Jan. 21, 1969 G. MARIER 3,422,630

CONCRETE PILE CONSTRUCTION

Filed Dec. 21, 1967 Sheet 1 of 2

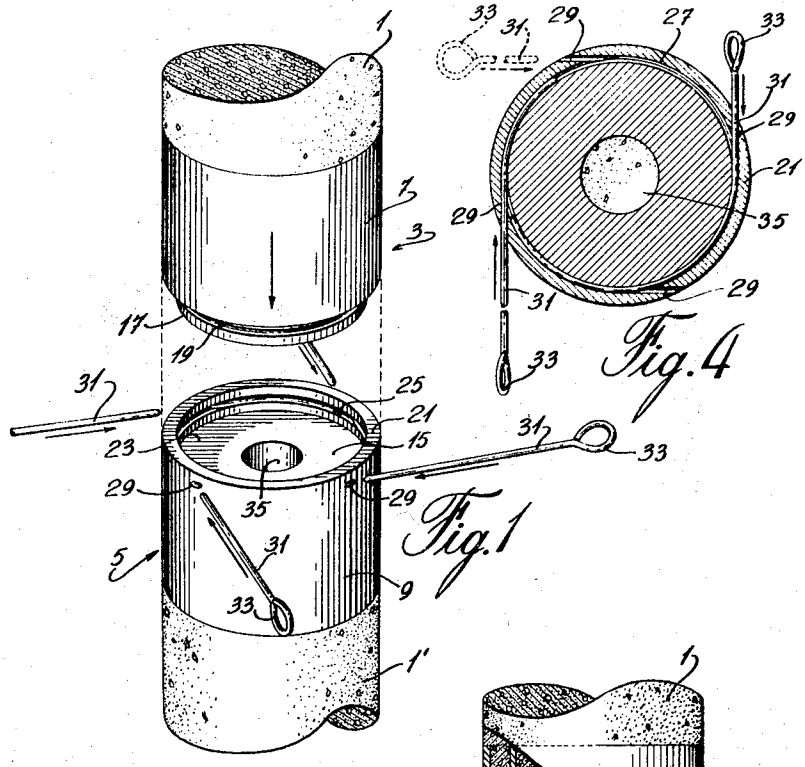

Fig. 4

Fig. 1

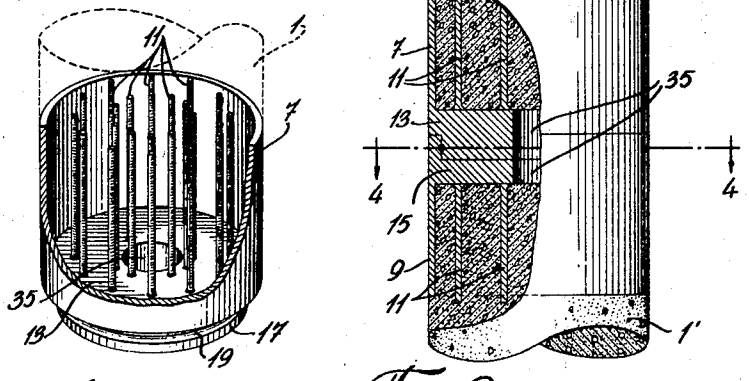

Fig. 2

Fig. 3

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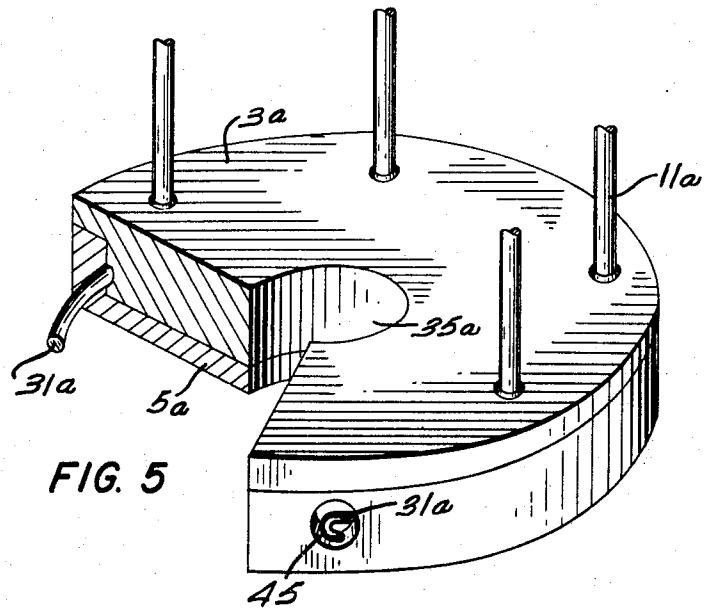

FIG. 5

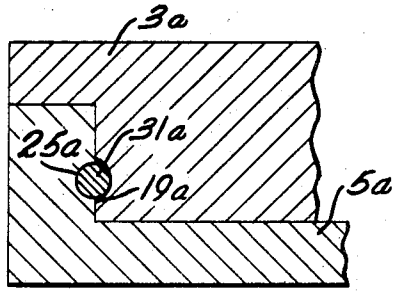

FIG. 6

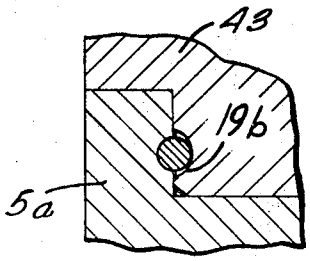

FIG. 8

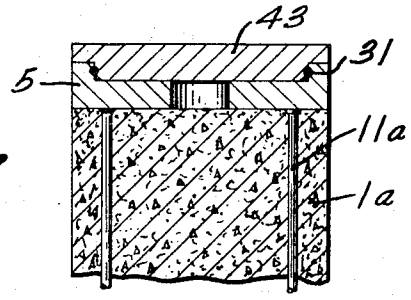

FIG. 7

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3,422,630

CONCRETE PILE CONSTRUCTION

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Continuation-in-part of application Ser. No. 458,299, May 24, 1965. This application Dec. 21, 1967, Ser. No. 697,275

U.S. Cl. 61—53 10 Claims

Int. Cl. E02d 5/30, 5/34; F16d 1/04

ABSTRACT OF THE DISCLOSURE

The method of driving piles and a concrete pile construction in which ends of cylindrical pile sections are telescopically connected by male and female metal caps having juxtaposed cylindrical surfaces having confronting grooves forming a passage removably receiving locking rod means inserted through at least one access passage opening to the exterior of one of the caps and communicating with the confronting passages, in which one groove fits the contour of one passage and the other groove is wider to allow for play when driving the piles and when driving the piles a male driving cap is provided and is temporarily connected with a female cap of the pile section being driven.

This application is a continuation-in-part of my copending application Ser. No. 458,299, filed May 24, 1965, titled, Mechanical Connector for Concrete Pile Sections, now abandoned.

The present invention relates to joining the adjacent ends of concrete pile sections.

Mechanical connectors are used to quickly and economically join together pile sections to form a composite pile structure which is driven into the ground to form part of the foundations of buildings, bridges and other structures of this nature and are intended to support the loads transmitted by the said structures. The piles may either be vertical or inclined.

Connectors for such purpose have been proposed that consist in the provision of a male and of a female member adapted to be coupled in vertical alignment, the female member having a peripheral upstanding flange defining a recess into which the male member fits. Thereafter, several pins are driven through holes in both the flange of the female member and in the male member to prevent uncoupling of the pile sections. It will be appreciated that this method has two main disadvantages: the pins used are relatively costly to manufacture since they must be machined and they have a limited cross section for shear resistance as compared to their volume.

In another such coupling disclosed in U.S. Patent 3,104,532 the structure is complex and thus costly to manufacture. Furthermore, coupling is difficult because the pile sections have to be rotated relative to one another.

It is consequently a main object of this invention to provide an improved coupling device of the above described type that is of simple structure and that can be manufactured at relatively low cost. Another object lies in that the coupling as proposed is convenient to use and offers a high shear resistance to uncoupling by axial displacement.

These objects may be obtained in a mechanical connection for joining together the adjacent ends of two cylindrical concrete pile sections of equal diameters comprising a female connecting member or cap having a circular recess at one end thereof surrounded by a circular peripheral surface and a male connecting member or cap having a projection at one end thereof defining a circular peripheral surface adapted to fit into the recess with the mentioned peripheral surfaces juxtaposed. The members are each formed with a groove in the circular surfaces

thereof and so disposed that when they are connected the grooves register to define a tubular locking enclosure or passage for a locking pin. The female member is formed with at least one passage, preferably several, therethrough from the outer surface to meet the tubular passage tangentially, and rods for locking the members together against uncoupling engageable in the passages and the locking enclosure. The depth of the enclosure in a radial direction of the piles is just great enough to accommodate the locking rod in a sliding fit. The width of one of the grooves in the axial direction is just great enough to accommodate the rod in a sliding fit without substantial movement in the axial direction, while the other groove is slightly wider to provide for a certain amount of play. Preferably the wider groove is on the projection of the male cap.

The piles are driven with the male cap down. For driving purposes a driving cap is provided. This is fitted onto the female cap at the top of a pile to be driven so as to be in position to be struck by the pile driver. This cap is similar to the permanent male cap mounted on the pile and is made up of a cylindrical plate of the diameter of the pile, having a cylindrical projection of reduced diameter to fit the recess of the female cap. The peripheral surface of the projection is provided with a groove adapted to register with the groove in the female cap to form a locking pin enclosure. The driving cap is held on to the female cap on the pile by inserting a locking rod in the locking enclosure. In the case of the driving cap, the groove is usually wider than that of the permanent male cap on the pile so as to provide greater latitude for play of the locking pin so as to facilitate its insertion and withdrawal. In contrast the permanent male cap once mounted is locked in place so that the rod can be forced in against resistance since it does not have to be withdrawn, whereas, with the driving cap, the rod has to be inserted and withdrawn with the driving of each pile section.

A better understanding of the invention will be afforded by the description that follows having reference to the appended drawings wherein:

FIGURE 1 is a perspective view of the ends of two piles about to be joined;

FIGURE 2 is an elevation view, partly cut away to show the internal structure with the two connecting caps in engagement;

FIGURE 3 is a perspective view of the male cap with a portion of the skirt thereof cut away to show the internal structure;

FIGURE 4 is a cross-sectional view taken along line 4—4 of FIGURE 2;

FIGURE 5 is an enlarged perspective view showing the relationship between a male connecting cap of simplified form and a female connecting cap in locked position, partly cut away to show the relationship of the respective caps and the locking rod, the concrete being omitted to simplify the showing;

FIGURE 6 is a still further enlarged fragmentary cross-section through mating male and female connecting caps in the region of the locking passage and rod;

FIGURE 7 is a cross-section showing a driving cap in place on a pile section to be driven; and

FIGURE 8 is a greatly enlarged fragmentary cross-section similar to FIGURE 6 showing the relationship between a driving cap and a female connecting cap.

Referring more particularly to the drawings the invention will be described in terms of a joint between respective pile sections 1 and 1'.

In the preferred embodiment shown in the drawing, the pile sections 1, 1' are provided respectively with a male connecting member or cap 3 and a female connecting member or cap 5 each generally cylindrical in shape and in this particular embodiment provided with a hollow

cylindrical skirt or flange portion **7** for member **3**, and **9** for member **5** of the same diameters as concrete pile sections **1**, **1'**. Within skirts **7** and **9** are provided a series of anchoring reinforcing rods **11** welded to or otherwise secured to bases **13** and **15**. It will be understood that in making the pile sections **1**, **1'**, a male cap **3** is molded integrally therewith at one end while a female cap is molded at the other end. Skirts **7** and **9** are optional and each cap may merely have a flat end surface abutting the concrete.

Male cap **3** has a central cylindrical projection **17** extending coaxially of pile section **1** from the base **13**. This projection **17** is formed with a peripheral annular groove **19**.

The female cap **5** has a circular peripheral flange **21** extending from the base **15** thereof to define therewith a recess **23** for the reception of the projection **17** of the male member **3**. The inner wall of flange **21** has an annular groove **25** and so disposed that when the male and female members are connected the grooves **19** and **25** are opposed and register to define a hollow conduit or tubular enclosure **27** adapted to receive a locking rod.

The groove **25** is preferably of semi-circular cross-section. The groove **19** is preferably of the same depth as the groove **25** and has the same depth and radius at its sides as the groove **25**, but is wider than the groove **25**. The reason for this is that it has been found that in driving a pile with the female cap uppermost, the groove in the female cap sometimes is displaced by distortion or displacement of the metal under hammering. The provision of a wider groove in the male cap compensates for this so even if the groove **25** is displaced the groove **19** always provides with it an enclosure big enough to receive a locking rod.

While a groove of semi-circular cross-section has been shown on the female cap and the wider groove on the male cap, this could be reversed. However, the present arrangement is more satisfactory for ease of manufacture. It is desirable to have one groove semi-circuit in cross-section to retain the locking pin itself from movement in the axial direction of the piles which would permit undesirable rocking of one section on the other.

If, of course, a rod other than circular is employed the shape of the grooves will be varied accordingly so that one groove is adapted to retain the locking rod in a relatively snug fit, the other groove being a bit wider than the locking rod to permit play. A circular locking rod is preferred because of ease of manufacture.

The female member **5** is formed with at least two passages **29** therethrough that extends from the outer surface thereof to the hollow conduit **27**, tangentially thereof and symmetrically disposed therearound. One arrangement is illustrated in FIGURE 4.

At least one rod **31** having a handle portion **33** at one end and a preferably rounded head at the other end are forced into a passage **29** to wind around the locking enclosure **27** between the projection **17** and the flange **21**.

FIGURE 1 shows four such rods **31** and FIGURE 4 shows only two. The number thereof will depend on the size of the pile sections to be coupled.

In order to provide efficient shear resistance, the outer diameter of projection **17** should only be slightly smaller than the inner diameter of shoulder **21**, that is, there should be sufficient clearance therebetween for easy entrance of the projection **17** into the recess **23**.

The coupling members **3** and **5** are preferably of machined cast steel.

The rods **31** may be made of steel, adapted to provide a spring action when forced to bend in the locking passage **27**, friction against the wall of groove **25** resulting from the spring action tending to retain the said rods in the passage.

Driving the piles is accomplished as follows. The first pile section to be driven is equipped with a male cap on its lower end and possibly a special driving foot and with a female cap on its top end. To accomplish driving, a special driving cap **43** is mounted on the female cap **5** as shown in FIGURE 7 with locking pins **31** locking the cap **43** to the cap **5**. The pile section is hammered home by blows of the pile driver on the cap **43**. When the pile section is fully driven, the cap **43** is removed and another pile section brought into position and its male cap **3** connected and locked to the female cap **5** of the driven pile.

In the case of the driving cap its locking groove **19*b*** (FIG. 8) is slightly wider than the locking groove **19** or **19*a*** of a male connecting cap as will be explained.

The relationship between the parts of the male and female caps and their locking grooves and the locking rod is best shown in FIGURES 5 and 6. The relationship between parts of a driving cap and a female locking cap is best shown in FIGURES 7 and 8.

The dimensions of the locking groove may vary for caps of different sizes. For example, for a ten inch pile, a preferred dimension for a groove in the female cap of semi-circular cross-section is a radius of one tenth (0.100) of an inch. The opposed groove in the male cap would preferably have quarter circle sides having a radius of one tenth (0.100) of an inch, but a width of twenty-two hundredths (0.220) of an inch at the edges. Thus the groove in the male member is two thousandths (0.002) of an inch greater in width than on the female member.

For a thirteen inch pile, the groove in the female cap has a preferred radius dimension of one hundred and fifteen thousandths (0.115) of an inch and is semi-cylindrical in shape while the mating groove in the male member preferably has sides having a radius of one hundred and fifteen thousandths (0.115) of an inch, but a width of twenty-five hundreds (0.250) of an inch. The groove in the male member is five hundreds (.05) of an inch greater in width than that on the female member.

Preferably, the width of the wider groove in a connecting cap exceeds that of the narrower groove by an amount with the range from about ten percent (10%) to about twenty percent (20%). In the case of a male driving cap the width of the groove may exceed that of the companion groove of the female connecting cap by up to about thirty percent (30%).

It will be noted in FIGS. 5–8 that structure of the male and female caps **3*a*** and **5*a***, respectively, as well as portions of driving cap **43** are followed by "*a*" when using reference characters identifying structure similar to that described in detail in FIGS. 1–4 and having a function corresponding to that shown and described with respect to FIGS. 1–4.

Although a specific embodiment of the invention has just been described, it will be understood that various modifications may be made thereto without departing from the spirit thereof, the scope of which is set forth in the appended claims.

I claim:

1. A concrete pile structure, comprising, a pair of pile sections each having a cylindrical reinforced concrete body and a connecting metal end cap of substantially the same diameter, the piles being connected in axial alignment with the cap of one pile butted against the cap of the other, one being a male cap presenting an axially extending cylindrical projection of lesser diameter than that of the pile body, the other being a female cap presenting an axially extending cylindrical depression receiving said projection and provided with a flange juxtaposed to said projection on the inside and an outside diameter substantially the same as the pile body, the flange and projection being provided respectively with opposed annular grooves forming therebetween an annular locking passage of a size to receive a locking rod, at least one access passage extending through said flange to join said locking passage tangentially and a metal locking rod of a thickness substantially greater than the depth of either groove and slightly less than their combined depth extending through said access passage into and about said an-

nular passage to lock the projection and flange from separation, the groove on the flange adapted to fit closely the contour of the rod to retain it from movement lengthwise of the pile, the groove on the projection being wider than the thickness of the rod.

2. A concrete pile structure, as defined in claim 1, in which the wider groove is on the male cap.

3. A concrete pile structure, as defined in claim 1, in which the width of the wider groove at the surface of the cap is from about ten percent (10%) to about twenty percent (20%) greater than that of the narrower groove.

4. A concrete pile structure, as defined in claim 1, in which the narrower groove is semi-circular in cross-section and the wider groove has side walls which are quarter-circular in cross-section.

5. A concrete pile structure, as defined in claim 1, in which the narrower groove is semi-circular in cross-section and the wider groove has side walls which are quarter-circular in cross-section, the width of the wider groove at the surface of the cap being from about ten percent (10%) to about twenty percent (20%) greater than that of the narrower groove.

6. A method of driving piles, comprising, providing a pile section with a female metal connecting cap having a base cylindrical recess surrounded by a cylindrical flange having in its inner wall an annular cylindrical groove, applying to said female cap a male cap having a cylindrical projection fitting said recess provided with an annular groove wider than that of the female cap on its cylindrical surface adapted to form with the groove in the female cap an annular locking passage with the groove in the male cap being wider than that of the female cap whereby it extends to each side thereof, said female cap being provided with at least one access passage through its wall leading tangentially to said passage, inserting in said access and locking passages a locking rod adapted to lock the male cap to the female cap, driving the pile section into the ground by hammering on top of the male cap, when the pile section has been driven to the desired depth removing the locking rod and removing the male cap from the female cap of the driven pile section, then bringing into axial alignment with the driven pile another pile section having a male connecting cap on the end juxtaposed to the driven pile and on the other end of a female cap provided with a locking groove so as to form an annular locking enclosure, coupling said other pile section to the driven pile section by inserting the projection of its male cap into the depression in the female cap and applying a locking pin, then applying and locking a male driving cap to the female cap and driving the connected pile sections by hammering on the male cap so connected to said other pile section.

7. A method, as defined in claim 6, in which the wider groove is on the male cap.

8. A method, as defined in claim 6, in which the width of the wider groove at the surface of the cap is from about ten percent (10%) to about twenty percent (20%) greater than that of the narrower groove.

9. A method, as defined in claim 6, in which the narrower groove is semi-circular in cross-section and the wider groove has side walls which are quarter-circular in cross-section.

10. A method, as defined in claim 6, in which the narrower groove is semi-circular in cross-section and the wider groove has side walls which are quarter-circular in cross-section, the width of the wider groove at the surface of the cap being from about ten percent (10%) to about twenty percent (20%) greater than that of the narrower groove.

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U.S. Cl. X.R.

61—56, 53.5; 287—119; 285—305