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(54) **SAFETY SYSTEM FOR ISOLATING THE DANGEROUS AREAS OF A DRILLING MACHINE, DRILLING MACHINE PROVIDED WITH SAID SAFETY SYSTEM AND PROCESS FOR USING SAID DRILLING MACHINE**

SICHERHEITSSYSTEM ZUR ISOLIERUNG DER GEFÄHRLICHEN BEREICHE EINER BOHRMASCHINE, BOHRMASCHINE MIT BESAGTEM SICHERHEITSSYSTEM UND VERFAHREN ZUR VERWENDUNG BESAGTER BOHRMASCHINE

SYSTÈME DE SÉCURITÉ PERMETTANT D'ISOLER LES ZONES DANGEREUSES D'UNE MACHINE DE FORAGE, MACHINE DE FORAGE POURVUE D'UN TEL SYSTÈME DE SÉCURITÉ ET PROCÉDÉ D'UTILISATION DE LADITE MACHINE DE FORAGE

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Description

Field of the invention

[0001] The present invention concerns a safety system for drilling equipment particularly but not exclusively used in a drilling machine for controlling the dangerous area around the machine and for interrupting the dangerous manoeuvres of the machine itself.

[0002] The present invention also concerns a drilling machine comprising the aforementioned safety system. More specifically, the safety system according to the present invention is used for preventing an operator from coming into contact with rotating or moving components of the drilling machine which are directly involved in the drilling process.

State of the art

[0003] The present invention is particularly suitable for being applied to drilling machines that, operating in several technological fields, can require the workers responsible for auxiliary services to carry out manual interventions in areas around the machine exposed to danger, in particular close to the guiding antenna or mast on which the rotating head or rotary slides and close to the drilling axis on which the shafts used for the excavation, mixing, jetting and driving-in processes are located. Drilling machines require interventions by workers that can generally be divided into three types: interventions of first mounting, maintenance interventions and interventions simultaneous to the work manoeuvres.

[0004] In the first two types of interventions, usually performed in the workshop, the experience of the skilled workers, the specificity of the problems and common practice make this step be considered not particularly dangerous. In the third type of intervention, in which manual interventions are required during the work steps, for example to add or remove the drilling shafts in the area close to the mast, there is a high exposure to risks since the operations are carried out on moving parts and are routinized and this physiologically causes a drop in attention by those repeatedly performing the same action; moreover, such interventions must be quick so as to reduce as much as possible the intervention time and increase productivity.

[0005] In the present description, dangerous area is meant to indicate the region of space around the guiding antenna where the rotating head slides and the region of space near the drilling area.

[0006] For these reasons, in order to allow the worker to gain access, during the normal operations of the machine, to the mobile parts of the machine itself that are directly involved in the drilling process, it can be thought of to install, around the dangerous area, protections such as fixed barriers or guards, mobile barriers or guards with interblock, sensitive protection devices or a combination thereof. Such protections must prevent access to the dangerous area during any dangerous movement.

[0007] In the case in which the mobile barriers are opened or when the sensitive protection devices are activated by the entry of an object into the dangerous area, the dangerous drilling manoeuvres must be blocked quickly and safely: standards require instantaneous blocking at least of the rotation of the shaft and alternatively simultaneous and instantaneous blocking both of the rotation and of the translation movements of the driving head.

[0008] As long as the mobile barriers remain open or while the sensitive devices remain activated, it is possible to reactivate the rotation of the shafts and the sliding of the rotating head only by selecting, through a suitable selector, a limited operating mode. In this limited operating mode all of the manoeuvres are suitably slowed down to values such as to eliminate the danger and allow inspection of the parts or manual interventions to be carried out.

[0009] In order to return to the normal functioning mode, i.e. the work mode, it is necessary that the interblocked mobile barriers are closed and reset or the sensitive protection devices are no longer active and have been reset, the normal functioning mode is selected through a suitable selector and the start command is triggered.

[0010] It is known in the field to use mobile guards with interblock made in the form of containment cages, arranged around the work components of the machine to isolate the dangerous area. Such containment cages generally consist of one or more load-bearing frames, made through tubular elements or shaped metal sheets forming its external shape, and metallic or plastic grids, meshes or other screens taking up the area enclosed by such a shape. Such load-bearing frames can for example be hinged at points integral with the mast so as to be able to open by rotating on a horizontal plane, when the mast is arranged vertically, and leave free access to the dangerous area.

[0011] These kinds of barriers or "guards" in closed position, i.e. in work condition, have substantial bulks that generally are greater in the horizontal direction than the shape of the rotary head or of the clamps in order to be able to receive the rotary itself inside the protected volume. Such bulks are linked to the need to delimit a sufficiently large hazardous area, i.e. to keep the operator sufficiently far away from the hazard represented by the rotating shafts.

[0012] Moreover, the possible presence has to be considered of mechanical loading-aid means, such as for example automated loading arms, the so-called rack or revolver loaders, or articulated cranes, which, in order to be able to operate correctly, should be contained inside the protected volume defined by the barriers.

[0013] The aforementioned substantial bulks, however, for various reasons constitute a severe limitation of the operating capabilities of the machine. In particular, such bulks do not allow drilling to be carried out close to

walls or corners formed by two walls, since when the machine is brought close to the walls the barriers make contact with such walls, preventing the drilling shafts from getting closer further. In this way, it would be possible to carry out no "wall-flush" drillings which are typical of consolidation and restructuring works. In the same way, in order for it to be possible to open the barriers, it is necessary to have sufficient space around the mast to allow the rotation or translation movement without interferences occurring with obstacles during the trajectory of the movement.

The presence of the barriers, therefore, constitutes an obstacle to the manoeuvres and is limiting for the drillings that can be carried out.

[0014] The aforementioned limitations are not compatible with the confined spaces of building sites in which drilling machines generally work, in particular in an urban environment, in which the agility of the machine is essential. The bulk of the barriers, also in open condition, hinders the step of adding or removing shafts into/from the drilling string.

Moreover, the need to carry out continuous opening and closing of the barriers to load the shafts results in an increase in work time and requires complication of the hydraulic and electrical systems to manage the actuation of such barriers.

[0015] A further limitation of this solution is the increased weight of the drilling machine, with a consequent reduction of the stability due to the frontally overhanging positioning of such barriers.

[0016] The use in horizontal drillings (tie rods) with very low heights, less than **1.6** metres, would also necessitate barriers being arranged for the entire length of the mast, so as to always protect the operator whatever position he/she is in. In this case, however, these barriers would have points of contact and interference with the ground and would make the loading of the shafts awkward, since the mobile parts for access to the shafts are substantially heavy, given that the length of the shafts themselves can even reach ten metres.

[0017] An alternative known solution consists of using sensitive devices, such as electrosensitive, photosensitive, laser, optical, radar, ultrasound or thermal devices. Such devices are arranged for producing a monitoring area that in turn at least partially comprises the dangerous area and to detect the presence and/or the passage of a body through such an area.

[0018] In the case in which an object crosses such monitoring areas, such passage triggers the sensitive devices causing the functions of the machine to stop. This solution also has some drawbacks. Such drawbacks are manifest, in particular, during drilling carried out with the supply of air (in deep hole drilling with hammer, commonly known as DTH) or water (tricone drilling or with hammers at the head and rotopercussions) or cement (injection and jetting) or during the mechanical mixing of the soil. During drilling or mixing, indeed, a lot of debris is projected from the excavation upwards due to the injection pressure or the motion of the shafts. In the same way, sprays of water, mud or cement can be projected upwards.

[0019] Such debris or sprays during their motion can, therefore, cross the monitoring areas by the sensitive devices. Such crossing can take place both from the excavation axis towards the outside of the dangerous area but also from outside of such an area towards the inside due for example to the bouncing of the debris against the parts of the machine, for example against the mast.

[0020] The crossing of the debris or of the sprays of water, mud or cement causes an undesired triggering of the sensitive devices and consequently causes the machine to stop even though there is no actual condition of danger due to the passage of people. This can lead to continuous stopping of the machine, severely slowing down work, also considering the length and complexity of the operations imposed by the standards for reactivating normal functioning mode.

[0021] A purpose of the present invention is to make a safety system for a drilling machine that overcomes the aforementioned drawbacks of the prior art, preventing direct contact with the rotary parts, eliminating at source the risk deriving in the dangerous area during the work steps of the machine, without limiting operating capabilities and at the same time allowing safe and easy access to the area of the tools during the loading or maintenance steps of the tools themselves.

Summary of the invention

[0022] Such a purpose is achieved, in a first aspect of the present invention, with a safety system having the characteristics according to claim **1.**

[0023] In a second aspect of the invention, such a purpose is achieved with a drilling machine having the characteristics according to claim **8.**

[0024] In a third aspect of the invention, such a purpose is achieved with a process having the characteristics according to claim **14.**

[0025] In a fourth aspect of the invention, such a purpose is achieved with a process having the characteristics according to claim **15.**

[0026] Further characteristics of the device are the object of the dependent claims.

[0027] In a particular embodiment of the machine according to the invention, the longitudinal sliding of the distal end (**9**D, **90**C) along the guiding antenna **(3)** is driven by means of a linear actuator **(61)** and flexible transmission means **(62, 64)** connected to the elements of the screen **(9, 90).**

[0028] In a particular embodiment of the machine according to the invention, the segment (**9**A-**9**D, **90**A-**90**C) furthest from the rotary **(5),** called distal element (**9**D, **90**C), is mounted on guides so as to be able to slide along the antenna **(3).**

[0029] In a particular embodiment of the machine according to the invention, the segments (**9**A-**9**D, **90**A-**90**C)

of the extensible screen **(9, 90)** have mechanical resting abutments for defining the position of the elements when they are completely extended and/or for gathering them in a contracted configuration.

[0030] In a particular embodiment, the machine according to the invention comprises a first slider unit **(82)** fixed in correspondence with or in the proximity of the proximal end (**9**A, **90**A, **900**A) of the screen **(9, 90, 900),** and a second slider unit (**82**A) fixed in correspondence with or in the proximity of the distal end (**9**D, **90**C, **900**B) of the extensible screen **(9, 90, 900),** and the first **(82)** and the second slider unit (82A) are arranged for driving the screen **(9, 90, 900)** causing it slide, extend and retract along the guiding antenna **(3).**

[0031] In a particular embodiment of the machine according to the invention, the first slider unit **(82)** is arranged for driving the proximal end (**9**A, **900**A) of the screen **(9, 900)** making it slide according to a first direction (FT**1**) transversal with respect to the guiding antenna **(3),** and the second slider unit (**82**A) is arranged for driving the distal end (**9**D, **900**B) of the screen **(9)** making it slide according to a second direction (FT**2**) parallel to the first direction (FT**1**).

[0032] In a particular embodiment of the machine according to the invention, the extensible screen comprises at least one segment provided with flexible or deformable walls capable of shortening and lengthening longitudinally to the axis of the segment itself and/or to the longitudinal axis of the drilling string.

[0033] In a particular embodiment of the machine according to the invention, the extensible screen comprises a single segment, and the extensible screen is arranged for shortening and lengthening longitudinally thanks to the deformations of the segment itself.

[0034] In a particular embodiment of the machine according to the invention, the at least one segment provided with flexible or deformable walls of the extensible screen comprises a tubular sleeve **(900, 900^{III}, 900^{IV}).**

[0035] In a particular embodiment of the machine according to the invention, such a tubular sleeve (**900^{IV}**) can be formed by a strip wound in a helix so as to form a plurality of coils, and so that the edges of two adjacent coils partially overlap one another.

[0036] In a particular embodiment of the machine according to the invention, the at least one segment provided with flexible or deformable walls of the extensible screen comprises at least one reinforcing ribbing or spiral **(99)** comprising a substantially rigid wire that winds in a helix.

[0037] In a particular embodiment of the machine according to the invention, the at least one segment provided with flexible or deformable walls of the extensible screen comprises at least one substantially annular reinforcing ribbing or hoop **(100).**

[0038] In a particular embodiment of the process according to claim **14,** the operations F.**3**) and F.**4**) take place simultaneously.

[0039] In a particular embodiment of the process according to claim **15,** during step F.**8**) the extensible screen **(9)** is moved integrally with the rotating head **(5)** in the aforementioned transversal direction with respect to the guiding antenna **(3).**

[0040] The document US3078933 discloses a drilling machine provided with a horizontal auger enclosed in a telescopic cage; such a cage is not able to translate perpendicular to the axis of the auger.

[0041] The advantages that can be obtained with the present invention will become clearer, to those skilled in the art, from the following detailed description of some particular non-limiting embodiments, illustrated with reference to the following schematic **Figures.**

List of Figures

[0042]

Figure **1** shows a side view of a drilling apparatus arranged with a safety system according to a first embodiment of the present invention, applied to a drilling machine, in extended configuration;

Figure **2** shows a partial side section (fig. **2**A) and a front view (fig. **2**B) of a second embodiment of the safety system with a first variant of motorisation, in extended configuration.

Figure **3** shows a partial side section (fig. **3**A) and a front view (fig. **3**B) of a third embodiment of the safety system, with a second variant of motorisation, in extended configuration.

Figure **4** shows a front view of the previous embodiments in the loading step of a shaft (fig. **4**A) and of an armature (fig. **4**B), in which the system is collected in a high position of the mast and transversally displaced.

Figure **5** shows a front view of the previous embodiments in which the system is collected in a low position of the mast and transversally displaced.

Figure **6** shows a partial side section (fig. **6**A) and a partial front section (fig. **6**B) of a fourth embodiment of the safety system with a third variant of motorisation, in collected configuration.

Figure **7** shows a side view of a fifth embodiment of the safety system with a second variant of motorisation, in extended configuration.

Figure **8** shows a partial side section (fig. **8**A) and a partial front section (fig. **8**B) of a sixth embodiment of the safety system with a second variant of motorisation, in extended configuration.

Figure **9** shows a front view of the safety system of Figures **8**A, **8**B in collected configuration at the bottom.

Figure **10** shows a partial side section (fig. **10**A) and a partial front section (fig. **10**B) of the safety system represented in Figures **8**A, **8**B and **9,** in collected configuration at the top.

Figure **11** shows a partial front section of the embodiment of Figure **10**A, **10**B in collected configuration

at the top, with the rotary laterally displaced with respect to the antenna.

Figure **12** shows a side view of an eighth embodiment of the safety system with a first variant of motorisation, in extended configuration.

Figure **13** shows a partial side section of a ninth embodiment of the safety system with a variant embodiment of the screen, shown in extended configuration (fig.**13**A) and in collected configuration (fig.**13**B) .

Figure **14** shows a partial side section of a tenth embodiment of the safety system with a variant embodiment of the screen, shown in extended configuration (fig.**14**A) and in collected configuration (fig**.14**B) .

Figure **15** shows a partial side section of an eleventh embodiment of the safety system with a variant embodiment of the screen, shown in extended configuration (fig**.15**A) and in collected configuration (fig**.15**B) .

Detailed description

[0043] As shown in **Figure 1,** the drilling machine, suitable for all excavation technologies by rotation, rotopercussion, vibration, driving-in and mixing and injection, suitable for being used for example to make piles, micro pile supports, tie rods or mechanical mixing and wholly indicated here with numeral **1,** substantially comprises a base machine **2,** for example mounted on tracks or wheels, which allow movement on the building site, a guiding antenna or mast **3,** on which the drilling means slide, and a linkage **4** that allows the movement of the antenna with respect to the machine-base **2** to take it from an enclosed configuration, used for transportation, to a work configuration in which the mast **3** can be arranged vertically, inclined or horizontal. At least one rotating head **5,** also called rotary, which applies the torque to the drilling string **6** and can slide along the antenna to cause the tool to move forwards or backwards in the excavation is mounted on the guiding antenna **3.** Alternatively, an excavation system can be mounted that uses percussion and/or vibration in addition to rotation.

[0044] Conventionally, in the present description, by "upper end of the antenna **3"** the end is meant which during use is furthest from the tip of the drilling string, and by "lower end of the antenna **3"** the end is meant that during use is closest to the tip of the drilling string.

[0045] At the base of the guiding antenna **3** there can be clamps **7,** in particular at least one pair, which allow the string already driven into the excavation to be held and the rotary to be disconnected or a shaft to be disconnected by unscrewing it from the string **6.** The clamps **7** can, in an equivalent manner, comprise a clamp and an unscrewer. Figure **1** also shows a possible auxiliary winch used for moving the drilling accessories (like shafts **6**A or armatures **23)** to be fixed to the hook **22** or to suitable lifting accessories.

[0046] As shown in Figure **2,** the rotary **5** can slide along the antenna **3** for example through the interposition of a slider unit **82** that can move longitudinally along the mast, for example guided on the suitable longitudinal guides **3**A and moved by a suitable known pull-push system, for example of the type with chains with cylinder or a geared motor. Preferably the guides **3**A integral with the mast **3** comprise elongated profiled elements in which it is possible to create a mechanical contrast on at least **3** sides. Advantageously, they are profiled with a closed, prismatic or "C-shaped" section.

[0047] The rotary can therefore carry out longitudinal strokes to the antenna **3** between an upper end close to the head and a lower end close to the clamps **7.**

[0048] According to an aspect of the invention, the safety system comprises a side displacement system **8** fixed, or in any case arranged for being fixed, to the guiding antenna **3** so as to move the rotary **5** both longitudinally to the guiding antenna **3,** and in a transversal direction, and preferably perpendicular, to the antenna **3.** Preferably, the side displacement system **8,** is arranged for moving the rotating head in a direction FT**1** perpendicular not only to the antenna **3,** but also to the ideal plane passing through the axes of the guiding antenna **3** and of the shafts of the drilling string **6,** as indicated in Figure **2**B.

[0049] The side displacement system **8** can comprise a first slider unit or carriage **82** mounted on the antenna so that it can slide along it, being guided longitudinally on the guides **3**A. The first slider unit **82** in turn comprising:

- a first slider **81** mounted so as to be able to slide along the guiding antenna **3** for example along suitable sliding guides;
- a second slider **80,** like for example a carriage or slide, mounted so as to be able to slide in a guided manner, on the first slider **81,** for example along suitable guides **83** formed on the first slider **81.**

[0050] The guides **83** extend transversally, and more preferably perpendicularly, to the guiding antenna **3** and can be formed for example as a mechanical contrast prismatic guide , or a groove or furthermore a tubular (circular or prismatic) profile with elongated shape (in the transversal direction of movement) on which the second slider **80** is coupled and mutually guided. The rotary **5** can be fixed to the second slider **80,** or include, in an irremovable manner, the second slider **80** itself.

[0051] The side displacement system **8** also comprises an actuator that is used to drive the movement of the second slider **80.** Said movement can for example be linear, like for example a hydraulic or pneumatic cylinder, or rotary - for example electric motor with screw and nut screw-type shaft - connected between the first slider **81** and the second slider **82,** advantageously fixed to the first slider to facilitate the installation of the supply systems.

[0052] Preferably, the actuator **11** is a hydraulic cylinder arranged transversally, and more preferably perpen-

dicularly, with respect to the axis of the antenna **3.** Figure **2**A refers to a start of processing condition of the drilling machine **1,** with the rotary **5** lifted with respect to the lower end stop position and with a drilling string **6** connected to the rotary. The string **6,** which can comprise a plurality of shafts **6**A, receives the motion of rotation and of translation along the mast **3,** from the rotary **5.** In this start of drilling condition shown in **Figures 2**A and **2**B it is necessary to protect and/or isolate the dangerous area surrounding the drilling string **6** for preventing worksite personnel fro getting close and coming into contact with the moving parts involved in the drilling process. In particular, it is necessary to eliminate the danger of a person being able to get caught in the rotating shafts and consequently being pulled.

[0053] In order to achieve such an objective, the safety system of the present invention comprises an extensible screen **9,** reversibly extendable and retractable along the guiding antenna **3,** thus of variable length, in particular proportional to the stroke of the rotary **5** and which is driven so as to pass from a contracted or collected configuration **9'** to an extended configuration **9,** said longitudinal movement taking place by guiding a part thereof at the mast **3,** in particular said part being the end opposite the part fixed to the rotary **5.**

[0054] Preferably, the screen **9** encloses and surrounds the drilling string **6** completely or at least for a fair extension thereof. The screen **9** can be coaxial to the drilling string or even eccentric with respect to the drilling axis defined by the axis of the drilling string **6,** and be equipped with circular cross sections (or in any case profiled with closed sections) and preferably have a length proportional to the stroke of the rotary **5** along the antenna **3,** so as to cover preferably almost entirely the string **6** for its extension in length.

[0055] The screen **9,** in its lowest portion does not pass beyond the clamps **7** to contain its circumferential dimensions and reduce the bulks and therefore advantageously reaches a height near the clamps **7,** preferably at a distance DAX not greater than **0-0.5** metres, and more preferably not greater than **0.2** metres from them (in particular from the one mounted at the top with respect to the other one(s)), and extends in a longitudinal direction preferably until it reaches close to the lower face of the body of the rotary **5,** such as to completely or almost completely cover the longitudinal extension of the shafts **6** in front of the antenna **3.**

[0056] The upper end **9**A of the screen **9,** also called "proximal end" in the present description because of the two ends of the screen **9** it is the one closest to the rotary **5,** in order to move in a synchronised manner with the movement of the rotary **5** imparted by the side displacement system **8** in the longitudinal direction on the antenna **3,** can be connected in a direct manner to the side displacement system **8,** in particular to the slider **82** or more advantageously to the rotary **5** or to the slider **80.**

[0057] The previous preferred values of the distance DAX substantially reduce the risks of workers suffering accidents by involuntarily touching the drilling string while it is rotating. Preferably, the proximal end **9**A of the screen **9** is fixed integrally to the rotary **5** or to the slider **80** so as to follow, in a synchronised manner, at least the longitudinal sliding of the rotary along the guiding antenna **3.**

[0058] With the direct connection the upper end of the extensible screen **9** can be bolted or welded to the slider **80** or even to the rotary **5,** so as to be pulled longitudinally (and laterally as will be explained hereafter), by the motion of the slider **80.** In the case of an indirect connection, the upper end **9**A of the extensible screen **9** can be held by a cable or other flexible means driven by a winch or other rotary actuator (not shown) fixed to the antenna **3.**

[0059] In this way, when the rotary **5** descends towards the base of the antenna, the actuator will unwind the cable that holds the upper end **9**A of the screen **9** so that such an end descends in a synchronised manner to the stroke of the rotary **5,** acting as a "hydraulic spring". The lower end **9**D of the screen **9** (Figure **2**A, Figure **2**B), also called "distal end **9**D" in the present description because it is located further away from the rotary **5** with respect to the proximal end **9**A, can, on the other hand, slide in the longitudinal direction of the antenna independently from the motion of the rotary **5** and of the side sliding system **8.**

[0060] Moreover, such a lower end can be kept at a predetermined axial height, and in particular at a minimum height above the clamps **7,** independently from the motion and from the position of the rotary **5** and of the side sliding system **8.**

[0061] In particular, said lower end **9**D can be rested on a lower mechanical abutment or be directly rested on the clamps **7.**

[0062] The attachment of the upper end **9**A of the screen **9** to the rotating head **5** and/or to the slider **80** makes the safety system easier to install on different types of machines, in general simplifies the mechanical and circuit construction of the system and makes it easier to keep it permanently mounted on the drilling machine **1** during a large number of manoeuvres and operating situations.

[0063] In the embodiment shown in **Figures 2**A and **2**B, the screen **9** comprises a plurality of segments, in particular:

- at least one upper segment **9**A equipped with axial movement synchronised with the rotary **5 ;**
- a lower segment **9**D positioned on the lower end during the operative drilling step; and possibly
- one or more intermediate segments **9**B, **9**C so as to cover, when extended, the stroke of the rotary **5.**

[0064] Again for the sake of simplicity of illustration, the antenna **3** is shown vertical but it should be understood that in the various operative conditions it can be inclined frontwards, backwards or sideways with respect to the base machine **2.** The segments **9**A, **9**B, **9**C, **9**D of

the screen **9** are shown sectioned in **Figure 2**A in order to allow the drilling string **6** that passes inside them using the suitable linkage **4** for positioning the antenna **3** to be seen. As shown in such a Figure, they can have closed cross sections so as to completely contain and surround the drilling string **6.**

[0065] The segments **9**A, **9**B, **9**C and **9**D can be made with progressively increasing cross sections, so as to be able to be inserted inside one another in coaxial position and in a mutually sliding manner in the longitudinal direction forming a telescopic-type assembly.

[0066] Advantageously, at least the segment **9**A closest to the rotating head **5** has an average or maximum diameter or more generally outer width, according to a direction parallel to the ideal plane passing through the axes of the guiding antenna **3** and of the shafts of the drilling string **6** (Figure **2**B), not greater than the maximum diameter or outer width of the rotary **5,** so as to reduce the overall bulk of the screen **9** and facilitate the manoeuvres of the machine **1** during drillings in restricted spaces, like for example in urban areas.

[0067] Each segment, as can be seen in Figure **2**A, is preferably equipped with upper and lower edges or abutments that act as mechanical stops for the relative sliding of each segment with respect to the one immediately inside and with respect to the one immediately outside. In this way, the segments are prevented from slipping out and decoupling.

[0068] The edges or abutments can also be dismountable, for example bolted, in order to facilitate the insertion of a segment of screen inside the other and then remountable once insertion has been carried out. The segments **9**A, **9**B, **9**C and **9**D of the telescopic screen can be made of rigid material, preferably of the metallic, light or lightened type, of low thickness. Possibly, each segment **9**A-**9**D can be made from perforated metal plates or from gratings with small-sized holes, preferably no larger than **20** mm to prevent the fingers of a worker from entering but at the same time allow the shafts to be visible from the outside when they are in rotation and to allow the possibility of material coming out from the inside (for example the drilling debris) or allow easy cleaning from the outside.

[0069] Alternatively, they can be made of plastic material in order to further reduce the weight and possibly be transparent to increase internal visibility. In a further alternative, there can also be a combination of the previous solutions described.

[0070] Preferably, the side displacement system **8** also comprises a second slider unit **82**A mounted on the antenna so that it can slide along it. The second slider unit **82**A preferably in turn comprises:

- a third slider **81**A mounted so as to be able to slide along the guiding antenna **3** for example along suitable sliding guides;
- a fourth slider **80**A, like for example a carriage or slide, mounted so as to be able to slide in a guided manner, i.e. along linear guides, on the third slider **81**A, for example along suitable guides **83**A formed on the third slider **81**A and that can be similar to the guides **83** described earlier.

[0071] The lower or distal segment **9**D is advantageously fixed to the fourth slider **80**A or be an integral part thereof or further more contain the abutments for coupling with the guides **83**A to carry out the side movements.

[0072] The slider **80**A can be driven by an actuator **11**A that can for example be linear, like for example a hydraulic or pneumatic cylinder, or rotary - for example electric motor with screw and nut screw-type shaft - mounted on the third slider **81**A. Advantageously, the second slider unit **82**A slides as a whole along the same guides **3**A along which the first slider unit **82** slides, if necessary using guide means such as rollers or sliding blocks to avoid wear.

[0073] The function of the second slider unit **82**A is to maintain the coaxiality of the lower section of the screen **9** with the upper rotary and therefore with the drilling string **6,** avoiding translations or misalignments of the screen elements **9**B, **9**C and **9**D on the plane perpendicular to the longitudinal axis of the antenna **3.**

[0074] The function of the guide means of the second slider unit **82**A is to prevent, when the antenna **3** is oriented with strong inclination with respect to the vertical, the extensible screen **9** from tending to belly, i.e. to be arranged in a deformed configuration according to a curved line. Indeed, in such a deformed configuration the segments of the screen **9** could come into contact with the string of rotary shafts **6** or they could tend to jam together preventing the telescopic movement.

[0075] Advantageously, the segments of the screen **9** in the abutment parts will also be partially guided with respect to one another so as to reduce the flexing due to its own weight. If this is not sufficient, many guides at the mast **3** can be inserted and connected to other segments of the screen **9.**

[0076] The slider units **82, 82**A belonging to the side displacement system **8** are preferably dismountable from the elements of the screen **9**A, **9**B, **9**C or **9**D, for example bolted, in order to facilitate the insertion of one screen segment inside the other and then remountable once insertion has been carried out. In any case, the distal screen **9**D can quickly decouple from the antenna **3,** dismounting one of the two attachment systems that make it integral either with the slider **80**A or with the slider **81**A.

[0077] In the embodiment shown in **Figure 2**A, the dimensions of the section of the most inner screen segment (**9**A in the case of **Figure 2**A) are such as to be able to house the shafts of the drilling string and the floating or system for damping and motion transmission to the shafts **6** from the rotary **5,** in directions perpendicular to the antenna **3.**

[0078] In the condition of **Figure 2**A,**2**B, with the screen **9** completely extended, the upper screen segment **9**A is

held in suspended position by the slider unit **82** or by the rotary **5** or by the second slider **80** to which it can be constrained (or by a flexible tensioning means in the case of indirect installation), whereas the intermediate segments **9**B, **9**C and **9**D are preferably each hung at the previous segment through the abutment edges and tend to be arranged in a position completely extracted through the effect of its own weight, when the antenna **3** is arranged in substantially vertical configuration.

[0079] Such an effect of its own weight is effective only while the inclination of the antenna remains within a limited range with respect to the vertical, but many types of processing are limited to this type of configuration: for example water wells, geothermal wells, core boring, ...

[0080] When, on the other hand, the antenna is very inclined, or close to horizontal or even sub-horizontal the segments **9**A-**9**D no longer tend to spontaneously extract and therefore it is preferable for the screen **9** to be driven or motorised to reach and maintain the extended or retracted configuration. For this reason, the lower screen segment **9**D can be driven/motorised in a first variant of motorisation through a system with at least one motorised pinion **41** that engages on at least one rack **42** integral with the antenna **3** and parallel to the guides **3**A.

[0081] Said motorised pinion is preferably mounted, or in any case constrained to the slider unit **82**A that moves slidably guided along the antenna **3** and thus substantially parallel to the mounting direction of the rack **42.** The rack **42** can be equivalently replaced for example by a roller chain. In the case in which for reasons of stability and symmetry it is necessary to mount two racks **42'** and **42" (Figure 2**B) they will preferably be mounted opposite with respect to the longitudinal middle plane of the antenna **3.**

[0082] As shown in Figures **3**A, **3**B, a safety device according to a particular embodiment of the invention can have a second type of motorisation, made through a flexible means (cable or chain) in a closed loop (with two branches, an upper one for lifting and a lower one for lowering). The rotation actuator **43** can be a winch or a geared motor. In an advantageous solution, the actuator **43** is a winch with two cable branches, wherein the upper branch **44** for lifting and the lower branch **45** for lowering, wind/unwind in a synchronised manner on the same drum.

[0083] The upper cable branch **44** is relayed through an upper pulley **46** fixed to the antenna **3** or to the upper head and connects to the screen **9**D, in particular in an upper area thereof or directly to the slider unit **82**A. The lower cable branch **45** is relayed through at least one lower pulley **47** fixed to the antenna **3** and connects to the screen **9**D and in particular to a lower area thereof or to the slider unit **82**A. In this way, if the actuator **43** is not actuated, the slider unit **82**A and therefore the lower screen **9**D stay in a fixed position with respect to the antenna **3** and such a position is maintained independently from the motion of the rotary **5.**

[0084] When the actuator **43** is activated to wind a certain amount of cable **44** on the drum, it will simultaneously unwind an equal amount of cable **45** obtaining a sliding of the lower screen **9**D towards the upper end of the antenna **3.** Similarly, by reversing the motion of the rotary actuator **43** there will be sliding of the lower screen **9**D and of the slider unit **82**A, towards the lower end of the antenna **3.** Thanks to this actuation/motorisation system of the screen **9,** it is possible to always drive a sliding of the screen **9**D upwards or downwards along the antenna **3** in all possible operative configurations (i.e. inclinations) that can be taken up by the antenna.

[0085] The safety system also comprises a sensor that detects the position of the distal end **9**D of the screen **9;** more specifically, such a sensor can detect the completely extended configuration of the screen **9,** when the lower screen **9**D is at the desired lower end, close to the clamps **7.**

[0086] Such a position at the minimum height, i.e. at a height DAX no greater than **200** millimetres with respect to the upper face of the clamps, ensures that the string of shafts **6** is covered by the extensible screen **9** and that therefore it is inaccessible to the operator of the machine or to other people during all of the operative drilling steps. In such a position, it is therefore in safe conditions and the danger of parts of the body getting caught or making contact with the moving parts **6** involved in the drilling is eliminated.

[0087] Therefore, as long as the sensor detects the completely lowered position of the screen **9,** the drilling machine **1** can work in normal operating mode allowing the rotation of the string **6** and the advancing of the rotary **5.**

[0088] When the lower screen segment **9**D is lifted, the sensor detects such movement and generates a control signal that directly, or for example through a suitable logic unit **17** (shown in Figure **1)** immediately commands all the dangerous manoeuvres to stop, in particular at least the rotation of the shafts, so as to protect the well-being of the operator; after this the logic unit **17** can for example automatically command the passage to safe operation of the machine, or simply enable it, leaving it at the operator's discretion whether to manually command the passage to safe operation of the machine or to return to normal operation.

[0089] The sensor, fixed to the mast **3,** can be of different types and can be installed in different positions of the machine, ensuring the same safety function. In a first mode of installation, the sensor is a microswitch or a proximity sensor fixed at a suitable height on the antenna **3** so as to be activated by an abutment part of the screen **9**D, or rather by the slider unit **82**A.

[0090] In a second mode of installation, the sensor can be an absolute encoder mounted on the rotary actuator **41** or **43** to read the rotations of the drum and thus derive the longitudinal position of the slider unit **82**A and thus of the screen **9.** After having done an initial zeroing of the encoder with the screen **9**D in a known position, a control unit **17** (e.g. a PLC), knowing the primitive winding

diameter of the cable/chain or the diameter of the pinion and knowing the revolutions of the rotary actuator, is able to calculate the exact position of the lower screen **9,** and in particular of the lower part **9**D and consequently can suitably activate or deactivate the limited operating mode. Other variants of the sensor, like those of the contactless type (for example laser and magnetic) are considered equivalent for the purpose.

[0091] Starting from the condition shown in **Figure 2**A or **3**A, with rotary **5** lifted, screen **9** extended and drilling machine **1** positioned with antenna **3** aligned with the drilling axis, it is possible to start the drilling step. The screen **9** is in completely extended configuration and to the minimum height, therefore the sensor continues to give approval for use in normal operating mode for this entire step. The drilling is carried out by lowering the rotary **5** and the slider unit **82** and setting the string **6** in rotation.

[0092] During the descent of the rotary, the actuator **41, 43** of the screen is not actuated and therefore the lower screen **9**D remains at a constant height with respect to the clamps **7.** The upper and intermediate screen elements (**9**A, **9**B and **9**C) slide with synchronised movement with respect to the rotary **5,** collapsing towards the lower part of the antenna **3** and reducing the overall length of the screen **9** to the minimum closure size.

[0093] The intermediate screen elements **9**B and **9**C progressively descend inside the lower element **9**D and thanks to its lower lips that act as scrapers also carry out cleaning of the inner wall of the screen **9**C. The screen **9**B descends inside the screen **9**C until it goes into mechanical abutment through suitable abutments. The screen segment **9**A moves in the longitudinal direction to the antenna in a synchronised manner with the rotary **5** and with the slider unit **82.**

[0094] Once the rotary has completed the entire stroke towards the base of the antenna **3,** the end of advancing condition shown for example in **Figure 9** is reached. In this condition the screen **9** is in completely contracted condition, enclosing most of the portion of the drilling string that is outside of the drilled hole and continuing to protect workers working around the machine.

[0095] The height (in the longitudinal direction to the antenna) of the screen elements **9**A, **9**B, **9**C and **9**D is suitably selected so that in this configuration, the presence of the screen **9** does not reduce the useful stroke of the rotary and does not obstruct its motion. Advantageously, the screen **9** can be installed on a machine that originally lacked it, without such installation reducing the stroke of the rotary.

[0096] The height of the screen elements sized in the manner just described implicitly determines the number of intermediate elements **9**B, **9**C necessary to allow a variation in length of the screen **9,** between the completely contracted configuration and the completely extended configuration, equal to the stroke of the rotary **5.** Typically values of such a height can vary between **0.5** metres and **1.5** metres.

[0097] Starting from the operative condition of **Figure 2**A or **3**A, if the desired drilling height has been reached and it is not necessary to add shafts, it is possible to lift the rotary **5** so as to extract the shafts from the ground until it returns to the configuration of **Figure 2.** During the lifting of the rotary, the rotary actuator **41, 43** is not actuated to move the lower screen **9**C. In this way, the lower element of the screen **9**D remains at a constant height above the clamps **7** ensuring the protection of the shafts. The sensor detects the lowered position of the screen and maintains the normal operating mode.

[0098] Starting from the operating condition of **Figure 2**A or **3**A, if the desired final drilling height has not been reached and it is therefore necessary to add shafts **6**A, it is necessary to hold the shafts already inserted in the excavation through the clamps **7** and disconnect them from the rotary **5,** unscrewing them. At this point it is possible to lift the rotary **5** advantageously also by activating the actuator **14** to make the lower screen segment **9**D translate upwards.

[0099] The lifting of the lower screen **9**D is detected by the sensor that is activated, thus sending off a command signal and can act directly on the actuators of the rotary **5** to immediately stop at least the rotation of the drilling string. Alternatively, when firstly the lifting of the slider unit **82** is completed and then the lower screen **9**D is lifted by acting on the slider unit **82**A, the sensor can simultaneously block both the rotation of the shafts and the axial sliding of the rotary **5** along the antenna.

[0100] In a variant, the command signal generated by the triggering of the sensor can be sent to a control unit **17** that as well as commanding at least the stopping of the rotation of the drilling string, can automatically manage multiple additional safety functions such as blocking the longitudinal sliding of the rotary **5** or emitting a sound or light warning signal; alternatively, the logic unit **17** can limit itself to enabling such additional safety functions, giving the possibility for an operator to activate them, or not, manually.

[0101] The screen **9**D, while rising, progressively encapsulates the intermediate screens **9**C and **9**B. The lower screen **9**D in its lower part is equipped with a horizontal edge that while rising progressively comes into contact with the lower edge of all of the intermediate and upper elements of the screen **9** pulling them up until the screen **9** is brought into the completely contracted condition **9'** visible in **Figure 4** whereas the edge with the upper segments resting on it is visible in **Figure 10.**

[0102] The lower edge of the screen **9**D partially closes the lower face of the screen and has an opening of slightly larger diameter than that of the shaft **6.** The lower edge thus acts as a screen against the debris rising from the excavation and at least partially obstructing the rise of the debris in the screen. Advantageously, the lower edge of the element **9**D can be concave towards the base of the antenna.

[0103] The concave shape allows the debris and the debris to be reflected towards the base of the antenna

and allows the radius of the area in which they fall to be limited. Once the collected configuration in an upper position has been reached, it is possible to load new shafts in the string **6,** while the machine is in limited operating mode - also called, in the present description, "safety operating mode ", so as to be able to then proceed with the drilling up to a greater depth. Such loading can take place manually, or if the service winch is used with the cable **21,** it is advantageous to laterally move the rotary **5** and the screen **9,** to leave free passage along the mast **3,** as shown in **Figure 4**A.

[0104] At least one linear actuator **11** driving the lateral or transversal movement of the rotary, in a rigid manner pulls the screen **9** that slides laterally and in a guided manner with respect to the slider unit **82**A.

[0105] From **Figures 4**A and **4**B it can be seen that the presence of the screen **9** does not increase the loading height of the shafts with respect to the ground. Since the two sliders **82** and **82**A are close to one another, it is advantageously possible, in this close-together configuration, for the two sliders to couple by means of a mechanical abutment such as to allow the synchronous movement of the two sliders with a single actuation, through the actuator **11** or **11**A.

[0106] Alternatively, the side displacement system can be actuated in a coordinated manner both by the actuator **11** and by the linear actuator **11**A. The transversal movement can be required also to carry out a loading of the shaft **6**A through the use of mechanized loading means installed on the machine **1** or through external mechanized loading means, which in some cases must be able to have free access over the entire front of the antenna **3** in order to be able to operate. When the rotary is in the transversally moved configuration the screen **9** can be lowered to protect a possible shaft **6** that is connected on the rotary.

[0107] In the case in which the shape of the screen is open on the antenna side, the simultaneous absence of the shaft **6** on the rotary and the lowering of the screen **9,** allow the later be easily cleaned, in its inner wall. If the screen is of the type with section open towards the antenna (for example "C-shaped") when it is moved transversally, it would become accessible. Therefore, in some operating conditions in which it is required to make the shaft rotate, it could be necessary to fix on that same side, to the antenna **3,** a protection, fixed or mobile, which closes the free side left by the screen. Variants of protection attached to the rotary, windable and retractable are considered totally equivalent for this purpose.

[0108] Once the final height of the excavation has been reached, it may be required to lower an armature **23,** and in this case it will be hooked to the service cable **21** through the hook **22** and it will be lowered into the hole exploiting the lateral movement of the rotary and of the safety system **9.**

[0109] F**igure 5** shows the end of drilling configuration in which the rotary and the screen **9** are translated laterally without being lifted in height, to save time, particularly when the shafts **6** must be extracted from the hole using the service cable **21** or lifting means outside of the machine (used to remove many shafts together, without having to dismount them all).

[0110] F**igure 6** again shows a first embodiment of the safety system described with a third variant of motorisation consisting of a linear actuator or cylinder **61** (hydraulic, electric or pneumatic) that moves the screen **9** through a cable relay system **62** and **64.** The actuator is connected at the bottom to the lower screen **9**C and at the top to the intermediate screen **9**B. In the example given here, the stroke of the rotary is shorter or the length of the segments is greater and therefore the number of them necessary to cover the entire stroke, when completely extended, is less than those shown in Figure **2.** Therefore, the distal element, in the case of Figure **6** is **9**C, whereas in Figure **2** it was **9**D.

[0111] The cable **62** is fixed at one end to the upper screen **9**A and at the other end to the lower part of the lower screen **9**C. The cable **64** is fixed at the top of the screen **9**A or directly to the rotary **5** or to the slider **80** or furthermore to the slider unit **82,** and at the other end to the upper part of the lower screen **9**C. Passing from a completely extended configuration to one in which the actuator is retracted, the lower **9**C and intermediate screen **9**B are moved by cable relays **62** and **64** passing to the completely contracted configuration.

[0112] This solution makes it possible to contain the dimensions of a linear actuator by exploiting the cable relays to make it compatible with the length of the antenna. In the case of direct connection of a jack to the distal or lower screen **9**C (or **9**D), to the rotary **5** or to the carriage, the stroke of the actuator would have to be of many metres and consequently when it is in collected configuration **9'**, it will jut several metres above the rotary generating problems of bulk in height and impossibility of using it in confined spaces or for drilling inside buildings. Vice-versa if it were kept mounted flush at the top, it would not allow all of the screen to be compacted up to the contracted configuration **9'** for which the free space left between the screen **9** and the clamps **7** is maximised. In the case illustrated in **Figure 6** it is necessary to supply the jack with a hydraulic/pneumatic pipe or with flexible electric cables that generate a bag so as to compensate the movement of the jack **61** with respect to the mast **3.**

[0113] Both in the case of **Figure 6** and in the previous cases, it could be necessary to reduce the "catching" effect, i.e. momentary locking or jamming caused by misalignment, of the segments of the screen **9** moving with respect to one another. In this case, an alternative solution to the addition of further guides on the intermediate segments, could be to apply a system like an adjustable cable tensioner, belt tensioner or chain tensioner, so as to ensure that it is rectilinear.

[0114] A further and ninth embodiment, which provides for the side displacement of the rotary and of the screen, is visible in **Figure 13.** In the solution of **Figure 13** the extensible screen **900,** reversibly extendable and retract-

able along the guiding antenna **3,** can consist of a single segment made with walls of a flexible or deformable material capable of shortening and lengthening longitudinally to its own axis and/or to the longitudinal axis of the drilling string when subjected to axial compression or traction.

[0115] Like in the embodiments of Figures **13**A, **13**B, **14**A, **14**B the extensible screen and in particular the single segment that forms it can shorten and lengthen substantially like a bellows.

[0116] Said single segment made of flexible or deformable material can thus pass from a contracted or collected configuration **900'** (visible in **Figure 13**B) to an extended configuration **900** (visible in **Figure 13**A). Examples of walls of a flexible or deformable material can be a wall in metallic mesh, a fabric sock, a tubular sheath in plastic material or in rubber.

[0117] Said screen **900** comprises a proximal end **900**A and a distal end **900**B. The end **900**A can be substantially similar to the upper end of the screen **9**A of **Figure 2,** whereas the end **900**B can be substantially similar to the lower end of the screen **9**D of **Figure 2,** with the important difference that in the embodiment of **Figure 13** the proximal end **900**A and the distal end **900**B belong to the same single segment of the screen **900.** Preferably, the proximal end **900**A of the screen **900** is fixed integrally to the rotary **5** or to the first slider unit **82** to follow in a synchronised manner at least the longitudinal sliding of the rotary along the guiding antenna **3.**

[0118] The lower or distal end **900**B of the screen **900** is preferably fixed to the second slider unit **82**A and advantageously fixed to the fourth slider **80**A. The second slider unit **82**A or preferably the fourth slider **80**A are equipped with a plate or frame **96** that extends in a direction perpendicular to the antenna extending around the drilling axis for a radial bulk at least equal to that of the screen **900.** The plate **96** has a central hole with a sufficient diameter to allow the passage of the string of shafts **6** and the passage of drilling debris. Such a plate **96** is fixed to the distal end **900**B of the screen **900.**

[0119] In this way, it is possible to use the side displacement system **8** in the same way already described for the first embodiment already explained relative to **Figures 2** and **4.** The second slider unit **82**A allows the lower section **900**B of the screen **900** and the plate **96** to be kept coaxial with the upper rotary and thus with the drilling string **6,** even when the rotary translates laterally with respect to the antenna **3,** avoiding misalignments of the screen **900** on the plane perpendicular to the longitudinal axis of the antenna **3.**

[0120] In the embodiment of **Figure 13,** fixed on the plate or frame **96** of the fourth slider unit there can be a plurality of winders **97,** from each of which a cable **98** extends, which connects to the rotary **5** or to the first slider unit **82.** Each winder **97** has a drum for accumulating cable and can be equipped with an inner spring, for example a coil spring, which allows the cable **98** to always be kept under tension. Possibly, the coil spring can be replaced by an electric or hydraulic motor that takes care of keeping the cable **98** under tension.

[0121] When the first and second slider unit **82** and **82**A move axially apart, each winder **97** allows the unwinding or release of the cable **98.** On the other hand, when the two slider units move together, each winder **97** recovers or rewinds the cable **98** and accumulates it in the drum. On the plate or frame **96** at least three winders are fixed, arranged so that the three cables **98,** if observed in plan, are the same radial distance from the drilling axis, or rather are on a circle of smaller radius with respect to the radius of the screen **900,** and arranged equally angularly spaced, or rather **120°** apart from one another. It is also possible to fix many winders **97,** for example four spaced apart by **90°** or six spaced apart by **60°** and so on.

[0122] It is thus possible to make a screen **900** with a substantially cylindrical shape with closed cross section, or alternatively with a substantially C-shaped cross section or in any case such as to contain and surround the drilling string **6.** In the case in which the screen is made with a mesh or a fabric, the weft of such a mesh or fabric must be sufficiently dense, i.e. it must leave sufficiently small empty spaces, such as to prevent the entry of an operator's fingers but at the same time make it possible to see from the outside when the shafts are in rotation and the possibility of making material come out from inside (for example the drilling debris) or to allow easy cleaning from the outside.

[0123] In the case in which the screen **900** is made of rubber it can have a "bellows" shape so as to be able to vary its own length.

[0124] In the solution of **Figure 13** the extensible screen **900** is mounted outside the cables **98,** so that they keep it radially distanced from the string of shafts **6.** In the condition with the screen extended, as shown in **Figure 13**A, it takes up an almost cylindrical shape with diameter not greater than the bulk of the rotary **5** but sufficiently large to encapsulate the cables **97** and the material from which such a screen is made takes up an almost rectilinear extended shape.

[0125] In addition it is also possible to mount a spiral or helix **99,** for example formed from a metallic or plastic rod that winds up, forming coils that wind around the drilling axis so that each coil, if seen in plan, includes all of the cables **97** inside it and is externally tangent to the cables **97,** still remaining inside the screen **900.** The spiral **900** is thus arranged between the cables and the screen in a radial direction with respect to the axis of the shafts **6.**

[0126] This elastic spiral **99** contributes to maintaining the desired shape of the screen, ensuring its distance from the shafts even when the antenna is laterally inclined. This spiral **99** can also be connected to the screen **900** by sliding inside through holes formed on the screen itself. The upper and lower end of the spiral **99** can be fixed, respectively, to the rotary **5** and to the plate **96.** When the lower slider unit **82**A moves towards the upper slider unit **82,** the screen **900** behaves like a sleeve and

tends to sag forming folds or creases that make it possible to accumulate the material of the screen in a contracted configuration **900'** shown in **Figure 13**B.

[0127] The cables **97** ensure that such folds form towards the area outside the cables, thus further from the shafts **6.** During the mutual approach of the lower and upper slider, the spiral **99** is compressed and reduces the pitch of its coils to take up a shorter configuration, whereas the cables **98,** which are inside the spiral **99** prevent it from taking up a laterally deviated configuration.

[0128] A further and tenth embodiment is shown in **Figure 14.** The solution of **Figure 14** again foresees an extensible screen **900**^{III}, reversibly extendable and retractable along the guiding antenna **3,** which can consist of a single segment made with flexible or deformable material that makes it possible to vary the longitudinal dimension of the screen when it is subjected to a force, of traction or of compression, in a direction parallel to the longitudinal axis of the drilling string.

[0129] Also in this case, the proximal end 900A is connected to the upper slider unit **82** and the distal end **900**B is connected to the second slider unit **82**A. The difference with respect to the solution of **Figure 13** consists of the fact that now the winders **97** are arranged so that the cables **98** slide outside the screen **900** ^{III}, i.e. at a greater radial distance with respect to the drilling axis. In order to keep the screen **900** ^{III} guided the spiral **99** is no longer present but it is possible to use hoops **100.**

[0130] These hoops **100** are substantially formed from a ring to which a plurality of guiding handles are fixed radially, arranged outside the ring itself. The ring of the hoop **100** has an inner diameter roughly corresponding to the diameter of the screen **900**^{III}. A plurality of hoops **100** is fixed outside the screen **900**^{III} at regular intervals along the axial dimension of the screen itself, for example gluing the rings of the hoops to the screen or making through hole on the screen inside which it is possible to pass the rings of the hoops **100.**

[0131] Each hoop **100** has a number of handles equal to the number of cables **98** intended to be used, for example three, four or six. Each handle has a through hole inside which the cable **98** can be slidably inserted, so that the hoop can slide with respect to the cables.

[0132] When the screen **900**^{III} is in extended configuration like in **Figure 14**A, the hoops are arranged perpendicular to the drilling axis, with the centre of the hoop positioned practically on the drilling axis, and they are kept in such a position thanks to the fact that they are guided on the cables **98** that in turn are arranged equally angularly spaced from the drilling axis. The hoops thus keep the screen distant from the shafts **6,** even when the antenna **3** is inclined with respect to the vertical and give the screen itself a preferably cylindrical shape.

[0133] When the lower slider unit **82**A moves towards the upper slider unit **82,** the hoops **100** sliding along the cables **98** through their handles, move towards one another keeping the screen centred and coaxial to the shafts **6.** The screen **900**^{III} during this step behaves like a sleeve and tends to sag forming folds and creases that allow the material of the screen to accumulate in a contracted configuration **900'** shown in **Figure 14**B.

[0134] Clearly, it would also be possible to fix the winders **97** to the upper slider unit **82** and connect the end of the cables **98** to the lower slider unit **82**A without it modifying the operation of the screen system **900**^{III}.

[0135] A further and eleventh embodiment is shown in **Figure 15.** In the solution of **Figure 15** the extensible screen **900**^{IV}**,** reversibly extendable and retractable along the guiding antenna **3,** consists of a single segment and in greater detail is made substantially as a coil spring. The coil springs preferably consist of a strip of harmonic steel that is wound around an axis creating concentric coils of increasing diameter, each of which partially covers the previous coil preferably also when the spring is in extended condition.

[0136] In this way, the spring takes up a cone shape with the walls completely closed, thanks to the juxtaposition of the various coils. The screen **900**^{IV} therefore has a proximal end **900**A with a greater diameter and a distal end **900**B with a smaller diameter. The elasticity of the harmonic steel tends to keep the coils in extended position, as can be seen in **Figure 15**A, i.e. with the minimum axial juxtaposition and therefore with the maximum length of the spring.

[0137] The juxtaposition of the coils and the conical shape of the spring also ensures that the coils are mutually guided in one another maintaining the rectilinear configuration of the spring without the need for external guides. When the coil spring is compressed, the coils tend to slide with respect to one another in the axial direction, thanks to the fact that they have increasing diameters, increasing their axial juxtaposition and reducing the overall length of the spring.

[0138] During the variations in length the spring always maintains a closed and continuous perimetric shape. It is thus possible to mount the coil spring, which forms the screen **900**^{IV}**,** in coaxial position to the drilling axis by selecting a minimum diameter of the spring that is such as to contain the shafts **6** and that allows the debris to be discharged and at the same time allows a maximum diameter of the spring to be selected that does not jut with respect to the bulk of the rotary **5.**

[0139] Preferably, the proximal end **900**A is connected to the rotary or to the upper slider unit **82** through a flange **100**A that partially inserts in the spiral, whereas the distal end **900**B is connected to the lower slider unit **82**A through a flange **100**B that partially inserts in the spiral. When the lower slider unit **82**A comes towards the upper slider unit **82,** the coil spring of the screen **900** compresses staying coaxial to the shafts **6** until it reaches a contracted configuration **900**$^{IV'}$, as shown in **Figure 15**B. The coil spring therefore prevents access to the shafts **6** during the work steps.

[0140] In the embodiments of **Figures 13,14** and **15** the movement of the slider units **82** and **82** can take place

with the same actuation systems already described relative to **Figures 2** and **3.**

[0141] Also in the embodiments of **Figures 13,14** and **15,** the safety system comprises a sensor that detects the position of the distal end **900**B of the screen **900,** in a totally analogous manner to what has already been described in the first embodiment. More specifically, such a sensor can detect the completely extended configuration of the screen **900,** when the lower screen **900**B is at the desired lower end, close to the clamps **7.**

[0142] The use of a screen made with a single flexible element made from fabric or mesh has the advantage of being lighter with respect to a screen with multiple rigid segments, and this case promote the stability of the machine.

[0143] When the extensible screen comprises a single segment, like for example in the embodiments of **Figures 13**A, **13**B, **14**A, **14**B, **15**A, **15**B, the latter in configuration of maximum extension has an overall length preferably equal to or greater than **2** metres, and preferably comprised between **2** metres and **10** metres, more preferably comprised between **2** metres and **8** metres or between **2-6** metres.

[0144] F**igure 7** shows a second embodiment, also motorised like the second variant already described in **Figure 3** and with the same modes of actuation, therefore we will not repeat it.

[0145] A difference with respect to the first embodiment described consists of the fact that the screen **90** instead of being laterally mobile like the screen **9,** and in phase with the movement of the rotary **5** with respect to the first slider **81,** as shown for example in **Figures 4** and **5,** it is again position so as to always contain the drilling string **6** and it is not equipped with this transversal translation movement.

[0146] Its shape is such as to contain the string of shafts **6** both when the rotary **5** is centred with respect to the drilling axis, and when it is in a laterally displaced position, being guided on the carriage **81.** In this case the second slider unit **82**A can comprise the third slider **81**A, mounted so as to be able to slide along the guiding antenna **3** for example along suitable sliding guides, but lack the fourth slider 80A.

[0147] The screen **90** consists of a plurality of segments **90**A, **90**B, **90**C, totally analogous to the corresponding ones **9**A, **9**B, **9**C described in the previous **Figures** (wherein **90**C, in this case being the lower screen, is comparable to **9**D of **Figures 2** to **5,** and to **9**C of **Figure 6**).

[0148] The upper screen **90**A is advantageously fixed to the slider unit **82,** or as described earlier it can be indirectly connected with flexible tensioning means that reach the screen **9**A from the high position of the antenna **3** (thus capable of keeping the screen **9**A always lifted and in the vicinity of the rotary, e.g. stopping on an abutment fixed to the rotary **5** or to the slider unit **82).** In the more difficult case in which the upper screen **90**A is fixed to the rotary **5** or to the slider **80,** it must be an attachment capable of keeping the screen **90** suspended but at the same time of releasing the lateral movement of the rotary **5** with respect to the upper screen **90**A, so as to allow the movement thereof.

[0149] The distal segment **90**C, in this case the lower one, as already illustrated in the previous configuration will be guided to the mast **3** through a carriage **81**A or more simply with at least one support arm among **92** and **93** (in **Figure 7** both are represented) that are guided on the same guides **3**A of the mast **3** on which the carriage **81** is also guided, or on additional guides **94** fixed to the sides of the mast **3.**

[0150] The guides to the mast **3** can also be fixed on the intermediate elements, as shown in **Figure 7** for the intermediate screen **90**B. Advantageously the wire-like guide **91** will be positioned in the higher part of the screen so that when the screen **90** passes from the extended configuration **90** to the compressed configuration **90'**, the guides **91** go into a pack on the guides **92,** optimising the minimum length in bulk totally closed. As previously, a sensor arranged at the base of the mast **3** notices the presence of the lower screen **90**C and enables normal drilling so long as said screen is not lifted by a motor means.

[0151] F**igure 8** shows a partial side and front section of said safety system in which the screen **90** surrounds on one side the drilling string **6** and on the opposite side it has an elongated shape so as to allow the lateral movement of the rotary **5** on the carriage **81.**

[0152] More generally, the retractable screen **90,** as shown in Figures **8**A, **8**B, **9**, **10**A, **10**B, **11, 12,** can have substantially elongated cross sections, preferably rectangular with semi-circular ends, i.e. with the so-called "obround" shape; in this case, the retractable screen **90** is longitudinally guided to the guiding antenna **3** so as not to be able to move perpendicularly or more generally transversally to the antenna **3,** and only moves the rotating head **5** laterally.

[0153] Clearly, the elongated cross sections are advantageously oriented in the direction of the lateral movement FT**1** of the rotary. Of course, said lateral movement of the rotary **5** is always represented in the **Figures** towards the left, but it is totally analogous to that to the right. In the detail of **Figure 8**A it is possible to see the lower attachment points **48** of the flexible elements forming part of the upper branch **44** to the lower screen **90**C and the lower attachment point **49** of the lower branch **43** of the flexible element.

[0154] It is also visible the guide of the screen carried out through the guides **3**A of the mast **3.** Advantageously, the maximum external width at least of the proximal end or of the proximal segment **9**A considered in the ideal plane passing through the axes of the antenna **3** and of the drilling string, is preferably no greater than the maximum external width of the rotating head **5** in the same ideal plane, so as to reduce the overall bulks of the screen **9** and increase the ease of manoeuvre of the machine **1** in small spaces.

[0155] F**igure 9** shows the rotary **5** in an end of drilling configuration, with the screen **90** in compressed or collected configuration **90',** at the base of the antenna close to the clamps **7.**

[0156] F**igure 10** shows the rotary **5** in a raised configuration, typically in the shaft loading step, with the screen **90** in compressed or collected configuration **90',** at the top of the antenna. The loading can take place manually by inserting the shaft **6**A beneath the screen since said screen **90** in contracted configuration **90'** no longer hampers the shaft **6** that always remains connected (also called "balancing rod") to the rotary **5** and that is used to arrive between the two clamps **7.** Basically, the screen **90'** is not lower than the lower end of the "balancing rod". In this sense, the screen in contracted configuration **90'** maximises the free space between the screen **9** and the clamps **7** or the ground.

[0157] F**igure 11** shows the rotary **5** in a laterally decentred position, obtained by being guided to the carriage unit **82,** in particular to the guides **83** of the first slider **81.** The screen is in collected configuration **90'** and both are arranged at the top of the antenna, or in any case in a raised position. In this case it is possible to use the service winch, moving the cable **21** to lift objects like for example armatures, substantially increasing ease of work and safety of the workers that add the shafts to the drilling string or remove them from it. Advantageously, the object will be lifted inside the most inner screen, i.e. **90**A, so as to also exploit the internal space of the screens as loading length, in an analogous manner to what was explained for **Figure 4**B.

[0158] F**igure 12** shows the second embodiment, motorised like the first variant already described in **Figure 2** and with the same modes of actuation, therefore we will not repeat them.

[0159] A further advantage of the extensible screens described previously is that they do not have to be dismounted from the guiding antenna **3** to move the rotating head **5** from the drilling axis allowing a substantial saving of time, for example to pass from the drilling steps to those in which the winch **21** needs to be used or in any case shafts need to be added or removed from the drilling string.

[0160] The examples embodiments described previously can undergo different modifications and variations without departing from the scope of protection of the present invention. For example, the extensible screen can have cross sections not only closed but also open, for example C-shaped or U-shaped in a manner to still enclose the drilling string. Moreover, all of the details can be replaced by technically equivalent elements.

[0161] it is possible to add elements outside of those present to increase the stroke of the rotary that in certain cases it is necessary to increase. In this case, a slider unit **82**A can be adapted to continue to be guided on the antenna and at the same time connect to the distal segment added. The distal segment added could itself contain the guide elements and perform the function of the slider **82**A. The actuation command with which the distal element of the screen **9** is motorised can also be carried out manually when the weight of the screen (due to small dimensions in sections, due to short strokes, due to use of light materials) is very low, e.g. less than **20**kg.

[0162] The presence of the screens does not preclude that the machine also has additional safety devices installed, like for example one or more emergency cables arranged laterally on the antenna, or one or more emergency buttons or furthermore sensitive devices (actuated by radio, photosensitive, optical, laser, etc.). In the case of double-head drillings with shafts and tubes, in which the following are provided: a lower rotary that supplies the rotation of an outer tube coaxial to the inner shaft, in this case moved by an upper rotary, it should be understood that the safety system applies to the same extent as described up to now, between the lower rotary (of the tube) and the clamps.

[0163] The two rotaries present can be fixed together (for example mounted on the same carriage unit **82**A or on the same second slider **80**), and therefore the possible protection of the shaft coming out from the upper rotary up to the lower rotary can be achieved with a fixed screen. If, on the other hand, the two rotaries are mounted longitudinally sliding with respect to one another (generally with distances up to **1** meter and axial actuations along the axis of the drilling string - here meaning the group of shafts and tubes - that are made with jacks) then the protection system can be made with extensible screens also between the two rotaries.

[0164] In the particular case in which the two rotaries are longitudinally movable with respect to one another with longitudinal moving means of the independent type for the entire stroke, then the extensible screen can be advantageously applied also between the two rotaries.

[0165] The materials used, as well as the sizes, cam ne whatever depending on the technical requirements. It should be understood that an expression of the type "A *comprises* B, C, D" or "A *is formed from* B, C, D" also comprises and describes the particular case in which "A *consists of* B, C, D". The examples and lists of possible variants of the present application should be considered non-exhaustive lists.

Claims

1. A safety system for isolating the dangerous areas of a drilling machine **(1)** provided with a guiding antenna **(3),** a rotary **(5)** fixed to the guiding antenna **(3)** so that it can slide along it and arranged for sustaining and driving a drilling string **(6),** the safety system comprising:

- an extensible screen **(9,90, 900)** reversibly extendable and retractable along the guiding antenna **(3)** and forming a proximal end (**9**A,**90**A, **900**A), closer to the rotary and a distal end

(**9**D,**90**C) further away from the rotary, and the extensible screen **(9,90, 900)** is arranged for enclosing the drilling string for at least part of its length;

- a side displacement system **(8)** arranged for being fixed to the guiding antenna **(3)** so as to allow the longitudinal sliding of the rotary **(5)** along the antenna, and so as to move the rotary **(5)** in a transversal direction with respect to the guiding antenna **(3);**
- a sensor arranged for detecting the position of the distal end (**9**D,**90**C, **900**B) in a longitudinal direction with respect to the guiding antenna **(3);**

wherein the proximal end (**9**A,**90**A, **900**A) is arranged for being fixed to the guiding antenna **(3)** so as to follow the longitudinal sliding of the rotary **(5)** along the guiding antenna **(3).**

2. The system according to claim **1,** wherein the extensible screen **(9,90, 900)** has cross sections selected from the following group: closed cross sections, substantially C-shaped, circular, closed and elongated sections.

3. The system according to claim **1,** wherein the extensible screen **(9,90)** comprises a plurality of segments (**9**A-**9**D, **90**A-**90**C) telescopically connected to each other.

4. The system according to claim **1,** wherein the distal end (**9**D,**90**C) and possibly one or more segments (**9**A-**9**D, **90**A-**90**C) adjacent to the segment on which the distal end (**9**D,**90**C) is provided, are arranged for sliding on guides along the guiding antenna **(3),** possibly driven by a motor.

5. The system according to claim **4,** wherein the longitudinal sliding of the distal end (**9**D,**90**C, **900**B) along the guiding antenna **(3)** is driven by means of a toothed pinion **(41)** and a rack **(42).**

6. The system according to claim **4,** wherein the longitudinal sliding of the distal end (**9**D,**90**C, **900**B) along the guiding antenna **(3)** is driven by means of a flexible wire- or chain system **(44,45)** through a winch or geared motor **(43).**

7. The system according to one of the previous claims, wherein the extensible screen **(9, 900)** is arranged for moving transversally with respect to the antenna **(3)** following the side movement of the rotary **(5).**

8. A drilling machine **(1)** comprising the system according to any of the previous claims, wherein:

the screen **(9,90, 900)** is arranged for enclosing the drilling string for at least a part of its length;

the side displacement system **(8)** is fixed to the guiding antenna and is arranged for moving the rotary **(5)** in a transversal direction with respect to the guiding antenna **(3),** wherein the proximal end (**9**A,**90**A) is fixed to the guiding antenna **(3)** so as to be able to slide along it on guides following the longitudinal sliding of the rotary **(5).**

9. The drilling machine according to claim **8,** wherein said side displacement system **(8)** comprises a first slider unit **(82)** fixed at or near the proximal end (**9**A,**90**A, **900**A) of the screen **(9,90, 900)** and is arranged for driving the screen (**9, 90, 900)** causing it slide along the guiding antenna **(3),** and wherein an end of the extensible screen is fixed to the rotary **(5)** or to the first slider unit **(82)** or is constantly kept in a predetermined fixed position with respect to the rotary **(5).**

10. The drilling machine **(1)** according to claim **8** or **9,** wherein the proximal end (**9**A,**90**A, **900**A) of the extensible screen **(9,90)** encloses the section of the drilling string **(6)** closest to the rotary **(5).**

11. The drilling machine according to claim **8** or **9,** comprising one or more clamps **(7)** arranged for blocking and keeping at least part of the drilling string suspended, also when the drilling string is not suspended to the rotating head (**5**), and the extensible screen (**9**) is arranged for extending towards one or more clamps (**7**) up to an axial distance (DAX) equal to or less than **0.4** metres from the clamp closest to the rotary.

12. The machine (**1**) according to claim **8** or **9,** wherein the proximal end (**90**A, **900**A) of the screen (**90**) is fixed to the guiding antenna **(3)** so as not to be able to move transversally with respect to the antenna itself.

13. The machine according to claim **8** or **9,** wherein the ends of the extensible screen (**9,90, 900**) are arranged for translating along the guiding antenna (**3**) and the machine is arranged for:

- detecting through a sensor when the distal end of the screen (**9**D, **90**C, **900**B) moves away from the maximum extension condition of the screen (**9,90**, **900**); and in this case switching the machine to a blocking mode and, possibly,
- enabling the machine (**1**) to switch from a normal or blocking functioning mode to a safety functioning mode, and wherein:

- in the safety functioning mode, the rotation or translation speeds of at least part of the components of the machine, such as for example the rotation of the drilling string (**6**) or

the longitudinal movements of the rotary (**5**), are reduced with respect to the normal functioning mode, and/or at least some functions, movements or manoeuvres of the machine are limited or impeded with respect to the normal functioning mode;
- in the blocking mode, some functions, movements or manoeuvres of the machine, such as for example at least the rotation of the drilling string (6) or also the longitudinal movements of the rotary (5), are stopped and impeded with respect to the normal functioning mode.

14. A process for using a drilling machine (**1**) having the features according to claim **8,** comprising the following operations:

F.**1**) orienting the drilling antenna (**3**) along a predetermined drilling axis, with the rotary (**3**) withdrawn in a position closer to the upper end of the guiding antenna **(3),** the drilling string **(6)** assembled on the rotary **(5)** and ready for being driven by the same and the extensible screen **(9, 90, 900)** contracted;
F.**2**) extending the extensible screen **(9, 90, 900)** and carrying out an excavation in a normal functioning mode;
F.**3**) moving the rotary **(5)** towards the upper end of the guiding antenna **(3),** extracting at least part of the drilling string from the excavation, contemporaneously keeping the extensible screen **(9, 90, 900)** extended;
F.**4**) contracting the extensible screen **(9, 90, 900),** revealing said contraction and consequently passing the machine to a blocking mode, and possibly enabling the passage of the machine **(1)** from a normal functioning or blocking mode to a safety functioning mode; wherein:

- in the safety functioning mode, the rotation or translation speeds of at least part of the components of the machine, such as for example the rotation of the drilling string **(6)** or longitudinal movements of the rotary **(5),** are reduced with respect to the normal functioning mode, and/or at least some functions, movements or manoeuvres of the machine are limited or impeded with respect to the normal functioning mode;
- in the blocking mode, some functions, movements or manoeuvres of the machine, such as for example at least the rotation of the drilling string **(6)** or also the longitudinal movements of the rotary **(5),** are impeded with respect to the normal functioning mode.

15. A process for using a drilling machine **(1)** having the features according to claim **8,** comprising the following operations:

- operations F.**1**) and F.**2**) according to claim **14;**
- F.**5**) blocking and keeping at least part of the drilling string suspended in the excavation by means of one or more clamps **(7);**
- F.**6**) disconnecting the drilling string **(6)** from the rotary **(5);**
- F.**7**) moving the rotary **(5)** towards the upper end of the guiding antenna **(3);**
effecting phase F.**4**) according to claim **14;**
- F.**8**) by driving the side displacement system **(8),** moving the rotary **(5)** in a transversal direction with respect to the guiding antenna **(3)** bringing it outside the drilling axis.

Patentansprüche

1. Sicherheitssystem zur Isolierung der gefährlichen Bereiche einer Bohrmaschine (1), die einen Führungsmast (3) und einen Drehkopf (5) aufweist, der so an dem Führungsmast (3) befestigt ist, dass er eine Gleitbewegung entlang desselben ausführen kann und der zum Halten und Antreiben eines Bohrstrangs (6) ausgebildet ist, wobei das Sicherheitssystem aufweist:

eine ausfahrbare Abschirmung (9, 90, 900), die reversibel entlang des Führungsmasts (3) aus- und einfahrbar ist und ein näher an dem Drehkopf gelegenes proximales Ende (9A, 90A, 900A) und ein vom Drehkopf weiter entferntes distales Ende (9D, 90C) bildet, wobei die ausfahrbare Abschirmung (9, 90, 900) dazu ausgebildet ist, den Bohrstrang entlang wenigstens eines Teil seiner Länge zu umschließen;
ein Seitenverschiebungssystem (8), das zum Befestigen an dem Führungsmast (3) ausgebildet ist, um die longitudinale Gleitbewegung des Drehkopfs (5) entlang des Masts zu ermöglichen und um den Drehkopf (5) in einer Querrichtung in Bezug auf den Führungsmast (3) zu bewegen;
einen Sensor ausgebildet zum Erfassen der Position des distalen Endes (9D, 90C, 900B) in einer Längsrichtung in Bezug auf den Führungsmast (3);
wobei das proximale Ende (9A, 90A, 900A) zum Befestigen an dem Führungsmast (3) ausgebildet ist, um der longitudinalen Gleitbewegung des Drehkopfs (5) entlang des Führungsmasts (3) zu folgen.

2. System nach Anspruch 1, wobei die ausfahrbare Abschirmung (9, 90, 900) aus der folgenden Gruppe

ausgewählte Querschnitte aufweist: geschlossene Querschnitte, im Wesentlichen C-förmige, runde, geschlossene und längliche Querschnitte.

3. System nach Anspruch 1, wobei die ausfahrbare Abschirmung (9, 90) eine Mehrzahl von teleskopisch miteinander verbundenen Abschnitten (9A-9D, 90A-90C) aufweist.

4. System nach Anspruch 1, wobei das distale Ende (9D, 90C) und gegebenenfalls ein oder mehrere Abschnitte (9A-9D, 90A-90C) benachbart zu dem Abschnitt, auf dem das distale Ende (9D, 90C) vorgesehen ist, so ausgebildet sind, dass sie, gegebenenfalls angetrieben durch einen Motor, auf Führungen entlang des Führungsmasts (3) gleiten.

5. System nach Anspruch 4, wobei die longitudinale Gleitbewegung des distalen Endes (9D, 90C, 900B) entlang des Führungsmasts (3) durch ein Ritzel (41) und eine Zahnstange (42) angetrieben wird.

6. System nach Anspruch 4, wobei die longitudinale Gleitbewegung des distalen Endes (9D, 90C, 900B) entlang des Führungsmasts (3) mittels eines biegsamen Kabel- oder Kettensystems (44, 45) durch eine Winde oder einen Getriebemotor (43) angetrieben wird.

7. System nach einem der vorhergehenden Ansprüche, wobei die ausfahrbare Abschirmung (9, 900) für einer Querbewegung in Bezug auf den Mast (3) ausgebildet ist, die der seitlichen Bewegung des Drehkopfs (5) folgt.

8. Bohrmaschine (1), die das System nach einem beliebigen der vorhergehenden Ansprüche aufweist, wobei:

die Abschirmung (9, 90, 900) dazu ausgebildet ist, den Bohrstrang entlang wenigstens eines Teils seiner Länge zu umschließen;
das Seitenverschiebungssystem (8) an dem Führungsmast befestigt und dazu ausgebildet ist, den Drehkopf (5) in einer Querrichtung in Bezug auf den Führungsmast (3) zu bewegen, wobei das proximale Ende (9A, 90A) an dem Führungsmast (3) befestigt ist, um, der longitudinalen Gleitbewegung des Drehkopfs (5) folgend, auf Führungen eine Gleitbewegung entlang des Führungsmasts ausführen zu können.

9. Bohrmaschine nach Anspruch 8, wobei das Seitenverschiebungssystem (8) eine an dem oder in der Nähe des proximalen Endes (9A, 90A, 900A) der Abschirmung (9, 90, 900) befestigte erste Gleiteinheit (82) aufweist und dazu ausgebildet ist, die Abschirmung (9, 90, 900) anzutreiben und so eine Gleitbewegung derselben entlang des Führungsmasts (3) zu bewirken, und wobei ein Ende der ausfahrbaren Abschirmung an dem Drehkopf (5) oder der ersten Gleiteinheit (82) befestigt ist oder konstant in einer vorbestimmten fixen Lage in Bezug auf den Drehkopf (5) gehalten wird.

10. Bohrmaschine (1) nach Anspruch 8 oder 9, wobei das proximale Ende (9A, 90A, 900A) der ausfahrbaren Abschirmung (9, 90) den am nächsten zum Drehkopf (5) gelegenen Abschnitt des Bohrstrangs (6) umschließt.

11. Bohrmaschine nach Anspruch 8 oder 9, mit einer oder mehreren Klammern (7), die dazu ausgebildet ist/sind, wenigstens einen Teil des Bohrstrangs zu arretieren und in einem hängenden Zustand zu halten, auch wenn der Bohrstrang nicht an dem Drehkopf (5) eingehängt ist, wobei die ausfahrbare Abschirmung (9) dazu ausgebildet ist, sich zu einer oder mehreren Klammern (7) hin zu erstrecken, bis zu einem axialen Abstand (DAX) von 0,4 Metern oder weniger von der dem Drehkopf am nächsten gelegenen Klammer.

12. Maschine (1) nach Anspruch 8 oder 9, wobei das proximale Ende (90A, 900A) der Abschirmung (90) an dem Führungsmast (3) befestigt ist, so dass es keine Querbewegung in Bezug auf den Mast selbst ausführen kann.

13. Maschine nach Anspruch 8 oder 9, wobei die Enden der ausfahrbaren Abschirmung (9, 90, 900) dazu ausgebildet sind, entlang des Führungsmasts (3) zu verfahren und wobei die Maschine dazu ausgebildet ist:

durch einen Sensor zu erfassen, wenn sich das distale Ende der Abschirmung (9D, 90C, 900B) von dem maximal ausgefahrenen Zustand der Abschirmung (9, 90, 900) wegbewegt; und, in diesem Fall, die Maschine auf einen Arretiermodus zu schalten und, gegebenenfalls,
die Maschine (1) in die Lage zu versetzen, von einem normalen oder einem Arretierfunktionsmodus auf einen Sicherheitsfunktionsmodus umzuschalten, und wobei:

in dem Sicherheitsfunktionsmodus die Dreh- oder Verfahrgeschwindigkeiten wenigstens eines Teils der Komponenten der Maschine, wie z.B. die Drehbewegung des Bohrstrangs (6) oder die longitudinalen Bewegungen des Drehkopfs (5), in Bezug auf den normalen Funktionsmodus reduziert sind, und/oder wenigstens einige Funktionen, Bewegungen oder Manöver der Maschine in Bezug auf den normalen Funkti-

onsmodus beschränkt oder gehemmt sind; in dem Arretiermodus einige Funktionen, Bewegungen oder Manöver der Maschine, wie z.B. wenigstens die Drehbewegung des Bohrstrangs (6) oder auch die longitudinalen Bewegungen des Drehkopfs (5), in Bezug auf den normalen Funktionsmodus unterbunden oder gehemmt sind.

14. Verfahren zur Verwendung einer Bohrmaschine (1), die die Merkmale nach Anspruch 8 aufweist, wobei das Verfahren die folgenden Arbeitsvorgänge umfasst:

F.1) Ausrichten des Führungsmasts (3) entlang einer vorgegebenen Bohrachse, wobei sich der Drehkopf (5) in einer näher am oberen Ende des Führungsmasts (3) befindlichen, zurückgezogenen Position befindet, der Bohrstrang (6) an dem Drehkopf (5) montiert und dazu bereit ist, von letzterem angetrieben zu werden, und die ausfahrbare Abschirmung (9, 90, 900) eingefahren ist;
F.2) Ausfahren der ausfahrbaren Abschirmung (9, 90, 900) und Ausführen eines Aushubvorgangs in dem normalen Funktionsmodus;
F.3) Bewegen des Drehkopfs (5) zum oberen Ende des Führungsmasts (3) hin, Herausziehen wenigstens eines Teils des Bohrstrangs aus der Aushöhlung, wobei die ausfahrbare Abschirmung (9, 90, 900) gleichzeitig im ausgefahrenen Zustand gehalten wird;
F.4) Einfahren der ausfahrbaren Abschirmung (9, 90, 900), Aufzeigen des Einfahrens und demzufolge Überführen der Maschine in einen Arretiermodus, und gegebenenfalls Ermöglichen eines Übergangs der Maschine (1) von einem normalen Funktions- oder Arretiermodus in einen Sicherheitsfunktionsmodus; wobei
in dem Sicherheitsfunktionsmodus die Dreh- oder Verfahrgeschwindigkeiten wenigstens eines Teils der Komponenten der Maschine, wie z.B. die Drehbewegung des Bohrstrangs (6) oder longitudinale Bewegungen des Drehkopfs (5), in Bezug auf den normalen Funktionsmodus reduziert werden, und/oder wenigstens einige Funktionen, Bewegungen oder Manöver der Maschine in Bezug auf den normalen Funktionsmodus beschränkt oder gehemmt werden;
in dem Arretiermodus einige Funktionen, Bewegungen oder Manöver der Maschine, wie z.B. wenigstens die Drehbewegung des Bohrstrangs (6) oder auch die longitudinalen Bewegungen des Drehkopfs (5), in Bezug auf den normalen Funktionsmodus gehemmt werden.

15. Verfahren zur Verwendung einer Bohrmaschine (1), die die Merkmale nach Anspruch 8 aufweist, wobei das Verfahren die folgenden Arbeitsvorgänge umfasst:

Arbeitsvorgänge F.1) und F.2) nach Anspruch 14;

F.5) Arretieren und Halten wenigstens eines Teils des Bohrstrangs in der Aushöhlung in einem hängenden Zustand mittels einer oder mehrerer Klammern (7);
F.6) Abkoppeln des Bohrstrangs (6) vom Drehkopf (5);
F.7) Bewegen des Drehkopfs (5) zum oberen Ende des Führungsmasts (3) hin;

Ausführen der Phase F.4) nach Anspruch 14;

F.8) durch Antreiben des Seitenverschiebungssystems (8), Bewegen des Drehkopfs (5) in einer Querrichtung in Bezug auf den Führungsmast (3), wodurch dieser aus der Bohrachse entfernt wird.

Revendications

1. Système de sécurité pour isoler les zones dangereuses d'une machine de forage (1) pourvu d'une antenne de guidage (3), d'une table de rotation (5) fixée sur l'antenne de guidage (3) de telle manière qu'elle peut coulisser le long et agencée pour soutenir et entraîner un train de tiges de forage (6), le système de sécurité comprenant :

un écran extensible (9, 90, 900) pouvant être étendu et rétracté de manière réversible le long de l'antenne de guidage (3) et formant une extrémité proximale (9A, 90A, 900A), plus proche de la table de rotation et une extrémité distale (9D, 90C) plus éloignée de la table de rotation, et l'écran extensible (9, 90, 900) est agencé pour enfermer le train de tiges de forage sur au moins une partie de sa longueur ;
un système de déplacement latéral (8) agencé pour être fixé sur l'antenne de guidage (3) de façon à permettre le coulissement longitudinal de la table de rotation (5) le long de l'antenne, et de façon à déplacer la table de rotation (5) dans une direction transversale par rapport à l'antenne de guidage (3) ;
un capteur agencé pour détecter la position de l'extrémité distale (9D, 90C, 900B) dans une direction longitudinale par rapport à l'antenne de guidage (3) ;
dans lequel l'extrémité proximale (9A, 90A, 900A) est agencée pour être fixée sur l'antenne de guidage (3) de façon à suivre le coulissement longitudinal de la table de rotation (5) le long de

l'antenne de guidage (3).

2. Système selon la revendication 1, dans lequel l'écran extensible (9, 90, 900) a des sections transversales sélectionnées dans le groupe suivant : sections transversales fermées, sections sensiblement en forme de C, circulaires, fermées et allongées.

3. Système selon la revendication 1, dans lequel l'écran extensible (9, 90) comprend une pluralité de segments (9A-9D, 90A-90C) reliés téléscopiquement les uns aux autres.

4. Système selon la revendication 1, dans lequel l'extrémité distale (9D, 90C) et possiblement un ou plusieurs segments (9A-9D, 90A-90C) adjacents au segment sur lequel l'extrémité distale (9D, 90C) est placée, sont agencés pour coulisser sur des guides le long de l'antenne de guidage (3), possiblement entrainés par un moteur.

5. Système selon la revendication 4, dans lequel le coulissement longitudinal de l'extrémité distale (9D, 90C, 900B) le long de l'antenne de guidage (3) est entraîné au moyen d'un pignon denté (41) et d'une crémaillère (42).

6. Système selon la revendication 4, dans lequel le coulissement longitudinal de l'extrémité distale (9D, 90C, 900B) le long de l'antenne de guidage (3) est entraîné au moyen d'une système à chaîne ou à câble flexible (44, 45) par l'intermédiaire d'un treuil ou d'un moteur à train d'engrenages (43).

7. Système selon l'une quelconque des revendications précédentes, dans lequel l'écran extensible (9, 900) est agencé pour se déplacer transversalement par rapport à l'antenne (3) suivant le mouvement latéral de la table de rotation (5).

8. Machine de forage (1) comprenant le système selon l'une quelconque des revendications précédentes, dans laquelle :

l'écran (9, 90, 900) est agencé pour enfermer le train de tiges de forage sur au moins une partie de sa longueur ;
le système de déplacement latéral (8) est fixé sur l'antenne de guidage et est agencé pour déplacer la table de rotation (5) dans une direction transversale par rapport à l'antenne de guidage (3), dans laquelle l'extrémité proximale (9A, 90A) est fixée sur l'antenne de guidage (3) de façon à pouvoir coulisser le long sur des guides suivant le coulissement longitudinal de la table de rotation (5).

9. Machine de forage selon la revendication 8, dans laquelle ledit système de déplacement latéral (8) comprend une première unité de coulisseau (82) fixée sur ou près de l'extrémité proximale (9A, 90A, 900A) de l'écran (9, 90, 900) et est agencé pour entraîner l'écran (9, 90, 900) le faisant coulisser le long de l'antenne de guidage (3), et dans laquelle une extrémité de l'écran extensible est fixée sur la table de rotation (5) ou sur la première unité de coulisseau (82) ou est constamment maintenue dans une position fixe prédéterminée par rapport à la table de rotation (5).

10. Machine de forage (1) selon la revendication 8 ou 9, dans laquelle l'extrémité proximale (9A, 90A, 900A) de l'écran extensible (9, 90) enferme la section du train de tiges de forage (6) la plus proche de la table de rotation (5).

11. Machine de forage selon la revendication 8 ou 9, comprenant une ou plusieurs brides (7) agencées pour bloquer et maintenir au moins une partie du train de tiges de forage suspendue, aussi quand le train de tiges de forage n'est pas suspendu à la table de rotation (5), et l'écran extensible (9) est agencé pour s'étendre vers une ou plusieurs brides (7) jusqu'à une distance axiale (DAX) inférieure ou égale à 0,4 mètre de la bride la plus proche de la table de rotation.

12. Machine de forage (1) selon la revendication 8 ou 9, dans laquelle l'extrémité proximale (90A, 900A) de l'écran (90) est fixée sur l'antenne de guidage (3) de façon à ne pas pouvoir se déplacer transversalement par rapport à l'antenne elle-même.

13. Machine de forage selon la revendication 8 ou 9, dans laquelle les extrémités de l'écran extensible (9, 90, 900) sont agencées pour translater le long de l'antenne de guidage (3) et la machine est agencée pour :

détecter par un capteur quand l'extrémité distale de l'écran (9D, 90C, 900B) s'éloigne de l'état d'extension maximal de l'écran (9, 90, 900) ; et dans ce cas commuter la machine dans un mode de blocage et, possiblement,
permettre à la machine (1) de commuter depuis un mode de fonctionnement normal ou de blocage à une mode de fonctionnement de sécurité, et dans laquelle :

dans le mode de fonctionnement de sécurité, les vitesses de rotation ou de translation d'au moins une partie des composants de la machine, comme par exemple la rotation du train de tiges de forage (6) ou les mouvements longitudinaux de la table de rotation (5), sont réduites relativement au

mode de fonctionnement normal, et/ou au moins quelques fonctions, mouvements ou manoeuvres de la machine sont limités ou entravés relativement au mode de fonctionnement normal ;
dans le mode de blocage, quelques fonctions, mouvements ou manoeuvres de la machine, comme par exemple au moins la rotation du train de tiges de forage (6) ou aussi les mouvements longitudinaux de la table de rotation (5), sont stoppés et entravés relativement au mode de fonctionnement normal.

14. Processus d'utilisation d'une machine de forage (1) ayant les caractéristiques selon la revendication 8, comprenant les opérations suivantes :

F.1) orienter l'antenne de forage (3) le long d'un axe de forage prédéterminé, avec la table de rotation (3) retirée dans une position plus proche de l'extrémité supérieure de l'antenne de guidage (3), le train de tiges de forage (6) assemblé sur la table de rotation (5) et prêt pour être entraîné par celle-ci et l'écran extensible (9, 90, 900) contracté ;
F.2) étendre l'écran extensible (9, 90, 900) et réaliser une excavation dans un mode de fonctionnement normal ;
F.3) déplacer la table de rotation (5) vers l'extrémité supérieure de l'antenne de guidage (3), extraire au moins une partie du train de tiges de forage de l'excavation, en maintenant dans le même temps l'écran extensible (9, 90, 900) étendu ;
F.4) contracter l'écran extensible (9, 90, 900), découvrir ladite contraction et passer en conséquence la machine dans un mode de blocage, et permettre possiblement le passage de la machine (1) d'un mode de fonctionnement normal ou de blocage à un mode de fonctionnement de sécurité ; dans lequel :

dans le mode de fonctionnement de sécurité, les vitesses de rotation ou de translation d'au moins une partie des composants de la machine, comme par exemple la rotation du train de tiges de forage (6) ou les mouvements longitudinaux de la table de rotation (5), sont réduites relativement au mode de fonctionnement normal, et/ou au moins quelques fonctions, mouvements ou manoeuvres de la machine sont limités ou entravés relativement au mode de fonctionnement normal ;
dans le mode de blocage, quelques fonctions, mouvements ou manoeuvres de la machine, comme par exemple au moins la rotation du train de tiges de forage (6) ou aussi les mouvements longitudinaux de la table de rotation (5), sont entravés relativement au mode de fonctionnement normal.

15. Processus d'utilisation d'une machine de forage (1) ayant les caractéristiques selon la revendication 8, comprenant les opérations suivantes :

opérations F.1) et F.2) selon la revendication 14 ;
F.5) bloquer et garder au moins une partie du train de tiges de forage suspendue dans l'excavation au moyen d'une ou plusieurs brides (7) ;
F.6) déconnecter le train de tiges de forage (6) de la table de rotation (5) ;
F.7) déplacer la table de rotation (5) vers l'extrémité supérieure de l'antenne de guidage (3) ; effectuer la phase F.4) selon la revendication 14 ;
F.8) en entraînant le système de déplacement latéral (8), déplacer la table de rotation (5) dans une direction transversale par rapport à l'antenne de guidage (3) en l'amenant à l'extérieur de l'axe de forage.

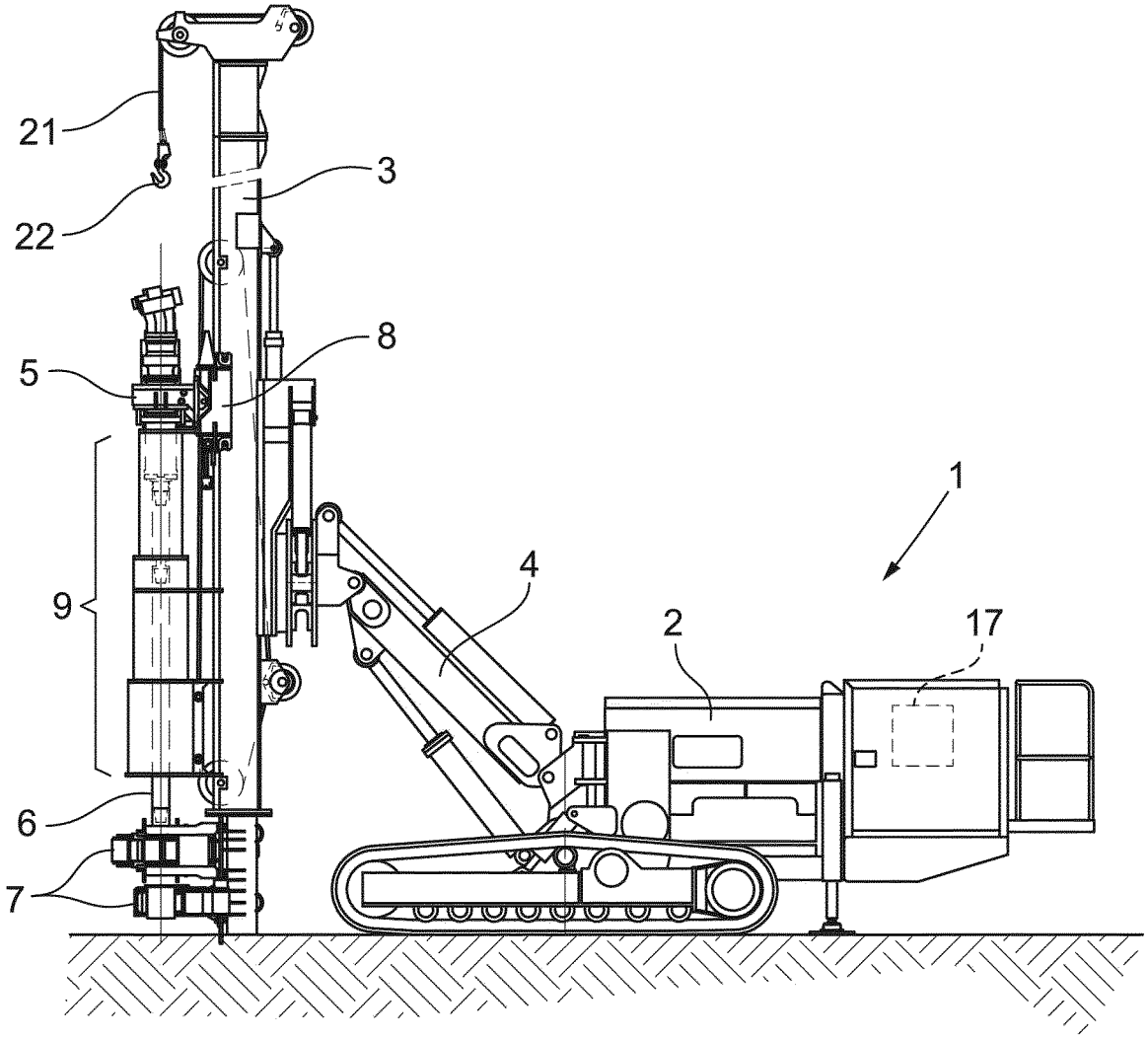


Fig. 1

Fig. 2A

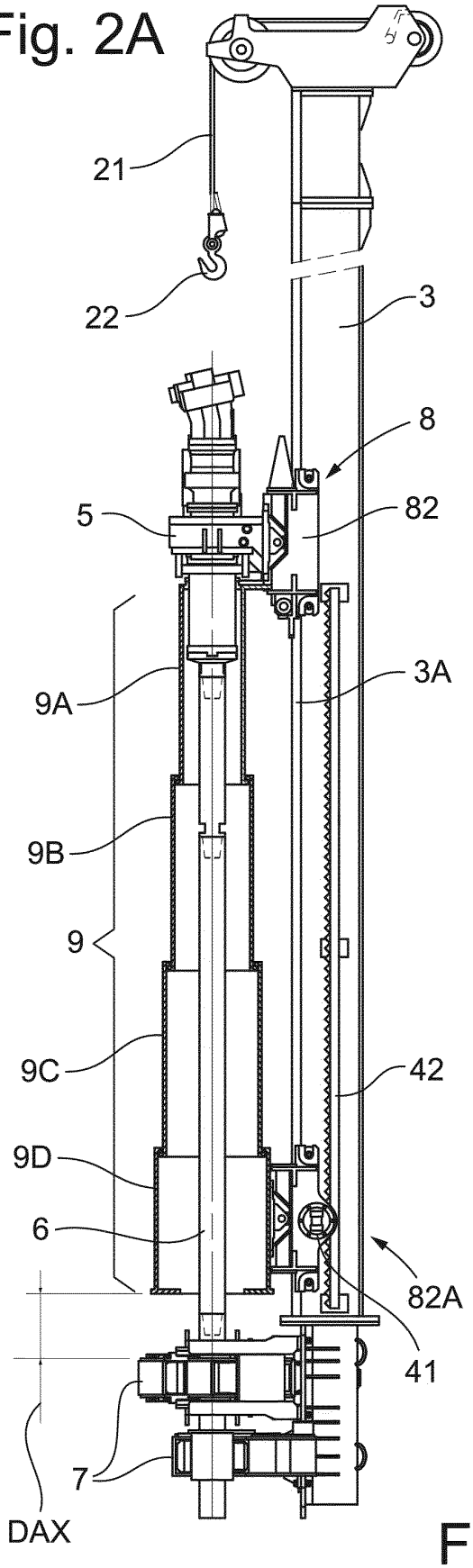


Fig. 2B

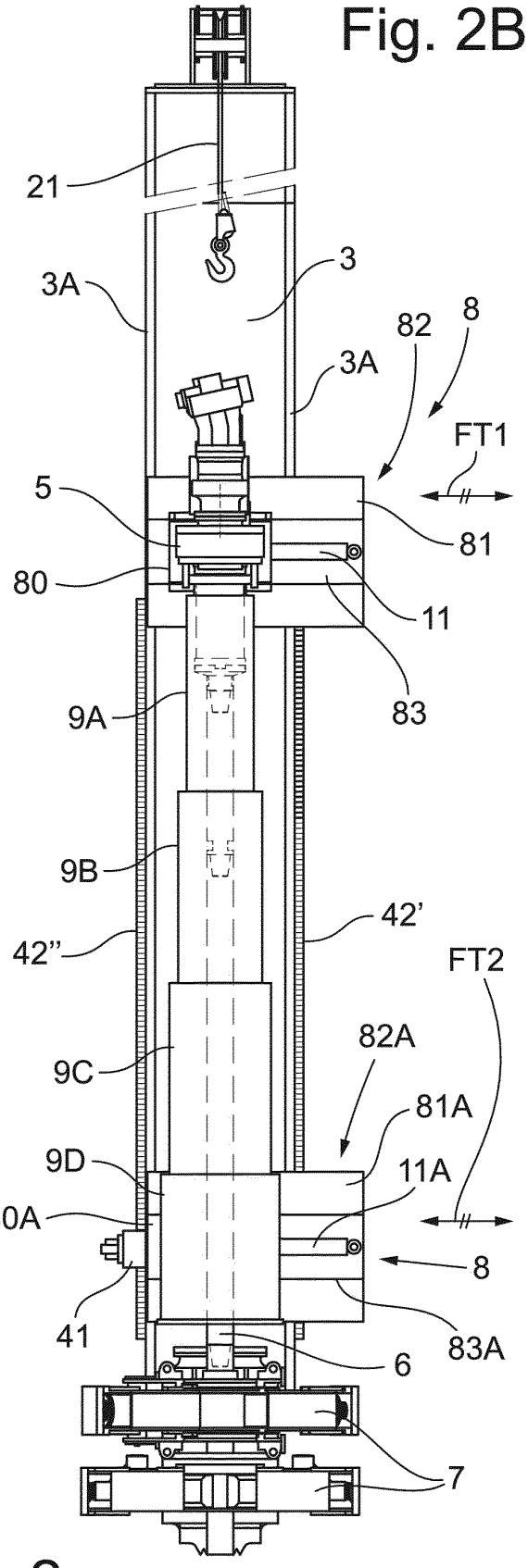


Fig. 2

Fig. 3A

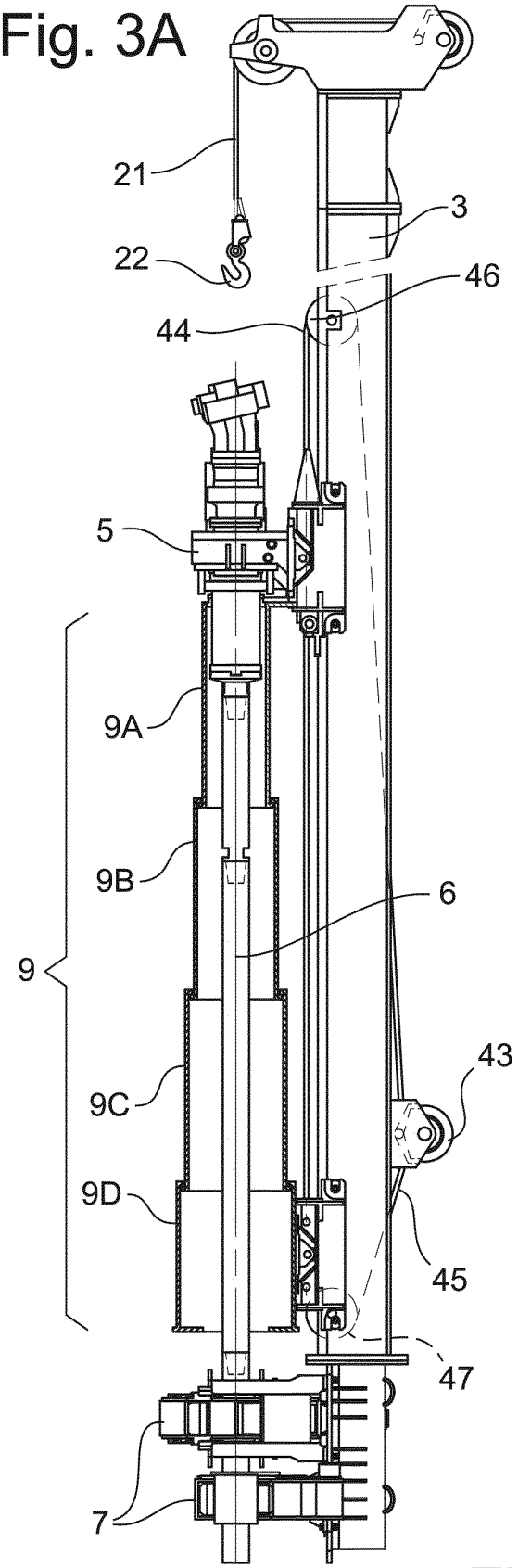


Fig. 3B

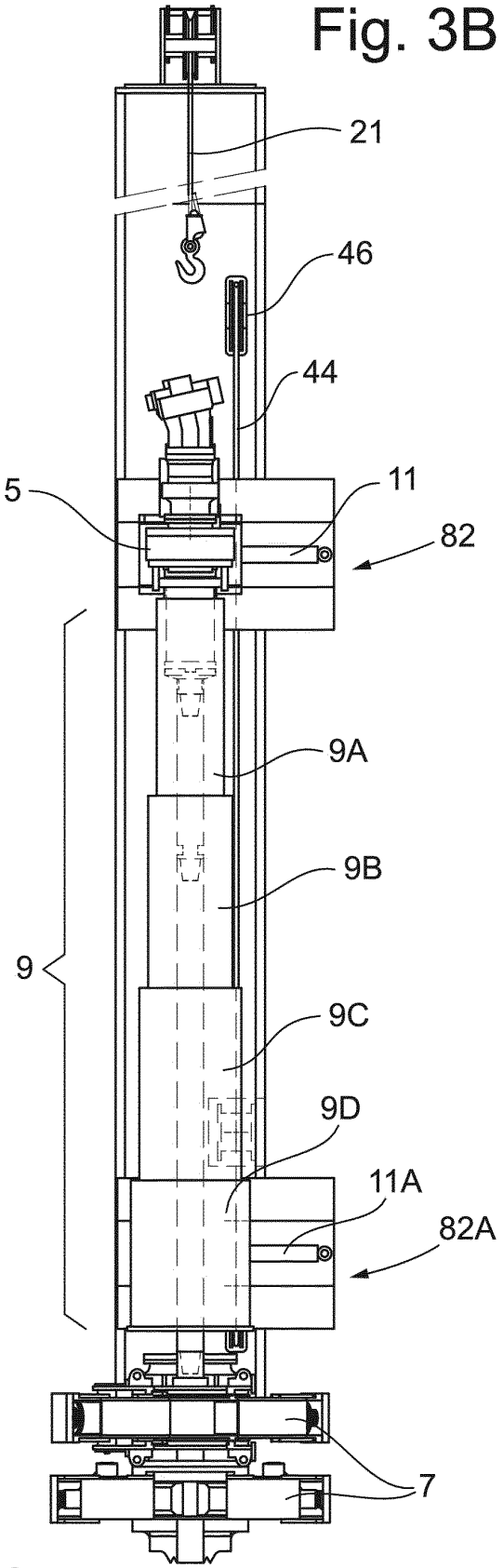


Fig. 3

Fig. 4A

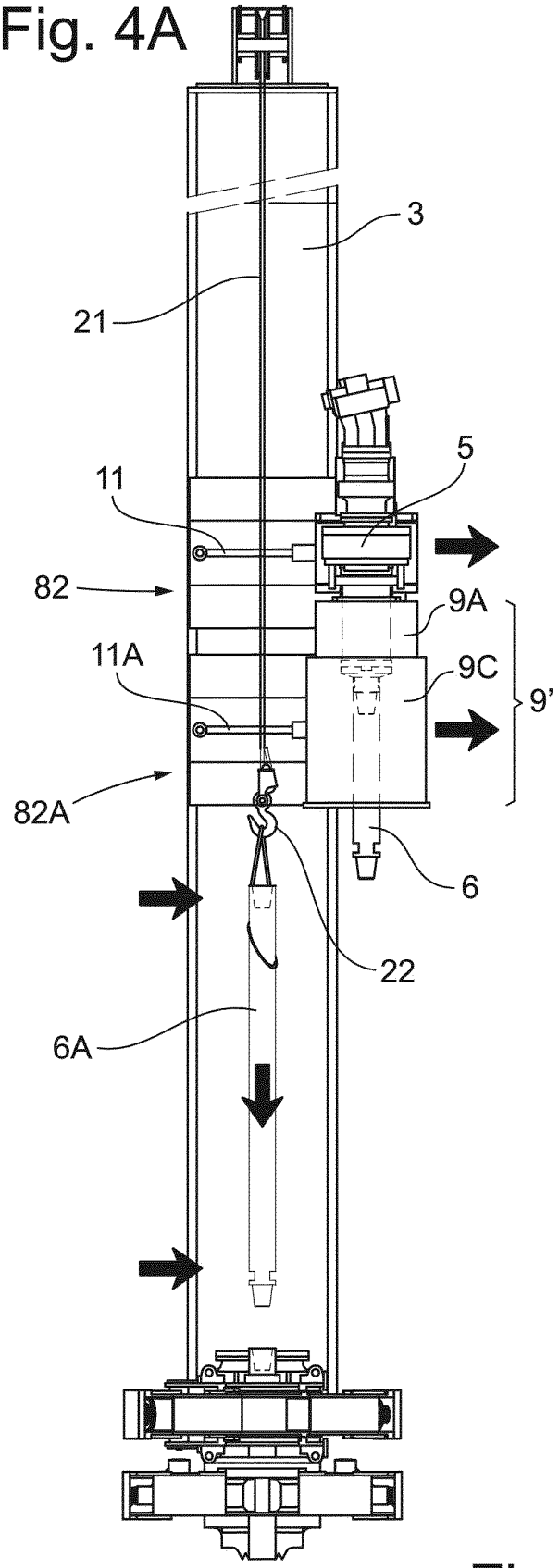


Fig. 4B

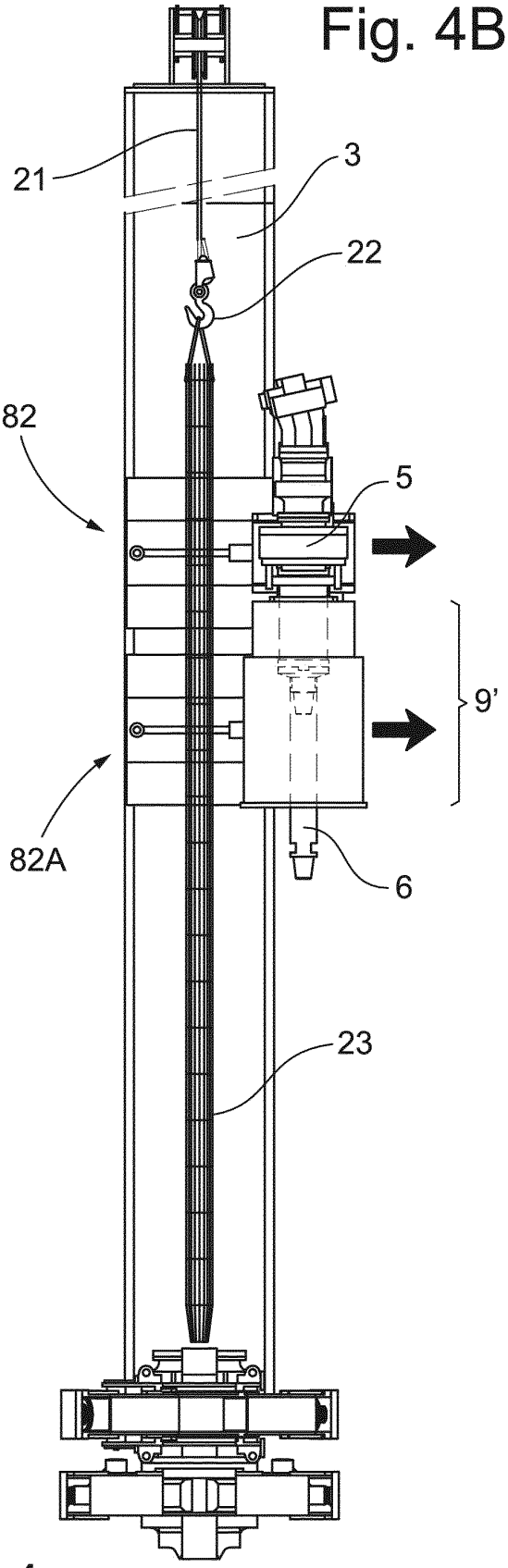


Fig. 4

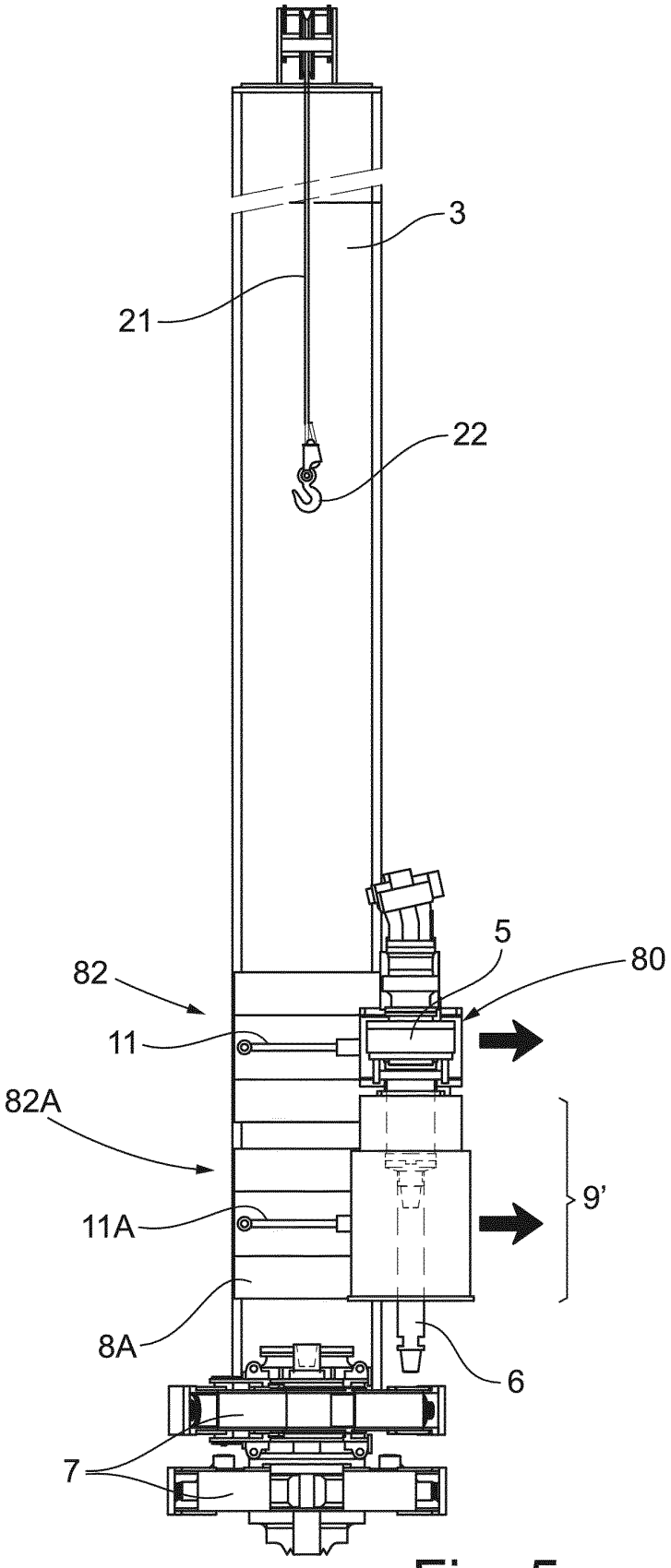


Fig. 5

Fig. 6A

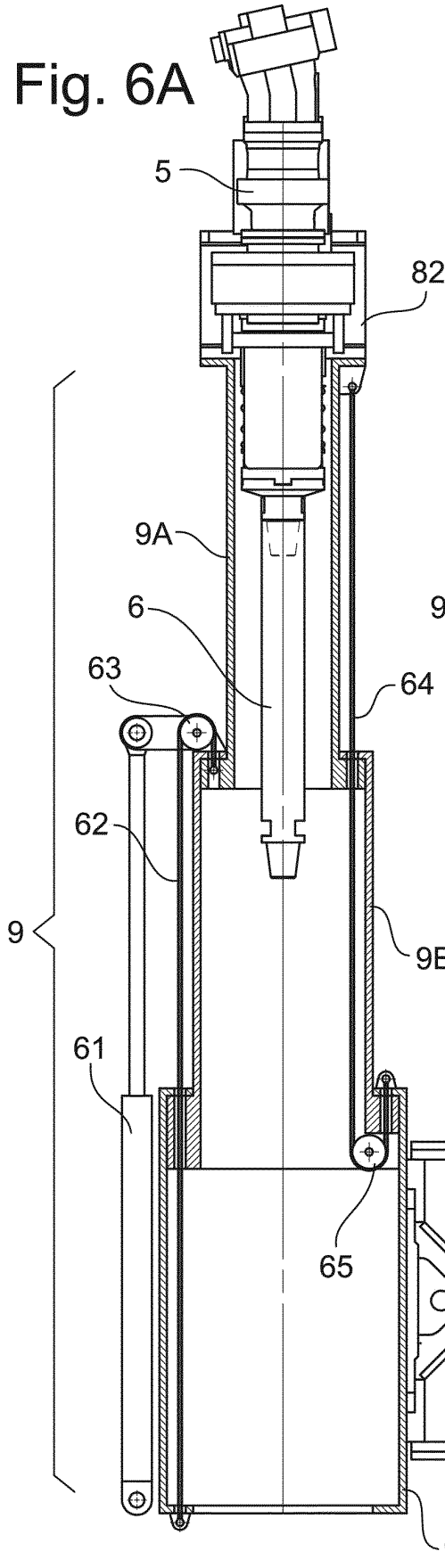


Fig. 6B

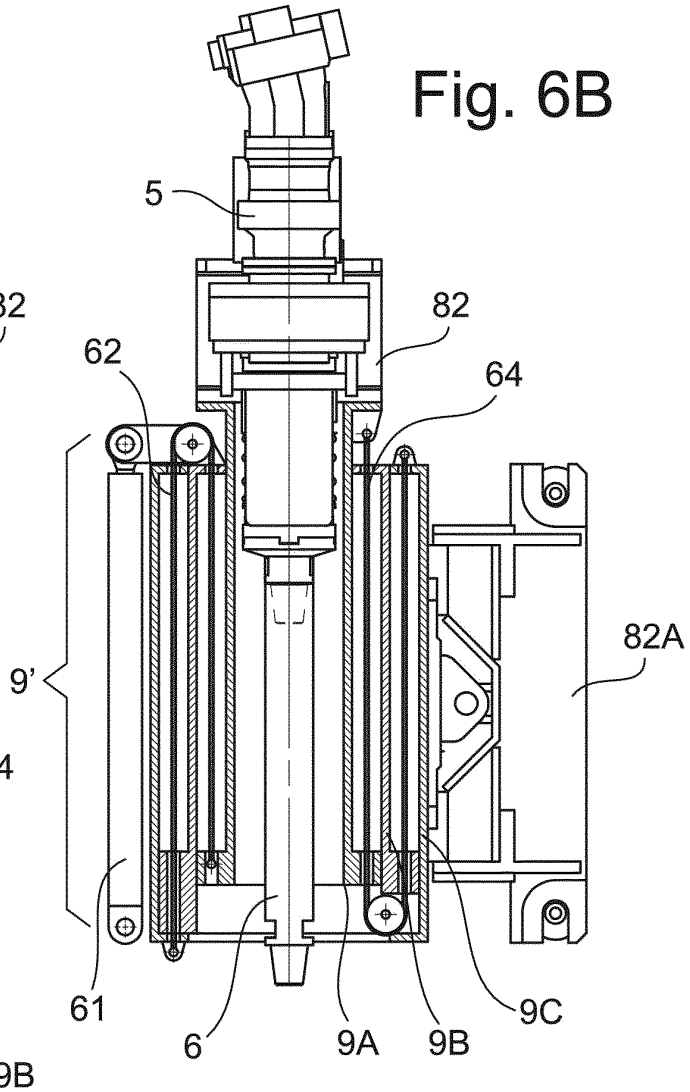


Fig. 6

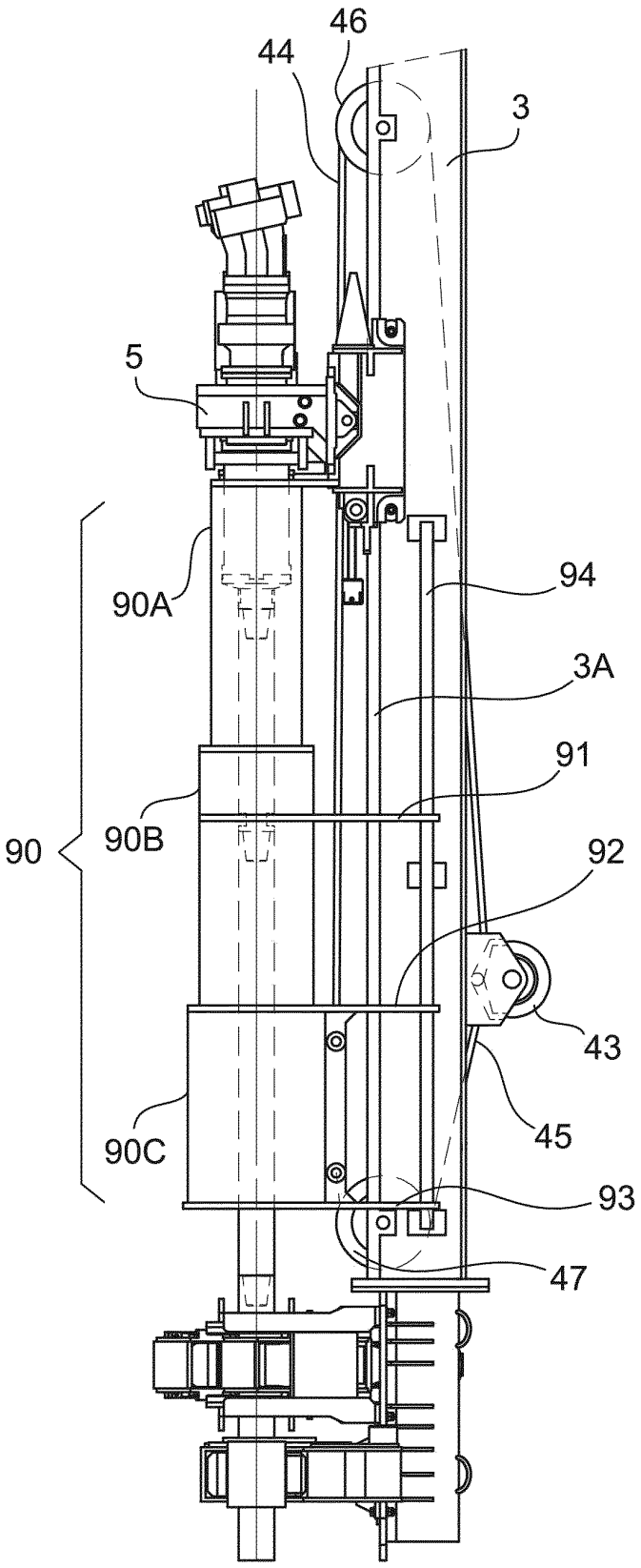


Fig. 7

Fig. 8A

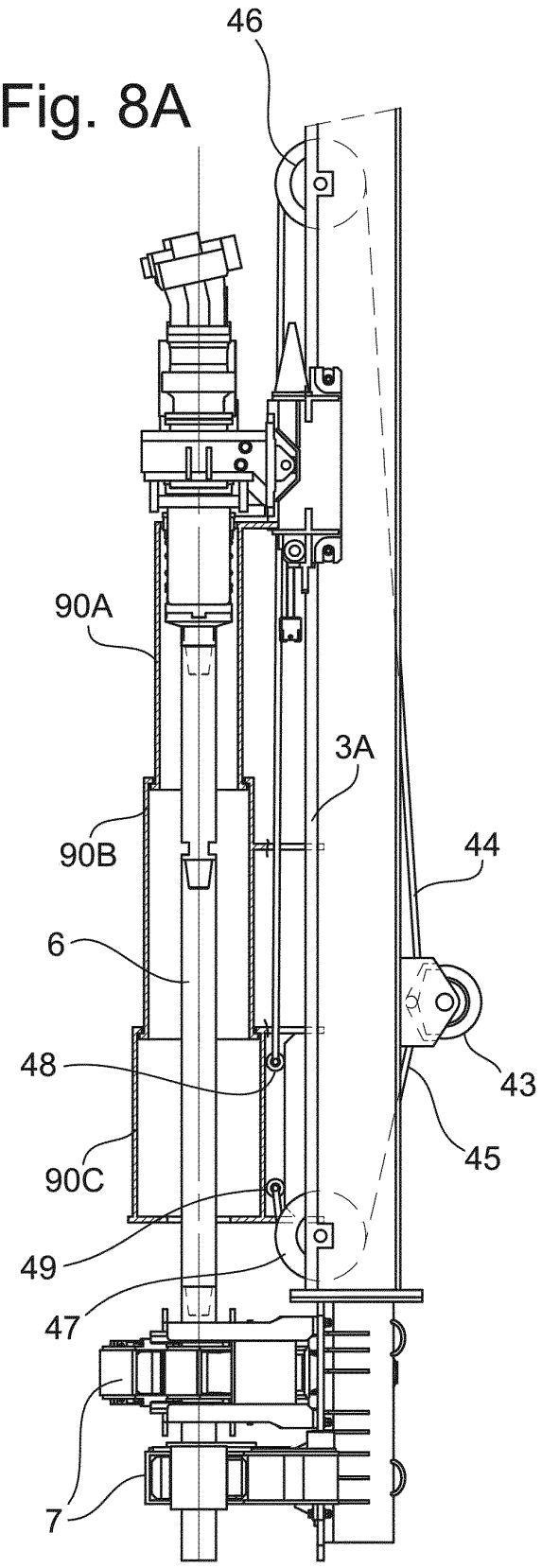


Fig. 8B

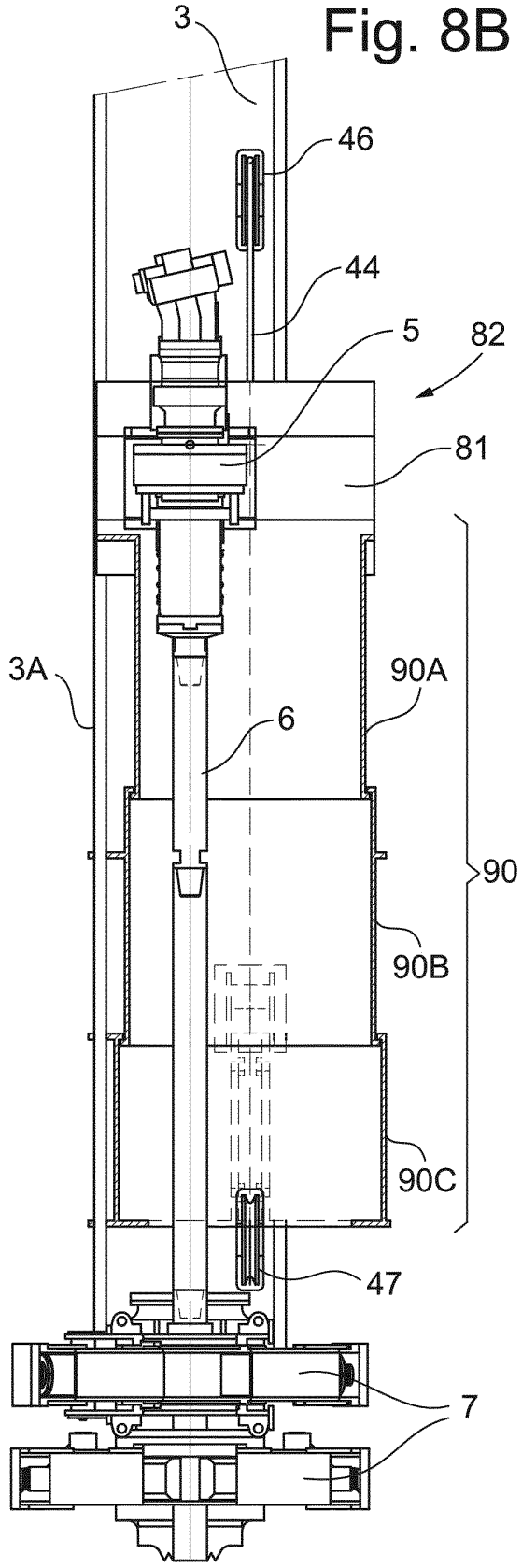


Fig. 8

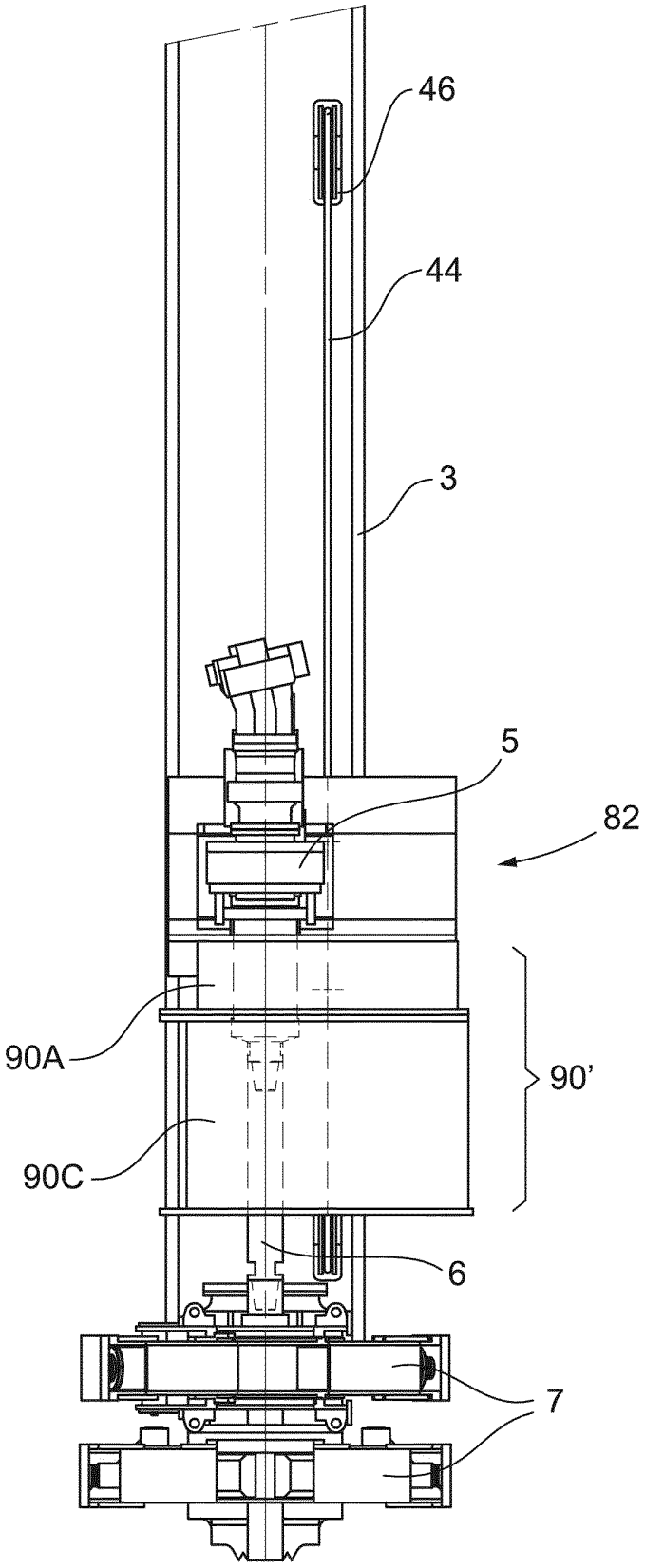


Fig. 9

Fig. 10A

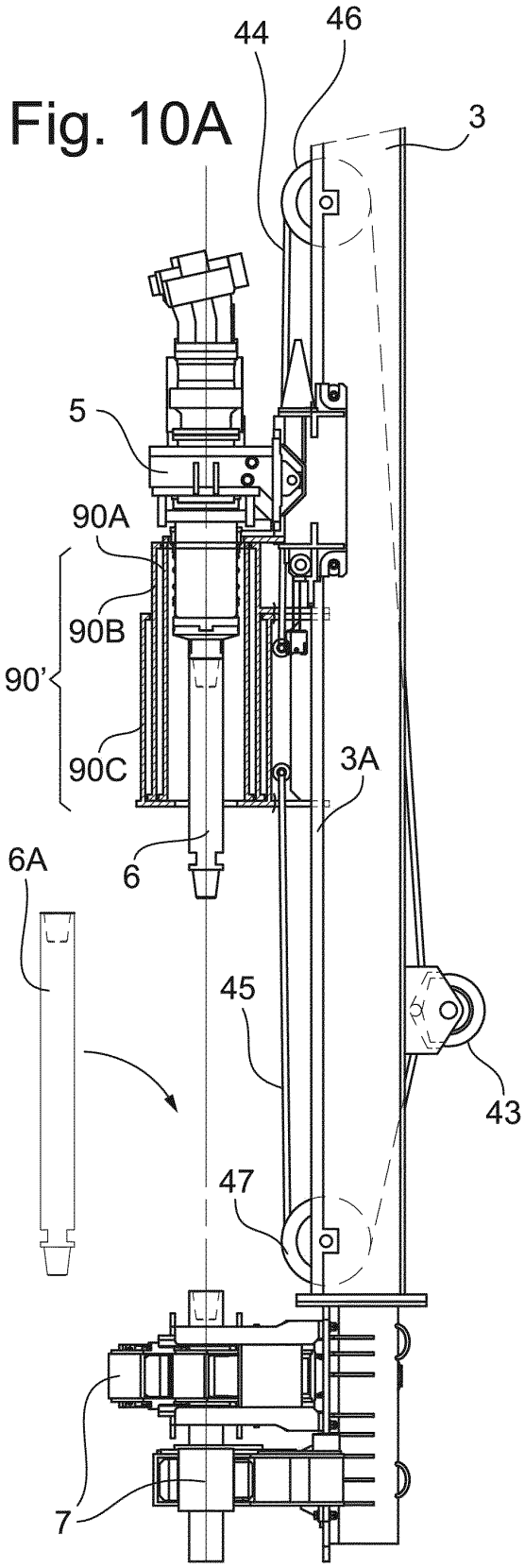


Fig. 10B

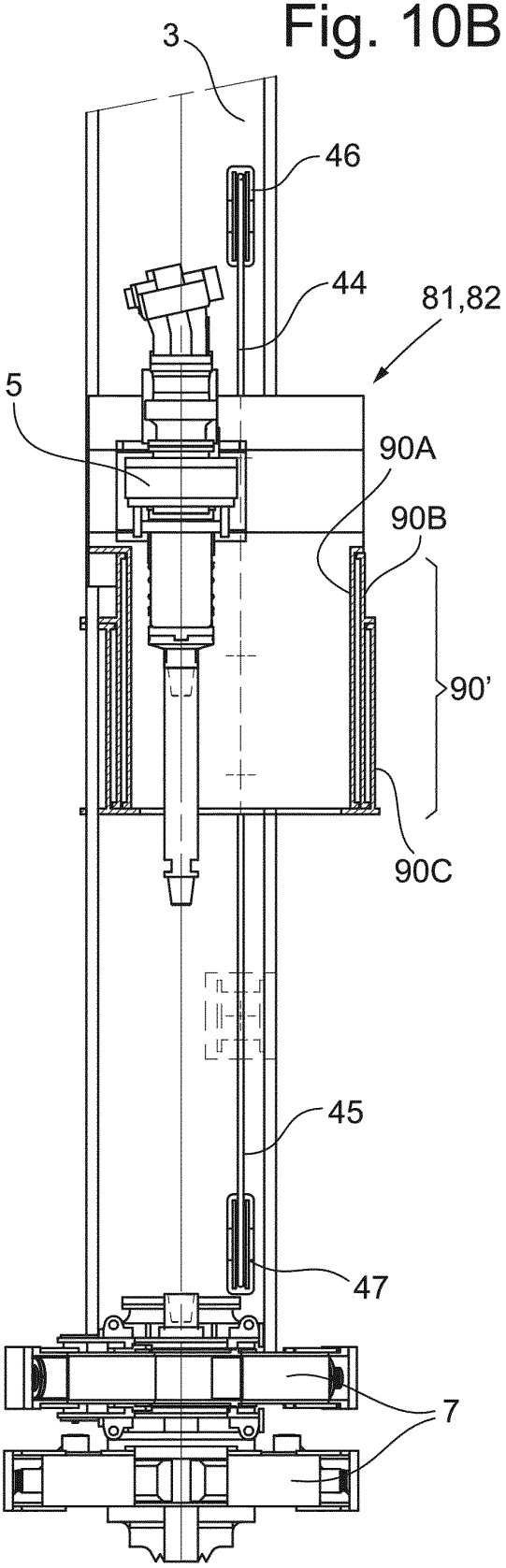


Fig. 10

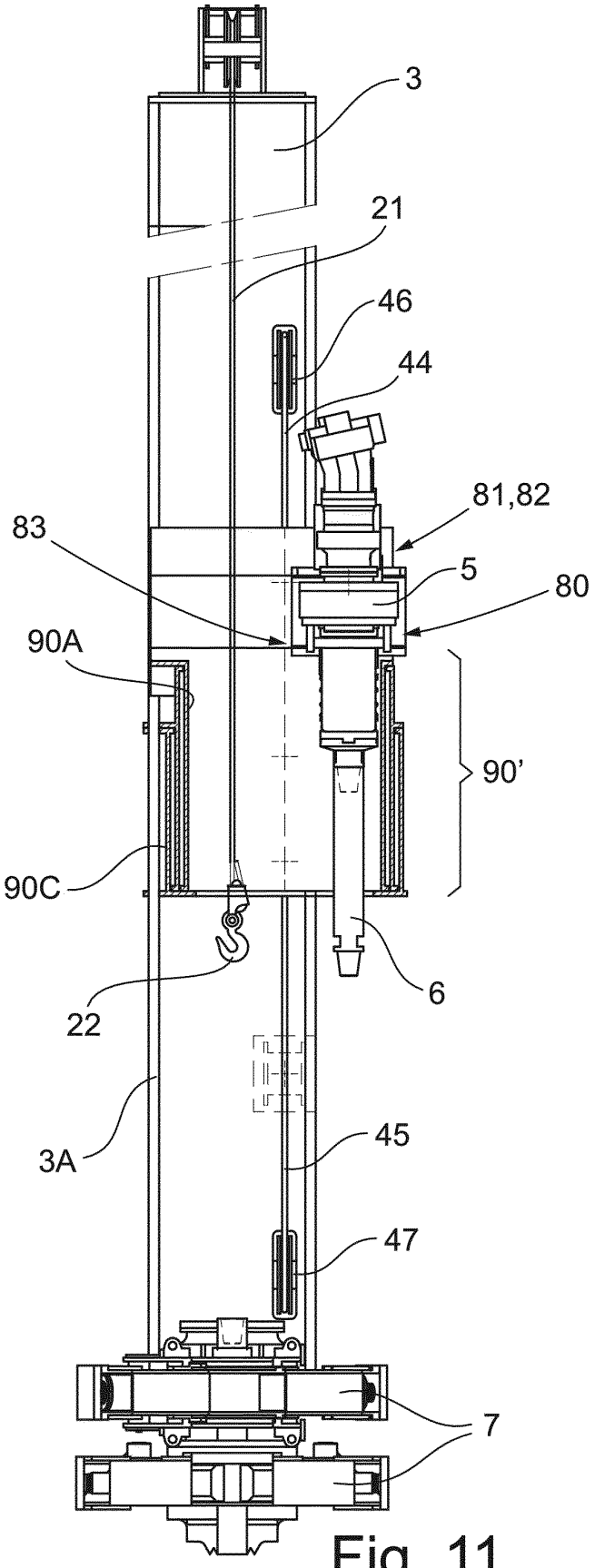


Fig. 11

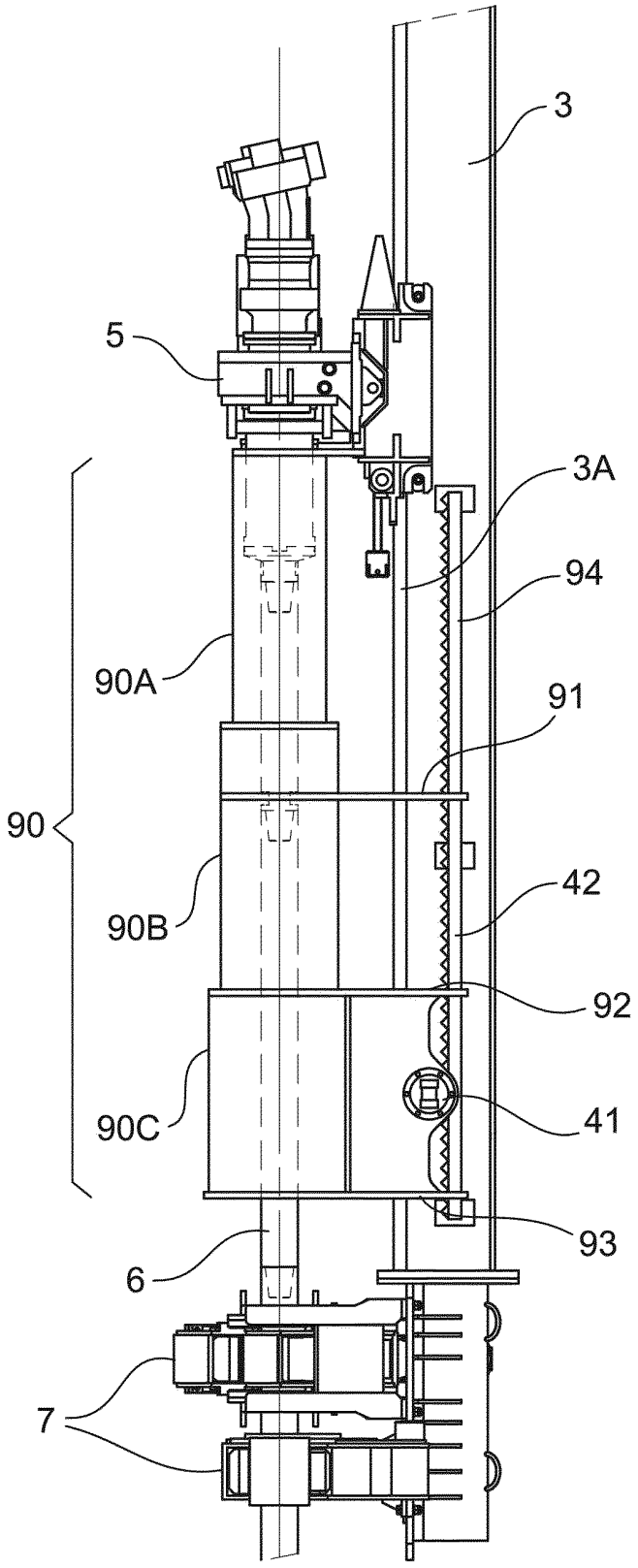


Fig. 12

Fig. 13A

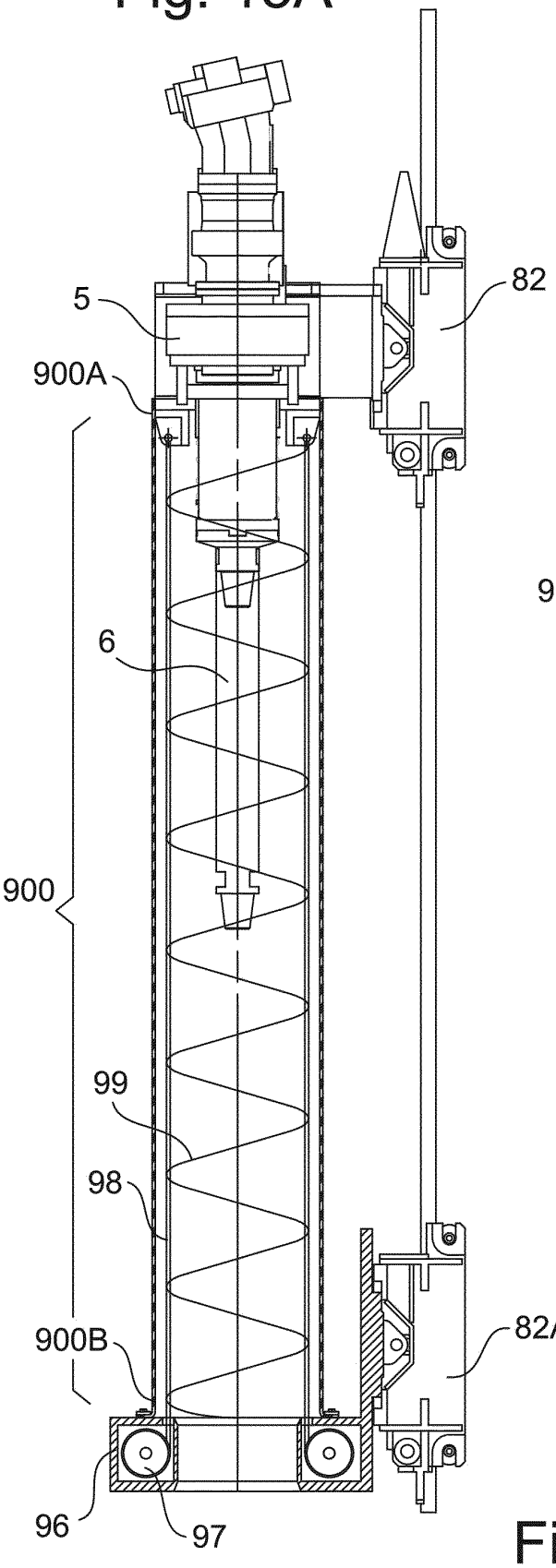


Fig. 13B

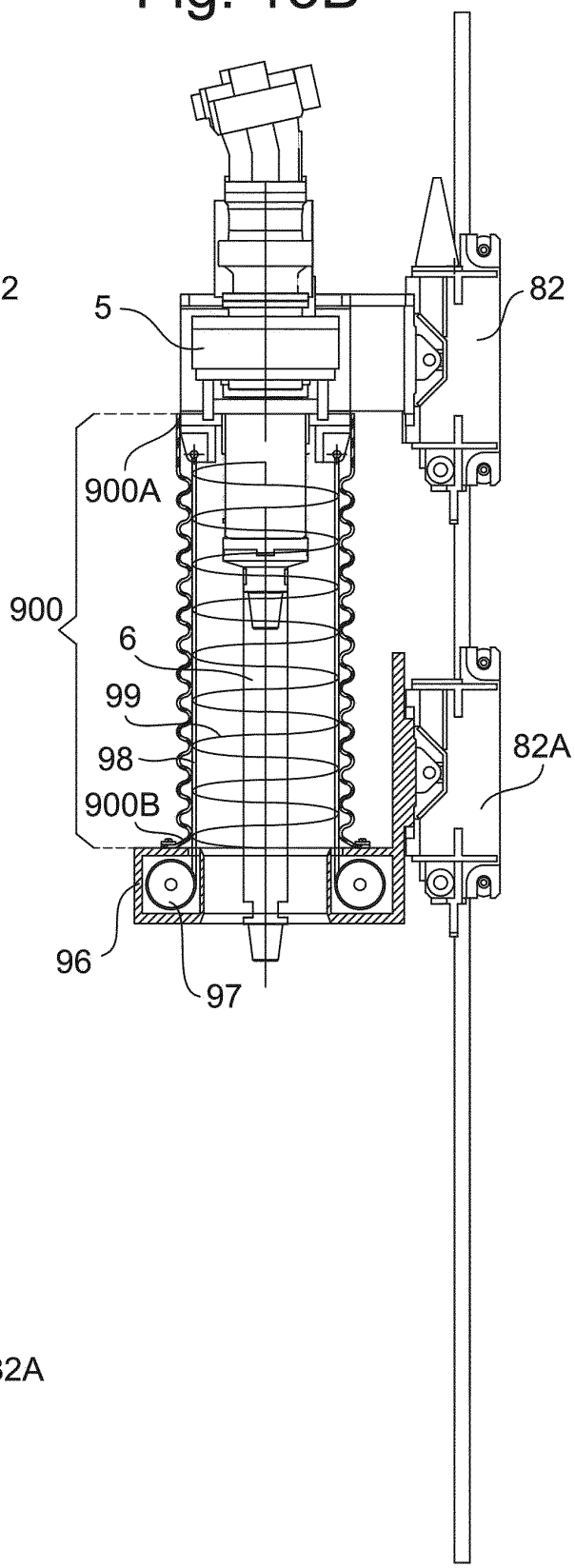


Fig. 13

Fig. 14A

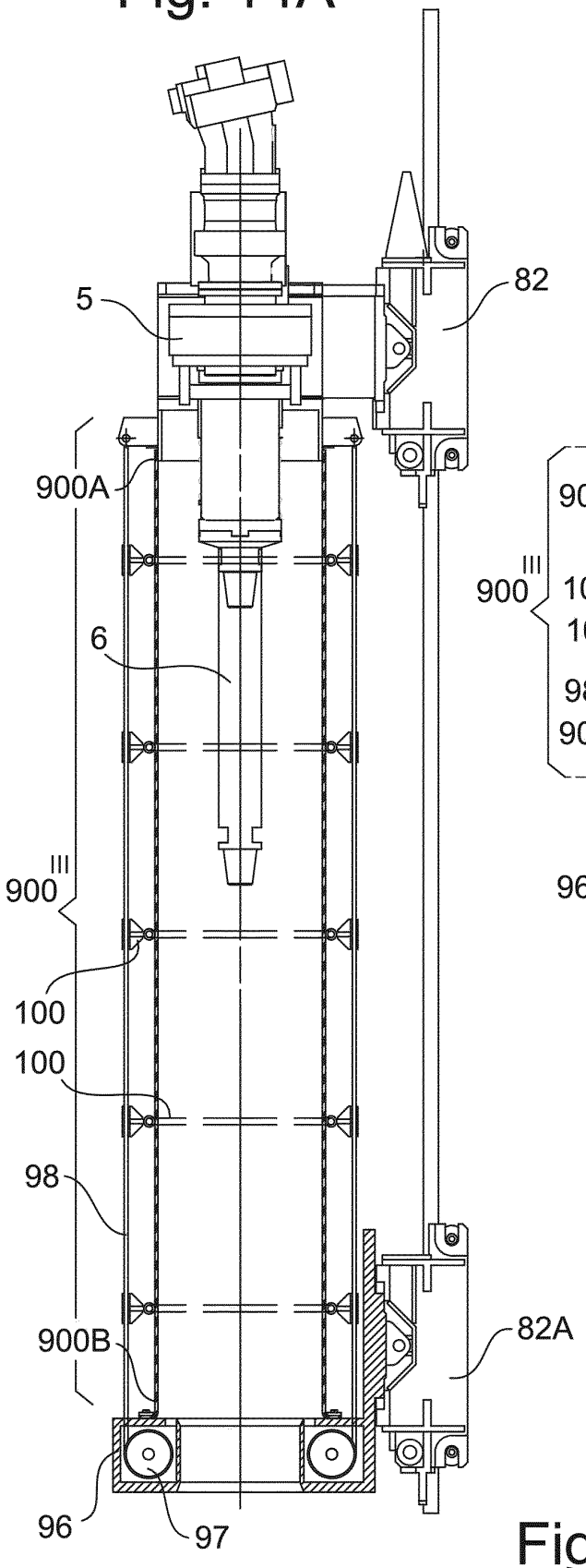


Fig. 14B

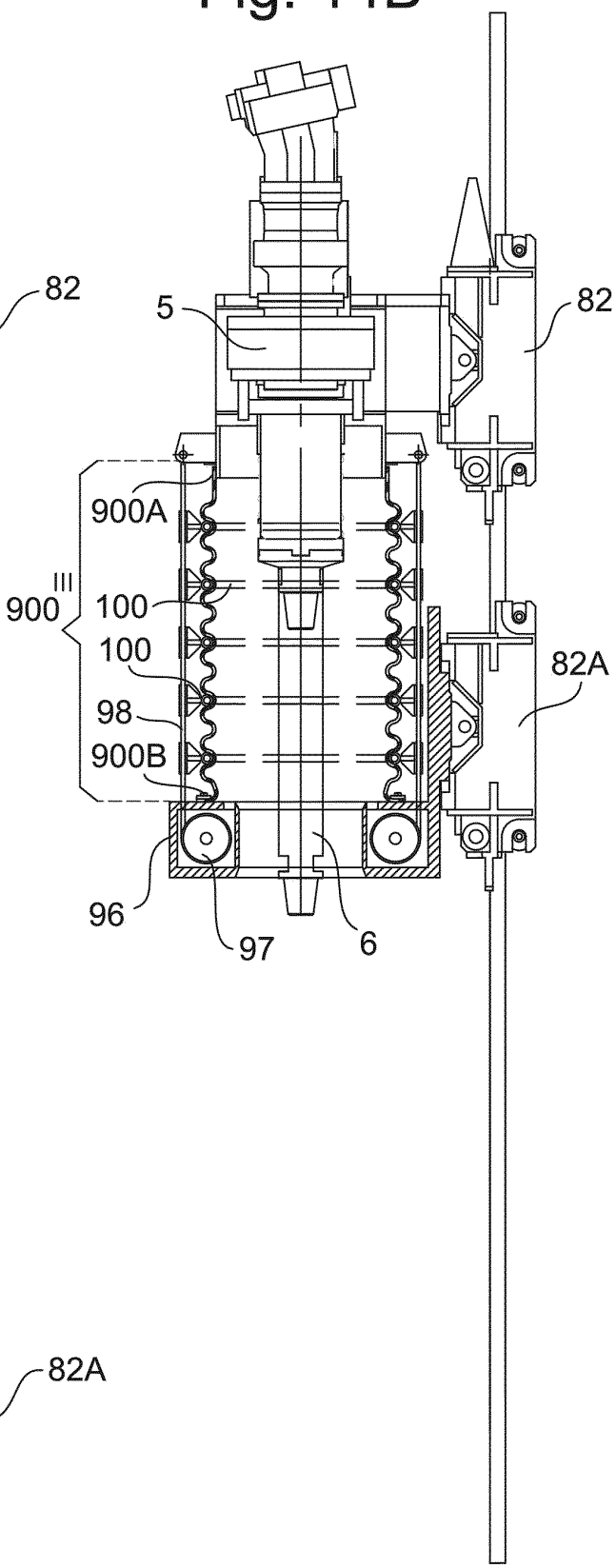


Fig. 14

Fig. 15A

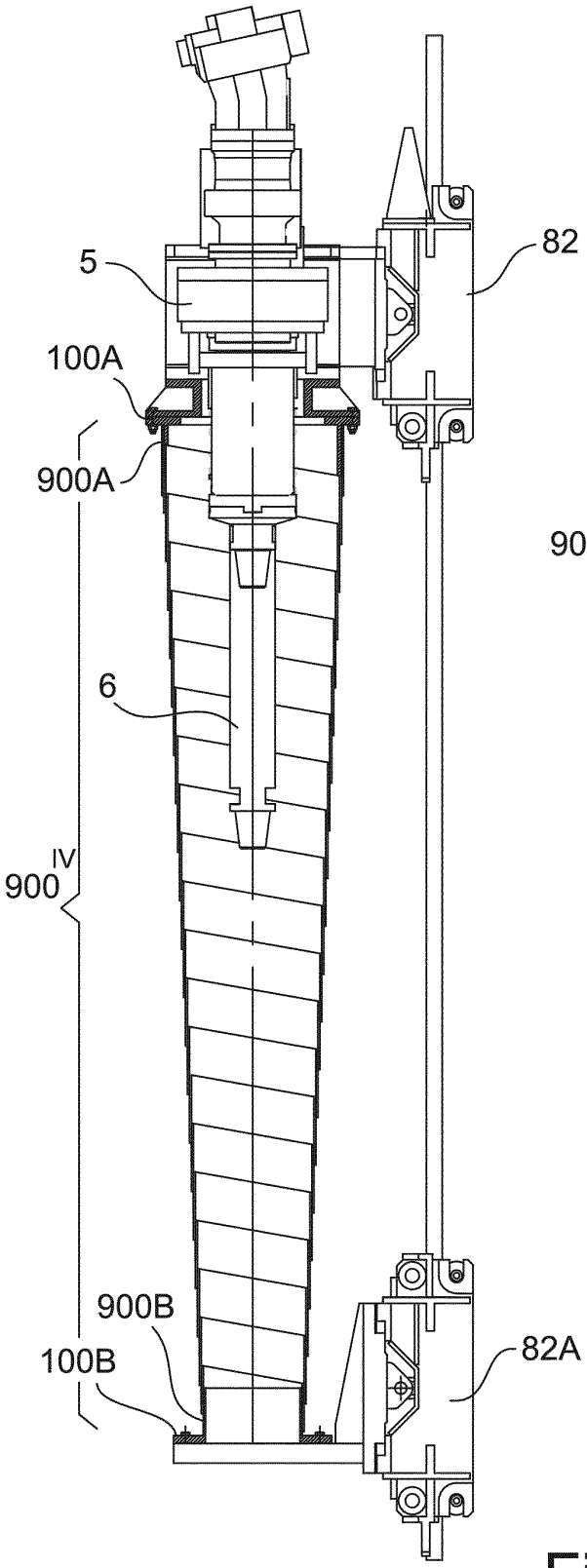


Fig. 15B

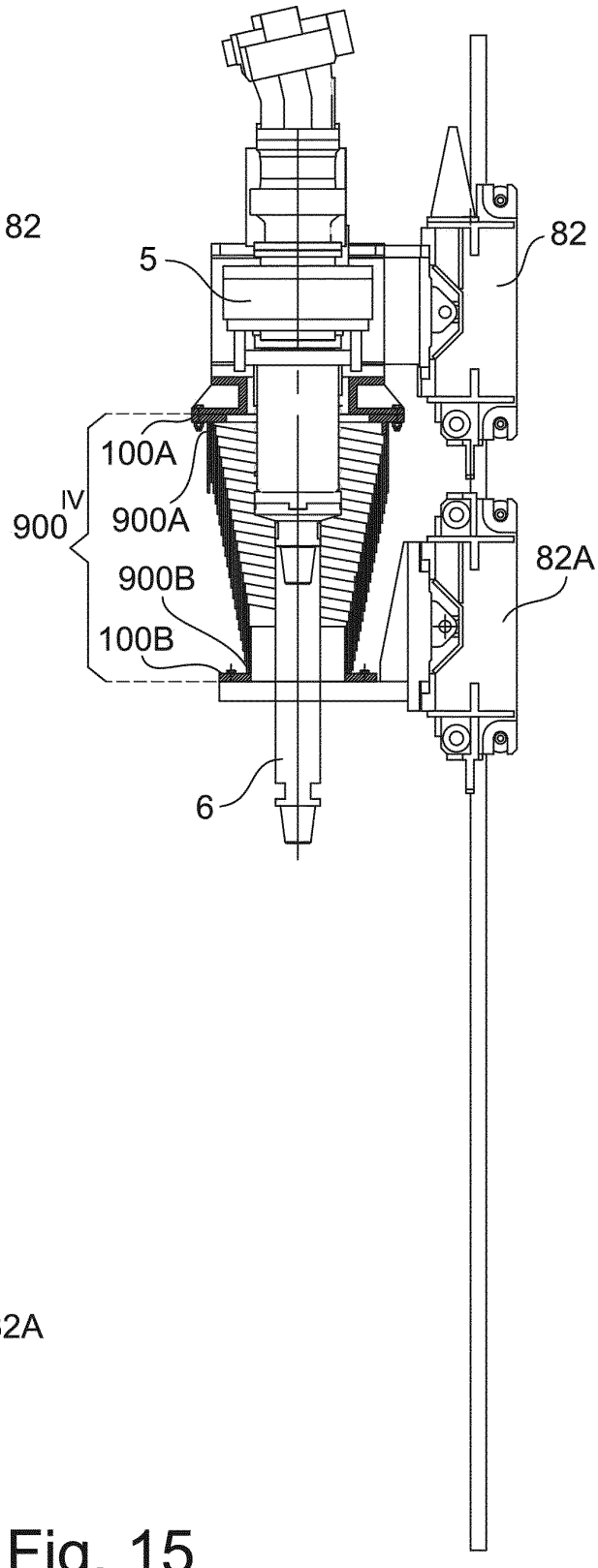


Fig. 15

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Patent documents cited in the description

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