

NAVAL AIRCRAFT

dynamic and undercarriage characteristics each played a part.

On the normal type of single-engined machine the view was rarely good enough to permit the approach to be straight and it therefore had to be made on a turn so that the ship was in sight all the time. The height was chosen so that the final approach was down a path inclined at about 4½ deg to the horizontal. Viewed from the ship's deck the angle appeared steeper due to the ship's motion. A smaller angle—less than, say, 3½ deg—for the approach path would result in the aircraft encountering the disturbed air of the ship's wake, while more than about 6 deg would result in difficulty in flattening out and too much vertical velocity. To obtain the desired approach path meant using about 1/5 max h.p.

The British Naval pilot was under the batsman's orders but on U.S. Navy carriers he was merely told what he was doing. The signals were, therefore, reversed.

Approach Technique

An approach was made at about 15 per cent above stalling speed. When flattening out and making contact with the deck the familiar float and/or bounce seen on airfields had to be avoided at all costs because they might well result in the aircraft floating or bouncing over all the wires and finishing up in the safety barrier. It was also essential for the same reason that the arrester hook should not bounce on striking the deck.

Good control characteristics at the stall were important in giving the pilot confidence that he could safely keep to a minimum his margin of speed.

Good rebound damping, needed to avoid bounce, was defined as the ratio of energy returned to aircraft to the

total vertical kinetic energy. This ratio should be less than about 0.25.

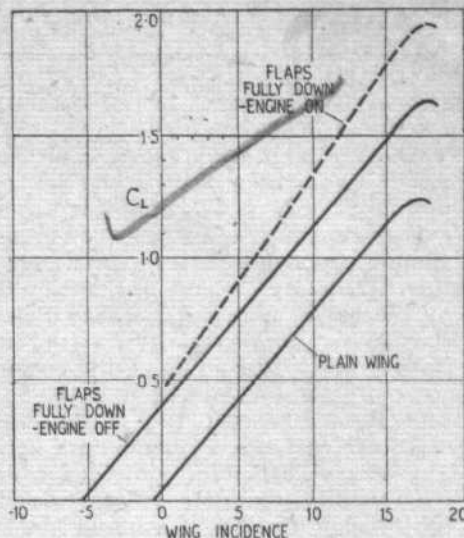
Excess lift was counteracted on airscrew-driven machines by a loss of slipstream lift when cutting the engine. It could also be counteracted by a tricycle undercarriage which reduced incidence on touchdown. Hook bounce was prevented by a suitable spring and damper which held the hook arm down. The hook must be so disposed that when arresting the aircraft it did not cause excessive pitching, otherwise the airscrew—or the pilot—might be damaged. A hook mounted at the tail end was found in the case of the Seafire to be more satisfactory than one which was mounted farther forward.

Absorbing the Energy

It was necessary to absorb the kinetic energy of the aircraft, which was travelling down an inclined path and this velocity could be resolved into two velocities, one vertical and one horizontal. The vertical velocity was absorbed in the undercarriage and was expressed in f.p.s. (ft/sec). The modern requirement was to cater for a vertical velocity of 16 f.p.s. For a landplane 10 or 15, per cent might be satisfactory.

The horizontal component was absorbed by the ship's arrester gear and as the ship was operated by sailors this had to be expressed in knots. The arrester gear could absorb about 60 knots relative to the ship, to which could be added about 20 knots relative wind over the ship, giving a total of 80 knots.

The importance of the relative wind was seen when it was realized that without it the arrester gear would have to absorb nearly twice the energy. Only about 2 per cent of the total kinetic energy was absorbed by the under-



Variation of lift coefficient with incidence showing effect of flaps and slipstream.

carriage. Maximum decelerations catered for were about 3G, both vertically and horizontally.

Turning to the other items in the list of added handicaps, Mr. Clifton said that on naval fighters the general-purpose radio set was heavier by about 10lb than the R.A.F. equivalent, while an additional set was carried for ship homing. Reconnaissance types might have to carry special radar apparatus for detecting ships, involving not only weight but often external blisters.

Concerning folding wings he said that it was obviously impossible to make a foldable joint without "loss" of weight, approximately 1½ per cent of all-up weight. While there was no fundamental difficulty from the engineering point of view in introducing a fold, it was necessary to see that the stiffness of the wing, particularly in torsion, was not impaired, otherwise aileron control might suffer. It was extremely important to reduce to a minimum the time taken after landing-on for the aircraft to taxi forward on to the lift and descend to the hangar, because this time governed the rate at which a squadron could be received on board, and hence the length of time a carrier might have to be "out of station." The time allowance for landing-on might be only 30 seconds per aircraft. Power folding was favoured so that the folding could be done while taxiing forward. This added further to the weight and complication.

Restriction on Size

Not only was the width for lift and stowage limited but length and height were also restricted. The effect of this upon the heavier types had been to encourage high-lift devices in order that wing area might be kept down to a minimum. Thus we had the Youngman flap on the Fairey Barracuda, a device which effectively increased wing area for landing, and was also usable as a dive-brake. Mr. Clif-



The variable-incidence wing of the Supermarine S. 24/37 ("Dumbo"). This development is now being applied to an amphibian.