Feb. 21, 1961 G. E. SUDEROW 2,972,234

METHOD OF CONSTRUCTING AND SETTING A CAISSON FOR A BRIDGE PIER OR LIKE SUPPORT

Filed Oct. 17, 1958 3 Sheets-Sheet 1

FIG. 1.

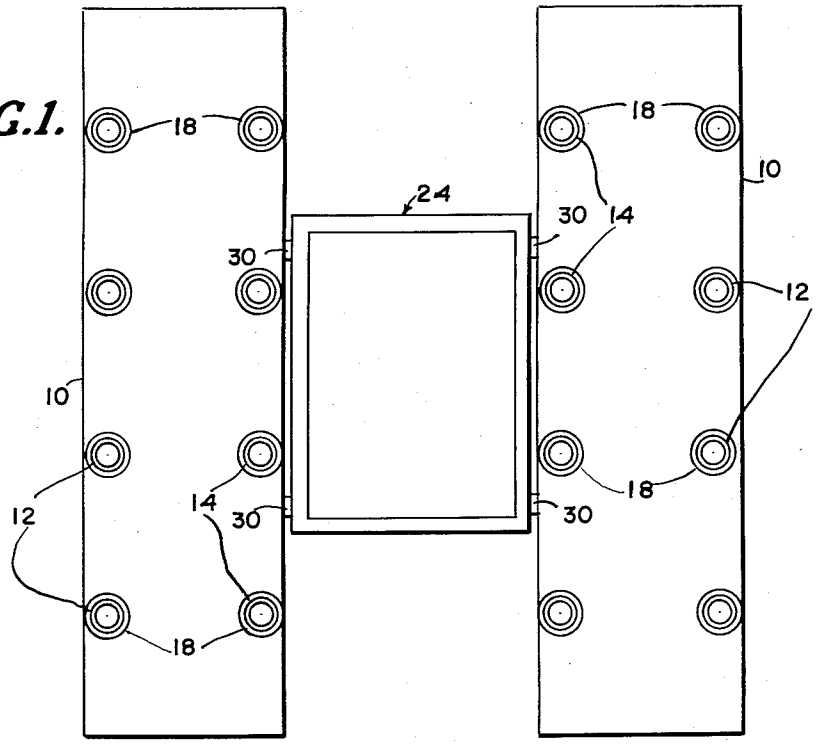
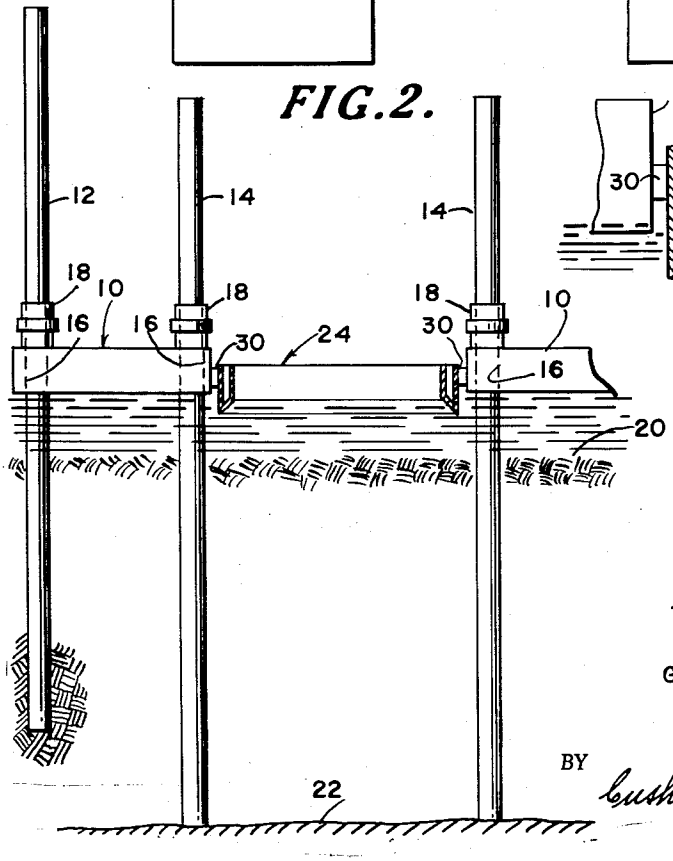


FIG. 2.



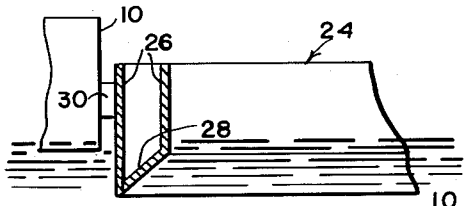


FIG. 10.

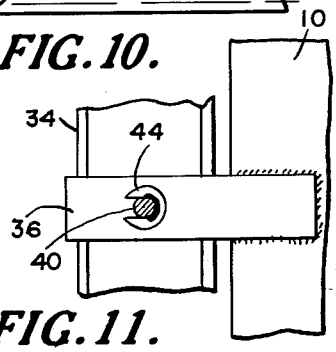


FIG. 11.

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FIG.3.

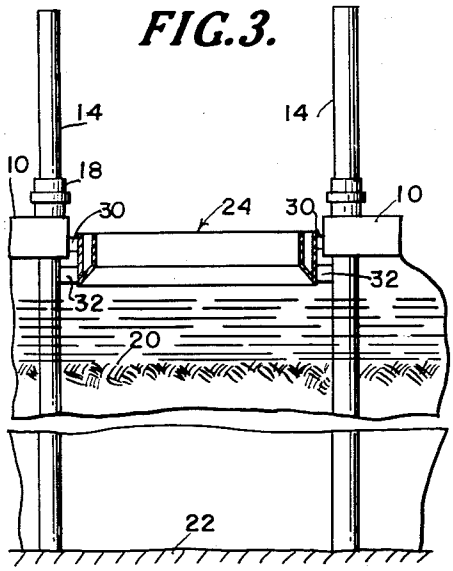

FIG.4.

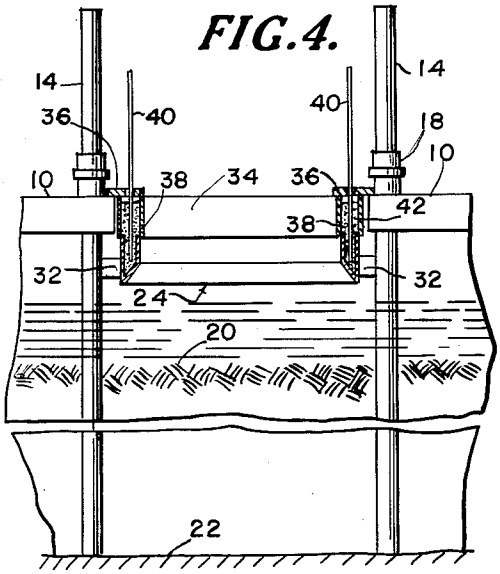

FIG.5.

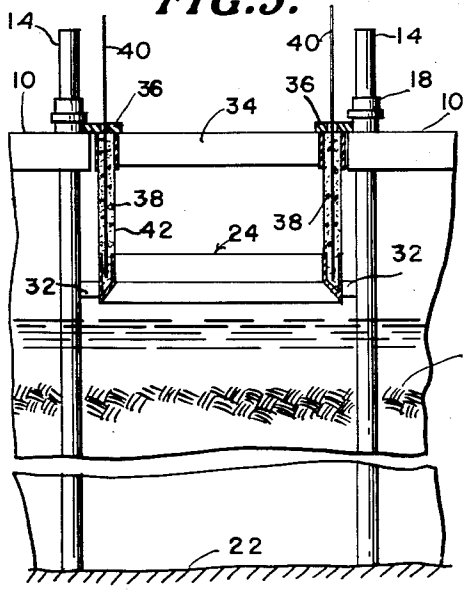

FIG.6.

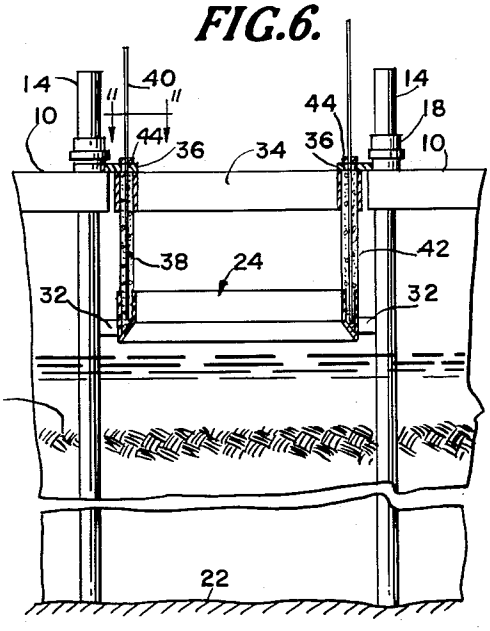

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FIG. 9.

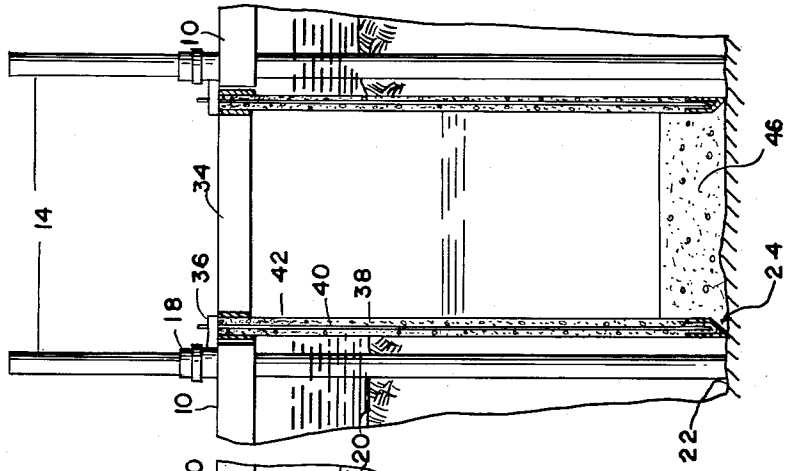


FIG. 8.

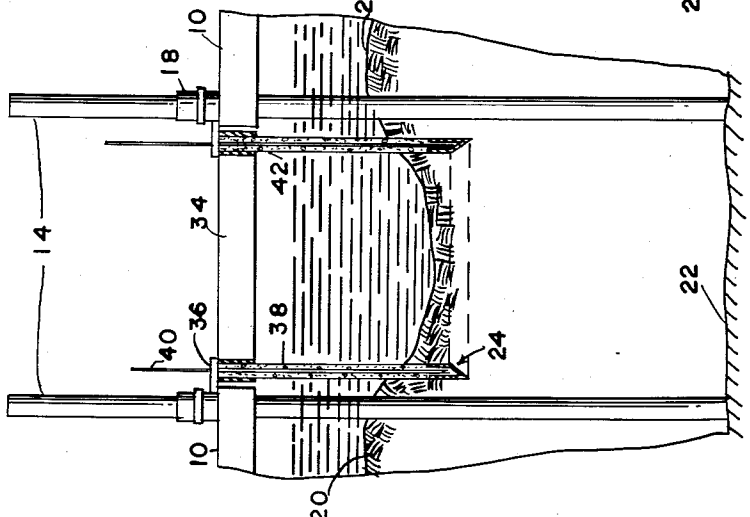
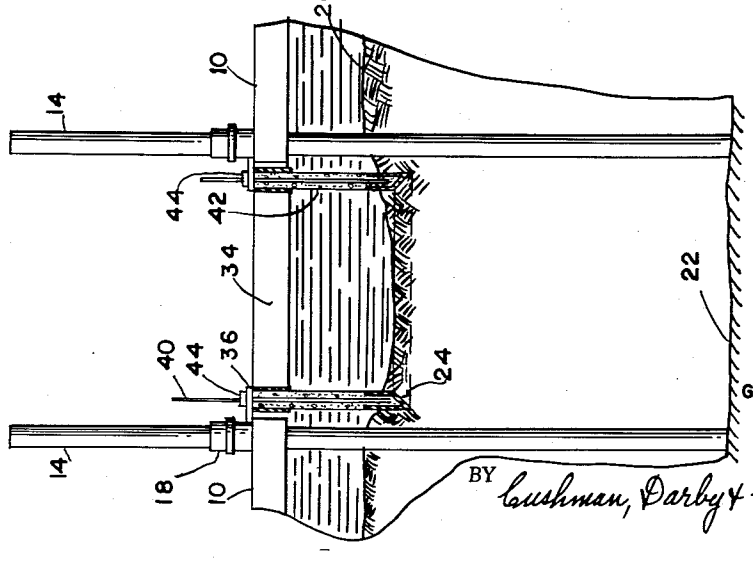


FIG. 7.



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METHOD OF CONSTRUCTING AND SETTING A CAISSON FOR A BRIDGE PIER OR LIKE SUPPORT

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Filed Oct. 17, 1958, Ser. No. 767,951

12 Claims. (Cl. 61—52)

This invention relates to an improved method for constructing and setting a caisson for a bridge pier or like support.

Up to the present invention, a caisson for a bridge pier or the like usually has been constructed on shore, floated out to the site either under its own buoyancy or on a barge, and at the site lowered into engagement with the marine bottom. In accordance with usual practice, the marine bottom then is excavated or dug out within the caisson to sink the same to a desired bearing, the bottom of the caisson is plugged with cement, the water pumped out, and finally the caisson is filled with concrete or broken rock and cement grout.

The aforementioned conventional method of constructing and setting a caisson is, however, extremely cumbersome, expensive and time-consuming, particularly as respects transporting such a large structure to a setting site and thereat lowering it to rest on the marine bottom.

Accordingly, it is an object of this invention to provide an improved method of constructing and setting a caisson for a bridge pier or the like which is less expensive and time-consuming than previous methods.

It is still another object of this invention to provide an improved method for constructing and setting a caisson of the type with which this invention is concerned wherein the caisson is actually constructed at the site where it is to be set, thus eliminating the necessity of floating to the site a large and cumbersome prefabricated caisson.

Other objects and advantages of the invention will become apparent from the following detailed description and accompanying drawings:

Figure 1 is a plan view illustrating an initial step in the construction and setting of a caisson in accordance with this invention.

Figure 2 is an elevational view, partly in vertical section, of the structure shown in Figure 1.

Figures 3 to 9 are views corresponding to Figure 2 but illustrating successive steps in the method involving this invention.

Figure 10 is an enlarged fragmentary view of a portion of Figure 2.

Figure 11 is an enlarged fragmentary sectional view taken on line 11—11 of Figure 6.

Referring now to the drawings there is shown in Figures 1 and 2 a pair of platform-like buoyant bodies **10**, preferably in the nature of steel barges each provided with two rows of upright supporting legs **12** and **14**, here shown as being in the form of elongated cylindrical caissons. Preferably, the rows are arranged along the longitudinal sides of the barges **10**. Each of the legs **12** and **14** is mounted and guided for substantially vertical movement relative to the corresponding platform **10** in a guide well **16** (Figure 2) which extends vertically through the platform. Operative on each leg **12** and **14** is a jacking mechanism **18** of a known type that is secured to the barge and releasably engageable with its corresponding leg for selectively restraining the aforementioned relative movement of the leg in its well **16** or positively effecting such movement in either direction. The jacking mechanism **18** may be of the type disclosed in detail in the patent to Pointer No. 2,775,869, or of the type disclosed in detail in the copending application of Suderow, Serial No. 523,323, and now Patent No. 2,932,486 dated April 12, 1960. In any event, however, each barge **10** is provided with an adequate number of supporting legs **12** and **14** and with appropriate power-operated mechanism **18** whereby the legs may be lifted or lowered relative to the barge or the barge lifted or lowered on the supporting legs when the latter are in engagement with a marine bottom.

In carrying out this invention two such barges or buoyant platforms **10** are floated to a caisson setting site and arranged in parallel relation with sufficient space therebetween for accommodating one or more caissons to be constructed and set. In this connection, while the invention will be illustrated and described with reference to the use of two barges **10**, it will be understood that one barge can be employed if it is provided with an open bay or slot that is large enough to accommodate the caisson to be set. After the two barges **10** have been properly located at the construction and setting site, their legs **12** and **14** are lowered down into engagement with the marine bottom **20** and the barges are raised on their legs, by their jacking mechanisms **18**, until substantially all of the weight of the platforms is supported upon the legs, as shown in Figure 2. For reasons later apparent, the legs **14** that are adjacent to the space or bay between the two barges **10** will have to carry a weight greater than their proportionate share of the weight of their corresponding barge. Consequently, after the barges **10** have been raised, as aforedescribed, these legs **14** are driven, either by their jacks **18** or by other suitable driving mechanism (not shown), to an extremely firm bearing in the marine bottom **20**. If bedrock **22** exists, as is shown in Figure 1, it is desirable that these supporting legs **14** be driven down into engagement therewith. Since these legs **14** usually must be driven deeper than the other legs **12**, they should be longer than the others, as shown in Figure 1.

After the platforms **10** have been so erected, the next step is to position therebetween a form or footing **24** for casting the bottom section of a concrete caisson. In the illustration shown in the drawings the caisson to be cast is generally rectangular in plan view, so that the bottom section form **24** is correspondingly rectangular, as shown in Figure 1, and may be described as being in the form of an endless open-top trough outlining the side walls of the caisson to be cast. The side walls **26** of the form **24** are upright and substantially parallel, while the bottom wall **28** preferably is inclined downwardly and outwardly to provide a relatively sharp edge at its junction with the outer side wall, as best shown in Figure 10, in order to facilitate penetration of the cast caisson into the marine bottom **20**, as later described. For this same reason, and also because the form **24** will have to support a tremendous weight, it preferably is made of steel. It will be seen that because of its very nature, the form **24** can easily be, and preferably is, constructed to be buoyant, so that it can be positioned precisely over the setting site by floating it into the bay or space between the two erected barges **10**, as shown in Figures 1 and 2. In this same connection, however, it will be realized that the form **24** could be transported to the setting site on one of the buoyant work platforms **10** and then lifted into position therebetween by means of a crane or the like (not shown).

After the form **24** has been properly positioned between the two platforms **10** it is secured to both of the latter by supporting brackets **30** in such a manner that

the weight of the form can be carried by the platforms. These brackets 30 may be detachably connected both to the form 24 and to the adjacent sides of the platforms 10 by bolts or the like (not shown), but in the present instance the brackets have been illustrated as being welded both to the form and to the adjacent sides of the steel paltforms 10, as is shown in Figure 10.

After the form 24 has been secured to the two platforms or barges 10, the latter are raised a short distance upon their legs 12 and 14 and, of course, they raise therewith the form 24, as is shown in Figure 3. As is shown in this latter figure, such elevation of the platforms 10 and the form 24 serves to expose opposed above-water portions of the outer sides of the form and of the sides of the supporting legs 14 adjacent thereto. Supporting brackets 32 are then secured to and between these opposed side portions of the form 24 and of the adjacent legs 14, as shown in Figure 3. Again, these brackets 32, which must carry a great weight, may be secured in place either by bolts (not shown) or by welding, as is illustrated in the drawings. The brackets 30 may then be removed, either by unbolting the same, if bolted, or by burning through with a torch, if welded, thus leaving the form 24 supported solely on the adjacent legs 14.

The next step is to fit snugly to the top of the form 24 a slip form 34 for casting the upper sections of the side walls of the caisson, and this slip form is secured in any appropriate manner to the two platforms 10 in order to be supported solely therefrom. Such support may take the form of brackets 36 that are bolted, welded, or otherwise suitably secured to the barges and to the slip form 34, as is shown in Figures 4 and 11. Appropriate horizontal and vertical reinforcing bars 38 and 40, respectively, are then disposed in the two forms 24 and 34. For reasons later described, the vertical bars 40, preferably are of a length substantially equal to the height of the caisson to be cast and, in this same connection, it is desirable for certain of the vertical reinforcing bars to extend through apertures in the brackets 36 which support the slip form 34. The pouring of concrete into the open top of the slip form 34, to thus cast the lowermost section of a caisson 42, can then commence. In this connection, the platforms or barges 10 can have enough deck space so that a concrete plant (not shown) can be carried on one or both of the barges.

After the concrete has hardened in the two forms 24 and 34, as shown in Figure 4, the next step is to raise the slip form 34 a distance upwardly so that another section of the side walls of the caisson 42 can be cast. The raising of the slip form 34 a distance substantially equal to its height or depth is accomplished by raising the two platforms 10 on their supporting legs 12 and 14 by means of the jacking mechanisms 18. After the slip form 34 has been so raised, concrete is again poured thereinto, the bottom of the form 34 being closed by hardened concrete from the previous pouring, in order to cast another side wall section of the caisson 42. This slip casting process is continued until the height of the thus cast caisson 42 is greater than the depth of the water at the site, as is best shown in Figure 5. At this time the support of the cast caisson 42 is transferred from the adjacent supporting legs 14 to the platforms 10. In order to accomplish such transfer, the vertical reinforcing bars 40 which extend through the slip-form-supporting brackets 36 may be welded to the latter, or otherwise suitably supported therefrom as by a split washer 44 welded to each bar 40 and bearing on the corresponding bracket 36 (Figures 6 and 11), so that the entire weight of the cast caisson 42 can be supported from the platforms 10. It also will be seen that there are other feasible ways of supporting the caisson 42 from the barges 10. After such support has been accomplished the brackets 32 are removed, either by unbolting them from the adjacent legs 14 and from the bottom section form 24, if bolted thereto, or by cutting them through with a torch, if they are secured in place by welding.

Both barges 10 then are lowered slowly and simultaneously on their supporting legs 12 and 14 by the jacking mechanisms 18 to thus slowly lower the cast caisson down into engagement with the marine bottom 20, until it is supported entirely on such bottom, as shown in Figure 7. In this connection, it will be seen that the sharp lower edge of the footing or bottom section form 24 will cause the caisson 42 to penetrate to a considerable depth into the marine bottom 20. It probably will be desirable, however, for the caisson 42 to have an even greater height than that illustrated in Figure 7. Accordingly, the slip casting process can be resumed, after first detaching the cast caisson 42 from the platforms 10, e.g., by disconnecting vertical supporting and re-enforcing bars 40 from the brackets 36 by removing the supporting washers 44, and in such casting process the slip form 24 is raised in successive steps by raising the barges 10. As successive upper sections are added to the caisson 42 and thus increase its weight, it will tend to settle or sink even deeper into the marine bottom 20. In order to further this sinking process, the marine bottom within the caisson 42 is dug out or excavated, as shown in Figure 8. Such excavation can be accomplished by an appropriate power shovel (not shown) located upon the deck of one of the platforms 10.

Such excavation and slip-casting to increase the height of the caisson 42 preferably is continued until the latter rests on bedrock 22, as shown in Figure 9, and the height of the caisson has been increased so that its upper end is at a desired elevation above water level. At this time the earth within the caisson 42 preferably is completely removed and the bottom end of the caisson is filled with a thick plug of concrete 46 which may be poured in a conventional manner by a tremie. Thereafter the water remaining in the caisson 42 may be pumped out and its interior filled with concrete or broken rock and cement grout (not shown), also in a conventional manner.

After the caisson 42 has been completely constructed and set as described above, the slip form 34 may be removed, as by removing the supporting brackets 36, the platforms 10 lowered on their supporting legs 12 and 14 until they are afloat, the supporting legs pulled up by their jacking mechanisms 18, and both platforms towed away for use at another construction site.

It thus will be seen that the objects of this invention have been fully and effectively accomplished. It will be realized, however, that the foregoing specific embodiment has been shown and described only for the purpose of illustrating the principles of this invention and is subject to extensive change without departure from such principles. Therefore, this invention includes all modifications encompassed within the spirit and scope of the following claims.

I claim:

1. The method of constructing and setting a caisson for a bridge pier or the like, the steps comprising: floating to a setting site buoyant platform-like body means equipped with vertically movable supporting legs and power operated means for selectively effecting or restraining relative vertical movement in either direction between the legs and the body means in order to lift or lower the legs relative to the body means when the latter is afloat or lift or lower the body means on the legs when the latter are engaged with the marine bottom; moving the legs down into engagement with the marine bottom; positioning adjacent the body means a hollow closed-bottom open-top form for casting the bottom section of a caisson; securing the form to the adjacent supporting legs of the body means below the latter to support the form on such legs; fitting to the upper end of the bottom section form a slip form for casting the caisson upper sections and securing the slip form to the body means to support it thereon; pouring concrete into the forms to cast the

lower portion of a caisson that is supported on the adjacent legs; raising the slip form by raising the body means on its legs a limited distance so that the open bottom of the slip form remains closed by the cast section; continuing to pour concrete into the slip form and raise it a limited distance to thus cast additional upper sections of the caisson and increase its height by slip-casting until such height is greater than the water depth at the site; securing the cast caisson to the body means to support it thereon and then detaching the bottom section form from the adjacent legs; lowering the body means, together with the cast caisson, on the legs until the cast caisson engages the marine bottom; and detaching the caisson from the body means so that the caisson is supported on the marine bottom.

2. The method defined in claim 1 in which the bottom section form is buoyant and the step of positioning such form is accomplished by floating it into position.

3. The method defined in claim 1 including the additional and subsequent step of further slip-casting concrete on top of the caisson to increase its height and in performing such slip-casting raising the slip form by raising the body means on its legs.

4. The method defined in claim 1 including the additional and subsequent steps of detaching the slip form from the body means, lowering the body means on its legs until it is afloat, pulling up the legs out of engagement with the marine bottom, and floating the body means away from the site leaving the cast caisson in situ.

5. The method of constructing and setting a caisson for a bridge pier or the like, the steps comprising: floating to a setting site and thereat arranging in spaced relation a pair of buoyant platform-like bodies each equipped with vertically movable supporting legs and power-operated means for selectively effecting or restraining relative vertical movement between the legs and the body in either direction in order to lift or lower the legs relative to the body when the latter is afloat or lift or lower the body on the legs when the latter are engaged with the marine bottom; moving the legs down into engagement with the marine bottom and raising the bodies on the legs until the latter support at least a portion of the weight of the bodies; positioning between the bodies a hollow closed-bottom open-top endless form for casting the bottom section of a caisson; securing the form to the adjacent supporting legs of both bodies below the latter to support the form on such legs; fitting to the upper end of the bottom section form a slip form for casting the caisson upper sections and securing the slip form to the bodies to support it thereon; pouring concrete into the forms to cast the lower portion of a caisson that is supported on the adjacent legs; raising the slip form by raising the bodies on their legs a limited distance so that the open bottom of the slip form remains closed by the cast section; continuing to pour concrete into the slip form and raise it a limited distance to thus cast additional upper sections of the caisson and increase its height by slip-casting until such height is greater than the water depth at the site; securing the cast caisson to the bodies to support it thereon and then detaching the bottom section form from the adjacent legs; lowering the bodies, together with the cast caisson, on the legs until the cast caisson engages the marine bottom; and detaching the caisson from the bodies so that it is supported on the marine bottom.

6. The method defined in claim 5 in which the bottom section form is buoyant and the step of positioning it is accomplished by floating it into position.

7. The method defined in claim 5 including the additional and subsequent step of further slip-casting concrete on top of the caisson to increase its height and in performing such slip-casting raising the slip form by raising the bodies on their legs.

8. The method defined in claim 5 including the additional and subsequent steps of detaching the slip form from the bodies, lowering the bodies on their legs until they are afloat, pulling up the legs out of engagement with the marine bottom and floating the bodies away from the site leaving the cast caisson in situ.

9. In the method of constructing and setting a caisson for a bridge pier or the like the steps comprising: floating to a setting site and thereat arranging in spaced relation a pair of buoyant platform-like bodies each equipped with vertically movable supporting legs and power-operated means for selectively effecting or restraining relative vertical movement between the legs and the body in either direction in order to lift or lower the legs relative to the body when the latter is afloat or lift or lower the body on the legs when the latter are engaged with the marine bottom; moving the legs down into engagement with the marine bottom and raising the bodies on the legs until the latter support at least a portion of the weight of the bodies; positioning between the bodies a hollow closed-bottom open-top endless form for casting the bottom section of a caisson; securing the form to the bodies; raising the bodies, together with the form, on the legs until above-water portions of the latter are exposed beneath the bodies; securing the form to said above-water portion of adjacent legs of both bodies to support the form on such legs, and then detaching the form from the bodies; fitting to the upper end of the bottom section form a slip form for casting the caisson upper sections and securing the slip form to the bodies to support it thereon; pouring concrete into the forms to cast the lower portion of a caisson that is supported on the adjacent legs; raising the slip form by raising the bodies on their legs a limited distance so that the open bottom of the slip form remains closed by the cast section; continuing to pour concrete into the slip form a limited distance to thus cast additional upper sections of the caisson and increase its height by slip-casting until such height is greater than the water depth at the site; securing the cast caisson to the bodies to support it thereon and then detaching the bottom section form from the adjacent legs; lowering the bodies, together with the cast caisson, on the legs until the cast caisson engages the marine bottom; and detaching the caisson from the bodies so that it is supported on the marine bottom.

10. The method defined in claim 9 in which the slip form is buoyant and the positioning step is performed by floating the slip form into position.

11. The method defined in claim 9 including the additional and subsequent step of further slip-casting concrete on top of the caisson to increase its height and in performing such slip-casting raising the slip by raising the bodies on their legs.

12. The method defined in claim 9 including the additional and subsequent steps of detaching the slip form from the body means, lowering the bodies on their legs until they are afloat, pulling up the legs out of engagement with the marine bottom, and floating the bodies away from the site leaving the cast caisson in situ.

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