July 14, 1959 C. J. FOSTER 2,894,472

FLOATING DRY DOCKS

Filed Jan. 9, 1957 2 Sheets-Sheet 1

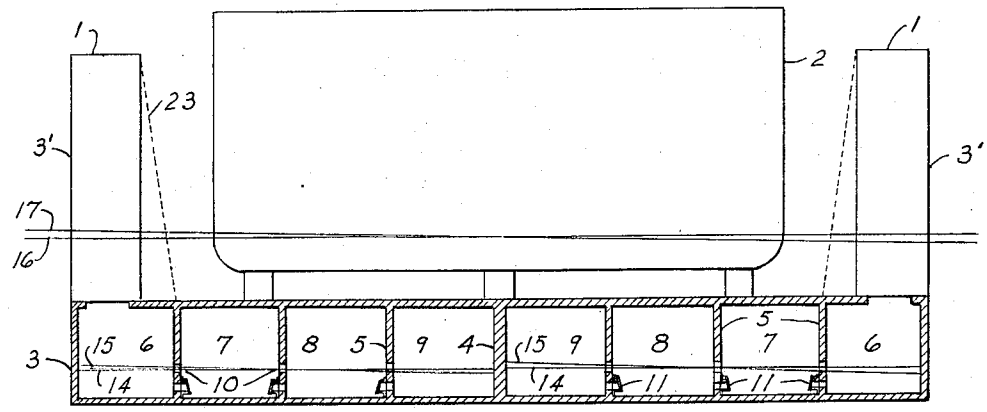


FIG. 1

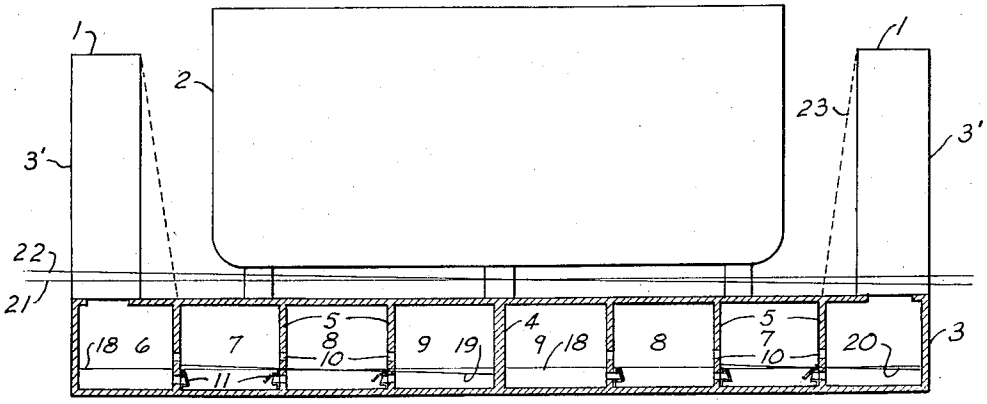


FIG. 2

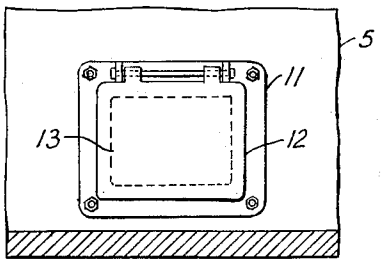


FIG. 3

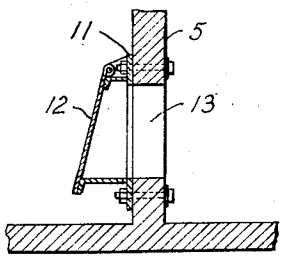


FIG. 4

WITNESSES

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FLOATING DRY DOCKS

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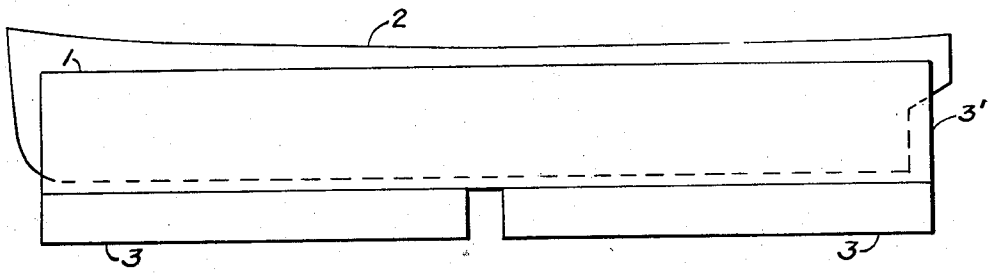


FIG. 5

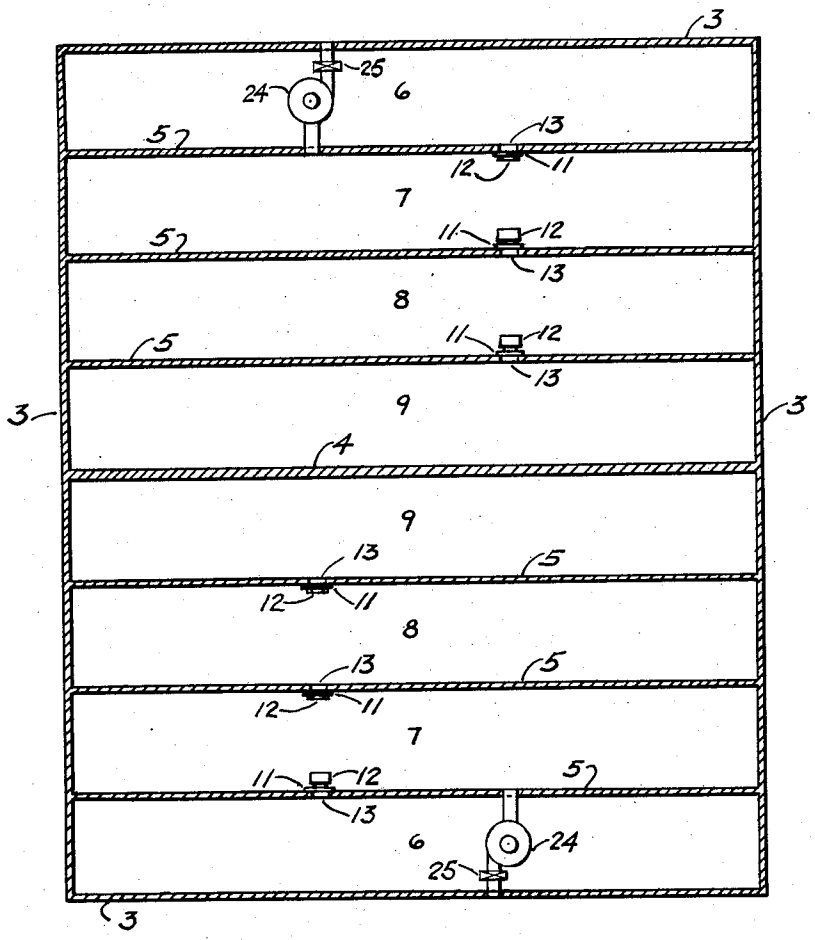


FIG. 6

WITNESSES

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FLOATING DRY DOCKS

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2 Claims. (Cl. 114—45)

My invention relates to an improvement in floating dry docks by increasing stability for larger lifts and is especially adapted for the reconditioning of floating dry docks to provide continuous steel wings to span a series of timber pontoons. Timber pontoons in a floating dry dock outlast the steel or timber wings thereof many times, and the wing walls must be renewed from time to time. As modern ships are built wider, a greater docking clearance is desirable but as the available slip widths often prohibit the use of a wider dock, an increase in dock clearance must be achieved without increasing the overall width of the dock.

As the wings in aforesaid docks are substantially wider at the bottom than at the top, where pumping machinery and ship handling paraphernalia are located, the problem resolves itself into retaining the top width throughout the entire wing height without reducing the stability at the critical interval when the ship has emerged from the water with the pontoon deck still under water and the dock and ship are relying for stability solely on the wings.

I have found that this is possible to do by utilizing the water tightness of the lower portion of the swash bulkheads in the timber pontoons to prevent the water flow in one direction while permitting the flow of the water in the opposite direction towards and into the swash compartment from which the water is being pumped during the critical interval.

I therefore provide a set of check valves at the bottom of the swash bulkheads with the communicating swash openings sufficiently elevated above the pontoon bottom to insure a substantial immersion of the ship bottom before the swash flow through the bulkhead openings ceases and the check valve control takes over. It is to be noted that in a conventional timber pontoon there are three swash bulkheads on each side of the watertight center bulkhead and I prefer to locate the check valves so that the water flows from the outermost swash compartment into the next one and the water from the two innermost compartments also empties into said compartment from which conventional pumping removes the water.

By such an arrangement, the width of the free water surface is reduced 50% on one side of the watertight center bulkhead and 25% on the other side thereof, and the total upsetting moment of the inside free water is cut to about one quarter of its original amount leaving the stability of the dock with the wider wing clearance equal to the original stability without change in the pump control of the dock.

It is to be noted that stability depends entirely upon the width of the interior contained water surfaces that are free to rise or fall vertically. Such interior contained water surfaces are conventionally characterized as free water surfaces.

The upsetting moment of a free rectangular water surface varies as the third power of its width, and therefore a pontoon, that comprises eight compartments of

substantially the same width *a* and with the valve setting as shown in Fig. 2, has one free water surface **19** extending through the three inner compartments on one side of the center bulkhead and one free water surface **20** extending through the two outer compartments on the other side.

The upsetting moments of the free water surfaces in the single compartments are very small and may be omitted as of no consequence. Thus the two free water surfaces **15**, extending through four compartments on each side of the center bulkhead, have been reduced 25% on the side where the free water surface **19** extends through three compartments, and 50° on the other side where the free water surface **20** extends through two compartments.

In the drawings Figure 1 is a cross section of the dock and ship, with the ship bottom substantially submerged and the check valve control inactive. Figure 2 shows the check valve control active with the ship out of water and the pontoon deck submerged. Figures 3 and 4 are detail drawings of my preferred check valve on an enlarged scale. Figure 5 is an elevation of a dry dock having two pontoons **3** spanned by continuous wing walls **3'**, and Figure 6 is a horizontal section through the lower portion of a pontoon with the pumping means connected to the compartments next to the side ones.

In the drawing where like reference characters denote corresponding parts **1** represents the dock in which the ship **2** is docked. The dock comprises a pontoon body **3** and two wing walls **3'** and it is at its center divided into two main pumping compartments by the watertight center bulkhead **4**. On each side of the center bulkhead are three swash bulkheads **5** which divide each main pumping compartment into four swash compartments **6**, **7**, **8** and **9** on each side of the center bulkhead. Each swash bulkhead is provided with a swash opening **10** located about four feet above the pontoon bottom. Each swash bulkhead is also provided at the bottom with a swing check valve **11** and the check valves are so located that the water flows into the swash compartment that is next to the outermost one on both sides of the dock.

The Figure 3 shows a face view of the swing check valve **11** and the Figure 4 is a cross section thereof. As indicated in the drawing, the swing disc **12** closes the passage **13** when the water pressure on the valve side of the bulkhead is higher than that on the other side.

Figure 1 shows the dock with the ship's bottom still substantially submerged and the inner water plane **14** is on the level with the bottom of the swash opening. The line **15** indicates the plane shift of the inside water at a slight list, and the outside water levels **16** and **17** indicate the outside water levels at a slight list.

Figure 2 shows the dock having raised the ship entirely out of water and the shifts in the inside water planes are indicated by the lines **18**, **19** and **20** while the outside water levels at the slight list are indicated by the lines **21** and **22**. Conventional centrifugal pulps **24** with shut off valve **25** are connected to the compartments **7**. It is to be noted that if the pumping were to proceed from the compartments **6**, the free water surface would extend through four compartments on one side of the bulkhead while on the other side the interior water surfaces would be contained in the individual compartments. As the upsetting moment of one free water surface that extends through four compartments is substantially 80% larger than the upsetting moments of the interior water with the pumping proceeding from the compartments **7**, the shown arrangement is to be preferred.

The action of my preferred check valve arrangement is as follows:

When docking a ship, pumping lowers the waterline

inside the pontoon and up to the time that the inside waterline reaches the bottom of the swash openings in the bulkheads, a list will cause the water line inside the pontoon on each side of the center bulkhead to conform with the list for the entire distance between the center bulkhead and the pontoon side.

For example the upsetting free water moment at a list of 1 in 100 in a dock 120 feet wide and 700 feet long equals $.3\times30\times40\times700/35$ or 7200 foot tons. As the wings of such a dock usually are 10 feet at the top and 15 feet at the bottom, the stability of the wings is reduced $.5\times5\times100\times700/35$ or 5000 foot tons. By using my invention, the inside upsetting moment of 7200 foot tons has been reduced to $.15\times15\times10\times20$ foot tons on one side of the dock and to $.225\times22.5\times10\times30$ foot tons on the other or 1970 foot tons in all which means a reduction of 5230 foot tons in the upsetting moment of the inside free water planes.

As the reduction in the stabilizing wing moment was in the order of 5000 foot tons, the stability is left unchanged although the ship docking clearance has been increased 10% while the original simple pump control is retained. The dotted lines **23** denote the wing outlines of the conventional dock.

It is now apparent that I have provided a dock that contributes an improvement on the prior art and I wish to be understood to claim such modifications that properly fall within the scope of my invention and the terms of the following claims.

I claim:

1. In a floating dry dock a pontoon, said pontoon having a centrally longitudinally extending watertight bulkhead, longitudinally extending swash bulkheads disposed on each side of said center bulkhead and spaced from the sides of the pontoon, said swash bulkheads having an unobstructed opening substantially elevated from the pontoon bottom, a non-return valve at the bottom of the swash bulkheads permitting flow of water in one direction only, and towards a compartment formed by the swash bulkheads from which compartment all water is withdrawn from the pontoon, substantially as described and for the purpose set forth.

2. In a floating drydock having a plurality of pontoons spanned at their ends by continuous wing walls, each pontoon having a centrally longitudinally-extending watertight bulkhead, longitudinally-extending swash bulkheads disposed on each side of said center bulkhead and spaced from the sides of the pontoon, said swash bulkheads having an unobstructed opening substantially elevated from the pontoon bottom, a non-return valve at the bottom of the swash bulkheads permitting the flow of water in one direction only towards a compartment from which compartment all water is withdrawn from the pontoon, substantially as described and for the purpose set forth.

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