Feb. 7, 1967 D. O. TALLEY ET AL 3,303,244

METHOD FOR FORMING FOUNDATION MEMBERS

Original Filed Sept. 23, 1960 3 Sheets-Sheet 1

Fig. 1

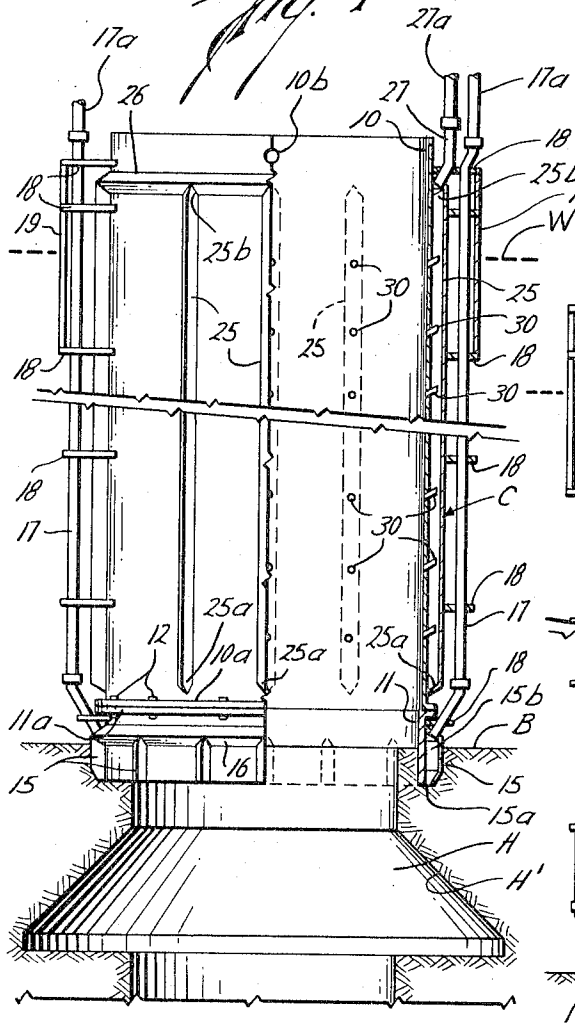


Fig. 2

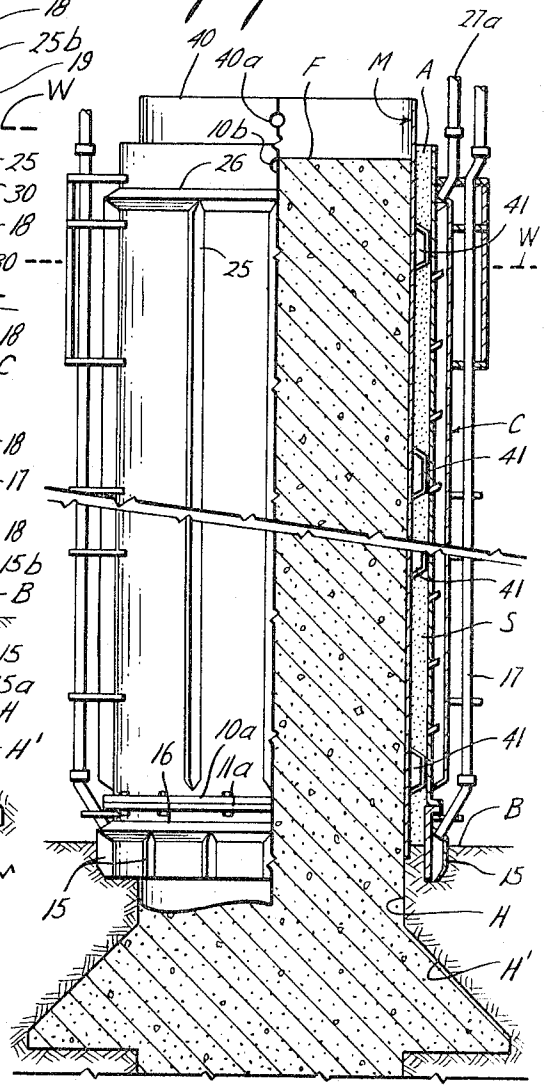
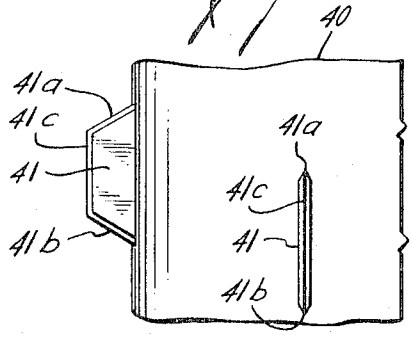


Fig. 4



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METHOD FOR FORMING FOUNDATION MEMBERS

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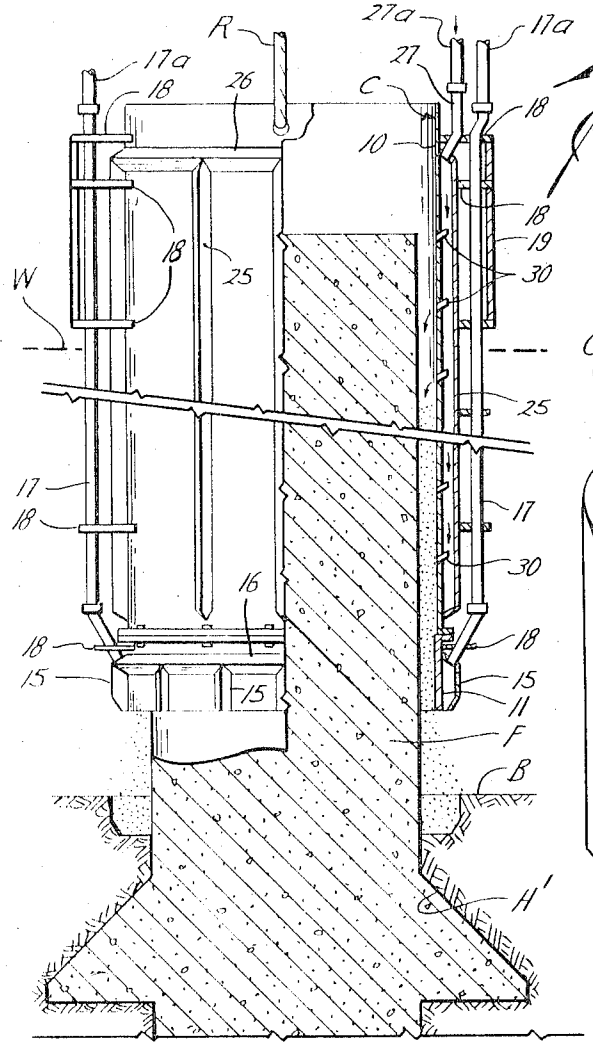


Fig. 3

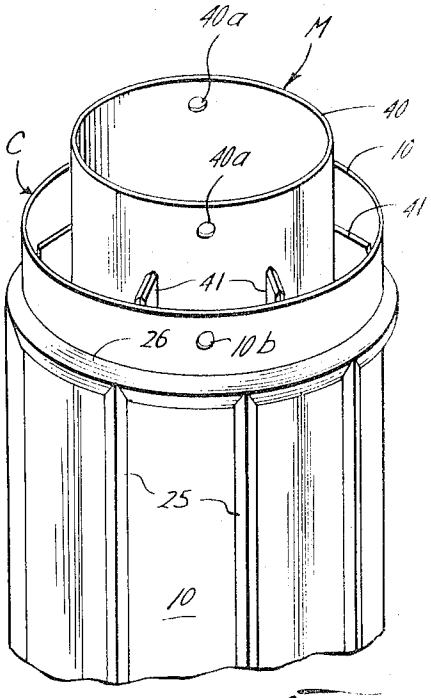


Fig. 5

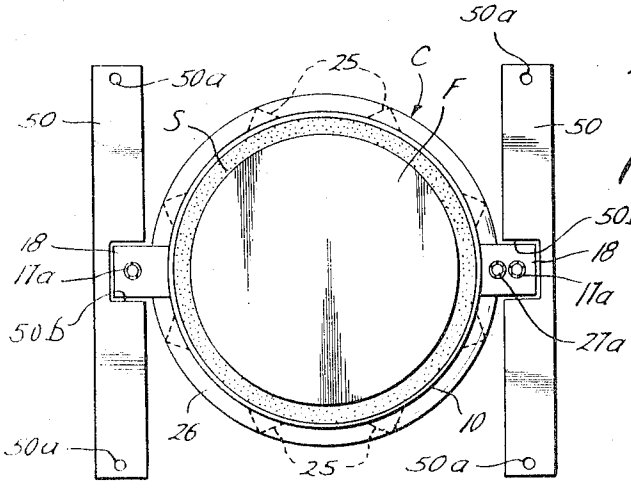


Fig. 6

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METHOD FOR FORMING FOUNDATION MEMBERS

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Fig. 7

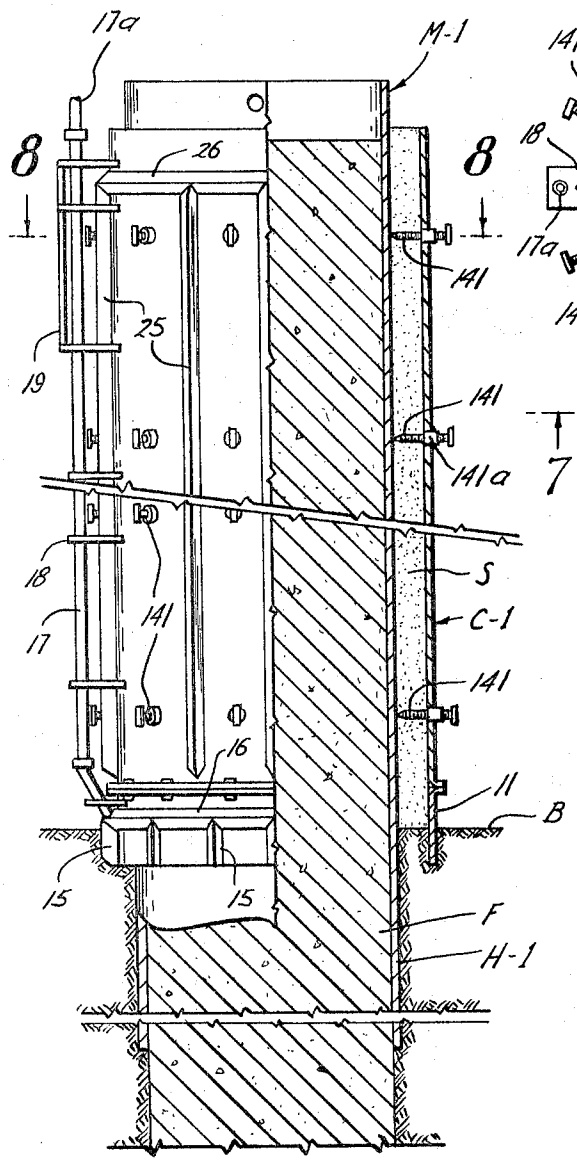


Fig. 8

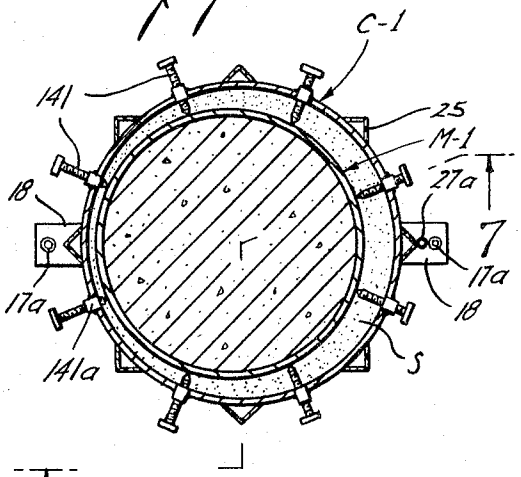
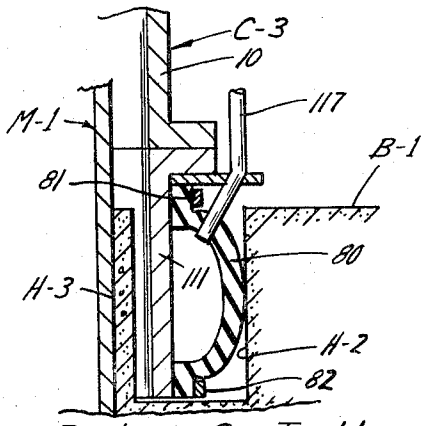


Fig. 9



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United States Patent Office 3,303,244 Patented Feb. 7, 1967

3,303,244

METHOD FOR FORMING FOUNDATION MEMBERS

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Original application Sept. 23, 1960, Ser. No. 58,050, now Patent No. 3,164,963. Divided and this application Aug. 20, 1964, Ser. No. 390,967

4 Claims. (Cl. 264—32)

This invention relates to new and useful improvements in methods and apparatus for forming foundation members.

This application is a division of our copending United States patent application Serial No. 58,050, filed September 23, 1960 now U.S. Patent 3,164,963.

An object of this invention is to provide a new and improved method and apparatus for forming foundation members wherein casing which is utilized during the forming of each foundation member is removable after the foundation member is completed so that such casing may be used again.

An important object of this invention is to provide a new and improved method and apparatus for forming concrete or similar hardenable foundation members under water wherein an outer casing is first positioned in the bottom sand, clay, or other material below the water to seal off the interior of the outer casing from water externally thereof wherein an inner casing is located within the outer casing to provide a mold for the concrete or similar material when poured in the fluid condition and wherein both of such casings are removable for use in the pouring and forming of other foundation members.

Another object of this invention is to provide a new and improved method for forming foundation columns or members wherein a tubular form is adapted to penetrate the bottom of a body of water by a fluid jetting action to seal the lower end of said form in the bottom so that drilling and other operations may subsequently be performed in said tubular form and down into said bottom even below the lower end of said form without the entry of water from externally of said form into the interior thereof.

A further object of this invention is to provide a new and improved method and apparatus for forming foundation columns or members, wherein a pair of casings are mounted with an annular space therebetween and with such annular space filled with sand or similar material, so that after the concrete is poured into the inner casing and prior to the hardening thereof, the inner casing is removable to leave the sand as the mold surface whereby the sand may be washed out or otherwise removed and the outer casing may then be readily removed after the foundation member has set or hardened.

Still another object of this invention is to provide a new and improved method and apparatus for forming foundation columns or members wherein an outer casing is provided with means for sealing with the wall of a bore whether such bore is formed of rock or other material so as to prevent fluid externally of the casing from entering the area internally thereof during the forming of the columns or members.

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, illustrating the outer casing of this invention in position for the initial steps of the method of this invention;

FIG. 2 is a view, partly in elevation and partly in section, illustrating the inner casing and the outer casing assembled together in position for the forming of the foundation member or column of concrete during the carrying out of the method of this invention;

FIG. 3 is a view illustrating the final steps in the method of this invention wherein the outer casing is removed from the foundation member or column which has been formed;

FIG. 4 is a fragmentary view illustrating a portion of the inner casing with the spacer members illustrated in detail;

FIG. 5 is an isometric view for illustrating the relationship between the outer casing and the inner casing during use;

FIG. 6 is a plan view illustrating a means for holding the outer casing in a stable position while the concrete or the like forming the foundation member or column is hardening or setting;

FIG. 7 is a view, partly in elevation and partly in section, taken on line 7—7 of FIG. 8 and illustrating a modified form of the invention;

FIG. 8 is a horizontal cross-sectional view taken on line 8—8 of FIG. 7 and further illustrating the modified form of the invention; and

FIG. 9 is a fragmentary view in section of another modification of this invention.

In the drawings, the letter C designates generally the outer casing and the letter M designates generally the inner casing of the apparatus of this invention. As will be explained more in detail, the apparatus of this invention is particularly adapted for carrying out the method of this invention for the forming of a foundation member or column in the ground at the bottom of a body of water W. The bottom of the body of water is indicated at B, and as will be explained, the outer casing C is adapted to be positioned in the ground at the bottom B to form a seal to prevent the entry of the water from the body of water W externally of the casing C into the interior thereof. Thereafter, the inner casing M is positioned inwardly of the outer casing C and drilling or other operations are performed for forming a hole H of any suitable configuration in the ground below the apparaus of this invention into which concrete or the like is poured for forming the foundation member or column. Also, as will be more fully explained, after the concrete for the foundation member F has been poured, the inner casing M is removed while the concrete is still soft or wet, and thereafter, when the concrete has hardened, the outer casing C is removed in a manner to be hereinafter described. Therefore, the entire apparatus of the invention is removable from the foundation member F after it has hardened so that such apparatus may be used again for forming other foundation members.

Considering the invention more in detail, the outer casing C includes a cylindrical or tubular body or shell **10** which is preferably formed of steel or similar material. The bore of the shell **10** is open at both the upper and the lower ends thereof. At the lower end of the cylindrical or tubular body or shell **10**, an outwardly extending radial flange **10***a* is provided which connects with a flange **11***a* on a lower cylindrical extention **11**. The flanges **10***a* and **11***a* are bolted together with bolts **12** or any other suitable securing means. Preferably, the thickness of the cylindrical or tubular extension **11** is greater than the thickness of the shell **10** so that such extension **11** has increased strength for penetration into the bottom B. The extension **11** has a plurality of jet nozzles **15** welded or otherwise suitably affixed to the external surface thereof. Each

of such nozzles **15** is preferably formed of an angle iron which is welded at its edges to the external surface of the extension **11** and which is open at the lower end **15***a* and is connected with an annular fluid conductor or tubular means **16** at its upper end **15***b* so that fluid supplied to the annular conductor **16** is transmitted or conducted to each of the jet nozzles **15** for discharge through the lower openings **15***a*. The fluid conductor **16** may be a pipe or it may be formed as illustrated from an angle iron which has its edges welded to the external surface of the extension **11**. Fluid is transmitted to the conductor **16** through a fluid pipe or tube **17** which extends to the upper end of the casing C and has a suitable hose **17***a* connected therewith for connection to any source of fluid under pressure. The tube **17** is secured to the body or shell **10** of the casing C by suitable brackets **18** which are longitudinally spaced and are welded to the shell **10**. The upper brackets are interconnected with a longitudinally extending frame **19** by welding or any other suitable securing means to protect the conductor **17** against damage and also for cooperation with an anchoring device to be hereinafter described. Preferably two fluid conductors or pipes **17** are provided as illustrated in FIG. 1, but it will be appreciated that more or less than that number may be utilized so long as fluid under pressure is supplied to the jet nozzles **15** for discharging fluid under pressure in a jetting action from the lower open ends **15***a* of such nozzles **15**.

The outer casing also has a plurality of longitudinally extending external channels or jet fluid jackets **25** formed on the external surface of the shell **10**. Such channels **25** are preferably formed of angle irons which have their edges welded or otherwise secured to the extenral surface of the shell **10**. The lower end **25***a* of each of the channels **25** is closed, but the upper end **25***b* of each of the channels **25** is in communication with an annular fluid conductor **26** which is also preferably formed of an angle iron having its edges welded or otherwise secured to the external surface of the shell **10**. A pipe or conductor **27** is connected to the conductor **26** for transmitting fluid under pressure to the annular conductor **26** and thus to the channels **25**. A flexible connection **27***a* is preferably provided with the conductor **27** for connection with a suitable source of fluid under pressure such as a fluid pump. It will be appreciated that the flexible conductors **17***a* and **27***a* may both be connected to the same source of fluid under pressure, but they are preferably separately controlled with valves or the like as will be more evident hereinafter in carrying out the method of this invention.

Within each of the channels **25**, there are a plurality of tubes or jet discharge nozzles **30** which extend downwardly and inwardly towards the bore of the shell **10**. Each of such tubes **30** is open on both of its ends and therefore fluid may pass therethrough from the channel **25** into the bore of the shell **10**. It is to be noted that the tubes **30** are preferably welded or are otherwise mounted in the wall of the shell **10** so as to extend therethrough and to provide a passage means from the channel **25** to the interior or bore of the shell **10**. The angle of inclination of the tube **30** is such that sand or other similar material within the bore of the shell **10** does not accumulate in such tubes **30**. Fluid under pressure from the supply source is adapted to be fed through the channels **25** and into the tubes **30** under a jetting or washing action for washing sand or other similar material from the interior of the shell **10** as will be more fully explained hereinafter.

The casing C may be raised and lowered by any suitable means, but as shown, an opening **10***b* is provided on each side of the shell **10** for the reception of a cable R (FIG. 3).

The inner casing or mold M is provided with a cylindrical or tubular body **40** which is formed of steel or similar material. Such body **40** has a plurality of longitudinally and laterally spaced radial spacers or separator members **41** welded or otherwise secured on the external surface of the body **40**. Each of such spacers **41** extends radially and is provided with sharp knife edges **41***a* and **41***b* at the upper and lower edges thereof, respectively. Also, each spacer **41** has a longitudinally extending knife edge **41***c*. Such knife edges **41***a*, **41***b*, and **41***c* are provided for preventing the accumulation of sand on the spacers **41** during the carrying out of the method of this invention so that the removal of the inner casing or mold M when desired is not seriously hampered by the sand which is confined between the inner casing M and the outer casing C as will be explained. The inner casing M and the outer casing C are preferably concentrically disposed and the spacers **41** maintain such concentric position. The spacers **41** also maintain the annular space A between the inner casing M and the outer casing C. Sand S or a similar material is placed in such annular space A to serve as the mold when the inner casing M has been removed as will be more fully explained.

The inner casing M may be lowered and raised into position for use and removed from position after use by any suitable means, but preferably openings **40***a* on diametrically opposite sides of the casing M are provided for receiving a cable such as the cable R shown in FIG. 3. It will be appreciated that hooks or any other kind of means may be used in place of the cable R. It should also be noted that in use the inner casing M extends above the upper edge of the outer casing C so that the holes **40***a* are exposed and are accessible.

During the use of the apparatus of this invention in carrying out the method thereof, it is freqeuntly desirable to anchor the outer casing C to prevent shifting thereof, particularly when the apparatus is used in a body of water such as a river which may have currents or similar fluid forces acting on the outer casing C. One type of anchoring means which may be used is illustrated in FIG. 6 wherein a pair of anchoring plates **50** are shown. Each anchoring plate **50** has a notch **50***b* which corresponds in configuration with the external surface of the bracket **18** so that the anchoring plate **50** and the bracket **18** interlock as shown in FIG. 6. The outer ends of the anchoring plate **50** are provided with holes **50***a* which are secured by lines, cables, or similar attaching means to a stable platform or another foundation member which has previously been formed. In some instances, the anchoring plates **50** may be secured to a barge which is floating on the body of water W and which is sufficiently stable to retain the casing C against movement while the concrete of the foundation member F is hardening.

In carrying out the method of this invention, the outer casing C is lowered into the body of water W until it reaches the ground at the bottom B. It will be appreciated that the hole H illustrated in FIG. 1 is not formed at that time. Therefore, the lower end of the casing C rests upon the bottom B when it is initially lowered into the water W to such position. The open ends **15***a* of the jet nozzles **15** are thus in position for directing fluid such as water or air under pressure to the bottom B. Such fluid under pressure is admitted through the line **17** or lines **17** to the annular conductor **16** and then to the jet nozzles **15**. The ground at the bottom B is thus jetted or removed by the fluid force from the jet nozzles **15** so that the lower end of the casing C is allowed to sink down and penetrate into the ground or clay forming the bottom to thereby provide a seal with the lower end of the casing C in the clay. The fluid externally of the casing C cannot thereafter flow around the bottom of the casing C into the interior of the casing C, and the casing C is of such height that it extends above the upper surface of the body of water W so that the casing C effectively seals off fluid from flowing from the exterior of the casing C to the interior thereof.

The interior of the casing C is then preferably pumped substantially dry by dropping a suction hose into the interior of the casing C or by any other suitable means. The water may even be bailed out from the interior of

the casing C since it is not necessary to remove all of such water.

The hole H may next be drilled into the ground below the bottom B and interiorly of the casing C as shown in FIG. 1, but preferably, the inner casing M is positioned within the casing C prior to the drilling operations. In such case, the inner casing M is lowered on hooks or cables such as the cable R to position the lower end of the inner casing M on the bottom B within the interior of the casing C, but with the annular space A therebetween. As previously pointed out, the spacers **41** center or position the inner casing F and maintain same in a substantially concentric relationship with the outer casing C and with the annular space A therebetween.

After the inner casing M is thus in position within the outer casing C, the sand S or similar filler is poured into the annular space A to fill same. The amount of the sand S may be varied so long as there is enough sand to extend above the upper end of the foundation member F when it is poured.

With the inner casing M in position and preferably with the sand S also in the annular space A, the usual type of drilling bit or auger for drilling into the ground is lowered for forming the hole H. An underreamer is also preferably used to form the underreamed flared section H'. The apparatus for such drilling and underreaming are, of course, well known. After the drilling operations, the inner casing M and the sand S are placed in position if they were not previously so positioned.

The concrete for the foundation member F is then poured into the interior of the inner casing M and downwardly into the hole H and the underreamed portion H' to fill the same to the desired height for the foundation member or column F. The inner casing M serves as the mold for the concrete above the hold H during the pouring of the concrete or the like. Other materials besides concrete may, of course, be used, but concrete is the most common for such foundation members. While the concrete of the foundation member F is still soft or wet, the inner casing M is lifted upwardly and is removed. When the inner casing M is thus removed, the sand S remains in position and shifts slightly downwardly and into contact with the concrete of the foundation member F to retain the same shape for the foundation member F as previously created by the inner surface of the mold M. Thus, the sand S actually becomes the mold for the portion of the foundation member F extending above the ground.

The concrete or other material of the foundation member F is then allowed to harden. During such hardening period, the anchoring plates **50** are preferably connected to the plates **18** at the upper end of the body **10** as illustrated in FIG. 6. Such anchoring plates **50** are connected to any stable platform, barge, or other foundation members or any other suitable supports so that the cylinder C is prevented from shifting.

After the concrete F has hardened, the anchoring plates **50** if used, are removed, and then, fluid such as water or air under pressure is introduced through the line **27***a* to the conductor **27** and to the annular channel **26** for discharge into the longitudinal channels **25** and then such fluid is discharged or jetted from the tubes **30** for washing or loosening the sand S. Such loosening and washing of the sand S is preferably done simultaneously with the introduction of fluid under pressure to the jet nozzles **15** and a lifting of the casing C upwardly with a cable or other means R. Therefore, as the casing C is raised and the jetting action is imparted through the jets **15** to the ground therebelow, the casing C is loosened from its sealed position and is raised as shown in FIG. 3. The sand S is washed from the interior of the casing C as also shown in FIG. 3 during such raising of the casing C. Thus, the casing C is completely removable from the foundation member F, leaving only the foundation member F after the method of this invention is performed. The apparatus of this invention is therefore ready for use again for the forming of other foundation members.

In connection with the foregoing description, it will be evident that various modifications may be made within the scope of the invention. For example, although the spacers **41** are shown as mounted on the inner casing M, such spacers **41** may instead be welded or otherwise secured to the interior of the outer casing C. Also, it should be pointed out that the invention is not limited to use under water.

Other specific modifications are illustrated in FIGS. 7 and 8. The outer casing C–1 is identical with the casing C except that adjustable spacer bolts **141** are provided therewith to take the place of the spacers **41**. Each of the spacer bolts **141** is threaded into a nut **141***a* which extends through the wall of the casing C–1 and is welded or otherwise secured thereto. The spacer bolts **141** are disposed circumferentially and longitudinally and are adjustable inwardly and outwardly to serve as spacers for spacing the inner casing or mold M–1 from the outer casing C–1, whether the mold M–1 is concentrically disposed with respect to the casing C–1 or is offset as shown in FIGS. 7 and 8.

In the use of the modification of FIGS. 7 and 8, the outer casing C–1 is positioned with its lower end in the clay at the bottom B. Then, after removing the water from inside the casing C–1, a hole H–1 is drilled with the usual auger (not shown) of sufficient size so that the inner casing M–1 may extend below the lower edge of the casing C–1 (FIG. 7) if it is desired to use such casing M–1 to retain the walls of the hole H–1 against collapse prior to the pouring of the concrete. The spacer bolts **141** are adjusted after the drilling and prior to the lowering of the casing M–1 so as to contact the external surface of the casing M–1 and maintain it in vertical alignment as it is lowered into the hole H–1.

The sand S or similar material is then poured into the annular space between the casings M–1 and C–1, after which the concrete is poured. The inner casing M–1 is preferably removed before the concrete has hardened, and then after the concrete has hardened, the sand S is washed away with fluid such as water or air under pressure which is supplied through the channels **25** and tubes **30**, and the outer casing C–1 is lifted upwardly, by discharging fluid under pressure from the jet nozzles **15** if desired or necessary.

In FIG. 9, a further modfication is illustrated wherein the lower annular extension **111**, a portion of which is shown, is modified as compared to the extension **11** of FIGS. 1 and 7, but otherwise, the outer casing C–3 of FIG. 9 may be the same as either the form of FIG. 1 or the modification of FIG. 7. The annular extension **111** is connected to the body or shell **10** by any suitable means such as the bolts **12** (FIG. 1). An annular resilient inflatable tube **80** which is formed of rubber or other flexible material is anchored to the extension **111** at its upper and lower ends by bands **81** and **82**, respectively. The tube **80** may also have its upper and lower ends vulcanized or otherwise adhered to the extension **111**. A fluid conductor tube **117** extends downwardly from the upper end of the shell **10** in the same manner as the tube **17** of FIG. 1, and such tube **117** extends into the tube **80** so as to supply fluid under pressure into the interior of the tube **80** for inflating same when desired. The fluid in the tube **80** may also be released through the tube **117** when it is desired to deflate the tube **80**.

The modification of FIG. 9 is used when the bottom B–1 is formed of rock or other material which is so hard that the jets **15** of FIGS. 1 and 7 cannot penetrate. In such cases, the bottom or material B–1 is drilled with a rock bit to form an annular hole H–2 and then the outer casing C–3 is lowered to position the lower end of the casing C–3 in the hole H–2. The tube **80** is deflated until in such position, and then the fluid under pressure is admitted into the tube **80** from the tube **117** to inflate

or expand the tube **80** into sealing contact with the wall of the hole H–**2**. Water is then prevented from passing from the area externally of the casing C–**3** to the interior thereof due to the seal provided by the tube **80**. The other steps in carrying out the method as described in connection with FIGS. 1 and 7 are then performed. After the concrete of the member F has hardened, the tube **80** is deflated by permitting a release of the fluid under pressure through the tube **117** and then the casing C–**3** is withdrawn. It should be noted that after the casing C–**3** is positioned in sealing contact with the wall of the hole H–**2**, the internal hole H–**3** is drilled and such hole H–**3** is smaller than the internal diameter of the extension **111** so that the concrete will not contact the casing C–**3**.

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 from concrete, comprising the steps of, positioning an outer casing and an inner casing in upright positions with an annular space therebetween and with the lower end of the outer casing extending into the bottom to provide a seal therewith, providing sand in the annular space, thereafter pouring concrete into the inner casing, removing the inner casing while the concrete is soft, and when the concrete has hardened simultaneously lifting the outer casing and washing the sand away from the concrete to free the outer casing.

2. A method of forming foundation members of concrete in a body of water, comprising the steps of, positioning the lower portion of an outer casing in the ground at the bottom of a body of water to seal off the water from entry into the interior of said outer casing from externally thereof, thereafter inserting an inner casing within said outer casing with an annular space therebetween, introducing sand into said annular space, pouring concrete in said inner casing to form a foundation member, removing the inner casing while the concrete is still soft, allowing the concrete to harden, and thereafter simultaneously lifting the outer casing and washing the sand away from the concrete to free the outer casing.

3. A method of forming foundation members of concrete in a body of water, comprising the steps of, positioning the lower portion of an outer casing in the ground at the bottom of a body of water to seal off the water from entry into the interior of said outer casing from externally thereof, thereafter inserting an inner casing within said outer casing with an annular space therebetween, introducing sand into said annular space, lowering a drilling bit through the inner casing for drilling in the ground below the lower portion of the outer casing, pouring concrete to fill the hole drilled and at least a portion of the area internally of the inner casing, removing the inner casing while the concrete is soft so that the sand serves as the external mold for the concrete above the ground, allowing the concrete to harden, and thereafter simultaneously lifting the outer casing and washing the sand away from the concrete to free the outer casing.

4. A method of forming foundation members of concrete in a body of water, comprising the steps of, jetting fluid under pressure from the lower end of an outer casing for effecting a penetration of such lower end into the ground at the bottom of a body of water to seal off the water from the entry into the interior of said outer casing from externally thereof, thereafter inserting an inner casing within said outer casing with an annular space therebetween, introducing a filler material into said annular space, pouring concrete in said inner casing to form a foundation member, removing the inner casing while the concrete is still soft, allowing the concrete to harden, and thereafter simultaneously lifting the outer casing and washing the filler material away from the concrete to free the outer casing.

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