June 3, 1969 C. HAVETTE ETAL 3,447,741

FAIRED PROPELLER WITH DIFFUSER

Filed Sept. 21, 1967

Sheet 1 of 4

FIG. 1

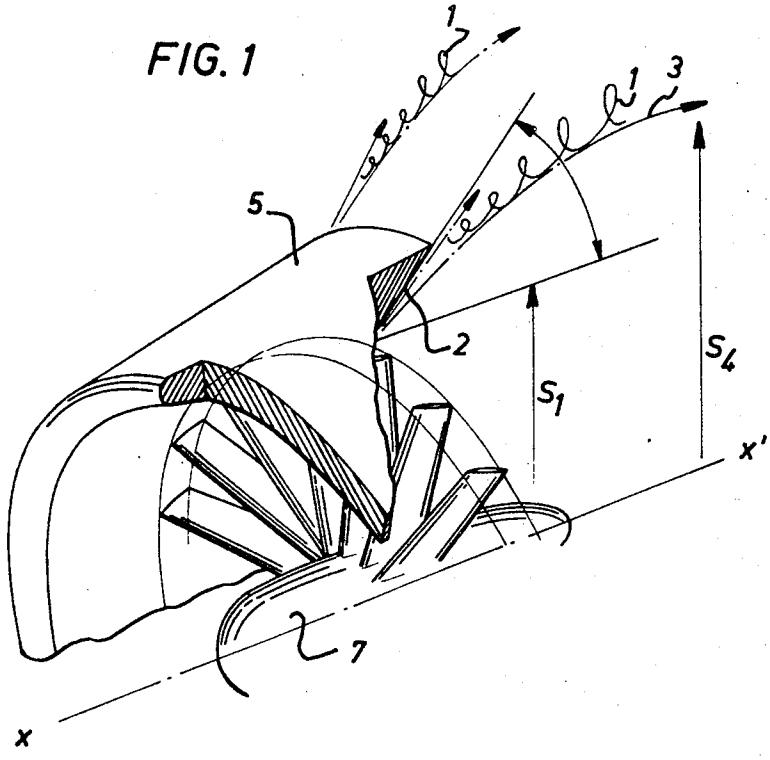


FIG. 2

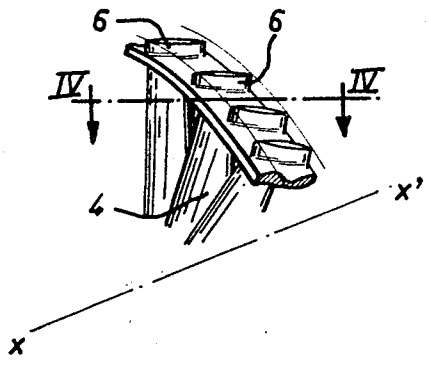
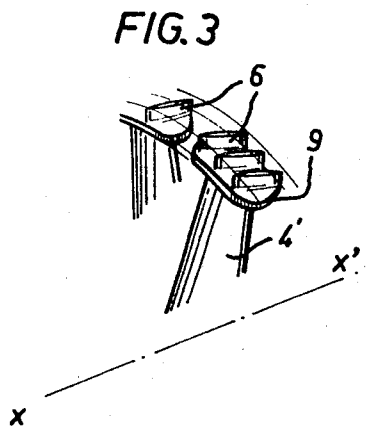


FIG. 3



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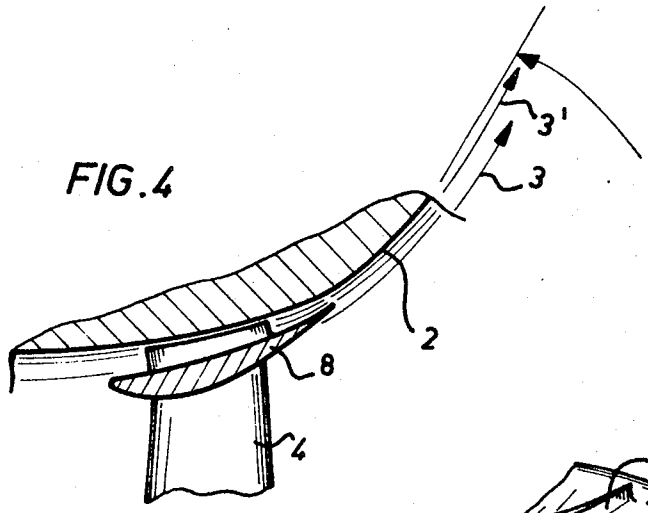
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FAIRED PROPELLER WITH DIFFUSER

Filed Sept. 21, 1967 Sheet 2 of 4

FIG. 4



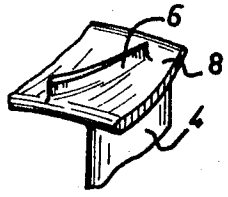
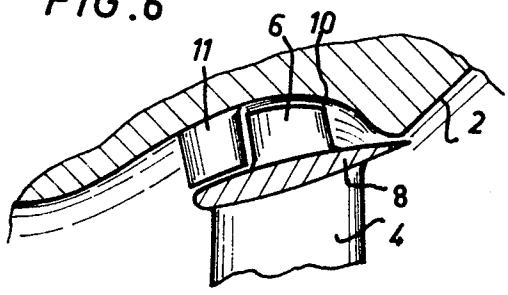


FIG. 5

FIG. 6



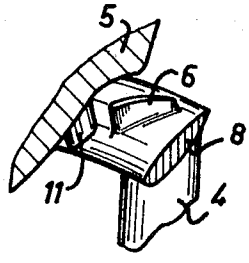


FIG. 7

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FAIRED PROPELLER WITH DIFFUSER

Filed Sept. 21, 1967 Sheet 3 of 4

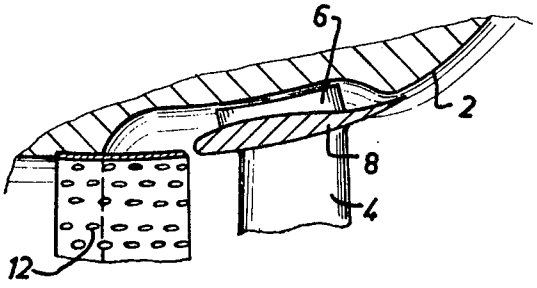


FIG. 8

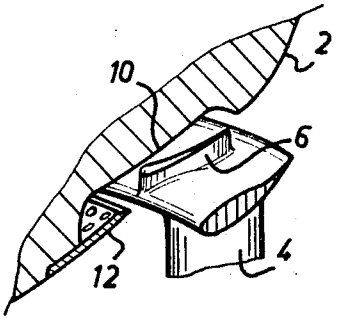


FIG. 9

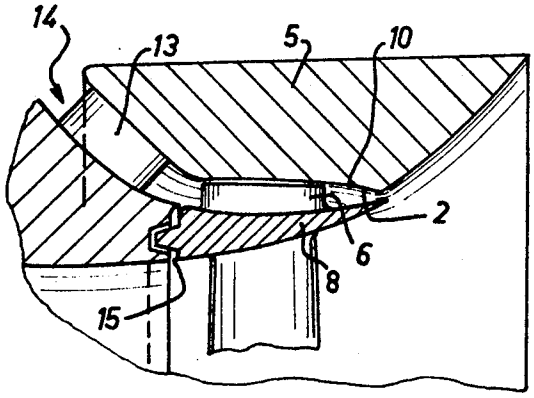
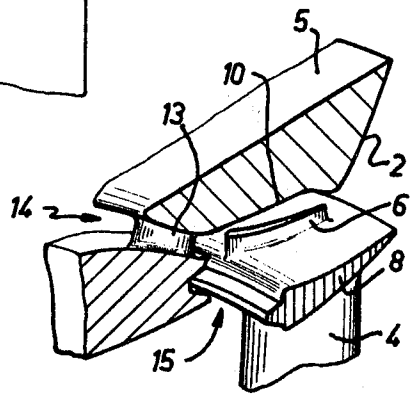


FIG. 10

FIG. 11



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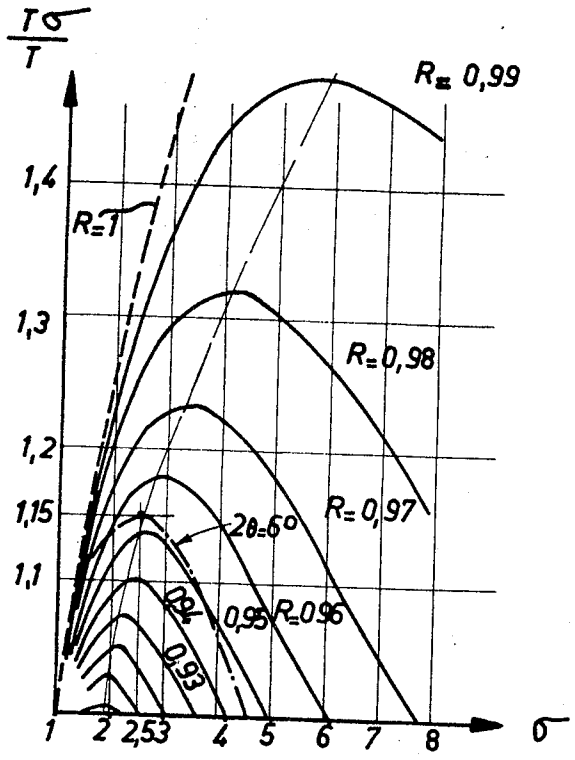


FIG. 12

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United States Patent Office 3,447,741
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3,447,741

FAIRED PROPELLER WITH DIFFUSER

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Claims priority, application France, Sept. 26, 1966, 77,679
Int. Cl. F04d 19/02, 27/00
U.S. Cl. 230—122
6 Claims

ABSTRACT OF THE DISCLOSURE

A propeller comprising a hub and blades faired by a diffuser channeling the flux which passes through the said propeller, characterized in that the said blades are coupled together at their free peripheral extremities by a circular ring, the said ring carrying vanes suitably orientated in the flux so as to produce a self-blowing effect of the parasitic vortex streams by wire-drawing said streams against the fairing of the diffuser.

The present invention relates to a faired propeller provided with a diffuser.

The diffusion of a jet produced by a propeller, the favourable effect of which is sought for in various cases such as that arising for example from the use of the faired propeller in the aeronautical field, is readily obtained by a short conical diffuser as long as the total angle of divergence does not exceed 6° on the average.

If however it is desired to increase the diffusion beyond this angle, it is necessary to provide a boundary-layer control in order to avoid detachment of the fluid stream.

The most usual control means of the prior art consists of producing through annular slots a screen of compressed air in the extension of the diffuser, but the concomitant draw backs of weight and bulk, both of the compressed air station and of the air-supply pipes and of the blowing slots have not made is possible up to the present time to contemplate the use of such a solution in the aeronautical field.

In order to overcome this disadvantage, the present invention provides a method permitting the production of a downstream blowing jet by means of the propeller itself, the said method consisting essentially of providing the extremities of the propeller blades with vanes or fins disposed on isolating plates or on a circular ring fixed to the said blades, and, when so desired, of arranging the internal portion of the diffuser in such manner as to facilitate the flow of the fluid.

In addition to the self-generated blowing effect thus produced, the invention provides, as compared with the prior art:

Improved homogeneity of the peripheral distribution of the fluid;

Zero clearance at the extremities of the blades of the propeller, and therefore a reduction of the marginal losses of the propeller;

Simultaneous use of the suction for the maintenance of the laminary boundary layer and of the blowing at the break of the diffuser;

Increased strength and added safety in the application with a propeller ring.

Other characteristic features and advantages will be brought out in the description which follows below, reference being made to the accompanying drawings illustrating by way of examples given purely by way of indication

and not in any limited sense, a number of forms of embodiment of the invention.

In the drawings:

FIG. 1 is a persepctive view of a conventional faired propeller;

FIG. 2 is a partial view in perspective of the blades of a propeller or air-screw according to the invention;

FIG. 3 is a view similar to that of FIG. 2;

FIG. 4 is a cross-section taken along the line IV—IV of the propeller of FIG. 2 placed under its fairing;

FIG. 5 is a partial view in perspective of the arrangement of FIG. 4;

FIG. 6 is a view in cross-section of an alternative form similar to that of FIG. 4;

FIG. 7 is a perspective view of the arrangement shown in FIG. 6;

FIG. 8 is a view in cross-section of another alternative form, similar to that of FIG.6;

FIG. 9 is a view in perspective of the arrangement shown in FIG. 8;

FIG. 10 is a view in cross-section of a further alternative form of construction;

FIG. 11 is a perspective view of the arrangement illustrated in FIG. 10;

FIG. 12 is an illustrative graph.

Generally speaking, the diffusion of the jet of a faired propeller is governed on the one hand by the diffusion ratio σ=S4/S1, in which S1 is the section level with the neck and S4 is the section of the jet at infinity downstream, and on the other hand by the diffusion efficiency R which takes into account all the possible degradations of the jet referred to the energy of the fluid at the neck.

Furthermore, it is known that the traction ratio T of a faired propeller with a diffuser, with respect to the traction without diffusion (T=1 for a given power W) can be correctly determined by the relation:

$$\frac{T_\sigma}{T}=\sqrt[3]{\frac{T}{[1+(1-R)_\sigma{}^2]^2}}$$

which is represented by the family of curves of the graph shown in FIG. 12. On this graph, there has been given by way of comparison the maximum possible gain (15% for a diffusion of 2.5) to be expected from a conventional conical diffuser with a total opening of 6°. It can be seen what difficulties must be overcome in order to obtain a diffusion σ of high efficiency, whereas a very small reduction of the efficiency R is sufficient to annul any substantial gain obtained elsewhere.

If it is attempted to analyze the variations of the diffusion efficiency R, it can be seen from FIG. 1 that for an angle θ of 6°/2, the cause of the drop in R is essentially due to the vortices **1** caused by the detachment of the fluid streams **3** from the wall of the diffuser **2**, these streams being then slowed-down during the re-combination of the jet with the ambient fluid.

For the purpose of obtaining a better diffusion and better efficiency, the invention proposes a faired propeller comprising a propeller rotating about the axis x–x', a fairing **5** and a diffuser **2**. By virtue of the self-blowing effect generated by the vanes **6** located at the extremities of the blades **4** of the propeller **7** (FIGS. 2 and 3) there is obtained a substantial increase in diffusion σ and in efficiency R by eliminating the parasitic vortices **1**; the said vanes are arranged for example either on a ring **8** surrounding the propeller or on isolating plates **9** mounted on the extremities of the probeller blades.

In accordance with FIGS. 4 and 5, which show a preferred form of the invention, it can be seen that the vanes **6**, of appropriate shape and inclination, are arranged on their support **8** which is coupled to the blades **4** of the propeller. In FIG. 4, the assembly vanes-support-propel-

ler is arranged in the interior of the diffuser **2** of high divergence ($\theta > 6°/2$) in such manner that the external edges of the vanes are as close as possible to the wall of the diffuser, and that the shape of the support **8** facilitates the carrying away of the streams **3** by accelerating the flow of the fluid streams **3'** ejected at increased speed.

In an alternative form shown in FIGS. 6 and 7, the diffuser is incurved at **10** in order to provide for the mounting of fins **11** intended to rectify the peripheral portion of the jet.

According to another alternative form shown in FIGS. 8 and 9, the arrangement of the wall **2** provides for the extraction of the flux to be accelerated by the vanes **6** to be effected through an annular grid **12**.

Finally, in a further alternative form shown in FIGS. 10 and 11, the extraction of air is effected, not from the flux discharged by the propeller but from the outer portion of the fairing **5**. In order to do this, fixed vanes **13** serve simultaneously to form the intake channel **14** and to rectify the flux drawn in by the moving vanes **6**. Similarly, a joint **15** provides relative isolation between the internal and external upstream fluxes.

However, and for certain particular cases, the vanes **6** which have previously been appropriately profiled, can be provided in the interior of the ring **8** in an arrangement similar to that of FIG. 10.

Furthermore, in addition to the self-blowing effect thus obtained on the downstream side, the self-suction effect which is consequently created in the upstream portion permits a laminar flow of all the flux contained inside the fairing.

It will of course be understood that the invention has been described above purely by way of indication and not in any limitative sense, and that any modifications of detail can be made thereto, in accordance with its spirit, without thereby departing from its scope.

We claim:

1. A propeller comprising a hub and blades faired by a diffuser adapted to channel the flux of the propeller, the extremities of said blades opposite to said hub being coupled together by a circular ring carrying vanes suitably orientated in said flux so as to produce a self-blowing effect on the conventional vortex streams, by wire-drawing said streams against the fairing of said diffuser.

2. A propeller as claimed in claim **1**, in which said ring is discontinuous and is constituted by isolating plates at the general level of the intake periphery of said diffuser.

3. A diffuser fairing for a propeller as claimed in claim **1**, comprising a cavity delimited by a recessed surface, said cavity constituting a housing adapted to receive said vanes at the exterior of the main flux.

4. A fairing as claimed in claim **3**, and further comprising, at the intake of the flux into said cavity, an annular grid for limiting the intake section of said cavity.

5. A fairing as claimed in claim **4**, comprising an extraction channel for fluid external to the flux, and fixed vanes provided in said channel.

6. A diffuser for a propeller as claimed in claim **1**, comprising a cavity delimited by a recessed surface, said cavity constituting a housing adapted to receive said vanes at the exterior of the main flux and a fluid extraction channel in said cavity, and fixed vanes directing the fluid in a certain direction in said channel.

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U.S. Cl. X.R.

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