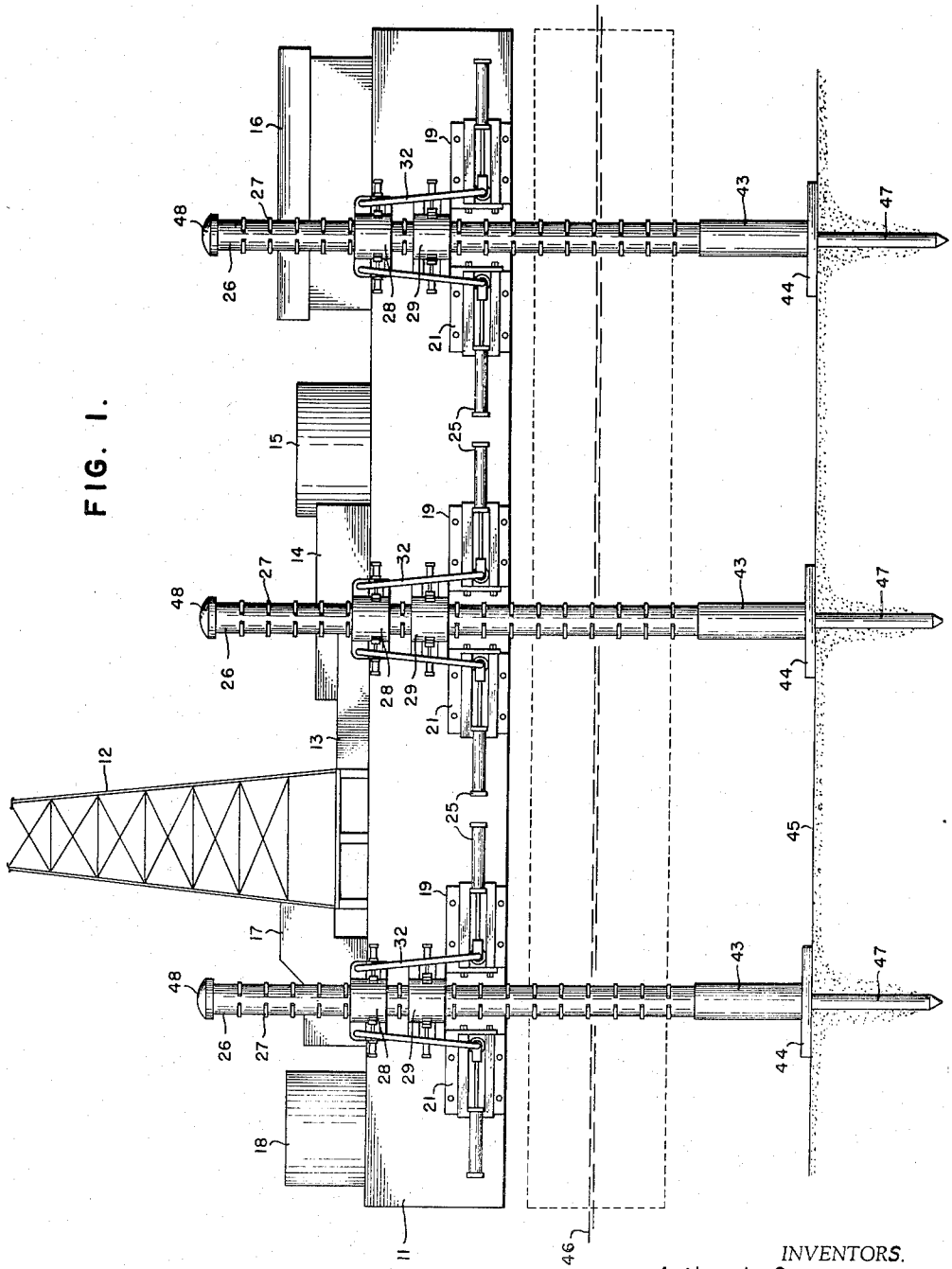
Oct. 4, 1960 A. L. GUY ET AL 2,954,676

LIFTING ASSEMBLY FOR STRUCTURES

Filed May 13, 1957 4 Sheets-Sheet 1

FIG. 1.



INVENTORS.
Arthur L. Guy,
Leo J. Castellanos,
BY

ATTORNEY.

Oct. 4, 1960 A. L. GUY ET AL 2,954,676

LIFTING ASSEMBLY FOR STRUCTURES

Filed May 13, 1957 4 Sheets-Sheet 2

FIG. 2.

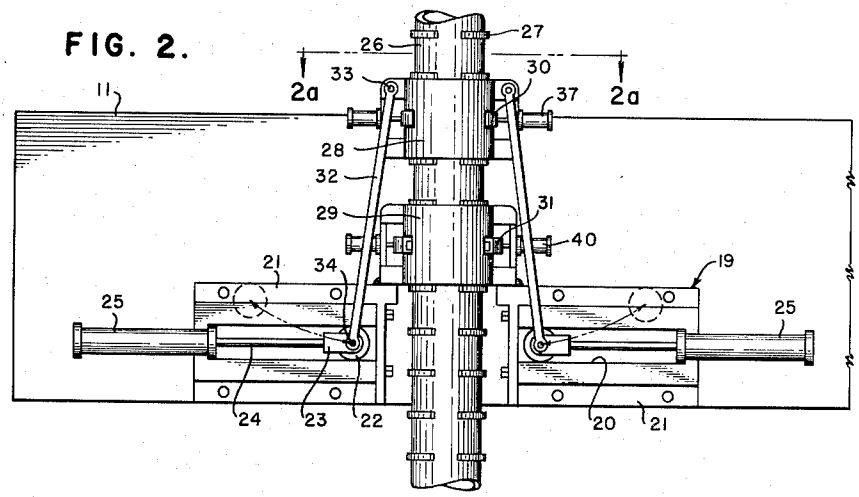
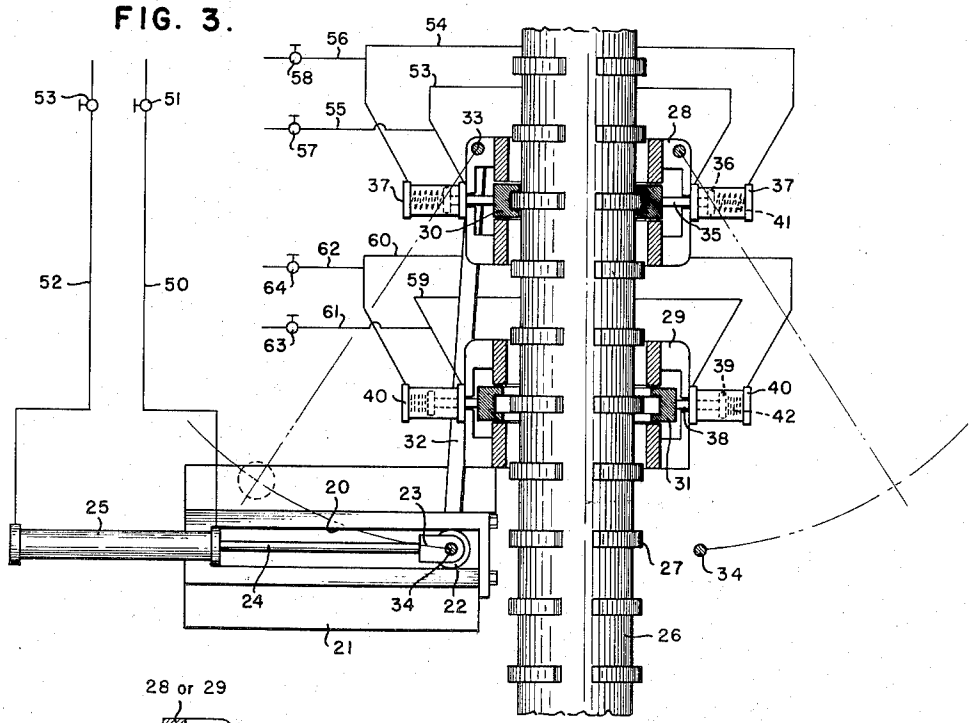


FIG. 3.



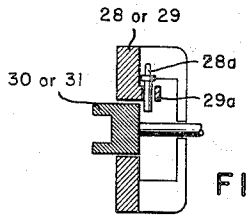


FIG. 4.

INVENTORS.
Arthur L. Guy,
Leo J. Castellanos,

BY

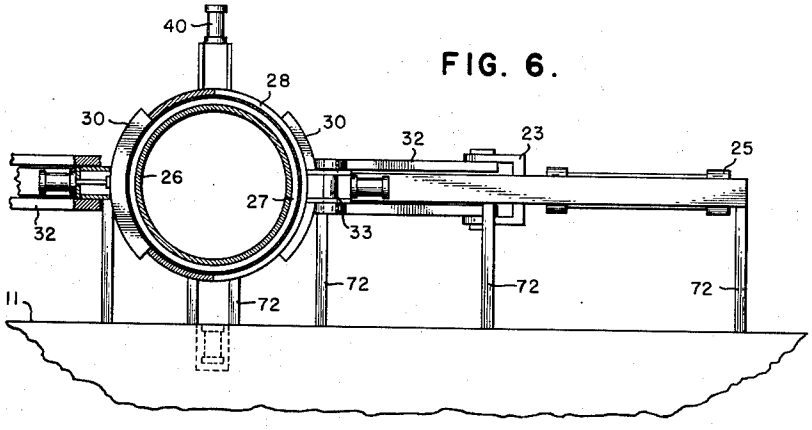
ATTORNEY.

Oct. 4, 1960 A. L. GUY ET AL 2,954,676

LIFTING ASSEMBLY FOR STRUCTURES

Filed May 13, 1957 4 Sheets-Sheet 3

FIG. 6.



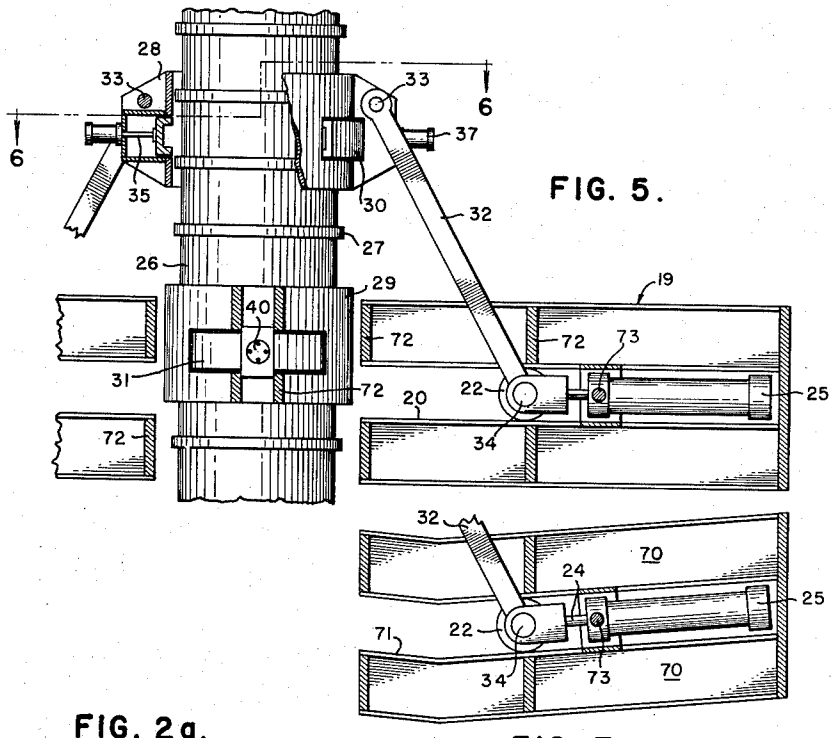
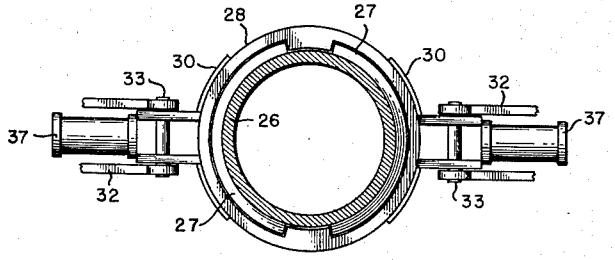


FIG. 5.

FIG. 7.

FIG. 2a.



INVENTORS.
Arthur L. Guy,
Leo J. Castellanos,

BY

ATTORNEY.

Oct. 4, 1960 A. L. GUY ET AL 2,954,676

LIFTING ASSEMBLY FOR STRUCTURES

Filed May 13, 1957

4 Sheets-Sheet 4

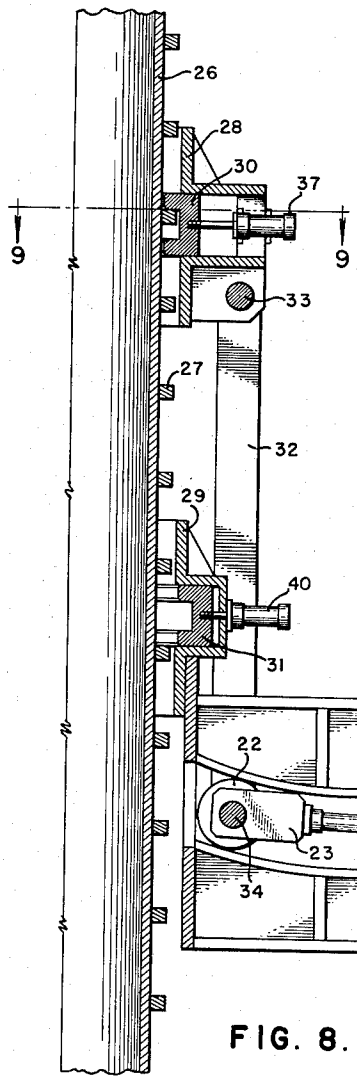


FIG. 8.

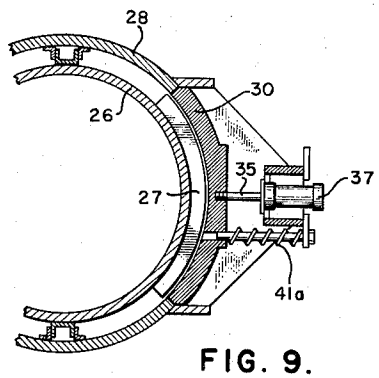


FIG. 9.

INVENTORS.
Arthur L. Guy,
Leo J. Castellanos,

BY

ATTORNEY

United States Patent Office 2,954,676 Patented Oct. 4, 1960

2,954,676

LIFTING ASSEMBLY FOR STRUCTURES

Arthur L. Guy and Leo J. Castellanos, Houston, Tex., assignors, by mesne assignments, to Jersey Production Research Company, Tulsa, Okla., a corporation of Delaware

Filed May 13, 1957, Ser. No. 658,693

8 Claims. (Cl. 61—46.5)

The present invention is directed to a lifting mechanism for moving large structural units. More particularly the invention is directed to a jacking assembly for raising structural units and the like. In its more specific aspects, the invention is concerned with a jacking assembly for moving a structural unit such as a barge upwardly or downwardly on an elongated member such as a column, a pile, and the like.

The present invention may be briefly described as a jacking assembly for moving a horizontal structure vertically. The assembly comprises an elongated vertical member such as a piling adapted to be anchored in and supported by the earth such as the bottom of a body of water. A horizontal supporting member such as a platform or a barge or a marine vessel, which is adapted to provide a working or structural surface is arranged on the elongated vertical member. First and second clamping members are arranged on the elongated member in vertically spaced-apart relationship and each of the clamping members is provided with means for engaging with the elongated vertical member. A housing is attached to the horizontal supporting member which provides a trackway. A roller member is arranged for lateral movement on the trackway and the roller member is provided with hydraulic or pneumatic means connected thereto for moving the roller member on the trackway. A mechanical linking member is pivotally connected to the roller and to the first clamping member for moving the horizontal supporting member vertically relative to the elongated member. The first clamping member is arranged above the second clamping member and the second clamping member is attached to the horizontal supporting member or to the housing for vertical movement therewith. Hydraulic, pneumatic, magnetic or other means are provided for actuating the engaging means such that the first clamping member and the first engaging means are adapted to interconnect the vertical elongated member with the housing when the horizontal supporting member is moved vertically with respect to the vertical elongated member on movement of the roller laterally on the trackway. The second clamping member and the second engaging means are adapted to release the vertical elongated member when the roller is moved laterally on the trackway.

The trackway may be a horizontal trackway but preferably is a trackway which describes a curve in a vertical plane having a subtended angle in the range from about 20 to about 45 degrees. A curve having a subtended angle of about 30 degrees may prove quite satisfactory. Thus, the trackways describe an angle deviating from the perpendicular to the longitudinal axis of the vertical elongated members.

Both the means connected to the roller member for moving the roller member on the trackway and the means for actuating the engaging means may suitably be hydraulic means comprising a piston rod having a piston attached thereto and movable in a piston cylinder and

actuated by hydraulic fluid exerted against the piston.

While the present invention is directed to raising barges and other marine vessels adapted for offshore marine operations, such as the drilling of oil and gas wells, the inventon is not limited thereto and may be adapted to move vertically any working or structural surface such as a platform or a wall which requires such moving. For example, in the construction of buildings where structural units are formed on the ground, the present jacking assembly may be used to raise or lower such structural units.

The present invention will be more completely described by reference to the drawing in which

Fig. 1 is a side elevational view of the apparatus connected to and forming part of a drilling barge for drilling oil and gas wells at a marine location;

Fig. 2 is an enlarged partial view of Fig. 1;

Fig. 2*a* is a view taken along the lines 2*a*—2*a* in Fig. 2;

Fig. 3 is a partial sectional enlarged view of Fig. 2;

Fig. 4 shows a locking mechanism for the device of Figs. 1 to 3;

Fig. 5 shows a modification of the device of Figs. 1 to 3;

Fig. 6 is a view taken along the lines 6—6 of Fig. 5;

Fig. 7 shows a modified trackway; and

Figs. 8 and 9 illustrate a still further modified trackway.

Referring now to Figs. 1 to 3, in which identical numerals will be employed to designate identical parts: Numeral 11 designates a drilling barge which is designed to support a drilling assembly comprising a derrick 12 and associated parts, generally indicated by the numerals 13, 14, 15, 16, 17 and 18, which may include all usual equipment associated with a drilling rig, such as a driving mechanism, mud pits, pipe racks, pumps and other equipment required at marine locations. The apparatus indicated by numerals 13, 14, 15, 16, 17 and 18 may also comprise living quarters for the drilling crew. Attached outboard to the drilling barge 11 are housings 19 providing a trackway 20 which are attached to the drilling barge 11 by attaching member 21. Arranged on the trackway 20 is a roller member 22 which is attached by yoke 23 to a piston rod 24 which is attached to a piston, not shown, movable in a piston cylinder 25. An elongated vertical member 26 provided on its external surface with a plurality of spaced apart outwardly extending lifting ring segments 27 is arranged in cooperative relationship with the housing 19. Vertically spaced apart on the elongated member 26 are clamping rings 28 and 29. These clamping rings 28 and 29 are each provided with engaging means 30 and 31 for engaging with the ring segments 27. The clamping ring 28 is connected with the roller 22 and the yoke 23 by means of a mechanical link 32 which is pivotally connected to clamp 28 by pivot means 33 and to the roller 22 by pivot means 34. The clamping ring 29 is connected directly to housing 19 of barge 11, as shown more clearly in Fig. 2.

The engaging means 30 and 31 are actuated respectively by a combination of a piston rod 35 attached to a piston 36 and movable in piston cylinder 37 and a piston rod 38 attached to a piston 39 movable in piston cylinder 40. It is to be noted that the piston 36 and the piston 37 are provided respectively with springs 41 and 42.

The elongated member 26 has a shoe or guide member 43 on its lower end and which is provided with a bearing surface 44 for engaging with the bottom 45 of a body of water 46 in which the drilling barge 11 is designed to be floated to the marine location where drilling operations and the like may be conducted. The shoe 43 may be attached to or rest on a submerged mat-type structure designed to support the weight of the barge 11. The mat structure may suitably be an extension of surface 44 mak-

ing it a continuous mat interconnecting all the bearing surfaces 44.

The elongated member 26 is suitably constructed to be hollow to be used as a pile or to allow a piling such as 47 to be driven therethrough. After the piling has been driven a cap member such as 48 may be placed on the elongated member 26 as may be desired although the cap member 48 may be dispensed with.

Hydraulic means are suitably provided for actuating the piston rods 24 and suitably includes a conduit 50 controlled by a valve 51 connected to a source of hydraulic fluid under pressure and a conduit 52 controlled by a valve 53, likewise connected to the source of hydraulic fluid under pressure. By admitting hydraulic fluid through either conduit 50 or 52 the piston rods 24 may be forced either to the left or the right as the case may be.

The engaging means 30 and 31 are likewise provided with hydraulic means for actuating the engaging means 30 and 31 and to place them into operative engagement with the ring segments 27 as shown more clearly in Figs. 2 and 3. The hydraulic means for actuating the engaging means 30 includes conduits 53 and 54 connected to the piston cylinder 37 and branch lines 55 and 56 controlled respectively by valves 57 and 58, lines 55 and 56 also being connected to a source of hydraulic fluid under pressure.

The piston cylinders 40 are also provided with hydraulic means including conduits 59 and 60 connected by means of branch lines 61 and 62, controlled respectively by valves 63 and 64, to a source of hydraulic fluid under pressure for moving the pistons to the left or to the right as the case may be.

It is to be noted that the pistons in the piston cylinders 37 and 40 are provided with springs 41 and 42 for returning the pistons toward the elongated member 26. The springs may be mounted externally to the cylinders in such a manner as to force the clamps 31 against the elongated member 26.

With respect to Fig. 4, it is to be noted that the clamping member, either 28 or 29, may be provided with a locking mechanism, which may include a lock pin such as 28*a* arranged in an eye 29*a* forming part of the clamp 28 or 29, which prevents the engaging means, such as 30 or 31, from moving away from the ring segment 27. Other locking means may suitably be employed and in fact the hydraulic system may serve to lock the clamping means with the engaging means 30 or 31 against the elongated member 26 into engagement with the rings 27. Other locking means may be employed in lieu of the lock pin arrangement. Thus means may be provided which makes it impossible to open or release both latches simultaneously. Thus, a system of interlocks on the valves and control system may be used to operate the clamping members or latches to insure that only one latch or clamp may be released at a time.

Referring now to Fig. 5, it will be seen that the clamping member 29 may be rotated with respect to the clamping member 28 90° and this clamping member 29 may be attached directly to the barge 11 instead of being attached directly to the housing 19 as shown in Figs. 1 to 3. In the embodiment of Figs. 5 and 6, identical numerals are employed to designate identical parts with respect to Figs. 1 to 4. The only difference between Figs. 5 and 6 and Figs. 1 to 4 is the rotation of the clamp 29 90° with respect to clamp 28 and the provision of the necessary tying members 72 connecting the housing 19 to the barge 11. The piston cylinder 25 of Figs. 5 and 6 is mounted to the track housing by pin 73.

Since it is desirable to preserve the mechanical advantage obtained by the device of the present invention in lifting a structure relative to a fixed member, an alternate trackway has been provided, such as in Fig. 7, where a housing 70 is provided which has a trackway 71 which describes a curve having a subtended angle in the range from about 20 to about 45 degrees. Actually the showing is of an angular trackway and it is contemplated that the trackway may be angular or curved. This allows the roller 22 to move in a curve as it approaches or recedes from the elongated member 26 in raising or lowering the structure relative to the elongated member 26. The cylinder 25 is pivotally mounted as at 73. The curve which the roller 22 describes as it moves to or away from the elongated member 26 is shown by the dashed lines in Fig. 3. Movement along the curved track bears a fixed ratio to the vertical movement of the upper pivot point and produces a fixed ratio between the force exerted by the pressure operating on piston 24 and the vertical lift exerted by member 32 through pivot point 34 and transmitted through the track housing and frame work to the barge 11.

While only one of the elongated members and the housings with trackway and associated linkage has been described particularly, it is to be understood that the several assemblies shown with respect to Fig. 1 may be employed and operated simultaneously. The several assemblies shown in Fig. 1 are operated simultaneously on the several assemblies 26 to lift or lower the barge 11. Thus one side of the barge 11 may be raised or lowered by the operation of the jacking mechanism and then the other side of the barge 11 is raised or lowered with the operations on both sides repeated until the barge 11 is placed at the desired position.

The jacking mechanism of Figs. 8 and 9 is provided with a trackway 81 which forms a decided curve. The piston cylinder 25 of this modification is pivotally mounted as at 82 to the track housing 80 to allow the piston rod to maintain alignment with the force exerted at roller pivot 34. Also, the latch springs 41*a* of Figs. 8 and 9 are mounted externally of the cylinders 37 and 40 and bear directly against the latch members 30 and 31.

As will be noted with reference to Figs. 5 through 9, the trackway and piston stroke are somewhat shortened as compared to that of the previous illustrations. This naturally causes shortening of the vertical travel of the latch members 30 and 31. The clamping rings 27 of these figures may, as shown, be spaced apart twice the distance of the vertical travel of the latch members 30 and 31. Whereas in the previous figures the latches entirely embrace the clamp rings upon each engagement, the latch members of Figs. 5 through 9 upon one engagement will embrace a clamp ring and on the next the entire latch member will bear against the top of the clamp ring. Shortening of the actuating stroke of the power piston rods 24 allows the jacking mechanism to be more compactly arranged about the columns 26 as compared to the illustrations of Figs. 1 through 4. Furthermore, it is to be understood that assemblies such as shown in Fig. 1 may suitably be arranged on both sides and both ends of the barge 11. Furthermore, while the present invention has been illustrated as being outboard of the barge 11 and preferably as such, the assembly may be suitably arranged inboard of the barge 11 in suitable slots or wells to provide the necessary associated mechanism.

In operating the device of the present invention the assembled structure such as shown in Fig. 1 may conveniently be floated or towed to the desired location where drilling operations are to be conducted with the drilling rig 12 and its associated equipment 13, 14, 15, 16, 17 and 18. When the site of the drilling operation is reached, it is desirable to raise the barge 11 with respect to the upper surface of the body of water 46. This may suitably be accomplished by manipulating the valves 63 and 64 to release the engaging means 31 of the lower clamp 29. By manipulating the valves 51 and 53 in conduits 50 and 52, which connects to a high pressure source of hydraulic fluid, the piston connected to piston rod 24 is caused to move which forces the roller 22 away from the elongated member 26 and which raises

the barge connected to the housing 21 upwardly on the elongated member 26. The valves 63 and 64 are then manipulated to engage the engaging means 31 with the rings 27. The valves 57 and 58 are then manipulated to disengage the engaging means 30 from the ring segments 27, and thereafter the valves 51 and 53 are manipulated to cause the roller 22 to be moved towards the elongated member 26, thus moving the clamping member 28 upwardly. The valves 57 and 58 are then manipulated to cause the engaging means 30 to engage the ring segments 27. The procedure is then repeated until the barge 11 and its associated equipment has been moved to a second position as shown in Fig. 1 from the first position as shown by the dotted lines. Drilling operations are then conducted through a suitable well or slot in the barge 11, not shown. It may be desirable and usually will be preferred to drive a piling through the elongated members 26 into the sea bottom 45 as has been shown.

When it is desirable to lower the barge 11 to the body of water 46, the procedure may be reversed to allow the barge 11 to be moved off the site and to be floated to another position.

The assembly of the present invention utilizes a mechanical linkage to multiply the lifting capacity of hydraulic cylinders providing a positive locking device to grip with the elongated, vertical, cylindrical member and to make a firm connection with the barge or structural unit to be lifted. The jacking assembly of the present invention is advantageous and useful in that it provides an adequate means of raising and lowering a marine vessel or barge. The invention requires few machine parts and requires only small hydraulic cylinders which allow positive engagement with an elongated, vertical member on which the structure is to be raised with respect thereto. By virtue of the mechanical linkage it is possible to multiply the lifting capacity of the hydraulic cylinders and to lift a structural unit with only a small expenditure of energy. Therefore, the invention is quite useful and advantageous over prior art devices.

As an example only of the dimensions and forces contemplated, the elongated member 26 may have a diameter of about 36 inches although larger or smaller vertical members 26 may be used. The height of members 26 will be sufficient to position the barge 11 at the desired level above the sea level 46. The piston cylinders 25 may be designed for a 6-inch diameter and a 26-inch stroke at a working pressure of about 3000 pounds per square inch. The capacity of the cylinders 25 is approximately 70,000 pounds at 3000 pounds per square inch. The clamping cylinders 37 and 40 may be provided for a 1½-inch diameter with 3-inch stroke at a working pressure of 2000 pounds per square inch.

It is understood that other dimensions and forces may be required for different sized structure. An important advantage of the present invention is that cylinder sizes and hydraulic pressures are relatively small and relatively high, respectively. In the present invention, a constant ratio of cylinder force to lift force is important, particularly after the angle of the link 32 becomes greater than about 20° with the vertical.

The nature and objects of the present invention having been completely described and illustrated, what we wish to claim as new and useful and secure by Letters Patent is:

1. A jacking assembly for moving a horizontal structure vertically which comprises a plurality of elongated vertical members each provided on its external surface with a plurality of vertically spaced-apart outwardly extending ring segments, said elongated vertical members being adapted to be supported by a bearing surface, a horizontal supporting member adapted to provide a working surface, first and second clamping members arranged on each of said elongated vertical members in vertically spaced-apart relationship, said clamping members each being provided, respectively, with first and second means for operatively engaging with said vertically spaced-apart ring segments, a plurality of housings attached to the horizontal supporting member each providing a trackway, said trackways being arranged horizontally relative to said horizontal supporting member, a roller member arranged in each of said trackways and movable laterally to and away from said elongated vertical members, means connected to said roller members for moving each of said roller members laterally in said trackways, mechanical linking members pivotally connected to said roller members and to said first clamping members for moving said horizontal supporting member vertically relative to said elongated vertical members, said first clamping members being arranged above said second clamping members and said second clamping members being attached to said horizontal supporting member for vertical movement therewith, and means for actuating said engaging means, said first clamping members and said first engaging means being adapted to releasably interconnect said elongated vertical members with said housings, said horizontal supporting member being moved vertically with respect to said elongated vertical members on movement of said roller members laterally in said trackways and said second clamping members and said second engaging means being adapted to releasably interconnect said vertical elongated members with said horizontal supporting member on release of said first clamping members and said first engaging means.

2. A jacking assembly in accordance with claim 1 in which the second clamping members are attached to said housings and thereby to said horizontal supporting member.

3. A jacking assembly for moving a horizontal structure vertically which comprises a plurality of elongated vertical members each provided on its external surface with a plurality of vertically spaced-apart outwardly extending ring segments, said elongated vertical members being adapted to be supported by the earth, a horizontal supporting member adapted to provide a working surface, first and second clamping members arranged on each of said elongated vertical members in vertically spaced-apart relationship, said clamping members each being provided, respectively, with first and second means for operatively engaging with said vertically spaced-apart ring segments, a plurality of housings attached to the horizontal supporting member each providing a trackway describing a curve in a vertical plane, said trackways describing an angle in the range from about 20° to about 45° from the perpendicular to the longitudinal axis of said elongated vertical members, a roller member arranged for arcuate movement in each of said trackways, means pivotally connected to said roller members for moving each of said roller members in said trackways, mechanical linking members pivotally connected to said roller members and to said first clamping members for moving said horizontal supporting member vertically relative to said elongated vertical members, said first clamping members being arranged above said second clamping members and said second clamping members being attached to said horizontal supporting member for vertical movement therewith, and means for actuating said engaging means, said first clamping members and said first engaging means being adapted to releasably interconnect said elongated vertical members with said housings, said horizontal supporting member being moved vertically with respect to said elongated vertical members on movement of said roller members arcuately in said trackways and said second clamping members and said second engaging means being adapted to releasably interconnect said vertical elongated members with said horizontal supporting mem-

ber on release of said first clamping members and said first engaging means.

4. A jacking assembly for moving a horizontal structure vertically which comprises a plurality of elongated vertical members each provided on its external surface with a plurality of vertically spaced-apart outwardly extending ring segments, said elongated vertical members being adapted to be supported by the earth, a horizontal supporting member adapted to provide a working surface, first and second clamping members arranged on each of said elongated vertical members in vertically spaced-apart relationship, said clamping members each being provided, respectively, with first and second means for engaging with said vertically spaced-apart ring segments, a plurality of housings attached to the horizontal supporting member each providing a trackway and movable laterally to and away from said elongated vertical members, said trackways being arranged horizontally relative to said horizontal supporting member, a roller member arranged in each of said trackways, hydraulic means connected to each of said roller members for moving said roller members in said trackways, mechanical linking members pivotally connected to said roller members and to said first clamping members for moving said horizontal supporting member vertically relative to said elongated vertical members, said first clamping members being arranged above said second clamping members and said second clamping members being attached to said horizontal supporting member for vertical movement therewith, and hydraulic means for actuating said engaging means, said first clamping members and said first engaging means being adapted to releasably interconnect said vertical elongated members with said housings, said horizontal supporting member being moved vertically with respect to said vertical elongated member on movement of said roller members laterally in said trackways and said second clamping members and said second engaging means being adapted to releasably interconnect said elongated vertical members with said horizontal supporting member on release of said first clamping members and said first engaging means.

5. A jacking assembly for moving a horizontal structure vertically which comprises a plurality of elongated vertical members each provided on its external surface with a plurality of spaced-apart outwardly extending ring segments, said elongated vertical members being adapted to be supported by the earth, a horizontal supporting member adapted to provide a working surface, first and second clamping members arranged on each of said elongated vertical members in vertically spaced-apart relationship, said clamping members each being provided, respectively, with first and second means for operatively engaging with said vertically spaced-apart ring segments, a plurality of housings attached to the horizontal supporting member each providing a trackway and movable laterally to and away from said elongated vertical members, said trackways being arranged horizontally relative to said horizontal supporting member, a roller member arranged in each of said trackways, hydraulic means connected to each of said roller members comprising a piston rod movable in a piston cylinder for moving said roller members in said trackways, mechanical linking members pivotally connected to said roller members and to said first clamping members for moving said horizontal supporting member vertically relative to said elongated vertical members, said first clamping members being arranged above said second clamping members and said second clamping members being attached to said horizontal supporting member for vertical movement therewith, and means for actuating said engaging means, said first clamping members and said first engaging means being adapted to releasably interconnect said vertical elongated members with said housings, said horizontal supporting member being moved vertically with respect to said vertical elongated members on movement of said roller members laterally in said trackways and said second clamping members and said second engaging means being adapted to releasably interconnect said elongated vertical members with said horizontal supporting member on release of said first clamping members and said first engaging means.

6. A jacking assembly for moving a horizontal structure vertically which comprises a plurality of elongated vertical members each provided on its external surface with a plurality of vertically spaced-apart outwardly extending ring segments, said elongated vertical members being adapted to be anchored in and supported by the bottom of a body of water, a marine vessel adapted to provide a working surface, first and second clamping members arranged on each of said elongated vertical members in vertically spaced-apart relationship, said clamping members each being provided, respectively, with first and second means for operatively engaging with said vertically spaced-apart ring segments, a plurality of housings attached to the marine vessel each providing a trackway and movable laterally to and away from said elongated vertical members, said trackways being arranged horizontally relative to said horizontal supporting member, a roller member arranged in each of said trackways, means connected to said roller members for moving said roller members in said trackways, mechanical linking members pivotally connected to said roller members and to said first clamping members for moving said marine vessel vertically relative to said elongated vertical members, said first clamping members being arranged above said second clamping members and said second clamping members being attached to said marine vessel for vertical movement therewith, and means for actuating said engaging means, said first clamping member and said first engaging means being adapted to releasably interconnect said vertical elongated members with said housings, said marine vessel being moved vertically with respect to said vertical elongated members on movement of said roller members laterally in said trackways and said second clamping members and said second engaging means being adapted to releasably interconnect said vertical elongated members with said marine vessel on release of said first clamping means and said first engaging means.

7. A jacking assembly for moving a horizontal structure vertically which comprises a plurality of elongated vertical members each provided on its external surface with a plurality of vertically spaced-apart outwardly extending ring segments, said elongated vertical members being adapted to be supported by the earth, a barge adapted to provide a working surface, first and second clamping members arranged on each of said elongated vertical members in vertically spaced-apart relationship, said clamping members each being provided, respectively, with first and second means for operatively engaging with said vertically spaced-apart ring segments, a plurality of housings attached to the barge each providing a trackway describing a curve in a vertical plane, said trackways describing an angle in the range from about 20° to about 45° from the perpendicular to the longitudinal axis of said elongated vertical members, a roller member arranged for arcuate movement in each of said trackways, hydraulic means pivotally connected to said roller members comprising a piston rod movable in a piston cylinder for moving said roller members in said trackways, mechanical linking members pivotally connected to said roller members and to said first clamping members for moving said barge vertically relative to said elongated vertical members, said first clamping members being arranged above said second clamping members and said second clamping members being attached to said barge for vertical movement therewith, and hydraulic means for actuating said engaging means, said first

clamping members and said first engaging means being adapted to releasably interconnect said vertical elongated members with said housings, said barge being moved vertically with respect to said vertical elongated members on movement of said roller members arcuately in said trackways and said second clamping members and said second engaging means being adapted to releasably interconnect said vertical elongated members with said barge on release of said first clamping members and said first engaging means.

8. A jacking assembly in accordance with claim 7 in

which the housings and the elongated vertical members are arranged outboard of the barge.

References Cited in the file of this patent

UNITED STATES PATENTS

696,338	Hullinger	Mar. 25, 1902
1,814,632	Rohr	July 14, 1931
2,596,854	Jack et al.	May 13, 1952
2,830,788	Bentley et al.	Apr. 15, 1958

FOREIGN PATENTS

760,646	Great Britain	Nov. 7, 1956