

Feb. 28, 1967

S. DORNIER

3,306,525

APPARATUS FOR AUGMENTING JET THRUST

Filed Nov. 2, 1964

FIG. 1

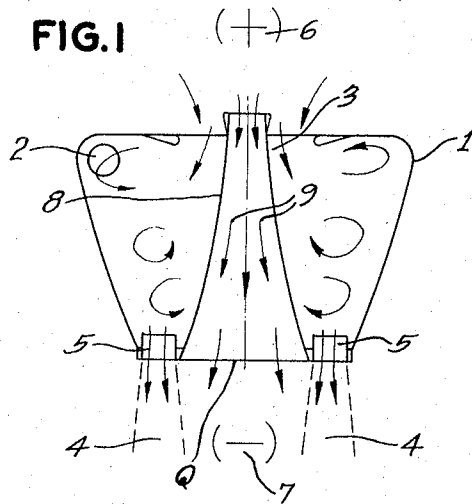


FIG. 2a

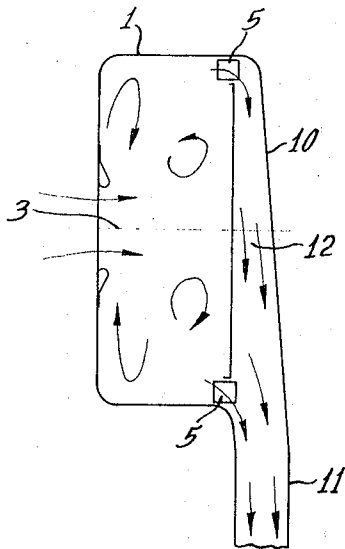
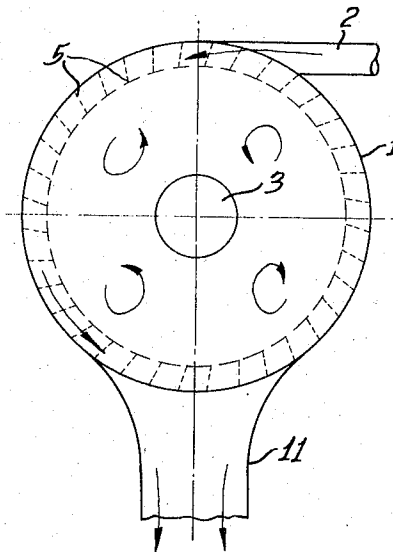


FIG. 2b



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APPARATUS FOR AUGMENTING JET THRUST
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Germany, a corporation of limited liability of Germany
Filed Nov. 2, 1964, Ser. No. 408,008
3 Claims. (Cl. 230-95)

In copending application Serial No. 407,638, filed October 30, 1964, now abandoned, there is described an apparatus for augmenting jet thrust which is susceptible to a spatially more favorable installation than are the known mixing tubes with their considerable longitudinal dimensions. The invention of the copending application, supra, employs a substantially cylindrical or drum-shaped mixing container having an inlet for a primary jet positioned tangentially to the drum and having an opening in the center of one wall for the inflow of the mixing medium, i.e., air. In this construction, the secondary jet is discharged in an annular form from the periphery of the wall opposite to that in which the opening for the mixing medium is provided.

In the invention of the copending application, supra, mixing is effected in a rotary motion instead of jet intermixture in a straight-line flow which was heretofore effected using jet pumps or other jet devices for thrust augmentation. In the construction of the apparatus of the copending application, supra, the secondary jet is discharged from one end of the container or drum in the form of an annular jet. In this arrangement, a system of vanes is required at the level of the annular jet in order to obtain the desired effect. This requires, in addition to an increased manufacturing cost, additional weight and additional over-all height. A further problem is presented by the thrust-reducing low pressure area within the discharging annular jet.

It has been found that in the construction of the copending application, supra, a low-pressure area or zone is formed within the annular secondary jet which does not permit the full development of the desired thrust augmentation. The present invention provides a construction whereby this low pressure area within the annular secondary jet and the adverse effects thereof are eliminated. The present invention does not utilize any displaceable elements, which are customary in known constructions, because of the unfavorable increase in the over-all structural height resulting therefrom and because of the additional flow resistance when using a mixing drum for thrust augmentation. In the construction of the present invention, a flow channel extending axially through the drum and connecting the low pressure area within the discharging secondary jet with the area of normal pressure at the opposite side of the drum is employed. The low pressure area thus can automatically draw in additional air from the opposite side of the drum, which results in the elimination of the low pressure area. A variation of the present invention includes a housing mounted below the discharging secondary annular jet and having a side opening therein. In this construction, the area enclosed by the discharging annular secondary jet is traversed by the deflected secondary jet so that the adverse effects resulting from the thrust-diminishing low pressure area are effectively obviated.

The invention will be further illustrated by reference to the accompanying drawings in which:

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FIGURE 1 is a sectional view through a mixing drum including a nozzle-shaped connecting channel between the upper and lower ends thereof,

FIGURE 2a is a sectional view through a mixing drum having a deflector housing thereon and a side outlet opening, and

FIGURE 2b is a plan view of the apparatus of FIGURE 2a.

Referring to the drawings, in FIGURE 1, reference numeral 1 indicates a mixing drum housing, numeral 2 designates the inlet opening of a primary jet entering the drum in a direction normal to the image plane, and numeral 3 designates the inlet opening for mixing air. The deflector vanes 5 are positioned in the annular discharge aperture for the discharging secondary jet 4. Reference numeral 6 designates a higher pressure area above the mixing drum while numeral 7 designates a low pressure area in the center of the annular secondary jet. Reference numeral 8 designates the nozzle-shaped connecting channel between the higher pressure area 6 above the mixing drum and the low pressure area 7 therebelow.

During the operation of the mixing drum, the low pressure area 7 disappears as a result of the air 9 flowing thereinto from the higher pressure area 6.

In a particularly advantageous construction, the largest cross-sectional area Q of the connecting channel 8 corresponds to the cross-sectional area of the bottom of the housing 1. In order to ensure that the diffuser angle of the connecting channel 8 does not become excessively large, which would result in cavitation, the mixing drum preferably has a decreasing or tapered cross-section in the downward direction. It is also advantageous if the entire bottom of the drum or housing is utilized as the diffuser outlet opening.

In FIGURE 2a, the reference numeral 10 designates a deflector housing which is mounted on the end of the mixing drum 1 and has a side outlet opening 11 preferably of an oval or rectangular cross-section. During operation, the low pressure area which ordinarily is formed in the region indicated by the numeral 12 can not build up because of the transverse flow of the deflected secondary jet at that point. The cross-sectional area of the deflector housing increases in the direction of the outlet opening 11 in order to accommodate the increased volume of flow in that direction.

The operation and construction of the mixing drum of FIGURE 2a is further illustrated in FIGURE 2b, which is a top plan view of the apparatus of FIGURE 2a.

The construction of the present invention may be employed in a particularly advantageous manner in those cases where the mixing drum is not employed directly as a thrust augmentor but as a flow source for blow-off or exhaust lines which are to be operated at a low pressure and a high volume throughput.

It will be obvious to those skilled in the art that many modifications may be made within the scope of the present invention without departing from the spirit thereof, and the invention includes all such modifications.

What is claimed is:

1. An apparatus for converting a primary propellant jet of a low mass flow and high flow velocity into a secondary propellant jet of higher mass flow and lower flow velocity as a result of admixture of the jet with a surrounding medium which comprises means for introducing the primary jet tangentially into a generally cylindrical

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mixing container having an inlet opening in one of the end walls thereof for the inflow of the mixing medium, an annular outlet opening for the secondary jet in the periphery of the other end wall, and a flow channel extending axially through the container.

2. An apparatus according to claim 1 in which the flow channel has an increasing diameter as it approaches the end of the container having the secondary jet opening therein.

3. An apparatus according to claim 1 in which the mixing container has a decreasing diameter as it approaches the end of the container having the secondary jet opening therein.

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MARK NEWMAN, *Primary Examiner.*D. HART, *Assistant Examiner.*

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,306,525

February 28, 1967

Silvius Dornier

It is hereby certified that error appears in the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

In the heading to the printed specification, between lines 6 and 7, insert -- Claims priority, application Germany, Sept. 26, 1964, D 45509 --.

Signed and sealed this 26th day of September 1967.

(SEAL)

Attest:

ERNEST W. SWIDER

Attesting Officer

EDWARD J. BRENNER

Commissioner of Patents