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(54) ANCHORING HEAD FOR AN ANCHORING ROD

VERANKERUNGKOPF FÜR EINE VERANKERUNGSSTANGE

TÊTE D'ANCRAGE POUR UNE BARRE D'ANCRAGE

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Description

[0001] The present description relates to the technical field of anchoring systems for geotechnical use, and more in particular it relates to an anchoring head for an anchoring rod as defined in the preamble of claim 1.

[0002] In anchoring systems for geotechnical use, see for example US 6 283 451 B1, it is known to use anchoring rods provided with a plurality of longitudinal reinforcement elements, which are made, for example, by means of steel strands. Such rods are commonly used to stabilize rocky walls, making supporting walls and bulkheads, consolidating excavation walls and tunnels, etc. In broad terms, the known anchoring rods made with steel strand reinforcement consist of three main elements: the anchoring head, the unbonded length and the anchor length (the latter also called bonded length or foundation bulb). The anchoring head consists of a steel plate which is shaped and sized so as to allow the transfer of forces onto a contrast structure (reinforced concrete wall, bulkhead, support wall etc.). The anchoring head must allow pulling the reinforcement made with strands and blocking them, as well as pulling them again in the event of load losses if this is required during the working life of the works. The unbonded length, which is the stretch measured from the head of the rod to beyond the slide line of the ground, constitutes the part of the rod not constrained to the ground, in which the reinforcement, generally protected by a smooth sheath, can freely extend. The anchor length is the part of the rod in which the reinforcement is anchored to the ground, typically by injecting cementitious mortar into the final stretch of the borehole. Having injected the cementitious material and after it has hardened, the strands of the rod are pulled with jacks and hydraulic power units and the head reinforcement is fixed with appropriate clamps. In this manner, the anchor length transfers the applied load to the ground by virtue of the friction resistance of the mortar-ground adherence. In the case of rods for geotechnical use of the permanent type (typically rods designed for a working life longer than two years), the anchoring head is protected with a protective cap filled with grease at the end of the operations. This grease has an anti-corrosive and lubrication function. Such cap must be removable so as to allow re-tensioning strands, which operation must always be performed using hydraulic jacks, once or more often during the working life of the rod. In particular, in this case, the protective cap is removed, the head is cleaned removing all the grease and then the strands are pulled again with the hydraulic jacks. In order to allow the new pulling of the strands by means of the hydraulic jacks, the strands have protruding portions which must protrude for a relatively long stretch beyond the anchoring head in order to allow an adequate grip by the hydraulic jacks. Consequently, the known protective caps are relatively long (typically they have a length of 40-60 cm) in order to be able to receive the aforesaid protruding portions of the strands inside them. Once the strands have been pulled again, the protective cap, filled again with grease, is replaced. It is worth noting that these operations, arduous in themselves, are often performed at great heights, where workers are exposed to the risk of falling.

[0003] There are many difficulties related to the above operations, because in addition to being performed at height, the works imply, for example, the following drawbacks:

- the disassembly of a cap, placed in an inclined or perpendicular position with respect to the consolidated wall (which is typically either vertical or substantially vertical), inside which a conspicuous amount of liquefied grease is usually contained, which can drip and fall by gravity, invading the work platform and/or the underlying areas;
- the collection and disposal of the removed grease, the amount of which may be considerable in the case of works having a large number of rods;
- the use of a plurality of hydraulic jacks at a height for re-tensioning the rod, which is difficult for both logistical problems and because, considering their weight and size, the presence of at least 2 workers is normally necessary;
- the restoration of the cap with a quantity of grease similar to that previously removed.

In addition to the aforesaid construction site difficulties, there is also the impact of unpleasant appearance, which often contrasts with the requirements of constraints in places of scenic beauty, when observing a wall from which a series of 40-60-cm-long caps emerge in a direction inclined to the wall itself.

[0004] It is a general object of the present description to provide an anchoring head for an anchoring rod which can solve or reduce at least in part the problems described above with reference to the prior art.

[0005] This and other objects are achieved by means of an anchoring head for an anchoring rod as defined in claim 1 in its most general form, and in some particular embodiments of it in the dependent claims.

[0006] According to an aspect of the present invention, it is an object of the present description to make available an anchoring head for an anchoring rod which that is particularly simple, effective, small in size and easily manageable in re-tensioning operations.

[0007] It is a further object of the present invention an anchoring rod as described in claim 15.

[0008] The invention will be better understood from the following detailed description of its embodiments, made by way of example and consequently not limiting in any way with reference to the accompanying drawings, in which:

- Fig. 1 is a plan, partial section view of an anchoring head for an anchoring rod according to a presently preferred embodiment;
- Figs. 2-7 are plan, partial section views anchoring

head in Fig. 1 showing the steps of installing of the anchoring head, where the head is coupled with longitudinal reinforcement elements of an anchoring rod arranged inside a borehole;

- Fig. 8 is a plan, section view of the anchoring head in Fig. 1 in the final installation configuration;
- Fig. 9 is a plan, section view of the anchoring head in Fig. 1 during a step of re-tensioning of the longitudinal reinforcement elements in Fig. 2;
- Figure 10 is a top plan view of a first component of the anchoring head in Fig. 1;
- Fig. 11 is a top plan view of a second component of the anchoring head in Fig. 1;
- Fig. 12 is a top plan view of a third component of the anchoring head in Fig. 1;
- Fig. 13 is a plan, section view of an anchoring head according to a second embodiment shown in the respective final installation configuration;
- Fig. 14 is a top plan view of two components of the anchoring head in Fig. 13; and
- Fig. 15 is a plan, side elevation view of a further component of the anchoring head in Fig. 13.

[0009] Similar or equivalent elements in the accompanying figures are indicated by means of the same reference numerals.

[0010] It is worth noting that in the following description and in the claims, the words "axial" and "radial" are to be understood as referring to the direction of axis X1 which will be described later. Furthermore, in the following description and in the claims, the words "inner" and "outer" are referred to the center of the anchoring head.

[0011] With initial reference to Fig. 8, the figure partially shows an anchoring rod 1, 10 for geotechnical use. In manner known in itself, the anchoring rod 1, 10 is used, by way of non-limiting example, to stabilize rocky walls, make supporting walls and bulkheads, to consolidate excavation walls and tunnels, etc. In Fig. 8, the anchoring rod 1, 10 is shown in the respective final installation configuration in which is installed inside a borehole P1. In particular, Fig. 8 partially shows the borehole P1 and some longitudinal reinforcing elements 10 of the rod 1, 10. Indeed, the parts of the borehole P1, of the unbonded length and of the anchor length of the longitudinal elements 10 which are not shown are widely known to a person skilled in the art. Preferably, the longitudinal elements 10 are strands 10, and more preferably steel strands 10. In general, the anchoring rod 1, 10 comprises a plurality of longitudinal reinforcing elements 10, preferably from two to eight longitudinal elements 10. In the example shown in the accompanying figures, the rod 1, 10 comprises in particular four longitudinal elements 10, only two of which are diagrammatically shown in Fig. 8. Again with reference to Fig. 8, the anchoring rod 1, 10 comprises a anchoring head according to a presently preferred embodiment, which is globally indicated by reference numeral 1. The anchoring head 1 makes it possible to pull the longitudinal elements 10 and to block them so as to allow the transfer of load onto a contrast wall CW1. Preferably, the contrast wall CW1 is a wall of a contrast structure CS1 suited to be coupled to a wall to be consolidated. The contrast structure CS1 may comprise, for example, a reinforced concrete slab, a bulkhead, a supporting wall etc.

[0012] Again with reference to Fig. 8, the anchoring head 1 comprises a first plate 20 having a central axis X1 perpendicular to the first plate 20. In other words, the plate 20 comprises a first face 210 and an opposite second face 220, which are preferably planar faces, and the axis X1 is perpendicular to the faces 210, 220. The first plate 20 comprises first holes 201 configured to be each crossed by a respective longitudinal reinforcing element 10. In the example, the rod 1, 10 comprises four longitudinal elements 10. Consequently, the plate 20 comprises four first holes 201, as can be seen in Fig. 10.

[0013] The anchoring head 1 comprises a second plate 40, which is smaller than the first plate 20. In other words, if the plates 20, 40 are circular plates, as in the example shown in the accompanying figures, the diameter of the plate 40 is smaller than the diameter of the first plate 20. In particular, it is worth noting that the diameter of the first plate 20 is greater than the diameter of the borehole P1 so as to be able to rest on the contrast wall CW1. Conversely, the diameter of the second plate 40 is smaller than the diameter of the borehole P1 so that it can be received inside the contrast wall P1. However, it is worth noting that, in general, the shape of the plates 20, 40 is not limited to a circular shape. The second plate 40 comprises a first face 410 and an opposite second face 420. The second plate 40 is arranged facing the first plate 20, preferably so that the second face 220 of the first plate 20 faces the first face 410 of the second plate 40. The second plate 40 comprises a plurality of second holes 401 aligned with said first holes 201. The second holes 401 are provided to be each crossed by a respective longitudinal reinforcing element 10. In the example, in which the rod 1, 10 comprises four longitudinal elements 10, as can be seen also in Fig. 11, the second plate 40 comprises four second holes 401. With reference to Fig. 1, according to a preferred embodiment, each hole 201 is aligned with a respective hole 401 along an axis which is inclined with respect to the central axis X1. In particular, Fig. 1 shows an inclined axis Y1 along which a hole 201 and a hole 401 are aligned and a further inclined axis Y2 along which a further hole 201 and a further hole 401 are aligned. As shown, for example in Fig. 1, each of the inclined axes Y1 and Y2 and the central axis X1 converge in the direction which goes from the first plate 20 to the second plate 40. Preferably, each of the axes Y1, Y2 forms an angle of about 3 degrees with the central axis X1.

Again with reference to Fig. 1, the anchoring head 1 is suitable for taking on a first configuration, wherein the first and the second plate 20, 40 are spaced apart from each other by a first axial distance D1. The distance D1 is a distance between the second face 220 of the first

plate 20 and the first face 410 of the second plate 40. Preferably, the configuration in Fig. 1 is an initial configuration of the anchoring head 1, i.e. the configuration assumed by the head 1 before it is coupled to the longitudinal elements 10. According to a preferred embodiment, the distance D1 is equal to about 7 cm.

[0014] Turning back to Fig. 8, the anchoring head 1 comprises a connection member 50 which crosses the first plate 20 and is connected to the second plate 40. In particular, the connection member 50 is connected to the second plate 40 so as to be integral in translation with the second plate 40 in the direction of said middle axis X1. The connection member 50 is suitable to be moved axially, i.e. in the direction of the central axis X1, in a first direction T1 (Fig. 1 or Fig. 6) so that the anchoring head 1 takes on a second configuration (not shown), wherein the first and the second plate 20, 40 are spaced apart from each other by a second axial distance which is smaller than said first axial distance D1. In other words, the connection member 50 is suitable to be moved axially so as to approach the second plate 40 to the first plate 20.

[0015] The anchoring head 1 conveniently also comprises a stop element 60 operatively connected to the connection member 50. The stop element 60 is suitable for engaging the first plate 20 so as to prevent a translation of the connection member 50 and accordingly of the second plate 40 in a second direction T2 (Fig. 1 or Fig. 6) opposite to said first direction T1. According to a convenient embodiment, the actuating element 60 is accessible from the side of first face 210 of the first plate 20. According to a preferred embodiment, the stop element 60 is suitable for axially moving said connection member 50 and accordingly the second plate 40 so as to axially move the first and the second plate 20, 40 close to each other with respect to the aforesaid first axial distance D1. According to a preferred embodiment, the connection member 50 comprises a threaded bar 50, and wherein said stop element 60 comprises a stop nut 60 coupled to the threaded bar 50. With this regard, it is worth noting that for the purposes of the present description the expression "threaded bar" is to be understood in a general manner so as to include not only a threaded bar for its entire length of the bar, as shown in the example illustrated in the appended figures, but also in general a pin, which can be threaded for only part of the respective length so as to make it possible to screw the stop nut 60 to the pin. According to a preferred embodiment, the first plate 20 comprises a central hole 205 (Fig. 1 and Fig. 10) crossed by the threaded bar 50, while the second plate 40 comprises a central hole 405 (Fig. 1 and Fig. 11). In particular, the central hole 205 is a smooth hole, i.e. a non-threaded hole, in which a portion 61 of the stop nut 60 operatively suitable to rotate around the central axis X1 is preferably received. The central hole 405 is preferably a threaded hole into which a portion 51 of the threaded bar 50 is screwed to make the second plate 40 integral with the threaded bar 50.

[0016] Turning back to Fig. 8, the anchoring head 1 comprises a plurality of locking elements 30. Each locking element 30 is suitable for being coupled to a respective longitudinal reinforcing element 10 and to engage a respective part 402 of the second plate 40 to make the respective longitudinal reinforcing element 10 integral with the anchoring head 40 and transfer a load from said respective longitudinal reinforcing element 10 to the anchoring head 1.

[0017] According to a preferred embodiment, the part 402 of the second plate 40 engaged by each locking element 30 comprises a side wall 402 of each second hole 401. In the example, the anchoring head 1 comprises in non-limiting manner four clamping elements 30, each of which is suited to engage the side wall 402 of a respective second hole 401.

[0018] With reference to Fig. 1, according to a convenient embodiment, the anchoring head 1 comprises a plurality of supporting tubes 80 for the locking elements 30. The supporting tubes are preferably rigid tubes, preferably metal tubes. In particular, each supporting tube 80 crosses a respective pair of holes comprising one of the first holes 201 and one of the second holes 401 aligned with one another. Each supporting tube 80 is suitable to be crossed by a respective longitudinal reinforcing element 10. Preferably, the locking elements 30 comprise a plurality of self-tightening clamps 30, each of which is coupled to a respective supporting tube 80 so as to be crossed by the respective supporting tube 80. The plurality of self-tightening clamps 30 is interposed between the first and the second plate 20, 40. According to a convenient embodiment, the self-tightening clamps 30 and the second holes 401 are shaped so that said clamps 30 may be coupled with said second holes 401 so as to interlock in the second plate 40. According to a preferred embodiment, shown in the accompanying figures, the clamps 30 act in practice as locking wedges suitable to interlock in the second holes 401. In particular, according to a convenient embodiment, the self-tightening clamps 30 are sized to be able to entirely cross neither the first holes 201 nor the second holes 401. According to a preferred embodiment, as can be seen for example in Fig. 1, the self-tightening clamps 30 and the second holes 401 have a tapered shape, preferably a generally frustoconical shape. With reference to Fig. 12, according to a preferred embodiment the self-tightening clamps 30 comprise a plurality of clamp portions 301, preferably three portions 301, which extend about a clamp axis M1 (axis M1 is shown in Fig. 12 and is orthogonal to the plane of the figure) and are elastically connected to one another so as to be subject to an elastic return force which tends to return the portions 301 towards the axis M1 when they are moved away from such axis M1.

[0019] With reference to Fig. 8, the anchoring head 1 comprises an elastic spacer element 70 to keep the first and second plate 20, 40 mutually spaced apart. The elastic spacer element 70 is operatively interposed between the first and the second plate 20, 40. According to a preferred embodiment, the elastic spacer element 70 com-

prises a helical spring 70 fitted on said connection member 50.

[0020] Again with reference to Fig. 1, according to a convenient embodiment, the anchoring head 1 comprises a plurality of sleeves 90. The sleeves 90 are preferably rigid sleeves, preferably metal sleeves. Each sleeve 90 is fixed to the second plate 40, preferably welded to the second plate 40, so as to protrude from the second face 420 of the second plate 40. Furthermore, each of the sleeves 90 is suitable to be crossed by a respective supporting tube 80 (Fig. 1). Conveniently, the sleeves 90 make it possible to receive inside a sheathed portion of the longitudinal reinforcing elements 10. In this manner, it is advantageously possible to obtain a better protection of the longitudinal elements 10 because it avoids the remaining exposed to corrosion, humidity, etc., of a bare, i.e. not sheathed, portion of the elements 10 at the stretches of the elements 10 which extend near the second plate 40 from the side of the second face 420 of the second plate 40. Indeed, the longitudinal elements 10 must each display in general a respective bare end portion which extends from the end of each longitudinal element 10 located outside the borehole P1 to a stretch of the elements 10 which extends near the second face 420 of the second plate 40 on the side of the second face 420.

[0021] Again with reference to Fig. 8, according to a convenient embodiment, the anchoring head 1 comprises an outer protective casing 100 suitable for containing therein the first and the second plate 20, 40, the connection member 50, the stop element 60 and the locking elements 30. According to a convenient embodiment, the outer protective casing 100 is made of an electrically insulating material, preferably polyethylene. The outer protective casing 100 comprises a first casing part 1010 and a cap 1020, 1030, which can be removably coupled, preferably screwed, to the first casing part 1010. The first part 1010 of the outer casing 100 is arranged so as to close laterally a space 2 or gap 2 comprised between the first and the second plate 20, 40. In this manner, the first part 1010 of casing 100, preferably together with the second plate 40, substantially forms a container which, as will be described in greater detail below in the present description, is suitable to be filled with a substance G1 having a lubricating and corrosion inhibiting function (shown by dotted lines in Fig. 8) which is used to protect some components of the anchoring head 1 and of the rod 1, 10. Preferably, the substance G1 either comprises or consists of grease G1. According to a preferred embodiment, the first part 1010 has a tubular shape and preferably has an annular edge 1011 (Fig. 1) on which a peripheral edge portion 421 of the second face 420 of the second plate 40 rests. In other words, according to a preferred embodiment, the plate 40 forms a movable bottom of a container defined by the second plate 40 and by the first part 1010 of casing, wherein such movable bottom in the configuration of Fig. 1 rests on the annular edge 1011 of the first part 1010 of casing.

[0022] According to a convenient embodiment, the cap 1020, 1030 protrudes beyond the first face 210 of the first plate 20 when it is coupled to the first portion 1010 of the casing 100. In particular, with reference to Fig. 1, according to a preferred embodiment, the connection member 50 comprises a protruding portion 501, which protrudes beyond the first face 201 of the first plate 20 on the side opposite to the second plate 40, and said cap 1020, 1030 is shaped so as to cover the protruding portion 501 of the connection member 50. Turning back to Fig. 8, according to a convenient embodiment, the cap 1020, 1030 comprises a first part 1020 of cap comprising an access opening 1021 and a second part 1030 of cap which can be removably coupled, preferably screwed, to the first part 1020 of cap. In practice, the second part 1030 of the cap 1020, 1030 acts as a plug for closing the access opening 1021.

[0023] Having described the structure of the anchoring head 1, a coupling method of the anchoring head 1 to the longitudinal reinforcing elements 10 anchored inside the borehole P1 will now be described by way of non-limiting example with reference to the embodiment of the anchoring head 1 shown in the accompanying figures.

[0024] With reference to Fig. 1, in this figure the anchoring head 1 is shown in the respective initial configuration. In practice, the anchoring head 1 preferably arrives already assembled to the construction site in the configuration of Fig. 1 or possibly also provided with the cap 1020, 1030 which must be removed before installing the head 1, ready to be installed. The threaded bar 50 is screwed into the central hole 405 of the second plate 40 and to the internal threading of the stop nut 60. The nut 60 is in turn inserted in the central hole 205 of the first plate 20. In Fig. 1, the spring 70 initially keeps the plates 20, 40 at the predetermined distance D1, which is preferably equal to about 7 cm. The sleeves 90, the number of which is equal to the number of strands 10 of rod 1,10, are preferably fixed to the second face 420 of the second plate 40. The supporting tubes 80, the number of which is also equal to the number of strands 10 of rod 1,10 on which they must engage, pass through the first holes 201 of the plate 20, cross the clamps 30 placed in the space 2 between the plates 20 and 40 and finally cross the sleeves 90, whereby protruding from them.

[0025] Fig. 2 shows the anchoring head 1 just inserted on the strands 10. The installation, which is very simple and fast, consists in approaching the head 1 to the contrast structure CS1 and threading it onto the strands 10 leading out from borehole P1. In particular, in the inserting operation, the strands 10 are inserted through the supporting tubes 80 from the side of the second plate 40 until the first plate 20 abuts against the contrast structure CS1. Conveniently, it is worth noting that the supporting tubes 80 also act as guiding elements, which make it possible to facilitate the positioning of the head on the contrast structure CS1. During the insertion of the strands in the supporting tubes 80, the strands 10 cross, in this order, the tubes 80, the sleeves 90, the second plate 40, the clamps 30, the first plate 20 to then protrude from the

supporting tubes 80 from the side of the first plate 20 by a length sufficient to allow the gripping by hydraulic jacks (not shown) for pulling the strands 10. During such insertion operation of the strands 10 in the tubes 80, the second plate 40 is also inserted inside the borehole P1. After having ended the insertion of the strands 10 with the concurrently resting and placement of the first plate 20 on the contrast structure CS1, the method proceeds by pulling out the supporting tubes 80. Fig. 3 shows the anchoring head 1, while the supporting tubes 80 are being pulled out in the senses indicated by the arrows F1, F2, an operation which is performed manually by an operator.

[0026] Fig. 4 shows the anchoring head in the configuration after having pulled out of the supporting tubes 80 completely. Having pulled off the last tubes 80, the clamps 30 tighten automatically about the strands 10. At this point, with reference to Fig. 5, the strands 10 can be tensioned, preferably by using hydraulic jacks 1500. In particular, Fig. 5 shows the pulling operation of the strands 10 by means of hydraulic jacks 1500. In this regard, it is worth noting that the hydraulic jacks generally available on the market are provided with inner pistons flush with one end of the jacks themselves. In this case, since the clamps 30 must be coupled with the second plate 40, the hydraulic jacks 1500 are jacks provided with modified pistons 1510. In particular, the pistons 1510 are elongated pistons of a predetermined length with respect to the pistons of a traditional jack so they can reach the clamps 30 and push them into the respective holes 401 of the plate 40. According to a preferred embodiment, the pistons 1520 protrude with respect to an end 1520 of the respective jack 1500 by a length equal to about 11cm. In order to couple the clamps 30 with the second plate 40, the pistons 1510 are then inserted in the holes 201 of the plate 20 so as to push the clamps 30 into the holes 401 of the plate 40. The pulling operation with multiple hydraulic jacks 1500 (jack applied to each strand 10 with simultaneous tensioning of the strands 10) ends when each strand 10 is stretched by the predetermined load. During the step of unloading, the clamps 30, pushed by the aforesaid pistons 1510, constrain the strands 10 to the plate 40 and consequently implement the transfer of load from the strands 10 to the plate 40 itself. The latter, being rigidly coupled to the first plate 20 by means of the threaded bar 50 and the stop nut 60, in turn transfers the load to the plate 20 itself, which goes into contrast with the contrast structure CS1.

[0027] Fig. 6 shows the anchoring head 1 after tensioning and with the clamps 30 wedged into the holes 401 of the plate 40. At this point, the method proceeds with the cutting of the strands 10, preferably flush or substantially flush with the first face 210 of the first plate 20. Fig. 7 shows the step in which the strands 10 are cut by means of the cutting tools L1, L2 diagrammatically shown by means of scissors L1, L2 in Fig. 7. Once having cut the strands 10, the final process of protecting the anchoring head 1 from the atmospheric elements begins.

[0028] Fig. 8 shows the anchoring head 1 in its final configuration. Having cut the strands 10, in the example substantially flush with plate 20 and coupled the cap 1020, 1030 with the first part 1010 of the outer casing 100, grease G1 is introduced and penetrates through the holes 201 of the first plate 20 into the space 2 between the plates 20 and 40, whereby saturating almost all spaces. Preferably, the grease G1 is introduced through the access opening 1021 of the cap 1020, 1030. The grease G1 thus penetrates even through the clamps 30 until it reaches sheathed part of the strands 10. The first part 1010 of the casing 100 filled with the grease G1 substantially seals the space 2, whereby creating a saturated volume of grease G1. Having filled the space 2, the grease G1 comes out of the holes 201 of the first plate 20. The method then proceeds introducing grease G1 until the entire segment 501 (Fig. 1) of the threaded bar 50 is covered. Finally, the second part 1030 of the cap 1020, 1030 is coupled to the first part 1020 of it so as to close the access opening 1021.

[0029] It is worth noting that the outer protective casing 100, together with the grease G1, guarantees an optimal protection with compact dimensions, whereby ensuring preservation, e.g. from water infiltrations and corrosion of the metal elements, preferably made of steel, of the head 1.

[0030] Having described an example of installation method of the anchoring head 1, we will now describe by way of non-limiting example an example of re-tensioning procedure of the strands 10, which as described above may be required in one or more occasions during the working life of the rod 1,10 due to losses of load. From the description that follows it can be readily understood that an anchoring head according to the present description makes it possible to easily manage this requirement.

[0031] Fig. 9 shows the anchoring head 1 upon re-tensioning which will be performed either with a simple torque wrench K1 by applying an appropriate tightening torque on the stop nut 60 or by a single jack 1600 for bars (said jack 1600 is partially and diagrammatically shown in Fig. 9), unlike the traditional anchoring systems, which are performed with a plurality of hydraulic jacks of the type used for the tensioning the strands 10. In this case, the jack 1600 acts only on the threaded bar 50 so as to pull the bar 50 and the second plate 40 in sense T1 (Fig. 1 or Fig. 6), while the stop nut 60 is engaged to block the bar 50 in the position defined by the jack 1600 by screwing the stop nut 60 onto the bar 50 until the nut 60 engages the first plate 20. With this regard, it is worth noting that an ordinary strand rod may typically be subjected at most to a load loss of 3-4 tons and that, for the purposes of load recovery, 1 cm of elongation during re-tensioning corresponds to about 3-4 tons recovered by the rod itself. So, in order to recover the lost load, which obviously will also depend on the length of the rod itself, a re-tensioning of about 3-4 centimeters will be generally required. An initial distance D1 between the plates 20 and 40 equal to about 7 centimeters can satisfy the aforesaid geometric requirements. Indeed, by applying the

tightening torque on the stop nut 60, or by pulling the bar 50 by means of the bar jack 1600, plate 40 approaches the plate 20, which instead remains motionless, pulling the strands 10 and following their elongation.

[0032] The re-tensioning operation is fundamentally very simple and easily manageable on the construction site. Having removed the cap 1020, 1030 of the outer protective casing 100, the size of which is very small compared to the traditional protective caps (according with an embodiment, the length of the cap 1020, 1030 in the direction of axis X1 is equal to about 10 cm), it will be necessary to remove only a small amount of grease G1 and, for example, use a common and manageable torque wrench to tighten the stop nut 60, whereby determining the translation of the plate 40 towards the plate 20 with the torque applied and the concurrent elongation of the strands 10 which will thus re-acquire the lost load. As mentioned above, as previously mentioned, the re-tensioning may be performed alternatively with the bar jack 1600. Finally, after re-tensioning, the cap 1020, 1030 is repositioned and the small quantity of grease G1 which was previously removed is introduced again.

[0033] In Fig. 13, an anchoring head for an anchoring rod for geotechnical use according to a further embodiment is globally indicated by reference numeral 1A. The anchoring head 1A differs from the anchoring head 1 described above, exclusively in that it is provided with a key 230 in addition to a first plate 20a and to a connection member 50A, which are slightly modified with respect to the first plate 20 and the connection member 50 of the head 1. In particular, as can be seen in Fig. 13 and Fig. 14, the first plate 20A differs from the first plate 20 in that a housing seat 231 is provided for the key 230. Furthermore, as shown in Fig. 13 and Fig. 15, the connection member 50A differs from the connection member 50 in that is provided on a respective side wall 52a with rectilinear longitudinal groove 53A extending parallel to said central axis X1. Preferably, the groove 53a extends from at least one end face 54a of the connection member 50A. With reference to Fig. 13, the rectilinear longitudinal groove 53A is coupled to the key 230 in such a way that during an axial sliding (axis X1) of the connection member 50A, the key 230 is at least partly received in the longitudinal groove 53A. Conveniently, the key 230 and the groove 53a make it possible to either avoid or reduce the negative effects due to possible torsional stresses on the first plate 20A. Except for the differences discussed above, the structure and the operation of head 1 and of head 1A are substantially and mutually identical. For this reason, for the sake of brevity of description, the structure and the operation of the head 1A will not be described here in further detail.

On the basis of the above, it is thus possible to understand how an anchoring head according to the present invention makes it possible to achieve the purposes indicated above with reference to the prior art.

[0034] Indeed, with an anchoring head according to the present description, all the longitudinal reinforcing elements of the rod can be re-tensioned simultaneously simply and quickly either by using a torque wrench or by using alternatively a bar jack. Furthermore, since with an anchoring head according to the present description for re-tensioning the rod it is not necessary to act directly on the longitudinal reinforcing elements by means of hydraulic jacks for the pulling them, the longitudinal reinforcing elements can be cut preferably flush with the plate of the head which rests on the contrast structure, advantageously allowing a significant reduction in the protrusion of the protective cap with respect to the solutions of the prior art. It is apparent that the use of an anchoring head according to the present description implies many advantages in terms of economy, execution time, safety, environment and practice, such as for example:

- anchoring head with a top protection system of much smaller geometric size, which forms a protrusion, e.g. of about 10 cm, compared to the caps commonly in use, which typically have a height of about 40-60 cm;
- the disassembly and reassembly of a cap of about 40-60 cm is avoided, the cap being located in an inclined or perpendicular position with to the consolidated wall, inside which a conspicuous amount of liquefied grease is usually contained which can drip and fall by gravity, invading the work platform and/or the underlying areas;
- the problem of collecting and disposing of the removed grease, the amount of which may be considerable in the case of works having a large number of rods, is reduced;
- greater guarantees in terms of protection from corrosion and from the infiltration of water with respect to the known anchoring heads;
- use of a plurality of hydraulic jacks at a height, which is difficult for logistical problems and because, since they are accompanied by bulky and heavy equipment, the presence of at least 2 workers is normally necessary during the steps of re-tensioning;
- simplicity and speed in the re-tensioning operation of the rod, which can be performed with a common and manageable torque wrench by a single worker;
- the use of a torque wrench does not presuppose particular technical preparation, which instead may be necessary for the use of hydraulic jacks;
- modern torque wrenches, in addition to being easy to use, provide the reading in a few seconds and have a more precise reading accuracy than that of the hydraulic jacks;
- lower environmental impact, because there is less grease to be disposed of;
- improved appearance (especially on sites of scenic beauty and/or with environmental constraints) due to the small size of the protection system at the top of the heads;
- shorter on-site execution times with advantages in economic terms and in terms of safety at the work-

place.

[0035] Notwithstanding the principle of the invention, embodiments and details may be greatly varied with respect to that described and illustrated herein exclusively by way of non-limiting example without because of this departing from the scope of protection of the invention as defined in the appended claims.

Claims

1. An anchoring head (1) for an anchoring rod (1, 10) for geotechnical use, the anchoring rod (1, 10) comprising a plurality of longitudinal reinforcing elements (10) and said head (1) comprising:

- a first plate (20) having a middle axis (X1) orthogonal to the first plate (20) and first holes (201) configured to be crossed each by a respective longitudinal reinforcing element (10) of said longitudinal reinforcing elements (10);
- a plurality of locking elements (30), each suitable for being coupled to a respective longitudinal reinforcing element (10) of said longitudinal reinforcing elements (10) and for engaging a respective part (402) of the anchoring head (1) to make said respective longitudinal reinforcing element (10) integral with the anchoring head (1) and transfer a load from said respective longitudinal reinforcing element (10) to the anchoring head (1);

the anchoring head (1) being **characterized in that** it comprises:

- a second plate (40) which is smaller than the first plate (20), the second plate (40) being arranged facing the first plate (20) and comprising a plurality of second holes (401) aligned with said first holes (201), said second holes (401) being provided to be crossed each by a respective longitudinal reinforcing element (10) of said longitudinal reinforcing elements (10);
- a connection member (50) which crosses the first plate (20) and is connected to the second plate (40) so as to be integral in translation with the second plate (40) in the direction of said middle axis (X1); and
- a stop element (60) operatively connected to the connection member (50);

wherein said respective part (402) of the anchoring head (1) suitable for being engaged by a respective locking element (30) of said locking elements (30) is a part (402) of the second plate (40),
wherein the anchoring head (1) is suitable for taking on a first configuration wherein the first and the second plate (20, 40) are spaced apart from each other by a first axial distance (D1);
wherein said connection member (50) is suitable for being axially moved in a first direction (T1) so that the anchoring head (1) takes on a second configuration wherein the first and the second plate (20, 40) are spaced apart from each other by a second axial distance which is smaller than said first axial distance (D1);
said stop element (60) being suitable for engaging the first plate (20) so as to prevent a translation of the connection member (50) and accordingly of the second plate (40) in a second direction (T2) opposite to said first direction (T1).

2. An anchoring head (1) according to claim 1, wherein said stop element (60) is suitable for axially moving said connection member (50) and accordingly the second plate (40) so as to axially move the first and the second plate (20, 40) close to each other with respect to the first axial distance (D1).

3. An anchoring head (1) according to claim 1 or 2, wherein the first plate (20) and the second plate (40) comprise each a first face (210, 410) and an opposite second face (220, 420), the second face (220) of the first plate (20) facing the first face (410) of the second plate (40), wherein said stop element (60) is accessible from the side of the first face (210) of the first plate (20).

4. An anchoring head (1) according to any one of the preceding claims, wherein said connection member (50) comprises a threaded bar (50) and wherein said stop element (60) comprises a stop nut (60) coupled to the threaded bar (50).

5. An anchoring head (1) according to any one of the preceding claims, comprising an elastic spacer element (70) for keeping the first and the second plate (20, 40) spaced apart from each other, said elastic spacer element (70) being operatively interposed between the first and the second plate (20, 40).

6. An anchoring head (1) according to claim 5, wherein said elastic spacer element (70) comprises a helical spring (70) fitted on said connection member (50).

7. An anchoring head (1) according to any one of claims 3 to 6, comprising a plurality of supporting tubes (80) for said locking elements (30), each supporting tube (80) crossing a pair of holes comprising one of said first holes (201) and one of said second holes (401) aligned with each other, each of said supporting

tubes (80) being suitable for being crossed by a respective longitudinal reinforcing element (10) of said longitudinal reinforcing elements (10), said locking elements (30) comprising a plurality of self-tightening clamps (30), each of which is coupled to a respective supporting tube (80) of said supporting tubes (80) so as to be crossed by the respective supporting tube (80), said plurality of self-tightening clamps (30) being interposed between the first and the second plate (20, 40).

8. An anchoring head (1) according to claim 7, wherein said self-tightening clamps (30) and said second holes (401) are shaped so that said clamps (30) may be coupled with said second holes (401) so as to interlock in the second plate (40).

9. An anchoring head (1) according to claim 7 or 8, comprising a plurality of sleeves (90), each sleeve being fixed to the second plate (40) so as to project from the second face (420) of the second plate (40), each of said sleeves (90) being suitable for being crossed by a respective supporting tube (80) of said supporting tubes (80) .

10. An anchoring head (1) according to any one of the preceding claims, comprising an outer protective casing (100) suitable for containing therein the first and the second plate (20, 40), the connection member (50), the stop element (60) and the locking elements (30), said outer protective casing (100) comprising a first part (1010) of casing and a cap (1020, 1030) which can be removably coupled to the first part (1010) of casing, said first part (1010) of casing being arranged so as to laterally close a space (2) comprised between the first and the second plate (20, 40).

11. An anchoring head (1) according to claim 10, wherein said connection member (50) comprises a protruding portion (501) which protrudes past the first face (201) of the first plate (20) on the side opposite to the second plate (40), wherein said cap (1020, 1030) is shaped so as to cover said protruding portion (501) of the connection member (50).

12. An anchoring head (1) according to claim 11, wherein said cap (1020, 1030) comprises a first part (1020) of cap comprising an access opening (1021) and a second part (1030) of cap which can be removably coupled to the first part (1020) of cap and which serves as plug for closing said access opening (1021).

13. An anchoring head (1) according to claim 12, wherein said outer protective casing (100) is made of an electrically insulated material.

14. An anchoring head (1A) according to any one of the preceding claims, comprising a key (230) accommodated in a housing seat (231) provided in the first plate (20A) and wherein the connection member (50A) comprises a side wall (52A) on which there is provided a straight longitudinal groove (53A) extending parallel to said middle axis (X1), said straight longitudinal groove (53A) being coupled to said key (230) so that the key (230) is at least partly received in said longitudinal groove (53A) during an axial sliding of the connection member (50A) .

15. An anchoring rod (1, 10) comprising an anchoring head (1) as defined in any one of the preceding claims.

Patentansprüche

1. Verankerungskopf (1) für eine Verankerungsstange (1, 10) zur geotechnischen Verwendung, wobei die Verankerungsstange (1, 10) mehrere Längsverstärkungselemente (10) umfasst und der Kopf (1) umfasst:

- eine erste Platte (20), aufweisend eine Mittelachse (X1) senkrecht zur ersten Platte (20) und erste Löcher (201), die dazu konfiguriert sind, jeweils von einem jeweiligen Längsverstärkungselement (10) der Längsverstärkungselemente (10) gekreuzt zu werden;
- mehrere Verriegelungselemente (30), die jeweils dazu geeignet sind, mit einem jeweiligen Längsverstärkungselement (10) der Längsverstärkungselemente (10) gekoppelt zu werden und mit einem jeweiligen Teil (402) des Verankerungskopfes (1) in Eingriff zu kommen, um das das jeweilige Längsverstärkungselement (10) mit dem Verankerungskopf (1) einstückig zu machen und eine Last von dem jeweiligen Längsverstärkungselement (10) auf den Verankerungskopf (1) zu übertragen;

wobei der Verankerungskopf (1) **dadurch gekennzeichnet ist, dass** er umfasst:

- eine zweite Platte (40), die kleiner als die erste Platte (20) ist, wobei die zweite Platte (40) der ersten Platte (20) zugewandt angeordnet ist und mehrere zweite Löcher (401) umfasst, die an den ersten Löchern (201) ausgerichtet sind, wobei die zweiten Löcher (401) dazu bereitgestellt sind, jeweils von einem jeweiligen Längsverstärkungselement (10) der Längsverstärkungselemente (10) gekreuzt zu werden;
- ein Verbindungselement (50), das die erste Platte (20) kreuzt und mit der zweiten Platte (40) verbunden ist, um in der Translation mit der

zweiten Platte (40) in Richtung der Mittelachse (X1) einstückig zu sein; und
- ein Anschlagelement (60), das funktionsmäßig mit dem Verbindungselement (50) verbunden ist;

wobei der jeweilige Teil (402) des Verankerungskopfes (1), der dazu geeignet ist, mit einem jeweiligen Verriegelungselement (30) der Verriegelungselemente (30) in Eingriff gebracht zu werden, ein Teil (402) der zweiten Platte (40) ist,
wobei der Verankerungskopf (1) dazu geeignet ist, eine erste Konfiguration anzunehmen, wobei die erste und die zweite Platte (20, 40) um einen ersten axialen Abstand (D1) voneinander beabstandet sind;
wobei das Verbindungselement (50) dazu geeignet ist, axial in einer ersten Richtung (T1) bewegt zu werden, sodass der Verankerungskopf (1) eine zweite Konfiguration annimmt, wobei die erste und die zweite Platte (20, 40) um einen zweiten axialen Abstand voneinander beabstandet sind, der kleiner als der erste axiale Abstand (D1) ist;
wobei das Anschlagelement (60) dazu geeignet ist, mit der erste Platte (20) in in Eingriff zu kommen, um eine Translation des Verbindungselements (50) und dementsprechend der zweiten Platte (40) in einer zweite Richtung (T2) entgegengesetzt zu der ersten Richtung zu verhindern (T1).

2. Verankerungskopf (1) nach Anspruch 1, wobei das Anschlagelement (60) dazu geeignet ist, das Verbindungselement (50) und dementsprechend die zweiten Platte (40) axial zu bewegen, um die erste und die zweite Platte (20, 40) nahe zueinander in Bezug auf den ersten axialen Abstand (D1) axial zu bewegen.

3. Verankerungskopf (1) nach Anspruch 1 oder 2, wobei die erste Platte (20) und die zweite Platte (40) jeweils eine erste Fläche (210, 410) und eine gegenüberliegende zweite Fläche (220, 420) umfassen, wobei die zweite Fläche (220) der ersten Platte (20) der ersten Fläche (410) der zweiten Platte (40) zugewandt ist, wobei das Anschlagelement (60) von der Seite der ersten Fläche (210) der ersten Platte (20) zugänglich ist.

4. Verankerungskopf (1) nach einem der vorhergehenden Ansprüche, wobei das Verbindungselement (50) eine Gewindestange (50) umfasst und wobei das Anschlagelement (60) eine Anschlagmutter (60) umfasst, die mit der Gewindestange (50) gekoppelt ist.

5. Verankerungskopf (1) nach einem der vorhergehenden Ansprüche, umfassend ein elastisches Abstandselement (70) zum voneinander beabstandet Halten der ersten und der zweiten Platte (20, 40), wobei das elastische Abstandselement (70) funktionsmäßig zwischen der ersten und der zweiten Platte (20, 40) eingefügt ist.

6. Verankerungskopf (1) nach Anspruch 5, wobei das elastische Abstandselement (70) eine Schraubenfeder (70) umfasst, die an dem Verbindungselement (50) angebracht ist.

7. Verankerungskopf (1) nach einem der Ansprüche 3 bis 6, umfassend mehrere Stützrohre (80) für die Verriegelungselemente (30), wobei jedes Stützrohr (80) ein Lochpaar kreuzt, das eines der ersten Löcher (201) und eines der zweiten Löcher (401) umfasst, die aneinander ausgerichtet sind, wobei jedes der Stützrohre (80) dazu geeignet ist, von einem jeweiligen Längsverstärkungselement (10) der Längsverstärkungselemente (10) gekreuzt zu werden, wobei die Verriegelungselemente (30) mehrere selbstspannende Klemmen (30) umfassen, von denen jede mit einem jeweiligen Stützrohr (80) der Stützrohre (80) gekoppelt ist, um von dem jeweiligen Stützrohr (80) gekreuzt zu werden, wobei die mehreren selbstspannenden Klemmen (30) zwischen der ersten und der zweiten Platte (20, 40) eingefügt sind.

8. Verankerungskopf (1) nach Anspruch 7, wobei die selbstspannenden Klemmen (30) und die zweiten Löcher (401) so geformt sind, dass die Klemmen (30) mit den zweiten Löchern (401) gekoppelt werden können, um in der zweiten Platte (40) ineinanderzugreifen.

9. Verankerungskopf (1) nach Anspruch 7 oder 8, umfassend mehrere Hülsen (90), wobei jede Hülse an der zweiten Platte (40) befestigt ist, um von der zweiten Fläche (420) der zweiten Platte (40) vorzustehen, wobei jede der Hülsen (90) dazu geeignet ist, von einem jeweiligen Stützrohr (80) der Stützrohre (80) gekreuzt zu werden.

10. Verankerungskopf (1) nach einem der vorhergehenden Ansprüche, umfassend ein äußeres Schutzgehäuse (100), das dazu geeignet ist, darin die erste und die zweite Platte (20, 40), das Verbindungselement (50), das Anschlagelement (60) und die Verriegelungselemente (30) zu enthalten, wobei das äußere Schutzgehäuse (100) einen ersten Teil (1010) des Gehäuses und eine Kappe (1020, 1030) umfasst, die entfernbar mit dem ersten Teil (1010) des Gehäuses gekoppelt sein kann, wobei der erste Teil (1010) des Gehäuses so angeordnet ist, um einen zwischen der ersten und der zweiten Platte (20, 40) umfassten Raum (2) seitlich zu schließen.

11. Verankerungskopf (1) nach Anspruch 10, wobei das Verbindungselement (50) einen vorstehenden Abschnitt (501) umfasst, der über die erste Fläche (201) der ersten Platte (20) auf der der zweiten Platte (40) gegenüberliegenden Seite hinaus vorsteht, wobei die Kappe (1020, 1030) so geformt ist, dass sie den vorstehenden Abschnitt (501) des Verbindungselements (50) bedeckt.

12. Verankerungskopf (1) nach Anspruch 11, wobei die Kappe (1020, 1030) einen ersten Teil (1020) der Kappe, der eine Zugangsöffnung (1021) umfasst, und einen zweiten Teil (1030) der Kappe umfasst, der entfernbar mit dem ersten Teil (1020) der Kappe gekoppelt werden kann und der als Stopfen zum Verschließen der Zugangsöffnung (1021) dient.

13. Verankerungskopf (1) nach Anspruch 12, wobei das äußere Schutzgehäuse (100) aus einem elektrisch isolierten Material besteht.

14. Verankerungskopf (1A) nach einem der vorhergehenden Ansprüche, umfassend einen Schlüssel (230), der in einem Gehäusesitz (231) untergebracht ist, der in der ersten Platte (20A) bereitgestellt ist, und wobei das Verbindungselement (50A) eine Seitenwand (52A) umfasst, auf dem eine gerade Längsnut (53A) bereitgestellt ist, die sich parallel zur Mittelachse (X1) erstreckt, wobei die gerade Längsnut (53A) mit dem Schlüssel (230) gekoppelt ist, sodass der Schlüssel (230) zumindest teilweise in der Längsnut (53A) während eines axialen Gleitens des Verbindungselements (50A) aufgenommen ist.

15. Verankerungsstange (1, 10), umfassend einen Verankerungskopf (1), wie in einem der vorhergehenden Ansprüche definiert.

Revendications

1. Tête d'ancrage (1) pour une barre d'ancrage (1, 10) à utilisation géotechnique, la barre d'ancrage (1, 10) comprenant une pluralité d'éléments de renforcement longitudinal (10) et ladite tête (1) comprenant :

- une première plaque (20) ayant un axe médian (X1) orthogonal à la première plaque (20) et aux premiers trous (201) configurés pour être traversés chacun par un élément de renforcement longitudinal respectif (10) desdits éléments de renforcement longitudinal (10) ;
- une pluralité d'éléments de verrouillage (30), chacun étant adapté pour être couplé à un élément de renforcement longitudinal respectif (10) desdits éléments de renforcement longitudinal (10) et pour venir en prise avec une partie respective (402) de la tête d'ancrage (1) pour réaliser ledit élément de renforcement longitudinal respectif (10) solidaire de la tête d'ancrage (1) et transférer une charge dudit élément de renforcement longitudinal respectif (10) à la tête d'ancrage (1) ;

la tête d'ancrage (1) étant **caractérisée en ce qu'**elle comprend :

- une deuxième plaque (40) qui est plus petite que la première plaque (20), la deuxième plaque (40) étant disposée face à la première plaque (20) et comprenant une pluralité de deuxièmes trous (401) alignés avec lesdits premiers trous (201), lesdits deuxièmes trous (401) étant prévus pour être traversés chacun par un élément de renforcement longitudinal respectif (10) desdits éléments de renforcement longitudinal (10) ;
- un élément de raccordement (50) qui traverse la première plaque (20) et est raccordé à la deuxième plaque (40) de manière à être solidaire en translation avec la deuxième plaque (40) en direction dudit axe médian (X1) ; et
- un élément d'arrêt (60) connecté fonctionnellement à l'élément de raccordement (50) ;

dans laquelle ladite partie respective (402) de la tête d'ancrage (1) adaptée pour venir en prise avec un élément de verrouillage respectif (30) desdits éléments de verrouillage (30) est une partie (402) de la deuxième plaque (40),
dans laquelle la tête d'ancrage (1) est adaptée pour adopter une première configuration dans laquelle la première et la deuxième plaque (20, 40) sont espacées l'une de l'autre d'une première distance axiale (D1) ;
dans laquelle ledit élément de raccordement (50) est adapté pour être déplacé axialement dans une première direction (T1) de sorte que la tête d'ancrage (1) adopte une deuxième configuration dans laquelle la première et la deuxième plaque (20, 40) sont espacées l'une de l'autre l'autre par une deuxième distance axiale qui est inférieure à ladite première distance axiale (D1) ;
ledit élément d'arrêt (60) étant adapté pour venir en prise avec la première plaque (20) de manière à empêcher une translation de l'élément de raccordement (50) et en conséquence de la deuxième plaque (40) dans une deuxième direction (T2) opposée à ladite première direction (T1).

2. Tête d'ancrage (1) selon la revendication 1, dans laquelle ledit élément d'arrêt (60) est adapté pour

déplacer axialement ledit élément de raccordement (50) et en conséquence la deuxième plaque (40) de manière à rapprocher axialement la première et la deuxième plaque (20, 40) l'une de l'autre par rapport à la première distance axiale (D1).

3. Tête d'ancrage (1) selon la revendication 1 ou 2, dans laquelle la première plaque (20) et la deuxième plaque (40) comprennent chacune une première face (210, 410) et une deuxième face opposée (220, 420), la deuxième face (220) de la première plaque (20) tournée vers la première face (410) de la deuxième plaque (40), dans laquelle ledit élément d'arrêt (60) est accessible depuis le côté de la première face (210) de la première plaque (20).

4. Tête d'ancrage (1) selon l'une quelconque des revendications précédentes, dans laquelle ledit élément de raccordement (50) comprend une barre filetée (50) et dans laquelle ledit élément d'arrêt (60) comprend un écrou d'arrêt (60) couplé à la barre filetée (50).

5. Tête d'ancrage (1) selon l'une quelconque des revendications précédentes, comprenant un élément d'espacement élastique (70) pour maintenir la première et la deuxième plaque (20, 40) espacées l'une de l'autre, ledit élément d'espacement élastique (70) étant interposé fonctionnellement entre la première et la deuxième plaque (20, 40).

6. Tête d'ancrage (1) selon la revendication 5, dans laquelle ledit élément d'espacement élastique (70) comprend un ressort hélicoïdal (70) monté sur ledit élément de raccordement (50).

7. Tête d'ancrage (1) selon l'une quelconque des revendications 3 à 6, comprenant une pluralité de tubes de support (80) pour lesdits éléments de verrouillage (30), chaque tube de support (80) traversant une paire de trous comprenant l'un desdits premiers trous (201) et l'un desdits deuxièmes trous (401) alignés l'un avec l'autre, chacun desdits tubes de support (80) étant adapté pour être traversé par un élément de renforcement longitudinal respectif (10) desdits éléments de renforcement longitudinal (10), lesdits éléments de verrouillage (30) comprenant une pluralité de pinces auto-serrantes (30), chacune étant couplée à un tube de support respectif (80) desdits tubes de support (80) de manière à être traversée par le tube de support respectif (80), ladite pluralité de pinces auto-serrantes (30) étant interposées entre la première et la deuxième plaque (20, 40).

8. Tête d'ancrage (1) selon la revendication 7, dans laquelle lesdites pinces auto-serrantes (30) et lesdits deuxièmes trous (401) sont conformés de sorte que lesdites pinces (30) puissent être couplées avec lesdits deuxièmes trous (401) de manière à se verrouiller dans la deuxième plaque (40).

9. Tête d'ancrage (1) selon la revendication 7 ou 8, comprenant une pluralité de manchons (90), chaque manchon étant fixé à la deuxième plaque (40) de manière à faire saillie à partir de la deuxième face (420) de la deuxième plaque (40), chacun desdits manchons (90) étant adapté pour être traversé par un tube de support respectif (80) desdits tubes de support (80).

10. Tête d'ancrage (1) selon l'une quelconque des revendications précédentes, comprenant un boîtier de protection externe (100) adapté pour contenir à l'intérieur la première et la deuxième plaque (20, 40), l'élément de raccordement (50), l'élément d'arrêt (60) et les éléments de verrouillage (30), ledit boîtier de protection externe (100) comprenant une première partie (1010) de boîtier et un capuchon (1020, 1030) qui peut être couplé de manière amovible à la première partie (1010) de boîtier, ladite première partie (1010) du boîtier étant agencée de manière à fermer latéralement un espace (2) compris entre la première et la deuxième plaque (20, 40).

11. Tête d'ancrage (1) selon la revendication 10, dans laquelle ledit élément de raccordement (50) comprend une partie saillante (501) qui dépasse de la première face (201) de la première plaque (20) du côté opposé à la deuxième plaque (40), dans laquelle ledit capuchon (1020, 1030) est conformé de manière à couvrir ladite partie saillante (501) de l'élément de raccordement (50).

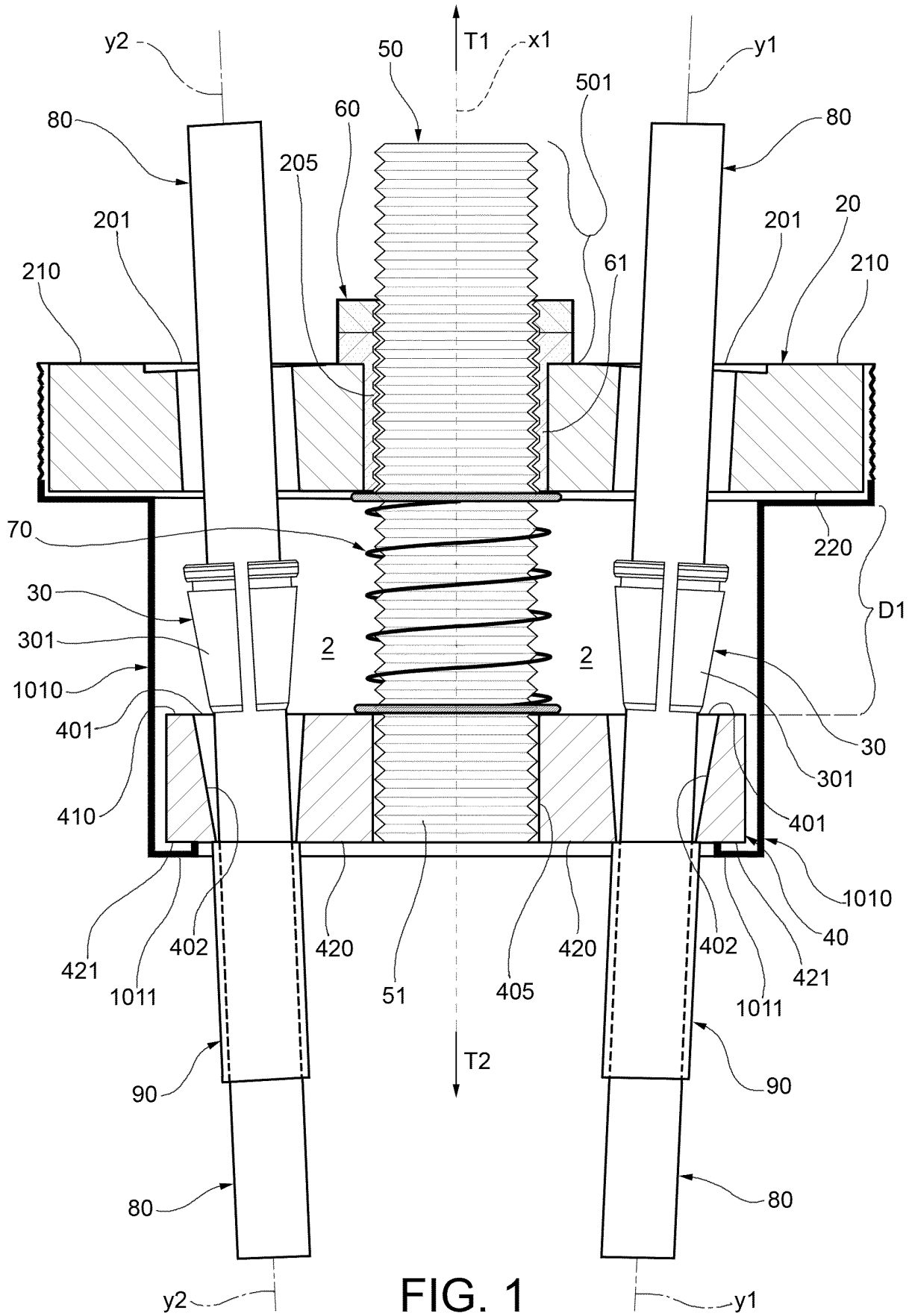
12. Tête d'ancrage (1) selon la revendication 11, dans laquelle ledit capuchon (1020, 1030) comprend une première partie (1020) de capuchon comprenant une ouverture d'accès (1021) et une deuxième partie (1030) de capuchon qui peut être couplée de manière amovible à la première partie (1020) du capuchon et qui sert de bouchon pour fermer ladite ouverture d'accès (1021).

13. Tête d'ancrage (1) selon la revendication 12, dans laquelle ledit boîtier de protection externe (100) est fait d'un matériau électriquement isolé.

14. Tête d'ancrage (1A) selon l'une quelconque des revendications précédentes, comprenant une clé (230) logée dans un siège de boîtier (231) prévu dans la première plaque (20A) et dans laquelle l'élément de raccordement (50A) comprend une paroi latérale (52A) sur laquelle est prévue une rainure longitudinale droite (53A) s'étendant parallèlement audit axe médian (X1), ladite rainure longitudinale droite (53A) étant couplée à ladite clé (230) de sorte

que la clé (230) soit au moins partiellement reçue dans ladite rainure longitudinale (53A) lors d'un coulissement axial de l'élément de raccordement (50A).

15. Barre d'ancrage (1, 10) comprenant une tête d'ancrage (1) telle que définie dans l'une quelconque des revendications précédentes.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T2
90
90
80
80
y2
y1

FIG. 1

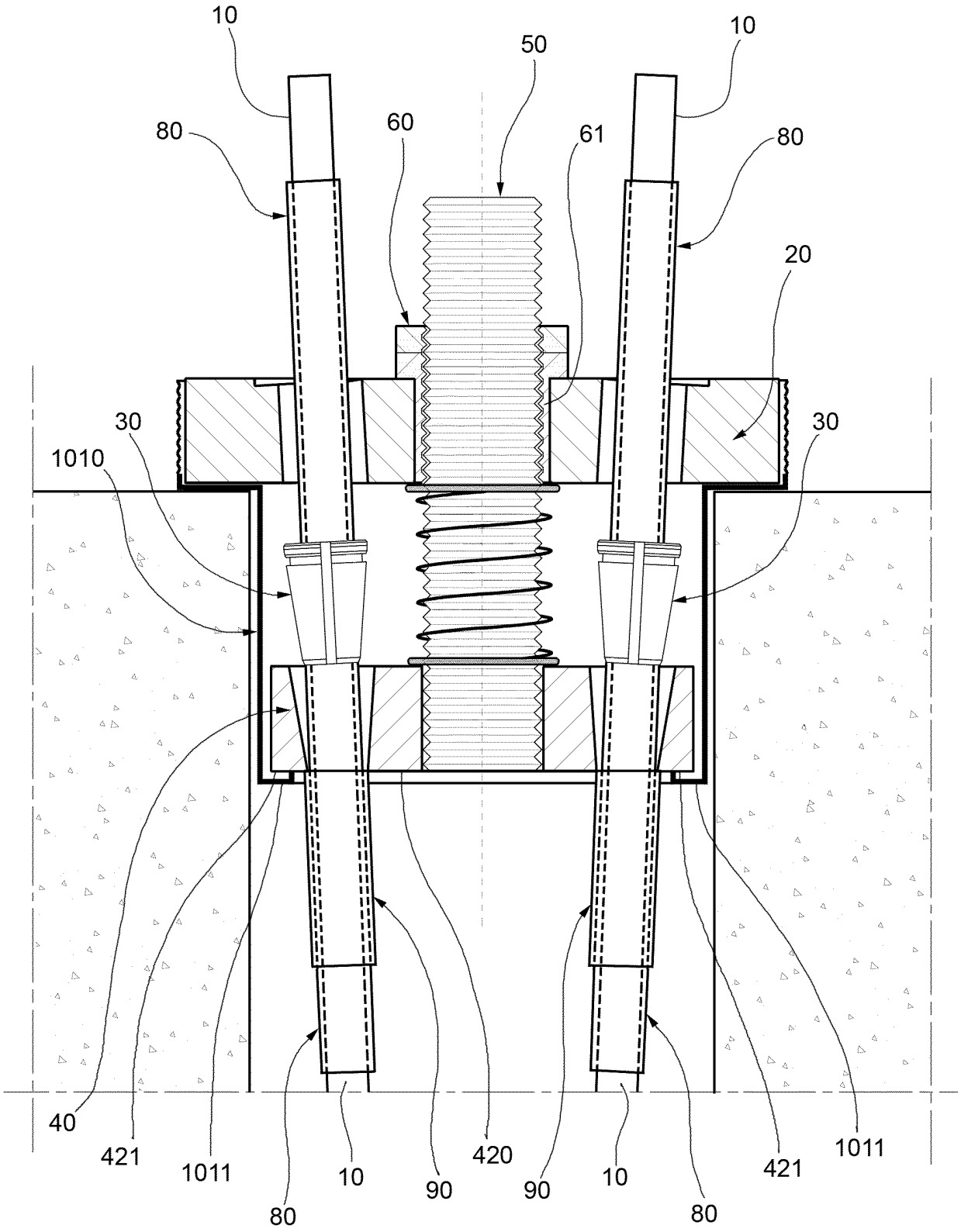
10
50
10
80
60
61
80
20
30
30
1010
40
421
1011
10
80
90
420
90
10
80
421
1011

FIG. 2

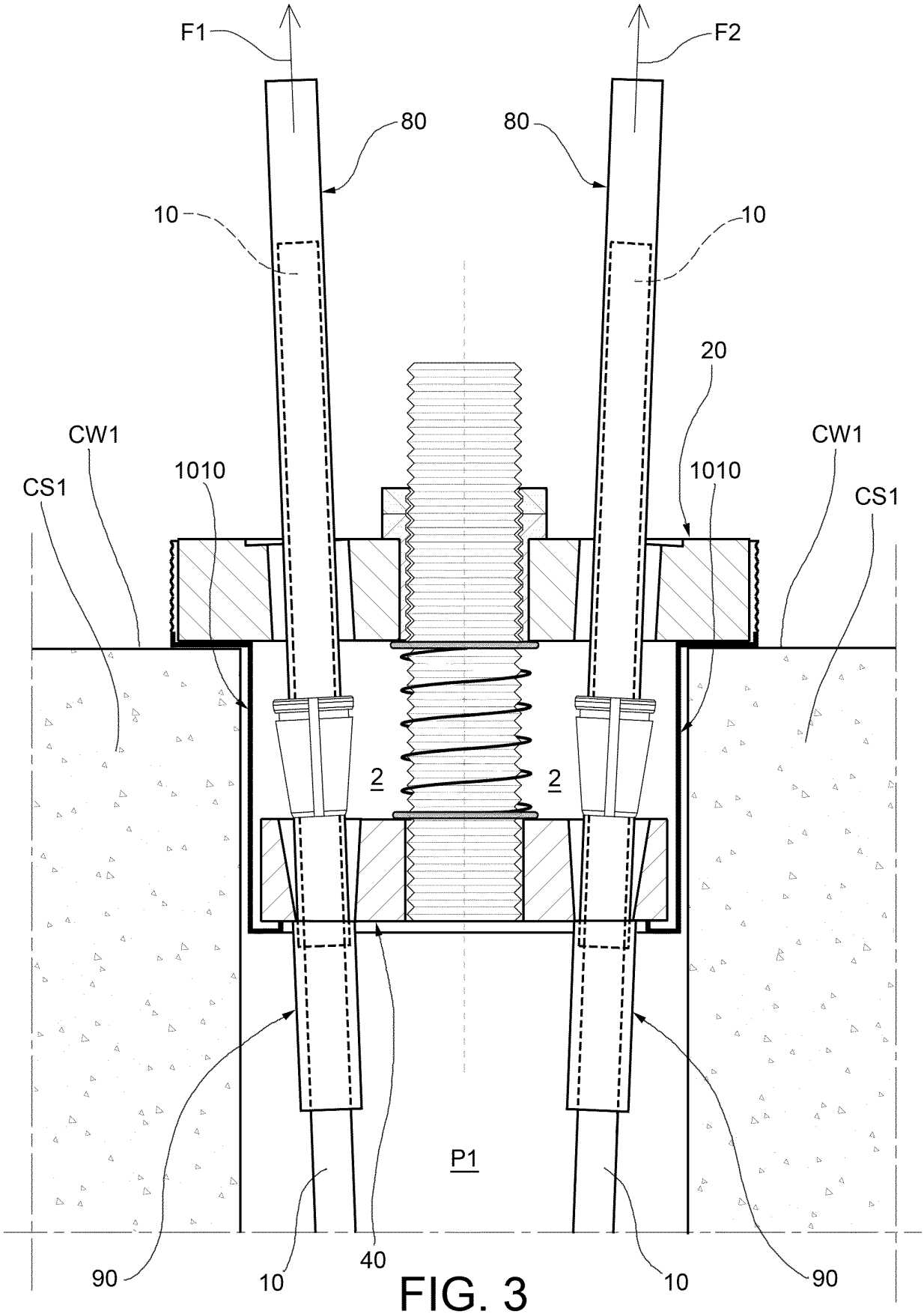

FIG. 3

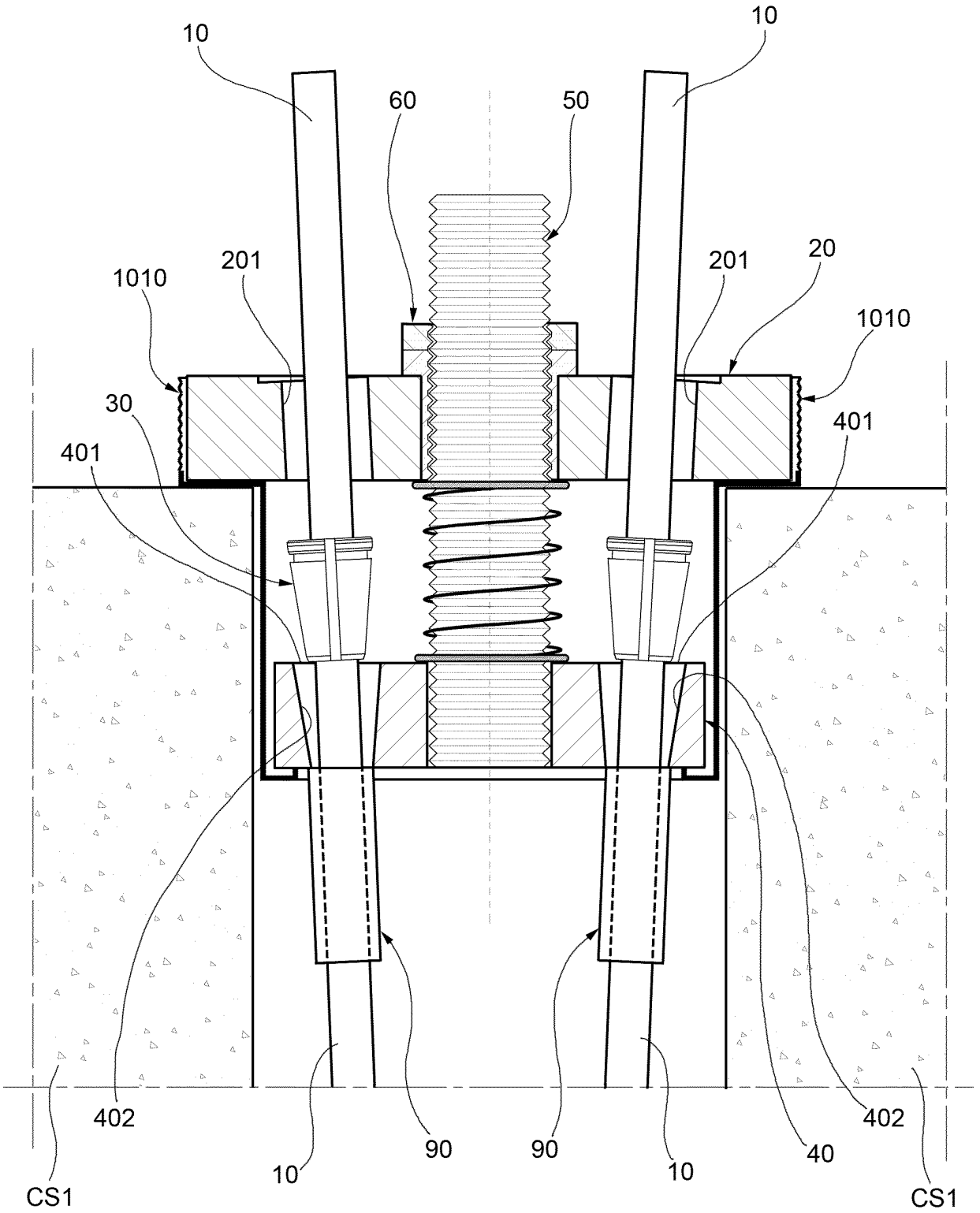
10
10
60
50
201
201
20
1010
1010
30
401
401
402
402
CS1
CS1
10
10
90
90
40

FIG. 4

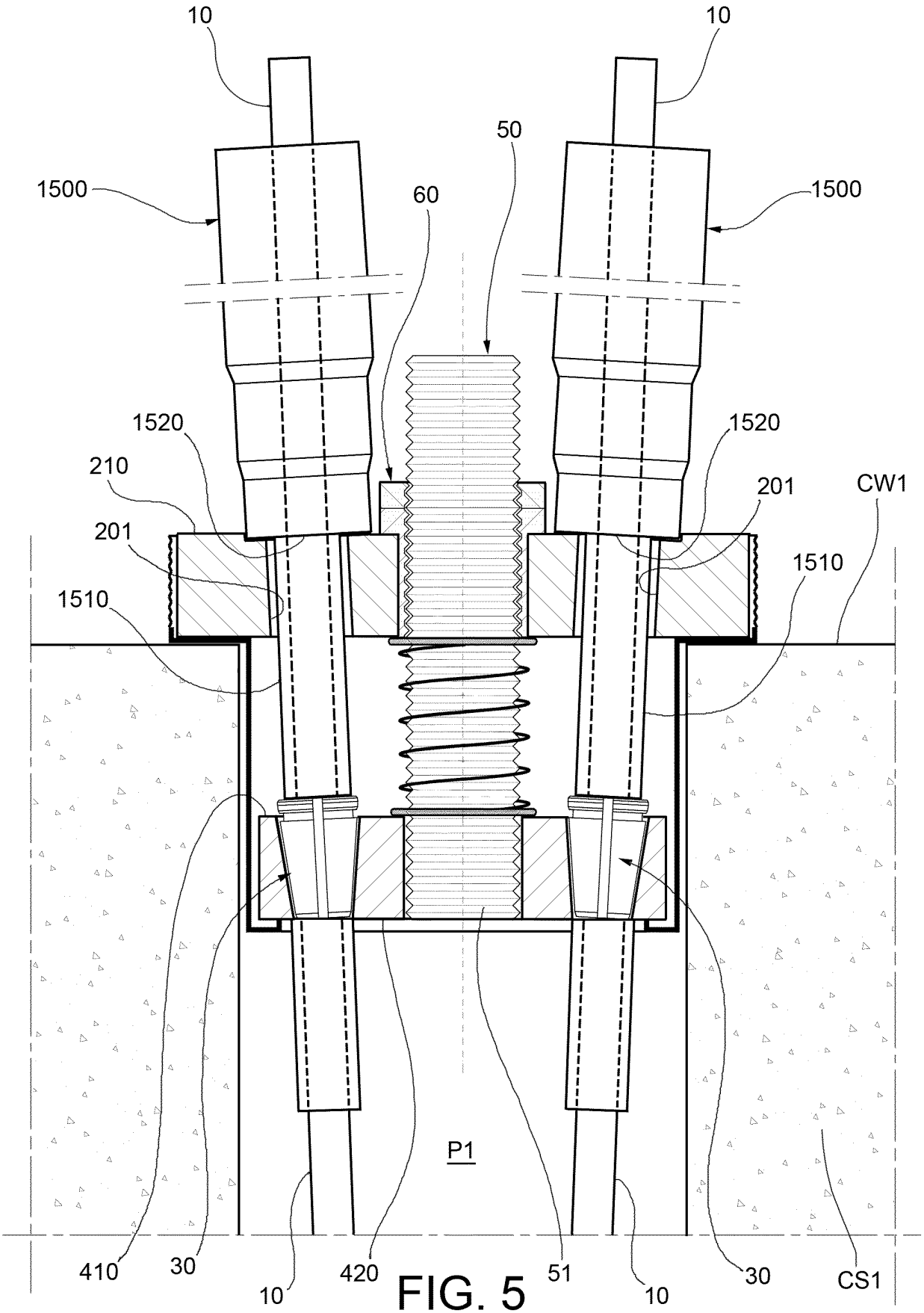
10
10
50
1500
60
1500
1520
1520
210
201
CW1
201
1510
1510
P1
410
30
10
420
51
10
30
CS1

FIG. 5

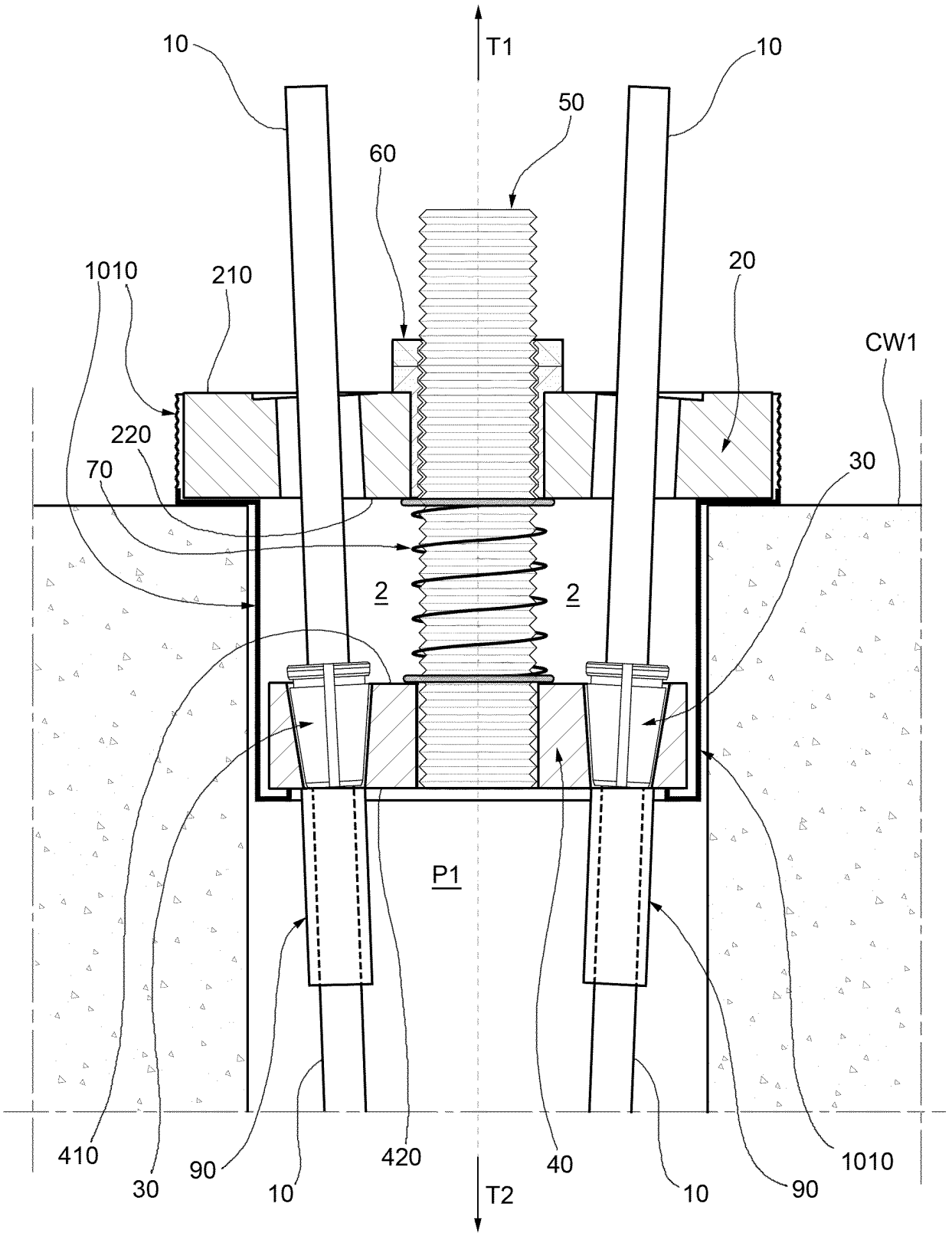
T1
10
10
50
60
1010
210
20
CW1
220
70
30
2
2
P1
410
30
90
10
420
40
10
90
1010
T2

FIG. 6

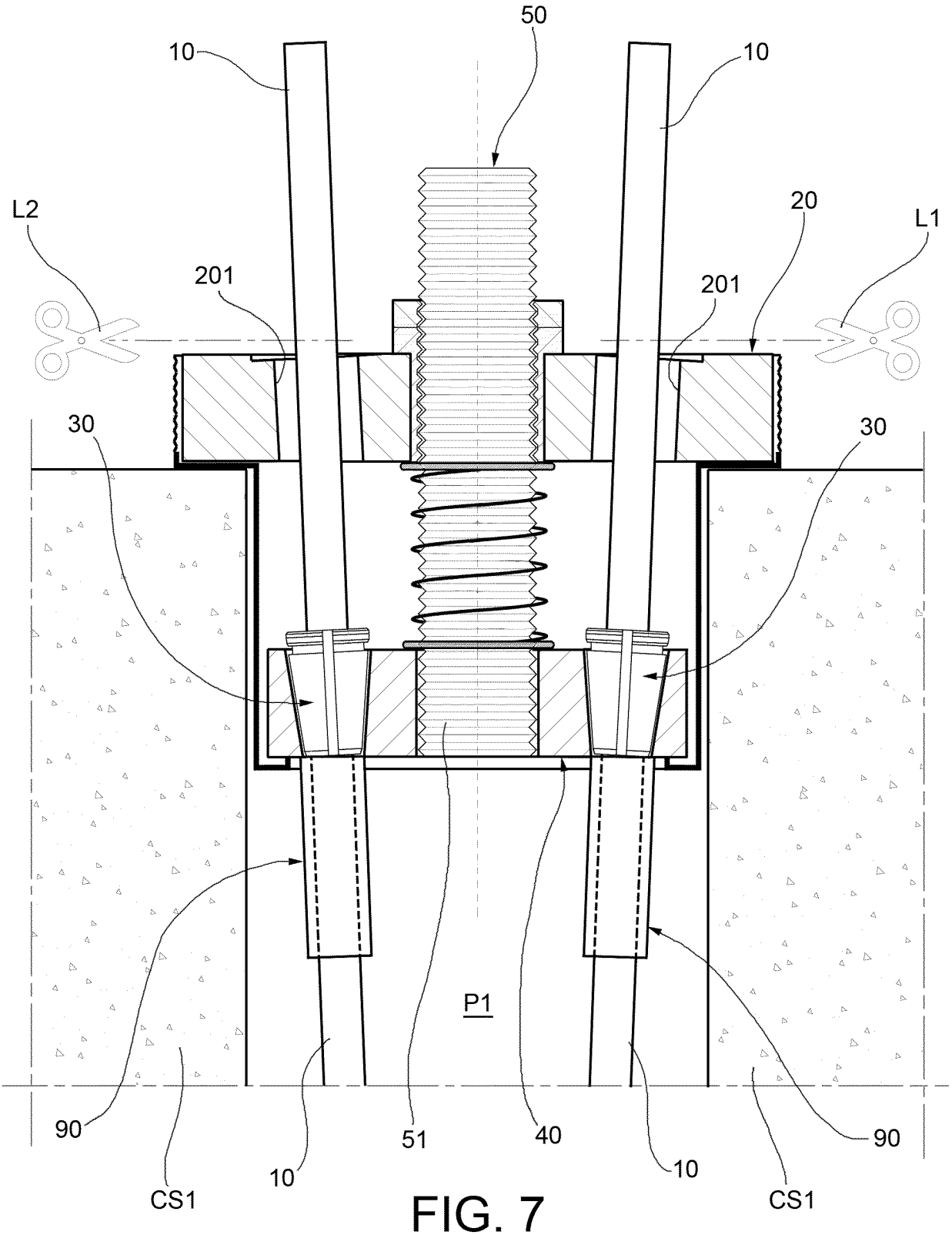

FIG. 7

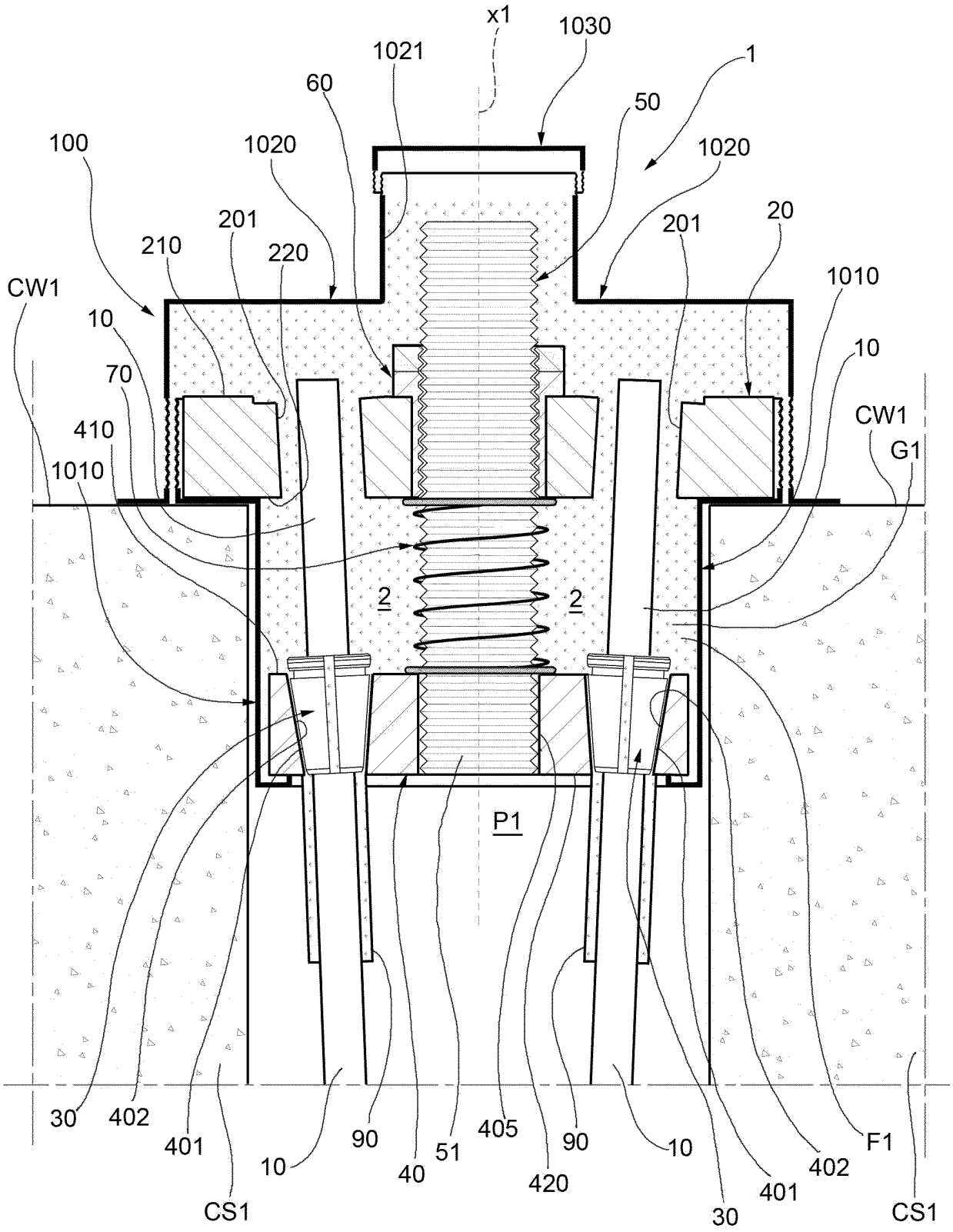
x1
1030
1021
1
60
50
100
1020
1020
201
201
20
210
220
CW1
1010
10
10
70
CW1
410
G1
1010
2
2
P1
30
402
401
10
90
40
51
405
420
90
10
30
401
402
F1
CS1
CS1

FIG. 8

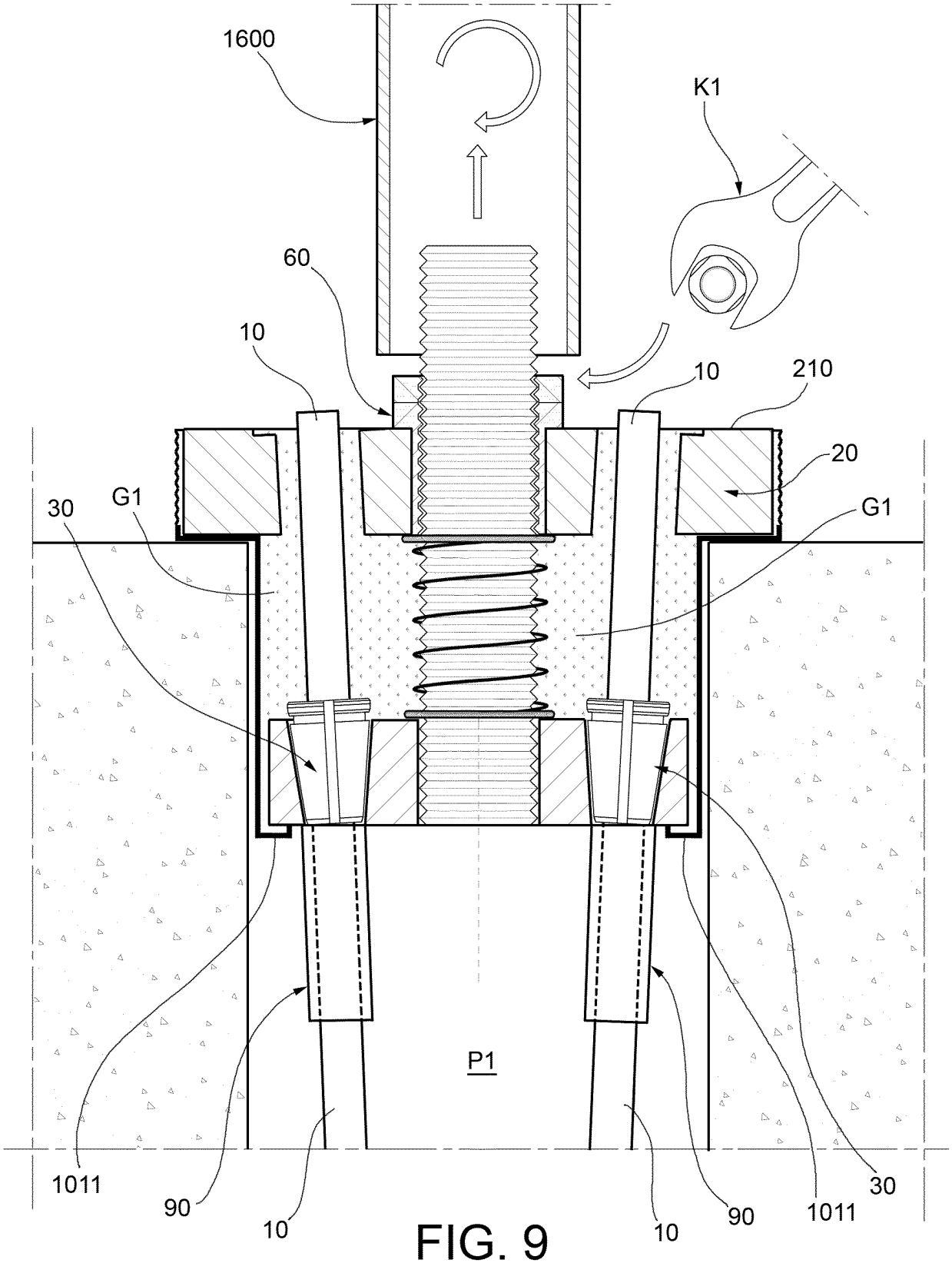

FIG. 9

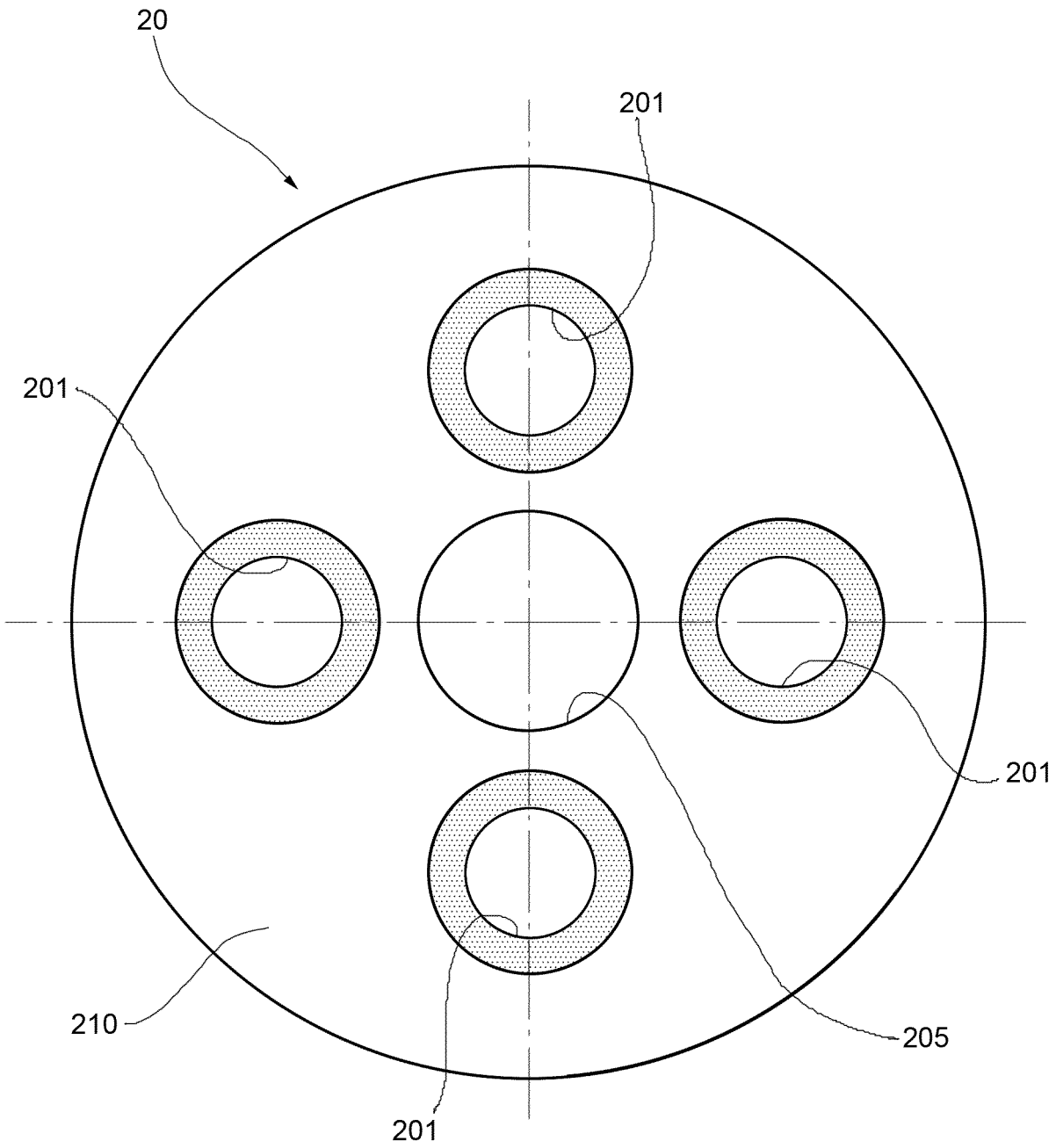

FIG. 10

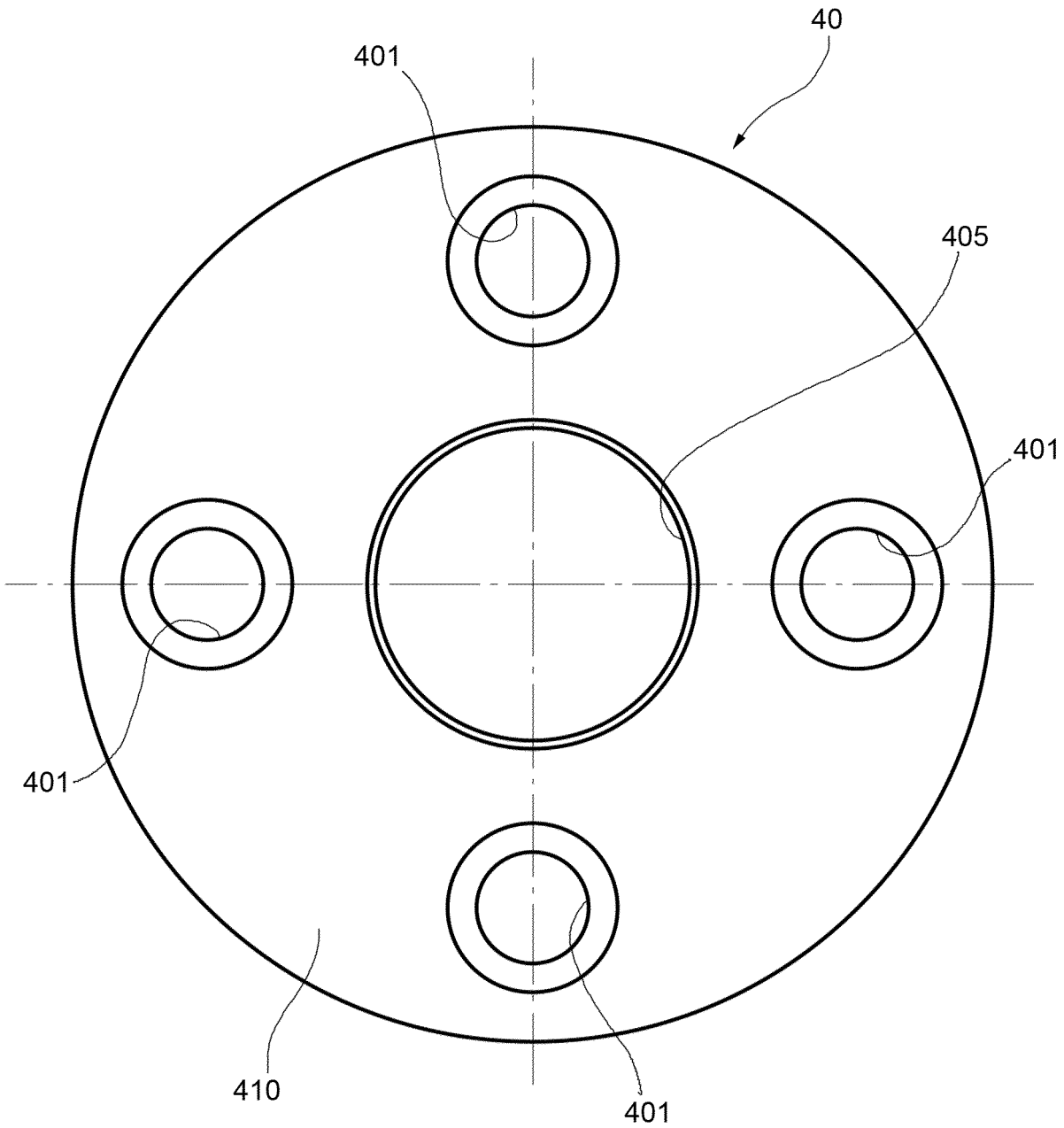

FIG. 11

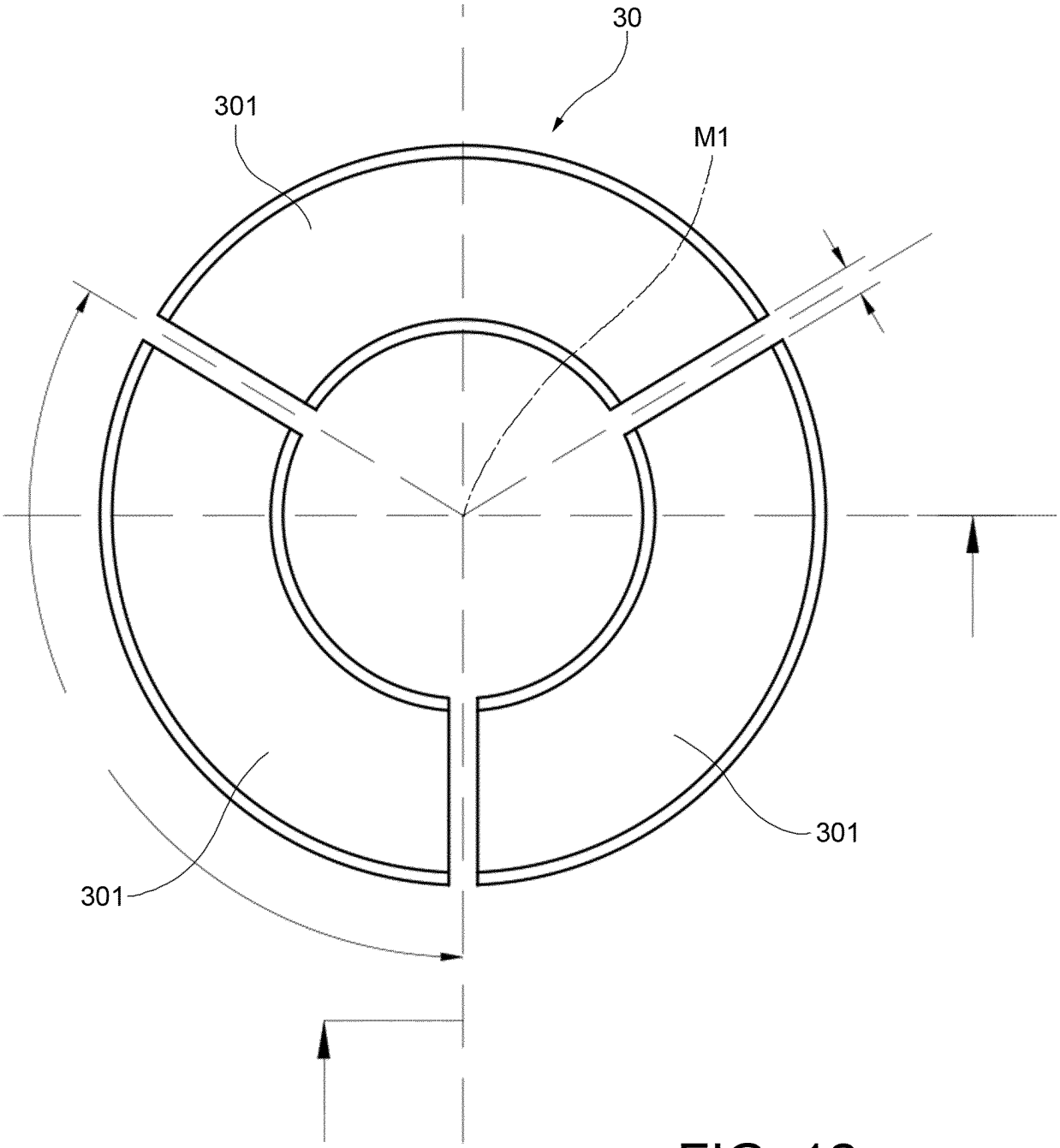

FIG. 12

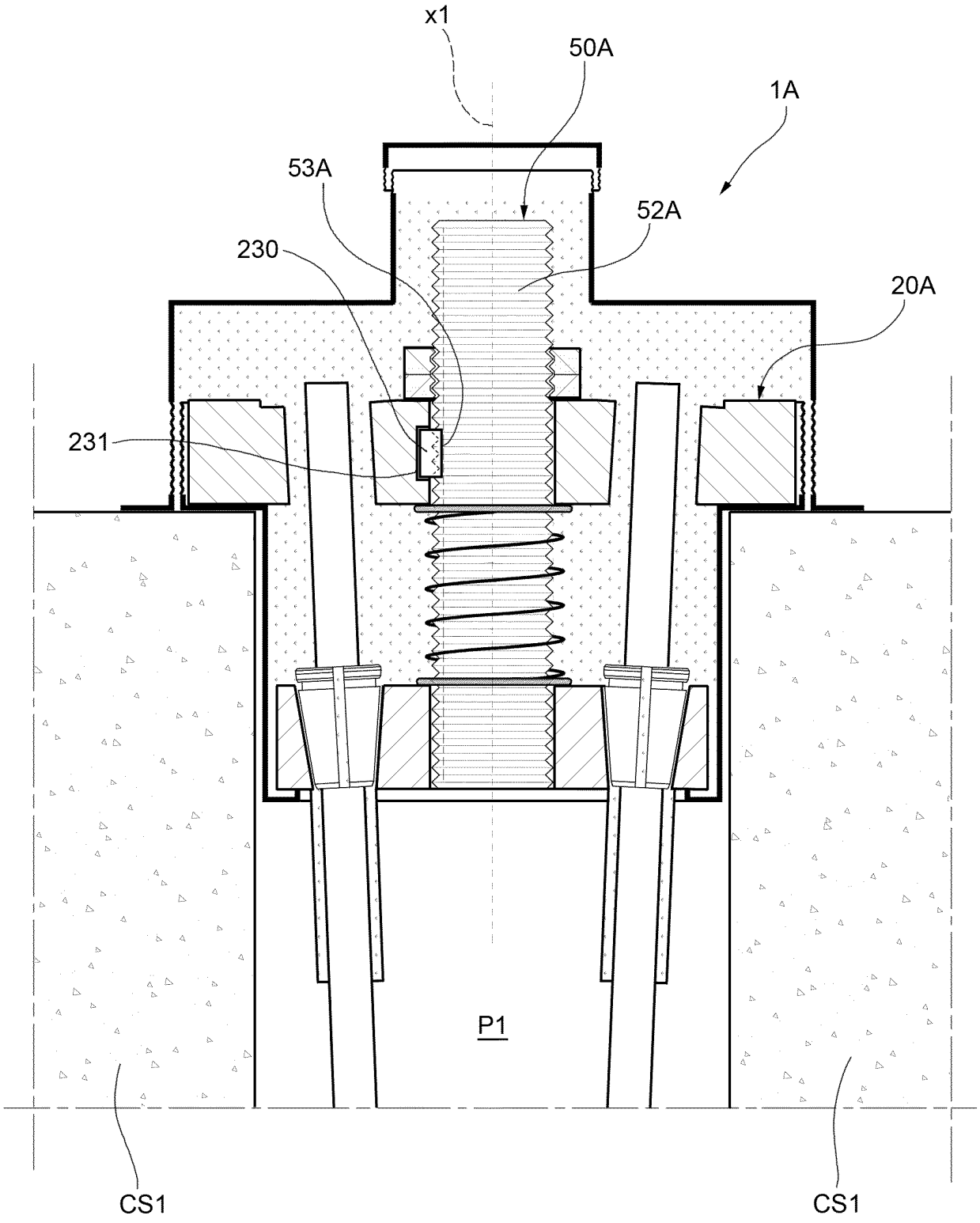

FIG. 13

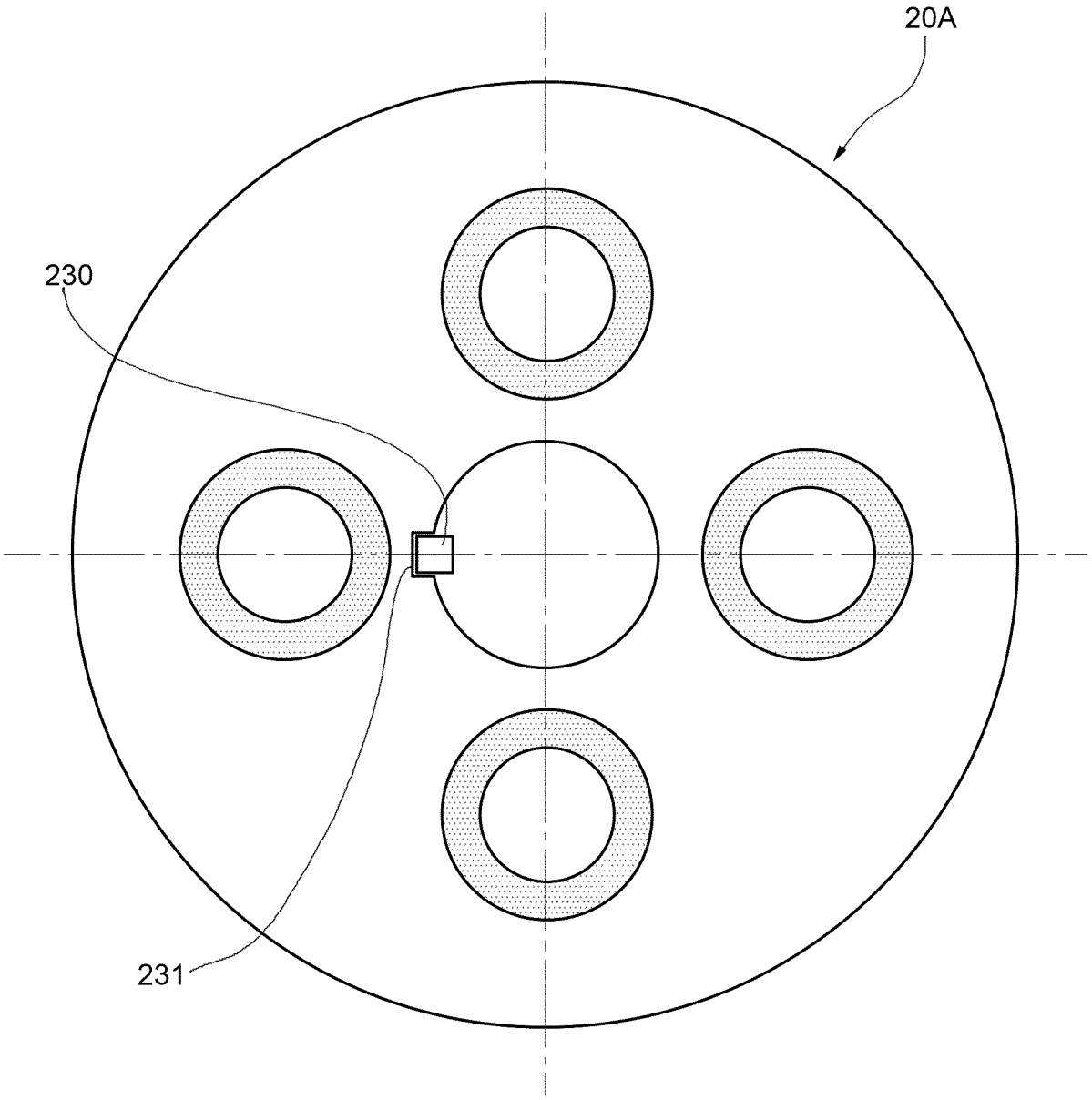

FIG. 14

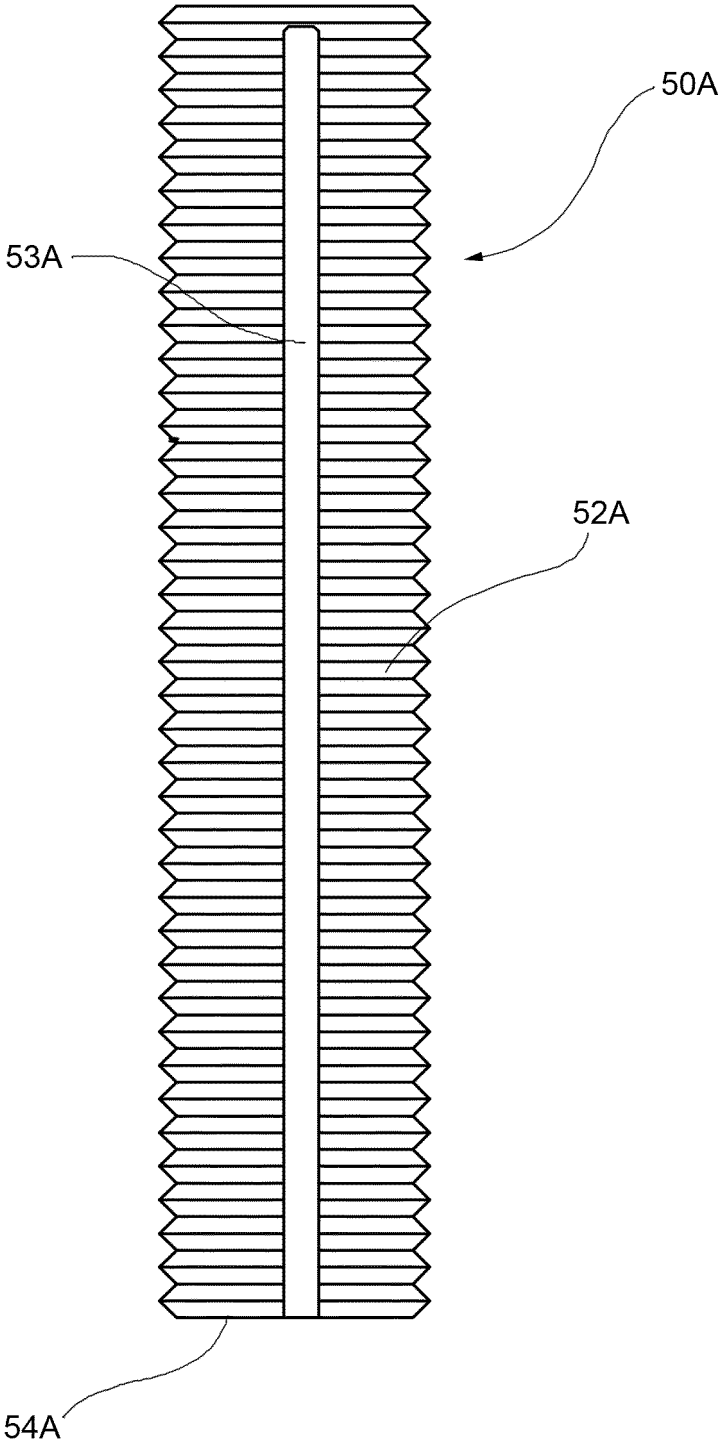

FIG. 15

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- US 6283451 B1 **[0002]**