United States Patent [19]

Lucas

[11] **3,876,181**

[45] **Apr. 8, 1975**

[54] **METHOD AND APPARATUS FOR QUICKLY ERECTING OFF-SHORE PLATFORMS**

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[73] Assignee: **Marine Engineering Company C.A.**, Caracas, Venezuela

[22] Filed: **Apr. 23, 1973**

[21] Appl. No.: **353,665**

[52] **U.S. Cl.** **254/107**; 61/46.5

[51] **Int. Cl.** **B66f 1/00**; E02d 21/00

[58] **Field of Search** ..... 254/105–107, 254/89 H; 61/46.5; 52/126, 745

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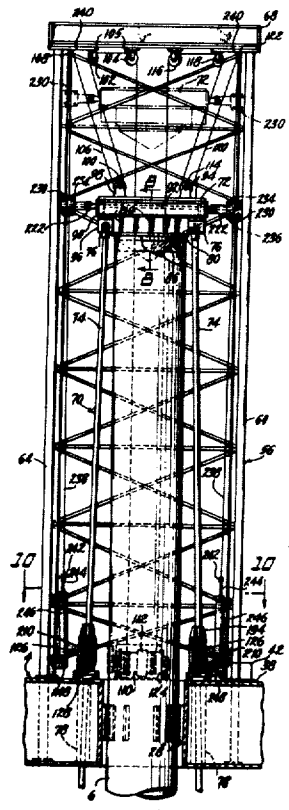
Primary Examiner—Othell M. Simpson
Attorney, Agent, or Firm—Harry W. F. Glemser

[57] **ABSTRACT**

Method and apparatus for elevating an off-shore well drilling or other platform on a support structure in a minimum of time with maximum safety. The platforms are elevated on one or more caissons, utilizing one or more jacking units.

One type of support structure comprises three caissons arranged as a tripod. The platform to be mounted thereon has three open caisson wells and is floated into position, with one caisson received in each well. A caisson locking gate is closed to hold the platform in place. A pre-set-up jacking unit is located near or straddles each caisson well. Each jacking unit includes a jacking head, one or more jacking legs pivotally connected at their upper end to the jacking head, and a jacking mechanism surrounding each jacking leg and connected by a gimbal joint at its lower end to the platform. A stabilizing frame for each jacking unit is mounted on the platform. Trolleys mounted on the opposite sides of the frame, pulleys and tensioned cables initially hold the jacking head centered in the frame. Additional cables hold the jacking head suspended above the upper end of its associated caisson, ready to be lowered onto the caisson to immediately commence the platform hoisting operation.

18 Claims, 31 Drawing Figures



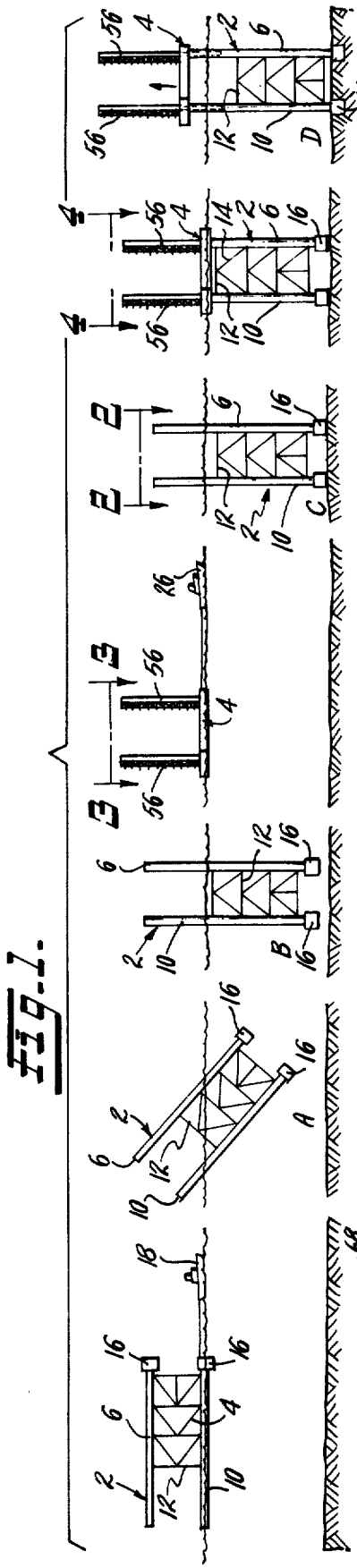


FIG. 1.

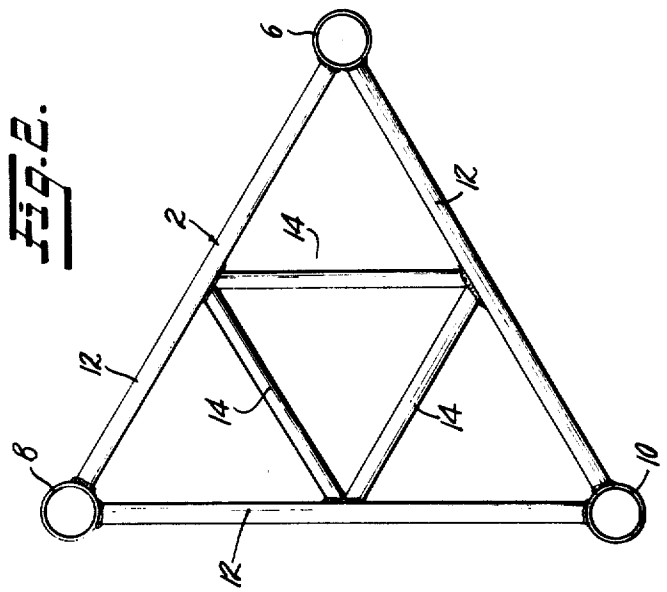


FIG. 2.

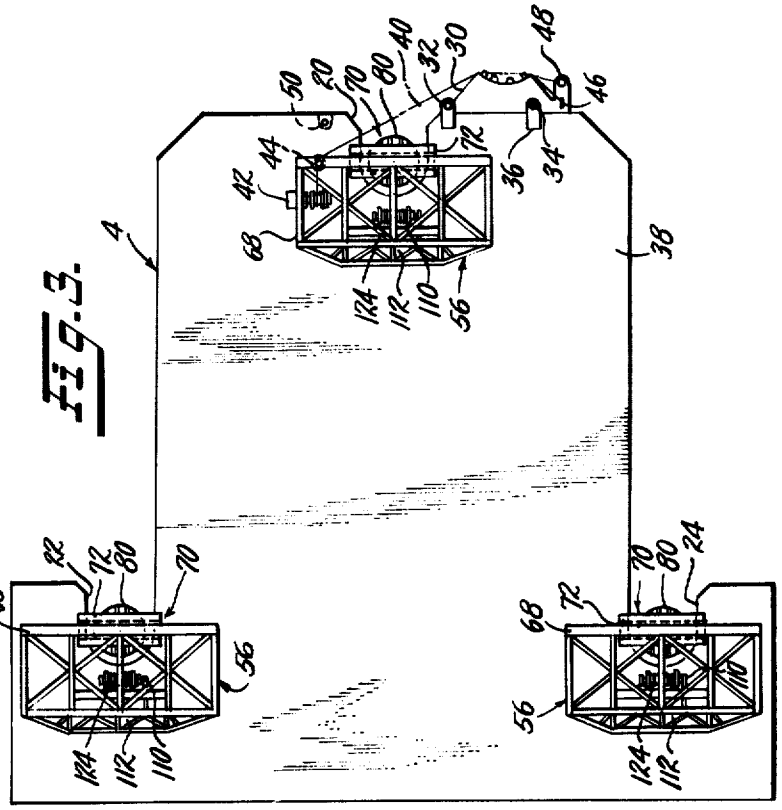


FIG. 3.

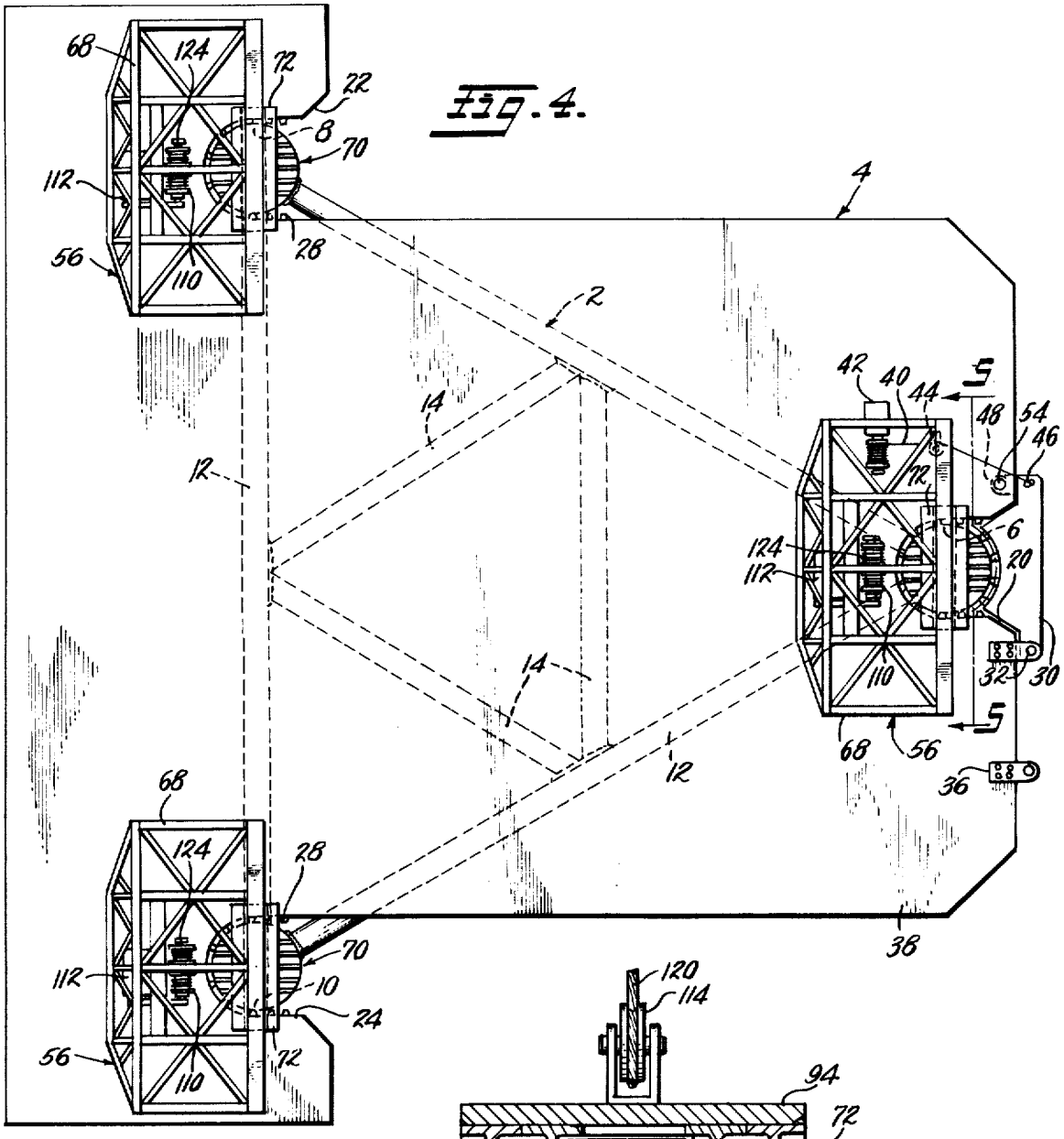

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Fig. 4.

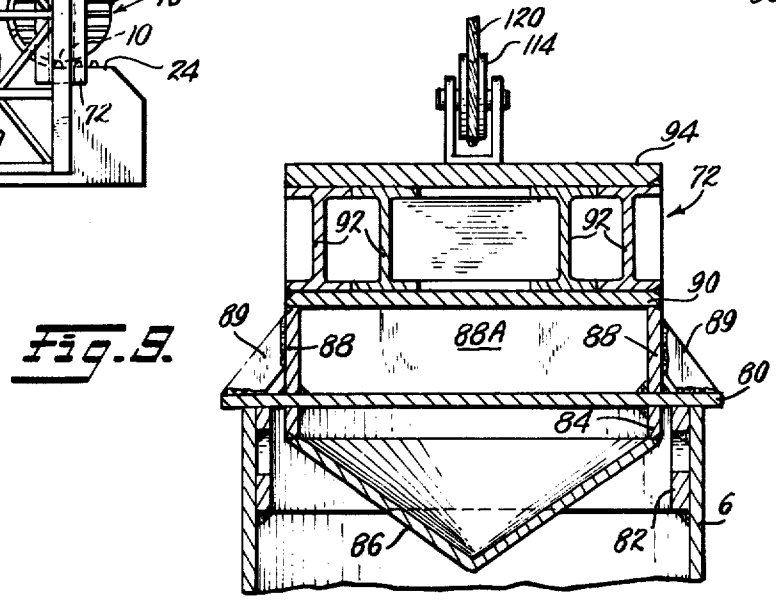
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Fig. 9.

Fig. 5.

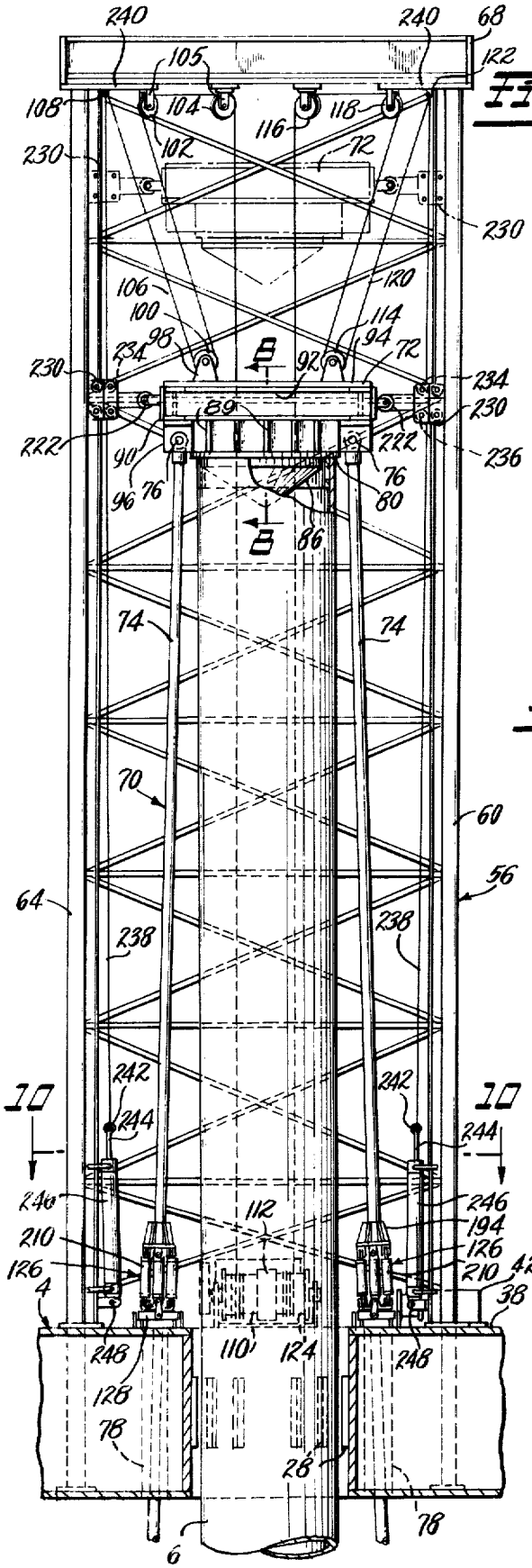
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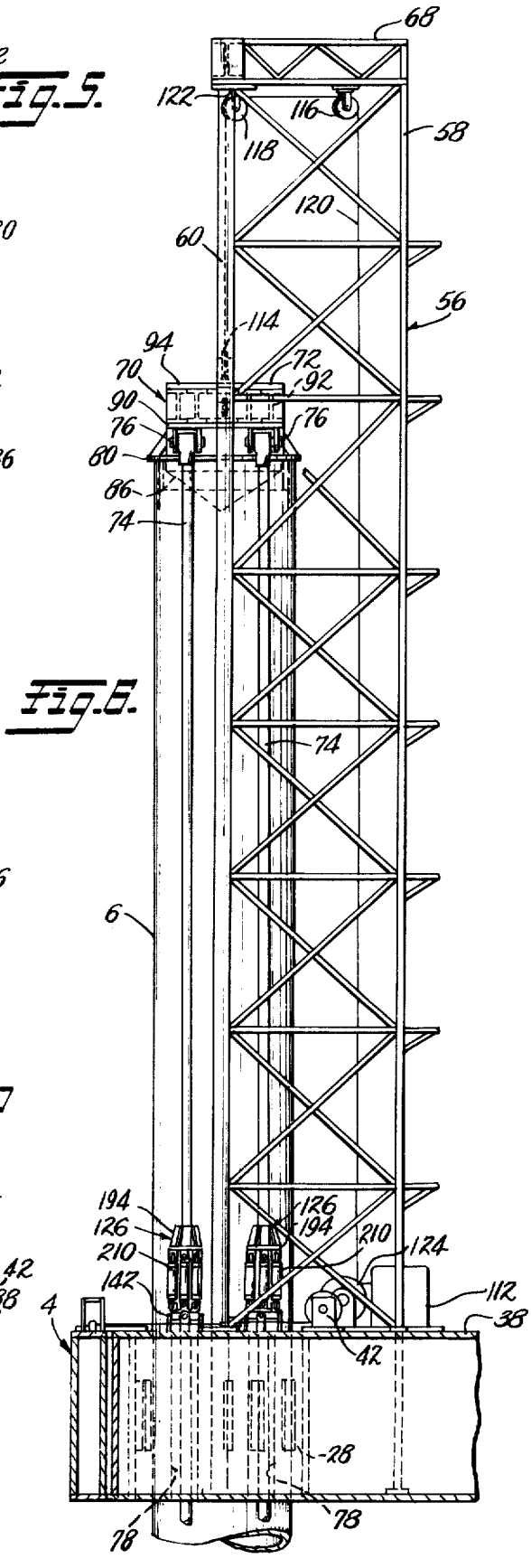
Fig. 6.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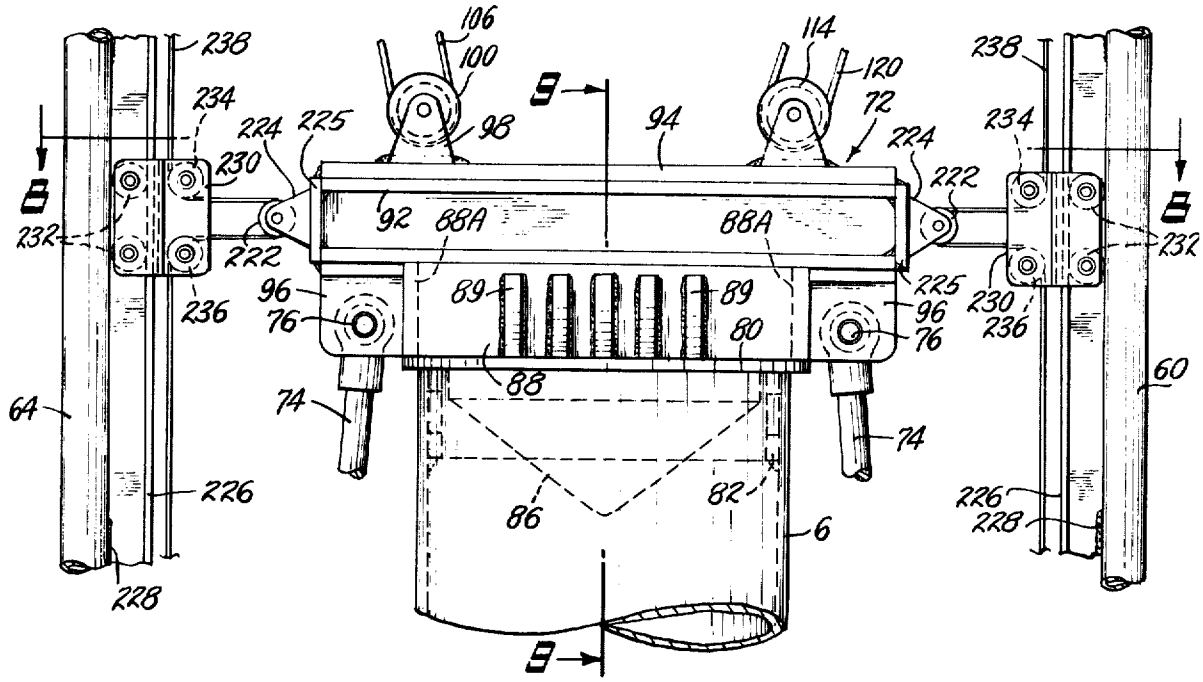
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Fig. 7.

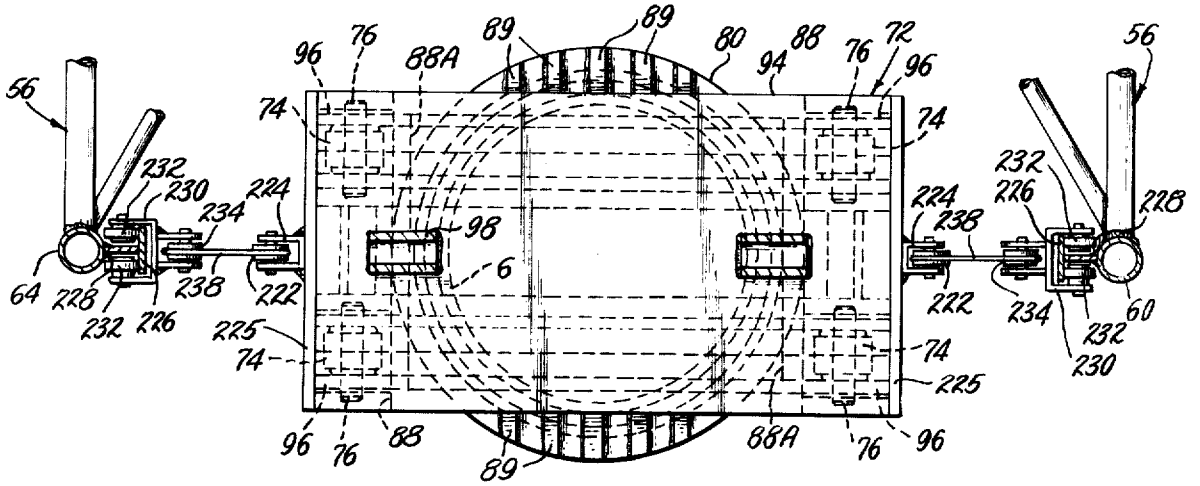
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Fig. 8.

Fig. 14.

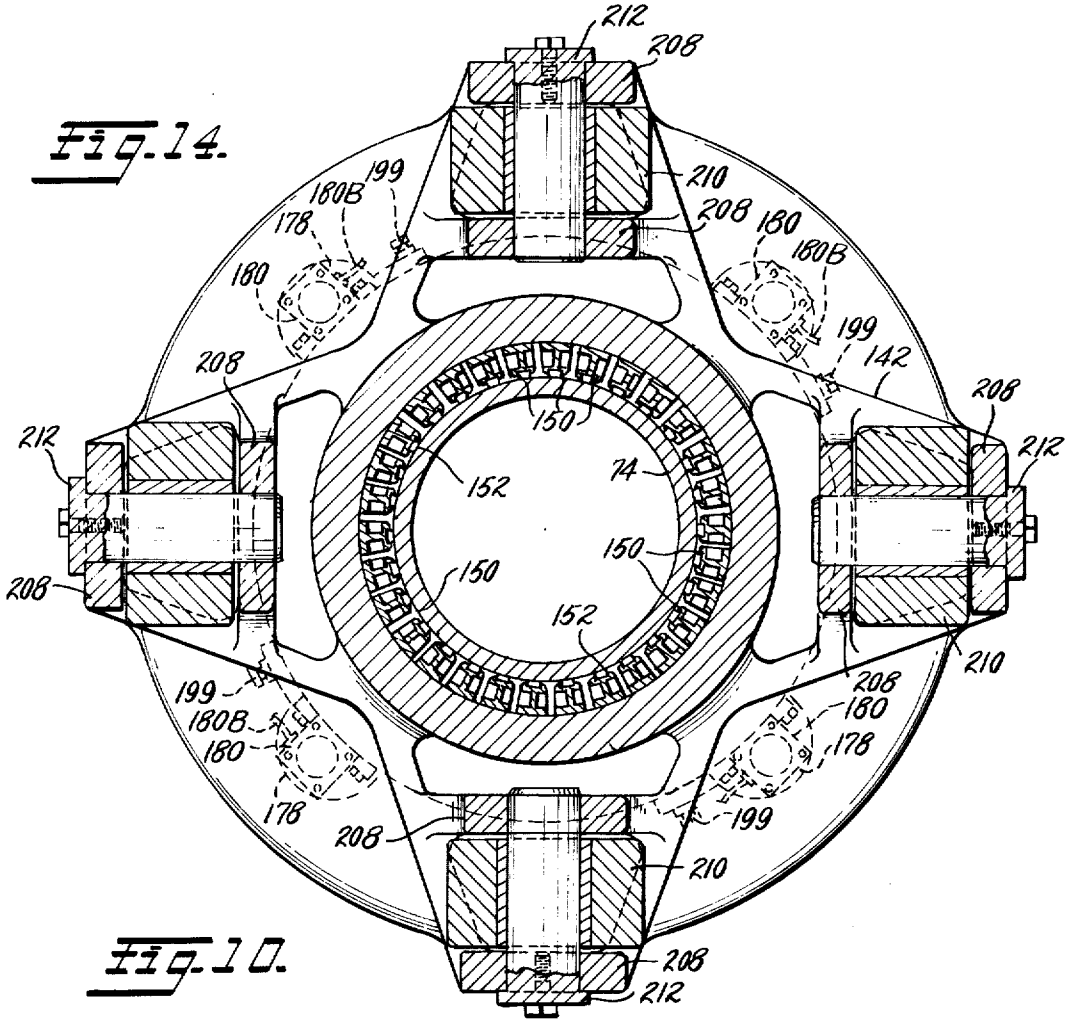
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Fig. 10.

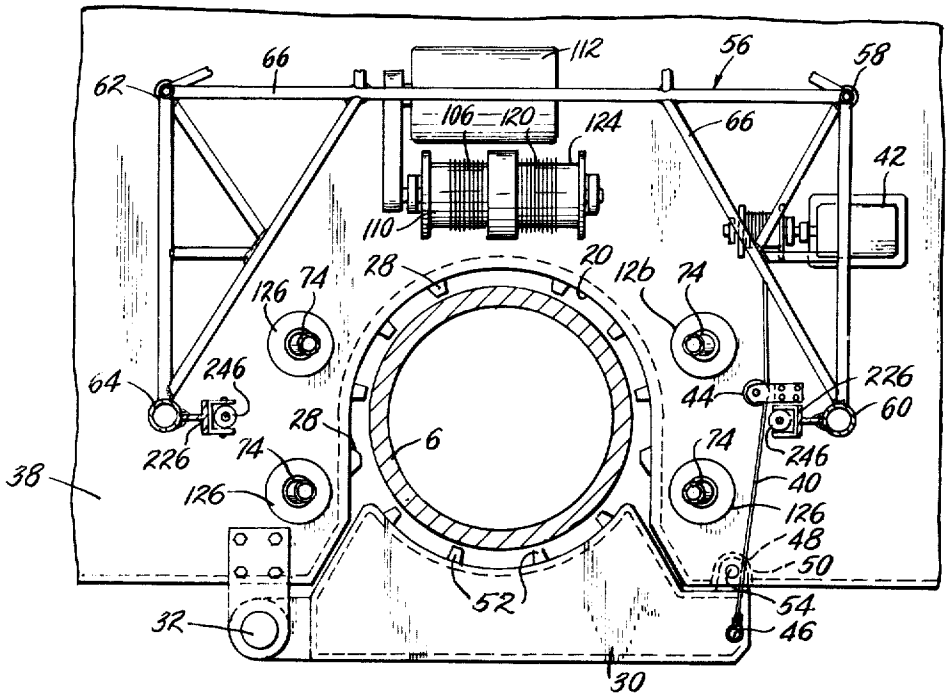
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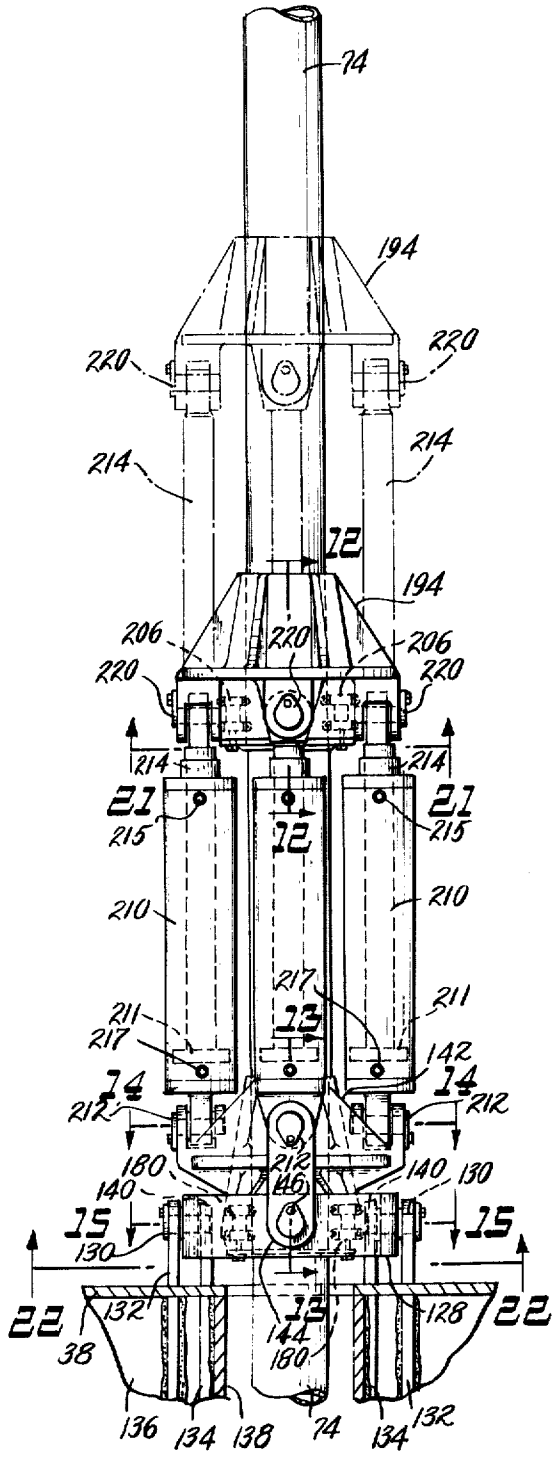
Fig. 11.



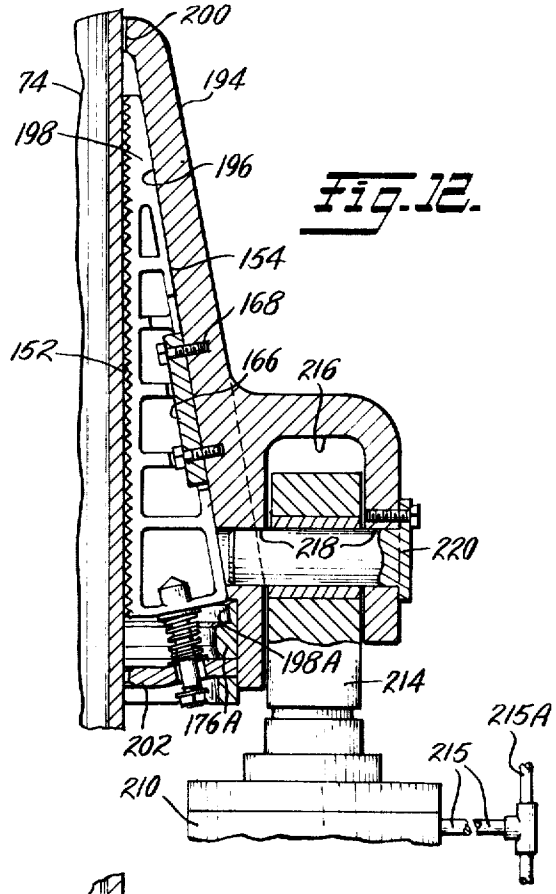


Fig. 12.

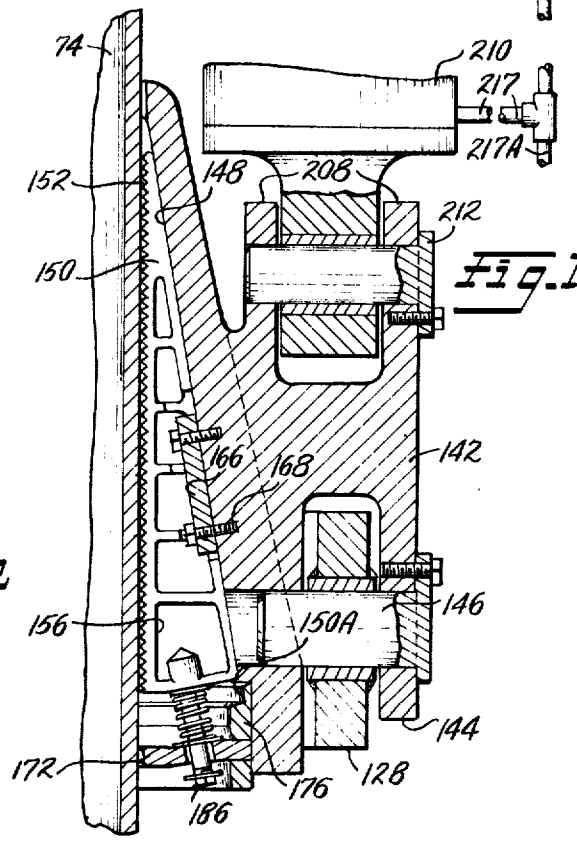
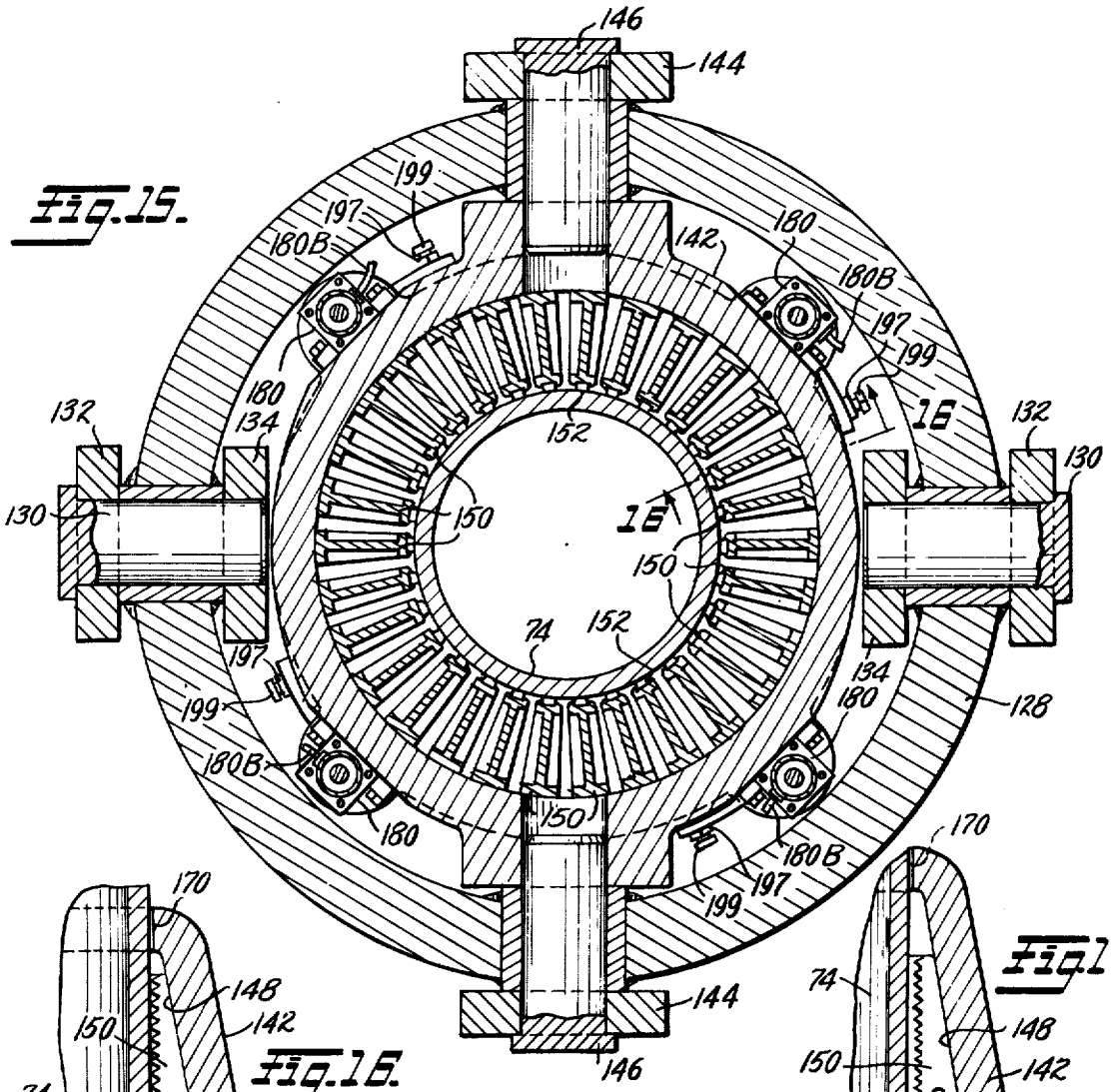


Fig. 13.

Fig. 15.



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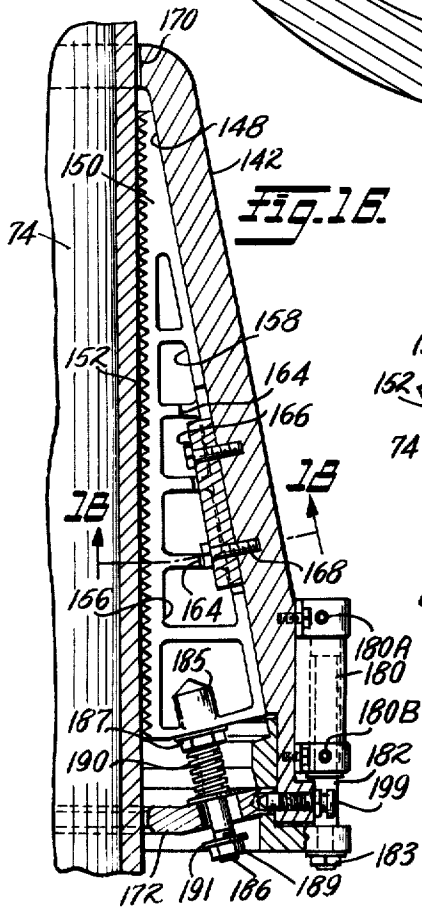

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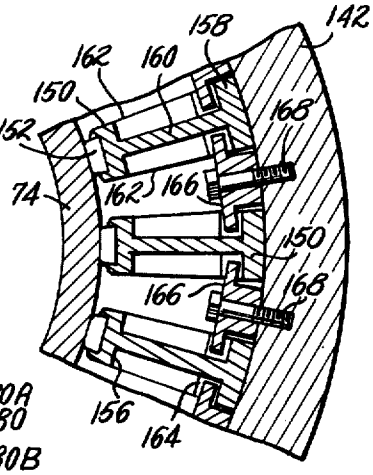

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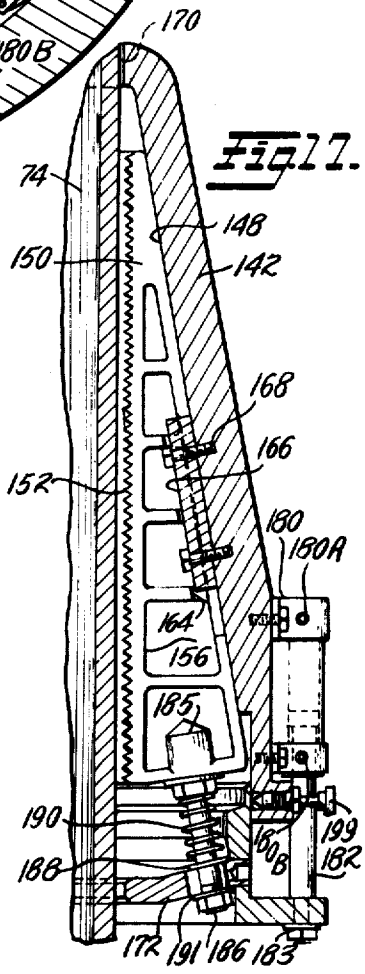

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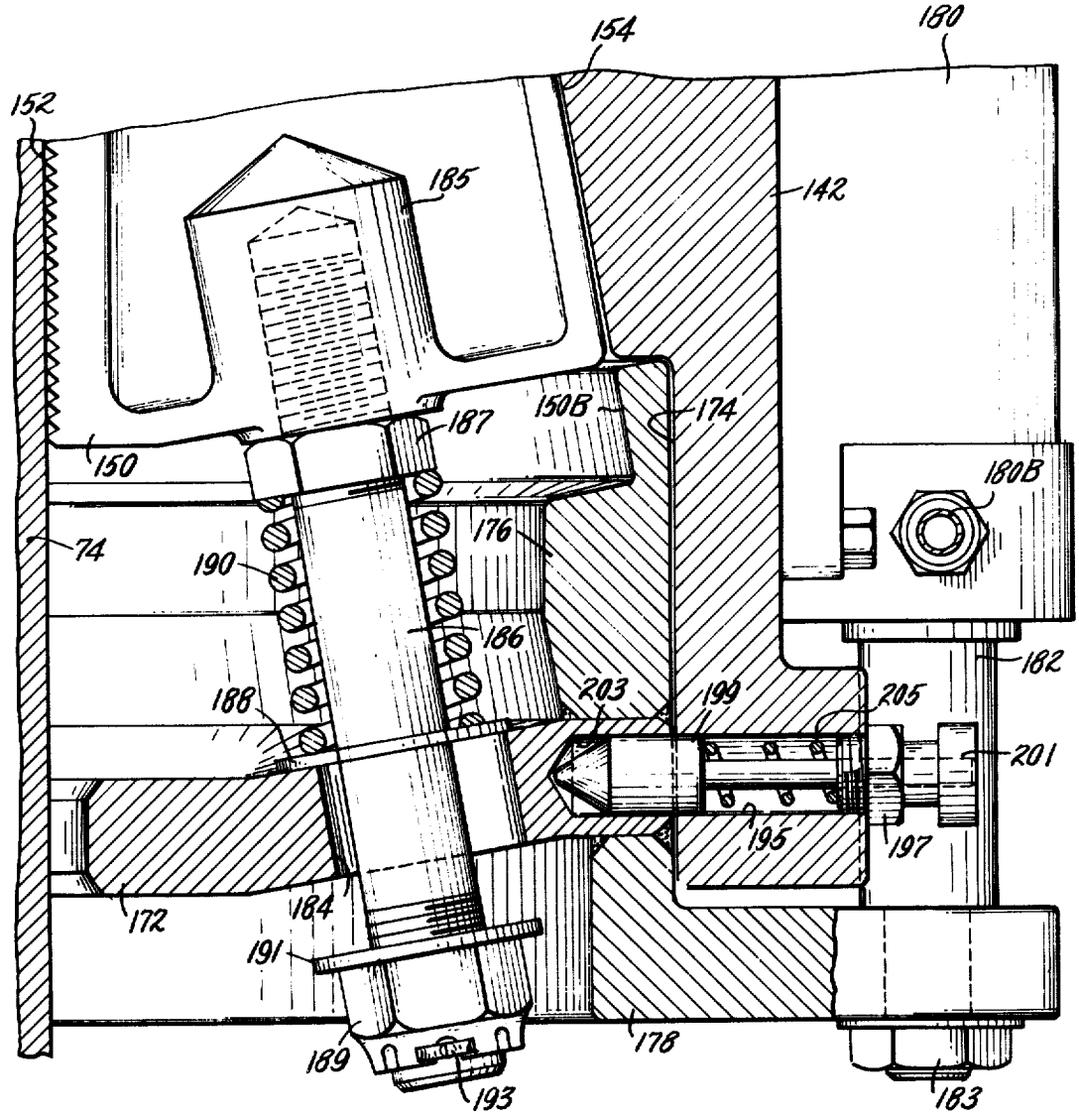

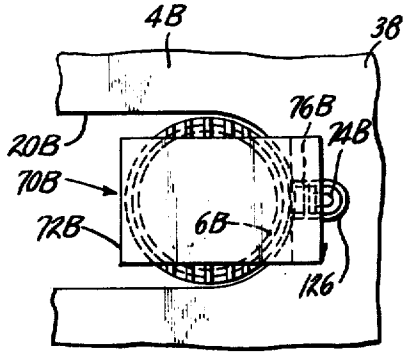

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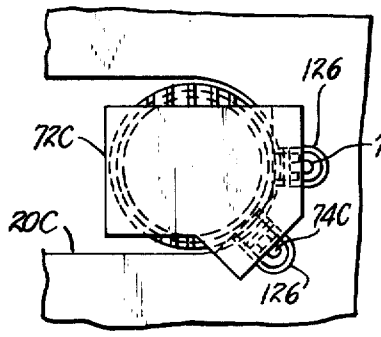
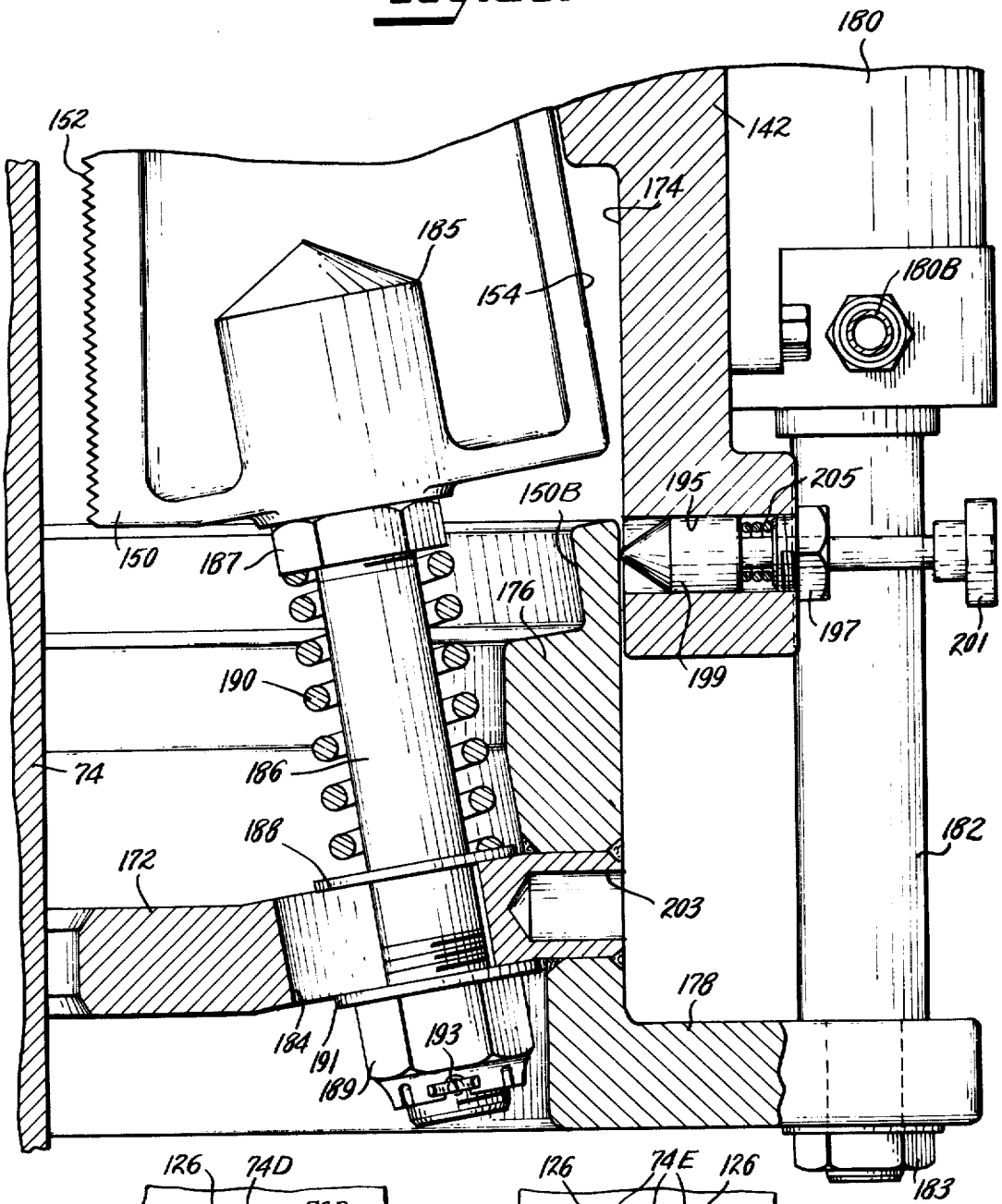
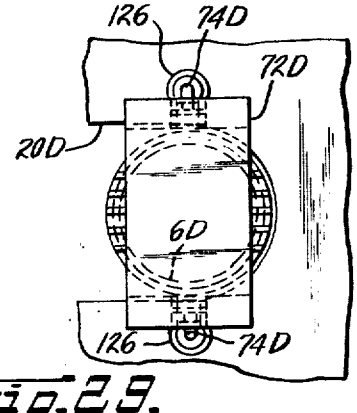


Fig. 28.

Fig. 20.





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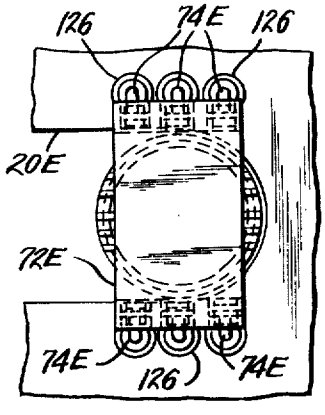
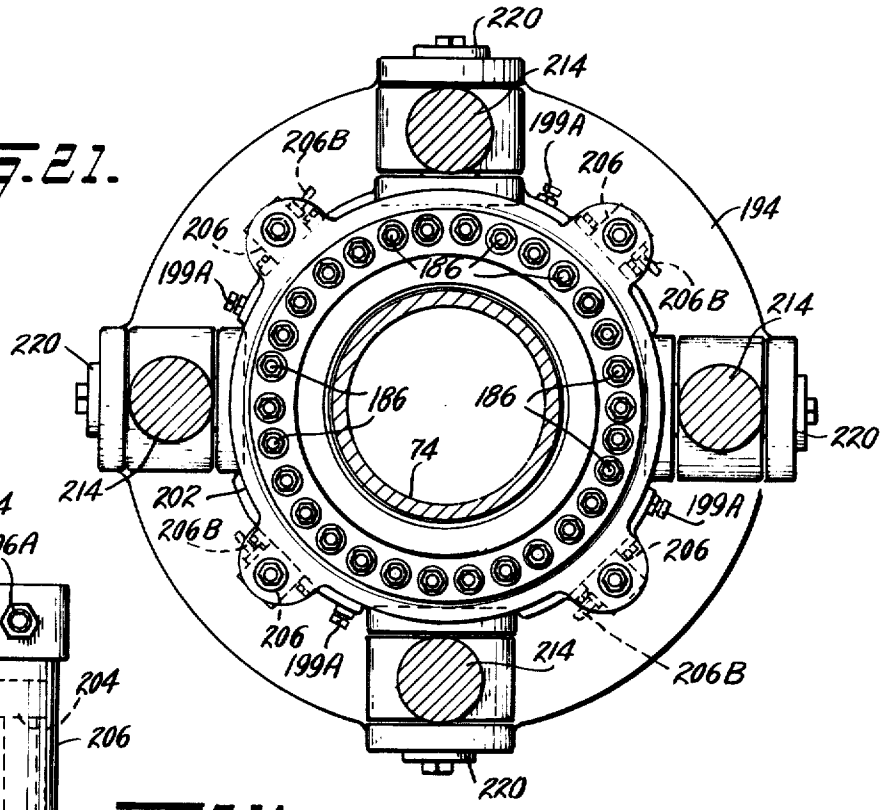


Fig. 30.

Fig. 21.



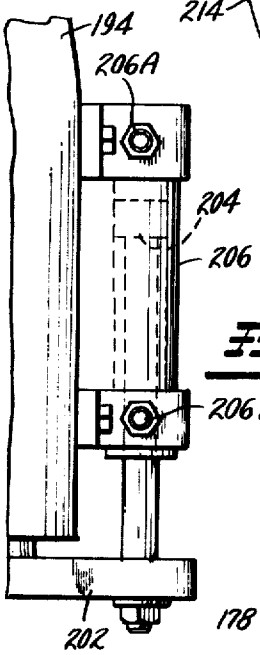
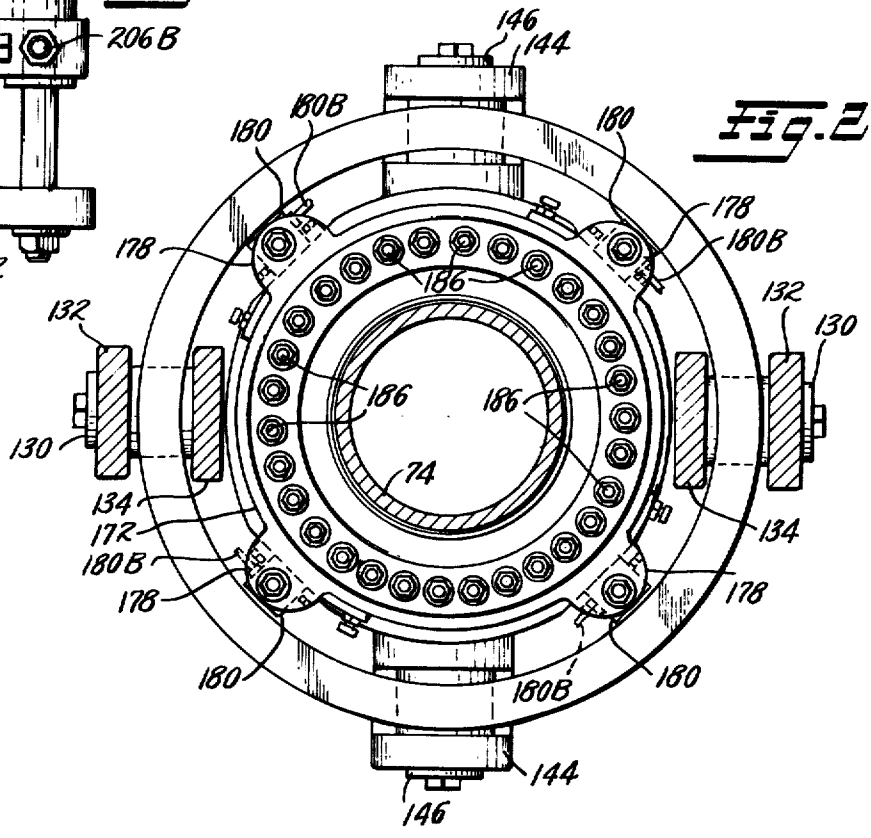


Fig. 21A.

Fig. 22.



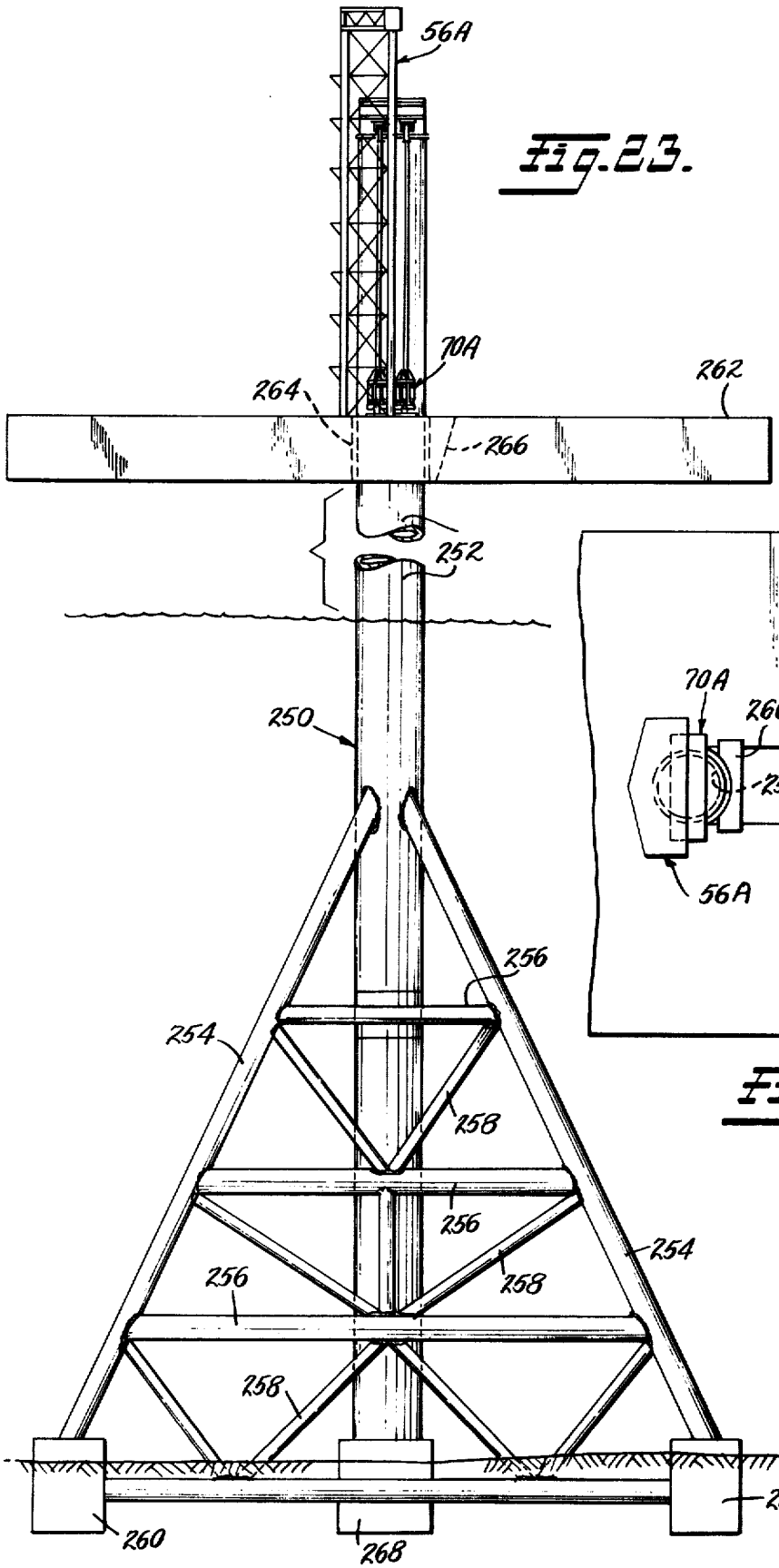

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Fig. 23.

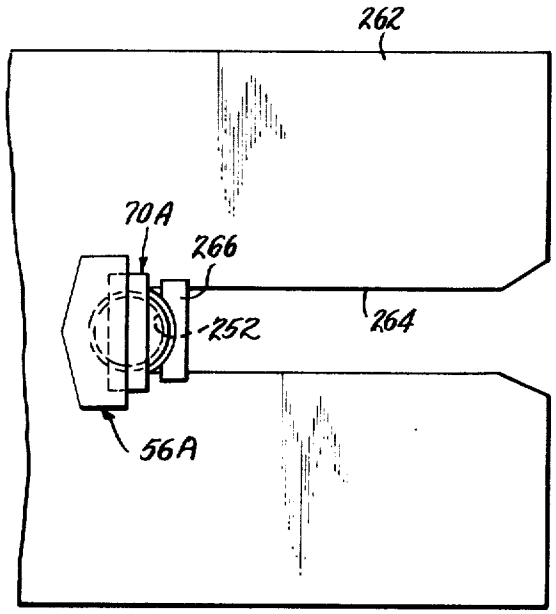
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Fig. 24.

Fig. 25.

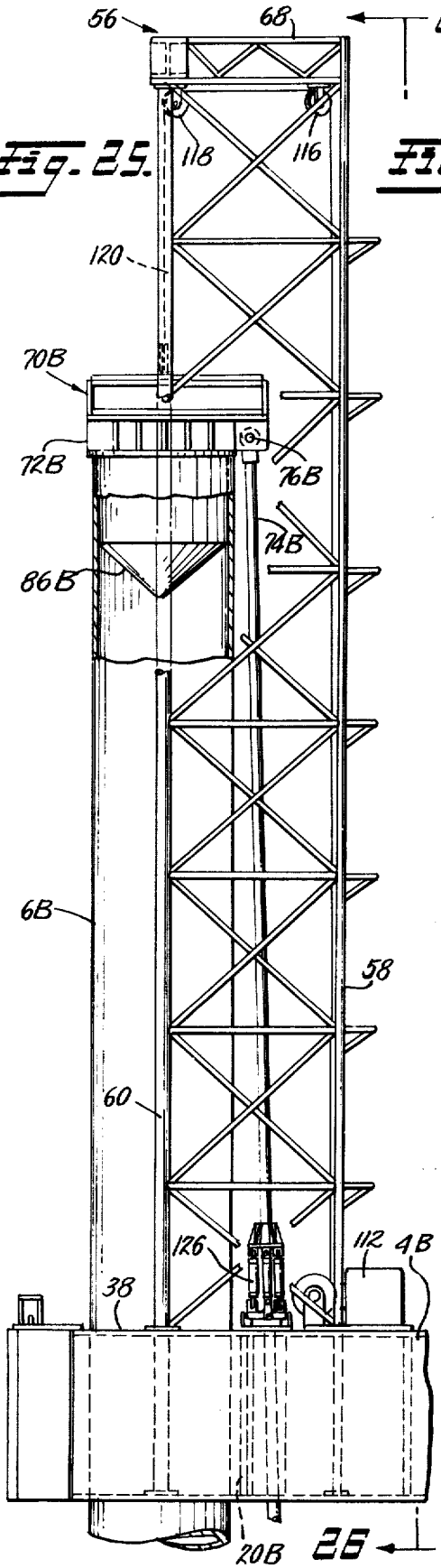
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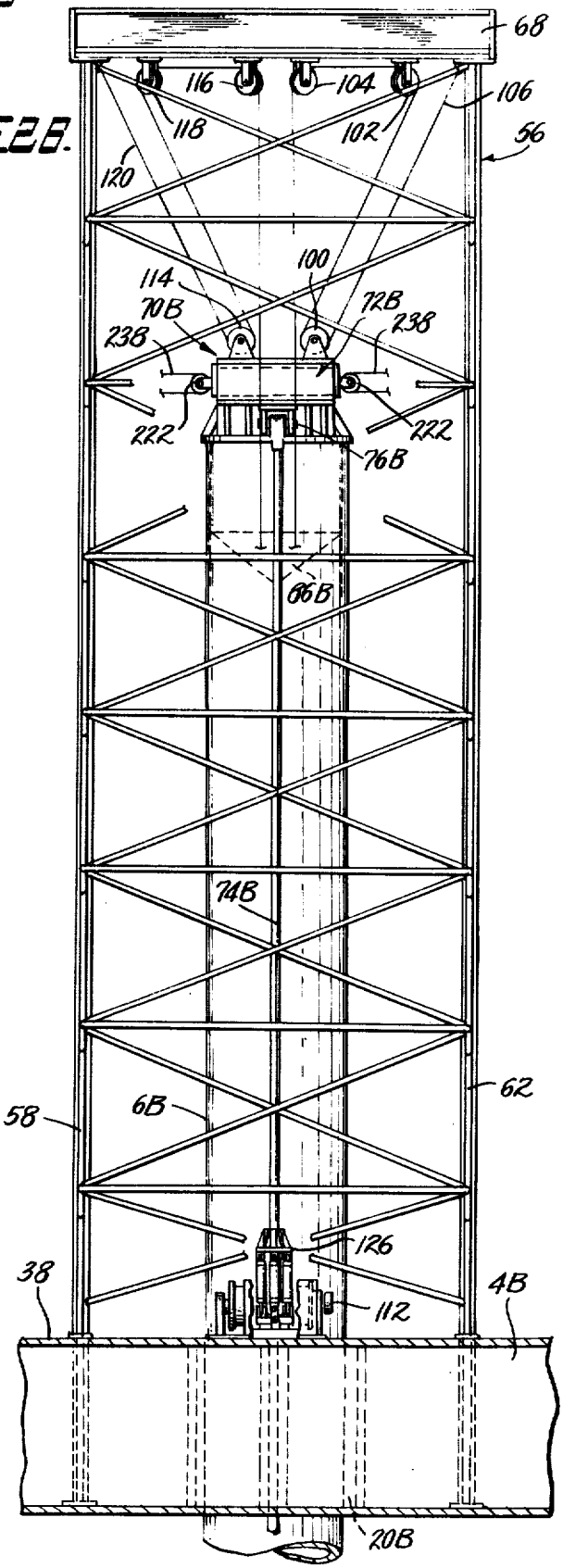
Fig. 26.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METHOD AND APPARATUS FOR QUICKLY ERECTING OFF-SHORE PLATFORMS

BACKGROUND OF THE INVENTION

1. FIELD OF THE INVENTION

This invention relates of off-shore well drilling and related equipment and, more particularly, to prefabricated drilling and production and other platforms, and prefabricated tripod and monopod support structures for maintaining the platforms at a desired elevation above the water, the platforms being buoyant and maneuverable into position relative to the supports and being provided with pre-set-up jacking means immediately operable to raise the platforms on the supports to the desired height above the water after the platforms have been moved into place.

2. DESCRIPTION OF THE PRIOR ART

Prefabricated drilling and production platforms and supports therefor, and jacking mechanisms for raising the platforms on the supports have been devised heretofore, but many of these are suitable only for use in shallow and relatively calm waters. Some of such prior platforms have utilized jacking mechanisms including racks and pinions with the racks attached to square spuds, but these have the disadvantage that the spuds must be pre-mounted in openings in the platform and the racks indexed with pinions mounted on the platform, so that proper engagement can be effected. Such structure is shown in Bulkley, et al. U.S. pat. No. 2,589,146. Racks and pinions when applied to caissons have the further disadvantage that pressure loads are applied to local areas, which may cause collapse, or require excessive and undesirable internal bracing of the caissons. The latter is particularly objectionable when conductor pipes are to be located in the caissons.

Other prior jacking devices include annular rubber tube-like elements carried by the barge or platform and surrounding the caissons. A jack of this type is disclosed in Suderow U.S. Pat. No. 2,948,119. The rubber elements must be inflated by air to grip the caissons, and manipulated to elevate the barge on the caissons. Such devices are objectionable because the rubber elements are subject to rapid wear, blow out, require substantial maintenance and frequent replacement. Furthermore, they have a tendency to slip relative to the caissons, particularly if the exterior surface of the caissons is contaminated by oil, algae, or mud. Such devices are subject to failure and allowing the barge to drop back onto the water whenever the air supply fails, as by the rupture of an air hose.

Still another jacking device, known as a cable jack, includes criss-crossed cables that are operable for positively gripping the exterior of the caissons and raising the barge on the caissons. Such jack is disclosed in my prior U.S. Pat. No. 2,858,105. The cable jacks are much more satisfactory than the rack and pinion type jack and inflatable rubber tube device. However, all of the foregoing types of jacking devices have the disadvantage that they are slow in operation and take considerable time to "set up" and to be operated to effect elevation of the barge to the desired working height. Such slow-operating jacking devices are unsuitable for use in rough waters, and particularly in areas subject to abnormally high changes in tide levels, say, 20 to 30 feet, or to high waves, because of the potential damage to either the caissons or the barge, or both, during the period that the barge is subject to movement by wave action. The hazards, of course, are less after the barge has been raised above wave level effect, but with slow-operating jacking devices it may take several hours' time to do this.

Another prior jacking apparatus, shown in Nixon U.S. Pat. No. 2,833,188, embodies the use of four sets of cables on each caisson, the cables being under tension and fastened at their opposite ends to the exterior of the caisson. A wedge type jacking mechanism is associated with each set of cables and is fixed to the barge or platform. The caissons are pre-positioned in openings in the barge. The jacking mechanism are designed to lower the caissons to the bottom and then elevate the barge. They can be used later to raise the caissons to enable the barge to be moved to another site. Such device has the objections that the cables become worn and frayed with repeated use; the caissons must be mounted in the platform before it is towed to the site or else much time is wasted in setting them up at the site; the caissons rise and fall with the barge in response to wave action; and it is possible for the barge to lift the caissons off the bottom at any time during the jacking operation until the barge is raised high enough to be clear of the waves. This makes it difficult to locate the barge at an exact point and could result in damage to the barge and/or caissons and injury to personnel.

A prefabricated platform support structure, including a tripod that is towed to the drilling site and sunk, is not new per se. A structure of this type is disclosed in the patent to Kuss, et al., U.S. Pat. No. 2,586,966. However, the patentees contemplate building a platform on the caissons after the support has been anchored to the bed of the ocean. Such procedure is objectionable because it is expensive, slow, impractical, and very hazardous. Considerable auxiliary equipment is required in the way of tugs and lighters to bring the platform components to the site, and derrick barges are required for use in erecting the components on the caissons. Obviously, no erection work can be done in rough seas, at which time all personnel and rented equipment remains idle at tremendous costs.

A prefabricated platform with three caisson wells has heretofore been used with a prefabricated tripod support in constructing a structure known as Texas Tower No. 4. Jacking devices somewhat similar to the cable jacks disclosed in the Nixon U.S. Pat. No. 2,833,188 were employed, but a great deal of time was wasted in threading the cables through the gripping devices before the hoisting operation could be started, and during which set up time the platform and caissons were in constant danger of being seriously damaged by wind and wave action. The danger continued during the jacking operation, which was very slow, until the platform was raised high enough to clear the waves.

SUMMARY OF THE INVENTION

The present invention overcomes the difficulties found in prior barge and platform elevating or jacking devices, in that it makes it possible to reduce to a minimum the jacing time required to elevate a barge or platform to working height on a supporting structure, particularly in rough seas, when time is a very critical factor.

The preferred support structure is prefabricated in the form of a tripod with the vertical legs consisting of large diameter caissons, rendered watertight, and provided with flood control valves. Conductor pipes for

suubsequeny use in drilling operations are preferably installed in the caissons at the shipyard, since this will save time later in starting drilling operations. The support structure is towed to the site in a horizontal position and caused to assume a vertical position by controlled flooding of the caissons to sink the structure until its footings engage the sea bottom. The drilling and production platform is also completely prefabricated in a shipyard and towed to the site. The platform is preferably fully equipped with all components necessary for drilling and oil production, and has cargo and pipe handling cranes, power plants, utilities, pumps, crew's quarters, a heliport, the present novel jacking equipment, etc. The design of the jacking equipment is such that safe, low maintenance drilling and production platforms can be installed in rough waters at substantial savings in time and money over prior conventional structures, and without requiring the use of additional auxiliary equipment, such as derrick barges, etc., which cause most of the weather delays in errcting a drilling platform. All machinery and jacking equipment is tested at the shipyard, insofar as the testing of equipment can be effected at such facility. This can also save a lot of time if any equipment is found to have a malfunction.

The platform has three caisson wells, open at one side, and spaced in the same geometric pattern as the caissons of the tripod support, with one caisson well located in the bow and two at the opposite sides of the platform adjacent the stern. The platform resembles a barge and is towed to the drilling site and floated and winched into position with one of the caissons received in each caisson well. At least the caisson well in the bow has a locking gate to prevent any substantial fore and aft movement of the platform relative to the caissons.

Three pre-assembled and set-up jacking units are provided, one for each caisson. Each jacking unit is disposed within a stabilizing and jack-positioning frame mounted on the deck of the platform. Each jacking unit includes a jacking head and two pairs of upright jacking legs that are connected by self-aligning bearings to the jacking head, one pair at each end of the jacking head. The two pairs of jacking legs straddle the associated caisson well and each leg extends through a respective one of four jacking mechanisms and into a corresponding opening in the platform hull. Each jacking mechanism is connected at its lower end to the platform deck by a gimbal joint. Each jacking head has a pilot to center it on the upper end of a caisson.

The jack-positioning and stabilizing frames have trolleys mounted therewithin on opposite sides of the frame, and pulleys and tensioned cables connected with the jacking head, and snubbing means to keep the jacking heads centered in the frame. Additional, winch-operated cables hold the jacking heads suspended above the upper end of their associated caissons until the jacking operation is to commence; whereupon, the jacking heads can be quickly lowered onto the upper end of the caissons and the operation of jacking up the platform can be started without delay. This is a valuable and unique feature of the invention because it avoids the delay due to set up time in starting jacking operations with prior devices. Such delays can be very costly and extremely hazardous in rough waters.

Each jacking mechanism includes two axially spaced slip holders surrounding a jacking leg and connected together by four hydraulically operated cylinders and pistons that are simultaneously operated. Each holder contains a set of wedge-shaped slips that are self-energizing in one direction, i.e., they can move freely upwardly on the jacking legs, but automatically grip the jacking legs and will not move downwardly unless deliberately de-energized. In this connection, the slips are de-energized to allow the jacking legs to move downwardly therethrough as the jacking heads are being lowered onto the upper end of the caissons.

The sets of slips are operable by the hydraulic cylinders to elevate the platform by incremental movement relative to the associated caisson. At the same time, the slips will hold the platform in any position to which it is raised by wave action and prevent it from dropping back onto the water. This is another important and valuable feature of the invention because it prevents damage to the platform and caissons, and possible injury to personnel. It also takes advantage of wave action during jacking by allowing the platform to move upwardly even during a jacking stroke, so that is quickly reaches a height where damage and danger from wave action is eliminated.

All four jacking mechanism of each jacking unit must be simultaneously operated. On the other hand, the three jacking units can be selectively operated, or all three can be simultaneously operated. In each instance, the upper end of the caisson takes the full reaction of the platform jacking effort. The stabilizing frames retain the jacking units in propor position, while permitting universal movement thereof relative to the platform without interfering with the jacking operation.

The use of self-energizing slips in the jacking mechanisms provides a valuable "fail safe" feature. Further safety is achieved with the present invention by designing the jacking mechanisms so that, once the jacking operation has been commenced, it must be continued to completion. This result is obtained by effecting automatic and positive locking of the slips in their energized position and requiring manual release of the locking means. The positive locking of the slips in energized position, and requiring manual release thereof, serves to prevent inadvertent release of the jacking mechanisms and dropping of the platform onto the water, which can and has occurred with the use of prior jacking devices.

The invention also contemplates elevating a platform having a single caisson well on a single caisson constructed in the form of a monopod and consisting of a single large caisson mounted upon three or more supporting legs. In such instance, a stabilizing frame and jacking unit may be mounted on the platform to receive the caisson in straddling relation. A jacking unit need not straddle the caisson, although such arrangement equalizes the jacking load on opposite sides of the caisson. One or mor jacking legs, arranged in non-straddling, cantilever fashion relative to the caisson, can be used in some instances.

The present methods and apparatuses are designed especially for use at sea in deep water of a depth of 200 to 400 feet or more, and to withstand severe wave action and high wind velocities. The present platforms may be elevated as high as 95 feet above mean water level to be certain that they will be clear of wave action during severe storms.

Accordingly, the principal object of the invention is to provide a method and apparatus for safely elevating

an off-shore platform above wave level and to a working height in a minimum of time.

Another object is to provide a method and apparatus for jacking up a platform on one or more bottomed caissons, wherein the platform is prefabricated and maneuvered into position relative to the caisson or caissons, and the jacking apparatus is rendered functional without requiring any substantial set up time.

Another object is to provide a method and apparatus for elevating a platform on one of more caissons, which employs the novel technique of utilizing the upper end of the caisson as a load-reaction and bearing point for the platform jacking effort, and which effort is also applied directly to the platform.

Still another object is to provide a method and apparatus for elevating a platform on a caisson, according to which a downward pull is exerted on the upper end face of the caisson simultaneously with exerting a direct upward pull on the platform.

Still another object is to provide a method and apparatus for elevating a platform on a caisson, according to which a connection is established by rigid means between the upper portion of the caisson and the platform deck, and the connection is successively shortened and the platform is correspondingly successively raised and held in the position to which it has been raised upon shortening of the connection.

A further object is to provide a method of erecting a prefabricated support structure, comprising at least one upright caisson, on a sea bed and moving a prefabricated platform into position to be supported on at least the one caisson, characterized by pre-positioning at least one jacking unit on the platform so that the jacking head thereof can be quickly lowered onto the upper end of at least the one caisson; and jacking operations commenced immediately after the platform has been positioned relative to at least the one caisson.

A still further object is to provide a platform with one or more self-elevating jacking units mounted thereon, with a jacking unit having a single jacking leg prepositioned to be connected with a caisson in cantilever fashion, or with the units having one or more pairs of jacking legs pre-positioned to receive and straddle one or more platform-supporting caissons.

Still another object is to provide a platform with a system of self-energizing jacking units embodying fail safe features, so that, once the operation of jacking the platform on one or more caissons has been started, the platform cannot accidentally drop back onto the water.

Still another object is to provide a platform jacking system including a jacking mechanism constructed so that during a jacking operation, if the platform is raised relative to a caisson by wave action, the jacking mechanism will automatically hold the platform in its raised position on the caisson and prevent it from moving downwardly as the wave action subsides.

A still further object is to provide a platform with one or more jacking units each including a jacking head and jack-positioning and stabilizing means therefore that serve to position the jacking head on a caisson, and which will also steady the jacking unit while compensating for movement of the platform relative to the caisson due to wind and wave action during the time that the platform is being elevated to a height clear of the water.

Still another object is to provide a jacking mechanism to be used with a jacking leg, including two holders each containing a set of one-way wedge slips enabling the holders to be moved freely only in an upward direction relative to the jacking leg.

Still another object is to provide a jacking mechanism to be used with a jacking leg, including two sets of wedge slips that are automatically locked in place when moved to their energized position, and wherein the locking means must be manually released before the slips can be moved to their de-energized position.

Other objects and advantages of the invention will be apparent from the following description taken in conjunction with the accompanying drawings.

DESCRIPTION OF THE DRAWINGS

FIG. **1** is a schematic view ilustrating the method of positioning a tripod type caisson supporting structure and erecting an off-shore drilling and production platform thereon in accordance with the present invention.

FIG. **2** is a plan view of the tripod supporting structure, as viewed on the line **2—2** FIG. **1.**

FIG. **3** is a plan view of the platform, as viewed on the line **3—3** of FIG. **1,** but showing the locking gate for one of the caissons in its open position.

FIG. **4** is an enlarged plan view similar to FIG. **3,** but showing the locking gate in its closed position.

FIG. **5** is an enlarged fragmentary elevational view, partly in cross-section, taken on the line **5—5** of FIG. **4,** particularly illustrating one of the jacking units and its positioning and stabilizing frame, the jacking head being shown in dot-and-dash lines elevated above a caisson, and in full lines in lowered position engaging the upper end of the caisson.

FIG. **6** is a fragmentary right-sidee elevational view, partly in cross-section, of the structure shown in FIG. **5.**

FIG. **7** is an enlarged fragmentary elevational view of the jacking head and trolleys, cables and pulleys of the jack-stabilizing means.

FIG. **8** is a sectional plan view, taken on the line **8—8** of FIG. **7.**

FIG. **9** is a vertical sectional view through the jacking head and upper end of the caisson, taken on the line **9—9** of FIG. **7.**

FIG. **10** is an enlarged fragmentary horizontal sectional view, taken on the line **10—10** of FIG. **5,** showing the power-operated means for closing the locking gate.

FIG. **11** is an enlarged fragmentary elevational view of one of the jacking legs and its associated jacking mechanism, and further showing the gimbal mounting for connecting the lower end of the jacking mechanism to the platform.

FIG. **12** is an enlarged fragmentary vertical sectional view, taken on the line **12—12** of FIG. **11,** through the upper set of slips of the jacking mechanism.

FIG. **13** is a fragmentary vertical sectional view, taken on the line **13—13** of FIG. **11,** through the lower set of slips of the jacking mechanism.

FIG. **14** is a horizontal section view through the lower set of slips and the upper section of the gimbal mounting, taken on the line **14—14** of FIG. **11.**

FIG. **15** is a similar view through both sections of the gimbal mounting, taken on the line **15—15** of FIG. **11.**

FIG. **16** is a fragmentary vertical sectional view, taken on the line **16—16** of FIG. **15,** through the lower set of slips and showing one of the slips engaging the

support caisson and the locking means for retaining the slips in energized position.

FIG. 17 is a fragmentary vertical sectional view similar to FIG. 16, but showing the locking means released and the ring connected with the slips retracted to move the slips to deenergized position.

FIG. 18 is an enlarged fragmentary horizontal sectional view, taken on the line 18—18 of FIG. 16, showing the retaining and guide means for the slips.

FIG. 19 is an enlarged cross-sectional view showing the slip-actuating ring locked in its slip-energizing position by a locking pin.

FIG. 20 is a similar view showing the locking pin withdrawn and the actuating ring in its slip de-energizing position.

FIG. 21 is an enlarged horizontal sectional view, taken on the liine 21-21 of FIG. 11, showing the slip-actuating ring for the upper set of slips and its operating cylinders.

FIG. 21A is a fragmentary elevational view of one of the operating cylinders shown in FIG. 21.

FIG. 22 is an enlarged horizontal sectional view, taken on the line 22—22 of FIG. 11, showing the slip-actuating ring and operating cylinders for the lower set of slips.

FIG. 23 is a side elevational view of another embodiment utilizing a monopod support and a platform having a single caisson well.

FIG. 24 is a plan view of the platform and caisson shown in FIG. 23.

FIG. 25 is a fragmentary side elevational view of still another embodiment with portions broken away, in which a single jacking leg is arranged in cantilever fashion rearwardly of a caisson.

FIG. 26 is a right side elevational view of the structure shown in FIG. 25 with portions of the frame broken away, as viewed on the line 26—26 of FIG. 25.

FIG. 27 is a diagrammatic plan view of the jacking head and single cantilever jacking leg, shown in FIGS. 25 and 26.

FIG. 28 is a diagrammatic plan view showing a further embodiment having a jacking head with two cantilever jacking legs disposed in non-straddling relation to a caisson well.

FIG. 29 is a diagrammatic plan view of another embodiment having a jacking head with a single pair of jacking legs attached thereto and straddling a caisson well.

FIG. 30 is a similar view of a still further embodiment having a jacking head with three pairs of jacking legs attached thereto.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

FIG. 1 of the drawings schematically illustrates the two principal components, and the successive steps involved in the method of erecting an off-shore well drilling platform in accordance with the present invention. The two components are: a prefabricated platform support structure 2; and a prefabricated drilling platform 4. The support 2 has three caissons 6, 8 (FIG. 2) and 10 rigidly interconnected by side frame member 12 and internal braces 14. The caissons 6, 8, and 10 and the frame members 12 form an equilateral triangle. Each caisson has an enlarged footing 16 at one end to engage and be embedded in and anchored to the sea bottom in a known manner. Conductor pipes (not shown) are preferably installed in the caissons during fabrication since this will save a great deal of time later in getting started with the drilling operations. The ends of the caissons are sealed watertight so that the assembly will float horizontally and can be towed to the drilling site by a tug 18. The caissons 6, 8 and 10 have flood valves (not shown) enabling the caissons to be flooded with sea water and gradually turned from a horizontal to a vertical position, as illustrated at A and B, respectively, and completely sunk at the drilling site, as shown at C, with the caissons disposed in the proper azimuth. The caissons 6, 8 and 10 are of predetermined length such that when the support 2 is sunk and anchored to the sea bottom, as shown at D, they project above the water to a height slightly greater than the working height to which the platform 4 is to be elevated. The length of the caissons 6, 8 and 10 is determined by the depth of the water at the drilling site and the height to which the platform 4 is to be elevated above the water.

The prefabricated platform 4 resembles the hull of a barge and is provided at the shipyard with living quarters and all equipment necessary for oil well drilling and production operations. All such equipment has been omitted from the drawings since it constitutes no part of the present invention.

The platform 4 preferably has the generally rectangular configuration shown in FIGS. 3 and 4. The bow has a central slot or caisson well 20, flaired and open for its full height, for receiving the caisson 6. Additional open slots or caisson wells 22 and 24 are provided on oppposite sides of the platform 4 near the stern for receiving the caissons 8 and 10, respectively. The platform is buoyant and is towed to the drilling site by a tug 26, FIG. 1. After the support 2 has been bottomed, the platform 4 is floated into position above the framework 12—14 and maneuvered by cables and winches (now shown) connected with the caissons, into a position wherein the caissons are received in their respective caisson wells, as shown in FIG. 4. All of the caisson wells 20, 22 and 24 have yieldable buffer strips 28 mounted therein for engagement with the caissons to prevent damage to the platform and caissons.

A locking gate 30, FIGS. 3, 4 and 10, is hinged at 32 adjacent one side of the caisson well 20 and, in FIG. 3, is shown held in open position by a pin 34 extending through a keeper 36 welded to the deck 38 of the platform 4, the pin extending into a suitable opening in the top of the gate 30. After the caisson 6 has been received in the caisson well 20, a cable 40, extending from a winch 42 and around a pulley 44 and across the front of the gate 30, is connected to a hook 46 on the gate 30. The winch 42 and the pulley 44 are both mounted on the platform deck 38. Upon removal of the pin 34 and operation of the winch 42, the cable 40 will pull the gate 30 from its open position into its locking position, illustrated in FIGS. 4 and 10. The gate 30 has a projecting tongue 48 and the platform has a recess 50 to receive the tongue as the gate 30 is closed. When the gate is in its fully closed position, a retaining pin 54 is inserted through an opening in the deck 38 and into an aligned opening in the tongue 48, thus positively locking the gate 30 in its closed position. It will be noted that the locking gate 30 has an arcuate face to which buffing elements 52 are attached and engageable with the caisson 6 to prevent damage to the gate and caisson as a result of any movement of the platform 4 relative to the caisson. It will be understood that locking gates

may also be provided for the caisson openings 22 and 24, if desired, and that in all instances a clearance is provided between the caissons and buffing elements.

A superstructure in the form of a jack-positioning and stabilizing frame 56 is mounted upon the deck 38 behind each of the caisson wells 20, 22 and 24, as shown in FIGS. 3, 4, 5, 6 and 10. The frame 56 comprises four uprights with two uprights 58 and 60 disposed at one side of each caisson well, and uprights 62 and 64 disposed at the other side of the wells, with the uprights 60 and 64 disposed in a vertical plane substantially coinciding with the axis of the associated caisson. The uprights 58, 60, 62 and 64 are connected together by braces and struts generally identified by the numberal 66. The upper end of each of the uprights 58, 60, 62 and 64 is connected to a fabricated top structure 68. It will be understood that the illustrated component of the frames 56 are welded together, and that the tops 68 of the frames 56 are at a height well above that of the upper end of the caissons 6, 8 and 10.

Each of the frames 56 serves as a positioning and stabilizing support for a jacking unit generally identified by the numeral 70. Each jacking unit uncludes a jacking head 72 and four jacking legs 74, pivotally connected at 76 to the jacking head 72 and arranged so that the legs will straddle a caisson, with one pair of legs disposed on either side of the caisson and extended through openings 78 in the platform hull adjacent to the frame uprights 60 and 64. The pivotal connections 76 are self-aligning bearings that permit universal movement between the upper end of each jacking leg 74 and the jacking head 72.

Referring to FIGS. 7, 8 and 9, the jacking head 72 may be constructed in any suitable manner, but, by way of example, is shown as a rectangular, box-like structure including a main, or head plate 80 which, when in use, rests upon the upper end face of a caisson 6, for example. Each caisson has a reinforcing ring 82 welded to the interior thereof so that the upper edge of the ring 82 lies in a plane flush with the upper end of the caisson. The ring 82 reinforces and increases the load bearing area at the upper end of the caisson with a consequent reduction in unit pressure. A ring 84, smaller in diameter than the ring 82, is welded to the underside of the head plate 80, and has a conical pilot member 86 welded thereto for guiding the jacking head 72 into position when lowered upon the caisson and for retaining the jacking head 72 in place and in axial alignment with the caisson 6. Side plates 88 and end plates 88A are welded to the upper side of the head plate 80 to form the rectangular box. Gussets 89 welded to the plates 88 and to the plates 80 reinforce the plates 80 in the areas thereof overlying the caisson. A rectangular plate 90 is welded to the upper edge of the plates 88 and 88A, and a plurality of I-beams 92, arranged side by side in spaced pairs, is welded at their lower flanges to the upper side of the plate 90. A top plate 94 is welded to the upper flanges of the I-beams 92. The opposite ends of the plate 90 extend beyond the end plates 88A and two brackets 96 are welded to each of the extended portions of the plate 90 and mount the bearings 76 connected with the upper end of the jacking legs 74. The plate and I-beam arrangement shown provides a very rigid and strong jacking head 72, capable of supporting a proportionate share of the weight (⅓) of the platform 4 and the drilling equipment (not shown) mounted thereon.

A bracket 98, FIGS. 5 to 9, is welded to the top plate 94 and has a pulley 100 mounted thereon. Additional pulleys 102 and 104 are mounted on brackets 105 secured to the lower side of the top beam 68, and a cable 106 has one end anchored at 108 to said top beam, and extends over the pulleys 100, 102 and 104, and then downwardly to a drum 110 of a dual drum winch 112 mounted on the deck 38. A pulley 114 is similarly mounted on the top plate 94 and two additional pulleys 116 and 118 are mounted in brackets 107 on the underside of the top beam 68. A second cable anchored to anchoredto the top beam at 122, extends around the pulleys 114, 116 and 118, and then downwardly to another drum 124 of the winch 112. It will be understood from the foregoing that the winch 112 can be operated to raise or lower the jacking head 72 and its attached jacking legs 74 as a unitary structure.

A jacking mechanism, generally identified by the numeral 126, surrounds each of the jacking legs 74 so that each jacking unit includes four separate jacking mechanisms 126 that are operated in unison. Each of the jacking mechanisms 126 has a gimbal joint connection the lower end thereof with the platform deck 38 for universal movement relative thereto. The gimbal joint comprises a ring 128, FIGS. 5 and 11, that is pivotally mounted at diametrically opposite points on pins 130 that are received in aligned openings in spaced plates 132 and 134, extending through the platform deck 38. The plates 132 and 134 are welded below the deck 38 to a bulkhead 136, the plate 134 being positioned adjacent to a cylindrical section 138 providing one of the openings 78 for a jacking leg 74. The upper end of each plate 134 is beveled, as shown at 140, to provide for at least 10° of angular movement between the lower gimbal ring 128 and a housing 142, constituting the other element of the gimbal joint. The housing 142 has diametrical lugs 144 extending downwardly therefrom that are connected by pins 146 with the gimbal ring 128. The pins 146 are disposed on a diametrical axis at right angles to the axis of the pins 130.

The housing 142, FIG. 13, has a frusto-conical internal recess 148 for receiving a series of wedge-shaped slips 150 having a toothed inner surface 152 for gripping a jacking leg 74, and an upwardly and inwardly inclined smooth outer surface 154 engaging the conical surface of the recess 148. The slips 150 are arranged side by side and, as is best shown in FIG. 15, are slightly spaced apart so that a maximum number can be carried by the housing 142, which serves as a slip holder. Each of the slips 150 has an inner wall 156 and an outer wall 158, a central web 160, and ribs 162 on opposite sides of the web 160 interconnecting the front and rear walls. A portion of three of the ribs 162 of each slip is cut away, as indicated at 164, FIGS. 16 and 18, to receive the head of a T-shaped retracting camming member 166. One of the camming member 166 is disposed between the adjacent sides of each pair of slips 150 and is secured to the holder 142 by bolts 168. Thus, means is provided to permit limited axial, as well as radial, movement of the slips 150 relative to the slip holder 142.

It will be noted from FIGS. 16 and 17 that the upper end of the slip holder 142 has an inwardly directed flange 170, spaced from the jacking leg 74 that serves as a guide for the upper portion thereof. A slip-acutating ring 172 (see also FIGS. 19 and 20) serves as a guide for the lower portion of the holder 142. With

further reference to FIGS. 13 and 15, the lower end of the holder 142 has a counterbore 174 to receive a flange 176 extending upwardly from the ring 172. Four lugs 178, FIG. 22, extend radially from the ring 172 at equally spaced, circumferential points. Four air cylinders 180, each having an upper air line connection 180A and a lower air line connection 180B are mounted on the slip holder 142 in alignment with the four lugs 178. A piston rod 182 extends from each cyclinder 180 and is connected by a nut 183 to one of the lugs 178. The ring 172 has an elongated opening 184, FIGS. 19 and 20, in alignment with a stud bolt 186 extending from each of the slips 150. Each stud bolt 186 is mounted in a boss 185 and locked by a jam nut 187. A washer 188 is mounted on each stud bolt 186 above the ring 172. A compression spring 190 surrounds each of the stud bolts 186 between the jam nut 187 and the washer 188 and normally urges the slip 150 upwardly into wedging engagement with the jacking leg 74. A castellated nut 189 carrying a washer 191 is threaded on each stud bolt 186 below the ring 172 and locked in place by a cotter pin 193.

The holder 142, FIGS. 16, 19 and 20, has four threaded openings 195 formed therein spaced 90° apart. A fitting 197 is mounted in each opening and slidable received a locking pin 199. The pin 199 has a portion that extends outwardly beyond the fitting 197 and has a retracting head 201 mounted thereon. The slip-actuating ring 172 has four holes 203 aligned with the four threaded openings 195 in the slip holder 142. A compression spring 205 in each of the openings 195 urges the locking pins 199 inwardly.

It will be understood that when the air cylinders 180 are operated to raise the actuating ring 172, the springs 190 will be compressed and urge the slips 150 upwardly and inwardly to their energized position engaging the jacking leg 74. The upper edge 150A of the flange 176 will engage the shoulder of the counterbore 174 and position the holes 203 in axial alignment with the locking pins 199, which will be forced by the springs 205 into the holes 203 to positively lock the actuating ring 172 in slip-energizing position. The cylinders 180 cannot now be inadvertently operated to de-energize the slips 150, and this is an important safety feature of the invention that prevents the platform from being dropped.

In order to release or de-energize the slips 150, each of the pins 199 must be manually retracted by a suitable tool (not shown) and held in its retracted position clear of the holes 203. When all four pis 199 have been retracted, the springs 190 will tend to move the ring 172 downwardly toward the position shown in FIG. 20. The foregoing procedure must be repeated with the jacking mechanism 126 associated with each of the four jacking legs 74 before the four cylinders 180 are operated to move the actuating ring 172 downwardly into engagement with the washers 191 and apply positive force to the stud bolts 186 to move the slips 150 downwardly. The camming members 166 will automatically cause the slips 150 to move radially outwardly to de-energized position as they are moved downwardly. The downward movement of the ring 172 is limited by the stroke of the piston rods 182.

Each jacking mechanism 126 includes an upper slip holder 194, FIGS. 11 and 12, that has a frusto-conical recess 196 containing a series of wedge-type slips 198, similar to the slips 150, and similarly mounted therein. A flange 200 at the upper end of the holder 194 has a suitable clearance with the jacking leg 74 and serves as a guide. An actuating ring 202, similar to the ring 172, is mounted at the lower end of the holder 194 and is connected with the slips 198 in the same manner that the slips 150 are connected with the ring 172. The ring 202 is also connected with the pistons 204 of four air-operated cylinders 206, FIG. 21 and 21A, mounted on the exterior of the slip holder 194 and can be similarly locked in slip-energizing position by locking pins 199A. The cylinders 206 have an upper air line connection 206A, FIG. 21A, and a lower air line connection 206B and are operable in the same manner as the cylinder 180 to operate the ring 202 to engage and release the slips 198.

Referring to FIGS. 11 and 13, the lower slip holder 142 has four sets of upwardly extending ears 208, spaced to receive the lower end of a hydraulic cylinder 210. Each cylinder 210 is pivotally connected with a pair of ears 208 by a pin 212, wherefore, it will be understood that four cylinders 210 are pivotally connected with the lower slip holder 142. Each of the cylinders 210 contains a piston 211 and has a piston rod 214 extending upwardly therefrom into a pocket 216 formed in the upper slip holder 194, FIG. 12. Each of the pockets 216 has aligned openings 218 to receive a pivot pin 220. Thus, the lower slip holder 142 and the upper slip holder 194 of each jacking mechanism 126 are pivotally connected together by four cylinder and piston rod assemblies 210–214. Fluid pressure is communicated to the opposite ends of the cylinders through upper connections 215 and lower connections 217. The upper end of all 16 cylinders 210 of each jacking unit is connected in parallel by an equalizing line 215A through the connections 215; and the loweer end of all of said cylinders is connected with an equalizing line 217A through the connections 217. This arrangement prevents unequal pressure building up in te cylinders 210 during the jacking operation as the result of movement of the platform relative to a caisson by wave action. Jacking up of the platform is effected in a manner described hereinafter. Each jacking unit 70 has its own Diesel driven high pressure hydraulic pump, complete with a control panel, pressure reservoir, filters, etc. (not shown). All three pumps are interconnected to provide mutual back-up in the event of the failure of any one pump.

Referring to FIGS. 5 and 6, the winches 112 may be operated to hold the jacking heads 72 aloft while the platform 4 is being towed to the drilling site. The jacking legs 74 are long enough to extend through the jacking mechanisms 126 even when the jacking heads are raised to their maximum height. Alternatively, and preferably, the jacking heads 72 are lowered toward the platfrom deck 38 until the jacking heads engage the upper slip holders 194 of the jacking mechanisms 126. This will eliminate swaying of the jacking heads 72 and jacking legs 74 while the platfrom is in transit. After the caisson support 2 has been set up on the sea bottom, and prior to moving the platfrom 4 into position to receive the caissons 6, 8 and 10 in the caisson wells 20, 22 and 24, respectively, the jacking heads 72 will be raised by the cables 106 and 120 through the operation of the winches 112 to a height above the upper end of the caissons, as indicated in dot-and-dash lines, so that as the platform 4 is maneuvered into position, the caissons will be disposed in axial alignment with the jacking

units **70**, with the jacking legs **74** set up and already straddling the caissons.

In order to stabilize the jacking heads **72** and the jacking legs **74** relative to their associated frames **56**, snubbing means is provided on both sides of each of the jacking units **70**. Such snubbing means comprises a pulley **222**, FIGS. **5** and **6**, carried by a bracket **224** mounted on a plate **225**, and welded to the I-beams **92** at each end of the jacking head, at about the midpoint of the plate **225**. A track member **226** that is T-shaped in cross-section has the end of the stem of the T welded at **228** to each of the uprights **60** and **64**, as is best shown in FIG. **8**. A trolley **230** carries rollers **232** that engage the inner side of the flange of the tracks **226**. The trolley **230** also carries an upper pulley **234** and a lower pulley **236**. A snubbing cable **238** has one end anchored at **240** to the top beam **68** of the frame **56** and extends downwardly around the trolley pulley **234**, around the pulley **222** mounted on the jacking head **72**, back around the other trolley pulley **236**, and then downwardly where its other end is connected at **242** to the piston rod **244** of an air pressure operated snubbing cylinder **246**. The cylinder **246** is pivotally connected at **248** to the T-shaped member **226**. The snubbing cylinder **246** is of substantial length, so that the rod **244** can be operated to pay out, ot take up, any necessary slack in the snubbing cable **238** and still maintain the cable under adequate tension.

It will thus be seen that the jacking heads **72** are stabilized between the frame uprights **60** and **64**, while at the same time they are permitted to move with respect to the frames **56** to accommodate relative movement between the platform **4** and the caissons **6**, **8** and **10** due to wind and wave action. It will also be clear that the trolleys **230** will automatically move up or down on the tracks **226** relative to the stabilizing frames **56**, depending upon the position of the jacking heads **72**.

Assuming that the slips **150** and **198** of the jacking mechanisms have been released, the jacking legs **74** lowered therethrough and the jacking heads **72** engaged with the upper end of the caissons **6**, **8** and **10**, the pneumatic cylinder **180** and **206** are operated to cause the rings **172** and **202**, respectively, to move upwardly and engage the slips **150** and **198** with their assoicated jacking legs **74**. When this has been done, the locking pins **199** and **199A** will automatically lock the rings **172** and **202** in slip-energizing position.

Assuming further that the pistons **211** in the hydraulic cylinders **210** are retracted, fluid is admitted through the connections **217** into the lower ends of the cylinders causing the piston rods **214** to move the upper slip holders **194** upwardly along the jacking legs **74**. The slips **150** in the lower slip holder **142** are urged downwardly and automatically grip the jacking legs **74** at this time and prevent any downward movement of the slip holder **142** on the jacking legs **74**. On the other hand, the slips **198** slide freely upwardly along the jacking legs **74**. Free downward movement of the slips **198** in the holders **194** is permitted by a recess **198A** in a flange **176A** (FIG. **12**). Upon completion of the piston stroke, operating fluid is admitted into the upper end of the cylinders **210** through the connections **215** and is simultaneously exhausted from the lower end of the cylinders through the connections **217**. Such reverse flow can be readily effected by reversing the direction of flow from the pump units in a manner well understood in the art.

The self-enegizing action of the slips **198** in the upper slip holder **194** will cause the slips **198** to tightly grip the jacking legs **74**, with the result that the pistons **211** will remain stationary and the cylinders **210** will be moved upwardly, raising the lower slip holders **142** and the platform **4** connected thereto a corresponding distance. The slips **150** slide freely upwardly along the jacking legs **74** during such movement and can move downwardly relative to the holders **142**, the flange **176** having a recess **150B** to permit such movement. This will complete the cycle of one increment of jacking movement of the platform.

Upon repeating the cycle, the slips **150** will automatically grip the jacking legs **74** and hold the platform **4** in its raised position, while the piston rods **214** are again actuated to move the upper slip holders **194** upwardly along the jacking legs **74** to be followed by another hoisting stroke. Should wave action raise the platform **4** during a jacking stroke, the upper slips **198** will move upwardly along the jacking legs **74** to accommodate the gratuitous "boost" and hold the platform **4** in such raised position and then continue to raise it until the jacking stroke has been completed. The cycle is repeated until the platform is raised to the desired working height above the water. It is impossible for the platform to move downwardy because of the self-energizing action of the slips. The heavier the load, the tighter will be their grip.

Any leveling of the platform **4** that may be required can be effected by operating one or more of the jacking units **70** individually. The platform is then fixed to the caissons **6**, **8** and **10** by welding plates (not shown) to both the caissons and platform in the caisson wells. The stabilizing frames **56** and the jacking units **70** can then be dismantled to get them out of the way.

The invention further contemplates elevating a platform on a single vertical caisson of large diameter supported on the sea bed by a plurality of angularly disposed legs. Such structure has been referred to hereinbefore as a monopod and is illustrated in FIGS. **23** and **24**. The monopod **250** comprises a main caisson **252** having its lower end welded to four angularly disposed legs **254** with connecting members **256** and braces **258** disposed between the legs, and an enlarged footing **260** secured to the lower end of each leg. The monopod structure is prefabricated, rendered watertight, towed to the drilling site, and sunk to the bottom in the same general manner as the tripod caisson structure **2** described hereinbefore. After the monopod has been sunk to sea bottom, a platform **262** having a single caisson slot or well **264** extending from the bow to a point at the center of the platform, is maneuvered into position. A locking gate **266** is lowered into place by a crane (not shown) on the platform **262** to hold the platform in place. A jacking unit **70A**, similar to the jacking unit **70** previously described, is pre-mounted upon the platform **262** in straddling relation to the caisson well **264**. A stabilizing structure **56A**, similar to the frame **56**, previously described, is also pre-mounted on the platform deck around the jacking unit **70A** in the same manner illustrated in FIGS. **5** and **6**. The jacking unit **70A** is operable in the same manner as the jacking unit **70**, previously descibed, and is capable of incrementally raising the platform **262** to the desired height on the caisson **252**. The platform **262** is fully equipped and includes the jacking unit **70A** straddling the caisson

well **264** and the stabilizing frame **56A** for the jacking unit.

The caisson **252** preferably has a footing **268** to engage the sea bottom to provide direct support for the platform **262**. The caisson well **264** is covered, after the caisson **252** has been locked in place, to provide more deck space.

It will be undestood that the present invention is not limited to the use of jacking units comprising four jacking legs, nor to be use of two pairs of jacking legs straddling a caisson well. On the contrary, a single pair, or any number of pairs, of jacking legs can be employed in straddling, or non-straddling, relation to a caisson well. Futhermore, a jacking unit can be employed which comprises a single jacking leg having associated therewith a slip type jacking mechanism, such as described above.

Referring to FIGS. **25, 26** and **27**, an embodiment is illustrated wherein a single jacking leg **74B** is attached to a jacking head **72B** of a jacking unit **70B** by a self-aligning bearing **76B** with the jacking leg **74B** extending substantially vertically, and disposed close to a caisson **6B**, so that a minimum of bending moment results from the cantilever action of the jacking leg **74B** on the caisson **6B**. In this embodiment, the jacking head **72B** has a pilot portion **86B** that extends into the caisson **6B** for a substantial distance, so as to hold the jacking head **72B** in position on the caisson and withstand the cantilever force applied by the jacking leg **74B**. It will be understood that the wall of the caisson **6B** is made sufficiently thick to withstand any bending stresses imposed thereon, without buckling. As is shown, the jacking leg **74B** and its gimbal-mounted jacking mechanism **126** are disposed rearwardly of a caisson well **20B**. The jacking unit **70B** operates on the same principles as the jacking unit **70**, except that a downward force is applied to the upper end of the caisson **6B**, to raise the platform **4B** and at only one side of the caisson, through the single jacking leg **74B**. In the interest of brevity, other parts shown in FIGS. **25, 26** and **27** and previously described herein, are identified by the same reference numerals.

FIG. **28** is a diagrammatic plan view similar to FIG. **27**, but illustrates two jacking legs **74C** connected with a jacking head **72C** in cantilever fashion. Each of the jacking legs **74C** extends through a gimbal-mounted jacking mechanism **126**. As is shown, the jacking legs are disposed rearwardly of the caisson well **20C** and, therefore, do not straddle the caisson well.

FIG. **29** is a diagrammatic plan view of a jacking head **72D** illustrating a pair of jacking legs **74D** and gimbal mounted jacking mechanisms **126** arranged diametrically with respect to a caisson **6D** and straddling a caisson well **20D**.

FIG. **30** is a view similar to FIG. **29**, but shows three pairs of jacking legs **74E** connected with the opposite ends of a jacking head **72E** and straddling a caisson well **20E**. Each jacking leg **74E** extends through a gimbal-mounted jacking mechanism **126**.

Thus, it will be seen that in the case of a platform that can be raised relative to a caisson by a single jacking leg, only one such jacking leg need be provided and, as shown in FIGS. **25, 26** and **27**, it may be disposed to the rear of the caisson well, although it could be disposed on either side, as desired. FIG. **28** shows a pair of jacking legs in non-straddling relation to a caisson well. FIGS. **29** and **30** illustrated assemblies wherein either on pair of jacking legs may be employed straddling the caisson well, or three pairs may be used, depending upon the weight and character of the platform to be elevated on the caisson or caissons. Thus, it will be clear that any number of jacking legs may be connected with a jacking head, in any arrangement desired, depending upon the jacking requirements of a particular platform.

It will be understood that various changes in design and arrangement of the components of the present jacking apparatus may be made, including changes in the slip type jacking mechanism and locking means, and in the jacking head itself; and that the method of stabilizing and manipulating the jacking heads and jacking up the platforms on the supports may be varied, all without departing from the principles of the invention or the scope of the annexed claims.

I claim:

1. A jacking unit for use in elevating a platform relative to an upright support, comprising: a rigid upright jacking leg to be connected at its upper end with said upright support; a jacking mechanism surrouding said jacking leg; means at the lower end of said jacking mechanism for connecting the same to the platform, said jacking mechanism including two sets of wedge-type gripping elements, each set being concentric to and engageable with substantially the full circumference of said jacking leg, one set being mounted in an upper holder and the other in a lower holder; air pressure operated means connected to and arranged to actuate said gripping elements axially upwardly to energized position and axially downwardly for retracting the same; and means between said holders operable to move said holders toward and away from each other along said jacking leg.

2. A jacking unit as claimed in claim **1**, including means for pivotally connecting the upper end of the jacking leg with the upright support; and means for pivotally connecting the lower end of the jacking mechanism with the platform.

3. The jacking unit claimed in claim **2**, wherein the means for pivotally connecting the upper end of the jacking leg with the upright support includes a self-aligning pivot joint, and the means for pivotally connecting the jacking mechanism to the platform is such as to provide for universal movement therebetween.

4. The jacking unit claimed in claim **3**, wherein the means for connecting the lower end of the jacking mechanism for universal movement relative to the platform comprises a gimbal joint.

5. The jacking unit claimed in claim **1**, wherein the gripping elements of the jacking mechanism are self-energizing wedge slips mounted in the holders and are simultaneously engageable with the jacking leg for gripping the same; and wherein the means for moving the holders toward and away from each other comprises a plurality of hydraulically operated cylinders and pistons disposed between the slip holders and connected therewith.

6. The jacking unit claimed in claim **1**, including means for locking the gripping elements in energized position, said locking means overriding and preventing retraction of the gripping elements by the air-pressure-operated means.

7. The jacking unit claimed in claim **6**, wherein the locking means is only manually releasable, to thereby prevent retraction of the gripping elements by inadvertent actuation of the air-pressure-operated means.

8. The jacking unit claimed in claim 5, wherein four hydraulically operated cylinders and pistons are disposed between the upper and lower slip holders of the jacking mechanism, and wherein one of the slip holders is pivotally connected with the cylinders and the other slip holder is pivotally connected with the pistons.

9. The jacking unit claimed in claim 5, wherein the wedge-type slips have toothed inner faces, and smooth outer faces inclined upwardly and inwardly and engaged with the inner surface of the holders; means slidably retaining said slips in said slip holders; and wherein the mounting means for the jacking mechanism includes a ring connected with the lower slip holder mounting the same for pivotal movement relative thereto on a diametrical axis; and means for mounting said ring for pivotal movement relative to the platform on an axis at right angles to said diametrical axis.

10. The jacking unit claimed in claim 9, wherein the ring constitutes one element of a gimbal joint, and the lower slip holder constitutes another element of said gimbal joint.

11. The jacking unit claimed in claim 5, wherein a slip actuating ring is mounted for limited vertical movement at the lower end of each slip holder, and wherein a compression spring is positioned between the slip-actuating rings and each slip, normally urging the slips in a direction upwardly away from said rings, each slip having an element connected thereto and engageable by one of said rings for moving the slips downwardly against the force of the compression springs; and wherein the air-pressure-operated means is carried by the respective slip holders and connected with their associated rings and selectively actuatable to move the rings downwardly relative to their holders to thereby release the slips.

12. The jacking unit claimed in claim 5, wherein each of the slips is connected to a slip-actuating ring, and a compression spring is disposed between each slip and the slip-actuating ring; and wherein the air-pressurue-operated means is connected with the slip-actuating ring.

13. The jacking unit claimed in claim 12, wherein each of the slip holders has a plurality of spring-pressed locking pins mounted thereon, and the slip-actuating ring has openings to receive said pins for locking the slips in energized position; and wherein the air-pressure-operated means connected with the slip-actuating rings is mounted on the slip holders.

14. The jacking unit claimed in claim 13, wherein the locking pins can only be released manually; and wherein the air-pressure-operated means for operating the slip-actuating ring to move the slips to retracted position can be operated only after the locking pins have been manually released.

15. The jacking unit claimed in claim 1, including a jacking head; and means pivotally connecting the jacking head with the upper end of the jacking leg.

16. The jacking unit claimed in claim 15, in combination with a frame to be mounted on the platform and having means for supporting the jacking head above the support and for lowering the jacking head into the upper end of the support.

17. The jacking unit claimed in claim 15, in combination with a frame to be mounted on the platform and having means for supporting the jacking head above the support and for lowering the jacking head into the upper end of the support; and wherein the frame has uprights to be positioned adjacent to and outwardly of the jacking legs; and wherein means including tensioned cables connect the frame uprights with the opposite ends of the jacking head for stabilizing the jacking unit relative to the platform.

18. A jacking unit for use in elevating a platform relative to an upright support, comprising a normally horizontal jacking head; means connected with said jacking head for raising and lowering said jacking head to position the same upon the upper end of the support; at least one pair of upright jacking legs; means connecting the upper end of said jacking legs with the jacking head; a jacking mechanism surrounding each jacking leg, said jacking mechanisms each including two sets of wedge-type, self-energizing gripping elements mounted in separate holders; resilient means normally urging said gripping elements in a direction to engage the jacking legs; and air-pressure-operated means connected with said gripping elements and operable to energize or retract said gripping elements with respect to the jacking legs.

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