TURBOJET CASING AND TURBOJET RECEIVING SUCH CASINGS

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ABSTRACT
A turbojet casing adapted to receive a plurality of vanes, the casing including attachment means (21, 30) for attaching one end of each vane to the casing, the casing being characterized in that the attachment means extend on a face of the casing facing away from the vanes, the casing including orifices (26) for passing the ends of the vanes so that they can co-operate with the attachment means of the casing. A turbojet including such a casing.
The present invention relates to a turbojet casing adapted to receive a plurality of vanes, and also to a turbojet incorporating such casings.

BACKGROUND OF THE INVENTION

Annular casings are known that have attachment means for co-operating with the ends of a vane.

Various attachment means have been proposed. For example, document US 2009/0317246 recommends ends making up a cylindrical platform forming a portion of the outer casing and carrying two fastener flanks, whereby leading to shapes that are complex to fabricate. Document US 2009/0317246 recommends joining the vanes together by means of a circular ring prior to mounting the assembly in this way in the casing. That solution is complex to implement and requires assembly tooling.

OBJECT OF THE INVENTION

The object of the invention is thus to propose a turbojet casing that is simple to produce and easy to mount.

BRIEF SUMMARY OF THE INVENTION

To this end, the invention provides a turbojet casing adapted to receive a plurality of vanes, the casing including attachment means for attaching one end of each vane to the casing. According to the invention, the attachment means extend on a face of the casing facing away from the vanes, the casing including orifices for passing the ends of the vanes so that they can co-operate with the attachment means of the casing.

Such an arrangement makes it possible to obtain a casing that is simple to produce and easy to mount.

In a preferred embodiment, the attachment means comprise an annular member extending around the casing, the casing comprising long fibers and thermoplastic resin, and the annular member being obtained by pultrusion and being impregnated with a thermoplastic resin that is heat-sealable with the thermoplastic resin of the casing, the assembly being joined together by hot compaction. This produces an assembly with strong cohesion.

The invention also provides a turbojet including at least one casing of the invention, and a plurality of vanes, each having one end connected to the casing.

Preferably, in this turbojet, each of the vanes comprises:

- an elongate one-piece front portion cut from a pultruded section member having fibers bonded by the resin and forming a leading edge;
- an elongate one-piece rear portion cut from a pultruded section member having fibers bonded by the resin and forming a trailing edge; and
- a skin cut from a fiber fabric impregnated with resin and extending to cover the side faces of the core and covering at least zones of the leading edge and of the trailing edge that are contiguous with the central portion;
- at least one of the leading edge and the trailing edge presenting extensions that project from the core at least from one end of the vane in order to carry attachment means for attaching the vane and co-operating with the attachment means of the casing of the turbojet.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a plan view of a vane that is designed to be fastened to a casing of the invention;

FIG. 2 is a perspective view of the FIG. 1 vane, the skin covering the core of the vane being partially cut away;

FIG. 3 is a perspective view of a first technique for fastening the vane to a casing of the invention; and

FIG. 4 is a perspective view of a second technique for fastening the vane to the casing of the invention.

DETAILED DESCRIPTION OF THE INVENTION

With reference to FIGS. 1 and 2, the vane 1 shown therein is a guide vane for extending behind the fan of a turbojet. In this embodiment, the vane 1 has a leading edge 2 that is in the form of a one-piece elongate structure. The vane 1 also has a trailing edge 3 that is likewise in the form of a one-piece elongate structure.

The leading edge 2 and the trailing edge 3 are cut from section members obtained by pultrusion, preferably with fibers being placed obliquely (the so-called “pullbraiding” method). The section members have fibers, e.g. carbon fibers, that are arranged essentially along a longitudinal axis in order to form an elongate body. Ideally, substantially 80% of the fibers are arranged along the longitudinal axis Y of the leading edge and along the longitudinal axis X of the trailing edge, and 20% of the fibers are arranged at an angle of inclination of about 60 degrees relative to the longitudinal axis. These proportions and this arrangement for the fibers are given by way of example. The fibers are impregnated in thermoplastic resin.

Between the leading edge 2 and the trailing edge 3 there extends a core 4. A skin 5 is made up in this example of two webs 5A and 5B that are obtained by being cut out from a fiber fabric that has been pre-impregnated with thermoplastic resin, the webs extending on either side of the core 4 so as to cover both the core and also zones 6, 7 of the leading edge 2 and of the trailing edge 3 that are contiguous with the core 4.

The faces of the core 4 that are not covered by the webs 5A and 5B form free ends of the core 4, and in this example they are protected and reinforced by means of a mixture 22 of short fibers and of resin inserted in a cavity defined by the webs 5A and 5B and the free edge of the core 4. The leading edge 2 and the trailing edge 3 include extensions 10, 11, 12, and 13 that extend projecting from the core 4 at each end of the vane 1.

The various components of the vane 1 are assembled together by hot compaction so as to join the components of the assembly to one another. This type of assembly imparts great strength to the vane 1 as a whole.

Finally, orifices 14, 15, 16, and 17 are formed in the extensions 10, 11, 12, and 13 so as to form the extensions into means for attaching the vane 1, which means are designed to co-operate with complementary attachment means in a casing of the turbojet, as described below in detail with reference to FIGS. 3 and 4.

FIG. 3 shows a first technique for fastening the vane 1 to an annular turbojet casing 20. (This figure shows the outer casing of the turbojet that is made of long fibers impregnated...
with thermoplastic resin.) The casing 20 has orifices 26 for passing the extensions 10 and 12 of the leading edge 2 and of the trailing edge 3 through the casing 20. The orifices 26 are shown as being of sufficient extent to allow the extensions from both the leading edge and the trailing edge to pass through the same orifice. Nevertheless, in a variant, it would be possible to make the orifices in two portions, comprising an upstream orifice and a downstream orifice respectively for passing the leading edge and the trailing edge.

The casing 20 is fitted with means for attaching the leading edges, which means are in the form of a peripheral rail 21 extending around the casing on a face thereof that faces away from the vanes. The rail 21 defines a housing suitable for receiving the heads 24 of fastener elements 23 that are generally T-shaped or L-shaped. One of these elements is shown in the figure.

The fastener element 23 has an opposite end 25 that is remote from its head 24 and that is cut so as to receive the extension 10 of the leading edge. In this example, the fastener element 23 is joined to the extension 10 by pinning. For this purpose, the end 25 includes an orifice (not shown in the drawing) that is situated in register with the orifice 14 in the extension 10 of the leading edge 2 in order to receive a fastener pin 27. The extension 12 of the trailing edge 3 is fastened in similar manner by means of a second rail 21' in which a second fastener element 23' is engaged to co-operate with the extension 12 of the trailing edge 3, the assembly being pinned together with the help of a pin 27.

In a preferred embodiment, the rails 21 and 21' and the fastener elements 23 and 23' are pultruded and are impregnated with thermosetting resin, thus enabling the entire assembly to be joined together by a single hot compaction operation on the casing 20.

Furthermore, FIG. 3 shows only half of the vane 1. The terminal portions 11 and 13 that are not shown are fastened to an inner casing in a manner that is identical to that described above. Nevertheless, if the vane does not have a structural function, the vane needs to be fastened to only one of the casings.

FIG. 4 shows a second technique for fastening the vane 1 to a turbojet casing 20. In this figure the attachment means comprise an angle bar 30 arranged peripherally all around the casing. The angle bar 30 passes over a face of the casing 20 facing away from the vane 1. The casing 20 has through orifices 26 for passing the extensions of the leading and trailing edges of the vane through the casing 20 so that they bear the angle bar 30.

In a preferred manner, the angle bar 30 is made by pultrusion and is impregnated with thermosetting resin.

The angle bar 30 has an L-shaped section with a first face 28 that is fastened to the casing 20 by hot compaction and a second face 29 that is fastened to the extension 10 by pinning. For this purpose, the face 29 of the angle bar 30 is pierced by an orifice that comes into register with the orifice 114 formed in the extension 10 of the leading edge. It should also be observed that the orifice 114 is formed perpendicularly relative to the orifice 14 of the above-described embodiment. It should also be observed that the extension 10 has been machined to present a flat face that comes to bear against the facing face of the flange 29.

As in the above-described example, the various elements of the casing are joined together by thermocompaction.

Furthermore, the extensions 11, 12, and 13 of the leading edge 2 and of the trailing edge 3 that are not shown are fastened to respective similar angle bars.

The operation of fastening the vane 1 to the angle bar 30 is repeated for all of the vanes that are to be installed.

In addition to their role in fastening the vanes via the extensions of their leading or trailing edges, it should be observed that the rails and the angle bars also contribute to stiffening the casing of the turbojet.

 Naturally, the invention is not limited to the embodiments described above and they may be subject to variations that appear to the person skilled in the art without going beyond the ambit of the invention as defined by the claims.

In particular, the materials used for making the various elements 2, 3, 4, 5 of the vane 1 and for making the attachment means 21, 23, 27 may equally well be composite materials or metals or a combination of both.

Similarly, the reinforcements 22 that are visible in FIG. 2 covering the free ends of the core 4 may be replaced by or associated with the skin of one or both of the webs 5A, 5B being folded over. Under such circumstances, the dimensions of the webs 5A, 5B should be adjusted to leave a flap suitable for covering the free end of the core.

Similarly, the attachment means of the casing and the attachment means of the leading and trailing edges may be joined together by operations involving hot compaction, adhesive, or indeed by using nut-and-bolt fasteners or any other solution that serves to hold the elements together.

In addition, the vanes may be of a structure that is different from that described, for example a one-piece structure.

Finally, although FIGS. 3 and 4 suggest identical fastener means for each of the extensions 10, 11, 12, 13 of the leading edge 2 and of the trailing edge 3 in two different embodiments, it is not contrary to the invention for each extension to be fastened to the casing 20 using one or the other of the fastener means in independent manner.

Although the attachment means described herein comprise an annular member in the form of a rail or a peripheral angle bar extending around the casing, other attachment means could be envisaged, such as fastener tabs to which ends of the vanes are fastened after they have passed through the casing.

1. A turbojet casing adapted to receive a plurality of vanes, the casing including attachment means (21, 30) for attaching one end of each vane to the casing, the casing being characterized in that the attachment means extend on a face of the casing facing away from the vanes, the casing including orifices (26) for passing the ends of the vanes so that they can co-operate with the attachment means of the casing.

2. A casing according to claim 1, wherein the attachment means comprise an annular member (21, 30) extending around the casing.

3. A casing according to claim 2, wherein the annular member comprises at least one peripheral rail (21) having the ends (24) of fastener elements (23) for fastening to the ends of the vanes inserted therein.

4. A casing according to claim 2, wherein the annular member comprises a peripheral angle bar (30) to which the ends of the vanes are fastened directly.

5. A casing according to claim 2, the casing being made of long fibers associated with a thermoplastic resin, while the annular member (21, 30) is obtained by pultrusion and impregnated with a thermoplastic resin that is heat-scaleable.
with the thermoplastic resin of the casing, the assembly being joined together by hot compaction.

6. A turbojet including at least one casing according to claim 1, and a plurality of vanes, each having one end connected to the casing.

7. A turbojet according to claim 6, wherein each of the vanes comprises:
   - an elongate one-piece front portion (2) cut from a pultruded section member having fibers bonded by the resin and forming a leading edge;
   - an elongate one-piece rear portion (3) cut from a pultruded section member having fibers bonded by the resin and forming a trailing edge;
   - a core-forming central portion (4) extending between the leading edge (2) and the trailing edge (3); and
   - a skin (5) cut from a fiber fabric impregnated with resin and extending to cover the side faces of the core (4) and covering at least zones (6, 7) of the leading edge (2) and of the trailing edge (3) that are contiguous with the central portion (4);
   - at least one of the leading edge (2) and the trailing edge (3) presenting extensions (10, 11, 12, 13) that project from the core (4) at least from one end of the vane (1) in order to curry attachment means (14, 15, 16, 17) for attaching the vane (1) and co-operating with the attachment means of the casing (20) of the turbojet.

8. A turbojet including at least one casing according to claim 1, and a plurality of vanes, each having one end connected to the casing.

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