Oct. 27, 1959 G. E. SUDEROW 2,909,900

OFF-SHORE WORKING ASSEMBLY

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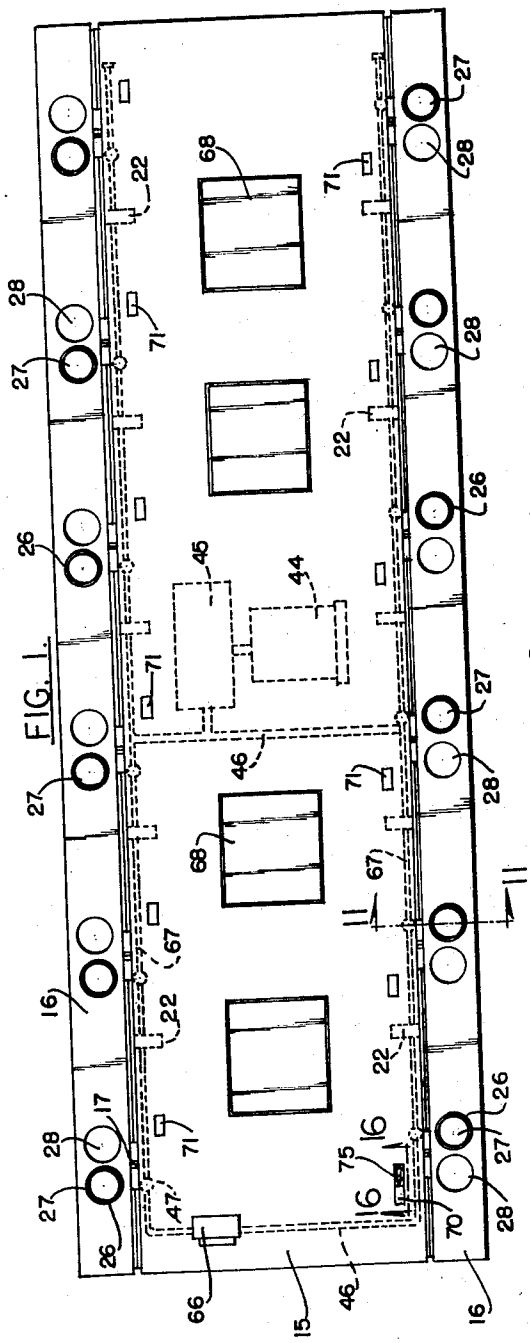


FIG. 1.

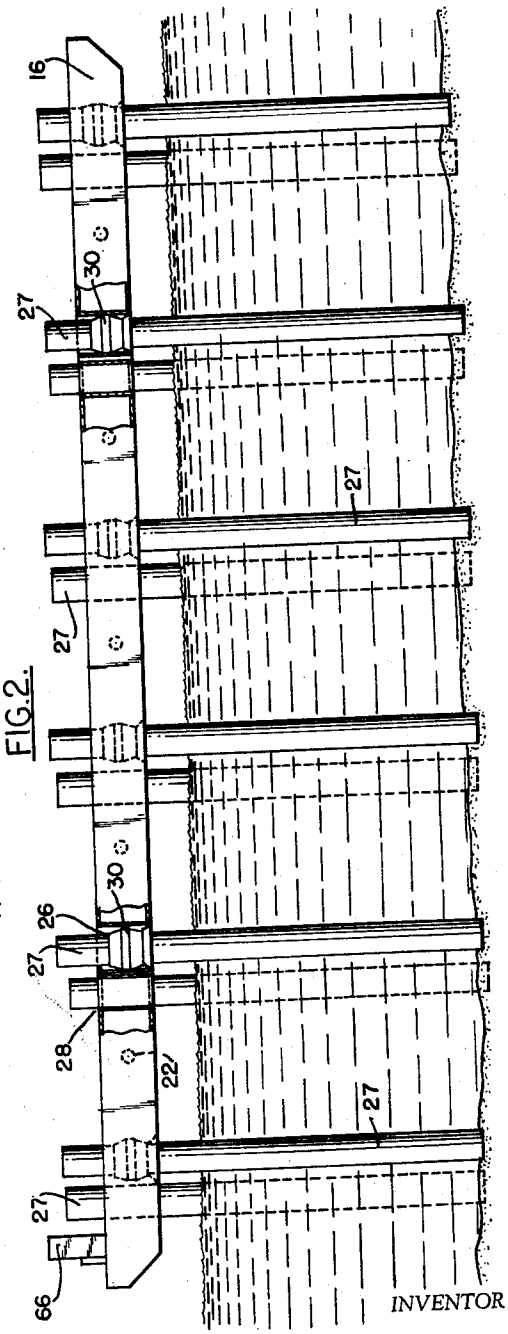


FIG. 2.

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FIG. 3.

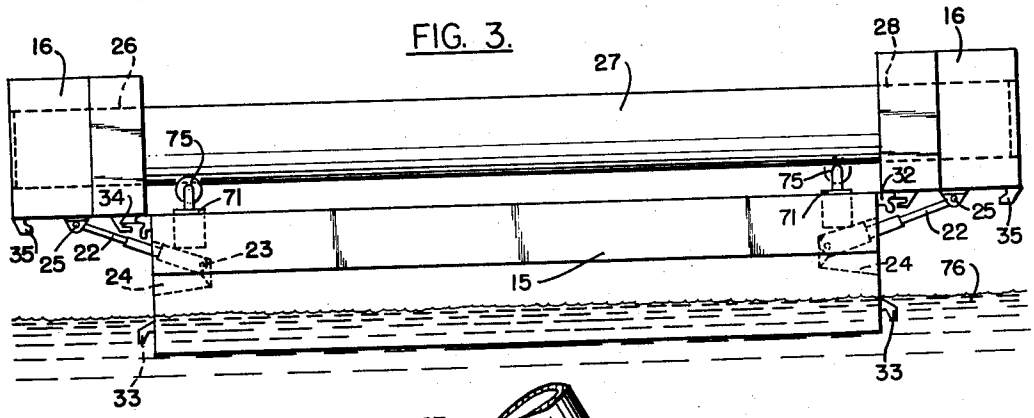


FIG. 4.

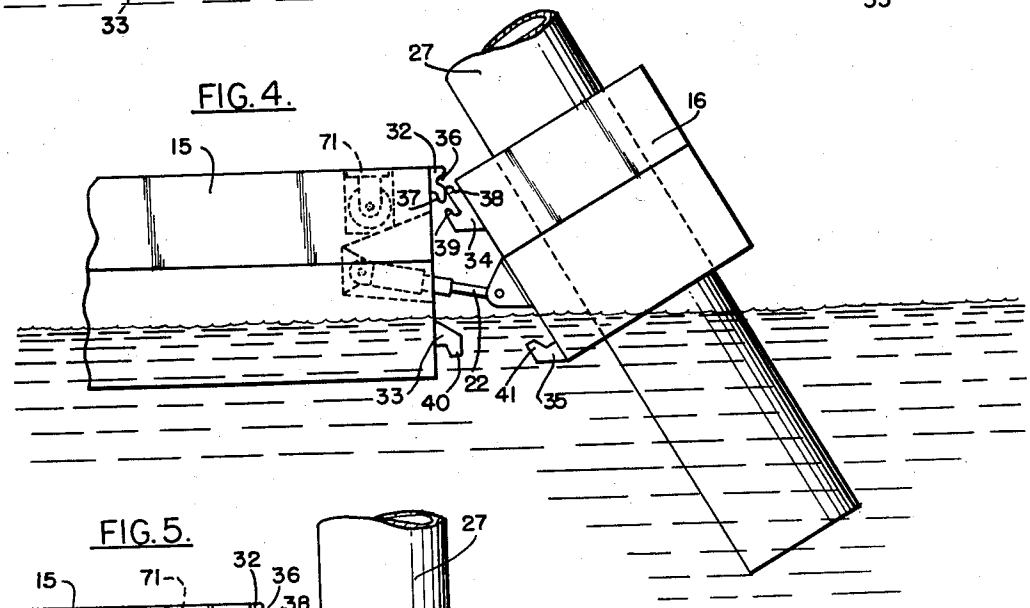


FIG. 5.

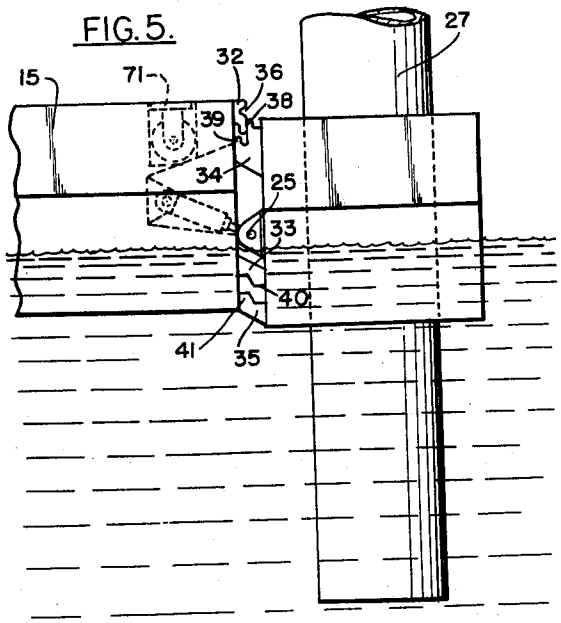
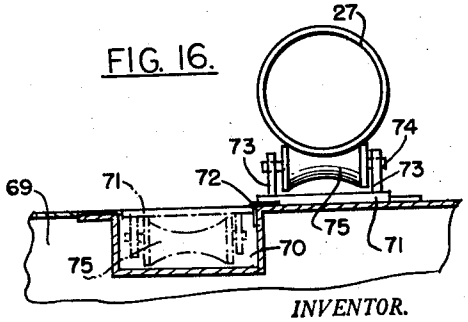


FIG. 16.



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FIG. 6.

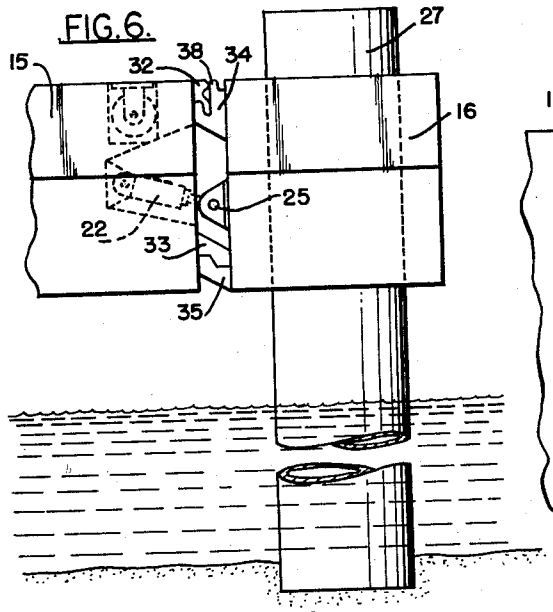
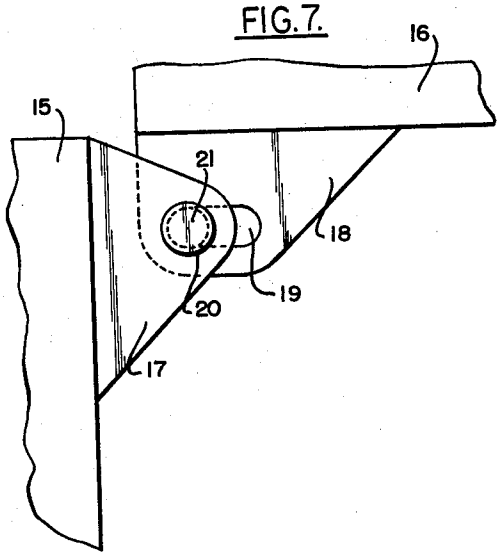


FIG. 7.



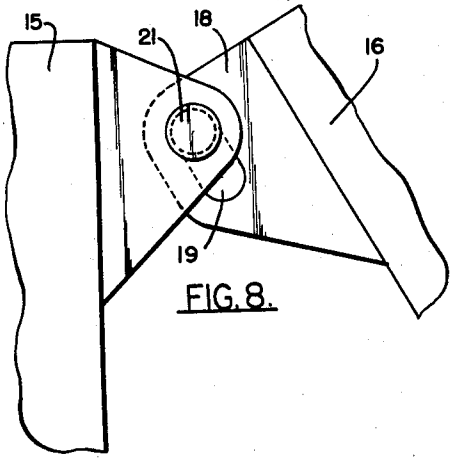
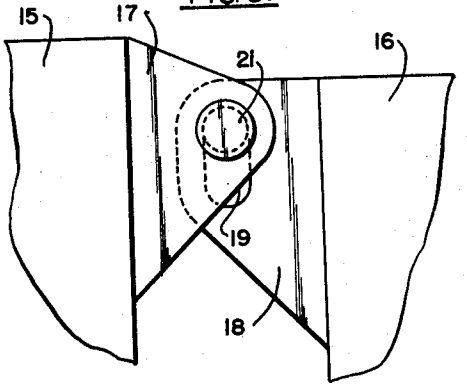


FIG. 8.

FIG. 9.



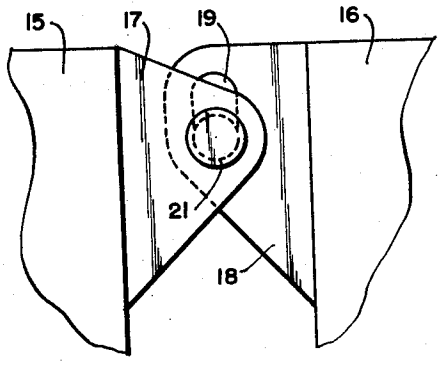


FIG. 10.

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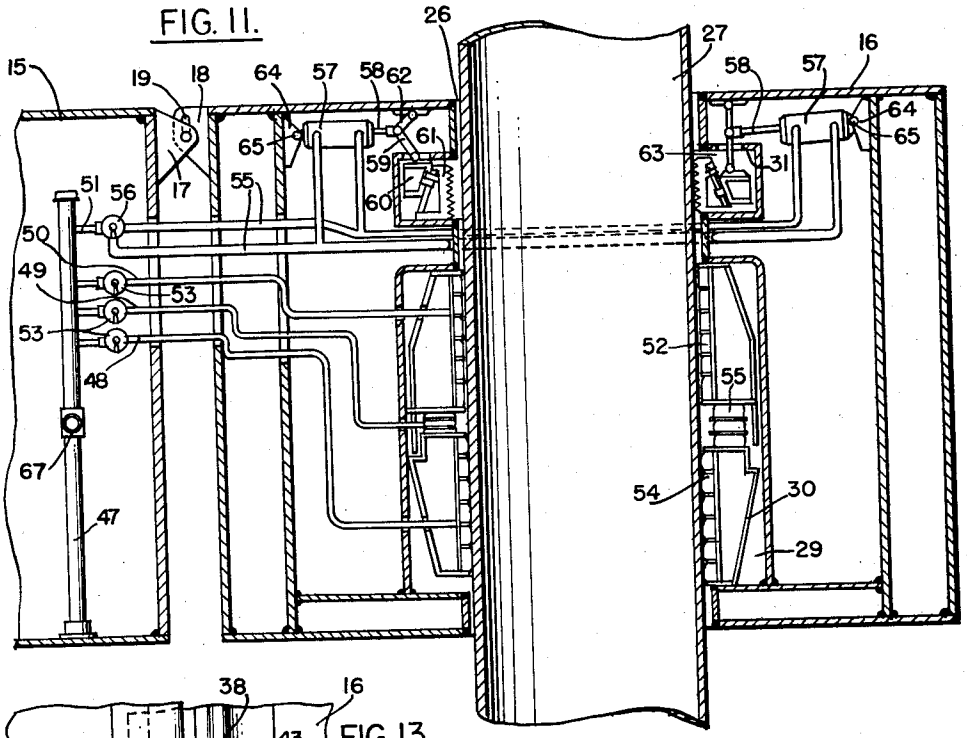
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FIG. 11.



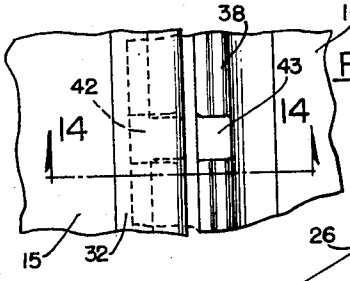


FIG. 13.

FIG. 12.

FIG. 14.

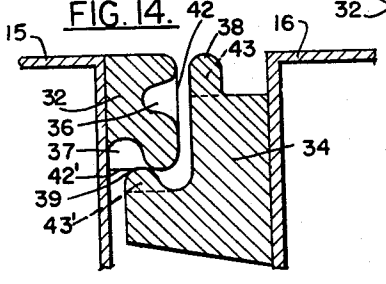


FIG. 15.

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United States Patent Office 2,909,900 Patented Oct. 27, 1959

2,909,900

OFF-SHORE WORKING ASSEMBLY

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Application January 6, 1954, Serial No. 402,523

8 Claims. (Cl. 61—46.5)

This invention relates to portable marine platforms of the type shown in the copending application of Pointer, Serial No. 283,567, now U.S. Patent No. 2,775,869. More particularly, this invention pertains to improvements in such platform.

In the aforementioned Pointer application, there is disclosed a buoyant body, conveniently in the form of a barge, having a plurality of upright supporting legs that are mounted on the body for substantially vertical movement relative thereto in a plurality of guiding wells extending vertically through the body. Such relative movement is selectively effected or restrained by jacking mechanisms that are mounted on the body and releasably engageable with each supporting leg. As a result of this construction, the entire assembly may be towed to an erection site, the supporting legs moved down into engagement with the marine bottom, and the body lifted out of the water on the supporting legs and then supported on the latter to form a fixed, stable, above-water marine platform suitable for use as a pier, dock, well drilling platform, etc. After operations at the site, such as well drilling, have been completed, the body may be lowered back down into the water by means of the jacking mechanisms, the supporting legs raised off the marine bottom, and the entire assembly floated to another erection site.

While the aforedescribed portable marine platform has proven to be extremely satisfactory for its intended purpose, certain disadvantages have arisen. For example, whenever a long tow occurs, the supporting legs usually are removed from their guiding wells and lashed to the deck. Were this not done, the extreme length of the supporting legs, which in actual practice usually are in the form of tubular steel caissons of the order of 6 feet in diameter and 100 feet or more in length, renders the entire structure somewhat top-heavy, because the legs usually are elevated until their lower ends are substantially flush with the bottom of the barge to reduce towage resistance. When the supporting legs are lashed to the deck, however, a large heavy duty crane must be used at the erection site to lift each supporting leg and insert it into its guiding well in the barge. Obviously, large cranes are extremely expensive machines and either must be transported on the barge to the site of erection or be available there. Furthermore, the manipulation of a supporting leg by a crane is a difficult procedure in a heavy sea.

Consequently, it is an object of this invention to provide a portable marine platform of the type under consideration wherein the assembly is provided with a self-contained means whereby the supporting legs may be transported on the body in a lowered fixed horizontal position to reduce both the center of gravity of the structure and its towing resistance, and at an erection site readily moved into an upright operative position for vertical movement by the jacks without the necessity of a large crane.

It is another object of this invention to provide a seaworthy portable marine platform of the type under consideration that is completely self-contained for operation at all times without the necessity of extra machinery or equipment, which may be floated through heavy seas without danger of capsizing, and erected quickly, even in fairly heavy seas, with a minimum expenditure of effort.

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

Figure 1 is a plan view of a portable marine platform embodying this invention and illustrating the platform in its erected condition;

Figure 2 is a side view of the platform shown in Figure 1 with parts in section to illustrate details;

Figure 3 is an end view of the platform shown in Figure 1 but illustrating the platform in its towing condition;

Figure 4 is an enlarged fragmentary view, corresponding to Figure 3, but illustrating a step in the erection of the platform;

Figure 5 is a fragmentary view corresponding to Figure 4 but illustrating a further step in the erection of the platform;

Figure 6 is a view corresponding to Figure 4 but illustrating a final step in the erection of the platform;

Figures 7 through 10 are enlarged, fragmentary views, corresponding to the relative positions shown in Figures 3 to 6, respectively, and illustrating a hinge connection;

Figure 11 is an enlarged, fragmentary sectional view taken substantially on the line **11—11** of Figure 1;

Figure 12 is a fragmentary perspective view of the erected platform shown in Figure 2, which parts broken away to illustrate details;

Figure 13 is an enlarged, fragmentary plan view of a portion of Figure 1, but showing parts slightly separated for illustrative purposes;

Figure 14 is a fragmentary sectional view taken substantially on the line **14—14** of Figure 13;

Figure 15 is an enlarged fragmentary perspective view, partly in section, of one of the parts shown in Figures 13 and 14; and

Figure 16 is an enlarged fragmentary sectional view taken substantially on the line **16—16** of Figure 1.

Referring now to the drawings, there is shown in Figures 1 through 3, a buoyant body **15** which may be in the form of a barge that is generally rectangular in plan view, although the body may be of any desired size and configuration as the particular operating conditions require. Wing sections **16**, coextensive in length with the barge **15**, are connected to the opposite longitudinal sides of the barge for swingable movement about a horizontal axis between the raised or stowed position shown in Figure 3 and the lowered or operative position shown in Figures 1, 2, 6, 11, and 12. In this latter position, it will be seen that the wing sections **16** essentially constitute lateral extensions of the barge **15**.

Each wing section **16** is connected to its side of the barge **15** by a plurality of longitudinally-spaced floating pivotal connections, each of which includes a hinge lug **17** secured to the side of the barge **15** and extending outwardly therefrom, and a hinge lug **18** on the opposed side of the wing section **16**. A pivot pin **21** extends through a circular opening **20** in each lug **17** and through an elongated slot **19** in the corresponding hinge lug **18**. It will be noted that when a wing section **16** is in its raised or stowed position, the slot **19** extends horizontally, as best shown in Figure 7, while when a wing section is moved to its lowered or operative position, the slot **19** extends vertically, as best shown in Figure 10. Movement of each wing section **16** between its raised and low-

ered positions is effected by a plurality of double-acting fluid pressure rams 22, each having one end thereof pivotally connected, as at 23, to the back wall of a recess 24 in the side of the barge 15, and the other end thereof pivotally connected, as at 25, to the opposed side wall of the wing section.

Each of the wing sections 16 is provided with a longitudinal series of openings extending vertically therethrough. These openings are arranged in opposite pairs on the two wing sections 16. One of the openings of each pair constitutes a guide opening or well 26 for a barge supporting leg 27, here shown as a caisson or tubular member, while the other opening 28 of each pair constitutes a pocket for receiving an end of a caisson 27 carried by the opposite guide well 26, as will be explained further hereinafter. As is best shown in Figure 11, each caisson well 26 is enlarged between the top and bottom of its wing section to provide an annular chamber 29. Disposed in the chamber 29 is a suitable jacking mechanism 30 that is releasably engageable with the corresponding caisson 27 to selectively effect or restrain relative longitudinal movement in either direction between the caisson and its wing section 16. The jacking mechanism 30 may be of the type disclosed in the aforementioned copending Pointer application, and have a lower set of inflatable gripping elements 54, an upper set of inflatable gripping elements 52, and an inflatable bellows 55 interposed between the upper and lower gripping elements. For illustrative purposes only, the bellows 55 is shown in Figure 11 as deflated on the left side of the caisson 27 and as inflated on the right side.

Each guide opening 26 also is additionally enlarged between the top and the bottom of its wing section 16 to provide an annular chamber 63, spaced from the chamber 29 and housing a self-energizing gripping device to engage the corresponding caisson 27 and support a load thereon. The device includes a segmental gripping ring 61, having inclined outer wedging surfaces on each segment engageable by the complementary inner surface of a rigid pressure ring 60 that is movable longitudinally or axially of the well 26. As described more in detail in the copending application of Suderow, Serial No. 382,948, downward movement of the pressure ring 60, as shown on the right of the caisson 27 in Figure 11 effects a contracting wedging engagement with the segmental gripping ring 61 to force the segments of the latter radially inwardly into tight gripping engagement with the caisson 27, while upward movement of the ring 60, as shown on the left of the caisson, serves to retract the separate segments of the ring 61 from such engagement. Vertical movement of the ring 60 may be effected by a plurality of circumferentially-spaced, double acting fluid pressure cylinders 57, each having the end of its cylinder pivotally connected, as at 65, to a bracket 64 fixed to the wing section 16 and its piston rod 58 pivotally connected to the pivotal connection of a pair of toggle links 59 and 62. The other end of each link 59 is pivotally connected to the ring 60 while the other end of each link 62 is pivotally connected to a bracket fixed to the wing section 16.

In addition to the aforedescribed hinges, each wing section 16 is fixedly interlocked with the barge 15, in both the raised and lowered positions, by interlocking means carried by the adjacent sides of the barge and the wing section. These interlocking means include an upper lug member 32 fixed to the side of the barge 15 adjacent its upper edge and a lower lug member 33 fixed to the side of the barge slightly above its lower edge. Similarly, the adjacent face of the wing section 16 is provided with an upper lug member 34 adapted to coact with the lug member 32 on the barge and a lower lug member 35 adapted to coact with the lower lug member 33 on the barge. All of these lug members extend substantially the full length of the barge, but are interrupted along their lengths to accommodate the hinges 17, 18. As best shown in Figure 14, the outer face of each lug member 32 is provided

with a longitudinally extending groove 36 while a similar groove 37 is provided in the undersurface of the lug 32. The corresponding upper wing section lug 34 is provided with laterally and vertically spaced ribs 38 and 39 adapted to engage within the grooves 36 and 37, respectively, as will be hereinafter explained. The barge lug 33 is provided with a downwardly extending longitudinal rib 40 while the corresponding wing section lug 35 is provided with an upwardly extending longitudinal rib 41 (Figures 4 and 5). As is best shown in Figures 13 to 15, the grooves 36 and 37 are interrupted along their lengths by transverse webs 42 and 42', respectively, and the ribs 38 and 39 by notches 43 and 43', respectively. These notches and ribs are adapted for interfitting engagement, as will be later explained, to prevent longitudinal relative movement between each wing section 16 and the barge 15, when the sections 16 are in their raised or in their lowered positions. Preferably, the noses of the ribs 38 and 39 and the bottoms of the grooves 36 and 37 are rounded to facilitate reception of the ribs in their corresponding grooves.

The jacking mechanism 30, the gripping device cylinders 57, and the rams 22 may be supplied with fluid under pressure by an air compressor 44 (Figure 1) disposed within the barge 15 and having a pressure reservoir or tank 45 which is connected via a pipe 46 to supply pipes 67 that extend along each longitudinal side of the barge. Within the barge and adjacent each jack 30 the supply pipes 67 communicate with a manifold 47 having flexible branch conduits 48, 49, and 50 communicating, respectively, with the lower gripper elements 54, the bellows 55, and the upper gripper elements 52 of the corresponding jack 30. The conduits 48, 49, and 50 may be controlled by corresponding manually operated valves 53. The manifold 47 also is provided with a branch conduit 51 leading to a control valve 56 which is connected to the cylinders 57 by flexible supply and exhaust conduits 55. Although individual control of each jack mechanism 30 and its corresponding gripping device can be effected by the valves 53 and 56, it is preferred that all of the jack mechanisms 30, the gripping devices, and the rams 22 also be controllable in unison, as from a master control panel 66 (Figures 1 and 2) that is positioned on the deck of the barge 15 and is connected via appropriate conduits to all of these power operated devices. Access to the interior of the barge may be had through hatches provided with conventional hatch covers 68.

The deck of the barge, adjacent each pocket 28 in a wing section 16, is provided with a recess 70 having a cover 71 hinged to the deck, as at 72 (Figure 16). Secured to the underside of the cover 71 are spaced lugs 73 rotatably mounting the trunnions 74 of a concave roller 75. When the cover is open, as shown in Figure 16, the roller 75 is positioned to receive and support the end of a caisson 27, when the latter is in its horizontal or stowed position as best shown in Figure 3. When the covers 71 are closed, it will be seen that the rollers 75 are stowed below the deck so that the latter has a smooth uninterrupted working surface. Obviously, a series of such rollers 75 can be provided for each caisson 27, if necessary.

When the entire assembly is to be floated to an erection site, a caisson 27 is inserted into each guide well 26 and the wing sections 16 are moved by the rams 22 to their raised positions, best shown in Figure 3, wherein the caissons 27 are horizontal. In this position, it will be seen that the upper end of each caisson 27 is received in a guiding pocket 28 in the opposite wing section 16, and that the caisson may be guided into such pocket, and have its upper end partially supported, by the corresponding roller 75. In this position of the wing sections 16, the ribs 38 are received within the grooves 36 and the webs 42 in the notches 43 and thereby firmly lock each wing section 16 against both vertical and longitudinal translational movement relative to the barge 15 independently of

the hinge connections. Therefore, each wing section **16** is effectively interlocked with the adjacent side edge of the barge **15** so that these two parts in effect form a girder extending the full length of the barge to strongly resist any bending moments imparted thereto by pitching of the barge while under tow. With the strength of the barge thus increased, the actual material requirements of the barge itself can be reduced with resultant economies in manufacture. It also will be seen that because both ends of each caisson **27** are received within openings in opposite wing sections **16**, the latter in effect are supported by the caissons and fixedly held against pivoting about their hinge connections **17**, **18**, while the caissons themselves are held against movement so that no lashings therefor are required.

It further will be seen that the raised wing sections **16** serve as guards to protect the deck of the barge from waves to thereby minimize any water damage to any machinery, equipment, or supplies stowed on the deck of the barge during tow. Furthermore, because the effective working area of the deck of the barge **15** is increased by the wing sections **16**, when the platform is erected as later described, the width of the barge **15** can be made smaller than that of a comparable barge as disclosed in the aforementioned Pointer application. Consequently, because of its reduced width, the barge has less towage resistance. Preferably, the length of each caisson **27** does not exceed the width of the barge plus twice the depth of a wing section **16**, so that the caissons do not project outwardly beyond the wing sections **16** when the latter are in the raised position shown in Figure 3. It also will be seen that the entire platform assembly, when under tow, has a relatively low center of gravity without any increase in towage resistance which would be effected by the extension of caissons therebelow.

Upon reaching an erection site, each caisson **27** is withdrawn from its pocket **28** by operation of its corresponding jack mechanism **30**. Such movement is continued until the caissons **27** project from the lower ends of the guiding wells **26** in each wing section **16** a distance sufficient to slightly overbalance the wing section on its connecting hinges **17**, **18**, and urge the section to pivot to its lowered position. At this time, the rams **22** are operated to control such pivotal movement and allow the wing sections **16** to move slowly from their raised to their lowered positions, an intermediate position being shown in Figure 4. On the initiation of this pivotal movement, it will be seen that the rounded configuration of the ribs **38** and the grooves **36** facilitates their disengagement. When the wing sections **16** are fully lowered, as shown in Figure 5 and pulled into such position by the rams **22**, the lugs **32**, **33**, **34**, and **35** serve as stops so that the caissons **27** are substantially vertical, while the entire weight of the wing sections **16** and the caissons **27** is borne by the hinge connections **17**, **18**. In this position of the parts the ribs **39** are spaced below and in vertical alignment with the grooves **37**, while the ribs **41** are spaced below but laterally inwardly of the ribs **40**.

At this time, the jack mechanisms **30** may be operated to release the caissons **27** and allow the latter to drop free into upright engagement with the marine bottom. Thereupon, the jacking mechanisms are operated to raise the wing sections **16** on the caissons **27** and upwardly relative to the barge **15**, thus causing the ribs **39** to engage in the grooves **37**, the webs **42'** in the notches **43'**, and the ribs **41** to engage behind the ribs **40**, as shown in Fig. 6. Such upward translational movement of each wing section **16** relative to the barge **15** is permitted by the slots **19** in the hinge element **18**. This interengagement of the various interlocking lugs serves to firmly interlock each wing **16** with the barge **15** into a rigid, substantially unitary structure capable of resisting wind and wave action thereon. At the same time, such interlocking engagement between the wing sections **16** and the barge **15** provides a strong connection therebetween that will permit the heavy barge **15** and all of the equipment and supplies carried thereon to be raised out of the water on the caissons **27** by appropriate operation of the jacking mechanisms **30**, as shown in Figures 2 and 6. In this connection, it also will be seen that the interlocking engagement of the various lugs **32** to **35** relieves the hinges connecting the wing sections **16** with the barge **15** from any strain that otherwise would be imposed thereon, were it attempted to lift the barge **15** through such hinges.

If the platform is to be maintained in its erected position for any extended period of time, the gripping devices **60**, **61** are engaged with the caissons **27** to support the wing sections **16** and the barge **15** on the caissons through such devices so that the gripping elements **52** and **54** of the jacking mechanisms **30** can be deflated and the compressor **44** turned off. In this connection and as pointed out in the aforementioned Suderow application, the gripping devices are self-energizing so that once the weight of the platform is supported thereby, the cylinders **57** need no longer be maintained under pressure.

When it is desired to move the platform to another erection site, the jacking mechanisms **30** are again engaged with their corresponding caissons **27** and the gripping devices, if engaged, are released. Thereupon, the jacking mechanisms **30** are operated to lower the entire platform, i.e., the wing sections **16** and barge **15**, back down into the water until it is afloat. The jacking mechanisms **30** are then operated to raise all of the caissons **27** out of their engagement with the marine bottom. This added weight imposed on the two sections **16** will serve to lower them relative to the barge **15** into the position shown in Figure 5, so that the interlocking engagement between the wing sections **16** and the barge **15** is disengaged. Thereupon, the caissons are continued to be elevated into a position wherein the wing sections **16** can be controllably pivoted to their raised positions by the rams **22** without any extensive overbalancing of the wing sections **16** by their caissons **27**. After the wing sections have been swung to their raised positions, shown in Figure 3, the caissons are jacked across the deck of the barge **15** and inserted into the pockets **28** in the opposite wing sections **16**. As previously stated, it will be seen that additional rollers **75** may be provided along the length of each caisson **27** to support the latter and facilitate such movement of the caissons **27** into the pockets **28**.

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

I claim:

1. A portable marine platform comprising: a platform-like body; wing sections pivotally connected to opposite sides of said body for swinging movement about horizontal axes through substantially 90 degrees between raised and lowered positions; a plurality of marine-bottom-engageable supporting legs mounted to each of said wing sections for swinging movement therewith between substantially horizontal and upright positions corresponding to said raised and lowered section positions and for longitudinal movement relative to the corresponding section; and power-operated means mounted on said sections for selectively effecting or restraining said relative movement of each of said legs in either direction, whereby when said sections are in said raised positions, said legs can be moved to position a major portion of their lengths horizontally across said body, and when said sections are in said lowered positions, said legs can be moved down into vertical engagement with a marine bottom

and said body raised and at least partially supported on said legs.

2. The structure defined in claim 1 including power-operated means connected to the body and to each of the wing sections for controlling the swinging movement of the latter.

3. The structure defined in claim 1 including retaining means on each of the sections engageable with an end of the legs mounted on the opposite section, when both of the latter are in their raised positions, to restrain movement of each of said ends transversely of the length of the corresponding leg.

4. The structure defined in claim 1 including rigid interlocking means on the body and on each section engageable in the lowered position of the latter to lock said section against any movement relative to said body except downward translation.

5. The structure defined in claim 1 including rigid interlocking means on the body and and on each section engageable in the raised position of the latter to lock said section to said body against vertical relative translation therebetween.

6. The structure defined in claim 1 including floating pivotal connections for connecting each section to the body and allowing a limited range of vertical translational movement of each section, when in its lowered position, relative to said body, and interlocking means on the opposed sides of said body and each lowered section that are interengageable on upward translational movement of each of the latter relative to said body to restrain any relative movement therebetween except downward translational movement of each section relative to said body.

7. The structure defined in claim 1 including pockets in each of the sections opposed to the legs of the opposite section, when said sections are in their raised position, for receiving an end of the legs when said legs are in their horizontal positions and restraining such ends against transverse movements.

8. The structure defined in claim 7 including rollers on the body for supporting a section of each leg, when the latter is in its horizontal position, and aligning the leg with its corresponding pocket.

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