

AIRCRAFT CIRCULARS
NATIONAL ADVISORY COMMITTEE FOR AERONAUTICS

No. 5

THE SHORT S.7 "MUSSEL"

A Training Seaplane with 65 HP. "Cirrus" Engine

From "Flight," March 11, 1926

Washington
May, 1926

FILE COPY
To be returned to
the files of the National
Advisory Committee
for Aeronautics
Washington, D. C.

NATIONAL ADVISORY COMMITTEE FOR AERONAUTICS.

AIRCRAFT CIRCULAR NO. 5.

THE SHORT S.7 "MUSSEL"

A Training Seaplane with 65 HP. "Cirrus" Engine.*

In many ways one of the most interesting low-power airplanes of recent years, is the Short "Mussel," or S.7, designed expressly for use as a light training airplane of robust and simple construction. In the general arrangement drawings (Fig. 1), it is shown as a seaplane, and this is the first form in which the "Mussel" will appear. Provision is, however, made for turning the "Mussel" into a landplane by substituting a wheel landing gear and a tail skid for the twin-float landing gear as shown in the drawings (Figs. 2 and 3). The engine fitted is an A.D.C. "Cirrus" four-cylinder air-cooled, developing a maximum of 65 B.H.P., similar to the engine fitted in the De Havilland "Moths" used by the British light airplane clubs.

It may be remembered that at the last two Lympne meetings an all-metal light monoplane known as the Short "Satellite" took part. The Short "Mussel" may be said in a way to be a development of that airplane, although differing from it in many respects, particularly in the general arrangement and in the details of the wing design and construction. The Short "Satel-

*From Flight, March 11, 1926.

"lite" was a cantilever monoplane with the wings attached approximately halfway up the sides of the fuselage, the Short "Mussel" is a low-wing monoplane and the wings are of the semicantilever type, with compression struts running from a point on the wing about one-third out from the fuselage to fittings on the sides, near the top of the fuselage structure. Constructionally the "Mussel" differs from the "Satellite" in that, whereas the latter had fabric-covered wooden wings, the "Mussel" has metal spars and wood ribs, with a fabric covering. The fuselage construction is practically identical in the two airplanes and is of the type originated and developed by Short Brothers during the last six or seven years, in which a sheet duralumin skin is employed as a part of the stress-resisting structure, the sheets being riveted to hoops or formers of L-section and built-up channel section. There are no longitudinal members or longerons running through the fuselage, the short V section stringers being interrupted at the formers and riveted to the skin. These longitudinal members are placed at intervals around the circumference of the fuselage, and merely serve to stiffen the skin against compression loads. Tensile loads are of course, taken by the skin itself or, more correctly speaking, by the rivets attaching the separate small plates of the skin to the hoops and to each other. The resultant structure may be regarded as a tapering tube of oval cross section, which should not only be very efficient aerodynamically, but should

also be remarkably strong, particularly in torsion. There are several advantages, apart from the general advantages of metal construction, in the particular form of fuselage construction used by Short Brothers. From a manufacturing point of view, the fact that there are no stringers running through the whole fuselage means that parts of the fuselage could be manufactured and made ready for erecting in small shops. In the case of a small seaplane like the "Mussel" this is perhaps of minor importance, but when it comes to building hulls for very large flying-boats, in which a fundamentally similar construction is employed, this saving in space is by no means negligible, and the only shop which is required to be of large size is that in which the seaplane is erected. Another advantage would seem to be that in case of damage a fuselage of the Short type can probably be more easily repaired than one in which there are longitudinal members running through, since the damaged section can be removed and a new one put in its place without interfering with the rest of the fuselage.

In order to facilitate internal inspection and painting, as well as transport, the fuselage is built in two sections, the tail portion being detachable immediately aft of the rear cockpit. The two cockpits are arranged in the usual way, one behind the other, each being provided with the usual stick and foot-bar controls. One of the sticks, however, is made instantly detachable, so that when the seaplane is not being used for

training purposes the stick can be removed and placed in clips inside the fuselage out of the way of the passenger. In front of the cockpits is a fireproof bulkhead separating the front cockpit from the engine. The central portion of the fuselage is of particularly robust construction, since it is at this point that all heavy loads are concentrated. Two of the fuselage hoops or formers are specially reinforced to receive the attachment for the two halves of the monoplane wing, and also the attachments for the landing gear struts at the same points. One of these fittings is shown in the sketch (Fig. 6).

The "Cirrus" engine is mounted in a particularly neat fashion in the nose of the fuselage. The standard "feet" of the engine have been removed, and another set of feet designed and made at the Short Works. These also are illustrated by sketches (Fig. 4) and it will be seen that they are of conical shape, with the apex of the cones resting against the bottom of the trough or channel-section formers, the square-headed bolts securing the feet of the formers projecting through the fuselage covering, so as to be readily accessible from outside. The mounting is one of the neatest we have yet seen, and is well illustrated by the sketches (Fig. 4) and by a photograph (Fig. 5). The fuel tank is mounted aft of the engine and faired into the shape of the fuselage, in which position it is placed sufficiently high above the carburetor to give direct gravity feed. The tank has a capacity of 15 gallons, suffi-

ent for flying four hours at cruising speed.

The wing construction is of particular interest, since the main spars are of the latest Short type, being built up of laminations of duralumin sheet, pressed out to corrugated sections. The construction of the spars may be understood from an inspection of some of our sketches (Fig. 6). By employing laminated flanges, all the strips can be pressed out in fairly light gauge material, and the necessary local strength obtained by gradually adding laminations to the top and bottom flanges, the laminations of course becoming shorter as the point of maximum stress is approached. With the form of wing construction employed this point naturally occurs at the point of attachment of the wing bracing struts, and here the spar flanges show several thicknesses of material. In order to avoid a too sudden change of section the ends of the laminations are sloped and beveled so as to make the transition, for example, from four laminations to three laminations, a fairly gradual one.

The drag bracing consists of drag struts secured to the spar webs by bolts passing through both webs of the spars, and by the usual diagonal drag bracing. The fittings for the wing bracing struts are of particularly neat design, those for the front struts being built up from sheet steel into the form shown in a sketch (Fig. 6). The curved portion of the fitting rests on the top flange of the spar, to which it is riveted, the whole making an exceptionally neat job. The rear spar fit-

ting is somewhat similar, but is rather lighter. The inner ends of the wing spars are attached to the fuselage by a form of gimbal mounting, also illustrated in a sketch (Fig. 6). Vertical bolts pass through the spar roots, and when once the wing bracing struts are adjusted for length no trueing up of the wings is required.

The wing ribs in the "Mussel" are of the lattice type, and in the first scaplane they are made of wood, although it is possible that in later airplanes duralumin ribs will be used. The wing section employed is the new R.A.F. 32, which is a thick section with practically stationary center of pressure. As far as we are aware, this section has not hitherto been tested full scale, so that the Short "Mussel" provides an instance of using a low power airplane for research purposes, apart from its direct usefulness as an airplane. Should it be found that in full scale, R.A.F. 32 does not bear out the model tests, it will be only a matter of making a set of new ribs of different section, to be slipped over the existing spars. The landing gear of the "Mussel" scaplane is of the twin float type, and the floats, like the fuselage, are built up of duralumin sheet riveted to L-section and channel-section formers. Constructionally the floats are very similar to those used on the British Schneider Cup scaplanes at Baltimore, which proved to stand up remarkably well against the hard pounding which they received. The floats are of the single step V bottom type, with domed

tops. Bulkheads riveted to the formers and skin divide the floats into water-tight compartments with suitable inspection covers, and the buoyancy of the floats is such that the displacement of each float is sufficient to support the seaplane. Water-tight axles are built into the floats to take detachable wheels provided for beaching purposes. The landing gear is completed by steel struts, pin-jointed to the fuselage and readily detachable and interchangeable with the land type.

The land type landing gear is of simple design and is of the type employing rubber blocks working in compression, and giving long travel.

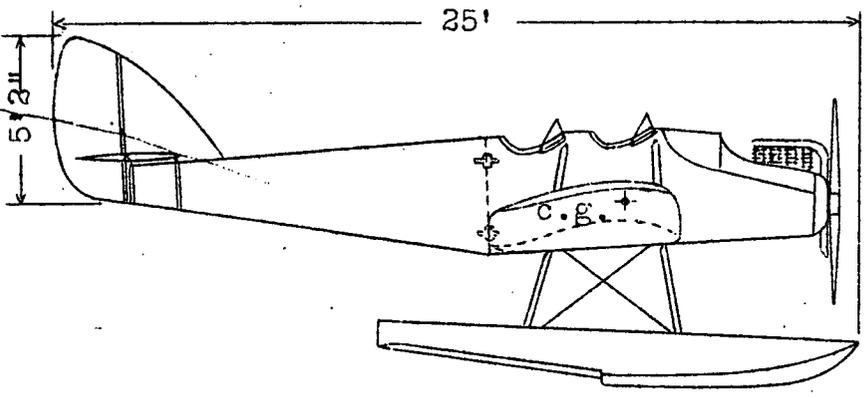
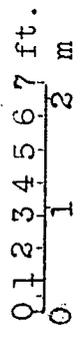
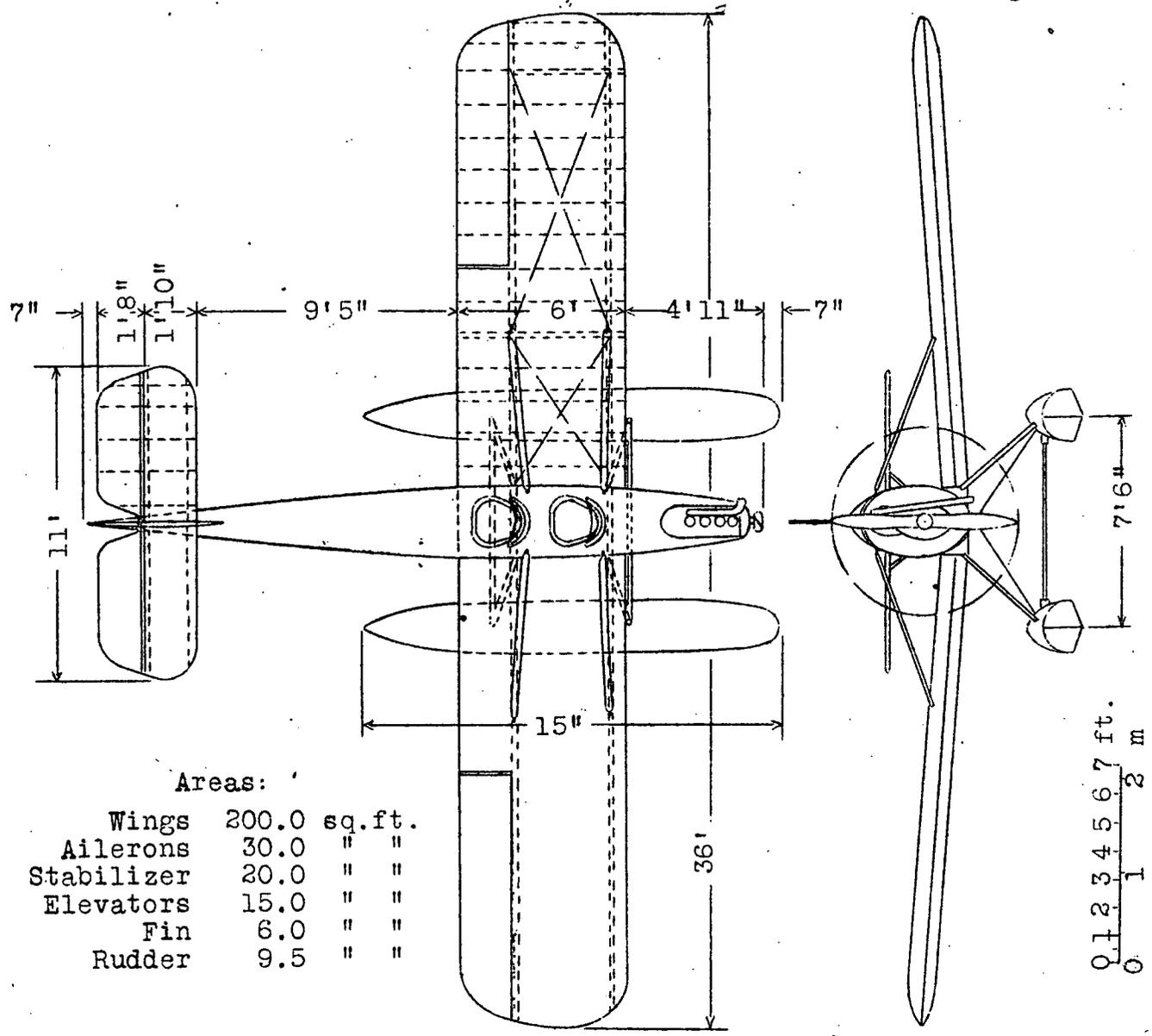
Considering the relatively low power of the engine, it is somewhat of an achievement to have produced a two-seater airplane of the seaplane type in which the surplus of power required to get over the hump speed is necessarily greater than the power required for a landplane. Nevertheless, it is not expected that there will be any difficulty in getting the seaplane to unstick, especially as exhaustive tests on models of floats have been carried out in the large tank forming part of Short Brothers' equipment at Rochester.

The main dimensions, etc., are shown on the general arrangement drawings. Following are the main characteristics of the Short "Mussel":

Weight of seaplane empty,	907 lb.
" " " fully loaded,	1400 "
Available load made up as follows:	493 "
Crew,	320 lb.
Instruments,	18 "
15 gallons of gasoline,	110 "
1½ " " oil,	15 "
Luggage,	30 "

The wing area is 200 sq.ft., giving a wing loading of 7 lb. per sq.ft. With a power loading of 23.3 lb. per HP., the following performance is estimated:

Maximum speed at sea level,	82 M.P.H.
Cruising "	65 "
Landing "	44 "
Range at cruising speed,	260 miles
Endurance at cruising speed,	4 hours.



"Cirrus"
65 HP
engine

Fig. 1 The Short "Mussel" light seaplane.

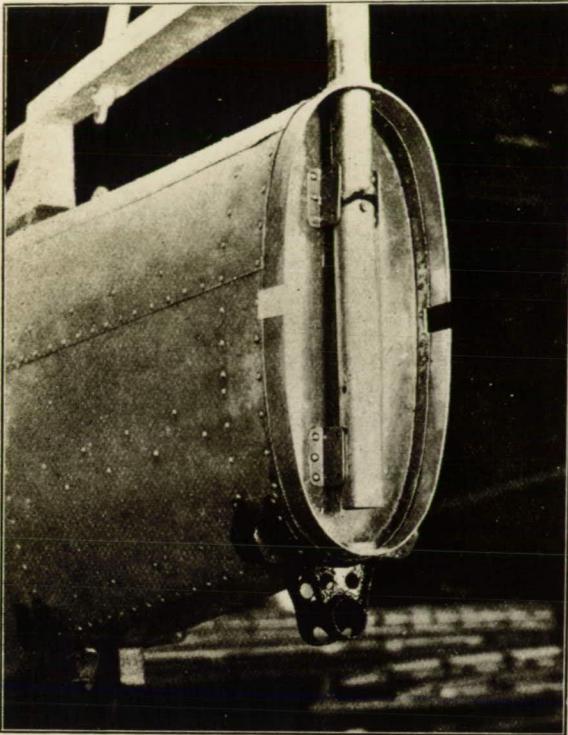


Fig.2 Photograph of stern showing neat attachment of fin and post to a duralumin plate, forming rear bulkhead of fuselage. Note the steel fittings under and to the side for the skid and struts of the stabilizer

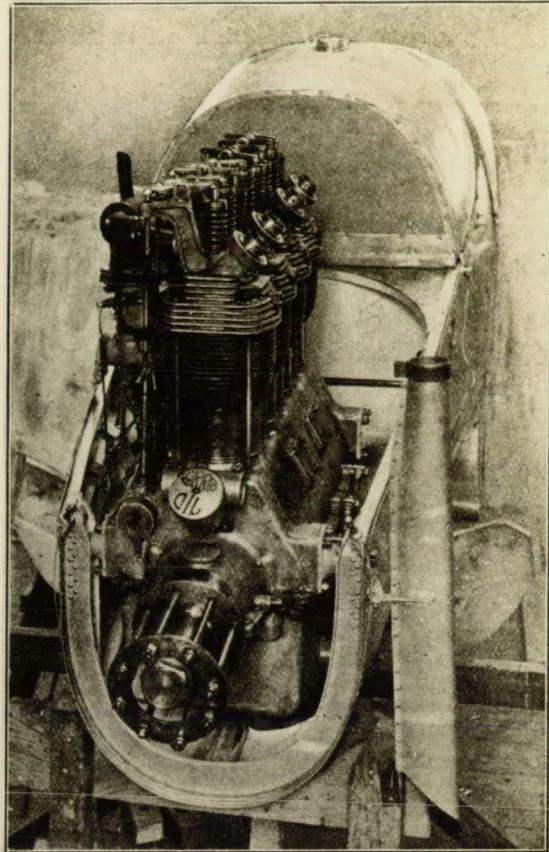


Fig.5 Photograph showing neat mounting of the "Cirrus" engine. The gravity tank may be seen above and aft of the eng.

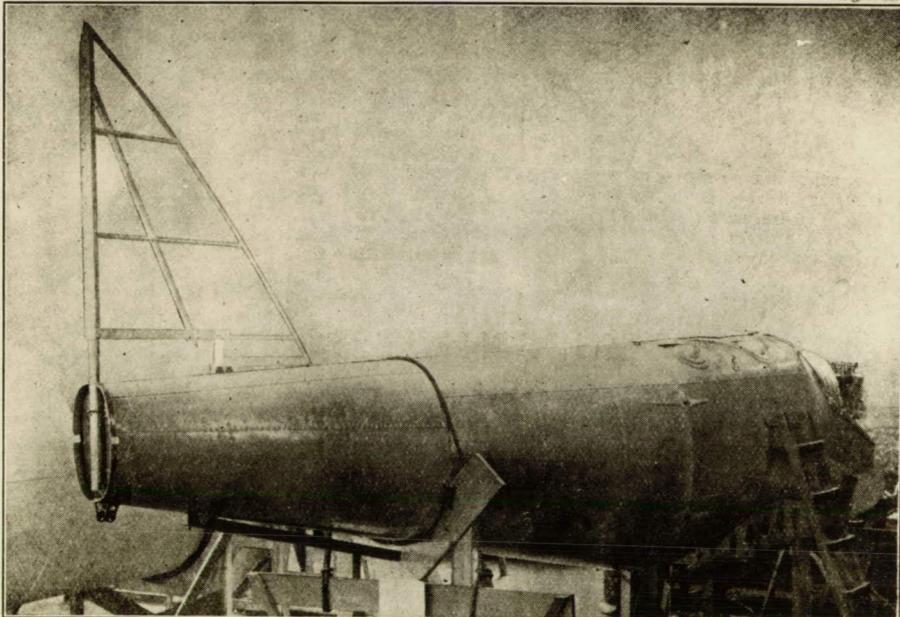


Fig.3 Photograph showing skeleton of fin

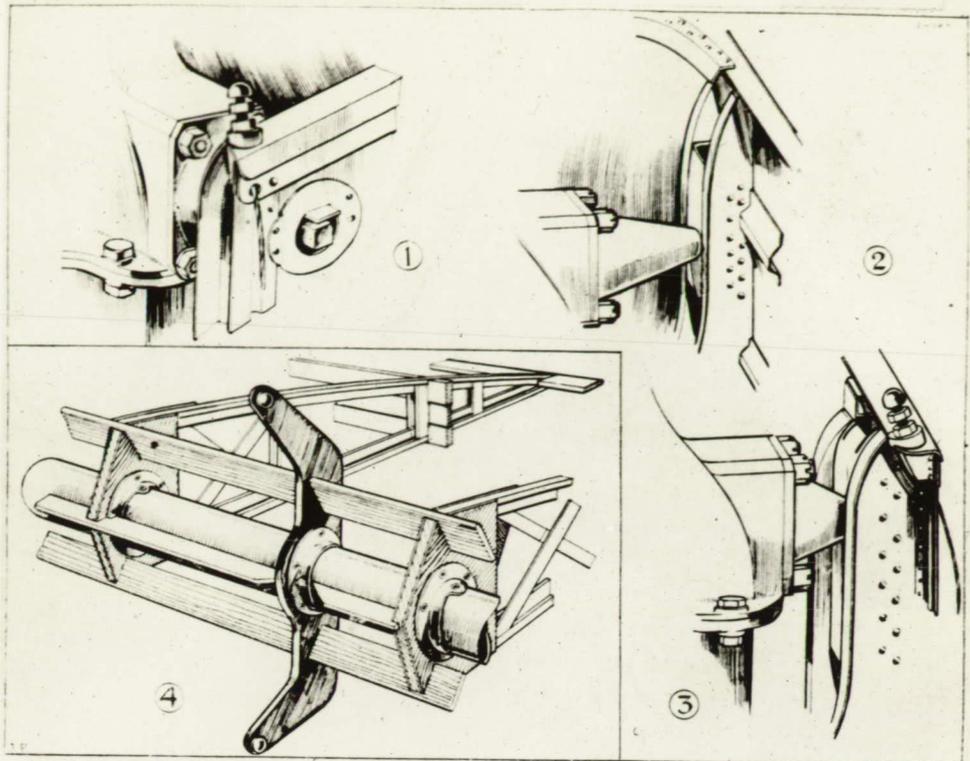


Fig. 4 Sketches of details: Nos.1,2 and 3 of engine mounting. The cone-shaped feet are bolted to channel-section formers and secured by bolts projecting through the fuselage covering and readily accessible from the outside. No.4 aileron construction, incorporating wood ribs attached to duralumin tubular spar with small duralumin sheet fittings.

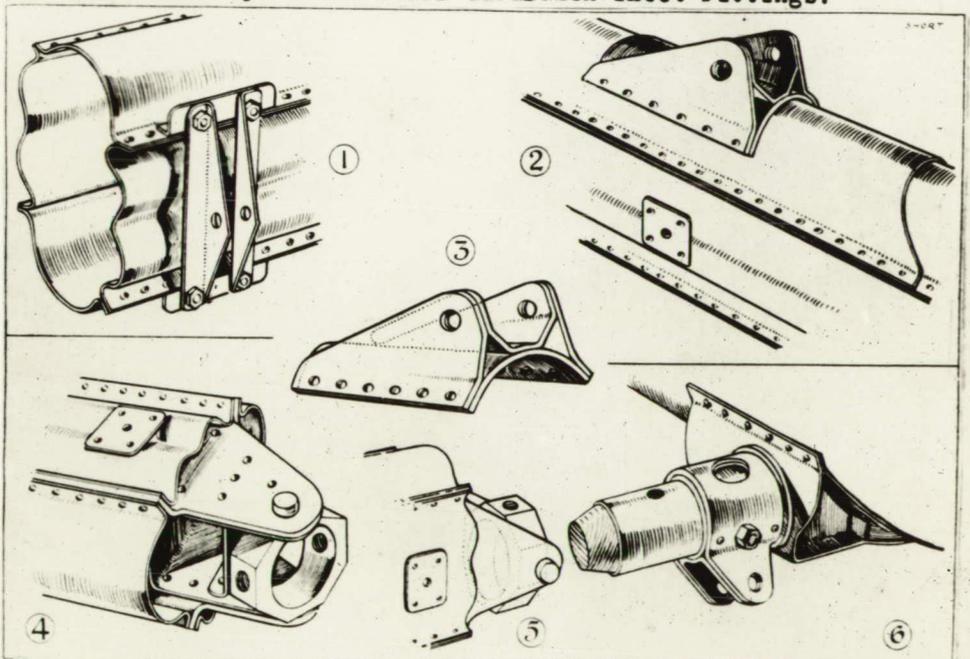


Fig. 6 Sketches of details. No.1 of spar section with aileron bracket. No.2, external view of spar showing fitting for lift strut. Fitting detail in No.3. No.4, spar root showing gimbaling. No.5, another view of same. No.6, attachment for receiving wing-gimbal mounting and landing gear strut.