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COAXIAL COMBUSTION PRODUCTS GENERATOR, TURBINE, AND COMPRESSOR

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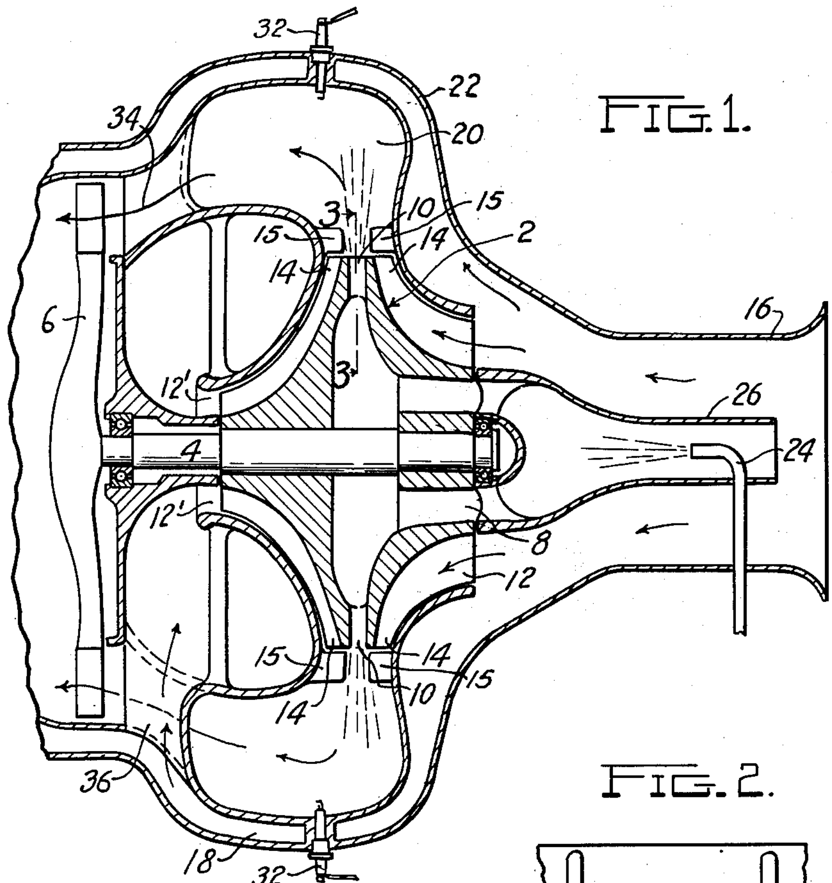


FIG. 1.

FIG. 2.

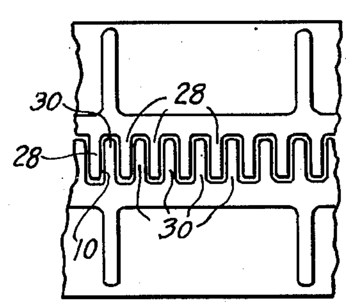
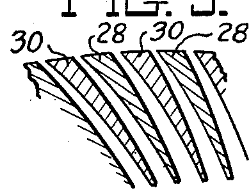


FIG. 3.



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COAXIAL COMBUSTION PRODUCTS GENERATOR, TURBINE, AND COMPRESSOR

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4 Claims. (Cl. 60—39.36)

This invention relates to a gas turbine of the type which utilizes a mixture of burned gas and air.

Recent developments in the jet propulsion of aircraft emphasize the importance of research in gas turbines of the type which are run by a mixture of burned gas and air. In aircraft design, size and weight of the power plant are factors of primary importance. Any development, therefore, which enables the power plant to be reduced in size and, correspondingly, in weight without sacrificing power is important.

It is the object of this invention to set forth a gas turbine design which will be an efficient power plant, but which will permit important size and weight reductions without sacrificing power. This is accomplished by reducing the size of the combustion chamber. In a smaller combustion chamber, the problem of burning fuel and air is increased, and this invention solves that problem by mixing fuel and air before entering the compressor. Another problem involving size of the power plant is the intimate mixing of burned and/or burning gas with secondary air; this invention solves that problem by accomplishing the mixing in a region of high turbulence.

In the drawings:

Fig. 1 is a longitudinal section through the engine.

Fig. 2 is a developed view of the periphery of the compressor rotor; and

Fig. 3 is a detail sectional view along the line 3—3 of Fig. 1.

A rotary compressor 2 is shown mounted for rotation on a shaft 4 at one end of which is mounted a power utilizer or turbine wheel 6. Rotor 2 is made with two sets of passages, one set of these passages being formed by inlet openings 8 in the hub or rotor 2 and immediately adjacent the axle 4, and outlet openings 10 in the periphery of rotor 2. The other set of passages through rotor 2 has openings 12 adjacent the openings 8 and located farther from the shaft 4 than openings 8, and outlet openings 14. Some of this second set of passages are disposed on the opposite end of rotor 2. These passages are shown as having inlet openings 12′ and outlet openings 14. It will be seen from Figs. 1 and 2 that outlet openings 14 are disposed on opposite sides of outlet openings 10. Diffuser vanes 15 are disposed in the path of the outlet openings.

An air duct 16 is arranged to supply air to inlet openings 8 and 12. Inlet openings 12′ are

supplied with air through enveloping passages 18 which constitute the space formed between the outer extremities of combustion chamber 20 and casing 22.

A fuel injection nozzle 24 is disposed in air duct 16 preferably in such a manner as to limit the fuel-air mixture to inlet openings 8 in the rotor. To this end, nozzle 24 may be arranged in a shield 26 located in air duct 16.

The outside passages formed by openings 12—14 and 12′—14 may be shrouded or not as may seem desirable. It has been found in this invention that the open or unshrouded passages provide satisfactory performance.

As can be readily seen from Figs. 2 and 3, there are disposed radial vanes 28 and 30 in outlet openings 10. In a practical embodiment of this invention rotor 2 may, if preferred, be constructed in two halves divided substantially along line 3—3 extended of Fig. 1, these two halves being bolted or otherwise fastened together. In this embodiment, the vanes 28 will be integral with one of the rotor halves and the vanes 30 will be integral with the other half, the vanes 28 and 30 alternating in the outlet opening 10. Vanes 28 and 30 are closely spaced together so as to have the effect of a flame-arresting means so that combustion of the fuel-air mixture will not take place inside rotor 2, in order that rotor 2 may be made of a very light and relatively soft material, such as aluminum.

In the preferred embodiment, just described, the set of passages made up by openings 8—10 has been set forth as the fuel-air passages, while the passages constituted by openings 12—14 and 12′—14 are set forth as the auxiliary air passages. If desired of course the function of the two sets of passages may be interchanged so that passages 8—10 carry auxiliary air and the passages 12—14 and 12′—14 carry fuel and air. It will be understood however that the flame-arresting means described will be disposed in the fuel-air passages. An ignition plug 32 of any of a number of satisfactory types may be provided for initial ignition of the fuel-air mixture in combustion chamber 20.

Operation

In operation, fuel and air are somewhat mixed in the air duct 16 and this mixing continues in the fuel-air passages 8—10 as the mixture passes through the rotor. As the mixture leaves the periphery of the rotor through openings 10, it is ignited, initially by ignition plug 32 and thereafter by the continuous combustion which takes place in the chamber **20**. Combustion inside rotor **2** is prevented by the flame-arresting action of closely spaced radial vanes **28** and **30**. Auxiliary air passes through the passages **12**—**14** and, by the way of passages **18**, through passages **12'**—**14** in such a manner that auxiliary air issues from the rotor periphery in two streams with the burning fuel-air mixture issuing from the rotor between the two streams of auxiliary air. This arrangement accomplishes the purpose of helping to insulate the combustion chamber against heat losses; also, this arrangement accomplishes intimate mixing of burning fuel-air and auxiliary air by mixing them in a region of extremely high turbulence, i. e., adjacent the periphery of fast rotating rotor **2**. The engine is further guarded against heat losses by having air for passages **12'**—**14** surround the combustion chamber by virtue of annular space or passage **18**. This feature serves also as a preheater for some of the auxiliary air. The arrangement of two jets of auxiliary air disposed on opposite sides of the fuel-air mixture serves the additional purpose of keeping the rotor **2** at a relatively cool temperature. The entire arrangement permits the use of an extremely light weight material for rotor **2** and, because of the mixture in a region of high turbulence, enables the use of a relatively small but efficient combustion chamber **20**.

The intimately mixed gases and auxiliary air issue from the combustion chamber through circumferentially spaced nozzles **34** to impinge upon the turbine wheel **6**. Nozzles **34** alternate with similarly circumferentially spaced air passages **36**, which afford communication between space **18** and inlet openings **12'**. Some auxiliary air from space **18** by-passes, or passes around, the turbine wheel, as can be seen from Fig. 1.

I claim:

1. An internal combustion engine comprising a fixed casing structure having an annular combustion chamber, a shaft rotatably supported axially of said casing, a turbine wheel mounted on said shaft and having turbine blades adapted to be disposed in the fluid stream exhausted from said combustion chamber, a compressor rotor mounted on said shaft and having separate passages all terminating in axially spaced outlets at the periphery of the rotor, an air duct carried by the casing structure and arranged to supply air to the rotor and having concentric inner and outer air passages terminating in outlets aligned with the inlets of a like number of passages in said rotor, a source of fuel supply, and means to supply fuel mixture to one of said rotor passages and air to the others of said rotor passages, all said rotor passages being separated and discharging directly into said combustion chamber.

2. An internal combustion engine comprising a fixed casing structure having an annular combustion chamber, a shaft rotatably supported axially of said casing, a turbine wheel to be disposed in the fluid stream exhausted from said combustion chamber, a compressor rotor mounted on said shaft and having separate passages all terminating in axially spaced outlets at the periphery of the rotor, an air duct carried by the casing structure and arranged to supply air to the rotor and having concentric inner and outer air passages terminating in outlets aligned with the inlets of a like number of passages in said rotor, a source of fuel supply, and means to supply fuel to one of said casing air passages, whereby to supply a fuel mixture to one of said rotor passages and air to the others of said rotor passages, all said rotor passages being separated and discharging directly into said combustion chamber, said casing structure provided with an extended passage connected with the air passage supplying air alone to said rotor, said extended passage encompassing the combustion chamber and communicating with another of said rotor passages having an inlet disposed on the rotor end opposite to the said other rotor passage inlets.

3. An internal combustion engine comprising a fixed casing structure having an annular combustion chamber, a shaft rotatably supported axially of said casing, a turbine wheel mounted on said shaft and having turbine blades adapted to be disposed in the fluid stream exhausted from said combustion chamber, a compressor rotor mounted on said shaft and having separate passages all terminating in axially spaced outlets at the periphery of the rotor, an air duct carried by the casing structure and arranged to supply air to the rotor and having concentric inner and outer air passages terminating in outlets aligned with the inlets of a like number of passages in said rotor, a source of fuel supply, and means to supply fuel to said inner air passage whereby to supply a fuel mixture to the rotor passage aligned therewith, and which is disposed in said rotor intermediate the others of said rotor passages, one of said other rotor passages having inlet ends aligned with said outer air passage, said casing structure provided with an extended passage connected with the said outer air passage and encompassing the combustion chamber and communicating with another of said other rotor passages, said third rotor passage having an inlet disposed on the rotor end opposite to said other rotor passage inlets.

4. An internal combustion engine comprising a fixed casing structure having an annular combustion chamber, a shaft rotatably supported axially of said casing, a turbine wheel mounted on said shaft and having turbine blades adapted to be disposed in the fluid stream exhausted from said combustion chamber, a compressor rotor mounted on said shaft and having separate passages all terminating in axially spaced outlets at the periphery of the rotor, an air duct carried by the casing structure and arranged to supply air to the rotor and having concentric inner and outer air passages terminating in outlets aligned with the inlets of a like number of passages in said rotor, a source of fuel supply, and means to supply fuel to said inner air passage whereby to supply a fuel mixture to the rotor passage aligned therewith, and which is disposed in said rotor intermediate the other of said rotor passages, one of said other rotor passages having inlet ends aligned with said outer air passage, said casing structure provided with an extended passage connected with the said outer air passage and encompassing the combustion chamber and communicating with another of said other rotor passages, said third rotor passage having an inlet disposed on the rotor end opposite to said other rotor passage inlets, said fuel mixture rotor outlet comprising interlaced staggered baffles serving as flame arresting means, and fixed baffles carried by the casing and extending inwardly from the walls of the combustion chamber adjacent to and solely overlying the outlets of the air passages in said rotor to create turbulences and resulting in immediate commingling of the air streams and intermediate fuel mixture stream

in that portion of the combustion chamber adjacent to the periphery of said rotor.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
2,256,198	Hahn	Sept. 16, 1941
2,404,707	Heppner	July 23, 1946
2,419,598	Schey	Apr. 29, 1947
2,476,218	Prime	July 12, 1949
2,477,683	Birmann	Aug. 2, 1949

FOREIGN PATENTS

Number	Country	Date
648,107	France	Aug. 7, 1928
685,830	France	Apr. 7, 1930
550,374	Germany	May 17, 1932
644,829	Germany	May 14, 1937
171,685	Great Britain	June 22, 1922