Naval Aircraft

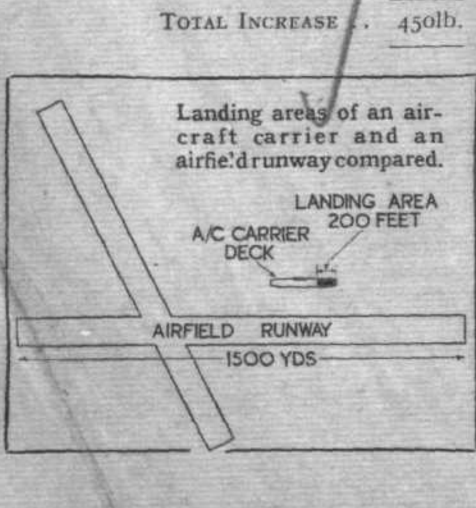
Design Requirements Discussed by Supermarine Technical Staff

LECTURING before the Southampton Branch of the Royal Aeronautical Society on December 11th, Mr. A. N. Clifton, M.B.E., B.Sc., F.R.Ae.S., chief of Vickers-Armstrongs (Supermarine) Technical Office, outlined the development of naval aircraft and explained something of the technical requirements in modern machines for naval use.

Naval aircraft design, he said, was really ordinary aircraft design made more difficult. The first handicap was the severity of take-off requirements. Although a certain amount of wind due to the ship's speed could be relied upon, long runs were out of the question and catapult spools and accelerator hooks must be provided and the aircraft must have the necessary strength to withstand the added forces imposed. Provision for rocket accelerating gear must also be made. Control characteristics and view must be specially studied and undercarriage shock absorption and rebound damping of a high order were necessary. An arrester hook and an airframe suitably strengthened for this attachment were other requirements. Radio equipment for naval use was more complicated and heavier than that required on landplanes and provision for wing folding and restrictions on dimensions were necessary.

To indicate the increase in weight necessary, Mr. Clifton gave an estimate for a fighter, showing that the additional weight for a machine of approximately 10,000lb was at least 450lb made up as follows:—

Accelerator hooks and provision for RATOG	50lb.
Arrester hook	60lb.
Extra radio	30lb.
Folding wings, slinging and lashing points	160lb.
Longer stroke undercarriage	40lb.
Provision for oil heating, fuel draining, etc.	5lb.
	345lb.
Extra structure weight at 30 per cent	105lb.
TOTAL INCREASE	450lb.

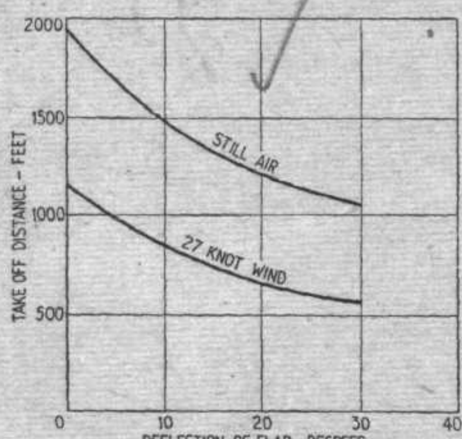


Landing areas of an aircraft carrier and an airfield runway compared.

Examining the take-off question in detail, Mr. Clifton dealt first with the normal take-off, using engine power alone. Bearing in mind that more than half the deck might be required for aircraft landing on, he said, this was only possible under favourable conditions. Partially lowered flaps were essential and a contra-rotating airscrew, which eliminated swing, was desirable.

Under less favourable conditions rockets could be used for acceleration. These were carried in jettisonable containers and delivered their thrust approximately through the C.G. in side elevation. The standard rocket gave a thrust of 1,200lb for four seconds and weighed 66lb, and a container for two rockets weighed 50lb. Four rockets might be carried on a fighter to attain a 500-ft run in still air, or a 250-ft run against a 20-knot wind. This worked out at an average acceleration of about 1 G, of which ½ G might be provided by the engine.

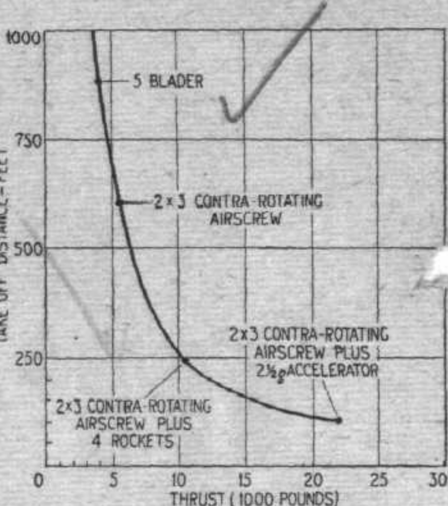
Finally there was the accelerator, a



Variation of take-off distance with flap deflection. (Naval fighter with 47·5 lb/sq ft wing loading.)

mechanical device. The British type consisted of a trolley which was rather similar to the naval catapult in that it engaged four spools on the airframe. The forward attachments supplied the thrust and floated vertically while the rear ones held up the tail. The trolley was hauled by a rope running below a slot in the deck and the motive power was compressed air or cordite. With a maximum acceleration of about 2½ G (or a mean acceleration of 1¾ G) plus airscrew thrust over a distance of 100 ft the speed at the end was about 60 knots, relative to the ship. To this speed could be added an allowance of 20 knots for the wind speed over the deck, giving a total airspeed of 80 knots.

A simpler method was developed by the U.S. Navy and had since been



Variation of take-off distance in 27 knot wind with thrust. (Naval fighter with wing loading of 47·5 lb/sq ft. Take-off power 1,900 b.h.p.

adopted here. This generally used two hooks on the aircraft with a strap to engage these, and a claw projecting through a slot in the deck and propelled by the accelerating mechanism. The aircraft ran on its own main and tail wheels and at the end of the run the cable was left behind and fell off the hooks. The loads on the undercarriage were fairly severe though generally speaking not severe enough to call for increased strength. These loads were due to the downward slope of the cable, and resulted in the machine running along on nearly flat tyres. The cable direction was carefully selected to pass just below the C.G. to avoid nosing over and too great a tail-wheel load. The advantages of this method were a minimum of gear above deck, quickness in operation (because no trolleys had to be lined up and engaged) and simpler and lighter attachments on the aircraft.

Launching Rate

An essential requirement for take-off was a high rate of launching. For one thing the aircraft might be wanted in a hurry, and secondly the carrier might have to lose station relative to accompanying ships due to the necessity to steam into wind. Under favourable conditions, a squadron of twelve aircraft could be launched by accelerator in about 10 minutes. In that time the remainder of the Fleet might be 7 or 8 miles ahead.

Landing-on was a different matter altogether. It was a hazardous process calling for a high degree of co-ordinated skill on the part of the pilot and the "batsman" directing him. In the air perfect control was essential, and once on the deck the aircraft must not bounce. In the latter respect aero-