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DISCUSSION ON THE PAPER "SOME ASPECTS OF PROPULSION FOR THE AUGMENTER-WING CONCEPT (NASA-CR-125540, BY D.C. WHITTLEY)"

H. Schmitt

Translation of discussion of "Some Aspects of Propulsion for the Augmenter-Wing Concept (NASA-CR-125540, by D.C. Whittley)", IN: AGARD CP 91-71, September, 1971, p. A9

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
WASHINGTON, D.C. 20546 JULY 1985

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16. Abstract

This discussion elaborates areas of research conducted by ONERA on suction/blowing boundary layer control systems.

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NASA-HQ

Discussion on the Paper

SOME ASPECTS OF PROPULSION FOR THE AUGMENTER-WING CONCEPT

(Paper 13)

presented by

D. C. Whittley

H. Schmitt

Developmental work on the concept of lift assisted by the use of bypass systems indeed appears to have originated in Europe.

Firstly there was the construction of the German Arado 232 aircraft in 1943 in which the boundary-layer suction/blowing system was supplied with a high-pressure vapor ejector.

Next, as soon as the French ONERA (Office National de Recherches Aeronautiques = National Bureau of Aeronautical Research) was founded in 1945 it commenced work on a compact suction/blowing system; the original system was supplied with compressed air taken from the discharge of a turbojet compressor, another technique which was also used for the first time. Figure 1 shows these two principles in the application of ejectors to the problem of blowing/suction.

Description of Figure 2. As early as September 1948 at the International Conference of Applied Mechanics in London, Mr. Poisson-Quinton spoke of the results obtained with a suction/blowing

double flap wing: the results were expressed by an original dimensionless coefficient, C_{μ}, representative of the quantity of movement expended in the operation.

The device was subjected to testing on a full-scale model of the SO 6020 aircraft and was then applied to the Breguet "Vultur" aircraft equipped with a turboprop and a turbojet.

Figure 3 shows the "Vultur" and a cross section of the system installed at the back of the wing.

The aircraft possessed very interesting qualities in flight. Unfortunately the complementary turbojet engine which it used initially was discontinued as the project evolved, and along with it the source of compressed air used for operation of the suction/blowing system.

In 1959 the company Bertin came up with the wing/ejector system whose basic theory of operation is presented in Figure 4.

The channel formed between the two variable-deflection mobile flaps is adapted to the particular phase of flight and, when in the extended position, forms the mixer/diffuser of the ejector; the injector is also mobile so that the engine jet can be appropriately directed.

In the normal position for cruise flight the flaps return to the usual wing profile. A slot, however, can be made in the trailing edge

through which the engine flow, becoming a propulsive component, would be exhausted. This kind of cut-off profile setup with blowing is advantageous in limiting drag.

The device constitutes an ejector whose purpose is to increase thrust by blowing on the trailing edge with a quantity that is greater than that of the jet engine; suction at the break in the profile creates a well effect which increases hypercirculation around the surface.

Figure 5 represents the results obtained with models tested in 1959 in the ONERA wind tunnel in Cannes.

Deflection of the pair of flaps is $_{v}$ = 30°. For greater deflection angles lift continues to increase.

These results enabled very interesting STOL aircraft projects to be initiated as of 1959-1960.

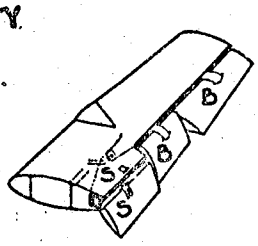
Unfortunately, since the short takeoff objective was dropped by the authorities at the beginning of the 1960's in favor of vertical takeoff, the program was abandoned.

Naturally, there remained some problems with channeling of the gas which required a high blowing pressure and a limitation on the blowing flow. Nevertheless, thanks to the bypass techniques developed since then, one can anticipate some future progress in renewed development of this concept.

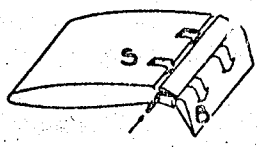
D.C.Whittley

It is most encouraging to be reminded again of work which has been carried out on other systems which, like the augmentor-wing, also use the principle of "suction by blowing" – that is to say, the generation of a suction source for boundary layer control by means of a propulsive jet. This serves to reinforce the view that it is an important principle. That is why, in my presentation, I took time to describe some of the aerodynamic advantages which result from this, even though this subject matter was not contained in the written paper.

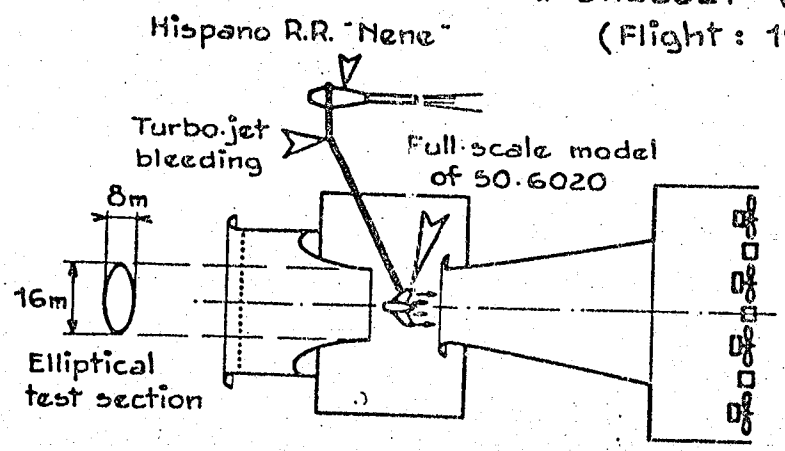
COMBINED SUCTION AND BLOWING WITH EJECTOR SYSTEMS for boundary-layer control.



ARADO METHOD
(Wagner. 1943)
Applications :
* ARADO 232
(Walter chemical ejector).
* CESSNA 309.
* CHASE 123 D.
(Aspin turbojet)



ONERA METHOD
(1947)
Patent ONERA/SNCASO
1952
Applications :
* SO.6020 (1949).
* BREGUET "VULTUR"
(Flight : 1956).



3B

Figure 1

INVENTION PATENT

Gr. 6 - Cl. 4. No. 952.926

Suction and blowing system combined in a wing profile by means of an induction ejector. (Invention: Philippe Poisson-Quinton.)

NATIONAL BUREAU OF AERONAUTICAL DESIGN AND RESEARCH (ONERA) in France (Seine).

Requested on July 31, 1947 at 10:40 AM in Paris.
Issued on May 16, 1949. - Published on November 28, 1949.

[Invention patent whose issuance was postponed in application of Article 11, § 7, of the Law of July 5, 1844, modified by the Law of April 7, 1902.]

[Text illegible]

THE REPUBLIC OF FRANCE

MINISTRY OF INDUSTRY AND COMMERCE

PATENT RIGHTS SERVICE

INVENTION PATENT

Gr. 6 - Cl. 4. _____ NO. 969.264

Improvements in the suction and blowing systems combined in a wing profile by means of an induction ejector. (Invention: Philippe Poisson-Quinton.)

NATIONAL COMPANY OF AERONAUTICAL CONSTRUCTION OF THE SOUTH WEST and the NATIONAL BUREAU OF AERONAUTICAL DESIGN AND RESEARCH (ONERA) in France (Seine).

Requested on July 17, 1948, at 10:40 AM in Paris.
Issued on May 17, 1950. - Published on December 18, 1950.

[text illegible]

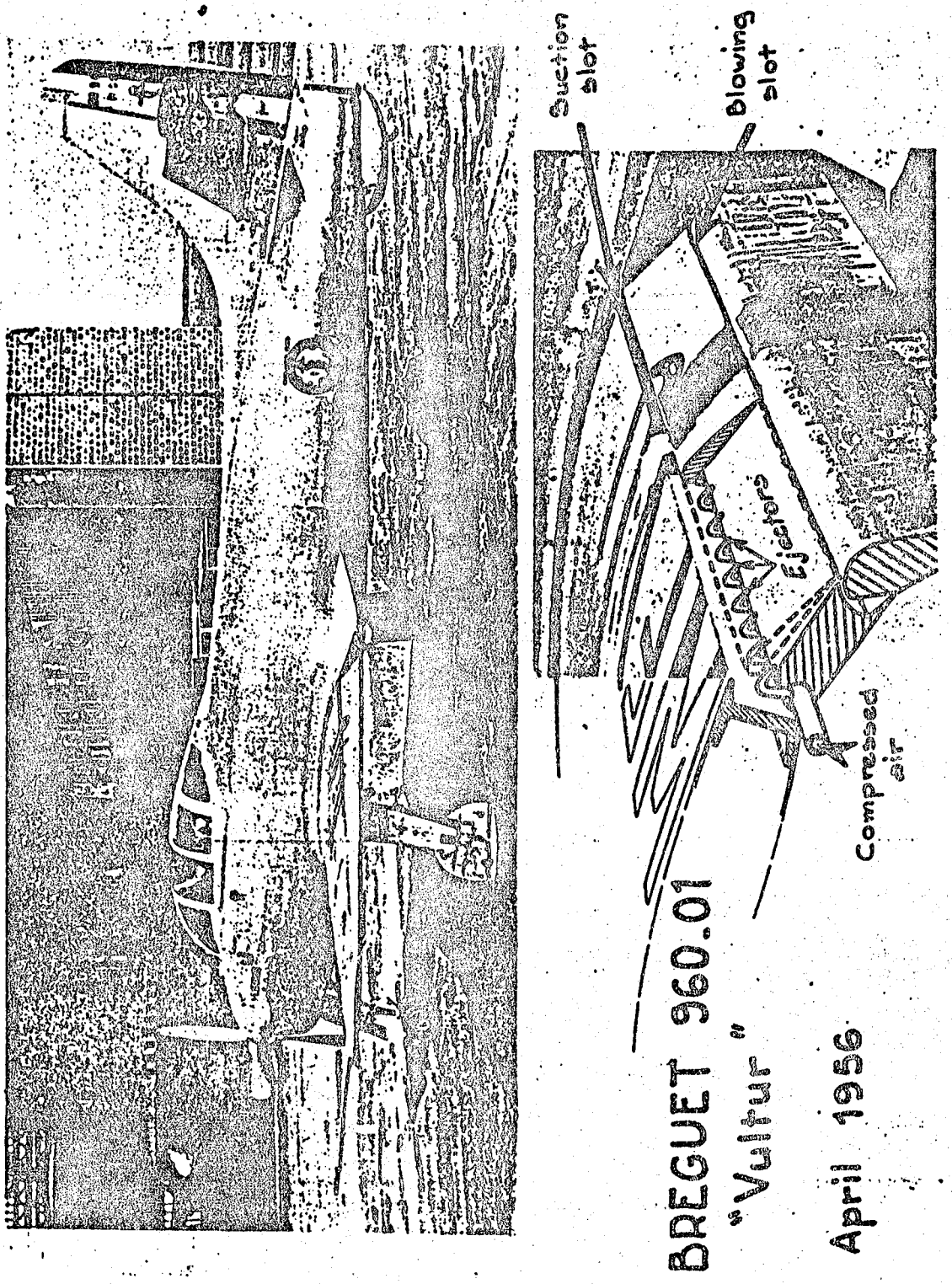


Figure 3

INVENTION PATENT

P. V. NO. 793.209 NO. 1.233.014

International classification: B24c

THE REPUBLIC OF FRANCE

MINISTRY OF INDUSTRY

PATENT RIGHTS SERVICE

Improvements in ejectors specially designed for aircraft lift.

Bertin Et Cie company in France (Seine).

Requested on April 24, 1959 at 7:00 PM, by mail.

Issued on May 2, 1960. - Published on October 12, 1960.

(Invention patent whose issuance was postponed in application of article 11, § 7, of the Law of July 5, 1844, modified by the Law of April 7, 1902.)

The ejectors usually comprise guides formed of diverging material walls placed around the induction jet(s). This is also the setup in the case of [text illegible]

the most advantageous design of the ejectors.

The description which follows next to the appended drawing, provided as a non-limitative example, helps to understand how the

invention can be made [text illegible]

No. 1.233.014

Bertin Et Cie Company

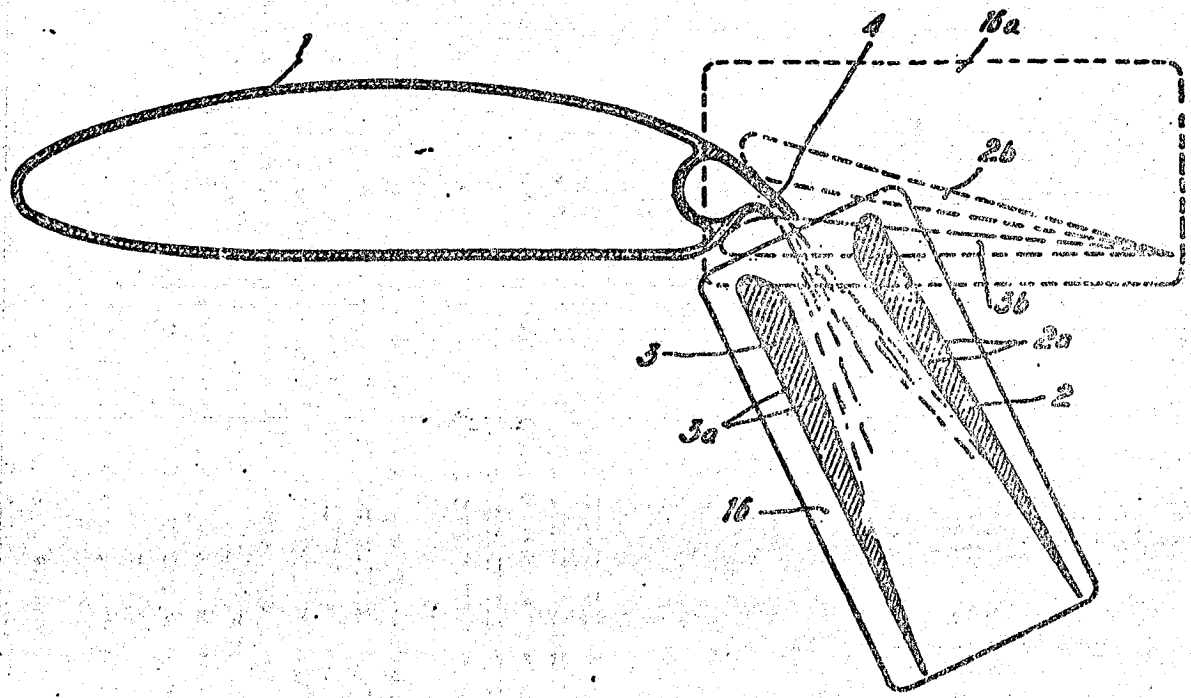
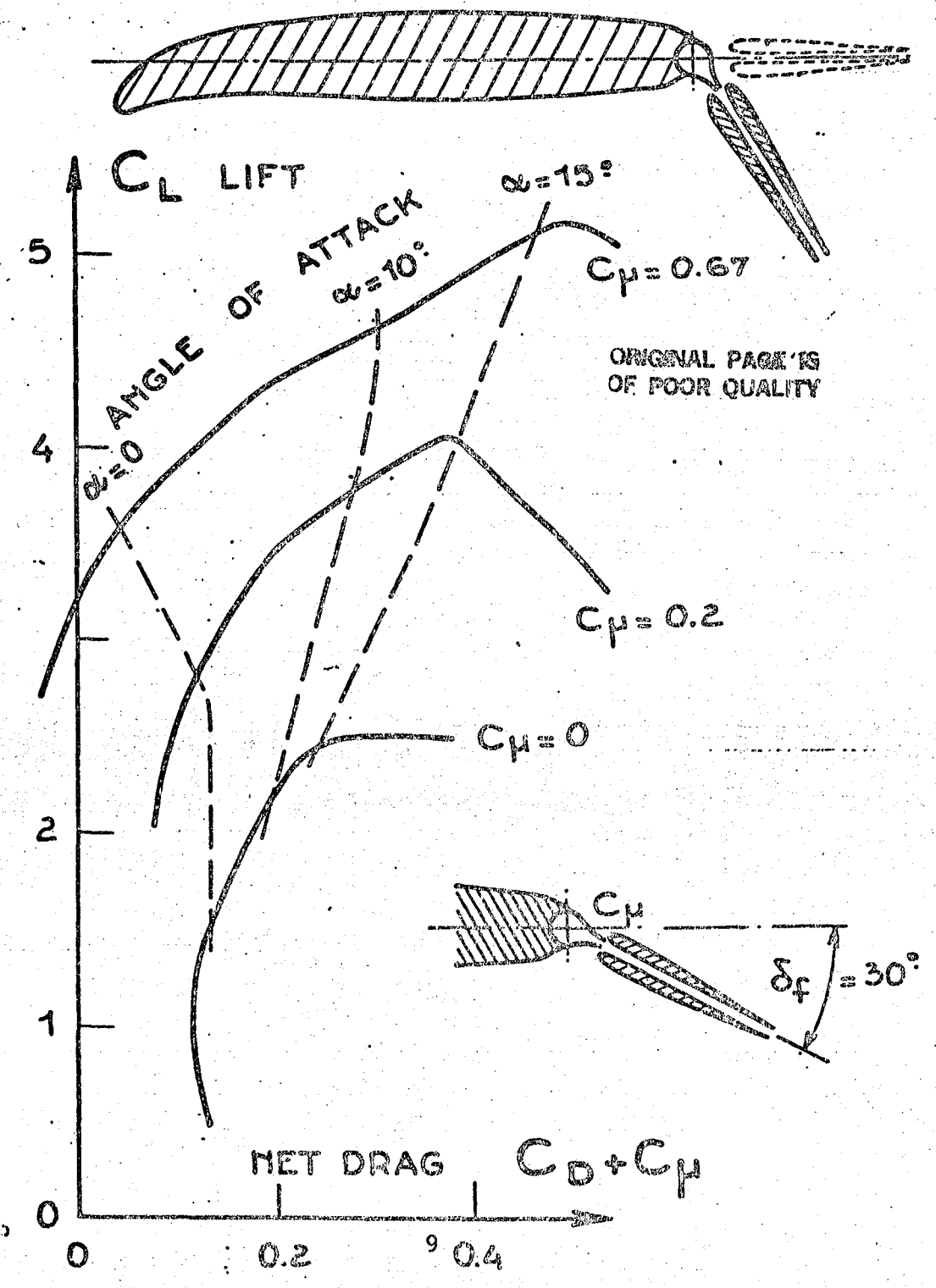


Figure 4

TWO-DIM TESTS OF BERTIN T.E. EJECTOR in the S_1 Cannes/ONERA wind-tunnel (october 1959)



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