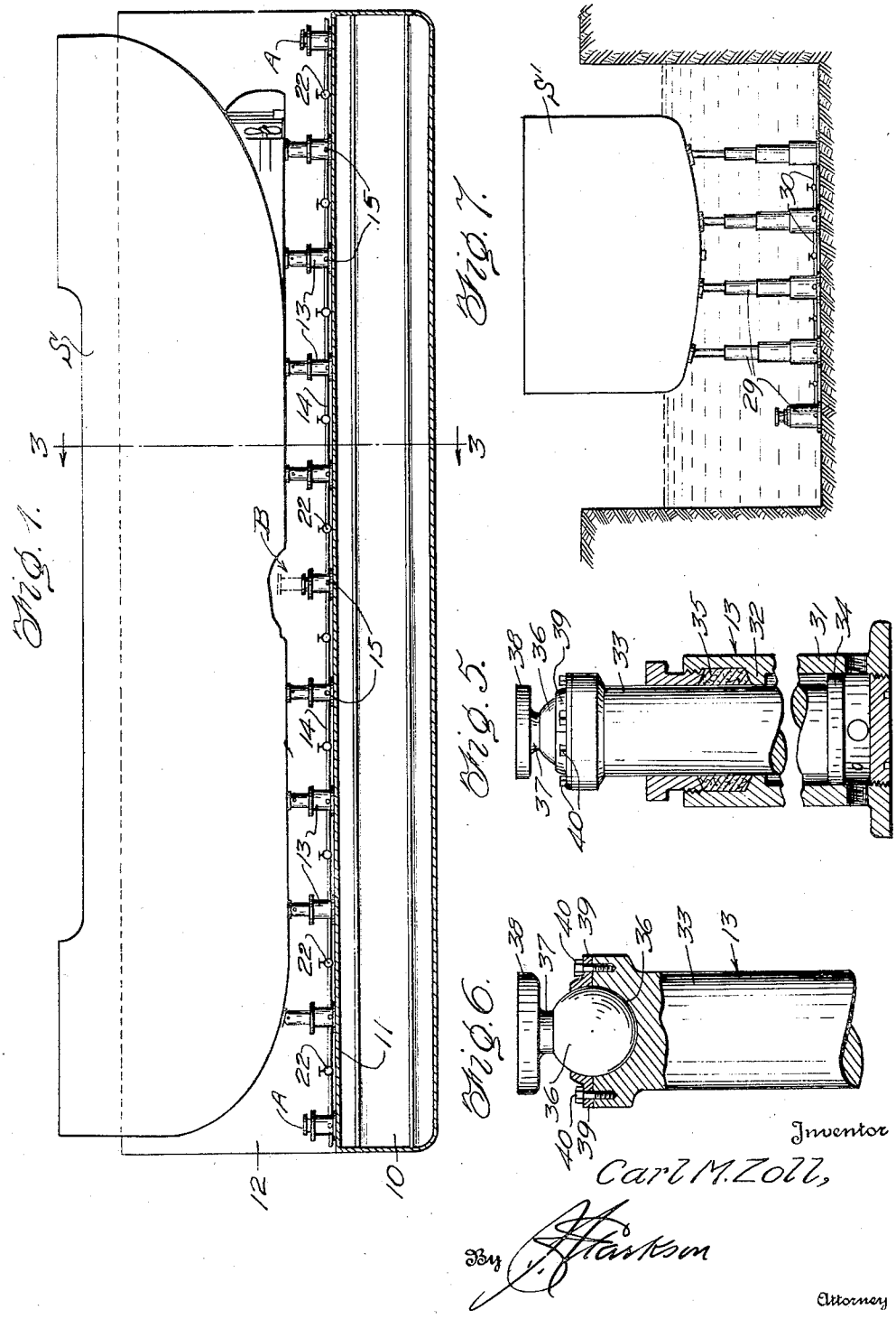
Aug. 3, 1943. C. M. ZOLL 2,325,994

LIFT EQUALIZING REPAIR DOCK

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LIFT EQUALIZING REPAIR DOCK

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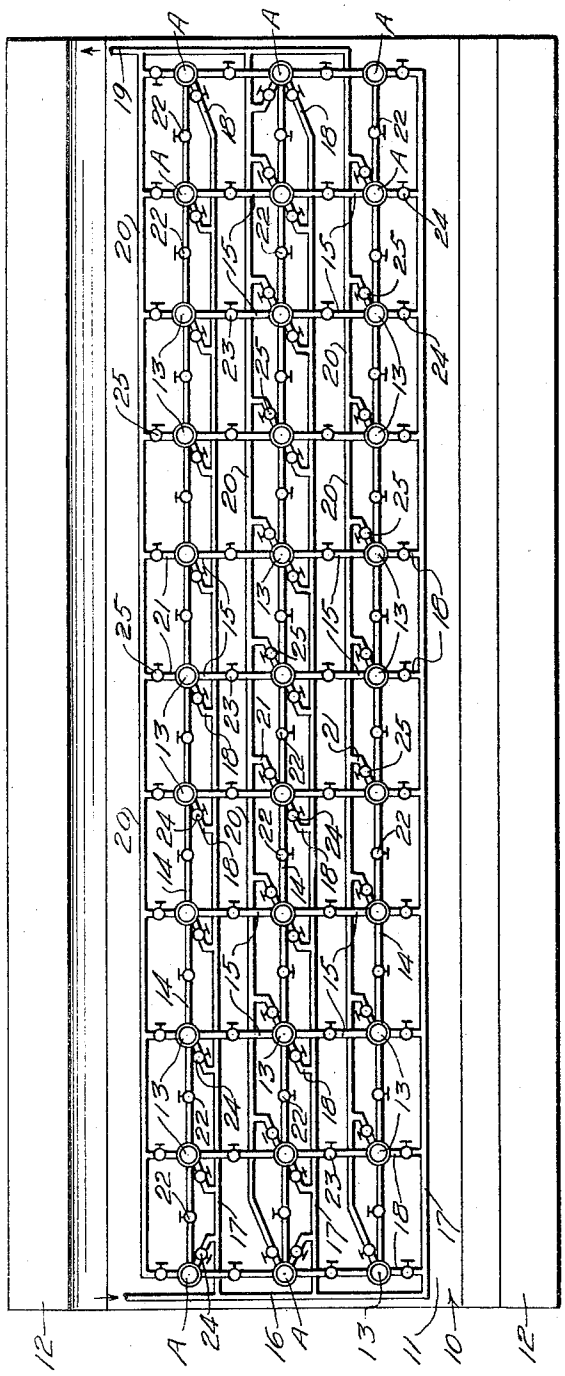


Fig. 2.

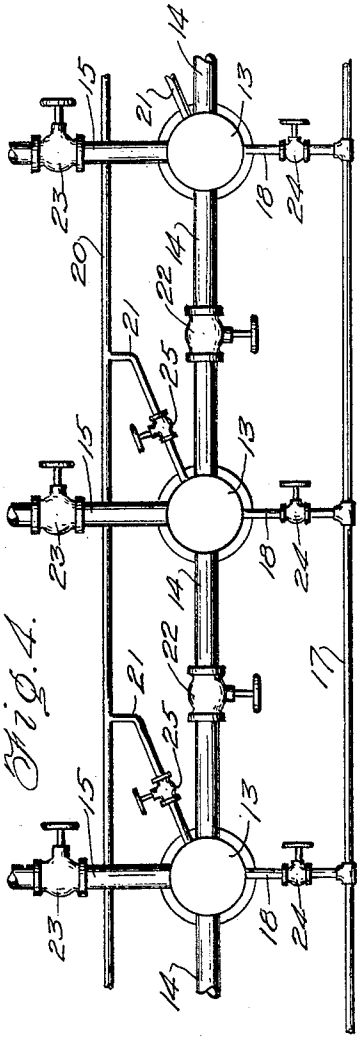


Fig. 4.

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LIFT EQUALIZING REPAIR DOCK

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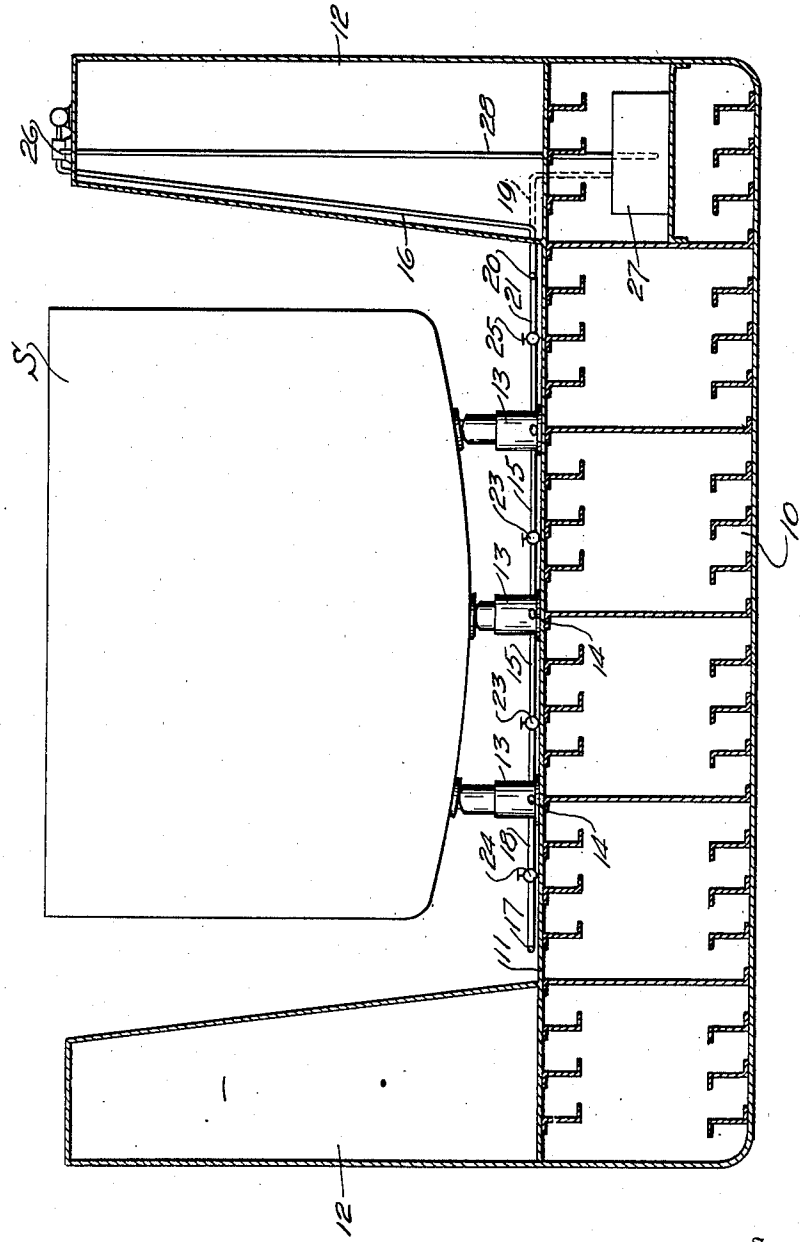



Fig. 3.

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# UNITED STATES PATENT OFFICE

2,325,994

## LIFT EQUALIZING REPAIR DOCK

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11 Claims. (Cl. 61—66)

This invention relates to docks which are used for repairing ships such as dry-docks, floating docks and wet docks, the invention being preferably termed a lift equalizing repair dock.

Floating docks as herein referred to are those docks which are so constructed that they be partially submerged to receive a ship and are then raised to lift the ship above the water, these operations being usually accomplished by admitting water to the ballast chambers with which such docks are provided and, after the ship is in the dock, pumping water ballast out until the buoyancy necessary to lift the ship is attained.

The dry-dock here mentioned is that type of dock wherein the dock floor is sufficiently below water level to admit the ships to be repaired, at least at high water, and which have an opening at one end closed by a gate after the ship is admitted. In this type of dock it is usual to pump the water out after the gate is closed although in locations where there is considerable rise and fall of the tide the operation may be assisted or even accomplished by allowing outward flow of the water within the dock under the influence of gravity.

Wet docks for ship repairs are ordinarily used by lightening the ship to be repaired until the injured parts are exposed. With such operations there is necessarily a limit to which a ship can be raised and a ship requiring repairs to its bottom or the lower parts of its sides can only be repaired, if at all, by the use of divers.

In using floating docks and dry-docks it is necessary to support the ship from the floor of the dock in such manner that, when dry, the ship will not list to one side or the other. It is also necessary that the supports for the weight of the ship be so distributed that each will carry its proper proportion of the load. This is usually accomplished by building up on the floor of the dock, while the latter is free of water, a series of spaced supports formed of heavy timbers secured together and weighted or anchored in such manner that they will not float or be otherwise displaced when water is admitted to the dock. Since ship's bottoms are of various shapes and ship's weights are not evenly distributed from bow to stern the distribution, heights and shapes of these supports or blockings requires much care in the calculation of such heights and locations and errors in the calculation will, and it has often happened, result in serious damage to the ship. The setting of such blockings is consequently a slow and expensive job each time a ship is docked.

It is one of the important objects of the present invention to provide docks, such as wet docks, dry-docks and floating docks, with novel ship supporting means whereby the stresses due to lifting or supporting a ship in the air will be uniformly distributed.

A second important object of the invention is to provide a novel arrangement of such supporting means wherein the lifting and supporting stresses will be automatically equalized.

A third important object of the invention is to provide a novel dock arrangement wherein hydraulic jacks effect the lifting and supporting of the ship using the dock.

A fourth important object of the invention is to provide a novel arrangement of hydraulic jacks for supporting a ship in a dock wherein the jacks are so interconnected that the pressures in the several jacks are automatically equalized.

When a ship is supported in a dock on blocking and it is desired to scrape the bottom to remove marine growths and old paint for repainting it is necessary, unless unscraped spots are to be left, to remove and rebuild the blocking. With the present method this removal of a blocking throws an undue load on the blockings adjacent to that removed.

It is also desirable at times to remove one or more blockings in order to remove a broken plate and replace it by a new one. With the use of the ordinary type of blocking this puts unequal loads on the remaining blockings.

A fifth important object of this invention is to provide a novel hydraulic jack arrangement for supporting ships in a dock wherein any one of the jacks may be disconnected from pressure transmitting connection with the other jacks and allowed to collapse so as to be out of the way in performing operations on the ship.

A sixth important object of the invention is to so arrange the connection between hydraulic jacks supporting a ship in a dock that if one jack be cut out the weight intended to be carried by the cut out jack will be evenly distributed on the other jacks.

With the above and other objects in view, the invention consists in general of certain novel details of construction and combinations of parts hereinafter fully described, illustrated in the accompanying drawings and particularly pointed out in the appended claims.

In the accompanying drawings like characters of reference indicate like parts in the several views, and:

Figure 1 is a vertical longitudinal median section through a floating dock showing a ship supported on the improved jack arrangement.

Figure 2 is a plan view of such a dock with the piping shown somewhat diagrammatically.

Figure 3 is an enlarged transverse section on the line 3—3 of Figure 1.

Figure 4 is an enlarged plan view of a portion of the piping and several jacks connected thereby.

Figure 5 is a fragmentary view partly in section and partly in elevation and showing to enlarged scale one of the jacks used herein.

Figure 6 is a view still further enlarged, partly in section and partly in elevation and showing a ball and socket arrangement for the hull engaging members of the jacks used in this invention.

Figure 7 is a view similar to Figure 3 but to reduced scale and showing the jack arrangement for a wet dock, the arrangement being such as to permit lifting of a ship as high as desired and even clear of the water.

While the arrangement shown in Figures 1 to 6 is shown in connection with a floating dock it will be obvious that the same arrangement may be used in connection with a dry-dock since the difference in operation of a floating dock and a dry dock is that in the former the floor of the dock and the blocking rises to the ship's hull while in the latter case the ship's hull moves downwardly to rest on the blocking as the water leaves the dock.

As here shown the bottom 10 of the dock is in the form of hollow chambers, the upper wall of the middle chambers providing a dock floor 11. Rising from the sides of this bottom are dock walls 12. Arrangements are made for admitting water into the dock bottom, to sink the dock low enough to admit a ship, and to pump out such water to raise the dock but as such arrangements form no part of the present invention and are old and well known they are not shown in the drawings since they would only tend to complicate the disclosure.

Securely fixed on the floor 11 are a multiplicity of hydraulic jacks 13 which are arranged preferably in longitudinal rows, and a number of jacks and rows being employed as may be necessary to suit the size of the dock and the size and weight of the largest ship to be docked. Preferably the jacks are evenly spaced in each row with the jacks of the several rows in transverse alignment. Longitudinal pipes 14 connect the jacks of each row in series and transverse pipes 15 connect the jacks in transverse lines. A supply pipe 16 extends across one end of the dock and supply headers 17 extend from the pipe 16, and branches 18 extend to the individual jacks. Across the other end of the dock is an exhaust or drain pipe 19 from which drain headers 20 extend along the rows of jacks and are connected to the individual jacks by branch pipes 21. Between each adjacent pair of jacks the pipes 14 are provided with valves 22 and the pipes 15 are provided with valves 23. Each branch pipe 18 is provided with a valve 24 and each branch pipe 21 is provided with a valve 25. The pipe 16 communicates with a pump 26 and the pipe 19 communicates with a sump 27 which is connected to the pump by a pipe 28. While much of the piping and the valves are here shown as exposed above the floor 11 it is to be understood that such piping and valves may be located below this floor although, for convenience in operating the valves, the valve stems may extend through the floor and be provided with operating handles above the floor.

In operation, assuming that the ship S is of such size as shorter than necessary for use of the jacks at the ends of the dock. Such jacks are those indicated at A for the ship shown in Figure 1. We may also assume that the jacks are all in their lowered or collapsed positions. The inlet valves 24 for the jacks A are closed and all other valves 24 are opened. The exhaust valves 25 for the jacks A are opened and all other valves 25 are closed. The valves 22 and 23 in the pipes 14 and 15 directly connected to the jacks A are closed and all other valves 22 and 23 are opened. The pump is now started and pumping is continued until the system has been supplied with sufficient oil to cause the jacks open to receive oil from the pipe 16 to fill to about one-half the extent of their movements. The valves 24, formerly open, may now be closed leaving those jacks to be used in free communication with each other through the pipes 14 and 15 which are of sufficient size to have little frictional resistance to the flow of the oil. The dock may now be sunk to the desired extent and the ship moved into the dock and there suitably moored. The dock next has the water ballast pumped out with the result that it rises beneath the vessel and the jacks come in contact with the hull. Since these jacks freely communicate and are of equal capacity they will contract or expand in conformity with the shape of the ship, each jack supporting an equal weight of said ship. Thus the lift on the ship will be equalized throughout.

As a means of illustrating selective operation of the jacks the ship S of Figure 1 has been shown as having a break in its hull over the jack B. Unless this break is so known that the jack B is cut out like the jacks A before beginning operations the jack B, carrying the load, will expand to its limit as shown by dotted lines. To lower this jack the valve 24 and valves 22 and 23 pertaining to the jack B are closed and the valve 25 for jack B is opened which allows the oil to drain off and the jack to collapse. Similarly any other jack may be lowered as for scraping or otherwise treating a spot on the hull covered by the jack head. Such temporarily lowered or collapsed jack may be restored to weight supporting position by simply manipulating the valves to restore them to normal operating position, the restored jack receiving oil from the remaining jacks and again equalizing the reaction of all jacks on the ships hull.

The form of the device suitable for use in a wet dock is schematically shown in Figure 7 wherein hydraulic jacks 29 each having a series of telescopic sections are employed so that, when fully expanded they may lift a ship S' clear of the water, the showing in Figure 7 indicating the ship as only partly lifted. The pipe connections 30 and means for supplying and exhausting oil are identical with the previous forms, but, if desired, remotely controlled valves of ordinary type may replace the valves used in the first form. Obviously any of the well known remote control devices may be used in either form for actuating the valves.

As illustrative of a jack type suitable for use in this invention reference is had to Figures 5 and 6 wherein is shown a jack body 31 having adjacent its upper end an annular internal rib 32. In this jack body is a plunger 33 fitting closely

within the rib and having a stop flange **34** at its lower end engageable with the rib **32** to limit the upward movement of the plunger. A stuffing box device **35** is provided to prevent leakage of oil around the plunger. At the upper end of the plunger **33** there is provided a hemi-spherical socket **36** wherein fits a ball **36** having a stem **37** carrying a disk-like head **38**. The ball is held in the socket by keeper ring sections **39** secured to the plunger by bolts **40**. By this means the head, through its ball and socket connection with the stem, automatically assumes proper position to conform to the surface of the hull at the place against which it engages.

What is claimed is,

1. In a ship repair dock having a floor, a series of rows of spaced hydraulic jacks mounted on said floor, pressure equalizing pipes connecting each jack of a row with the adjacent jacks of the row and each jack of a row with the corresponding jacks of the next adjacent rows, and a control valve interposed in each equalizing pipe.

2. In a ship repair dock having a floor, a series of rows of spaced hydraulic jacks mounted on said floor, pressure equalizing pipes connecting each jack of a row with the adjacent jacks of the row and each jack of a row with the corresponding jacks of the next adjacent rows, a control valve interposed in each equalizing pipe, and piping supplying actuating fluid to said jacks.

3. In a ship repair dock having a floor, a series of rows of spaced hydraulic jacks mounted on said floor, pressure equalizing pipes connecting each jack of a row with the adjacent jacks of the row and each jack of a row with the corresponding jacks of the next adjacent rows, a control valve interposed in each equalizing pipe, fluid supply piping having branches leading individually to each jack, and a control valve in each of said branches.

4. In a ship repair dock having a floor, a series of rows of spaced hydraulic jacks mounted on said floor, pressure equalizing pipes connecting each jack of a row with the adjacent jacks of the row and each jack of a row with the corresponding jacks of the next adjacent rows, a control valve interposed in each equalizing pipe, piping supplying actuating fluid to said jacks, and drainage means for said jacks.

5. In a ship repair dock having a floor, a series of rows of spaced hydraulic jacks mounted on said floor, pressure equalizing pipes connecting each jack of a row with the adjacent jacks of the row and each jack of a row with the corresponding jacks of the next adjacent rows, a control valve interposed in each equalizing pipe, piping supplying actuating fluid to said jacks individually, and means to drain said jacks individually.

6. In a ship repair dock having a floor, a series of rows of spaced hydraulic jacks mounted on said floor, pressure equalizing pipes connecting each jack of a row with the adjacent jacks of the row and each jack of a row with the corresponding jacks of the next adjacent rows, a control valve interposed in each equalizing pipe, fluid supply piping having branches leading to each jack individually, drainage piping having branches leading from each jack individually, and a valve in each of said branches.

7. In a ship repair dock having a floor, a plurality of rows of spaced hydraulic jacks, said rows extending longitudinally of the floor and the jacks of each row being transversely opposite each other, equalizing pipes connecting the jacks of each row in series and provided with a valve between each pair of jacks in the row, and equalizing pipes connecting the jacks of the several rows in lateral lines and having valves interposed in the last mentioned pipes between each jack of a row and the corresponding jack of the adjacent row.

8. In a ship repair dock having a floor, a plurality of rows of spaced hydraulic jacks, said rows extending longitudinally of the floor and the jacks of each row being transversely opposite each other, equalizing pipes connecting the jacks of each row in series and provided with a valve between each pair of jacks in the row, equalizing pipes connecting the jacks of the several rows in lateral lines and having valves interposed in the last mentioned pipes between each jack of a row and the corresponding jack of the adjacent row, piping supplying actuating fluid to said jacks individually, and means to drain said jacks individually.

9. In a ship repair dock having a floor, a plurality of rows of spaced hydraulic jacks, said rows extending longitudinally of the floor and the jacks of each row being transversely opposite each other, equalizing pipes connecting the jacks of each row in series and provided with a valve between each pair of jacks in the row, equalizing pipes connecting the jacks of the several rows in lateral lines and having valves interposed in the last mentioned pipes between each jack of a row and the corresponding jack of the adjacent row, fluid supply piping having branches leading to each jack individually, drainage piping having branches leading from each jack individually and a valve in each of said branches.

10. In a ship repair dock having a floor, a plurality of rows of spaced hydraulic jacks, said rows extending longitudinally of the floor and the jacks of each row being transversely opposite each other, equalizing pipes connecting the jacks of each row in series and provided with a valve between each pair of jacks in the row, equalizing pipes connecting the jacks of the several rows in lateral lines and having valves interposed in the last mentioned pipes between each jack of a row and the corresponding jack of the adjacent row, a fluid supply pipe extending along each row of jacks, branches extending from said supply pipes individually to the jacks, a drainage pipe extending along each row of jacks, branches extending from said drainage pipes individually to the jacks, and a valve in each of said branches.

11. In a ship repair dock having a floor, a series of rows of spaced hydraulic jacks mounted on said floor, pressure equalizing pipes connecting each jack of a row with the adjacent jacks of the row and each jack of a row with the corresponding jacks of the next adjacent rows, a control valve interposed in each equalizing pipe, fluid supply piping having branches leading to each jack individually, drainage piping having branches leading from each jack individually, a valve in each of said branches, and a remote control for said valves.

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