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Jones

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(54) **VACUUM NITRIDING FURNACE**

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C21D 1/06 (2006.01)
C21D 1/74 (2006.01)

(52) **U.S. Cl.** **266/252**; 266/250; 148/216; 432/247

(58) **Field of Classification Search** 266/205, 266/249–264; 432/247, 200–205; 148/216
See application file for complete search history.

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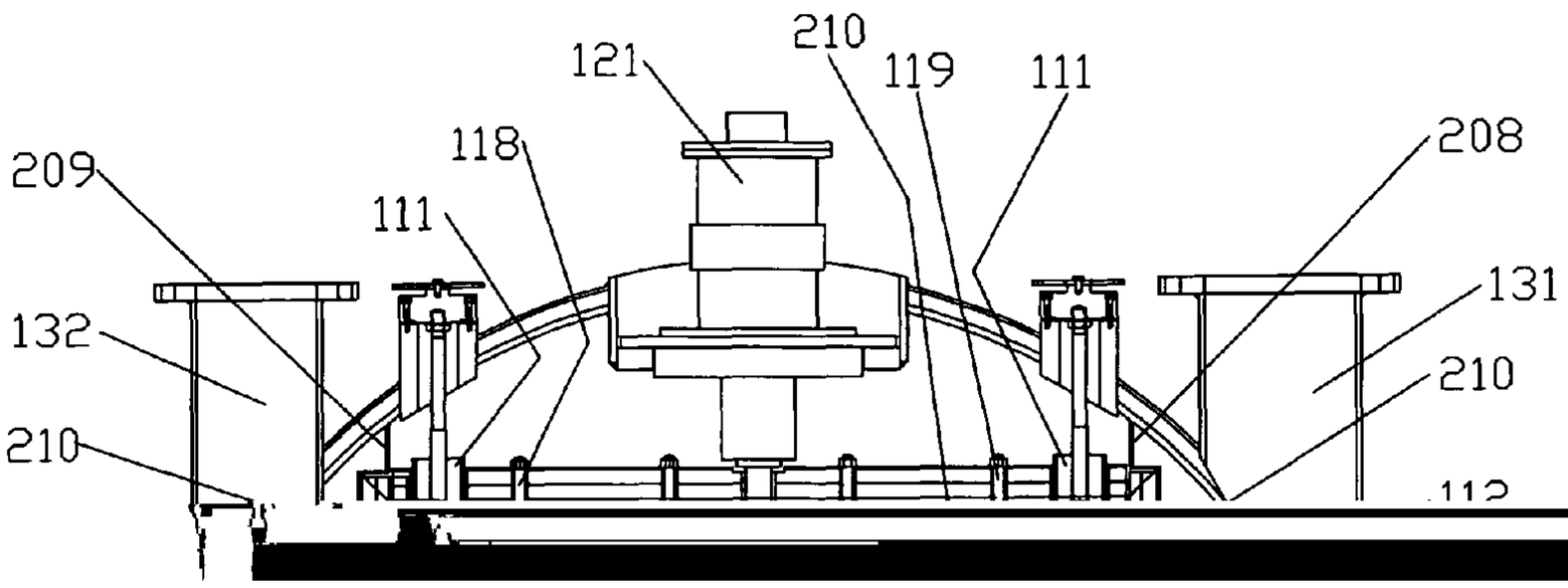
(57) **ABSTRACT**

A heat treating furnace is disclosed for nitride case hardening and gas cooling a stationary workload in the same furnace which is comprised of a single chamber and an access door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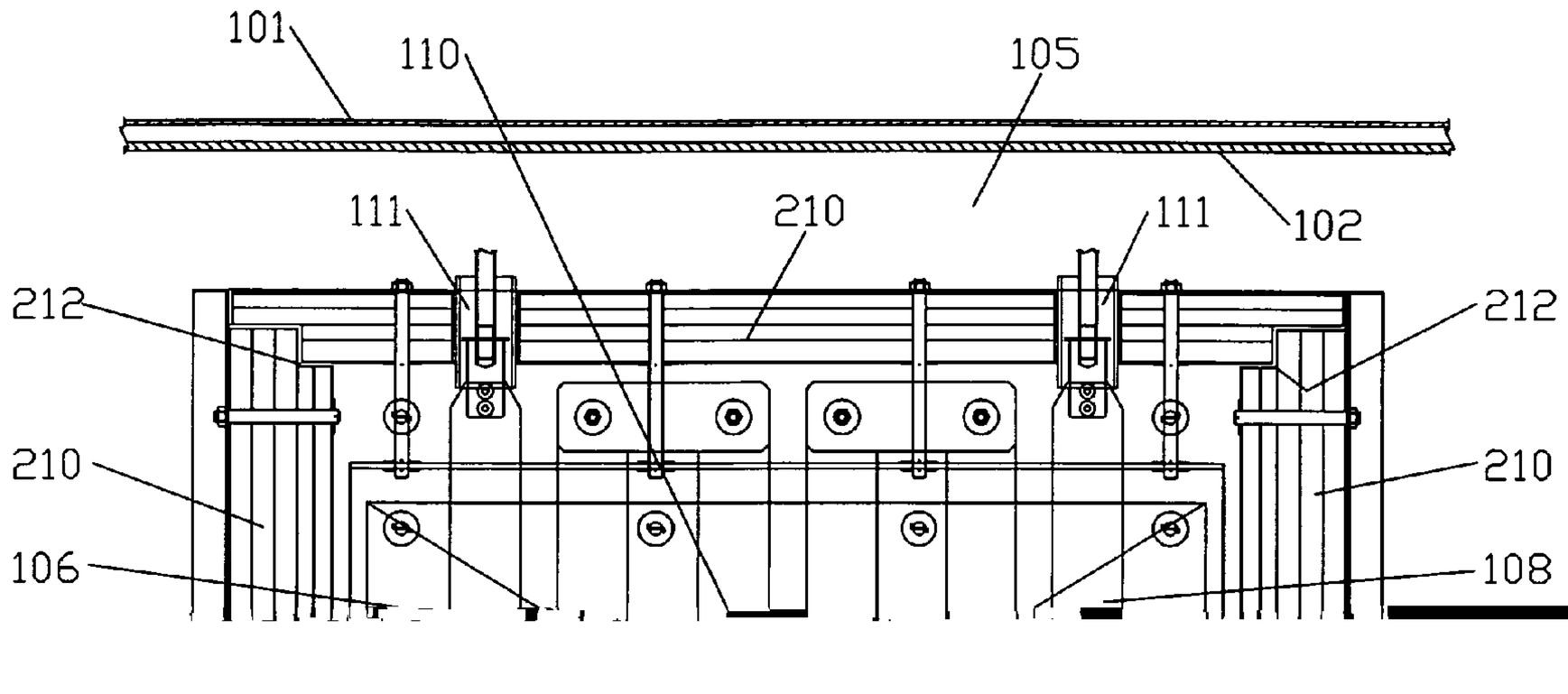
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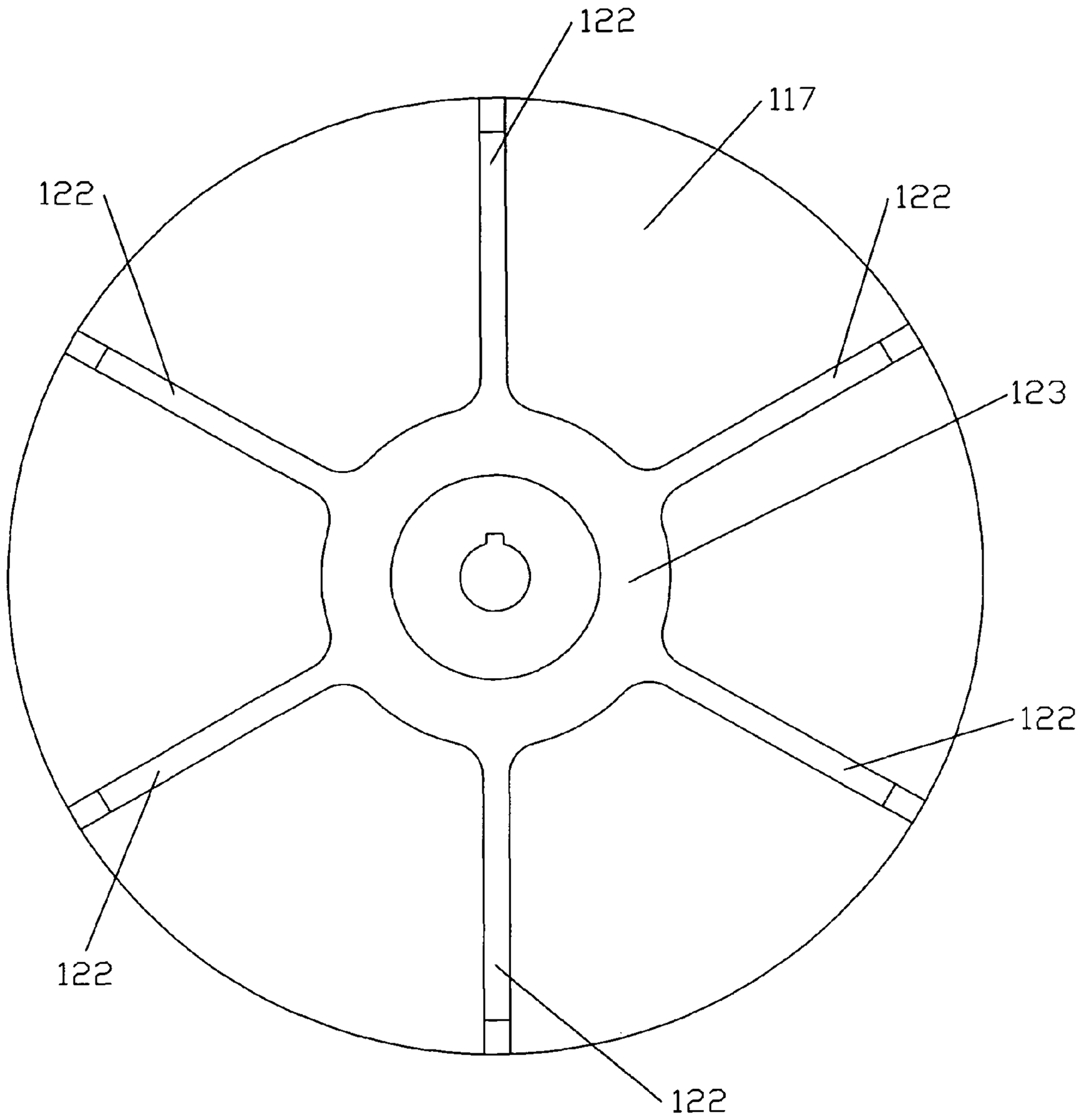
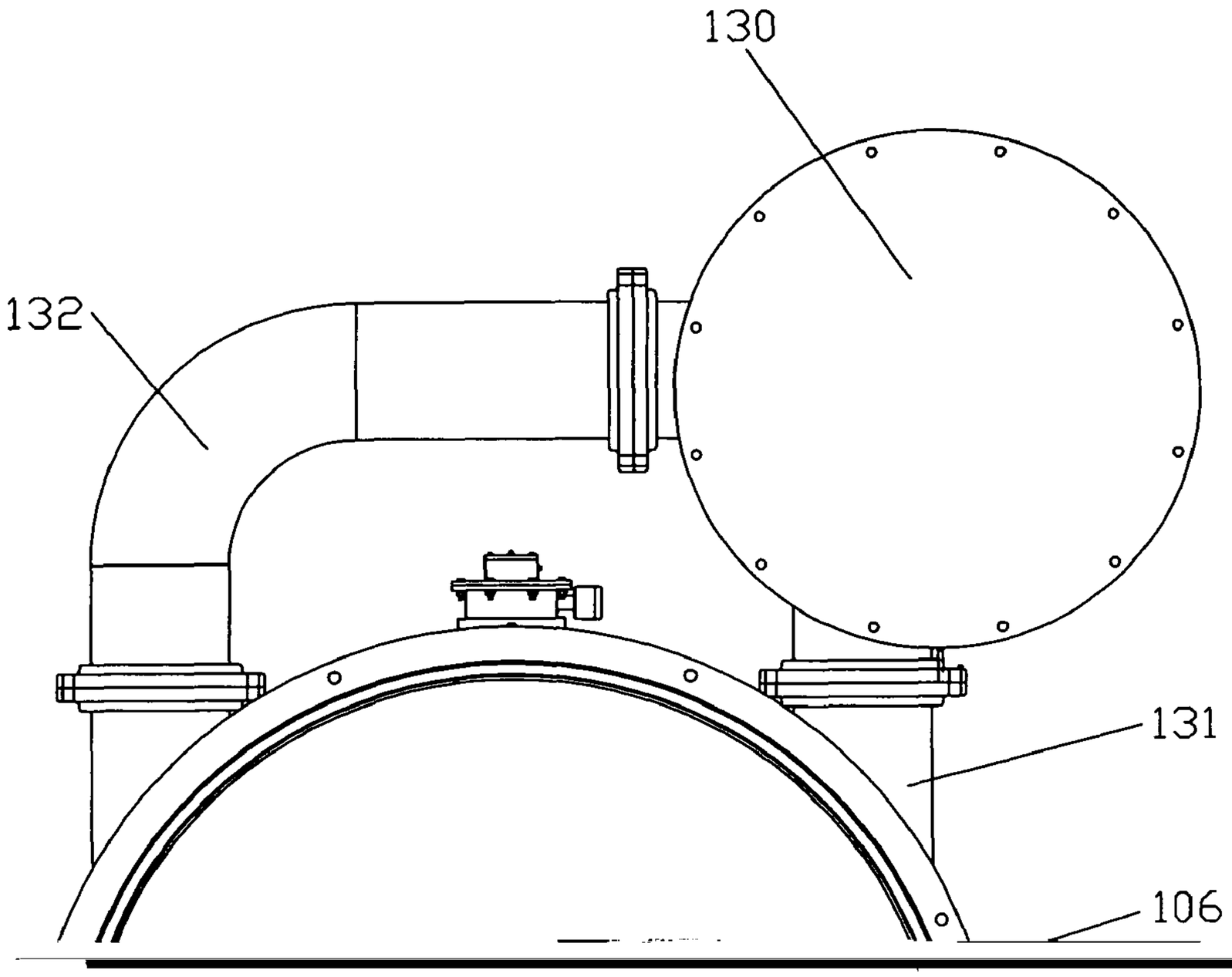


FIG. 4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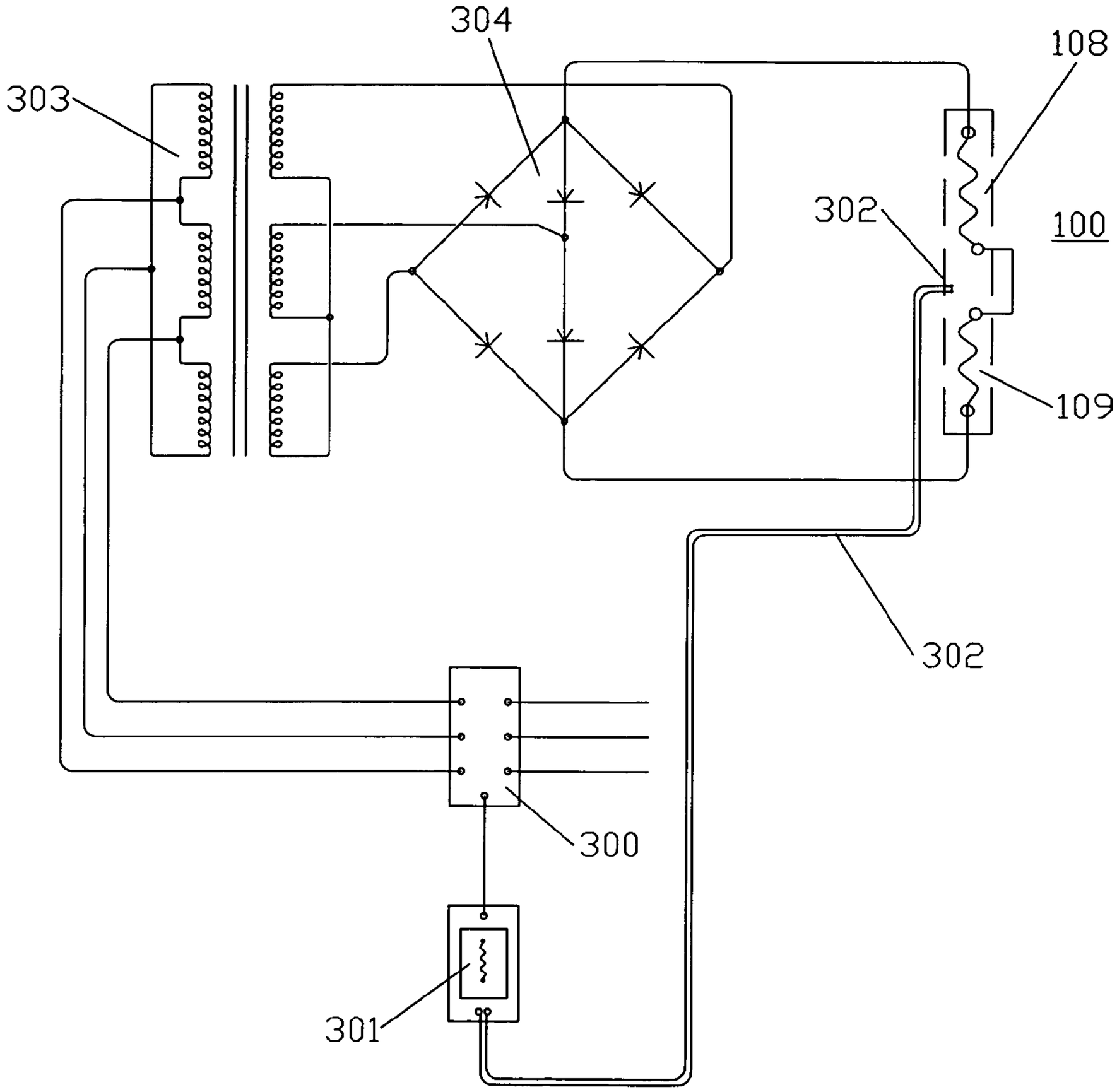

FIG. 6

VACUUM NITRIDING FURNACE

BACKGROUND OF THE INVENTION

1. Field of the Invention

Both designs described in these prior art patents are subject to potential gas leakage during the heating cycle due to their inability to maintain a completely positive seal. Thus both designs can cause thermal gradients within the hot zone during processing and can result in non-uniform core hardness of

vacuum nitriding furnace **100**. The hot zone is generally of a rectangular design and consists of all graphite materials.

detail in connection with FIG. **6** and the operation of the furnace.

Two graphite plates **113** and **114** are located in front of

back down into hot zone **106** and forces the flow radially around to heating elements **108** and **109**. Fan wheels **117** are strategically located in the top front center and top rear center of the 48 inch deep dimension of the furnace chamber. These specially engineered wheels facilitate the convection heating within the furnace and continuous recirculation during nitride case hardening, and they assist in gas cooling of the workload in hot zone **106**. The convection heating is performed at

opening **127** and a cooling gas exit tube **132** to an external blower can **130**, which will be described in greater detail in connection with FIG. **5**.

The external gas cooling system shown in FIG. **5** includes blower can **130** containing a commercially available 30 hp motor and fan (not shown) for providing high velocity gas flow. The system further includes an all stainless steel, water cooled heat exchanger (not shown) and a blower assembly (not shown) which includes a computer balanced fan wheel

vacuum pump (not shown) to a set pressure—preferably 10^{-2} torr—to remove substantially all air from the furnace. The furnace is then backfilled with nitrogen to approximately +1 psig (800 torr) via a backfill valve (not shown). Partial pressure nitrogen is then introduced through gas inlet **220**. Gas

extremely large difference in the amount of ammonia used results in significant benefits and cost savings. Environmentally, there is less discharge of ammonia gas into the atmosphere for each nitriding process cycle. Financially, there is less maintenance required of furnace parts used in prior art

8. A vacuum heat treating furnace in accordance with claim 1 wherein said fan assembly means includes a radial fan wheel in said chamber inner portion.

9. A vacuum heat treating furnace in accordance with claim 8 wherein said radial fan wheel is graphite.

10. A vacuum heat treating furnace in accordance with claim 1 wherein said graphite insulation means surrounding said inner portion is formed from a plurality of layers of high purity graphite felt insulation.

11. A vacuum heat treating furnace in accordance with direct current heating elements and the voltage thereto is rectified by a three phase bridge rectifier and a three phase power transformer to provide a balanced three phase load across the input power line.

13. A vacuum heat treating furnace in accordance with claim 1 wherein said furnace further includes external fan assembly means and external heat exchanger means, and wherein said port means are opened after the nitride case hardening heat treating cycle has been completed and said external fan assembly means and said external heat exchanger