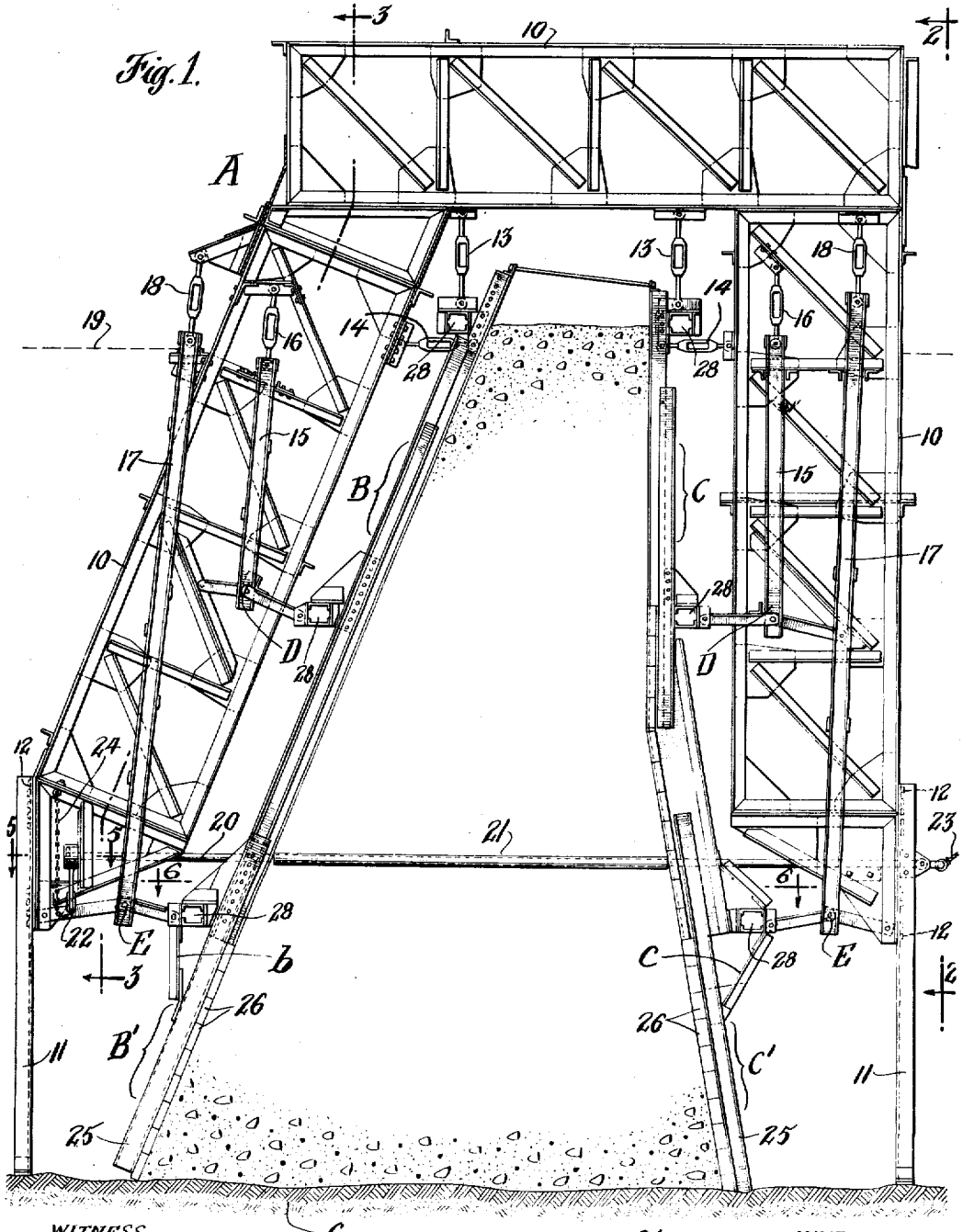
Jan. 18, 1927. 1,615,069

C. BRYNOLDT

METHOD OF AND APPARATUS FOR BUILDING CONCRETE STRUCTURES IN WATER

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Fig. 1.



WITNESS.

Gustav Genzlinger.

Christian Brynoldt INVENTOR

BY Sprinestvedt & Lechner

ATTORNEYS

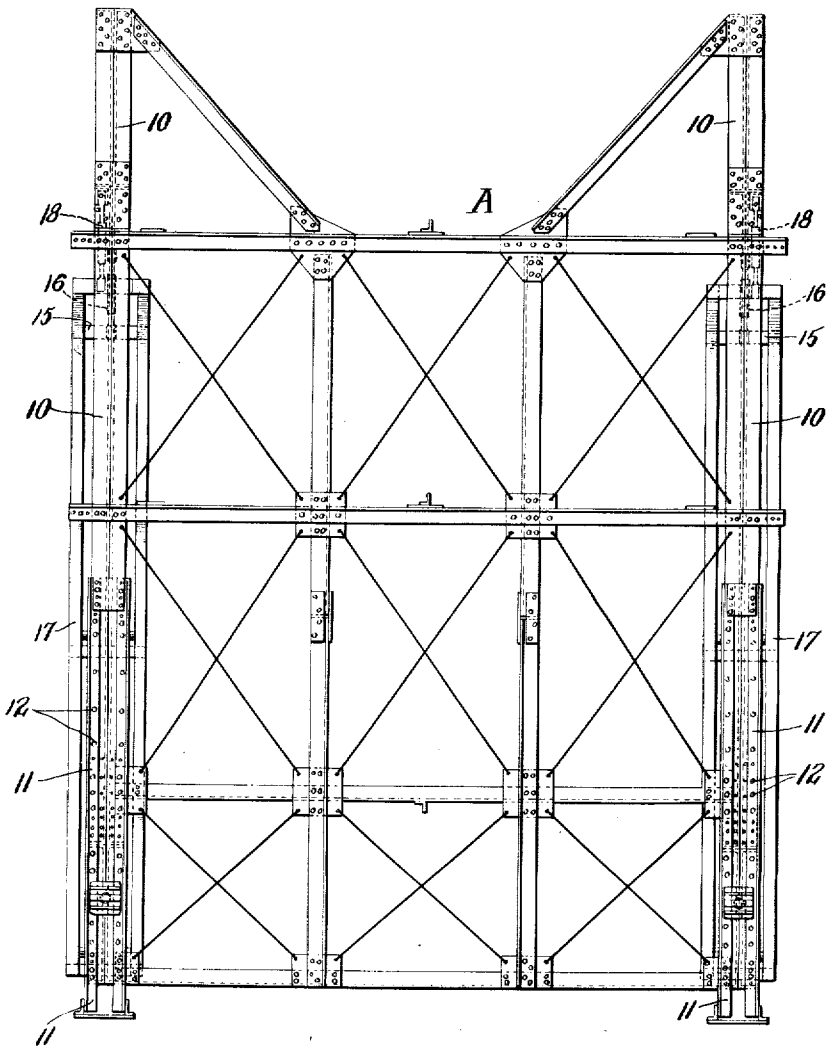
Jan. 18, 1927. 1,615,069

C. BRYNOLDT

METHOD OF AND APPARATUS FOR BUILDING CONCRETE STRUCTURES IN WATER

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Fig. 2.



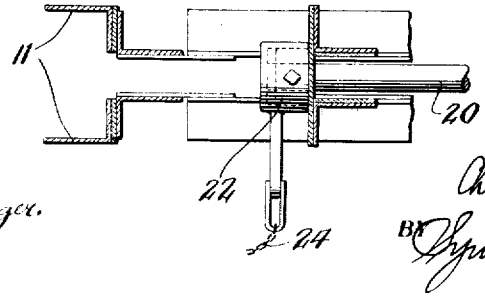


Fig. 5.

WITNESS:
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Jan. 18, 1927. 1,615,069

C. BRYNOLDT

METHOD OF AND APPARATUS FOR BUILDING CONCRETE STRUCTURES IN WATER

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Fig. 3.

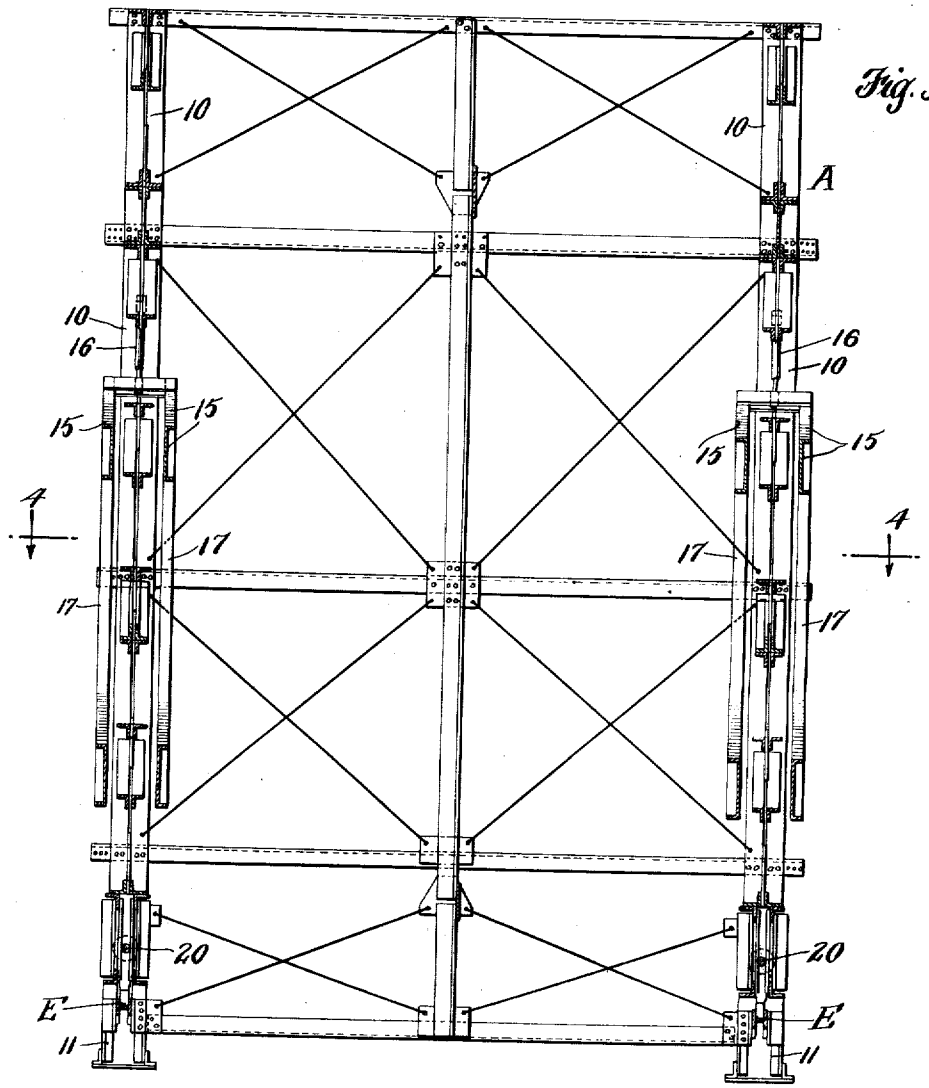
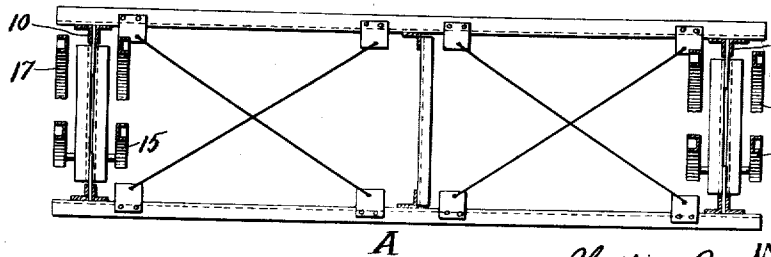


Fig. 4.



WITNESS.
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METHOD OF AND APPARATUS FOR BUILDING CONCRETE STRUCTURES IN WATER

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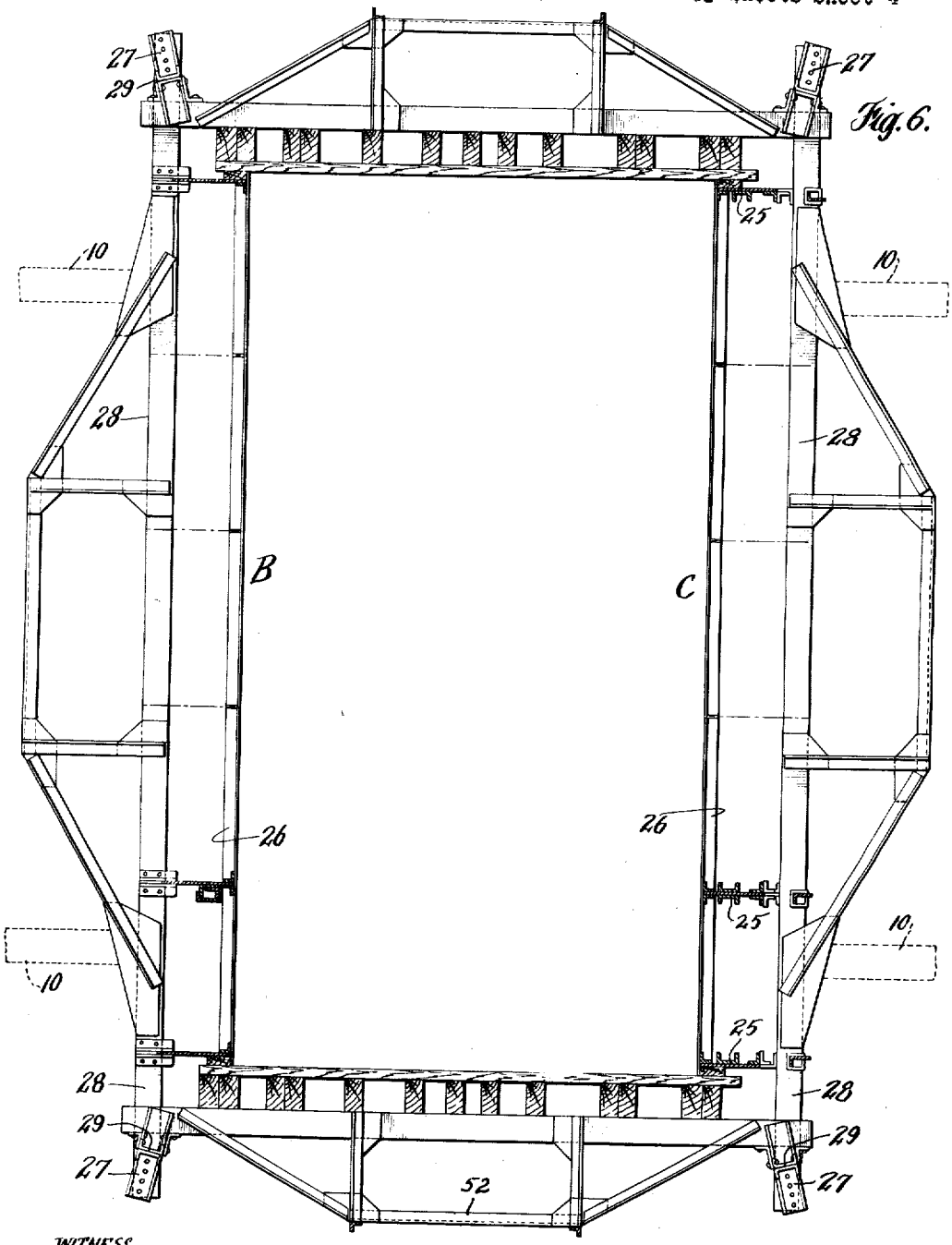


Fig. 6.

WITNESS.
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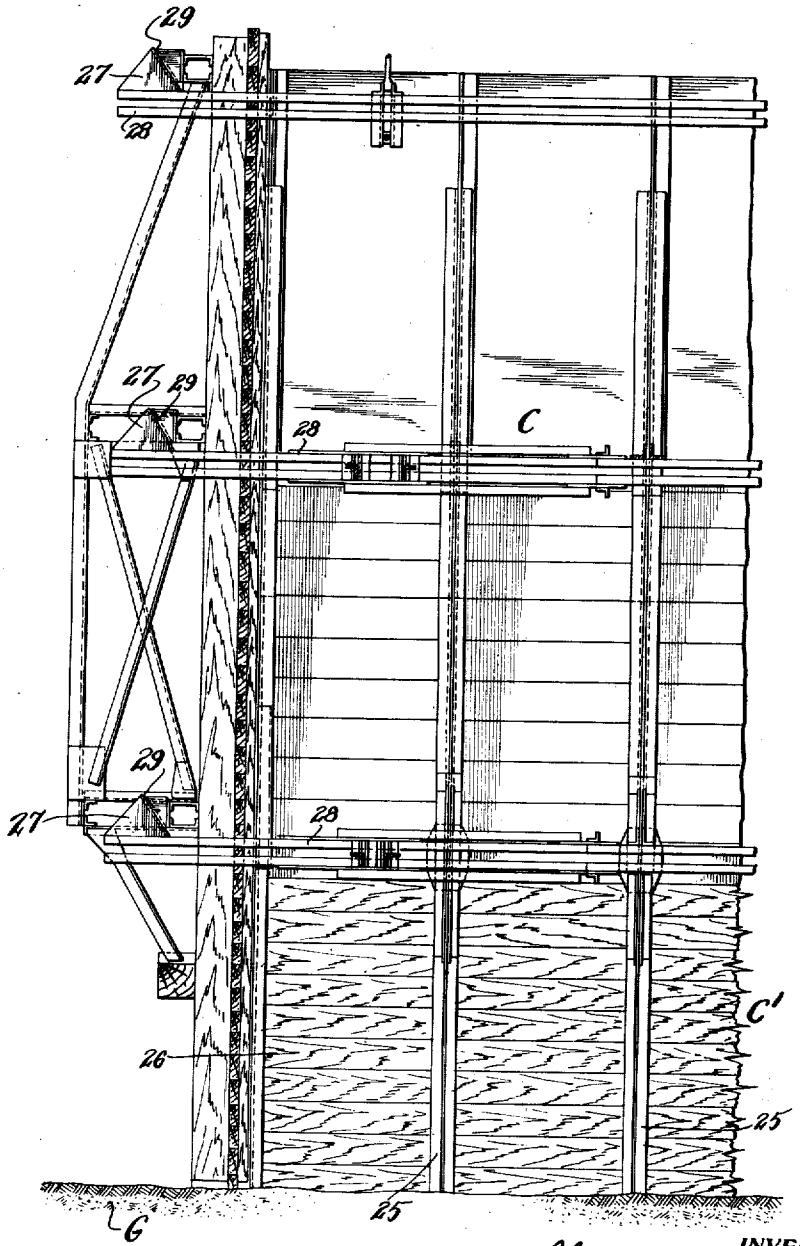
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METHOD OF AND APPARATUS FOR BUILDING CONCRETE STRUCTURES IN WATER

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Fig. 7.



WITNESS.
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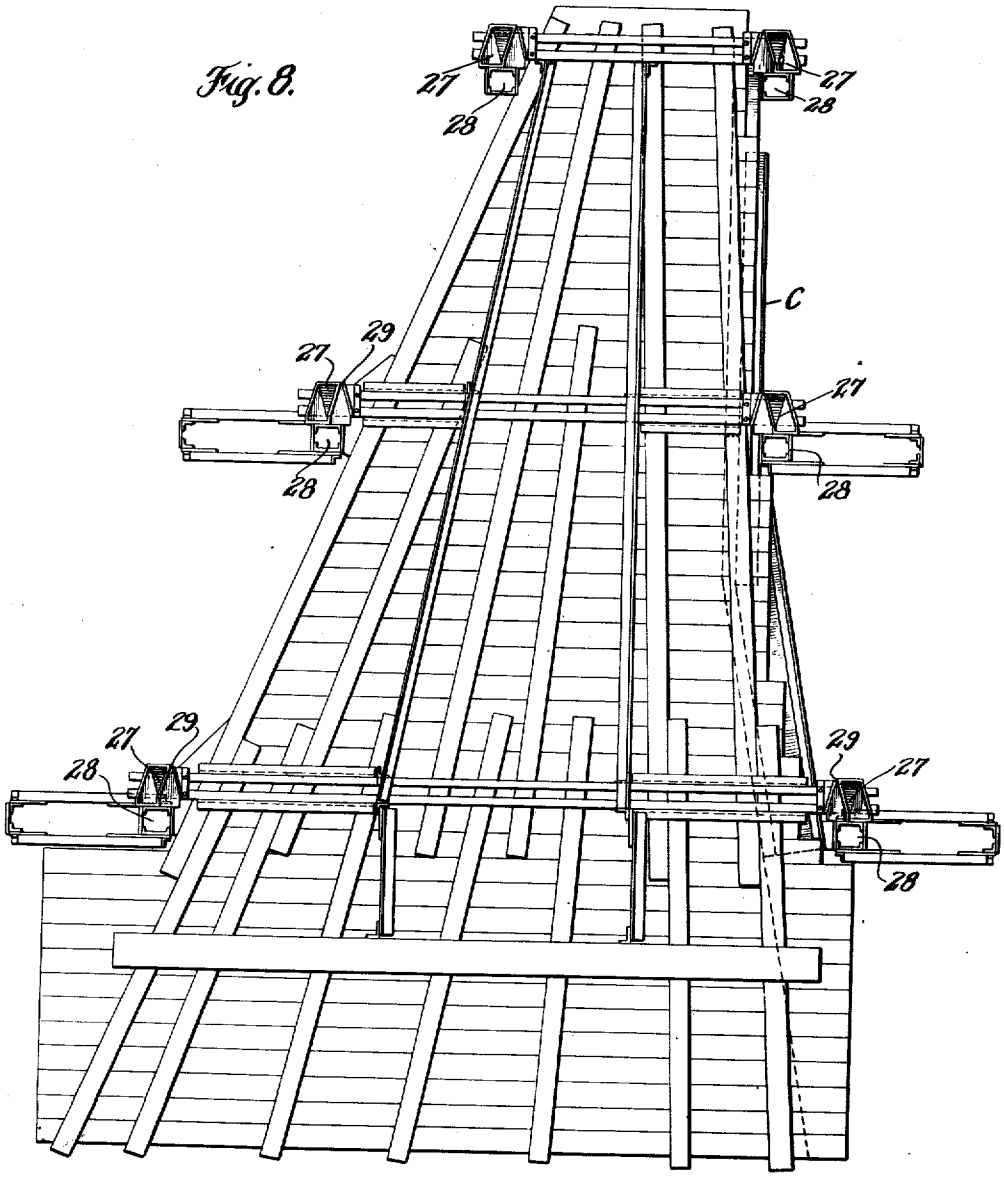
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METHOD OF AND APPARATUS FOR BUILDING CONCRETE STRUCTURES IN WATER

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Fig. 8.



WITNESS.
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METHOD OF AND APPARATUS FOR BUILDING CONCRETE STRUCTURES IN WATER

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Fig. 9.

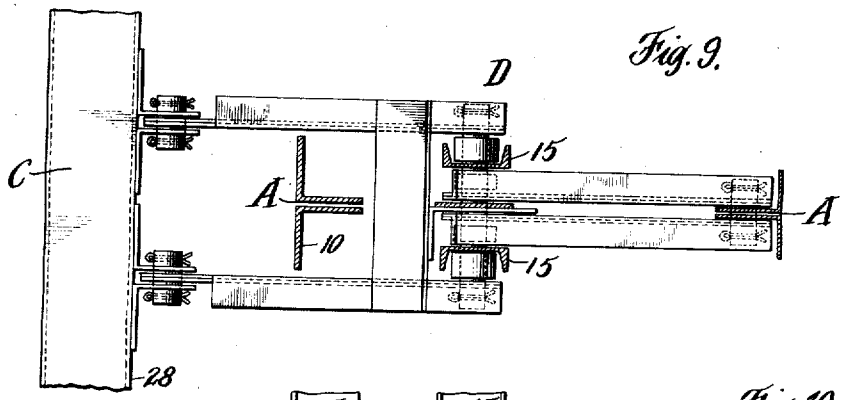


Fig. 10.

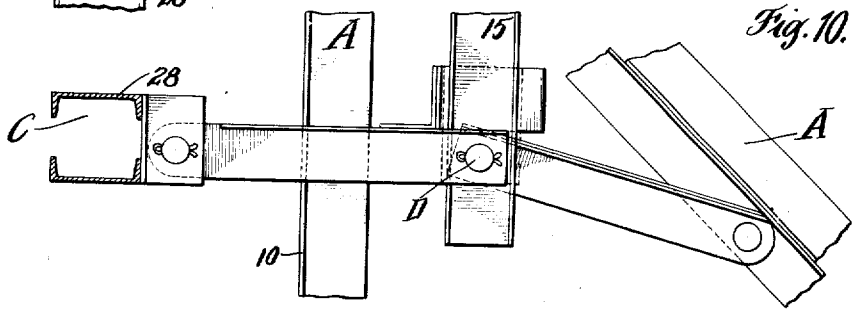


Fig. 11.

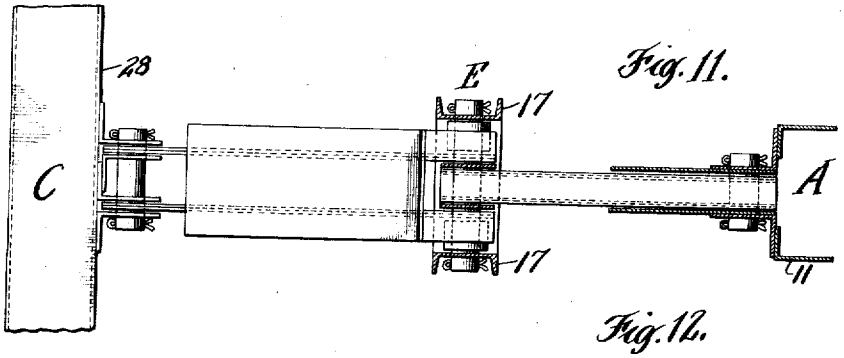
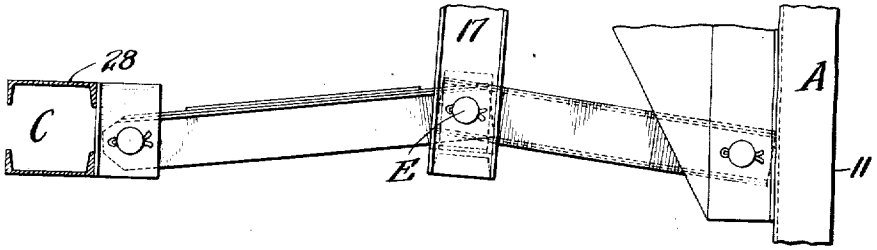


Fig. 12.



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METHOD OF AND APPARATUS FOR BUILDING CONCRETE STRUCTURES IN WATER

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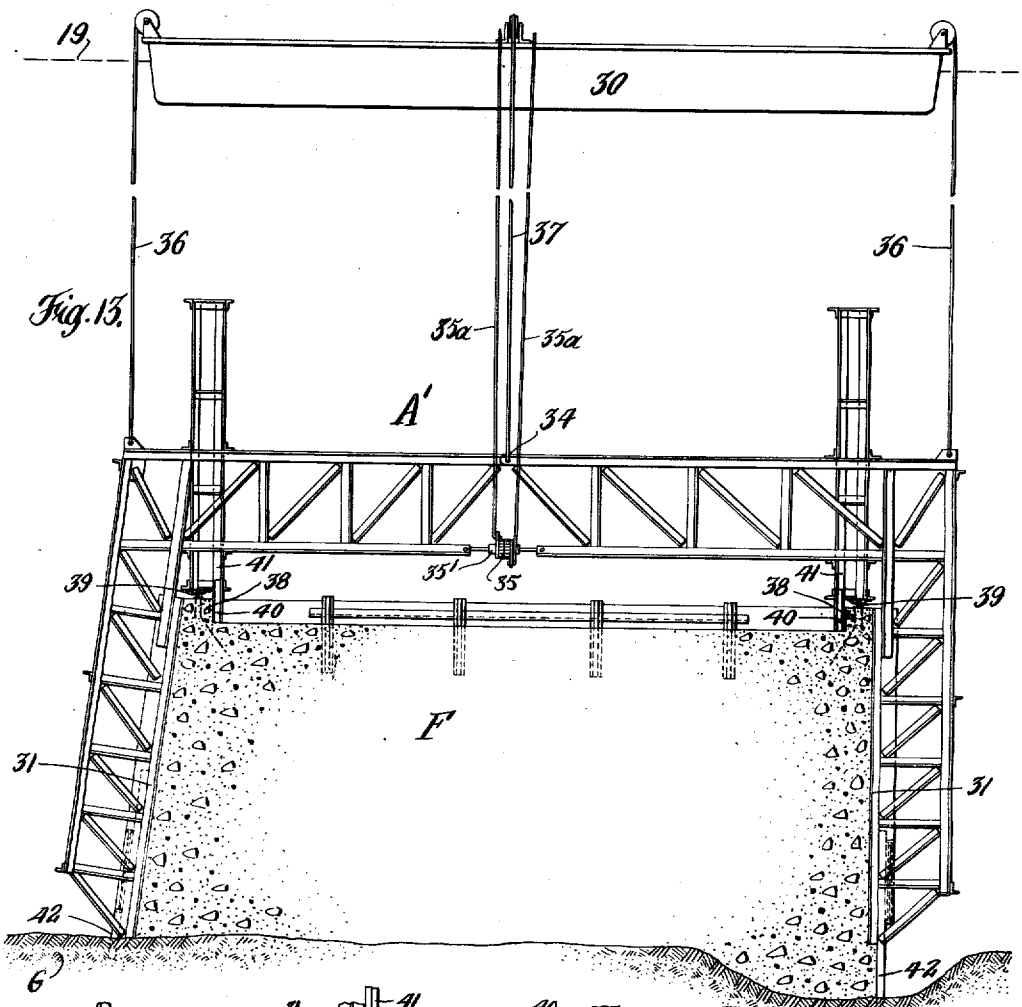


Fig. 13.

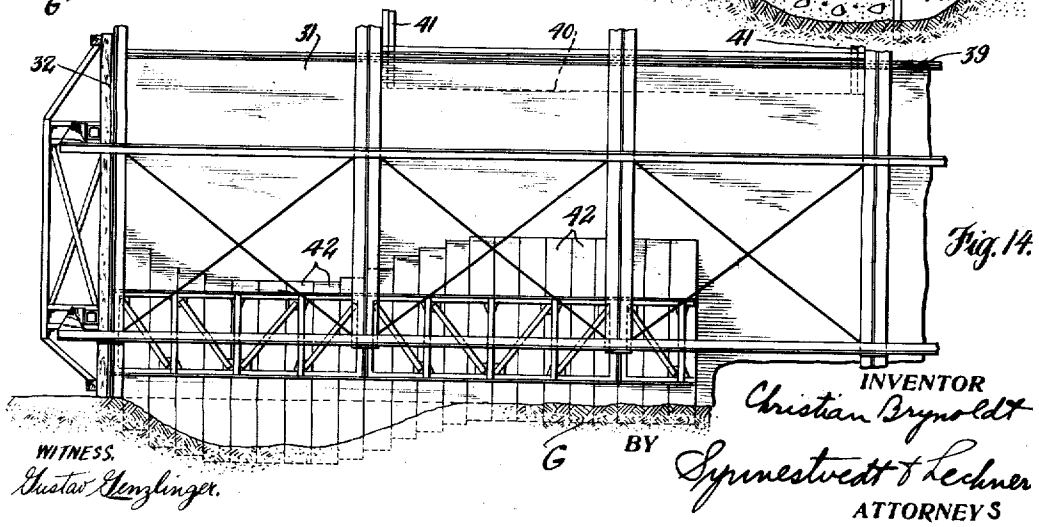


Fig. 14.

WITNESS.
Gustav Glenzlinger.

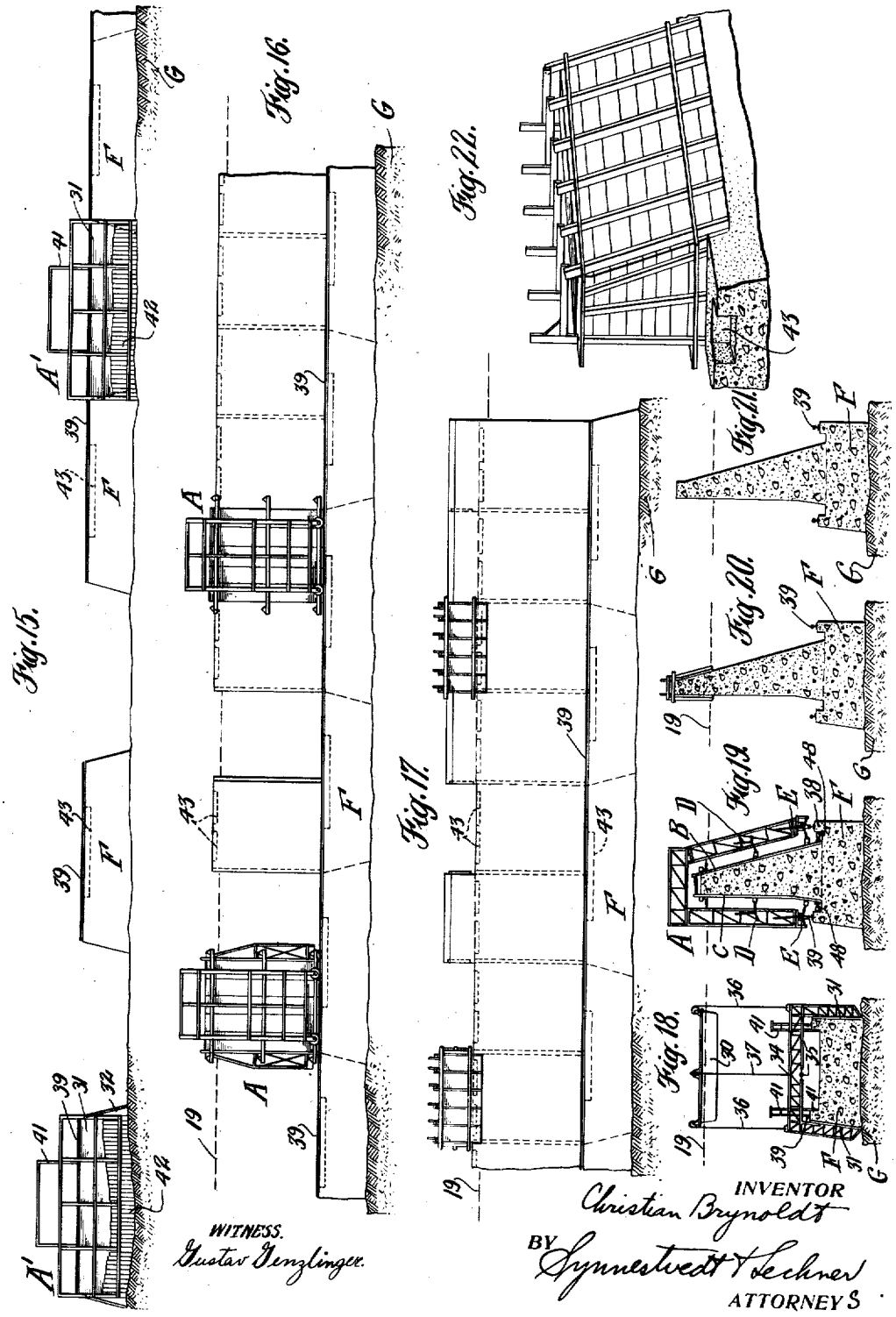
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METHOD OF AND APPARATUS FOR BUILDING CONCRETE STRUCTURES IN WATER

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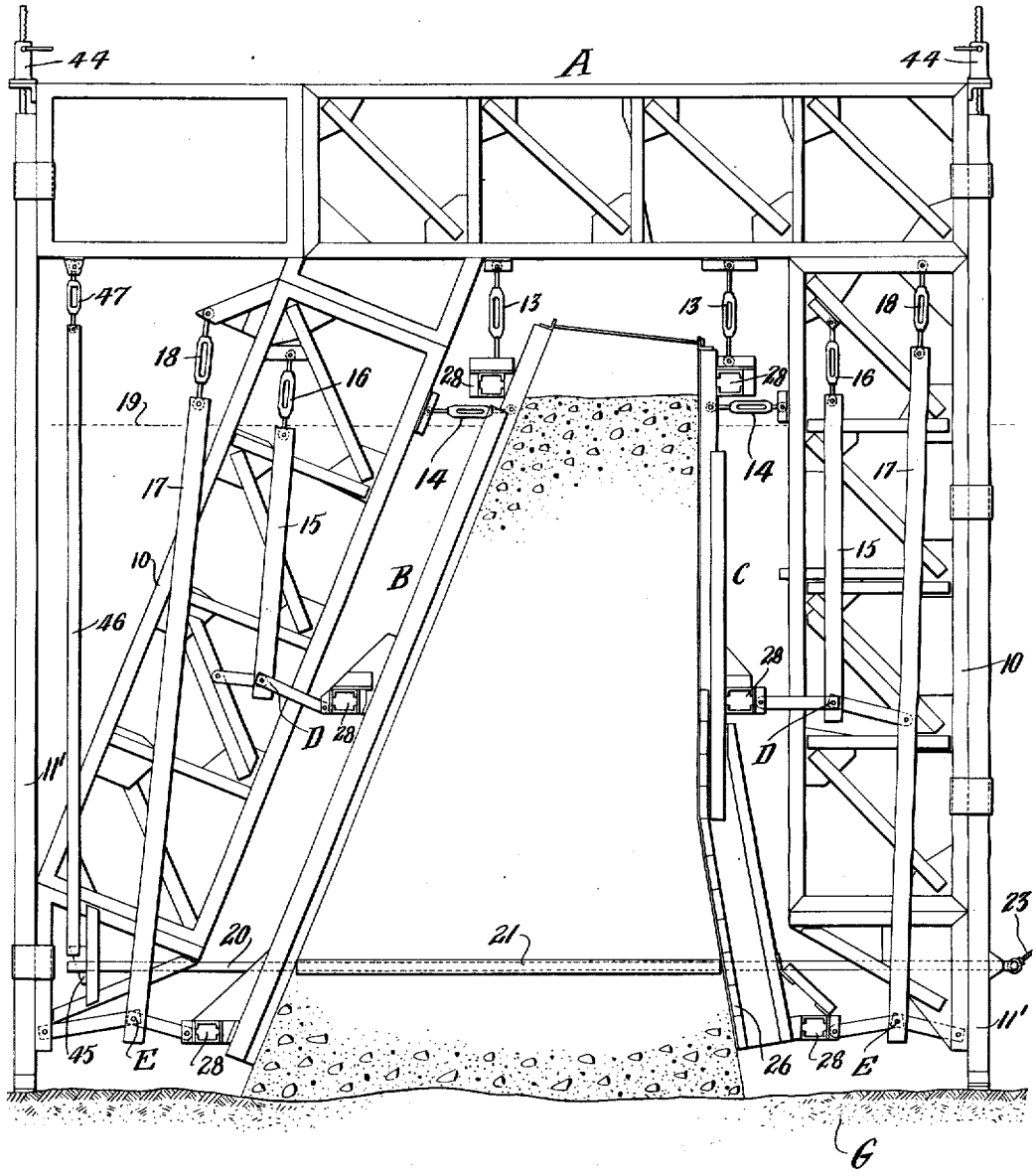
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METHOD OF AND APPARATUS FOR BUILDING CONCRETE STRUCTURES IN WATER

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Fig. 23.



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Jan. 18, 1927. **1,615,069**

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METHOD OF AND APPARATUS FOR BUILDING CONCRETE STRUCTURES IN WATER

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Fig. 24.

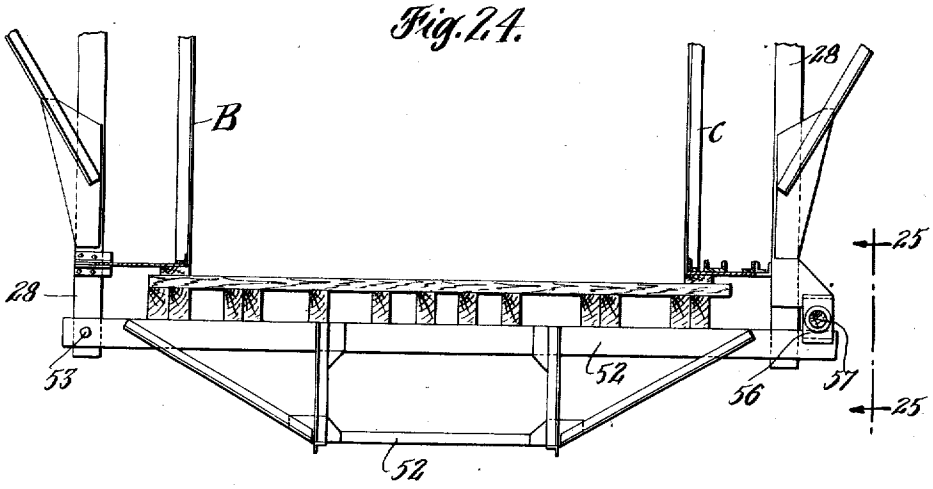


Fig. 25.

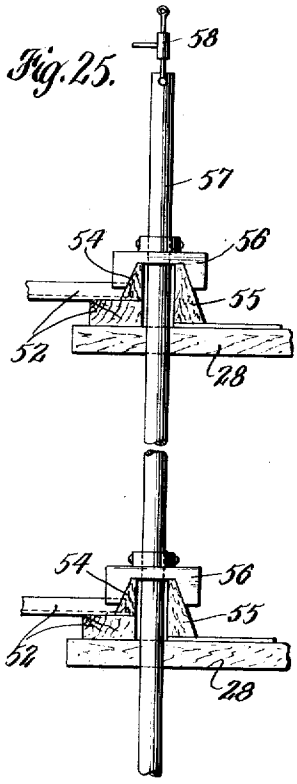
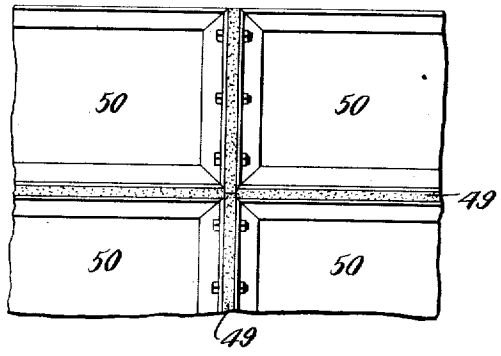


Fig. 26.



Fig. 27.



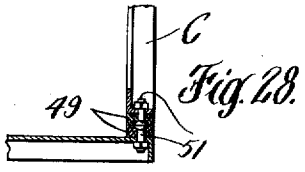


Fig. 28.

WITNESS

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BY

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Patented Jan. 18, 1927. 1,615,069

UNITED STATES PATENT OFFICE.

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METHOD OF AND APPARATUS FOR BUILDING CONCRETE STRUCTURES IN WATER.

Application filed February 10, 1922. Serial No. 535,464.

This invention relates to a method of and to an apparatus for building concrete structures in water and it has for its principal object the provision of means whereby the usual coffer dam may be dispensed with and whereby the building of a submerged wall with a type of form similar to that shown in my Patent No. 1,298,450 may be made expeditiously and accurately possible. In building structures in water it has heretofore been the practice to first provide a coffer dam and then to pump out the water before erecting a form for the work. This involves an enormous expense incident to the driving of piling, caulking, and bracing sufficiently to withstand the water pressure. Then the making of the actual form takes in addition approximately as much material and money as does the coffer dam.

I propose to eliminate the greater part of this expense and to greatly reduce the amount of time and materials necessary to build such a structure and my method consists in using apparatus which answers the combined purpose of the former coffer dam with its contained form. Among the objects, therefore, of my invention are the provision of a form which can be placed directly in the water, which can be moved as a unit and used continuously without being in any way destroyed or rebuilt and one which can be made to fit the variations in the profile or contour of the bottom at the different locations in which it is set. The invention can be aptly summed up as involving the provision of a combined traveling coffer dam and form.

The invention is particularly useful in the building of concrete walls and piers in water. In the accompanying drawings I have illustrated it as embodied in a structure which is especially designed for the building of walls. With this purpose in view further objects of the invention may be stated as follows: the provision of means for casting a footing on the bottom; the provision of a track on this footing; and the provision of a traveling form on this track by means of which the wall may be built up on this footing. It is also an object of my invention to accomplish all of the foregoing steps with the least possible assistance from a diver and, in fact, most of them absolutely without such assistance.

Generally stated the foregoing constitute the objects of my invention but others will appear hereinafter in connection with the description of the accompanying drawings which illustrate the idea in a preferred form and in which

Fig. 1 is an end elevation of a structure for forming walls which embodies my invention with the supporting legs extended and the forms in position with the concrete poured;

Fig. 2 is a side elevation of the framework which carries the forms with the legs retracted and looking in the direction of the arrows 2—2 of Fig. 1;

Fig. 3 is a section of the framework taken on the line 3—3 of Fig. 1;

Fig. 4 is a section of the framework taken on the line 4—4 of Fig. 3;

Fig. 5 is a section of the framework on an enlarged scale taken on the line 5—5 of Fig. 1 and illustrating the details of a ratchet for removing the nuts on the tie rods;

Fig. 6 is a plan section of the structure taken on the line 6—6 of Fig. 1 showing the side forms, the bulkheads and their bracing;

Fig. 7 is a half side elevation looking toward the left of Fig. 6 which shows the side form in place and an edge view of a bulkhead;

Fig. 8 is an elevation of a bulkhead;

Fig. 9 is an enlarged plan view of the upper toggle on the right hand side of Fig. 1;

Fig. 10 is an elevation of the structure of Fig. 9;

Fig. 11 is an enlarged plan view of the lower toggle on the right hand side of Fig. 1;

Fig. 12 is an elevation of the structure of Fig. 11;

Fig. 13 is an end elevation of a framework with side forms in position for forming a wall footing, the concrete having been poured and the near bulkhead removed;

Fig. 14 is a side elevation of Fig. 13 partly broken away and looking toward the left;

Fig. 15 is a diagrammatic small scale elevation showing the progressive steps in forming a footing;

Fig. 16 is a view, similar to that of Fig. 15 which illustrates the steps for forming a wall on the footing;

Fig. 17 is a view which follows out the diagrammatic showing of Figs. 15 and 16 and illustrates the progressive steps in completing a wall by casting extensions above water on the portions already built under water;

Fig. 18 is a diagrammatic small scale cross section of a footing with the footing form in place and should be read in connection with Fig. 15;

Fig. 19 is a diagrammatic small scale cross section of footing and wall built thereon with traveling wall form in place and should be read in connection with Fig. 16;

Fig. 20 is a diagrammatic small scale cross section of footing, wall and wall extension with the extension form in place and should be read in connection with Fig. 17;

Fig. 21 is a small scale cross section of a completed wall;

Fig. 22 is a perspective view of a wall extension form;

Fig. 23 is a view similar to that of Fig. 1 but showing a means for adjusting the forms from above water and means for removing tie rods from above;

Fig. 24 is a partial cross section taken similarly to that of Fig. 6 illustrating a modified arrangement for hanging the bulkhead;

Fig. 25 is a partial side elevation of Fig. 24 looking as indicated by the arrows 25—25; and

Figs. 26, 27 and 28 are fragmentary views illustrating a manner in which the form structure can be made water tight.

In cases where the depth of the water is not too great I cast a wall directly on the bottom without first casting a footing and will now describe this procedure, reference being had particularly to Figs. 1 to 12, inclusive.

The structure constitutes in general a unitary, rigid, framework of an inverted U-shape, which I have indicated as a whole by the reference character A, to which are adjustably attached opposing side forms B and C. The frame is made up of a plurality of trusses 10, suitably rigidly braced in both vertical and horizontal directions in any approved manner and when submerged, it is adapted to rest upon four adjustable posts 11, one at each corner. Adjustment can be made by sliding the legs up or down and then bolting them in the desired position through the medium of a series of holes 12. (See Fig. 2.) Other means of adjustment might be used and in Fig. 23 I have shown an arrangement employing screw jacks which are worked from above the surface. Where the holes are used, as in the figures under particular consideration, the posts or legs 11 are set to the desired position while the form is out of the water. Careful soundings are made in exactly the spots where the legs are to be placed and the adjustments made accordingly.

The side forms B and C are supported from the frame at the top by the vertically disposed turn-buckles 13. Adjustment of the forms to the exact shape and size of the wall to be built is accomplished by means of the horizontally disposed turnbuckles 14 and the upper and lower toggle constructions indicated as a whole by the reference characters D and E respectively.

The upper toggles are each operated by means of a member 15 and a turnbuckle 16 and the lower toggles by a similar but longer member 17 and a turnbuckle 18. The members 15 and 17 extend above the water level 19 and the turnbuckles 16 and 18 are, therefore, operated from above the surface so that it is unnecessary to employ a diver in setting the forms or in collapsing them away from the work after the concrete has hardened.

Where the wall is not of too great height the frame A, with the toggles and turnbuckles mentioned, is of sufficient strength to withstand the pressures by itself but where the height is sufficient to create too much pressure I provide tie rods 20 between the forms near the bottom thereof which extend through pipes 21 afterwards left in the concrete. When it is desired to collapse the forms and move the frame a nut at one end of the rod is unscrewed by means of a ratchet 22 operated by a diver or from above with a double acting ratchet operated by means of ropes and the rod pulled out from the other end by means of a cable 23 attached to any suitable hoisting mechanism on the surface of the water. The ratchet is provided with a safety chain 24 so that there may be no danger of losing it.

The permanent or fixed main or body portions of the forms B and C are of all metal construction but the lower portions thereof, B′ and C′ may be made of wood for the reason that it is necessary to make the permanent part of the forms somewhat shorter than is actually required and then to provide extensions B′ and C′, in order to take care of inequalities in depth. For instance, an entirely permanent or fixed form could probably be used in one location only as no two sections of the bottom are liable to be exactly similar in contour or exactly the same distance beneath the surface of the water, especially if the bottom be rock. In starting a form of this character, therefore, on a new job, it is preferable to obtain the maximum and minimum distances to the

bottom, to design the steel form for the minimum depth, and then to fix the wooden extensions for the deepest part. This part is poured first followed in sequence by the gradually decreasing shallower portions. The timber extensions can by this procedure be steadily reduced so that shimming will be unnecessary except possibly in occasional instances. If desired the extensions may be provided with adjustable vertical liners capable of sliding movement with respect to the main portion of the form. The extensions may be built up of horizontally extending planks 26 which can be removed or replaced as conditions require. The extensions may be braced through the medium of any suitable bracing structure *b* and *c*. (See Fig. 1.)

The structure and the procedure just described are particularly adapted for work where the contour of the bottom is more or less irregular. The form is forced through any mud or other viscous matter to a solid bottom and then the inside is cleaned out by pumping before the concrete is run. The depth to which the extension should be built is determined by careful sounding and the work all done before the form is placed in position so that no divers are necessary.

The bulkheads for a form of this type are preferably made so that they can be either removed separately or handled with the side forms. They are built up in any desired manner and may be held to the side forms by means of lugs 27 riveted to the ends of the steel wales 28 of the side forms. The lugs have inclined faces 29 and portions of the truss formation of the bulkhead are adapted to fit against these inclined faces. The bulkhead is placed in position and as it falls into place it rides inwardly on the inclined faces to a firm tight seat. By this arrangement the pressure of the concrete on the bulkheads is transmitted to the longitudinal wales 28 on the side forms.

Instead of having the bulkheads removable as just described they can be hinged in the manner illustrated in Figs. 24 and 25. The bulkhead truss 52 can be hinged at one side to the end of the wale 28 of the form B at the point 53. At the other side is provided a suitable locking structure comprising the upstanding members 54 and 55 secured respectively to the truss 52 of the bulkhead and the wale 28 of form C; the clamp 56 straddling said upstanding members; and the lifting post 57 to which the clamp is secured. The post is raised and lowered from above by any suitable means such, for example, as the jack 58 and when raised the bulkhead is free to swing out around the point 53. The structures has been described in the singular but it is to be understood that it may be duplicated for each truss 52 that might be used in building up the bulkhead. I prefer to use such swinging bulkheads wherever the traveling method is employed, that is, where rails are placed under the water as will hereinafter appear.

The scheme so far described can be utilized in constructing a wall of almost any size desired the only limit being the capacity of the available derricks since the structure as a whole, framework and forms including sometimes the bulkheads, is lifted bodily as a unit and moved from one position to the next. I prefer to use two form structures in carrying out the work one of which is provided with bulkheads but the other of which is not and what is generally called the alternate block method of wall construction is employed; that is, one where separated blocks are cast with complete forms including bulkheads the space between blocks corresponding to the length of a block, and then the spaces filled in by overlapping two precast blocks with side forms without the bulkheads.

Where a very high or large wall is to be built which would necessitate an unusually large, heavy and cumbersome form it is generally advisable, instead of lifting the form each time it is to be moved, to precast a footing under the water by means of a form very similar in principle to the one already described and then in providing this footing with a track. On this track are mounted form structures substantially identical in character with that already described and in order to move them from one position to the next it is only necessary to roll them along the track much in the manner disclosed for the building of walls above water in my Patent No. 1,298,450 issued March 25, 1919. The track can be laid on the footing for some distance ahead. In carrying out this part of my invention divers should be used to see that everything is in readiness before the form structures are pulled ahead.

In Figs. 13 and 14 I have illustrated my method of precasting a footing under the water. A frame A′, very similar to the frame A already described, is suspended from a scow 30 and to this frame are secured the side forms 31. Bulkheads 32 which may be very similar to the bulkheads already described are provided which can be handled, as before, either separately or with the side forms.

The frame A′ is constructed so that the legs or side trusses can swing outwardly around the point 34 when it is desired to collapse the form from the work. This is accomplished by loosening the turnbuckle 35′ by means of the double acting ratchet 35 operated from above by ropes 35ª and winding up on the two end cables 36 before pulling up on the central cable 37.

I prefer to cast parapets 38 on the footing

F upon which I mount the rails 39 for the track along which the wall form structure proper is later to be moved. As shown in Fig. 19 these parapets may be used to take the pressure of the concrete poured into form A. This is accomplished by introducing jacks 48 between the parapets and the lower ends of the forms thereby relieving the rails 39 of the greater proportion at least of the side thrust. The parapet bulkheads 40 are mounted upon movable legs 41 so that they may be raised and lowered out of the way or into position. The legs 41 are also adapted to set the rails 39.

In order to be able to cast upon very uneven or irregular bottoms I provide a series of narrow vertically movable extension members 42 which are adapted to slide up and down in the truss work of the side forms as most clearly shown in Fig. 14. In this way I can very easily make my structure conform to the contour or profile of the bottom. The bottom is indicated in the various figures by the reference character G.

Figs. 15 to 22 inclusive have been introduced as a sort of a diagram to illustrate the sequence of operations as they are carried out when building a wall on a footing with what I have termed my submarine form and they may be said to briefly sum up my method in outline. The work is conceived of as progressing to the right in these figures. First, at the left of Fig. 15, is a complete footing form structure in place including bulkheads. This casts a block of footing F as seen next to the right in the figure. The spaces between blocks are filled in by placing a form without the bulkheads between two blocks already cast as seen to the right of the figure.

The form A now comes into operation as seen in Fig. 16 and exactly the same method is used in casting the main or body portion of the wall as was used in casting the footing, namely, the alternate block method.

In Fig. 17 I have illustrated a step which has not been touched upon before but which involves simply the casting of an extension to the wall above the water level. The alternate block method is used here also. Suitable construction joints between the blocks are provided as indicated by the character 43.

In Fig. 23 I have illustrated a couple of modifications of details. The legs 11 are adjustable from the surface after the form is in place by means of the screw jacks 44 and the rod 20 is released from above simply by withdrawing the wedge 45 through the medium of the bar 46 and the turnbuckle 47.

It will be seen from the foregoing that I have developed an apparatus for and a method of building walls under water which eliminates the necessity for a coffer dam and one in which the form can be set and collapsed without using a diver. The structure I have called a submarine form. It is handled as a unit and constitutes permanent equipment which can be used repeatedly. The structure is lifted bodily by derricks operating from barges on the surface of the water.

In some instances, where the water is salt or where it is so impure as to be injurious to the concrete, it may be desirable or necessary to seal the bottom of the form by running in a small quantity of concrete under water and then in pumping out the water and finishing the work without having to run the main part or body of the concrete into water. Where this is done the form would be furnished with suitable gaskets 49 (either rubber or wood) as shown in Figs. 26, 27 and 28. In Figs. 26 and 27 these gaskets are shown between the abutting edges of the panels 50 composing a form, and in Fig. 28 they are shown as secured to the abutting edges of the side form and the bulkhead by means of bolts 51. Any manner of making the completed form structure water tight would suffice and the foregoing is mentioned merely as one possibility. When used in this way the form is, in effect, a coffer dam and it will be seen that the apparatus is capable of taking either external or internal pressures. Of course, it is my intention to do away with the use of coffer dams but in some instances they may be desirable and my improved form, as has been shown, is designed to meet such contingencies.

I claim:

1. The herein described process of building concrete walls and the like under water which consists in lowering and positioning a form in the relatively deeper portions of the water, in pouring the concrete, in collapsing the form, in removing a portion of the bottom of the form, and in repositioning the form in relatively shallower portions.

2. The herein described method of constructing a concrete wall in water which consists in casting a footing under water, in mounting a traveling form on the footing, in casting a section of wall on said footing by means of said form, and then in moving the form along the footing to a new position.

3. A method of building a wall under water in superposed sections which comprises casting a lower section with parapets along its top, and setting up and filling a form for the section above with its lower edges laterally sustained from said parapets.

4. A method of building a wall under water in superposed courses with traveling forms which comprises casting a lower course with parapets along its top, mounting a traveling form to travel along said

lower course and casting the course above in successive sections therewith, laterally bracing the lower edges of said form against said parapets for the casting of said sections.

5. Apparatus for building a concrete wall under water comprising a float and a form adjustably suspended therefrom, so that it may be shifted up or down according to the depth of water.

6. Apparatus for building a concrete wall under water comprising a float and a form adjustably suspended therefrom, so that it may be shifted up or down according to the depth of water, and extension members on the form walls slidable up and down to vary the outlines of the lower edges of the walls.

7. Apparatus for building a concrete wall under water comprising a float, and a form structure for straddling the work including sides adjustably suspended from the float and a flexible transverse connection between them also adjustably suspended from the float; so that the form may be shifted up or down according to the depth of water and opened laterally for disengagement from the work.

8. Apparatus for building concrete walls under water comprising form walls and a sustaining frame therefor adapted to straddle the work, with supports for sustaining the frame from the bottom individually adjustable for variations in the bottom contour, and means for tying the frame sides together through the form removable under water after a casting operation.

9. Apparatus for building concrete walls under water comprising form walls and a sustaining frame therefor adapted to straddle the work, with extensions of said form walls variable in outline and extension downward to conform to the bottom, and individually adjustable supporting legs for sustaining frame and form walls from the bottom independently of engagement of said form walls therewith.

10. Apparatus for building concrete walls under water comprising form walls and a sustaining frame therefor, with extensions of said form walls variable in outline and extension downward to conform to the bottom, and means for laterally sustaining said form wall extensions for the frame sides.

11. Apparatus for building concrete walls under water comprising a frame adapted to straddle the work, form walls collapsibly sustained by the frame sides, extensions of said form walls variable in outline and extension downward to conform to the bottom, means for sustaining said wall form extensions from the frame sides, and means for tying the frame sides together through the form removable under water after a casting operation.

12. Apparatus for building concrete walls under water comprising a frame, with supports for sustaining the frame from the bottom individually adjustable for variations in the bottom contour, form walls collapsibly sustained by the frame sides, extensions of said form walls variable in outline and extension downward to conform to the bottom, and means for also sustaining said form wall extensions from the frame sides.

13. Apparatus for building a concrete wall under water comprising, in combination, a frame, wall forms between the frame sides, and toggles for sustaining said forms from the frame sides beneath the water, with means for operating said toggles from above the water.

14. Apparatus for molding concrete walls in water which comprises in combination, a movable supportig structure, means for adjusting the height of the supporting structure, forms carried by said structure, toggles for adjusting and releasing said forms, and means, accessible from above the water, for operating the toggles.

15. Apparatus for molding concrete structures in water which comprises in combination, a movable supporting structure, a form carried thereby, means for adjusting the height of the supporting structure, means for adjusting and releasing the form, and means for operating the height adjusting means and the form adjusting and releasing means from above the water.

16. Apparatus for molding concrete structures in water which comprises in combination, an inverted, substantially U-shaped, movable supporting structure straddling the work, oppositely disposed molds attached thereto, an under water tie rod extending between the legs of the U-shaped supporting structure, means for adjusting the height of the supporting structure, means for adjusting and releasing the forms, and means, all accessible from above the water, for releasing and removing the tie rod, for operating the height adjusting means, and for operating the form adjusting and releasing means.

17. Apparatus for molding concrete walls in water which comprises in combination, a movable supporting structure, a pair of oppositely disposed mold sections, toggles connecting the mold sections to the supporting structure, and operating rods for the toggles accessible from above the water by means of which the toggles may be straightened to adjust and set the mold sections in the desired forming position and afterwards broken to release said sections from the work.

18. Apparatus for molding concrete walls in water which comprises in combination, an inverted substantially U-shaped, movable supporting structure straddling the work, oppositely disposed molds carried thereby, an underwater tie rod extending between the legs of the U-shaped supporting struc-

ture and adapted to aid in preventing spreading thereof under the pressure of the concrete, means, accessible from above the water, for releasing said rod, and means, also accessible from above the water, for withdrawing the rod after a casting operation.

19. Apparatus for casting concrete walls in water which comprises in combination, a supporting structure, a pair of oppositely disposed side wall mold sections secured thereto, and end bulkheads carried by the side mold sections, the side mold sections and the bulkheads having sliding interengagement means releasable to permit removal of the bulkheads upon substantially vertical upward movement thereof.

20. Apparatus for casting concrete walls in water which comprises in combination, a supporting structure, a pair of oppositely disposed side wall mold sections secured thereto having longitudinally extending wales, and end bulkheads carried by said wales, the bulkheads and the wales being provided with inclined engaging surfaces which act to urge the bulkheads to a tight seat when the apparatus is in use but permit ready removal of the bulkheads upon substantially vertical upward movement thereof.

21. Apparatus for casting concrete walls in water which comprises in combination, an inverted, substantially U-shaped, movable supporting structure straddling the work, oppositely disposed side wall molds carried thereby, end bulkheads carried by the side molds, and means for adjusting or releasing the forms and the bulkheads from above the water.

22. Apparatus for casting concrete walls in water which comprises in combination, an inverted, substantially U-shaped, movable supporting structure straddling the work, oppositely disposed side wall molds carried thereby, end bulkheads carried by the side molds, and means for releasing the bulkheads from above the water.

23. Apparatus for casting concrete walls in water which comprises in combination, a supporting structure, a pair of oppositely disposed side wall mold sections secured thereto, and end bulkheads carried by the side mold sections, the side mold sections and the bulkheads having inclined interengagement means which act to urge the bulkheads to a tight seat when the apparatus is in use but which permit ready removal of the bulkheads upon substantially upward movement thereof.

24. Apparatus for casting concrete structures in water comprising in combination; a movable substantially inverted U-shaped supporting structure adapted to straddle the work; oppositely disposed mold sections carried thereby; adjustable legs on the supporting structure; adjustable lower edges on the mold sections adapted to telescope with the mold sections proper; and means, accessible from above the water, for effecting the adjustment of the legs.

25. Apparatus for casting a wall under water which comprises an inverted, substantially U-shaped forming structure the two legs of which are pivoted together over the straddled work, a parapet forming bulkhead at the upper inner side of a leg of the U, means for supporting the pivot point from above the water, and means for raising the legs of the U around said pivot point whereby to release the mold structure from the work.

26. Apparatus for casting a wall under water which comprises an inverted, substantially U-shaped forming structure the two legs of which are pivoted together over the straddled work, and an adjustable member at the upper inner side of a leg of the U adapted to carry a parapet bulkhead, said leg also being adapted to carry a rail for placement on the parapet, means for supporting the pivot point from above the water, and means for raising the legs of the U around said pivot point whereby to release the mold structure from the work.

In testimony whereof, I have hereunto signed my name.

CHRISTIAN BRYNOLDT.

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19. Apparatus for casting concrete walls in water which comprises in combination, a supporting structure, a pair of oppositely disposed side wall mold sections secured thereto, and end bulkheads carried by the side mold sections, the side mold sections and the bulkheads having sliding interengagement means releasable to permit removal of the bulkheads upon substantially vertical upward movement thereof.

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21. Apparatus for casting concrete walls in water which comprises in combination, an inverted, substantially U-shaped, movable supporting structure straddling the work, oppositely disposed side wall molds carried thereby, end bulkheads carried by the side molds, and means for adjusting or releasing the forms and the bulkheads from above the water.

22. Apparatus for casting concrete walls in water which comprises in combination, an inverted, substantially U-shaped, movable supporting structure straddling the work, oppositely disposed side wall molds carried thereby, end bulkheads carried by the side molds, and means for releasing the bulkheads from above the water.

23. Apparatus for casting concrete walls in water which comprises in combination, a supporting structure, a pair of oppositely disposed side wall mold sections secured thereto, and end bulkheads carried by the side mold sections, the side mold sections and the bulkheads having inclined interengagement means which act to urge the bulkheads to a tight seat when the apparatus is in use but which permit ready removal of the bulkheads upon substantially upward movement thereof.

24. Apparatus for casting concrete structures in water comprising in combination; a movable substantially inverted U-shaped supporting structure adapted to straddle the work; oppositely disposed mold sections carried thereby; adjustable legs on the supporting structure; adjustable lower edges on the mold sections adapted to telescope with the mold sections proper; and means, accessible from above the water, for effecting the adjustment of the legs.

25. Apparatus for casting a wall under water which comprises an inverted, substantially U-shaped forming structure the two legs of which are pivoted together over the straddled work, a parapet forming bulkhead at the upper inner side of a leg of the U, means for supporting the pivot point from above the water, and means for raising the legs of the U around said pivot point whereby to release the mold structure from the work.

26. Apparatus for casting a wall under water which comprises an inverted, substantially U-shaped forming structure the two legs of which are pivoted together over the straddled work, and an adjustable member at the upper inner side of a leg of the U adapted to carry a parapet bulkhead, said leg also being adapted to carry a rail for placement on the parapet, means for supporting the pivot point from above the water, and means for raising the legs of the U around said pivot point whereby to release the mold structure from the work.

In testimony whereof, I have hereunto signed my name.

CHRISTIAN BRYNOLDT.

Certificate of Correction.

Patent No. 1,615,069, granted January 18, 1927, to CHRISTIAN BRYNOLDT.

It is hereby certified that error appears in the printed specification of the above-mentioned patent requiring correction as follows: Page 5, line 53, claim 10, for the word "for" read *from;* and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 1st day of March, A. D. 1927.

[SEAL.]

M. J. MOORE,
Acting Commissioner of Patents.

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