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PATENT SPECIFICATION

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(54) AN ANCHOR ON A TENDON FORMED OF SEVERAL STEEL WIRES, METHOD TO PRODUCE THE SAME AND APPARATUS FOR CARRYING OUT THE METHOD

(71) We, LOSINGER AG, a Swiss body corporate, of K nizstrasse 74, 3008 Berne, Canton of Berne, Switzerland do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The invention relates to an anchor on a tendon comprising a number of stranded together steel wires intended to be anchored in prestressed concrete to a method of producing the same and to an apparatus for carrying out the method.

In structures made of concrete there are frequently anchored steel inserts of rods, wires, wire coils or cables. This is done either by means of anchoring bodies specially built for the purpose which are fastened on one hand to the steel inserts to be anchored, and on the other hand they are supported by the exposed surface of the concrete, or by directly utilizing the shear bond between the steel inserts and the concrete. In order to keep the bond length required to produce a given bonding force as short as possible special measures have to be taken. So, for example, steel rods are provided with a special profile which serves for strengthening the bond effect. The deforming of individual wires in waves serves the same purpose. The end parts of the steel inserts are often provided with hooks, spirals and loops in order to obtain a reliable anchoring of the same.

There are special problems with the anchoring of tendons of twisted high-strength steel wires. It is important to provide very high anchoring forces with very small cross-sectional areas and with smaller surfaces, using the above-mentioned measures. A method in which the tendons are opened (untwisted) at their ends and there provided with a round insert by means of which a local widening of the tendon can be achieved, is known; however, in such a

method the energy consumption is very high and the space opened by spreading the tendon is small.

A first aspect of the invention provides an anchor on a tendon formed of a number of twisted steel wires intended to be anchored in prestressed concrete, comprising either at least two widenings or at least one widening with a broomed end, which widenings are formed by tendon wires which are spaced apart from one another, each widening being in the form of a double-cone comprised of individual wires permanently buckled outwardly, the cones having their bases towards each other, the bases of the cones having diameter three to fifteen times that of the unwidened tendon.

A second aspect of the invention provides a method of producing an anchor on a tendon formed of a number of twisted steel wires intended to be anchored in a hardening agent capable of being poured, including the steps of holding the tendon at two axially spaced apart places and exerting axially compressive forces on the tendon to cause it to bulge by moving said two places toward each other, wherein said axially compressive forces are exerted over a portion of the tendon to form a double-cone comprised of the individual wires permanently buckled outwardly, the cones having their bases towards one another, the bases having a diameter three to fifteen times larger than that of the unwidened tendon whereafter the buckled tendon section is released.

The invention also provides a portable apparatus for performing the method of the second aspect of the invention, said apparatus comprising a frame and a hydraulic press attached to one side of said frame, said hydraulic press being connected with a first means for holding the tendon at one place, and a second means slidably arranged on said frame for holding the tendon at another place spaced from the

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first one, in order to exert an axial thrust on the tendon section between said two holding means by actuating said press, at least one of said means for holding the tendon comprising a conical wedge bolt attached to said frame having two axially movable clamping jaws, forming in their open state a slit in which said tendon is to be inserted and the other means being provided on an axially movable portion of a press attached to said frame, the holding means being capable of releasing the buckled tendon section.

By pushing the individual wires of the tendon into a double-cone widening of the wire coil there can be provided a sufficiently big space which will be filled with concrete. In this way the stability of the complete anchor is secured even if it is under load. When the opposite tendon end is now pulled the widened part of the tendon provides a good support against the pulling force and prevents the tendon from being pulled out of the anchorage.

An anchor embodying the present invention may be formed on at least one of the tendons of a cable twisted out of a number of tendons.

The invention will be further described with reference to the accompanying drawings, in which:

Figure 1 shows an elevation of an anchor formed from a tendon twisted of several steel wires;

Figures 2 shows an elevation of a device for producing the anchor according to Figure 1, partially in section;

Figure 3 shows a plan view of the same, partially in section;

Figure 4 shows an elevation of a headpiece for receiving a tendon end according to Figure 3, partially broken away;

Figure 5 shows an elevation of an anchor formed from a tendon and having two widenings;

Figure 6 shows an elevation of a device for producing the anchor according to Figure 5, partially in section; and

Figure 7 shows a plan view of the same, partially in section.

Figure 1 shows a tendon comprising a number of stranded together steel wires. There is a double-cone widening 2 on its one end which was caused by bulging the tendon, as it will be explained in detail. The fanned tendon wires which are spaced apart from one another surround a space which will be filled with concrete, when the tendon will be anchored because the distances between the individual tendon wires 1 are sufficiently big in the region of this widening to allow the intrusion of hardening concrete mixture capable of being poured. As it can be seen from the Figure the end part of the tendon is

formed as a fanned end 12 which helps to a better anchorage of the tendon and also to a better carrying capacity thereof.

The biggest diameter a of the widening forming the anchor comprising the fanned tendon wires 1 is in the embodiment five times as big as the diameter b of the unfanned tendon part. Good anchoring will also be achieved when the biggest diameter a is from 3 to 15 times the diameter b of the unfanned part of the tendon.

The device for producing the anchor of Figure 1 is shown in Figure 2 up to 4. It has a frame 3 to which a hydraulic press 8 is attached. A headpiece 6 arranged inside the frame 3 is connected with the press piston. The headpiece 6 is shown in detail in Figure 4. It is with advantage a cylindrical body which is connected at its one side with the press piston and which has at its other side a bore 13, the diameter of which approximately equals the diameter of the tendon. The bore is chamfered or rounded over from one fifth to one third of its depth as indicated at 14. The headpiece 6 serves for receiving the end part of the tendon 4, as it can be seen from the Figure 3. The diameter of the bore 13 is such that it allows a small play of the tendon end in it. The chamfered aperture 14 of the bore 13 is inclined to the longitudinal axis of the bore by approximately 30° . The depth of the bore 13 equals approximately the diameter of the tendon 4.

At the other end of the frame there is attached to the same a part 21 in which a wedge bolt 5 comprising two clamping jaws is axially movable the part 21 being open at the bottom to enable the device to be lifted off the cable once an anchor has been formed. A lever 7 actuated by springs 17 serves for clamping the jaws guided in slots 20. The lever 7 pivots in a fish plate 19 and is slidably connected with guide shoes 18 positioned on each clamping jaw. By pushing the lever 7 the clamping jaws will be clamped on the tendon 4. Each clamping jaw has a chamfered or rounded part facing the headpiece 6 which corresponds with 14 of the headpiece 6.

A handle 9 serves for transporting the whole device.

By means of the device of Figures 2 to 4 an anchor is produced on a tendon as follows: The device is pushed over the end of the tendon 4 till the tendon end is brought into the bore 13 of the headpiece 6. The clamping jaws of the wedge bolt 5 are clamped on the tendon 4 at a place spaced from the headpiece 6 by pushing the lever 7. By driving out the hydraulically operated press piston the tendon 4 between the headpiece 6 and the wedge bolt 5 will be axially loaded so that the individual wires 1 of the tendon 4 buckle radially outwardly of

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the axis of the tendon. By adjusting the working stroke of the press the diameter of the anchor can be exactly determined. During the back stroke of the press 8 the tendon 4 is loosened from the headpiece 6, whereby because of the elasticity of the tendon wires the fanned end 12 according to Figure 1 is formed. The counterslope curving of the anchor is formed by the chamfered aperture 14 of the bore 13.

When the anchoring force of the tendon widening is not sufficiently great, the anchor can comprise several widenings arranged one after the other as it can be seen from Figure 5.

The device for producing such an anchor is shown in Figure 6 and 7. The device has a frame 3 and a press 8 in the same way as the device according to Figures 2 to 4. In addition it comprises two wedge bolts 10, 11 having each two clamping jaws positioned eccentrically to the press 8 and to the frame 3. The wedge bolts 10, 11 are axially movable in a part 22 fixed to the frame 3 or in a part 23 movable on a guide bar 3a of the frame 3 by pushing levers 15, 16. The parts 22 and 23 are each open at the bottom so that the device can be lifted off the cable and moved to another axial location once one anchor has been formed. The remaining parts of the device are the same as with the device according to Figures 2 to 4. The wedge bolts can be positioned at any place on the tendon 4 so that it is possible to produce the widening 2 also on other places than at the end of the tendon.

When the clamping jaws of the wedge bolt 11 of Figures 7 or 8 are replaced with an insert which is similar to the headpiece 6 according to Figures 2 to 4, it is possible to produce with such a device also a simple widening according to Figure 1.

The production of the anchors according to Figures 1 or 5 by using the above-mentioned devices is very simple and quick and there are very low costs involved. By means of these devices the anchor can be produced at the end or at any other place on the tendon. The above-mentioned anchor can be applied on at least one of the tendons of a cable twisted of several tendons.

When the complete tendon is simultaneously anchored only a part of the force will be taken by the anchor in combination with the shear bond of the tendon.

The pulling-out of the tendon from the concrete is prevented by the anchored anchor.

WHAT WE CLAIM IS:—

1. An anchor on a tendon formed of a number of twisted steel wires intended to be anchored in prestressed concrete, comprising either at least two widenings or

at least one widening with a broomed end, which widenings are formed by tendon wires which are spaced apart from one another, each widening being in the form of a double-cone comprised of individual wires permanently buckled outwardly, the cones having their bases towards each other, the bases of the cones having a diameter three to fifteen times that of the unwidened tendon.

2. Method of producing an anchor on a tendon formed of a number of twisted steel wires intended to be anchored in a hardening agent capable of being poured, including the steps of holding the tendon at two axially spaced apart places and exerting axially compressive forces on the tendon to cause it to bulge by moving said two places toward each other, wherein said axially compressive forces are exerted over a portion of the tendon to form a double-cone comprised of individual wires permanently buckled outwardly, the cones having their bases towards one another, the bases having a diameter three to fifteen times larger than that of the unwidened tendon whereafter the buckled tendon section is released.

3. A method according to Claim 2, wherein the axially compressive forces are exerted over a radially unobstructed portion of the tendon.

4. A method according to Claim 2 or 3, wherein the bulging of the tendon is effected by a hydraulic press piston exerting a pressure on a means for holding that tendon.

5. A portable apparatus for performing the method according to Claim 2, said apparatus comprising a frame and a hydraulic press attached to one side of said frame, said hydraulic press being connected with a first means for holding the tendon at one place, and a second means slidably arranged on said frame for holding the tendon at another place spaced from the first one, in order to exert an axial thrust on the tendon section between said two holding means by actuating said press, at least one of said means for holding the tendon comprising a conical wedge bolt attached to said frame having two axially movable clamping jaws, forming in their open state a slit in which said tendon is to be inserted and the other means being provided on an axially movable portion of a press attached to said frame, the holding means being capable of releasing the buckled tendon section.

6. Apparatus according to Claim 5, wherein said first and said second means for holding the tendon each comprise a wedge bolt having two clamping jaws for clamping said tendon.

7. Apparatus according to Claim 6 wherein each clamping jaw of the wedge



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the axis of the tendon. By adjusting the working stroke of the press the diameter of the anchor can be exactly determined. During the back stroke of the press 8 the tendon 4 is loosened from the headpiece 6, whereby because of the elasticity of the tendon wires the fanned end 12 according to Figure 1 is formed. The counterslope curving of the anchor is formed by the chamfered aperture 14 of the bore 13.

When the anchoring force of the tendon widening is not sufficiently great, the anchor can comprise several widenings arranged one after the other as it can be seen from Figure 5.

The device for producing such an anchor is shown in Figure 6 and 7. The device has a frame 3 and a press 8 in the same way as the device according to Figures 2 to 4. In addition it comprises two wedge bolts 10, 11 having each two clamping jaws positioned eccentrically to the press 8 and to the frame 3. The wedge bolts 10, 11 are axially movable in a part 22 fixed to the frame 3 or in a part 23 movable on a guide bar 3a of the frame 3 by pushing levers 15, 16. The parts 22 and 23 are each open at the bottom so that the device can be lifted off the cable and moved to another axial location once one anchor has been formed. The remaining parts of the device are the same as with the device according to Figures 2 to 4. The wedge bolts can be positioned at any place on the tendon 4 so that it is possible to produce the widening 2 also on other places than at the end of the tendon.

When the clamping jaws of the wedge bolt 11 of Figures 7 or 8 are replaced with an insert which is similar to the headpiece 6 according to Figures 2 to 4, it is possible to produce with such a device also a simple widening according to Figure 1.

The production of the anchors according to Figures 1 or 5 by using the above-mentioned devices is very simple and quick and there are very low costs involved. By means of these devices the anchor can be produced at the end or at any other place on the tendon. The above-mentioned anchor can be applied on at least one of the tendons of a cable twisted of several tendons.

When the complete tendon is simultaneously anchored only a part of the force will be taken by the anchor in combination with the shear bond of the tendon.

The pulling-out of the tendon from the concrete is prevented by the anchored anchor.

WHAT WE CLAIM IS:—

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at least one widening with a broomed end, which widenings are formed by tendon wires which are spaced apart from one another, each widening being in the form of a double-cone comprised of individual wires permanently buckled outwardly, the cones having their bases towards each other, the bases of the cones having a diameter three to fifteen times that of the unwidened tendon.

2. Method of producing an anchor on a tendon formed of a number of twisted steel wires intended to be anchored in a hardening agent capable of being poured, including the steps of holding the tendon at two axially spaced apart places and exerting axially compressive forces on the tendon to cause it to bulge by moving said two places toward each other, wherein said axially compressive forces are exerted over a portion of the tendon to form a double-cone comprised of individual wires permanently buckled outwardly, the cones having their bases towards one another, the bases having a diameter three to fifteen times larger than that of the unwidened tendon whereafter the buckled tendon section is released.

3. A method according to Claim 2, wherein the axially compressive forces are exerted over a radially unobstructed portion of the tendon.

4. A method according to Claim 2 or 3, wherein the bulging of the tendon is effected by a hydraulic press piston exerting a pressure on a means for holding that tendon.

5. A portable apparatus for performing the method according to Claim 2, said apparatus comprising a frame and a hydraulic press attached to one side of said frame, said hydraulic press being connected with a first means for holding the tendon at one place, and a second means slidably arranged on said frame for holding the tendon at another place spaced from the first one, in order to exert an axial thrust on the tendon section between said two holding means by actuating said press, at least one of said means for holding the tendon comprising a conical wedge bolt attached to said frame having two axially movable clamping jaws, forming in their open state a slit in which said tendon is to be inserted and the other means being provided on an axially movable portion of a press attached to said frame, the holding means being capable of releasing the buckled tendon section.

6. Apparatus according to Claim 5, wherein said first and said second means for holding the tendon each comprise a wedge bolt having two clamping jaws for clamping said tendon.

7. Apparatus according to Claim 6 wherein each clamping jaw of the wedge

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5 bolt is chamfered or rounded on its side lying opposite to the other wedge bolt, said chamfered or rounded surface being inclined by substantially 30° to the longitudinal axis of the tendon.

8. Application of the anchor according to Claim 1 on at least one of the tendons of one cable twisted from a number of tendons.

10 9. An anchor on a tendon twisted from a number of steel wires substantially as hereinbefore described with reference to the accompanying drawings.

10. Apparatus for carrying out the method of claim 3 and substantially as hereinbefore described with reference to the accompanying drawings.

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