Jan. 24, 1967 J. SZYDLOWSKI 3,299,631

GAS TURBINES AND APPLICATIONS THEREOF

Filed April 3, 1964 5 Sheets-Sheet 1

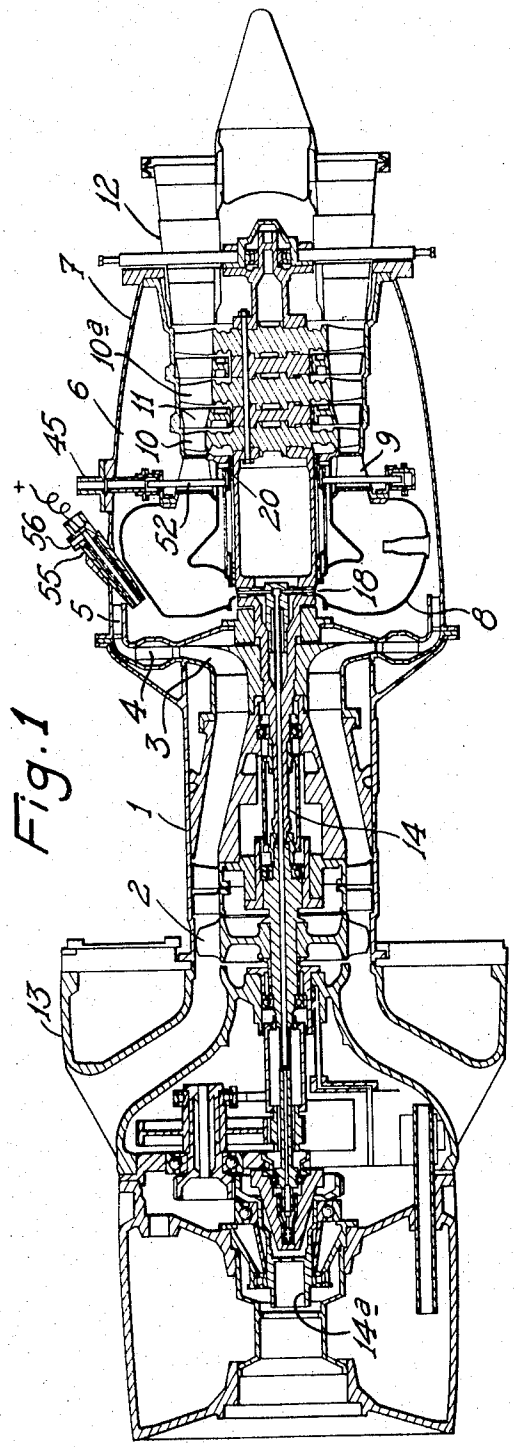


Fig. 1

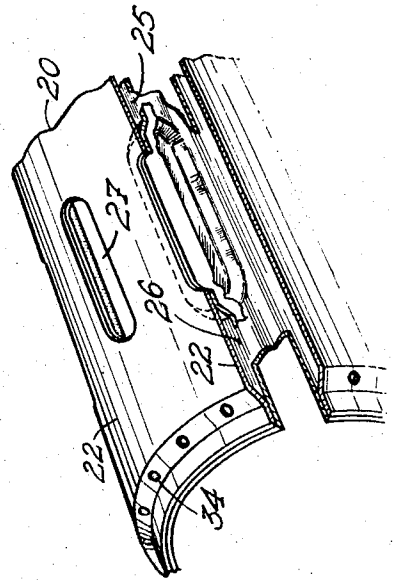


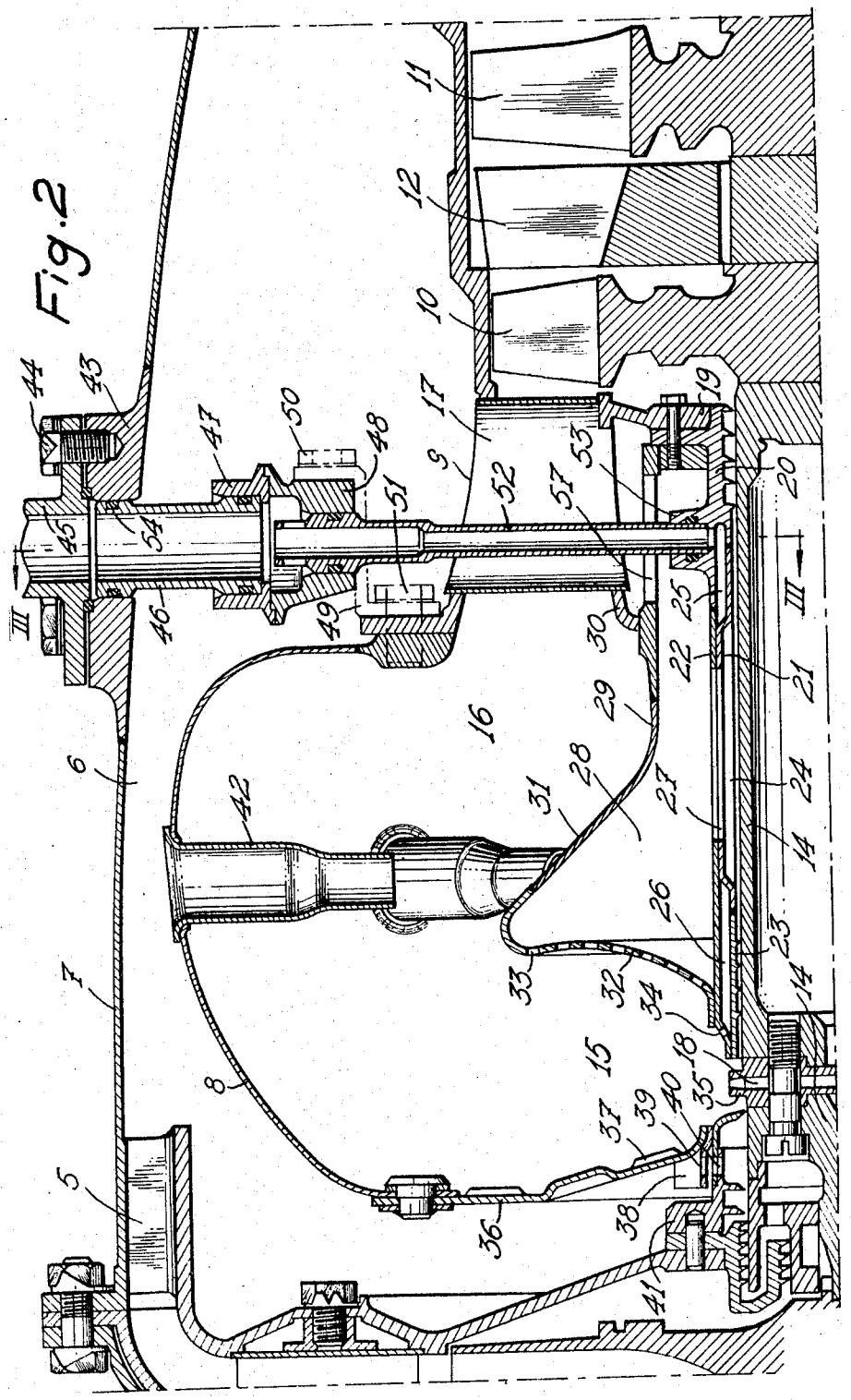
Fig. 8

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Fig. 2



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Fig.3

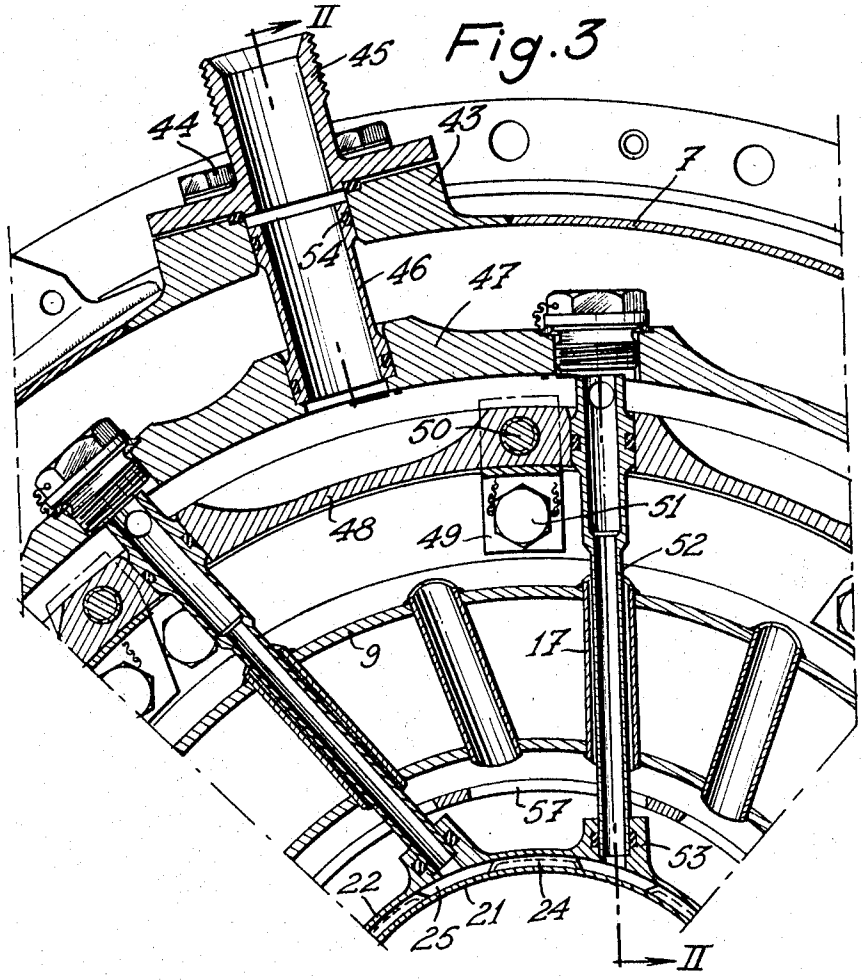


Fig.5

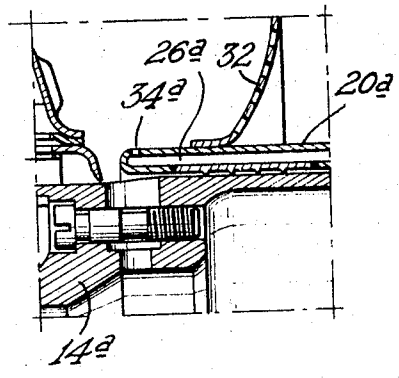
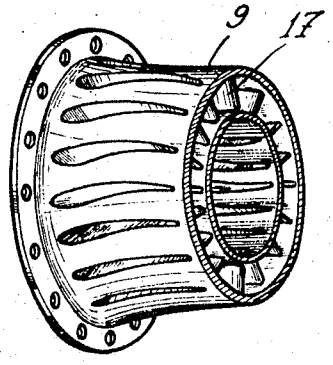


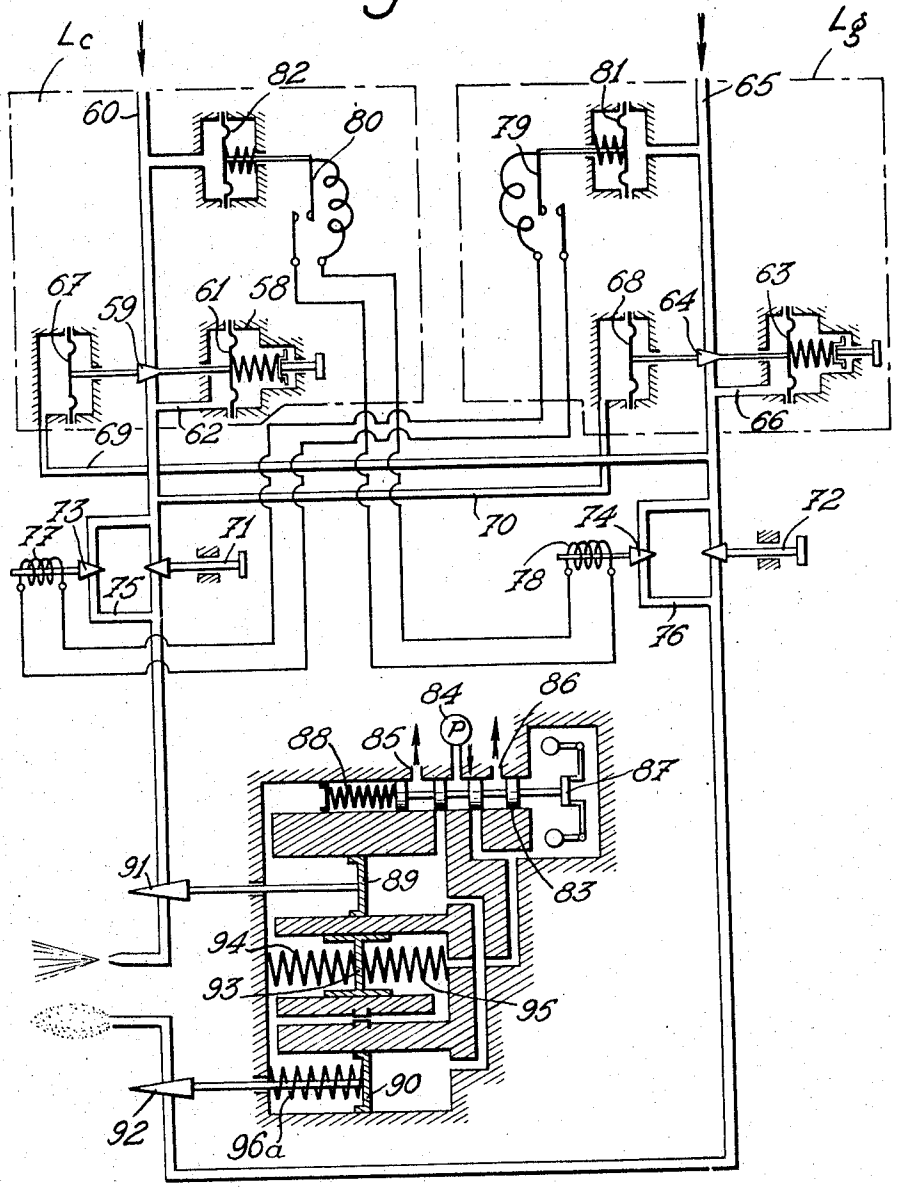
Fig.4



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Fig.6

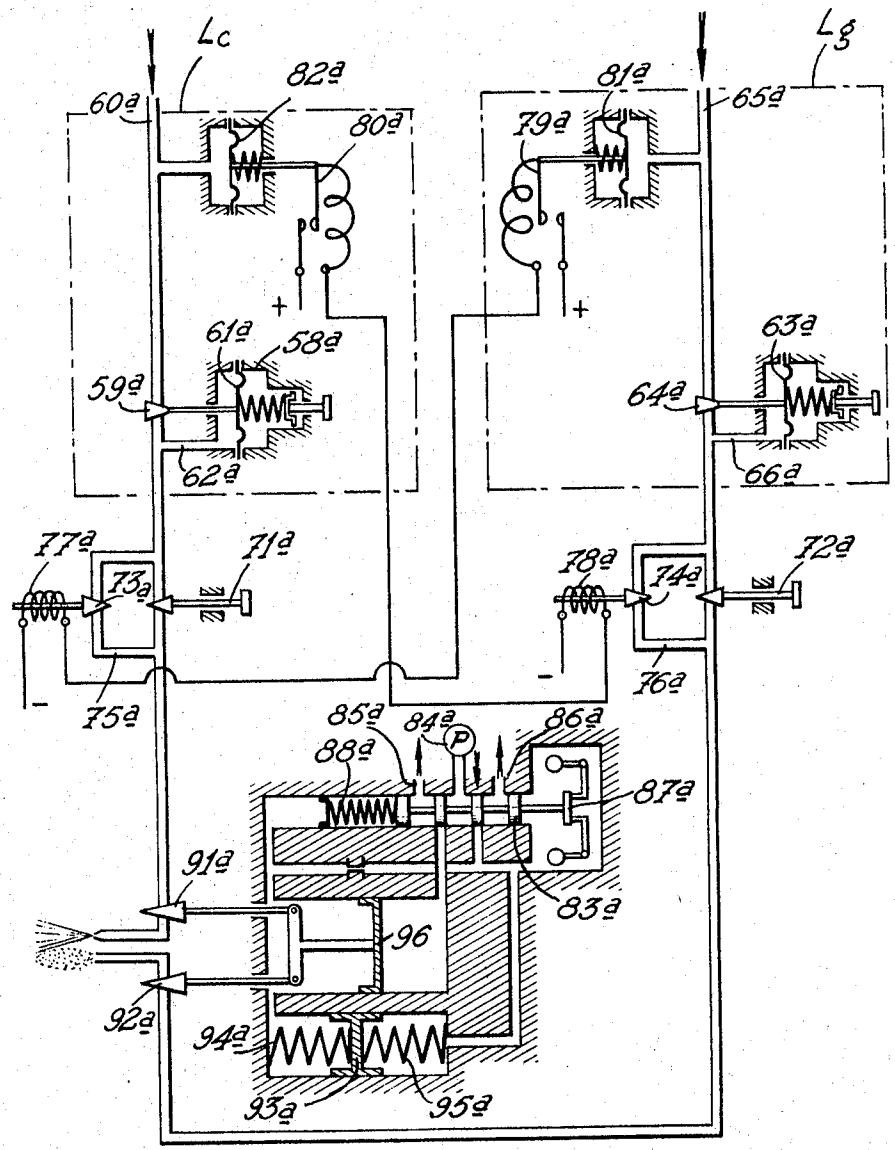


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Fig. 7



United States Patent Office 3,299,631 Patented Jan. 24, 1967

3,299,631

GAS TURBINES AND APPLICATIONS THEREOF

Joseph Szydlowski, Usine Turbomeca, Bordes, France

Filed Apr. 3, 1964, Ser. No. 357,201
Claims priority, application France, May 3, 1963, 933,581, Patent 1,363,418
8 Claims. (Cl. 60—39.28)

The expanding use of gas turbines in the aeronautical field has let to considerable technical advances which have conferred weight and size advantages on these units as compared to the conventional type of powerplant burning petroleum or its derivatives, such as diesel engines.

As a result, it has become possible to use gas turbines in the industrial field because of the high endurance they must have to meet the exacting requirements of aeronautical applications.

In addition, the exploitation of natural gas deposits has endowed the industry with a source of fuel which is usable more specifically for gas turbines of this type, all the more so as, in general, oil and natural gas deposits are related to one another.

With a view to permitting a rational use to be made of these natural fuels, the present invention has for its object the provision of a gas turbine arrangement of the type having a combustion apparatus inserted between a front compressor and a rear turbine characterized in that it comprises at least one combustion chamber supplied with air by the compressor and, separately or simultaneously, with cross-streams of liquid fuel and natural gas through the medium of regulating means of the intake of the two fuels connected to the liquid and the gaseous fuel inlets and associated to an isodromic speed regulator adapted to maintain at a constant value the r.p.m. of the turbine through a tachometric adjustment of the amount of fuel or fuels delivered thereto.

The isodromic speed regulator comprises a distributing slide-valve adapted to feed with a liquid under pressure either a servo-control piston mechanically connected to a regulation control device for the fuel feed of an internal combustion engine or a temporary follow-up acting piston hydraulically connected to said servo-control piston, according to whether the actual number of revolutions of the engine is lower or higher than the number of revolutions to be adjusted, the two faces of said temporary follow-up acting piston being interconnected through an adjustable restricted valve providing a laminar flow and being respectively connected to two chambers housing the ends of said slide-valve on which act respectively a tachometric regulator driven by the engine and the throttle lever for said engine, as described in the U.S. Patent No. 3,002,502 filed by applicant.

In accordance with a preferred embodiment, the combustion apparatus is of the type in which a fixed outer casing houses a fixed annular combustion chamber having a radial cavity adjacent the compressor and an axial annular cavity extending towards the turbine while leaving with respect to said casing an annular space for passage of the principal air flow from the compressor, said annular chamber being supplied with liquid fuel by rotary injection into its radial cavity through openings provided in a hollow shaft which connects the compressor and the turbine and is itself connected to a liquid fuel feed device, and the air flow delivered by the compressor filling the space between the outer casing and the chamber and undergoing a subdivision into combustion air and dilution air and is characterized in that the combustion air, which is in turn subdivided into two streams, is admitted into the radial cavity on each side of the combustion zone, after the rearward stream has passed through the hollow vanes of the distributor of the combustion

gases to the turbine, while the dilution air penetrating into the axial annular cavity dilutes the combustion gases and lowers them to a temperature compatible with satisfactory mechanical durability of the turbine, as described in the U.S. Patent No. 2,856,755 filed by applicant.

In accordance with the present invention, the gaseous fuel is admitted into the base of the radial cavity of the combustion chamber through a series of holes disposed level with the liquid fuel injection holes and embodied in a labyrinth seal surrounding said hollow shaft and forming a double-walled cylindrical case embodying a series of separate chambers through which circulate gaseous fuel and the combustion air from the distributor vanes, said labyrinth being supplied with gaseous fuel through a multiplicity of substantially radial tubes which extend through the hollow distributor vanes and are connected to a manifold which is accommodated in the annular vanes level with said distributor and connected by a tube extending through the casing to the source of gaseous fuel.

In accordance with the present invention, the gas turbine arrangement comprises in alignment within casings one or more axial compressors possibly followed by one or more centrifugal compressors supplying an annular combustion chamber, the gas which issues from said chamber and passes through the distributor with hollow vanes supplying the turbine or turbines which are always aligned within a casing along the same axis, and these turbines, a number of which can be of the free type, driving the compressors on the one hand and delivering, on the other, the motive power for driving the load (such as an A.C. generator), through a suitable transmission, the air intake shroud enclosing the drive to the accessories mounted on the end-closure of said shroud, as described in the U.S. Patent No. 2,922,278 filed by applicant.

Lastly, the invention encompasses applications of gas turbines of the type hereinbefore described in batteries thereof forming a self-contained set or a standby set for driving constant-speed pumps and producing electric power and heat with or without a compressed air bleed, more particularly for air conditioning and for producing hot water in public buildings, schools, hotels, residential building, hospitals and clinics.

The description which follows with reference to the accompanying drawings, which are filed by way of non-limitative examples, will give a clear understanding of how the invention can be carried into practice and disclose yet further particularities thereof.

In the drawings:

FIG. 1 shows schematically in diametrical section a gas turbine according to the invention.

FIG. 2 shows in section, through the line II—II of FIG. 3 and on an enlarged scale, the combustion apparatus of the gas turbine of FIG. 1.

FIG. 3 shows in fragmental diametrical section through the line III—III the combustion apparatus of FIG. 2.

FIG. 4 shows in perspective, on a reduced scale, the distributor with hollow vanes equipping the turbine of FIG. 1.

FIG. 5 shows an alternative embodiment for use in cases where the turbine is supplied only with gaseous fuel.

FIG. 6 is the circuit diagram of a fuel intake regulator for equipping the turbine of FIG. 1, executed in accordance with a first embodiment.

FIG. 7 is the circuit diagram of a fuel intake regulator executed in accordance with a second embodiment.

FIG. 8 is a partial perspective view with cutaway of the gaseous fuel inlet labyrinth.

In the specific embodiment shown in FIG. 1, the gas turbine, which is of the type described in the aforementioned U.S. Patent No. 2,922,278 comprises a com-

pressor casing 1 within which are disposed in succession and alignment an axial compressor 2 and a centrifugal compressor 3, followed by a radial diffusor 4 and an axial diffusor 5 leading the air flow into an annular space 6 provided between a main casing 7 and a combustion chamber 8. The gas issuing from the combustion chamber passes through a hollow-vaned distributor 9 and thence through the blades 10 of a single- or multi-stage turbine which, in the latter event, includes distributors 11 between each stage 10 and 10*a* said gas exhausting from the turbine through a conventional jet-pipe 12.

Forward of casing 1 is coaxially fitted a shroud 13 which constitutes the engine intake and encloses the kinematic drive to the accessories, to wit the oil pumps with their filters, the dynastarter, the fuel pump and the speed regulator required for engine operation. The turbine further includes a reduction gear coupled to its shaft 14, which reduction gear is housed within the shroud 13 and the output shaft 14*a* of which can be coupled directly to the load (an A.C. generator, for instance). For clarity in the drawing, the accessories are not shown.

The alignment of casings 13, 1, 7 and 12 along a common axis and the structure of the devices housed therein provide the highest possible reduction of the maximum cross section area by constraining the moving fluids to follow a path constituted solely by annular tracks without return bends.

As disclosed in the aforementioned U.S. Patent 2,856,755, in the combustion apparatus utilized in such a turbine the combustion chamber 8 has a radial cavity 15 adjacent the air intake of compressors 2 and 3 followed by an axial annular cavity 16 which extends in the direction of the turbine and communicates therewith via the distributor 9 equipped with hollow vanes 17 through which the air supplied by the compressors and issuing from the annular space 6 can flow whereby to cool the combustion gas streaming between said hollow vanes 17. Combustion chamber 8 is fed with liquid fuel into its radial cavity 15 by rotary injection, through openings 18 provided in a distributor which is rendered rigid in any convenient known manner with hollow shaft 14 and supplied with fuel through the same, which shaft is accordingly connected to a convenient feed device.

The rear part of distributor 9 is secured by means of screws and a flange 19 to a labyrinth 20 and also to the rear part of the inner portion 29 of the combustion chamber. The front part of labyrinth 20 consists of a double casing the walls 21 and 22 of which comprise shaped and drilled portions 27 which are welded along their circumference. These portions cause the space 28, which is bounded by the inner portion 29 of the combustion chamber and by the wall 22, to communicate with the annular space 24 located between wall 21 and the turbine shaft 14. Wall 21 is provided with forward baffles 23 the utility of which will be explained hereinafter. Walls 21 and 22 bound chambers 25 and 26, which in turn intercommunicate through spaces included between the shaped portions 27. Chambers 26 open into the radial cavity through holes 34 positioned substantially at the same level as the injector-ring ducts 18 and the nozzles 35.

The front wall 36 of the outer portion of combustion chamber 8 is provided with openings 37 through which passes almost the entire quantity of the initial combustion air stream. Said wall 36 additionally supports a cooling ring 38 provided with openings 39 which communicate with holes 40 provided in a labyrinth 41. The outer part of the combustion chamber is equipped with tubes 42 through which annular space 6 communicates with axial cavity 16 and through which dilution air is admitted into the chamber.

Onto outer casing 7, level with distributor 9 is welded a boss 43 onto which screws 44 secure a natural-gas inlet pipe 45. Into said boss is fitted a tube 46 which penetrates into space 6 and opens into an annular ring

which serves as a manifold and consists of two parts 47 and 48 welded together. The assembly is supported on brackets 49 fixed to the manifold and the combustion chamber by screws 50 and 51.

A number of tubes 52 extend from manifold 47, 48 and extend through the hollow vanes 17 of distributor 9 and open into bosses 53 which are provided at the rear extremity of labyrinth 20 and communicate with chambers 25, whereby to convey the gas to orifices 34. The size of tubes 52, chambers 25 and 26 and orifices 34 are predetermined to ensure the necessary flow rate, having regard for the anticipated gas pressures.

The gaskets 54 provide gastightness between the various component parts of the gas fuel inlet system, and these gaskets are made of a material capable of withstanding the high temperatures prevailing inside casing 7.

Ignition in the combustion chamber when the engine is started is effected by means of one or more igniters 55 (FIG. 1) comprising a fuel inlet 56 which is connected to the fuel supply lines through a three-way valve which permits operation with gas alone or with liquid fuel alone.

The combustion apparatus hereinbefore described functions in the following manner:

After liquid fuel, gaseous fuel or both at once have been admitted under the control of a regulting unit to be described hereinafter, and after either of these fuels or the mixture of both has been ignited by igniter 55, stable combustion devoid of flame-lift is maintained by subdivision of the combuston air stream into two principal streams, while the dilution air which penetrates into the chamber through the tubes 42 and the holes provided adjacent thereto dilutes the combustion gas and lowers it to a temperature compatible with satisfactory mechanical durability of the turbine. Almost all the first combustion air stream penetrates into the chamber through the slits 37 in the front portion 36 thereof and supplies the forward portion of the combustion chamber. A small part of this first air stream which passes through the holes and orifices 39 and 40 reaches that portion of the flame which is nearest orifices 18 and 34 after it has flowed beneath the rear lip of labyrinth 41 and thus assists flame stability. The second combustion air stream flows along the outer part of the chamber, cools the same, then flows through the hollow vanes 17 of distributor 9, after which it streams through the passageways 57, reaches the space 28 and finally enters the combustion chamber through the holes 33 in wall 32, thus feeding the rear portion of the flame. A small part of this second stream which passes through the openings 27 reaches the space 26 in annular chamber 24, whence it is admitted, at a very low rate and low velocity and after streaming beneath the baffles 23, to the lower part of the flame, thereby likewise assisting stability of the same.

When it is desired to run the turbine illustrated in FIG. 1, equipped with a combustion apparatus of the type hereinbefore described, by the separate or joint use of liquid and gaseous fuels, recourse is had to a fuel intake regulating unit of the type illustrated in FIGS. 6 and 7.

In the specific embodiment shown in FIG. 6, said regulating unit comprises a liquid fuel pressure reducing valve 58 having a slide-valve 59 which is inserted into the liquid fuel line 60 and is connected to a calibrated diaphragm 61 subjected to the liquid fuel pressure, which pressure is reduced, by means of a pipe 62 tapped downstream of slide-valve 59. Similarly, a slide-valve 64 inserted into the gas inlet line 65 is connected to the diaphragm 63 of a pressure reducing valve subjected to the gas pressure, which pressure is reduced, by means of a pipe 66 tapped downstream of slide-valve 64. These two pressure reducing valves are corrected, respectively, by the pressure of the pressure-relieved gas and by that of the pressure-relieved liquid fuel. Such correction is accomplished by diaphragms 67 and 68 which are respectively connected to slide-valves 59 and 64 and respectively subjected to the pressures of the pressure-relieved gas and

pressure-relieved liquid fuel, which pressures are relieved by means of pipes **69** and **70** tapped, respectively, off pipe **65** downstream of the by-pass **66** and off pipe **60** downstream of by-pass **62**. The greater the pressure of one of the pressure-relieved fuels, the greater the slide-valve **59** or **64** of the pressure reducing valve of the other fuel closes, and vice versa, to become fully open when the pressure of the second fuel cancels out. When this is the case, the quantity of the first fuel admitted into the turbine must be sufficient to ensure maximum power.

Valves **71** and **72** fitted downstream of pipes **70** and **69** permit, depending on their adjustment, of determining the maximum proportions of liquid and gaseous fuels admitted into the combustion chamber.

The metering system further includes electrovalves **73** and **74** inserted into by-passes **75** and **76** which interconnect the upstream and downstream parts of valves **71** and **72**. These electrovalves, which are closed in normal operation, are actuated by relays **77** and **78** energized by mano-contacts **79** and **80**, and these mano-contacts are closed by calibrated diaphragms **81** and **82** which are in turn subjected to the pressures of the incoming gaseous and liquid fuels. When the pressure of the gaseous fuel becomes null in pipe **65**, calibrated diaphragm **81** closes mano-contact **79**, thereby energizing relay **77** and opening valve **73**, whereby to let through a quantity of liquid fuel which is complementary to the quantity determined by the adjustment of valve **71** and thereby ensure conservation of the maximum power. The same result is obtained when the liquid fuel pressure becomes null in pipe **60**, by means of diaphragm **82** which closes mano-contact **80**, thereby energizing relay **78** and opening slide-valve **74**.

In addition to the fuel flow regulation obtained by means of the system described hereinabove, the turbine is equipped with an isodromic piston type tachometric regulator comprising, in the manner well known per se, a slide-valve **83** which is interposed between a fluid pressurizing pump **84** and two returns **85** and **86** thereto and which is subjected to the action of a centrifugal regulator **87** driven by the turbine as well as to the action of a spring **88** connected to means for setting up the desired turbine r.p.m. figure.

Slide-valve **83** is hydraulically connected to two working pistons **89** and **90** connected respectively to metering devices **91** and **92** which are inserted into the liquid fuel and gaseous fuel lines **60** and **65** downstream of the means for proportioning the quantity of each fuel admitted into the combustion chamber. These two working pistons are hydraulically associated with an isodromic piston **93** which is subjected to the action of two opposed springs **94** and **95** of equal strength. A spring **96***a* is fitted ahead of that working piston **89** or **90** which controls the position of the metering device inserted into the preferred fuel circuit, whereby to ensure priority of supply with that particular fuel. This device is of the type described in the aforementioned U.S. Patent No. 3,002,502. It will be noted that metering devices **91** and **92** are so adjusted that when they are fully open the fuel flow through each is alone sufficient to provide maximum engine power.

In the specific embodiment shown in FIG. 7, like components to those in FIG. 6 bear like reference numerals followed by the letter *a*. Essentially, this embodiment differs from that of FIG. 6 in that the isodromic speed regulator has a single working piston **96** for controlling the two metering devices **91***a* and **92***a*, which devices are inserted into the liquid fuel and gaseous fuel lines **60***a* and **65***a* and assume identical positions in operation. In addition, the liquid fuel and gaseous fuel pressure reducing valves **58***a* and **63***a*, respectively, are devoid of means for correction as a function of the pressure of the other fuel.

The manner of operation of this regulating system differs from that of the system in FIG. 6 only in that because metering devices **91***a* and **92***a* are displaced synchronously, they always open or close by the same amount and will not permit of as full as possible a preferred adaptation to one or the other fuel. In the previous embodiment referred to, the biased metering unit, which is equipped with a spring, can be fully opened while the other supplies only the make-up fuel required to obtain the desired power. Metering devices **91***a* and **92***a* are so adjusted that when fully open they be individually capable of letting fuel through at a rate enabling maximum power to be obtained. Similarly, electro-valves **73***a* and **74***a* must be so adjusted that, when open, the fuel flow through them, added to that through valves **71***a* and **72***a*, is sufficient to ensure maximum power with only one of the fuels.

More particularly in the industrial field the combustion apparatus hereinbefore described can be utilized with natural gas as the sole fuel fed thereto. As is clearly shown in FIG. 5, hollow shaft **14***a* is to that end no longer connected to a liquid fuel feed device, and chambers **26***a* of labyrinth **20***a* are extended well beyond wall **32** in such manner that the orifices **34***a* be disposed substantially level with the position which the liquid fuel rotary injection nozzles would have occupied.

From the industrial standpoint, depending on the power demand, a single turbine or a plurality of paralleled turbine sets could be used. In most cases, recourse is had to batteries comprising a number of sets such that the required maximum power can always be furnished notwithstanding alternate shutting-down of the individual units of the set for maintenance purposes, while at the same time enabling a certain number of units to be shut-down during off-peak hours.

A set made up of turbines of the type specified hereinabove is particularly suitable for driving constant-speed pumps, for producing electric power and heat by utilization of the exhaust gases (with or without a compressed air bleed), particularly in industrial buildings or on airfields, for air-conditioning public buildings, schools, hotels and residential buildings, and as a standby set for generating electricity and producing hot water for air-conditioning hospitals and clinics, or for any other category of users for whom a failure in the public electricity distribution grid could have serious consequences.

It is of course to be understood that many modifications can be made to the specific embodiments described hereinabove, without departing from the scope of the invention as defined in the appended claims.

What I claim is:

1. A gas turbine comprising a fixed outer casing, a turbine member within said casing, means defining a fixed annular combustion chamber within said casing, an air compressor, a hollow shaft connecting the compressor and the turbine member, said combustion chamber having a radial cavity adapted for receiving compressed air from the compressor and in which combustion proper is effected and an axially disposed annular cavity extending rearwardly towards the turbine member for supplying the latter with combustion gas, said combustion chamber defining an annular space with the casing for the passage of principal air flow from the compressor, means for supplying said radial cavity of the combustion chamber with liquid fuel from a source of liquid fuel by rotary radial injection into said radial cavity of streams of said liquid fuel through openings provided in said hollow shaft, a distributor between said annular cavity and the turbine member and having hollow vanes around which the combustion gas flows as it passes from the combustion chamber to the turbine member, said hollow vanes opening into said annular space to receive air which flows in a stream from said annular space to the radial cavity while first cooling the combustion gases flowing to the turbine member, means for directing the air in said annular space into said radial cavity as a further stream such that said air streams are admitted into the radial cavity on either side of the liquid fuel supply openings,

said combustion chamber having an opening in communication with said annular space to permit direct introduction therein of dilution air for lowering the temperature of the combustion gases, a source of natural gaseous fuel, means for supplying said radial cavity of the annular combustion chamber with streams of natural gaseous fuel which intersect the streams of liquid fuel supplied to said cavity by radial injection, the gaseous fuel supply means comprising a labyrinth seal surrounding the hollow shaft adjacent the turbine member and constituted by a double-walled cylindrical case defining a series of separate interconnected chambers some of which are in communication with the hollow vanes of the distributor while the others are in communication with said radial cavity through a series of gaseous fuel injection holes which are disposed at the level of the liquid fuel injection openings, a plurality of substantially radial tubes extending through said hollow vanes and connected to said other chambers of the labyrinth seal, a manifold accommodated in the annular space between the annular cavity of the combustion chamber and the outer casing and connected to said radial tubes, a gaseous fuel line extending through said casing and interconnecting said manifold and the source of natural gaseous fuel, regulating means connected to said gaseous fuel source and to the source of liquid fuel for regulating the quantity of both said fuels to be admitted into said radial cavity, and a tachometric adjusting device interconnecting, on the one hand, said regulating means and, on the other hand, said gaseous fuel supply means and the liquid fuel feed device for adjusting the amount of said fuels delivered to said radial cavity to maintain at a constant value the rotational working speed of the turbine member.

2. A gas turbine arrangement according to claim 1 wherein the liquid fuel supply means comprises a fuel line from the liquid fuel supply for supplying fuel to the hollow shaft and the regulating means comprises, for each one of said lines, a fuel pressure reducing means, a slide-valve in such line, connected to, and controlled by, said fuel pressure reducing means and so adjusted that, when fully open, the fuel flow therethrough is sufficient to ensure maximum power for the turbine member with only the corresponding fuel, means sensitive to the reduced pressure of the other fuel connected to, and correcting, said fuel pressure reducing means so that the flow of said corresponding fuel through said slide-valve varies in a reverse direction with respect to the variations of the reduced pressure of said other fuel, adjustable means inserted in said line downstream of said slide-valve for adjustably determining the relative amount of said corresponding fuel to be admitted into the combustion chamber, a connection connected to said line upstream and downstream of said adjustable means, and means sensitive to the pressure of the other fuel and disposed in said connection for providing, when the pressure of said other fuel becomes null, a fuel flow therethrough which is complementary to that determined by the adjustment of said adjustable means in order to ensure maximum power for the turbine member with only said corresponding fuel.

3. A gas turbine arrangement according to claim 1 wherein the liquid fuel supply means comprises a fuel line from the liquid fuel supply for supplying fuel to the hollow shaft and the regulating means comprises, for each one of said lines, a slide-valve in said line so adjusted that, when fully open, the fuel flow therethrough is sufficient to ensure maximum power to the turbine member with only the fuel corresponding to said line, a calibrated diaphragm-type pressure reducing device mechanically connected to said slide-valve and hydraulically connected to said line downstream of said slide-valve, a pressure corrector mechanically connected to said slide-valve and hydraulically connected to the other line downstream of the connection thereof with the pressure reducing device for the other fuel, an adjustable valve disposed through said line downstream of the connection thereof with the

pressure corrector for the other fuel for adjusting the relative quantity of said corresponding fuel to be admitted into the combustion chamber, a connection connected to said line upstream and downstream of said adjustable valve, a normally closed electrovalve disposed in said connection, a calibrated diaphragm-type device having a diaphragm hydraulically connected to the other line upstream of the corresponding slide-valve, a normally open contact connected to the said electrovalve, and means carried by said diaphragm for closing said contact when the pressure of the other fuel becomes null in order to fully open said electrovalve for providing a fuel flow therethrough which is complementary to that determined by the adjustment of said adjustable valve to ensure maximum power for the turbine member with only said corresponding fuel.

4. A gas turbine arrangement according to claim 3, wherein the tachometric adjusting device comprises a fluid pressurizing pump, two returns to said pump, a regulating slide-valve interconnecting said pump and said returns, a centrifugal regulator driven by the turbine and acting on one end of said regulating slide-valve, means for setting up the desired rotational speed for the turbine member acting on the other end of said regulating slide-valve, two metering devices respectively inserted in the liquid and gaseous fuel lines downstream of the corresponding connections, two working pistons one face of which is hydraulically connected to said regulating slide-valve while their other faces are mechanically connected to said metering devices, respectively, and hydraulically connected to said other end of the regulating slide-valve, an isodromic piston one face of which is hydraulically connected to said slide-valve and to said one end of said regulating slide-valve while the other is hydraulically connected to the other end of said regulating slide-valve, and two opposed springs of equal strength respectively acting on the faces of said isodromic piston.

5. A gas turbine arrangement according to claim 4, wherein a spring biases the face of one of the working pistons which is connected to the corresponding metering device whereby to use as the preferred fuel the fuel into the supply line of which said biased metering device is interposed, the other metering device furnishing only the complementary quantity of the other fuel required to obtain the desired power when the biased metering device is fully open.

6. A gas turbine arrangement according to claim 1, wherein the liquid fuel supply means comprises a fuel line from the liquid fuel supply for supplying fuel to the hollow shaft and the regulating means comprises, for each one of said lines, a fuel pressure reducing means, a slide-valve disposed in such line, connected to, and controlled by, said fuel pressure reducing means and so adjusted that, when fully open, the fuel flow therethrough is sufficient to ensure maximum power for the turbine member with only the corresponding fuel, adjustable means inserted in said line downstream of said slide-valve for adjustably determining the relative amount of said corresponding fuel to be admitted into the combustion chamber, a connection connected to said line upstream and downstream of said adjustable means, and means sensitive to the pressure of the other fuel and disposed in said connection for providing, when the pressure of said other fuel becomes null, a fuel flow therethrough which is complementary to that determined by the adjustment of said adjustable means in order to ensure maximum power for the turbine member with only said corresponding fuel.

7. A gas turbine arrangement according to claim 1, wherein the liquid fuel supply means comprises a fuel line from the liquid fuel supply for supplying fuel to the hollow shaft and the regulating means comprises, for each one of said lines, a slide-valve in such line so adjusted that, when fully open, the fuel flow therethrough is sufficient to ensure maximum power to the turbine member

with only the fuel corresponding to said line, a calibrated diaphragm-type pressure reducing device mechanically connected to said slide-valve and hydraulically connected to said line downstream of said slide-valve, an adjustable valve disposed in said line downstream of the connection thereof with said pressure reducing device for adjusting the relative quantity of said corresponding fuel to be admitted into the combustion chamber, a connection connected to said line upstream and downstream of said adjustable valve, a normally closed electrovalve disposed in said connection, a calibrated diaphragm type device having a diaphragm hydraulically connected to the other line upstream of the corresponding slide-valve, a normally open contact connected to the said electrovalve, and means carried by said diaphragm for closing said contact when the pressure of the other fuel becomes null in order to fully open said electrovalve for providing a fuel flow therethrough which is complementary to that determined by the adjustment of said adjustable valve to ensure maximum power for the turbine member with only said corresponding fuel.

8. A gas turbine arrangement according to claim 7, wherein the tachometric adjusting device comprises a fluid pressurizing pump, two returns to said pump, a regulating slide-valve interconnecting said pump and said returns, a centrifugal regulator driven by the turbine member and acting on one end of said regulating slide-valve, means for setting up the desired rotational speed for the turbine member acting on the other end of said regulating slide-valve, two metering devices respectively inserted in the liquid and gaseous fuel lines downstream of the corresponding connections, a working piston one face of which is hydraulically connected to said regulating slide-valve while its other face is mechanically connected to said metering devices and hydraulically connected to said other end of the regulating slide-valve, an isodromic piston one face of which is hydraulically connected to said slide-valve and to said one end of said regulating slide-valve while the other is hydraulically connected to the other end of said regulating slide-valve, and two opposed springs of equal strength respectively acting on the faces of said isodromic piston, said metering devices assuming in operation absolutely identical positions and being so determined that, when fully open, they individually supply enough of the corresponding fuel alone to obtain the maximum power for the turbine member.

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