AIRCRAFT CIRCULARS

NATIONAL ADVISORY COMMITTEE FOR AERONAUTICS

No. 94

THE BLACKBURN "BLUEBIRD" MARK IV (BRITISH)

All-Metal Biplane

Washington
April, 1929

NATIONAL ADVISORY COMMITTEE FOR AERONAUTICS.

AIRCRAFT CIRCULAR NO. 94.

THE BLACKBURN "BLUEBIRD" MARK IV (BRITISH)*

All-Metal Biplane.

In designing the all-metal "Bluebird," the general lines of earlier models have been retained, but a number of changes and improvements have been made, and the "lines" of the somewhat wide fuselage are extremely pleasing, and much better than one would have imagined possible with a side-by-side seating arrangement. The cockpit is by no means cramped, so that the good form has not been obtained by any sacrifice in this direction. For elementary school work it should be a considerable advantage to have the pupil placed next to the instructor, where conversation can be carried on comfortably, and where, moreover, the pupil can watch as well as feel the movements which the instructor makes with the various controls. For touring there can be little doubt that the side-by-side seating arrangement has many advantages, and as a sort of "conservatory roof" is to be an optional fitting on the production airplane, those who prefer the shelter of a coupé will be able to fly in comfort in almost any kind of weather.

Of the aerodynamic design little need be said, as this follows in the main the earlier wooden airplanes. Attention has already been drawn to the fact that by making use of the

*From Flight, January 17, 1929.

wind tunnel, and experimenting with different "noses," it has been possible to reduce the drag of the airplane to quite a low figure. The biplane wings are of normal design, but in the tail an innovation has been made in that there is no vertical fin surface. The rudder has a large balance, and is of large area, giving powerful directional control, even at large angles of incidence. If desired, the "Bluebird" can be fitted with Handley Page automatic wing-tip slots on the upper wing. Ailerons (of the Bristol-Frise type) are fitted to the lower wing only (Fig. 1).

Constructional Features

In the construction of the all-metal "Bluebird" the designers have displayed a good deal of ingenuity, and forms of metal construction have been evolved which are so amazingly simple as to remind one irresistibly of the well-known Meccano toy, translated into real engineering. Standardization has been carried to a quite surprising extent, and the result is that the "Bluebird" should be capable of being produced both rapidly and cheaply. Yet the figures for empty weight given at the end of these notes indicate that this simplicity of construction has been achieved without any great sacrifice in structure weight. In fact, the production type all-metal "Bluebird" will be rather lighter than was the wooden model.

Fuselage.- In the construction of the fuselage the simplicity is exemplified by the use of but one size of steel tube throughout, with the exception of a tube in the engine bearer and one or two others elsewhere. In the rear portion of the fuselage this reduction is carried to the extent of length as well as diameter and gauge. This section of the fuselage is symmetrical, so that all four longerons are of the same length, whereas usually the lower longeron is longer than the upper, owing to its greater angle.

The vertical and horizontal struts are of the same diameter and gauge as the longerons, and the joint used is of very simple type, as shown in Figure 4. Flat sheet steel plates and tubular rivets of fairly large diameter are employed for making the joint, the plates being shaped as shown in the figure, and reversed for staggering vertical and horizontal struts in relation to each other. The diagonal bracing is by threaded tie rods, but in place of the fork ends usually employed, the Blackburn Company makes use, not only in the "Bluebird" but in several other types, of trunnions which swivel in bearings in the flat plates. The arrangement is clear from the figure. This form of terminal fitting is probably a good deal cheaper than fork ends, and should be quite as satisfactory in use.

In the forward portiom of the fuselage a slightly different form of comstructiom is employed. The fuselage, by the way, is in three sections, not counting the engine unit. The

first extends from the engine bulkhead to just aft of the cockpit, the second from there to just in front of the tail, while the third forms the stern post, tail and skid attachment, etc. Longerons and side panel struts are of steel tube, as in the rear portion, but duralumin frames are used instead of the transverse struts, while the side panel bracing is by diagonal tubes. The stern piece of the fuselage is perfectly symmetrical, and can, therefore, be put on "either side up."

The main fuselage structure is of rectangular section. This is changed into a rounded one by the addition of fairings consisting of duralumin stringers carried on short stubs clamped to the fuselage struts. The stringers are of rounded U-section, and are simply sprung into place on their supporting stubs. Apart from simplicity and rapidity of erecting, this arrangement has the advantage that when, after many months of service, the fuselage is stripped for thorough inspection, the stringers can be removed in a few minutes, giving access to every detail of the main fuselage structure.

A fireproof bulkhead closes the forward end of the fuselage proper, and carries the engine bearers, which are of steel tubes very simply arranged and carrying a cowling, the removal of which gives access to every part of the engine (Figs. 3 and 7).

Wings.- If the fuselage structure is of simple construction, the wings are no less so. They are composed of steel

spars carrying duralumin ribs, and both spars and ribs are of ingenious simplicity (Figs. 5 and 6). The wing spar consists of two identical halves, joined by riveting along the neutral axis. The two halves of the spar are produced by rolling flat steel strip, an operation which, once the plant is available, cannot be described otherwise than as quite cheap; as there is but one row of rivets, the spar assembly is reduced to a minimum. Moreover, the type of spar lends itself admirably to the attachment of ribs and fittings.

The ribs, of duralumim, have flanges made from strip and rolled to the sectiom shown in Figure 6. The webs are merely small pieces of duralumin sheet, placed at intervals, and having flanged lightening holes stamped in them.

Needless to say, the wings are designed to be folded, and an improved type of hinge arrangement has been adopted which avoids the necessity for using jury struts. Ailerons of the Bristol-Frise type are fitted to the lower wing only, and purchasers who so desire can have Handley Page automatic wing tip slots fitted to the top wing.

Tail.- The tail surfaces have spars, leading and trailing edges of steel tube, with light ribs of duralumin. The stabilizer is so mounted that it can be trimmed for incidence during flight, this being accomplished by a smaller lever in a notched quadrant in the cockpit, via a lay shaft, cranks and cables. There is no fixed fin, but the rudder is of large area

and provided with a horn balance.

Landing gear.- The landing gear is of simple "split" V-type, of fairly wide track. No wire or cable bracing is used in it, the structure being stabilized by the diagonal arrangement of the steel tubes which compose the landing gear (Fig. 8). The rear struts form the radius rods, while the front legs are telescopic. The load is taken on spiral steel springs, while an oil dashpot prevents bouncing. In the plane of the front struts are the bent axles, which brace the structure laterally. The float landing gear picks up the same fuselage fittings, and like the land landing gear is devoid of both wires and transverse members.

The Cockpit

In spite of the side-by-side seating arrangement, the cockpit is by no means cramped. Two seats of special design are detachably mounted in such a manner that, when the airplane is being flown solo, the second seat can be easily removed if desired. The seats are of aluminum and are shaped to take a parachute pack if one is carried. The controls are of normal type, with one control stick easily removable. A very small and neat instrument board is fitted centrally, as shown in Figure 3, and just below it, within easy reach from both seats, are the engine control levers. The stabilizer trimming lever is also centrally placed between and slightly ahead of the two seats. For ordinary flying, a sloping wind screen is fitted,

but this can be complemented if desired by a coupé attachment which turns the airplane into an enclosed one.

Aft of the cockpit is a large luggage compartment, and above that, and extending a considerable distance aft inside the top deck fairing, is a space for long articles such as golf clubs, etc. (Fig. 3).

Gasoline System

The center section of the top wing forms the gasoline tank and the top spar passes through and forms part of the tank, which is easily removed when the wings are folded. Needless to say, gravity feed is employed, so that the gasoline system is the simplest possible.

Brief Specification

The main dimensions of the "Bluebird" Mark IV, are given on the general arrangement drawing (Fig. 1). These drawings show the airplane with de Havilland "Gipsy" or A.D.C. "Cirrus III" engine. When the Armstrong-Siddeley "Genet" is fitted, the wings are given a slight sweepback. In the following table are given the main weight figures, etc. Actual performance figures are not yet available, but the calculated top speed is well over 100 M.P.H.

As an Airplane

Engine	Tare weight lb.	Tare weight kg	Load carried lb.	Load carried kg	Loaded weight lb.	Loaded weight kg
"Gipsy"	884	401	536	243	1420	644
"Cirrus III"	910	413	536	243	1446	656
"Genet"	841	382	541	245	1382	627
		As a Seaplane				
"Gipsy"	974	442	536	243	1510	685
"Cirrus III"	1000	455	536	243	1536	698
"Genet"	931	424	541	245	1472	669

The load carried is composed as follows:

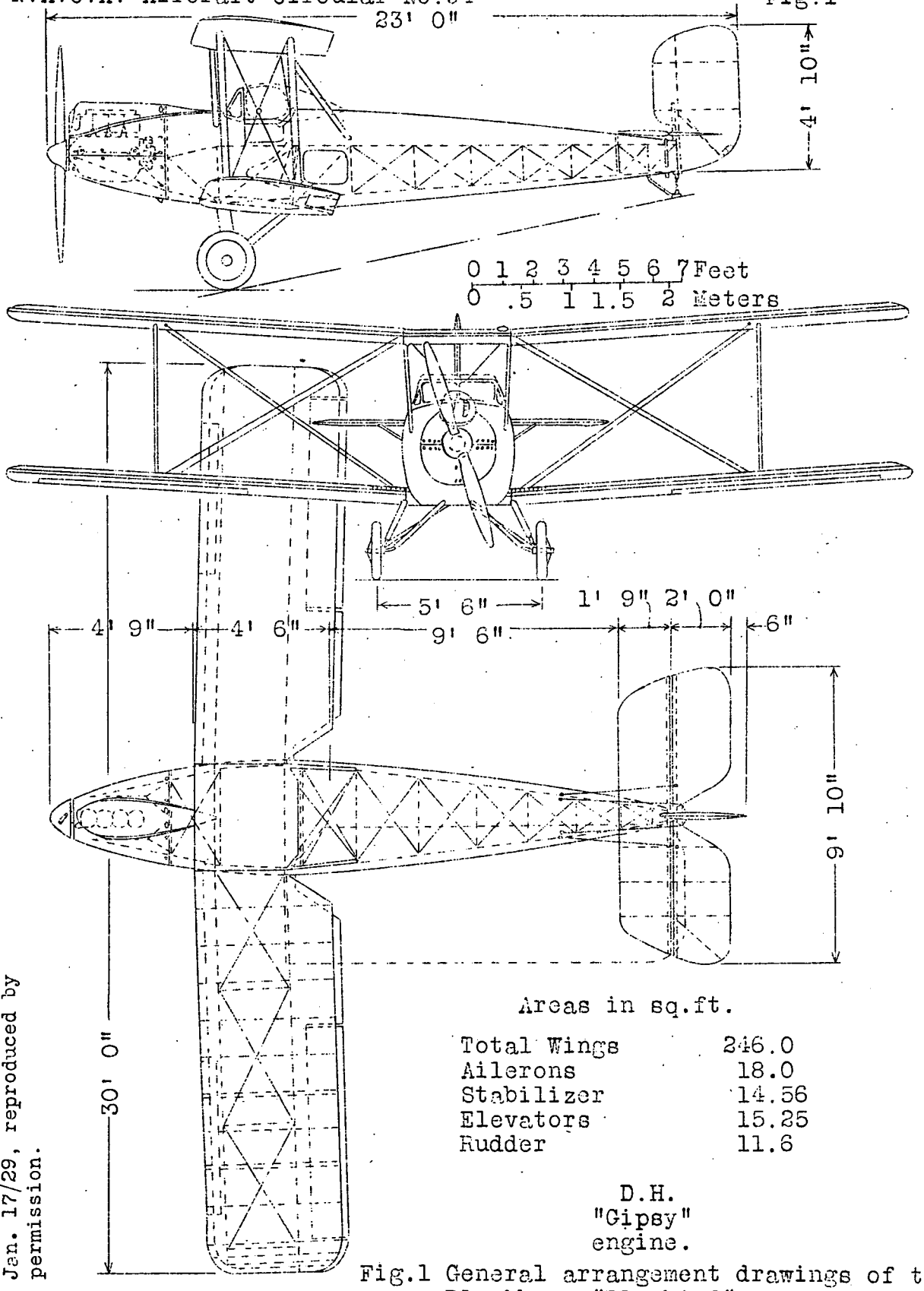
	lb.	kg
Pilot and passenger	320	145
Luggage	40	18.1
Gasoline	144	65
Oil	20	9.1
Sundries	12	5.5
Total	536	242.7

In the case of the "Genet" engine, this load is increased by 5 lb., representing that amount of extra oil.

The maximum permissible flying weight is 1550 lb. (703 kg).

Main Dimensions

Length	23	ft.
Span	30	"
Areas:		
Total wings	246	sq.ft.
Ailerons	18	"
Stabilizer	14.56	"
Elevators	15.25	"
Rudder	11.6	"



Areas in sq.ft.

Total Wings	246.0
Ailerons	18.0
Stabilizer	14.56
Elevators	15.25
Rudder	11.6

D.H.
"Gipsy"
engine.

Fig.1 General arrangement drawings of the Blackburn "Bluebird", Mark IV airplane.

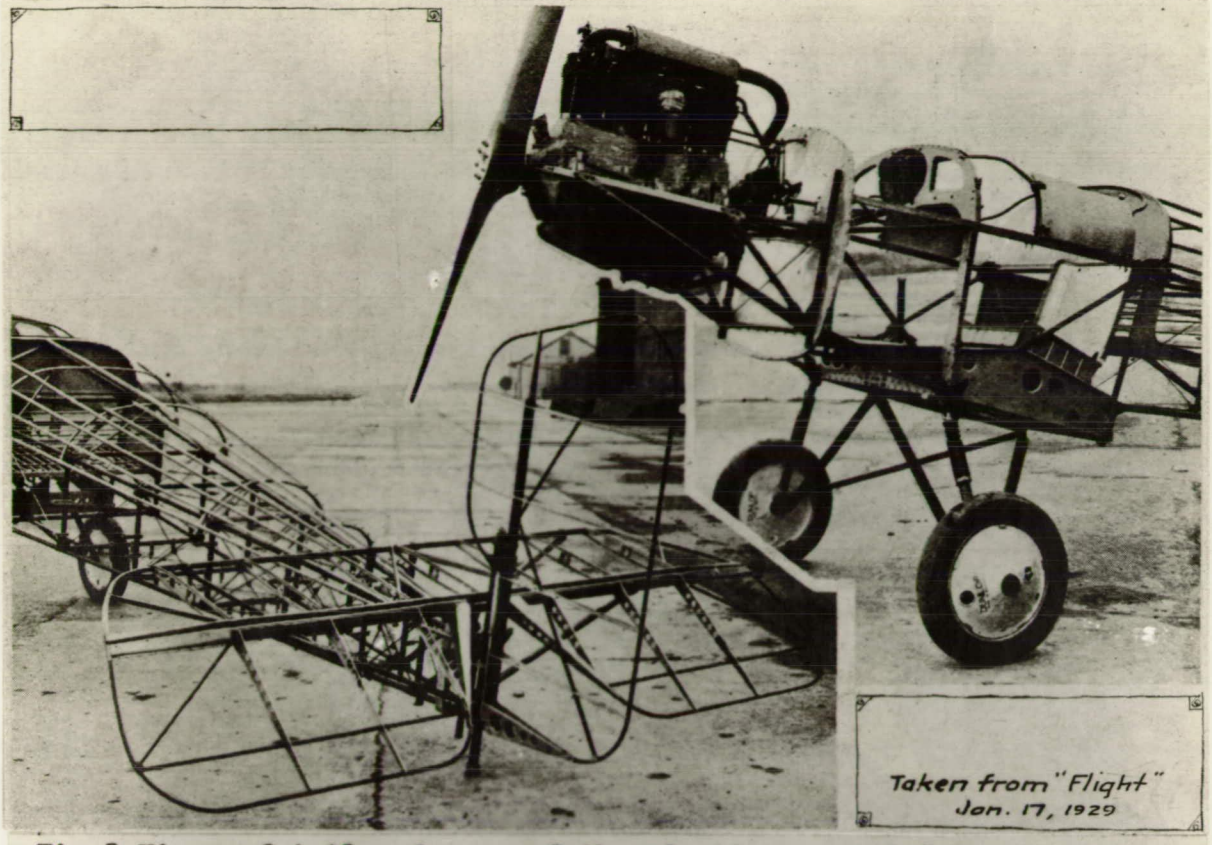


Fig.2 Views of tail and nose of the Blackburn metal "Bluebird" Mark IV airplane. The engine is a de Havilland "Gipsy".

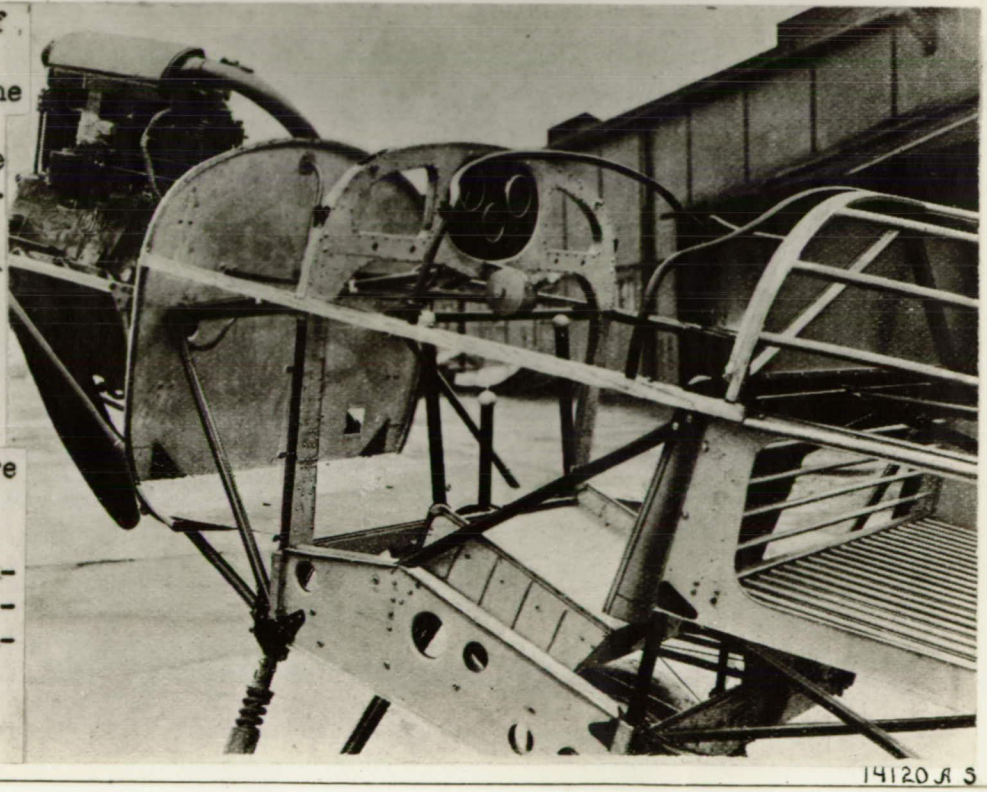


Fig.3 View of the cockpit of the "Bluebird". Note the side by side seating arrangement and dual controls. The small levers placed centrally under the instrument board are the engine controls, while the central lever between the control sticks trims the stabilizer.

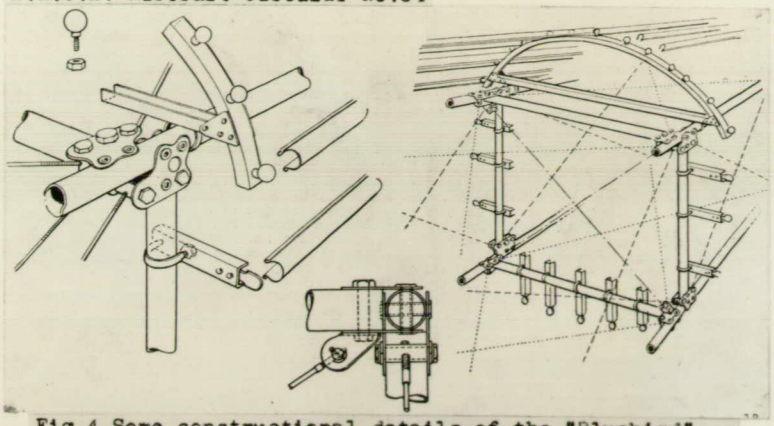


Fig.4 Some constructional details of the "Bluebird" fuselage. The general arrangement is shown on the right, while on the left are given the details of a typical joint, shown in section in the third sketch.

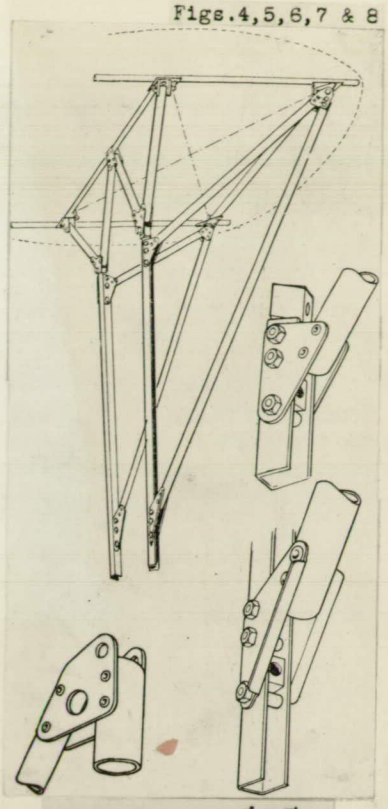


Fig.7 Details of the tubular engine mounting of the "Bluebird". The actual engine bearers are of channel sections and tilted to simplify attachment to the tubes. The "feet" on the engine are sloped to correspond.

Taken from "Flight" Jan. 17, 1929

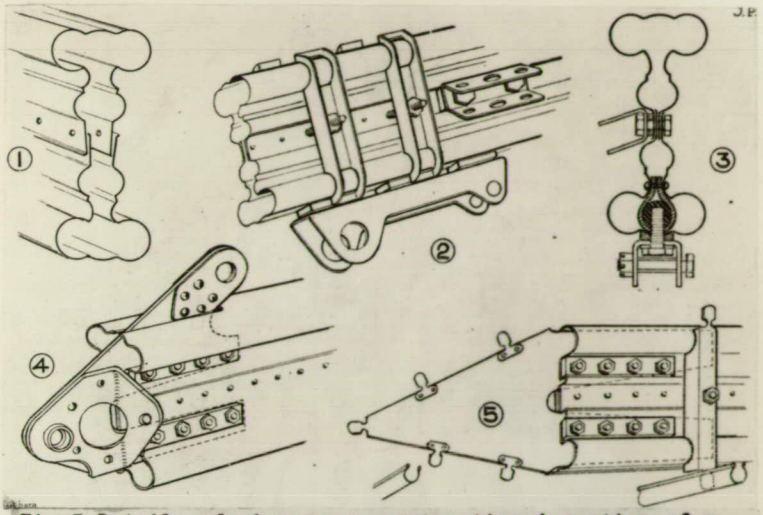


Fig.5 Details of wing spar construction. A section of a main spar is shown in 1, while 2 shows how drag and interplane struts are attached. The section in 3 shows method of reinforcing spar for attachment of strut fittings. A spar end with flat plate fitting is shown in 4, while 5 illustrates the method of forming the wing tip.

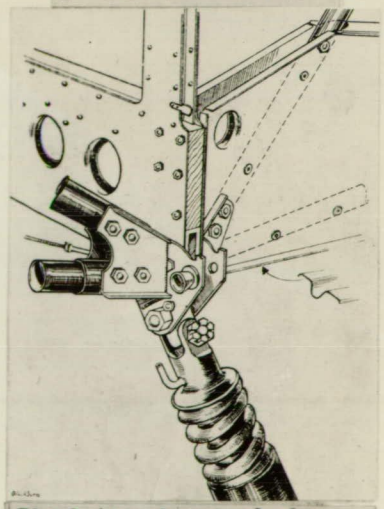


Fig.8 Attachment of oleo leg to fuselage corner of "Bluebird" airplane.

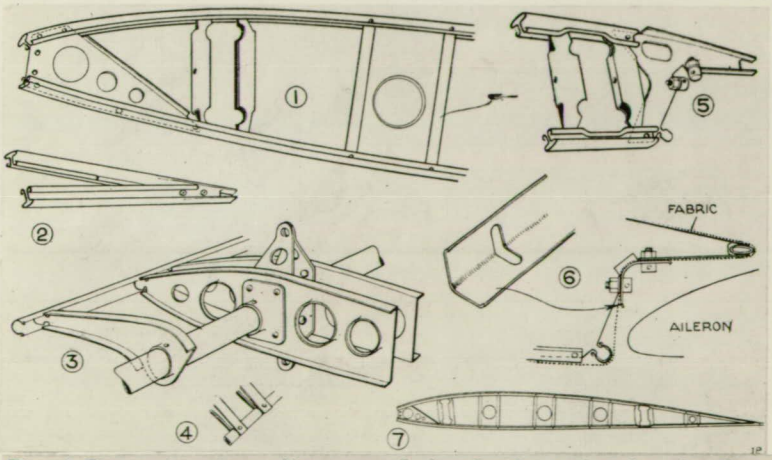


Fig.6 The main wing ribs are of duralumin and take the form shown in 1 & 2. The Bristol Frise ailerons are illustrated in 3 & 4. The manner of attaching the fabric over the rear spar to house the aileron is shown in 5 & 6, while 7 shows a complete rib.