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**Fradette et al.**

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(54) **HIGH TEMPERATURE VACUUM FURNACE**

F27D 7/06; F27D 2007/066; F27D

**EFFICIENCY**

1/008; B23K 3/08; B23K 3/087; H05B 3/06; H05B 3/10; H05B 3/16; H05B

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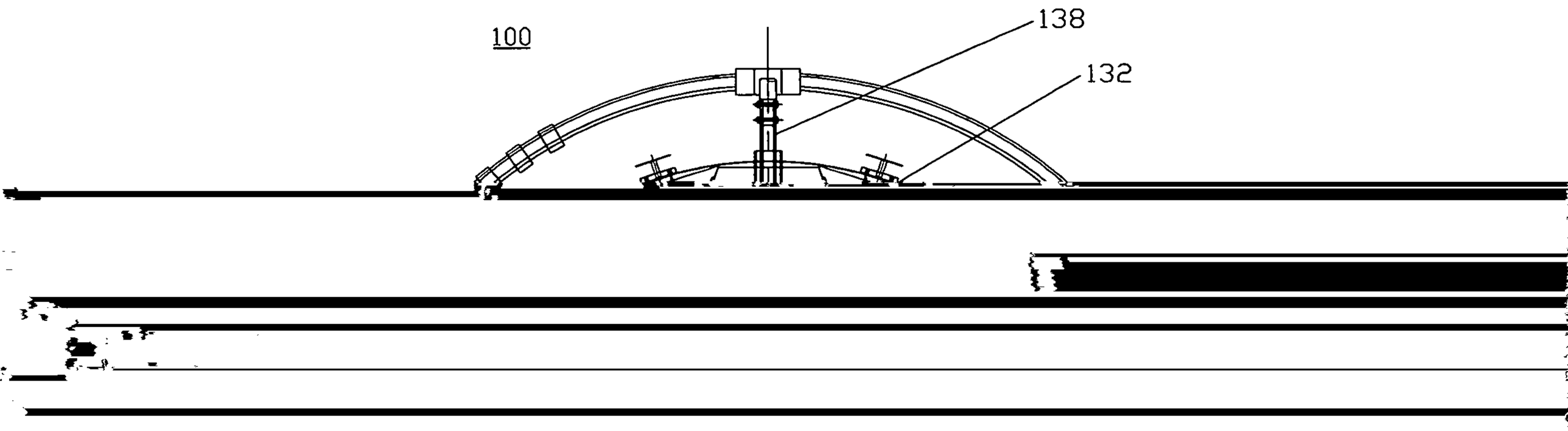
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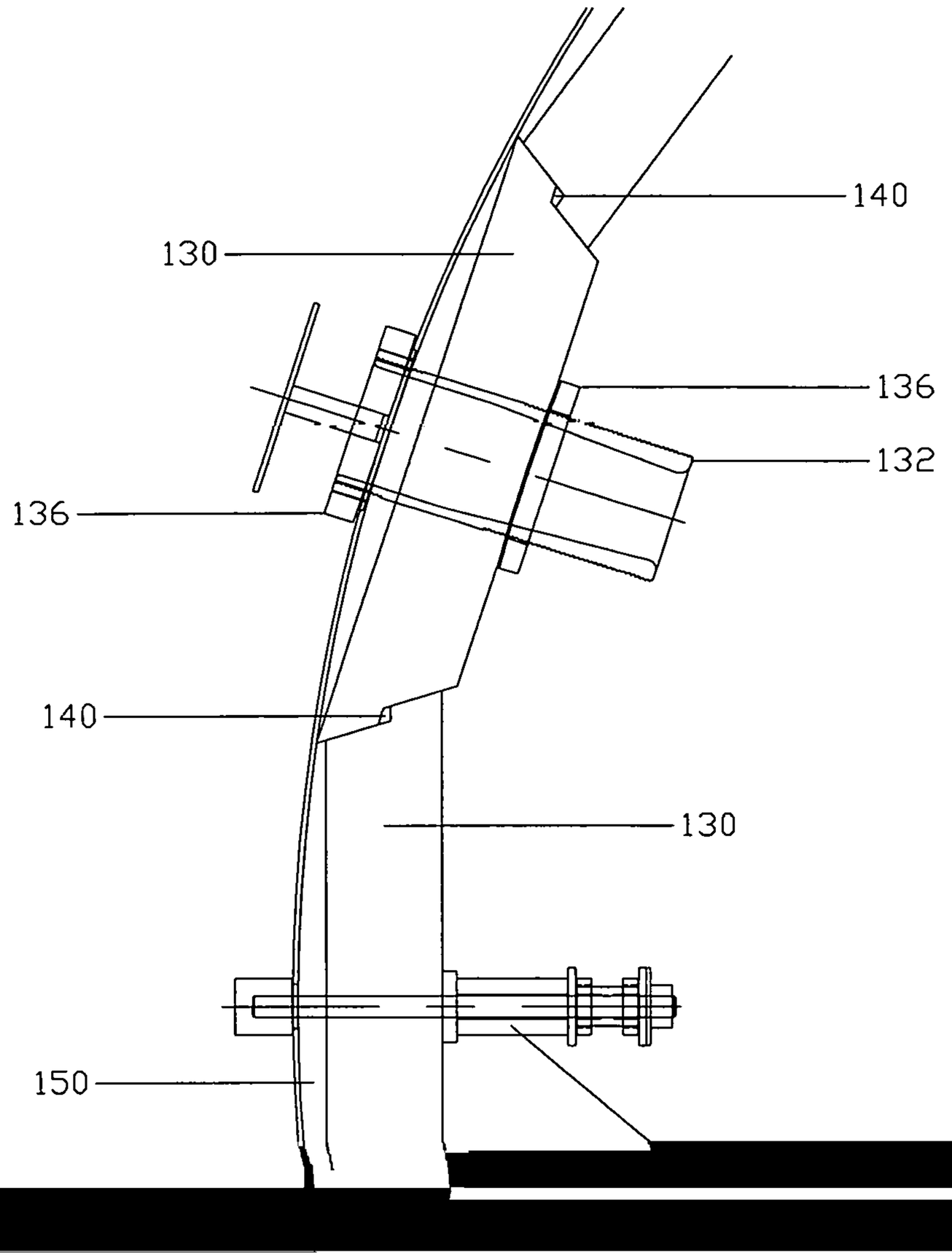
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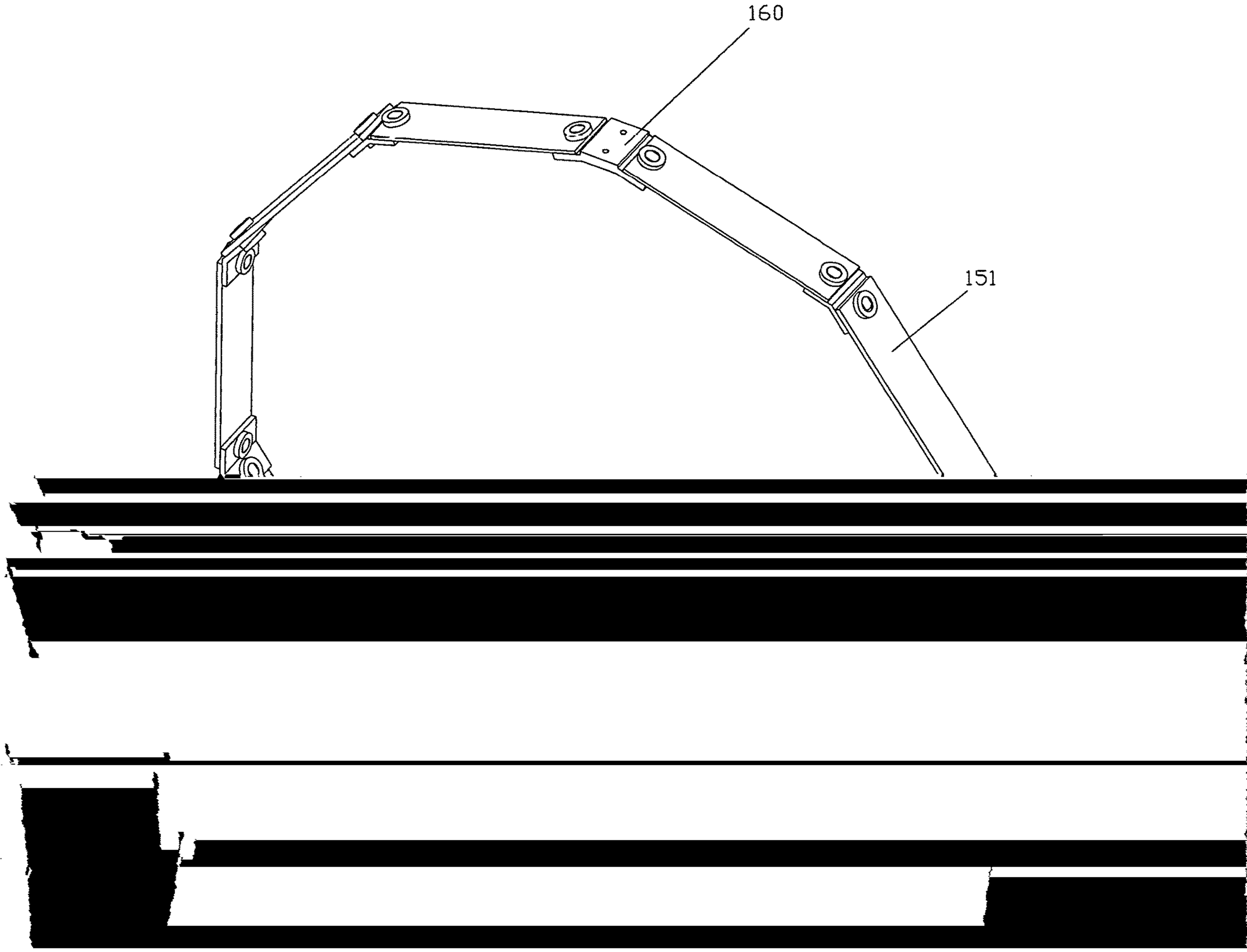
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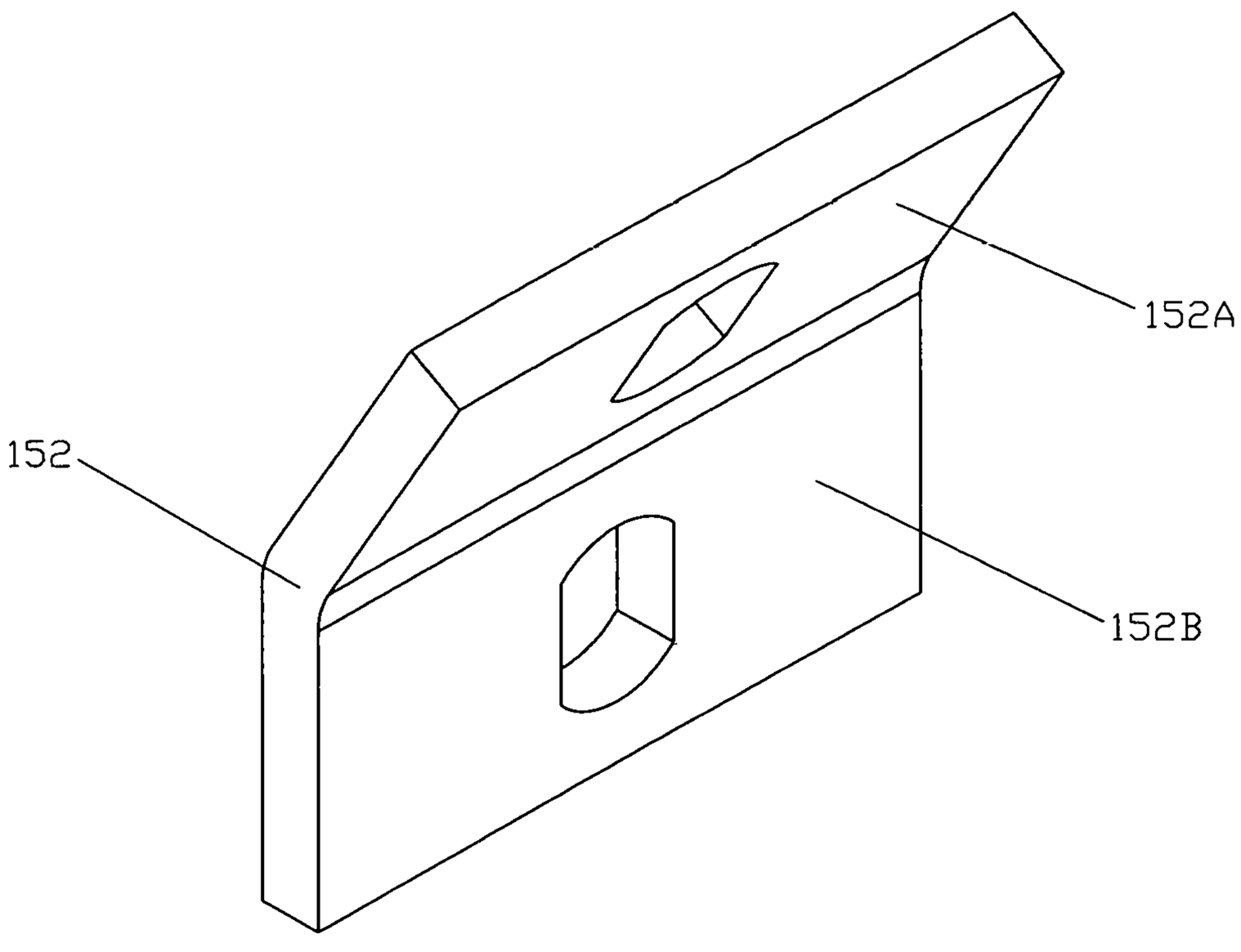
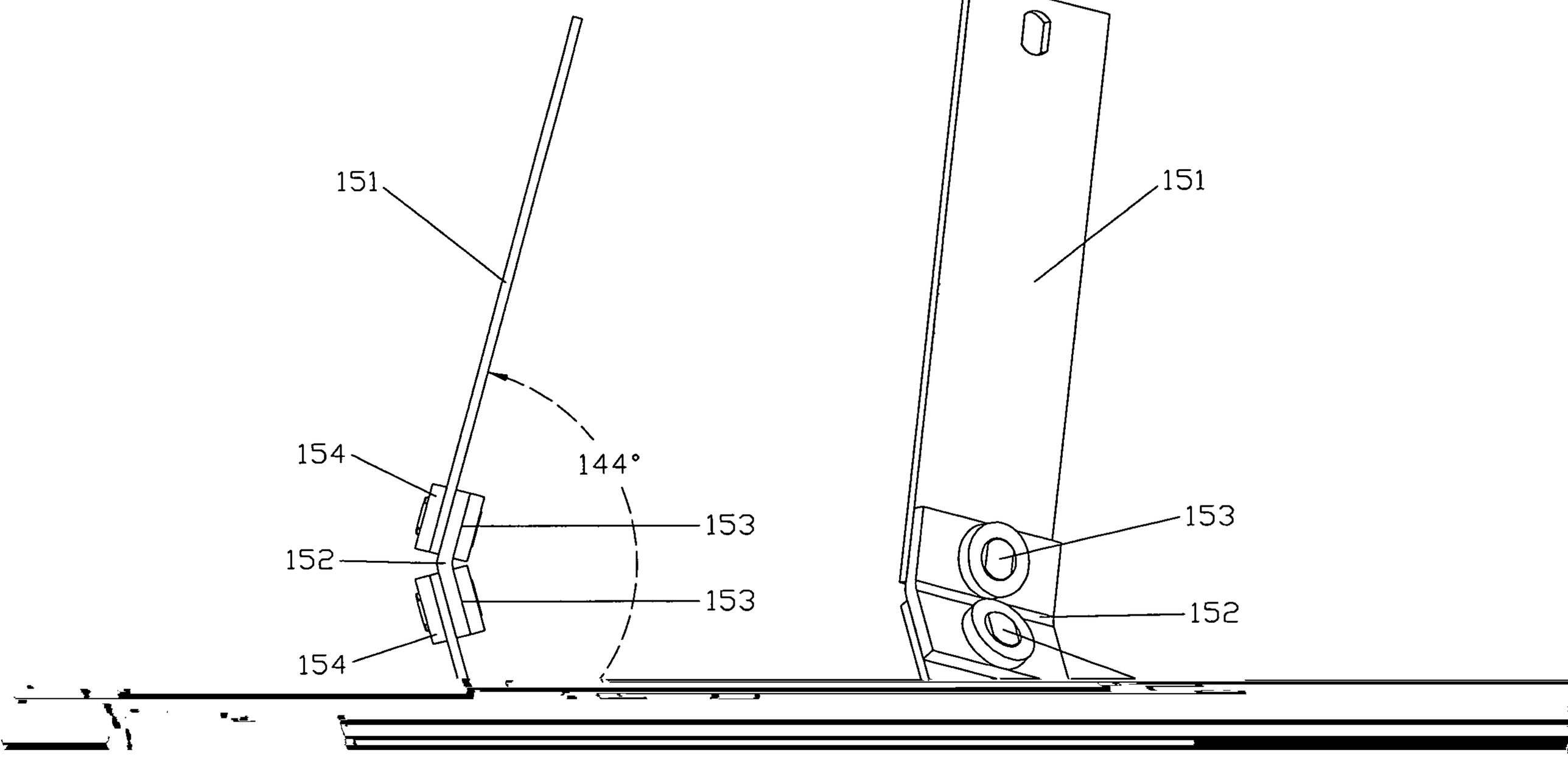



FIG. 4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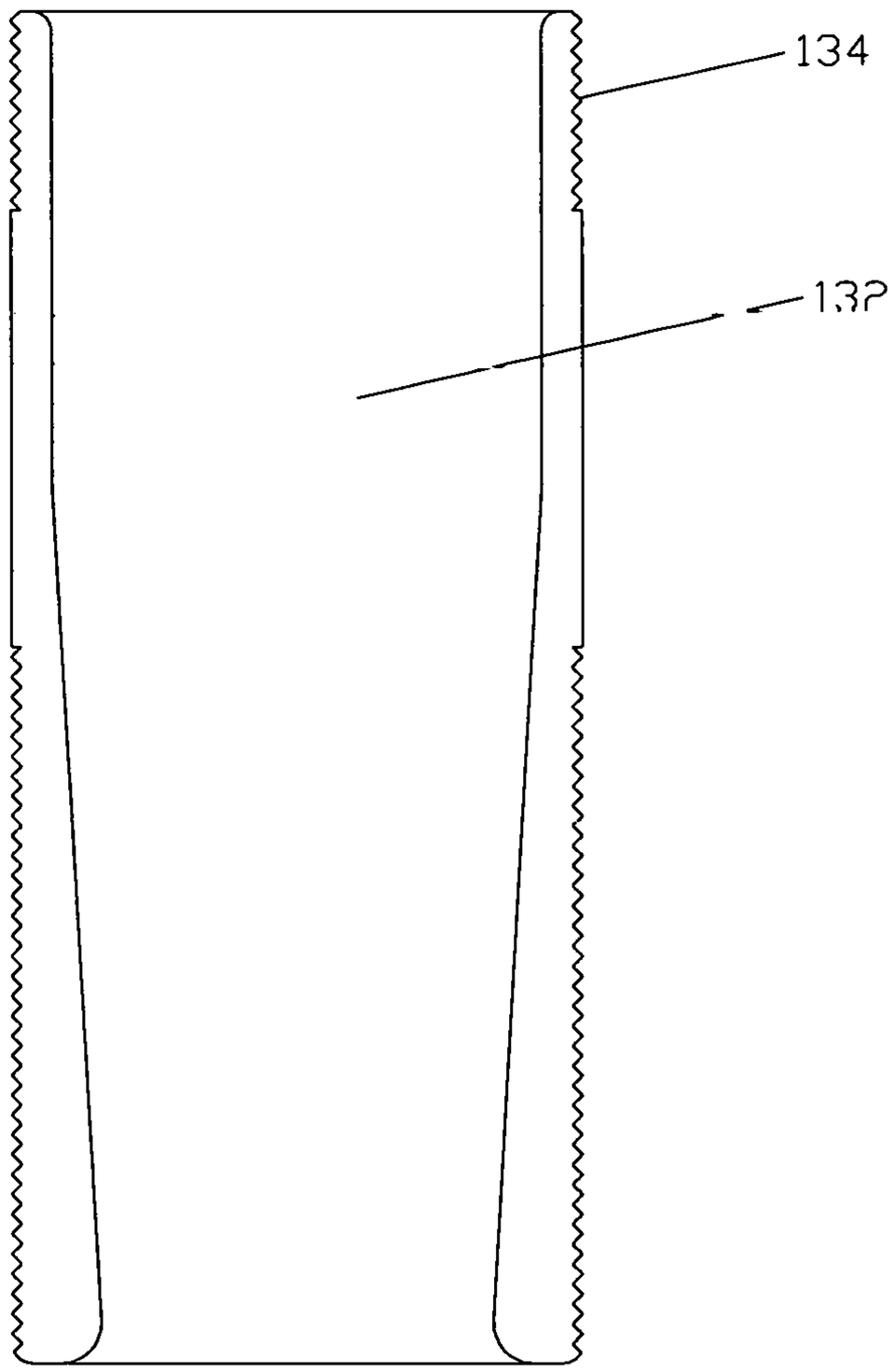


FIG. 6

# HIGH TEMPERATURE VACUUM FURNACE HOT ZONE WITH IMPROVED THERMAL EFFICIENCY



in a loss of strength when they were exposed to rapid heating and cooling. These two significant failures, extreme mois-

and repair and replacement costs. Heat treating furnace

improvements in heating element design for ease of replacement in the heat treating facility, as opposed to replacement in the furnace manufacturing facility. The polygon design



HEFVAC graphite insulation boards, the insulation board retainers, the heating elements, the gas cooling nozzles and the power supply terminal.

plurality of compensator bars to join straight molybdenum tion boards as shown in FIG. **1**, particularly illustrating the

ture and thus maintain a tight tolerance for temperature uniformity without an excessive input of electrical energy

The design of nozzles **132** represents another unique feature of the present invention. These nozzles have a smaller outer radius (thinner wall) to reduce the mass of the nozzle as compared to the nozzles described and shown in U.S. Pat. Nos. 9,187,799 and 7,514,035. The present lower

boards **130** and support ring **122**, thus further decreasing thermal conductive losses from the hot zone during the heat treating cycle.

While the present preferred embodiment utilizes flat insulation board **130** segments, it should be understood by those skilled in the high temperature vacuum furnace art that curved (or other-shaped) insulation boards could be used

FIGS. **1** and **3** show in detail the new polygon-shaped heating element design. Each heating element **151** is manufactured from a single high purity graphite block and cut into rectangular segments with equal resistance. The ability to manufacture more than one element segment from a single

TABLE 1

| INSULATION TYPE | HOLD 1750° F. | HOLD 2900° F. | HOLD 2350° F. |
|---|---|---|---|
| a. All-Metal (3 Molybdenum, 2 Stainless) | 551° F. | 650° F. | 733° F. |
| b. Foil/Kaowool | 452° F. | 548° F. | 640° F. |

electrical resistance heating element means arranged in a continuous ring within said hot zone adjacent to said insu-

fastening means for securing said connector plate means to two adjacent heating element means.