

July 8, 1958

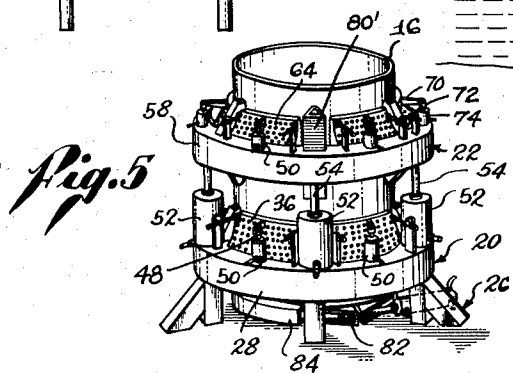
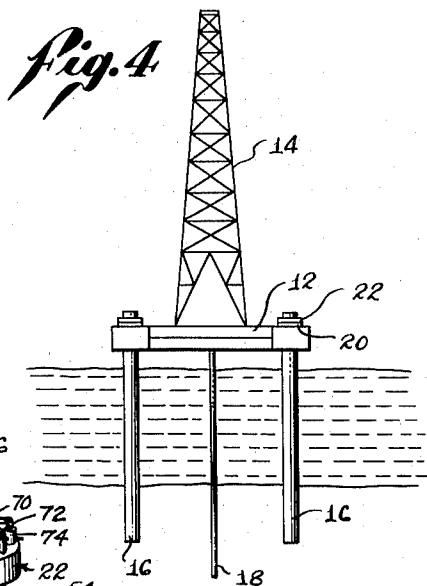
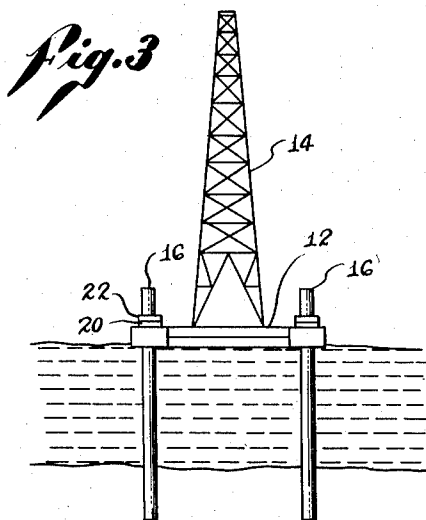
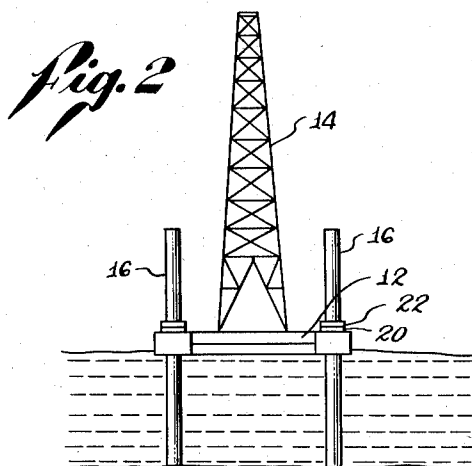
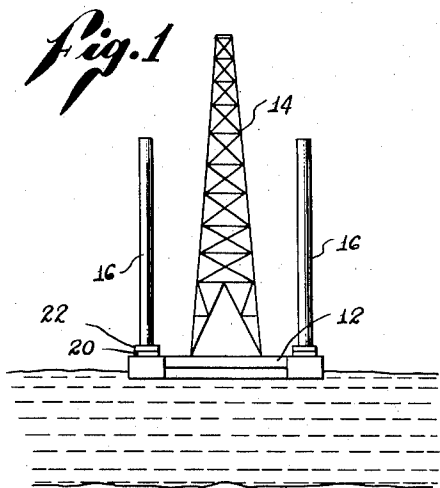
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2,841,961

OFF-SHORE DRILLING BARGE

Filed April 13, 1953

2 Sheets-Sheet 1



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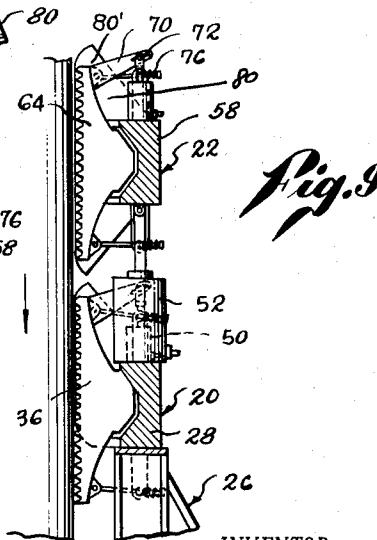
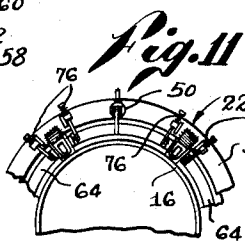
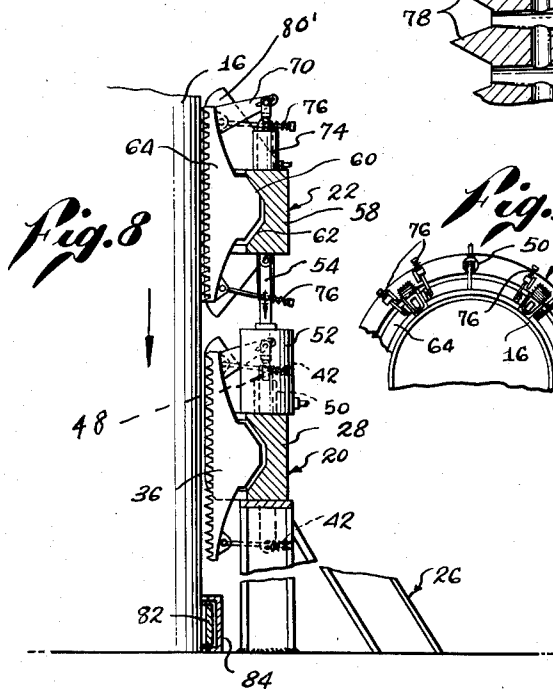
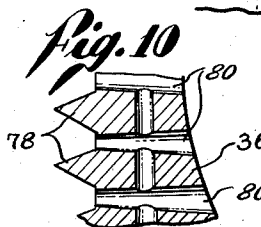
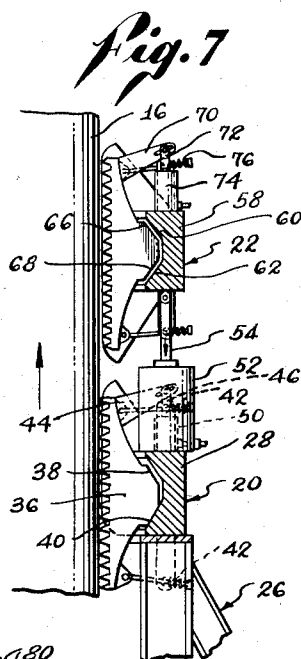
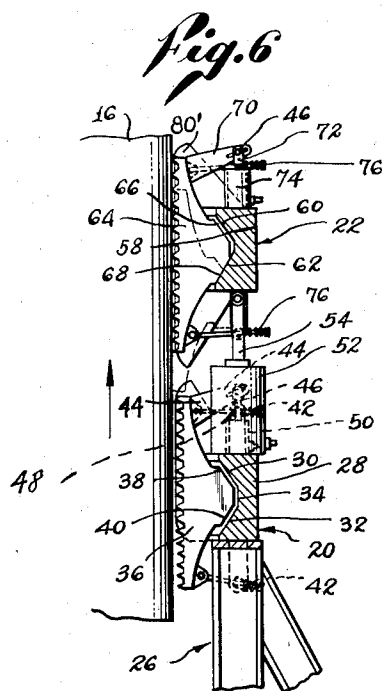
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2 Sheets-Sheet 2



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2,841,961

OFF-SHORE DRILLING BARGE

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Application April 13, 1953, Serial No. 348,269

14 Claims. (Cl. 61—46.5)

This invention relates to mechanism for elevating and/or lowering a structure such as a drilling barge, dock structure and other types of heavy construction and is particularly adapted for use in over-water well drilling operations commonly known as off-shore drilling operations. The invention is susceptible to other uses, the primary object however being in connection with the drilling of oil wells where the oil pools lie beneath bodies of water. This invention is particularly suited to use on bodies of water subject to storm, hurricane and violent wave action.

Objects of the invention are to provide a mechanism to elevate or lower a barge or other structure; to provide a structure which eliminates the fabricating of platforms or other structures above the water in a piece-by-piece operation; to provide effective means for quickly elevating and/or lowering such a structure; to provide a highly efficient type of supporting upright in combination with an improved gripping means for engaging the upright to provide an effective mechanical wedging self-locking mechanism to maintain the relative positions of the supporting uprights to the structure; to provide an improved power jack construction in case of normal operational failure including a device having a "failing safe" arrangement; and to provide a guide for the caissons or uprights. The above and other objects will more fully appear from the following description in connection with the accompanying drawings.

Fig. 1 is a diagrammatic view of an embodiment of the invention with the barge supporting uprights elevated and the barge in a full floating condition.

Fig. 2 is a diagrammatic view showing the uprights lowered to engage the bottom of the body of water.

Fig. 3 is a diagrammatic view showing the uprights driven or jacked into the bottom of the water body and the barge being elevated.

Fig. 4 is a diagrammatic view showing the barge elevated above the water level and in drilling position.

Fig. 5 is a perspective view of a portion of one upright and its elevating mechanism assembly.

Fig. 6 is an enlarged fragmentary sectional view through a portion of an upright and the elevating mechanism, the upper clamping element being shown in full and broken lines and the arrows indicating movement of the upper clamping element to elevate the upright.

Fig. 7 is a view similar to Fig. 6 with the elevating mechanism in position for a downward stroke of the upper element.

Fig. 8 shows the elevating mechanism in position to raise the barge on the upright or drive the upright into the marine bottom.

Fig. 9 shows the position of the clamping elements when the barge is supported on the upright by the lower clamping elements.

Fig. 10 is an enlarged sectional detail of a portion of one of the gripping shoes or slips.

Fig. 11 is a horizontal sectional detail through one of

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the clamping elements to illustrate the general location of the radially disposed centering guides.

In Figs. 1 through 4 is shown a barge 12 which is adapted to suitably support a well drilling unit. At each corner of the barge 12 is a large tubular upright 16 which extends slideably through the barge 12. As the barge is floated into the desired location for drilling, the uprights 16 are elevated as in Fig. 1 or they may be partially elevated to lend stability to the floating barge and clear the bottom of the body of water.

When the barge has been floated onto the desired location, the uprights 16 are lowered by dropping or jacking until their lower ends engage the bottom of the body of water as illustrated in Fig. 2. At this point, and as illustrated in Fig. 3, the barge 12 is jacked up on the uprights 16. The weight of the barge and the equipment carried thereby causes the uprights 16 to penetrate the bottom of the body of water a distance depending upon the softness of the bottom and the weight of the barge. When the uprights 16 cannot be forced downwardly into the bottom any further, the barge 12 will be lifted as illustrated in Fig. 4 until the entire barge is above the water surface and water action is exerted only against the uprights 16 which present a minimum surface. Thus there is quickly and efficiently provided a stationary structure from which drilling or other operations can be efficiently conducted. The drill pipe 18 indicated in Fig. 4 can conveniently be lowered through a suitable slot and drilling procedures can be carried on in the usual manner.

Upon completion of the well a minimum producing platform may be installed and the drilling barge may then be lowered, the uprights retracted from the bottom and elevated to towing position and the barge towed to a new location.

Figs. 5 through 10 illustrate the structure of pairs of clamping elements indicated in their entirety at 20 and 22. These elements are shown diagrammatically in Figs. 1 through 4.

The lower slip or wedge ring assembly 20 includes an outer rigid ring 28 and an inner arcuate sectional gripping shoe 36 adapted to engage a tubular barge-supporting upright 16. The ring 28 is mounted on suitable framing 26 which is rigidly secured to the deck of the barge 12. The inner periphery of the ring 28 is provided with inwardly-diverging frusto-conical wedge surfaces 30 and 32 separated by a cylindrical surface 34, while the shoe 36 is provided with complementary wedge surfaces 38 and 40 which cooperate with the wedge surfaces 30 and 32, respectively. Each section of the shoe 36 is urged radially outwardly toward the ring 28 by springs 42.

Connected to the upper portion of each section of the gripping shoe 36 is an arm 44 having the outer end thereof pivotally connected, as at 46, to an upright piston rod 48 of a fluid-operated power cylinder 50. The cylinders 50 are mounted in upright position on the ring 28, so that simultaneous operation of the cylinders will serve to move all of the sections of the gripping shoe 36 upward or downward.

When the cylinders 50 are operated to hold the sections of the gripping shoe 36 in the neutral position shown in Figures 6 and 8, the cooperating wedging surfaces on the shoe 36 and on the ring 28 will be ineffective and the springs 42 will urge the shoe sections radially outwardly and out of engagement with the upright 16. When the cylinders 50 are operated to move the gripping shoe 36 downwardly from its neutral position, the wedging surfaces 32 and 40 are engaged and become effective to move the shoe into gripping engagement with the upright 16. When the cylinders 50 are operated to move the shoe 36 upwardly from its neutral position, the wedging surfaces 30 and 38 are engaged and become effective to urge the shoe 36 into gripping engagement with the upright 16.

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The two gripping actions of the shoe 36 on the upright 16, which may be alternatively effected by the two sets of wedging surfaces, are provided to take care of proper gripping of the upright, depending upon whether the vertical force exerted on the upright is to be upward or downward, as will later become evident.

The upper slip or wedge ring assembly 22 and its operating means are substantially identical to the lower wedge ring assembly 20, save that the rigid ring 58 is attached to the upper ends of piston rods 54 of a plurality of upright power cylinders 52 rigidly mounted on the ring 28 of the lower slip ring assembly 20. Hence, the upper slip ring assembly 22 can be moved upwardly or downwardly with respect to the lower slip ring assembly 20, and consequently with respect to the barge 12.

Thus, the upper wedge ring assembly 22 includes an outer rigid ring 58 and an inner arcuate sectional gripping shoe 64, the ring 58 and each section of the shoe 64 being provided with complementary frusto-conical wedging surfaces 60, 62, 66, and 68, similar to the cooperating wedging surfaces on the ring 28 and the shoe 36 of the lower slip ring assembly 20. Likewise, each section of the shoe 64 is provided with an arm 70 connected to a piston rod 72 of a power cylinder 74, which cylinders are mounted vertically on top of the ring 58. In like manner, each section of the shoe 64 is urged radially outwardly toward the rigid ring 58 by springs 76, which also tend to center the shoe 64 in its non-effective neutral position.

As best shown in Figure 10, the inner arcuate surface of each section of the gripping shoes 36 and 64 are provided with arcuately-extending teeth 78. The shoe sections are provided with radial holes 80 between pairs of adjacent teeth 78, so that mud, marine growth, and other semi-solid material will not pack between the teeth 78 in operation of the slip ring assemblies 20 and 22, but will be forced through the openings 80 as it accumulates between the teeth.

The quick release band unit 82, frame 84 and a suitable tensioning member such as a cylinder and piston unit will cause this quick release band to firmly grip the caisson or tubular upright in a firm manner, to permit the upper and lower gripping shoes to be released from engagement with the caisson so that the caissons may be dropped.

When the apparatus is operated to elevate the uprights 16 to place them in the position of Fig. 1 or to remove them from engagement with the bottom, the clamping rings 20 and 22 are manipulated as illustrated in Figs. 6 and 7. In such operation the upward force exerted on the tubular upright 16 results in a downward force on the barge and the lower set of gripping shoes 36.

Consequently, the shoe 36 of the lower slip ring assembly 20 is first lowered so that the wedge surfaces 32 and 40 will engage and force the shoe into gripping engagement with the upright 16. The upper ring assembly 22, with its gripping shoe 64 maintained in its neutral position, is then lowered to the broken-line position shown in Figure 6 by operation of the power cylinders 52. The power cylinders 74 are then operated to lower the shoe 64 of the upper ring assembly 22 and engage the wedging surfaces 62 and 68 into engagement to force the shoe 64 into gripping engagement with the upright 16. The power cylinders 52 are then operated to move the upper ring assembly upwardly. Coincidental with the raising of the upper ring assembly, the gripping shoes 36 of the lower ring assembly 20 are released by relieving the weight of the upright 16 therefrom and by simultaneously operating the power cylinders 50 to move the gripping shoe 36 to its neutral position, as shown in Figure 6.

It will be seen that the connection 46 between the arms 44 and 70 and the corresponding piston rods 48 and 72 is in the form of a pin and slot so that the shoes can be moved vertically in either direction by the power cylinders 50 and 74, while permitting radial inward and

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outward movement of the several sections of the shoes to grip or release the upright 16.

Carried by either or both of the wedge rings 20 and 22 are elements 80' which constitute centering guides to maintain the clamping elements in proper positional relationship to the caissons or uprights 16. This will insure effective operation of the gripping shoes 36 and 64 relative to the uprights or caissons 16.

The clamping elements and their component parts have combined wedging, lifting and compressive functions; which combined functions cooperate to produce a highly effective means of raising, and/or lowering the caissons or the barge to effect the elevating or lowering of the barge or other above-the-water structure.

The clamping elements 20 and 22 and their gripping shoes 36 and 64 comprise a highly practical raising and lowering mechanism for the type of structure disclosed herein. Furthermore, the wedge construction provides a "fail safe" device because any tendency of the barge to drop is prevented by the wedging action between the outer rings of each slip ring assembly and the gripping shoes.

When the tubular support 16 has been raised a sufficient distance, the lower shoes 36 are re-engaged with the upright 16 and the cycle can be repeated.

Figs. 8 and 9 are illustrative of the manner on which the uprights 16 can be lowered into engagement with the bottom of the body of water and the barge raised above the water level. With the lower gripping shoes 36 engaging the upright 16, the entire upper ring assembly is lowered. The upper shoes are then brought into gripping engagement with the upright, the lower shoes are coincidentally disengaged by releasing operating pressure and the action of springs 42 and then the entire upper assembly is raised by upward movement of the piston rod 54. When the upper assembly is raised, the upper shoes are out of engagement with the upright as indicated in Fig. 9 and when force is applied to lower the upright (or to raise the barge) the parts are positioned as shown in Fig. 8.

The angles of the wedging surfaces on the gripping shoes and slip rings are such that the wedging action is self-energizing. This wedging action is a function of the wedging surfaces and the weight of the barge, in combination with the movement produced by actuation of the power cylinders 50 or 74. The ratio of self-energization to power piston forces can be varied to suit conditions.

In Fig. 5 it is seen that the gripping shoes 36 and 64 have arcuate shapes to follow the contour of the uprights 16 and each shoe extends a substantial distance about the upright.

Another important feature is the provision of a gripping shoe which has appreciable vertical extent and which serves, with its two opposed wedging surfaces as a compound shoe for exerting either upward or downward forces. This single shoe with its dual function provides gripping engagement with the tubular upright 16 over an extensive surface area so that the tremendous forces applied to the upright will not bend or crush it.

It will be understood that various changes can be made in the form, details, arrangement and proportions without departing from the spirit of the invention.

I claim:

1. A movable gripper assembly of the class described arranged to releasably engage a supporting column, said gripper assembly including an upper slip ring and a lower slip ring, each of said rings having its inner periphery formed of spaced converging oppositely inclined surfaces, segmental gripping shoes within each of said rings, each of said shoes having converging oppositely inclined surfaces arranged to engage and complementary to said ring surfaces, means movably connecting the shoes to said rings, means for normally maintaining the shoes out of engagement with the rings, pressure operated means for

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selectively moving the inclined surfaces of the shoes into engagement with the inclined surfaces of the rings so as to cause the shoes to be moved radially into frictional engagement with the supporting member, means for displacing one of said rings axially relative to the other ring, and a clamping bar spaced from said rings for releasably engaging the column to independently support the same.

2. A movable gripper assembly of the class described arranged to releasably engage a supporting column, said gripper assembly including vertically spaced upper and lower slip rings, each of said rings having its inner periphery formed of spaced converging oppositely inclined surfaces, segmental gripping shoes within each of said rings, each of said shoes having converging oppositely inclined surfaces arranged to engage and complementary to said ring surfaces, circumferentially spaced fluid pressure means mounted on one of said rings and operatively connected to the other ring for displacing the latter axially, auxiliary fluid pressure means mounted on the lower slip ring and operatively connected to the lower segmental shoes and auxiliary pressure means mounted on the upper slip ring and operatively connected to the upper gripping shoes for moving each of the shoes axially into and out of engagement with the inclined surfaces of its associated ring, and means yieldably connecting the shoes to said rings and normally maintaining the shoes out of engagement with the rings, said auxiliary fluid pressure means being operable for displacing the shoes relative to the rings so as to selectively force the shoes into contact with the supporting column, said fluid pressure means being operable to move either the column or the base vertically when one of the shoes is in gripping engagement with the supporting column.

3. A movable gripper assembly of the class described arranged to releasably engage a supporting column, said gripper assembly including vertically spaced upper and lower slip rings, each of said rings having its inner periphery formed of spaced converging oppositely inclined surfaces connected by a vertical flat surface, segmental gripping shoes within each of said rings, each of said shoes having converging oppositely inclined surfaces arranged to engage and complementary to said ring surfaces means yieldably connecting the shoes to said rings, means for normally maintaining the shoes out of engagement with said rings, pressure operable means for selectively moving the inclined surfaces of the shoes into engagement with the inclined surfaces of the rings so as to cause the shoes to be moved radially into frictional engagement with the supporting member, means for displacing one of said rings axially relative to the other ring, a clamping bar spaced from the rings for releasably engaging the column to independently support the same, and fluid pressure operated means for controlling the expansion and contraction of said clamping bar.

4. A gripper assembly of the class described including an annular member provided on its inner periphery with converging surfaces forming upper and lower oppositely inclined sides, a gripping shoe within the annular member and provided with converging surfaces complementary to and arranged alternately to engage the inclined surfaces of said annular member, and means for moving the shoe axially so as to bring the upper inclined complementary sides into wedging engagement with each other or the lower inclined complementary sides into such engagement.

5. A gripper assembly of the class described including vertically spaced annular members, each of said members being provided on its inner periphery with converging surfaces forming upper and lower oppositely inclined sides, segmental gripping shoes within the annular members, each of said shoes having converging inclined surfaces complementary to and arranged selectively to engage the upper and lower inclined surfaces of the adjacent annular member, yieldable means for movably connecting

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the shoes to the annular members, and means for moving each shoe axially so as to bring either the upper or the lower inclined side thereof into contact with the adjacent inclined complementary surface of the annular member.

6. A gripper assembly of the class described including vertically spaced annular members, each of said members being provided on its inner periphery with converging surfaces forming upper and lower oppositely inclined sides, segmental gripping shoes within the annular members, each of said shoes having converging inclined surfaces complementary to and arranged selectively to engage the upper and lower inclined surfaces of the adjacent annular member, each of said shoes having vertically spaced yieldable means connected thereto, means connecting said yieldable means to an annular member so as to movably connect the shoe to the annular member, and means for moving each shoe axially so as to bring either the upper or the lower inclined side thereof into contact with the adjacent inclined complementary surface of the annular member.

7. A structure comprising: a buoyant platform; at least one elongated supporting member therefor; guide means on said platform mounting said member for movement relative to said platform in directions extending substantially longitudinally of said member; jack means for selectively effecting or restraining said relative movement comprising a pair of upper and lower holding means, each including power-operated double-acting slip means, spaced along the length of said member and each independently releasably engageable therewith against movement relative thereto selectively in either of said directions; double-acting hydraulic motor means connected to both of said holding means for selectively effecting or restraining relative linear movement between said upper and lower holding means in either of said directions; and means securing one of said holding means to said platform against movement relative to the latter in either of said directions.

8. A marine structure comprising: a buoyant platform; a plurality of elongated marine-bottom-engageable platform-supporting members; guide means on said platform for mounting each of said members for movement relative to said platform in directions extending longitudinally of said member; jack means for each of said members for selectively effecting or restraining said relative movement comprising a pair of upper and lower holding means, each including power-operated double-acting slip means, spaced along the length of the corresponding member and each independently releasably engageable therewith against movement relative thereto selectively in either of said directions, and double-acting hydraulic motor means connected to both of said holding means for selectively effecting or restraining relative linear movement therebetween in either of said directions; and means for securing one of the holding means of each pair to said platform against movement relative to the latter in either of said directions.

9. In a jack assembly for selectively effecting or restraining relative movement between a platform and an elongated supporting member therefor selectively in either direction longitudinally of the member, the combination comprising: a slip ring adapted to surround the supporting member and having a pair of oppositely-inclined frusto-conical interior wedging surfaces; segmental slip means within said ring and having a pair of surfaces substantially complementary to and alternatively cooperable with said ring surfaces, on movement of said means in either direction from a neutral position axially of said ring, for forcing the segments of said slip means inwardly into gripping engagement with the supporting member and thereby lock said ring against axial movement relative thereto in one direction; and power-operated means mounted on said ring and connected to said slip means for selectively effecting or restraining said relative axial

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movement between said slip means and said ring selectively in either direction.

10. The structure defined in claim 9 including means loosely connecting the power-operated means to the segments for effecting the axial relative movement while permitting the inward movement.

11. The structure defined in claim 9 including power-operated means connected to the ring and to the platform for selectively restraining or effecting relative movement between said ring and the platform selectively in either direction axially of the former.

12. The structure defined in claim 11 in which the power-operated means connected to the ring and to the platform includes a fluid-pressure-operated double-acting power cylinder secured to the platform and having its piston rod secured to said ring.

13. In a jack assembly for selectively effecting or restraining relative linear movement between a platform and an elongated supporting leg guided on the platform for linear movement in directions extending longitudinally of the leg, the combination comprising: a ring-like member adapted to surround the leg and having a pair of oppositely-inclined inwardly-facing interior wedging surfaces; segmental gripping shoe means movably carried by said member for interposition between the latter and the leg and having a pair of surfaces complementary and opposed to said member wedging surfaces, movement of said shoe means axially of said member in either direction from a neutral position serving to cause a wedging

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action between one of said shoe means surfaces and the corresponding opposed member wedging surface effective to contract said shoe means into tight-gripping engagement with the leg and lock said member thereto against axial movement in one direction, whereby relative movement between said member and leg in said one direction serves to increase said gripping engagement; and power-operated means mounted on said member and connected to said shoe means for selectively effecting or restraining movement of said shoe means selectively in either direction axially of said member.

14. The structure defined in claim 13 including a plurality of fluid-pressure-operated double-acting jacking cylinders connected to the ring and to the platform for selectively effecting or restraining relative movement therebetween selectively in either direction axially of said member.

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