Jan. 17, 1950 A. A. LOMBARD 2,494,821

MEANS FOR SUPPORTING THE NOZZLES OF THE COMBUSTION CHAMBERS OF INTERNAL-COMBUSTION TURBINES.

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Fig. 1.

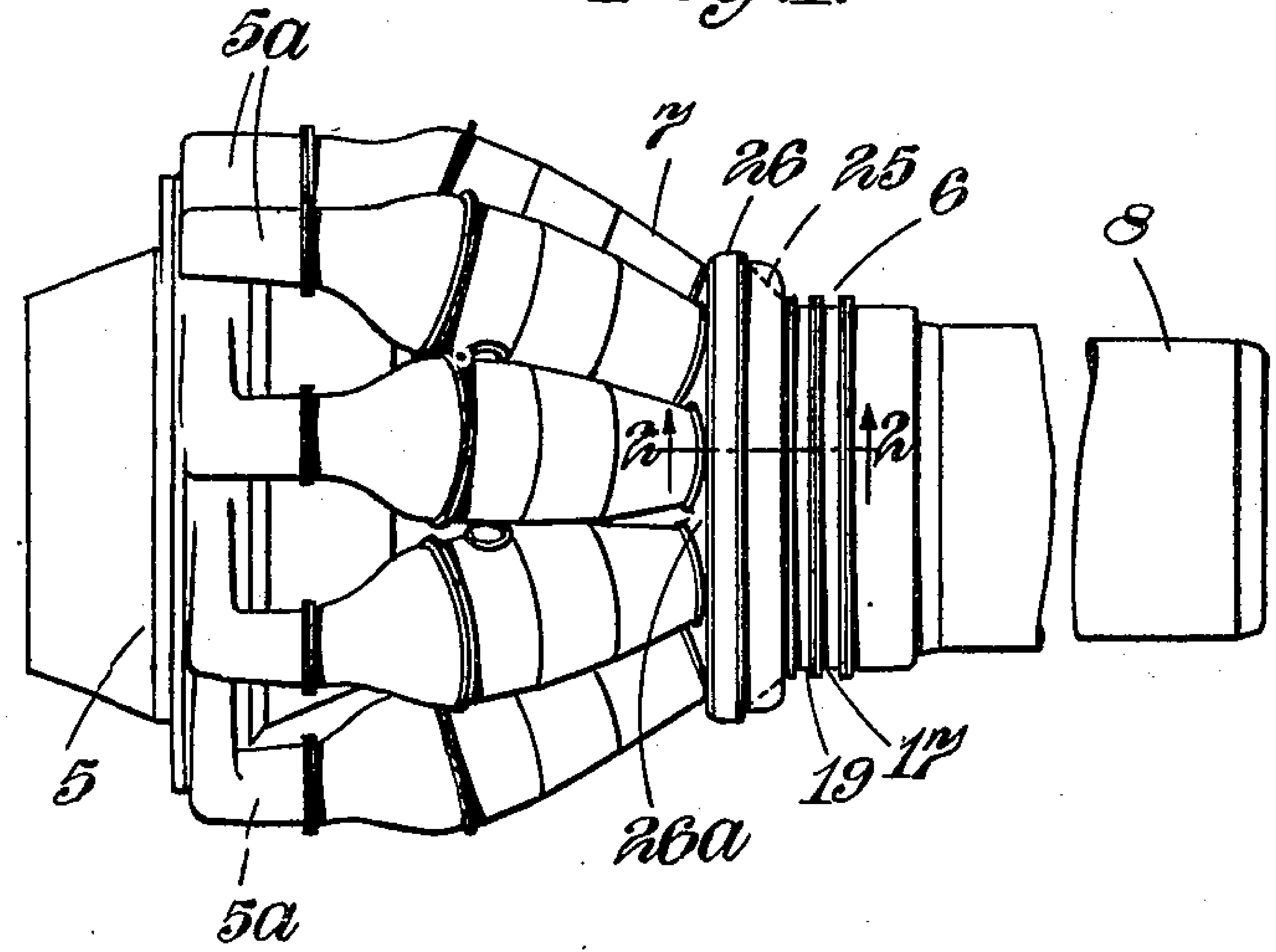
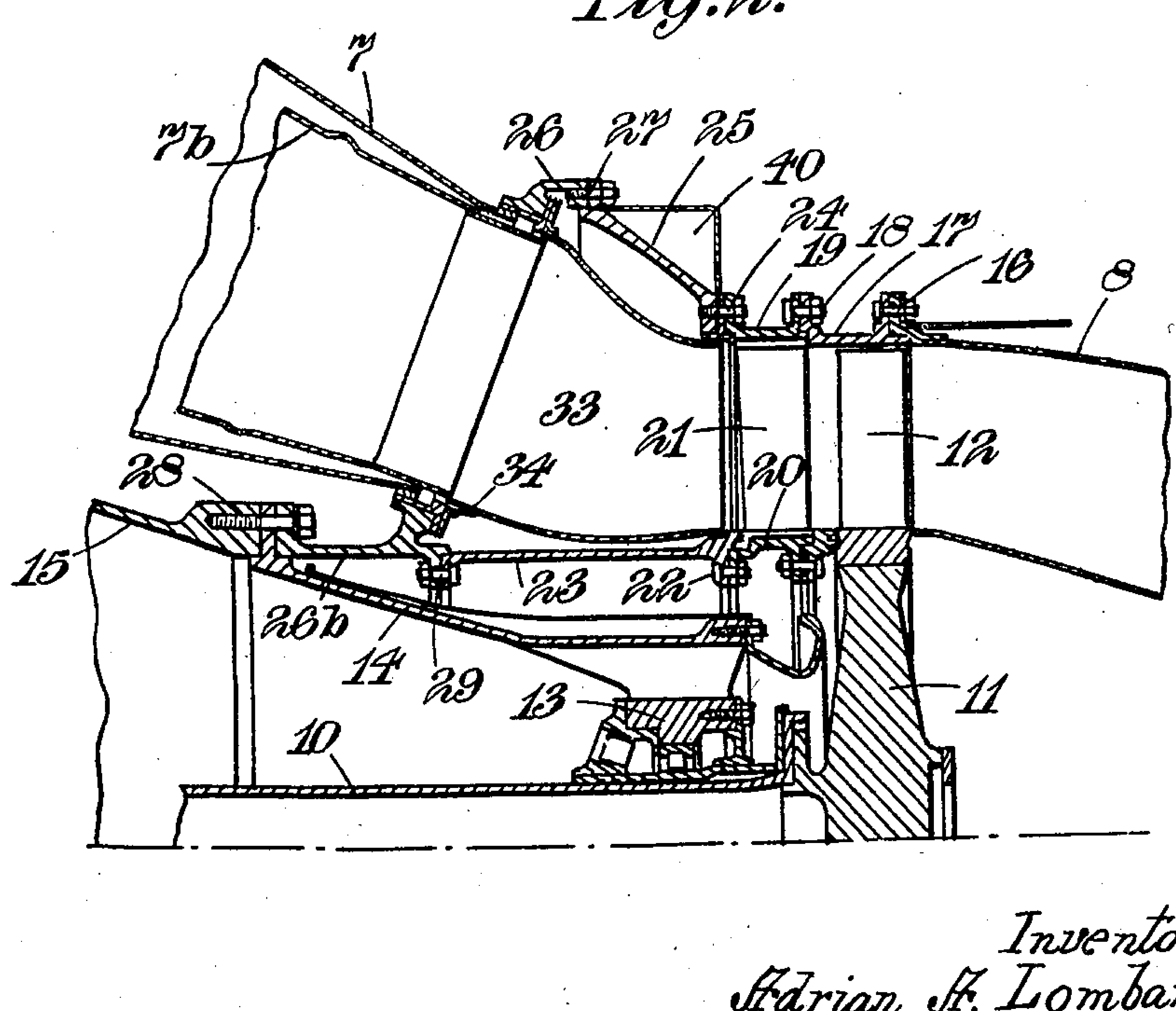


Fig. 2.



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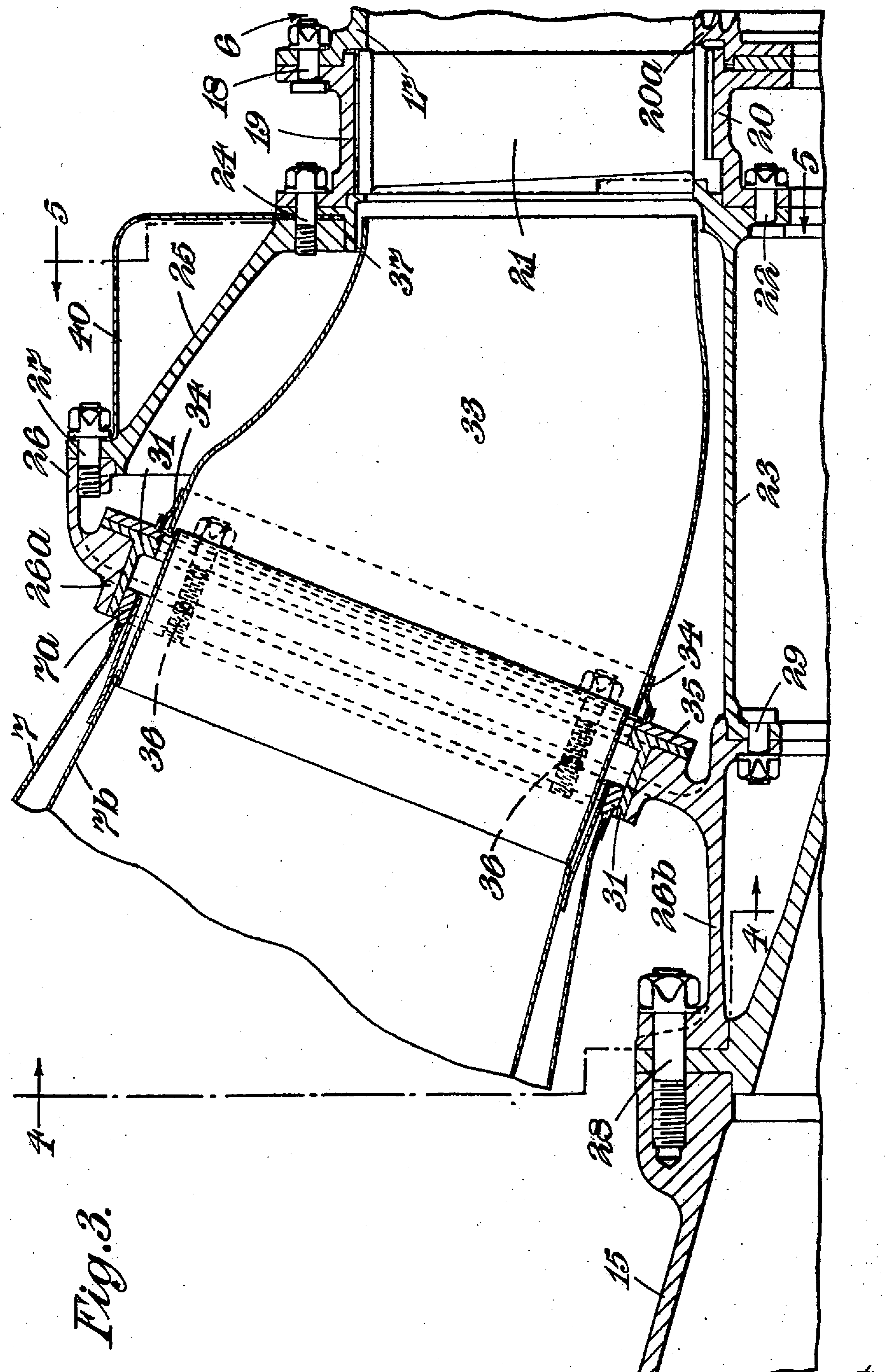

Fig. 3.

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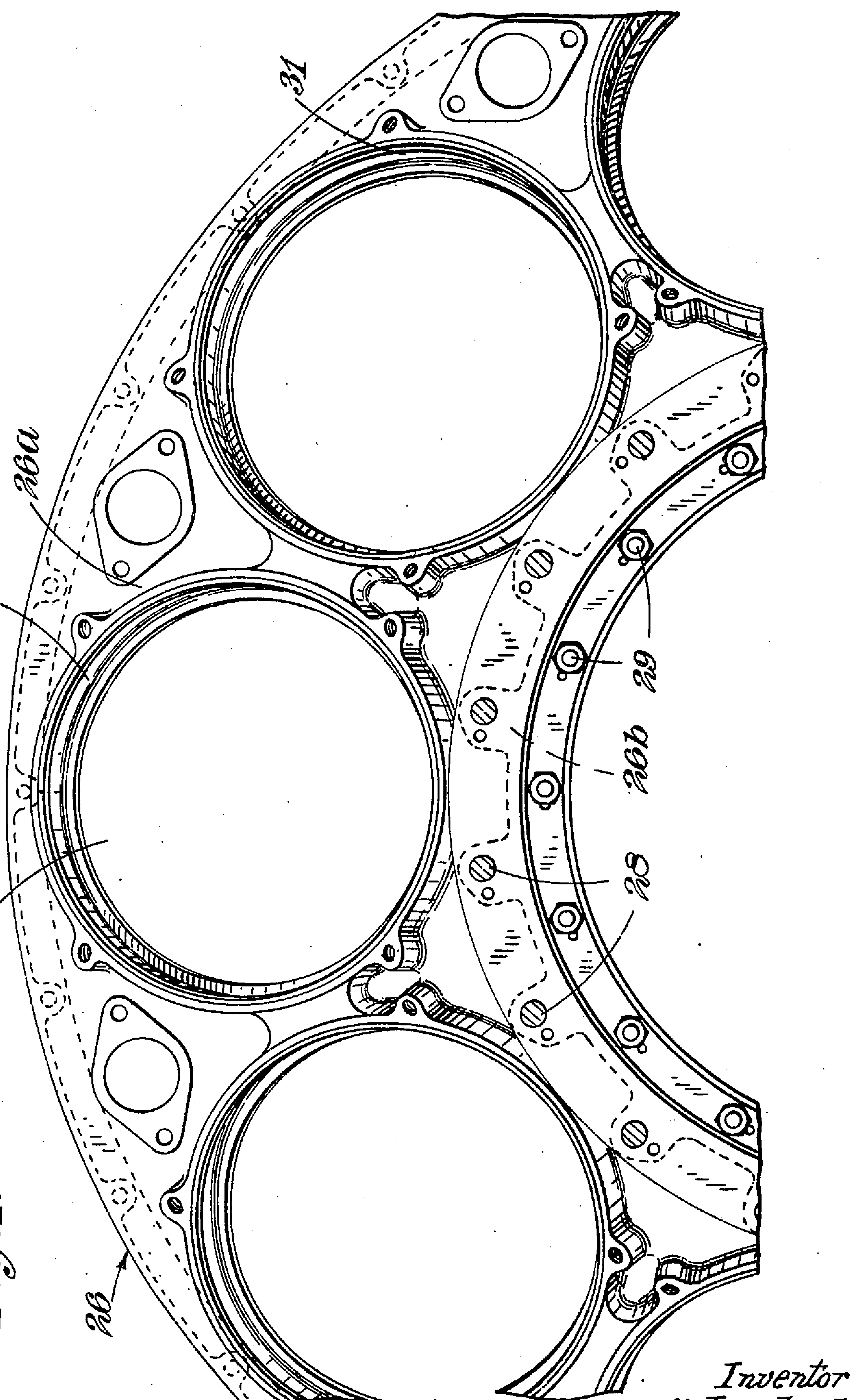

Fig. 4.

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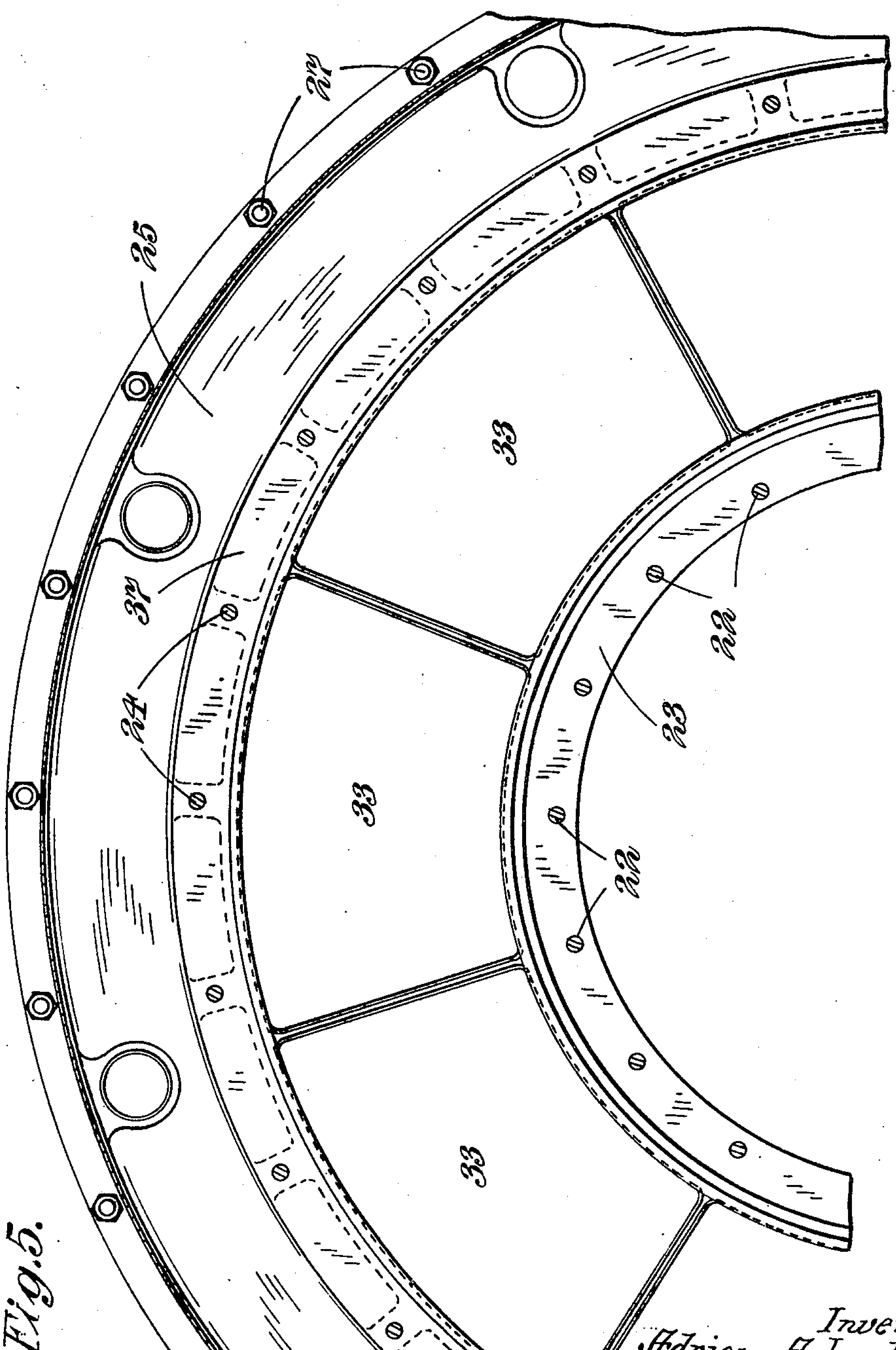

Fig. 5.

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2,494,821

MEANS FOR SUPPORTING THE NOZZLES OF THE COMBUSTION CHAMBERS OF INTERNAL-COMBUSTION TURBINES

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3 Claims. (Cl. 60—41)

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This invention relates to internal-combustion turbines of the kind in which a compressor delivers compressed air to a plurality of combustion chambers arranged externally in a ring around the turbine and the products of combustion flow from the combustion chambers through a ring of nozzle guide vanes or turbine stator blading to one or more turbine rotors which drive the compressor and, further, in which the main structure for supporting the turbine rotor assembly comprises the compressor casing and an intermediate casing lying within the ring of combustion chambers and enclosing the drive between the turbine rotor or rotors and the compressor rotor. Additionally, the turbine stator assembly, including shroud ring or rings, stator blading or guide vanes, and possibly exhaust assembly, is supported from the intermediate casing.

Hitherto it has been the practice to provide nozzles, which are circular at their forward or inlet ends—where they receive the combustion products from the combustion equipment—and substantially rectangular at their rear or outlet ends—where they direct the combustion products on to the nozzle guide vane assembly; the outlet ends of the nozzles were arranged side by side to form a complete annular ring corresponding to the annulus of the nozzle guide vane assembly. In such known constructions the nozzles were welded together along radially abutting edges at their outlet ends and further the inner and outer diametral edges at the outlet ends were welded to inner and outer support rings. With such a construction, it has been the practice to support the inner ring from the intermediate casing referred to, whilst the turbine shroud ring or rings (together with the jet pipe) are supported from the outer ring. As a consequence the weight of the jet pipe is taken through the welded nozzles and also through the nozzle guide vanes themselves should these be rigidly secured by welding or otherwise to their inner and outer shroud rings.

The object of the present invention is to provide a construction in which the nozzles and the nozzle guide vanes which operate at high temperature are relieved of structural loading and which permits of these components being so supported that they can expand freely within the assembly.

According to the present invention an internal-combustion turbine of the above kind is provided with an apertured ring to receive and support the outlet ends of the combustion chambers, the ring being secured to the intermediate casing and to

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the outer ring of the nozzle guide vane assembly so that structural loads are transmitted from one to the other solely through the ring.

A preferred embodiment of the invention will now be described, by way of example, with reference to the accompanying drawings in which:

Figure 1 is a side elevation of a jet propulsion gas turbine engine for an aeroplane incorporating a turbine in accordance with this invention,

Figure 2 is a cross section on the line 2—2 of Figure 1 and to an enlarged scale,

Figure 3 is a similar view to Figure 2 showing to a greater scale certain details of construction of the invention, and

Figures 4 and 5 are respectively sections on the lines 4—4 and 5—5 of Figure 3.

Referring to Figure 1: The jet-propulsion gas-turbine engine comprises a compressor casing 5 to house a centrifugal impeller, which is driven by a single-stage turbine generally indicated at 6. A plurality of combustion chambers 7 receive air from the compressor 5 by ducts 5*a*, and liquid fuel is burnt in these chambers. The products of combustion are delivered to turbine 6 and then pass to atmosphere by way of exhaust assembly 8. The exhaust gases being directed rearwardly by the exhaust assembly relative to the direction of flight of the aeroplane provide reaction propulsion.

Referring now in greater detail to Figure 2 it will be observed that a turbine shaft 10 supports the turbine disc 11 which carries blades 12. The shaft 10 is supported by a roller bearing, generally indicated at 13, carried by a structure 14 extending from an intermediate casing 15 which is bolted to the compressor casing 5. In this way the turbine rotor assembly is supported from the compressor casing, the intermediate casing 15 and extension casing 14 providing a "backbone" structure for the engine.

The exhaust duct assembly, which is shown at 8 (Figure 2) is bolted, as at 16, to a turbine shroud ring 17, which in turn is bolted at 18 to an outer turbine fixed-blade supporting ring 19. The fixed-blade assembly of the turbine comprises outer and inner blade-supporting rings 19 and 20 respectively, and the blades 21 extending therebetween.

The fixed-blade assembly is also shown in Figure 3 and it will be observed that a ring 20*a*, forming one part of a labyrinth seal, is bolted to the inner ring 20, which in turn is bolted at 22 to a tubular member 23. The outer stator blade ring 19 is secured by studs, as at 24, to an annular ring 25 that forms part of the nozzle box structure. This structure further comprises a cast, annular ring 26 having an apertured face 26a and an axially extending cylindrical portion 26b. At its periphery ring 26 is secured to ring 25 by studs 27, whilst the forward end of the cylindrical portion 26b is bolted to the intermediate casing 15 by studs 28. In addition bolts 29 attach the cylindrical portion 26b of the apertured ring 26 to the member 23.

It will be observed that loads applied to the turbine shroud ring 17, e. g., arising from the weight of the exhaust assembly 8, are transferred to bolts 18, ring 19, studs 24, ring 25, studs 27 and thence to ring 26 and the intermediate casing 15 through studs 28. The structure recited constitutes the main load carrying structure between the exhaust assembly 8 and the intermediate casing 15. The structure comprising casing 23, which is bolted at 29 to ring 26 and which carries the inner stator ring 20 with its seal 20a, is substantially unstressed. The stator blades 21 have radial clearance in rings 19 and 20 so that the loads on rings 19 and 20 are not imparted to the blades.

Referring now to Figures 3, 4 and 5: Combustion chambers 7 carry at their outlet ends strengthening rings 7a each of which slides into engagement with the inner cylindrical surface of a flanged bush 31. The bush 31 extends through a circular aperture 32 (Figure 4), in the cast ring 26. The ring 7a being in sliding engagement with bush 31 permits a degree of axial relative expansion between casing 7 and the nozzle-box structure constituted by rings 25, 26 and member 23.

The nozzle boxes 33 which are fabricated sheet metal are of circular section at their end nearer ring 26 (their entry end) and are welded, as at 34, each to a flanged ring 35. The ring 35 and bush 31 are secured to the ring 26 by studs 36. At their entry ends, therefore the nozzle boxes 33 receive combustion products from a flame tube 7b housed within the chamber 7. At their exit ends the nozzle boxes 33 are of substantially trapezoidal form (as shown in Figure 5) so that when assembled they form an annular gas duct leading to the nozzle guide vanes 21 of the turbine. The exit ends (Figure 3) are supported between casing 23 and an intermediate ring 37, disposed between the supporting ring 19 and ring 25.

The provision of the nozzle boxes 33 serves not only their normal function of directing the combustion products from the flame tube 7b to the nozzle guide vanes but also to prevent the gases coming into contact with the housing structure. The latter not being subjected to high temperature does not have its structural strength impaired.

A sheet metal collector ring 40 is attached to the nozzle box structure by studs 27 and 24 (Figures 2 and 3). The purpose of this ring is to define, with casing 25, an annular space to receive cooling air which is conveyed thereto from the interior of the casing 23 by pipes (not shown).

I claim:

1. A gas-turbine engine comprising a compressor having a rotor and a stator casing enclosing the rotor, a turbine having a rotor coaxial with and axially-spaced from the compressor rotor and a stator casing enclosing the rotor, a driving shaft connecting the compressor rotor to the turbine rotor, a plurality of combustion chambers disposed in a ring around the said shaft to extend from the compressor toward the turbine, an exhaust unit supported from the turbine casing on the side thereof remote from the compressor, an intermediate casing surrounding the shaft within the ring of combustion chambers and secured to the compressor casing to extend towards the turbine, a ring-like casing member having formed therein a plurality of circumferentially-spaced apertures one for each combustion chamber to receive and support its outlet end, said ring-like casing member being connected to the intermediate casing and to the outer periphery of the turbine casing to transmit structural loads therebetween, and a plurality of nozzle-boxes one for each combustion chamber extending from the outlets of the combustion chambers to deliver the working fluid from the combustion chambers to the turbine, the walls of the nozzle-boxes being spaced from the ring-like casing member so that the latter is out of direct contact with the flow of working fluid through said nozzle boxes.

2. A gas-turbine engine as claimed in claim 1, wherein said turbine casing comprises a stationary shroud for the turbine rotor, an outer ring secured directly to said shroud, an inner ring located within and radially spaced from the outer ring, and a series of guide-blades supported between the inner and outer rings, and wherein the outer edge of said apertured ring-like casing member is connected to the outer ring by a first tubular member surrounding said nozzle-boxes and the inner edge of said apertured ring-like casing member is connected to the inner-ring by a second tubular member disposed radially inside the nozzle-boxes said apertured ring-like casing member and said first and second tubular members together forming a chamber enclosing the nozzle-boxes.

3. A gas-turbine engine as claimed in claim 1 wherein said turbine casing comprises a stationary shroud for the turbine rotor, an outer ring secured directly to said shroud, an inner ring located within and radially spaced from the outer ring, and a series of guide-blades supported between the inner and outer rings, wherein said apertured ring-like casing member is of dished form, extends outwardly from the intermediate casing and has its concave face towards the turbine, and wherein the outer edge of said apertured ring-like casing member is connected to the outer ring by a first tubular member surrounding said nozzle-boxes and the inner edge of said apertured ring-like casing member is connected to the inner-ring by a second tubular member disposed radially inside the nozzle-boxes said apertured ring-like casing member and said first and second tubular members together forming a chamber enclosing the nozzle-boxes.

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