

Foldable Cargo Bags Deployable in Cargo Holds, and
Methods for Transporting Bulk Cargo

Related Application

- 5 [001] The present invention claims priority to Singapore patent application no. 10202400294U filed on 1 February 2024, the disclosure of which is incorporated in its entirety.

Field of Invention

- 10 [002] The present invention relates to foldable cargo bags for containing bulk cargo in cargo holds of ships, carriers, barges or similar cargo vessels; these bulk cargoes may be dry, flowable, granular materials or liquid. With use of foldable cargo bags, different types of bulk cargoes can be transported in one vessel without cross-contamination; in addition, these foldable bags reduce the need, cost or frequency for cleaning of the cargo holds after delivery
15 of bulk cargoes; these foldable bags also help to minimize occurrence of empty cargo holds when transporting goods.

Background

- [003] Bulk cargoes are usually transported by bulk carriers via water transportation means;
20 such bulk cargoes are flowable and may be dry, liquid or granular cargoes. Examples of dry bulk cargoes may be mineral ores, cement, sand, raw materials or manufactured products in powder or pellet form, and so on; examples of liquid cargoes may be water, fuel oils, crude oils, chemicals, and so on. An example of granular cargo may be grains. Conventionally, these bulk carriers are specifically built for dedicated transportation depending on the types
25 of cargoes. An issue for bulk cargo transportation is cross contamination; for example, dry bulk carriers for transporting mineral ores do not carry granular cargo of grains, or dry bulk carriers do not carry liquid bulk cargoes. As a result, some trips of these dedicated bulk carriers are often empty after making port calls. This problem is also compounded when the sea ports are equipped to handle specific types of cargoes, such as for bulk dry cargoes, and
30 other sea ports are equipped to handle food grains.

[004] In another example, the decks of conventional liquid bulk carriers are occupied by pipelines and flow controls to handle a specific type of liquid bulk; it is too costly to clean a

liquid bulk carrier to transport another type of liquid cargo to overcome cross contaminations; the decks of these liquid bulk carriers are also not suitable to transport other types of cargoes or shipping containers. In another example, container carriers are only dedicated to transport shipping containers. In other words, the cargo holds of these conventional and cargo-dedicated vessels are not fully utilized for transporting goods.

[005] In an attempt to solve cargo cross-contamination issue, JP2021109490, by Shin Kurushima Dockyard Co. Ltd., discloses a cargo bag that is inscribed into a cargo hold of a bulk carrier; when loading powdery or granular cargo, it is possible to reduce dirt such as residue adhering to the inner walls of the cargo hold after cargo handling or to prevent mechanical damage to the hull. The cargo hold inner bag is provided for collecting the remaining cargo by pulling the bag outboard after cargo handling without having to sweep out the bulk cargo that has accumulated in a narrow part of the cargo hold.

[006] From the above, it can thus be seen that there still exists a need to provide foldable cargo bags that are deployable in cargo holds, to allow bulk cargo vessels or barges to transport multiple types of bulk cargoes in attempts to maximise capacities of cargo holds; at the same time, this invention attempts to reduce cross contaminations, to reduce costs or frequencies of cleaning the cargo holds or to minimize occurrence of an empty cargo hold during cargo delivery.

Summary

[007] The following presents a simplified summary to provide a basic understanding of the present invention. This summary is not an extensive overview of the present invention, and is not intended to identify key features of the invention. Rather, it is to present some of the inventive concepts of this invention in a generalised form as a prelude to the detailed description that is to follow.

[008] The present invention seeks to provide foldable cargo bags to allow cargo vessels to transport bulk cargoes; these foldable cargo bags can be deployed in cargo holds to contain different types of cargoes; with these foldable cargo bags, cross-contaminations are prevented, and cleaning of the cargo holds may be reduced in frequency, leading to cost savings; in addition, the use of these foldable cargo bags contributes to eliminating trips with empty cargo holds after deliveries at some ports as there is no longer any contamination

issue; therefore, with no cleaning required in the cargo hold, the turn-around time at a port-of-call is short.

[009] In one embodiment, the present invention provides a foldable cargo bag for disposing
5 inside a cargo hold of a cargo vessel, the foldable cargo bag comprising: an open-top cargo bag, with side fold lines being formed at sidewalls of the foldable cargo bag and bottom fold lines formed at a bottom of the foldable cargo bag; wherein both the side and the bottom fold lines allow opening of the foldable cargo bag to line walls and a bottom of the cargo hold when the foldable cargo bag is filled, so that the side fold lines and the bottom fold lines
10 facilitate folding or closing of the foldable cargo bag.

[0010] Preferably, the material of the cargo bag is moisture-impermeable, ultra-violet light resistant and tear-resistant thermoplastic. Also preferably, reinforcement members are provided for bonding along the side fold lines and the bottom fold lines to provide
15 reinforcement strength.

[0011] Preferably, a tiltable segmented base plate is provided to support the bottom of the foldable cargo bag. It is also possible that the tiltable segmented base plate is bonded on the bottom of the foldable cargo bag.

20 [0012] Preferably, the bottom of the cargo bag is open but the open bottom edges of the foldable cargo bag are bonded to a tiltable segmented base plate or a tiltable segmented gate valve plate; with the tiltable segmented gate valve plate, selective opening of gate valves located on the gate valve plate allows controllable discharge of the bulk cargo from the
25 foldable cargo bag onto a conveyor located beneath the foldable cargo bag.

[0013] Preferably, rings or grommets are provided along a bottom edge of the foldable cargo bag, tiltable segmented base plate or tiltable segmented gate valve plate for deploying a foldable cargo bag into the cargo hold or for partially hoisting up a bottom edge of the
30 foldable cargo bag or an edge of the tiltable segmented base plate/gate valve plate to accumulate residual bulk cargo at the bottom of the foldable cargo bag or on the tiltable segmented base plate/gate valve plate, thereby allowing cleaner discharging of any bulk cargo near an end of a cargo discharging operation.

[0014] Preferably, connecting members attached along a mouth edge of the cargo bag are provided to suspend the cargo bag for opening, folding or stowing away the foldable cargo bag.

5 [0015] In another embodiment, the present invention provides cargo hold located in a cargo vessel; the cargo hold comprising: a foldable cargo bag made according to the present invention; a pair of spaced apart guide rails located along top edges of the cargo hold at a side thereof to support roller assemblies, to which two sides of the cargo bag are suspended therefrom; and a pair of spaced apart support rails located along an adjacent top edges of the
10 cargo hold to suspend two other opposite sides of the cargo bag, with ends of one support rail or both pairs of the spaced apart support rails being suspended from the pair of spaced apart guide rails by roller assemblies and link members; wherein the roller assemblies are slidable inside the pair of spaced apart guide rails to move the support rail or the pair of spaced support rails, thereby to unfold, to fold or to stow away the foldable cargo bag.

15 [0016] Preferably, the cargo hold further comprises a pair of pivot bar assembly, each pair of pivot bar assembly being formed by two pivot bars and a pivot joining the two pivot bars, and a terminal pivot located at each of two ends of the pivot bar assembly that is connected to a respective end of each of the pair of spaced apart support rails, such that connect
20 members disposed along mouth edges of the cargo bag suspend the cargo bag from the pivot bars and the pair of spaced apart support rails, and roller assemblies are slidable inside the spaced apart guide rails to move the pair of spaced apart support rails, and at the same time, to move and rotate the pivot bars connected to the respective ends of the support rails, thereby allowing the foldable cargo bag to unfold, fold or stow away.

25 [0017] In an embodiment, the pivot bar assembly further comprises an intermediate pivot bar and a pivot at each of two ends of the intermediate pivot bar. In another embodiment, the cargo hold comprises a plurality of pivot bar assemblies. The intermediate pivot bar or plurality of pivot bar assemblies create additional or multiple fold lines at a respective side
30 of the foldable cargo bag.

[0018] Preferably, the cargo hold further comprises a gear-motor-pulley assembly, an idler-pulley assembly and an endless wire rope supported between the pulleys located in the motor-pulley and idler-pulley assemblies, so that the endless wire rope is located inside the
35 pair of spaced apart guide rails, and the wire rope is operable to pull the roller assemblies,

thereby to move the pair of spaced apart support rails, and at the same time, to move and to turn the pivot bars, with the pivots and the terminal pivots providing relative rotations, for the cargo bag to unfold, to fold or to close/collapse or to stow away a closed/collapsed cargo bag to a side of the cargo hold.

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[0019] Preferably, after the foldable cargo bag is emptied of its cargo and is stowed to a side of the cargo hold, shipping containers are located inside the cargo hold, with the shipping containers being stacked up and secured by lashing, for transporting the shipping containers inside the cargo hold.

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[0020] In another embodiment, the present invention provides a method for transporting bulk cargo in a cargo hold, the method comprises: deploying a cargo bag in a cargo hold of a vessel; unfolding or opening the cargo bag; filling the cargo bag with bulk cargo at a port-of-call, so that sidewalls of the cargo hold support sidewalls of the cargo bag and a bottom surface of the cargo hold supports a bottom of the cargo bag, so that the cargo bag prevents direct contamination of the cargo hold; discharging the bulk cargo at a destination port-of-call; if necessary, lifting or tilting a bottom edge of the cargo bag or a bottom edge of a tiltable segmented plate supporting a bottom of the cargo bag to accumulate residual bulk cargo at the bottom of the cargo bag or to a centre of the tiltable segmented plate to allow cleaner emptying or discharging of the bulk cargo; folding and stowing away the emptied cargo bag to a side of the cargo hold; and repeat, where necessary, unfolding or opening of the cargo bag, filling the cargo bag at a port-of-call, discharging the cargo bag at a destination port-of-call, and tilting a bottom edge of the cargo bag or a bottom edge of the tiltable segmented plate to allow cleaner discharging of the bulk cargo; wherein the cargo bag prevents direct contamination of the cargo hold by the bulk cargo, thereby allowing the cargo hold to contain cargo without cross-contamination and thus reducing frequency of cleaning the cargo hold or reducing occurrence of an empty cargo hold during any transporting trip.

[0021] In yet another embodiment, the present invention provides a method for transporting bulk cargo in a cargo hold, the method comprising: deploying a cargo bag in the cargo hold of a vessel; unfolding or opening of the cargo bag; filling the cargo bag with bulk cargo at a port-of-call, so that sidewalls of the cargo hold support sidewalls of the cargo bag, a bottom surface of the cargo hold supports a tiltable segmented base plate disposed at the bottom of the cargo bag, with the tiltable segmented base plate being equipped with gate valves, so that

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the cargo bag prevents direct contamination of the cargo hold; discharging the bulk cargo at a destination port-of-call, by selectively opening the gate valves to discharge the bulk cargo onto a conveyor located in the hull below the cargo bag; and if necessary, tilting the tiltable segmented base plate to accumulate residual bulk cargo at the gate valves to enable cleaner emptying or discharging of the bulk cargo; folding and stowing away the emptied cargo bag to a side of the cargo hold; and repeat, where necessary, unfolding or opening of the cargo bag, filling the cargo bag at a port of call, discharging the cargo bag at a destination port of call, and tilting the tiltable segmented base plate to accumulate residual bulk cargo at the gate valves to allow cleaner discharging of the bulk cargo; wherein the cargo bag prevents direct contamination of the cargo hold by the bulk cargo, thereby allowing the cargo hold to contain cargo without cross-contamination and thus reducing frequency of cleaning of the cargo hold or reducing occurrence of an empty cargo hold during any transporting trip as there is no contamination and discharging issue.

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Brief Description of the Drawings

[0022] This invention will be described by way of non-limiting embodiments of the present invention, with reference to the accompanying drawings, in which:

20 [0023] FIG. 1 illustrates a cargo vessel equipped with foldable cargo bags disposed inside the cargo holds according to an embodiment of the present invention;

[0024] FIG. 2 illustrates a simplified section view of the above cargo hold equipped with a cargo bag;

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[0025] FIG. 3 illustrates a simplified plan view of the above cargo hold showing gear-motor-pulley assemblies installed through a deck of the vessel and operable to pull open or to close the cargo bag;

30 [0026] FIGs. 4-5 illustrate 2 stages of folding of the above cargo bag according to one embodiment; whilst FIG. 6 illustrates complete folding of the cargo bag, and FIG. 7 illustrates moving or stowing a folded cargo bag towards a lateral side of the cargo hold;

[0027] FIG. 8 illustrates two cargo bags being deployed inside a cargo hold, so that one cargo bag can be selected and deployed for use;

[0028] FIGs. 9-10 illustrate cargo bags formed with fold lines and reinforced members;

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[0029] FIGs. 11-12 illustrate 2 stages of packing or folding of a cargo bag according to another embodiment;

10 [0030] FIG. 13 illustrates the above cargo bag being equipped with a base-plate support according to another embodiment;

[0031] FIG. 14 illustrates a cargo bag being equipped with a base-plate bonded to form a closed bottom according to another embodiment; FIG. 15 illustrates the base-plate shown in FIG. 14;

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[0032] FIG. 16 illustrates a base-plate provided with gate valves according to another embodiment;

20 [0033] FIG. 17 illustrates an elevation view of the cargo bag in connection with a support rail and a guide rail; whilst FIG. 18 illustrates a plan view of the cargo bag suspended at the support rail and the guide rail, and FIG. 19 illustrates an elevation view of the cargo bag in connection with pivot rails and the guide rails;

25 [0034] FIG. 20 illustrates sides of the above cargo bag are foldable with multiple creases or multiple vertical fold lines;

[0035] FIGs. 21-22 illustrate connecting members for suspending upper edges of the above cargo bag to the support rails and the pivot rails disposed along top edges of a cargo hold;

30 [0036] FIG. 23 illustrates a barge for use with the cargo bag shown in FIG. 25;

[0037] FIG. 24 illustrates another barge for use with the cargo bag shown in FIG. 25; FIG. 25 illustrates a cargo bag equipped with gate valves, whilst FIGs. 26-28 illustrate stages of closing of the cargo bag; and

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[0038] FIG. 29 illustrates a flat-top barge equipped with the cargo bag shown in FIG. 25.

Detailed Description

[0039] One or more specific and alternative embodiments of the present invention will now be described with reference to the attached drawings. It shall be apparent to one skilled in the art, however, that this invention may be practised without such specific details. Some of the details may not be described at length so as not to obscure the invention. For ease of reference, common reference numerals or series of numerals will be used throughout the figures when referring to the same or similar features common to the figures.

[0040] FIG. 1 shows a bulk cargo vessel **100** being equipped with a foldable cargo bag **101** which is deployed inside a respective cargo hold **14** according to the present invention. Generally, a cargo hold **14** may be in the range of substantially 10-30m in length, width or height, or more depending to a size of the cargo vessel. It is possible that each cargo hold **14** is equipped with one or two foldable cargo bags **101**, giving a choice of one foldable cargo bag being put to use one at a time, for example, for a particular type of cargo to avoid cross-contamination; the cargo bag is generally parallelepiped when it is opened up and is formed of a thin thermoplastic membrane of substantially 0.3 to 2 mm thick; preferably, a top of the cargo bag **101** is open. When the cargo bag **101** is empty, it can be folded and stowed away, preferably at a lateral side of the cargo hold, that is, at the port side or starboard side, or to a longitudinal side. The bulk cargo is flowable and may be dry, granular or liquid. The method of unloading the bulk cargoes depends on facilities provided at the port-of-call; for example, a screw conveyor connected to a suction nozzle and a suction duct may be inserted into the cargo bag to discharge dry or granular bulk cargo; alternatively, a suction nozzle and suction duct may be deployed to discharge liquid bulk cargo from each cargo hold **14**; alternatively, clam grabbers may be used to unload dry bulk cargo, such as, mineral ores onto onshore belt conveyors; in yet another embodiment, a bottom of the cargo bag is equipped with gate valves that allow bulk cargo to discharge onto a belt conveyor provided below the cargo bags. In yet another embodiment (but not illustrated), a liquid pump system can also be used for unloading liquid cargo, such as water or fuel oil, for example; the bottom of the cargo bag is provided with an opening that sealingly discharges the liquid cargo through a valve into a pipeline that is located in the hull, below the cargo bag, to a cargo pump located at a stern, with the cargo pump being operated to deliver the fluid cargo to an onshore facility. As seen in FIG. 1, each cargo hold **14** has a hatch opening, which is covered by an associated hatch cover **16**; preferably, an onboard crane **12** is provided on a deck **11** to serve each associated cargo hold **14**. If the cargo vessel **100** is not equipped with hatch covers,

removeable weather covers may be draped over the cargo holds to protect the cargo from the weather elements.

[0041] In one embodiment, the cargo bag **101** may be made of polyvinyl, PVC, polyurethane, polyethylene, polypropylene, polyamide, or similar thermoplastic membrane. Preferably, the material of the cargo bag is moisture or gas impermeable, ultra-violet (UV) light resistant and tear resistant. Preferably, the cargo bag **101** material is formed with a membrane thickness of substantially 0.3 to 2 mm, but the thickness or materials are not so restrictive. Preferably, the cargo bag **101** is formed by coating or laminating a woven fabric (such as, synthetic fibres including polyester, nylon, polypropylene, etc.; natural fibres such as cotton, and so on) with such thermoplastic. Such cargo bag membranes form reinforced layered membranes similar to those marine grade thermoplastic membranes in used as covers or tarpaulin on ships. It is also possible that the cargo bag is configured by inserting two cargo bags in a bag-in-bag arrangement, or a polymer bag is inserted inside a fabric bag in another bag-in-bag arrangement where the fabric bag may provide additional strength.

[0042] FIG. 2 shows a simplified sectional view of a cargo hold **14** according to one embodiment. As seen from FIG. 2, a cargo bag **101** is deployed inside a cargo hold **14**, with a bottom **102** of the cargo bag being supported by a bottom **15** of the cargo hold **14** and sidewalls of the cargo bag are being supported by the sides of the cargo hold; the cargo bag **101** is of an open-top or open-mouth configuration according to one embodiment. In one embodiment, an upper part of the cargo bag is suspended with two spaced apart guide rails **120** and two spaced apart support rails **160**, for eg., being suspended from a recessed ceiling of the cargo hold. The support rails **160** are suspended below of the guide rails **120** by roller assemblies **130** and link member **135**; this arrangement will become clearer after FIGs. 17-19 are described. Preferably, the guide rails **120** are transversely arranged in a y-direction, whilst the support rails **160** are longitudinally arranged in a x-direction; in this arrangement, the cargo bag **101** can be moved and stowed away to a lateral side (ie. towards the port or starboard side) of the cargo hold **14**; if the guide rails **120** are arranged along the longitudinal x-direction, then the cargo bag **101** is foldable and movable for stowing away to a longitudinal side of the cargo hold. Above the cargo bag **101** at the recessed ceiling of the cargo hold **14**, there are also provided some hoists **112**; each hoist **112** is equipped with a wire rope or chain and a hook **113**. In an alternative embodiment, the hoists **112** are suspended on the lateral sidewalls of the cargo hold **14** and/or from the support rails **160**.

The hoists **112** and hooks **113** are provided to partially hoist up a bottom edge of the cargo bag by hooking onto rings or grommets **106** (as seen in FIG. 4) located along bottom edges of the cargo bag **101**. When a bottom edge of the cargo bag **101** is partially raised and become tilted, residual bulk cargo in the cargo bag is made to flow and to accumulate at the bottom of the cargo bag, so that a cleaner discharge of the cargo can be carried out. The guide rails **120** and the support rails **160** are provided to facilitate folding and collapsing of the cargo bag **101**, and the rails functions are clearer after FIGs. 17-19 are described. These rings/grommets **106** can also be used for initial deployment of the cargo bag **101** into a cargo hold **14**.

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[0043] FIG. 3 schematically shows assemblies of a gear-motor **140** and an idler **141** which are installed on the deck **11** for pulling open or close a cargo bag **101**; the gear-motor **140** is located on one lateral side of the cargo hold **14**, whilst the idler **141** is located on an opposite lateral side. The gear-motor **140** and the idler **141** extend down into an associated cargo hold **14** so that the gear-motor **140** drives a pulley or sprocket **142** located near the top of the cargo hold, whilst the idler **141** supports another pulley or sprocket **142**; an endless wire rope or chain **145** is supported between the two pulleys/sprockets **142**, and the wire rope/chain **145** runs inside the associated guide rails **120**. Member **146** is used to connect the wire rope/chain to a roller assembly **130** that is moveable inside the guide rail **120**. Preferably, the gear-motor **140** is configured by an electric motor and a gear reducer; when the gear-motor **140** is operated, the wire rope/chain **145** pulls onto a roller assembly **130** to open up the mouth of the cargo bag **101** or the roller assembly **130** is pulled in a reverse direction to close the cargo bag; when one lateral side of the cargo bag **101** is fixed, and after the cargo bag **101** is closed and collapsed, it is also moved along the guide rails **120** and be stowed away to a lateral side of the cargo hold **14**. In another arrangement, when the roller assemblies **130** at opposite ends of the cargo bag **101** are connected to opposite portions of the endless wire rope/chain **145**, then the cargo bag is configured to open or to close near the centre of the cargo hold **14**. It is even possible to provide two sets of gear-motors, idlers and endless wire-ropes, for example on opposite lateral sides of the cargo hold **14**, so that the cargo bag **101** can be operated to close or collapse and then be stowed away to either side of the cargo hold **14**. The opening, closing or stowing away of the cargo bag **101** will be clearer after FIGs. 17-20 are described.

[0044] FIG. 4 shows the cargo bag **101**, according to one embodiment, for deploying inside a cargo hold **14**, whilst FIGs. 5-6 show two stages of folding of the cargo bag **101** in the cargo hold **14**, whilst FIG. 7 shows the support rails **160** when the cargo bag **101** has been closed and stowed to a lateral side (but the cargo bag is not shown). FIGs. 5-6 show simplified illustrations of the cargo bag **101** with one vertical folding along 3 vertical fold lines **108** formed at each opposite lateral sides. As seen in FIGs. 4-7, the cargo bag **101** is suspended from pivot bars **122** which are hinged at pivot **123** with roller assemblies **130** disposed inside the guide rails **120**, in addition to the cargo bag being suspended from the support rails **160**; in one embodiment, terminal pivots **125** allow relative rotation at the pivot bars **122** and the support rail **160**. The connections at the terminal pivots **125**, the pivot bar **122**, the roller assemblies **130**, the guide rails **120** and the support rails **160** will be described in further details with reference to FIGs. 17-20. Preferably, each of the pivot **123** is provided with a torsion spring **124** which urges the pivot bars **122** to hinge in a closing rotation; the torsion springs **124** thus help in the closing direction of the pivots **123** and these hinge-torsion spring mechanisms contribute to folding of the cargo bag **101** when it is being pulled along the guide rails **120** for it to fold and be compacted for stowing away to a lateral side, as shown in FIG. 7.

[0045] As described above, it is possible to locate two cargo bags **101** in a cargo hold **14**; this is illustrated in FIG. 8. The cargo bags **101** can be used to contain similar or different types of bulk cargoes to avoid cross-contamination; one cargo bag is used at a time; for eg., the first cargo bag is used to carry dry cargo, such as grains, and after the grains have been discharged, the cargo bag is folded and stowed away to a side of the cargo hold and the second cargo bag is then deployed for carrying another cargo, for eg. fuel oil during a return or another forward trip; after the second cargo has been discharged, the second cargo bag is folded and stowed away to a side of the cargo hold, after which the first cargo bag can be deployed again for carrying another dry cargo. Thus, with the cargo bags of the present invention, there is no need to wait for cleaning of the cargo holds between deliveries; in addition, all the cargo holds are utilized to carry cargo and there is no need to ballast seawater in or out; when there are any empty cargo holds, ballasting is required to maintain stability of the cargo vessels during their journeys.

[0046] In FIGs. 4-6, the bottom **102** of the cargo bag **101** is made of the same material as the material at the sidewalls; in other words, the bottom **102** is flexible, and when the bottom is

folded along creases or fold lines **110**, with edges of the bottom **102** being folded upward, as seen in FIGs. 5-6. FIG. 9 shows a cargo bag **101a** according to a variation of the above cargo bag. As shown in FIG. 9, the cargo bag **101a** is similar to the above cargo bag **101** except that the vertical fold lines **108** are now strengthened with reinforcement members **180**. The

5 reinforcement members **180** strengthen the vertical fold lines **108** and the folding edges of the cargo bag **101a**; these reinforcement members **180**, preferably made of the same material of the cargo bag, are bonded to the cargo bag **101a**, for eg., by means of an adhesive or heat bonding. In another variation, the reinforcement members **180** are made of adhesive sealing tapes, preferably of a marine grade. It is also possible that the bottom of the cargo bag is

10 lined with a base plate **170**. Later description will elucidate uses of the base plate **170** and its variations.

[0047] FIGs. 10-12 show a cargo bag **101b** according to a variation of the above cargo bag; the cargo bag **101b** also has a flexible bottom **102**, but the entire bottom **102** of the cargo

15 bag **101b** is configured to be flipped up to a lateral side of the cargo hold **14** during folding of the cargo bag; this can be performed, for eg., by hooking onto the rings or grommets **106** located at the bottom edge and hoisting an edge of the cargo bag **101b** with the hoists **112**, so that the cargo bag **101b** is folded near its bottom along some fold lines **109**. As in the above embodiment, the edges of the cargo bag **101b** around the bottom **102** are also

20 strengthened with the reinforcement members **180**, as seen in FIG. 10 (but the reinforcement members are not shown in FIGs. 11-12). By tilting and hoisting a bottom edge of the cargo bag **101b**, any residual bulk cargo, such as a flowable or liquid cargo, is made to flow and to accumulate at the bottom of the cargo bag to facilitate cleaner discharging of the bulk cargo.

25 [0048] In another variation, FIG. 13 shows the above cargo bag **101** is provided with the base plate **170** to support the bottom **102** of the cargo bag **101**. The base plate **170** is segmented and adjacent segments are hinged or pivoted, so that the segmented base plate **170** cooperates with the folding of the bottom **102** of the cargo bag **101, 101a**, at least to concentrate residual bulk cargo inside the cargo bag to facilitate cleaner discharging. After the bulk cargo has

30 been discharged, the segmented base plate **170** is lowered onto the bottom **15** of the cargo hold **14**. After the cargo bag is folded and stowed to a side, container mounting rails can be installed at the lateral sidewalls of the cargo hold **14** (according to IMO practice) to which shipping containers can be secured thereto and the shipping containers be mounted and stacked up inside the cargo hold. In another embodiment, such as in coastal or riverine

transport, shipping containers are located inside the cargo holds; these shipping containers are stacked-up and secured by lashing. In yet another embodiment, it is possible that the base plate 170 is configured like a base plate 170a, as shown in FIG. 15.

5 [0049] In another variation, FIG. 14 shows the above cargo bag 101a is provided with the base plate 170a bonded onto the bottom 102 of the cargo bag 101a. As an example, the base plate 170a is bonded onto the bottom 102 of the cargo bag by means of an adhesive, heat sealed and/or bonded thereon with a sealing material and metal strips. In one embodiment, the base plate 170a is segmented and adjacent segments are pivoted or hinged along joints
10 171 to allow folding of the cargo bag 101,101a. In another embodiment, the base plate 170a is segmented and a gap is present in between adjacent segments; in another variation, along these gaps, adhesive sealing tapes, preferably of a marine grade, are used to strengthen the bag material located along the joints 171 and to prevent powdery residue from the bulk cargo from accumulating below the base plate 170a. FIG. 15 illustrates the segmented base plate
15 170a for use with the cargo bag 101,101a.

[0050] In yet another embodiment, a cargo bag 101c is equipped with a gate valve plate 170c. The cargo bag 101c is formed with a cargo bag without a bottom (ie. in the form of a sleeve), and bottom edges of the sleeve are bonded around a peripheral edge of the gate valve plate
20 170c. FIG. 16 illustrates the gate valve plate 170c (without showing the cargo bag 101c). As shown in FIG. 16, the gate valve plate 170c is formed with segmented and pivoted plates, with a centre segment 172 being equipped with a series of gate valves 177. Preferably, the gate valves 177 are arranged in a row along the centre segment 172; each gate valve 177 is actuated by a fluid or electric actuator to operate between a closed position and an open
25 position. Preferably, the fluid or electric actuator is located below the respective gate valve 177. In use, where the cargo holds 14 are equipped with a screw or belt conveyor (for eg., as illustrated in FIGs. 23-24) extending along the bottom 15 of the cargo holds and along the length of the hull; selective actuation of the gate valves 177 allow bulk cargo from selected cargo holds 14 to be controllably discharged by the screw or belt conveyor to a shore facility.
30 With the cargo bag 101c of the present invention, bulk cargo can be shipped without contaminating the cargo holds 14; the cargo bag 101c also contributes to minimizing cleaning of the cargo holds 14 after delivering some shipments.

[0051] The above base plates **170,170a** and gate valve plate **170c** are made of pivoted or hinged segments; when the base plates **170,170a** and the gate valve plate **170c** are partially raised around a peripheral edge or by partially lifting the associated bottom edges of the cargo bag **101,101b,101c**, the segments become inclined/tilted and residual bulk cargo on the base plate or gate valve plate is made to flow and to accumulates along the centre segment **172** or at the gate valves **177**, thereby allowing cleaner discharging of the bulk cargo. In one embodiment, the base plates **170,170a** and gate valve plates **170c** are made of segments of hinged metal plates, such as, steel or aluminium, of substantially 1 to 5 mm thick with or without reinforcement members. Sealing tapes of marine grade can also be applied along the hinged joints, to strengthen the joints along the segments or to minimize residual powders from the bulk cargo to accumulate below the base plate **170,170a** or gate valve plate **170c**.

[0052] FIG. 17 shows partial sectional views AA and BB in FIG. 18 of the above guide rails **120** and support rails **160**. In one embodiment, the support rails **160** are longitudinally aligned and suspended below the guide rails **120**. Preferably, the guide rails **120** are hollow and each has an open slot **121** formed along the length of the guide rail, and the support rails **160** are suspended from the guide rails **120** by the link members **135**; the link members **135** are in turn connected to the roller assemblies **130**. In one embodiment, the roller assemblies **130** are disposed and slidable inside the guide rail **120** to open, close or stow away of the cargo bag, whereas connect members **105** extending from an adjacent mouth edge of the cargo bag **101,101a-101c** connect to an underside of the support rails **160**, as seen in FIGs. 17 and 22.

[0053] FIG. 18 shows a partial plan view at the guide rails **120** and the support rails **160**. In this example embodiment, the terminal ends of the support rails **160** are suspended below the roller assemblies **130** via the link members **135**, and the terminal pivot **125** located at each of the two ends of the support rails **160** allow relative rotation thereof; this is more clearly shown in FIG. 19.

[0054] FIG. 19 shows a part sectional view along the guide rail **120**. FIG. 19 is simplified to illustrate two pivot bars **122** are hinged at a pivot **123** to form a pivot bar assembly; each of two ends of the pivot bar assembly is hinged at a terminal pivot **125** to a respective end of the support rail **160**, with the pivot **123** and the terminal pivots **125** allowing relative rotations; thus, the connect members **105** suspended from the pivot bars **122** suspend the

mouth edges of the cargo bag **101,101a-101c** whilst connect members **105** at the support rails **160** suspend the adjacent mouth edges of the cargo bag inside the cargo hold. The endless wire rope or chain **145** runs inside the guide rails **120**, so that by operating the gear-motor **140** and the pulleys **142**, the wire rope/chain **145** pulls on the roller assemblies **130** to
5 slide inside the guide rails **120**; sliding motion of the roller assemblies **130** pulls on the support rails **160**, the pivot bar assembly and the terminal pivots **125**, so that the pivot bars **122** move and rotate, to close or to open the mouth of the cargo bag **101,101a-101c** or to stow away the closed cargo bag **101,101a-101c** to a side of the cargo hold **14** whilst the support rails **160** suspend the adjacent mouth edges of the cargo bag. It is possible that the
10 roller assembly **130** at either end of the guide rail **120** is stationary (without being connected by member **146** to the wire rope **145**), so that the cargo bag when closed can be stowed away at a lateral or longitudinal side at which the roller assembly **130** is stationary. As the roller assembly **130** is slidable, a stopper **126** is provided at the end of each the guide rail **120** for soft stopping of the roller assembly **130**. When two sets of gear-motors, pulleys and wire
15 ropes/chains are provided, such as on opposite sides of the cargo hold and operable by electrical interlocking, the cargo bags can be opened up, closed up or stowed away at any desired side of the cargo hold.

[0055] The cargo bags shown in FIGs. 4-6 have been simplified for illustration purposes. In
20 another embodiment, the lateral sides of the cargo bag **101,101a-101c** located below the guide rails **120** are configured with multiple creases or multiple vertical fold lines **108** and are accordingly foldable, as seen in FIG. 20. In one embodiment, it is possible that multiple pivot bar assemblies (ie. the pivot bars **122** and the pivots **123**) are arranged in series, with each of two terminal ends of the pivot bar assemblies is connected by a respective terminal
25 pivot **125** to a respective end of the support rails **160**; by pulling on the roller assemblies **130** at the two ends, the support rails **160** suspended by the terminal pivots **125** follow and are moved along the guide rails **120** together with the cargo bag; as a result, the pivot bars **122** move and rotate to fold/unfold the cargo bag, with the pivots **123** allowing relative rotations at the pivot bars, and the terminal pivots **125** allowing relative rotations with the support rails
30 **160**. In another embodiment, it is possible that connect members **105a** at the mouth edges of the cargo bag are connected or suspended directly from the roller assemblies **130** by the link members **135**, as can be visualised in FIG. 21 whilst the connect members **105** are connected/suspended from the support rail **160** (as shown in FIG. 22).

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[0056] In the above embodiments, when the cargo bag **101,101a-101c** is loaded with bulk cargo, the bottom **102** of the cargo bag **101,101a-101c** becomes supported by the bottom **15** of the cargo hold **14** whilst the sidewalls of the cargo bag are supported by the sides of the cargo hold **14**. In this way, the guide rails **120**, the support rails **160** and the pivot bars **122** need only to support weights of empty cargo bags **101,101a-101c** plus some residual bulk cargo. With the present invention, the cargo bags **101,101a-101c** serve to prevent direct contamination of the cargo hold **14** with the bulk cargo. Near the end of discharging of the bulk cargo, the bottom edge of the cargo bag **101,101a-101c** may be partially hoisted up, so that the residual bulk cargo accumulates at the bottom of the cargo bag **101,101a** or entire bottom of the cargo bag **101b** is tilted to accumulate residual bulk cargo to facilitate cleaner discharging of the bulk cargo; such accumulation of residual bulk cargo is also facilitated by tilting the above segmented base plates **170,170a** or tilting the segments of the gate valve plate **170c** that are located around the gate valves **177** to allow cleaner discharging of the bulk cargo.

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[0057] The above FIG. 16 shows the gate valve plate **170c** but the associated cargo bag **101c** is not shown; the cargo bag **101c** with gate valve plate **170c** is now shown in FIG. 25. For a more complete disclosure, FIGs. 23-28 now illustrate the cargo bag **101c** is being implemented inside a barge **100a**, which is another type of cargo vessel for use with the present invention. As shown in FIG. 23, the barge **100a** has load inclined plates **15a** that are arranged mutually to form a substantially central V channel **13**, which is aligned along the longitudinally length at the bottom of the hull. The V channel **13** may already be equipped with valve gates **177**, for eg., in a retrofit implementation; in a new implementation, one set of the gate valves **177** is provided with the cargo bag **101c**. Arranged below the central V channel **13** is a screw or belt conveyor **25**. The screw or belt conveyor **25** is operable to transport bulk cargo that has been controllably discharged through the gate valves **177** and the central V channel **13**. Preferably, transverse bulkheads **18** are provided to partition the cargo area in the barge **100a** into separate cargo holds **14a** to facilitate further controllable discharging of the cargo through the central V channel **13** and onto the screw/belt conveyor **25**. Preferably, the cargo holds **14a** are formed with surrounding sidewalls **17a** according to a carrying capacity of the barge **100a**. At the stern of the barge, a control tower **21** is located to house controls and crew for the barge **100a**.

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- [0058] FIG. 24 shows the cargo bag **101c** is implemented in a cargo hold **14b** of another barge **100b**; the barge **100b** has load plates **15b** that are operable between a flat orientation and an inclined orientation; at the inclined orientation, the load plates **15b** form a central V channel **13** similar to that of the above barge **100a**. As can be visualized from FIG. 24, when the cargo bag **101c** is located inside the barge **100b**, the central segment **172** of the gate valve plate **170c** of the cargo bag **101c** is aligned with the central V channel **13** such that the gate valves **177** are operable to controllably discharge bulk cargo through the central V channel **13** and onto the screw/belt conveyor **25**. As similarly described above, the cargo bag **101c** can be implemented inside the barge **100b** that is purpose-built or by retrofitting.
- [0059] FIG. 25 illustrates the cargo bag **101c** for use inside the above barge **100a,100b**. Whilst not shown, the top edges of the cargo bag **101c** are being supported by the roller assemblies **130**, the guide rails **120**, the support rails **160**, the pivot bars **122**, the pivots **123** and the terminal pivots **125**, with these components being similar to those counterparts in the above cargo vessel **100**, except that the pivot bar assembly includes an additional intermediate pivot bars **122a** located between the pivot bars **122**; the ends of the intermediate pivot bars **122a** are also connected to the adjoining ends of the pivot bars **122** by the pivots **123**; the intermediate pivot bars **122a** may help to create side fold lines **108** that connect to the central segment **172** of the segmented base plate **170,170a** or the segmented gate valve plate **170c**; the guide rails **120** are mounted along the upper edges of the sidewalls **17a** of the cargo hold **14b**, the roller assemblies **130** are slidable along the slot on the guide rails **120**, the support rails **160** are suspended below the guide rails **120** by the roller assemblies **130** and the link member **135**, each of two ends of the pivot bars **122** or each end of the terminal pivot bar assemblies are connected to respective ends of the support rails **160** by terminal pivots **125**, so that the cargo bag **101c** can be deployed inside the cargo hold **14b**, for folding, unfolding or stowing away. When an edge or edges of the base plate **170c**, segments of the gate valve plate **170c** located around the gate valves **177** are operable to further tilt by partially lifting at the rings or grommets **106**, residual bulk cargo is made to accumulate at the gate valves **177**; accumulating residual bulk cargo at the gate valves **177** allow a cleaner emptying of the cargo from the cargo bag. The base plate **170c** can be tilted further by folding the cargo bag **101c**, and FIGs. 26-28 are simplified to show the cargo bag **101c** in various stages of folding.

[0060] For the barge **100b** shown in FIG. 24, instead of using hoists to tilt an edge of the segmented gate plate **170c**, it is possible that the load plates **15b** of the cargo hold are operated by some tilting mechanisms located below (but not shown in the figures) to incline the load plates to some angles of inclination to accumulate residual bulk cargo at the gate valves **177**. Where the above gear-motor assemblies **140**, pulleys **142** and wire rope/chain **145** are provided, the roller assemblies **130** are pulled to move the support rails **160**, and to move and rotate the pivot bars **122,122a** during the process of opening or closing the mouth edge (ie. unfolding or folding) of the cargo bag or stowing away of a closed cargo bag to a side of the cargo hold. Where two cargo bags **101c** are provided, after the first cargo bag has been emptied of its cargo and been stowed away to a side of the cargo hold, the second cargo bag can then be deployed to contain another cargo.

[0061] FIG. 29 shows a flat-top cargo barge **100c** according to another variation that can use the cargo bag **101c**. As shown in FIG. 29, the cargo barge **100c** is configured with flat-top and cargo holds **14c**. Like the above implementations, towards the end of emptying or discharging bulk cargo, the peripheral edges of the gate valve plate **170c** are tilted so that residual bulk cargo accumulates along the central V channel thus formed to achieve cleaner cargo discharging through the gate valves **177**. Where the above gear-motor assemblies **140**, the pulleys **142** and the wire rope/chain **145** are provided, the roller assemblies **130** are pulled to move the support rails **160**, and to move and rotate the pivot bars **122,122a**, with the terminal pivots **125** and the pivots **123** for providing relative rotations, during the process of opening or closing the mouth edge (ie. unfolding or folding) of the cargo bag or stowing away of a closed cargo bag to a side of the cargo hold. Where two cargo bags **101c** are provided, after the first cargo bag has been emptied of its cargo and been stowed away to a side of the cargo hold, the second cargo bag can then be deployed to contain another cargo.

[0062] In the above drawings, the segmented base plate **170,170a** or the gate valve plate **170c** is shaped and dimensioned to substantially match the base **102** of the cargo hold; it is possible that the segmented base plate **170,170a** or the gate valve plate **170c** is smaller in dimensions than the base **102** as long as the segmented base plate **170,170a** or the gate valve plate **170c** is provided to be tilted to accumulate residue cargo to a centre of the segmented base plate **170,170a** or to the gate valves **177** to enable cleaner discharging of cargo.

[0063] In the above drawings, the cargo holds **14** are illustrated to include recessed ceilings; the guide rails **120** and the support rails **160** are mounted on sidewalls of the cargo hold **14** at locations below the recessed ceilings; in addition, hoists **112** may be suspended from these recessed ceilings. For cargo holds without recessed ceilings, the guide rails **120**, the support rails **160**, pivot bars **122**, pivots **123**, terminal pivots **125**, hoists **112**, the drive and driven pulleys, the endless rope and all the components provided to open or to close the cargo bag **101,101a,101b**, etc, are removably mounted on the sidewalls of the cargo hold **14**; when the guide rails, the support rails, hoists and all these components are dismantled, the entire space inside a cargo hold can be utilized, for example, to stack shipping containers or IMO tanks, whilst other cargo holds are utilized to transport bulk cargoes or liquid cargoes.

[0064] In the above embodiments, the hoists, the wire ropes, the hooks and rings/grommets are used to tilt peripheral edges of the segmented base plate **170,170a** or the gate valve plate **170c**; in some implementations, the barge **100a-100c** may not be equipped with the hoists **112** and the barge **100a-100c** will have to rely on external hoists located onshore at the port-of-call. Also, the cargo holds **14a-14c** may not have hatch covers, and removeable weather covers (not shown in the figures) can be draped over the top of the cargo holds **14a-14c** to protect the cargo.

[0065] While specific embodiments have been described and illustrated, it is understood that many changes, modifications, variations and combinations of variations disclosed in the text description and drawings thereof could be made to the present invention without departing from the scope of the present invention. For example, the cargo bags **101,101a-101c** are shown to be an open-mouth type; it is possible that the top of the cargo bags is provided with a lid membrane having an aperture to allow charging of bulk cargo into the cargo bag and discharging of the bulk cargo from inside of the cargo bag. In the above description, the lateral direction is referring to the direction towards the port and starboard sides; the principle of the present invention remains unchanged if the lateral and longitudinal directions are interchanged. Also, in the above, the cargo vessel **100** is described as an example; the above cargo bags **101,101a-101c** can also be used in a cargo hold of a mixed-cargoes vessel or barge which may also carry shipping containers; it is also possible to modify a deck of a liquid carrier to include hatches, so that the interior cargo holds can accommodate the above cargo bags **101,101a-101b**.

CLAIMS:

1. A foldable cargo bag for disposing inside a cargo hold of a cargo vessel, the foldable cargo bag comprises:
an open-top cargo bag, with side fold lines being formed at sidewalls of the cargo
5 bag and bottom fold lines formed at a bottom of the cargo bag;
wherein both the side fold lines and the bottom fold lines allow unfolding or opening of the foldable cargo bag to line walls and a bottom of the cargo hold before the foldable cargo bag is being filled with a cargo, and the side fold lines and the bottom fold lines facilitate folding to close the foldable cargo bag after it is emptied of its cargo.
10
2. The foldable cargo bag according to claim 1, wherein a material of the foldable cargo bag is configured with moisture- or gas-impermeable, ultra-violet light resistant and tear-resistant thermoplastic.
- 15 3. The foldable cargo bag according to claims 1 or 2, further comprises reinforcement members for bonding along the side fold lines and the bottom fold lines to provide reinforcement strength.
4. The foldable cargo bag according to any one of the preceding claims, further
20 comprises a tiltable segmented base plate disposed to support the bottom of the foldable cargo bag.
5. The foldable cargo bag according to any one of claims 1-3, further comprises a tiltable segmented base plate bonded onto the bottom of the foldable cargo bag.
25
6. The foldable cargo bag according to any one of claims 1-3, wherein the bottom of the foldable cargo bag is open, so that the open bottom edge of the foldable cargo bag is bonded to a peripheral edge of a tiltable segmented base plate.
- 30 7. The foldable cargo bag according to any one of claims 1-3, wherein the bottom of the foldable cargo bag is open, so that the open bottom edge of the foldable cargo bag is bonded to a peripheral edge of a tiltable segmented gate valve plate, such that selective opening of gate valves located on the gate valve plate allows controllable discharging of the

bulk cargo from the foldable cargo bag onto a conveyor located beneath the foldable cargo bag.

8. The foldable cargo bag according to any one of claims 4-7, further comprises rings
5 or grommets disposed along a bottom edge of the cargo bag or an edge of the tiltable segmented base plate or an edge of the tiltable segmented gate valve plate, wherein the rings/grommets allow deploying a cargo bag into the cargo hold or for partially hoisting up a bottom edge of the cargo bag or an edge of the tiltable segmented base plate or tiltable segmented gate valve plate to accumulate residual bulk cargo at the bottom of the foldable
10 cargo bag or on the tiltable segmented plate or gate valve plate, thereby allowing cleaner discharging of any bulk cargo near an end of a cargo discharging operation.

9. The foldable cargo bag according to any one of the preceding claims, further comprises connect members attached along a mouth edge of the cargo bag to suspend the
15 cargo bag for opening, folding or stowing away the foldable cargo bag.

10. A cargo hold located in a cargo vessel comprising:
a foldable cargo bag made according to any one of claims 1-9;
a pair of spaced apart guide rails located along a top of the cargo hold at two sides
20 thereof to support roller assemblies, to which two sides of the cargo bag are suspended therefrom; and
a pair of spaced apart support rails located along an adjacent top of the cargo hold to suspend two other opposite sides of the cargo bag, with ends of one support rail or both the pair of spaced apart support rails being suspended from the pair of spaced apart guide rails
25 by roller assemblies and link members;
wherein the roller assemblies are slidable inside the pair of spaced apart guide rails to move the support rail or the pair of spaced support rails, thereby to unfold, to fold or to stow away the foldable cargo bag.

30 11. The cargo hold according to claim 10, wherein each of the pair of spaced apart guide rail has an open longitudinal slot and the roller assemblies are slidable inside the pair of spaced apart guide rails.

12. The cargo hold according to claim 11, further comprises:

a pivot bar assembly formed by two pivot bars and a pivot joining the two pivot bars;
and

a terminal pivot located at each of two ends of the pivot bar assembly that is connected to a respective end of each of the pair of spaced apart support rails;

5 wherein connect members disposed along mouth edges of the cargo bag suspend the cargo bag from the pivot bars and the pair of spaced apart support rails, so that roller assemblies are slidable inside the spaced apart guide rails to move the pair of spaced apart support rails, and at the same time, rotate and move the pivot bars, with the pivot and the terminal pivots providing relative rotations, thereby allowing the foldable bag to unfold, fold
10 or stow away.

13. The cargo hold according to claim 12, wherein the pivot bar assembly further comprises an intermediate pivot bar and a pivot located at each of two ends of the intermediate pivot bar, to create additional fold lines at a respective side of the foldable cargo
15 bag.

14. The cargo hold according to claim 12, further comprises a plurality of pivot bar assemblies, to create multiple fold lines at a respective side of the foldable cargo bag.

20 15. The cargo hold according to any one of claims 12 to 14, further comprises a torsion spring disposed at the pivot between the pivot bars or the pivot between the pivot bar and the intermediate pivot bar to urge the pivot bars to rotate in a closing manner.

16. The cargo hold according to any one of claims 12 to 15, further comprising a gear-
25 motor-pulley assembly, an idler-pulley assembly and an endless wire rope supported between pulleys located in the motor-pulley and the idler-pulley assemblies, so that the endless wire rope is located inside the pair of spaced apart guide rails, and the wire rope is operable to pull the roller assemblies, thereby to move the pair of spaced apart support rails, and at the same time, to move and to turn the pivot bars assembly, with the pivots and the
30 terminal pivots providing relative rotations, for the foldable cargo bag to unfold, to fold or close/collapse the foldable cargo bag or to stow away a closed/collapsed foldable cargo bag to a side of the cargo hold.

17. The cargo hold according to any one of claims 10-16, wherein, after the foldable cargo bag is emptied of its cargo and is stowed to a side of the cargo hold, and shipping containers are located inside the cargo hold, with the shipping containers being stacked up and secured by lashing, for transporting shipping containers inside the cargo hold.
- 5
18. A method for transporting bulk cargo in a cargo hold, the method comprises:
- deploying a cargo bag in a cargo hold of a vessel;
 - unfolding or opening the cargo bag;
 - filling the cargo bag with bulk cargo at a port of call, so that sidewalls of the cargo
- 10 hold support sidewalls of the cargo bag and a bottom surface of the cargo hold supports a bottom of the cargo bag, so that the cargo bag prevents direct contamination of the cargo hold;
- discharging the bulk cargo in the cargo bag at a destination port-of-call;
 - if necessary, lifting or tilting a bottom edge of the cargo bag or a bottom edge of a
- 15 tiltable segmented plate that support a bottom of the cargo bag to accumulate residual bulk cargo at the bottom of the cargo bag or to a centre of the tiltable segmented plate to allow cleaner emptying or discharging of the bulk cargo;
 - folding and stowing away the emptied cargo bag to a side of the cargo hold; and
 - repeat, where necessary, unfolding or opening of the cargo bag, filling the cargo bag

20 at a port-of-call, discharging the cargo bag at a destination port-of-call, and tilting a bottom edge of the cargo bag or a bottom edge of the tiltable segmented plate to allow cleaner discharging of the bulk cargo;

 - wherein the cargo bag prevents direct contamination of the cargo hold by the bulk cargo, thereby allowing the cargo hold to contain cargo without cross-contamination and

25 thus reducing frequency of cleaning of the cargo hold or reducing occurrence of an empty cargo hold during any transporting trip as there is no contamination and discharging issue.

19. A method for transporting bulk cargo in a cargo hold, the method comprising:

 - deploying a cargo bag in the cargo hold of a vessel;

30 unfolding or opening the cargo bag;

 - filling the cargo bag with bulk cargo at a port-of-call, so that sidewalls of the cargo

hold support sidewalls of the cargo bag, a bottom surface of the cargo hold supports a tiltable segmented base plate disposed at the bottom of the cargo bag, with the tiltable segmented

base plate being equipped with gate valves, so that the cargo bag prevents direct contamination of the cargo hold;

discharging the bulk cargo at a destination port-of-call, by selectively opening the gate valves to discharge the bulk cargo onto a conveyor located in the hull below the cargo

5 bag;

if necessary, tilting the tiltable segmented base plate to accumulate residual bulk cargo at the gate valves to enable cleaner emptying or discharging of the bulk cargo;

folding and stowing away the emptied cargo bag to a side of the cargo hold; and

10 repeat, where necessary, unfolding or opening of the cargo bag, filling the cargo bag at a port of call, discharging the cargo bag at a destination port of call, and tilting the tiltable segmented base plate to accumulate residual bulk cargo at the gate valves to allow cleaner discharging of the bulk cargo;

15 wherein the cargo bag prevents direct contamination of the cargo hold by the bulk cargo, thereby allowing the cargo hold to contain cargo without cross-contamination and thus reducing frequency of cleaning of the cargo hold or reducing occurrence of an empty cargo hold during any transporting trip as there is no contamination and discharging issue.