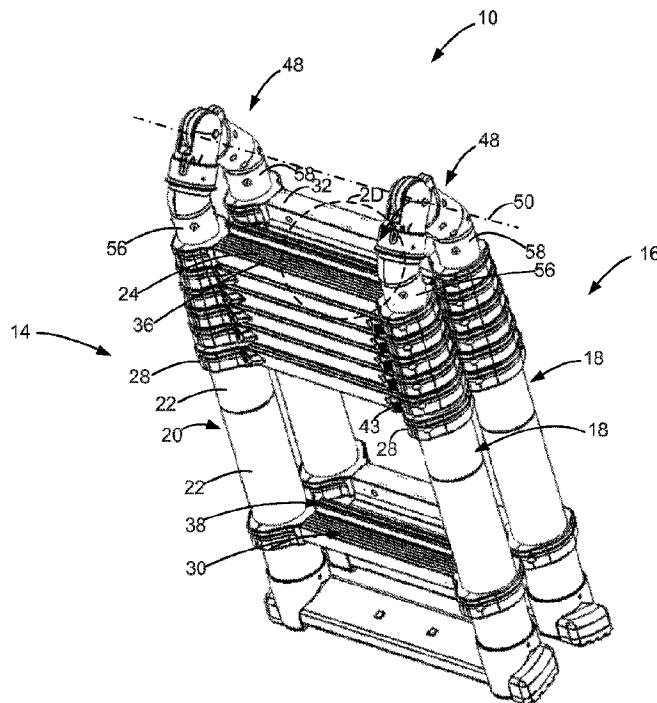




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A foldable ladder has a first ladder portion and a second ladder portion hingedly attached to the first ladder portion by a pair of hinge mechanisms. Each hinge mechanism adapted to lock the first and second ladder portions such that the first ladder portion and the second ladder portion form an angle therebetween. The hinge mechanism has a shifting mechanism and a ladder angle selector coupled thereto to allow manual selection of the angle between the first and second ladder portions, and a locking pin to lock the first and second ladder portions at an angular position.

ABSTRACT

A foldable ladder has a first ladder portion and a second ladder portion hingedly attached to the first ladder portion by a pair of hinge mechanisms. Each hinge mechanism adapted to lock the first and second ladder portions such that the first ladder portion and the second ladder portion form an angle therebetween. The hinge mechanism has a shifting mechanism and a ladder angle selector coupled thereto to allow manual selection of the angle between the first and second ladder portions, and a locking pin to lock the first and second ladder portions at an angular position.

FOLDABLE LADDER

BACKGROUND

[01] Ladders typically include rungs supported between stiles formed from a plurality of columns. In some cases, the ladder can be a telescoping ladder and can be expanded to separate the columns from one another for extension of the ladder, or collapsed together for retraction of the ladder. Such ladders often include mechanisms which can allow the ladder to be folded for storage and unfolded during use.

SUMMARY OF THE INVENTION

[02] Certain embodiments of the invention include a foldable ladder comprising a first ladder portion and a second ladder portion hingedly attached about a hinge axis to the first ladder portion by a pair of hinge mechanisms. Each hinge mechanism can lock the first and second ladder portions such that the first ladder portion and the second ladder portion form an angle therebetween. Each hinge mechanism has a shifting mechanism, comprising a shift pattern defined by a plurality of slots, each corresponding to an angular position of the first ladder portion with respect to the second ladder portion. The shifting mechanism comprises a selector pin that can be shifted in the shift pattern and received by a slot to lock the second ladder portion at an angular position with respect to the first ladder portion.

[03] In certain embodiments, the hinge mechanism comprises a locking pin moveable along its central axis radially away from and towards the hinge axis. The locking pin can be spring biased radially towards the hinge axis and rotatable about its central axis. The hinge mechanism comprises a plurality of recesses each directed radially inward towards the hinge axis from the end of a hinge member. The plurality of recesses can be spaced angularly about the hinge axis, wherein the angular position about the hinge axis of each recess corresponding to a predetermined angle between the first and second ladder portions. In such embodiments, each recess has a corresponding ladder angle opening having an opening shape. The opening shape can permit insertion of the locking pin therethrough when locking pin is rotated about its central axis to a rotation where the

orientation of the locking pin cross-section generally matches the opening shape. The opening shape can block insertion of the locking pin therethrough when locking pin is rotated about its central axis to a rotation where the orientation of the locking pin cross-section does not generally match the opening shape.

- [04]** Certain embodiments include a method of folding a ladder. The method can comprise the step of providing a foldable ladder, moving the selector pin away from a first slot to release the first and second ladder portions from a first angular position, shifting the selector pin in the shift pattern and proximal to a second slot, hingedly rotating one of the first and second ladder portions about the hinge axis to a second angular position, and securing the selector pin in the second slot and correspondingly securing the locking pin in a recess to the lock the first and second ladder portions at the second angular position.
- [05]** Certain embodiments of the invention include a telescoping ladder, comprising a first stile, a second stile each having a plurality of columns disposed in a nested arrangement for relative axial movement in a telescopic fashion along an axis of the plurality of columns between an extended position and a collapsed position. A first column proximal to the floor surface has a flange positioned in the hollow body of the first column coaxially with the axis of the plurality of columns. The ladder comprises a plurality of rungs extending between the first stile and the second stile. Each rung is connected to a column of the first stile and a column of the second stile. A first stabilizer housing proximal to the floor surface on which the telescoping ladder is positioned is connected to the first and second columns.
- [06]** In certain embodiments, the telescoping ladder comprises a first stabilizer connected to the first stabilizer housing. The first stabilizer can move between an extended position and a collapsed position, wherein, in the extended position, the first stabilizer extends out of a hollow body portion of the first stabilizer housing past the first stile in a direction substantially normal to the axis of the plurality of columns in the extended position. The first stabilizer collapses into the hollow body portion of the first stabilizer housing in the collapsed position. The first stabilizer comprises a hollow body in sliding engagement with an interior surface of the first stabilizer housing, and a locking button adapted to

protrude past an aperture defined on the first stabilizer housing to lock the first stabilizer in its extended position.

- [07] In certain embodiments, the locking button and the aperture are coaxial to the axis of the plurality of columns in the extended position of the first stabilizer. In such embodiments, the flange can abut against the locking button protruding past the aperture of the first stabilizer housing due to the telescoping movement of the first column toward the first stabilizer housing. The abutment of the flange against the locking button pushes the locking button away from the aperture and thereby unlocking the first stabilizer from its extended position and into the collapsed position.
- [08] In certain embodiments, the ladder is a foldable telescoping ladder, comprising a first ladder portion, a second ladder portion hingedly connected to the first ladder portion such that the first and second ladder portions are rotatable about a hinge axis. At least one of the first and second ladder portions can have a rung comprising a pair of stabilizers adapted to extend past each of the first and second stiles of the first ladder portion in a direction substantially normal to the axis of the plurality of columns and collapse into a hollow body portion of the first stabilizer housing.

BRIEF DESCRIPTION OF DRAWINGS

- [09] The following drawings are illustrative of particular embodiments of the present invention and therefore do not limit the scope of the invention. The drawings are not necessarily to scale (unless so stated) and are intended for use in conjunction with the explanations in the following detailed description. Embodiments of the invention will hereinafter be described in conjunction with the appended drawings, wherein like numerals denote like elements.
- [10] Figure 1A is a perspective view of a foldable ladder locked at a first angular position according to an embodiment;
- [11] Figure 1B is a perspective view of the foldable ladder of FIG. 1A locked at a second angular position;

- [12] Figure 2A is a perspective view of the foldable ladder of FIG. 1A locked at a third angular position shown in a collapsed state;
- [13] Figure 2B is a perspective view of the foldable ladder of Figure 2A shown in an extended state;
- [14] Figure 2C is a close-up perspective view of portion “2C” of Figure 2B;
- [15] Figure 2D is a left side view of the foldable ladder of portion “2D” of Figure 1A showing only the rungs of the first and second ladder portion;
- [16] Figure 2E is a sectional plan view of a portion of the ladder showing details of a connector assembly according to an embodiment;
- [17] Figure 3 is a perspective view of a hinge mechanism according to an embodiment;
- [18] Figure 4A is a side view of the hinge mechanism of Figure 3 with the selection collar removed from view for showing certain details of the hinge mechanism;
- [19] Figure 4B is a side perspective view of the hinge mechanism of Figure 3 shown in an unlocked state with the selection collar removed from view for showing certain details of the hinge mechanism;
- [20] Figure 4C is a side view of the hinge mechanism shown in Figure 4B with the second hinge member and the selection collar removed from view for showing certain details of the hinge mechanism;
- [21] Figure 5 is a cross-sectional view of the hinge mechanism taken along the line 5-5 shown in Figure 3;
- [22] Figure 6 is a detailed view of the hinge mechanism of Figure 5 with certain components of the first hinge member removed from view to show certain details of the hinge mechanism;

- [23] Figure 7 is a detailed perspective view of a locking pin, a locking plate, a selector pin and a biasing spring according to an embodiment;
- [24] Figure 8A is a cross-sectional side view of the hinge mechanism of Figure 5 with certain features removed from view for showing certain details of the hinge mechanism;
- [25] Figure 8B is a close-up view of portion 8B of Figure 8A;
- [26] Figure 9A is a perspective view of a foldable ladder locked at a first angular position according to an embodiment;
- [27] Figure 9B is a perspective view of the foldable ladder of FIG. 9A locked at a second angular position in a collapsed state;
- [28] Figure 9C is a perspective view of the foldable ladder of Figure 9B shown in an extended state;
- [29] Figure 9D is a perspective view of the foldable ladder of FIG. 9A locked at a third angular position;
- [30] Figure 10A is a close-up perspective view of a portion 10A of the ladder shown in Figure 9A;
- [31] Figure 10B is a perspective view of the ladder of 10A showing the stabilizers in an extended position;
- [32] Figure 10C is a perspective view of the ladder of 10A showing a stabilizer in an extended position and a stabilizer in a collapsed position;
- [33] Figure 10D is a perspective view of a portion 10D shown in Figure 10A;
- [34] Figure 11A is an exploded perspective view of the ladder portion illustrated in Figure 10A with the first and second columns hidden from view to show certain internal detail;

- [35] Figure 11B is a cross-sectional front view of the ladder portion shown in Figure 10B, with the cross-section taken along the plane 3B-3B;
- [36] Figure 12 is a perspective view showing a first stabilizer housing and first and second air dampers with a stabilizers shown in a collapsed state according to an embodiment;
- [37] Figure 13 is a perspective view showing the stabilizers of Figure 12 shown in an extended state;
- [38] Figure 14 is a perspective view of a stabilizer according to an embodiment;
- [39] Figure 15A is a right side view of the stabilizer of Figure 14 with the caps removed to illustrate internal detail;
- [40] Figure 15B is a cross-sectional right side view of a portion of Figure 10B taken along the plane 15B-15B;
- [41] Figure 16 is an exploded perspective view of the stabilizer of Figure 14 shown along with a connector;
- [42] Figure 17 is a close-up exploded view of a portion 17 shown in Figure 10B;
- [43] Figure 18 is a front view of an air damper according to an embodiment; and
- [44] Figure 19 is a perspective view of the air damper of Figure 18.

DETAILED DESCRIPTION

- [45] The following detailed description is exemplary in nature and is not intended to limit the scope, applicability, or configuration of the invention in any way. Rather, the following description provides some practical illustrations for implementing exemplary embodiments of the present invention. Examples of constructions, materials, dimensions, and manufacturing processes are provided for selected elements, and all other elements employ that which is known to those of ordinary skill in the field of the invention. Those

skilled in the art will recognize that many of the noted examples have a variety of suitable alternatives.

- [46] Figure 1A is a front perspective view of a ladder 10 according to some embodiments. Figures 1B, 2A and 2B are front perspective views of a ladder 10 unfolded from its folded position illustrated in Figure 1 and locked at various angles, according to some embodiments. In Figure 1B, the ladder 10 has been unfolded from its folded position in Figure 1A and locked at an angle θ of about 30 degrees. In Figures 2A and 2B, the ladder 10 has been locked at an angle θ of about 180 degrees. In Figure 2A, an upper portion 12 of the ladder 10 is in a collapsed/retracted state, whereas in Figure 2B, the upper portion 12 of the ladder 10 is in an extended state. The ladder 10 illustrated in these views can have a first ladder portion 14 and a second ladder portion 16, each including two opposing stiles, a left side stile 18 and a right side stile 20, each formed by a plurality of columns 22. According to the illustrated embodiment each opposing column of each stile includes a rung 24 extending therebetween, wherein each rung 24 is coupled on either end to an opposing column by a connector assembly 28. In some embodiments, the columns 22 are formed of aluminum. Other materials are contemplated and are within the scope of the invention. The columns 22 are illustrated as having a circular cross-section (when viewed along the longitudinal axis 40 of the columns 22), the columns 22 can have a rectangular cross-section such as those illustrated in U.S. Publication No. 2012/0267197 A1 assigned to the assignee of the instant application. Other cross-sections (e.g., square, oval or polygonal shapes) are also contemplated. As will be described herein, in some embodiments, the columns 22 can be substantially hollow so as to allow a connector assembly 28 to fasten the rung 24 to a column on each of the right side and left side stiles 20, 18.
- [47] Figure 2C illustrates a close-up perspective view of a rung 24 of the first ladder portion 14. FIG. 2D illustrates a side view showing a rung 24 of the first ladder portion 14 and a rung 24 of the second ladder portion 16 when the ladder 10 is folded as shown in Figure 14. In some embodiments, each rung 24 comprises a planar first surface 30 and a planar second surface 32 opposite to the planar first surface 30. The first surface 30 of each rung 24 of the first ladder portion 14 defines a planar standing surface 34. At least

one of the planar first and second surfaces of the second ladder portion 16 defines a planar standing surface 34. Referring back to Figures 2A-2B, when the ladder 10 is unfolded for use, the first surface 30 of each rung 24 of the second ladder portion 16 has a planar standing surface 34 as shown by the close-up view of Figure 2C. However, when ladder 10 is folded for storage or unfolded to angles other than about 180 degrees (e.g., as shown in Figure 1B), the first surface 30 of each rung 24 of the second ladder portion 16 may not face the top and therefore the planar standing surface 34 may be defined on the underside of the rung 24 when the ladder 10 is folded for storage or unfolded to angles other than 180 degrees. The planar standing surface 34 of each rung 24 of the first and second ladder portions 14, 16 may have treads 36 defined therein to provide friction between the planar standing surface 34 and the contact surface of a user (e.g., soles of the user's shoes). As will be described herein, the rungs can be substantially hollow so as to allow a connector assembly 28 to fasten the rung 24 to a column on each of the right side stile 20 and left side stile 18. The rungs can be extruded from aluminum, although other materials and means of manufacturing can also be used.

- [48] While Figures 2C and 2D illustrate a rung 24 with a substantially rectangular cross-section, other cross-sectional shapes of the rung 24 are also contemplated. For instance, the rung 24 can have a parallelogram cross-section such as those illustrated in U.S. Publication No. 2012/0267197 A1, assigned to the assignee of the instant application. While the illustrated Figures 2C and 2D show a substantially rectangular rung 24, at least a portion of the first surface 30 of the first and second ladder portions 14, 16 forms an angle θ with respect to a horizontal plane 42. In the illustrated embodiment, when the angled portions of the first surface 30 form an angle θ with respect to the horizontal plane 42. The angle θ can be between about 5 degrees and 45 degrees (e.g., between 5 degrees and 20 degrees). Such embodiments allow at least the angled portion 38 of the first surface 30 of the ladder 10 to be horizontal when the ladder 10 is rotated towards a vertical wall (e.g., propped against a wall at an angle) so that during normal use, at least a portion of the vertical wall can be nearly horizontal. However, depending on the angle at which the ladder 10 is propped against a vertical wall, the angled portion 38 may be past or short of being horizontal.

- [49] Referring back to FIG. 2C, each rung 24 is connected to a column of the plurality of columns 22 by a connector assembly 28. In some cases, the plurality of columns 22 are disposed in a nested arrangement for relative axial movement in a telescopic fashion such that the ladder 10 is extendable or collapsible along the longitudinal axis 40 of the columns 22. Such telescoping ladders and various types of connector assemblies are described in detail in U.S. Patent No. 8,387,753 B2 and U.S. Patent No. US 6,883,645 B2, both assigned to the assignee of the instant application. In such telescoping ladders, the connector assembly 28 includes a release button 43 slidable along a front surface 44 of the rung 24 to unlock or selectively lock the relative axial movement between two adjacent columns 22 of the plurality of columns 22, the front surface 44 of the rung 24 being generally perpendicular to a plane 46 normal to the longitudinal axis 40 of the plurality of columns 22.
- [50] FIG. 2E illustrates a sectional top view of a portion of the ladder according to some embodiments, taken along a plane parallel to the top surface of a rung, illustrating details of the connector assembly 28. The sectional view of FIG. 2E is representative of all rungs of the ladder with a connector assembly 28. The connector assembly comprises a collar portion 28a surrounding the columns 22 and in contact with the perimeter surface of an outer column, and a rung portion 28b inserted into a rung 24. In the embodiment shown in FIG. 2E, the connector assembly 28 includes a latch mechanism housed in the rung portion 28b including two release buttons 43a and 43b and a pin 45. Release button 43a is slidable along the front surface 44 of the rung, and release button 43b is slidable along the back surface 47 of the rung 24. In the embodiment of FIG. 2E, the pin 45 is disposed in an extended position in which pin 45 extends into an aperture 29 defined on the connector assembly 28 and into openings 41 on the columns 22. In some embodiments of the present invention, pin 45 is biased (e.g., by spring 49) to assume the extended position. When this is the case, pin 45 may be selectively urged to assume a retracted position by applying sliding either button 43a or button 43b in a direction 51. According

to the illustrated embodiment, the pin 45 includes one or more through-holes 53 through which the shanks 55 of each button 43a, 43b can be inserted (e.g., by a friction fit) for coupling the buttons 43a, 43b to the pin 45 in a cooperative fashion. As is apparent from FIG. 2E, the pin 45 may be retracted or extended by sliding either the button 43a or button 43b along the respective surface 44 or 47 in the direction 51 as illustrated. The sliding movement of either button would also slide the other button in the direction 51 because of the cooperative connection therebetween via the pin 45. In some cases, each rung 24 of the first ladder portion 14 and the second ladder portion 16 may have a button slidable on the front surface 44 and a button slidable on the back surface 47 as illustrated. Alternatively, any one ladder portion (first ladder portion 14, or second ladder portion 16) can have buttons on both the front surface 44 and the back surface 47.

- [51] Referring back to Figure 1A, the foldable ladder 10 comprises a pair of hinge mechanisms hingedly connecting the first ladder portion 14 to the second ladder portion 16. Figure 3 illustrates a perspective view of a hinge mechanism 48 and Figures 4A-4B illustrate various detailed views of the hinge mechanism 48 according to certain embodiments of the invention. As seen in Figures 1A-2B and Figure 3, the hinge mechanism 48 can fold the first and second ladder portions 14, 16 about a hinge axis 50. The hinge mechanism 48 can lock the first and second ladder portions 14, 16 such that the first ladder portion 14 and the second ladder portion 16 form an angle 60 therebetween. As best seen in Figure 1B, the angle 60 can be defined as the angle between the longitudinal axis 40 of the columns 22 of the first ladder portion 14 and the longitudinal axis 40 of the columns 22 of the second ladder portion 16. In Figure 1A, the first and second ladder portions 14, 16 form an angle 60 of about 0 degrees. In Figure 1B, the first and second ladder portions 14, 16 form an angle 60 of about 30 degrees. In Figures 2A-2B, the first and second ladder portions 14, 16 form an angle 60 of about 180 degrees.
- [52] Referring now to Figures 4A-4C, each hinge mechanism 48 comprises a first hinge member 52 connectable to the first ladder portion 14 and a second hinge member 54 connectable to the second ladder portion 16. As seen in Figure 1B, the first hinge member 52 can be connected coaxially with the longitudinal axis 40 of the columns 22 of

the first ladder portion 14, and the second hinge member 54 can be connected coaxially with the longitudinal axis 40 of the columns 22 of the second ladder portion 16. For instance, as seen in Figure 1A, the first hinge members 52 of the left and right side hinge mechanisms are both connected to the top most columns 56 (left and right side columns 56) of the first ladder portion 14, and the second hinge members 54 of the left and right side hinge mechanisms are both connected to the top most columns 58 (left and right side columns 58) of the second ladder portion 16. The hinge mechanisms on the left and right side shown in Figure 1A can be substantially similar. Alternatively, the hinge mechanism 48 on the right side can be a mirror image of the hinge mechanism 48 on the left side. The first and second hinge members 52, 54 are rotatable with respect to each other about the hinge axis 50. As the first and second hinge members 52, 54 are rigidly coupled to the first and second ladder portions 14, 16, rotation of the first and second hinge members 52, 54 rotate the first and second ladder portions 14, 16 with respect to each other and vice versa. The rotation of the first and second ladder portions 14, 16 is about the hinge axis 50 such that the first and second ladder portions 14, 16, and the first and second hinge members 52, 54 when rotated, form an angle 60 therebetween. At least a portion of an edge 62 of the second hinge member 54 can be semi-circular. Additionally, at least a portion of an edge 64 of the first hinge member 52 can be semi-circular. Other shapes of the portion of the edges 62, 64 are also contemplated, such as semi-elliptical or other arcuate shapes.

- [53] With continued reference to Figures 3 and 4A-4C, the hinge mechanism 48 comprises a shifting mechanism 70. The shifting mechanism 70 can act as a selector and allow a user to select the angle 60 between the first and second ladder portions 14, 16. The shifting mechanism 70 comprises a shift pattern 72 defined by a plurality of slots 74, 76, 78 positioned peripherally on the first hinge member 52. Each slot 74, 76, 78 corresponds to an angular position of the first ladder portion 14 with respect to the second ladder portion 16, and adjacent slots 74, 76, 78 are separated by a distance 80 defined along a perimeter of the first hinge member 52. As best seen in Figure 4A, a selector pin 82 can be shifted in the shift pattern 72 and received by a slot 74, 76, 78 at a first end 84 of the slot 74, 76, 78 to lock the second ladder portion 16 at an angular position with respect to the first

ladder portion 14. In the illustrated embodiments shown in Figures 4A and 4B, the shifting mechanism comprises three slots 74, 76, 78 corresponding to three angular positions at which the first and second ladder portions 14, 16 can be positioned. As shown in Figure 4C, the selector pin 82 can be released from the first end 84 and moved proximal to the second end 86 to release the first and second ladder portions 14, 16 from their locked position. Once released, the first and second ladder portions 14, 16 can be rotated with respect to each other to change the angle 60 between them.

[54] As seen in Figures 4A-4C, the hinge mechanism 48 includes one or more safety indicators. The safety indicators can be a visual indicator such as indicia or color-coded bands to indicate whether the first and second ladder portions 14, 16 are locked in an angular position. The safety indicators can be audible “click” or a tactile indicator to provide auditory or tactile feedback to the user to indicate that the first and second ladder portions 14, 16 are locked securely in an angular position. In the embodiments illustrated in Figure 4A, the safety indicators provide a first visual indication 90 (e.g., a green colored strip or zone, or other indicia in a first region 96) when the first and second ladder portions 14, 16 are locked at an angular position. In the embodiment illustrated in Figures 4B and 4C, the safety indicators provide a second visual indication 92 (e.g., a red colored strip or zone or other indicia placed in a second region 98) when the first and second ladder portions 14, 16 are unlocked. Additionally the ladder 10 can include other indicia (e.g., alphanumeric characters, images, symbols etc.) to indicate the predetermined angles at which the first and second ladder portions 14, 16 can be positioned. For instance, in the embodiment illustrated in Figure 4B, the three indicia 94 are symbolic representations of the angular positions of the ladder 10 indicating that the first and second ladder portions 14, 16 can be locked at about 0 degrees, about 30 degrees, and about 180 degrees. Such indicia 94 can also be positioned proximal to each slot 74, 76, 78 to provide information to the user as to by what rotational angle 60 the first and second ladder portions 14, 16 are to be rotated when the selector pin 82 is positioned proximal to (e.g., at or near the second end 86 of) each slot 74, 76, 78.

[55] Referring now to Figure 5, in some embodiments, the hinge mechanism 48 comprises a locking plate 100 positioned in the second hinge member 54 such that a center 110 of the

locking plate 100 is concentric with the hinge axis 50. As seen from the cross-sectional view of Figure 5, the locking plate 100 can be bolted to the second hinge member 54 such that the hinge axis 50 coincides with the center 110 of the locking plate 100.

Alternatively, the locking plate 100 can be connected to the second hinge member 54 such that it forms a frictional fit with the inner surfaces (e.g., ribs) of the second hinge member 54 such that the center 110 of the locking plate 100 is concentric with the hinge axis 50. When coupled in this manner, the locking plate 100 is fixedly positioned in the second hinge member 54 and does not move or rotate relative to the second hinge member 54.

[56] With continued reference to Figure 5, the locking plate 100 comprises a plurality of recesses 112, 114, 116. Each recess extends radially inwardly from an outer edge 118 of the locking plate 100 and toward the center 110 of the locking plate 100. The recesses 112, 114, 116 are each therefore directed radially inward towards the hinge axis 50 from an end of the second hinge member 54 due to the concentric positioning of the center 110 of the locking plate 100 and the hinge axis 50. The recesses 112, 114, 116 are spaced angularly about the hinge axis 50 such that the angular position of each recess about the hinge axis 50 corresponds to a predetermined angle 60 between the first and second ladder portions 14, 16. At this position, the selector pin 84 is received in a slot 74, 76, 78. For instance, in an exemplary embodiment, each recess can be separated from another recess by an angle 119 corresponding to the angle 60 between the first and second ladder portions 14, 16. In such cases, the number of recesses 112, 114, 116 corresponds to the number of positions at which the first and second ladder portions 14, 16 are lockable. In the illustrated embodiment, the locking plate 100 includes three recesses 112, 114, 116: a first recess 112, a second recess 114 and a third recess 116. The first and second ladder portions 14, 16 can be therefore locked at three angular positions, corresponding to an angle 119 between each of the recesses 112, 114, 116. In operation, the first and second ladder portions 14, 16 can be rotated by an angle 60 corresponding to the angle 119 between two recesses (e.g., 112 and 114, or 112 and 116) and locked therein. As described above, the angle 60 between the first and second ladder portions 14, 16 can be between about 0 degrees and about 180 degrees. For instance, the locking plate 100 in the

illustrated embodiment includes three recesses 112, 114, 116 and the first and second ladder portions 14, 16 are lockable at a first angular position, a second angular position and a third angular position at angles of about 0 degrees, about 30 degrees and about 180 degrees respectively. Accordingly, in the illustrated embodiments shown in Figure 5, the angle 119 between the first recess 112 and the second recess 114 is about 30 degrees, and the angle 119 between the first recess 112 and the third recess 116 is about 180 degrees. Additional recesses corresponding to additional lockable configurations of the first and second ladder portions 14, 16 (e.g., at about 45 degrees, about 60 degrees, about 120 degrees or other additional angles) are also contemplated.

- [57] Referring now to Figure 6, in some embodiments, the foldable ladder 10 comprises a locking pin 120 connected to the selector pin 82. The locking pin 120 has an elongate body disposed about a central axis 122 of the locking pin 120. As illustrated in Figure 6, the locking pin 120 moves in a direction along its central axis 122 into and out of a recess (112, 114, 116) and is receivable by a recess (112, 114, 116) of the locking plate 100. For instance, the locking pin 120 is received by a first recess 112 to lock the first and second angular portions at a first angle 60 (e.g., 0 degrees), at a second recess 114 to lock the first and second angular portions at a second angle 60 (e.g., 30 degrees) and at a third recess 116 to lock the first and second angular portions at a third angle 60 (e.g., 180 degrees). As described above, the locking plate 100 can have any number of recesses 112, 114, 116 and accordingly the first and second ladder portions 14, 16 can be lockable in corresponding number of angular positions. Referring back to FIG. 5, the locking pin 120 is received in the second recess 114. Correspondingly, the selector pin 82 is received in the second slot 76. The angle between the first and second ladder portions is about 30 degrees in the embodiment illustrated in FIG. 5. Other angular positions are contemplated. For instance, when the first and second ladder portions are locked at an angle 60 of about zero degrees, the locking pin 120 is fully received in the first recess 112, and the selector pin 82 is fully received in the slot 74. When the first and second ladder portions are locked at an angle 60 of about 180 degrees, the locking pin 120 is fully received in the third recess 116, and the selector pin 82 is fully received in the slot 78.

- [58] As shown in Figures 6 and 7, the locking pin 120 has a rectangular cross-section with a lengthwise edge 121 and a widthwise edge 123, although any non-circular cross-section is also contemplated. The locking pin 120 can be mounted to the first hinge member 52 for movement along its central axis 122 radially away from and towards the hinge axis 50. As will be described below, the locking pin 120 is spring-biased with a biasing spring 124 radially towards the hinge axis 50. The locking pin 120 is rotatable about its central axis 122 such that the cross-sectional shape of the locking pin 120 aligns with the shape of a recess (112, 114, 116) on the locking plate 100.
- [59] With continued reference to the embodiments illustrated in Figures 6 and 7, the locking pin 120 has an aperture 126 in which the selector pin 82 is received. The locking pin 120 and the selector pin 82 are therefore coupled such that they move in a cooperative manner as will be described below. In the illustrated embodiments, the locking pin 120 and the selector pin 82 are coupled such that the central axis 122 of the locking pin 120 is transversely located at an angle θ (e.g., 90 degrees) with respect to the axis 128 of the selector pin 82. Other angles between the axis of the locking pin 120 and the selector pin 82 are also contemplated. Referring back to Figure 5 and with continued reference to Figure 6, the selector pin 82 and the locking pin 120 can be coupled to each other such that the locking pin 120 moves into a recess (112, 114, 116) of the locking pin 120 when the selector pin 82 moves into a slot 74, 76, 78 of the shift pattern 72. Additionally, the coupling between the selector pin 82 and the locking pin 120 can be such that the locking pin 120 moves away from a recess (112, 114, 116) of the locking plate 100 when the selector pin 82 moves away from a slot 74, 76, 78 of the shift pattern 72. While Figures 5 and 6 illustrate the locking pin 120 in a position where it is received by a recess (112, 114, 116) of the locking plate 100, Figure 7 illustrates the locking pin 120 in a position where it is retracted away from the recess of the locking plate 100. As seen in Figure 7, the locking pin 120 can be spring-biased with the biasing spring 124 radially toward the hinge axis 50. When it is fully retracted away from the recess of the locking plate 100, the locking pin 120 can abut against a seat 130 when the locking pin 120 is retracted away from a recess (112, 114, 116) of the locking plate 100. As described previously, the first ladder portion 14 and the second ladder portion 16 are rotatable with respect to each

other about the hinge axis 50. The rotation of the first ladder portion 14 and second ladder portion 16 with respect to each other can position the locking pin 120 proximal to a recess (e.g., at a ladder angle opening 132). Once the angle 60 between the first and second ladder portions 14, 16 is adjusted to correspond to the angle 119 between any two of the recesses (112, 114, 116) of the locking plate 100, the locking pin 120 is brought proximal to a recess (112, 114, 116), and extends into the recess due to the spring action from a spring housed in the seat 130.

[60] As described previously, the engagement between the locking pin 120 and the selector pin 82 allows the locking pin 120 to be received fully into a recess (e.g., second recess 114 shown in Figure 5) to lock the first ladder portion 14 and the second ladder portion 16 in an angular position and fully retract from a recess (112, 114, 116) to release the first and second ladder portions 14, 16 from an angular position. When the locking pin 120 is fully received in the recess, the entire length of the recess is occupied by at least a first end 134 of the locking pin 120, as seen in Figures 5 and 6. In this position, the selector pin 82 is received in a slot 74, 76, 78 (e.g., second slot 76 as shown in Figure 5) such that the selector pin 82 rests in the first end 84 of the slot 74, 76, 78. In the fully received position, the first and second ladder portions 14, 16 are locked with respect to each other and an angle 60 between them is fixed. When the locking pin 120 is fully released from the recess (e.g., second recess 114, as shown in Figure 7), a second end 136 of the locking pin 120 is seated against the seat 130. In the fully released position, the first end 134 of the locking pin 120 retracts almost entirely from the recess. Correspondingly, the selector pin 82 moves to the second end 86 of the slot 74, 76, 78 (e.g., second slot 76 best seen in Figure 5). In the fully released position, the first and second ladder portions 14, 16 are rotatable and an angle 60 between them can be changed. Prior to changing the angle 60 between the first and second ladder portions 14, 16, the selector pin 82 can be positioned proximal to another slot 74, 76, 78 (e.g., first slot 74 or third slot 78 shown in Figure 5). When the first and second ladder portions 14, 16 are rotated to a desired angular position, the locking pin 120 is received by another recess (e.g., first or third recess 112, 116) and the selector pin 82 is received by the first end 84 of another slot 74, 76, 78 (e.g., first or third slot 78).

- [61] Referring now to Figures 8A and 8B, the locking pin 120 can be shaped and oriented such that the locking pin 120 abuts against the edge 62 of the second hinge member 54 when the first and second ladder portions 14, 16 are angled at any angle 60 other than a plurality of predetermined angles. As seen from the close up view of Figure 8B, each recess has a corresponding ladder angle opening 132 defined in the edge 62 of the second hinge member 54. Each ladder angle opening 132 has an opening shape. The opening shape can permit insertion of the locking pin 120 therethrough when the locking pin 120 is rotated about its central axis 122 to a rotation where the orientation of the locking pin 120 cross-section generally matches the opening shape as (e.g., as shown in Figures 5 and 6). As seen in Figures 8A and 8B, the opening shape of a ladder angle opening 132 can block insertion of the locking pin 120 therethrough when locking pin 120 is rotated about its central axis 122 to a rotation where the orientation of the locking pin 120 cross-section does not generally match the opening shape. As shown in Figures 8A and 8B, the lengthwise edge 121 and the widthwise edge 123 do not match the opening shape of the ladder angle opening 132 of the recess 112, thereby preventing the passage of the locking pin 120 into the recess 112. In the illustrated embodiment, each recess is disposed radially inwardly along a radial line 138 toward the hinge axis 50. When the locking plate 100 is positioned concentrically with the hinge axis 50, the center 110 of the locking plate coincides with the intersecting point of the radial lines 138. The recesses 112, 114, 116 are rectangular, and the ladder angle opening shapes allow passage of the locking pin 120 having a rectangular cross-section oriented such that the central axis 122 of the locking pin 120 is inline with a radial line 138 of the recess, and the locking pin 120 rotated about its central axis 122 such that the cross-section of the locking pin 120 aligns with the opening shape of the ladder angle opening 132.
- [62] Referring back to Figures 5 and 6, the locking pin 120 is rotatable about its central axis 122 by a selection collar 142. As described above, each recess has a ladder angle opening 132 that allow passage of the locking pin 120 therethrough when the locking pin 120 is rotated about its central axis 122 so as to match the opening shape. In such cases, the ladder angle selector permits manual selection of the desired angle 60 between the first and second ladder portions 14, 16. In some embodiments, the ladder angle selector is a

selection collar 142 slidably engaging with the first hinge member 52. The selection collar 142 rigidly engages with the selector pin 82. In turn, the selector pin 82 engages rigidly with the locking pin 120, thereby allowing the selection collar 142 to manipulate the movement and rotation of the locking pin 120. For instance as shown in Figure 5, the selection collar 142 can slide against the first hinge member 52 along a collar axis 144 along a direction illustrated by the arrow “d” defined generally parallel to the collar axis 144 and the central axis 122 of the locking pin 120. As the selection collar 142 slides along the direction “d”, the selector pin 82 moves along with the selection collar 142 and out of the second slot 76 in the direction “d” toward the second end 86 of the second slot 76 (best illustrated in Figure 4C). In turn, referring back to Figure 5, the locking pin 120 moves along the direction “d” parallel to its central axis 122, and radially outwardly from the second recess 114. When the selector pin 82 rests against the second end 86 of the second slot 76, the second end 136 of the locking pin 120 abuts against the seat 130 (best seen in Figure 7).

[63] Referring back to Figures 4A-4C and 5, when the selection collar 142 moves in a direction “d” such that the selector pin 82 moves to the second end 86 of the second slot 76, the first and second ladder portions 14, 16 are not locked in an angular position. Accordingly, as described above, the second region 98 previously hidden under the selection collar 142 when the first and second ladder portions 14, 16 were locked becomes visible to the user to indicate that the first and second ladder portions 14, 16 are not locked securely. Once the angle 60 between the first and second ladder portions 14, 16 are adjusted to the desired angle the locking pin 120 moves along direction “f” due to it being spring biased toward the hinge axis 50. The direction “d” can be opposite to direction “f”. The selector pin 82 moves along direction “f” and proximal to the first end 84 of the second slot 76. During this movement, the selection collar 142 also moves along direction “f” due to the rigid coupling between the selection collar 142, the locking pin 120 and the selector pin 82. The locking pin 120 is received in a recess (112, 114 or 116) and the selector pin 82 is received in a slot 74, 76, 78, thereby preventing any relative rotational motion about the hinge axis 50 between the first and second hinge members 52, 54 and the first and second ladder portions 14, 16 connected thereto. As the

selection collar 142 moves along the direction “f”, the first region 96 previously hidden under the selection collar 142 when the first and second ladder portions 14, 16 were unlocked, becomes visible to the user to indicate that the first and second ladder portions 14, 16 are securely locked.

- [64] With continued reference to Figures 4A-4C and Figure 5, the selection collar 142 can be rotatable about the collar axis 144 with respect to the first hinge member 52. As the selection collar 142 is rotated (e.g., along the direction “e” about the collar axis 144 illustrated in Figure 5), the selector pin 82 moves along the shift pattern 72 defined on the first hinge member 52. For instance, the selection collar 142 can be moved until the selection pin moves adjacent to the third slot 78. As the selection collar 142 rotates about the collar axis 144 with respect to the first hinge member 52, the rigid coupling between the selector pin 82 and the locking pin 120 transmits the rotational motion of the selection collar 142 and rotates the locking pin 120 about its central axis 122. When the selection collar 142 rotates sufficiently to bring the selector pin 82 proximal to the third slot 78 (e.g., at the second end 86 of the third slot 78), the locking pin 120 is rotated about its central axis 122 such that its cross-section matches the opening shape of the third recess 116. Such manual manipulation can allow a user to manually select the desired angle 60 out of a plurality of predetermined angles between the first and second ladder portions 14, 16.
- [65] In use, a user can unfold a ladder 10 from its angular position during storage (e.g., the first and second ladder portions 14, 16 forming an angle 60 of about 0 degrees as illustrated in Figure 1A). Referring to Figures 4A-4C, the user can shift the selection collar 142 along a direction “d” and rotate the selection collar 142 in a direction “e” until the selection pin is proximal to the second end 86 of another slot 74, 76, 78. The rotational motion of the selection collar 142 rotates the locking pin 120 about its central axis 122 such that the cross-section of the locking pin 120 matches a ladder angle opening 132 of a recess (112, 114, 116). The user can then rotate first and second ladder portions 14, 16 with respect to each other to the desired angle 60 (chosen from predetermined angles at which the first and second ladder portions 14, 16 can be locked). Once the desired angle 60 is reached, the locking pin 120 is automatically pushed into a

recess (112, 114 or 116) because the locking pin 120 is spring-biased toward the hinge axis 50 along a direction “f”. The selector pin 82 and the selection collar 142 are also move along the direction “f”. The first and second ladder portions 14, 16 are locked in the desired angular position, and the selector pin 82 rests in the first end 84 of a slot 74, 76, 78 corresponding to the desired angular position. The first and second ladder portions 14, 16 may not be further rotated until the locking pin 120 is released from the recess (112, 114 or 116) by moving the selection collar 142 along the direction “d” and repeating the steps described above.

- [66] Embodiments of the foldable ladder described herein can allow a user to fold a ladder for storage to minimize footprint and unfold it and lock it securely in a plurality of angles. Embodiments of the foldable ladder described herein are safe and easy to use.
- [67] Figure 9A is a front perspective view of a ladder 210 according to some embodiments. Figures 9B-9D are front perspective views of a ladder 210 unfolded from its folded position illustrated in Figure 9A and locked at various angles, according to some embodiments. In Figures 9B and 9C, the ladder 210 has been unfolded from its folded position in Figure 9A and locked at an angle of about 180 degrees. In Figure 9D, the ladder 210 has been locked at an angle of about 30 degrees. In Figure 9B an upper portion 222 of the ladder 210 is in a collapsed state, whereas in Figure 9C, the upper portion 222 of the ladder 210 is in an extended state.
- [68] Referring now to Figure 9A, the telescoping ladder 210 comprises a first stile 214 and a second stile 216 (e.g., left hand and right hand stiles illustrated in Figure 9A). The first and second stiles each have a plurality of columns 218 disposed in a nested arrangement for relative axial movement in a telescopic fashion along an axis 220 of the plurality of columns 218 between an extended position and a collapsed position. For instance, in Figure 9A, an upper portion 222 of the ladder 210 is shown in a collapsed position where the columns 218 are nested within each other along the axis 220 of the columns 218 in a telescoping fashion, and in Figure 9D, the upper portion 222 of the ladder 210 is shown in an extended position.
- [69] As seen in Figure 9A, the ladder 210 comprises a plurality of rungs 224 extending between the first stile 214 and the second stile 216. Each rung 224 can be connected to a

column 218 of the first stile 214 and a column 218 of the second stile 216. As shown in Figure 9A, each rung 224 can be connected to the columns 218 by a connector assembly 226. With continued reference to Figure 9A, in some cases, each rung 224 comprises a planar first surface 228 and a planar second surface 230 opposite to the planar first surface 228. The first surface 228 of each rung 224 of the first ladder portion 250 defines a planar standing surface 232. At least one of the planar first and second surfaces 228, 230 of the second ladder portion 254 defines a planar standing surface 232. Referring to Figures 9B and 9C, when the ladder 210 is unfolded for use, the first surface 228 of each rung 224 of the second ladder portion 254 has a planar standing surface. However, when ladder 210 is folded for storage or unfolded to angles other than about 180 degrees (e.g., as shown in Figure 9A or 9D), the first surface 228 of each rung 224 of the second ladder portion 254 may not face the top and therefore the planar standing surface 232 may be defined on the underside of the rung 224 when the rung 224 is folded for storage or unfolded to angles other than 180 degrees. The planar standing surface 232 of each rung 224 of the first and second ladder portions 250, 254 may have treads 234 defined therein to provide friction between the planar standing surface and the contact surface of a user (e.g., soles of the user's shoes). As will be described herein, the rungs 224 can be substantially hollow so as to allow a connector assembly 226 to fasten the rung 224 to a column 218 on each of the right-hand stile and left-hand side stile. The rungs 224 can be extruded from aluminum, although other materials and means of manufacturing can also be used.

- [70]** While Figures 9A-9D illustrate a rung 224 with a substantially rectangular cross-section, other cross-sectional shapes of the rung 224 are also contemplated. For instance, the rung 224 can have a parallelogram cross-section such as those illustrated in U.S. Publication No. 2012/0267197 A1, assigned to the assignee of the instant application. While the illustrated Figures 9A-9D show a substantially rectangular rung 224, as best seen in Figure 10D, at least a portion 238 of the first surface 228 of the first and second ladder portions 250, 254 can form an angle θ with respect to a horizontal plane 242. In the illustrated embodiment, when the angled portion 238 of the first surface 228 form an angle with respect to a horizontal plane (not shown). The angled portion 238 can form an

angle between about 5 degrees and 45 degrees (e.g., between 5 degrees and 20 degrees) with respect to the horizontal plane 242. Such embodiments allow at least the angled portion 238 of the first surface 228 of the rung 224 to be horizontal when the ladder 210 is rotated towards a vertical wall (e.g., propped against a wall at an angle) so that during normal use, at least a portion 238 of the rung 224 can be nearly horizontal. However, depending on the angle at which the ladder 210 is propped against a vertical wall, the angled portion 238 may be past or short of being horizontal.

- [71] In some embodiments, the columns 218 are made of aluminum. Other materials are contemplated and are within the scope of the invention. The columns 218 are illustrated as having a circular cross-section (when viewed along the axis 220 of the columns 218). However, the columns 218 can have a rectangular cross-section such as those illustrated in U.S. Publication No. 2012/0267197 A1 assigned to the assignee of the instant application. Other cross-sections (e.g., square, oval or polygonal shapes) are also contemplated. The columns 218 can be substantially hollow to receive another column 218 from above. Additionally, the rungs 224 can be substantially hollow such that a pair of latch assemblies (not shown) can be housed in the hollow rung 224.
- [72] As described above, the rungs 224 are connected to the columns 218 by a plurality of connector assemblies 226. The connector assemblies 226 can have latch assemblies housed in the hollow portion of each rung 224 to unlock or selectively lock relative axial movement between adjacent columns 218. Such connector assemblies 226 are described in U.S. Patent No. 8,387,753 B2 and U.S. Patent No. US 6,883,645 both assigned to the assignee of the instant application. Each latch assembly has a release button 246 that can be manually actuatable to unlock the selectively locked relative axial movement between two adjacent columns 218. In the embodiment shown in Figure 9A, the release buttons may be slid inwardly along a front surface 248 of rung 224 (e.g., by the thumbs of the user), to unlock their respective latch assemblies. Thus, when release buttons on both the right and left hand sides of rung 224 are actuated, adjacent columns 218 are permitted to move axially. Gravity can cause such columns 218 and their rung 224 to collapse downward to assume a position similar to rungs 224 shown in the collapsed portion of the ladder 210 shown in Figure 9A.

- [73] In some cases, the ladder 210 can comprise a first ladder portion 250 and a second ladder portion 254 that are coupled to each other in a hinged fashion. For instance, the ladder 210 is foldable such that the first and second ladder portions 250, 254 form a first angle 258 therebetween. The first angle 258 can be equal to between about zero degrees and about 180 degrees. In Figure 9A, the first angle 258 is about zero degrees. In Figures 9B and 9C, the first angle 258 is about 180 degrees. In Figure 9D, the first angle 258 is about 30 degrees. Each of the first and second ladder portions 250, 254 can have a first stile 214 and a second stile 216 having a plurality of columns 218, and a plurality of rungs 224 extending between the columns 218. The first and second ladder portions 250, 254 can be locked at various angular positions by hinge mechanisms known in the art. An exemplary hinge mechanism 260 is described and illustrated in the co-pending U.S. Application No. 14/557,944 titled “Foldable ladder”, assigned to the assignee of the instant application, filed on December 2, 2014.
- [74] Referring now to Figures 10A and 10B, the first stile 214 comprises a first column 264 and the second stile 216 comprises a second column 268. The first and second columns 218 each have a hollow body. The first and second columns 218 can be connected to a first stabilizer housing 270. The first stabilizer housing 270 and the first and second columns 218 can be proximal to a floor surface 272 on which the ladder 210 is positioned during use. The first stabilizer housing 270 and the first and second columns 218 can be coupled by a pair of connector assemblies 226 as described above. Alternatively, a connector 274 can fixedly connect the first and second columns 218 to the first stabilizer housing 270. The connector 274 can have a connector opening 276 (e.g., best illustrated in Figure 16) for receiving the first stabilizer housing 270. The connector 274 additionally receives the first and second columns 218 in an interior surface 278 thereof. The first and second columns 218 form a friction fit with the interior surface 278 of the connector 274.

- [75] Referring back to Figures 10A and 10B, the ladder 210 can include a first stabilizer 280 and a second stabilizer 282 connected to the first stabilizer housing 270. The first and second stabilizers 280, 282 can each move between an extended position and a collapsed position. The first and second stabilizers 280, 282 can be substantially similar although the right hand side stabilizer 282 can be a mirror image of the left hand side stabilizer 280 (about the axis 220 of the columns 218). The first and second stabilizers 280, 282 are movable slidingly with respect to the first stabilizer housing 270. In some cases, the first and second stabilizers 280, 282 can be extended independently. For instance, the first stabilizer 280 can be extended while the second stabilizer 282 is collapsed and vice versa, as illustrated in Figure 10C. As seen in Figures 10B and 10C, the first and second stabilizers 280, 282 can collapse into a hollow body portion 286 of the first stabilizer housing 270 in the collapsed position. In the extended position, the first and second stabilizers 280, 282 extend out of the hollow body portion 286 of the first stabilizer housing 270 past one of the first and second stiles in a direction substantially normal to the axis 220 of the plurality of columns 218.
- [76] Referring now to Figures 11A-11B and 12, the first stabilizer housing 270 has an aperture 290 defined coaxially with the axis 220 of the plurality of columns 218. As shown in Figure 13, each of the first and second stabilizers 280, 282 has a locking button 294 that can protrude past the aperture 290 defined on the first stabilizer housing 270 to lock the stabilizer 280, 282 in an extended position. The locking button 294 can be generally in a depressed position when the first and second stabilizers 280, 282 are collapsed and abut against an inner surface 296 of the first stabilizer housing 270 and are proximal to a centerline 310 of the first stabilizer housing 270 through which the locking buttons can protrude past when the first and second stabilizers 280, 282 are in a collapsed position. When the first and second stabilizers 280, 282 are drawn out to an extended position, the locking buttons remain depressed and abut against an inner surface 296 of the first stabilizer housing 270. Upon encountering the aperture 290, the locking buttons protrude past them and thereby lock the first and second stabilizers 280, 282 and prevent them from moving slidingly with respect to the first stabilizer housing 270. When the locking buttons protrude past the aperture 290, the locking buttons lock the stabilizers 280, 282 in

the extended position. Such configurations can be used to improve the stability of the ladder 210 by having a center of gravity of the ladder 210 fall within the footprint of the ladder 210.

[77] Referring back to Figure 11A-11B, the first and second columns 218 each have a flange 320 positioned in the hollow body of the first and second columns 218 coaxially with the axis 220 of the plurality of columns 218. Figure 12 illustrates a close-up perspective view of the flanges of the first and second columns 218 (not shown in Figure 12). As seen in Figures 11A-11B and 12, the flange 320 of the first and second columns 218 can depress the locking button 294 away from the aperture 290, thereby releasing the first and second stabilizers 280, 282 from their locked position, as a result of which the first and second stabilizers 280, 282 move generally inwardly into the hollow body portion 286 of the first stabilizer housing 270. The flanges can be positioned and oriented in the first and second columns 218 such that when a column (e.g., column 370 or column 380 shown in Figure 10A) above each of the first and second columns 264, 268 nests therein, the flanges are pushed in a direction toward the first stabilizer housing 270 (e.g., from a distance “a” shown in Figure 19B to a distance “b”). Referring to Figure 11A-11B, the flange 320 abuts against the locking button 294 protruding past the aperture 290 of the first stabilizer housing 270 due to the telescoping movement of the first column 264 toward the first stabilizer housing 270, the locking button 294 is pushed away from the aperture 290 thereby unlocking the first stabilizer 280 from its extended position and moving it into a collapsed position.

Figure 14 is a perspective view of a stabilizer 280, 282 according to an embodiment of the invention. Figure 15A is a side view of the stabilizer 280, 282 of Figure 14 with the end cap 330 removed. As seen in Figures 14 and 15A, the stabilizer 280, 282 has a generally hollow body portion with a length “L1” equal to about one-half the length of the first stabilizer housing 270 “L2”. The first and second stabilizers 280, 282 shown in the embodiments above, for instance, can both have a length L1, and the first stabilizer housing 270 can have a length L2, allowing both the first and second stabilizers 280, 282 to abut against each other when collapsed. The length of the stabilizer 280, 282 can be measured from a first end 332 of the stabilizer 280, 282 to the second end 334 and may

not include the end cap 330 of the stabilizer 280, 282 of any other additional caps. Likewise, the length of the first stabilizer housing 270 can be an end-to-end length of the body portion of the first stabilizer housing 270. The stabilizer 280, 282 is of a parallelogram cross-section to facilitate sliding engagement with the first stabilizer housing 270 (also having a parallelogram cross-section as shown in Figure 15B). Referring back to Figures 14 and 15A, a first surface 340 of the stabilizer 280, 282 is generally planar and a second surface 342 of the stabilizer 280, 282 has one or more recessed tracks 344. The first and second surfaces 340, 342 are generally parallel and opposite to each other, and form an angle "A" with respect to the horizontal plane 242. When positioned in the first stabilizer housing 270, the first surface 340 forms a top surface, the second surface 342 forms a bottom surface 212. The stabilizer 280, 282 also has a third surface 346 and fourth surface 348 that form the parallelogram shape of the stabilizer 280, 282. As described above, other shapes of the stabilizer 280, 282 are also contemplated, corresponding to the shape of the first stabilizer housing 270 (e.g., rectangular). Referring to Figures 15A and 15B, a connecting member 350 connects the stabilizer 280, 282 to the hollow body portion 286 of the first stabilizer housing 270. For instance, the connecting member 350 is a square-headed bolt or screw resting in the recessed portions of the tracks of the stabilizer 280, 282 and forming a frictional fit therewith. One or more ends of the connecting member 350 can rest against inner surface 296 of the first stabilizer housing 270 and facilitate sliding movement of the stabilizer 280, 282 with respect to the first stabilizer housing 270. As mentioned above, the locking button 294 extends past the first surface 340 of the stabilizer 280, 282 (e.g., out of the aperture 290 best illustrated in Figure 16). The locking button 294 can be spring-biased to protrude out of the aperture 352 of the stabilizer 280, 282, and consequently aperture 290 of the first stabilizer housing 270 by a clamp 360. An end 364 of the clamp 360 is received by the second surface 342 of the stabilizer 280, 282 (e.g., via a slot, not illustrated) and an opposite end 362 of the clamp 360 is received by a slot 366 on the first surface 340 of the stabilizer 280, 282. The stabilizer 280, 282 can also have an end cap 330 having a cross-section greater than the cross-sectional area of the hollow body portion 286 of the first stabilizer housing 270. The end cap 330 therefore does not

collapse into the first stabilizer housing 270 when the stabilizer 280, 282 is collapsed. Such embodiments facilitate accessing the stabilizer 280, 282 manually to extend it from its collapsed position. In addition to the end cap 330, the stabilizer 280, 282 can have an additional cap 368 positioned proximal to the centerline 310 of the first stabilizer housing 270 and within the hollow body portion 286 of the first stabilizer housing 270.

[79] As mentioned above, and referring now to Figure 17, the locking buttons of the stabilizers 280, 282 can be actuated by flanges positioned in the first and second columns 218 due to nesting telescoping movement of the plurality of columns 218 into the first and second columns 218 (not shown in Figure 17). Figure 17 illustrates a third column 370 positioned above the first column 264. Likewise, a fourth column 380 can be positioned above the second column 268 (best seen in Figure 10A). Referring back to Figure 17, the third column 370 can nest within and extend from the first column 264 along the axis 220 of the plurality of columns 218. In some cases, each column can include an air damper 200 positioned coaxially with the axis 220 of the column to limit the relative axial movement of the plurality of columns 218. In the illustrated embodiment, the air damper 200 caps a bottom perimeter edge 210 of the third column 370 to restrict air flow through the third column 370. An exemplary air damper 200 is described in U.S. Publication No. 2012/0267197 A1 assigned to the assignee of the instant application. As illustrated, the flange 320 can extend from a bottom surface 412 of a first air damper 400 positioned within the first column 264 of the first stile 214. As seen in Figure 17, the first air damper 400 is coaxial with the locking button 294 of the first stabilizer 280 when the locking button 294 protrudes past the aperture 290 of the first stabilizer housing 270 in an extended position.

[80] Referring now to Figures 18 and 19, the air dampers 400 can each have a tab 414 defined on a perimeter surface thereof to facilitate insertion into the third column 370 and prevent removal of the air damper 400 from the third column 370. The tab 414 has a tapered leading edge 416 facilitating engagement with a corresponding opening 418 of the third column 370, and an upright trailing edge 420 preventing removal of the tapered tab 414 from the third column 370. The air damper 400 is coupled to the third column 370 such

that the tabs of the air damper 400 protrude past corresponding openings (best seen in Figure 19A) of the third column 370. The air damper 400 can be positioned such that the openings are proximal to the bottom perimeter edge of the third column 370. The air damper 400 is coupled to the third column 370 so that the nesting movement of the third column 370 toward the first column 264 moves the flange 320 of the air damper 400 toward the aperture 290 of the first stabilizer housing 270. As additional columns 218 descend toward the first column 264 from above, the air damper 400 is moved even more proximal to the first stabilizer housing 270 until the flange 320 abuts against the locking button 294 protruding past the aperture 290. The flange 320 of the first air damper 200 can then push the locking button 294 away from the aperture 290 and collapses the first stabilizer 280 when the third column 370 is fully nested within the first column 264. The air damper 400 can also have a recessed portion 422 on a perimeter surface 410 thereof. The recessed portion 422 can receive a locking pin 430 (as shown in Figure 17) that locks the first and third columns 218 to prevent relative axial movement therebetween.

- [81] While the embodiments above have been described with respect to one half of a foldable ladder 210 (e.g., the first ladder portion 250), the stabilizers 280, 282 of the second ladder portion 254 are substantially similar to those of the first ladder portion 250. For instance, the second ladder portion 254 can comprise a second stabilizer housing 440 having a pair of stabilizers 280, 282 that extend past each of the first and second stiles of the second ladder portion 254 in a direction substantially normal to the axis 220 of the plurality of columns 218 and collapse into a hollow portion of the second stabilizer housing 440. The second stabilizer housing 440 can be proximal to the floor surface 272 when the first and second ladder portions 250, 254 form angles such as between about zero degrees and about 60 degrees (e.g., 0 degrees as illustrated in Figure 9A and 30 degrees as illustrated in Figure 9D), whereas the second stabilizer housing 440 is distal to the floor surface 72 when the first and second ladder portions 250, 254 form angles greater than 90 degrees (e.g., 180 degrees as illustrated in Figures 9B and 9C). The stabilizers 280, 282 of the second ladder portion 254 can collapse into the hollow portion of the second stabilizer housing 440 when the plurality of columns 218 are nested within each other in a telescopic fashion to collapse the ladder 210 into a collapsed position (e.g., as seen in

Figure 9A and 9B), and wherein the stabilizers 280, 282 of the second ladder 210 portions can extend out of the second stabilizer housing 440 when the plurality of columns 218 extended in a telescopic fashion (e.g., as seen in Figures 9C and 9D).

[82] In use, when the columns 218 of the first and second ladder portions 250, 254 are extended, the flange 320 moves away from the aperture 290 of the first stabilizer housing 270 of the first ladder portion 250 and the second stabilizer housing 440 of the second ladder portion 254. The stabilizers 280, 282 of the first and second ladder portions 250, 254 extend out of the first and second stabilizer housings 270, 440 respectively until the locking buttons protrude past the apertures inline with the axis 220 of the columns 218. The first and second ladder portions 250, 254 can be locked at a desired angular position. The ladder 210 can be folded and the stabilizers 280, 282 can be collapsed during storage. To collapse the stabilizers 280, 282, the first and second ladder portions 250, 254 can first be unlocked from a desired angular position. The columns 218 of each of the first and second ladder portions 250, 254 can then be collapsed until a third column 370 fully nests inside the first column 264 and a fourth column 380 fully nests inside the second column 268. The flanges 320 of air dampers 400 of the third and fourth columns 218 abut against the aperture 290 and the locking button 294 protruding past it when the third and fourth columns 218 fully nest within the first and second columns 218. The flange 320 pushes the locking button 294 inwardly into the hollow portion of the respective stabilizer housing (e.g., first and second stabilizer housing 270, 440), and thereby collapses the stabilizers 280, 282 for storage.

[83] Certain embodiments of the telescoping ladder 210 illustrated herein can improve safety by stabilizing the ladder 210 during use. For instance, some embodiments of the telescoping ladder 210 with stabilizers 280, 282 extending therefrom ensure that the center of gravity of the ladder 210 always falls within the horizontal extent (e.g., footprint) of the ladder 210 during use, thereby minimizing or eliminating any moments that may overturn the ladder 210 during operation. Additionally, the stabilizers 280, 282 can be collapsed during storage, thereby facilitating compact footprint of the ladder 210 when not in use. Further, collapsing the columns 218 of the ladder 210 automatically collapses the stabilizers 280, 282 thereby offering ease of use.

[84] Thus, embodiments of the ladder are disclosed. Although the present embodiments has been described in considerable detail with reference to certain disclosed embodiments, the disclosed embodiments are presented for purposes of illustration and not limitation and other embodiments are possible. One skilled in the art will appreciate that various changes, adaptations, and modifications may be made without departing from the spirit of the invention.

CLAIMS

1. A telescoping ladder, comprising:

a first stile,

a second stile, the first and second stiles each having,

a plurality of columns disposed in a nested arrangement for relative axial movement in a telescopic fashion along an axis of the plurality of columns between an extended position and a collapsed position, wherein,

a first column of the first stile and a second column of the second stile each having a hollow body, the first and second columns being proximal to a floor surface on which the ladder is positioned, the first column having a flange positioned in the hollow body of the first column coaxially with the axis of the plurality of columns,

a plurality of rungs extending between the first stile and the second stile, each rung connected to a column of the first stile and a column of the second stile;

a first stabilizer housing being connected to the first and second columns, the first stabilizer housing being proximal to the floor surface on which the telescoping ladder is positioned, the first stabilizer housing having a hollow body portion;

a first stabilizer slidably connected to the first stabilizer housing, the first stabilizer adapted to move between an extended position and a collapsed position, wherein, in the extended position, the first stabilizer extends out of the hollow body portion of the first stabilizer housing, the first stabilizer extending past the first stile in a direction normal to the axis of the plurality of columns in the extended position, and the first stabilizer adapted to collapse into the hollow body portion of the first stabilizer housing in the collapsed position, the first stabilizer comprising a locking button adapted to protrude past an aperture defined on the first stabilizer housing to lock the first stabilizer in its extended position, wherein, the locking button and the aperture are coaxial to the axis of the plurality of columns in the extended position of the first stabilizer, and wherein the flange abuts against the locking button protruding past the aperture of the first stabilizer housing due to the telescoping movement of the plurality of columns in a direction toward the first stabilizer housing, the abutment of the flange against the locking button pushing

the locking button away from the aperture and thereby unlocking the first stabilizer from its extended position and into the collapsed position; and

a plurality of air dampers positioned coaxially within the plurality of columns, the air dampers adapted to limit the relative axial movement of the plurality of columns, wherein the flange extends from a bottom surface of a first air damper of the plurality of air dampers, the first air damper being coaxial with the locking button of the first stabilizer when the locking button protrudes past the aperture of the first stabilizer housing in the extended position of the first stabilizer.

2. The telescoping ladder of claim 1 further comprising a second stabilizer connected to the first stabilizer housing, the second stabilizer being actuable by a flange positioned on the bottom surface of the plurality of air dampers a second air damper, the second stabilizer being actuable between the extended position to extend past the plurality of columns in a direction perpendicular to the axis of the plurality of columns, and the collapsed position to collapse slidingly into the hollow body portion of the first stabilizer housing.

3. The telescoping ladder of claim 2, wherein the first air damper is coupled to a third column such that nesting movement of the third column toward the first column moves the flange of the first air damper toward the aperture of the first stabilizer housing.

4. The telescoping ladder of claim 3, wherein the first air damper has a tab defined on a perimeter surface thereof, the tab having a tapered leading edge facilitating engagement with a corresponding opening of the third column, and an upright trailing edge preventing removal of the tab from the third column.

5. The telescoping ladder of claim 4, wherein the flange of the first air damper is adapted to push the locking button away from the aperture and collapses the first stabilizer when the third column is fully nested within the first column.

6. The telescoping ladder of claim 5, wherein the first air damper is coupled to the third column such that tabs of the first air damper protrude past corresponding openings of the third column, the openings of the third column being proximal to a bottom perimeter edge of the third column.

7. The telescoping ladder of claim 2, wherein the first and second stabilizers have a length equal to about one-half of a length of the first stabilizer housing.

8. The telescoping ladder of claim 1, wherein the telescoping ladder is foldable, the telescoping ladder comprising;

a first ladder portion defined by and including the first and second stiles, the plurality of rungs, the first stabilizer housing and the first stabilizer,

a second ladder portion hingedly connected to the first ladder portion such that the first and second ladder portions are rotatable about a hinge axis, the second ladder portion comprising:

a first stile,

a second stile, the first and second stiles of the second ladder portion each having

a plurality of columns disposed in a nested arrangement for relative axial movement in a telescopic fashion along an axis of the plurality of columns between an extended position and a collapsed position, and a plurality of rungs extending between the first and second stiles of the second ladder portion, each rung connected to a column of the first stile of the second ladder portion and a column of the second stile of the second ladder portion.

9. The foldable telescoping ladder of claim 8, wherein the first and second ladder portions are foldable such that they form a first angle therebetween, the first angle being equal to between about zero degrees and about 180 degrees.

10. The foldable telescoping ladder of claim 9, further comprising a second stabilizer housing of the second ladder portion, the second stabilizer housing comprising a pair of stabilizers each adapted to extend past each of the first and second stiles of the second ladder portion in a direction normal to the axis of the plurality of columns of the second ladder portion and collapse into a hollow portion of the second stabilizer housing.

11. The foldable telescoping ladder of claim 10, wherein the second stabilizer housing is proximal to the floor surface on which the ladder is mounted when the first and second ladder portions form an angle of about zero degrees therebetween.

12. The foldable telescoping ladder of claim 10, wherein the pair of stabilizers of the second ladder portion are adapted to collapse into the hollow body portion of the second stabilizer housing when the plurality of columns of the second ladder portion are nested within each other in a telescopic fashion to collapse the ladder into a collapsed position, and wherein the pair of stabilizers of the second ladder portion are adapted to extend out of the second stabilizer housing when the plurality of columns of the second ladder portion are adapted to extend in a telescopic fashion.

13. The foldable telescoping ladder of claim 8, wherein each stabilizer of the first ladder portion and the second ladder portion is extensible independently and separately of the other stabilizers.

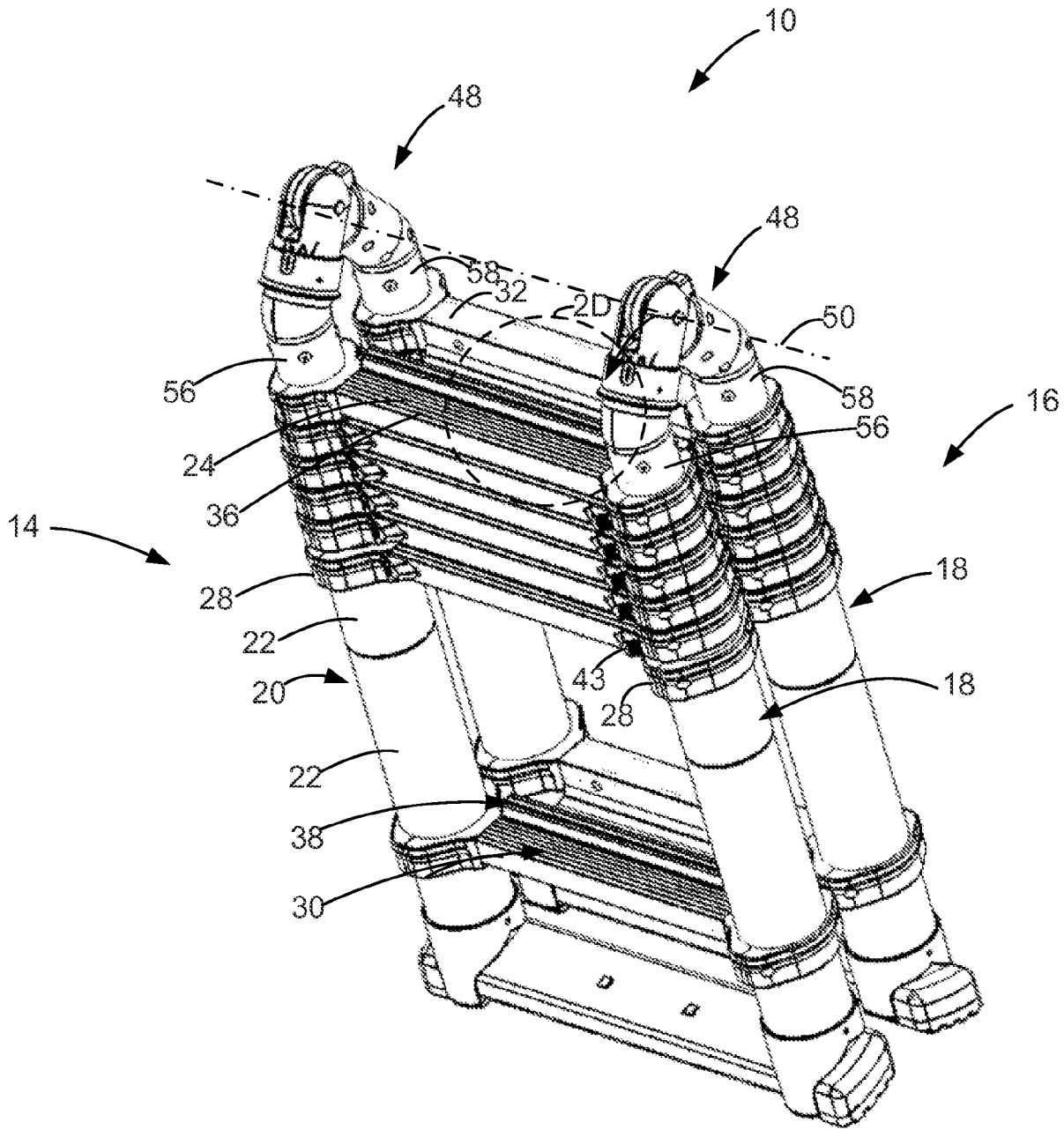


FIG. 1A

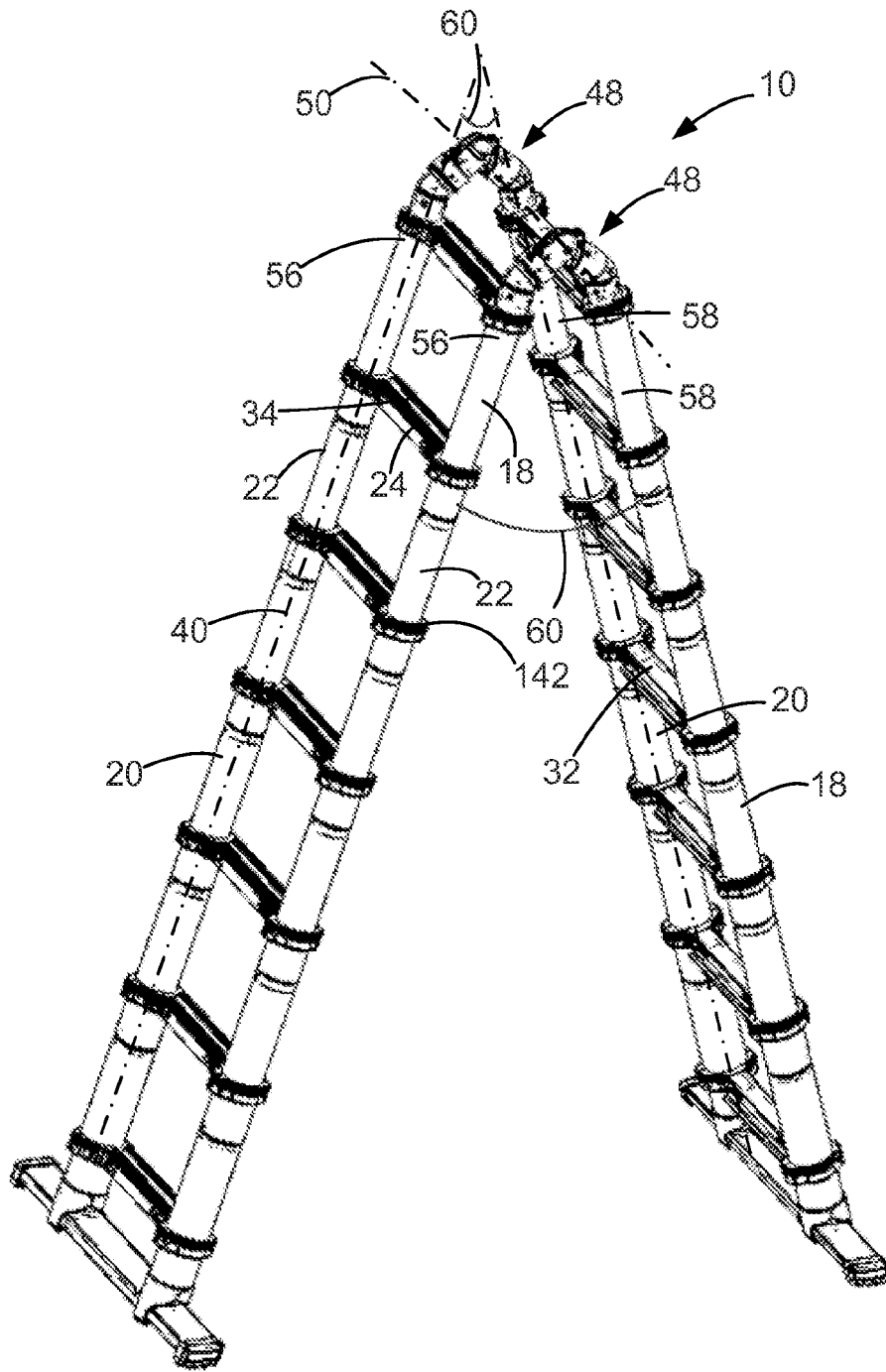


FIG. 1B

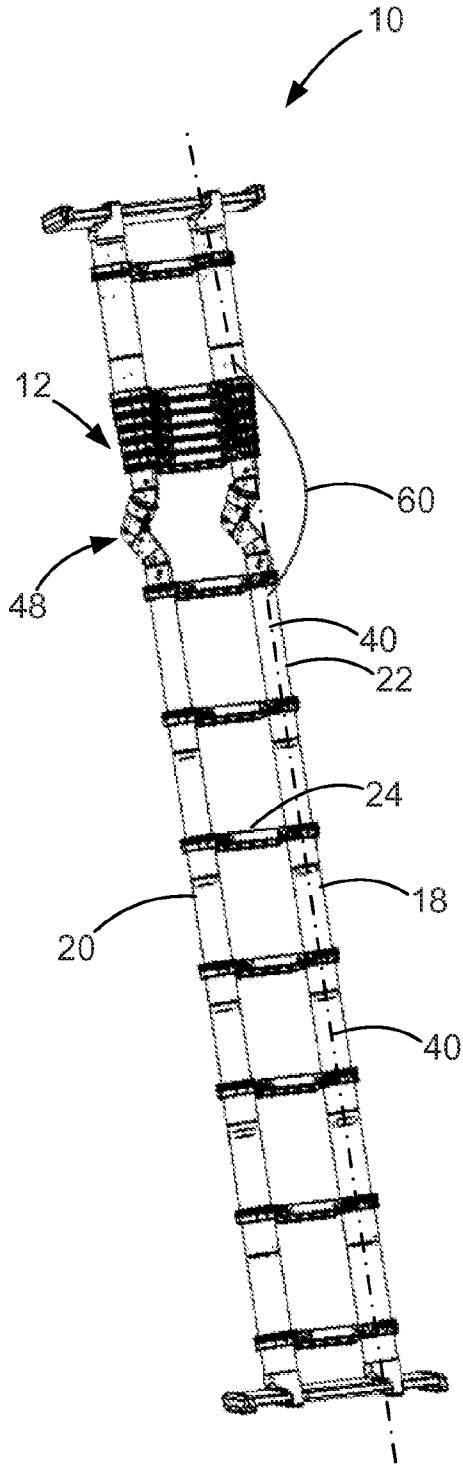


FIG. 2A

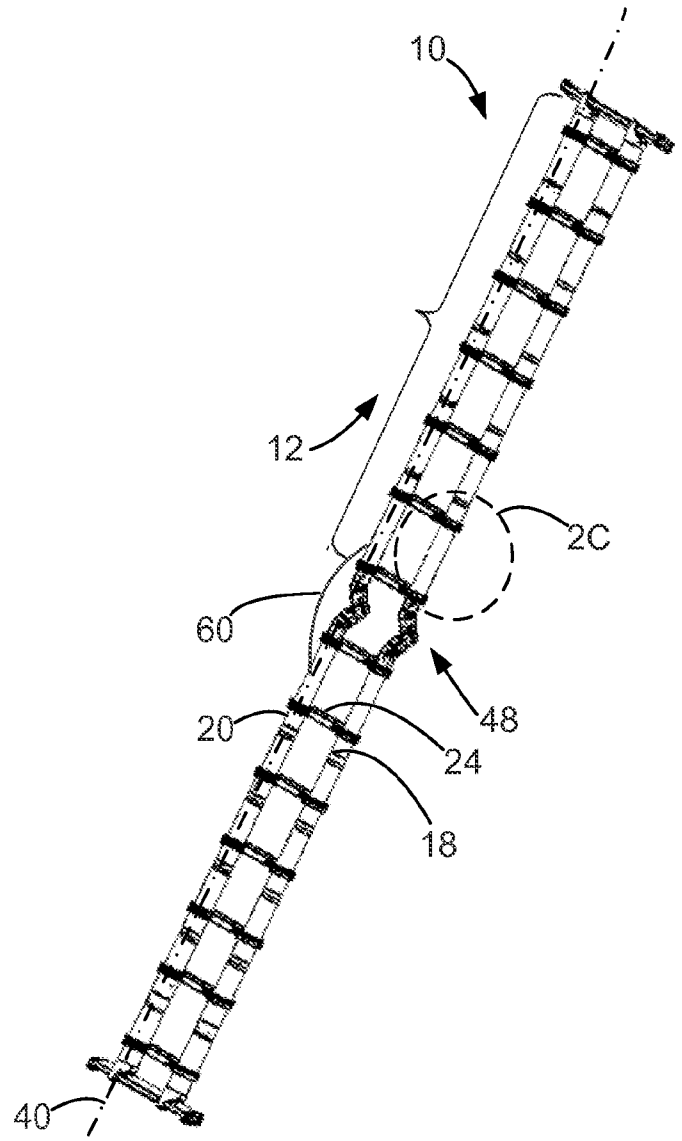


FIG. 2B

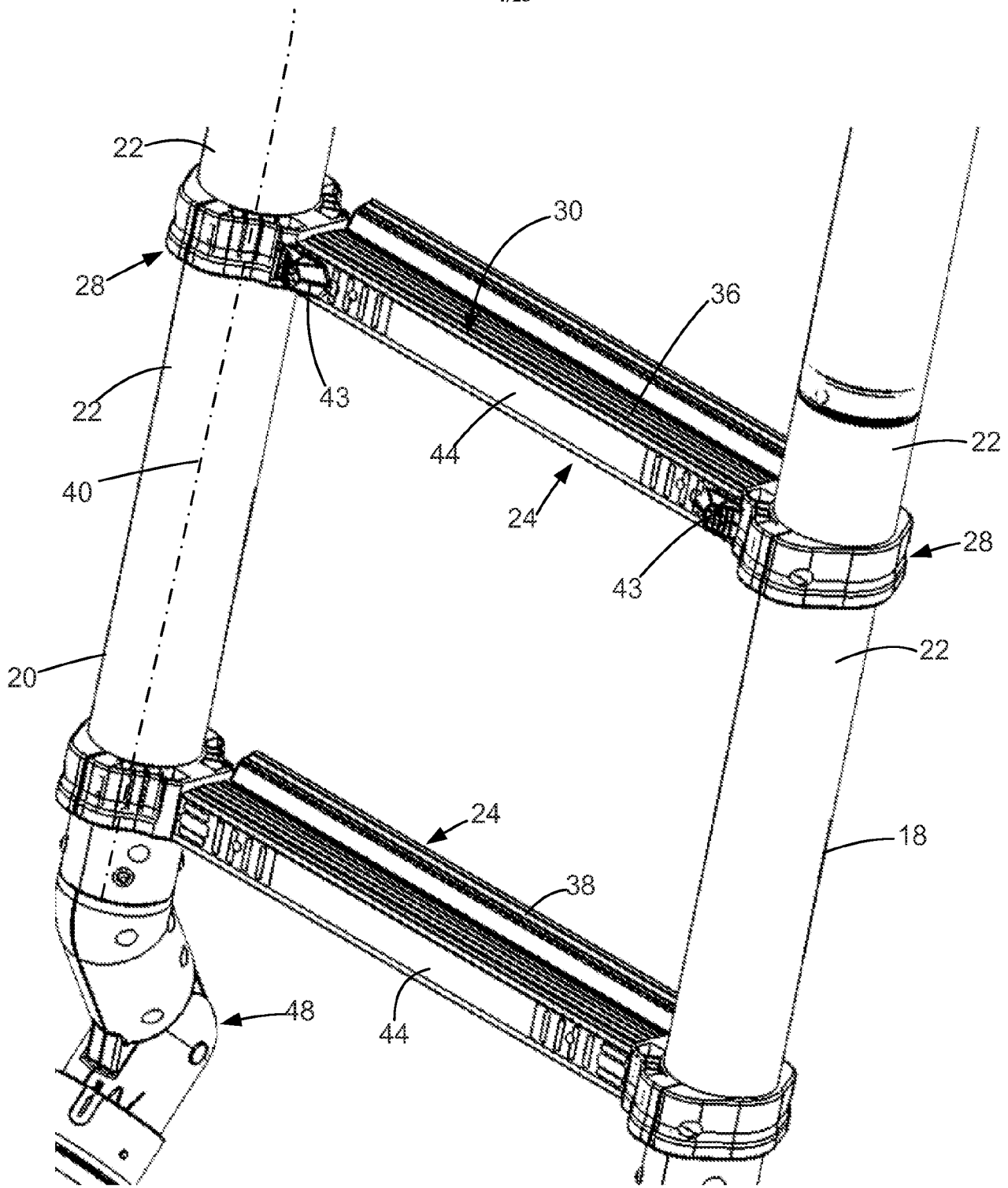


FIG. 2C

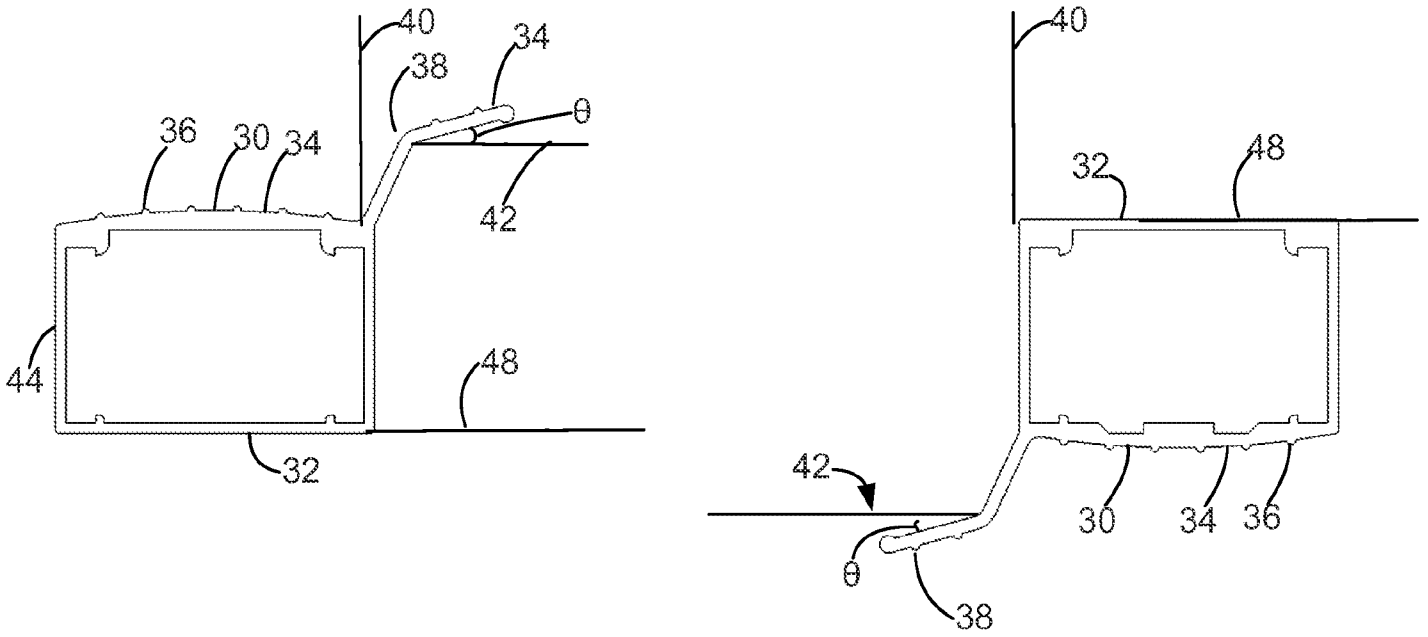


FIG. 2D

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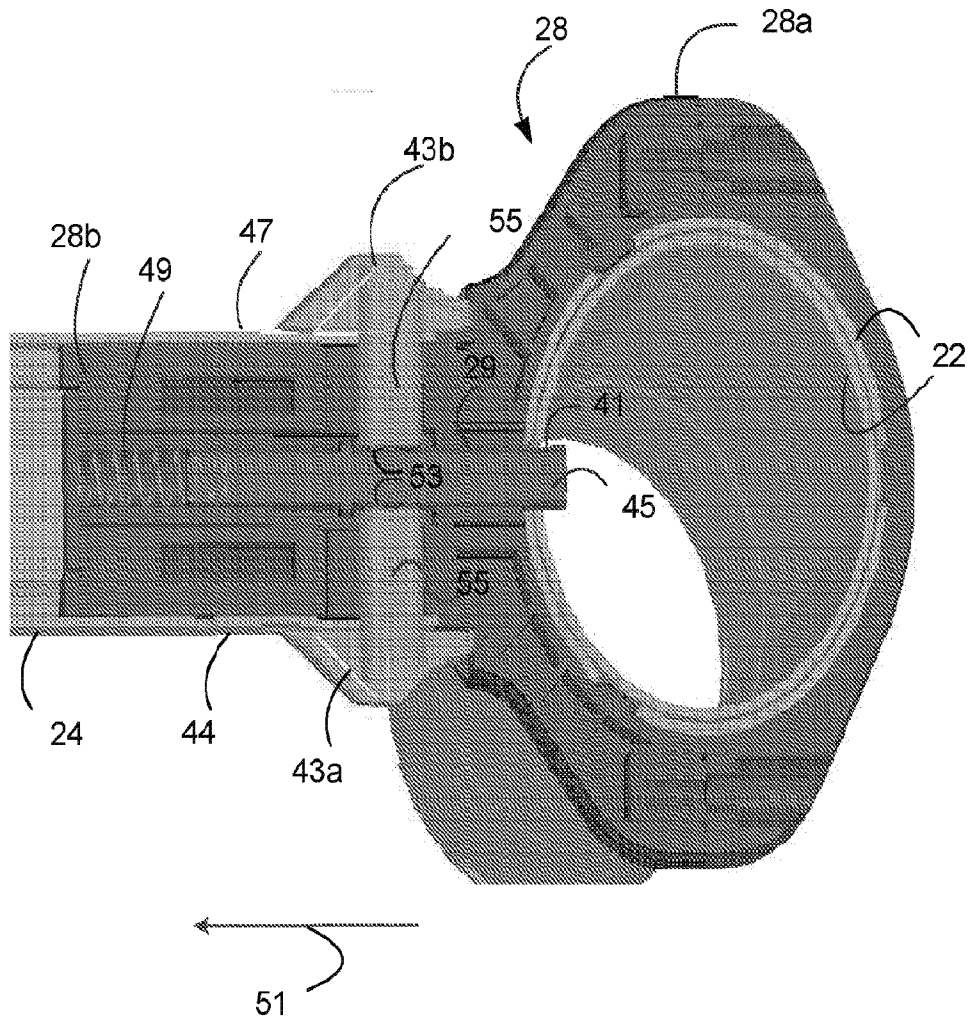


FIG. 2E

SUBSTITUTE SHEET (RULE 26)

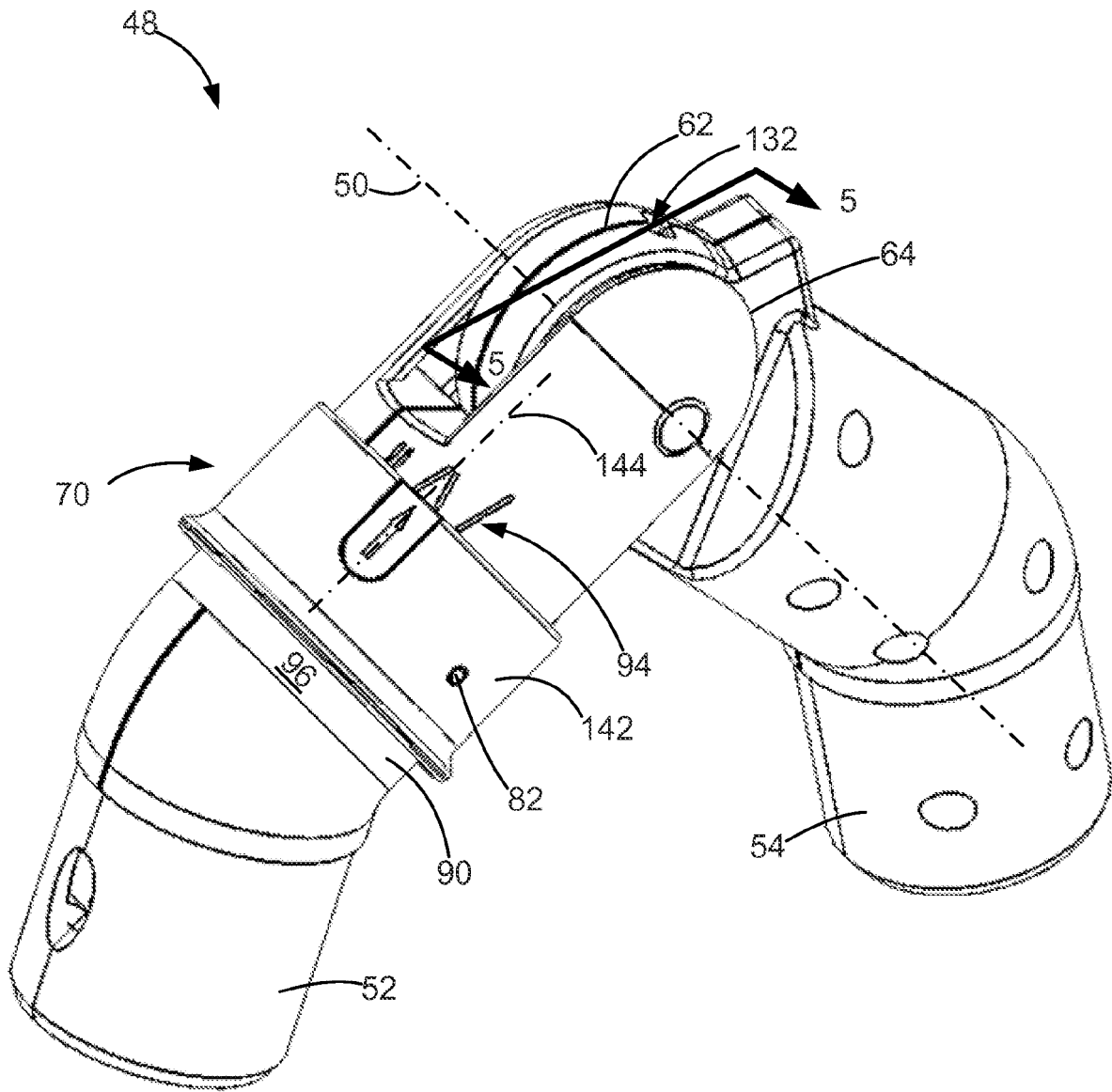
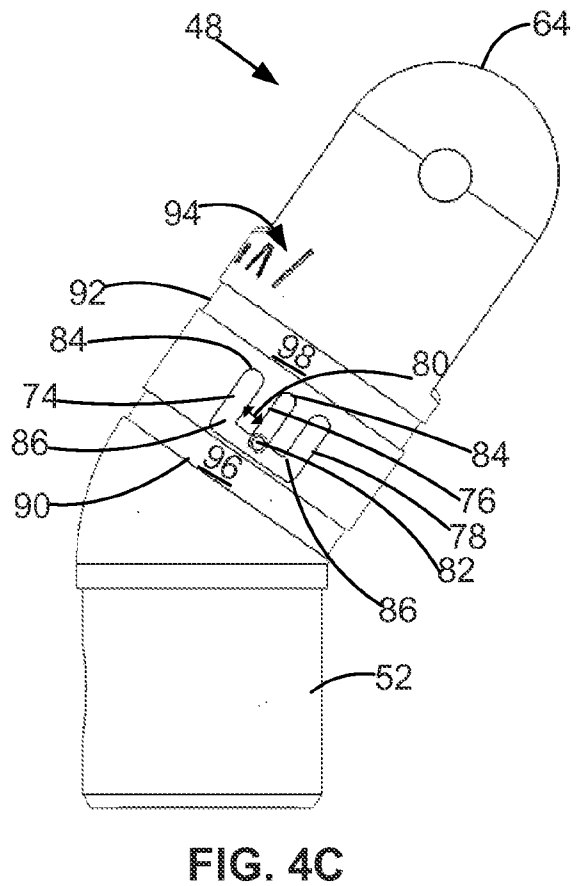
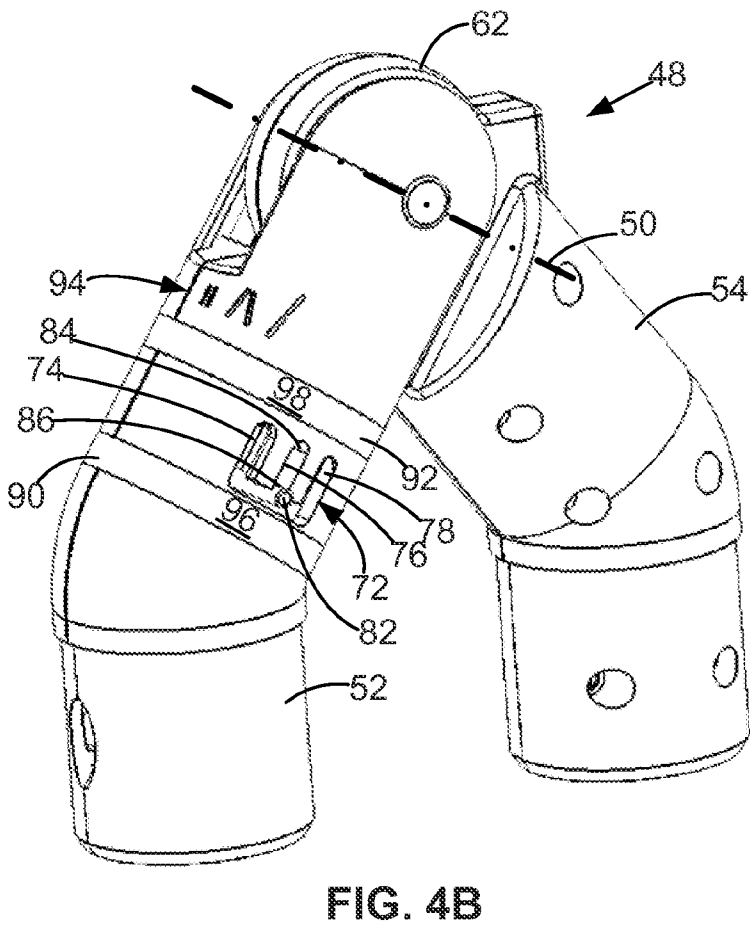
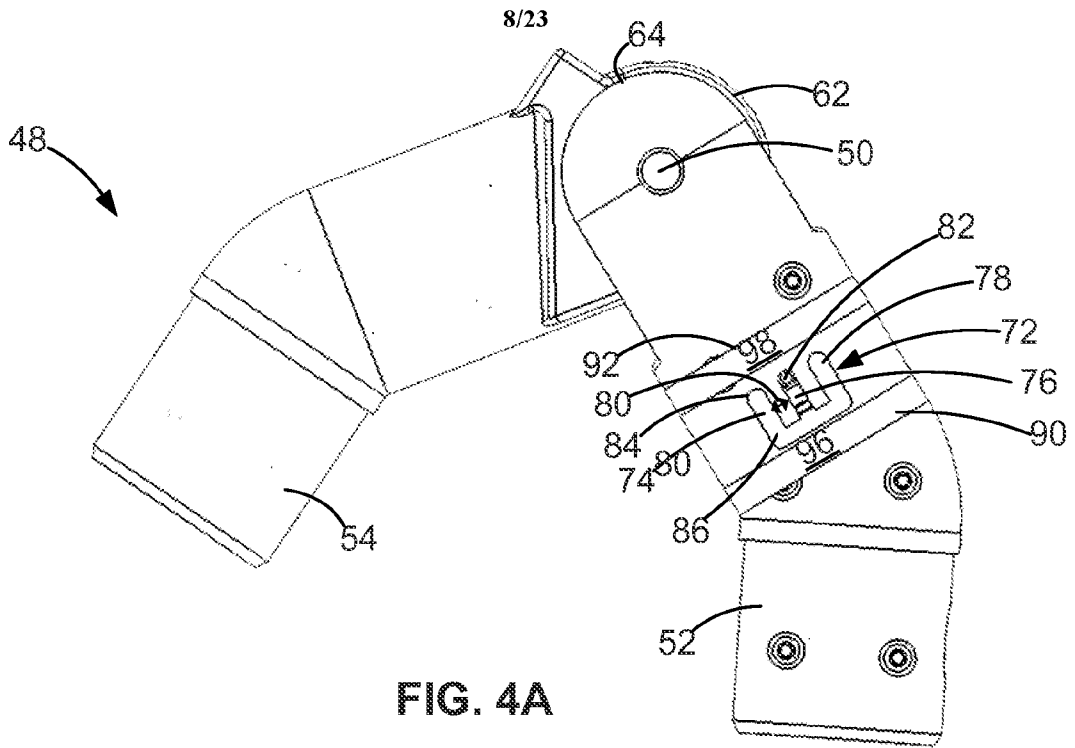


FIG. 3



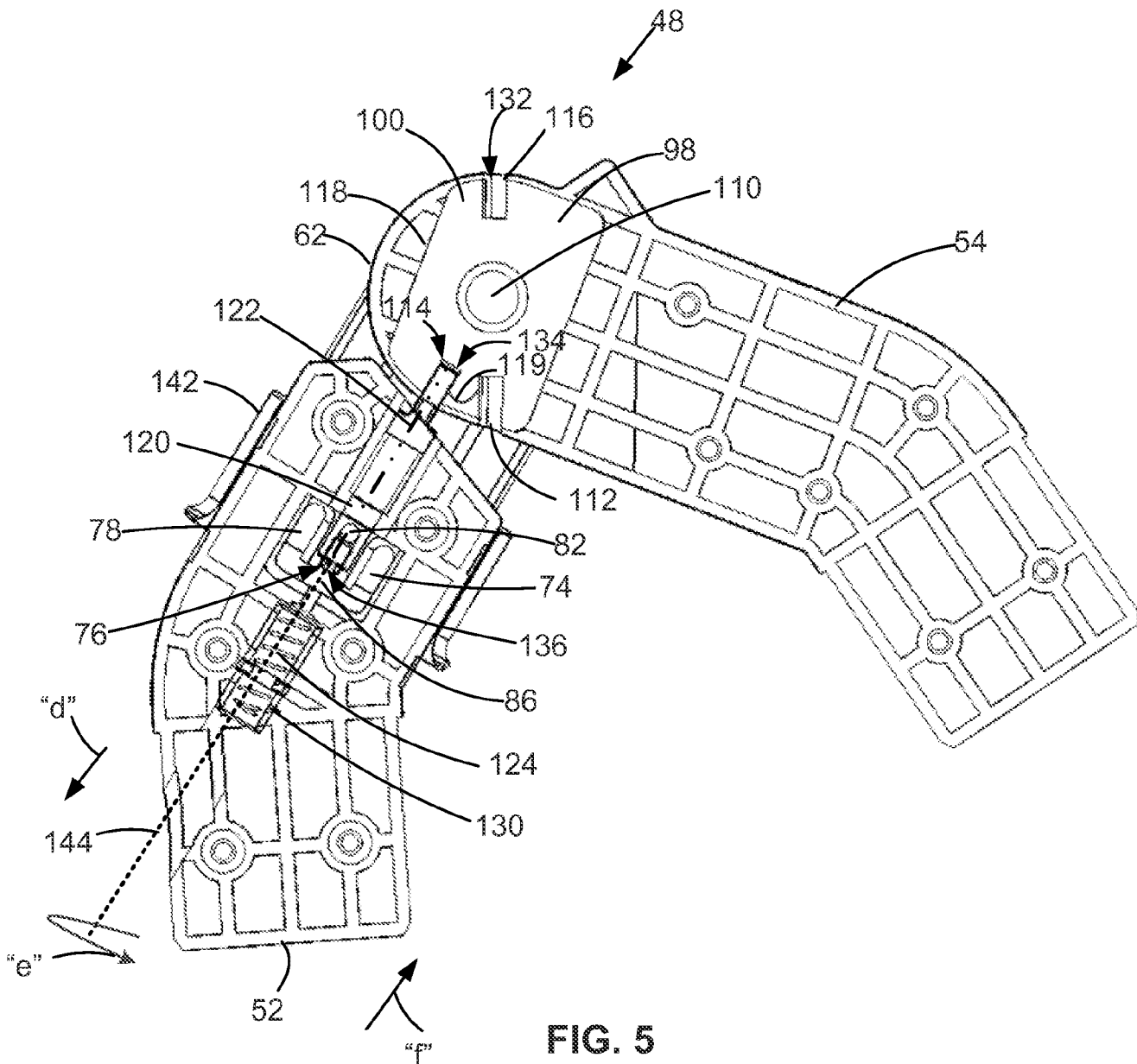


FIG. 5

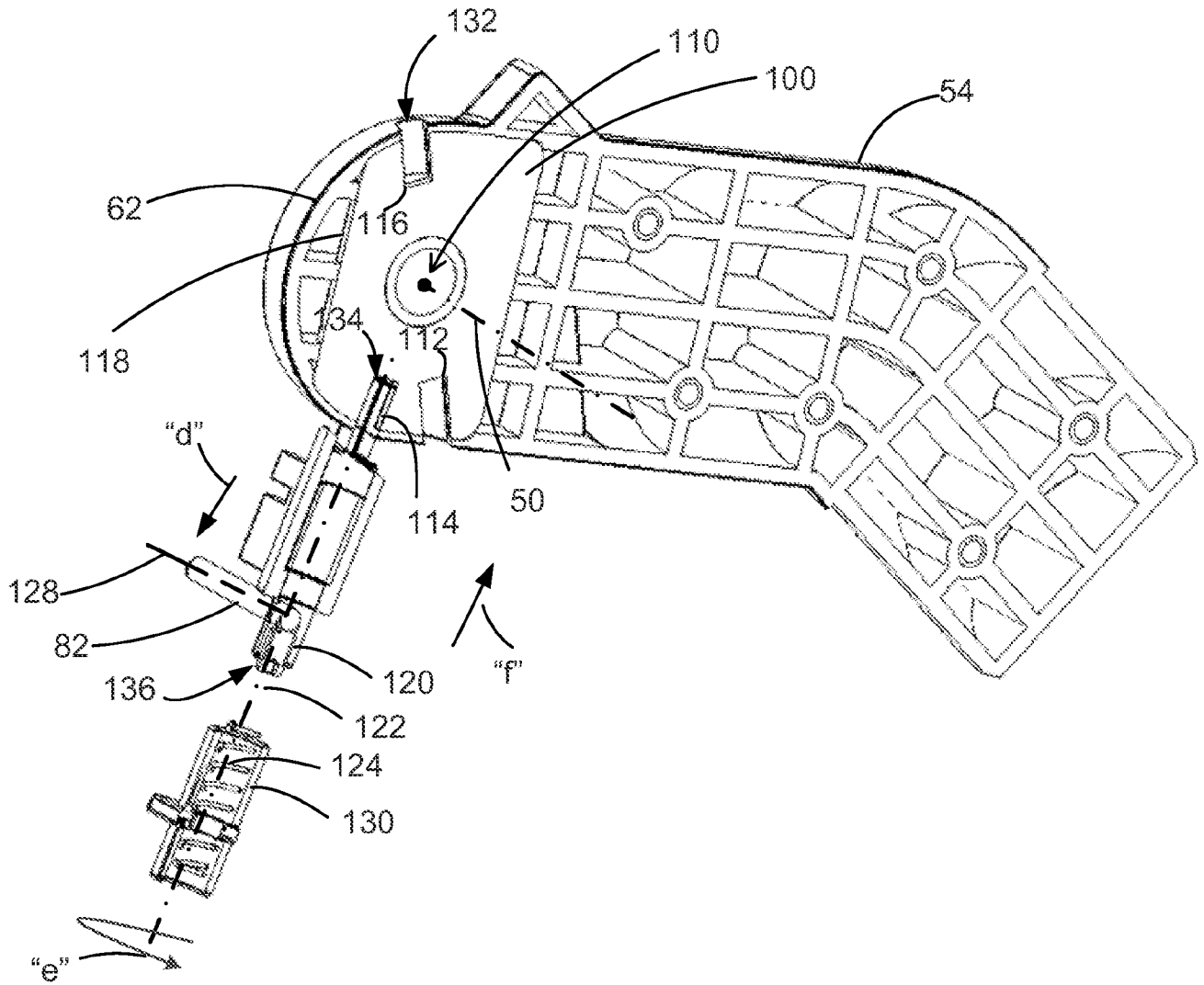


FIG. 6

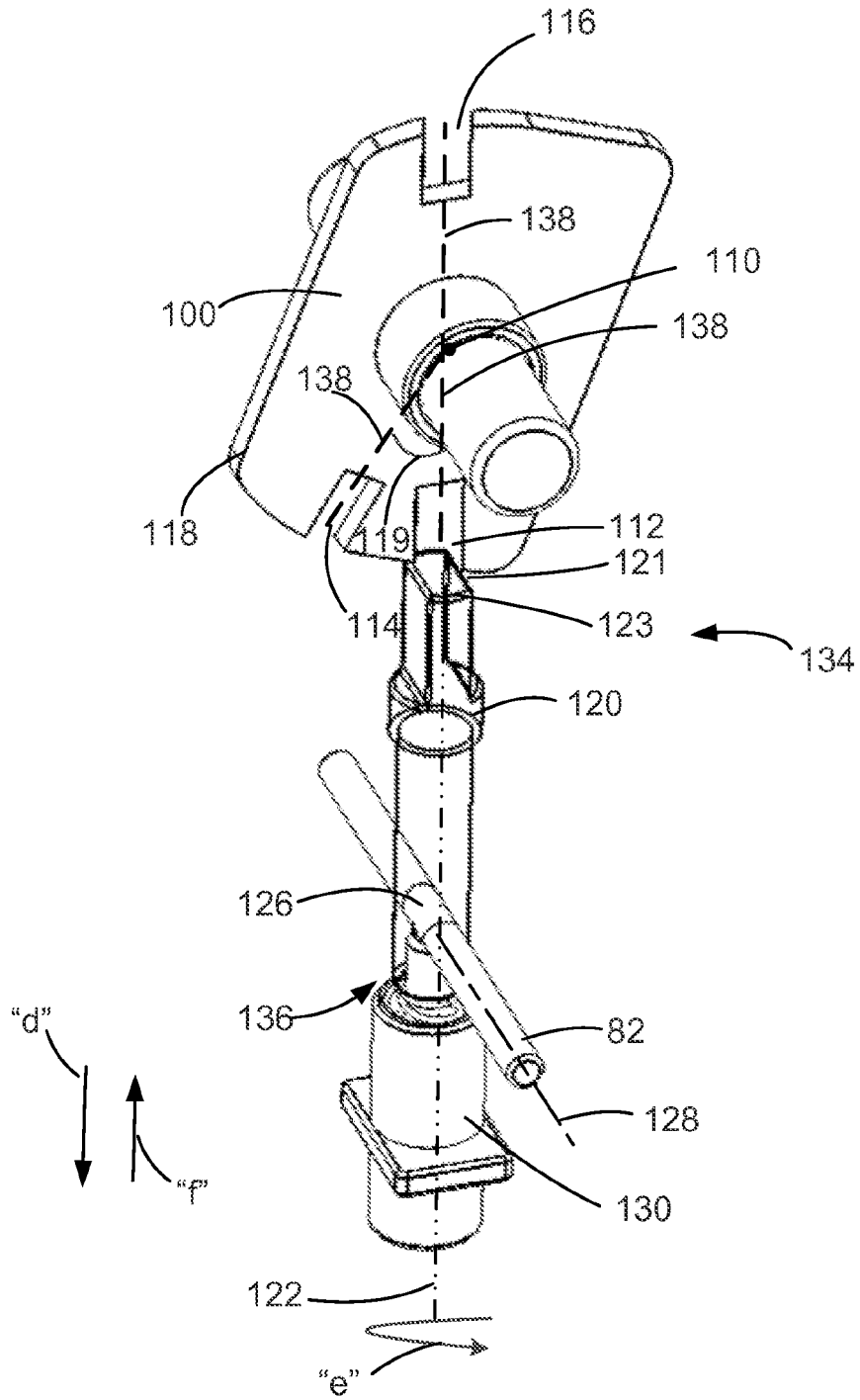
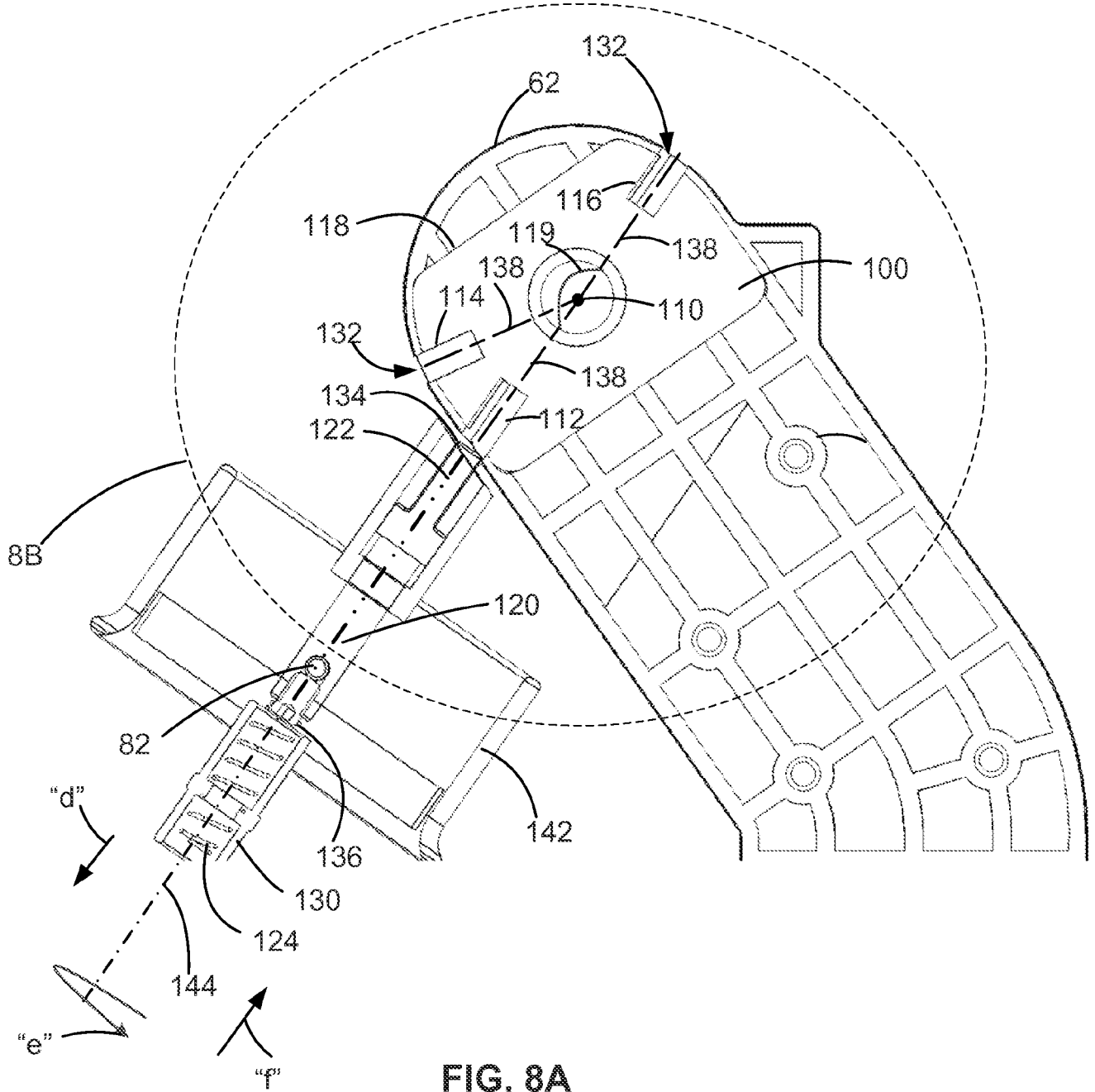


FIG. 7



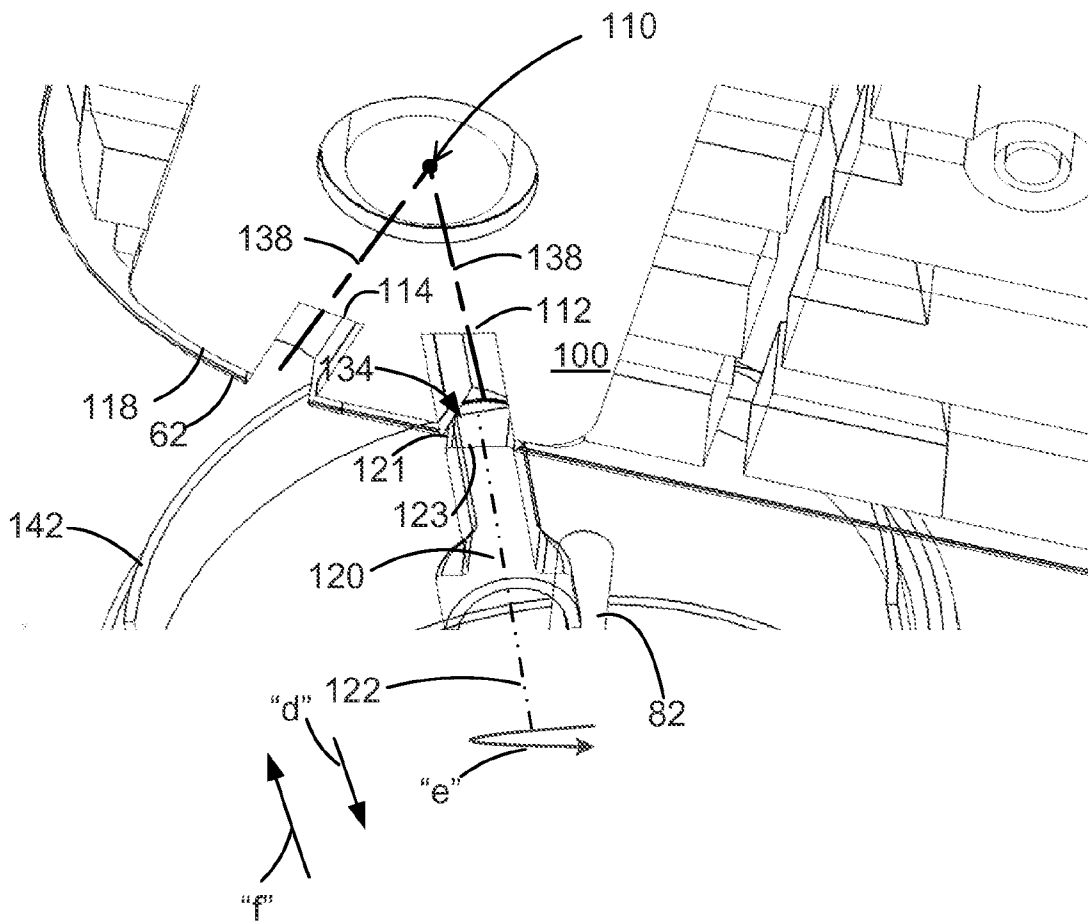


FIG. 8B

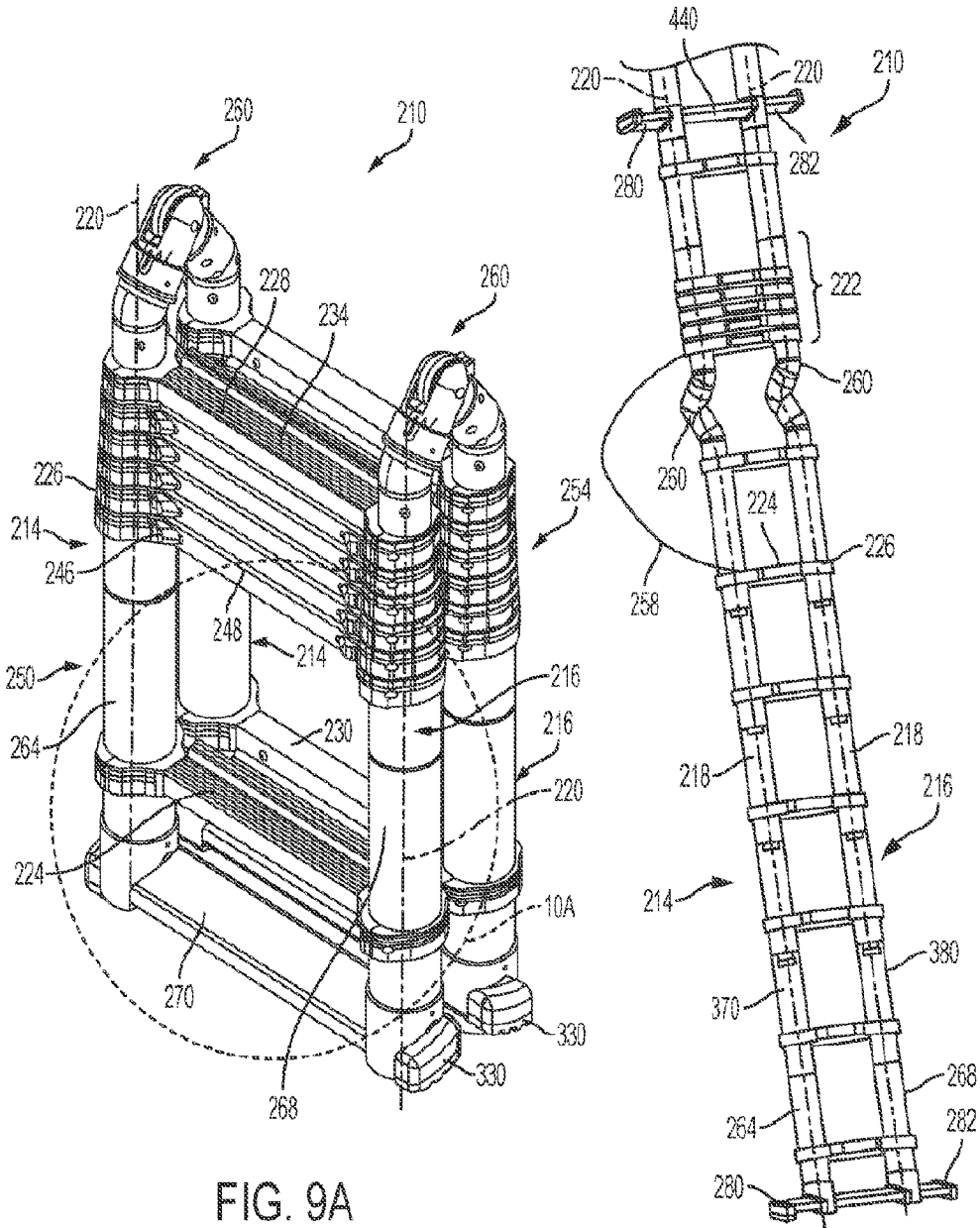


FIG. 9A

FIG. 9B

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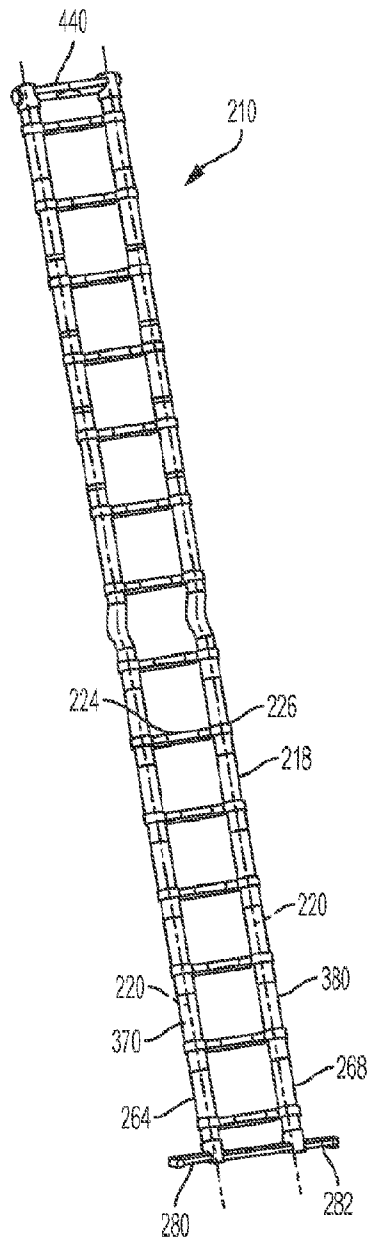


FIG. 9C

SUBSTITUTE SHEET (RULE 26)

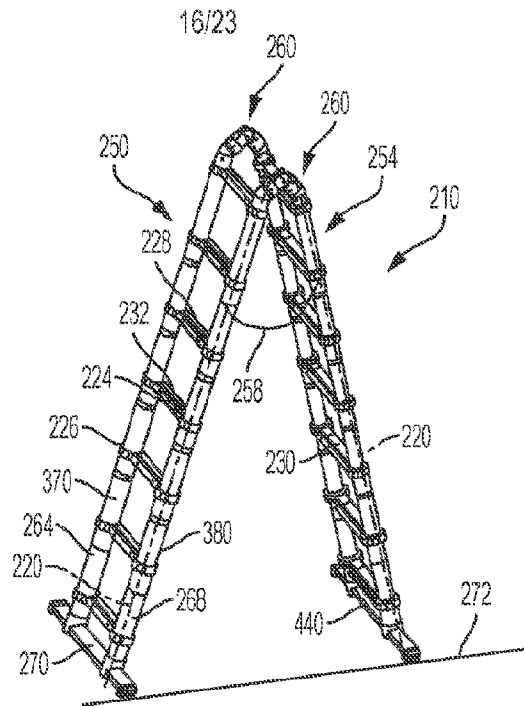


FIG. 9D

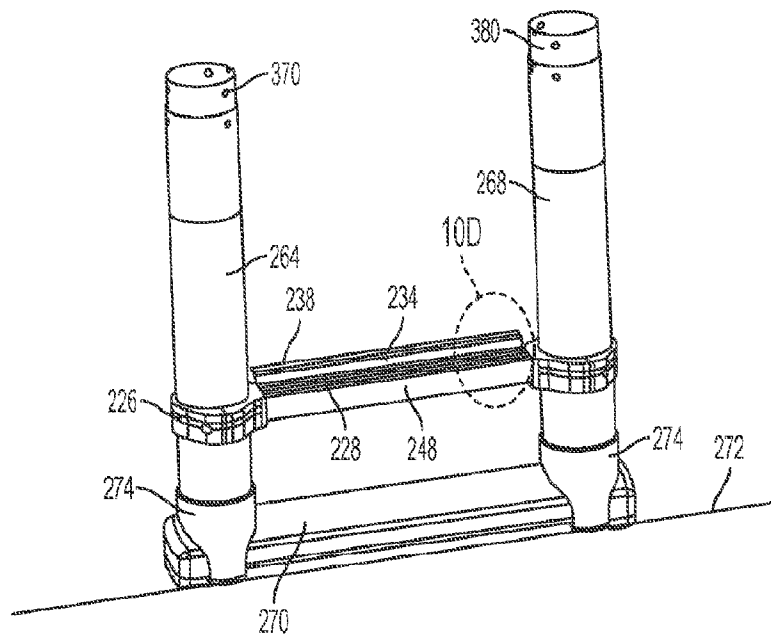


FIG. 10A

SUBSTITUTE SHEET (RULE 26)

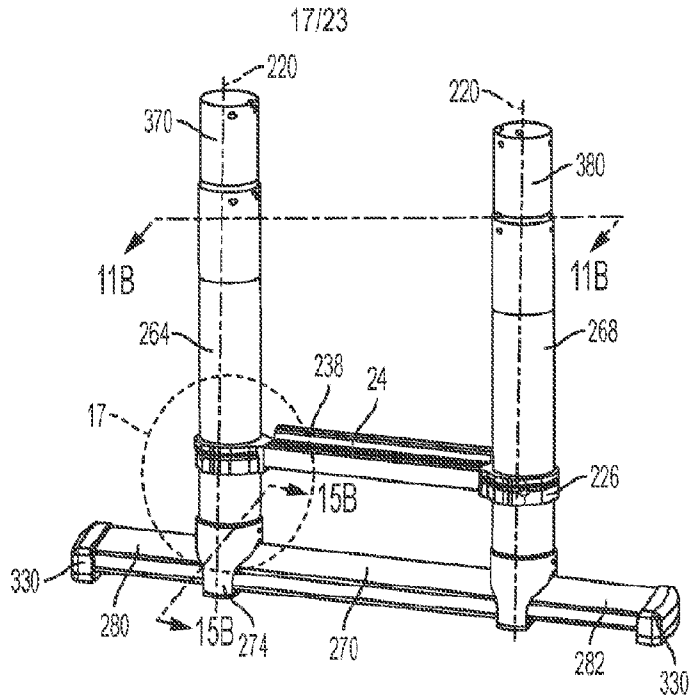


FIG. 10B

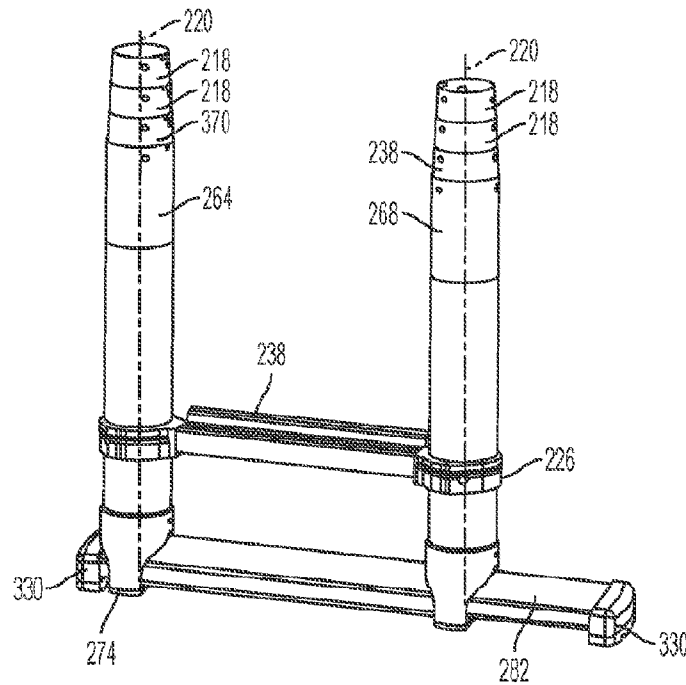


FIG. 10C

SUBSTITUTE SHEET (RULE 26)

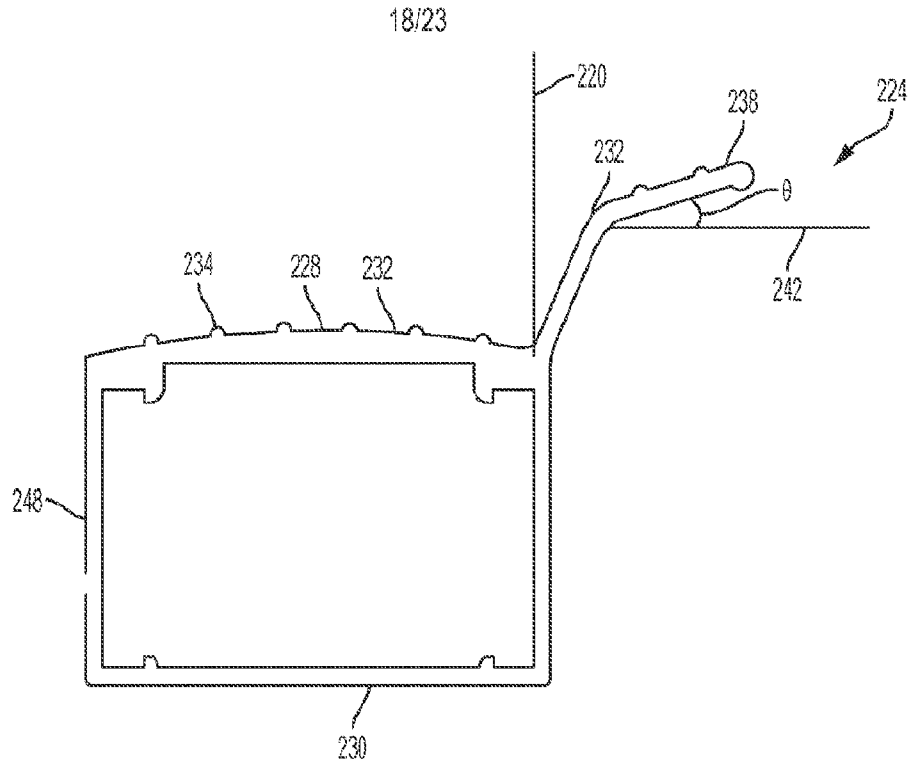


FIG. 10D

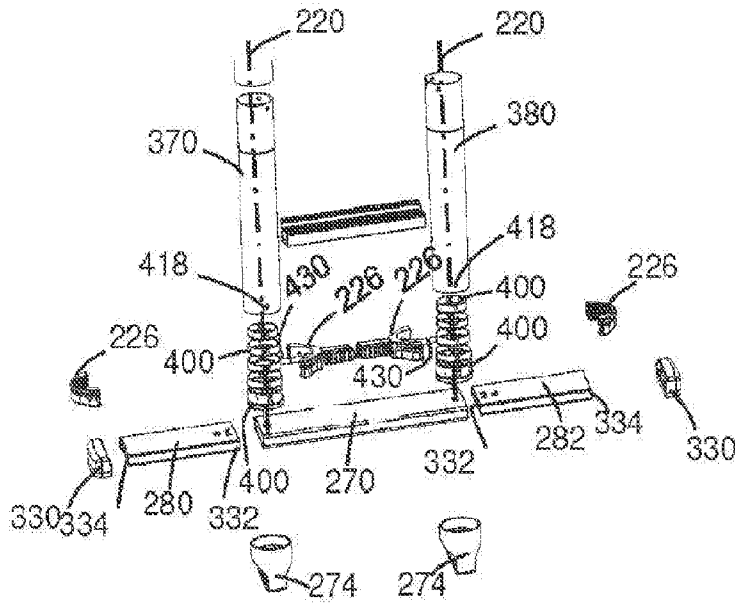


FIG. 11A

SUBSTITUTE SHEET (RULE 26)

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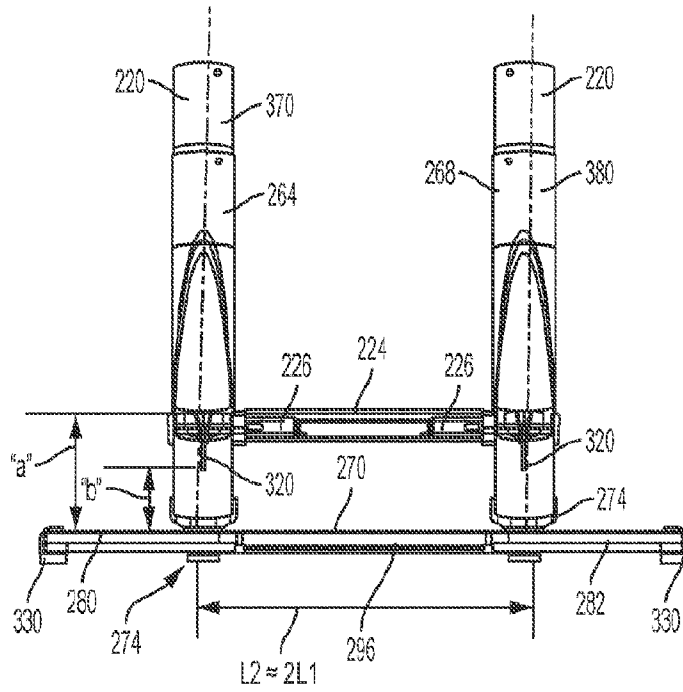


FIG. 11B

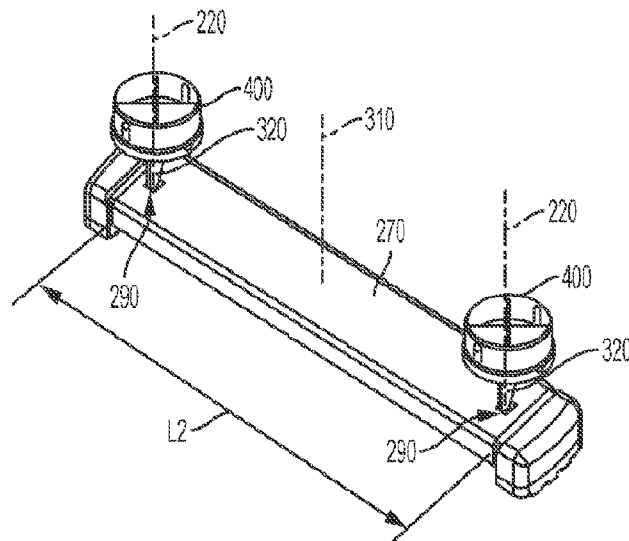


FIG. 12

SUBSTITUTE SHEET (RULE 26)

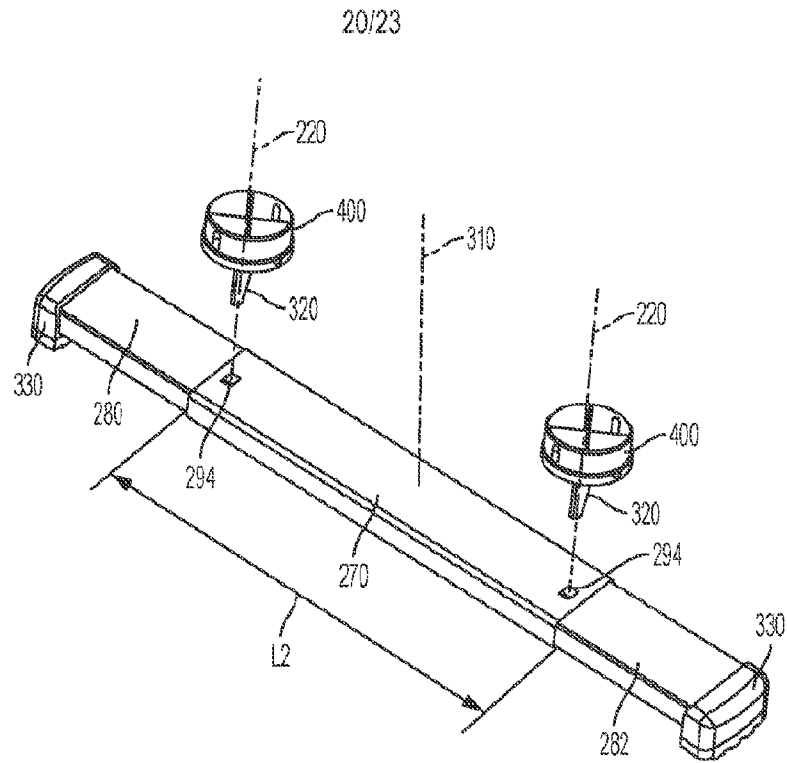


FIG. 13

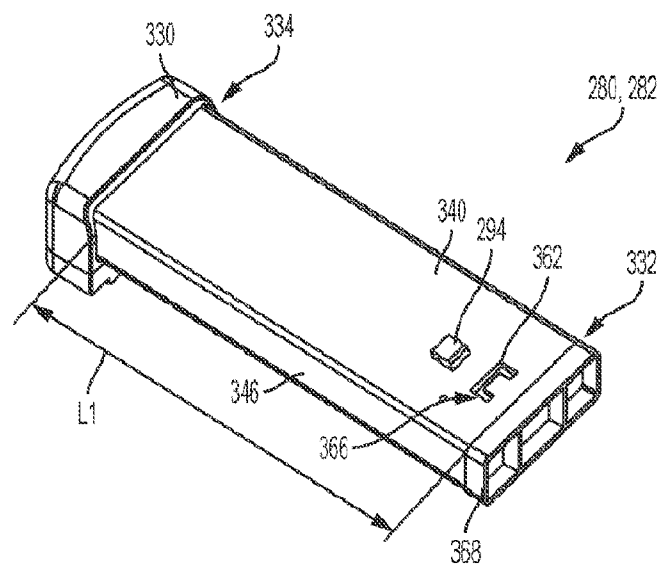


FIG. 14

SUBSTITUTE SHEET (RULE 26)

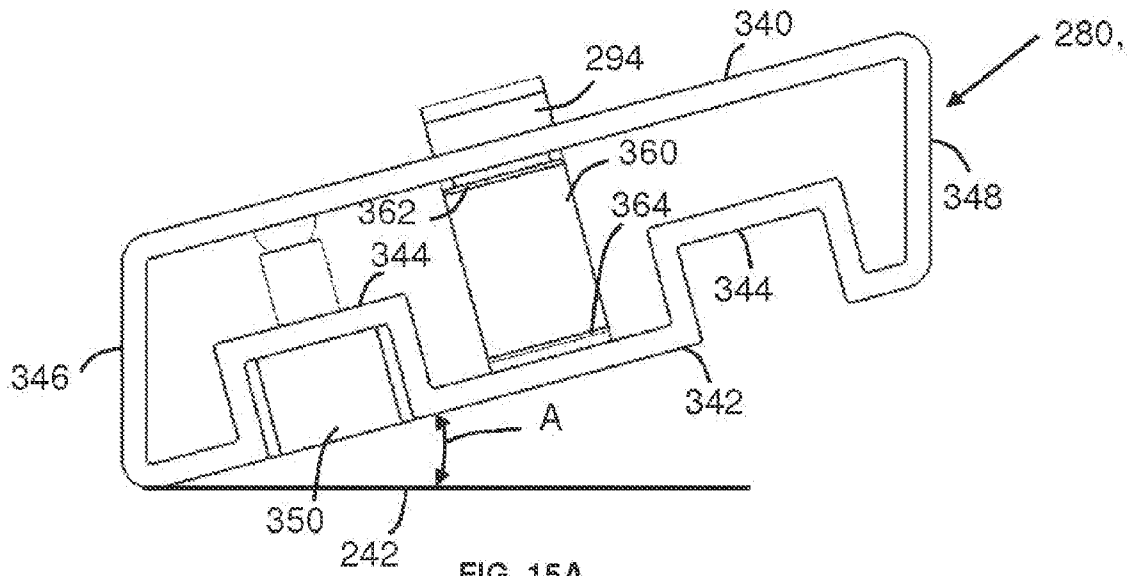


FIG. 15A

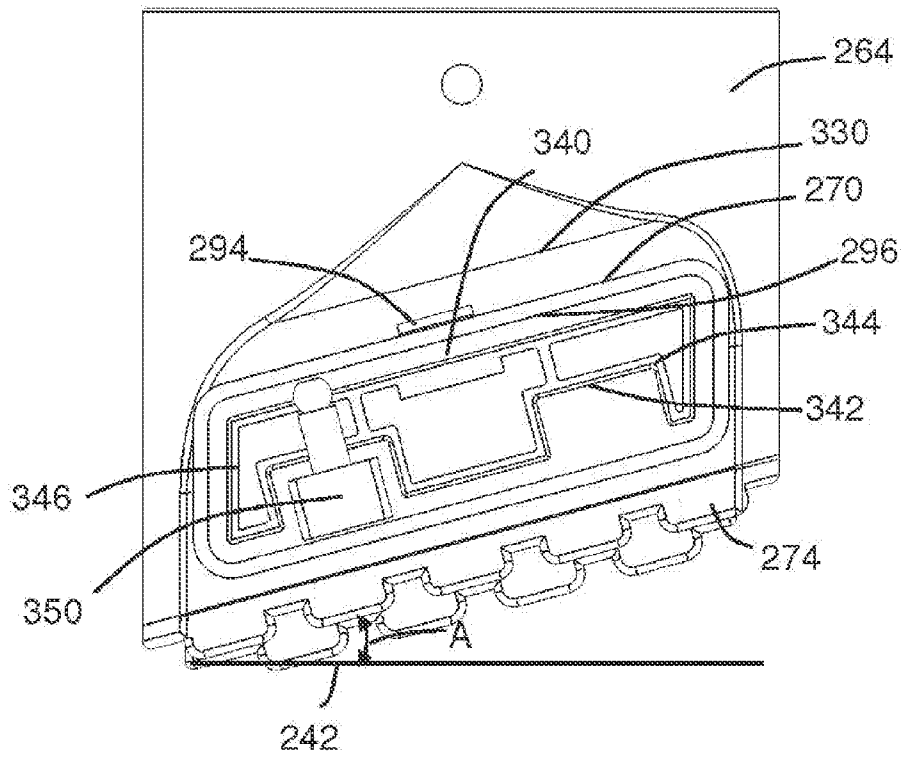


FIG. 15B

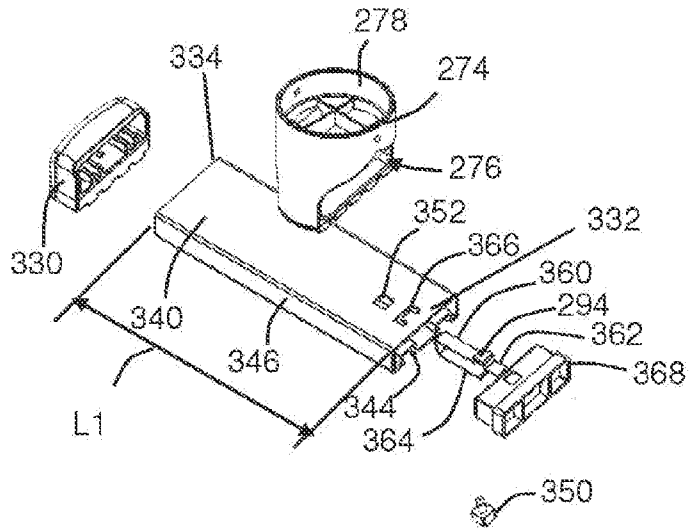


FIG. 16

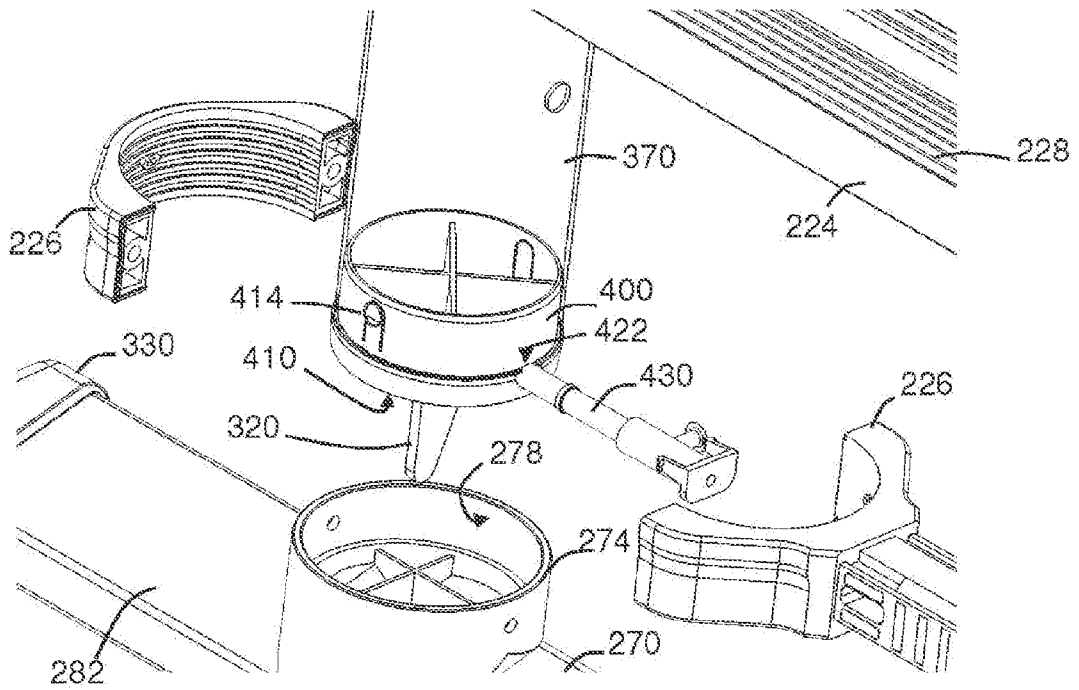


FIG. 17

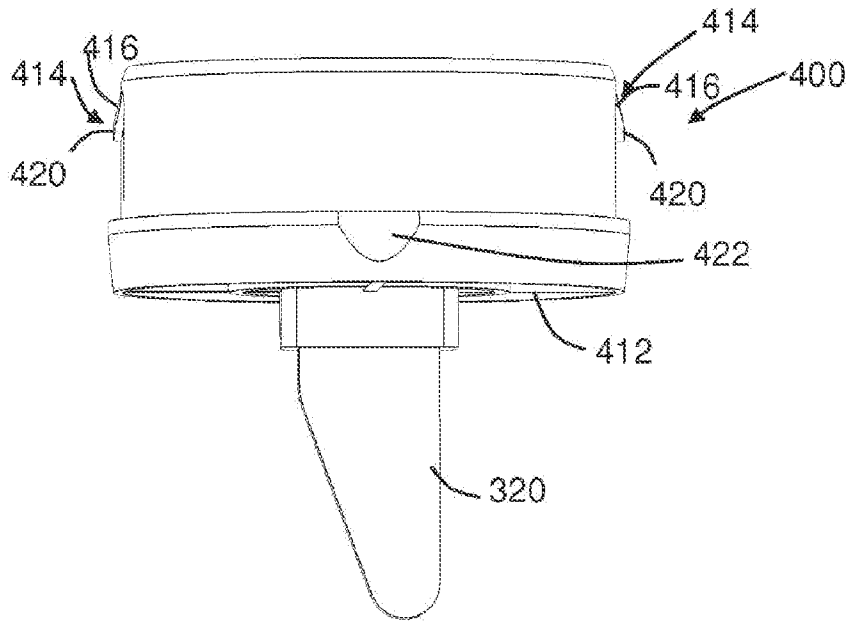


FIG. 18

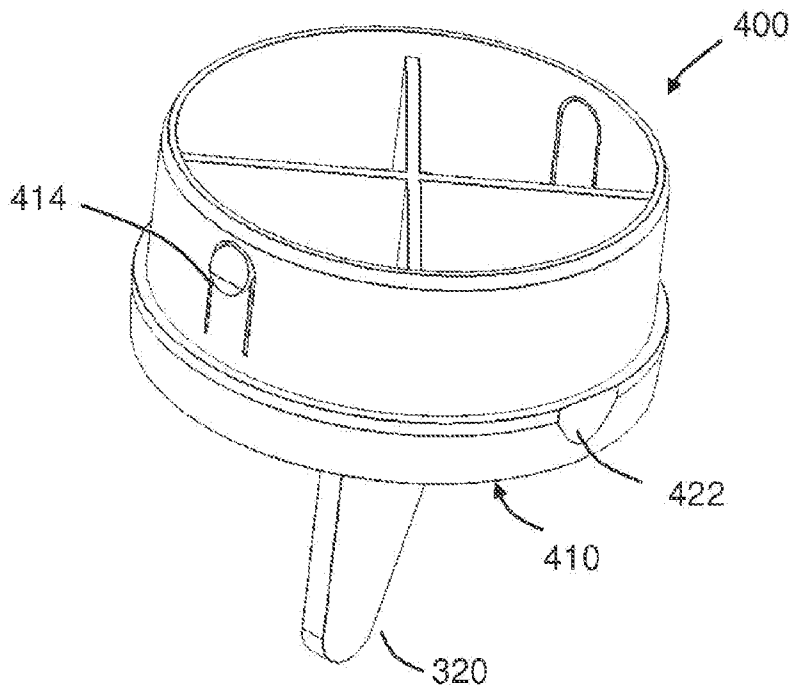


FIG. 19

