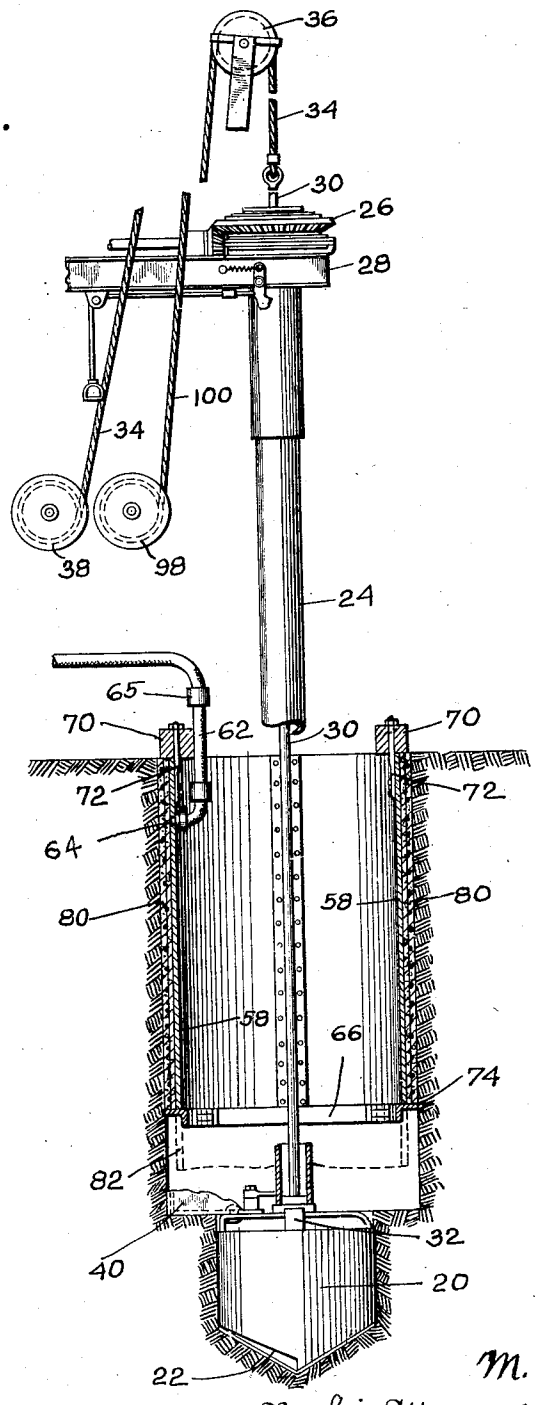
Jan. 5, 1932. M. M. UPSON 1,839,358

METHOD OF AND APPARATUS FOR FORMING CAISSONS

Original Filed Sept. 15, 1927 2 Sheets-Sheet 1

FIG. 1.



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FIG.2.

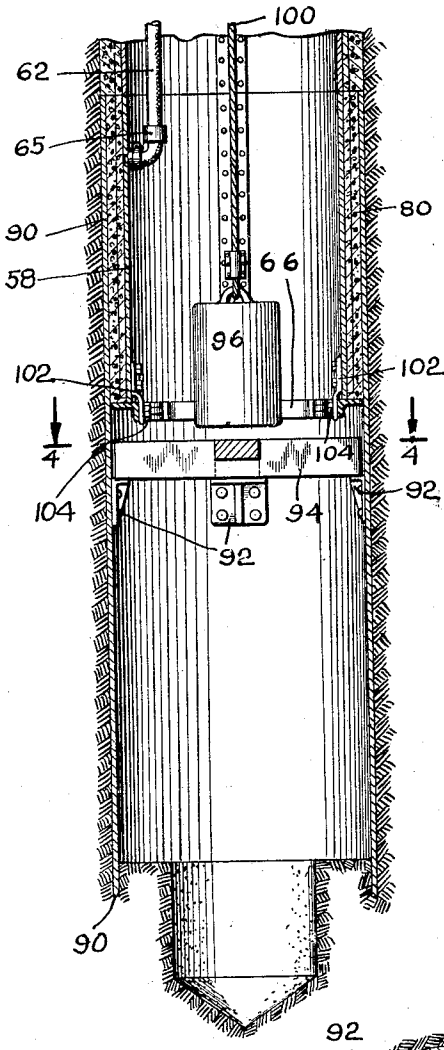


FIG.3.

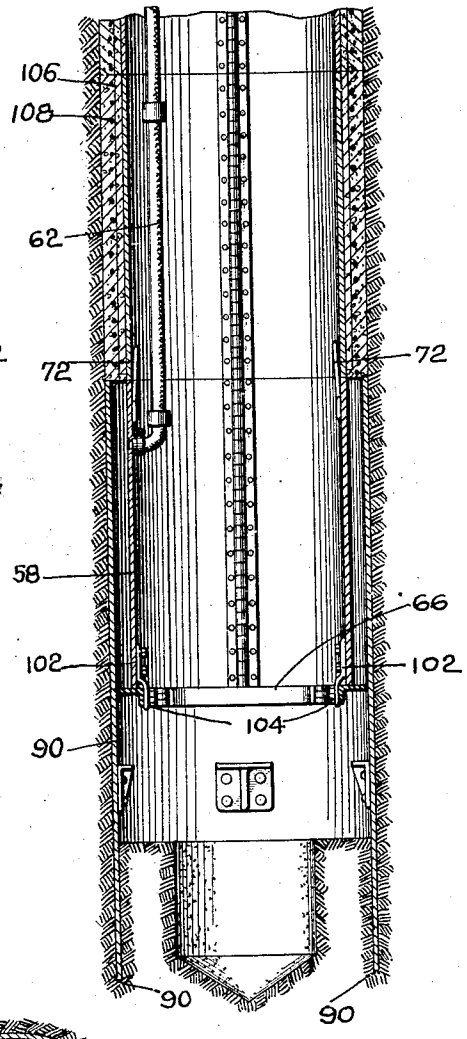
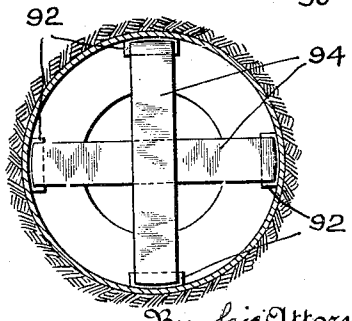


FIG.4.



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UNITED STATES PATENT OFFICE

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METHOD OF AND APPARATUS FOR FORMING CAISSONS

Original application filed September 15, 1927, Serial No. 219,572. Divided and this application filed June 26, 1928. Serial No. 288,428.

This application is a division of my copending application, Serial No. 219,572, filed September 15, 1927, which pertains to a method and apparatus for making caissons, or in other words, for lining or sheeting walls of excavations, cavities, or holes in the ground to prevent their collapse while structures of steel, masonry, concrete, etc., are being built therein.

One common method of forming caissons is to sink telescopic steel shells, one inside the other, as the excavating progresses. One objection to this method is the cost; another is the fact that the excavation must be larger at the top than at the bottom, which adds still more to the cost, especially when the excavation is very deep.

Although caissons may be of any desired shape, the present invention has particular utility in connection with the sinking of circular caissons; therefore a modification adapted for that particular work will be described.

The invention contemplates boring or digging a hole to a certain depth, lining the hole with quick-setting cement, plaster of Paris, or other quick strength material, then sinking the hole further and lining it section by section, as the digging proceeds, just as the first section of the hole was lined. I prefer to use collapsible steel forms to aid in forming the cement lining or caisson.

The sections of cement lining are all substantially alike and when the job is finished the bore is lined from top to bottom with a vertical hollow caisson of concrete. Each section of the caisson abuts the adjoining sections with the result that collapse or caving of the excavation is prevented while the desired work is done therein.

The primary object, therefore, of the invention is to disclose an improved method and apparatus for forming caissons which comprises lining the excavation with a series of concrete shells as the digging progresses.

Under certain conditions, for instance wet soil, some supplemental apparatus is desirable, and this application is directed particularly to the method and equipment especially suitable for such conditions.

In the drawings,

Fig. 1 shows one embodiment of the apparatus at work. The first section of the hole has been lined and the collapsible form is in place.

Figs. 2 and 3 show the apparatus and method suitable for use in wet soil.

Fig. 4 is a cross-section on the line 4—4 of Fig. 2.

As a convenient and practical means for digging a circular hole of any desired diameter and depth, I prefer to use a rotary digging bucket and reamer of the type described in the copending application of Francis H. Hunt, Serial No. 184,407, filed April 16, 1927; therefore, although other methods of digging may be used, I shall in the present specification for convenience make use of the Hunt apparatus.

This device comprises a rotary digging bucket 20 provided on its bottom with cutters 22 so arranged that when the bucket is rotated in proper direction the bucket bores vertically into the ground. The detritus produced by cutters 22 passes up into the bucket. The bucket is rotated by a telescopic kelly 24 which is actuated by gearing 26 supported on an overhead frame 28. The bucket is raised and lowered by rod 30 passing through the kelly and attached at its lower end to bails 32 of the bucket. The upper end of rod 30 is connected to cable 34 which passes over a head-sheave 36 to a hoisting drum represented conventionally at 38.

Attached to the top of the bucket is an adjustable, retractable reamer or plow 40 so arranged as to enlarge the hole bored by the bucket. Material removed by the reamer falls into the bucket to be later raised with the bucket and dumped therefrom.

The collapsible form is preferably of steel, in three sections 58, so connected together by hinge joints as to be capable of assuming circular form or of being collapsed.

The supply pipe 62 is connected to one section 58 so that material poured through the pipe will emerge through outlet 64 to the outside of the shell. Pipe 62 is provided with

couplings 65 so as to be easily adjusted in length as the digging proceeds. Each section of the pipe is usually the same length as one of the forms.

In like manner the bottom form ring comprises three arcuate angle iron sections 66, jointed to permit ready collapsing.

With the above in mind the method of using the apparatus will be readily understood by reference to Fig. 1. After bucket 20 and reamer 40 have dug a hole deep enough to accommodate one of the collapsible forms and somewhat larger than the form in diameter, a form is placed in the position shown in the drawings supported concentrically in the cavity by timbers 70 through which pass bolts 72 which are riveted to the shell. The space between the lower end of the shell and the wall of the excavation is closed by collapsible ring 66. The outer diameter of this ring is somewhat greater than the diameter of the excavation; therefore the flange of the ring indents the wall of the excavation as at 74, thus enabling the ring to support itself in position together with the weight of the material which is later poured into the space above the ring. Under certain conditions the bottom ring may even support the steel form, thus obviating the necessity for timbers 70 and rods 72.

After the form and lower flange are properly supported in the cavity, quick strength material is poured through pipe 62 until the annular space between shell and excavation wall is filled to form a casing 80. After that material has set sufficiently to hold its shape the form and ring are removed and moved down to the next succeeding position and the operation is repeated.

If it be desired to form the next section of the concrete casing before it is feasible to remove the supporting form from the first section, the second section of collapsible form is supported in position with its upper end as indicated at 82 by dotted lines in Fig. 1. Then when the space around the second section is filled with material up to ring 74, the ring is removed and the filling continued, thereby filling with material the space which had been occupied by the flange of the ring. In actual practice the ring flange is of much less thickness than indicated in the drawings. In this manner the lining of the excavation may be carried on at substantially the same speed as it is dug.

It will be noted that the above apparatus offers no obstruction to the raising and dumping of the bucket; therefore the forming of the concrete casing does not interfere with the progress of digging operations.

For certain conditions, for instance wet soil, I may use the supplemental equipment shown in Figs. 2, 3 and 4. A comparatively long steel sleeve 90 is provided, of such diameter as to permit reamer 40 to work inside the sleeve. Riveted or bolted to the sleeve near the middle of its length are a number of brackets 92, upon the upper surfaces of which may rest an anvil 94. The anvil is collapsible, for instance in the form of a two-piece cross (Fig. 4) in order to be readily insertible or removable through rings 66.

In operation, anvil 94 is placed on brackets 92. Then by means of hammer 96, shell 90 is driven into the ground. Hammer 96 is operated by drum 98 and cable 100, the hammer being applied to anvil 94. When sleeve 90 has been driven as far as brackets 92 will permit, hammer 96 and anvil 94 are removed and the digging bucket excavates the contents of the lower half of the sleeve. Then the sleeve is again driven as far as brackets 92 permit, and its lower half again excavated by the bucket. At this stage of the operation a hole has been bored to a depth equal to the length of sleeve 90, and the hole is lined by the sleeve.

The next step is to put a collapsible form 58 and ring 66 in position in the upper half of sleeve 90 and fill the space between sleeve and form with concrete exactly as when sleeve 90 is not used. In the method now being described the rim of ring 66 cannot indent the wall of the excavation to hold itself in place, therefore the ring is attached to the form above it by brackets 102 and bolts 104, the form itself being supported from above by rods 72.

When the space between form 58 and sleeve 90 is filled with concrete, anvil 94 and hammer 96 are again used to drive sleeve 90. The beginning of this operation is shown in Fig. 2. As the sleeve is driven, additional concrete may be added through pipe 62 to fill the space left vacant by the wall of sleeve 90.

After the newly poured concrete has set sufficiently, ring 66 is removed and another form 58 is put in position as shown in Fig. 3, and the above described operation repeated.

In this manner is sleeve 90 utilized to permit formation of the successive caisson sections without hindrance from the wet soil.

When bed rock is reached, sleeve 90 is not removed, but is simply left in its last operative position to form the bottom section of the caisson. It if be desired to line the sleeve with concrete all the way to the bottom, that may be done because brackets 92 do not project far enough inwardly to interfere with the form. Brackets 92 may be detached if desired but are usually left imbedded in the concrete of the bottom or next to the bottom section of the caisson.

If desired the caisson may be reinforced as for instance by vertical rods 106 or circumferential rings 108, or by both, as shown in Figs. 12 and 13. Reinforcement is found particularly valuable when the sleeve 90 is used, in order to prevent the tendency of the con-

crete to adhere to the sleeve and follow it downwardly when it is driven to a new position.

It is to be understood that the invention is not limited to the construction herein specifically illustrated but can be embodied in other forms without departure from its spirit as defined by the following claims.

I claim:

1. The method of forming a caisson which comprises driving a sleeve into the ground, excavating the soil within the sleeve, lining the sleeve with a concrete shell supported independently of said sleeve, driving the sleeve further independently of the shell, excavating the soil from the sleeve in its new position, and lining the sleeve with another concrete shell similar to said first mentioned shell which joins the bottom of the first shell.

2. The method of forming a caisson which comprises driving a sleeve into the ground, excavating the soil within the sleeve, placing a collapsible form within the sleeve and supported independently thereof, filling the space between sleeve and form with quick-strength concrete to form a caisson shell, driving the sleeve further independently of the form before said concrete has set, and repeating the above described operations within the sleeve in its new position to join successive shells one above the other.

3. Apparatus for forming a caisson comprising in combination, a sleeve, means for driving said sleeve into the ground, means for excavating the space within the sleeve, a collapsible form, means for supporting said form within but independently of said sleeve, and means for introducing freshly mixed concrete into the space between said form and said sleeve to form a section of the caisson.

4. Apparatus for forming a caisson comprising in combination, a sleeve, means for driving said sleeve into the ground, means for excavating the space within the sleeve, a collapsible form, means for supporting said form within but independently of said sleeve, and means for introducing freshly mixed concrete into the space between said form and said sleeve to form a section of the caisson, said driving means being operable before said concrete has fully set for driving said sleeve still further independently of the caisson section into the ground to leave the outer wall of the newly formed caisson section in contact with the ground.

5. The invention set forth in claim 4, in which the concrete introducing means is movable with the form for introducing additional concrete into the space between said form and the ground to fill the space previously occupied by said sleeve.

6. Apparatus for forming a caisson in wet soil comprising in combination, a long sleeve, a bracket attached to the interior of said sleeve midway of its length to divide said sleeve into an upper portion and a lower portion, means acting on the bracket for driving said sleeve into the ground, means for excavating the soil from said sleeve, and means for forming a section of concrete caisson shell within the upper section of said sleeve, said driving means being operable for driving said sleeve independently of the shell into the ground before said newly formed concrete has set whereby the sleeve may again be excavated and another section of caisson shell formed therein substantially as described.

In testimony whereof I hereto affix my signature.

MAXWELL M. UPSON.