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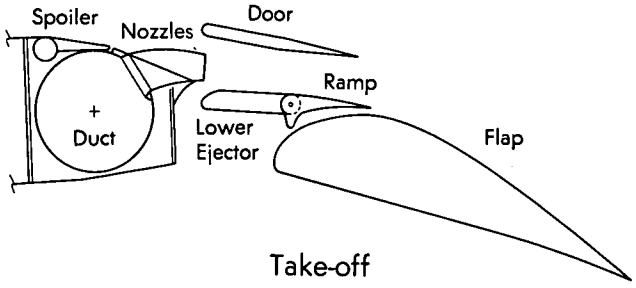
NASA TECH BRIEF

Ames Research Center

Ejector Nozzle with Massive Blowing

A novel ejector nozzle jet-flap wing-blowing system for use in short-take-off-and-landing aircraft (STOL) may provide many of the desirable features of two-stream "quiet" augmentor flap systems, that is, low noise, high lift, etc. The new system directs all or

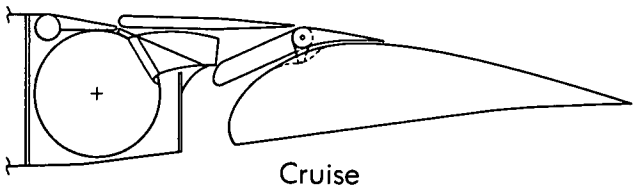


Take-off

most of the fan airflow to the wing through a duct-and-nozzle system like those presently used in augmentor-wing designs. The ejector nozzle system makes use of a relatively short acoustically lined ejector to obtain sound suppression and some thrust augmentation. The ejector exit forms a thick slot-type nozzle near the knee of the flap, and coanda turning is used to achieve high lift. The dimensions of the ejector, relative to the multielement nozzle dimensions, are sized to achieve the degree of noise suppression and amount of multielement flow mixing desired. The ejector nozzle makes possible the use of a simpler and lighter flap structure, and also permits incorporation of a wing-mounted thrust reverser with the ejector segments; use of the nozzle provides "uncoupling," that is, the ability to optimize noise suppression and lift characteristics independently of each other.

The results of tests of a plain jet flap with a multielement nozzle indicate that the new system has a noise level as low as the augmentor wings in present use. The use of ejector nozzles simplifies many of the flow turning problems at high flap angles because a single thick flap allows a larger flap radius and because the ejector exit area can be adjusted as a function of flap angle to obtain a satisfactory ratio of flap radius to blowing-nozzle height. The single thick flap could also contain a conventional duct nozzle to aid in attaching the ejector airflow. However, the thrust in the wing is an order of magnitude larger owing to massive blowing and, therefore, different geometries are required to achieve maximum performance.

The above diagram shows the principal elements of the ejector nozzle jet-flap concept; for simplicity, linkages and other mechanical details are omitted. The configuration is for take-off, and the air streams from the nozzle are channeled between the door and the lower ejector and its ramp; this mode of operation provides the high values of lift required for short take offs. The gap between the ramp and the flaps can be open for maximum takeoff thrust. For a cruise mode, the nozzles are inoperative; the door, ejector, ramp, and the flap are positioned as shown below.

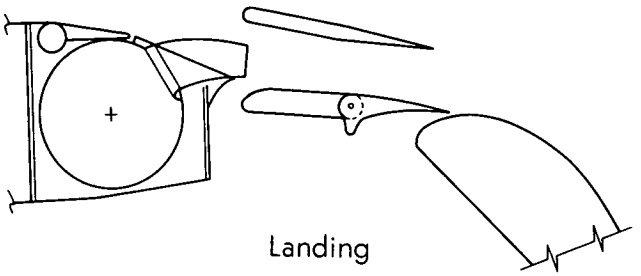


Cruise

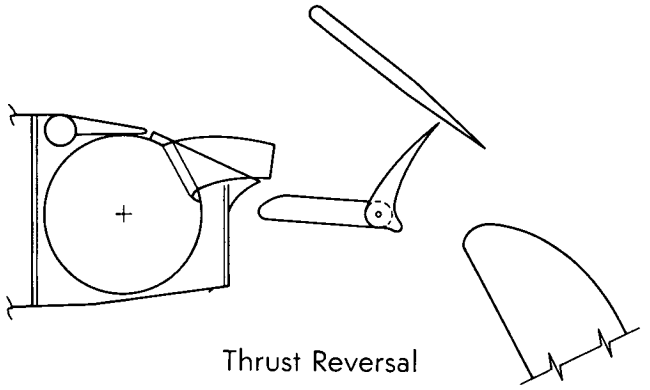
The landing configuration shown below is quite similar to the takeoff arrangement, except that the flap deflection is higher and the gap between the ramp

(continued overleaf)

and flap is closed to enhance the attachment of the ejector airflow to the flap.



Thrust reversal can also be provided by suitable disposition of the working elements; as indicated in the diagram below, the door is elevated to a much higher position than in other modes of operation and the ramp is rotated into the air stream issuing from the nozzles. The ramp thus acts as a blocker door, and the thrust reversing pocket is seen to be the volume formed by the lower ejector, the ramp, and the door.



Notes:

1. The door dimensions are determined by noise and flow mixing requirements.
2. No additional documentation is available. Specific questions, however, may be directed to:

   Technology Utilization Officer
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Patent status:

NASA has decided not to apply for a patent.

Source: Harold C. True of
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