Nov. 26, 1968 G. T. RICHARDSON 3,412,981

MARINE PLATFORM SUPPORT ASSEMBLY

Filed Sept. 29, 1966 3 Sheets-Sheet 1

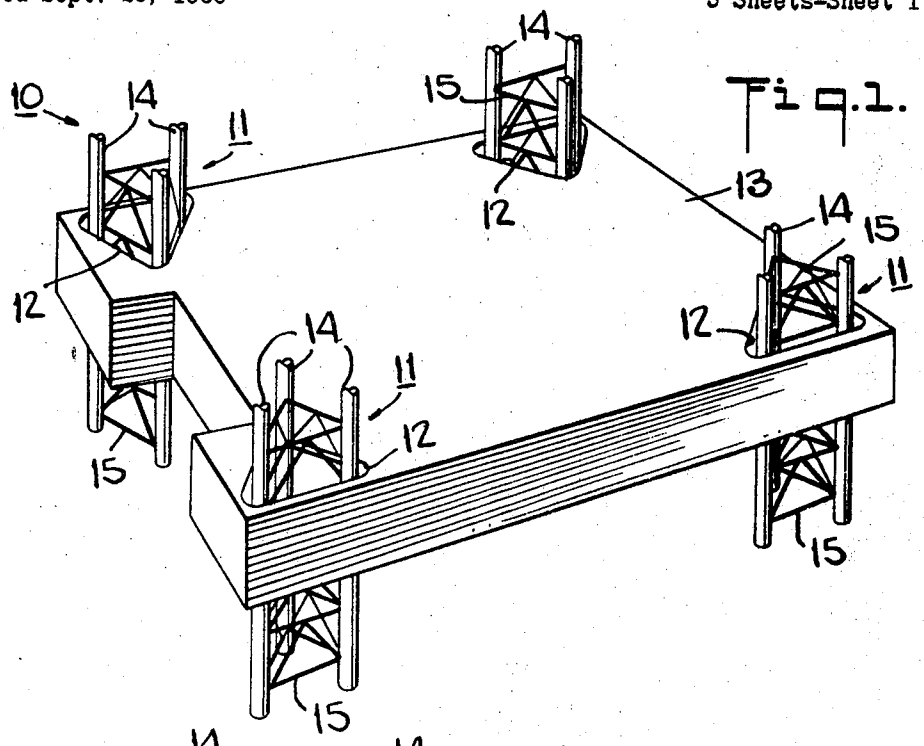

Fig. 1.

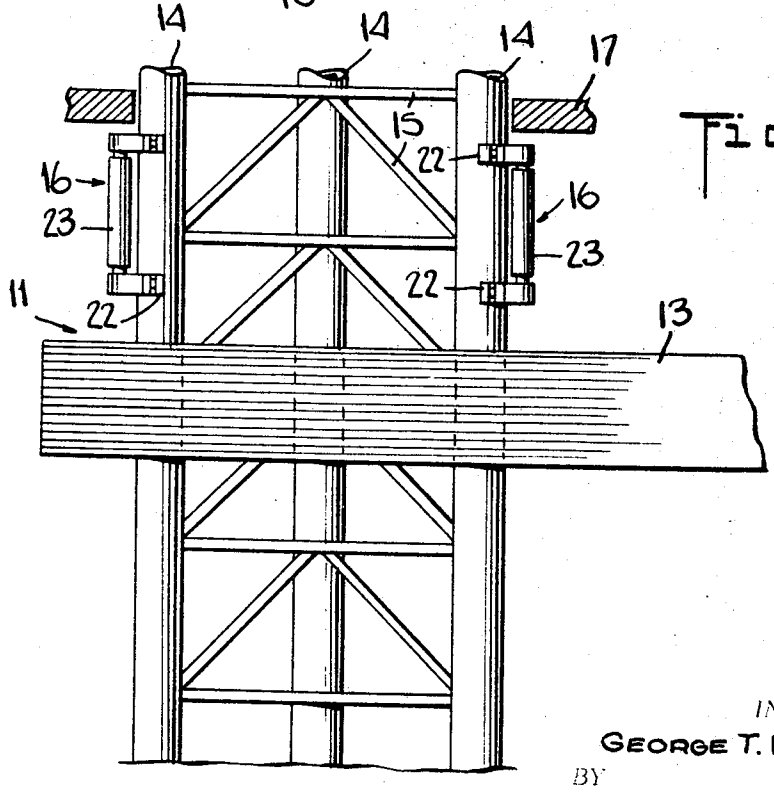

Fig. 2.

INVENTOR.
GEORGE T. RICHARDSON
BY
Kenyon & Kenyon
ATTORNEYS

Nov. 26, 1968 G. T. RICHARDSON 3,412,981

MARINE PLATFORM SUPPORT ASSEMBLY

Filed Sept. 29, 1966 3 Sheets-Sheet 2

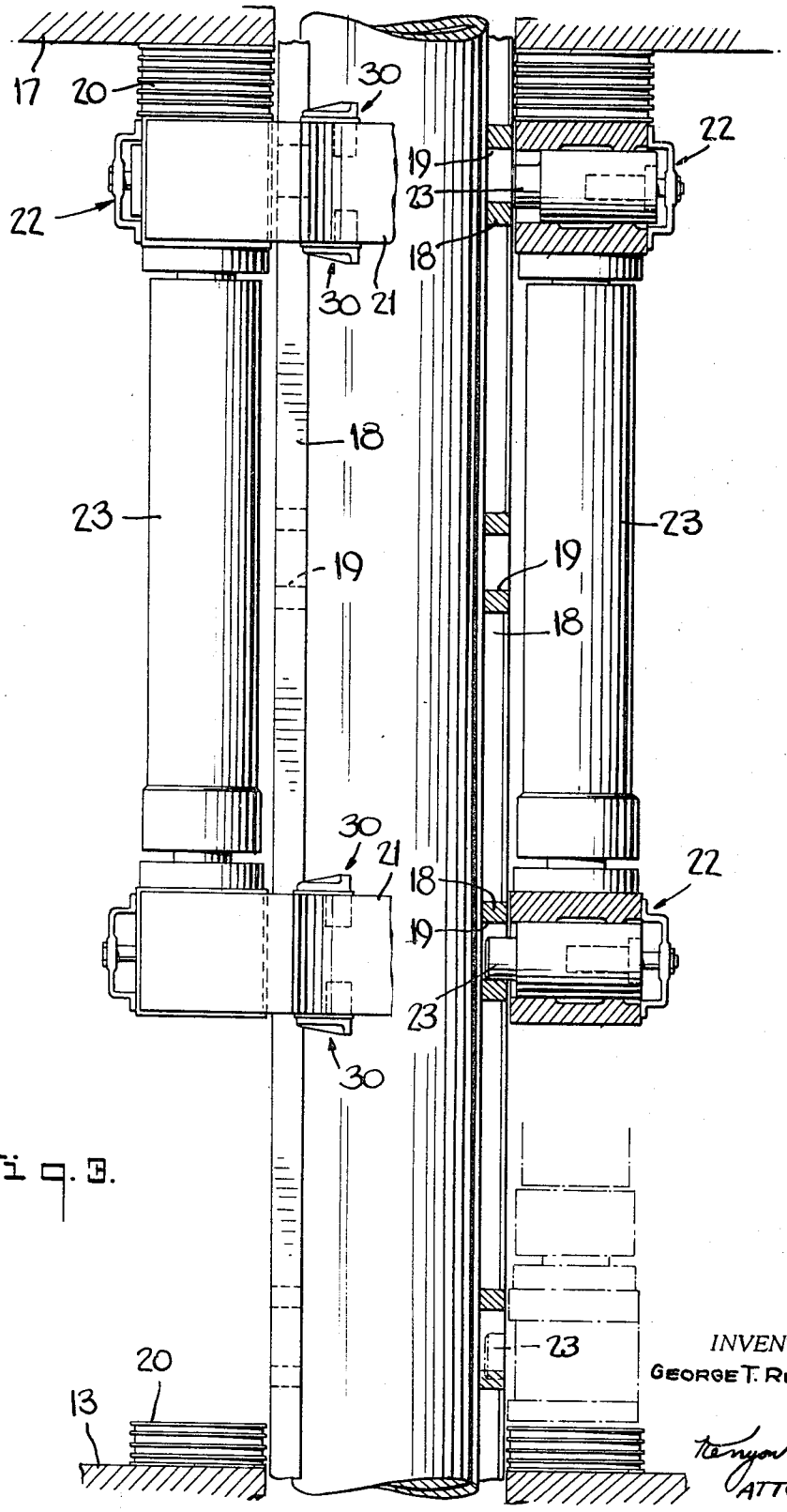

Fig. 3.

INVENTOR.
GEORGE T. RICHARDSON

Kenyon & Kenyon
ATTORNEYS

Nov. 26, 1968 G. T. RICHARDSON 3,412,981

MARINE PLATFORM SUPPORT ASSEMBLY

Filed Sept. 29, 1966 3 Sheets-Sheet 3

Fig. 4.

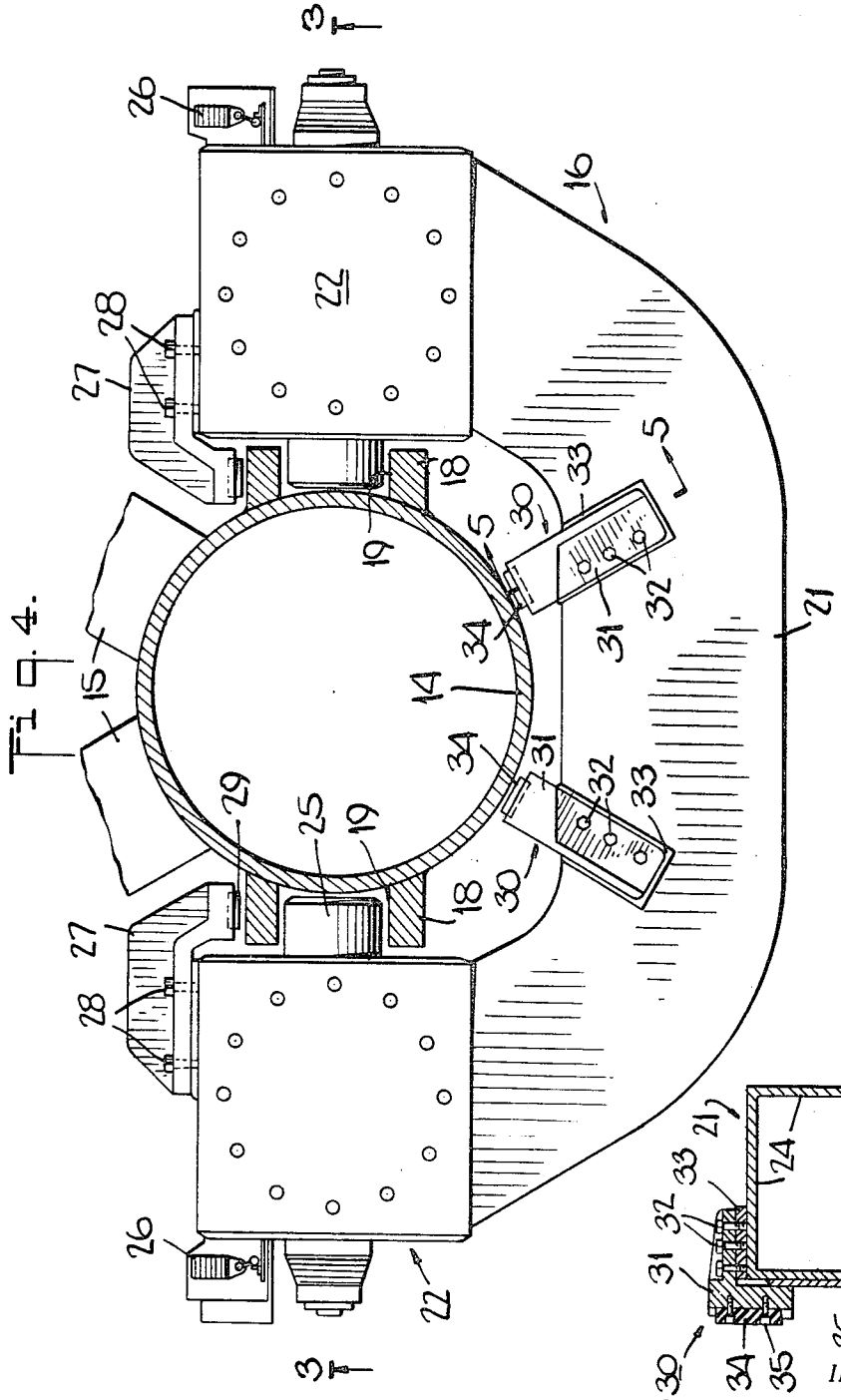

Fig. 5.

INVENTOR.
GEORGE T. RICHARDSON
BY
Kenyon & Kenyon
ATTORNEYS

United States Patent Office 3,412,981
Patented Nov. 26, 1968

3,412,981

MARINE PLATFORM SUPPORT ASSEMBLY

George T. Richardson, Houston, Tex., assignor to The Offshore Company, Houston, Tex., a corporation of Delaware

Filed Sept. 29, 1966, Ser. No. 582,984
13 Claims. (Cl. 254—106)

This invention relates to a marine platform support assembly. More particularly, the invention relates to a marine platform support assembly having a rigid support leg comprised of a plurality of tubes to extend between the marine platform and a marine bottom. Still more particularly the invention relates to a horseshoe or crescent-like jacking assembly for such a multitube support leg of a marine platform.

Marine platforms, such as dock or offshore oil well drilling barges which are buoyant and adapted to be towed or otherwise propelled to a marine site are frequently provided with openings through which a corresponding number of supporting legs are arranged to be extended These supporting legs have been constructed of single tubes which have been raised and lowered relative to the platforms by jacking assemblies which completely enveloped the tubes. However when used in deep water, for example, in depths over 100 feet, with the supporting legs embedded in the marine bottom and the platform raised on the supporting legs to an operative position above wave action, such tubes have had a long unsupported length extending between the marine bottom and the platform. Thus, the tubes have been subjected to high bending forces created by wave, wind or current action, particularly during storms, creating a condition which in some circumstances may be unsafe as well as unstable.

In order to satisfactorily brace the tubes against the forces causing the high bending forces, proposals have in some cases been made to increase the dimensional extent of the tubes to provide a greater section modulus against bending. This has also been accompanied by proposals to increase the weight of the tubes. However, such would not only cause the handling of these tubes to be extremely difficult but would also make the tubes too cumbersome to be manipulated by a jacking mechanism of practical size. Also, increasing the dimensional extent has increased the possibility of localized buckling of sections of the tubes. Further, strengthening of the tubes by increasing the cross section would not adequately solve the platform stabilizing problem occasioned by increased leverage of the platform with respect to the tubes at greater water depths. Other proposals have been made to interconnect the tubes by auxiliary bracing after the platform has been erected. However, such is also not a wholly satisfactory solution as it cannot be readily accomplished underwater where it is most needed without the use of divers. Similarly, providing the platform with a set of temporary supporting legs and a set of permanent interconnected supporting legs is also not wholly satisfactory as not only are structures of excessive bulk and weight needed but also a greater erection time is required for proper positioning of the platform.

Generally, this invention provides a marine platform with a support assembly having a plurality of supporting legs constructed of a plurality of tubular members interconnected by bracing which are raised and lowered relative to the platform by jacking assemblies of horseshoe or crescent-like shape mounted on the platform. Each supporting leg is sized to pass through a cut-out in the deck of the platform and is of sufficient rigidity to withstand the bending loads imposed by the wind, wave or current action when embedded in a marine bottom to support the marine platform. The crescent-like jacking assemblies are each constructed of a pair of vertically spaced horseshoe or crescent-like yokes which are disposed longitudinally of a tubular member of the support leg and movable relative to each other by a vertical jack means. Each yoke has a pair of hydraulic pin cylinder devices mounted at the ends which are adapted to cooperate with apertures in or apertured racks on a tubular member of a support leg. The jacking assemblies are shaped so as to move transversely of a leg when being mounted or dismantled for maintenance without interfering with the bracing connecting the tubular members of a support leg. In addition, each jacking assembly has a guide means removably secured thereon which maintains the jacking assembly on the associated tubular member and guides the jacking assembly during longitudinal movement relative to the associated tubular member. The guide means is secured in place after a jacking assembly is brought into position on a tubular member.

The jacking assemblies are mounted on the support legs between a platform and a jackhouse and actuated in unison to move relative to the support leg. Each jacking assembly is of such dimensions so as to resist skewing on a support leg tubular member. Since the jacking assemblies do not completely surround the tubular members, the jacking assemblies are of reduced weight. Consequently, each jacking assembly can be handled with greater ease and portability.

Accordingly, it is an object of the invention to provide a jacking assembly for a marine platform support leg of multi-member construction.

It is an other object of the invention to provide a jacking assembly of crescent-like shape for cooperation with a tube of a multitube support leg of a marine platform.

It is another object of the invention to provide a crescent-like jacking assembly for a multitube support leg which is portable.

It is another object of the invention to provide a jacking assembly of crecent-like shape for a support leg of a marine platform which is readily movable transversely of the support leg.

It is another object of the invention to provide a jacking assembly for a support leg of a marine platform which is of reduced weight.

It is another object of the invention to provide a crescent-shaped jacking assembly for engaging a leg support of a marine platform at points 180° apart.

It is another object of the invention to provide a jacking assembly which utilizes the same power in both directions of travel relative to a leg support of a marine platform.

These and other objects and advantages of the invention will become more apparent from the following detailed description and appended claims taken in conjunction with the accompanying drawings in which:

FIG. 1 illustrates a perspective schematic view of a marine platform with a support leg according to the invention;

FIG. 2 illustrates a segmented schematic view of a support leg of the invention passing through the deck of a marine platform;

FIG. 3 illustrates a partially broken front view of a jacking assembly of the invention on a tubular member of the support leg;

FIG. 4 illustrates a plan view of the jacking assembly of FIG. 3 on the tubular member of the support leg; and

FIG. 5 illustrates a view taken on line 5—5 of FIG. 4.

Referring to FIGS. 1 and 2, a marine platform 10 constructed in accordance with the invention includes a support assembly having a plurality of leg supports 11, for example, four passing through cut-outs 12 in the deck 13 of the marine platform 10 to support the platform 10 on

a marine bottom. Each support leg **11** is formed of three elongated tubular members **14** which are interconnected by lateral bracing **15** to form a single rigid leg. The tubular members **14** are arranged in a triangular fashion with respect to each other in order to present a support leg which is able to resist the high bending forces imparted by wind and water, for example, during periods of storm or when the legs extend through great depths of water to support the platform **10**. The bracing **15** is secured to the tubular members **14** in any suitable manner such as by welding and may consist of pipes, rods, angles or other conventional bracing members.

The leg supports **11** are moved in a vertical direction relative to the platform **10** by means of jacking assemblies **16** mounted on each of the tubular members **14** in order to raise or lower the leg supports **11** relative to a marine bottom or to raise or lower the platform **10** on the leg supports **11** when supported on the marine bottom. The jacking assemblies are mounted in a floating condition on the tubular members between the deck **13** and a jackhouse **17** positioned above the deck **13**. Each jacking assembly **16** is independent of fixed connection with the deck **13** and jackhouse **17** (FIG. 2).

Referring to FIGS. 3, 4 and 5, each tubular member **14** is of cylindrical cross section, although any suitable polygonal cross section can be utilized, and is provided with a pair of racks **18** extending longitudinally along the exterior of member **14**. Each rack **18** is provided with an aligned series of apertures **19** disposed along the length of the rack for cooperation with a jacking assembly **16**. Alternatively, the racks **18** can be omitted and the apertures can be formed in the tubular member **14**. Also, other types of known rack devices can be used such as gear types. The racks **18** are disposed on the tubular member **14** outside the points of connection of the bracing **15** interconnecting the tubular member **14** with the remaining tubular members of the leg support **11** so as to provide a sufficient clearance between the jacking assembly **16** and bracing **15**. For example, where three tubular members are used in equilateral fashion, the racks are disposed 180° apart.

Each jacking assembly **16** is of crescent-like or horseshoe shape so as to be moved transversely of a tubular member **14** during mounting of the jacking assembly on the tubular member or removal therefrom. This shape permits separate jacking assemblies **16** to be mounted individually on each of the tubular members **14** of a leg support **11** instead of using a single massive jacking assembly to envelop the entire support leg circumferentially. The jacking assembly **16** is mounted between the deck **13** and jackhouse **17** in floating relation for abutment with a resilient buffer means **20** secured to the upper surface of the deck **13** and the underside of the jackhouse **17**. Depending on the operation of the marine platform, that is, whether the leg supports **11** are being raised or lowered relative to a marine bottom or whether the platform **10** is being raised or lowered on the leg supports **11**, the jacking assembly **16** is in abutment with one of the buffer means **20**.

The jacking assembly **16** includes a pair of vertically spaced crescent-like yokes **21** disposed longitudinally of the tubular member **14** opposite the bracing **15**, a pair of hydraulic pin cylinder devices **22**, similar to the hydraulic pin cylinder apparatus disclosed in copending U.S. patent application Ser. No. 562,400, filed July 1, 1966, mounted at the ends of each yoke **21** for cooperation with the racks **18** and a vertical jack means **23** for moving the yokes **21** relative to each other.

The yokes **21** are constructed of metal plates **24**, such as steel plates which are welded together, in tubular form with a substantially square cross section (FIG. 5) which is suitably stiffened by interior stiffener plates (not shown). Each yoke is shaped with a substantially straight intermediate section and arcuate-like end sections to form a substantially crescent-like or horseshoe shape. However, any suitable shape can be used for the yokes provided the pin cylinder devices are in cooperation with a pair of apertured racks and the yokes are able to resist skewing on the tubular member, for example, a block C, L or arcuate shape. The term crescent-like is thus used to provide a generic definition for these various shapes.

The pin cylinder devices **22** are connected to the ends of the yokes **21** as by welding so as to be disposed opposite the racks **18** of the tubular member **14**. Each pin cylinder device **22** has a hydraulically operated reciprocally mounted pin **25** which, as described in the above mentioned patent application, is adapted to be reciprocated into and out of the apertures **19** of the racks **18** for moving the tubular member **14** relative to the deck **13**. In addition, each pin cylinder device **22** is provided with a limit switch mechanism **26** and an electrical circuit (not shown) which is integrated with similar structure of the other pin cylinder devices **22** of the jacking assemblies **16** so that all the jacking assemblies are operated in unison in a manner similar to the system described in patent application Ser. No. 562,401, filed July 1, 1966.

The vertical jack means **23** consists of a pair of telescoping jacks, as disclosed in the above mentioned patent application, each of which is secured to a vertically aligned pair of pin cylinder devices **22** to connect the yokes **21** together for relative movement to each other.

In addition, each jacking assembly **16** is provided with a guide means for maintaining and guiding the jacking assembly **16** on the tubular member **14**. The guide means includes a guide bracket **27** (FIG. 4) removably mounted, as by bolts **28**, on each pin cylinder device **22** on a side opposite the yoke **21**. Each guide bracket **27** includes a bearing pad **29**, such as a brass pad, on the face disposed opposite to and in slightly spaced relation to the side of a rack **18** to the other side of the yoke **21**. The guide brackets **27** are each mounted on the respective pin cylinder devices **22** after the jacking assembly has been brought into mounting position on the tubular member **14** with each pin **25** in a retracted position. Conversely, when the jacking assembly **16** is to be removed from the tubular member **14**, the guide brackets **27** are each removed.

Also, each jacking assembly **16** is provided with bumpers **30** centrally of each yoke **21** for guiding the jacking assembly **16** along the tubular member **14**. The bumpers **30** are arranged in pairs on the upper and lower surfaces of each yoke **21** and disposed in the direction of the tubular member **14**. Each bumper **30** consists of a generally L-shaped bracket **31** which is mounted by bolts **32** to a mounting plate **33** fastened to the yoke surface as by welding. The face of the bracket **31** depends along the inside of the yoke **21** in opposition to the tubular member **14** and has a projecting bearing plate **34** secured thereon by bolts **35** in slightly spaced relation to the tubular member **14**. The bumpers **30** serve with the guide bracket **27** to guide the jacking assembly **16** on the tubular member **14** during use.

Alternatively, the bumpers may be omitted and the yokes shaped to conform substantially to the shape of the tubular member, with or without pads between the yokes and tubular member.

The invention thus provides a marine platform with a support assembly having a multi-member support leg which is able to resist the high bending forces imparted to the support legs during towing of the platform as well as during adverse wind and water conditions when erected at a marine site. The members of the support legs are each sized of smaller cross section than a single tube which has been used before for the same water depths and thus allow an easier handling of the support leg. Additionally, the jacking assembly of the support assembly is of a size and shape so as to be easily positioned and secured on the members of the support leg. It is seen from the foregoing how these and other objects of the

invention referred to herein may be achieved by the invention.

Having thus described the invention, it is not intended that it be so limited as changes may be readily made therein without departing from the scope of the invention. Accordingly, it is intended that the subject matter described above and shown in the drawings be interpreted as illustrative and not in a limiting sense.

What is claimed is:

1. In combination with a support leg of a marine platform having a plurality of spaced elongated members in interconnected braced relation; a plurality of jacking assemblies, each of said jacking assemblies being disposed on a respective one of said members, each of said jacking assemblies including a pair of spaced crescent-like yokes disposed longitudinally of said member, a jack means connecting each of said yokes in movable relation to each other, and a pair of pin cylinder devices mounted at respective ends of each of said yoke for removable engagement with said member.

2. The combination as set forth in claim **1** wherein each said member includes a pair of apertured racks thereon for removable engagement with said pin cylinder devices.

3. The combination as set forth in claim **2** wherein each said jacking assembly includes a removable guide means for maintaining said jacking assembly on said member and for guiding said jacking assembly on said member during relative movement thereto.

4. The combination as set forth in claim **1** wherein each said jacking assembly includes bumper means mounted on each of said yokes in opposition to said member for guiding said jacking assembly on said member.

5. The combination as set forth in claim **1** wherein each member is tubular.

6. The combination as set forth in claim **1** wherein said pair of pin cylinder devices are disposed substantially 180° apart.

7. The combination as set forth in claim **1** wherein said support leg is formed of at least three tubular members.

8. In combination with a marine platform having a deck, a vertically spaced jackhouse above said deck, and a plurality of support legs passing through said deck for supporting the platform on a marine bottom, each support leg having a plurality of spaced tubular members

in interconnected braced relation and each support tubular member having a pair of longitudinally disposed racks thereon; a jacking assembly on each of said tubular members between said deck and jackhouse for movement relative to said tubular member, said jacking assembly comprising a pair of spaced crescent shaped yokes disposed longitudinally of said tubular member, a jack means connecting said yokes for relative movement to each other, a pair of hydraulic pin cylinder devices mounted at respective ends of each of said yokes for removable engagement with said racks on said tubular member, said devices being disposed substantially 180° to each other, and removable guide means on each of said devices at one side of a respective rack for maintaining said jacking assembly on said tubular member and for guiding said jacking assembly on said tubular member during relative movement thereto.

9. The combination as set forth in claim **8** wherein each said jacking assembly further includes bumper means mounted on each said yoke for guiding said jacking assembly on a tubular member.

10. The combination as set forth in claim **9** wherein said support leg has at least three equi-spaced tubular members.

11. A jacking assembly for an elongated member including a pair of spaced crescent-like yokes, a jacking means connecting each of said yokes in movable relation to each other, and a pair of pin cylinder devices mounted at respective ends of each said yokes for removable engagement with the elongated member.

12. A jacking assembly as set forth in claim **11** further including a removable guide means for maintaining and guiding said jacking assembly on said elongated member.

13. A jacking assembly as set forth in claim **11** wherein said pin cylinder devices are disposed substantially 180° apart.

References Cited

UNITED STATES PATENTS

2,992,812	7/1961	Rasmussen et al.	254—107
3,171,259	3/1965	Roussel	254—105 X

FOREIGN PATENTS

949,420	2/1964	Great Britain.

OTHELL M. SIMPSON, *Primary Examiner.*