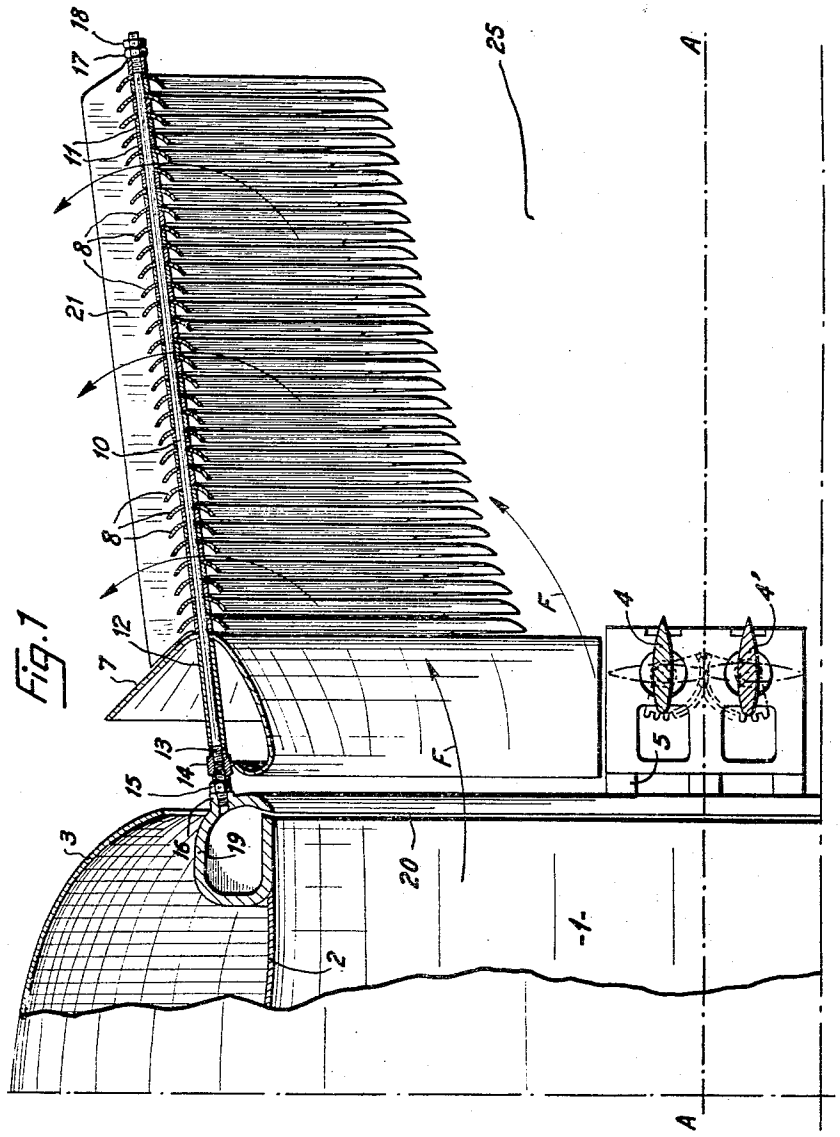
Nov. 22, 1960 J. H. BERTIN 2,960,822

ARRANGEMENT FOR DEFLECTING THE JETS OF REACTION PROPULSION UNITS

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Fig. 1



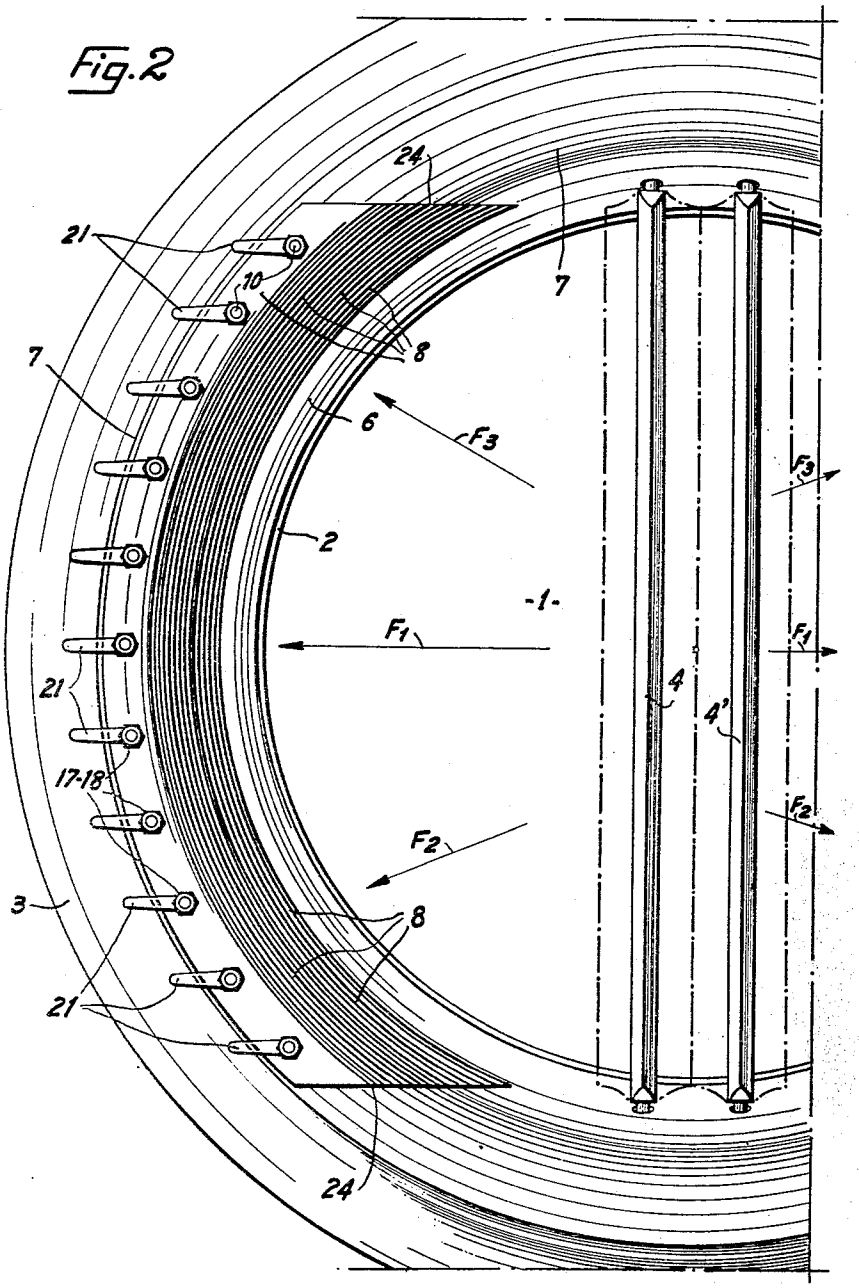
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Fig. 2



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Fig. 3

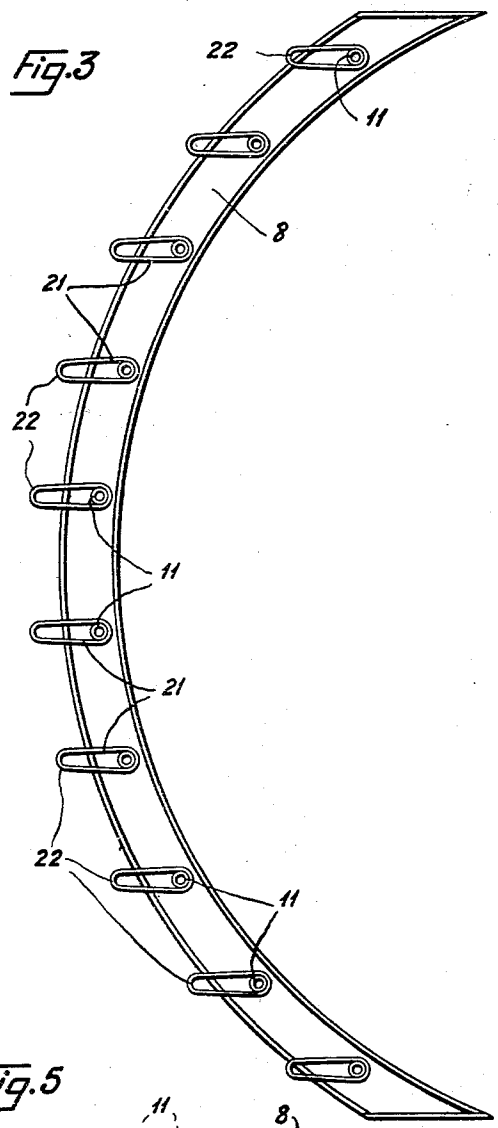
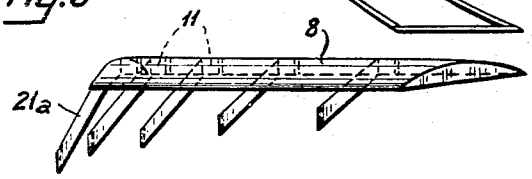


Fig. 5



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Fig. 4

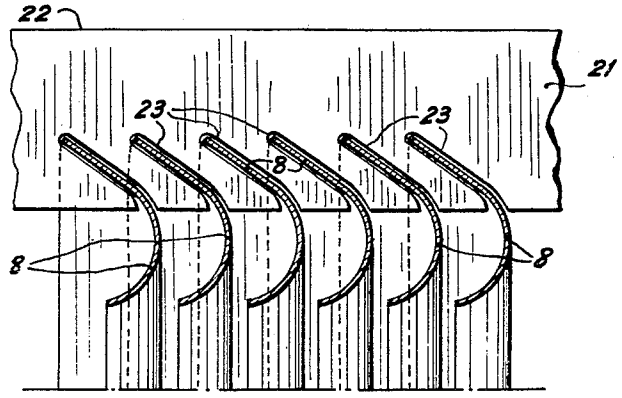
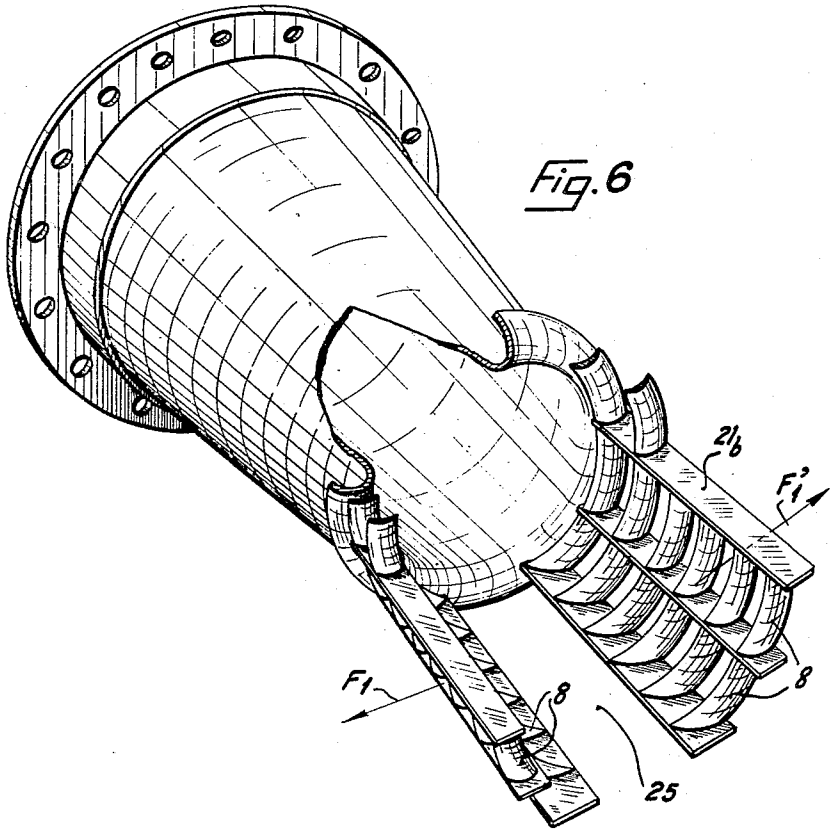


Fig. 6



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United States Patent Office 2,960,822 Patented Nov. 22, 1960

2,960,822

ARRANGEMENT FOR DEFLECTING THE JETS OF REACTION PROPULSION UNITS

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Filed Sept. 14, 1954, Ser. No. 456,046

Claims priority, application France Sept. 21, 1953

2 Claims. (Cl. 60—35.54)

Arrangements are already known for deflecting the jet passing out of the discharge-nozzle of a reaction-propulsion unit, with a view to obtaining either a braking effect on the body propelled or a change in the direction of the thrust so as to control the evolutions of the said body.

The jet issuing axially from the nozzle has a more or less cylindrical compact shape and, as known, the thrust it produces is proportional to its velocity. Now, as this jet is deflected, i.e. urged sideways from the axis of the nozzle, it spreads out radially, thereby losing its compacity and wasting velocity, with a consequential reduction of side thrust or back thrust as the case may be.

The present invention has for its object to counteract this tendency of the jet to spread out when deflected and, as far as possible, to maintain the compacity and velocity it has at the nozzle end. For this purpose, the jet deflecting device, whatever its type may be, is supplemented, in accordance with the invention, with a plurality of parallel walls or partitions extending to the rear of the nozzle along, but outside of, the normal undeflected path of the jet, these walls bounding lateral passages for the deflected jet, which passages are of uniform width thereby preventing the spreading of the jet.

This improvement is of particular interest in combination with grids of deflecting blades placed at the rear extremity of the discharge nozzle and at the periphery of the normal flow of the jet, in accordance with arrangements previously proposed by the present applicant. In fact, these blades which surround the normal path of the jet, tend to disperse the streams of the deflected jet all round the axis of the discharge nozzle, and it is therefore of particular importance to reduce this divergence of the deflected jet for the purpose indicated above.

In this particular embodiment of the invention, the guiding members may be constituted by a kind of spacing-support members which may be flat or profiled in section and are arranged between successive blades. Instead of extending all round the path of normal flow of the jet, the blades may be limited to portions of rings arranged on the side or the sides towards which the deflection is desired to be effected. This facilitates the assembly of the members controlling the deflection and also the intake of external air brought in to supply the zone of subpressure which tends to be produced between the deflected streams.

The description which follows below with respect to the attached drawings (which are given by way of example only and not in any sense by way of limitation), will make it quite clear how the invention may be carried into effect, the special features which are brought out, either from the text or in the drawings, being understood to form a part of the said invention.

Figs. 1 and 2 are respectively an axial half cross-section and a partial rear view of the downstream extremity of a reaction discharge-nozzle provided with the improved deflection device in accordance with one form of embodiment of the invention.

Fig. 3 shows to a larger scale the details of a blade with the combined guiding members, the whole being projected on to a plane at right angles to the axis of the discharge nozzle.

Fig. 4 shows a side view of one of the guiding members common to a number of blades.

Fig. 5 shows the detail of an alternative form in which separate guiding members are provided for the various spaces between the blades.

Fig. 6 is a perspective view of the downstream portion of a reaction discharge-nozzle provided with a device in accordance with an alternative form of the invention.

In Fig. 1 there will be seen at 1 the rear portion of the discharge-nozzle of a reaction-propulsion unit, at 2 the internal wall of this discharge-nozzle (the latter being supposed to be of circular section but without any limitation as to this section), and at 3 the external casing of the reaction unit. On each side of the diametral plane passing through the axis A—A of the discharge-nozzle and perpendicular to the plane of Fig. 1, are symmetrically arranged two aerofoil-section blades 4—4' mounted parallel to each other and adapted to pivot at their extremities in supports 5 fixed to the end of the discharge-nozzle at two diametrically-opposite points.

The pivots of these blades may be coupled to each other by means of two pinions, in such manner that the said blades pivot through the same angles and in opposite directions with respect to each other. An actuating system (not shown) enables the pilot to rotate the said blades either to the position shown in full lines, or to that shown in dotted lines. In the full-line position, the aerofoil blades 4—4' present a minimum resistance to the passage of the jet and the latter is discharged normally from the exhaust nozzle. On the other hand, in the position shown in dotted lines, the blades form an obstacle to the flow of the jet and the latter is deflected on each side of the plane of symmetry A—A, as shown by the arrows F for that half of the discharge-nozzle shown in Fig. 1. Any other type or system of deflecting obstacles could, of course, be employed. At the downstream extremity of the discharge nozzle there is provided a curved or convex surface 6 which is outside the normal path of the jet and which is curved in such a way that the marginal zone of the streams of the deflected jet come into contact with it, this surface 6 being extended outwards at 7 towards the exterior and in the desired direction of deflection. In the zones of the two streams formed by the jet as it opens out and separates on each side of the diametral plane A—A, are located a series of blades 8 placed one behind the other and serving to split up the deflected jet into as many further streams as there are spaces between the said blades, and also serving to guide these streams and to give the deflection of the jet its desired angular value.

In the example shown, these blades are constituted by parts of a torus produced by stamping-out rings of thin metal sheet, these rings being cut from sheet metal. These blades are dimensioned so as to be located outside the path of normal flow of the jet and not to come into contact with the peripheral part of the jet, whilst at the same time they fall inside the flow of air passing over the external casing 3 of the reaction unit.

This grid of blades may be conical, as shown in Fig. 1, in which case the mean diameter of the blades increases, starting from the downstream extremity of the discharge-nozzle. The grid may, however, also be cylindrical.

The blades are held in position by wire rods 10 of high tensile steel, which are distributed around the axis A—A of the discharge-nozzle, following the generators of a cone or of a cylinder, in dependence on the shape given to the grid of blades. These wire rods are passed through holes formed in the blades and also through

tubular spacing members **11** alternating with the blades and serving to maintain the desired separation between the blades. The rods **10** also pass through holes formed in the deflecting edge **6—7** which they also serve to fix, and through a tubular spacing member **12** which retains this edge at the desired distance from the discharge nozzle. The rods are threaded at **13** at their extremities close to the discharge nozzle and are secured by means of a sleeve **14** having an oppositely-threaded bore, to threaded rods **15** screwed to the discharge nozzle at **16**. At their opposite extremities, the rods are also threaded so as to take a nut **17** (and, if required, a locking nut **18**) which ensures the tensioning of the rods and the rigidity of the whole assembly.

In the form of embodiment shown, the fixing of the rods is effected at the rear of the discharge nozzle on the wall **19** of an annular collector which is connected to the delivery side of the air compressor of the reaction unit and supplies the annular nozzle **20**, which has the form of a slot, and which enables the effective cross-section of the outlet of the discharge nozzle to be regulated by gaseous constriction.

When the aerofoil blades **4—4'** are in the deflecting position shown in dotted lines in Fig. 1, there is obtained, as has already been stated, a deflection of the jet into two streams opening out on each side of the plane A—A, the mean direction of one of these streams corresponding to the arrow F_1 shown in Fig. 2, while the mean direction of the other stream corresponds to the opposite arrow F'_1. However, by reason of the peripheral location of the grid of blades, the currents of the streams tend to diverge, as shown in Fig. 2 by the arrows F_2, F_3, F'_2, F'_3. This divergence is a drawback, since it produces a reduction in the stream of the jet and, in consequence, leads to a reduction in the counter-thrust which can be obtained by the deflection of the jet.

In the form of embodiment shown in Figs. 1 and 2, this disadvantage is obviated by the arrangement of the guiding members **21** mounted parallel to each other and also parallel to the directions F_1, F'_1. As shown in Figs. 3 and 4, each of these members is constituted by a strip of metal sheet folded on itself so as to form a hollow profiled section, and the abutting edges are welded at **22**. The said strips are provided with notches **23** in which the blades **8** are inserted; the members **21** pass over and around the tubular spacers **11** and are fixed thereto by welding.

The divergence of the streams of the jet being prevented by the members **21**, the blades need no longer be extended around the entire periphery of the jet. There may only be retained two half-rings of blades, of which one has been shown in Fig. 2 and which are located on opposite sides of the plane of symmetry A—A. These half-rings are each terminated by two metal plates **24** parallel to F_1, the extremities of the sections of blades being welded to these said plates.

In the alternative form of embodiment shown in Fig. 5, instead of the continuous members **21** to which the various blades are connected, there are provided partial members **21*a***, each of which is only associated with one of the spaces between two successive blades. These members are also made of small strips of sheet metal folded to form a profiled section of the kind shown in Fig. 3, each member being adapted to surround one spacing tube between two blades and being welded to the said spacing tube.

Finally, in the alternative form shown in Fig. 6, the blades **8** and the flat supporting members **21*b*** disposed parallel to each other and also parallel to the direction in which it is desired to deflect the streams of the jet in accordance with the foregoing description, form a kind of grid with perpendicular bars, of which only portions are shown in Fig. 6. The blades may be formed by a number of portions, the extremities of which are fixed to or welded on the flat supports. The latter may also be provided with notches similar to the notches **23** shown in Fig. 4 for the insertion of the blades which are welded to the said supports along the edges of the notches.

As has already been stated in the preamble to the present description, the spaces **25**, which are left free between the two half-rings of blades, facilitate the assembly of the deflecting vanes **4—4'**; they also enable air from the exterior to be led into the zone of sub-pressure which tends to be formed between the two streams of the jet, and which opposes the separation of these streams, this effect, which is prejudicial to the deflection, being annulled by the influx of air at external pressure.

It will furthermore be understood that the forms of embodiment which have been described above may be modified, in particular by the substitution of equivalent technical means, without thereby departing from the spirit or from the scope of the present invention.

What I claim is:

1. The combination, with a jet propulsion unit having a propulsive nozzle opening towards the rear of the unit through a substantially circular outlet, of a jet deflecting device comprising controllable means for forming a substantially diametrical obstacle in the normal undeflected flow path of the jet issuing from said nozzle, close to said circular outlet, whereby the jet divides into two portions oppositely diverted from the normal axial flow direction of the jet in directions substantially perpendicular to said diametrical obstacle, and a lattice-work deflector arrangement exposed to the atmosphere and extending downstream of the outlet of said nozzle, close to but outside said normal undeflected flow path, to engage said diverted portions and deflect the same further from said axial flow direction, said lattice-work arrangement comprising a succession of curved, arcuate vanes substantially centered on the axis of the nozzle and spaced along said normal undeflected flow path, and a plurality of parallel, planar vanes intersecting said arcuate vanes and extending in planes perpendicular to said diametrical obstacle, said planar vanes being bathed on both sides by the diverted fluid.

2. The combination of claim 1, wherein the planar parallel vanes are equidistant from each other and symmetrically distributed about a plane through the axis of the nozzle and perpendicular to the diametrical obstacle.

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