



(51) International Patent Classification:

E04B 1/04 (2006.01) *E04B 5/32* (2006.01)
E04B 1/14 (2006.01)

(21) International Application Number:

PCT/US2019/013021

(22) International Filing Date:

10 January 2019 (10.01.2019)

(25) Filing Language:

English

(26) Publication Language:

English

(30) Priority Data:

62/615,499 10 January 2018 (10.01.2018) US

(71) Applicant: **JENCOL INNOVATIONS, LLC** [US/US];
875 Roosevelt Hwy., Suite 130, Colchester, VT 05446
(US).

(72) Inventor: **HARDY, Tim**; 875 Roosevelt Hwy., Suite 130,
Colchester, VT 05446 (US).

(74) Agent: **MCCABE, Justin, W.**; Dunkiel Saunders Elliott
Raubvogel & Hand PLLC, 91 Colledge St., Burlington, VT
05401 (US).

(81) Designated States (*unless otherwise indicated, for every kind of national protection available*): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DJ, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JO, JP, KE, KG, KH, KN, KP, KR, KW, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States (*unless otherwise indicated, for every kind of regional protection available*): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM,

(54) Title: THERMAL BREAK FOR CONCRETE SLABS

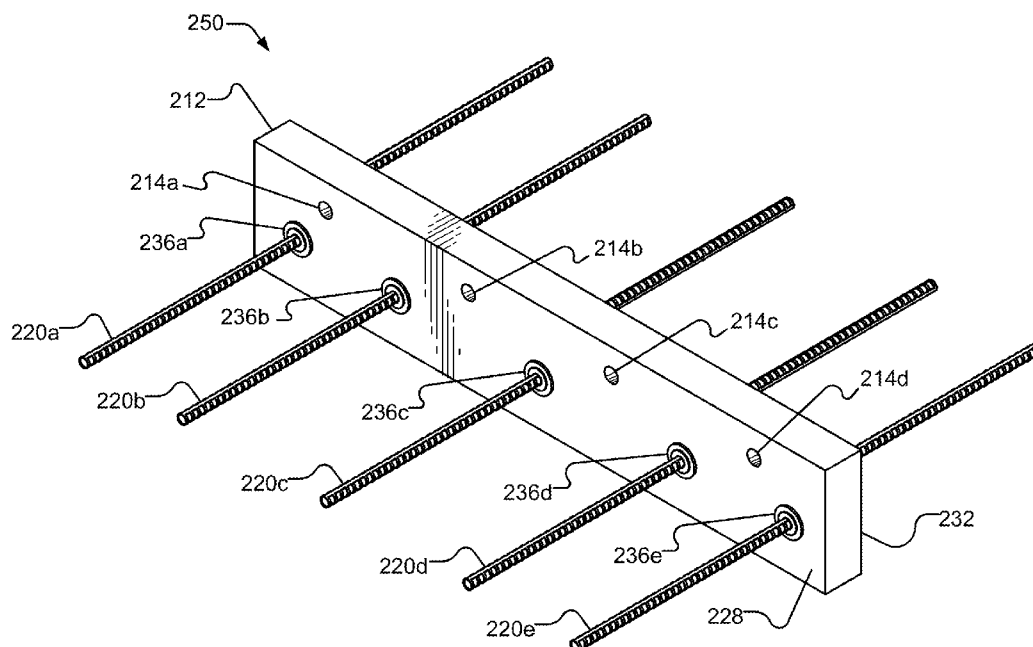


Fig. 9

(57) Abstract: A thermal break system for cast-in-place concrete slabs is provided that includes a load-bearing structural foam barrier designed to separate an interior portion of concrete slab from an exterior portion of concrete slab. The thermal break system includes a plurality of reinforcing tension bars holes passing through the insulating barrier. In addition, reinforcing shear bars are inserted through the insulating foam at a non-horizontal angle and bent such that the shear bars are horizontal on either side of the insulating barrier.

TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW,
KM, ML, MR, NE, SN, TD, TG).

Published:

- *with international search report (Art. 21(3))*
- *with amended claims (Art. 19(1))*

THERMAL BREAK FOR CONCRETE SLABS

FIELD OF THE INVENTION

[0001] The present invention generally relates to concrete slab construction. In particular, the present invention is directed to a thermal break for concrete slabs.

BACKGROUND

[0002] Concrete slabs that overhang or extend beyond exterior walls of buildings, such as slabs used for balconies and similar, are extensions of a main building structure but are exposed to the outside and not thermally insulated from the main structure. Because of this, heat can be conducted into or out of a building through such concrete slabs. In this way, overhanging slabs can allow heat to escape from the interior of a building on cold days (or heat to enter a building on hot days), creating an inefficient area in the thermal envelope of the building.

[0003] Several attempts have been made to address this problem, including U.S. Patent No. 8,973,317 to Larkin, U.S. Pat. No. 4,959,940 to Witschi, and U.S. Pat. No. 8,092,113 to Penzkofer. Larkin discloses the use of a “relatively thin flat panel of thermal insulating material” between the overhanging concrete slab and the main structure with holes in the material for reinforcing bars to pass through. However, Larkin does not include any transverse force bars passing through the insulating barrier. Witschi and Penzkofer do include transverse force bars passing through an insulating barrier but include additional components such as articulation elements or face plates that tend to increase the complexity of the installation process.

SUMMARY OF THE DISCLOSURE

[0004] In an exemplary embodiment, a thermal break system for separating concrete slabs, is provided that includes a thermally insulating body sized and configured to separate a first area for an interior concrete slab from a second area for an exterior concrete slab, the insulating body being load-bearing structural foam and including a plurality of reinforcing tension rod holes and a plurality of reinforcing shear rod holes, wherein the plurality of shear rod holes pass through the insulating body at a non-horizontal angle. A plurality of reinforcing shear rods are included, and each of the plurality of reinforcing shear rods includes a first bend at a first point to form an angled portion that substantially matches the non-horizontal angle of the plurality of shear rod holes, wherein each of the plurality of reinforcing shear rods is inserted through the thermally insulating body via respective

ones of the plurality of shear rod holes such that the angled portion is within the insulating body and the first point is aligned with a first side of the insulating body, wherein each of the plurality of reinforcing shear rods each include a washer welded near the first point, wherein each of the plurality of shear rods include a second bend at a second point where each of the plurality of reinforcing shear rods exits respective ones of the plurality shear rod holes on a second side of the insulating body such that exterior portions of each of the plurality of shear rods are substantially horizontal, and wherein each washer is secured to the thermally insulating body.

[0005] Additionally or alternatively, the insulating body has an R-value of at least 2.

[0006] Additionally or alternatively, each of the plurality of reinforcing shear rods is a size #3 rebar.

[0007] Additionally or alternatively, the system includes no plates on a first side or a second side of the insulating body, wherein no compression struts pass through the insulating body, and wherein no articulating elements protrude through the insulating body into the first area or the second area.

[0008] In another exemplary embodiment, a thermal break system is prepared by a process that includes forming, from a load-bearing, thermally insulating structural foam material, an insulating body such that the insulating body is sized and configured to separate a first area for an interior concrete slab from a second area for an exterior concrete slab; drilling a plurality of reinforcing tension rod holes through the insulating body; drilling a plurality of reinforcing shear rod holes through the insulation body at a non-horizontal angle; welding a washer to each of a plurality of reinforcing shear rods; bending each of the plurality of reinforcing shear rods at a first point to form a plurality of bent reinforcing shear rods; inserting the plurality of bent reinforcing shear rods through the plurality reinforcing shear rod holes in the insulating body such that the first point is aligned with a first side of the insulating body; bending, while inserted in the insulating body, the plurality of reinforcing shear rods at a second point, the second point being aligned with a second side of the insulating body, such that portions of the plurality of reinforcing shear rods extending from the first side of the insulating body and extending from the second side of the insulating body are substantially horizontal; and securing each washer to the insulating body.

[0009] In another exemplary embodiment, a system for preparing a thermally broken, cast-in-place concrete slab is provided that includes a thermally insulating body configured to separate a first area for an interior concrete slab from a second area for an exterior concrete slab, the insulating body being load-bearing structural foam and including a plurality of reinforcing tension rod holes and a plurality of reinforcing shear rod holes, wherein the plurality of shear rod holes include washers secured to the insulating body to limit rod twisting and wherein the plurality of shear rod holes pass through the insulating body at a non-horizontal angle. A plurality of reinforcing tension rods are configured to pass through a respective one of the plurality of tension rod holes and extend into the first area and the second area. A plurality of reinforcing shear rods are bent at a first point to form an angle that substantially matches the non-horizontal angle of the plurality of shear rod holes, wherein when inserted into the plurality of shear rod holes, the plurality of reinforcing shear rods are bent at a point where each of the plurality of reinforcing shear rods exit respective ones of the plurality shear rod holes such that an exterior portion of each of the plurality of shear rods is substantially horizontal.

[0010] Additionally or alternatively, a plurality of cross tension rods are included, wherein each of the plurality of cross tensions rods are substantially perpendicular to the plurality of reinforcing tension rods.

[0011] Additionally or alternatively, each of the plurality of cross tension rods is secured to one or more of the plurality of reinforcing tension rods.

[0012] Additionally or alternatively, each of the plurality of cross tension rods is secured to one or more of the plurality of shear rods.

[0013] Additionally or alternatively, each of the plurality of cross tension rods is secured to one or more of the plurality of reinforcing tension rods and one or more of the plurality of shear rods.

[0014] Additionally or alternatively, a plurality of washers are secured around a respective one of the plurality of shear rod holes.

[0015] Additionally or alternatively, the insulating body has an R-value of at least 2.

[0016] Additionally or alternatively, each of the plurality of reinforcing tension rods is a size #5 rebar.

[0017] Additionally or alternatively, each of the plurality of reinforcing shear rods is a size #3 rebar.

[0018] In another exemplary embodiment, method for installing a thermally broken, cast-in-place concrete slab includes bending a plurality of reinforcing shear rods at a first point to form a first point angle; inserting the plurality of bent reinforcing shear rods through a plurality of angled reinforcing shear rod holes in a load-bearing, thermally insulating structural foam body configured to separate an interior concrete slab from an exterior concrete slab such that the first point angle is aligned with the first side of the insulating body; bending, while inserted in the insulating body, the plurality of reinforcing shear rods at a second point to form a second point angle, the second point angle being aligned with the second side of the insulating body, wherein a first portion of each of the plurality of reinforcing shear rods extends from the first side of the insulating body and a second portion of each of the plurality of reinforcing shear rods extends from the second side of the insulating body and wherein the plurality of reinforcing shears rods are substantially parallel with the plurality of reinforcing tension rods on the second side and the second side of the insulating body; inserting a plurality of reinforcing tension rods through a plurality of reinforcing tension rod holes in the insulating body such that a first portion of each of the plurality of reinforcing tension rods extends from a first side of the insulating body and a second portion of each of the plurality of reinforcing tension rods extends from a second side of the insulating body; and pouring concrete over the plurality of reinforcing tension rods and reinforcing shear rods on both the first side and the second side of the insulating body to form an exterior concrete slab and an interior concrete slab.

[0019] Additionally or alternatively, placing on both the first side and the second side of the insulating body a plurality of cross tension rods substantially perpendicular to the plurality of reinforcing tension rods is included.

[0020] Additionally or alternatively, securing each of the plurality of cross tension rods to one or more of the plurality of reinforcing tension rods is included.

[0021] Additionally or alternatively, securing each of the plurality of cross tension rods to one or more of the plurality of shear rods.

[0022] Additionally or alternatively, securing each of the plurality of cross tension rods to one or more of the plurality of reinforcing tension rods and to one or more of the plurality of shear rods is included.

[0023] Additionally or alternatively, securing a plurality of washers around a respective ones of the plurality of shear rod holes is included.

[0024] Additionally or alternatively, the insulating body has an R-value of at least 2.

[0025] Additionally or alternatively, each of the plurality of reinforcing tension rods is a size #6 rebar.

[0026] Additionally or alternatively, each of the plurality of reinforcing shear rods is a size #4 rebar.

[0027] A system for preparing a thermally broken, cast-in-place concrete slab comprising:

[0028] In another exemplary embodiment, a thermally insulating body is provided that has a first side and a second side, the insulating body being configured to separate a first area for an interior concrete slab from a second area for an exterior concrete slab, the insulating body being load-bearing structural foam and including a plurality of reinforcing tension rod holes and a plurality of reinforcing shear rod holes, wherein the plurality of shear rod holes include washers secured to the insulating body to limit rod twisting and wherein the plurality of shear rod holes pass through the insulating body at a non-horizontal angle. A plurality of reinforcing tension rods are each configured to through a respective one of the plurality of tension rod holes and extend into the first area and the second area. A plurality of reinforcing shear rods are each of the plurality of reinforcing shear rods being bent at a first point to form an angle that substantially matches the non-horizontal angle of the plurality of shear rod holes, wherein when inserted into the plurality of shear rod holes, the plurality of reinforcing shear rods are bent at a point where each of the plurality of reinforcing shear rods exit respective ones of the plurality shear rod holes such that an exterior portion of each of the plurality of shear rods is substantially horizontal, wherein the system includes

no plates on the first side or the second side of the insulating body, wherein no compression struts pass through the insulating body, and wherein no articulating elements protrude through the insulating body into the first area or the second area.

[0029] Additionally or alternatively, a plurality of cross tension rods are substantially perpendicular to the plurality of reinforcing tension rods.

[0030] Additionally or alternatively, each of the plurality of cross tension rods is secured to one or more of the plurality of reinforcing tension rods.

[0031] Additionally or alternatively, each of the plurality of cross tension rods is secured to one or more of the plurality of shear rods.

[0032] Additionally or alternatively, each of the plurality of cross tension rods is secured to one or more of the plurality of reinforcing tension rods and one or more of the plurality of shear rods.

[0033] Additionally or alternatively, a plurality of washers are secured around a respective one of the plurality of shear rod holes.

[0034] Additionally or alternatively, the insulating body has an R-value of at least 2.

[0035] Additionally or alternatively, each of the plurality of reinforcing tension rods is a size #5 rebar.

[0036] Additionally or alternatively, each of the plurality of reinforcing shear rods is a size #3 rebar.

[0037] In another embodiment, a thermal break kit contains a thermally insulating body including a plurality of apertures, wherein at least some of the apertures extend non-horizontally from a first side to a second side; a plurality of twice bent reinforcing shear rods coupled to the thermally insulating body; and a plurality of reinforcing tension rods with instructions on insertion and securing of the plurality of reinforcing tension rods with the thermally insulating body.

[0038] Additionally or alternatively, a plurality of cross tension rods are installed substantially perpendicular to the plurality of reinforcing tension rods.

[0039] Additionally or alternatively, each of the plurality of cross tension rods is secured to one or more of the plurality of reinforcing tension rods.

[0040] Additionally or alternatively, each of the plurality of cross tension rods is secured to one or more of the plurality of shear rods.

[0041] Additionally or alternatively, each of the plurality of cross tension rods is secured to one or more of the plurality of reinforcing tension rods and one or more of the plurality of shear rods.

[0042] Additionally or alternatively, a plurality of washers are secured around a respective one of the plurality of shear rod holes.

[0043] Additionally or alternatively, the insulating body has an R-value of at least 2.

[0044] Additionally or alternatively, each of the plurality of reinforcing tension rods is a size #5 rebar.

[0045] Additionally or alternatively, each of the plurality of reinforcing shear rods is a size #3 rebar.

BRIEF DESCRIPTION OF THE DRAWINGS

[0046] For the purpose of illustrating the invention, the drawings show aspects of one or more embodiments of the invention. However, it should be understood that the present invention is not limited to the precise arrangements and instrumentalities shown in the drawings, wherein:

[0047] FIG. 1 is perspective view of a thermally broken cast-in-place concrete connection in accordance with an embodiment of the present invention;

[0048] FIG. 2 is a perspective view of the thermally broken cast-in-place concrete of FIG. 1 with the concrete in outline;

[0049] FIG. 3A is a perspective view of a thermal barrier with rebar installed in accordance with an embodiment of the present invention;

[0050] FIG. 3B is a top view of the thermal barrier structure of FIG. 3A;

[0051] FIG. 3C is a side view of the thermal barrier structure of FIG. 3A;

- [0052] FIG. 3D is a front view of the thermal barrier structure of FIG. 3A;
- [0053] FIG. 3E is a rear view of the thermal barrier structure of FIG. 3A;
- [0054] FIG. 4 is perspective view of a thermally broken cast-in-place concrete connection in accordance with another embodiment of the present invention;
- [0055] FIG. 5 is a perspective view of the thermally broken cast-in-place concrete of FIG. 4 with the concrete in outline;
- [0056] FIG. 6A is a perspective view of a thermal barrier with rebar installed in accordance with an embodiment of the present invention;
- [0057] FIG. 6B is a top view of the thermal barrier structure of FIG. 6A;
- [0058] FIG. 6C is a side view of the thermal barrier structure of FIG. 6A;
- [0059] FIG. 6D is a front view of the thermal barrier structure of FIG. 6A;
- [0060] FIG. 6E is a rear view of the thermal barrier structure of FIG. 6A;
- [0061] FIG. 7A is a perspective view of the thermal barrier structure without rebar installed;
- [0062] FIG. 7B is a cutaway view of the thermal barrier structure of FIG. 7A;
- [0063] FIG. 7C is another cutaway view of the thermal barrier structure of FIG. 7A;
- [0064] FIG. 8A is a cutaway side view of the thermal barrier structure showing a partially installed reinforcement shear bar;
- [0065] FIGS. 8B-8C depict the installation of a reinforcement shear bar in the thermal barrier structure; and
- [0066] FIG. 9 is a perspective view of a pre-fabricated thermal break system in accordance with an embodiment of the present invention.

DESCRIPTION OF THE DISCLOSURE

[0067] A thermal break system for thermally isolating concrete slabs is provided that is easy to install and results in a structurally secure concrete slab construction. The system may be compiled in a kit or package that can be delivered to a construction site and that includes the components necessary to install the thermal break system.

[0068] At a high level, the thermally isolating system includes a thermally insulating barrier, such as a section of load-bearing structural foam, that is sized to be positioned between an exterior concrete slab and an interior concrete slab of a main structure. The thermally insulating barrier includes sets of holes therethrough. A first type of sets of holes are sized and configured to accommodate reinforcing tension bars that will pass through the foam barrier and be embedded in both the interior and exterior concrete slabs when poured. A second type of sets of holes are sized and configured to accommodate reinforcing shear bars that will also pass through the foam barrier and be embedded in both the interior and exterior concrete slabs. The reinforcing shear bars, however, are inserted through the barrier prior to being sent to the construction site and are angled within the foam barrier such that the reinforcing shear bars enter the foam on the interior concrete slab side at, for example, a higher point than the reinforcing shear bars exit the foam barrier on the exterior concrete slab side. In addition, washers may be welded to the reinforcing shear bars and then, after the shear bars are inserted into the barrier, secured to the foam to prevent twisting of the bars. During fabrication of the system, the reinforcing shear bars are passed through the angled holes and then bent at the exit point so that the reinforcing shear bars are substantially horizontal on both sides of the barrier. Upon arrival at a construction site, reinforcing tension bars are inserted through the pre-drilled tension bars holes and then concrete is poured on both sides of the barrier to form the interior and exterior concrete slabs.

[0069] Turning to the figures, and in particular FIGS. 1-3E, a thermally broken cast-in-place concrete slab 100 includes an exterior slab 104, an interior slab 108, and an insulating barrier 112, which provides a thermal break between interior slab 108 and exterior slab 104. Running through insulating barrier 112 are reinforcing tension bars 116 (e.g., 116a-116b) and reinforcing shear bars 120 (e.g., 120a-120c), which continue on either side of barrier 112 and are embedded in both interior slab 108 and exterior slab 104, thereby providing structural integrity for exterior slab 104. In addition, reinforcing cross tension bars 124 (e.g., 124a, 124c, 124d, 124e, 124i) may be embedded in

either interior slab 108 or exterior slab 104 in an orientation running perpendicular to tension bars 116 and shear bars 120. The reinforcement bars may be of any size suitable for the intended construction project, and preferably for typical construction projects reinforcing tension bars 116 will be #5 or #6 rebars and reinforcing shear bars 120 will be #3 or #4 rebars.

[0070] Barrier 112 is preferably made of load-bearing structural foam having an R-value of about 2 per inch and will have a length to approximately match the widths of the concrete slabs to be thermally separated. The height of barrier 112 will similarly preferably approximately match the height of the concrete slabs to be separated, and the thickness may be any suitable thickness that provides sufficient insulating properties while also allowing for adequate structural integrity of concrete slab 104. The load-bearing structural foam of barrier 112, as a thermal break between concrete slabs as described herein, additionally adequately handles all the compression forces typically exerted by concrete slabs that are part of structures, which eliminates the need for having steel compression struts that pass through the thermal break. Material from which barrier 112 is made may be 500-280 Structural Thermal Break Material from ArmathermTM of Acushnet, Massachusetts.

[0071] Barrier 112 includes a plurality of tension bar holes for accommodating reinforcing tension bars 116. Tension bar holes pass generally straight through the barrier at a single height so that reinforcing tension bars 116 remain generally parallel with the lengthwise direction of the slabs. Tension bar holes are pre-drilled prior to shipment to a construction site based on the needs of the slabs to be constructed. In addition, a plurality of reinforcing shear bar holes for accommodating reinforcing shear bars 120 are drilled through barrier 112. Reinforcing shear bar holes pass through barrier 112 at an angle, preferably about a 45 degree angle, sloping downward from an interior side 132 to an exterior side 128 of barrier 112 for cantilever conditions. (Alternatively, reinforcing shear bar holes may slope upward from an interior side 132 to an exterior side 128 of barrier 112 for simple span conditions.) In addition, barrier 112 includes washers 136 (e.g., 136a-136c) on one side of the reinforcing shear bar. Washers 136 are welded onto shear bars 120 prior to insertion and then secured to barrier 112 when shear bars 120 are inserted, and serve to prevent twisting of installed reinforcement shear bars 120.

[0072] In operation, distal ends of reinforcing tension bars 116 and reinforcing shear bars 120 are designated as the ends that will be embedded in interior concrete slab 108. Then proximate ends

of reinforcing tension bars 116 are fed through the reinforcing tension bar holes of barrier 112 such that the distal ends protrude through interior side 132 a distance that reinforcing tension bars 116 will be embedded in interior concrete slab 108. In a preferred embodiment, tension bars 116 are inserted through barrier 112 at the construction site.

[0073] To fabricate the thermal break system, washers 136 are welded to reinforcing shear bars 120 so that washers 136 can later be secured to barrier 112. Then reinforcing shear bars 120 are bent at points that correspond to the points where reinforcing shear bars 120 will enter exterior side 128 of barrier 112, at an angle appropriate for the angle through which reinforcing shear bars will pass through barrier 112. Then bent reinforcing shear bars 120 are fed through barrier 112. Reinforcing shear bars 120 are then bent a second time at another point, pivoting until the proximal ends are again parallel with their distal ends and with reinforcing tension bars 116. This post-insertion bending during the fabrication process is preferable due to properties of barrier 112, which is made of load-bearing structural foam that is not conducive to having a bent bar fed through an angled hole. Washers 136 that are welded to shear bars 120 are then secured to barrier 112 with, for example, screws passing through pre-drilled holes in washers 136, which serve to prevent twisting of shear bars 120. In addition, washers 136 may provide a supporting element for assisting with the bending of reinforcing shear bar 120 while the angled portion resides within barrier.

[0074] The assembled thermal break system is then delivered to the construction site and installed where the concrete slabs are to be constructed. Once barrier 112 is in place, tension bars 116 are inserted through the pre-drilled holes, and cross tension bars 124 may be added. Cross tension bars 124 may be tied to reinforcing tension bars 116 and/or reinforcing shear bars 120 in interior slab 108 and exterior slab 104. Then concrete is poured to form thermally broken cast-in-place concrete slab 100 without the need for plates to sandwich the insulating material, steel compression struts passing through the thermal break, or articulating elements protruding through the insulating material and into the concrete slabs.

[0075] In another exemplary embodiment, shown in FIGS. 4-7C, a thermally broken cast-in-place concrete slab 200 includes an exterior slab 204, an interior slab 208, and an insulating barrier 212, which provides a thermal break between interior slab 208 and exterior slab 204. Running through insulating barrier 212 are reinforcing tension bars 216 (e.g., 216a-216d) and reinforcing shear bars 220 (e.g., 220a-220e), which continue on either side of barrier 212 and are

embedded in both interior slab 208 and exterior slab 204, thereby providing structural integrity for exterior slab 204. In addition, reinforcing cross tension bars (not shown) may be embedded in either interior slab 208 or exterior slab 204 in an orientation running perpendicular to tension bars 216 and shear bars 220. The reinforcement bars may be of any size suitable for the intended construction project, and preferably for typical construction projects reinforcing tension bars 216 will be #5 or #6 rebars and reinforcing shear bars 220 will be #3 or #4 rebars.

[0076] Barrier 212 is preferably made of load-bearing structural foam having an R-value of about 2 per inch and will have a length to approximately match the widths of the concrete slabs to be thermally separated. The height of barrier 212 will similarly preferably approximately match the height of the concrete slabs to be separated, and the thickness may be any suitable thickness that provides sufficient insulating properties while also allowing for adequate structural integrity of concrete slab 204. The load-bearing structural foam of barrier 212, as a thermal break between concrete slabs as described herein, additionally adequately handles all the compression forces typically exerted by concrete slabs that are part of structures, which eliminates the need for having steel compression struts that pass through the thermal break.

[0077] In addition, washers 236 (e.g., 236a-236e) may be included on one side of reinforcing shear bar holes, as can be seen in FIGS. 6B, 6C, and 6E, by welding, for example. Washers 236 that are attached to shear bars 220 can be secured to barrier 212 when shear bars 220 are inserted, thus preventing twisting of installed reinforcement shear bars 220.

[0078] Turning to FIGS. 7A-7C, barrier 212 includes a plurality of tension bar holes 214 (e.g., 214a-214d) for accommodating reinforcing tension bars 216. Tension bar holes 214 pass generally straight through barrier 212 at a single height so that reinforcing tension bars 216 remain generally parallel with the lengthwise direction of the slabs. A plurality of reinforcing shear bar holes 218 (e.g., 218a-218e) for accommodating reinforcing shear bars 220 are also included in barrier 212. Reinforcing shear bar holes 218 pass through barrier 212 at an angle, sloping downward from an interior side 232 to an exterior side 228 of barrier 212 for cantilever conditions. (Alternatively, reinforcing shear bar holes 218 may slope upward from an interior side 232 to an exterior side 228 of barrier 212 for simple span conditions (not shown).)

[0079] FIGS. 8A-8C are cut-away views of barrier 212 that has been cut to size for forming a thermal break for a concrete slab. Tension bar holes 214 (e.g., 214a-214d) are pre-drilled for accommodating tension bars to be inserted at the construction site. Additionally, shear bar holes 218 (e.g., 218a-218e) are drilled where reinforcing shear bars will be inserted. As can be seen in FIG. 7C, shear bar holes 218 pass through barrier 212 at an angle (in a preferred embodiment, at a 45 degree angle).

[0080] In operation, distal ends of reinforcing tension bars 216 and reinforcing shear bars 220 are designated as the ends that will be embedded in interior concrete slab 208. Then proximate ends of reinforcing tension bars 216 are fed through the reinforcing tension bar holes of barrier 212 such that the distal ends protrude through interior side 232 a distance that reinforcing tension bars 216 will be embedded in interior concrete slab 208. In a preferred embodiment, tension bars 216 are inserted through barrier 212 at the construction site.

[0081] To fabricate a prefabricated thermal break system 250 (shown in FIG. 9), washers 236 (e.g., 236e as shown in FIG. 8A) are welded to reinforcing shear bars 220 and then reinforcing shear bars 220 are bent at points 240 (e.g., point 240e in FIG. 8A), which correspond to the point where reinforcing shear bars 220 will enter exterior side 228 of barrier 212, at an angle appropriate for the angle through which reinforcing shear bars will pass through barrier 212. Then bent reinforcing shear bars 220 are fed through barrier 212. Reinforcing shear bars 220 are then bent a second time at points 244 (e.g., 244e in FIG. 8B), pivoting until the proximal ends are again parallel with their distal ends, i.e., generally horizontal. This bending during the installation process is necessitated by properties of barrier 212, which is made of load-bearing structural foam that is not conducive to having a bent bar fed through an angled hole. Washers 236 are then secured to barrier 212 with, for example, screws passing through pre-drilled holes in washers 236, which serve to prevent twisting of shear bars 220. In addition, washers 236 may provide a supporting element for assisting with the bending of reinforcing shear bar 220 while angled portion 221 resides within barrier 212.

[0082] The assembled thermal break system 250 is then delivered to the construction site and installed where the concrete slabs are to be constructed. Once barrier 212 is in place, reinforcing tension bars 216 are inserted through pre-drilled holes 214 and cross tension bars may be added. Cross tension bars may be tied to reinforcing tension bars and/or reinforcing shear bars in interior slab and exterior slab. Then concrete is poured to form thermally broken, cast-in-place concrete slab

200 without the need for plates to sandwich the insulating material, steel compression struts passing through the thermal break, or articulating elements protruding through the insulating material and into the concrete slabs.

[0083] Exemplary embodiments have been disclosed above and illustrated in the accompanying drawings. It will be understood by those skilled in the art that various changes, omissions, and additions may be made to that which is specifically disclosed herein without departing from the spirit and scope of the present invention.

What is claimed is:

1. A thermal break system for separating concrete slabs, comprising:
 - a thermally insulating body sized and configured to separate a first area for an interior concrete slab from a second area for an exterior concrete slab, the insulating body being load-bearing structural foam and including a plurality of reinforcing tension rod holes and a plurality of reinforcing shear rod holes, wherein the plurality of shear rod holes pass through the insulating body at a non-horizontal angle; and
 - a plurality of reinforcing shear rods, wherein each of the plurality of reinforcing shear rods includes a first bend at a first point to form an angled portion that substantially matches the non-horizontal angle of the plurality of shear rod holes, wherein each of the plurality of reinforcing shear rods is inserted through the thermally insulating body via respective ones of the plurality of shear rod holes such that the angled portion is within the insulating body and the first point is aligned with a first side of the insulating body, wherein each of the plurality of reinforcing shear rods each include a washer welded near the first point, wherein each of the plurality of shear rods include a second bend at a second point where each of the plurality of reinforcing shear rods exits respective ones of the plurality shear rod holes on a second side of the insulating body such that exterior portions of each of the plurality of shear rods are substantially horizontal, and wherein each washer is secured to the thermally insulating body.
2. The thermal break system according to claim 1, wherein the insulating body has an R-value of at least 2.
3. The thermal break system according to claim 2, wherein each of the plurality of reinforcing shear rods is a size #3 rebar.
4. The thermal break system according to claim 1, the system includes no plates on the first side or the second side of the insulating body, wherein no compression struts pass through the insulating body, and wherein no articulating elements protrude through the insulating body into the first area or the second area.
5. A thermal break system prepared by a process comprising the steps of:

- forming, from a load-bearing, thermally insulating structural foam material, an insulating body such that the insulating body is sized and configured to separate a first area for an interior concrete slab from a second area for an exterior concrete slab;
- drilling a plurality of reinforcing tension rod holes through the insulating body;
- drilling a plurality of reinforcing shear rod holes through the insulation body at a non-horizontal angle;
- welding a washer to each of a plurality of reinforcing shear rods;
- bending each of the plurality of reinforcing shear rods at a first point to form a plurality of bent reinforcing shear rods;
- inserting the plurality of bent reinforcing shear rods through the plurality reinforcing shear rod holes in the insulating body such that the first point is aligned with a first side of the insulating body;
- bending, while inserted in the insulating body, the plurality of reinforcing shear rods at a second point, the second point being aligned with a second side of the insulating body, such that portions of the plurality of reinforcing shear rods extending from the first side of the insulating body and extending from the second side of the insulating body are substantially horizontal; and
- securing each washer to the insulating body.
6. A thermal break system according to claim 5.
7. A system for preparing a thermal barrier for a cast-in-place concrete slab consisting essentially of:
- a thermally insulating body configured to separate a first area for an interior concrete slab from a second area for an exterior concrete slab, the insulating body being load-bearing structural foam and including a plurality of reinforcing tension rod holes and a plurality of reinforcing shear rod holes, and wherein the plurality of shear rod holes pass through the insulating body at a non-horizontal angle;

a plurality of reinforcing tension rods, each passing through a respective one of the plurality of tension rod holes and extend into the first area and the second area; and

a plurality of reinforcing shear rods, each of the plurality of reinforcing shear rods being bent at a first point to form an angled portion that substantially matches the non-horizontal angle of the plurality of shear rod holes, wherein each of the plurality of reinforcing shear rods are pass through respective ones of the plurality of reinforcing shear rod holes and are bent at a second point where each of the plurality of reinforcing shear rods exit the respective ones of the plurality shear rod holes such that an exterior portion of each of the plurality of shear rods is substantially horizontal.

8. The system according to claim 7, further including a plurality of cross tension rods, wherein each of the plurality of cross tensions rods are substantially perpendicular to the plurality of reinforcing tension rods.
9. The system according to claim 8, wherein each of the plurality of cross tension rods is secured to one or more of the plurality of reinforcing tension rods.
10. The system according to claim 8, wherein each of the plurality of cross tension rods is secured to one or more of the plurality of shear rods.
11. The system according to claim 8, wherein each of the plurality of cross tension rods is secured to one or more of the plurality of reinforcing tension rods and one or more of the plurality of shear rods.
12. The system according to any of claims 7, 8, 9, 10, or 11, further including a plurality of washers, each of the plurality of washers secured around a respective one of the plurality of shear rod holes.
13. The system according to any of claims 7, 8, 9, 10, 11, or 12, wherein the insulating body has an R-value of at least 2.
14. The system according to any of claims 7, 8, 9, 10, 11, 12, or 13, wherein each of the plurality of reinforcing tension rods is a size #5 rebar.

15. The system according to any of claims 7, 8, 9, 10, 11, 12, 13, or 14, wherein each of the plurality of reinforcing shear rods is a size #3 rebar.
16. A method for installing a thermally broken, cast-in-place concrete slab comprising:
- bending a plurality of reinforcing shear rods at a first point to form a plurality of bent reinforcing shear rods;
 - inserting the plurality of bent reinforcing shear rods through a plurality of angled reinforcing shear rod holes in a load-bearing, thermally insulating structural foam body configured to separate an interior concrete slab from an exterior concrete slab such that the first point angle is aligned with a first side of the insulating body;
 - bending, while inserted in the insulating body, the plurality of reinforcing shear rods at a second point, the second point being aligned with a second side of the insulating body, wherein a first portion of each of the plurality of reinforcing shear rods extends substantially horizontally from the first side of the insulating body and a second portion of each of the plurality of reinforcing shear rods extends substantially horizontally from the second side of the insulating body;
 - inserting a plurality of reinforcing tension rods through a plurality of reinforcing tension rod holes in the insulating body such that a first portion of each of the plurality of reinforcing tension rods extends substantially horizontally from a first side of the insulating body and a second portion of each of the plurality of reinforcing tension rods extends substantially horizontally from a second side of the insulating body; and
 - pouring concrete over the plurality of reinforcing tension rods and reinforcing shear rods on both the first side and the second side of the insulating body to form an exterior concrete slab and an interior concrete slab.
17. The method for installing a thermally broken, cast-in-place concrete slab according to claim 16, further including placing on both the first side and the second side of the insulating body

a plurality of cross tension rods substantially perpendicular to the plurality of reinforcing tension rods.

18. The method for installing a thermally broken, cast-in-place concrete slab according to claim 17, further including securing each of the plurality of cross tension rods to one or more of the plurality of reinforcing tension rods.
19. The method for installing a thermally broken, cast-in-place concrete slab according to claim 17, further including securing each of the plurality of cross tension rods to one or more of the plurality of shear rods.
20. The method for installing a thermally broken, cast-in-place concrete slab according to claim 17, further including securing each of the plurality of cross tension rods to one or more of the plurality of reinforcing tension rods and to one or more of the plurality of shear rods.
21. The method for installing a thermally broken, cast-in-place concrete slab according to any of claims 16, 17, 18, 19, or 20, further including securing a plurality of washers around a respective ones of the plurality of shear rod holes.
22. The method for installing a thermally broken, cast-in-place concrete slab according to any of claims 16, 17, 18, 19, 20, or 21, wherein the insulating body has an R-value of at least 2.
23. The method for installing a thermally broken, cast-in-place concrete slab according to any of claims 16, 17, 18, 19, 20, 21, or 22, wherein each of the plurality of reinforcing tension rods is a size #6 rebar.
24. The method for installing a thermally broken, cast-in-place concrete slab according to any of claims 16, 17, 18, 19, 20, 21, 22, or 23, wherein each of the plurality of reinforcing shear rods is a size #4 rebar.
25. A thermal break for a cast-in-place concrete slab comprising:
 - a thermally insulating body having a first side and a second side, the insulating body being configured to separate a first area for an interior concrete slab from a second area for an exterior concrete slab, the insulating body being load-bearing structural foam and including a plurality of reinforcing tension rod holes and a plurality of reinforcing shear rod holes, and wherein the plurality of shear rod holes pass through the insulating body at a non-horizontal angle;

a plurality of reinforcing tension rods, wherein each of the plurality of tensions rods passes through a respective one of the plurality of tension rod holes and extends into the first area and the second area; and

a plurality of reinforcing shear rods, each of the plurality of reinforcing shear rods being bent at a first point to form an angled portion that substantially matches the non-horizontal angle of the plurality of shear rod holes, wherein each of the plurality of reinforcing shear rods are pass through respective ones of the plurality of reinforcing shear rod holes and are bent at a second point where each of the plurality of reinforcing shear rods exit the respective ones of the plurality shear rod holes such that an exterior portion of each of the plurality of shear rods is substantially horizontal,

wherein the system includes no plates on the first side or the second side of the insulating body, wherein no compression struts pass through the insulating body, and wherein no articulating elements protrude through the insulating body into the first area or the second area.

26. The thermal break according to claim 25, further including a plurality of cross tension rods, wherein each of the plurality of cross tensions rods are substantially perpendicular to the plurality of reinforcing tension rods.
27. The thermal break according to claim 265, wherein each of the plurality of cross tension rods is secured to one or more of the plurality of reinforcing tension rods.
28. The thermal break according to claim 26, wherein each of the plurality of cross tension rods is secured to one or more of the plurality of shear rods.
29. The thermal break according to claim 26, wherein each of the plurality of cross tension rods is secured to one or more of the plurality of reinforcing tension rods and one or more of the plurality of shear rods.
30. The thermal break according to any of claims 25, 26, 27, 28, or 29, further including a plurality of washers, each of the plurality of washers secured around a respective one of the plurality of shear rod holes.

31. The thermal break according to any of claims 25, 26, 27, 28, 29, or 30, wherein the insulating body has an R-value of at least 2.
32. The thermal break according to any of claims 25, 26, 27, 28, 29, 30, or 31, wherein each of the plurality of reinforcing tension rods is a size #5 rebar.
33. The thermal break according to any of claims 25, 26, 27, 28, 29, 30, 31, or 32, wherein each of the plurality of reinforcing shear rods is a size #3 rebar.
34. A thermal break kit containing:
 - a thermally insulating body including a plurality of apertures, wherein at least some of the apertures extend non-horizontally from a first side to a second side;
 - a plurality of twice bent reinforcing shear rods coupled to the thermally insulating body; and
 - a plurality of reinforcing tension rods with instructions on insertion and securing of the plurality of reinforcing tension rods with the thermally insulating body.
35. The thermal break kit according to claim 34, further including a plurality of cross tension rods, wherein each of the plurality of cross tensions rods are substantially perpendicular to the plurality of reinforcing tension rods.
36. The thermal break kit according to claim 35, wherein each of the plurality of cross tension rods is secured to one or more of the plurality of reinforcing tension rods.
37. The thermal break kit according to claim 35, wherein each of the plurality of cross tension rods is secured to one or more of the plurality of shear rods.
38. The thermal break kit according to claim 35, wherein each of the plurality of cross tension rods is secured to one or more of the plurality of reinforcing tension rods and one or more of the plurality of shear rods.
39. The thermal break kit according to any of claims 34, 35, 36, 37, or 38, further including a plurality of washers, each of the plurality of washers secured around a respective one of the plurality of shear rod holes.
40. The thermal break kit according to any of claims 34, 35, 36, 37, 38, or 39, wherein the insulating body has an R-value of at least 2.

41. The thermal break kit according to any of claims 34, 35, 36, 37, 38, 39, or 40, wherein each of the plurality of reinforcing tension rods is a size #5 rebar.
42. The thermal break kit according to any of claims 34, 35, 36, 37, 38, 39, 40, or 41, wherein each of the plurality of reinforcing shear rods is a size #3 rebar.

AMENDED CLAIMS

received by the International Bureau on 15 May 2019 (15.05.2019)

1. A thermal break system for separating concrete slabs, comprising:
 - a thermally insulating body sized and configured to separate a first area for an interior concrete slab from a second area for an exterior concrete slab, the insulating body being load-bearing structural foam and including a plurality of reinforcing tension rod holes and a plurality of reinforcing shear rod holes, wherein the plurality of shear rod holes pass through the insulating body at a non-horizontal angle; and
 - a plurality of reinforcing shear rods, wherein each of the plurality of reinforcing shear rods includes a first bend at a first point to form an angled portion that substantially matches the non-horizontal angle of the plurality of shear rod holes, wherein each of the plurality of reinforcing shear rods is inserted through the thermally insulating body via respective ones of the plurality of shear rod holes such that the angled portion is within the insulating body and the first point is aligned with a first side of the insulating body, wherein each of the plurality of reinforcing shear rods each include a washer welded near the first point, wherein each of the plurality of shear rods include a second bend at a second point where each of the plurality of reinforcing shear rods exits respective ones of the plurality shear rod holes on a second side of the insulating body such that exterior portions of each of the plurality of shear rods are substantially horizontal, and wherein each of the washers is secured to the thermally insulating body.
2. The thermal break system according to claim 1, wherein the insulating body has an R-value of at least 2.
3. The thermal break system according to claim 2, wherein each of the plurality of reinforcing shear rods is a size #3 rebar.
4. The thermal break system according to claim 1, the system includes no plates on the first side or the second side of the insulating body, wherein no compression struts pass through the insulating body, and wherein no articulating elements protrude through the insulating body into the first area or the second area.

5. A thermal break system prepared by a process comprising the steps of:
 - forming, from a load-bearing, thermally insulating structural foam material, an insulating body such that the insulating body is sized and configured to separate a first area for an interior concrete slab from a second area for an exterior concrete slab;
 - drilling a plurality of reinforcing tension rod holes through the insulating body;
 - drilling a plurality of reinforcing shear rod holes through the insulation body at a non-horizontal angle;
 - welding a washer to each of a plurality of reinforcing shear rods;
 - bending each of the plurality of reinforcing shear rods at a first point to form a plurality of bent reinforcing shear rods;
 - inserting the plurality of bent reinforcing shear rods through the plurality reinforcing shear rod holes in the insulating body such that the first point is aligned with a first side of the insulating body;
 - bending, while inserted in the insulating body, the plurality of reinforcing shear rods at a second point, the second point being aligned with a second side of the insulating body, such that portions of the plurality of reinforcing shear rods extending from the first side of the insulating body and extending from the second side of the insulating body are substantially horizontal; and
 - securing each of the washers to the insulating body.
6. A thermal break system for separating concrete slabs prepared by the process of claim 5.
7. A system for preparing a thermal barrier for a cast-in-place concrete slab consisting essentially of:
 - a thermally insulating body configured to separate a first area for an interior concrete slab from a second area for an exterior concrete slab, the insulating body being load-bearing structural foam and including a

plurality of reinforcing tension rod holes and a plurality of reinforcing shear rod holes, and wherein the plurality of shear rod holes pass through the insulating body at a non-horizontal angle;

a plurality of reinforcing tension rods, each passing through a respective one of the plurality of tension rod holes and extend into the first area and the second area; and

a plurality of reinforcing shear rods, each of the plurality of reinforcing shear rods being bent at a first point to form an angled portion that substantially matches the non-horizontal angle of the plurality of shear rod holes, wherein each of the plurality of reinforcing shear rods pass through respective ones of the plurality of reinforcing shear rod holes and are bent at a second point where each of the plurality of reinforcing shear rods exit the respective ones of the plurality of shear rod holes such that an exterior portion of each of the plurality of shear rods is substantially horizontal.

8. The system according to claim 7, further including a plurality of cross tension rods, wherein each of the plurality of cross tensions rods are substantially perpendicular to the plurality of reinforcing tension rods.
9. The system according to claim 8, wherein each of the plurality of cross tension rods is secured to one or more of the plurality of reinforcing tension rods.
10. The system according to claim 8, wherein each of the plurality of cross tension rods is secured to one or more of the plurality of shear rods.
11. The system according to claim 8, wherein each of the plurality of cross tension rods is secured to one or more of the plurality of reinforcing tension rods and one or more of the plurality of shear rods.
12. The system according to any of claims 7, 8, 9, 10, or 11, further including a plurality of washers, each of the plurality of washers secured around a respective one of the plurality of shear rod holes.
13. The system according to any of claims 7, 8, 9, 10, or 11, wherein the insulating body has an R-value of at least 2.

14. The system according to any of claims 7, 8, 9, 10, or 11, wherein each of the plurality of reinforcing tension rods is a size #5 rebar.
15. The system according to any of claims 7, 8, 9, 10, or 11, wherein each of the plurality of reinforcing shear rods is a size #3 rebar.
16. A method for installing a thermally broken, cast-in-place concrete slab comprising:
 - bending a plurality of reinforcing shear rods at a first point to form a plurality of bent reinforcing shear rods;
 - inserting the plurality of bent reinforcing shear rods through a plurality of angled reinforcing shear rod holes in a load-bearing, thermally insulating structural foam body configured to separate an interior concrete slab from an exterior concrete slab such that the first point angle is aligned with a first side of the insulating body;
 - bending, while inserted in the insulating body, the plurality of reinforcing shear rods at a second point, the second point being aligned with a second side of the insulating body, wherein a first portion of each of the plurality of reinforcing shear rods extends substantially horizontally from the first side of the insulating body and a second portion of each of the plurality of reinforcing shear rods extends substantially horizontally from the second side of the insulating body;
 - inserting a plurality of reinforcing tension rods through a plurality of reinforcing tension rod holes in the insulating body such that a first portion of each of the plurality of reinforcing tension rods extends substantially horizontally from the first side of the insulating body and a second portion of each of the plurality of reinforcing tension rods extends substantially horizontally from the second side of the insulating body; and
 - pouring concrete over the plurality of reinforcing tension rods and reinforcing shear rods on both the first side and the second side of the insulating body to form the exterior concrete slab and the interior concrete slab.
17. The method for installing a thermally broken, cast-in-place concrete slab according to claim 16, further including placing on both the first side and the second side of the

insulating body a plurality of cross tension rods substantially perpendicular to the plurality of reinforcing tension rods.

18. The method for installing a thermally broken, cast-in-place concrete slab according to claim 17, further including securing each of the plurality of cross tension rods to one or more of the plurality of reinforcing tension rods.
19. The method for installing a thermally broken, cast-in-place concrete slab according to claim 17, further including securing each of the plurality of cross tension rods to one or more of the plurality of shear rods.
20. The method for installing a thermally broken, cast-in-place concrete slab according to claim 17, further including securing each of the plurality of cross tension rods to one or more of the plurality of reinforcing tension rods and to one or more of the plurality of shear rods.
21. The method for installing a thermally broken, cast-in-place concrete slab according to any of claims 16, 17, 18, 19, or 20, further including securing a plurality of washers around a respective ones of the plurality of shear rod holes.
22. The method for installing a thermally broken, cast-in-place concrete slab according to any of claims 16, 17, 18, 19, or 20, wherein the insulating body has an R-value of at least 2.
23. The method for installing a thermally broken, cast-in-place concrete slab according to any of claims 16, 17, 18, 19, or 20, wherein each of the plurality of reinforcing tension rods is a size #6 rebar.
24. The method for installing a thermally broken, cast-in-place concrete slab according to any of claims 16, 17, 18, 19, or 20, wherein each of the plurality of reinforcing shear rods is a size #4 rebar.
25. A thermal break for a cast-in-place concrete slab comprising:
 - a thermally insulating body having a first side and a second side, the insulating body being configured to separate a first area for an interior concrete slab from a second area for an exterior concrete slab, the insulating body being load-bearing structural foam and including a plurality of reinforcing tension rod holes and a plurality of reinforcing shear rod holes, and

wherein the plurality of shear rod holes pass through the insulating body at a non-horizontal angle;

a plurality of reinforcing tension rods, wherein each of the plurality of tensions rods passes through a respective one of the plurality of tension rod holes and extends into the first area and the second area; and

a plurality of reinforcing shear rods, each of the plurality of reinforcing shear rods being bent at a first point to form an angled portion that substantially matches the non-horizontal angle of the plurality of shear rod holes, wherein each of the plurality of reinforcing shear rods pass through respective ones of the plurality of reinforcing shear rod holes and are bent at a second point where each of the plurality of reinforcing shear rods exit the respective ones of the plurality of shear rod holes such that an exterior portion of each of the plurality of shear rods is substantially horizontal,

wherein the system includes no plates on the first side or the second side of the insulating body, wherein no compression struts pass through the insulating body, and wherein no articulating elements protrude through the insulating body into the first area or the second area.

26. The thermal break according to claim 25, further including a plurality of cross tension rods, wherein each of the plurality of cross tensions rods are substantially perpendicular to the plurality of reinforcing tension rods.
27. The thermal break according to claim 26, wherein each of the plurality of cross tension rods is secured to one or more of the plurality of reinforcing tension rods.
28. The thermal break according to claim 26, wherein each of the plurality of cross tension rods is secured to one or more of the plurality of shear rods.
29. The thermal break according to claim 26, wherein each of the plurality of cross tension rods is secured to one or more of the plurality of reinforcing tension rods and one or more of the plurality of shear rods.
30. The thermal break according to any of claims 25, 26, 27, 28, or 29, further including a plurality of washers, each of the plurality of washers secured around a respective one of the plurality of shear rod holes.

31. The thermal break according to any of claims 25, 26, 27, 28, or 29, wherein the insulating body has an R-value of at least 2.
32. The thermal break according to any of claims 25, 26, 27, 28, or 29, wherein each of the plurality of reinforcing tension rods is a size #5 rebar.
33. The thermal break according to any of claims 25, 26, 27, 28, or 29, wherein each of the plurality of reinforcing shear rods is a size #3 rebar.
34. A thermal break kit containing:
 - a thermally insulating body including a plurality of apertures, wherein at least some of the apertures extend non-horizontally from a first side to a second side;
 - a plurality of twice bent reinforcing shear rods coupled to the thermally insulating body; and
 - a plurality of reinforcing tension rods with instructions on insertion and securing of the plurality of reinforcing tension rods with the thermally insulating body.
35. The thermal break kit according to claim 34, further including a plurality of cross tension rods, wherein each of the plurality of cross tensions rods are substantially perpendicular to the plurality of reinforcing tension rods.
36. The thermal break kit according to claim 35, wherein each of the plurality of cross tension rods is secured to one or more of the plurality of reinforcing tension rods.
37. The thermal break kit according to claim 35, wherein each of the plurality of cross tension rods is secured to one or more of the plurality of shear rods.
38. The thermal break kit according to claim 35, wherein each of the plurality of cross tension rods is secured to one or more of the plurality of reinforcing tension rods and one or more of the plurality of shear rods.
39. The thermal break kit according to any of claims 34, 35, 36, 37, or 38, further including a plurality of washers, each of the plurality of washers secured around a respective one of the plurality of shear rod holes.

40. The thermal break kit according to any of claims 34, 35, 36, 37, or 38, wherein the insulating body has an R-value of at least 2.
41. The thermal break kit according to any of claims 34, 35, 36, 37, or 38, wherein each of the plurality of reinforcing tension rods is a size #5 rebar.
42. The thermal break kit according to any of claims 34, 35, 36, 37, or 38, wherein each of the plurality of reinforcing shear rods is a size #3 rebar.

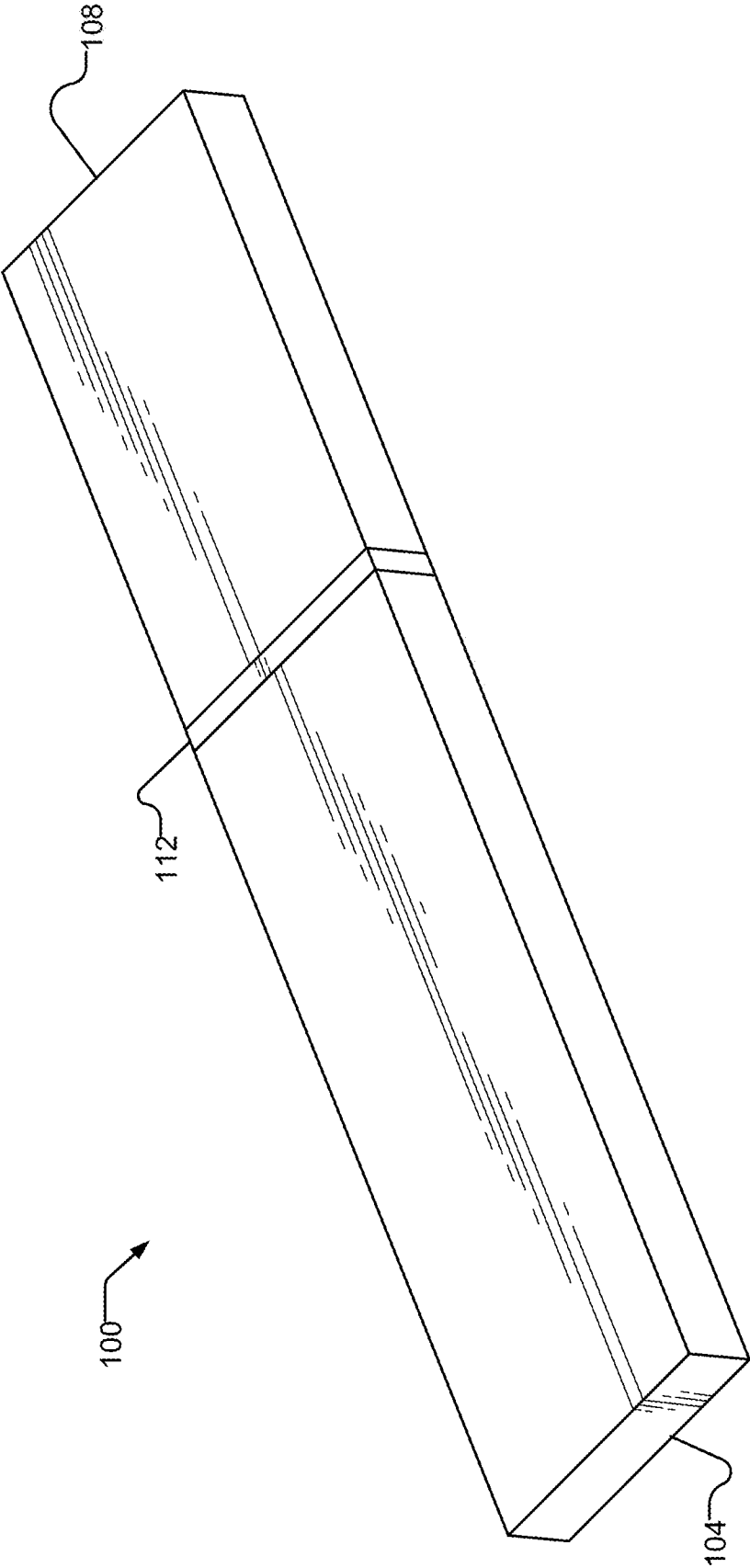


Fig. 1

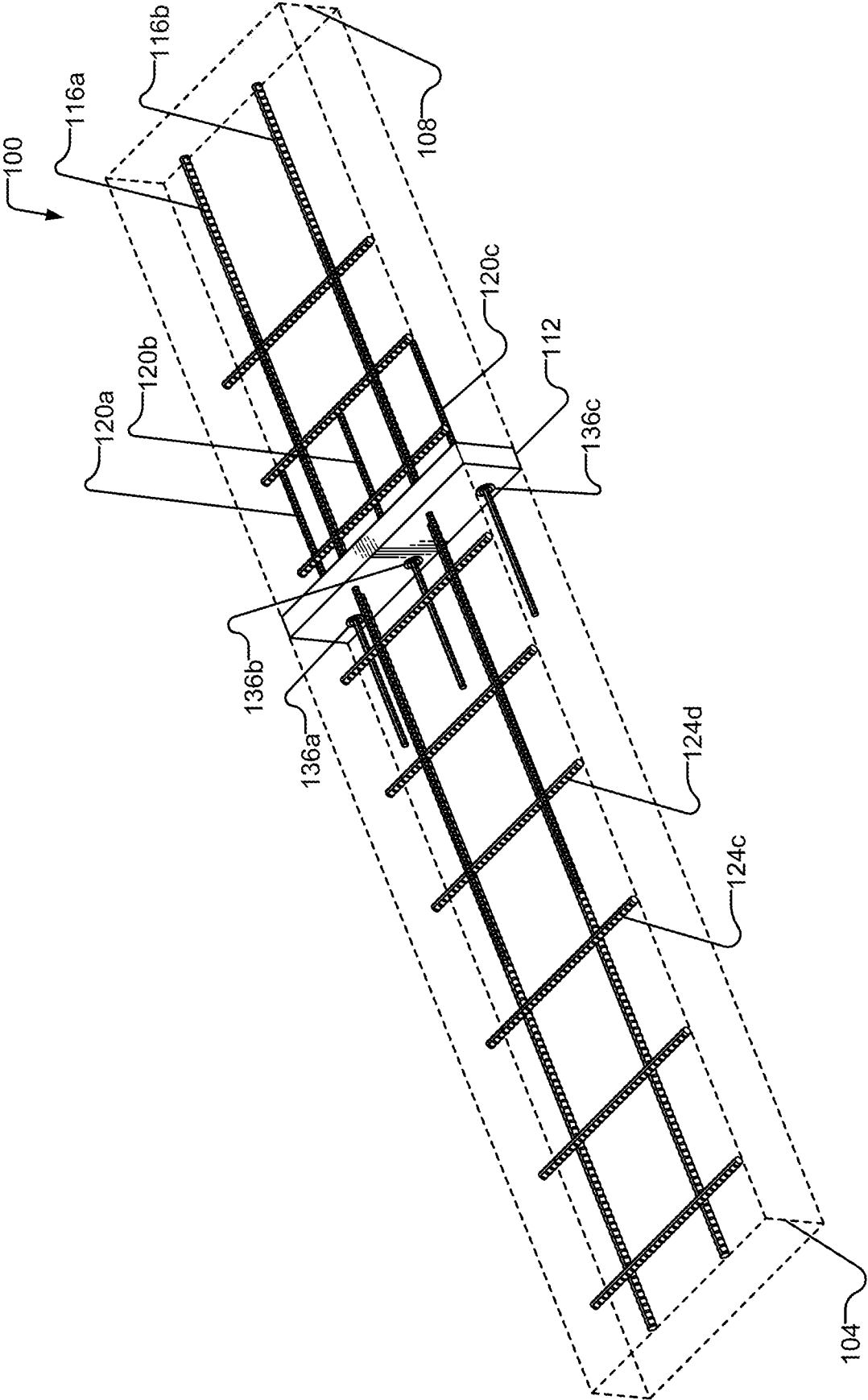


Fig. 2

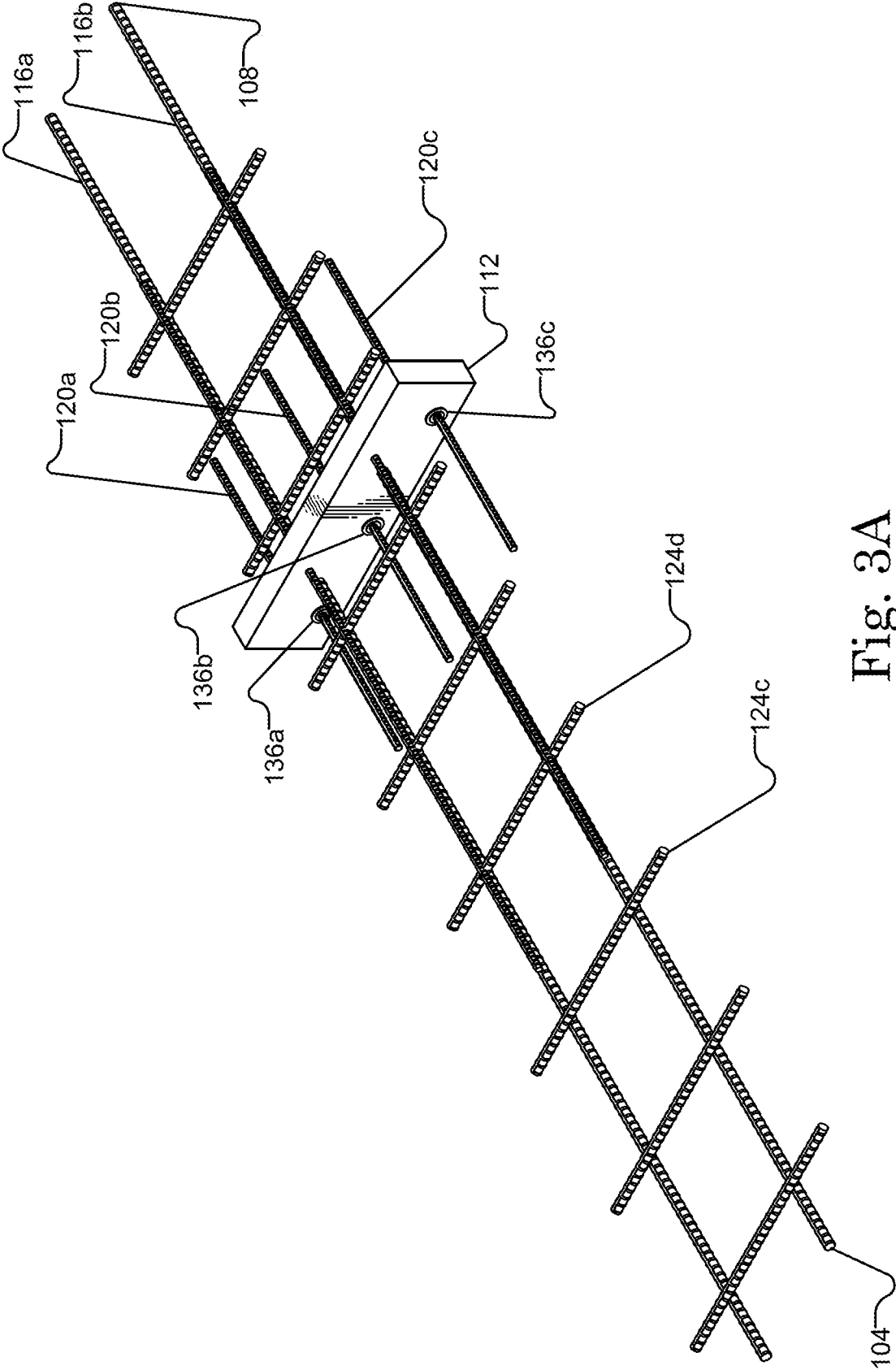


Fig. 3A

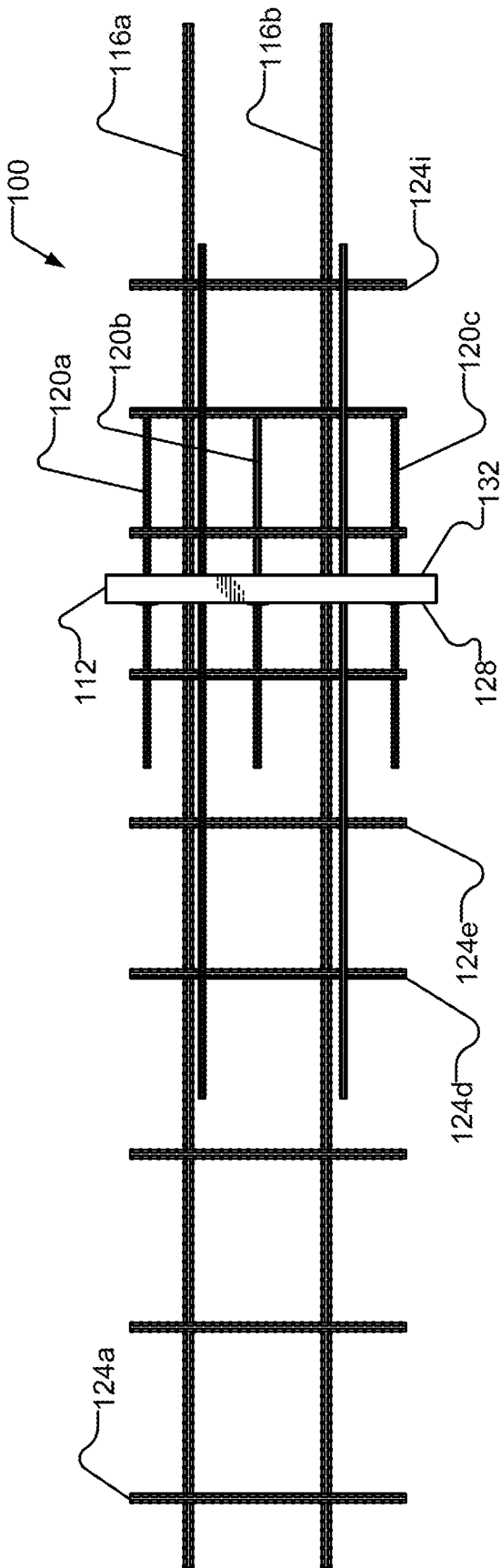


Fig. 3B

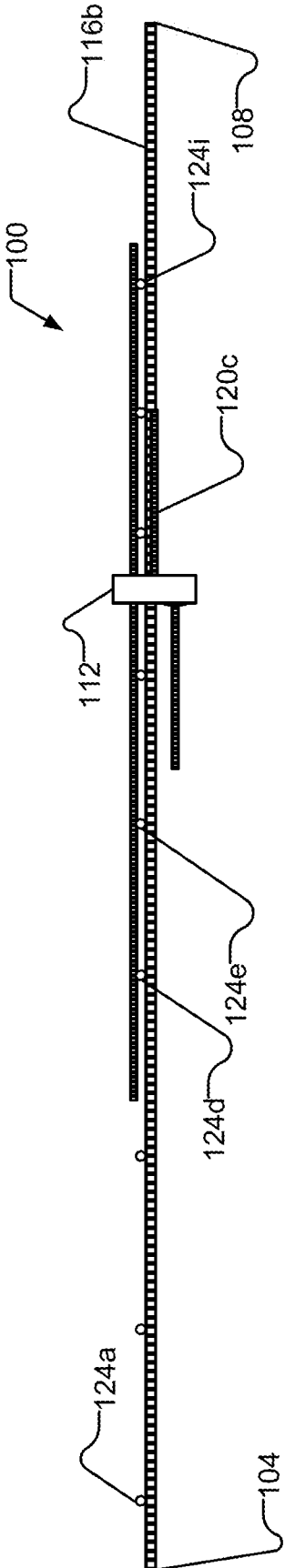


Fig. 3C

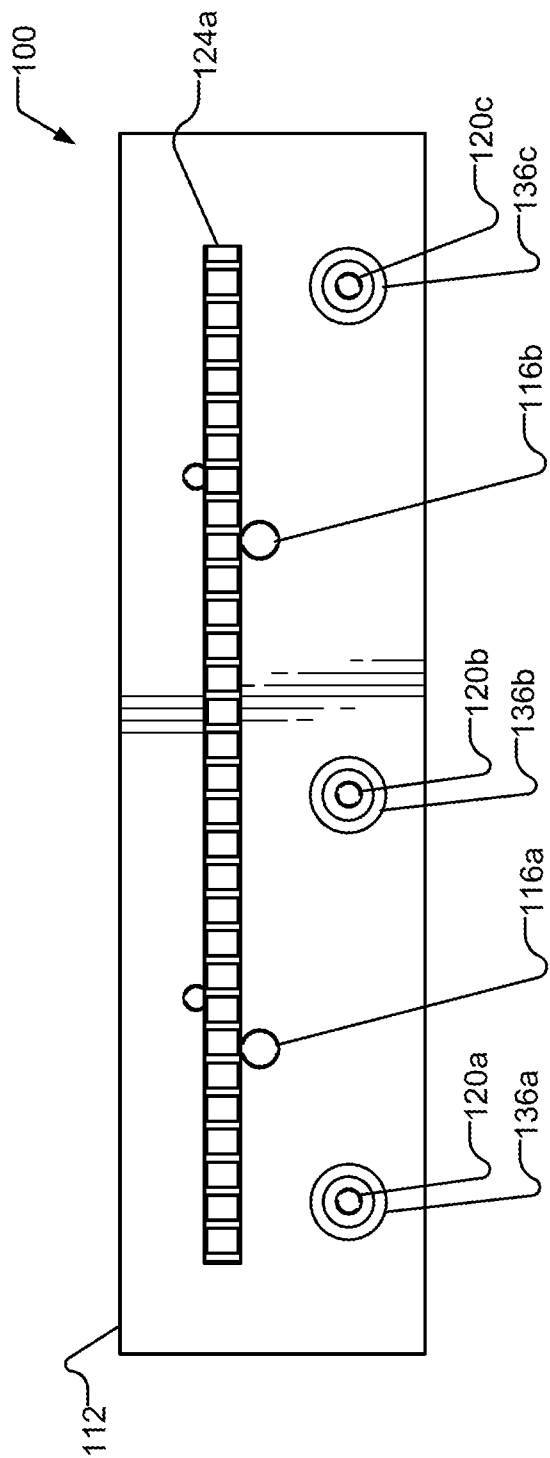


Fig. 3D

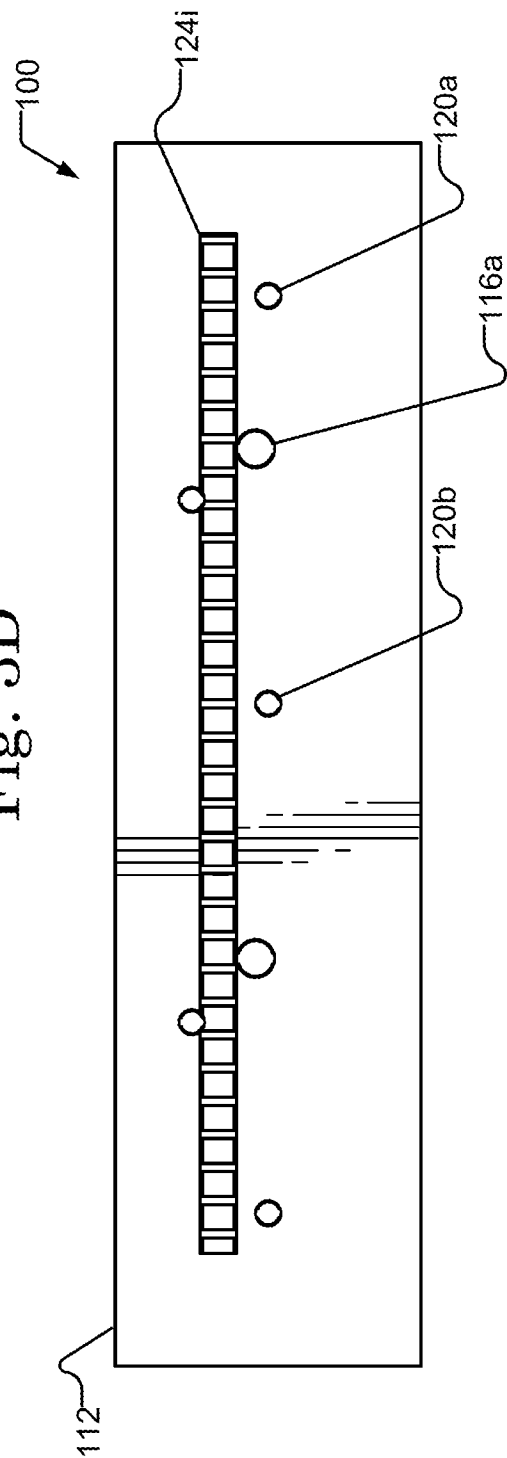


Fig. 3E

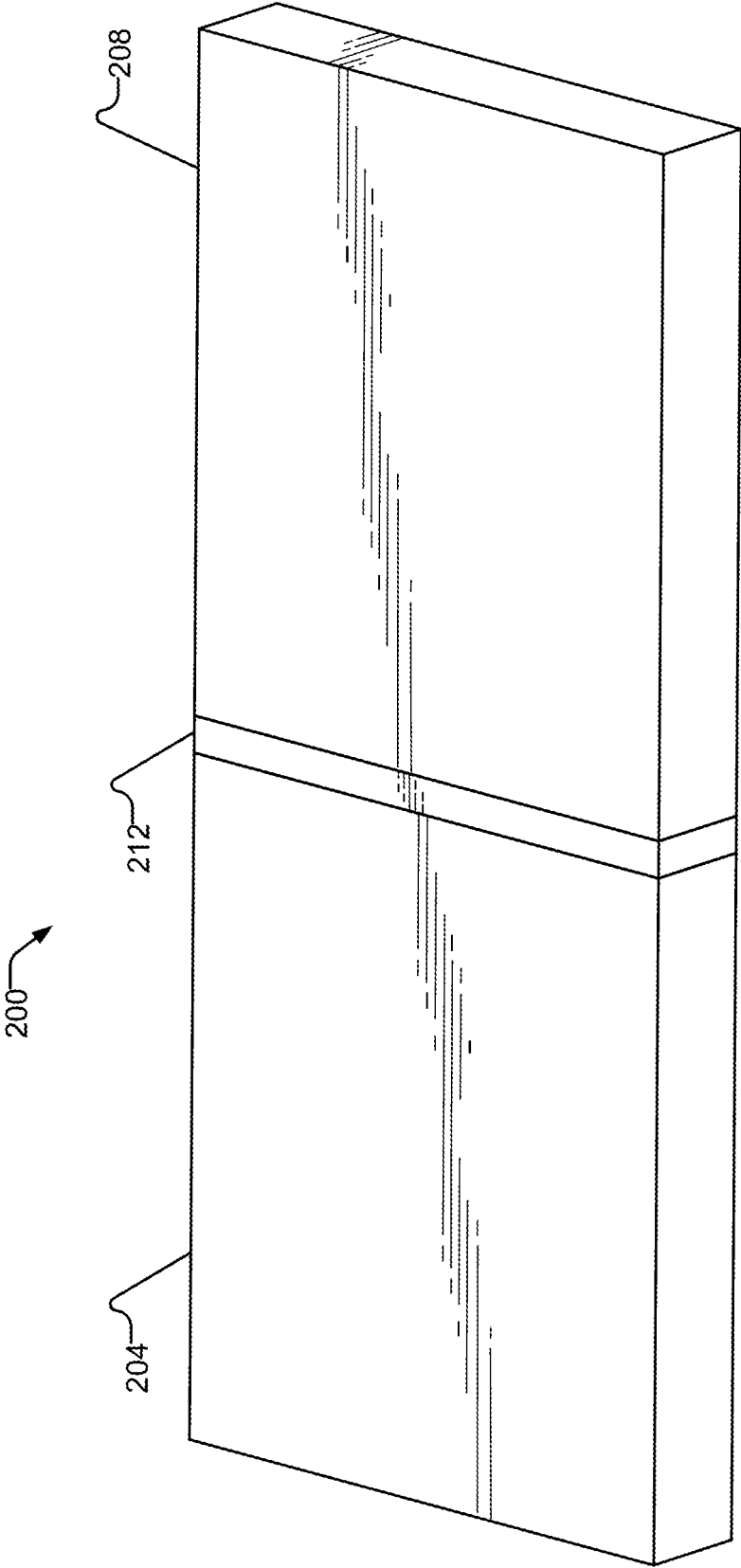


Fig. 4

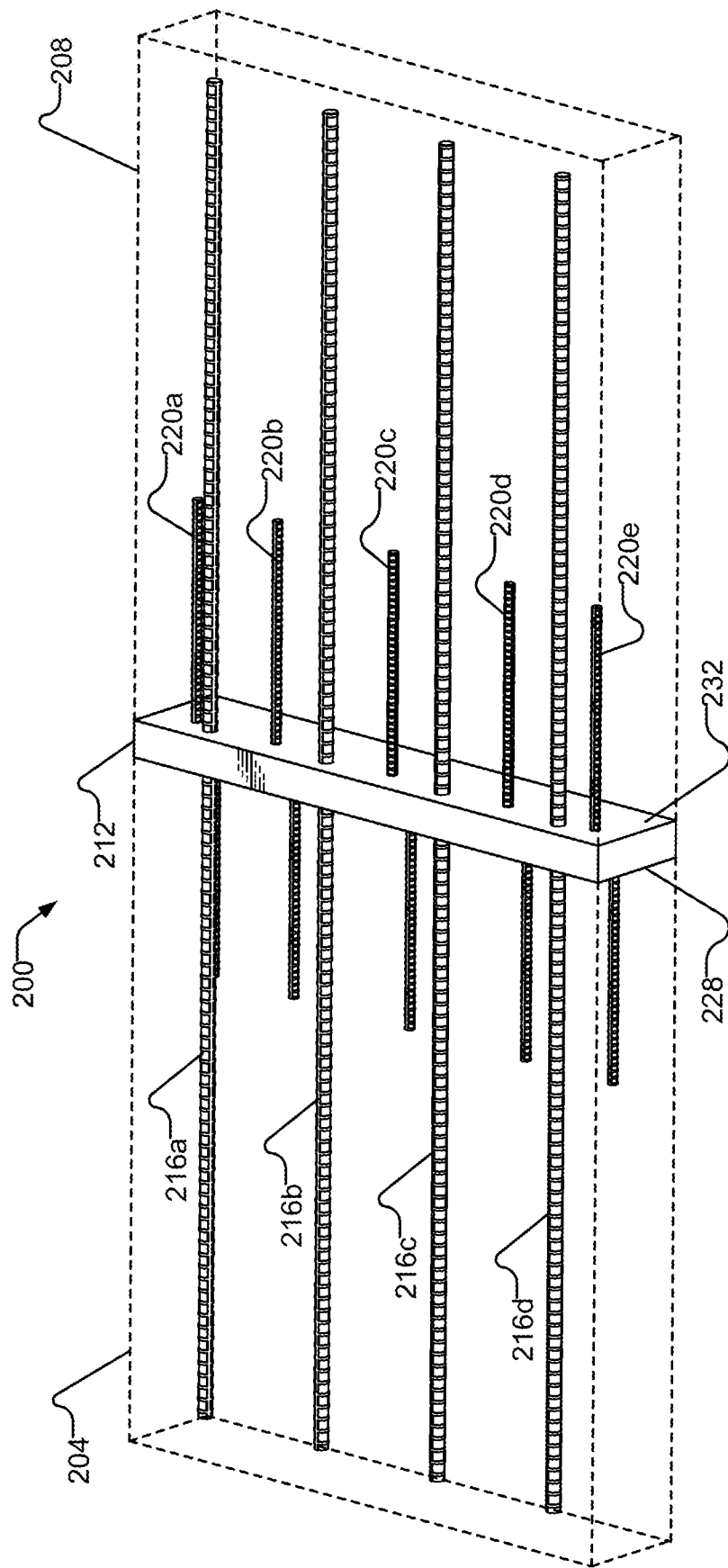


Fig. 5

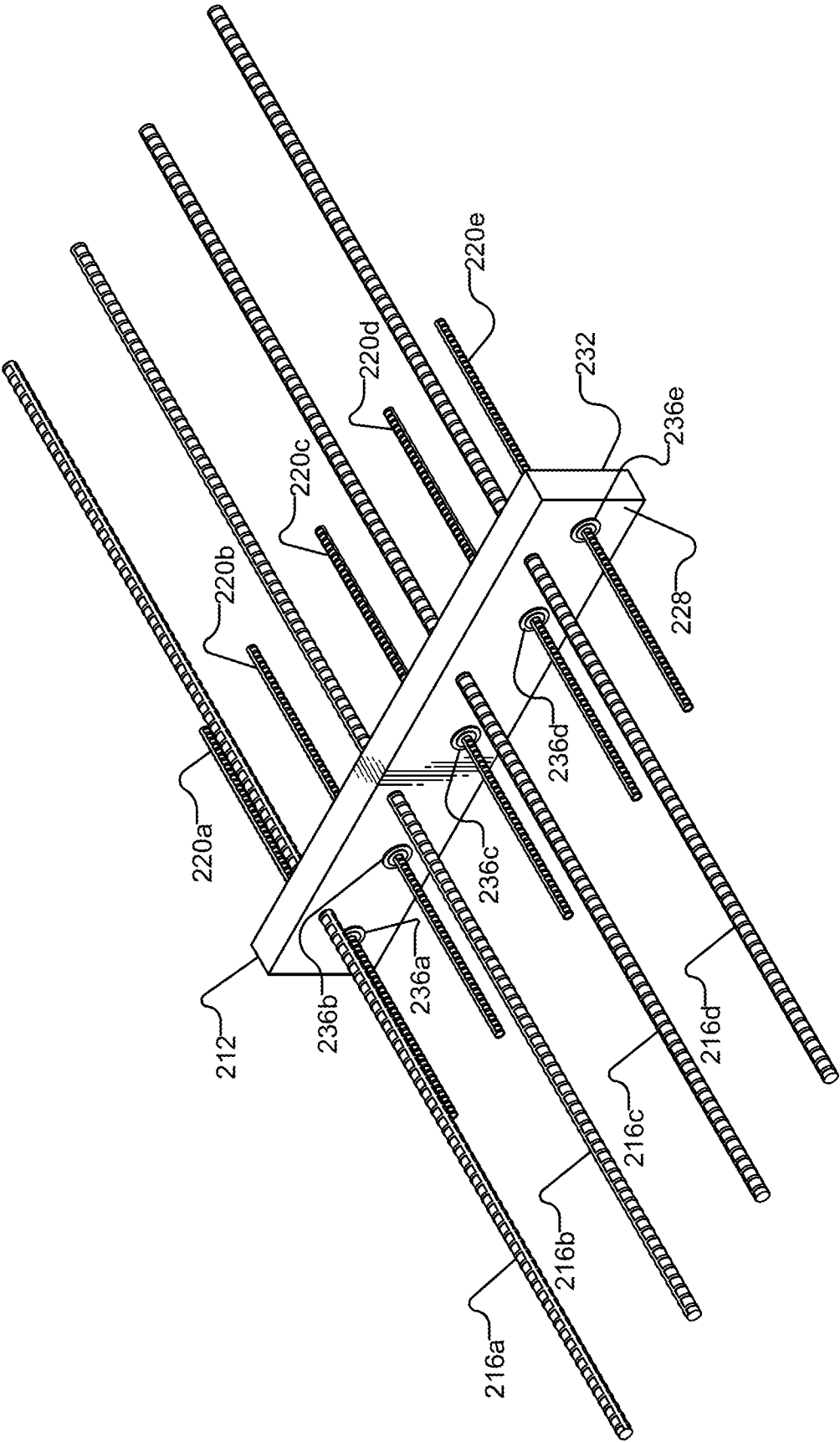


Fig. 6A

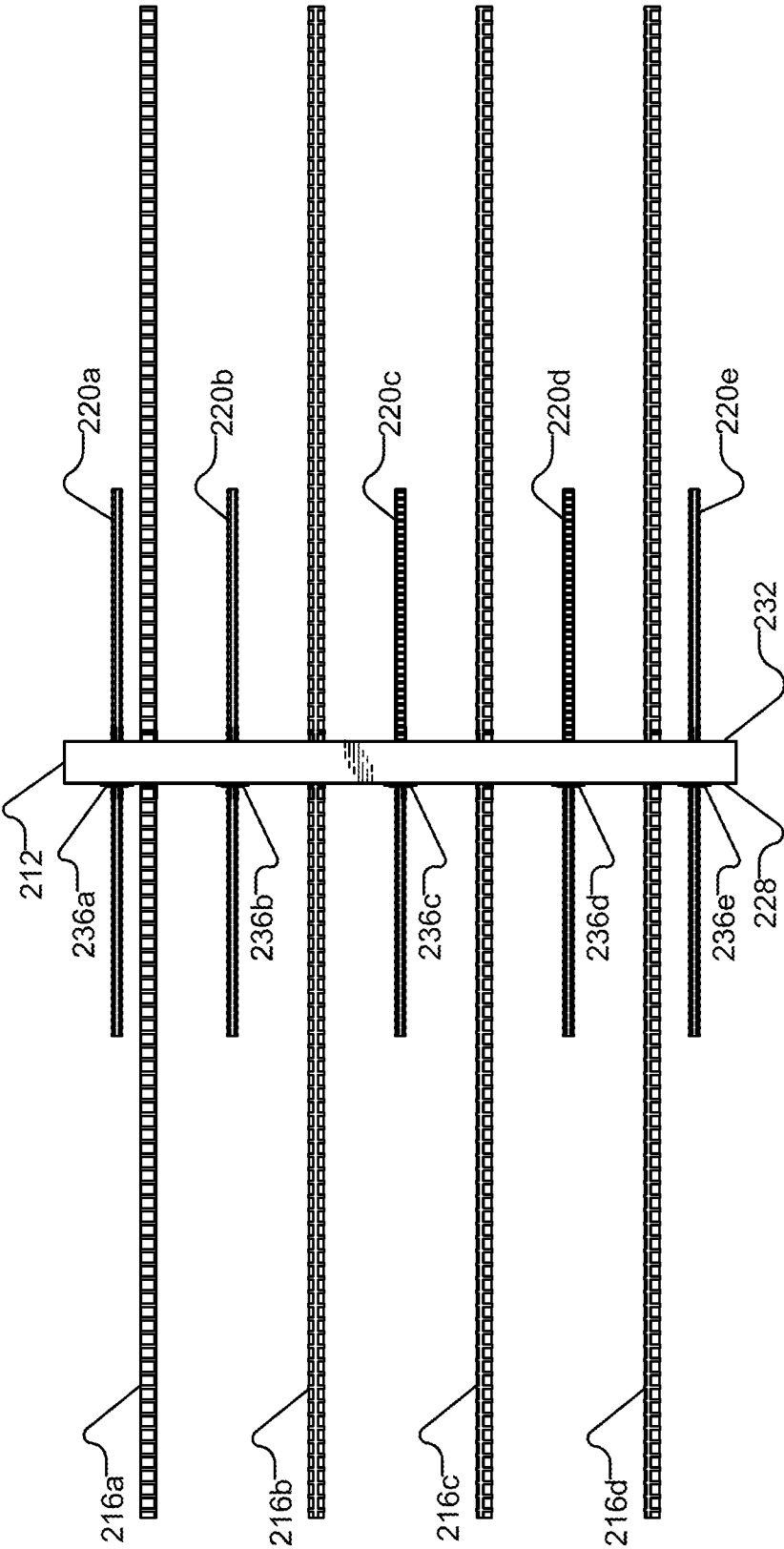


Fig. 6B

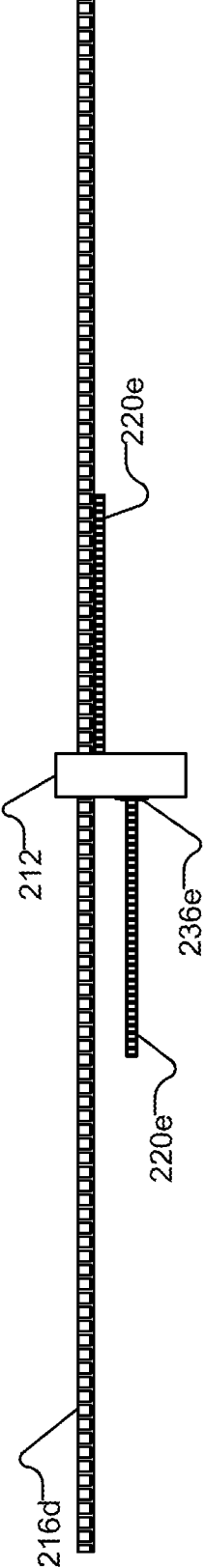


Fig. 6C

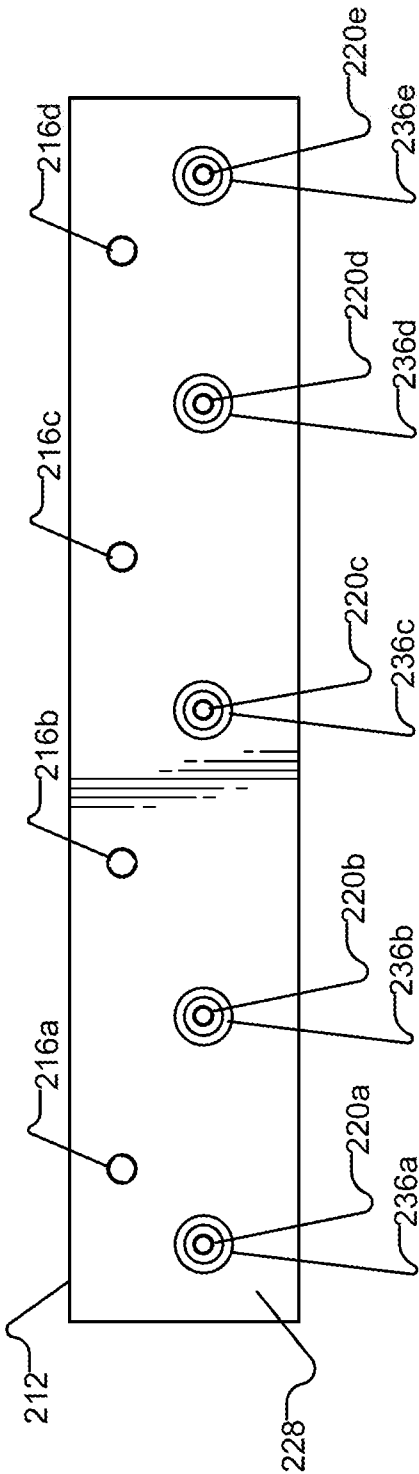


Fig. 6D

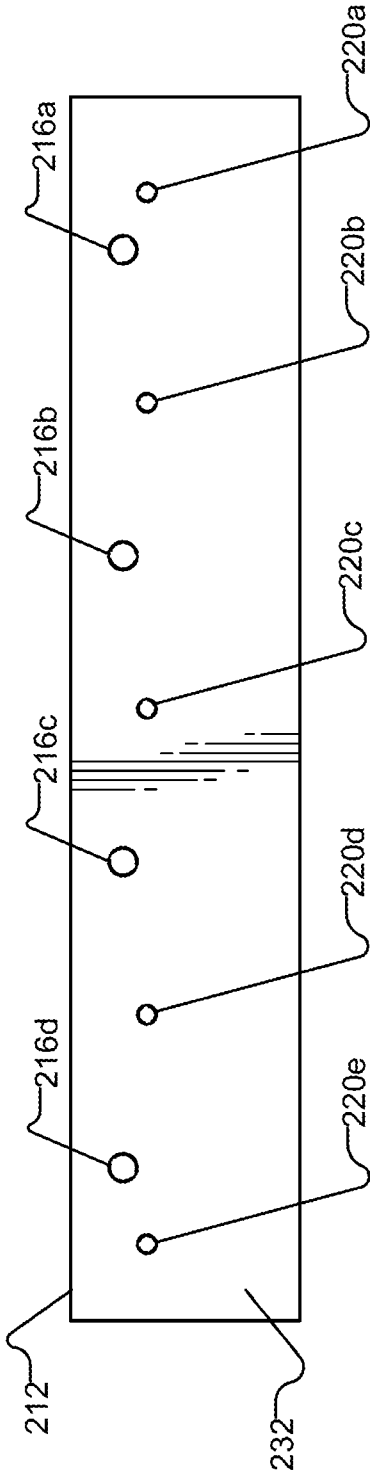


Fig. 6E

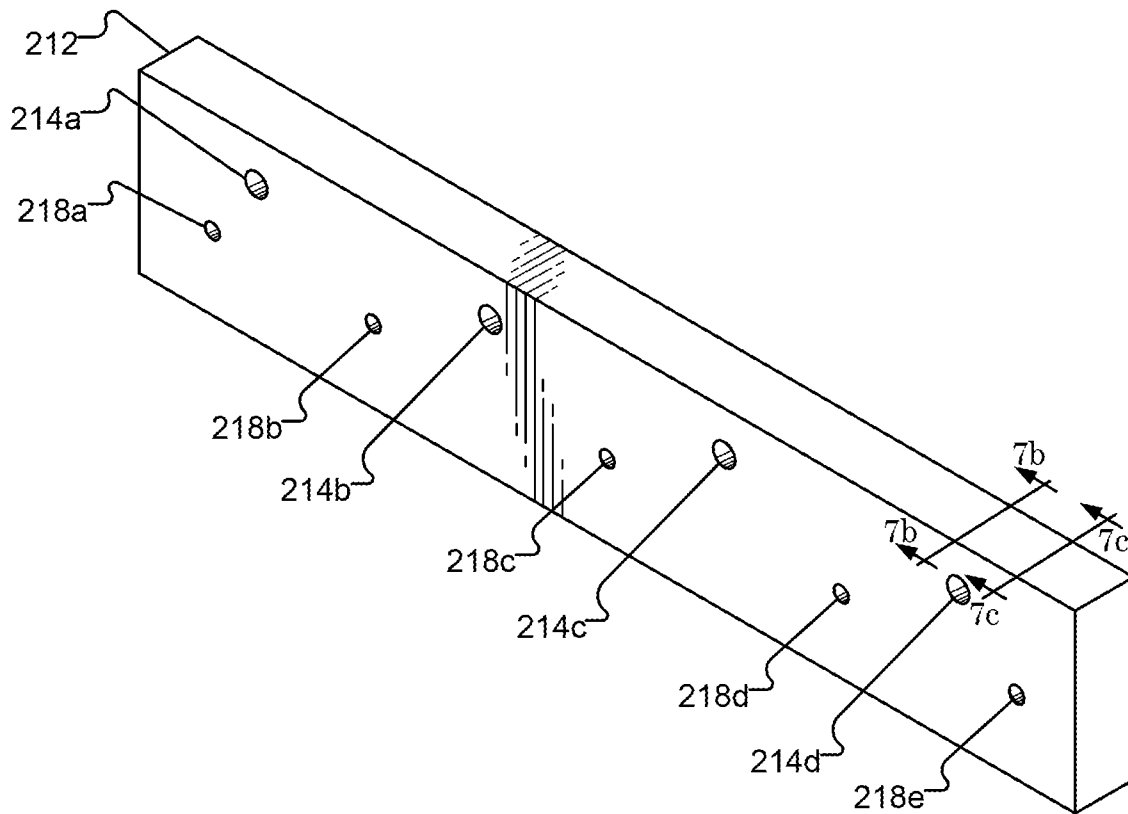


Fig. 7A

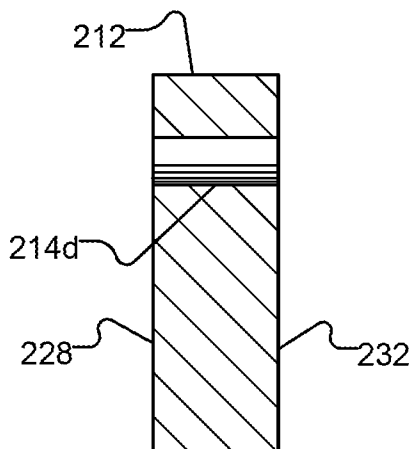


Fig. 7B

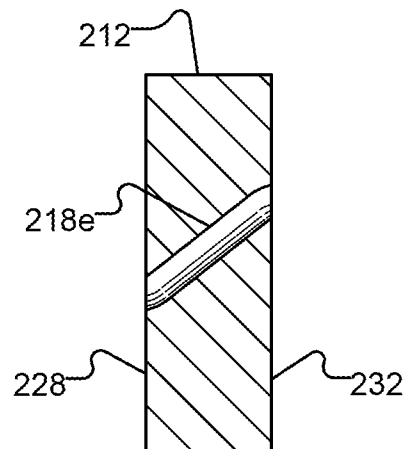


Fig. 7C

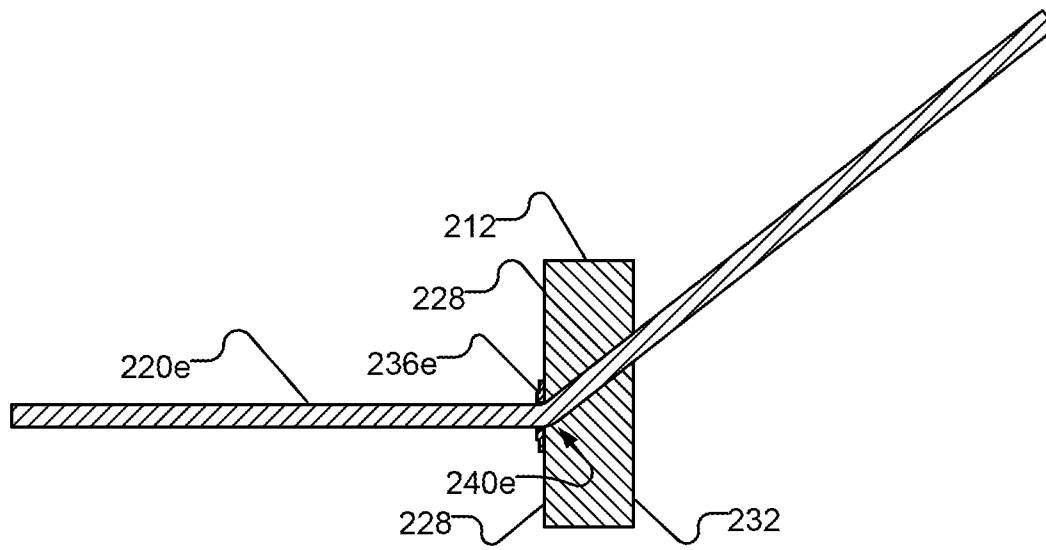


Fig. 8a

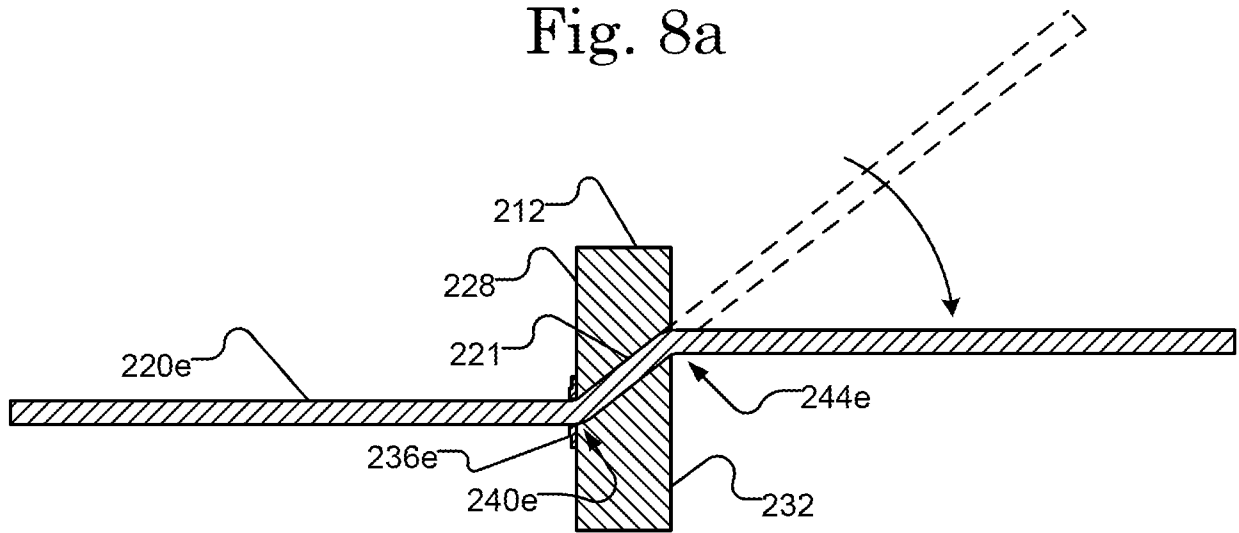


Fig. 8b

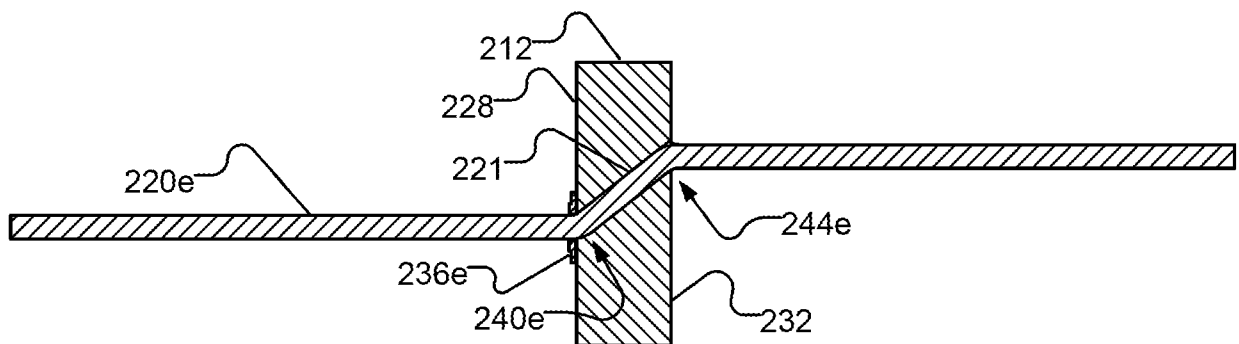


Fig. 8c

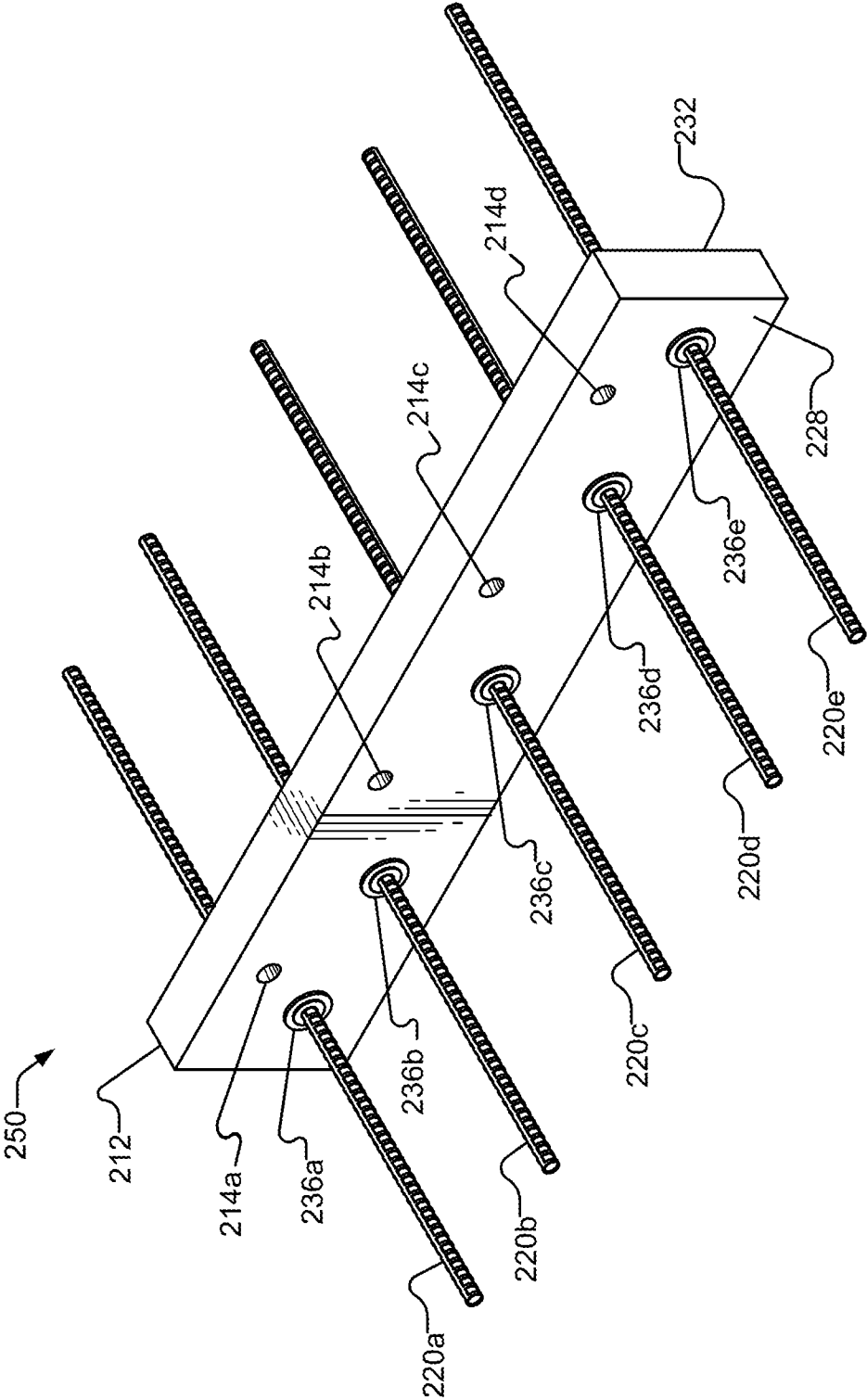


Fig. 9

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US19/13021

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☒ Claims Nos.: 13-15, 22-24, 31-33, 40-42
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying additional fees, this Authority did not invite payment of additional fees.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- ☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- ☐ No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US19/13021

A. CLASSIFICATION OF SUBJECT MATTER
 IPC - E04B 1/04, 1/14, 1/78, 5/32 (2019.01)
 CPC - E04B 1/0038, 1/04, 1/14, 1/78, 5/32

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

See Search History document

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

See Search History document

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

See Search History document

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X --- Y	DE 197 11 187 A1 (SCHOECK BAUTEILE GMBH) 24 September 1998; see machine translation	7 --- 1-4, 8-12, 25-30
Y	CN 106917456 A (HUYU FIBREGLASS REINFORCEMENT PRODUCTS NANTONG CO. LTD.) 04 July 2017; see machine translation	1-4, 12, 30, 39
Y	US 5,799,457 A (SCHUMACHER A et al.) 1 September 1998; figures 3, 4; column 5, lines 35-45	8-11, 12/8-12/11, 26-29, 30/26-30/29
Y	DE 10 2011 109 959 A1 (SCHOECK BAUTEILE GMBH) 14 February 2013; see machine translation	4, 25-29, 30
Y	"Installation Guidelines" by SCHOCK ISOKORB, March 2012 [retrieved 2019-03-14] Retrieved from the internet <URL: https://www.schock-na.com/view/4821/Schoeck_Isokorb_Installation_Manual_Canada_%5B4821%5D.pdf >	34-39
Y	US 5,673,525 A (KEITH DO et al.) 7 October 1997; column 11, lines 25-40	34-39
A	US 5,771,649 A (ZWEIG PJ) 30 June 1998; entire document	1-12, 16-21, 25-30, 34-39

☐ Further documents are listed in the continuation of Box C.☐ See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

14 March 2019 (14.03.2019)

Date of mailing of the international search report

26 MAR 2019

Name and mailing address of the ISA/

Mail Stop PCT, Attn: ISA/US, Commissioner for Patents
 P.O. Box 1450, Alexandria, Virginia 22313-1450
 Facsimile No. 571-273-8300

Authorized officer

Shane Thomas

PCT Helpdesk: 571-272-4300
 PCT OSP: 571-272-7774