

The invention concerns a process according to the preamble of patent claim 1 and a tension member according to the preamble of patent claim 3.

For the construction of edifices extending several
5 floors down into the ground, excavations are frequently surrounded by a subterranean curtain or sheet piling and anchored at the rear by means of soil anchors with tension members. The tension members are temporarily anchored in the ground at the soil anchors. However, the tension
10 members may also be used in the structures themselves, as is the case in the supporting of a bridge, for example. There, during construction of the bridge, the supports may be acted upon by forces requiring their temporary reinforcement by tension members.

15 After use, the tension members are removed from the ground or the structure and may possibly be reused. For mechanical extraction, the principle of a breaking point on the tension member is utilized. By means of the breaking point, a reduction in the cross-section of the
20 tension member is achieved. This method is usually limited to rod-shaped steel tension members having a single traction rod. The tension member is torn off at the breaking point by overstressing beyond the limit of tensile strength and removed for the most part from the
25 ground or the structure.

In DE-PS 26 27 524 describes a soil anchor having a tension member surrounded by an encasing tube. The tension member in the form of a stranded steel wire extends slidingly through the tube; it is led through an
30 anchor plate by its earth-side end and held by means of a sheath braced against the anchor plate. An adhesive is disposed as an intermediate layer between the sheath and the tension member, which is pressed flat by the sheath. The tension load of the sheath is so calculated that the
35 maximum resistance necessary for extracting the tension

member is somewhat greater than the load exerted upon the tension member. The drawback of this removable anchor is that the adhesive must be so measured and of such composition that its load capacity is indeed situated
5 between the limits of the working load and the breaking strength. However, the range of tolerance during its production is very narrow, and any inaccuracy can magnify the uncertainty factor of the load capacity of this prior art soil anchor.

10 In the European published patent application 244 353, a tension member anchorable in, and removable from, the ground or a structure is described. This tension member consists of a central member and several outer members surrounding the same. In this prior art tension member,
15 the central member is always completely severed at one point, and a supporting element is pressed around the tension member over this point of severance. By displacing the point of severance within the supporting element, the working load to be exerted upon the tension
20 member can be adapted to the needs. This tension member having a severed central member within the supporting element is very suitable when there are no great requirements have to be made for a certain ductility of the tension member.

25 Especially in the case of tension members to be anchored in the ground, however, a sufficient ductility is required before the failure of the tension member so that, after prestressing, additional forces on the anchor arising possibly as a result of pressure of soil, etc, can
30 be accepted through as great a stretching as possible (plastic deformation of the tension member), and are thus recognizable in good time by means of a visible movement or shift of the anchor head.

It is the object of this invention to provide an
35 improved method of producing a removable tension member by

which such a member having greater ductility can be easily made and whereby the tension member possesses considerably greater ductility compared to that disclosed in the aforementioned European patent application.

5 The process according to the invention is characterized by the features cited in the characterizing part of patent claim 1.

 The tension member according to the invention is defined by the characterizing features of patent claim 3.

10 The invention will be explained more closely in the following, by means of embodiments, with reference to the drawings in which

 Fig. 1 is a sectional view of a portion of a tension member comprising a stranded steel wire, one of the
15 outer members of which has been completely severed, and having a supporting element just encompassing the point of severance, the central member being severed on the side of the supporting element turned toward the rearward end of the tension member,

20 Fig. 2 is a section taken on the line II-II of Figure 1,

 Fig. 3 is a partial sectional view of the tension member of Fig. 1 broken apart at the point of severance of the outer member,

25 Fig. 4 is a sectional view of a portion of a tension member comprising a central rod and several parallel steel rods concentric therewith, two of the outer members being completely severed, and having a supporting element pressed about the tension member
30 behind the points of severance, the central member being severed after the end of the supporting element turned toward the rearward end of the tension member,

 Fig. 5 is a partial sectional view of the tension member of Fig. 4 broken apart at the two points of
35 severance, and

Fig. 6 is a partial sectional view of a tension member comprising a stranded steel wire, one of the outer members being completely severed, and having a supporting element in the form of a wedge-type anchoring pressed on about the point of severance.

For producing a tension member 1 to be anchored in the ground or in a structure and subjected to a load, as depicted in Figs. 1 and 2 and intended to be removed for the most part from the ground or a structure after use, the procedure is as follows:

The tension member 1 comprises a stranded steel wire. Of the outer members disposed about outer members 3, one, 3', is completely severed at a point 4. For this purpose, the twisted outer members 3 consisting of wires are partially unraveled, and the respective outer member 3' is sawed all the way through.

After the outer member 3' has been severed, a tubular supporting element 5 is slid over the rearward end portion 1a of tension member 1, subsequently to be anchored in the ground, until the point of severance 4 lies just in front of the supporting element 5 or is only just covered by the latter. Then central member 2 on the other side of the supporting element is also severed at a point 19. This second point of severance 19 lies in any case outside the supporting element on the side of supporting element 5 turned toward the rearward end of tension member 1 to be anchored in the ground. The supporting element 5 is then subjected to forces directed radially inwards, whereby the supporting element 5 is pressed fast against tension member 1 through angular extruding. Between the inside surface of the tubular supporting element 5 and the tension member 1 there is an insert 11. Insert 11 is made of a harder material than the supporting element 5 and the tension member 1. The surface of the insert 11 resting

against the outer members 3 of the tension member 1 is provided with teeth for secure gripping of the tension member 1.

The length L of the supporting element 5 is about four to six times the diameter of the tension member 1, and the distance L_1 from the point of severance 4 to the end of the supporting element 5 remote from the rearward end of the tension member 1 is, in the embodiment of Fig. 1, about one-twentieth of the length L of the supporting element 5. However, the point of severance 4 may be situated in a range of $\frac{1}{2}L$ in front of or behind the mentioned end of the supporting element 5.

Into the earth surrounding that portion 1a of the tension member 1 to the right of the plate 8, as viewed in Fig. 1, a cement emulsion is later injected. In the earth surrounding part 1a, located above and to the right of supporting element 5 as viewed in Fig. 1, a soil anchor is thereby formed by a soil body (not shown).

Fig. 3 shows tension member 1 depicted in Figs. 1 and 2, the major part of which has been separated from the supporting element 5 held in the soil body (not shown) by exerting a load P on the free end of the tension member 1.

Fig. 3 shows that the outer members 3 not severed in the state of use of the anchor are broken in the vicinity of the point of severance 4 of the outer member 3' completely severed from the outset. Contrary thereto, the segment of the central member 2 originally situated in the portion 1a of tension member 1 within the soil body has not been broken but only withdrawn from the portion 1a due to the second point of severance 19 of the central member.

Tests have shown that the elongation of the tension member 1 according to Fig. 1 until breaking is about five times that of the tension member described in the previously mentioned European patent application, in which in any case at least the central member within the

supporting element is completely severed, the dimensions of the tension member, i.e., its length and the diameter of the central member and outer members, being the same.

The tension member 1 illustrated in Fig. 4 has a central steel rod 10 and six outer steel rods 9 of which the rods 9' are completely severed at the first points 4 and 6. In order for the steel rods 9 and 10 to run uniformly and parallel to one another, they are held together at regular intervals by collets 7, only one of which is shown in Fig. 4. The rearward portion 1a of the tension member 1 is compressed and held fast by the tubular supporting element 5. The first point of severance 4 and 6 are located on the left side of supporting element 5, viewed from Fig. 4, i.e., at a distance of about one-fourth the length of supporting element 5 in front of the latter. The disposition of second point of severance 20 corresponds to that of Fig. 1.

Fig. 5 shows the part of tension member 1 separated from the anchored portion 1a by the action of a load greater than the working load, the four outer steel rods 9, only two of which are visible, being broken by the greater stress. As in the embodiment illustrated in Fig. 3, the part of the central steel rod 10 originally situated in the portion 1a has been withdrawn from the portion 1a.

Illustrated in Fig. 6 is a further embodiment of the tension member 1 according to the invention, made up of a stranded steel wire having a central member 2 and outer members 3, as in the embodiment of Figs. 1 and 2. The supporting element 5' surrounding the portion 1a, intended for anchoring, of the tension member 1 has a bore 12 widening towards the rear, i.e., towards the right as viewed in Fig. 6, in which there are two wedges 14 and 15

having inner teeth 16 for gripping the portion 1a of the tension member 1.

The point of severance 4 of the outer member 3' is set back about one-seventh of the length of the supporting element 5' from the front end of the latter. The active part of the tension member depicted in Fig. 6 is surrounded by a casing pipe 17, and the space between the tension member 1 and inside of the casing pipe 17 is filled with a lubricant 18 for facilitating both prestressing and extraction of the active part of the tension member 1. Such a casing pipe 17 may also be provided in the embodiments shown in Figs. 1 and 4.

The supporting elements 5 with the associated points of severance 4 may also be disposed at a location of the active part of the tension member 1. Such embodiments have an extended passive portion, i.e., the portion to be anchored. Upon the application of a load, all non-severed outer members of such a tension member break in the region of the supporting element 5 so that the tension member can for the most part be removed from the ground.



Patent Claims

1. A process for making a tension member (1) adapted to be anchorable or capable of being stressed in the ground having a central member (2; 10) about which outer members (3; 9) are disposed, which tension member, which has a rear end anchorable in the ground, is intended to be removed for the most part from the ground after use, at least one of the outer members (3; 9) of the tension member (1) being completely severed at a first point (4), and the central member (2; 10) being completely severed at a second point (19; 20), which is closer to the rear end of the tension member than the first point (4), and a supporting element (5) whose first end is turned away from the rear end of the tension member and whose second end is turned toward the rear end of the tension member, being pressed essentially radially around the tension member in such a way that the first point of severance (4) is situated in an area whose middle lies near the first end of the supporting element (5) and whose length corresponds approximately to the length of the supporting element, characterized in that the second point of severance lies behind the second end of the supporting element (5).

2. The process according to claim 1, characterized in that a further outer member (3) is severed in the vicinity of the said first point of severance (4).

3. A tension member, produced by the process according to claim 1 or 2, with a central member (2; 10) and outer members (3; 9) disposed around the central member, a supporting member (5) being disposed spaced apart from the rear end of the tension member anchorable in the ground, surrounding the latter, the first end of the supporting member turned away from the rear end of the tension member and the second end of the supporting member



turned toward the rear end of the tension member, at least one of the outer members (3; 9) being completely severed at a first point (4) and the central member (2; 10) at a second point, and the first point of severance being disposed in an area the length of which corresponds approximately to the length of the supporting member and extends from the first end of the supporting member along the tension member symmetrically in both directions, characterized in that the second point of severance is arranged behind the second end of the supporting member, the end turned toward the rear end of the tension member.

4. The tension member according to claim 3, characterized in that the central member and the outer members are parts of a stranded steel wire.

5 The tension member according to claim 3, characterized in that the central member is a central steel rod (10) and the outer members are a plurality of steel rods (9) disposed concentrically around the central steel rod (10) and running parallel to one another.

6. The tension member according to claim 5, characterized in that collets (7) are provided disposed spaced apart from the supporting element and are intended to press the outer steel rods (9) against the central steel rod (10).