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CONTAINER TRANSPORT SYSTEM

Field of the Invention

- 5 The invention relates to the manipulation of intermodal devices such as containers, etc.
In particular the invention relates to spreaders used to engage two or more containers at the same time and move these to required locations.

Background

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To increase the rate of processing of shipping containers and other intermodal devices, the advent of multiple spreaders used for engaging two or more containers simultaneously is becoming more prevalent.

- 15 One of the difficulties faced with moving two containers at the same time is that whilst generally standard in dimensions, they still do vary to a degree. Therefore, when moving and disengaging two containers the platforms upon which the containers are placed may be at a differential height or positions such as on top of two dissimilar containers. It is therefore necessary for the spreaders to be able to accommodate
20 variations in the height and position of the containers in order to effectively manage more than one container at a time.

Another such movement is the ability to "skew" two containers by the same amount.

The reason for the requirement for the skew is because containers may not be placed



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parallel to spreaders. In this case, the spreaders have to be skewed to an angle till they are parallel to the containers before they could be landed on to the containers. In another case, when the spreaders with containers attached try to land the container on to the container trailers that are parked in a slight misaligned angle and are not parallel to the spreaders, the spreader also has to be skewed to the right angle before they could be landed on to the trailer. Conventionally, twin spreaders will comprise two head blocks connected by linkages arranged to vary the horizontal distance between the two containers. However, in the vertical direction it is necessary to have flexibility within the system such that when placing the two containers if one container contacts a platform higher than the other, the linkage is not permanently deformed trying to accommodate the height differential.

It is therefore an object of the invention to include apparatus so as to permit the total "skew" of two containers engaged by a twin spreader. But at the same time still permit height differential between the 2 spreaders.

Summary of Invention

In a first aspect the invention provides a twin spreader assembly for engaging at least two containers, the assembly comprising: a pair of head blocks, each for engaging at least one spreader, said head blocks connected by an intermediate linkage, said linkage having at least one actuator and arranged to selectively space the head blocks along a horizontal axis, and; a locking device mounted to the linkage; wherein said locking

device is arranged to selectively prevent movement of the linkage corresponding to spacing of the head blocks along a vertical axis.

In a second aspect the invention provides a method of skewing a twin spreader assembly,
5 said twin spreader assembly comprising a pair of head blocks connected by an intermediate linkage, the method comprising the steps of: applying an external force to diagonally opposed corners of said head blocks; locking the linkage and so; preventing movement of the linkage corresponding to spacing of the head blocks along a vertical axis; redistributing the applied force so as to asymmetrically arrange the twin spreader,
10 and so; rotating the twin spreader about the vertical axis corresponding to a skew arrangement.

In a third aspect the invention provides a trolley assembly for use in a hoist system, the trolley assembly comprising: a trolley; a pair of sheave sets for directing cables in
15 engagement with a twin spreader assembly, said sheave sets in spaced relation within said trolley; wherein said sheave sets linearly movable within said trolley along parallel axes to each other, said sheaves sets arranged such that on moving said pair of sheaves sets in opposed direction along their respective axes, the twin spreader assembly rotates about a vertical axis in a skew arrangement.

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Accordingly, the invention involves a locking device that locks the linkage, such that on application of an eccentric force, the locking prevents differential height and instead allows the entire twin spreader to “skew”.

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 1C are isometric views defining rotational movement of twin spreaders;
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Figure 2 is a schematic view of a hoist system for a quayside crane;

Figures 3A to 3C are elevation views of the effect of the application of an eccentric load to a twin spreader assembly of the prior art;
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Figures 4A to 4C are elevation views of a twin spreader assembly according to one embodiment of the present invention.

Figures 5A and 5C are elevation views of the effect on twin spreaders when adopting a
20 locking device according to Figure 5B;

Figure 6 is schematic view of a hydraulic circuit of a locking device according to a further embodiment of the present invention;

Figures 7A to 7D are schematic views of the hydraulic circuit of Figure 6;

Figure 8 is a schematic view of a hoist system according to a further embodiment of the present invention.

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Detailed Description

Figures 1A, 1B and 1C show various rotations of a twin spreader assembly 5 engaged with a pair of containers 10. Rotation about the longitudinal axis of the containers is identified as list 15, with rotation about the lateral axis of the containers known as trim 20 and rotation about the vertical axis known as skew 25.

Figure 2 shows a schematic arrangement 30 for a quayside crane used for moving a single spreader. Here, a pair of hoist drums 35 control cables 55, 60, 65, 70 which extend from the hoist drums 35 to actuators 45 at the opposed end of the cables.

The cables pass through a trolley 40 and through sheaves of the spreader assembly 42 intermediate the hoist drums 35 and the trim actuators 45.

Whilst the hoist drums 35 tend to operate the cables uniformly, the trim actuators 45 act individually on each cable and so are able to extend or retract the cables on an individual basis. It is this extending and retracting of cables which achieve a list, trim or skew the spreader 42.

For instance, extending or retracting the cables 55, 60 engaged with laterally opposed sheaves will achieve a trim whereas extending the cables 55, 70 engaged with longitudinally opposed sheaves will achieve a list. To achieve a skew, it is necessary to extend or retract cables 55, 65 engaged with diagonally opposed sheaves. As mentioned,

5 these actions are applicable for a single spreader. The difficulty arises when instead of a single spreader, a twin spreader is used instead, having a linkage (not shown) connecting the head blocks of the spreader. The linkage of a twin spreader is used to space the head blocks in the horizontal plane, and so it provides resistance in the horizontal plane but not the vertical plane. Whilst the trim actions will produce the

10 same result as that for a single spreader, it will not achieve a skew and list. By extending the diagonally opposed cables 55, 65, instead of skewing the spreader this will achieve a relative trim (that is a relative rotation of the two containers about the transverse axis) rather than the desired skew. Accordingly, in this orientation it is not possible for the hoist arrangement to achieve a skew on a twin spreader. By extending

15 the cables 55, 70, instead of listing the spreader this will cause one of the containers to be lifted up and achieve a height differential rather than the desired list.

Figures 3A to 3C demonstrate the effect of attempting the skew of a twin spreader. In the “neutral” position of Figure 3A the two head block 75, 76 lie symmetrically about a

20 centerline 80, which is an imaginary line vertically down from the centre between the two trolley sheaves.

Figure 3C shows the effect of applying an eccentric force through retracting a corner cable 100. In order to distribute the weight of the containers, one head block 76 lifts 115

relative the other head block through the flexibility of the linkage 115, which is incapable of resist the unbalanced force.

If, however, the linkage could resist the upward component of the redistributed forces,
5 the result would be that shown in Figure 3B. Here again, one cable is retracted leading to an eccentric application of force to one head block 76. As the linkage resist the vertical component of the force redistribution, the twin spreader assembly shifts so as to no longer lie symmetrically about the centerline. The result is a skew of the twin spreader. The question remains, therefore, how to lock the linkage and it still being
10 capable of performing its primary function.

An example of the solution is shown in Figure 4A to 4C. In this embodiment, the linkage 143 in question is a parallelogram arrangement of members having an upper beam 145 and lower beam 150 and upright members 157, 158, all of which span
15 between the sheaves 135, 140.

It will be appreciated that several different forms of linkage can be used, for instance a scissor arrangement having a central pivot about which beams connecting the head blocks rotate.

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The core solution to the present problem is a locking device 143, comprising a frame 160 mounted to the upper beam 145 and a locking ram 155 mounted an upright. In order for the linkage to rotate about the sheaves 135, 140 as shown in Figures 4A and 4C, the

ram needs to retract or extend due to the variation in angle between the upper beam 145 and the upright 157.

If the ram 155 is prevented from moving, the linkage is prevented from rotating and so
5 the head blocks are prevented from moving in a relative vertical direction. This will have the effect shown in Figure 3B of redistributing the force of the cable retraction and so skewing the twin spreader.

Figures 5A to 5C demonstrate the two operating conditions of the locking device,
10 whereby Figure 5A has the cylinder 155 shown in Figure 5B locked, and Figure 5C showing the effect of the cylinder 155 in an unlocked position and so permitting the head blocks to move vertically relative to each other.

Figures 6 and 7A to 7D show a hydraulic circuit 185 for the locking device according to
15 one embodiment of the present invention. Here the circuit 185 includes a pump line 184 which supplies pressurized hydraulic oil to operate the locking cylinder 210 and a tank line 182 which return the hydraulic oil back to the hydraulic tank. In this circuit, the pump line pressure is reduced to a lower preset pressure, say 5-10 bar, before it reach the cylinder. In normal condition, when the headblock stayed static, there is no external
20 force acting on the cylinder, both end of the cylinder will be fill with pressurize oil, at the said low preset pressure. At this condition, due to different in area between the rod end and cylinder end, there will be a net resultant force for the cylinder to extend. However, due to the low preset pressure and, the net resultant force will not be sufficient to effect any movement on the heavily constructed linkage and the headblock.

A series of check valve 195 are used to direct and permit the flow of hydraulic oil in a single intended direction to fulfill the overall hydraulic circuit requirement, as typical application in hydraulic circuit.

5 The first path (Figures 7C and 7D), which is associated with unlocking of the cylinder/ram and so “releasing” the ram, is via a low pressure relief valve 240 which is set to a level (first pre-determined threshold) that will allow the static arrangement of the cylinder to remain under the application of a small external load. For instance, the movement of the spreader during normal operation may impart vibration or shifting of
10 the container load which may impart small loads to the cylinder of the locking device. The pressure relief valve, being set to a relatively low pre-determined threshold, is sufficient to prevent movement of the cylinder under such loads. As an example only, the pressure relief valve may be set to a first pre-determined threshold of 30 Bar which may be sufficient to resist such loads, even though the ram is in a “released” condition.

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Under this condition, the spreader is under ideal conditions for adjusting the height differential of the engaged containers. On lowering two containers, should one container contact the platform (such as another container at rest), the differential in applied load of one container compared with the other will exert a force on the linkage which will in
20 turn apply a load 224 on the locking cylinder and increase its pressure. When the pressure has increased sufficiently and become higher than the preset pressure of the pressure relief valve 240 it will overcome the pressure relief valve and so permit the cylinder to move and consequently the linkage to move.

The alternative path (Figures 7A and 7B) when selecting the directional valve 235 passes through a higher pressure relief valve. This alternative path is used for the total skew of the twin spreader according to the present invention. On application of the external load 222 on the locking cylinder as a result of the retraction of cables engaged with the sheaves, the lower relief valve 240 is of insufficient level (first pre-determined threshold) to overcome the applied loads, and will allow the cylinder to slip. Therefore, when the total skew is required, the directional valve 235 is switched to the other path through the higher pressure relief valve 245 which is set at a higher pressure (second pre-determined threshold) sufficient to resist the pressure associated with the skewing load 222 from the cable. The higher pressure relief valve 245 is set, however, to allow the cylinder to slip on the application of a considerably higher load 223, such as for the height differential mentioned previously. Such a second pre-determined threshold pressure may be 200 Bar, but can be determined through normal design procedures for particular applications.

By including the higher pressure relief valve 245, the benefits of a total skew can be achieved, without risking damage to the linkage, which may occur if the cylinder was completely blocked. If, instead of the higher pressure relief valve a complete block was applied, if one container was accidentally lowered onto a higher platform than the other causing a height differential condition, the cylinder would be completely locked leading to the permanent deformation of the linkage.

Figure 8 shows an alternative arrangement of the present invention. In particular, Figure 8 shows a hoist system having hoist drums 35 operating cables 55, 60, 65, 70 which

terminate at trim actuators 45. Where the arrangement of Figure 8 varies from Figure 2 is in the use of a specialized trolley 255. The trolley 255 includes sliding sheaves 280, 270, such that the sheaves selectively able to move 285, 275 relative to the trolley 255. By moving the sheaves 280, 270 in opposed directions 285, 275, this applies a moment
5 about the vertical axis to the twin spreader 260, 265. As there is no eccentric force involved, the flexibility of the linkage is not relevant, and so the twin spreader “skews” about the vertical axis. In such an arrangement, a skew can be applied to a twin spreader that is not fitted with a locking device, and so is a more generally applicable method of skewing than that of the locking device.

Claims

1. A twin spreader assembly for engaging at least two containers, the assembly comprising:
5 a pair of head blocks, each for engaging at least one spreader, said head blocks connected by an intermediate linkage, said linkage having at least one actuator and arranged to selectively space the head blocks along a horizontal axis, and; a locking device mounted to the linkage;
wherein said locking device is arranged to selectively prevent movement of the
10 linkage corresponding to spacing of the head blocks along a vertical axis.
2. The assembly according to claim 1, wherein the linkage is a parallelogram linkage comprising an upper and lower beam, with upright members at opposed ends of said beams;
15 said locking device mounted between one of the beams and one of the upright members so as to selectively prevent relative rotation of the beam and upright member.
3. The assembly according to claim 1 or 2, wherein the locking device comprises a
20 ram, such that prevention of the corresponding movement is achieved by locking the ram from extension or retraction.
4. The assembly according to any one of claims 1 to 3, wherein the twin spreader assembly is engaged with cables at corners of said head blocks, such that on

locking of the locking device, extension or retraction of diagonally opposed cables results in the skew of the twin spreader assembly.

- 5 5. The assembly according to any one of claims 1 to 4, wherein the linkage is arranged such that on release of the locking device, on application of an external load the linkage is movable so as to permit relative movement of the head blocks along the vertical axis.
- 10 6. The assembly according to claim 5, wherein the ram is a hydraulic ram such that releasing of the hydraulic ram includes the engagement of a low pressure relief valve having a first pre-determined pressure threshold.
- 15 7. The assembly according to claim 6, wherein the ram is a hydraulic ram such that locking of the hydraulic ram includes the engagement of a high pressure relief valve having a second pre-determined pressure threshold.
- 20 8. A method of skewing a twin spreader assembly, said twin spreader assembly comprising a pair of head blocks connected by an intermediate linkage, the method comprising the steps of:
applying an external force to diagonally opposed corners of said head blocks;
locking the linkage and so;
preventing movement of the linkage corresponding to spacing of the head blocks along a vertical axis;

redistributing the applied force so as to asymmetrically arrange the twin spreader, and so rotating the twin spreader about the vertical axis corresponding to a skew arrangement.

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9. A trolley assembly for use in a hoist system, the trolley assembly comprising a trolley;

a pair of sheave sets for directing cables in engagement with a twin spreader assembly, said sheave sets in spaced relation within said trolley;

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wherein said sheave sets linearly movable within said trolley along parallel axes to each other, said sheaves sets arranged such that on moving said pair of sheaves sets in opposed direction along their respective axes, the twin spreader assembly rotates about a vertical axis in a skew arrangement.