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MOVEMENT ABSORBING TRANSFERRING SYSTEM

The present invention relates to a motion absorbing conveyance system for transferring personnel and/or objects between a floating vessel and an installation, for example, an oil platform, in accordance with the preamble of claim 1, cited hereafter. The invention also relates to a method of forming a walkable connection between a floating vessel and an installation.

There are currently employed a number of different arrangements to provide for the transfer of personnel and goods between a floating vessel and an offshore platform. Due to the relative movement between the floating vessel and the platform, strong demands are made on these types of conveyance systems. There have previously been used baskets suspended on a crane boom, where the basket is hoisted by means of a winch equipped with a heave compensator system. Hoistable baskets of this type, however, represent a high safety risk, as the relative movements between the vessel and the platform can easily cause the basket to strike against the vessel or the platform with considerable force. There is also a risk that the basket will tip over on landing, causing personnel and/or goods to fall out. Between platforms there have also been used gangways, which form a rigid connection between these platforms. These gangways, however, are not suitable for transferring personnel between a platform and a floating vessel when the relative movements are heavy.

Examples of known art are shown in NO 145,131, NO 151,579, 157,255, US 3,008,158, US 4,011,615 and US 4,169,296. For example, US 4,169,296 shows the use of a ball joint between the outer end of the gangway and the platform. NO 145,131, for example, shows the utilization of a pull-down wire to draw the outer end of the gangway down to the platform. None of these publications, however, suggests the possibility of using a pull-down wire in combination with a ball joint. Furthermore, all the known arrangements have the disadvantage that the gangway is self-supporting. Nor is it possible to transfer cargo of any significant weight or size along the gangway connection.

Therefore, there is a great need for a far more secure conveyance system which can form a safe, walkable connection between a floating vessel and an installation, and which at the same time is adapted to be capable of transferring cargo between two installations. Thus, according to the invention there is provided a motion absorbing conveyance system in accordance with the characterizing clause of the following claim 1. In

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addition, there is provided a method in accordance with the characterizing clause of the subsequent claim 6.

The invention will now be described in more detail with reference to the accompanying
5 drawings, wherein:

Figure 1 is a lateral view of the conveyance system in its entirety,

Figure 2 shows a section from the conveyance system at the vessel's slewing column,
10 which supports the gangway at one end thereof,

Figure 3 shows the outer end of the conveyance system,

Figure 4 shows the conveyance system in its unemployed position on board the vessel,
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Figure 5 is a lateral view of the conveyance system in different positions at varying distances between the platform and the vessel in the vertical and horizontal direction,

Figure 6 is a top view of the conveyance system in various positions,
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Figure 7 illustrates the method of connecting the conveyance system to the platform,

Figure 8 shows a means of emergency disconnection of the conveyance system,

25 Figures 9 - 47 show an alternative embodiment of the invention, currently considered to be the most preferable embodiment,

Figure 9 illustrates the main components,

30 Figures 10a, b and c show the inner part of the conveyance system,

Figure 11 shows the articulated boom,

Figure 12 shows the outer end of the boom with the frame,
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Figure 13 shows the frame with a coupling device,

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Figure 14 shows the coupling device,

Figures 15a and b show a rapid release mechanism,

5 Figures 16a, b and c show a footing,

Figures 17a and b illustrate a detail of the coupling device,

Figures 18a, b and c show a bearing housing,

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Figures 19 - 34 show stages in the connection of the conveyance system.

Figures 35 - 38 show stages of a normal disconnection procedure,

15 Figures 39 - 43 show stages of an emergency disconnection, and

Figures 44 - 47 show stages in disconnecting and stowing the gangway.

20 Figure 1 shows a motion absorbing conveyance system 1 according to the invention, which is mounted on a vessel 2. The conveyance system 1 consists generally of a column 3, positioned on the deck 4 of the vessel 2, a tower 5, a gangway 6, a boom 7 and a frame 8.

Column 3 and tower 5 are shown in more detail in Figure 2. Tower 5 is pivotably
25 connected to column 3, thus permitting tower 5 to rotate at least approximately 360° relative to column 3, which is permanently mounted on the deck 4 of vessel 2. To achieve this rotational capability there is provided a conventional swivel link 9 between tower 5 and column 3. Boom 7 is pivotably mounted on the tower in a joint 10. Boom 7 is thereby capable of a swinging movement in the vertical plane. A winch (not
30 shown) is connected via a wire 11 (see Figure 1) to boom 7, enabling the outer end of boom 7 to be hoisted up and down in the vertical plane. Gangway 6 is also pivotably connected to tower 5 by a joint 12, thereby also enabling gangway 6 to swing in the vertical plane.

35 The outer end of conveyance system 1 is best illustrated in Figure 3. Frame 8 joins together the outer ends of boom 7 and gangway 6. Frame 8 comprises a first leg 13 and a second leg 14, both of which are pivotably connected to boom 7 by a joint 15. Legs

13 and 14 define between them an open area 16. Frame 8 surrounds gangway 6 and is pivotably connected thereto by a joint 17. On the underside of frame 8 there is formed a ball. Ball 18 is designed to be received in a ball seat 19 fixedly mounted on, for example, the deck of a platform 20.

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Between boom 7 and frame 8 is further provided a hydraulic actuator 21, which is designed to induce forced swinging of frame 8 in relation to boom 7. A trolley, or travelling winch, 22 is positioned in a guide rail 23 on the underside of boom 7, with capability of running along boom 7 from the outer end to the inner end thereof.

10 Connected to trolley 22 via a wire 24a is a hoistable hook 24, which makes it possible to convey goods between vessel 2 and platform 20. Due to the open space 16 in frame 8, and a corresponding open space 25 in tower 5, the trolley and hook 24 are permitted to move unhindered along boom 7 above gangway 6.

15 Gangway 6 comprises at least two parts 6a and 6b, of which the one part 6a is telescopically received in the other part 6b. Both parts 6a and 6b are constructed of a framework, which provides protection on all sides for personnel who are on the gangway 6. Gangway 6 may either be completely enclosed, like a tunnel, or may contain openings. An access stairway 26 provides access from deck 4 to gangway 6 via
20 the top of column 3. On the platform side, the outer end of gangway 6 is situated close enough to the platform deck that stairs on this side usually are not necessary. However, there may optionally be provided a small set of stairs on the platform deck or a descendible stairway at the outer end of gangway 6.

25 In Figure 4 the conveyance system is shown in its unemployed state, where boom 7 and gangway 6 have been swung to a rest position above vessel 2. In an unemployed state, gangway 6 may optionally be released from tower 5 and frame 8 and removed, and frame 8 may either be swung inward against boom 7 or also removed, permitting column 3, tower 5 and boom 7 to be used as a conventional crane.

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Figure 5 shows the conveyance system in various states depending on the particular positioning of vessel 2 in relation to platform 20. Due to the ball joint, gangway 6 and frame 8 will be capable of pivoting in three directions relative to platform 20 around the ball joint 18, 19. In Figure 5a the inner end of the gangway is situated 1 meter lower
35 than nominal position and 6.5 meters further away from the platform than nominal position. The movement toward and away from the platform is primarily accommodated by the telescopic action of gangway 6. In Figure 5b the inner end of

gangway 6 is situated 2.5 meters higher than nominal position and 5.5 meters closer to the platform than nominal position. Figures 5c and 5d illustrate the two extreme positions for the conveyance system, with Figure 5c showing vessel 1 at its lowest position and greatest distance away from platform 20, and Figure 5d showing vessel 2 at its highest position and shortest distance to platform 20. Here the distance from the vessel to the platform may vary by about 20 meters without imposing undue strain on the conveyance system. The wave height from top to bottom may be as much as 13 meters without straining the conveyance system.

Figure 6 shows the conveyance system viewed from above; in Figure 6a it is in nominal position and Figure 6b shows four different extreme positions. As is apparent from Figure 6b, the conveyance system is capable of pivoting over a 90° sector without being overextended. The vessel may also alter its position in relation to the platform by 180°.

In Figure 3 the maximum rolling movement of conveyance system 1 is indicated by angle V.

The method of providing a walkable connection between vessel 2 and platform 20 will now be explained with reference to Figure 7. In Figure 7a the outer end of gangway 6 is brought to a position generally over the ball seat 19 on platform 20. In order to position the ball over the ball seat, tower 5 is rotated and frame 8 is swung with the aid of actuator 21 until the ball is in the correct position. A wire 27, which passes through a hole 28 in ball 19 is lowered down toward platform 20. Wire 27 may be secured in a receiving device 29 in ball seat 19, either by remote control or manually with the aid of personnel on platform 20. While the winch that holds boom 7 is put into operation under constant pressure, and the slewing motor and the brake controlling the rotation of tower 5 and actuator 21 for frame 8 are disengaged, a winch is engaged to exert a tension on wire 27, in order thereby to draw ball 18 down toward ball seat 19. As soon as contact is made between ball 18 and ball seat 19, the winch supporting boom 7 is slackened, allowing ball 18 to come to rest in ball seat 19 and to be pressed thereagainst by the weight of boom 7, frame 8 and gangway 6.

The procedure for disengagement will be the opposite of the above, as the winch for boom 7 is put into operation, and the winch for wire 27 is slackened until ball 18 has lifted from ball seat 19 to a sufficient degree for wire 27 to be released from ball seat 19. Boom 7 and gangway 6 can then be swung in over vessel 2.

An emergency procedure for disengaging the connection is shown in Figure 8. In this type of situation the winch for boom 7 is actuated at the same time as the vessel is driven in a direction away from platform 20. The telescopic connection between gangway sections 6a and 6b enables gangway 6 to be extended until it has reached its end position and, due to the combined effect of the boom 7 lifting the outer end of gangway 6 and the outwardly directed force of gangway 6, ball 18 is released from ball seat 19. The connection between wire 27 and ball seat 19 is disengaged when the emergency procedure is started.

10 In the following is a description of a system with an articulated boom, with reference to Figures 9 to 47. An articulated boom substantially reduces the torque imposed on the column during engagement and disengagement. In addition, it is a space saving feature when the boom is stowed on the deck during transit.

15 Figure 9 shows the system's main components, including a column 30, a boom 31, a frame 32 and a gangway 33. The boom is a two-part structure, with an inner section 34 and outer section 35, which are connected together at joint B via a hinge mechanism 36.

20 Figures 10a - 10c show column 30 with suspension and hoisting means 37 for boom 31. The boom is articulated, as mentioned above, and only the innermost section 34 is shown here. Boom 31 is lifted by a wire hoisting system 37 from the top of column 30. Boom 31 is suspended in a biaxial bearing system 38 in column 30. Boom 31 pivots about the transverse horizontal axis A (Figure 10a) on lifting and lowering and is
25 capable of free rotation about the longitudinal axis A1 (Figure 10b).

Column 30 is mounted on the ship deck on a bearing and is capable of rotation about the vertical axis A2 (Figure 10c). Slewing actuators 39 are mounted in connection with bearing 40; these may be disengaged, or they may control the pivotal motion of column
30 30.

Figure 11 shows boom 31 with hinge mechanism 36 at joint B. A hydraulic cylinder 41 mounted at the top of boom 31 controls the folding thereof and limits the movement on maximum swing. On contraction of cylinder 41, boom 31 is straightened and the
35 movement is mechanically restricted such that the lower edge of the two boom sections 34, 35 form a straight line.

Figure 12 shows the connection between outer section 35 of boom 31 and frame 32. Frame 32 is hinged to boom section 35 at axis C. The rotation of frame 32 is controlled by means of a hydraulic cylinder 42 mounted between the top 43 of frame 32 and a bracket 44 on boom 31.

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Figures 13 and 14 show frame 32 with bearing 49 and coupling member 45. Frame 32 and coupling member 45 are able to swing freely relative to each other about horizontal axis D, which as shown in Figure 14 extends through two journal bearings 46, mounted on two arms 48 on bearing housing 49, which journal bearings 46 receive the legs 47 of frame 32. A pivot bearing 50 mounted between bearing housing 49 and coupling member 45 defines the vertical axis D1 around which frame 32 with bearing housing 49 can rotate.

Below there will now be explained, with reference to Figures 15a and 15b, 16a - c, 17a and 17b and 18a - c, the elements in the landing system for the platform connection, which consists of the following main components: rapid release mechanism 51 (see Figures 15a - b), footing 52 with locking ball 53 (see Figures 16a - c), coupling member 45 with pull-down cylinder 54 (see Figures 17a - b) and bearing housing 49 for frame 32 (see Figures 18a - c).

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The rapid release mechanism in Figures 15a - b consists of a housing 55, a locking pawl 56 and a tripping device 57. Tripping device 57 is connected with the ship and is controlled therefrom via mechanical or electrical remote control. On the platform there are provided two such rapid release mechanisms 51, which are welded fast to the platform on each side of a footing 52 having a locking ball 53 (see Figures 16a, b and c).

Footing 52 consists of a circular housing 58 with an internal conical guide surface 59, locking ball 53 with an internal vertical bore 60 for a pull-in wire, a horizontal bore 61 for locking of the pull-in wire and anchor pins 62. Locking pawls 56 lock the pins 62 so that footing 52 is secured to the platform deck.

Figure 17a shows a vertical section through coupling member 45 with pull-down cylinder 54, while Figure 17b shows a bottom view of the same. In Figure 17a is seen a circular terminal cap 75 having a top flange 63 for insertion of a pull-down cylinder 54 and a landing flange 64 at the bottom, together with an external flange 65 for a pivot bearing. Eight locking dogs 66 are suspended at the lower end of a cylinder rod 67.

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Locking dogs 66 are spherical in shape internally and circular-conical externally. A skirt 68 having a corresponding circular-conical form internally, is vertically movable with the aid of actuators 69 attached to a flange 70 which, in turn is attached to cylinder rod 67. On lowering of skirt 68 the locking dogs 66 are forced together and thereby are lockable around ball 53 (see Figure 16a). Cylinder rod 67 is provided with a through longitudinal bore 71 for pulling through wires and is mounted in a piston 72 which is vertically movable in cylinder 54. Rod 67 passes through top flange 73 of cylinder 54 and has an external nut 74 screwed thereon.

Figures 18a - c show bearing housing 49 for frame 32, consisting of a circular housing 49 having arms 48 supporting bearing 46 for the mounting of legs 47 of frame 32, and a pivot bearing 76. Bearing 76 is bolted to flange 65 (see Figure 17a), so that it follows the movement of frame 32.

The establishment of a bridge connection between a ship and platform takes place according to the following procedure:

Footing 52 in accordance with Figure 16 is locked beforehand to the platform deck by rapid release mechanism 51 in accordance with Figure 15, by the locking of locking pawls 56 around pins 62. The ship is put into position, and a wire 77 has beforehand been secured to footing 52 on the platform, as shown in Figure 24. Wire 77 is threaded through bore 60 in ball 53 and through bore 71 in cylinder rod 67 and is attached to the winch V (see Figure 19). This can be done on the deck of the ship while boom 31 is folded and frame 32 is laid down completely. The inner section 34 of boom 31 is then raised to maximum upright position, while outer section 35 of boom 31 remains folded and frame 32 descends to a vertical position when actuator 42 is disengaged.

Winch V pulls in wire 77, and frame 32 is drawn toward a mechanical stopper on boom section 35 so that this is pulled along, and boom 31 is straightened (see Figure 20). Actuator 41 is now activated, and boom 31 is straightened out so that coupling 45 is held above footing 52 on the platform (see Figure 21).

A boom lift actuator 78 and the boom joint actuator 41 maintain a constant force while winch V continuously draws coupling 45 toward footing 52 on the platform (see Figure 22). Figures 23a, 23b and 24 illustrate the angular deviation and positional deviation that may be permitted for coupling 45 during the pull-in process. Figures 25 and 26 show the internal steering in footing 52 toward the outer part of coupling 45, which

ensures the centering of locking dogs 66 against ball 53. Figure 27 shows the situation where coupling 45 has been lowered onto ball 53 and is held in position by the tractive force of wire 77.

- 5 Actuator 79 in coupling 45 is activated, skirt 69 is pushed forward and locking dogs 66 secure the connection to the footing 52 (see Figure 28).

At the same time, boom joint actuator 78 and frame actuator 42 are disconnected, and boom actuator 41 begins to lower the outer boom section 35 on boom 31 (see Figure 10 29). The pull-down cylinder 54 in coupling 45 is activated by applying pressure on the underside of piston 72 (Figure 17a), which pulls terminal cap 75 downward so that landing flange 68 (Figure 17a) meets the footing 52 (see Figure 30). Pull-down cylinder 54 draws landing flange 68 toward a seat 80 in footing 52 such that coupling 45 with bearing housing 49 and frame 32 are straightened up to vertical position (see Figures 31 15 and 32), at the same time as inner section 34 on boom 31 is lowered to operational position (see Figure 31), and boom lift actuator 38 is slackened completely so that boom 31 lies freely suspended in column 30 and in frame 32 (see Figure 33).

- 20 Nut 74 is tightened manually, and the pressure for pull-down cylinder 54 is drained so that the anchoring is mechanically secured (see Figure 34).

A normal disengagement procedure will be as follows: boom lift actuator 78 is activated so that the inner section 34 of boom 31 is raised, constant force on boom joint actuator 41 is activated (see Figure 35), coupling 45 is opened (see Figure 36), coupling 25 45 is lifted clear when boom 31 is in a sufficiently upright position (see Figures 37 and 38) and the ship is immediately driven away.

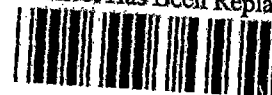
Rapid disengagement in an emergency situation will be as follows: boom lift actuator 78 is activated so that inner section 34 of boom 31 is raised, constant force on 41 is 30 activated (see Figures 39 and 40), and pawls 56 in rapid release mechanism 51 are opened (see Figure 41). The ship drives away from the platform at the same time as boom lift actuator 41 raises boom 31 and constant force is activated on frame actuator 42 to dampen the rotation of frame 32 as footing 52 leaves the platform (see Figure 42). Boom 31 is folded and the system is driven into stowed position on deck (see Figure 35 43).

In the above mentioned description, gangway 33 is not shown in order to avoid making the drawings unnecessarily complicated. Gangway 33 is brought up and lowered down by the use of a hoisting and conveyance system 81 after the connection between ship and platform via boom 31 and frame 32 has been established. Figures 44 - 47 show the
5 disengagement of gangway 33, with the engagement being carried out in the same manner, but in the opposite sequence.

As shown in Figure 44, gangway 33 is suspended from column 30 at the inner end 82 thereof and in frame 32 at the outer end 83 thereof. When gangway 33 is to be
10 disengaged, its outer end 83 is connected to a trolley or travelling winch 84, which is adapted to run along boom 31. Gangway 33 is lifted out of engagement with frame 31 and trolley 84 moves gangway 33 telescopically toward column 30 (see Figure 45).

When gangway 33 has been telescoped completely, trolley 84 drives further, with its
15 point of attachment in gangway 33 rolling along gangway 33 until trolley 84 has arrived at the end position at column 30. During this process, the outer end of gangway 33 is lowered onto the ship's deck (see Figure 46). Finally, the inner end of gangway 33 is also lowered onto the deck.

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P a t e n t C l a i m s

1.

A motion absorbing conveyance system (1) for transferring personnel and/or objects
5 between a floating vessel (2) and an installation (20), for example, an oil platform,
wherein the vessel (2) and the installation (20) exhibit a relative movement, which
system (1) comprises a boom (7, 31), provided with an articulated connection to the one
of the vessel (2) and the installation (20), and a variable length gangway (6, 33), having
an articulated connection to the same one of the vessel (2) and the installation (20), and
10 a frame (8, 32) which joins together the ends of the boom (7, 31) and the gangway (6,
33) opposite to the articulated connection, wherein there is provided on the other of the
vessel (2) and the installation (20) one of a ball seat (19, 45) and a ball (18, 53), and
wherein at the outer end of the gangway (6, 33) or at the lower end of the frame (8, 32)
there is provided the other of the ball seat (19, 45) and the ball (18, 53), which is
15 adapted to engage with the one of the ball seat (19, 45) and the ball (18, 53) on the other
of the vessel (2) and the installation (20), such that the ball/seat connection is capable of
accommodating triaxial relative movement between the vessel (2) and the installation
(20),
characterized in that the ball (18, 53) and/or the ball seat (19, 45) comprises a
20 through-going hole (28, 60) for a pull-down wire (27, 77), which is connectible to the
other of the ball seat (19, 45) and the ball (18, 53) in order to pull the gangway down
toward the other of the vessel (2) and the installation (20).

2.

A conveyance system according to claim 1, characterized in that the frame (8,
25 32) comprises two legs (13, 14; 47) which are pivotably connected to the boom (7, 31)
and extend from their respective sides of the boom (7, 31) and enclose the gangway (6,
33) on two sides, and that the legs (13, 14; 47) define an opening (16) therebetween,
through which opening (16) a trolley (22, 84) that runs along the boom (7, 31) is
30 capable of moving.

3.

A conveyance system according to claim 2, characterized in that the ball (18,
53) and the ball seat (19, 45) are drawn toward each other with the aid of a positive
35 downward tractive force, there being used a winch with constant tractive force to
counter the downward tractive force.



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4.

A conveyance system according to claim 3, characterized in that the frame (8, 32) may be compelled to pivot relative to the boom (7, 31) by means of an actuator (21, 42).

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5.

A conveyance system according to any one of the preceding claims, characterized in that the boom (31) is articulated.

10 6.

A conveyance system according to any one of the preceding claims, characterized in that the gangway (6, 33) is designed to be telescoped into contracted state by means of a trolley (22, 84) and that the trolley (22, 84) is adapted to lay the gangway down onto the deck of the vessel (20).

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7.

A conveyance system according to any one of the preceding claims, characterized in that it comprises a coupling means to hold the ball (53) in the ball seat (45).

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8.

A method of forming a walkable connection between a floating vessel (2) and an installation (20), characterized in that a boom (7, 31) which supports a gangway (6, 33) and which is connected to the one of the vessel (2) and the installation (20) is swung into a position in which the one of a ball seat (19, 45) and a ball (18, 53) at the outer end of the gangway (6, 33) is generally over the other one of a ball seat (19, 45) and a ball (18, 53) on the other one of the vessel (2) and the installation (20), that a pull-down wire (27, 77) is connected between the ball (18, 53) and the ball seat (19, 45), that the ball (18, 53) and the ball seat (19, 45) are drawn toward each other and that the ball (18, 53) is landed in the ball seat (19, 45).

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9.

A method according to claim 8, characterized in that a winch with constant tractive force is used to hold the boom (7, 31) hoisted above the other of the ball seat (19, 45) and the ball (18, 53) and that the winch is unloaded when the ball (19, 53) is landed in the ball seat (19, 45), such that the weight of the boom (7, 31) and the

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gangway (6, 33), assisted optionally by a gripping device, holds the ball (18, 53) and the ball seat (19, 45) in engagement.

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