April 2, 1968 E. C. GARCIA 3,375,669

OFFSHORE MARINE STRUCTURES

Filed Sept. 15, 1966 7 Sheets-Sheet 1

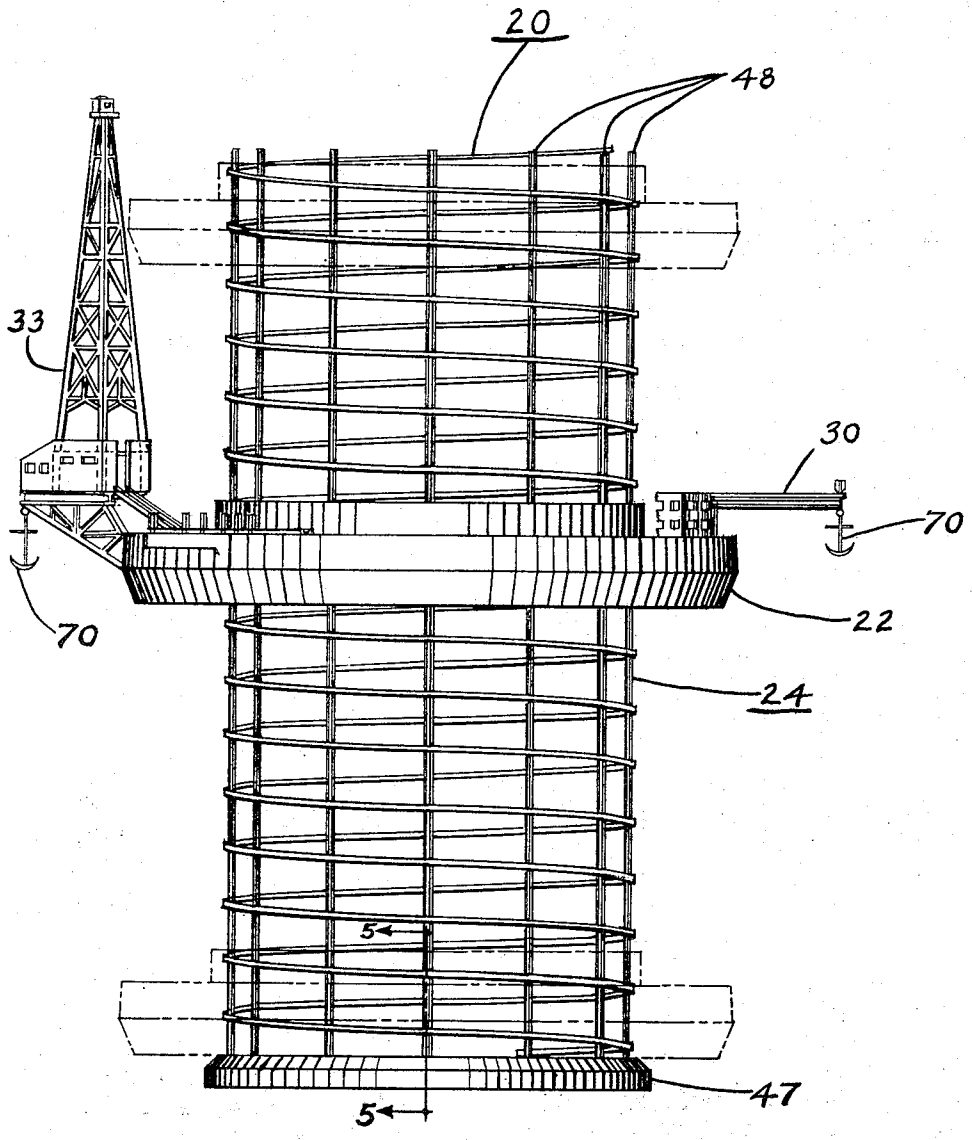


Fig. 1

INVENTOR.
EMILIO C. GARCIA
BY
ATTORNEY

April 2, 1968 E. C. GARCIA 3,375,669

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Filed Sept. 15, 1966 7 Sheets-Sheet 2

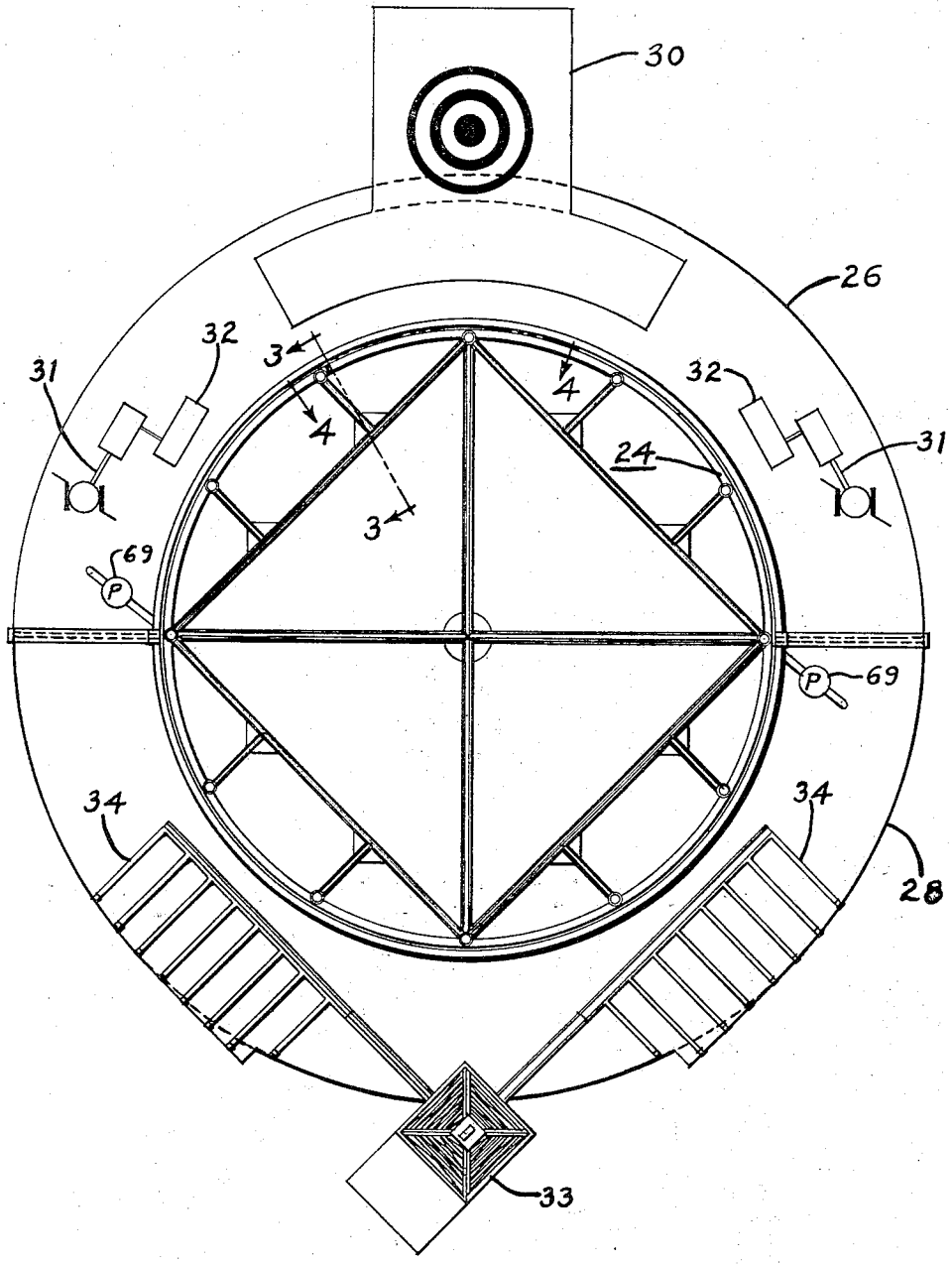


Fig. 2

INVENTOR.
EMILIO C. GARCIA
BY James B. Lasky
ATTORNEY

April 2, 1968 E. C. GARCIA 3,375,669

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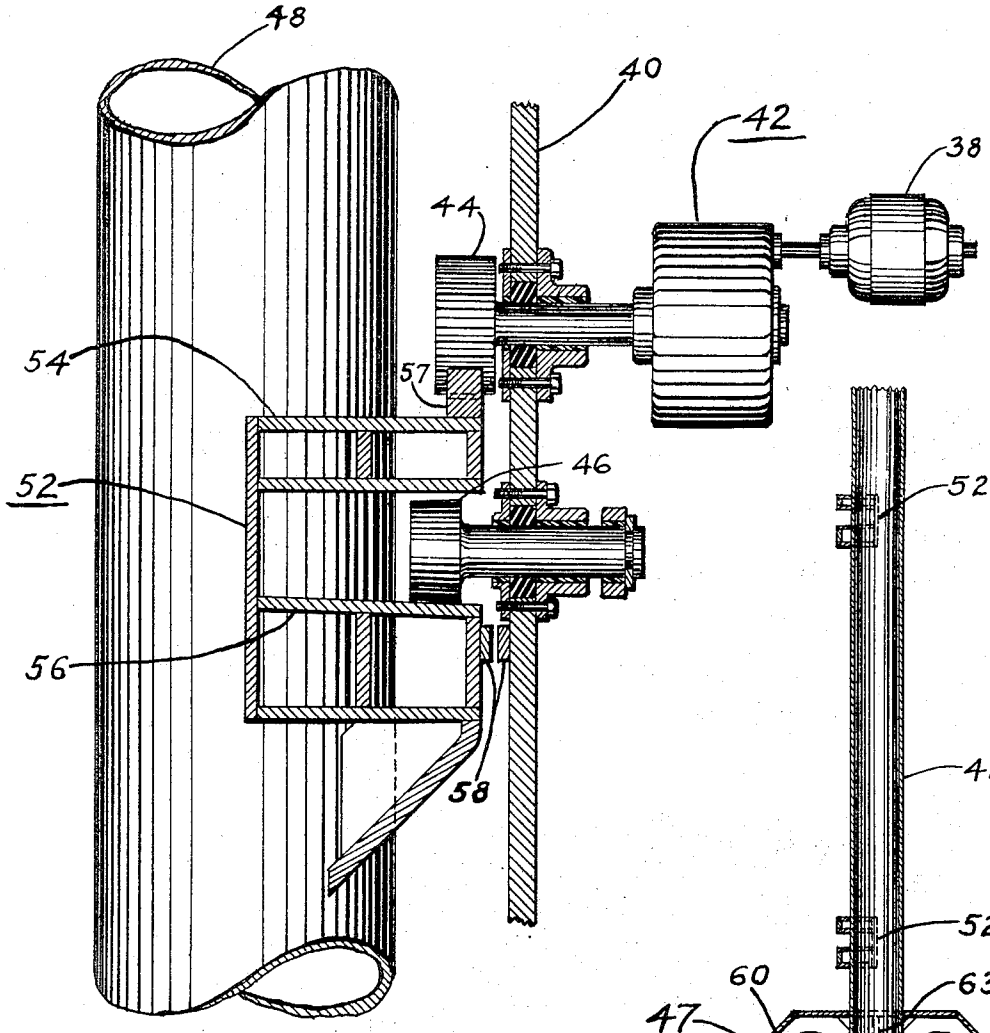


Fig. 3

Fig. 5

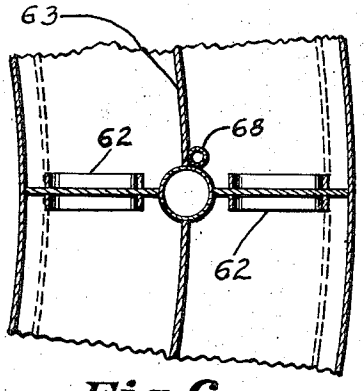


Fig. 6

INVENTOR.
EMILIO C. GARCIA
BY
ATTORNEY

April 2, 1968 E. C. GARCIA 3,375,669

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Filed Sept. 15, 1966 7 Sheets-Sheet 4

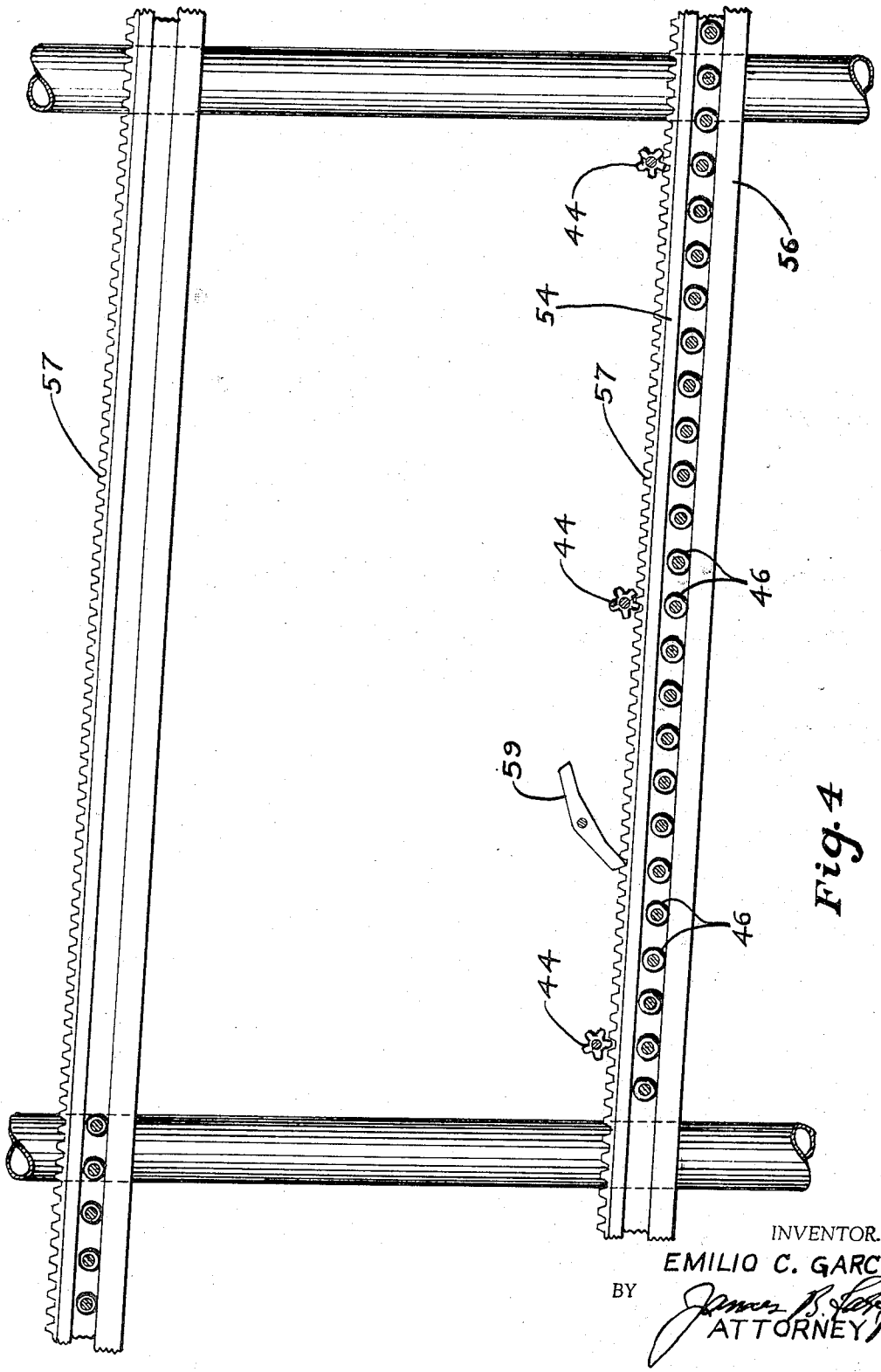


Fig. 4

INVENTOR.
EMILIO C. GARCIA
BY
ATTORNEY

April 2, 1968 E. C. GARCIA 3,375,669

OFFSHORE MARINE STRUCTURES

Filed Sept. 15, 1966 7 Sheets-Sheet 5

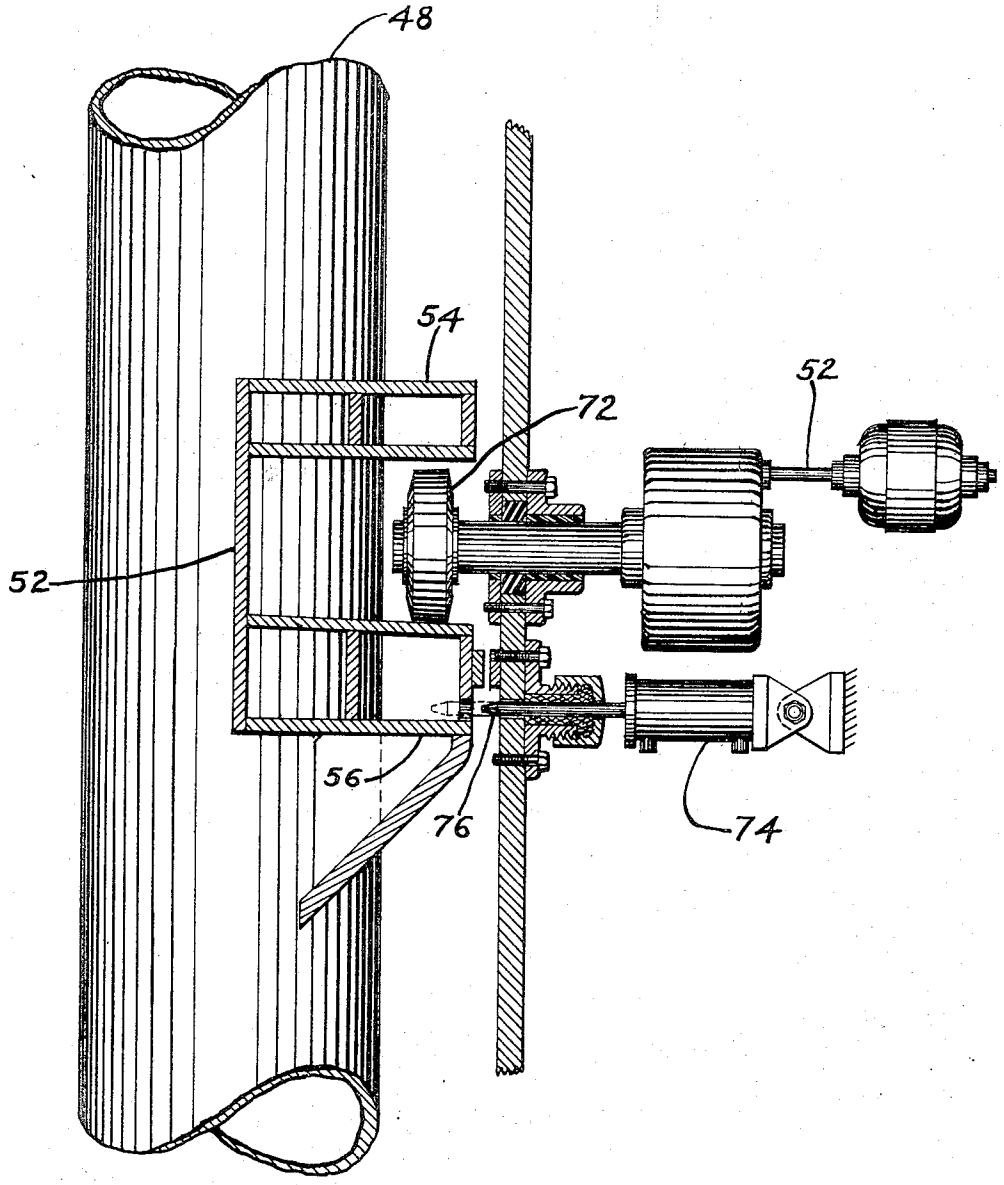


Fig. 7

INVENTOR.
EMILIO C. GARCIA
BY James B. Fahey Jr.
ATTORNEY

April 2, 1968 E. C. GARCIA 3,375,669

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Filed Sept. 15, 1966 7 Sheets-Sheet 6

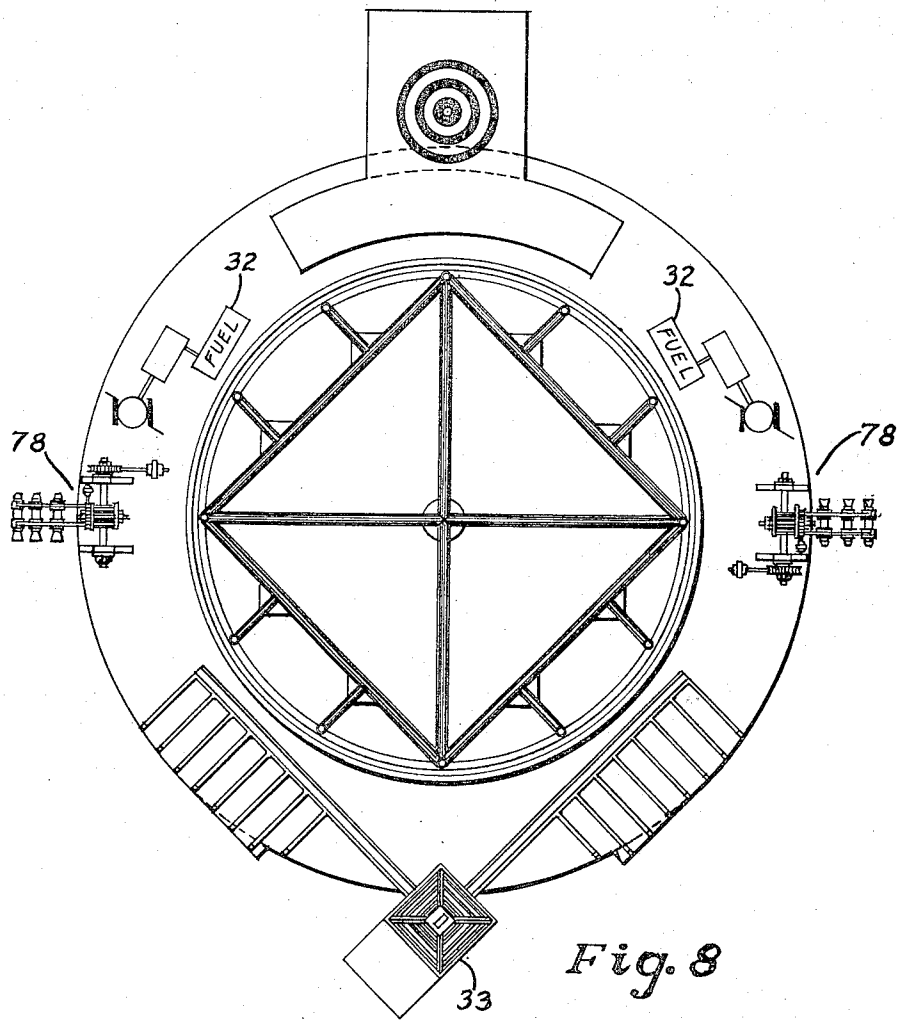


Fig. 8

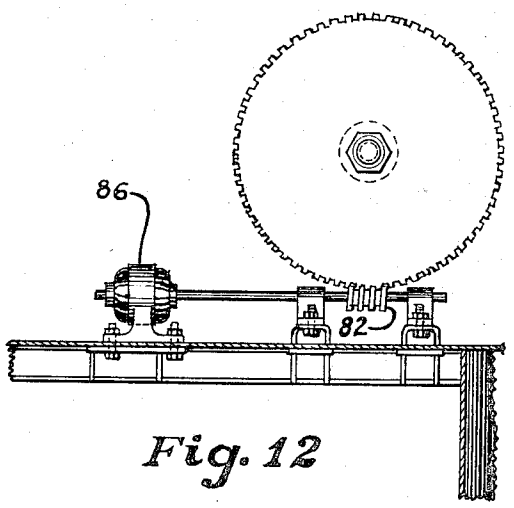


Fig. 12

INVENTOR.
EMILIO C. GARCIA
BY
ATTORNEY

April 2, 1968 E. C. GARCIA 3,375,669

OFFSHORE MARINE STRUCTURES

Filed Sept. 15, 1966 7 Sheets-Sheet 7

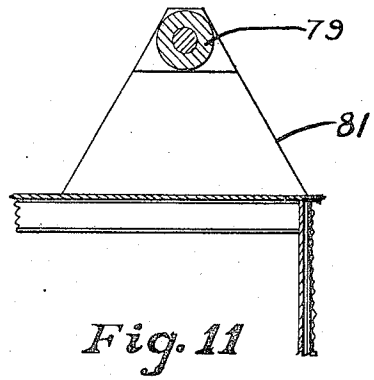


Fig. 11

Fig. 9

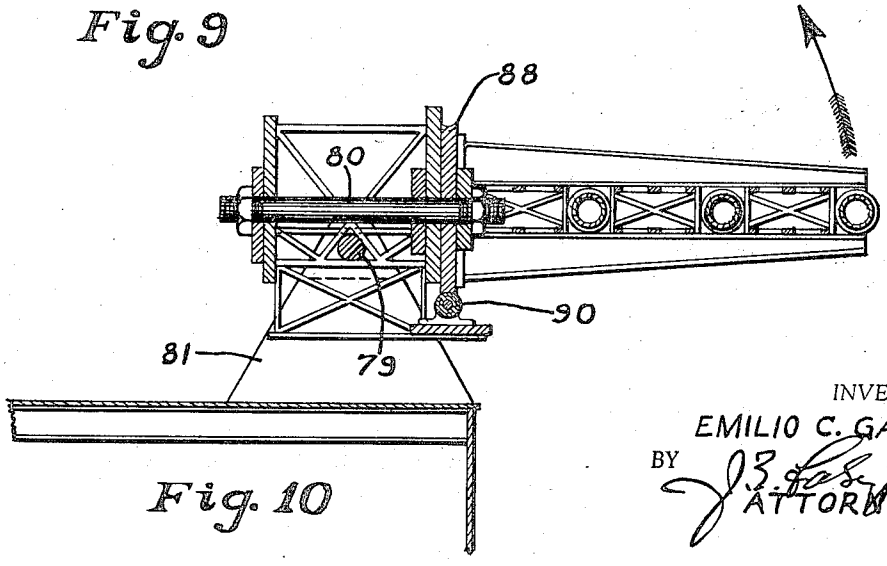


Fig. 10

INVENTOR.
EMILIO C. GARCIA
BY J. J. Gaskey
ATTORNEY

United States Patent Office

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3,375,669

OFFSHORE MARINE STRUCTURES

Emilio C. Garcia, 302 Magazine St.,
New Orleans, La. 70130

Filed Sept. 15, 1966, Ser. No. 579,704
6 Claims. (Cl. 61—46.5)

ABSTRACT OF THE DISCLOSURE

A marine tower and an annular combination barge and work platform, said tower having helical tracks extending from end to end is carried vertically on the barge to an offshore location, supported in and above the annular aperture of the combination barge and work platform by radially extending rollers mounted thereon engaging the helical tracks of the tower, and means for driving the rollers in rotation thereby rotating the tower and the annular combination relative to each other to initially drive a base end of the tower into rotational contact with the sea bottom to cut a level footing therein assisted by streams of water jetted downward from said base end and then to drive the annular combination toward the top of the tower and out of the water to position it as desired vertically and any part of it in azimuth horizontally, said tower passing through said annular aperture in its relative movements.

The invention relates generally to offshore marine structures and methods of erection, and more specifically to a seagoing combination of tower and work platform, said work platform being adjustable in height and azimuth relative to said tower, and an improved method of erecting said marine structure at a marine site.

An offshore marine structure of the type with which the invention is concerned usually comprises approximately upright supporting members or tower, a work platform, and means for erecting the tower on a marine site and raising the work platform on the tower to a working height. It is old in the art for the work platform to double as a barge for transporting the tower in an erect position to a marine site and to provide linear jacking means for lowering one end of the tower to the marine bottom and raising the work platform an adjustably variable height above the water on the other end.

It is an object of the invention to provide an offshore marine structure with a work platform that is adjustable both vertically and in azimuth relative to the supporting tower.

Another object of the invention is to provide improved means for lowering one end of the tower to the marine bottom and raising the work platform toward the other end.

Another object of the invention is to provide novel means for leveling a footing for said tower on a soft, sloping marine bottom.

Other objects and a fuller understanding of the invention may be had by referring to the following description and claims and the accompanying drawings, in which:

FIGURE 1 is a side elevation view of the invention equipped for drilling and showing the work platform in semi-erected position, the barging and work platform positions being shown in phantom at the bottom and top of the tower respectively,

FIGURE 2 is a plan view of the invention showing an arrangement on the work platform of a drilling rig including drill pipe and casing racks, a heliport, motor generator sets and fuel tanks,

FIGURE 3 is an enlarged view along section line 3—3 of FIGURE 2 showing one specie of means for adjusting the work platform,

FIGURE 4 is an enlarged view along section line 4—4 of FIGURE 2 showing partial side view of details in the FIGURE 3 species of work platform adjusting and locking apparatus,

FIGURE 5 is an enlarged sectional view along section line 5—5 of FIGURE 1 showing details of the tower base,

FIGURE 6 is a sectional view (plan) taken along section line 6—6 of FIGURE 5 showing the tower base stiffeners, high pressure hose and nozzles, and depending sharp edges,

FIGURE 7 is a view similar to FIGURE 3 showing a second specie of work platform adjusting and locking means,

FIGURE 8 is a view similar to FIGURE 2 showing a third specie of means for adjusting the work platform,

FIGURE 9 is an enlarged view of the jet engine installation illustrated in FIGURE 8,

FIGURE 10 is a sectional view along section line 10—10 of FIGURE 9,

FIGURE 11 is a sectional view along section line 11—11 of FIGURE 9 showing jet installation support brackets, and

FIGURE 12 is a sectional view along section line 12—12 of FIGURE 9 showing jet control gear for raising and lowering a jet engine into secured and operative positions, respectively.

The invention will be described as used for offshore drilling but it should be understood that it can be equipped for any use requiring a stable work platform offshore such as a radar station, etc.

Referring to FIGS. 1 and 2, the invention comprises a floatable annular shaped combination barge and work platform **22** having a circular inner perimeter and mounted on and around a composite tower **24** of uniform cross-section for rotation thereon. As shown in FIG. 2 the barge and work platform, hereinafter called the platform, comprises two semi-annular parts **26** and **28**, respectively, that are joined in place around the tower **24**. A heliport **30**, motor generator sets **31** and fuel tanks **32** are included on semi-annular parts **26**, and a drilling rig **33** with drill pipe and casing racks **34** on semi-annular part **28**, both drilling rig and heliport are shown mounted on and extending beyond the outer perimeter **36** of platform **22**. Referring to FIGS. 2, 3, and 4, a plurality of electric motors **38**, activated by the motor generator sets **31**, are mounted adjacent the inner perimeter **40** of platform **22** and drive through respective gearing and shaft **42** the spur gears **44** which are mounted for rotation parallel to said inner perimeter **40** on radial shafts extending radially inward therebeyond. A plurality of support rollers **46** are radially mounted for rotation around the inner perimeter **40** of the platform **22** and below spur gears **44** for rotation in planes parallel to said inner perimeter.

Referring to FIGURES 1, 3 and 7, the tower **24** comprises an annular base **47** in which a plurality of vertical elements **48** are secured to define a uniform circular cross-section and are horizontally bound in place by cross-bracing **50** and by a double helical track **52** and **54** rising from said base **47**, exteriorly of said vertical elements **48**, to and around the tops of the vertical elements in about a two degree slope. The double track **52** comprises an upper track **54** and a lower track **56**. A rack **57** is mounted on the upper track **54** and extends for the length of the track. The spur gears **44**, mounted on the inner perimeter **40** of the platform **22**, operatively engage this rack for driving the platform around the helical track and up and down the tower. Rollers **46** are engaged between the upper and lower tracks **54** and **56** for joining and rollably supporting the tower and the platform in their travel with respect to each other. Stainless steel chaffing bars **58** opposedly mounted on the inner perim-

eter **40** and the lower track **56** reduce any sliding friction between these movable parts (see FIG. 3). Locking pawls **59** (FIG. 4) are pivotally mounted on the platform between the spur gears **44** and engage the rack to allow relative rotation of tower and platform in only one direction at a time.

Referring to FIGS. 5 and 6, the annular base **47** is shown in vertical and horizontal cross-section, and comprises a hollow metal annulus with a body **60** having perforated metal stiffeners **62** and **63** and depending sharp edges **64** to assist in cutting a circular trench in the sea bottom. The upper surfaces **66** of the body **60** are bevelled downward from the center thereof to present as little friction or resistance to the flow of any currents as possible, and the body is floodable to increase its mass and thereby provide greater stability to the structure if it should be needed as in a high sea. High pressure hoses **68**, one of which is illustrated in cross-section in FIG. 6, are supplied from high pressure pumps **69** mounted on the platform. The hose nozzles are spaced around the body of the annular base and directed downward to deliver jet streams for washing away sea bottom material cut by the sharp edges **64** as they rotatively descend.

To assemble the invention **20**, the tower **24** is fabricated a shore and suspended vertically by crane over water near a dock. The two semi-annular parts **26** and **28** of the platform **22**, which can be built in a dry dock and launched, are floated over to the tower and fastened together around it with their respective rollers **46** engaged between the tracks **54** and **56** and the spur gears **44** engaged in the helical rack **57**. The relative relation of the platform and the tower should be as indicated in FIG. 1 with the platform in the lower phantom position. The annular base could be flooded and/or partially lowered at this time to increase stability. The invention **20** is then floated to its off-shore drilling position or location. Anchors **70**, mounted as illustrated in FIG. 1, are dropped to hold the platform stationary and the spur gears are driven by their respective motors to rotate up the helical track and rack thereby rotating the tower around the upper track and lowering it toward the bottom of the sea. As the revolving annular base reaches the bottom, the sharp edges begin to cut a circular trench. The high pressure pumps are started and jet streams are discharged into the cut to wash away the cut material from the trench trace. The rotating annular base thus cuts itself a level footing and at the same time settles itself in the trench, in any but a rocky bottom. After the annular base has cut its level footing, the anchors are weighed and with the tower stationary, the platform rolls itself up the lower track **54** by means of the spur gears and rack until the platform reaches the upper phantom position at the top of the tower as shown in FIG. 1. The platform can be stopped at any desired height from the water, the locking pawl and its mass keeping it stationary until the pawl is released. As the platform turns in rising, it can be stopped with the drilling rig at any point of the azimuth within small variations in the desired height.

A second specie of driving the platform in rotation up and down the tower is illustrated in FIG. 7. In this specie, the supporting rollers engaged between the tracks **54** and **56** are rubber tired rollers **72** which are directly driven by gears and motor **42** and combine the action of the rollers **46** and the spur gears **44** of the first specie. Pneumatic cylinders **74**, one of which is shown in FIG. 7, are mounted on the platform below the rollers **72** and actuate locking bars **76** to cooperatively engage in respective holes defined in the lower track **56** of the tower thereby locking the tower and platform against relative rotation.

A third specie of driving the platform up and down the tower is illustrated in FIGS. 8–12. Batteries of jet engines **78** are mounted diametrically on the deck of the platform. FIGS. 8 and 9 show the jet engines in operating position. Control of each battery in two axes normal to each other but parallel to the plane of the platform is

provided by shafts **79** and **80**, shaft **79** being directly supported in brackets **81**. Each battery of jet engines is lowered into operating position outboard of the platform by rotation around shaft **79** by means of a worm **82** and bull gear **84** driven by a motor **86**, respectively. When not in use the jet engines are raised inboard of the outer perimeter of the platform. Referring to FIG. 10 each battery of jet engines can be rotated around their respective shaft **80** by a bull gear **88** and a cooperating worm **90** driven by a motor **92** (FIG. 9) to thereby reverse the direction of thrust and making it possible to drive the tower and platform in either direction of relative rotation. The locking arrangement of the second specie is used to prevent relative motion when it is not desired.

The invention has been described with a certain degree of particularity but it should be understood that the present disclosure has been made only by way of example and that numerous changes in details of construction and the combination and arrangement of parts may be resorted to without departing from the spirit and scope of the invention as hereinafter claimed.

What is claimed is:

1. An improved offshore structure comprising in combination: a tower having oppositely disposed ends for vertical erection on the sea floor with the lower of said ends of the sea floor and the upper of said ends extending out of the water; a combination barge-work platform defining an aperture and adapted to receive said tower vertically in said aperture, said combination as a barge being water-tight and buoyant for floating said tower to an offshore location; dual engaging means respectively mounted on said tower and combination barge-work platform for cooperatively joining them and for relative rotation, one said engaging means comprising helical means mounted on and extending around said tower for defining a helical path between said oppositely disposed ends, and the other said engaging means comprising a plurality of rotatable means mounted on said combination barge-work platform and extending radially into said aperture for rotatably engaging said helical means mounted on said tower; driving means mounted on said combination barge-work platform and operatively connected to said plurality of rotatable means for driving them in rotation along said helical path and thereby rotating said tower for the lower end to descend to the sea floor and, sequentially, rotating the combination bare-work platform to ascend toward the upper end of said tower; and locking means adapted to lock said tower and combination barge-work platform in relative positions and against relative rotation.

2. A marine structure as described in claim **1** characterized in that the lower of said oppositely disposed ends of said vertical tower comprises an annular base having a beveled upper portion to reduce resistance to water currents and depending sharp edges for cutting into the sea bottom as the tower rotatingly descends to level a footing.

3. An annular base as described in claim **2** wherein a plurality of high pressure nozzles are spaced around said annular base and mounted to discharge downward between said depending sharp edges for washing cut material from between said sharp edges and thereby forming a trench to receive said annular base on said level footing.

4. A marine structure as described in claim **1** characterized in that said vertically opposed parallel tracks define said helical path with a slope of approximately two percent.

5. An improved method of erecting on the sea bottom a marine structure having a supporting tower with a helical track extending externally therearound and an annular floatable barge-work platform with drivable rotary engaging means extending therebetween and mounted thereon, said means being adapted to rotationally engage said helical track and supportably connect said tower and platform in concentric relationship, said method comprising: floating said marine structure to an offshore comselected site; anchoring said platform against rotation;

driving said drivable rotary engaging means along said helical track to rotate said tower downward to engage the sea bottom; weighing said anchors and driving said drivable engaging means up said helical track and support tower above the surface of the sea to a preselected height and azimuth.

6. An improved method of erecting a marine structure as described in claim 5 wherein driving said drivable engaging means to rotate said tower downward to engage the sea bottom, said driving is repetitively reversed to successively and rotationally engage and reengage said sea bottom to cut a level footing therein; and jetting a high pressure stream on said cut footing to form a trench for

the engaging end of said tower, whereby said tower is erected firmly upright on a relatively sloping sea bottom.

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JACOB SHAPIRO, *Primary Examiner.*