Feb. 7, 1961 U. FINSTERWALDER 2,970,406

ANCHORAGES OF ROD SHAPED TIE MEMBERS OF PRESTRESSED CONCRETE

Filed June 15, 1955 2 Sheets-Sheet 1

FIG. 1

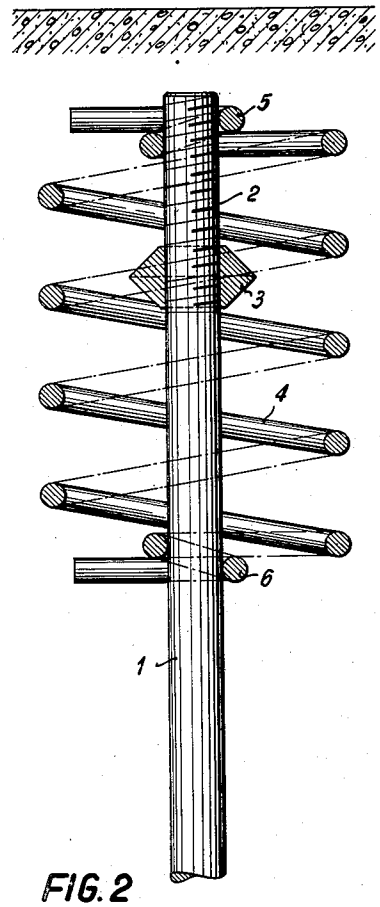


FIG. 2

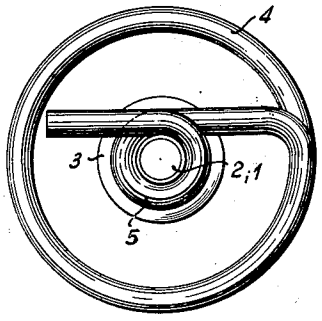


FIG. 3

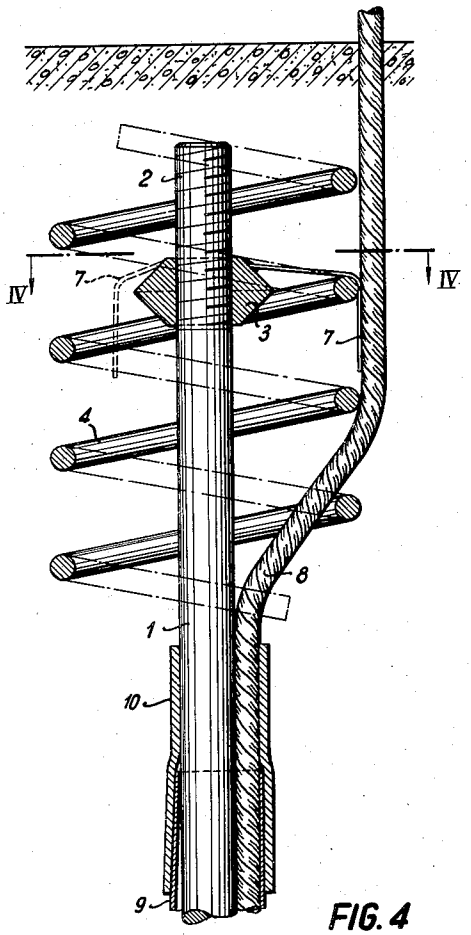
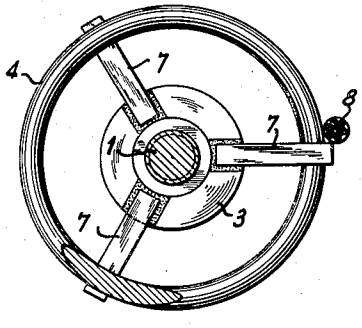


FIG. 4



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FIG. 5

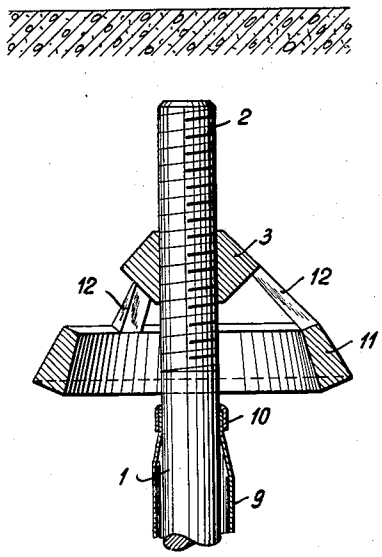


FIG. 7

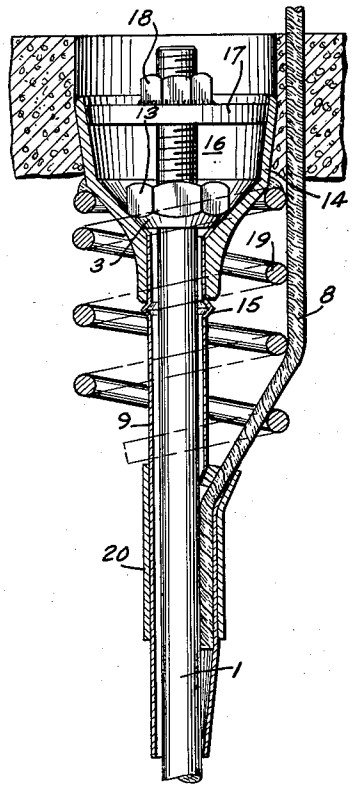
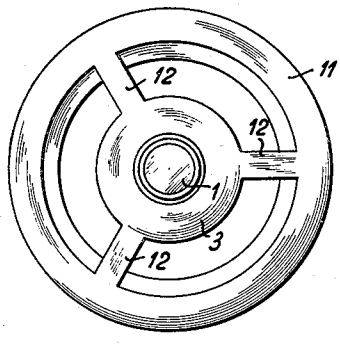


FIG. 6



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ANCHORAGES OF ROD SHAPED TIE MEMBERS OF PRESTRESSED CONCRETE

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The present invention relates to the anchoring of rod shaped tie members in prestressed concrete into which high tensile forces are introduced either before the hardening of the concrete in a tension bed or after the hardening of the concrete.

The primary object of the present invention is to achieve an efficient anchorage of high initial tension loads with the aid of simple means and at a low cost.

The invention consists in the provision of one or more locking members projecting annularly over the surface of the tie rod and approximately of triangular cross section, in conjunction with a reinforcement enclosing the locking member or members.

By the cooperation of the locking members transmitting the anchoring force to the concrete with a reinforcement which surrounds the rod in the anchoring area and which prevent the radial splitting up of the concrete body in planes passing through the axis of the rod, an excellent transmission of the entire forces is ensured.

A particularly simple construction of the anchorage according to the present invention may be achieved by using a thread rolled on in a cold rolling process, which thread may be regarded as a plurality of locking members arranged in series. It is known that a rolled on thread has a greater diameter than the shaft in the region of the thread, in contrast to an incised thread. To achieve extraction of a rod embedded in concrete, and provided with a rolled on thread, the hole would have to be enlarged to the greater thread diameter or the concrete would have to split radially owing to the anchorage. Since this is prevented by a correctly calculated and arranged reinforcement, a surprisingly powerful force is required to extract a tie rod of the present invention from the concrete.

In the preferred form of the new anchorage locking members are used which are of approximately triangular cross section and project annularly beyond the surface of the tie rod.

The fixing of the locking members on the tie rod is carried out according to the invention not exclusively with a form-dependent connection, but in a combination of form-dependent connection and friction lock. For this purpose each locking member may be provided with an inner thread by which it is screwed onto the end of the tie rod to be anchored. Another possibility of obtaining a form-dependent connection consists in the feature that the locking member is so pressed into the serration of a thread on the rod, under the action of radial force components, by hammer blows for example, that a provisional seat for the locking member on the tie rod is ensured. The locking member may also be shrunk onto the tie rod or secured thereto by any other suitable means.

When introducing the initial tension load into the tie rod, the reinforcement enclosing the locking member causes a pressure on the locking member on all sides, radially directed towards the axis of the tie rod, whereby the friction lock is produced. At the same time the

outer surface of the locking member may be so constructed that it favours the occurrence of the said effect, namely the production of a friction lock. By selecting a suitable bevel or incline of the outer surfaces, the radial pressures occurring may be laterally directed towards the axis of the rod whereby the locking member is suitably keyed.

It is preferable to proportion the locking member always so that it reduces its diameter by shrinkage under the action of the radial forces whereby these forces become effective as friction forces. To assist this effect it is preferable to slit the locking member radially in order to cut out the annular effect, since this would reduce the friction pressure.

The concrete is pressure stressed round about the locking member in a radial and a tangential direction, that is to say in two directions extending at a right angle to each other. According to experience the strength of the concrete is particularly high under such high stressing. It reaches a multiple of the crushing strength of cubic proportion so that such a locking member may be constructed much smaller than a normal anchor plate.

The reinforcement enclosing each locking member may consist of a spiral which may be fixed in the desired position relative to the tie rod. For this purpose the ends of the spiral may engage around the tie rod with a friction lock effect for example the locking member and the appropriate spiral may also be interconnected by intermediate members.

Instead of a spiral a conical ring may also be used as a reinforcing member corresponding in diameter approximately to the said spiral and which points towards the end of the tie rod with the smaller opening and can be firmly connected by cross-pieces to the locking member. Locking member cross-pieces and anchoring ring may also consist of one piece.

As a further construction of the invention the locking member may in an anchorage having only one locking member screwed onto the end of the tie rod, be supported against the inner wall of a funnel shaped tensioning cup, slipped over the enclosing tube of the tie rod and have a hexagonal head towards the end of the tie rod.

Transverse tensions at the anchorage point of the tie rod may be avoided in accordance with the present invention in an anchorage having only one locking member screwed onto the end of the tie rod by the feature that the locking member is supported against an annular bowl slipped over the tie rod. In this case the forces radiating from the locking member are supported against the edge of the said bowl and result in annular tensile stresses which are completely received by the bowl. At the same time the forces radiating from the locking member are reversed in the marginal area of the bowl. By this means the transverse tensile stresses are kept low.

In a preferred form of construction of this embodiment of the anchorage of the bowl which is particularly important to the art the edge of the bowl disposed on the tie rod is raised parallel to the axis of the tie rod, while the outer edge of the bowl is curved with a radius corresponding approximately to the diameter of the tie rod. In a further construction of the object of the present invention holes may be arranged in the bottom of the annular bowl in order to prevent the formation of air cushions inside the bowl during the concreting.

The locking member may be provided on the tension side of the steel rod with a hexagonal head so that it can be tightened by mounting a socket wrench after the tension loads have been introduced into the tie rod in order to anchor the induced tensile forces.

Further features of the present invention and details of the advantages obtained thereby will be apparent from

the following description of various forms of construction of the anchorage shown in the accompanying drawings, in which:

Figures 1 and 2 show one embodiment of an anchorage of a rod shaped tie member having a screwed-on locking member in longitudinal section and plan view respectively, while Figures 3 and 4 similarly illustrate a modification.

Figures 5 and 6 show in longitudinal section and plan view an anchorage with a locking member and a conical ring connected thereto by yokes or cross pieces.

Figure 7 is a longitudinal section through an anchorage having a tensioning cup shaped member and a welded-on spiral reinforcement.

In Figures 1–4 of the drawings the anchorage of a rod shaped tie member **1** is shown in concrete on the pure anchoring side, that is to say the side on which the end of the tie rod is firmly anchored, it being assumed that the tension loads are exerted on the tie rod from the other end thereof.

A locking member **3** annularly projecting beyond the surface of the tie rod, and approximately of triangular cross section, is screwed onto the threaded end of the tie rod **1** which consists of high grade steel. The thread **2** may be rolled on by cold rolling or incised. The side surfaces of the locking member of triangular cross section are inclined towards the axis of the tie rod by about 30° to 60° but preferably 45°. The tensile force introduced into the tie rod **1** is radiated to the sides by the locking member **3** and in a simple manner transmitted over a lengthy stretch of the concrete.

In order to prevent radial splitting up of the concrete owing to the lateral forces exerted by the locking member, the latter is enclosed by a spiral reinforcement **4**. In the embodiment shown in Figures 1 and 2 the upper and lower windings **5**, **6** of the spiral are guided around the tie rod **1** in a friction lock to prevent changes of position of the spiral and the locking member relative to each other.

In the embodiment shown in Figures 3 and 4, the spiral **4** and the locking member **3** are interconnected by angle members **7** to maintain their relative position. A rope **8** is used to produce ventilation of the jacket tube **9** during the pressing out with cement mixture. The end of the jacket tube **9** is sealed against the tie rod **1** by means of a sleeve **10**.

Figures 5 and 6 show the anchorage of a tie rod at the end of the rod bedded in the concrete. The tie rod **1** in this form of construction is also provided with a thread on which the locking member **3** is screwed. In this form of construction shown in Figures 5 and 6 the spiral reinforcement of Figures 1–4 is replaced by a conical ring **11** which is firmly connected to the locking member **3** by yokes or cross pieces **12**. The latter may be secured by welding to the locking member **3** and to the ring **11**. They may however be formed integrally with the locking member and the ring.

In the longitudinal section through the stressed end of a tie rod of Figure 7, the end of the tie rod **1** is again provided with a thread on to which a locking member **3** is screwed. The outer part of the locking member **3** is constructed as a hexagon **13** and is used for subsequently mounting a socket wrench such as a box spanner for tightening the locking member, that is to say, for anchoring the tensile forces imparted to the tie rod.

The locking member **3** is supported against the inner wall of a funnel-shaped tension cup **14** which is slipped onto the end of a tubular jacket **9** receiving the tie rod **1**. The tension cup **14** is supported against a bead **15** in the jacket **9**. To prevent soiling and blocking of the inner space **16** of the tension cup during the concreting operation, the tension cup is closed by a plate **17** on which is welded a nut **18** for screwing the plate onto the thread of the tie rod. In addition, a spiral reinforcement **19** for receiving transverse tensile stresses, is welded to the tension cup **14**. The rope **8** is used to produce a ventilation of the jacket **9** during the subsequent filling with cement mixture. The point where the rope **8**, which forms the ventilation passage, is introduced into the jacket **9**, is sealed by a sleeve **20**.

I claim:

1. In a prestressed concrete structure, an anchoring tie rod construction comprising, in combination, an elongated stressable tie rod member of steel having threads adjacent one end, an annular locking member engaging the threaded end of said rod over a large cylindrical area along the threaded surface of said rod and having the shape of two frusto-cones integrally connected at their bases and having in cross-section at each side a triangular confine with the vertex of the triangle approximately midway between the terminal surfaces of said locking member, the sides converging at said vertex forming an angle of between 30° and 60° with respect to the axis of said tie rod member, the shape of said annular locking member transmitting stress forces from said tie rod member radially outwardly and a spiral reinforcing member surrounding said tie rod member for receiving transverse tensile strength stresses in said concrete after hardening, and frictional locking means formed at both end portions of said spiral member near one end of said rod to prevent at said one end displacement of said spiral member relative to said rod, the remaining portion of said spiral member being unattached to said rod.

2. A prestressed concrete structure incorporating an anchoring tie rod construction as claimed in claim 1 wherein the angle defined by the conical surfaces meeting at the vertex of said triangular cross-section of said annular locking member is substantially 45° with respect to the axis of said rod.

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