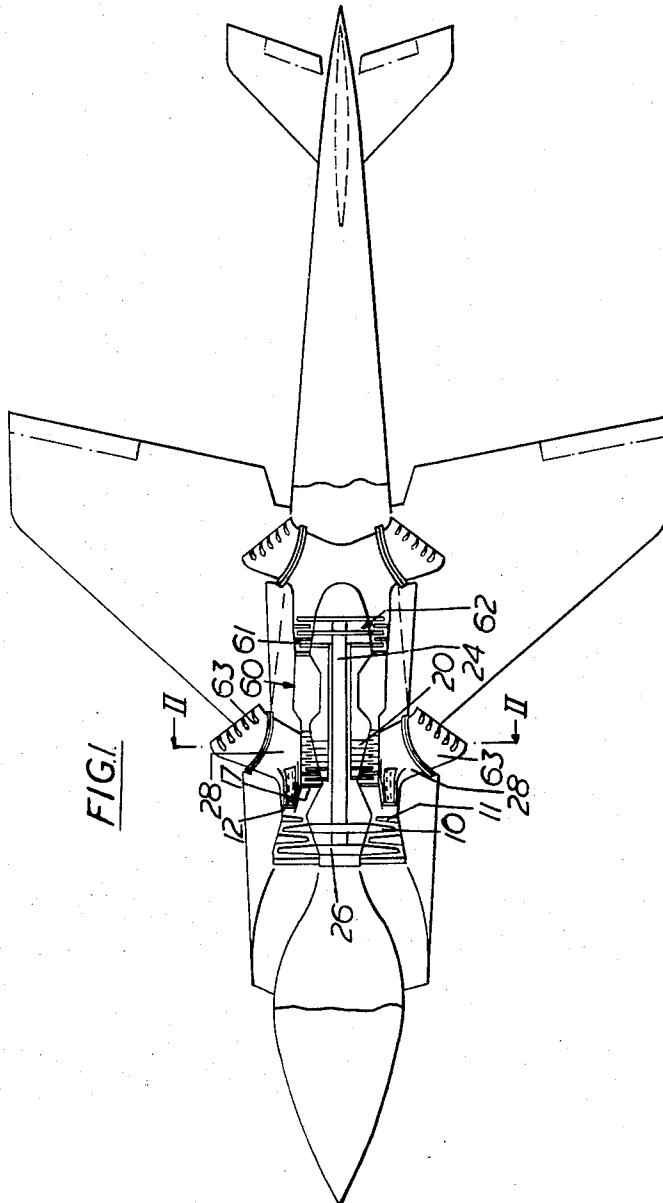


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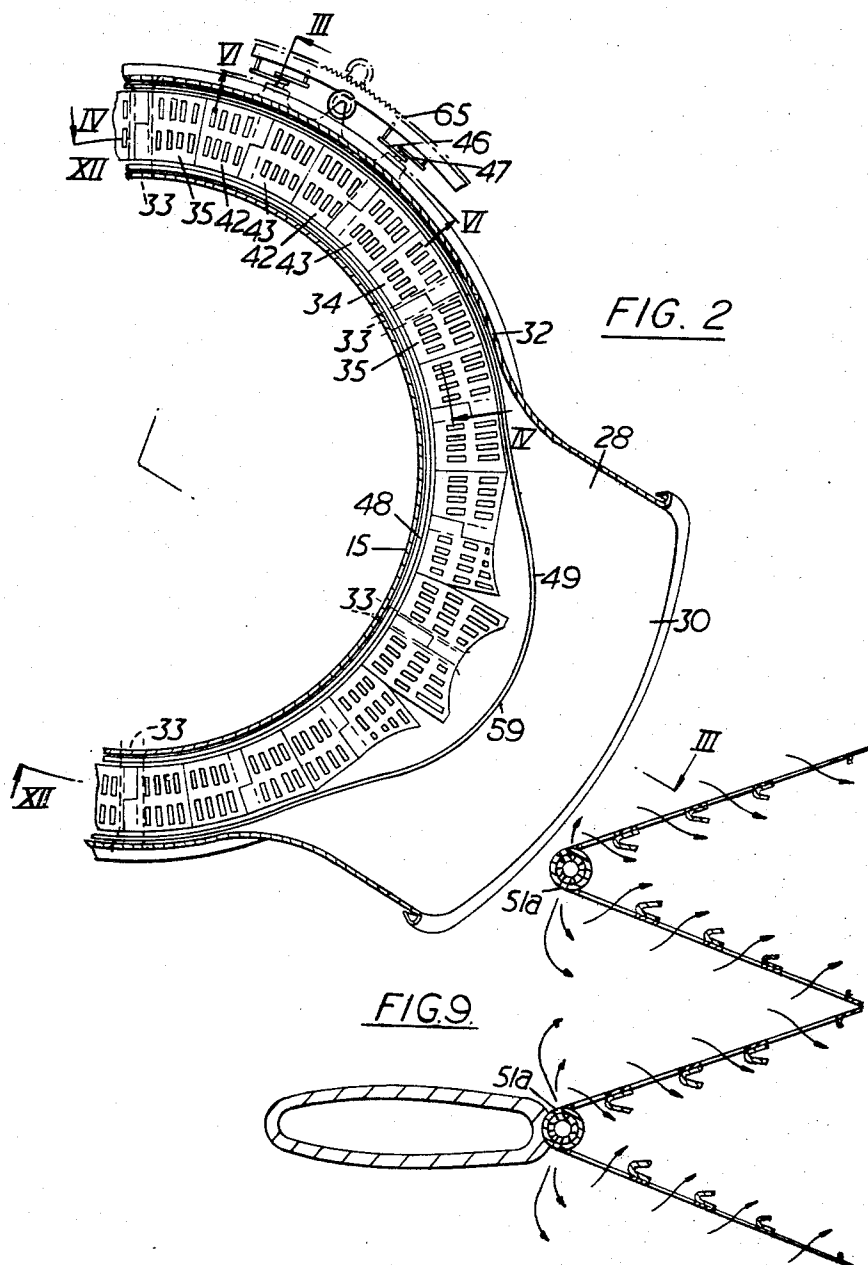
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JET PROPULSION ENGINE WITH VARIABLE BAFFLES AND FUEL SUPPLY

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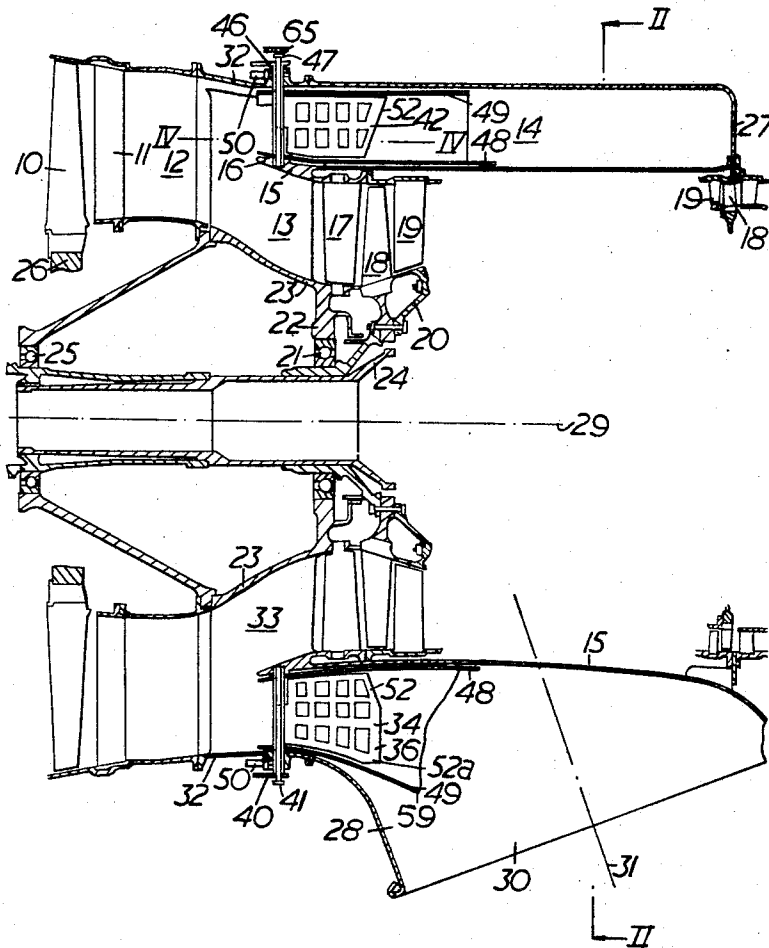
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FIG. 3



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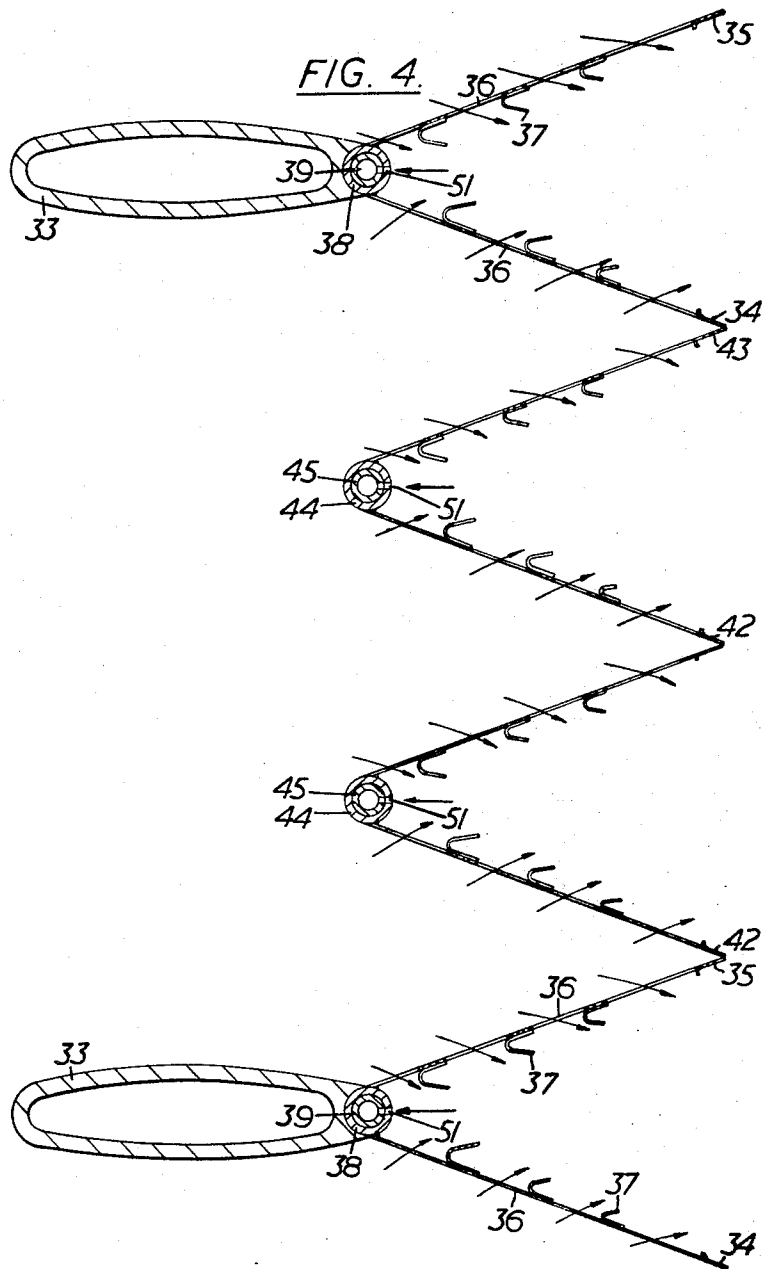
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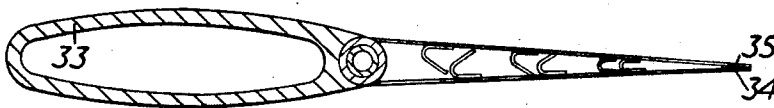
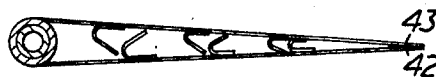
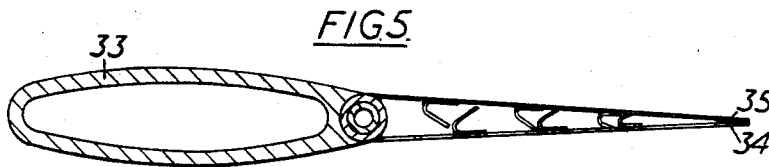
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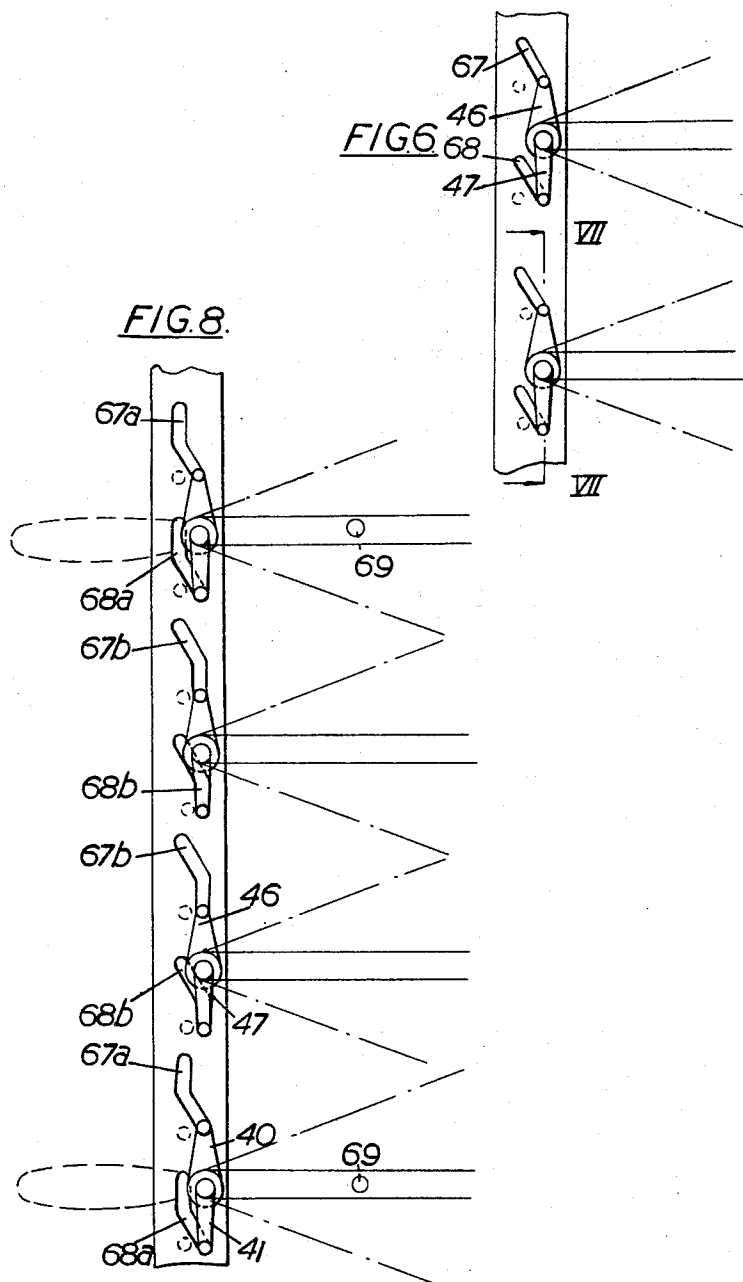
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FIG. 10

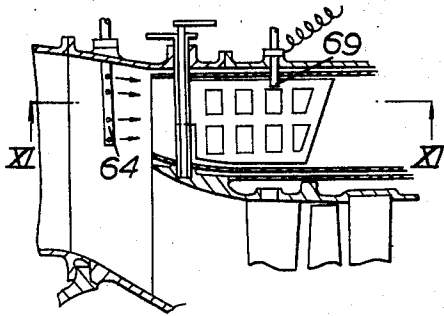


FIG. 11

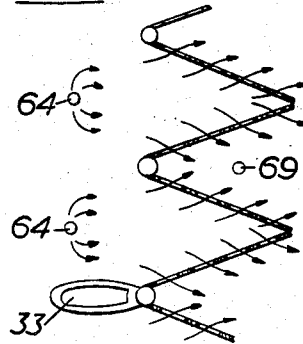


FIG. 13

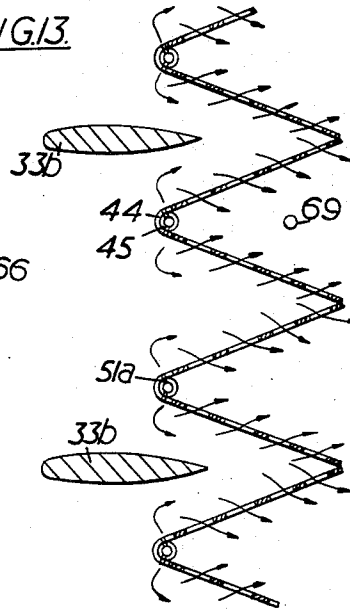
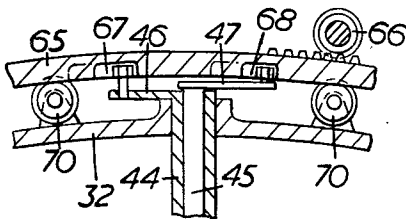


FIG. 7



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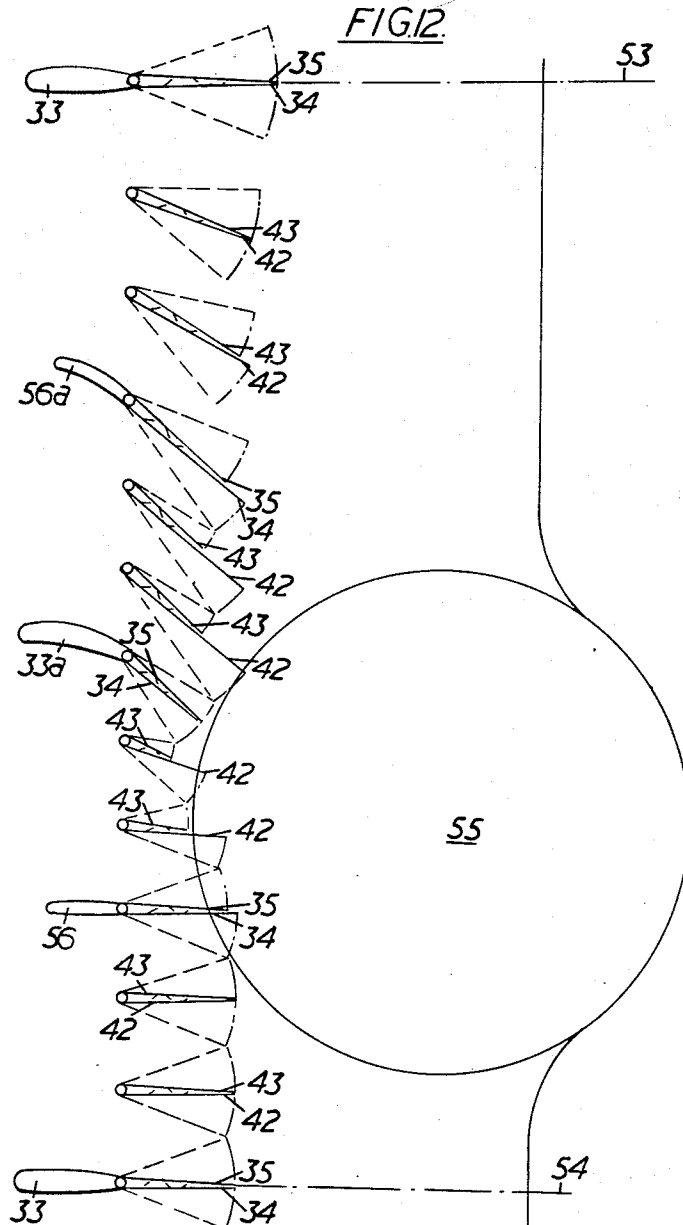
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JET PROPULSION ENGINE WITH VARIABLE BAFFLES AND FUEL SUPPLY

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21,687/62

8 Claims. (Cl. 60—35.55)

The invention relates to the provision, in an aircraft jet propulsion power plant including an axial flow air compressor arranged to deliver air to an annular section passage, of means for burning liquid fuel in the passage when desired in order to increase the jet thrust.

According to the invention a plurality of struts or pillars are provided spaced around the passage and projecting into it transversely to the direction of airflow there-through, each strut or pillar carrying a pair of perforated baffles extending downstream of the strut or pillar and arranged for relative swinging movement from an open V position, with the strut or pillar constituting the apex of the V, to a closed together position, and means for dispersing fuel either into the V-shaped space between each pair of baffles when open, or into the air flowing through the perforations of the baffles into that space, for combustion therein.

When fuel is not being burnt in the passage, the perforated baffles are closed together to reduce obstruction to the airflow.

The pairs of baffles may be moved into or out of their operative positions simultaneously or in groups according to the amount of heating required.

The invention is particularly applicable to power plants in which the axial flow compressor is arranged to deliver air to an annular section passage divided into inner and outer annular parts by a partition wall extending downstream from a leading edge spaced from the compressor, the outer part of the passage being connected to at least one stub duct extending outwards from the axis of the compressor to an outlet carrying a swivelling nozzle. In this case the struts or pillars carrying the baffles project into the outer part of the passage adjacent to the leading edge of the partition wall. The combustion thus takes place as far upstream of the swivelling nozzle or nozzles as possible, and difficulties due to local overheating of the nozzles are minimised.

Another example of a situation to which the invention is applicable is a power plant of bypass type, having an annular air discharge nozzle around the jet nozzle, and having means for burning fuel in a part of the bypass passage a little upstream of the nozzle, so as to augment thrust when required.

The accompanying drawings show examples of equipment according to the present invention. In these drawings:

FIGURE 1 is a diagrammatic underneath plan of a power plant in place in an aircraft;

FIGURE 2 is a half section of part of the power plant on the line II—II in FIGURES 1 and 3, omitting the swivelling part of the nozzle;

FIGURE 3 is a longitudinal section of part of the power plant on the line III—III in FIGURE 2;

FIGURE 4 is a developed sectional view, corresponding to the lines IV—IV in FIGURES 2 and 3, through the fuel burning equipment, with the baffles in the open position;

FIGURE 5 is a corresponding view with the baffles in the closed together position;

FIGURE 6 is a fragmentary diagrammatic view of operating mechanism, seen from the line VI—VI in FIGURE 2;

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FIGURE 7 is a fragmentary section on the line VII—VII in FIGURE 6;

FIGURE 8 is a view, similar in nature to FIGURE 6, showing an alternative arrangement;

FIGURE 9 illustrates an alternative fuel dispersing arrangement;

FIGURE 10 and FIGURE 11 illustrate another alternative, FIGURE 11 being a section on the line XI—XI in FIGURE 10;

FIGURE 12 is a developed sectional view, similar in nature to FIGURES 4 and 5, showing a modified arrangement of the baffles; and

FIGURE 13 shows another modification.

The power plant shown in FIGURES 1 to 3 includes a low pressure axial flow compressor or ducted fan having a final row of moving blades 10 followed by a row of stator blades 11. Air leaving the stator blades flows through an annular-section passage 12 divided into inner and outer annular parts 13 and 14 respectively (FIGURE 3) by a partition wall 15 extending downstream from a leading edge 16 spaced from the blades 11. The air flowing through the inner passage 13 passes through a high pressure compressor comprising a row of inlet guide vanes 17, and several rows of rotor blades 18 (only the first and last of which are shown in FIGURE 3) with intermediate stator blades 19. After discharge from the high pressure compressor the air passes through a combustion system 60 and high and low pressure turbines 61, 62. The high pressure turbine drives the rotor 20 of the high pressure compressor which is journaled at its forward end in a bearing 21 carried by a diaphragm 22 projecting inwards from the inner wall 23 of the duct 13, while the low pressure turbine drives a shaft 24 journaled in a bearing 25 and to which the low pressure compressor rotor 26 is attached.

The outer passage 14 is closed at its rear end 27 but has two stub ducts 28 (one of which appears in FIGURES 2 and 3), each extending obliquely outwards from the axis 29 of the engine to an outlet 30 to which a swivelling nozzle may be attached (as shown at 63 in FIGURE 1), the arrangement being preferably as described in the complete specification accompanying our co-pending patent application No. 159,106, now Patent No. 3,153,906, that is to say with the swivel axes 31 of the nozzles symmetrically arranged on opposite sides of the engine, dropped somewhat below a horizontal plane through the engine axis 29 and diverging rearwards.

The passages 12, 13 and 14 are partly formed in a casing section comprising the inner wall 23, a leading edge part of the partition wall 15 and an outer wall 32, these walls being interconnected by six hollow radial struts 33 of generally streamlined cross section. Two of these struts are shown in the developed section of FIGURES 4 and 5.

For the purpose of permitting fuel to be burnt in the outer passage 14 as far upstream from the swivelling nozzles as possible, there is mounted at the trailing edge of each strut 33 a pair of baffles 34 and 35 (see the lower part of FIGURE 3 and FIGURE 4) provided with perforations 36 and internal deflectors 37. The baffles are attached to co-axial tubes 38 and 39 supported at their inner ends in bearing sockets in the partition wall 15 and projecting through the outer wall 32 to receive operating levers 40 and 41 whereby they may be moved individually from an open V position as illustrated in FIGURE 4, for use when fuel is being burnt, to a closed together position as illustrated in FIGURE 5, in which obstruction to the airflow is reduced when fuel is not being burnt.

To supplement these baffles there are provided, in the space between adjacent struts 33, two further pairs of baffles 42 and 43 (see the upper part of FIGURE 3),

similarly mounted on co-axial tubes 44 and 45, constituting pillars, provided with operating levers 46 and 47.

In the region of the baffles and for about an equal distance downstream of them, inner and outer liners 48 and 49 are provided, spaced a suitable distance from the walls 15 and 32 so as to convey secondary and/or dilution air to a region downstream of the primary combustion zone in the wake of the baffles, and also to protect the passage walls from overheating. In the regions of the stub outlet ducts 28, the outer liner 49 is lipped outwards as illustrated at 59 in FIGURES 2 and 3 to control the direction of discharge of the hot gases into the stub ducts. The liners can be perforated if desired.

The co-axial tube assemblies 38, 39 and 44, 45 may also constitute fuel supply ducts, receiving liquid or gaseous (e.g. vaporised) fuel through pipe connections 50 (FIGURE 3) on the outside of the casing 32 and being provided with one or more orifices 51 to disperse a spray of fuel into the V-shaped space between the baffles. Alternatively, as shown in FIGURES 9 and 13, the orifices may be arranged at 51a to disperse fuel in the upstream direction so that it is carried into the V-shaped spaces by the air flowing through the perforations 36. Separately mounted fuel dispersing devices mounted upstream or downstream of the pillars may however be used if desired, for example as shown at 64 in FIGURES 10 and 11.

The operating levers 40, 41, 46 and 47 may each carry a cam-follower roller engaging in a cam track 67, 68 in a ring 65 (FIGURES 2, 6 and 7) surrounding the casing 32 and rotated about the axis 29 of the engine by suitable means, such as a pinion 66, while supported by rollers 70. The cam tracks may be arranged either, as in FIGURE 6, to move all the baffles simultaneously into or out of their operative positions, or, as in FIGURE 8, to bring successive pairs or groups of baffles into operation in dependence upon the setting of a power control member, fuel supply selector valves (not shown) being operated simultaneously to supply fuel to the dispersion means pertaining to each pair of baffles as it reaches its operative position. In FIGURE 8, the first half of the downward movement of the portion of the ring 65 shown causes opening of the baffles associated with the vanes 33 by means of cam tracks 67a, 68a, while the second half of the downward movement causes opening of the remaining baffles by means of cam tracks 67b, 68b.

Each pair of baffles or group of pairs of baffles to be brought into operation initially is provided with a separate ignition means, which may be a torch igniter projecting into the V-shaped space between a pair of baffles, as shown at 69 in FIGURES 8, 10, 11 and 13. The baffles are preferably shaped, as shown, so that in their operative positions their trailing edges 52 engage the trailing edges of adjacent baffles to form a continuous wake zone around the annular passage 14, thus promoting the spread of flame from one V-shaped space to the next. This means that the edges 52 are inclined outwards and rearwards. Those baffles in the region of the stub outlet ducts may have a trailing edge part cut away as shown at 52a to avoid an undesirably great projection into the stub ducts, and to direct dilution air into the central part of the stub ducts.

FIGURE 12 illustrates an improved arrangement of the struts and baffles and is a diagrammatic development of half of the cylindrical surface indicated by the section lines XII—XII in FIGURE 2, except that in this embodiment, as described below, the six vanes 33 are replaced by eight struts. The chain-dotted line 53 represents the upper intersection of the cylindrical surface with a vertical plane through the axis 29 of the engine, and the line 54 the lower intersection. The stub outlet duct opening is seen at 55, and it will be understood that the other half of the development is a mirror image of FIGURE 12 about either of the lines 53 or 54.

In this arrangement there are four equally spaced principal struts extending across the passages 12, 13 and 14,

the top and bottom struts being flat and lying in radial planes, and the side struts 33a being curved to offset unequal flow distribution between the upper and lower halves of the passages 12 and 14 due to the stub duct outlets 55 being displaced below the horizontal plane through the axis 29 of the engine. Between the principal struts there is a smaller lower-quarter strut 56 on each side which is also flat, and an upper-quarter strut 56a on each side which is curved to improve the flow distribution. Each of these struts 33, 33a, 56 and 56a carries a pair of perforated trailing edge baffles 34 and 35 which in their closed together positions form a continuation of the profile shape of the struts. Between each of these pairs of baffles a further two supplementary pairs of baffles 42 and 43 are provided, the arrangement being generally similar to that illustrated in FIGURES 4 and 5 except that, in the closed together positions, the pairs of baffles are aligned with the general flow directions determined by the struts 33, 33a, 56 and 56a and their associated baffles. Where the closed together positions are displaced from radial planes, the baffles of each pair are made unequal in length so that in the opened positions, indicated by dotted lines, the trailing edges of adjacent baffles can engage one another as described in connection with the first arrangement. This feature can be omitted in the upper quarter of the passage 14 where the flow velocities downstream of the baffles are somewhat lower than those nearer the outlet ducts.

There may be struts or pillars additional to those which carry baffles. In particular, as shown in FIGURE 13, the tube assemblies 44, 45 carrying the baffles may all be separate from the struts 33b, the struts 33b being located between two pillars. This allows a degree of independence of choice of the location of the baffles and of the struts in the up-and-downstream direction. In particular the V-shaped combustion zones may be arranged further upstream without subjecting the vanes 33, which are stress carrying members, to additional heating.

I claim:

1. An aircraft jet propulsion power plant including means defining an annular section passage, an axial flow air compressor arranged to deliver air to the passage, a plurality of elongated members spaced around the passage and projecting into it transversely to the direction of air-flow therethrough, pairs of perforated baffles extending downstream of each member, means mounting each pair of baffles on the corresponding member for relative swinging movement from an open V position, with the member constituting the apex of the V, to a closed together position, means for dispersing fuel to reach the V-shaped space between each pair of baffles when open for combustion in that space, at least one stub duct extending outwards from the axis of the compressor to an outlet carrying a swivelling nozzle, and means connecting said passage, downstream of said pairs of baffles, to said stub duct.

2. A plant according to claim 1 including means for bringing successive pairs of baffles into operation in dependence upon the setting of a power control member.

3. A plant according to claim 1 in which at least most of the baffles are shaped so that in their operative positions their trailing edges engage the trailing edges of adjacent baffles.

4. A plant according to claim 1 in which the means for dispersing fuel includes orifices in the mounting means of each pair of baffles.

5. A plant according to claim 1 in which, in the region of the baffles and for a distance downstream of them, there are inner and outer liners spaced from walls of the passage.

6. A plant according to claim 1 in which the annular section passage is divided into inner and outer annular parts by a partition wall extending downstream from a leading edge spaced from the compressor, the outer part

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of the passage being connected to said one stub duct, and the members carrying the baffles project into the outer part of the passage adjacent to the leading edge of the partition wall.

7. A plant according to claim 5 in which the passage is connected to at least one stub duct extending outwards from the axis of the compressor to an outlet carrying a swivelling nozzle, and, in the region of each stub duct, the outer liner is lipped outwards.

8. A plant according to claim 6 including means for actuating the baffles so that in their closed positions they

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are substantially aligned with the local air flow as influenced by the presence of the stub ducts.

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