which picks up the fuselage by four bolts, disposed longitudinally in order to avoid passing bending moments directly into the wing. Extruded Z-section stringers lie spanwise, parallel to the wing is made up of two main planes permanently joined to a take the compressive loads between the wing skins under bending and by the forgings at frame 16. The lower butt strap in each root spars and also hold the bolts attaching the wing to fuselage frames, rib is bolted to the magnesium zirconium shear wall in the fuselage. The bolts screw into the fittings in the root and by the forgings at frame 16. The lower butt strap in each root spars but are located inside sleeves which themselves carry a nut at their outer end. These sleeves provide a good tight fit and avoid movement and fretting under heavy flight loads. The nuts act as extractors as well. Main wing loads are taken by the rear spar and by the forgings at frame 16. The lower butt strap in each root rib is bolted to the magnesium zirconium shear wall in the fuselage. Frames and skinning completing the fuselage over the wing are a permanent part of the carry-through structure, the skin being bolted to adjoining sections fore and aft of it to carry end loads caused by bending moments originating at the tail. There is no access to the wing torsion box, but the aileron hinge fittings are detachable and therefore offer easy aileron repair and servicing.

The Gnat fuselage is a conventional frame and stringer, stressed-skin monocoque supported by two vertical shear walls and four main longerons, but many of the frames act also as bulkheads and only three of them are anything like identical. Each one earns its keep. Of the original total of 30, one has been eliminated—and, say Follands, it is pure coincidence that this should have been No. 13. Co-incidently the elimination occurred at about the time that the first Gnat orders were placed.

Final assembly of Gnats at Hamble. The machine in the foreground is the first for Finland. The small size of the aircraft makes it particularly easy to work on without staging. Note dielectric nose-cap and deletion of rearward-vision windows.

**GNAT MK I . . . .**

**ANATOMY OF THE GNAT**

To a consideration of the structure of the Gnat one might very well apply that overworked but effective American term, systems concept. It is a delicate blend of the demands of structural efficiency, with extreme compactness, as the drawing overleaf clearly shows.

Although large-scale forging and machining can be expensive in plant and material, they normally pay dividends in structural economy. Though machined skins might be considered the progressive of heavy aircraft, the Gnat contains several examples. Follands point out that, since doubling is required in parts of the wing skin, some constructors of Gnats under licence might find it just as cheap to set up a skin-milling plant or chemical etching equipment as to install a Reducing plant, which is the alternative. These firms may make their own choice, but Follands themselves are turning to machining. Of ease of access (and therefore of repair), Follands have nowhere lost sight; and one of the main factors in achieving this goal is, indeed, the universal simplification of systems—with no attendant lessening of their effectiveness—which is at the root of the design-thinking behind the whole project.

The Gnat, then, is—basically at any rate—simple. The wing of the Mk 1 is in fact almost wholly given over to providing lift and does not house more equipment than is required for under-wing armament and drop-tanks. Neither wheel wells nor internal tankage complicate it; and even the aileron actuating gear is housed in the fuselage. But the fuselage is a rather different case. Here every member has more than one function. No one frame housed in the fuselage. But the fuselage is a rather different case. Here every member has more than one function. No one frame

The spars are simply made up from 12 s.w.g. plate formed by a power press tool into channel section, the inboard portion of the rear spar being stiffened by a second 10 s.w.g. channel section riveted to it back-to-back. Interspar ribs are plate pressings, flanged all round and with flanged lightening holes. The spanwise stringers pass through cut-outs in the flanges; and the separator fittings pick up the stringers at these points, being riveted at the top and secured with blind bolts to welded fittings at the bottom. Spar/rib junctions are riveted. Stringers aft of the rear spar, where the wing supports only air loads, are of L section, with their horizontal faces riveted to elongated portions of the rib flanges. The trailing edge is formed by a sheet wrapped round the ends of the ribs. The outboard end of the main wing structure is a pressed closing rib, to which the detachable, built-up tip structure proper is fastened by spigots.

Two pylons in each semi-span are based on fork lugs which are part of magnesium zirconium castings ahead of the front spar. Three bolts in each lug take the load, while further castings within the torsion box locate the aft portion of the pylon between special ribs. Pipes and leads are disposed in the leading edge and are accessible through circular panels adjacent to each pylon.

Like the other control surfaces, the ailerons are of conventional built-up structure, skinned with 22 s.w.g. sheet inboard and 20 s.w.g. outboard. Tubes in the leading edges carry lead mass-balancing and the operating levers are magnesium zirconium castings bolted to the inboard end of each surface.

Initially the torsion box skin had a 12 s.w.g. doubler over approximately half of the chord, the doubling being projected along stringer and rib lines. The two skins were Reduced flat and then rolled to contour. Now Follands have to machine a tapered skin to the same thicknesses and then roll it. All wingskins are riveted to the supporting structure, 16 s.w.g. with 20 s.w.g. doubling near the spar being applied to the leading edge and 18 s.w.g. with an 18 s.w.g. doubler in parts, aft of the rear spar.

Each wing abuts on a root rib, having sheet webs bolted to extruded T-section booms which are stretch-formed to the aerofoil section and bolted with four bolts per rib. Skielen, done in turn by butt straps formed to take both aerofoil section and anhedral angle. Special fittings carry the stringers through the ribs. Die-forged fittings join the root rib webs with the channel section spars and also hold the bolts attaching the wing to fuselage frames 12 and 16. A doubler skin (or machined extra thickness) reinforces the skin aft of 50 per cent chord at each surface of the carry-through structure.

The wing picks up the fuselage through the main forgings at frame 16 and the webs of frame 12, by four bolts parallel to the fuselage centre-line. The bolts screw into the fittings in the root ribs but are located inside sleeves which themselves carry a nut at their outer end. These sleeves provide a good tight fit and avoid movement and fretting under heavy flight loads. The nuts act as extractors as well. Main wing loads are taken by the rear spar and by the forgings at frame 16. The lower butt strap in each root rib is bolted to the magnesium zirconium shear wall in the fuselage. Frames and skinning completing the fuselage over the wing are a permanent part of the carry-through structure, the skin being bolted to adjoining sections fore and aft of it to carry end loads caused by bending moments originating at the tail. There is no access to the wing torsion box, but the aileron hinge fittings are detachable and therefore offer easy aileron repair and servicing.

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