

March 24, 1970

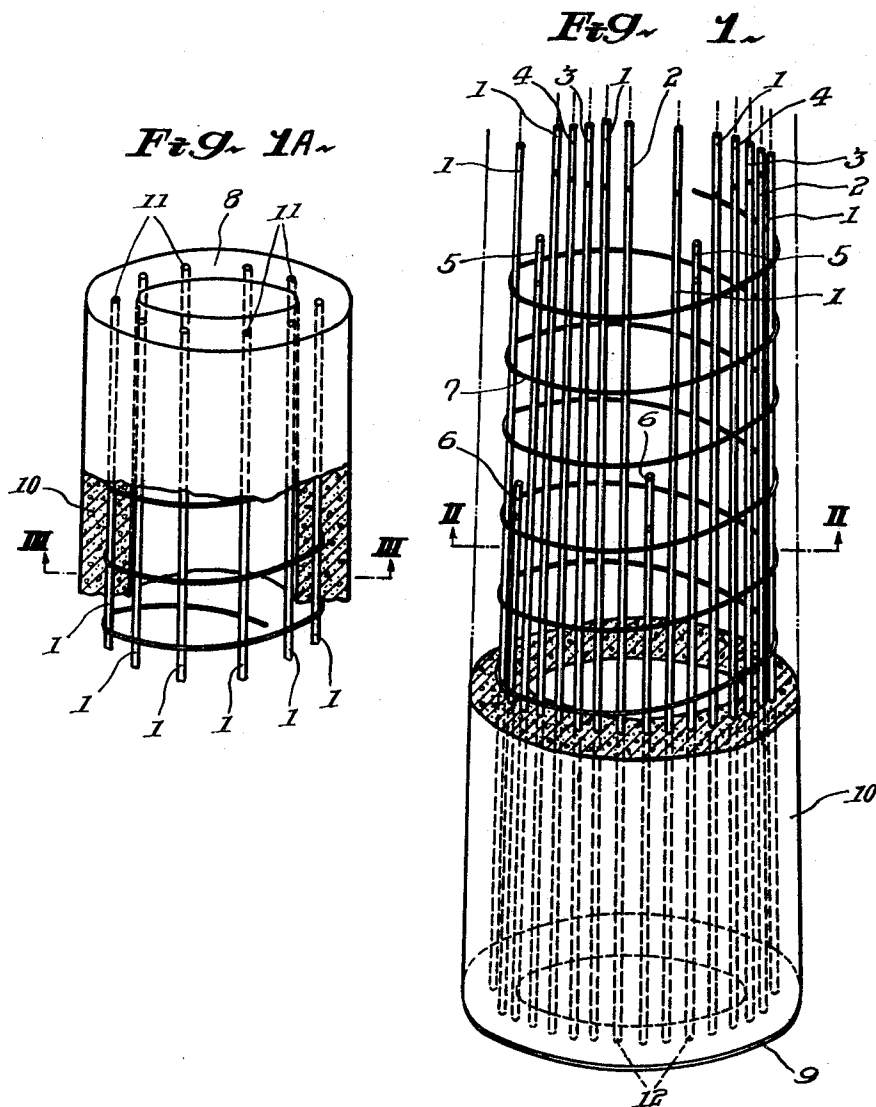
MINORU UCHIYAMA

3,501,920

REINFORCED CONCRETE POLES, PILES AND THE LIKE

Filed Nov. 15, 1967

3 Sheets-Sheet 1



INVENTOR.

BY *Minoru Uchiyama*
Oldham & Oldham
Attys.

March 24, 1970

MINORU UCHIYAMA

3,501,920

REINFORCED CONCRETE POLES, PILES AND THE LIKE

Filed Nov. 15, 1967

3 Sheets-Sheet 2

Fig. 2~

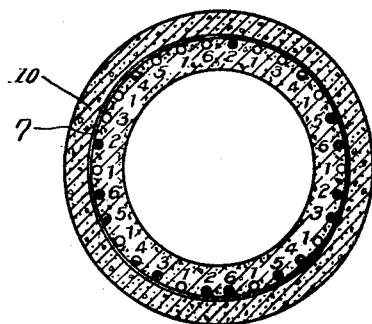


Fig. 3~

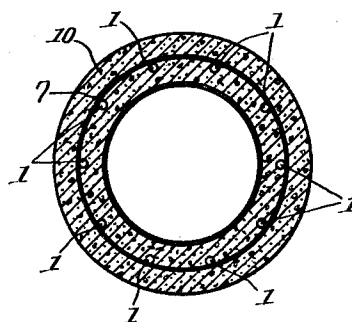
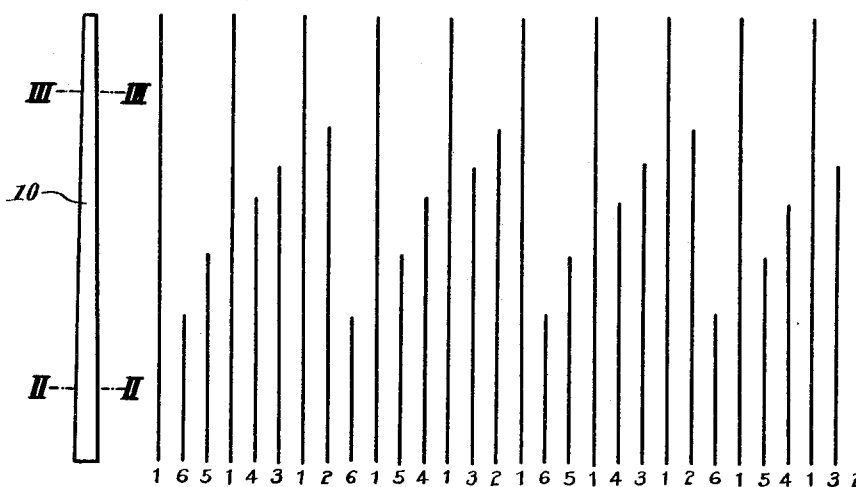


Fig. 4~



INVENTOR.

BY *Minoru Uchiyama*
Oldham & Oldham
attys.

March 24, 1970

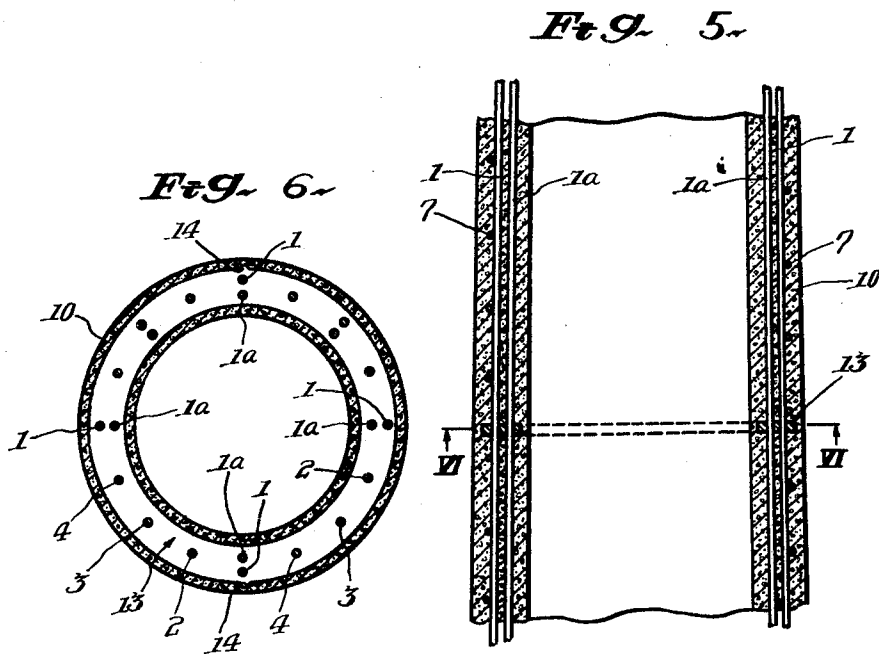
MINORU UCHIYAMA

3,501,920

REINFORCED CONCRETE POLES, PILES AND THE LIKE

Filed Nov. 15, 1967

3 Sheets-Sheet 3



INVENTOR.

BY *Minoru Uchiyama*

Oldham & Oldham
Attys.

1

3,501,920

REINFORCED CONCRETE POLES, PILES AND THE LIKE

Minoru Uchiyama, Tokyo, Japan, assignor to Nippon
Concrete Kogyo Kabushiki Kaisha, Tokyo, Japan
Filed Nov. 15, 1967, Ser. No. 683,242
Int. Cl. E02d 5/58; E04c 3/10

U.S. Cl. 61-56

1 Claim

ABSTRACT OF THE DISCLOSURE

For axial reinforcement of precast concrete poles, piles or the like products, nontensioned ordinary-strength steel wires are used in different lengths and in combination with conventional pretensioned high-strength steel wires thereby to save the latter as much as possible while imparting to the product a breaking strength varying along the axis of the pole in such a fashion as to afford a satisfactory crack-resisting feature thereto.

The present invention relates to a novel construction of concrete poles, piles or the like precast concrete products.

In general, concrete poles, piles or the like long rod-like bodies of concrete are subjected in use to a bending moment which varies in magnitude along their longitudinal axis. This means that different portions of such poles or piles are required to have different ultimate or breaking strengths. Further, with such rod-like concrete bodies, it is undesirable from the standpoint of durability or service life that cracks may form in the surface of such concrete bodies under different loads including the wind pressure to which they are subjected in use and the impacts normally unavoidably given to them at the work site. It has recently been a practice, therefore to use such concrete members in a prestressed state, that is, in a state subjected in advance to an appropriate compressive stress. Accordingly, in the manufacture of such rod-like concrete members, pretensioned wires of high-strength steel are commonly used as axial reinforcement therefor.

According to the present invention, rod-like concrete members having a breaking strength varying along their length are obtainable by use of a cage of axial reinforcement including: a minimized number of high-strength pretensioned steel wires which extend the entire length of the rod-like member and are effective to impart a required crack-resisting feature to the latter; a plurality of nontensioned ordinary-strength steel wires which have different lengths shorter than the entire, length of the rod-like member and, as an auxiliary reinforcement, are arranged in combination with the longer high-strength pretensioned steel wires; and a spiral or hoop reinforcement applied to the combined arrangement of high-strength pretensioned and ordinary-strength nontensioned steel wires. For example, in the case of concrete poles, which in use are required to exhibit a breaking strength increasing in value to its maximum close to the ground, the requirement for such breaking strength can be met by use of pretensioned steel wires in combination with nontensioned steel wires but not by use of pretensioned wires alone. In other words, the combined use of pretensioned and nontensioned steel wires enables formation of concrete poles which have a desired crack-resisting feature with a breaking strength varying along the pole axis in a predetermined fashion.

According to the present invention, the material cost of rod-like concrete members can be reduced while fully maintaining the required strength thereof by employing a combined form of axial reinforcement which includes a reduced quantity of expensive high-strength steel wire and a substantial quantity of inexpensive nontensioned ordinary-strength steel wire.

2

In carrying out the present invention, preferably, cold-drawn steel wires are employed as pretensioned high-strength wires and hot-rolled steel wires as non-tensioned ordinary-strength wires. It is to be noted here that, where the axial reinforcement is arranged in a single row, the pretensioned and nontensioned steel wires are all included in the single row, ordinarily forming a common circle. In contrast, where the reinforcement is arranged in two or more rows, the pretensioned steel wires are included only in the outermost row or circle.

In the latter arrangement, the required amount of pretensioned steel wires can be reduced to a substantial extent, all of the wires being utilized most efficiently to impart the desired crack-resistance to the pole structure.

In the former arrangement, the use of pretensioned steel wires can be substantially saved by utilizing the fact that the exceptionally large adhesive force obtainable between the concrete and the rough surface of hot-rolled steel wires can take a great role in giving the required crack-resisting feature to the product. In this manner, not only the cost of reinforcing steel material can be reduced but at the same time the fabricating facilities can be simplified to a substantial extent and the manufacturing cost reduced.

The practical tests conducted by the inventor have shown that in bending tests of reinforced concrete poles primary cracks are occurable in the concrete surface when the tensile stress reaches a value of approximately 2,400 kg./cm.² where the nontensioned wires used are of cold-drawn steel but only when the tensile stress reaches a value of approximately 3,200 kg./cm.² where the nontensioned wires of hot-rolled steel are used. Upon the basis of the above, the inventor could minimize the total quantity of reinforcing steel used by determining the total number and quantity of pretensioned wires. With due account taken of the effect on the crack resistance of the adhesion occurring between the hot-rolled wires and the concrete.

Thus, the present invention is intended to provide rod-like concrete members having a satisfactory breaking strength and crack resistance by arranging nontensioned steel wires so as to give the combined effect of affording a breaking strength comparable to that obtainable with use of pretensioned steel wires and at the same time imparting a crack resistance to the rod-like member, as required.

As apparent from the foregoing, the present invention is advantageous in that it makes it possible to reduce the quantity of high-strength pretensioned steel wires required in concrete poles, piles or the like for the desired breaking strength and crack resistance and to simplify the construction and operation of the axial reinforcement, forms, pretensioning device, etc.

A further advantage of the present invention is that the use of hot-rolled wires in concrete poles as part of its axial reinforcement is effective to eliminate any severe reduction in crack resistance such as occurable with conventional poles employing pretensioned steel wires alone when involved in a fire and also to reduce the adverse effects of impacts to which the poles are often subjected.

These and other objects, features and advantages of the present invention will become apparent from the following description when taken in conjunction with the accompanying drawings, which illustrate a few preferred embodiments of the invention and in which:

FIG. 1 is a fragmentary perspective view of a concrete pole embodying the invention;

FIG. 1A is a fragmentary perspective illustration of the top portion of the concrete pole shown in FIG. 1;

FIG. 2 is a transverse cross section substantially taken along the line II—II of in FIG. 1;

3

FIG. 3 is a transverse cross section substantially taken along the line III—III in FIG. 1A;

FIG. 4 is a schematic development illustrating the circular arrangement of axial reinforcements in the concrete pole of FIGS. 1, 1A, 2 and 3;

FIG. 5 is a fragmentary longitudinal cross section of another embodiment of the present invention, in which pretensioned wires are arranged in two rows, one including wires radially aligned with these forming the other; and

FIG. 6 is a transverse cross section substantially taken along the line VI—VI in FIG. 5.

Referring to the accompanying drawings and particularly to FIGS. 1 and 1A, reference numeral 10 indicates a long tubular body of concrete pole in which a required number of pretensioned wires 1, extending longitudinally of the pole along its whole length, are arranged at equal intervals in a circle of appropriate diameter and serve to impart a so-called prestress to the concrete pole 10. In order to hold these steel wires in a pretensioned state, annular anchoring plates of steel 8 and 9, each having anchoring recesses formed therein, are arranged at the opposite ends of the pole length and reinforcing wires 1 are anchored to the steel plates 8 and 9 by engaging the enlarged heads 11 and 12, formed at the opposite ends of the wires, in the respective anchoring recesses in the adjacent plates. Concrete is then placed in the form and the anchoring plates 8 and 9 are moved away from each other to tension the wires. The procedure and equipment are conventional and well-known in the art as far as they have been described above. According to the present invention, however, several different lengths of ordinary nontensioned steel wire are also arranged in the same circle in which the pretensioned wires 1 are arranged and in a predetermined order, as indicated at 2, 3, 4, 5 and 6, and extend upwardly from the bottom end of the pole to points short of its top end. These nontensioned wires themselves have a diameter preferably equal to that of pretensioned wires 1. The number of such nontensioned wires arranged in each spacing of the pretensioned wires 1 and the respective lengths of the nontensioned wires are suitably determined according to the length, diameter and strength required for the concrete pole or pile being fabricated.

FIG. 4 is a schematic development of the circumferential arrangement of the pretensioned wires 1 and nontensioned wires of shorter lengths 2, 3, 4, 5 and 6 used in the embodiment of FIGS. 1, 1A, 2 and 3. The numeral references at the bottom of vertical lines in FIG. 4 apparently indicate the respective lengths of the wires used. As shown, nontensioned steel wires 2, 3, 4, 5 and 6 have successively reduced lengths and are themselves so-called "black" or rough hot-rolled steel wires. For pretensioned steel wires, cold-drawn high-strength material should be selected to obtain the desired performance.

In addition to the axial reinforcement including the pretensioned (1) and nontensioned (2, 3, 4, 5, 6) steel wires extending longitudinally of the concrete pole, steel wire 7 of appropriate thickness is spirally wound along the outer periphery of the axial reinforcement to complete a cage-like structure, in which the pretensioned

4

wires 1 are all anchored at the opposite ends to the steel plates 8 and 9 and held in tension. Such cage structure is used as a composite reinforcement in the well-known centrifugal compaction technique of fabricating long frustoconical or cylindrical concrete poles such as 10.

Reference will next be made to FIGS. 5 and 6, which illustrate another embodiment of the invention. This embodiment is characterized in that it includes additional pretensioned wires 1a arranged radially inward of the normal pretensioned wires 1 to form a double row of prestressing wires together therewith. Numerals 2, 3 and 4 in FIG. 6 indicate nontensioned steel wires similar to those used in the first-described embodiment and differing in length from each other. These nontensioned wires are arranged in the same circle as the radially outward pretensioned wires 1 and, around the circular arrangement of these nontensioned and pretensioned wires, a steel wire 7 is spirally wound. In FIGS. 5 and 6, reference numeral 13 indicates spacers embedded in the body of concrete pole 10 at points spaced from each other longitudinally thereof. The spacers 13 are each formed with a multitude of holes to receive reinforcing wires. With pretensioned (1, 1a and nontensioned (2, 3, 4) steel wires inserted through the spacers 13 as shown, concrete is placed and the reinforcing wires are fixed in place, maintaining their relative positions determined by the spacers. Projections 14 are formed on each of the spacers 13 along the outer periphery thereof, especially to serve the positioning purpose.

What is claimed is:

1. An elongate tubular concrete pole, pile or the like member including an axial reinforcement comprised of a plurality of longitudinally pretensioned high strength cold rolled steel wires arranged at equal intervals in a common circle and each anchored at its opposite ends in tension, a plurality of longitudinally nontensioned hot rolled, rough surfaced ordinary strength steel wires arranged at regular intervals between such pretensioned steel wires in the same circle in which said pretensioned steel wires are arranged, and an auxiliary reinforcement wound spirally along the outer periphery of said axial reinforcement, with all wires and the auxiliary reinforcement being encapsulated by concrete whereby an improved strength, crack-resistant member is obtained.

References Cited

UNITED STATES PATENTS

3,046,749	7/1962	Blessey	61—56
3,382,680	5/1968	Takano	61—56

FOREIGN PATENTS

152,244	7/1953	Australia.
---------	--------	------------

OTHER REFERENCES

Prestressed Concrete, Theory and Design by Evans & Bennet, pub. 1958, John Wiley & Sons, p. 32.

JACOB SHAPIRO, Primary Examiner

U.S. Cl. X.R.

52—223, 224, 720