

Nov. 4, 1947.

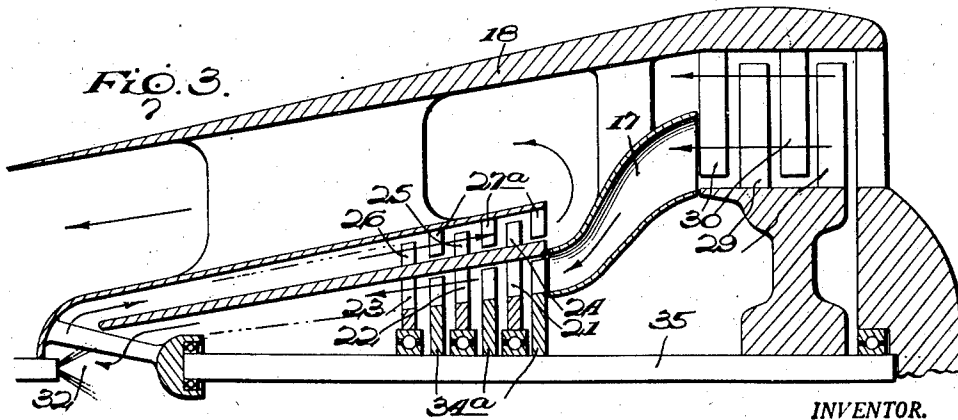
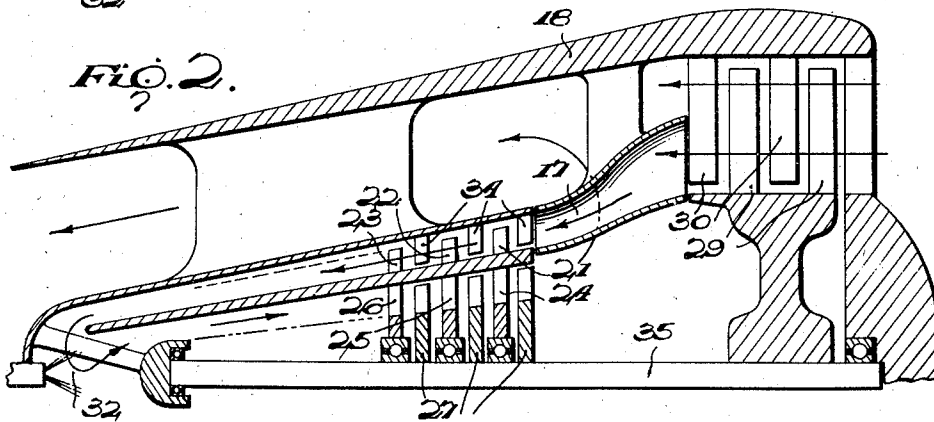
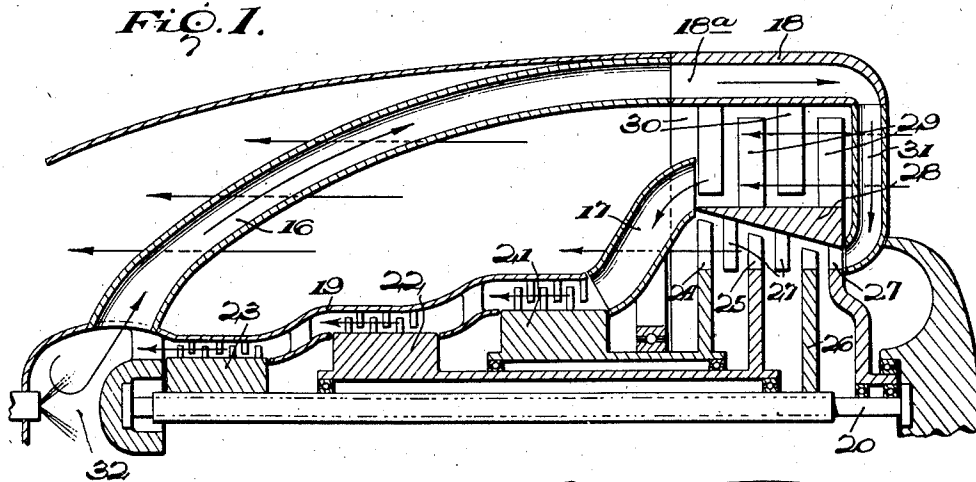
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2,430,398

JET-PROPULSION INTERNAL-COMBUSTION TURBINE PLANT

Filed Aug. 31, 1943

2 Sheets-Sheet 1



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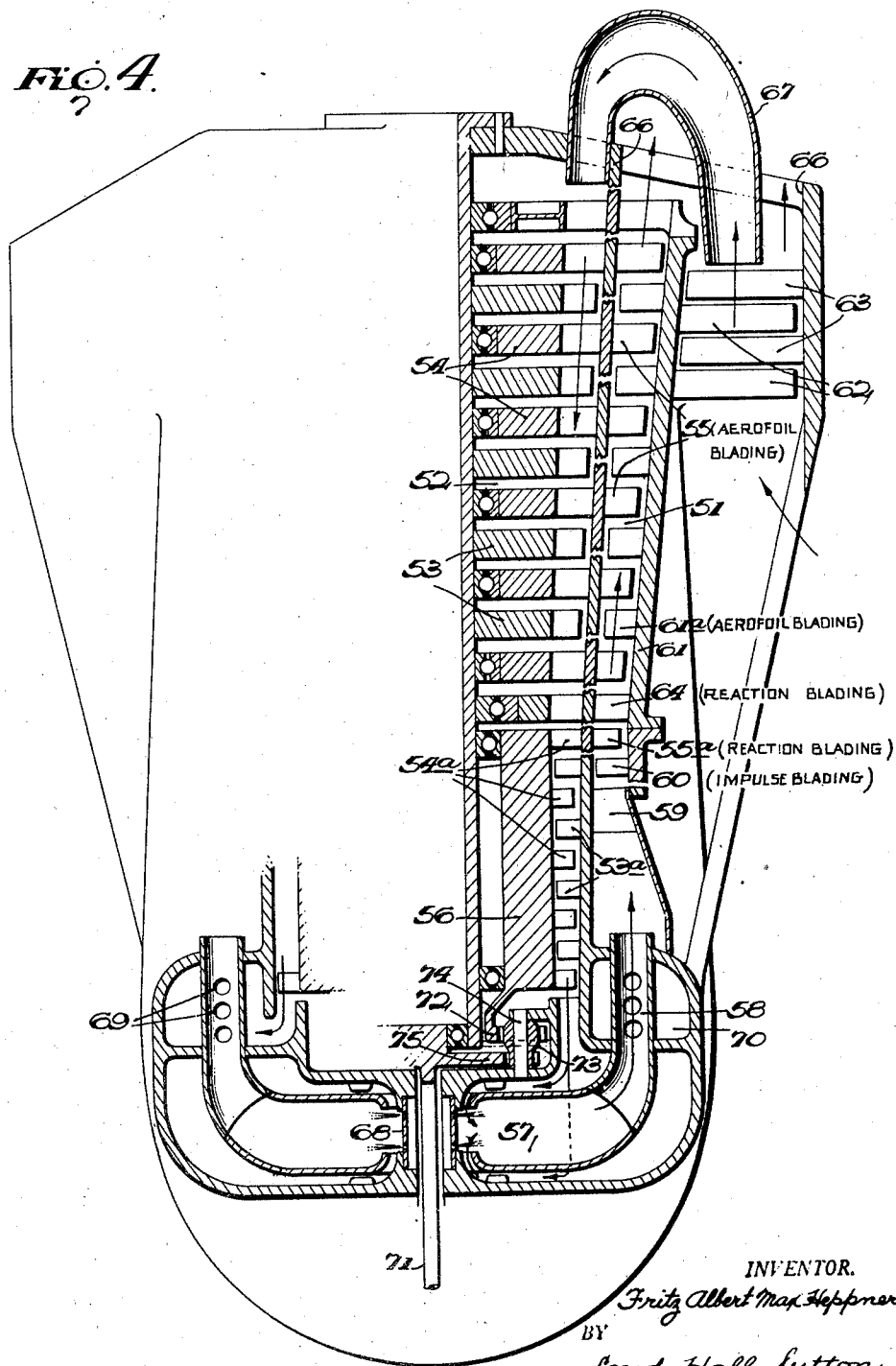
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2 Sheets-Sheet 2

FIG. 4.



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2,430,398

JET-PROPULSION INTERNAL-COMBUSTION
TURBINE PLANTFritz Albert Max Heppner, Leamington Spa, Eng-
land, assignor to Armstrong Siddeley Motors
Limited, Coventry, EnglandApplication August 31, 1943, Serial No. 500,697
In Great Britain September 3, 1942

1 Claim. (Cl. 60—35.6)

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This invention relates to a jet-propulsion internal-combustion turbine plant, particularly for use on aircraft, of the kind incorporating an aug-
menter which is driven by the plant and com-
presses a certain amount of air which is delivered
to the jet along with the exhaust from the
turbine.

My main object is to provide an improved means in the supply to the compressor.

This and other objects and advantages of the invention will best be understood if attention be directed to the following description in which reference is made to the accompanying diagrammatic drawings. All the four figures of the drawings are fragmentary sectional elevations through different forms of jet-propulsion turbine plants according to the invention.

According to the invention, the augmenter supplies some or all of the air taken in by the compressor, as will be more particularly described hereinafter.

According to a further feature of the invention, the compressor sucks from, and the turbine delivers into, the jet duct at points which are preceded by the jet-augmenter blades. Preferably the plant has a turbine shell which carries the rotatable augmentor blades. Preferably, too, there is substantially no difference in pressure between the compressor intake and the turbine exhaust, ducts being provided to prevent mixing of the compressor intake and turbine exhaust.

Figs. 1, 2 and 3 are respectively diagrammatic views showing different arrangements of the compressor, turbine and augmenter that may be employed in the present invention; and

Fig. 4 is a sectional elevation of an embodiment of the present invention.

In the construction of Figure 1 there is a stationary shaft 20 upon which are mounted the rotors 21, 22 and 23 of three compressor sections, and a shell 19 on which the stationary, coacting blades are carried. The compressor rotors are mechanically coupled to turbine sections 24, 25 and 26, respectively, all of which coact with blade rows 27 on a contra-rotating turbine shell 28 which carries externally jet-augmenter blade rows 29 coacting with stationary augmentor blade rows 30 carried by shell 18.

Part of the air compressed by the augmenter, (which is at the front of the plant) is delivered to the first compressor section 21 through a plurality of tubular members 17 and thence to the second and third sections, as indicated by the arrows, after which combustion is effected in the combustion chamber indicated at 32, the burning

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gases then travelling with reversed flow, as shown by the arrows, through a plurality of curved pipes 16, connecting passages 18a formed in the annular shell 18, and pipes 31 to the inlet of the turbine, whilst the exhaust of the latter and the remainder of the air compressed in the augmenter constitute the propulsion jet.

In the construction of Figure 2 there is a series of rotary compressor sections of which only the first three are shown in full lines, being marked 21, 22 and 23, and these are mechanically coupled with turbine sections 24, 25 and 26, respectively. The coacting compressor blade rows 34 are stationary, whilst the coacting turbine blade rows 27 are fast with the rotary shaft 35 and rotate in the direction opposite to that in which the turbine portions 24—26 rotate. The shaft 35 carries rotary jet-augmenter blades 29 which coact with stationary augmentor blades 30.

It will be observed that the compressor is arranged to be radially outwardly of the turbine, air for the compressor being taken in from the jet-augmenter (again at the front of the unit) through the tubular members 17 and, on leaving the compressor, being reversed in the combustion chamber, indicated at 32 at the tail end of the plant, before entering the turbine. The exhaust from the turbine is again reversed in flow, as indicated by the arrows, to join the remainder of the air compressed by the augmenter and to constitute the propulsion jet.

In the construction of Figure 3 there are again several rotary compressor sections, of which only three are indicated at 21, 22 and 23, which are respectively coupled with turbine portions 24, 25 and 26, the latter coacting with stationary turbine blade rows 27a. The rotary compressor portions coact with sets of rotary blades 34a which are fast on a shaft 35 carrying the rotary blades 29 of a jet-augmenter, of which 30 represents the stationary blades. The compressor, it will be observed, is disposed radially inwardly of the turbine, and part of the air passing through the jet-augmenter is directed to the compressor inlet through the tubular members 17, the delivery therefrom entering the combustion chamber and being reversed there before passing into the turbine. The exhaust of the latter is again reversed in direction and joins the remainder of the output from the jet-augmenter to constitute the propulsion jet.

In Figure 4 the plant illustrated is one in which the turbine 51 is disposed radially outwardly of the compressor 52, the flow through the latter being from the top to the bottom as shown in the

figure. The compressor comprises stationary blade rows 53, 53 and rotary rows 54, 54, the latter rows being fast with independent turbine rows 55, 55. The first independent turbine row 55a is mounted to revolve with a sleeve 56 carrying a plurality of compressor rows 54a coacting with stationary compressor rows 53a.

The primary output of the compressor flows, as indicated by the arrows, around and into the combustion chamber 57, which may be of any suitable construction. As shown, the chamber 57 is annular in form, open at its radially inner surface to receive the primary air required for combustion and the injected fuel which issues from suitable orifices in a hollow nozzle sleeve 58, and is provided with a plurality of elbow-shaped tubular members 58 which extend axially toward and deliver the products of combustion to the inlet of the turbine. Each of the tubular members 58 is also provided with a plurality of holes 69 communicating with an annular space 70 to which the remainder of the output of the compressor is delivered in the manner indicated at the lower left-hand portion of Figure 4.

The burning gases, mixed with the diluent air entering through the holes 69, are led from the tubular members 58 to a stationary row of blades 59 forming nozzles through which the gases pass at high speed to the first row 60 of turbine blades 61a mounted on the shell 61, these blades 60 being partly or wholly of the impulse type. The shell carries external augments blades 62 coacting with stationary augments blades 63. The next row of turbine blades 55a fast on the sleeve 56 rotates at high speed to drive the final portion of the compressor, this row and the next row 64 (on the shell) being of the reaction type. The final independent rows 55 and the coacting blades 61a are all of the aerofoil type. Such a turbine is disclosed in copending patent application Serial No. 517,272, filed January 6, 1944.

The compressor sleeve 56 also drives a shaft 71 through a gear 72 fixed to the sleeve, a compound pinion 73 mounted on a countershaft 74 and a gear 75 fixed to the shaft 71. Shaft 71 extends forwardly through the hollow nozzle sleeve 58 and may be used as a power take-off for any desired purpose, such as driving auxiliaries.

It will be observed that the discharge from the turbine is into the jet duct 66 behind the augments, and that the intake to the compressor, through a plurality of curved pipes 67 (of which only one appears in the drawing), is also from behind the augments, but clear of the turbine discharge. There is substantially no difference in pressure between the turbine exhaust and the compressor intake, the latter being segregated from the turbine exhaust by the ducts 67.

As with the previously described embodiments of this invention the hot gases from the combustion chamber 57 flow to and through the turbine including blades 60, 55a, 64, 61a, 55. As the shell 61, with its blades 61a, is rotatably mounted as shown, as are also the mechanically connected sets of turbine blades 55 and the compressor

blades 54, the reaction between said blades drives both the shell 61 to rotate the augments blades 62 and the rotatable compressor rows 54 of the lower pressure stage of the compressor, while the blades 55a in driving relationship with the sleeve 56 rotate the blades 54a of the higher speed stage of the compressor. The jet-augments delivers part of its output through the curved pipes 67 which communicate with the inlet of the compressor, the outlet of the compressor communicating with the inlet to the combustion chamber 57. The remainder of the output of the jet-augments joins with the exhaust from the turbine to form the propulsion jet. Thus as in previously described embodiments air from the jet-augments is compressed in the compressor and delivered to the combustion chamber while the hot gases from the combustion chamber drive the oppositely rotating blade rows of the turbine to respectively drive the compressor and the augments, the exhaust from the turbine joining with part of the output of the jet-augments as a propulsion jet.

What I claim as my invention and desire to secure by Letters Patent of the United States is:

An internal-combustion, jet-propulsion plant comprising a number of independent, rotatable compressor sections, a combustion chamber to which compressed air is supplied by said compressor sections, turbine sections respectively in driving relation with said compressor sections, a jet-augments, said jet-augments having rows of blades arranged to rotate freely, turbine blades, in addition to said turbine sections in driving relation with said rows of jet-augments blades, said compressor-driving turbine sections comprising freely rotatable turbine blades intercalated with and adapted to rotate oppositely to said turbine blades which are in driving relation with said rows of jet-augments blades, means for supplying hot compressed gas from said combustion chamber to said turbine sections and additional turbine blades to drive the same, and duct means in communication with the turbine outlet, said jet-augments also having an outlet in communication with said duct means and said duct means directing the combined turbine exhaust and jet-augments output as a propulsion jet.

FRITZ ALBERT MAX HEPPNER.

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