and saying that the result gives the instability angle, which is 197·6°. This may be called the *Modified Euler instability angle.*

A simple, but instructive, example will now be given showing the effect of the position of stiffening on the strength and the instability angles of two struts of the same weight. Everyone knows, in a vague way, that a strut stiffened in the centre is stronger than a strut with the same length of stiffening, but placed at the ends. This example will, it is hoped, bring out the differences between the two arrangements.

(To be continued.)

REFERENCES

(1) Aeronautical Research Committee, R. & M. No. 1233.
(2) *l.c.*, p. 29.
(3) Air Ministry Publication No. 970, Appendix No. IB.
(4) *l.c.*
(5) Air Ministry Publication No. 970, Appendix No. VII.
(6) R. & M. No. 1233, Fig. 14.

TECHNICAL LITERATURE

SUMMARIES OF AERONAUTICAL RESEARCH COMMITTEE REPORTS

These Reports are published by His Majesty's Stationery Office, London, and may be purchased directly from H.M. Stationery Office at the following addresses: Adastral House, Kingsway, W.C.2; 120, George Street, Edinburgh; York Street, Manchester; 1, St. Andrew's Crescent, Cardiff; 15, Donegall Square West, Belfast; or through any Bookseller.

SPINNING EXPERIMENTS ON A SINGLE-SEATER FIGHTER WITH DEEPENED BODY AND RAISED TAILPLATE. PART I. MODEL EXPERIMENTS. By H. B. Irving, B.Sc., and A. S. Batson, B.Sc. PART II. FULL-SCALE SPINNING TESTS. By A. V. Stephens, B.A. R. & M. No. 1421. (16 pages and 21 diagrams.) December, 1931. Price 1s. 3d. net.

In its original form the single-seater fighter which is the subject of this report spun rather flat and very fast, and recovery was extremely difficult if delayed beyond a very few turns. Model experiments were made on this form both in the wind tunnel* and by free-flight dropping tests†, followed later by a cautious exploration of the spin of the full scale aeroplane‡ in which it was found that the incidence attained an angle approaching 60°, the time of turn being about 1·2 seconds. These experiments were discontinued after two such spins, in which 40 and 34 turns were made before recovery.

The next stage was the modification of the fighter by lengthening the body, and at the same time considerably increasing the fin and rudder areas and placing the tailplane on top of the body. Model and full-scale experiments on such modifications are described in R. & M. 1278§. The full-scale experiments showed that recovery was very greatly improved but was slow, three to four turns being required.

The present report describes model and full-scale experiments in which, keeping to the original length of body and the original rudder, the body was deepened above and below and the tailplane raised nearly to the top of the rudder. On the full-scale the deepening was effected by adding fin area above and below the body.

The model work includes rolling and sideslip experiments together with measurement of pitching moment on the model with raised tail. In the full-scale experiments, rate of turn and normal acceleration at the centre of gravity were measured for various conditions of centre of gravity, petrol load and elevator position. The effect of applying full engine was also examined.

The general conclusion reached is that deepening the body and raising the tailplane have entirely eliminated the vicious spinning properties of the original aeroplane. Rapid recovery from all spins can be made and the pilots are of opinion that the good qualities of the original machine both in aerobatics and in normal flight are not only maintained but enhanced.

* R. & M. 1184. Experiments on a model of a single seater fighter in connection with spinning.—Irving and Batson.
† R. & M. 1404. Free flight spinning experiments with several models.—A. V. Stephens.
‡ R. & M. 1403.—Measured spins on aeroplane—H. Gates.
§ R. & M. 1278.—Spinning experiments on a single-seater fighter. Part I. Further model experiments.—Batson and Irving. Part II. Full-scale spinning tests.—Gates.

WIND TUNNEL TESTS ON AILERON LOADS. By F. B. Bradfield, Math. & Nat. Sci. Triposes, G. F. Midwood and F. R. C. Hounsfield. Communicated by the Director of Scientific Research, Air Ministry. R. & M. No. 1443. (20 pages and 25 diagrams.) September, 1931. Price 1s. 3d. net.

The purpose of investigation was to provide data on which to base revised strength requirements for ailerons.

Force normal to the aileron has been measured on aerofoils of R.A.F. 28 and R.A.F. 34 section, and on R.A.F. 34 section slotted all along the span and at the tips only. The ailerons were balanced and unbalanced. The types of balance, and degree of balance have been varied, as also the span and chord of the aileron. Aileron angles of from ± 40° have been tested at angles of incidence corresponding to high-speed and stall. The centre of pressure of the force is given. In addition, the force on the main wing ahead of the aileron has been measured at various positions along the span with unbalanced and slotted ailerons. The centre of pressure of this force was measured.

Of the total change in load due to moving the ailerons, roughly 40 per cent. is carried on the aileron, and 60 per cent. on the main wing. An exception to this occurs with the slotted aileron at negative angles of incidence greater than 10°; in this case the load on the aileron becomes steadily more negative as the aileron is pulled up, whereas the load on the main wing remains constant.

This method of testing the force on a section of the wing seems satisfactory for obtaining quick results of this type. The results can be obtained much more rapidly than by pressure plotting.

THRUST INTEGRATING TUBES, WIND TUNNEL EXPERIMENTS. By C. N. H. Lock, M.A., F. C. Johansen, M.Sc., and H. L. Nixon. R. & M. No. 1447. (22 pages and 10 diagrams.) August, 1931. Price 1s. 3d.

A series of wind-tunnel experiments has been carried out in order to investigate the characteristics of thrust integrating tubes of similar design to that used as a zero thrust indicator during the full-scale trials of the Blackburn "Iris" seaplane, described in R. & M. 1354.*

As a means of estimating the possibilities of such an instrument over a range of values of thrust, tests have been made on exact and modified small scale models of the "Iris" tube, in conjunction with a 19½-in. diameter model airscrew, for which thrust grading and force measurements were available from an earlier research (R. & M. 1380†). A number of auxiliary experiments have also been undertaken to elucidate the mechanism of the thrust integrating tube, and to reveal any influences of scale-effect, as between model and full-size instruments, in qualifying the conclusions drawn from model tests. Such auxiliary work includes "shielding" experiments on models and on actual full-scale tubes, in which an artificial variation of pressure was produced by a movable shield; and "flowmeter" experiments, in which the rate of flow of air through the holes of a simplified form of thrust integrating tube was measured by an orifice meter.

The present experiments have revealed certain general considerations affecting the design of thrust integrating tubes, which may be summarised as follows:—

(1) When the apertures in the tube are simply circular orifices, the diameter of such orifices should not exceed one quarter the bore of the tube; otherwise the pressure gradient along the tube will not be negligible.

(2) The orifice type of tube is sensitive to orientation about its axis, but its indications of thrust should be sufficiently accurate over the normal working range, excluding the "static" condition, but including zero thrust, if the holes are inclined at about 5 deg. into the direction of rotation of the slipstream. This defect may be avoided by substituting short projecting "pitot" tubes for the plain orifices.

(3) The integrating tube should not be mounted in front of any considerable obstruction, such as a radiator, situated close behind the airscrew and occupying only a small part of the circumference.

At zero thrust, the model tests show that small variations in the radial spacing of the holes in the integrating tube are not of much importance. At other values of thrust, the model tests suggest that the integrating tube could be used with reasonable accuracy.

* R. & M. 1354. Full scale measurements of lift and drag af large seaplanes. Experiments on Blackburn "Iris."—Coombes & Cushing.
† R. & M. 1380. Pressure and force measurements on airscrew-body combinations.—Bateman & Johansen.

TESTS OF ANCHORS FOR USE ON FLYING-BOATS. By L. P. Coombes, B.Sc., and the Experimental Staff of the Marine Aircraft Experimental Establishment, Felixstowe. Communicated by the Director of Scientific Research, Air Ministry. R. & M. No. 1449. (14 pages and 14 diagrams.) May, 1931. Price 1s. 3d. net.

A great deal of experimental work on anchors for seaplanes was done at Felixstowe several years ago. A large proportion of the work was devoted to the production of a suitable Service anchor, and the Felixstowe Mark XIIA anchor was the result of this work. The increasing size of flying boats has once more brought forward the problem of anchors, and the present investigation was therefore commenced, which led to the following conclusions.

(1) Model anchor tests, if done under suitable conditions, give results from which the drag of a full-scale anchor can be predicted.

(2) The drag of an anchor is primarily dependent on its shape and very little on its weight.

(3) Weighting the anchor line by means of chain cable or with concentrated weights is of little value in increasing the holding force under steady conditions.

(4) The holding force of an anchor decreases rapidly as the angle of the cable to the horizontal is increased, and anchors are very inefficient at cable angles greater than 20°. A length of cable not less than 3½ times the depth of water should be regarded as the minimum length, and this should be increased whenever circumstances permit.

(5) Anchors with stocks are much more efficient than stockless anchors, which are generally unstable.

(6) The holding force o fthe Felixstowe Mark XIIA anchor is increased from about 800 lb., to about 1,000 lb., by increasing the linear dimensions of the flukes 25 per cent.

MEASUREMENT OF TAKE-OFF AND LANDING RUNS. By D. Rolinson, M.Eng. Communicated by the Director of Scientific Research, Air Ministry. R. & M. No. 1458. (3 pages and 2 diagrams.) November, 1931. Price 4d. net.

In determining lift coefficients of an aircraft taking off or landing, the value of wind velocity assumed introduces a possible error. The precise value at the instant of take-off is not known, and a mean figure for the average wind during the run has been used. Under-estimation of wind speed leads to over-estimation of lift coefficient. It was suggested, therefore, that a landing and take-off down wind should be photographed. In this case, the assumption that the wind speed was zero would correspond to a minimum value of lift coefficient. It was also hoped that some light would be shed on the high value of rate of climb ascribed to wind gradient.

A Wapiti aircraft was taken off and landed down wind, the runs being photographed with the panoramic camera. The down wind values of lift coefficient were of the same order as values obtained for normal take-off and landing. The most marked difference between the down wind and up wind runs was in the distance to clear a given height.