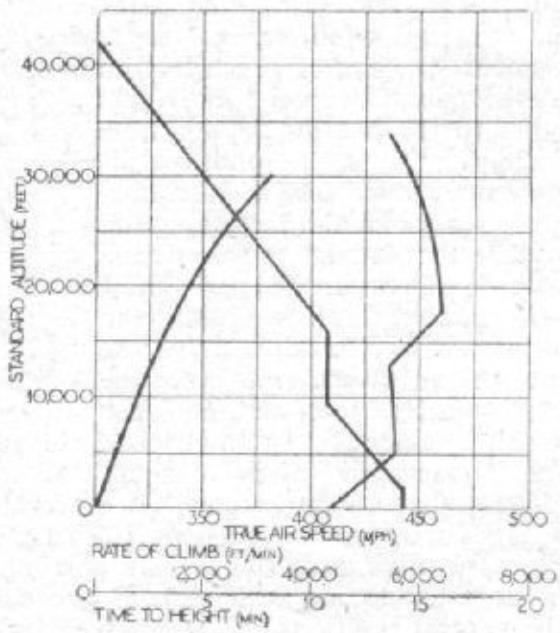
SEA FURY X

Latest Single-seat Hawker Fighter : Ingenious Hydraulic Wing Folding : Outstanding Rate of Climb



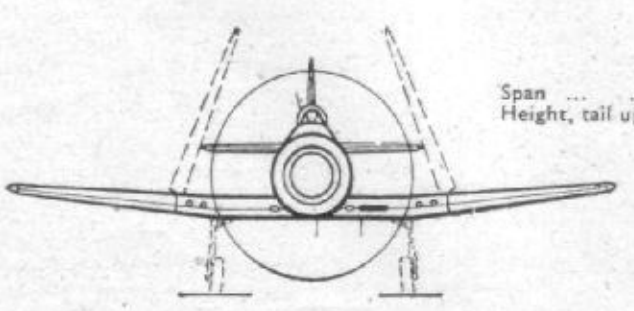
These curves of climb, time to height and level speeds show the Sea Fury's quality.

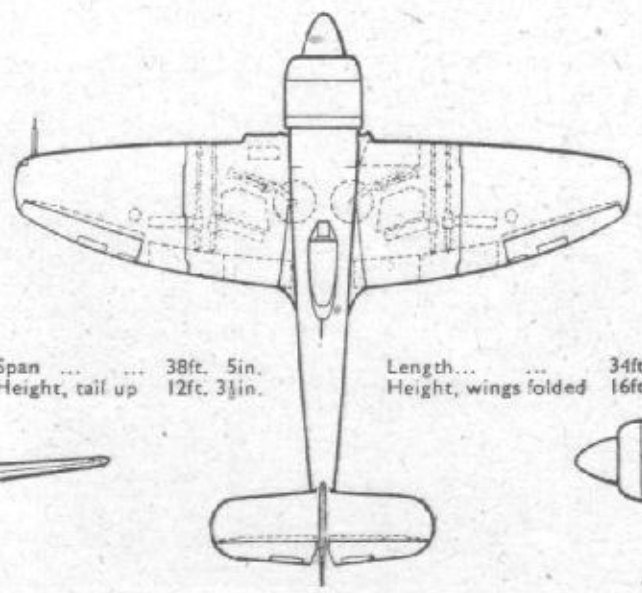
IT is, perhaps, something of a good omen that in releasing details of the Hawker Sea Fury X it can be accepted that the Fleet Air Arm is finally getting a deserved priority of types, for this high-performance single-seater Fleet fighter is more advanced than its R.A.F. counterparts. The plural is used intentionally since there are two versions of the "land" Fury, one powered with a Bristol Centaurus XV and the other—the Fury I—powered with a Napier Sabre VII, both aircraft being types distinct from the Sea Fury, which employs a Centaurus XVIII to drive its Rotol five-blade metal airscrew. Aside from individuality in power unit, the major difference of the Sea Fury as compared with the two "land" Furies lies in the provision of folding wings and an arrester hook; other than this the three aircraft are pretty well alike.

We do not wish in any way to detract from the quality of the Fury, but it is difficult not to regard it as something of a wasted effort, for although there are, no doubt, many aspects of the problem worthy of considerable attention, it would nevertheless appear that the day of the piston-engine/airscrew fighter has now gone in a welter of jet effluent.

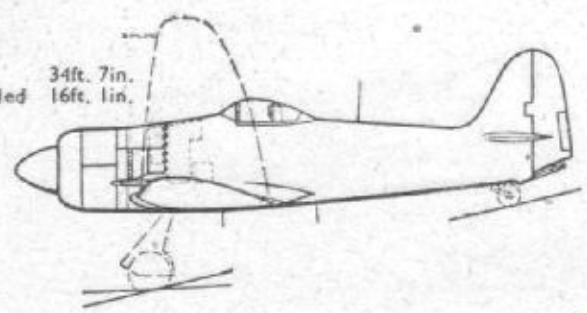
From personal inspection and from all we can gather on the flying side, the Sea Fury is a magnificent aircraft *per se*—but it cannot be gainsaid that, as a fighter judged on present standards, it is eclipsed on every count except that of range by jet types. However, it is probably a good thing that fighter pilots, both of the R.A.F. and F.A.A., should in future be given the opportunity of flying a high-quality "orthodox" machine such as the Fury as a supplement to their experience on jet-propelled fighters.

Although the Furies bear a very distinct resemblance to their forerunner, the Tempest, they are all entirely new aircraft and should certainly not be regarded as modifications of their immediate forerunner. The most noteworthy difference lies in the break-away from the established Hawker practice of employing a tubular braced structure in the fuselage; the Fury fuselage is monocoque throughout. Further, the





Span ... ... 38ft. 5in.
Height, tail up 12ft. 3½in.



Length... ... 34ft. 7in.
Height, wings folded 16ft. 1in.

wings are now joined on the centre-line and this alteration has resulted in a reduction of span and of undercarriage track relative to the Tempest.

Pilots who fly the Fury seem all to be agreed that it is a truly delightful machine to handle, and has none of the idiosyncrasies which beset its predecessors. Control response is said to be really excellent, and the rate of roll is extremely fast (well in excess of 100 deg. per second) and these qualities can both be regarded as being directly attributable to the patent Hawker spring servo-tabs—although in the case of the rate of roll the reduction in span is undoubtedly a contributory factor.

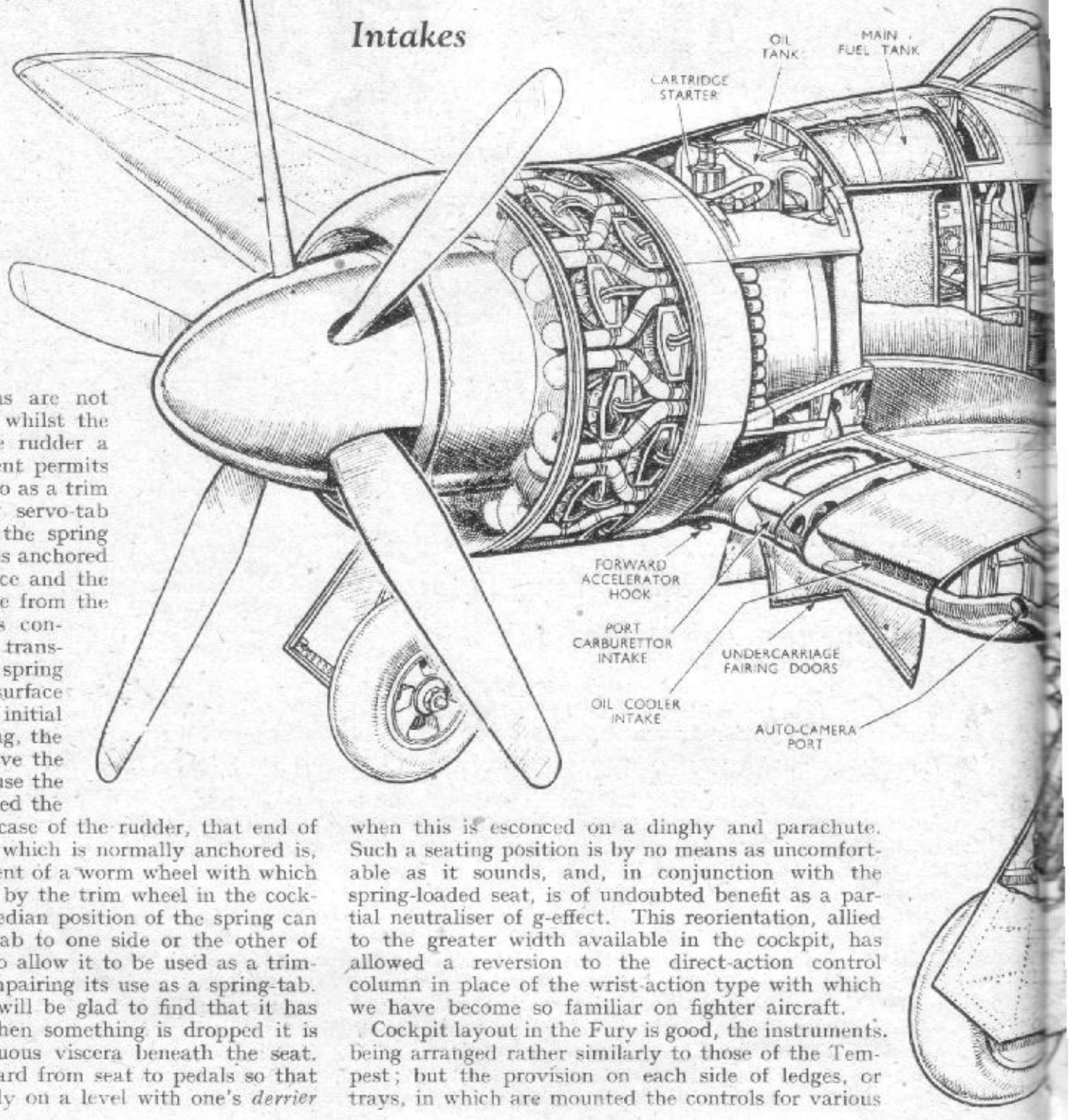
Spring servo-tabs are fitted to each aileron and to the rudder, but not to the elevators; the ailerons are not fitted with trimming tabs whilst the elevators are; and for the rudder a rather ingenious arrangement permits the servo-tab to be used also as a trim tab. The Hawker spring servo-tab employs a torsion bar as the spring element, one end of which is anchored to the parent control surface and the other to the control linkage from the cockpit. Thus the pilot's control input force has to be transmitted through the torsion spring and, as the air load on the surface is always greater than the initial deflection value of the spring, the latter will twist and so move the tab which, in turn, will cause the parent surface to be deflected the requisite amount. In the case of the rudder, that end of the torsion spring element which is normally anchored is, instead, fitted with a segment of a worm wheel with which engages a worm controlled by the trim wheel in the cockpit. By this means the median position of the spring can be adjusted to move the tab to one side or the other of the neutral position, and so allow it to be used as a trim-tab without in any way impairing its use as a spring-tab.

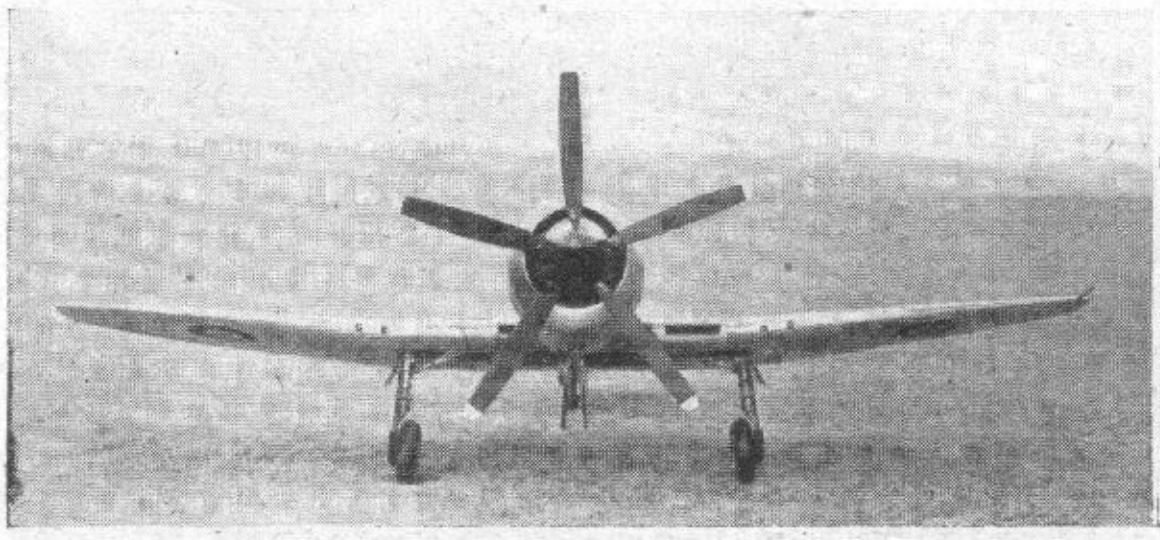
Pilots new to the Fury will be glad to find that it has a cockpit floor, so that when something is dropped it is no longer lost in the tortuous viscera beneath the seat. The floor itself slopes upward from seat to pedals so that the latter are approximately on a level with one's *derrier* when this is esconced on a dinghy and parachute. Such a seating position is by no means as uncomfortable as it sounds, and, in conjunction with the spring-loaded seat, is of undoubted benefit as a partial neutraliser of g-effect. This reorientation, allied to the greater width available in the cockpit, has allowed a reversion to the direct-action control column in place of the wrist-action type with which we have become so familiar on fighter aircraft.

Cockpit layout in the Fury is good, the instruments being arranged rather similarly to those of the Tempest; but the provision on each side of ledges, or trays, in which are mounted the controls for various

SEA FURY X

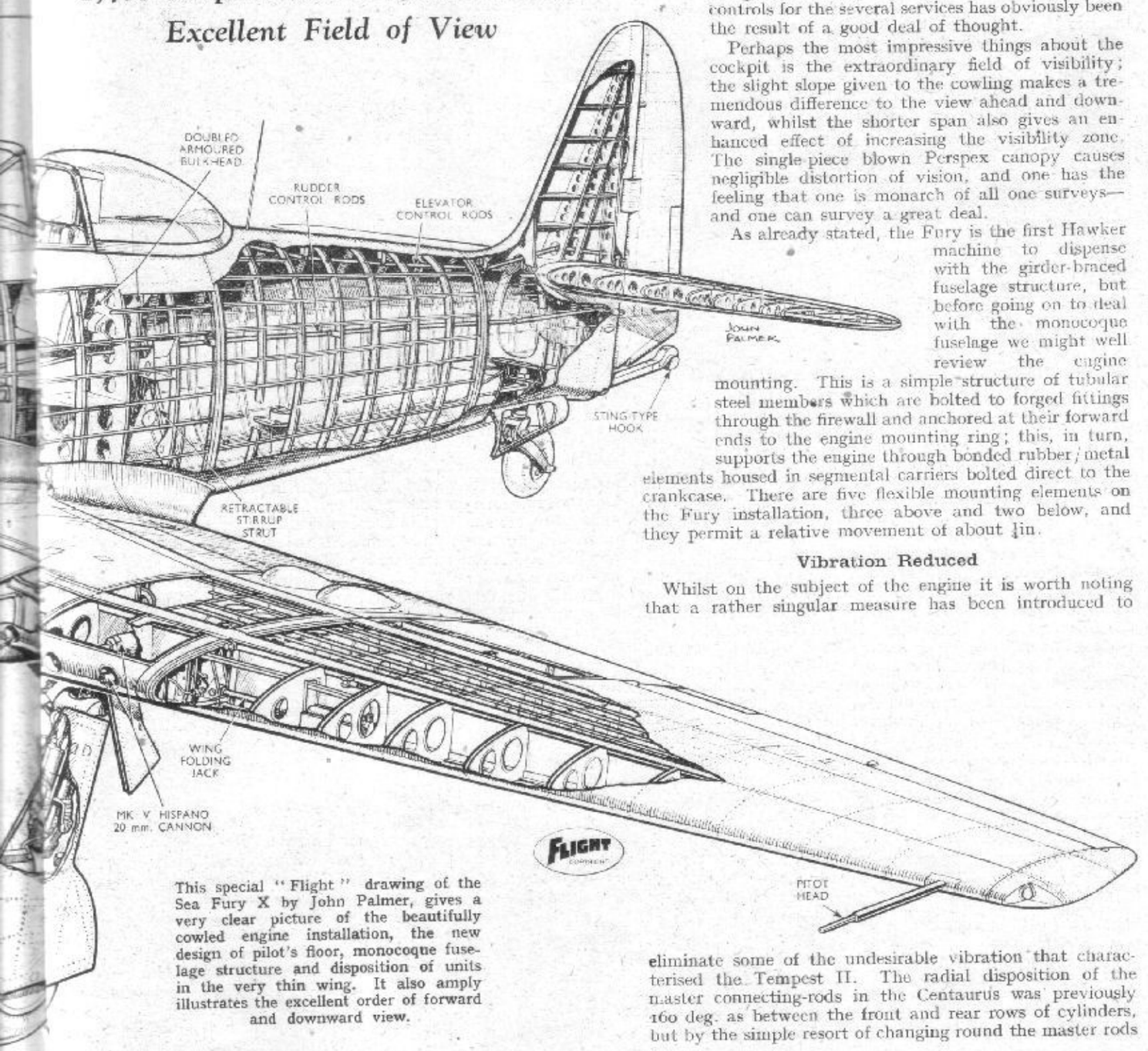
Monocoque Fuselage : High-speed Section Wing : Leading-edge Intakes





2,400 b.h.p. Bristol Centaurus XVIII

Excellent Field of View



This special "Flight" drawing of the Sea Fury X by John Palmer, gives a very clear picture of the beautifully cowled engine installation, the new design of pilot's floor, monocoque fuselage structure and disposition of units in the very thin wing. It also amply illustrates the excellent order of forward and downward view.

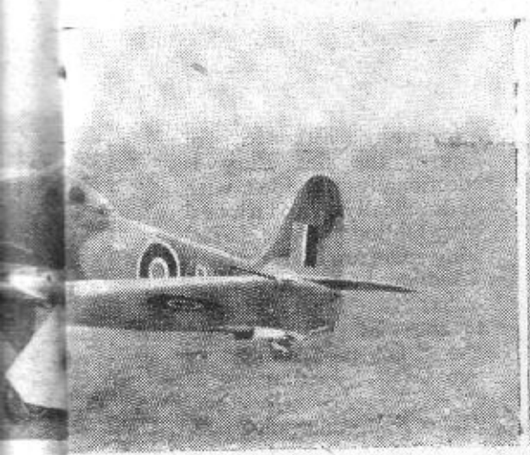
ancillaries, is a very convenient feature. Everything comes nicely to hand and the grouping of controls for the several services has obviously been the result of a good deal of thought.

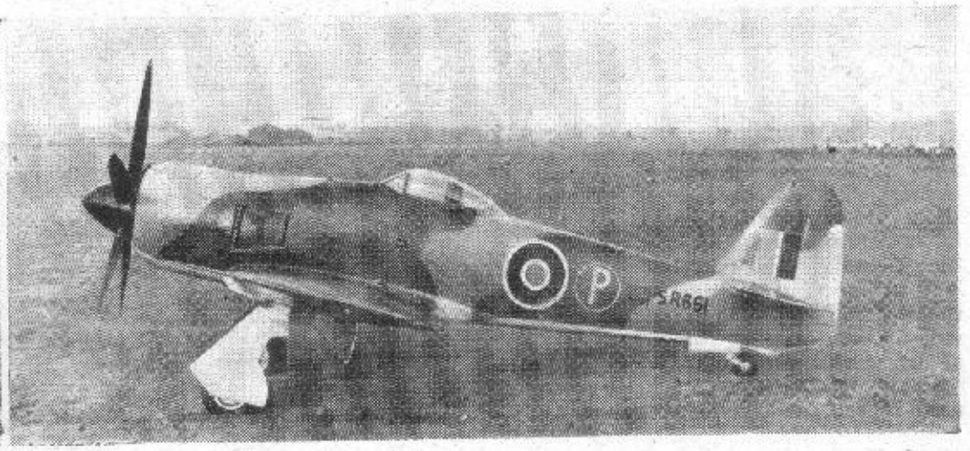
Perhaps the most impressive things about the cockpit is the extraordinary field of visibility; the slight slope given to the cowling makes a tremendous difference to the view ahead and downward, whilst the shorter span also gives an enhanced effect of increasing the visibility zone. The single-piece blown Perspex canopy causes negligible distortion of vision, and one has the feeling that one is monarch of all one surveys—and one can survey a great deal.

As already stated, the Fury is the first Hawker machine to dispense with the girder-braced fuselage structure, but before going on to deal with the monocoque fuselage we might well review the engine mounting. This is a simple structure of tubular steel members which are bolted to forged fittings through the firewall and anchored at their forward ends to the engine mounting ring; this, in turn, supports the engine through bonded rubber/metal elements housed in segmental carriers bolted direct to the crankcase. There are five flexible mounting elements on the Fury installation, three above and two below, and they permit a relative movement of about ¼in.

Vibration Reduced

Whilst on the subject of the engine it is worth noting that a rather singular measure has been introduced to eliminate some of the undesirable vibration that characterised the Tempest II. The radial disposition of the master connecting-rods in the Centaurus was previously 160 deg. as between the front and rear rows of cylinders, but by the simple resort of changing round the master rods





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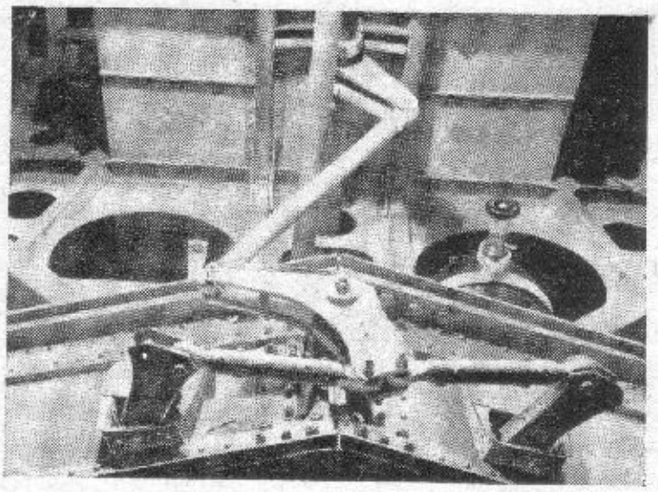
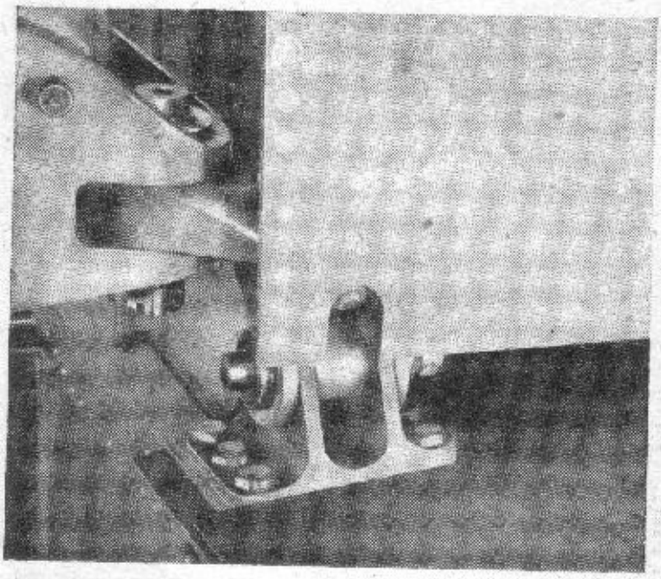


View from below of rear spar joint at centre line with aileron control transmission linkage.



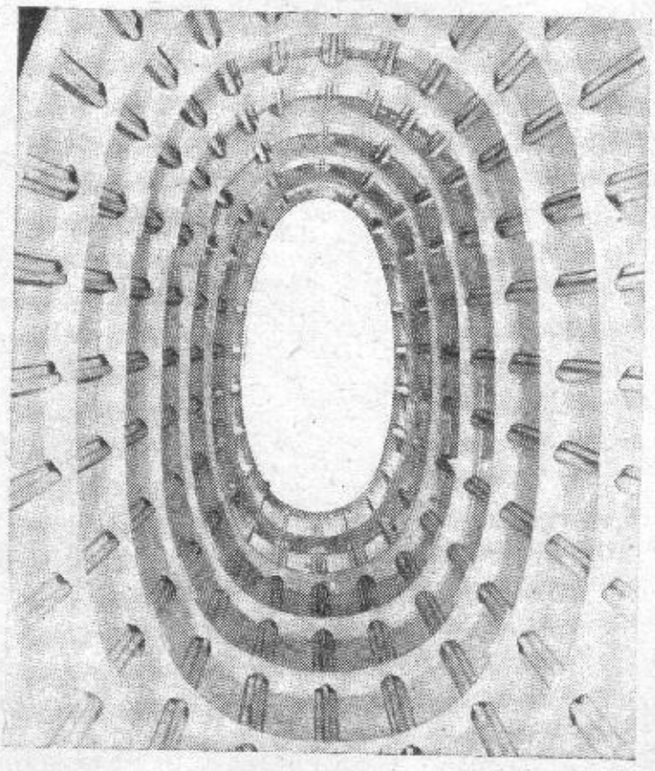
Detail of wing/fuselage attachment at front spar, and lower port anchorage of engine mounting.

so that they serve adjacent cylinders, their angular disposition has been changed to 20 deg., and this has had the effect of so reducing vibration that the results are, in the words of one of the pilots, "revolutionary." It should be pointed out that whilst this measure is applicable to the Fury airframe it would not necessarily have the same effect in another aircraft in which the inherent vibration periods might well be different.

Aft of the front bulkhead-firewall, which is built above the front spar, are housed two fuel tanks, the main tank of 94-gallon capacity being interconnected with a 30-gallon auxiliary tank housed aft of it immediately beneath the rudder pedals. Two 28-gallon inter-spar tanks, one in each wing, and the 20-gallon nose tank in the starboard leading edge all feed into the main fuselage fuel tank, from the sump of which the fuel is fed to the engine.

The centre fuselage, which embraces the cockpit, is a monocoque structure comprising four main longerons and a number of hefty frames notched for intersection with the top-hat stringers. Wing attachment is made at the front spar, by single bolts in forged fittings, to the base of the front bulkhead, and at the rear spar by similar fittings anchored to the base of a main-frame immediately forward of the pilot's seat. Plain angle extrusions form butting members at the joint between centre and rear fuselage portions, and these are bolted one to the other. Armour protection for the pilot consists of a single ⅝in. slab for head and neck preservation, and two thinner plates, with a space of about 4in. between them, for back protection. As in the Tempest, the miscellany of impedimenta below the cockpit floor would provide at least some measure of deflective protection.

Of the rear fuselage, little need be said; it is a plain monocoque of Z-section frames and half- and full top-hat stringers, the frames being notched for intersection. Control transmissions for rudder and elevators run respectively along the port side and in the centre of the "roof," and, unusually, are made up of short lengths of push/pull tube pivoted to idler links. There would seem to be great merit in this system, for not only is static friction reduced to a negligible quantity, but the transmission is absolutely positive and needs no adjustment.



Looking rearward through monocoque showing simple, light structure of stringers and frames.

Tail Surfaces

The tail unit comprises a single-piece tailplane assembled by passing it through an aperture in the base of the integral fin and bolting it to attachment fittings on the frames of the fuselage tail end. Elevators are fully balanced and are, like the rudder, carried in conventional self-aligning bearings; the rudder is covered with a pre-stretched metal skin and, by so being, makes the Fury the first completely all-metal Hawker aircraft.

A sting-type arrester hook is fitted beneath the rudder (which has, therefore, been reduced slightly in area) and when the hook is released, the light spring in the telescopic hook strut causes it to extend about 12in.; an oleo-pneumatic snubber prevents the hook from bouncing along the deck and so ensures that it engages the first available arrester wire.

Structurally the wings of all three Furies are basically similar to that of the Tempest although, of course, the Sea Fury is additionally provided with hydraulically actuated wing-folding gear. The wing spars are built up with T-section booms and plate webs; from the centre line to the change in dihedral the "T" is made up of two thick L-section extrusions riveted together, whilst from this point out-

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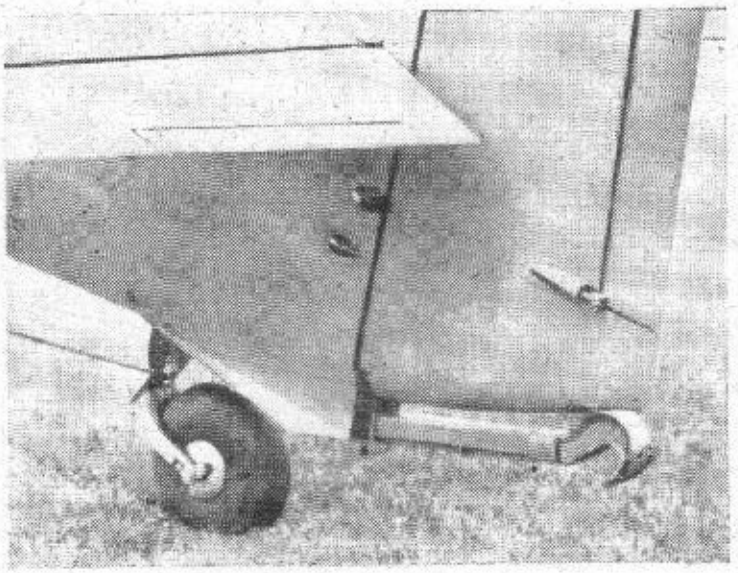
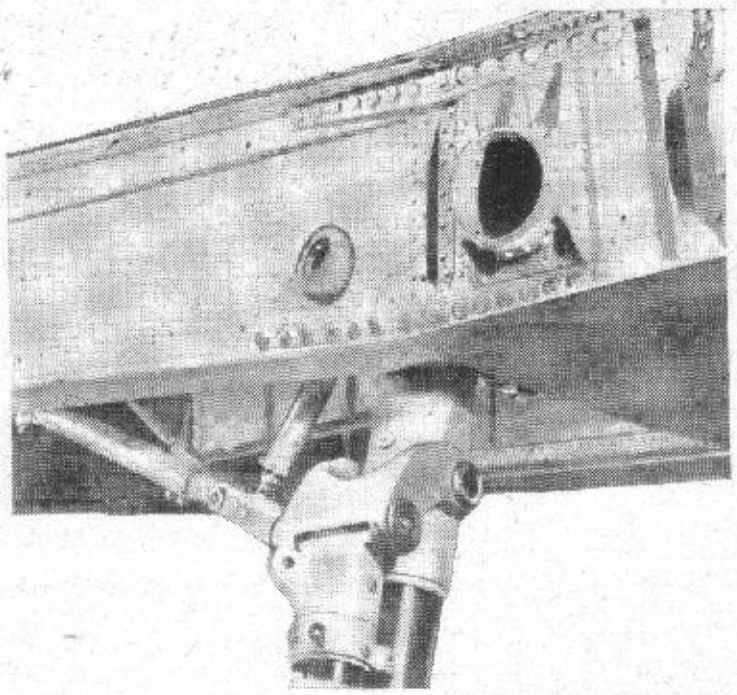


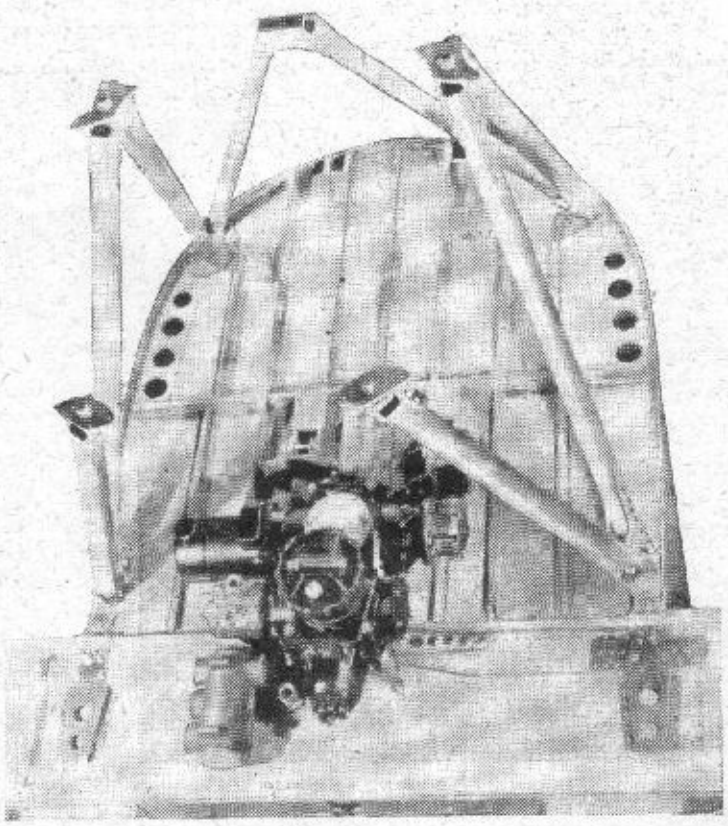
Detail of rear end showing the sting-type hook, levered suspension tailwheel and rudder servo-cum-trim tab.



Front spar joint at dihedral break showing the inboard cannon aperture and port undercarriage bracing struts.

board the booms are of normal extruded T section. Spar joints both at the centre line and the dihedral break are effected with high-tensile steel shackle straps through-bolted to the booms with butt-straps to the webs. Chordal ribs are all of the pressed-sheet diaphragm type, notched for intersection with the stringers to which the skin is riveted. Commonly with the Tempest, the rear spar is cranked sharply forward to the dihedral break, this measure allowing the breech mechanism of the cannon and the ammunition boxes to be installed behind the rear spar, where they are easily accessible for servicing and re-arming. A torsion box encloses the gun bay; it is made up of the front and rear spars, the interspar bounding ribs, and the heavy-gauge sheet top and bottom skin covering.

Carburettor air-intake ram-heads are fitted in the wing-root leading edges port and starboard. In the leading edge of the port wing, immediately outboard of the intake,



Firewall bulkhead on front spar showing engine mounting structure and Rotol auxiliary gear box.

the oil-cooling radiator is fitted, hot air being exhausted through a slot in the under surface of the wing forward of the front spar. A 20-gallon fuel tank in the starboard leading edge outboard of the root intake complements the oil cooler in the port wing.

The Fury undercarriage is almost identical with that of the Tempest insofar as its structure is concerned, although, as previously stated, the wheel track has been reduced. Each undercarriage leg comprises two struts joined together by link arms to provide parallel motion; the shock absorber unit is fitted in the rear strut and is pinned to the lower link arm, thus providing a form of levered suspension as the wheels are carried on cantilever axles at the base of the front strut. This special form of undercarriage was devised to permit retraction into the very thin wing which, we might here point out, is a special high-speed section developed by Hawkers.

With a maximum depth of section at 37.5 per cent. of the chord, and thickness/chord ratios of 14 per cent. at the root and 10 per cent. at the tip, this aerofoil section has excellent characteristics over the whole speed range. However, the section was primarily designed for high-speed conditions and, owing to the fact that there are no sharp changes in the pressure gradients, the onset of compressibility effects is delayed and the Fury is thus able to manœuvre at very high speeds without adverse effect on stability or control.

Wing Folding Gear

The provision of folding wings has occasioned very little trouble with the Fury, and the solution to the problem is remarkably simple. The folding point comes immediately outboard of the gun emplacements, and forged high-tensile steel fork-end- and lug-fittings bolted to the spars are the stress-carrying members, those to the top booms of each spar being the hinges and those to the bottom booms acting as latches. Wing folding is a power service on the Sea Fury; a hydraulic jack in the outboard wing panel has its rod pivotally anchored in a box on the end rib of the inner wing, extension of the jack causing the outer wing panel to hinge upward. However, the latch pins must be withdrawn to unlock the wing for folding, and this is automatically arranged very ingeniously by a sequence operation in the hydraulic circuit. A sequence valve on the inboard wing end-rib is served with oil and feeds it to a small jack which, through a simple toggle mechanism, withdraws the latch pins; the flow of oil is then automatically transferred by the sequence valve to the main wing-folding jack and the wing is lifted. The reverse process ensures that when the wings are lowered the latch pins are thrust home and the

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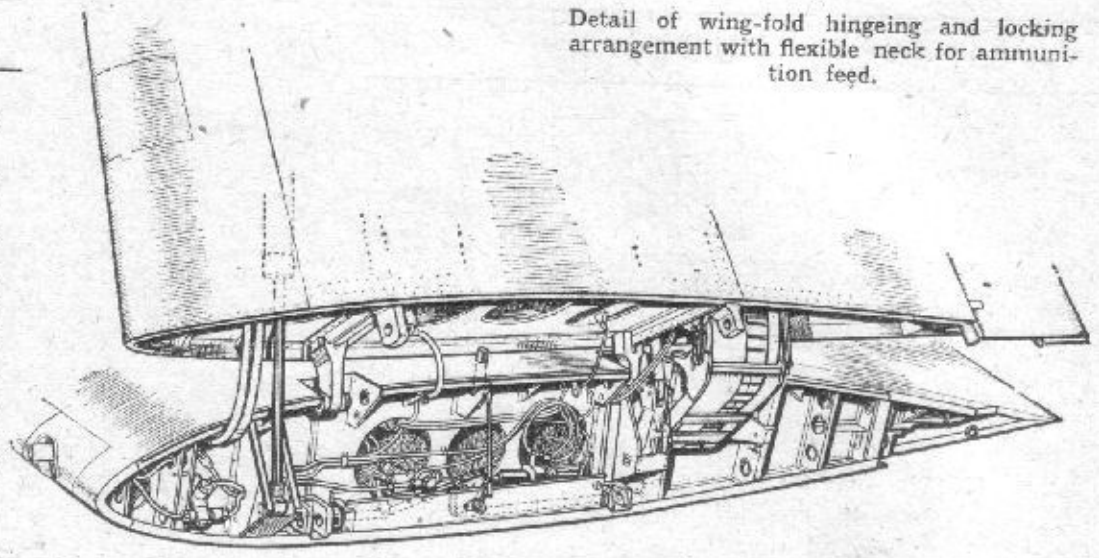


Detail of wing-fold hingeing and locking arrangement with flexible neck for ammunition feed.

wings thus securely locked in the down position.

As the split trailing-edge flaps extend beyond the folding point, quite obviously some provision has to be made to allow for this. The flaps on the outer panels are spring loaded to maintain them in the "up" position, and in the inboard edge on the outer flap is fitted a "bullet" plunger which engages in a socket in the outboard edge of the inner wing flap; thus it is that only the inner flaps are positively driven, the motion being transmitted to the pre-loaded outer flaps through the simple plunger and socket device.

The skin surface of the Fury is very good, but that of the wings from the leading edge to 30 per cent. of the chord is really excellent, rivet heads being rubbed down and filled to provide a continuity of surface which ensures the very least disruption of airflow—an essential quality when a high-speed aerofoil section is employed.

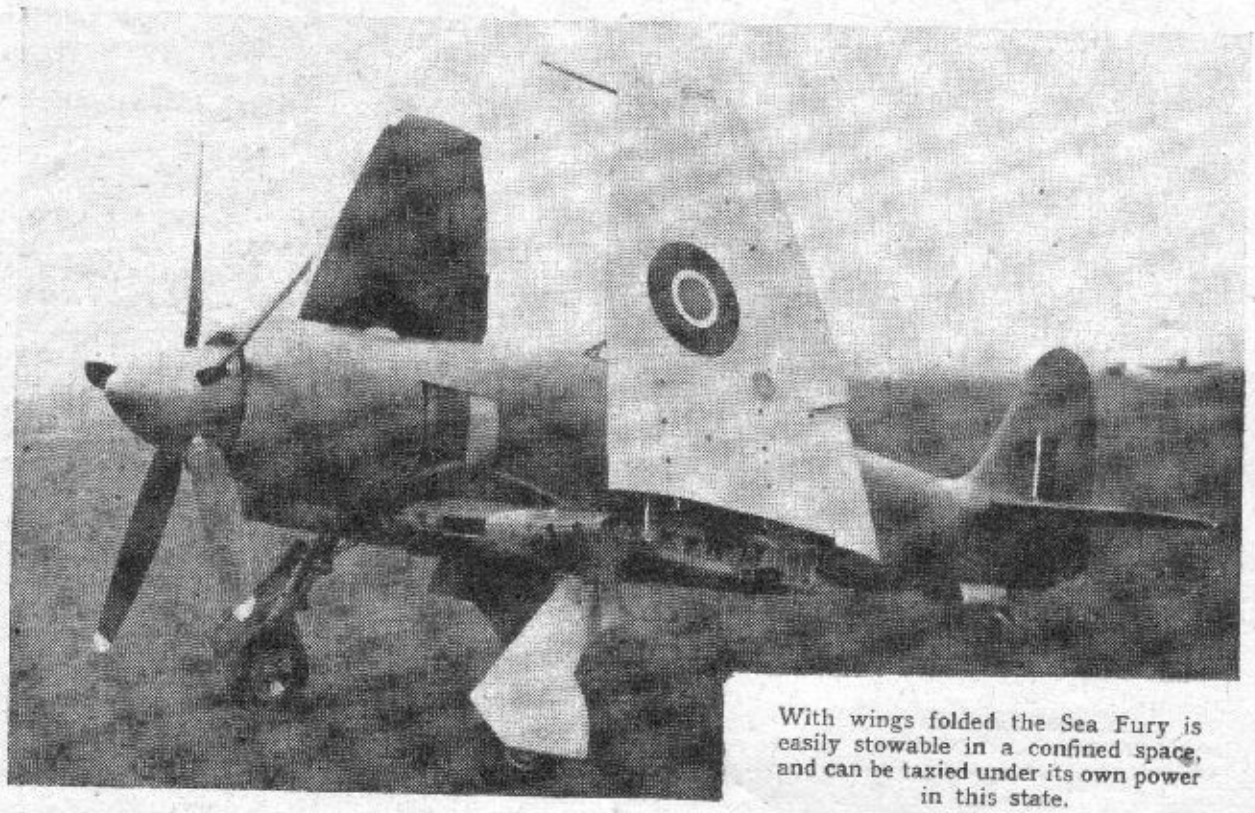
PRINCIPAL DATA AND PERFORMANCE FIGURES

Bristol Centaurus XVIII Engine with 5-blade Rotol 12ft. 9in. dia. airscrew. Gear ratio : 0.444 : 1. Solidity : 0.153.

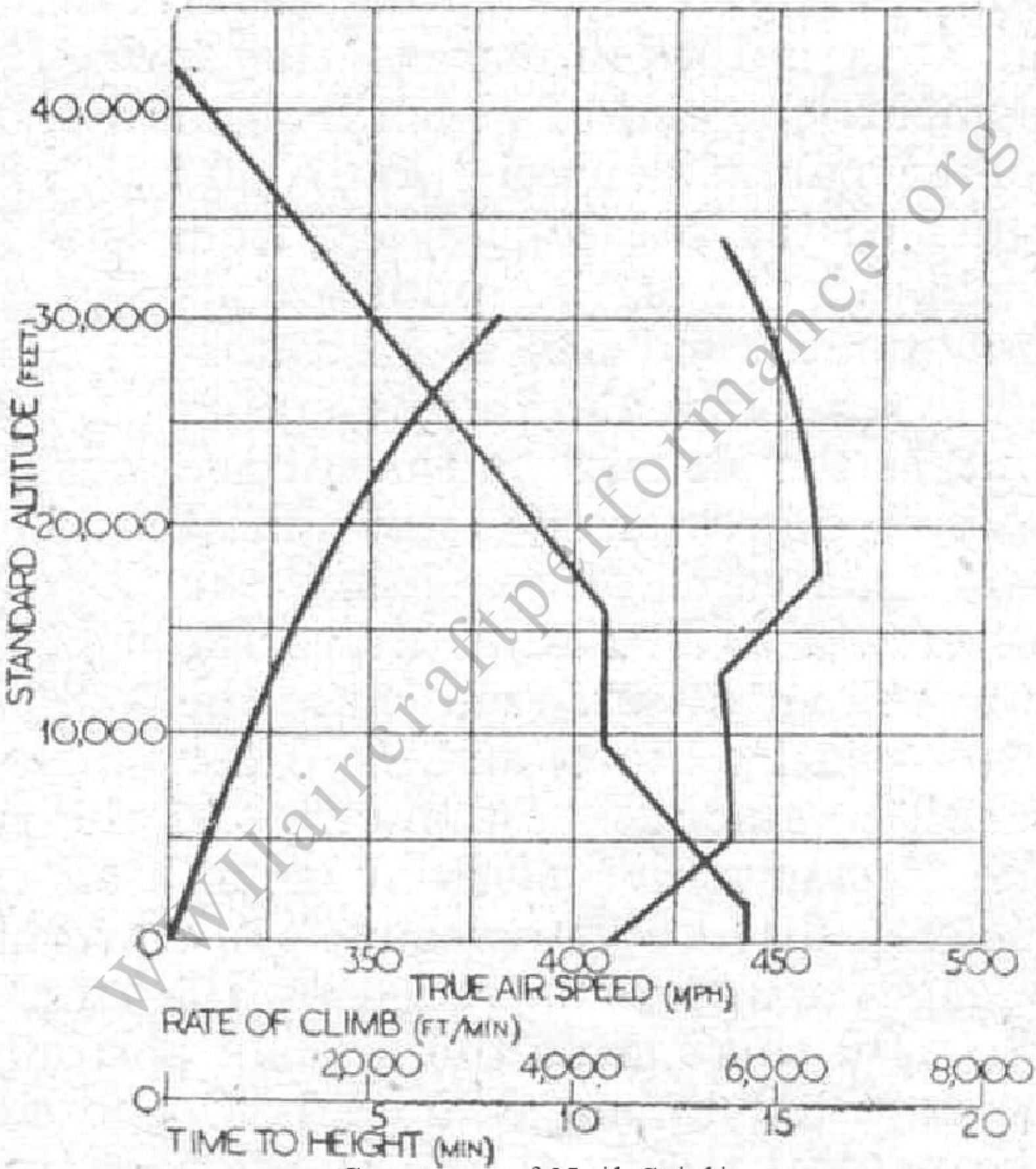
	M. Gear	S. Gear
Take-off power	2,300 b.h.p.	—
Combat power (5 min.)	2,400 ,,	2,400 b.h.p.
Max. power up to 30 min. ...	2,100 ,,	1,920 ,,
Max. cont. cruise power (R.M.)...	2,100 ,,	1,920 ,,
Max. cont. cruise power (W.M.)	1,600 ,,	1,450 ,,

Maximum speed (T.A.S.)	460 m.p.h. at 18,000ft.
Maximum rate of climb	5,640 ft/min. at S.L.
Time to 30,000ft.	8 minutes
Optimum economical cruise speed ...	207 m.p.h. I.A.S.
Rad. of action with extra 90-gall. in drop tanks	520 miles

Wing area	280 sq. ft.	Incidence	2½ deg.
Aspect ratio	5.26	Dihedral (outer panels)	5½ deg.
Aerofoil	Hawker High-Speed	Wing loading	43 lb/sq. ft.
Mean chord	7ft. 4in.	All-up weight	12,030 lb.
T/C ratio—root...	14.5 per cent.	Percentage structure weight ...	29
tip	10 per cent.	Percentage power-unit weight ...	38



With wings folded the Sea Fury is easily stowable in a confined space, and can be taxied under its own power in this state.



Courtesy of Neil Stirling