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ATTYS.
FIG. 3.

FIG. 7.
The invention described herein may be manufactured and used by or for the Government of the United States of America for governmental purposes without the payment of any royalties thereon or therefor.

This invention relates to drydocks and more particularly to drydocks having improved end closure or caisson means and improved work and shop areas.

It is one important object of this invention to provide an improved drydock which is particularly suitable for carrying out the method of drydocking disclosed in U.S. Patents Nos. 3,153,420 and 3,133,518 whereby ships of deeper draft than could be drydocked in a conventional manner may be conveniently drydocked through the expedient of superlifting the drydock basin to permit placement of bilge and keel blocks.

Another object of this invention is the provision of an improved drydock basin closure means or caisson which can be moved between its open and its closed positions solely by adjusting the buoyancy thereof, thereby avoiding the prior requirement of tugs, cranes, or other special hauling apparatus for maneuvering a caisson between its open and closed positions.

It is another object of this invention to provide an improved drydock basin having a closure means or caisson of the foregoing character which is adapted to be sealed alternatively against internal and external water pressures, is pivoted in a novel manner near its lower edge, and is provided with ballasting tanks whereby the caisson may be floated vertically from its grooved seat and then ballasted to swing outwardly and downwardly in the manner of a door to permit entry of a ship, and then the tanks may be selectively pumped and flooded to cause the caisson to swing about its pivots to a vertical position and then to sink into its grooved seat.

Yet another object of this invention is the provision of a drydock having improved sealing means for assuring the attainment of a watertight condition of the caisson or door, particularly when the door is positioned to hold water out of the basin.

Still another object of this invention is the provision of an improved drydock wherein the basin is defined by side walls at least one of which separates the basin from one or more shops, service rooms, or the like on the same floor level as the basin and having a doorway thereinto, and watertight door means for closing the doorway, whereby the basin can be flooded without flooding the room or rooms.

As another object of this invention it aims to provide vacuum means for perfecting the seal around the caisson and the seal of the watertight door means between the basin and adjacent rooms.

Other objects and many of the attendant advantages of this invention will be readily appreciated as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawings wherein:

FIG. 1 is a plan view of a floating drydock embodying the present invention;

FIG. 2 is a vertical sectional view of the drydock of FIG. 1 taken substantially along line 2-2 thereof;

FIG. 3 is an enlarged fragmentary sectional view of a portion of the drydock taken substantially along line 3-3 of FIG. 1;

FIG. 4 is a fragmentary vertical sectional view illustrating a portion of the drydock on an enlarged scale;

FIGS. 5 and 6 are views similar to FIG. 4, but with parts in different operating positions; and

FIG. 7 is an enlarged sectional view taken substantially along line 7-7 of FIG. 1.

The invention will be described hereinafter with reference to embodiment in a floating drydock generally indicated at 10, however, it will be understood that this is only by way of example and that the invention may be embodied in graving docks as well. The drydock 10 comprises a hollow bottom wall 11, a hollow side wall 13, a fixed end wall 12, and a caisson 14.

In FIG. 5 is shown a portion of the drydock 10 in which the caisson 14 is in尚 a floating condition, whereas in FIG. 6 the caisson is stationary.

The walls and caisson define a ship accommodating basin 20 which may be flooded and pumped dry in accordance with the method of drydocking described in the aforementioned Patents Nos. 3,153,420 and 3,133,518 in order to achieve drydocking of a ship 21 indicated in broken lines. The drydock 10 may be of steel and as hereinbeforeinferred concrete construction in accordance with well known practice. Of course, it will be understood that the hollow bottom and side walls 11 and 12 may be suitably compartmented to permit control of flooding thereof as necessary to lowering and raising of the drydock during drydocking operations.

The caisson 14, which is movable to an open position indicated in broken lines in FIG. 1 to permit entry and exit of a ship 20 or from the basin, is adapted to be seated in a channel shaped caisson seat 25 formed in the side walls 12, 14 and bottom wall 11 and having spaced, caisson engaging surfaces 25a and 25b. As is best viewed in FIGS. 3-6, the caisson 14 is provided near its lower edge with a pair of recesses 27 in each of which is positioned a transverse hinge pin 28. The hinge pins 28 extend through inverted T-shaped openings 29 in laterally spaced gudgeon members 30 extending horizontally into recesses from the drydock floor. The gudgeon members 30 are conveniently formed of I beams with the openings 29 formed in the web portions thereof. The hinge pins 28 cooperate with the openings 29 in the gudgeon members 30 to permit horizontal movement of the caisson into engagement alternatively with either of the opposed seat FIG. 4. The openings 29 further permit limited vertical faces 25a, 25b as is shown respectively in FIG. 5 and movement of the caisson 14 to the position illustrated in full lines in FIG. 6 sufficient to release it from the confines of the seat 25 and to permit it to swing outwardly and downwardly about the axis of the pins 28 in the manner of a door to the substantially horizontal position illustrated in broken lines in FIG. 6 to permit entry or exit of a ship.

The caisson 14, which is hollow, has its interior divided into separate water and air tight chambers such as indicated at 31, 32 and 33, which chambers are controllably and selectively flooded and/or blown to adjust the buoyancy of the caisson, whereby the vertical and swinging movements thereof may be effected without the use of cranes, tugs or the like. Such controlled flooding and blowing may be carried out through the agency of suitable valves and piping by which water and air may be selectively admitted to or vented from the chambers. Thus, the chambers 31, 32 and 33 may be served by a first set of pipes 35, 36 and 37 controlled by valves 38, 39, 40, the first set of pipes terminating in the uppermost portions of their respective chambers. A second set of pipes 41, 42, and 43 controlled by valves 44, 45, and 46, serve the cham-
bers 31, 32, and 33, respectively, and terminate in the bottoms of the chambers.

The valves 38, 39, 40 may be used to vent air from the chambers when being flooded as by water pumped through flexible hoses (not shown) to the valves 44, 45 and 46. Alternatively, the valves 38, 39, 40 may be supplied with compressed air from a suitable source through flexible hoses to blow water from the chambers through pipes 41, 42 and 43. Suitable sealing valves 44, 45, and 46.

The caisson 14, being designed to be seated in seat 25 to seal water either in or out of the basin 11, is provided (see FIGS. 3 and 4) on its outer surface with a resilient sealing strip 48 and on its inwardly directed surface with spaced resilient sealing strips 49. The former is engageable with the surface 25a of the drydock when in use but the latter are engageable with the surface 25b to hold water out when the basin is dry. The strips 49 define one or more enclosed areas for purposes which will presently be made apparent.

In order to assist in sealing the caisson 14 against the surface 25a, there are provided hydraulic rams 50 which are fixed with respect to the seat 25 and operable against pads 50a on the caisson to force it outwardly to bring the sealing strip 48 thereof tightly against the surface 25a. Similarly, there are provided hydraulic rams 51 which are operable against pads 51a on the caisson to bring the spaced strips 49 into tight engagement with the surface 25b.

The surface 25b is provided with a groove 52 which lies between the portions of that surface which are enclosed by the spaced sealing strips 49. The groove is connected by suitable conduits or passageways 53 to a manifold 54 which is connected to a suitable vacuum pump (not shown). The sealing strips, when in engagement with the surface 25b define with the groove 52 a closed zone in which a vacuum may be drawn by the just mentioned vacuum pump to assist in producing a tight seal of the caisson in its seat. By observing the ability of the sealing strips to maintain a vacuum, as with a vacuum gauge (not shown) connected to manifold 54, the quality of the seal may be readily determined.

As a safety feature, the drydock 10 comprises a trough 55 just inboard of the seat 25, which trough is below the upper surface of floor level 11 of the drydock bottom wall 11. Defined in the bottom wall and below trough 56 is a safety tank 57 which communicates with the trough through drain ports 59 having suitable trash grids therein. The safety tank 57 is adapted to be pumped dry by a suitable water pump and serves to collect any seepage past the caisson 14 when sealed against surface 25b.

Referring now to FIGS. 1, 2, and 7, the side wall structure 15 of the drydock located in what is referred to as the drydock basin through doorways 77 and 78 which are illustrated in FIG. 7 in a condition closed by watertight doors 79, 80 and 81.

Inasmuch as the structures and use of rooms 16, 17, trunk 70 and doors 73, 74, 75 correspond to the structures and use of rooms 18, 19, trunk 71 and doors 79, 80, 81, only the latter structures and uses will be described in detail although it will be understood that the description applies as well to the former.

With particular reference to FIG. 7, the doors 79 and 80 have been positioned by being lowered through trunk 71 to positions overlying doorways 77 and 78, the lower edges of the doors being received in a recess 83. The doors 79, 80 are provided with peripheral resilient sealing strips 84 which engage the wall surfaces surrounding the doorways 77, 78, and the doors are forced into tight sealing engagement therewith by a plurality of hydraulic or other pressure fluid operated rams 86.

The door 81 is conveniently of the horizontally sliding type carried at the top by rollers 87 engaging a suitable rail 88, with the lower edge of the door running in a recess 89 in the basin floor. The door 81 is provided with a resilient sealing strip 90 which is engageable with the wall surface surrounding doorway 78 when the door is closed. Hydraulic or other fluid pressure rams 92 are mounted on the rail 88 and floor surface 11a and are operative to urge the door into tight sealing engagement.

In order to enhance the seal of door 81, means are provided for drawing a vacuum in the space defined between that door and door 80. To this end there is provided a conduit 95 one end of which communicates with the space between the doors 80, 81 and the other of which is connected to a suitable vacuum pump 93 which may be conveniently located in room 19. A vacuum gauge 96 may be provided to give a ready indication of the state of vacuum in the space between doors 80, 81 and hence provide an indication of the quality of seal thereacross.

By virtue of the just described door arrangements and constructions, the room 19 may be effectively maintained dry even when the basin 20 is flooded for entry or exit of a ship. When the basin 20 is dry with a ship docked therein, the doors 79, 80, 81 may be opened and the room 19 used as a shop located on the level of the basin floor. Similarly, room 17 may be rendered water-tight and kept dry during flooding of the basin, and then may be opened for use in working on a ship in the basin.

The rooms 16 and 18 are accessible from the level of wall 65 through suitable openings 98, 99. These rooms may be kept continually dry or, as necessary, may be flooded to aid in sinking the drydock 10 to a desired level for entry of a ship, and then evacuated of water into the river or into the ship's basin during raising of the ship. When empty of water the rooms 16, 18 may be used for additional workshop space.

From the foregoing detailed description it will be appreciated that there has been provided by the features of this invention an improved drydock which satisfies the aforesaid objectives and advantages as well as others apparent from this description.

Obviously many modifications and variation of the present invention are possible in the light of the above teachings. It is therefore to be understood that within the scope of the appended claims the invention may be practiced otherwise than as specifically described.

What is claimed is:
1. A drydock comprising:
   side and bottom walls means defining a ship basin open at least at one end;
   a caisson for closing said open end;
   said side and bottom wall means having defined therein a seat for said caisson, said seat being U-shaped in section and presenting first and second spaced, vertical surfaces for alternative sealing engagement by said caisson for sealing water in and out of said basin, respectively;
   hinge means pivotally connecting the lower portion of
said caisson to said wall means for swinging movement of said caisson between vertical and horizontal positions, said hinge means comprising cooperating pin and gudgeon means permitting limited horizontal and vertical movements of said caisson when in said vertical position, whereby said caisson may be moved horizontally between said spaced vertical surfaces of said seat, and may be moved vertically out of said seat to permit said swinging movements.

2. A drydock as defined in claim 1 and wherein said caisson comprises:

a plurality of floodable compartments; and

means for selectively flooding and emptying said compartments so as to effect said vertical and swinging movements of said caisson by adjusting the buoyancy thereof.

3. A drydock as defined in claim 1 and wherein:
said gudgeon means comprise at least one member having defined therein an inverted T-shaped slot in which movements of a hinge pin are confined.

4. A drydock as defined in claim 1 and further comprising:

sealing means for effecting a watertight seal between said caisson and said vertical surfaces;
said sealing means comprising resilient means for defining an enclosed zone between said caisson and at least one of said vertical surfaces; and

means for effecting a vacuum in said zone.

5. A drydock as defined in claim 4 and wherein:
said resilient means comprises sealing strip means carried on said caisson for engagement with said one of said vertical surfaces; and

said means for effecting a vacuum includes vacuum conduit means having openings through said one of said vertical surfaces.

6. A drydock as defined in claim 5 and wherein:
said bottom wall means has defined therein a trough just inboard of said one of said vertical surfaces; and

sump and pump means for collecting and expelling from said drydock water which finds its way into said trough.

7. A drydock as defined in claim 1 and wherein:
said side wall means comprises at least one wall defining therein at least one room having substantially the same floor level as the upper surface of said bottom wall means;
said wall structure having a first doorway defined therein for passage of personnel between said room and said basin when the latter is free of water; and

first watertight door means operative to close said doorway whereby said basin can be flooded without flooding said room.

8. A drydock as defined in claim 7 and wherein:
said one wall structure comprises a vertical trunk leading from the top of said structure into said room;
said trunk having defined therein a second doorway aligned with said first doorway;

second and third watertight door means for closing said second doorway;
said second and third door means being adapted to define an enclosed space therebetween; and

means for drawing a vacuum between said second and third door means.

9. A drydock as defined in claim 7 and wherein:
said drydock is a floating drydock;
said wall structure defines at least a second room at a level above said one room;
said second room being accessible from the top of said wall structure; and

said second room being floodable to assist in sinking said drydock to a desired depth.

10. A drydock comprising:

side and bottom wall means defining a floodable ship basin;
said side wall means comprising at least one wall structure defining therein at least one room having substantially the same floor level as the upper surface of said bottom wall means;
said wall structure having at least a first doorway defined therein for passage of personnel between said room and said basin when the latter is free of water; first watertight door means operative to close said doorway whereby said basin can be flooded without flooding said room;
said one wall structure comprising a vertical trunk leading from the top of said structure into said room; said trunk having defined therein a second doorway aligned with said first doorway;

second and third watertight door means for closing said second doorway;
said second and third door means being adapted to define an enclosed space therebetween; and

means for drawing a vacuum between said second and third door means.

11. A drydock as defined in claim 10 and wherein:
said drydock is a floating drydock;
said wall structure defines at least a second room at a level above said one room;
said second room being accessible from the top of said wall structure; and

said second room being floodable to assist in sinking said drydock to a desired depth.

References Cited

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MILTON BUCHLER, Primary Examiner.
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