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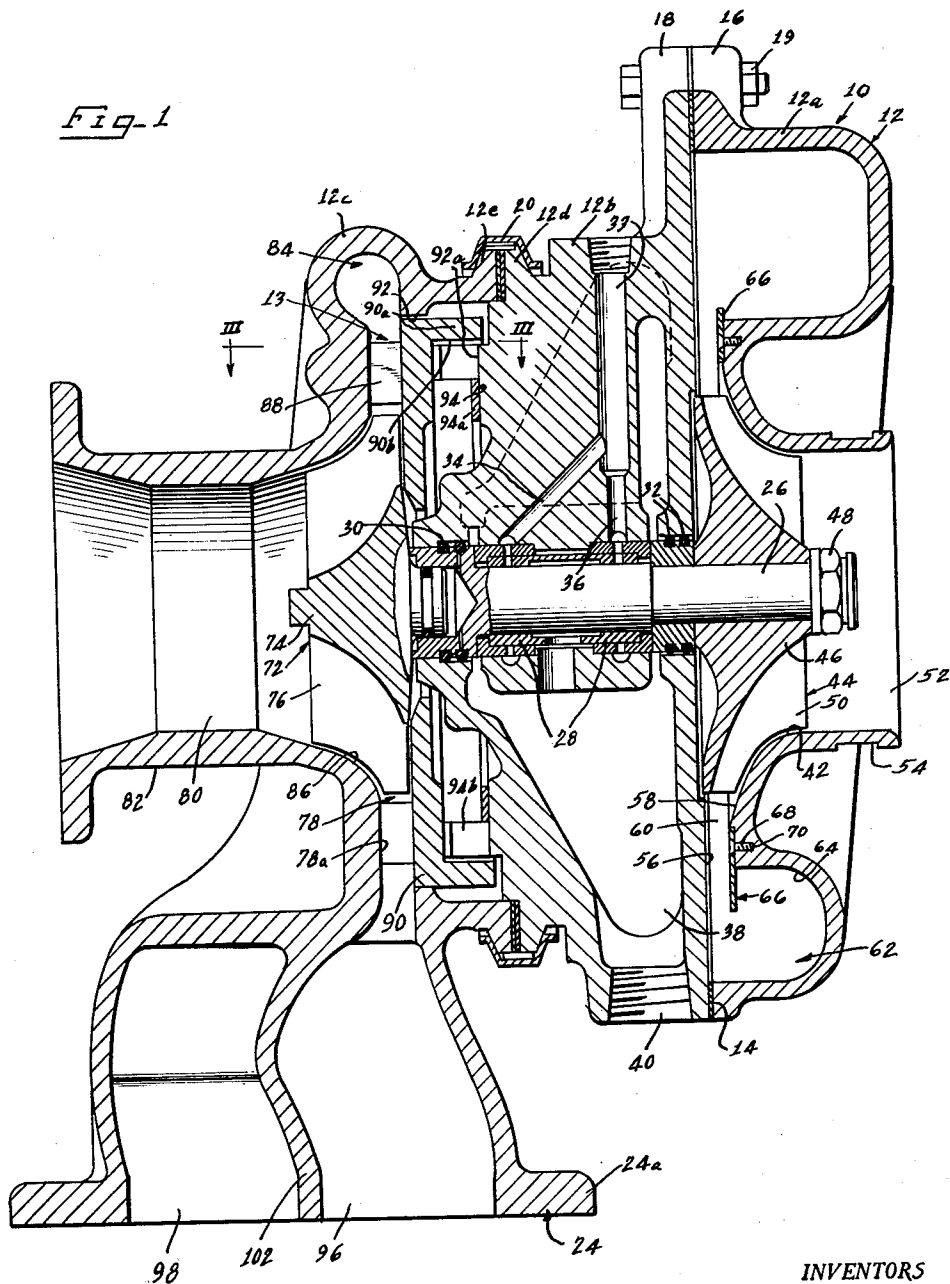
L. R. LAZO ET AL

3,112,096

TURBOCHARGER FLEXIBLE NOZZLE RING

Original Filed June 16, 1958

2 Sheets-Sheet 1



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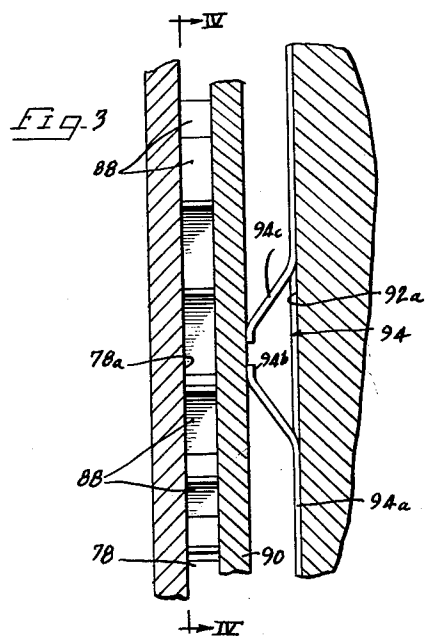
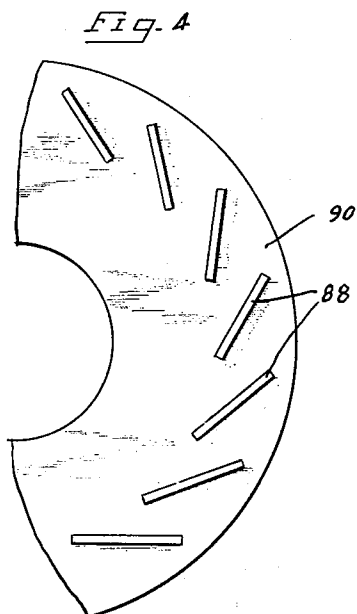
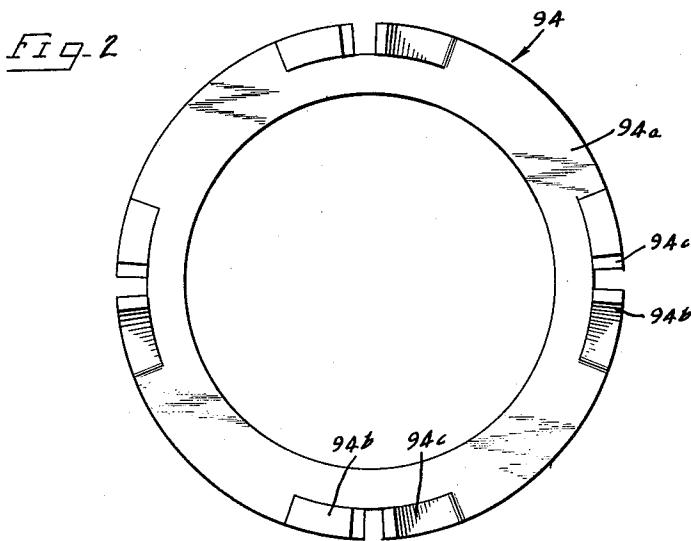
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## TURBOCHARGER FLEXIBLE NOZZLE RING

Luis R. Lazo, Mentor, and Benjamin Barish, Lyndhurst, Ohio, assignors to Thompson Ramo Wooldridge Inc., Cleveland, Ohio, a corporation of Ohio  
Original application June 16, 1958, Ser. No. 742,071, now Patent No. 3,010,697, dated Nov. 28, 1961. Divided and this application Nov. 28, 1960, Ser. No. 72,067  
2 Claims. (Cl. 253—55)

The present invention relates to improvements in turbines and particularly to an improved turbine nozzle ring structure for gas driven turbines.

The invention contemplates the provision of a gas operated turbine having an improved structure for directing a flow of operating gas to a rotor, the turbine structure is particularly well adapted for use in a turbocharger of the type shown and described in our copending patent application entitled "Turbocharger," U.S. Serial No. 742,071, filed June 16, 1958, now Patent No. 3,010,697, and the present application is a division of that application.

An object of the present invention is to provide an improved gas turbine which is better able to accommodate the temperature changes which must occur in a gas turbine.

Another object of the invention is to provide a gas turbine of the type which is well adapted to be driven by the exhaust gases from an internal combustion engine such as is frequently the arrangement in an internal combustion engine turbocharger.

A further object of the invention is to provide an improved and simplified nozzle arrangement for a gas turbine which permits independent expansion of the nozzle ring and housing and other related parts without introducing excessive stresses in the materials.

Another object is to provide an improved gas turbine wherein a nozzle ring is provided of simplified construction for ease of assembly and disassembly with the turbine housing for manufacture or replacement.

Another object of the invention is to provide an improved stator vane construction for a gas driven turbine for directing the flow of gases to the rotor and for receiving operating gas in dual flows.

Other objects and advantages will become more apparent with the teaching of the principles of the invention in connection with the disclosure of the preferred embodiment thereof in the specification, claims and drawings, in which:

FIGURE 1 is a sectional view taken through a turbocharger employing construction in accordance with the principles of the present invention;

FIGURE 2 is an elevational view showing details of the spring ring of the mechanism of FIGURE 1;

FIGURE 3 is a sectional view taken substantially along line III—III of FIGURE 1; and

FIGURE 4 is a sectional view taken substantially along line IV—IV of FIGURE 3.

As shown on the drawings:

FIGURE 1 illustrates a turbocharger 10 incorporating a gas turbine embodying the features of the present invention. The turbocharger is enclosed in a housing 12 and the compressor end is enclosed in housing parts 12a and 12b and the turbine end is enclosed in a housing part 12c. Within the housing part 12c is a ring assembly 13 which will later be described in detail. The turbine, with its features of construction including the housing 12c and the ring assembly 13 incorporate the unique features of

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the instant invention and the overall features of the turbocharger provide a preferred environment for the turbine and are shown and described for that purpose.

The compressor housing parts 12a and 12b are formed with annular meeting faces and a gasket 14 is located between the faces to seal the parts. Bosses, such as 16 and 18, may project from the housing parts to receive bolts 19 for securing the parts 12a and 12b together.

The housing parts 12b and 12c are provided with flanges 12d and 12e which are utilized for clamping the housing parts 12b and 12c together by an annular clamping band 20. The band is provided with inclined inner faces which mate with the inclined outer faces of the flanges 12d and 12e to securely clamp the parts together, and the band 20 may be loosened for relatively rotationally shifting the parts 12c and 12b to change the relative positions of the compressor end and turbine end of the turbocharger. The housing part 12a is provided with a compressed air discharge outlet fitting, not shown. The housing part 12c is provided with a large inlet boss 24 for hot gases. The conduits to which these fittings connect and their positions can be better accommodated with relative rotational shifting of the parts 12a and 12c.

Extending axially through the housing is a shaft 26 supported in bearing means 28 with seals 30 and 32 along the shaft to prevent the escape of lubricant and to prevent the pressurized air and hot operating gases from entering the lubricant compartments. Lubricating oil is fed downwardly through a passage 33 in the housing part 12b and feeds to lubricating branches 34 and 36, which supply openings in the bearings. The lubricant flows from the bearings down to a lubricant drain compartment 38, and through a lubricant drain opening 40.

At one end of the housing 12 the parts 12a and 12b form a compressor rotor chamber 42 in which rotates a vaned compressor rotor 44. The compressor rotor has a hub 46 mounted on the shaft 26 and held thereon by a threaded nut 48. The compressor rotor is provided with impeller vanes 50 which force the air centrifugally outwardly to compress it in a known manner. Air is taken in through an air inlet opening 52 formed by an annular hub 54 on the housing part 12a. The housing part 12b has a radial flat face 56 extending outwardly from the rotor and with an opposing inwardly facing surface 58 on the housing part 12a forms an air flow throat 60 extending radially outwardly for the flow of air from the vanes 50 of the compressor rotor 44. The air passes outwardly from the throat 40 into an involute scroll air chamber 62. As the compressor rotor 44 forces the compressed air outwardly through the throat 60, it enters the chamber 62 and is discharged out through the discharge passage for the compressor. The air flowing outwardly along the flat wall 56 tends to circle in the chamber 62 and flow inwardly along the inner surface 64 to interfere with the flow out through the throat 60. This effect may be referred to as back wash or as boundary layer flow back. A fence 66 in the form of an annular ring is secured to the wall 58 beside the throat and projects radially outwardly into the chamber 62. The fence ring is provided with circumferentially spaced holes through which are inserted screws 68 threaded into threaded holes 70 in the housing part 12a to secure the fence ring 66 in place.

The shaft 26 is driven by a turbine rotor 72 mounted at the other end of the shaft. The turbine rotor has a hub 74 suitably secured on the shaft with shaped outwardly extending vanes 76. The turbine rotor vanes 76 face outwardly toward a slot or throat 78 through which the heated operating gases flow to drive the rotor. The gases

are discharged through an exhaust passage 80, formed in an annular hub 82 which is part of the housing part 12c. The operating gases are supplied to the throat through a scroll or operating gas chamber 84 which extends annularly around the throat 78 which supplies the rotor chamber 86.

Within the throat 78 are stator or nozzle vanes 88 secured to a nozzle vane plate or ring 90. As illustrated in FIGURES 1, 3 and 4, beside the throat 78 and extending axially therefrom is an annular recess 92 in which the vane ring is located. The annular recess also provides a location for a spring ring 94. The spring ring is backed against the wall 92a, and urges the vane ring and vanes 88 against the wall 78a which is the side of the throat 78. Between the nozzle ring 90 and the spring ring 94 is a means for maintaining the two rings in centered alignment and in the preferred form illustrated, the vane ring has an annular flange 90a with an inner surface 90b that centers the spring ring 94.

Thus, the housing part 12c can be inexpensively made, and the vane ring 90 and vanes 88 are substantially independent of the housing in contraction and expansion with temperature change. This greatly reduces the cost of manufacture and improves the safety and operational performance, avoiding expensive mountings for vanes and the cost of constructions of the type heretofore used.

The spring ring 94, as shown in FIGURES 1, 2 and 3, may take various forms, as will be appreciated by those skilled in the art, but is especially advantageous in being formed with a ring shaped annular back 94a from which facing tongues such as 94b and 94c are cut to resiliently project outwardly and engage the vane ring 90. This forms an inexpensive, easily assembled spring arrangement, and the vane assembly and spring assembly comprise only two parts. The nozzle ring 90 is always held firmly against the wall 78a which forms a support for the nozzle ring and also forms one side of the nozzles with each complete nozzle being formed by the surface of the wall 78a, the surfaces of the vanes 88 and the surface of the ring 90. The ring assembly including the nozzle ring 90 and the spring ring 94 provides nozzles which will remain concentric with the rotor and yet be substantially independent permitting free expansion and contraction of the housing and of the nozzles. This arrangement is well adapted to accommodating the dual flow of heated operating gases provided by the divided hot gas inlet.

A divided hot gas inlet is provided for improved operation and for the receipt of operating gas from dual banks of cylinders when the turbocharger is used in an engine having cylinders arranged in banks. The divided inlet is illustrated as preferably formed integrally within the housing part 12c, and is illustrated in FIGURE 1. The inlet connector 24 has an outwardly extending flange 24a for connecting a gas supply conduit which is of a size to supply the passage 96 and the passage 98, and has dual passages.

Operating gas distribution is obtained by the annular extending chamber 84 which is divided into two parts. At the upper end, the chamber is divided by a generally radially extending wall not shown. The inlet passage 96 supplies one half of the annular extending chamber 84 and the inlet passage 98 supplies the other half. A wall 102 extends substantially radially outwardly and forms a common wall for the passages 96 and 98.

In operation of the turbocharger 10, a heated operating gas is directed to the inlet fitting 24 and the gas divides to the passages 96 and 98 to flow in opposite directions. The gas flows inwardly through the openings defined by the nozzle vanes 88 to drive the turbine rotor 72. With temperature change, the vanes and their supporting ring 90 expand and contract substantially independently of the housing part 12c, and are held in firm operating position by the spring ring 94. The compressor rotor 44 draws in air through the inlet 52 forcing it outwardly through the throat 69 and into the involute compressor chamber 62.

Thus, it will be seen that we have provided an improved turbine structure which meets the objectives, advantages and features hereinbefore set forth. The turbine structure incorporating the improved nozzle ring assembly provides an inexpensive, easily assembled improved arrangement well suited for gas turbines.

The drawings and specification present a detailed disclosure of the preferred embodiments of the invention, and it is to be understood that the invention is not limited to the specific forms disclosed, but covers all modifications, changes and alternative constructions and methods falling within the scope of the principles taught by the invention.

We claim as our invention:

1. A turbine assembly comprising, a housing having a turbine rotor chamber therein, a turbine rotor mounted for rotation within said chamber, an exhaust passage leading from said chamber, an annular gas supply chamber formed in said housing radially outwardly of said rotor chamber and having a radial surface, a radially extending annular throat opening radially inwardly from said gas supply chamber into said rotor chamber, an annular throat ring having a smooth continuous side surface forming a side wall of said throat and having an annular outer surface at the outer edge thereof, an annular radially inwardly facing support surface on said housing adjacent said throat forming an axially extending recess in which said ring is positioned with said outer surface of said ring facing said annular inner surface of said housing, said inwardly facing surface enclosing said ring therein and radially positioning the ring, an axially facing surface means in the housing engaged by the ring limiting axial movement of the ring toward said throat, an annular spring ring having spring tongues cut therefrom extending axially toward the throat ring and engaging the throat ring and holding it against said surface means, an axially facing spring support surface in the housing supporting said spring ring, and an axially extending annular flange on the throat ring extending away from the throat and surrounding said spring ring holding it radially centered, said side surface of the throat ring forming a continuation of the surface of the housing in said gas supply chamber for the smooth flow of gas from the supply chamber into the throat.

2. A turbine assembly for a turbine having an exhaust passage, a rotor chamber, an annular supply chamber outwardly of the rotor chamber, and a throat leading inwardly from the supply chamber to the rotor chamber, the assembly comprising, a cast housing part having an annular hub portion forming the exhaust passage, having an annular outer portion extending concavely and defining the supply chamber terminating at one side of the supply chamber in an annular axial flange integral with the cast housing part, having a portion between the hub portion and outer portion forming one side of the annular throat, and having a portion between the hub portion and throat forming one side of the rotor chamber, a vane rotor within said rotor chamber, an annular integral one-piece ring having a radial planar surface with an outer portion forming the other side of the throat, said ring extending inwardly from the outer portion behind the rotor providing a planar inner portion forming the other side of said rotor chamber with said planar inner portion exposed between the vanes of said rotor, said inner and outer portions of said ring being co-planar for the smooth flow of fluid and forming a unitary side wall for the turbine interior free of rigid attachment to the cast housing part, said inner portion of the ring extending sufficiently radially inwardly to be axially exposed to said exhaust passage, an annular axially facing support surface on the housing part axially engaged by said annular ring for determining the axial position thereof relative to said throat and said rotor chamber, and a spring means behind said annular ring urging the ring against said support surface, said flange on said housing part having

an annular inwardly facing surface surrounding the ring  
and holding it coaxial with the rotor.

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