



(11)

EP 4 826 177 A1

(12)

EUROPEAN PATENT APPLICATION

(43) Date of publication:
21.10.2026 Bulletin 2026/43

(51) International Patent Classification (IPC):
E04B 1/41 (2006.01) E04B 1/76 (2006.01)

(21) Application number: **26172403.3**

(52) Cooperative Patent Classification (CPC):
E04B 1/4178; E04B 1/7616

(22) Date of filing: **14.04.2026**

(84) Designated Contracting States:
**AL AT BE BG CH CY CZ DE DK EE ES FI FR GB
GR HR HU IE IS IT LI LT LU LV MC ME MK MT NL
NO PL PT RO RS SE SI SK SM TR**
Designated Extension States:
BA
Designated Validation States:
GE KH LA MA MD TN

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(30) Priority: **16.04.2025 GB 202505753**

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(54) **RESTRAINT SYSTEM**

(57) A restraint system 50 is provided for securing masonry cladding 16 to an externally insulated solid wall 12. The restraint system comprises: an anchor element 100 comprising an aperture 120 and an anchor formation 150 which is configured to receive one or more wall ties 300, and a fastener 200 for connecting the anchor element to the solid wall through an insulation layer 14. The fastener comprises a head 202 and a

shaft 210 which has a first threaded portion 220 distal the head and a second threaded portion 260 proximal to the head. The first threaded portion is configured for self-tapping into the solid wall and the second threaded portion is configured for directly engaging a periphery 112 of the aperture 120 in the anchor element in order to fix the anchor element to the solid wall at a predetermined distance from the solid wall.

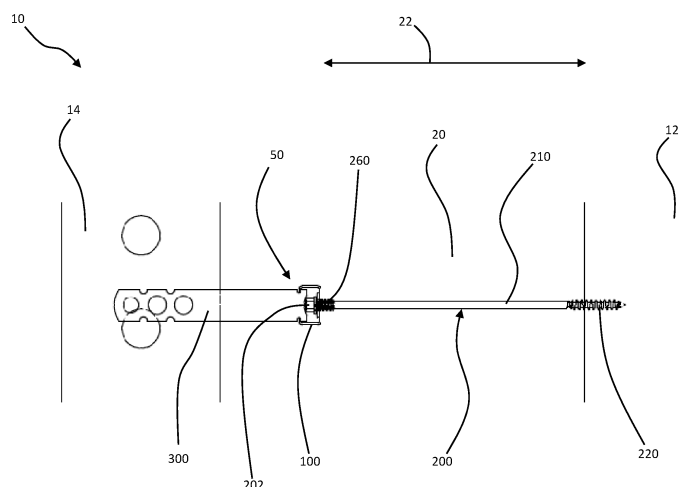


Fig. 1B

Description

FIELD

[0001] The present invention relates to a restraint system, to a building structure, and to a fastener for a restraint system.

BACKGROUND

[0002] A common type of building structure includes: an inner solid wall (e.g., a concrete frame); an outer masonry cladding; and an insulation layer provided between the solid wall and the masonry cladding. In such a building structure, there may be a requirement to secure the masonry cladding to the solid wall, so that the masonry cladding is restrained by the solid wall.

[0003] Various types of restraint systems are known for securing masonry cladding to an insulated solid wall. One such example includes an anchor element which is secured to the solid wall through the insulation layer and which is configured to receive wall ties which are embedded between layers of the masonry cladding.

[0004] In one example, the anchor element is secured to the solid wall using a multi-part fastener system including a standard screw and a compression sleeve which passes through the insulation later. The screw passes through the anchor element and the compression sleeve, and is screwed into the solid wall. The compression sleeve abuts against the solid wall and the anchor element to maintain the position of the anchor element at a predetermined distance from the solid wall.

[0005] In another example, the anchor element is secured to the solid wall using a multi-part fastener system including a bolt and a screw. The bolt has a first end which screws into the solid wall, and a second end which defines an internal bore. The anchor element is placed against the second end of the bolt to maintain the anchor element at a predetermined distance from the solid wall. The screw passes through the anchor element and engages the internal bore of the bolt in order to secure the anchor element to the solid wall via the bolt.

[0006] It is an aim of the present invention to address one or more of the disadvantages associated with the prior art.

SUMMARY

[0007] The present teachings provide a restraint system, a building structure and a fastener according to the appended claims.

[0008] An aspect of the teachings provides a restraint system for securing masonry cladding to an externally insulated solid wall. The restraint system may comprise an anchor element comprising an aperture and an an-

chor formation which is configured to receive one or more wall ties for coupling the anchor element to the masonry cladding. The restraint system may also comprise a fastener for connecting the anchor element to the solid wall through an insulation layer. The fastener may comprise a head and a shaft which has a first threaded portion distal to the head and a second threaded portion proximal to the head. The first threaded portion may be configured for self-tapping into the solid wall. The second threaded portion may be configured for directly engaging a periphery of the aperture in the anchor element in order to fix the anchor element to the solid wall at a predetermined distance from the solid wall.

[0009] Such a restraint system allows the anchor element to be secured to a solid wall using a single fastener, by virtue of the shaft of the fastener having a first threaded portion configured to self-tap into a solid wall, and a second threaded portion configured to directly engage the aperture in the anchor element in order to fix the anchor element to the solid wall at a predetermined distance. This may simplify assembly, reduce costs and reduce the likelihood of errors in assembly in comparison to alternative configurations in which a multi-part fastener system is used.

[0010] It will be understood that the predetermined distance may correspond to a desired thickness of an insulation layer placed between the anchor element and the solid wall.

[0011] Optionally, the anchor element comprises a support member which defines the aperture, and one or more anchor sides extending transversely away from the support member to define the anchor formation. Optionally, the restraint system is configured so that a portion of the support member surrounding the aperture is secured between adjacent threads of the second threaded portion via an interference fit to engage the second threaded portion with the periphery of the aperture in the support member and thereby inhibit movement of the anchor element along the shaft of the fastener.

[0012] In other words, the second threaded portion and the support member may be sized so that the support member fits snugly between adjacent threads of the second threaded portion. In this way, the anchor element can be maintained at a predetermined distance from the solid wall.

[0013] Optionally, the aperture comprises an aperture diameter and the second threaded portion comprises a major diameter which is at least 0.65mm greater than the aperture diameter, optionally at least 0.7mm greater, optionally at least 0.75mm greater, optionally at least 0.8mm greater, optionally at least 0.85mm greater.

[0014] In this way, an overlap of such a dimension may be defined between the threads of the second threaded portion and the portion of the support member surrounding the aperture. This may facilitate a robust

connection.

[0015] Optionally, the major diameter of the second threaded portion is in a range of around 7mm to around 7.6mm, optionally around 7.15mm to around 7.45mm, optionally around 7.25mm to around 7.35mm; and/or wherein the second threaded portion comprises a minor diameter in a range of around 4mm to around 5.2mm, optionally around 4.3mm to around 4.9mm, optionally around 4.5mm to around 4.7mm.

[0016] In other words, an outer diameter defined by the crests of the threads of the second threaded portion may be in such a range. Such a major diameter may be particularly suitable for directly engaging the periphery of the aperture of the anchor element (e.g., clamping the support member of the anchor element).

[0017] In some embodiments, the major diameter of the second portion tapers inwardly in a direction away from the head towards the first threaded portion. In such embodiments, it will be understood that the major diameter will vary, but the point along the second threaded portion which is configured to engage the aperture in the anchor element may be in one of the ranges outlined above.

[0018] In other words, an inner diameter defined by the roots of the threads of the second threaded portion may be in such a range. Such a minor diameter may be particularly suitable for directly engaging the periphery of the aperture of the anchor element (e.g., clamping the support member of the anchor element).

[0019] Optionally, the aperture in the anchor element comprises an aperture diameter in a range of around 6.0mm to around 7.1mm, optionally around 6.3mm to around 6.8mm, optionally around 6.4mm to around 6.7mm, optionally in the range 6.5mm to 6.6mm.

[0020] An aperture sized in such a range may cooperate with the second threaded portion of the fastener to provide a robust connection therebetween.

[0021] Optionally, the second threaded portion comprises a thread height in a range of around 0.9mm to around 1.8mm, optionally around 1.1mm to around 1.6mm, optionally around 1.2mm to around 1.5mm.

[0022] In other words, a difference between the major and minor diameters of the second threaded portion may be in such a range. Such a thread height may be particularly suitable for directly engaging the periphery of the aperture of the anchor element (e.g., clamping the support member of the anchor element). For example, such a thread height may provide a greater overlap with the portion of the anchor element surrounding the anchor aperture than in shallower alternatives, which may improve robustness.

[0023] Optionally, the second threaded portion comprises a thread pitch in a range of around 1.3mm to around 2.3mm, optionally around 1.5mm to around 2mm, optionally around 1.7mm to around 1.9mm, optionally around 1.75mm to around 1.85mm, optionally approximately 1.81mm.

[0024] Such a thread pitch may be particularly suitable

for clamping the support member of the anchor element.

[0025] Optionally, the portion of the support member surrounding the aperture has a thickness in a range of around 0.8mm to around 1.6mm, optionally around 1.0mm to around 1.4mm, optionally around 1.1mm to around 1.3mm, for example approximately 1.2mm.

[0026] Optionally, the second threaded portion comprises a flank angle in a range of around 20 degrees to around 40 degrees, optionally around 25 degrees to around 35 degrees, optionally around 27.5 degrees to around 32.5 degrees, optionally approximately 60 degrees.

[0027] Such a flank angle may be particularly suitable for directly engaging the periphery of the aperture of the anchor element (e.g., for spacing the threads in order to clamp the support member of the anchor element).

[0028] Optionally, the first threaded portion comprises a different thread profile to the second threaded portion. Optionally, the thread pitch of the first threaded portion is greater than the thread pitch of the second threaded portion.

[0029] Having different thread profiles allows the first and second threaded portions to be adapted for their respective purposes. For example, a larger thread pitch may be used at the first threaded portion for tapping into the solid wall, whereas a smaller thread pitch may be used at the second threaded portion for clamping the anchor element.

[0030] Optionally, the first threaded portion comprises a thread pitch in a range of around 2mm to around 4mm, optionally around 2.5mm to around 3.5mm, optionally around 2.75mm to around 3.25mm, optionally approximately 3mm.

[0031] Such a thread pitch may be particularly suitable for self-tapping into the solid wall.

[0032] Optionally, the first threaded portion comprises a high-low thread profile comprising a high thread and a low thread.

[0033] Such a high-low thread profile may be particularly suitable for self-tapping into the solid wall.

[0034] Optionally, the high thread comprises a major diameter in a range of around 5.75mm to around 7mm, optionally around 6mm to around 6.75mm, optionally around 6.25mm to around 6.5mm.

[0035] Optionally, the low thread comprises a major diameter in a range of around 4.7mm to around 5.7mm, optionally around 4.9mm to around 5.5mm, optionally around 5.1mm to around 5.3mm.

[0036] Such high and low thread major diameters (i.e., outer circumferences defined by the crests of the respective threads) may be particularly suitable for self-tapping into the solid wall.

[0037] Optionally, the high thread comprises a flank angle in a range of around 10 degrees to around 30 degrees, optionally around 15 degrees to around 25 degrees, optionally around 17.5 degrees to around

22.5 degrees, optionally approximately 20 degrees.

[0038] Optionally, the low thread comprises a flank angle in a range of around 20 degrees to around 40 degrees, optionally around 25 degrees to around 35 degrees, optionally around 27.5 degrees to around 32.5 degrees, optionally approximately 60 degrees.

[0039] Such flank angles may be particularly suitable for self-tapping into the solid wall.

[0040] Optionally, the first threaded portion comprises a minor diameter in a range of around 3.75mm to around 5.1mm, optionally around 4.1mm to around 4.75mm, optionally around 4.3 degrees to around 4.55 degrees.

[0041] In other words, an inner diameter defined by the roots of the threads of the first threaded portion may be in such a range. This may be particularly suitable for self-tapping into the solid wall (e.g., when combined with other properties of the thread such as the major diameter and thread pitch ranges outlined above).

[0042] Optionally, the first threaded portion is longer than the second threaded portion.

[0043] It will be understood that the second threaded portion does not need to be particularly long in order to secure the anchor element. Therefore, by having a longer first threaded portion, a robust connection to the solid wall can be provided whilst minimising the length of the second threaded portion.

[0044] Optionally, the first threaded portion comprises a length in a range of around 20mm to around 50mm, optionally around 25mm to around 45mm, optionally around 30mm to around 40mm, optionally approximately 35mm.

[0045] Optionally, the second threaded portion comprises a length in a range of around 5mm to around 15mm, optionally around 7.5mm to around 12.5mm.

[0046] Optionally, the first threaded portion comprises a pointed end having a point angle in a range of around 20 degrees to around 65 degrees, optionally around 35 degrees to around 50 degrees.

[0047] Such a point angle may be particularly suitable for self-tapping into the solid wall.

[0048] Optionally, the shaft of the fastener comprises a shank portion between the first threaded portion and the second threaded portion. Optionally, the shank portion is not threaded.

[0049] Such an unthreaded shank portion can be passed easily through the insulation layer to space the first and second threaded portions apart from each other.

[0050] In other configurations, the first threaded portion may extend all the way to the second threaded portion (i.e., the shank portion may be omitted).

[0051] Optionally, the shank portion comprises an outer diameter which is narrower than the major diameters of the first and second threaded portions.

[0052] Optionally, the shank portion comprises an outer diameter in a range of around 4.4mm to around 5.3mm, optionally around 4.65mm to around 5.05mm,

optionally around 4.85mm to around 4.95mm.

[0053] Optionally, the shank portion comprises a length in a range of around 30mm to around 270mm.

[0054] Optionally, the fastener is made from a steel material, optionally a stainless steel material, optionally a non-magnetic, austenitic stainless steel, such as A2 stainless steel.

[0055] Such a fastener may be particularly suitable for self-tapping into the solid wall, and for securing the anchor element robustly in order to transfer load from the masonry cladding to the solid wall.

[0056] Optionally, the restraint system further comprises a washer arrangement configured to be placed between the head of the fastener and the anchor element.

[0057] Optionally, the washer arrangement comprises at least a compressible washer.

[0058] It will be understood that the compressible washer will be compressed between the head of the fastener and the anchor element as the fastener is tightened. In this way, the compressible washer may absorb some of the force which is applied when the fastener is tightened, which may reduce the amount of force transferred to the insulation layer and thus inhibit deformation of the insulation layer.

[0059] In embodiments where the anchor element is clamped between adjacent threads of the second threaded portion, the compressible washer may also urge the anchor element into contact with one of the threads to provide a robust clamping connection.

[0060] Optionally, the washer arrangement is a hybrid washer arrangement comprising a rigid washer and the compressible washer.

[0061] Such a rigid (e.g., metallic) washer may be pushed by the head of the fastener in order to compress the compressible washer.

[0062] Optionally, the rigid washer and compressible washer are fixed to each other.

[0063] Having the rigid washer and compressible washer fixed to each other provides a simplified assembly in comparison to alternatives in which two separate washers are used. This may also reduce the likelihood of incorrect assembly (e.g., by missing one of the washers).

[0064] Optionally, the rigid washer comprises a first washer thickness and the compressible washer comprises a second washer thickness in an uncompressed state, wherein the second washer thickness is greater than the first washer thickness.

[0065] Optionally, the first washer thickness is in a range of around 0.25mm to around 1.75mm, optionally around 0.5mm to around 1.5mm, optionally around 0.75mm to around 1.25mm, optionally approximately 1mm.

[0066] Optionally, the second washer thickness is in a range of around 2mm to 4mm, optionally around 2.5mm to around 3.5mm, for example approximately 3mm.

[0067] Having a greater thickness of the compressible washer facilitates an increased amount of compression and/or an improved ability to absorb forces exerted by tightening of the fastener.

[0068] Optionally, the rigid washer is made of metallic material such as steel, for example stainless steel, or aluminium.

[0069] Optionally, the compressible washer is made of an elastomeric material. Optionally the compressible washer is made of a rubber material, for example ethylene propylene diene terpolymer (EPDM) or neoprene.

[0070] Such materials may be particularly suitable for forming the respective washers.

[0071] Optionally, the anchor element comprises a C-shaped cross-section along its length, wherein the C-shaped cross section defines a channel and a slot through which said wall ties can be inserted into the channel.

[0072] Such a C-shaped cross-section can be constructed simply (e.g., bent from sheet metal).

[0073] Optionally, the anchor element comprises a length in a range of around 2500mm to around 3500mm.

[0074] Optionally, the anchor element comprises a width in a range of around 20mm to around 30mm, optionally around 22.5mm to around 27.5mm.

[0075] Optionally, the anchor element comprises a depth in a range of around 10mm to around 20mm, optionally around 12mm to around 16mm.

[0076] Optionally, the slot comprises a slot width in a range of around 10mm to around 20mm, optionally around 14mm to around 18mm.

[0077] Optionally, the restraint system further comprises one or more wall ties comprising a first end configured to be located between adjacent layers of the masonry cladding, and a second end configured to be coupled to the anchor element.

[0078] Such wall ties provide a means for coupling the masonry cladding to the anchor element (and consequently to the solid wall via the fastener).

[0079] Optionally, the anchor element comprises a support member which defines the aperture, and first and second sides extending transversely away from the support member to define the anchor formation. Optionally, the first and second sides comprise free ends which define a slot therebetween. Optionally, each of the one or more wall ties comprises notches on opposing sides of the wall tie proximal to the second end, such that the second end of the wall tie can be inserted through the slot and then twisted in order to engage the notches with edges of the slot, in order to secure the wall tie to the anchor element.

[0080] Such a configuration provides a simple means of securing the wall ties to the anchor element.

[0081] Optionally, the head of the fastener comprises a non-circular (e.g., hexagonal) circumference for being driven by a rotational tool having a corresponding inner formation (e.g., wrench, spanner, socket, etc.).

[0082] Such a head can easily be driven by a variety of commercially available tools.

[0083] Optionally, the head of the fastener comprises a non-circular (e.g., hexagonal, cross-shapes etc) inner formation for being driven by a rotational tool having a corresponding circumference (e.g., Allen key, screwdriver, etc.).

[0084] Such a head can easily be driven by a variety of commercially available tools.

[0085] A further aspect of the teachings provides a building structure comprising: a solid wall; a masonry cladding; an insulation layer provided between the solid wall and the masonry cladding; and a restraint system as disclosed herein. The wall ties may be embedded between adjacent layers of the masonry cladding and secured to the anchor element. The anchor element may be secured to the solid wall via the fastener, in order to secure the masonry cladding to the solid wall.

[0086] Such a building structure benefits from the advantages of the restraint system outlined above.

[0087] A further aspect of the teachings provides a fastener for a restraint system as disclosed herein. The fastener may comprise a head and a shaft. The shaft may comprise a first threaded portion distal to the head, wherein the first threaded portion is configured for self-tapping into a solid wall structure. The shaft may also comprise a second threaded portion proximal to the head, wherein the second threaded portion is configured for engaging an aperture in an anchor element in order to fix the anchor element to the solid wall structure.

[0088] Such a fastener may be used in a restraint system to provide the benefits outlined above.

[0089] Optionally, the second threaded portion comprises a major diameter in a range of around 7mm to around 7.6mm, optionally around 7.15mm to around 7.45mm, optionally around 7.25mm to around 7.35mm.

[0090] Optionally, the second threaded portion comprises a minor diameter in a range of around 4mm to around 5.2mm, optionally around 4.3mm to around 4.9mm, optionally around 4.5mm to around 4.7mm.

[0091] In some embodiments, the major diameter of the second portion tapers inwardly in a direction away from the head towards the first threaded portion. In such embodiments, it will be understood that the major diameter will vary.

[0092] Optionally, the second threaded portion comprises a thread height in a range of around 0.9mm to around 1.8mm, optionally around 1.1mm to around 1.6mm, optionally around 1.2mm to around 1.5mm. In other words, a difference between the major and minor diameters of the second threaded portion may be in such a range.

[0093] Optionally, the second threaded portion comprises a thread pitch in a range of around 1.3mm to around 2.3mm, optionally around 1.5mm to around 2mm, optionally around 1.7mm to around 1.9mm, optionally around 1.75mm to around 1.85mm, optionally

approximately 1.81mm.

[0094] Optionally, the second threaded portion comprises a flank angle in a range of around 20 degrees to around 40 degrees, optionally around 25 degrees to around 35 degrees, optionally around 27.5 degrees to around 32.5 degrees, optionally approximately 60 degrees.

[0095] Optionally, the first threaded portion comprises a different thread profile to the second threaded portion. Optionally, the thread pitch of the first threaded portion is greater than the thread pitch of the second threaded portion.

[0096] Optionally, the first threaded portion comprises a thread pitch in a range of around 2mm to around 4mm, optionally around 2.5mm to around 3.5mm, optionally around 2.75mm to around 3.25mm, optionally approximately 3mm.

[0097] Optionally, the first threaded portion comprises a high-low thread profile comprising a high thread and a low thread.

[0098] Optionally, the high thread comprises a major diameter in a range of around 5.75mm to around 7mm, optionally around 6mm to around 6.75mm, optionally around 6.25mm to around 6.5mm.

[0099] Optionally, the low thread comprises a major diameter in a range of around 4.7mm to around 5.7mm, optionally around 4.9mm to around 5.5mm, optionally around 5.1mm to around 5.3mm.

[0100] Optionally, the high thread comprises a flank angle in a range of around 10 degrees to around 30 degrees, optionally around 15 degrees to around 25 degrees, optionally around 17.5 degrees to around 22.5 degrees, optionally approximately 20 degrees.

[0101] Optionally, the low thread comprises a flank angle in a range of around 20 degrees to around 40 degrees, optionally around 25 degrees to around 35 degrees, optionally around 27.5 degrees to around 32.5 degrees, optionally approximately 60 degrees.

[0102] Optionally, the first threaded portion comprises a minor diameter in a range of around 3.75mm to around 5.1mm, optionally around 4.1mm to around 4.75mm, optionally around 4.3 degrees to around 4.55 degrees.

[0103] Optionally, the first threaded portion is longer than the second threaded portion.

[0104] Optionally, the first threaded portion comprises a length in a range of around 20mm to around 50mm, optionally around 25mm to around 45mm, optionally around 30mm to around 40mm, optionally approximately 35mm.

[0105] Optionally, the second threaded portion comprises a length in a range of around 5mm to around 15mm, optionally around 7.5mm to around 12.5mm.

[0106] Optionally, the first threaded portion comprises a pointed end having a point angle in a range of around 20 degrees to around 65 degrees, optionally around 35 degrees to around 50 degrees.

[0107] Optionally, the shaft of the fastener comprises

a shank portion between the first threaded portion and the second threaded portion. Optionally, the shank portion is not threaded.

[0108] In other configurations, the first threaded portion may extend all the way to the second threaded portion (i.e., the shank portion may be omitted).

[0109] Optionally, the shank portion comprises an outer diameter which is narrower than the major diameters of the first and second threaded portions.

[0110] Optionally, the shank portion comprises an outer diameter in a range of around 4.4mm to around 5.3mm, optionally around 4.65mm to around 5.05mm, optionally around 4.85mm to around 4.95mm.

[0111] Optionally, the shank portion comprises a length in a range of around 30mm to around 270mm.

[0112] Optionally, the fastener is made from a steel material, optionally a stainless steel material, optionally a non-magnetic, austenitic stainless steel, such as A2 stainless steel.

[0113] Optionally, the head of the fastener comprises a non-circular (e.g., hexagonal) circumference for being driven by a rotational tool having a corresponding inner formation (e.g., wrench, spanner, socket, etc.).

[0114] Optionally, the head of the fastener comprises a non-circular (e.g., hexagonal, cross-shapes etc) inner formation for being driven by a rotational tool having a corresponding circumference (e.g., Allen key, screwdriver, etc.).

[0115] A further aspect of the teachings provides a method of securing an anchor element to an externally insulated solid wall. The method may comprise positioning the anchor element against an insulation layer provided adjacent to the solid wall, the anchor element having an aperture and an anchor formation. The method may further comprise inserting a shaft of a fastener through the aperture in the anchor element and through the insulation layer. The method may further comprise self-tapping a first threaded portion of the shaft into the solid wall. The method may further comprise directly engaging a second threaded portion of the shaft with a periphery of the aperture in the anchor element in order to fix the anchor element to the solid wall at a predetermined distance from the solid wall.

[0116] Optionally, the method further comprises coupling one or more wall ties to the anchor formation of the anchor element and positioning the one or more wall ties between one or more mortar joints of a masonry cladding in order to secure the masonry cladding to the solid wall. In other words, the method may be a method of securing a masonry cladding to a solid wall.

[0117] It will be appreciated that any feature of any of the aspects of the teachings outlined above may be combined with any compatible features of any of the other aspects of the teachings above. For the sake of brevity, not all combinations are explicitly recited above.

BRIEF DESCRIPTION OF DRAWINGS

[0118] Embodiments will now be described by way of example only with reference to the accompanying figures, in which:

Figure 1A is a perspective sectional view of a wall structure having a restraint system according to an embodiment;

Figure 1B is plan sectional view of the wall structure and restraint system of Figure 1;

Figure 2 is a perspective view of an anchor element of the restraint system of Figures 1A and 1B;

Figures 3A and 3B are perspective views of a wall tie and the anchor element of the restraint system of Figures 1A and 1B, in disconnected and connected conditions respectively;

Figure 4 is a side view of a fastener of the restraint system of Figures 1A and 1B;

Figures 5A and 5B are enlarged side views of sections A and B of the fastener of Figure 4;

Figure 6 is an enlarged plan sectional view of a portion of the restraint system of Figures 1A and 1B;

Figure 7 is a further enlarged plan sectional view of a portion of the restraint system of Figures 1A and 1B;

Figure 8 is a perspective view of a hybrid washer of the restraint system of Figures 1A and 1B; and

Figure 9 is a flow chart of a method of securing masonry cladding to an externally insulated solid wall, according to an embodiment.

DETAILED DESCRIPTION

[0119] In the following detailed description, numerous specific details are set forth in order to provide a thorough understanding of various embodiments and the teachings. However, those skilled in the art will understand that: the present teachings may be practiced without these specific details or with known equivalents of these specific details; that the present teachings are not limited to the described embodiments; and, that the present teachings may be practiced in a variety of alternative embodiments. It will also be appreciated that well known methods, procedures, components, and systems may not have been described in detail.

[0120] With reference to Figures 1A and 1B, a portion of a building structure 10 is illustrated. The building

structure 10 includes a solid wall 12, such as a concrete frame or other solid structural frame. The building structure 10 also includes a masonry cladding 14 formed of bricks 16 connected together via mortar joints 18. An insulation layer 20 (shown partially cut away in Figure 1A) is provided between the solid wall 12 and the masonry cladding 14 in order to insulate an external surface of the solid wall 12.

[0121] The building structure 10 also includes a restraint system 50 for securing the masonry cladding 14 to the externally insulated solid wall 12. The restraint system 50 includes an anchor element 100, a fastener 200 and one or more wall ties 300. As will be described in more detail below, the one or more wall ties 300 are embedded between adjacent layers of the masonry cladding 14 (e.g., in horizontal mortar joints 18) and are secured to the anchor element 100. The anchor element 100 is secured to the solid wall 12 via the fastener 200, in order to secure the masonry cladding 14 to the solid wall 12. In other words, there is a path for transfer of load from the masonry cladding 14 to the solid wall 12 via the one or more wall ties 300, the anchor element 100, and the fastener 200.

[0122] As best illustrated in Figures 2 to 3B, the anchor element 100 has an aperture 120 which can be engaged by the fastener 200 to secure the anchor element 100 to the solid wall 12. In the illustrated embodiment, the anchor element 100 is configured to be oriented vertically or upright. There are a plurality of apertures 120 spaced apart vertically along a length 102 of the anchor element 100. This allows a plurality of fasteners 200 to be used to secure the anchor element 100 to the solid wall 12 at a plurality of vertically distributed fastening points along the length 102 of the anchor element 100. In other embodiments a single aperture 120 may be provided.

[0123] The anchor element 100 also has an anchor formation 150 which is configured to receive the one or more wall ties 300 for coupling the anchor element 100 to the masonry cladding 14.

[0124] In the illustrated embodiment, the anchor element 100 has a support member 110 which defines the apertures 120. The support member 110 is configured to abut the insulation layer 20 and to support a first side 130 and a second side 140 of the anchor element 100. The first and second sides 130, 140 extend transversely away from the support member 110 to define the anchor formation 150. In the illustrated embodiment, the anchor formation 150 is provided in the form of a channel defined between the first and second sides 130, 140. The first and second sides 130, 140 have respective free ends 132, 142 which define a slot 160 therebetween.

[0125] The length 102 of the anchor element 100 may be in a range of around 2500mm to around 3500mm. A width 104 of the anchor element 100 may be in a range of around 20mm to around 30mm, e.g., around 22.5mm to around 27.5mm. A depth 106 of the

anchor element 100 may be in a range of around 10mm to around 20mm, e.g., around 12mm to around 16mm. A slot width 162 of the slot 160 may be in a range of around 10mm to around 20mm, e.g., around 14mm to around 18mm.

[0126] In the illustrated embodiment, the anchor element 100 has an approximately C-shaped cross-section along its length 102 (e.g., as illustrated in the plan view of Figure 1B). For example, the support member 110 and first and second sides 130, 140 define the C-shaped cross section.

[0127] Each wall tie 300 has: a first end 302 configured to be located between adjacent layers of the masonry cladding 14, a second end 304 configured to be coupled to the anchor element 100, and opposing sides 306 extending between the first and second ends 302, 304.

[0128] In the illustrated embodiment, each wall tie 300 has notches 308 on the opposing sides 306 of the wall tie 300, proximal to the second end 304. In this way, the second end 304 of the wall tie 300 can be inserted through the slot 160 into the channel 150 and then twisted in order to engage the notches 308 with the edges of the slot 160 (i.e., the free ends 132, 142 of the sides 130, 140), in order to secure the wall tie 300 to the anchor element 100. For example, Figure 3A illustrates how a wall tie 300 may be oriented parallel to the slot 160, inserted into the channel 150 through the slot 160 (in the direction of arrow A1), and twisted in the direction of arrow A2 in order to engage the notches 308 with the edges of the slot 160 (as shown in Figure 3B). In this way, movement of the wall tie 300 relative to the anchor element 100 in directions transverse to a longitudinal axis of the channel 150 is inhibited. However, as illustrated in Figure 3B, the wall tie 300 may slide up and down the channel 150 (e.g., in the direction of arrows A3 or A4) in order to position the wall tie 300 at a suitable height corresponding to the height of a horizontal mortar joint 18 in which the wall tie 300 is to be positioned.

[0129] As best illustrated in Figures 1B, the fastener 200 is configured to connect the anchor element 100 to the solid wall 12 through the insulation layer 20 of the building structure 10. In particular, the fastener 200 has a head 202 and a shaft 210 which has a first threaded portion 220 distal to the head 202 and a second threaded portion 260 proximal to the head 202.

[0130] As will be described in more detail below, the first threaded portion 220 is configured for self-tapping into the solid wall 12. For example, a pilot hole may be drilled in the solid wall 12, and the first threaded portion 220 may be screwed into the pilot hole in order to self-tap into the solid wall 12.

[0131] The second threaded portion 260 is configured for directly engaging a periphery 112 of one of the apertures 120 in the anchor element 100, in order to fix the anchor element 100 to the solid wall 12 at a predetermined distance from the solid wall 12.

[0132] In the illustrated embodiment, the predetermined distance corresponds to an insulation thickness 22 of the insulation layer 20 positioned between the anchor element 100 and the solid wall 12.

5 **[0133]** As best illustrated in Figures 6 and 7, the restraint system 50 is configured so that a portion 112 of the support member 110 surrounding the aperture 120 (i.e., otherwise referred to as the periphery 112 of the aperture 120) is clamped between adjacent threads 262 of the second threaded portion 260 to engage the second threaded portion 260 with the periphery 112 of the aperture 120 and thereby inhibit movement of the anchor element 100 along the shaft 210 of the fastener 200. In other words, the second threaded portion 260 and the support member 110 are sized so that the support member 110 fits snugly between adjacent threads 262 of the second threaded portion 260. In this way, the anchor element 100 can be maintained at the predetermined distance from the solid wall 12.

20 **[0134]** The aperture 120 has an aperture diameter 122 (illustrated on Figure 7) and the second threaded portion 260 has a major diameter 264 (illustrated on Figures 5A and 7) which is greater than the aperture diameter 120. In this way, an overlap is defined between the threads 262 of the second threaded portion 260 and the portion 112 of the support member 110 surrounding the aperture 120, to provide the clamping function. In the illustrated example, the major diameter 264 of the second threaded portion 260 is approximately 0.7mm greater than the aperture diameter 122. In some embodiments, the major diameter 264 of the second threaded portion 260 may be at least 0.65mm greater than the aperture diameter 122, e.g., at least 0.7mm greater, e.g., at least 0.75mm greater, e.g., at least 0.8mm greater, e.g., at least 0.85mm greater.

35 **[0135]** The term "major diameter" will be understood to refer to the outer diameter defined by the crests of the corresponding threads of the threaded portion.

40 **[0136]** In some embodiments, the major diameter 264 of the second threaded portion 260 (illustrated on Figure 5A) is in a range of around 7mm to around 7.6mm, e.g. around 7.15mm to around 7.45mm, e.g., around 7.25mm to around 7.35mm. In such embodiments, the aperture diameter 122 may be in a range of around 6.0mm to around 7.1mm, e.g., around 6.3mm to around 6.8mm, e.g., around 6.4mm to around 6.7mm, e.g. around 6.5mm to around 6.6mm. In the illustrated example, the aperture diameter 122 is in the range 45 6.5mm to 6.6mm, and the major diameter 264 of the second threaded portion 260 is in the range of around 7.25 to 7.35mm.

50 **[0137]** In the illustrated embodiment, the major diameter 264 of the second threaded portion 260 is approximately constant along a length 272 of the second threaded portion 260. In other embodiments, the major diameter 264 of the second portion 260 tapers inwardly in a direction away from the head 202 towards the first threaded portion 220. In other words, the major dia-

meter 264 of the second threaded portion 260 may vary.

[0138] As illustrated on Figure 5A, the second threaded portion 260 also has a minor diameter 266. In some embodiments, the minor diameter 266 is in a range of around 4mm to around 5.2mm, e.g., around 4.3mm to around 4.9mm, e.g., around 4.5mm to around 4.7mm.

[0139] The term "minor diameter" will be understood to refer to the inner diameter defined by the roots of the corresponding threads of the threaded portion.

[0140] The second threaded portion 260 has a thread height, which is equal to the difference between the major and minor diameters 264, 266 of the second threaded portion 260. In some embodiments, the thread height is in a range of around 0.9mm to around 1.8mm, e.g., around 1.1mm to around 1.6mm, e.g., around 1.2mm to around 1.5mm.

[0141] As illustrated on Figure 5A, the second threaded portion has a thread pitch 268. In some embodiments, the thread pitch 268 is in a range of around 1.3mm to around 2.3mm, e.g., around 1.5mm to around 2mm, e.g., around 1.7mm to around 1.9mm, e.g., around 1.75mm to around 1.85mm, e.g., approximately 1.81mm.

[0142] The portion 112 of the support member 110 surrounding the aperture 120 has a thickness 114. In some embodiments, the thickness 114 is in a range of around 0.8mm to around 1.6mm, e.g., around 1.0mm to around 1.4mm, e.g., around 1.1mm to around 1.3mm, for example approximately 1.2mm. The thickness 114 may be similar or slightly smaller than the thread pitch 268 of the second threaded portion 260 to facilitate clamping.

[0143] As illustrated on Figure 5A, the second threaded portion 260 has a flank angle 270. In some embodiments, the flank angle 270 in a range of around 20 degrees to around 40 degrees, e.g., around 25 degrees to around 35 degrees, e.g., around 27.5 degrees to around 32.5 degrees, e.g., approximately 30 degrees.

[0144] The term "flank angle" will be understood to refer to the angle between a flank (or side) of the corresponding thread, and a line extending perpendicular to the crest of the corresponding thread.

[0145] As best illustrated in Figures 5A and 5B, the first threaded portion 220 has a different thread profile to the second threaded portion 260. This allows the first and second threaded portions 220, 260 to be adapted for their respective purposes.

[0146] In the illustrated embodiment, the thread pitch 222 of the first threaded portion 220 (illustrated on Figure 5B) is greater than the thread pitch 268 of the second threaded portion 260 (illustrated on Figure 5A).

[0147] In some embodiments, the thread pitch 222 of the first threaded portion 220 is in a range of around 2mm to around 4mm, e.g., around 2.5mm to around 3.5mm, e.g., around 2.75mm to around 3.25mm, e.g.,

approximately 3mm.

[0148] As best illustrated in Figure 5B, the first threaded portion 220 has a high-low thread profile having a high thread 224 and a low thread 226. The high thread 224 has a major diameter 228 which is greater than a major diameter 230 of the low thread 226.

[0149] In some embodiments, the major diameter 228 of the high thread 224 is in a range of around 5.75mm to around 7mm, e.g., around 6mm to around 6.75mm, e.g., around 6.25mm to around 6.5mm.

[0150] In some embodiments, the major diameter 230 of the low thread 226 is in a range of around 4.7mm to around 5.7mm, e.g., around 4.9mm to around 5.5mm, e.g., around 5.1mm to around 5.3mm.

[0151] As illustrated in Figure 5B, the high thread 224 and low thread 226 each have respective flank angles 232, 234. The flank angle 232 of the high thread 224 may differ from the flank angle 234 of the low thread 226.

[0152] In some embodiments, the flank angle 232 of the high thread 224 is in a range of around 10 degrees to around 30 degrees, e.g., around 15 degrees to around 25 degrees, e.g., around 17.5 degrees to around 22.5 degrees, e.g., approximately 20 degrees.

[0153] In some embodiments, the flank angle 234 of the low thread 226 is in a range of around 20 degrees to around 40 degrees, e.g., around 25 degrees to around 35 degrees, e.g., around 27.5 degrees to around 32.5 degrees, e.g., approximately 30 degrees.

[0154] In some embodiments, the first threaded portion 220 may have single thread profile instead of a high-low thread profile. In such embodiments, the major diameter of the single thread profile may correspond to the major diameter 228 of the illustrated high thread 224. Similarly, the flank angle may correspond to the flank angle 232 of the illustrated high thread 224.

[0155] As illustrated in Figure 5B, the first threaded portion 220 has a minor diameter 236. In some embodiments, the minor diameter 236 of the first threaded portion 220 is in a range of around 3.75mm to around 5.1mm, e.g., around 4.1mm to around 4.75mm, e.g., around 4.3mm to around 4.55mm.

[0156] As best illustrated in Figure 4, the first threaded portion 220 is longer than the second threaded portion 260. In particular, the first threaded portion 220 has a length 238 which is greater than a length 272 of the second threaded portion 260.

[0157] In some embodiments, the length 238 of the first threaded portion 220 is in a range of around 20mm to around 50mm, e.g., around 25mm to around 45mm, e.g., around 30mm to around 40mm, e.g., approximately 35mm.

[0158] In some embodiments, the length 272 of the second threaded portion 260 is in a range of around 5mm to around 15mm, e.g., around 7.5mm to around 12.5mm.

[0159] In the illustrated embodiment, the first threaded portion 220 has a pointed end 240 having a

point angle 242. In some embodiments, the point angle 242 is in a range of around 20 degrees to around 65 degrees, e.g., around 35 degrees to around 50 degrees.

[0160] As best illustrated in Figure 4, the shaft 210 of the fastener 200 has a shank portion 290 between the first threaded portion 220 and the second threaded portion 260. In the illustrated embodiment, the shank portion 290 is not threaded. In other configurations, the first threaded portion 220 may extend all the way to the second threaded portion 260 (i.e., the non-threaded shank portion 290 may be omitted).

[0161] The illustrated shank portion 290 has an outer diameter 292. In the illustrated embodiment, the outer diameter 292 is narrower than the major diameters 228, 230, 264, of the first and second threaded portions 220, 260.

[0162] In some embodiments, the outer diameter 292 of the shank portion 290 is in a range of around 4.4mm to around 5.3mm, e.g., around 4.65mm to around 5.05mm, e.g., around 4.85mm to around 4.95mm.

[0163] It will be understood that a length 294 of the shank portion 290 will vary depending on the insulation thickness 22 of a particular installation. For example, the length 294 may be within a range of around 30mm to 270mm, corresponding to common thicknesses of insulation material.

[0164] In some embodiments, the fastener 200 is made from a steel material, e.g., a stainless steel material. For example, the fastener 200 may be made of a non-magnetic, austenitic stainless steel, such as A2 stainless steel.

[0165] In the illustrated embodiment, the head 202 of the fastener 200 has a non-circular (e.g., hexagonal) periphery 204 for being driven by a rotational tool having a corresponding inner formation (e.g., wrench, spanner, socket, etc.). In other embodiments, the head 202 of the fastener 200 may have a non-circular (e.g., hexagonal, cross-shapes etc) inner formation for being driven by a rotational tool having a corresponding peripheral shape (e.g., Allen key, screwdriver, etc.).

[0166] In the illustrated embodiment, the restraint system 50 also includes a washer arrangement 400 configured to be placed between the head 202 of the fastener 200 and the anchor element 100. The washer arrangement 400 is shown schematically in Figures 1B and 6, and as a standalone component in Figure 8.

[0167] The illustrated washer arrangement 400 includes a compressible washer 402. The compressible washer 402 is arranged to be compressed between the head 202 of the fastener 200 and the anchor element 100 as the fastener 200 is tightened. In this way, the compressible washer 402 may absorb some of the force which is applied when the fastener 200 is tightened, which may reduce the amount of force transferred to the insulation layer 20 and thus inhibit deformation of the insulation layer 20.

[0168] The compressible washer 402 may also urge

the anchor element 100 into contact with one of the threads 262 of the second threaded portion 260 to facilitate a robust clamping connection.

[0169] In the illustrated embodiment, the washer arrangement 400 is a hybrid washer arrangement including a rigid washer 404 as well as the compressible washer 402. In some embodiments, the rigid washer 404 and compressible washer 402 are fixed to each other, to provide a simplified assembly.

[0170] The rigid washer 404 has a first washer thickness 406 and the compressible washer 402 comprises a second washer thickness 408 when it is in an uncompressed state.

[0171] In the illustrated embodiment, the second washer thickness 408 is greater than the first washer thickness 406.

[0172] In some embodiments, the first washer thickness 406 is in a range of around 0.25mm to around 1.75mm, e.g., around 0.5mm to around 1.5mm, e.g., around 0.75mm to around 1.25mm, e.g., approximately 1mm.

[0173] In some embodiments, the second washer thickness 408 is in a range of around 2mm to around 4mm, e.g., around 2.5mm to around 3.5mm, for example approximately 3mm.

[0174] In one embodiment, the first washer thickness 406 is approximately 1mm and the second washer thickness 408 is approximately 4mm.

[0175] In some embodiments, the rigid washer 404 is made of metallic material such as steel, stainless steel or aluminium.

[0176] In some embodiments, the compressible washer 402 is made of an elastomeric material. Optionally the compressible washer is made of a rubber material, for example ethylene propylene diene terpolymer (EPDM) or neoprene.

[0177] In other embodiments, the rigid washer 404 may be omitted. Similarly, the entire washer arrangement 400 may be omitted.

[0178] Referring now to Figure 9, a method of securing an anchor element 100 (e.g., of the kind described above) to an externally insulated solid wall 12 is illustrated as a flow chart. The method includes, at step a), positioning the anchor element 100 against an insulation layer 20 provided adjacent to the solid wall 12. The method also includes, at step b), inserting a shaft 210 of a fastener 200 through an aperture 120 in the anchor element 100 and through the insulation layer 20. The method also includes, at step c), self-tapping a first threaded portion 220 of the shaft 210 into the solid wall 12. The method also includes, at step d), directly engaging a second threaded portion 260 of the shaft 210 with a periphery 112 of the aperture 120 in the anchor element 100 in order to fix the anchor element 100 to the solid wall 12 at a predetermined distance from the solid wall 12.

[0179] In the illustrated embodiment, the method also includes, at step e), coupling one or more wall ties 300

to an anchor formation 150 of the anchor element 100 and positioning the one or more wall ties 300 between one or more mortar joints 18 of a masonry cladding 14 in order to secure the masonry cladding 14 to the solid wall 12. In other words, the method is a method securing the masonry cladding 14 to the solid wall 12. The one or more embodiments are described above by way of example only and it will be appreciated that the variations are possible without departing from the scope of protection afforded by the appended claims.

[0180] It should also be noted that whilst the appended claims set out particular combinations of features described above, the scope of the present disclosure is not limited to the particular combinations hereafter claimed, but instead extends to encompass any combination of features herein disclosed.

Claims

1. A restraint system for securing masonry cladding to an externally insulated solid wall, the restraint system comprising:

an anchor element comprising an aperture and an anchor formation which is configured to receive one or more wall ties for coupling the anchor element to the masonry cladding; and a fastener for connecting the anchor element to the solid wall through an insulation layer, wherein the fastener comprises a head and a shaft which has a first threaded portion distal the head and a second threaded portion proximal to the head; wherein the first threaded portion is configured for self-tapping into the solid wall and the second threaded portion is configured for directly engaging a periphery of the aperture in the anchor element in order to fix the anchor element to the solid wall at a predetermined distance from the solid wall.

2. The restraint system of claim 1, wherein the anchor element comprises a support member which defines the aperture, and one or more anchor sides extending transversely away from the support member to define the anchor formation, wherein the restraint system is configured so that a portion of the support member surrounding the aperture is clamped between adjacent threads of the second threaded portion to engage the second threaded portion with the periphery of the aperture in the support member and thereby inhibit movement of the anchor element along the shaft of the fastener.
3. The restraint system of claim 2, wherein the aperture comprises an aperture diameter and the second threaded portion comprises a major diameter

which is at least 0.65mm greater than the aperture diameter, optionally at least 0.7mm greater, optionally at least 0.75mm greater, optionally at least 0.8mm greater, optionally at least 0.85mm greater.

4. The restraint system of claim 2 or claim 3, wherein the second threaded portion comprises a thread height in a range of around 0.9mm to around 1.8mm, and/or comprises a thread pitch in a range of around 1.3mm to around 2.3mm.
5. The restraint system of any preceding claim, wherein the second threaded portion comprises a flank angle in a range of around 20 degrees to around 40 degrees, optionally around 25 degrees to around 35 degrees, optionally around 27.5 degrees to around 32.5 degrees, optionally approximately 60 degrees.
6. The restraint system of any preceding claim, wherein the first threaded portion comprises a different thread profile to the second threaded portion; optionally, wherein the thread pitch of the first threaded portion is greater than the thread pitch of the second threaded portion.
7. The restraint system of any preceding claim, wherein the first threaded portion comprises a thread pitch in a range of around 2mm to around 4mm, optionally around 2.5mm to around 3.5mm, optionally around 2.75mm to around 3.25mm, optionally approximately 3mm.
8. The restraint system of any preceding claim, wherein the first threaded portion comprises a high-low thread profile comprising a high thread and a low thread, optionally wherein the high thread comprises a major diameter in a range of around 5.75mm to around 7mm and/or wherein the low thread comprises a major diameter in a range of around 4.7mm to around 5.7mm.
9. The restraint system of any preceding claim, wherein the first threaded portion comprises a pointed end having a point angle in a range of around 20 degrees to around 65 degrees, optionally around 35 degrees to around 50 degrees.
10. The restraint system of any preceding claim, wherein the shaft of the fastener comprises a shank portion between the first threaded portion and the second threaded portion, wherein the shank portion is not threaded; optionally, wherein the shank portion comprises an outer diameter which is narrower than the major diameters of the first and second threaded portions; and/or optionally, wherein the shank portion comprises an outer diameter in a range of around 4.4mm to around

5.3mm, optionally around 4.65mm to around 5.05mm, optionally around 4.85mm to around 4.95mm; and/or optionally, wherein the shank portion comprises a length in a range of around 30mm to around 270mm.

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11. The restraint system of any preceding claim, comprising a washer arrangement configured to be placed between the head of the fastener and the anchor element, wherein the washer arrangement comprises at least a compressible washer.

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12. The restraint system of any preceding claim, wherein the anchor element comprises a C-shaped cross-section along its length, wherein the C-shaped cross section defines a channel and a slot through which said wall ties can be inserted into the channel.

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13. A building structure comprising:

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a solid wall;

a masonry cladding;

an insulation layer provided between the solid wall and the masonry cladding; and

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a restraint system according to any preceding claim, wherein wall ties are embedded between adjacent layers of the masonry cladding and secured to the anchor element, and wherein the anchor element is secured to the solid wall via the fastener, in order to secure the masonry cladding to the solid wall.

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14. A fastener for the restraint system of any preceding claim, wherein the fastener comprises a head and a shaft, wherein the shaft comprises:

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a first threaded portion distal the head, wherein the first threaded portion is configured for self-tapping into a solid wall structure; and

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a second threaded portion proximal to the head, wherein the second threaded portion is configured for engaging an aperture in an anchor element in order to fix the anchor element to the solid wall structure.

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15. A method of securing an anchor element to an externally insulated solid wall, the method comprising:

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a) positioning the anchor element against an insulation layer provided adjacent to the solid wall, the anchor element having an aperture and an anchor formation;

b) inserting a shaft of a fastener through the aperture in the anchor element and through the insulation layer,

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c) self-tapping a first threaded portion of the

shaft into the solid wall, and

d) directly engaging a second threaded portion of the shaft with a periphery of the aperture in the anchor element in order to fix the anchor element to the solid wall at a predetermined distance from the solid wall;

optionally, wherein the method further comprises:

e) coupling one or more wall ties to the anchor formation of the anchor element and positioning the one or more wall ties between one or more mortar joints of a masonry cladding in order to secure the masonry cladding to the solid wall.

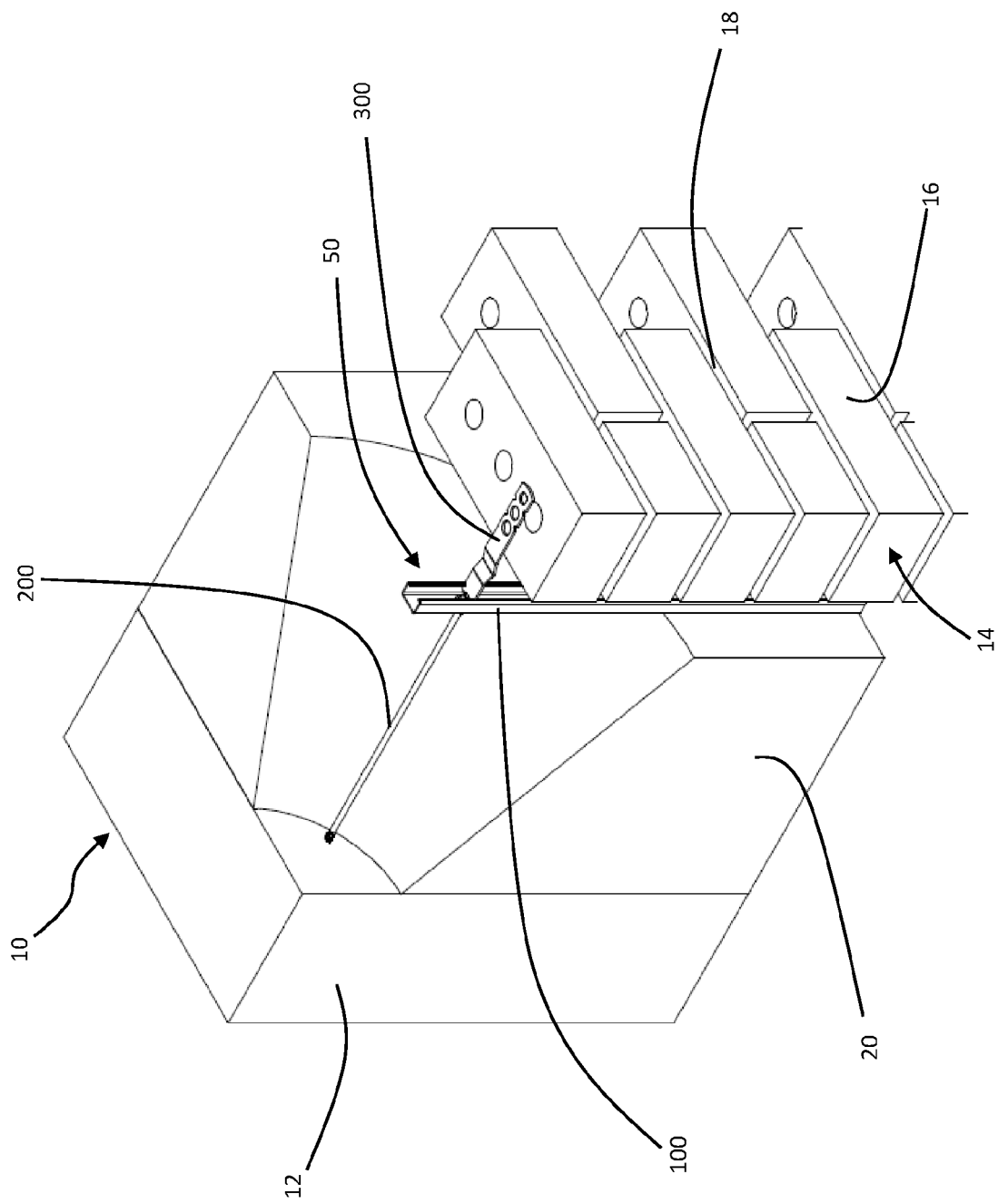


Fig. 1A

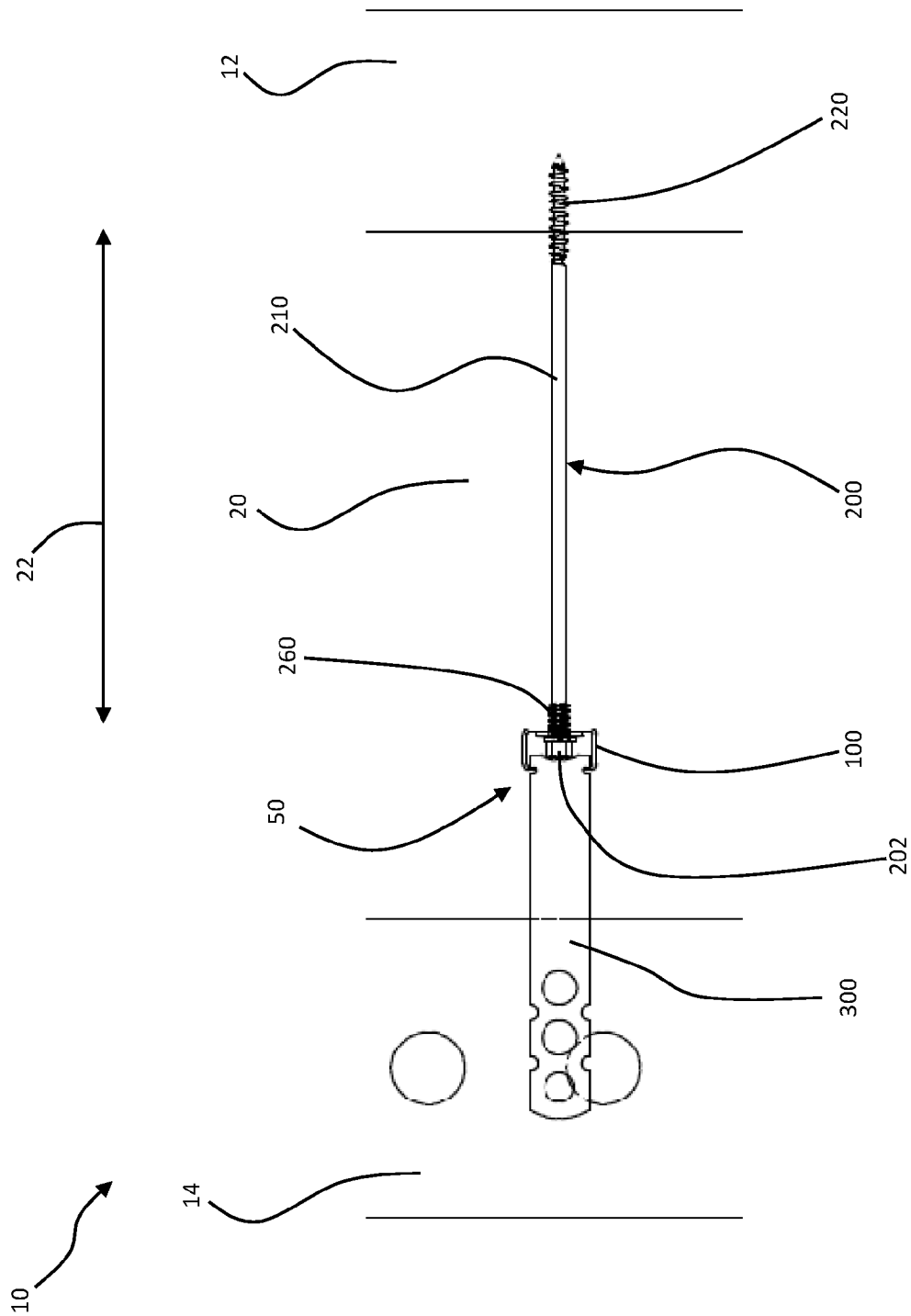


Fig. 1B

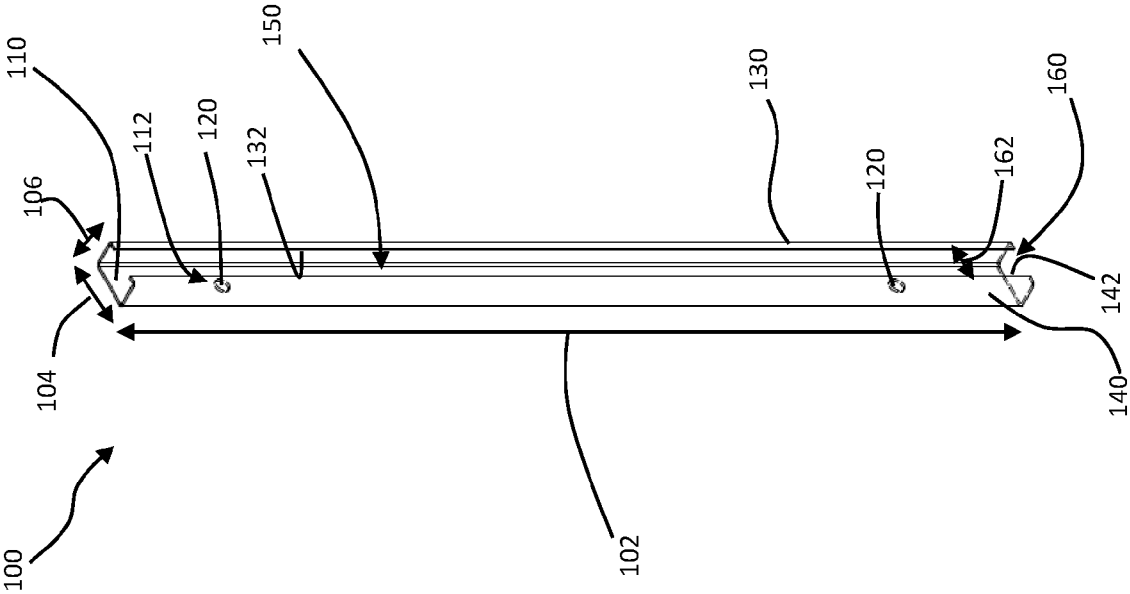


Fig. 2

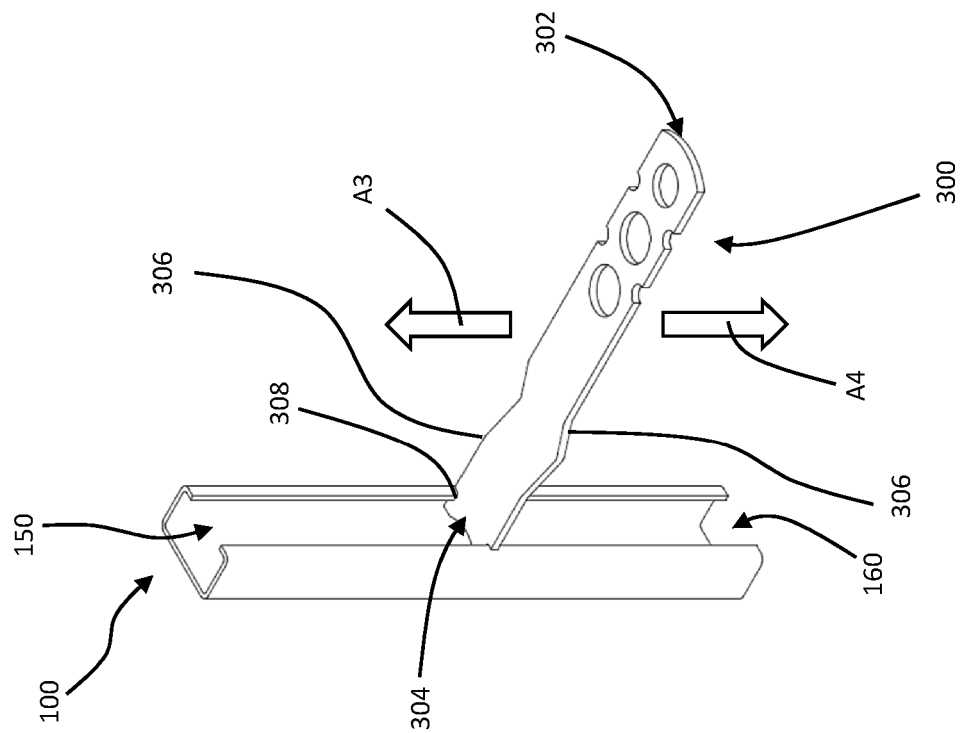


Fig. 3B

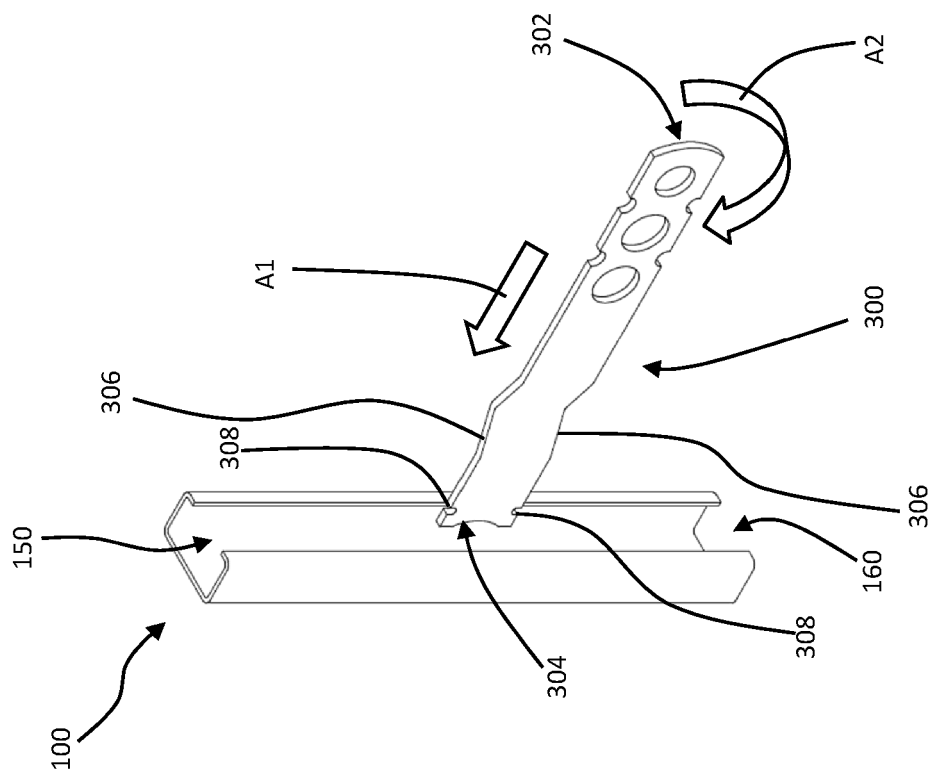


Fig. 3A

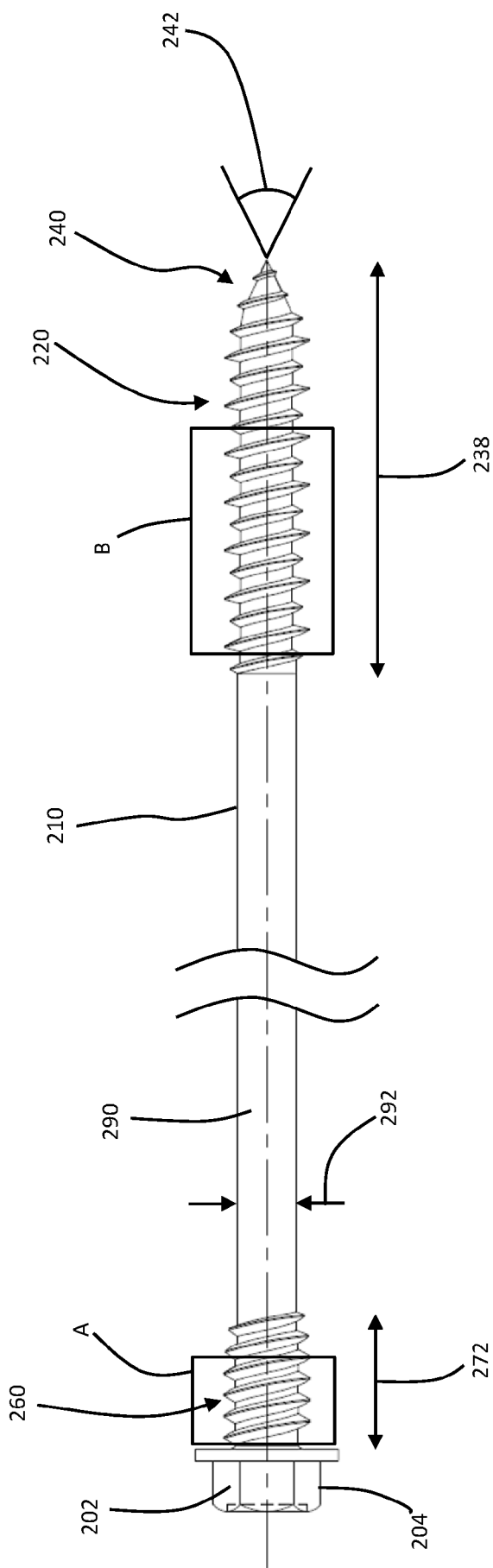


Fig. 4

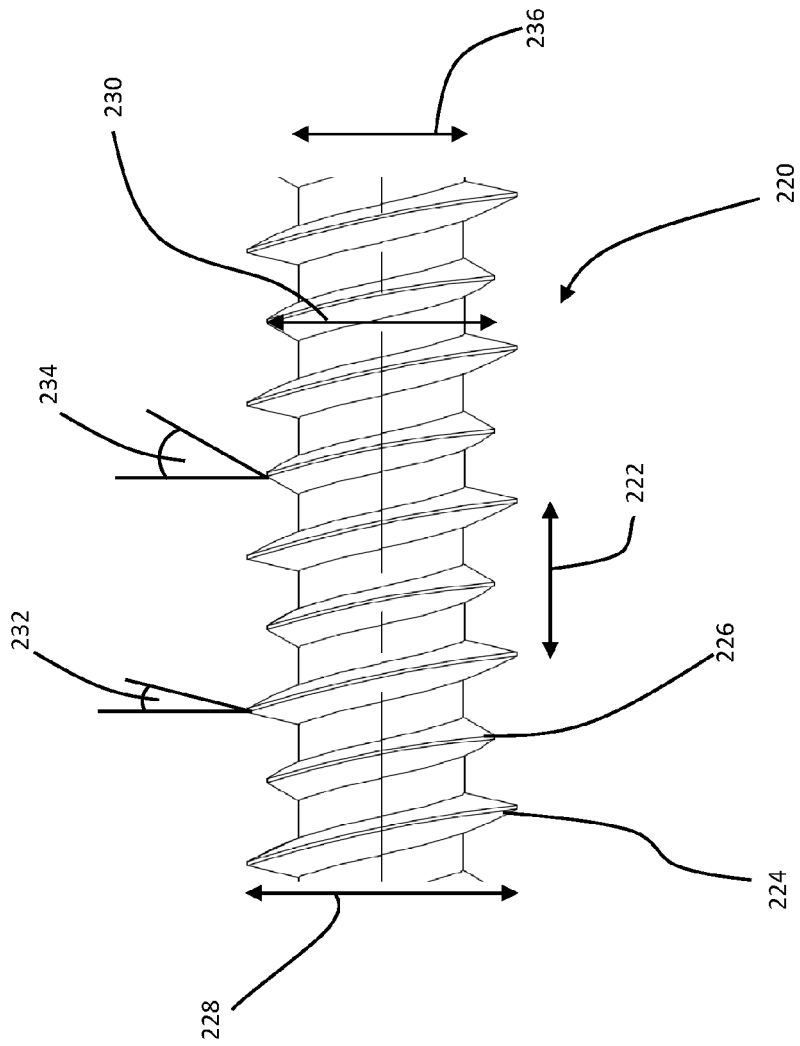


Fig. 5B

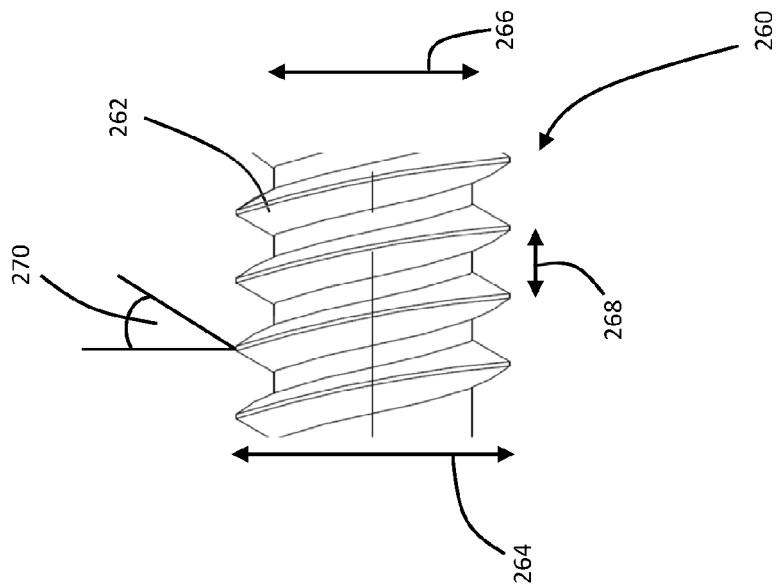


Fig. 5A

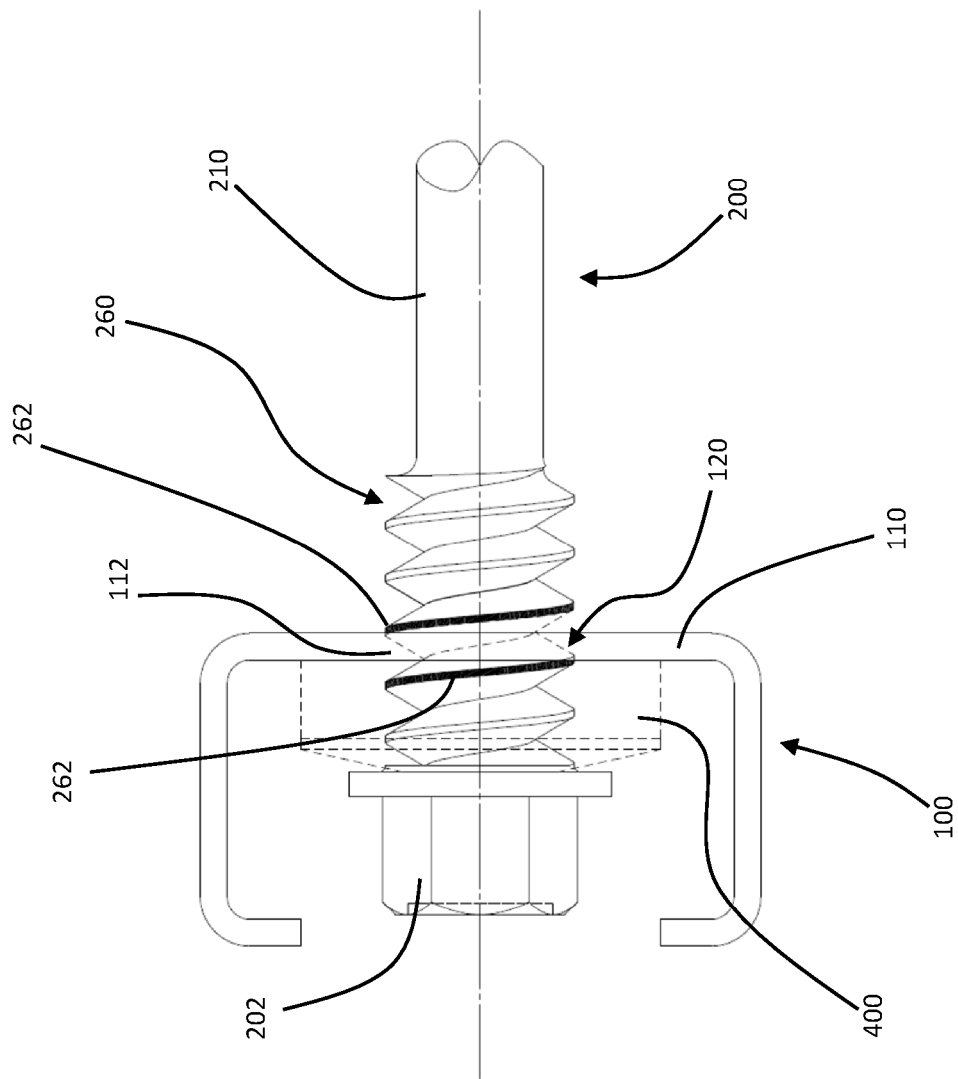


Fig. 6

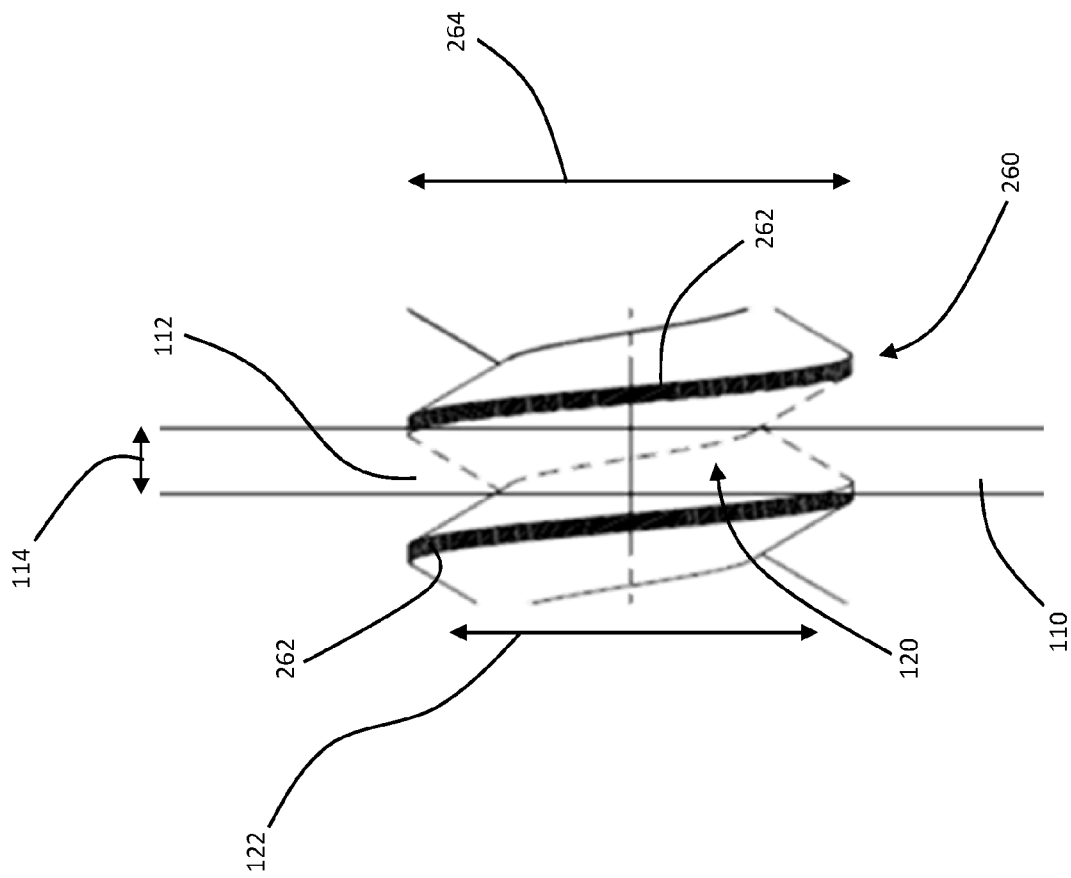


Fig. 7

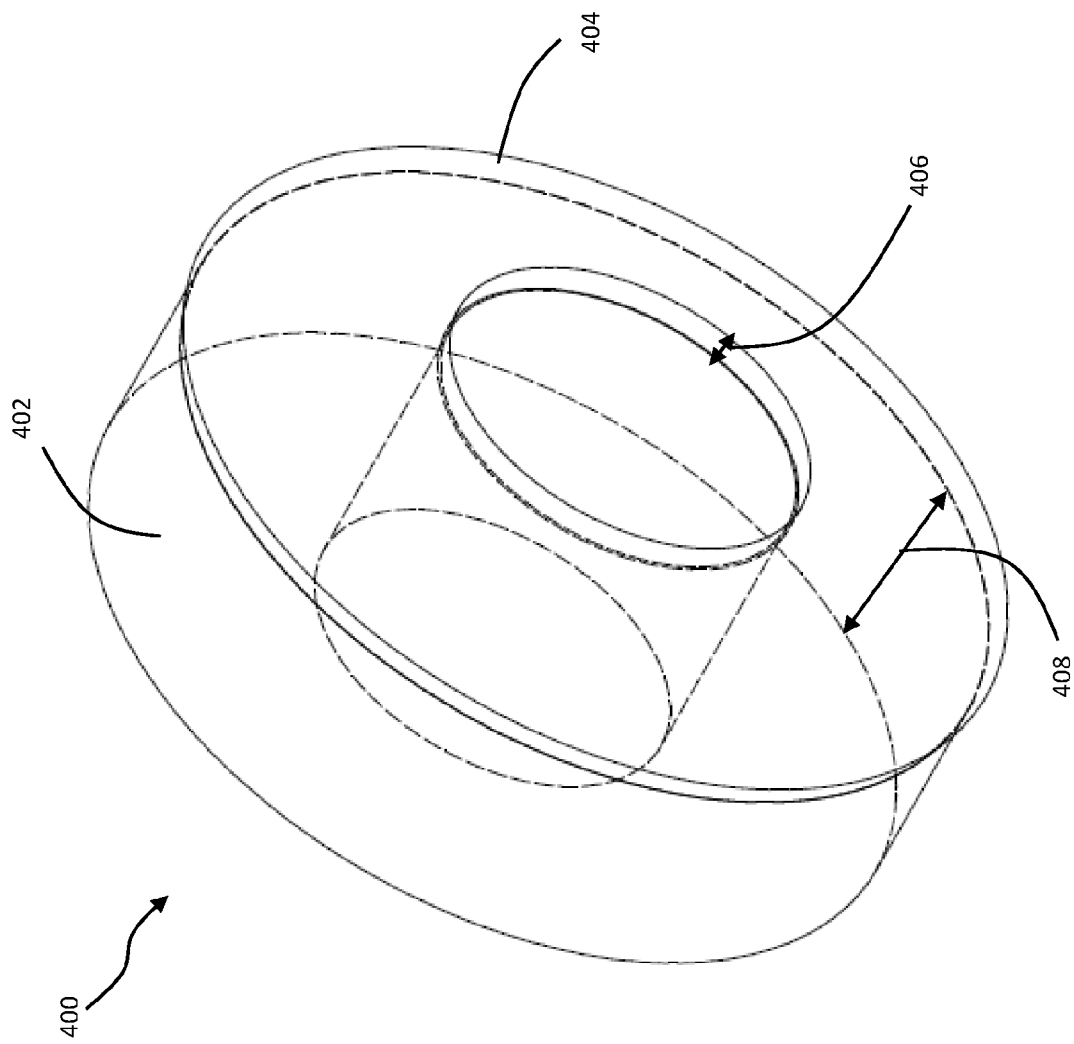


Fig. 8

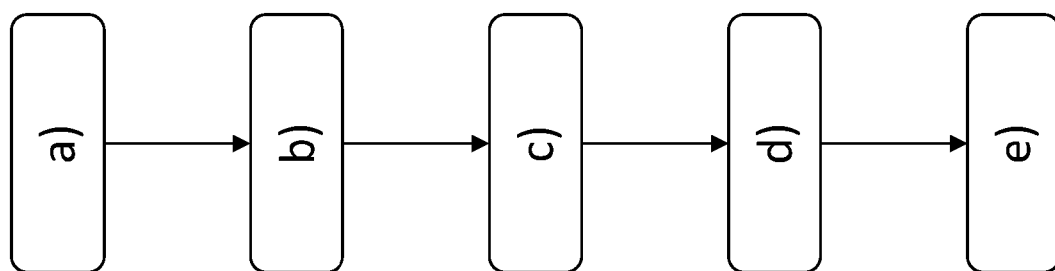


Fig. 9



EUROPEAN SEARCH REPORT

Application Number

EP 26 17 2403

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	US 2009/133357 A1 (RICHARDS JOSEPH P [US]) 28 May 2009 (2009-05-28) * paragraph [0059] - paragraph [0075]; figures 1-7 *	1-11, 13-15	INV. E04B1/41 E04B1/76
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The present search report has been drawn up for all claims			
Place of search		Date of completion of the search	Examiner
The Hague		3 September 2026	Melhem, Charbel
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T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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EP 26 17 2403

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This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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03-09-2026

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