

PATENT SPECIFICATION

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COMPLETE SPECIFICATION

DRAWINGS ATTACHED

Improvements in or relating to Prestressed Concrete Pile Sections

We, NIPPON CONCRETE KOGYO KABUSHIKI KAISHA, a corporation organized under the laws of Japan, of No. 19, 8-chome, Ginza-Higashi, Chuo-ku, Tokyo, Japan, 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:—

10 This invention relates to prestressed concrete piles and particularly to unit sections thereof.

The present invention has for its object to provide a prestressed concrete pile or 15 pile section which has an improved structure particularly designed to enable effective pretensioning of the axial reinforcement, which takes the form of reinforcing steel wires and is high in structural strength.

20 Another object of the present invention is to provide a prestressed concrete pile section of the character described which can be readily connected with another pile section of the same structure, forming therebetween 25 a joint having a strength at least equal to that of the body portions of the pile sections.

According to the invention, there is provided a prestressed concrete pile section 30 comprising a tubular body of concrete, a pair of annular steel discs or rings arranged at opposite ends of said tubular concrete body, and reinforcing steel wires extending between said annular steel discs or rings 35 longitudinally through said tubular concrete body, said reinforcing steel wires being pretensioned by applying forces to said annular steel discs or rings to pull the latter away from each other prior to casting the concrete and releasing the forces after the concrete body has set.

40 For a better understanding of the invention, and to show how the same may be

carried into effect, reference will now be made, by way of example, to the accompanying drawings, in which:—

Fig. 1 is a longitudinal cross-sectional view of a prestressed concrete pile section in accordance with the invention.

Fig. 2 is a top plan view of the pile section of Fig. 1 taken along line II-II in Fig. 1.

Fig. 3 is a transverse cross-sectional view of the pile section taken along the line III-III in Fig. 1.

Fig. 4 is a fragmentary longitudinal cross-sectional view of another embodiment of two prestressed concrete pile sections in accordance with the invention and connected with each other in end-to-end relationship.

Fig. 5 is a view similar to Fig. 4, illustrating the connection between two prestressed concrete pile sections of another embodiment of the present invention.

Fig. 6 is a fragmentary longitudinal cross-sectional view illustrating one end portion of a further embodiment of the present invention.

Fig. 7 is a longitudinal cross-section of the pile section shown in Fig. 1 with a conical shoe connected to the bottom end thereof, and

Fig. 8 is a view similar to Fig. 7, illustrating a cylindrical steel pile connected with the pile section shown in Fig. 1.

Referring to the drawings and particularly to Figs. 1 to 3, there is shown a prestressed concrete pile section which includes a tubular body 1 of concrete and a pair of annular steel discs or rings 2 arranged at the opposite ends of the body of concrete 1 to form opposite end faces of the pile section. The pile section has an axial steel reinforcement in the form of circumferentially equally spaced parallel steel wires 3 secured at opposite ends to the respective

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steel rings 2 to extend therebetween. For the pretensioning of the steel wires 3, forces are applied, prior to the casting of the concrete 1, to the opposite steel rings 2 to pull the latter away from each other and, with all the wires tensioned substantially uniformly, concrete is poured or cast into a tubular form in such a manner that the wires 3 are embedded in the body of concrete 1. Subsequently, after the concrete has set, the forces acting upon the steel rings 2 are removed, transferring the prestress to the concrete 1 through its bond to the steel wires.

The tubular concrete pile section thus obtained includes at its opposite ends steel rings 2 exteriorly exposed with the stretched axial reinforcing wires 3 embedded in the wall of the tubular body of concrete 1 and is longitudinally prestressed owing to the bond between the concrete and the axial reinforcing steel wires 3 and also to the restraining effect of the annular steel rings 2 to which the wires 3 are secured at their opposite ends.

When it is desired to connect this pile section with another unit of the same structure in end-to-end relation, the steel rings 2 forming the adjacent end faces of the two pile sections are brought into abutment against each other and welded together along their peripheral edges, as shown in Fig. 4. It is to be noted that the welded connection forms a joint having a strength at least equal to that of the tubular body portion 1 of the pile sections since the steel rings 2 welded together are each connected with the pretensioned steel wires 3 in the associated pile section and that there occurs no opening between the body of concrete and the adjacent steel ring even if the joined pile portion is subjected to bending stress. Also, the top steel ring 2 of the upper pile section serves as a protection against blows applied when the pile is driven.

As shown, the steel rings 2 are formed with circumferentially equally spaced apertures 4 each having an enlarged outer end portion for securing the reinforcing steel wire 3 therein. To this end, the steel wire 3 is formed at each end with an enlarged head 5, which is received in the enlarged portion of the associated aperture 4 in the steel ring 2. For pretensioning the steel wires, the heads 5 of each of the wires 3 may be welded to the respective steel rings 2, if desired. It is to be noted that the wire heads 5 are entirely in the enlarged portions of the apertures 4 not projecting beyond the end surface of the associated steel ring 2 and thus form no obstacle to the driving of the pile or to the face-to-face connection of the steel rings 2 of the adjoining pile sections.

Referring again to Fig. 4, which illustrates

a second embodiment of the present invention, a tubular steel plate 6 is welded to the periphery of each of the annular steel rings 2 and extends therefrom longitudinally of the pile section around the periphery of the tubular body of concrete 1. To interconnect two pile sections formed in this manner, the annular steel rings 2 forming the adjacent end faces of the two sections are brought together in face-to-face relation and are welded together along the peripheral edges, as indicated at 8 in Fig. 4. In this figure, reference numeral 7 indicates rings of steel wire welded to the inner peripheral surface of the tubular steel plate 6 for the purpose of increasing its bond to the tubular body of concrete 1. The annular steel ring 2 and tubular steel plate 6 together form an integral steel structure bonded to the body of concrete 1 along its end and peripheral surfaces, effectively preventing any opening between the annular steel ring 2 and the body of concrete 1. Also, the joint, connecting the two pile sections with each other, has a strength at least equal to that of the tubular bodies of concrete.

Referring to Fig. 5, which illustrates a modification of the embodiment shown in Fig. 4, reference numeral 9 indicates a number of deformed steel bars each having an appropriate length and welded at one end to the inside face of the adjacent annular steel ring 2. The steel bars 9 are embedded in the body of concrete 1 thus increasing the bond of the annular steel ring 2 to the latter.

Fig. 6 illustrates a further modification of the embodiment shown in Fig. 4. In this modification, the steel bars 9, embedded in the tubular body of concrete 1 and preferably deformed, are insulated from the concrete by a bituminous material 10 along the major part of their length adjacent their outer threaded end. A nut 15 is threaded on the outer end of each of the steel bars 9 to clamp the latter against the annular steel ring 2. By tightening the nuts 15, it will be noted that the engaging pressure between the annular steel ring 2 and the tubular body of concrete 1 can be effectively increased. As shown, the inner ends of the steel bars 9 are also threaded to carry respective nuts 9a.

Fig. 7 illustrates a combination of a prestressed concrete pile section of the form shown in Fig. 1 and a conical shoe secured to the bottom of the pile section. The conical shoe includes an inverted cone of concrete 11 and an annular steel disc 12 of the same configuration as the ring forming the bottom end face of the pile section 1. The steel disc 12 is secured to the top face of the inverted cone of concrete 11 and welded to the bottom steel ring 2 of the pile section 1, as shown. The bottom end or

apex portion of the inverted cone of concrete 11 is capped with a conically formed steel sheet 14, which is connected with the steel disc 12 by a number of reinforcing steel wires 13 embedded in the inverted cone of concrete 11. The annular steel disc 12 of the conical shoe is brought into face-to-face contact with the bottom steel ring 2 of the pile section 1 and is welded thereto along their peripheral edges as indicated at 16a. The conical shoe 11 forming the bottom point of the pile unit serves to facilitate driving the latter into earth.

Fig. 8 illustrates another form of pile unit which includes a prestressed concrete pile section of the form shown in Fig. 1 and a cylindrical steel pile 16 connected therewith in end-to-end relation. The steel pile 16 has an annular steel disc 20 welded to its one end and the disc is placed in face-to-face contact with the bottom ring 2 of the pile section 1. As shown, the annular steel ring 2 and disc 20 are welded together along their peripheral edges. Annular steel bands 17 are fitted over the opposite end portions of the cylindrical steel pile 16 for the purpose of reinforcing the latter.

As will be readily understood from the foregoing description, prestressed concrete pile sections according to the present invention can be easily connected with each other and with pile attachments such as, for example, the conical shoe 11 shown in Fig. 7, or the cylindrical steel pile 16 such as is shown in Fig. 8, and experiments have revealed that the simple connecting structure according to the present invention gives a joint strength at least equal to that of the pile body.

WHAT WE CLAIM IS:—

1. A prestressed concrete pile section comprising a tubular body of concrete, a pair of annular steel discs or rings arranged at opposite ends of said tubular concrete body, and reinforcing steel wires extending longitudinally through said tubular concrete body, said reinforcing steel wires being pretensioned by applying forces to said annular steel discs or rings to pull the latter away from each other prior to casting the concrete and releasing the forces after the concrete body has set.

2. A prestressed concrete pile including a number of prestressed concrete pile sections each as claimed in claim 1 and successively arranged in end-to-end relation to each other with the adjacent annular steel discs or rings of any two adjacent pile sections welded together along their peripheral edges.

3. A prestressed concrete pile section as claimed in claim 1 in which said annular steel discs or rings are both formed with a plurality of circumferentially equally spaced apertures each having an enlarged outer end portion and the opposite end portions of said reinforcing steel wires extending into said respective apertures of the annular steel discs or rings, are formed with enlarged heads to be anchored in said enlarged outer end portions of the respective associated apertures.

4. A prestressed concrete pile section as claimed in claim 1 or 3 and further comprising a number of steel bars fixed to either of the two annular steel discs or rings to extend therefrom parallel to said pretensioned reinforcing steel wires and embedded in said body of concrete.

5. A prestressed concrete pile section as claimed in claim 1, claim 3 or claim 4 and further comprising a conical shoe of concrete which includes an annular steel disc similar to either of those arranged at opposite ends of said tubular body of concrete and which is connected thereto by welding together the adjacent annular steel discs along their peripheral edges.

6. A prestressed concrete pile section as claimed in claim 1, claim 3 or claim 4 and further comprising a cylindrical steel pile which includes an annular steel disc similar to either of those arranged at opposite ends of said tubular body of concrete and which is connected thereto by welding together the adjacent annular steel discs along their peripheral edges.

7. A prestressed concrete pile section substantially as hereinbefore described with reference to any of the embodiments illustrated in the accompanying drawings.

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apex portion of the inverted cone of concrete 11 is capped with a conically formed steel sheet 14, which is connected with the steel disc 12 by a number of reinforcing steel wires 13 embedded in the inverted cone of concrete 11. The annular steel disc 12 of the conical shoe is brought into face-to-face contact with the bottom steel ring 2 of the pile section 1 and is welded thereto along their peripheral edges as indicated at 16a. The conical shoe 11 forming the bottom point of the pile unit serves to facilitate driving the latter into earth.

Fig. 8 illustrates another form of pile unit which includes a prestressed concrete pile section of the form shown in Fig. 1 and a cylindrical steel pile 16 connected therewith in end-to-end relation. The steel pile 16 has an annular steel disc 20 welded to its one end and the disc is placed in face-to-face contact with the bottom ring 2 of the pile section 1. As shown, the annular steel ring 2 and disc 20 are welded together along their peripheral edges. Annular steel bands 17 are fitted over the opposite end portions of the cylindrical steel pile 16 for the purpose of reinforcing the latter.

As will be readily understood from the foregoing description, prestressed concrete pile sections according to the present invention can be easily connected with each other and with pile attachments such as, for example, the conical shoe 11 shown in Fig. 7, or the cylindrical steel pile 16 such as is shown in Fig. 8, and experiments have revealed that the simple connecting structure according to the present invention gives a joint strength at least equal to that of the pile body.

WHAT WE CLAIM IS:—

1. A prestressed concrete pile section comprising a tubular body of concrete, a pair of annular steel discs or rings arranged at opposite ends of said tubular concrete body, and reinforcing steel wires extending between said annular steel discs or rings longitudinally through said tubular concrete body, said reinforcing steel wires being pretensioned by applying forces to said annular steel discs or rings to pull the latter away from each other prior to casting the concrete and releasing the forces after the concrete body has set.

2. A prestressed concrete pile including a number of prestressed concrete pile sections each as claimed in claim 1 and successively arranged in end-to-end relation to each other with the adjacent annular steel discs or rings of any two adjacent pile sections welded together along their peripheral edges.

3. A prestressed concrete pile section as claimed in claim 1 in which said annular steel discs or rings are both formed with a plurality of circumferentially equally spaced apertures each having an enlarged outer end portion and the opposite end portions of said reinforcing steel wires extending into said respective apertures of the annular steel discs or rings, are formed with enlarged heads to be anchored in said enlarged outer end portions of the respective associated apertures.

4. A prestressed concrete pile section as claimed in claim 1 or 3 and further comprising a number of steel bars fixed to either of the two annular steel discs or rings to extend therefrom parallel to said pretensioned reinforcing steel wires and embedded in said body of concrete.

5. A prestressed concrete pile section as claimed in claim 1, claim 3 or claim 4 and further comprising a conical shoe of concrete which includes an annular steel disc similar to either of those arranged at opposite ends of said tubular body of concrete and which is connected thereto by welding together the adjacent annular steel discs along their peripheral edges.

6. A prestressed concrete pile section as claimed in claim 1, claim 3 or claim 4 and further comprising a cylindrical steel pile which includes an annular steel disc similar to either of those arranged at opposite ends of said tubular body of concrete and which is connected thereto by welding together the adjacent annular steel discs along their peripheral edges.

7. A prestressed concrete pile section substantially as hereinbefore described with reference to any of the embodiments illustrated in the accompanying drawings.

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