

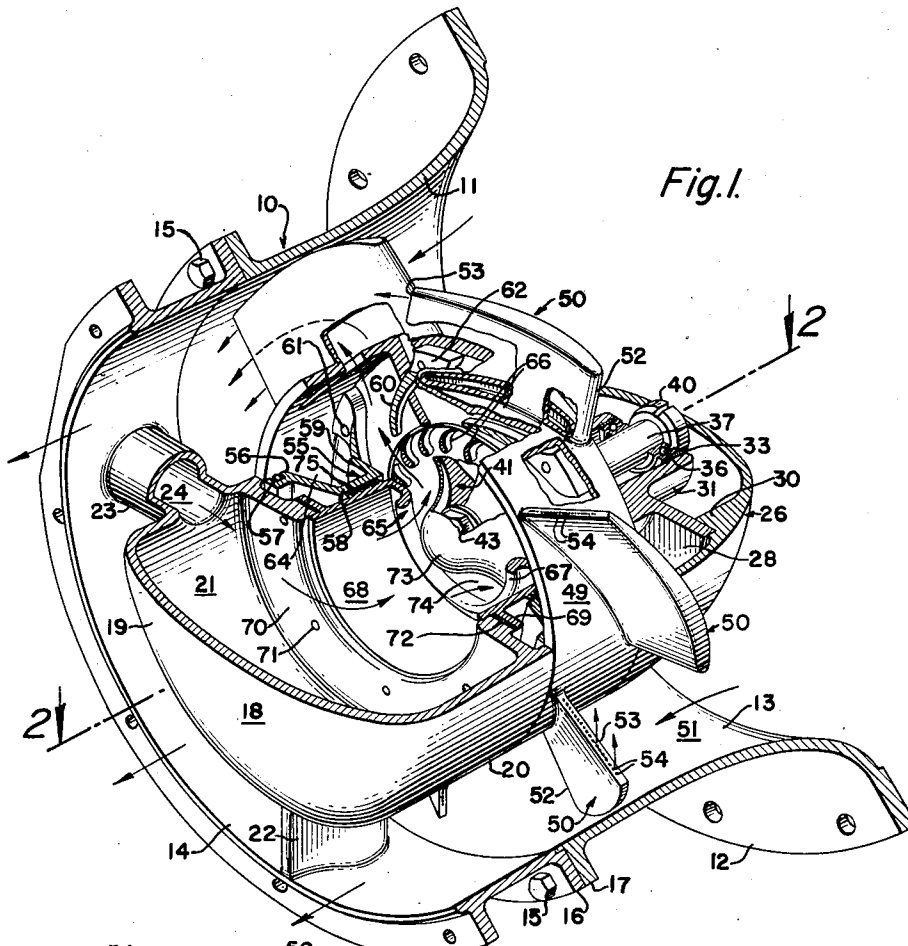
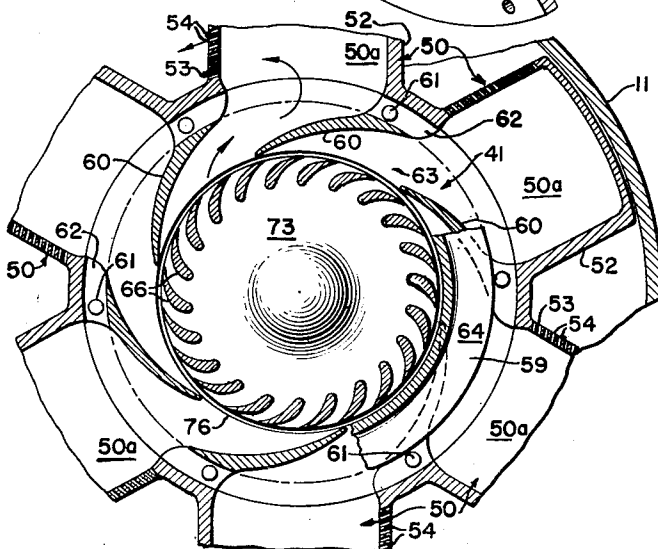
Feb. 8, 1955

F. DALLENBACH ET AL
ROTOJET IMPELLER

2,701,682

Filed June 1, 1953

3 Sheets-Sheet 1



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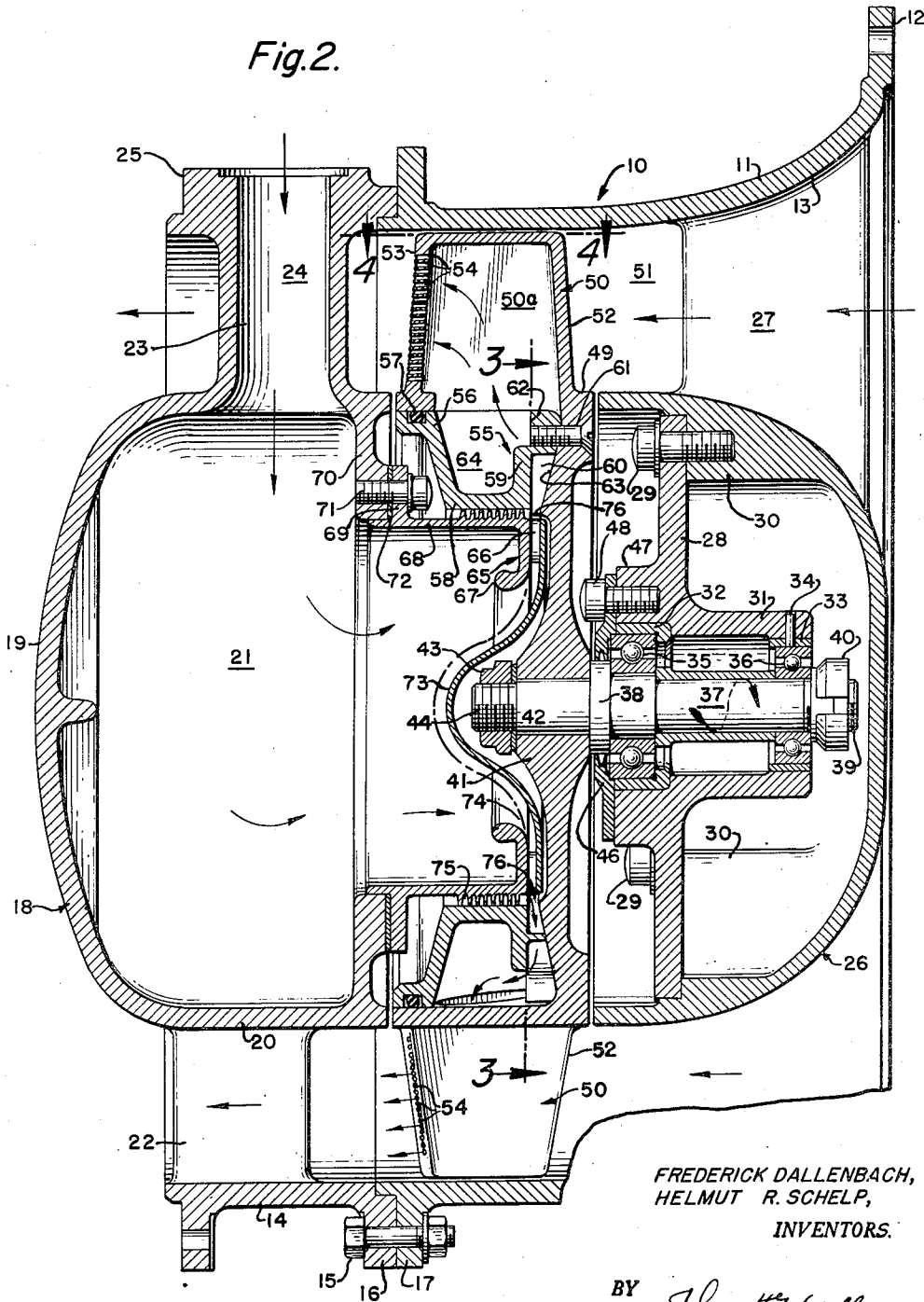
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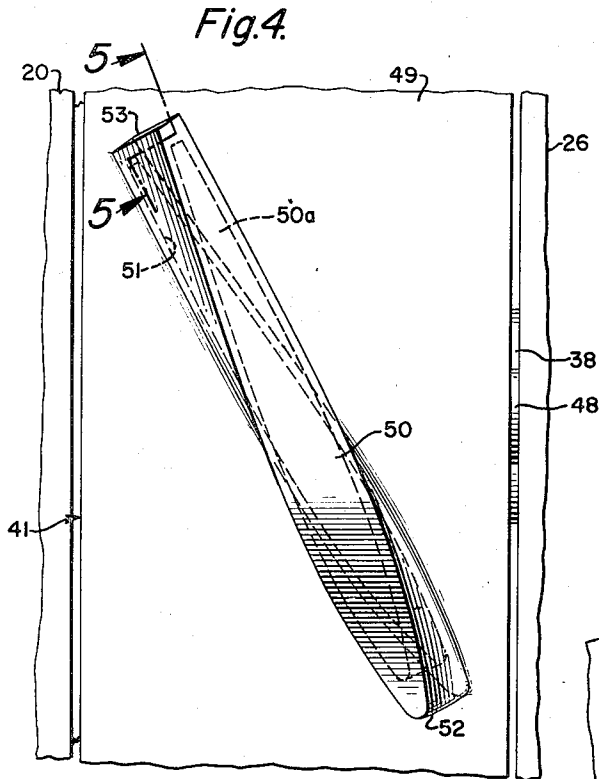
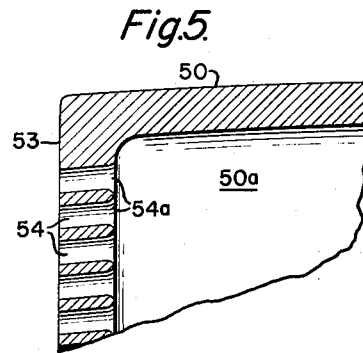
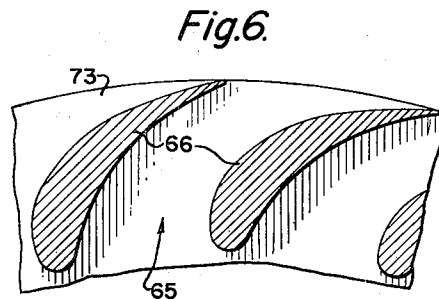
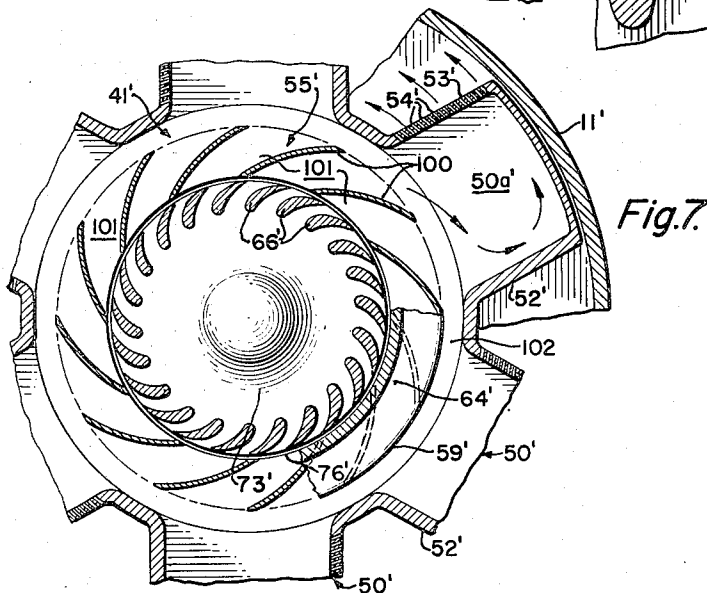
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3 Sheets-Sheet 3



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2,701,682

ROTOJET IMPELLER

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Application June 1, 1953, Serial No. 358,864

24 Claims. (Cl. 230—116)

The present invention relates generally to a rotating impeller or fan device driven by an outside source of compressed motive fluid and more particularly to a so-called "rotojet" impeller or fan utilizing both the expansion of a motive fluid and the jet efflux of such motive fluid to drive the device.

The term "rotojet fan" as utilized herein is a term relatively new in the art and is employed to describe the class of fans which are driven in part by the reaction of a jet of motive fluid issuing from the blades at their trailing portions.

Heretofore, fan wheels utilizing the discharge of air through openings in the trailing edges of hollow blades have been relatively inefficient in that they failed to make use of more than a small portion of the available energy in the motive fluid. Additionally, these prior devices have been necessarily large, with associated excessive weight and material, conditions which cannot be tolerated when such devices must be placed in a relatively restricted envelope and whenever considerations of weight and material are of importance.

It is, therefore, an object of the present invention to provide a rotojet fan having means to overcome such disadvantages and difficulties in the prior art.

It is another object of the present invention to provide a novel rotojet fan that is relatively simple in construction, light in weight, efficient in operation, and reliable in use.

It is a further object of the invention to provide a novel rotojet fan wherein motive driving fluid delivered thereto may be conducted through an improved flow path whereby to efficiently utilize a high percentage of the energy contained therein.

A still further object of the invention is to provide a novel rotojet fan employing effective boundary layer suction control along the trailing edge of the blades to reduce the noise level of the fan to a considerable degree as well as to permit higher aerodynamic loadings on the blades.

It is a further object of the invention to provide a novel rotojet fan employing a stationary radial outflow nozzle ring in combination with a diffuser mounted on a rotating wheel structure, said wheel structure being adapted to carry the fan blades.

It is a still further object of the invention to provide a rotojet fan employing a rotating diffuser mounted inside a fan-carrying wheel, and to provide novel means for ducting motive fluid from the diffuser into the rim of the wheel and thence through the blades and nozzles contained therein.

It is a further object of the present invention to provide a novel rotating fan wherein driving forces therefor are in equilibrium, thus to transmit substantially no torque to the shaft supporting said fan.

Other and further important objects of the present invention will become apparent from the following specification, appended claims, and accompanying drawings wherein:

Fig. 1 is a perspective view, partially in section, showing the rotojet fan of the present invention;

Fig. 2 is a longitudinal sectional view of the rotojet fan taken as indicated by line 2—2, Fig. 1;

Fig. 3 is a transverse sectional view taken as indicated by line 3—3, Fig. 2, showing one arrangement for the stationary nozzle vanes and diffuser mechanism employed therewith;

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Fig. 4 is an enlarged fragmentary view of the outer end of one of the rotating fan blades, taken substantially as indicated by line 4—4, Fig. 2;

Fig. 5 is an enlarged fragmentary sectional view of a portion of the trailing edge of one of the fan blades, taken substantially as indicated by line 5—5, Fig. 4;

Fig. 6 is an enlarged fragmentary sectional view of a portion of the stationary nozzle blades employed in the rotojet fan of the present invention; and

Fig. 7 is a fragmentary sectional view similar to Fig. 3 and showing a modified form of rotating diffuser construction.

Referring primarily to Fig. 2 of the drawings, the rotojet fan of the present invention is indicated generally at 10. The fan includes an annular housing 11 provided with a suitable mounting flange 12 and an entrance section 13 which may be bell-mouthed as shown, or may alternatively be cylindrical. An exhaust portion 14 is secured to the portion 11 by means of nuts and bolts 15 which extend through suitable flanges 16 and 17. A centrally disposed portion 18 has a closed end 19 and a cylindrical side portion 20 to form a primary plenum chamber 21, this chamber being located in the exhaust portion 14 of the housing. The central portion 18 is in the form of a shroud and is supported axially within the housing 11 and exhaust portion 14 by means of suitable struts 22.

A conduit 23 has a passage 24 which extends between the plenum chamber 21 and a boss 25, the construction being such that a suitable conduit may be secured to the boss 25 for the delivery of a fluid medium such as compressed air to the plenum chamber 21.

A second shroud member 26 is supported axially within the housing 11 by means of suitable struts 27 and is spaced from the shrouded hub 18. An annular bearing carrier 28 is secured to the interior of the hub 26 by means of screws 29 which engage in threaded openings in axially extending internal bosses 30 within the hub 26. The bearing support 28 has an axially extending cylindrical flange member 31 which is adapted to carry bearing inserts 32 and 33, insert 33 being held against rotation by means of a pin 34. Anti-friction bearings such as ball bearings 35 and 36, are mounted in the inserts 32 and 33 respectively and a shaft 37 is adapted to be rotatably supported thereby. The shaft 37 has an enlarged flange portion 38, adjacent the bearing 35, and is provided with an outwardly extending threaded end portion 39 which is adapted to be engaged by a nut 40, thereby to retain the shaft in rotatable engagement with the bearings 35 and 36.

A rotating fan wheel 41 is mounted on an extension 42 of the shaft 37 and secured thereon, and against the flange 38, by means of a suitable nut 43 which engages a threaded portion 44 on the shaft. An annular member 46 engages the periphery of the flange 38 intermediate the wheel 41 and the bearing 35 and provides a seal intermediate the fan wheel and the bearings. The member 46 is secured to an annular flange 47, extending from the bearing carrier 28, by means of suitable screws 48, thereby to prevent contaminants from entering the bearings from the area of the wheel 41.

The wheel 41 extends radially outwardly and has a peripheral axially extending portion 49, the outer surface of which is co-extensive with the adjacent outer surfaces of the hubs 18 and 26. Hollow blades 50 are formed integrally with the peripheral portion 49 of the wheel 41, and extend into an annular passage 51 formed intermediate and defined by the interior surfaces of the housing 11, exhaust portion 14, the surfaces of the shrouds 18 and 26, and the wheel 41. As shown in Figs. 1 and 4, the blades 50 are substantially air-foil shaped in cross section and are provided with a radial twist about the median line thereof, thereby decreasing the angle of attack of the blade from a point adjacent the wheel portion 49 to the radial outer end of the blade. Each of the blades 50 is provided with an interior chamber 50a, a leading edge 52, and a trailing edge 53. The trailing edges 53 are formed substantially blunt and each is provided with a plurality of closely spaced cylindrical exhaust nozzles 54 which extend along the entire radial length of the blunt trailing edge 53 and communicate

with the interior chamber 50a of the blade. While the blades are shown as being integral with the portion 49, it is to be understood that they may be formed as separate inserts suitably secured in place.

As may be seen from the enlarged fragmentary view in Fig. 5, the exhaust nozzles 54 of each blade extend substantially parallel to a plane through the axis of rotation of the wheel 41. The nozzles 54 are further provided with bell-mouthed inlet portions 54a to thus provide a smooth flow entry from the interior chamber 50a of the blades 50. Hence, the nozzles 54 are so positioned as to provide means to conduct the motive fluid from within the blades to the exterior thereof, the exhaust from these nozzles being directed preferably inwardly from the inner wall of the housing 11 for a purpose which will be later described.

A rotating diffuser, indicated generally at 55, comprises a radially extending flange portion 56 which carries a peripheral seal 57, the seal 57 engaging the inner periphery of the portion 49 of the wheel 41; an axially extending portion 58; and another radially extending flange portion 59. The flange portion 59 carries a plurality of substantially air-foil shape, radially directed, integrally formed diffuser vanes 60. The diffuser assembly 55 is secured to the wheel 41 as by screws 61 which extend through the portions 62 of the diffuser vane 60. The portions 62 of the diffuser vanes extend radially outwardly beyond the flange 59. As seen in Fig. 2, the diffuser vanes 60 radially diverge outwardly on axial sides thereof and engage a beveled area 63 formed on an axial surface of the wheel 41 to thus provide a diffusion path for the motive fluid intermediate the surface 63, the flange 59 and between the surfaces of adjacent vanes 60. While the diffuser 55 has been shown and described as comprising a unit separate from the wheel 41, it is to be understood that the diffuser may be formed integrally with the wheel or alternately, the diffuser vanes 60 may be formed on the radially extending axial surface 63 of the wheel.

The flange 56, portion 58, flange 59, and the wheel 41, together with the outer portion 49 of the wheel 41, define an annular, rotating, secondary plenum chamber 64 into which the discharge of the motive fluid from intermediate the portions 62 of the diffuser vanes 60 is adapted to be delivered. This plenum chamber 64 communicates with the radially inwardly open ends of the interior chamber 50a of the blades 50 and rotates with the wheel 41, its associated blades and the diffuser 55.

A nozzle ring indicated generally at 65 is positioned immediately upstream from the diffuser assembly 55 and radially inwardly therefrom. The nozzle ring 65 comprises a plurality of air-foil shape nozzle blades 66, Figs. 3 and 6, which are formed integrally with an annular bell-mouthed flange 67 carried by an axially extending ring 68. The ring 68 has a radially outwardly extending flange 69 formed thereon, which is adapted to be secured to an inwardly directed flange 70, formed on the cylindrical portion 20 of the shroud 18, by means of screws 71. Shim stock 72 is disposed between the flanges 69 and 70 to adjust the clearance between the nozzle ring 65 and the wheel 41. A shroud faring 73 is secured, as by brazing, for example, to the axially extending surfaces of the blades 66, remote from the flange 67, and extends about the end 44 of the shaft 37. There is thus provided, in cooperation with the bell-mouth flange 67, a converging passageway 74 for the conduction of motive fluid from the plenum chamber 21 to the inlet to the stationary nozzle blades 66.

A labyrinth seal 75 is formed integrally with the ring 68 and extends between this ring and the inner surface of the axial portion 58 of the diffuser assembly 55.

In operation of the device of the present invention, a compressed motive fluid such as air, for example, is delivered through the passage 24 and into the primary plenum chamber 21 wherein the velocity thereof is reduced while the static pressure is maintained or increased. From the plenum chamber 21 the motive fluid is conducted through the passage 74, formed intermediate the bell-mouthed flange 67 and the shroud 73, and through the row of stationary nozzle blades 66 whereby a whirl velocity is imparted to the motive fluid. A circumferential clearance space 76 is formed between the discharge of the blades 66 and the entrance to the rotating diffuser vanes 60. Upon leaving the nozzle blades 66, a small portion of the motive fluid leaks through the laby-

rinth seal 75 which is provided in order to substantially prevent escape of fluid.

In order to provide for efficient conversion and use of the available energy in the motive fluid, the proportion of the energy expended when the air discharges through the nozzles 54 in the trailing edges 53 of the fan blades 50, depends, as will be later described, upon the magnitude of the available fluid pressure ratio for operating the machine and on the peripheral speed of the fan blades which, in turn, is governed by the fan characteristics. Under normal conditions of operation, in which relatively high pressure ratios, of the order of say 3:1 are available, the absolute velocity of the air leaving the nozzle blades 66 is approximately equal to or slightly less than the local sonic velocity.

Since the peripheral speed of rotation of the wheel 41, adjacent the discharge from the nozzle blades 66, is considerably lower than the velocity of sound, the relative velocity of the motive fluid with respect to the rotating diffuser vanes 60 is only slightly less than the absolute velocity of the motive fluid leaving the nozzle blades 66. The rotating diffuser 55 is provided in order to efficiently make use of this relative velocity.

After leaving the stationary blades 66 of the nozzle ring 65, the motive fluid enters the passages formed intermediate the diffuser vanes 60, and is restricted in its flow through the radial inward portion of these passages by means of the flange 59, there being expansion of the fluid therein as previously described. The motive fluid is discharged from the space intermediate the diffuser vanes 60 into an area extending radially outwardly from the outer peripheral edge of the flange 59, and into the annular, rotating, secondary plenum chamber 64 from which the motive fluid is delivered to the interior chambers 50a of the blades 50 and is exhausted through the nozzles 54 in the trailing edges 53 thereof, thus causing a reactive force to be applied to rotate the wheel 41. As previously described the nozzles 54 are formed in a direction such that the motive fluid discharges from the openings in a direction parallel to a plane through the axis of rotation and slightly inwardly, in a direction away from the inner wall of the housing 11. With pressure ratios of the order of 3:1, the motive fluid leaving the nozzles 54 discharges at nearly sonic velocity.

The momentum for driving the wheel 41 and the blades 50 is therefore provided in part by the reaction of the motive fluid delivered from the stationary pre-rotation nozzle blades 66 to the vanes 60 and in part by the jet reaction due to the efflux of motive fluid discharging from the nozzle openings 54 of the blades 50. With no external torque action upon the fan shaft 37, the torque reaction due to the internal forces driving the blades 50 is balanced by the forces acting upon the fan blades which in turn cause the fan to revolve at an equilibrium speed which establishes the amount of flow which the fan is capable of producing at a particular pressure rise thereacross. In other words, the balance of forces about the wheel 41 is such as to eliminate substantially all torque reaction applied to the central supporting shaft 37, to thus reduce the load applied to the bearings 35 and 36 and enable the use of a relatively small and lightweight shaft structure as well as eliminating complex and necessarily heavy mechanism for securing and supporting the wheel 41 of the shaft 37.

The fan-propelled air enters through the bell-mouthed inlet 13, is drawn through the passage 51 and discharges at the outlet from the blades 50 in a plane slightly downstream from the trailing edges of the blades 50. Since the velocity of the fan-propelled air discharging from the blades is substantially lower than the velocity of the motive fluid discharging from the nozzles 54 in the trailing edges of the blades, a further increased pressure rise is afforded upon completion of the mixing of the two fluid streams. This mixing action will take place some distance downstream from the fan and slightly downstream from the exhaust section 14. Thus, the energy, that has not been converted into useful mechanical work in driving the fan wheel 41, is utilized in creating a pressure rise in the air ultimately discharging from the device.

In Fig. 7, a modification of the rotating diffuser of the invention is shown wherein parts corresponding to those previously discussed are indicated by primed reference numerals. In this modification, the rotating diffuser 55' comprises a plurality of spaced relatively thin sheet

metal guide vanes 100 which are positioned radially outwardly of the discharge of the stationary nozzle blades 66'. The guide vanes 100 are radially divergent and, as previously, constitute means to conduct the motive fluid discharging from the blades 66' to the hollow interior chambers 50a' of the blades 50' and means to maintain the pre-swirl imparted to the motive fluid by the nozzle blades 66'. The motive fluid issuing from the spaces 101, intermediate the guide vanes 100, is therefore directed into the interior chambers of the blades 50' wherein the motive fluid is caused to change direction prior to emission from the trailing edges of the blades to thus impart additional rotating force to the wheel 41' and to the blades 50'. It is to be noted that the terminal ends of the vanes 100 are adjacent the outer periphery of the flange portion 59' and the discharge therefrom is directed into an annular radially disposed opening 102 and thence into the plenum chamber 64'.

We claim:

1. In a rotojet impeller: a housing; a stationary shroud structure disposed axially within said housing; a passage defined intermediate said housing and said shroud structure; a wheel rotatably mounted in said shroud structure; a plurality of fan blades having leading and trailing portions, said fan blades being carried by said wheel and disposed in said passage; passage means within the bodies of said fan blades and extending through the trailing portions thereof for conducting fluid therethrough and expelling it from said trailing portions; diffuser means carried by said wheel and disposed radially inwardly from said fan blades, the discharge therefrom communicating with said passage means; and nozzle means positioned to prerotate and direct fluid into said diffuser means.

2. In a rotojet impeller: a housing; a stationary shroud structure disposed axially within said housing; a passage defined intermediate said housing and said shroud structure; a wheel rotatably mounted in said shroud structure; a plurality of fan blades having leading and trailing portions, said fan blades being carried by said wheel and disposed in said passage; passage means within the bodies of said fan blades and extending through said trailing portions thereof for conducting fluid therethrough and expelling it from said trailing portions; radial outflow rotatable diffuser means carried by said wheel and disposed radially inwardly from said fan blades, the discharge from said diffuser means communicating with said passage means; and stationary nozzle means positioned to prerotate and direct fluid into said diffuser means.

3. In a rotojet fan: a housing; a stationary shroud structure disposed axially within said housing; a passage defined intermediate said housing and said shroud structure; a wheel rotatably mounted in said shroud structure; a plurality of fan blades having leading and trailing portions, said fan blades being carried by said wheel and disposed in said passage; passage means within the bodies of said fan blades and extending through the trailing portions thereof for conducting fluid therethrough and expelling it from said trailing portions; rotatable diffuser means carried by said wheel and disposed radially inwardly from said fan blades, the discharge from said diffuser means communicating with said passage means; and stationary radial outflow nozzle means positioned to direct fluid into said diffuser means.

4. In a rotojet fan: a housing; a stationary shroud structure disposed axially within said housing; a passage defined intermediate said housing and said shroud structure; a wheel rotatably mounted in said shroud structure; a plurality of fan blades having leading and trailing portions, said fan blades being carried by said wheel and disposed in said passage; passage means within the bodies of said fan blades and extending through the trailing portions thereof for conducting fluid therethrough and expelling it from said trailing portions; a plurality of radial outflow rotatable diffusers carried by said wheel and disposed radially inwardly from said fan blades, the discharge from said diffusers communicating with said passage means; and stationary radial outflow nozzle blades positioned to direct fluid into said diffusers.

5. In a rotojet fan: a housing; a stationary shroud structure disposed axially within said housing; a passage defined intermediate said housing and said shroud structure; a wheel rotatably mounted in said shroud structure; a plurality of fan blades having leading and trailing edges, said fan blades being carried by said wheel and disposed in said passage; passage means within the bodies

of said fan blades; nozzle means extending through the trailing edges of said fan blades and communicating with said passage means for conducting fluid therethrough; diffuser means carried by said wheel and disposed radially inwardly from said fan blades, the discharge from said diffuser means communicating with said passage means; and stationary nozzle means positioned to prerotate and direct fluid into said diffuser means.

6. In a rotojet fan: a housing; a stationary shroud structure disposed axially within said housing; a passage defined intermediate said housing and said shroud structure; a wheel rotatably mounted in said shroud structure; a plurality of fan blades having leading and trailing edges, said fan blades being carried by said wheel and disposed in said passage; passage means within the bodies of said fan blades; nozzle means extending through the trailing edges of said fan blades and communicating with said passage means for conducting fluid therethrough; a plurality of radial outflow diffusers carried by said wheel and disposed radially inwardly from said fan blades, the discharge from said diffusers communicating with said passage means; and stationary radial outflow nozzle blades positioned to direct fluid into said diffusers.

7. In a rotojet fan: a cylindrical housing; stationary shrouded hubs disposed axially within said housing; an annular passage defined intermediate said housing and said hubs; a wheel rotatably mounted in one of said hubs; a plurality of fan blades having leading and trailing edges, said fan blades being carried by said wheel and disposed in said passage; passage means within said blades; nozzle means in said trailing edges of said fan blades and communicating with said passage means for conducting fluid therethrough; diffuser means carried by said wheel and disposed radially inwardly from said fan blades, the discharge from said diffuser means communicating with said passage means; a plenum chamber formed in one of said hubs; and stationary nozzle means positioned upstream from said diffuser means to direct fluid from said plenum chamber and into said diffuser means.

8. In a rotojet fan: a cylindrical housing; a pair of stationary shrouded hubs disposed axially within said housing; an annular passage defined intermediate said housing and said hubs; a wheel rotatably mounted in one of said hubs; a plurality of fan blades having leading and trailing edges, said fan blades being carried by said wheel and disposed in said passage; passage means within said fan blades; nozzle means in said trailing edges of said fan blades and communicating with said passage means for conducting fluid therethrough; a plurality of radial outflow diffusers carried by said wheel and disposed radially inwardly from said fan blades, the discharge from said diffusers communicating with said passage means; a plenum chamber formed in one of said hubs; conduit means positioned for the delivery of motive fluid to said plenum chamber; and stationary radial outflow nozzle blades positioned upstream from said diffuser means to direct fluid from said plenum chamber and into said diffusers.

9. In a rotojet fan: a housing; a stationary shroud structure disposed axially within said housing; a passage defined intermediate said housing and said shroud structure; a wheel rotatably mounted in said shroud structure; a plurality of fan blades having leading and trailing edges, said fan blades being carried by said wheel and disposed in said passage; passage means within said fan blades; nozzle means in said trailing edges of said fan blades and communicating with said passage means for conducting fluid therethrough; diffuser vanes carried by said wheel and disposed radially inwardly from said fan blades; axially restricted passage means intermediate said vanes and extending over a portion of the radial length thereof, the discharge from said diffuser vanes communicating with said passage means within said fan blades; and stationary nozzle means positioned upstream from said diffuser means to direct fluid into said diffuser vanes.

10. In a rotojet fan: a housing; a stationary shroud structure disposed axially within said housing; a passage defined intermediate said housing and said shroud structure; a wheel rotatably mounted in said shroud structure; a plurality of fan blades having leading and trailing edges, said fan blades being carried by said wheel and disposed in said passage; passage means within said fan blades; nozzle means in said trailing edges of said

fan blades and communicating with said passage means for conducting fluid therethrough; diffuser vanes carried by said wheel and disposed radially inwardly from said fan blades; axially restricted passage means intermediate said vanes and extending over a portion of the radial length thereof; a plenum chamber formed intermediate said restricted passage means and said passage means in said fan blades, the discharge from said diffuser vanes communicating with said passage means in said fan blades; and stationary nozzle means positioned to direct fluid into said diffuser vanes.

11. A rotojet fan comprising: a cylindrical housing; a pair of stationary shrouded hubs disposed axially within said housing; an annular passage defined intermediate said housing and said hubs; a wheel rotatably mounted in one of said hubs; a plurality of fan blades having leading and trailing edges, said fan blades being carried by said wheel and disposed in said passage; passage means within said fan blades; nozzle means in said trailing edges of said fan blades and communicating with said passage means for conducting fluid therethrough; a plurality of radial outflow diffuser vanes carried by said wheel and disposed radially inwardly from said fan blades; axially restricted passage means intermediate said vanes and extending over a portion of the radial length thereof, the discharge from said diffuser vanes communicating with said passage means within said fan blades; a stationary chamber formed in the other one of said hubs; conduit means positioned for the delivery of motive fluid to said plenum chamber; and stationary radial outflow nozzle blades positioned upstream from said diffuser means to direct fluid from said plenum chamber and into said diffuser vanes.

12. A rotojet fan comprising: a cylindrical housing; a pair of stationary shrouded hubs disposed axially within said housing; an annular passage defined intermediate said housing and said hubs; a wheel rotatably mounted in one of said hubs; a plurality of fan blades having leading and trailing edges, said fan blades being carried by said wheel and disposed in said passage; passage means within said fan blades; nozzle means in said trailing edges of said fan blades and communicating with said passage means for conducting motive fluid therethrough; a plurality of radial outflow diffuser vanes carried by said wheel and disposed radially inwardly from said fan blades; axially restricted passage means intermediate said vanes and extending over a portion of the radial length thereof; a secondary rotatable plenum chamber formed intermediate said restricted passage means and said passage means in said fan blades, the discharge from said diffuser vanes communicating with said passage means in said fan blades; a primary stationary plenum chamber formed in the other one of said hubs; conduit means positioned for the delivery of motive fluid to said primary plenum chamber; and a passage positioned upstream from said diffuser vanes and having stationary radial outflow nozzle blades positioned therein to direct motive fluid from said primary plenum chamber and into said diffuser vanes.

13. A rotojet fan comprising: a cylindrical housing; a pair of stationary shrouded hubs disposed axially within said housing; an annular passage defined intermediate said housing and said hubs; a wheel rotatably mounted in one of said hubs; a plurality of fan blades having leading and trailing edges, said fan blades being carried by said wheel and disposed in said passage; passage means within said fan blades; spaced nozzles in said trailing edges of said fan blades and communicating with said passage means for conducting motive fluid therethrough, said nozzles being arranged along substantially the entire radial length of said trailing edges; a plurality of radial outflow diffusers carried by said wheel and disposed radially inwardly from said fan blades, the discharge from said diffusers communicating with said passage means; a plenum chamber formed in the other one of said hubs; conduit means positioned for the delivery of motive fluid to said plenum chamber; and a passage positioned upstream from said diffusers and having stationary radial outflow nozzle blades positioned therein to direct motive fluid from said plenum chamber and into said diffusers.

14. A rotojet fan comprising: a cylindrical housing; a pair of stationary shrouded hubs disposed axially within said housing; an annular passage defined intermediate said housing and said hubs; a wheel rotatably mounted

in one of said hubs; a plurality of fan blades having leading and trailing edges, said fan blades being carried by said wheel and disposed in said passage; passage means within said fan blades; spaced nozzles in said trailing edges of said fan blades and communicating with said passage means for conducting motive fluid therethrough, said nozzles being arranged along substantially the entire radial length of said trailing edges; a plurality of radial outflow diffuser vanes carried by said wheel and disposed radially inwardly from said fan blades; axially restricted passage means intermediate said vanes and extending over a portion of the radial length thereof, the discharge from said restricted passage means communicating with said passage means within said blades; a plenum chamber formed in the other one of said hubs; conduit means positioned for the delivery of motive fluid to said plenum chamber; and a passage positioned upstream from said diffuser vanes and having stationary radial outflow nozzle blades positioned therein to direct motive fluid from said plenum chamber and into said diffuser vanes.

15. A rotojet fan comprising: a cylindrical housing; a pair of stationary shrouded hubs disposed axially within said housing; an annular passage defined intermediate said housing and said hubs; a wheel rotatably mounted in one of said hubs; a plurality of fan blades having leading and trailing edges, said fan blades being carried by said wheel and disposed in said passage; passage means within said fan blades; spaced nozzles in said trailing edges of said fan blades and communicating with said passage means for conducting motive fluid therethrough, said nozzles being arranged along substantially the entire radial length of said trailing edges; a plurality of radial outflow diffuser vanes carried by said wheel and disposed radially inwardly from said fan blades; axially restricted passage means intermediate said vanes and extending over a portion of the radial length thereof; a secondary plenum chamber formed intermediate said restricted passage means and said passage means in said fan blades, the discharge from said secondary plenum chamber communicating with said passage means in said fan blades; a primary plenum chamber formed in the other one of said hubs; conduit means positioned for the delivery of motive fluid to said primary plenum chamber; and a further passage positioned upstream from said diffuser vanes and having stationary radial outflow nozzle blades positioned therein to direct motive fluid from said primary plenum chamber and into said diffuser vanes.

16. In a rotojet fan having hollow fan blades with discharge openings, said blades being disposed in a duct and secured to a rotatable wheel, said fan having stationary nozzle means for directing motive fluid thereto: rotatable diffuser means adjacent the discharge from said nozzle means, said diffuser means being carried by said wheel; and a plenum chamber rotatable with said wheel and positioned intermediate said diffuser means and said blades.

17. In a rotojet fan having hollow fan blades with discharge openings, said blades being disposed in a duct and secured to a rotatable wheel, said fan having stationary nozzle blades for directing motive fluid thereto: rotatable diffuser vanes positioned adjacent the discharge from said nozzle blades, said diffuser vanes being carried by said wheel; and a plenum chamber rotatable with said wheel and positioned intermediate said diffuser vanes and said blades.

18. In a rotojet fan having hollow fan blades with discharge openings, said blades being disposed in a duct and secured to a rotatable wheel, said fan having stationary nozzle blades for directing motive fluid thereto: rotatable diffusers positioned adjacent the discharge from said nozzle blades, said diffusers being carried by said wheel; a plenum chamber rotatable with said wheel and positioned intermediate said diffusers and said blades; and sealing means intermediate said stationary nozzle blades and said rotatable wheel.

19. In a rotojet fan having hollow fan blades with discharge openings, said blades being secured to a rotatable wheel disposed in a duct, said fan having nozzle blades for directing motive fluid thereto: rotatable diffuser vanes adjacent the discharge from said nozzle blades, said diffuser vanes being carried by said wheel; axially restricted passage means intermediate said diffuser vanes and extending over a portion of the radial length thereof; and a plenum chamber rotatable with said wheel

and positioned intermediate said diffuser vanes and said fan blades.

20. In a rotojet fan having hollow fan blades with discharge openings, said blades being secured to a rotatable wheel disposed in a duct, said fan having nozzle blades for directing motive fluid thereto: rotatable diffuser vanes adjacent the discharge from said nozzle blades, said diffuser vanes being carried by said wheel; axially restricted passage means intermediate said diffuser vanes and extending over a portion of the radial length thereof; a plenum chamber rotatable with said wheel and positioned intermediate said diffuser vanes and said fan blades; and sealing means intermediate said stationary nozzle blades and said rotatable wheel.

21. In a rotojet fan having a primary plenum chamber adapted to receive a compressed fluid medium, said fan having hollow fan blades with nozzles directed from the trailing portions thereof, said fan blades being positioned for rotation in a duct, the combination of: passage means for said compressed fluid medium from said primary plenum chamber to the hollow spaces within said fan blades; stationary nozzle means disposed in said passage means; diffuser means positioned in said passage means immediately downstream from said nozzle means, said diffuser means being adapted to rotate with said fan blades; and a secondary plenum chamber formed in said passage means immediately downstream from said diffuser means, the discharge from said secondary plenum chamber being directed into said hollow spaces within said fan blades.

22. In a rotojet fan having a primary plenum chamber adapted to receive a compressed fluid medium, and hollow fan blades with nozzles directed from the trailing portions thereof, said fan blades being positioned for rotation in a duct, the combination of: passage means for said compressed fluid medium from said primary plenum chamber to the hollow spaces within said fan blades; stationary nozzle blades disposed in said passage means; diffuser vanes positioned in said passage means immediately downstream from said nozzle blades, said diffuser vanes being adapted to rotate with said fan blades; a secondary plenum chamber rotatable with said wheel and formed in said passage means immediately downstream from said diffuser vanes, the discharge from said secondary rotatable plenum chamber being directed into said hollow spaces within said fan blades; and sealing means intermediate said stationary nozzle blades and said rotating wheel.

23. In a rotojet fan having a primary plenum chamber adapted to receive a compressed fluid medium, said fan having hollow fan blades with nozzles directed from the trailing portions thereof, said fan blades being positioned for rotation in a duct, the combination of: passage means for said compressed fluid medium from said primary plenum chamber to the hollow spaces within said fan blades; stationary nozzle means disposed in said passage means; converging shroud means formed intermediate said nozzle means and said primary plenum chamber; diffuser means positioned in said passage means immediately downstream from said nozzle means, said diffuser means being adapted to rotate with said fan blades; and a secondary plenum chamber formed in said passage means immediately downstream from said diffuser means, the discharge therefrom being directed into said hollow spaces within said fan blades.

24. In a rotojet fan having a primary plenum chamber adapted to receive a compressed fluid medium, said fan having hollow fan blades with nozzles directed from the trailing edges thereof, said fan blades being positioned for rotation in a duct, the combination of: passage means for said compressed fluid medium from said primary plenum chamber to the hollow spaces within said fan blades; stationary nozzle blades disposed in said passage means; converging shroud means formed intermediate said nozzle blades and said primary plenum chamber; diffuser vanes positioned in said passage means immediately downstream from said nozzle blades, said diffuser vanes being adapted to rotate with said fan blades; a secondary plenum chamber formed in said passage means immediately downstream from said diffuser vanes, the discharge from said secondary plenum chamber being directed into said hollow spaces within said fan blades; and sealing means intermediate said stationary nozzle blades and said rotating wheel.

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