May 2, 1967 M. H. SCHUTTE 3,316,723

METHOD AND APPARATUS FOR FORMING FOUNDATION MEMBERS

Filed Nov. 2, 1964 2 Sheets-Sheet 1

Fig. 1

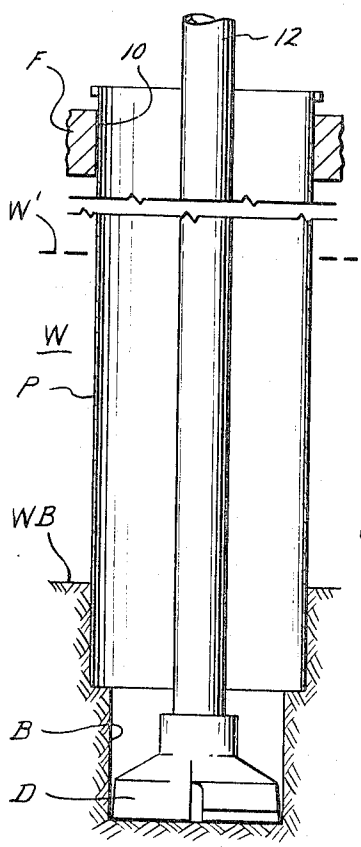


Fig. 2

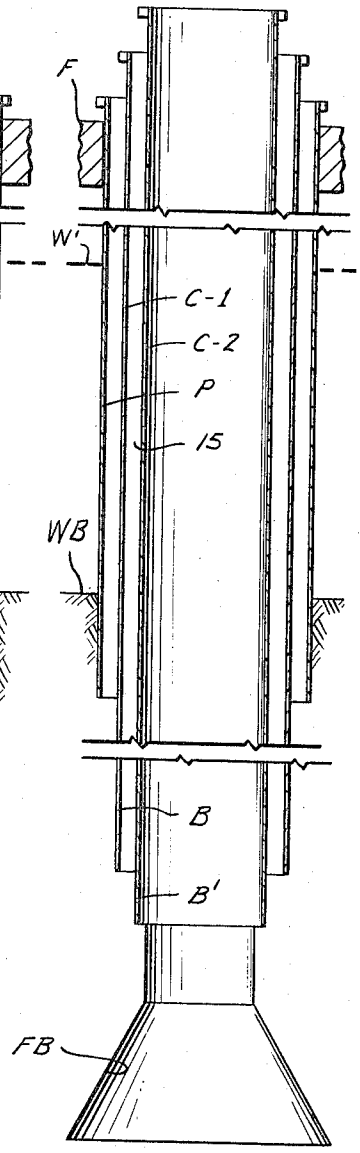
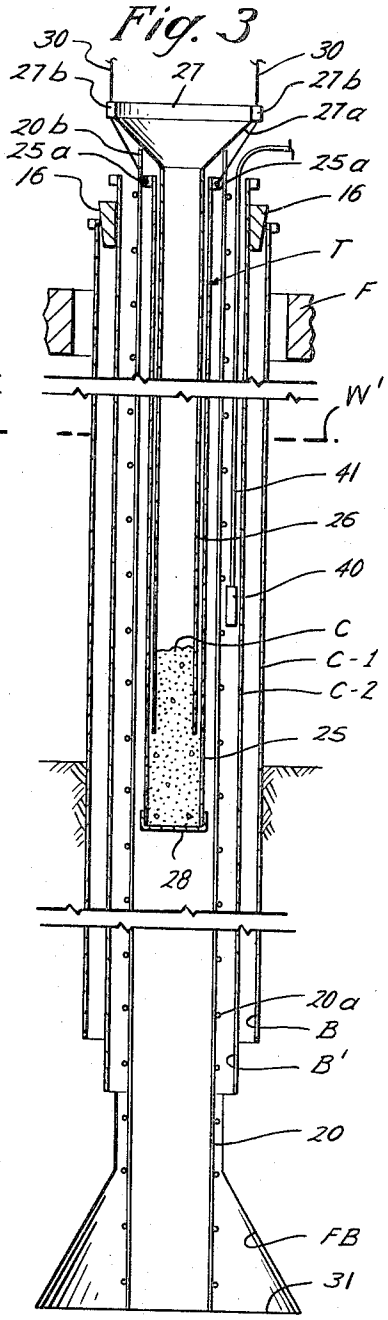


Fig. 3



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METHOD AND APPARATUS FOR FORMING FOUNDATION MEMBERS

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Fig. 4B

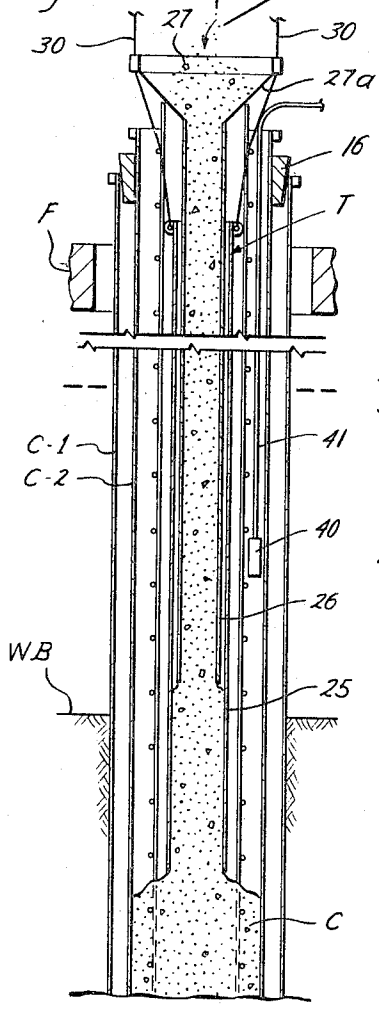


Fig. 5

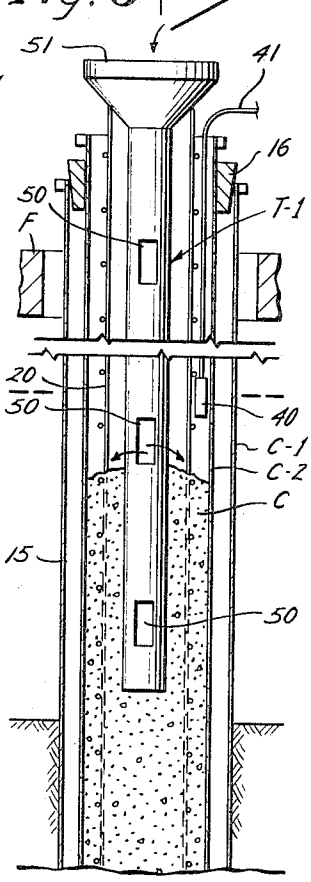


Fig. 7

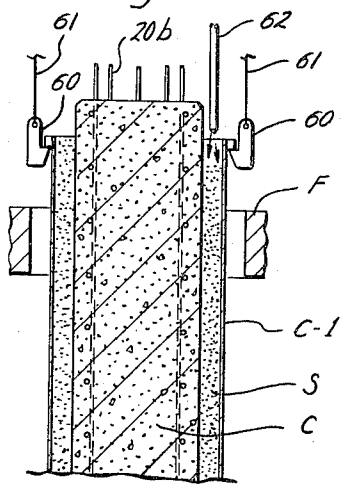


Fig. 8

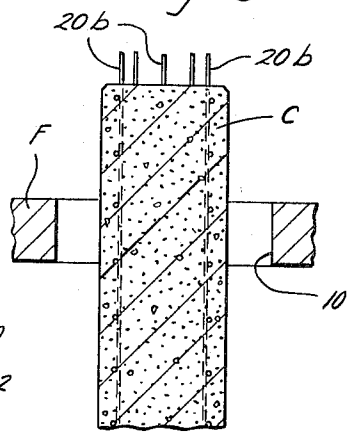


Fig. 4A

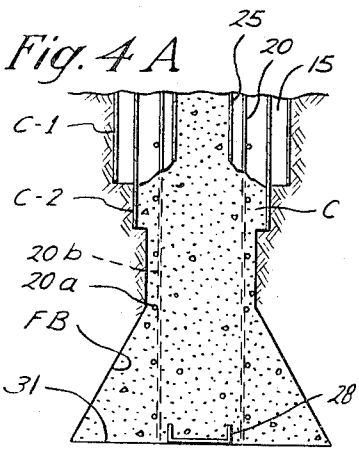
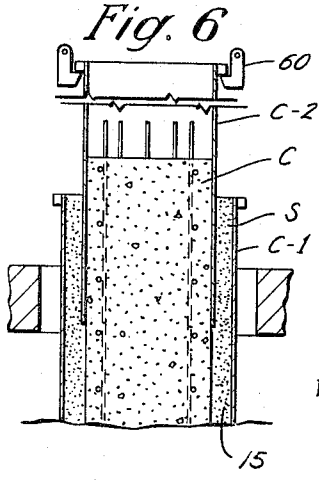


Fig. 6



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METHOD AND APPARATUS FOR FORMING FOUNDATION MEMBERS

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Filed Nov. 2, 1964, Ser. No. 408,309
6 Claims. (Cl. 61—53.64)

This invention relates to new and useful improvements in methods and apparatus for forming foundation members, and particularly methods for forming concrete columns in a body of water.

In United States patent application, Ser. No. 58,050, now issued as U.S. Patent No. 3,164,963, an apparatus and method is disclosed for forming foundation members or columns in a body of water.

An object of this invention is to provide a new and improved apparatus and method for forming foundation members or columns which is an improvement on the apparatus and method disclosed in said application.

An important object of this invention is to provide a new and improved apparatus and method for forming foundation members or columns in a body of water wherein a simplified apparatus is provided as compared to the apparatus disclosed in said application.

Another object of this invention is to provide a new and improved apparatus and method for forming foundation members wherein the concrete is introduced into an inner casing from a control unit so as to deposit the concrete with a minimum fall and so as to distribute same from the center outwardly in the formation of the concrete foundation member.

A further object of this invention is to provide a new and improved apparatus and method for forming foundation members wherein an inner casing and an outer casing are employed, with the inner casing serving to confine the concrete forming the foundation member and the outer casing serving to confine sand which is introduced into the annular space between the inner and outer casings so as to maintain the level of such sand above the lower end of the inner casing during the withdrawal of the inner casing.

Still another object of this invention is to provide a new and improved apparatus and method for forming concrete foundation members wherein inner and outer casings are employed with sand being provided therebetween during the removal of the inner casing from the concrete therein so as to leave the concrete surrounded by sand within the outer casing as the concrete hardens, and wherein such sand is loosened by a fluid stream from a fluid conductor so as to enable the outer casing to be pulled upwardly for releasing it from the hardened concrete foundation member.

A particular object of this invention is to provide a new and improved method and apparatus for forming foundation members, wherein a multiple-section concrete injection unit is employed, such unit having a lower section which is adapted to sink slowly downwardly as the weight of the concrete increases until the lower section is at or near the bottom of the hole for the member at which time the bottom of such lower section is opened to release concrete into the hole for forming the concrete foundation member.

The preferred embodiment of this invention will be described hereinafter, together with other features thereof, and additional objects will become evident from such description.

The invention will be more readily understood from a reading of the following specification and by reference to the accompanying drawings forming a part thereof, wherein an example of the invention is shown, and wherein:

FIG. 1 is a view, partly in elevation and partly in section which illustrates one of the first steps in carrying out the method of this invention;

FIG. 2 is a sectional view illustrating a subsequent step in carrying out the method of this invention;

FIG. 3 is a sectional view indicating a further step in carrying out the method of this invention and also illustrates details of the apparatus of this invention;

FIG. 4A is a vertical sectional view schematically illustrating the lower portion only of the apparatus used in a subsequent step in the method of this invention;

FIG. 4B is a vertical sectional view schematically illustrating only the upper and intermediate portions of the apparatus used in the step following that of FIG. 4A;

FIG. 5 is an elevational view, partly in section, illustrating schematically a fragmentary upper portion of the apparatus of this invention used in carrying out a further step of the method of this invention;

FIG. 6 is a sectional view schematically illustrating another step in carrying out the method of this invention;

FIG. 7 is a sectional view schematically illustrating a subsequent step in carrying out the method of this invention; and

FIG. 8 is a view illustrating in vertical section a concrete foundation member which has been formed by the process and apparatus of the present invention.

The method of this invention is preferably performed in a body of water W having an upper level W' and a bottom WB. Typically, such body of water W may be a lake, river, gulf or bay, wherein it is desired to form a foundation member or column from concrete or the like. Such foundation members may be used to support any type of bridge, platform, building or other structure above the level or surface W' of the body of water W. Therefore, each foundation member formed by the method of this invention, using the apparatus of this invention, is usually constructed so that it extends down into the earth or ground forming the sub-soil of the body of water W and so that it also extends through the water and upwardly to a distance above the surface or upward level W' of the body of water W. As will be more evident hereinafter, the method of this invention is illustrated schematically by FIGS. 1–8 of the drawings. Likewise, the apparatus of this invention is illustrated in the drawings and particularly in FIGS. 3 and 4 thereof.

Considering now the invention more in detail, the first step in carrying out the method of this invention involves the use of a temporary section of pipe P which is lowered downwardly from a platform F which has a hole **10** or similar opening formed therein. Such platform F may be a floating type of platform such as a barge, or it may be a fixed deck which has previously been mounted on piling or other support. The temporary pipe P is lowered downwardly through the opening **10** by any suitable equipment and is forced to penetrate into the bottom WB of the body of water W to some extent. The temporary pipe P may be pounded at the surface with suitable weights or hammers to force it further into the bottom WB of the water W, but the pipe P does not have to enter the bottom WB to any substantial extent so long as it is anchored firmly enough to prevent interference from wave action when the drilling operations are commenced.

With the temporary pipe P thus in position so as to provide an area therein which is free from the wave action, the drilling of the bottom WB is initiated using a conventional drill bit D operated through a drill stem **12** in the known manner. Such drill bit D thus drills a bore hole B which is preferably of a slightly smaller diameter than the diameter of the temporary pipe P, and which is large enough to receive an outer casing C–1 (FIG. 2). The outer casing C–1 is lowered gradually as the bore hole B is drilled by the drill bit D so as to prevent collapse of

the bore hole B. It is to be noted that during the drilling operations with the drill bit D, no attempt is made to remove the water which is initially present in the temporary pipe P, although in some cases this may be found desirable to enhance the rate of drilling operations. The temporary pipe P may be left in position during the drilling operations for the inserting of the outer casing C–1 to its full extent, or it can be removed after a substantial amount of hole is penetrated by the drill D. As illustrated in FIG. 2, after the casing C–1 is in position, an inner casing C–2 is then lowered downwardly into the inside of the outer casing C–1 so as to leave an annular space **15** therebetween. Since it is normally preferable to drill the bore hole B at a slightly reduced diameter as indicated at B′ for lowering the inner casing C–2 to a slightly lower level than the outer casing C–1, the drilling with the bit D is continued at a reduced diameter below the lower end of the outer casing C–1. In that way, the inner casing C–2 is lowered so that its lower end reaches a point below the lower end of the outer casing C–1 as seen in FIG. 2.

After the inner casing C–2 has reached the lowest point at which it is set by wedging the inner casing to the outer casing with wedge blocks **16** (FIG. 3), or any other suitable mechanical means, the hole B′ may be further drilled downwardly and enlarged to provide a flared bottom FB which provides an increased footing for the foundation member or column to be poured therein.

If the temporary pipe P has not been removed from the bottom WB prior to the final setting of the inner casing C–2, it normally would be removed at least after such setting of the inner casing C–2 has been accomplished. However, the presence of the temporary pipe P is not a problem and it could be left in position until the final operations are completed, as will be better understood from the following description.

After the enlarged outwardly and downwardly tapered bottom FB is provided in the bore hole, it is desirable to lower a reinforcing rod cylinder **20** into the bore, preferably to the bottom of the enlarged tapered bore portion FB. Such reinforcing rod cylinder **20** is in the form of a mesh with a plurality of longitudinally extending steel reinforcing rods which are held together in a cylindrical shape by circling bands or helically wrapped wires **20***a*. Such cylinder **20** is of a smaller diameter than the diameter of the inner casing C–2, and preferably the vertical rods **20***b* are adapted to extend above the upper end of the inner casing C–2 so as to provide the usual connection to additional support elements positioned at the upper end of the foundation member or column formed within the casing C–2, as will be more evident hereinafter.

For introducing the concrete into the bore B′ within the inner casing C–2 and the enlarged bore portion FB to form the foundation member or column, a filling tube T is provided. Such filling tube T is of a special construction which includes a lower filling tube section **25** and an upper filling tube section **26**. The lower filling tube section **25** is preferably slightly longer than the upper filling tube section **26** and is of a larger diameter so as to telescope over the upper filling tube section **26** as best seen in FIG. 3. The upper end of the upper filling tube section **26** is provided with a hopper **27** which is funnel-shaped and which is also adapted to rest upon the upper ends of the longitudinal reinforcing rods **20***b*, or upon the upper end of the inner casing C–2, depending upon the extent to which the rods **20***b* extend upwardly. For example, if the rods **20***b* do not extend above the upper end of the inner casing C–2, the sloping surface **27***a* of the hopper **27** will rest upon the upper end or annular edge of the inner casing C–2 instead of the rods **20***b* as shown in FIG. 3. In any event, the lower filling tube section **25** is provided with a cover or closure **28** which is temporarily attached to the lower end of such tube section **25**. Since the method of this invention is normally carried out with a certain amount of water still in the bore and in the inner casing C–2, the closure **28** should be waterproof and therefore normally is formed with a protective layer of polyethylene or other similar plastic releasably tied with a string or wire around the closure cap **28**. The closure cap **28** itself may be made of light gauge metal such as sheetmetal which is frictionally held in position so that it too can be releasably attached while going into the hole and later released, as will be explained. During the positioning of the filling tube T within the inside of the inner casing C–2, the upper end of the lower section **25** is held upwardly by cables **30** formed of wire or other similar material which are suspended from a drag line or other heavy supporting device. Such cables **30** extend through guide tubes **27***b* on the sides of the hopper **27** and are connected to brackets **25***a* at the upper end of the section **25**.

As best seen in FIG. 3, the filling tube T is of a smal enough diameter to fit within the cylindrical framework **20**. As will be more evident hereinafter, in carrying out the method of this invention, concrete C is introduced into the hopper **27** so as to fall downwardly through the inner tube section **26** to the bottom of the outer or lower tube section **25**. The cover **28** is secured sufficiently to the lower end of the tube section **25** so that the concrete does not displace it or remove it from the lower end of the section **25** during the initial dropping of the concrete C in the tube T. Normally, the inner casing C–2 is filled with water to a level which corresponds generally with the level W′ and therefore the outer section **25** tends to float even when the cables **30** are slacked off. However, when a sufficient amount of concrete C is dumped or dropped into the section **25**, the weight then overcomes the floating action and the outer section **25** begins to lower slowly through the liquid towards the bottom of the bore hole. When the cover **28** reaches the bottom **31**, the lower section **25** may be jiggled or moved rapidly upwardly and downwardly by pulling upwardly and sharply releasing the cables **30**. Such movement results in a release of the cover **28** from the lower end of the tubing filler section **25** as illustrated in the fragmentary view of FIG. 4A. Thereafter, as the section **25** is raised, the concrete is released from the center of the bore hole outwardly so as to fill the bore hole and the enlarged portion FB. Such concrete displaces any water or other liquid present in the hole. The concrete C is discharged from the lower tube section **25** as the section **25** is raised by pulling upwardly on the cables **30**, as best seen in FIG. 4B. When the section **25** has been returned to the uppermost position shown in FIG. 3, then the balance of the concrete which may be in the inner or upper tubing filler section **26** is discharged by raising both the lower section **25** and the upper section **26** by pulling upwardly on the cables **30**. It is to be noted that the upper end of the lower section **25** engages the tapered surface **27***a* so that the entire filling tube T is raised by pulling upwardly on the cables **30** after the lower section **25** has reached its uppermost position.

In order to facilitate the pouring of the final portion of the concrete at the upper end or portion of the inner casing C–2, it is preferable to remove the water or mud from the top of the concrete which has already been poured into the inner casing C–2. This may be accomplished by lowering a submersible pump **40** of conventional construction on a supporting electrical power line **41** which also has a fluid conductor therewith. Thus, the submersible pump **40** is operated by an electric motor which is supplied with electrical power through the electrical support wires **41**, and such pump **40** operates to pump the liquid through the hose or tube extending upwardly from the pump **40** to the surface or upper end of the inner casing C–2 for discharge at any appropriate place away from the bore hole or casing C–2.

After the water or other liquid has been sufficiently removed from the inner casing C–2, a second filling tube T–1 is lowered into the inner casing C–2 (FIG. 5). Such

filling tube T–1 has a plurality of longitudinally spaced holes or openings 50 through which concrete is capable of moving when the level of the concrete within the tube T–1 reaches a point in alignment with the particular opening 50. Thus, with the second filler tube T–1 a hopper 51 is provided which corresponds with the hopper 27 and concrete is discharged into such hopper 51 so that it flows downwardly through the tube T–1 to the lower end thereof and is discharged therefrom. As the concrete fills the inner casing C–2 and the level thereof rises, the tube T–1 is not moved, but instead, the movement of the concrete occurs by the flow thereof through the openings 50. It should be noted that only three openings 50 are shown in FIG. 5, but normally there would be more of such openings and they would be staggered in different positions around the circumference of the tube T–1. In some instances, it may be desirable to raise and lower the tube T–1 enough to jiggle or agitate the concrete to facilitate its movement through the openings 50 during the pouring of the concrete, but generally the entire tube T–1 is not lifted upwardly so that discharge is only at the lower end of the tube T–1. To this extent there is a major difference between the filling tube T and the second tube T–1. Also, it is to be observed that there is no telescoping of the second tube T–1 and other features thereof which are different as between the two types of filling tubes. While the concrete C is being poured into the second filling tube T–1, the submersible pump 40 may be kept above the level of the concrete to be certain that all water and mud are removed, but normally such use of the pump 40 is unnecessary because the liquid or mud is removed prior to the use of the second filling tube T–1.

Ultimately, the inner casing C–2 will be filled, or substantially filled, to a predetermined level with the concrete C and then the second filling tube T–1 is also removed from the inner casing C–2, leaving only the concrete therein with the reinforcing cylinder framework 20. At this point, time is important because if the concrete C hardens with the casing C–2 in position, it is substantially impossible to remove such inner casing C–2 and therefore it is lost and cannot be used again. Furthermore, the presence of the iron or steel casing C–2 is objectionable in many instances where the foundation member is exposed above the surface of the water. It is desirable to have all of the foundation members of the same texture and appearance and therefore if only one or two of the foundation members has the casing C–2 thereon, they will present a different appearance from those that do not have such casing thereon. Therefore, it is important to remove the casing C–2 from the standpoint of economy and appearance.

While the concrete C is thus still in a soft or unhardened condition, the removal of the inner casing C–2 begins. However, prior to the lifting of the casing C–2, which is scehmatically indicated in FIG. 6, by hooks 60 or other suitable means, sand is poured into the annular space 15 between the inner casing C–2 and the outer casing C–1. It is significant, however, that the sand which is poured into such annular space is not poured for the entire height or length of the casing C–1 at the beginning of the operation. It is desirable, and in most cases necessary, to introduce only a small increment of sand so as to fill only a small distance, for example about six to ten feet of the annular space 15 at the lower end prior to the starting of the pull upwardly on the inner casing C–2. By providing a predetermined height of the sand S in the annular space 15, the operator can begin the pull of the inner casing C–2 and he can pull up to a point which is below the upper level of the sand S. Therefore, if the operator has put approximately ten feet of sand into the annular space 15, he knows that he can only pull the inner casing C–2 a distance less than ten feet to stay below the upper level of the sand S.

When the operator has pulled the inner casing C–1 upwardly to a point which is substantially equal to, but slightly less than, the height of the sand which has been poured into the annular space 15, the upward movement of the inner casing C–2 is stopped and an additional increment of sand is introduced into the annular space 15. For example, another ten feet of sand might be added and during such addition of the sand S, the inner casing C–2 is stationary, but upon reaching the desired height of sand, the inner casing C–2 is again pulled upwardly so that it is somewhere below the upper level of the sand S again. Thereafter, an additional increment of sand S is dumped into the annular space 15 and the raising of the inner casing C–2 is repeated so that the lower end of the casing C–2 always remains below the upper level of the sand S. Such procedure is continued until the entire inner casing C–2 has been removed from the hole and the sand S completely fills the annular space between the outer casing C–1 and the concrete column C (see FIG. 6 and FIG. 7).

It should be pointed out that the introduction of the sand S in the increments in the various levels and the sequential pulling of the inner casing C–2 so as to always keep the lower end thereof below the upper level of the sand S, is significant in that it inhibits a sticking or a wedging of the inner casing C–2 by the concrete C and the sand S. In other words, if the sand S is poured so as to fill the entire annular space 15 and then an effort is made to pull the inner casing C–2, it has been found that it is often impossible to accomplish such pulling, particularly if the length of the column being poured is the magnitude of fifty to one hundred feet, which is often the case.

After the concrete hardens, then it is relatively easy to remove the outer casing C–1 since there is only the sand S between the concrete C and the outer casing C–1. Furthermore, a jet pipe 62 is generally lowered downwardly into the sand S to introduce a jet of water or other fluid so as to loosen the sand and wash it away or liquefy it to facilitate the release of the outer casing C–1, particularly at the bottom. The tube 62 may be inserted starting from the top and jetting as it moves downwardly until it reaches a point near the lower end of the casing C–1. Such jetting may be sufficient for releasing the casing C–1, but it is sometimes necessary to lift the tube 62 from its first position and then lower it in the sand S at one or more different circumferential positions to loosen the sand before the casing C–1 can be released from the ground and pulled upwardly. In any event, the jetting of the fluid is accomplished with a relatively simple mechanism, namely, the pipe 62, although a plurality of such pipes 62 may be employed to facilitate the release. Once the lower end of the casing C–1 has been lifted above the bottom WB, the sand will tend to fall out into the water and thereafter the lifting of the casing C–1 is accomplished without further restriction. It should be noted that FIG. 7 illustrates the hooks 60 on the cables 61 which are again used for raising the outer casing C–1 in the same manner as previously explained in connection with the inner casing C–2.

The final concrete column C is illustrated in FIG. 8, standing alone with the vertical reinforcing rods 20*b* extending thereabove for use in making a structural connection with another concrete member to be poured thereon. It should also be noted that the platform F is left in position if it is a fixed platform, but if it is a movable platform F, the opening 10 is such that it is opened to permit the removal of the platform F while leaving the foundation member or column standing and firmly positioned with its lower end in the ground.

The method of this invention is believed evident from the foregoing description, but for a brief review, it should be pointed out that the method steps are schematically illustrated in FIGS. 1–8 of the drawings. Thus, starting with the step of positioning the temporary pipe P

in the ground WB and the drilling with the bit D, the method proceeds so as to enable the first casing C–1 to be positioned in the bore hole B. Thereafter, the inner casing C–2 is positioned in the casing C–1 so as to leave the annular space **15**. Preferably, an enlarged flared bottom FB is formed by drilling with an underreamer type of tool of known construction in the bore hole B'. Thereafter, the method of this invention is carried out by inserting the reinforcing cage or wire **20** into the inner casing C–2 and then the concrete is introduced by using the filler tube T.

The filler tube T is positioned as shown in FIG. 3 initially, with the closure cap **28** in position. The concrete is then introduced into the hopper **27** and is confined by the filler tube T as it falls to the lower end of the lower section **25**. When the weight of the concrete C within the tube T is enough to cause a lowering of the section **25**, so as to overcome the floating action due to the presence of water in the casing C–2, the downward movement of the lower section **25** begins. Such action is continued as the concrete is added to the tube T and ultimately the cover **28** reaches the bottom **31**. When the cover **28** reaches such position, it is released by jiggling the outer tubular section **25** so that the weight of the concrete acts as a hammer to cause the removable cover **28** to fall from the section **25** to the bottom **31** and thereafter the concrete C is released in the center portion of the bore and flows outwardly to fill the entire bore from the bottom upwardly. The concrete C thus displaces any water, mud or other fluid within the bore hole from the bottom upwardly. The outer section **25** is raised upwardly to discharge the concrete C therefrom as best illustrated in FIGS. 4A and 4B until the outer section **25** reaches its uppermost position which is approximately that shown in FIG. 3, at which point the cables **30** are used to pull both the outer section **25** and the inner section **26** upwardly so as to remove the filler tube T from the inner casing C–2.

Thereafter the mud or other liquid in the casing C–2 may be removed with the submersible pump **40** and then the second filler tube T–1 is lowered into the casing C–2 and additional concrete is added until a desired upper level of the concrete C is reached. Thereafter, the second filler tube T–1 is removed, and sand is added to the annular space **15** to a predetermined level. The amount of sand which is added depends upon the particular soil conditions, but only enough sand should be added so as to provide for an initial raising of the lower end of the inner casing C–2 without developing any substantial amount of resistance by the sand and the concrete working on the lower end of the inner casing C–2. As expressed above, it is customary to provide an increment of about ten feet of sand S in the annular space **15** as the first increment, although this may be varied depending upon other factors and the experience of the operator. The addition of the sand in increments and the successive pulling of the inner casing C–2 is carried out until the inner space **15** has been filled with the sand S and the inner casing C–2 has been removed.

The concrete C is allowed to harden and then the sand S is loosened by introducing a jet stream of water or other fluid through a pipe **62** moving downwardly from the upper end of the sand S to the lower end of the outer casing C–1. Once the lower end of the casing C–1 has been pulled upwardly above the ground level WB, thereafter the outer casing C–1 may be readily removed and the sand will be discharged into the water. The final foundation member of column is illustrated in FIG. 8. The casings C–1 and C–2, as well as the temporary pipe P may be all used again in the carrying out of the method of this invention. Likewise the filling tubes T and T–1 are available for subsequent use.

The foregoing disclosure and description of the invention is illustrative and explanatory thereof and various changes in the size, shape and materials, as well as in the details of the illustrated construction, may be made within the scope of the appended claims without departing from the spirit of the invention.

What is claimed is:

1. A method of forming foundation members, comprising the steps of:
   (a) drilling a substantially vertical hole in the ground for a foundation member,
   (b) disposing an inner casing and an outer casing in the hole with an annular space therebetween for substantially the full length of the casings,
   (c) pouring concrete into the inner casing to substantially fill same to a predetermined level,
   (d) thereafter promptly pouring sand into the annular space to partially fill same,
   (e) pulling the inner casing upwardly prior to the hardening of the concrete to remove it from the hole while gradually adding sand in the annular space to maintain the level of the sand in the annular space above the lower end of the inner casing and
   (f) thereafter pulling the outer casing upwardly after the concrete has hardened to remove such outer casing from the hole.

2. A method of forming foundation members, comprising the steps of:
   (a) drilling a substantially vertical hole in the ground for a foundation member,
   (b) disposing an inner casing and an outer casing in the hole with an annular space therebetween for substantially the full length of the casings,
   (c) pouring concrete into the inner casing to substantially fill same to a predetermined level,
   (d) thereafter promptly pouring sand into the annular space to partially fill same,
   (e) pulling the inner casing upwardly prior to the hardening of the concrete to remove it from the hole while gradually adding sand in the annular space to maintain the level of the sand in the annular space above the lower end of the inner casing,
   (f) thereafter introducing a fluid jet downwardly through the sand to loosen same, and
   (g) pulling upwardly on the outer casing after the concrete has hardened and while jetting the fluid in the sand to effect a removal of the outer casing from the concrete.

3. A method of forming foundation members, comprising the steps of:
   (a) drilling a substantially vertical hole in the ground for a foundation member,
   (b) disposing an inner casing and an outer casing in the hole with an annular space therebetween for substantially the full length of the casings,
   (c) pouring concrete into the inner casing to substantially fill same,
   (d) thereafter alternately introducing sand in increments into the annular space and pulling upwardly on the inner casing so as to periodically add sand to always maintain the level of the sand for a substantially short distance above the lower end of the inner casing whereby removal of the inner casing is faciliitated, and
   (e) thereafter pulling the outer casing upwardly after the concrete has hardened to remove such outer casing from the hole.

4. A method of forming foundation members, comprising the steps of:
   (a) drilling a substantially vertical hole in the ground for a foundation member,
   (b) disposing an inner casing and an outer casing in the hole with an annular space therebetween for substantially the full length of the casings,
   (c) lowering a filling tube into the inner casing to direct concrete to the center of the hole for outward distribution therefrom,

(d) raising the filling tube gradually as the level of the concrete in the inner casing increases so as to continue to direct the concrete to the center of the hole for outward distribution therefrom until the concrete reaches a desired predetermined height,

(e) thereafter promptly pouring sand into the annular space to partially fill same,

(f) pulling the inner casing upwardly prior to the hardening of the concrete to remove it from the hole while gradually adding sand in the annular space to maintain the level of the sand in the annular space above the lower end of the inner casing, and

(g) thereafter pulling the outer casing upwardly after the concrete has hardened to remove such outer casing from the hole.

5. A method of forming foundation members, comprising the steps of:

(a) drilling a substantially vertical hole in the ground for a foundation member,

(b) disposing an inner casing and an outer casing in the hole with an annular space therebetween for substantially the full length of the casings,

(c) lowering a filling tube into the inner casing to direct concrete to the center of the hole for outward distribution therefrom,

(d) raising the filling tube gradually as the level of the concrete in the inner casing increases so as to continue to direct the concrete to the center of the hole for outwardly distribution therefrom until the concrete reaches a desired predetermined height,

(e) thereafter promptly pouring sand into the annular space to partially fill same,

(f) pulling the inner casing upwardly prior to the hardening of the concrete to remove it from the hole while gradually adding sand in the annular space to maintain the level of the sand in the annular space above the lower end of the inner casing,

(g) thereafter introducing a fluid jet downwardly through the sand to loosen same, and

(h) pulling upwardly on the outer casing after the concrete has hardened and while jetting the fluid in the sand to effect a removal of the outer casing from the concrete.

6. A method of forming foundation members, comprising the steps of:

(a) drilling a substantially vertical hole in the ground for a foundation member,

(b) disposing an inner casing and an outer casing in the hole with an annular space therebetween for substantially the full length of the casings,

(c) lowering a filling tube having an upper section and a lower section telescoped together,

(d) maintaining the lower end of the lower section closed while introducing concrete into the tube to cause a lowering of the lower section to a point near the bottom of the hole,

(e) opening the lower end of the lower section while it is near the bottom of the hole to release the concrete therefrom into the bottom of the inner casing,

(f) gradually raising the lower section as the concrete level is raised by the release of concrete into the inner casing,

(g) thereafter removing the filling tube,

(h) inserting a second filling tube having longitudinally spaced openings therein,

(i) introducing concrete into the second filling tube while leaving such tube substantially undisturbed until the desired predetermined level of concrete is reached,

(j) then pulling the second filling tube out of the concrete, and

(k) subsequently pulling the inner casing from the hole prior to the hardening of the concrete.

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