The Aircraft Production Conference—3

MAKING THE P.1 WING

Details of the Structural Design and Production Problems

Riveting one of the main wing skins of the P.1 in the English Electric (Aircraft Division) factory at Preston, Lancashire.

SECURITY restrictions applying to the airframe of the English Electric P.1 supersonic fighter were largely lifted last week, to enable the Institution of Production Engineers conference in Southampton (see p. 45) to hear and discuss a most informative paper entitled *Some Aspects of the Design, Development and Manufacture of the P.1 Wing*. The joint authors were Mr. F. Bradford, A.F.R.Ae.S., English Electric (Aircraft Division) principal designer, and Mr. G. H. Taylor, aircraft development engineer.

The structure revealed is naturally of an advanced nature, for the P.1 has a very highly swept wing, with a low thickness/chord ratio and a box structure forming an integral tank. Integrally stiffened skins are not used, but material gauges are obviously high and the interior is very strongly constructed with multiple vertical and diagonal members between the skins—"built like a bridge," said our artist who prepared the drawing on pages 48-49. The following is a very slightly abridged text of the paper:—

The P.1 is a fully supersonic single-seat fighter with equipment enabling it to operate in all weathers by day or by night. The wings have a sweep angle of 60 deg, are of a moderately thin section and are fitted with the usual flying control surfaces. The airframe has the usual breakdown into the main components of fuselage, wings, tailplanes and fin. The order of assembly is, however, unusual in the case of the wings to fuselage, each wing being built independently and joined together at the aircraft centre-line, forming a continuous span-wise unit.

Each wing has a main structural unit or torsion box, part of which is sealed off to contain fuel in a pressure-tight compartment. To this unit are attached the leading and trailing edges, tip structure and ailerons.

Due to the shallowness of the wing-box, the production-shop personnel could not be expected to assemble the unit in the usual manner, where the structure is built up in skeleton form and the outer skins subsequently attached. Further, since squeeze-riveting was considered essential for fuel tightness, the limited access did not permit the entry of a riveting machine capable of applying sufficient force to close the rivets.

The restricted access, the need to maintain a very high standard of sealed riveting, the effective sealing of permanently attached structure and the exclusion of all drilling on the final assembly stage decided, apart from the aerodynamic and stressing cases, the following requirements on which the design was to be based:—

The assembly of all structural members to the skin panels in an open condition to permit sealing of the structure and obtain the best possible access for riveting.

Separate components of the structure to be kept to a minimum.

Minimum of final assembly work inside the confined space of the tank.

Consequent upon the above, and to prevent contamination of sealant by swarf, the elimination of all drilling at the final stage of assembly.

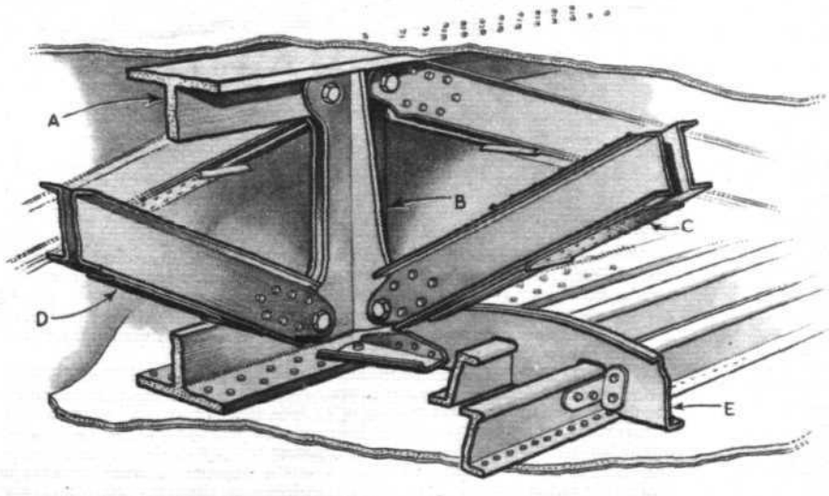
Avoidance (where possible) of skin and structure joints in the tank area.

Simplification of connections inside the structure by elimination where practical of multiple bolted or riveted joints.

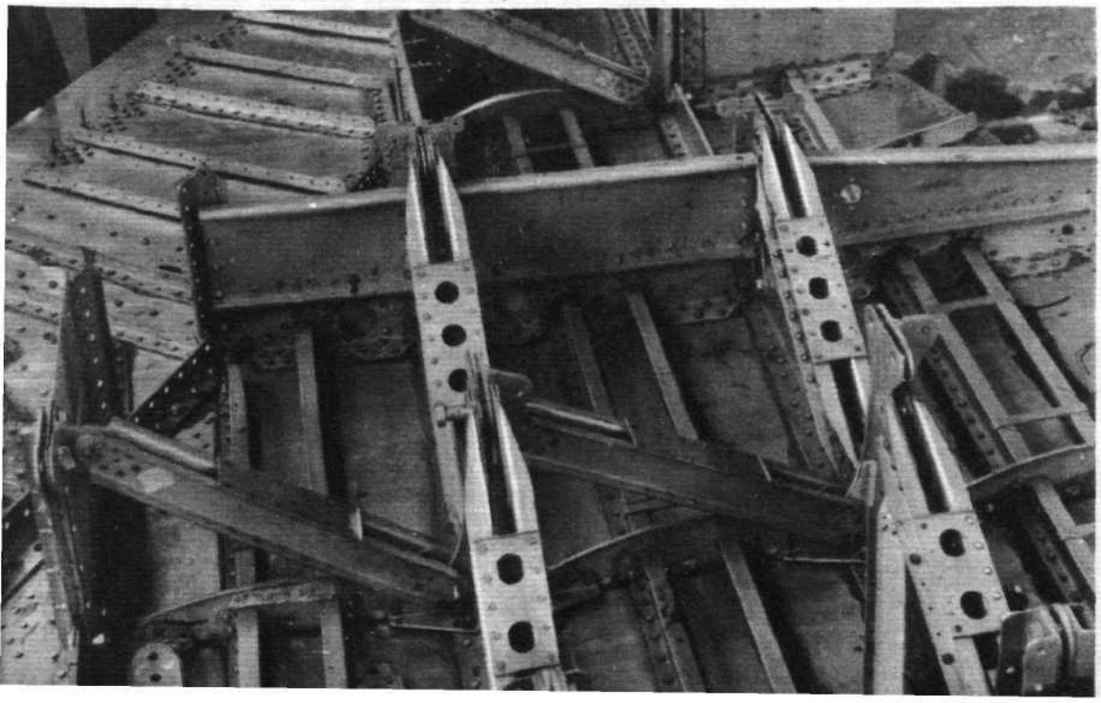
The skin panel is cut from a large sheet of DTD.687 0.2in thick. The inboard end of the panel is reinforced by the addition of thick laminations, and the outer end reduced in thickness by controlled-depth routing. By careful arrangement of the reinforcing and locality of machining, it has been possible to maintain a uniform stress distribution. Choice of skin thickness with additional reinforcings depended on availability of material, the size representing the maximum which could then be obtained.

The internal structure consists of five spars. Between each pair of spar booms are two extruded stringers, each being riveted to the skin panel. Crossing these are rib members similarly attached. The main essentials for these spars and ribs are booms, diagonal bracings, and vertical members or posts between the booms. The posts provide a combined attachment for both rib and spar diagonals, and only the latter are required to be inserted on the final assembly.

(*Contd. overleaf*



Above is a detail showing the generol type of interior structure employed between the wing skins. A, spar boom; B, vertical post; C, diagonal rib bracing; D, diagonal spar bracing; E, under-surface rib former.



On the left is a photograph of a portion of the bottom skin adjacent to the root, showing the interior structure being assembled thereon. The light-coloured area at the upper left lies within the fuselage and terminates at the aircraft centre-line.