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Tests on a Model Body-Wing Combination at Supersonic Speed

By

P. J. WINGHAM,
of the Aerodynamics Division, N.P.L.

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The tests described in this report were made in the 1-ft Circular Tunnel at the National Physical Laboratory at a Mach number of about 1·4. The main object was to determine the lift obtainable from wings of very short span and in particular to see whether the lift curve departed much from a straight line at incidences up to about 12 deg., it being already known that the lift curve for a two-dimensional aerofoil was sensibly straight up to 20 deg. or so of incidence. Unfortunately it was not possible to measure the drag load, so that only normal force and pitching moment values are available.

Method of Test.—The tests were made by supporting the hollow model on an internal bar attached near the nose, as shown in Fig. 1. This bar carried two sets of wire strain-gauges, one at M a position near the centre of pressure of the air forces, and one at L some distance behind. The readings of these gauges give the bending moment about two axes at L and M and therefore provide enough data to determine the normal force and pitching moment. The technique is new, and is particularly convenient for this kind of measurement, but it is not yet by any means perfect, and the present results are to be regarded as a reasonable indication, but not an accurate determination of the forces on the model. An attempt was made, by the use of a simple spring deflection method, to measure the force component along the axis of the model, but this was not a success, and no results are yet available from which drag can be obtained.

Particulars of Model.—The body had a length of 10 in. and a diameter of 1 in. The wing area was in all cases 2·56 sq in. The three sets of wings tried were as under :—

A. Double wedge 4 per cent. thick, each wing 1·6 in. chord and 0·8 in. span.

B. Double wedge 4 per cent. thick, each wing 3·2 in. chord and 0·4 in. span.

C. Single wedge 4 per cent. thick, each wing 1·6 in. chord and 0·8 in. span.

The body was also tested alone.

Fig. 1 gives a drawing of the model and also of the means of altering incidence at the rear end of the supporting bar.

Results of the Tests.—The normal force results are plotted in Fig. 2 and the moments in Fig. 3. For the double wedge B, the points marked by squares were obtained by using an estimated pitching moment, as the pitching moment strain-gauge had failed. The following broad conclusions emerge :—

(1) The double and single wedges of the larger aspect ratio (A and C) give substantially the same normal force which increases linearly with incidence up to 13 deg., which was the highest that could be tested.

(2) The double wedge of the smaller aspect ratio produces less normal force than the other two at the same incidence.

(3) The moment results are not very good; they suggest that the centre of pressure is slightly forward of the point L, but never by more than $\frac{1}{2}$ in.

(4) The lift on the wings of the larger aspect ratio is closely that calculated by the simple two-dimensional Ackeret theory, for small angles of incidence.

(5) The lift on the body is about 30 per cent. greater than the value established for shells, presumably because of the greater length.

Conclusions.—It thus appears that wings whose chord is twice their span would be quite satisfactory but that doubling the chord and halving the span is going too far, and a less efficient wing results. It also appears that the simple Ackeret theory for the wings can be used with some confidence, and that there is no indication of any considerable interference between wings and body. It is desirable to establish whether the drag also can be estimated with like success.

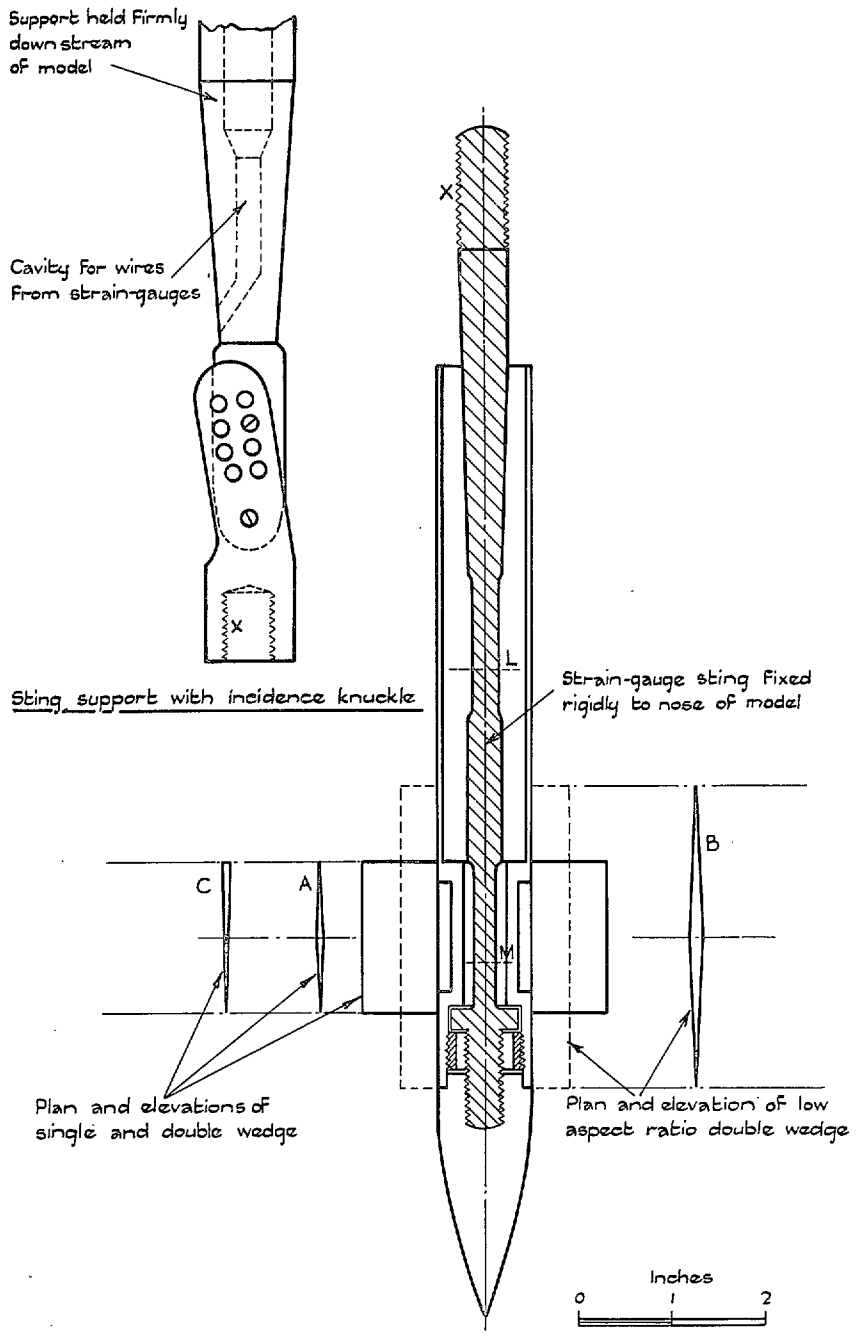

FIG 1. Cross-section on axis of assembled model in plane of wing.

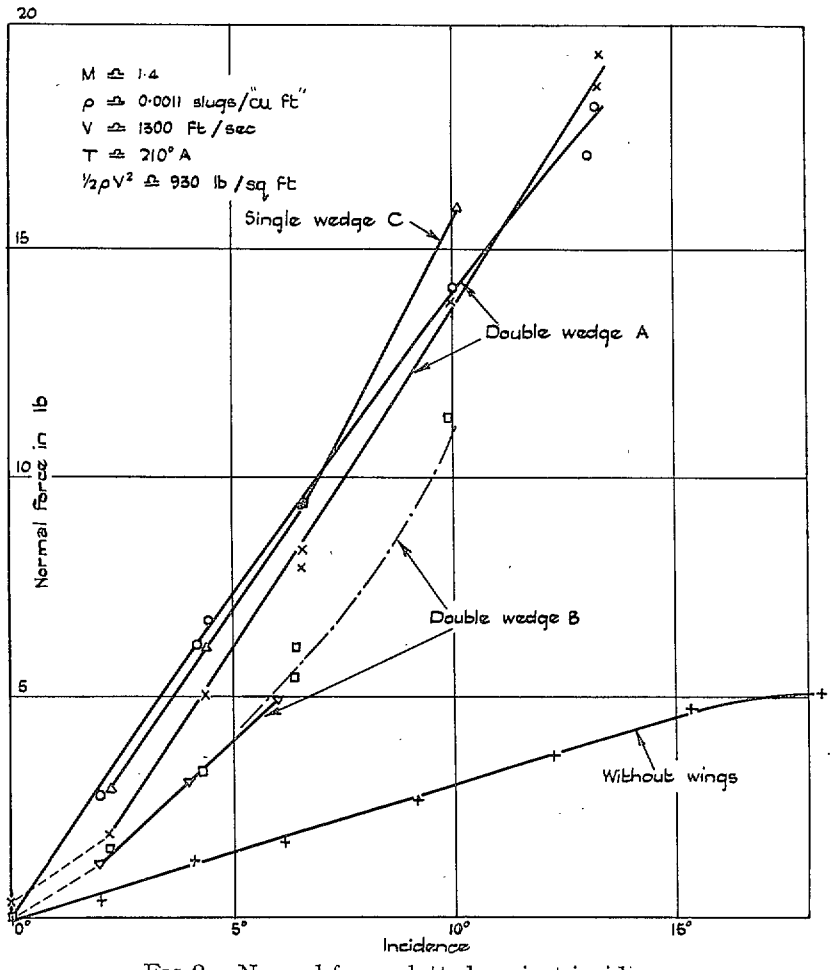

FIG 2. Normal force plotted against incidence.

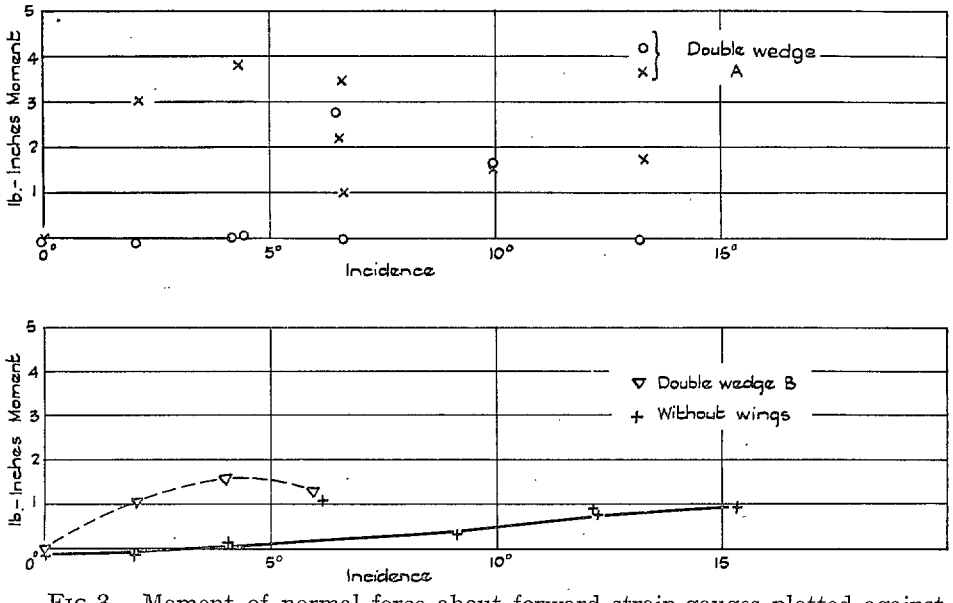

FIG 3. Moment of normal force about forward strain-gauges plotted against incidence.

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