Sept. 21, 1948. W. H. JAMESON ET AL 2,449,781

APPARATUS FOR LIFTING MASSIVE OBJECTS

Original Filed March 18, 1944 4 Sheets-Sheet 1

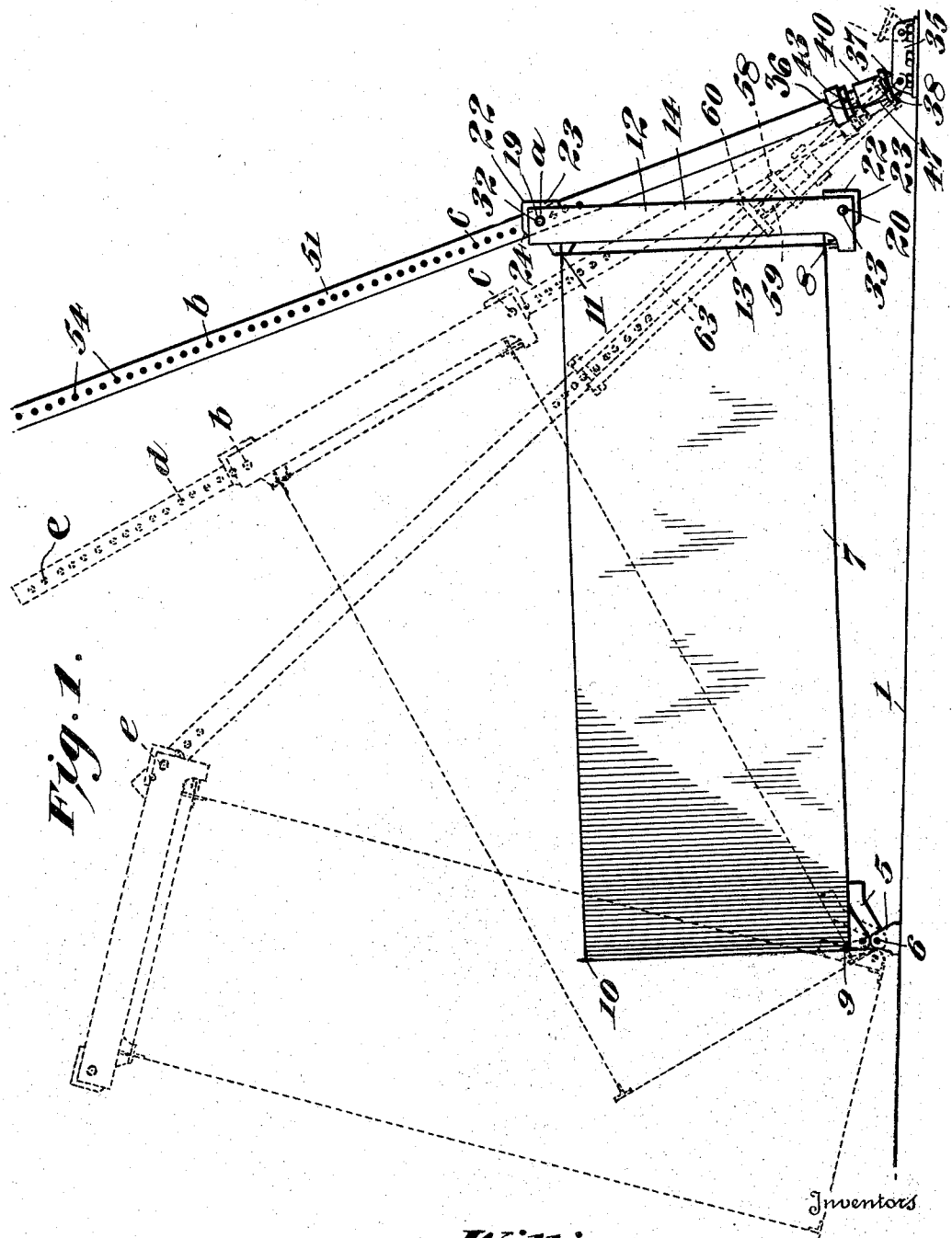


Fig. 1.

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Original Filed March 18, 1944 4 Sheets-Sheet 2

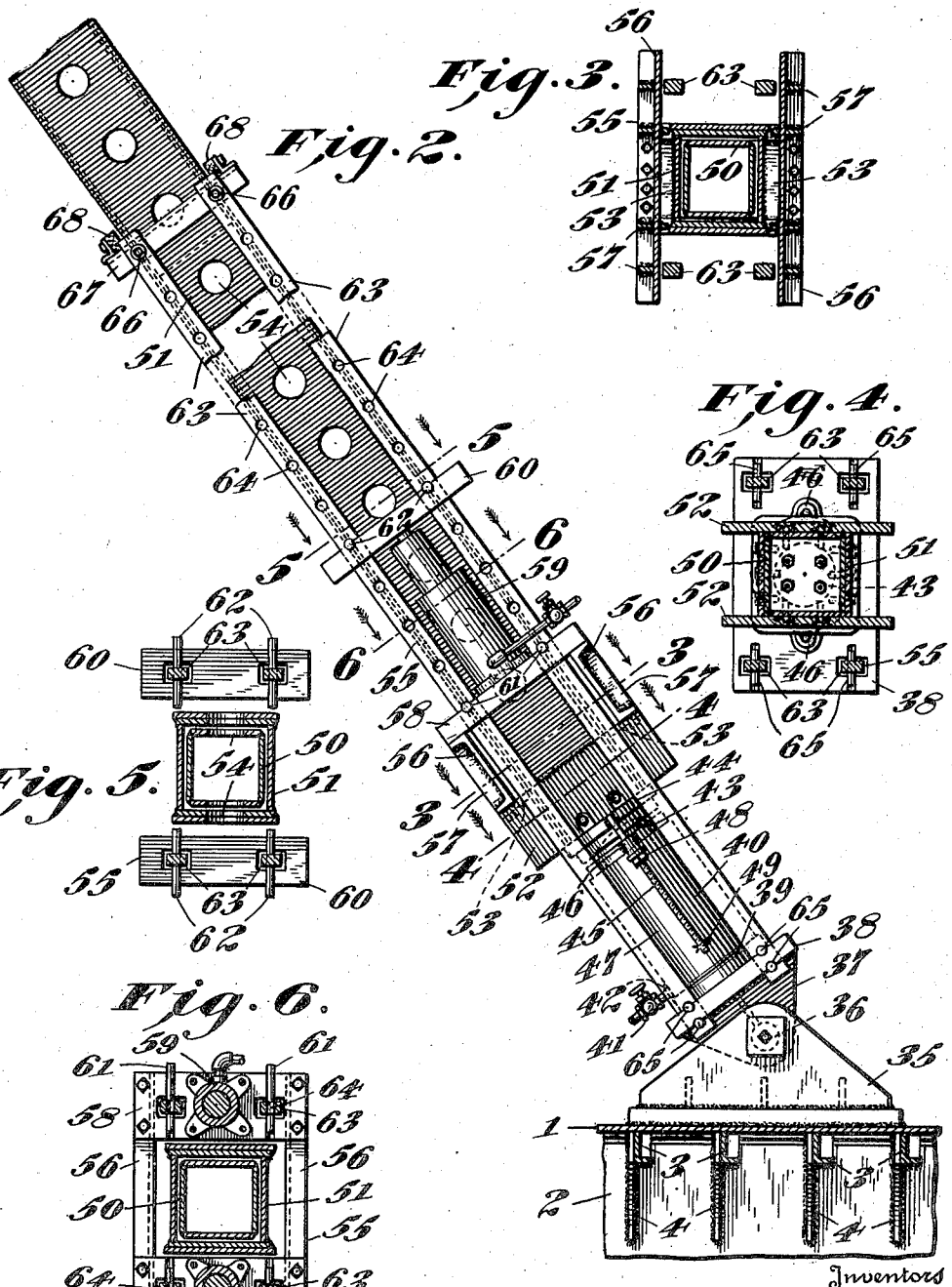


Fig. 2.

Fig. 3.

Fig. 4.

Fig. 5.

Fig. 6.

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Original Filed March 18, 1944 4 Sheets-Sheet 3

Fig. 7.

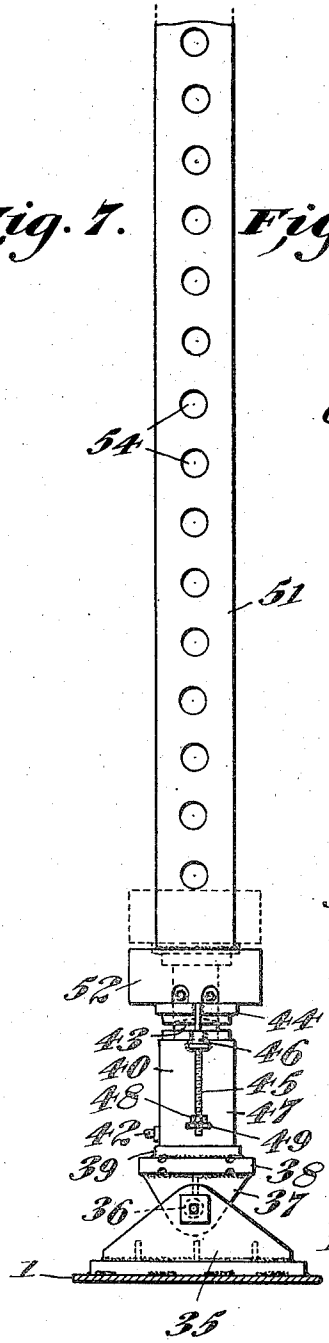


Fig. 8.

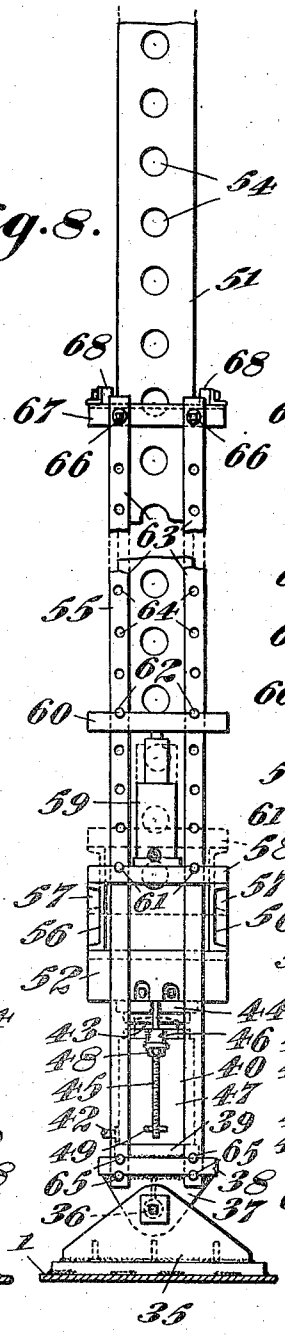
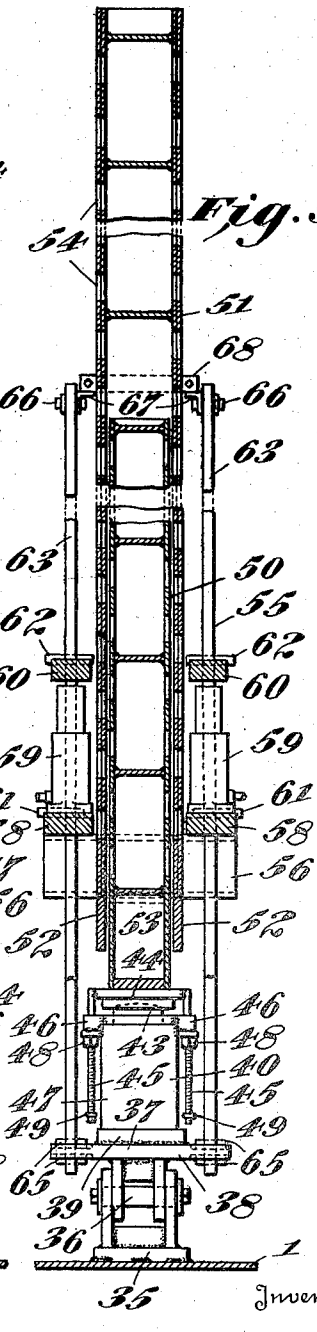


Fig. 9.



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APPARATUS FOR LIFTING MASSIVE OBJECTS

Original Filed March 18, 1944 4 Sheets-Sheet 4

Fig. 10.

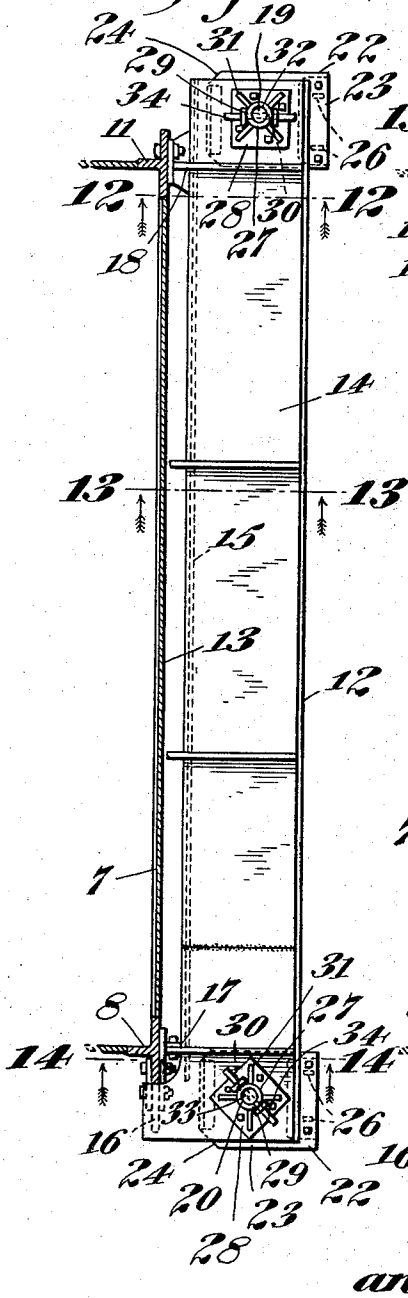


Fig. 11.

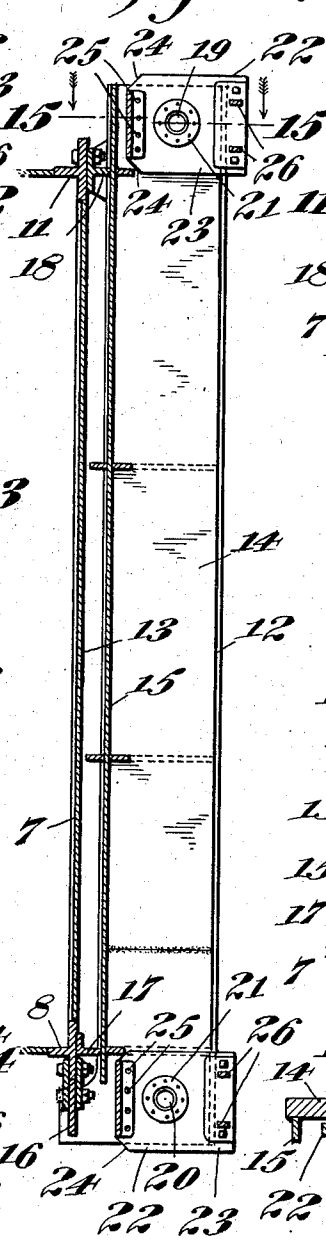


Fig. 12.

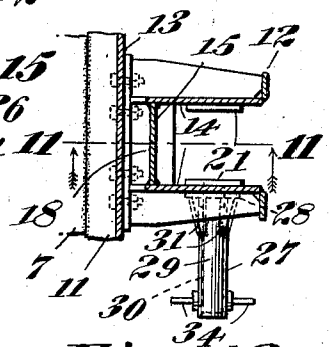


Fig. 13.

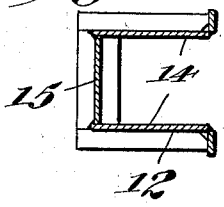


Fig. 14.

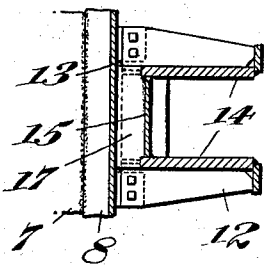


Fig. 15.



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Patented Sept. 21, 1948 2,449,781

UNITED STATES PATENT OFFICE

2,449,781

APPARATUS FOR LIFTING MASSIVE OBJECTS

William Howe Jameson and E. Leland Durkee, Bethlehem, Pa., assignors to Bethlehem Steel Company, a corporation of Pennsylvania

Original application March 18, 1944, Serial No. 527,091. Divided and this application June 5, 1945, Serial No. 597,612

9 Claims. (Cl. 254—93)

1

This application relates to apparatus for raising and lowering massive wall sections with speed and safety, and is a division of our copending application filed March 18, 1944, Serial No. 527,091, for Wing raising devices for floating dry docks.

Dry docks which must be towed for long distances to their final destination are sometimes built in a plurality of connectable pontoon sections, the side wing walls of each section being hinged thereon, for greater stability, to fold inboard during towage.

Such wing walls in the larger sizes of docks, however, may weigh several hundred tons, and raising such heavy walls from prone to upright position has heretofore been thought to require elaborate compartmentation and piping, powerful pumps, and complicated signal systems for the controlled submergence and pumping out of the pontoons.

One object of this invention, therefore, is to provide a relatively inexpensive mechanical means for raising and lowering massive wall sections.

Another object is to provide simple lifting systems which may be operated by personnel without special skills with a minimum of training.

Still other objects, purposes and advantages of our invention will appear hereinafter in the specification and in the appended claims, and in order to describe the invention more clearly we shall now refer to the annexed four sheets of drawings forming a part of the specification and in which like reference numerals indicate like parts:

Figure 1 is a side elevation of a wing wall equipped with wing latch, showing in full lines the initial raising position and in dotted lines positions of the main raise and tensile stages;

Fig. 2 is a side elevation of the lower portion of one of the jacking columns showing the tension harness;

Fig. 3 is a transverse section taken on the line 3—3 of Fig. 2;

Fig. 4 is a transverse section on the line 4—4 of Fig. 2;

Fig. 5 is a transverse section on the line 5—5 of Fig. 2;

Fig. 6 is a transverse section on the line 6—6 of Fig. 2;

Fig. 7 is a side elevation of the lower portion of one of the jacking columns and large compression jack, the latter being shown extended in dotted lines in one step of the main raise;

Fig. 8 is a side elevation, at the commencement of the tensile stage, of the lower portion of one

2

of the jacking columns with the tension harness applied thereto, with the compression jack "killed" and the tension jacks shown extended in full lines, and the movement of the tension jacks and jacking column shown in dotted lines;

Fig. 9 shows the lower portion of the jacking column with tension harness applied thereto as indicated in Fig. 8 but disposed at right angles to said figure with the jacking and guide columns and parts of the tension harness shown in section after the initial movement of the tensile stage;

Fig. 10 is a side elevation of the wing latch;

Fig. 11 is a vertical longitudinal section of the wing latch taken on the line 11—11 of Fig. 12;

Fig. 12 is a transverse section of the wing latch on the line 12—12 of Fig. 10;

Fig. 13 is a transverse section on the line 13—13 of Fig. 10;

Fig. 14 is a transverse section on the line 14—14 of Fig. 10; and

Fig. 15 is a detail section on the line 15—15 of Fig. 11.

In the embodiment of our invention shown in Fig. 2, the pontoon is provided with a flat deck 1, suitably braced at points of support and concentrated load during lifting by the welded reinforcing bulkhead plates 2, angle stiffeners 3, and gusset plates 4. Upon heavy plate hinges 5 having pivot pins 6 is pivoted the rectangular wing wall 7 provided with the welded reinforcing T-bars 8, 9, 10, and 11, at each corner edge, and with two (or more) double web girder wing latches 12 on the top face 13. As shown in Figs. 10 to 14, inclusive, each wing latch 12 comprises the pair of web plates 14, welded in spaced parallel relation on back plate 15, provided with reinforcing flanges and rib plates, and bolted through the lower bracket-plate 16, the lug 17, and the upper bracket-plate 18 to said T-bars 8 and 11.

Said wing latch 12 is provided also with an upper pin hole 19 and a lower pin hole 20, at the inner sides of which pin holes are the collars 21 tap-bolted to the web plates 14 and supporting the rotating guide frames 22. Said guide frames 22 comprise pairs of substantially square plates 23 with cut-off inner corners 24 and held in suitably spaced relation by means of the spacing members 25 and 26. Bolted to an outer side of one web plate 14 at the upper and lower pin holes are the guide supports 27, comprising centrally perforated square plates 28 to each of which is welded a projecting pipe 29, slotted longitudinally at 30 and braced by welded gussets 31. Said guide supports 27 hold the retractable upper and

lower latch pins 32 and 33 provided with handles 34 projecting through the slots 30.

Welded or bolted to the pontoon deck 1 directly opposite each wing latch 12 is a lower bearing shoe 35, as shown in Fig. 2, which lower bearing shoe is pivotally secured by the pin 36 to the upper bearing shoe 37. Atop said upper bearing shoe 37 is the slab 38, upon which slab is mounted the base 39 of the large hydraulic jack 40. Said jack 40 is provided with a valve 41 and inlet 42 for admitting fluid to the inner chamber thereof, and with a ram or piston 43 having a cap 44. Welded to said cap 44 are threaded rods 45 which pass through lugs 46 on the jack barrel or cylinder 47 and have the nuts 48 normally run out to the cotters 49 to permit full extension of said piston 43. Also welded or bolted securely to said cap 43 is the short rectangular inner guide column 50 upon which is mounted and adapted to slide freely the long rectangular outer jacking strut or column 51 welded to bracket plates 52 and 53 as in Figs. 2, 3, and 7 to 9, inclusive. Said rectangular columns 50 and 51 are provided with corresponding sets of pin-holes 54, spaced longitudinally apart a little less than maximum jack runout, and adapted to receive the latch pins 32 and 33.

Around said jacking column 51 is placed the tension harness 55, shown in Figs. 2 to 9, inclusive, which comprises two channels 56 mounted on said jacking column 51, reinforced by stiffener bars 57, bolted to the bracket plates 53 and a pair of slabs 58, upon each of which slabs 58 is bolted a hydraulic jack 59, with a second pair of slabs 60 thereabove. Said pairs of slabs 58 and 60, suitably perforated, are held by movable pins 61 and 62 to four corner tension bars 63, which pass therethrough and are provided with series of spaced pin-holes 64 and held by pins 65 in grooves in slab 38 at the bottom and by bolts 66 in rectangular sliding yoke 67 of welded or bolted angles, provided with soft wood rubbing strips 68 at the top.

All the above-mentioned hydraulic jacks may be actuated by any suitable fluid, pumped by a conventional power pump through an ordinary piping system and valves (not shown). Certain pontoons may also carry a revolving gantry crane or the like.

Assuming now that the wing walls are resting on temporary blocks or the like (not shown) after travel, the operation of raising the wing walls to working position divides naturally into three successive stages, in accordance with shifts in weight distribution, which stages may be described as follows: (1) the main raise; (2) the transition stage; and (3) the tensile stage.

The initial stage or main raise is accomplished by the two jacking struts or columns 51, which are operated by the hydraulic jacks 40 located between the lower end of said columns and the upper bearing shoe 37, connected by pin 36 to lower bearing shoe 35 welded to the deck 1.

Beginning with the upper latch pins 32 of the wing latches 12 in holes *a* on the jacking columns 51, the wing wall 7 is raised by means of the bottom jacks 40 in successive one-hole lifts, with said jacks 40 hydraulically coupled together so as to carry the load equally. At the top of each lift the load is held entirely on one column and jack while the other column and jack are fleeted by pulling said upper latch pin 32, lowering the jack ram and column and pinning the wing latch 12 off to the next higher pin hole in the column, then picking up and holding on that jack while

the other column is similarly slacked and repinned.

As the wing is raised the load on the jacks will diminish continuously, until the load is sufficiently reduced to permit raising to the next hole and holding on one column, while the second column is pinned off with its jack closed and the said second jack is pumped up enough to take the entire load. Latch pin 32 in the first column is pulled and the first column is lowered under no load while the second column and jack are pumped up under load and the process repeated. This results in pinning one column in the odd numbered pin-holes only, and the other column in the even numbered holes. When the neighborhood of holes *b* on the jacking strut is reached, the upper and lower pin holes 19 and 20 in the wing latches 12 are brought into exact register with the corresponding holes in the jacking column 51 by carefully manipulating the jacks 40. The lower latch pins 33 are then driven and the upper pins 32 withdrawn, and raising is continued from hole *c* with the use of the lower pins 33 only.

At a certain point in the gradual raising of the wing wall 7 it will reach a point of equilibrium beyond which it will exert a pull instead of a push on the jacking columns 51, which must thereafter be restrained with a tensile force through the latches 12 instead of propelled with a compressive force. Somewhat below the point of theoretical equilibrium, therefore, the tension harness 55 actuated by the pairs of hydraulic jacks 59 is attached to each jacking column 51 to ease the elevation through the second or transition stage without shock or insecurity.

With the wing wall 7 shown, the transition stage will be between the holes *d* and *e* of the jacking columns 51. Each wing is raised in this stage by one jacking column only. This column is jacked up by both the lower jack 40 and the upper jacks 59, with a fixed load of about 10% of the total weight of the wing on the jack 40 at all times to guard against sudden overbalance. In order to maintain the specified load, ascertainable by a pressure gauge (not shown) on said jack 40, excessive pressure being bled through relief valves (not shown), it is necessary to vary the load on the jacks 59 as the load on the column 51 changes. When this first column is being fleeted, the load is laid on the second column, with the jack 40 pushing against slabs 60 through the jacks 59 under the fixed load, thus making it possible for the column to take either tension or compression. By cradling the columns in this manner full control over the motion of the wing is assured at all times, regardless of the effects of wind or wave action, since there is continuously a compressive load in the jack 40 working against a tensile load in the tension harness 55.

Accordingly, the lower latch pin 33 being withdrawn on the second column, jacking of the first column on its lower jack 40 is continued until the slabs 58 bear on the pins 61 in their pin-holes 64 on tension-bars 63. Pressure on the jack 40 being held as above, the upper jacks 59 are bled sufficiently to allow said jack 40 to extend and free the slabs 60 from the pins 62, which latter pins are then pulled out and moved to the pin-holes next above. The jacks 59 are pumped up until the slabs 60 again bear against the pins 62 and the pins 61 are freed. Said pins 61 are withdrawn and placed in the next higher pin-holes on the tension-bars 63.

Still on the first column, its jacks **59** are bled slowly and jack **40** is simultaneously pumped up until the withdrawn latch pin **33** of the second column registers with the next above pin-hole on that column, whereupon the said latch pin **33** is inserted. The jacks **59** of the first column are slacked off fully, transferring the load from the first column to the second column, and the latch pin **33** of the first column is pulled back into its guide support **27**.

Jack **40** of the first column is slacked off until the next higher pin-hole in that column registers with its latch pin **33**, which is then inserted, and pins **61** and **62** are moved to the respective next lower pin-holes **64** in the tension bars **63**. Jacks **59** of said first column are pumped up, without moving the column, until the gauge on the jack **40** shows proper pressure, and said jack **40** is raised slightly while bleeding the jacks **59** to free the latch pin **33** of the second column.

These operations are continued until the wing has been raised to the point where the latch pins **33** have been inserted in the holes *e* of both columns. which are now in final tension.

In the last or tensile stage, after accidental reversals to compression are no longer possible, both lower jacks **40** go out of service. Their drain valves are opened and the nuts **48** are screwed up on the threaded rods **45** welded to the jack caps **44** to prevent further movement of these jacks or of the inner guide column **50**. The pairs of upper jacks **59** in the tension harnesses **55** together lower the wing to its final seat. Each jacking column **51** in this stage pulls against the pair of slabs **58** which in turn react against the pins **61** in the anchored tension bars **63**. Holding on said slabs **58** the jacks **59** are run out until the slab **60** is held by the pins **62** in the pin-holes next above in said tension bars. After each such increment the load is held on the slabs **60**, the jacks **59** are fleeted, and the slabs **58** are pinned off to the next higher set of holes in the tension bars **63**. The telescoping inner guide column **50** is exposed and provides lateral support as the main jacking column **51** pulls away from the jack cap **44** at its base. At the end of this operation the wing wall is bolted or otherwise secured to its seat and the lifting equipment is removed for other use or storage.

The procedure for lowering the wings is in general the reverse of the raising procedure just described. The jacking columns **51** and tension harness **55** are erected in the extended position in which they were last used in raising the wing walls and pinned off to the wing latches **12** at the hole *e*. The inside guide columns **50** are extended with the jacks **40** "killed" by screwing up the nuts **48** on the threaded rods **45** welded to the jack caps **44**. The upper bearing shoe **37** is pinned by the pin **36** to the lower bearing shoe **35** welded or bolted to the deck **1**. The foregoing three stages are then reversed in sequence, until the wing walls are again lowered to their prone position.

It is within the contemplation of this application that other massive objects beside dry dock wing walls may be raised and lowered in a similar manner by the use of our invention; and in general, although we have hereinabove shown and described our invention in considerable detail, we do not wish to be limited to the exact and specific structures and procedures stated, but may use such substitutes, modifications or equivalents thereof as are within the scope and

spirit of the invention and of the appended claims.

Having thus described our invention, what we claim as new and useful and desire to secure by Letters Patent is:

1. A jacking strut comprising, a load support comprising withdrawable pins, a pivotally movable strut fulcrum support, a jacking column adapted to engage said pins selectively at a plurality of apertures spaced along its axis and comprising an abutment slab at its lower end, a hydraulic jack cylinder secured to said strut fulcrum support, and a hydraulic jack ram operable within said jack cylinder and comprising at its upper exterior end an abutment cap and an upwardly extending guide member, the said jacking column being adapted for telescopic engagement with said guide member and in abutting engagement with said abutment cap.

2. A jacking strut comprising, a load support comprising withdrawable pins, a strut fulcrum support, a jacking column adapted to engage said pins selectively at a plurality of apertures spaced along its axis and comprising an abutment slab at its lower end, a hydraulic jack cylinder secured to said strut fulcrum support, a hydraulic jack ram operable within said jack cylinder and comprising at its upper exterior end an abutment cap and an upwardly extending guide member, the said jacking column being adapted for telescopic engagement with said guide member and in abutting engagement with said abutment cap, tension rods secured at their lower ends to said strut fulcrum support and comprising a plurality of apertures spaced along its axis, a tension abutment slab slidable axially of said tension rods, pins selectively engageable in said apertures to limit upward movement of said tension abutment slab, a hydraulic jack cylinder secured to the upper face of said jacking column abutment slab, and a hydraulic jack ram operable within said jack cylinder and adapted at its upper end to engage the underside of said tension abutment slab.

3. A jacking strut comprising, a duplex load support having withdrawable pins, a strut fulcrum support, a jacking column adapted to engage said pins selectively at a plurality of apertures spaced along its axis and comprising an abutment slab at its lower end, a hydraulic jack cylinder secured to said strut fulcrum support, a hydraulic jack ram operable within said jack cylinder and comprising at its upper exterior end an abutment cap and an upwardly extending guide member, the said jacking column being adapted for telescopic engagement with said guide member and in abutting engagement with said abutment cap, tension rods secured at their lower ends to said strut fulcrum support and comprising a plurality of apertures spaced along its axis, a tension abutment slab slidable axially of said tension rods, pins selectively engageable in said apertures to limit upward movement of said tension abutment slab, a hydraulic jack cylinder secured to the upper face of said jacking column abutment slab, and a hydraulic jack ram operable within said jack cylinder and adapted at its upper end to engage the underside of said tension abutment slab.

4. A jacking strut comprising, a load support having withdrawable pins, guide frames mounted to rotate on said load support, a strut fulcrum support, a jacking column slidable within the guide frames and adapted to engage said pins

selectively at a plurality of apertures spaced along its axis and comprising an abutment slab at its lower end, a hydraulic jack cylinder secured to said strut fulcrum support, and a hydraulic jack ram operable within said jack cylinder and comprising at its upper exterior end an abutment cap and an upwardly extending guide member, the said jacking column being adapted for telescopic engagement with said guide member and in abutting engagement with said abutment cap.

5. A jacking strut comprising, a load support having withdrawable pins, rotatable guide frames mounted on said load support, a strut fulcrum support, a jacking column slidable on the guide frames and adapted to engage said pins selectively at a plurality of apertures spaced along its axis and comprising an abutment slab at its lower end, a hydraulic jack cylinder secured to said strut fulcrum support, a hydraulic jack ram operable within said jack cylinder and comprising at its upper exterior end an abutment cap and an upwardly extending guide member, the said jacking column being adapted for telescopic engagement with said guide member and in abutting engagement with said abutment cap, tension rods secured at their lower ends to said strut fulcrum support and comprising a plurality of apertures spaced along its axis, a tension abutment slab slidable axially of said tension rods, pins selectively engageable in said apertures to limit upward movement of said tension abutment slab, a hydraulic jack cylinder secured to the upper face of said jacking column abutment slab, and a hydraulic jack ram operable within said jack cylinder and adapted at its upper end to engage the underside of said tension abutment slab.

6. A jacking strut comprising, withdrawable pins, a strut fulcrum support, a jacking column adapted to engage said pins selectively at a plurality of apertures spaced along its axis and comprising an abutment slab at its lower end, a hydraulic jack cylinder secured to said strut fulcrum support, a hydraulic jack ram operable within said jack cylinder and comprising at its upper exterior end an abutment cap and an upwardly extending guide member, the said jacking column being adapted for telescopic engagement with said guide member and in abutting engagement with said abutment cap, and bolts for preventing movement of the jack ram when desired.

7. A jacking strut comprising, a load support comprising withdrawable pins, a strut fulcrum support, a jacking column adapted to engage said pins selectively at a plurality of apertures spaced along its axis and comprising an abutment slab at its lower end, a hydraulic jack cylinder secured to said strut fulcrum support, a hydraulic jack ram operable within said jack cylinder and comprising at its upper exterior end an abutment cap with hold-down bolts to regulate the movement of the jack ram and an upwardly extending guide member, the said jacking column being adapted for telescopic engagement with said guide member and in abutting engagement with said abutment cap, tension rods secured at their lower ends to said strut

fulcrum support and comprising a plurality of apertures spaced along its axis, a tension abutment slab slidable axially of said tension rods, pins selectively engageable in said apertures to limit upward movement of said tension abutment slab, a hydraulic jack cylinder secured to the upper face of said jacking column abutment slab, and a hydraulic jack ram operable within said jack cylinder and adapted at its upper end to engage the underside of said tension abutment slab.

8. A jacking strut comprising, duplex load support having withdrawable pins, guide frames rotatably connected to said load support, a strut fulcrum support, a jacking column slidable on said guide frames and adapted to engage said pins selectively at a plurality of apertures spaced along its axis and comprising an abutment slab at its lower end, a hydraulic jack cylinder secured to said strut fulcrum support, a hydraulic jack ram operable within said jack cylinder and comprising at its upper exterior end an abutment cap and an upwardly extending guide member, the said jacking column being adapted for telescopic engagement with said guide member and in abutting engagement with said abutment cap, and bolts for limiting the movement of the jack ram.

9. A jacking strut comprising, a duplex load support having withdrawable pins, guide frames adapted to rotate on said load support, a strut fulcrum support, a jacking column adapted to slide on the guide frames and to engage said pins selectively at a plurality of apertures spaced along its axis and comprising an abutment slab at its lower end, a hydraulic jack cylinder secured to said strut fulcrum support, a hydraulic jack ram operable within said jack cylinder and comprising at its upper exterior end an abutment cap with hold-down bolts to restrict the movement of the jack ram when desired and an upwardly extending guide member, the said jacking column being adapted for telescopic engagement with said guide member and in abutting engagement with said abutment cap, tension rods secured at their lower ends to said strut fulcrum support and comprising a plurality of apertures spaced along its axis, a tension abutment slab slidable axially of said tension rods, pins selectively engageable in said apertures to limit upward movement of said tension abutment slab, a hydraulic jack cylinder secured to the upper face of said jacking column abutment slab, and a hydraulic jack ram operable within said jack cylinder and adapted at its upper end to engage the underside of said tension abutment slab.

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