T. H. HAMILTON.

LIFTING DOCK.

APPLICATION FILED JULY 6, 1918.

1,380,141.

Patented May 31, 1921.

5 SHEETS—SHEET 1.

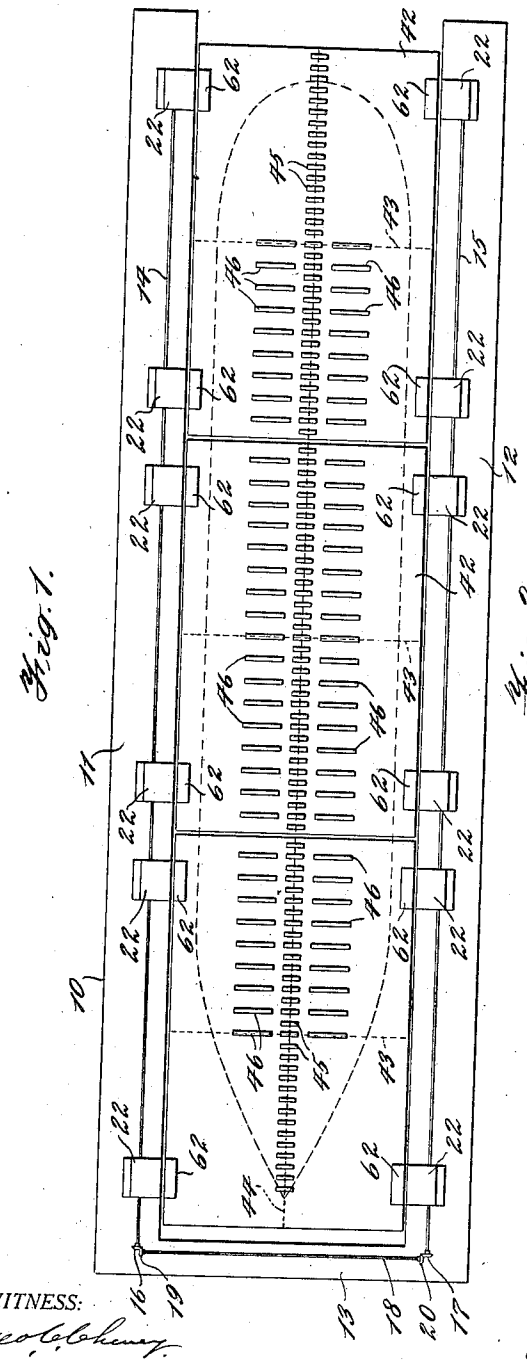


Fig. 1.

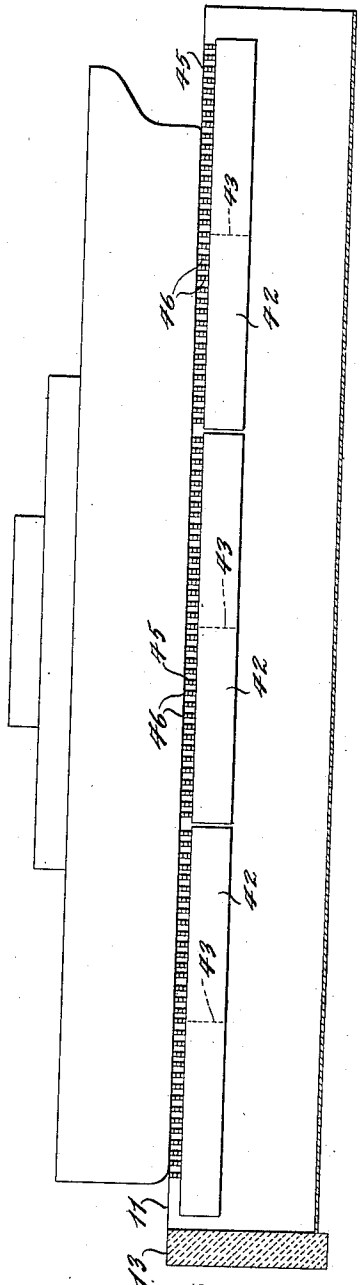


Fig. 2.

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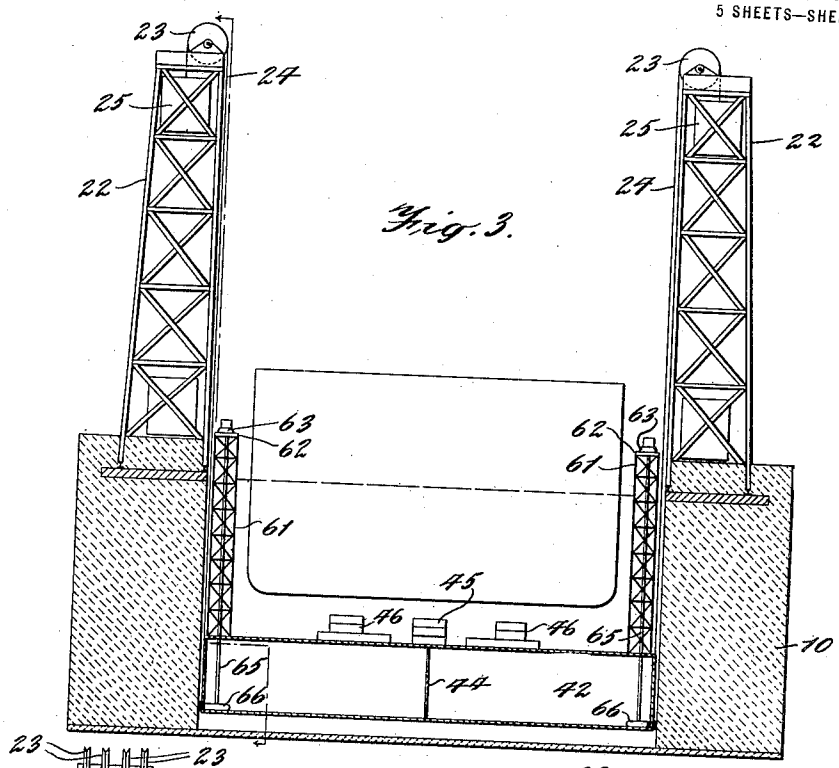


Fig. 3.

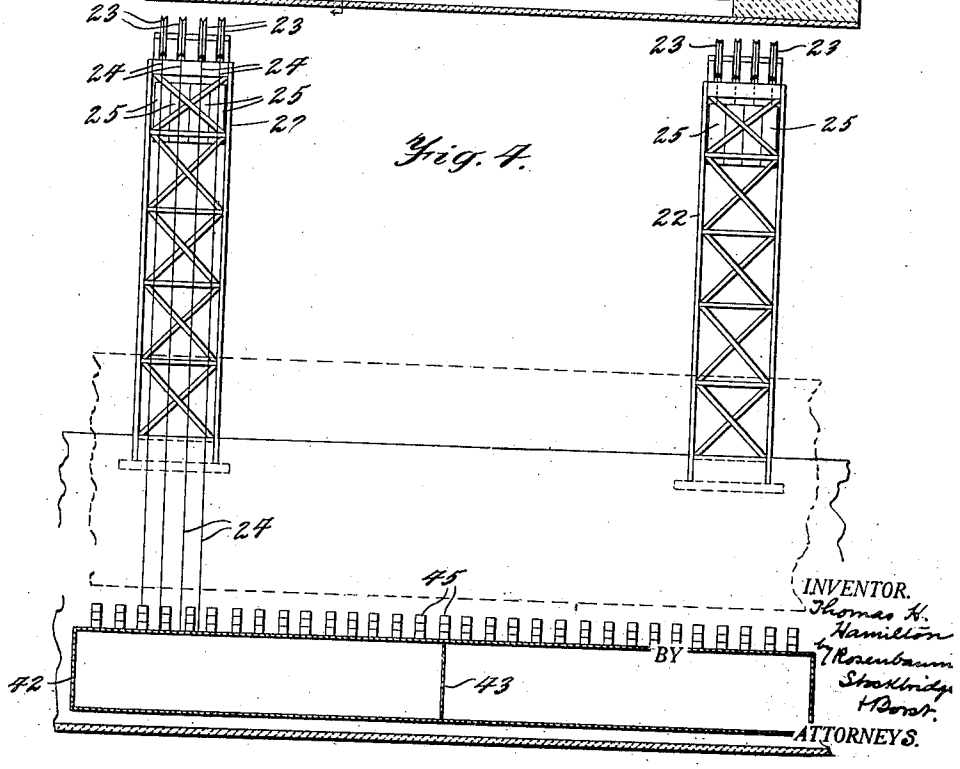


Fig. 4.

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5 SHEETS—SHEET 3.

Fig. 6.

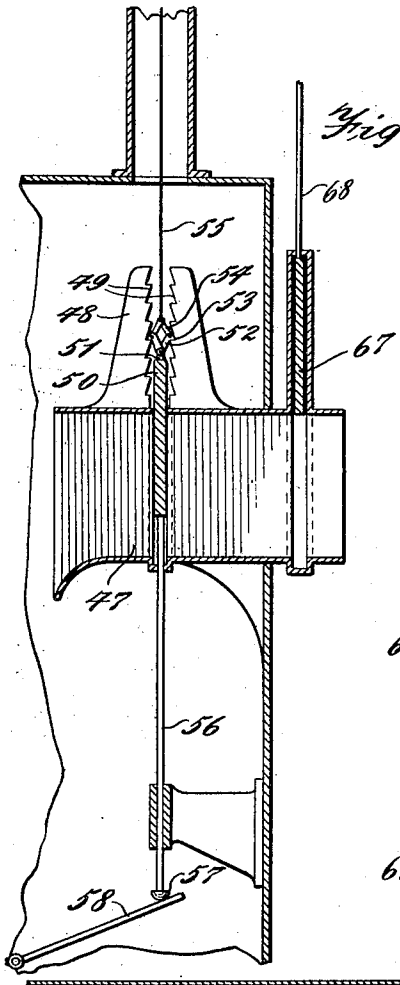


Fig. 5.

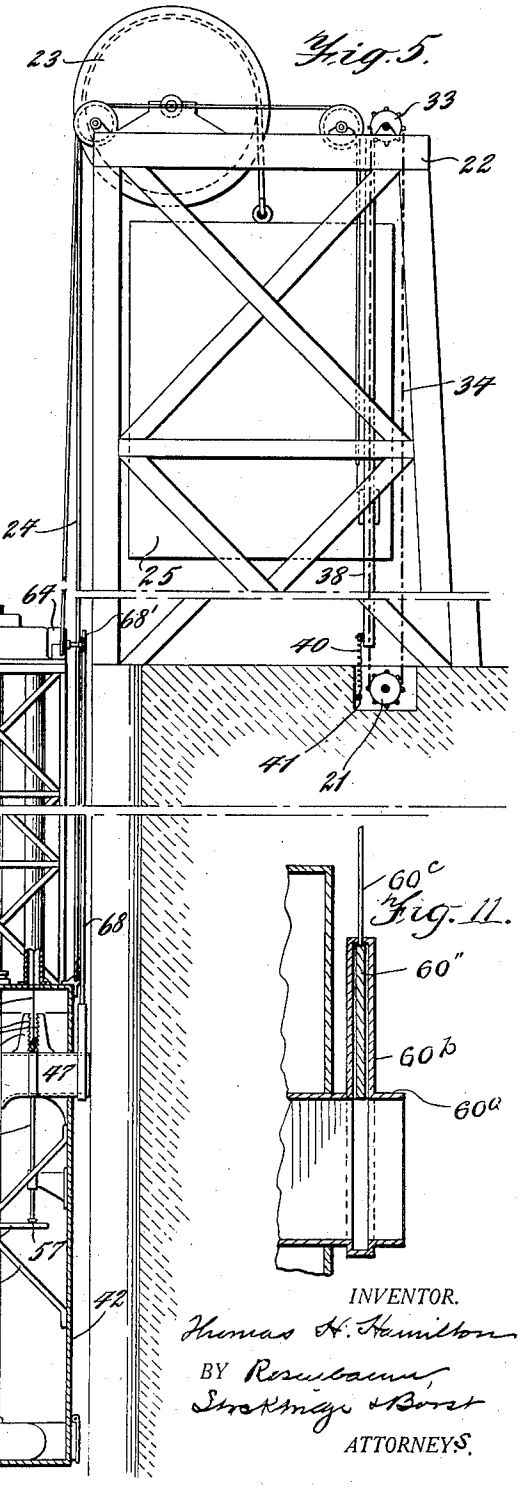


Fig. 11.

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5 SHEETS—SHEET 4.

Fig. 7.

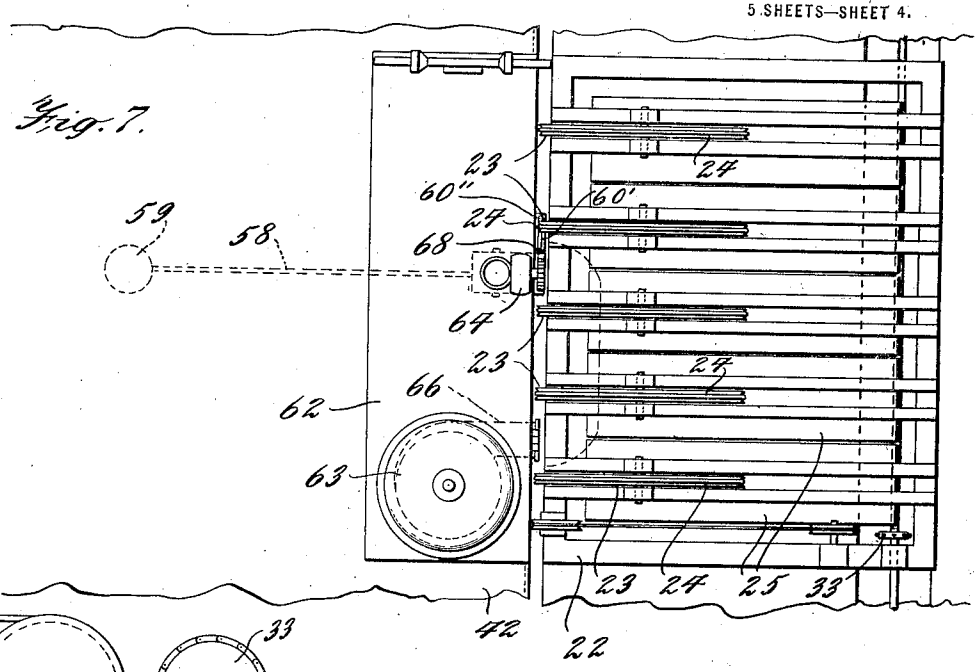


Fig. 8.

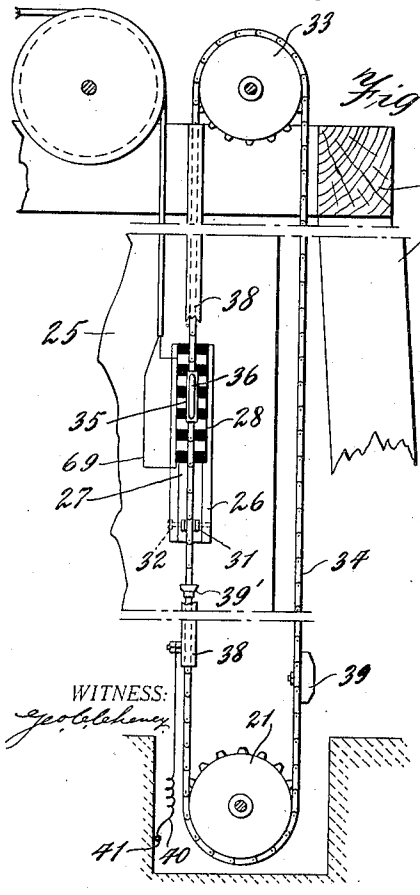
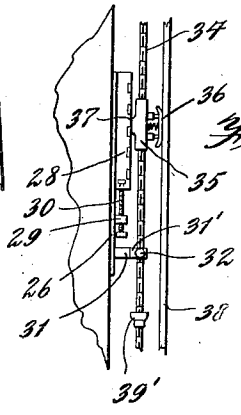


Fig. 9.



WITNESS:

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5 SHEETS—SHEET 5.

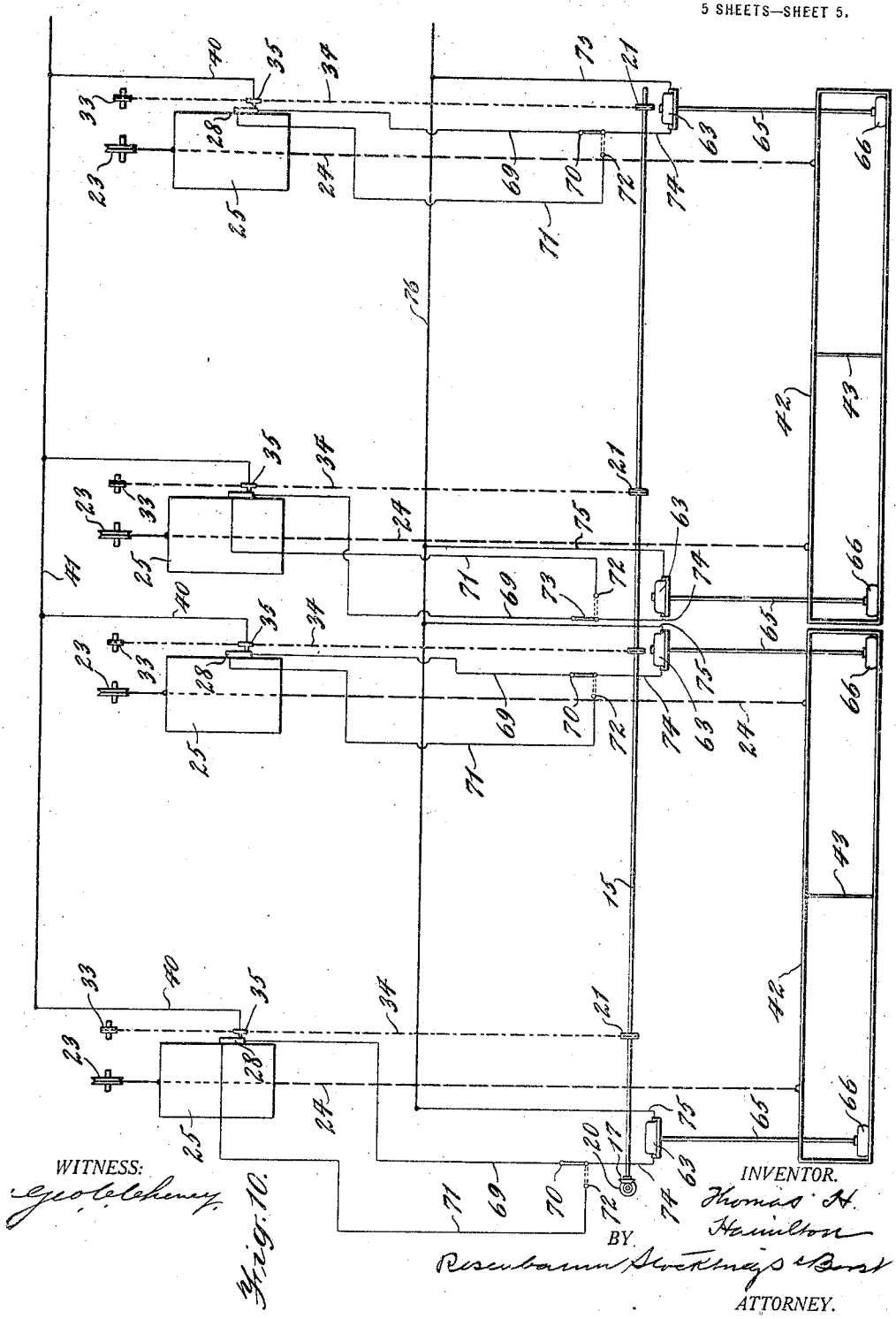


Fig. 10.

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UNITED STATES PATENT OFFICE.

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LIFTING-DOCK.

1,380,141. Specification of Letters Patent. Patented May 31, 1921.

Application filed July 6, 1918. Serial No. 243,580.

To all whom it may concern:

Be it known that I, THOMAS HAYDEN HAMILTON, a citizen of the United States, residing at the city of New York, in the borough of Manhattan and State of New York, have invented certain new and useful Improvements in Lifting-Docks, of which the following is a full, clear, and exact description.

My invention relates generally to dry docks and particularly to a lifting dock in which submersible pontoons move the vessel to be repaired relatively to the material platform of quays forming the dock.

My invention contemplates the use of both stationary quays which are carried to firm foundations and floating quays which may in such case be pontoons in themselves.

I am aware that submersible dry docks commonly known as floating dry docks are known. Such docks have several disadvantages, one of which is that in order to make them seaworthy the sides must be carried up a considerable distance from the keel. In order to reduce the distance which the dock must be submerged the vessel to be raised is positioned as near to the keel as possible. Hence the vessel in the dock is remote from the floor surface of the quays and loss of time in transporting materials to the part to be repaired is incurred. Another disadvantage is that the entire structure of the dock must be raised to dry dock the vessel. Hence a great deal of pumping is required.

My invention, due to the provision of means to move the vessel relatively to the quays, largely obviates the disadvantages of floating dry docks while retaining substantially all their advantages.

Other types of dock are known in which the vessel is raised by chains and counterweights, but such docks are only suited to raising small vessels and even in such case subjecting the vessel to irregular stresses and strains.

My invention further contemplates partly balancing the dead weight of the pontoons so that a minimum of pumping is required and the provision of means to automatically control the evacuation of water from the pontoons so that they gradually assume such relative positions as to finally have their surfaces in substantially the same plane despite the fact that some of the pontoons may be carrying a heavier load than others. Vessels which are to be dry-docked usually enter such docks without any cargo in the hold. As most vessels are designed so as to float nearly horizontal when in cargo, a vessel to be dry docked (*i. e.*, empty), usually has the bow in a relatively higher position with respect to the other portions than when in cargo. This is particularly true of some forms of cargo carriers in which the engine and boilers are located at the stern as in tank steamers. Hence mechanism for regulating the relative buoyancy of the pontoons so that they gradually carry the vessel to be dry-docked upwardly to a substantially horizontal position is of importance, otherwise the vessel would be subjected to undue stresses and strains and an irregular working platform caused by the difference in elevation of the pontoons would result. The structure disclosed in my present application archieves this result in a substantially automatic manner.

The drawings accompanying this specification and forming part thereof, illustrate one embodiment of my invention.

Figure 1 shows a top plan diagrammatic view of the dock and its appurtenances with a vessel shown by dotted lines in position;

Fig. 2 shows a longitudinal section of Fig. 1;

Fig. 3 is a transverse section of the dock;

Fig. 4 is a side elevation of some of the elements shown in Fig. 1, partly in section;

Fig. 5 is an enlarged fragmentary detail view of some of the elements shown in Fig. 3;

Fig. 6 is an enlarged view of some of the elements shown in Fig. 5;

Fig. 7 is an enlarged top plan view of some of the elements shown in Fig. 4;

Fig. 8 is an enlarged detail view of some of the elements of the electrical control apparatus shown in Fig. 5;

Fig. 9 is an enlarged fragmentary elevation of some of the elements shown in Fig. 8;

Fig. 10 is a diagrammatic representation of the wiring and electrical control mechanism;

Fig. 11 is a detail view of some of the elements shown in Fig. 7 partly in section.

Referring to the drawings, a dock indicated in its entirety by 10 is either located in a suitable excavation on the shore and having its bottom a suitable distance below high water mark, or it may be of the float-

ing type, submerged to a suitable distance. The dock 10 comprises relatively stationary quays 11, 12 and 13, forming an inclosed water basin in which submersible pontoons, which will be described hereinafter, operate. The top of the quays provides the necessary floor room for tools and materials required to make repairs to the vessel in the dock. The quays 11 and 12 are each provided with a suitable channel or chase in which are located rotatable shafts 14 and 15, each supparted by suitable bearings and having bevel gears 16 and 17, respectively, secured to their rear ends. The quay 13 is also provided with a channel or gutter in which is located a shaft 18 suitably supported in bearings and provided with bevel gears 19 and 20 at each end thereof, which mesh respectively with the bevel gears 16 and 17. The three shafts 14, 15 and 18 operate in unison and any movement imparted to shaft 14 will be transmitted to shaft 15 and vice versa. A plurality of sprocket wheels 21 are secured to each of the shafts 14 and 15, and, with corresponding sprocket wheels and appurtenances which will be described, form part of the electrical pump control apparatus for regulating the rise and fall of the pontoons. A plurality of towers 22, preferably of skeletonized construction, are located on each of the quays 14 and 15, in spaced relation so as to provide convenient passageway for the materials and machinery to be used in repairing the vessel. Each of these towers is placed over one of the sprocket wheels 21 and carries a grooved pulley 23 supported in suitable bearings. The pulleys 23 are preferably located to project beyond the face of the quay and tower and each carries a cable 24 having one end connected to a counterweight 25 adapted to operate within towers 21, and the other to pontoons in a manner to be described. The location of the pulleys with respect to the quays and towers 21 permits the stretch of cable secured to the pontoon to have a free fall. The counterweights 25 are of any shape, preferably rectangular, and are each provided on one face with a guideway 26 having grooves in which a plate 27 secured to a rheostat 28 slides. The rheostat 28 may be of any suitable construction, as for example a rheostat comprising a plurality of helical coils of high resistance wire serially connected with each other. A bracket 29 is secured to each counterweight and carries an adjusting screw 30 adapted to vertically move the rheostat 28 relatively to the counterweight 25. A bracket 31 having a guide ring 31′ is secured to the counterweight 25. The guide ring 31′ surrounds and guides a chain to be described, and is provided with a stop pin 32 to lock the chain to the bracket. Each tower 22 is provided near its upper end with a sprocket wheel 33 positioned in the same plane as one of the accompanying sprocket wheels 21. A sprocket chain 34 passes over sprocket wheel 33 and its accompanying sprocket wheel 21 located on either shaft 14 or 15. Each chain 34 carries on one stretch a contact element, indicated in its entirety by 35, which comprises a contact shoe 36 and a contact point 37. The contact point 37 is adapted to bear on the resistance wire of the rheostat 28, while contact shoe 36 is adapted to bear on an electrified contact rail 38. One of the chains 34 is further provided with a weight 39 located on the stretch opposite to which the contact element 35 is secured and of sufficient mass to overbalance the contact elements 35 of all the chains and normally tending to move these elements upwardly. A stop collar 39′ is secured to one of the chains 34 and is adapted to abut against the guide ring 31′ of the bracket 31 and thus limit the upward movement of the contact element so that it remains near the rheostat. The contact rail 38 is connected by a wire 40 to a main electrical supply wire 41 and forms with the contact element 35 and rheostat 28 one part of an electrical circuit. A plurality of submersible pontoons 42, preferably of equal displacement capacity, are located in the dock 10 and are adapted to submerge in the water basin formed by quays 11, 12 and 13, and, when totally submerged, are adapted to rest on the bottom of the dock. Each pontoon may be and preferably is provided with a transverse wall 43 and a longitudinal wall 44, dividing it into four submerging compartments. In case one pump is provided for each pontoon the compartments communicate with each other, whereas if more than one pump is used for a pontoon, as will be usual, adjacent pairs of compartments may communicate. Any number of walls may be provided dividing the pontoon into any number of compartments, which may communicate with each other in any suitable manner, as will readily suggest itself. The top of each pontoon is provided with a suitable number of keel blocks 45 and bilge blocks 46 adapted to support the vessel to be raised in an elevated position so as to permit working underneath. Each pontoon 42 has an intake flume or flumes 47 located in its upper portion for flooding the compartments of the pontoons and has one end preferably extending beyond the outer wall of the pontoon. This intake flume 47 is provided on its inwardly projecting end with a pair of vertically extending jaws 48 provided on their opposed faces with a plurality of upwardly inclined rack teeth 49. A vertically slidable sluice valve 50 is located in the flume 47 and is adapted to move between the vertically extending jaws and vary the effective orifice of the flume. The sluice valve

50 is provided with a plurality of ears 51 having pivotally secured thereto a plurality of hooks 52 having their bills 53 oppositely disposed and connected at their upper ends by a toggle joint 54. A light cable or rope 55 is attached to the knuckle of the toggle joint and extends to any convenient point of the dock and is adapted to release the bills of the hooks from engagement with the rack teeth of the vertically extending faces and the valve from engagement with the rack. The sluice valve 50 has a downwardly extending rod 56 secured thereto in any convenient manner and provided at its lower end with a semi-spherical bearing head 57 adapted to rest on one leg of an arm 58 having a ball float 59 secured to the other leg and pivotally supported in a bracket 60 secured to one wall of the pontoon. When the ball float 59 descends it moves the rod 56 and its accompanying valve 50 upwardly, which hangs by the hook bills 53 on the rack teeth until released. Each pontoon 42 is provided at any convenient point with an orifice 60′ preferably located in the same horizontal plane as the orifice of flume 47. A flanged intake flume 60^a is secured to the portion and is concentrically located with respect to the orifice 60′. The flume 60^a is provided with a transverse gate box 60^b similar to that provided for gate valve 67 (shown in Fig. 6). A gate valve 60″ is adapted to slide vertically in the box 60^b and is independently controlled for the purpose of permitting water to enter the pontoons so that they may sink at equal speeds until the water rises above the keel blocks and begins to buoy the vessel. The gate valve 60″ may be raised and lowered in any convenient manner, for example, by a light cable 60^c (similar to cable 68) secured to its upper end. Obviously other types of gate might be used to close the orifice, for example, a hinged gate. A pair of towers 61, preferably of skeletonized construction, are located on the upper wall of each pontoon and on opposite sides thereof and extend upwardly a sufficient distance so that a top platform constituting a quay 62 is out of water when the pontoons are totally submerged. Two motors 63 and 64 are located on this platform 62. A shaft 65 of the motor 63 is either directly or through suitable reducing gears connected to a bilge pump 66 located at the lower end of the pontoon. The pump 66 is adapted to expel the water from the compartments of the pontoons. A gate valve 67 is located in a suitable casing in the intake flume and is connected by a rod 68 with the motor 64 in any convenient manner, for example, by a rack as 68′ actuated by a pinion on the shaft of motor 64. The gate valve is adapted to close the intake flume during the raising of the vessel and to remain open during the operation of submerging the pontoons. The motor 64 raises the gate valve 67 when operated. A wire 69 connects one end of the series of resistance coils of the rheostat 28 with a switch contact point 70, while a wire 71 connects the other end of the series of resistance coils of the rheostat 28 with a contact point 72, similar to point 70. A pivotally mounted switch blade 73 has one end connected with a wire 74 which connects it with motor 63, while the other end of the blade is adapted to contact with either one of the contact points 70 or 72. A wire 75 connects the motor 63 with a feed main 76. When the switch is in the position shown in full in Fig. 10, the circuit is closed through the series of resistance coils between the contact point 37 and the lower end of the rheostat, and thence through motor 63, while if the switch blade is in contact with the point 72 the circuit is completed through the series of resistance coils at the upper part of the rheostat 28. Hence, for any given position of the contact point 37 the shifting of the blade 73 will close the circuit through either high or low resistance and thus vary the speed of the pumps 66.

In the operation of my device, the pontoons 42 being flooded and preferably totally submerged, a vessel to be repaired is floated over them. All the valves of the pontoons are then closed. If the pontoons are resting on bottom of dock 10, as will be necessary when a vessel of the maximum draft capacity of the dock is to enter it, the counterweights 25 will be in their highest position. The motors 63 are then started, the pumps operated thereby expelling the water from the compartments of the pontoons until sufficient amount of water has been expelled to render them buoyant, and permitting them to rise until each pontoon is in contact with the lower part of the vessel to be floated. The pontoon under the lowermost position of the vessel, *i. e.*, the heaviest part, rises slower as it is lifting a portion of the vessel. The center of buoyancy of the vessel is thus shifted by these pontoons, causing the vessel to take a more nearly horizontal position. The sprocket chain under the heaviest part is then locked to the bracket 31 by clamping pin 32, thus preventing all the chains and their accompanying sprocket wheels and shafts from rotating except in accordance with the movement of the counterweight to which the chain is locked. The pontoons under the lighter portion of the vessel, however, rise more rapidly than those under the heavier portions of the vessel, and all the counterweights 25 secured to the pontoons 42 descend in the towers 22, those secured to pontoons under the lighter part of the vessel descending more rapidly and shifting their accompanying rheostats 28 relatively to the contact points 37 in accordance with the

speed of emersion of these pontoons. The contact point 37 coöperating with the rheostats 28 on the counterweight 25 secured to the pontoons under the lighter parts of the vessel thus includes more resistance coils of the rheostats in the electrical circuit, reducing the speed of the pump motor 63 and the bilge pump 66 and the expulsion of water from the pontoons, while the pumps 66 of the pontoons under the heavier parts of the vessel are operating at a higher rate of speed and maintaining a higher rate of evacuation of water. In this way the rate of evacuation of the water from the pontoons is automatically regulated, bringing the surfaces of the pontoons to substantially the same plane.

When the pontoons carrying the vessel are in their raised position and it is desired to lower the vessel, the gate valve 60″ is opened, permitting substantially equal quantities of water to enter the compartments of the pontoons and causing them to sink at the same rate. When the keel and bilge blocks are submerged the buoyancy of the vessel starts to exert an effect. I then close valves 60″ covering orifice 60′ and open gate valves 67. As less water has been pumped from some of the pontoons in raising the vessel than from others, the ball floats will be at different positions, opening sluice valves 50 to a varying degree, *i. e.*, the sluice valve 50 of the bow pontoons, from which but little water has been pumped, is closed or nearly closed, while the sluice valves of the pontoons under the heavier part of the vessel having their water almost all pumped out are open, hence the water enters these portions more rapidly and they sink more rapidly than the other portions. In order to overcome any irregularity in the sinking I release the chains 34 and the weights 39 carry the contact elements 35 upwardly. I then adjust the rheostat 28 so that the contact points 37 bear on the upper end of the coils of the resistance wire. I reverse the resistance of the rheostats by moving switch blade 73 to the contact point 72, *i. e.*, opposite to that employed when rising, and lock the chain 34 of the pontoons under the lightest part of the vessel to its counterweight. As some of the pontoons, as above stated, may sink more quickly than others, their counterweights will move relatively to the contact points and cause them to bear on higher speeds, hence the pumps in the pontoons which are sinking faster than the others will operate faster and cause water to be expelled, thus slowing down the rate of submergence of these pontoons and regulating the sinking.

It will be seen that the control which I have devised causes the pontoons and the vessel supported thereon to submerge in such a manner that the vessel is gradually brought to its original floating position, thus obviating stresses and strains which the vessel otherwise would be subjected to.

When I use the term quays in my claims without further qualification I mean to include both stationary quays and floating quays, which may be pontoons in themselves.

I claim:

1. In a lifting dock, the combination of submersible pontoons, individual means to evacuate the water from said pontoons, and automatic regulating mechanism for each evacuating means whereby the rate of evacuation is proportional to the weight supported on each pontoon.

2. In a lifting dock, the combination of submersible lifting pontoons, individual means for evacuating the water from said pontoons, and automatic means controlled by the degree of emersion of each pontoon for regulating the rate of evacuation of it by the individual evacuating means.

3. In a lifting dock the combination of submersible lifting pontoons, electrically operated means for evacuating the water from each pontoon, and automatic means controlled by the degree of emersion of each pontoon for regulating the rate of operation of the evacuating means.

4. In a lifting dock the combination of submersible lifting pontoons, electrically controlled means for evacuating the water from each pontoon, means controlled by the degree of emersion of each pontoon, for varying the controlling means and thereby the rate of operation of the evacuating means.

5. In a lifting dock, the combination of submersible lifting pontoons, electrically controlled means for evacuating the water from each pontoon, a relatively fixed support adjacent the pontoons, regulating means for the first mentioned means comprising two parts, one of which is connected to move with the pontoon and the other of which is adjustably carried by the support.

6. In a lifting dock, the combination of submersible lifting pontoons, individual means for evacuating the water from each pontoon, a regulating mechanism for each of the above means comprising two relatively movable parts, connections between one part of each mechanism and its pontoon whereby movement of the pontoon moves its part proportionally, means connecting all the other parts of said mechanism for movement together, and means for connecting the said connecting means to one pontoon.

7. In a lifting dock, the combination of submersible lifting pontoons, individual means for evacuating the water from each pontoon, a regulating mechanism for each of the above means comprising two relatively movable parts, connections between one part of each mechanism and its pontoon whereby movement of the pontoon moves

its part proportionally, means connecting all the other parts of said mechanism for movement together, and means for selectively connecting the said connecting means to any pontoon.

8. In a lifting dock the combination of submersible lifting pontoons, a support adjacent the pontoons, counterweights mounted for movement on said supports and connected to each pontoon, individual means for evacuating the water from each pontoon, regulating mechanism for each evacuating means comprising two relatively movable parts, one of which is carried by each counterweight, means for adjusting said parts on the counterweights, means for connecting all the other of said parts for movement together, and means for connecting the last named means to one pontoon.

9. In a lifting dock the combination of submersible lifting pontoons, a support adjacent the pontoons, counterweights mounted for movement on said supports and connected to each pontoon, individual means for evacuating the water from each pontoon, regulating mechanism for each evacuating means comprising two relatively movable parts, one of which is carried by each counterweight, means for connecting all the other of said parts for movement together, and means for selectively connecting the last named means to one of said pontoons.

10. In a lifting dock the combination of submersible lifting pontoons, individual electrically operated means for evacuating the water from each pontoon, regulating mechanism for each of said means including a rheostat, means controlled from each pontoon for operating its rheostat, and means selectively connectible to any one pontoon, for also operating a plurality of said rheostats simultaneously.

11. In a lifting dock, the combination of a plurality of submersible pontoons of equal size normally supporting an object of greater weight at one end in a horizontal position, means for automatically controlling the influx of water into each pontoon when sinking the pontoons to float the object, whereby the object is lowered uniformly at both ends, said means including a member operated by the water in the pontoon.

12. In a lifting dry dock, the combination of submersible pontoons, means to evacuate the water from said pontoons, and automatic means to regulate the evacuation in each pontoon at a rate proportional to the weight supported on the pontoon.

13. In a lifting dry dock, the combination of stationary quays surrounding a water basin, submersible pontoons in said basin, means carried by said piers to balance the pontoons, and means coöperating with the balancing means to evacuate each of said pontoons at a rate directly proportional to the weight supported on the pontoon.

14. In a lifting dry dock, the combination of piers forming a basin, pontoons in said basin, towers on said piers, counterweights carried by said towers to balance the pontoons, and means controlled by said counterweights to regulate the movement of the pontoons.

15. In a lifting dry dock, the combination of piers forming a basin, pontoons in said basin, towers on said piers, counterweights carried by said towers to balance the pontoons, an adjustable rheostat carried by each of said counterweights, motor actuated pumps for each of said pontoons, electrical connections between said rheostat and the pumps to regulate the evacuation of the pontoons.

16. In a lifting dry dock, the combination of quays forming a basin, pontoons in said basin, towers on said quays, counterweights carried by said towers to balance the pontoons, an adjustable rheostat for each of said counterweights, pumps for each of said pontoons to expel the water therefrom, an adjustable point contacting with said rheostat and an electrical circuit including the actuating means for said pumps and the rheostat.

In witness whereof, I subscribe my signature.

THOMAS HAYDEN HAMILTON.