May 2, 1967 YOSHIRO TSUZUKI 3,316,724

CONCRETE PILE JOINT AND METHOD OF ASSEMBLY

Filed Jan. 13, 1964 2 Sheets-Sheet 1

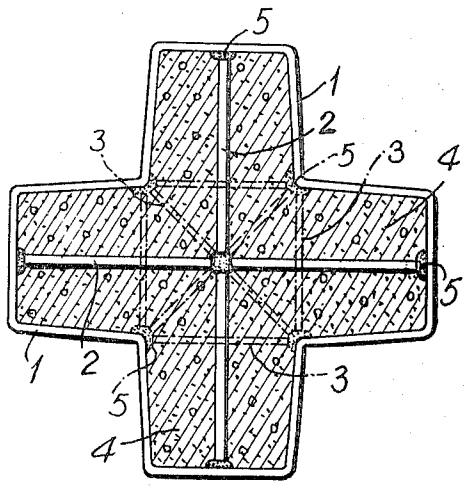
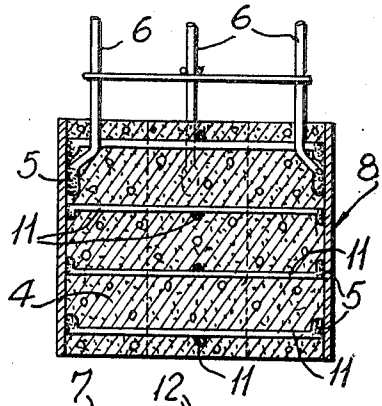


FIG. 1.



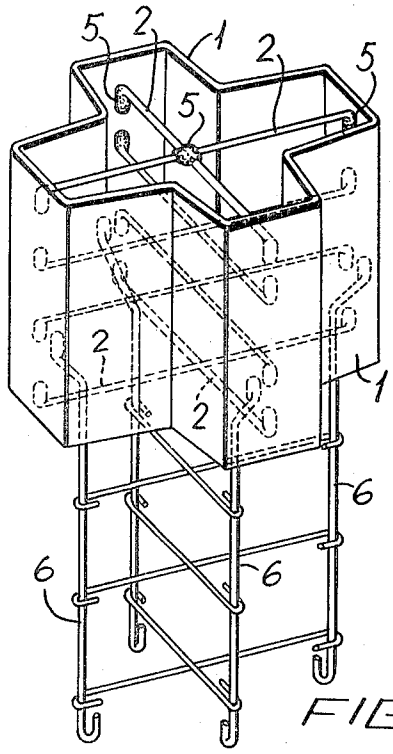


FIG. 2.

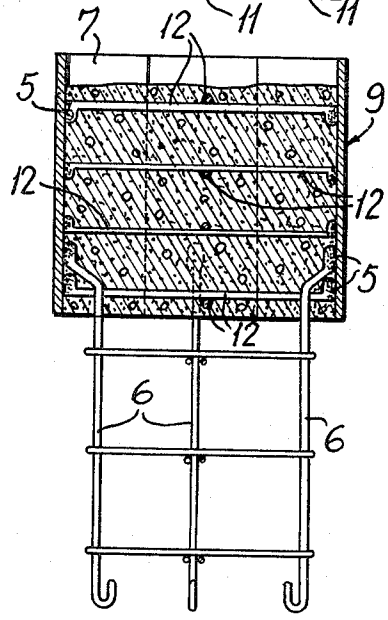


FIG. 3.

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CONCRETE PILE JOINT AND METHOD OF ASSEMBLY

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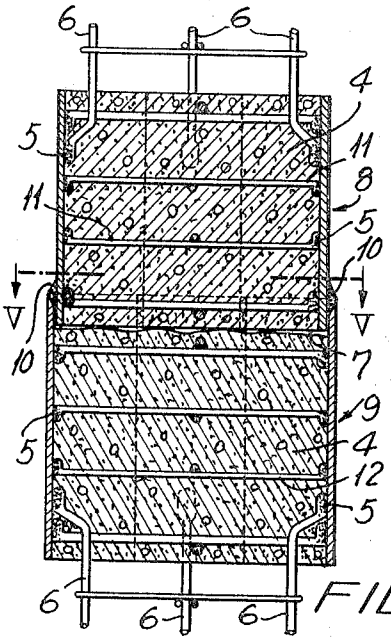


FIG. 4

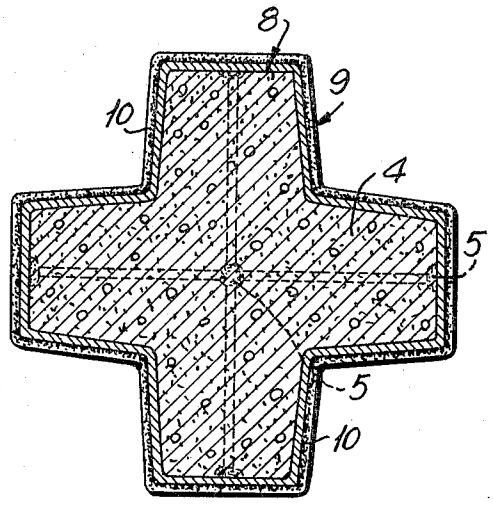


FIG. 5

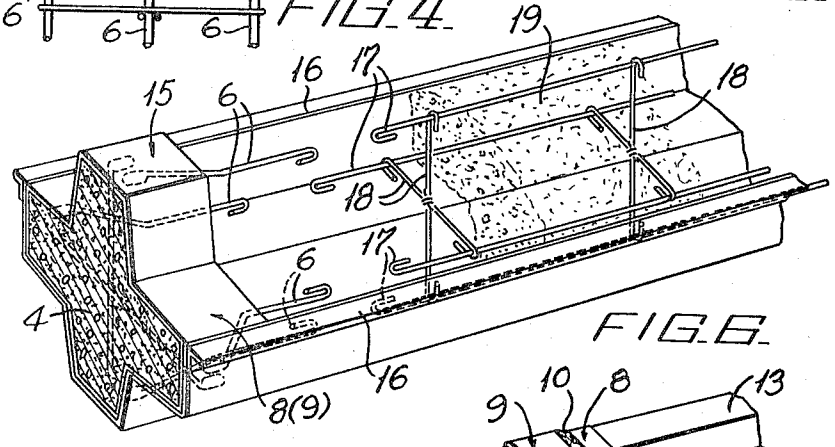


FIG. 6

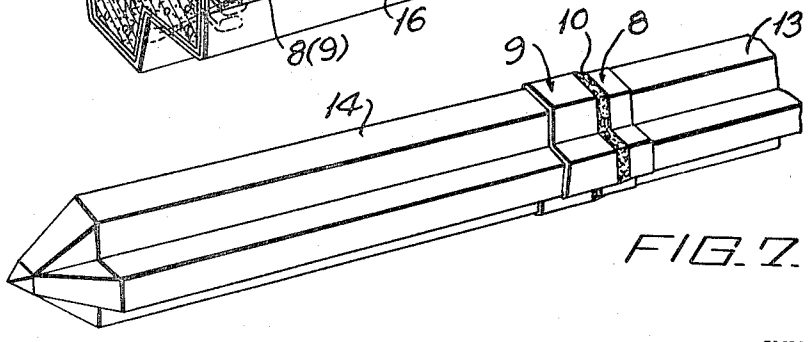


FIG. 7

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CONCRETE PILE JOINT AND METHOD OF ASSEMBLY

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The present invention relates to a connecting apparatus for solid cross shape concrete piles and method for the constitution of the said connecting apparatus.

An object of the present invention is to obtain an inexpensive, strong and durable connecting apparatus for solid cross shape concrete piles in an easy and rapid manner.

Another object of the present invention is to provide easily and rapidly a connecting apparatus for the continuous connection of solid cross shape concrete piles by using upper joint fittings for an upper pile and lower joint fittings for a lower pile which are respectively formed by bending a flat iron band or strip having the desired thickness and width into a cross shape, dimensioning the said upper and lower joint fittings such that the former joint fittings may closely be fitted into the latter joint fittings, and filling concrete in the joint fittings equipped with crossed reinforcing bars and connecting reinforcing bars.

A further object of the present invention is to provide an improved method for the constitution of connecting apparatus for solid cross shape concrete piles, which can rapidly constitute an inexpensive, strong and durable connecting apparatus by fitting upper cross shape joint fittings for an upper pile into lower cross shape joint fittings for a lower pile and welding the contacting peripheral edge of these fitted upper and lower joint fittings, in correlation with a mass production of the inexpensive cross shape joint fittings.

Other objects, features and advantages will be apparent from the following description.

Various connecting apparatuses have hitherto been proposed for the connection or joining of concrete piles. As an example thereof there may be exemplified, for instance, a joint for cylindrical hollow concrete piles produced by centrifugal casting. However, such joint entails the following defects:

(1) The axial reinforcing steel bars or concrete steels of the upper concrete pile is disconnected from those of the lower concrete pile, and measures for compensating the said disconnection are not taken.

(2) Mortar is penetrated into the space between the end faces of the upper and lower concrete piles for the purpose of uniformly transmitting the impact force of hammer to the lower pile and preventing the destruction at the bottom end of the upper pile and the head of lower pile, but it is difficult to expect the same strength as that of the concrete of pile in the said penetrated mortar.

(3) It is impossible to prevent completely the destruction at the aforesaid end faces of the upper and lower piles by means of the said mortar and moreover, no measures are taken for the compensation of the destruction when destroyed.

(4) From the reasons on the manufacture of piles and the working or operation in pile driving, it is customary that an appreciable gap is existing between the inner surface of the pile and the interior tenon and moreover, from the same reasons, it is unavoidable that more or less gap remains also between the outer band and the outer surface of the pile. For these reasons, the bending strength of the joint portion to the traverse load becomes far smaller than the pile itself.

In view of these facts in the hitherto known joint of the concrete piles, the present invention is intended to obivate such defects and improve the conventional known joints. The connecting apparatus according to this invention is characterized in that cross shape joint fittings for an upper solid cross shape concrete pile and cross shape joint fittings for a lower solid cross shape concrete pile are respectively formed by bending a flat iron band or strip having the desired thickness and width into a cross shape, the cross shape joint fittings for the upper pile and the cross shape joint fittings for the lower pile being respectively used for the bottom end of the upper pile and the head of the lower pile and being so dimensioned that the former joint fittings may closely be fitted into the latter joint fittings; at least one set of crossed reinforcing steel bars is respectively positioned inside of the joint fittings and each free bent end of the said bars is respectively welded to the corresponding inside face of the joint fittings; each rear portion of connecting reinforcing bars, which have respectively, at their front end, been welded to the inside faces of the joint fittings and/or the welded crossed reinforcing bars, is extended rearwardly from the joint fittings; and concrete is filled in the joint fittings and then hardened; and thus, the desired connecting apparatus is obtained by fitting the joint fittings for the upper pile into those for the lower pile and fillet-welding continuously the contacting peripheral edge of these fitted upper and lower joint fittings.

According to the present invention, the cross shape joint fittings of the upper and lower solid cross shape piles are able to connect perfectly the axial reinforcing bars in the upper and lower piles and, at the same time, the connection of the joint fittings is assured by arc welding, and accordingly, there is no need to fill the mortar as in the conventional known joints, and the cross shape joint fittings can prevent the pile head from the destruction due to the impact force of hammer. Thus, all defects inherent in the mortar filling in the known joints for the concrete piles can be overcome by the present invention. Furthermore, the cross shape joint fittings in this invention can be manufactured in such a manner that they adhere closely to the pile body, and at the same time, as the joint fittings can directly be connected with the axial reinforcing bars of the pile body through the connecting reinforcing bars, the bending strength to the traverse load can extremely be increased and for example, the bending strength amounting to about 2.5 times the proof stress of the pile body can surely be obtained.

On the contrary, in the joint portion of the conventional known concrete pile, the bending strength is remarkably decreased as described above, and there is also a danger that the joint portion is destroyed in the course of the pile driving. Moreover, about 20% of the fundamental proof stress is generally diminished each time the pile is connected with each other, and the connection of piles is extremely restricted by reason of the decrease in the proof stress. Consequently, according to the conventional connecting working for the concrete piles, the connection of two piles is practically regarded as its limit, judging from the safety rate. This decrease in the proof stress due to the connection of piles is the fatal defect in the conventional connecting working. In contrast therewith, the cross shape joint fittings according to the present invention is entirely different from the conventional joint for the concrete pile and 20% decrease of the fundamental proof stress as described above is wholly excluded, and the fundamental problem on the concrete piles, that is, the indispensable requirements for supporting pile, in which any number of concrete piles can freely be connected, is solved by the present invention

and thus, according to this invention, the solid cross shape piles can freely be connected continuously one by one, which is the remarkable characteristic feature of the present invention.

Furthermore, as set forth hereinbefore, in the present invention, a flat iron band having the desired thickness and width is bent to form cross shape joint fittings, and the cross shape joint fittings thus formed are respectively mounted on the bottom end of the upper solid cross shape pile and the head of the lower solid cross shape pile. After the former joint fittings have been fitted into the latter joint fittings, the peripheral edge in contact with each other is continuously fillet-welded, whereby the connection of the upper pile and the lower pile can firmly and rapidly be carried out. On the other hand, as at least one set of crossed reinforcing bars and the connecting reinforcing bars are respectively welded to the inside faces of the joint fittings, these joint fittings are completed when concrete is filled in the joint fittings and then hardened. Thus, the strong and durable connecting apparatus can simply and rapidly be obtained at low cost.

In order that the invention may more readily be understood, reference is now made by way of example to the accompanying drawings wherein like reference characters indicate like parts throughout the figures.

In the drawings:

FIG. 1 is a horizontal sectional view of cross joint fittings in the present invention, in which a set of crossed reinforcing bars is positioned inside of the joint fittings, each free bent end of said bars is respectively welded to the corresponding inside face of the joint fittings and concrete was filled in the joint fittings.

FIG. 2 is a perspective view of the cross shape joint fittings in the present invention, in which crossed reinforcing bars are welded to the cross shape joint fittings and each rear portion of connecting reinforcing bars welded, at each front end, to the inside faces of the joint fittings is extended rearwardly from the joint fittings.

FIG. 3 is a sectional front view showing the state before connecting upper joint fittings for the upper solid cross shape concrete pile to lower joint fittings for the lower solid cross shape concrete pile.

FIG. 4 is a sectional front view showing the state in which upper joint fittings for the upper pile have been fitted into lower joint fittings for the lower pile,

FIG. 5 is a sectional view taken on line V—V of FIG. 4,

FIG. 6 is a perspective view showing a method for the constitution of the connecting apparatus according to this invention, and

FIG. 7 is a perspective view of a complete pile of the upper solid cross shape pile and the lower solid cross shape pile, connected by the connecting apparatus according to the present invention, with a part of the upper pile being removed.

Referring to the figures, in FIG. 1, **1** designates cross shape joint fittings formed by bending a flat iron band having the desired width and thickness, for example about 9 mm. thickness in a known manner. At least one set of crossed reinforcing bars **2** is positioned inside of the cross shape joint fittings and each free bent end of the said bars **2** is respectively welded to the corresponding inside face of the joint fittings **1**. **5** shows the welded portion. The constitution of essential part as connecting apparatus for solid cross shape concrete piles is completed by filling concrete **4** in the inside of said joint fittings. That is, as the crossed reinforcing bars welded, at their free bent ends, to the inside of the joint fittings are embedded in the concrete **4**, the said crossed reinforcing bars **2** can perfectly be anchored to the concrete **4**, and the joint fittings **1** can be assured that they adhere perfectly to the concrete **4**. Furthermore, when the crossed reinforcing bars **2** are welded to the inside faces of the joint fittings **1**, together with X-shaped or square auxiliary reinforcing bars **3**, the adherence of the joint fittings to the concrete is further heightened.

The thus formed upper cross shape joint fittings to be used for the upper solid cross shape concrete pile and the lower cross shape joint fittings to be used for the lower solid cross shape concrete pile are so designed that the former fittings can closely be fitted into the latter fittings.

As the cross shape joint fittings **1** firmly adhered to the concrete **4** as described above can be seen from FIG. 4, the upper cross shape joint fittings **8** mounted on the bottom end of the upper solid cross shape concrete pile is closely fitted into the lower cross shape joint fittings **9** mounted on the head of the lower solid cross shape concrete pile and thereafter, the contacting peripheral edge of both joint fittings **8** and **9** is continuously fillet-welded and moreover, the welding can downwardly be carried out. Thus, the connection of the upper solid cross shape pile with the lower solid cross shape pile can perfectly be carried out by welding the upper joint fittings **8** and the lower joint fittings **9** together and therefore, the connecting apparatus of the present invention constitutes an extremely firm and rigid joint in correlation with the insurance of the adhering power of the cross shape joint fittings to the concrete. In addition, as the peripheral length of the cross shape joint fittings is considerably longer, the proof stress of the iron plate becomes large and moreover, as the fillet welding can continuously weld a line consisting of twelve sides of the cross shape iron, the said fillet welding can readily and rapidly be carried out, and the sure welding operation can be achieved without any danger of failure in the welding. Consequently, the connecting apparatus of the present invention is not only inexpensive but also can easily and rapidly perform the firm and strong welding and increase remarkably the pile driving efficiency. In addition, the cross shape joint fittings consisting of the desired thick iron band which is an essential member for the constitution of the connecting apparatus brings about remarkable function and effect in that the said apparatus can surely prevent the head of pile from the destruction due to the impact of driving hammer.

In FIGS. 1 to 5, **1** designates likewise cross shape joint fittings formed by bending a flat iron band, as set forth hereinbefore, **2** and **3** are respectively crossed reinforcing bars and auxiliary reinforcing bars, which are respectively welded to the inside face of the joint fittings **1**, **4** is concrete filled in the joint fittings and **5** welded portion. **6** designates a connecting reinforcing bar to be connected with axial reinforcing bar of the pile body, **7** an air space wherein the upper cross shape joint fittings **8** for the upper solid cross shape concrete pile is fitted into the lower cross shape joint fittings **9** for the lower solid cross shape concrete pile, and **10** a fillet-welded portion. **11** designates crossed reinforcing bars welded to the upper cross shape joint fittings **8**, and **12** crossed reinforcing bars welded to the lower cross shape joint fittings **9**.

Reference is made to a method for the constitution of the aforesaid connecting apparatus as follows:

As shown in FIGS. 1 and 2, a suitable set of the crossed reinforcing bars **2** is welded to the inside of the cross shape joint fittings **1** and auxiliary crossed reinforcing bars **3** are further welded to the cross shape joint fittings **1**, if desired. As shown in FIG. 6, each rear portion of connecting reinforcing bars **6** which have respectively, at their front ends, been welded to the inside faces of the cross shape joint fittings **1** and/or the welded crossed reinforcing bars **2**, is extended rearwardly from the cross shape joint fittings. As shown in FIGS. 3, 4 and 5, and set forth hereinbefore, the upper cross shape joint fittings **8** to be mounted on the bottom end of the upper cross shape pile and the lower cross shape joint fittings **9** to be mounted on the head of the lower cross shape pile are so designed that the former fittings **8** can closely be fitted into the latter fittings **9**. Concrete is

respectively filled in the said joint fittings 8 and 9 and then hardened, and the concrete block 15 consisting of the thus obtained joint fittings with the reinforcing bars 6 extending rearwardly is placed in a cross shape matrix or mould 16 and then the aforesaid extending reinforcing bars 6 are connected with reinforcing bars 17 and/or crossed reinforcing bars 18 of the pile body in an usual manner, after which concrete 19 is further charged in the said matrix or mould 16 by a known process to manufacture the desired solid cross shape concrete pile provided with the aforesaid cross shape joint fittings, and after the cross shape joint fittings of the upper solid cross shape concrete pile thus obtained has been fitted into the cross shape joint fittings of the thus obtained lower solid cross shape concrete pile, the contacting peripheral edge of the said upper and lower joint fittings is continuously filled-welded, whereby the constitution of the connecting apparatus for the solid cross shape concrete pile is completed. The cross shape joint fittings 8 and 9 formed by bending simply a flat iron band can not only play the part of the mould frame but also can be formed by the mere bending of flat iron band. Accordingly, the form of these cross shape joint fittings can be assured by forming the joint fittings by means of a press and the like and made on a mass production.

Furthermore, the cross shape joint fittings for the upper cross shape pile and those for the lower cross shape pile, which are so dimensioned that the former can accurately be fitted into the latter, not only provide the rapid connecting operation but also assure the reliable welding operation, and moreover, the method for the constitution of connecting apparatus of the present invention can rapidly constitute the inexpensive, strong and durable connecting apparatus in correlation with a mass production of the cross shape joint fittings.

Finally, FIG. 7 shows the state in which the connection of the upper solid cross shape pile with the lower solid cross shape pile has been completed by the connecting apparatus of the present invention. 8 designates the upper joint fittings mounted on the bottom end of the upper pile 13, and 9 is the lower joint fittings mounted on the head of the lower pile 14. After the said joint fittings 8 have been fitted into the joint fittings 9, the contacting peripheral edge of these both joint fittings 8 and 9 is welded together by arc welding. 10 shows the welded portion.

What is claimed is:

1. A connecting apparatus for solid cross shape concrete pile, which includes iron cross shape joint fittings for an upper solid cross shape concrete pile and iron cross shape joint fittings for a lower solid cross shape concrete pile, said joint fittings being dimensioned such that the former joint fittings may closely be fitted into the latter joint fittings, the cross shape joint fittings for the upper pile and the cross shape joint fittings for the lower pile being respectively used for the bottom end of the upper pile and the head of the lower pile; at least one set of crossed reinforcing bars having free bent ends are positioned inside of the said joint fittings, each free bent end of the said reinforcing bars being respectively welded to the corresponding inside face of the joint fittings; and connecting reinforcing bars, which are at their front ends welded to the inside faces of the joint fittings, each rear portion of the said connecting reinforcing bars being extended rearwardly from the cross shape joint fittings.

2. A connecting apparatus as defined in claim 1, wherein a few sets of the crossed reinforcing bars are respectively positioned inside of the cross shape joint fittings in spaced relation with one another in accordance with the width of the cross shape joint fittings, and each free bent end of each set of the crossed reinforcing bars is respectively welded to the corresponding inside face of the cross shape joint fittings.

3. A connecting apparatus as defined in claim 1, wherein concrete is disposed in the said cross shape joint fittings equipped with the cross reinforcing bars and the connecting reinforcing bars.

4. A connecting apparatus as defined in claim 1, wherein the joint fittings for the upper cross shape concrete pile are fitted into those for the lower cross shape concrete pile, and the contacting peripheral edge of these upper and lower cross shape joint fittings is continuously fillet-welded.

5. A method for the constitution of connecting apparatus for solid cross shape concrete pile having reinforcing rods, which comprises positioning at least one set of crossed reinforcing bars having free bent ends respectively inside of cross shape joint fittings for an upper solid cross shape concrete pile and cross shape joint fittings for a lower solid cross shape concrete pile, formed respectively by bending a flat iron band having the desired thickness and width into a cross shape and dimensioned such that the former cross shape joint fittings may closely be fitted into the latter cross shape joint fittings, each free bent end of the aforesaid crossed reinforcing bars being respectively welded to the corresponding inside face of the joint fittings; welding respectively connecting reinforcing bars, at their front ends, to the inside faces of the joint fittings, each rear portion of the said connecting reinforcing bars being extended rearwardly from the said joint fittings; filling concrete in the joint fittings equipped with the crossed reinforcing bars and the connecting reinforcing bars, the concrete being thereafter allowed to harden; placing the thus obtained concrete block comprising the said cross shape joint fittings in a cross shape mold; placing reinforcing rods for concrete pile body in the mold; connecting the aforesaid extending connecting reinforcing bars respectively to the reinforcing bars of the concrete pile body; charging concrete further in the said mold by a usual process to manufacture whereby the desired solid cross shape concrete pile provided with the aforesaid cross shape joint fittings and extending connecting reinforcing bars; and fitting the cross shape joint fittings of the upper solid cross shape concrete pile into the cross shape joint fittings of the lower solid cross shape concrete pile and then fillet-welding continuously the contacting peripheral edge of these fitted upper and lower cross shape joint fittings.

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