various experimental conditions

have confirmed that the injection head of the invention, characterised by the stabilising ridges, advantageously has, compared to the injection heads and monitors currently known on the market, an extremely low load and energy loss in the flow of the fluid mixture which flows in the conduit and the outlet lateral nozzle, with the same energy used to feed under pressure the fluid mixture to the injection head as well as a very regular and extremely powerful and effective jet of the fluid mixture that is emitted outside by the injection lateral nozzle.

[0051] Without being tied to any specific theory and scientific explanation, it is presumed that these important results and advantages, as verified by the carried out experiments, mainly result from the presence of the stabilising ridges that characterise the injection head of the invention. These stabilising ridges have presumably the effect of producing a flow as laminar as possible of the fluid mixture, which flows along the conduit, and the injection hole of the outlet lateral nozzle. A laminar flow represents a stream substantially free from turbulent motions, which, if they were present, would entail a significant loss of load and power of the same flow, particularly in the area adjacent to the injection hole in which the flow of fluid mixture undergoes the greatest change in direction.

[0052] In other words, thanks to the presence of these stabilising ridges that characterise the injection head of the invention, the fluid threads, which form the flow of fluid mixture along the conduit and the injection hole maintain a very regular trend practically free from turbulent motions, even in the areas of greatest change of direction. This results in a very low load and energy loss in the flow, as well as in an extremely powerful and effective jet of the fluid mixture out of the lateral nozzle.

[0053] It is therefore clear that the present invention achieves its predetermined aims and objectives and in particular proposes a novel and inventive injection head or monitor for the injection of a consolidating fluid mixture under pressure into the soil. The novel and inventive injection head or monitor exhibits a high and improved efficiency with respect to known and conventional injections heads, with the same energy consumed to feed the fluid under pressure to the injection head, i.e. an improved and more advantageous ratio between the energy consumed to feed, via the battery of tubular rods, the fluid mixture under pressure to the injection head and the disaggregating power and consolidating capability of the jet of fluid mixture injected by the injection head into the soil.

[0054] For example, supposing feeding of the injection head of the invention with a fluid mixture at a pressure of 400 bar, which represents the order of magnitude of the pressure at which the fluid mixture is usually fed to the injection head by the battery of tubular rods, the injection head of the invention produces and generates a jet of the fluid mixture injected into the soil having a disaggregating power and a consolidation capability of the soil significantly greater than those of the jet or of the jets injected into the soil by a conventional injection head fed with a fluid mixture at the same pressure of 400 bar.

[0055] Conversely, for the same disaggregating power and consolidating capability of the fluid mixture injected into the soil, the injection head of the invention is advantageously fed by the battery of tubular rods with a fluid mixture at a pressure that is substantially lower than that at which it is necessary to feed the same fluid mixture in a conventional injection head, therefore, with a lower energy consumption and also less wear in time of the overall soil consolidation equipment including both the battery of tubular rods and the injection head, in comparison to known and conventional injection heads.

[0056] Without prejudice to the basic concepts of the present invention, it is also clear that the injection head described hitherto for injecting a consolidating fluid mixture into the soil can bring modifications and improvements without thereby departing from the scope of the same invention.

Claims

1. Injection head (10) for injecting consolidating fluid mixtures under pressure into the soil (T), comprising:

- an outer cylindrical body (11) defining a central longitudinal axis (Z) and having an upper inlet (11a) coaxial to said central longitudinal axis (Z);
- at least one outlet lateral nozzle (12) placed in said outer cylindrical body (11) and defining an injection hole (12a) extending along a respective axis (X) substantially perpendicular to the central longitudinal axis (Z); and
- at least one conduit (13) for connecting the upper inlet (11a) to the outlet nozzle (12);

wherein the conduit (13) has along its axial extension a section progressively decreasing from the zone of the upper inlet (11a) to the zone of the outlet lateral nozzle (12);
the injection head (10) being **characterised in that** the conduit (13) and the outlet lateral nozzle (12) have one or more stabilising ridges (14) that are formed on the surface of the conduit (13) and of the injection hole (12a) of the outlet lateral nozzle (12) and that extend along their length,
wherein said one or more stabilising ridges (14) have the function of stabilising the flow of fluid mixture (M) that flows along the conduit (13) and the outlet lateral nozzle (12) so as to confer a high efficiency to the injection head.

2. An injection head (10) according to claim 1, wherein the conduit (13) has a curved configuration that extends and develops in said outer cylindrical body (11) along a respective curved axis (13c) that tangentially connects, in an upper area of the conduit (13), to the

axis (Z) of the upper inlet (11a), and, in a lower area of the conduit (13), to the axis (X) of the injection hole (12a) of the outlet lateral nozzle (12).

3. An injection head (10) according to claim 1 and 2, wherein the curved axis (13c), along which the conduit (13) extends and develops with progressively decreasing section, lies in a longitudinal plane (Z-X) defined by the central longitudinal axis (Z) of the outer cylindrical body of the injection head (10) and by the axis (X) of the outlet lateral nozzle (12).

4. Injection head according to claim 1 to 3, wherein said one or more stabilising ridges (14), formed along said conduit (13), each have a triangular or cusp shape in section.

5. Injection head according to any one of the preceding claims, wherein said stabilising ridges (14), formed along said conduit (13), are three in number and, viewed in section, are uniformly distributed and equally distanced one from the other on the conduit surface.

6. Injection head according to any one of the preceding claims, wherein the curved axis (13c), along which extends and develops the conduit (13) which connects the upper inlet to the outlet lateral nozzle (12), has a clothoidal-curved shape.

7. Injection head (10) according to any one of the preceding claims, wherein said one or more stabilising ridges (14) extend along the entire length of the conduit (13) and of the injection nozzle (12a) of the outlet lateral nozzle (12), from the upper inlet area (11a) to the outlet of the injection hole (12a).

8. Injection head (10) according to any one of the preceding claims, wherein said outer cylindrical body (11) has a composite structure comprising:

- an outer lower body (11b) placed in a lower region of the injection head (10) and of the respective outer cylindrical body (11); and
- an adapter in turn consisting of:
- an external adapter body (11 c); and
- an internal adapter body (11d) defining a rectilinear conduit, corresponding to the upper inlet (11a), extending along the central axis (Z) of the outer cylindrical body (11);

wherein said adapter has the function of adapting the injection head (10) to the tip of the battery (B) of tubular rods, on which is mounted, in the upper inlet area (11a), the outer cylindrical body (11) of the same injection head (10).

9. Injection head (10) according to claim 8, wherein said outer lower body (11b) and said adapter outer body (11c) of the outer cylindrical body (11) are screwed one to the other, and said adapter outer body (11c) is apt to be screwed on a corresponding part (B') of the battery (B) of tubular rods on which the injection head (10) can be mounted.

10. Injection head (10) according to claim 8 or 9, wherein said conduit (13) is formed in a connection block (13a) which is placed and securely locked in said injection head (10), between said inner adapter body (11d) and said outer lower body (11b).

11. Injection head (10) according to claim 10, wherein said outlet lateral nozzle (12) comprises an outer body (12b) housed in a corresponding seat (13b) formed in said connection block (13a) in which said conduit (13) is formed and extends.

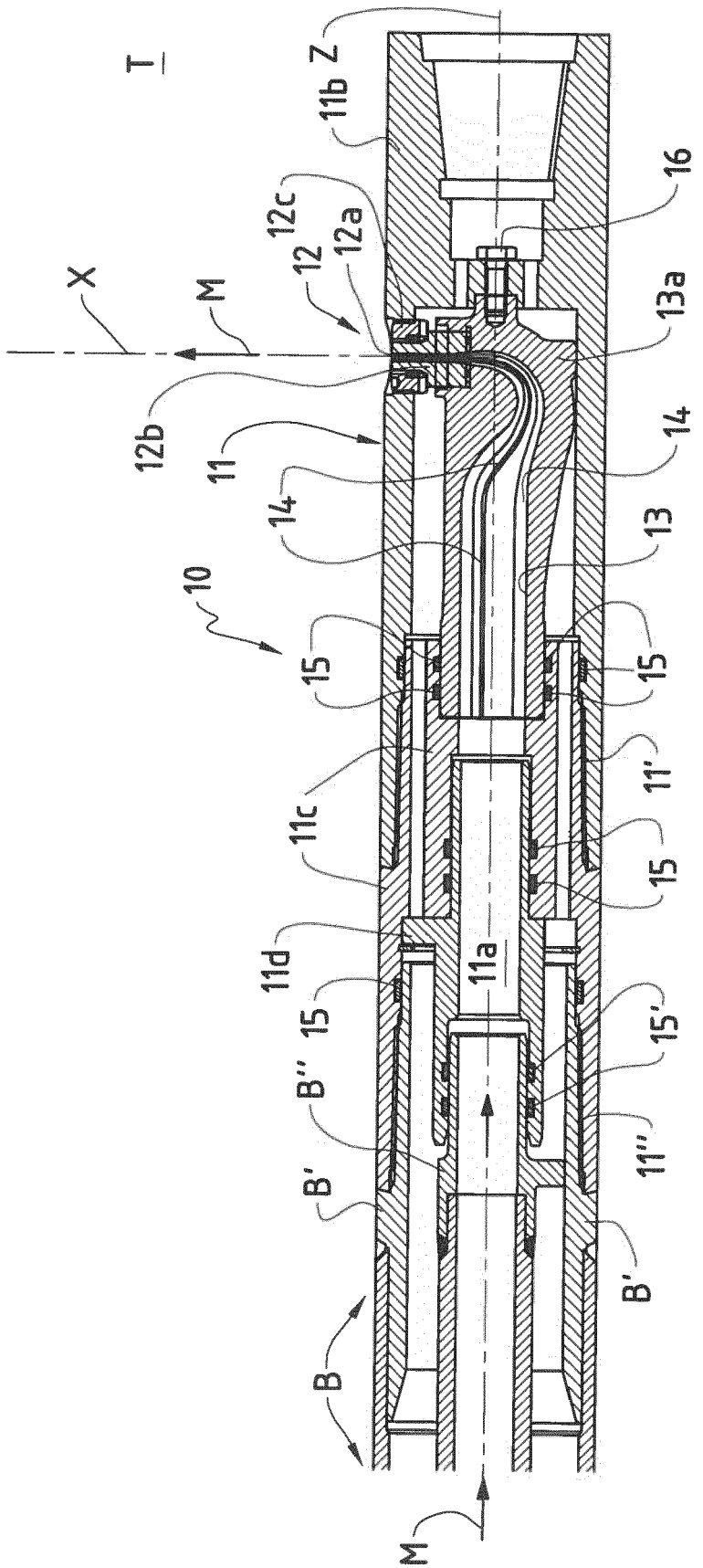
T
Z
11b
16
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FIG. 1

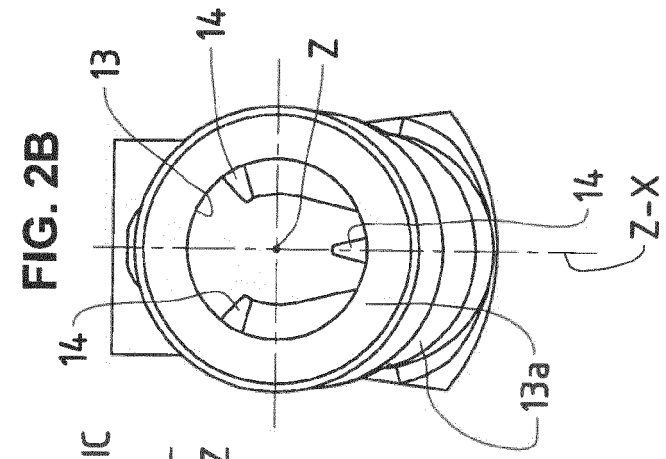


FIG. 2B

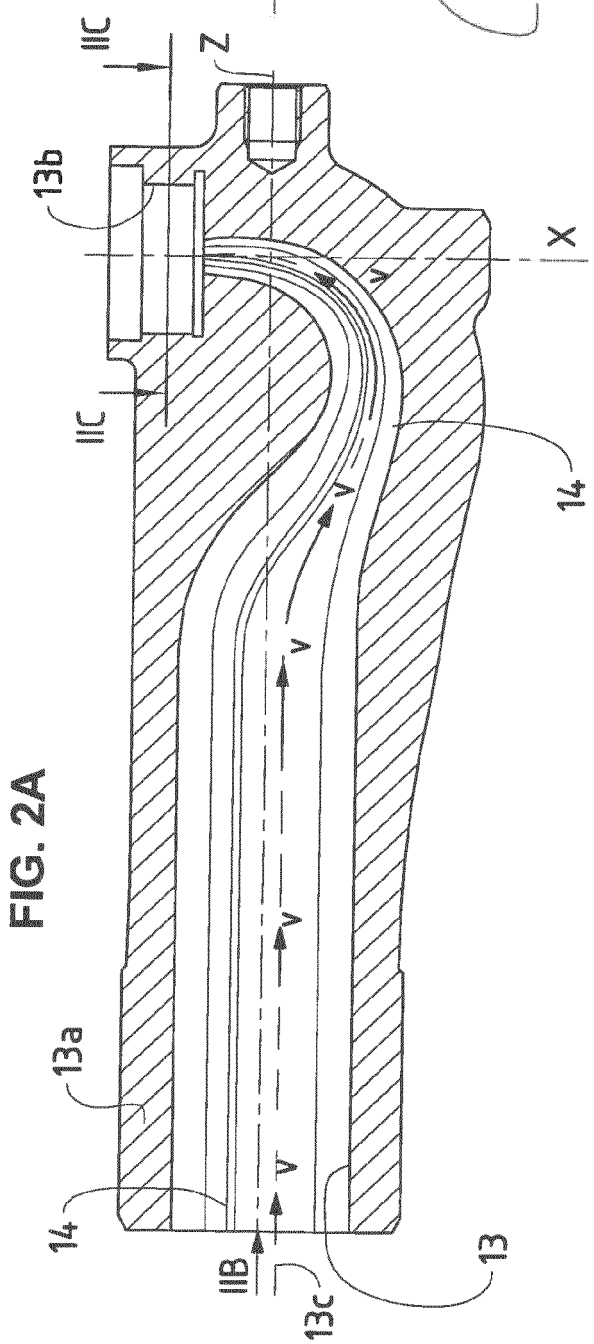


FIG. 2A

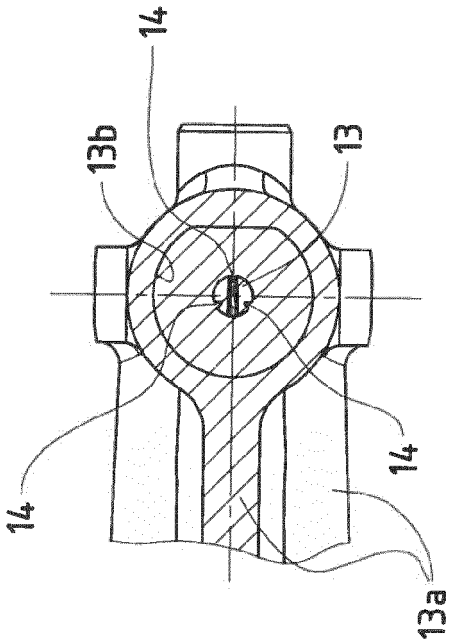


FIG. 2C

FIG. 3C

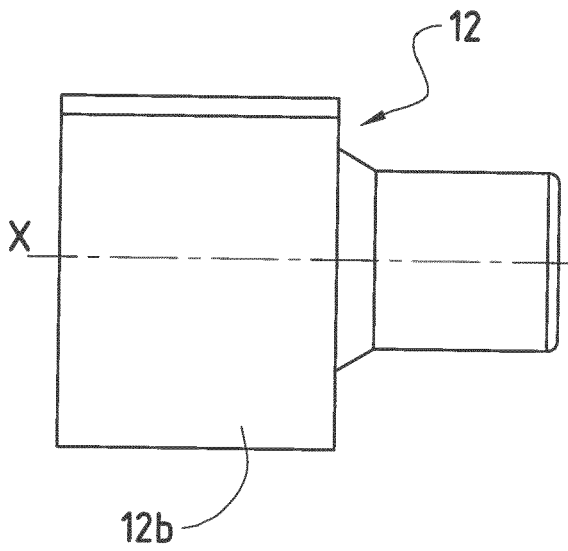
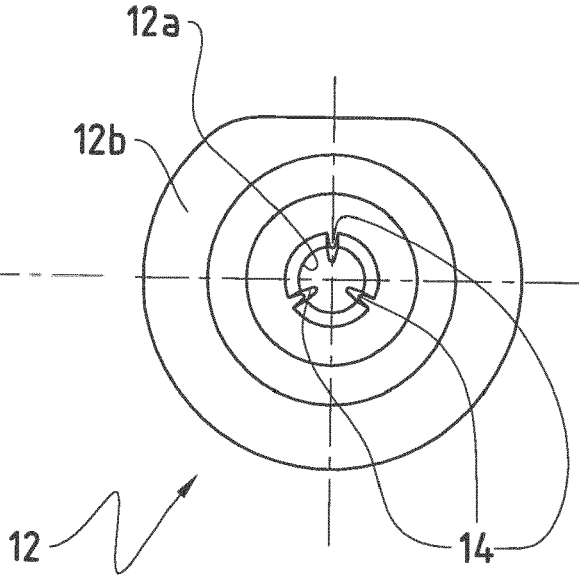


FIG. 3A



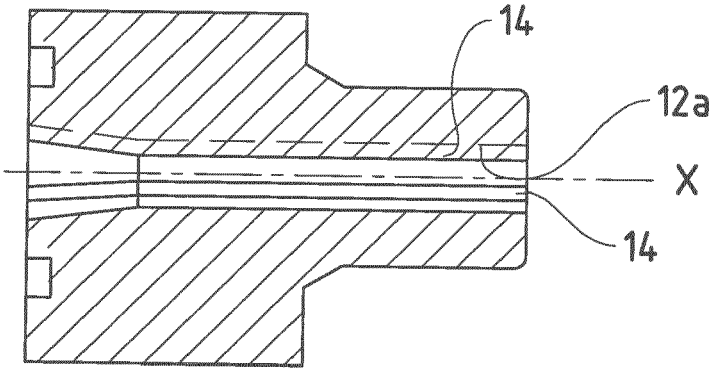


FIG. 3B

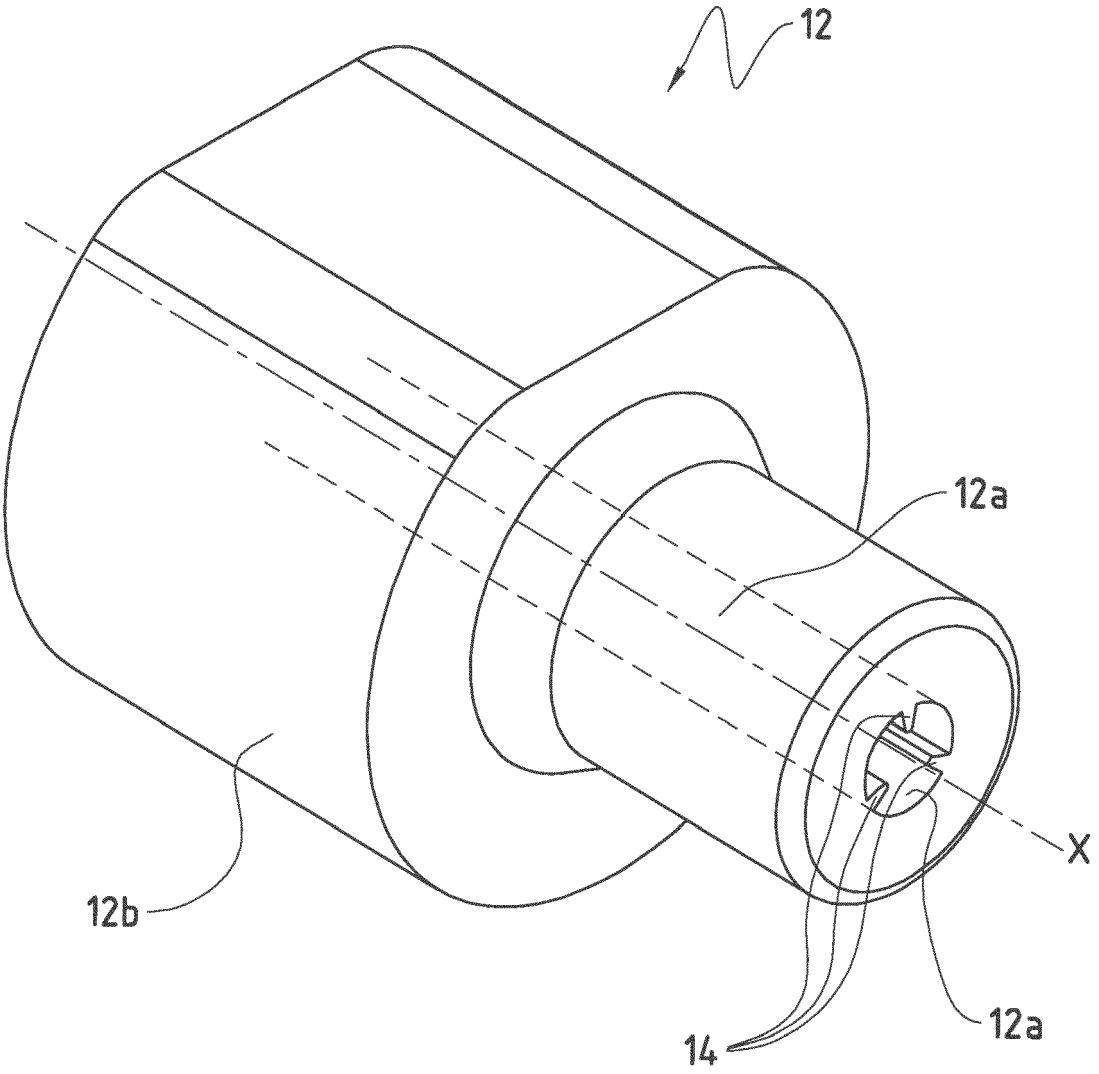


FIG. 3D

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EUROPEAN SEARCH REPORT

Application Number
EP 17 20 3408

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E02D
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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	27 April 2018	Friedrich, Albert

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