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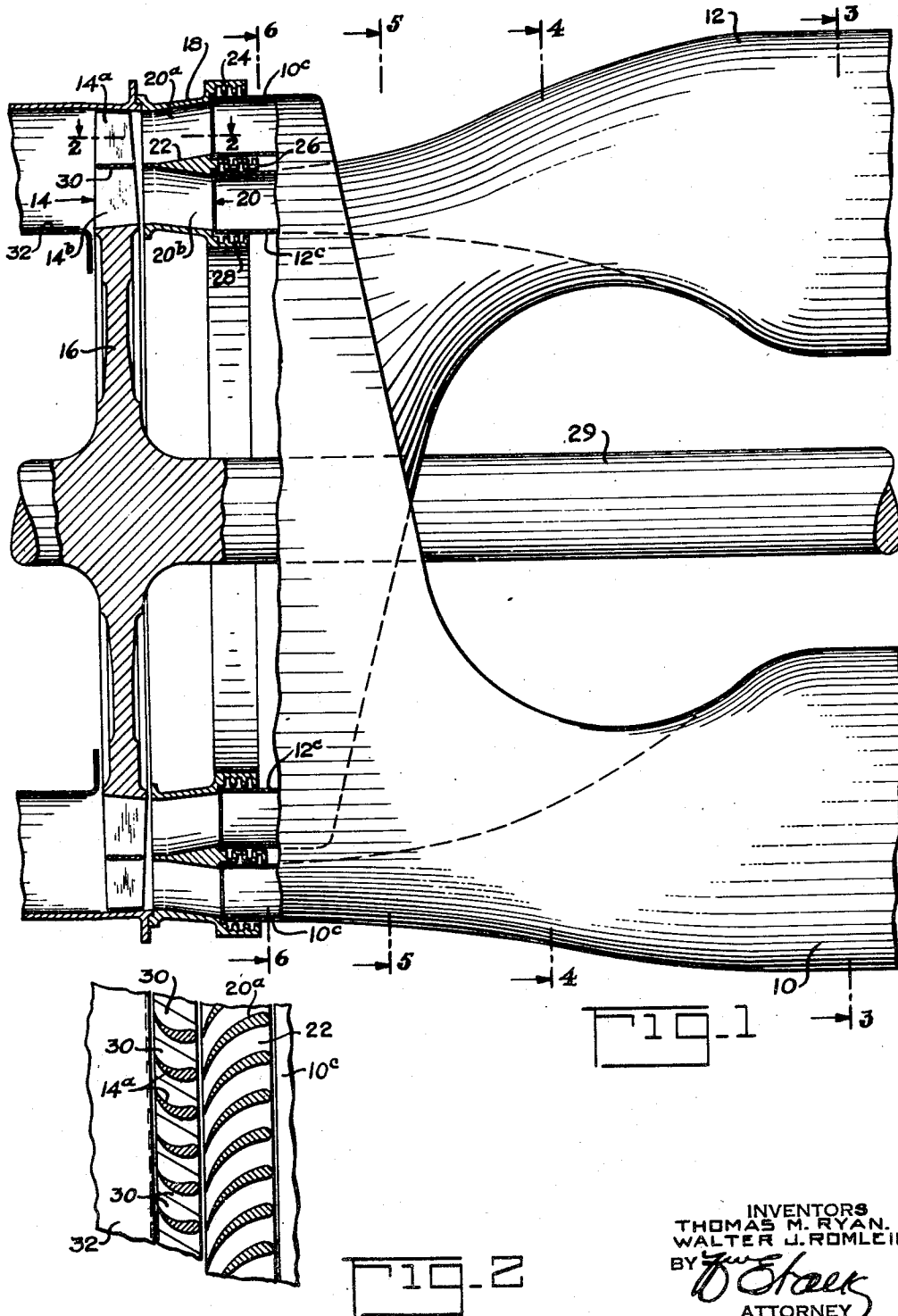
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TURBINE AND TURBINE NOZZLE CONSTRUCTION

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2 Sheets-Sheet 1



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2 Sheets-Sheet 2

FIG. 7

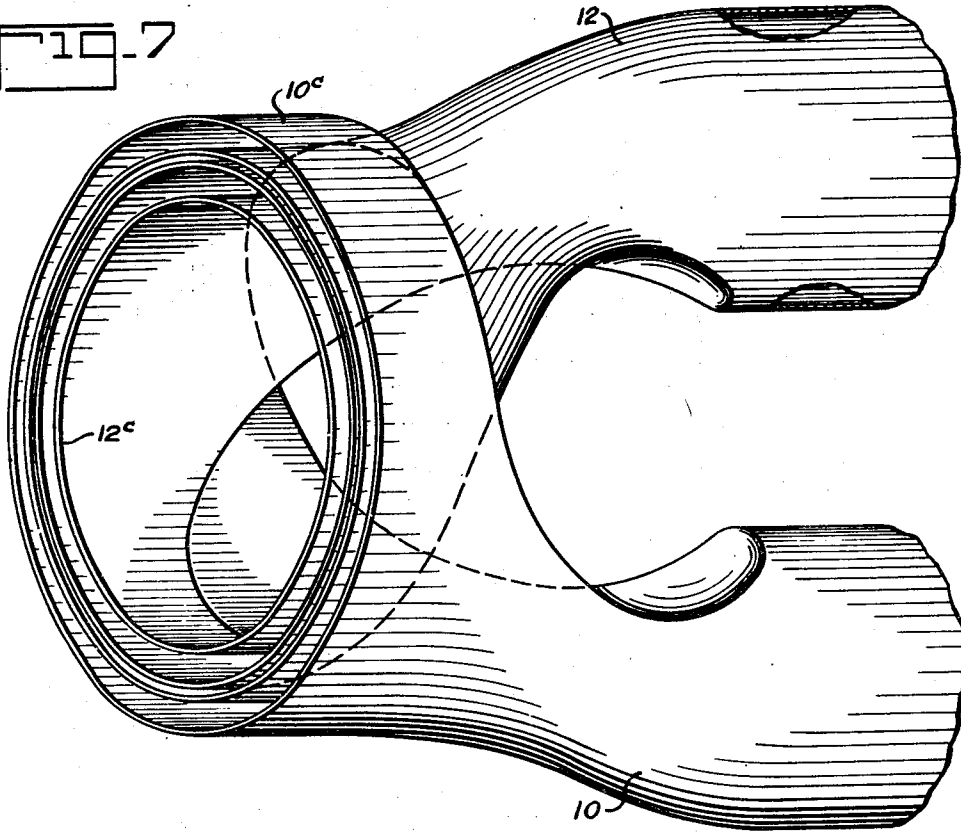
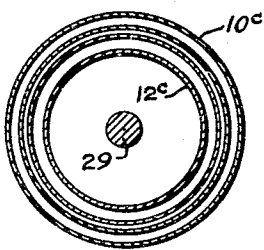


FIG. 6

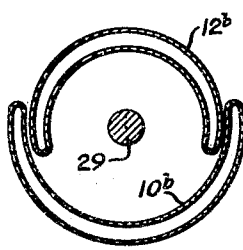


FIG. 5

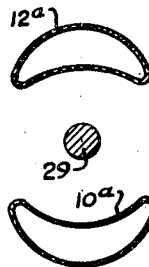


FIG. 4

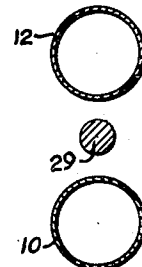


FIG. 3

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TURBINE AND TURBINE NOZZLE
CONSTRUCTION

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3 Claims. (Cl. 253—65)

1

This invention relates to fluid engines and is more particularly directed to an annular nozzle construction for the engine motive fluid.

In a gas turbine power plant having a plurality of independently operable gas generators, the general practice is to circumferentially divide the turbine nozzle into segments, one for each gas generator. For example, with two gas generators, each generator would supply turbine motive fluid approximately to only 180° of the annular turbine nozzle whereby, with one of the gas generators shut down, the turbine blades would receive motive fluid from only ½ the circumference of the nozzle.

This conventional arrangement has numerous drawbacks, particularly during partial admission of the turbine motive fluid, that is, when less than all of the gas generators are operating. For example, with partial admission of turbine motive fluid; there is buffeting of the turbine blades by the turbine motive fluid; the intermittent filling and emptying of the spaces between the turbine blades by said fluid results in pressure surging; the temperature distribution around the nozzle is non-symmetrical relative to the nozzle axis whereby the turbine blades alternately rotate through hot and cold zones; and the pressure of said motive fluid on the turbine rotor is non-uniform around the rotor.

An object of this invention comprises the provision of a novel turbine nozzle construction in which the aforementioned disadvantages, which accompany partial admission of turbine motive fluid, are avoided. Specifically the invention comprises a turbine nozzle construction and turbine therefor, in which the turbine nozzle structure comprises a plurality of concentric nozzles each directing turbine motive fluid from an individual combustion chamber or gas generator against the turbine blades. Said nozzles are concentrically disposed about each other and the turbine blades extend radially across the concentric discharge ends of said nozzles. In addition each turbine blade is divided into a plurality of radially-spaced sections each receiving turbine motive fluid from only one of said nozzles.

Other objects of the invention will become apparent upon reading the annexed detailed description in connection with the drawing in which:

Figure 1 is a schematic view partly in section of a gas turbine power plant embodying the invention.

Figures 2, 3, 4, 5, and 6 are sectional views taken along lines 2—2, 3—3, 4—4, 5—5, 6—6 respectively of Figure 1; and

2

Figure 7 is a perspective view of the discharge end of the combustion chambers.

Referring to the drawing, reference numerals 10 and 12 designate ducts for conveying a fluid under pressure. Each duct 10 and 12 may comprise all or part of a combustion chamber to which air under pressure is supplied and mixed with fuel for combustion therein, or each said duct may simply comprise a passage for conveying fluid under pressure from either a combustion chamber or some other source of fluid under pressure, as for example, the exhaust from a high pressure turbine. The fluid ducts 10 and 12 supply combustion gases or other suitable fluid under pressure to a turbine nozzle construction from which said fluid is directed against the blades 14 of the turbine rotor 16 for driving said rotor.

The cross-section of the fluid duct 10 gradually changes from a tubular or circular cross-section, at a relatively upstream point, through the cross-sections indicated at 10a and 10b in Figures 4 and 5 respectively, to an annular discharge end 10c as best illustrated by the progressive sectional views of Figures 3, 4, 5, and 6 and by the perspective view of Figure 7. The cross-section of the fluid duct 12 goes through a similar transition from a circular or tubular cross-section, through its cross-sections indicated at 12a and 12b to its annular discharge end 12c. In order to permit the annular nozzles or discharge ends 10c and 12c of the fluid ducts to be concentrically disposed one about the other, the outer diameter of the annular discharge end 12c of the fluid duct 12 is slightly smaller than the inner diameter of the annular discharge for 10c of the fluid duct 10. In addition the tubular portions of the ducts 10 and 12 are disposed on opposite sides of and are spaced from the common axis of their annular discharge ends.

The discharge ends of the fluid ducts 10 and 12 merge with a fixed annular nozzle vane section 18 having vanes 20 comprising sections 20a and 20b for directing the combustion gases or other motive fluid against the turbine rotor blades 14. The nozzle vane sections 20a and 20b are generally similar and are separated by an annular flange 22 which is disposed in alignment with the small annular gap between the concentric discharge ends 10c and 12c of the fluid ducts 10 and 12. The arrangement is such that the annular flange 22 in effect joins the facing annular walls of the discharge ends 10c and 12c. For structural reasons, the nozzle vane section 18 is not rigidly secured to the discharge ends of the fluid ducts 10 and 12 but instead these parts

are disposed in telescopic relation with annular labyrinth seals 24, 26, and 28 therebetween.

With the aforedescribed construction the motive fluid supplied through the fluid duct 10 discharges through the annular nozzle provided by the nozzle vane section 20a and the motive fluid supplied through the fluid duct 12 discharges through the annular nozzle provided by the nozzle vane section 20b.

The turbine rotor 16 is mounted for rotation on the axis of the annular discharge ends 10c and 12c and a shaft extension 29 of the rotor 16 extends co-axially through said annular discharge ends. As illustrated the rotor 16 is provided with a single set of turbine blades 14 about its periphery. Obviously, however, the turbine rotor may be provided with any number of axially spaced sets or stages of turbine blades as is conventional practice in multi-stage turbine rotors. Each turbine blade 14 is divided into two sections 14a and 14b separated by an annular flange or shelf construction 30 projecting laterally on opposite sides of each turbine blade into abutting engagement with the corresponding flanges 30 of adjacent blades. If desired said flanges 30 may be welded or otherwise secured together along their abutting edges to form an integral rim separating the blade sections 14a and 14b. Whether or not the flanges 30 are welded together these flanges 30 greatly strengthen the blades 14.

The turbine blade flanges 30 are disposed in alignment with the annular nozzle flange 22 whereby the turbine motive fluid directed by the nozzle vanes 20a discharges against only the blade sections 14a and the turbine motive fluid directed by the nozzle vanes 20b discharges against only the blade sections 14b. From the discharge end of the turbine rotor blades 14 the turbine motive fluid exhausts into an exhaust duct 32.

With the aforedescribed construction when turbine motive fluid is being supplied through both fluid ducts 10 and 12, there is full admission of turbine motive fluid to both turbine blade sections 14a and 14b. That is, motive fluid is admitted to both said blade sections from the entire 360° of their nozzles 20a and 20b. With only one of the fluid ducts 10 or 12 supplying motive fluid, there is full admission of turbine motive fluid from the entire 360° of its nozzle 20a or 20b to the associated turbine blade sections 14a or 14b thereby maintaining the operating efficiency of this section of the turbine blades. In addition the clearance between the annular flange 22 and the composite annular blade flange 30 may be made quite small thereby minimizing leakage of turbine motive fluid from one of the nozzles 20a or 20b to the other during partial admission. Also with the present invention, there is no blade buffeting and/or pressure surging during partial admission of the turbine motive fluid as occurs in the conventional arrangement wherein certain circumferentially spaced sections of an annular nozzle are blanked out during partial admission. Furthermore, with the present invention the temperature and pressure conditions around the nozzle and/or turbine rotor are substantially symmetrical relative to the rotor axis.

The invention has been described in connection with a gas turbine power plant provided with two combustion chambers. Obviously, however, the invention is applicable to a gas turbine power plant having any plural number of combustion chambers.

While we have described our invention in detail in its present preferred embodiment, it will be obvious to those skilled in the art, after understanding our invention, that various changes and modifications may be made therein without departing from the spirit or scope thereof. We aim in the appended claims to cover all such modifications.

We claim as our invention:

1. A pair of ducts for the motive fluid of an engine; said ducts having concentric annular passage portions disposed one within the other throughout parts of their respective lengths, throughout other parts of their respective lengths said ducts each having a tubular passage portion in series with its annular passage portion, each duct also having an intermediate passage portion providing a smooth transition between its said annular and tubular passage portions, each of said duct passage portions extending substantially parallel to the axis of said annular passage portions with the tubular passage portion of one duct being disposed laterally to one side of the tubular passage portion of the other duct.

2. A pair of ducts for the motive fluid of an engine; said ducts having concentric annular passage portions disposed one within the other throughout parts of their respective lengths, throughout other parts of their respective lengths said ducts each having a tubular passage portion in series with its annular passage portion, said tubular passage portion of one duct being disposed to one side of the axis of said annular passage portions and said tubular passage portion of the other duct being disposed on the diametrically opposite side of said axis.

3. In a turbine power plant; a pair of ducts for supplying motive fluid to the turbine rotor, said ducts having annular discharge passage portions disposed one within and immediately adjacent to the other, each said duct also having a tubular passage portion and an intermediate passage portion serially connecting and providing a smooth transition between its annular and tubular passage portions, each of said duct passage portions extending substantially parallel to the axis of said annular passage portions with the tubular passage portions of said ducts being disposed on diametrically opposite sides of said axis; and blades on said rotor adapted to receive motive fluid from the annular discharge passage portions of said ducts for imparting rotation to said rotor, each of said turbine blades having a laterally extending flange intermediate its ends such that said flanges define an annular rim separating each blade into two sections, the one blade section of each blade being disposed in alignment with one of said annular discharge passages and its other blade section being disposed in alignment with the other of said annular discharge passages.

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