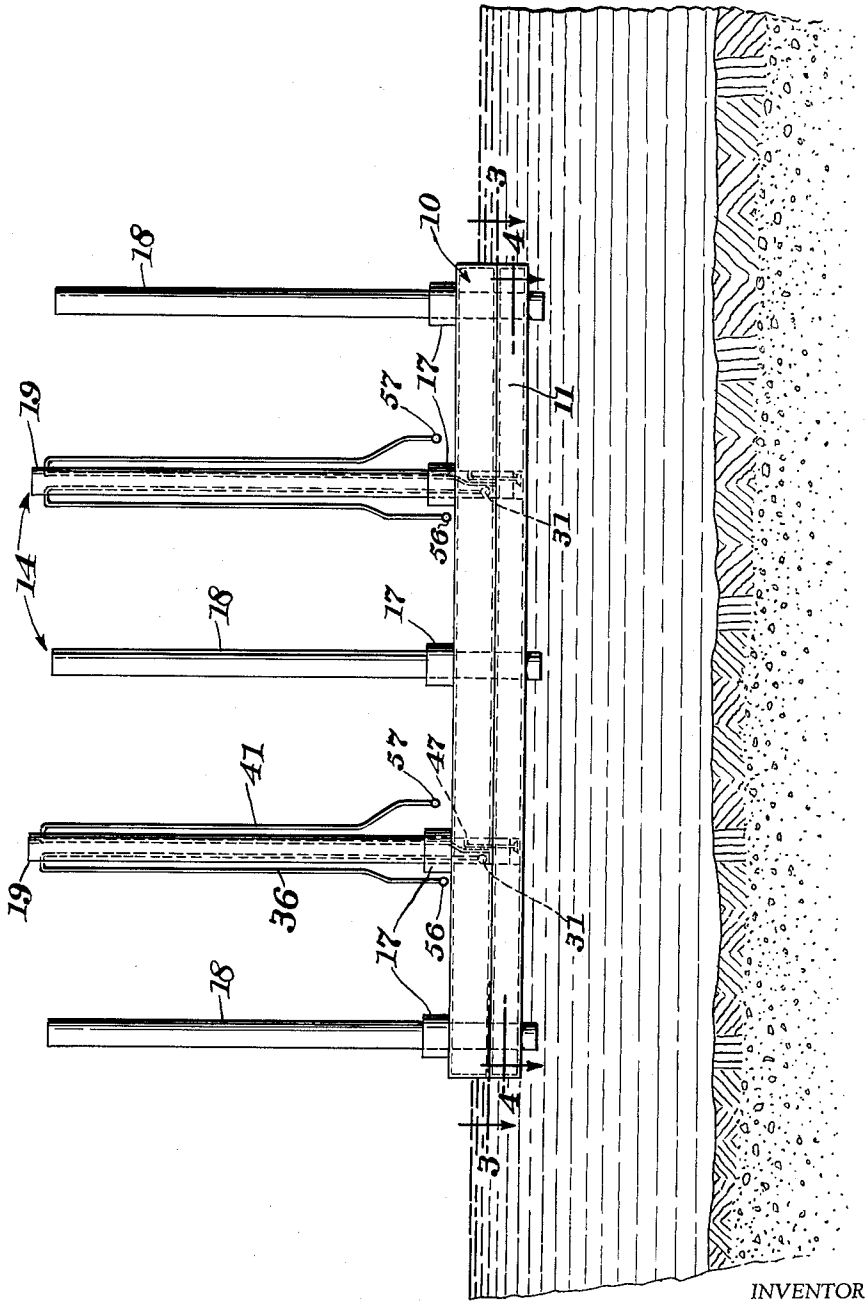
Dec. 19, 1961 G. E. SUDEROW 3,013,396

CONVERTIBLE FLOATING BARGE AND WORKING PLATFORM ASSEMBLY FOR MARINE OPERATIONS

Original Filed Oct. 6, 1954 17 Sheets-Sheet 1

Fig. 1.



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Dec. 19, 1961 G. E. SUDEROW 3,013,396

CONVERTIBLE FLOATING BARGE AND WORKING PLATFORM ASSEMBLY FOR MARINE OPERATIONS

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Fig. 2.

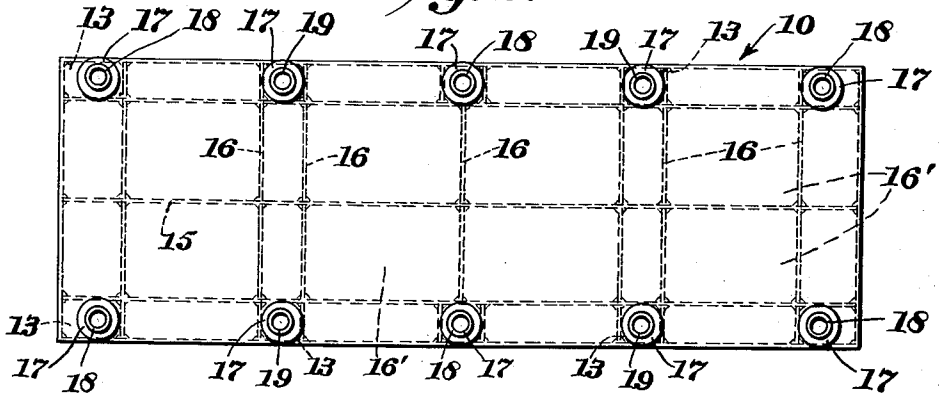


Fig. 3.

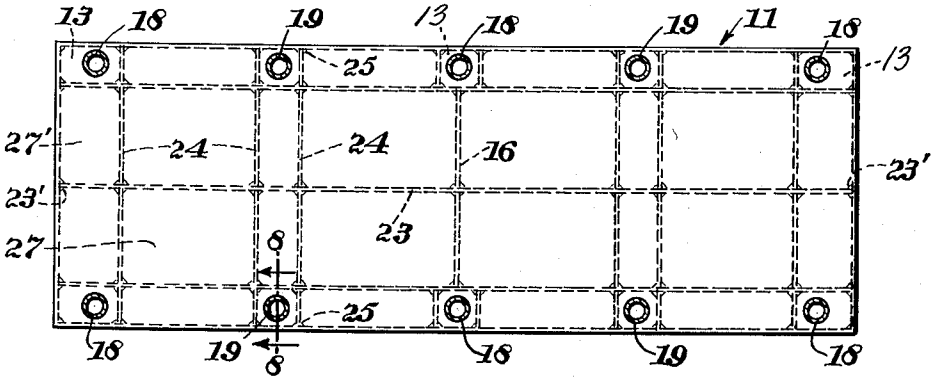
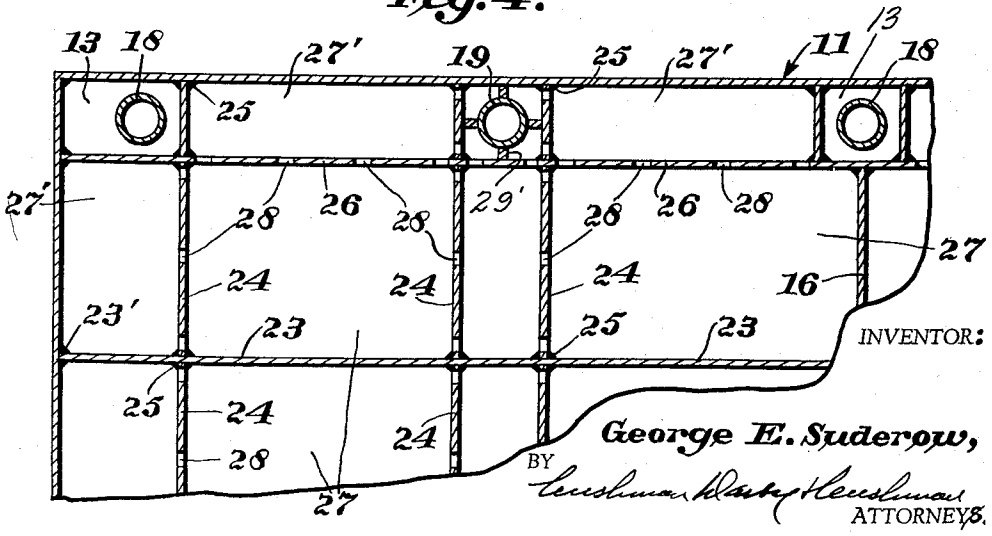


Fig. 4.



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CONVERTIBLE FLOATING BARGE AND WORKING PLATFORM ASSEMBLY FOR MARINE OPERATIONS

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Fig. 5.

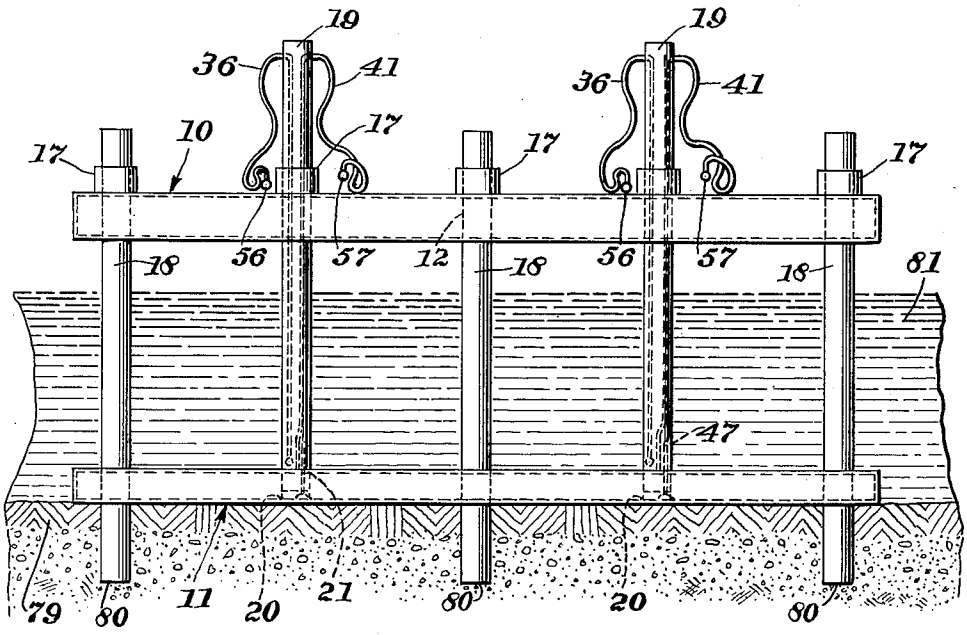


Fig. 7.

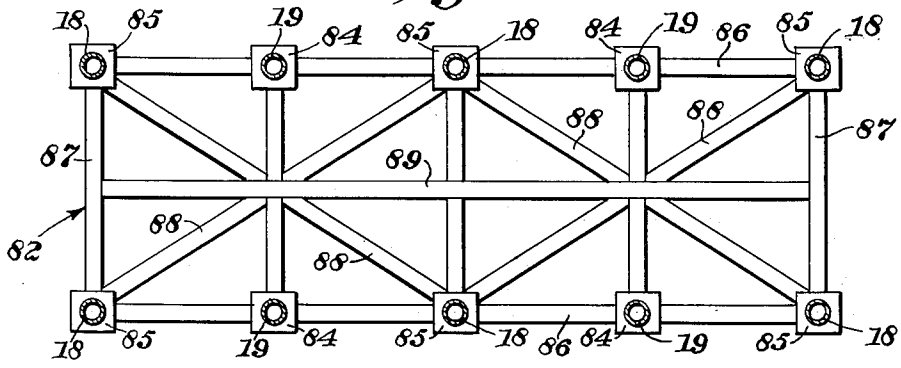
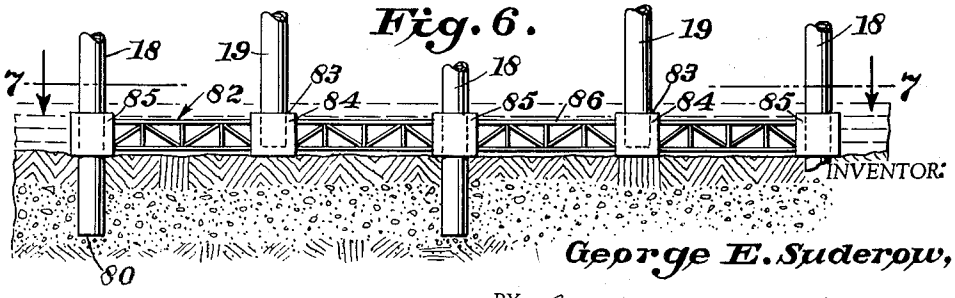


Fig. 6.



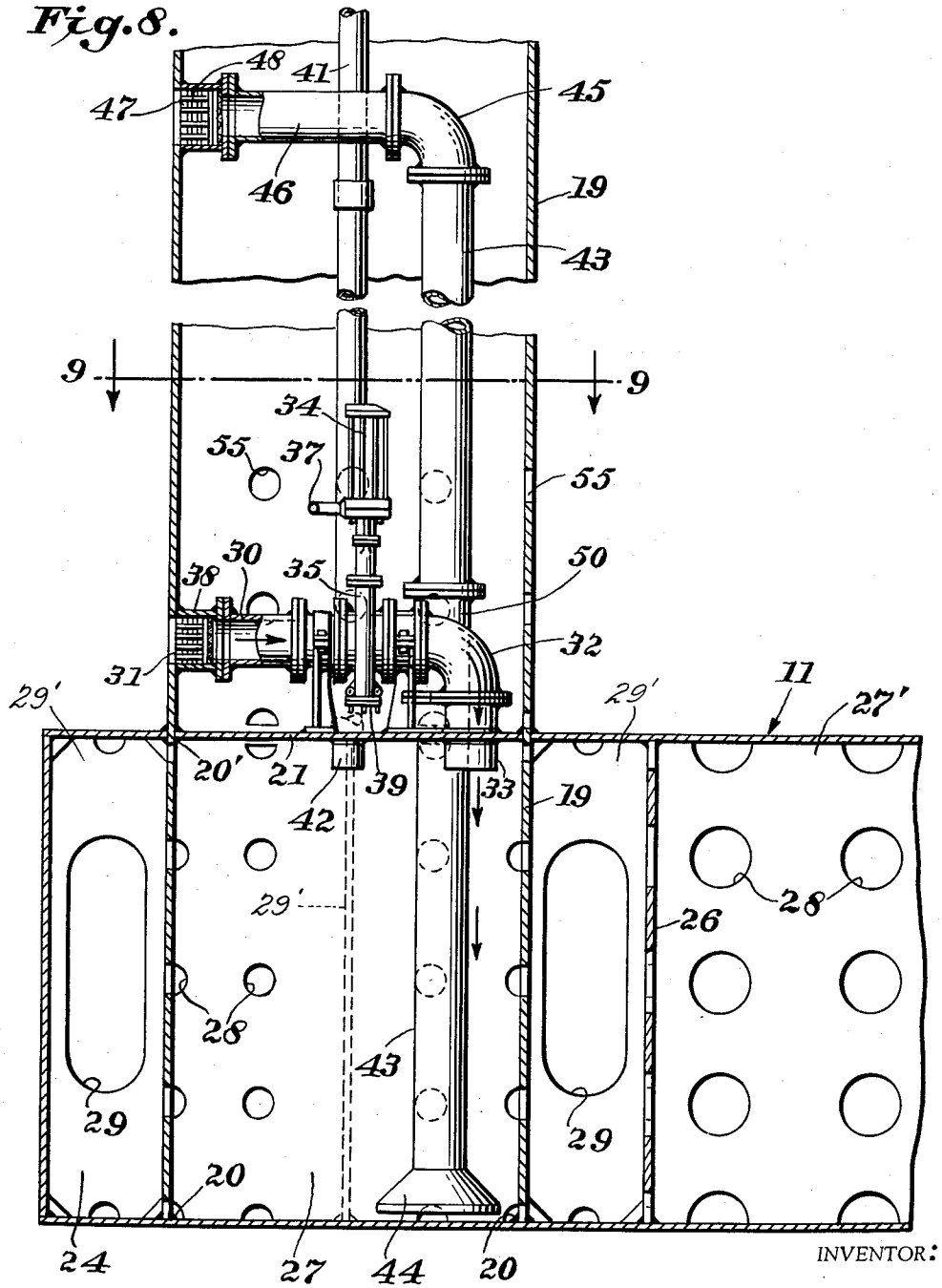
INVENTOR:
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Dec. 19, 1961 G. E. SUDEROW 3,013,396

CONVERTIBLE FLOATING BARGE AND WORKING PLATFORM ASSEMBLY FOR MARINE OPERATIONS

Original Filed Oct. 6, 1954 17 Sheets-Sheet 4

Fig. 8.



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Dec. 19, 1961 G. E. SUDEROW 3,013,396

CONVERTIBLE FLOATING BARGE AND WORKING PLATFORM ASSEMBLY FOR MARINE OPERATIONS

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Fig. 9.

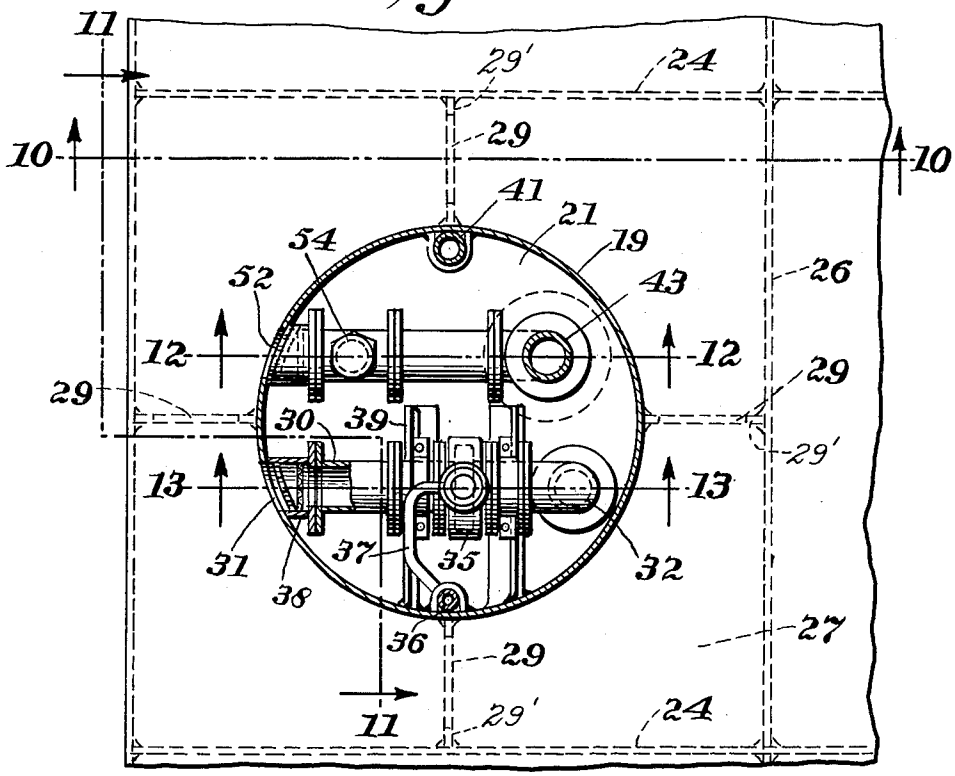
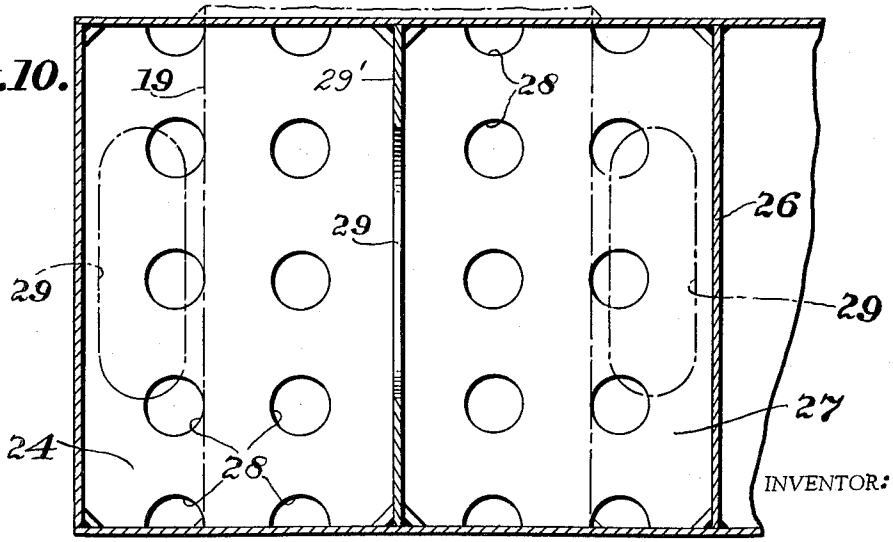


Fig. 10.



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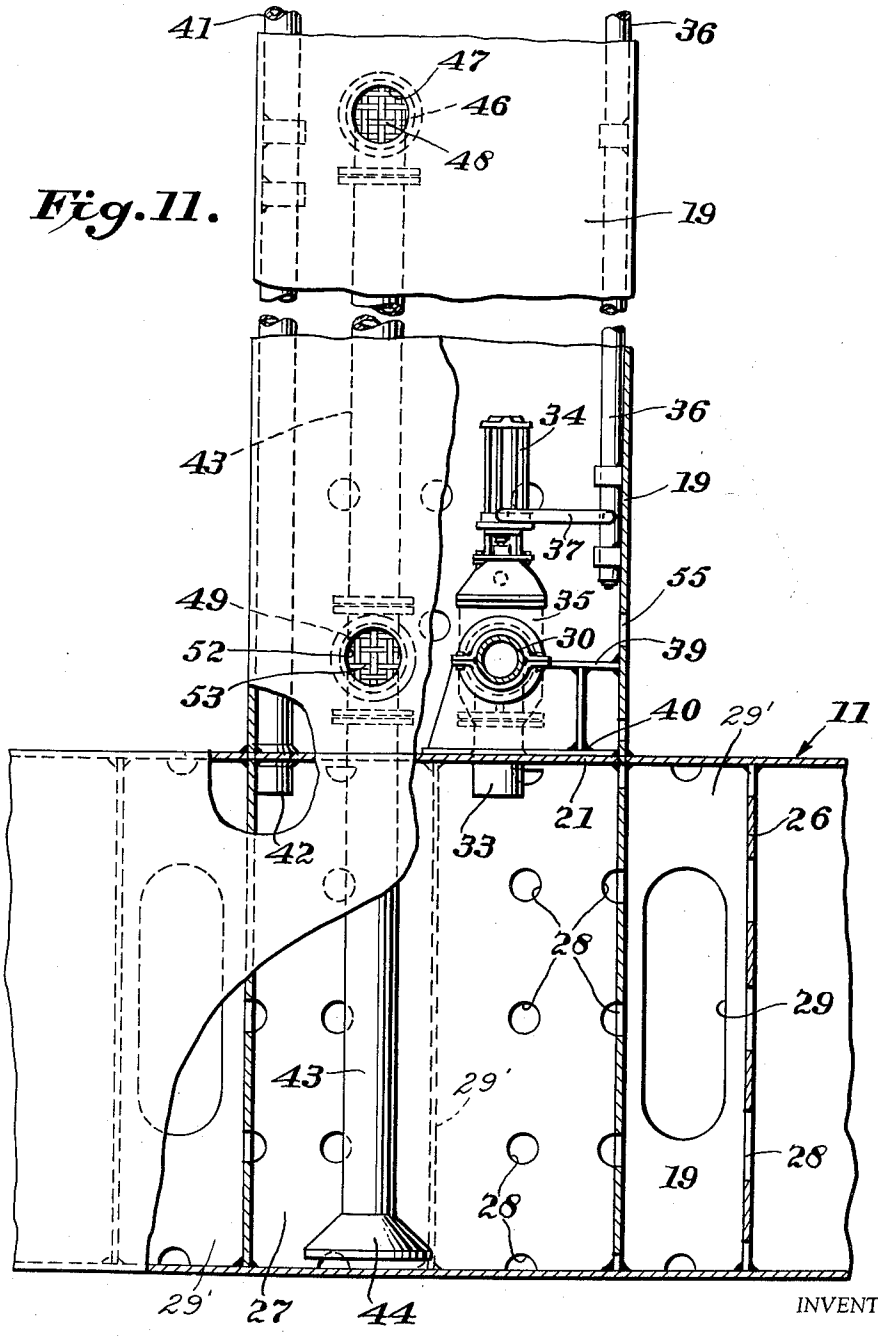
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Dec. 19, 1961 G. E. SUDEROW 3,013,396

CONVERTIBLE FLOATING BARGE AND WORKING PLATFORM ASSEMBLY FOR MARINE OPERATIONS

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Fig. 11.



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CONVERTIBLE FLOATING BARGE AND WORKING PLATFORM ASSEMBLY FOR MARINE OPERATIONS

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Fig. 12.

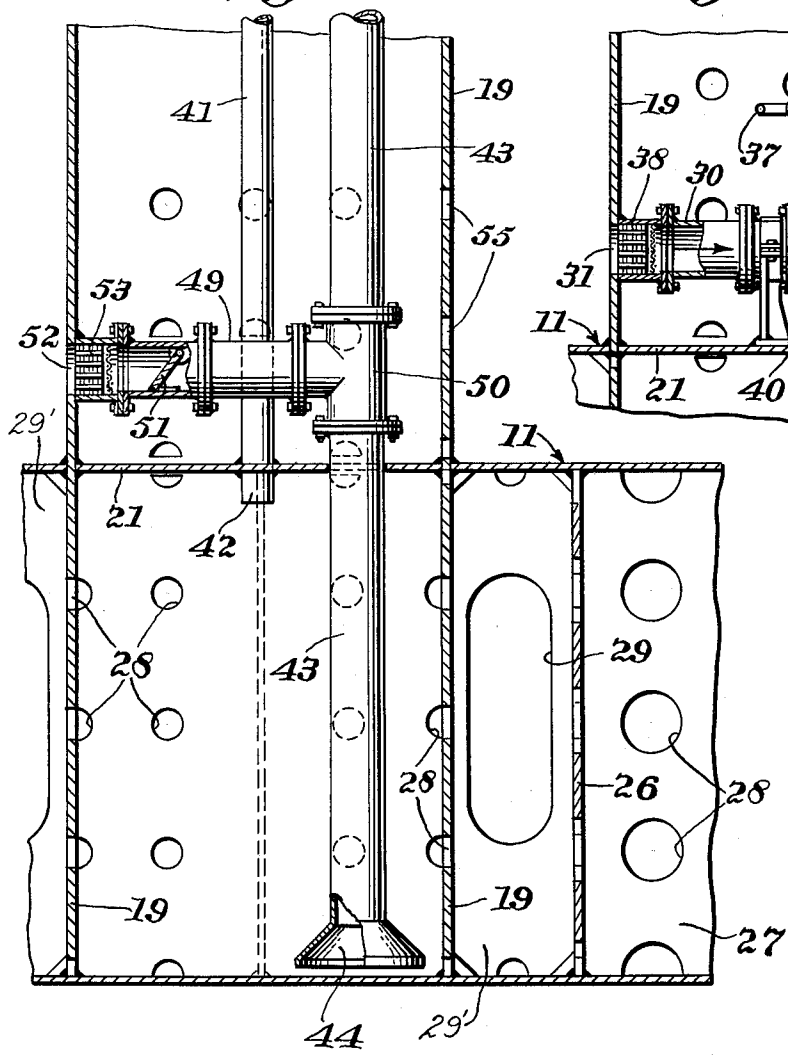


Fig. 13.

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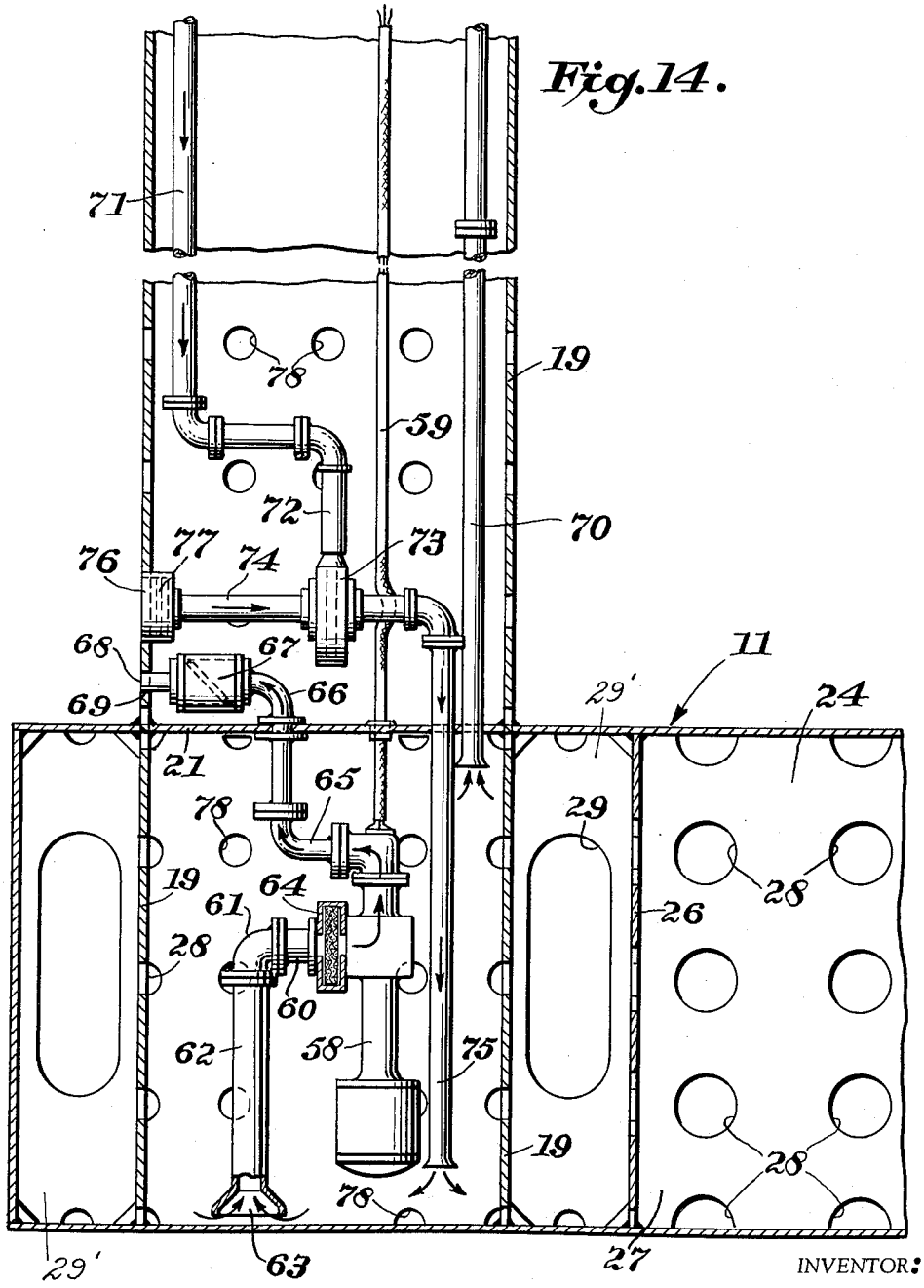
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Dec. 19, 1961 G. E. SUDEROW 3,013,396

CONVERTIBLE FLOATING BARGE AND WORKING PLATFORM ASSEMBLY FOR MARINE OPERATIONS

Original Filed Oct. 6, 1954 17 Sheets-Sheet 8

Fig. 14.



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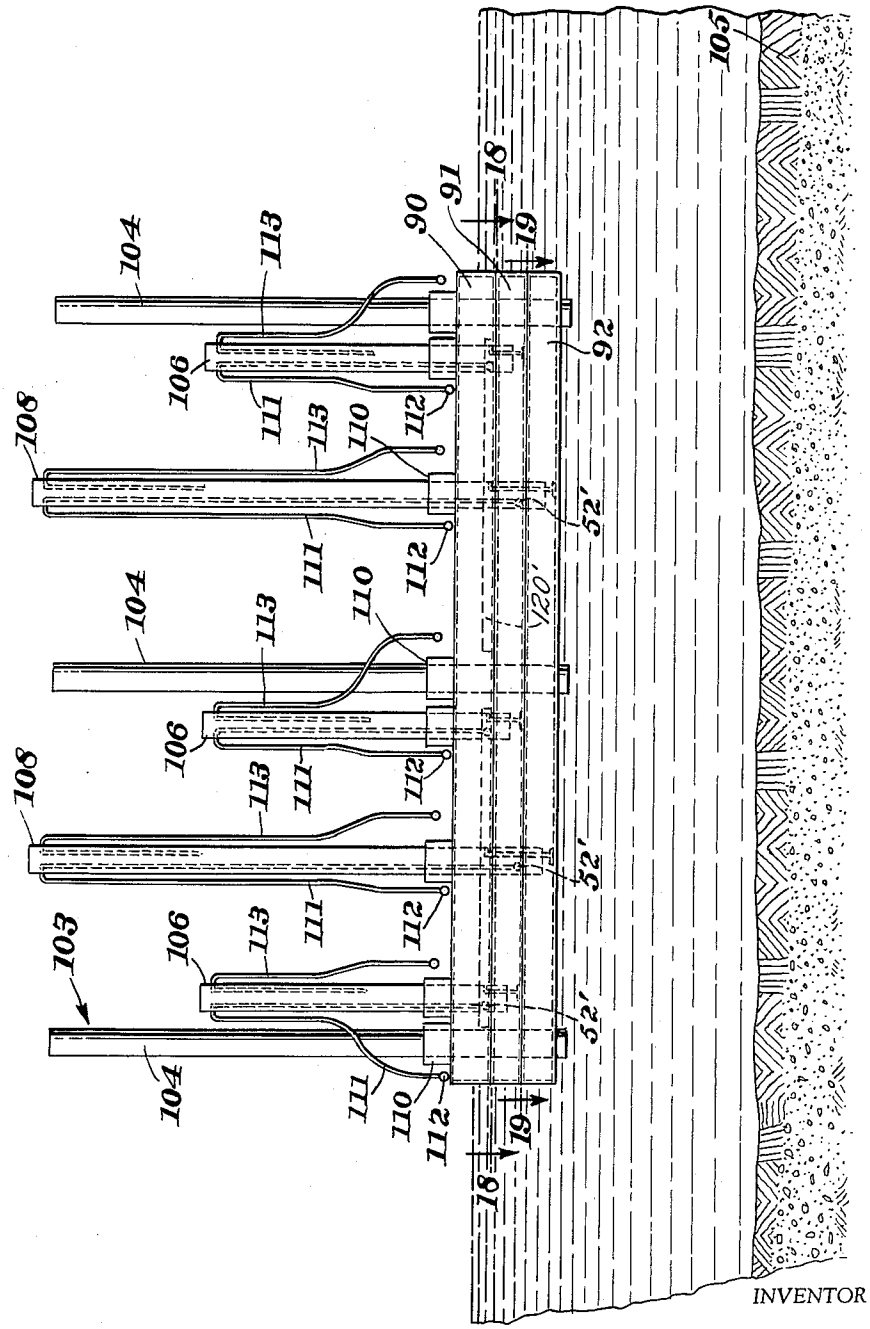
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Dec. 19, 1961 G. E. SUDEROW 3,013,396

CONVERTIBLE FLOATING BARGE AND WORKING PLATFORM ASSEMBLY FOR MARINE OPERATIONS

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Fig. 15.



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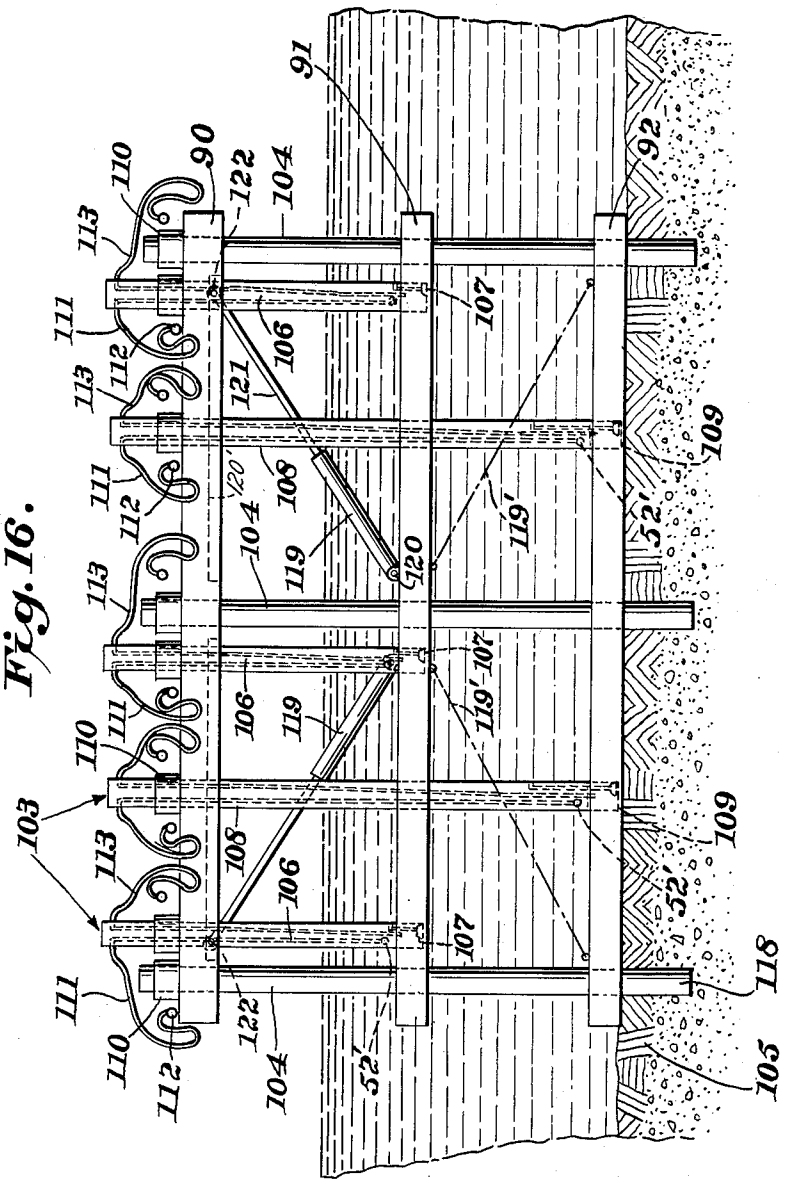
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Dec. 19, 1961 G. E. SUDEROW 3,013,396

CONVERTIBLE FLOATING BARGE AND WORKING PLATFORM ASSEMBLY FOR MARINE OPERATIONS

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Fig. 16.



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Dec. 19, 1961 G. E. SUDEROW 3,013,396

CONVERTIBLE FLOATING BARGE AND WORKING PLATFORM ASSEMBLY FOR MARINE OPERATIONS

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Fig. 17.

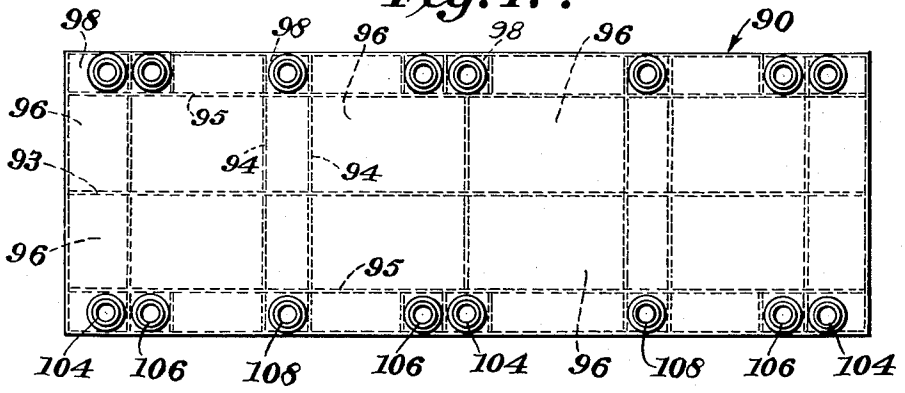


Fig. 18.

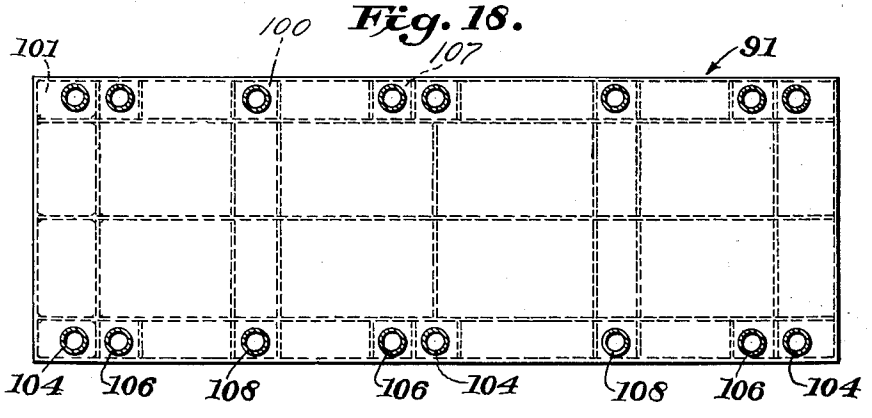
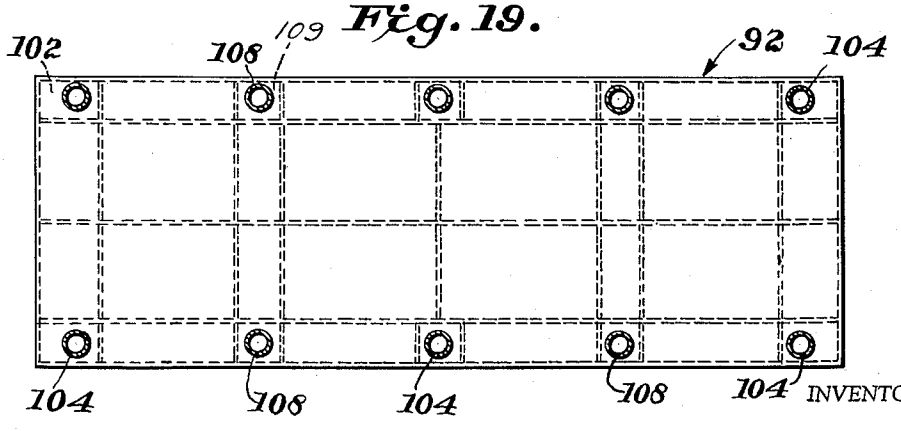


Fig. 19.



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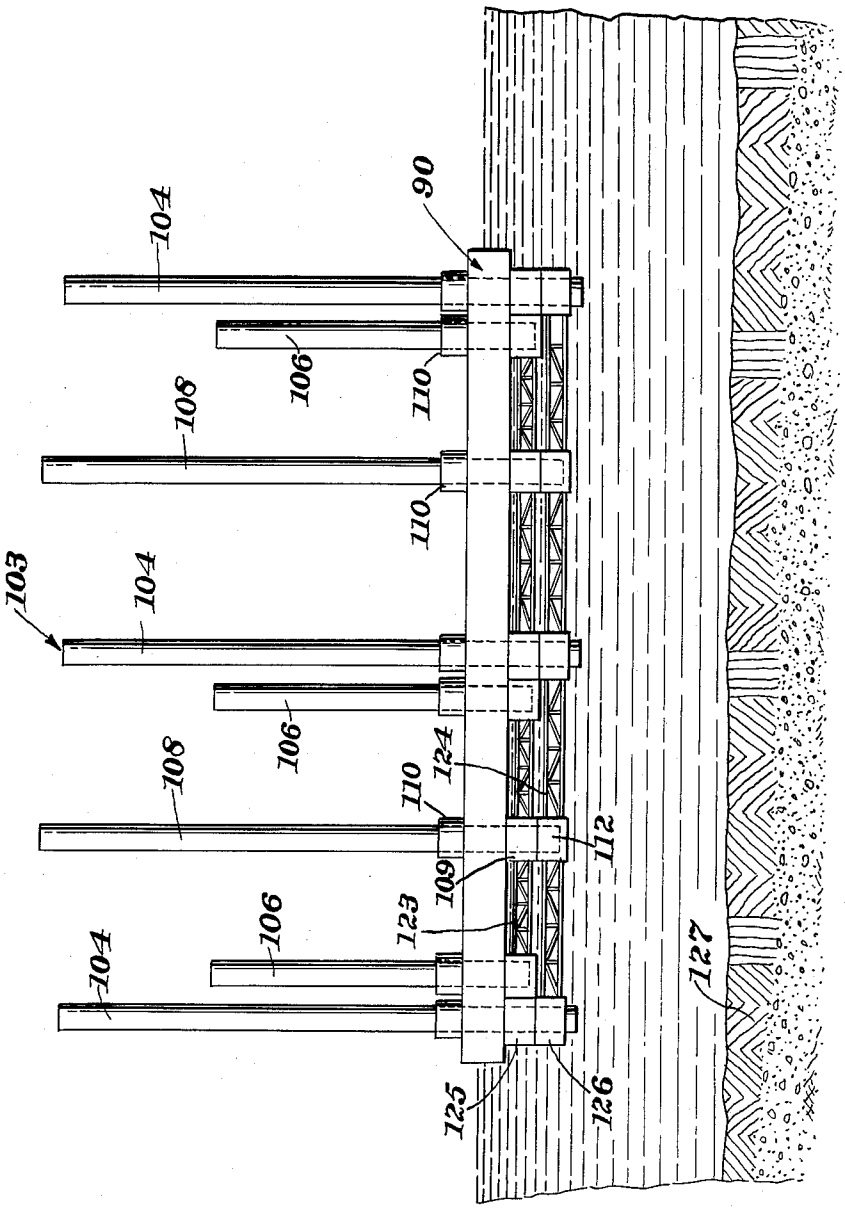
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Dec. 19, 1961 G. E. SUDEROW 3,013,396

CONVERTIBLE FLOATING BARGE AND WORKING PLATFORM ASSEMBLY FOR MARINE OPERATIONS

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Fig. 20.



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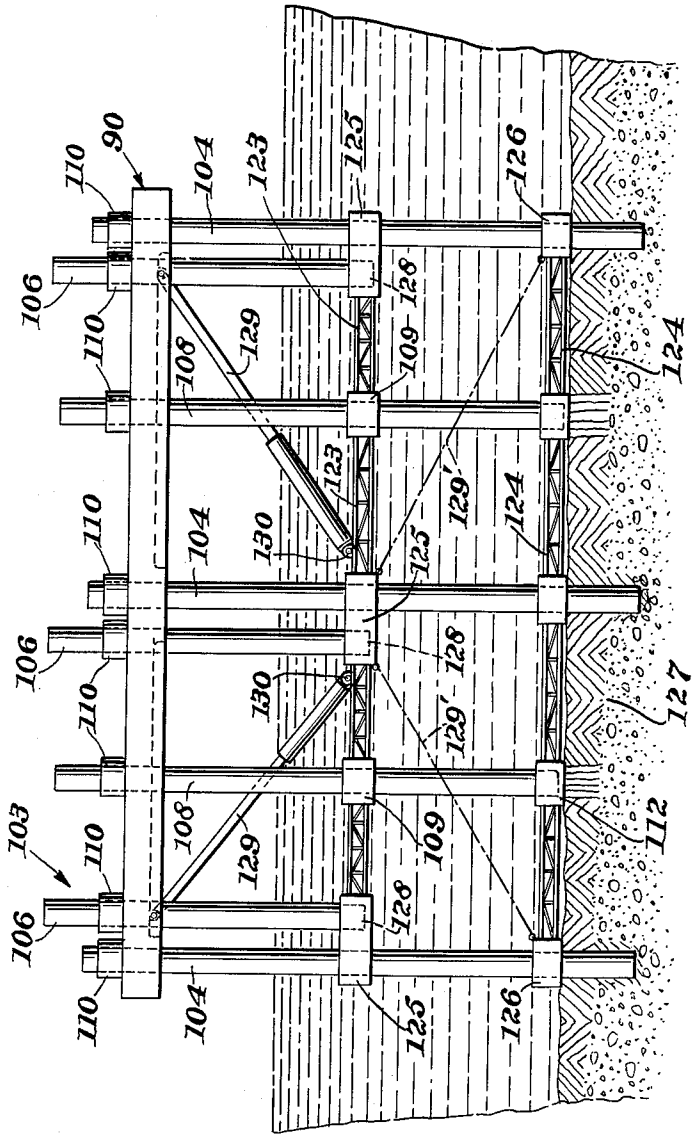
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CONVERTIBLE FLOATING BARGE AND WORKING PLATFORM ASSEMBLY FOR MARINE OPERATIONS

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Fig. 21.



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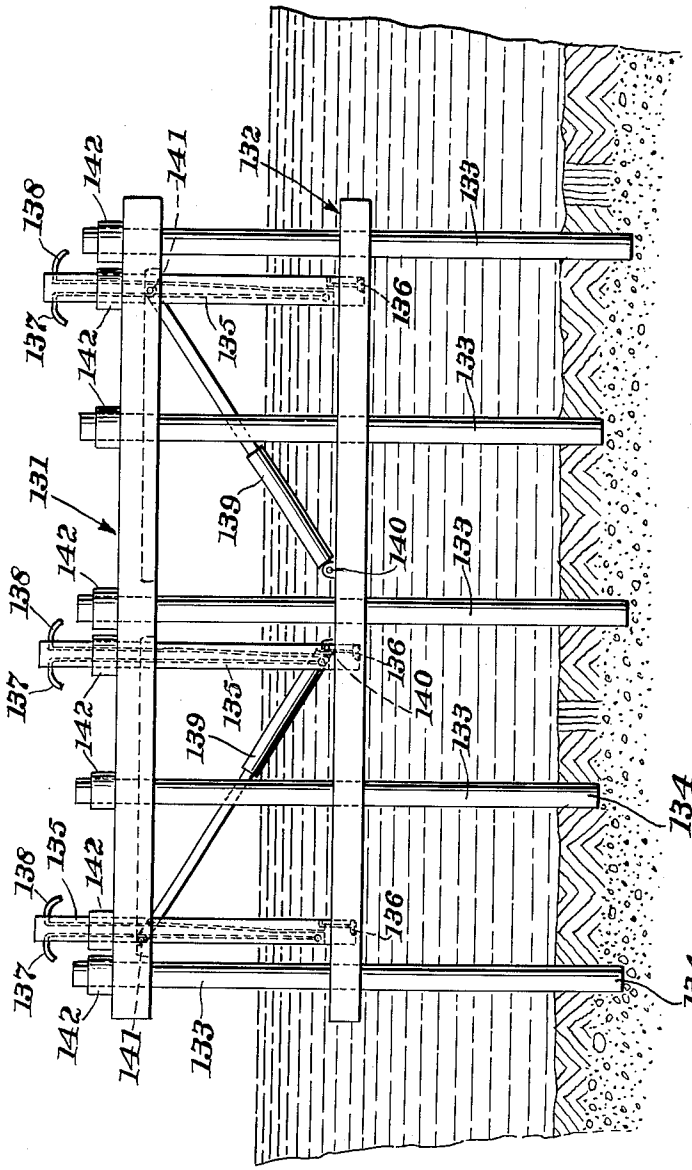
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Dec. 19, 1961 G. E. SUDEROW 3,013,396

CONVERTIBLE FLOATING BARGE AND WORKING PLATFORM ASSEMBLY FOR MARINE OPERATIONS

Original Filed Oct. 6, 1954 17 Sheets-Sheet 14

Fig. 22.



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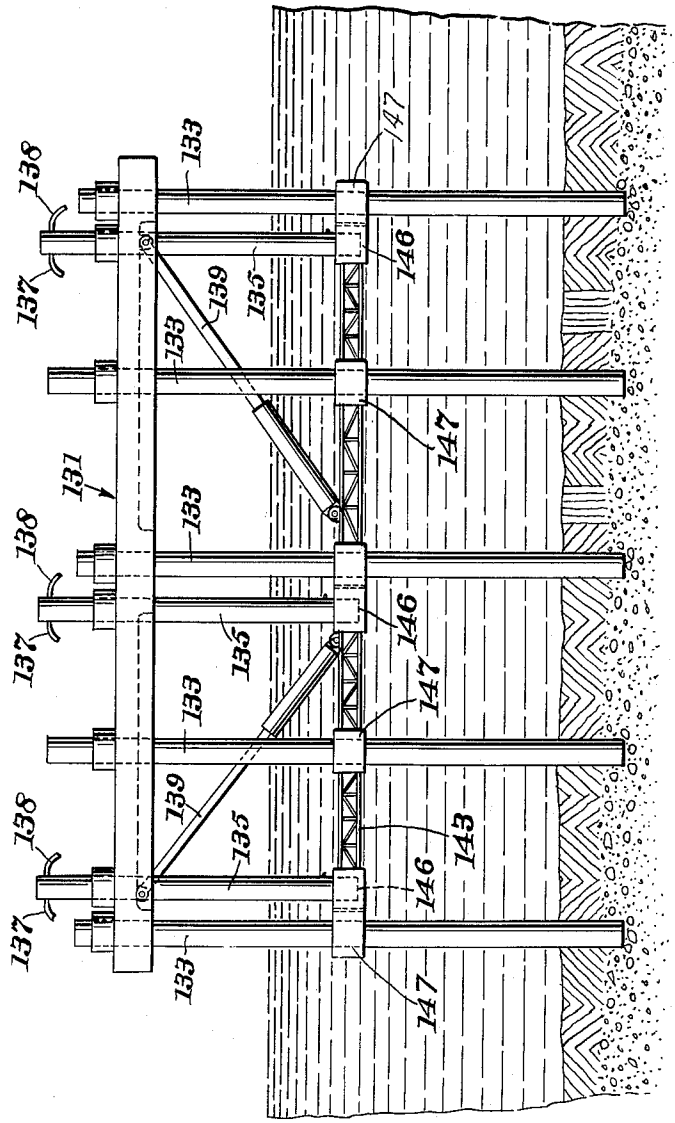
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Dec. 19, 1961 G. E. SUDEROW 3,013,396

CONVERTIBLE FLOATING BARGE AND WORKING PLATFORM ASSEMBLY FOR MARINE OPERATIONS

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Fig. 23.



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Dec. 19, 1961 G. E. SUDEROW 3,013,396

CONVERTIBLE FLOATING BARGE AND WORKING PLATFORM ASSEMBLY FOR MARINE OPERATIONS

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Fig. 24.

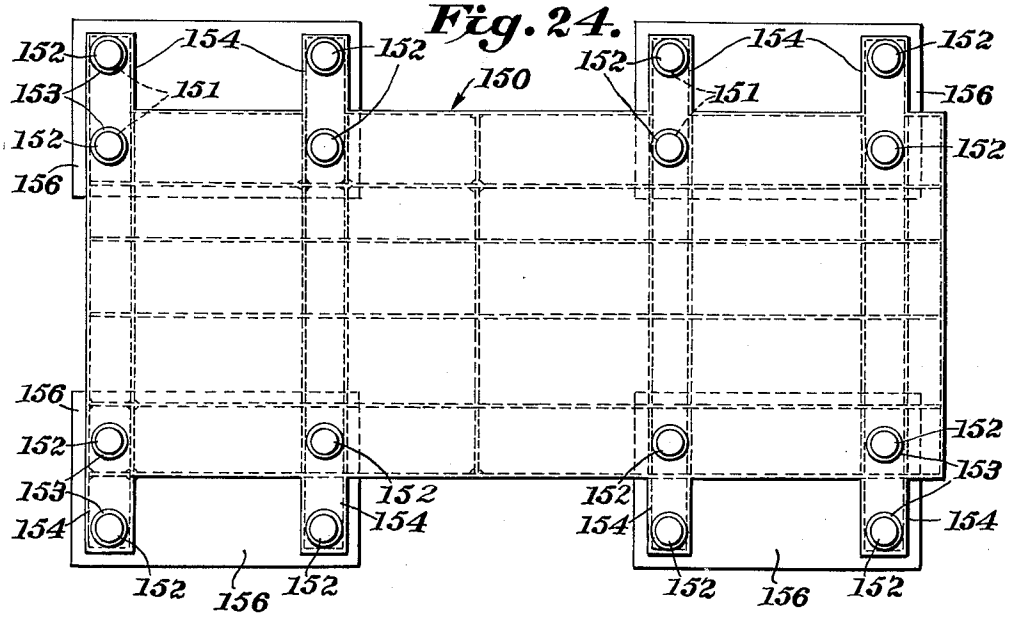
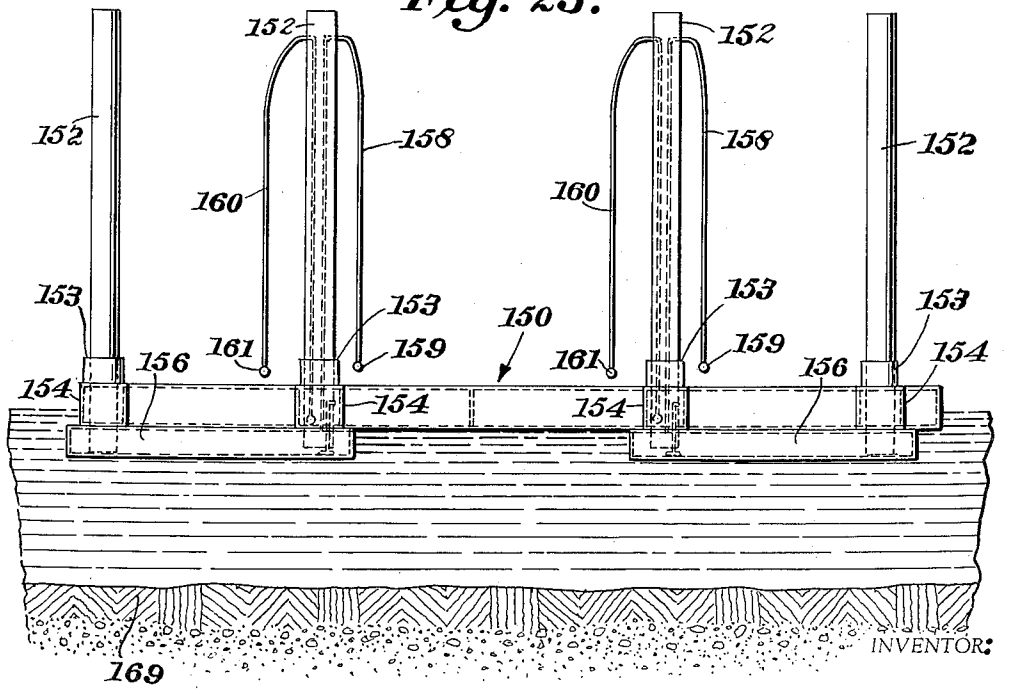


Fig. 25.



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Dec. 19, 1961 G. E. SUDEROW 3,013,396

CONVERTIBLE FLOATING BARGE AND WORKING PLATFORM ASSEMBLY FOR MARINE OPERATIONS

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Fig. 26.

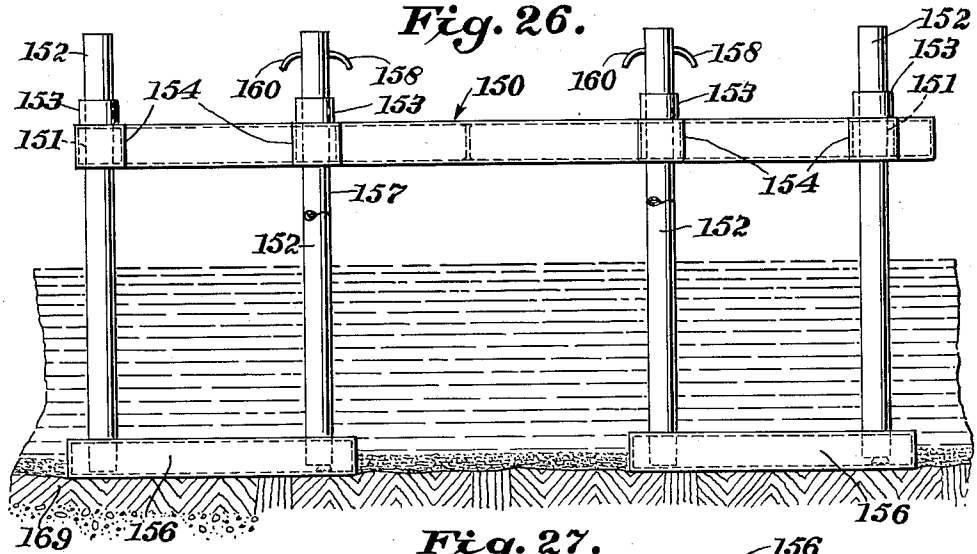


Fig. 27.

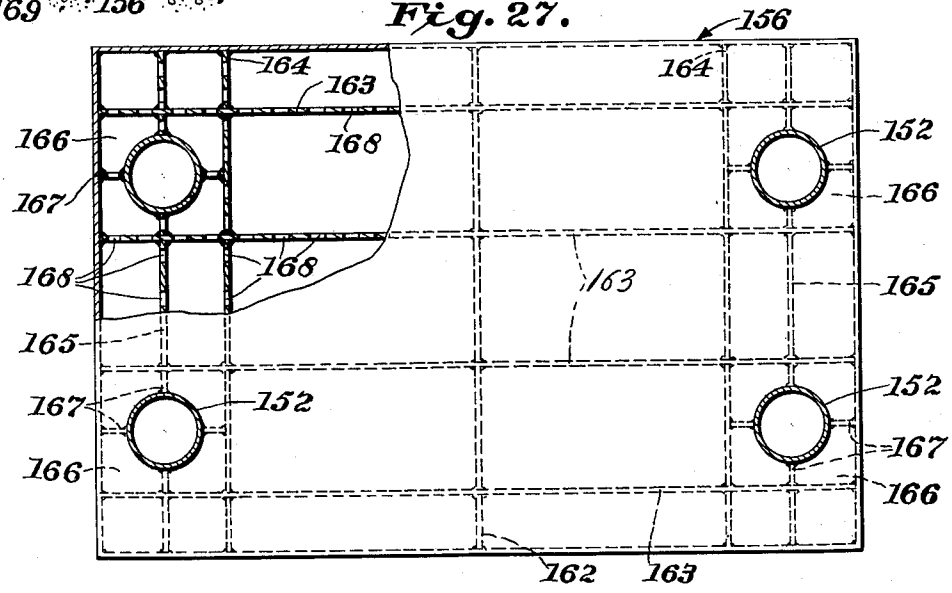
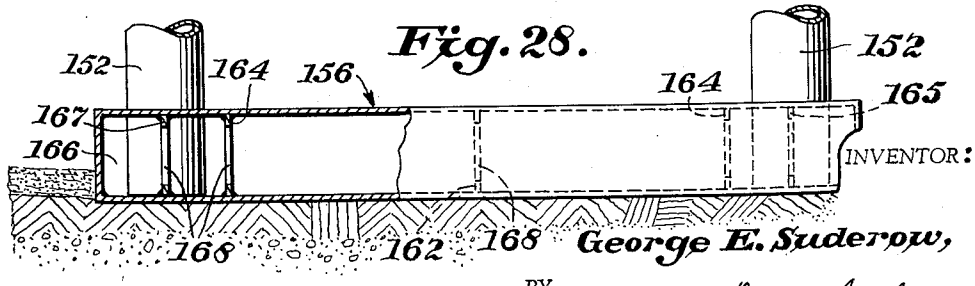


Fig. 28.



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United States Patent Office 3,013,396
Patented Dec. 19, 1961

3,013,396

CONVERTIBLE FLOATING BARGE AND WORKING PLATFORM ASSEMBLY FOR MARINE OPERATIONS

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Continuation of application Ser. No. 460,598, Oct. 6, 1954. This application Dec. 30, 1959, Ser. No. 474
13 Claims. (Cl. 61—46.5)

The present invention relates to a convertible working platform barge and submerged marine assembly for subaqueous operations.

This application is a continuation of my co-pending application Serial No. 460,598, filed October 6, 1954, now abandoned.

An important object is to provide a marine unit assembly composed of floating and submergible members, such as two barges or an upper buoyant barge and a coacting structural frame or truss movable to assume a stacked position when the unit assembly is being floated from place to place, and to provide a marine ground-engaging base and a working platform above the level of the water, when the assembly is in its marine operative position. The barges and the structural frames which are arranged in superimposed relation are provided with vertical aligned guide openings or wells through which extend caissons or supporting members. Certain of these caissons extend through the openings in the lower barge or structural frame so as to be embedded or anchored into the marine ground. Others of the caissons extend through the upper barge and are connected to the lower barge or a structural frame member. Thus, it will be seen that each floating unit when the barges or members are in their stacked position, are transportable from place to place and that the upper barge may be readily converted into a working platform when raised above the water level on the supporting members by jacking mechanism operable thereon. Further, the lower or bottom barge or the structural frame member may be submerged so as to rest on the marine bottom and provide a strong, stable, supporting base for maintaining the working platform and its associated parts in a firm operative position irrespective of the irregularity of the contour of the marine ground or bottom on which it rests.

A further object consists in providing an improved method for erecting a convertible barge and submergible floating assembly over a body of water, which includes floating at least two barges or members stacked one on top of the other to the desired location. The barges or members are provided with vertical registering openings through which extend caissons or the like. Certain of the caissons are arranged to extend through the openings in the lower barge or member so as to be embedded into the marine ground to prevent lateral displacement of the unit assembly when the upper or top barge is raised and maintained above the water level. The other caissons extend loosely through the upper barge and are connected to a lower barge or member so as to be movable therewith. After the lower barge is moved firmly into engagement with the marine ground, the upper barge which now constitutes the working platform, is raised above the level of the water to provide a structure capable of being efficiently used for drilling oil or other wells, driving piles,

building of permanent structures, installing temporary or permanent docks, and for various other marine uses in which a working platform over water is required, such as a dry dock for repairing boats and the like.

A further object comprehends the provision of an improved submergible marine assembly and method of erecting the same, in which three watertight barges or members are arranged normally to be stacked so as to be transported from place to place. The floating unit assembly may also include one buoyant barge with two vertically spaced metal frames or trusses positioned below the barge. The barges and structural frames are provided with vertical openings through which extend caissons or other similar tubular supporting members. Certain of the caissons extend through all of the barges so as to penetrate the marine ground in order to maintain the barge assembly in a fixed or anchored position. Other of the caissons extend through the upper barge and an intermediate barge or member and are connected to the bottom barge or member while the remaining caissons extend loosely through the upper barge and are connected to an intermediate barge or structural frame member. Thus, it will be seen that simple, efficient and economical means are provided for converting a floating barge assembly into a working platform that is firmly supported by means engaging the marine bottom, when the working platform is raised above the water. The intermediate barge or member serves to impart the desired strength, rigidity, and stability to the barge assembly so that it may efficiently support the heavy working platform and its associated parts in a fixed position during the marine operation.

Other objects and advantages of the invention will become apparent from the following description when taken in conjunction with the accompanying claims and drawings.

Referring to the drawings in which several preferred embodiments of the convertible barge and submergible marine assembly are shown for the purpose of illustration:

FIGURE 1 is a side elevational view of a two barge marine assembly constructed in accordance with the present invention and showing the barges in their stacked or floating position;

FIGURE 2 is a detailed plan view of FIGURE 1;

FIGURE 3 is a longitudinal sectional view taken substantially along the line 3—3 of FIGURE 1;

FIGURE 4 is a longitudinal sectional view taken substantially along the line 4—4 of FIGURE 1;

FIGURE 5 is a view similar to FIGURE 1, but showing the upper barge converted into a working platform and positioned above the level of the water and the lower or bottom barge submerged and maintained in firm engagement with the marine bottom by the ground-penetrating caissons.

FIGURE 6 is a detailed view similar to the lower portion of FIGURE 5 but showing structural frames or trusses substituted for the bottom barge;

FIGURE 7 is a longitudinal sectional view taken substantially along the line 7—7 of FIGURE 6;

FIGURE 8 is an enlarged sectional view taken substantially along the line 8—8 of FIGURE 3;

FIGURE 9 is a sectional view taken substantially along the line 9—9 of FIGURE 8;

FIGURE 10 is a sectional view taken substantially along the line 10—10 of FIGURE 9;

FIGURE 11 is a sectional view taken substantially along the line 11—11 of FIGURE 9;

FIGURE 12 is a sectional view taken substantially along the line 12—12 of FIGURE 9;

FIGURE 13 is a sectional view taken substantially along the line 13—13 of FIGURE 9;

FIGURE 14 is a view similar to FIGURE 8 showing a modified form of pressure valve operating means;

FIGURE 15 is a side elevational view of a further modification showing a three barge arrangement and with the barges in their stacked or floating position;

FIGURE 16 is a view similar to FIGURE 15 with the barges moved to their operative position and showing bracing means for maintaining the barges separated;

FIGURE 17 is a detailed plan view of FIGURE 15;

FIGURE 18 is a longitudinal sectional view taken substantially along the line 18—18 of FIGURE 15;

FIGURE 19 is a longitudinal sectional view taken substantially along the line 19—19 of FIGURE 15;

FIGURE 20 is a side elevational view of a modified form of the invention shown in FIGURE 15 in which structural frames are substituted for the intermediate and bottom barges;

FIGURE 21 is a view similar to FIGURE 20 but showing the upper barge raised above the water level and the intermediate and bottom barges in their respective operative positions. Additionally, bracing means are shown for maintaining the upper barge and the lower frame member in a fixed position relative to the intermediate frame member;

FIGURE 22 is a side elevational view of a modified form of the invention disclosed in FIGURES 15 and 16 but with the bottom barge removed;

FIGURE 23 is a side elevational view of a modified form of the invention shown in FIGURE 21 with the bottom structural frame or truss removed;

FIGURE 24 is a plan view of a further modified form of the invention;

FIGURE 25 is a side view of FIGURE 24 with the pontoons in their raised position;

FIGURE 26 is a view similar to FIGURE 25 with the pontoons in their lowered or ground engaging position;

FIGURE 27 is a detailed plan view with parts in section of a pontoon shown in FIGURE 26; and

FIGURE 28 is a side view of FIGURE 27 with parts removed.

Referring to the drawings, the convertible floating barge and submergible marine assembly or floating unit, as shown in FIGURE 1, includes an upper buoyant barge **10** and a lower, hollow barge **11** of any suitable size and shape depending upon the purpose for which the assembly is to be used. The buoyant barge **10** is of substantially box-like shape (FIGURE 2) and is provided along each longitudinal side with a row of caisson wells **13** having upper and lower guide openings (not shown) through which loosely extend elongated supporting members, here shown as caissons or tubular members **14**, which may be alternately of different lengths in each row, for a purpose subsequently to be described. The interior of the barge **10** may be divided up by longitudinally disposed bulkheads or partitions **15** (FIGURE 2) and by transverse partitions **16** so as to provide separate, water-tight compartments **16'**. Associated with each of the caissons **14** on the upper barge is a suitable jack mechanism **17** for selectively effecting or restraining relative vertical movement between each of the caissons and the upper barge. The jack mechanism embodied in the Pointer copending application, Serial No. 143,627, is such a suitable mechanism and may be used for moving and maintaining barges and caissons in predetermined positions relative to each other.

The caissons **14** are grouped to include ground-penetrating caissons **18** and barge-connecting caissons **19** (FIGURE 5) which, as shown, are alternately spaced longitudinally along opposite sides of the barge **10** (FIGURE 2). The caissons **18** extend freely through the lower barge **11**, and for this purpose the latter also is provided with caisson wells **13** having upper and lower guide openings (not shown) through which the caissons **18** extend. The lower ends of the caissons **19**, however, are rigidly secured to the lower barge **11**. For this purpose, the lower ends of the caissons **19** (FIGURE 8) each extend through an opening or cut out portion in the top of the lower barge **11**, and is welded to the bottom thereof, as at **20**, and to the edges of such opening. The lower portion of each caisson **19** is closed off by a water-tight diaphragm plate **21** which may be coplanar with the top of the barge **11** and is welded, as at **20'**, to the side wall of the caisson **19**.

The lower or ground-engaging barge **11** is also provided interiorly with a longitudinally and centrally disposed water-tight bulkhead or partition **23** (FIGURE 4), which may be welded as at **23'** to the opposite end walls of the barge, with a central water-tight, transverse bulkhead **16**, and also with additional longitudinal bulkheads **26** spaced inwardly from each side of the barge **11**. Longitudinally spaced partitions **24** extend transversely between the bulkheads **23** and **26** and between the latter and the side walls of the barge **11** and may be welded thereto as at **25**. The bulkheads **16**, **23**, and **26** and the partitions **24** form interior compartments **27** and side and end wall compartments **27'** separate from the caisson wells **13**, while the partitions **24**, the bulkheads **26**, and the side walls of the barge **11** also form additional compartments about the lower ends of the caissons **19**. Preferably, stiffening and reinforcing plates or webs **29'** extend and are welded between the lower end of each caisson **19** and the walls of its compartment, and such plates **29'** are provided with elongated openings **29**. The lower ends of the caissons **19** and those portions of the bulkheads **26** and the partitions **24** bounding the compartments **27** and **27'**, separately from the caisson wells **13**, are provided with openings **28** to permit free flow of water between all of the compartments **27** and **27'** in each quarter section of the barge **11**.

In order to submerge the lower barge **11** so that the same will firmly rest on the marine bottom, means are provided for introducing water into the compartments **27** and **27'**. Additionally means are provided for withdrawing this water so as to raise or refloat the barge **11**. As shown in FIGURE 8, this means includes positioning immediately above the diaphragm **21** of each of the caissons **19**, a horizontal pipe or conduit **30** which at its outer end communicates with an opening **31** in the wall of the caisson **19** and at its opposite end has a depending elbow **32** which communicates as at **33** with the interior of the tubular caisson **19** below the diaphragm, which in turn communicates through openings **28** with compartments **27** and **27'**. An air actuated valve mechanism controls flow through the pipe **30** and includes a cylinder **34** (FIG. 13) in which is reciprocally mounted a piston that is operatively connected to a conventional type of flood valve in the housing **35**. An air delivery pipe **36** communicates through a branch connection **37** (FIG. 11) with the interior of the cylinder **34** so as to control the opening and closing of the valve. The pipe or compressed air line **36** extends upwardly out of the top of the caisson and thence to a point adjacent the deck of the barge **10** so as to be operable by remote control means. A mesh or reticulated wire strainer **38** is positioned within the pipe **30** adjacent the inlet opening **31** to prevent foreign matter from being introduced into the barge **11** with the sea water. The flood valve housing **35** and its associated parts may be supported within the caisson **19** by the T-shaped bracket **39**, which is welded, as at **40**, to the diaphragm plate **21** when the parts are assembled (FIG. 13). Thus, it will be seen that when the flood valve in the housing **35** is moved from its closed to its open position and the opening **31** is submerged, sea water

is introduced into the compartments 27 and 27' through the pipe 30 and its discharge outlet 33.

Also positioned within each of the caissons 19 and extending upwardly out of the top thereof is a compressed air and vent pipe or line 41 (FIG. 11) which at its lower end extends through the diaphragm plate 21, as at 42, to communicate with the space therebelow. Also mounted in each of the caissons 19 is a pipe or tubular member 43 (FIG. 12) which projects through the diaphragm plate 21 into the lower end of the caisson 19 and terminates in an enlarged bell portion 44 spaced a short distance above the bottom wall of the barge 11 so as to constitute means for expelling water from the compartments 27 and 27'. At its upper end, the pipe 43 is connected by an elbow 45 to a horizontal pipe 46 (FIG. 8) which communicates with an opening 47 in the caisson 19 spaced a considerable distance above the opening 31. A reticulated metal strainer 48 is positioned in the pipe 46 so as to prevent the introduction of foreign matter with any sea water which may pass therethrough into the compartments 27 and 27' of the lower barge 11. Intermediate the length of the pipe 43 above the barge 11, a branch outlet pipe 49 (FIG. 12) is connected by a T-fitting 50 to the pipe 43. A one way check valve 51 is mounted in the pipe 49 so as to prevent the flow of the water into the pipe from outside the barge but permits the escape of water from the barge through the pipe 49. The end of the pipe 49 communicates with an opening 52 in the wall of each caisson 19 on a level with the openings 31, and a reticulated metal strainer 53 is positioned in the pipe 49 adjacent the opening 52 (FIG. 12). A threaded closure plug 54 (FIG. 9) in the pipe 49 is arranged when removed to provide access to the interior of the check valve housing for inspection purposes. The lower end portion of each of the caissons 19 above the lower barge 11 has a plurality of openings or ports 55 to facilitate the introduction of sea water and the discharge of the same from within each of the caissons 19 above the closure plates 21.

As previously stated, the compressed air pipe 36 controls the operation of the flood valve in the housing 35 while compressed air may be introduced into the barge through line 41 so as to force the water out from the compartments through the pipe 43. Pipe 41 also constitutes an air vent for allowing the escape of air from the barge 11 when the same is being flooded. The pipes 36 and 41 may have their outer ends positioned, as shown in FIGURE 1, adjacent the top or deck of the barge 10 and are provided with suitable operable valve means as at 56 and 57 for selectively controlling the flow of air through these pipes.

In the modified form of the invention shown in FIGURE 14, water in the compartments 27 and 27' of the barge 11 may be withdrawn therefrom so as to lighten the barge 11 by mounting in each of the caissons 19, a submergible pump 58 which is electrically connected through the line 59 with suitable switch means (not shown) positioned on the upper barge 10 and preferably adjacent to the means 56 and 57, previously described. The pump 58 communicates through a horizontal pipe 60 and an elbow 61 with a vertical suction pipe 62 which is provided at its lower end with a bell mouth 63 spaced above the bottom shell of the barge 11 so as to allow the withdrawal of water in the compartments 27 and 27' when the pump 58 is actuated. A strainer 64 is positioned in the horizontal pipe 60. An outlet conduit 65 also communicates with the pump 58 and has a portion 66 extending upwardly through the diaphragm plate 21 so as to communicate with a check valve 67 which in turn communicates with a pipe 68 that extends outwardly through an opening 69 to discharge the water overboard from the compartments 27 and 27' when the pump 58 is in operation. An air vent pipe or line 70 extends downwardly in the caisson 19 and through the plate 21, so as to communicate with compartments 27 and 27'. An air pressure line or pipe 71 communicates with an air cylinder 72 having a piston operatively connected to a reciprocating valve in the valve housing 73 which in turn communicates on one side with an intake pipe 74 and on its opposite side with a discharge pipe 75 that extends downwardly through the plate 21 for communication with the compartments 27 and 27'. The outer end of the pipe 74 terminates in an opening 76 in the caisson wall and may be provided with a strainer 77. A valve in housing 73 controls the admission of the water into the compartments 27 and 27' of the barge 11 when the opening 76 is submerged.

In operation, the barges are normally in their floating position and stacked as shown in FIGURE 1 so as to be easily towed to the site of operation. In this position it will be noted that the openings 31 are submerged. The barges may be maintained in this stacked position by the jack mechanisms 17 or other suitable mechanical means engaged with the caissons 19. When the barge assembly reaches the site of operation, the lower or ground-engaging barge 11 is submerged so as to firmly engage marine ground by opening the flood valves 35 and venting air through the pipes 41, both of which are controlled from the barge 10. Sufficient water is permitted to enter the compartments 27 and 27' through the intake pipes 30 (FIG. 13) to a level where the barge 11 will be submerged deep enough so that the water will now enter the intake pipe 46 and opening, 47, above the pipe 30 (FIG. 8). The flood valves 35 may then be closed and water will continue to enter the compartments 27 and 27' through the pipes 46 in the caissons 19. In other words, the valves in the housings 35 preferably are closed as soon as the outside water starts to enter the intake pipes 46. Air in the compartments 27 and 27' escapes or is vented through the pipes 41 (FIG. 11) to the atmosphere. The rate of descent of the barge 11 is controlled by operation of the jack mechanisms 17 on the caissons 19, and the jacks 4, the caissons 18 are also operated to move the latter downwardly with the caissons 19 during the submerging operation.

When the barge 11 is brought in engagement with the marine ground 79 (FIG. 5), the jacks 17 associated with the ground-penetrating caissons 18 are actuated so as to force the caissons 18 into the submerged ground as at 80 in order to firmly maintain the supporting barge 11 anchored in a fixed position and thus prevent lateral displacement of the assembly, as well as to provide additional support for the barge 10. All of the jacks 17 are now actuated to raise the barge 10 on all the caissons above the level of the water 81 so that the upper barge is converted into a working platform or superstructure on which may be conveniently mounted means for drilling oil or other wells, driving of piles, building of permanent structures, temporary and permanent dry docks, or in fact any kind of working platform for marine operations or the like. The barge 10 is maintained in its working position above the water either by the jacks 17 or by suitable mechanical gripping devices engageable with the caissons and which may readily be released when the work is completed. It will be manifest that while normally the barge 10 which is substantially similar in construction to the barge 11 is not submerged, it may be provided with compartments and means for introducing water and air similar to the means for controlling the submergence of the barge 11. Thus, the assembly may then be used for dry dock purposes and the barge 10 submerged a sufficient distance to receive a boat in order to subsequently be raised above the water so as to operate as a dry dock for marine repairs.

The barge assembly is returned to its floating position (FIG. 1) by reversing the action of the jacks 17 so as to lower the barge 10 to again float in the water. Air is then introduced into the interior of the submerged barge 11 through the pipes 41 in each of the caissons 19 and under sufficient pressure to force the water upwardly through the bell mouths 44 of the pipe 43 (FIG. 12) and

through the branch discharge pipes 46 and/or 49 FIGURE 8 and so as to empty into the sea. The rate of ascent of the barge 11 to its floating position, is controlled by the operation of the jacks 17 on the caissons 19, and when all the water is withdrawn from the barge 11, it is raised so as to assume the stacked position as shown in FIGURE 1. The caissons 18 are raised by their jacks 17 preferably simultaneously with the raising of the caissons 19. It will be observed that when the barge 11 is in engagement with the marine ground and the caissons 18 embedded therein, there is provided a strong, stable base for supporting and maintaining the barge assembly in a fixed operative position, and which readily accommodates itself to soils of varying bearing capacities and contour.

As an alternate means for raising the barge 11, the submergible pumps 58 may be used (FIG. 14). In this case, assuming that the barge 11 is submerged and in engagement with the marine ground, it will be seen that upon operation of the pump 58 through the electrical control line 59, the suction created will cause the withdrawal of the water in the compartments 27 and 27' through pipe 62 into the pump 58 from where it discharges through the pipe 65, past the check valve 67 and through the outlet pipe 69 to the sea. The operation and construction of the air vent pipe 70 and the air line 71 which controls the actuation of the flood valve 73 are substantially similar to the air pipes 36 and 41, previously described. When the barges are returned to their normal position, as shown in FIGURE 1, they may be suitably secured together so as to be floated or moved to a new location and at a minimum expenditure of time, labor and cost.

In the modified forms of the invention shown in FIGURES 6 and 7, a metal open framework or truss structure 82 is substituted for the lower or ground-engaging barge 11 shown in FIGURE 5. Otherwise, the two assemblies are the same. In this form, the flood valves and the means for supplying air pressure thereto, as well as the compressed air and vent pipes and their associated controlling means, are eliminated, and the lower ends of the caissons 19 are arranged to extend into sockets 83 formed in the shoes or footing members 84 (FIG. 6) and be welded thereto. The ground-penetrating caissons 18 extend loosely through sleeves 85 so as to be embedded in the ground by the actuation of the jack mechanism 17 in the manner previously described. The metal framework 82 as shown, comprises spaced longitudinal brace side members 86 which connect the shoes 84 to adjacent sleeves 85, and to the transverse spaced brace members 87. Additionally the framework 82 is reinforced by the diagonal brace members 88 and the longitudinal brace 89 which extends medially between the side brace members 86 (FIG. 7). Thus, it will be seen that a rugged, strong, durable metal framework or truss is provided which under certain operating conditions may be substituted and efficiently used in place of the submergible barge 11.

In the modified form of the floating submergible marine assembly shown in FIGURE 15, three watertight barges or buoyant members 90, 91, and 92 are normally floated in a stacked position so as to be transported from place to place. The upper barge 90 is arranged to be converted into a working platform and the intermediate or middle barge 91 is submergible so as to provide additional strength and stability to the structure. The lower barge 92 is arranged to be lowered and spaced from the barge 91 so as to rest on the marine ground and thus afford a strong, stable supporting base irrespective of the contour of the ground or the varying bearing capacity thereof so as to firmly maintain the barge 90 and the equipment carried thereby, when raised above the level of the water, in a fixed operative position. The upper barge or working platform 90 is hollow and may be of any size as the particular marine operating conditions require. The interior of the buoyant barge 90 is separated by a central and longitudinally extending bulkhead 93, perforated partition plates 94, and longitudinal side perforated plates 95, into communicating compartments or chambers 96. It will be noted that the buoyant upper barge 90 as well as the buoyant barge 10 (FIG. 1) normally do not submerge. However, they may when used as dry docks and water and air introduced into the compartments in the same manner as they are fed into the submerged barges. Opposite sides of the barge 90 are provided with caisson wells 98 having upper and lower guide openings. Certain of the wells 98 register with guide openings for caisson wells 101 and 102, in the barges 91 and 92, respectively. Arranged to extend through the wells 98 are three separate groups of caissons or tubular members generally indicated by the numeral 103. One group of these caissons such as 104 (FIG. 16) are of such a length as to loosely extend through the aligned wells 98, 101, and 102 in the barges so as to penetrate and be embedded in the marine ground 105. A second group of caissons 106 extend loosely through certain of the wells 98 in the upper barge 90 and have their lower ends extending into sockets 107 in the intermediate barge 91 and connected thereto in any suitable manner such as by welding or the like. The third group of caissons 108 extend loosely through certain of the wells 98 in the barge 90, through wells 100 in the barge 91 and fit in aligned sockets 109 in the lower barge 92 and are suitably connected thereto as by welding. Each of the caissons 103 is separately operable by a suitable jack mechanism, such as the jacks 110 mounted on the upper barge 90 and which may be similar to the jack mechanism disclosed in the said Pointer application, Serial No. 143,627.

Within each of the caissons 106 and 108, is positioned an air actuated flood valve similar to the valve mechanism 35, previously described. A flexible pipe 111 is controlled by suitable valve means 112 on the deck of the upper barge 90 (FIG. 15) for operating the flood valve. A compressed air and vent pipe or line 113 communicates with an air vent and supply pipe similar to the pipe 42, previously described, so as to force air into the intermediate barge 91 or the lower barge 92 for the purpose of discharging water from the interior compartments thereof through openings 52'. The upper ends of the flexible pipes 113 are also positioned adjacent the deck of the barge 90 so as to be conveniently operated. The interior of each of the barges 91 and 92 may be interiorly compartmented similar to the barge 11 previously described.

When the barges are stacked as shown in FIGURE 15, the bottom barge 92 may be lowered so as to engage the marine ground 105 (FIG. 16) by opening the flood valves in the caissons 108. As the barge 92 is lowered, its descent is controlled by the jacks 110 operating on the caissons 108 and the caissons 104 are lowered therewith by their jacks. When the barge 92 rests on the marine bottom 105, the jacks are operated on the caissons 104 to force the latter into the marine ground as at 118 (FIG. 16), thus maintaining the barge assembly in a fixed position. The barge 90 is then raised on the caissons 104 and 108 above water to a desired elevation, by the operation of the jacks 110 associated with the caissons 104 and 108, and maintained by suitable gripping mechanism in its raised position. During this raising operation of the barge 90, the intermediate barge 91 remains afloat on the water by releasing the jacks 110 associated with the caissons 106. The barge 91 is then submerged by opening its flood valve mechanism, and lowered by the jacks associated with the caissons 106 to a position which affords the greatest strength and stability to the entire structure so that the convertible barge assembly may be efficiently used for various marine operations, such as drilling oil wells or the like, driving piles, building permanent marine installations, or in fact any operation where a working platform is to be used over water. Usually the barge 91 will be positioned midway between

the barges 90 and 92 to provide lateral bracing for the otherwise unbraced lengths of the caissons 104 and 108 extending between the barges 90 and 92.

In order to provide additional strength and rigidity to the assembly, when erected as shown in FIGURE 16, an inclined upper telescopic bracing connection may be provided which includes a cylinder 119 arranged to be pivotally connected as at 120 to the intermediate barge 91. A slidable piston rod 121 extends outwardly from the cylinder 119 and is connected at its free end as at 122 to the upper barge 90. When the barges 90 and 91 are in their stacked position, shown in FIGURE 15, the cylinder 119 and its rod 121 may be received in a recess in one of the opposed surfaces of the two barges, such as the recess 120' in the bottom of the barge 90. Additional flexible bracing members 119' may be connected to the intermediate barge 91 and the lower barge 92. Any number of such bracing means may be used, and, as shown, are disposed so as to extend diagonally and outwardly in opposite directions from the barge 91 so as to be connected to the upper and lower barges 90 and 92, respectively.

The barge assembly may be returned from its erected position, as shown in FIGURE 16, to its floating or stacked position as shown in FIGURE 15, by actuating the air valves communicating with the interior of the intermediate barge 91 so as to force the water from its interior compartments. The rate of ascent of the barge 91, is, of course, controlled by the jack mechanisms 110 operating on the caissons 106. After the barge 91 is afloat, the jacks 110 are released from the caisson 106, and the upper barge 90 is lowered to its floating position, where it rests on top of the barge 91 by operation of the jacks 110 on the caissons 104 and 108. Air is then forced into the interior compartments in the lower barge 92 so as to discharge the water therefrom and the rate of its ascent is controlled by operation of the jacks 110 on the caissons 103 until the barge engages the underside of the barge 91. All three barges in their stacked position may then be interlocked by suitable mechanical gripper means or the like so as to be floated to any suitable point for further use.

In the modified form of the invention shown in FIGURES 20 and 21, the upper barge 90 and the caissons 103 are similar to those previously described in connection with FIGURE 15. However, instead of the intermediate barge 91 and the lower barge 92, there is substituted an intermediate metal framework or truss member 123 and a lower framework 124, both similar to those previously described with reference to FIGURES 6 and 7, which can be used when the marine ground provides a sufficiently firm base for supporting the convertible barge and working platform 90. The ground-penetrating caissons 104 extend loosely through aligned guide sleeves 125 and 126 on the frameworks 123 and 124, respectively, so as to be embedded in the marine ground 127. The caissons 106 extend into sockets in the members 123 and are connected thereto, as at 128, so as to be moved therewith. The caissons 108 extend loosely through sleeves 109 on the framework 123 and have their lower ends connected to socketed shoes 112 on the lower framework 24. Telescopic bracing means 129 of limited extensibility may be connected at their lower ends as at 130 to the intermediate brace member 123 and at their upper ends to the upper barge 90, as described above with reference to FIGURE 16. Flexible brace members 129' connecting the members 123 and 124 also may be provided to impart additional rigidity to the assembly when the parts are in their guide position (FIG. 21).

In the modified form of the invention shown in FIGURE 22, the lower or ground-engaging barge 92 (FIG. 16) is omitted and the upper barge 131 and the barge 132 and their associated parts are substantially similar in construction and operation to the barges 90 and 91 (FIG. 16) previously described. The caissons 133 are of such length as to extend through the barges 131 and 132 and be anchored in the marine ground as at 134. The caissons 135 extend through guide openings in the upper barge 131 and are connected at their lower ends as at 136 to the submergible barge 132 and are provided with flood valves controllable by the air lines 137. Also mounted in each of the caissons 135 is a compressed air vent pipe or line 138 so that these parts are substantially similar in construction and operation to the air control means 111 and 113 previously described. Adjustably extensible bracing members 139, similar to those previously described may be connected as at 140 to the barge 132 and at their upper ends to the barge 131, as at 141. Suitable jacks 142 mounted on the upper barge 131 are associated with each of the caissons or columns for controlling the axial movement thereof. Thus, it will be seen that when the normally stacked barges 131 and 132 are moved to the position as shown in FIGURE 22 and the caissons 133 embedded in the sufficiently firm marine ground, a stable base or support is provided without requiring the use of a submergible ground-engaging barge.

In the modified form of the invention shown in FIGURE 23, the parts are substantially similar to the form shown in FIGURE 22, with the exception that for the barge 132 is substituted, a metal framework 143 having sockets 146, to which the lower ends of the caissons 135 are connected, and sleeves 147 through which the caissons 133 extend. Otherwise, the barge assembly is constructed and operated substantially similar to the form shown in FIGURE 22.

Thus, it will be seen that by reason of the novel arrangement of parts, the barge assembly may be constructed of one or more watertight buoyant barges, the upper one of which is readily convertible when raised above the water into a working platform and the lower one, when submerged, constituting a firm base for supporting the working platform above the level of the water. Further, the lower barge of the intermediate barge may be omitted and a metal framework substituted for guiding, bracing, and maintaining the caissons in proper position during the operation of the floating unit. It will be seen that the intermediate barge or framework when used affords greater strength and stability to the barge assembly and that the raising and lowering of the barges may be conveniently controlled from the upper barge so that the barges not only can be quickly and readily moved from their stacked floating position to their erected position, but conversely, may be readily returned to their floating position at a minimum expenditure of time, effort and cost.

Further, the submergible pump mechanism may be interchangeably used with the air pressure system for de-watering the barges. Manifestly, the length and size of the barges or framework may be varied, also the number of jacks and caissons may be increased or decreased depending upon the specific requirements of the work to be done and the size and loads to be supported by the floating assembly. The ground-engaging lower barges 11 and 92 may be broken up in separate spaced sections which provide separate footing or base members for receiving the caissons and for maintaining the superstructure firmly in a fixed position when the working platform is raised above the level of the water.

In the modified form of the invention shown in FIGURES 24 to 28 inclusive, the floating unit is shown composed of a watertight barge and two or more pontoons connected to steel caissons so as to be movable therewith. As shown, the floating unit includes a convertible floating barge and platform 150 having longitudinally spaced well openings 151 through which extend the caissons or tubular supporting members generally identified by the numeral 152. Associated with each of the caissons and mounted on the barge are suitable jacks 153, such as the jack mechanism embodied in the said Pointer application, Serial No. 143,627. The barge 150

is provided with longitudinally spaced pairs of lateral projecting guide members **154** (FIG. 24) also provided with well openings **151** through which extend caissons **152**. Associated with the barge **150** are two or more submergible pontoons **156**. For the purpose of illustration, four of such pontoons are shown but this number may be varied as the particular operating conditions require. Connected to each pontoon **156** are four caissons **152**. All the caissons **152** extend loosely through the well openings **151** in the barge **150** and have their lower ends disposed within the pontoons **156** so as to be welded or otherwise permanently connected thereto. One of the caissons associated with each of the pontoons **156**, has mounted therein the necessary valves and controls for flooding the pontoons substantially similar to the mechanism shown in FIGURE 11, previously described. A compressed air and vent line **158** communicates at one end with the interior of the pontoons **156** and at its opposite end is conveniently positioned as at **159** adjacent the deck of the barge **150** so as to be operable by remote control. A flexible air line **160** similarly is connected to a flood valve for each pontoon and also to operating means **161** on the deck of the barge **150**.

Each of the pontoons **156** is provided centrally with a transverse bulkhead or partition **162** (FIG. 27) and longitudinal partitions **163** for forming compartments. Additionally, the ends of the pontoons are provided with transverse plates **164** and **165** which coact with the longitudinal partitions **163** to form chambers **166** into each of which extends the lower end of a caisson **152** so as to be welded or firmly secured thereto. Radial webs **167** are positioned in each of the chambers **166** and engage the adjacent caisson **152** so as to firmly maintain the same in a fixed position. The longitudinal and transverse plates or partitions are provided with openings or perforations **168** so as to facilitate the circulation of the water into and out of the pontoons in order to raise and lower the same.

Thus, it will be seen that the watertight barge **150** is arranged to coact with two or more pontoons which are readily submerged by the operation of the jacks **153** to rest on the marine ground and provide a strong stable base on soils of varying bearing capacities. Additionally, when the pontoons **156** are in their ground engaging position, the barge **150** may be raised above the level of the water (FIG. 26) so as to provide a working platform or dock as the particular operating conditions may require. It will be seen that by varying the buoyancy of the different pontoons, means are provided for counterbalancing wind and wave reactions against the barge and caissons. In other words, if a hurricane is approaching from the south and would tend to capsize the floating unit, the north pontoons are made buoyant, or partially so, so as to counteract the overturning movement, thus insuring the efficient operation of the device under difficult working conditions.

The pontoons **156** are lowered to the bottom of the marine ground **169** by actuating the flood valves in the caissons **157** through the controls **161** and have their descent controlled by the jacks **153**. Each pontoon is vented through the air line **158** in substantially the same manner as previously described and as shown in FIGURE 11. The barge **150** is maintained in its raised or operative position as shown in FIGURE 26, by the jacks **153** or other suitable mechanical gripping means until the work is completed. The entire unit may be then returned to its floating position by reversing the operation of the parts so as to force air into the pontoons under sufficient pressure to withdraw the water in the manner as previously described, so that when the barge and pontoons are in their stacked position, the assembly may be moved or floated to a new location for further operation.

Thus, a simple and efficient method of erecting a submergible floating assembly is provided which insures the assembly being capable of withstanding the severe uses to which devices of this character are normally subjected.

It will be understood that the forms of the invention shown are merely illustrative and that such changes may be made as come within the scope of the following claims.

What is claimed is:

1. A convertible floating structure and marine platform assembly comprising: a platform-like body having sufficient buoyancy to float the assembly; a plurality of substantially upright marine-bottom-engageable supporting legs; guide means associated with said body and mounting said legs for substantially vertical relative movement between said legs and said body and for projection above and below the latter; power-operated means engaged with said body and said legs for selectively effecting or restraining said vertical relative movement in either direction to lift or lower said legs relative to said body when the latter is afloat or lift or lower said body on said legs when the latter are in bearing engagement with the marine bottom; at least one leg-bracing member extending laterally between said legs and arranged beneath said body for vertical relative movement between the latter and said member; guide means associated with said member and mounting said legs for substantially vertical relative movement in either direction between said legs and said member and for projection above and below the latter; and means for selectively effecting or restraining vertical relative movement in either direction between said body and said member, said last-mentioned means including a plurality of substantially upright supporting legs having their lower ends connected to said member for movement therewith, guide means associated with said body for mounting said member-connected legs for substantially vertical relative movement between the latter and said body and for projection thereabove and therebelow, and power-operated means engaged with said body and said member-connected legs for selectively effecting or restraining said last-mentioned vertical relative movement.

2. A convertible floating structure and marine platform assembly comprising: a platform-like body having sufficient buoyancy to float the assembly; a plurality of substantially upright marine-bottom-engageable supporting legs; guide means associated wtih said body and mounting said legs for substantially vertical relative movement between said legs and said body and for projection above and below the latter; power-operated means engaged with said body and said legs for selectively effecting or restraining said vertical relative movement in either direction to lift or lower said legs relative to said body when the latter is afloat or lift or lower said body on said legs when the latter are in bearing engagement with the marine bottom; at least one leg-bracing member extending laterally between said legs and arranged beneath said body for vertical relative movement between the latter and said member; guide means associated with said member and mounting said legs for substantially vertical relative movement in either direction between said legs and said member and for projection above and below the latter; means for selectively effecting or restraining vertical relative movement in either direction between said body and said member; a second bracing member arranged beneath the one bracing member for vertical movement relative to the body; guide means associated with said second bracing member and said legs and mounting the latter for substantially vertical relative movement in either direction between said legs and said second member and for projection above and below the latter; and means for selectively effecting or restraining vertical relative movement in either direction between said body and said second member.

3. A convertible floating barge and working platform assembly of the class described including an upper

buoyant member and at least one lower lateral brace member, said members being arranged to be stacked one above the other to provide a floating unit, said members having vertically aligned openings, ground-penetrating and upper-member-supporting caissons extending through said aligned openings so as to be in supporting engagement with the marine ground, said upper member having additional vertical openings therein, caissons extending through said additional openings and connected to said lower member so as to be vertically movable therewith, and power-operated means on said upper member for selectively effecting or restraining relative vertical movement between said upper member and said caissons in either direction.

4. A convertible floating barge and working platform assembly of the class described including a top buoyant member and submergible bottom brace member arranged to be stacked one above the other to provide a floating unit, said members having vertically aligned openings, ground-penetrating and top-member supporting caissons loosely extending through said aligned openings, said top member having additional vertical openings, auxiliary caissons extending through said additional openings and connected to said bottom member, and power-operated means mounted on the top member and operatively engageable with each of said caissons for selectively effecting or restraining relative vertical movement between each said caisson and said top member in either direction.

5. A marine assembly of the class described including at least top and bottom barges arranged to be stacked one above the other to provide a floating unit, said barges having vertically aligned openings, ground-penetrating caissons loosely extending through said aligned openings, said upper barge having vertical auxiliary openings, auxiliary caissons extending through said auxiliary openings and connected to said bottom barge so as to be movable therewith, power operated means on said top barge and operatively engageable with said caissons for selectively restraining or imparting axial movement to each of said caissons in either direction relative to said top barge, and means for submerging said bottom barge to rest on the marine ground, said top barge being adapted to be raised above the level of the water on said caissons by said power-operated means so as to constitute a working platform.

6. A marine assembly as called for in claim 5 in which the submerging means includes means for introducing water into the bottom barge so as to submerge the same, and means for withdrawing the water so as to refloat said bottom barge.

7. A marine assembly of the class described including a buoyant top barge and a buoyant bottom barge arranged to be stacked one above the other to provide a floating unit, said top barge having vertical openings, caissons extending through said vertical openings and connected to said bottom barge, said barges having vertically aligned openings, ground-penetrating caissons extending through said aligned openings, fluid pressure means for imparting axial movement to said caissons in either direction relative to said top barge, valve controlled means for introducing water into said bottom barge so as to submerge the same, and pump means for withdrawing the water from said bottom barge to refloat the latter.

8. A marine assembly of the class described including a top buoyant member and at least one lower buoyant member arranged to be stacked one above the other to provide a floating unit, said buoyant members having vertically aligned openings forming caisson wells, ground-penetrating caissons extending through said openings, said upper buoyant member having auxiliary vertical openings, auxiliary caissons extending through said auxiliary openings and connected to said lower buoyant member so as to be movable therewith, means for introducing water into said lower member so as to submerge the same, means for withdrawing the water in said lower member to refloat the later, and power-operated means mounted on said top member and engageable with each of said caissons for selectively imparting or restraining relative vertical movement between said each caisson and said top member.

9. A marine assembly of the class described including an upper buoyant member, an intermediate member, and a bottom member arranged to be stacked one above the other to provide a floating unit, said upper member having a plurality of vertical guide openings, caissons extending loosely through said openings, said intermediate member having vertical openings aligned with said openings in said upper member, certain of said caissons extending loosely through said intermediate member openings and others of said caissons being connected at their lower ends to said intermediate member, said lower member having a plurality of openings registering with said openings in the intermediate member, certain of said caissons extending loosely through said lower member openings and other of said caissons extending loosely through said registering openings in said upper member and said intermediate member and connected with said lower member, and power-operated means on said upper member for selectively effecting or restraining vertical relative movement between said caissons and said upper member in either direction.

10. A marine assembly of the class described including a top barge, an intermediate barge, and a bottom barge arranged to be stacked one above the other to provide a floating unit, said barges having a plurality of vertically aligned guide openings, caissons extending loosely through said guide openings, said top barge and intermediate barge having vertically aligned auxiliary guide openings, and auxiliary caissons extending through said last-mentioned openings and connected to said bottom barge, secondary caissons extending through additional guide openings in said top barge and connected to said intermediate barge, and power-operated means on said top barge operatively associated with said caissons for selectively affecting or restraining relative vertical movement between said caissons and said top barge.

11. A marine assembly of the class described including a top barge, an intermediate barge, and a bottom barge arranged to be stacked one above the other to provide a floating unit, said barges having a plurality of vertically aligned guide openings, caissons extending loosely through said guide openings, the top barge and the intermediate barge having auxiliary vertically aligned guide openings, auxiliary caissons extending through said last-mentioned openings and connected to said bottom barge, secondary caissons extending through additional guide openings in said top barge and connected to said intermediate barge, power-operated means on said top barge operatively associated with said caissons for moving the same axially relative to said top barge, means for selectively introducing water into and withdrawing water from said bottom and intermediate barges so as to selectively submerge or float said intermediate barge and said bottom barge, and said top barge being adapted to be raised above the water level on said caissons and auxiliary caissons so as to constitute a working platform.

12. A convertible, floating structure and marine platform assembly comprising: an upper platform-like body and at least one lower submergible body with the former arranged over the latter for vertical relative movement therebetween; means for imparting to at least one of said bodies sufficient buoyancy to float the assembly; a plurality of substantially upright, elongated body-supporting legs; guide means associated with said upper body and mounting said legs for substantially vertical relative movement between said legs and said upper body and for projection above and below said upper body; power-operated means mounted on said upper body and engageable with said legs for selectively effecting or re-

straining said movement in either direction; means securing said lower body to the lower ends of a first group of said legs for movement therewith; guide means associated with said lower body and mounting a second group of said legs for substantially vertical relative movement between said second group of legs and said lower body and for projection both thereabove and therebelow; and limitedly-extensible cross-bracing means interconnecting said upper and lower bodies.

13. The structure defined in claim 12 in which the cross-bracing means comprises cylinder and rod means having the opposite ends thereof pivotally connected to the bodies.

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