AIRCRAFT CIRCULARS

NATIONAL ADVISORY COMMITTEE FOR AERONAUTICS

No. 90

THE BOULTON AND PAUL "PARTRIDGE" (BRITISH)

All-Metal Single-Seat Fighter

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THE BOULTON AND PAUL "PARTRIDGE" (BRITISH)*

All-Metal Single-Seat Fighter.

The "Partridge" is a tractor biplane of orthodox design as regards the general layout, having a top wing of larger span and chord than the lower wing. The wing section is a biconvex one, presumably with a small travel of the center of pressure. Great care has been taken in streamlining the fuselage, the carefully thought-out engine cowling being one of the obvious refinements (Figures 1, 2, and 3).

Constructional Features

It is, however, in the constructional details that the "Partridge" is particularly interesting, and by the courtesy of Boulton and Paul, Ltd., we are able to illustrate these very fully.

The Fuselage.- The fuselage frame, which is in two parts, a forward portion which carries wings, gasoline, and oil tanks, pilot, guns, etc., and a rear portion extending from the cockpit to the sternpost, is of all-metal construction with exception of the covering. In the front portion of the fuselage the longerons are of high tensile solid-drawn steel tube of stock sizes.

*From Flight, December 6, 1928.

The top longerons in the bay occupied by the cockpit are of very large diameter tube, and form the sole support of the Vickers guns. By their great size and strength they also give exceptional stiffness to this bay, and afford good protection in the event of a crash. In the rear portion of the fuselage, the longerons are of the well-known "closed-joint" type of tube, manufactured from steel strip, which this firm has developed during recent years, and which is used so extensively in the rigid airship R.101. Stock sizes are used in the "Partridge."

The fuselage struts are of various types according to the location in the fuselage and the diameter-thickness ratio required. Solid drawn high-tensile steel tubes, closed-joint tubes in steel and duralumin, and solid drawn duralumin tubes are all employed. The sockets and end fittings are all stock parts, and tubular magnesium pads are used. The figures show the standard arrangement found in the rear portion of the fuselage. In the front portion the joints are slightly different, particularly those which carry the front and rear wing spars. These also are illustrated in Figure 4, from which it will be seen that use is made of a light alloy sleeve and two high-tension steel discs. Bracing is by tie rods throughout with the exception of the side bays of the cockpit, which are braced by diagonal tubes.

Great attention has been paid to the fairing of the fuselage in order to obtain as far as possible an unbroken stream-

line. With the exception of the gun tunnels, which are of sheet steel, the construction of the fairing is carried out in wood and fabric. Doors of adequate size are provided for access to wireless crate, guns, ammunition boxes, oxygen cylinders, gasoline filter, instruments, etc.

Wings.- As already mentioned, the wings of the "Partridge" are of biplane formation, and in the second airplane ailerons of the "Frise" type will be fitted to both top and bottom wings, as indicated in Figure 1. The wing tips are kept square in order to retain simplicity of construction. It is thought that the square type of wing tip used is as efficient aerodynamically as would be a rounded tip.

A somewhat unusual feature in the wing arrangement of the "Partridge" is provided by the absence of any top center section. The two halves of the top wing meet on the center line, and the top spars are joined together by simple fish plates. One result of this arrangement is a certain saving in the number of spares required. The bottom wing halves are joined to the fuselage frame by pin joints, details being illustrated in (4) Figure 4. The wing bracing is in the form of a single bay each side, with the usual lift, antilift and incidence bracing of streamline wire.

In the construction of the wings standard stock sections are employed throughout, the main spars being of high tensile

steel and the ribs of duralumin. Figure 7 shows most of the typical details of the wing construction, such as main spars, ribs, leading and trailing edges, etc. The spars are of the standard Boulton and Paul type, with corrugated flanges and webs, with tubular and plate stiffeners. In nearly all types of built-up box spars of metal, the problem is not so much to produce a strong and cheap spar but to turn out one to which ribs and interplane strut fittings can be easily and neatly attached. The way in which the ribs are attached to the spars in the "Partridge" is illustrated in Figure 7. Channel section pressings have projections which enter the rib flanges and are riveted to them, the pressings being slotted to locate the rib on the spar, and held in place by large tubular rivets which pass through the standard tubular stiffeners in the spar webs. The methods of attaching leading and trailing edges will be clear from the figure, but it might be pointed out that in the case of the trailing edge use is made of small die castings riveted to the rib flanges. The ribs, it should be mentioned, are all of duralumin, and are generally of the type shown, although certain special ribs are of slightly different construction.

The interplane struts are made of Boulton and Paul standardized sections of duralumin. They consist of a main member made in two parts: a front portion of U-section and closed at the back by a transverse wall, which forms the load-carrying

part of the strut and also of the nose of the streamline section. To this main strut structure is attached a tail fairing of wood, which slides into the flanges provided at the rear of the main front member. The attachment to main spar joints is by a "T"-shaped fitting and one bolt, as shown in (2) Figure 4.

The type of joint used for connecting interplane struts, drag struts, wire bracing, etc., to main spars is shown in (1) Figure 4. The joint consists of high-tensile steel channel plates riveted to the spar webs on each side, and of detachable high-tension steel side plates. With the exception of the side plates, all parts of the spar joints are made with standardized tools.

The tail surfaces are, generally speaking, of similar construction to the wings.

Landing Gear.- This is of standard type for single-seat fighters, i.e., a plain two-wheeled structure with cross axle and oleo-pneumatic front legs for absorbing the shock, the rear legs of the vee being radius rods. A diagrammatic sectional view (Fig. 5) of a landing gear leg illustrates the general principle.

The tail skid is of the tracking type, and has a shock-absorbing leg making use of rubber blocks in compression. The skid is steerable by the rudder bar through cables and a spring box, to absorb ground shocks.

Engine Mounting and Cowling.- The engine mounting consists of a high-tensile steel ring plate connected to the longerons of the front frame of the fuselage by four solid drawn high tensile steel tubes, braced in the side bays by similar tubes and in the top wing bay by tie rods. The engine cowling, which blends into the streamline body shape, consists of a forward heavy ring or dummy exhaust ring, and a ring behind the cylinders connected by stiffened plates between each pair of cylinders. The cowling has been designed with a view to its easy and rapid removal, and is very robust. The dummy exhaust ring can be replaced by a real exhaust ring without modification to the remainder of the cowling.

Gasoline and Oil Systems.- The gasoline tank is situated in the front frame of the fuselage, between engine and pilot ((6) Fig. 4). It consists of an outer shell with its top surface forming a removable lid, an internal tubular structure partly braced by tie rods and partly by the inner service tank which is built into the main tank. The inner tank serves the dual purpose of service tank and baffle, and is filled automatically through a re-entrant filler from the main tank. Inner and outer tanks are connected to a three-way cock so constructed that only one tank can feed the engine at one time. The internal structure, in addition to stiffening the tank, forms the greater part of the tank bearer and also braces the fuselage frame bay

which contains it without transmitting the stresses to the tank shell. The connection between the tank shell and the internal structure ends consists of plugs screwed into the tube ends from outside, and using special cork washers.

The oil tank is situated on the starboard side of the fuselage, and incorporates an oil cooler in its outer surface, which conforms to the shape of the body (Fig. 2 and (9) Fig. 4). Oil is fed into the cooler through a valve so arranged that should the oil pressure rise above a certain amount, the oil is by-passed direct into the tank, the cooling being thus automatically controlled.

Cockpit Arrangements

The pilot's seat is of the "pan" type to accommodate the seat type of parachute. It is adjustably mounted ((8) Fig. 4) by means of a lever working in a notched quadrant, so that the pilot can raise and lower the seat while in flight.

The controls are of normal type, and include a tail-trimming gear with an indicator of angles placed on the instrument board. A perspective diagrammatic sketch (Fig. 6) illustrates the general scheme of the controls, and should be self-explanatory.

The equipment includes two Vickers guns with ammunition, wireless, parachute, oxygen apparatus, etc.

Main Characteristics and Performance

Span, top	35 ft.
" , bottom	31 "
Length	23 ft. 1 in.
Total wing area	311.3 sq.ft.
Stabilizer "	24.0 "
Ailerons "	45.4 "
Elevators "	19.3 "
Fin "	4.8 "
Rudder "	9.5 "

With Bristol "Jupiter Series VII" the airplane has a total weight of 3,097 lb. (1,408 kg) made up as follows:

Power unit (including fuel and oil	1,500 lb.	682 kg
Wings	424 "	193 "
Fuselage	342 "	155 "
Tail unit	79 "	36 "
Landing gear and skid	156.5"	71 "
Controls	45.5"	20.7"
Military load	550.0"	250.0

For a total loaded weight of 3,160 lb. (1,436 kg) the "Partridge" has a top speed at 20,000 ft. (6,100 m) of 164 mi./hr. (264 km/h), and a service ceiling of 28,950 ft. (8,825 m). The landing speed is 81 mi./hr. (98 km/h).

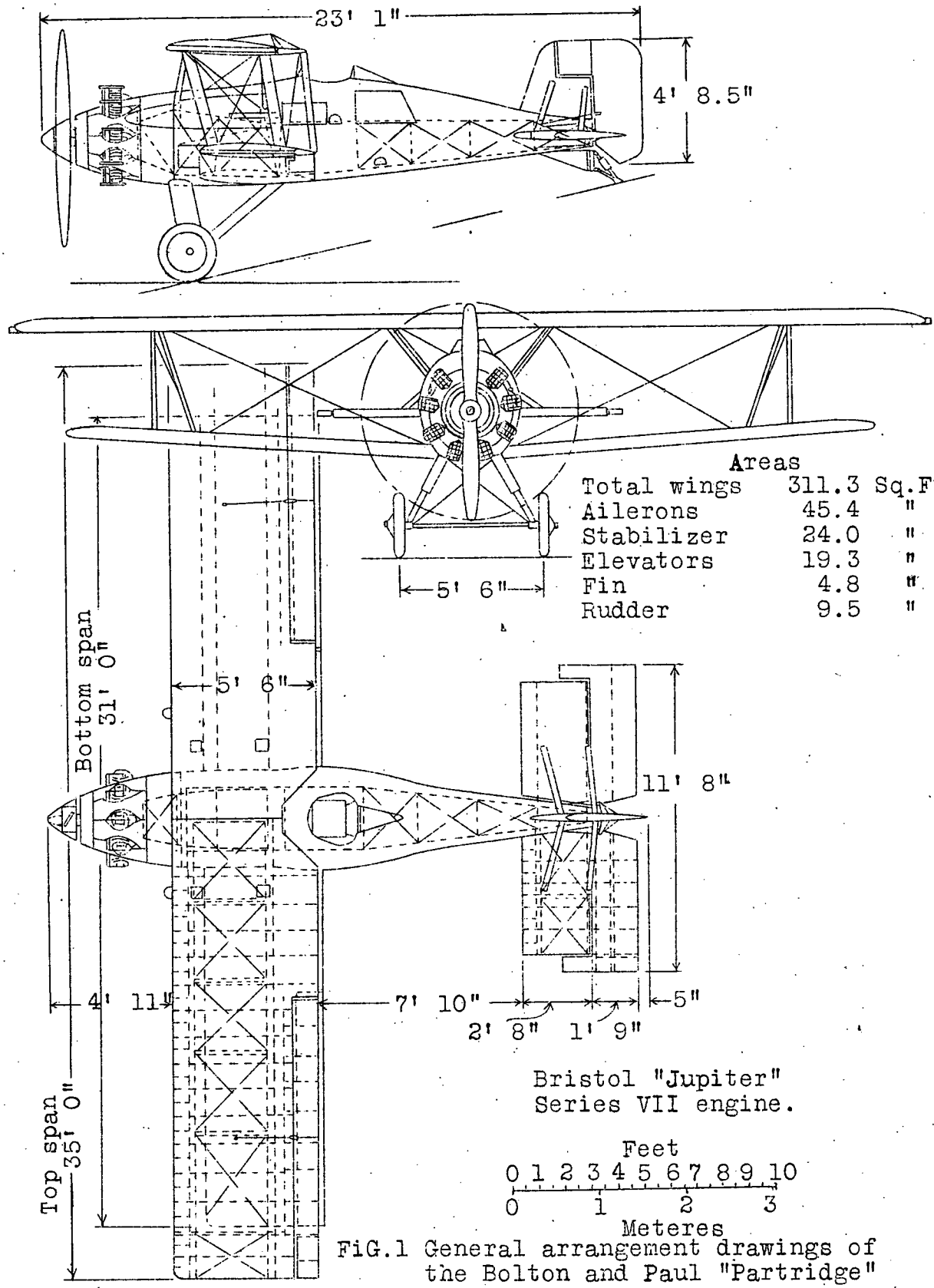

FiG.1 General arrangement drawings of the Bolton and Paul "Partridge" fighter airplane.

Fig.3
Boulton & Paul
"Partridge"
with a
Jupiter VII
engine.

Views of first model. In the second, ailerons are fitted to both wings. See Fig.1

Fig.3
Boulton & Paul
"Partridge"
with a
Jupiter VII
engine.
(Supercharged)

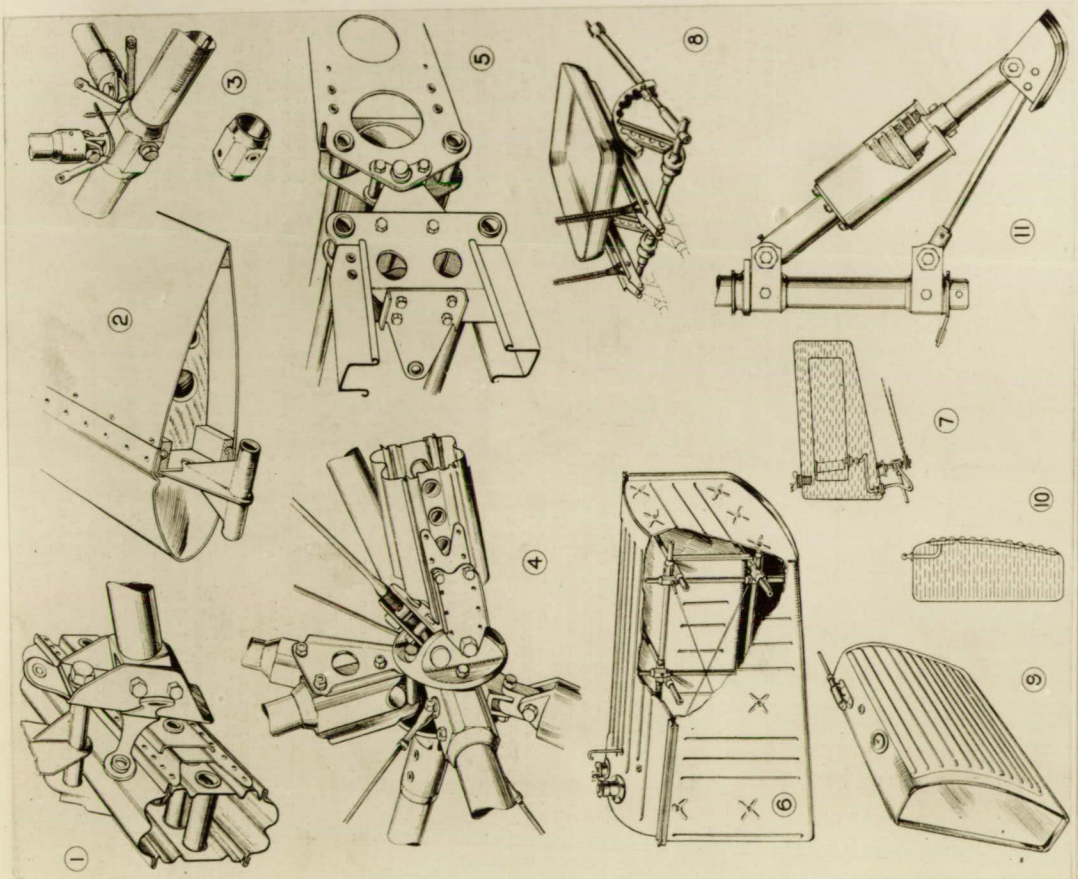

Fig.4 Constructional details of the Partridge airplane.(1)Main wing spar joint.(2)Inter-plane strut with end attachment. (3)A typical fuselage frame joint.(4)The wing spar attachment joint in front portion of fuselage frame.(5)Outer hinge of elevator.(6)&(7)Sectional view and section of gasoline tank.(8) The arrangement of pilots adjustable seat.(9)The oil tank.(10) Vertical section of oil tank showing cooler.(11)The tail skid.

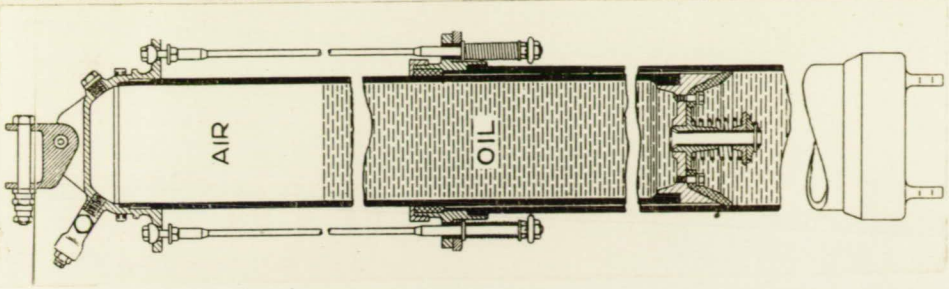

Fig. 5 Sectional view of oleo-pneumatic landing gear leg.

From "Flight" Dec. 6 1928

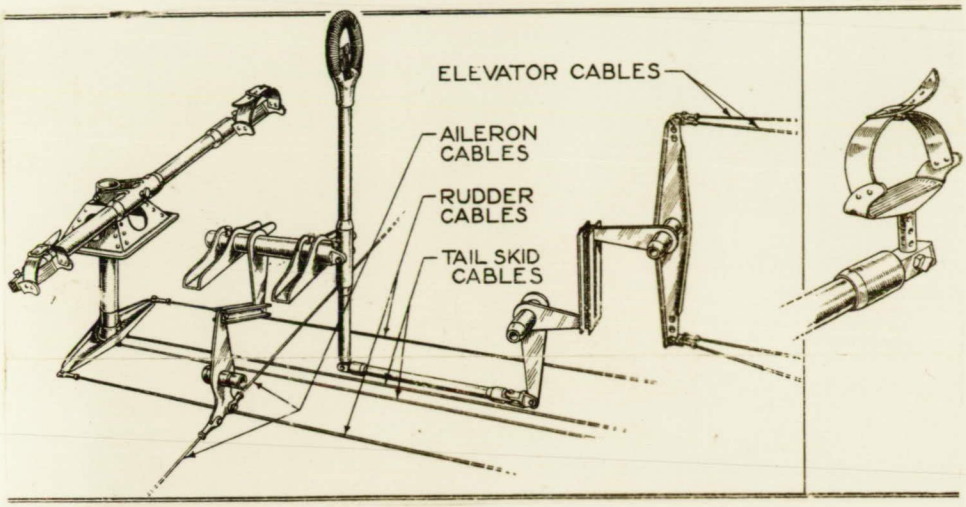

Fig. 6 Diagramatic view of the controls. Inset the adjustable pedal.

Boulton and Paul "Partridge" airplane

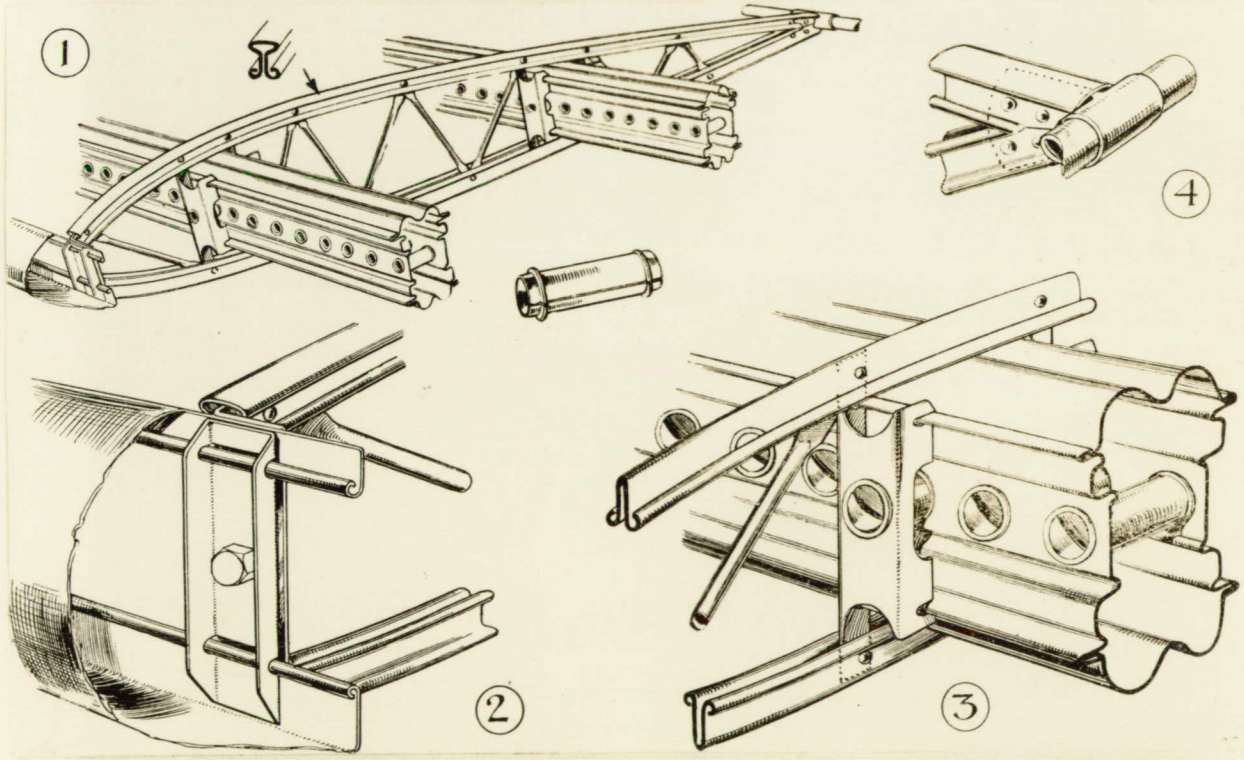

Fig. 7 Constructional details of the wings. (1) General view showing main spars and a rib. (2) Attachment of metal leading edge to rib. (3) Attachment of rib to main spar. (4) Attachment of tubular trailing edge to rib.