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(54) Title: LIGHTWEIGHT CRANE-SET FORMING PANEL

(57) Abstract: A forming panel is provided which is particularly useful as a large, crane-set forming panel for forming concrete walls. The forming panel includes a face plate and a frame, the frame including channels having a slot extending longitudinally therealong. The slot is adapted to receive a filler insert having a bushing which includes a flexible barrier having a brush-like element with a plurality of filaments extending into a passage configured to receive either a tie bar or a tie rod. The forming panel preferably includes a shiftably mounted bracket for supporting a waler, scaffold or strongback thereon, wherein the bracket includes an arm which may be pivoted to a position substantially parallel to the frame and its mounting plate for transport and/or storage. The face plate may be provided as a multilayered composite panel and the frame may include rails having grooves on the side opposite the face plate which receive flexible barriers for inhibiting the passage of fine particles of concrete therepast.



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LIGHTWEIGHT CRANE-SET FORMING PANEL

This application claims the benefit of U.S. Provisional Application No. 60/885,587, filed January 18, 2007.

Background of the Invention

1. Field of the Invention

The present invention concerns a lightweight metal forming panel used in the construction of concrete or other cementitious walls. More particularly, the present invention concerns a forming panel which is constructed with dimensions typical of a crane-set forming panel but lighter in weight, may include a composite face plate and a frame including a resilient barrier, and may feature a reinforcing spine adapted to receive a shiftable bracket which permits sealing against internally placed form connecting elements such as ties bars or tie rods of different configurations and includes a retractable support bracket.

2. Description of the Prior Art

Forming panels are well known in the construction industry as providing a system for retaining flowable cementitious material such as concrete in a desired shape during pouring and curing. Forming panels of metal represent a significant advance over panels of wood because of their durability which permits their removal and reuse on successive construction projects. One typical use of such forming panels is the formation of upright walls including foundation walls, above-grade walls, parapet walls and the like.

Such metal forms are typically modular in character such that a number of panels are coupled together to providing a forming system. Such forming systems are generally shown and described in U.S. Patents No. 4,708,315, 4,744,541, 4,958,800, 4,976,401, 4,978,099, 5,058,855, 5,080,321, 5,174,909, 5,184,439, 5,288,051, 5,965,053, 6,935,607 and 7,144,530, the entire disclosures of which are incorporated herein by reference. Prior forming systems and their panels included openings or channels which permitted attachment of accessories, such as shown in U.S. Patent Nos. 5,965,053, 6,935,607 and 7,144,530. However, the channels of the 5,965,053 patent required the use of complementary nuts and bolts, clamps or pins with retainers to enable attachment of hardware and accessories such as connecting elements, e.g. tie bars and tie rods, braces, stiffbacks, scaffold boards, supports and other forming accessories. Such loose parts are problematic at a construction site, being broken, misplaced or lost as the forming walls are disassembled or moved. Moreover, the location for receipt of these attachment members were limited and by necessity often were between reinforced areas of the forming panels and thus placed stress on portions

of the panels in locations least configured to accept such stresses and strains. The forming panel shown in U.S. Patent No. 6,935,607 and 7,144,530 represents a significant advancement. However, the use of the "O" ring as a sealing member requires relatively frequent replacement and provides limited tolerances to differences in the diameters of the tie rod against which it seals. Furthermore, the use of the "O" ring as a sealing member presents inherent limitations as to the dimensions or configuration of the tie rod, and typically not configured for sealing around conventional tie bars to inhibit the passage of concrete therepast. While improvements in inhibiting leakage around a form and to an extent through openings in the form are shown in U.S. Patent No. 6,655,650, the improvements in such sealing have been limited to use on the forming panel itself, and limited in the ability to provide a barrier to concrete intrusion when an opening is later made through the face plate of the forming panel inboard of the side rail or other parts of the frame.

Particularly in connection with large forming panels which are set by cranes, there has developed a need for a panel which is easier for the workmen to handle during setting both in regard to weight and depth of the forming panel. There is also a need for a forming panel which minimizes the use of separate attachments. There is a further need for a forming panel which is of sufficient height and width to replace two or more conventional hand-set forming panels which are typically about 3 feet or 4 feet wide, 8 feet or 10 feet high, and have a depth of about 4 inches, but which is configured to readily align with these hand-set panels so as to be more readily compatible therewith.

Summary of the Invention

These and other objects have largely been addressed by the lightweight crane-set forming panel of the present invention. That is to say, the forming panel of the present invention presents significant improvements over prior art in regard to providing a lightweight panel of a size typical of crane-set forming panels, but presents improved capabilities for inhibiting the passage of fine particles of concrete around the frame or through openings in a face plate of the forming panel, and facilitates its use with other conventional panels by the provision of a folding bracket for holding a waler or other structural support. Moreover, while it is common to mount tie bars to the side rails of a forming panel, the present invention provides a forming panel capable of reuse and which permits the insertion of a tie rod or tie bar through an opening such as a hole or slot positioned internally of the side rails of the frame.

The forming panel of the present invention broadly includes a face plate and a generally rearwardly extending frame which includes rails extending along the edge of the face plate. One or a plurality of strengthening members, such as channels and commonly known in the trade as "hats", extend along the rear side of the face plate to provide support and rigidity. In a preferred embodiment of the invention, the face plate may be provided as a composite sheet of several layers of material received in a groove in the frame, the frame including a flexible barrier on the outside edge of the frame to inhibit the passage of fine particles of concrete therepast. In one aspect of the present invention hereof, a filler insert is configured for receipt into a slot defined by the channel and includes a bushing. The bushing is preferably provided with a flexible, brush type barrier which may be of either a round or O-shaped configuration, or present a rectangular, slot-type opening configuration. Most preferably, alternative configurations of the bushing in the filler insert permit replacement of the filler insert and substitution of a bushing of a different configuration. The filler insert may be selectively placed along the slot of the channel where a hole or slot is located in the face plate of the forming panel. In especially preferred embodiments, a progressive sealing element is provided in the bushing of the filler insert, such that depending on the size of the rod or bar to be sealed, one or more seals of the progressive seal are engaged by the bar or rod. In some preferred embodiments, threaded slots are provided in the frame, and the filler insert may be mounted by bolts to the threaded slots, and/or a threaded ring may be placed around the bushing and used for holding the filler insert in position.

Another aspect of the invention includes a support bracket which is shiftably mounted to frame. The shiftable support bracket is preferably pivotally mounted to the frame, whereby it may be pivoted to a position which extends rearwardly from the face plate and frame to receive a structural or alignment member such as a scaffold, waler or strongback, and then pivoted to a position extending in a plane substantially parallel to the face plate for storage and transport. The shiftable support bracket is advantageously slidably mounted along one or a plurality of slots through the use of bolts or studs received in the slot. Moreover, the shiftable support bracket is removably mounted whereby it may be removed and repositioned to provide for holding either a vertical or horizontally positioned support member. Two or more sets of such brackets of different capacities may be provided, such as to enable contemporaneous, overlapping use of a scaffold, a waler (horizontal orientation of the bracing member) and a strongback (vertical orientation of the bracing member) on the rear side of the forming panel.

The channel, preferably though not necessarily unitary in construction and extending either fully or partially between the rails of the frame, and a central slot extending therealong is preferably threaded. As used herein in connection with the slot in the channel, the term “threaded” refers to the presence of opposed ridges or flights on the opposing, inward-facing sides of the wall surfaces of the channel forming the slot to permit a threaded member such as a bolt, stud, tie-rod or other externally threaded member to advance into and be withdrawn from the slot when rotated. Because the slot is open at the ends, an encircling opening with internal threads as typically understood by the term “threaded” is not provided, but the ridges on the channel nonetheless permit threadable attachment of such threaded members. Preferably, the channel includes at least a pair of wall surfaces each having a plurality of ribs which cooperatively define a threaded surface in the slot. The channel is preferably formed by extrusion whereby the threaded slot extends longitudinally along the channel permitting the positioning of a complementary threaded member, such as a bolt, receiver or plug, to be capable of infinite adjustment along the threaded portion of the channel. The threaded slot further preferably extends substantially the entire length of the channel. Multiple channels may be included in the frame in parallel or transverse orientations. For example, a first set of one or a plurality of channels may be oriented in an upright position when the panel is positioned for use, and another set of channels may be positioned in horizontal relationship. The channels not only serve to provide a grid for multiple attachment locations for accessories to the panel, but also help to reinforce the face panel against deflection. Both the face panel and the frame may be provided of aluminum alloy or other suitable metal which is durable and capable of outdoor use. The face plate may also be provided as a composite panel of layers of material such as synthetic resin and metal sheets. The channel may also have external serrations to facilitate gripping of the channel by clamps or other accessories. Beneficially, the preferred embodiment of the invention further includes slot rails accessible from the rear of the form which may be positioned laterally from but extend parallel to the channel. The slot rails may advantageously be sized so as to capture and hold a nut or bolt head against turning, thereby greatly facilitating attachment and then tightening to the rear side of the form of form hardware such as the shiftable support bracket described above.

The threaded slot provided by the channel may be used to anchor various types of accessories to the panel. For example, the face plate may be provided with a hole thereon to permit a threaded tie rod to pass through a hole in the face plate and into the slot. A receiver may then be threaded into the threaded slot for engaging and supporting the tie rod and inhibiting the passage of water or concrete through the hole

and past the tie rod which may result in a rough and uneven concrete finish around the tie rod. The channel may also permit a large attachment nut to bear against the back side of the channel and thread onto the threaded end of the tie rod. Bolts or similar threaded fasteners may be readily threaded directly into the channel to attach braces, stiffbacks, or the like. In addition, a bolt may be threaded into the threaded slot and extend past the channel and through an opening in the face plate for anchoring into the concrete either before or after curing. Such a usage may be desirable for providing an anchor in the cured concrete whereby a plurality of sequential concrete pours may be employed to construct a multistory wall of sequentially poured wall sections by removing a panel from a completed wall and reinstalling the panel atop a cap or the like for providing a second, third or further walls after the poured concrete or other cementitious material of the lower wall has cured to hardness. The bolt and cap may then be withdrawn and reused for each successive wall section to be poured, and the hole in the forming panel filled by a stopper, caulk, or other sealing means.

The forming panel hereof is useful as part of a forming system wherein a plurality of such panels may be connected by fasteners to provide a forming wall which faces another, opposite one of the forming walls to receive poured cementitious material such as concrete therebetween. The threaded slots in the channels and the non-threaded slot rails of the channels greatly facilitate the attachment and securement of tie rods at multiple locations internal to the surrounding edges of the form and the mounting of hardware and accessories such as an expandable wall brace, a horizontal waler, a scaffold bracket, a lifting bracket with a clevis, and a gang leveler without the need for small nuts which must be positioned in narrow channel slots. Rather, the bolts for coupling such members to the panel may be secured directly to the panel and threaded into the channels while retaining the capability of infinite adjustment along the threaded portion of the panel. Moreover, the forming panel of the present invention may be provided of a reduced rearward depth from the face plate as compared to other crane set forms. This permits the forming panel of the present invention to favorably align along the rear side of the frame, so that the forming panel is complementary in depth and location of holes in the rails to smaller, typically man-set forms. Thus, while retaining the strength required of large, crane-set forms, the forming panel of the present invention can be placed side-by-side with smaller man-set forms and readily coupled thereto using pins and wedges or other fastening members such as the PINLOCK fastener of Western Forms as shown in U.S. Patent No. 5,058,855, the entire disclosure of which is incorporated by reference. In addition, a waler or scaffold placed in

spanning relationship across the crane-set form of the present invention may not only provide alignment of the forming panel hereof, but also smaller man-set forms.

These and other advantages will be readily apparent to those skilled in the art with reference to the drawings and description which follow.

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Brief Description of the Drawings

Figure 1 is a left rear perspective view of the forming panel in accordance with the present invention wherein the frame of the forming panel includes channels having threaded slots and unthreaded slot rails parallel thereto open to the rear of the panel extending in both upright and transverse orientations, and showing waler brackets gripping a waler and a strongback in overlapping relationship;

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Fig. 2 is a rear elevational view of the forming panel shown in Fig. 1 showing the grid-like positioning of the channels and the positioning of the waler brackets and slidable filler brackets on the channels;

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Fig. 3 is an enlarged top plan view of the forming panel shown in Fig. 2 to illustrate the positioning of the shiftable support brackets;

Fig. 4 is an enlarged, fragmentary vertical cross-sectional view taken along line 4-4 of Fig. 2 to show the mounting of the shiftable support bracket to one of the channels of the forming panel;

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Fig. 5 is an enlarged, fragmentary, rear perspective view of a forming panel in accordance with the present invention showing the combination of two shiftable support brackets to hold a waler and a strongback in overlapping relationship;

Fig. 6 is an enlarged, fragmentary rear perspective view of a forming panel similar to Fig. 5, but showing the waler and strongback removed and the support arms of the shiftable support brackets pivoted to a storage or transport position;

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Fig. 7 is an enlarged front perspective view of a shiftable support bracket in accordance with the present invention with portions broken away for clarity to show a slot in a clamping member of the bracket;

Fig. 8 is an enlarged, rear perspective view of the shiftable support bracket of Fig. 7, showing the hinge for the pivotally mounted arm of the bracket;

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Fig. 9 is a top rear fragmentary perspective exploded view of a forming panel system including two opposed forming panels as shown in Fig. 1 opposed to one another and connected by a tie rod showing the use of filler inserts having a bushing, a nut, a plate, and externally threaded retaining rings for coupling the filler inserts and tie rod to the opposed forming panels;

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Fig. 10 is an enlarged fragmentary top view in partial cross-section of two opposed forming panels of the present invention shown in Fig. 9 showing a progressive seal provided in a filler member mounted to a primary channel of forming panels for sealing against a tapered tie rod;

Fig. 11 is an enlarged exploded perspective view of two opposed forming panels hereof with portions of the face panel and frame broken away for clarity to show an alternative filler member having a bushing with guide members with flat central surfaces for mounting a flat tie bar to the forming panel through a hole or slot in the face plate;

Fig. 12 is an enlarged exploded perspective view of two opposed forming panels in an opposite direction of Fig. 11, showing the bushing sealing against the face plate;

Fig. 13 is an enlarged exploded perspective view of the filler member of Figs. 11 and 12 and showing in greater detail the flexible barrier positioning to engage a tie bar received between the guide members;

Fig. 14 is an enlarged vertical cross-sectional view of the filler member with the guide members of Fig. 11 mounting a tie bar to one of the horizontal channels of the forming panel;

Fig. 15 is an enlarged horizontal cross-sectional view of the filler member with the guide members of Fig. 11 showing the orientation of the pin and the flexible barrier in engagement with the tie bar passing through the face plate of the forming panel;

Fig. 16 is a perspective view of an alternate forming panel similar to that shown in Fig. 1 and which includes attachment members for mounting locking coupler assemblies, alternate brackets configured particularly for mounting scaffold boards, and filler inserts for attachment by bolts and/or locking rings;

Fig. 17 is an enlarged perspective view of the alternate bracket for supporting a scaffold board, shown in an extended, scaffold-supporting position;

Fig. 18 is an enlarged perspective view of the alternate bracket for supporting a scaffold board, shown in a retracted, fold-down position;

Fig. 19 is an enlarged, perspective view of a filler insert for use with a tapered tie rod configured for attachment to the forming panel by bolts;

Fig. 20 is an enlarged, perspective view of a filler insert for use with a tapered tie rod configured for attachment to the forming panel by either bolts or a threaded annular retaining ring;

Fig. 21 is an enlarged, vertical cross-sectional view of a forming panel in accordance with the present invention having a composite face plate received in a groove in the rails of the frame, and showing flexible barriers in the rail proximate the face plate which engage a tie bar secured by a coupling pin and wedge; and

Fig. 22 is an enlarged, vertical cross-sectional view of the forming panel having the composite face plate as shown in Fig. 21, wherein the reinforcing channel is secured to the face plate by a rivet and adhesive bonding.

Description of the Preferred Embodiment

Referring now to the drawings, a forming panel 10 in accordance with the present invention broadly includes a face plate 12 and a frame 14 and includes at least one channel 16 having an elongated, internally threaded slot 18. The forming panel 10 is preferably of aluminum or an aluminum alloy. The frame 14 preferably includes upper rail 20, lower rail 22 and side rails 24 and 26. The face plate 12 is a generally planar sheet of aluminum or aluminum alloy welded to the frame 14. Alternatively, as shown in Figs. 21 and 22, a face plate 12A may be of a composite structure mounted to the frame 14 and mechanically held by groove or other fasteners such as adhesive bonding. Preferably, a plurality of channels 16 are provided, such that at least one of the channels 16 and two of the rails are oriented to be generally parallel to one another, with other channels 16 oriented generally normal to the at least one of the channels 16. The channels 16 are preferably formed by extruding in a unitary or integral member. Most preferably all of the channels 16 oriented in generally parallel alignment with respect to one another may be extruded with the face plate 12 and the two rails parallel thereto, with the other channels 16 oriented at an angle thereto extruded separately and attached to the face plate 12 and the rails by welding. For example as shown in Fig. 1, a plurality of primary upright channels 28, the side rails 24 and 26 and the face plate 12 can be extruded, with the horizontal channels 30 and secondary perimeter channels 31 extending vertically adjacent the upper rail 20 and lower rail 22 separately extruded and, along with the upper rail 20 and the lower rail 22, welded in separate operation to the extruded member including the face plate 12. Of course, it is to be understood that the orientation of the channel as generally horizontal, vertical or otherwise, depends on the placement of the forming panel at the jobsite and/or how the channel is initially incorporated in the frame 14, so that it may be understood that the channels 16 may be oriented to extend horizontally or diagonally as well as in a generally upright orientation. The orientation of the members described herein are with reference to the drawings only, it being understood that the forming panel 10 may be used in different orientations on the job site.

In greater detail, the face plate 12 of the forming panel 10 shown herein is preferably of a relatively thin extruded sheet of aluminum which may be cut or pierced to provide a hole 32 therein for the passage of members such as tie rods or tie bars which extend into the poured concrete 34 between opposing forming panels. The face plate 12 includes a front face 36 and a rear face 38, the front face being smooth or textured, as desired, to provide a surface against which the poured concrete cures in the desired configuration. The rails 18, 20, 22 and 24 extend rearwardly from the face plate 12 and are preferably welded together at their junctions forming corners of the forming panel 10 and a plurality of openings 40 are preferably provided in each in order to receive connectors such as pins 194 held by wedges and other couplers such as the locking assembly shown in U.S. Patent No. 5,058,855 known to those skilled in the art for coupling the forming panel 10 to adjacent panels or other forming hardware. Hangers 46 for tie rods and the like and attachment pins 48 useful for lifting and moving the forming panels 10 may be located at suitable locations on the rear side of forming panel 10 as shown in Figs. 1 and 2 to provide access thereto during use, and additional reinforcements may be fastened, extruded or welded to the frame or the face plate in addition to the channels 16 as shown in Fig. 1.

As shown in Figs. 1 and 2, the channels 16 may be positioned at convenient locations and open to the rear side of the forming panel 10. Preferably, the channels 16 do not extend rearwardly beyond the rear edge of the rails. The channels 16 each include at least a first wall 50 and a second wall 52 which extend rearwardly from the face panel 12 and longitudinally therealong, the walls 50 and 52 being generally parallel to one another to provide threaded slot 18 therebetween. The walls 50 and 52 have respective opposing wall surfaces 54 and 56 each having a plurality of longitudinally extending ribs 58 which are parallel to one another and transversely spaced, preferably equidistant from one another as shown in the drawing figures to define the pitch of the thread. The ribs 58 of one wall surface 54 are transversely positioned relative to the ribs 58 of the other wall surface 56 so as to permit threading of a threaded member 60 in the slot 18. For a typical threaded member, such as a bolt or the like, the ribs of the one wall surface 54 will be offset and alternate with the ribs 58 of the other wall surface 56 to accommodate the threads of the threaded member. The channels 16 may be upright channels 28 or horizontal channels 30, or placed in other orientations such as diagonally if desired. The provision of a plurality of upright channels 28 and horizontal channels 30 not only provides the user with a large number of opportunities to select for attachment of threaded members, but also provides

substantial reinforcement to the face panel 12 to resist deflection caused by the weight of the concrete thereagainst.

The threaded slot 18 is adapted to threadably receive different threaded members 60 and thereby couple with a variety of different forming accessories such as, for example, tie rods 62. In particularly preferred embodiments, the horizontal channels 30 and secondary perimeter channels 31 permit attachment of other components by having exterior slots 64 adapted to receive bolt heads for coupling strongbacks, beams or other members through the use of conventional bolts and nuts as illustrated in the embodiment shown in Fig. 4. Various uses of the forming panels 10 are illustrated in the drawing figures.

Figs. 9 and 10 illustrate an example of how a threaded tie rod 62 may pass through opposite forming panels 10 and held in place. A filler insert 66 is provided which includes a bushing 68, a U-shaped backing 70 and a pair of longitudinally spaced, U-shaped brackets 72 and 74. The U-shaped brackets 72 and 74 are welded or otherwise secured to the U-shaped backing so that the legs of the backing extend opposite to the legs of the brackets 72 and 74 and the bights of each are back to back, with the bushing 68 coupled to the backing 70 so that the bushing 68 resides in the space 76 between the brackets 72 and 74. The bushing 68 is preferably substantially tubular having a cylindrical outer surface and a passage 69 therethrough sized complementally to closely fit around a tie rod 62. The bushing includes a progressive seal which provides sealing against tie rods 62 of different tapers or diameters. The progressive seal is provided by providing two spaced circumferentially extending internal grooves in the bushing 68 into which O-rings 42 and 44 are inserted in a snap-fit relationship for sealing around the tie rod 62. Additionally, a flexible brush-like barrier 78 is inserted into a circumferentially extending groove 79 which projects forwardly toward the face plate 12. The flexible barrier 78 is arranged in a circular orientation and has brush tips which extend radially inwardly into the passage 69 a greater distance than the edges of the O-rings 42 and 44. The flexible brush-like barrier 78 has a backing which holds a multiplicity of hair-like brush filaments which are resilient and are oriented generally inwardly into the passage 69 and forwardly toward the face plate 12 so as to inhibit the escape of fine particles of concrete or other cementitious material through the hole 32. Thus, when larger diameter tie-rods are inserted into the passage, these larger diameter tie-rods may be sealed both by the O-rings 42 and 44 and also the flexible barrier 78, but when smaller diameter tie-rods are inserted into the passage, they are still engaged and sealed by the flexible barrier 78 even if the diameter is insufficient to contact the O-rings 42 and 44. The bushing 68

further includes an exterior groove which receives therein a sealing ring 80. When inserted into the threaded slot 18, the sealing ring 80 is positioned proximate the hole 32 in the face plate 12 to aid in sealing around the bushing 68 and inhibiting the migration of water or fine particles of cement past the hole 32 and rearwardly of the face plate 12. The threaded member 60 may be an externally threaded retaining ring 82 is provided having a threaded exterior 84 which is complementary in size and pitch to the threaded slot 18 and a substantially smooth interior surface 86 which is sized to receive the cylindrical outer surface of the bushing 68 therein. While the retaining ring 82 is coarsely threaded and may be tightened to some extent by hand, most preferably at least one end of the retaining ring 82 has a depression, recess, slot or groove therein to facilitate turning the ring 82 so that it may be threaded into the threaded slot 18. The tie rod 62, having one threaded end 92 and another threaded end 94, may be secured in place by a nut 96 threaded onto one of the ends 92 and 94 which when tightened engages one of the filler inserts 66 and a plate 98 threaded onto the other of the ends 92 and 94 which when tightened engages the channel 16.

The channels 16 may be extruded in various configurations and reinforced. Figs. 9 and 10 illustrate one of the primary upright channels 28 of the embodiment shown in Fig. 1, wherein the channel walls 50 and 52 are formed separately from one another. Each of the channel walls 50 and 52 have wall respective wall surfaces 54 and 56 with ribs which are oriented to project into the threaded slot 18. In addition, each of the walls 50 and 52 of the primary upright channels 28 include rear walls 100 having an rearwardly facing surface 102 which is flat for abutting against, for example, plate 98, while the inwardly facing surface 104 is extruded with reinforcing corrugations 106. The respective wall surfaces 54 and 56 extend forwardly toward the face plate 12 to a front wall portion 108 having a rearwardly extending projection 110. A reinforcing bar 112, such as a steel bar, may be inserted into an elongated interior slot 114 formed by one of the corrugations 106 and the projection 110 to reinforce the channel 28 and thus the face plate 12.

In the combination shown in Figs. 9 and 10, holes 32 are first cut or pierced into the face plates 12 in alignment with threaded slots 18 so that a tie rod 62 may pass through the holes as illustrated. The retaining ring 82 is then passed over the ends 92 and 94 of the tie rod 62 and threaded into the threaded slots 18 of each of the opposing forming panels 10. The filler insert 66 is then inserted into each of the threaded slots 18 as illustrated with the tie rod passing through the passage 69 of the bushing 68. As the tie rod 62 is inserted along the passage 69, it is engaged by the progressive seal of the O-rings 40 and 42 and the flexible barrier 78. The filler insert

66 is held in place in the slot of the primary channel 28 by the retaining ring 82 with the sealing ring 80 proximate to the hole 32. Plate 98 is then threaded onto one of the ends of the tie rod 62 until it abuts the rear wall 100 of one of the channels 16 and then nut 96 is threaded onto the other end of the tie rod 62 and tightened against the filler insert 66. The tie rod 62 thus passes through the gap 116 between the forming panels 10 into which concrete is to be poured, and widening of the gap 116 is resisted by the attachment of the tie rod 62 to the forming panels 10 as described.

The horizontal channel 30 of Fig. 4 is shown for example in Figs. 1, 2, 4 and 6, and the use of a different coupling hardware is enabled by its configuration, although it may also use the filler insert 66 and retaining ring 82 as described with reference to Figs. 1, 2 and 9, and wherein like numbers are used to refer to like elements. The channel 16 is in this instance the horizontal channel 30 or secondary perimeter channel 31 in the orientation of Figs. 1 and 2, and thus provided as commonly extruded or two separately extruded channel walls 50B and 52B each having respective wall surfaces 54B and 56B with ribs 58 as described above. Each of the rear walls 100B, rather than having a relatively flat exterior surface, is provided with an exterior slot 64 configured as a longitudinally extending bolt slot 118 including a narrowed neck 120 defined by flanges and a recess 121 positioned forwardly and enlarged relative to the neck 120 bordered by slot walls 122 and 124, such that the transverse dimension of the neck is less than the transverse dimension of the walls defining the recess adjacent thereto. The recess is sized to receive the head of a bolt, nut or the like therein when inserted in a gap in the neck, but the neck 120 is sized to prohibit the passage directly rearwardly in a perpendicular direction of a correctly sized bolt head or nut when attached to a shank therethrough. Preferably the bolt head would be rectangular or hexagonal so the sides of the bolt head engage the slot walls 122 and 124 defining the recess to inhibit turning of the bolt within the bolt slot 118.

The bolt slot 118 is particularly useful for supporting a shiftable waler bracket 126, shown in greater detail in Figs. 4-8. The shiftable waler bracket 126 includes a mounting panel 128 having a plurality of holes 130 for receiving therethrough fasteners such as bolts 132 which may threadably receive nuts 134 on the shanks thereof. The waler bracket 126 further includes a hinge 136 which may be configured with bearings 138 connected by welding or other fastening means to the mounting panel, and a pivot pin 140 having a spacer bearing 142 affixed thereto by welding or the like. The spacer bearing 142 are also affixed by welding or the like to a bracket arm 144. As may be seen in 5 and 6, the bracket arm 144 may be of different lengths, such that a bracket arm 144A may be provided which is longer than bracket

arm 144 for holding a wider support such as a scaffold, or for holding a waler 146 or a strongback 148 in overlapping relationship as shown in Figs. 1, 2 and 5. The bracket arms 144 and 144A extend through a portal 150 in the mounting panel 128 whereby the bracket arm may be extended substantially perpendicular to the mounting panel as shown in Fig. 5, or pivot to be substantially parallel to the mounting panel 128 as shown in Fig. 6. The bracket arms 144 and 144A each preferably include a pair of spaced apart, substantially parallel bracket supports 152 and 154. The bracket support 152 extends through the pocket 150 and includes a hook shaped lip 156 which is affixed to the spacer bearing. The bracket support 154 is sized to be slightly shorter in length than bracket support 152 and the portal 150 is sized such that the bracket arm 154 has a rear margin 158 which abuts the mounting panel 128 when fully pivoted to a perpendicular position as shown in Fig. 7, and thereby acts as a stop against further pivoting. The spaced bracket supports 152 and 154 have pins 160, 162 and 164 extending therebetween in order to support and position clamping arm 166 which slides between the bracket supports 152 and 154. The clamping arm 166 includes a forward inclined edge 168 and a slot 170 which defines an upright shifting axis B which is inclined relative to the pivot axis A of the pivot pin 140 and also to the mounting panel 128, the slot extending and is oriented parallel to the edge 168. Thus, the clamping arm 166 is configured with the pins 160, 162 and 164 to have a rear edge 172 angled relative to the forward inclined edge 168 and slot 170, the rear edge thus moving closer to the mounting panel 128 and the frame of the forming panel 10 as it slides downwardly along the pins. This configuration provides a self-locking feature which helps to securely hold a waler, strongback, scaffold or other support against the frame of the forming panel unless a positive upward force is applied against a bottom edge 176. A hole 178 is provided at the outboard edge of the bracket arms 146 and 146A to permit an adjustable wall brace or other form hardware to be conveniently mounted by a pin or other fastener to the support bracket when mounted on the frame of the forming panel 10. By loosening the bolts and nuts 132 and 134, the shiftable waler bracket 126 may be shifted along the bolt slot for selective positioning along the rear side of the forming panel 10.

The filler insert 66 may be provided as a modified filler insert 66A as shown in Figs. 11 through 15 for receiving a flat tie bar 180 instead of the tie rod as shown in Figs. 9 and 10. Using like numbers as applicable, the filler insert 66A includes a bushing 68A having a pair of opposed, spaced apart semi-cylindrical guides 182 and 184 connected by a mount 186 extending rearwardly from the U-shaped brackets 72 and 74. The guides 182 and 184 each have preferably flat central surfaces

188 defining a passage 69A for receiving a tie bar 180, and an arcuate outer surface 189 including grooves 190 which presents an arc of preferably less than 180° to permit the retaining ring 82 to be received thereon. The arcuate outer surfaces include the grooves 190 for receiving a sealing ring 80 thereon for positioning proximate the face plate 12 of the forming panel 10 where a hole or slot through the face plate is located. The flat central surfaces 188 define a central axis along which the tie bar 180 is inserted. The guides 182 and 184 include a pin-receiving hole 192 transverse and preferably perpendicular to the central axis and the plane along which the tie bar 180 is received, whereby a pin 194 may be inserted through a hole 196 in the tie bar 180 for securing it in position relative to the forming panel 10. As may be seen in Figs. 11 through 15, a flexible barrier 198 is provided and received in a groove 200 in the central surfaces 188 to be oriented toward the longitudinal axis and thus the tie bar 180 received therealong, and to extend forwardly toward the face plate 12. The flexible barriers 198 are preferably a brush like member with flexible filaments which resiliently yields to permit passage of the tie bar 180 but seals thereagainst. The pin 194 resists movement of the tie bar 180 away from the face plate of the forming panel 10 by its engagement with the U-shaped brackets 72 and 74.

Figs. 16, 17, 18, 19 and 20 show a forming panel 10A substantially similar to the forming panel 10 of Figs. 1 and 2, with like numbers showing like features. In the forming panel 10A, mounts 210 are positioned on the back side of the face plate 12A and positioned proximate holes in the rails of the frame in order that locking assemblies such as those shown in U.S. Patent No. 5,058,855 may be mounted thereto for coupling adjacent forming panels. In addition, the forming panel 10A as shown in Figs. 16 through 22 is shown as also having brackets 212, filler insert 66B, and filler insert 66C mounted thereto. In other respects, the forming panel 10A includes the frame 14 and channels 16 as described with respect to forming panel 10 above.

The bracket 212 is shown in greater detail in Figs. 16 and 17. The bracket, like brackets 126 and 126A, is designed to fold or retract when not in use to thereby minimize the likelihood of damage during transport and reduce the required space during storage, but remain with the forming panel to also reduce the need for separate storage and consequent inconvenience or possibility of loss. The bracket 212 includes a mounting panel 214 which is provided with a plurality of holes through which the shank of bolts 132 may pass, the head of the bolt being retained in the bolt slot 118. The mounting panel may be secured by affixing and tightening a nut 134 to the shank of the bolt 132, or the nut may be loosened to permit the mounting panel to slide along the channels 16 as the bolt moves along the bolt slot 118. The mounting

panel 214 has two parallel, spaced-apart upright bars 216 and 218 extending away from the mounting panel 214, each having a plurality of holes 220 positioned in substantially horizontal registry with those of the other bar, therethrough. A U-shaped bracket arm 222 is pivotally mounted by hinge pin 224 at the proximate end 226 of the bracket arm for enabling movement between a substantially horizontal extended position as shown in Fig. 17, and a retracted position wherein the bracket arm is stowed and thus located between the upright bars 216 and 218 as shown in Fig. 18. Thus, the bracket arm 222 is narrower in width than the space between the upright bars 216 and 218. The bracket arm 222 has flanges 230 and 232 which are also separated by a space therebetween, and is shown with a series of holes along its upper side to facilitate receipt of nails for securing a scaffold board thereto. In addition, at least one mounting hole 233 is provided in each of the flanges 230 and 232, the holes 233 in each of the flanges being in substantially horizontal registry. An elongated support arm 234 is provided proximate the remote end 236 of the bracket arm 222 and preferably pivotally coupled thereto by a hinge pin 238. The support arm 234 may be a solid member or, as shown in Figs. 17 and 18, a U-shaped member having at least one and preferably a plurality of holes 236 through each of the spaced apart beams 238 and 240 such that the holes 236 in each beam are opposed and substantially horizontally aligned with one another. The width of the support arm 234 is less than the space between the flanges 230 and 232 of the bracket arm 222. To maintain the bracket arm in an extended position shown in Fig. 17, a support pin 242 is inserted through the holes 220 and 236 and held by a clip 244, cotter pin or similar retaining member. In order to retract or stow the bracket 212 in the position shown in Fig. 18, the support pin 242 is removed, the support arm 234 is permitted to pivot downwardly from the remote end of the bracket arm 222, and the bracket arm swings downwardly for receipt between the upright bars 216 and 218. Support pin 242 may then be reinserted through the holes 233 in the bracket arm 222 so that the bracket arm 222 is held between the bars 216 and 218 and secured in a substantially vertically aligned position along the channels 16 of the forming panel 10 or 10A.

The filler insert 66B is shown in greater detail in Fig. 19 and the filler insert 66C is shown in greater detail in Fig. 20. The filler insert 66B is similar to filler insert 66 in having a bushing 68, and a U-shaped backing 70. The bushing 68 is tubular and has a cylindrical passage 69 therethrough sized for fitting around a tie rod 62, and includes internal grooves which receive O-rings and a flexible brush-like barrier as in filler insert 66. However, the U-shaped backing is secured, by welding, mechanical fasteners, adhesive bonding or similar fastening means, to a mounting plate

250. The mounting plate is sized to extend across a channel and includes holes 252 sized and arranged for alignment with the bolt slots 118 using bolts 132 and nuts 134 as shown in Fig. 16.

The filler insert 66C is in similarly constructed to filler insert 66B, except that the U-shaped backing 70C includes gaps 260 which are located adjacent to bushing 68. A retaining ring 262 may then be inserted into the channel 28 and turned a 1/4 turn whereby the threads 264 on the outside of the ring engage the ribs of the threaded slot 18. To facilitate insertion and engagement, the retaining ring 262 has circumferentially spaced, opposite external unthreaded or flat surfaces 266 and 268, and semicircular recesses 270 to facilitate insertion of a tool for dislodgement of the retaining ring 262 from the channel 28 when desired. The retaining ring 262 may also have an internal, circumscribing groove to receive an O-ring therein for sealing around the bushing 68. In use, the retaining ring 262 is inserted into the channel 28, turned a 1/4 turn, then the filler insert 66C is positioned with the bushing 68 inserted into the retaining ring 262. The tapered tie rod is then passed through the bushing 68 as described above and secured with a nut 270 or plate 98 as described above. The filler insert 66C is also provided with 4 holes 252 in the mounting plate 272 and may be held in place using nuts 134 and bolts 132 as described above. The provision of the mounting plate 272 provides a broad surface so that a tie rod nut 270 may be used instead of a threaded plate 98, the same being true with respect to the mounting plate 250 of filler insert 66B.

As seen in greater detail in Figs. 21 and 22, the face plate 10A is provided as a multilayered composite panel 280 of synthetic resin and aluminum. One preferred, the face plate 10A extruded or otherwise formed having a synthetic resin, such as a foamed polypropylene, core 310 sandwiched between metal sheets, such as, for example, first aluminum sheet 312 and second aluminum sheet 314, and most preferably having synthetic resin surface coating layers 316 and 318 on the outside of the sheets 312 and 314. Such panels 280 are available in various thickness and dimensions, and one source for such panels 280 is Alkus AL sheets in millimeter denominated thicknesses (e.g., Alkus AL 23 corresponding to a composite panel of 23 mm thickness) from Alkus AG of Schaan, Liechtenstein. The upper rail 20A, lower rail 22A, and side rails 24A and 26A are each provided with a first groove 282 located on the panel-facing interior side 284 as shown in greater detail in Fig. 21. The first groove 282 preferably extends the longitudinal length of the corresponding rail and has a transverse dimension corresponding to the thickness of the panel 280. The first groove 282 is recessed rearwardly of a front edge 286 (i.e., the edge against which concrete is

received) of the corresponding rail in which it is located, whereby a flange 288 extends over the outer edge 290 of the panel 280 to both retain and protect the edge. The panel 280 may be further held in the first groove 282 by adhesive or mechanical fasteners. The upper rail 20A, lower rail 22A, and side rails 24A are also preferably provided with an outer side 292 which is oriented away from the panel 280 and in use typically engages adjacent forming panels and/or tie bars 180 depending on whether such tie bars are used in a forming panel assembly and where they are located. A second groove 294 is provided in the outer side 292 to extend along substantially the entire longitudinal length of the corresponding rail, and is located proximate to the front edge 286 and proximate but opposite the first groove 282, and offset sufficiently relatively rearwardly to avoid weakening the flange 288, as shown in Fig. 21. The second groove 294 is preferably oriented at an angle relative to outer side 292 so as to extend outwardly and slightly forwardly as illustrated in Fig. 21 and thereby receive and orient a flexible barrier 298 which is preferably a flexible barrier having a multiplicity of hair-like brush filaments substantially as described with respect to flexible barrier 78 hereinabove. The placement of the flexible barrier 298 proximate to the composite panel 280 and first groove 282 is unique and provides significant advantages in both the finish and durability of the forming panel 10A.

As shown in Fig. 22, the composite panel 280 is also reinforced by the channels 16. Primary upright channel 28 is shown attached to the composite panel 280 by both adhesive 300 and rivet 302, although in many applications either will be sufficient, especially where the flexible barrier 296 is used to thereby minimize cleaning of the back or non-concrete-receiving side of the composite panel 280. Most preferably, rivet 302 has a countersunk head 304 and is inserted through a passage 306 in both the composite panel 280 and the channel which is countersunk in at least the panel 280 corresponding to the size of the head 302, to thereby enhance the finish of the concrete poured thereagainst.

In use, the forming panel 10 or 10A hereof is a large form typically about 9 feet or more in width and 8 feet or more height, and thus is typically set in position by a crane. Typically, crane-set aluminum forming panels weigh about 7 lbs. or more per square foot measured by the area of the concrete-receiving face. However, the construction of the forming panel 10 or 10A hereof dramatically reduces the weight, such that the weight of the forming panel 10 or 10A hereof is desirably less than about 6.5 pounds per square foot. Thus, the forming panel may be more easily manipulated by the contractor to position the form alongside other forms both similarly sized and of

smaller sizes for coupling together as opposed forming walls as is well known to those in the art.

Once positioned and attached by pins or other fasteners to adjacent forming panels, it may be desirable to provide support for maintaining alignment of the forming panels 10 or 10A set side by side. In this regard, the shiftable waler bracket 126 is particularly useful. Once its bolts are received in the slot rail 118, the waler bracket may be shifted along the horizontal channels 30 until selectively positioned, and then the bolts or nuts are tightened to hold the waler bracket 126 in place. The bracket arm 144 may then be pivoted from the position shown in Fig. 6 for transport and storage, to the position shown in Fig. 5. A waler 146 is then positioned on the bracket arm 144 and pushed downwardly toward the bracket arm whereby it is held fast against the rear of the frame 14 by the clamping arm 166. It is to be understood that a plurality of waler brackets 126 should be used to safely and securely hold a waler in place. Moreover, the waler 146, which is typically a dimensional lumber board, is longer than that shown in Figs. 1 and 2 in order to span across two or more forming panels, but shortened in the drawings for clarity. Also, depending on the length of the bracket arm (e.g., the use of longer bracket arm 144A), a wider piece of lumber or other beam may be placed and used as a scaffold. Advantageously, the bolts and/or nuts can be completely loosened to permit removal of the mounting plate and the mounting plate may be turned and remounted at a 90° angle from its initial orientation as shown in Figs. 1, 2, 5 and 6. In this orientation, shown by bracket arm 144A, a vertical support also known as a strongback 148 may be used and held by the waler bracket 126. Advantageously as shown in the drawings, the present invention permits the use of waler brackets with arms 144 and 144A oriented at 90° angles whereby the strongback and waler may overlap as shown in Figs. 1, 2 and 3. In a similar manner, when bracket 212 is used to support a scaffold board or the like, the nuts 134 are loosened on the bolts 132 and the bracket 212 is shifted along the bolt slot 118 or remounted at a desired position, and the bracket arm 222 is pivoted from the position shown in Fig. 18 to the position shown in Fig. 17 and held by pin 242. A scaffold board (not shown) typically of dimensional lumber, may then be placed on the bracket arm 222 and temporarily held in place by nails.

To maintain the desired spacing between opposing forming panels 10, typically tie bars 180 are positioned between adjacent forming panels and extend across the concrete-receiving space 202 between opposed forming panel walls. The tie bars are then held in place by clamps, pins or other similar fasteners. However, in using large crane-set forms of the type shown in the preferred embodiment, it may also be

desired to provide a hole which penetrates through the face plate 12 inboard of the side rails and top and bottom rails, as shown in Figs. 9-15 so that a tie rod or tie bar may connect the opposed forming panels 10. However, such an opening presents sealing problems, especially when differently sized tie rods or tie bars are used. In this regard, when such a hole in the face plate 12 is not sealed, concrete or other cementitious material make leak around the tie rod or tie bar and attach to the forming panel, making removal difficult and time consuming, and making the wall formed thereby uneven and pitted.

In the present invention, the use of the progressive seal provided by the O rings 42 and 44 and flexible barrier 78 helps to inhibit the leakage of fine concrete particles carried by water in the poured concrete past the tie rod. After the hole is created in the face plates 12 of the opposing forming panels, the tie rod is inserted through the slot in the channel and the passages of the bushings in the filler insert 66. Internally threaded cap 204 and nut 296 may then be threaded onto the threaded ends of the tie rod to hold it in position to resist outward displacement of the forming panel 10 or the portion of the face plate 12 thereof. The retaining ring 82 is then tightened against the ribs of the channel 16 in order to help hold the filler insert 66 from movement along the channel.

In some circumstance, the workman may desire to use a tie bar 180 instead of a tie rod in such applications. The tie bar 180 may be positioned between adjacent forming panels and held by a pin 194 and wedge 306 as shown in Fig. 21, or may be placed interiorly of the rails as illustrated in Fig. 11. The present invention includes the alternate filler insert 66A to accommodate this need. The tie bar is inserted between the opposed guides 182 and 184 as shown, and then the retaining ring 82 is positioned over the bushing 68A and rotated against the ribs of the channel 30 to hold the filler insert 66A in position. A pin 194 is then inserted through the hole 192 to couple the tie bar 180 to the forming panel 180.

Concrete may then be poured between the forming walls made up of the forming panels 10 positioned side by side and coupled together. After the concrete has cured to sufficient hardness, the pins, nuts, retaining rings, caps, walers, scaffolds and strongbacks, together with other forming hardware and accessories, are removed. While the tie bars remain embedded in the concrete, the tapered tie rods may typically be removed from the cured concrete prior to stripping the forming panels from the concrete wall. After the forming panels 10 are stripped, the bracket arms 144 and 144A conveniently pivot back to the storage position as shown in Fig. 6 for transport and storage until their use is desired again. Such ability to pivot to a position substantially

parallel to the face plate 12 and against the channels to which they are attached not only permits the waler brackets to remain with the forming panels 10 for convenience of use and limiting loss on the jobsite, as well as permitting a larger number of forming panels 10 to be stored or transported in a given space, but helps to avoid damage to the waler brackets during transport and storage.

Although preferred forms of the invention have been described above, it is to be recognized that such disclosure is by way of illustration only, and should not be utilized in a limiting sense in interpreting the scope of the present invention. Obvious modifications to the exemplary embodiments, as hereinabove set forth, could be readily made by those skilled in the art without departing from the spirit of the present invention.

The inventors hereby states their intent to rely on the Doctrine of Equivalents to determine and assess the reasonably fair scope of their invention as pertains to any apparatus not materially departing from but outside the literal scope of the invention as set out in the following claims.

Claims:

1. A forming panel for receiving thereagainst flowable cementitious material comprising:

a face plate presenting a rear side and a concrete-receiving side;

a frame including a plurality of rails extending rearwardly from the rear side of the face plate and at least one channel extending along the rear side of the face plate and positioned between said plurality of rails, said channel having a longitudinally extending slot therealong, said face plate including at least one opening therethrough adapted for receiving a connecting element; and

a filler insert removably mounted to said frame and configured for receipt in said slot, said filler insert including a bushing having a passage therethrough for positioning in alignment with the opening and a flexible barrier of brush-like filaments extending into the passage.

2. A forming panel as set forth in claim 1, wherein said channels include opposed longitudinally extending first and second walls having longitudinally extending ribs thereon with said longitudinally extending slot being located intermediate said walls.

3. A forming panel as set forth in claim 2, further including a retaining ring configured for mounting over said bushing and having an outer surface including a thread configured for threadably engaging said ribs.

4. A forming panel as set forth in claim 3, said retaining ring further including an interior surface mounting a resilient member thereon adapted for engaging the bushing when mounted thereon.

5. A forming panel as set forth in claim 4, said retaining ring further including a rearward edge presenting a relief therein.

6. A forming panel as set forth in claim 1, said passage in said bushing having an arcuate configuration.

7. A forming panel as set forth in claim 1, said bushing having a pair of opposed guides each presenting a substantially flat central surface defining said passage.

8. A filler insert for selective mounting to a forming panel for receiving thereagainst flowable cementitious material, said filler insert comprising:

a backing member;

a bushing mounted to the backing member and having a passage through the bushing; and

a flexible barrier of brush-like filaments mounted on the bushing and extending into the passage.

9. A bracket for selective positioning along a frame of a forming panel for concrete having a face plate presenting a concrete-receiving surface, said bracket comprising:

a mounting plate adapted for mounting to the frame ;

a bracket arm; and

pivot structure for pivotally mounting the bracket arm to the mounting plate for shifting the bracket arm about a pivot axis from a position substantially parallel to the mounting plate to a position substantially perpendicular to the mounting plate.

10. A bracket as set forth in claim 9, further including a clamping member shiftably mounted to said bracket arm.

11. A bracket as set forth in claim 10, said clamping member being in a generally upright plane including a slot which is inclined relative to the mounting plate whereby shifting of clamping member relative to the arm causes the clamping member to move toward or away from the mounting plate.

12. A bracket as set forth in claim 9, wherein said bracket arm includes a pair of spaced-apart flanges and said bracket further includes a support arm pivotally mounted to said bracket arm and sized for receipt between said flanges.

13. A forming panel for receiving thereagainst flowable cementitious material, said forming panel comprising:

a frame including an upper rail, a lower rail and spaced-apart side rails, each of said rails including an inner surface, an outer surface, and a front edge, wherein the inner surface includes a first groove located proximate the front edge, the outer surface includes a second groove proximate the front edge, and the front edge includes a flange extending forwardly of the groove;

a face plate mounted to the frame and received in the first groove of said rails, wherein said face plate includes a panel having a synthetic resin core received between metal sheets; and

a flexible barrier mounted in said second groove and extending generally away from said face plate.

14. A forming panel as set forth in claim 13, wherein said flexible barrier includes a brush having a multiplicity of filaments.

15. A method of forming a wall of concrete or other cementitious material comprising the steps of:

providing a pair of opposed forming panels each having a face plate and a frame including spaced apart upper and lower rails and a pair of spaced apart side rails positioned along perimeter edges of the face plate;

coupling the forming panels in opposition to define a concrete-receiving space therebetween;

pouring concrete into the space between the opposed forming panels;

allowing the concrete to at least partially cure to a self-sustaining condition;

and

removing the forming panels from the concrete,

wherein said coupling step includes providing a hole through the face plate of each of the forming panels inboard of the upper and lower rails and the side rails, and providing a brush-like flexible barrier adjacent the face plate, and providing a tie member extending between the opposed forming panels extending through their respective holes, positioning the brush-like flexible barrier adjacent the face plate and in engagement with the tie member, and operatively coupling the tie member to the frames of the respective forming panels to inhibiting displacement of the opposed forming panels away from each other.

16. A method of forming a wall of concrete or other cementitious material comprising the steps of:

providing a pair of opposed forming panels each having a face plate and a frame including spaced apart upper and lower rails and a pair of spaced apart side rails positioned along perimeter edges of the face plate;

coupling the forming panels in opposition to define a concrete-receiving space therebetween;

pouring concrete into the space between the opposed forming panels;

allowing the concrete to at least partially cure to a self-sustaining condition;

and

removing the forming panels from the concrete,

further including the steps of providing a plurality of brackets each including a mounting plate and an arm pivotally mounted thereto, and a support member for receipt on the arm and positioning adjacent to the frame of at least one forming panel, and mounting the brackets to the frame, positioning the brackets at a desired location along the frame, supporting

the support member on the arm, removing the support member, and pivoting the arm to a position substantially parallel to the mounting plate.

5 17. A method as set forth in claim 16, wherein said pivoting step includes pivoting the arm about a substantially vertical axis.

18. A method as set forth in claim 16, wherein said pivoting step includes pivoting the arm about a substantially horizontal axis.

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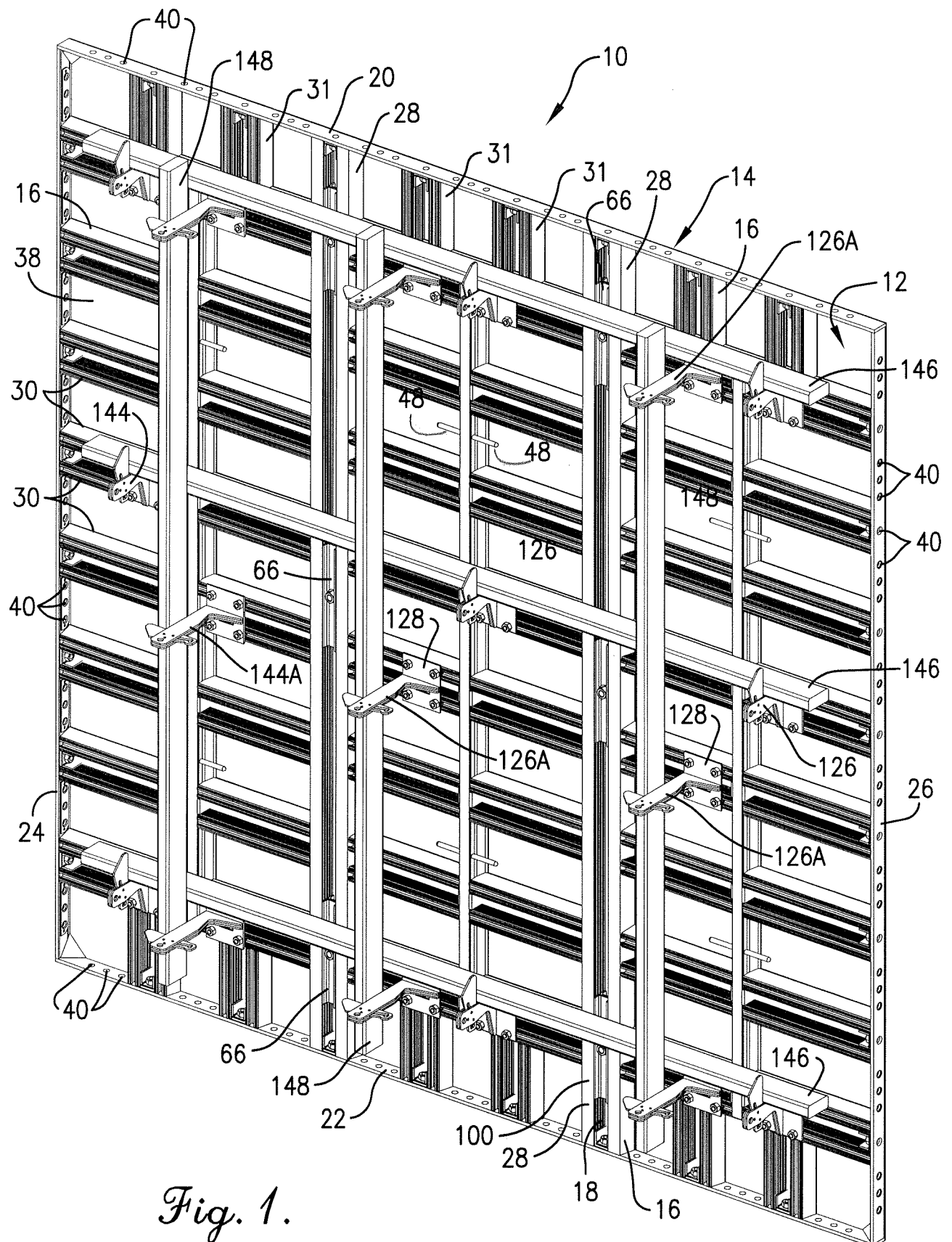


Fig. 1.

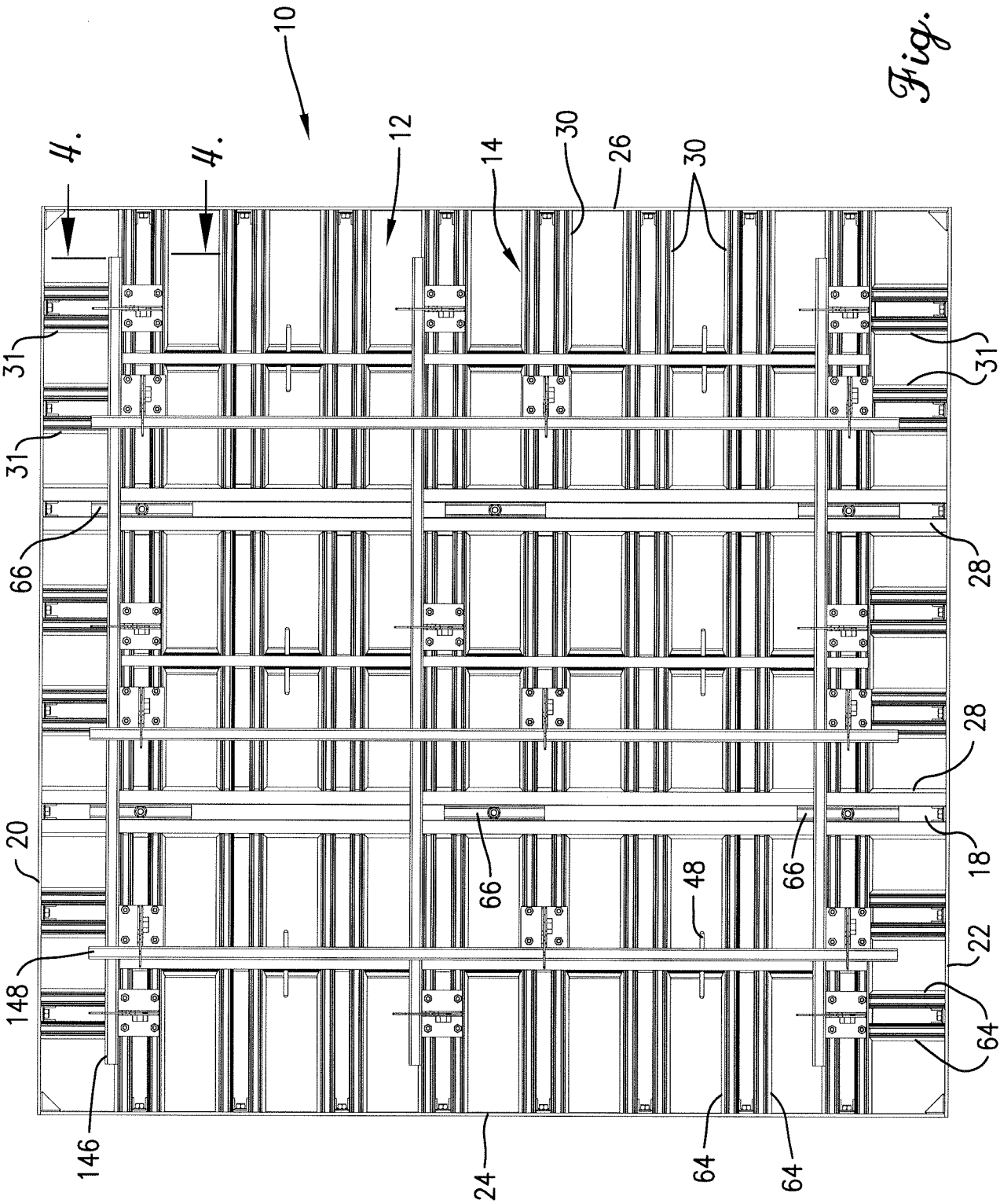


Fig. 2.

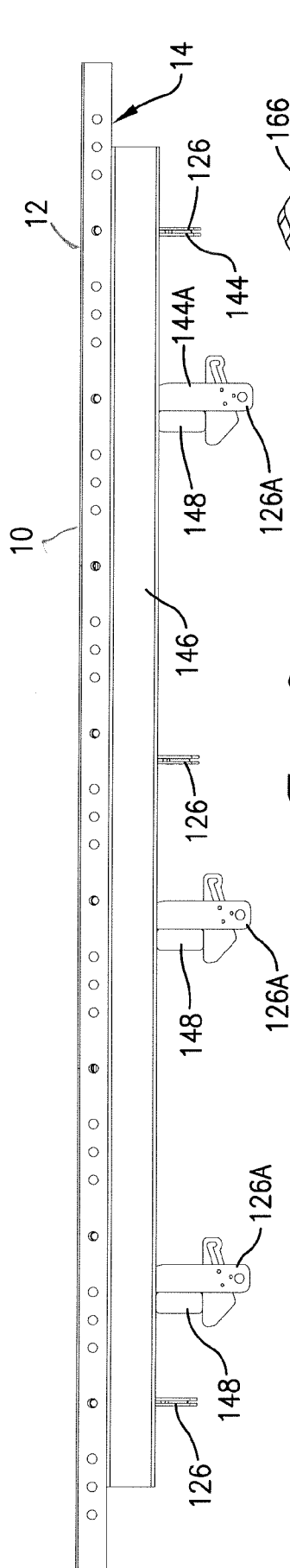


Fig. 3.

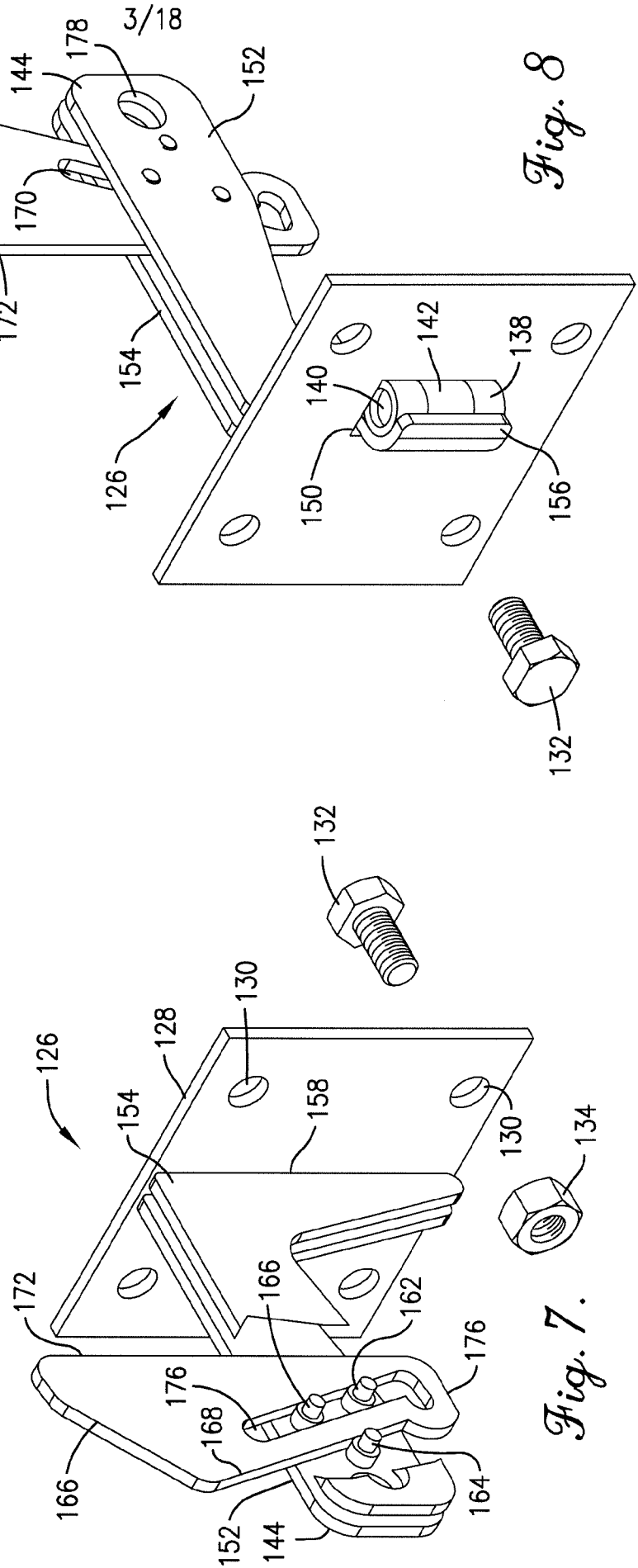


Fig. 7.

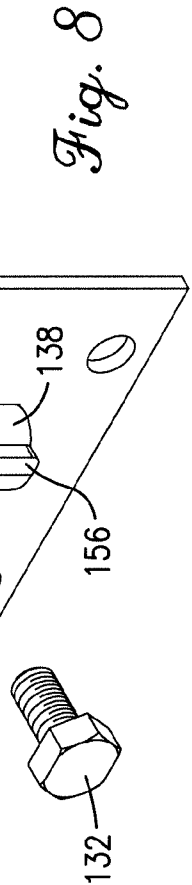
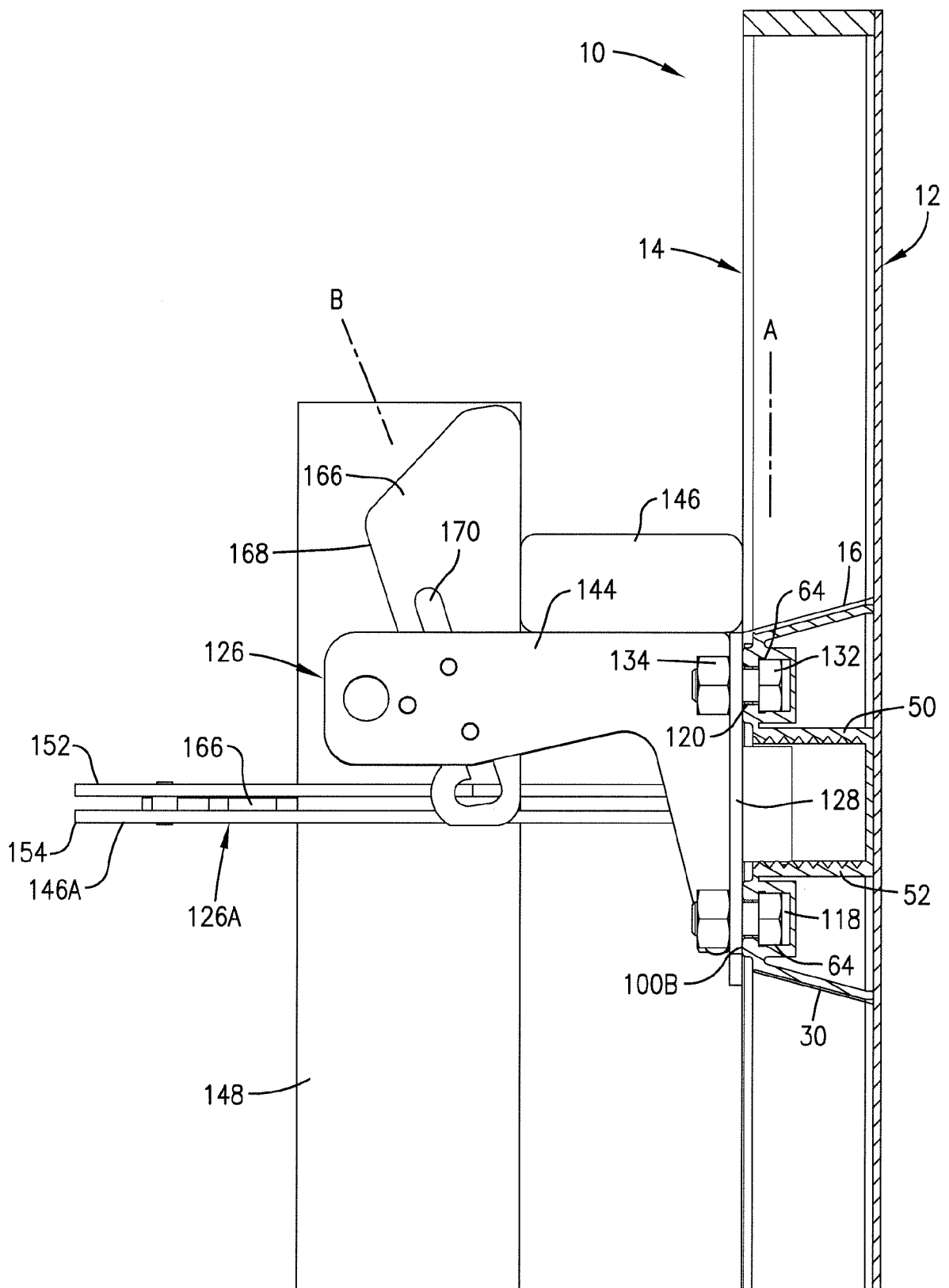


Fig. 8.

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*Fig. 4.*

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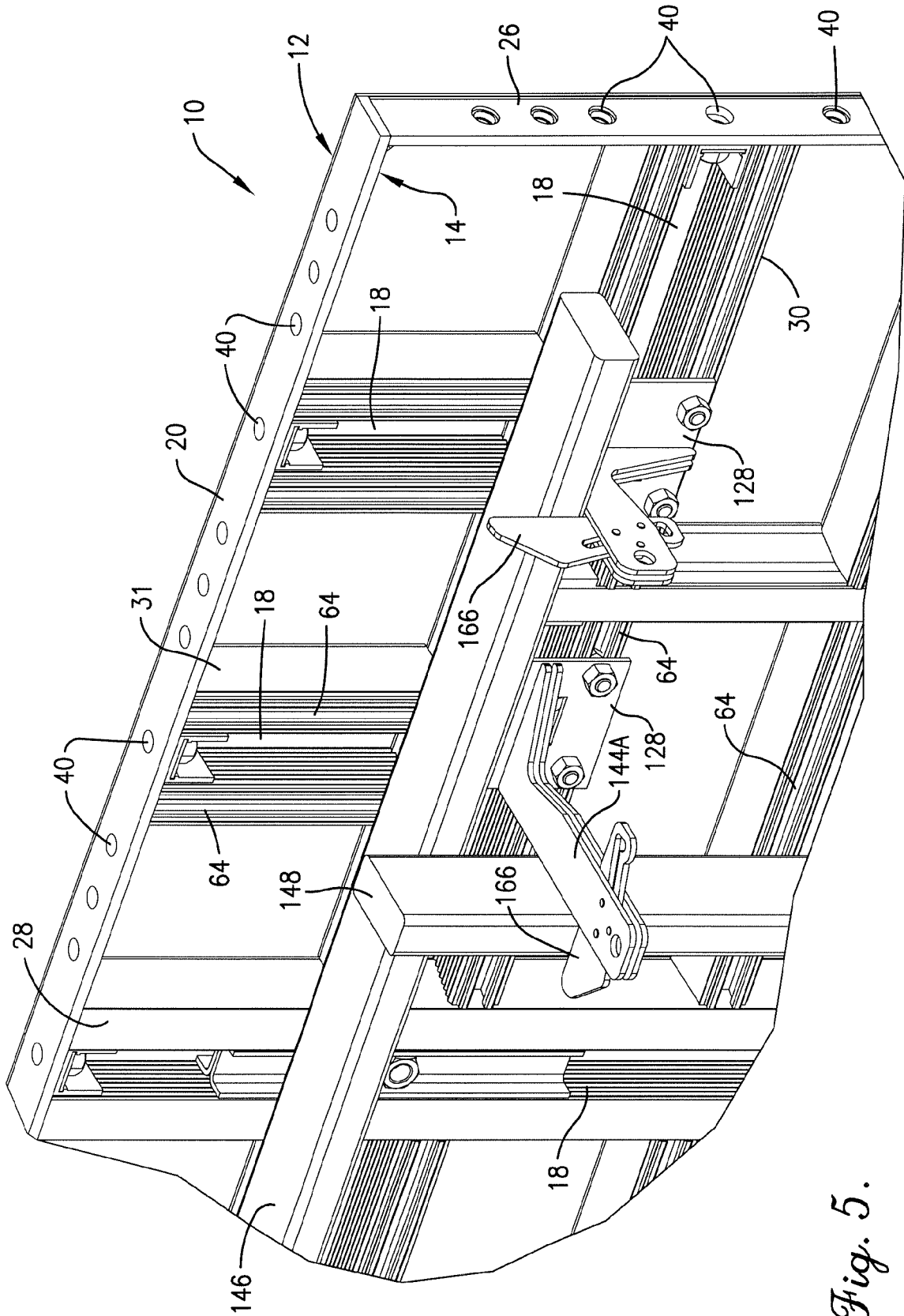


Fig. 5.

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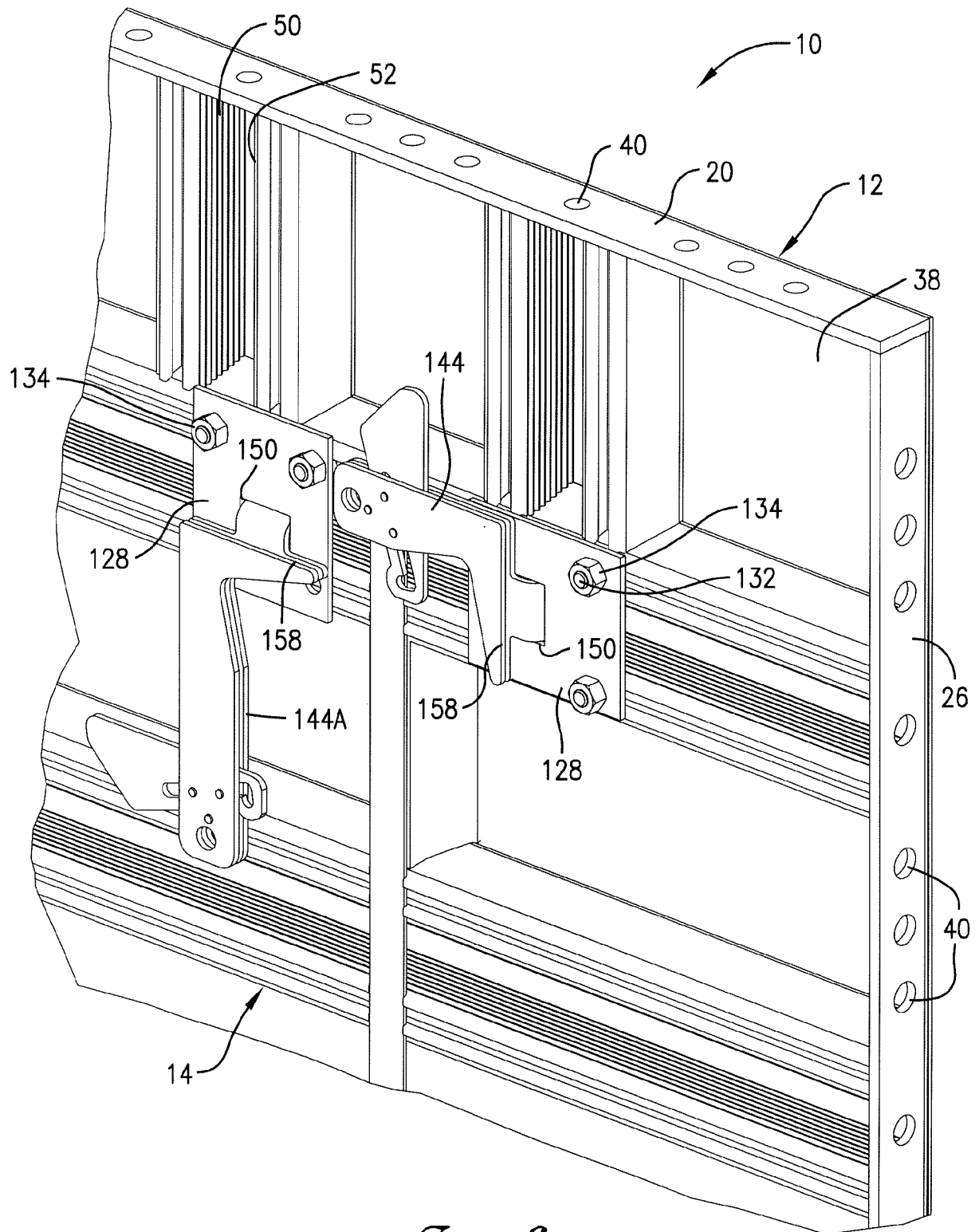
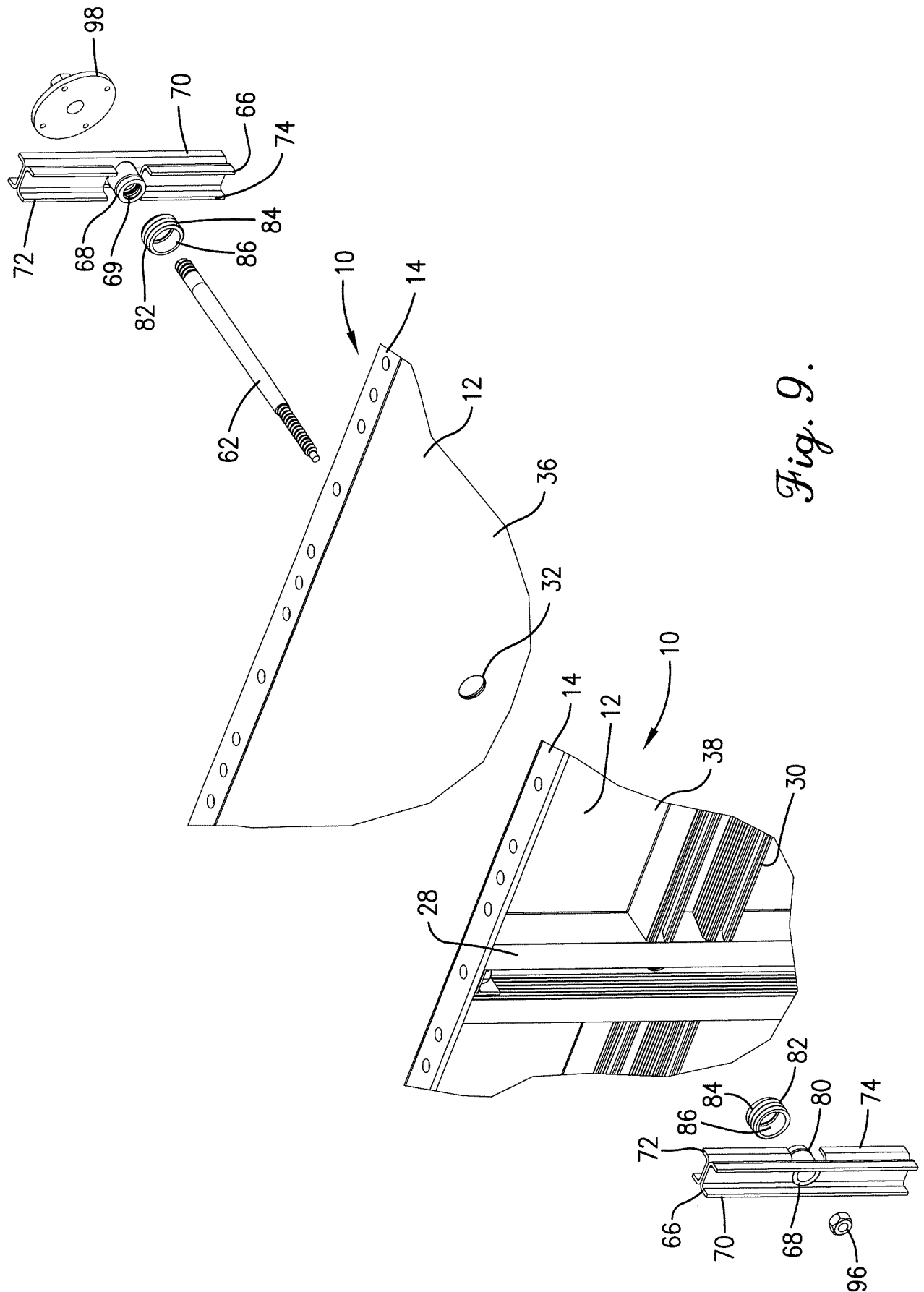


Fig. 6.



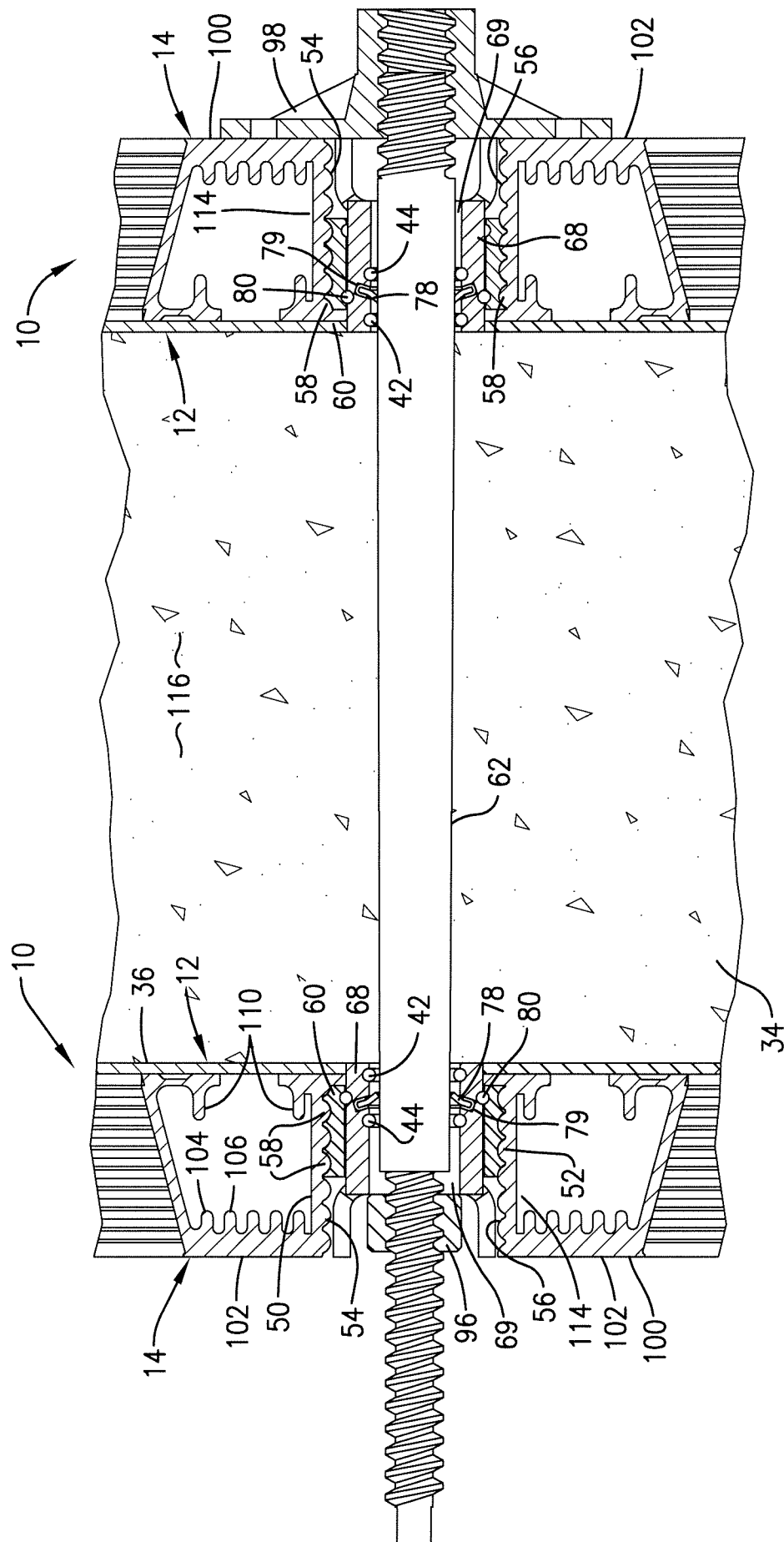


Fig. 10.

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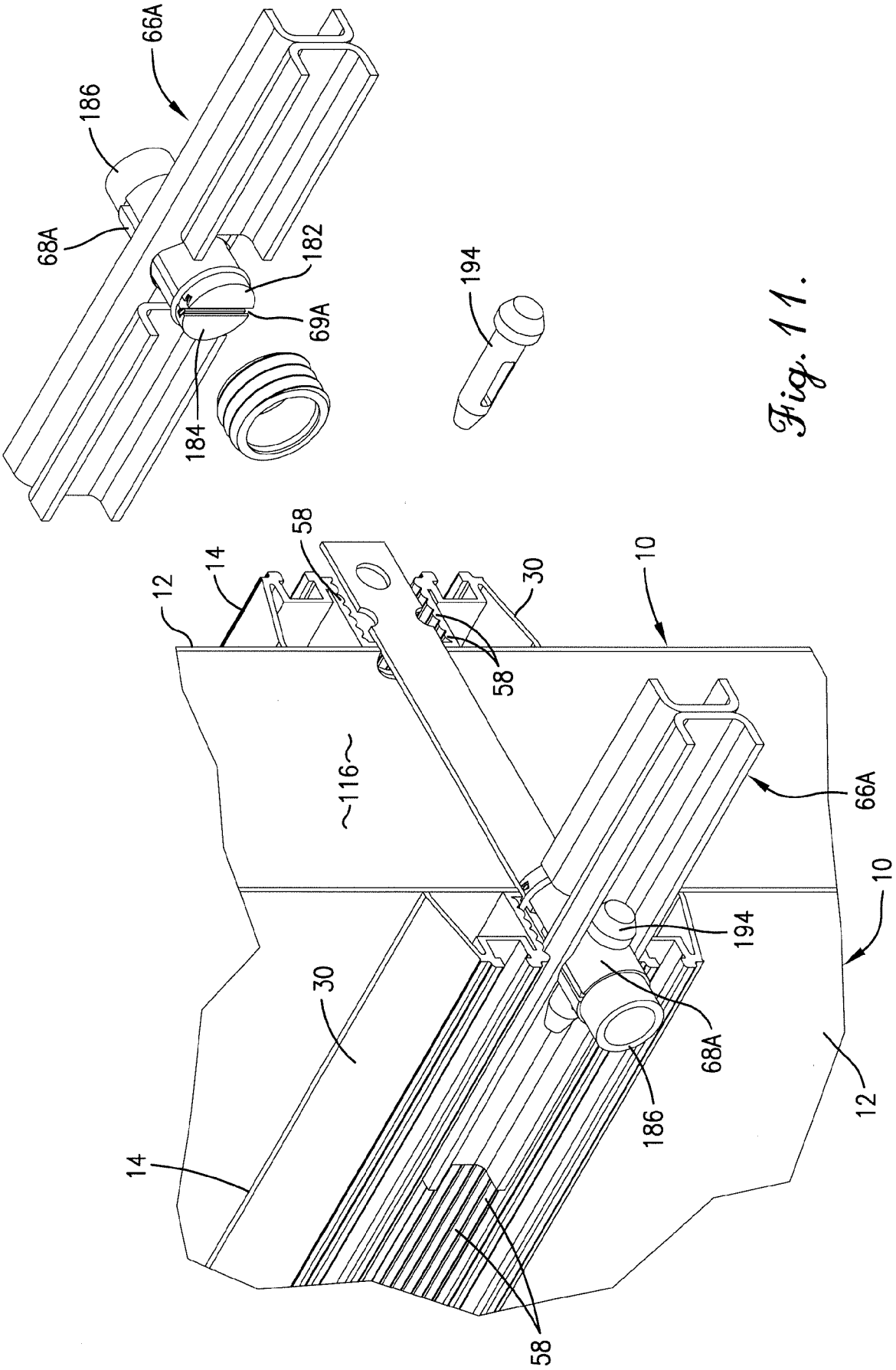


Fig. 11.

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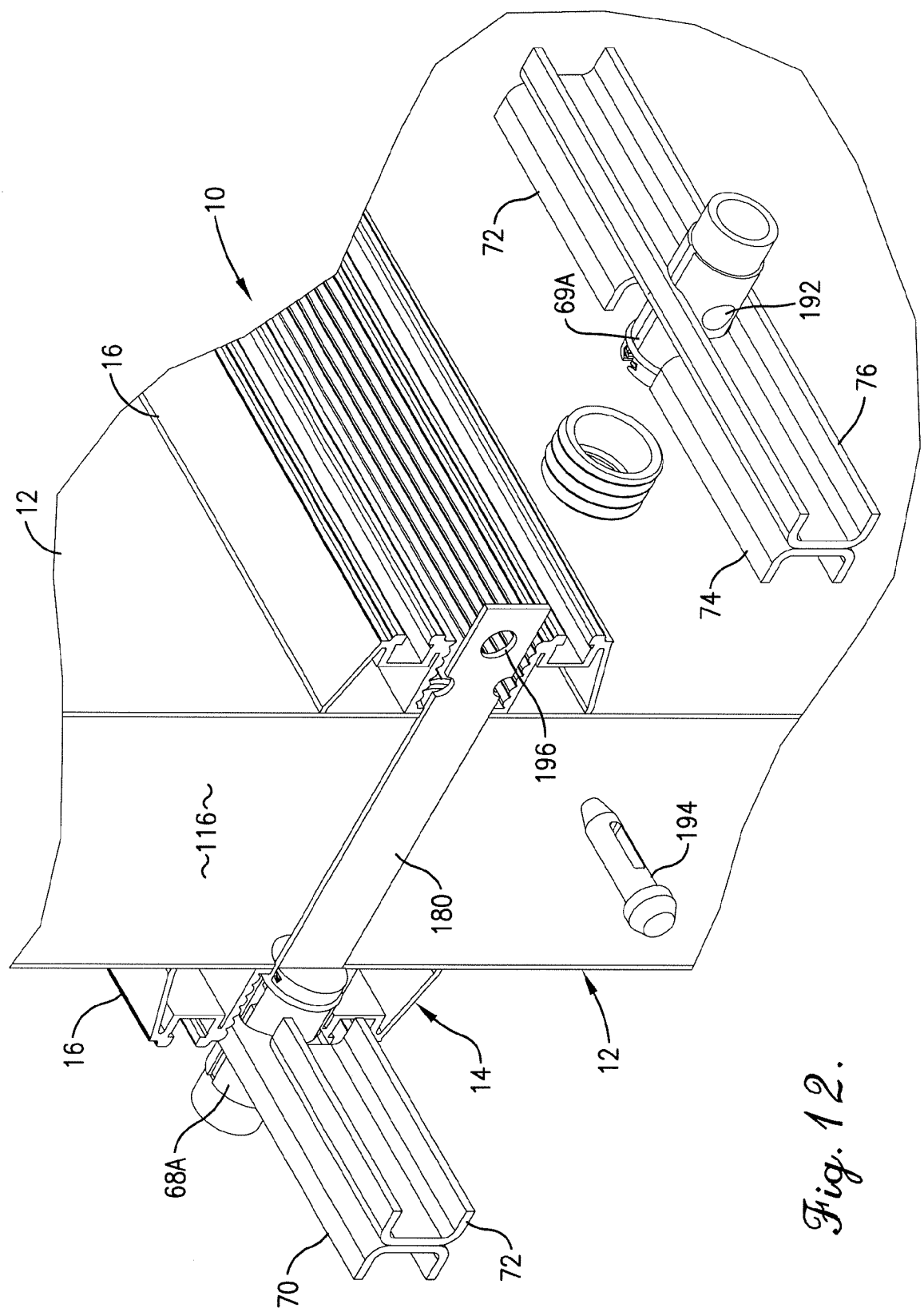


Fig. 12.

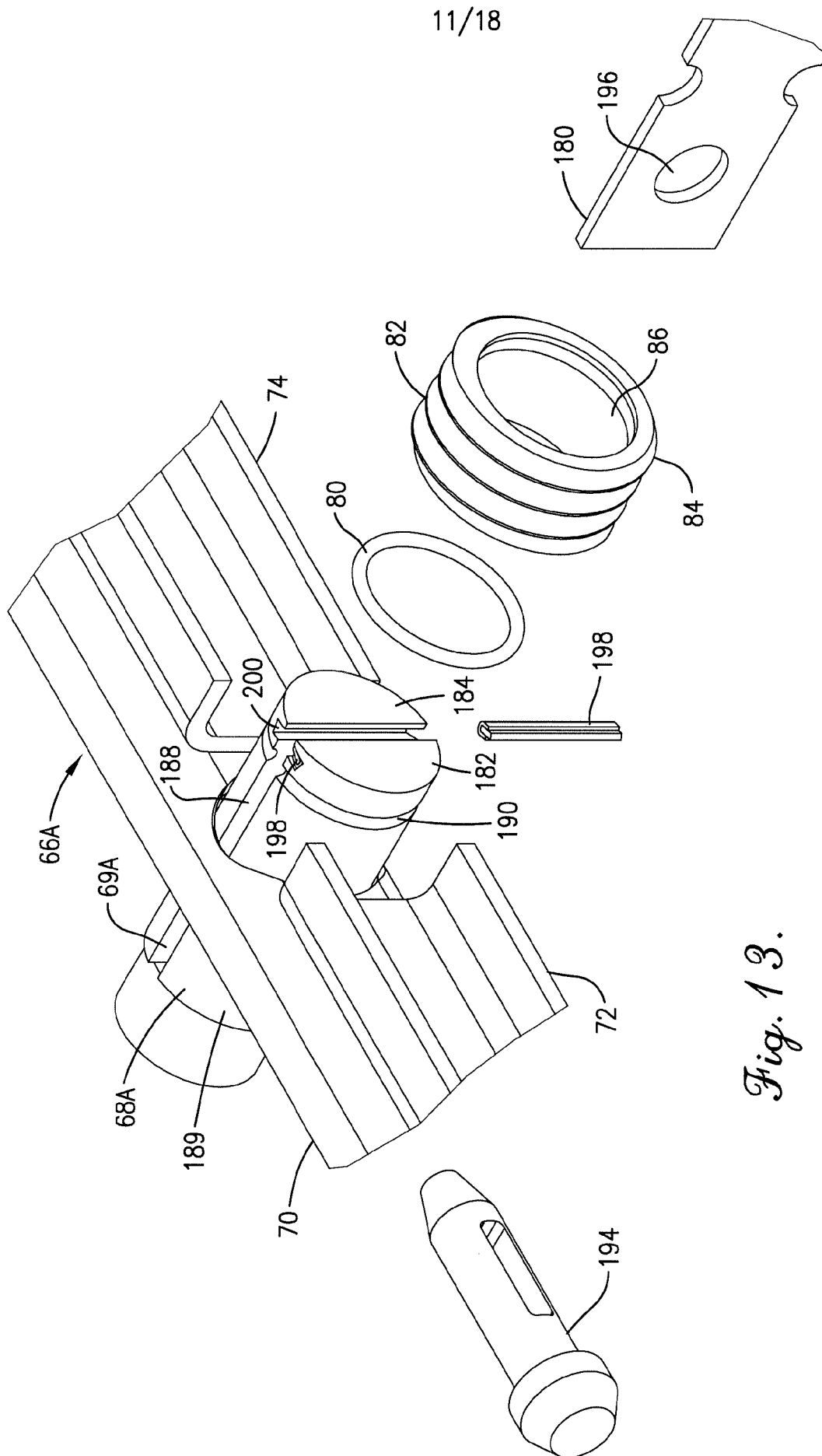


Fig. 13.

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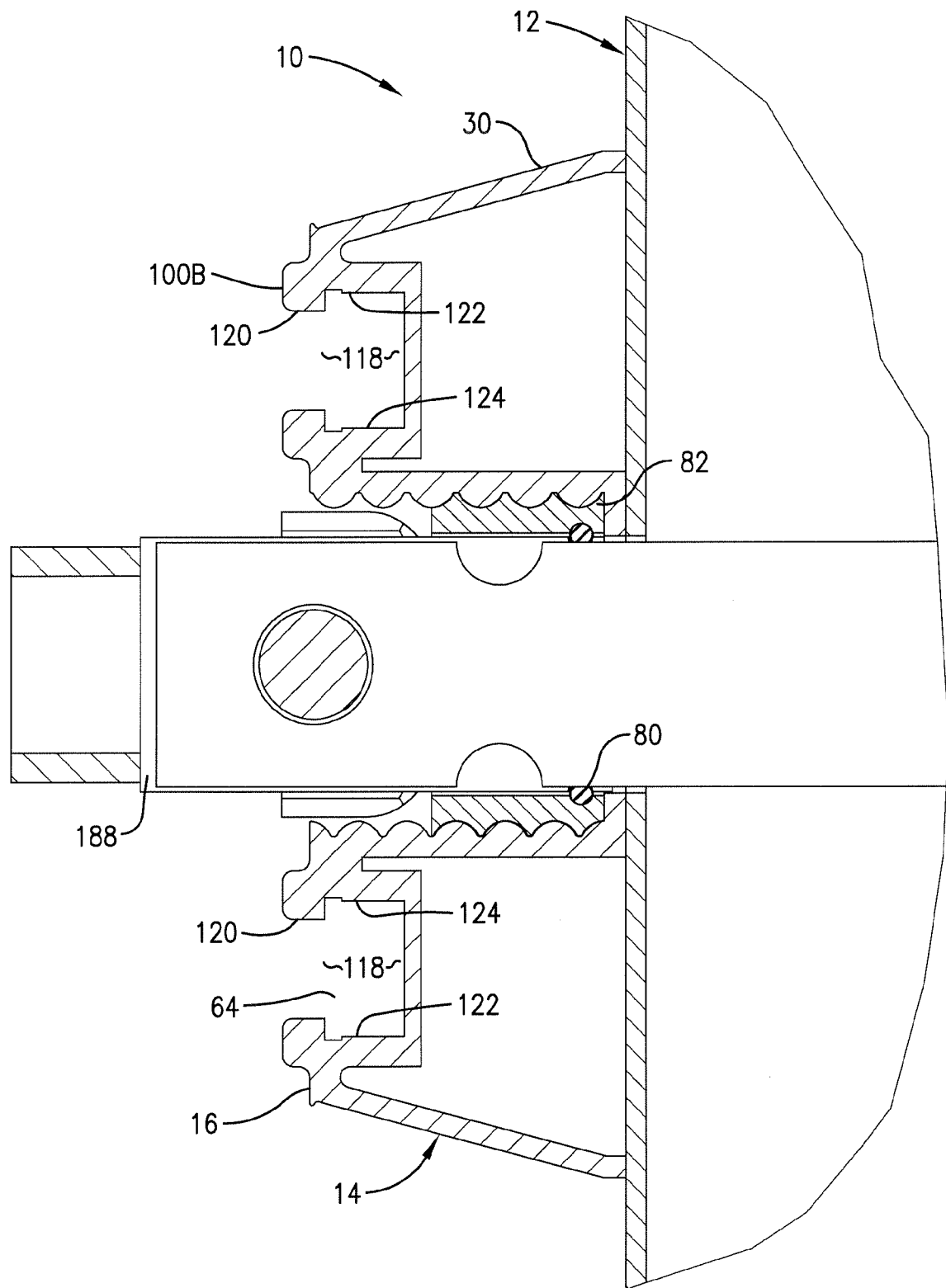


Fig. 14.

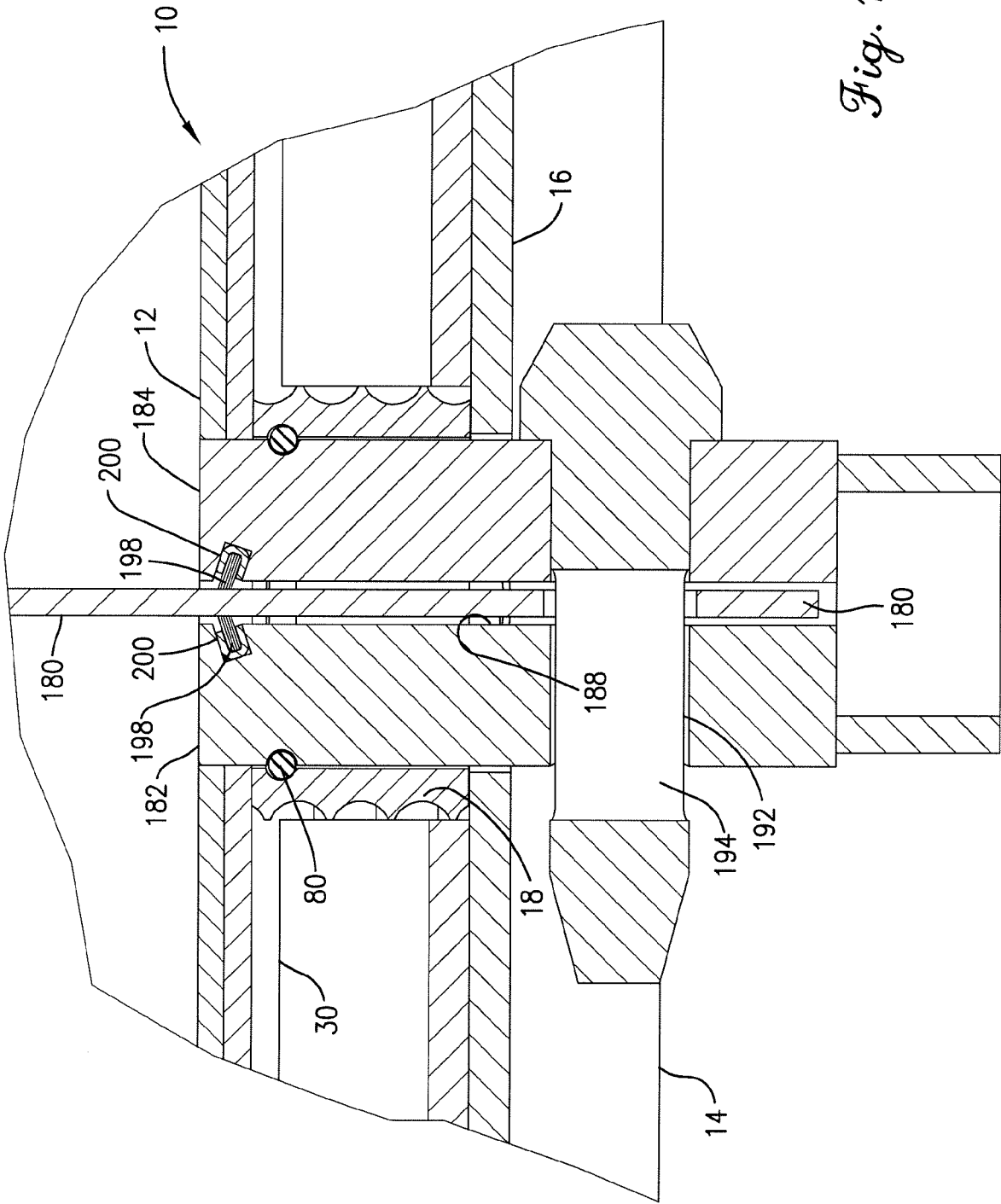
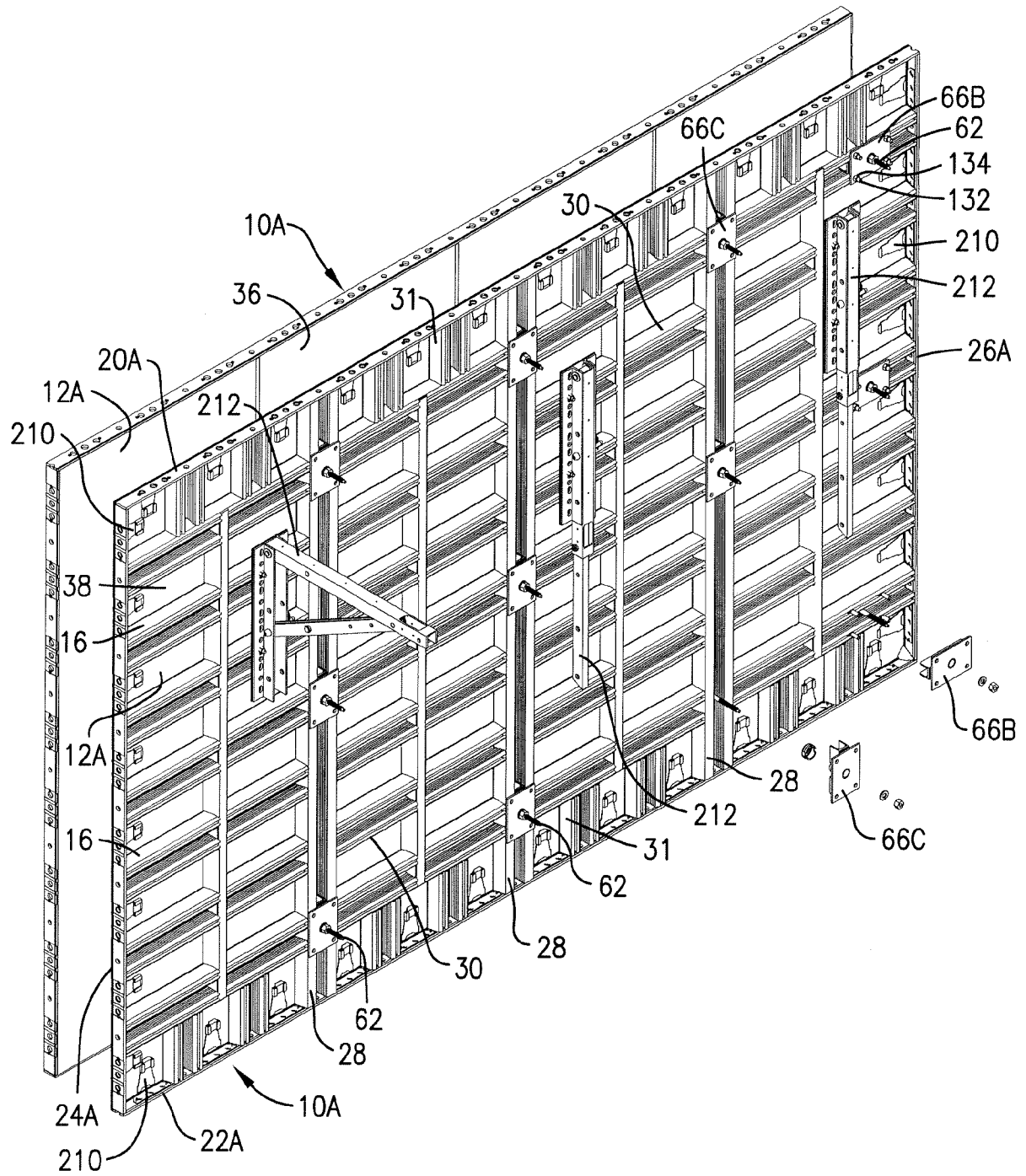
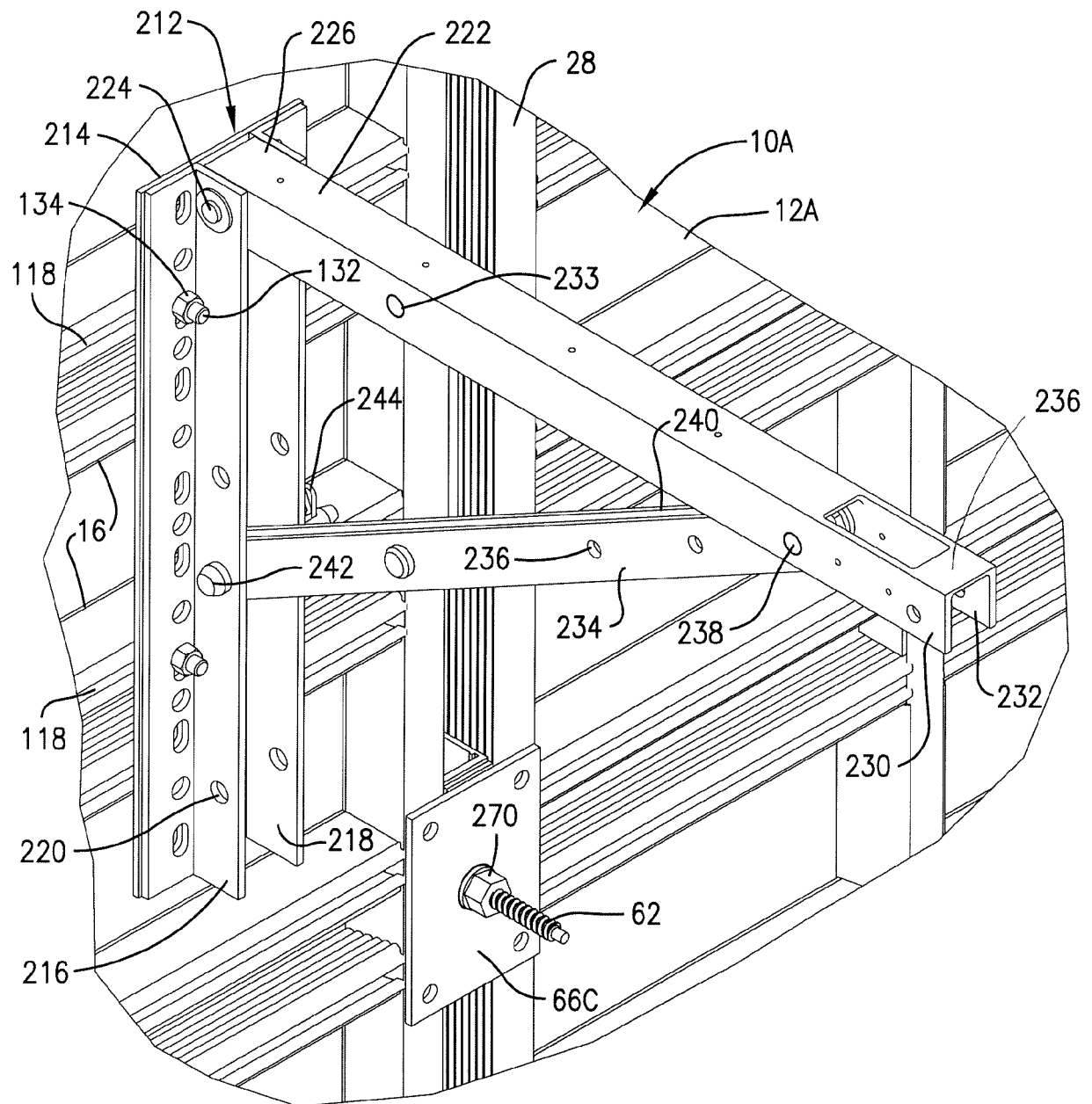


Fig. 15.

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*Fig. 16.*

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*Fig. 17.*

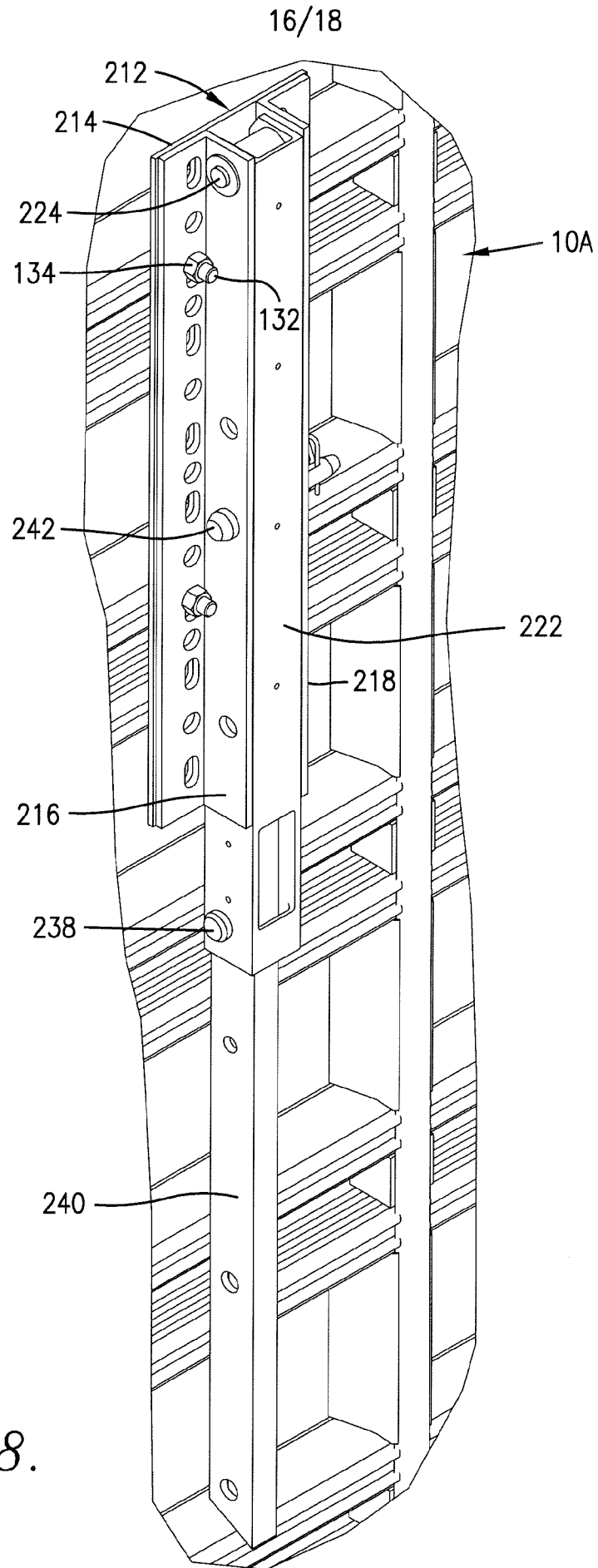


Fig. 18.

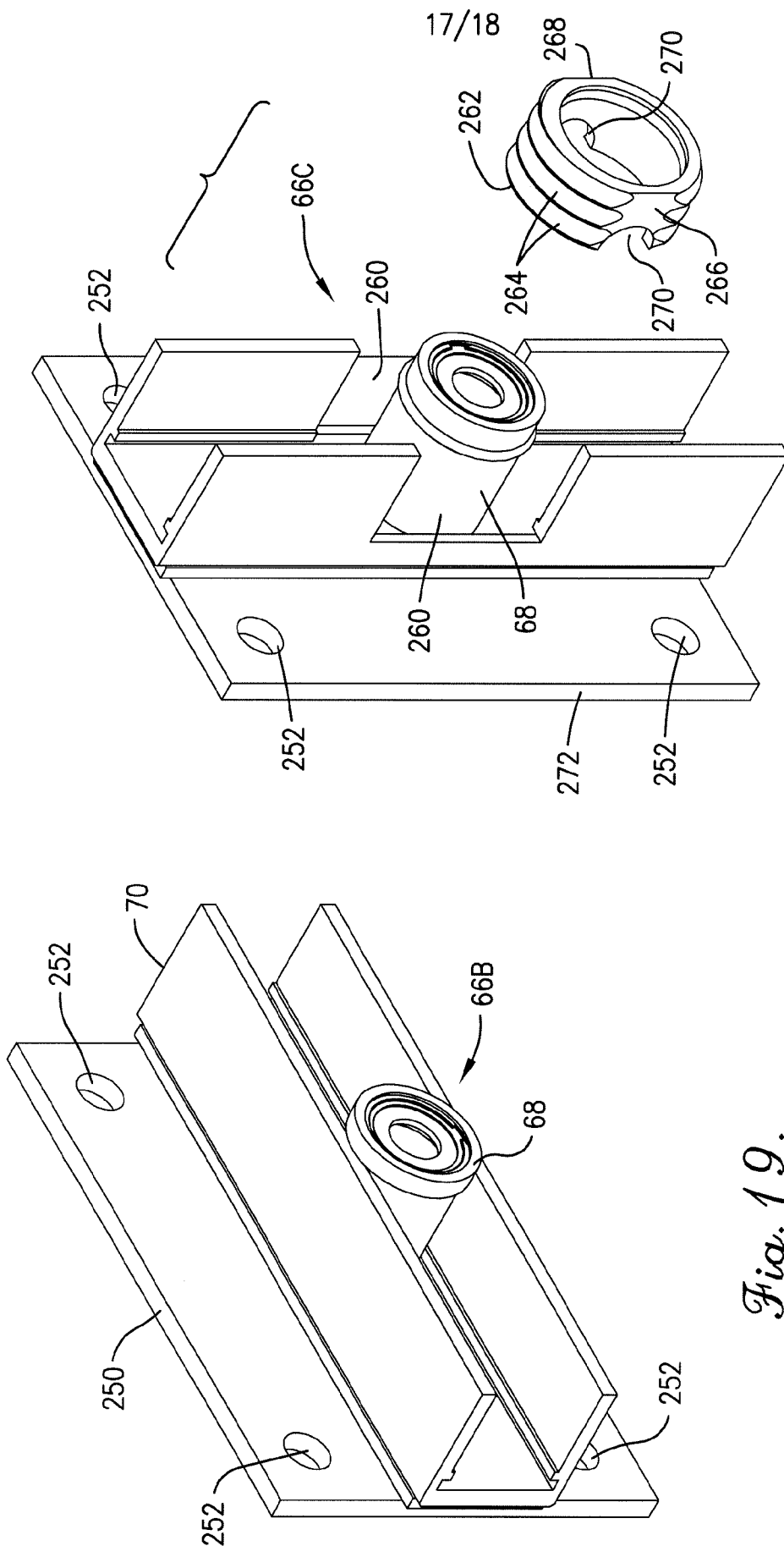


Fig. 20.

Fig. 19.

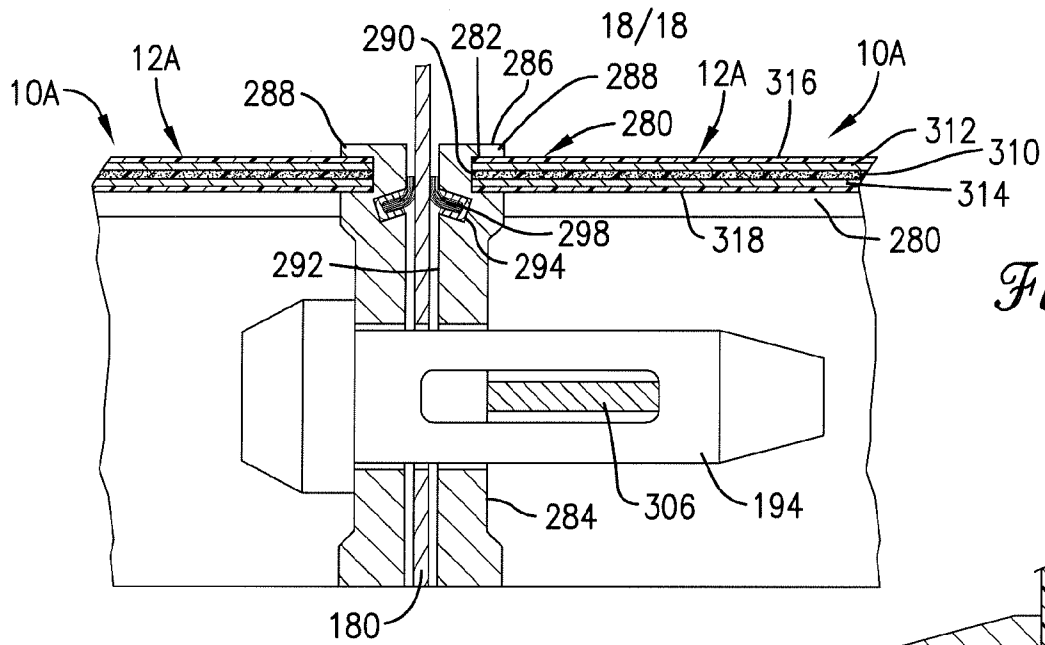


Fig. 21.

Fig. 22.

