

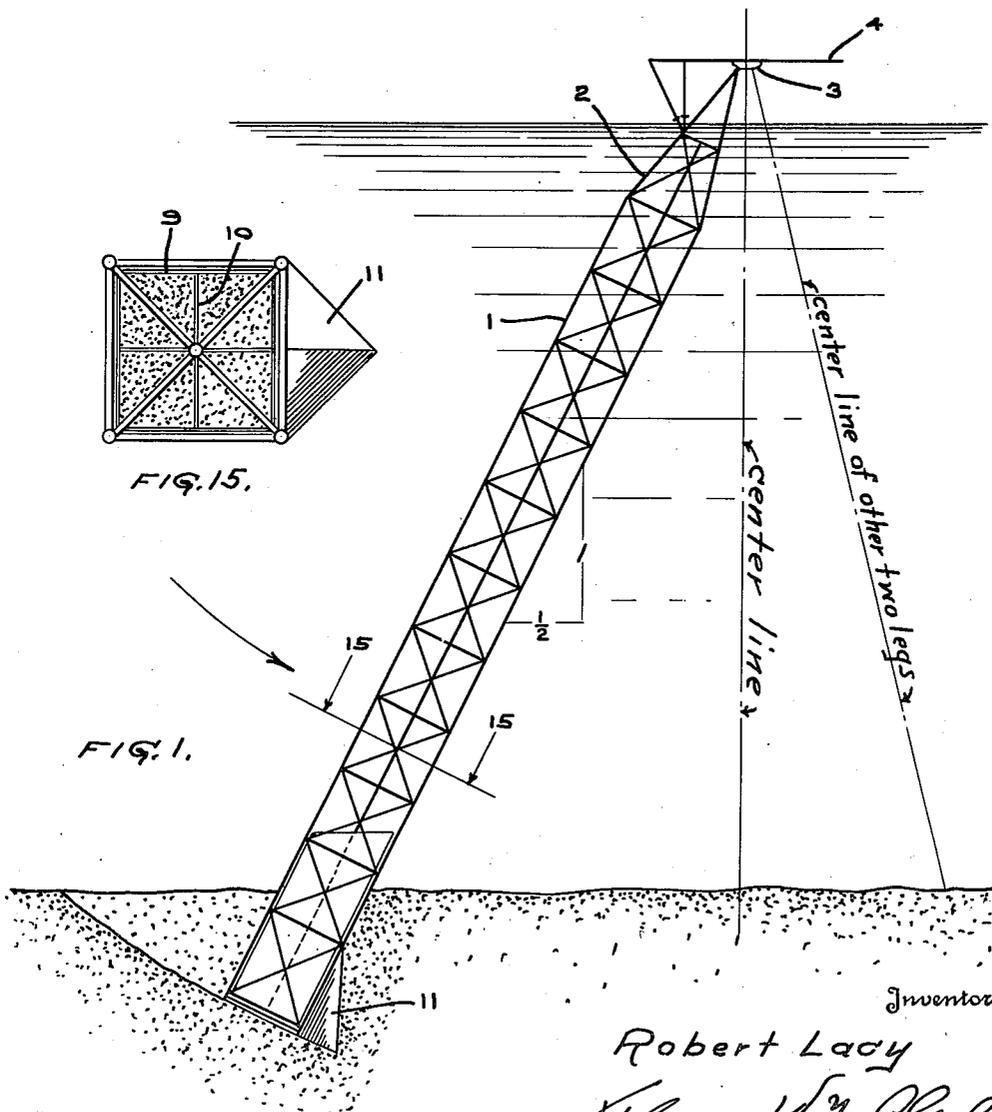
May 20, 1952

R. LACY  
MARINE STRUCTURE

2,597,110

Filed Aug. 12, 1949

9 Sheets-Sheet 1



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FIG. 1A.

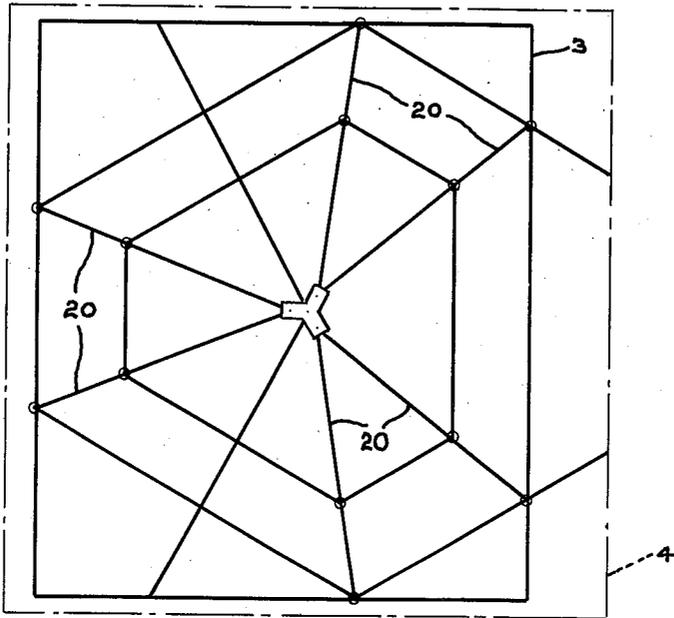
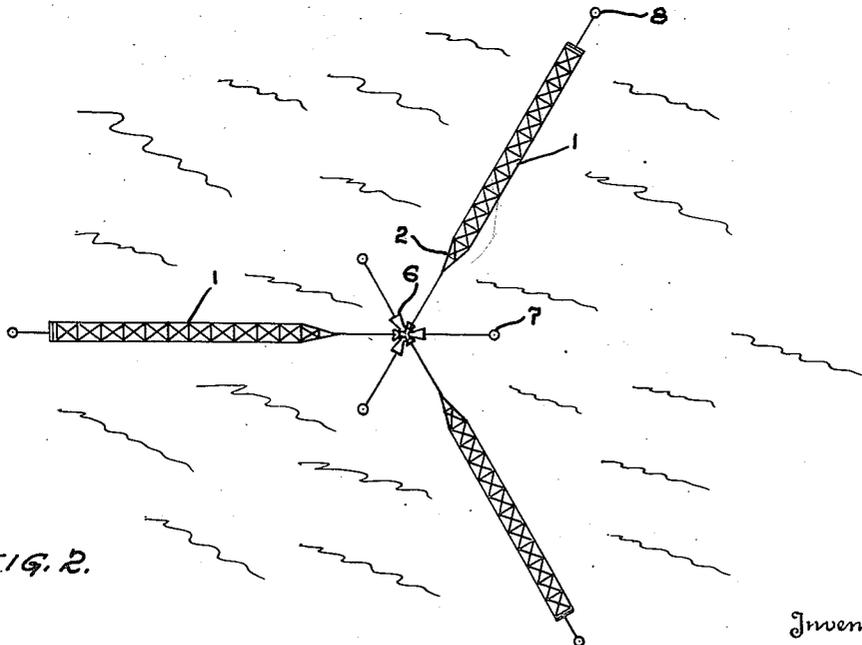


FIG. 2.



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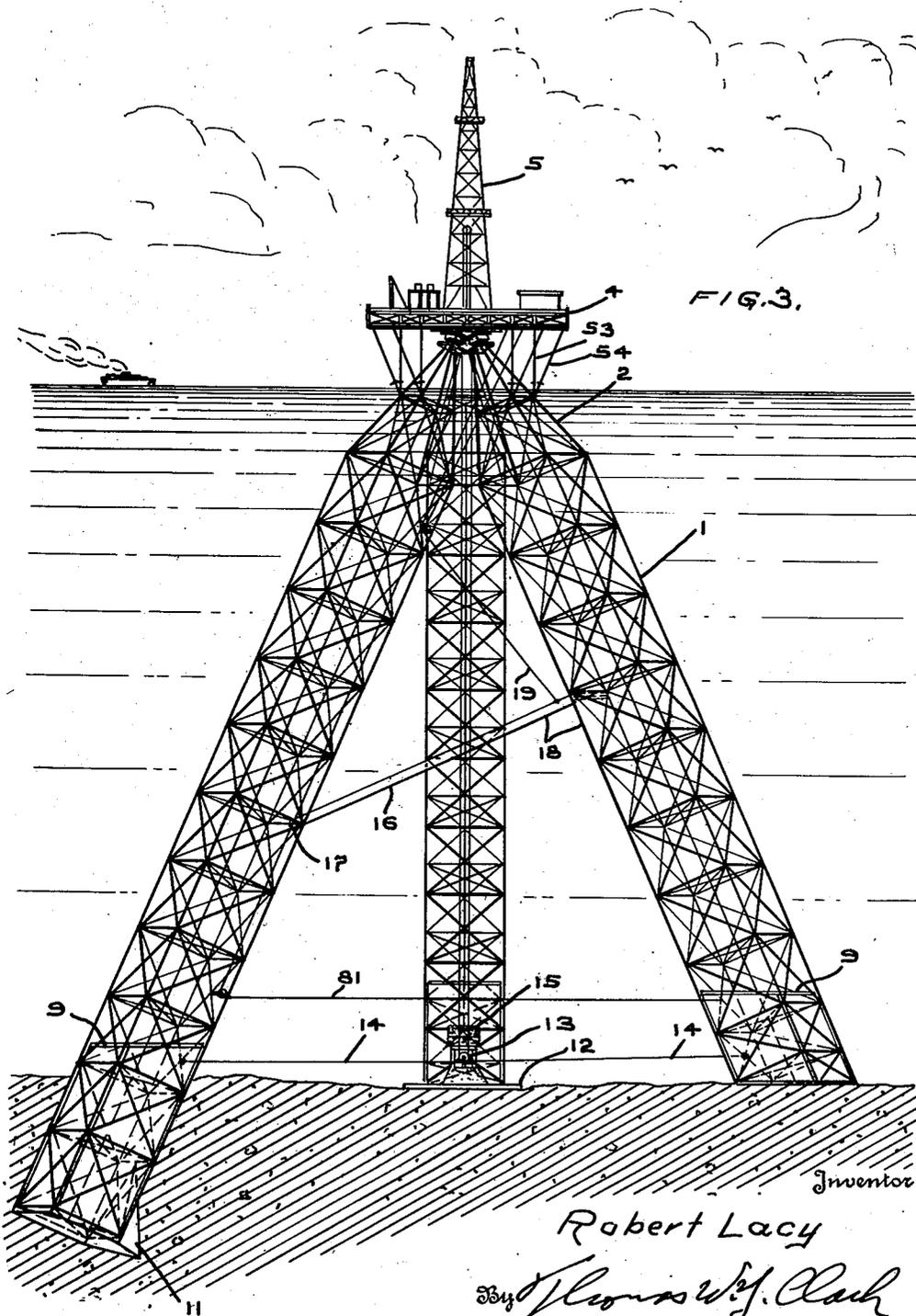
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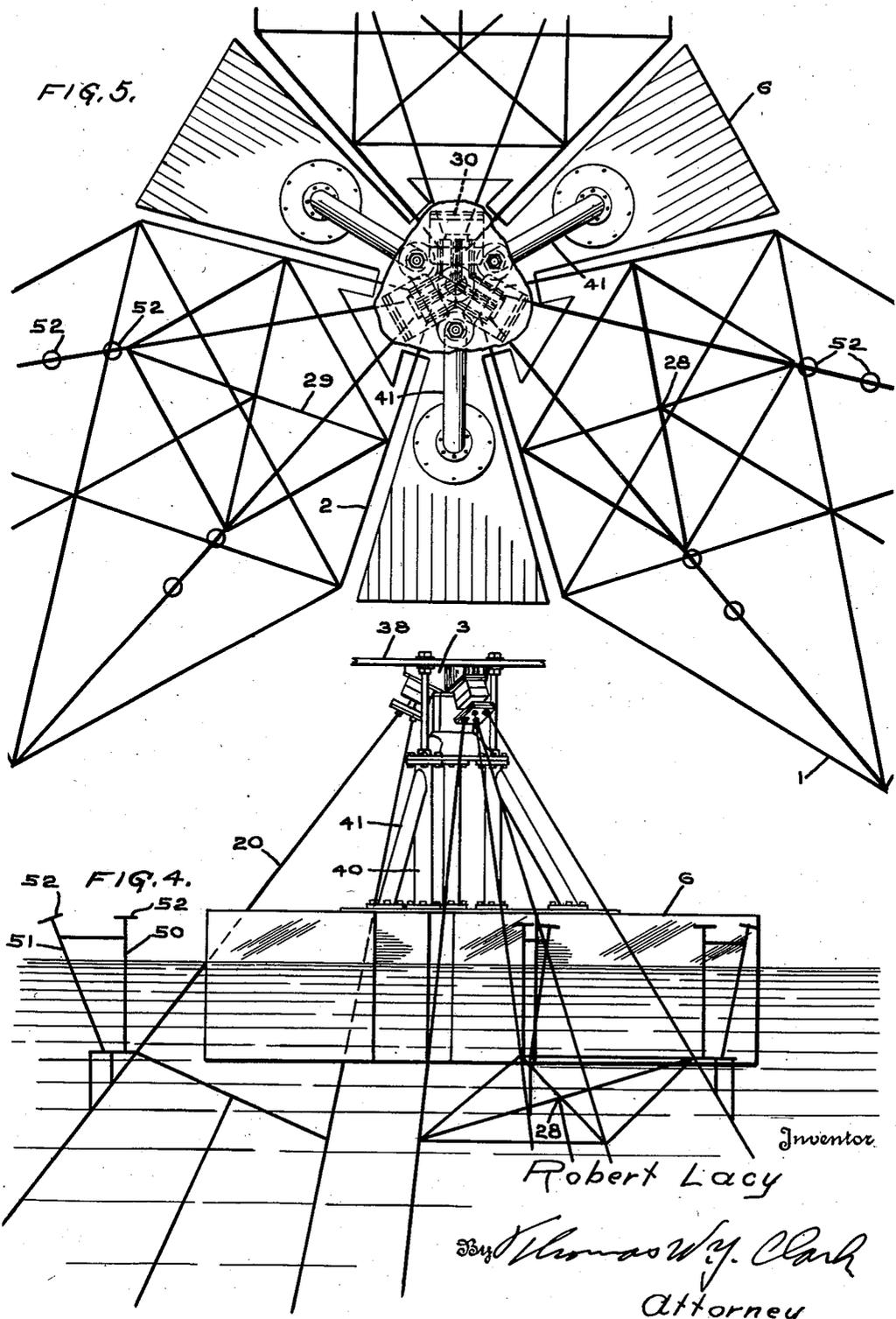
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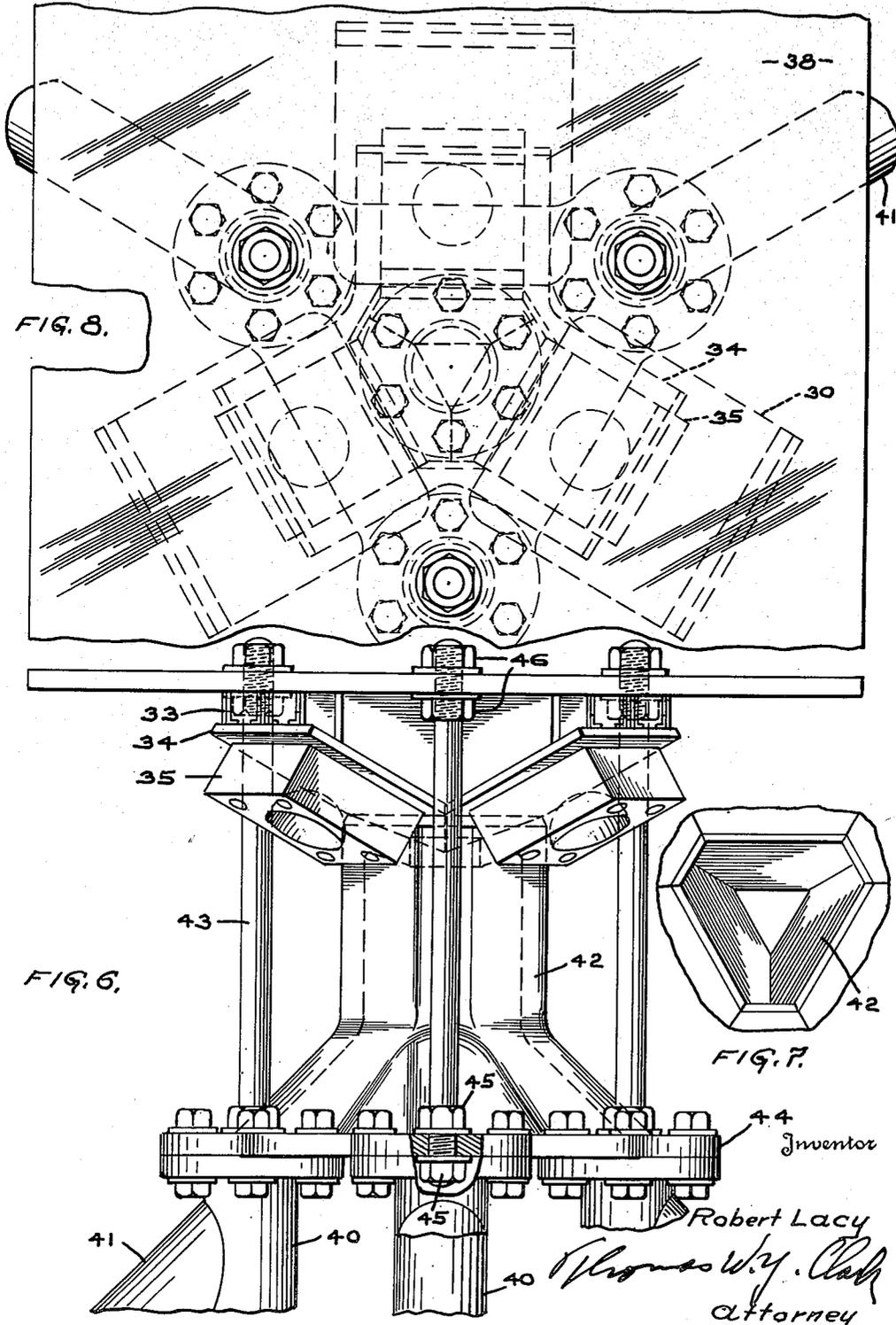


FIG. 8.

FIG. 6.

FIG. 7.

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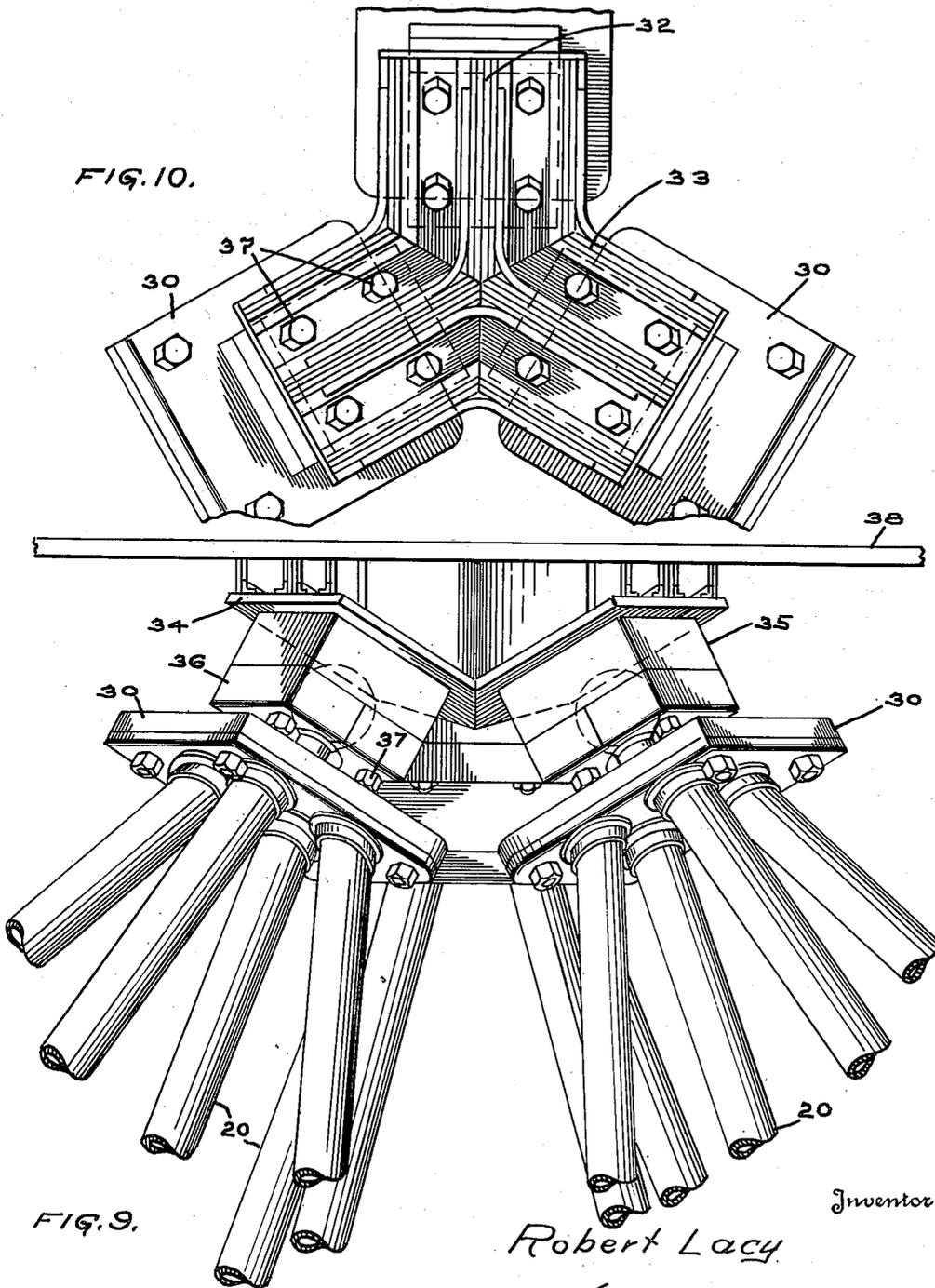


FIG. 9.

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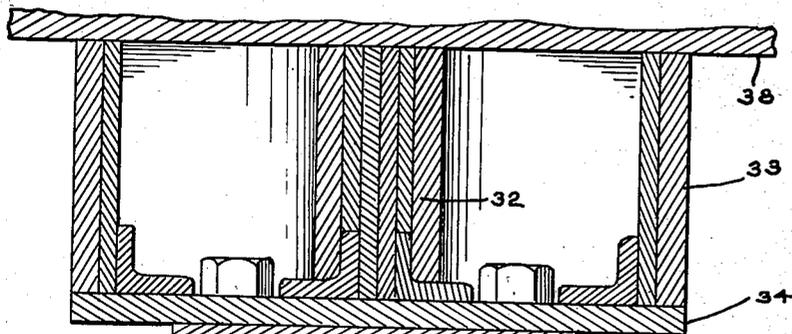


FIG. 11.

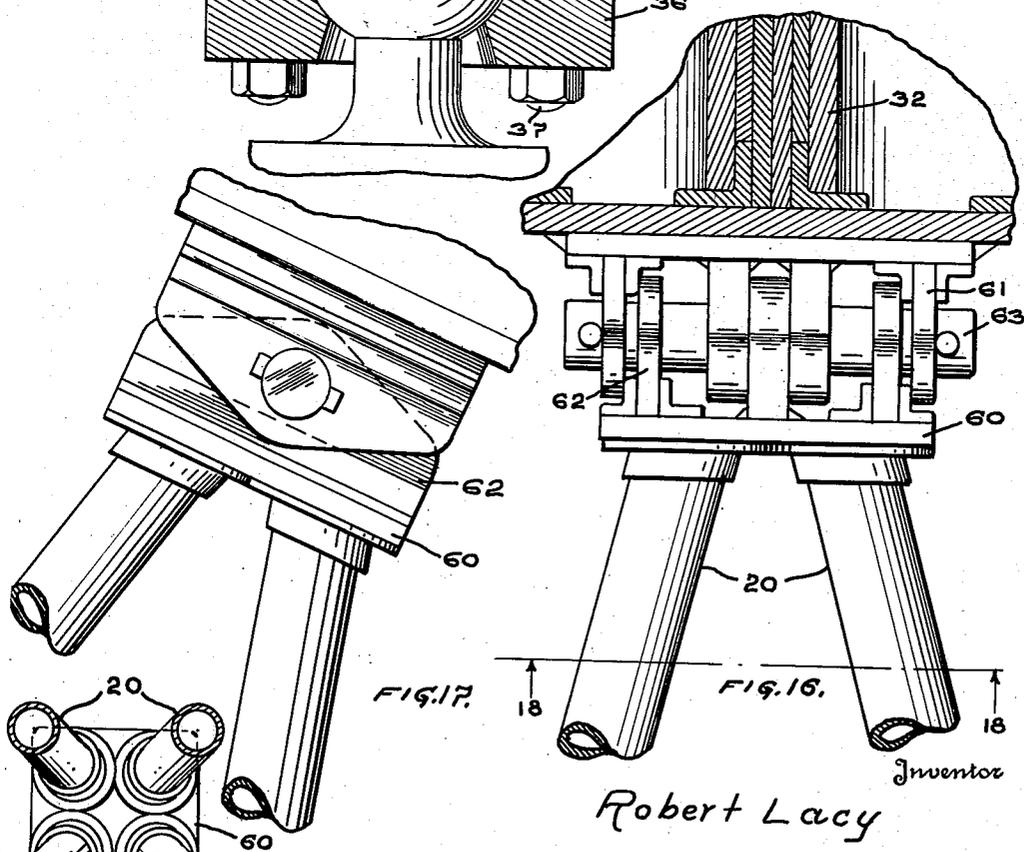


FIG. 17.

FIG. 16.

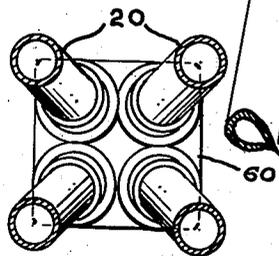


FIG. 18.

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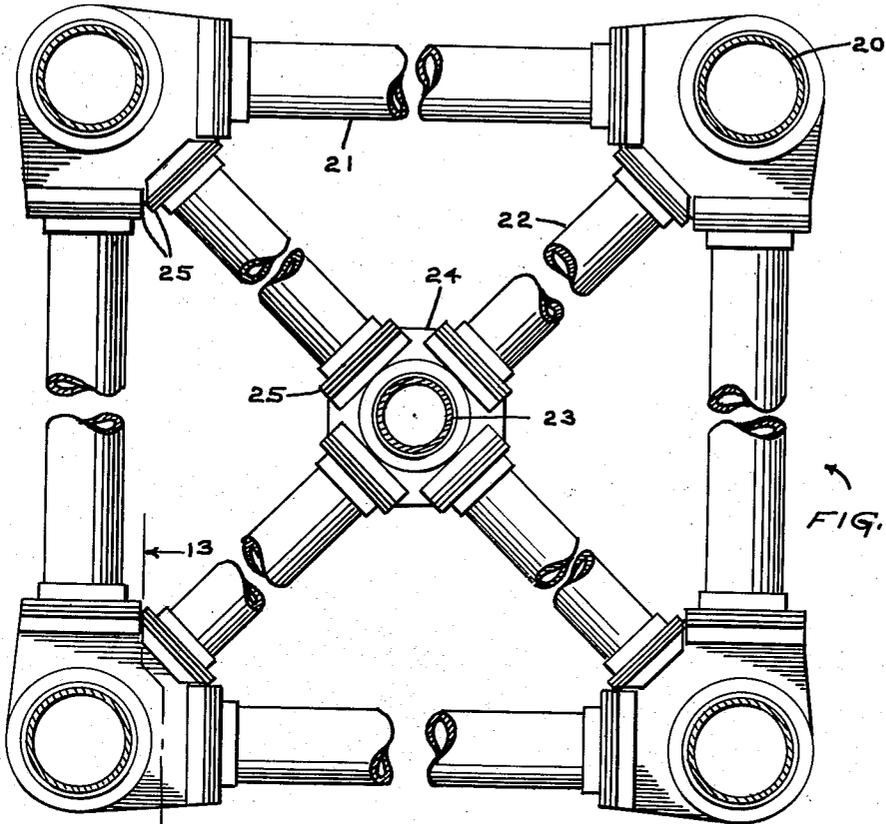


FIG. 12.

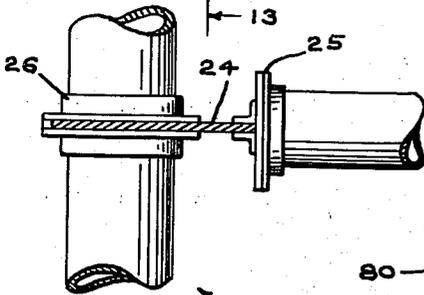


FIG. 13.

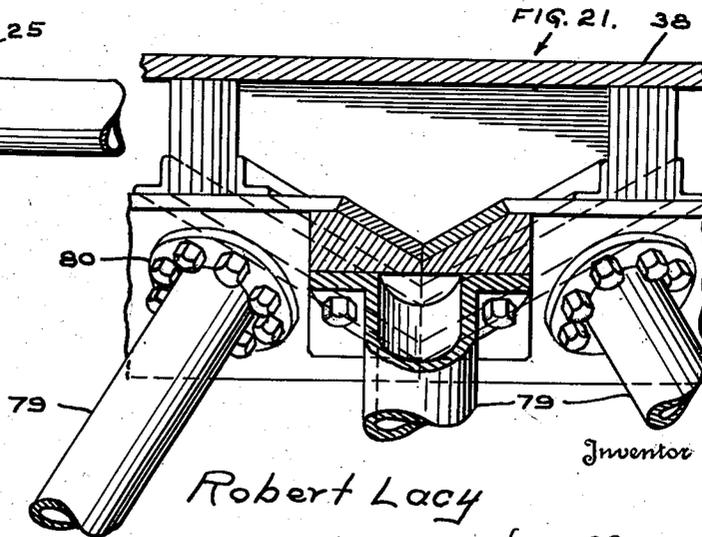


FIG. 21.

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FIG. 20.

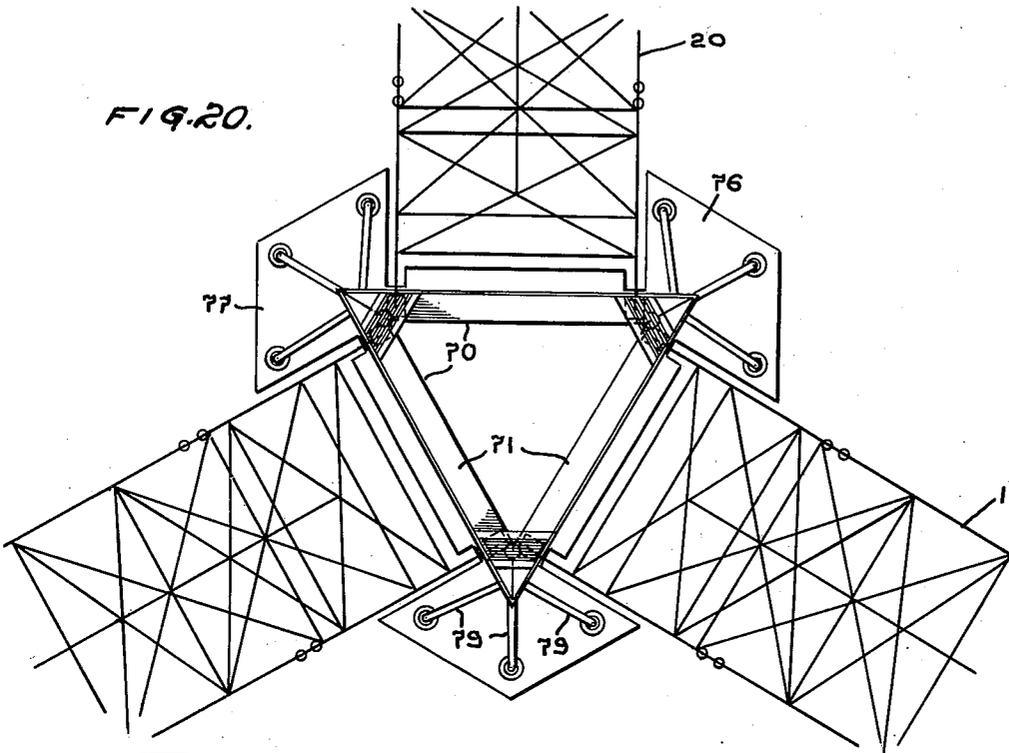
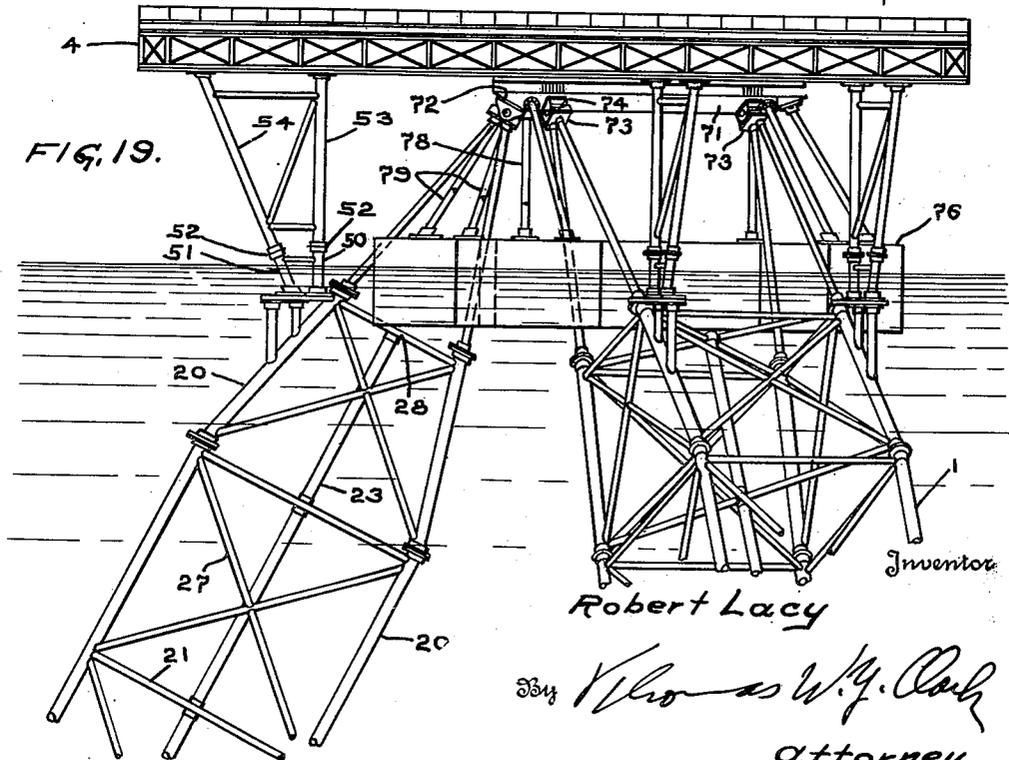


FIG. 19.



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# UNITED STATES PATENT OFFICE

2,597,110

## MARINE STRUCTURE

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Application August 12, 1949, Serial No. 109,889

7 Claims. (Cl. 61-46)

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Drilling for oil on the continental shelf has grown in proportions in the last few years. It has been estimated that perhaps one-fourth of the amount of oil that is available in the United States is to be found in this continental shelf.

Heretofore drilling rigs have been erected in relatively shallow water near the coasts, especially in the Gulf of Mexico near Texas and Louisiana but it is known that the shelf extends quite gradually in most locations to a depth of perhaps 600 feet before it reaches such sheer drops as to make drilling impractical. This acreage, however, out to this 600 feet has heretofore been largely unavailable because of the drilling supports available for use in depths of from 100 to 600 feet. This invention relates to a drilling platform to be used in any depth up to and even in excess of 600 feet. It is a prefabricated platform, the structural parts of which may be made up in a harbor and transported to the desired location and there assembled in a relatively short time, during the time within which it is reasonable to estimate that the weather will remain suitable, for the speed of erection of a stable structure is a critical element in its success.

The invention primarily comprises a plurality of legs, three or more in number, each having a length, when used in 600 feet of water, of approximately 715 feet or more and each leg having a cross-sectional measurement of approximately 60 feet. These legs have at one of their ends means to pivot them to a center framework and at the other end they have bins for the receipt through pipes of sand or other material to sink them, their lower ends or feet, to or into the bed of the water.

The center platform likewise has means extending around its horizontal edges substantially symmetrically to which the legs are pivoted and then to permit them to swing down into the water by placing sand or other weight into bins in the feet of the legs.

The center frame is held securely by a special large strong wooden float or a derrick ship or a large buoy, above the water and the legs must be initially lifted at their pivot ends to fit the pivoting means in the leg tops to those in the center frame and the swinging down of the feet of the legs takes place after the tops of the legs are secured radially to the center frame. After the center frame is fixed in position and held securely by these sunk legs, on an angle in which the vertical extent is approximately twice the horizontal, the center frame supporting means is removed and a permanent platform is affixed to the center frame and the legs at a height

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adequate to be above the waves of the storms. Drilling rigs, living quarters and the necessary machinery may then be placed upon the platform.

Several millions of dollars have already been spent for the erection of drilling rigs in shallow water and one of the objects of the present invention is to make a stable platform which may be disassembled should a dry hole be found or the well exhausted, for removal to a new location without the loss of the platform and its supports.

Soundings and tests will of course have to be made at the desired location of the legs prior to sending them to their particular location and the legs will have been constructed of the required length, relative to each other and with the required type of footing, whether for use on a hard bottom or soft bottom.

It is preferred that the legs of the invention be made of buoyant material, legs of water tight steel or iron pipes are preferred because of their convenience in handling at sea. The legs may be made of three or more buoyant pipes strongly braced together, with welded or riveted connections. When it is considered that steel pipe of 12 inch diameter and  $\frac{3}{8}$  inch thickness will easily float in fresh water with the ends sealed and that a similar 48 inch pipe, with  $\frac{7}{8}$  inch thickness will float almost half out of water, it is evident that a wide range of design is possible. The chosen design is of four columns in a square of 60 feet, the pipes being made water tight by welding or other methods. It is preferred that the portions of the legs above the water should be as small in cross-section as is safe in order to reduce the force of wave action. The legs are designed with ample strength to act as beams of about 600 feet span and as leaning columns or tension members bearing the weight of the platform and the materials on it as well as its own weight or buoyancy and the bin material to withstand the forces of waves and winds which should be previously measured on existing structures. The above objects and advantages and other advantages of the invention will be apparent from the following description and the accompanying drawings forming a part hereof and in which:

Figure 1 is a diagrammatic view showing the relative location of the legs in a tripod formation.

Figure 2 is a diagrammatic view of the legs floating prior to their attachment to the center frame.

Figure 3 is an elevational view of the completed platform with its support therefor and equipment thereon.

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Figure 4 is a partially diagrammatic view in elevation of the legs prior to the removal of the center frame float.

Figure 5 is a plan view similar to that of Fig. 4.

Figure 6 is a fragmentary elevational view of the center platform and its float supports.

Figure 7 is a fragmentary plan view of the top of the float support member.

Figure 8 is a top plan view similar to Fig. 6.

Figure 9 is a fragmentary elevational view of the top of the legs as they are pivoted in the center frame.

Figure 10 is a fragmentary plan view of the center frame, with its top plate removed.

Figure 11 is a cross-sectional view of the connecting means between the leg tops and the center frame.

Figure 12 is a cross-sectional view through one of the leg structures.

Figure 13 is a fragmentary sectional view on line 13—13 of Figure 12.

Figure 14 is a diagrammatic plan view showing the location of the platform upon the tripod and its center frame.

Figure 15 is a sectional view on line 15—15 of Fig. 1.

Figure 16 is an elevational view of a hinge construction modification instead of the ball and socket joint.

Figure 17 is a side elevation of the hinge structure of Figure 16.

Figure 18 is an inverted plan view of the attachment of the tops of the leg pipes to the bottom of the hinge member on line 18—18 of Figure 16.

Figure 19 is a fragmentary elevational view of a modified hinge form for the pivoting of the legs to the center frame.

Figure 20 is a diagrammatic plan view of the modified hinge structure of Figure 19.

Figure 21 is a fragmentary view partly in section showing the float support connection to the center frame in this last modification.

In the drawings similar numerals refer to similar parts throughout the several views.

Although it is apparent that a stable structure may be made with a greater number of legs, the invention is illustrated as and the preferred structure has the form of a tripod. It is shown more or less schematically in Figures 1, 2 and 3. The legs 1 are preferably buoyant and are constructed of closed iron or steel pipes attached together in sections and rigidly braced to form rigid columns of a length to reach to a sound footing in the bed of the water and to extend perhaps 50 feet above the water. The legs are preferably constructed at the top as shown at 2, like a pyramid, and at the top they are fastened to a horizontally extending frame 3 substantially equidistantly, or 120° apart, around the frame. Over the frame and leg tops is placed a platform 4 on which is erected a derrick 5 and living quarters and such other machinery as is required.

Explorations are carried on prior to placing the structure to determine the nature of the bottom or bed of the water at the point where the bottom or feet of the legs will strike in order to determine whether the legs should be longer or shorter and whether they should have widened feet for resting in soft earth or whether they should have smaller or pointed feet for resting on hard bottom. After this determination has been made and the legs built on barges in a harbor they are floated to the desired location ready for erection. The center frame 3 has been placed

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upon a float 6 and held in proper position by buoys 7. The barges under the legs 1 are sunk by filling them with water so that the legs float on the surface because of their own buoyancy and they are securely held by buoys 8. After the legs and float are in position as shown in Figure 2, by means of a derrick ship, or ships the tops of the legs are raised for attachment to the center frame and there made fast in a pivoting relationship with the center frame. The float 6 has adequate buoyancy and strength to hold the weight of the legs in this position. Bins 9 which are preferably partitioned as shown at 10 are then filled through pipes to an extent to sink the feet of the legs, after removal of the buoys 8 from their attachment to the legs. The initial filling may be done from a derrick ship.

As the feet of the legs swing down they are guided by the operators between the projecting sides of the float 6 as shown in Figure 5.

Those legs which enter into soft earth may be equipped with a plow as shown at 11 and they may be jetted into place by jets of air or water which pass through pipes leading down along the central bracing together with other pipes for filling and for emptying the bins, and for filling holes in the bottom or for lifting a leg from the foundation if desired. The legs while supported by the float will tend to swing toward the center with a force equal to about half of their weight.

As a variation, the legs may be pulled toward the center so that they stand in a vertical position angularly with approximately twice the vertical extent as the horizontal. They may be pulled into place either by tugs with attached ropes, or by placing a non-buoyant raft 12 approximately under the center frame and on which is a heavy weight with attached sheaves 13 having wire ropes 14 therethrough which are attached one to the foot of each leg and leading upwardly, from the sheaves to the working position above water. Additional concrete weights 15 sufficient to hold the sheaves down may be added as needed.

Also if desired braces 16 may be pivoted from each leg as at 17 and made to rest in a right angular position as shown at 18 with respect to an adjacent leg, the movement of the brace being controlled by a rope 19. The legs may be tied together by wire ropes 81 pulled through fixed sheaves placed before sinking.

An excess of weight may be placed in bins 9 to make sure they are stable against all storms, and then this excess may be removed through pipes provided for that purpose or by other means.

In the preferred form of the invention the legs have a square formation of four large corner columns 20 and each of the columns are joined by bracing pipes 21 to form a square and then by diagonal pipes 22 which are joined to a smaller central pipe 23. These pipes are all joined together by welding, riveting or bolting of the joints which preferably consist of plates 24 which are welded to headings 25 placed respectively on pipes 21 and 22 and to which heads on pipes 20 and 23 are welded and located by means of collars 26. It is preferred that all these pipes, or at least enough of them to float the columns, be sealed with enclosed air.

The legs may be made of a different height by the insertion or removal of the separate sections of the pipes 20 and 23 with their respective bracings. Also angularly between the horizontal pipes 21 are placed pipes 27 so that complete rigidity of the leg structure is obtained and this

is quite important since each leg is approximately 60 feet square, in order to produce adequate strength for a leg something over 700 feet long.

Toward the top the legs are preferably brought into the shape of a pyramid as shown at 2, the center pipe 23 terminating below the water line as shown at 23, held by the struts 29, and the four corner columns being connected at the top to a plate 30 which has centrally of its top a ball 31.

The center frame 3 is a plural-membered structure welded or riveted together and made of strips of steel 32 passing through its center and with steel strips 33 at its three outer edges and these vertically extending plates or strips 32 and 33 have welded to their bottom base plate 34 with three wings which are angularly extending to the horizontal, as shown in Figures 6 and 9. To the bottom of this plate 34 are welded sockets 35. It is within these sockets that the balls 31 are initially placed in the assembly on the sea of the tripod structure, the lower half of the guards or collars 36 have previously been put around the necks attaching the balls 31 to their plates 30 and these collars 36 by means of bolts 37 are then securely attached to the sockets 35 to hold the balls securely in place with limited universal movement. The plates 32 and 33 have welded horizontally to their top a plate 33 forming the top of the center frame 3.

The center frame 3 is initially attached to the float 6 in a rigid position by means of posts 40 and braces 41 which are attached through means of face plates to which they are welded to the underside of the triangular member 42 on the top of which rests centered the center of the plate 34 carrying the three sockets of the center frame. This temporary support for the center frame is attached to the center frame by means of bolts 43 which are securely held to the temporary support by nuts above and below the flange 44 as shown at 45, welded to the member 42. As shown the bottom nuts pass into the posts 40. The center frame is held at the top on the bolts 43 by similar nuts 46 and the removal of the three top nuts will permit the barge 3 to pass free or fall free of the center frame.

As best shown in Figure 5 the float 6 has three extending wings to give adequate buoyancy. After the feet of the legs are properly positioned the float 6 may be sunk far enough down between the legs of the structure to be withdrawn. Each of the two outer columns of each of the three legs has built thereon a vertical post 50 and an angular brace 51 having flanges 52 at their tops. Thus each leg has two posts and two braces projecting upwardly to join corresponding posts 53 and braces 54 projecting from the bottom of the working platform 4. These posts and braces 53 and 54 have corresponding flanges thereon which are welded or bolted to the flanges 52 on the posts and braces 50 and 51, all above the water line.

The firm positioning of the rigid legs on or in the bed of the body of water and the firm holding of the balls in the sockets of the center frame and thereafter the firm positioning of the working platform 4 upon the posts and braces held by the legs and of course with the platform resting on the top plate 38 gives a rigid and adequate structure for the placing of the derrick for drilling for oil or for such other purposes as the platform may be adapted. In the structure illustrated the platform 4 measures approximately 150 feet along each edge and it therefore presents an adequate area for the task intended.

It is of course apparent that the substantial movement allowed by the ball and socket connection allows the legs to fall from their substantially horizontal position to their angular position in the water and some movement of the leg sidewise is not injurious to that vertical swinging downwardly of each leg. The fan shaped formation of the float 6 furnishes some guidance to the legs as they are made to swing by the addition of weight to the bins 9.

If desired instead of the legs having ball and socket connections with their center frame they may be given a hinge connection with that frame as shown in Figures 16 and 17. As shown in these views the columns 20 are brought up like a pyramid to a central plate 60 and the center frame instead of having thereon sockets 35, has thereon hinge members 61 and mating hinge members 62 are welded to the plate 60 and a pin 63 may be passed through the holes in the respective hinge members when they are properly aligned by means of a derrick raising the top of the floating legs into proper position to the center frame. The hinges, of course, allow no lateral swing of the legs but they permit the vertical swinging of the legs down into the water until their feet are properly positioned on the bed of the water. This structure is otherwise the same as that previously described.

Another modification is shown in Figures 19, 20 and 21 in which the center frame 70 has a triangle formation as shown in Figure 20, the plates 71 forming the triangle being placed at an angle as shown at 72 in Figure 19. In this modification the legs 20 are brought up to a wedge-shaped form, the columns at each side being brought together and welded to separate plates 73 which are hinged, by one section of the hinge being welded thereto, to the other section 74 of the hinge welded to the side of the triangle 71. The posts and braces for supporting the platform 4 in this modification are similar to those of the modification first described.

The float 76 in this modification must have a different configuration to have adequate buoyancy to support the center frame and to be removed therefrom. It is shown in Figure 20 as having a central portion with diamond shape extensions 77 to which posts 78 and braces 79 are attached. These posts and braces on the barge 76 may be removed from their temporary support of the center frame by removing the bolts 80.

After utilizing the structure as thus assembled at any given site, it may be disassembled by reversing the above processes and removed to another side without destruction of the parts.

Certain modifications of the preferred form of the invention have been described and it is apparent that other modifications may be made without departing from the invention as defined in the following claims.

What is claimed as new and is desired to be secured by Letters Patent is:

1. A prefabricated marine structure for supporting a working platform above water from the bed of a body of water comprising three or more buoyant legs each leg having pivoting means at one end and bins for the receipt of sinking weight at the other end, a center horizontally extending frame having pivoting means for each leg distributed symmetrically therearound, said legs being joined to said frame by the interconnecting of the pivoting means on the legs and frame and extending to or into the bed of the water on an

angle, downwardly, outwardly from each other and from the frame the bins being filled with sufficient weight to sink and hold the bin end of the legs stable on or in the bed of the water, a platform, and means securely connecting the platform to the center frame and legs.

2. The marine structure of claim 1 in which said legs have means at their lower ends to dig them into the bed of the water.

3. The marine structure of claim 1 in which said legs are made of a plurality of hollow sealed columns containing captive air.

4. A prefabricated marine structure for supporting a working platform above water from the bed of a body of water comprising three or more buoyant legs having pivoting means at one end and bins for the receipt of sinking weight at the other end, a center horizontally extending frame having pivoting means for each leg distributed symmetrically therearound, means adjacent the feet of the legs to pull them to the desired supporting position, said legs being joined to said frame by the interconnecting of the pivoting means on the legs and frame and extending to or into the bed of the water on an angle, downwardly, outwardly from each other and from the frame the bins being filled with sufficient weight to sink and hold the bin end of the legs stable on or in the bed of the water, a platform, and means securely connecting the platform to the center frame and legs.

5. A prefabricated marine structure for supporting a working platform above water from the bed of a body of water comprising three or more buoyant legs each leg having pivoting means at one end and bins for the receipt of sinking weight at the other end, a center horizontally extending frame having pivoting means for each leg distributed symmetrically therearound, a weight sinkable beneath the frame having sheaves thereon and cables attached to the legs and passing through the sheaves, whereby the legs may be pulled to the desired supporting position beneath the frame, said legs being joined to said frame by the interconnecting of the pivoting means on the legs and frame and extending to or into the bed of the water on an angle, downwardly, outwardly from each other and from the frame the bins being filled with sufficient weight to sink and hold the bin end of the legs stable on or in the bed of the water, a platform, and means securely connecting the platform to the center frame and legs.

6. A prefabricated marine structure for supporting a working platform above water from the

bed of a body of water comprising three or more buoyant legs, each made up of a plurality of columns, all said columns being braced relatively to the others to form rigid structures for each of the legs, each leg having pivoting means at one end and bins for the receipt of sinking weight at the other end, a center horizontally extending frame having pivoting means for each leg distributed symmetrically therearound, said legs being joined to said frame by the interconnecting of the pivoting means on the legs and frame and extending to or into the bed of the water on an angle, downwardly, outwardly from each other and from the frame the bins being filled with sufficient weight to sink and hold the bin end of the legs stable on or in the bed of the water, a platform, and means securely connecting the platform to the center frame and legs.

7. A prefabricated marine structure for supporting a working platform above water from the bed of a body of water comprising three or more buoyant legs, each made up of a plurality of columns, all said columns being braced relatively to the others to form rigid structures for each of the legs, said legs being constricted adjacent their tops to present less resistance to wave action at the water line, each leg having pivoting means at one end and bins for the receipt of sinking weight at the other end, a center horizontally extending frame having pivoting means for each leg distributed symmetrically therearound, said legs being joined to said frame by the interconnecting of the pivoting means on the legs and frame and extending to or into the bed of the water on an angle, downwardly, outwardly from each other and from the frame the bins being filled with sufficient weight to sink and hold the bin end of the legs stable on or in the bed of the water, a platform, and means securely connecting the platform to the center frame and legs.

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