SHIP FOR TRANSPORTING SLURRY ORE, COAL AND OIL

Inventor: Amos Baki, Santa Monica, Calif.


Filed: Nov. 10, 1971

Appl. No.: 197,439

U.S. Cl. 114/73, 114/74. R

Int. Cl. B63b 25/02, B63b 25/08

Field of Search 114/73, 72, 74, 75, 114/78, 220/22; 244/135 R

References Cited

UNITED STATES PATENTS

3,255,724 6/1966 Campbell et al. 114/73
1,699,709 1/1929 Osh 114/74 R
3,572,276 3/1971 Skaarup 114/73
3,399,645 9/1968 Dahan 114/74 R

ABSTRACT

A ship for the marine transportation of slurry ore, slurry coal and oil is equipped with an inner shell spaced within the hull and at least one cofferdam longitudinal bulkhead within the inner shell. In a preferred embodiment the cofferdam is a continuous longitudinal cofferdam dividing the cross section of the inner shell into a plurality of port and starboard smooth bulkhead cargo carrying tanks and a plurality of transverse bulkheads including a number of transverse cofferdam bulkheads divide the cargo space into a number of cargo carrying tanks. In the preferred embodiment a fluid cargo such as oil may be carried in tanks within the longitudinal cofferdam bulkhead and in port and starboard tanks between the inner shell and the hull of the ship.

1 Claim, 6 Drawing Figures

Primary Examiner—George E. A. Halvosa
Assistant Examiner—Edward J. Kazenske
Attorney—Alan C. Rose et al.
SHIP FOR TRANSPORTING SLURRY ORE, COAL AND OIL

BACKGROUND OF THE INVENTION

This invention pertains to the art of constructing ships adapted to carrying several different types of cargo such as slurry ore, slurry coal and oil. The multipurpose ships of the prior art are subject to several problems. One common type of ship used in the prior art has a cross section with a single center tank which may be used to transport either slurry or oil and has a pair of wing tanks, one on the port and one on the starboard side, for the transportation of oil. However, the center tank in this type of ship has insufficient volume for economic operation on certain trade routes and projected trade routes such as the coal trade from the eastern United States to the Far East. To increase volume by increasing the depth of the ship would tend to make the ship unstable.

A second type of ship of the prior art has a single hold and a double-shell. Such a hull cross section will provide sufficient volume for slurry, but the free surface effect of slurry coal or oil would render unstable a ship of adequate volume.

Also known in the prior art are ships having a double bottom, center and wing tanks for transporting oil. In ships of prior art wing tanks cannot be used for the transport of slurry because the required framing for longitudinal and local strength would obstruct the water jets required to reconstitute the slurry material. A ship of this type is illustrated in an article in the March 1970 issue of Shipping World and Shipbuilder entitled “Mobile Pegasus, Japanese Built Tanker With A Double Bottom,” beginning at page 400.

SUMMARY OF THE INVENTION

The ship system of the invention overcomes the above and other disadvantages of the prior art by providing a ship having an inner shell spaced within its hull forming cargo tanks and at least one longitudinal cofferdam bulkhead within the inner shell for providing ship strength and for reducing the free surface effect of cargo. The inner surfaces of the inner shell which are a portion of a cargo carrying tank, and the outer surfaces of cofferdam bulkhead are relatively smooth for facilitating the discharge of cargo such as slurry from the tank. Cargo is discharged from an aperture in the bottom of the tank into a discharge pipe running between the inner shell and the hull. In the preferred embodiment the cofferdam bulkhead is a continuous longitudinal bulkhead dividing the cargo space within the inner shell into at least a pair of tanks for carrying cargo and the space within the longitudinal cofferdam bulkhead and the space between vertical uprising sides of the inner shell and the hull are adapted to carry fluid cargo such as oil. Thus the longitudinal cofferdam bulkhead reduces the free surface effect of cargo by providing smooth wing tanks of smaller beam without reducing substantially the volume of the cargo space. The cofferdam bulkhead and double shell also facilitate the discharge of cargo because all projected structure is inside the double shell, the double bottom or the double cofferdam-type bulkhead. The ship of the invention may be constructed with a volume adequate for economic operation and with adequate strength and stability.

DESCRIPTION OF THE DRAWINGS

FIG. 1 is a half cross-section of the ship system of the invention. The cross-section is symmetrical. FIG. 2 is a perspective view of a portion of a midbody of a ship having a cross-section as shown in FIG. 1. FIG. 3 is a tank plan for a typical ship using the concepts of the invention. FIG. 4 is a profile view of the ship shown in FIG. 3. FIG. 5 is a cross-section of a sump for discharging both oil and slurry material. FIG. 6 is a perspective view showing a tank and sump.

DESCRIPTION OF THE PREFERRED EMBODIMENT

In FIG. 1 there is shown generally the ship system 10 of the present invention which comprises an outer hull 12, an inner shell 14 and a longitudinal cofferdam bulkhead 16. The outer hull and the inner shell are connected and structurally reinforced, both in the longitudinal and transverse directions, by conventional framing techniques. In addition, transverse cofferdam bulkheads are used in the manner discussed below. Longitudinal framing includes a plurality of longitudinal girders 18; longitudinal stiffeners 20 and horizontal webs 21. Located within the volume of hull 12 are three different types of tanks for carrying cargo. The longitudinal inner surfaces of a first tank 22 are formed by longitudinal plates in inner shell 14 and in cofferdam 16. For example, plates 14a, 14b, 14c, 14d, 14e of the inner shell and plates 16a, 16b and 16c of the cofferdam comprise the inner surfaces of tank 22a in FIG. 1. Deck 23 is shown in FIG. 1 as flush plating forming the top of the tanks. However, a hatch could be constructed between longitudinal girders 18a and 18b for loading and unloading dry cargo. The surfaces of these plates inside the tank are relatively smooth for facilitating the discharge of cargo from tank 22. Tank 22 may be utilized for carrying either slurry ore, slurry coal, or oil. To maintain the easy flow of slurry material from tank 22, all projected structure is located between hull 12 and inner shell 14 including the double bottom or is within longitudinal cofferdam bulkhead 16.
Longitudinal cofferdam bulkhead 16 contributes to ship strength of course, and also reduces the free surface effect of cargo carried in tank 22. In the preferred embodiment, bulkhead 16 is continuous and divides the volume within inner shell 14 into at least two symmetrical cargo tanks 22a and 22b. However, it would be possible to construct bulkhead 16 in a manner such that tank 22a would communicate with tank 22b to provide a single tank extending throughout the cross section of inner shell 14. In the preferred embodiment, bulkhead 16 is a centerline bulkhead. It would, of course, be feasible to employ more than one longitudinal cofferdam bulkhead.

The upper plates of inner shell 14 and of longitudinal cofferdam 16 are flared to further reduce the free surface effect of cargo in tanks 22 and to minimize the amount of material required in construction. For example, plate 14a, which forms a part of the inner surface of tank 22a, is flared inwardly from the vertical plane of upri...

4. dam 16. Referring to FIG. 1, the sides of tank 24 are formed by girder 18a, plates 16a, 16b, 16c, a portion of plate 14e, longitudinal girder 18b, plates 12a, 12b, 12c in hull 12, a longitudinal girder symmetrically spaced with respect to girder 18b (not shown), a portion of plate 14f in inner shell 14, plates 16d, 16e and 16f, and a longitudinal girder 18d (girder 18d is shown in FIG. 3). Tank 24 is adapted to carry oil and other fluid cargoes.

Although it would be possible to construct a single tank 24 running the length of the cargo-carrying space formed by inner shell 14 and cofferdam bulkhead 16, in the preferred embodiment each tank 24 is subdivided into several tanks by a transverse bulkhead in the manner shown in FIGS. 2, 3, and 4 and discussed below.

The space between hull 12 and inner shell 14 may be utilized to provide a third type of cargo-carrying tank 26. The sides of third tank 26 are formed by either the port or starboard upri...

5. dam. Plates forming the lower region of the sides of tanks 22 and 24 are beveled to minimize the amount of material required for construction and to facilitate the discharge of cargo from the tanks. For example, plate 14c is flared inwardly from the vertical plane of upri...

The discharge of cargo from tank 22 is facilitated by inclining the bottom plating of these tanks toward a discharge tunnel located between hull 12 and inner shell 14. In FIG. 1, inner bottom plates 14d and 14e have a straight pitch toward a longitudinal axis 28. In the preferred embodiment, axis 28 is located on the centerline of each tank 22. The inclination of the inner bottom of tanks 22 will facilitate a flow of slurry to sumps which are described below. Longitudinal axis 28 is preferably located at the centerline of a discharge tunnel formed by portions of hull 12 and inner shell 14, and by a pair of longitudinal girders 18. For example, in FIG. 1 the discharge tunnel is formed by longitudinal girder 18b, bottom plate 12f, longitudinal girder 18b, and portions of inner bottom plates 14d and 14e. At least one pipe 30 is used to discharge slurry and at least one pipe 32 is used to discharge oil. A typical means for discharging cargo from the tanks is shown in FIGS. 5 and 6 and is discussed below.

Consider now the transverse framing of the preferred embodiment of the invention as shown in FIGS. 2 and 3. Several types of transverse frames and bulkheads are utilized. These include a single transverse plane bulkhead; a transverse cofferdam bulkhead; and a transverse structure of the type shown in FIG. 1. Plane bulkhead 36a is a continuous plate which extends in a transverse direction from one side of hull 12 to the other. Plane bulkhead 36a is used singly to subdivide the cargo space within inner shell 14 into a plurality of tanks 22, 24, and 26. Plane bulkhead 36a is also used in combination with a pair of transverse plates 36b to
form a transverse cofferdam bulkhead. Transverse plate 36b has the shape of a cross section of tank 22a or 22b. Each transverse plate 36 forms the end wall for a pair of longitudinally adjacent tanks 24, for a pair of port tanks 26, for a pair of starboard tanks 26, and for one tank 22a and for one tank 22b. A pair of transverse plates 36b in the transverse cofferdam bulkhead form the end of walls of a pair of port and starboard tanks 22a and 22b. The surfaces of plane bulkhead 36a and transverse plate 36b which are surfaces inside a tank 22 are relatively smooth to facilitate the discharge of cargo. The space between inside a transverse cofferdam bulkhead may be utilized, for example, to provide ventilation and escape trunks to the discharge tunnel containing pipes 28 and 30.

Transverse structure 38 is used singly at predetermined locations between bulkheads to provide additional local strength. Transverse structure 38 has a number of apertures 40 for permitting a fluid such as oil to flow. The length of each tank is thus determined by the spacing between a pair of transverse plane bulkheads 36a or by the spacing of a pair of transverse plates 36b. Vertical flow of fluid in tanks 24 and 26 is permitted by the apertures in web 21.

A typical arrangement of cargo tanks 22, 24 and 26 is shown in FIGS. 3 and 4. A continuous cofferdam-type bulkhead 16 on the centerline, six cofferdam-type transverse bulkheads, two plane bulkheads and a continuous inclined double bottom divide the cargo space into sixteen tanks adapted to carry slurry material and oil; five center tanks 24 adapted to carry oil; and ten outboard tanks 26 adapted to carry oil. Of course, any of the tanks 22 may be used for ballast only. Each tank has an aperture 41 in its top for loading cargo and for access into the tank.

Referring now to FIGS. 5 and 6, there is shown a sump 56 for discharging cargo from each tank 22. Each tank 22 has at least one and preferably more than one such sump 56. Sump 56 comprises an aperture 58 in the bottom 22a, a grating 60 as shown in FIG. 2, an inclined bottom plate 62, and a retractable nozzle 64. Grating 60 has been omitted from FIGS. 5 and 6 to better illustrate the other components of sump 56. Retractable nozzle 64 comprises a housing 66, an extender tube 68 and a jet 70. Extender tube 68 is selectively elevated by hydraulic pressure from coupling 72 which is connected to the ship's hydraulic system (not shown). Nozzle 64 is connected to water pipe 54 to receive water for reconstituting slurry. The connection to the water pipe is not shown but is accomplished by conventional piping.

Inclined bottom 62 drains into a pipe on either side. Pipe 74 is connected to slurry pipe 30. Pipe 76 is connected to oil pipe 32. Discharge from a particular tank is controlled by a pair of valves 78 and 80 in pipes 74 and 76 respectively.

The ship system of the invention may be propelled with conventional machinery such as a cross-compound impulse/reaction steam turbine and double reduction lock-train gearing driving five-blade, nickel-aluminum-bronze, RH propeller. Because the ship is designed to spend a great majority of its sea time in loaded condition, a cylindrical bow is preferred as shown in FIGS. 3 and 4.

For cargo handling, the slurry pump room 42 is located forward of the cargo space and the oil pump room 44 is located aft of the cargo space. Slurry pump room 42 contains a pair of slurry pumps 46 for reslurry operation which may be piston-type, reciprocating pumps and a pair of centrifugal pumps 48 for unloading slurry. Oil pump room 42 contains four centrifugal, vertical, steam-driven cargo pumps 50 and one centrifugal, vertical, steam-driven pump 51 for ballast and two vertical, electric-driven striping pumps 52. Centrifugal pumps 48 are connected to slurry pipe 30 for unloading. (Connection not shown). Slurry pipe 30 is the main discharge line running through the discharge tunnel under the tanks. Pumps 50 are connected to oil pipe 32 which is a main discharge line for unloading oil threading through the discharge tunnel under the tanks (connection now shown). Pump 46 is supplied by water pipe 54 which also runs through the discharge tunnel for delivering water to slurry-reconstituting jets in each tank 22. The slurry-reconstituting jets and sumps for removing oil and slurry from each tank 22 are discussed below.

In operation of the ship system of the invention, cargo is loaded in each tank through an aperture 41 in its top. Either slurry ore, slurry coal or oil would be loaded in each tank 22. Only a fluid such as oil may be loaded in each tank 26 and 24. Loading is accomplished by conventional means such as cargo lines (not shown) and conventional deck machinery for handling cargo lines such as self-supporting derrick posts 58 with booms.

The unloading of oil from each tank 24 and 26 is accomplished in a conventional manner by using the oil pumps to selectively pump oil from each such tank into oil discharge pipe 32.

The unloading of oil from each tank 22 is accomplished by opening valve 80 for the tank to be unloaded while maintaining valve 78 closed. One or more pumps 50 may then be used to unload the oil in a conventional manner.

The unloading of slurry material from each tank 22 is accomplished by opening valve 78 while maintaining valve 80 in a closed position. In addition, extender tube 68 in retractable nozzle 64 is elevated by applying hydraulic pressure to housing 66 to coupling 72. Water is applied to jet 70 through pipe 54 for reconstituting the slurry. As the slurry is reconstituted, it drains into sump 62. Draining is assisted by the inclined bottom plate 14d and 14e. Sump 56 is drained by pipe 74 into slurry discharge pipe 30. Slurry pumps 46 apply water under pressure through pipe 54 and centrifugal pumps 48 are used for pumping reconstituted slurry through discharge pipe 30. Alternatively, slurry material in a dry state may be removed through a hatch (not shown) in deck 23.

I claim:

1. A ship system adapted for the marine transportation of slurry ore, coal and oil, including:
   a. a hull;
   b. an inner shell spaced within said hull;
   c. at least one longitudinal cofferdam bulkhead within said inner shell for providing ship strength and for reducing the free surface effect of cargo;
   d. a plurality of transverse bulkheads located at predetermined locations along the centerline axis, said longitudinal cofferdam bulkhead and said plurality of transverse bulkheads dividing a portion of the
volume within said hull into a plurality of tanks for carrying cargo, said plurality of tanks including a number of first tanks formed by said inner shell, said longitudinal cofferdam bulkhead and a pair of said plurality of transverse bulkheads, a number of second tanks each formed by a pair of said plurality of transverse bulkheads bounding a portion of the volume within said longitudinal cofferdam, and by a first set of longitudinal girders sealably disposed between lengths of said inner shells and said hull; a number of third tanks each formed by a pair of said transverse bulkheads bounding a portion of the space between said hull and said inner shell, and by a second set of longitudinal girders sealably disposed between the length of said inner shells and said hull, the inner surfaces forming each said first tank being relatively smooth to facilitate the discharge of cargo, each said second tank and each said third tank being adapted to carry a fluid, each said first, second and third tank having an aperture for discharging cargo; and e. means for discharging cargo from each said first, second and third tank located between said inner shell and said hull, and between said first and said second sets of longitudinal girders and adapted to selectively receive cargo from each said tank.

* * * * *