Jan. 27, 1959 V. K. FRY 2,870,847

TURBINE DRIVEN OPPOSITELY ROTATING PROPELLERS

Filed May 9, 1955 4 Sheets-Sheet 1

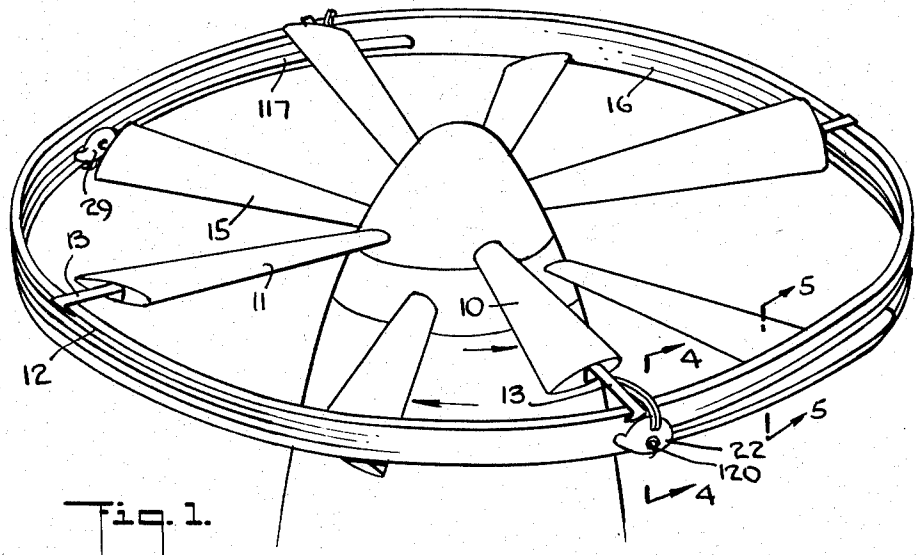
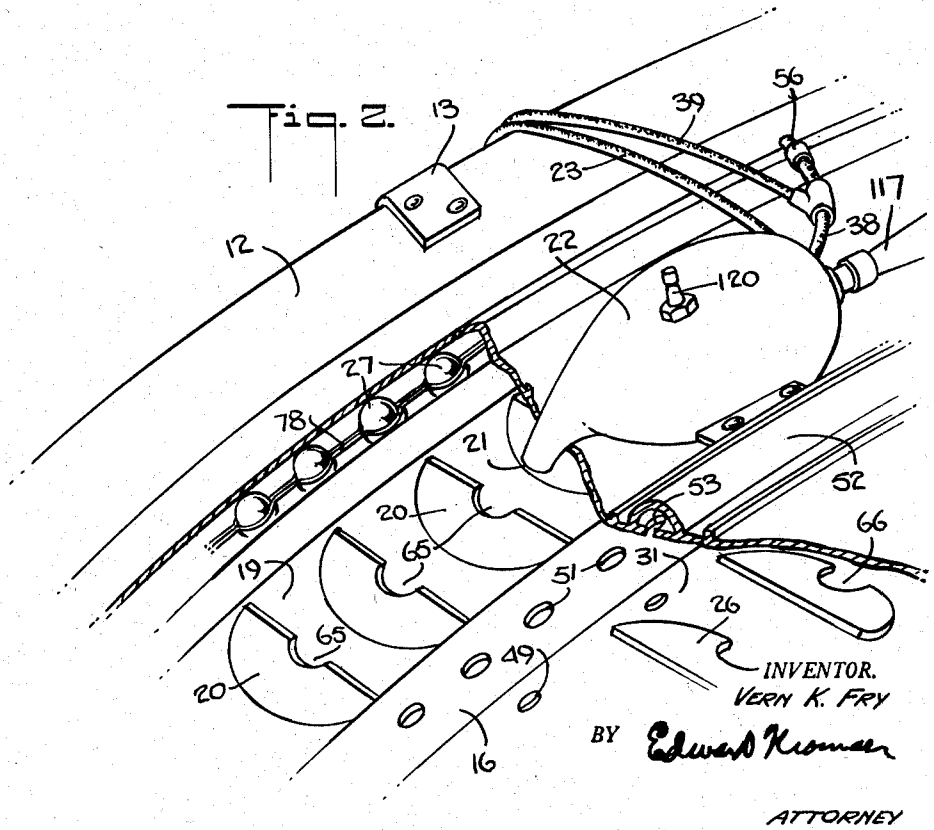


Fig. 1.

Fig. 2.



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TURBINE DRIVEN OPPOSITELY ROTATING PROPELLERS

Filed May 9, 1955 4 Sheets-Sheet 2

Fig. 4.

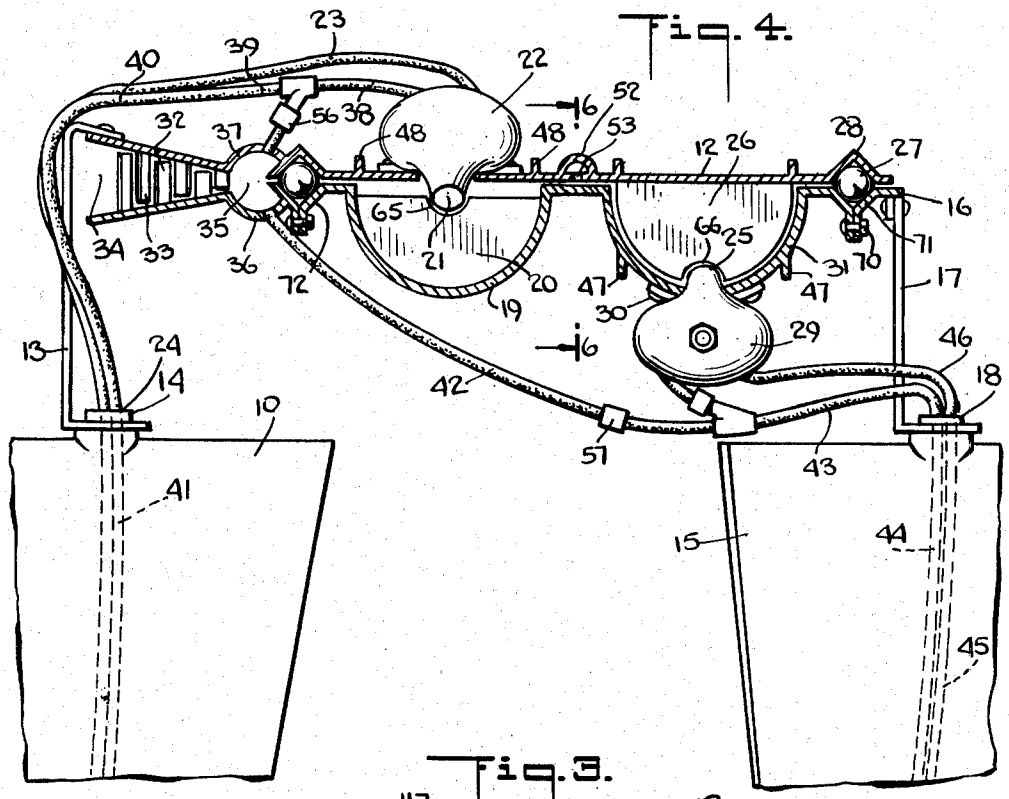
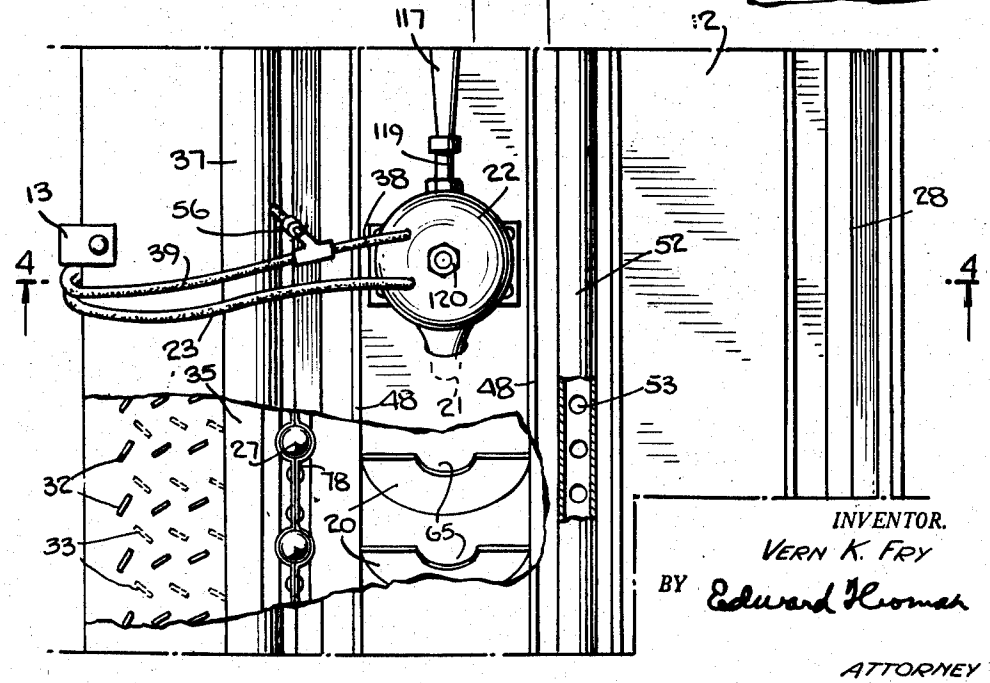


Fig. 3.



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TURBINE DRIVEN OPPOSITELY ROTATING PROPELLERS

Filed May 9, 1955 4 Sheets-Sheet 3

Fig. 5.

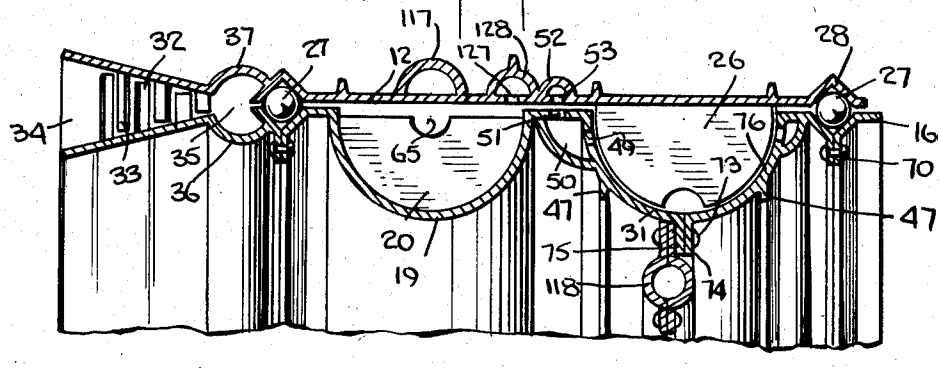
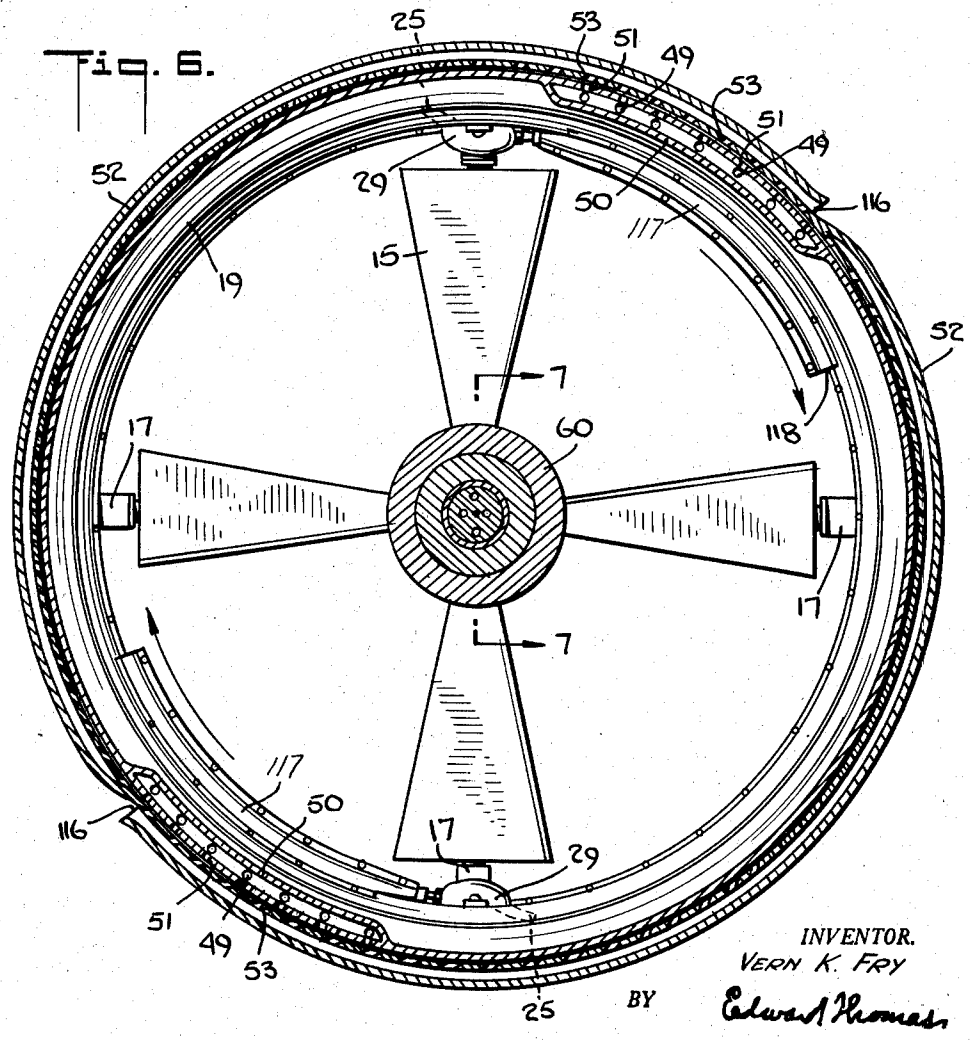


Fig. 6.



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Jan. 27, 1959 V. K. FRY 2,870,847

TURBINE DRIVEN OPPOSITELY ROTATING PROPELLERS

Filed May 9, 1955 4 Sheets-Sheet 4

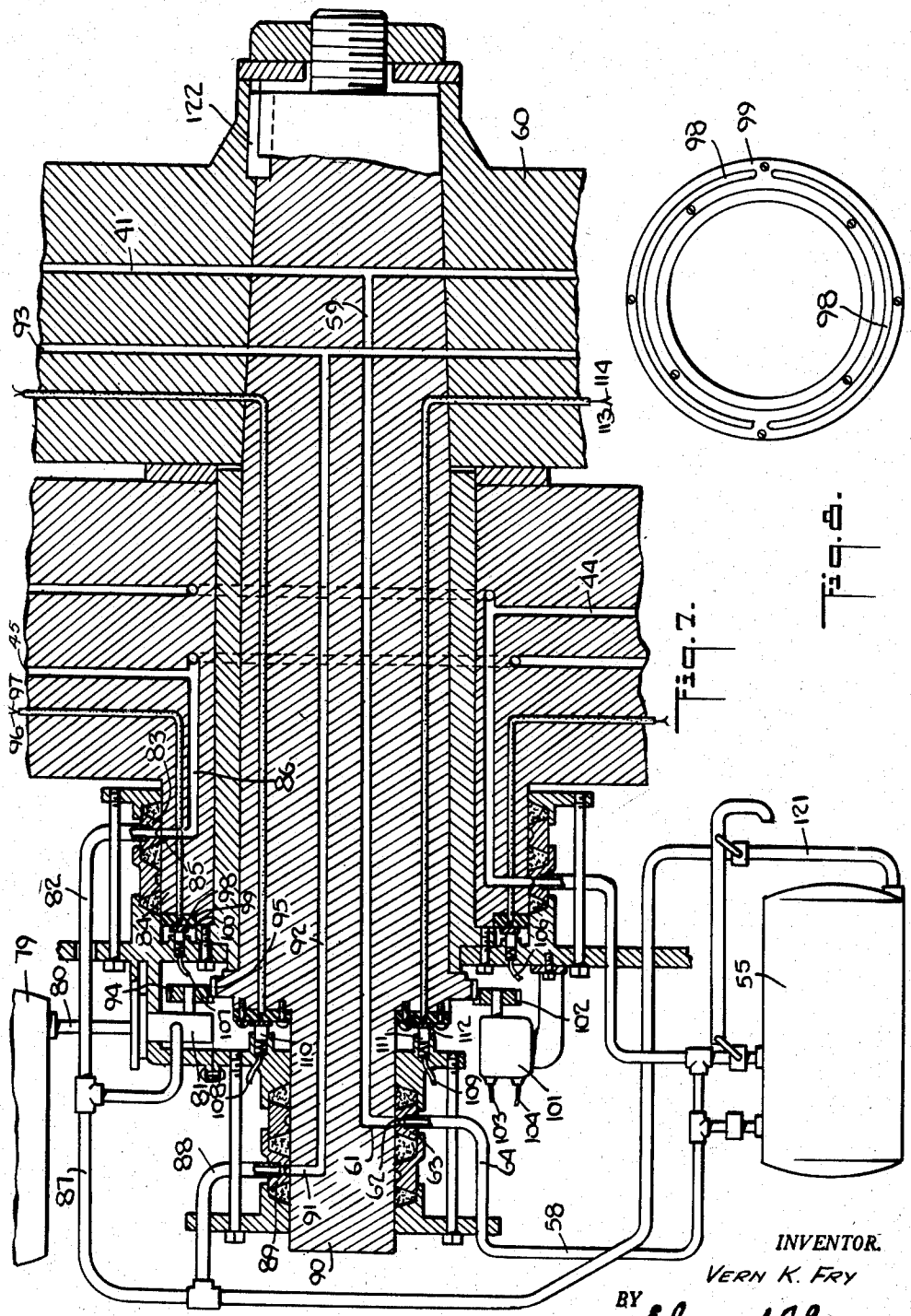


Fig. 4.

Fig. 2.

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2,870,847

TURBINE DRIVEN OPPOSITELY ROTATING PROPELLERS

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Application May 9, 1955, Serial No. 506,901

9 Claims. (Cl. 170—135.28)

This invention relates to a propeller drive suitable for airplanes, and is herein illustrated in some detail as embodied in an airplane power plant which may include two propellers rotating in opposite directions and driven by jets emanating from the propeller tips and each impinging on a peripheral ring mounted on the other propeller. These rings are so carried on the tips of the propeller blades that they form supports on the one hand for power jets, and on the other hand carry what may be called turbines against which the jets project their issuing gases.

Many attempts have been made to utilize jets as direct drives for airplane propellers such as by causing the jet or jets to issue from a trailing or downstream edge of the propeller blade, or roughly tangentially from the tips of the propeller blade or by guiding through the propeller blades exhaust from a reciprocating internal combustion engine.

One objection to propeller tip jets has arisen from the fact that reaction of the issuing jet was wholly relied on to drive the propeller.

One serious problem in dealing with jet propulsion is the problem of providing a sufficient volume of air at a suitable pressure to operate the jet engine effectively.

Another problem has arisen from the heat of the issuing jet which introduced difficulties with the small rings and blades heretofore used in jet engines, and thus necessitated the use of expensive metals and alloys to withstand the heat.

According to the present invention, the rings mounted on the propeller blades may carry devices that serve as air scoops to take in the air needed and deliver it to the mixing chambers of the power plant. Thus, the air, except for starting, is readily gathered in, leaving ample space in the body of the propeller blades for fuel lines to carry fuel to the jets and also carry electric connections for the spark devices which ignite the fuel mixture.

If desired, these air scoops may provide air for air pressure tanks to serve as starting devices, and in that case, the air gathered by the scoops is fed to the tank by a separate passage through the propeller blade and connections to the blade along the propeller shaft to the tank.

The peripheral rings may be so carried by standards embracing bearings on the feathering axis of the propeller blades that they do not interfere with the feathering of the propellers, and they may be steadied the one against the other by suitable ball bearings holding the rings close to each other so that their peripheral faces may be flat at various points.

Cross partitions forming turbine rotor elements in the peripheral blades may be so arranged that the issuing gases impinge on them, each jet helping by their blades to drive the other propeller. Moreover, the exhaust gases may escape transversely of the rings, and thus avoid being trapped by the centrifugal forces of the rotating rings. Moreover, the rings may be as large as the peripheral travel of the propeller tips, and then are adequately

cooled after leaving one jet before meeting the next jet.

In one form shown, the scoops take the form of short projecting vanes so set that the vanes of one ring rotate between the rows of the other ring, and the faces of the vanes lie at angles to their planes of rotation so that air gathered at an outer vane is thrust inward by the face of the vane, and further inward by the vanes of the next row, and so on, thus producing a stream of compressed air.

Other features and advantages will hereinafter appear.

In the accompanying drawings,

Figure 1 is a perspective view, largely diagrammatical, showing propellers embodying the present invention.

Figure 2 is a detail with parts broken away to show the relationship of a jet to the turbine elements of a ring.

Figure 3 is a diagrammatic view showing the same parts as viewed from the outside.

Figure 4 is a section on the line **4—4** of Figure 1 or 3.

Figure 5 is a section on the line **5—5** of Figure 1.

Figure 6 is a sectional view of a modification of the device taken in the plane of the propeller between the two sets of blades on the line **6—6** of Figure 4, and Figure 7 is a section on the line **7—7** of Figure 6, also showing many associated parts.

Figure 8 shows an electric contact ring, greatly enlarged.

In the form shown, a front propeller having blades **10**, which carry fuel, and blades **11**, which may be solid blades is shown as carrying an outer ring **12** supported by brackets **13**, which in turn (see Figure 4) are carried by journals **14** radially set on the ends of the propeller blades **10**. In a somewhat parallel manner, rear propeller blades **15**, carry an inner ring **16** supported by brackets **17** rotatable in journals **18** on the ends of the blades **15** (see Figure 4). The ring **16** is shown as arching inwardly at **19** so that it carries nearly semicircular blades **20** transversely of the arch. These blades **20** are adapted to receive the issuing jet from the nozzle **21** of a mixing chamber **22**, set at an angle in a radial plane on the outer ring **12**. The mixing chamber **22** is shown as receiving fuel from a fuel line **23** connected to the blade **10** and entering through the journal **14** on the axis of feathering at **24**, the terminus of this fuel line which runs through the central body of blade **10**.

The outer ring **12** rotates in one direction whereas the inner ring **16** rotates in the opposite direction and ball bearings are shown as provided to preserve the rings in alignment so that the nozzle **21** is properly adjusted with respect to the blades **20**, and also to preserve the alignment of a second nozzle **25** in another radial plane with reference to the turbine blades **26** carried by the ring **12**.

These ball bearings are shown near opposite ends of the rings **12** and **16** as including balls **27** and ball races **28**, diagrammatically shown near each edge of the rings. The mixing chamber for the nozzle **25** is diagrammatically shown at **29** and as fastened by bolts **30** to the arched section **31** of the ring **16**—said arch **31** being so curved as to allow a space in which the turbine partitions **26** of the ring **12** travel.

The air needed for the burning of the fuel in the mixing chamber **22** and **29** is shown as scooped from the air by sets of vanes **32** and **33** carried respectively on the funnel-shaped facing parts of ring **12** and **16**, and seen at the left in Figure 4. The vanes **32** and **33** are so set that as the rings are carried around by the revolving propellers, the blades suck in and compress air at the flares **34** to the left of the blades **32** and **33** and deliver it to a chamber **35** formed by an arched section **36** in the ring **16** and the arched section **37** in the ring **12**. The compressed air is shown as carried to the mixing chamber **22** by a pipe **38** which may be branched at **39** to carry air by a pipe **40** to an interior passage **41**

of the blade **10**. Air for the mixing chamber **29** is shown as carried by a pipe **42** from the lower arch section **36** to the mixing chamber **29**, and the pipe **42** may be provided with a branch **43** carrying air to a passage **44** in the blade **15**.

The blade **15** is shown provided with a fuel line **45** passing through the journal **18** and connected to a pipe **46** which delivers the fuel to the mixing chamber **29**.

The ring **16** is shown as provided with fins **47** for the purpose of radiating heat from the arched portion **31**, and correspondingly, the ring **12** is shown as provided with fins **48** to radiate heat generated from the combustion between the vanes **20**.

To provide exhaust orifices, the arched portion **31** of the inner ring **16** is provided on one side with openings **49** which open into a peripheral exhaust element **50** (see Figure 5), and second exhaust orifices **51** are provided in the ring to carry off exhaust from the exhaust element **50**, through slanted openings **53** in the ring **12** shown as an arch or blister **52** on the ring **12**. The long row of slanted openings **53** into the blister **52** insure that the exhaust gases escape along a substantial fraction of the travel of each of the rings. The slant of the openings **53** adds to the suction on the exhaust.

In Figure 6, the ring **16** is shown broken away to show a turbine blade **26** of the adjacent ring setup.

As seen in Figure 2, the turbine partitions **20** and **26** in the two rings slope in opposite directions, thus giving pockets into which the nozzles **21** and **25** deliver their oppositely issuing jets.

The air scoop mechanism, including the vanes **32** and **33**, compresses air not only for the combustion chambers **22** and **29**, but also may be caused to compress air which is stored in a tank such as the tank **55** (see Figure 7), and for this purpose there are shown as provided check valves **56** and **57** between the air lines **40** and the chamber **35**, and the air line **42** and the chamber **35** respectively. These check valves **56** and **57** permit compressed air from the scoop **32**, **33** to be forced into combustion chambers **22** and **29**, and also permit the compressed air to be forced into air lines **40** and **43**, but prevent air coming from the air tank **55** from escaping backward through the air scoop **32**, **33**. When the air scoop **32**, **33** is forcing air into combustion chambers **22** and **29**, any excess pressure flows through the air lines **41** and **44** which extend down through the propeller blades and terminate in air conduits such as at conduit **58**.

The air connections to the air tank **55** are illustrated for the propeller hubs in Figure 7, in which the air lines **58** lead to a conduit **59** in the hub member **60**, and the conduit **59** runs transversely of the hub **60** and turns outwardly at **61** so as to face an inner peripheral channel **62** in a ring **63** which carries the air to a fixed air conduit **64**, leading into **58**.

It will be noted that the vanes **33**, as seen in Figure 4, rise from the inner ring **16** and are set apart so that the vanes **32** rising from the outer ring may travel between the rows of vanes **33**. Moreover, as seen in Figure 3, the vanes **32** are set in spaced rows, and the vanes **33** are also set in spaced rows so that in sliding the ring **16** within the ring **12**, the rows of vanes **33** will clear the rows of vanes **32**. The spaces between the rows of vanes provide channels for the currents of air carried inward between the air scoop of which they form a part.

To enable the jets **21** and **25** to be set close to the path of the turbine blades **20** and **26**, the blades **20** are cut away at their upper edges, as seen in Figure 4, at the center as at **65**, and the turbine blades **26** are similarly cut away at their periphery at a point **66** near the jet **25**, and as seen in Figure 2, the blades **20** and **26** are set at an angle to the radius of the ring so that each set of blades tends to catch the gases issued from its jet most effectively.

As shown in Figure 1, the ring-carried devices are set at intervals around each ring so that each ring is substantially balanced as it revolves and thus avoids creating vibration or distortion of the ring. In the form shown in Figure 1, the jets on any one ring are set at the tips of opposing propeller blades. Thus it comes about that the rings **12** and **16** may be assembled by sliding the ring **16** axially into the ring **12**, and then the ball bearings **27** hold the rings in place on each other to enable the ring **16** to be slid within the ring **12**, and provide the ball bearings. Each ball bearing is shown as including a pair of races coming together at the peak and held together at that peak preferably separably by being bolted together by bolts **70** holding together the two races **71** and **72**. The ball bearings thus split are preferably, as shown, the races carried on the inner ring **16**.

To further provide for the sliding of the ring **16** within the ring **12**, the ring **16** is shown as also split at its arch **31** and bolted together by bolts **73** which unite wings **74** and **75**. With this construction the ring **16** can be slid inwardly from the left to right as viewed in Figure 5 while assembling the ball bearing adjacent the air scoop **32**, and then the right hand section **76** of the arch **31** slid into place, bolted by the bolts **73**, and then the adjacent ball bearing may be assembled by bringing together the races **71** and bolting them by the bolts **70**, so as to close in the race **71** upon the balls **27**. This enables the ball spacers **78** to be inserted at the same time that the balls are inserted. The fuel which has been described above as coming through a fuel line **45**, reaches that line from a fuel tank **79** through a main feeder **80** connecting the fuel tank **79** to a fuel pump **81** so that the fuel pump may send the fuel through the feed pipe **82** to a ring **83** encircling the hub **84** which carries the propeller blade **15**, and draws the oil through an opening **85** in that hub. The opening **85** conveys the oil through a cross conduit **86** to the fuel line **45** and thus the fuel reaches the nozzle **25** carried by that blade. In the same way, the fuel pump through a connecting pipe **87** draws oil through a short conduit **88** to a ring **89** encircling the shaft **90** of the front propeller **10**, and draws the oil into an opening **91** which turns to convey the oil through a long pipe **92** to the fuel line **23** by way of conduit **93** (see Fig. 7) of the front propeller blade **10**.

The fuel pump **81** is shown as driven by a spur gear **94** which meshes with a spur gear **95** encircling the shaft **90** so that when the propeller shaft turns, it operates the pump **81**.

For simplicity the electric wires **96** and **97** which ignite the fuel mixture at the jets are shown as terminating in a contact ring **98** carried by and also interrupted by insulation **99** which is shown as forming a ring on the annular face **100** of hub **84**. The usual cut-out switch is not shown to avoid confusing the details of the drawing.

Current is provided for the contacts of the wires **96** and **97** through the conducting arcs **98** by a magneto **101** driven by a spur gear **102** meshing with the spur gear **95** and connected by wires **103** and **104** to brushes **106** and **107**. The magneto **101** also supplies current for the conductors **108** and **109** which through brushes **110** and **111** convey the current to a ring **112** like the ring **99** but attached to the hub of the front propeller **10** and thus provide current for the conductors **113** and **114** carried on the blades of the propeller **10** and provide a spark for the spark plug **120** at the nozzle **21**.

For simplicity in description, other details may be described as identical in the fuel lines for the blades of the propellers **15** and **10**.

The exhaust gases, after they have impelled the respective propeller blades **20** and **26** are shown as described above passing through exhaust members **50** and **52**, the exhaust is shown as reaching the arcuate trumpet shaped discharge members **116**, discharging the exhaust as a trailing exhaust outside the ring **12**.

The scoop device **32**, **33** of Figure 3 may sometimes be supplemented by, or even replaced by the scoops

shown diagrammatically in Figure 6 as arcuate substantially sized pipes **117** with open ends **118** adapted to gather in the air that they cut into and convey that air through a pipe **119** each to its own mixing chamber.

In order to enable stored up air in the air tank **55** to start the device, provision is made through a valved pipe **121** adapted to deliver any amount of fuel oil under pump pressure to the compressed air in the tank **55** and deliver that through the connections described above to the jets **21** and **25**, and be held to go to them by the check valves described above, and other check valves if desired, so that the oil-laden air from the tank **55** comes out under pressure from the two jets **21** and **25** and starts the propellers turning by impinging on the turbine blades of the respective propeller blades **10** and **15**.

It has been found necessary to distort sizes of parts, such as the mixing chambers **22** and **29**, and the ball bearings **27** and the passages in the propeller blades and other parts.

In the interest of clearness all thermal insulation has been omitted especially around the mixing chambers **22** and **29**.

Also the various parts of Figure 6 were distorted in size in order to enable a broad grasp of the parts. The same is true to a less degree of other figures.

What is claimed is:

1. In a power plant, a pair of oppositely rotating propellers, each having a set of blades, a central shaft about which both propellers rotate, a first ring concentric with the propellers, supports for said first ring carried by one set of said propeller blades, a set of turbine blades carried by said first ring, a delivery nozzle carried by said first ring and delivering in a radial plane, a second ring concentric with the first ring and overlapping the first ring, supports for said second ring carried by the other set of propeller blades, a set of turbine blades carried by said second ring against which said nozzle is adapted to deliver a driving jet, a nozzle carried by the second ring adapted to deliver in a radial plane a driving jet against the first ring turbine blades, and conveying devices adapted to deliver fuel and air to said nozzles.

2. In a power plant, a pair of oppositely rotating propellers, each having a set of blades, a central shaft about which both propellers rotate, a first ring concentric with the propellers, supports for said first ring carried by one set of said propeller blades, a set of turbine blades carried by said first ring, a delivery nozzle carried by said first ring and delivering in a radial plane, a second ring concentric with the first ring and overlapping the first ring, supports for said second ring carried by the other set of propeller blades, a set of turbine blades carried by said second ring against which said nozzle is adapted to deliver a driving jet, a nozzle carried by the second ring adapted to deliver in a radial plane a driving jet against the first ring turbine blades, conveying devices adapted to deliver fuel and air to said nozzles, overlapping axial extensions of said rings, and air gathering blades carried on said extensions and delivering air to said conveying devices for said nozzles.

3. In a power plant, a pair of oppositely rotating propellers, each having a set of blades, a central shaft about which both propellers rotate, a first ring concentric with the propellers, supports for said first ring carried by one set of said propeller blades, a set of turbine blades carried by said first ring, a delivery nozzle carried by said first ring and delivering in a radial plane, a second ring concentric with the first ring and overlapping the first ring, supports for said second ring carried by the other set of propeller blades, a set of turbine blades carried by said second ring against which said nozzle is adapted to deliver a driving jet, a nozzle carried by the second ring adapted to deliver in a radial plane a driving jet against the first ring turbine blades, conveying devices adapted to deliver fuel and air to said nozzles, radial supports on said blades separately supporting each ring, ball-bearing races on each ring in the vicinity of each line of supports, and balls running in said races and holding the rings aligned.

4. In a power plant, a pair of oppositely rotating propellers, each having a set of blades, a central shaft about which both propellers rotate, a first ring concentric with the propellers, supports for said first ring carried by one set of said propeller blades, a set of turbine blades carried by said first ring, a delivery nozzle carried by said first ring and delivering in a radial plane, a second ring concentric with the first ring and overlapping the first ring, supports for said second ring carried by the other set of propeller blades, a set of turbine blades carried by said second ring against which said nozzle is adapted to deliver a driving jet, a nozzle carried by the second ring adapted to deliver in a radial plane a driving jet against the first ring turbine blades, conveying devices adapted to deliver fuel and air to said nozzles, certain of said blades including fuel conduits, a fuel supply near the central shaft, delivering to said conduits, and fuel delivery pipes between the blade conduits and the devices conveying fuel to nozzles.

5. In a power plant, a pair of oppositely rotating propellers, each having a set of blades, a central shaft about which both propellers rotate, a first ring concentric with the propellers, supports for said first ring carried by one set of said propeller blades, a set of turbine blades carried by said first ring, a delivery nozzle carried by said first ring and delivering in a radial plane, a second ring concentric with the first ring and overlapping the first ring, supports for said second ring carried by the other set of propeller blades, a set of turbine blades carried by said second ring against which said nozzle is adapted to deliver a driving jet, a nozzle carried by the second ring adapted to deliver in a radial plane a driving jet against the first ring turbine blades, conveying devices adapted to deliver fuel and air to said nozzles, and a combustion chamber carried by each ring and forming part of the conveying devices delivering air and fuel.

6. In a power plant, a pair of oppositely rotating propellers, each having a set of blades, including blades with conduits, a central shaft about which both propellers rotate, an outer ring concentric with the propellers, supports for said outer ring carried by one set of the propeller blades, an inner ring concentric with the propellers, supports for the inner ring carried by the other set of the propeller blades, outside turbine blades carried by the inner ring, inside turbine blades carried by the outer ring, a delivery nozzle directed radially inward toward the outside turbine blades and carried by the outer ring, a delivery nozzle directed radially outward towards the inside turbine blades and carried by the inner ring, and means for supplying fuel to said nozzles through said conduits.

7. In a power plant, a pair of oppositely rotating propellers, each having a set of blades, including blades with conduits, a central shaft about which both propellers rotate, an outer ring concentric with the propellers, supports for said outer ring carried by one set of the propeller blades, an inner ring concentric with the propellers, supports for the inner ring carried by the other set of the propeller blades, outside turbine blades carried by the inner ring, inside turbine blades carried by the outer ring, a delivery nozzle directed radially inward toward the outside turbine blades and carried by the outer ring, a delivery nozzle directed radially outward towards the inside turbine blades and carried by the inner ring, means for supplying fuel to said nozzles through said conduits, ball-bearing races on each ring in the vicinity of each line of supports, and ball running in said races and holding the rings aligned.

8. In a power plant, a pair of oppositely rotating propellers, each having a set of blades, including blades with conduits, a central shaft about which both propellers rotate, an outer ring concentric with the propellers, supports for said outer ring carried by one set of the propeller blades, an inner ring concentric with the propellers, supports for the inner ring carried by the other set of the propeller blades, outside turbine blades carried by the inner ring, inside turbine blades carried by the outer ring, a delivery nozzle directed radially inward toward the outside turbine blades and carried by the outer ring, a delivery nozzle directed radially outward towards the inside turbine blades and carried by the inner ring, means for supplying fuel to said nozzles through said conduits, overlapping extensions of said rings, air gathering blades carried on said extensions, and connections for delivering air gathered by said blades to said nozzles.

9. In a power plant, a pair of oppositely rotating propellers, each having a set of blades, including blades with conduits, a central shaft about which both propellers rotate, an outer ring concentric with the propellers, supports for said outer ring carried by one set of the propeller blades, an inner ring concentric with the propellers, supports for the inner ring carried by the other

set of the propeller blades, outside turbine blades carried by the inner ring, inside turbine blades carried by the outer ring, a delivery nozzle directed radially inward toward the outside turbine blades and carried by the outer ring, a delivery nozzle directed radially outward toward the inside turbine blades and carried by the inner ring, means for supplying fuel to said nozzles through said conduits, overlapping extensions of said rings, air gathering blades carried on said extensions, connections for delivering air gathered by said blades to said nozzles, means supplying air through some of said conduits, a combustion chamber for each nozzle, and connections for carrying conduit air to each combustion chamber.

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