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A. C. BALLAUER ET AL

2,740,254

COMPOUND AIRCRAFT PROPELLING
RAM JET AND PULSE JET ENGINE
Filed Nov. 26, 1947

FIG. 1.

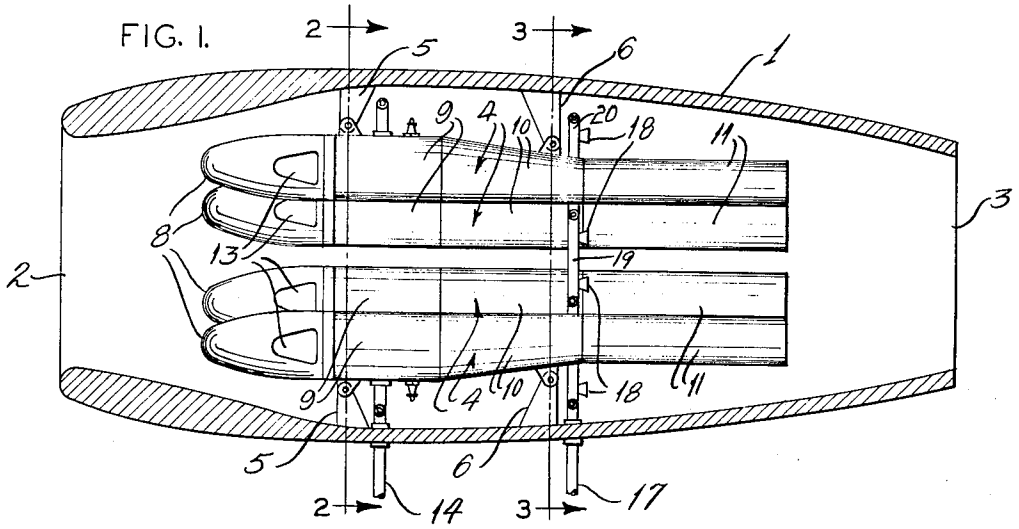


FIG. 2.

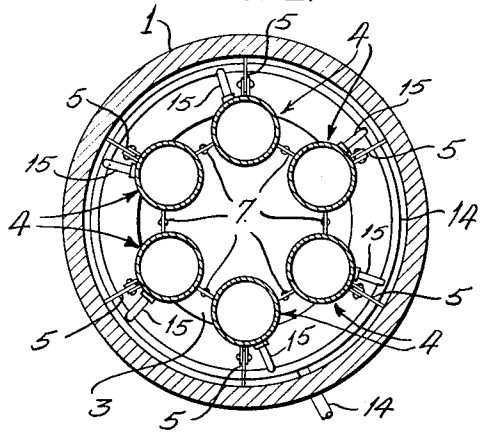


FIG. 3.

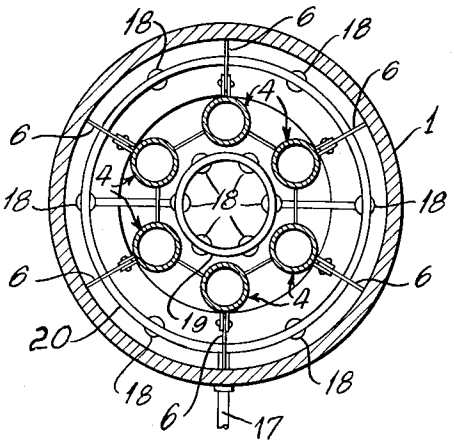
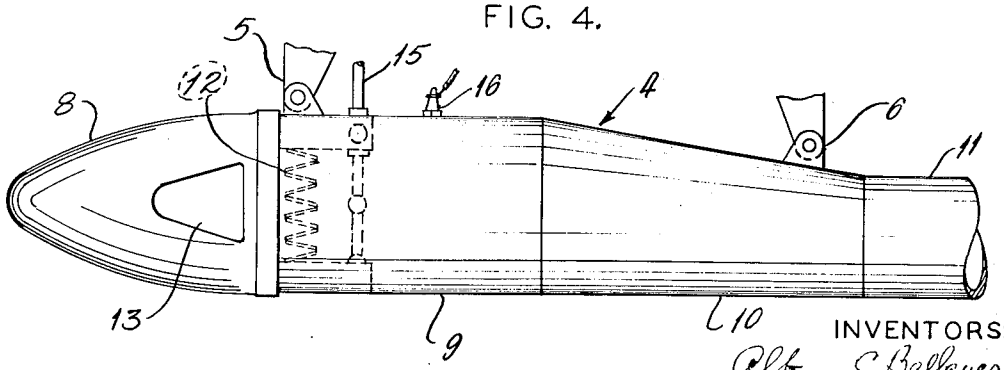


FIG. 4.



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COMPOUND AIRCRAFT PROPELLING RAM JET AND PULSE JET ENGINE

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5 Claims. (Cl. 60—35.6)

This invention relates to power producing means for aircraft and in its more specific aspects is directed to an aircraft propelling device made up of a pulse jet engine and a ram jet engine.

The object of this invention is to combine into a single engine the most advantageous features of a ram jet engine and a pulse jet engine so as to produce a power producing device that possesses a combiantion of the advantageous characteristics of each.

It is well known in the art that a pulse jet engine and a ram jet engine each have certain specific advantages and when combined into a single engine produce one of greater efficiency than that possessed by either engine operating alone. The pulse jet by virtue of its ability to operate without an impinging air stream develops a static thrust capable of initiating movement in a vehicle in which it is installed. The ram jet requires motion through the air in order for it to develop a thrust. The combination of the two results in an engine that has static thrust as well as one having a high dynamic thrust, which will, therefore, result in an engine having an increased efficiency. The characteristic of this engine is such as to eliminate the need for auxiliary starting means which is required for vehicles propelled by ram jet engines alone. In the ram jet the nozzles and the holder therefor, which are required for efficient combustion, cause a drag or energy loss which directly affects the efficiency of the engine by reducing it. The combining of the pulse jet and the ram jet as in the instant invention causes the pulse jet engine to become the igniter for the ram jet engine, thereby reducing power losses due to drag and may in fact have a negative effect or drag.

In the drawing:

Fig. 1 is a longitudinal sectional view of a compound jet engine,

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

Fig. 3 is a sectional view taken along the line 3—3 of Fig. 1; and

Fig. 4 is an enlarged side elevational view of the pulse jet engine employed in the Fig. 1 disclosure.

Referring now to the drawing, numeral 1 designates the shell of a ram jet engine in which the air enters at 2 and exhaust gases and the air leave at 3. The shell is so shaped that the internal dimensions thereof gradually increase to a point substantially midway the length of the shell and thence commence decreasing again to a point adjacent the exhaust outlet 3.

Disposed within the shell 1 is a plurality of pulse jet engines 4 as clearly illustrated in Figs. 1, 2 and 3. These pulse jet engines are suspended from the interior of the shell 1 by means of supports 5 and 6. The pulse jet engines are further supported by interconnecting links 7 so that a uniform and constant circumferential spacing will be maintained between them.

Each of the pulse jet engines is provided with a forward structure or nose-piece 8 to which a tube 9 is connected, whose interior constitutes the combustion chamber for the engine. The engine is next provided with a reduced diameter piece of tubing 10 shaped internally, as indicated in Fig. 4, and with a tail-piece 11 which constitutes the exhaust member of the pulse jet engine. Disposed between the nose-piece 8 and the chamber in tube 9 is a valve 12 which is of conventional type provided with a plurality of vanes which are spring actuated and which vanes are opened against spring pressure whenever a pressure differential exists between the exterior and the interior of the jet engine so that whenever the internal pressure is low, air will be caused to flow into the combustion chamber in the tube 9 through an air inlet 13 cut in the nose-piece 8. Inasmuch as the normal operation of the pulse jet engine is well known, it is not believed that a further discussion is necessary. A suitable fuel line 14 leads to each of the individual engines with a connecting tube 15 connected between it and a circular portion of the fuel line which surrounds the interior of the shell 1. Each of the jet engines is provided with a firing means preferably in the form of a spark plug 16 whereby the fuel in the air mixture is ignited.

The fuel supply for the ram jet is introduced into the shell 1 by means of a fuel line 17 that leads to fuel nozzles 18 suitably secured to manifolds 19 and 20 each of which is maintained as illustrated in Fig. 3. In each of these cases the fuel is suplied under proper pressure so that the supply thereof to the two engines will be constant.

The operation of the compound engine produces certain results of which one is that it is capable of starting motion in a vehicle to which the compound engine is connected. The exhaust from each of the pulse jet engines serves as a firing means for the fuel and air mixture in the combustion chamber provided in the ram jet shell which is just aft of the manifold 19. When both engines are delivering power, they will mutually assist each other in producing a thrust axially of the longitudinal axis of shell 1 and in which over-all efficiency will exceed that of one engine operating individually when of the same or equivalent rating. Another important feature and advantage of the compound engine resides in the use of a multiplicity of small pulse jets which results in a lighter weight and shorter length engine unit than a single pulse or ram jet for a given thrust or power output would be if made up in a single unit. Also the use of a number of small pulse jets allows the burned gases thereof to mix more efficiently with the air and fuel mixture that is introduced in and flowing through the ram jet and will result in a more thorough combustion of the ram jet fuel and air mixture. The use of a plurality of small pulse jets improves the dependability of the engine by reducing the likelihood of total failure. While one or more of the pulse jets may become inactive, there is only a small possibility that all of them will be disabled. Another advantage of the compound engine lies in the fact that the fuel consumption of the engine illustrated is less than the fuel consumption of either of the two engines working alone and of equivalent output would be or the total fuel consumption in a compound engine of the type illustrated is less than that of either a ram jet or a pulse jet engine working alone and capable of delivering the same amount of power. Also the use of the pulse jet as a burner for the ram jet results in more efficient burning and heat release per unit volume of air and fuel mixture that is far in excess of that obtained in ram jets or in pulse jets operating alone. In a combination pulse jet and ram jet engine the desirable features of the pulse jet operation extend into the range of supersonically moving fluid which is not possible with the pulse jet engines operating alone. The use of a multiplicity of small pulse jets reduces the noise level below that of one large pulse jet engine delivering the same amount of power by reason of the interference of the sound waves that the several

small units have on each other. These sound waves have a tendency to cancel each other out whereas in a single large unit there is no such result.

It is clear, therefore, that a compound jet engine has been produced which is capable of delivering a greater amount of power per fuel unit consumed than would be possible to be produced by the same fuel unit when burned in either a pulse jet engine or a ram jet engine operating individually.

What we claim is:

1. A compound aircraft propelling jet engine comprising a ram jet propelling engine, a plurality of pulse jet propelling engines in said ram jet, means to support said pulse jet engines in spaced relation, fuel supply means for said ram jet engine and for each of said pulse jet engines, fuel igniting means in each pulse jet engine for igniting the fuel supplied thereto, and the fuel in the ram jet engine being ignited by the ignited fuel issuing from the pulse jet engines.

2. A compound aircraft propelling engine comprising a ram jet propelling engine including an elongated tubular member contracted at its inlet and outlet ends and defining a combustion chamber therebetween; a pulse jet propelling engine having an elongated tubular body disposed within said ram jet combustion chamber, an inlet valve carried by said tubular body and located adjacent said contracted inlet end of said tubular member, an exhaust tube projecting from said tubular body and extending toward said contracted outlet end of said tubular member; means to supply fuel into said pulse jet engine; fuel ignition means in said pulse jet engine; and means to supply fuel into said ram jet engine, fuel supplied to said ram jet being fired by the exhaust stream issuing from said pulse jet exhaust tube.

3. A compound aircraft propelling jet engine comprising a ram jet propelling engine including an elongated tubular member open at its opposite ends to form an inlet and an exhaust for a combustion chamber located therebetween; a pulse jet propelling engine with inlet and exhaust located within said combustion chamber between said first mentioned inlet and exhaust ends; means to support said pulse jet engine spaced from the sides of said combustion chamber and with its exhaust spaced inwardly of said ram jet exhaust end; fuel supply means connected into said pulse jet engine; fuel ignition means for said pulse jet engine; and fuel supply means connected into said ram jet engine to supply fuel thereto fired by the exhaust gases from said pulse jet engine.

4. A compound aircraft propelling engine comprising a ram jet propelling engine including an elongated tubular member having contracted intake and exhaust ends and a combustion chamber portion between said ends forming the body for the ram jet engine; a pulse jet propelling engine having an elongated tubular body disposed in said combustion chamber of the ram jet engine with an exhaust end having a diameter less than that of the remainder thereof; means for supporting said pulse jet engine within said ram jet engine combustion chamber so that the exhaust end of the pulse jet engine terminates a distance from the exhaust end of the ram jet combustion chamber; means for introducing fuel into said pulse jet engine; means for igniting said fuel; and means for introducing fuel into said ram jet engine body and firing said latter fuel by the burning fuel issuing from the exhaust end of said pulse jet engine.

5. A compound aircraft propelling engine comprising a ram jet propelling engine including an elongated tubular member having inlet and exhaust ends convergingly toward the longitudinal axis of the ram jet engine, and the latter engine being provided between its ends with a combustion chamber; a pulse jet propelling engine comprising a tubular body provided with a reduced diameter tail-piece forming the exhaust end for the pulse jet engine mounted in said ram jet tubular member and spaced therein, said tail-piece extending into the ram jet engine combustion chamber; means for supplying fuel to said pulse jet engine; means for igniting said fuel; and means for supplying fuel to said ram jet engine that is fired by gases issuing from the tail-piece of said pulse jet engine.

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