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R. P. KROON

2,402,418

TURBINE APPARATUS

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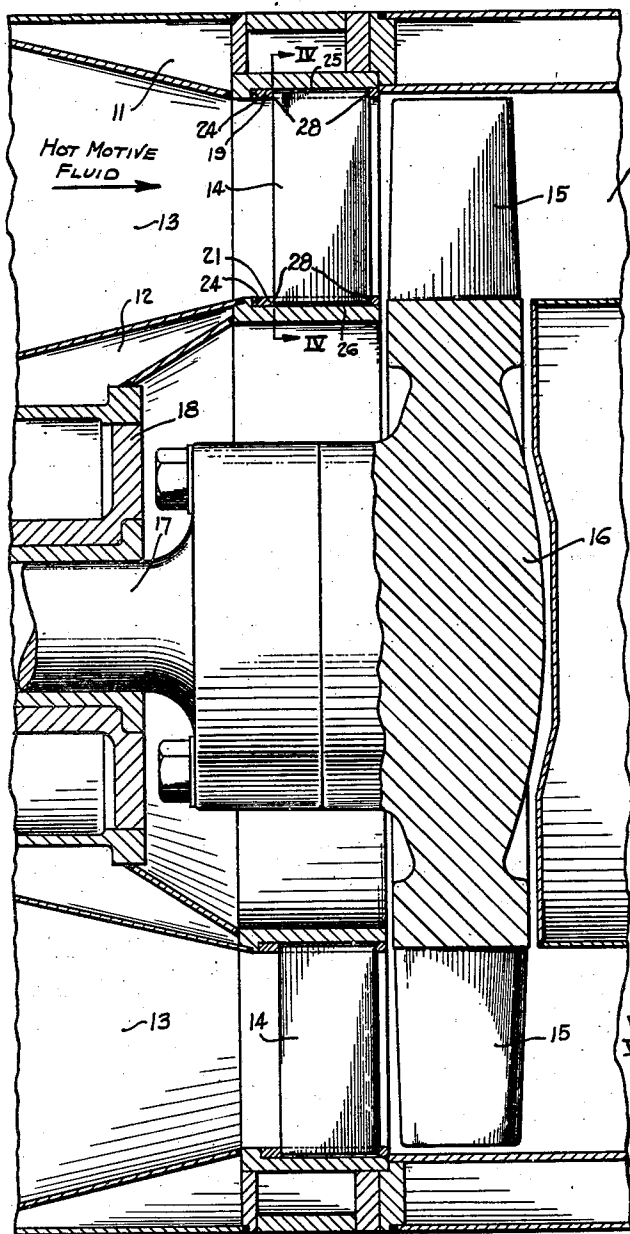


Fig. 1

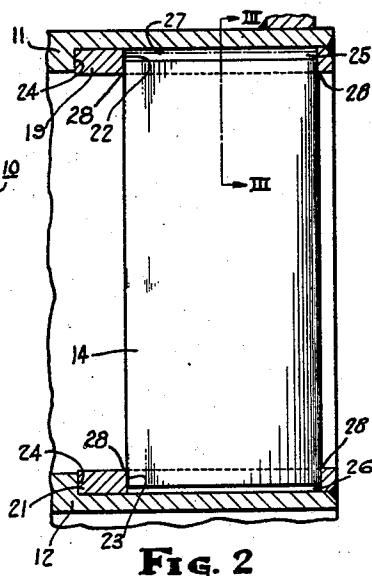


Fig. 2

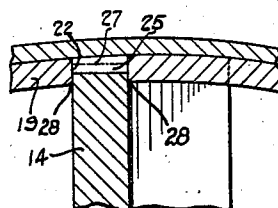


Fig. 3

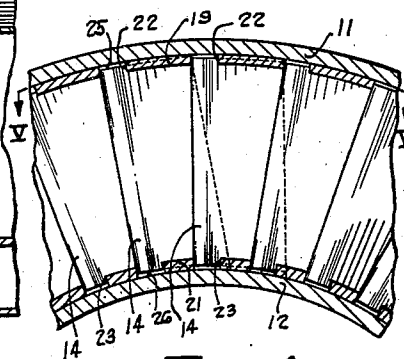


Fig. 4

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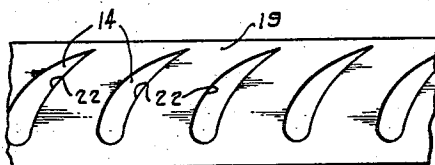


Fig. 5

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TURBINE APPARATUS

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Application January 20, 1943, Serial No. 472,957

8 Claims. (Cl. 253—78)

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This invention relates to power plants and particularly to the stationary nozzle structure of a gas turbine and it has for an object to provide an improved device of the character described.

It is desirable that gas turbines start quickly requiring high temperatures to bring the unit up to speed with the result that the turbine is subjected to a rapid increase in temperature and attendant expansion of the turbine parts. In contrast to steam turbines, changes in load on gas turbines are normally accompanied by changes in temperature of the motive fluid entering the turbine. Hence, sudden and large-temperature variations.

The blades on the turbine rotor are, of course, free to expand longitudinally into the clearance space provided in the casing. However, if the stationary guide vanes are welded or fixed to the turbine casing structure, rapid heating of the vanes and the surrounding parts may cause substantial differential expansion and set up very high stresses which may result in cracking of welds and rupture of the vanes or of the supporting structure.

It is, accordingly, a further object of the invention to provide an improved turbine in which stresses between the stationary guide vanes and their supporting structure, due to rapid temperature changes, is substantially eliminated.

These and other objects are effected by the invention as will be apparent from the following description and claims taken in connection with the accompanying drawing, forming a part of this application, in which:

Fig. 1 is a longitudinal sectional view of the stator and rotor section of a turbine in which the present invention has been incorporated;

Fig. 2 is an enlarged view of the stator shown in Fig. 1;

Fig. 3 is a view taken substantially on the line III—III of Fig. 2 and shown on an enlarged scale;

Fig. 4 is a sectional view taken substantially on the line IV—IV of Fig. 1; and,

Fig. 5 is an elevational view of an outer guide vane ring, as seen substantially on the line V—V of Fig. 4.

The turbine shown in the drawing may be of any type, although the present invention is particularly suitable for use in a gas turbine wherein a heated motive fluid, such as hot compressed air, serves to drive the turbine. For example, air may be compressed in a compressor, driven by the turbine, and heated in a suitable combustion apparatus in which the compressed air is mixed

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with and supports combustion of a fuel, the hot compressed air and products of combustion serving to drive the turbine. A power plant of this character is shown in my copending application Serial No. 474,093, filed January 30, 1943, and assigned to the assignee of the present invention.

The turbine, generally indicated 10, comprises an outer casing structure 11, which, with an inner supporting structure, generally indicated 12, provides an annular passage 13 for the flow of the heated motive fluid. The motive fluid is directed by nozzle vanes 14 against turbine blades 15 of a turbine wheel 16. The turbine wheel is carried on a shaft 17 which is journaled in the inner supporting structure 12, as by means of a bearing 18.

The nozzle vanes 14 are supported in the turbine casing by means of concentric rings 19 and 21 carried by the structures 11 and 12, respectively. These rings are provided with radially-aligned holes 22 and 23 of a shape corresponding to the cross section of the vanes. These holes may be punched in the rings and serve as mortises in which the ends of the guide vanes are slidably received. The vanes 14 may be inserted in the rings 19 and 21 and the assembly placed in the turbine with the rings seated in recesses 24 provided in the structures 11 and 12. The rings may then be fixed to the structure in any suitable manner as by welding or peening. The mortise openings 22 and 23 in the rings hold the vanes at the proper angle to direct the fluid against the turbine blades 15 and substantially prevent lateral movement of the vanes. However, the vanes are free to move longitudinally in the openings. Thus, during rapid temperature variations, the ends of the vanes may move, as shown by the broken lines 27 in Figs. 2 and 3, into clearance spaces 25 and 26 provided between the ends of the vanes and the structures 11 and 12 and prevent stresses from being developed between the vanes and their supporting structure.

A small clearance may be provided at 28 between the nozzle vanes and the walls of the holes on the supporting rings, so that the vanes are able to distort in bending, without setting up stresses at the ends of the nozzle vanes. Such bending may result from unequal expansion of the inlet and discharge edges of the vanes.

While it is preferred to slidably mount each end of the guide vanes in the supporting rings, if desired, the vanes may be fixed, as by welding, at one end to one of the rings 19 or 21, thus permitting expansion and contraction of the vanes in the openings of the other ring.

While the invention has been shown in but

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one form, it will be obvious to those skilled in the art that it is not so limited, but is susceptible of various changes and modifications without departing from the spirit thereof, and it is desired, therefore, that only such limitations shall be placed thereupon as are specifically set forth in the appended claims.

What is claimed is:

1. A turbine comprising an outer casing structure, an inner supporting structure spaced from said casing and defining therewith a passage for the flow of motive fluid, a first ring member secured to the inside of said outer casing structure, a second ring member secured to said inner supporting structure and arranged substantially concentric with respect to said first ring member, said ring members having a plurality of circumferentially-spaced holes therein, and guide vanes extending across said passage for guiding said motive fluid through said passage, the end portions of said vanes being received in said holes in said first and second ring members and both end portions of said vanes being free to move longitudinally in said holes.

2. A turbine nozzle ring comprising a pair of ring members disposed in spaced, concentric relation, a plurality of guide vanes carried by said ring members and extending between them, and means connecting the ends of said vanes to the rings, said connecting means fixing said vanes in definite circumferentially-spaced relation while permitting limited longitudinal movement of both ends thereof.

3. A supporting structure for a nozzle vane for turbines or the like in which the parts are subjected to temperature changes, comprising spaced supporting members fixed relative to each other, said members having holes therein, and vanes extending between said members with both ends of the vanes slidably received in said holes whereby said vanes and supporting members may expand or contract due to temperature changes thereof without exerting excessive stresses between said vanes and members.

4. A nozzle structure for turbines or the like comprising spaced supporting members defining therebetween a passage for the flow of a motive fluid, vanes extending across said passage for guiding said fluid through said passage, and means for securing said vanes to said members to prevent movement of said vanes in a lateral direction, said means being arranged to permit said vanes to have limited longitudinal movement at each end with respect to said supporting members.

5. A nozzle structure for turbines or the like comprising spaced supporting members defining

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therebetween a passage for the flow of motive fluid, vanes extending across said passage for guiding said fluid through said passage, said members having holes therein to slidably receive the end portions of said vanes, said holes being of a shape corresponding to the cross section of and receiving the ends of said vanes to substantially prevent lateral motion while permitting longitudinal movement of each end of said vanes in said holes.

6. In a turbine, a casing, a rotor having a row of blades, said casing including inner and outer annular structures having exterior and interior cylindrical surfaces, respectively, at the inlet side of said blades and spaced radially to suit the height of the latter, a row of nozzle vanes extending radially between said surfaces and each having a length which is slightly less than the radial distance therebetween, means for retaining said vanes in circumferentially-spaced relation and comprising inner and outer rings having openings conforming to the section of and receiving the ends of the vanes so that such ends are capable of sliding in the openings, said outer ring fitting the interior cylindrical surface of the outer annular structure and said inner ring fitting the exterior cylindrical surface of the inner annular structure, and means for securing the rings in place with respect to the annular structure.

7. A nozzle structure for turbines or the like comprising a pair of ring members disposed in spaced concentric relation, and a plurality of guide vanes carried by said members and extending between them, said pair of ring members being formed with radially-aligned holes of a shape corresponding to the cross section of the end portions of said guide vanes, and said guide vane end portions being received in said holes for limited longitudinal movement of each end portion thereof.

8. A turbine or the like comprising an outer casing structure, an inner supporting structure spaced from said casing and defining therewith a passage for the flow of fluid, a first ring member secured to the inside of said outer casing structure, a second ring member secured to said inner supporting structure and arranged substantially concentric with respect to said first ring member, said ring members having a plurality of circumferentially-spaced holes therein, and guide vanes extending across said passage for guiding fluid through said passage, the end portions of said vanes being received in said holes in said first and second ring members and both end portions being slidable longitudinally therein.

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