

IMPROVED SPREADER AND USE THEREOF

Field of the Invention

5 The invention relates to the transportation of shipping containers and other intermodal devices and in particular, the manipulation of said containers and devices by cranes and spreaders. Specifically, the invention relates to purpose-built bulk containers and devices for transporting particulate matter whereby access to the particulate matter is provided through the top surface of said containers.

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Background

For the transport of particulate material such as grain, minerals, in particular, iron ore etc., a particular type of container is used having a top surface as the means of filling the container.

15 For transportation, this top surface is sealed by a lid so as to contain and provide security for the material therein.

As preliminary steps in the loading and unloading of the material from said container is to engage the container with a spreader to lift it to the required position, setting it down and
20 disengaging the spreader and then manually removing the lid for subsequent loading and unloading.

It is important for the economic efficiency of the transport of intermodal devices to limit the number of steps in the manipulation of said containers and so having a separate step for the
25 placement and removal of the lid adds to the cost of transportation.

Summary of Invention

In a first aspect, the invention provides a spreader assembly comprising a spreader having
5 container engagement devices for engaging and disengaging a container; and a lid
engagement device mounted to the spreader, said lid engagement device comprises at least
one actuator for positioning a lid engagement frame proximate to a lid of a container, wherein
said lid engagement frame includes an adhesion device arranged to adhere to said lid on
application of an external force to permit the actuator to move said lid relative to the
10 container.

The provision of a lid engagement device which is mounted to, or suspended from, the
spreader according to the present invention advantageously allows for the removal, and
placement of the lid as part of the manipulation of the container. No separate process is
15 required prior to loading or following the unloading of material from the container as the
operator of the spreader can control the lid engagement device as part of the normal operation
of the spreader. To this end, embodiments of the invention simplify and accelerate the
process of loading, and unloading of particulate materials during transportation. It follows
that cost of transportation may therefore be reduced.

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In one embodiment, the adhesion device may be an electro-adhesion device. The electro-
adhesion device may comprise one or more electropermanent magnetic devices configured to
apply magnetic forces for magnetic engagement with a lid of a container; a power supply for
each magnetic device; and a user input device arranged to apply current to each magnetic
25 device in response to a user input for demagnetizing said magnetic device.

It will be appreciated that each of the electro-adhesion device produces, and maintains a magnetic effect for engagement with the container lid without requiring a continuous supply of electrical energy. In this regard, the electropermanent magnetic device provides a fail-safe mechanism for secured engagement with the container lid even in the absence of a power supply. It follows, therefore, that any reduction or saving in energy improves the economic efficiency of the transport of intermodal devices, and so provide a significant commercial advantage.

10 In a further embodiment, the adhesion device may include vacuum seals. To remove and place a container lid in respect to a container, one or more of the vacuum seals may be provided as an interface between the lid, and lid engagement device. In one embodiment, each vacuum seal may be arranged to selectively permit fluid communication with a vacuum source to apply a fluid pressure for engagement with a lid of a container; a user input device
15 arranged to permit fluid communication between the vacuum source and each vacuum seal in response to a user input.

In embodiments of the invention, the lid engagement frame may include one or more suspensions for suspending each adhesion device, either an electropermanent magnetic
20 device or vacuum seal from the lid engagement device. In particular, the suspensions permit contact, and thus provide a secured engagement between the lid engagement device and container lid.

In a second aspect, the invention provides a lid engagement device comprising at least one
25 actuator for positioning a lid engagement frame proximate to a lid of a container, wherein

said lid engagement frame includes an adhesion device arranged to adhere to said lid on application of an external force to permit the actuator to move said lid relative to the container.

- 5 In embodiments of the present invention, the lid engagement device may be permanently fixed to the spreader so as to have the spreader and lid engagement device as an original equipment manufacturer construction at the time of manufacturing the spreader. Alternatively, the lid engagement device may be selectively mountable to any spreader suitable for lifting containers so as to fit to existing spreaders for improving the capability of
- 10 a standard spreader.

In an embodiment, the spreader may comprise a first and second frame with the lid engagement device mounted to or suspended from the first frame, and the container engageable by the second frame, said first and second frames being in rotational engagement.

- 15 In this embodiment, the spreader may be a tipping spreader whereby the first frame remains stationery whilst the second frame rotates the container so as to tip out the particular matter from the container. In this regard, a further process step may also be removed in that the unloading of the material can also be under the control and operation of the spreader operator.

- 20 In a third aspect, the invention provides a container lid selectively mountable to a container having a top opening for sealing said container, said container lid comprising a top surface for engagement with a lid engagement device according to any aspect of the present invention, said top surface comprises one or more planar regions for engagement with said lid engagement device.

Brief Description of Drawings

It will be convenient to further describe the present invention with respect to the accompanying drawings that illustrate possible arrangements of the invention. Other
5 arrangements of the invention are possible and consequently, the particularity of the accompanying drawings is not to be understood as superseding the generality of the preceding description of the invention.

Figures 1A to 1D are isometric views of containers and their corresponding container lids
10 according to various embodiments of the present invention;

Figures 2A and 2B are sequential isometric views of a spreader assembly and lid engagement device according to one embodiment of the present invention;

15 Figures 3A to 3C are sequential side elevation views of the spreader assembly and lid engagement device of Figures 2A and 2B;

Figure 4 is a detailed view of the lid engagement device of Figures 2A, 2B, 3A to 3C;

20 Figures 5A and 5B are sequential isometric views of a spreader assembly and lid engagement device according to an embodiment of the present invention;

Figure 6 is an isometric view of a spreader assembly and lid engagement device according to one embodiment of the present invention;

Figure 7A to 7C are sequential side elevation views of a spreader and lid engagement device according to an embodiment of the present invention; and

Figure 8A to 8C are sequential side elevation views of a spreader and lid engagement device according to a further embodiment of the present invention.

Detailed Description

As used herein, the term “adhere” shall be interpreted as a connection between objects in the absence of mechanical engagements. The connection may be created by means including but not limited to a force exerted by a magnetic field and a force exerted by fluid pressure. The terms “adhering” and “adhesion” shall be construed accordingly.

As used herein, the terms “lid” and “container lid” may be used interchangeably.

Figures 1A to 1D show containers according to various embodiments of the present invention. Figure 1A shows a container 20 comprising a container lid 27 removed from its top opening 26. Figure 1B shows the container lid 27 of Figure 1A in cooperation with, or fitted to the top opening of container 20. It will be appreciated that the lid 27 of container 20 may be constructed from steel panels with magnetic properties, and so may be subjected to magnetic forces exerted by a magnetic field.

In embodiments of the invention, the container lid may further comprise one or more fork or fork-lift pockets on its top surface. The fork pockets permit the insertion of forks from a forklift so as to secure the container lid, or both the container and lid, in respect to the forklift

for subsequent lifting and/or transportation. The fork pockets may be constructed from steel and so may be subjected to magnetic forces exerted by a magnetic field. In the embodiment of Figures 1A and 1B, container lid 27 may include two fork pockets 28 and 29. In particular, the fork pockets 28, 29 may comprise a flat or planar region 6, 7 for engagement
5 with a lid engagement device of the present invention. It will be appreciated that whilst a flat or planar region is preferred for engagement with a lid engagement device of the present invention, the lid engagement device may engage container lids in a similar manner by means of contact with any other parts of the container lid cover. In one embodiment, the lid engagement device of the present invention may engage with uneven profiles of the container
10 lid cover, and subsequently, move or place the lid with respect to the container.

It will be appreciated that the fork pockets may be permanently fixed to a container lid so as to have the container lid, and fork pockets as an original equipment manufacturer (OEM) construction at the time of manufacturing the container lid. Alternatively, the fork pockets
15 may be selectively mounted or welded to the top region of a container lid, so as to fit to existing container lids, and thus improving their compatibility with the various designs of spreaders, and/or lid engagement devices.

Figure 1C shows a container lid 32 according to a further embodiment of the present
20 invention. Container lid 32 comprises two sets of forklift pockets 33, 34. Specifically, each set 33, 34 may comprise a series of steel brackets mounted to the top region of the container lid 32, and aligned for receiving forks from a forklift. Each steel bracket may comprise a sufficiently flat or planar region 39 for engagement with a lid engagement device of the present invention.

In embodiments of the invention, the container lid may further include one or more flat or planar region or surface. These flat regions may be constructed from steel and so may be subjected to magnetic forces exerted by a magnetic field. The container lid according to the embodiment of Figure 1C comprises two flat regions 36, 37. Figure 1D shows a container lid 5 38 according to another embodiment of the present invention. Container 38 is provided with two sets of brackets 41, 42. In particular, each set of bracket may comprise two or more steel brackets mounted onto the top region of the container lid 38, and aligned for receiving forks from a forklift. Each steel bracket may comprise flat region 43, 44. It will be appreciated that the number of steel brackets provided may vary according to a particular load requirement 10 and/or intended application.

Figures 2A, 2B and Figures 3A to 3C show a spreader assembly 5 and lid engagement device 10 according to an embodiment of the present invention. The spreader assembly 5 comprises a spreader 23 and a lid engagement device 10 suspended thereof for engaging a container 20 15 as illustrated in Figures 1A and 1B.

In one embodiment, the adhesion device may be an electro-adhesion device. The electro-adhesion device may comprise one or more electropermanent magnetic devices configured to apply magnetic forces for magnetic engagement with a lid of a container; a power supply for 20 each magnetic device; and a user input device arranged to apply current to each magnetic device, in response to a user input, for demagnetizing said magnetic device.

In this embodiment, each electropermanent magnetic device may comprise one or more permanent magnets, and an electromagnet. The electropermanent magnetic device may be 25 configured to provide a fail-safe mechanism for providing a secured engagement with the

container lid. In one embodiment, each permanent magnet may comprise a magnetically hard material and a magnetically soft material, of which the soft material have a much lower intrinsic coercivity (measure of the ability of a ferromagnetic material to withstand an external magnetic field without becoming demagnetized) than the hard material. Specifically, the hard and soft materials of the permanent magnet are configured to generate a magnetic field such that magnetic forces are applied for engagement with the container lid without requiring a continuous supply of electrical energy.

The electromagnet in this embodiment may comprise a coil wound around the magnetically soft material, and may be connected to a power supply, and a user input device for receiving a user input. Further, the electromagnet and permanent magnet may be arranged to inject a pulse of current in response to a user's input. Specifically, the pulse of current generates a magnetic field with an intrinsic coercivity that is higher than that of the magnetically soft material of the permanent magnet. As a result, the pulse of current generates a magnetic field that changes the magnetization of the soft material but not the magnetization of the hard material. With opposite magnetizations, the magnetic fields of the magnetically soft and hard materials are thus confined within the electropermanent magnetic device. In other words, the external magnetic field that was initially present prior to the application of the pulse of current has become almost non-existence. To this end, the lid engagement device of this embodiment advantageously reduces operational expenditure as power supply is only required during disengagement between the lid engagement device and the container lid.

Figure 4 shows a detailed view of a lid engagement device 10 according to an embodiment of the present invention. Here, the lid engagement device 10 comprises a lid engagement frame 65 and an electro-adhesive device comprising four electropermanent magnetic devices 55. The electropermanent magnetic devices 55 may comprise components and a set-up which are

similar to that as afore-described, and hence not repeated for brevity. The lid engagement device 10 may include two vertical actuators 60 arranged to lift, and lower the electromagnetic devices 55 relative to a container 20 as illustrated in Figures 2A and 2B. It will be appreciated that the number of electromagnetic devices, suspensions and actuators
5 used for lifting and/or placement of a container lid may vary according to the requirements of an intended application.

In one embodiment, the adhesion device may comprise one or more vacuum seals, each vacuum seal arranged to selectively permit fluid communication with a vacuum source to
10 apply a fluid pressure for engagement with a lid of a container; a user input device arranged to permit fluid communication between the vacuum source and each vacuum seal in response to a user input.

It will be appreciated that a lid lifting device of the present invention may remove and place a
15 container lid in respect to a container, when one or more vacuum seals are provided as an interface between the lid, and lid engagement device. Figures 8A to 8C show a spreader 160 comprising a lid engagement device 165 mounted thereto according to a further embodiment of the present invention. The lid engagement device 165 may incorporate a lid engagement frame 170, one or more vertical actuators 175, 180, one or more suspensions, a power supply,
20 a user input device and a configuration, which are similar to that as afore-described for Figure 4, and hence not repeated for brevity. Importantly, the lid engagement device 165 is provided with one or more vacuum seals 185 for engagement with a container lid 190 of a container.

In this embodiment, each vacuum seal may be connected to one or more vacuum pumps through a series of pneumatic tubes. The vacuum seal and vacuum pumps may in turn be connected to a user input device and power supply, and configured to permit fluid communication between each vacuum seal, and vacuum pump in response to a user's input.

5 In one configuration, one or more vacuum seals are first positioned proximate to a container lid prior to engagement. This is followed by activation of the vacuum pump, in response to a user's input, to remove air between the container lid, and one or more vacuum seals. This in turn creates one or more partial vacuum or lower pressure regions defined by the space between the vacuum seal and container lid. To this end, the pressure difference between the
10 low pressure regions within each vacuum seal, and the atmosphere keeps the one or more vacuum seals adhered to the container lid. Specifically, the atmosphere exerts atmospheric (fluid) pressure for connecting or adhering the container lid to the vacuum seals.

In another configuration, the vacuum pump may be de-activated in response to a user's input,
15 and configured to return air to the vacuum seals. This reduces the pressure difference between each vacuum seal and the atmosphere, and causes disengagement between the lid and one or more vacuum seals of the lid engagement device.

Each vacuum seal may be a cup or a pad of any shape suitable for forming a seal between the
20 lid engagement device and the container lid. For example, suitable shapes include but are not limited to: circular, elliptical and rectangular. In addition, the vacuum seal may be made from any suitable materials. Suitable materials may include but are not limited to silicon and nitrile.

In one embodiment, the lifting or loading capacity of each electromagnetic device may be more than the weight of a container lid, or preferably at least twice the weight of the container lid. In another embodiment, the lifting or loading capacity of each vacuum seal may be more than the weight of a container lid, or preferably be at least twice the weight of the container lid. It will be appreciated that the weight of a typical 20 foot and 40 foot container lid, made from standard material such as steel, may be within the range of 300 to 500 kg and 600 to 1,000kg respectively.

In embodiments of the present invention, the power required for each electromagnetic device for the placement and removal of a typical container lid may be within the range of 3kW to 4kW.

In embodiments of the present invention, the user input device may be located in a control room, remote from the spreader assembly, such that it is accessible to the operator. The user input device may be operated to selectively position the lid engagement frame, together with the electropermanent magnetic devices or vacuum seals, in respect to a container lid.

In one embodiment, the user input device may permit the user to inject a pulse of current for disengagement between the container lid and lid engagement device. In an alternative embodiment, the user input device may allow selectively fluid communication between each vacuum seal and a corresponding vacuum source in response to a user's input, for permitting engagement or disengagement between the lid engagement device, and a lid of a container.

In embodiments of the present invention, the electrical energy required by the electropermanent magnetic devices or vacuum seals may be provided by a central power

source, which also supplies electrical energy required for other spreader functions such as container engagement and rotation. In an alternative embodiment, a separate power source may be provided and arranged so as to supply electrical energy to one or more electropermanent magnetic devices or vacuum seals.

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In embodiments of the invention, the lid engagement frame may include one or more suspensions for suspending each electropermanent magnetic device or vacuum seal from the lid engagement device. With the lid engagement frame of Figure 4, the suspensions 70 may include one or more of: a spring, a chain, a shock absorber or dampeners, and a linkage. The
10 suspensions 70 facilitate contact and engagement between the electropermanent magnetic devices 55 or vacuum seals and the lid 27 of said container.

In an embodiment, the lid engagement device 10 may include at least one landing sensor (not shown) in communication with a processor arranged to identify a predetermined object
15 detected by the sensor. The processor may be arranged to signal to an operator on identification of the predetermined object, which may in one instance correspond to a forlift pocket, flat region or planar surface on the lid of a container. In one embodiment, the landing sensor may be positioned adjacent to each electropermanent magnetic device or vacuum seal.

20 In embodiments of the invention, the lid engagement device may include two electropermanent magnetic devices or vacuum seals. For convenience, the following embodiments will refer to the invention provided with electropermanent magnetic devices. It will be recognized that the following embodiments would function in a similar manner when the invention is provided with other adhesion devices such as the afore-described vacuum

seals. Accordingly, the reference to electropermanent magnetic devices is not to be read as limiting the application of the invention.

Figures 5A shows a spreader assembly 75 comprising a lid engagement device 80 with two
5 electropermanent magnetic devices 90 according to an embodiment of the present invention.

It will be appreciated that lid engagement device 80 may also incorporate a lid engagement frame, one or more actuators, one or more suspensions, a power supply, a user input device and a configuration, similar to that as afore-described for Figures 2A, 2B, 3A to 3C and 4, and hence not repeated for brevity. Here, the lid engagement device 80 is positioned
10 proximate to the container lid 89. Figure 5B shows the lid engagement device 80 of Figure 5A arranged to adhere to said lid on application of a magnetic force, so as to move the lid 89 away from the container opening 88.

In embodiments of the present invention, the lid engagement device may be located centrally
15 on the spreader, so as to be within the arrangement of one or more flat regions and/or one or more fork pockets. The lid engagement device 10 of Figures 3A to 3C may be located centrally on the spreader 23 so as to be within the arrangement of fork pockets 35. It will be appreciated that the lid engagement device 10 may be provided with horizontal actuators (not shown) to permit horizontal adjustments of the lid engagement device 10 relative to the
20 container lid 27.

As shown in Figures 3A and 3B, the actuators 50 lower the lid engagement device 10 such that it is proximate to the fork pockets 35 of container lid 27. The fork pockets 35 are thus brought within the magnetic field of the electropermanent magnetic devices 55, and so
25 encounter a pulling force towards the electropermanent magnetic devices 55. In other words,

the electropermanent magnetic devices 55 apply magnetic forces for engagement with the fork pockets 35 of container lid 27.

Container lid 27 is consequently lifted through lifting of the spreader 23 by a crane. Thus, the spreader assembly 5 comprising a lid engagement device 10 is capable of engaging and disengaging with a container 20 whilst at the same time being able to engage and disengage with a lid 27 for removal from the container 20.

In another embodiment, the operator may engage a container lid by contacting the electropermanent magnetic devices with any other flat region provided on the container lid. Figure 6 shows a lid engagement device adhered to the fork lift pads 100 of container lid 105. The lid engagement device 95 of this embodiment may incorporate a lead engagement frame, one or more vertical and/or horizontal actuators, one or more suspensions, a power supply, one or more electropermanent magnetic devices or vacuum seals, a user input device and a configuration, similar to that as afore-described for Figures 2A, 2B, 3A to 3C and 4, and hence not repeated for brevity.

Figure 7A shows a spreader 115 comprising a lid engagement device 120 mounted thereto according to an embodiment of the present invention. The lid engagement device 120 may incorporate a lead engagement frame, at least one vertical and/or horizontal actuator, one or more suspensions, one or more electropermanent magnetic devices or vacuum seals, a power supply, a user input device and a configuration, which are similar to that as afore-described for Figures 2A, 2B, 3A to 3C and 4, and hence not repeated for brevity. In this embodiment, the operator may engage container lid 125 by positioning the adhesion devices 130 proximate to the flat regions of forklift pockets 135, 140.

Alternatively, the operator may engage container lid 125 by positioning the adhesion devices 130 proximate to the flat regions of steel brackets 145, 150 on the top surface of container lid 125. Figure 7C shows the spreader 115 of Figures 7A and 7B engaged with a container 155 whilst at the same time being able to engage or disengage with container lid 125 for removal from the container 155.

In embodiments of the present invention, the lid engagement device may be permanently fixed to the spreader so as to have the spreader, and lid engagement device as an original equipment manufacturer (OEM) construction at the time of manufacturing the spreader. Alternatively, the lid engagement device may be selectively adapted or mounted to the any spreader suitable for lifting containers so as to fit to existing spreaders, and thus improve the capability of a standard spreader. For example, spreaders suitable for lifting containers may include but are not limited to: a single-lift spreader, a twin-lift spreader, a telescopic spreader and a revolving or tipping spreader.

Figure 2A shows a spreader assembly 5 according to an embodiment of the present invention. The spreader assembly 5 may comprise a first frame 30 and a second frame 40. The first and second frames 30, 40 are in rotational engagement through a rotational actuator 45. In this embodiment, the first frame 30 remains fixed in place relative to the second frame 40 with the second frame 40 being able to rotate relative to the first frame 30 on operation of the rotational actuator 45.

As seen in Figures 2A and 3B, the spreader assembly 5 engages a container 20. In this embodiment, the engagement is through the second frame 40 which has engagement portions

47 for engaging the container 20 through normal twistlock devices. The lid engagement device 10 having actuators 50 lowers the magnets 55 suspended thereof to engage with castings 35 located in the lid 27 of the container 20. Figures 2B and 3C then show the actuators 50 retracting so as to lift the lid 27 clear from the container 20 so as to expose the
5 containment area within the container.

The rotational actuator 45 is activated so as to rotate the container 20 to empty the contents from the void or containment area, and thus unload the container 20 whilst still engaged with the spreader assembly 5. It will be appreciated that the angle of rotation of container 20 may
10 vary according to the requirements of an intended application, for instance the type of particulate matter being held and transported.

It will be appreciated that the spreader may in turn be adapted to any suitable machinery for lifting the spreader, together with the one or more containers. For example, suitable
15 machinery may include but are not limited to: a crane, a forklift, a straddle carrier and a reach stacker.

CLAIMS

1. A spreader assembly comprising:
 - a spreader having container engagement devices for engaging and disengaging a container; and
 - a lid engagement device mounted to the spreader;
 - said lid engagement device comprises at least one actuator for positioning a lid engagement frame proximate to a lid of a container, wherein said lid engagement frame includes an adhesion device arranged to adhere to said lid on application of an external force to permit the actuator to move said lid relative to the container.
2. The spreader assembly according to claim 1, wherein the adhesion device is an electro-adhesion device comprising:
 - one or more electropermanent magnetic devices configured to apply magnetic forces for magnetic engagement with a lid of a container;
 - a power supply for each magnetic device; and
 - a user input device arranged to apply current to each magnetic device, in response to a user input, for demagnetizing said magnetic device.
3. The spreader assembly according to claim 1, wherein the adhesion device comprises:
 - one or more vacuum seals, each vacuum seal arranged to selectively permit fluid communication with a vacuum source to apply a fluid pressure for engagement with a lid of a container,
 - a user input device arranged to permit fluid communication between the vacuum source and each vacuum seal in response to a user input.
4. The spreader assembly according to claim 2, wherein the lid engagement frame includes one or more suspensions for suspending each electropermanent magnetic device from the lid engagement device.
5. The spreader assembly according to claim 3, wherein the lid engagement frame includes one or more suspensions for suspending each vacuum seal from the lid engagement device.

6. The spreader assembly according to claim 4 or 5, wherein the suspension may comprise one or more of: a spring, a chain, a shock absorber and a linkage.