

COUPLING ASSEMBLY AND METHOD OF COUPLING

CROSS-REFERENCE TO RELATED APPLICATION

[0001] This application claims the benefit of priority of Singapore application No. 10201912116W filed December 13, 2019, the contents of it being hereby incorporated by reference in its entirety for all purposes.

TECHNICAL FIELD

[0002] Various embodiments of this disclosure may relate to a coupling assembly including a first coupling member and a second coupling member. Various embodiments of this disclosure relate may relate to a method of coupling a first coupling member and a second coupling member.

BACKGROUND

[0003] As new materials with high weight to strength ratios are developed for precast or prefabricated components (e.g. precast walls) are developed, the thickness of such components (e.g. thickness of the precast walls) can be reduced to save space and material while maintaining the same structural integrity. For instance, it has been reported that the current minimal wall thickness is about 40 mm.

[0004] However, reducing the thickness of the precast or prefabricated components may lead to a challenge during lifting of the components as even slight collisions between the lifting gear and the components may cause the components to crack.

[0005] Current lifting gear (e.g. spherical head lifting anchors, eyebolt lifting anchors, thread-based lifting anchors) that are available in the market are not able to resolve this challenge. FIG. 1 shows some conventional lifting gears.

SUMMARY

[0006] Various embodiments may relate to a coupling assembly. The coupling assembly may include a first coupling member including a first protruding portion along a first direction and a second protruding portion along a second direction different from the first direction. The coupling assembly may also include a second coupling member including a cover defining a slot opening and a holder coupled to the cover, the holder defining an enclosure. The slot opening may be configured to receive therethrough the first protruding portion when the first protruding portion is aligned with the slot opening. The slot opening may be further configured to receive therethrough the second protruding portion when the second protruding portion is aligned with the slot opening. The enclosure may be configured to receive the first protruding portion and the second protruding portion.

[0007] Various embodiments may relate to a method of coupling a first coupling member and a second coupling member. The method may include aligning a first protruding portion of the first coupling member to a slot opening defined on a cover of the second coupling member, the first protruding portion extending along a first direction. The method may also include inserting the first protruding portion of the first coupling member through the slot opening such that the first protruding portion is received by an enclosure defined by a holder of the second coupling member, the holder coupled to the cover. The method may additionally include aligning a second protruding portion of the first coupling member to the slot opening, the second protruding portion extending along a second direction different from the first direction. The method may further include inserting the second protruding portion of the first coupling member through the slot opening such that the second protruding portion is received by the enclosure.

BRIEF DESCRIPTION OF THE DRAWINGS

[0008] In the drawings, like reference characters generally refer to the same parts throughout the different views. The drawings are not necessarily drawn to scale, emphasis instead generally being placed upon illustrating the principles of various embodiments. In the following description, various embodiments of the invention are described with reference to the following drawings.

FIG. 1 shows some conventional lifting gears.

FIG. 2 is a general illustration of a coupling assembly according to various embodiments.

FIG. 3 is a schematic illustrating a method of coupling a first coupling member and a second coupling member according to various embodiments.

FIG. 4A shows a schematic of a first coupling member according to various embodiments.

FIG. 4B shows a schematic of a second coupling member according to various embodiments.

FIG. 4C shows a schematic of the first coupling member being coupled to the second coupling member according to various embodiments.

FIG. 5A shows a schematic of a first coupling member including a lifting attachment according to various embodiments.

FIG. 5B shows a schematic of a first coupling member including an eyebolt attachment according to various embodiments.

FIG. 5C shows a schematic of a second coupling member including a built-in reinforcement according to various embodiments.

FIG. 5D shows a schematic of a second coupling member including a reinforcement attachment component according to various embodiments.

FIG. 6 illustrates a method of coupling a first coupling member with a second coupling member according to various embodiments.

FIG. 7 is a schematic illustrating a coupling assembly being used during operation according to various embodiments.

DESCRIPTION

[0009] The following detailed description refers to the accompanying drawings that show, by way of illustration, specific details and embodiments in which the invention may be practised. These embodiments are described in sufficient detail to enable those skilled in the art to practise the invention. Other embodiments may be utilized and structural, logical, and electrical changes may be made without departing from the scope of the invention. The various embodiments are not necessarily mutually exclusive, as some embodiments can be combined with one or more other embodiments to form new embodiments.

[0010] Embodiments described in the context of one of the members, assemblies or methods are analogously valid for the other members, assemblies or methods. Similarly, embodiments described in the context of a method are analogously valid for a member or assembly, and vice versa.

[0011] Features that are described in the context of an embodiment may correspondingly be applicable to the same or similar features in the other embodiments. Features that are described in the context of an embodiment may correspondingly be applicable to the other embodiments, even if not explicitly described in these other embodiments. Furthermore, additions and/or combinations and/or alternatives as described for a feature in the context of an embodiment may correspondingly be applicable to the same or similar feature in the other embodiments.

[0012] The member or assembly as described herein may be operable in various orientations, and thus it should be understood that the terms “top”, “bottom”, etc., when used

in the following description are used for convenience and to aid understanding of relative positions or directions, and not intended to limit the orientation of the member or assembly.

[0013] In the context of various embodiments, the articles “a”, “an” and “the” as used with regard to a feature or element include a reference to one or more of the features or elements.

[0014] In the context of various embodiments, the term “about” or “approximately” as applied to a numeric value encompasses the exact value and a reasonable variance.

[0015] As used herein, the term “and/or” includes any and all combinations of one or more of the associated listed items.

[0016] FIG. 2 is a general illustration of a coupling assembly according to various embodiments. The coupling assembly may include a first coupling member 202 including a first protruding portion along a first direction and a second protruding portion along a second direction different from the first direction. The coupling assembly may also include a second coupling member 204 including a cover defining a slot opening and a holder coupled to the cover, the holder defining an enclosure. The slot opening may be configured to receive therethrough the first protruding portion when the first protruding portion is aligned with the slot opening. The slot opening may be further configured to receive therethrough the second protruding portion when the second protruding portion is aligned with the slot opening. The enclosure may be configured to receive the first protruding portion and the second protruding portion.

[0017] In other words, the coupling assembly may include two coupling members 202, 204 which may be coupled together. The first coupling member 202 may include two protruding portions which extend along different directions. The second coupling member 204 may include a cover with a slot opening and a holder coupled to the cover. The slot opening may allow for the two protruding portions to pass through only when they are aligned along the length of the slot opening. As the two protruding portions extend along different

directions, the two protruding portions would provide for redundant safety features when the first coupling member 202 is coupled to the second coupling member as the first coupling member 202 would have to rotate before the first coupling member passes through the slot opening and rotate again before the second coupling member passes through the slot opening for the first coupling member 202 to be decoupled from the second coupling member 204.

[0018] The first coupling member 202 may alternatively be referred to as an insert or a connector. A “protruding portion” may alternatively be referred to as “protrusion”, and may for instance, be a rod or pin.

[0019] The second coupling member 204 may alternatively be referred to as an adaptor or a socket.

[0020] Various embodiments may seek to address the issues facing conventional lifting gears. Various embodiments may allow the handling of thin precast or prefabricated components.

[0021] In various embodiments, the first coupling member 202 may include a central shaft. The central shaft may be an elongate member. The first protruding portion may extend from the central shaft along the first direction. Likewise, the second protruding portion may extend from the central shaft along the second direction. The first protruding portion may be at an angle greater than 0 degrees and less than 180 degrees with respect to the second protruding portion. The first protruding portion and the second protruding portion may extend laterally in different directions. The first protruding portion and the second protruding portion may be substantially perpendicular to a length of the central shaft.

[0022] In various embodiments, the first coupling member 202 may include a necking portion extending from the central shaft. The necking portion may alternatively be referred to as a necking or a neck. The necking portion may be arranged along the length of the central shaft above the first protruding portion and the second protruding portion. In other words, the

second protruding portion may be between the first protruding portion and the necking portion. The necking portion may function as a stopper and may prevent the first coupling member 202 from being inserted further into the second coupling member when the necking portion comes into contact with the second coupling member 204. The necking portion may also act as a visual guide and may indicate the proper coupling of the coupling members 202, 204.

[0023] In various embodiments, the first coupling member 202 may include a handle extending from the central shaft. The handle may be at one end of the first coupling member 202, e.g. above the first protruding portion and the second protruding portion. The handle may, for instance, be a lifting attachment or an eyebolt attachment.

[0024] In various embodiments, the second coupling member 204 may include an add-on component. The add-on component may, for instance, be a built-in reinforcement or a reinforcement attachment component for attaching a reinforcement bar.

[0025] In various embodiments, the second coupling member 204 may include a locking mechanism or a safety lock configured to lock the second protruding portion when the second protruding portion is received in the enclosure of the second coupling member.

[0026] In various embodiments, the second coupling member 204 may be configured to be embedded within a solid object, such as a precast component or a prefabricated component. The precast component or prefabricated component may be thin. In various embodiments, the precast component or prefabricated component may be as thin as 40 mm. The solid object may be made of concrete or the like.

[0027] In various embodiments, the first coupling member 202 may include or be made of any suitable material with high tensile strength, such as steel or tungsten. Likewise, the second coupling member 204 may include or be made of any suitable material with high tensile strength, such as steel or tungsten.

[0028] Various embodiments may relate to a first coupling member 202. The first coupling member 202 may include a first protruding portion along a first direction and a second protruding portion along a second direction different from the first direction. The first coupling member 202 may be configured to be coupled to a second coupling member 204. The first protruding portion may be configured to be inserted through a slot opening defined on a cover of the second coupling member 204, when the first protruding portion is aligned with the slot opening. The first protruding portion may be received by an enclosure defined by a holder of the second coupling member 204, the holder coupled to the cover, when the first protruding portion is inserted through the slot opening. Further, the second protruding portion may be configured to be inserted through the slot opening, when the second protruding portion is aligned with the slot opening. The second protruding portion may be received by the enclosure, when the second protruding portion is inserted through the slot opening.

[0029] Various embodiments may relate to a second coupling member 204. The second coupling member 204 may including a cover defining a slot opening and a holder coupled to the cover, the holder defining an enclosure. The slot opening may be configured to receive therethrough a first protruding portion of a first coupling member 202 when the first protruding portion is aligned with the slot opening. The slot opening may be further configured to receive therethrough a second protruding portion of the first coupling member 202 when the second protruding portion is aligned with the slot opening. The enclosure may be configured to receive the first protruding portion (when the first protruding portion is inserted through the slot opening) and the second protruding portion (when the second protruding portion is inserted through the slot opening).

[0030] FIG. 3 is a schematic illustrating a method of coupling a first coupling member and a second coupling member according to various embodiments. The method may include, in 302, aligning a first protruding portion of the first coupling member to a slot opening defined

on a cover of the second coupling member, the first protruding portion extending along a first direction. The method may also include, in 304, inserting the first protruding portion of the first coupling member through the slot opening such that the first protruding portion is received by an enclosure defined by a holder of the second coupling member, the holder coupled to the cover. The method may additionally include, in 306, aligning a second protruding portion of the first coupling member to the slot opening, the second protruding portion extending along a second direction different from the first direction. The method may further include, in 308, inserting the second protruding portion of the first coupling member through the slot opening such that the second protruding portion is received by the enclosure.

[0031] In other words, coupling the first coupling member to the second coupling member may include aligning the first protruding portion of the first coupling member with the slot opening of the second coupling member, inserting the first protruding portion through the slot opening, aligning the second protruding portion of the second coupling member with the slot opening, and inserting the second protruding portion through the slot opening.

[0032] In various embodiments, the first coupling member may include a central shaft. The first coupling member may extend from the central shaft along the first direction. The second coupling member may extend from the central shaft along the second direction.

[0033] In various embodiments, the first coupling member may include a necking portion extending from the central shaft.

[0034] In various embodiments, the first coupling member may include a handle extending from the central shaft. For instance, the handle may be a lifting attachment or an eyebolt attachment.

[0035] In various embodiments, the second coupling member may include an add-on component. For instance, the add-on component may be a built-in reinforcement or a reinforcement attachment component for attaching a reinforcement bar.

[0036] In various embodiments, the method may further include using a locking mechanism of the second coupling member to lock the second protruding portion when the second protruding portion is received in the enclosure of the second coupling member.

[0037] In various embodiments, the second coupling member may be embedded within a solid object, such as a precast component or a prefabricated component. The solid object may be made of concrete or the like.

[0038] Various embodiments may relate to a method of forming a first coupling member. The method may include forming a first protruding portion along a first direction and a second protruding portion along a second direction different from the first direction. The method may also include forming a central shaft.

[0039] Various embodiments may relate to a method of forming a second coupling member. The second coupling member may include a cover defining a slot opening and a holder coupled to the cover, the holder defining an enclosure. The holder may be joined, welded or attached to the cover. In various embodiments, the holder and the cover may form a single integral piece.

[0040] FIG. 4A shows a schematic of a first coupling member 402 according to various embodiments. The first coupling member 402 may include a central shaft 402a, a first protruding portion 404b extending laterally along a first direction, and a second protruding portion 404c extending laterally along a second direction different from the first direction. The first protruding portion 404b and the second protruding portion 404c may be substantially perpendicular to a length of the central shaft 402a. The first coupling member 402 may also include a necking portion 402d and a handle 402e extending from the central shaft 402a. As shown in FIG. 4A, the first protruding portion 402b may be at one end of the first coupling member 402, while the handle 402e may be at another end of the first coupling member 402. The second protruding portion 402c may be between the first protruding portion 402b and the

handle 402e, while the necking portion 402d may be between the second protruding portion 402c and the handle 402e.

[0041] FIG. 4B shows a schematic of a second coupling member 404 according to various embodiments. The second coupling member 404 may include a cover 404a defining a slot opening and a holder 404b coupled to the cover 404, the holder 404b defining an enclosure. In various embodiments, the cover 404a and the holder 404b may be joined or welded together. In various embodiments, the cover 404a and the holder 404b may form a single integral piece. In other words, the cover 404a and the holder 404b may be different portions of the second coupling member 404, and may be continuous and may not be separate or distinct from each other.

[0042] FIG. 4C shows a schematic of the first coupling member 402 being coupled to the second coupling member 404 according to various embodiments. The first coupling member 402 and the second coupling member 404 may form a coupling assembly. The protruding portions of the first coupling member 402 are received in the enclosure of the second coupling member 404. As shown in FIG. 4C, the second coupling member 404 may be embedded within a solid object 406 such as a precast component or a prefabricated component, e.g. a component wall or panel. In order to reduce clutter and improve clarity, the different features of the first coupling member 402 and the second coupling member 404 are not shown in FIG. 4C.

[0043] FIG. 5A shows a schematic of a first coupling member 502 including a lifting attachment 502e according to various embodiments. As shown in FIG. 5A, the first coupling member 502 may include a central shaft 502a, a first protruding portion 502b extending from the central shaft 502a along a first direction, a second protruding portion 502c extending from the central shaft 502a along a second direction different from the first direction, a necking portion 502d, and the lifting attachment 502e. The lifting attachment 502e may be attached,

joined or welded to the central shaft 502a. In various embodiments, the lifting attachment 502e and the central shaft 502a may form a single integral piece. The lifting attachment 502e may define a hole for passing a cable through.

[0044] FIG. 5B shows a schematic of a first coupling member 502' including an eyebolt attachment 502e' according to various embodiments. As shown in FIG. 5B, the first coupling member 502' may include a central shaft 502a', a first protruding portion 502b' extending from the central shaft 502a' along a first direction, a second protruding portion 502c' extending from the central shaft 502a' along a second direction different from the first direction, a necking portion 502d', and the lifting attachment 502e'. Similar to the lifting attachment 502e shown in FIG. 5A, the eyebolt attachment 502e' may be attached, joined or welded to the central shaft 502a'. In various embodiments, the eyebolt attachment 502e' and the central shaft 502a' may form a single integral piece. The eyebolt attachment 502e' may define a hole for passing a cable through.

[0045] FIG. 5C shows a schematic of a second coupling member 504 including a built-in reinforcement 504c according to various embodiments. The second coupling member 504 may include a cover 504a defining a slot opening and a holder 504b coupled to the cover 504a, the holder 504b defining an enclosure. The holder 504b may be joined, welded or attached to the cover 504a. In various embodiments, the holder 504b and the cover 504a may form a single integral piece. The second coupling member 504 may also include the built-in reinforcement 504c extending from the holder 504b. The reinforcement 504c and the holder 504b may form a "T" shape. The reinforcement 504c may be joined, welded or attached to the holder 504b. In various embodiments, the reinforcement 504c and the holder 504b may form a single integral piece.

[0046] FIG. 5D shows a schematic of a second coupling member 504' including a reinforcement attachment component 504c' according to various embodiments. The second

coupling member 504' may include a cover 504a' defining a slot opening and a holder 504b' coupled to the cover 504a', the holder 504b' defining an enclosure. The holder 504b' may be joined, welded or attached to the cover 504a'. In various embodiments, the holder 504b' and the cover 504a' may form a single integral piece. The second coupling member 504' may also include the reinforcement **attachment component 504c'** extending from the holder 504b'. The reinforcement attachment component 504c' may define a clearance or hold for insertion of a reinforcement bar 506. The reinforcement **attachment component 504c'** may be joined, welded or attached to the holder 504b'. In various embodiments, the reinforcement 504c' and the holder 504b' may form a single integral piece.

[0047] FIG. 6 illustrates a method of coupling a first coupling member 602 with a second coupling member 604 according to various embodiments. Under (A), the second coupling member 604 may be embedded in an object 606 such as a precast component or a prefabricated component. The top of the second coupling member 604 may be flush with the surface of the object 606, and the second coupling member 604 may not be visible when viewed from the side of the object 606. Under (B), the first coupling member 602 may be brought to the second coupling member 604. The first coupling member 602 may include a central shaft, as well as a first protruding portion (or pin), a second protruding portion (or pin), a necking portion and a handle extending from the central shaft. Under (C), the first protruding portion of the first coupling member 602 is aligned with a slot opening defined on a cover of the second coupling member 604, and the first protruding portion is inserted therethrough. The first protruding portion and the second protruding portion of the first coupling member 602 may extend laterally in different directions, and the angle between the first protruding portion and the second protruding portion may be about 30°. The second protruding portion has not yet been aligned with the slot opening and may be prevented from passing through the slot opening. The necking portion may serve as a visual guide, and may

be seen way above the surface of the object 606. Under (D), the first coupling member 602 may be rotated about an axis along the central shaft of the first coupling member 602 by about 30° such that the second protruding portion is aligned with the slot opening, and may be inserted through the slot opening. When the second protruding portion is inserted through the slot, the necking portion may be seen to be in contact with the surface of the object, indicating both first and second protruding portions have been inserted fully into the enclosure of the second coupling member 604. Under (E), the first coupling member 602 may be rotated about the axis along the central shaft of the first coupling member 602 by about 30° back such that the second protruding portion is locked in position. For instance, there may be inverted “U” shaped cavities of the cover facing the enclosure or circular recesses along a wall of the enclosure to accommodate the ends of the second protruding portion. When the first coupling member is rotated back, the ends of the second protruding portion may be received by the cavities or recesses, thereby causing the second protruding portion to be locked in place. The cavities or recesses may form the locking mechanism (i.e. safety lock) of the second coupling member 604 for securing or “locking” the first coupling member 602.

[0048] Various embodiments may be able to handle heavy loads. Various embodiments may be configured to handle a maximum loading up to 250 kN. Various embodiments may help in the protection of precast or prefabricated components. Various embodiments may have a small size. In various embodiments, the diameter of the first coupling member or the second coupling member may only be about 20 mm in diameter. The small device size may allow for use with thin precast or prefabricated components.

[0049] The engagement or coupling process may include the following steps: (1) alignment and insertion of first protruding portion or pin into the second coupling member (socket); (2) rotating the first coupling member (connector) until the second protruding

portion or pin is aligned and can be inserted; and (3) rotating the first coupling member (connector) until the second protruding portion or pin is secured by safety lock.

[0050] In various embodiments, the assembly can be quickly and easily operated.

[0051] Various embodiments may include two protruding portions or pins which provide for redundancy and added safety from decoupling.

[0052] In various embodiments, the second coupling member (socket) may be flush with a top surface of the precast or prefabricated component. This may be ideal for precast wall/panel applications when the walls or panels need to be stacked on top of one another during construction.

[0053] FIG. 7 is a schematic illustrating a coupling assembly being used during operation according to various embodiments. The second coupling members (sockets) 704 are embedded in the object 706, which may be a prefabricated or precast component. A first coupling member (insert) 702 may be coupled into each second coupling member 704. The first coupling members 702 may be coupled to the lifting system 710, e.g. a crane, via cables 708.

[0054] By “**comprising**” it is meant including, but not limited to, whatever follows the word “**comprising**”. Thus, use of the term “**comprising**” indicates that the listed elements are required or mandatory, but that other elements are optional and may or may not be present.

[0055] By “**consisting of**” is meant including, and limited to, whatever follows the phrase “**consisting of**”. Thus, the phrase “**consisting of**” indicates that the listed elements are required or mandatory, and that no other elements may be present.

[0056] The inventions illustratively described herein may suitably be practiced in the absence of any element or elements, limitation or limitations, not specifically disclosed herein. Thus, for example, the terms “**comprising**”, “**including**”, “**containing**”, etc. shall be read expansively and without limitation. Additionally, the terms and expressions employed

herein have been used as terms of description and not of limitation, and there is no intention in the use of such terms and expressions of excluding any equivalents of the features shown and described or portions thereof, but it is recognized that various modifications are possible within the scope of the invention claimed. Thus, it should be understood that although the present invention has been specifically disclosed by preferred embodiments and optional features, modification and variation of the inventions embodied therein herein disclosed may be resorted to by those skilled in the art, and that such modifications and variations are considered to be within the scope of this invention.

[0057] By “about” in relation to a given numerical value, such as for temperature and period of time, it is meant to include numerical values within 10% of the specified value.

[0058] The invention has been described broadly and generically herein. Each of the narrower species and sub-generic groupings falling within the generic disclosure also form part of the invention. This includes the generic description of the invention with a proviso or negative limitation removing any subject matter from the genus, regardless of whether or not the excised material is specifically recited herein.

[0059] Other embodiments are within the following claims and non-limiting examples. In addition, where features or aspects of the invention are described in terms of Markush groups, those skilled in the art will recognize that the invention is also thereby described in terms of any individual member or subgroup of members of the Markush group.