

March 13, 1956

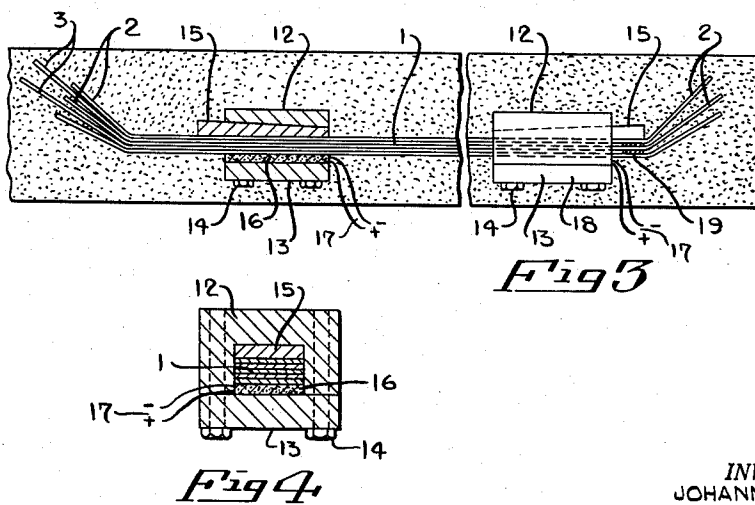
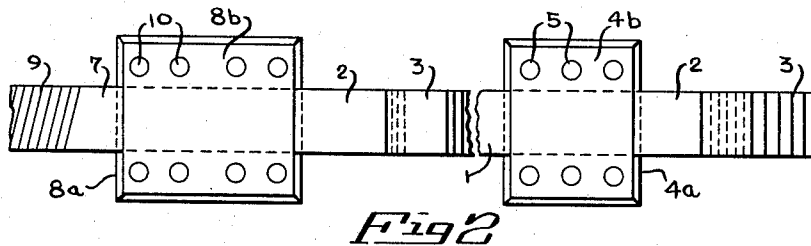
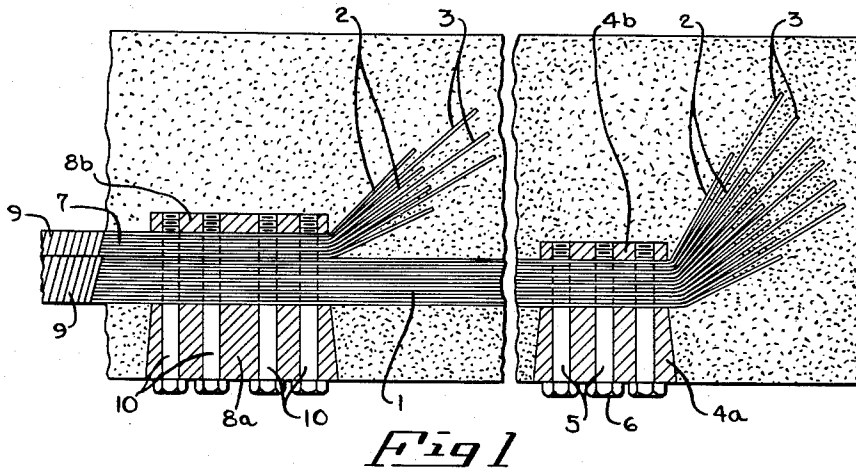
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2,737,802

COMPOSITE PRESTRESSING REINFORCEMENT

Filed Oct. 17, 1950

2 Sheets-Sheet 1



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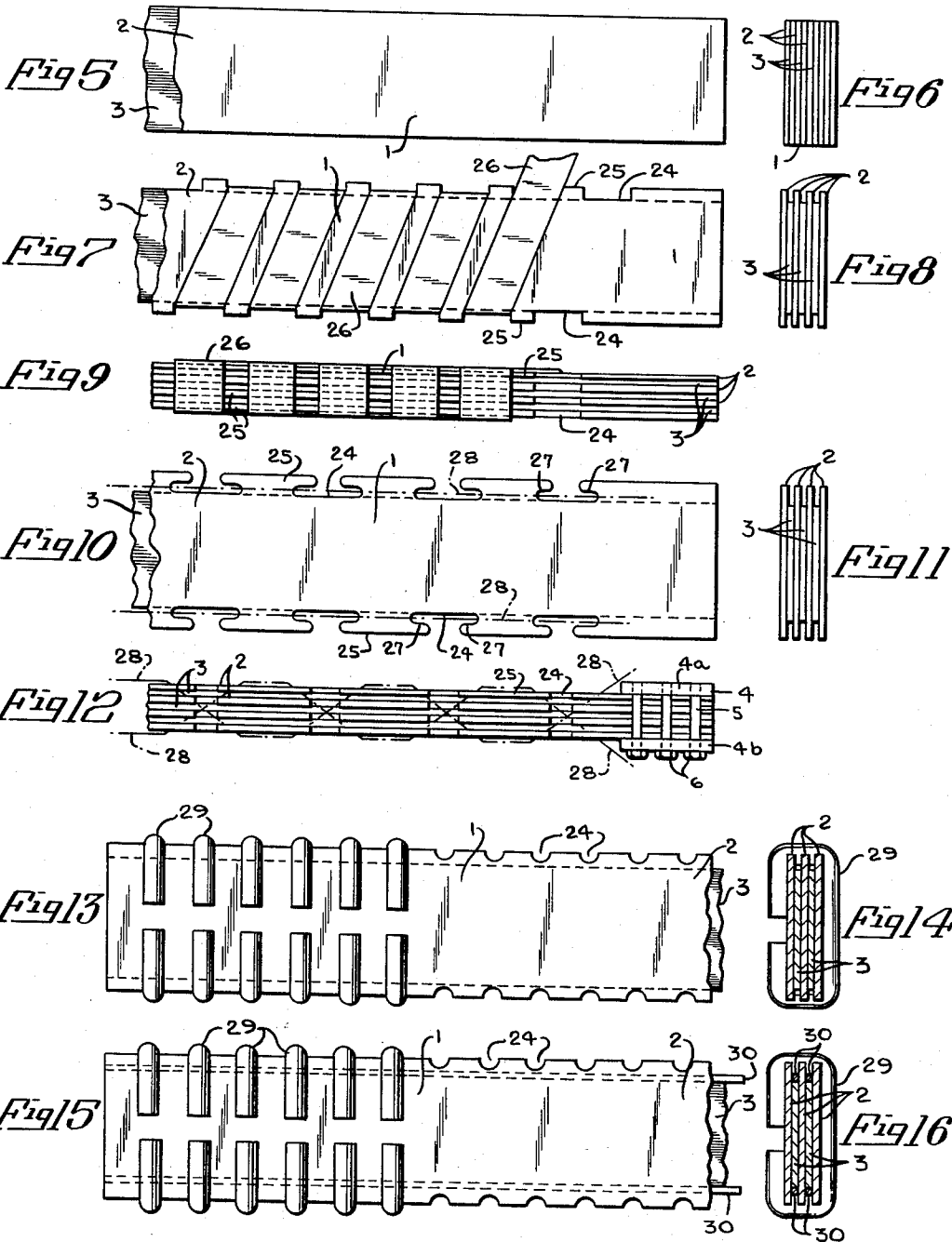
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COMPOSITE PRESTRESSING REINFORCEMENT

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2 Sheets-Sheet 2



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1

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COMPOSITE PRESTRESSING REINFORCEMENT

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9 Claims. (Cl. 72—110)

The invention relates to an armouring for giving prestressing pressure to concrete, and relates more particularly to a reinforcement for concrete having a part which is brought under tensile stress and a part which is brought under compressive stress, which parts are mutually connected in a releasable manner at the ends, so that after embedding of the armouring in the concrete and setting of the concrete this latter can be prestressed by the part standing under tensile stress by releasing the connection between the two parts.

According to the invention the armouring is made as a laminated rod, the lamellae of which consist of flat steel bands lying in the longitudinal direction and serving in a definite sequence alternating as tensile and compressive stress elements. In this manner an armouring can be obtained, which can take up a large quantity of energy in a very small space and several armourings of this type can be arranged close to one another in the concrete if necessary.

The invention will now be further elucidated with reference to the drawings in which some examples of performance of armourings and clamps belonging to it according to the invention are shown.

In the drawings:

Fig. 1 shows in cross section an end of an armouring according to the invention embedded in the concrete and partly reinforced, with clamps belonging to it,

Fig. 2 a top elevation of the armouring according to Figure 1,

Fig. 3 a cross section of another embedded armouring according to the invention with another clamp construction,

Fig. 4 a cross section of the clamp,

The Figures 5 and 6 show a top elevation and an end view of a bundle shaped band metal armouring according to the invention,

The Figures 7 to 9, inclusive, show another example of performance of a prestressed armouring according to the invention in top elevation, end view and side elevation respectively,

The Figures 10—12, inclusive, show another example of performance of a prestressed armouring according to the Figures 7—9,

The Figures 13 and 14 show a top elevation and a cross section of a further armouring according to the invention, and

The Figures 15 and 16 show a modification of the armouring according to the Figures 13 and 14.

In the example of performance according to the Figures 1 and 2 the armouring consists of a laminated rod 1, which is assembled from a number of strips of band steel lying on one another in the longitudinal direction of the armouring. Of these strips or lamellae the two outer ones and the intermediate ones are made alternating as tensile stress elements 2 and the rest as compressive stress elements 3. For clearness sake in the drawing the compressive stress elements 3 are shown longer than the tensile stress elements and are supposed to be wrapped

2

with oiled paper, but in practice they can also be made considerably shorter than the tensile stress elements and without wrapping. The tensile stress elements 2 are in practice provided with anchoring members at the ends, which for clearness sake are not shown in the drawing. The tensile stress elements are stressed beforehand simultaneously with the compressive stress elements by means of a jack working with one side on the compressive stress elements and with the other side on the tensile stress elements and are kept stressed by the intermediate compressive stress elements, as the elements are passed through clamps 4 arranged on both ends of the armouring. These clamps consist of a loosening clamp foot 4a and a clamp plate 4b, which can be drawn on the clamp foot by screw bolts 5. The clamp plate possesses threaded holes and the screw bolts are for the rest conducted by the clamp foot. The clamp foot has a height which is adapted to the position of the armouring in the concrete, so that the bolt heads 6 lie in recesses in the concrete form and are accessible from the outside.

In the left hand part of the Figures 1 and 2 the end of a reinforced part of the armouring is shown. The reinforcement is formed by a second laminated armouring rod 7 according to the invention, which is arranged above the first one and of which the end clamps 8a, 8b embrace at the same time the first laminated armouring rod 1. This is possible because armourings according to the invention can be delivered in great lengths, prestressed and rolled up and, according to the needs, parts thereof can be clamped off and severed. Also of the second armouring rod 7 the compressive stress elements 3 are shown longer than the tensile stress elements 2, which are again provided with anchoring means (not shown). The armouring rods 1 and 7 are each provided with a wrapping 9 of metal band for keeping the stressed lamellae together and a wrapping arranged around it of corrosion resistant material, such as oiled paper or other material. The armouring is embedded in the concrete as shown in Figure 1 and after setting of the concrete the bolts 5 and 10 are loosened, whereby the compressive stress elements 3 can release in rooms left free at least at one end thereof and the tensile stress of the tensile stress elements 2 can transmit their stress on the concrete by the anchoring means and can bring the concrete under pressure. When the screw bolts are entirely removed, the clamp feet 4a and 8a, which are then loose, can be removed and reused, while the recesses can be filled up with concrete mortar. The bending up of the ends of the armouring is not absolutely necessary and when these ends are kept as much as possible in the extension of the armouring, the compressive stress elements 3 can, if desired, be made projecting outside the form and can be pulled out afterwards. It is however also possible to leave the released compressive stress elements 3 in place in the armouring and to use them as safety armouring, for instance in case of fire, in which as a consequence of the heating of the concrete the prestressed armouring can loose its stress. In this connection, and also for facilitating the control of the buckling tendency of the compressive stress elements 3, these latter are appropriately made heavier or thicker than the tensile stress elements 2. In order to prevent with certainty that the released compressive stress elements could again come under pressure and then could counteract the tensile stress elements, the clamps 4 and 8 are also left intact and the compressive stress elements are anchored again by fixing the clamps after releasing of the compressive stress elements with uncharged armouring, that is to say when the concrete is still in the form or is supported outside the form, or with beams when they are turned on one side. When the armouring is charged afterwards, its own weight causes a slight tensile stress in

3

the former compressive stress elements 3 and on further charging these elements 3 will cooperate as normal armouring and when the prestressed armouring falls out they will be able to protect the construction against fully collapsing.

The Figures 3 and 4 show another embodiment of the clamps, which here consist of a two part rectangular sleeve 12, 13 the parts of which are screwed together by bolts 14, but the opening of which is higher than the armouring to be clamped in it and in which the clamping occurs by means of a wedge 15. The loosening of the clamp is operated by a fuse lining 16, for instance composed of sulphur ribbon, which contains an electrical heating element, the connecting wires 17 of which are kept projecting outside the concrete and with which the fuse lining can be brought to fuse or soften. In the left hand part the compressive stress elements 3 are again shown projecting outside the tensile stress elements 2, but in the right hand part they are cut off closely behind the clamp 18. At this side the expansion spaces 19 for the compressive stress elements 3 are formed by wrapping the laminated rod till the bend of the strips with oiled paper and filling up the slots between the tensile stress elements 2 partly with loose small wads of paper.

The Figures 5 and 6 show an armouring consisting of a number of band metal strips 2 and 3 lying flat on one another, more particularly of band steel, having all the same breadth and thickness. The bundle can in practice be kept together by a wrapping of band iron (not shown). The affixion area of the separate strips is considerably greater than of the wires usual up till now, so that the strips can always be used without additional anchorings in lighter constructions. In the bundled shape the bundle has a very high space factor which can be estimated at nearly 100% in the Figures 6 and 7.

The Figures 7, 8 and 9 show a prestressed armouring, in which between the strips 2, which are brought under tensile stress, still strips 3 are arranged, which are brought under compressive stress. For the anchoring of the tensile stress strips 2 in the concrete these strips 2 are provided with lateral recesses 24, so that at the same time lateral projections 25 are formed which can take care of the anchoring. The bundle is kept flexibly together by a wrapping 26 of band steel or band iron, which is passed through the recesses. The compressive stress strips 3 have smooth side edges and have a breadth which is equal to the breadth between the recesses of the tensile stress strips 2. The recesses are in the shown case only shown at one end, but can of course also be arranged along the whole length of the strips.

The embodiment according to the Figures 10, 11 and 12 distinguishes itself from the above described construction only by the fact that the lateral recesses 24 are still provided with under cuts 27, while the mutual connection is formed by metal wires 28 which are passed in zigzag fashion crossing one another on both sides through the under cuts 27 and the recesses 24.

The prestressed armourings according to the Figures 7-12 are kept stressed after stressing by clamps 4-6, one of which is shown in Figure 13, consisting of two clamp plates 4a, 4b, which can be pulled towards one another by bolts 5, 6 passing outside of the strip bundle. These clamps are in practice kept at the outside of the form or boarding and are disconnected after the setting of the concrete, whereby the compressive stress strips 3 will be released and the tensile stress strips 3 transmit their stress onto the concrete by means of the projections 25 serving for the anchoring. The released compressive stress strips can be removed if desired. The projecting armouring ends are cut off and are painted with bitumen against corrosion.

In the embodiment according to the Figures 13 and 14 the tensile stress lamellae 2 are broader on both sides than the compressive stress lamellae 3 and are provided in the broader parts with half circle shaped border recesses 24

4

through which pass metallic clamps 29 embracing the whole lamella bundle. By that the clamps lie for the greater part at the outside around the bundle, they form not only a good protection of the bundle against buckling out of the compressive stress lamellae, but also form anchoring means which are active on the whole length of the armouring. The clamps can be arranged in a simple mechanical manner and by springing back they lie so loosely around the bundle, that the compressive stress elements can easily operate between the tensile stress elements.

In order to prevent that with armourings of great lengths the metallic clamps 29 will tighten the parts 2 and 3 of the armouring 1 too much, according to the Figures 16-17 wires 30, for instance with round cross section, can be arranged along the two outer edges of the compressive stress lamellae 3, which wires have a diameter which is for instance about 0.1 mm. larger than the thickness of the compressive stress lamellae. These wires then at the same time give a good sealing to the outside, so that no adhesion of concrete to the compressive stress lamellae can take place.

Having now particularly described and ascertained the nature of my said invention and in what manner the same is to be performed I declare that what I claim is:

1. A composite reinforcing assembly adapted to be embedded in a concrete structure, said assembly comprising an elongated, laminated rod having releasable clamping means adjacent the opposite ends thereof, said rod including first and second groups of longitudinally extending, relative narrow, flat steel bands, the first group of bands constituting tension elements and the second group of bands constituting compression elements, the bands of both groups being in alternating side-by-side relationship, said first group of bands being in a high state of tension and the bands in said second group being in a high state of compression, said clamping means frictionally clamping all of said bands together and maintaining the respective groups of bands in said state of tension and compression, the laminated rod having bond-preventing means thereon between said clamping means which prevents the material of the concrete structure from bonding with at least the second group of bands, said clamping means being adapted for release from the rod after embedment in the structure whereby the tensile stresses maintained in the first group of bands is transmitted to the material of said concrete structure to produce compressive stresses therein.

2. The reinforcing assembly of claim 1 wherein the alternating bands of both groups are in contacting relationship along the length of the rod between said clamping means and said compression bands being adapted for withdrawal from the structure upon the hardening of the material thereof.

3. The reinforcing assembly according to claim 1 wherein said bond-preventing means comprises a helically-wound metallic band surrounding said rod between the clamping means, said helically-wound band materially increasing the lateral stiffness of said rod.

4. A reinforcing assembly as recited in claim 1 wherein each clamping means includes at least two parts connected together by bolts, said bolts drawing the two parts of each clamping means together and frictionally clamping the laminated rod therebetween.

5. The reinforcing assembly recited in claim 4 wherein at least one of said clamping means includes a wedge element positioned between one of the parts and an outermost band of the rod and an electrically softenable lining positioned between the other of said parts and the other outermost band of the rod whereby softening of said lining produces the release of the clamp on the rod.

6. A reinforcing and prestressing armouring for use in connection with a concrete block, having in combination, a laminated rod comprising a plurality of longitudinal lamellae superposed and in close surface contact,

5

each lamella comprising a flat steel strip, said rod being adapted to be embedded within said block, some of said lamellae forming a first group and its strips constituting tensile stress elements, and other lamella forming a second group and its strips constituting compressive stress elements, the lamellae of each group alternating in said rod with those of the other group and being releasably interconnected thereto, each tensile stress strip having at least near its ends recesses formed in its opposite longitudinal edges leaving therebetween on each of said edges projections for anchoring in the concrete, each compressive stress strip having a width substantially equal to the distance between the innermost parts of opposite recesses of said tensile stress strips, and releasable means connecting the ends of the lamellae of both groups.

7. An armouring according to claim 6, together with clamp means engaging said recesses holding the laminated rod together in a flexible manner.

8. An armouring according to claim 6, together with binding means including a plurality of metallic clamps each engaging said laminated rod at two opposite recesses of said tensile stress strip.

9. The armouring recited in claim 6 wherein the edges of the lamellae of the second group are disposed inwardly

6

of the edges of the lamellae of the first group, the inwardly disposed edges of the second group defining longitudinal recesses between adjacent lamellae of the first group, longitudinally extending wires disposed in said recesses, the diameter of the wires being slightly greater than the width of the recesses, whereby the material of the block is prevented from bonding with the compressive stress lamellae.

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