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(54) **LOCKING ARRANGEMENT FOR LOCKING CONTAINERS TOGETHER, CONTAINER LOCK AND METHOD FOR JOINING CONTAINERS STACKED ON TOP OF EACH OTHER**

(57) A locking arrangement for joining together an upper and a lower container stacked on top of each other, wherein the locking arrangement comprising a lower corner piece (7) of the upper container comprising a bottom flange (9); a upper corner piece (10) of the lower container comprising a top flange (12); and a container lock (1) for locking to each other the lower corner piece (7) and the upper corner piece (10); wherein the lock arrangement in a tension position is configured to fulfil a formula wherein a tension clearance TC = E - B = F + D3; wherein the tension clearance (TC) is from 0 to 12 mm. Also a container lock (1) and a method is disclosed.

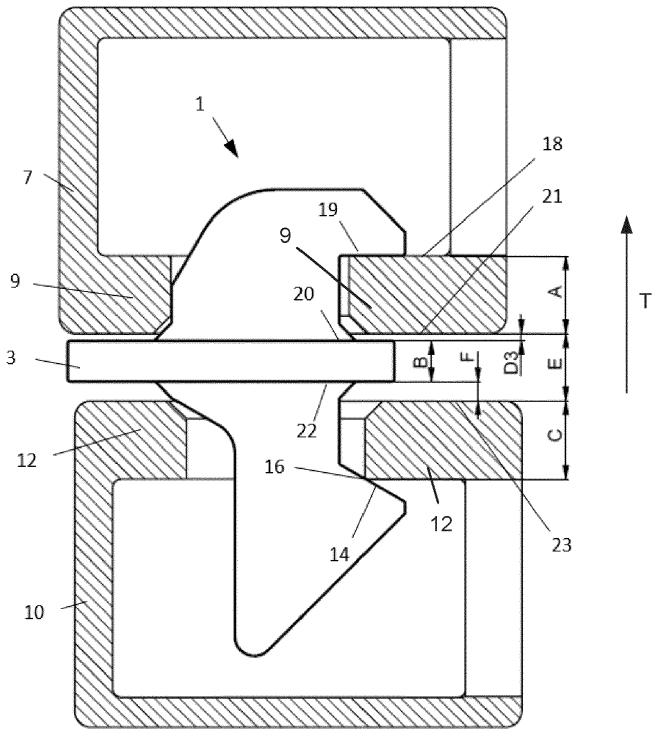

FIG. 2

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Description

FIELD OF THE INVENTION

[0001] The present application relates generally to a locking arrangement. More specifically, the present application relates to joining together an upper and a lower container stacked on top of each other.

BACKGROUND OF THE INVENTION

[0002] At sea, large compression and tension forces are exerted on container locks and on corner pieces of a container when a ship, and correspondingly a stack of containers on its deck, inclines. Known container locks have relatively much free space between contact surfaces of the container lock and corresponding container corners. This may cause a big vertical gap between the container corners when the ship is heeling, and the container stacks are tilting from side-to-side at rough sea. Geometry of a container lock in relation to container corner pieces to which the container lock is attached to may be optimized to improve security of container locking.

SUMMARY

[0003] This summary is provided to introduce a selection of concepts in a simplified form that are further described below in the detailed description. This summary is not intended to identify key features or essential features of the claimed subject matter, nor is it intended to be used to limit the scope of the claimed subject matter. The scope of protection sought for various embodiments of the present disclosure is set out by the independent claims.

[0004] Example embodiments of the present disclosure provide a locking arrangement for joining together an upper and a lower container stacked on top of each other with a container lock having an optimized geometry. When using this type of container locks more cargo may be carried on a similar ship as heavier containers are allowed in the container stacks on a deck of the ship. This may have a positive impact on the productivity of the ship. Also greenhouse gas emissions per carried cargo ton may be reduced when a full capacity of the container ship is utilized. From manufacturing point of view the optimized geometry may not bring any new challenges and conventional manufacturing methods may be applicable. As a result the manufacturing costs may not be higher than with traditional container locks.

[0005] According to a first aspect, a locking arrangement for joining together an upper and a lower container stacked on top of each other is disclosed. The locking arrangement may comprise a lower corner piece of the upper container comprising a bottom flange; an upper corner piece of the lower container comprising a top flange; and a container lock for locking to each other the lower corner piece of the upper container and the upper corner piece of the lower container; wherein the lock arrangement in a tension position may be configured to fulfil a formula wherein a tension clearance TC = E - B = F + D3, wherein E is a vertical distance between a bottom flange bottom surface and a top flange top surface; B is a thickness of a central flange of the container lock; D3 is a third vertical distance, which is a vertical distance between the bottom flange bottom surface (21) and a central flange top surface of the container lock; and F is a vertical distance between the top flange top surface and a central flange bottom surface of the container lock; wherein the tension clearance (TC) may be from 0 to 12 mm. The container lock with optimized geometry improves security of the container locking i.e. container-to-container locking in each stack of containers on a deck of the ship by minimizing the opening slack or clearance under a full tension load.

[0006] According to an example embodiment of the first aspect, the tension clearance may be a total vertical clearance generated by an upward tension stress from the upper container.

[0007] According to an example embodiment of the first aspect, the tension clearance may be from 0 to 8 mm.

[0008] According to an example embodiment of the first aspect, the tension clearance may be from 0 to 4 mm.

[0009] According to an example embodiment of the first aspect, the tension clearance may be 0 mm.

[0010] According to an example embodiment of the first aspect, in a resting position, the upper container may be configured to rest on top of the bottom container, wherein between an upper cone bottom surface and a lower cone contact point may be a rest clearance from 0 to 4 mm. The container lock with optimized geometry may minimize the opening slack under full tension load and allow large loads.

[0011] According to an example embodiment of the first aspect, the rest clearance may consist of a sum of a first vertical distance D1 and a second vertical distance D2, wherein D1 is the first vertical distance, which is a distance between a lower container corner piece contact point (16) and the lower cone contact point (17); and D2 is the second vertical distance, which is a distance between an upper container corner piece contact surface (18) and the upper cone bottom surface (19).

[0012] According to an example embodiment of the first aspect, the rest clearance may be 0 to 2 mm.

[0013] According to an example embodiment of the first aspect, the rest clearance may be 0 mm.

[0014] According to an example embodiment of the first aspect, in the resting position, the lock arrangement may be configured to fulfil a formula X = A + B + C + D1 + D2, wherein X is a vertical distance between the upper cone bottom surface and the lower cone contact point; A is a thickness of the bottom flange of the lower corner piece of the upper container; B is the thickness of the central flange of the container lock; C is a thickness of the top flange of the upper corner piece of the lower container; D1 is the first vertical distance, which is the vertical

distance between the lower container corner piece contact point and the lower cone contact point; and D2 is the second vertical distance, which is the vertical distance between the upper container corner piece contact surface and the upper cone bottom surface.

[0015] According to an example embodiment of the first aspect, the container lock may be a fully automated lock. The automated lock enables easy locking of the containers together.

[0016] According to a second aspect, a container lock for locking together an upper container and a lower container stacked on top of each other is disclosed. The upper container may comprise a lower corner piece and the lower container may comprise an upper corner piece. The container lock may be configured to lock to each other the lower and upper corner pieces. The container lock in a tension position may be configured to fulfil a formula wherein a tension clearance TC = E - B = F + D3, wherein E is a vertical distance between a bottom flange bottom surface of the lower corner piece and a top flange top surface of the upper corner piece; B is a thickness of a central flange of the container lock; D3 is a third vertical distance, which is a vertical distance between the bottom flange bottom surface of the lower corner piece and a central flange top surface of the container lock; and F is a vertical distance between the top flange top surface of the upper corner piece and a central flange bottom surface of the container lock; wherein the tension clearance is from 0 to 12 mm. The container lock according to the second embodiment may comprise all the features of the container lock according to the first embodiment above.

[0017] According to an example embodiment of the second aspect, the upper container may rest on top of the bottom container, wherein between an upper cone bottom surface and a lower cone contact point may be a rest clearance. The rest clearance may be a sum of a first vertical distance D1 and a second vertical distance D2, wherein D1 is the first vertical distance, which is a distance between a lower container corner piece contact point and the lower cone contact point; and D2 is the second vertical distance, which is a distance between an upper container corner piece contact surface and the upper cone bottom surface, wherein the rest clearance RC = D1 + D2 from 0 to 4 mm.

[0018] According to a third aspect, a method for joining together an upper and a lower container stacked on top of each other with a locking arrangement is disclosed. The locking arrangement may comprise a lower corner piece of the upper container comprising a bottom flange; an upper corner piece of the lower container comprising a top flange; and a container lock, wherein the method may comprise locking to each other the upper corner piece and the lower corner piece with the container lock; wherein the lock arrangement in a tension position fulfils a formula, wherein a tension clearance is TC = E - B = F + D3, wherein E is a vertical distance between a bottom flange bottom surface and a top flange top surface; B is a thickness of a central flange of the container lock; D3 is a third vertical distance, which is a vertical distance between the bottom flange bottom surface and a central flange top surface of the container lock; and F is a vertical distance between a top flange top surface and a central flange bottom surface of the container lock; wherein the tension clearance may be from 0 to 12 mm. The container lock with optimized geometry may improves security of the container locking i.e. container-to-container locking in each stack of containers on a deck of a ship by minimizing the opening slack or clearance under a full tension load.

[0019] According to an example embodiment of the third aspect, the upper container may rest on top of the bottom container, wherein between an upper cone bottom surface and a lower cone contact point may be a rest clearance . The container lock with optimized geometry may minimize the opening slack under full tension load and allow large loads. The rest clearance may be a sum of a first vertical distance D1 and a second vertical distance D2, wherein D1 is the first vertical distance, which is a distance between a lower container corner piece contact point and the lower cone contact point; and D2 is the second vertical distance, which is a distance between an upper container corner piece contact surface and the upper cone bottom surface, wherein the rest clearance RC = D1 + D2 is from 0 to 4 mm.

[0020] According to an example embodiment of the third aspect, in the resting position, the rest clearance RC = D1 + D2 = X - A - B - C, wherein X is a vertical distance between the upper cone bottom surface (19) and the lower cone contact point; A is a thickness of the bottom flange of the lower corner piece; B is the thickness of the central flange of the container lock; C is a thickness of the top flange of the upper corner piece; D1 is the first vertical distance, which is the vertical distance between the lower container corner piece contact point and the lower cone contact point; and D2 is the second vertical distance, which is the vertical distance between the upper container corner piece contact surface and the upper cone bottom surface.

BRIEF DESCRIPTION OF THE DRAWINGS

[0021] The accompanying drawings, which are included to provide a further understanding of the invention and constitute a part of this specification, illustrate embodiments of the invention and together with the description help to explain the principles of the invention. In the drawings:

Fig. 1 shows schematically an example of a cross-sectional side view of a locking arrangement in a resting position according to an example embodiment;

Fig. 2 shows schematically an example of a cross-sectional side view of a locking arrangement of Fig. 1 in a tension position according to an example em-

bodiment; and

Fig.3 shows an example method according to an example embodiment.

[0022] Like references are used to designate like parts in the accompanying drawings.

DETAILED DESCRIPTION

[0023] Reference will now be made in detail to example embodiments, examples of which are illustrated in the accompanying drawings. The detailed description provided below in connection with the appended drawings is intended as a description of the present examples and is not intended to represent the only forms in which the present example may be constructed or utilized. The description sets forth the functions of the example and the sequence of steps or operations for constructing and operating the example. However, the same or equivalent functions and sequences may be accomplished by different examples.

[0024] On a cargo ship, containers may be transported on a deck on top of hatch covers in a number of parallel rows and lines and also in a number of tiers one on top of the other. The containers may have corner pieces on all their eight corners, by means of which corner pieces the containers may be locked to each other. Typically, two containers one above the other may be locked to each other with container locks installed into the corner pieces of the containers. When the container lock is used it may first be manually installed into a bottom corner of a container. Totally four pieces container locks may be installed into the bottom of the one container, one in each corner. In more detail, the upper cone of the container lock may now be inside the bottom corner of the container. Then the container may be lifted by crane onto another container on a deck of the ship. The lower cones of the container locks that are hanging in the lifted bottom corners of the container may be guided and locked into the top corners of the container already on board the ship. Same procedure may be repeated to all containers that are lifted on the deck.

[0025] At the sea, the container locks may connect together the containers of one vertical stack. When the ship is heeling at rough weather each stack of containers may be tilted sideways. In this situation the container locks me be subjected to heavy tension load. The upper container may pull the container lock upwards while the lower container may cause an opposite force downwards. As there is usually some clearance between the container locks and the container corner pieces, additional dynamic forces may be generated. When the ship is heeling the forces may cause a big vertical gap between the container corners and the container stacks may tilt from side-to-side at rough sea. As this kind of a large vertical gap may exist between all the containers in a stack the total effect may be remarkable. For example, there may be ten containers on top of each other in one stack. As a result there may be big tension forces in the container locks and lashing bars that may give additional support to stacked containers. Therefore any extra slack or clearance between the mentioned components should be eliminated.

[0026] According to the example embodiment, the containers may be locked to each other in such a way that the seaway-induced tension force is smaller than before, in which case the number and/or weight of the containers being transported on a cargo ship may be increased. The locking arrangement may present an optimized geometry of the container lock in relation to the container corner pieces to which the container lock is attached to. The optimized geometry may mean that the container lock has no or very little clearance between the contact surfaces of the corner pieces and the container lock. The container lock with optimized geometry may improve the security of the container locking i.e. container-to-container locking in each stack of containers on the deck of the ship by minimizing the opening slack or clearance under full tension load.

[0027] According to an example embodiment, the container lock may be so called fully automatic lock which does not require any manual locking and un-locking operations when containers are lifted onto the cargo ship or lifted away from the ship. The automatic function may be based on diagonal movement of container sideways that may be caused by wedge-type guiding surfaces of a container lock bottom part when the container is landing onto a container below - or when the container is lifted up from top of another container.

[0028] Examples of Fig. 1 and Fig. 2 present a container lock 1 between containers onboard a ship. Possible securing elements that may be used for attaching the container lock 1 to the bottom corner of the container are excluded. It may be possible to modify the container lock 1 geometry compared to what is presented in Fig. 1 and Fig. 2. Also angles of a triangular section 6 may be changed. The container may have at least one locking arrangement. However, the containers may have locking arrangements on all their eight corners, by means of which locking arrangements the containers may be locked to each other.

[0029] An example of Fig. 1 shows schematically a cross-sectional side view of a locking arrangement in a resting position. It may present the corner pieces of two containers that are one above the other. The lower corner piece 7 belongs to the upper container and the upper corner piece 10 to the lower container. The actual containers are not presented in these drawings, but the containers may have a corner piece on each corner, by means of which corner pieces the containers may be locked together by using the container lock 1. The container lock 1 thus may lock together the container corner pieces 7, 10 that are one above another.

[0030] A container lock 1 may comprise following functional parts: an upper cone 2, a central flange 3, and a lower cone 4. The lower cone 4 may be divided to a linear section 5, located below the central flange 3, and a nose-

like triangular section 6 further down.

[0031] The container lock upper cone 2 may be installed into the lower corner piece 7 of the upper container through a bottom flange opening 8 at the bottom flange 9. The container lock lower cone 4 may be inside the upper corner piece 10 of the lower container. There may be a top flange opening 11 at the top flange 12 of the upper corner piece 10. A front-side 13 of the container lock triangular section may be formed by a sloped upper contact surface 14 and a sloped lower contact surface 15.

[0032] According to an example embodiment, a container lock 1 for locking together an upper container and a lower container stacked on top of each other is disclosed. The upper container 1 may comprise a lower corner piece 7 and the lower container may comprise an upper corner piece 10. The container lock 1 may be configured to lock to each other the lower and upper corner pieces. The container lock 1 in a tension position may be configured to fulfil a formula wherein a tension clearance TC = E - B = F + D3, wherein E is a vertical distance between a bottom flange bottom surface 21 of the lower corner piece 7 and a top flange top surface 23 of the upper corner piece 10, B is a thickness of a central flange 3 of the container lock 1, D3 is a third vertical distance, which is a vertical distance between the bottom flange bottom surface 21 of the lower corner piece 7 and a central flange top surface 20 of the container lock 1, and F is a vertical distance between the top flange top surface 23 of the upper corner piece 10 and a central flange bottom surface 22 of the container lock 1. The tension clearance TC may be from 0 to 12 mm.

[0033] According to an example embodiment, in a resting position, the upper container is resting on top of the bottom container, wherein between an upper cone bottom surface 19 and a lower cone contact point 17 is a rest clearance RC, wherein the rest clearance RC is a sum of a first vertical distance D1 and a second vertical distance D2, wherein D1 is a distance between a lower container corner piece contact point 16 and the lower cone contact point 17, and D2 is a distance between an upper container corner piece contact surface 18 and the upper cone bottom surface 19. The rest clearance RC may be from 0 to 4 mm.

[0034] An example of Fig. 1 shows the container lock 1 and the container corner pieces 7, 10 in a resting position. In this position the bottom flange 9 of the upper container may be in contact with the central flange 3, and the central flange 3 may be in contact with the top flange 12 of the bottom container. Depending on the actual dimensions of the flanges 3, 9, 12 and the dimension X of the container lock there may be some vertical clearance between a lower container corner piece contact point 16 and a lower cone contact point 17 on the upper contact surface 14. This may be marked a first vertical distance D1 as shown in Fig.1. The lower cone contact point 17 may be the closest point of the container lock 1 below the lower container corner piece contact point 16 in vertical direction in the resting position. The lower container corner piece contact point 16 may be the point to which upper contact surface 14 of the container lock 1 first hits when the container lock 1 is lifted vertically upwards from the resting position.

[0035] Another vertical clearance may exist between the upper container corner piece contact surface 18 and the upper cone bottom surface 19 of the container lock 1. This second vertical distance may be marked D2 as shown in Fig.1. The total vertical rest clearance RC may consist of a sum of D1 and D2. A container lock 1 may have no or very little clearance between the contact surfaces of the container corner pieces 7, 10 and the container lock 1.

[0036] According to an example embodiment, in a resting position, the upper container is configured to rest in an idle state on top of the bottom container, wherein between an upper cone bottom surface 19 and a lower cone contact point 17 is a rest clearance RC from 0 to 4 mm. The container lock with optimized geometry may minimize the opening slack under full tension load and allow large loads.

[0037] According to an example embodiment, the rest clearance RC consist of a sum of the first vertical distance D1 and the second vertical distance D2, wherein the first vertical distance D1 is a distance between the lower container corner piece contact point 16 and the lower cone contact point 17, and the second vertical distance D2 is a distance between an upper container corner piece contact surface 18 and the upper cone bottom surface 19.

[0038] According to an example embodiment, the rest clearance RC is 0 to 4 mm. This may allow at least 5 % larger loads compared to a rest clearance of 10 mm of conventional locking arrangements, for example. According to an example embodiment, the rest clearance RC is 0 to 2 mm. This may allow at least 10 % larger loads compared to a rest clearance of 10 mm of conventional locking arrangements, for example. The rest clearance RC with value 0 mm may allow 20 % larger loads compared to, for example, rest clearance of 10 mm, for example. Even 0 mm rest clearance may be possible due to manufacture tolerances and variations caused by the dimensions of the container.

[0039] According to an example embodiment, in the resting position, the lock arrangement is configured to fulfil a formula X = A + B + C + D1 + D2, wherein

X is a vertical distance between the upper cone bottom surface 19 and the lower cone contact point 17;
A is a thickness of the bottom flange 9 of the lower corner piece 7;
B is the thickness of the central flange 3 of the container lock 1;
C is a thickness of the top flange 12 of the upper corner piece 10;
D1 is the first vertical distance, which is the vertical distance between the lower container corner piece contact point 16 and the lower cone contact point 17; and

D2 is the second vertical distance D2, which is the vertical distance between the upper container corner piece contact surface 18 and the upper cone bottom surface 19.

[0040] According to an example embodiment the resting clearance RC = D1 + D2 = X - A - B - C.

[0041] Example of Fig. 2 shows schematically a cross-sectional side view of a locking arrangement of Fig. 1 in a tension position. Tension may be exerted at least in the direction of a tension arrow T. Tension loading may be produced, for example, when a ship inclines a sufficient amount at the sea and the second edge of the upper container starts to rise upwards and a container stack may start to incline. The container lock 1 and the container corner pieces 7, 10 may be in a tension position. On one side of the container stack the container corners may be compressed downwards while on the opposite side of the stack the container lock 1 and the lower container upper corner piece 10 are pulled upwards by the upper container. However, the container locks 1 may keep the container stacks together. The smaller the clearance between the container corner pieces 7, 10 and the container lock 1 is the smaller may be the tension forces acting between these components when the ship is heeling from side to side.

[0042] In the tension position the upper container lower corner piece 7 may typically have moved upwards and also sideways due to vertical and horizontal clearances between the container corner pieces 7, 10 and the container locks 1. In tension position the contact surface 18 of the upper container lower corner piece 7 may be in contact with the upper cone bottom surface 19, and the lower container corner piece contact point 16 may be in contact with the lower cone contact point 17 of the upper contact surface 14 the container lock 1.

[0043] The total vertical tension clearance, a sum of vertical clearances or distances F and D3 (F + D3) in Fig. 2, may be beneficially as low as possible, even zero. The vertical tension clearance may also be a difference of E and B (E - B) in the tension position. With an optimized container lock geometry the total vertical tension clearance TC may be from zero to twelve millimeters.

[0044] According to an example embodiment, a locking arrangement for joining together an upper and a lower container stacked on top of each other is disclosed, wherein the locking arrangement comprising a lower corner piece 7 of the upper container comprising a bottom flange 9, an upper corner piece 10 of the lower container comprising a top flange 12, and a container lock 1 for locking to each other the lower corner piece 7 of the upper container and the upper corner piece 10 of the lower container. The lock arrangement in a tension position may be configured to fulfil a formula wherein a vertical tension clearance TC = E - B = F + D3, wherein

E is a vertical distance between the bottom flange bottom surface 21 and the top flange top surface 23;

B is the thickness of a central flange 3 of the container lock 1;

D3 is the third vertical distance, which is a vertical distance between the bottom flange bottom surface 21 and a central flange top surface 20 of the container lock 1; and

F is a vertical distance between the top flange top surface and a central flange bottom surface 22 of the container lock 1.

[0045] The tension clearance TC may be from 0 to 12 mm. The tension clearance TC may be a total vertical clearance generated by an upward tension stress T from the upper container.

[0046] According to an example embodiment, the tension clearance TC is from 0 to 8 mm. Preferably the tension clearance TC may be from 0 to 4 mm. More preferably the tension clearance TC may be 0 mm.

[0047] According to an example embodiment, the tension clearance TC is from 0 to 12 mm. This may allow at least 5 % larger loads compared to a tension clearance of 20 mm of conventional locking arrangements, for example. According to an example embodiment, the tension clearance TC is 0 to 8 mm. This may allow at least 10 % larger loads compared to the tension clearance of 20 mm of conventional locking arrangements, for example. According to an example embodiment, the tension clearance TC is 0 to 4 mm. This may allow at least 15 % larger loads compared to the tension clearance of 20 mm of conventional locking arrangements, for example. The tension clearance TC with value 0 mm may allow 20 % larger loads compared to, for example, tension clearance of 20 mm, for example.

[0048] In an optimal situation the resting clearance RC may be 0 and also tension clearance TC may be 0. Even 0 mm tension or rest clearance may be possible due to manufacture tolerances and variations caused by the dimensions of the container.

[0049] Fig. 3 illustrates an example of a method for joining together an upper and a lower container stacked on top of each other with a locking arrangement. The locking arrangement may comprise a lower corner piece 7 of the upper container comprising a bottom flange 9, an upper corner piece 10 of the lower container comprising a top flange 12, and a container lock 1.

[0050] At operation 300, the method may comprise locking to each other the lower corner piece 7 and the upper corner piece 10 with the container lock 1.

[0051] At operation 310, the method may comprise that the lock arrangement in a tension position fulfils a formula, wherein a tension clearance is TC = E - B = F + D3.

[0052] According to an example embodiment, E may be a vertical distance between a bottom flange bottom surface 21 and a top flange top surface 23, B may be a thickness of a central flange 3 of the container lock 1, D3 may be a third vertical distance, which may be a vertical distance between the bottom flange bottom surface 22 and a central flange top surface 20 of the container lock

1, and F may be a vertical distance between a top flange top surface 23 and a central flange bottom surface 22 of the container lock 1 wherein the tension clearance TC may be from 0 to 12 mm.

[0053] Further features of the method directly result from functionalities of, for example, the locking arrangement. Different variations of the method may be also applied, as described in connection with the various example embodiments.

[0054] The locking arrangement for joining together an upper and a lower container stacked on top of each other may be configured to perform or cause performance of any aspect of the method(s) described herein.

[0055] Any range or device value given herein may be extended or altered without losing the effect sought. Also, any embodiment may be combined with another embodiment unless explicitly disallowed.

[0056] Although the subject matter has been described in language specific to structural features and/or acts, it is to be understood that the subject matter defined in the appended claims is not necessarily limited to the specific features or acts described above. Rather, the specific features and acts described above are disclosed as examples of implementing the claims and other equivalent features and acts are intended to be within the scope of the claims.

[0057] It will be understood that the benefits and advantages described above may relate to one embodiment or may relate to several embodiments. The embodiments are not limited to those that solve any or all of the stated problems or those that have any or all of the stated benefits and advantages. It will further be understood that reference to 'an' item may refer to one or more of those items.

[0058] The steps or operations of the methods described herein may be carried out in any suitable order, or simultaneously where appropriate. Additionally, individual blocks may be deleted from any of the methods without departing from the scope of the subject matter described herein. Aspects of any of the embodiments described above may be combined with aspects of any of the other embodiments described to form further embodiments without losing the effect sought.

[0059] The term 'comprising' is used herein to mean including the method, blocks, or elements identified, but that such blocks or elements do not comprise an exclusive list and a method or apparatus may contain additional blocks or elements.

[0060] Although subjects may be referred to as 'first', 'second', or 'third' subjects, this does not necessarily indicate any order or importance of the subjects. Instead, such attributes may be used solely for the purpose of making a difference between subjects. It will be understood that the above description is given by way of example only and that various modifications may be made by those skilled in the art. The above specification, examples and data provide a complete description of the structure and use of exemplary embodiments. Although various embodiments have been described above with a certain degree of particularity, or with reference to one or more individual embodiments, those skilled in the art could make numerous alterations to the disclosed embodiments without departing from scope of this specification.

Claims

1. A locking arrangement for joining together an upper and a lower container stacked on top of each other, wherein the locking arrangement comprising

   a lower corner piece of the upper container comprising a bottom flange;
   an upper corner piece of the lower container comprising a top flange; and
   a container lock for locking to each other the lower corner piece and the upper corner piece; wherein
   the lock arrangement in a tension position is configured to fulfil a formula wherein a tension clearance TC = E - B = F + D3, wherein

   E is a vertical distance between a bottom flange bottom surface and a top flange top surface;
   B is a thickness of a central flange of the container lock;
   D3 is a third vertical distance, which is a vertical distance between the bottom flange bottom surface and a central flange top surface of the container lock; and
   F is a vertical distance between the top flange top surface and a central flange bottom surface of the container lock; wherein the tension clearance is from 0 to 12 mm.

2. The locking arrangement according to claim 1, wherein the tension clearance is a total vertical clearance generated by an upward tension stress from the upper container.

3. The locking arrangement according to claim 1 or claim 2, wherein the tension clearance is from 0 to 8 mm.

4. The locking arrangement according to claim 1, wherein the tension clearance is from 0 to 4 mm.

5. The locking arrangement according to claim 1, wherein the tension clearance is 0 mm.

6. The locking arrangement according to any one of the preceding claims, wherein in a resting position the upper container is configured to rest on top of the bottom container, wherein between an upper

cone bottom surface and a lower cone contact point is a rest clearance, wherein the rest clearance consists of a sum of a first vertical distance D1 and a second vertical distance D2, wherein

D1 is a distance between a lower container corner piece contact point and the lower cone contact point; and
D2 is a distance between an upper container corner piece contact surface and the upper cone bottom surface, wherein
the rest clearance is from 0 to 4 mm.

7. The locking arrangement according to claim 6, wherein the rest clearance is from 0 to 2 mm.

8. The locking arrangement according to claim 6, wherein the rest clearance is 0 mm.

9. The locking arrangement according to any one of the preceding claims 6 to 8, wherein in the resting position the rest clearance RC = D1 + D2 = X - A - B - C, wherein

X is a vertical distance between the upper cone bottom surface and the lower cone contact point;
A is a thickness of the bottom flange of the lower corner piece;
B is the thickness of the central flange of the container lock;
C is a thickness of the top flange of the upper corner piece;
D1 is the first vertical distance, which is the vertical distance between the lower container corner piece contact point and the lower cone contact point; and
D2 is the second vertical distance, which is the vertical distance between the upper container corner piece contact surface and the upper cone bottom surface.

10. The locking arrangement according to any of the preceding claims, wherein the container lock is a fully automated lock.

11. A container lock for locking together an upper container and a lower container stacked on top of each other, wherein the upper container comprising a lower corner piece and the lower container comprising an upper corner piece, wherein

the container lock is configured to lock to each other the lower and upper corner pieces; and
the container lock in a tension position is configured to fulfil a formula wherein a tension clearance TC = E - B = F + D3, wherein
E is a vertical distance between a bottom flange bottom surface of the lower corner piece and a top flange top surface of the upper corner piece;
B is a thickness of a central flange of the container lock;
D3 is a third vertical distance, which is a vertical distance between the bottom flange bottom surface of the lower corner piece and a central flange top surface of the container lock; and
F is a vertical distance between the top flange top surface of the upper corner piece and a central flange bottom surface of the container lock; wherein
the tension clearance is from 0 to 12 mm.

12. The container lock according to claim 11, wherein in a resting position, the upper container is resting on top of the bottom container, wherein between an upper cone bottom surface and a lower cone contact point is a rest clearance, wherein the rest clearance is a sum of a first vertical distance D1 and a second vertical distance D2, wherein

D1 is a distance between a lower container corner piece contact point and the lower cone contact point; and
D2 is a distance between an upper container corner piece contact surface and the upper cone bottom surface, wherein
the rest clearance is from 0 to 4 mm.

13. A method for joining together an upper and a lower container stacked on top of each other with a locking arrangement, wherein the locking arrangement comprising

a lower corner piece of the upper container comprising a bottom flange;
an upper corner piece of the lower container comprising a top flange; and
a container lock, wherein the method comprising locking to each other the lower corner piece and the upper corner piece with the container lock; wherein
the lock arrangement in a tension position fulfils a formula, wherein a tension clearance TC = E - B = F + D3, wherein

E is a vertical distance between a bottom flange bottom surface and a top flange top surface;
B is a thickness of a central flange of the container lock;
D3 is a third vertical distance, which is a vertical distance between the bottom flange bottom surface and a central flange top surface of the container lock; and
F is a vertical distance between a top flange top surface and a central flange bottom surface of the container lock; wherein the ten-

sion clearance is from 0 to 12 mm.

14. The method according to claim 13, wherein in a resting position, the upper container is resting on top of the bottom container, wherein between an upper cone bottom surface and a lower cone contact point is a rest clearance, wherein the rest clearance is a sum of a first vertical distance D1 and a second vertical distance D2, wherein

D1 is a distance between a lower container corner piece contact point and the lower cone contact point; and
D2 is a distance between an upper container corner piece contact surface and the upper cone bottom surface, wherein
the rest clearance is from 0 to 4 mm.

15. The method according to claim 13 or claim 14, wherein in the resting position, the rest clearance RC = D1 + D2 = X - A - B - C, wherein

X is a vertical distance between the upper cone bottom surface and the lower cone contact point;
A is a thickness of the bottom flange of the lower corner piece;
B is the thickness of the central flange of the container lock;
C is a thickness of the top flange of the upper corner piece;
D1 is the first vertical distance, which is the vertical distance between the lower container corner piece contact point and the lower cone contact point; and
D2 is the second vertical distance, which is the vertical distance between the upper container corner piece contact surface and the upper cone bottom surface.

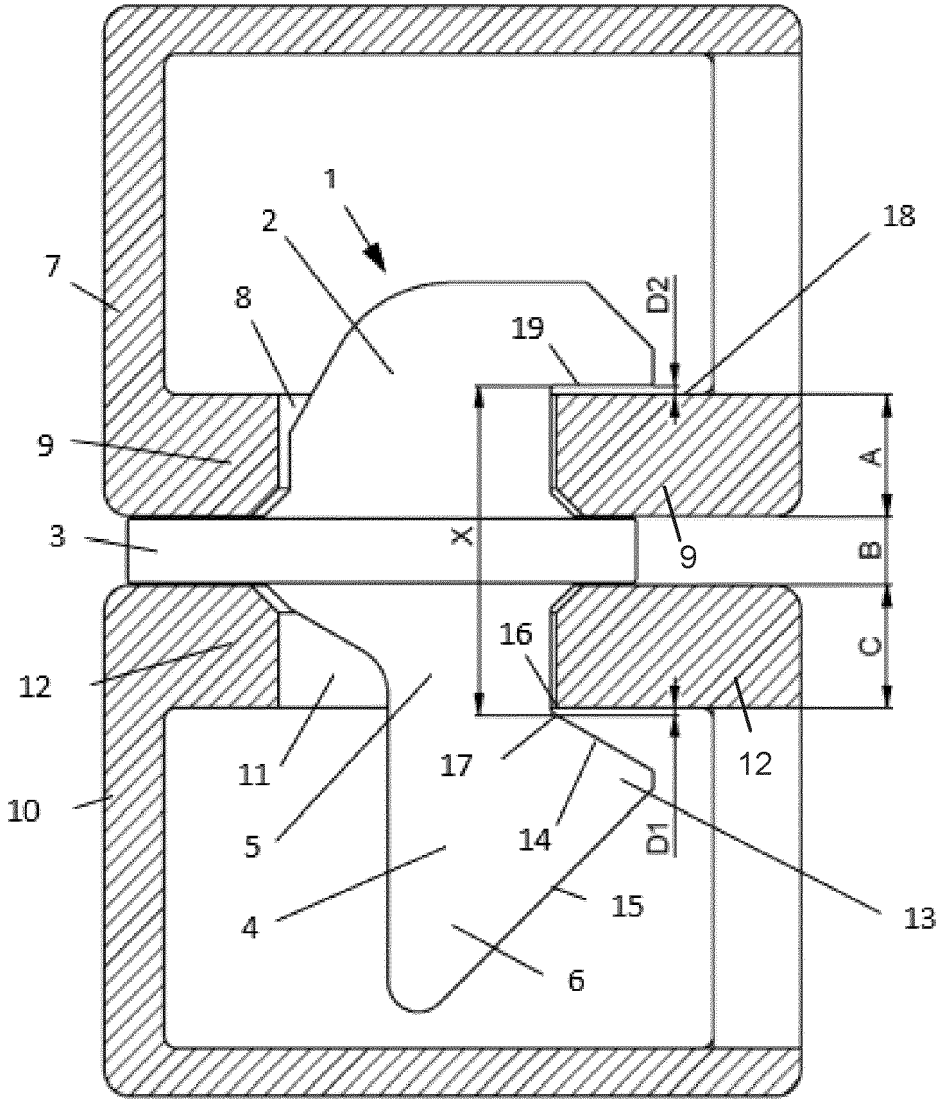

FIG. 1

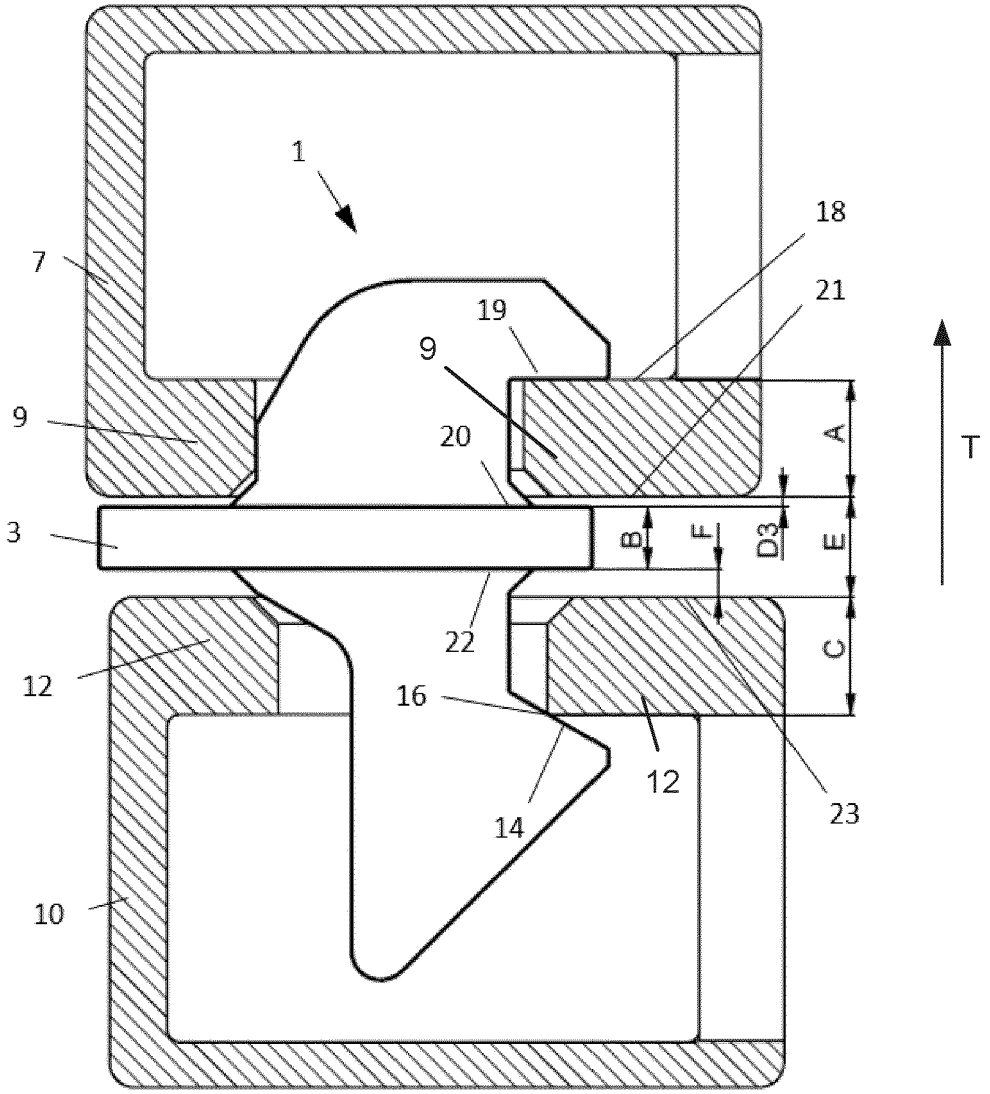
1
7
18
21
19
9
9
20
3
A
T
B
F
D3
E
22
C
12
16
12
23
14
10

FIG. 2

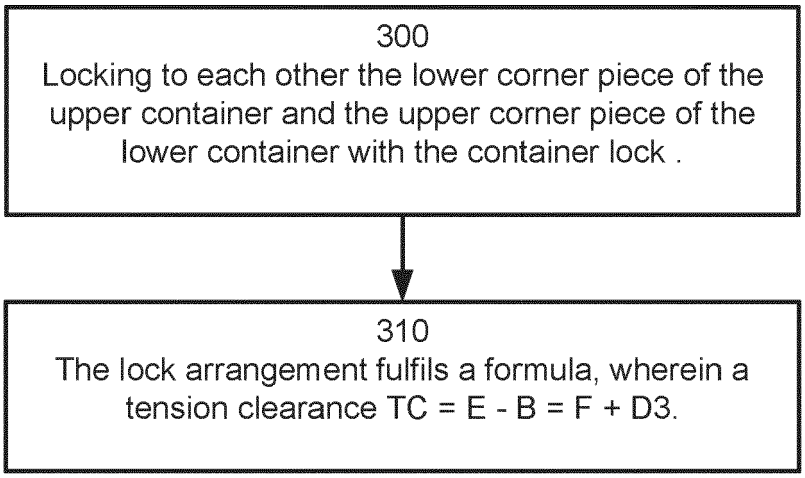
300
Locking to each other the lower corner piece of the upper container and the upper corner piece of the lower container with the container lock .
310
The lock arrangement fulfils a formula, wherein a tension clearance TC = E - B = F + D3.

FIG. 3

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EUROPEAN SEARCH REPORT

Application Number
EP 22 19 3211

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	WO 2016/067095 A1 (HANS BOHMAN INV HOLDING B V [NL]) 6 May 2016 (2016-05-06) * page 5, paragraph 24 * * page 7, paragraphs 30, 31 * * page 9, paragraph 40 - page 11, paragraph 43 * * figures 1-5 *	1-15	INV. B65D90/00
X	WO 2010/003331 A1 (MIKEMA INC [CN]; MA LONG-CHING [CN]) 14 January 2010 (2010-01-14) * page 2, paragraph 4 - page 3, paragraph 1 * * figure 1 *	1-15	
X	WO 2019/081810 A1 (MACGREGOR FINLAND OY [FI]) 2 May 2019 (2019-05-02) * page 5, line 17 - page 8, line 14 * * figures 1-6 *	1,3-5, 10,11,13	

TECHNICAL FIELDS SEARCHED (IPC)

B65D

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	7 February 2023	Piolat, Olivier

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07-02-2023

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 2016067095 A1	06-05-2016	TW 201623117 A	01-07-2016
		WO 2016067095 A1	06-05-2016
WO 2010003331 A1	14-01-2010	CN 101624124 A	13-01-2010
		WO 2010003331 A1	14-01-2010
WO 2019081810 A1	02-05-2019	CN 111247074 A	05-06-2020
		EP 3700834 A1	02-09-2020
		FI 20175943 A1	26-04-2019
		JP 2021500272 A	07-01-2021
		KR 20200074980 A	25-06-2020
		SG 11202002534T A	29-04-2020
		WO 2019081810 A1	02-05-2019

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