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GAS DIFFUSERS FOR AIR SUPPLIED TO COMBUSTION CHAMBERS

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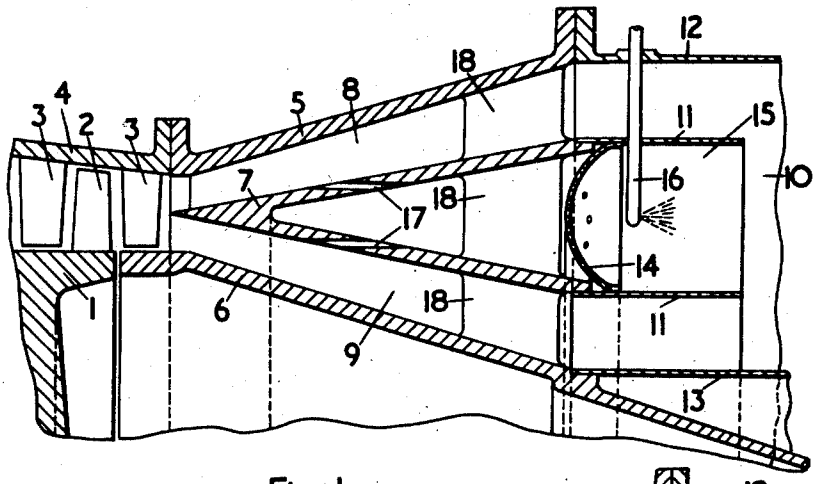


Fig. 1.

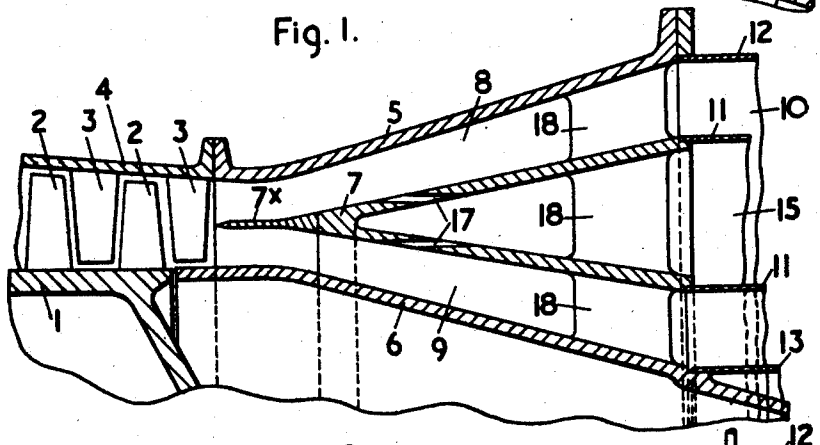


Fig. 2.

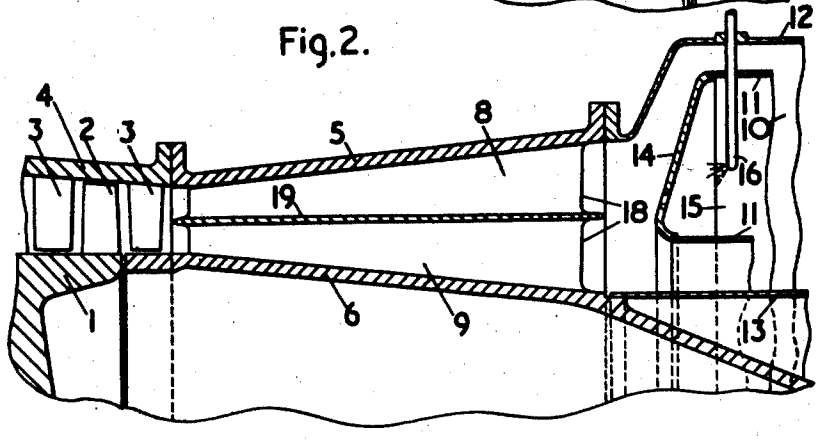


Fig. 3.

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GAS DIFFUSERS FOR AIR SUPPLIED TO COMBUSTION CHAMBERS

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10 Claims. (Cl. 60—44)

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This invention relates to gas diffusers such, for example, as may be employed for reducing the velocity of air delivered into the primary zone of the combustion chamber of an internal combustion turbine power unit of the axial flow type; the chief object being to provide a diffuser which will enable diffusion of a gas flow to be obtained rapidly and efficiently.

In order to obtain efficient diffusion in a simple diffuser in the form of a diffuser passage of progressively increasing cross-sectional area from the inlet to the outlet, the taper or rate of change of cross-section of the diffuser passage must be small so as to preserve a uniform distribution of the gas throughout the passage and prevent the flow breaking away from the walls thereof. The deceleration of the gas flow is consequently gradual and the use of a long diffuser passage is entailed if the velocity is required to be reduced considerably.

In the design of certain apparatus a long diffuser of simple taper form is difficult to accommodate; this is particularly the case in the design of internal combustion turbine power plants for aircraft where there are limitations upon the overall length and lateral dimensions of the power unit which can be installed.

According to the invention, the diffuser is adapted to divide the flow into two or more streams before any diffusion commences and to lead or direct said streams each into a separate diffusion passage having a diffusion angle between 4° and 12°, the number of diffusion passages being sufficient to obtain the requisite rate of diffusion.

Optimum diffusion efficiency has been found to obtain with a diffusion angle of 6°.

The invention will now be described more particularly with reference to the accompanying drawing in which Figs. 1, 2 and 3 are fragmentary radial sections illustrating different embodiments of diffuser as applied to an internal combustion turbine power plant of the axial flow type, the diffuser in each embodiment being employed for reducing the velocity of air delivered into the combustion chamber.

Referring to the embodiment illustrated in Fig. 1, an axial flow compressor, comprising a rotor 1 with rows of blades 2 inter-digitating with rows of stator blades 3 on a stator casing 4, discharges compressed air directly from its convergent flow annulus into a divergent annular diffusion chamber defined by outer and inner walls 5, 6, respectively. The diffusion chamber is divided internally by an annular member 7 of hollow wedge

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section to afford between it and the outer and inner walls 5, 6 outer and inner diffusion passages 8, 9, respectively. The wedge shaped member 7 has its pointed end or leading edge located at the junction of the diffusion chamber inlet with the supply conduit or inlet accelerator constituted by the convergent flow annulus of the compresser, and the said wedge shaped member 7 extends throughout the length of the diffusion chamber so that the diffusion passages 8, 9 discharge into the secondary zone of the combustion chamber 10. Annular partitions 11 serve in conjunction with the walls 12, 13 of the combustion chamber to lead the air to the secondary zone, whilst the annular space between said partitions is bridged on the upstream side by a perforated dished ring 14 so as to constitute a flame chamber or primary zone 15 in which fuel is injected and burnt by burner jets 16 (only one of which is shown). Primary air to support the combustion of the fuel injected into the flame chamber or primary zone 15 is supplied through axially disposed ports 17, which lead from the diffusion passages 8, 9 into the interior of the wedge shaped member 7, and by the perforations in the ring 14.

Radial webs 18 locate and support the wedge-shaped member 7 in the diffuser chamber.

Each diffusion passage 8, 9 has a diffusion angle between 4° and 12°, and preferably an angle of 6° with which aerodynamic losses are found to be a minimum.

Referring now to the embodiment illustrated in Fig. 2, in which like references to those in Fig. 1 indicate like or analogous features, the modification consists in the inlet end of the diffusion chamber being formed as a continuation of the supply conduit or inlet accelerator and the provision on the forward portion of the wedge-shaped member 7 of a plate-like extension 7* with a sharp leading edge located at the junction of the diffusion chamber inlet with the discharge end of the flow annulus of the compressor.

In the embodiment illustrated in Fig. 3, in which like or analogous features to those in Fig. 1 are again indicated by the same reference numerals, the divergence between the walls 5, 6 of the diffusion chamber is equal to the sum of the angles of diffusion of the two diffusion passages 8, 9, the division in this instance being made by a centrally located plate 19 which extends throughout the length of the diffusion chamber and has a sharp leading edge at the junction of the diffusion chamber inlet and the discharge end of the flow annulus of the compressor.

In each of the three embodiments above described, the air flow is divided into two streams, by the leading edge of the wedge (Fig. 1), plate-like extension (Fig. 2), or dividing plate (Fig. 3), at or in advance of the point where diffusion commences. It has been found that by splitting the flow before diffusion commences and providing for the separate diffusion of each stream as above described, the degree and efficiency of diffusion through each passage is the same as obtains with a simple diffuser; consequently with a split diffuser affording two diffusion passages the same amount of diffusion as in a simple diffuser can be obtained in half the overall length with little increase in aerodynamic loss.

It will, of course, be understood that the number of diffusion passages provided in any instance will be in accordance with the rate of diffusion required and any limitations imposed on the overall length, and that, whereas the invention has been described more particularly in relation to its application to internal combustion turbine power plants, it is of general application to various types or kinds of apparatus which require for their satisfactory operation or design that the gases are diffused rapidly and efficiently.

What we claim as our invention and desire to secure by Letters Patent is:

1. Gas diffuser means comprising wall means defining an upstream non-diffusing gas passage and wall means defining a plurality of downstream diffusing gas passages arranged in parallel and having a common inlet connected with the outlet of said upstream passage, the total cross-sectional area of the downstream passages at their common inlet being equal to that of the upstream passage at its outlet, each downstream passage having an effective diffusion angle between 4° and 12° and an upstream extension of the wall means defining said downstream passages, said extension being so constructed and arranged as to divide the total gas flow into the downstream passages before diffusion takes place.

2. Gas diffuser means comprising an inner wall of frustoconical form, an outer wall of frustoconical form coaxial and corresponding in axial length with said inner wall, said walls diverging from their upstream ends toward their downstream ends, wall forming means supported coaxially between said inner and outer walls defining therewith a plurality of diffuser passages having effective diffusion angles of between 4° and 12°, combustion means arranged to receive air from said diffuser passages, said wall forming means being provided with passages therethrough so located as to supply air from said diffuser passages to said combustion means prior to complete diffusion.

3. Gas diffuser means comprising an inner wall of frustoconical form, an outer wall of frustoconical form coaxial and corresponding in axial length with said inner wall, said walls diverging from their upstream ends toward their downstream ends, wall forming means supported coaxially between said inner and outer walls defining therewith a plurality of diffuser passages having effective diffusion angles of between 4° and 12°, said wall forming means comprising a structure of wedge section and annular in form.

4. Gas diffuser means according to claim 2 wherein the air prior to complete diffusion is led into the primary combustion zone of said combustion means.

5. A gas generator for a gas turbine that comprises a compressor to supply air having means defining an outlet, combustion means, and connecting means between said combustion means and the outlet of said compressor, said combustion means including an inner and outer annular spaced partition defining a primary zone, and an inner annular wall spaced from said inner annular partition and an outer annular wall spaced from said outer annular partition defining a secondary zone, said connecting means including a continuous tapered extension of said partitions to form in lengthwise section a hollow wedge, and a continuous extension of said walls defining with the extension of said partitions a plurality of passages communicating between the outlet of said compressor and said secondary zone to transmit air therebetween, the extension of said partitions having openings communicating between said passages and its interior, and said connecting means constituting a diffusion chamber.

6. A gas generator for a gas turbine that comprises a compressor to supply air having means defining an outlet, combustion means, and connecting means between said combustion means and the outlet of said compressor, said combustion means including an inner and outer annular spaced partition defining a primary zone, and an inner annular wall spaced from said inner annular partition and an outer annular wall spaced from said outer annular partition defining a secondary zone, said connecting means including a continuous tapered extension of said partitions to form in lengthwise section a hollow wedge having openings, and a continuous extension of said walls defining with the extension of said partitions a plurality of passages communicating between the outlet of said compressor and said secondary zone to transmit air therebetween, each of said plurality of passages having an effective diffusion angle between 4° and 12°, and said openings communicating between said passages and the inside of said hollow wedge.

7. A gas generator for a gas turbine according to claim 5 wherein the extension of said walls includes a non-tapered continuation defining a common inlet for air from the outlet of said compressor and a plate-like extension on said hollow wedge extending into said common inlet so that air from said compressor is divided before diffusion takes place.

8. A gas generator for a gas turbine that comprises a compressor to supply air having means defining an outlet, combustion means, and connecting means between said combustion means and the outlet of said compressor, said combustion means including partition means defining a primary zone, and an inner annular wall spaced from said partition means and an outer annular wall spaced from said partition means, said walls defining therebetween a secondary zone, said connecting means including an annular member forming in lengthwise section a hollow wedge, the interior of said member communicating with said primary zone, and a continuous extension of said walls spaced from and defining with said annular member a plurality of passages communicating between the outlet of said compressor and said secondary zone to transmit air therebetween, said annular member having openings communicating between said passages and the interior of said member, and said connecting means constituting a diffusion chamber.

9. A gas generator for a gas turbine that comprises a compressor to supply air having means

defining an outlet, combustion means, and connecting means between said combustion means and the outlet of said compressor, said combustion means including partition means defining a primary zone, and an inner annular wall spaced from said partition means and an outer annular wall spaced from said partition means, said walls defining therebetween a secondary zone, said connecting means including an annular member forming in lengthwise section a hollow wedge having openings, the interior of said member communicating with said primary zone, and a continuous extension of said walls spaced from and defining with said annular member a plurality of passages communicating between the outlet of said compressor and said secondary zone to transmit air therebetween, each of said plurality of passages having an effective diffusion angle not greater than 12°, and said openings communicating between said passages and the interior of said hollow wedge.

10. A gas generator for a gas turbine according to claim 9 wherein the extension of said walls includes a non-tapered continuation defining a common inlet for air from the outlet of said compressor and a plate-like extension on said

hollow wedge extending into said common inlet so that air from said compressor is divided before diffusion takes place.

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JAMES ROY.

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