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Fradette et al.

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(45) **Date of Patent: *Mar. 17, 2020**

(54) **SIMPLIFIED AND IMPROVED THERMAL EFFICIENCY VACUUM FURNACE HOT ZONE WITH PREFABRICATED INSULATION ASSEMBLY**

USPC 266/114, 249, 250, 252, 208, 283, 286;
373/109, 110, 111, 112, 113, 114, 117,
373/118, 120, 122, 125, 128, 130, 132,
373/134, 137; 219/390, 408, 520, 532,
219/539, 541, 542, 552, 553

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See application file for complete search history.

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(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 231 days.

This patent is subject to a terminal disclaimer.

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(65) **Prior Publication Data**

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(57) **ABSTRACT**

Abstract text is present but illegible due to heavy redaction.

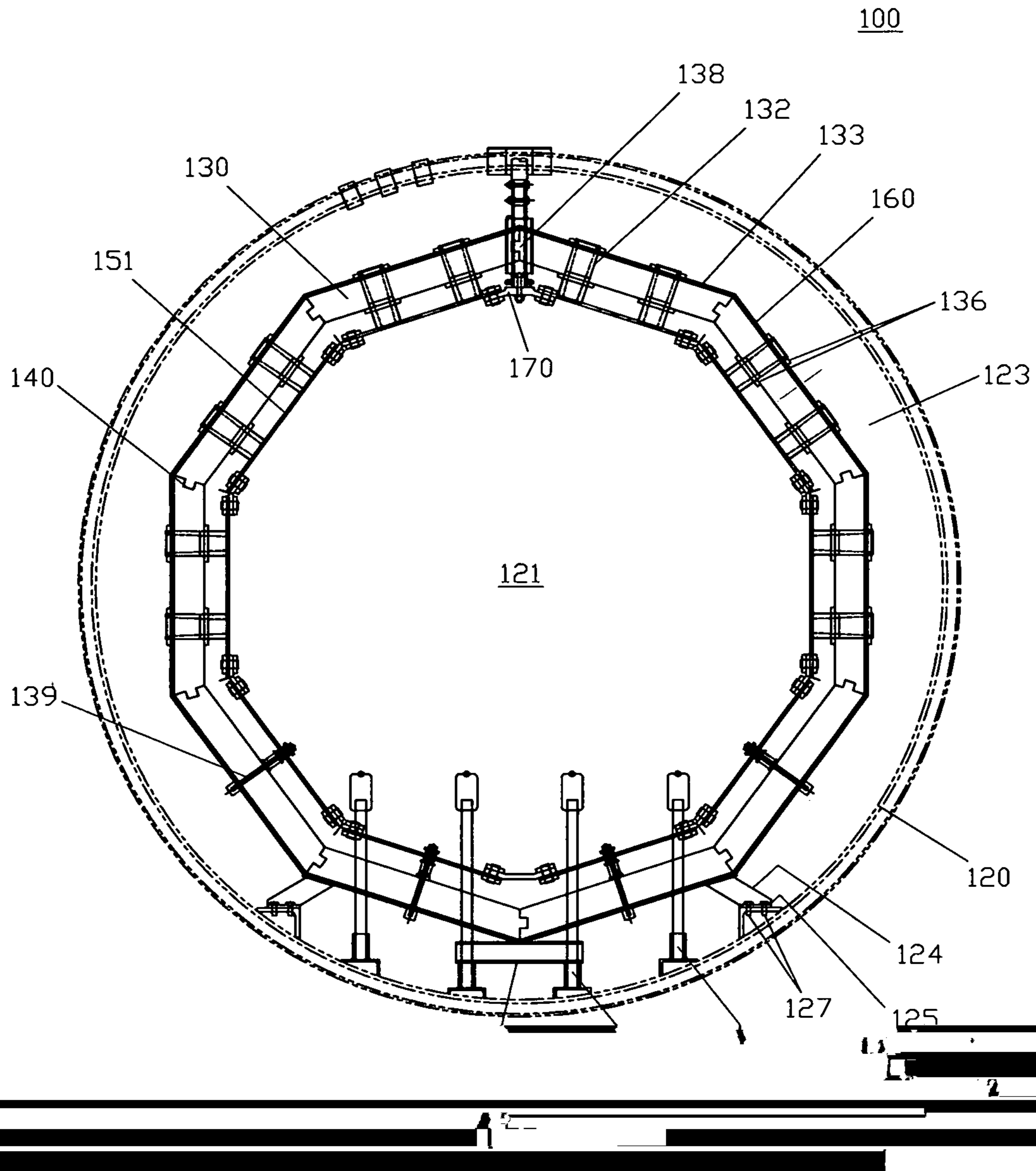
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- (51) **Int. Cl.**
F27D 7/06 (2006.01)
F27D 9/00 (2006.01)
F27D 11/02 (2006.01)

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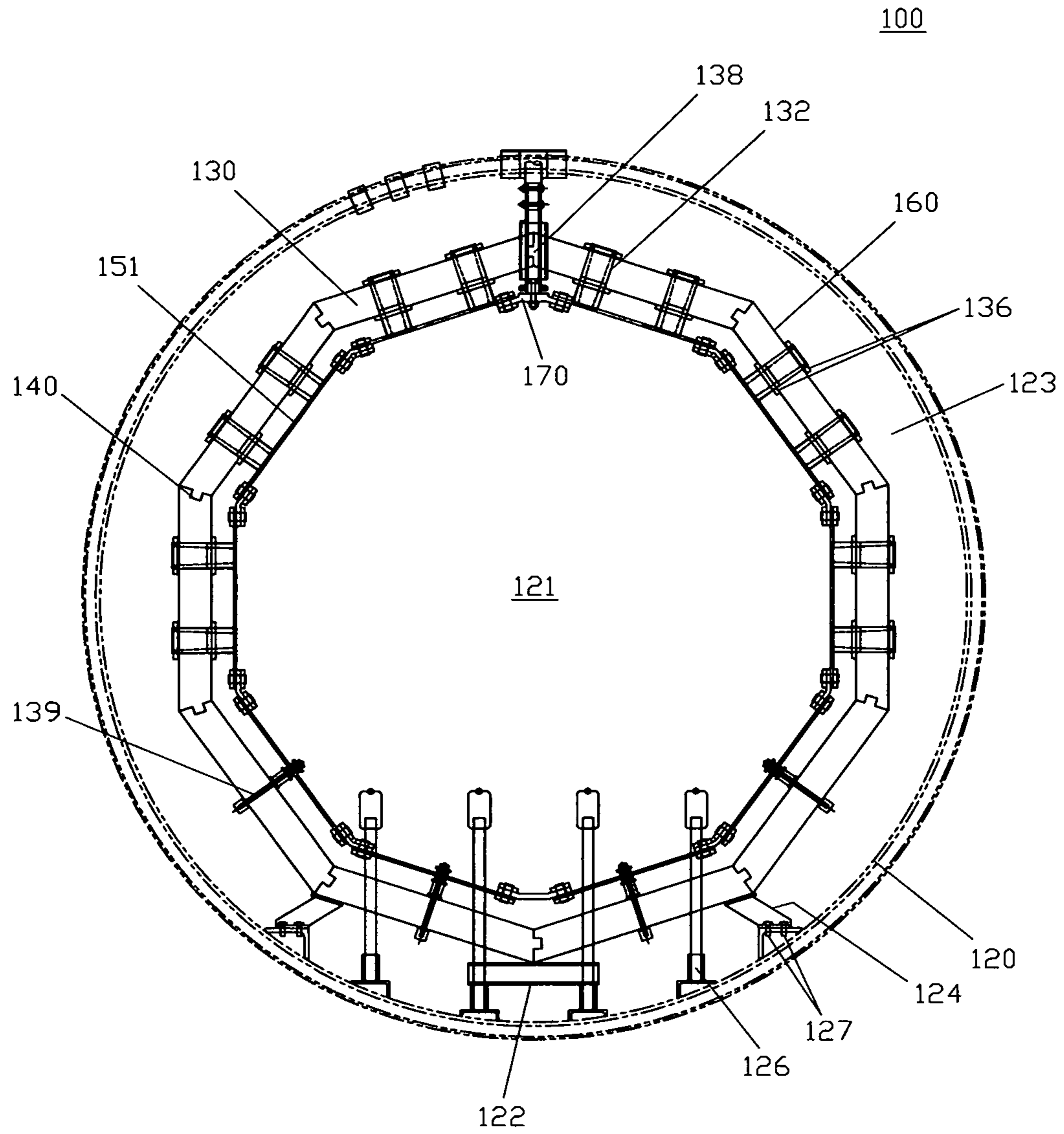
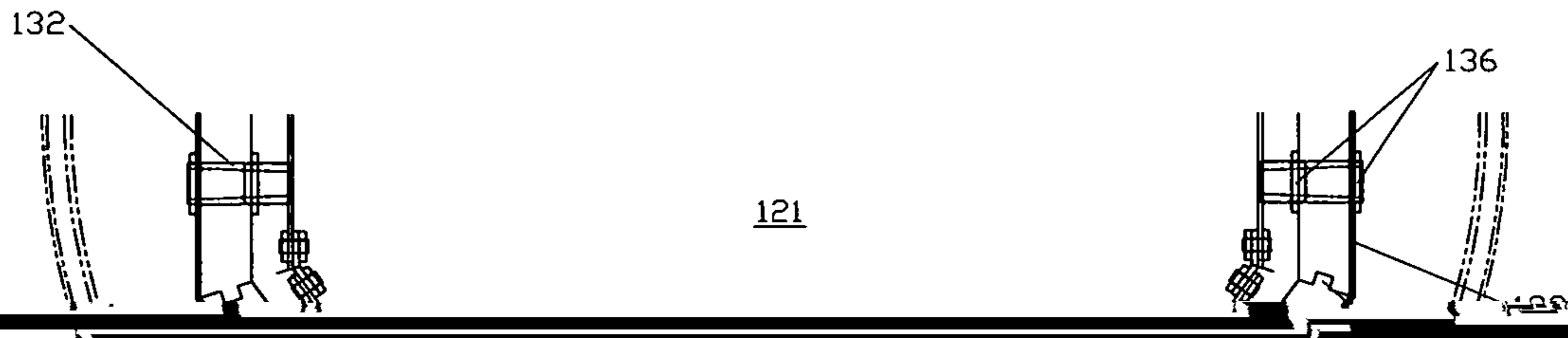


FIG. 2



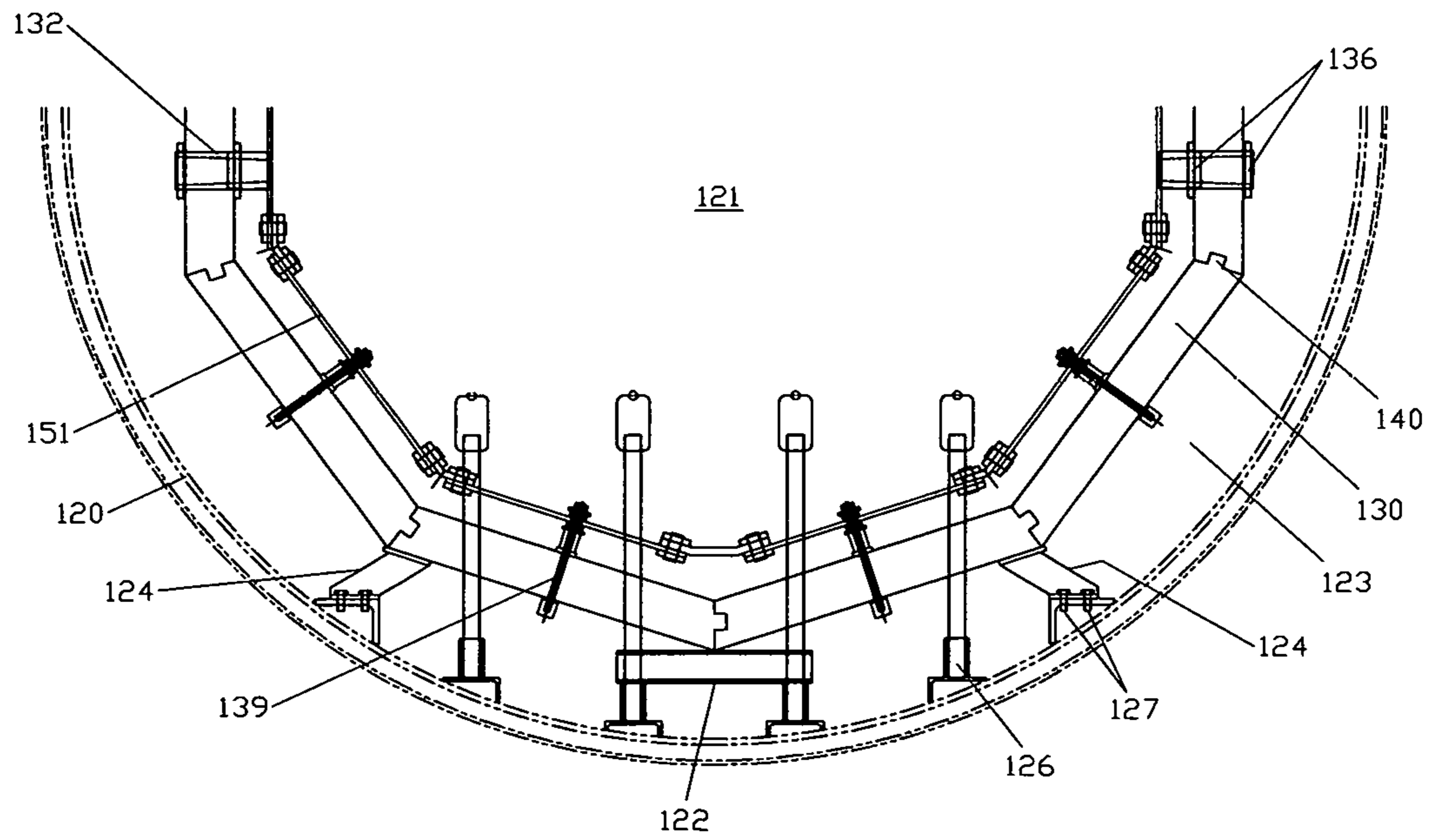


FIG. 4

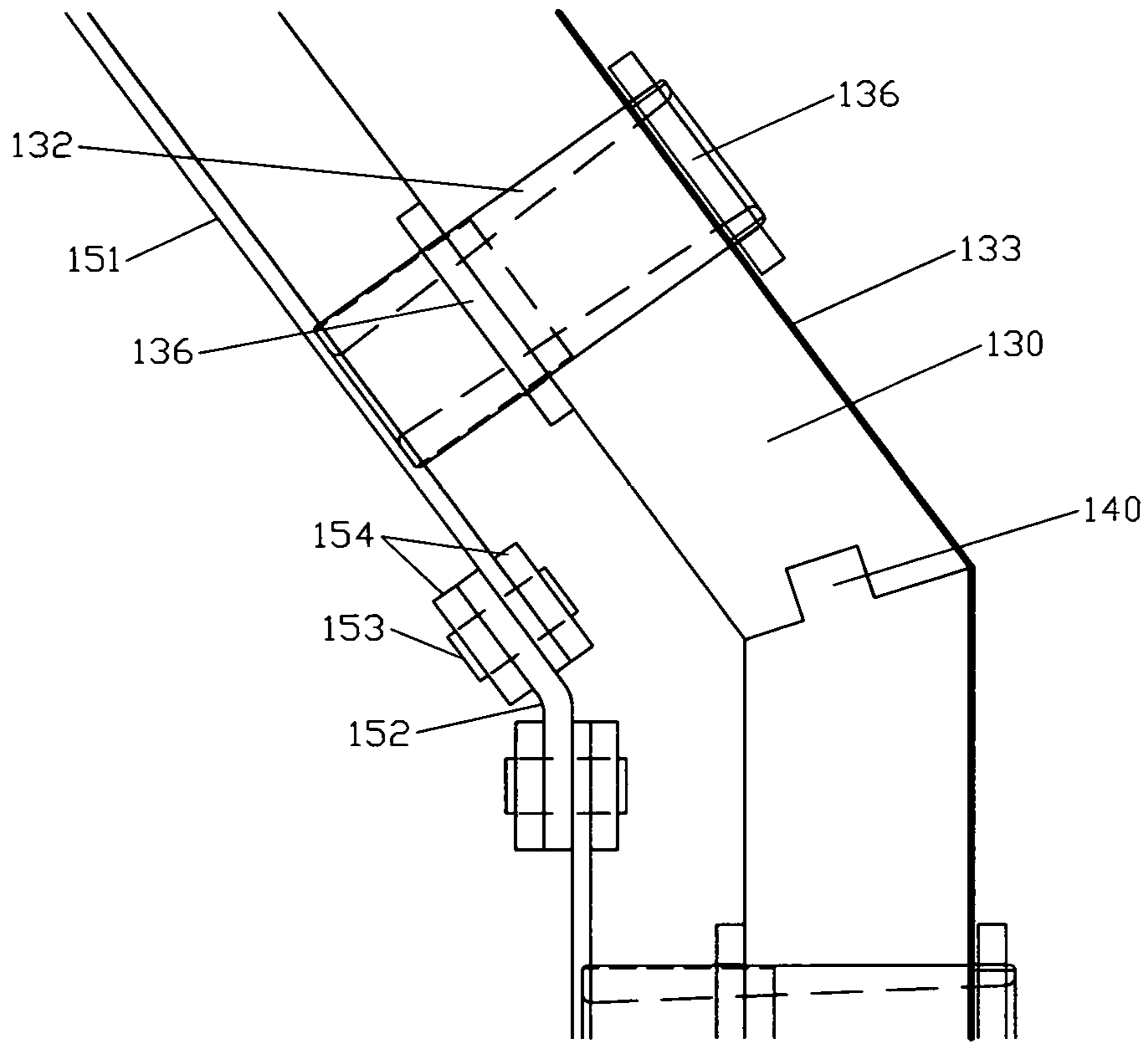


FIG. 5A

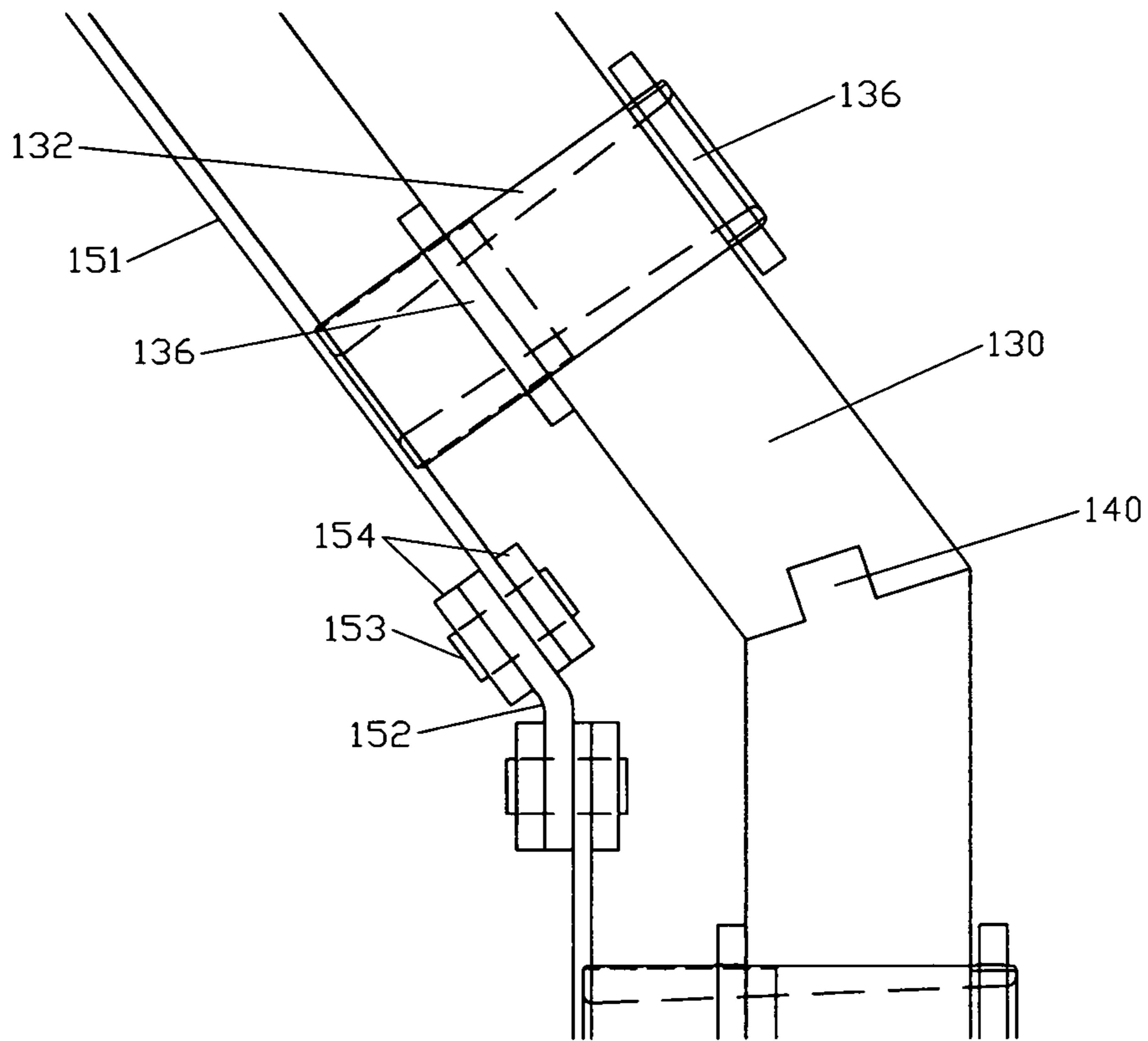


FIG. 5B

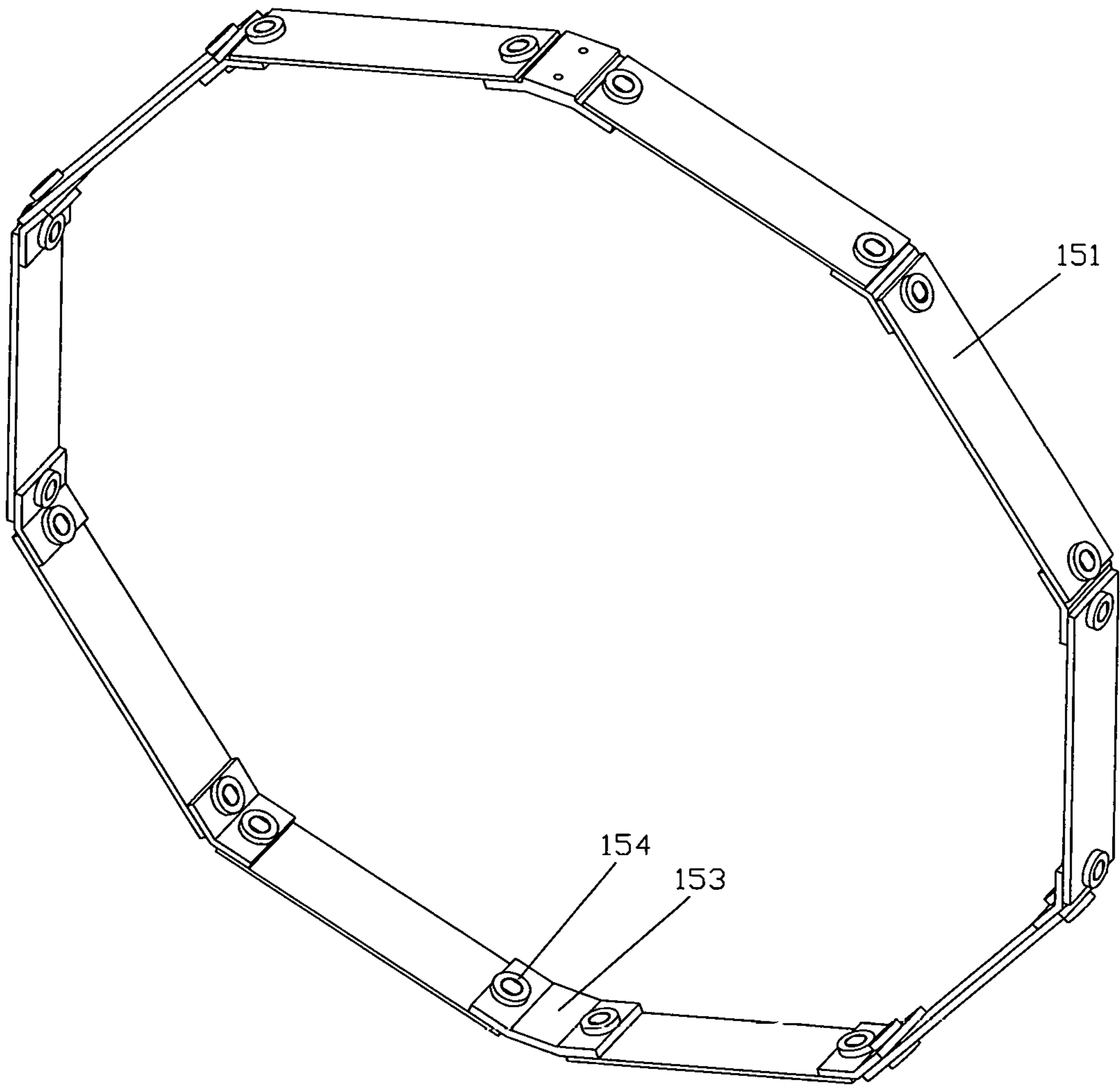
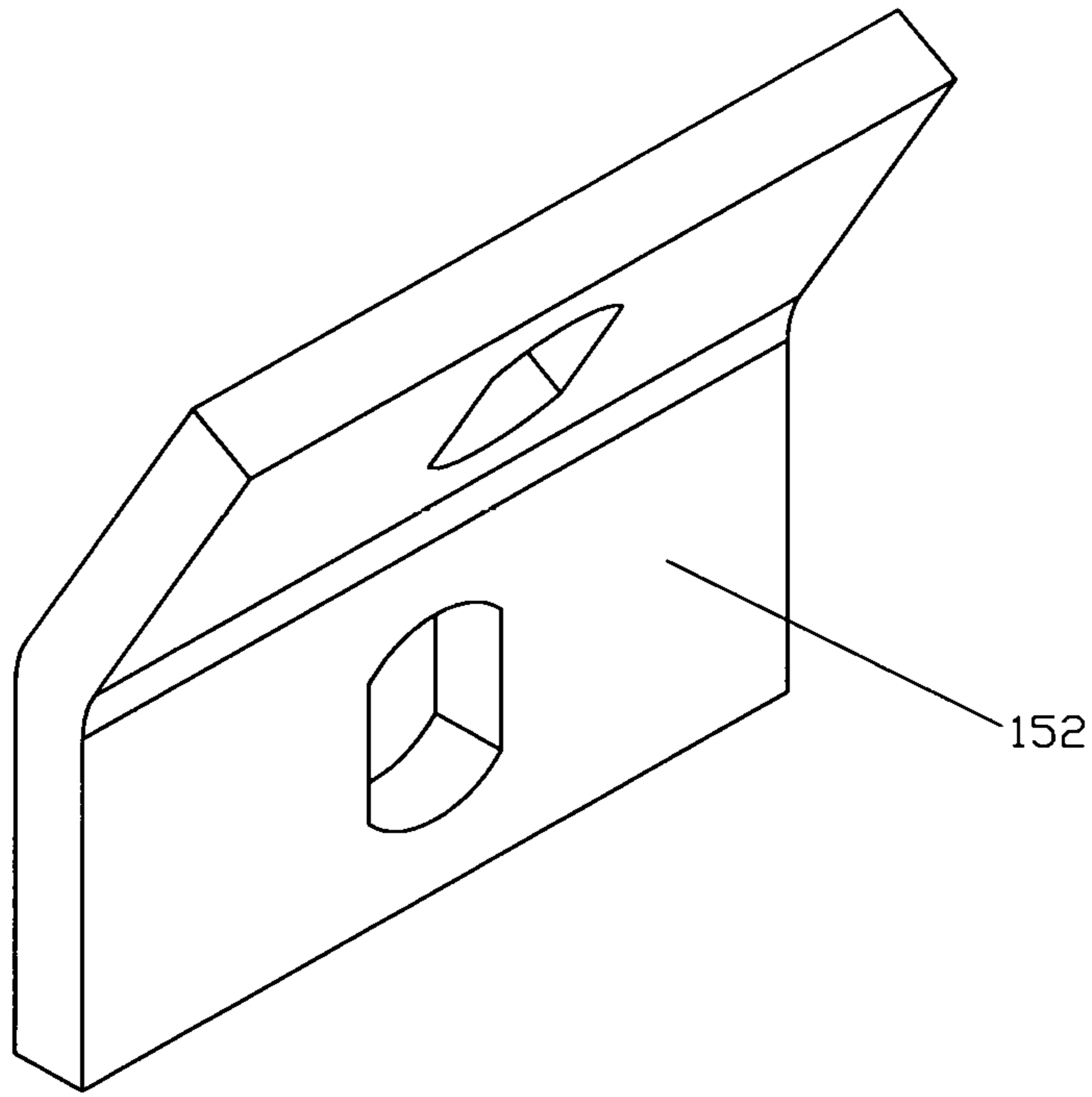


FIG. 6



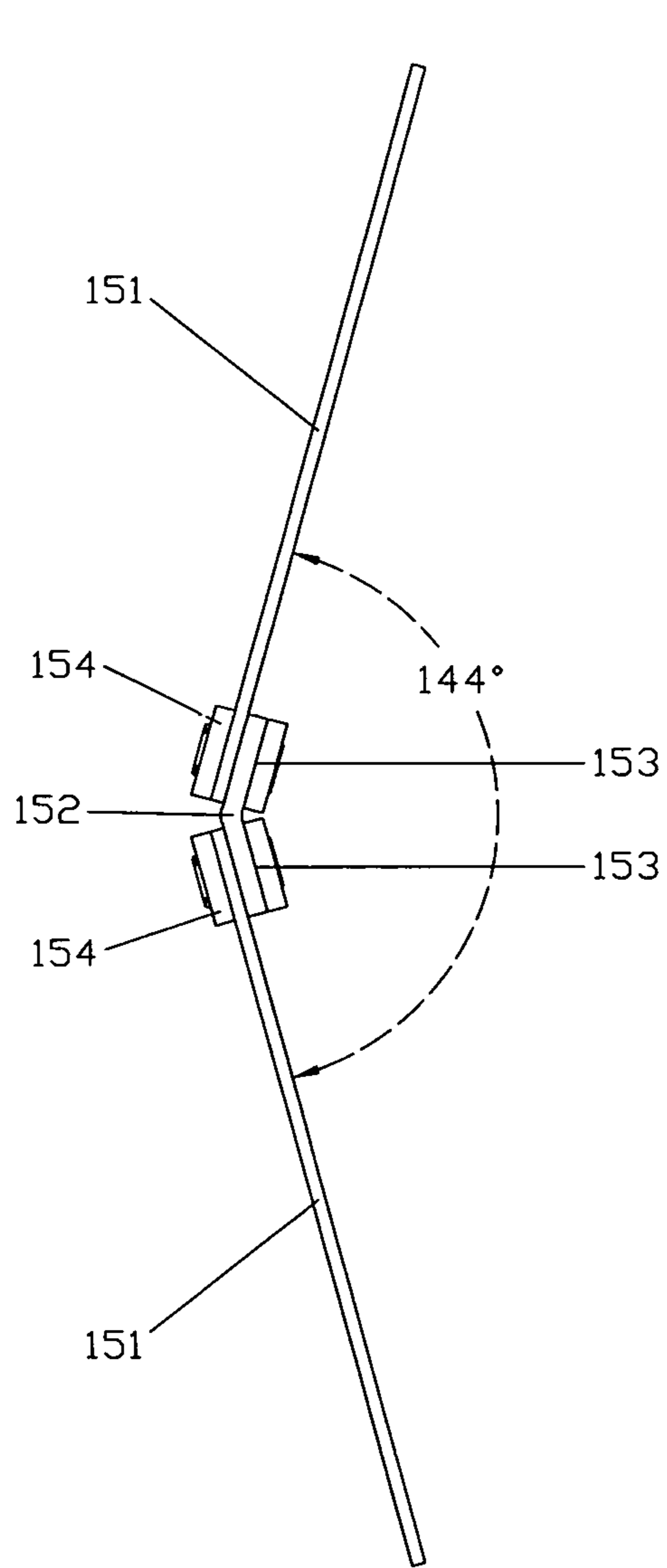


FIG. 8A

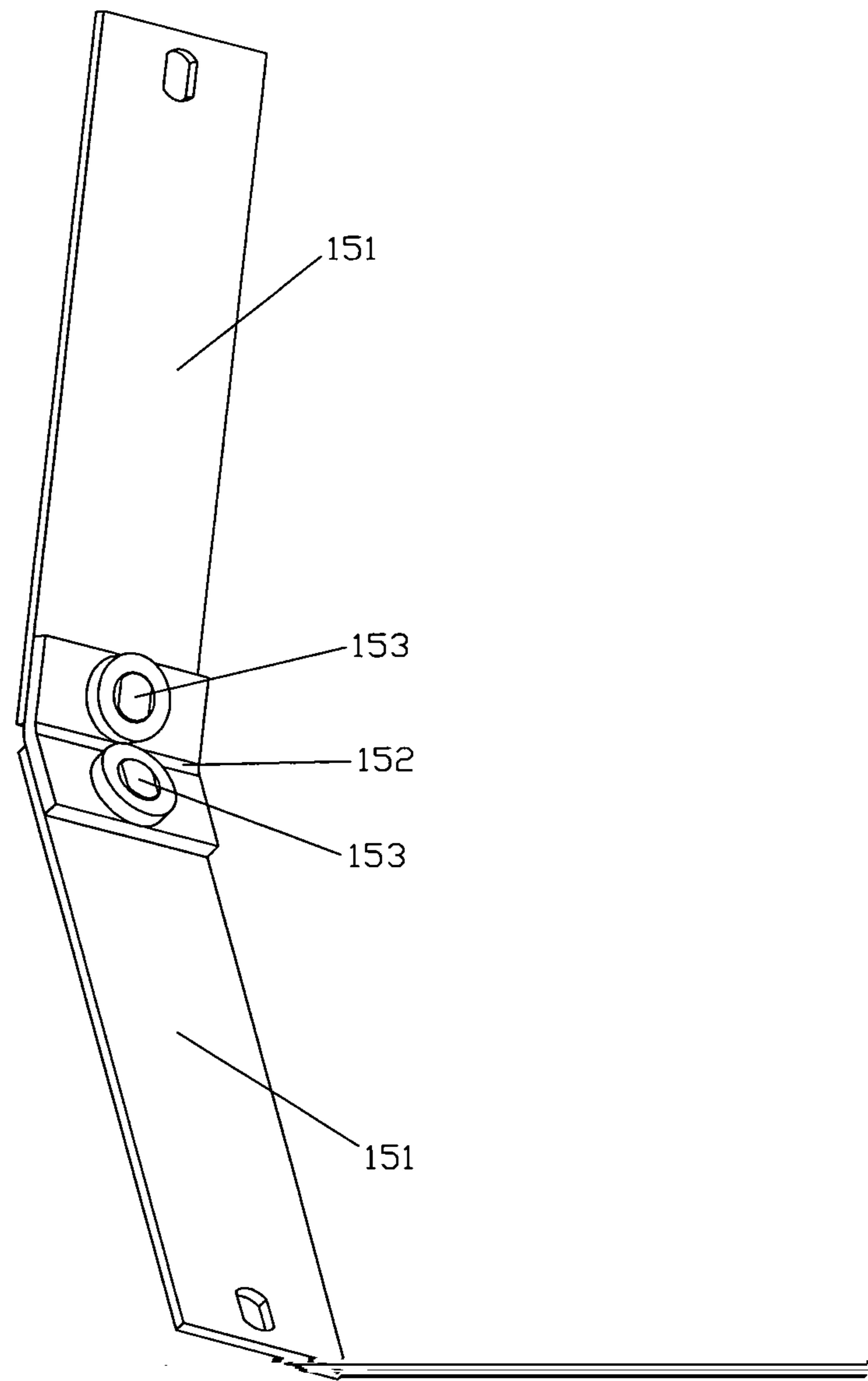


FIG. 8B

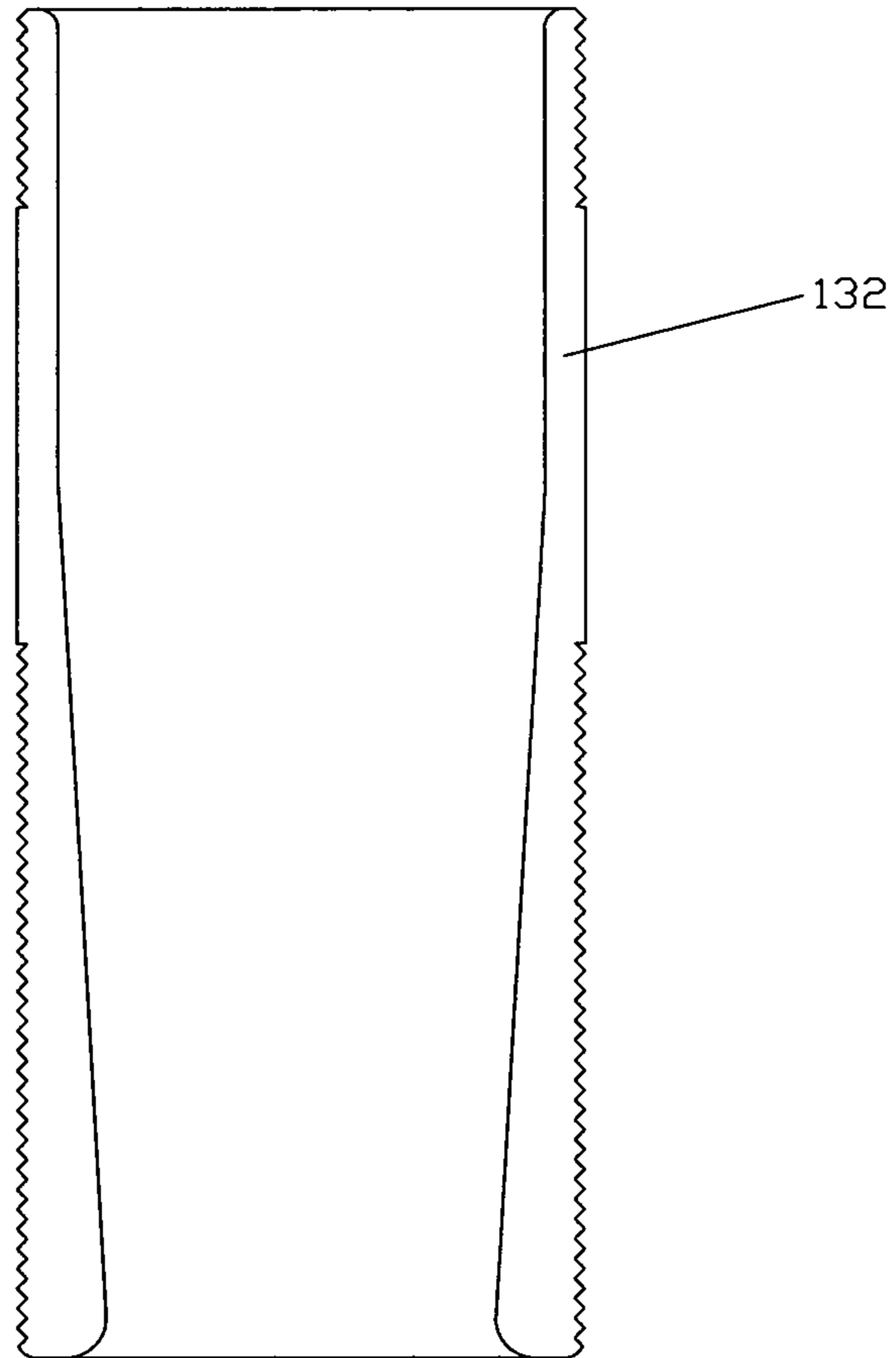


FIG. 9

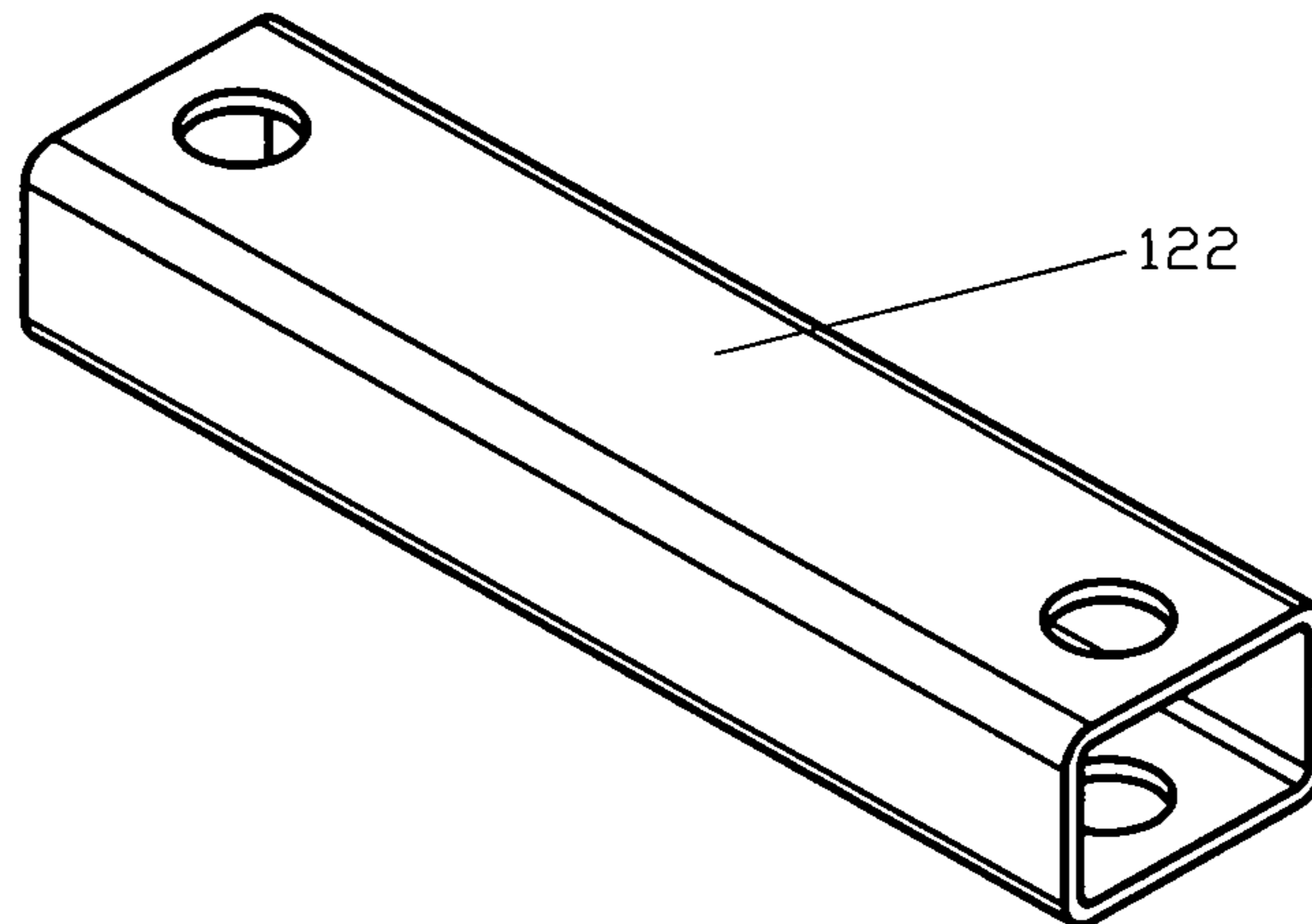
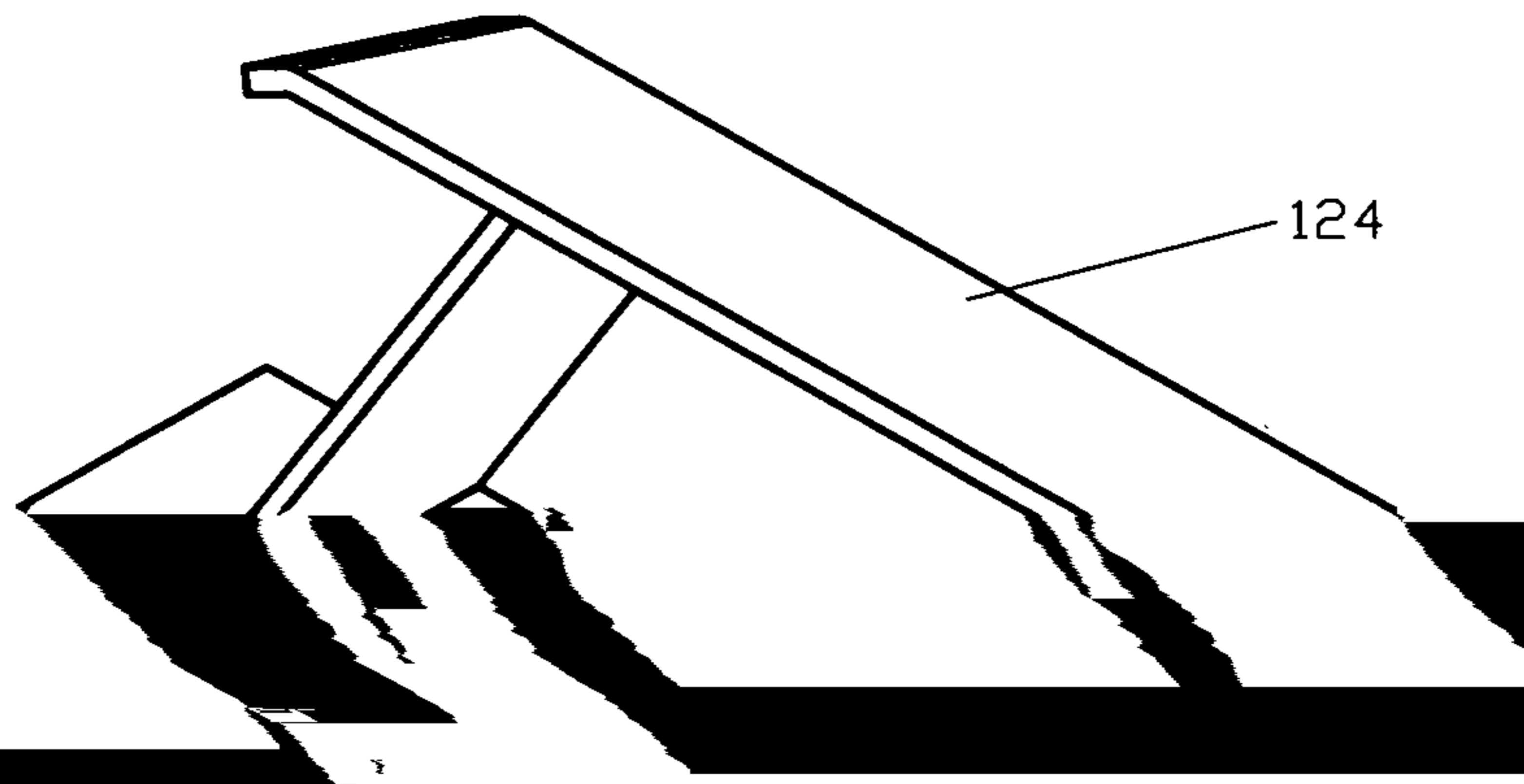


FIG. 10A



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**SIMPLIFIED AND IMPROVED THERMAL
EFFICIENCY VACUUM FURNACE HOT**

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cation Ser. No. 15/330,396. The outer wall support ring
typically is fabricated as a stainless steel or carbon steel ring

**ZONE WITH PREFABRICATED
INSULATION ASSEMBLY**

FIELD OF THE INVENTION

This invention relates to high temperature vacuum heat
treating furnace hot zones that include electric resistance

and is situated and isolated within a water-cooled chamber.
The inner insulating wall typically is fabricated with all
5 metal radiation shields or a combination of graphite felt and
foil, or rigidized graphite board. In one instance described in
U.S. Pat. No. 4,489,920, and in U.S. patent application Ser.
No. 15/330,396, a standard, fully enclosed stainless steel
support ring is utilized to support the insulation ring package

said insulation board means being connected at one longitudinal edge thereof to an adjacent board means by a tongue-and-groove connection to form a continuous assembly around said hot zone, and each one of said insulation board means engaging the adjacent insulation board means

heating element segments, as shown in FIG. 6.

FIG. 9 is a cross-sectional view of a lower mass, streamlined gas-cooling nozzle.

FIG. 10A is an isometric view of one side of the support structure for supporting the insulation board assembly, as shown in FIG. 1.

[The main body of the page is redacted with thick black horizontal bars.]

FIG. 15 is a cross-sectional view of the hot zone assembly of FIG. 14, taken along line 15-15 of FIG. 14, showing the hot zone assembly in a second configuration. The hot zone assembly includes a hot zone 150, a hot zone support 152, and a hot zone cover 154. The hot zone 150 is supported by the hot zone support 152, and the hot zone cover 154 is positioned over the hot zone 150. The hot zone support 152 is supported by a base 156. The hot zone cover 154 is supported by a top plate 158. The hot zone 150 is supported by the hot zone support 152, and the hot zone cover 154 is positioned over the hot zone 150. The hot zone support 152 is supported by a base 156. The hot zone cover 154 is supported by a top plate 158.

FIG. 16 is a cross-sectional view of the hot zone assembly of FIG. 14, taken along line 16-16 of FIG. 14, showing the hot zone assembly in a third configuration. The hot zone assembly includes a hot zone 160, a hot zone support 162, and a hot zone cover 164. The hot zone 160 is supported by the hot zone support 162, and the hot zone cover 164 is positioned over the hot zone 160. The hot zone support 162 is supported by a base 166. The hot zone cover 164 is supported by a top plate 168. The hot zone 160 is supported by the hot zone support 162, and the hot zone cover 164 is positioned over the hot zone 160. The hot zone support 162 is supported by a base 166. The hot zone cover 164 is supported by a top plate 168.

Temperature Comparisons of Outer Wall of the Hot Zone

thereof to an adjacent board means by a tongue-and-groove means being operatively connected at one end thereof to an

zone, and each one of said insulation board means engaging another end thereof through said outer surface of a third one

inner wall formed by a plurality of high density, high strength, low conductivity, and low moisture-sensitive graphite insulation board means, each one of said insulation board means being connected at one longitudinal edge thereof to an adjacent board means by a tongue-and-groove connection to form a continuous assembly around said hot

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accordance with claim 23 wherein said hot zone further comprises power terminal means for supplying electrical power to said heating element means, said power terminal means being operatively connected at one end thereof to an outer wall of the furnace and being operatively connected at another end thereof through said outer surface of a third one

providing faster pump down rates, deeper vacuum levels,
and reduced cycle times with less energy consumption
during a heat treating cycle.

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