

IMPROVED ADJUSTABLE COMPACT LIFTING COUPLER AND METHOD OF USE

PRIORITY CLAIM

[0001] The present application claims priority from Australian provisional patent application number 2023901213, filed on 24 April 2023. The contents of the priority application are hereby incorporated herein by reference.

TECHNICAL FIELD

[0002] The present invention relates generally to the field of lifting couplers for screw jacking, lifting, pushing apart, or otherwise aligning and securing concrete structures via their opposing reinforcement bars (rebar) during the construction of a building.

[0003] Specifically, the improved adjustable compact lifting coupler comprises less parts than prior art couplers and has less threaded connections between those parts. Further, there has been a simplification of some of the more complex parts of prior art coupling systems. This provides a coupler that can be used where there is narrow spacing between prefabricated concrete elements.

BACKGROUND

[0004] In most multi-level construction methodologies, there is a need to connect one reinforced concrete element (such as a column) to another reinforced concrete element from the level below. To maintain the structural integrity of the building, this connection must transfer the design loads between elements and is typically done through the development of the reinforcing steel from one element to another.

[0005] In many cases, these elements are made in a factory as prefabricated concrete elements and delivered to site. The connection of these prefabricated concrete elements at each floor level is critical to ensure the structural integrity of the building is maintained.

[0006] Prior art rebar connection means are as varied as the building construction.

[0007] A common method of connecting the bars is by overlapping and tie wiring them together with a stipulated safety overlap length of normally thirty to forty times individual bar diameter. While this method is common practice for in-situ cast structures, it becomes even more complicated when the opposing structural elements are precast away from the building, for example, at a remote factory location. As a consequence, there is an unavoidable degree of complexity and material wastage associated with this method, which is not only expensive but is also time and labour intensive.

[0008] One solution is to extend the reinforcing bars from one prefabricated concrete element into hollow grout tubes located in the adjoining prefabricated concrete element. This connection is carried out after the concrete floor has been placed and the method requires the adjoining prefabricated concrete element to be temporarily propped and grout must be installed into the hollow grout tubes as well as to the gap between the concrete floor and the base of the prefabricated concrete element.

[0009] Another method of joining reinforcement bars utilises mechanical device connectors which are threaded or attached by an epoxy adhesive adapted to join the ends of the rebar. The use of mechanical connectors however invariably requires the bars to be very closely or near perfectly aligned. Moreover, this method is usually satisfactory if there is only a single bar to be joined to an opposite bar. Furthermore, it is quite a labour-intensive solution and the need to install (and later remove) temporary props and braces, mix and place grout, etc., prolongs the floor cycle time (construction programme) on multi-level building projects.

[0010] In particular, WO 2015/178621 discloses a mechanical device connector in the form of a rebar connector having a pair of locking members that can be used to connect single rebars. This prior art coupler is able to apply a pulling or tensile force on the opposing bars, but it is unable to provide a pushing force and

is certainly not designed to do so. In other words, this prior art coupler does not provide a jacking function.

[0011] One of the advantages of the present invention, is that the specific arrangement of the components enables the coupler to perform a jacking function, which is a significantly different function to other prior art couplers.

[0012] One prior art solution that utilises a mechanical device connector that is capable of performing a jacking function is the adjustable coupler system disclosed in the Applicant's previously published International PCT patent publication WO 2017/181244, which discloses an adjustable coupler that allows a prefabricated concrete element to be attached to the one below prior to the placement of the concrete floor when constructing a building. This system negates the need for temporary propping and in-situ grouting, and also provides for vertical adjustability through its jacking functions, as well as providing sufficient lateral tolerance required for the installation of prefabricated concrete elements.

[0013] However, one disadvantage of this coupler is that it is very expensive due to the large number of complex parts that are required to be accurately machined and assembled. There would be an advantage to reduce both the number of total parts, and the complexity in the parts that are utilised in a mechanical coupler.

[0014] This prior art coupler, having a large number of individual parts, and specifically because of the configuration of these individual parts, results in the minimum spacing between adjoining prefabricated concrete elements being too large in some cases for the system to be utilised.

[0015] Furthermore, as these prior art couplers need to cater for a large range floor depths (meaning the spacing between adjoining prefabricated concrete elements), the vertical adjustability allowed in the system is dictated by the overall length of the "inner coupler. Accordingly, because of the limitations arising from the configuration of the individual parts of the Applicant's own prior art coupler, it is therefore necessary to carry many "threaded stud" sizes to cater for all the various floor depths that may occur on projects.

[0016] Therefore, it would be advantageous to provide a mechanical device connector, and particularly in the form of an adjustable compact lifting coupler that would overcome at least some of the disadvantages of previously known approaches in this field, or would provide a useful alternative.

DISCLOSURE OF THE INVENTION

[0017] In a first aspect, the present invention comprises a concrete reinforcement bar (rebar) coupler for coupling a rebar of a first structural element to an opposing rebar of a second structural element, comprising a threaded post attachable to an end of the rebar of the first structural element, an adjustable seating head having an internally threaded aperture, the adjustable seating head being adapted to be screwed onto the threaded post, an inner coupler member permanently affixable to an end of the opposing rebar of the second structural element and comprising an internal cavity adapted to receive an end of the threaded post therewithin through an opening, the internal cavity opening being sized to freely receive the end of the threaded post, but not the adjustable seating head, therethrough, a bearing surface surrounding the internal cavity opening and being adapted to face towards the first structural element, and an outer threaded wall, and an enclosing coupler member being shaped to comprise an internal cavity sized to receive a portion of the inner coupler member therewithin, the cavity having an open end facing towards the second structural element, an opposing end wall having a locking surface, an end wall aperture extending through the end wall, the end wall aperture sized such that the enclosing coupler member can freely slide along the threaded post, and an internally threaded side wall sized to engage with the outer threaded wall of the inner coupler member. In an embodiment, in use, the adjustable seating head is able to be screwed to move along the threaded post and is able to bear against the bearing surface of the inner coupler member, moving the adjustable seating head along the threaded post adjusts an extent to which the threaded post is able to extend through the bearing surface aperture when the adjustable seating head bears against the bearing surface, screwing the adjustable seating head to urge against the bearing surface induces a jacking force between the first and second structural elements, and screwing the enclosing coupler member onto the inner coupler member

encloses and locks the adjustable seating head between the locking surface and the bearing surface, thereby inhibiting further movement of the adjustable seating head along the threaded post and coupling the first and second rebar together.

[0018] In an embodiment, the end wall aperture and the internal cavity opening each have a diameter wider than a diameter of the threaded post.

[0019] In an embodiment, the rebar coupler further comprises an internally threaded socket affixable to an end of the rebar of the first structural element, the internally threaded socket being sized to receive and threadedly engage with the threaded post therewithin.

[0020] In an embodiment, the threaded post is welded to the end of the rebar of the first structural element.

[0021] In an embodiment, the inner coupler member is welded to the end of the opposing rebar of the second structural element.

[0022] In an embodiment, the rebar coupler further comprises a locking nut screwable along the threaded post and arranged between the first structural element and the enclosing coupler member, the locking nut being adapted to be tightened against the enclosing coupler member when the enclosing coupler member is screwed onto the inner coupler member.

[0023] In an embodiment, the internal cavity opening is a transversely extending slot. In an embodiment, a transverse direction of the transversely extending slot, relative to a longitudinal direction of the opposing rebar, is adjustable.

[0024] In an embodiment, the inner coupler member is formed by a coupler base affixable to the opposing rebar and a separate bearing element that interfits therewith, and the bearing element comprises at least the bearing surface and the internal cavity opening.

[0025] In an embodiment, the internal cavity of the inner coupler member is formed by the coupler base and the bearing element interfitting with one another. In an alternative embodiment, the bearing element further comprises the internal cavity.

[0026] In an embodiment, at least one of the coupler base and the bearing element are shaped such that the bearing element interfits with the coupler base at a plurality of angles, each angle of the plurality of angles corresponding to a different transverse direction of the transversely extending slot.

[0027] In an embodiment, the adjustable seating head is an elongated head adapted to be extendable past an end of the threaded post without losing threaded engagement therewith.

[0028] In an embodiment, the rebar coupler further comprises a cap affixable into a distal end of the adjustable seating head when said distal end extends past the end of the threaded post, the cap having a protrusion adapted to be received within the internal cavity opening of the inner coupler member.

[0029] A further aspect of the invention may lie in a method of coupling a first and second structural element using a rebar coupler, comprising, in any suitable order, the operations of:

- a. affixing a threaded post to a rebar of the first structural element;
 - b. affixing an inner coupler member to an opposing rebar of the second structural element;
 - c. sliding an enclosing coupler member onto the threaded post such that an open end thereof faces the inner coupler member;
 - d. screwing an adjustable seating head onto the threaded post;
 - e. adjusting a position of the first and/or second structural element such that the threaded post is aligned with an opening of the inner coupler member;
 - f. screwing the adjustable seating head to bear against a bearing surface of the inner coupler member;
 - g. sliding the enclosing coupler member towards the inner coupler member;
- and

- h. screwing the enclosing coupler member onto the inner coupler member so as to enclose and lock the adjustable seating head between an end wall of the enclosing coupler member and the bearing surface of the inner coupler member.

[0030] In an embodiment, the method further comprises the operation of, prior to the operation of screwing the adjustable seating head to bear against the bearing surface, adjusting a position of the first and/or second structural element such that the threaded post extends into an opening of the inner coupler member.

[0031] In an embodiment, the adjustable seating head is an elongated head adapted to be extendable past an end of the threaded post without losing threaded engagement therewith.

[0032] The method of any one of claims 15 - 17, further comprising the operations of, prior to the operation of sliding the enclosing coupler member onto the threaded post, screwing a locking nut thereonto, and following the operation of screwing the enclosing coupler member onto the inner coupler member, screwing the locking nut to urge against the enclosing coupler member.

[0033] In an embodiment wherein an internal cavity opening of the inner coupler member is a transversely extending slot having an adjustable transverse direction, the operation of adjusting a position of the first and/or second structural element such that the threaded post is aligned with the opening of the inner coupler member additionally or alternatively comprises the operation of adjusting the transverse direction of the transversely extending slot to align said transversely extending slot with the threaded post.

[0034] In an embodiment wherein the inner coupler member is provided as a coupler base and a bearing element that interfits therewith, the operation of affixing the inner coupler member to the opposing rebar comprises the sub-operations of affixing the coupler base to the opposing rebar, and interfitting the bearing element with the coupler base.

[0035] Further or alternative embodiments of the invention may be disclosed herein or may otherwise become apparent to the person skilled in the art through the disclosure herein. These and other embodiments are considered to fall within the scope and object of the invention.

DESCRIPTION OF FIGURES

[0036] Embodiments of the present invention will now be described in relation to figures, wherein:

Figure 1 depicts an embodiment of a coupler of the present invention, as well as a cross-section thereof;

Figure 2 depicts an expanded view of an embodiment thereof;

Figure 3 depicts an embodiment thereof wherein the structural elements are not perfectly aligned;

Figure 4 depicts an embodiment thereof comprising a transversely extending slot;

Figures 5A & 5B depict particular radii of components of an embodiment of the present invention comprising an annular or circular opening;

Figure 6 depicts particular radii of components of an embodiment of the present invention comprising a transversely-extending slot;

Figures 7 & 8 depict further alternate embodiments comprising a transversely-extending slot;

Figure 9 depicts an embodiment of the invention having an alternate adjustable seating head; and

Figures 10A & 10B depict embodiments of the present invention in use.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

[0037] In a first aspect, the present invention comprises a concrete reinforcement bar (rebar) coupler for coupling a rebar of a first structural element to an opposing rebar of a second structural element. In an embodiment and with reference to Fig. 1, the rebar coupler 10 comprises a threaded post 12 that is attachable to an end of the rebar 14 of the first structural element 16, an adjustable seating head 18 having an internally threaded aperture and being adapted to be screwed onto the threaded post 12, an inner coupler member 20 that is permanently affixable to an end of the opposing rebar 22 of the second

structural element 24, and an enclosing coupler member 26 that is shaped to receive and engage with a portion of the inner coupler member 20 therewithin.

[0038] In an embodiment and with reference to Fig. 2, the inner coupler member 20 comprises an internal cavity 28 that is adapted to receive an end 12A of the threaded post 12 through an opening 30 therewithin, a bearing surface 32 that is adapted to face towards the first structural element 16, and an outer threaded wall 34. In an embodiment, the internal cavity opening 30 is sized to freely receive the end 12A of the threaded post 12 therethrough, but not the adjustable seating head 18.

[0039] In an embodiment, the enclosing coupler member 26 comprises an internal cavity 36. The internal cavity 36 comprises an open end 36A that faces towards the second structural element 24, an opposing end wall 38 that has a locking surface, an end wall aperture 40 that extends through the end wall 38, and an internally threaded side wall 42 that is sized to threadedly engage with the outer threaded wall 34 of the inner coupler member 20. In an embodiment, the end wall aperture 40 is sized such that the enclosing coupler member 26 can freely slide along the threaded post 12.

[0040] In use, the adjustable seating head 18 is able to be screwed to move along the threaded post 12, and thus is able to bear against the bearing surface 32 of the inner coupler member 20. Moving the adjustable seating head 18 along the threaded post 12 adjusts an extent to which the threaded post 12 is able to extend through the internal cavity opening 30, and thereby adjusts a distance between the first and second rebars 14,22. Furthermore, screwing the adjustable seating head 18 to urge against the bearing surface 32 may induce a jacking force between the first and second structural elements 16,24, urging them apart. Alternatively, if the first and second structural elements 16,24 are already correctly positioned, the adjustable seating head 18 may be screwed to urge against the bearing surface 32 sufficiently to merely induce a firm and positive contact to improve stability of the coupler 10.

[0041] The enclosing coupler member 26 may be screwed onto the inner coupler member 20, which encloses and locks the adjustable seating head 18 between the

end wall 38 and the bearing surface 32, thereby inhibiting further movement of the adjustable seating head 18 along the threaded post 12 and coupling the first and second rebars 14,22 together.

[0042] In a further embodiment, the end wall aperture 40 and the internal cavity opening 30 may each have a diameter that is wider than a diameter of the threaded post 12. Without limiting the scope of the invention through theory, it is envisaged that having an aperture and/or opening diameter greater than the threaded post diameter may provide improved lateral or transverse tolerance T in coupling the first and second rebars 14,22. In particular, and with reference to Fig. 3, an increased aperture/opening diameter may permit lateral displacement tolerance T between the threaded post and the second rebar 14 without inhibiting the ability of the enclosing coupler member 26 to threadedly engage and couple with the inner coupler member 20. As depicted in Fig. 3, the threaded post 12 is not aligned with the second rebar 14 - nevertheless, the inner coupler member 20 and enclosing coupler member 26 are able to threadedly engage with one another and couple the first and second rebars 14,22 together.

[0043] In an embodiment and with return reference to Fig. 1, the rebar coupler 10 may further comprise an internally threaded socket 44 that is affixable to an end of the rebar 14 of the first structural element 16. In such an embodiment, the internally threaded socket 44 may be sized to receive and threadedly engage with the threaded post 12 therewithin. In an alternative embodiment and as depicted in Fig. 3, the threaded post 12 may be welded directly to the end of the rebar 14 of the first structural element 16.

[0044] In an embodiment, the inner coupler member 20 may be welded to the end of the opposing rebar 22 of the second structural element 24.

[0045] In an embodiment and with further reference to Fig. 1, the rebar coupler 10 may further comprise a locking nut 46 that is screwable along the threaded post 12. In use, the locking nut 46 is arranged between the first structural element 16 and the enclosing coupler member 26. The locking nut may be adapted to be tightened against the enclosing coupler member 26 when the enclosing coupler member 26 is screwed onto the inner coupler member 20.

[0046] In a further embodiment, the spanner engaging portions 26A of the enclosing coupler member 26 may be arranged to be proximal to where the locking nut 46 will bear thereagainst. Positioning the engaging portions 26A adjacent to the locking nut 46 may enable a spanner to be used to tighten both components. It may also enable a gap between the first and second structural elements 16,24 to be reduced to its absolute minimum, i.e., a gap sufficient for a spanner to fit through in order to tighten the enclosing coupler member 26 and the locking nut 46.

[0047] In an embodiment and with reference to Fig. 4, the internal cavity opening 30 may be a transversely extending slot 48, where the opposing rebar 22 extends in the longitudinal direction. Fig. 4 depicts a first dash-and-dot arrow showing the direction W of the transversely extending slot 48, and a second dash-and-double-dot arrow showing the longitudinal direction L of the opposing rebar 22. As depicted, arrows/directions L & W are at right angles to one another.

[0048] Without limiting the scope of the invention through theory, it is envisaged that a transversely extending slot may provide for a greater lateral tolerance than an annular opening for an inner coupler member 20 of a particular size. With reference to Figs. 5A & 5B, a given inner coupler member 20 of radius C_i has an internal lateral radial tolerance T_i in all lateral directions. In one arrangement, the inner coupler member 20 comprises an internal cavity 28 having an annular or circular opening 30 with radius I_i , and a bearing surface 32 having surface length B_i . The threaded post 12 has radius P_i , and the adjustable seating head 18 has a radius of H_i and a surface length of S_i , where $H_i = S_i + P_i$. The skilled person will appreciate that the surface length S_i is dependent upon the material properties of the components of the coupler 10 as well as the forces that will be present within the coupler 10 when in use. The properties of such a given inner coupler member 20 having a desired internal lateral radial tolerance T_i are as follows:

$$T_1 = I_1 - P_1 \rightarrow I_1 = T_1 + P_1 \quad (1)$$

$$B_{1,min} = S_{1,min} = H_{1,min} - P_1 \quad (2)$$

$$C_{1,min} = I_1 + B_{1,min} \rightarrow C_{1,min} = I_1 + H_{1,min} - P_1 \quad (3)$$

$$H_{1,min} = (2I_1 - P_1) + S_{1,min} \rightarrow H_{1,min} = (2T_1 + P_1) + S_{1,min} \rightarrow H_{1,min} \propto 2T_1 \quad (4)$$

$$C_{1,min} = (3I_1 - 2P_1) + S_{1,min} \rightarrow C_{1,min} = (3T_1 + P_1) + S_{1,min} \rightarrow C_{1,min} \propto 3T_1 \quad (5)$$

[0049] As the above series of equations describe, the minimum radius C_1 of the inner coupler member 20 is proportional to three times the value of the desired radial tolerance, while the minimum radius of the adjustable seating head 18 is proportional to twice the desired radial tolerance. This is because, and with reference to Fig. 5B, the adjustable seating head 18 must be able to urge against the bearing surface 32 on both sides of the opening 30 to ensure proper and balanced distribution of forces throughout the coupler 10 regardless of the transverse position of the threaded post 12 within the opening 30. Therefore, . This is without accounting for material thickness, or shear forces exhibited upon the adjustable seating head 18 and bearing surface 32 – which will affect the minimum value of the surface length S_1 of the adjustable seating head 20, so the true minimum values for C_1 , B_1 and H_1 will be even larger.

[0050] In contrast, and with reference to Fig. 6, an inner coupler member 20 of radius C_2 has an internal lateral radial tolerance T_2 in one direction. In one arrangement, the inner coupler member 20 comprises an internal cavity 28 having a transversely extending slot 48 with half slot length I_2 and half slot width i_2 , and a bearing surface 32 having surface length B_{2a} and B_{2b} . The threaded post 12 has radius P_2 , and the adjustable seating head 18 has a radius of H_2 and a surface length of S_2 , where $H_2 = S_2 + P_2$. The skilled person will appreciate that the surface length S_2 is dependent upon the material properties of the components of the coupler 10 as well as the forces that will be present within the coupler 10 when in use. The properties of such a given inner coupler member 20 having a desired internal lateral radial tolerance T_2 are as follows:

$$T_2 = I_2 - P_2 \rightarrow I_2 = T_2 + P_2 \quad (6)$$

$$B_{2a,min} = S_{2,min} = H_{2,min} - P_2 \quad (7)$$

$$C_{2,min} = I_2 + B_{2a,min} \rightarrow C_{2,min} = I_2 + (H_{2,min} - P_2) \quad (8)$$

$$H_{2,min} = i_2 + S_{2,min} \rightarrow i_2 = P_2 \rightarrow H_{2,min} = P_2 + S_{2,min} \quad (9)$$

$$C_{2,min} = I_2 + (P_2 + S_{2,min}) - P_2 \rightarrow C_{2,min} = I_2 + S_{2,min} \rightarrow C_{2,min} \propto I_2 \quad (10)$$

[0051] As the above series of equations describe, the minimum radius of the inner coupler member 20 is directly proportional to the value of the desired radial tolerance T_2 . This is because, regardless of how long the slot length l_2 is, the slot width i_2 does not change (*except for curved slot ends, if present*). As a result, the minimum radius H_2 of the adjustable seating head 18 merely needs to be sufficient to be supported on both sides 48A, 48B of the transversely extending slot 48 regardless of the position of the threaded post 12 therealong. Again, the aforementioned equations do not account for material thickness, or shear forces exhibited upon the adjustable seating head 18 and bearing surface 32 – which will affect the minimum value of the surface length S_2 , so the true minimum values for C_2 , B_2 and H_2 will be larger.

[0052] In an embodiment, a transverse direction W of the transversely extending slot 48 may be adjustable. In one example embodiment, the bearing surface 32 of the inner coupler member 20 may be rotatable about an axis formed by longitudinal direction arrow L . In an alternate embodiment and with reference to Fig. 7 as well as Inset 7A, the inner coupler member 20 may be formed by a coupler base 20-1 that is affixable to the opposing rebar 22, and a separate bearing element 20-2 that interfits therewith. In such an embodiment, the bearing element 20-2 may comprise at least the bearing surface 32 and the internal cavity opening 30.

[0053] In an embodiment, the internal cavity 28 of the inner coupler member 20 may be formed by the coupler base 20-1 and the bearing element 20-2 interfitting with one another. In one further embodiment (*not depicted*), the internal cavity 28 may be substantially within the coupler base 20-1 and the bearing element 20-2 forms an upper end thereof. In an alternate further embodiment and as depicted in Fig. 7, the internal cavity 28 may be partially within the coupler base 20-1 and partially within the bearing element 20-2. In an alternate embodiment and with reference to Fig. 8, the internal cavity 28 may be wholly contained within the bearing element 20-2.

[0054] In an embodiment and with return reference to Fig. 7, at least one of the coupler base 20-1 and the bearing element 20-2 may be shaped such that the bearing element 20-2 interfits with the coupler base 20-1 at a plurality of angles.

The skilled person will appreciate that each of these angles will correspond to a different transverse direction *W* of the transversely extending slot 48. Fig. 7 depicts an example embodiment wherein the bearing element 20-2 comprises a circumferential indent 50 and the coupler base 20-1 comprises a complementary shoulder 52 that interfit with one another. The bearing element 20-2 can, when seated upon the coupler base 20-1 such that the indent 50 and shoulder 52 interfit, be rotated to any required transverse angle.

[0055] In an embodiment and with reference to Fig. 9 and Inset 9A, the adjustable seating head 18 may be an elongated head that is adapted to be extendable past an end 12A of the threaded post 12 without losing threaded engagement therewith. Such an embodiment may be of utility in situations wherein a gap between the first and second rebars 14,22 is higher than expected. Such an embodiment may also enable use of shorter threaded posts 12 than may otherwise be required.

[0056] In a further embodiment and with reference to Inset 9A in particular, the coupler 10 may further comprise a cap 54 that is affixable into a distal end 18A of the adjustable seating head 18 when said distal end 18A extends past the end 12A of the threaded post 12. In a further embodiment, the cap 54 may have a protrusion 56 that is adapted to be received within the internal cavity opening 30 of the inner coupler member 20.

[0057] Figures 10A & 10B depict two example uses of embodiments of the coupler 10 of the present invention. Fig. 10A depicts an example wherein the first and second structural elements 16,24 are parallel to one another, and in particular, the rebar 14 and opposing rebar 22 are substantially parallel to one another. In contrast, Fig. 10B depicts an example wherein the first and second structural elements 16,24 are not parallel to one another – in the particular depicted example, the rebar 14 and opposing rebar 22 are substantially at right angles to one another. As depicted, in such an arrangement the threaded post 12 may be affixed to the rebar 14 at right angles. If and as necessary, the threaded post 12 may be affixed to multiple rebars 14A, 14B within the first structural element 16 to ensure that the threaded post 12 is sufficiently secured. The

threaded post 12 may be affixed to the opposing rebar through any suitable means known in the art without departing from the scope of the present invention.

[0058] As illustrated in Figs. 10A & 10B, the coupler 10 may be recessed into one or both of the first and second structural elements 16,24. In particular embodiments wherein the engaging portions 26A of the enclosing coupler member 26 are adjacent to the locking nut 46 may enable a spanner to be used to tighten both components. It may also enable a gap between the first and second structural elements 16,24 to be reduced to its absolute minimum, as depicted.

[0059] Although Fig. 10A depicts an embodiment of the inner coupler member 20 as a single unit and Fig. 10B depicts an embodiment of the inner coupler member 20 comprising a coupler base 20 and bearing element 20, this should not be construed as limiting different embodiments of the inner coupler member to the particular arrangements of first and second structural elements 16,24 depicted in each figure.

[0060] A further aspect of the invention lies in a method of coupling a first and second structural element using a rebar coupler, comprising, in any suitable order, the operations of:

- a. affixing a threaded post to a rebar of the first structural element;
- b. affixing an inner coupler member to an opposing rebar of the second structural element;
- c. sliding an enclosing coupler member onto the threaded post such that an open end thereof faces the inner coupler member;
- d. screwing an adjustable seating head onto the threaded post;
- e. adjusting a position of the first and/or second structural element such that the threaded post is aligned with an opening of the inner coupler member;
- f. screwing the adjustable seating head to bear against a bearing surface of the inner coupler member;
- g. sliding the enclosing coupler member towards the inner coupler member; and
- h. screwing the enclosing coupler member onto the inner coupler member so as to enclose and lock the adjustable seating head between an end

wall of the enclosing coupler member and the bearing surface of the inner coupler member.

[0061] In an embodiment, the rebar coupler may be a rebar coupler 10 of an embodiment of a first aspect of the invention.

[0062] In an embodiment, the method may further comprise, prior to the operation of screwing the adjustable seating head to bear against the bearing surface, the operation of adjusting a position of the first and/or second structural element such that the threaded post extends into an opening of the inner coupler member. In an alternative embodiment, the adjustable seating head may comprise an elongated head adapted to be extendable past an end of the threaded post without losing threaded engagement therewith. In such an embodiment, the threaded post may not need to extend into the opening of the inner coupler member.

[0063] In an embodiment, the method may further comprise, prior to the operation of sliding the enclosing coupler member onto the threaded post, the operation of screwing a locking nut thereonto. In a further embodiment, the method may further comprise, following the operation of screwing the enclosing coupler member onto the inner coupler member, the operation of screwing the locking nut to urge against the enclosing coupler member.

[0064] In an embodiment wherein an internal cavity opening of the inner coupler member is a transversely extending slot having an adjustable transverse direction, the operation of adjusting a position of the first and/or second structural element such that the threaded post is aligned with the opening of the inner coupler member may additionally or alternatively comprise the operation of adjusting the transverse direction of the transversely extending slot to align said transversely extending slot with the threaded post.

[0065] In an embodiment wherein the inner coupler member is provided as a coupler base and a bearing element that interfits therewith, the operation of affixing the inner coupler member to the opposing rebar may further comprise the

sub-operations of affixing the coupler base to the opposing rebar, and interfitting the bearing element with the coupler base.

[0066] While the invention has been described with reference to preferred embodiments above, it will be appreciated by those skilled in the art that it is not limited to those embodiments, but may be embodied in many other forms, variations and modifications other than those specifically described. The invention includes all such variation and modifications. The invention also includes all of the steps, features, components and/or devices referred to or indicated in the specification, individually or collectively and any and all combinations or any two or more of the steps or features.

[0067] In this specification, unless the context clearly indicates otherwise, the word “comprising” is not intended to have the exclusive meaning of the word such as “consisting only of”, but rather has the non-exclusive meaning, in the sense of “including at least”. The same applies, with corresponding grammatical changes, to other forms of the word such as “comprise”, etc.

[0068] Other definitions for selected terms used herein may be found within the detailed description of the invention and apply throughout. Unless otherwise defined, all other scientific and technical terms used herein have the same meaning as commonly understood to one of ordinary skill in the art to which the invention belongs.

[0069] Any promises made in the present document should be understood to relate to some embodiments of the invention, and are not intended to be promises made about the invention in all embodiments. Where there are promises that are deemed to apply to all embodiments of the invention, the applicant/patentee reserves the right to later delete them from the description and they do not rely on these promises for the acceptance or subsequent grant of a patent in any country.

CLAIMS

1. A concrete reinforcement bar (rebar) coupler for coupling a rebar of a first structural element to an opposing rebar of a second structural element, the rebar coupler comprising:
 - a threaded post attachable to an end of the rebar of the first structural element;
 - an adjustable seating head having an internally threaded aperture, the adjustable seating head being adapted to be screwed onto the threaded post;
 - an inner coupler member permanently affixable to an end of the opposing rebar of the second structural element, the inner coupler member comprising:
 - an internal cavity adapted to receive an end of the threaded post therewithin through an opening, the internal cavity opening being sized to freely receive the end of the threaded post, but not the adjustable seating head, therethrough;
 - a bearing surface surrounding the internal cavity opening and being adapted to face towards the first structural element; and
 - an outer threaded wall; and
 - an enclosing coupler member being shaped to comprise an internal cavity sized to receive a portion of the inner coupler member therewithin, the cavity having:
 - an open end facing towards the second structural element;
 - an opposing end wall having a locking surface;
 - an end wall aperture extending through the end wall, the end wall aperture sized such that the enclosing coupler member can freely slide along the threaded post; and
 - an internally threaded side wall sized to engage with the outer threaded wall of the inner coupler member;
- wherein in use, the adjustable seating head is able to be screwed to move along the threaded post and is able to bear against the bearing surface of the inner coupler member;

moving the adjustable seating head along the threaded post adjusts an extent to which the threaded post is able to extend through the bearing surface aperture when the adjustable seating head bears against the bearing surface;

screwing the adjustable seating head to urge against the bearing surface induces a jacking force between the first and second structural elements; and

screwing the enclosing coupler member onto the inner coupler member encloses and locks the adjustable seating head between the locking surface and the bearing surface, thereby inhibiting further movement of the adjustable seating head along the threaded post and coupling the first and second rebar together.

2. The rebar coupler of claim 1, wherein the end wall aperture and the internal cavity opening each have a diameter wider than a diameter of the threaded post.
3. The rebar coupler of claim 1 or 2, further comprising an internally threaded socket affixable to an end of the rebar of the first structural element;
the internally threaded socket being sized to receive and threadedly engage with the threaded post therewithin.
4. The rebar coupler of claim 1 or 2, wherein the threaded post is welded to the end of the rebar of the first structural element.
5. The rebar coupler of any one of the above claims, wherein the inner coupler member is welded to the end of the opposing rebar of the second structural element.
6. The rebar coupler of any one of the above claims, further comprising a locking nut screwable along the threaded post and arranged between the first structural element and the enclosing coupler member;
the locking nut being adapted to be tightened against the enclosing coupler member when the enclosing coupler member is screwed onto the inner coupler member.

7. The rebar coupler of any one of the above claims, wherein the internal cavity opening is a transversely extending slot.
8. The rebar coupler of claim 7, wherein a transverse direction of the transversely extending slot, relative to a longitudinal direction of the opposing rebar, is adjustable.
9. The rebar coupler of claim 8, wherein the inner coupler member is formed by a coupler base affixable to the opposing rebar and a separate bearing element that interfits therewith; and
the bearing element comprises at least the bearing surface and the internal cavity opening.
10. The rebar coupler of claim 9, wherein the internal cavity of the inner coupler member is formed by the coupler base and the bearing element interfitting with one another.
11. The rebar coupler of claim 9, wherein the bearing element further comprises the internal cavity.
12. The rebar coupler of any one of claims 9 - 11, wherein at least one of the coupler base and the bearing element are shaped such that the bearing element interfits with the coupler base at a plurality of angles, each angle of the plurality of angles corresponding to a different transverse direction of the transversely extending slot.
13. The rebar coupler of any one of the above claims, wherein the adjustable seating head is an elongated head adapted to be extendable past an end of the threaded post without losing threaded engagement therewith.
14. The rebar coupler of claim 13, further comprising a cap affixable into a distal end of the adjustable seating head when said distal end extends past the end of the threaded post;

the cap having a protrusion adapted to be received within the internal cavity opening of the inner coupler member.

15. A method of coupling a first and second structural element using a rebar coupler of any one of claims 1 - 14, comprising, in any suitable order, the operations of:
 - affixing a threaded post to a rebar of the first structural element;
 - affixing an inner coupler member to an opposing rebar of the second structural element;
 - sliding an enclosing coupler member onto the threaded post such that an open end thereof faces the inner coupler member;
 - screwing an adjustable seating head onto the threaded post;
 - adjusting a position of the first and/or second structural element such that the threaded post is aligned with an opening of the inner coupler member;
 - screwing the adjustable seating head to bear against a bearing surface of the inner coupler member;
 - sliding the enclosing coupler member towards the inner coupler member; and
 - screwing the enclosing coupler member onto the inner coupler member so as to enclose and lock the adjustable seating head between an end wall of the enclosing coupler member and the bearing surface of the inner coupler member.
16. The method of claim 15, further comprising the operation of:
 - prior to the operation of screwing the adjustable seating head to bear against the bearing surface, adjusting a position of the first and/or second structural element such that the threaded post extends into an opening of the inner coupler member.
17. The method of claim 15, wherein the adjustable seating head is an elongated head adapted to be extendable past an end of the threaded post without losing threaded engagement therewith.

18. The method of any one of claims 15 - 17, further comprising the operations of:
- prior to the operation of sliding the enclosing coupler member onto the threaded post, screwing a locking nut thereonto; and
 - following the operation of screwing the enclosing coupler member onto the inner coupler member, screwing the locking nut to urge against the enclosing coupler member.
19. The method of any one of claims 15 - 18, wherein an internal cavity opening of the inner coupler member is a transversely extending slot having an adjustable transverse direction; and
- the operation of adjusting a position of the first and/or second structural element such that the threaded post is aligned with the opening of the inner coupler member additionally or alternatively comprises the operation of adjusting the transverse direction of the transversely extending slot to align said transversely extending slot with the threaded post.
20. The method of claim 19, wherein the inner coupler member is provided as a coupler base and a bearing element that interfits therewith; and
- the operation of affixing the inner coupler member to the opposing rebar comprises the sub-operations of:
 - affixing the coupler base to the opposing rebar; and
 - interfitting the bearing element with the coupler base.