

EARTH DRILLING MACHINE

The present invention refers to machines for the drilling of the ground.

In particular, the present invention relates to an equipment used in machines for the mixing, consolidation and compaction of grounds.

Various procedures are known for the consolidation of the ground through the formation of cylindrical columns of consolidated soil, based on the mixing of particles of the soil itself with legants, usually cemented mixtures.

The traditional procedure, through which a mainly mechanic mixing is carried out, uses the rotating movement of tools able to dig and disintegrate the soil through appendixes which radially extend to the axis of the tool itself. The soil so disintegrated is kneaded with a low-pressure (1-2 MPa) cemented mixture pumped through openings obtained on the tubular shaft which supports the digging tool.

A known variant of the described procedure is to use higher pressures for the cemented mixtures. This technique, by using the combination of the mechanical action of the disintegrating members of the tool and of the kinetic energy of the pressurized jets,

differs for a substantial execution speed, with considerable economic advantages.

Figure 1 shows a typical machine M normally tracked for the drilling of the ground, which can bear the characteristics of the present invention.

This machine is provided with a vertical tower 2 or antenna along which slides a group 3 for the movement of drill rods commonly named "rotary table".

This motorized group moves along guides 21 of the tower and is hanged to one or more traction and thrust handling devices (i.e.: hoists). Traction can be direct or multiplied (typical by two or four multiplications). The rotary table is of mainly hydraulic type and transforms the energy provided by a pressurized fluid into mechanical energy. One or more hydraulic motors give the rotary movement to one or more gears coupled to a crown. In the centre of the crown a flanged sleeve 31 to the same crown and provided with internal vertical listels 32 normally three or six, gives the rotation to a cylindrical rod provided also itself with external listels. The listels of the sleeve get in contact with the ones of the cylindrical rod making this last in the movement of rotation.

When the cylindrical rod is provided with external

listels for the transmission of movements or if it extends at least partially over the "rotary table", it is commonly called tube 4.

In the bottom part of the tube it is fixed the first of the rods of battery 5. Each rod is fixed to the following one with a joint having many shapes, screwed, flanged with screws or locked through pins. The last rod bears in its lower part digging tool 6. The tube is therefore a fundamental part of the machine because it receives the traction torque and the thrust of the rotary table and transmits them to the rods and conveys at the same time the pressurized fluid in direction of the digging tool.

The digging fluid is typically a consolidating fluid, generally a cement mixture, chemical mixture or concrete.

Trying to increase the depth of the excavation, it has been thought to increase the length of the tubes of traditional type.

In this light, it has been realized the possibility of stopping at various levels of the tube the rotary table, by inserting coupling and supporting points 41. In this way when the rotary is at the lower limit switch with respect to the guides of the tower, the tube can be inserted in the ground for some meters in

such a way as to realize treatment depths deeper than the length of the tower (typically up to 8-9 meters). In order to face the extension of the tube, it is then mounted a rudder 7 which has the function of blocking the rotation of the fixed part of the cement grout feeding head 8 mounted on the top of the tube. In the absence of this accessory, the rubber pipes of the feeding of the treatment fluid would wound around the tube at every turn of the rod. The rudder is therefore an indispensable element, even if extremely exile or at least not to so easy to handle and is also generally stressed by heavy oscillations when the rotation speed of the rotary acquires high values.

The technology and the available materials cautiously suggest not realizing too long tubes, having for example length higher than 8-9 meters, also for not endangering the stability of the machine.

A kind of tube is described into the patent application TO2004A000457 which refers to a continuous propeller ground drilling tool having an extension rod provided with at least two coaxial extensions, which moving between them, determine a fictitious extension of the drilling. They are connected at the bottom side to the propeller battery

and have a propeller in the most external element. This system actually permits a relative displacement between the two sliding elements but with an encumbrance in length equal to "x", permits an extension of the drilling equal to the encumbrance itself, that is to "x". The relative movement between the parts has the only function of moving the propeller in a more suitable position for generating the hoisting of the ground caused by the spirals and does not increase however the drilling depth.

Furthermore, the document US2008/2170037 describes a machine provided with a telescopic tube which comprises at least two extended elements coaxial between them and reciprocally extractable. The tube extracts proportionally to the movement of the carriage which supports it and slides on the antenna. It is to be noted that there is not a passage of pressurized fluid through the elements of the tube.

The present invention proposes to realize a machine for the drilling of the ground provided with a telescopic tube able to substantially increase its length (for example by doubling it at a value equal to approx. 2 times "x"), without losing the abovementioned characteristics of torque transmission, traction/thrust and above all the

conservation of the pressure of the fluid which flows inside them.

An aspect of the present invention refers to a drilling machine having the characteristics of the attached claim 1.

Further characteristics of the machine according to the present invention are contained in the attached dependent claims.

The characteristics and the advantages of the present invention will be clearer and evident from the following description, exemplificative and not limitative, of an embodiment with reference to the attached figures wherein:

- figure 1 shows a drilling machine provided with the tube according to the present invention;
- figures 2a and 2b show a detail of the group for the moving of the drilling rods of the drilling machine;
- figures 3a and 3b show the telescopic tube respectively in closed condition and open and extracted condition;
- figure 4a shows the tube of figure 3a in longitudinal section;
- figure 4b shows the tube of figure 3b in longitudinal section;

- figure 5 shows a particular sectioned from the zone of the pressure seals among the rods of the tube in extracted condition;
- figures 6a and 6b show respective radial sections in the insertion zone with respectively tube closed and tube open;
- figure 7 shows the constraining zone between the group for the handling of the drilling rods and the telescopic tube.

With reference to the mentioned figures, telescopic tube 4 according to the present invention comprises an external extended element 42, intermediate extended element 43 and an inner extended element 44 all of them having approximately the same length and being coaxial among them.

Furthermore, the inner element and the external element are integral between them and the intermediate element is extractable with respect to the other two.

On the tube there are also a rod adapter 45, arranged on the lower end of the tube and associated to the extractable intermediate extended element, a locking collar 46, a sleeve (preferably chromium plated) 47, and at least a support/joint collar 48 substantially provided at the lower end of the intermediate

extended element.

External element 42 is provided with external listels 421 of torque transmission along substantially all of its length which associate to inner vertical listels 32 of the group of rod handling (rotary table).

Furthermore, in its inner part the external element has other listels 422, which transmit the same torque to the intermediate element when respectively this last one is completely closed, or completely open that is when it is extracted. External element 42 supports in its lower part locking collar 46 realized for example with manual opening, which safely and definitively constrains the elements when the extraction of the tube is not required.

In the shown embodiment, inner element 44 ensures the conveying of the consolidating pressurized fluid from feeding head 8 flanged in its upper part of the tube, up to a channel realized inside intermediate element 43.

inner element 44 is not stressed with twisting torque and brings in its lower external part a waterproof sealing pack 49.

intermediate element 43 receives the torque from external element 42 by means of radial listels positioned in its upper part 431. These listels

insert in corresponding inner listels 422 of external element 42, when the tube is respectively completely closed and completely open or extracted.

Intermediate element 43 is not provided with any seal and shows itself as an externally and internally turned tube, having in its external upper part the transmission listels of torque and thrust 431 and in its lower part a male hexagonal coupling 432, with seats for fixing pins 433 which ensures the interface, through adapter 45, with the first of drilling rods 5. The adapter can be advantageously replaced according to the rod typology adopted.

Intermediate element 43 shows advantageously on all of its surfaces a surface hardening and anti-oxidation treatment for preserving for the longest possible time the seals mounted in the grooves of the elements and against which, internally and externally, the extractable telescopic element slides.

Intermediate element 43 is therefore the extraction of the telescopic tube and is controlled by lifting or lowering the external and inner elements (engaged together) through for example a ropes traction, fixed directly on the external element or indirectly on the rotary table within which the external element is

inserted.

For helping these movements, on the tube there are suitable venting devices. On external element 42 there are for example openings on the top for evacuating the fluid contained into the room closed between this element and intermediate one 43 during the closing or for inserting it in case of opening.

Temporary openings are also provided on some elements for permitting a direct access for the washing of the parts or for the necessary cleaning.

Sleeve 47 is fixed to the lower opening of intermediate element 43 and has a double function. First of all, it is a wear element, easily replaceable, because the waterproof seals of the cement grout, work on its inner diameter, when the telescopic tube is completely closed. Furthermore, by dismounting the sleeve from the intermediate element, it is possible to access almost all of the waterproof seals, without having to extract the three elements which compose the telescopic tube, the one with respect to the other.

For further helping the replacement of the seals, in particular the one in the ending part of inner element 44, the seal packs more stressed are mounted not directly on the inner element but on the

watertight rings axially mounted on the inner element and here kept in correct position through a seeger 436.

An openable guide 11, preferably controlled hydraulically, arranged in fixed or slidable position in the lower part of tower 2 near to the ground, has the task of retaining the rod battery to which the intermediate element is constrained, in the extraction and/or closing maneuvers of the telescopic element of the tube. Support/joint collar 48, mounted in its suitable seat present on adapter 45 and which finds an adequate checking element on the abovementioned guide 11 helps the task of axially locking the telescopic of the tube while the other elements slide relatively in it, rising (opening) or descending (closing).

A secondary form of embodiment provides to obtain the telescopic tube with two extended elements, extractable relatively the one with respect to the other. In this case external extended element 42 and intermediate one 43 are realized identically to what has been already described, whereas inner element 44 is not present. According to this embodiment, when the telescopic tube is extracted, the consolidating fluid deriving from feeding head 8 contacts the inner

part of external element 42 filling completely all the inner room. Therefore, the fluid finds itself in direct contact with listels 422 and 431 during the movement and working phases and this can result into a fast wear of the parts in contact or the relative seizure. For these reasons the primary form of embodiment is more advantageous because it permits to insulate in a clean environment the parts designed for the transmission of the movement. However, the preferred solution is more complex because it requires inserting a third extended element provided with seals and fixed to external element 42 already present.

Some working typologies require operating in lowered environment, for example for realizing consolidations under existing structures and buildings, under bridges or viaducts. In this case, the limited height implies a reachable maximum level which is relatively little (5-8m the typical heights). The drillings, and in particular the consolidation treatments, in this case are discontinuous because the rod battery is not always sufficient for covering the drilling depth required. Therefore, rod batteries are added and removed for obtaining the required depths.

The telescopic tube can be advantageously used for

preventing the handling of drilling rods and could be mounted on all the extension of the tower and be connected directly to the drilling tool through an appropriate joint (typically as the adapter 45 already described).

In this case the drilling could reach depths approximately doubled with respect to the height available without requiring the handling of the rods.

CLAIMS

1. Machine for the drilling of the ground comprising:

- a guide tower (2) along which it slides a group (3) for the maneuvering of a battery of drilling rods (5) that moves along guides (21) of the tower,
- said group comprising a sleeve (31) that conveys the rotation to a tube (4) to which at least a drilling rod (5) with a digging tool (6) or directly a digging tool (6) can be engaged to its lower part,
- said tube is a telescopic tube and comprises at least two extended coaxial and reciprocally extractable elements,

characterized in that

- said tube is designed to work with an inner fluid under pressure that flows inside at least one of the extended elements,
said telescopic tube comprising an external extended element (42), an intermediate extended element (43) and an inner extended element (44) coaxial among them,
- the inner element and the external element being

integral between them and the intermediate element being extractable with respect to the other two elements.

2. Machine according to claim 1, wherein the fluid under pressure is a consolidating fluid.

3. Machine according to claim 1, wherein a rod adapter (45), arranged on the lower ending of the tube itself and associated to the intermediate extended element is present on the tube.

4. Machine according to claim 1, wherein at least a locking collar (46) is present on the tube.

5. Machine according to claim 1, wherein at least a support/joint collar is present on the tube (48) substantially provided on the lower end of the intermediate extended element.

6. Machine according to claim 1, wherein the external element (42) is substantially provided for all of its length of external listels (421) of torque transmission which associate to inner vertical listels (32) of the sleeve (31) of the rod handling group (3).

7. Machine according to claim 1, wherein the intermediate element (43) is controlled by lifting or lowering the external and inner elements through a ropes traction, fixed directly to the external

element or indirectly acting on the handling group (3) within which the external element is fixed.

8. Machine according to claim 1, wherein the intermediate element (43) has on all of its extended surfaces a protection treatment against oxidation and erosion.

9. Machine according to claim 1, wherein an openable guide (11) arranged in fixed or slidable position in the lower part of the tower has the task of retaining the rod battery (5) to which the intermediate element is constrained, in the extraction and/or closing maneuvers of the telescopic of the tube.

10. Machine according to claim 9, wherein said openable guide (11) is not manually controlled.

11. Machine according to claim 9, wherein said openable guide (11) is hydraulically controlled.

12. Machine according to claim 9, wherein the support/joint collar (48), mounted in its suitable seat present on the adapter (45) finds an adequate match with said guide (11) which axially locks the telescopic movement of the tube.