

Sept. 30, 1947.

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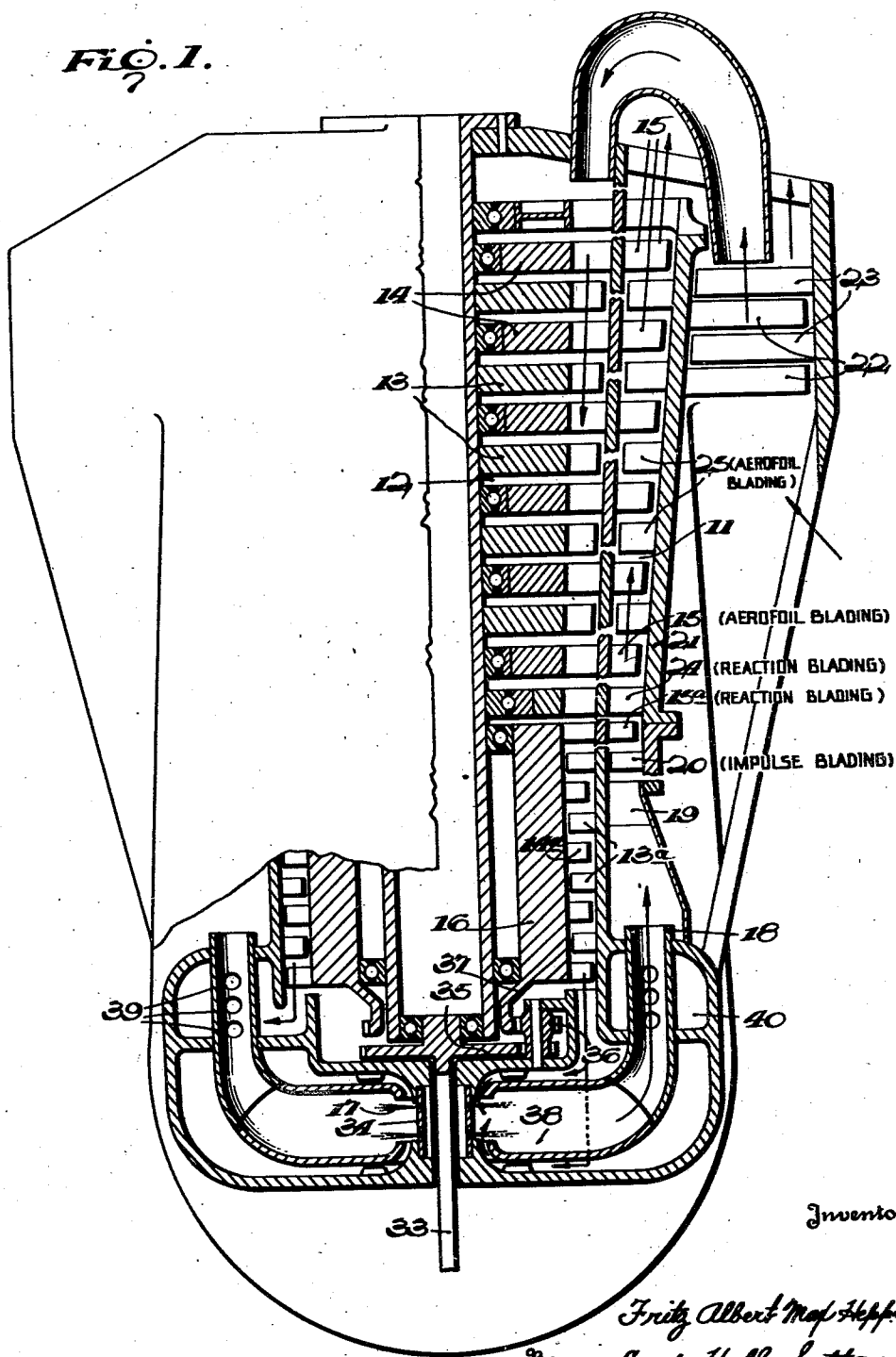
2,428,330

ASSEMBLY OF MULTISTAGE INTERNAL-COMBUSTION TURBINES
EMBODYING CONTRA-ROTATING BLADED MEMBERS

Filed Jan. 6, 1944

3 Sheets-Sheet 1

FIG. 1.



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3 Sheets-Sheet 2

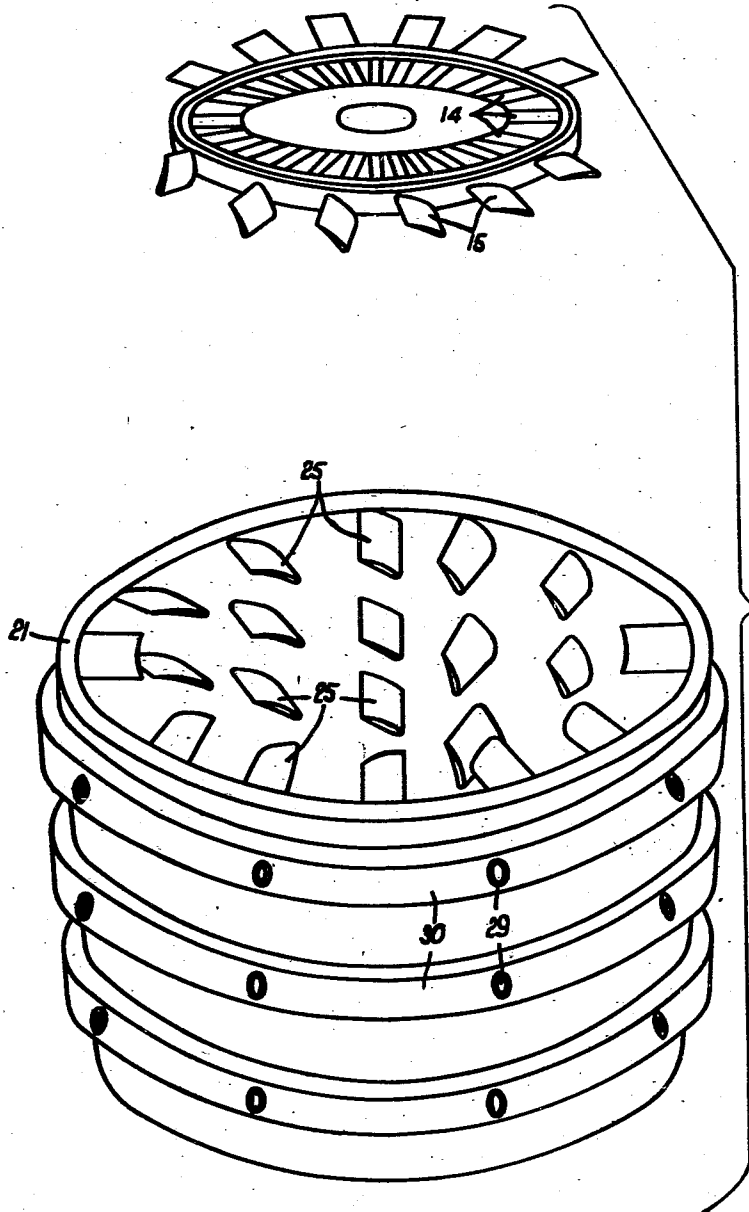


FIG. 2.

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3 Sheets-Sheet 3

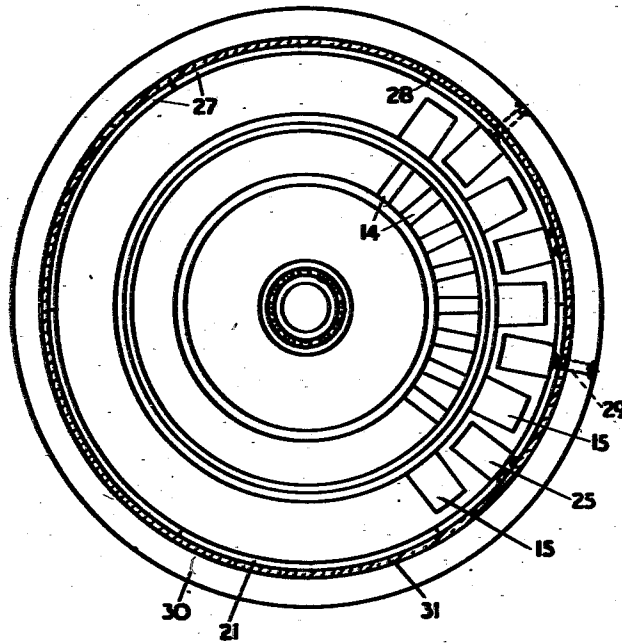


FIG 3

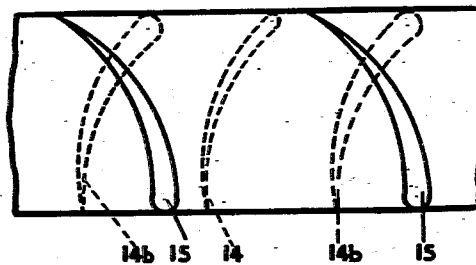


FIG 4

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ASSEMBLY OF MULTISTAGE INTERNAL-COMBUSTION TURBINES EMBODYING CONTRAROTATING BLADED MEMBERS

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5 Claims. (Cl. 60—35.6)

1

This invention relates to a multi-stage internal-combustion turbine plant, and particularly to a compound, internal-combustion, turbine plant for jet-propulsion purposes, the plant having a contra-rotating shell carrying externally jet-augmenter blades.

My main object is to facilitate assembly of the parts.

For an understanding of this and of other objects and advantages of the invention attention should be directed to the following description, in which one arrangement, according to the invention, is described with reference to the accompanying diagrammatic drawings, in which—

Figure 1 is a part-sectional elevation of a jet-propulsion turbine plant; and

Figures 2, 3 and 4 are views mainly of one of the independent turbine and compressor sections, Figure 2 being a perspective view of the shell with the augmentor blades omitted and with one independent turbine and compressor section shown withdrawn, whilst Figure 3 is an axial view thereof and Figure 4 a fragmentary developed plan of the independent section.

According to the invention, there are outwardly-extending compressor and/or turbine blade rows on an inner member or members coacting with inwardly-extending blade rows on an outer member or members, and the blades in each row are arranged and spaced from one another so as to admit of axial assembly of the said inner and outer members after the blades have been secured in position. Consequently, the outer member (or members) need not be split, i. e., it (or they) may be integrally formed.

Referring now to Figures 1 to 4, the plant illustrated is one in which the turbine 11 is disposed radially outwardly of the compressor 12, the flow through the latter being from the top to the bottom, i. e., from the jet end to the front. The compressor comprises stationary blade rows 13, 13 and rotary rows 14, 14, the latter rows being fast with independent turbine rows 15, 15 from which they are shielded by shrouds. The first independent turbine row 15a is mounted to revolve with a sleeve 16 carrying a plurality of compressor rows 14a coacting with stationary compressor rows 13a.

The primary output of the compressor flows, as indicated by the arrows, around and into the combustion chamber 38, which may be of any suitable construction. As shown, the chamber 38 is annular in form, open at its radially inner surface to receive the primary air required for combustion and the injected fuel which issues in the

2

form of sprays 17 from suitable orifices in a hollow feed nozzle sleeve 34, and is provided with a plurality of elbow-shaped tubular members 18 which extend axially toward and deliver the products of combustion to the inlet of the turbine. Each of the tubular members 18 is also provided with a plurality of holes 39 communicating with an annular space 40 to which the remainder of the output of the compressor is delivered in the manner indicated at the lower left-hand portion of Figure 1.

The burning gases, mixed with the diluent air entering through the holes 39, are led from the tubular members 18 to a stationary row of blades 19 forming nozzles through which the gases pass at high speed to the first row 20 of turbine blades mounted on the shell 21, these blades being partly or wholly of the impulse type. (The shell carries external augmentor blades 22 coacting with stationary augmentor blades 23.) The next row of turbine blades 15a fast on the sleeve 16 rotates at high speed to drive the final portion of the compressor, this row and the next row 24 (on the shell) being of the reaction type. The final independent rows 15 and the coacting blades 25 are all of the aerofoil type.

As will be seen from Figures 2, 3 and 4 the blades 15 are spaced from one another sufficiently to allow of assembly into the shell through the larger (top in Figure 1) end thereof, the blades passing between the blades 25 fast with the shell. As each disc 14 has only a single compressor row the power to drive it is small enough to allow wide spacing of the turbine blades without excessive lift figures on the turbine blades. In other words, the turbine blades in a row have only small deflections.

Figure 4 shows at 14b some of the compressor blades strengthened to carry the centrifugal forces.

Conveniently the shell 21 is mainly of aluminum, the blades 25 being carried by ring sections 27 having end clearance from one another when cold, as indicated at 28 (Figure 3), the portions 27 being riveted at 29 to aluminum ribs 30 with heat insulating material 31 interposed. Alternatively, the shell can be made from steel in one piece with the turbine blades 25 permanently fixed in it, this being possible by the new way of assembly as a consequence of the wide spacing of the turbine blades. This feature also allows of assembling and dismantling the shell without interfering with the balance, which is a very important point because of the relatively great weight of the shell.

Furthermore, as regards the compressor sleeve 16, in a similar way the blade rows 14a are arranged so that they can be slid axially between the stationary blade rows 13a.

At 33 I show a drive shaft, for auxiliaries, passing through the hollow feed nozzle 34, the drive shaft carrying a gear 35 which is driven from the compressor sleeve 16 through a compound pinion 36 and gear 37.

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

1. In an internal-combustion turbine plant, a rotating shell carrying inwardly-extending blade rows, coacting contra-rotating blade rows, and a plurality of compressor portions rotatably mounted within said shell, each of said contra-rotating blade rows being carried by and driving one of said compressor portions, the blades in said rows being spaced circumferentially and arranged so that said compressor portions can be inserted into said shell in an axial direction after said blades have been secured in position.

2. In an internal-combustion turbine plant, a rotating shell carrying inwardly-extending turbine blade rows, contra-rotating shrouds within said shell each carrying an outwardly-extending coacting turbine blade row and also an inwardly-extending compressor blade row, and coacting stationary compressor blade rows, the blades in said rows being spaced circumferentially and arranged so that said shrouds can be inserted into said shell in an axial direction after said blades have been secured in position.

3. Apparatus as defined in claim 2, including outwardly-extending jet-augmenter blade rows on said shell and coacting stationary jet-augmenter blade rows, the augmentor blades of said rows being spaced circumferentially and arranged so that said shell can be moved in an axial direc-

tion with its blades passing between said stationary blades to bring said blade rows into coacting position.

4. In an internal-combustion turbine plant, a rotating shell carrying inwardly-extending turbine blade rows, a support extending axially through said shell, contra-rotating shrouds within said shell each carrying an outwardly-extending coacting turbine blade row and also an inwardly-extending compressor blade row, said shroud rings being rotatably mounted on said support, and coacting stationary compressor blade rows mounted on said support between said rotatable compressor blade rows, the blades of said turbine blade rows being spaced circumferentially and arranged so that said shrouds can be inserted into said shell in an axial direction after said blades have been secured in position.

5. In an internal-combustion turbine plant, an outer shell having inwardly-extending blade rows, and a member within said shell having coacting outwardly-extending blade rows, said shell and member being mounted for relative rotation, the blades of said rows being spaced circumferentially and arranged so that said member may be moved axially into coacting position within said shell with the blades secured in position on said shell and member.

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