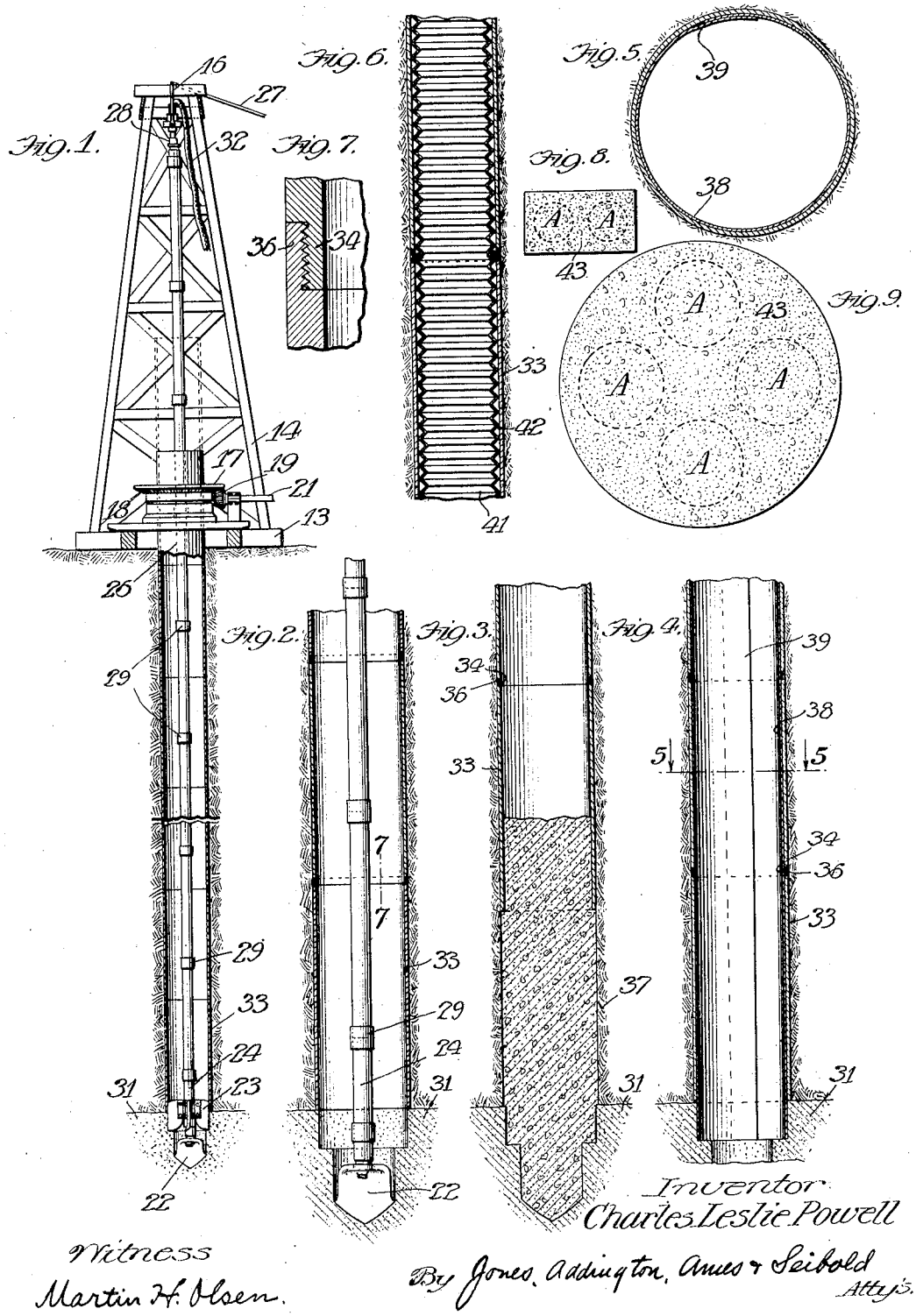
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METHOD OF CONSTRUCTING CAISSONS

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METHOD OF CONSTRUCTING CAISSONS.

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My invention relates to the construction and formation of caissons, abutments, piles and the like and particularly to such as are formed from concrete or other plastic compounds.

In the construction of caissons, etc., it has been the usual practice to dig or sink holes in the ground and then fill with concrete. This method is not only very laborious but is very expensive and slow in that the dirt must all be dug and taken from the hole manually. I am aware that many other methods for removing the dirt have been experimented with and several patents have been granted on methods and apparatus for accomplishing this purpose but none of these have ever come into such general and practical use as to obsolete the hole digging methods. The term "caisson" has come to be known in construction work as meaning the concrete pillar or foundation post formed in the earth and may extend partly through water, rock, etc. In the present day construction of caissons the forms or, as I shall refer to them, the casings when placed in the holes into which the concrete or other plastic compound is poured, are left in position surrounding the concrete. This is very costly and from the standpoint of strength is usually unnecessary.

In my improved method of constructing caissons and the like I first employ the well known method used in drilling oil and gas wells, i. e. drilling into the ground with a tool of the required diameter, so as, to loosen the earth in the path of the drill and supplying the end of the drill with a copious amount of water which mixes with the loosened earth to form soft mud. This drilling passes through occasional rock, shale, etc., and extends downward to bed rock. By this method any water or quicksand encountered is quickly sealed by the mud which is forced back into the sandy formation or water so as to wall up the same, which supports and prevents the leakage thereof into the drilled area, all of which is very advantageous and is accomplished by the employment of the rotary drill process utilized for breaking up the earthy material and which is not accomplished by the old oil well boring method or present caisson digging method.

In some instances the drilling tool is now removed and a casing substantially the same diameter as the drilled tool is now inserted through the mud with its lower end resting on the bed rock. In other instances the cutting tool will be left in position until the casing is inserted through the mud. I then remove the soft mud from the interior of the casing, and the periphery of the casing will be in substantially close proximity to the undrilled earth which defines the circumferential line of cutting of the drilling tool. This operation of drawing the mud from the inside of the casing may be accomplished in any one of several different ways, for instance it may be bailed out as in the ordinary gas or oil well, or it may be drawn out by suction.

After all the mud has been removed from the inside of the casing, concrete or other plastic compound is poured into the interior of the casing and as it reaches the bottom thereof the casing is gradually withdrawn so that the concrete settles against the undrilled walls of the hole and embeds itself therein. The adhesion of the concrete or plastic compound with the walls of the hole is greatly assisted by intermittently tamping the material during the filling operation. After the casing has been entirely removed we have a solid body of concrete or other material firmly embedded in the uncut walls of earth and where desired one in which there is no surrounding casing.

With this method of constructing caissons it has been found caissons requiring one week to ten days to build by the present day methods can be completed in from six to eight hours. Another very important feature and one of the principal objects of this invention is the elimination of frequent trouble caused by the crumbling and the caving of the earth around the hole. In my improved method the uncut side walls of the hole will be supported by the soft mud within the same and before this mud is withdrawn the casing is inserted which provides adequate support for the side walls of uncut earth.

Other objects and advantages of my im-

proved method of constructing caissons will be apparent from the following description when considered in connection with the accompanying drawing in which:

Figure 1 is a view of a derrick showing a section of earth with the cutting tool and the casing resting on the bed rock;

Fig. 2 is an enlarged vertical sectional view of the bottom of the hole and with the cutting blades removed from the drill;

Fig. 3 is a like view showing the cutting and drilling tool removed, the bottom of the hole filled with concrete and the casing drawn up to about the line of fill;

Fig. 4 is a like view showing a permanent inner casing inserted within the sunk casing;

Fig. 5 is an enlarged cross sectional view taken on the line 5—5 of Fig. 4;

Fig. 6 is a like view showing the permanent inner casing formed of corrugated metal;

Fig. 7 is an enlarged vertical section on the line 7—7 of Fig. 2 showing the manner in which the sections of casing are joined together;

Fig. 8 is a top plan view showing the manner in which the caissons are sometimes connected in tandem; and

Fig. 9 is a like view showing four of the caissons constructed in the same manner.

In the drawing like symbols of reference indicate like parts.

Having briefly described the method practiced in constructing my improved caisson, I will now refer to the drawing and describe the apparatus employed in carrying out the method.

A platform 13 is constructed on the ground with its center at the position where the caisson is to be located. Upon this platform is constructed a derrick 14 which is provided with the usual block and tackle devices 16. On the platform or derrick floor 13, I locate a standard rotary machine 17 which is provided with a geared rack 18 driven by the beveled gear 19 mounted on the shaft 21 which extends to and is driven by any suitable source of power. Let us assume that the drilling tool 22, above which are located the cutting blades 23 and all mounted on the sectional stem 24, to be resting upon the ground at the point which I have indicated by the numeral 26. The stem 24 extends through the rotary machine 17 and is rotated from the shaft 21 with the said machine and this machine while gripping the said shaft to rotate the same will permit longitudinal movement thereof as the same drills and cuts its way into the earth. To prevent the tools from drilling too rapidly a cable 27 is attached to the head-piece 28 of the stem and said cable extends to and is paid out from the drum of an ordinary hoist (not shown). After the tools have drilled themselves a short distance into the earth loosening the soil around the same the rotary machine 17 is stopped, the first section of the stem 24 is detached from the head-piece 28 by unscrewing the collar 29, raising the head-piece and inserting another section of stem whereupon the rotary machine 17 is again placed in operation. This operation of adding sections to the stem 24 will continue until the cutting tools 23 have reached and cut a short distance into the bed rock, which I have indicated by the numeral 31. During all the time the drilling tool 22 and cutting tools 23 have been loosening the earth they have been supplied with a constant stream of water entering the interior of the stem 24 from the flexible pipe 32 so that the loosened earth mixing therewith has been changed to mud of very thin consistency.

At this point in the operation I may withdraw the tools 22 and 24 by again operating the rotary machine 17 and placing tension on the cable 27, stopping the machine after the tools have been raised a short distance, disconnecting one of the sections of the stem, lowering the head piece 28 connecting same with the end of the next section of stem and then again operating the rotary machine and continuing to disconnect sections as the tools are withdrawn through the mud.

In other instances I may prefer to leave the tools at the bottom of the loosened material for the time being.

In either event I now open the jaws (not shown) of the rotary machine 17 so that they will accommodate a section of the casing 33. This casing is then rotated by the machine 17 and as it is substantially of the same diameter as the overall dimension of the cutting tools 23, it will be rotated through the mud and with its outer surface in close proximity to the uncut earth around the mud. This casing 33 is formed in sections and the sections are joined together by the threaded portion 34 on the lower end of the upper section meshing with the threaded portion 36 on the upper end of the lower section so that the entire casing will present a smooth and finished appearance and with no lugs, bolts, or other impedimenta to resist the passage of the casing through the mud. As the casing is rotated until it gradually rests upon the bed rock the soft mud will entirely fill the interior thereof and the next operation is the removal of all mud therefrom. This may be accomplished by using an ordinary driller's bailing tool or suction may be applied thereto in any suitable manner. If the drilling tool 22 and cutting tools 23 have not been formerly removed, a man is now lowered through the casing and after he has unbolted the cutting tools or blades 23 they are hoisted through the casing by means of a rope, after which the stem 24 and drilling tool 22 are raised

and the stem disconnected, section by section, as previously described. In such case, where the tools are left in the hole, and where they are removed by the foregoing method, the earth around the hole is of such a crumbling nature that it is advisable to have the casing closely follow the cutting members in order to hold up the uncut walls around the mud.

All the mud having been removed from the interior of the casing 33, concrete or other plastic compound is now poured into the casing and as it settles the casing is gradually rotated in a clockwise direction and gradually raised from the bedrock as the concrete drops from the lower end thereof. As a matter of fact the bottom of the casing will always be within the concrete so that there is no opportunity for any portion of the earth 37 around the hole crumbling or caving during the withdrawal of the casing. At intervals throughout the filling of the hole with the concrete the pouring thereof is stopped and the concrete already in the hole is tamped by any suitable means, such as a weight having a cable passing over the block and tackle 16 and allowed to drop onto the top of the fill, and this tamping action will force the soft, pliable concrete firmly against the uncut earthen walls surrounding the hole. This filling and tamping will continue, and the sections of the casing will be removed as they emerge from the ground until the entire hole has been filled with the concrete mixture firmly tamped into the hole and with no other support than the uncut wall of earth surrounding the same.

The casing 33 is preferably formed of steel or cast-iron, and its walls are in most cases about $\frac{3}{8}''$ to $\frac{1}{2}''$ thick, so that a section of the same is of sufficient weight to readily sink through the mud when the same is rotated by the machine 17 without any additional pressure being placed on the top thereof. The tools 22 and 23 are also of sufficient weight to cut their way through the earth and any rock which may be encountered without applying any pressure thereto.

In some instances, and particularly where specifications require, a permanent metal casing is provided around the concrete caisson, and this may be provided for by leaving the casing 33 in the position shown in Figs. 1 and 2 and filling the same with concrete, as described, or a thin metal casing 38 about $\frac{1}{16}''$ thick having its ends overlapped, as shown at 39, in Fig. 5, may be inserted within the casing 33 and when the concrete is poured therein and the casing 33 withdrawn, the weight of the concrete assisted by the tamping thereon will expand the thin metal casing 38 so that it will be forced firmly against the material 37 comprising the walls of the hold. In some cases I may use the form of inner casing 41 shown in Fig. 6, said casing being formed of corrugated metal so that when the concrete is poured therein and the outer casing 33 withdrawn from around the same and the concrete tamped, as above explained, the points of the corrugations 42 will be driven into the walls of the earth 37 so as to provide great resistance against crushing strains applied to the top of the caisson. In this connection it may be noted that the adherence of the caisson to the earth surrounding the same, or the pressure of the earth around the caisson is so great that even with the bedrock support removed from the lower end thereof a tremendous upper pressure on the caisson is required to move it downwardly into the earth or to crush the same. This particular feature plays a very important part in the construction of caissons, and with my improved method of construction none of the essential features existing in caissons formed after the general practice of today has been impaired.

Bearing in mind the pressure of the earth around the caisson contributing largely to its support, in some instances it may be advisable to sink caissons in tandem form, as shown in Fig. 8, or even in quadruple form, as shown in Fig. 9. By this method of construction the individual caissons A have the pressure of the earth around the entire circumference of the same so that for a much less quantity of concrete a greater and stronger multiple caisson can be constructed. If desired, these caissons may be topped by a square or round portion of crown 43 uniting them together.

In many cases, and particularly where the caissons are to be placed in hard earth or clay, it may be desirable to first drill a hole with the drilling tool 22 only, attached to the stem 24, and in some cases even a smaller drill might be first used, and a larger drill subsequently connected with the stem, and the hole redrilled. This drilling would be without the cutting tools 23 which ream the hole to the proper diameter. In such cases after the drilling operation has been completed, the cutting tools or reamers 23, would be connected with the stem, and the drilling tool 22 either left in position or removed if desired. It might also be stated in this connection that in some instances even the outer diameter of the cutting tools 23 would on the first reaming cut be smaller than the required diameter of the finished hole, in which case after making the first cut, new cutting tools 23 of the required diameter would be attached to the stem 24 and the earth, rock, etc., cut to the required diameter of the finished hole. While I have in my foregoing description described the hole as being drilled and cut in one operation, it will be apparent that so long as I arrive at

the finished result of a hole cut to the required diameter and filled with soft mud, various methods of cutting and drilling the same may be employed.

It will, of course, be apparent from the foregoing description that caissons of any required diameter may be constructed by this method, and on account of its facility, a great amount of time will be saved in the construction of foundations for buildings and the like over the present-day methods. In practice this method has been found very efficient, and the derrick 14 and rotary machine 17 mounted on the platform 13 may be moved from spot to spot as the work of constructing the required number of caissons advances.

While I have shown and described a preferred embodiment of my invention, it will be understood that I do not limit myself to the devices shown and described herein for carrying out my improved method, nor do I limit myself to each and every of the steps described in putting the same into effect. Having in mind the variations which may be practiced in connection with the method and the different kinds of apparatus which may be used in carrying out the same, I claim all such modifications and combinations of my improved method as properly fall within the spirit and scope of the appended claims.

I claim:

1. The herein described method of constructing caissons and the like comprising the steps of first loosening the earth and introducing water to form soft mud, then inserting an open ended casing into the mud, then removing the mud from the interior of the casing, then filling the resulting hole by pouring plastic compound into the casing, and drawing the casing from the hole gradually as the concrete fills the hole.

2. The herein described method of constructing caissons and the like comprising the steps of first drilling to bed rock while mixing the loosened earth with water to form soft mud, then inserting a casing through said mud to the bedrock, then removing the mud from within the casing, and then filling the resulting hole with plastic compound while gradually drawing the casing from said resulting hole.

3. The herein described method of constructing caissons and the like comprising the steps of first drilling to bedrock while mixing the loosened earth with water to form soft mud, then inserting a casing through said mud, said casing being of substantially the same diameter as the drill, then removing the mud from within the casing, then removing the drill, and then filling the resulting hole with plastic compound while gradually drawing the casing from said resulting hole.

4. The herein described method of constructing caissons and the like comprising the steps of first drilling to bedrock while mixing the loosened earth with water to form soft mud, then removing the drill from the mud, then inserting a casing through said mud, said casing being of substantially the same diameter as the drill, then removing the mud from within the casing, and then filling the resulting hole with plastic compound while gradually drawing the casing from said hole.

5. The herein described method of constructing caissons and the like comprising the steps of first drilling to bedrock while supplying the drill with sufficient water which, when mixed with the loosened earth, forms soft mud, then inserting a casing through said mud to the bedrock, then removing the mud from within the casing, then filling the resulting hole by pouring plastic compound into the casing, drawing the casing gradually from the hole as the concrete fills the same, and intermittently tamping the concrete so as to force it into firm contact with the ground around the hole.

6. The herein described method of constructing caissons and the like comprising the steps of first loosening the earth down to bed-rock and introducing sufficient water to form soft mud, then inserting a casing through the mud to the bedrock, then removing the mud from within the casing, then inserting an expansible casing within said first casing, then filling said expansible casing with plastic compound while drawing said first casing from the resulting hole so as to permit the expansion of said expansible casing into contact with the ground around the hole.

7. The herein described method of constructing caissons and the like comprising the steps of first loosening the earth and introducing sufficient water to form soft mud, then inserting a casing through the mud to the bedrock, then removing the mud from within said casing, then inserting an expansible corrugated casing within said first casing, then filling said corrugated casing with plastic compound while drawing said first casing from the resulting hole so as to permit the expansion of said corrugated casing into contact with the ground around the hole.

8. The herein described method of constructing caissons and the like comprising the steps of first loosening the earth and introducing sufficient water to form soft mud, then inserting a casing through the mud to the bedrock, then removing the mud from within said casing, then inserting an expansible corrugated casing within said first casing, then filling said corrugated casing with plastic compound while drawing

said first casing from the resulting hole, tamping said plastic material intermittently while filling said corrugated casing so as to expand the same and drive the corrugations into the ground around the hole.

9. The method of constructing caissons which consists in loosening the earth and supplying the same with water to form a soft mud that is allowed to remain in the loosened area after the loosening operation ceases, inserting a sectional casing through said mud, removing the said mud from the interior of said casing, and finally filling concrete into the interior of said casing and progressively withdrawing and disconnecting sections of said casing as the filling proceeds.

10. The method of constructing caissons which consists in drilling into the ground with a tool of progressive diameters and supplying said tool with a copious amount of water to form a mud that is allowed to remain in situ, inserting a sectional casing through the soft mud formed by the mixing of said water with the earthy material loosened by said tool, removing said mud from the interior of said casing, and finally filling concrete into the interior of said casing and progressively withdrawing and disconnecting sections of said casing as the filling proceeds.

11. A method of sinking caissons in the earth, comprising loosening and breaking up the earthy material which is to be displaced to make room for the caisson, supplying liquid to the broken up material while it is still in the drilled area to form a fluid mass in said area which exerts pressure against the uncut sides thereof sufficient to resist caving in and the entrance of water and quicksand to the loosened area, sinking a casing in said area while the fluid mass is still therein, withdrawing the fluid mass from within the casing, and supplying the caisson material to the resulting hole through said casing.

12. A method of sinking caissons in the earth, comprising loosening and breaking up the earthy material which is to be displaced to make room for the caisson, supplying liquid to the broken up material while it is still in the drilled area to form a fluid mass in said area which exerts pressure against the uncut sides thereof sufficient to resist caving in and the entrance of water and quicksand to the loosened area, sinking a casing in said area while the fluid mass is still therein, withdrawing the fluid mass from within the casing, supplying the caisson material to the resulting hole through said casing, and withdrawing the casing from the hole, leaving the caisson material in place in the hole.

13. The herein described method of constructing caissons and the like, which comprises the steps of first loosening the earth with introduction of water to form a soft mud, thereupon inserting an open ended casing down into the soft mud, removing the mud from within the casing, placing a plastic setting material into said casing, and removing the casing before said plastic material has set.

14. The method of preventing the caving in of openings being made in the earth, which comprises loosening the earth with the addition of water so as to form mud that remains in the loosened area, and thereupon inserting an open ended casing into said mud.

15. The method of constructing caissons and the like which comprises drilling into the earth with the addition of water to form a mud that remains in the loosened area, allowing a casing open at both ends to sink downwardly into and through said mud by its own weight until it strikes and rests against the non-loosened undrilled earth, removing the mud from within said casing, placing a plastic material capable of setting into said casing, withdrawing the said casing prior to the setting of the said plastic material, and allowing said material to set and harden.

In witness whereof, I have hereunto subscribed my name.

CHARLES LESLIE POWELL.