May 15, 1956 J. S. WINTER ET AL 2,745,248

CONVERTIBLE PULSE JET AND RAM JET ENGINE

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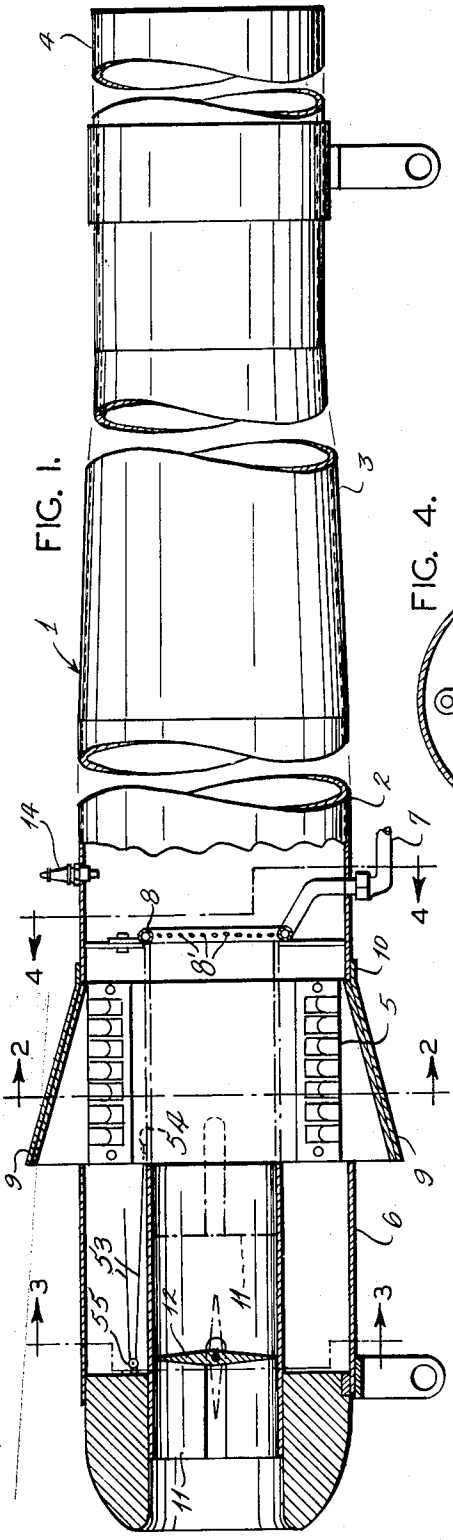


FIG. 1.

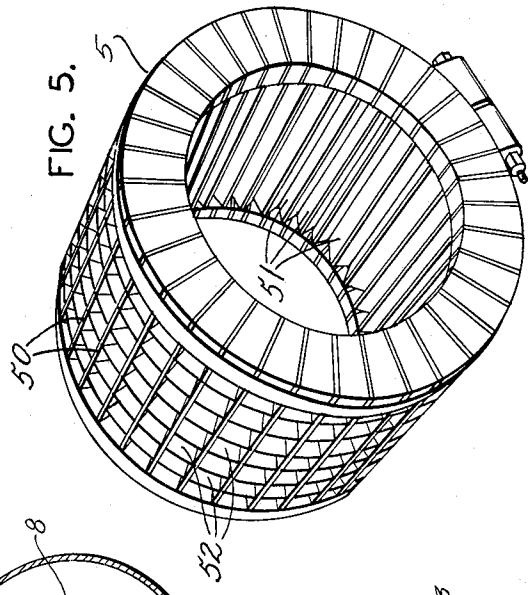


FIG. 5.

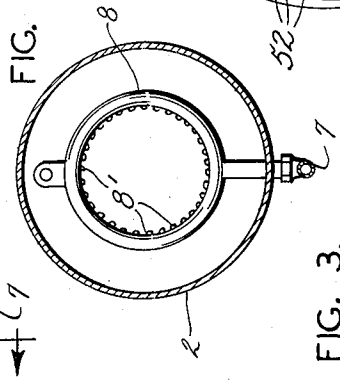


FIG. 4.

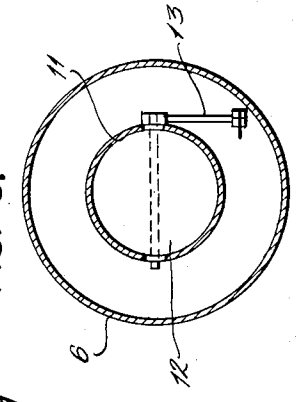


FIG. 3.

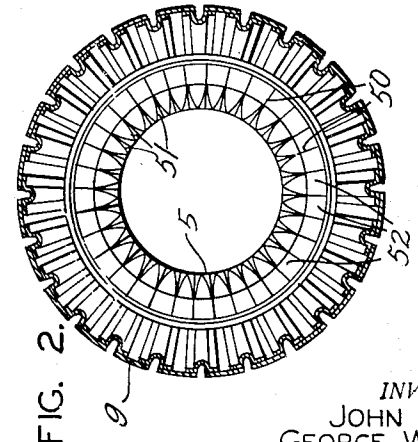


FIG. 2.

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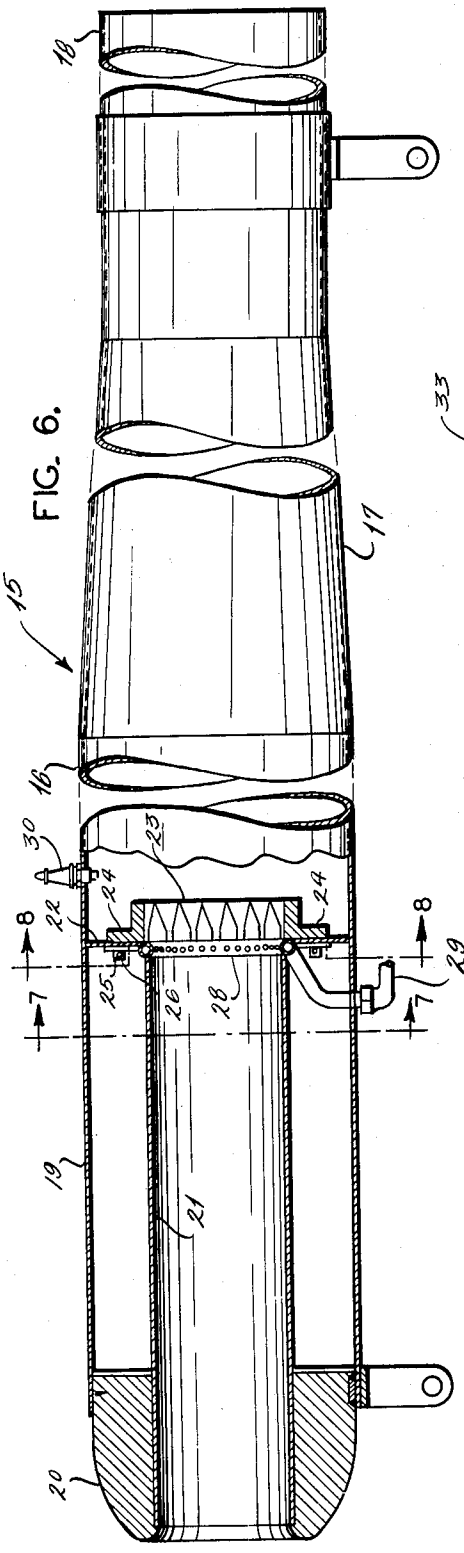


FIG. 6.

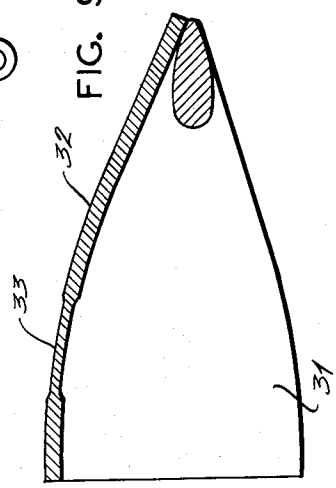


FIG. 9.

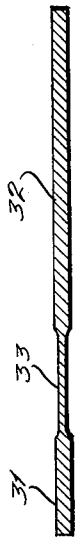


FIG. 10.

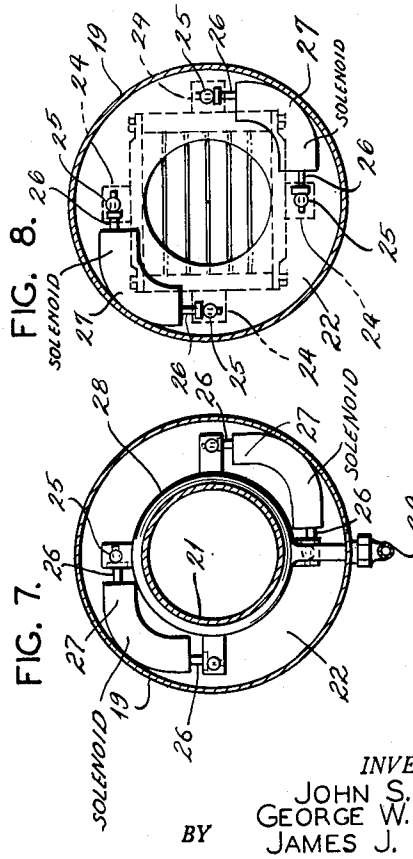


FIG. 8.

FIG. 7.

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United States Patent Office 2,745,248 Patented May 15, 1956

2,745,248

CONVERTIBLE PULSE JET AND RAM JET ENGINE

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Application October 12, 1950, Serial No. 189,736

3 Claims. (Cl. 60—35.6)

This invention relates to jet engines and is more particularly directed to a pulse jet engine in which the inlet valve may be rendered ineffective.

The primary object of the invention is to provide an engine capable of developing a static thrust and which may be operated in a manner similar to a ram jet engine when the craft in which it is mounted is travelling at high speeds.

Another object of the invention is to provide a control means in a pulse jet engine that will permit the engine to operate in a manner similar to that of a ram jet engine.

The invention consists in the provision of a pulse jet engine having either a drum type inlet valve or a bulk-head type of valve which includes means for rendering the inlet valve ineffective so that the engine may operate thereafter in a manner similar to a ram jet engine.

In the drawings:

Fig. 1 is a longitudinal sectional view of a pulse jet engine embodying the invention,

Fig. 2 is a sectional view taken substantially along the line 2—2 of Fig. 1,

Fig. 3 is a sectional view taken substantially along the line 3—3 of Fig. 1,

Fig. 4 is a sectional view taken substantially along the line 4—4 of Fig. 1,

Fig. 5 is a perspective view of the drum type vane and reed valve shown in section in Fig. 2,

Fig. 6 is a longitudinal sectional view of a modified form of pulse jet engine,

Fig. 7 is a sectional view taken substantially along the line 7—7 of Fig. 6, parts being omitted,

Fig. 8 is a sectional view taken along the line 8—8 of Fig. 6,

Fig. 9 is a sectional view of a modified form of a vane and reed valve; and

Fig. 10 is an end view of the reed shown in Fig. 9.

The invention is embodied in the structure illustrated in Figs. 1 through 5 in which the numeral 1 designates the casing for a pulse jet engine made up of a plurality of tubular sections 2, 3 and 4. Section 2 constitutes the combustion chamber for the engine to which section 3 is connected. Section 3 is tapered, section 4 being connected thereto and defining the exhaust nozzle of the engine.

A drum type of vane and reed valve 5 is connected to the forward end of section 2. A cowling 6 is connected to the drum valve and constitutes the air inlet end of the pulse jet engine. A fuel manifold 8 having jet nozzles 8' of suitable type is mounted in section 2 aft of the drum valve for introducing fuel into the engine, fuel being forced therein under pressure by a pump (not shown). A suitable conduit 7 is connected between the manifold and the pump.

The drum type vane and reed valve 5 may include longitudinal divider vanes 50 forming radial sections in which two cooperating valve reeds 51 are movably mounted. The reeds 51 are normally urged to closed

positions and open upon pressure differential conditions across the same. Circumferential dividers 52 are shown to stiffen the drum.

An annular air deflector 9 is mounted on section 2 that flares outwardly and forwardly for the purpose of directing air into the drum valve and thence into the engine. The air deflector is provided with a cylindrical portion 10 welded to section 2. A sleeve valve 11 is slidably mounted in cowling 6 and has a length somewhat greater than the axial length of the drum valve 5. The sleeve valve 11 controls the flow of air through drum valve 5. A butterfly valve 12 is rotatably mounted in the cowling and may be actuated by a lever 13 (Fig. 3) which is connected by suitable mechanism to a manually-operated control member (not shown). Operation of the engine as a ram jet requires that the valve 12 be opened (dotted position of Fig. 1) and sleeve valve 11 be moved rearwardly (dotted position) to close valve 5. Obviously, pulse jet operation necessitates forward setting of sleeve valve 11 and closing of valve 12. The sleeve is operated by suitable mechanism under control from the pilot's station in the aircraft. Such mechanism may be a cable 53 attached to the sleeve 11 at anchor 54. One reach of the cable may be run through a pulley 55, the other reach (not shown) being run to a pulley on the body of valve 5. A spark pluy 14 is mounted in section 2 for initially igniting the fuel introduced therein through the manifold 8.

The above described engine is started as a pulse jet and during starting the sleeve 11 is in the full line position indicated in Fig. 1 so that the drum valve 5 is free to function. The butterfly valve 12 is in closed position so that all air entering the casing section 2 must pass through the drum vane and reed valve 5. Fuel is then admitted to section 2 of the casing through jet orifices 8' formed in manifold 8 and is ignited by the spark plug 14. The deflector causes air to pass through the vane and reed valve 5 where it is mixed with the fuel, after which the combustion process takes place. The engine now operates as an ordinary pulse jet so that static thrust will be developed.

The efficiency of a pulse jet engine decreases after a velocity of 500 miles per hour has been reached because the drag forces on the valve exceeds the thrust developed by the engine. When critical speeds have been attained, sleeve 11 is moved to the dotted line position, thereby preventing flow through the vane and reed valve 5. The air flow through drum valve 5 is effectively checked because sleeve 11 is positioned in alignment therewith and since it also extends past the right hand end of the drum in abutment with the manifold 8, only a small amount of air passes therethrough. The butterfly valve 12 is then moved to the open, or dotted line position so that the engine will operate as a ram jet engine. At high speeds the efficiency of a ram jet engine exceeds that of a pulse jet. For this reason the type of operation most suitable for maximum efficiency can be selected by the pilot of the aircraft in which the engine is mounted. It is possible to start the aircraft from "rest" position and, when the critical speeds have been attained, the engine can be converted ino a valveless pulse jet or a ram jet engine so that no loss of overall efficiency will be experienced.

A modified form of the invention is illustrated in Fig. 6 in which the engine casing is designated by the numeral 15 and which consists of a tubular section 16, a tapered section 17, and a tail piece tubular section 18, the latter constituting a discharge nozzle for the engine. An inlet section 19 is connected to the casing section 16 and suitable cowling 20 is secured to the forward end of the inlet section 19. A tubular member 21 is disposed with-

in section 19 and terminates at a disc-like plate or bracket 22 mounted in section 19, the bracket being disposed a short distance from the joint between sections 17 and 19. The tubular member 21 constitutes an air inlet connected between the cowling 20 and the bracket 22.

A vane and reed type valve 23 is mounted at the discharge end of the tubular member 21. This valve is provided with stud brackets 24, the stud portion extending through the bracket 22. The stud portion of brackets 24 has an aperture 25 therein for receiving a pin 26. There are four stud brackets illustrated, the pins therefore being actuated by suitable solenoids 27 whose function is to hold pin 26 in aperture 25 and to withdraw it therefrom when the reed and vane valve 23 is to be jettisoned. The solenoids may be secured to bracket 22 as a matter of convenience.

A fuel manifold 28 circumscribes the tubular member 21 for the purpose of introducing fuel into the air stream entering said member. The manifold is connected to a suitable source of pressurized fuel supply through a conduit 29. A spark plug 30 is mounted in the casing section 19 aft of the reed and vane valve for initially igniting the fuel introduced into the engine casing.

As illustrated, the engine operates as a pulse jet. Since pulse jets lose their operating efficiency at critical speeds for reasons set forth above, the engine must be converted into a valveless pulse jet or ram jet if speeds higher than critical are to be attained by the jet engine. In the instant disclosure the reed and vane valve 23 is jettisoned by withdrawing pins 26 from the stud brackets 24. Thereafter the engine operates as a valveless pulse jet or ram jet engine so that maximum efficiency will be attained by the engine at higher speeds.

Another modified form of the invention is illustrated in Figs. 9 and 10. Figure 9 shows a section of a reed and vane valve in which 31 is the vane portion of the valve and 32 the reed portion thereof. The vane is constructed in a conventional manner and the reed is secured thereto in the same manner. However, the reed is ground as at 33 in order to reduce the section thereof. The purpose of this reduced section is to stimulate breakage of the vibrating portion of the reed after a predetermined amount of time. The aircraft in which the engine is mounted will have attained critical speeds when breakage occurs so that the reeds may then be jettisoned, thus enabling the engine to operate as a valveless pulse jet or ram jet engine. The vanes remaining in the engine will impede the air flow through the tubular member 21, but the essential portion of the valve will be removed therefrom. The engine will not attain speeds as great as in the Fig. 6 disclosure when operating as a valveless pulse jet engine but will exceed speeds possible when operating as a pulse jet engine.

What we claim is:

1. A jet engine comprising a casing, a tubular valve connected to said casing, an air inlet cowling secured to said tubular valve, means for introducing fuel into said casing, means for igniting said fuel, means for preventing the flow of air through said tubular valve while the engine is operating as a ram jet; and means for preventing flow of air into said cowling while the engine is operating as a pulse jet.

2. A jet engine comprising a casing, a tubular valve connected to one end of said casing, an air inlet cowling provided with an air inlet tube connected to said tubular valve, a valve member mounted in said air inlet tube to control the flow of air into the casing selectively for ram jet operation and to cut off the flow of air for pulse jet operation, a sleeve slidably mounted in said air inlet tube to surround said valve member, said sleeve being movable to a position opposite said tubular valve to prevent flow of air through said tubular valve while the engine is operating as a ram jet; and means for directing air into said tubular valve while the engine is operating as a pulse jet.

3. A convertible pulse jet or ram jet engine comprising a casing, an air flow control valve in said casing, means for introducing fuel into said casing, means for igniting said fuel, valve elements in said control valve reversibly movable to open and closed position in response to pressure for causing said engine to operate as a pulse jet engine, means movable between a position admitting air through said control valve elements for engine operation as a pulse jet and a position preventing air flow through said control valve elements for engine operation as a ram jet, and valve control means for admitting air for ram jet operation.

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