

April 15, 1958

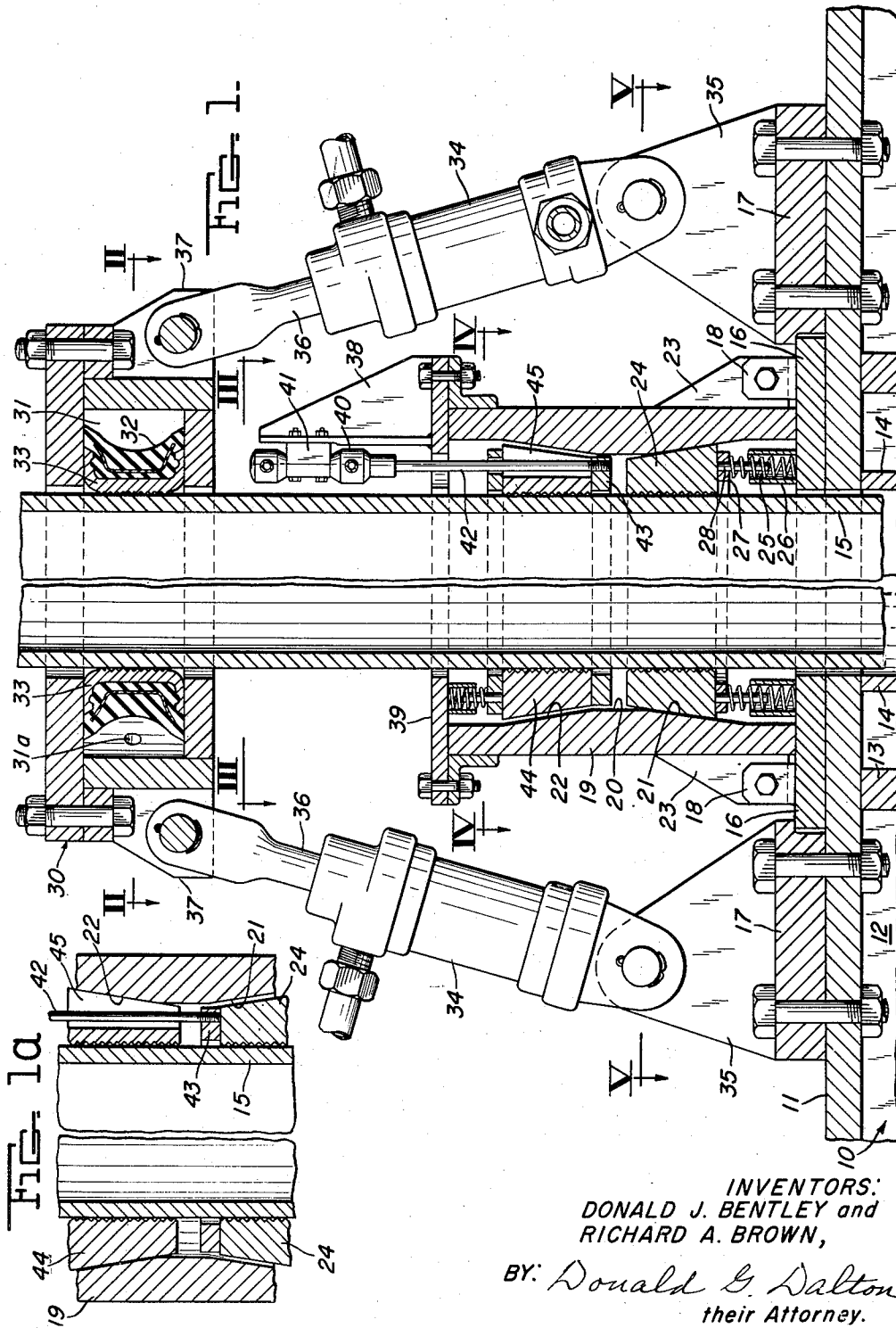
D. J. BENTLEY ET AL

2,830,788

PUSHING AND PULLING APPARATUS

Filed Sept. 10, 1954

6 Sheets-Sheet 1



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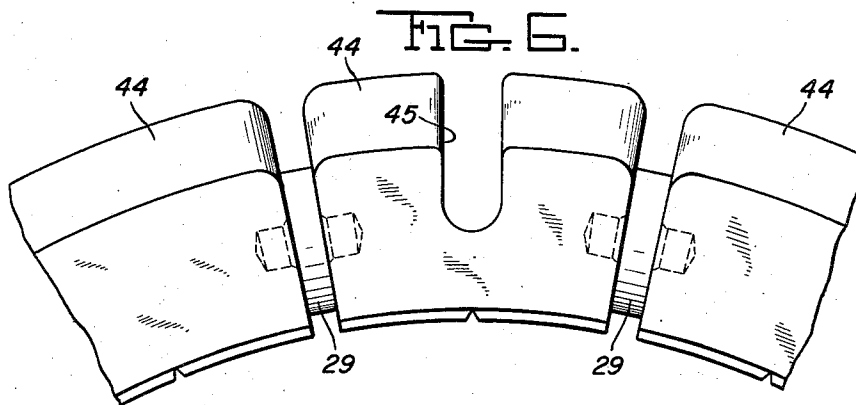
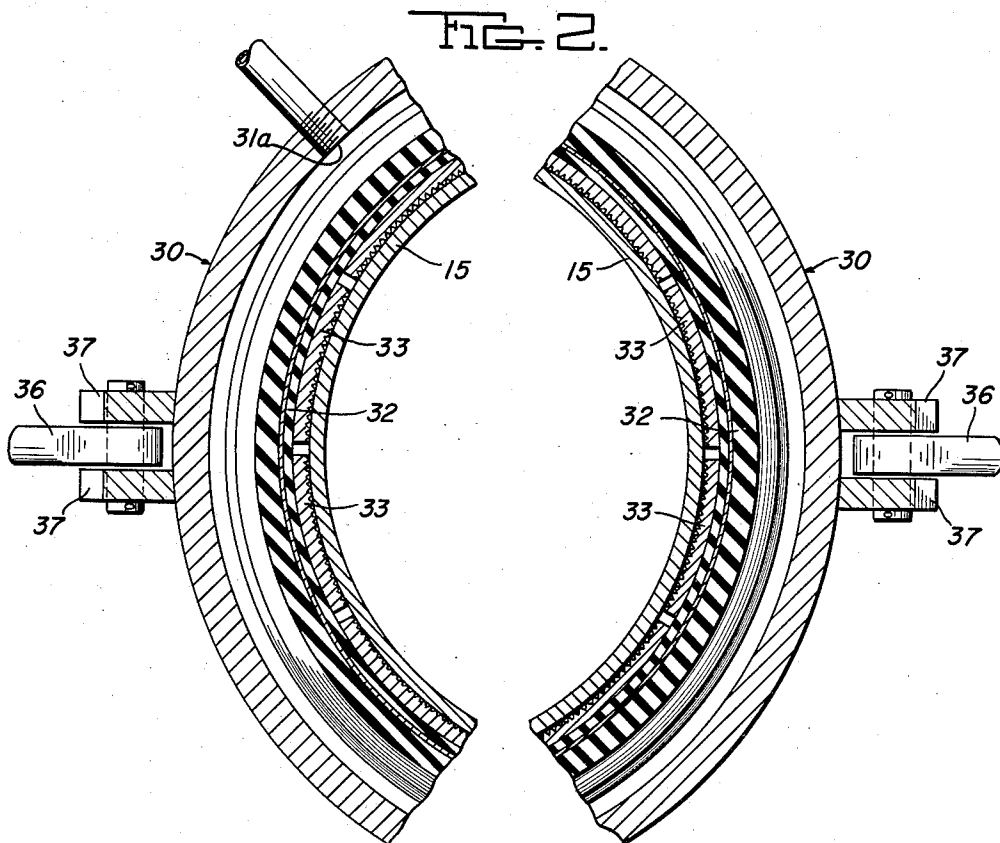
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6 Sheets-Sheet 2



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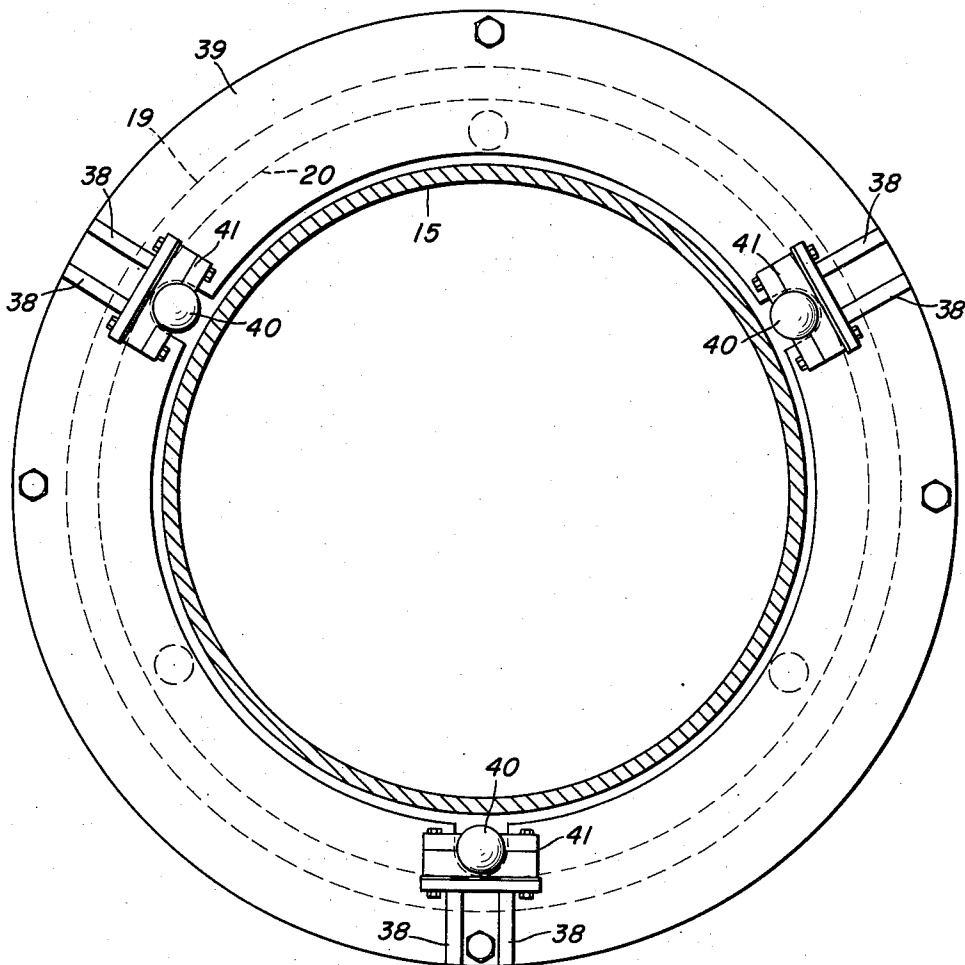
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FIG. 3.



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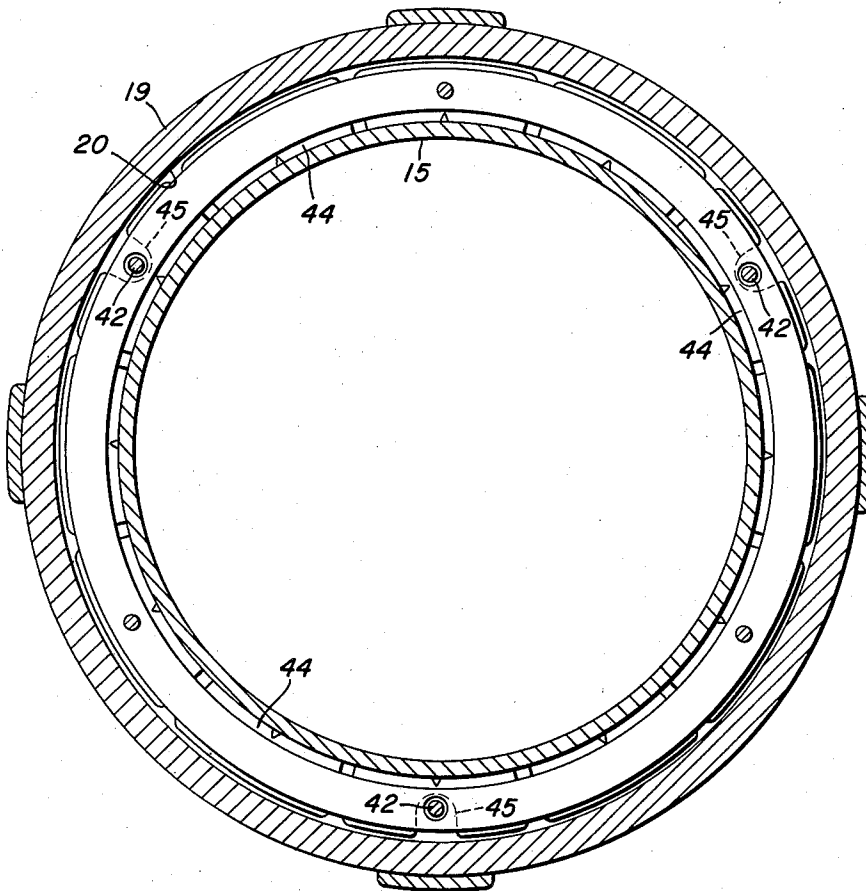
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FIG. 4.



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PUSHING AND PULLING APPARATUS

6 Sheets-Sheet 5

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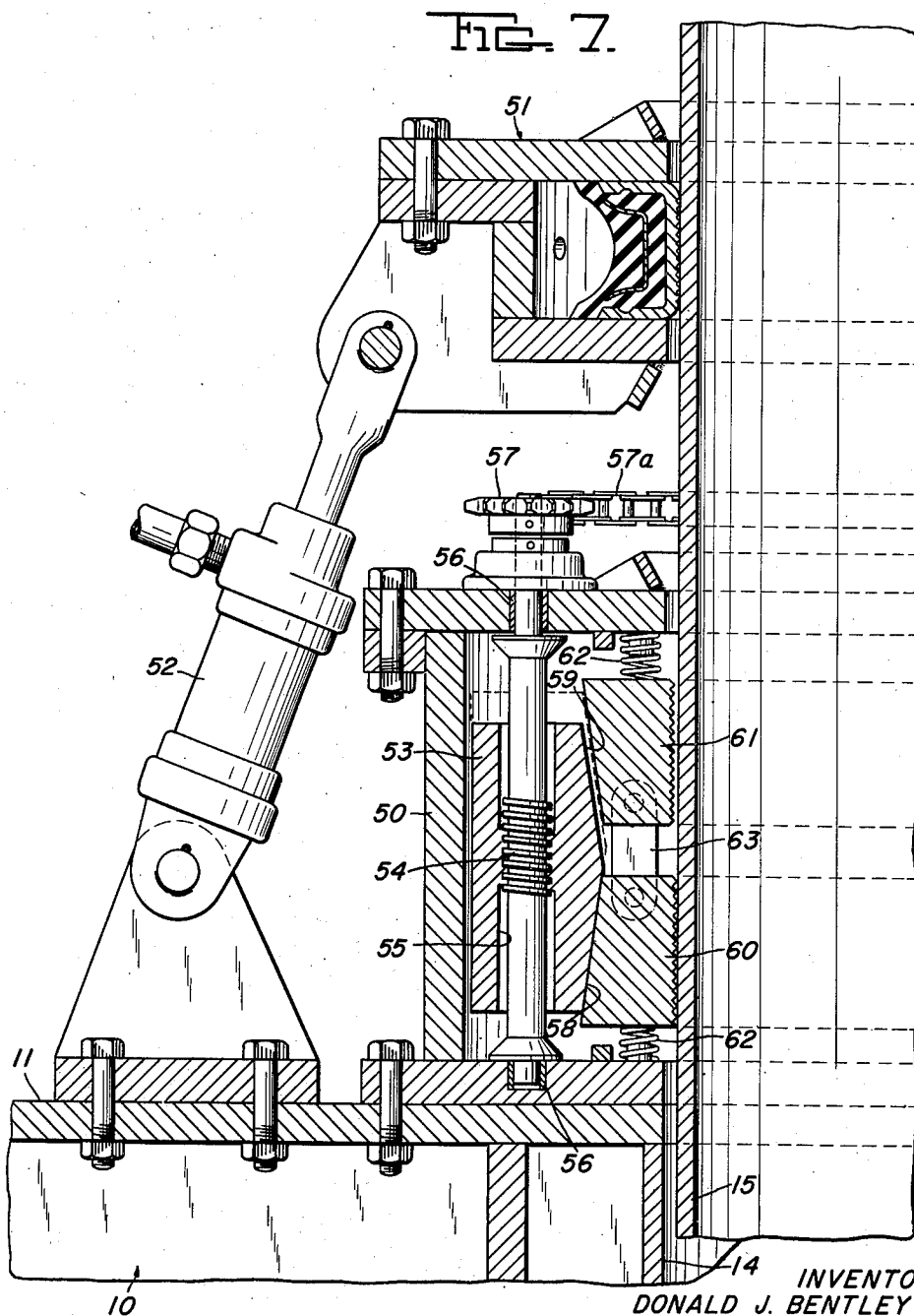
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D. J. BENTLEY ET AL
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6 Sheets-Sheet 6



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2,830,788

PUSHING AND PULLING APPARATUS

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5 Claims. (Cl. 254—31)

This invention relates to apparatus for exerting longitudinal thrust on an elongated member such as a column for moving either the column or a member carried thereby relative one to another.

One application for the invention is a jack for "climbing" the columns or caissons slidably inserted through wells in a decked barge fabricated from metal plate, to lift it above water level so it may serve as a dock, as described in "U. S. Steel News" July 1952, pp. 4-9. For the installation there described, an unusual expedient was used, i. e., rubber pneumatic rings encircling each caisson in spaced groups were alternately inflated to grip it while another group of such rings exerted the necessary lift.

It is the object of our invention to improve generally on such prior apparatus by providing a construction especially adapted for repeated use as required in modern off-shore drilling wherein the barge, after installation and use at one location, must be lowered into the water for travel to a different location.

A further object is to provide means effective automatically to exert a frictional grip on the caisson to hold it against movement in one direction relative to the barge, or vice versa, while the caisson is being moved stepwise in the other direction.

In a preferred embodiment, we provide a slip casing secured to the barge deck, having opposed sets of upper and lower slips forming chocks adapted selectively to hold the barge or the caisson against movement in one direction, while it is being moved in the other direction in a series of lifts or descents. A plurality of double-acting fluid pressure cylinders and pistons effect these lifts or descents. A fluid-operated gripper ring spaced from the slip casing makes temporary frictional engagement with the caisson to afford reaction for a lift on the barge or the grip necessary to raise the caisson. The cylinders and pistons extend between the barge deck and the gripper ring and are pivotally connected thereto. We provide power-operated means effective selectively to retract one of the two sets of slips from operative position.

A complete understanding of the invention may be obtained from the following detailed description and explanation which refer to the accompanying drawings illustrating the present preferred embodiment. In the drawings:

Figure 1 is a vertical section through our improved apparatus, with parts in elevation, showing a portion of the barge and one of the caissons for supporting it;

Figure 1a is a portion of Figure 1 showing parts in alternate positions;

Figures 2 through 5 are partial or complete transverse sections taken along the planes of lines II—II, III—III, IV—IV, and V—V, respectively;

Figure 6 is a partial bottom plan view of the upper slips; and

Figure 7 is a view similar to Figure 1 showing a modification.

Referring now in detail to the drawings and, for the present, to Figure 1, a barge 10 fabricated from metal

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plate includes a deck 11, longitudinal and transverse bulkheads 12 and 13 and a number of spaced cylindrical wells 14 extending from the deck through the bottom (not shown). A caisson 15 is slidably inserted into each well. The caissons are large cylindrical metal columns adapted to support the barge when they are lowered to the bottom of the body of water on which the barge is operating and the barge is jacked up on the caissons. When the barge is to be moved to a different location it is lowered into the water and the caissons are pulled from the bottom and raised to a height suitable for travel of the barge. Thus, when the caissons are lowered, they support the barge but when raised they are supported by it. Our invention concerns only the means for raising and lowering the caissons and for jacking the barge up and down thereon.

A base plate 16, having a central opening in alignment with well 15 to accommodate a caisson, is secured to deck 11 by an anchor plate 17 bolted thereto. Plate 16 has lugs 18 upstanding thereon in pairs spaced circumferentially about its periphery. A slip casing 19 in the form of a cylinder having a bore 20 therethrough with spaced, oppositely tapering, frusto-conical portions 21 and 22, stands vertically on plate 16 and has radial webs 23 fitting between lugs 18 bolted thereto. The slip casing telescopes exteriorly onto the caisson as the latter is inserted through well 14.

A ring of segmental slips 24 in casing 19 cooperates with tapered portion 21 of bore 20. The slips are adapted by wedging action to hold the casing against downward movement relative to the caisson 15. Slips 24 are constantly urged toward operative position by springs 25 inserted in four tubular sockets 26 equally spaced circumferentially on plate 16 and compressed between it and a bearing ring 27 engaging the slips at the bottom thereof. Ring 27 has guide pins 28 extending downwardly therefrom through the springs and into the sockets. The slips are spaced from each other by compressible washers 29 of rubber or like material (see Figure 6), which permit the slips to contract radically about the caisson for gripping yet tend to spread them apart to maintain them in contact with the bore of casing 19.

A friction gripper 30 spaced above the slip casing 19 also telescopes onto the exterior of the caisson when it is inserted in well 14. The gripper includes an annular fluid chamber 31 open on the inner side, fabricated from metal plate. A contractible ring 32 of rubber-like material forms the inner wall of the chamber and is fitted with segmental metal shoes 33 having serrated faces adapted to engage the caisson. When fluid under pressure is admitted to chamber 31 through a port 31a, the ring 32 is contracted with slight radial sliding movement in the chamber and shoes 33 take a firm frictional grip on the caisson.

Thrust means in the form of double-acting fluid-pressure cylinders 34 are provided for exerting either an upward push or a downward pull on the caisson from the barge. The cylinders are pivoted to ears 35 upstanding on plate 17 while their piston rods 36 are pivoted to radial webs 37 spaced circumferentially of gripper 30. Thus, if the piston rods be extended fully and gripper 30 operated to seize the caisson, retraction of the pistons in cylinders 34 will exert a downward pull on the caisson, the reaction of which will be an upward lift on the barge. Conversely, if the gripper be operated to seize the caisson while the pistons of the cylinders are retracted, extension of the piston rods will cause a lowering of the barge if above water or a lift on the caisson if the barge be floating.

Three brackets 38 are mounted on a plate 39 secured

on top of slip casing 19, and are equally spaced circumferentially thereof. A fluid-pressure cylinder 40 is mounted vertically on each bracket by clamp blocks 41 and has its piston rod 42 extending downwardly into the casing. A bearing ring 43 to which the lower ends of the rods are secured, supports a second set of segmental slips 44 adapted to cooperate with tapered portion 22 of bore 20 in casing 19. Certain of slips 44 are grooved as at 45 to admit rods 42 and all the slips are constantly urged downwardly by three equally spaced springs similar to those shown at 25. When the pistons of cylinders 40 are retracted, however, slips 44 are held in the position shown in Figure 1, out of operative engagement with casing 19. When piston rods 42 are extended, slips 44 are permitted to engage the tapered portion 22 of the casing bore and ring 43 displaces slips 24 downwardly to inoperative position, as shown in Figure 1a.

It will be understood that slips 24 and 44 serve selectively as chocks or holding clutches to control relative movement between the barge and caisson, depending on which set is permitted to engage its tapered portion of the casing bore, the selection being made by operating the pistons of cylinders 40 to their upper or lower positions. When the barge is floating, slips 44 are brought into play to control lowering of the caissons to sea bottom, and hold the caisson between successive lowering steps while the gripper is being disengaged, moved upwardly on the caisson and then re-engaged therewith. Slips 44, of course, must be retracted to disengage the caisson during each actual lowering step.

When the caissons reach firm footing on the bottom, ring 43 is raised whereupon slips 24 serve to hold the barge against downward movement between successive raising steps while the gripper is being reset for the next lift. Slips 24 and 44 also function in the same manner, respectively, during lowering of the barge and raising of the caissons. Together, slips 24 and 44 constitute a double-acting chock effective selectively to permit relative movement in one direction between the barge and caisson while preventing such movement in the other direction.

Figure 7 shows a modification generally similar to the apparatus described above but differing slightly therefrom in structure and operation. As shown, the modified apparatus comprises a slip casing 50 adapted to be secured to the deck 11 of barge 10, a gripper 51 similar to that shown at 30, and fluid-pressure cylinders and pistons 52 pivoted to the gripper and the barge deck. Casing 50 is a rigid annular member fabricated from metal plate, open on the inner side and adapted to telescope on the exterior of caisson 15 when it is inserted through well 14.

A wedging ring 53 is slidable axially within casing 50. Adjusting screws 54 extend through holes 55 spaced circumferentially of ring 53 and have threaded engagement therein. The screws are journaled in bearings 56 in the upper and lower walls of casing 50 and have sprockets 57 on their upper ends whereby all the screws may be driven simultaneously by a chain 57a trained over the sprockets and extending continuously around the caisson. The interior of ring 53 is bored to form opposed frusto-conical portions 58 and 59.

Opposed upper and lower sets of slips 60 and 61 are disposed in ring 53 and are adapted to make frictional contact with the exterior of the caisson. The slips are urged toward operative position by springs 62 and alined slips in the two opposed sets are loosely connected by links 63 and pivot pins. It will be evident that the adjustment of ring 53 to its lower or upper position determines which set of slips will be effective to permit relative movement in one direction between the barge and caisson, and prevent movement in the other direction. When ring 53 is moved downwardly to its solid-line position, slips 60 become effective. When it is desired to make use of slips 61 it is only necessary to adjust the ring to its upper posi-

tion shown in dotted lines. Operation of the chain to drive the adjusting screws may be manual or by suitable power means. In other respects, the operation of the apparatus of Figure 7 is the same as that of the apparatus shown in Figures 1 to 6.

It will be apparent from the foregoing that our invention provides a safe and highly effective apparatus for repeatedly raising and lowering a barge and its supporting caissons, whereby it may be readily moved from one location to another as required by the nature of the operations carried out thereon, such as exploratory drilling. The apparatus, furthermore, is simple and well adapted to be designed for the heavy loads involved. At the same time, it is easily controlled, requiring only a source of operating fluid under suitable pressure and appropriate valves. Only a single operation, i. e., reciprocation of the pistons of cylinders 40, is necessary to shift from a raising to a lowering operation. Once the barge is raised to the desired height, the slips 24 serve automatically to hold it there, but semi-permanent fasteners such as bolted brackets will, of course, be employed as the principal means to secure the barge to the caissons for extended use.

Although we have disclosed herein only the present preferred embodiment of our invention and certain variants thereof, we intend to cover as well any change or modification therein which may be made without departing from the spirit and scope of the invention.

We claim:

1. Apparatus for raising and lowering a marine vessel having a vertical well therethrough, on a bottom-grounded column slidably extending through said well, said apparatus comprising a slip casing secured to the vessel and telescoped on said column, said casing having a bore with two oppositely tapering frusto-conical portions, opposed sets of slips in said portions effective in opposite directions, adapted frictionally to grip the column on relative movement between the column and vessel, control means for selectively rendering said sets of slips ineffective, a friction gripping ring operable by fluid pressure, telescoped on said column, spaced therealong from said casing and effective when engaged to exert thrust on the column in either direction therealong, and jacks secured to said ring and to the vessel whereby to raise and lower the column when the vessel is floating and to raise and lower the vessel on the column when the column is on bottom.

2. Apparatus according to claim 1 characterized by said gripping ring including a rigid annular fluid chamber open on the inner side and a contractible collar slidable radially in said chamber and forming the inner wall thereof.

3. Apparatus according to claim 1 characterized by power means for actuating said slip-control means.

4. Apparatus according to claim 1 characterized by said slip-control means including a shifter ring movably disposed between said sets of slips.

5. Apparatus according to claim 1 characterized by said slip-control means including means mounting said slip casing slidably toward and from the vessel, and screws journaled in the vessel and extending through said casing effective to shift it bodily in an axial direction relative to both sets of slips.

References Cited in the file of this patent

UNITED STATES PATENTS

1,121,718	Derby et al.	Dec. 22, 1914
1,454,088	Thrift	May 8, 1923
1,895,132	Minor	Jan. 24, 1933
1,909,696	List	May 16, 1933
2,555,145	McKinney	May 29, 1951

FOREIGN PATENTS

28,406	Great Britain	June 25, 1914
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