

Document Title: Specification

Title of Invention: Bottom-Parting Outfeed Discharge Apparatus

Technical Field

5 0001

The present invention relates to a bottom-parting outfeed discharge apparatus, and in particular to an apparatus capable of holding granular material such as coal, iron ore, or other ore, or grains such as soy beans or corn in a storage section and discharging this held granular material from the bottom of
10 the storage section.

Background Art

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The work of unloading coal, iron ore, or granular materials such as soy
15 beans, corn, or other grains from a cargo ship or barge to dockside is accomplished, for example, using a bucket crane installed on a dock. However, unloading in this manner using a bucket crane must be accomplished by repeatedly gathering the granular material using a bulldozer or the like inside the cargo hold of the barge, moving a bucket onto the barge and depositing the
20 gathered grain into the bucket, rotating the crane to move the bucket to the dock, and discharging the granular material – a very time consuming process.

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An example of equipment disclosed, for example, in Patent Citation 1 for
25 smoothly carrying out the unloading of granular material is a cargo vessel comprising a hopper-shaped cargo hold, an outfeed machine having rotating blades which travels back and forth in the longitudinal direction of the hull along the bottom surface of the cargo hold, and a conveyor for feeding granular material taken out of the bottom of the cargo hold by this outfeed machine to
30 dockside.

Prior Art References

Patent Citations

0004

Patent Citation 1: Japanese Patent Application Publication No.2000-43784

Summary of the Invention

Problems the Invention Seeks to Resolve

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However, when a large volume of a granular material such as coal is stored in the cargo hold of such a cargo vessel, the weight of the granular material acts on the outfeed machine. This causes a large resistance to act on the rotating blades of the outfeed machine, posing the problem that the outfeed machine cannot be smoothly moved, so the work of discharging the granular material cannot be smoothly accomplished.

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Embodiments of the present invention afford a smooth discharge of granular material even when a large volume of coal or other granular material is stored in the cargo space of a cargo vessel or the like.

Means for Resolving the Problem

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According to an aspect, there is provided a storage equipment for holding granular material, including a storage section for holding the granular material, formed in an elongated rectangular shape in plan view, wherein at least the lower portion reduces in width toward the bottom, with an aperture formed at the bottom end thereof to extend longitudinally and open toward the side; wherein the storage section has a receiving section disposed to extend at the bottom of the aperture along the aperture, on which granular material flowing out from the aperture piles up, such that outflow of the granular material from the aperture is stopped by the granular material piled up on this receiving section; furthermore, the storage equipment includes: a scrape-out means for causing granular material piled up on the receiving section to fall from the receiving section; a conveyor disposed at a position on which granular material falls

from the receiving section; and a closing plate for adjusting the width of the aperture; wherein the storage section has a pair of side walls inclined so as to be in close proximity at least at the lower portion, such that a space for holding the granular material is formed between the pair of side walls, and the aperture is formed between the bottom edges of the side walls; the receiving section continues from the bottom edges of one of the pair of side walls and extends more than the aperture toward a position on the other side wall side; and the receiving section includes a vertical plumb portion extending essentially vertically downward from the bottom edge of one side wall, and a horizontal portion extending more than the aperture, essentially horizontally from the bottom edge of the plumb portion toward the other side wall side; and wherein the scrape-out means has a scrape-out member formed of a triangular column member and capable of essentially fixed speed movement on the receiving section with the bottom surface in contact with the horizontal portion and one side surface in contact with the plumb portion.

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In an embodiment of the present invention thus constituted, because one side wall extends below the other, the aperture opens to the side or diagonally downward, and even when there is a large volume stored in the storage section, the granular material load acting on the outfeed apparatus can be reduced and the outfeed apparatus smoothly driven.

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In an embodiment of the present invention the outfeed apparatus preferably comprises: a rotary blade portion having a shaft extending along the longitudinal direction of the aperture and outfeed blades extending in the radial direction around the shaft; and a drive apparatus for rotationally driving the shaft.

In an embodiment of the present invention thus constituted, granular material is fed out by rotary blades rotating around a shaft, therefore a fixed amount of granular material can be continuously discharged.

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In an embodiment of the present invention the rotating blade portion is preferably divided into multiple sections in the axial direction of the shaft, and the attachment angle of the rotating blade portion in at least one section relative to the shaft differs from the attachment angle of the rotating blade portion in one of other sections

relative to the shaft.

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In an embodiment of the present invention thus constituted, the load applied to the drive apparatus can be averaged irrespective of the angle of the rotating blade portion.

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In an embodiment of the present invention the attachment angles of the rotating blade portions in the multiple sections are preferably respectively set at one of multiple angles determined so as to form equal angle spacings.

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In an embodiment of the present invention thus constituted, since the offsets of the attachment angles of each of rotating blade portions are uniform, the load applied to the drive apparatus can be even further averaged.

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In an embodiment of the present invention the outfeed apparatus preferably comprises a scraping member capable of moving at essentially a fixed speed on the receiving portion.

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In an embodiment of the present invention thus constituted, an approximately fixed amount of granular material per hour falls from the receiving portion onto the conveyor at all times, therefore a stable amount of granular material can be unloaded at all times.

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In an embodiment of the present invention, the receiving portion preferably continues from the

bottom edge of one of the pair of side walls and extends more than the aperture to a position on the other side wall side.

In an embodiment of the present invention thus constituted, the receiving portion extending from one side wall is positioned directly below the bottom of the opening, and granular material piles up on the receiving portion.

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An embodiment of the present invention preferably has a closing plate capable of changing the width of the opening in the aperture.

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In an embodiment of the present invention thus constituted, by adjusting the width of the aperture with a closing plate, an essentially fixed amount of granular material can be caused to drop onto the receiving portion, even if the sizes or weights of the granular materials differs, and even if the amount of granular material stored varies.

Effect of the Invention

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According to embodiments of the present invention, granular material can be smoothly discharged even when a large amount of coal or other granular material is stored in a cargo storage.

Brief Explanation of Figures

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Fig. 1: A side view showing the constitution of a barge having a discharge apparatus according to a first embodiment of the present invention.

Fig. 2: A plan view of the barge shown in Fig. 1.

Fig. 3: A section through III-III in Fig. 1.

Fig. 4: A general perspective view showing the constitution of a discharge

apparatus according to the first embodiment.

Fig. 5: A sectional diagram in the width direction showing a discharge apparatus according to the first embodiment.

Fig. 6: Shows the constitution of the outfeed apparatus; (A) is a front elevation; (B) is a cross section through B-B in (A); (C) is a cross section through C-C in (A); (D) is a cross section through D-D in (A).

Fig. 7: A side view showing a transport vessel having the second embodiment discharge apparatus.

Fig. 8: A plan view of the transport vessel shown in Fig. 7.

Fig. 9: An elevation view of a discharge apparatus mounted on the transport vessel shown in Fig. 7.

Fig. 10: A horizontal cross section showing the constitution of a barge having cargo equipment according to an embodiment of the present invention.

Fig. 11: A cross section through B-B in Fig. 10.

Fig. 12: A cross section through C-C in Fig. 10.

Fig. 13: A width-direction cross section showing the constitution of the barge storage section and scrape-out means shown in Fig. 10.

Fig. 14: A perspective view showing the constitution of the barge storage section and scrape-out means shown in Fig. 10.

Fig. 15: An elevation view showing the constitution of the scrape-out means shown in Fig. 10.

Embodiments of the Invention

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-- First Embodiment --

Below, referring to figures, we explain in detail a first embodiment of a bottom-parting outfeed discharge apparatus of the present invention. Note that in the explanation below we discuss as an example of the case in which the bottom-parting outfeed discharge apparatus is disposed on a barge, and coal is transferred from this barge to another barge or to shore.

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Fig. 1 is a side elevation showing the constitution of a barge 1 having a discharge apparatus according to the first embodiment of the present invention;
5 Fig. 2 is a plan view of barge 1 shown in Fig. 1; and Fig. 3 is a cross section through III-III of Fig. 1.

As shown in Figs. 1 through 3, barge 1 comprises: an elongated storage section 2 extending in the longitudinal direction of a barge in to which coal can be inserted; an outfeed apparatus 4 disposed on the bottom portion of storage
10 section 2; a shipbottom conveyor 6 disposed at the bottom of storage section 2; and a spreader 8 extending from the end portion of shipbottom conveyor 6 to a dock. Bottom-parting outfeed discharge apparatus 10 ("discharge apparatus" below) comprises storage section 2, outfeed apparatus 4, and shipbottom conveyor 6.

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In the width direction (i.e., the width direction of barge 1), storage section 2 has an inverted triangle sectional shape, and the plan view shape of the rear portion thereof in the longitudinal direction (i.e., the direction from the bow to
20 stern on barge 1) is formed to taper in width toward the rear. In the rear portion of storage section 2, the deepest portion thereof inclines diagonally upward toward the rear.

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25 Fig. 4 is a general perspective view showing the constitution of discharge apparatus 10; Fig. 5 is a cross section in the width direction of discharge apparatus 10. As shown in these figures, discharge apparatus 10 comprises a pair of side wall portions 12A, 12B inclining in the width direction and disposed to extend in the longitudinal direction; a closing plate 14 disposed along the bottom
30 portion of one side wall portion 12B and rotatably connected to the bottom edge

of this side wall portion 12A; and a receiving portion 16 disposed in continuity with the bottom of side wall portion 12B.

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5 The pair of side wall portions 12A, 12B inclines downward to approach one another, by virtue of which a triangular columnar storage section 2 having an inverted triangular shape is formed between the pair of side wall portions 12A, 12B. The bottom edge of one side wall portion 12B extends further down than the bottom edge of the other side wall portion 12A, and an aperture 18, which
10 opens in a diagonally downward direction and extends horizontally, is formed between the bottom edge of one side wall portion 12B and the bottom edge of the other side wall portion 12A. Receiving portion 16 is positioned below aperture 18. In addition, the angle of inclination of these side wall portions 12A, 12B should be determined according to the properties of the granular material
15 stored in storage section 2; for example, when holding coal as in this embodiment, approximately 50° is suitable.

0026

 Closing plate 14 consists of a plate material rotatably connected to the
20 bottom edge portion of side wall portion 12A and extending in the longitudinal direction. This closing plate 14 can be rotated using a jack or the like affixed to side wall portion 12A, from an initial position (shown by the broken line in Fig. 5) on the same plane as side wall portion 12A, in a direction such that it separates from second side wall portion 12B, by which means the width of aperture 18 can
25 be adjusted.

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 Receiving portion 16 comprises a plumb portion 20 extending downwardly plumb from the bottom edge of one of the side wall portions 12B; a horizontal
30 portion 22 extending horizontally from plumb portion 20 to the other side wall

portion 12B side; and an arcuate portion 23 having arcuate section and disposed along horizontal portion 22 and plumb portion 20. Outfeed apparatus 4 is disposed along horizontal portion 22 on these plumb portions 20 so that the rotational axis of the rotary blade portion, described below, matches the center
5 axis of arcuate portion 23. Ship bottom conveyor 6 is disposed approximately directly below the leading end of horizontal portion 22.

0028

The height of plumb portion 20 and width of horizontal portion 22 should be
10 determined so that when outfeed apparatus 4 is in a stopped state, coal does not fall from the edge of horizontal portion 22 until coal flowing out through aperture 18 and piling up on receiving portion 16 and outfeed apparatus 4 closes aperture 18.

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Fig. 6 shows the constitution of the outfeed apparatus; (A) is a front elevation; (B) is a cross section through B-B in (A); (C) is a cross section through C-C in (A); (D) is a cross section through D-D in (A). As shown in this drawing, outfeed apparatus 4 comprises a motor 24 and a rotary blade portion 26,
20 wherein a shaft 26A is connected to motor 24. Rotation of motor 24 causes rotary blade portion 26 to rotate around shaft 26A.

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Rotary blade portion 26 has a horizontally extending shaft 26A, and
25 outfeed blades 26B extending toward the perimeter from shaft 26A. Four outfeed blades 26B are attached, separated by a 90° angle in the perimeter direction; flange plates 26C are disposed vertically relative to outfeed blades 26B and the shaft so as to support the load acting on these outfeed blades 26B.

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Outfeed blades 26B are divided into multiple sections at predetermined intervals along the axial direction of shaft 26A; in each section outfeed blades 26B are attached to shaft 26A at offset attachment angles. I.e., in the present embodiment, in the state shown in Fig. 6, within the section furthest separated from motor 24 (the "B cross sectional portion"), outfeed blades 26B, as shown in Fig. 6(B), are disposed to extend in the vertical and the horizontal directions from shaft 26A. The attachment angle in the section adjacent to the motor 24 side of the B cross section portion (the "C cross section portion" below) is offset by 30° relative to the B cross section portion, as shown in Fig. 6(C). The attachment angle in the section adjacent to the motor 24 side of the C cross section portion (the "D cross section portion" below) is offset by 30° relative to the C cross section portion; i.e., it is offset by 60° relative to the B cross section portion. Moreover, the attachment angle in the section adjacent to the motor 24 side of the D cross section portion is offset by 30° relative to the D cross section portion; i.e., as with the B cross section portion, outfeed blades 26B extend vertically and horizontally. Thus in the present embodiment there is a repeating alignment of B cross section portions, C cross section portions offset at a 30° attachment angle relative to the B cross section portions, and D cross section portions offset at 60° relative to the B cross section portions. As is done in this embodiment, the load applied to motor 24 can be averaged, regardless of the rotation angle of rotary blade portion 26, by constituting rotary blade portion 26 of multiple parts with differing outfeed blade 26B attachment angles. Also, by using rotary blade portion 26 in this way, outfeeding of granular material can be reliably performed even when the rotational axis of the rotary blade portion at the rear of barge 1 or the like is disposed at an angle.

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As shown in Fig. 1, the rear portion of conveyor 6 is inclined upward, and the rear end portion thereof is positioned above the rotational center of spreader 8. Spreader 8 extends diagonally upward, and can be rotated around the bottom

end thereof.

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Below we explain the operation of holding coal in a barge 1 furnished with
5 the discharge apparatus of the present embodiment, and of unloading the held
coal into an adjacent barge 1.

First, if a barge 1 furnished with the discharge apparatus of the present
embodiment is holding coal, closing plate 14 is rotated and the aperture 18
formed at the bottom of side wall portion 12A is closed. With aperture 18 thus
10 closed by closing plate 14, coal can be stored in storage section 2 by loading
coal into storage section 2 from above.

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When unloading held coal dockside, barge 1 is first made to standby,
15 aligned to the dock, and spreader 8 is rotated so that its tip is positioned on the
dock.

Closing plate 14 is then rotated and aperture 18 is opened. When aperture
18 is opened, coal flows out from inside storage section 2 through aperture 18 to
receiving section 16. Coal thus flowing out to receiving section 16 accumulates
20 on receiving section 16 in a hill shape. This coal accumulated in a hill shape
reaches a height at which it blocks aperture 18, and with aperture 18 in a
blocked state, it is stable and self-sustained, with no coal collapsing. Thus the
outflow of coal from storage section 2 through aperture 18 is stopped.

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Note that it is desirable to adjust the angle of closing plate 14 so the width
of the opening in aperture 18 is narrow when the amount of coal held in storage
section 2 is high and wide when that amount is low. Thus irrespective of the
amount of coal held, a fixed amount of coal is discharged to receiving section 16.

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In this state, motor 24 of outfeed apparatus 4 is driven to turn rotary blade portion 26. The rotation of rotary blade portion 26 causes coal falling on receiving section 16 from aperture 18 to be scraped out onto shipbottom conveyor 6.

5 When coal is scraped out from receiving section 16 by outfeed apparatus 4, essentially the same amount of coal as the scraped out coal flows out again from aperture 18. Therefore by rotating rotary blade portion 26 at a fixed speed, an essentially fixed amount of coal per unit time can be continuously caused to drop onto shipbottom conveyor 6.

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When coal falling onto shipbottom conveyor 6 in this way is fed by shipbottom conveyor 6 to the downstream end thereof, it then falls on spreader 8. Coal falling on spreader 8 is then carried to the end portion on the downstream side and piled up dockside.

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As explained above, in the present embodiment, one of the side wall portions 12B extends below the other side wall portion 12A, therefore aperture 18 opens toward the side or in a diagonal downward direction, so that even when there is a large amount held in storage section 2, the load of the granular material acting on outfeed apparatus 4 can be reduced, and outfeed apparatus 4 can be smoothly driven. Moreover, because outfeed apparatus 4 comprises outfeed blades 26B rotating around the axis of rotation, a fixed amount of granular material can be continuously discharged.

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Since the rotary blade portion 26 is divided into multiple sections in the axial direction of shaft 26A and the angle of attachment of outfeed blades 26B to shaft 26A in each section differs from the angle of attachment of outfeed blades

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26B to shaft 26A in other sections, the load on motor 24 can be averaged independently of the angle of rotary blade portion 26.

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5 Furthermore, since the attachment angles of outfeed blades 26B in each section, at 30°, 60°, and 90° are offset by 30° relative to the reference section and thus the offset of the attachment angles of each of the outfeed blades 26B is made uniform, the load on motor 24 can be even further averaged. Thus by reducing the load on the motor or other drive force source, running costs for fuel
10 etc. can also be reduced.

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By adjusting the width of aperture 18 with closing plate 14, an essentially fixed amount of granular material can be caused to drop onto the receiving
15 portion even if sizes or weights of granular materials differs, and even if the amount of granular material stored varies.

Moreover, since it becomes unnecessary to scoop up granular material inside the storage section with a bulldozer or the like, time and fuel costs, etc. can be reduced.

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-- Second Embodiment --

Below we discuss the case in which the discharge apparatus of a second embodiment is applied to a transport ship for transferring coal or other granular
25 material from a large barge to shore or to another large barge. Note that those constituent elements which are the same as in the first embodiment are assigned the same reference numerals, and an explanation thereof is omitted.

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30 Figs. 7 and 8 show transport ship 101 of the second embodiment; Fig. 7 is

a side view and Fig. 8 is a plan view. Also, Fig. 9 is an elevation view of discharge apparatus 102 mounted on transport ship 101.

As shown in Fig. 7, transport ship 101 is a large vessel shaped approximately as a rectangle in plan view. As shown in Figs. 7 and 8, multiple
5 discharge apparatuses 102 and multiple backhoes 104 are mounted on the deck of transport ship 101. Also first through fifth conveyors 106, 108, 110, 112, and 114, and a spreader 116 are installed on the deck of transport ship 101. First conveyor 106 extends along one longitudinal edge portion of transport ship 101, and the downstream end portion thereof is positioned above the upstream and
10 portion of second conveyor 108. Second conveyor 108 extends along one of the short edge portions, and the downstream end portion thereof is positioned above the upstream end portion of third conveyor 110. Third conveyor 110 extends along the other longitudinal edge portion, and the downstream end portion thereof is connected to fourth conveyor 112. Fourth conveyor 112 is adjacent to
15 third conveyor 110 and extends along the other longitudinal edge portion. Fifth conveyor 114 is connected to the intermediate portion of fourth conveyor 112, and its downstream end portion is positioned on the rotational center of spreader 116. Using this configuration, granular material dropped onto first conveyor 106 is transported to spreader 116 via first through fifth conveyors 106, 108, 110,
20 112, and 114, and can be dropped to a desired location by spreader 116.

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As shown in Fig. 9, discharge apparatus 102 is installed on mount 120, having wheels 1222 on its lower portion. As in the first embodiment, discharge
25 apparatus 102 has a storage section 2, an outfeed apparatus 4, and a conveyor 6.

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Storage section 2 is formed of a pair of sidewall portions 12A and 12B; an
30 aperture 18 is formed at the bottom of side wall portion 12A, and a closing plate

14 is rotatably connected to the bottom end of side wall portion 12A. A receiving section 16 is formed at the bottom of aperture 18.

In the present embodiment as well, an apparatus comprised of the motor and rotating blade portion described with reference to Fig. 6 is used as the
5 outfeed apparatus 4.

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Below we explain a method for transporting coal from dockside to a barge using transport ship 101 of the present embodiment.

10 To move coal from a large barge to shore, transport ship 101 is first disposed so that the edge portion of the side on which backhoe 104 is mounted will be adjacent to the dock. Spreader 116 is then rotated so that its leading end is positioned above the hold portion of the barge. Discharge apparatus 102 is disposed so that the downstream end portion of the discharge apparatus 102
15 conveyor 6 is positioned above conveyor 106.

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Next, closing plate 14 is rotated and aperture 18 opened, and coal on the shore is dropped into the storage section 2 of discharge apparatus 102 by
20 backhoes 104. Motor 24 of outfeed apparatus 4 is then driven, and rotary blade portion 26 is rotated.

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Coal thus dropped into storage section 2 is discharged from aperture 18
25 onto receiving section 16, and coal discharged from receiving section 16 is dropped onto conveyor 6 by outfeed apparatus 4. Coal dropped onto conveyor 6 is conveyed by conveyor 6 and dropped onto first conveyor 106. Coal is then transported up to spreader 116 via first through fifth conveyors 106, 108, 110, 112, and 114, and is dropped onto a barge by spreader 116.

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A similar effect to that of the first embodiment can also be obtained by this embodiment.

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Note that in the embodiments above, we explained the case in which the aperture of the storage section was made to face diagonally downward, however without limitation thereto, one of the sidewall portions can be made to extend until the bottom end thereof is positioned beneath the bottom end of the other
10 sidewall portion, opening toward the side.

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In each of the embodiments above, we explained the case in which four outfeed blades were attached at 90° intervals to the shaft, but there is no
15 limitation on the number of outfeed blades attached.

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Also, in each of the embodiments above we discussed the case of a sequential array of spaces offset by 30° each in the attachment angle of the
20 outfeed blades, but the angle of offset (the "setting angle" below) relative to the outfeed blade reference attachment angle may be an angle other than 30°; there is no limitation on the setting angle. For example in the case where setting angles are offset by 15° each, there could also be a sequence of a section with a setting angle of 75°, a section with a setting angle of 15°, a section with a setting
25 angle of 45°, and a section with a setting angle of 30°; in other words, so long as the setting angles are set to have equal spacing, the order is not important. In addition, if the attachment angle in any one section differs from the angle of another space, the effect of dispersing the load acting on the motor is obtained.

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Also, in this embodiment we explained the case of unloading from a barge to shore, but without limitation thereto the present invention may also be applied to transfer from a barge to a barge or from shore to a barge.

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Also, in the present embodiment we explained the case of transfer of coal as a granular material, but without limitation thereto the present invention may also be applied to ore such as iron ore, or to grains such as soy beans, corn, or the like; in other words the invention may be applied to any small pieces.

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Also, in the present embodiment we discussed case in which a closing plate is rotatably attached to the bottom end of a sidewall portion, but without limitation thereto it may also be made movable along a sidewall portion; in other words the aperture width of the aperture simply needs to be adjustable.

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-- Third Embodiment --

Below, referring to figures, we explain in detail a third embodiment of the discharge apparatus of the present invention. Note that in the explanation below we discuss as an example of the case in which the discharge apparatus (hold equipment) is disposed on a barge, and coal is transferred from this barge to another barge or to shore.

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Fig. 10 is a horizontal section showing the constitution of a barge 201 having a discharge apparatus according to a third embodiment of the present invention; Fig. 11 is a section through B-B in Fig. 10, and Fig. 12 is a section through C-C in Fig. 10.

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As shown in Figs. 10 through 12, barge 201 comprises a hold equipment

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main unit 202 capable of loading coal from above and having an elongated shape extending in the longitudinal direction of the barge; a scrape-out means 204 disposed at the bottom portion of hold equipment main unit 202; a shipbottom conveyor 206 disposed below a hopper-shaped hold equipment; and
5 a transport conveyor group 208 extending from shipbottom conveyor 206 to the quay.

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The hold equipment main unit 202 has a reverse triangular shape in section
10 across the width direction (i.e., in the width direction of barge 1), and a pair of storage sections 210 extending in the longitudinal direction (i.e., in the direction from prow to stern of barge 201), approximately rectangular in plan view.

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15 Figs. 13 and 14 show storage sections 210 and scrape-out means (outfeed apparatus) 204, and are respectively a width-direction section and a perspective view. As shown in Figs. 13 and 14, storage sections 210 comprises a pair of side wall portions 212A, 212B inclining in the width direction and disposed to extend in the longitudinal direction, a closing plate 214, disposed along the bottom
20 portion of one of the side wall portions 212B and movable up and down along this side wall portion 212B, and a receiving section 216 contiguous with the bottom of side wall portion 212A.

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25 The pair of side wall portions 212A, 212B incline downward to approach one another, by virtue of which a triangular columnar storage space 213 having an inverted triangular shape is formed between the pair of side wall portions 212A, 212B. The bottom edge of one side wall portion 212A extends beneath the bottom edge of the other side wall portion 212B, and is positioned
30 approximately directly beneath the bottom edge of the other side wall portion

212B; an aperture 218 extending longitudinally between the bottom edge of one sidewall portion 212A and the bottom edge of the other sidewall portion 212B is formed to open sideways. Note that the angle of inclination of these side wall portions 212A, 212B should be determined according to the properties of the granular material stored in storage section 210; for example, when holding coal as in this embodiment, approximately 50° is suitable.

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Closing plate 214 is made of plate material extending longitudinally along the bottom and portion of side wall portion 212B. Multiple chains 224 are connected to the top portion of closing plate 214; by feeding out and winding up these chains 224 with a winch (not shown), closing plate 214 can be made to move up and down along side wall portion 212B. The vertical direction width of aperture 218 formed between the pair of side wall portions 212A and 212B can be adjusted by moving closing plate 214 up and down.

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Receiving section 216 comprises a plumb portion 220 extending vertically downward from the bottom edge of one of the side wall portions 212A, and a horizontal portion 222 extending from the bottom end of plumb portion 220 to the side of the other side wall portion 212B. The height H of plumb portion 220 and width W of horizontal portion 222 should be determined so that outflowing coal passing through aperture 218 and piling up on receiving section 216 does not fall from the edge of the horizontal portion 222 until aperture 218 is closed.

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In other words, outflow of coal from storage section 210 to receiving section 216, as described below, is stopped with the accumulated coal blocking aperture 218. At this point, the pile of coal on receiving section 216 is inclined at approximately the angle of repose. Therefore by determining the width W of

receiving section 216 horizontal portion 222 based on the height H of aperture 218 relative to horizontal portion 222 and the angle of repose of the coal, coal can be piled up on receiving section 216 until it reaches a height at which aperture 218 is blocked by the accumulated coal. Note that when holding coal in the form of this embodiment, it is desirable to set the width W of aperture 218 at approximately 100 mm or less, the height H of plumb portion 220 at approximately 500 mm, and the width W of horizontal portion 222 at approximately 1000 mm.

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Fig. 15 is a front elevation showing the constitution of scrape-out means 204. As shown in Fig. 15, scrape-out means 204 comprises a scrape-out member 226 capable of sliding in the longitudinal direction of horizontal portion 222 of receiving section 216, a wire 228 forming a loop connected to this scrape-out member 226, and an outfeed apparatus 230 capable of feeding out wire 228.

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The scrape-out member 226 consists of steel formed in a triangular column, the bottom face of which forms an isosceles triangle. One side surface extending from the bottom surface is formed to be approximately vertical relative to the bottom surface. Scrape-out member 226 can be moved along receiving section 216 with its bottom surface in contact with horizontal portion 222 of receiving section 216, and its side surface in contact with the plumb portion 220 of receiving section.

Alternately outfeeding wire 228 backward and forward by outfeed apparatus 230 causes scrape-out member 226 to move back and forth along receiving section 216.

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As shown in Figs. 10 through 12, transport conveyor group 208 comprises first through third transport conveyors 232, 234, and 236. First transport conveyor 232 is disposed to extend widthwise under the downstream end portion of each of the shipbottom conveyors 206. Second transport conveyor 234 is positioned so that its upstream end portion is below the downstream end portion of first transport conveyor 232, and it extends diagonally upward in the longitudinal direction of barge 201. The third transport conveyor 236 is disposed so that its upstream end portion is positioned below second transport conveyor 234 and it can be rotatable around this position.

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Below we explain the operation of holding coal in a barge 201 having the hold apparatus of the present embodiment, and unloading of the held coal into an adjacent barge 201.

First, in the case where a barge 201 having the hold apparatus of the present embodiment is holding coal, closing plate 214 is lowered and the aperture 218 formed at the bottom of side wall portion is closed. With opening 218 thus closed by closing plate 214, coal can be stored in hold space 213 by loading coal into hold space 213 from above.

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When loading the held coal onto an adjacent barge, barges 201 are first parallelly aligned, third transport conveyor 236 is rotated, and the front end thereof is positioned above the position of the point of discharge on barge 201.

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Closing plate 214 is then elevated and aperture 218 is opened. When aperture 218 is opened, coal flows out from inside hold equipment main unit 202 through aperture 218 to receiving section 216. Coal flowing out to receiving section 216 piles up on receiving section 216 in a hill shape with a peak at plumb

portion 220. This coal accumulated in a hill shape reaches a height at which it blocks aperture 128, and with aperture 218 in a blocked state, it is stable and self-sustained, with no coal collapsing. Thus the outflow of coal from storage section 202 through aperture 218 is stopped.

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Note that it is desirable to adjust the width of the opening in aperture 218 to be narrow when the amount of coal held in storage section 210 is high, and wide when that amount is low. Thus irrespective of the amount of coal held, a fixed amount of coal is discharged to receiving section 216.

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In such a state, scrape-out member 226 of scrape-out means 204 is moved back and forth over the entire length of receiving section 216. When scrape-out member 226 moves on receiving section 216, coal accumulated on receiving section 216 in the moved portion falls onto shipbottom conveyor 206. Therefore by moving scrape-out member 226 at a fixed speed, an approximately fixed amount of coal per hour can be made to fall onto shipbottom conveyor 206.

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Coal then flows out again from aperture 218 and piles up in a hill shape in the area in which it falls on receiving section 216. When the coal accumulated in a hill shape reaches a height such that it blocks aperture 218, that aperture 218 is again blocked by coal. Thus by causing the scrape-out member 226 of scrape-out means 204 to move back and forth, an approximately fixed amount of coal per hour can be continuously scraped onto shipbottom conveyor 6.

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When coal falling as described above on shipbottom conveyor 206 is fed as far as the downstream end portion of shipbottom conveyor 206 by this conveyor,

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it then falls onto first transport conveyor 232. Coal falling onto first transport conveyor 232 is conveyed as far the downstream end portion thereof, then falls onto second transport conveyor 234. In addition, coal falling onto second transport conveyor 234 is conveyed as far the downstream end portion thereof, then falls onto third transport conveyor 236. Coal falling on third transport conveyor 236 is conveyed up to the position at which it is to be piled onto barge 201, and is there deposited.

0074

As explained above, in the present embodiment a receiving section 216 is provided on side and below position relative to aperture 218 of hold equipment main unit 202, therefore coal accumulates in a hill shape on receiving section 216 and stands on its own, and is stable in a state whereby it blocks aperture 218. The height of the hill of coal accumulated in this way on receiving section 216 is low, and no major pressure acts on the interior, therefore no major load is placed on scrape-out member 226 of scrape-out means 204, and the work of discharging coal can be smoothly performed.

0075

Since it was decided to provide closing plate 214 to adjust the width of aperture 218, even granular material differing in size or weight from coal can be accumulated in a hill shape on receiving section 216, and aperture 218 can be closed off by this hill. In addition, by adjusting the width of aperture 218 in response to the amount of coal held, a constantly fixed amount of coal can be made to pile up on receiving section 216.

0076

Since scrape-out member 226 on scrape-out means 204 moves receiving section 216 at an approximately fixed speed, an approximately fixed amount of coal per hour falls constantly on shipbottom conveyor 206 from receiving section

216, enabling a constantly stable amount of coal to be unloaded.

0077

5 Note that in the present embodiment we discussed the discharging of held coal as an example, but without such limitation, the present invention can be applied to any granular solid object such as coal or grain. In such cases, it is desirable to adjust the width to which aperture 218 closes by adjusting closing plate 214 so that the granular material piles up on receiving section 216.

10 0078

Also, in the present embodiment we assumed that the entirety of side wall portions 212A and 212B were inclined, but without such limitation, the top portion may also have a shape extending in the plumb direction. It is also acceptable to divide storage space 213 into multiple parts by leaving a space on the interior in the longitudinal direction and erecting multiple bulkheads. In the present embodiment, aperture 218 is continuously erected in the longitudinal direction, but it is also acceptable to erect multiple apertures 218 along the longitudinal direction, separated by spaces.

20 0079

In the present embodiment the horizontal portion 222 of receiving section 216 was erected at a position lower than the bottom end of aperture 218, but without such limitation it may also be erected to the same height as the bottom end of aperture 218.

25 In addition, in the present embodiment aperture 218 opens approximately toward the side, but without such limitation it may also open downward. In such cases it is acceptable, for example, to erect a horizontal plate-shaped receiving section beneath the aperture and arrange for the granular material to be scrapable from between a pair of side wall portions and the receiving section, on both sides of this receiving section.

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0080

Note than in the present embodiment we have explained the case in which cargo is discharged from one barge to another barge or cargo ship, but without
5 such limitation the present invention may also be applied to unloading from a barge to a quay or the like. Moreover, in the present embodiment we explained the case in which a storage apparatus is erected on a barge, but without such limitation it may also be installed on land such as on a quay, or on a cargo ship. By installing it on a quay, the apparatus can also be used when loading a barge
10 or cargo ship with granular material.

Explanation of Reference Numerals

0081

1, 201: barge
15 2, 201: storage section
4: outfeed apparatus
6: shipbottom conveyor
10, 102: discharge apparatus
12A, 12B, 212A, 212B: side wall portions
20 14, 214: closing plates
16, 216: receiving sections
18, 218: apertures
20: plumb portions
22: horizontal portion
25 24: motor
26: rotary blade portion
26A: shaft
26B: outfeed blades
26C: flange plates
30 202: hold equipment main unit

204: scrape-out means

206: shipbottom conveyor

226: scrape-out member

CLAIMS

1. Storage equipment for holding granular material,

including a storage section for holding the granular material, formed in an elongated rectangular shape in plan view, wherein at least the lower portion reduces in width toward the bottom, with an aperture formed at the bottom end thereof to extend longitudinally and open toward the side;

wherein the storage section has a receiving section disposed to extend at the bottom of the aperture along the aperture, on which granular material flowing out from the aperture piles up, such that outflow of the granular material from the aperture is stopped by the granular material piled up on this receiving section;

furthermore, the storage equipment includes:

a scrape-out means for causing granular material piled up on the receiving section to fall from the receiving section;

a conveyor disposed at a position on which granular material falls from the receiving section;

and a closing plate for adjusting the width of the aperture;

wherein the storage section has a pair of side walls inclined so as to be in close proximity at least at the lower portion, such that a space for holding the granular material is formed between the pair of side walls, and the aperture is formed between the bottom edges of the side walls;

the receiving section continues from the bottom edges of one of the pair of side walls and extends more than the aperture toward a position on the other side wall side;

and the receiving section includes a vertical plumb portion extending essentially vertically downward from the bottom edge of one side wall, and a horizontal portion extending more than the aperture, essentially horizontally from the bottom edge of the plumb portion toward the other side wall side; and

wherein the scrape-out means has a scrape-out member formed of a

triangular column member and capable of essentially fixed speed movement on the receiving section with the bottom surface in contact with the horizontal portion and one side surface in contact with the plumb portion.

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