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(54) **BOAT LIFT**

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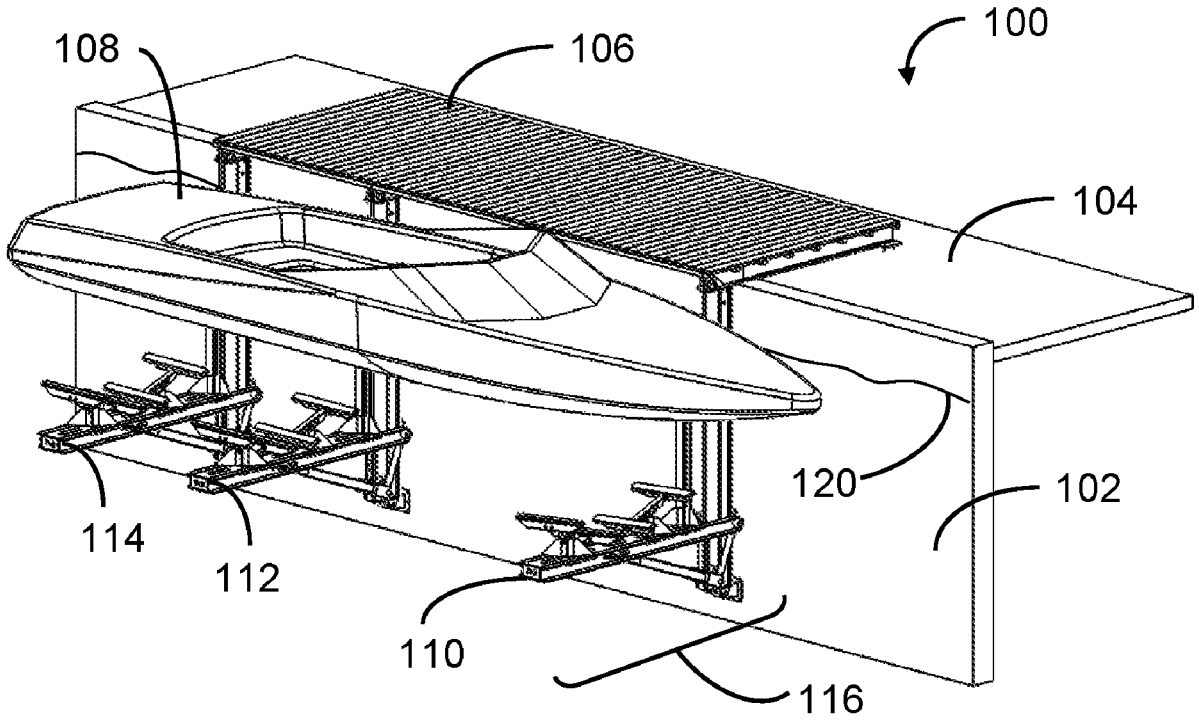
(57) **ABSTRACT**

A boat lift for raising boats out of the water to facilitate maintenance and to reduce corrosion and contamination. The boat lift includes two or more boat lift assemblies positioned and spaced apart so that each boat lift assembly lifts approximately the same fraction of the overall weight of the boat. Each boat lift assembly has a lifting structure with bunk cushions mounted on pivoting bunk bases to prevent damage to the boat hull when lifting. Hydraulic lift mechanisms are enclosed within each boat lift assembly providing a cleaner appearance as well as protection against corrosion and fouling. A dual-pulley mechanism enables lifting distances substantially larger than the length of the lift mechanism. A hydraulic control system ensures that all the boat lift assemblies move up and down simultaneously and at the same rate, thereby maintaining the boat horizontal at all lifting positions.



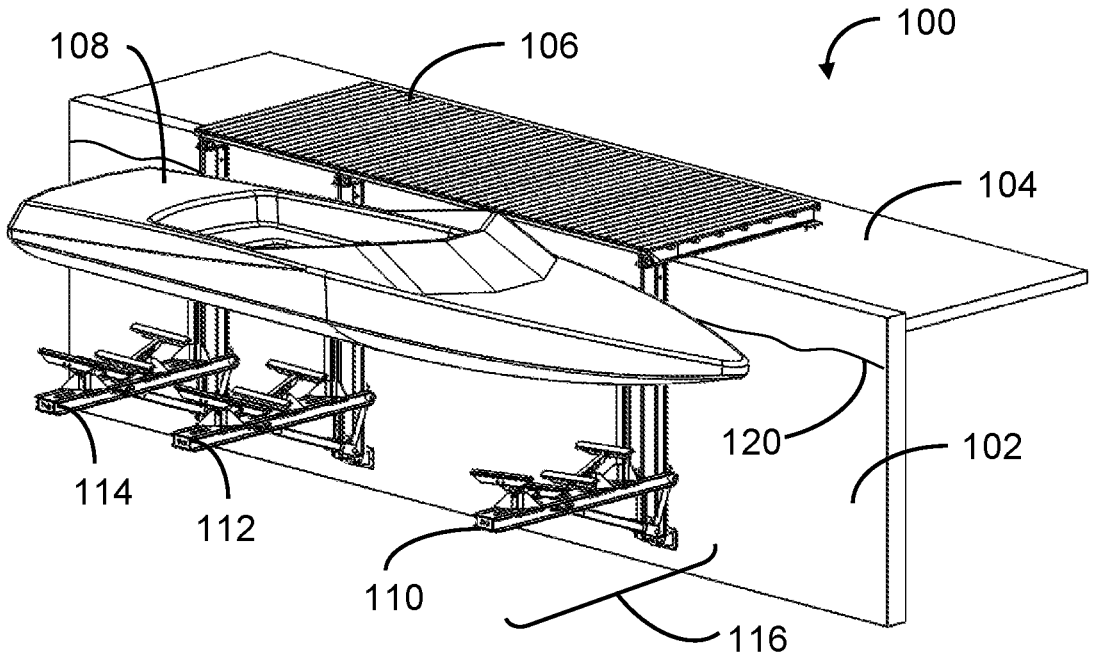

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FIG. 1

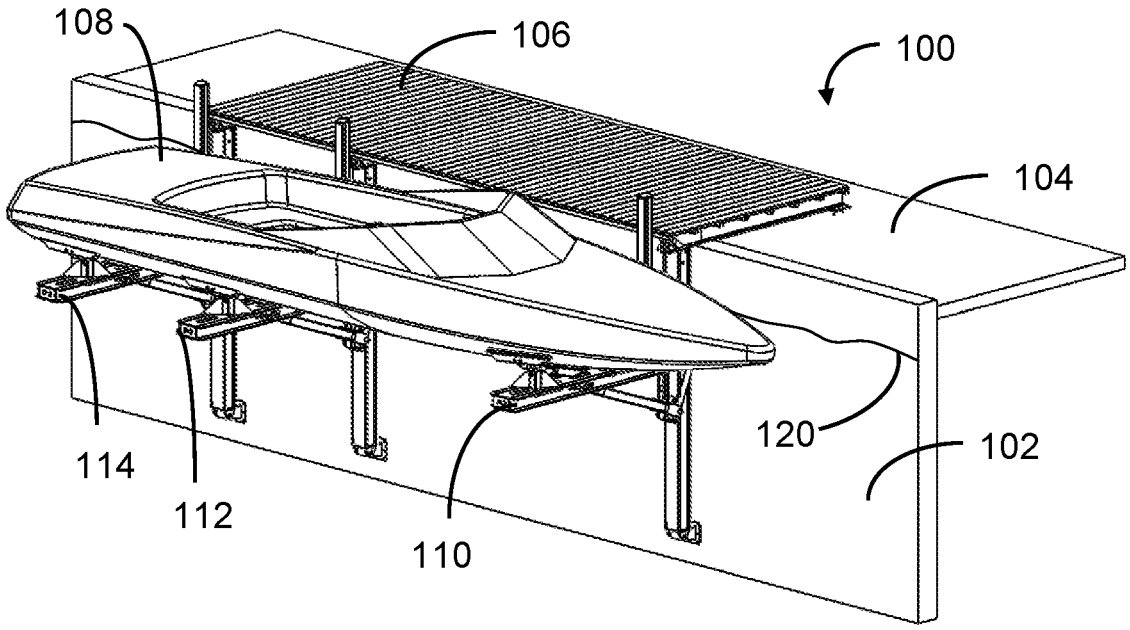
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FIG. 2

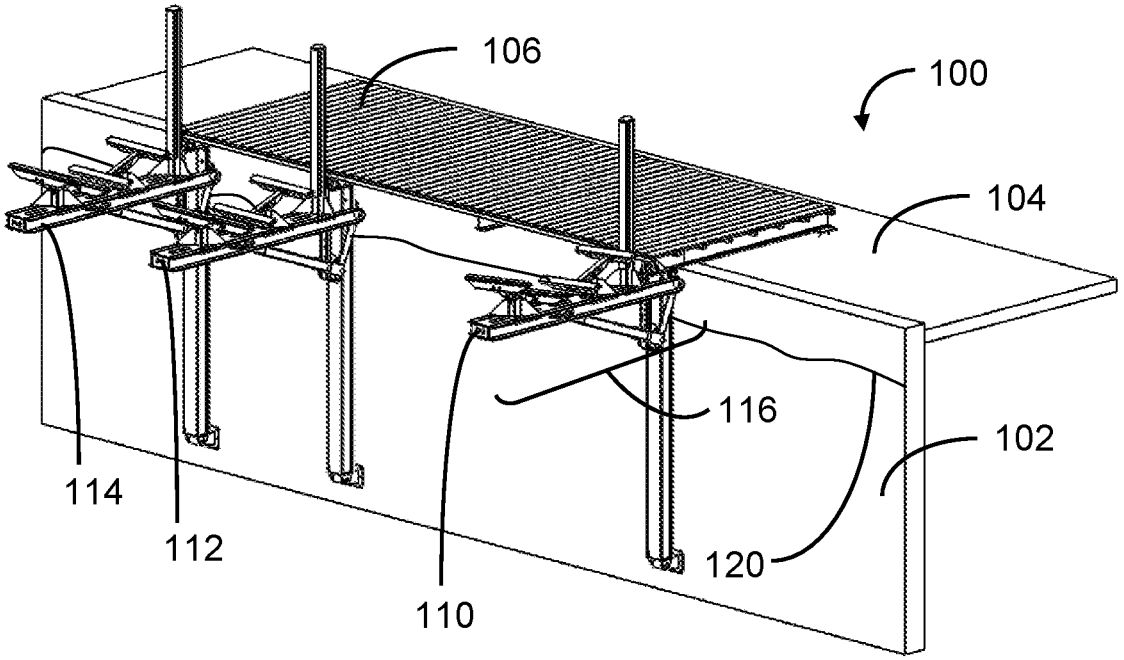
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FIG. 3

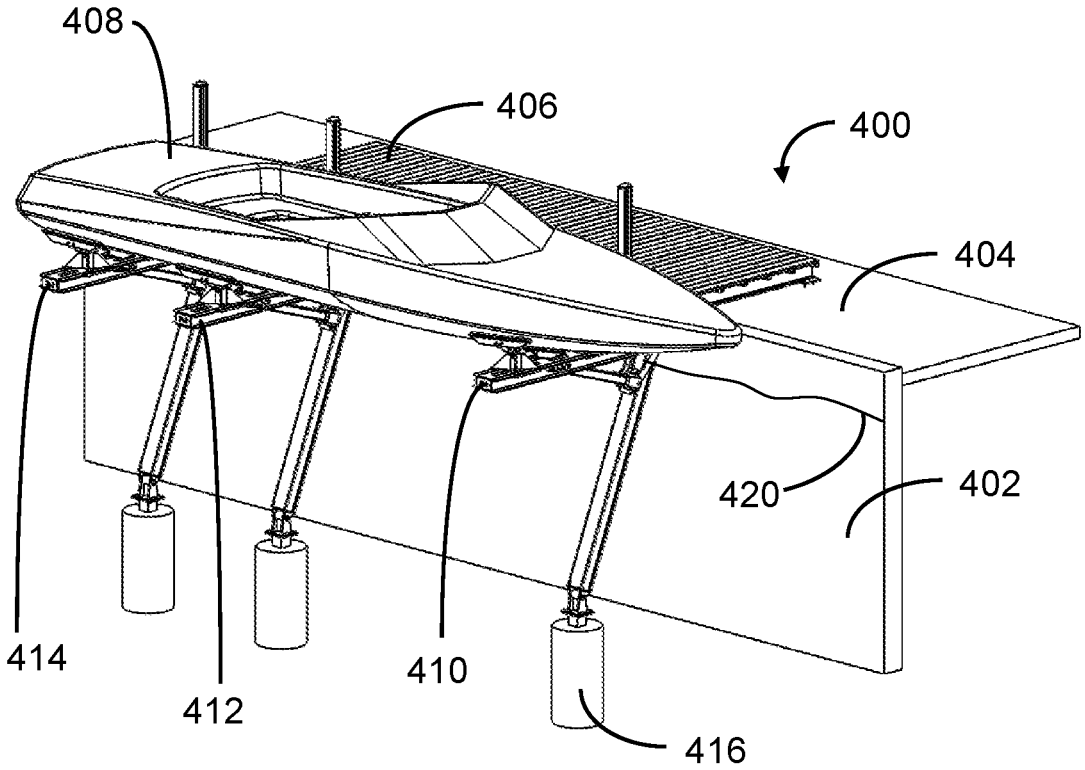
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FIG. 4

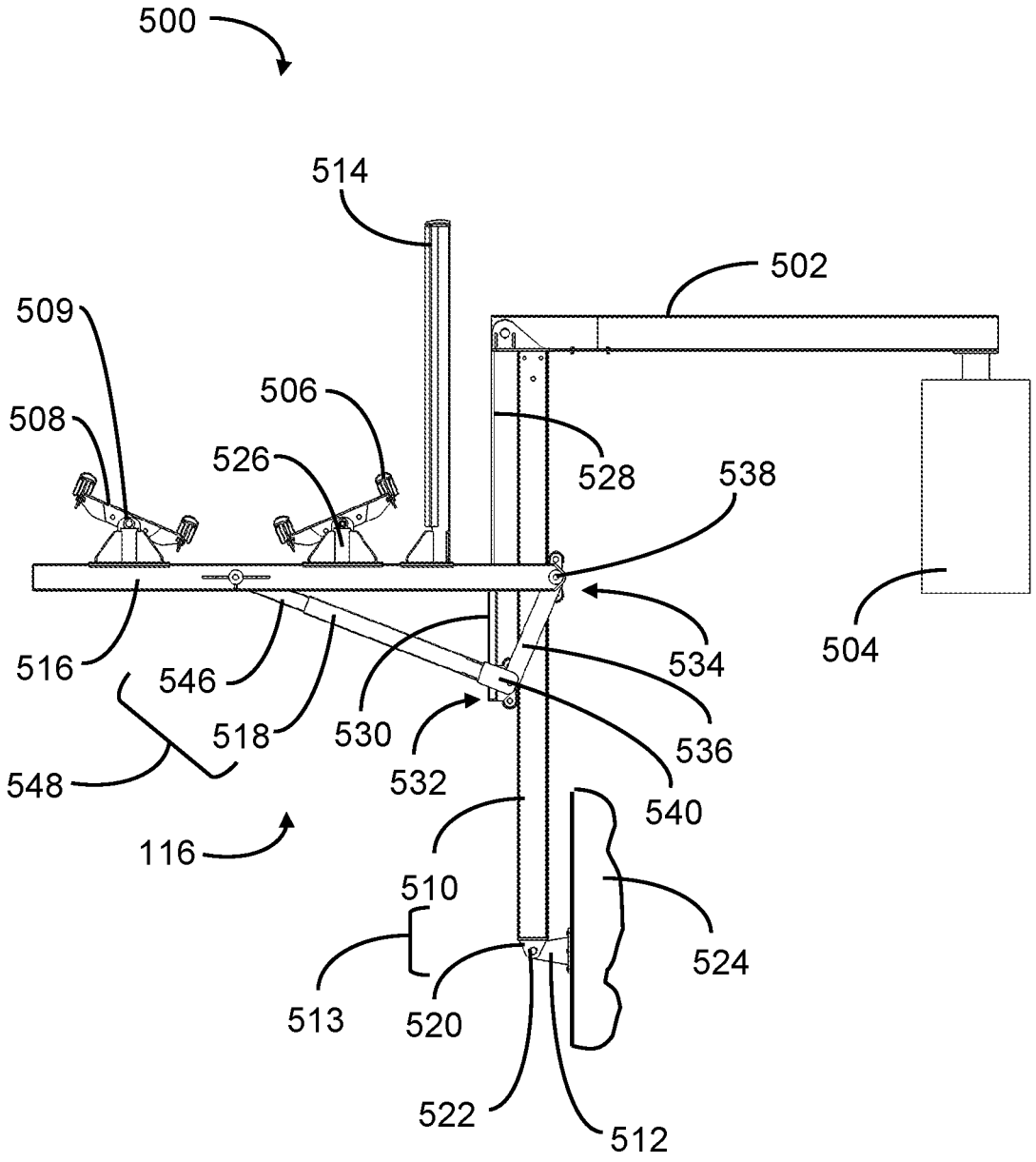
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FIG. 5

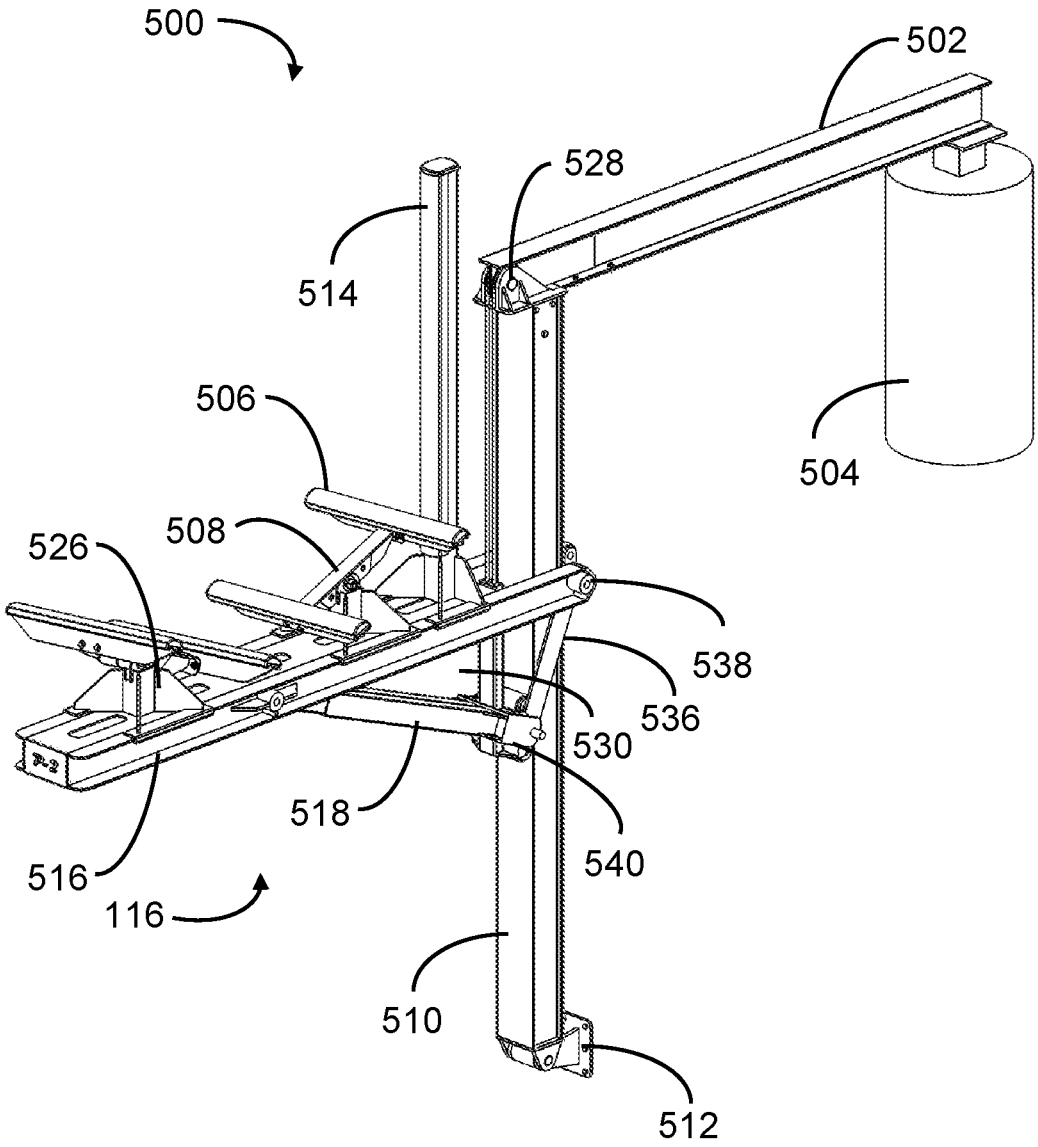
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FIG. 6

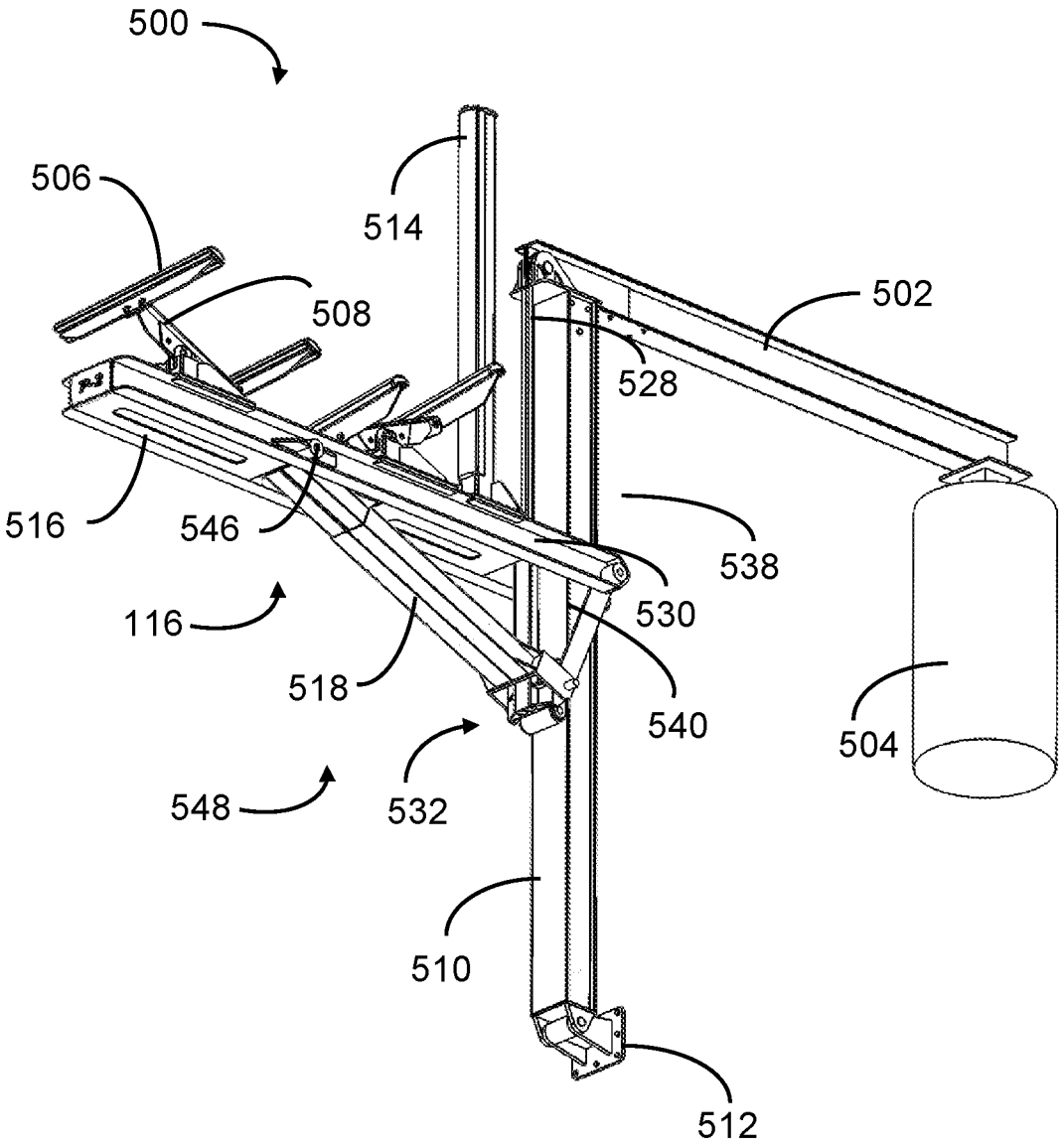
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FIG. 7

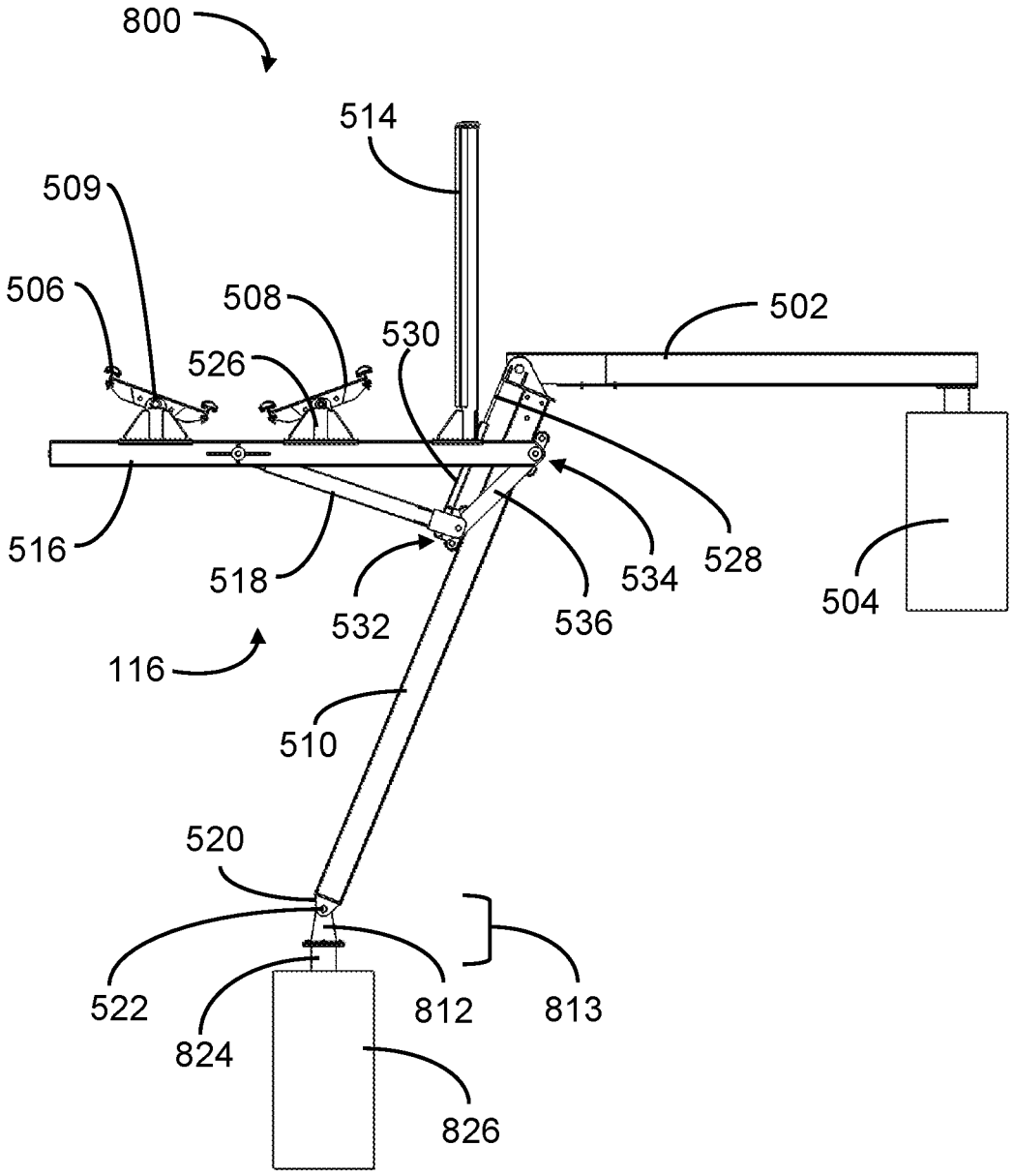
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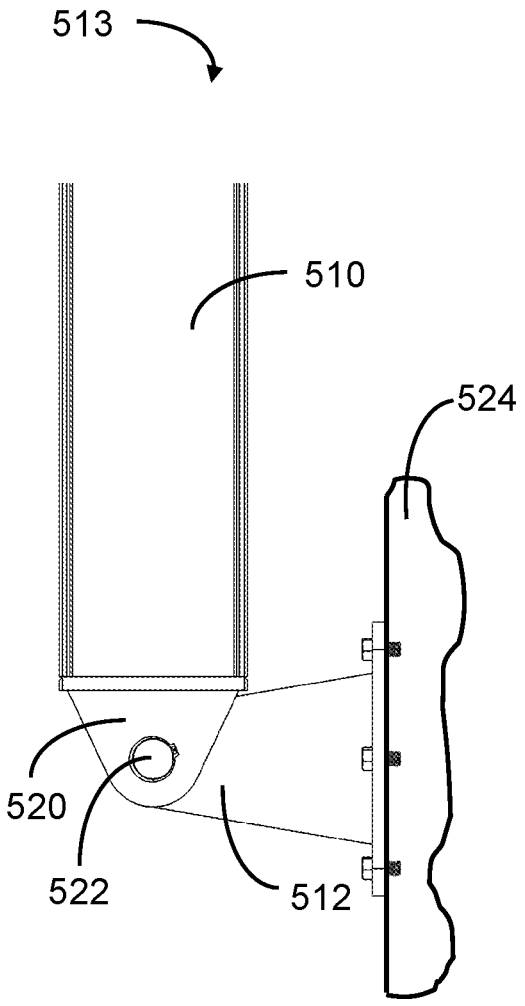
FIG. 8



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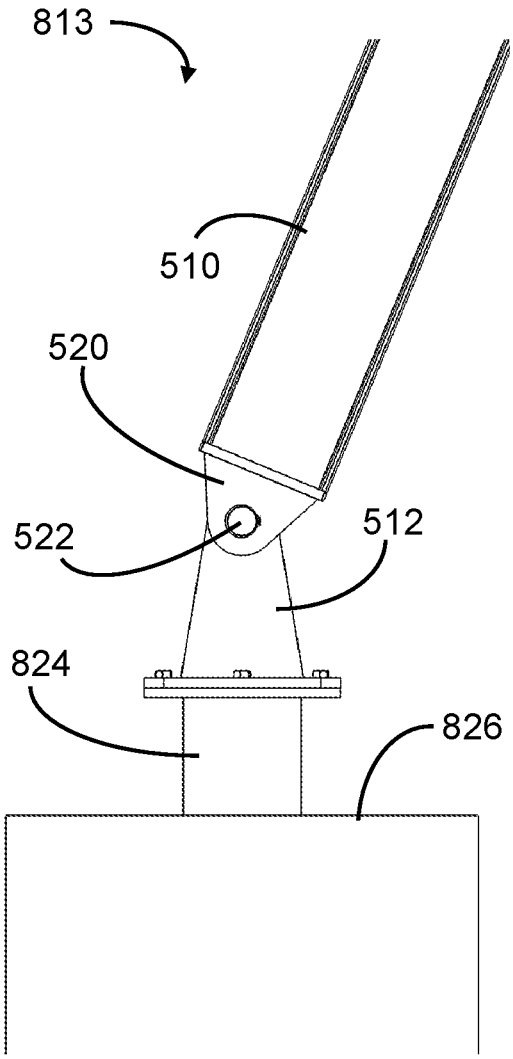

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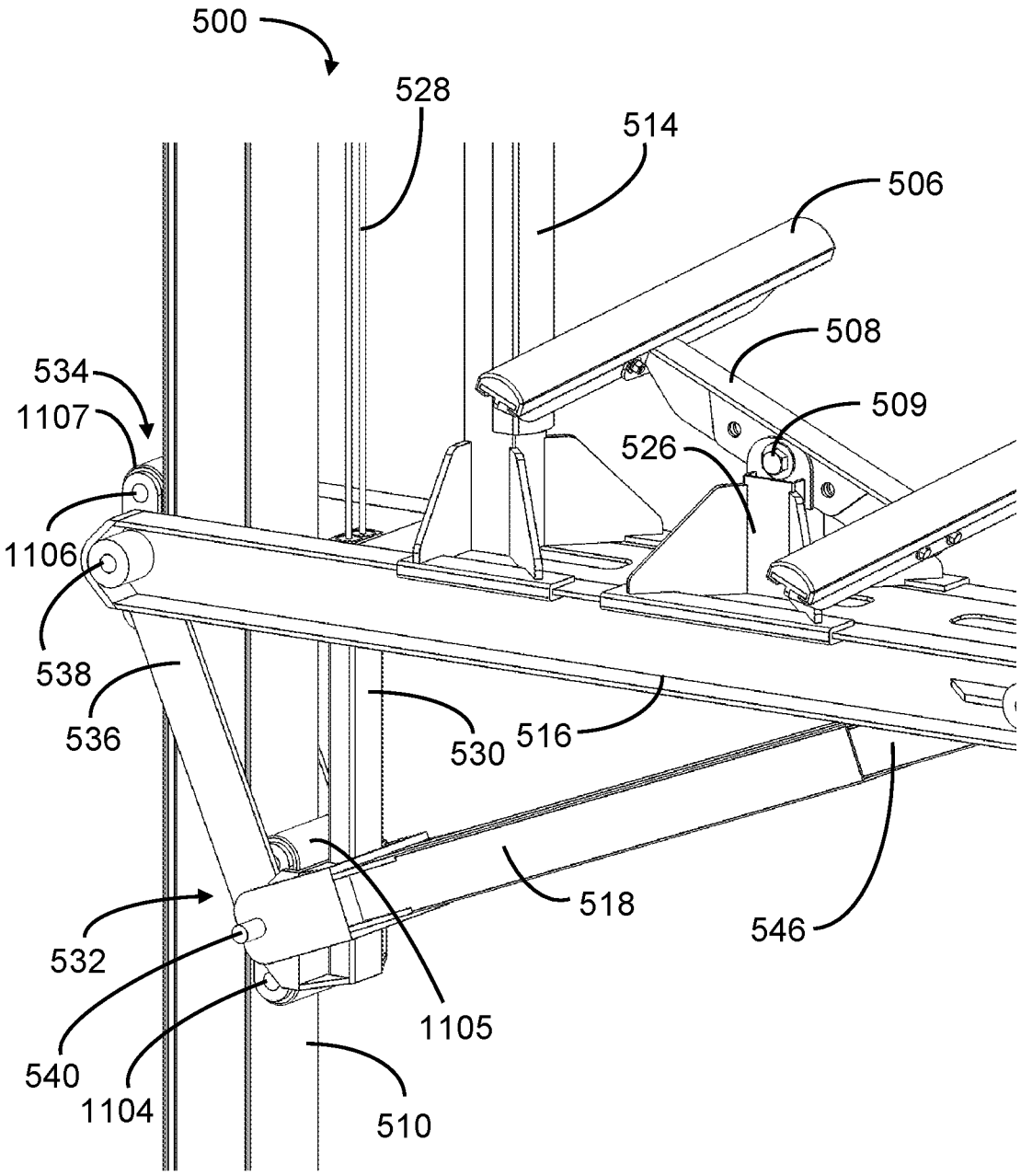
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FIG. 11

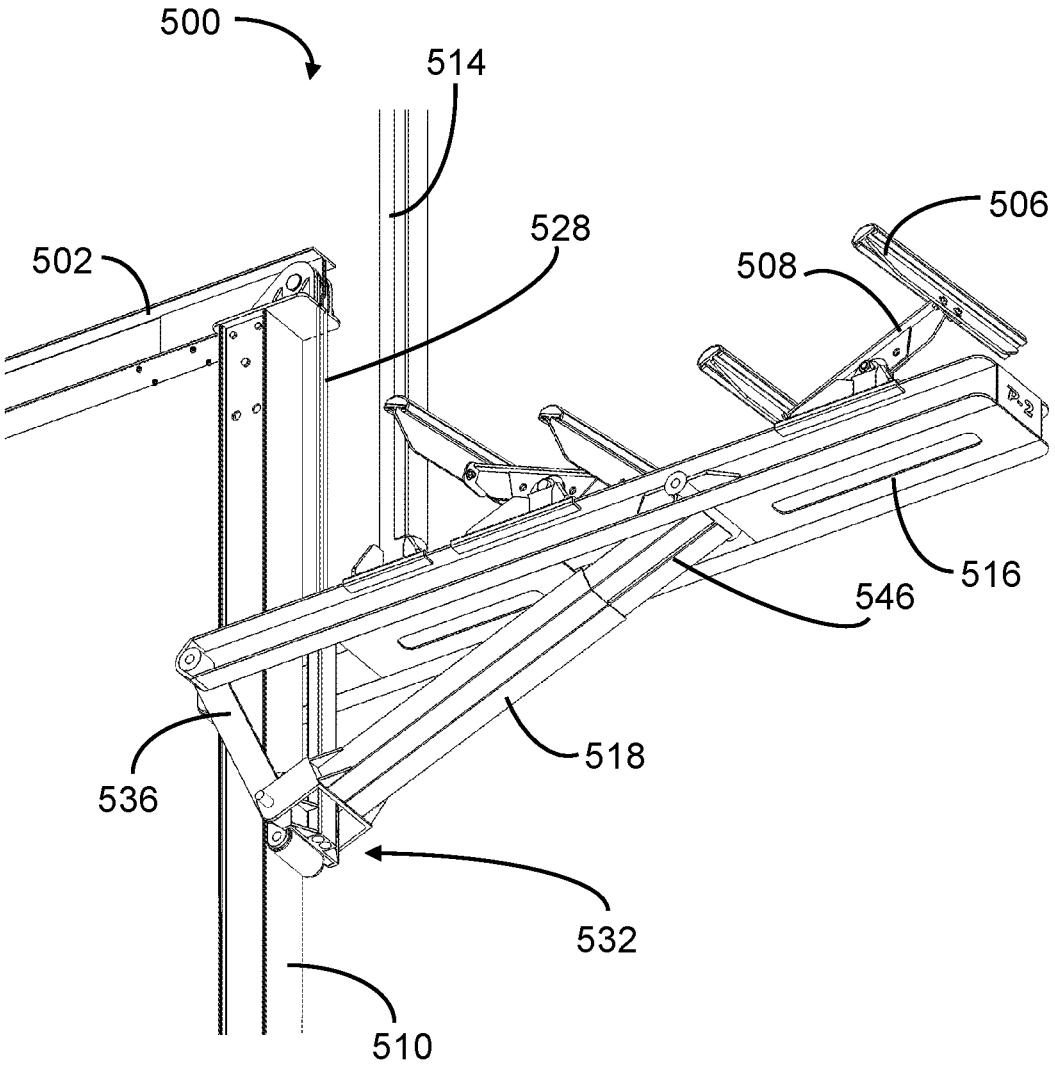

FIG. 12

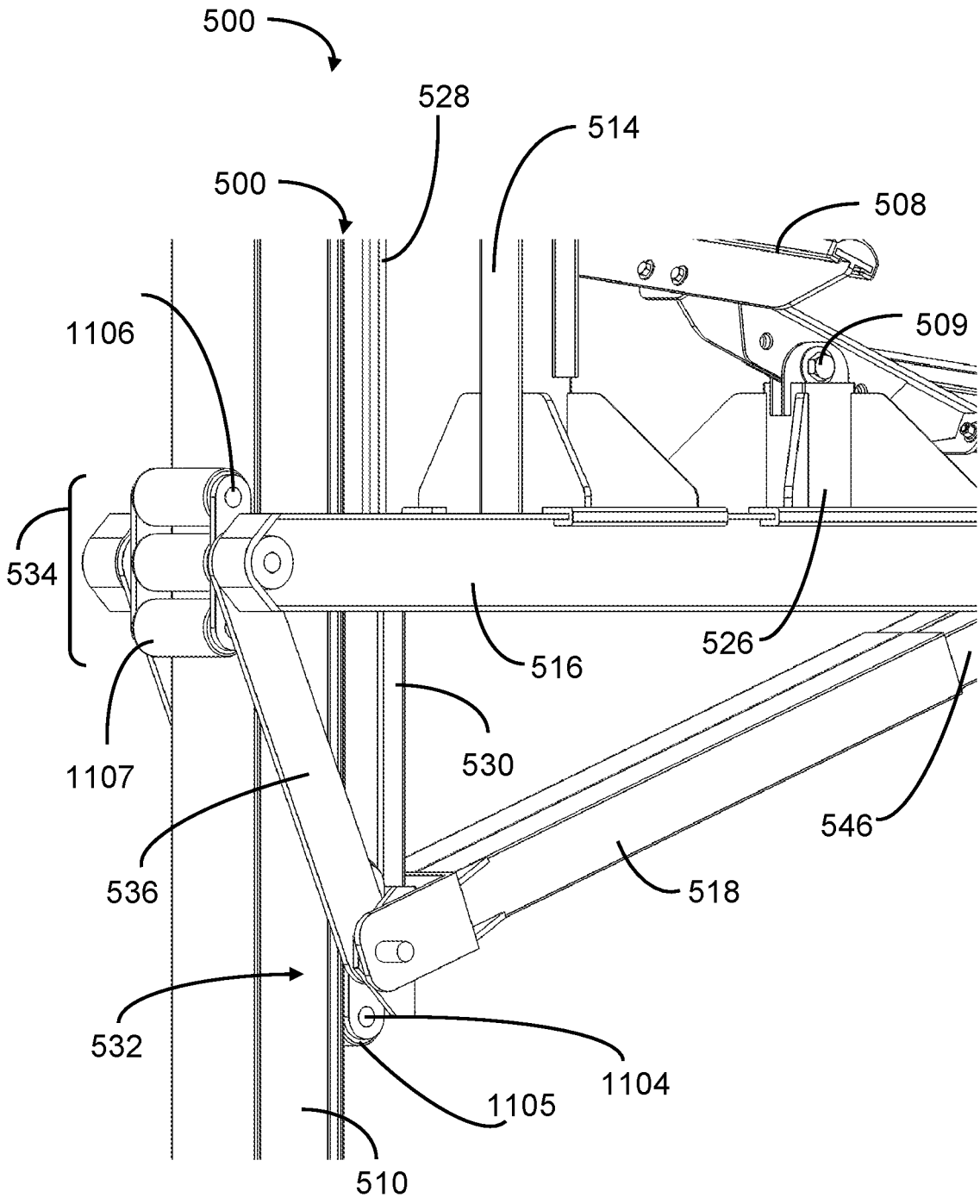
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FIG. 13

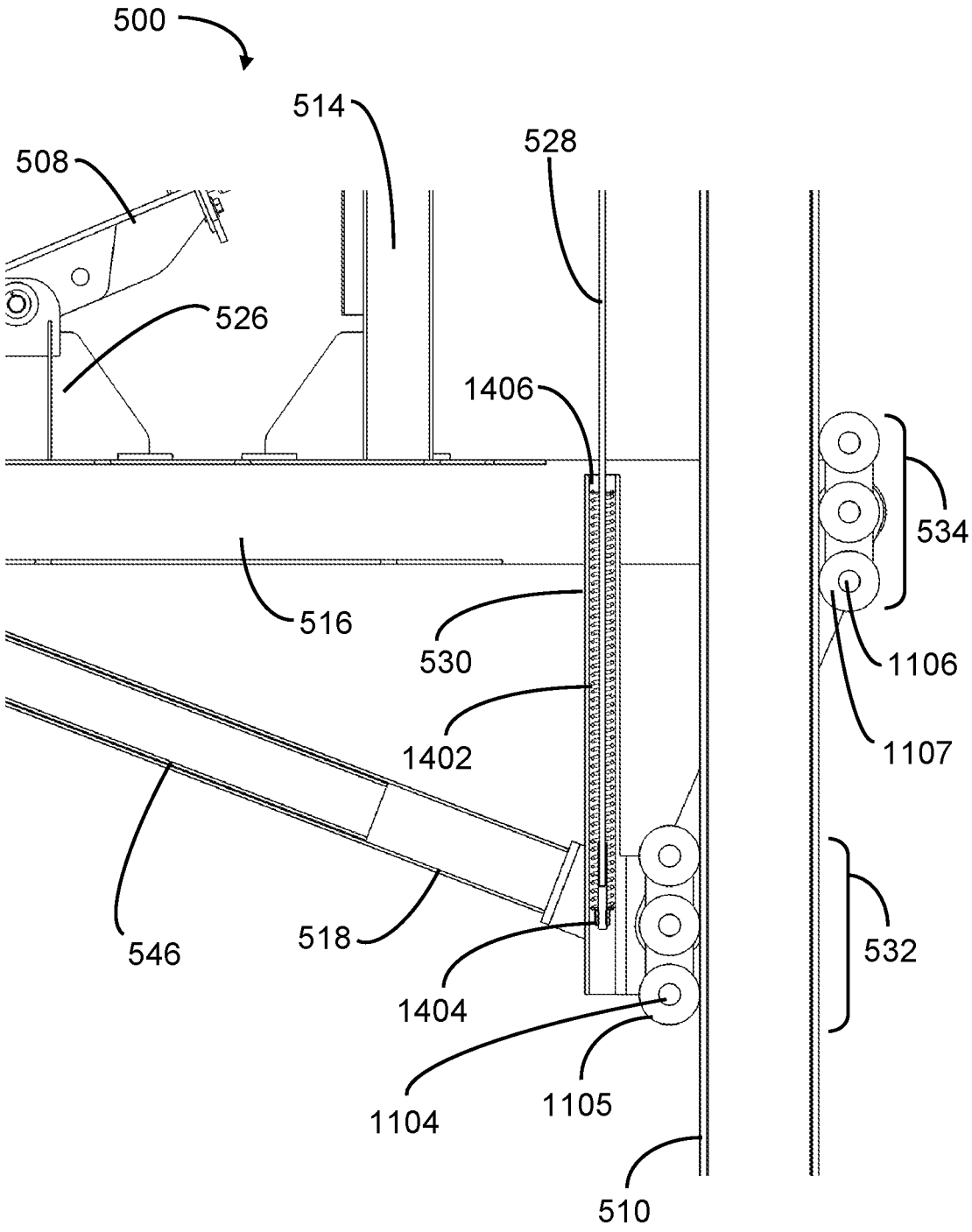
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FIG. 14

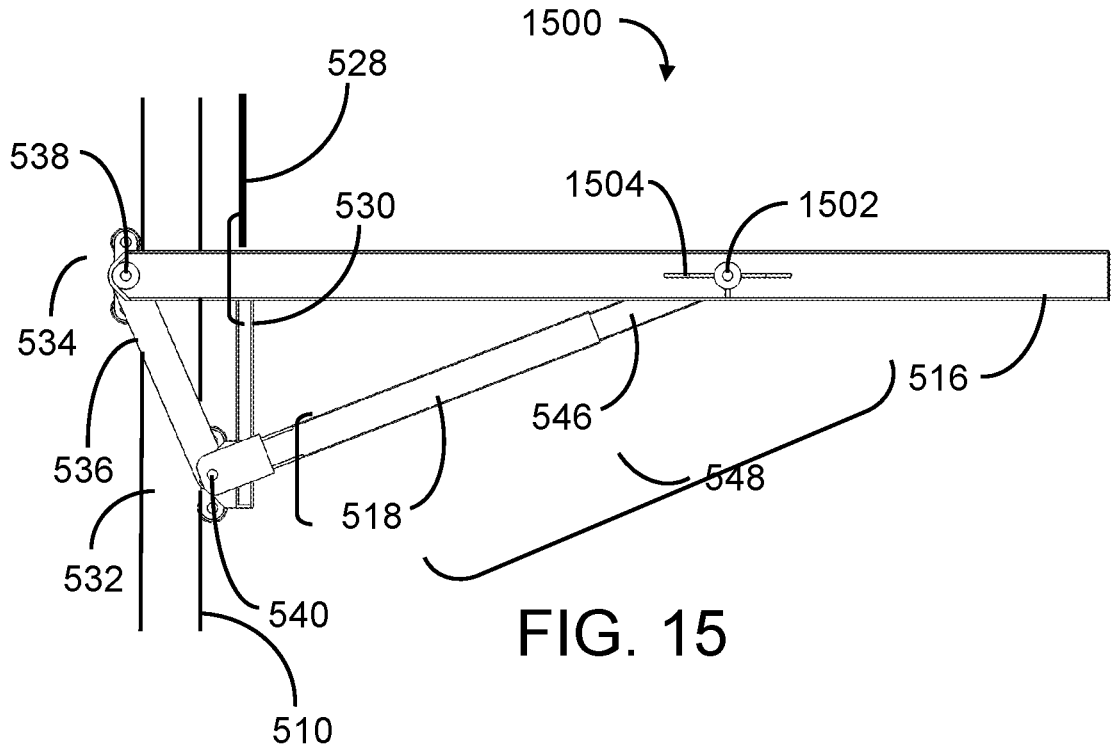
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FIG. 15

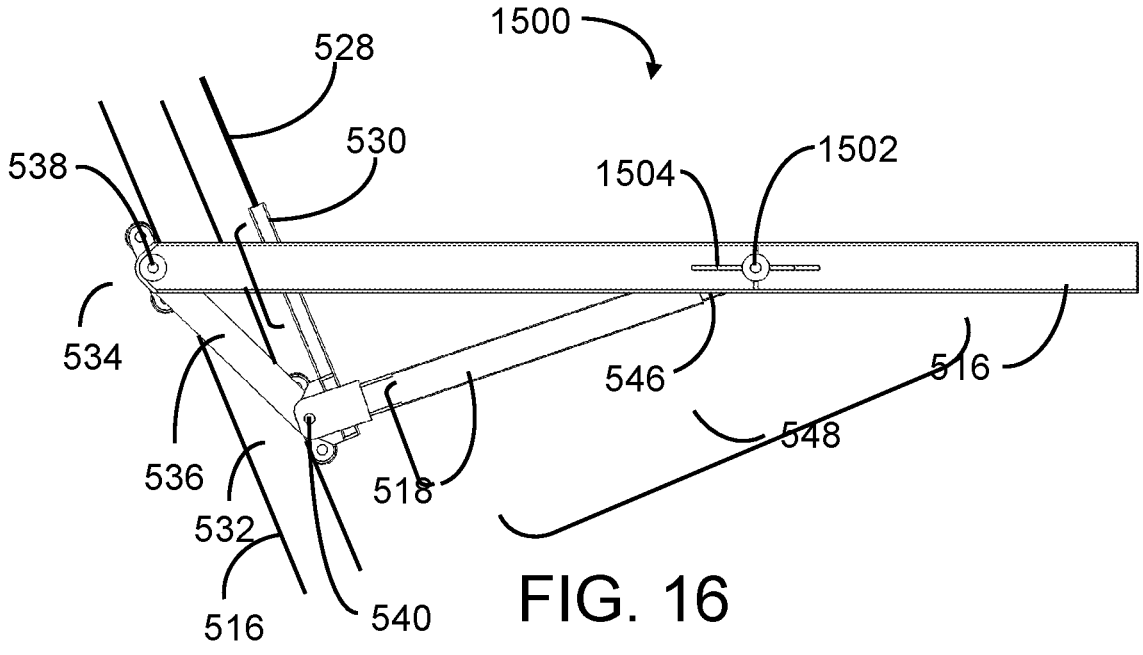
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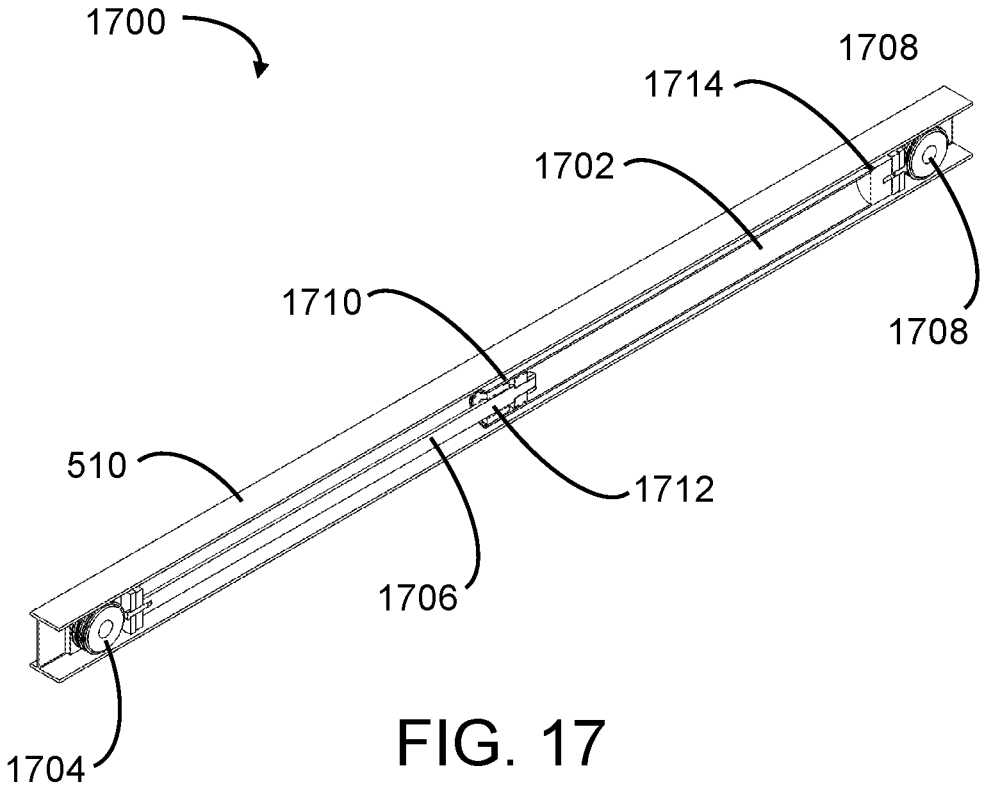
FIG. 16



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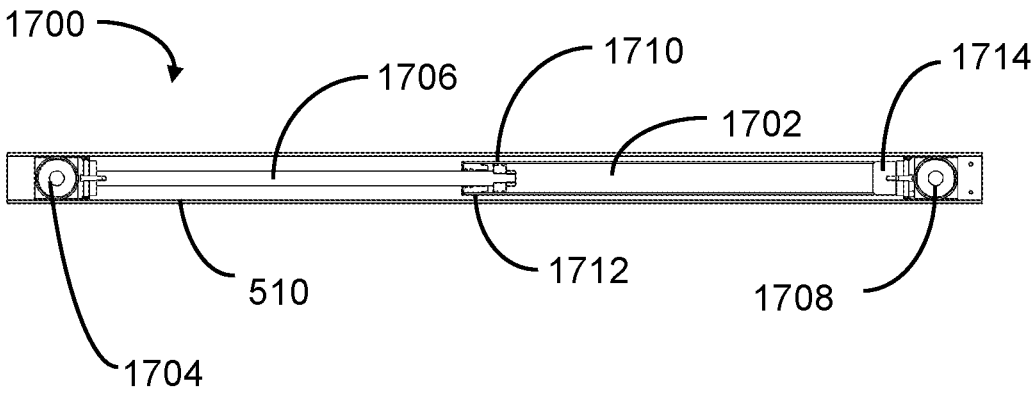
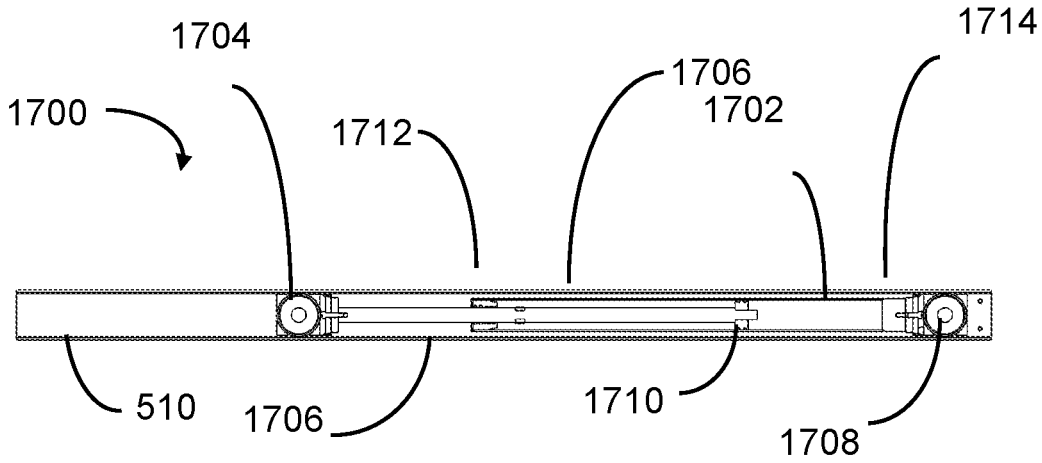


FIG. 18



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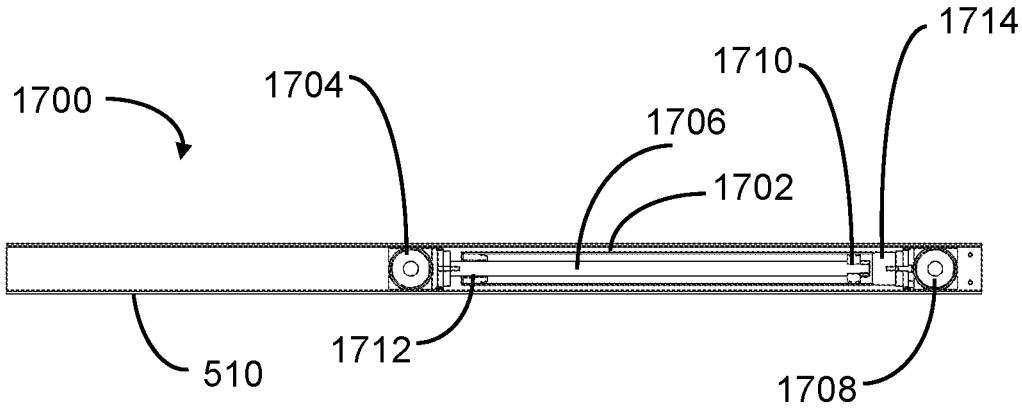

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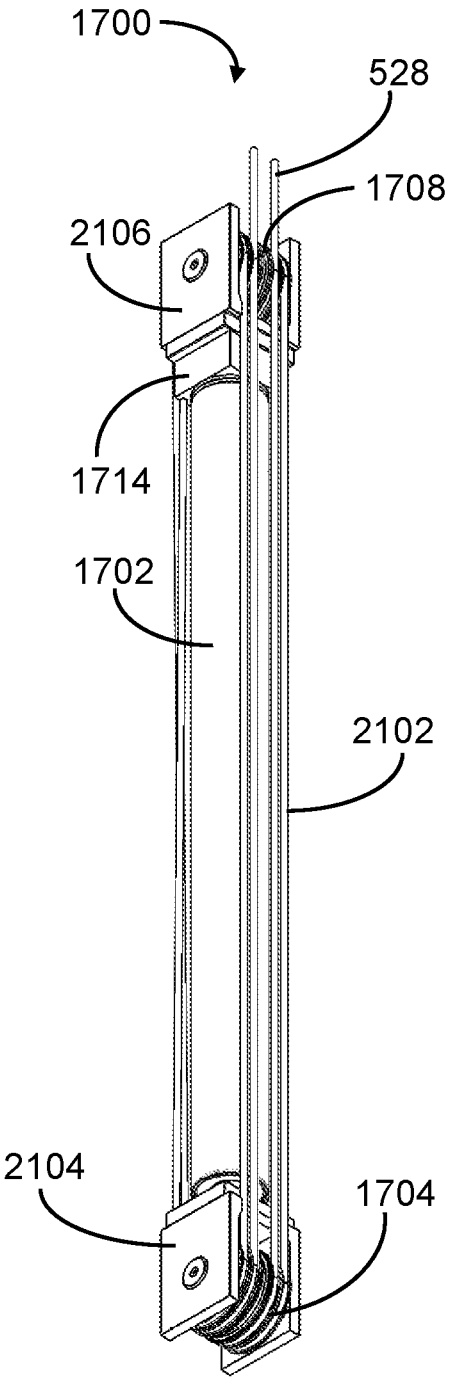
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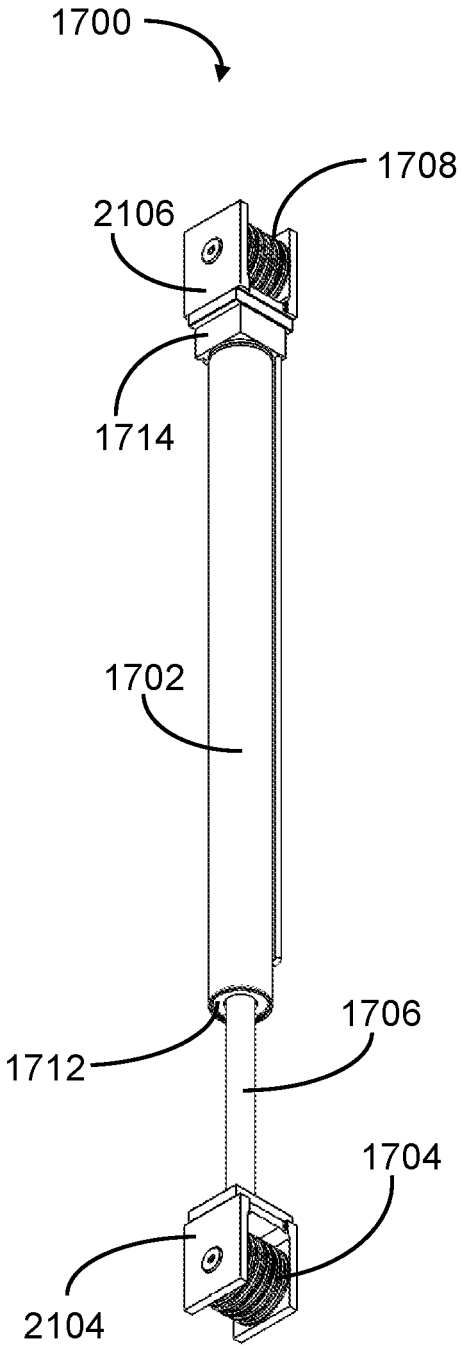
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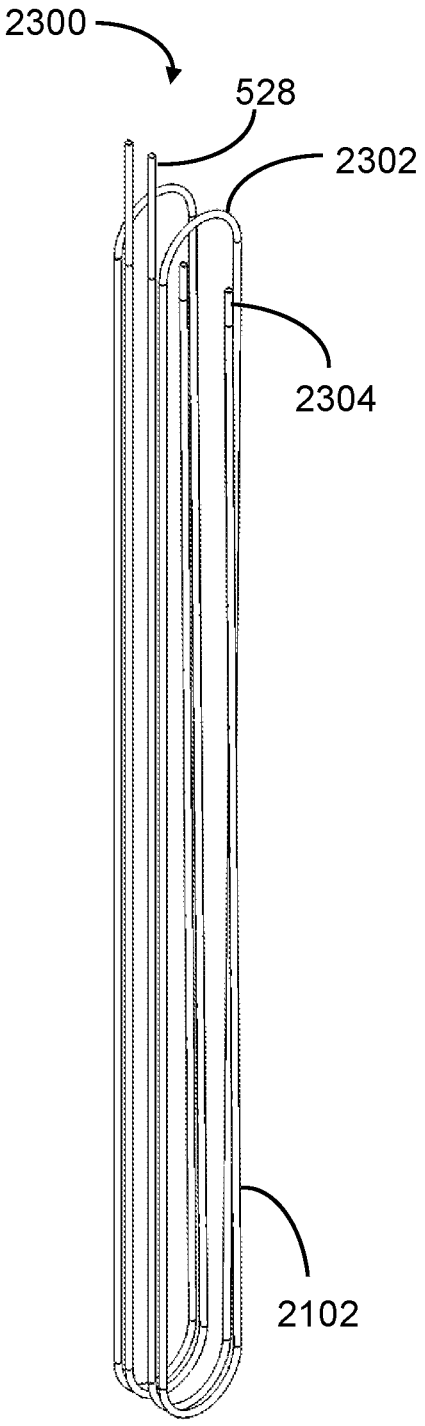

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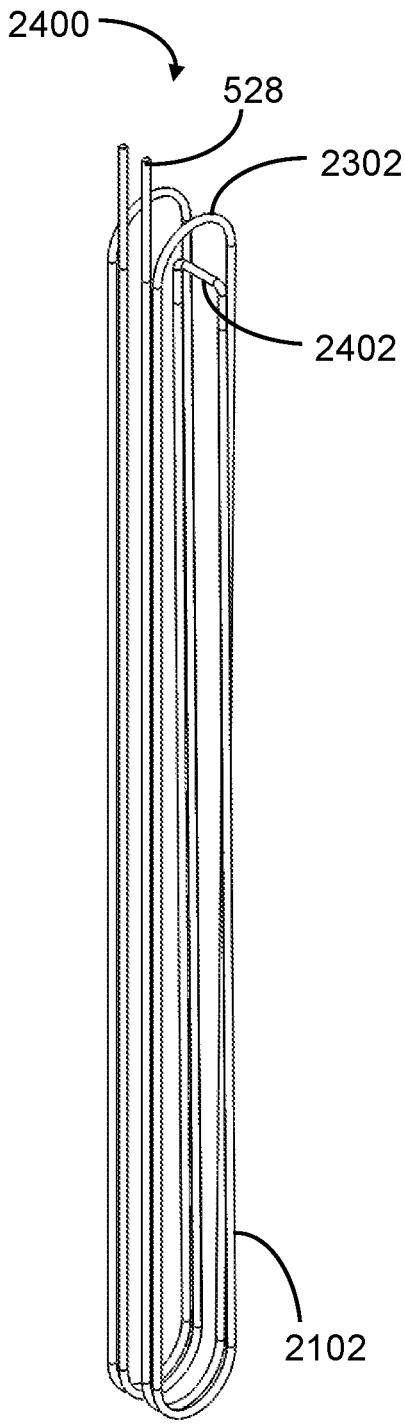

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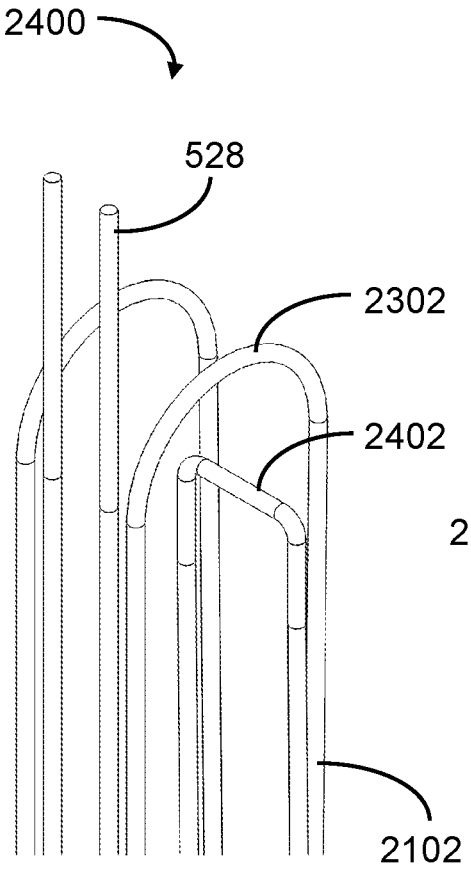
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FIG. 25

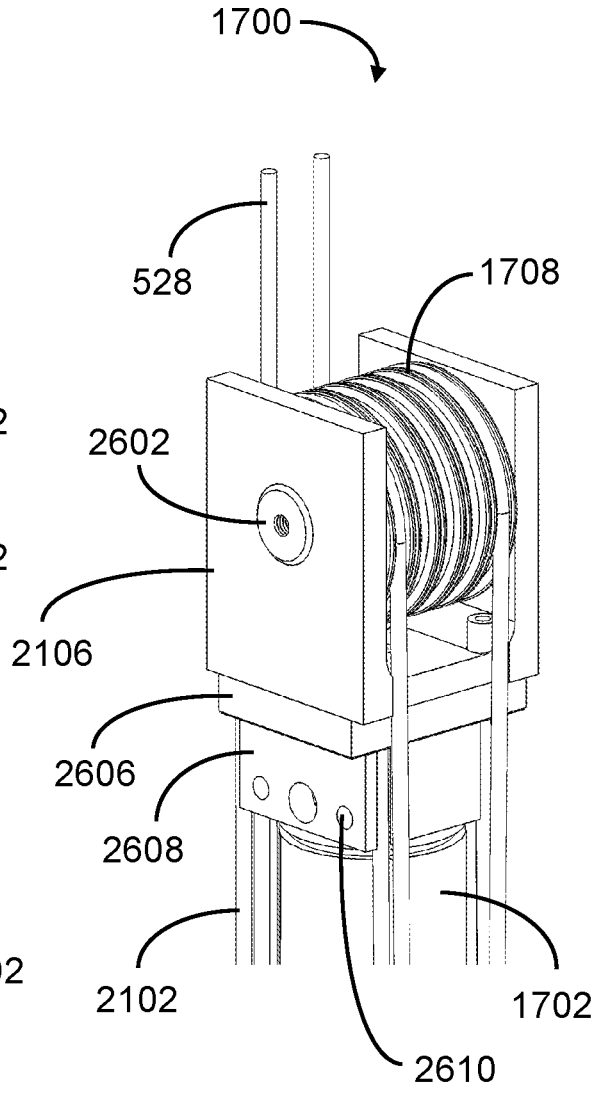
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FIG. 26

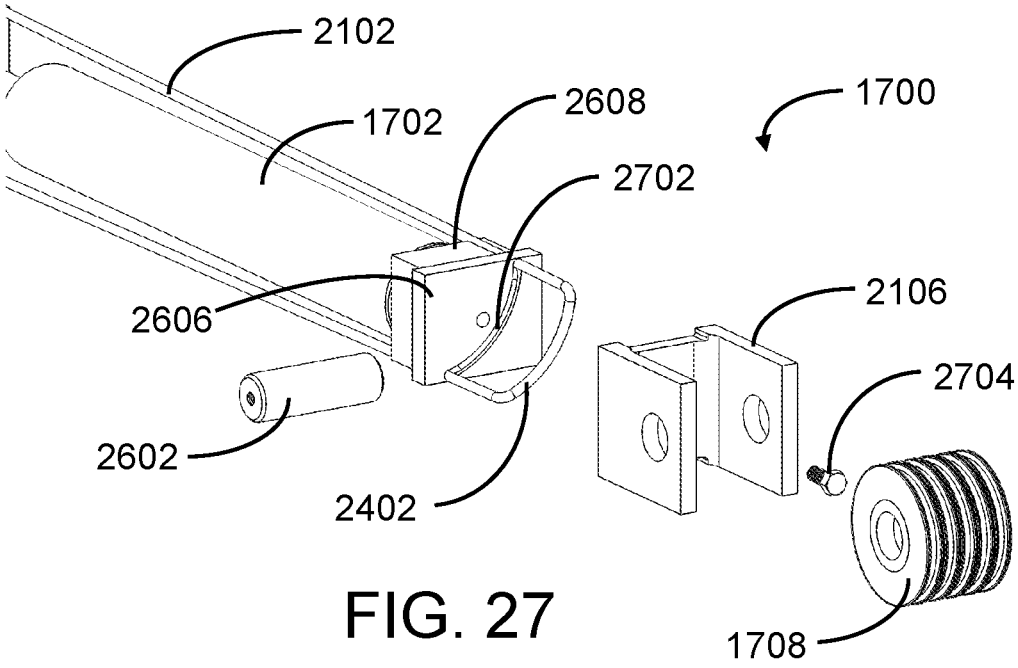
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FIG. 27

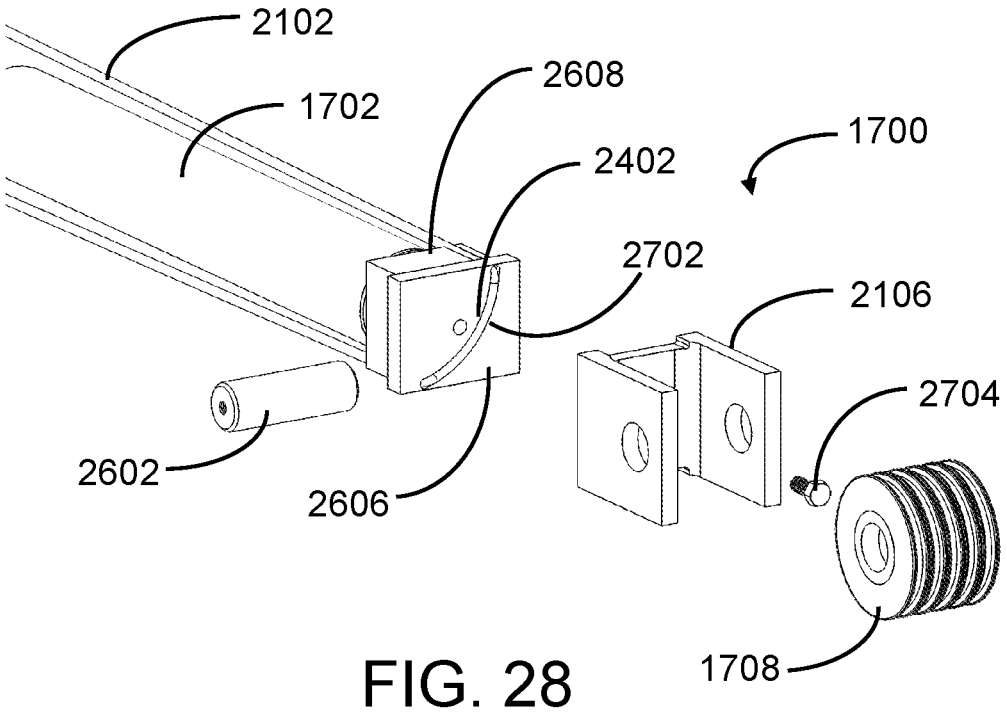
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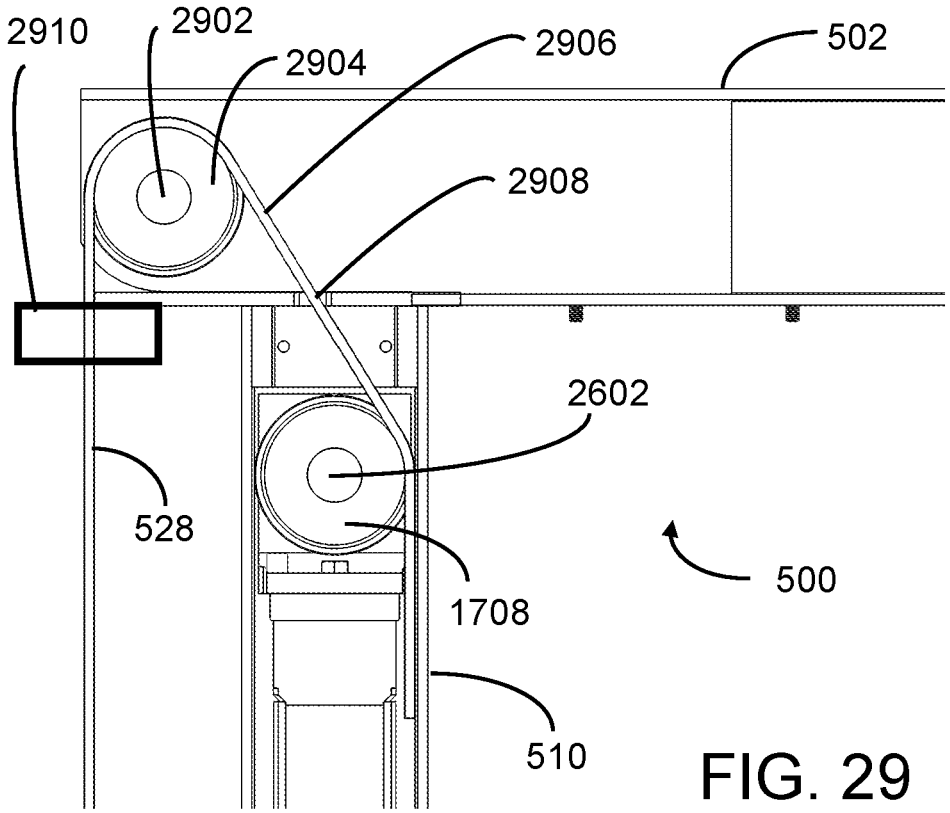
FIG. 28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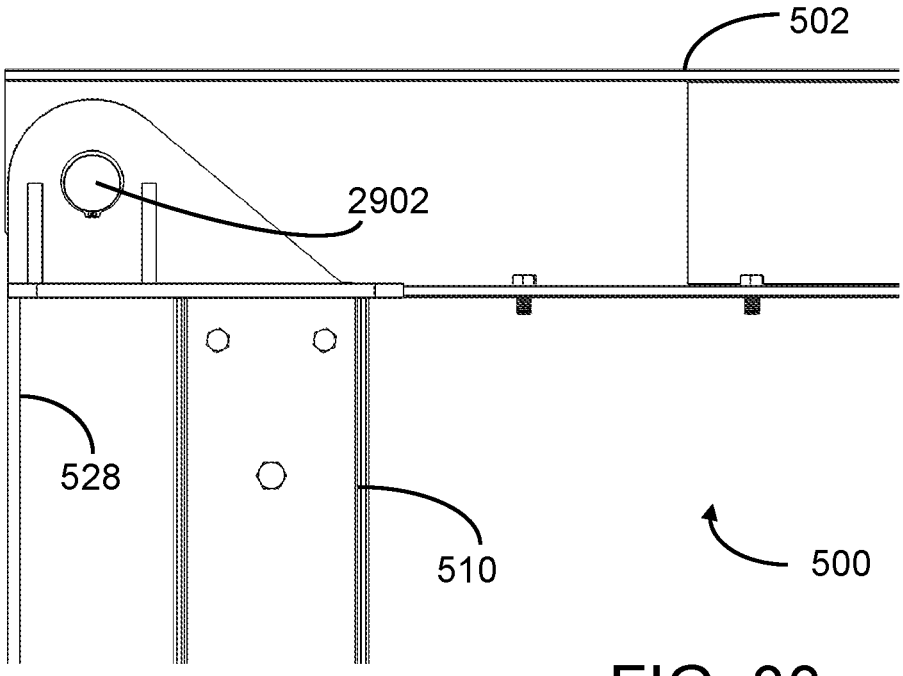
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FIG. 30

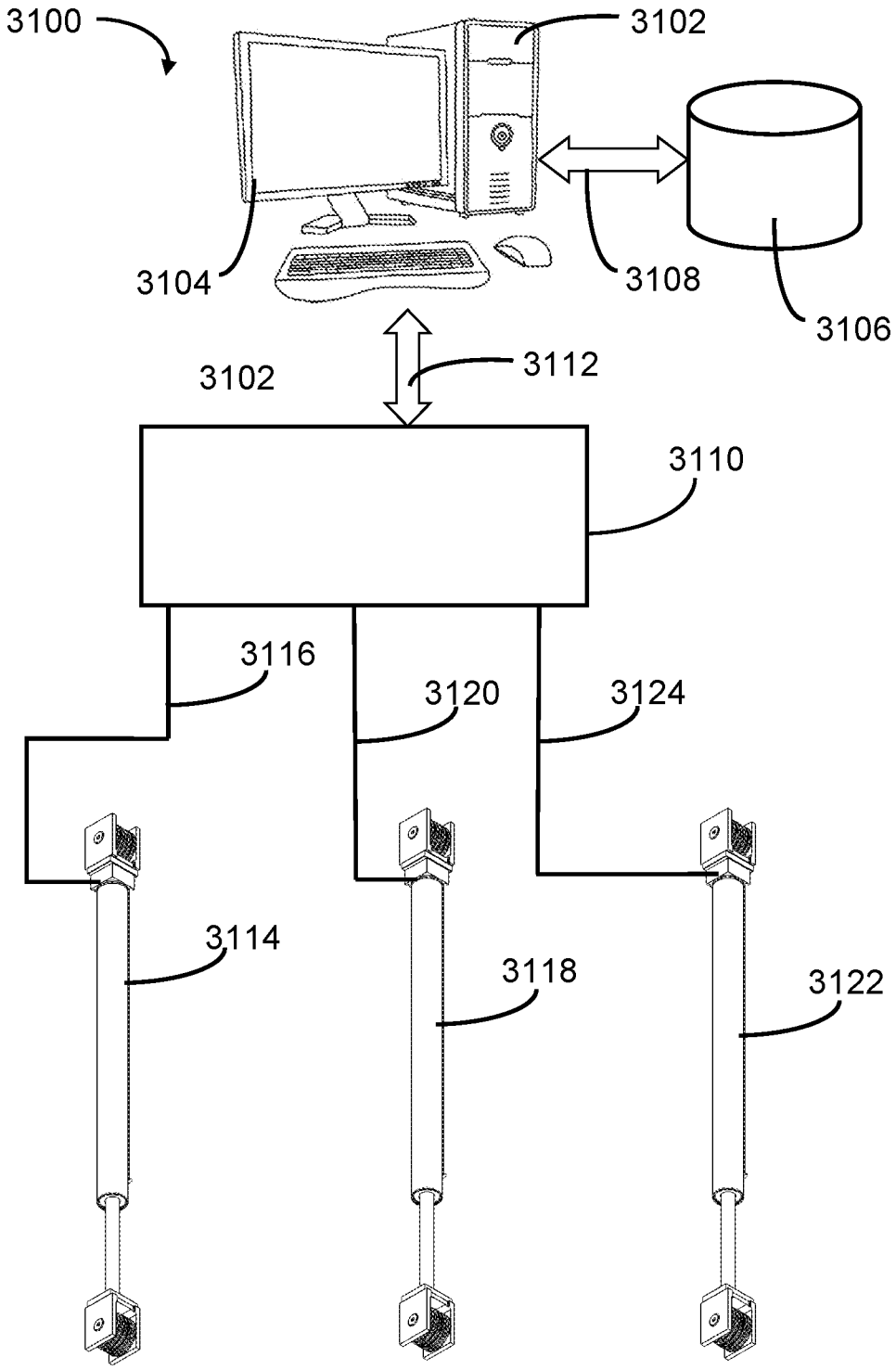
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FIG. 31

BOAT LIFT

RELATED APPLICATIONS

[0001] The present application claims priority from U.S. Prov. Pat. No. 62/857,711, filed Jun. 5, 2019.

TECHNICAL FIELD OF THE INVENTION

[0002] The present invention relates to systems for lifting boats out of the water to facilitate maintenance and to reduce corrosion and contamination.

BACKGROUND OF THE INVENTION

[0003] Boat maintenance, cleaning, repairs and/or storage may be facilitated by raising the boat out of the water, typically using a boat lift. Thus, boat lifts are now widely used. However, these boat lifts may be visually unattractive at the pier, as well as presenting dangers to both equipment and personnel when a boat has been raised from the water and is suspended on cables with a danger of unwanted swinging motions.

[0004] Often, boat lifts have employed cable lifting mechanisms which are essentially overhead cranes. For stability, there are typically at least two or more of these hoisting mechanisms spaced along the length of the boat to enable more even lifting of the hull and to avoid undue bending stresses as the boat emerges from the water and buoyancy is reduced. However, suspending the boat from hanging cables presents difficulties in an outdoor environment since wind forces on the boat may induce swinging which can be hazardous to both the boat and personnel. During lifting or lowering, while the boat is partially out of the water, wave forces present additional opportunities for unwanted boat motions possibly leading to hull damage and/or personnel injuries. In addition to these operational disadvantages, a group of overhead cranes arrayed along the length of a pier clearly will present an unattractive appearance.

[0005] Thus, it would be advantageous to configure a boat lift which may raise a boat uniformly with minimal stresses to the hull during lifting, while avoiding environmental effects such as wind and wave forces during lifting and lowering, as well as when the boat has been fully lifted out of the water for maintenance, cleaning, repairs and/or storage.

[0006] It would also be advantageous to configure a boat lift with an improved visual appearance at the pier while maintaining these desirable operational improvements.

SUMMARY OF THE INVENTION

[0007] An object of the invention is to provide a lifting system for a boat. The lifting system is designed with improved stability for the boat when it is lifted out of the water, as well as a more attractive visual profile for the lifting assembly.

[0008] The foregoing has outlined rather broadly the features and technical advantages of the present invention in order that the detailed description of the invention that follows may be better understood. Additional features and advantages of the invention will be described hereinafter. It should be appreciated by those skilled in the art that the conception and specific embodiments disclosed may be readily utilized as a basis for modifying or designing other structures for carrying out the same purposes of the present invention. It should also be realized by those skilled in the art that such equivalent constructions do not depart from the scope of the invention as set forth in the appended claims.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009] For a more thorough understanding of the present invention, and advantages thereof, reference is now made to the following descriptions taken in conjunction with the accompanying drawings, in which:

[0010] FIG. **1** shows an isometric view of a boat floating above a boat lift with three boat lift assemblies in a lowest position.

[0011] FIG. **2** shows an isometric view of a boat ready for lifting by the boat lift of FIG. **1**.

[0012] FIG. **3** shows an isometric view of the boat lift of FIG. **1** at a highest position with no boat.

[0013] FIG. **4** shows an isometric view of a boat lift supported by counterweights.

[0014] FIG. **5** shows a side view of a boat lift assembly with a vertical lift beam.

[0015] FIG. **6** shows a top isometric view of the boat lift assembly from FIG. **5**.

[0016] FIG. **7** shows a bottom isometric view of the boat lift assembly from FIG. **5**.

[0017] FIG. **8** shows a side view of boat lift assembly with a tilted lift beam.

[0018] FIG. **9** shows a close-up side view of a bottom foot assembly with a vertical lift beam.

[0019] FIG. **10** shows a close-up side view of a bottom foot assembly with a tilted lift beam.

[0020] FIG. **11** shows a close-up top isometric view of a portion of the boat lift assembly from FIGS. **5-7**.

[0021] FIG. **12** shows a close-up bottom isometric view of the boat lift assembly from FIGS. **5-7**.

[0022] FIG. **13** shows a close-up side isometric view of the boat lift assembly from FIGS. **5-7**.

[0023] FIG. **14** shows a close-up cutaway side view of the boat lift assembly from FIGS. **5-7**.

[0024] FIG. **15** shows a side view of a carriage channel assembly configured for a vertical lift beam.

[0025] FIG. **16** shows a side view of the carriage channel assembly of FIG. **15** configured for a tilted lift beam.

[0026] FIG. **17** shows an isometric cutaway view of a lift beam actuator assembly.

[0027] FIG. **18** shows a side cross-sectional view of the lift beam actuator of FIG. **17** fully extended.

[0028] FIG. **19** shows a side cross-sectional view of the lift beam actuator of FIG. **17** partially extended.

[0029] FIG. **20** shows a side cross-sectional view of the lift beam actuator of FIG. **17** fully retracted.

[0030] FIG. **21** shows an isometric view of the lift beam actuator of FIG. **17** with cabling.

[0031] FIG. **22** shows an isometric view of the lift beam actuator of FIG. **17** without cabling.

[0032] FIG. **23** shows an isometric view of cabling with button cable ends.

[0033] FIG. **24** shows an isometric view of cabling with a loop.

[0034] FIG. **25** shows a close-up isometric view of a portion of FIG. **24**.

[0035] FIG. **26** shows a close-up isometric view of a portion of FIG. **21**.

[0036] FIG. **27** shows an isometric exploded view of a fixed pulley assembly.

[0037] FIG. **28** shows an isometric exploded view of the fixed pulley assembly of FIG. **27** with the cable loop in a slot.

[0038] FIG. **29** shows a side cross-sectional view of a top of a lift beam.

[0039] FIG. **30** shows a side view of the top of the lift beam.

[0040] FIG. **31** shows a schematic diagram of a hydraulic control system for a boat lift.

DETAILED DESCRIPTION OF EMBODIMENTS

Exemplary Boat Lift Installations

[0041] Various embodiments of the invention provide different advantages over the prior art. Not all embodiments provide all the advantages made possible by the invention.

[0042] Some embodiments provide multiple lifting structures for raising and lowering a boat. Embodiments can be adapted to particular application by using any desired number of lifting structures and positioning the lifting structure at different positions to provide the desired support for a particular size and boat design. For example, a light boat may use only two lifting structure, while a heavy boat may use 3, 4, or more lifting structures, and the lifting structure may be closer together under the heavier portions of the boat. The lifting structures are preferably arranged with a center lifting structure at the center of gravity of the boat, with additional lifting structures proportionally placed toward the transom and the bow to keep the boat balanced as it is raised and lowered. Each lifting structure, in one embodiment, can lift about 3,500 pounds. A jet ski lift can use a single lifting structure. In some embodiments, the lifting structures are standardized, and additional lifting structures are added for heavier boats. In other embodiments, each of the lifting structures themselves can be designed for an appropriate load, for example, by using thicker structural components, heavier cabling, and higher capacity hydraulics for heavy boats, or thinner structural components, lighter cabling, and lower capacity hydraulics for lighter boats. That is, a boat lift can be readily customized by changing the capacity and/or the number of lifting structures.

[0043] Each lifting structures is preferably supported by, and move up and down on, a lifting beam. The lifting beam is preferably stationary. The top of each lifting beams can be attached, directly or indirectly, at a pier. The bottom of each lifting beam can be supported on the bottom of the water on a submerged footing or can be supported on the side of the pier, depending on the pier structure. If supported on a submerged footing, the lifting beam is typically oriented at an acute angle to the pier. Different lifting beams of the same boat lift may be supported differently. The same lifting beam can be oriented vertically and attached to the side of the pier or slanted and supported by a submerged footing. The design of the lifting beam does not need to be modified for different support methods, thereby standardizing components and providing flexibility in adapting the boat lift to different piers. The boat lift does not rely on vertical posts extending above the water line as part of its lifting and support mechanism, although an optional guide post may extend above the water when a boat is lifted.

[0044] The lifting structure is supported on only one side by the lifting beam, that is, the lifting structure is a cantilevered out from the lifting beam. The cantilevered design eliminates the requirement for providing a dock, footing, or other means to anchor the lifting structure on the opposing side of the slip space. This design reduces cost, eases installation, and provides a cleaner-looking boat lift.

[0045] By using standardized lifting structures and varying the number of lifting structures and the method of support of the lifting beam (e.g., bottom supported or attached to the side of the pier), the boat lift can be adapted to different sized boats and different pier structures using standardized components. An optional dampener, i.e., shock absorbers, such as springs or pneumatic cylinders, acting as wave attenuators, may be attached to the lifting cables to reduce the forces on the boat lift and on the boat being lifted due to waves and wind.

[0046] In some embodiments, cables are used to transfer the mechanical force to lift a boat and the cables are attached to the wave attenuators. Some embodiments use two cables in each lifting assembly, the two cables reduce the required cable thickness and provide redundancy in case one of the cables breaks. In some embodiments, the cables are retracted to lift the boat by a hydraulic cylinder in each of the lift beams. Using a common hydraulic pump to pressurize all of the lift beams facilitates in the boat lift facilitates moving all the lift beams in unison to keep the boat level as it is being lifted. A flow divider is preferably used to ensure equally proportion flow to raise each of the lift assemblies uniformly and keep the boat level as it is being raised. Mechanical flow dividers are preferred as they are more accurate.

[0047] Positioning the hydraulic pistons inside the lifting beams keeps the hydraulic mechanism out of sight and reduces the visibility of the boat lift, improving aesthetics. Nothing is exposed and the system provides a lower profile compared to prior art lifts that include winches on top of the I-beams. The lift beam may be sealed to keep the interior with the hydraulic cylinder dry or immersed in oil, or the interior of the lift beam may be exposed to the water. The hydraulic lift assemblies could alternatively be located in or on the lifting beams.

[0048] In some embodiments, each lifting beam is connected to a top beam supported by the surface of the pier. The top beams spread the weight of the boat and boat lift over a broad area of the pier, reducing the dependence on connecters screwed into the pier to support the weight of the boat and boat lift. A pier counterweight may be attached to the top beam on the side opposite of the lift beam to counter the weight of the boat as it is lifted out of the water. For example, the pier counterweight may hang below surface of the pier from the top beam on the opposite side of the pier from the The combination of a top beam supported on the surface of the pier and the lifting beam, connected to the top beam and supported on the side of the pier or on the bottom of the water, provides a novel support method that allows much of the boat lift to be invisible when a boat is not being lifted.

[0049] As use herein, "pier" refers to any platform adjacent to, or extending in to, a body of water and used as a landing stage for boats.

[0050] FIGS. **1-3** illustrate a first exemplary boat lift in various operating positions.

[0051] FIG. **1** shows an isometric view of a boat lift **100** in a lowest position with a boat **108** still afloat, not yet being lifted by the boat lift—a waterline **120** along a pier wall **102** is shown. In this example, boat lift **100** is configured with three boat lift assemblies: a forward boat lift assembly **110**,

a center boat lift assembly **112**, and a rear boat lift assembly **114**. The spacings and positions of the three boat lift assemblies **110**, **112**, and **114** typically may be set to distribute the weight of boat **108** approximately equally among the three boat lift assemblies **110**, **112**, and **114**. Other embodiments may comprise two boat lift assemblies (typically for shorter or lighter boats), or four or more boat lift assemblies (typically for longer or heavier boats). The number of boat lift assemblies may also depend on the lifting capacity of each of the boat lift assemblies (determined by the detailed design of the boat lift assemblies) as well as the mechanical strength of the hull of boat **108** (determining how far apart the boat lift assemblies may be spaced). The design and operation of the boat lift assemblies are further discussed with regard to FIGS. **5-30**. Portions of boat lift assemblies **110**, **112**, and **114** may extend horizontally underneath a pier deck grating **106**, supported by a pier decking **104**. In some embodiments, portions of boat lift assemblies may be attached to the pier deck grating **106** and/or to the pier decking **104**. Each boat lift assembly is configured with a lifting structure **116** which is vertically-movable (compare with FIGS. **2** and **3**). The lifting structures **116** are configured to provide a non-abrasive contact with, and support for, the hull of boat **108**, enabling lifting without damage to hull surfaces.

[0052] FIG. **2** shows an isometric view of boat **108** ready for lifting by boat lift **100**. The lifting structures **116** of each of the three boat lift assemblies **110**, **112**, and **114** have moved upwards to come into contact with the hull of boat **108**. The upward motion of lifting structures **116** is regulated by a common hydraulic control system (not shown) which ensures that the boat is lifted uniformly out of the water.

[0053] FIG. **3** shows an isometric view of boat lift **100** of at a highest position with boat **108** (not shown) having been removed. The three lifting structures **116** have moved to the upper limits of their vertical travel ranges. Typically, after boat **108** has been removed from the boat lift, the three lifting structures **116** may be lowered again into the water to present a more attractive visual appearance of the pier. Alternatively, the three lifting structures **116** may remain in the positions illustrated in FIG. **3** until boat **108** is again loaded into the boat lift for lowering back into the water.

[0054] FIG. **4** shows an isometric view of a second exemplary boat lift **400** supported by submerged footing **416** where a boat **408** has been raised above a water level **420** by three boat lift assemblies: a forward boat lift assembly **410**, a center boat lift assembly **412**, and a rear boat lift assembly **414**. The same considerations for placement and the number of boat lift assemblies apply here as for FIGS. **1-3**. In some cases, a pier wall **402** may be sloped or unsuitable structurally for mounting and supporting the lower ends of the boat lift assemblies (as shown in FIGS. **1-3**). In these cases, submerged footing **416** may be used to support the lower ends of boat lift assemblies **410**, **412**, and **414**, as shown. Portions of boat lift assemblies **410**, **412**, and **414** may extend horizontally underneath a pier deck grating **406**, supported by a pier decking **404**. In some embodiments, portions of boat lift assemblies may be attached to the pier deck grating **406** and/or to the pier decking **404**. Note that the boat lift assemblies **410**, **412** and **414** may be the same design as in FIGS. **1-3** since some embodiments of the boat lift enable various mounting configurations for the boat lift assemblies.

Boat Lift Assembly Having a Vertical Lift Beam

[0055] FIGS. **5-7** show three views of a boat lift assembly **500** as illustrated in FIGS. **1-3**.

[0056] FIG. **5** shows a side view of boat lift assembly **500** having a lift beam **510** oriented vertically, as could be the case in a boat lift installation where a pier wall **524** is also approximately vertical and has mechanical integrity suitable to support a lower end of the lift beam **510** as shown. Lift beam **510** is preferably includes an enclosed portion. For example, lift beam **510** could be a hollow square or rectangular beam, or an H-beam having an enclosed, hollow center portion. A hydraulic mechanism is preferably positioned inside the hollow portion of the beam.

[0057] Lifting structure **116** comprises a plurality (four shown) of bunk cushions **506** which contact the hull of a boat being lifted when the lifting structure is moved vertically upwards (compare FIG. **1** with FIG. **2**). Bunk cushions **506** are attached to bunk pivots **508**, which are pivotally-supported by bunk pivot pins **509** on bunk bases **526**, wherein the pivoting support enables bunk pivots **508** to accommodate the local shape of the hull of the boat being lifted at the location of each boat lift assembly. This allows stresses on the hull to be equalized as the boat is lifted out of the water and no longer has buoyant support. In the embodiment shown, two bunk cushions **506** are shown on each bunk pivot **508**, however in some embodiments other numbers of bunk cushions **506** on each bunk pivot **508** are possible. In some embodiments, other numbers of bunk pivots **508** are also possible. Bunk bases **526** are mounted on a horizontal carriage channel **516** which is capable of vertical motion along lift beam **510**. Carriage channel **516** is cantilevered out from the lift beam **510**. Because carriage channel **516** is cantilevered, there are two cables coming out of the same side, providing a redundant support. The cantilever design allows the carriage channel to be supported on only one side, eliminating the requirement for providing a dock, footing, or other means to anchor the carriage channel on the opposing side. This design reduces cost, eases installation, and provides a cleaner-looking boat lift.

[0058] A lower end of lift beam **510** may be attached to pier wall **524** by a bottom foot assembly **513** comprising: a bottom foot beam bracket **520** pivotally-connected by a bottom foot pivot **522** to a stationary bracket **512** (see FIG. **9**). An upper end of lift beam **510** may be attached to an end of a top beam **502**, wherein another end of top beam **502** may be supported by a submerged footing **504**. As illustrated in FIGS. **1-4**, top beams **502** of the boat lift assemblies in a boat lift (e.g., assemblies **110**, **112**, and **114** in FIGS. **1-3** or assemblies **410**, **412**, and **414** in FIG. **4**) may be covered by a pier deck grating (such as grating **106** in FIGS. **1-3** or grating **406** in FIG. **4**), and may be on top of pier decking (such as decking **104** in FIGS. **1-3** or decking **404** in FIG. **4**). In some embodiments, top beams **502** may be attached to the pier deck grating and/or to the pier decking.

[0059] Vertical motion of carriage channel **516** along lift beam **510** is supported and guided by an upper roller assembly **534** and a lower roller assembly **532**. Each of the roller assemblies **532** and **534** may comprise one or more rollers (see FIGS. **11-14**, with three rollers pre assembly shown in this embodiment). Upper roller assembly **534** is pivotally-mounted using an upper pivot pin **538** onto ends of both carriage channel **516** and a carriage strap **536** as shown. Lower roller assembly **532** is pivotally-mounted using a lower pivot pin **540** to ends of carriage strap **536** and outer

beam extension **518** as shown. Because the carriage channel **516** is cantilevered out from the lift beam **510**, the downward force of the weight of carriage channel **516**, the bunks, and the boat being lifted, will apply a torque around an axis at lift beam **510** and perpendicular to both carriage channel **516** and to lift beam **510**. The torque will be balanced by lower roller assembly **532** pressing against the lift beam **510** on the same side of the lift beam as the bunk, and upper roller assembly **534** pressing into lifting beam **510** on the opposite side of the lift beam from the bunk, to keep carriage channel **516** substantially perpendicular to lift beam **510**.

[0060] A beam extension assembly **548** comprising an inner beam extension **546** telescoping into, and rigidly attached to, an outer beam extension **518**, provides support for carriage channel **516** (see FIGS. **15** and **16**). Carriage strap **536** connects between lower roller assembly **532** and upper roller assembly **534**. An end of carriage channel **516** is attached to upper roller assembly **534**. Carriage channel **516**, carriage strap **536**, and beam extension assembly **548** form a rigid triangular structure as shown in FIGS. **5-7** and in more detail in FIGS. **15** and **16**—this structure provides the mechanical strength and stability to support the weight of the portion of the boat being lifted by each boat lift assembly. Guide post **514** positions the boat to fit into the cradle structure created by the multiple bunk cushions **506** as the lifting structure **116** moves up to contact the hull of the boat (the change in position from FIG. **1** to FIG. **2**). In some embodiments, lift post **514** may be replaced by bumpers (not shown) to provide a less obtrusive appearance. Lifting cables **528** connect through a wave attenuating spring mechanism to raise and lower carriage channel **516** (see FIG. **14**).

[0061] FIG. **6** shows a top isometric view of boat lift assembly **500**. Details of the bunk cushions **506** and bunk pivots **508** may be seen more clearly here.

[0062] FIG. **7** shows a bottom isometric view of boat lift assembly **500**. Details of the beam extension assembly **548** and lower roller assembly **532** may be seen more clearly here.

Boat Lift Assembly Having a Tilted Lift Beam

[0063] FIG. **8** shows a side view of a boat lift assembly **800** with lift beam **510** installed in a tilted orientation and supported by a submerged footing **826**, instead of being mounted on the pier wall as in FIGS. **5-7**. For boat lifts according to some embodiments, this configuration may be preferred due to irregularities of the pier wall, or lack of sufficient mechanical integrity in the pier wall surface to enable mounting onto the pier wall as in FIGS. **5-7**. Note that the depicted configuration boat lift installation may, in some embodiments, be achieved with a reconfiguration of the same embodiment as shown in FIGS. **5-7**, thus the majority of callouts are unchanged from FIGS. **5-7**. A difference between the installations in FIGS. **5-7** and in FIG. **8** is the orientation of the lift beam **510**. In order to maintain the horizontal orientation of the carriage channel **516**, some adjustments are necessary as illustrated in FIG. **15** (vertical lift beam **510**) and FIG. **16** (tilted lift beam **510**). The only structural differences between the installation in FIG. **5-7** and the installation in FIG. **8** is the pier and the bottom support for the boat lift assembly—this illustrates that some embodiments may be installed and operated in a range of pier environments. The lower end of the lift beam **510** may be attached to submerged footing **826** by a bottom foot assembly **813** comprising: bottom foot beam bracket **520** pivotally-connected by bottom foot pivot **522** to a pier bracket **824** which is attached to submerged footing **826** (see FIG. **10**). The upper end of lift beam **510** is attached to the top beam **502**. The upper and lower mounting connections of beam **510** enable the moving carriage to capture the beam, thereby increasing the lifting strength (see FIG. **14**).

Alternative Bottom Foot Assemblies

[0064] FIG. **9** shows a close-up side view of bottom foot assembly **513** with a vertical lift beam **510**, as in FIGS. **5-7**. To allow the boat lift assembly to be installed in a variety of alignment conditions with respect to the pier wall **524**, the pivoting connection (bottom foot pivot **522**) between bottom foot beam bracket **520** and the stationary bracket **512** enables various alignments to be accommodated by pivoting motion between brackets **520** and **512**.

[0065] FIG. **10** shows a close-up side view of bottom foot assembly **813** with a tilted lift beam **510** (see FIG. **8**). Again, as in FIG. **9**, the pivoting connection (bottom foot pivot **522**) between bottom foot beam bracket **520** and stationary bracket **512** enables various alignments with respect to the pier bracket **824** and submerged footing **826** to be accommodated by pivoting motion between brackets **520** and **512**. Note that the same mounting components are applicable to this alternative installation as were used in FIG. **9**, and only pier bracket **824** and submerged footing **826** are different.

[0066] It should be noted that, in some embodiments, bottom foot assembly **513** (FIG. **9**) may be employed with a tilted lift beam **510**, as might be the situation where the pier walls are sloped and have sufficient mechanical integrity to support the boat lift assembly. Further, in some embodiments, bottom foot assembly **813** (FIG. **10**) may be employed with a vertical lift beam **510**, as might be the situation where the pier walls are approximately vertical but have insufficient mechanical integrity to support the boat lift assembly.

Close Up Views of the Carriage Lift Assembly

[0067] FIG. **11** shows a close-up top isometric view of a portion of boat lift assembly **500**.

[0068] FIG. **12** shows a close-up bottom isometric view of a portion of boat lift assembly **500**.

[0069] FIG. **13** shows a close-up side isometric view of a portion of boat lift assembly **500**.

[0070] FIG. **14** shows a close-up cutaway side view **1400** of a portion of boat lift assembly **500**. Referring to FIGS. **11-14**, lower roller assembly **532** comprises one or more lower rollers **1105**, three lower rollers in the embodiment shown, each rotating on a lower roller axle **1104**. Upper roller assembly **534** comprises one or more upper rollers **1107**, three upper rollers in the embodiment shown, each rotating on an upper roller axle **1106**. Lifting cable **528** extends down through the center of wave attenuating spring **1402** (FIG. **14**), connecting to the bottom end of wave attenuating spring **1402** through wave attenuating spring retainer **1404**. The upper end of wave attenuating spring **1402** presses against wave attenuating spring stop **1406** which transfers the upward lifting force through wave attenuating spring housing **530** to the lower end of beam extension assembly **548**, which then conveys the lifting force to carriage channel **516**. Wave attenuating spring **1402** also cushions the lifting structure (see FIGS. **17-22**) against

vertical boat motions due to water and wind forces. In some embodiments, wave attenuating spring **1402** may comprise a spring, a rubber tube, a pneumatic cylinder, or other type of wave attenuating spring device.

Carriage Channel Assemblies for Various Lift Beam Orientations

[0071] FIGS. **15** and **16** illustrate how a carriage channel assembly **1500**, comprising carriage channel **516**, carriage strap **536**, and beam extension assembly **548** (comprising outer beam extension **518** and inner beam extension **546**), may be configured for two installed orientations of lift beam **510**. Inner beam extension **546** slides into outer beam extension **518** to form beam extension assembly **548**.

[0072] FIG. **15** shows a side view of carriage channel assembly **1500** configured for a boat lift installation where lift beam **510** is vertical as in FIGS. **1-3**. In this configuration, both the upper roller assembly **534** and the lower roller assembly **532** will also be oriented vertically as shown.

[0073] During installation of the boat lift, the horizontal spacing between the roller assemblies **532** and **534** should be set to correspond to the width of lift beam **510** so that lower rollers **1105** and upper rollers **1107** will simultaneously be in contact with opposing walls of lift beam **510**. Also, the orientation of carriage channel **516** also must be set during installation to be horizontal (independent of the orientation of lift beam **510**). Both of these settings are effected by sliding inner beam extension **546** into outer beam extension **518** a distance which simultaneously configures carriage channel **518** to be horizontal while both upper roller assembly **534** and lower roller assembly **532** may roll along the walls of lift beam **510**—once this has been achieved, one or more holes are match-drilled through the wall of outer beam extension **518** (over a portion of outer beam extension **518** which overlaps with inner beam extension **546**) and then continues through the wall of inner beam extension **546**. Once this hole is drilled, a pin, screw or other fastening means may be inserted through the match-drilled hole to lock-in the distance that inner beam extension **546** extends into outer beam extension **518**—this operation sets the length of the beam extension assembly **548**. During installation of the boat lift, a carriage shaft **1502** is fitted through a hole in carriage channel **516**. Slot **1504** may enable adjustment of the location of carriage shaft **1502** along the length of carriage channel **516**.

[0074] FIG. **16** shows a side view of carriage channel assembly **1500** set for a boat lift installation where lift beam **510** is tilted as in FIG. **4**. All callouts are the same since the same carriage channel assembly **1500** is illustrated here as in FIG. **15**—the ability to install the carriage channel assembly **1500** to operate with lift beams **510** mounted at multiple tilt angles is an aspect of some embodiments. When lift beam **510** is tilted, beam extension assembly **548** will be shorter than in FIG. **15**—this is effected by inserting inner beam extension **546** farther into outer beam extension **518** before performing the match-drilling operation described above for FIG. **15**. The overall set-up and installation method here is the same as for FIG. **15**.

Lifting Actuator Assembly

[0075] FIGS. **17-22** and their descriptions discuss the design and operation of a lifting actuator assembly **1700** according to an example embodiment. The lifting actuator assembly **1700** is positioned inside each lift beam **510** in the boat lift assemblies and effectuates the raising and lowering of the lifting structures by means of retracting or paying out cable **528**, respectively.

[0076] FIG. **17** shows an isometric cutaway view of lift beam **510** with a lifting actuator assembly **1700** mounted inside lift beam **510**. In some embodiments, the interior of lift beam **510** is sealed at a bottom end to prevent water from entering, wherein an open top end is above the water line. In some embodiments, the interior of lift beam **510** may be sealed at a bottom end and filled with a lubricating fluid to aid in smooth operation of the lifting actuator assembly **1700**. In some embodiments, the lift beam **510** may not be sealed. This view does not show the cabling that is wrapped back-and-forth between a fixed pulley **1708** and a moving pulley **1704** (see FIGS. **21**, **23**, and **24**). Fixed pulley **1708** is attached to an end of a hydraulic cylinder **1702** attached to lift beam **510**. Moving pulley **1704** is attached to a moving end of a piston rod **1706**. Piston rod **1706** is attached to a piston **1710** which slides from one end of hydraulic cylinder **1702** to the other end due to the force applied to an inner surface of piston **1710** by the pressurized hydraulic fluid (not shown) in hydraulic cylinder **1702**. A sliding seal **1712** at an end of hydraulic cylinder **1702** opposite from the end where fixed pulley **1708** is attached allows passage of piston rod **1706** while preventing leakage of the pressurized hydraulic fluid. The upper right end of lift beam **510** in FIG. **17** would be the upper end of lift beam **510** in FIG. **5**, while the lower left end of lift beam **510** in FIG. **17** would be the lower end of lift beam **510** in FIG. **5**. The lower end of lift beam **510** may be sealed to prevent entry of water, and the interior of lift beam **510** may be filled with oil (e.g., food-grade oil), or another fluid to reduce corrosion and improved lubrication of the pulley mechanism. A counterbalance valve **1714** is operable to set up a back-pressure in the control circuit which controls the flow of hydraulic fluid into and out of the cylinder **1702**, to 'counterbalance' the effects of the load on the cylinder.

[0077] Other types of linear actuators may perform the function of hydraulic cylinder **1702** in some embodiments, such as motorized lead-screw actuators, motorized recirculating-ball lead-screw actuators, motorized rack-and-pinion geared actuators, motorized worm-gear actuators, etc. Different numbers of moving pulleys **1704** and fixed pulleys **1708** may be employed in some embodiments—the choice of number of pulleys may be determined by the requirements for how far to raise a boat from the water, as well as the weight to be raised by each boat lift assembly and the drive capacity of the linear actuator.

[0078] FIGS. **18-20** show side cross-sectional views of lifting actuator assembly **1700** in three positions: fully extended (FIG. **18**), partially extended (FIG. **19**), and fully retracted (FIG. **20**)—in FIGS. **5-8**, the left sides of FIGS. **18-20** would be at the bottoms of lift beams **510** and the right sides of FIGS. **18-20** would be at the tops of lift beams **510**. Progressing from FIG. **20** through FIG. **19** to FIG. **18**, piston **1710** and piston rod **1706** are pushed to the left by the pressurized hydraulic fluid in hydraulic cylinder **1702**, thereby causing moving pulley **1704** to move to the left, farther away from fixed pulley **1708**. As the pulleys **1704** and **1708** move farther apart, the cabling (see FIGS. **21**, **23**, and **24**) rotates around the pulleys, causing lifting cables **528** to be retracted, thereby pulling lifting structure **116** upwards along lift beam **510**.

[0079] FIG. **21** shows an isometric view of lifting actuator assembly **1700** with cabling. Fixed pulley **1708** is mounted within a fixed pulley block **2106** (see FIGS. **26-28**). Moving pulley **1704** is mounted within a moving pulley block **2104**, which is attached to an outer end (i.e., the end outside of hydraulic cylinder **1702**) of piston rod **1706**. Cables **2012** wind back-and-forth between moving pulley **1704** and fixed pulley **1708**. Lifting cables **528** extend out from pulley **1708** as shown—the weight of lifting structure **116**, as well as the weight of a portion of the boat being lifted, tend to pull upwards on lifting cables **528** in FIG. **21** (because an additional pulley reverses the cable direction—see FIG. **29**), which in turn applies a force upon moving pulley **1704** tending to push piston rod upwards (i.e., into hydraulic cylinder **1702**). When pressurized hydraulic fluid (not shown) is admitted into hydraulic cylinder **1702**, pressure is exerted against piston **1710**, causing piston rod **1706** to move downwards in FIG. **21** (going from the configuration illustrated in FIG. **20** towards that in FIG. **18**), thereby lowering moving pulley **1704**. Thus, lifting cable **528** will be pulled downwards in FIG. **21**. Note that the distance that lifting cable **528** is retracted will be larger than the distance that moving pulley **1704** moves downwards—if there are N cable lengths **2102** between fixed pulley **1708** and moving pulley **1704**, then the retraction length of lifting cables **528** (i.e., the distance that lifting structure **116** will be pulled upwards) will be N times the travel distance of moving pulley **1704**, however the pulling force of lifting cables **528** on lifting structure **116** will be reduced at least by 1/N (typically to less than 1/N due to friction).

[0080] FIG. **22** shows an isometric view of lifting actuator assembly **1700** without cabling for clarity—piston rod **1706** is shown partially extended through sliding seal **1712**.

Lifting Actuator Assembly Cabling

[0081] FIG. **23** shows an isometric view of an embodiment of cabling **2300** corresponding to FIG. **21**, but not showing any of the mechanical components. There are two separate cables, each cable having cable loops **2302** around the pulleys (not shown), with cable portions extending back-and-forth between fixed pulley **1708** and moving pulley **1704** (not shown)—each cable is terminated with a button cable end **2304**. In this illustration, each of the two cables **2102** has four lengths **2102** between fixed pulley **1708** and moving pulley **1704** (corresponding to loops **2302**), thus N=4 (see FIG. **21**), thus the retraction ratio for lifting cables **528** will be four times the distance that moving pulley **1704** travels downwards. This travel gain factor enables some embodiments to pull a lifting structure **116** a substantial upward distance with a relatively shorter lifting actuator assembly **1700**.

[0082] FIG. **24** shows an isometric view of an alternative embodiment, relative to FIG. **23**, of cabling **2400**, wherein instead of two separate cables as in cabling **2300**, here a single cable is used (i.e. lifting cables **528** are the two ends of the same cable). A loop **2402** is clamped within support plate **2702** (see FIG. **27**). Operation of the lifting actuator assembly is the same as in FIG. **23**.

[0083] FIG. **25** shows a close-up isometric view of an upper portion of cabling **2400**.

[0084] FIG. **26** shows a close-up isometric view of an upper portion of lifting actuator assembly **1700**. Fixed pulley **1708** is supported by a fixed pulley axle **2602** which extends between the two sides of fixed pulley block **2106**. For added mechanical strength, a cylinder end plate **2606**, typically made from a strong material such as steel, may function to spread the force exerted by hydraulic cylinder **1702** across the entire base of fixed pulley block **2106**, which thus may be made from a lighter material such as aluminum. Pressurized hydraulic fluid may be introduced into hydraulic cylinder **1702** through hydraulic fluid connections **2610** in a cylinder hydraulic connections block **2608**. The use of two redundant lifting cables **528** provides improved reliability and safety.

Fixed Pulley Assembly

[0085] FIG. **27** shows an isometric exploded view of the fixed pulley end of lifting actuator assembly **1700**. A slot **2702** in cylinder end plate **2606** is configured to clamp cable end loop **2402** when fixed pulley block **2106** is attached to cylinder end plate **2606** using a pulley block connector **2704**.

[0086] FIG. **28** shows an isometric exploded view **2800** of the fixed pulley end of lifting actuator assembly **1700** with cable loop **2402** inserted into slot **2702**. The depth of slot **2702** may be slightly smaller than the cable diameter in loop **2402** so that when fixed pulley block **2106** is attached to cylinder end plate **2606** by pulley block connector **2704**, then loop **2402** is clamped tightly, preventing motion of the cable.

Details of the Top of the Lift Beam

[0087] FIG. **29** shows a side cross-sectional view of a top portion of boat lift assembly **500**. An upper pulley **2904** is mounted on an upper pulley axle **2902**. A short section of cable **2906** extends between fixed pulley **1708** and upper pulley **2904**. The function of upper pulley **2904** is to change the direction of the cable emerging upwards from the lifting actuator assembly to extend downwards towards lifting structure **116** (see FIG. **14**). A wiping brush **2910** is operable to wipe water off cable **528** as it moves upwards towards upper pulley **2904**. Cable section **2906** passes through a wiping seal **2908** to further remove water from cable **2906** as it is moving through the wiping seal **2908**.

[0088] FIG. **30** shows a side view of a top portion of boat lift assembly **500**.

Exemplary Boat Lift Hydraulic Control System

[0089] FIG. **31** shows a schematic diagram of an exemplary hydraulic control system **3100** for a boat lift. A control computer **3102** may be configured with a display screen **3104** to present to an operator various options for controlling the status and operation of a boat lift, as in FIGS. **1-4**, for example. Instructions for controlling the boat lift may be stored in a non-volatile computer-readable storage medium **3106**, which may be configured as a hard-disk drive, a flash memory, or other type of computer data storage device. Communication between the non-volatile computer-readable storage medium **3106** and the computer **3102** may be through a link **3108** which may be hard-wired or wireless. Computer **3102** may be a desktop computer, a laptop computer, a tablet computer, or another type of computing device capable of executing instructions stored in storage medium **3106**. Computer **3102** communicates with a hydraulic controller **3110** through a link **3112**, which may be hard-wired or wireless. Hydraulic controller **3110** is typically configured with individual hydraulic feed lines to hydraulic cylinders in each lifting assembly of the boat lift. In the

example shown here, corresponding to the boat lift in FIGS. **1-4**, there are three lifting assemblies: front lift assembly **3114**, center lift assembly **3118** and rear lift assembly **3122**. Front lift assembly **3114** is activated by a front hydraulic line **3116** from hydraulic controller **3110**. Similarly, center lift assembly **3118** is activated by a center hydraulic line **3120**, and rear lift assembly **3122** is activated by a rear hydraulic line **3124**.

[0090] In some embodiments, hydraulic lines **3116**, **3120**, and **3124**, may be single bi-directional hydraulic lines in which the pressurized hydraulic fluid may flow out from hydraulic controller **3110** to the lifting assembly to cause upward (lifting) motion, and the pressurized hydraulic fluid may also flow back to hydraulic controller **3110** from the lifting assembly during downward (lowering) motion. In some embodiments, lines **3116**, **3120**, and **3124** may comprise multiple hydraulic lines, wherein at least one line may enable pressurized hydraulic fluid to flow from hydraulic controller **3110** to the lifting assembly (during lifting), while one or more lines may enable pressurized hydraulic fluid to flow from the lifting assembly back to the hydraulic controller **3110** (during lowering).

[0091] Hydraulic controller **3110**, operating under control of computer **3102** through commands conveyed over link **3112**, may control each of the lifting assemblies **3114**, **3118** and **3122** individually to ensure that the boat lift will lift and lower a boat uniformly and smoothly, to avoid undesirable tilting or bending of the boat as it is raised out of the water and an increasing fraction of the weight of the boat falls on the lifting assemblies as buoyant support decreases.

[0092] The following are additional example embodiments according to the present disclosure:

[0093] A first embodiment, which is a boat lift, comprising multiple boat lift assemblies, at least one boat lift assembly including a lift beam; a lifting structure configured to move along the lift beam; and a lifting actuator assembly, located inside the lift beam and configured to move the lifting structure.

[0094] A second embodiment, which is the boat lift of the first embodiment, wherein the boat lift assembly further comprises a top beam; and a pier counterweight; wherein a first end of the top beam is attached to an upper end of the lift beam, and wherein a second end of the top beam is attached to the pier counterweight.

[0095] A third embodiment, which is the boat lift of the first embodiment, wherein in the boat lift assembly, the lifting structure further comprises a bunk pivot; and a bunk cushion attached to the bunk pivot.

[0096] A fourth embodiment, which is the boat lift of the third embodiment, wherein in the boat lift assembly, the lifting structure further comprises a carriage channel; and a bunk base; wherein the bunk base is attached to the carriage channel, and wherein the bunk pivot is pivotally attached to the bunk base.

[0097] A fifth embodiment, which is the boat lift of the first embodiment, wherein in the boat lift assembly, the lifting structure further comprises a guide post.

[0098] A sixth embodiment, which is the boat lift of the first embodiment, wherein in the boat lift assembly, a lower end of the lift beam is configured to be mounted on a wall of a pier.

[0099] A seventh embodiment, which is the boat lift of the first embodiment, wherein the boat lift assembly further comprises a submerged footing, and wherein a lower end of the lift beam is configured to be mounted on the submerged footing.

[0100] An eighth embodiment, which is the boat lift of the first embodiment, wherein in the boat lift assembly, the lifting actuator assembly further comprises a hydraulic cylinder, having a first end attached at an end of the lift beam; a fixed pulley, attached at the first end of the hydraulic cylinder; a piston rod; a piston, inside the hydraulic cylinder, and attached to a first end of the piston rod; a moving pulley attached to a second end of the piston rod; and a cable routed between the fixed pulley and the moving pulley; wherein an end of the cable protrudes from the lifting actuator assembly, and wherein motion of the moving pulley away from the fixed pulley causes the protruding end of the cable to be retracted into the lifting actuator assembly.

[0101] A ninth embodiment, which is the boat lift of the eighth embodiment, wherein in the boat lift assembly, the retraction of the cable into the lifting actuator assembly raises the lifting structure.

[0102] A tenth embodiment, which is the boat lift of the eighth embodiment, further comprising a control computer; a hydraulic control system, configured with a hydraulic line to at least one boat lift assembly; a connection between the control computer and the hydraulic control system, the connection being configured to send commands from the control computer to the hydraulic control system; a non-volatile computer-readable storage medium, configured to store instructions to be executed by the control computer; and a connection between the control computer and the non-volatile computer-readable storage medium, the connection being configured to relay computer instructions to the control computer.

[0103] An eleventh embodiment, which is a boat lift assembly, comprising a lift beam; a lifting structure configured to move along the lift beam; and a lifting actuator assembly, located inside the lift beam and configured to move the lifting structure.

[0104] A twelfth embodiment, which is the boat lift assembly of the eleventh embodiment, further comprising a top beam; and a pier counterweight; wherein a first end of the top beam is attached to an upper end of the lift beam, and wherein a second end of the top beam is attached to the pier counterweight.

[0105] A thirteenth embodiment, which is the boat lift assembly of the eleventh embodiment, wherein the lifting structure further comprises a bunk pivot; and a bunk cushion attached to the bunk pivot.

[0106] A fourteenth embodiment, which is the boat lift assembly of thirteenth embodiment, the lifting structure further comprising a carriage channel; and a bunk base; wherein the bunk base is attached to the carriage channel, and the bunk pivot is pivotally attached to the bunk base.

[0107] A fifteenth embodiment, which is the boat lift assembly of the eleventh embodiment, the lifting structure further comprising a guide post.

[0108] A sixteenth embodiment, which is the boat lift assembly of the eleventh embodiment, wherein a lower end of the lift beam is configured to be mounted on a wall of a pier.

[0109] A seventeenth embodiment, which is the boat lift assembly of eleventh embodiment, further comprising a submerged footing, wherein a lower end of the lift beam is configured to be mounted on the submerged footing.

[0110] An eighteenth embodiment, which is the boat lift assembly of the eleventh embodiment, the lifting actuator assembly further comprising a hydraulic cylinder, having a first end attached at an end of the lift beam; a fixed pulley, attached at the first end of the hydraulic cylinder; a piston, inside the hydraulic cylinder; a piston rod, attached at a first end to the piston; a moving pulley attached to a second end of the piston rod; and a cable routed between the fixed pulley and the moving pulley; wherein an end of the cable protrudes from the lifting actuator assembly, and wherein motion of the moving pulley away from the fixed pulley causes the protruding end of the cable to be retracted into the lifting actuator assembly.

[0111] A nineteenth embodiment, which is the boat lift assembly of the eighteenth embodiment, wherein the retraction of the cable into the lifting actuator assembly raises the lifting structure.

[0112] A twentieth embodiment, which is a method for raising and lowering a boat out of and into the water, the method comprising configuring a boat lift to include a multiple boat lift assemblies, each boat lift assembly including a lift beam; a lifting structure configured to move along the lift beam; and a lifting actuator assembly, located inside the lift beam and configured to move the lifting structure; a control computer; a hydraulic control system, configured with a hydraulic line to at least one boat lift assembly; a connection between the control computer and the hydraulic control system, the connection being configured to send commands from the control computer to the hydraulic control system; a non-volatile computer-readable storage medium, configured to store instructions to be executed by the control computer; and a connection between the control computer and the non-volatile computer-readable storage medium, the connection being configured to relay computer instructions to the control computer; loading instructions from the non-volatile computer-readable storage medium into the control computer; executing the instructions in the control computer; sending commands to the hydraulic control system from the control computer; directing hydraulic fluid through the hydraulic lines from the hydraulic control system to each boat lift assembly to activate the lifting actuator assemblies based on the commands from the control computer.

[0113] Although the present invention and its advantages have been described in detail, it should be understood that various changes, substitutions and alterations can be made to the embodiments described herein without departing from the scope of the invention as defined by the appended claims. Moreover, the scope of the present application is not intended to be limited to the particular embodiments of the process, machine, manufacture, composition of matter, means, methods and steps described in the specification.

[0114] As one of ordinary skill in the art will readily appreciate from the disclosure of the present invention, processes, machines, manufacture, compositions of matter, means, methods, or steps, presently existing or later to be developed that perform substantially the same function or achieve substantially the same result as the corresponding embodiments described herein may be utilized according to the present invention. Accordingly, the appended claims are intended to include within their scope such processes, machines, manufacture, compositions of matter, means, methods, or steps.

1. A boat lift, comprising multiple boat lift assemblies, at least one boat lift assembly including:
- a lift beam;
- a lifting structure configured to move along the lift beam; and
- a lifting actuator assembly, located inside the lift beam and configured to move the lifting structure.

2. The boat lift of claim **1**, wherein the lifting structure extends cantilevered from the lift beam.

3. The boat lift of claim **1**, wherein the boat lift assembly further comprises:
- a top beam for resting on a pier surface; and
- a pier counterweight;

wherein a first end of the top beam is attached to an upper end of the lift beam, and wherein a second end of the top beam is attached to the pier counterweight.

4. The boat lift of claim **3** further comprising a pier deck grating over the top beam.

5. The boat lift of claim **1**, wherein in the boat lift assembly, the lifting structure further comprises:
- a carriage channel; and
- a bunk base;

wherein the bunk base is attached to the carriage channel, and wherein the bunk pivot is pivotally attached to the bunk base.

6. The boat lift of claim **5** in which the lifting structure further comprises an outer beam extension extending from the carriage channel to the lift beam.

7. The boat lift of claim **6** further comprising at least one roller connected between the outer beam extension and the lift beam.

8. The boat lift of claim **7** further comprising at least a second roller connected between the carriage channel and the lift beam.

9. The boat lift of claim **1**, wherein in the boat lift assembly, the lifting structure further comprises a bunk pivot; and a bunk cushion attached to the bunk pivot.

10. The boat lift of claim **1**, wherein in the boat lift assembly, the lifting structure further comprises a guide post.

11. The boat lift of claim **1**, wherein in the boat lift assembly, a lower end of the lift beam is configured to be mounted on a wall of a pier.

12. The boat lift of claim **1**, wherein the boat lift assembly further comprises a submerged footing, and wherein a lower end of the lift beam is configured to be mounted on the submerged footing.

13. The boat lift of claim **1**, further comprising an actual within the lift beam and at least one cable connected to the actuator for raising and lowering the lifting structure.

14. The boat lift of claim **13**, in which the at least one cable comprises two cables.

15. The boat lift of claim **13**, in which the at least one cable is connected to the lifting structure through a damper to attenuate motion due to waves or wind.

16. The boat lift of claim **1**, wherein in the boat lift assembly, the lifting actuator assembly further comprises:
- an actuator rod;
- a linear actuator, having a first end attached at an end of the lift beam, and wherein the linear actuator is configured to move the actuator rod linearly along a long axis of the lift beam;
- a fixed pulley, attached at the first end of the linear actuator;

a moving pulley attached to an end of the actuator rod; and

a cable routed between the fixed pulley and the moving pulley;

wherein an end of the cable protrudes from the lifting actuator assembly, and wherein motion of the moving pulley away from the fixed pulley causes the protruding end of the cable to be retracted into the lifting actuator assembly.

17. The boat lift of claim **16**, wherein the linear actuator comprises a hydraulic cylinder.

18. The boat lift of claim **16**, wherein the linear actuator comprises a motorized lead-screw actuator, a motorized rack-and-pinion geared actuator, or a motorized worm-gear actuator.

19. The boat lift of claim **16**, wherein in the boat lift assembly, the retraction of the cable into the lifting actuator assembly raises the lifting structure.

20. The boat lift of claim **16**, further comprising:

a control computer;

a hydraulic control system, configured with a hydraulic line to at least one boat lift assembly;

a connection between the control computer and the hydraulic control system, the connection being configured to send commands from the control computer to the hydraulic control system;

a non-volatile computer-readable storage medium, configured to store instructions to be executed by the control computer; and

a connection between the control computer and the non-volatile computer-readable storage medium, the connection being configured to relay computer instructions to the control computer.

21. The boat lift assembly of claim **1** in which the lift beam is sealed to prevent water from contacting the lifting actuator assembly.

22-36. (canceled)

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