

A GEARBOX FOR A FLIPPER ASSEMBLY

FIELD OF INVENTION

- 5 The present invention relates a transmission gearbox for a flipper assembly. Particularly, a transmission gearbox that is adaptable for hydraulic or electric input drives for driving operation of a flipper arm.

BACKGROUND OF THE INVENTION

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Current technologies for flipper operation on a mainstream spreader is hydraulic driven, wherein hydraulic actuators drive the flipper rotary movement. The actuator provides the flipper gathering and holding torque to assist the spreader placement onto the shipping containers. However, conventional hydraulic systems are sensitive to
15 temperature changes and are susceptible to oil leak, which compromise the hydraulic systems' performance and reliability. The hydraulic system needs to be constantly powered to deliver pressurized hydraulic energy to actuate the various spreader operations. This may lead to energy wastage due to system inefficiency in operation. With the global climate action gaining traction, port operators desire to have sustainable
20 and resilient operation by adopting electric equipment over conventional electro-hydraulic equipment. Nevertheless, current electric flipper drives available in the market are huge, heavy, and complex in design, and have poor performance with low reliability and maintainability.

- 25 As such, many technologies have been investigated and implemented to improve on the transmission gearbox for flipper assembly. For example, a Singaporean patent with publication no. SG186520A1 discloses a spreader assembly comprising a spreader having container engagement devices for engaging and disengaging a container, a lid engagement device mounted to the spreader, said lid engagement device having an

actuator for positioning a lid engagement frame proximate to lid of said container, said frame arranged to engage said lid so as to permit the actuator to move said lid relative to the container.

- 5 A United States patent with publication no. US11708247B2 discloses a container spreader for coupling a container with a hoisting installation having a number of assemblies of a guiding plate and a displacing device connected hereto, for displacing the guiding plate between an active position A and an inactive position B. The displacement device has a hydraulic swivel motor provided with an output shaft which
- 10 is connected to the guide via connecting elements. A hydraulic unit is coupled to the swivel motor via coupling device for supplying and discharging hydraulic oil from and to the swivel motor. By applying a hydraulic swivel motor, a final transmission can be omitted and no valves are required for keeping the hydraulic motor at pressure.
- 15 Another United States patent with publication no. US8025324B2 discloses an arrangement on a spreader for lifting containers, the arrangement comprising a flipper arm which is supported at the corner of the spreader such that the flipper arm is pivotable between an upraised rest position and a lowered operative position wherein the flipper arm is effective for positioning of the spreader corner relative to the
- 20 corresponding corner of a container upon connecting the spreader to the container. The arrangement is characterized in that the flipper arm is carried on a rotatable shaft and driven by a motor, and wherein a power transmission is inserted between the motor and the flipper arm, the power transmission being effective for the transfer of torque from the motor to the flipper arm upon energizing the motor, and operative for locking the
- 25 flipper arm in its pivoted position upon non-energizing the motor.

SUMMARY OF INVENTION

An object of the present invention is to accommodate for different types of input drives,

whether electric, hydraulic or both. It is also an object of the present invention to provide a modular design that allows the gearbox to be transformed into different configurations with the input drive installed at different angle orientations. Another object of the present invention is to provide a gearbox that is easily maintained,
5 serviced, and troubleshoot.

In one aspect of the present invention, there is provided a flipper assembly for engaging a shipping container, the flipper assembly comprising a flipper arm pivotably mounted on a spreader, with said flipper arm being moveable between an opened position and a
10 closed position about said pivoted mounting; and a transmission gearbox operatively connected to the flipper arm and an input drive, in which said transmission gearbox is adapted to transfer incoming torque from the input drive to move the flipper arm between its opened position and closed position; wherein the transmission gearbox includes a locking mechanism operable to prevent linear vertical movement of one or
15 more components within said transmission gearbox in the event of impact by external force during operation.

Preferably, the flipper arm is operatively connected to the transmission gearbox by an output shaft extending therethrough.
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Preferably, the transmission gearbox is encased in a standing housing.

Preferably, the input drive is connected to the transmission gearbox by a plurality of spur gears connected in series and is encased in a base housing.
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Preferably, the base housing is pivoted at a bottom section of the standing housing, such that the base housing is positioned at an angle that revolves around the pivot relative to the standing housing.

Preferably, the input drive is either an electric drive or a hydraulic drive.

Preferably, the locking mechanism comprises of a rack gear and a pinion gear integrated with a screw jack.

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Preferably, the screw jack is incorporated with a screw jack shaft, a screw jack top nut, and a screw jack bottom boss.

Preferably, the screw jack top nut and the screw jack bottom boss constrains the vertical
10 linear movement of the screw jack when impacted by external force during operation.

One skilled in the art will readily appreciate that the present invention is well adapted to carry out the objects and obtain the ends and advantages mentioned, as well as those inherent therein. The embodiment described herein is not intended as limitations on the
15 scope of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

For the purpose of facilitating an understanding of the invention, there is illustrated in
20 the accompanying drawing the preferred embodiments from an inspection of which when considered in connection with the following description, the invention, its construction and operation and many of its advantages would be readily understood and appreciated.

25 **FIG. 1** is an isometric view illustrating a preferred embodiment of a flipper assembly.

FIG. 2 illustrates a front cross-sectional view of a gearbox for the flipper assembly.

FIG. 3 illustrates a side cross-sectional view of the gearbox for the flipper assembly.

FIG. 4 illustrates a top cross-sectional view of the gearbox for the flipper assembly.

DETAILED DESCRIPTION OF THE INVENTION

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Hereinafter, the invention shall be described according to the preferred embodiments of the present invention and by referring to the accompanying description and drawings. However, it is to be understood that limiting the description to the preferred embodiments of the invention is merely to facilitate discussion of the present invention and it is envisioned that those skilled in the art may devise various modifications without departing from the scope of the appended claim.

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The invention will now be described in greater detail, by way of example, with reference to the drawings.

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In **FIG. 1**, a flipper assembly for engaging a shipping container is illustrated, particularly, the flipper assembly is one of a plurality of flipper assemblies for a shipping container lifting spreader. The flipper assembly is preferably mounted to each corner of the spreader, with the flipper assembly being directed outwards at an inclined angle, such as 45 degrees relative to the corner of the shipping container. For guidance of the spreader during a connection operation with the shipping container, the flipper assembly may comprise of a flipper arm **1** which is pivotably mounted onto the spreader, in which said flipper arm **1** is moveable between an opened position and a closed position. The opened position may be depicted as an upraised rest position or initial position, while the closed position may be depicted as a lowered operative position, these terms being interchangeable throughout the description of the present invention. In operation, the flipper arm **1** may extend below the spreader and adjacent a side or a corner of the container to position and guide the spreader when lowering to a top side of the shipping container for connection engagement therewith.

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It shall be understood that upon bringing the spreader into proximity with the shipping container, high impact load may be applied to the flipper arm **1**. As a result, the flipper arm **1** may be configured to resist high impact loads with the shipping container while
5 guiding the spreader to said shipping container. It is also appreciated that as the spreader contacts the shipping container, a considerable amount of rattling or bouncing may occur while the flipper arm **1** is lowered onto the corners of the shipping containers. This occurrence of rattling may lead to impact loads which is to be resisted by the flipper arm, in which high impact loads may potentially cause damage to the flipper
10 arm **1** and corresponding components driving said flipper arm **1**. According to the present invention, the flipper arm **1** may be operatively connected to a transmission gearbox by an output shaft **14** extending therethrough, in which the transmission gearbox includes a locking mechanism that is operable to prevent linear vertical movement of one or more components within said transmission gearbox in the event of
15 impact by external forces during operation, with said external forces being the rattling or bouncing of the flipper arm **1** while being lowered onto the corners of the shipping containers.

With reference to **FIG. 2** to **FIG. 4**, a preferred embodiment of the present invention is
20 shown in cross-sectional views of the transmission gearbox which is preferably encased in a standing housing **7** having standing housing walls **15a**, **15b**, **15c** for protecting the components within said transmission gearbox from external impurities or impact load. Additionally, the transmission gearbox includes a base housing **4** for encasing a plurality of spur gears **5**, **6** in a series configuration, which operatively connects the
25 transmission gearbox to an input drive **2**, enabling said transmission gearbox to transfer incoming torque from the input drive **2** to move the flipper arm **1** between its opened position and its closed position. The base housing **4** may be pivoted at a bottom section of the standing housing, such that the base housing **4** may be positioned at an angle that revolves around the pivot relative to the standing housing **7**, by way of example, ranging

between 0° to 180°. Advantageously, this configuration enables the present invention to be modular, scalable, and expandable. Further, the base housing **4** and the standing housing **7** may both also be filled with lubricating oil to minimize wear and improve efficiency of the components therein by reducing friction generated during operation, allows heat generated from said friction to be dissipated to prevent overheating, and increases the longevity of the components therein.

With reference to **FIG. 2** to **FIG. 4**, the input drive **2** may be a hydraulic drive or an electric drive, and may be mounted vertically to eliminate adverse effects of cantilever mounting, and may also be installed on a same plane adjacent to the transmission gearbox to reduce an overall height of the flipper assembly. Hydraulic drives tend to offer a higher force output and smooth operation but requires additional components such as hydraulic pumps, valves, and fluid, which makes it more complex. On the other hand, electric drives offer more precise control over speed and position of the flipper arm **1**, and is generally more energy-efficient as compared to hydraulic drives. Additionally, electric drives are cleaner and requires less maintenance as they do not require hydraulic fluid to operate, reducing the risk of hydraulic fluid leaking or contaminating the transmission gearbox. Although hydraulic drives typically generally high force output compared to electric drives, advancements in electric drives allow them to generate more force while maintaining a high precision in control. However, the optimal choice for applications using either hydraulic drives or electric drives depends on specific requirements of said applications. Nevertheless, the transmission gearbox is catered to accommodate either the hydraulic drive or the electric drive, allowing flexibility in arrangement depending on user requirement.

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In a preferred embodiment, the input drive **2** may comprise an input drive shaft **3** that is operatively connected to a first spur gear **5** in said base housing **4**. The first spur gear **5** may then be in series connection with a second spur gear **6**, which is subsequently connected to a screw jack **8** in the transmission gearbox. Preferably, the first spur gear

5 and the second spur gear **6** have a variable ratio of teeth, by way of example, 1:2, 1:3, or the likes, such that a speed of both the first spur gear **5** and the second spur gear **6** may be the optimally adjusted throughout the flipping operation, allowing for an efficient distribution of torque from the input drive **2** to the screw jack **8**. In a further embodiment, additional spur gears may be employed and connected in series to accommodate for any increased spacing between the input drive **2** and the standing housing **7** and flipper arm **1**.

Preferably, the screw jack **8** is a mechanical device that converts rotational motion into linear motion. To achieve this, the screw jack **8** is incorporated with a screw jack shaft **9**, a screw jack bottom boss **10**, and a screw jack top nut **11**. Preferably, the screw jack **8** is encased in the standing housing **7**, such that the screw jack **8** may be integrated with a rack gear **12** and a pinion gear **13**, all of which make up the locking mechanism as mentioned earlier. In a preferred embodiment, the rack gear **12** and pinion gear **13** complement the screw jack shaft **9** by converting rotational motion into linear motion and vice versa. Preferably, the rack gear **12** may be a linear gear, particularly a toothed gear that travels vertically along threads of the screw jack shaft **9**, whereas the pinion gear **13** may be a circular gear that meshes with the rack gear **12** and converts the linear motion of the rack gear **12** into rotational motion thereafter. In this embodiment, the standing housing walls **15a**, **15b**, **15c** further facilitate the linear movement of the rack gear **12** up and down along the screw jack shaft **9**. Further, the pinion gear **13** may be incorporated to an output shaft **14** that extends outwards from the standing housing **7** and supports the flipper arm **1**, such that the rotation motion of the pinion gear **13** actuates a rotary movement of the flipper arm **1** between its opened position and closed position.

In operation, the input drive **2**, the spur gears **5**, **6**, the screw jack **8**, and the output shaft **14**, together form a power transmission that transfers the input drive's **2** rotation and torque to the flipper arm **1**, whereby a rotational speed of the input drive **2** may be

changed and adjusted accordingly to supply an output rotational speed that is suitable for the flipper arm **1**. During the operation of lowering the flipper arm **1**, the input drive **2** may drive the first spur gear **5** by the input drive shaft **3**. The first spur gear **5** may then drive the second spur gear **6** accordingly, subsequently driving the screw jack shaft **9** to rotate in the same direction as the second spur gear **6**. Depending on the rotation of the screw jack shaft **9**, the rack gear **12** may then travel vertically either up or down along the screw jack shaft **9**. The screw jack bottom boss **10** may constraint the upwards movement of the rack gear **12** while the screw jack top nut **11** may constraint the downwards movement of the rack gear **12** respectively. As a result, the input drive **2** may generate gathering torque to the flipper arm **1**, particularly to the screw jack **8**.

In this embodiment, the transmission gearbox may also be subjected to external impact load while the flipper arm **1** is moving between the opened position and the closed position. In the event of this external impact load, a backward movement of the flipper arm **1** may cause the screw jack **8** to move linearly in a vertical motion due to the rotary movement of the output shaft **14**. However, the vertical motion of the screw jack **8** is constrained by the screw jack bottom boss **10** and screw jack top nut **11**, which constrained the upwards and downwards movements respectively. In turn, this generates a strong holding torque back to the flipper arm **1** to hold said flipper arm **1** in position against the external impact load. This strong holding torque prevents the screw jack **8** and the flipper arm **1** from moving uncontrollably, which may potentially cause damage to the transmission gearbox therewithin.

Advantageously, the present invention provides a transmission gearbox that is suitable for various types of input drives **2**, and is modular in design which allows it to be transformed into different configurations. The transmission gearbox can be installed in the most confined spaces on the spreader and can be scalable to incorporate other options such as a slip clutch feature if required. The transmission gearbox is also simpler in design in comparison with the prior arts, and can be easily maintained and

troubleshooted when a fault occurs.

The present disclosure includes as contained in the appended claims, as well as that of the foregoing description. Although this invention has been described in its preferred
5 form with a degree of particularity, it is understood that the present disclosure of the preferred form has been made only by way of example and that numerous changes in the details of construction and the combination and arrangements of parts may be resorted to without departing from the scope of the invention.

CLAIMS

1. A flipper assembly for engaging a shipping container, the flipper assembly comprising:
a flipper arm (1) pivotably mounted on a spreader, with said flipper arm (1) being
5 moveable between an opened position and a closed position about said pivoted mounting; and
a transmission gearbox operatively connected to the flipper arm (1) and an input drive (2), in which said transmission gearbox is adapted to transfer incoming torque from the input drive (2) to move the flipper arm (1) between its opened position
10 and closed position;
wherein the transmission gearbox includes a locking mechanism operable to prevent linear vertical movement of one or more components within said transmission gearbox in the event of impact by external force during operation.
- 15 2. The flipper assembly according to claim 1, wherein the flipper arm (1) is operatively connected to the transmission gearbox by an output shaft (14) extending therethrough.
3. The flipper assembly according to claim 1 or 2, wherein the transmission gearbox
20 is encased in a standing housing (7).
4. The flipper assembly according to any one of the preceding claims, wherein the input drive (2) is connected to the transmission gearbox by a plurality of spur gears (5, 6) connected in series and is encased in a base housing (4).
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5. The flipper assembly according to claim 4, wherein the base housing (4) is pivoted at a bottom section of the standing housing (7), such that the base housing (4) is positioned at an angle that revolves around the pivot relative to the standing housing (7).

6. The flipper assembly according to any one of the preceding claims, wherein the input drive (2) is either an electric drive or a hydraulic drive.
- 5 7. The flipper assembly according to any one of the preceding claims, wherein the locking mechanism comprises of a rack gear (12) and a pinion gear (13) integrated with a screw jack (8).
8. The flipper assembly according to claim 7, wherein the screw jack (8) is
10 incorporated with a screw jack shaft (9), a screw jack bottom boss (10), and a screw jack top nut (11).
9. The flipper assembly according to claims 8, wherein the screw jack top nut (11) and the screw jack bottom boss (10) constrains the vertical linear movement of the
15 screw jack (8) when impacted by external force during operation.