June 3, 1958 J. A. WARD III 2,836,958

JET POWER PLANT WITH UNOBSTRUCTED ROTATING COMBUSTION CHAMBER

Filed Feb. 17, 1954 2 Sheets-Sheet 1

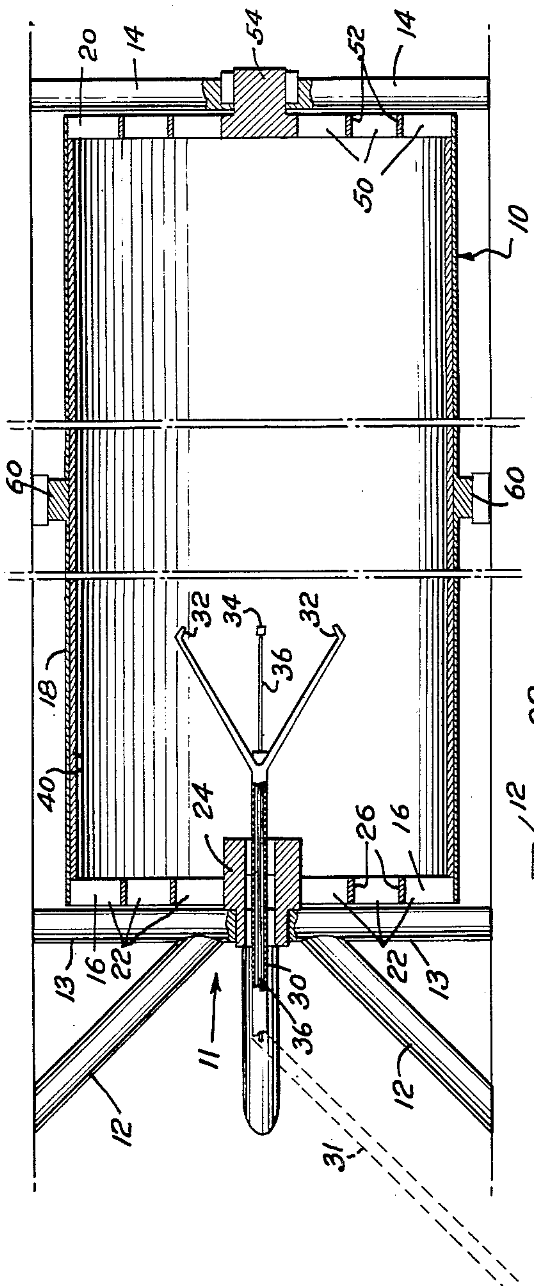

Fig. 1.

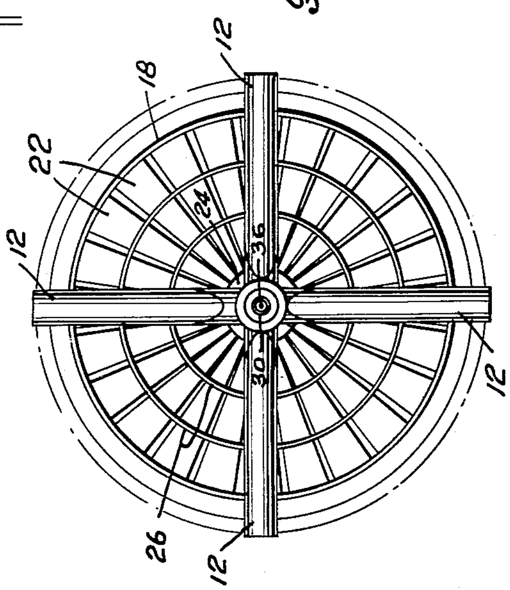

Fig. 2.

INVENTOR

JOHN A. WARD, III.

BY Munson H. Lane

ATTORNEY

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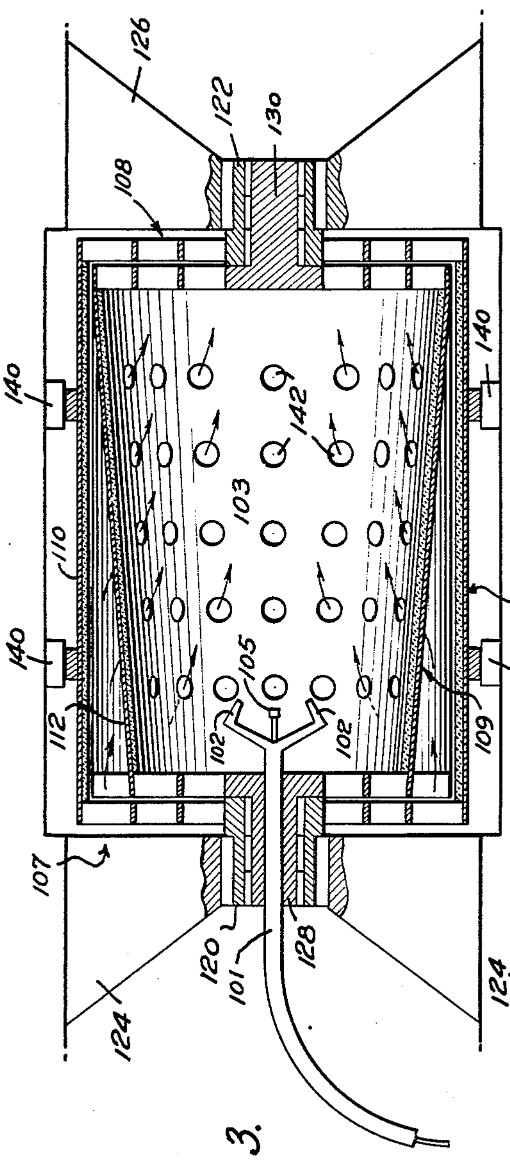

Fig. 3.

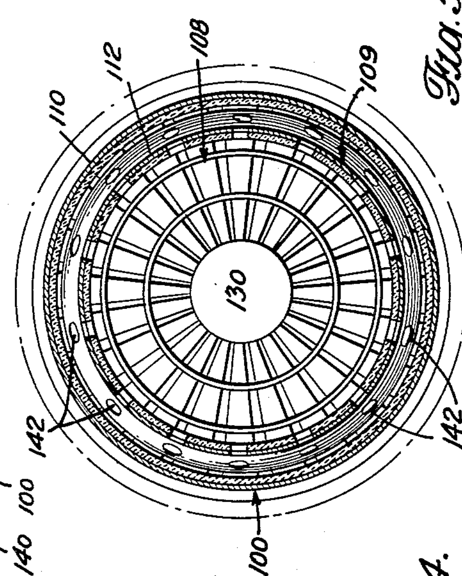

Fig. 5.

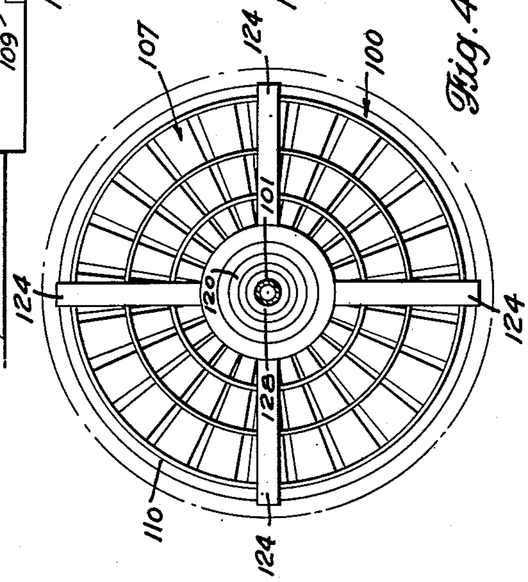

Fig. 4.

INVENTOR

JOHN A. WARD, III

BY Munson H. Lane

ATTORNEY

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JET POWER PLANT WITH UNOBSTRUCTED ROTATING COMBUSTION CHAMBER

John A. Ward III, Duluth, Minn.

Application February 17, 1954, Serial No. 410,905

5 Claims. (Cl. 60—39.35)

The invention relates to improvements in jet engines, and more particularly to an improved jet engine comprising a rotatably mounted engine unit including a front compressor portion, an unobstructed intermediate tubular body portion which includes the combustion chamber, and a rear turbine portion.

The invention is adapted for use in commercial and military airplanes, and its simplicity of design permits its use as well in miniature engines for toys or model airplanes.

In previous devices of this general character with which I am familiar the problem of supplying fuel to the combustion chamber has been a serious one. In prior patents various means of feeding fuel have been suggested which generally require some sort of rotating or flexible connection to allow fuel to flow from a stationary fuel source into a rapidly rotating hollow shaft. I have found that it is virtually impossible to construct such a fuel connection so as to eliminate the extreme fire hazard attending fuel leaks in jet engines. In accordance with my invention this difficulty is avoided and fuel may be supplied to the combustion chamber through a stationary fuel pipe or the like which does not require flexible joints as it does not rotate with the engine. This accordingly reduces the fire hazard due to fuel leaks inherent in previous patented devices.

An object of my invention is accordingly to eliminate flexible joints in the fuel supply line and thus avoid fire hazards.

Among the advantages of my improved device over existing jet engines with which I am familiar may be mentioned the following:

(1) No close-tolerance clearances are necessary for the turbine and compressor blades, thereby lowering manufacturing costs and time.

(2) A far stronger bearing structure is possible, making the engine less susceptible to mechanical failures due to metal fatigue.

(3) The design of the engine allows a greater airflow through the engine than any existing jet engine of a comparable size and weight, giving the engine a greater potential thrust-for-size than other jet engines.

(4) Simplicity of design and construction permits economical manufacture of the engine in sizes small enough to be of use to the hobbyist who builds model airplanes, while at the same time it can be made large enough and strong enough for installations in commercial and military airplanes.

The invention will be more readily understood by reference to the accompanying drawings and the following detailed description in which specific embodiments of my invention are set forth by way of illustration rather than by way of limitation.

In the drawings:

Fig. 1 is a longitudinal section of one form of rotatable engine unit embodying my invention;

Fig. 2 is an end view of the same;

Fig. 3 is a longitudinal section of a modified form in which the engine unit comprises a pair of concentric contra-rotating shells having turbine and compressor blades fixed firmly thereon and revolving with the shells;

Fig. 4 is an end view of the modified construction; and

Fig. 5 is a transverse sectional view thereof.

Referring particularly to the embodiment of my invention shown in Figs. 1 and 2, my improved jet engine comprises an engine unit generally designated by the reference numeral **10**, rotatably mounted on front and rear stationary mounting units. The front mounting unit is generally designated by the reference numeral **11** and as shown comprises two sets of arms designed to take thrust and centrifugal loads, such sets of arms being indicated at **12** and **13**, respectively, and including four interconnected arms. The engine is also provided with a rear mount comprising a plurality of arms **14** similar to the arms **13** of the front mount, very little thrust load being required to be borne by the rear mount.

The engine unit comprises three interconnected parts, namely an air compressor unit **16** at the forward end of the engine unit, an intermediate tubular body portion **18**, and a rear turbine portion **20**. As shown the air compressor **16** consists of a number of fan shaped blades **22** rigidly mounted on a large hub **24** which serves as the front bearing for the engine unit as a whole. The compressor blades **22** may be strengthened by the addition of several concentric metal rings **26** which prevent buckling of the fan blades **22**. The hub or front bearing **24** is apertured through its center to permit passage therethrough of a fuel inlet pipe **30** connected through a line **31** to any suitable source of fuel. The hub or bearing **24** is securely fastened to the blades **22** of the compressor **16** and the engine unit **10** rotates as a whole upon the front bearing **24** and the rear bearing or hub **54**. The fuel pipe **30** may be provided with a plurality of fuel nozzles **32**, the number of which may be varied as desired for proper combustion in a particular instance. For initial ignition of the fuel mixture in the engine a spark plug **34** may be provided. High tension electrical leads **36** may be brought into the combustion chamber either through the central opening in the front bearing, as shown, or if preferred through a central opening in the rear bearing in the event it is undesirable to bring such leads through the front bearing along with the fuel line.

The body **18** of the engine as shown is cylindrical in form and extends between the air compressor **16** at the front of the engine and the turbine **20** at the rear thereof. The body may be and preferably is lined with ceramic material **40** in order to enable the engine to withstand operation at very high temperatures.

The rear turbine unit **20** may be similar in construction to the air compressor **16**, and as shown comprises a plurality of turbine blades **50** strengthened by concentric rings **52** and mounted securely on the hub **54**, which serves as a rear bearing for the engine unit **10**. These parts should be made of materials which will withstand high temperatures.

The reference numeral **60** denotes a stationary intermediate bearing which supports the body portion **18** of the engine unit. Any number of bearings may be used along the length of the body portion **18** to prevent warping thereof by reason of the centrifugal force to which the engine is subjected, only one such ring or bearing being shown by way of illustration. All bearings may be of the ball and/or roller type to minimize friction and heat. Suitable means (not shown) may be provided for lubricating the bearings in a manner which will be apparent to those skilled in the art. Such lubrication is desirable, however, for the successful operation of the engine. Likewise, a fuel pump (not shown) will preferably be employed for introducing fuel under pressure through the fuel nozzles **32**. All necessary auxiliary units such as the fuel pump, oil pump and electrical generators may be driven by a conventional reducing gear system mounted on the main front bearing **24** of the compressor **16**, or on the outer edge of the compressor **16**.

The number and design of the compressor and turbine blades on members **16** and **20** will be such as to give maximum aerodynamic and thermal efficiency, as will be apparent to those skilled in the art.

The operation of the engine will be largely apparent from the foregoing description. Air will be drawn into the engine by rotation of the blades of compressor **16**, and fuel is sprayed into the combustion chamber within the body **18** of the engine through the nozzles **32** and is vaporized in the air introduced by means of the compressor. The fuel-air mixture will be originally ignited by the spark plug **34** and thereafter combustion will be maintained by the continuous addition of further air and fuel. The resultant expansion of hot gases forces the turbine **20** to rotate. Since the parts of the engine unit **16**, **18** and **20** are secured together the force applied to the turbine by the outgoing combustion gases will be transmitted to the compressor, causing it to force more air into the engine, and the operation is continuous so long as fuel is being supplied through the nozzles into the combustion chamber. The action of the hot gases passing out through the rear of the engine produces a reaction of the engine in the opposite direction, making the engine mechanically useful.

A modified form of my invention is disclosed in Figs. 3 to 5, inclusive. As in the previously described embodiment the present form of my device comprises a rotatable engine unit, herein designated by the reference numeral **100**, which is freely rotatable about a longitudinal axis and is provided with a stationary fuel pipe **101** leading from a suitable stationary source of fuel and passing through one end of the rotatable unit **100** into the interior thereof, the fuel being discharged through suitable nozzles **102** into the combustion chamber **103** of the engine unit. A suitable spark plug **105** may be provided, as in the previously described construction, having high tension electrical leads which may be brought into the combustion chamber through either end of the rotating unit.

As in the previously described embodiment, the forward part of the engine unit **100**, generally designated **107**, constitutes the compressor portion of the unit, and the rear portion generally designated **108** constitutes the turbine portion. The portion **109** of the unit intermediate the compressor and turbine portions may be termed the body portion and includes the combustion portion **103**. The blades making up the compressor and turbine portions of the unit may be of any suitable number and design and are such as to give maximum aerodynamic and thermal efficiency. As in the previously described embodiment the compressor and turbine blades are secured to the shell and hub members of the engine and rotate therewith.

The modified form differs from the previously described embodiment in that it consists of two or more contra-rotating shells having turbine and compressor blades fixed firmly thereon and revolving with the shells. The modified form operates on the same general principles as the previously described embodiment, the principal difference being that a second rotating engine unit similar to the first rotates within the first but in the opposite direction.

As shown the rotatable engine unit **100** comprises an outer shell **110** and an inner shell **112** concentric with the outer shell and rotating therein but in the opposite

direction. The outer shell is shown as provided with end bearings **120** and **122** mounted in stationary front and rear supporting units **124** and **126**, respectively. The inner shell **112** is shown as frusto conical in form and is provided with bearings **128**, **130** rotatably mounted within the bearings **120** and **122** for the outer shell. The fuel line **101** and the high tension electrical leads supply the spark plug **105** here shown as passing through the front bearing **128**, though if desired the electrical leads could be passed through the rear bearing **130** to avoid close contact with the fuel line. The outer shell **110** is shown as rotatably supported within stationary rings **140**, **140**, suitable bearings being interposed, and any desired number of rings may be employed.

The inner shell **112** is shown as frusto conical in form and flaring outwardly from the front toward the rear end of the engine unit. This shell is provided with a plurality of apertures **142** spaced throughout substantially the entire area of the wall of the inner combustion chamber. As in the previously described embodiment the front portion of the rotating engine unit functions as a compressor, and the rear portion as a turbine, the blades of the compressor being suitably shaped and braced as in the previously described embodiment.

Both the shells **110** and **112** may be lined with heat resistant material, and the portions of the engine unit at the rear or discharge end thereof must be made of materials designed to withstand high temperatures. As the inner shell **112** is tapered toward the front, cooler air will then be forced to enter the inner shell through the holes **122**, cooling the inner shell by providing a layer of cooler air next to the surface, helping keep the heat of the flame away from the combustion chamber walls. This will allow a higher temperature within the combustion chamber than would be possible otherwise, and it is well known that since a jet engine derives its energy from the expansion of heated air the higher temperatures made possible by my design will also make possible a greater thrust for weight and size of the engine.

The invention has been described in detail for the purpose of illustration but it will be obvious that numerous modifications and variations may be resorted to without departing from the spirit of the invention.

I claim:

1. In a rotary jet engine, the combination of spaced front and rear stationary supports having axially aligned bearings therein, front and rear outer hubs rotatable in the bearings of the respective supports, front and rear inner hubs rotatable in the respective outer hubs, outer compressor blade means and outer turbine blade means rigid with the respective front and rear outer hubs and extending radially outwardly therefrom, inner compressor blade means and inner turbine blade means rigid with the respective front and rear inner hubs and extending radially outwardly therefrom, an open-ended shell having front and rear ends thereof secured to the respective inner compressor blade means and inner turbine blade means coaxially with said bearings and affording an unobstructed combustion chamber therein, an open-ended jacket having front and rear ends thereof secured to the respective outer compressor blade means and outer turbine blade means and surrounding said shell in radially outwardly spaced coaxial relation, said compressor blade means and said turbine blade means having spaces in direct communication with the respective front and rear ends of said combustion chamber and with the respective front and rear ends of the space between said shell and said jacket whereby gases may flow through the engine in a straight path coaxial with said bearings, and stationary fuel supply means extending into said combustion chamber through one of said inner hubs.

2. The combination as defined in claim 1 wherein said shell is of a frusto-conical configuration having a relatively small front end and a relatively large rear end.

3. The combination as defined in claim 1 wherein said shell is of a frusto-conical configuration having a relatively small front end and a relatively large rear end, said jacket being of cylindrical form whereby the space between the shell and the jacket is greater in cross-section at the front than at the rear of the engine.

4. The combination as defined in claim 1 wherein said shell is provided with gas passages connecting the space between the shell and said jacket with said combustion chamber.

5. The combination as defined in claim 1 wherein said outer compressor blade means and said outer turbine blade means are pitched reversely with respect to the respective inner compressor blade means and the inner turbine blade means, whereby said jacket and said shell are rotated in relatively opposite directions by the flow of gasses through the turbine blade means.

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