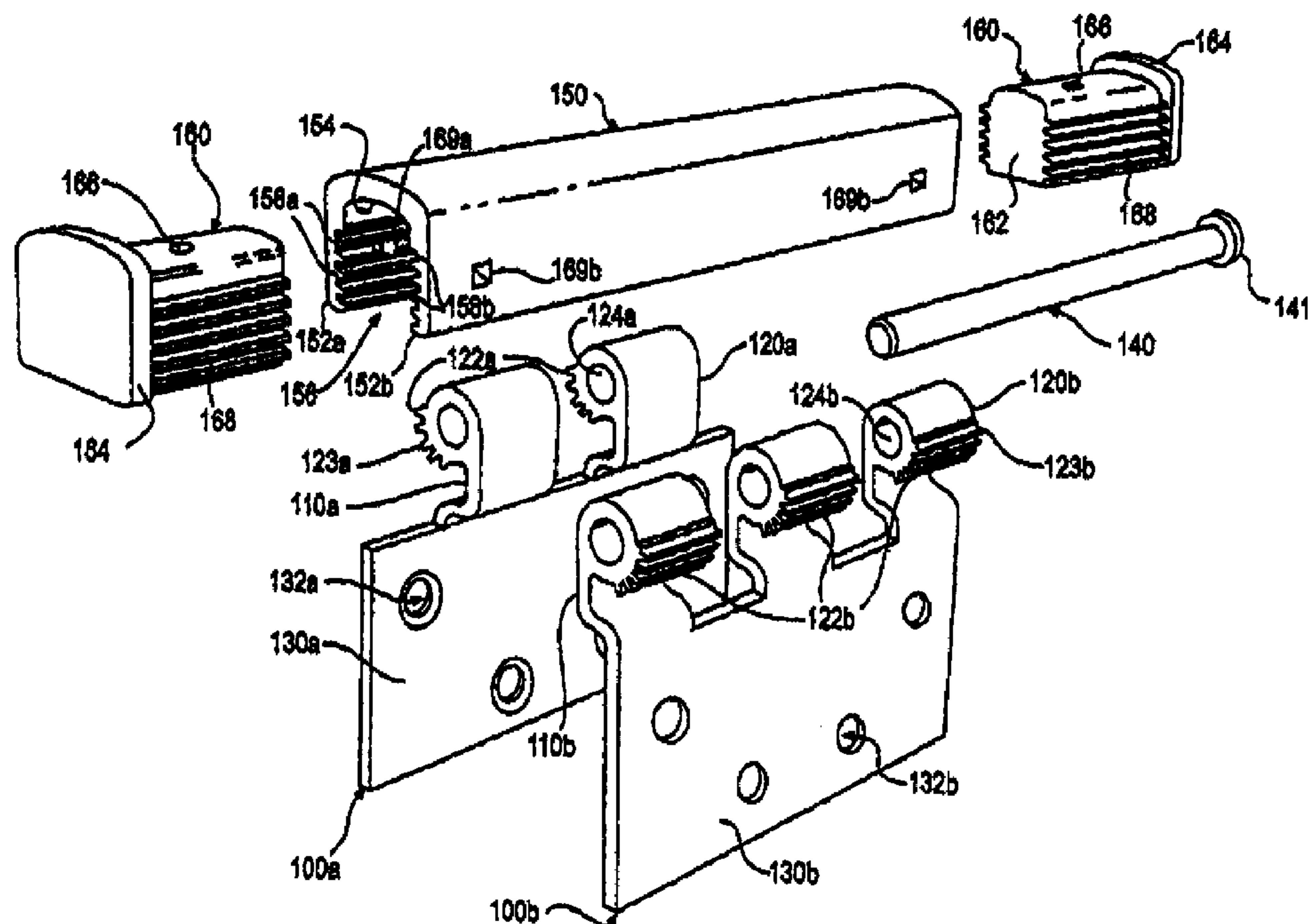




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(54) **CHARNIERE ENVELOPPEE**  
(54) **COVERED PINNED HINGE**



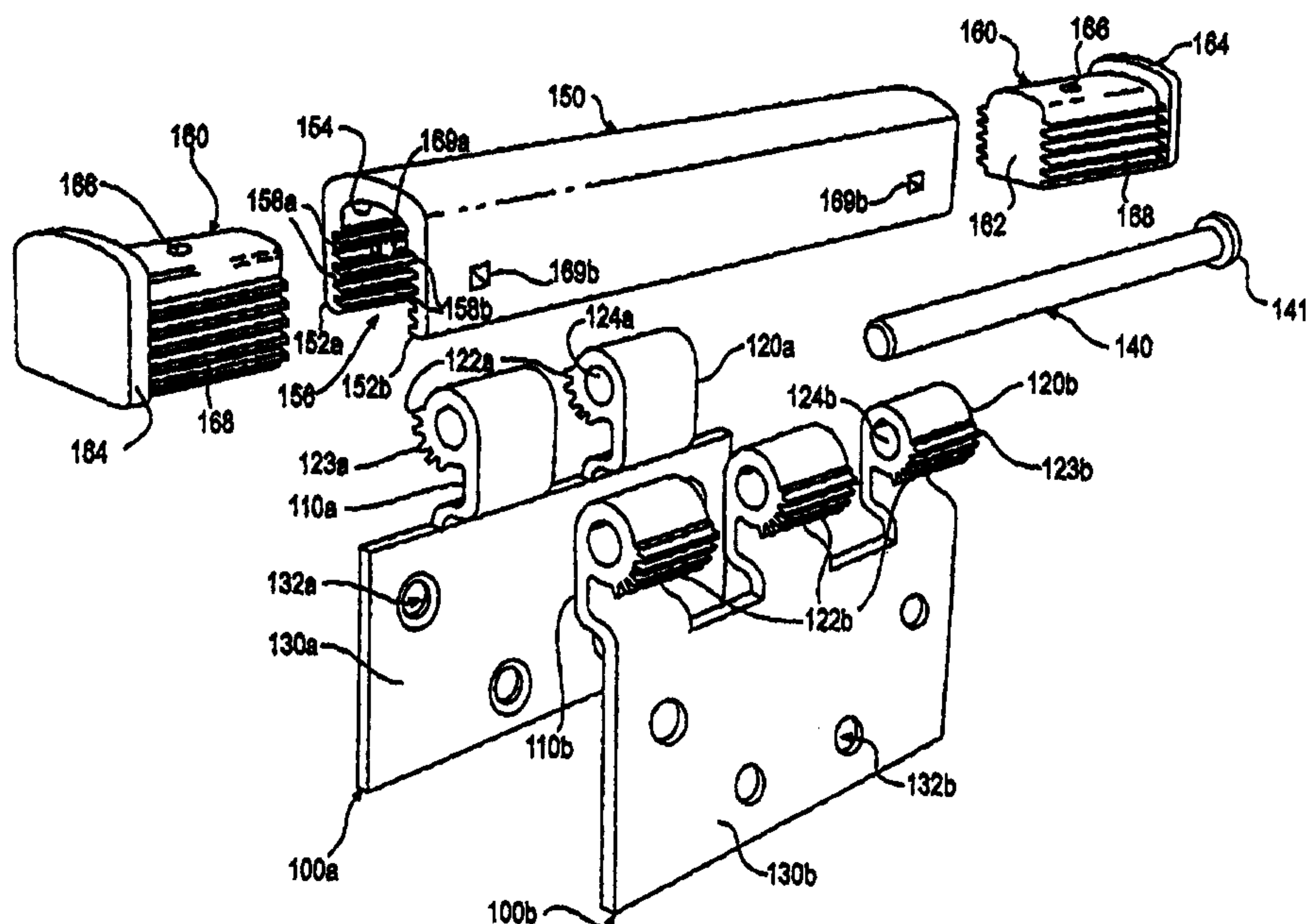
(57) La présente invention concerne une charnière comprenant un premier et un second élément à charnière comportant chacun des première et seconde pattes (100). Ces pattes sont pourvues de charnons (120) formant des premiers trous (124) s'étendant à travers les charnons dans une direction longitudinale. Une cheville (140) est introduite dans les trous des deux pattes, s'assemblant avec elles de manière pivotante. Une enveloppe (150) formant une voie longitudinale (156) entoure les charnons pour les protéger. Les pattes sont reliées à l'enveloppe de manière fonctionnelle, de sorte que le déplacement de pivotement des pattes déplace l'enveloppe par rapport à la cheville. Par ailleurs, des dents (110) reliées aux charnons retardent l'interférence entre l'enveloppe et les pattes pendant leur pivotement.

(57) A pinned hinge comprising first and second hinged members respectively including first and second leaves (100). The leaves have knuckles (120) that define first bores (124) that extend through the knuckles in a longitudinal direction. A pin (140) is received within the bores of both leaves, pivotally joining the leaves. A cover (150), defining a longitudinal channel (156), surrounds the knuckles, protecting them. The leaves are operatively connected to the cover such that pivotal movement of the leaves displaces the cover with respect to the pin. Shanks (110) connect the knuckles to retard interference between the cover and the leaves during pivoting.

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## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

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| <b>(51) International Patent Classification <sup>6</sup> :</b><br><b>E05D 11/02, E05F 1/08</b>                                                                                                                                                                                                                                                                                                                                                                                        | <b>A1</b> | <b>(11) International Publication Number:</b> <b>WO 99/23337</b><br><b>(43) International Publication Date:</b> 14 May 1999 (14.05.99)                                                                                                                                                                                                              |
| <b>(21) International Application Number:</b> PCT/US98/23530<br><b>(22) International Filing Date:</b> 4 November 1998 (04.11.98)<br><br><b>(30) Priority Data:</b><br>08/964,638      5 November 1997 (05.11.97)      US<br><br><b>(71)(72) Applicant and Inventor:</b> BAER, Austin, R. [US/US];<br>24416 Highway 550, Ridgway, CO 81432 (US).<br><br><b>(74) Agents:</b> FANUCCI, Allan, A. et al.; Pennie & Edmonds LLP,<br>1155 Avenue of the Americas, New York, NY 10036 (US). |           | <b>(81) Designated States:</b> CA, JP, MX, European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE).<br><br><b>Published</b><br><i>With international search report.</i><br><i>Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.</i> |

**(54) Title:** COVERED PINNED HINGE**(57) Abstract**

A pinned hinge comprising first and second hinged members respectively including first and second leaves (100). The leaves have knuckles (120) that define first bores (124) that extend through the knuckles in a longitudinal direction. A pin (140) is received within the bores of both leaves, pivotally joining the leaves. A cover (150), defining a longitudinal channel (156), surrounds the knuckles, protecting them. The leaves are operatively connected to the cover such that pivotal movement of the leaves displaces the cover with respect to the pin. Shanks (110) connect the knuckles to retard interference between the cover and the leaves during pivoting.

COVERED PINNED HINGEFIELD OF THE INVENTION

The present invention relates to pinned hinges with  
5 covered knuckles. More particularly, the invention relates  
to a pinned hinge with knuckles protected by a cover, and  
with leaves that are operatively connected to a cover for  
moving the cover in response to pivotal movement between the  
leaves.

10

BACKGROUND OF THE INVENTION

Hinges with at least two leaves pivotably  
connecting structural members are known. In these hinges,  
the leaves generally have knuckles defining concentrically  
aligned cylindrical bores therethrough. A pin is inserted  
15 within the bores of the knuckles of both leaves, pivotably  
connecting the leaves. The bodies of the leaves are  
connected to the structural members.

One type of pinned hinge is known as a "butt" or  
"mortise" hinge. Two or more of these hinges are commonly  
20 used to hang a door from a door frame. In butt hinges, the  
length of each pin is short compared to the length of the  
door or other structural member mounted to the hinge.

"Piano" hinges are similar to mortise hinges,  
except that the length of the hinge and its pin usually runs  
25 most of the length of one of the attached structural member.  
These hinges are sometimes known as "continuous hinges".

To seal the gaps between a door and a frame between  
individual mortise hinges, the leaves of the hinges are often  
recessed or inletted into the door and the frame to a depth  
equal to the thicknesses of the leaves. This permits the  
30 leaves to lie flush with both the door and the frame to  
produce a closer fit and allow sealing when the door is  
closed. This is usually not necessary with piano hinges

because the leaves extend approximately the whole length of the door, spanning gaps that would otherwise exist between individual mortise hinges.

To decrease gaps between opposing leaves  
5 themselves, the leaves can be swaged. Swaging involves deforming flat leaf bodies, ideally so that the leaf bodies remain parallel and can contact or almost contact each other when the door is closed.

Bearings have been placed between leaf knuckles to  
10 reduce friction between adjacent knuckles. U.S. Patent No. 4,097,959, for example, shows ball bearings placed between knuckles of opposed leaves and the pin. U.S. Patent No. 3,499,183, for instance, discloses the use of bushings to lower hinge friction. Washer type bushings or bearings have also been placed between adjacent knuckles.

15 Hinge leaves have also been pivotally biased with respect to one another to produce a self opening or closing door. U.S. Patent No. 4,583,262 shows a hinge in which a spring coils around a split pin and resiliently biases one leaf of the hinge with respect to the other.

20 The knuckles of known pinned hinges, however, are exposed. This allows debris to collect within the moving parts and bearing surfaces within the hinge, causing wear, squeaking, binding, and premature hinge failure. Lubricants on the knuckles so exposed can wash away or dry out. Also,  
25 exposed knuckles are susceptible to weather that can speed corrosion of the moving parts.

Exposed pinned hinges are also subject to vandalism. The knuckles in doors that open outwardly of a building, as required by many fire codes, are located on the outside of a door. The pins retaining these knuckles are  
30 subject to removal from the outside, effectively enabling disassembly of the door and permitting unauthorized entry.

Various methods exist for retaining the pin within the knuckles. These methods include inserting a cross-pin through the pin and the knuckles; providing a knurled surface on the pin to create an interference fit with the knuckle bores; and providing one end of the pin with a wide stop that is too big to fit through the bores, and flaring out the other end of the pin once it is inserted in the knuckles. Even with these precautions, the knuckles and the pin still remain exposed and accessible to vandals.

Finally, exposed hinges generally have distracting and unsightly knuckles that extend outwardly from the plane of the door. Once corrosion sets in, exposed surfaces of these hinges become even less attractive.

U.S. Patent No. 4,999,879 discloses a continuous hinge that is not pinned, but has a clamp that covers two hinge members. The hinge members lack knuckles and thus lack a pin to join them pivotably. Instead, the hinge members are retained laterally by the clamp against a rod fitted therebetween. The clamp and the hinge members have geared surfaces in mesh with each other. The rod keeps the hinge members in contact with the clamp, but cannot alone keep the hinge members from separating radially. This hinge relies on the clamp to pivotably join and retain the hinge members together. Thus, the clamp must be constructed with sufficient strength to support all lateral loads imposed on the hinge members. The clamp cannot be tailored to have merely sufficient strength for another intended purpose, other than joining the hinge members laterally and pivotably, such as protecting the internal hinge components from vandalism or from the elements, or for simply improving hinge aesthetics by covering moving parts. The clamp must be significantly overbuilt if this hinge is chosen merely for a function such as these. Also, as the disclosed hinge lacks interposed knuckles from the hinge members, the hinge

WO 99/23337

PCT/US98/23530

requires the addition of thrust bearings to prevent relative, longitudinal movement between the hinge members that must be able to resist shearing between the members. Such a thrust bearing is not essential in pinned hinges because the  
5 interposed knuckles prevent relative longitudinal movement therebetween.

A need exists for a pinned hinge whose knuckles are protected and concealed by a cover. This need is especially present for a covered pinned hinge that permits pivotal movement over more than  $100^\circ$ , and especially more than  $120^\circ$   
10 or  $180^\circ$ .

#### SUMMARY OF THE INVENTION

The invention provides a pinned hinged combination that is generally referred to herein as a hinge and that  
15 includes two hinged members. The hinged members respectively include first and second leaves that respectively have first and second knuckles. The hinged members can also include structural members attached to the leaves. A pin is received in a bore extending through the second knuckle in a  
20 longitudinal direction and is associated with the first for pivotably joining and retaining the knuckles together. Both knuckles preferably define bores, extending through the knuckles in a longitudinal direction, with the pin received through the bores to pivotably join and retain the leaves so  
25 that the knuckles of each leaf are interposed with the knuckles of the other leaf. A cover, defining a longitudinal channel, surrounds and covers the knuckles, protecting them from the environment and from vandals. Also, the leaves are operatively connected to the cover such that pivotal movement of the leaves displaces the cover with respect to the pin,  
30 moving the cover out of the pivot path of the leaves and delaying contact therewith.

In a preferred embodiment, the leaves have a position in which the cover extends circumferentially around the pin axis by at least about  $270^\circ$  and the leaves are pivotable more than about  $100^\circ$ , more preferably by more than about  $120^\circ$ , and most preferably by more than about  $180^\circ$ .

The cover preferably has a cap that blocks and preferably seals a portion of the channel. The cap is most preferably fitted and secured to an end of the cover. An embodiment of the cap has a lubricant port for feeding lubricant into the channel to lubricate moving parts therein.

In an embodiment of the hinge, the knuckles have gear sectors, and the cover has geared surfaces corresponding thereto. Preferably, the geared surfaces are racks. The gear sectors and the geared surfaces are meshed such that pivotal movement of the leaves displaces the cover radially with respect to the pin.

In one embodiment, the leaves are configured so that opening pivotal movement of the leaves displaces the cover away from the pin. To increase the angle over which the leaves can pivot, each leaf has shanks joining its leaf body to its knuckles. The shanks preferably have at least double bends so that the leaves are pivotable to a position in which the shanks cross-over each other, a shank of one leaf overlapping a shank of the other leaf along the longitudinal direction. As a result, in this position, the ends of the shank of one leaf are disposed on opposite sides of the other leaf. In an open position, concave portions of the shanks formed by the double bends surround the cover walls and permit greater pivotal movement of the hinged members.

In another embodiment, opening pivotal movement of the leaves displaces the cover towards the pin. The shank preferably has at least a triple bend such that it has a U-

shaped portion that fits around walls of the cover when the hinge is open.

In another embodiment, the gear segments of one leaf have a first gear radius, while the gear segments of the other leaf have a second gear radius, with the second radius being larger than the first radius. This causes the cover to travel along a curved locus with respect to the pin when the leaves are pivoted.

The knuckles and the gear segments may be of integral construction, or made from separate pieces or materials. Where the gear segment and the knuckle are separate, an embodiment has a knuckle with a notch, and a gear segment with a tongue that mates with the notch. In another embodiment, the knuckle has a tongue, and the gear segment has a notch that receives the tongue. Pivoting of the first leaf thus causes the first gear segment to pivot therewith. The separate gear segment can include a bearing for placement between adjacent knuckles.

Another embodiment includes a seal disposed for sealing the cover to the hinged members when the hinge is in a predetermined position, such as when the hinge is closed. This seal can prevent heat, fluid, or particle flow between the hinged members. The operative connection between the cover and the leaves preferably causes the cover to compress the seal when the hinge is closed and to release the seal when the hinge is open. When one sealed hinge embodiment is closed, its seal is disposed between the cover and at least one of the hinged members on the side of the cover opposite the open side of the channel, wherein the leaves are received.

In a further embodiment, one of the hinge members includes an extension that extends over the cover. The extension and the cover are configured for selectively

opening and closing an electrical circuit when the cover and the extension abut and separate.

To further control the movement of the pin with respect to the cover, an embodiment includes a cross guide  
5 attached to the cover and associated with the pin for guiding movement of the cover with respect to the pin. This cross guide can be a guide pin received transversely and slideably through the hinge pin. Alternatively, the cross guide can have a forked end comprised of guide members disposed on  
10 opposite sides of the hinge pin.

The invention also provides self opening or closing hinges. These embodiments include a biasing member associated with the cover and configured for pivotally  
15 biasing the hinged members in response to relative movement between the pin and the cover. The biasing member preferably includes a resiliently deformable structure which pivotally  
biases the leaves in response to a relative position of the cover with respect to the pin and causes the leaves to move. Preferably, the biasing member biases the cover along a  
direction substantially perpendicular to the pin.

20 In another embodiment, the cover itself is the resilient member. In this embodiment, a third and the first knuckles are pivotally fixed relative to each other, by being part of the same hinged member. A fourth and the second  
knuckles are pivotally fixed to each other. The first and  
25 second opposing knuckles move a first portion of the cover along a locus extending in a first direction with respect to the pin when the leaves pivot. The third and fourth  
knuckles, on the other hand, move a second portion of the cover along another locus extending in a different direction  
with respect to the pin when the leaves pivot. Pivoting of  
30 the leaves thus resiliently twists the cover, which pivotally biases the leaves back to their original pivotal position.

WO 99/23337

PCT/US98/23530

In an alternative embodiment, instead of a geared connection between the cover and the leaves, a leaf spring is attached to at least one knuckle of each leaf and also to the cover. The leaf springs are bent around the knuckles when  
 5 the leaves are pivoted in one direction and straighten when the leaves are pivoted in another direction. Resiliently biased towards their normal shape, the leaf springs pivotably bias the leaves. Also, because their deformation can be predicted, the leaf springs operatively connect the leaves to the cover for repositionably displacing the cover radially  
 10 with respect to the pin as the leaves pivot.

The hinge may have a plurality of leaves connected to a same structural member. The hinge may also be a piano hinge, with only two long leaves with numerous knuckles mounted about a single pin, or the hinge may have only a  
 15 single knuckle on each leaf.

#### BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is an exploded, perspective view of a hinge according to the invention;

20 FIGS. 2A-D show cross-sectional end views of a hinge in various positions, from closed to open;

FIGS. 2E-F show cross-sectional end views of another embodiment of a hinge in various positions;

25 FIGS. 3A-C are exploded, perspective views of a hinge according to the invention with varying numbers of knuckles and different pin arrangements;

FIGS. 4A-B show a perspective and an end view of an end cap with a nipple for lubricant introduction;

FIGS. 5A-L are end views of hinge with C-shaped knuckles;

30 FIGS. 6A-E are cross-sectional end views of another embodiment of the inventive hinge in various positions, from closed to open;

FIGS. 6F-G are cross-sectional end views of a hinge with electrical contacts along an extension of a hinged member;

FIGS. 7A-B show cross-sectional end views of a hinge with gear segments of different radii;

FIGS. 8A-D show cross-sectional end views of a hinge with a sealing pad;

FIG. 9 is a cross-sectional end view of a cover with seals on ends of cover walls;

FIGS. 10A-C show cross-sectional end views of a hinge with seal inserts mounted to hinged members;

FIGS. 11A-C are cross-sectional end views of a hinge with seal supporting members extending from leaves;

FIGS. 12A-D are cross-sectional end views of a hinge with seals on the outside of a hinge cover;

FIGS. 13A-B show a perspective and a side exploded view of a hinge with a pin mounted on a cross guide;

FIGS. 13C is an exploded perspective view of another embodiment with a cross guide;

FIG. 13D is an end view of the cross guide and pin of FIG. 13C;

FIGS. 14 and 15 are cross-sectional end views of hinges with covers that are spring biased with respect to hinge pins;

FIGS. 16A-B show the operation of another hinge with a spring disposed between a cover and the pin;

FIGS. 17A-B are a perspective and a side view of a hinge with a spring mounted around the pin;

FIG. 18 is a side view of a closed hinge according to the invention;

FIGS. 18A-C are cross-sectional end views taken through planes A-A, B-B, and C-C of FIG. 18, but with the hinge in a partially open position;

FIG. 19 and FIGs. 19A-D are cross-sectional end views of a hinge with leaf springs operatively connecting leaves to a cover;

FIGs. 20, 21, and 22 are perspective, exploded  
5 views of hinges with attachable gear segments;

FIGs. 20A, 21A, and 22A are end views of the gear segments of FIGs. 20, 21, and 22, respectively;

FIGs. 23A-D show a method for assembling a hinge according to the invention;

FIGs. 24A-E show alternative constructions of  
10 covers according to the invention; and

FIGs. 25A-C are side views of hinges according to the invention.

#### DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

15 FIG. 1 shows, in an exploded view, the components of an embodiment of a hinge according to the invention. Hereinafter, similar reference numerals beginning with a number and ending in a letter are referred to collectively by the number alone. The hinge shown has at least two hinged  
20 members including two leaves 100. Each leaf 100 has a knuckle 120, a shank 110, and a body 130.

Bodies 130 of this embodiment are flat and define openings 132 therethrough. The openings 132 are shaped to receive fasteners for fixing the respective leaf 100 to the remainder of each hinged member, such as a structural member  
25 like a door or door frame. Thus fixed, one hinged member is comprised of one of the leaves 100 and the door, and another hinged member is comprised of the other leaf 100 and the door frame. Shanks 110 connect the leaf bodies 130 to the  
30 knuckles 120, preferably extending tangentially from the knuckles 120 to provide increased clearance with the cover when the hinge is opened.

WO 99/23337

PCT/US98/23530

Knuckles 120 define through bores 124 that extend longitudinally and are aligned with bores 124 of other knuckles 120 of the same leaf 100. Gear sectors 122 are formed on the outer surface of the knuckles 120. The gear  
5 sectors 122 have a plurality of teeth 123. Leaf 100b has three shanks 110b and knuckles 120b that are spaced from each other to receive the two shanks 110a and knuckles 120a of leaf 100a interposed therebetween.

The leaves 100 may be manufactured from a variety  
10 of materials, including steel, aluminum, brass, and architectural or structural grades of plastics or composites; and by techniques including roll forming, extruding, casting, or otherwise molding. Also, although the knuckles 120 are shown integrally formed with the central bores 124, the leaves 100 may be made from a flat, stamped sheet, with the  
15 knuckles 122 rolled into a semicylindrical shape axially defining the bores 124.

Referring to FIGs. 1 and 2A-D, pin 140 is received through the bores 124 of the leaves 100 when the bores 124 are aligned coaxially. When assembled, the pin 140 pivotably  
20 joins the leaves 100. Pin 140 has a head 141 that facilitates assembly, as it prevents insertion through the knuckles 120 passed a predetermined point, and keeps the pin from sliding through the knuckles 120 in one direction when the hinge is assembled. Although a single pin 140 is shown, other embodiments may have multiple pins as long as at least  
25 one of the pins joins knuckles 120 of both leaves 100.

The hinge also has a cover 150. Two opposite walls 152 joined at a base 154 form the cover 150. The interior of the cover 150 defines a U-shaped channel 156 that extends longitudinally. On the interior of the cover walls 152 are  
30 geared surfaces that face each other. These geared surfaces are preferably racks 158 and correspond to and are meshed with the gear segments 122 of the leaves 100 in the assembled

WO 99/23337

PCT/US98/23530

hinge. The cover 150 fits over the knuckles 120 to provide protection from the environment and vandalism and to conceal the knuckles 120 from view. Preferably, the cover 150 does not support a significant portion of the loads imposed on the  
5 leaves 100 or hinged members.

End caps 160 fit into the ends of the cover 150, closing and blocking the interior channel 156. The cross-sections of the caps 160 preferably match the interior of the channel 156, providing a snug fit therewith. Flanges 164  
10 protrude laterally from the end caps 160, beyond the dimensions of the channel 156. When the caps 160 are inserted in the channel 156, the flanges 164 limit the depth of this insertion. Preferably, the flanges 164 are pressed tightly against the cover 150, so both the close fit of the end caps 160 within the channel 156 and the flanges 164  
15 effectively seal the interior of the channel 156.

Although press or snap fits are preferred between the end caps 160 and the cover 150, these two hinge components may be cemented together. Alternatively, a rivet extending through the cover 150 and into openings 166 in the  
20 end caps 160 may fix these two members. In the embodiment shown, the cover 150 is deformed locally at indentations 169 to penetrate the sides of the end caps 160. Cross pins may otherwise be inserted through the cover 150 and end caps at the locations of the indentations 169 shown. The interlock  
25 between the gear-shaped portions 168 of the end caps 160 and the racks 158 prevents rotational movement of the end caps 160 and end-cap movement laterally towards the open side of the channel 156. The end caps 160 in this embodiment restrict longitudinal movement of the leaves 100 along the cover 150. The end caps 160 and their attachment to cover  
30 150 are sufficiently sturdy to support the weight of the cover 150 against a topmost knuckle 120 or the top part of the pin 140.

In another embodiment, the end caps can be integrally formed with the cover. The end cap may comprise a flange extending from the cover end, which is then bent down to close the channel.

5           FIG. 3A shows a hinge in which a leaf 30a has a single knuckle 31a, which is interposed between the two knuckles 31b of leaf 30b. The pin 32 of this embodiment has a constant cross-sectional diameter, unlike the pin 140 of FIG. 1, which has a head 141. Pin 32 is retained within the  
10 knuckles 31 by the end caps 160, which are spaced from one another to provide room for the leaves 30, but preferably no additional room exceeding the amount required for the pin to slide longitudinally out from any single knuckle 31.

Referring to FIG. 3B, leaves 33 have a single knuckle 34 each. Pin 35 has two cross holes 36 and 37.  
15 Knuckle 34a has a cross hole 38 that corresponds to pin cross-hole 37, as it is aligned therewith when the hinge is assembled. A drum-shaped end piece 39 defines a cross hole 40 that corresponds and aligns with pin cross-hole 36. The pin 35 is placed through both knuckles 34 and the end piece  
20 39. Cross pin 41 is press fit into holes 37 and 38, and cross pin 42 is press fit into holes 36 and 40, fixing the pin 35 to leaf 33a and to the end piece 39. Knuckle 34b is thus retained between the end piece 39 and knuckle 34a. The pin 35 preferably has a head 43 configured to stop insertion of the pin 35 into knuckle 34a when holes 37 and 38 are  
25 disposed at the same longitudinal location.

Whereas the hinge shown in FIGS. 1, 3A, and 3B are longitudinally short, FIG. 3C shows a piano hinge embodiment of the invention. Leaves 180 of the piano hinge extend most of the length of the structural members to be hinged. These  
30 leaves 180 have a larger number of interposed knuckles 181 than leaves 100 of FIG. 1.

Referring to FIGs. 4A-B, an alternative end cap 171 has a nipple 170 through which to feed lubricant into channel 156. A passageway 172 passes through the nipple 170 and the length of the end cap 171. The passageway 172 is open to the channel interior 156. Lubricant introduced through the nipple 171 travels through the passageway 172 and is then distributed over the moving parts within the cover 150 during normal hinge operation.

The embodiment illustrated contains an additional feature to improve the securing of the end cap 171 to the cover 150. A slot 173 is defined through the end cap 171, substantially in parallel to the walls 152 of the cover 150 when the hinge is assembled. The passageway 172 is defined through the slot 173. The nipple 170 has a threaded male portion 174 that screws into a corresponding threaded bore communicated with the passageway 172. As the nipple 170 is screwed into the end cap 171, the male portion 174 spreads the end cap 171 at the slot 173, compressing sides 176 of the end cap 171 against the cover walls 152, improving end-cap retention within the cover 150.

The operation of a hinge according to the invention is illustrated in FIGs. 2A-D. In FIG. 2A, the hinge is closed. As shown, the shanks 110 of this embodiment are formed with a double bend, which may be produced by swaging, extruding, or otherwise, such that the leaves 100 have a position in which the shanks 110a of one leaf 100a cross-over and overlap the shanks 110b of the other leaf 100b along the longitudinal direction parallel to the pin 140. In this embodiment, this overlap occurs at least when the hinge is closed. The shanks 110 thus cross over from one side of the other leaf 100 to the opposite side thereof. For instance, where it meets knuckle 120a, shank 110a is disposed to the right of the other leaf 100b. But where it meets the leaf body 130a, shank 120a is to the left of the other leaf 100b.

PCT/US 98/23530  
IPEA/US 21 OCT 1999

5 The double bends of the shanks 110 include bends  
112 and 115. This curvature of the double bend shanks 120  
retards interference or contact between the leaves 100 and  
the cover 150 as the hinge is pivoted. The double bends  
10 produce concave portions 114 of the shanks 110 that surround  
the walls 152 of the cover when the hinge is in an open  
pivotal position, as seen in FIG. 2D. The leaves 100 are  
thus pivotable by more than 180°. Although the shank 120 may  
be made without double bends, as shown in FIGs. 2E-F, double  
bends are preferred as they increase allowable pivot angle of  
the leaves 100, which is limited to about 90° with the leaves  
995 of FIGs. 2E-F.

15 Referring to FIGs. 2E-F, gear segments 997 of  
knuckles 996 and racks 998 of cover 994 are shorter and  
extend over a smaller rotational angle about the pin 140 than  
the gear segments 122 and racks 158 from FIGs. 2A-D due to  
the limited pivotal range of the leaves 995 without double  
bends. Shanks 999 of leaves 995 have at most a single bend,  
and the shanks 999 of one leaf 995 do not cross from one side  
20 of the other leaf 995 to the opposite side thereof, as do  
shanks 110 of FIGs. 2A-D.

25 Referring again to FIGs. 2A-D, the gear segments  
122 associated with the knuckles 120 are meshed with the  
racks 158. This mesh operatively connects the cover 150 to  
the leaves 100 to displace the cover 150 with respect to the  
pin 140 in a controlled manner as the leaves 100 are pivoted,  
while maintaining the cross-section of the channel 156.  
Preferably, this displacement is radial with respect to the  
pin 140. This operative connection preferably prevents the  
30 cover 150 from rocking about the knuckles 120 and provides a  
stable mounting surface on the channel 150 for attachments  
such as electrical switches. Together with the operative  
connection between the leaves 100 and the cover 150, the  
double bend shanks 110 permit operation of the preferred  
35 embodiment in which the cover 150 circumferentially surrounds

the knuckles 120 and the pin 140 by at least about  $270^\circ$  in one pivoted position of the leaves 100, preferably permitting more than about  $100^\circ$  of pivotal travel of the hinged members, and more preferably more than about  $120^\circ$  of pivotal travel.

5 As the hinge is opened and the leaves 100 rotate around the pin 140, progressively from FIG. 2A to 2D, the gear segments 122 move the cover 150 away from the pin 140. The cover 150 is thus moved out of the way of the leaves 100. The distance between the walls 152 of the cover 150 and the leaf shanks 110 is controlled by the cover 150  
10 displacement as the hinge pivots.

FIGs. 5A-L show an alternative embodiment of the hinge with leaves 101 that are manufacturable with an extrusion die that is cheaper than that required for the leaves 100 of FIGs. 2A-D. Knuckles 121 of the leaves 101 are  
15 C-shaped in cross-section. As seen in FIGs. 5C-L, the C-shaped knuckles 121 contact the pin 140 at points spread over more than  $270^\circ$ . This angle may be smaller than  $270^\circ$ , but is preferably more than  $180^\circ$  to adequately retain the leaves 101 in pivotable engagement. The extrusion die required to  
20 produce these knuckles 121 need not produce a closed circular cross-section, reducing manufacturing costs.

Also, the leaves 101 include lips 116 which extend laterally adjacent the shanks 111. The shanks 111 have double bends and an outer surface 113 which is contiguous  
25 along the shanks 111 and lips 116 and is contoured to travel close to or in contact with the ends 153 of walls 152 of the cover 150 as the hinge is pivoted, as shown in FIGs. 5C-L.

Whereas the leaves 100 and the cover 150 in FIGs. 2A-D and 5A-L are configured and dimensioned such that opening pivotal movement of the leaves 100 displaces the  
30 cover 150 away from the pin 140, the opposite is true in the embodiment of FIGs. 6A-E. FIGs. 6A-E progressively show the opening pivoting movement of this hinge embodiment. As the

hinge opens, knuckles 120 and pin 140 move deeper into the cover 150. In other words, the cover 150 moves radially towards the pin 140. When the hinge is closed, as shown in FIG. 6A, the gear segments 222 are meshed towards the  
5 outer end of the racks 158. When the hinge is closed, the operative connection between the leaves 200 and the cover 150 places the gear segments 222 toward the inner end of the racks 158.

One leaf 200a is affixed to a door frame 260, and the other leaf 200b is affixed to a door 262. When the hinge  
10 is closed, as shown in FIG. 6A, leaf bodies 230 are preferably disposed close to or contact each other. The shanks 210 of leaves 200 have triple bends, as they have a concave portion 211 with a deep U-shaped cross-section in a plane substantially perpendicular to the axis of the pin 140.  
15 The base of the U-shaped portion of each shank 210 is disposed towards a direction opposite the body 230 to which it is connected. When the hinge is opened, the shanks 230 extend around the cover walls 152. This shank shape keeps the shanks 210 out of the way of the cover 150 during  
20 pivoting of the leaves 200.

Both the door and the frame have recessed portions 264 that extend longitudinally, parallel to the pin 140. When the hinge is closed, as shown in FIG. 6A, recess 264a receives shank 210b, and recess 264b receives shank 210a. As  
25 seen, each recess 264 receives the shank 210 that is fixed to the other of the structural members: the door frame 260 or the door 262. As the hinge is opened, the cover 150 is moved out of the relative arcs of travel of these structural members 260 and 262. When the hinge is completely open, as shown in FIG. 6E, the cover 150 is contained within the space  
30 266 defined by both recessed portions 264 and the hinge. In this embodiment, hinged member 201a includes door frame 260

WO 99/23337

PCT/US98/23530

and leaf 200a, and hinged member 201b includes door 262 and leaf 200b.

In the embodiment of FIGs. 6F-G, as in the embodiment of FIGs. 6A-E, cover 900 moves radially towards  
5 pin 901 when the hinge is opened, and radially away from pin 901 when the hinge is closed. An arcuate extension 902 extends from at least one of the hinged members 903, in this case from leaf 904a. The extension 902 extends around the cover and has an end 905 that substantially closes the space  
10 between the cover 900 and the interior of the extension 902.

The interior of the extension 902 houses electrical contacts 906 (only one of which is shown) disposed at different locations along the length of the extension 902. The contacts 906 are electrically insulated from the extension 902. The cover 900 comprises an electrical  
15 conductor such that a circuit is formed between the contacts 906 and the cover 900 when the hinge is closed and the cover 900 abuts the contacts 906, as shown in FIG. 6G. If an intruder attempts to pry open the hinge by bending the extension 902 away from the cover 900, the circuit will be  
20 broken when the cover 900 and the contacts 906 separate, preferably setting off an alarm. Alternatively, the contacts 906 can be replaced with switches to perform similar or different functions.

The leaves 300 of the embodiment of FIGs. 7A-B have gear segments 320 of different radii. Cover 350 also has  
25 corresponding racks 358 with different geared-surface radii. Because the gear radius of gear segment 320b is larger than the gear radius of gear segment 320a, a predetermined amount of pivoting of the leaves 300 causes a greater displacement of rack 358b than of rack 358a. Hence, as the hinge is  
30 opened, as seen in FIG. 7B, the cover travels along an arcuate locus 359, with respect to the pin 140, that is curved towards leaf 300a. By selecting an appropriate

WO 99/23337

PCT/US98/23530

difference in gear segment 320 radii, the locus 359 of the cover 350 can be altered. Furthermore, non-circular gear segments and differently shaped cover walls may be employed to further alter the locus of the cover to provide virtually any position with respect to the pin at any pivotal position of the leaves.

Referring to FIGs. 8A-D, the cover 450 of the hinge can also be used to positively seal the hinged members 401, including, in this embodiment, leaves 400 and structural members comprising door frame 460 and door 462. The hinge shown is pivotable by more than 90°. A seal in the form of sealing pad 460 is fixed to door frame 460. Cover wall 452a is shorter than cover wall 452b. When the hinge is closed, the shorter cover wall 452a abuts in sealing contact the sealing pad 464, and the longer wall 452b contacts door 462. In this position, the cover 450 is sealed to the door frame 460 and the door 462. An edge 466 of the sealing pad 464 is rounded to permit the shorter cover wall 452a to move with respect thereto without catching as the hinge opens, as shown in FIGs. 8B-C, but to produce the seal shown in FIG. 8A when the hinge is closed.

Although the longer wall 452b of cover 450 is part thereof, it and the door 462 are also a seal. The longer wall 452b is shaped to abut and seal against the door 462 when the hinge is closed, and to move away from the door 462 as it opens.

Opening pivoting movement of this embodiment is limited to the pivoting position at which the longer cover wall 452b contacts shank 410b of leaf 400b. This shank 410b is also configured to allow the longer cover wall 452b to travel relative thereto as the hinge is pivoted.

FIG. 9 shows an alternative cover 470 with resilient gasket seals 474 extending along the ends of the cover walls 472. The gaskets 474 improve sealing to the

WO 99/23337

PCT/US98/23530

hinged members on both sides of the cover 470. A hinge employing cover 470 with gasket seals 474 may not need the additional sealing pad 464 shown in FIGs. 8A-D.

5 The hinge embodiment of FIGs. 5A-L is particularly suited for use with cover 470 of FIG. 9. The outer surface of the lips 116 and shank 111 can be configured as wipers to wipe the gaskets 474 each time the hinge is pivoted.

10 The embodiment of FIGs. 10A-C has a cover 550 with cover walls 552 of substantially equal lengths. Resilient seal inserts 584 are secured to the structural members: door frame 560 and door 562. Thus, the seal inserts 584 are coupled to move with the leaves 100. When the hinge is closed, the cover 550 presses into the seal inserts 584, sealing the space within the cover 550 from the outside. As the hinge is opened, the cover 550 moves away from the seal  
15 inserts 584, permitting the hinge to pivot.

The seal inserts 584 have tongue portions 585 that are press or snap fit into grooves 586 in the structural members 560 and 562. This tongue-in-groove fit seals the seal inserts 584 to the structural members 560 and 562 and  
20 secures them thereto.

Also, the seal inserts 584 extend laterally up to the leaves 100, and are in contact therewith, improving sealing. This contact between the seal inserts 584 and the leaves 100, however, is not necessary in the shown embodiment if adequate sealing is accomplished between the cover walls  
25 552 and the seal inserts 584.

The embodiment of FIGs. 11A-C is similar to the one of FIGs. 10A-C, except that seal inserts 590 are fitted to seal supporting members 501 of leaves 500. This hinge embodiment with seal supporting members 501 does not require  
30 additional seals affixed to the door and door frame to which it is attached. As shown in FIG. 11C, the opening pivoting travel of the leaves 500 stops where the cover walls 552 and

the shanks 510 contact. In an alternative embodiment with shorter cover walls, the opening pivoting travel can be limited when the seal inserts 590 contact the sides of cover walls 552.

5 Referring to FIG. 12A-D, leaves 50 are fastened to structural members 52. The hinged structural members 52 have arcuate portions 54 that extend around cover 56. Sealing extensions 58 protrude laterally from the cover 56 towards the arcuate portions 54 of the structural members 52. These  
10 sealing extensions support resilient gaskets 60. When the hinge is closed, the gaskets 60 are compressed between the sealing extensions 58 of the cover 56 and the arcuate portions 54 of the structural members 52, sealing the space between the structural members.

The cover 56 and leaves 50 are operatively  
15 connected in a manner similar to the leaves 200 and the cover 150 of FIGs. 6A-E. As the hinge opens, the cover 56 moves towards pin 140, and as the hinge closes, the cover 56 moves away from the pin 140. The shanks 62 and the ends of the arcuate portions 54 of the structural members 52 of this  
20 hinge are configured to limit the pivoting of the hinge to slightly more than 90°.

As shown in FIG. 12D, the cover 56 is not in contact with the structural members 52. Instead, it is enclosed within the arcuate portions 54. In another  
25 embodiment however, the arcuate portions and the operative connection between the cover and the leaves can be tailored so the cover slides along the arcuate portion, never losing its seal therewith.

In the embodiment shown, one hinged member 51a includes leaf 50a and structural member 52a, and the other  
30 hinged member 51b includes leaf 50b and structural member 52b. The leaf 50 and structure member 52 of each hinged

member 51 interact functionally. In most embodiments, one of the hinged members may comprise an entire door.

FIGs. 13A-B show an embodiment of a hinge with an additional interconnection between a cover 650 and a pin 640. Within channel 656 of cover 650, preferably adjacent the cover base 654, the cover 650 defines longitudinal keyways 694 that extend along the length of the cover 650. A mount plate 692 fits within the keyways 694. Mount plate 692 includes a tapped bore 696 for receiving a cross guide 690. The cross guide 690 is preferably a cylindrical pin with a threaded portion 698 that is screwed against the cover base 654, securing the mount plate 692 and the cross guide 690 in place.

Pin 640 defines a bore 642 transversely therethrough dimensioned to slideably receive the cross guide 690. Pin 640 pivotably joins leaves 600. Instead of having three knuckles 620, as does leaf 100 of FIG. 1, a central knuckle is missing to make room for the cross guide 690 when the hinge is closed.

During operation of the hinge, the cross guide 690 prevents pin 640 from rotating relative to the cover 650. Cross guide 690 helps maintain the locus of the cover 650 with respect to the pin 640. Additionally, the cross guide 690 ensures that the knuckles 620 of the two leaves 630 rotate through the same angle with respect to the pin 640. Thus, each knuckle 630 rotates about the pin 690 over half the angle over which rotate knuckles of a hinge in which another leaf is fixed to the hinge pin. As a result, wear is reduced and equalized in both leaves 630. Also, the leaves 600 define notches 634 aligned with the cross guide 690 such that when the hinge closes and the leaves 600 move towards the cover 650, leaf bodies 630 do not interfere with the cross guide 690.

A cylindrical guide sleeve 643 is slideably mounted on pin 640. The sleeve 643 defines a traverse hole aligned with the bore 642 and configured for receiving the cross guide 690. On the longitudinal ends of the sleeve 643 are  
5 end faces 644 that limit the longitudinal travel of the leaves 630 when the knuckles 620 contact the end faces 644. The hinge of this embodiment thus does not require end caps on the cover 650 because the cross guide 690 and guide sleeve 643 retain the leaves 630 and the pin 640 within a  
10 predetermined longitudinal position with respect to the cover 650. The arrangement of this embodiment also eliminates any need to secure the pin 640 to one of the knuckles 620. In an alternative embodiment without the sleeve 643, knuckles 630 disposed adjacent the cross guide 690 can be spaced close to the cross guide 690, fulfilling the function of the sleeve  
15 643.

Another embodiment employing a cross guide is illustrated in FIGs. 13C-D. The cross guide 90 is a bent sheet of metal with base 94 and a forked end, which includes guide members 91 defining a space 95 therebetween. The base  
20 94 of cross guide 90 fits within keyways 694 of the cover 650 and is secured to the cover 650 by screw 96. Pin 92 preferably has a groove 93 which is received within the space 95 of the forked end of the cross guide 90. The outer diameter of the pin 92 is larger than the space 95 so that the cross guide 90 is retained longitudinally with respect to  
25 pin 92.

Leaf 600b from FIGs. 13A-B can be used with the embodiment of FIGs. 13C-D. Notch 634b allows the leaf 600b to pivot without being blocked by the cross guide 90. Leaf 97a has knuckles 98, which are separated longitudinally by  
30 little more than the thickness of the cross guide 90. Thus, when assembled, the cross guide 90 is retained longitudinally with respect to the leaves 97a and 600b. Notch 99 in leaf

97a serves a similar purpose as notch 634b, allowing the body 89a of leaf 97a to pivot past the cross guide 90.

The embodiment of FIG. 14 has a cross guide 790 with a threaded end 798 screwed directly into a threaded hole in cover 750. The end 796 of the cross guide 790 opposite the threaded end 798 is configured to receive a tool such as a screw driver for securing the cross guide 790 to the cover 750 once leaves 700 are assembled into the cover 750. A transverse bore 742 through pin 740 slideably receives the cross guide 790.

10 A resilient biasing member biases the cover 750 away from the pin 740. In this embodiment, the biasing member is a helical spring 774 disposed surrounding the cross guide 790. A plate or washer 776 is fitted between and against the spring 774 and the pin 740. The spring 774 is thus compressed as the hinge is closed and the pin 740. The spring 774 biases the cover 750 away from the pin 740, automatically opening the hinge. Consequently, the leaves 700 are biased in response to a relative position of the cover 750 with respect to the pin 740. Although in this embodiment, this bias forces the cover 750 in a direction perpendicular to the pin 740, the locus of the cover 750 may be curved in other embodiments. As will be understood, the helical springs described herein can be replaced by other biasing members, such as elastomeric rods, solenoids, and hydraulic or pneumatic actuators. Dampers may also be employed as the biasing member in order to control impact loads on the hinged members.

As opposed to FIG. 14, FIG. 15 shows an embodiment of a self-closing hinge in which a resilient biasing member, spring 775, biases cover 751 towards pin 741. Cross guide 791 is threaded through mount plate 793 to bear against the cover 751 to clamp the cross guide 791 longitudinally thereto. The cross guide 791 is slideably received through

transverse bore 743 in pin 741. Spring 775 is received around the cross guide 791 and is biased against an enlarged end 779 of the cross guide 791 and the plate 777, which abuts pin 741. Spring 775 thus biases the hinge towards a closed  
5 position.

Referring to FIGs. 16A-B, a resilient member, spring 702, is compressed between pin 704 and cover 706. The cover base 708 forms a cover seat 710 with an elevated rim. A seat member 712 forms a seat on one side and a  
10 semicylindrical wall on the other. Ends of the spring 702 fit in the cover seat 710 and the seat of the seat member 712. The semicylindrical wall of the seat member 712, in turn, is slideably biased against pin 714 by the spring 702. As a result of the bias separating the cover 708 from the pin 714, leaves 716 are biased towards a closed position because  
15 the leaves are pivotably mounted about the pin 714 and are operatively connected to the cover 706 in a manner similar to that in the FIGs. 6A-E embodiment.

FIGs. 17A-B show another embodiment wherein a spring 601 is coiled around pin 641. Spring ends 603 bias  
20 leaf bodies 630 of leaves 600 towards each other, biasing the hinge towards a closed position. The cover 150, in this embodiment, hides from view the otherwise unattractive spring 601. This embodiment may be altered by placing the spring ends 603 between the leaves 600 to produce a self-opening  
25 hinge.

Referring to FIG. 18, the hinge shown has a cover 70 and three pairs of opposed leaves 72. Leaves 72a, 72c, and 72e are connected to a first structural member 71 and are thus coupled and pivotally fixed to each other, and leaves 72b, 72d, and 72f are connected to a second structural member  
30 (not shown) and are thus coupled and pivotally fixed to each other. The leaves 72 are operatively connected to the cover 70 such that leaves 72a, 72b, 72e, and 72f move the cover 70

towards the left in FIGs. 18A and 18C as the hinge is opened, whereas leaves 72c and 72d move the cover 70 to the right in FIG. 18B as the hinge is opened. As a result, the center of the cover 70 is twisted right with respect to pin 74, while  
5 the ends of the cover 70 are twisted left with respect to pin 74 as the hinge is opened. Thus twisted about its longitudinal axis, the cover 70 resiliently creates a bias towards its natural, straight configuration. This resiliency pivotally biases all of the leaves 72 towards a closed  
10 position.

FIG. 19 shows not only a self-opening hinge, but also an alternative way of operatively connecting hinge-leaves to a cover to move the cover in response to the pivoting position of the leaves. This hinge has two opposed leaves 76 that are pivotably mounted about a pin 78. A cover  
15 80 surrounds leave knuckles 82. Leaf springs 84 have ends 86 anchored to the cover 80, and opposite ends 88 anchored to the knuckles 82.

The leaf springs 84 are resiliently biased towards a configuration in which they are straight, although in other  
20 embodiments, they can be resiliently biased towards a configuration in which they are rolled up over themselves. FIGs. 19A-D show the hinge of FIG. 19 progressively as the leaf springs 84 bias the leaves 76 towards the open position of FIG. 19D. The leaf springs 84 are bent over a greater  
25 portion of their length in FIG. 19A than in the other figures. The leaf springs 84 thus naturally assume a straighter position as shown in FIG. 19D. As the leaf springs 84 bias the hinge towards an open position, their predictable unfolding moves the cover 80 along a  
30 predetermined locus with respect to the pin 78. Once the hinge is completely open, as shown in FIG. 19D, a limited additional pivoting of leaves 76 is permitted by additional determination of the leaf springs 84.

FIGs. 20 and 20A illustrate assembly of an alternative embodiment of an inventive hinge. Knuckles 802 of leaves 800 are formed separately from gear segments 804. The knuckles 802, shanks 806, and leaf bodies 808 are formed  
5 by shaping a single sheet of metal. The gear segments 804 have inner surfaces 810 that conform to the shape of the knuckles 802. The gear segments 804 also have tongues 812 that mate and couple with notches 814 formed in the knuckles 802, preferably in a snap-fit engagement. Thus joined,  
10 pivoting of the leaves 800 causes the gear segments 804 to pivot. Alternative manners of joining the gear segments to the knuckles exist, including adhering them together.

Referring to FIGs. 21 and 21A, gear segments 816 include a bearing portion 818 that functions as a bushing between adjacent knuckles 822. Gear teeth 820 of gear  
15 segments 816 extend from the bearing portion 816 in a common transverse plane. The knuckles 822 define notches 824 formed into their longitudinal ends. The gear segments 816 have tongues 826 configured to mate with notches 824 for coupling the gear segments 816 to the knuckles 822 in rotation.

20 Gear segments 816 are preferably made from hardened material to better withstand bearing and load forces imposed by adjacent knuckles 822. The bearing portions 818 may alternatively comprise a race for ball bearings or may otherwise support ball bearings mounted about the hinge pin.

25 FIGs. 22 and 22A show an embodiment of hinge leaves that combines elements from the embodiments of FIGs. 20 and 21. Gear segments 828 include bearing portions 830, as well as wide geared-portions 832 overlying inner surfaces 834 that conform to the surface of knuckles 836. The gear segments 828 also have tongues 838 configured to mate with notches 840  
30 in the longitudinal ends of the knuckles 836.

Various ways exist to assemble the hinges of the present invention. Referring to FIG. 1, in a first

embodiment, the leaves 100 may first be joined together by inserting the pin 140 into the knuckle bores 124. The gear segments 122 and the cover racks 158 may be configured to disengage when the leaves 100 are opened by more than a  
5 preselected amount, such as 185°. The cover 150 may then be fit over the knuckles 120, and the leaves 100 may be closed, meshing the gear segments 122 with racks 158. This hinge may then be employed with a door that opens only up to less than the preselected amount.

10 An alternative manner of assembling the hinge is illustrated in FIGs. 23A-D. Before the leaves 100 are joined with the pin 140, the knuckles 122a of a first of the leaves 100a are placed within the cover channel 156, as shown in FIG. 23A, and moved into mesh with rack 158a, as shown in FIG. 23B. The same process is repeated with leaf 100b, as  
15 shown in FIGs. 23C-D. Once the leaves 100 are properly seated in the cover channel 156, pin 140 is inserted. This hinge will not fall apart if the leaves 100 are spread as far as structurally possible.

Alternatively, the gear segments 122 of the leaves  
20 100 can be slid longitudinally along the cover racks 158, up to their desired assembled position. At least one end cap 160 should be fitted to the cover 150 after insertion of the leaves 100.

FIGs. 24A-E illustrate various embodiments of  
25 geared covers suitable for use with geared leaves of the present invention. Cover 840 is formed from flexible sheet metal or plastic and has racks 842 formed separately therefrom and brazed or glued thereto. Cover 844 is formed from a flexible sheet corrugated to form racks 846. Cover 848 is similar to cover 844, but additionally includes an  
30 outside jacket 850 adhered to the base of the cover 848, for example made of plastic or wood, for improving aesthetics of the hinge or for increasing the rigidity of the base of the

WO 99/23337

PCT/US98/23530

cover 848. Walls 854 of cover 852 comprise self-lubricating plastic rack-inserts 856 held in C-shaped metal clamps 858. The clamps 858 are welded to a flexible base 860. Cover 862 is made from a single, relatively stiff piece of metal,  
5 preferably aluminum or steel. The base of the cover 862 is reinforced with longitudinally extending ribs 864. Other cover embodiments can include a U-shaped insert within an outer cover.

10 In the covers of FIGs. 24A-D, at least part of each cover is flexible. This facilitates assembly as the walls of these covers can be spread as leaves, already joined with a pin, are inserted therein. Cover 862, of FIG. 24D, on the other hand, is better suited for a high-security door as it is much stiffer than its counterparts shown in FIGs. 24A-D.

Finally, FIGs. 25A-C illustrate various  
15 arrangements for attaching hinges according to the invention to structural members. In FIG. 25A, leaf pairs 866, 868, and 870 are fixed to structural members 872, only one of which is shown. Leaf pair 866 has its own cover 874, while leaf pairs 868 and 870, disposed adjacent each other, are fitted with a  
20 single cover 876. In FIG. 25B, leaf pairs 878, 880, and 882 are all connected through a single cover 884, and are all affixed to structural members 886, one of which is shown. The embodiment of FIG 24C is a piano hinge with a cover 888 and a single pair of leaves 890 fixed to structural members  
25 892, only one of which is shown.

One of ordinary skill in the art can envision numerous variations and modifications. For example, each hinged member may be constructed integrally as a single piece including a leaf and a door. All of these modifications are contemplated by the true spirit and scope of the following  
30 claims.

PCT/US 98/23530  
IPEA/US 21 OCT 1999

CLAIMS

What is claimed:

1. A pinned hinged combination comprising:  
a first hinged member including a first leaf with a first knuckle;  
a second hinged member including a second leaf with a second knuckle that defines a bore extending therethrough in a longitudinal direction;  
a pin received within the bore of the second knuckle and associated with the first knuckles for pivotably joining and retaining the leaves; and  
a cover defining a longitudinal channel of a channel cross-section surrounding the knuckles for protecting the knuckles;  
wherein the hinged members are pivotable between a closed position and an open position, the cover being operatively connected to the first and second leaves such that pivotal movement of the leaves displaces the cover substantially incrementally with respect to the pin substantially throughout the movement between the closed and open positions while substantially maintaining the channel cross-section.
2. The combination of claim 1, wherein the leaves have a position in which the cover extends circumferentially around the pin by at least about 270° and the leaves are pivotable more than about 100°.
3. The combination of claim 1, wherein the knuckles have gear sectors and the cover has geared surfaces corresponding thereto, with the gear sectors and the geared

PCT/US 98/23530  
IPEA/US 23 OCT 1999

surfaces being meshed such that pivotal movement of the leaves displaces the cover radially with respect to the pin.

4. The combination of claim 1 further comprising first and second leaf springs attached to the first and second knuckles respectively and also to the cover, the leaf springs being bent around the knuckles when the leaves are pivoted in one direction and straightening when the leaves are pivoted in an opposite direction for repositionably displacing the cover radially with respect to the pin in response to pivotal movement of the leaves.

5. A pinned hinged combination, comprising:  
a first hinged member including a first leaf with a first knuckle;  
a second hinged member including a second leaf with a second knuckle that defines a bore extending therethrough in a longitudinal direction;  
a pin received within the bore of the second knuckle and associated with the first knuckles for pivotably joining and retaining the leaves;  
a cover defining a longitudinal channel surrounding the knuckles for protecting the knuckles; and  
a seal disposed for sealing the cover to the hinged members when the hinged combination is in a predetermined pivotal position.

6. The combination of claim 5, wherein the hinged combination is in the predetermined position when the hinged combination is closed.

7. The combination of claim 5, wherein the cover and the leaves are operatively connected for moving the cover such that it compresses the seal when the hinged combination

PCT/US 98/2555 U  
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is in said predetermined position and releases the seal when the hinged combination is pivoted to another predetermined position.

8. The combination of claim 7, wherein the cover channel has an open side receiving the leaves, the seal being disposed between the cover and the hinged members on a side of the cover opposite the open side of the channel when the hinged combination is closed.

9. The combination of claim 1 further comprising a biasing member associated with the cover and configured for pivotally biasing the leaves and causing relative movement between the pin and the cover.

10. A pinned hinged combination, comprising:  
a first hinged member including a first leaf with a first knuckle;  
a second hinged member including a second leaf with a second knuckle that defines a bore extending therethrough in a longitudinal direction;  
a pin received within the bore of the second knuckle and associated with the first knuckles for pivotably joining and retaining the leaves; and  
a cover defining a longitudinal channel surrounding the knuckles for protecting the knuckles;  
wherein at least one of the hinged members includes an extension that extends over the cover, the extension and the cover being configured for selectively opening and closing an electrical circuit when the cover and the extension abut and separate.

11. The combination of claim 1, further comprising a cap associated with the cover for blocking a portion of the

PCT/US 98/23530  
IPEA/US 23 OCT 1999

channel, wherein the first knuckle defines a bore extending therethrough in the longitudinal direction, and the pin is also received within the bore of the first knuckle.

12. The combination of claim 11, wherein the channel has an end and the cap is fitted to the cover at the end of the channel.

13. The combination of claim 11, wherein the cap has a lubricant port for feeding lubricant into the channel.

14. The combination of claim 1, wherein the first leaf has a plurality of said first knuckles and the second leaf has a plurality of said second knuckles, the first knuckles being interposed with the second knuckles.

15. The combination of claim 1, further comprising a cross guide attached to the cover and associated with the pin for guiding movement of the cover with respect to the pin.

16. A pinned hinged combination, comprising:

a first hinged member including a first leaf with a first knuckle, the first leaf comprising a first body and a first shank having ends joining the first body to the first knuckle;

a second hinged member including a second leaf with a second knuckle that defines a bore extending therethrough in a longitudinal direction, the second leaf comprises a second body and a second shank having ends joining the second body to the second knuckle;

a pin received within the bore of the second knuckle and associated with the first knuckles for pivotably joining and retaining the leaves; and

98/23530  
PCT/US 98/23530  
PCT/US 98/23530

a cover defining a longitudinal channel surrounding the knuckles for protecting the knuckles;

wherein the shanks are configured such that the leaves are pivotable to a first position in which the first shank overlaps the second shank along the longitudinal direction.

17. The combination of claim 16, wherein the ends of the shank of one of the leaves in the first position are disposed on opposite sides of the other leaf.

18. The combination of claim 16, wherein at least one of the shanks has at least a double bend.

19. The combination of claim 1, wherein the hinged members include a wiper configured and dimensioned to wipe the cover as the hinged combination pivots.

20. The combination of claim 1, further comprising a spring mounted to the pin for pivotably biasing the hinged members, wherein the cover is configured and dimensioned for concealing the spring.

21. A pinned hinged combination comprising:  
a first hinged member including a first leaf with a first knuckle;

a second hinged member including a second leaf with a second knuckle that defines a bore extending therethrough in a longitudinal direction;

first and second gear segments associated with the first and second knuckles respectively;

a pin received within the bore of the second knuckle and associated with the first knuckles for pivotably joining and retaining the leaves; and

**PCT/US 98/23530**  
IPER 01 01 1999

a cover defining a longitudinal channel surrounding the knuckles for protecting them, the cover having first and second geared surfaces within the channel meshed with the first and second gear segments respectively such that pivotal movement of the leaves displaces the cover radially with respect to the pin.

22. The combination of claim 21, wherein the leaves are configured and dimensioned such that opening pivotal movement of the leaves displaces the cover away from the pin, the first knuckle defines a bore extending therethrough in the longitudinal direction, and the pin is also received within the bore of the first knuckle.

23. The combination of claim 21, wherein the leaves are configured and dimensioned such that opening pivotal movement of the leaves displaces the cover towards the pin.

24. The combination of claim 23, wherein at least one of the leaves comprises a body and a shank joining the body to the knuckle of the at least one of the leaves, the shank having a U-shaped portion for fitting around the cover when the hinged combination is open.

25. The combination of claim 24, wherein the shank has at least a triple bend defining the U-shaped portion.

26. The combination of claim 21, wherein the first gear segment has a first gear radius, and the second gear segment has a second gear radius that is a different size than the first gear radius such that the cover travels along a curved locus with respect to the pin when the leaves are pivoted.

PCT/US 98/23530  
IPEA/US 25 OCT 1999

27. The combination of claim 1, further comprising a biasing member associated with the cover and configured for biasing the pin and knuckles towards or away from the cover.

28. The combination of claim 27, wherein the biasing member has ends attached to the cover and the leaves.

29. A pinned hinged combination, comprising:  
a first hinged member including a first leaf with a first knuckle;

a second hinged member including a second leaf with a second knuckle defining a bore extending therethrough in a longitudinal direction;

a pin received within the bore and associated with the first knuckle for pivotably joining and retaining the leaves;

a cover defining a longitudinal channel surrounding the knuckles for protecting them, the cover having first and second portions connected to the hinged members at first and second longitudinally spaced locations, respectively; and

wherein the first and second knuckles are operatively connected to the first portion of the cover at the first location such that pivoting of the leaves resiliently twists the first portion of the cover with respect to the second portion for pivotally biasing the leaves.

30. The combination of claim 29, comprising:  
a third knuckle coupled with the first leaf; and  
a fourth knuckle coupled with the second leaf;  
wherein the first and second knuckles are operatively connected to the first portion of the cover at the first location such that pivoting of the leaves moves the

**PCT/US 98/23530**  
IPEA/US 98/007 1999

first portion of the cover along a locus extending in a first direction with respect to the pin, the third and fourth knuckles being operatively connected to the second portion of the cover at the second location such that the pivoting of the leaves moves the second portion of the cover along another locus extending in a second direction with respect to the pin for causing the twisting of the cover.

31. The combination of claim 30, wherein each of the first, third, and fourth knuckles define a bore extending therethrough in the longitudinal direction, the first and second knuckles being pivotably pinned together through their respective bores and the third and fourth knuckles being pivotably pinned together through their respective bores.

**1/34**

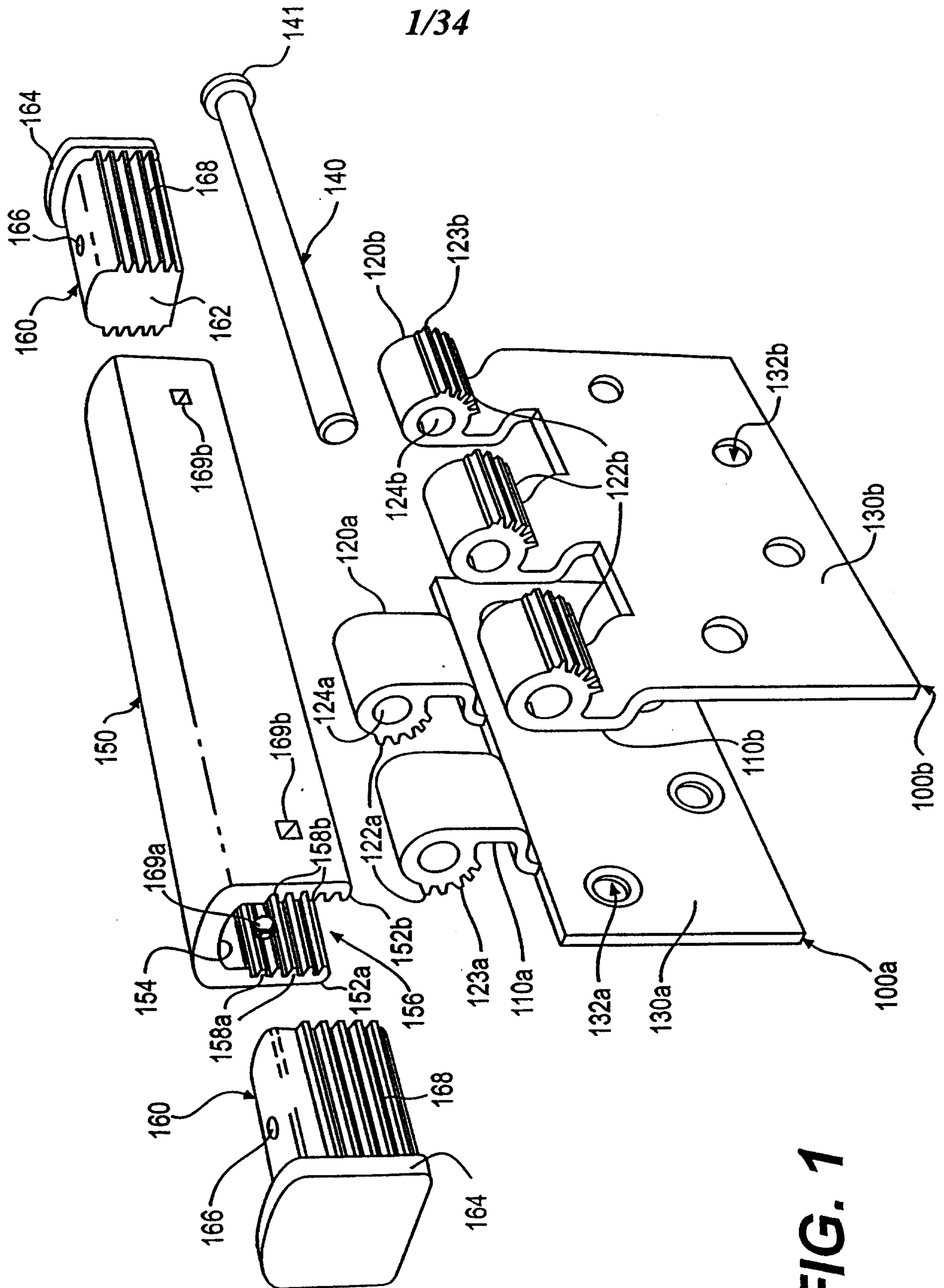
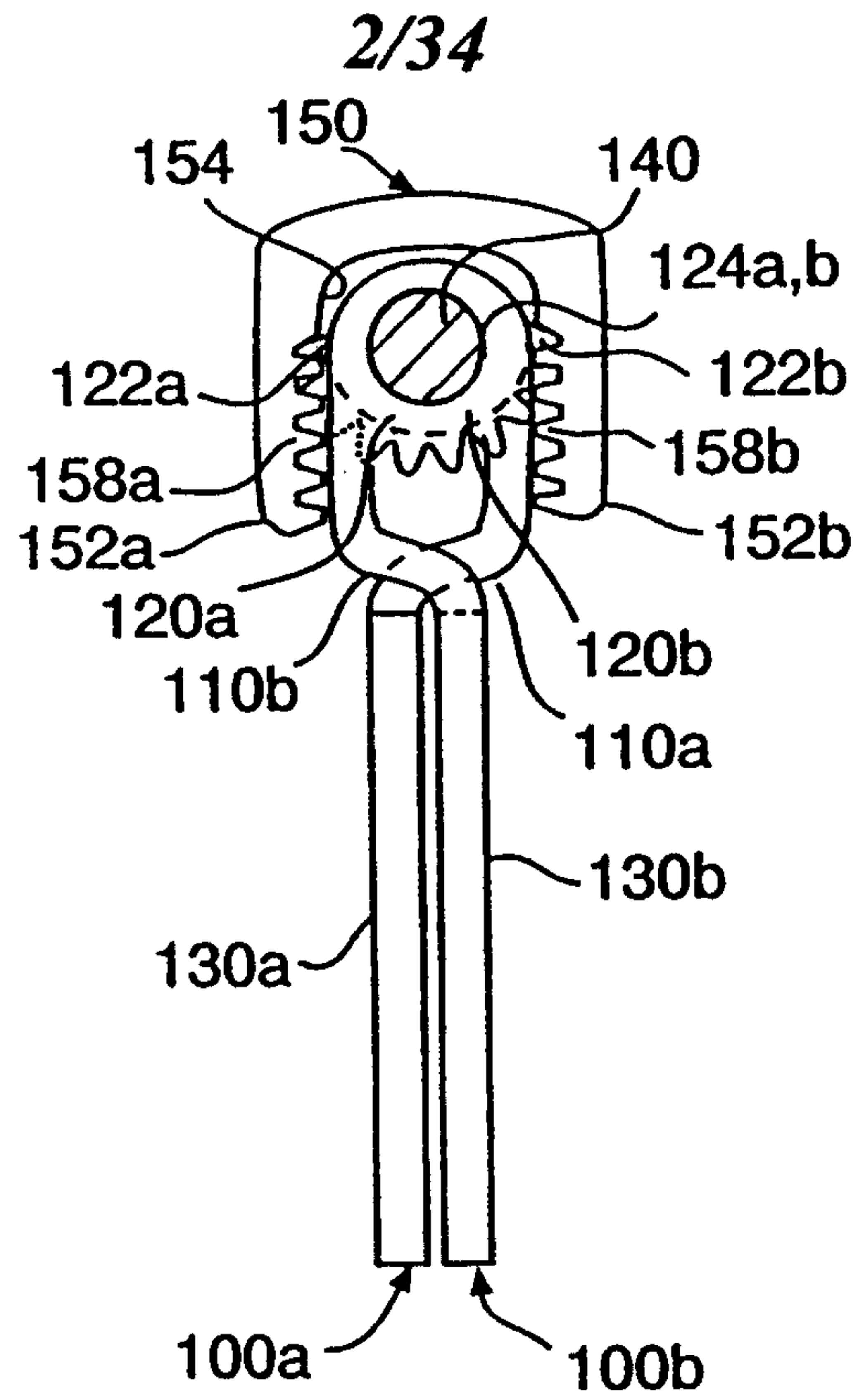
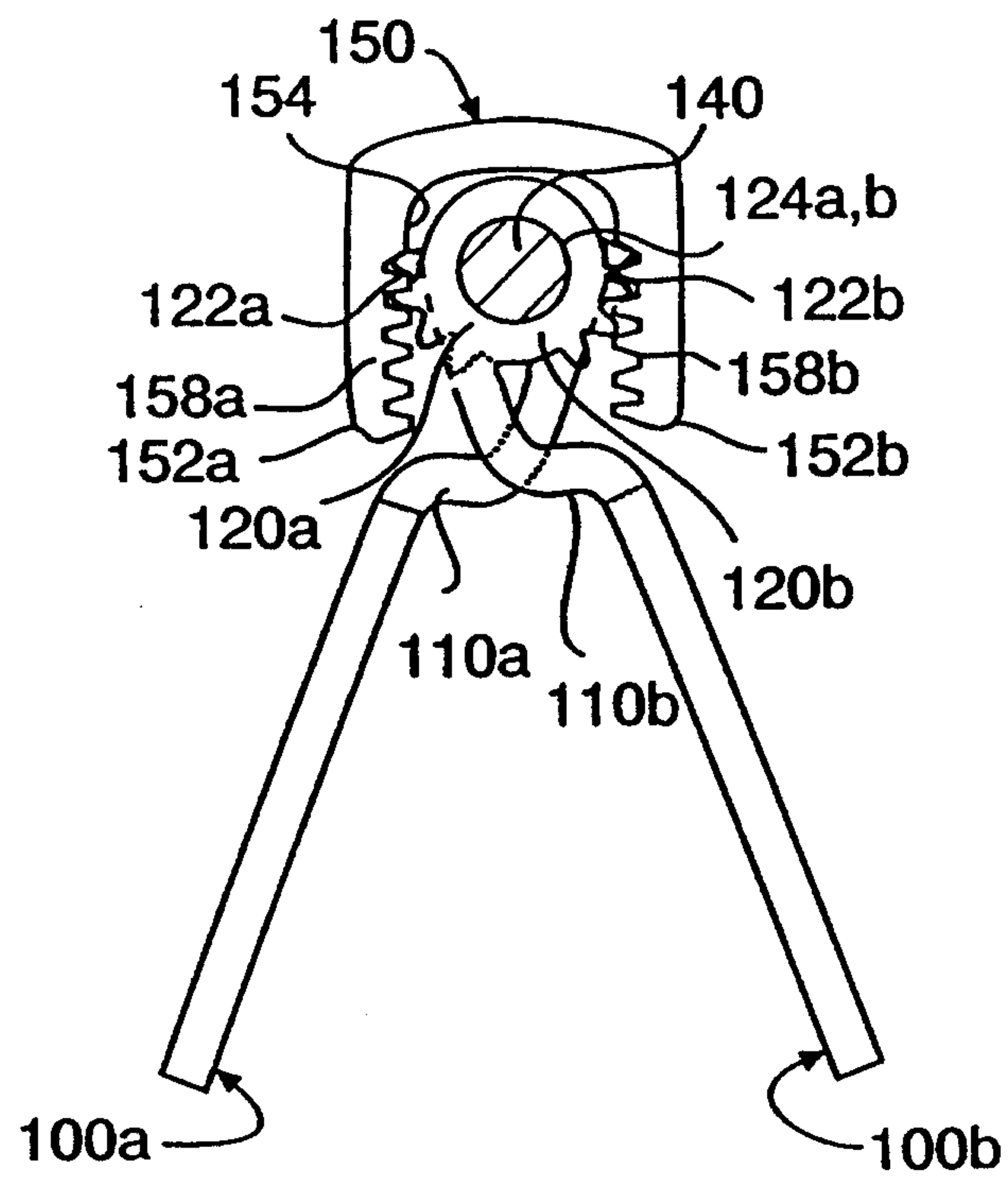
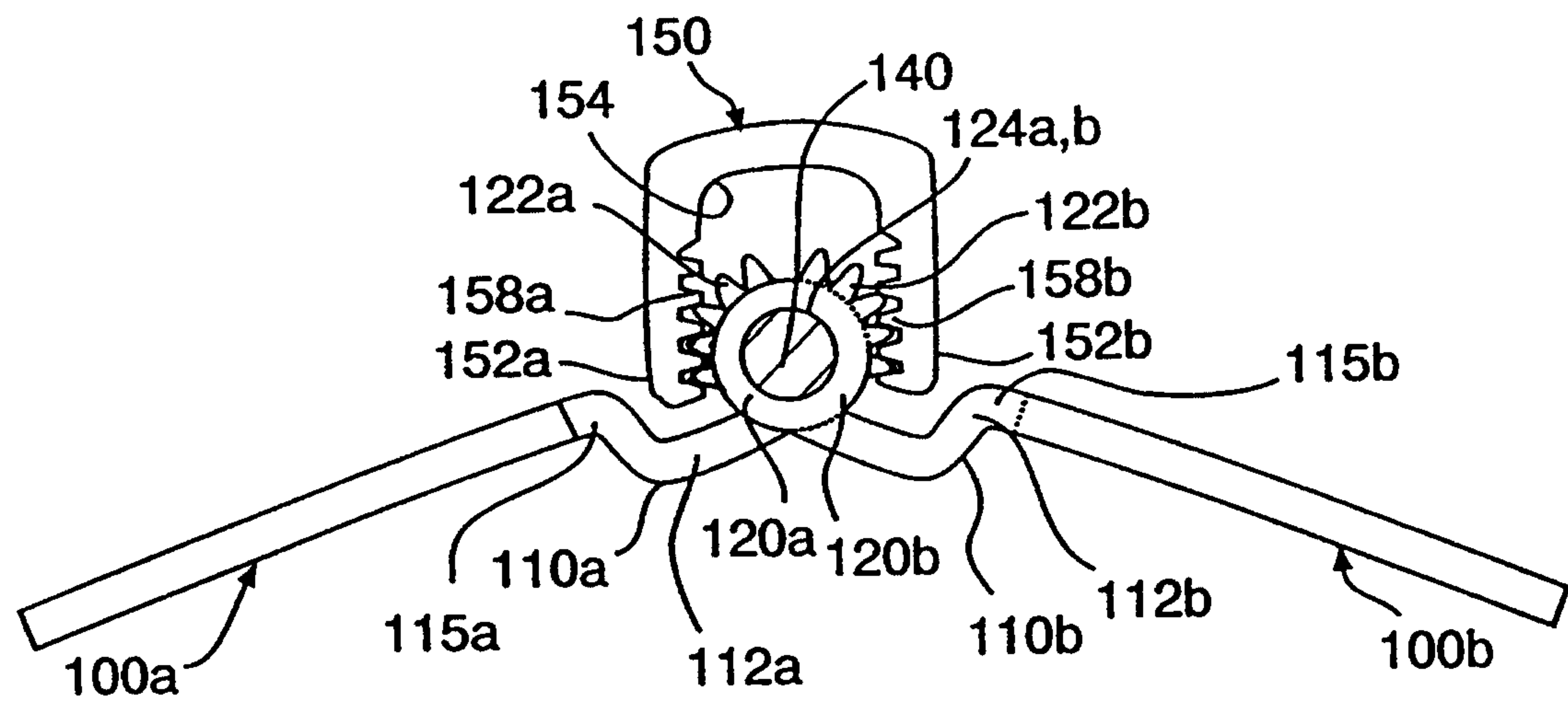
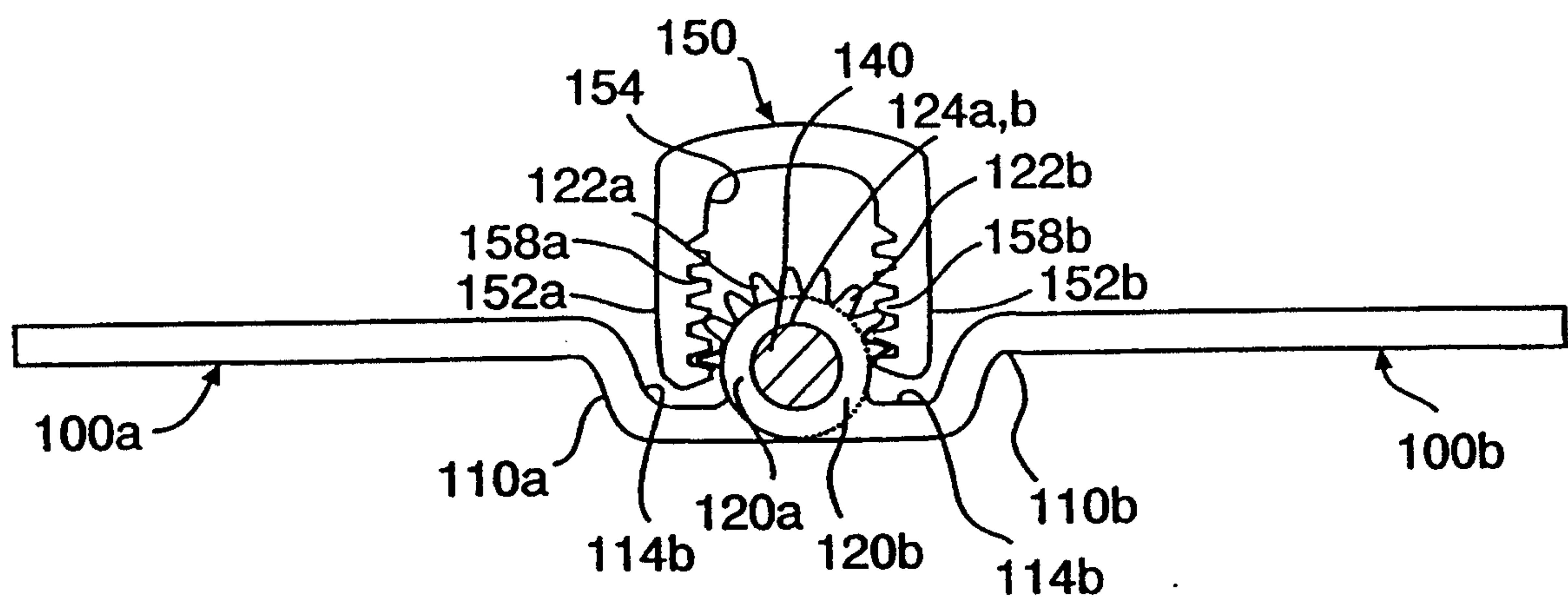


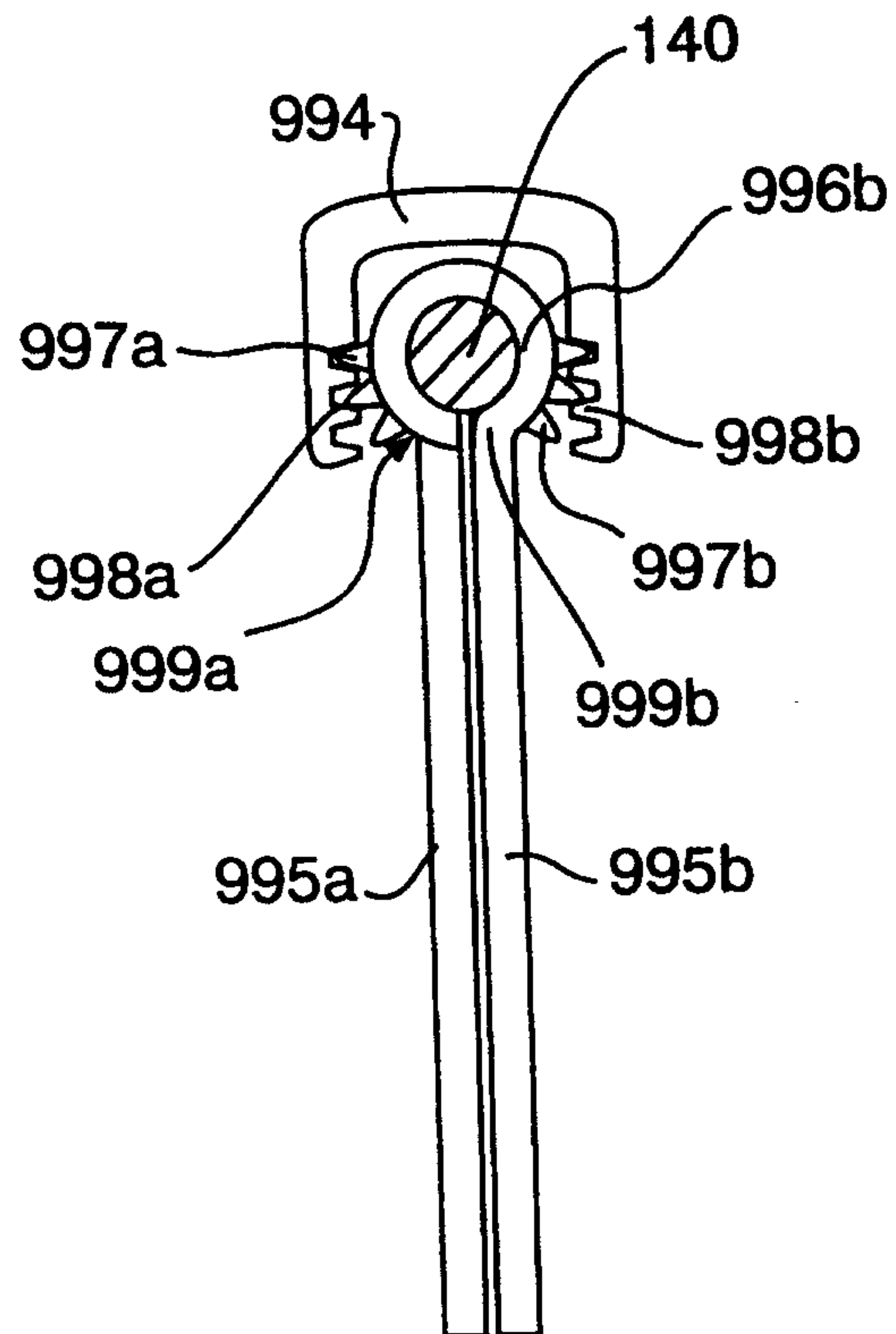
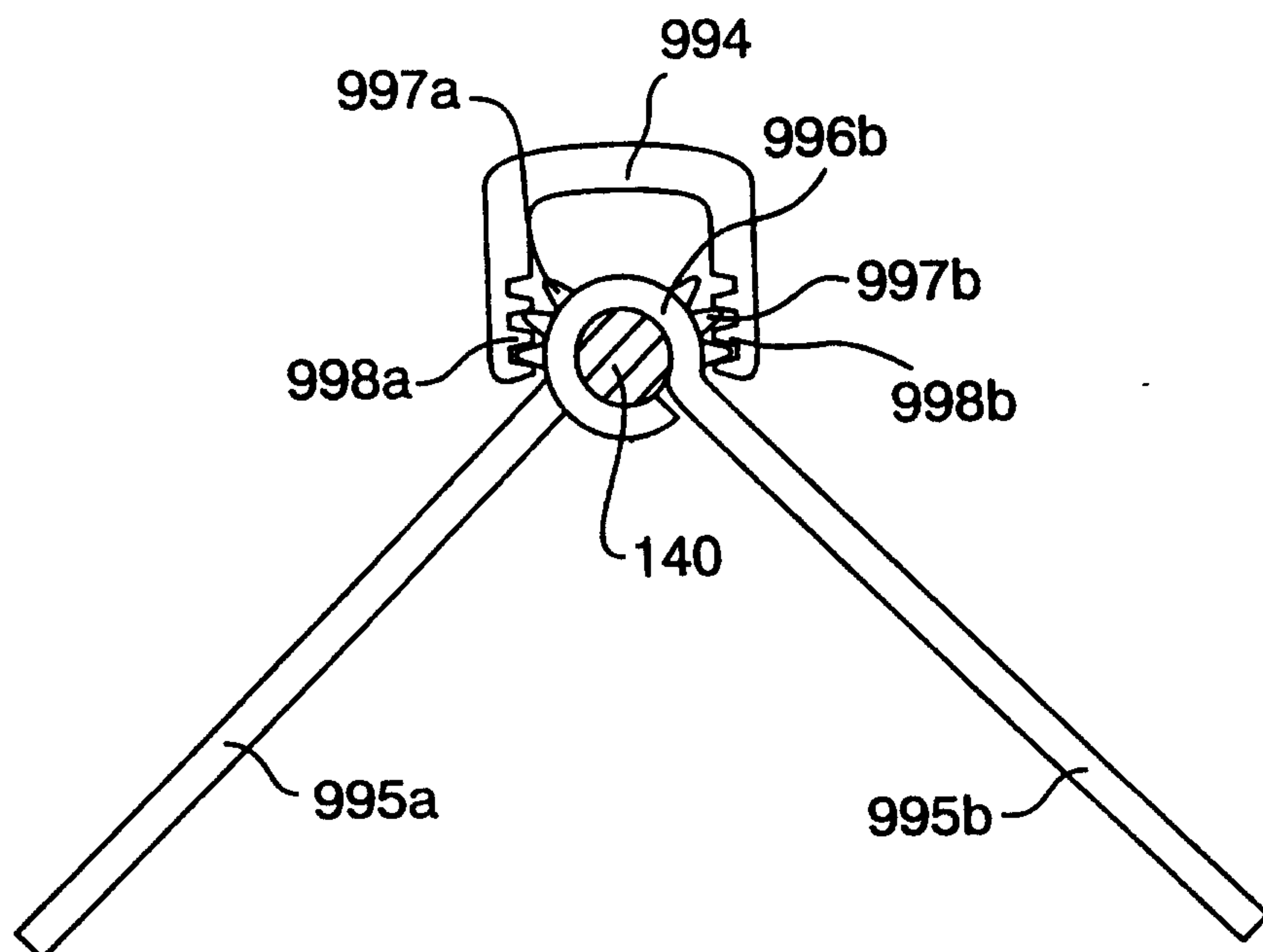
**FIG. 1**

**FIG. 2A****FIG. 2B**

3/34

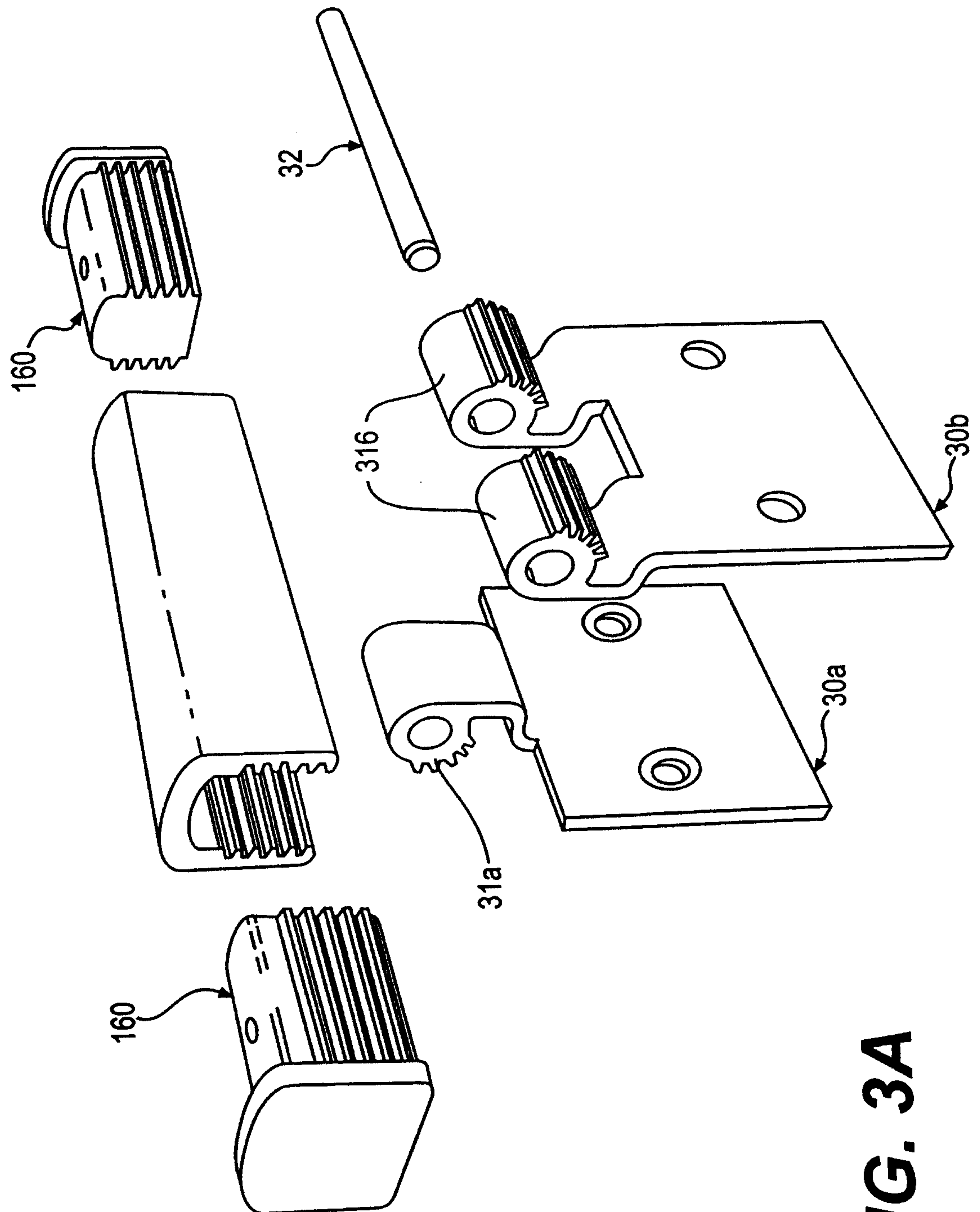
**FIG. 2C****FIG. 2D**

4/34

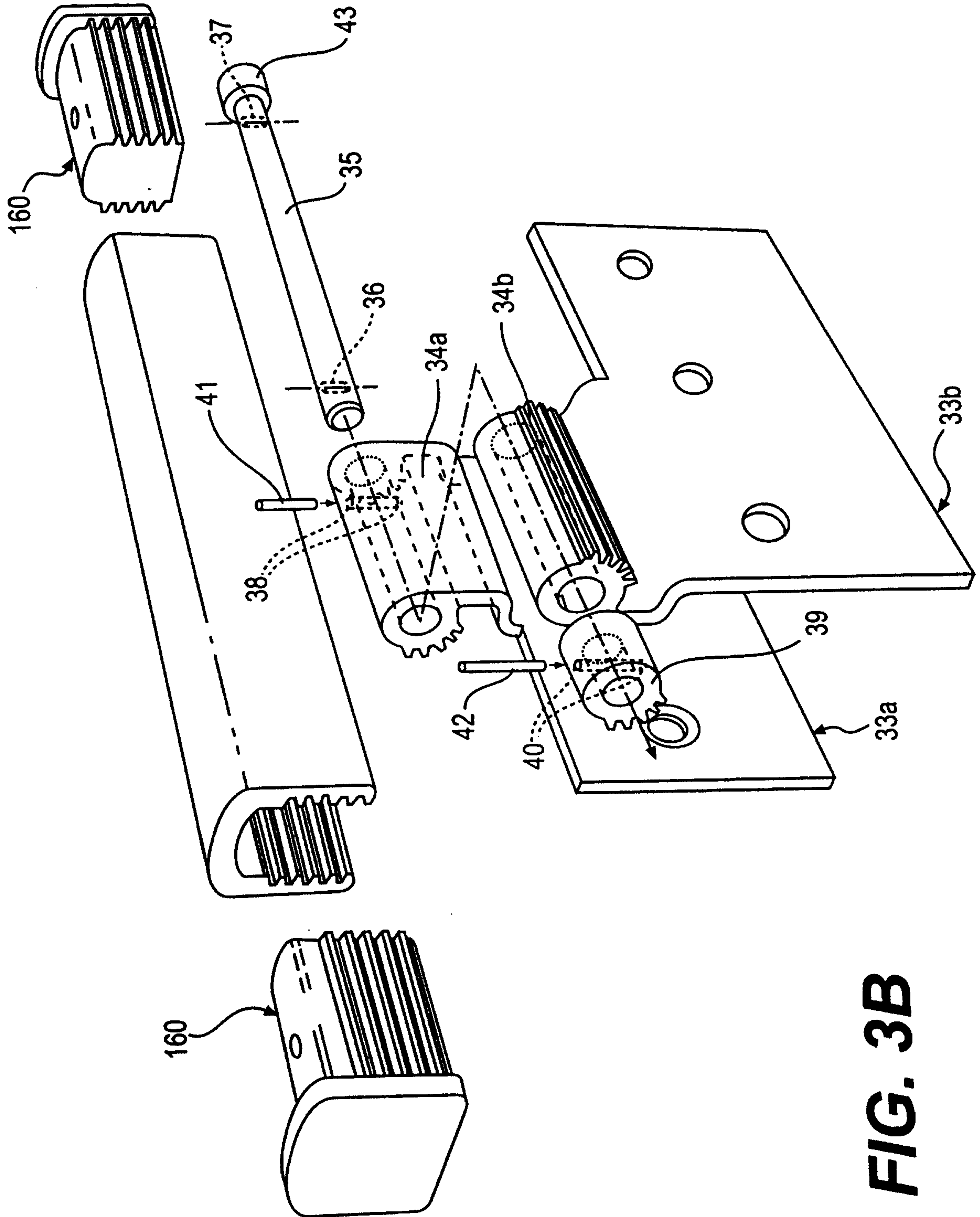
**FIG. 2E****FIG. 2F**

SUBSTITUTE SHEET (RULE 26)

5/34

**FIG. 3A**

6/34

**FIG. 3B**

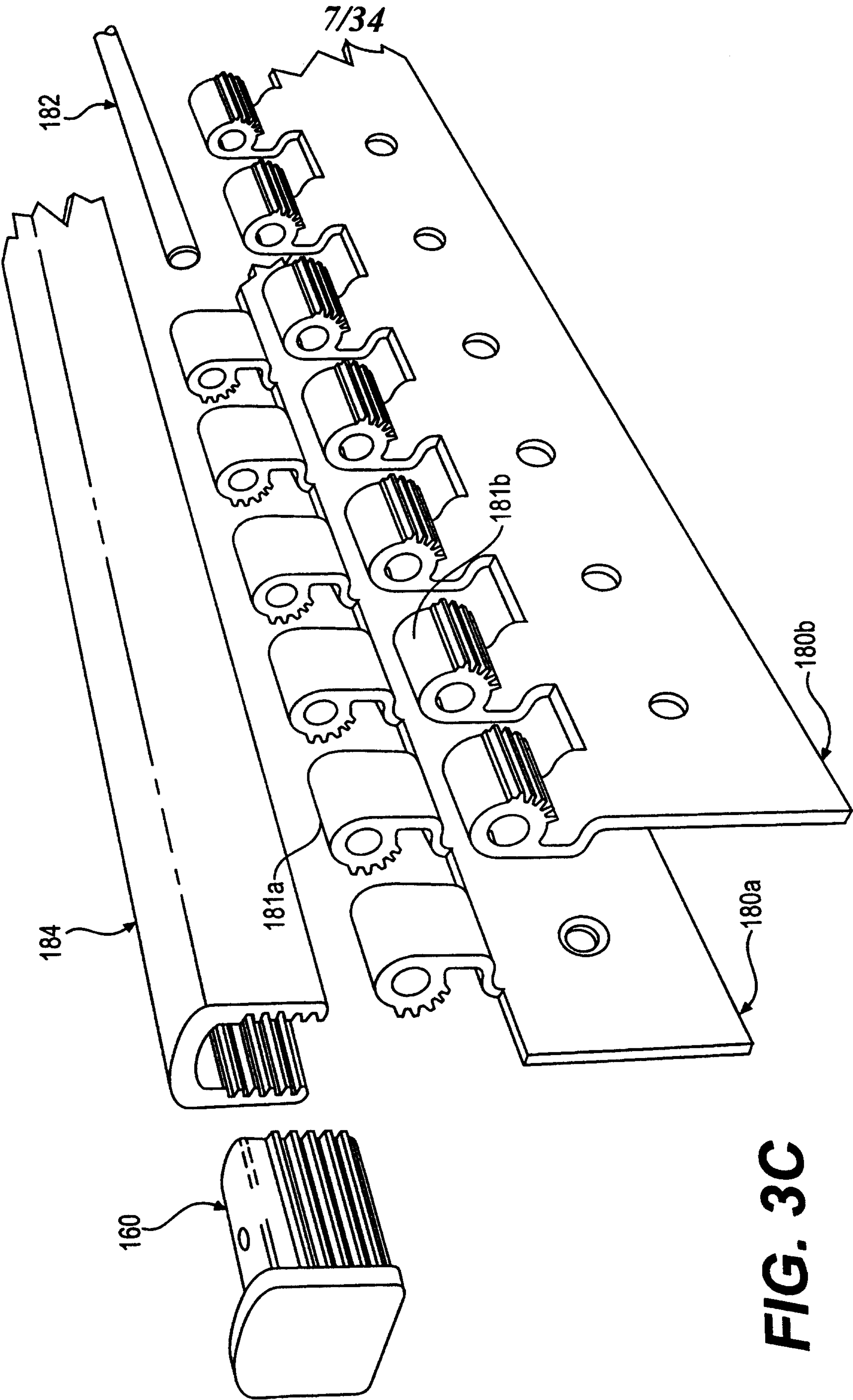
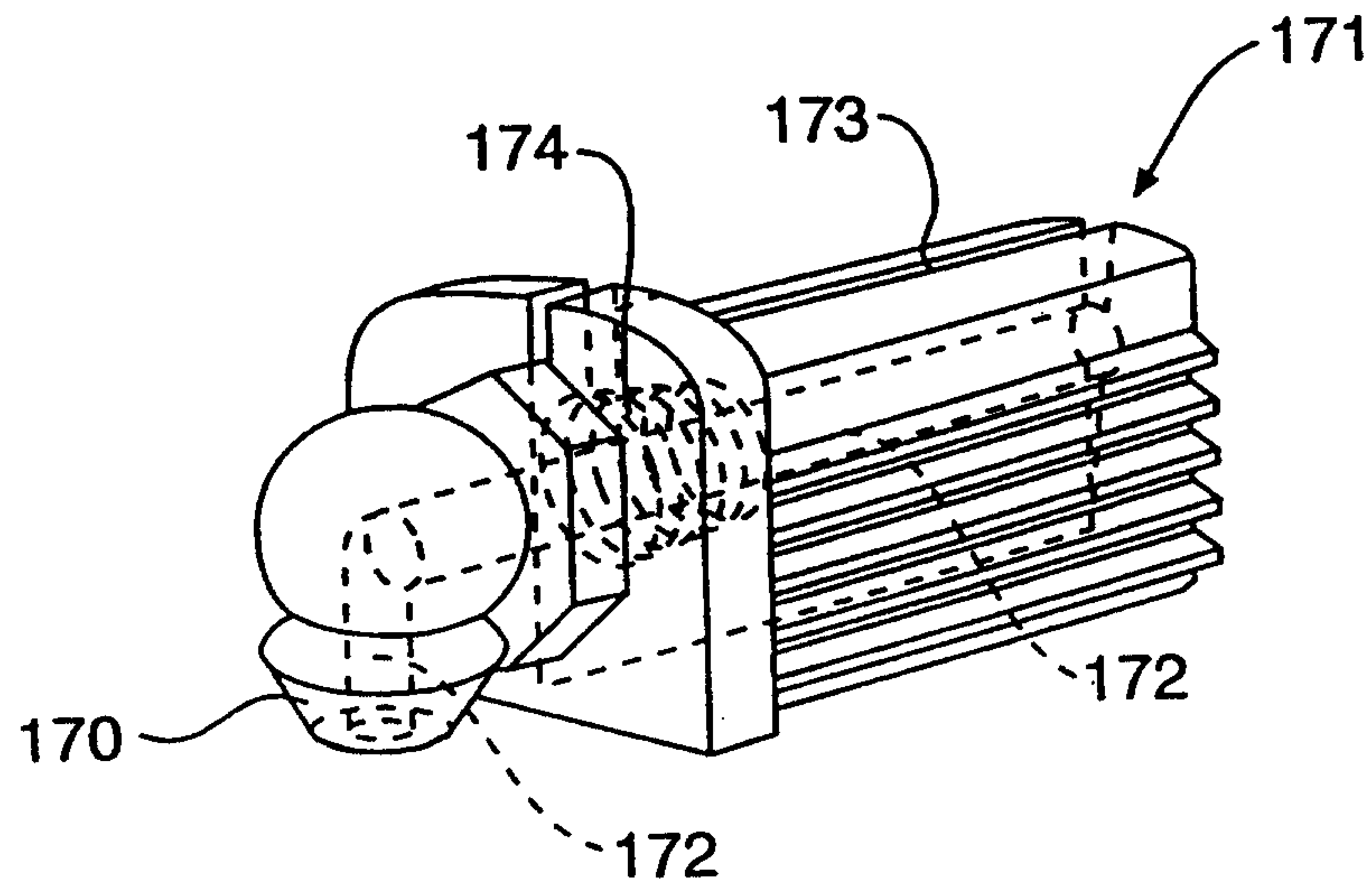
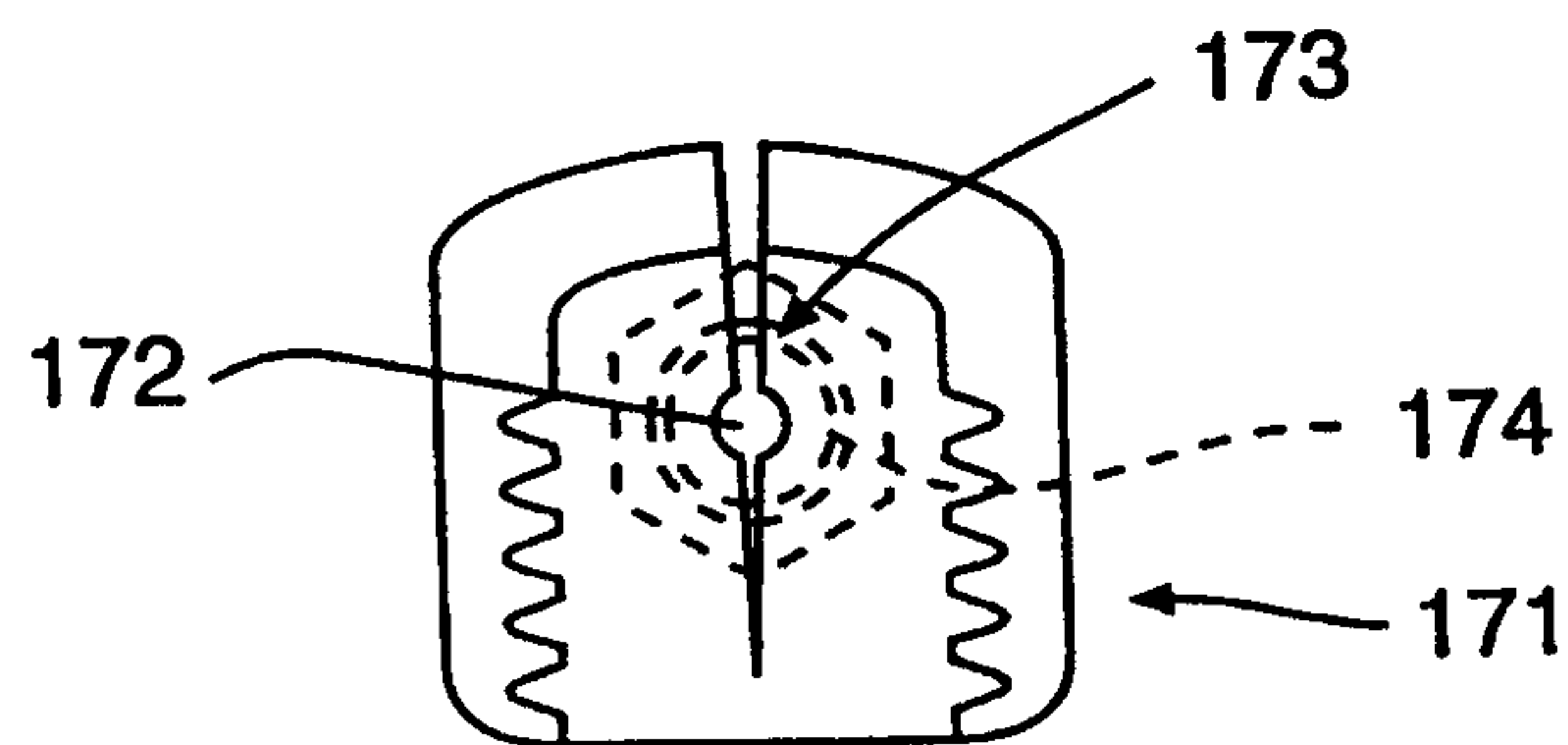
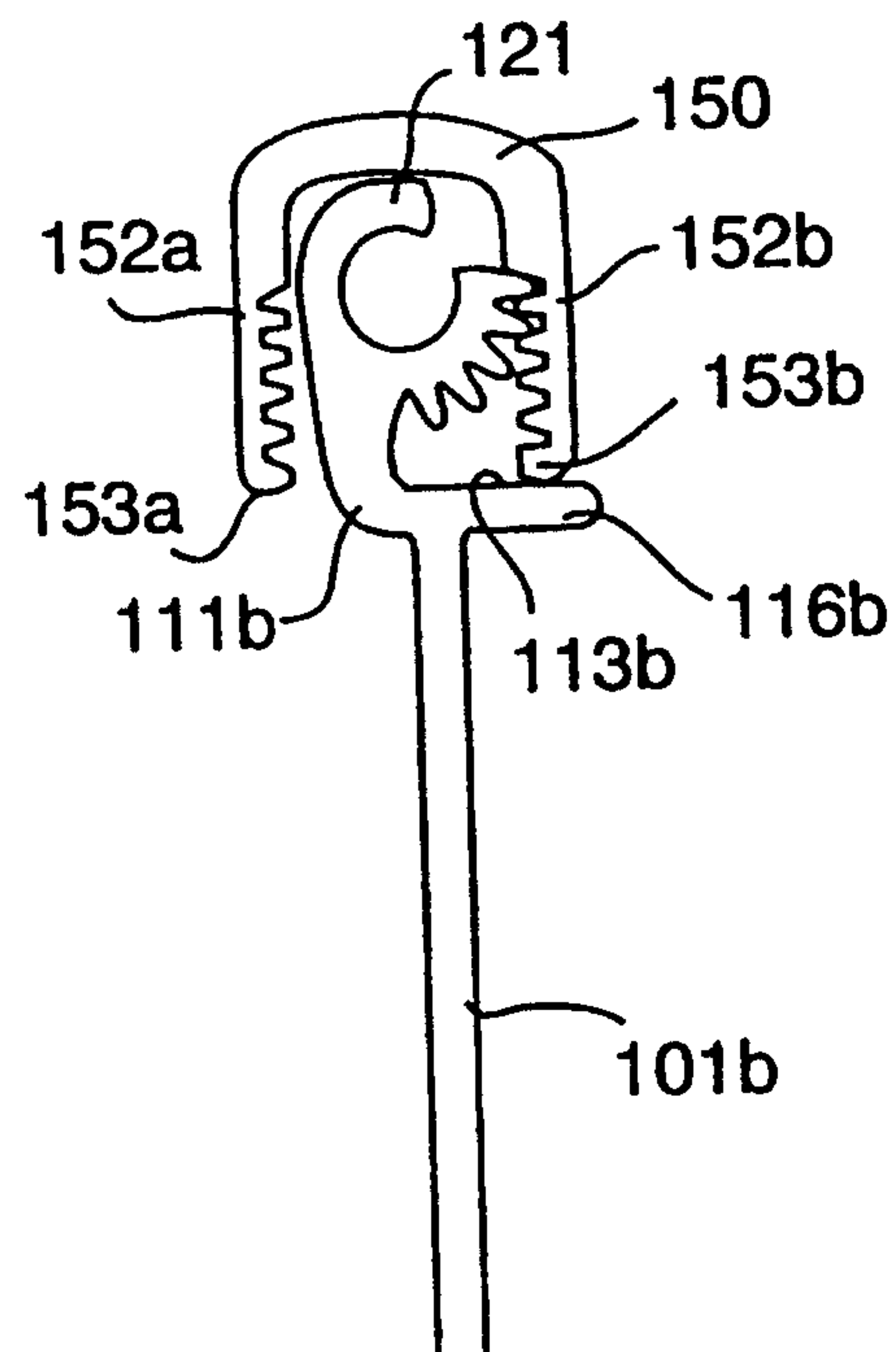
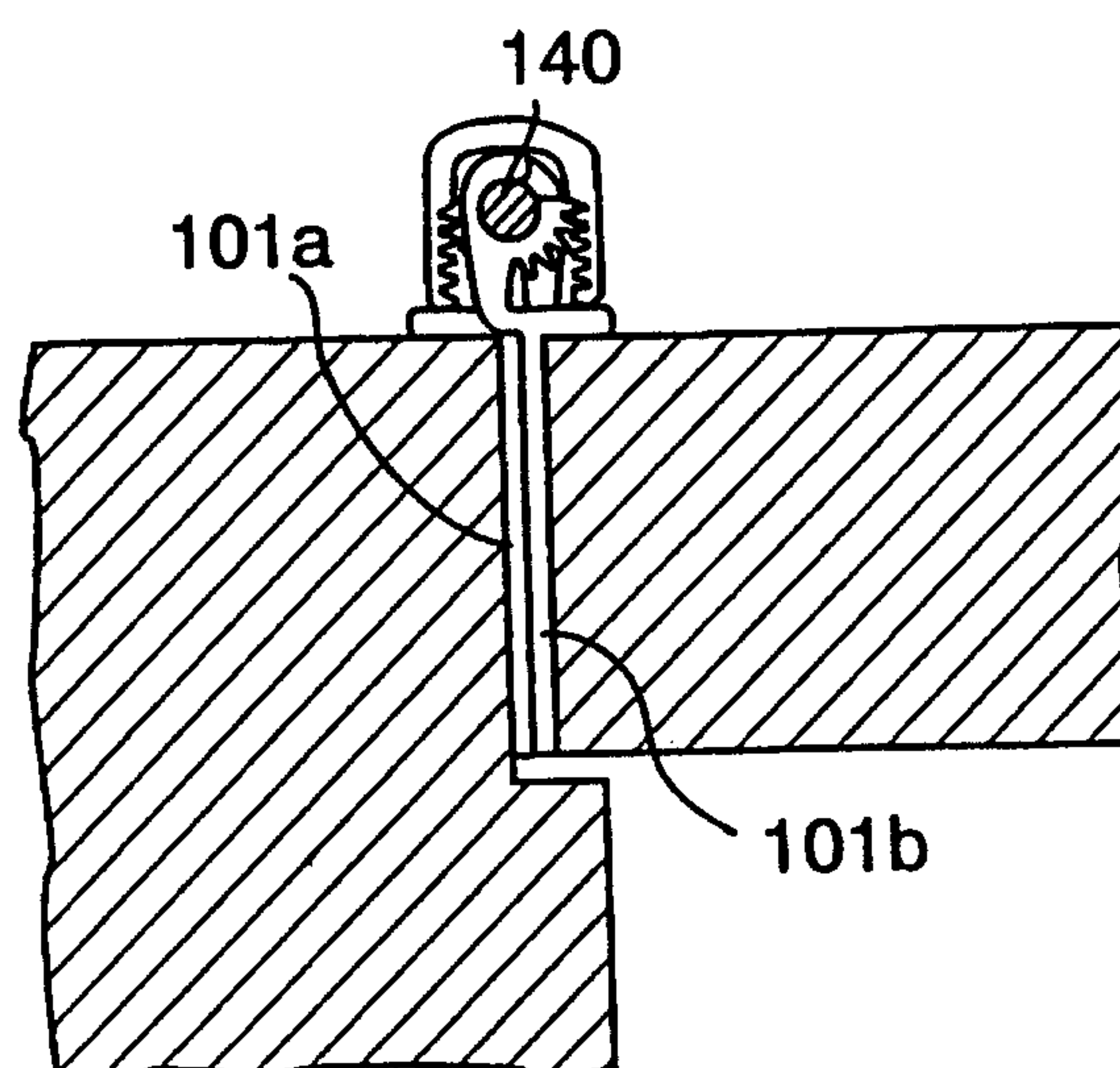


FIG. 3C

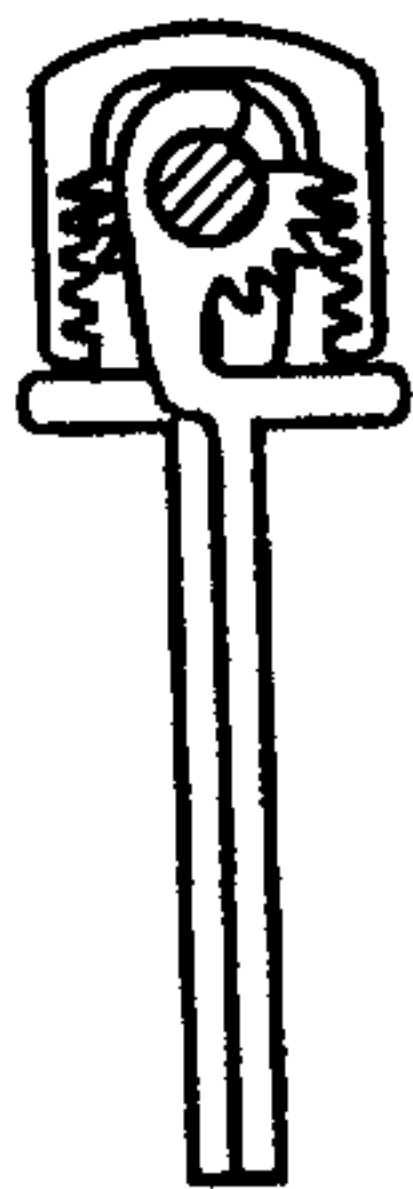
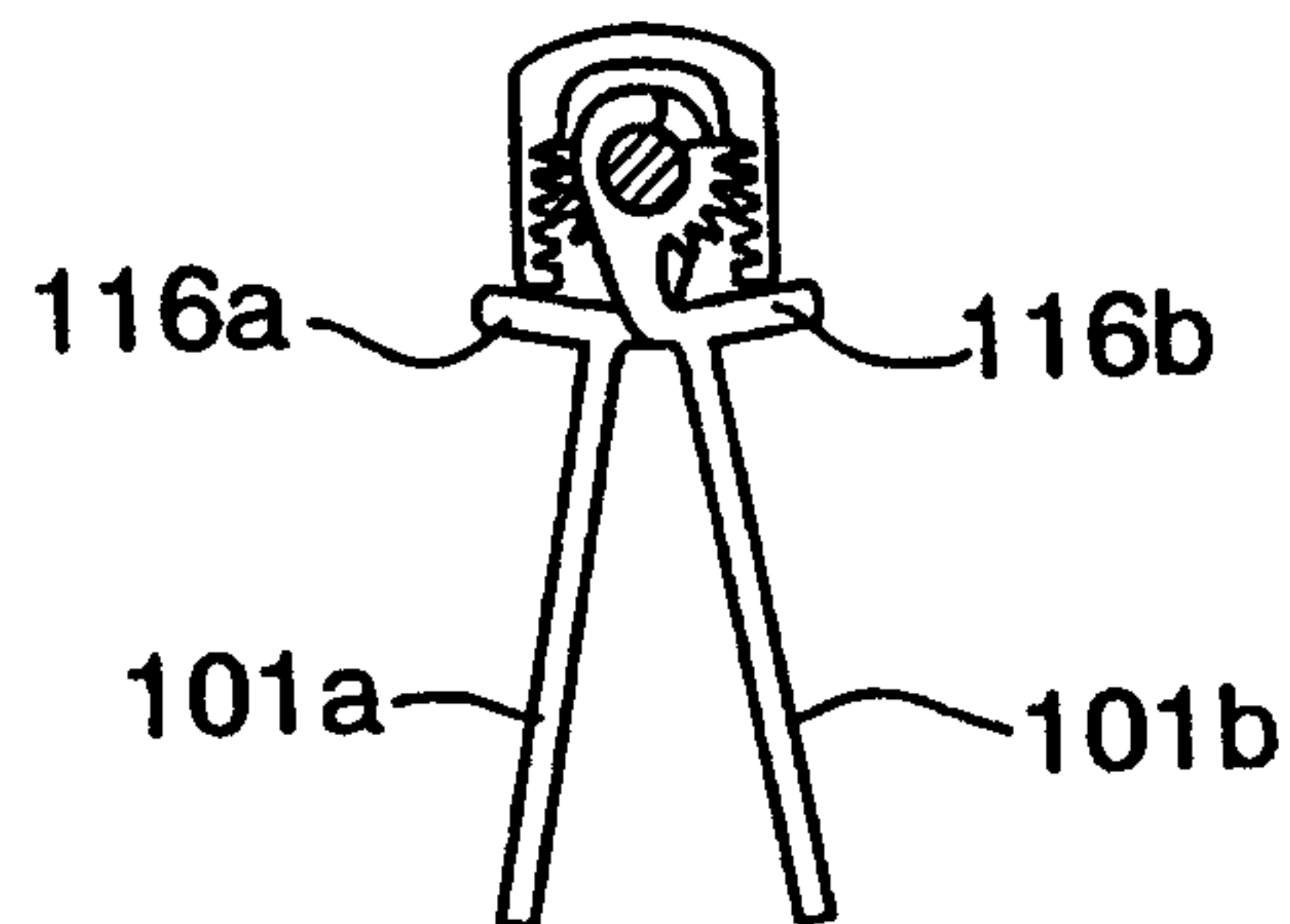
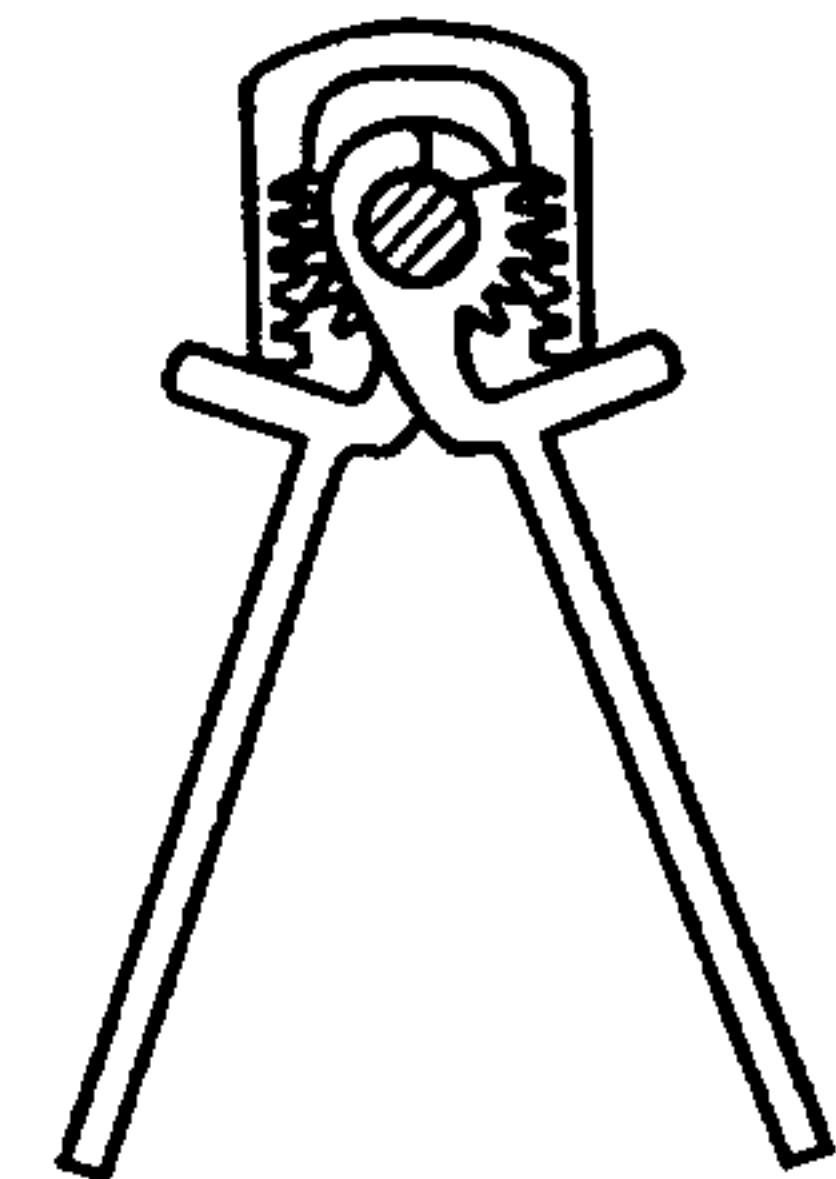
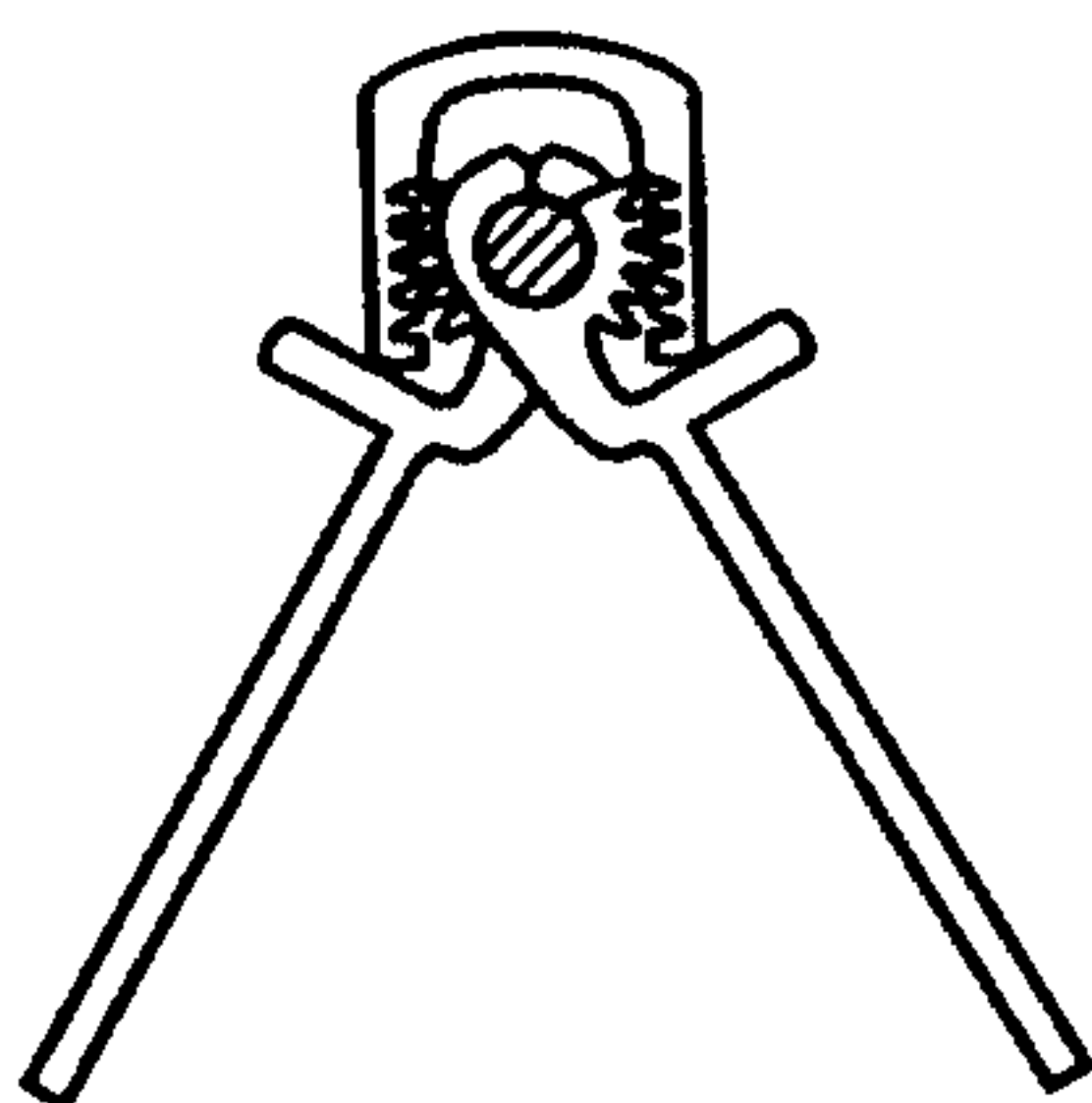
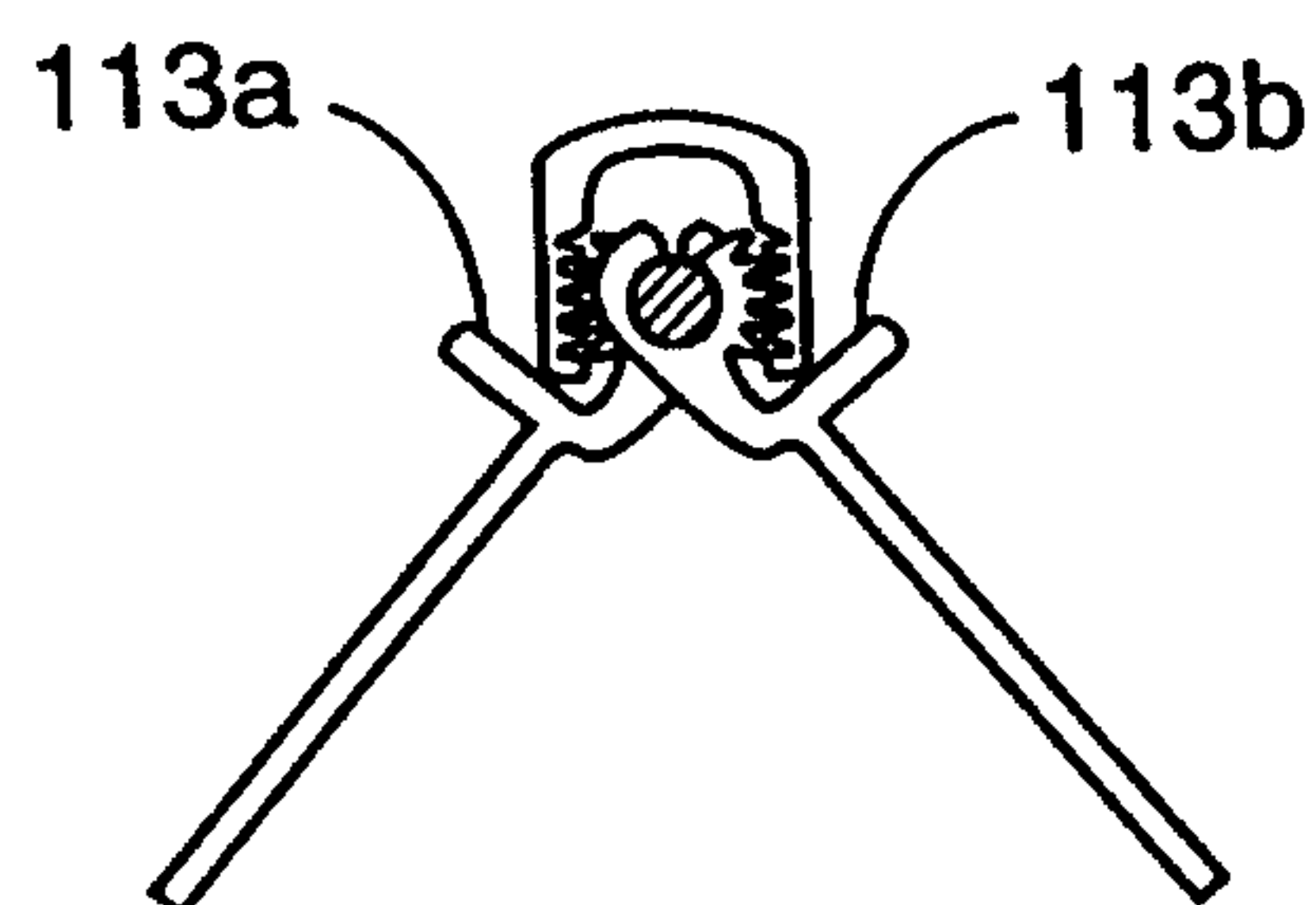
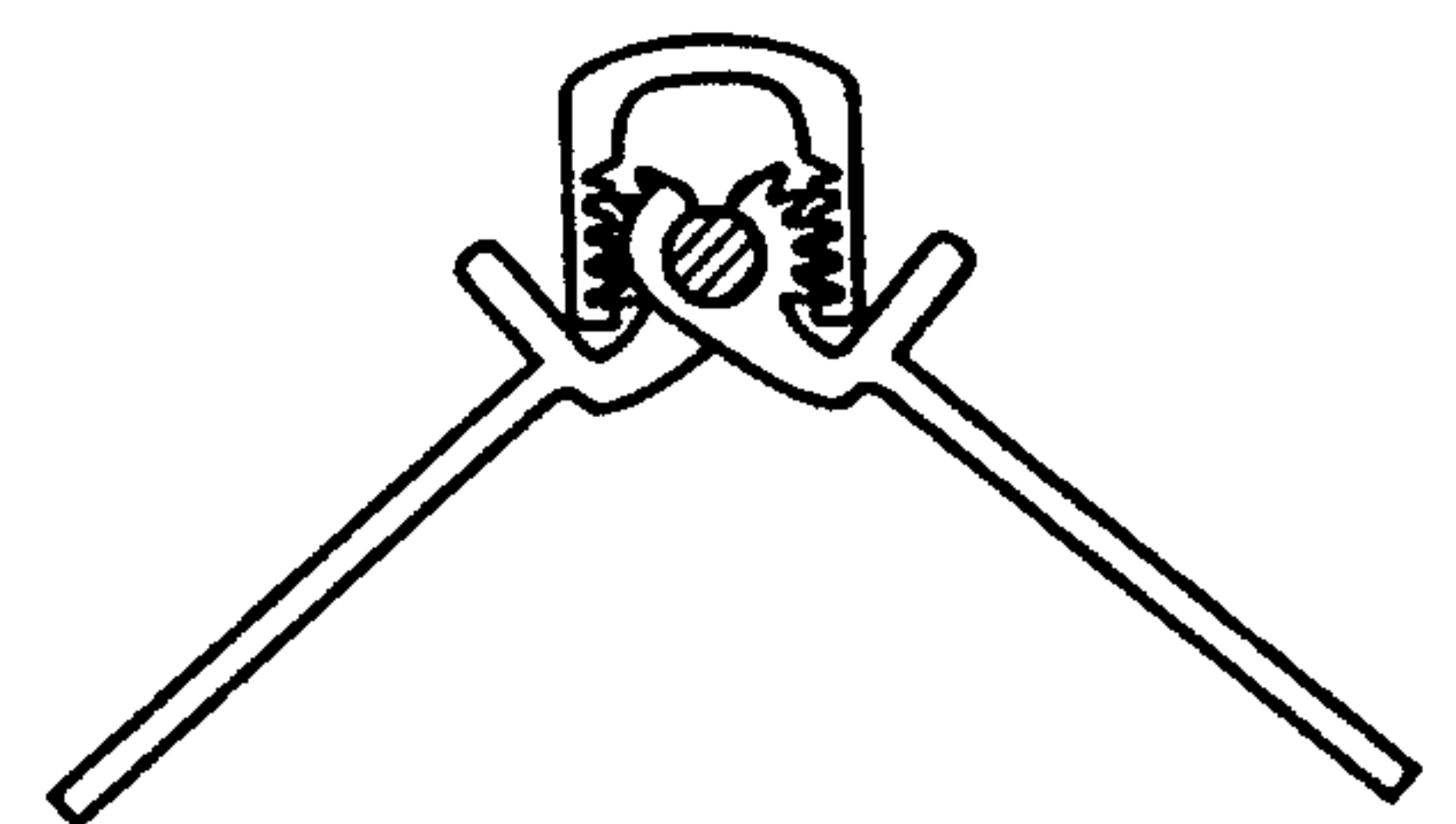
8/34

**FIG. 4A****FIG. 4B**

9/34

**FIG. 5A****FIG. 5B**

10/34

**FIG. 5C****FIG. 5D****FIG. 5E****FIG. 5F****FIG. 5G****FIG. 5H**

11/34

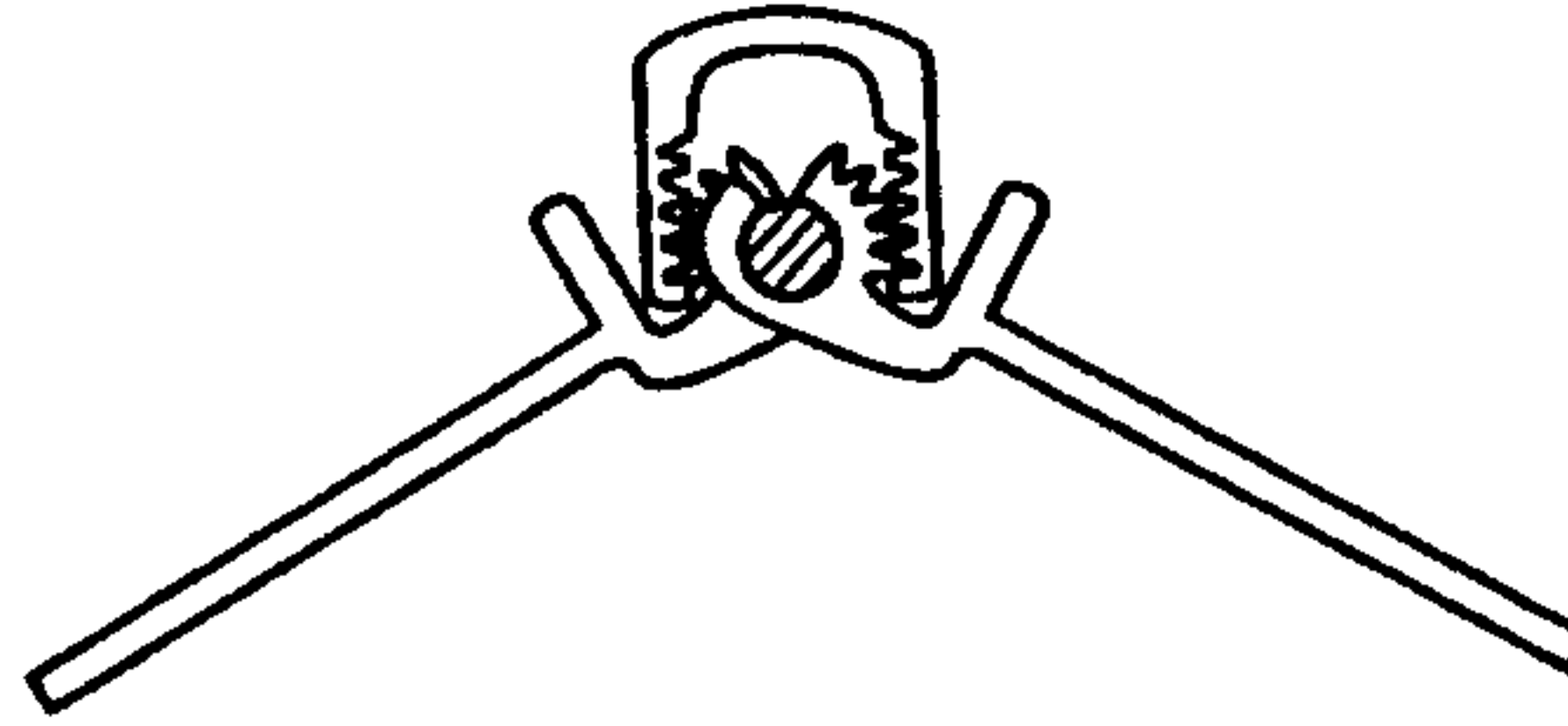


**FIG. 5I**

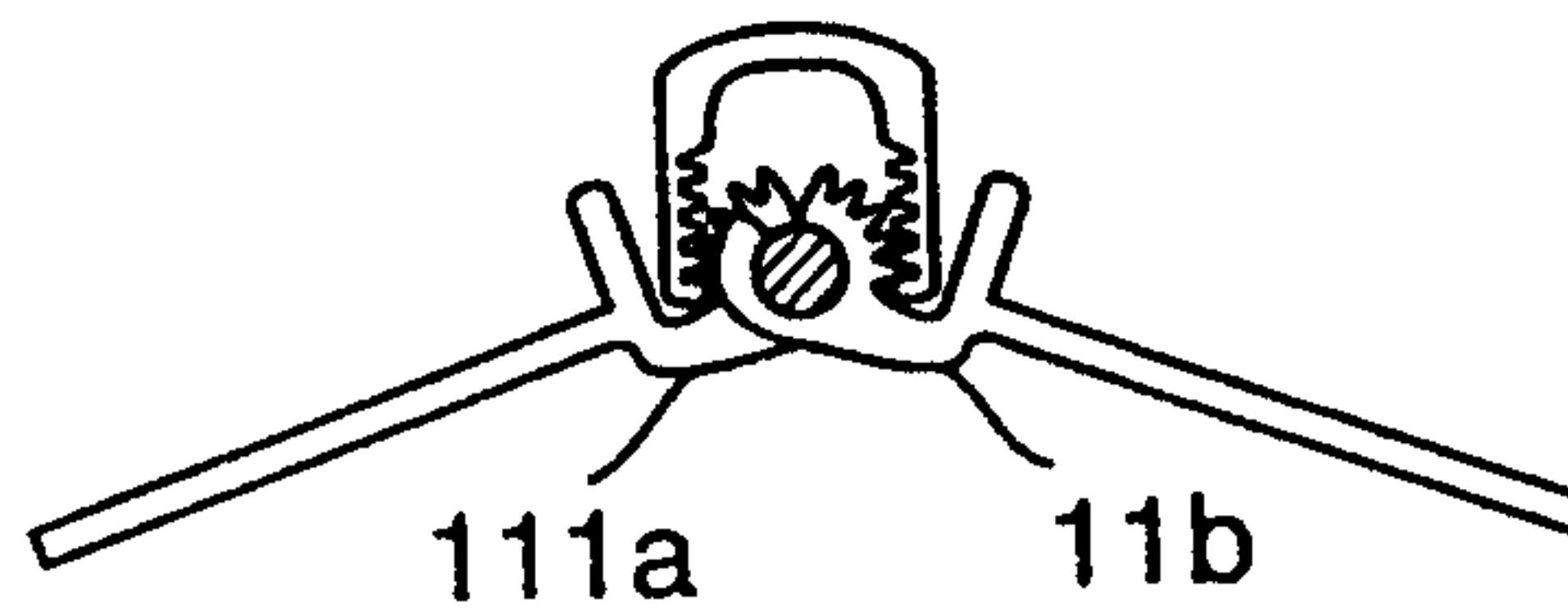


**FIG. 5J**

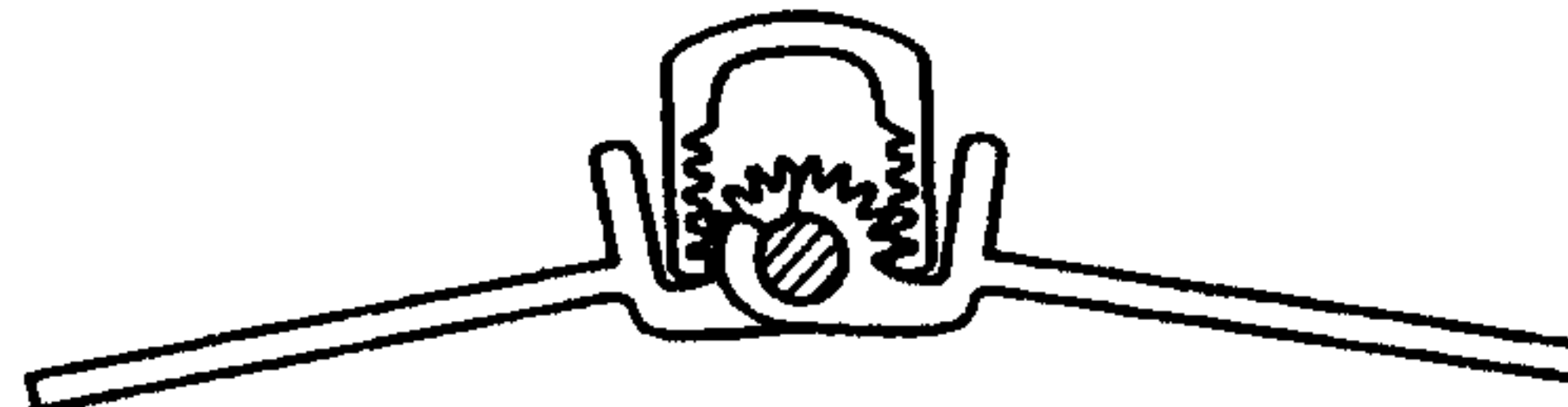
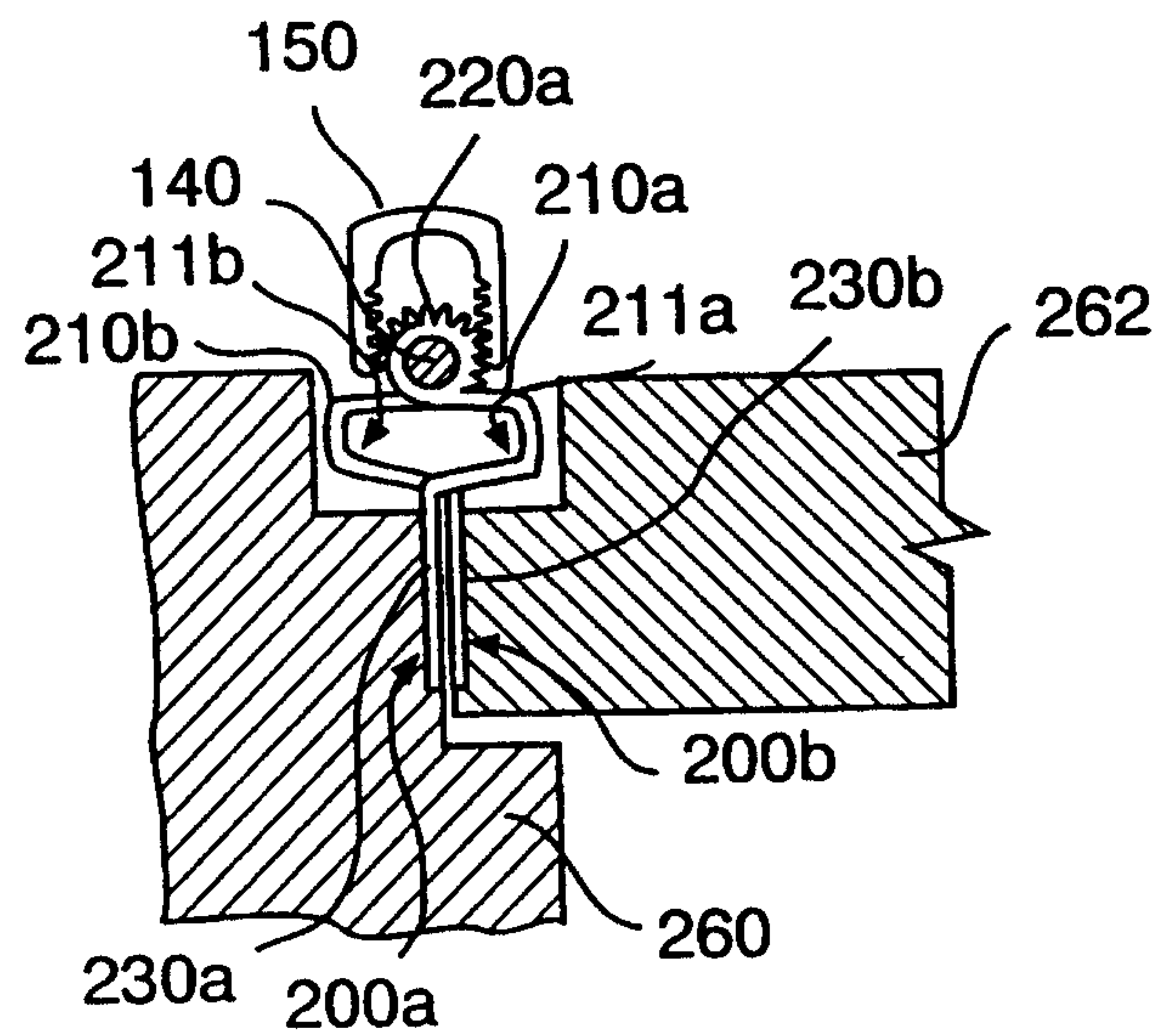
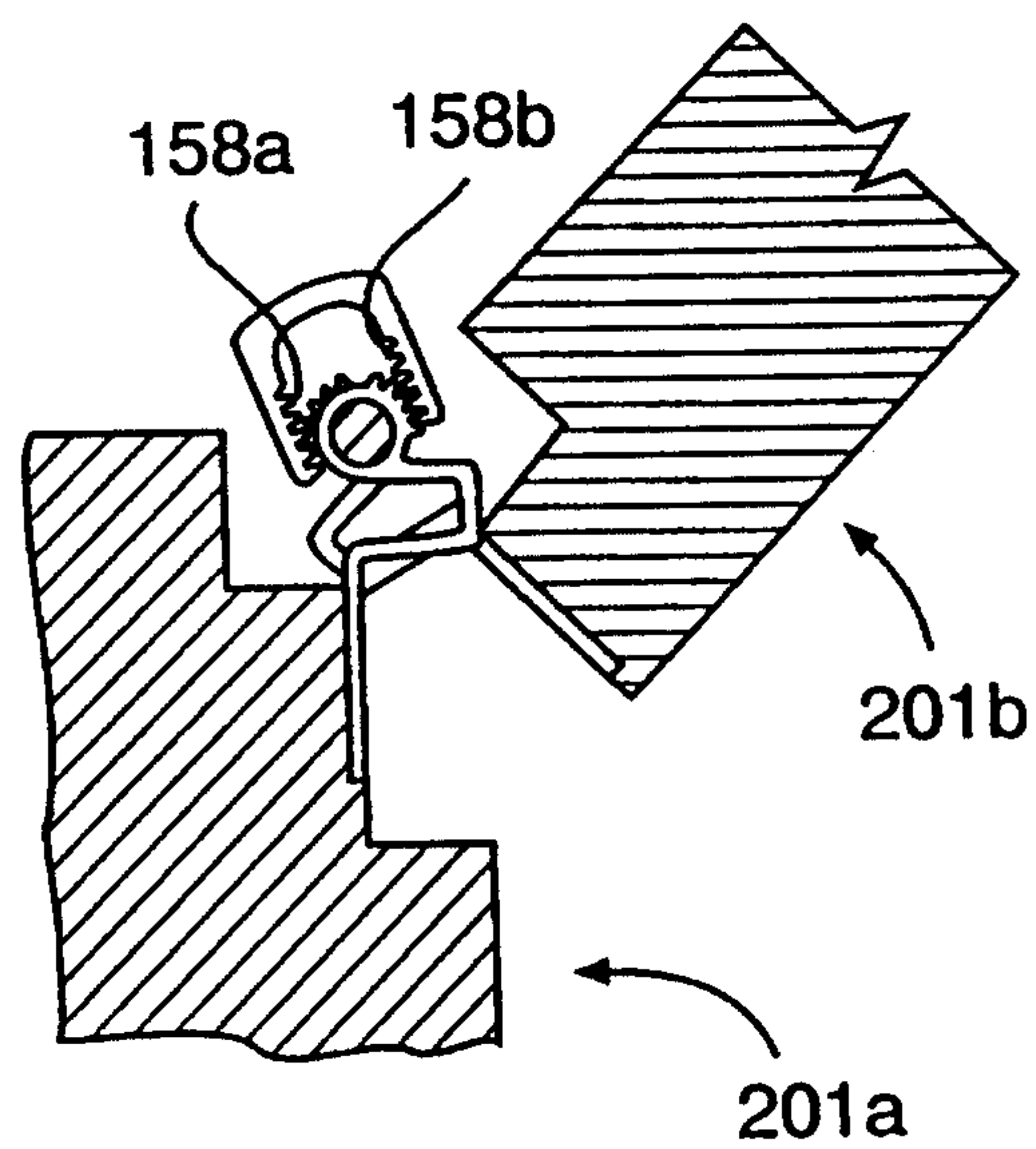


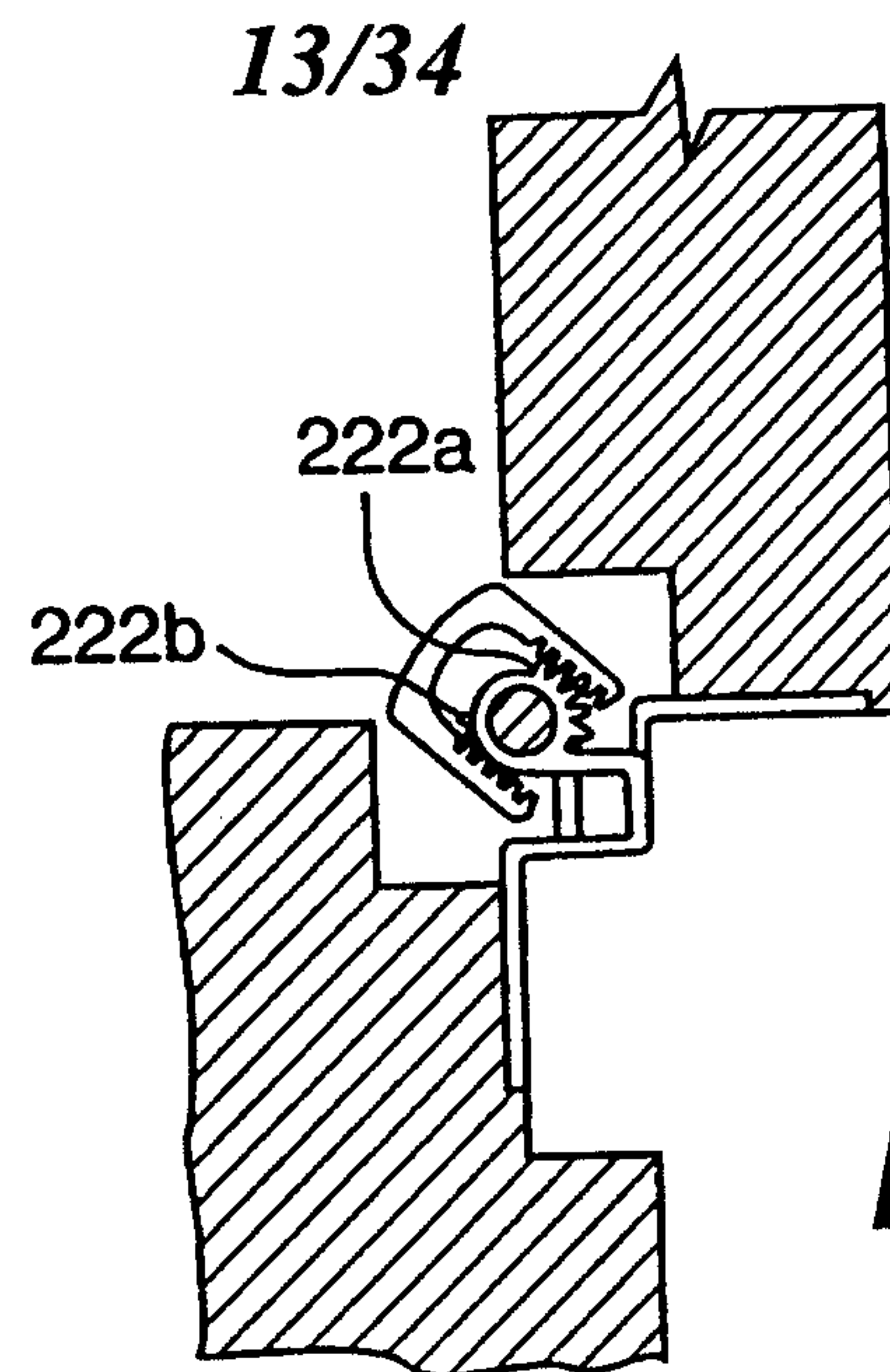
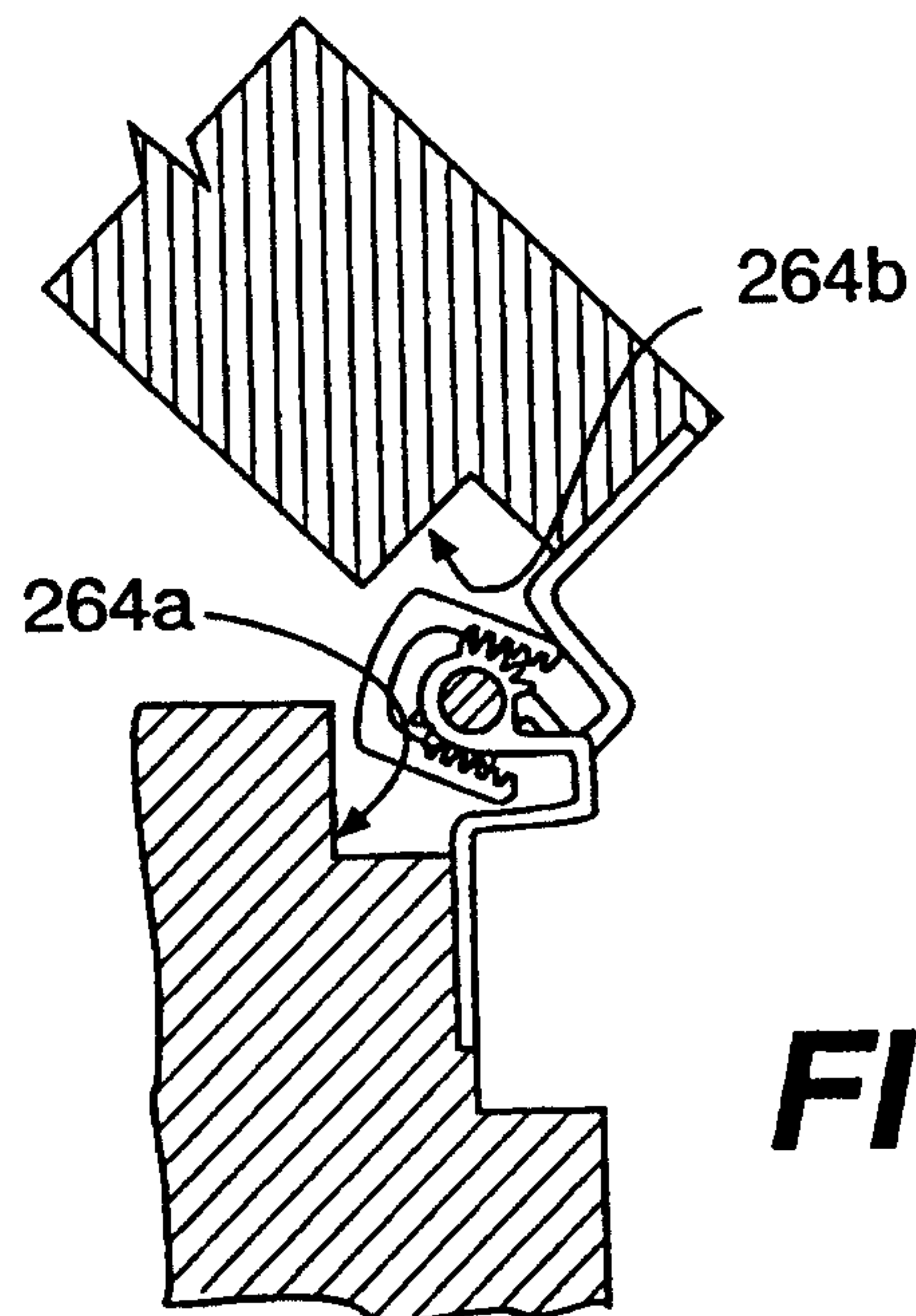
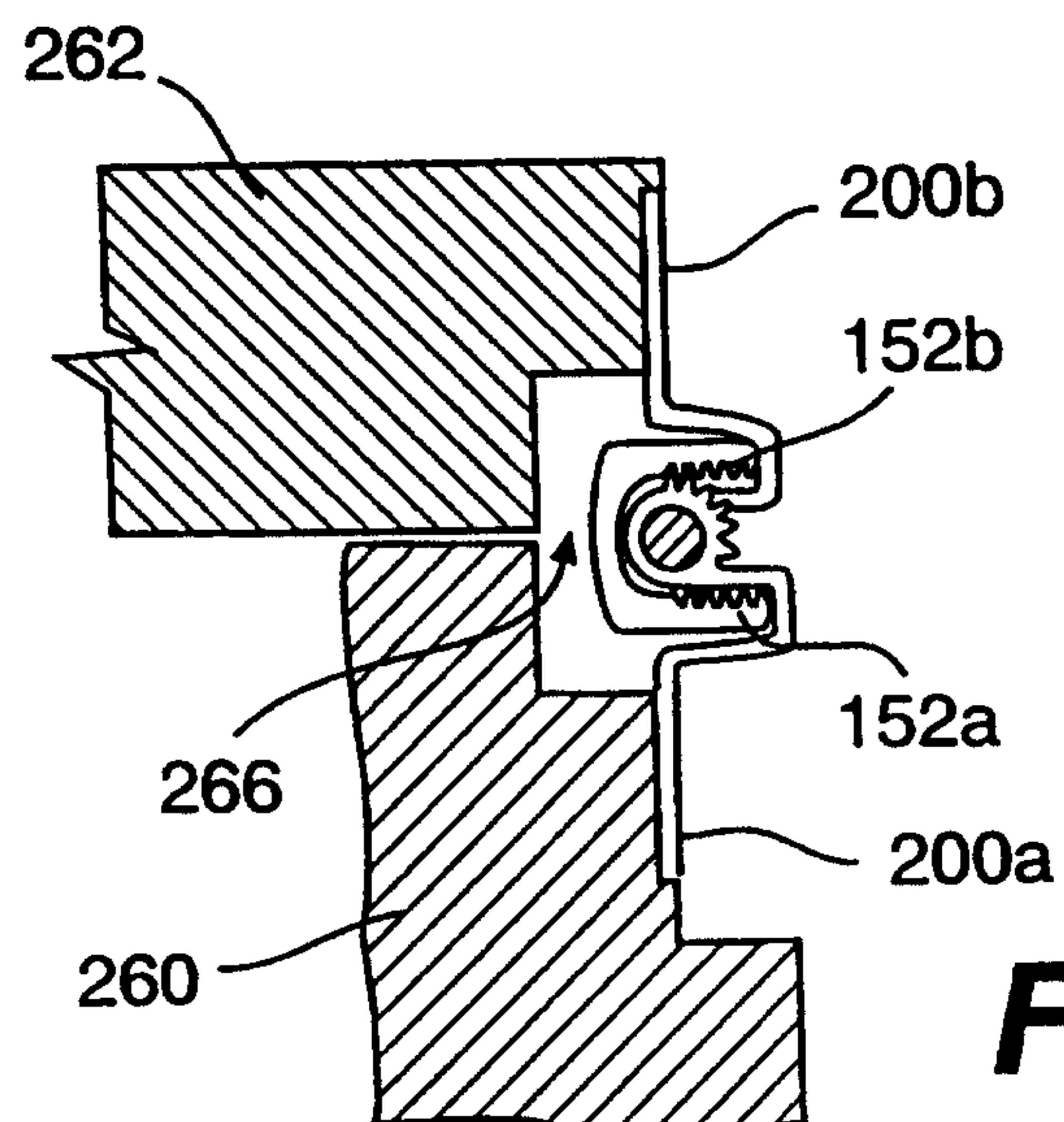
**FIG. 5K**

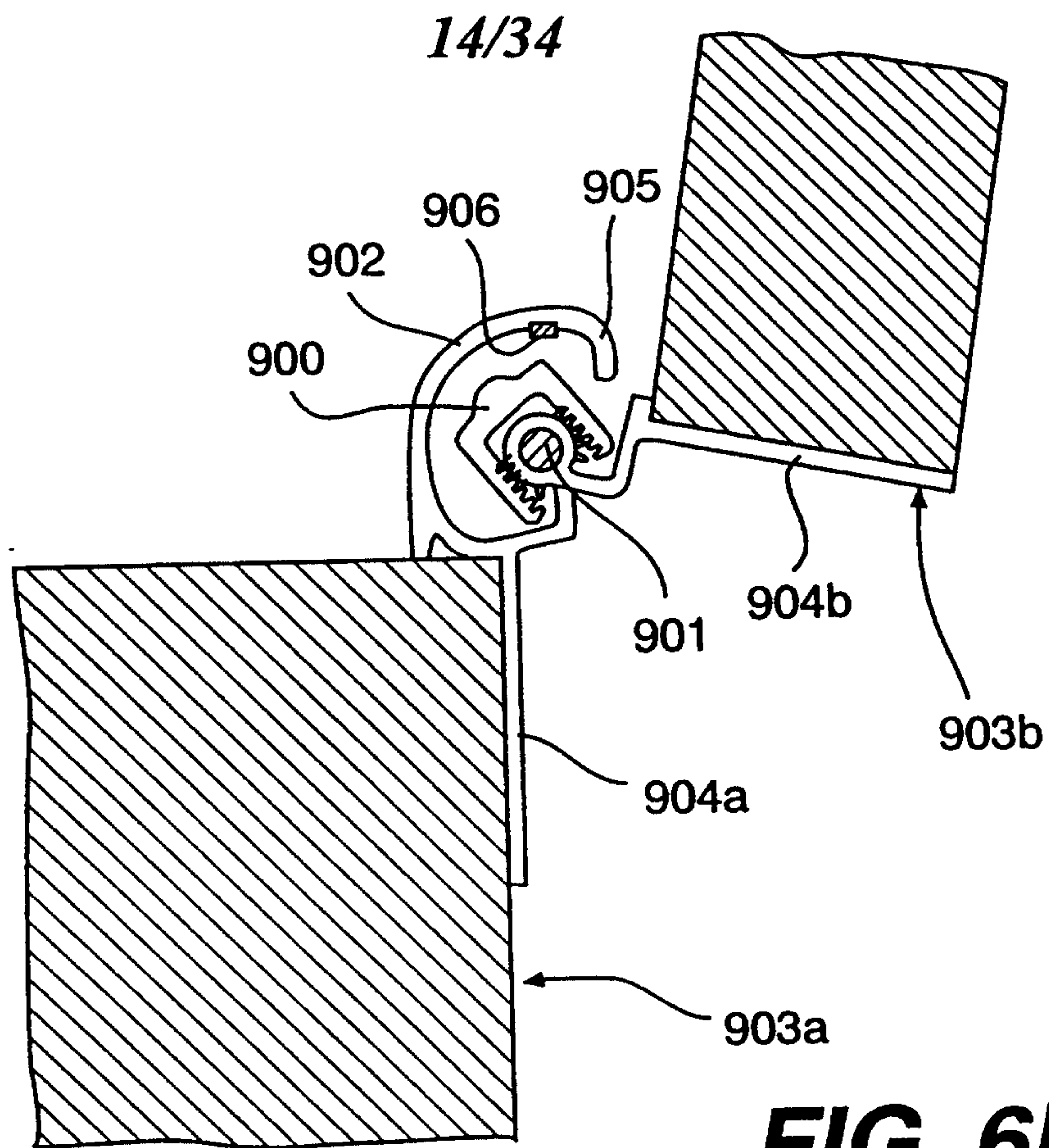
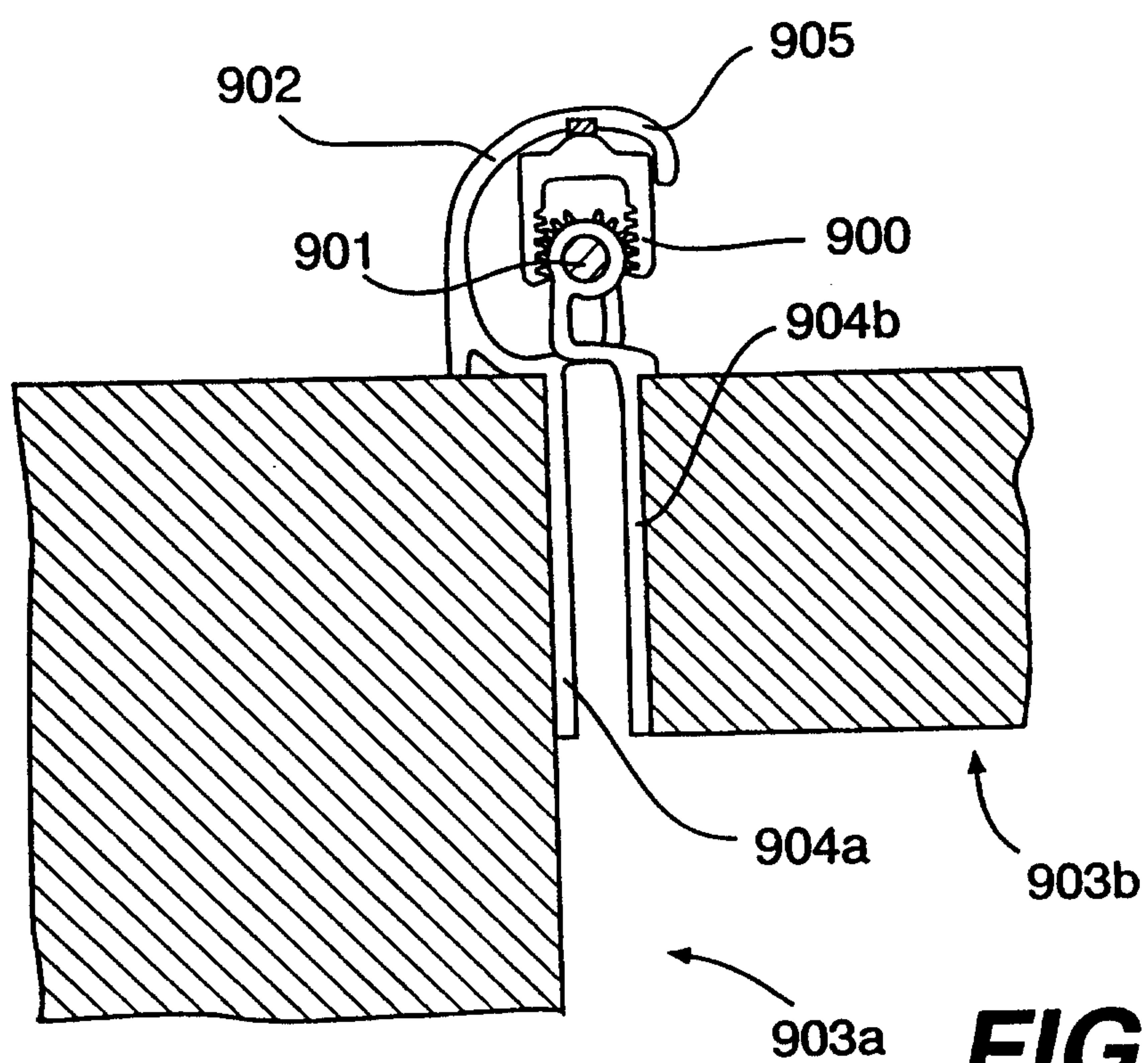


**FIG. 5L**

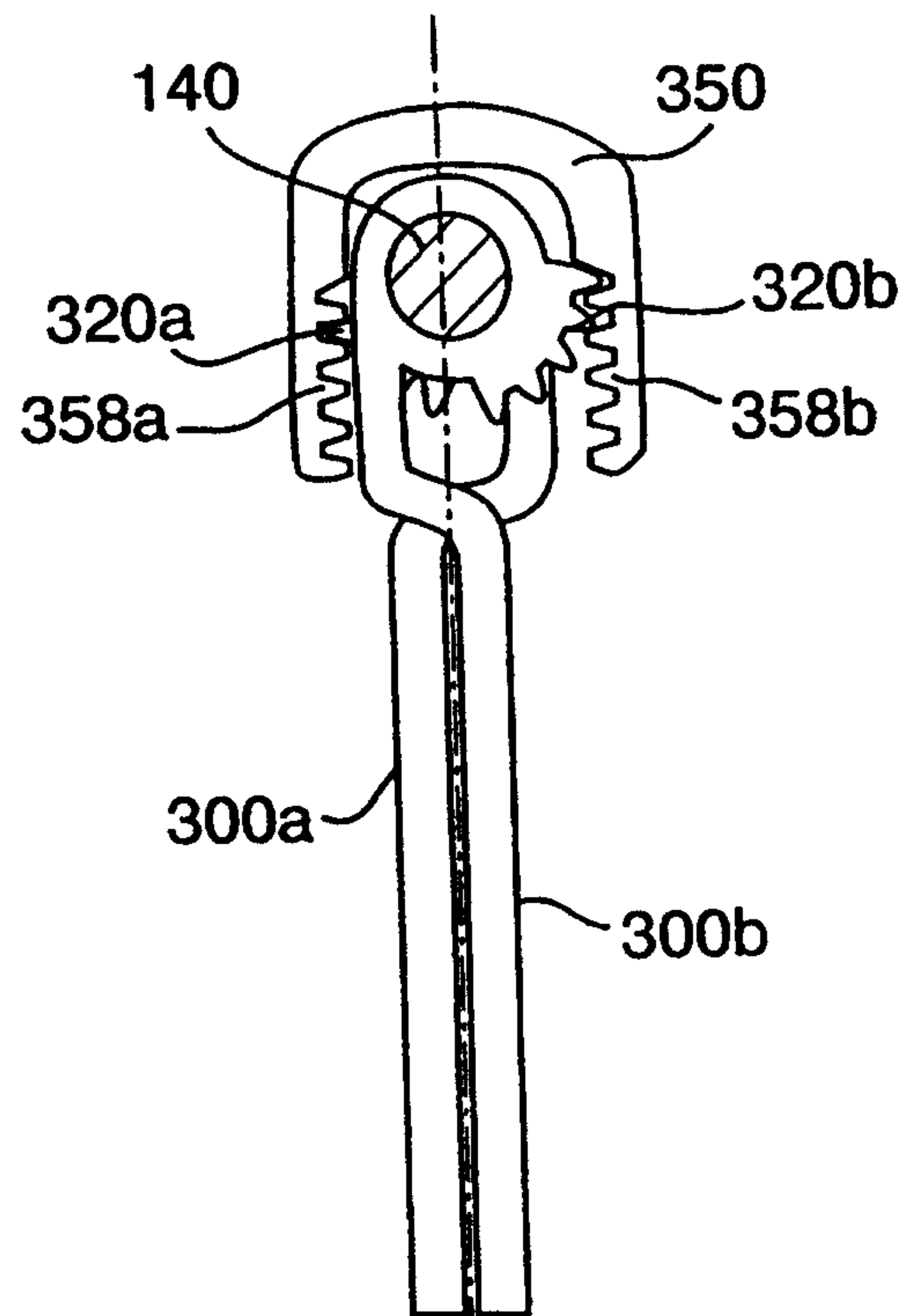
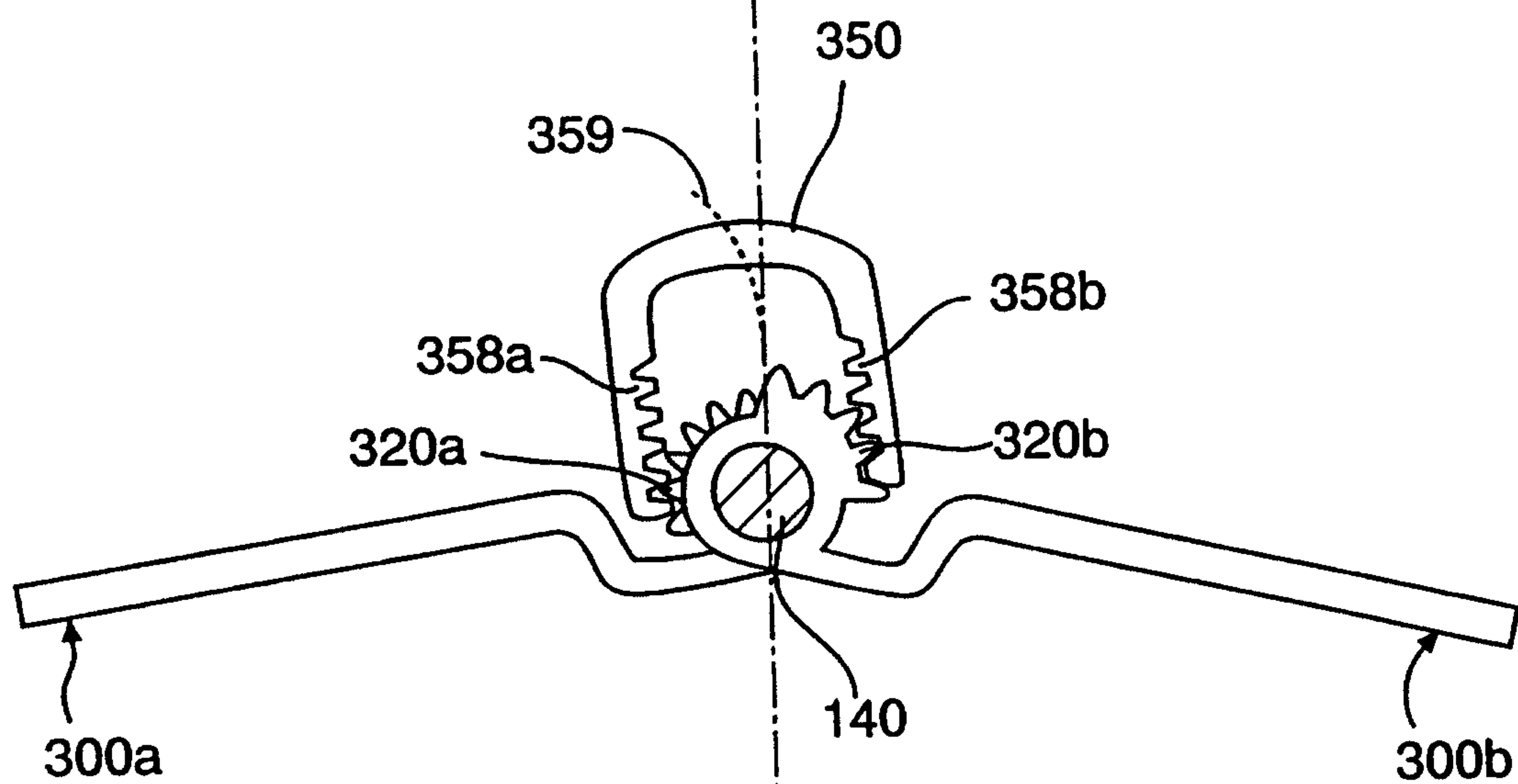
12/34

**FIG. 6A****FIG. 6B**

**FIG. 6C****FIG. 6D****FIG. 6E**

**FIG. 6F****FIG. 6G**

15/34

**FIG. 7A****FIG. 7B**

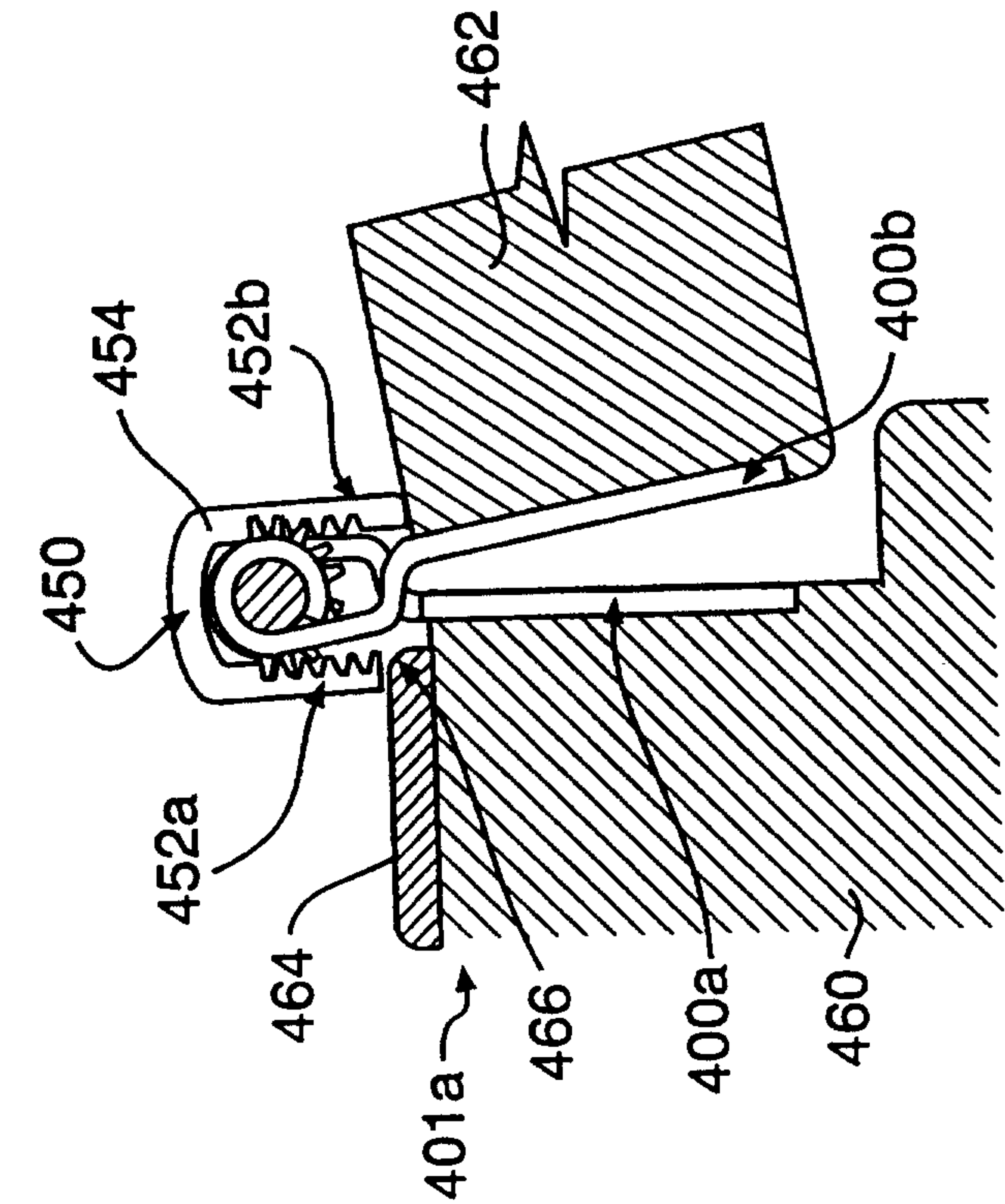


FIG. 8B

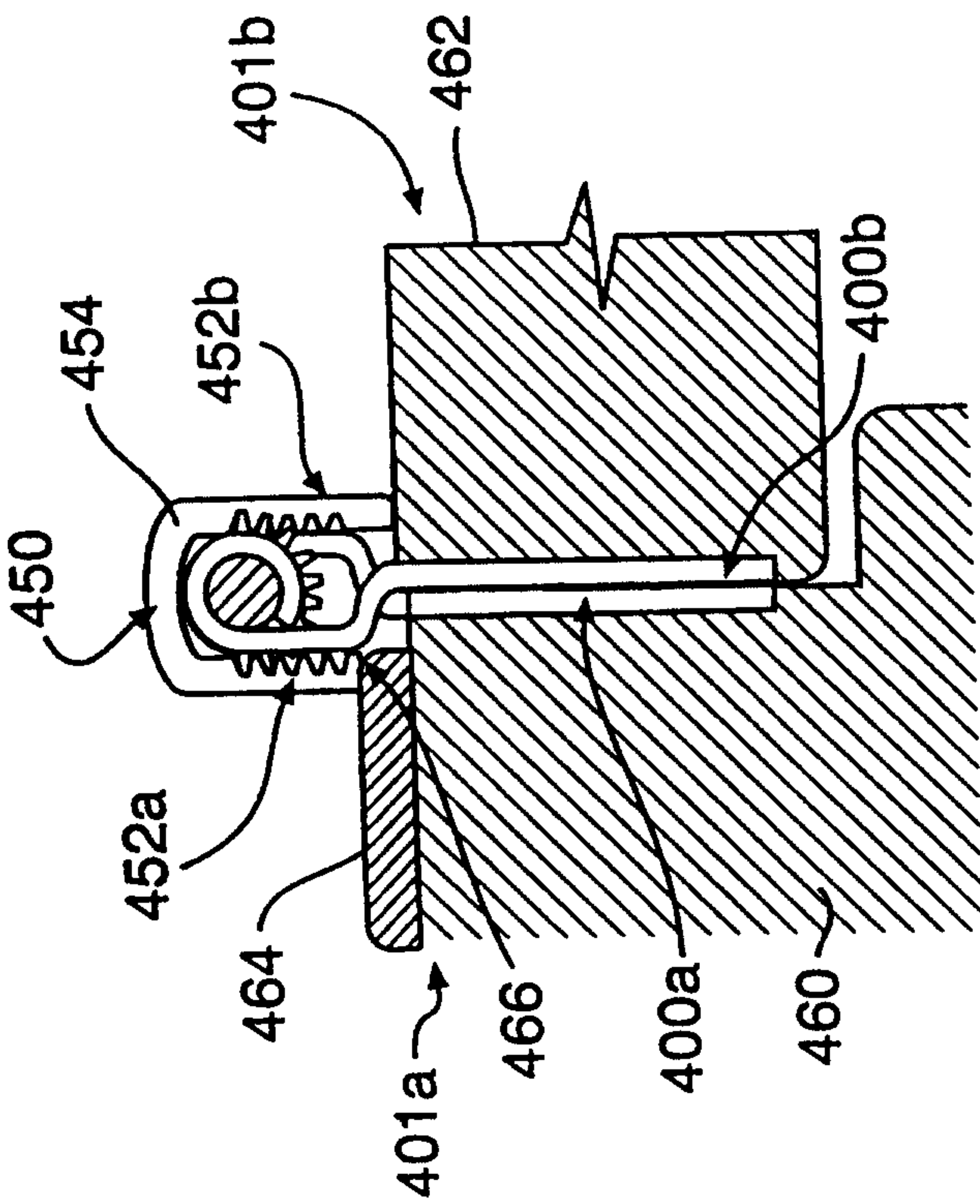


FIG. 8A

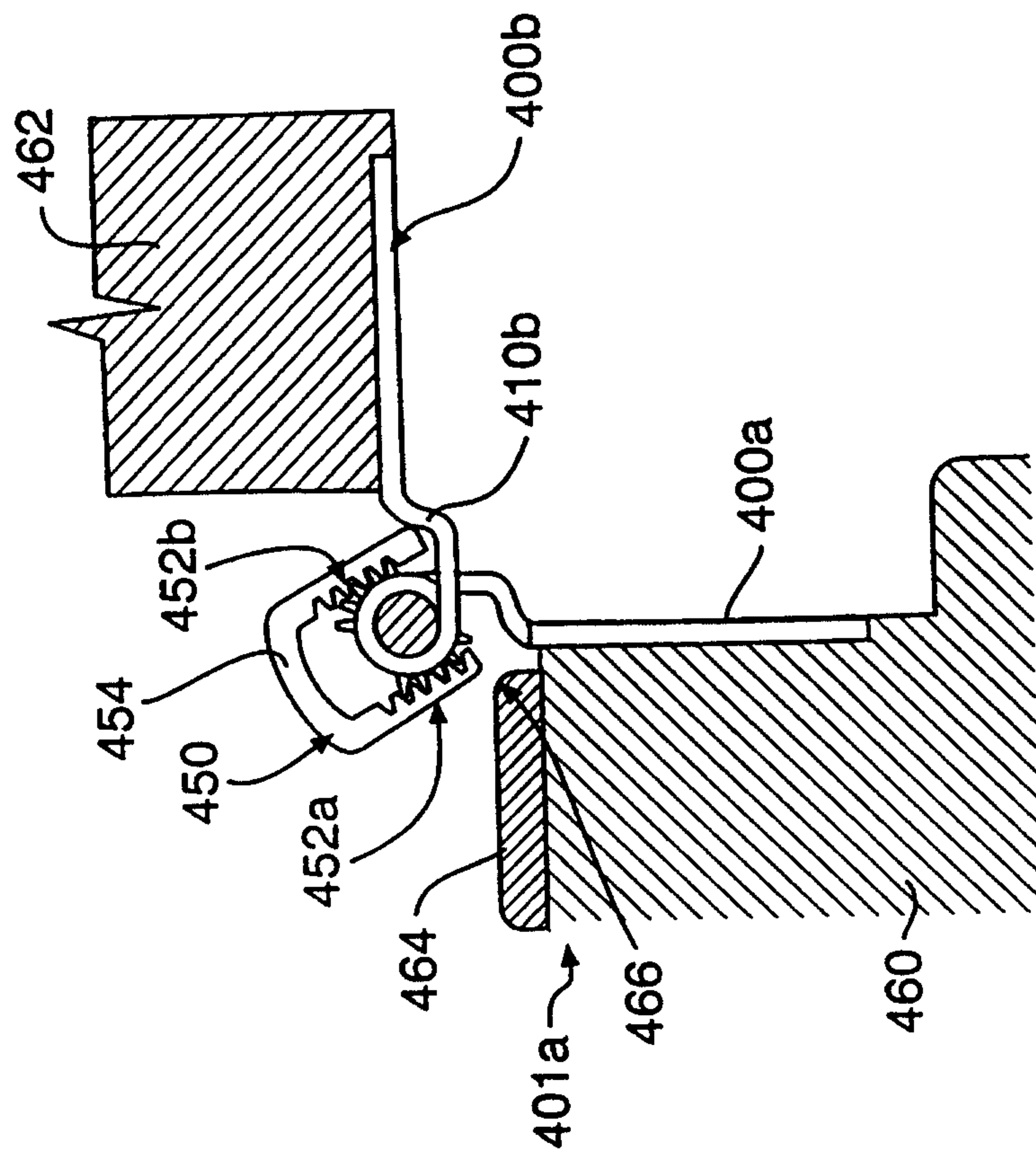


FIG. 8D

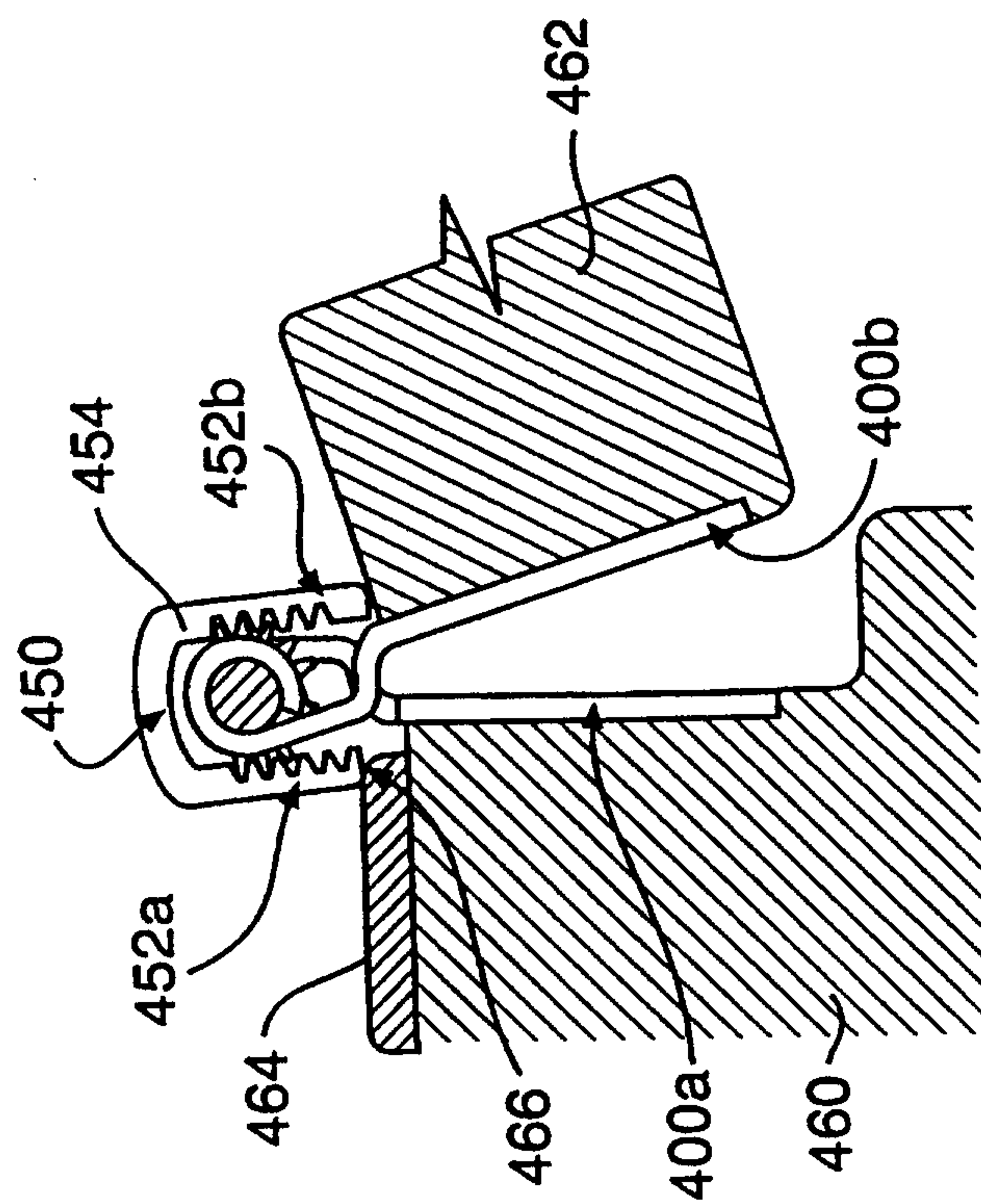
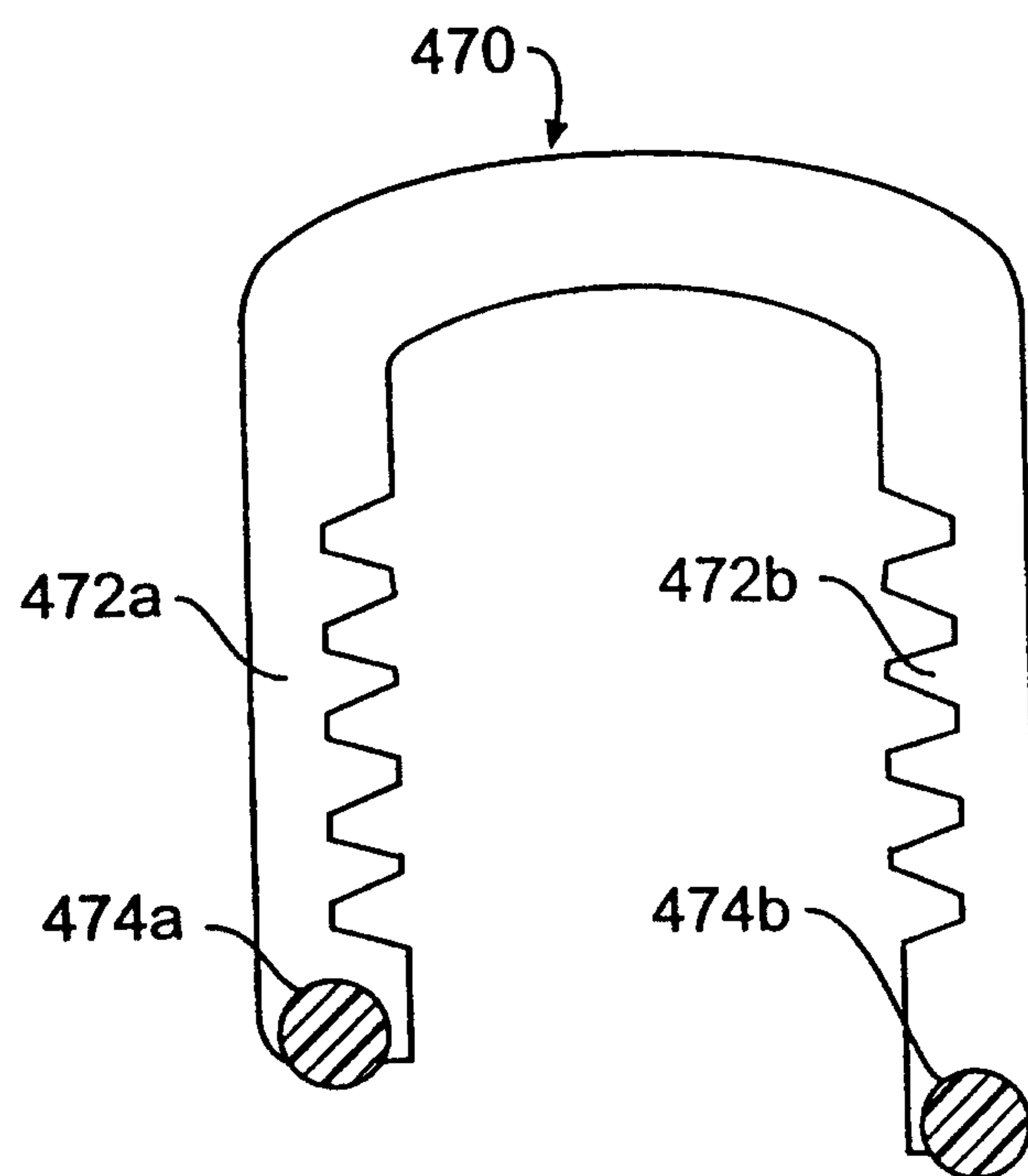


FIG. 8C

18/34

**FIG. 9**

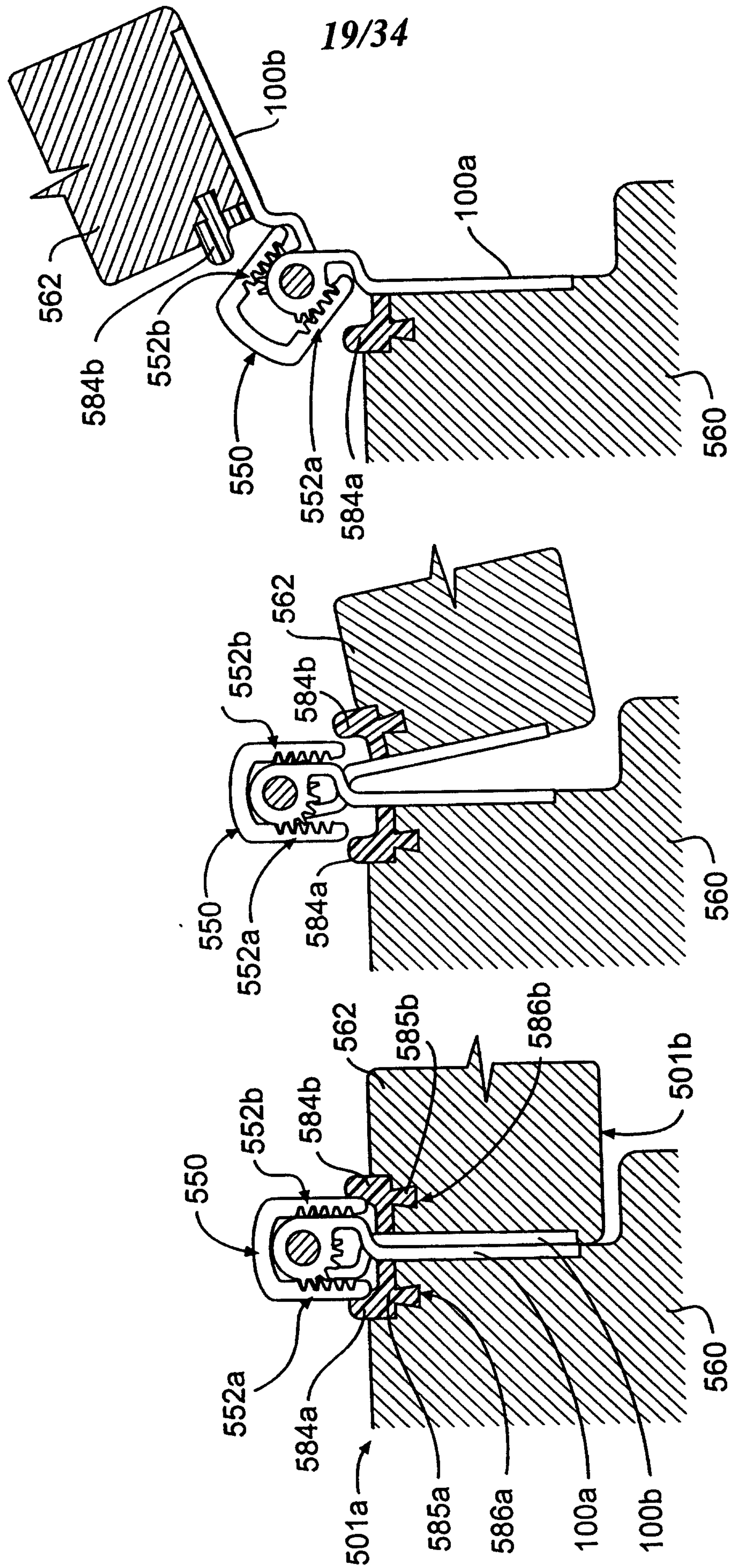


**FIG. 10C**

**FIG. 10B**

**FIG. 10A**

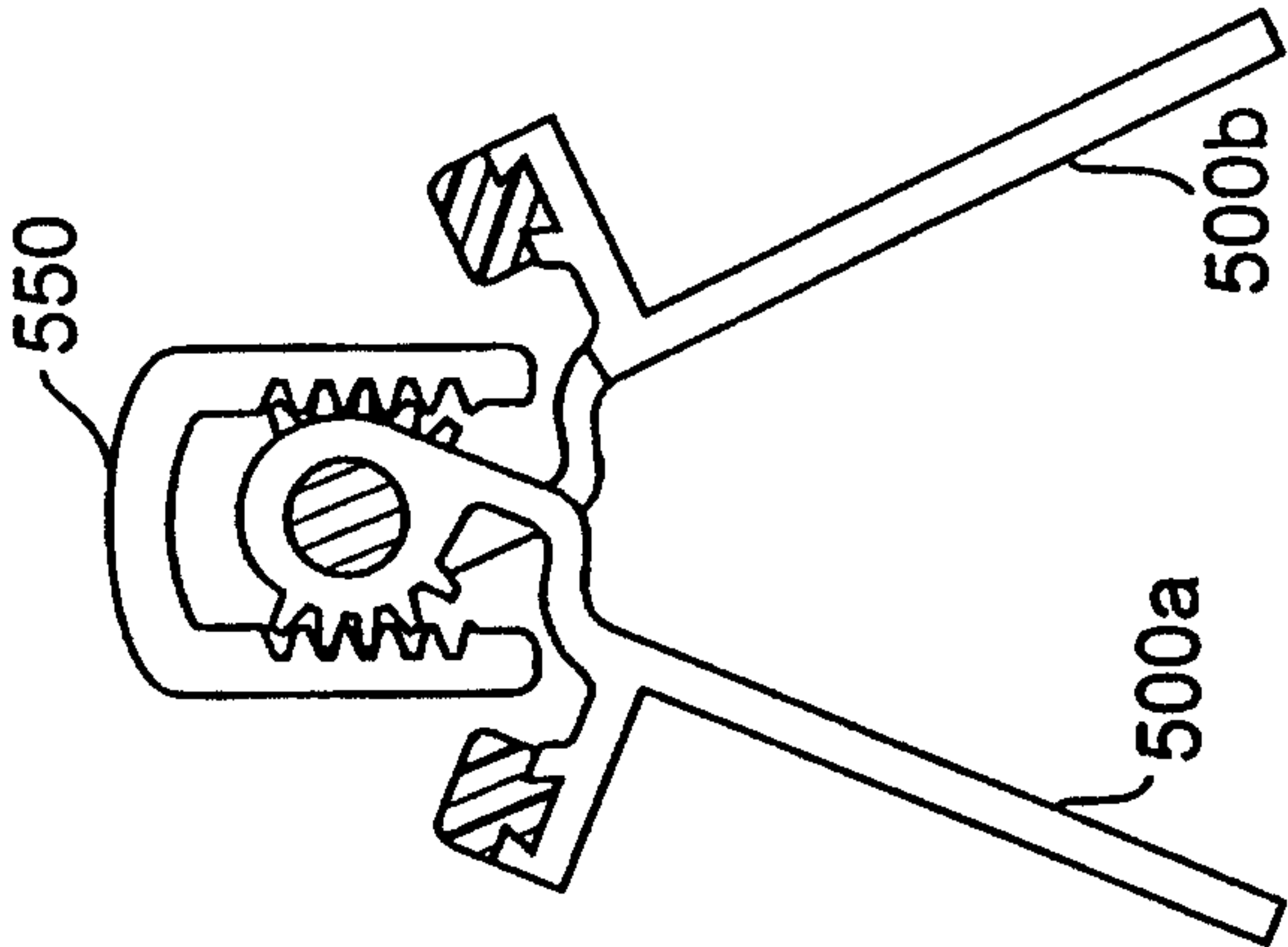


FIG. 11B

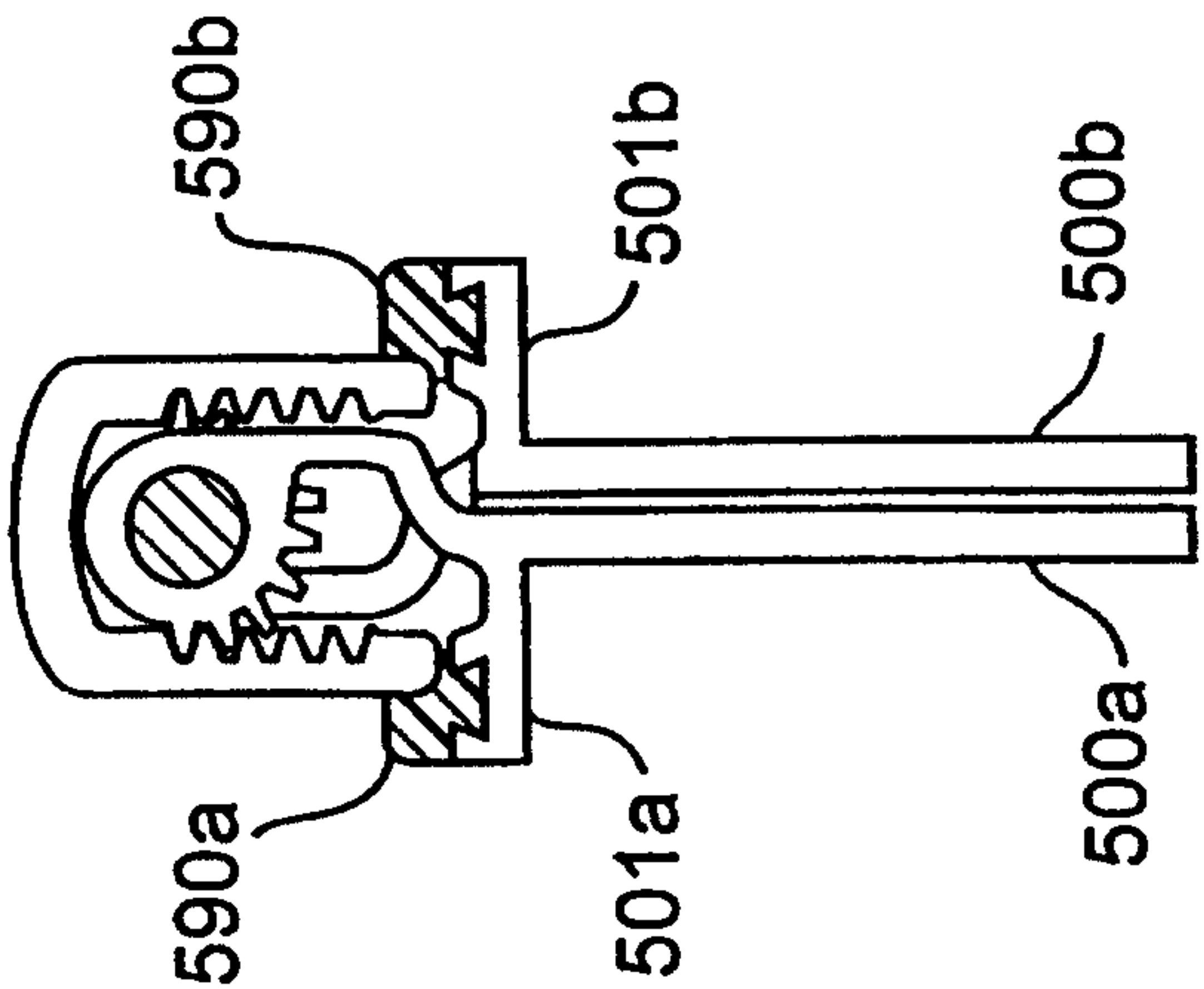


FIG. 11A

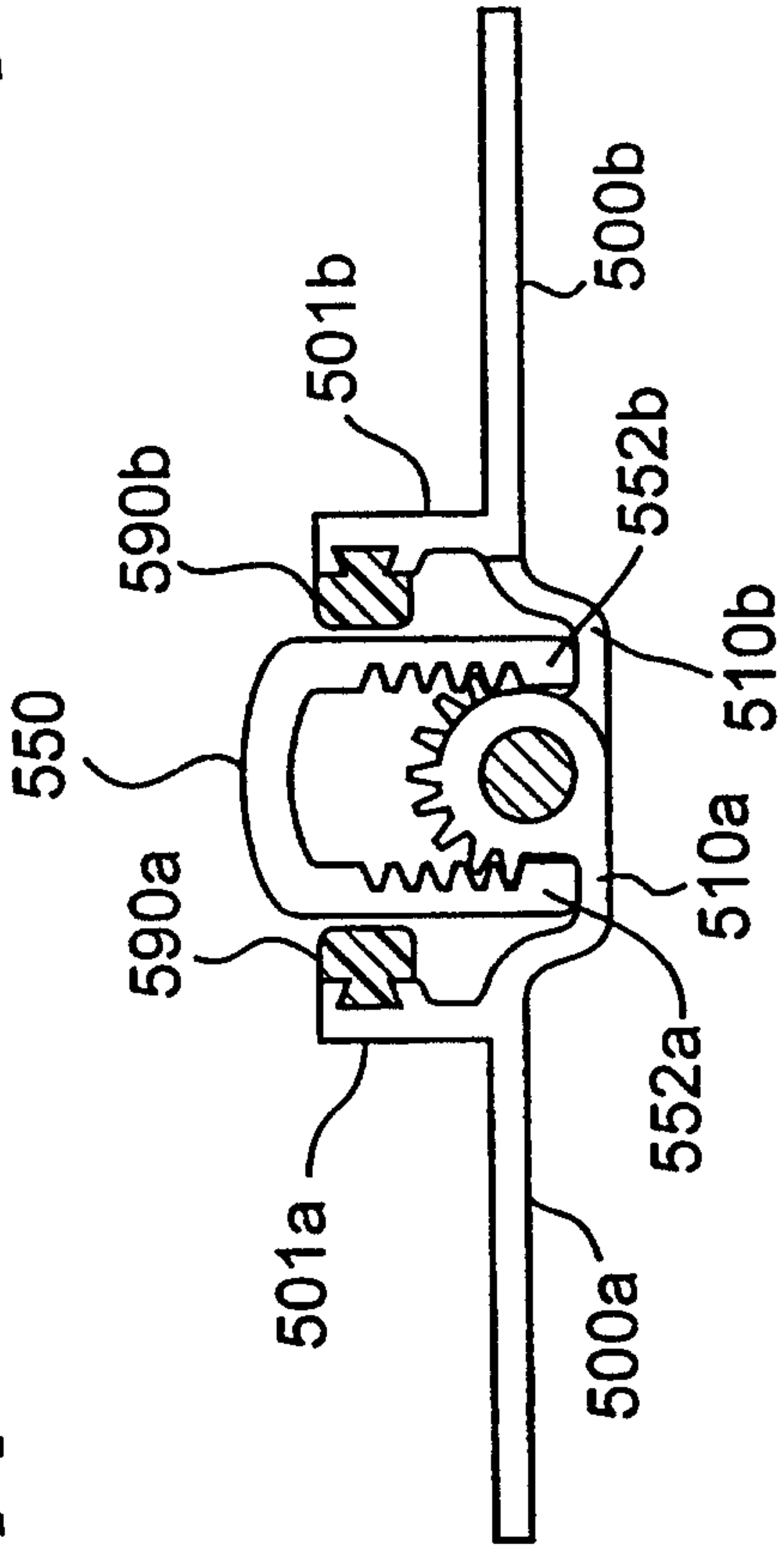


FIG. 11C

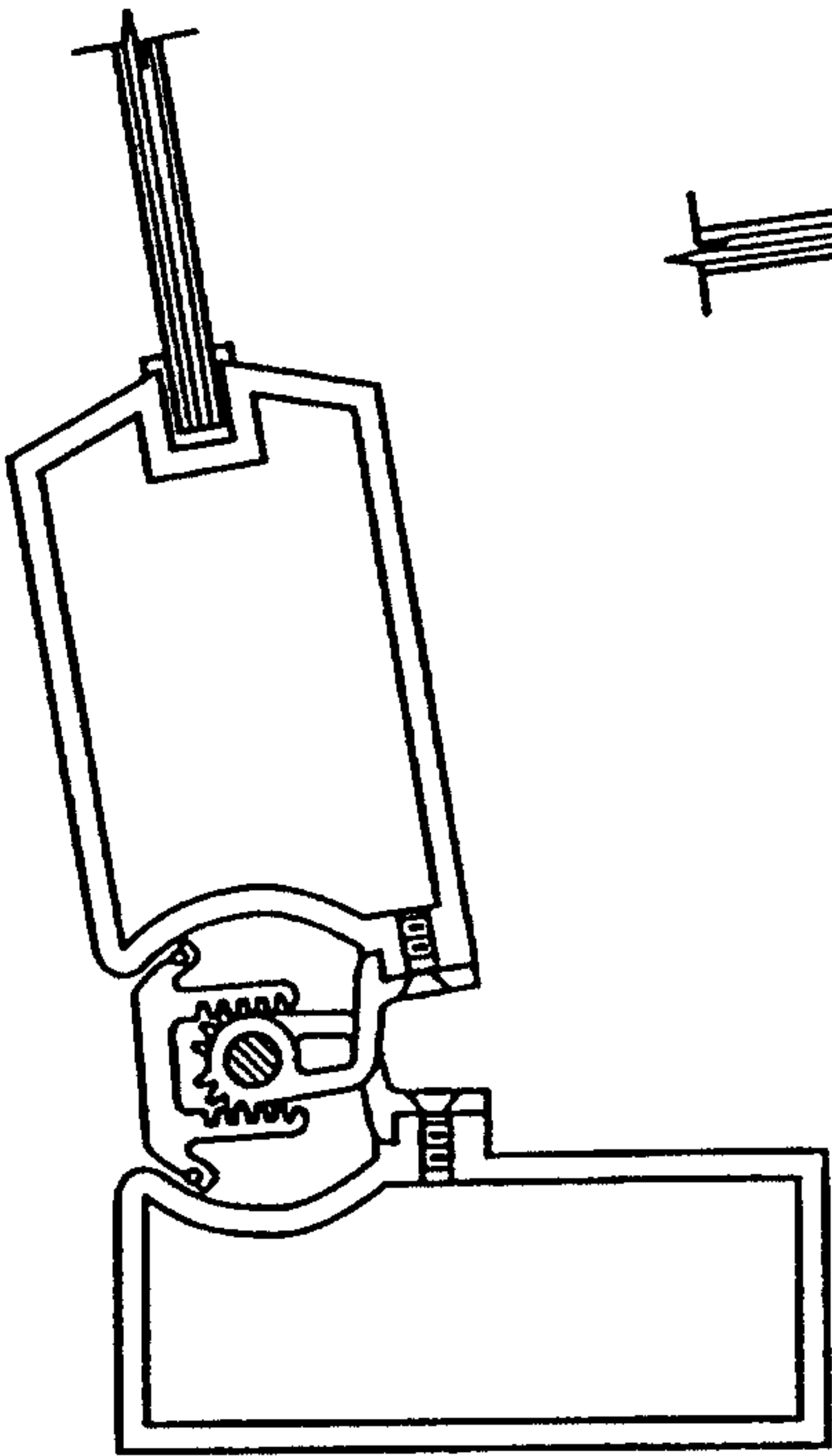


FIG. 12B

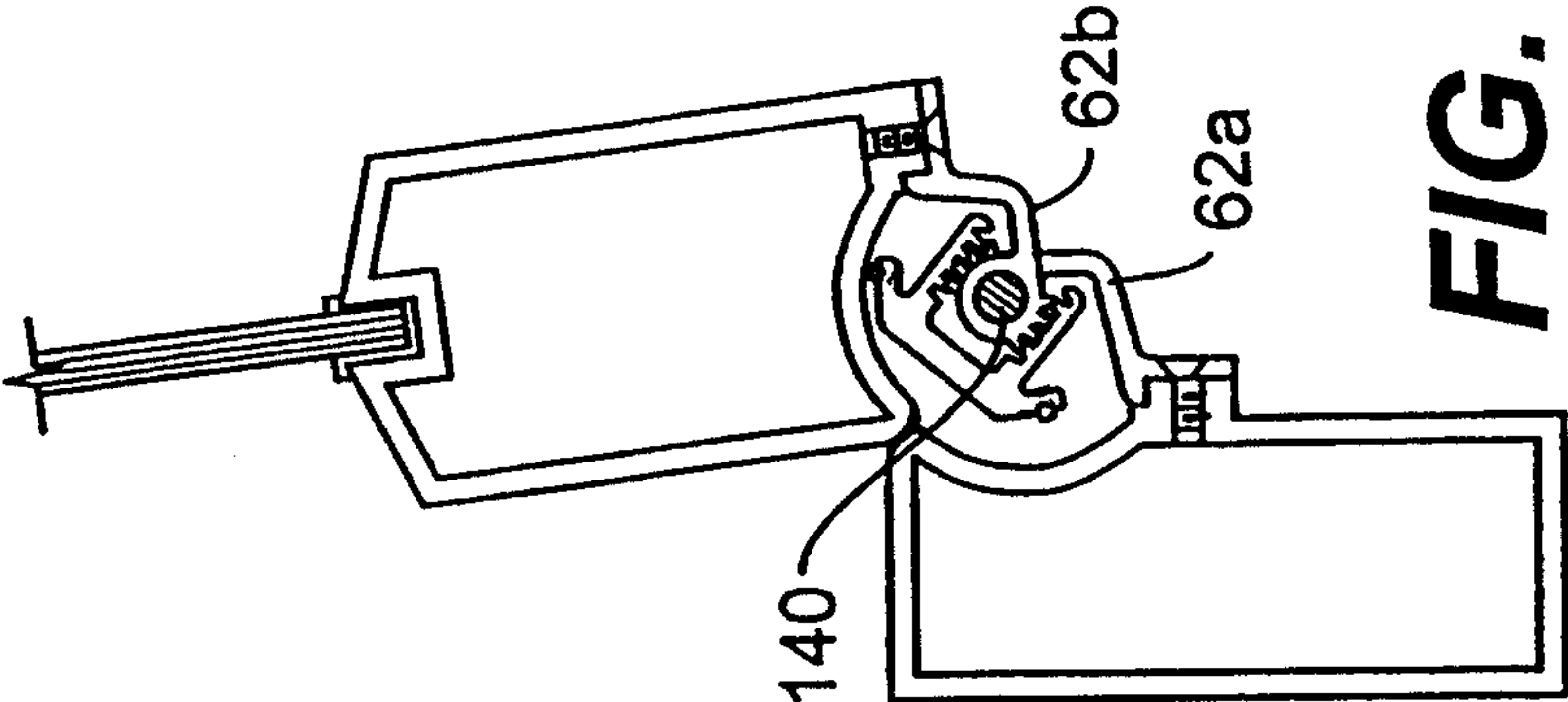


FIG. 12D

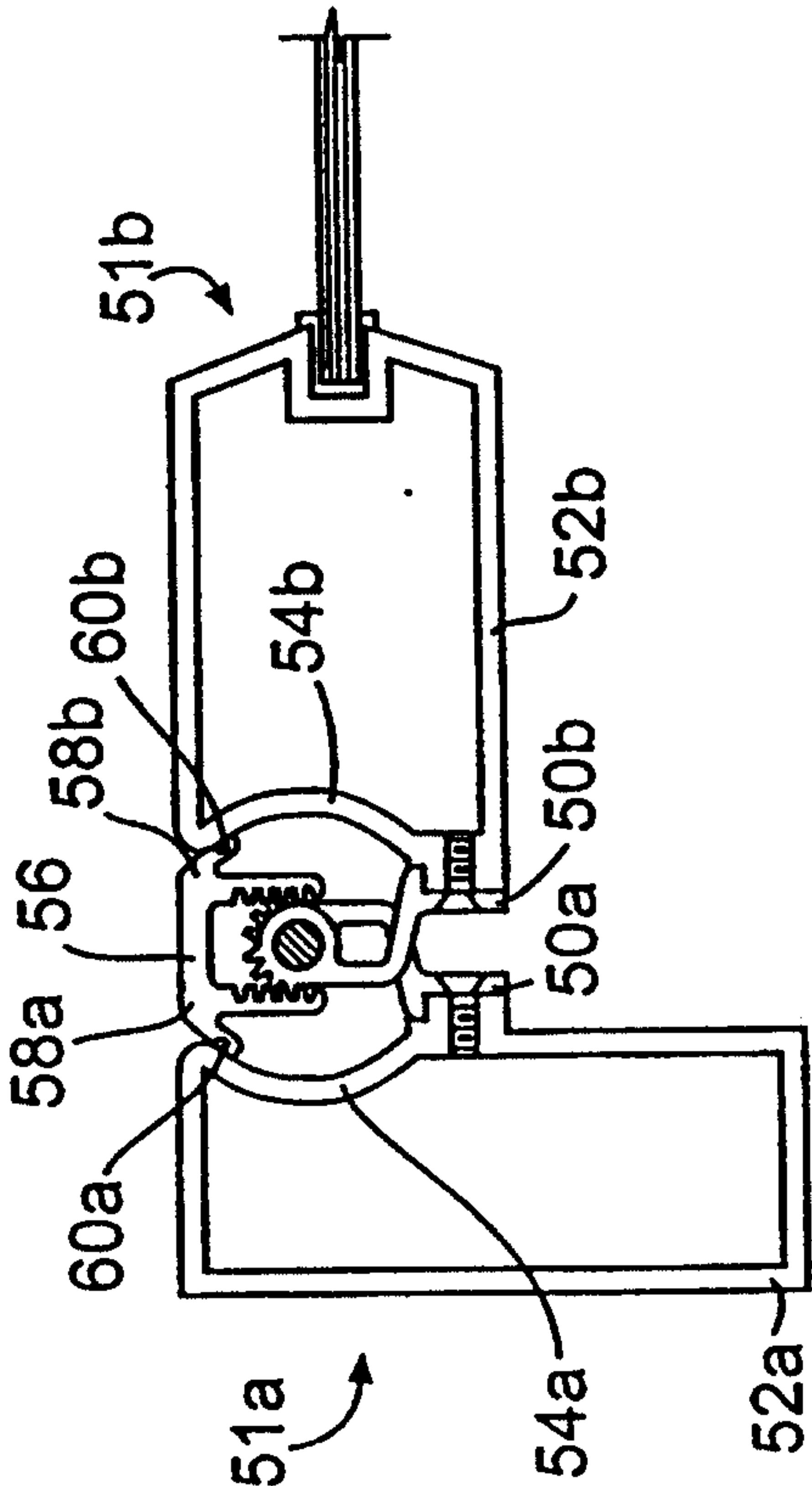


FIG. 12A

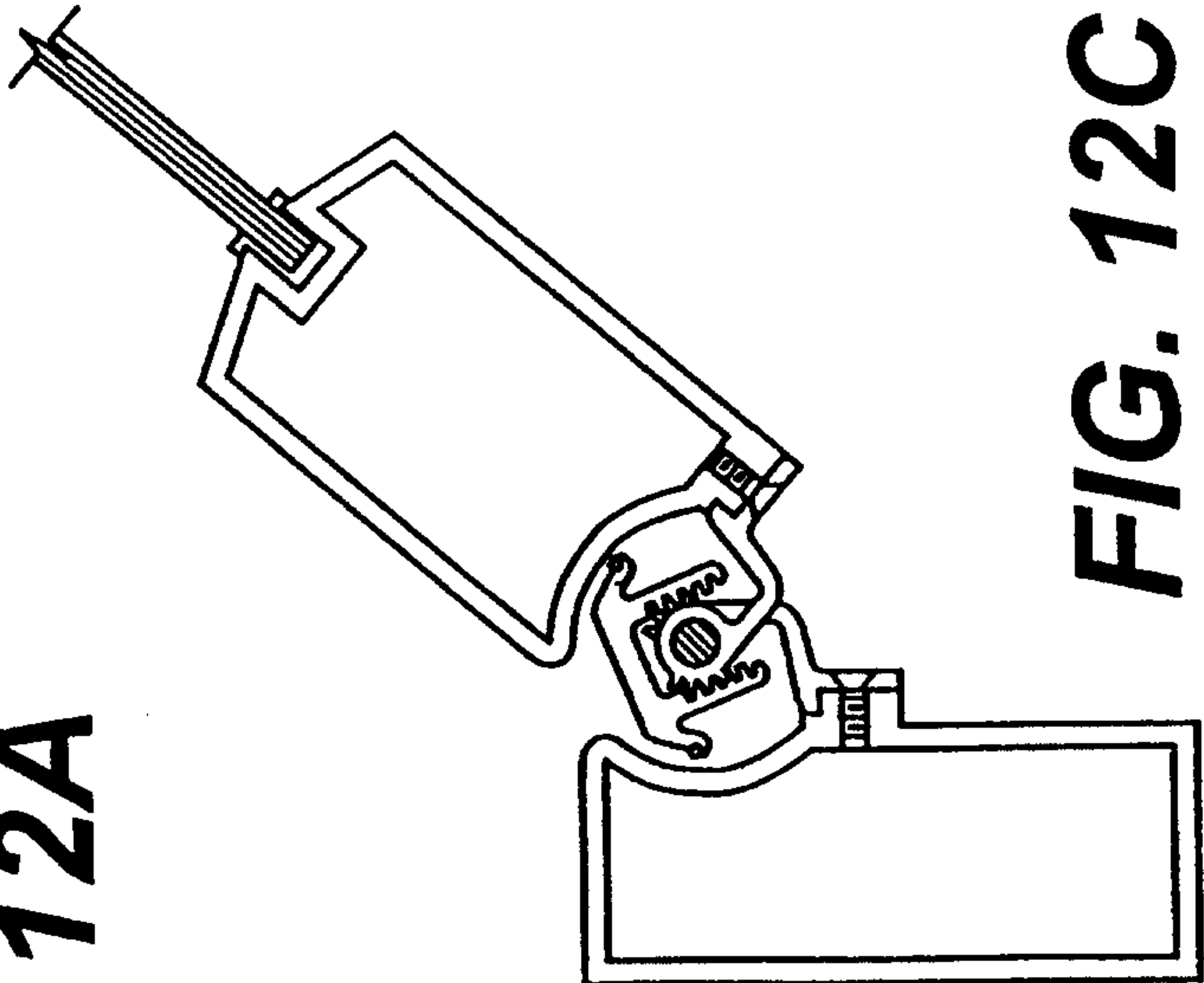


FIG. 12C

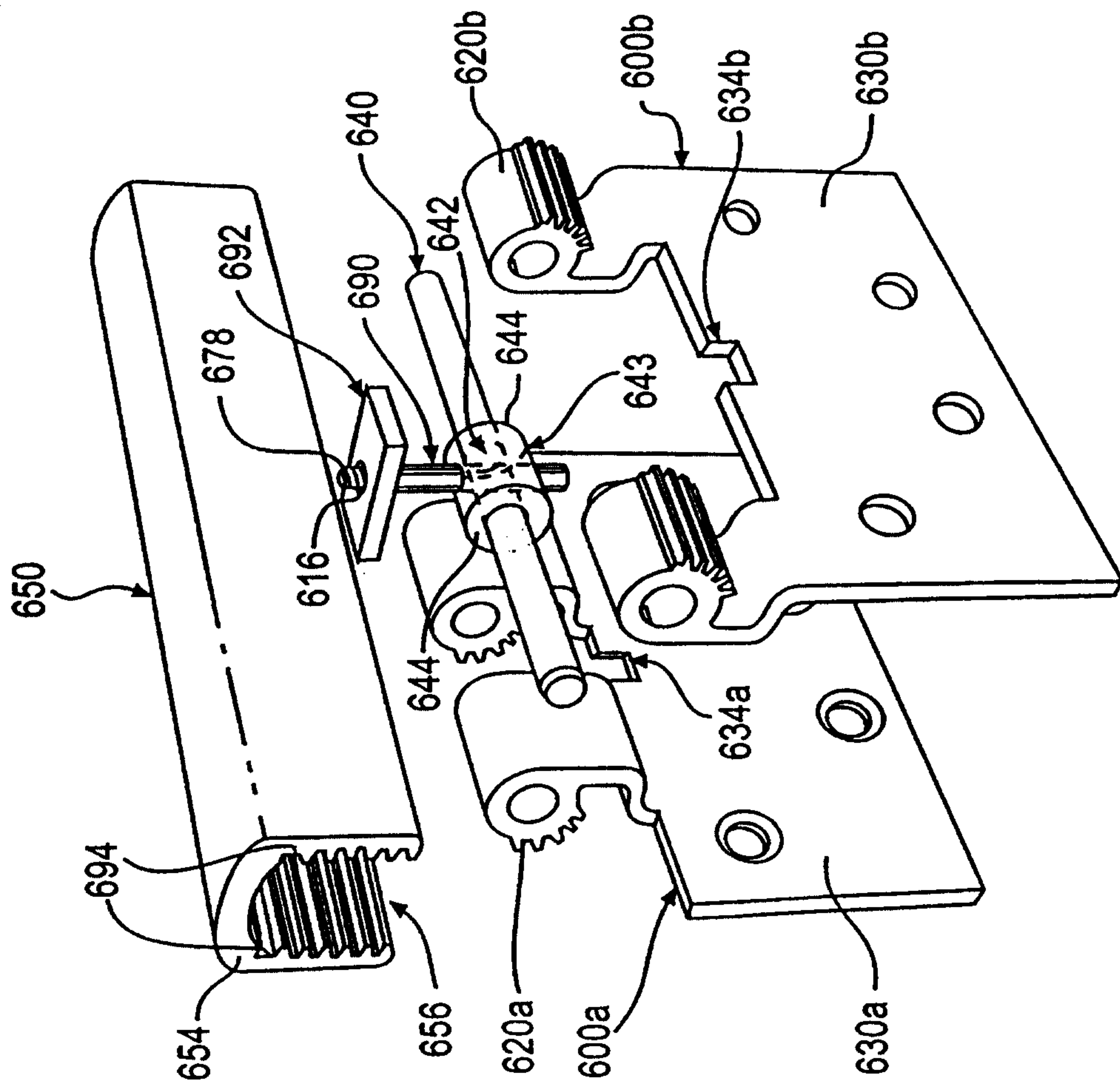


**FIG. 13A**

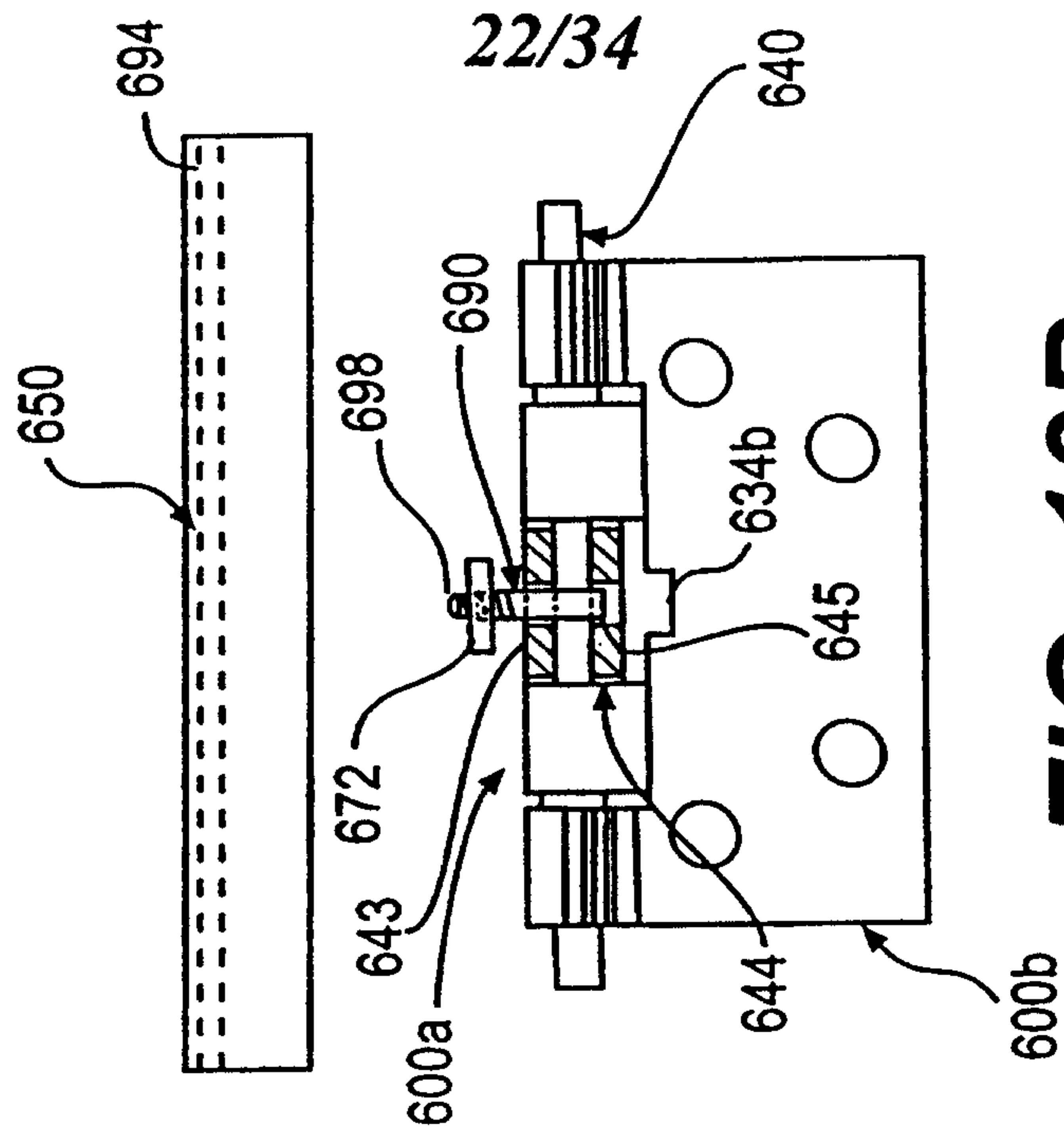


**FIG. 13B**

**23/34**

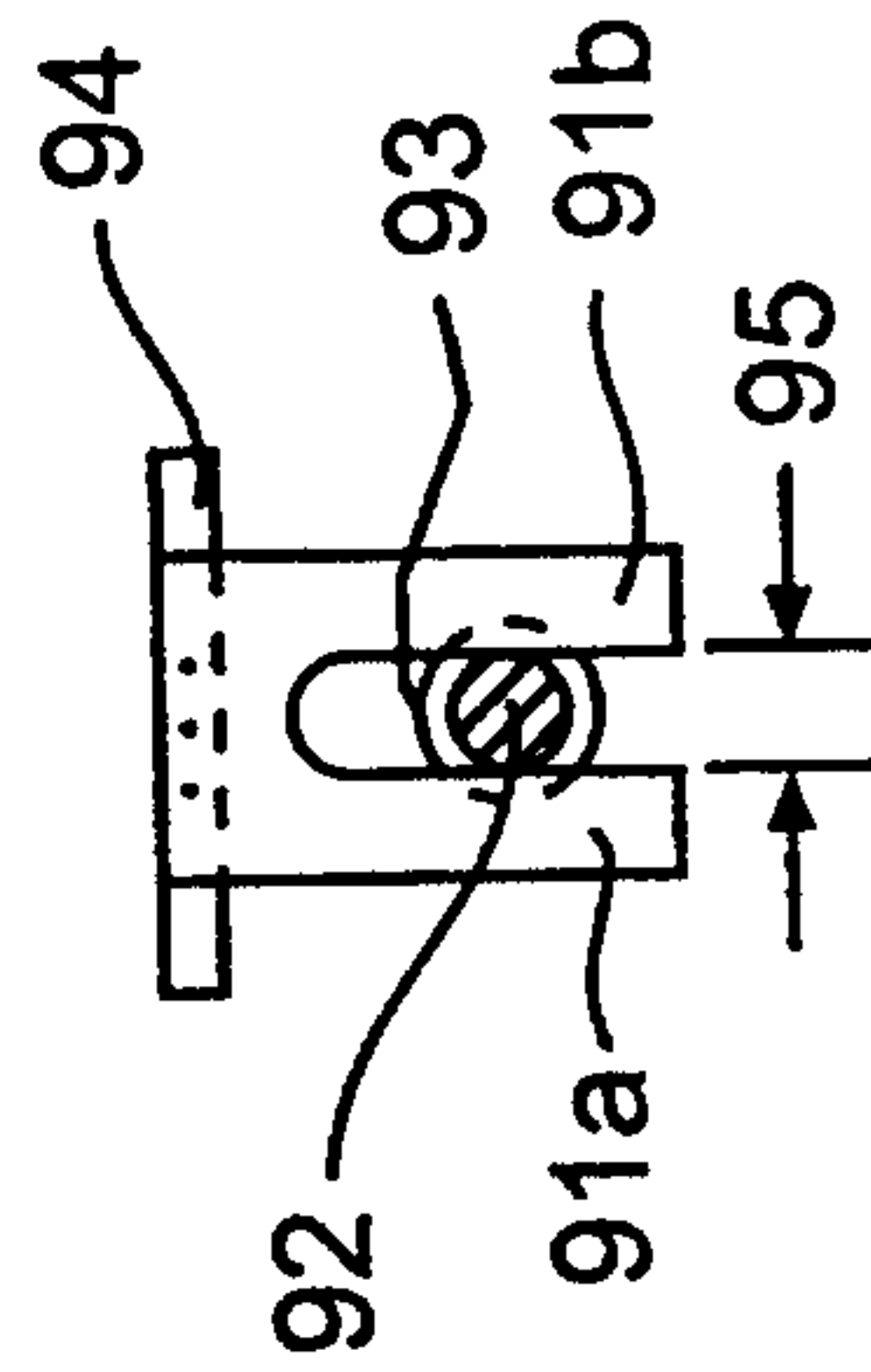


**FIG. 13D**

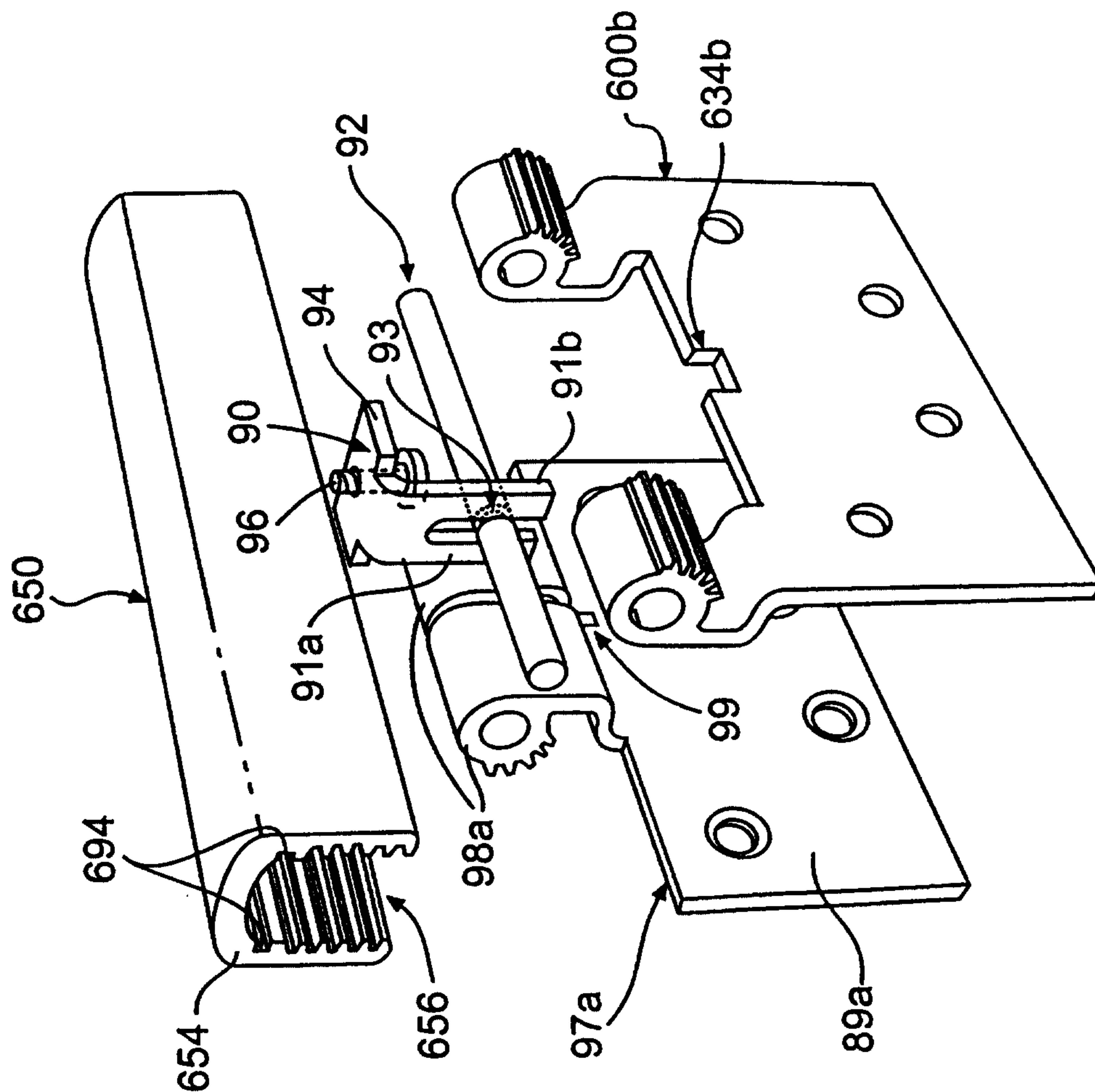
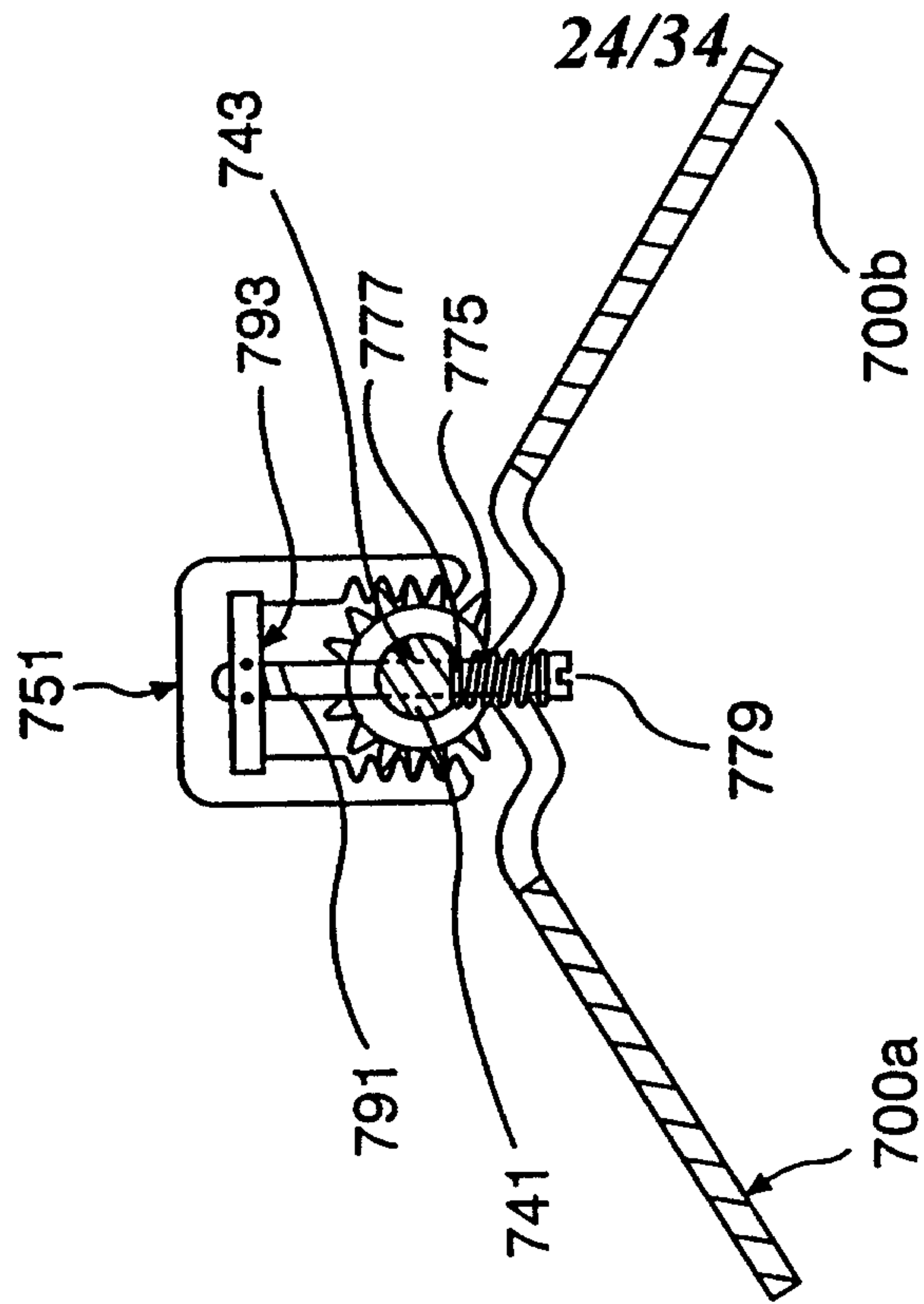
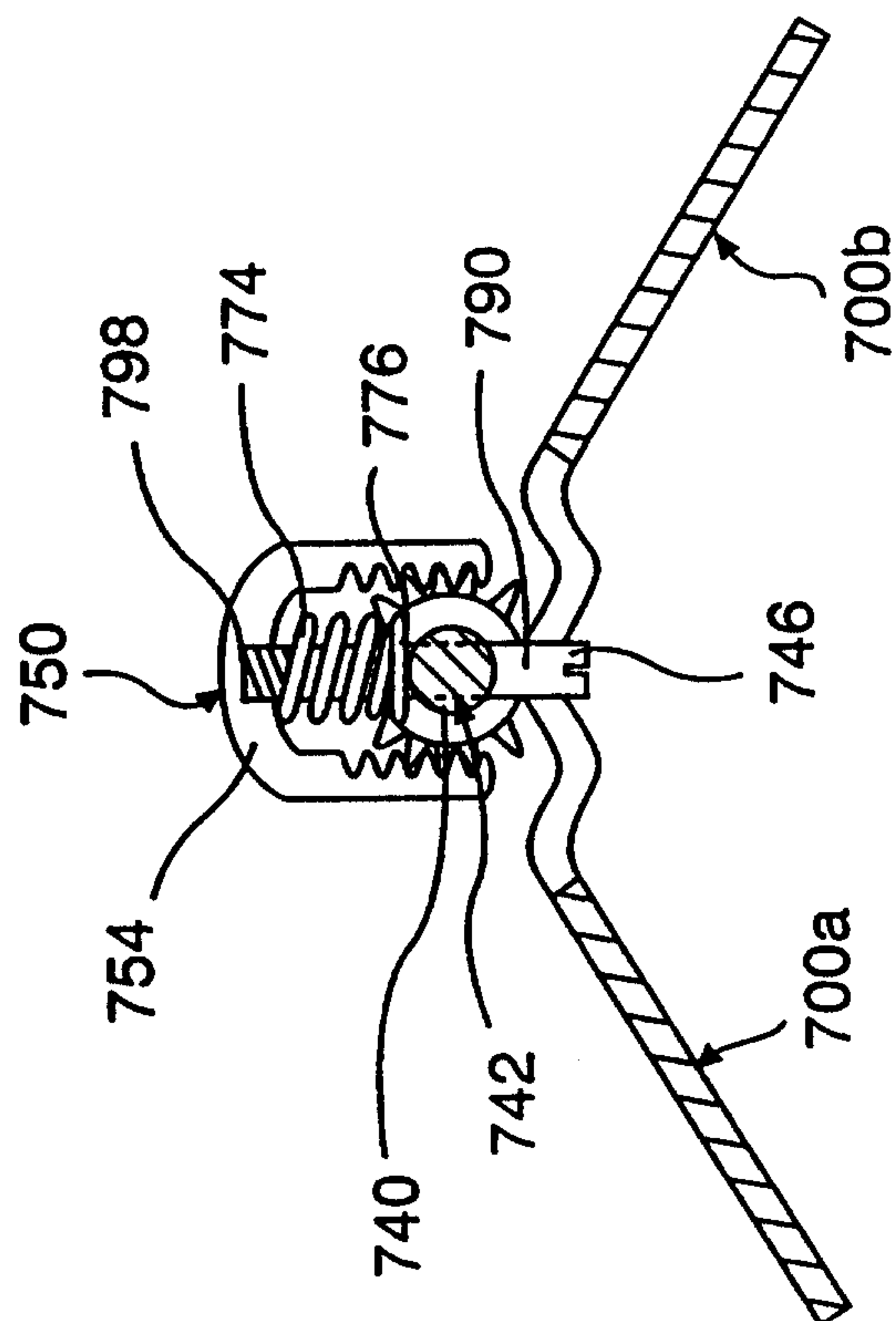


**FIG. 13C**

**FIG. 14****FIG. 15**

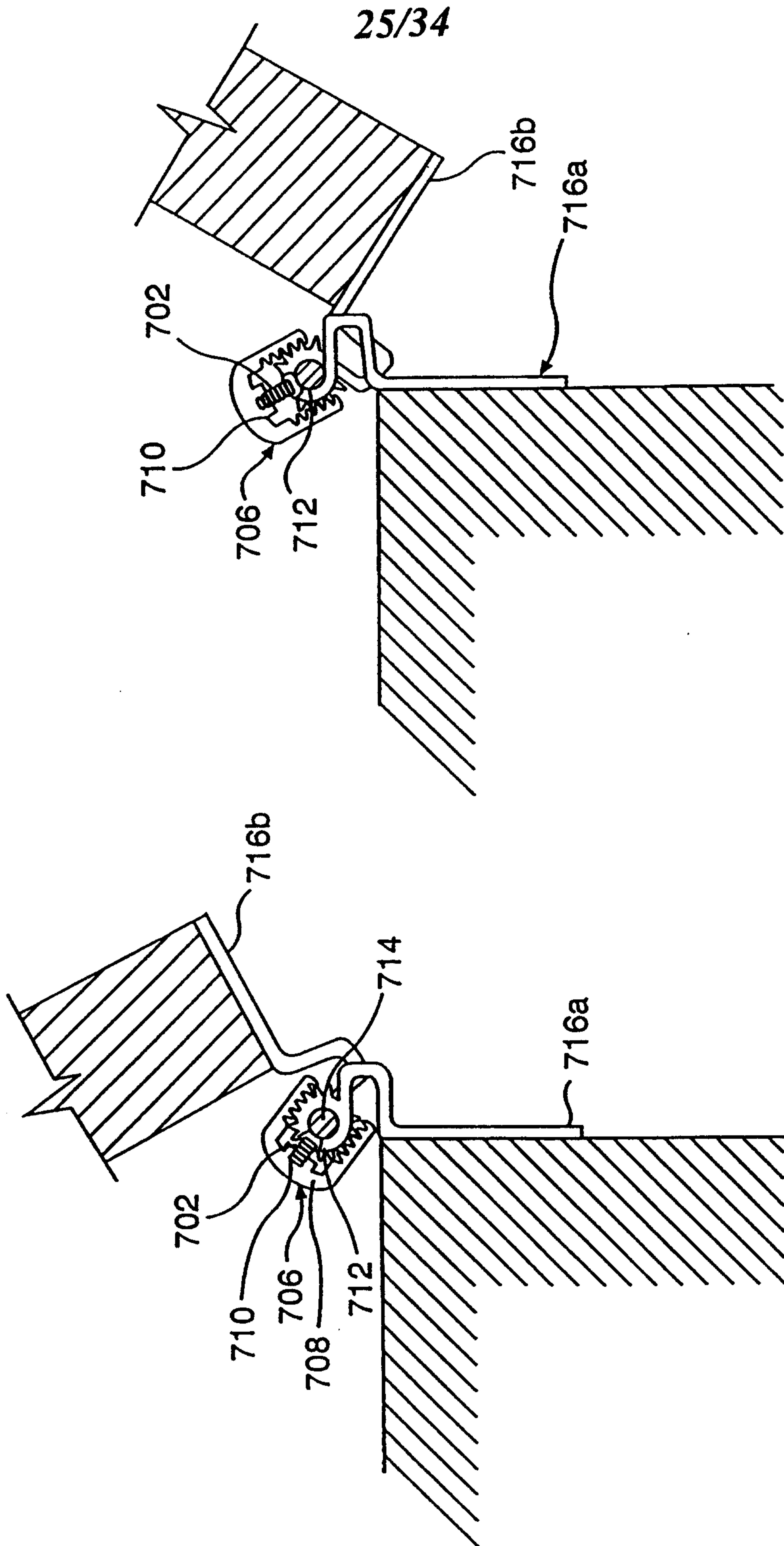


FIG. 16B

FIG. 16A

26/34

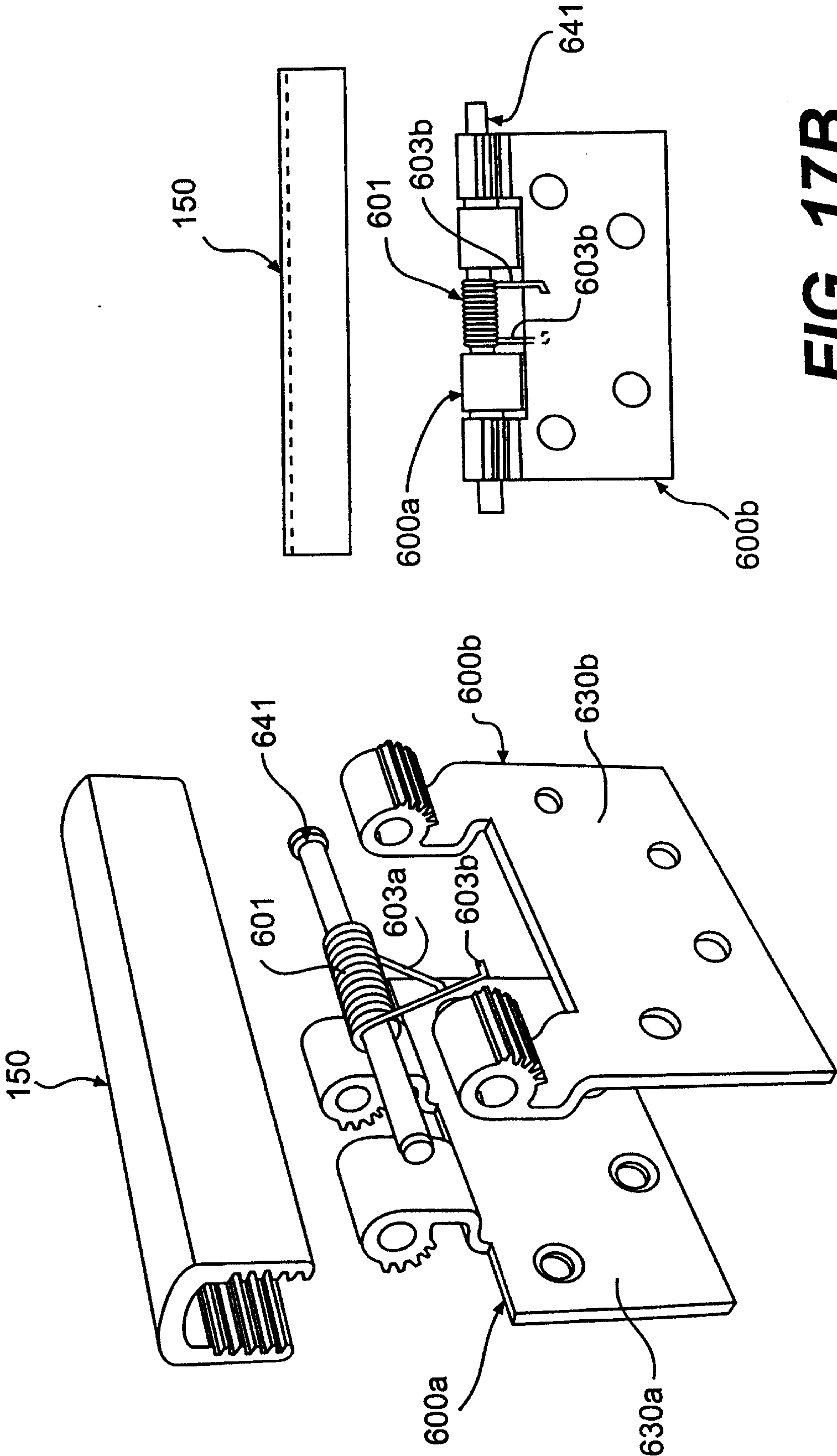


FIG. 17B

FIG. 17A

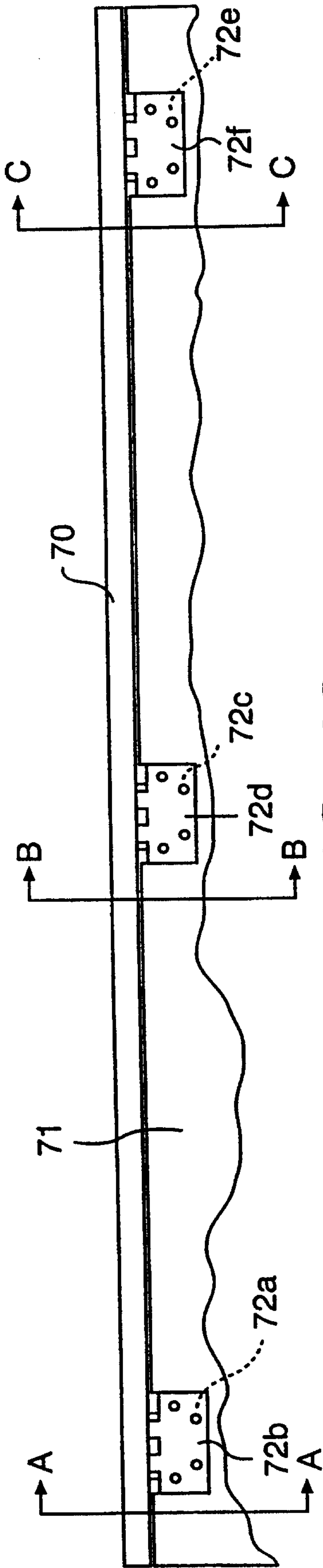


**FIG. 18**



**FIG. 18A**

**FIG. 18B**

**FIG. 18C**

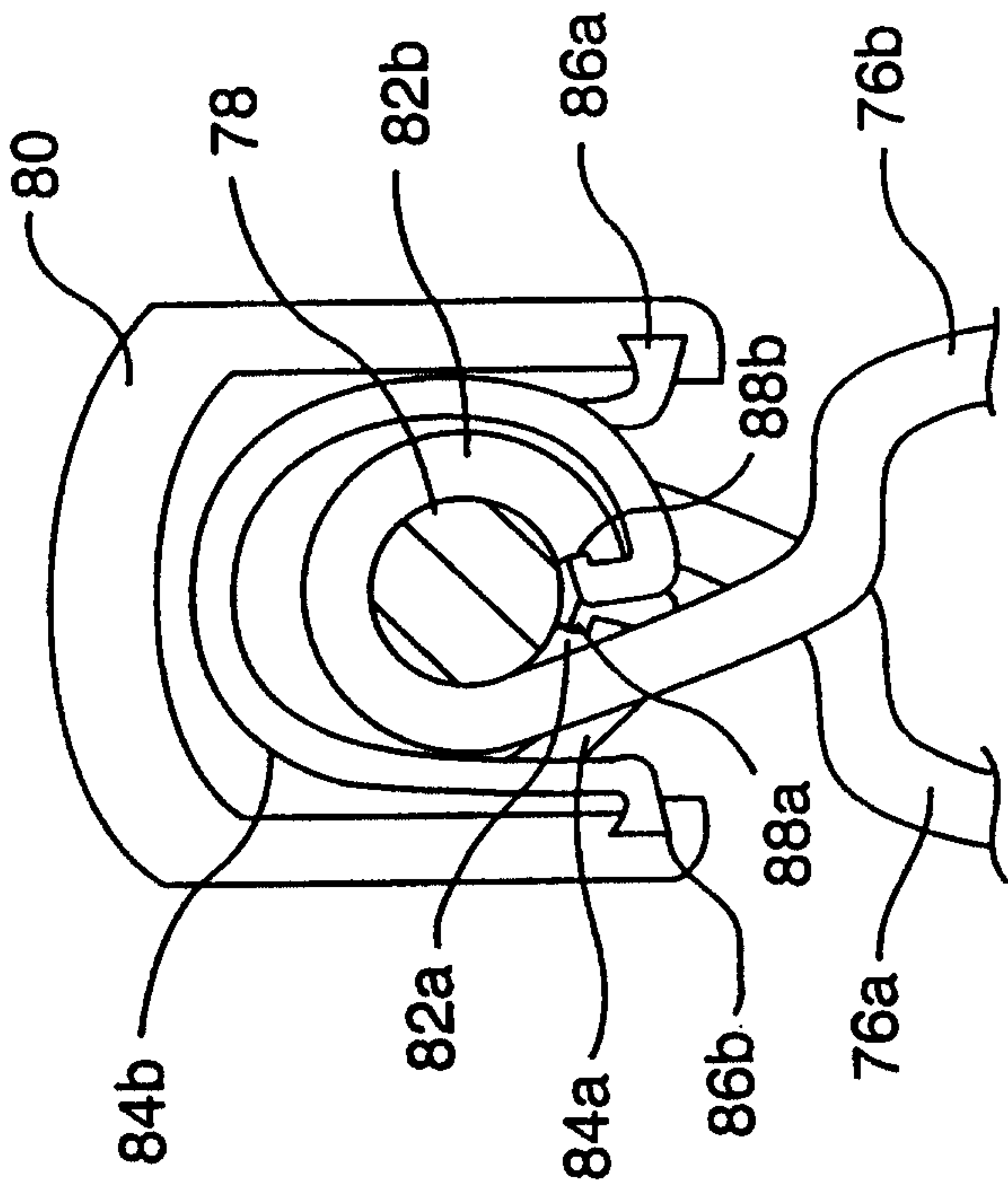


FIG. 19

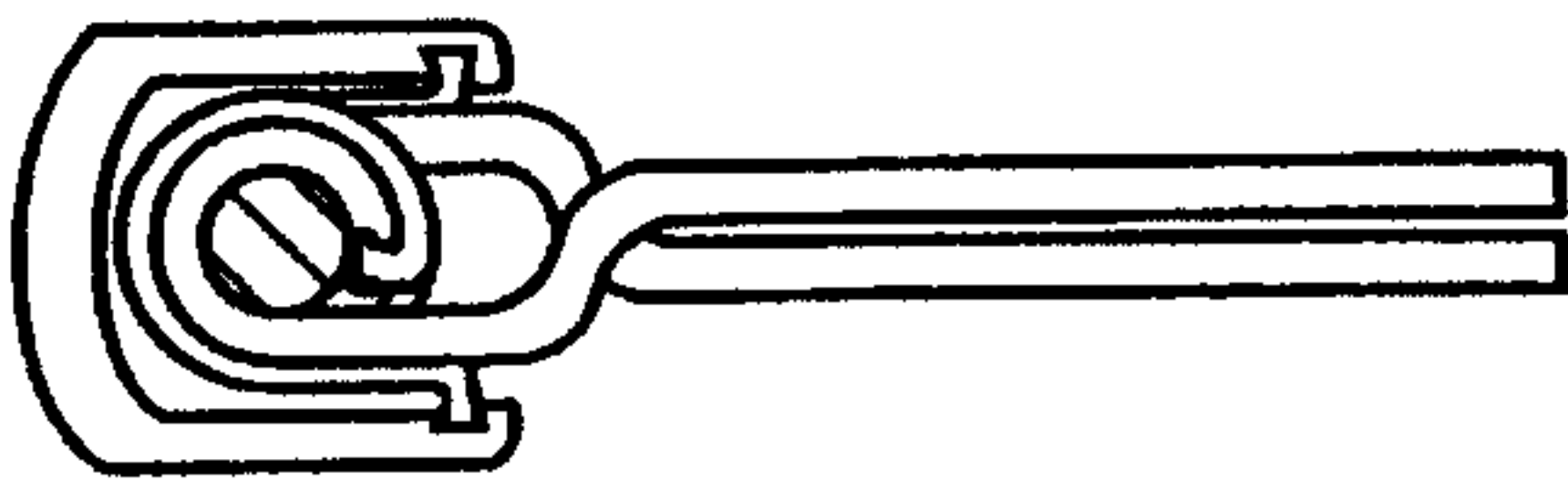


FIG. 19A

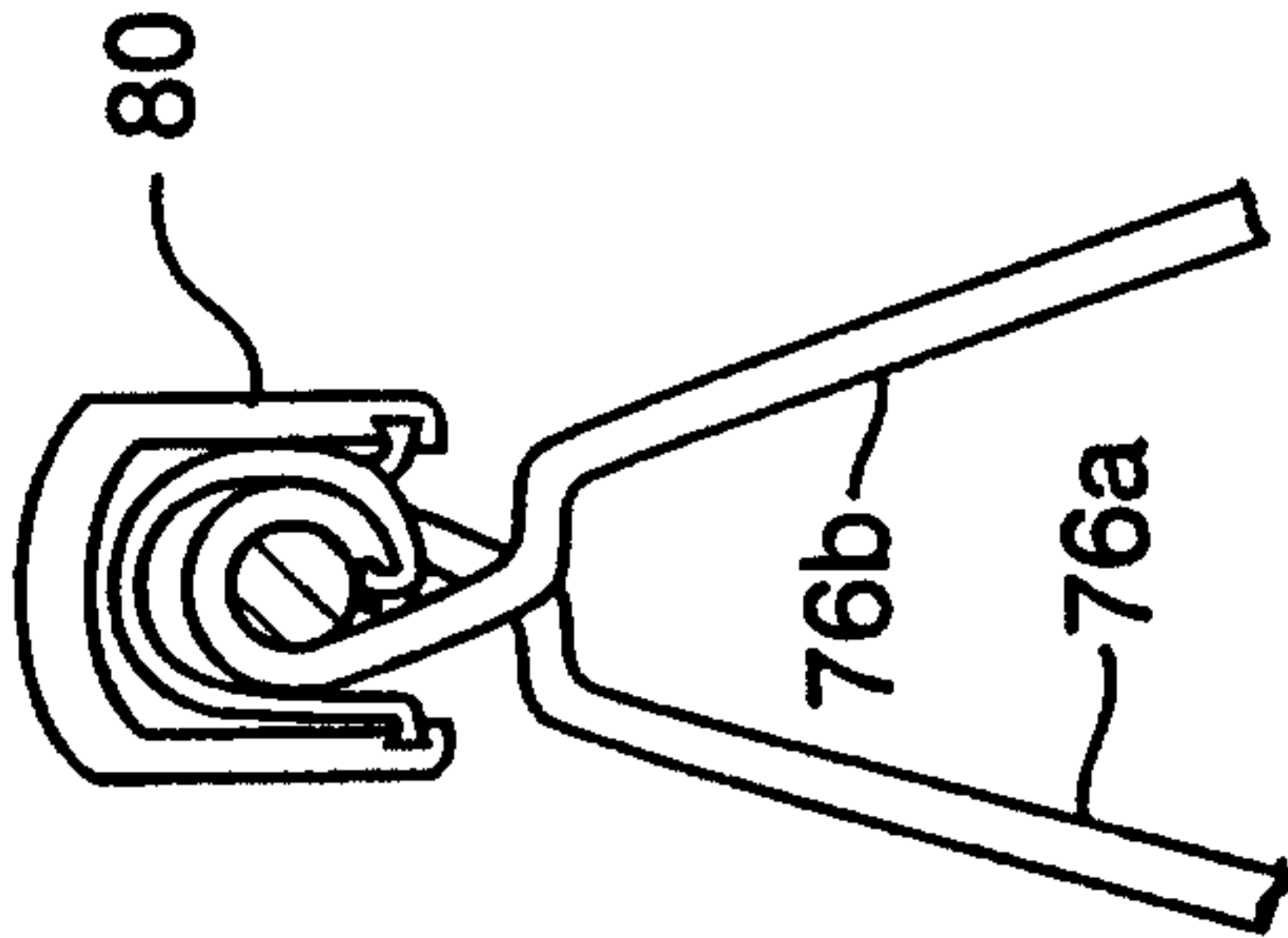


FIG. 19B

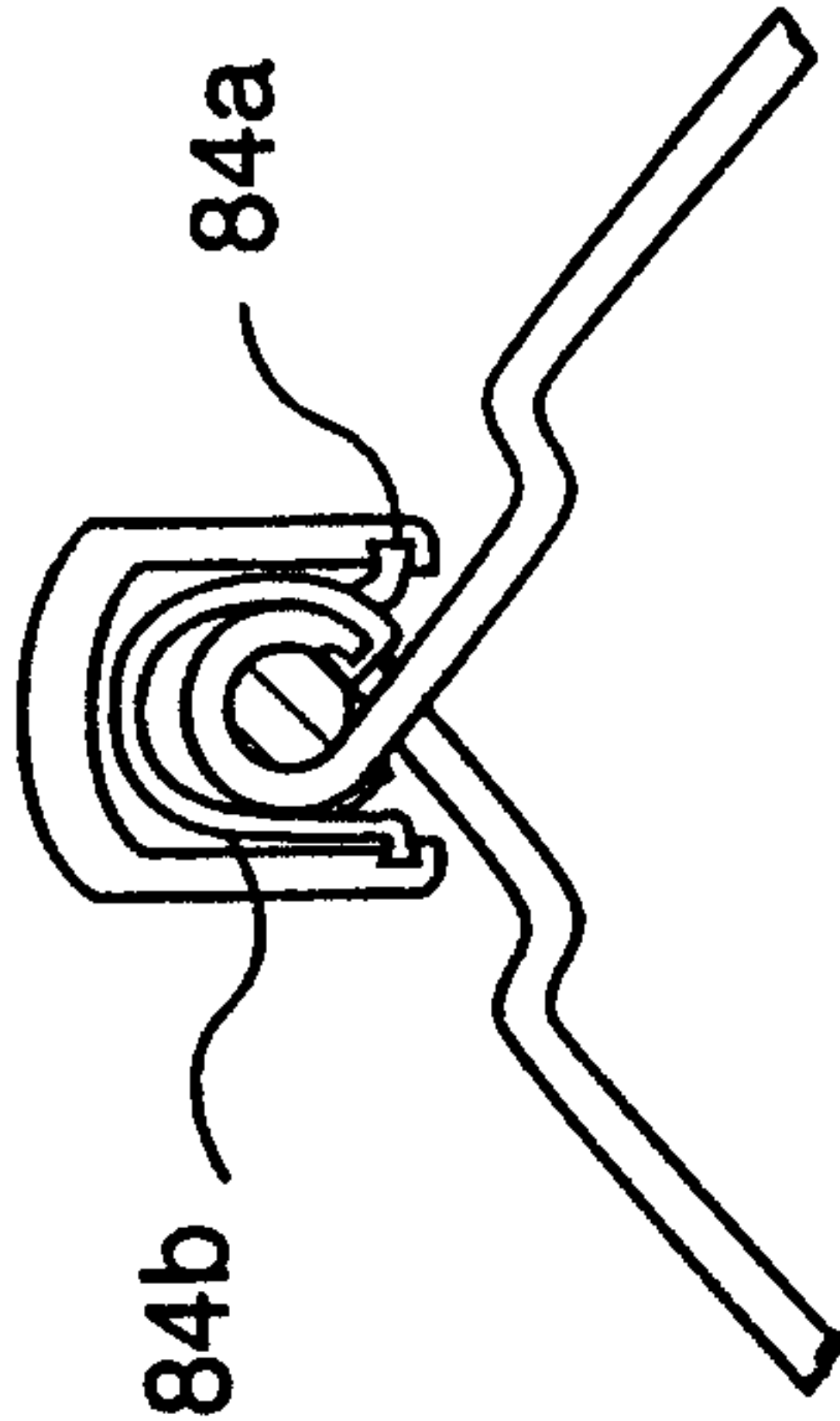


FIG. 19C

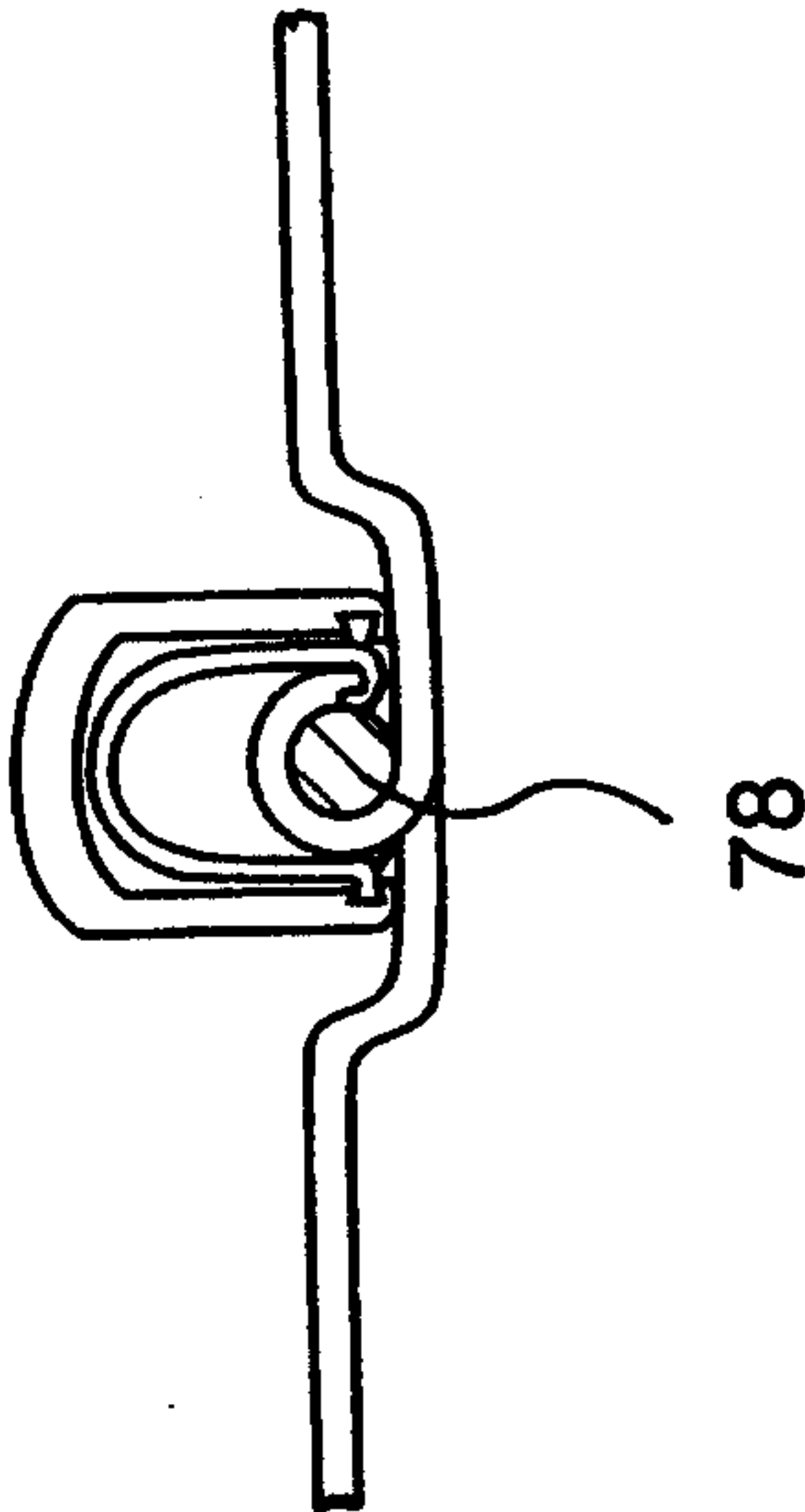


FIG. 19D

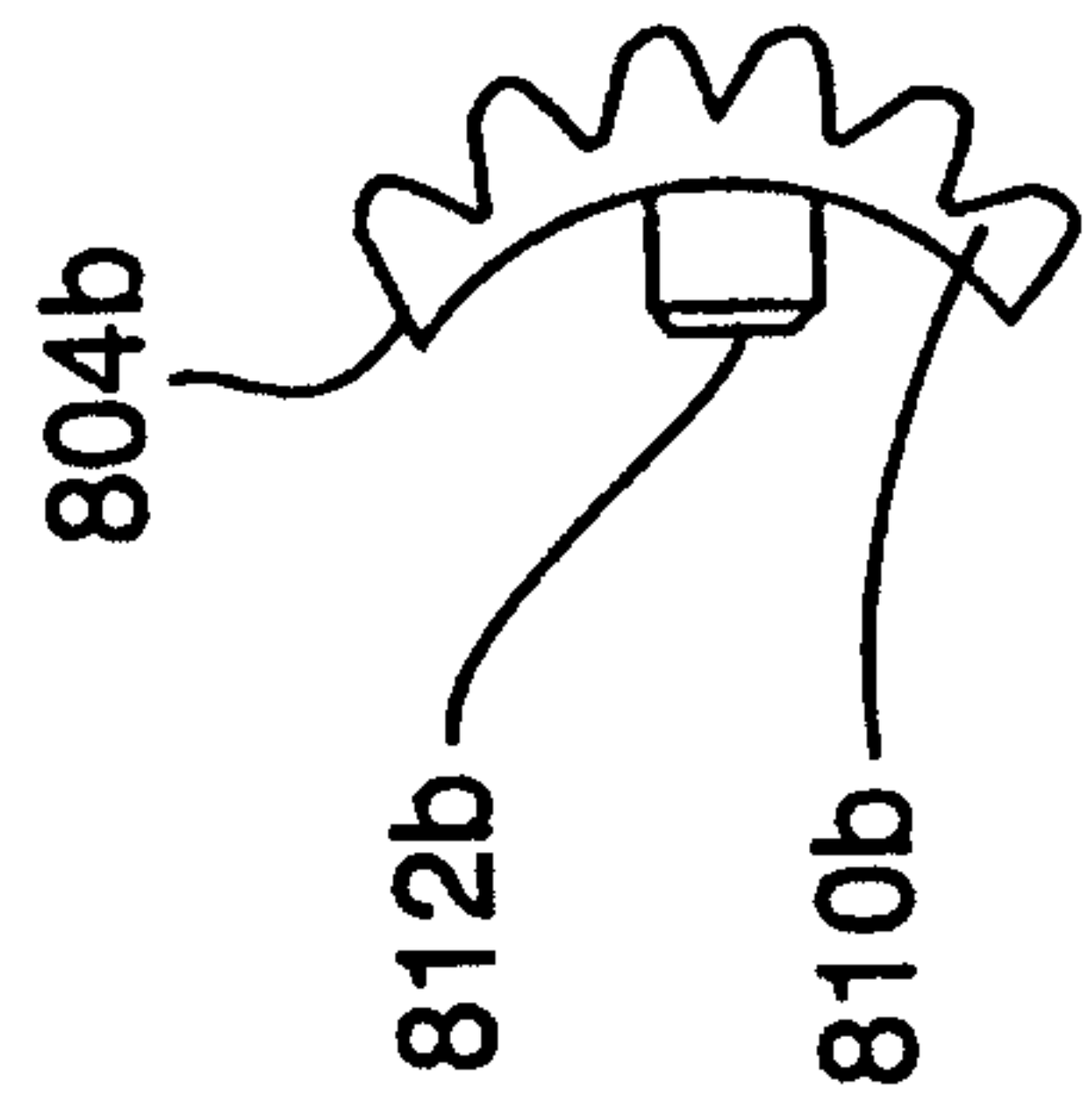


**FIG. 20A** 29/34

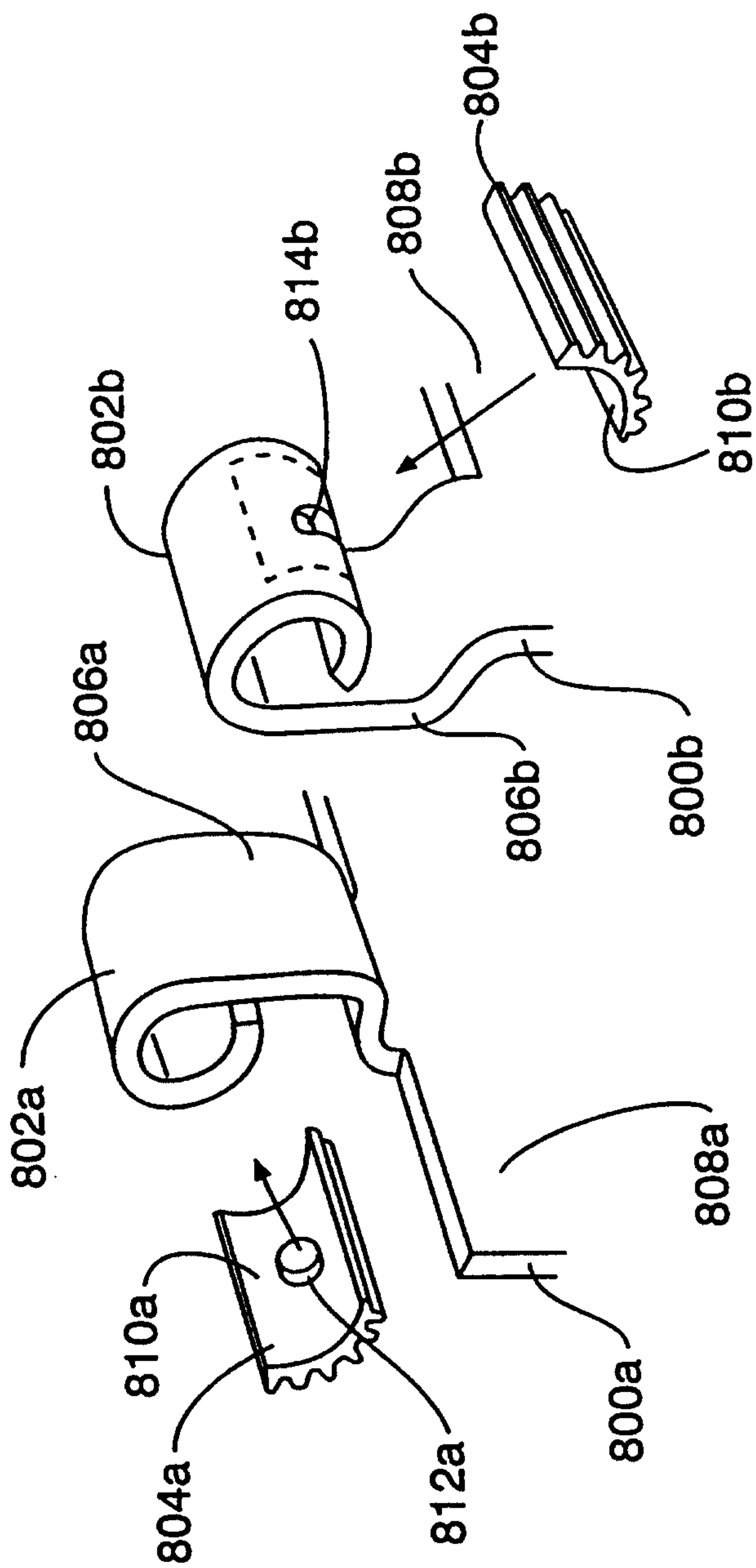


**FIG. 20**

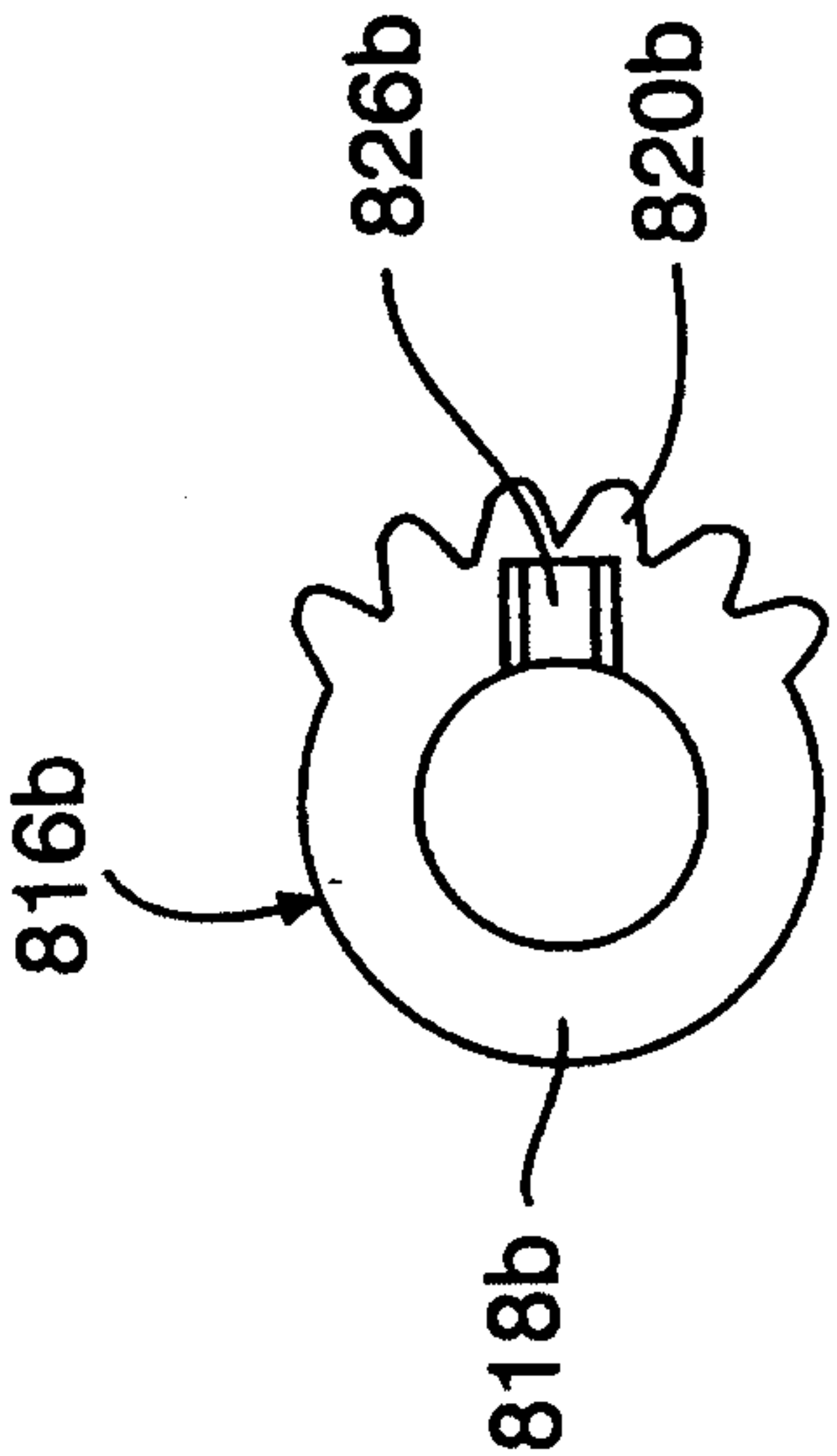


FIG. 21A

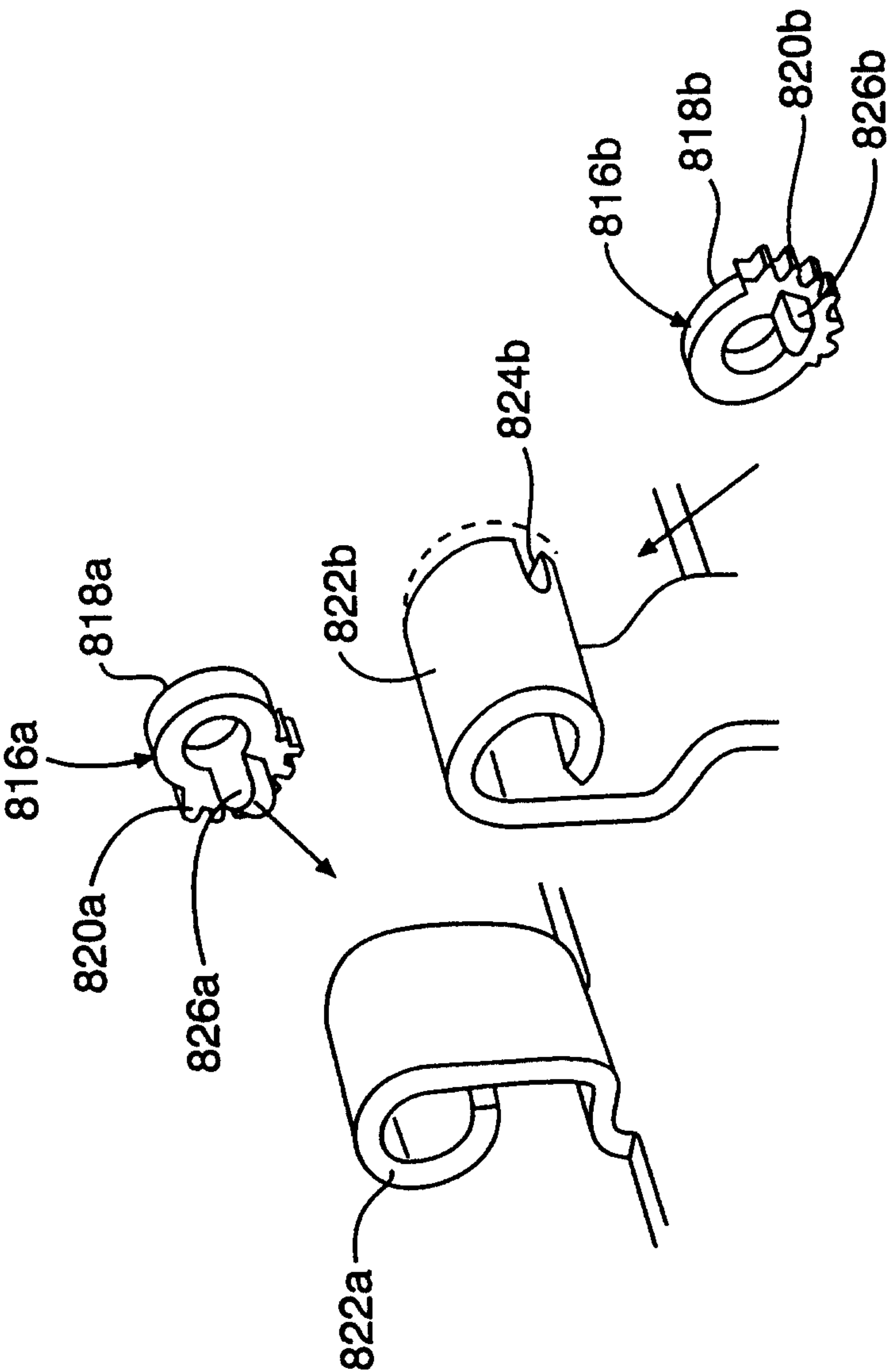


FIG. 21

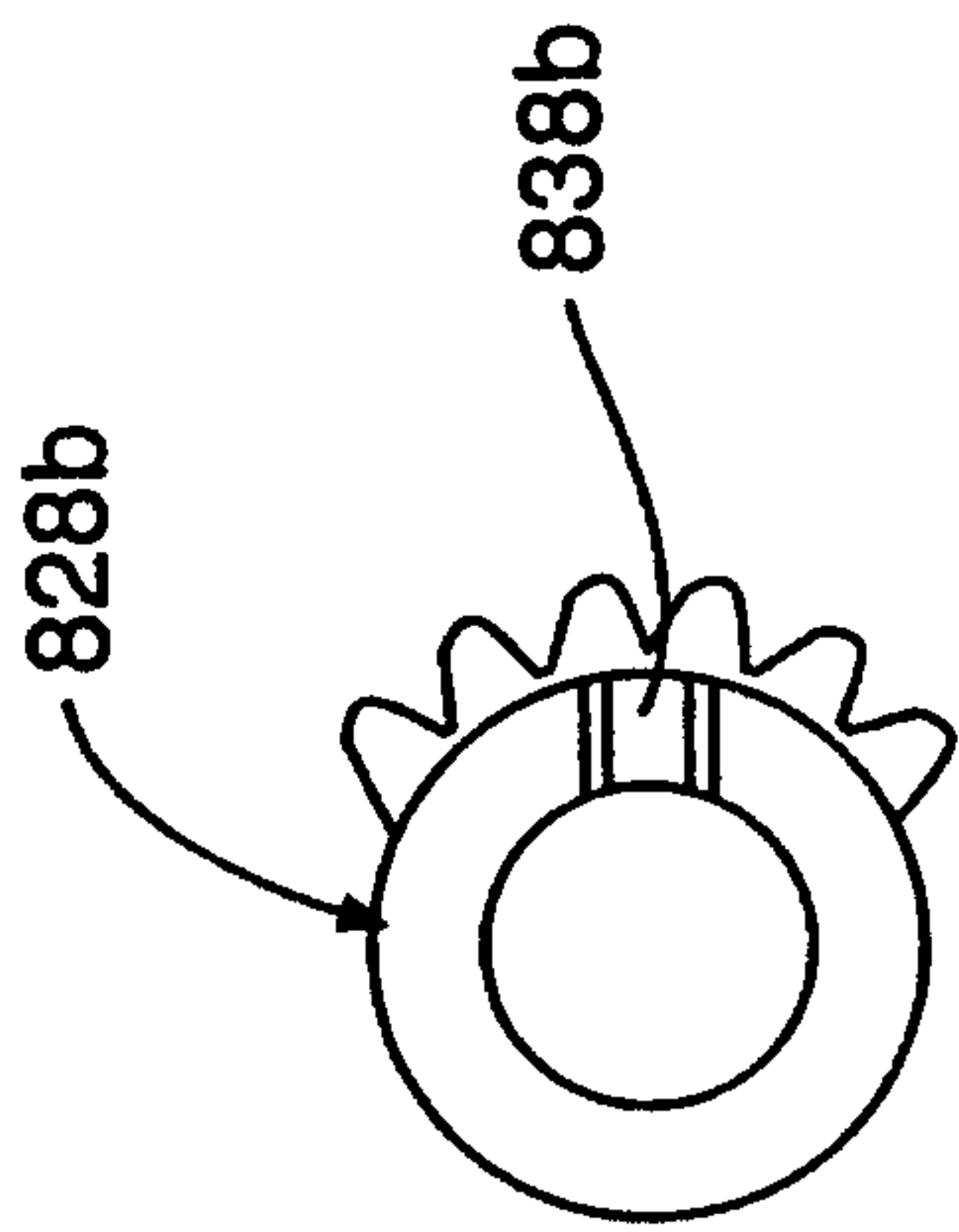


**FIG. 22A**

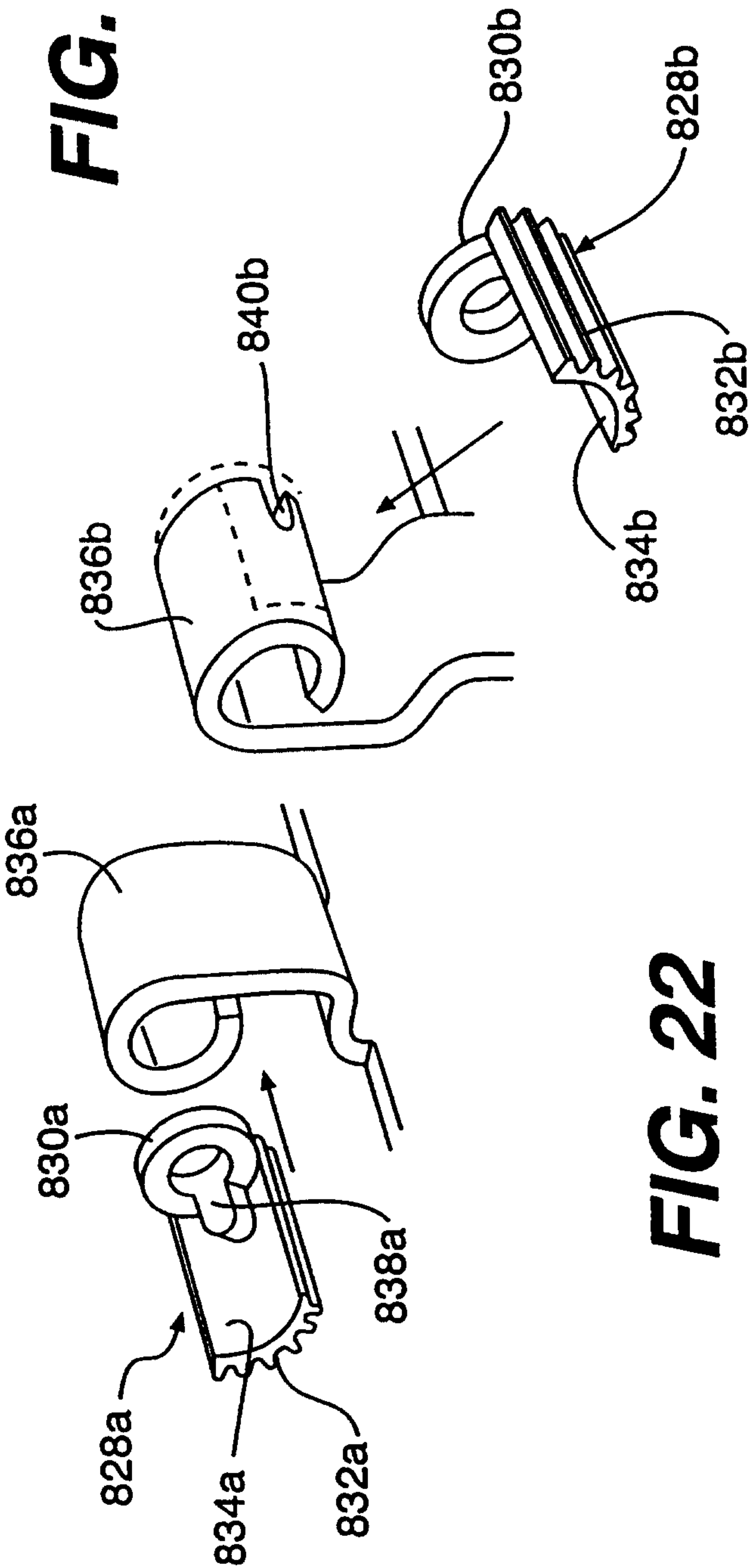
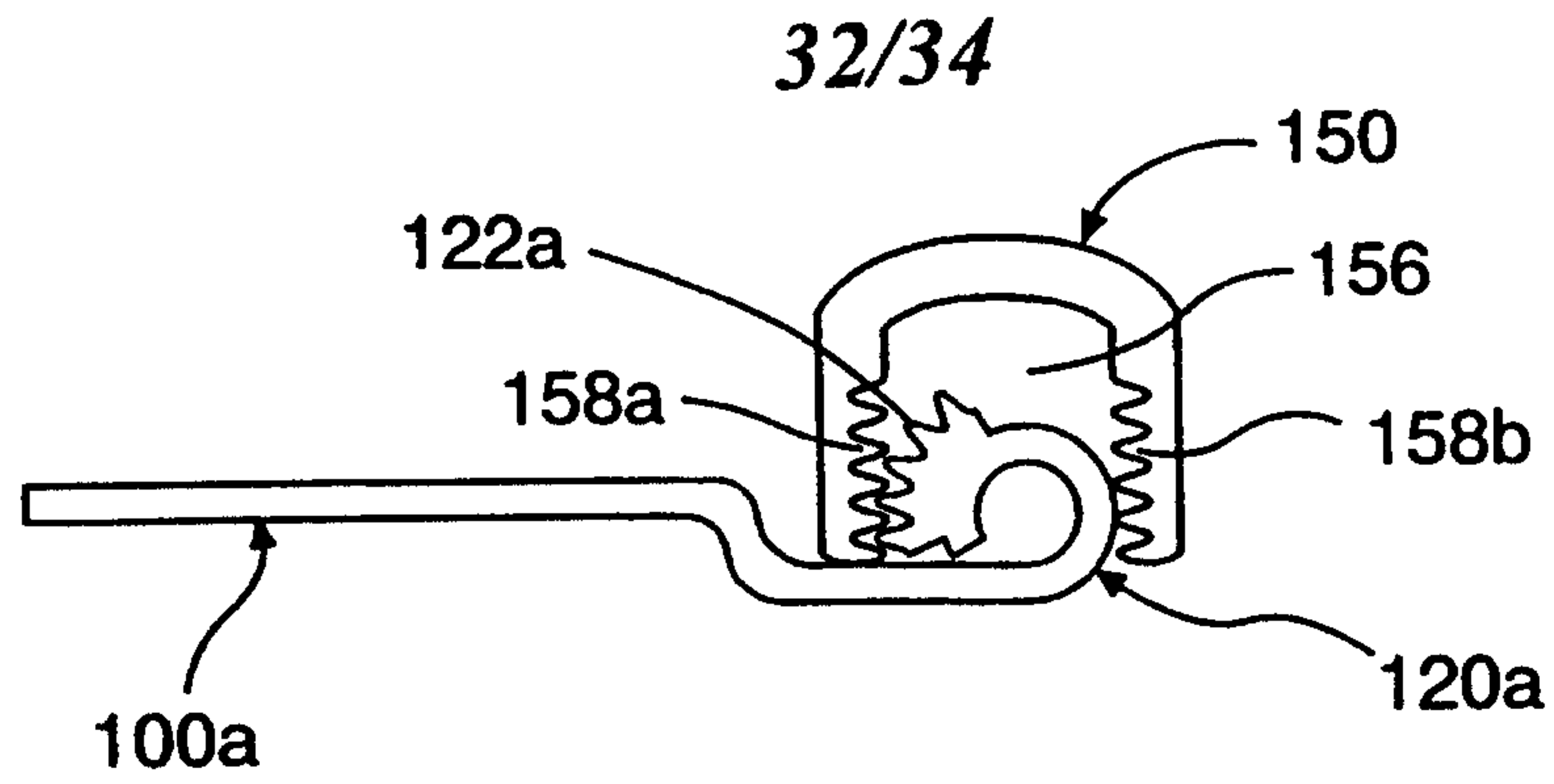
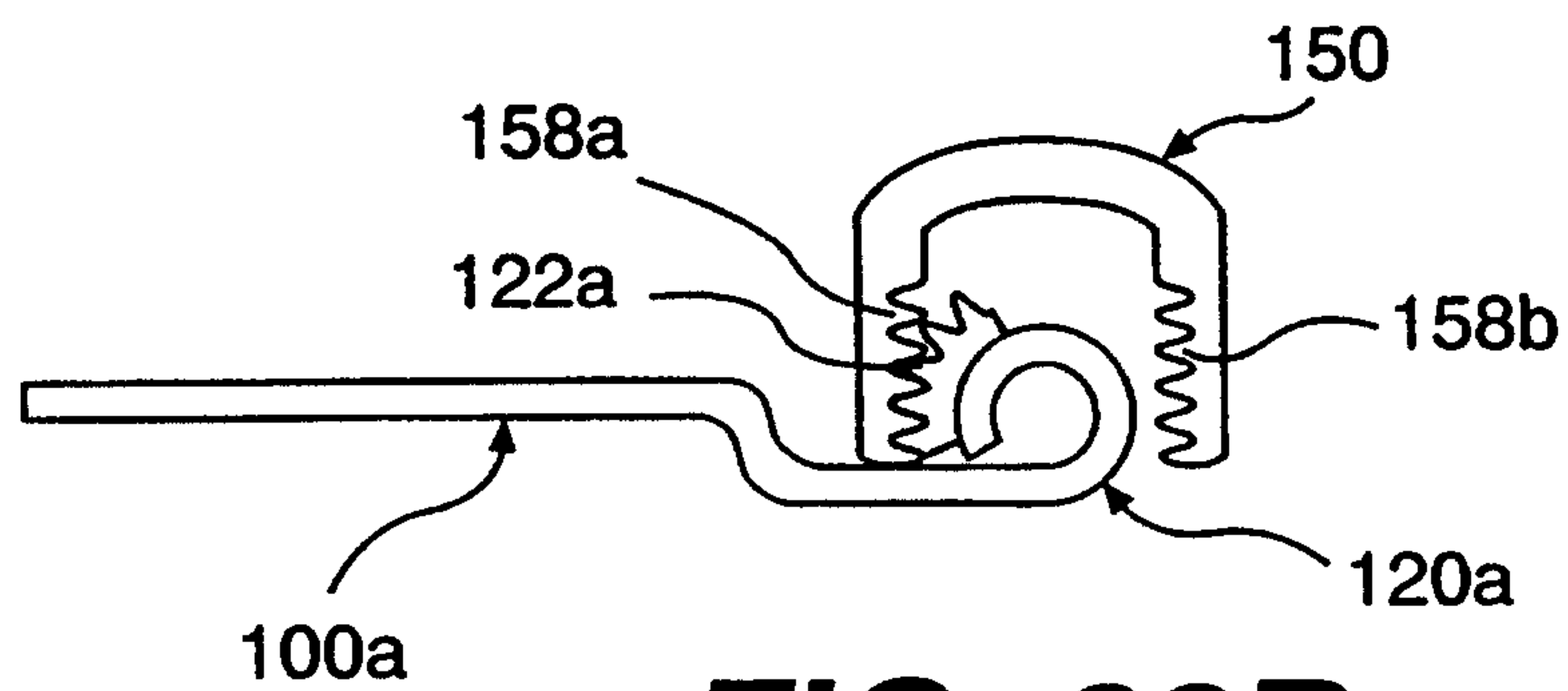
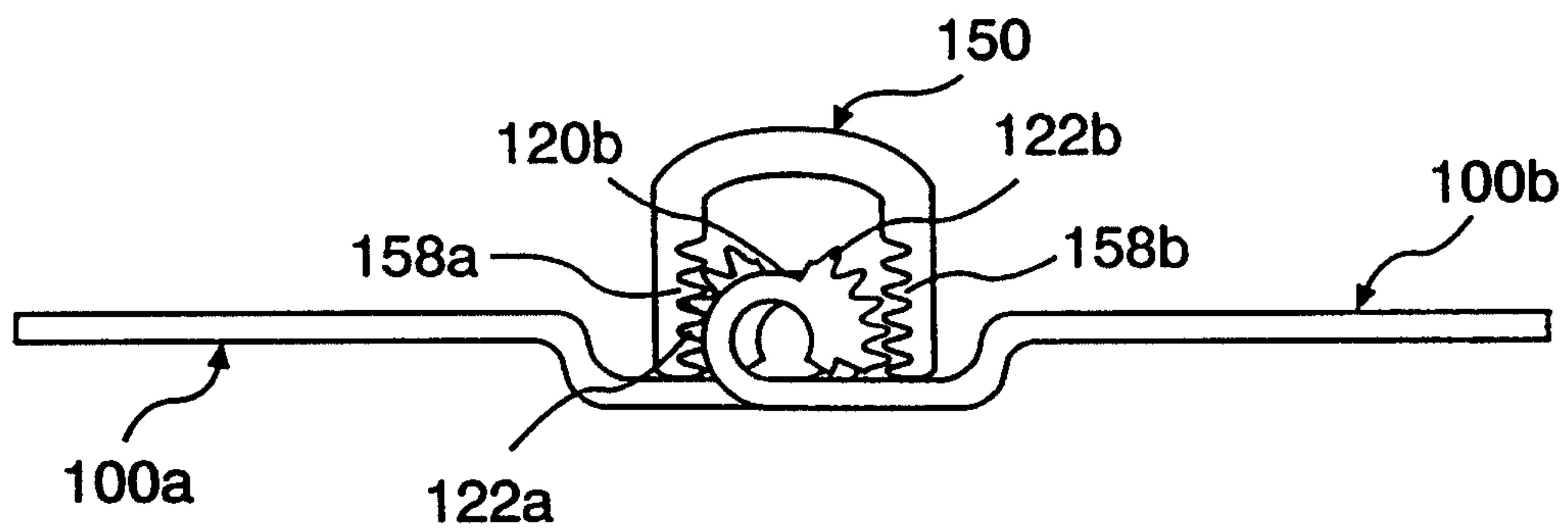
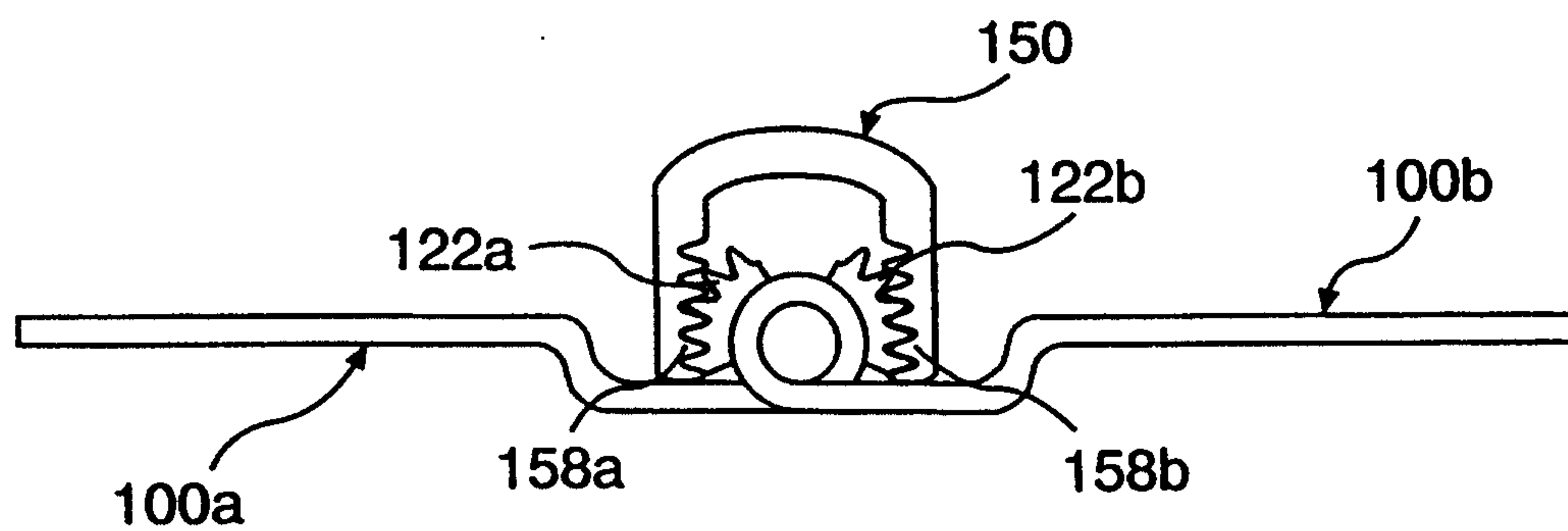


**FIG. 22**

**FIG. 23A****FIG. 23B****FIG. 23C****FIG. 23D**

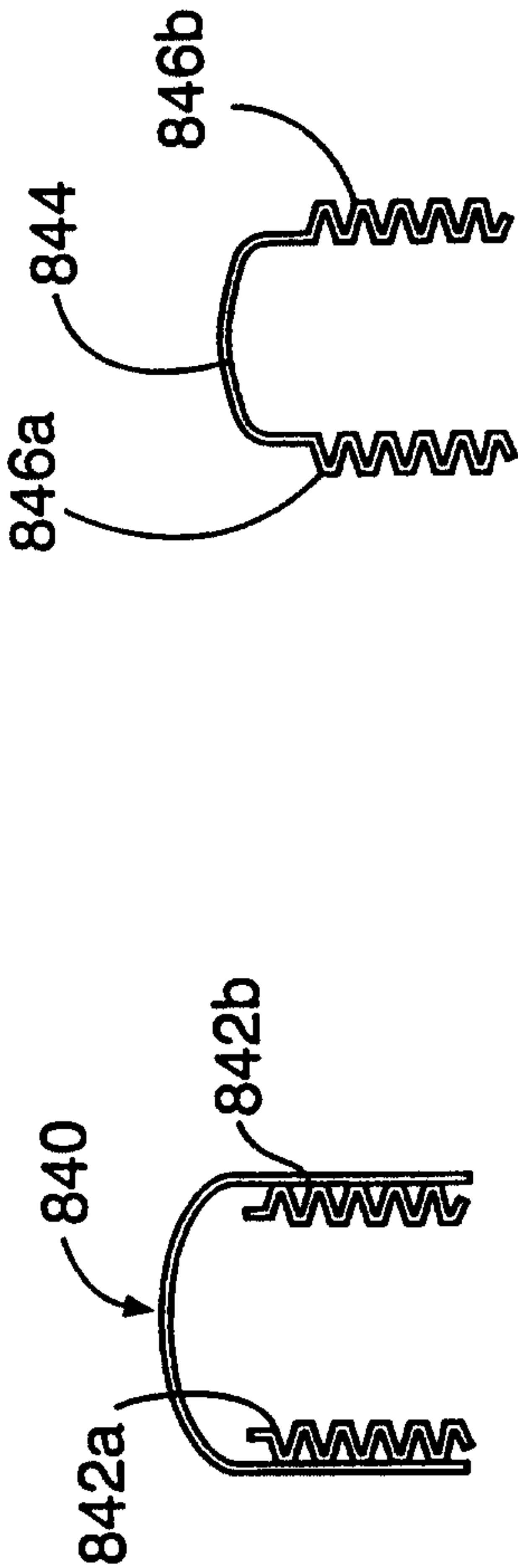


FIG. 24A

FIG. 24B

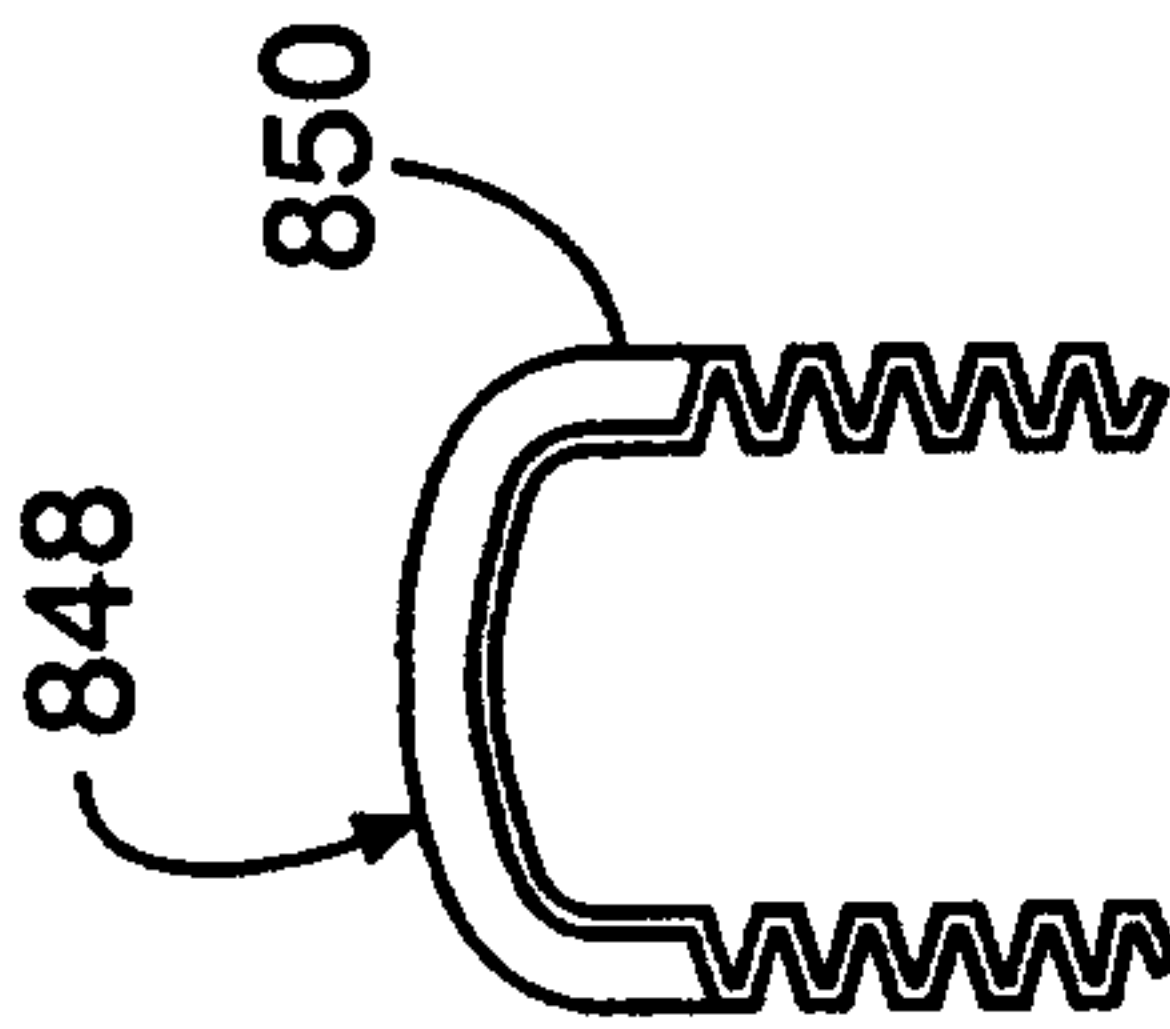


FIG. 24C

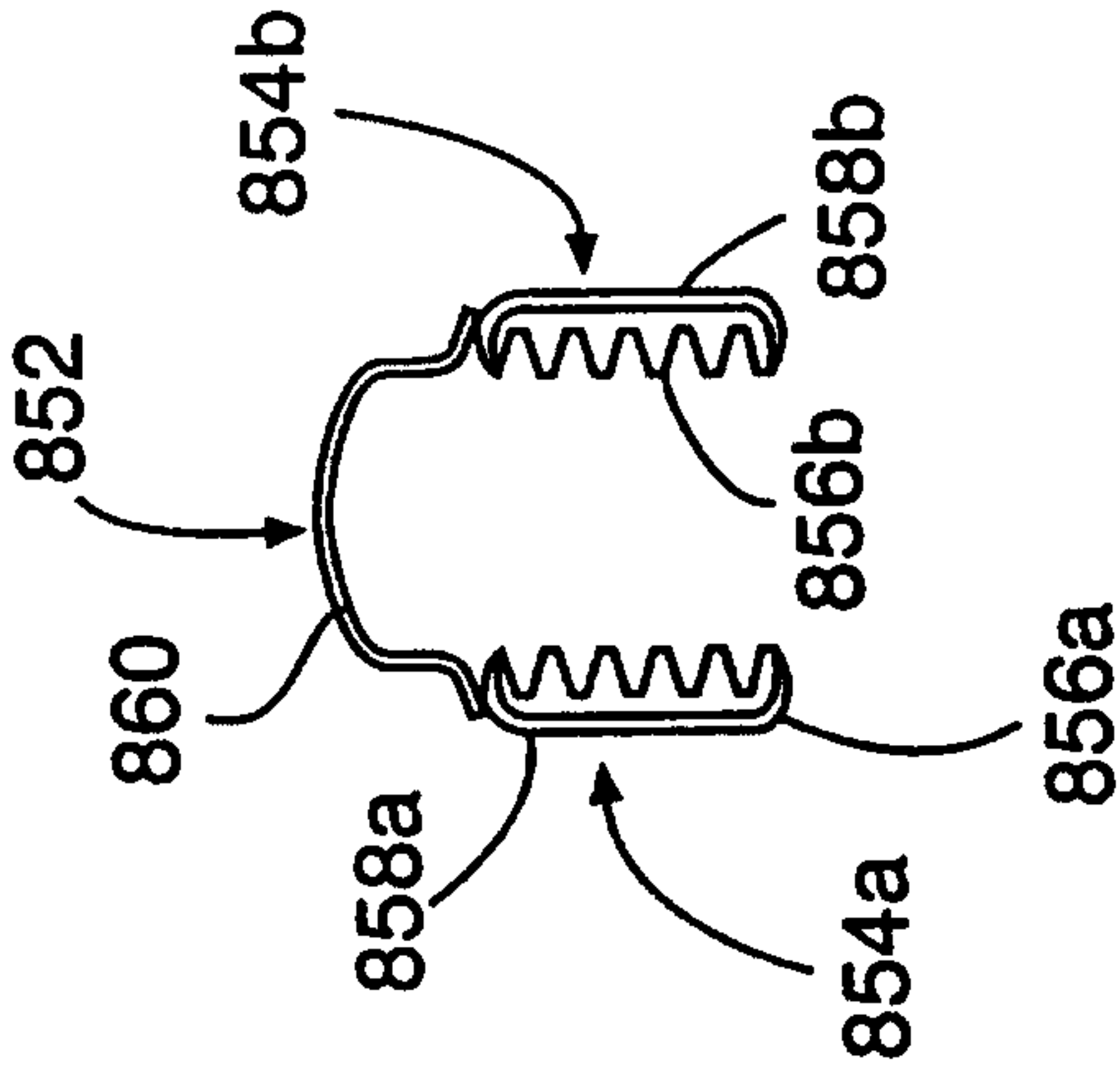


FIG. 24D

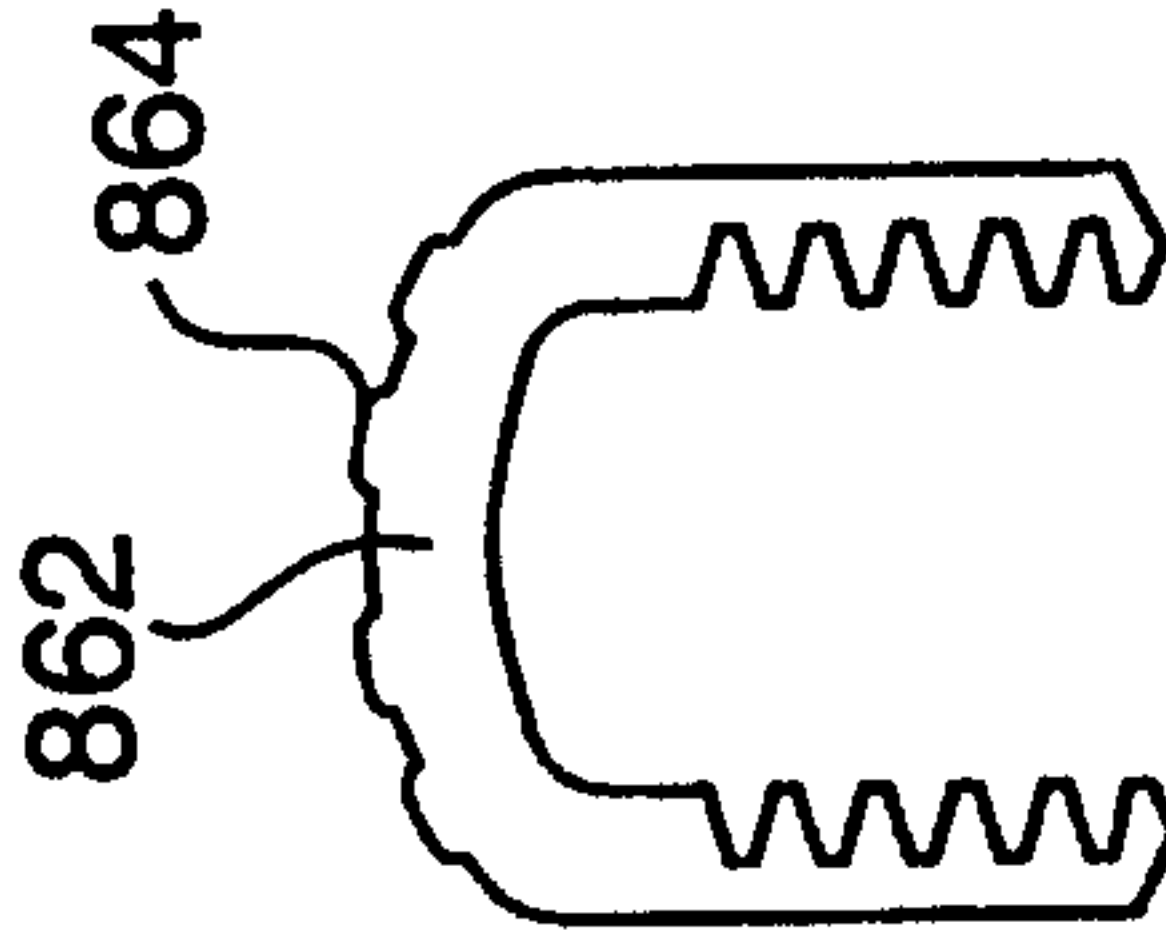
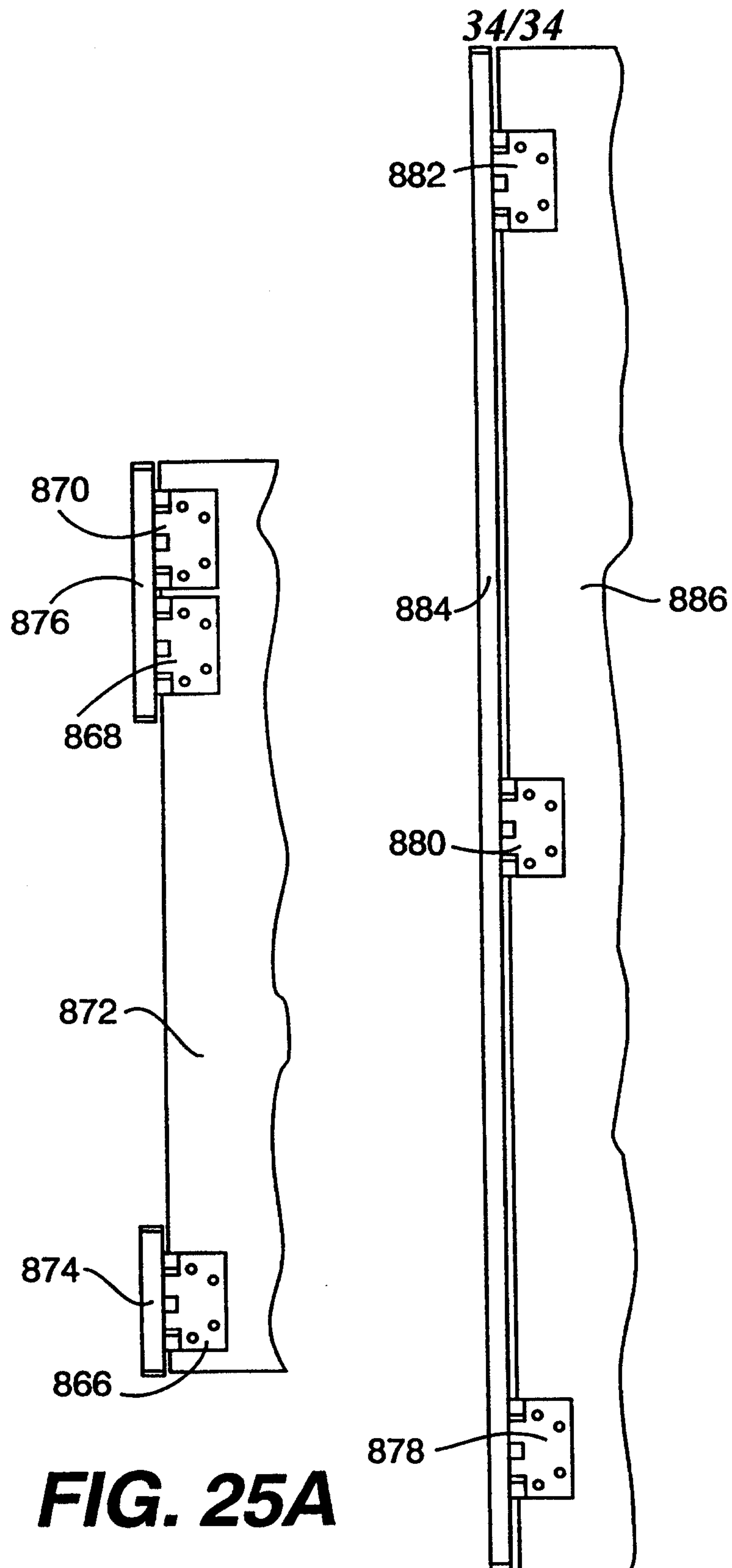
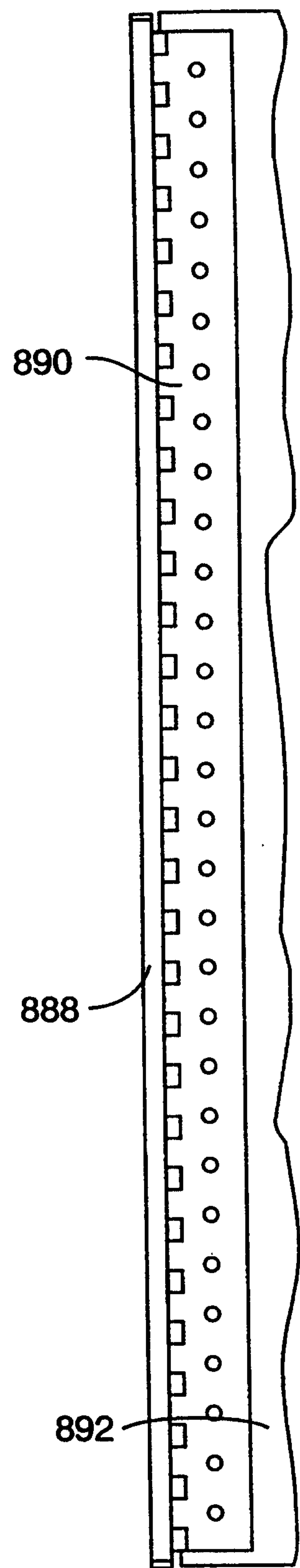


FIG. 24E

**FIG. 25A****FIG. 25B****FIG. 25C**