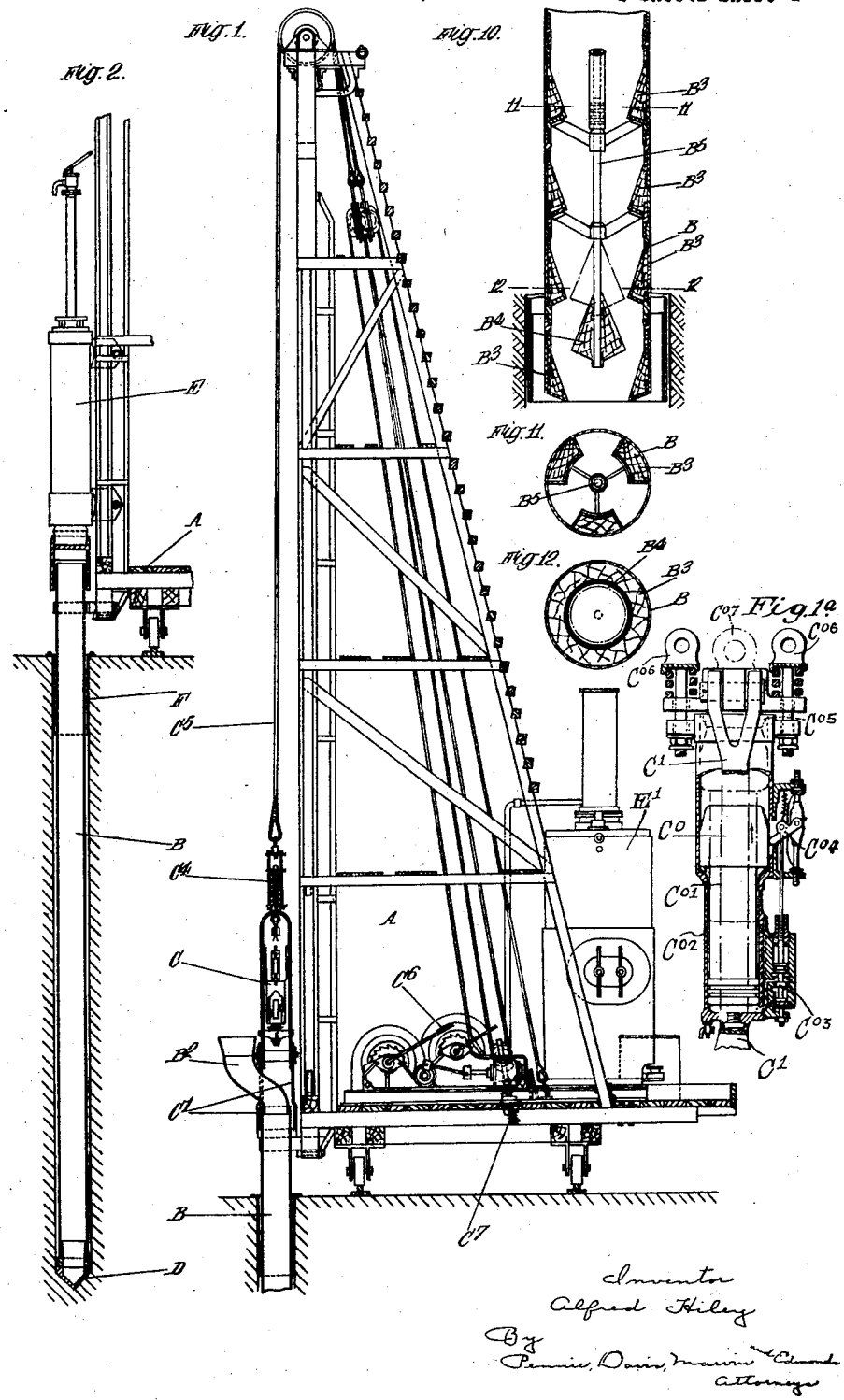
June 28, 1927. 1,634,231

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CONSTRUCTION OF CONCRETE PILES OR COLUMNS

Filed Jan. 6, 1922 2 Sheets-Sheet 1

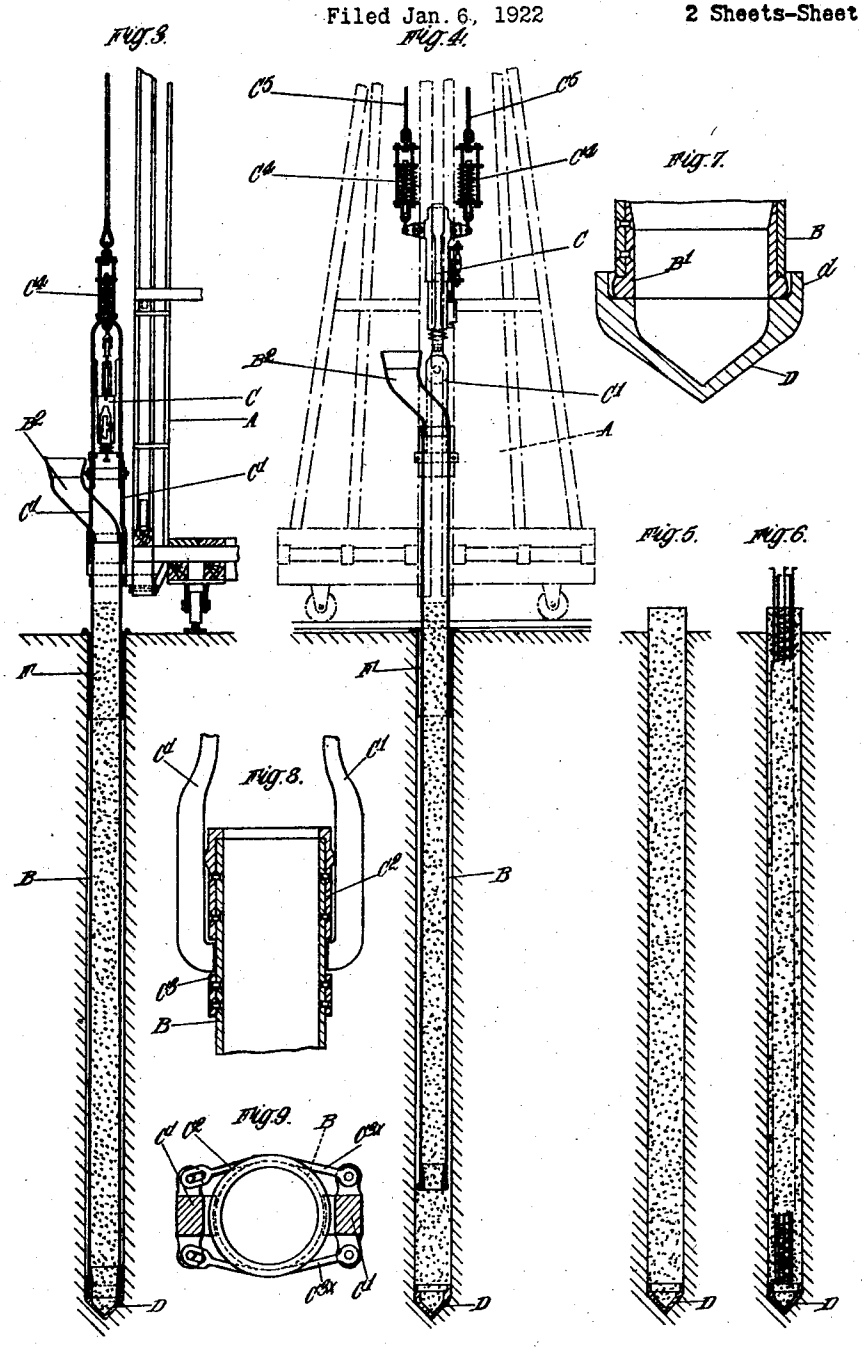


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CONSTRUCTION OF CONCRETE PILES OR COLUMNS

Filed Jan. 6, 1922 2 Sheets-Sheet 2



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Patented June 28, 1927. 1,634,231

UNITED STATES PATENT OFFICE.

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CONSTRUCTION OF CONCRETE PILES OR COLUMNS.

Application filed January 6, 1922, Serial No. 527,389, and in Great Britain February 17, 1921.

This invention relates to the construction of concrete piles or columns in situ and has for its chief object to improve upon the known methods of depositing concrete in a hole or cavity in the ground by means of a tube which is disposed in the hole and is gradually raised during the depositing of the concrete.

In the improved method according to the present invention the concrete is both deposited from the aforesaid tube and tamped and consolidated within the hole by vertical vibratory movements given to the tube, the pile being built up by a succession of operations each of which involves the depositing of a portion of the concrete from the tube by an upward movement of the latter and the tamping of the deposited concrete by a downward movement of the tube during which operations the tube gradually rises in the hole upon the concrete pile that is being built up. The upward movements of the tube may be caused by an inverted steam or other power operated hammer carried by the tube and acting preferably in the manner of a pile extractor and the downward movements may be effected merely by the weight of the tube or such portion thereof as is not balanced by a counteracting pull as by a winch connected by ropes to the tube. Preferably the winch is used without any counterbalance weights and the pull from the winch may be recorded or ascertained by means of a dynamometer so that the extent of the support given to the tube may be known.

The tube is preferably supported on or suspended by springs from the piling structure so that the structure is not materially affected by the vibrations caused by the hammer. The springs are preferably arranged in the rope connections between the hammer and the counterbalance weights or the winch so that the springs and the hammer assist each other in giving a synchronous effect in vibrating the tube and cause the energy from the hammer to be imparted principally to the tube which is allowed to vibrate without resistance from the mass of the piling structure. With ropes having sufficient extensibility the springs may be omitted, the ropes in this case performing the function of the aforesaid springs.

The said hammer and tube are the only essential operating parts of the apparatus for carrying the improved method into effect and by their use the disadvantages resulting from the use of a spiral vane for feeding and tamping the concrete and for raising the tube are obviated.

In order that the said invention may be clearly understood and readily carried into effect the same will now be described more fully with reference to the accompanying drawings, in which:—

Figure 1 is a side view showing one form of apparatus for carrying the invention into effect.

Fig. 1ª is a vertical section of the preferred form of inverted steam hammer for effecting the upward movements of the tube.

Figure 2 is a side view showing one form of apparatus for driving the tube into the ground, this tube in Figures 1 to 4 and 7 to 9 serving both as the driving tube and as the concrete depositing and tamping tube.

Figure 3 is a view similar to Figure 2 showing the tube filled with concrete and the apparatus of Figure 1 ready for imparting vibratory movements to the tube.

Figure 4 is a front view of Figure 3 with the tube slightly withdrawn.

Figures 5 and 6 are views of two forms of completed piles, the former showing a plain concrete pile and the other a reinforced concrete pile.

Figure 7 is an enlarged section showing the preferred shape of the driving shoe and the lower end of the tube, and

Figures 8 and 9 are a sectional elevation and a sectional plan showing the preferred method of detachably connecting the hammer to the tube.

Figures 10, 11 and 12 are respectively a vertical section and sections taken on the lines 11, 11 and 12, 12 of Figure 10 showing a modified form of tube which may be used in carrying out this invention.

A is the piling structure which is shown as being mounted on rails so that it can readily be moved on wheels or rollers in making a succession of piles close together. B is the aforesaid tube and C is the hammer for imparting the aforesaid vertical vibratory movements to this tube. This hammer may as aforesaid be an inverted steam or other hammer and is preferably detachably connected to the upper part of the tube B by the arrangement shown by Figures 8 and 9 which comprises two arms C^1, C^1 depend-

ing from the hammer casing or anvil and having hook-shaped lower ends engaging under the lower edge of a metal band C^2 riveted around the upper part of the tube, this band overlapping the upper end of the tube as shown to protect it during the driving operation. Below said (hook-shaped) ends there is a second band C^3 against which these ends press during the downward movements of the arms under the influence of the reaction of the hammer C. The said arms are also held together by links C^{3x}, C^{3x} shown in Figure 9. The said hammer is shown diagrammatically in Figures 1, 3 and 4 and the preferred constructional form is shown in detail in Figure 1^a, this form of hammer being fully described in English Patent No. 188,061. In Figure 1^a, C^0 is the hammer head formed on a ram C^{01} working in a cylinder C^{02} to which pressure fluid is admitted and from which it is exhausted, by a control valve C^{03} operated by the hammer head C^0 through the intermediary of an adjustable tappet C^{04}. C^{05} is the anvil carying the aforesaid arms C^1, C^1. C^{06}, C^{06} are eyes on the cylinder and C^{07} is an eye on the anvil, the aforesaid ropes C^5, C^5 being connected through the aforesaid springs C^4, C^4 to the eyes C^{06}, C^{06} or to the eye C^{07} as desired.

The casing of the hammer C is connected by springs C^4, C^4 to ropes C^5, C^5 which pass over pulleys at the top of the structure A and are connected by means of the tackle shown in Figure 1 to a winch C^6. A dynamometer spring balance C^7 (Figure 1) is provided for recording or indicating the pull exerted by the winch. D is the driving shoe which is preferably of the form shown by Figure 7 with an upwardly projecting flange *d* within which the lower end of the tube B is disposed. This end of the tube may have a ring B^1 riveted therein so as to strengthen this end of the tube, protect the lower edge of this tube and increase the tamping area of the tube. The ring may however be omitted when the tube is sufficiently thick.

In carrying out my invention with the apparatus shown by Figures 1 to 9, the structure A is moved so that the tube B carried on the face thereof is above the position where the pile is to be constructed. A steam pile driving hammer E (Figure 2) is connected to the upper end of the tube in any suitable manner and steam is admitted to this hammer from a boiler E^1 carried by the structure. The tube, with the shoe D below it, is thus driven into the ground to the required depth. When a protective tube F is to be employed to retain the ground from falling inwards at the upper part of the hole as shown, this tube may be detachably connected to the tube B before the latter has been driven into the ground so that the tube F is forced into the ground with the tube B. This is the position of affairs shown in Figure 2. The hammer E is then removed and replaced by the aforesaid hammer C which is connected with the winch C^6 as aforesaid and the tube F is filled with concrete through the chute B^2, this being the condition shown by Figure 3. The hammer C is then brought into operation and under its action and that of the winch C^6 and the springs C^4, C^4 the tube B is caused to rise step by step and to exert or create a downward pressure on the concrete deposited between each of these movements; each upward movement deposits a quantity of concrete from the tube into the hole left by the tube and each downward pressure tamps and consolidates the concrete within the hole. When the tube B has nearly completed its upward movement, a connection is established between it and the protective tube F so that the latter is then drawn out of the hole with the tube B. The shoe D is left at the bottom of the hole as shown in Figures 4 to 6. Completed piles are shown in Figures 5 and 6, the former showing a plain concrete pile and Figure 6 showing a reinforced concrete pile, the reinforcement having been placed in position in the tube B before the latter was filled with concrete.

In the alternative construction of the tube B shown by Figures 10, 11 and 12, this tube is provided near its lower end with a number of internal circumferential collars B^3, B^3—which are continuous or interrupted and which are arranged a suitable distance apart. These collars are of substantial length and depth and are triangular in cross-section with the upper surfaces longer than the lower surface so that the former is arranged at a more acute angle than the latter. By this arrangement the concrete can flow freely downwards over the sloping upper surface of each collar during the upward movements of the tube whilst the lower surfaces serve to press the concrete downwards during the downward pressure of the tube.

In cases (for example in sub-aqueous piling) where it is desired to retain a charge of concrete within the tube when the latter is being lowered into the hole in the ground, there may be provided in the lower part of the tube (preferably between the last two collars therein) a conical member B^4 arranged with its apex uppermost and attached to a central rod B^5. This rod is so connected to the upper part of the tube (by screw gear for example) that the said conical member can at will be moved into a closed position relatively to the adjacent collar or into an open position to permit the concrete to flow past it. The said conical member when in the last mentioned or open

position also serves to assist in the tamping operation by its base, which is bluntly conical, pressing on the central portion of the concrete that is not acted upon by the lower surface of the lowermost collar.

What I claim and desire to secure by Letters Patent of the United States is:—

1. The method of constructing concrete piles or columns in situ, consisting in depositing the concrete into a hole from a conveying member which is disposed in the hole and with the inner surface of which the concrete is in contact, imparting vertical vibratory movement to said member in such a manner as to deposit some of the concrete from said member during its upward movements, said upward movements consisting of short, discontinuous vertical vibratory translations imparted by sudden blows of a hammer and utilizing a structural part of said member to act as tamping means for the concrete in the hole on the downward movement of said member, the pile being built up and the member being gradually and automatically caused to rise in the hole upon the concrete by the said vibratory movement.

2. The method of constructing concrete piles or columns in situ consisting in depositing the concrete into a hole from a tube which is disposed in the hole and with the inner surface of which the concrete is in contact, imparting vertical vibratory movement to said tube in such a manner as to deposit some of the concrete from said tube during its upward movements, said upward movements consisting of short, discontinuous vertical vibratory translations imparted by sudden blows of a hammer and utilizing a structural part of the tube to act as tamping means for the concrete in the hole on the downward movement of said tube, the pile being built up and the tube being gradually and automatically caused to rise in the hole upon the concrete by the said vibratory movement.

3. A method of constructing concrete piles or columns in situ, wherein the concrete is deposited from a tube with the inner surface of which the concrete is in contact and tamped and consolidated within a hole in which this tube is disposed, by vertical vibratory movements given to the tube, the pile being built up and the tube gradually and automatically caused to rise in the hole upon the concrete, by a succession of operations, each of which involves the depositing of a portion of the concrete from the tube by an impulsive upward movement of the said tube and the tamping of the deposited concrete by a structural part of the tube on the downward movement of the said tube.

4. Apparatus for constructing concrete piles or columns in situ, comprising a tube which contains the concrete in contact with its inner surface and is disposed in a hole in which the pile is to be formed, and means for imparting vertical vibratory movements to said tube.

5. Apparatus for constructing concrete piles or columns in situ, comprising a tube which contains the concrete in contact with its inner surface and is disposed in a hole in which the pile is to be formed and means for imparting upward shocks to said tube for raising it step by step out of said hole and depositing the concrete therein.

6. Apparatus for constructing concrete piles or columns in situ, comprising a tube which contains the concrete in contact with its inner surface and is disposed in a hole in which the pile is to be formed and a power operated hammer for imparting upward shocks to said tube for raising it step by step out of said hole and depositing the concrete therein.

7. Apparatus for constructing concrete piles or columns in situ, comprising a tube which contains the concrete in contact with its inner surface and is disposed in a hole in which the pile is to be formed and a power-operated hammer carried by said tube for imparting upward shocks to said tube for raising it step by step out of said hole and depositing the concrete therein.

8. Apparatus for constructing concrete piles or columns in situ, comprising a tube which contains the concrete in contact with its inner surface and is disposed in a hole in which the pile is to be formed, a power operated hammer for imparting upward shocks to said tube for raising it step by step out of said hole and depositing the concrete therein and means for exerting an upward pull on said tube during the operation of said hammer.

9. Apparatus for constructing concrete piles or columns in situ, comprising a tube which contains the concrete in contact with its inner surface and is disposed in a hole in which the pile is to be formed, a power operated hammer for imparting upward shocks to said tube for raising it step by step out of said hole and depositing the concrete therein, and a winch and ropes for exerting an upward pull on said tube during the operation of said hammer.

10. Apparatus for constructing concrete piles or columns in situ, comprising a tube which contains the concrete in contact with its inner surface and is disposed in a hole in which the pile is to be formed, a power operated hammer for imparting upward shocks to said tube for raising it step by step out of said hole and depositing the concrete therein, means for exerting an upward pull on said tube during the operation of said hammer and a spring in the connections between said means and said tube.

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