PATENT SPECIFICATION

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PROVISIONAL SPECIFICATION.

Improvements relating to the Propulsion of Aircraft and other Vehicles.

I, FRANK WHITTLE, of Glenhaven, Regent St., Coventry, British Subject, do hereby declare the nature of this invention to be as follows:—

This invention concerns improvements relating to propulsion and whilst at present it is deemed to be particularly adapted to the propulsion of aircraft, it is not necessarily limited to this use and may be adapted for the propulsion of other vehicles.

The main object of this invention is to provide means whereby the principle of obtaining propulsive force in the one sense of direction by the reaction caused by expelling fluid in the opposite sense of direction, may be applied efficiently to aircraft or other vehicles.

It is believed that an embodiment of this invention will provide a large thrust in proportion to its weight, that it will perform at greater altitudes than are at present obtainable, that it makes possible higher speeds than have up to the present been obtained, that it will operate with any fuel now in use, and that it will have a reasonably low fuel consumption. Further that simplicity and convenient external form is achieved.

According to the invention, a heat cycle is employed, consisting of one, or more stages of compression, one or more stages of expansion and a heat addition between the end of compression and the beginning of expansion, part of the work done in expansion being employed to do the work of compression, and the remainder to provide the fluid reaction.

Describing the invention in a simple form as applied to aircraft, there is a compression apparatus, consisting of a compressor, which may be a blower type compressor, a cylinder compressor, or a combination of the two, by means of which air as the working fluid is compressed into a heating chamber where heat is added by the combustion of fuel. The air then expanding through apparatus designed to absorb sufficient of the work of expansion to drive the compressor, and which may consist of a turbine rotor, or cylinder expander or a combination of the two, and which is on the same shaft as, or connected with the compressing mechanism. The air then passes through a suitably designed tunnel to the atmosphere, either having velocity as a result of its passage through expansion apparatus, of being capable of further expansion through suitably designed nozzles at the rear, or both.

In another form, a portion of the air only may expand through the expansion apparatus which drives the compression apparatus, and the remainder expands to the atmosphere providing fluid reaction.

In more particularly describing the invention in an aircraft adaption, I propose to use a centrifugal rotary vane blower or turbo-compressor as a compressor. The air intake is a tunnel situated in the nose of the aircraft and leading in an axial direction to the inlet orifice of blower. The gas is passed circumferentially through suitably designed passages or diffusers into the heating chamber, which is of suitable material, and probably lagged externally to conserve heat. Into this chamber are directed burners for oil fuel and any further necessary details of construction such as pilot burners, cleaning devices etc. At the rear of the heating chamber the gas passes through suitable nozzles to impinge on the buckets or blades of a De Laval or Curtis type turbine wheel, the latter being mounted on the same shaft as the compressor. The gas passes into a tunnel after leaving the turbine and is led to the rear, where the final stage of expansion to the atmosphere takes place through suitably designed nozzles.

The invention is not limited to the mechanism detailed above. For instance, instead of the air passing through apparatus for driving compressor after heating, it may pass through and give up some of its heat to the water in a steam boiler, the steam so generated being utilised to drive the compression mechanism by means of a steam turbine or other steam engine. This would then be a substitute for the gas turbine above specified.

Controlling means may include fuel control, gas flow control, or mechanical control of the speed of the blower and/or

its mover. The final emission of gas may perhaps be directionally controlled for manœuvring purposes. One or a plurality of the complete power units may be provided in a single vehicle or aircraft and they may to some extent be interdependent, e.g. a single turbine may operate subsidiary blowers etc.

It may be necessary to provide auxiliary apparatus for starting, fuel injections, lubrication or like purposes.

It will be clear that the invention gives scope for wide modification without departing from its principle as herein outlined.

Dated this 14th day of January, 1930.
F. WHITTLE.

COMPLETE SPECIFICATION.

Improvements relating to the Propulsion of Aircraft and other Vehicles.

I, FRANK WHITTLE, late of "Glenhaven", Regent Street, Coventry, and now of "Hill Crest" Dorrington, Lincoln, British Subject, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

This invention relates to apparatus for propulsion of the type in which air is taken in, compressed, heated, and expelled with high velocity on re-expansion in order to provide a propulsive thrust.

The main object of this invention is to provide improved apparatus of the above mentioned type, and in particular improved means for driving the compressor.

According to the invention I provide means for propulsion of the above mentioned type characterised by the feature that the compressor is driven by a turbine, and that the pressure drop on expansion takes place in two stages, the first pressure drop taking place through the nozzles of the turbine, and the second pressure drop taking place through the propelling nozzles.

Describing the invention in a simple form as applied to aircraft, there is a compressor, preferably of the turbo-centrifugal type, by means of which air as the working fluid is compressed into a heating chamber where heat is added by the combustion of fuel. The air is then expanded through apparatus designed to absorb sufficient of the work of expansion to drive the compressor, and which consists of a turbine rotor, and which is on the same shaft as or connected with the compressing mechanism. The air then passes through a suitably designed tunnel or nozzles to the atmosphere, either having velocity as a result of its expansion through the expansion apparatus, or being capable of further expansion through suitably designed nozzles at the rear, or both.

The invention will now be described with aid of the accompanying drawing and diagram in which:—

Fig. 1 is a diagram showing the cycle of energy or thermal cycle on which the invention relies fundamentally.

Fig. 2 is a part-section showing diagrammatically a preferred form of the invention, applicable to the propulsion of aircraft.

The thermal cycle employed which is shown in Fig. 1 is a pressure-volume diagram in which:

AG represents the atmospheric line.

DC represents compression.

CE represents heating at constant pressure.

EF represents that portion of expansion which is utilised to do the work of compression.

FG represents the expansion to the atmosphere providing thrust by fluid reaction.

The device consists of a compressor having casing "1" intake passages 2, a rotor "3", with bucket rings "4" working in conjunction with stator bucket or nozzle rings "5" inside the casing "1" and centrifugal radial blading "7" and diffusers "8" through which the output is delivered under pressure through header or collector ring "9" into combustion or heating chambers "10" in which fuel is burnt. This may be heavy oil or other fuel burning at jets "11". The chambers "10" are preferably lagged or otherwise heat insulated to conserve heat energy, and perhaps lined with refractory material. The heated gases pass into a collector or header "12" from chambers "10" which are of any suitable number and disposition. From header "12" the gases expand through a turbine "13" with buckets "14" and stator "15", the turbine rotor "13" being fast on the spindle "16", which is also the driving spindle of the compressor rotor "3",

" 7 ". From the turbine the gases further expand through nozzles " 17 " to the atmosphere in an axial direction.

Any suitable type of turbine may be used, but in order that the relatively high temperature proposed to be employed may be withstood, the buckets may be of some suitable refractory material.

The turbine drives the compressor direct as shown, but direct drive is not essential, any gearing or the like may of course be employed.

The air entering at " 2 " is first of all compressed by the bucket system " 4 " " 5 ", and by blades " 7 ". In the chambers " 10 " the air is heated at constant pressure and expands through the turbine " 13 " losing energy by driving the turbine and compressor. Its remaining pressure and velocity energy is then converted into velocity out of the nozzles " 17 ", whereby reaction in the nature of axial thrust is set up according to the usual laws.

It can be demonstrated that the efficiency of this device conceived as a propulsive engine. will not be reduced by reduction of the density of the atmosphere, and owing to the low temperature of the upper atmosphere may actually be enhanced.

Controlling means may include fuel control, gas flow control, or mechanical control of the speed of the blower and/or its mover. The final emission of gas may perhaps be directionally controlled for manœuvering purposes.

It may be necessary to provide auxiliary apparatus for starting, fuel injections, lubrication or like purposes.

Having now particularly described and ascertained the nature of my said invention and in what manner the same is to be performed, I declare that what I claim is:—

1. Means for propulsion of the type described, characterised by the feature that the compressor is driven by a turbine, and that the pressure drop on expansion takes place in two stages, the first pressure drop taking place through the nozzles of the turbine, and the second pressure drop taking place through the propelling nozzles.

2. Means for propulsion according to Claim 1, in which a multi-stage turbine is employed.

3. A propulsion device in which a centrifugal turbo-compressor supplies compressed air to a heating chamber whence the air passes to drive a turbine which mechanically drives the compressor, and whence in turn the air and products of combustion escape to the atmosphere through passages which cause them to produce propulsive thrust.

4. A device according to claims 1 and 3, constructed and operating substantially as described with reference to Fig. 2 of the accompanying drawings.

Dated this 14th day of October, 1930.

F. WHITTLE.

Redhill: Printed for His Majesty's Stationery Office, by Love & Malcomson, Ltd.—1931.

[This Drawing is a reproduction of the Original on a reduced scale]

FIG. 1.

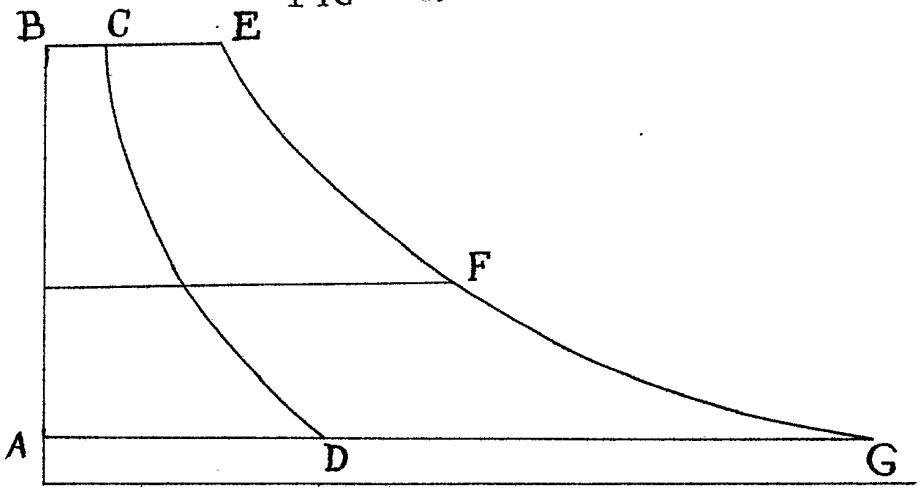
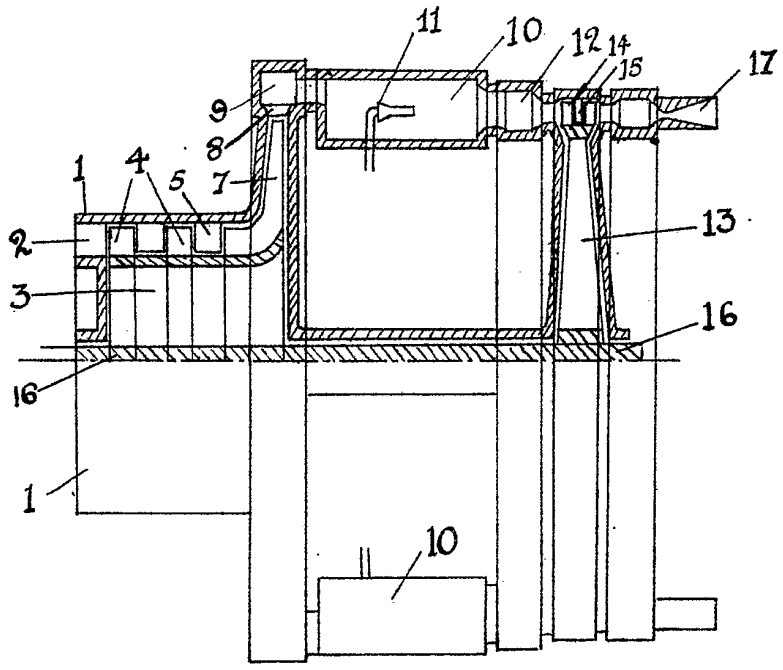


FIG. 2



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