3

AIRCRAFT CIRCULARS

NATIONAL ADVISORY COMMITTEE FOR AERONAUTICS

No. 169

THE BLÉRIOT 137 MILITARY AIRPLANE (FRENCH)

A Twin-Engine Multiplace Monoplane

Washington
August, 1932

NATIONAL ADVISORY COMMITTEE FOR AERONAUTICS

AIRCRAFT CIRCULAR NO. 169

THE BLÉRIOT 137 MILITARY AIRPLANE (FRENCH)*

A Twin-Engine Multiplace Monoplane

The Blériot 137 (figs. 1 and 2) is the metal modification of the Blériot 127. It belongs to the same general type as the Amiot S.E.C.M. 140 M** and the Breguet 410,*** and the S.P.C.A. 30, which will be described soon. These airplanes carry a maximum crew of five: a pilot, three gunners (including one qualified as a bomb dropper), and a second pilot (or radio operator or photographer).

The equipment consists of a rack for 500 kg (1,100 lb.) of bombs, radio sending and receiving apparatus with a range of 600 km (373 mi.) both ways, and both oblique and vertical cameras. They are completely equipped for night flying with navigation lights controlled by the pilot, position lights and signal lights.

The fundamental problem of the multiplace fighter is that of the best fields of fire. The Blériot Company, which has investigated theoretically, and then experimentally on its type 127, the possibilities of firing rearward from balconies back of the engine nacelles or wing, does not claim to have made any final solution of this problem. It has placed the two rear gun mounts on two lateral projections of the fuselage. (Figs. 3 and 4.) This arrangement has many advantages, aside from the sense of companionship while fighting off an enemy attacking from the rear. It is possible to fire downward forward of the vertical, while the dead angle toward the rear is reduced to only a few degrees.

In order to make it possible to fire downward at an angle of 75 to 90°, for which the standard gun mounts are not adapted, a machine gun is mounted on a pivot for fir-

---

*From L'Aéronautique, July, 1932, pp. 199-204.

**The Amiot 140 M Military Airplane (French) - An All-Metal Multiplace High-Wing Monoplane. A.C. No. 134, N.A.C.A., 1931.

***The Breguet 410 and 411 Military Airplanes (French) - Multiplace Sesquiplane Fighters. A.C. No. 163, N.A.C.A., 1932.

ing through a trapdoor in the bottom of the fuselage. This gun can be operated by either of the two rear gunners, in the event of an attack from below.

Systematic firing tests between pursuit planes and multiplace fighters have demonstrated that such a maneuver has little chance of success, even when the multiplace is alone. Such an attack is evidently still more dangerous, if several multiplace planes of the 127 type now in use come to the rescue, but would appear impossible with the Blériot 137, due to the firing through the bottom of the fuselage, since the lateral guns leave a very small dead sector of only 15° either side of the vertical. Figures 14 to 18 show the different firing sectors which partially overlap one another.

For example, when the right-hand gun (fig. 16) is directed 45° forward (heavy vertical line), firing is possible between 33 and 75° below the horizontal, excepting for a dead angle of 41° (33° below the level of the gun mount and 8° above it), due to the wing and engine nacelle, beyond which firing is again possible up to 75° above the horizontal. When the gun is inclined 30° downward (heavy horizontal line), firing is possible in a sector of 128°, the zero direction being a plane perpendicular to the longitudinal axis and the limiting angles 38° forward and 90° aft. For the central gun, firing is possible in the whole forward hemisphere, save for the vertical limitations of the gun mounts beyond 75°. The bottom gun (fig. 18) covers a sector of 60° transversely and 80° longitudinally (15° forward and 63° rearward).

This representation of the field of fire is not so direct as a view into space. It is more conventional, but it must be recognized that the representation of a perspective (on a sphere, for example) would cause confusion in the case of an airplane with a large number of firing stations.

Since the useful sectors partially overlap, a good method for multiplace airplanes, would be to determine the sectors covered by different guns simultaneously and differentiate them by different methods of hatching, without trying to determine whether a given point can be reached from this or that station. This would yield an immediate image of the total firing capacity of the airplane and the most favorable directions for defending it.

Tests with models have demonstrated that the lateral gun mounts of the 137 type offer less aerodynamic resistance than the balconies behind the engine nacelles on the 127 type.

The Blériot Company's solution was not lightly adopted. As always, it was the inevitable compromise between the aerodynamic and practical requirements. This compromise was the result of painstaking investigations in connection with the several new multiplace airplanes which have been produced during the past year.

The forward gun mount is of the ring type with windshield, as used on the Blériot 127, the first French combat plane in service. On the Blériot 137, this windshield, which enables firing at high speeds, is not perfectly round, but is diminished in width, in order to reduce its head resistance without diminishing the available inside space. (Fig. 2.)

We shall say but little of the construction proper. We shall try, rather, to analyze the principles and the method of the designing engineer, Mr. Kirste, to whom the problem was thus stated: "The 127 being given, design an airplane of the same power and category, with all the possible improvements in fineness, useful load, practical utilization and facility of production." We have already seen the result of these instructions in the installation of the guns.

The requirements of metal structures, from the viewpoints of cost and repairs, are well known. They consist of simplicity in design of all the parts and their assembly, with the elimination of all special shapes. All the metal sections used in the 137 are obtained by the simple folding of sheet-metal plates of standard sizes. In case of injury, the parts can be duplicated on the spot without special tools. Wherever the local stresses are great, the folding of the plates to 90° has been avoided. At this angle the rivets no longer work in shear, which is their normal function, but in tension. The spars and longerons afford good examples of folding at less than 90°, which also avoids excessive stressing of the sheet metal.

The manufacture of tapered wings is more expensive than that of wings of uniform cross section, because a pattern must be made for each rib and the parts of the ribs (flanges and bracings) will also vary along the wing

span. The wing of the Blériot 137 is tapered and has a trapezoidal plan form. Nevertheless a geometric artifice renders it possible to use, for the top of the wing structure between the two spars, like flanges for all the ribs.

If the decrease in the thickness were homothetic (i.e., proportional to the decrease in chord), the profile at the tip would be that indicated by the dash line in Figure 8. A simultaneous decrease in the relative thickness (from 17.4 per cent to 10 per cent) made it possible to use the same arc for both parts of the covering, as shown by the plain lines in the same figure. Moreover, the lower sides are flat. The inclinations α and β of the spar flanges therefore remain constant and the upper and lower coverings form perfectly developable cylindrical surfaces.

The wing of the Blériot 127, with load factors of 1.5 in torsion and 7 in flexure, weighed 429 kg (946 lb.). The wing of the 137 is much stronger, having corresponding load factors of 2.5 and 9.5, although it weighs over 10 per cent less. The cantilever portions of the wing, which have the same cross section and contour as those of the Blériot 127, weigh each 380 kg (838 lb.) instead of 429 kg (946 lb.), despite the metal covering.

All the control surfaces have trailing-edge balancing devices. Those of the elevator and rudder also serve as correctors, i.e., their position of equilibrium can be regulated in flight by the pilot, in order to offset the moments due to the stopping of an engine or a variation in the equilibrium. The combined control of the elevator obviates the use of outside rods. The balancing effect is produced by the eccentric motion d of the two ball-headed spindles integral with the shaft A. (Fig. 33.) It is obvious that, for a deflection α of the elevator, the relative setting of the balance is

$$\alpha \frac{b}{a} \frac{d}{c}$$

The correction is made by rotating the shaft B, which is controlled by the rod C. The main ball of the shaft A is situated at the hinge axis of the aileron. Figures 32 and 33 show the simple and ingenious application of this device.

The first airplane of this type was equipped with two

500 hp Salmson 18 Ab engines; the second one with two 650 hp Hispano-Suiza 12 Nb engines.

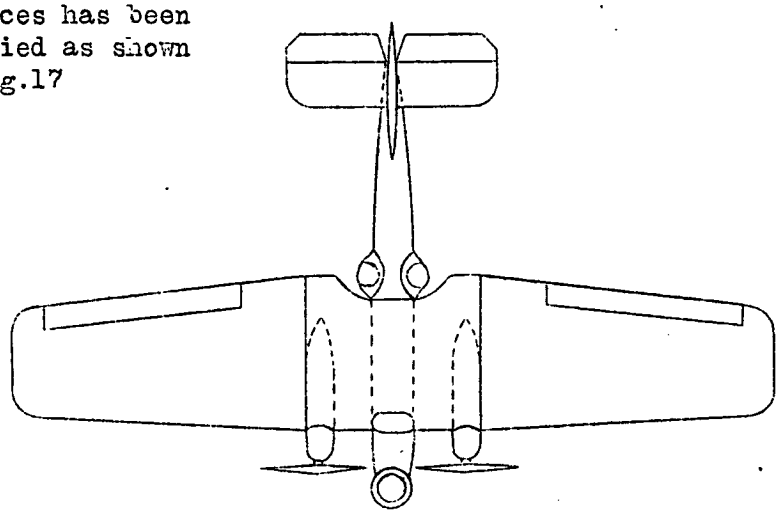
CHARACTERISTICS AND PERFORMANCES

of the Blériot 137 Equipped with Two 500 hp Salmson Engines

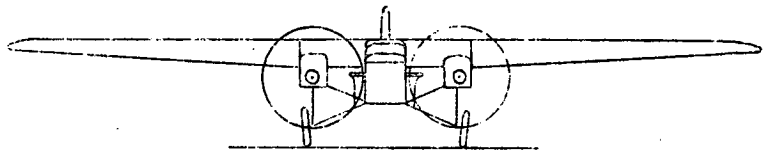
Span	23.27 m	76.34 ft.
Height	3.20 "	10.50 "
Length	14.40 "	47.24 "
Wing area	93.44 m^2	1,005.78 sq.ft.
Weight equipped	3,700 kg	8,157.09 lb.
Gross weight	5,500 "	12,125.41 "
Speed at 4,500 m (14,764 ft.)	200 km/h	124.3 mi./hr.
Climb to 6,000 m (19,685 ft.)	in less than an hour	
Range	800 km	498 mi.

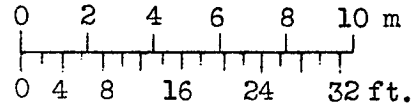
Translation by Dwight M. Miner,
National Advisory Committee
for Aeronautics.

Note: The shape of the horizontal tail surfaces has been modified as shown in Fig.17



Span	23.27 m (76.34 ft.)
Height	3.20 m (10.50 ft.)
Length	14.40 m (47.24 ft.)
Wing area	93.44 m^2 (1005.78 sq. ft.)





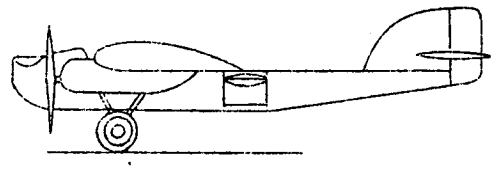


Fig.1 General arrangement drawings of the Blériot 137 airplane.

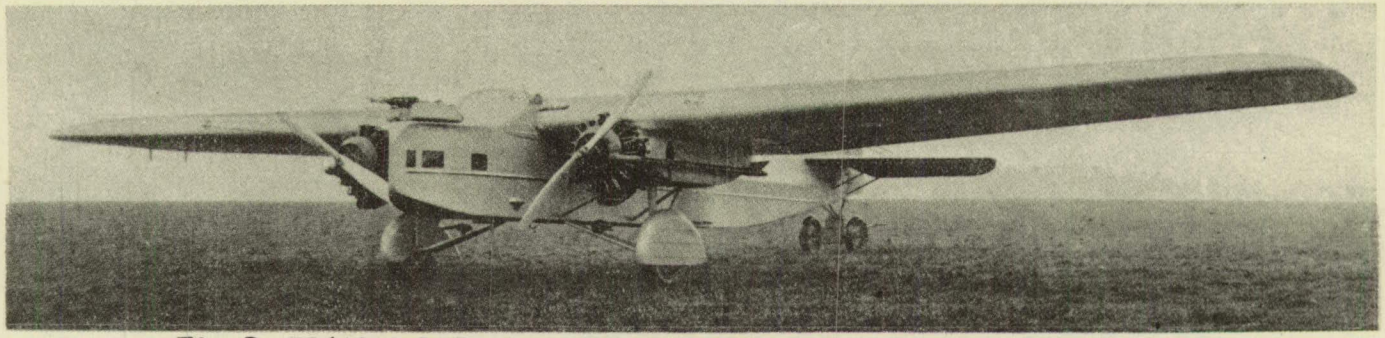


Fig.2 Blériot 137, equipped with two 500 hp Salmson 18Ab engines.

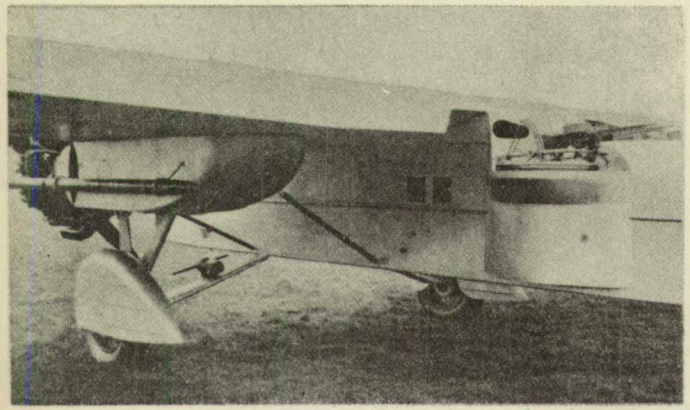


Fig.3 Note cutaway in rear of wing, to permit forward firing.

Taken from L'Aéronautique

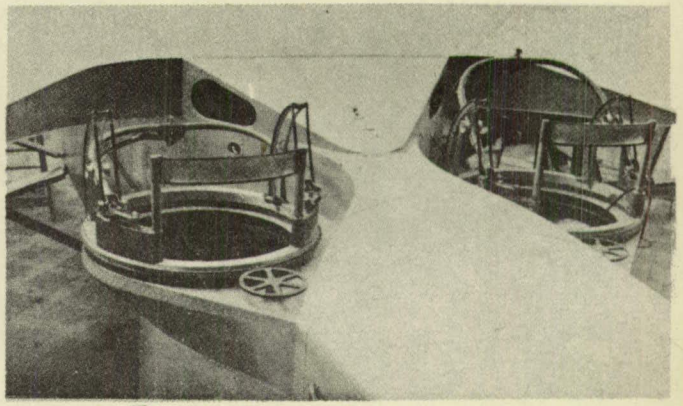


Fig.4 Lateral gun mounts.

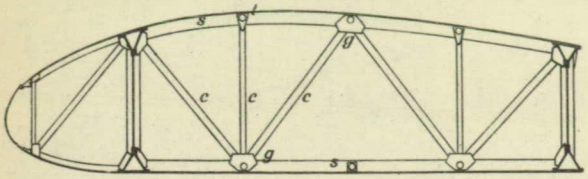


Fig.5 Main section of wing. s, rib flanges; c,braces; g, gussets; t, longitudinal tubes; spars indicated by heavy lines.

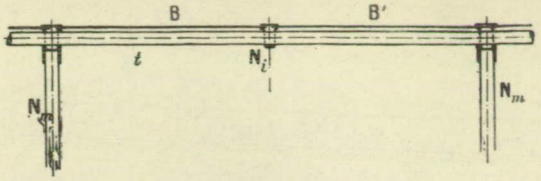


Fig.6 Attachment of covering to ribs. Each plate (B,B') covers the space between a main rib N_m and an intermediate rib N_i. t, tube holding N_i; B and B' are joined by a fishplate.

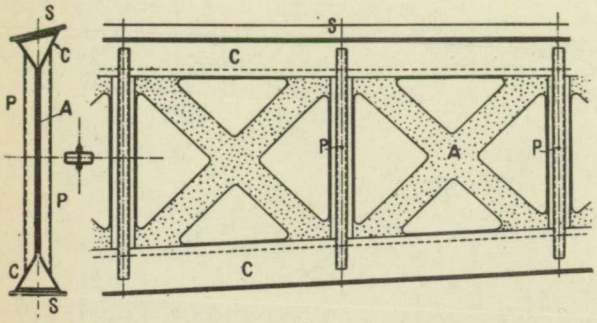


Fig.7 Vertical end and side views of spar. A, openwork web whose vertical parts are reinforced by stiffeners P of U cross section; C, oblique angle pieces connecting flanges S with web A.

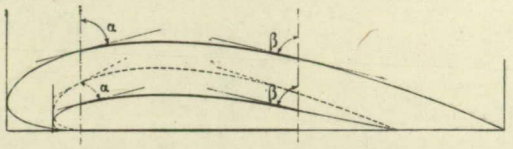


Fig.8 Evolution of the profile along the span.

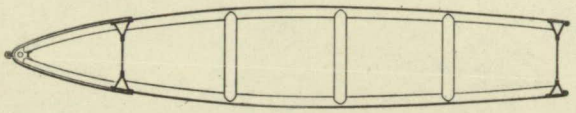


Fig.9 Stabilizer structure. The covering of the leading edge is in two parts.

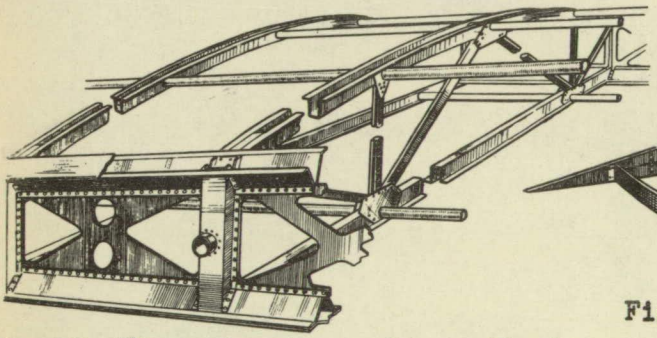


Fig.10 Wing structure. On vertical stiffener of rear spar, note stud for centering the trailing edge.

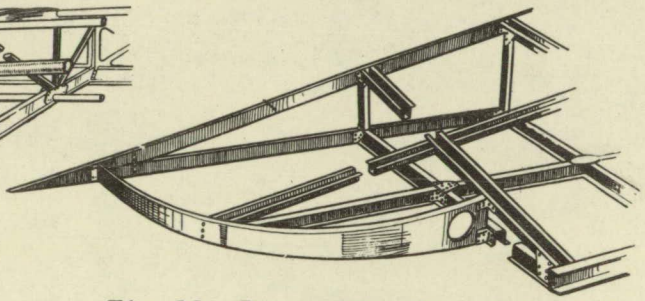


Fig.11 Removable tip of trailing edge.

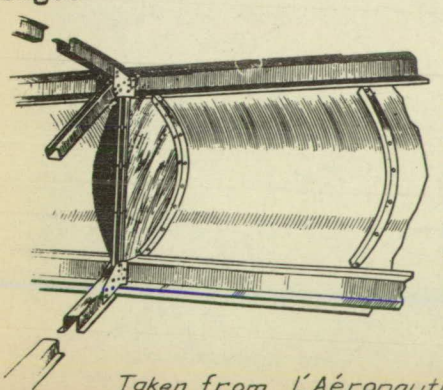


Fig.12 Inside view of leading edge of wing, with formers.

Taken from L'Aéronautique

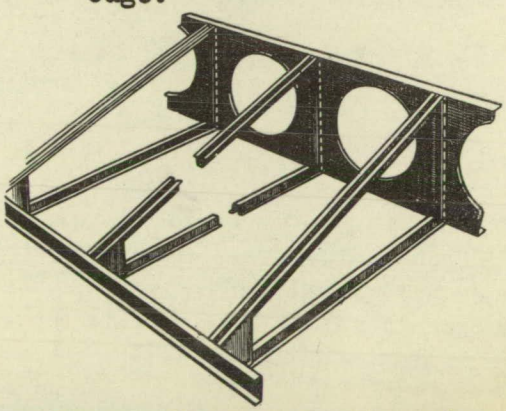


Fig.13 Aileron. Note U at rear edge, in which pivots the balancing flap shown in Fig.33.

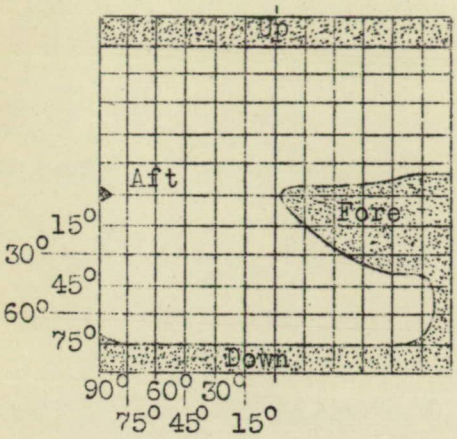


Fig.14

a, Gun inclined 45° forward
b, " " 30° downward

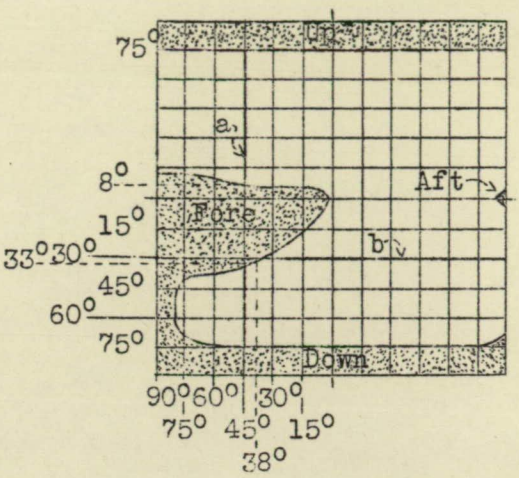


Fig.16

Figs.14,15,16 Firing sectors of left, central and right machine guns. Fig.17 Plan view of Blériot 137 airplane. Fig.18 Firing sector of fourth machine gun, firing through bottom of fuselage. Dead angles are indicated by the hatching.

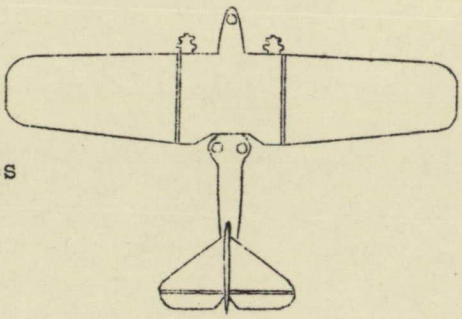


Fig.17

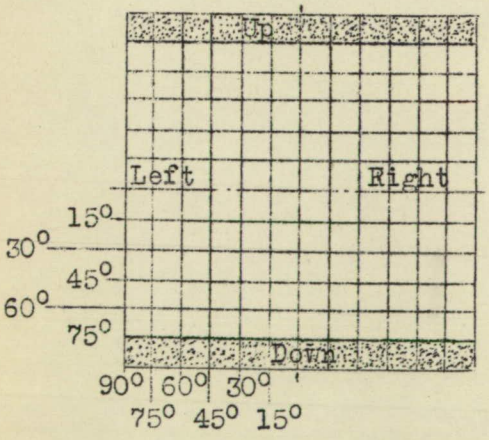


Fig.15

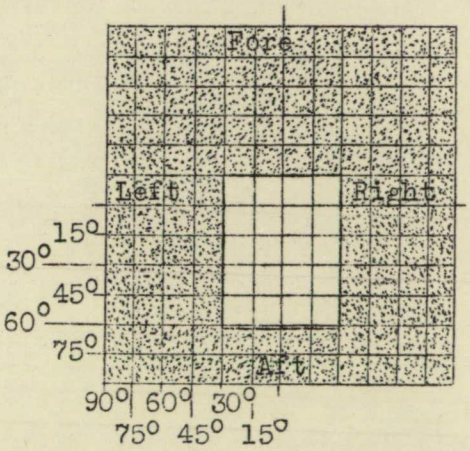


Fig.18

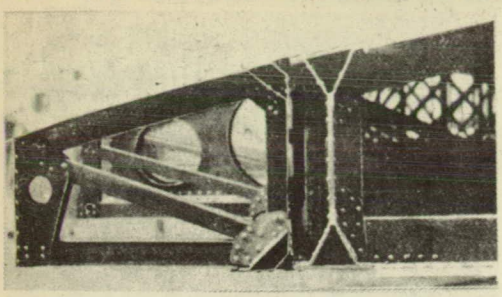


Fig.19 Assembly of the trailing edge to the rear spar.

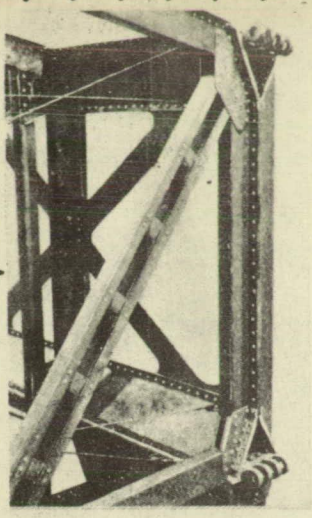


Fig.20 Central portion of wing showing four-part attachments for lateral portion.

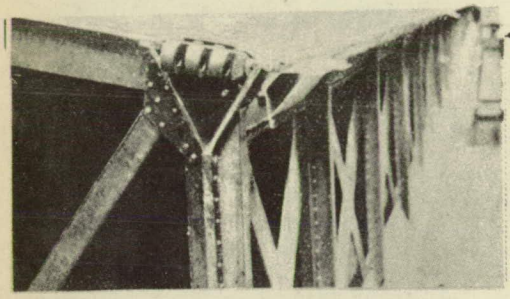


Fig.21 Portion of lateral wing, showing attachment and bracing of spar flange. Note bend of less than 90°.

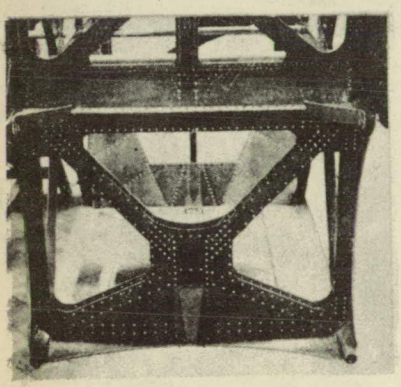


Fig.23 Wing attachments for engine bearer.

Taken from L'Aéronautique

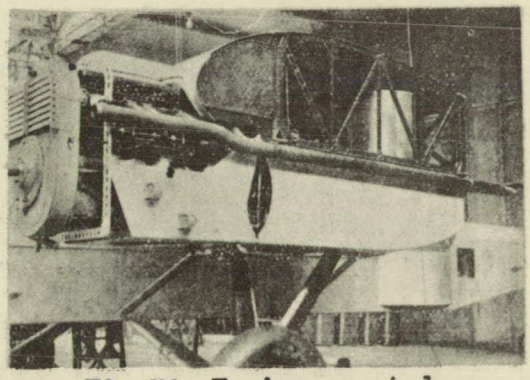


Fig.24 Engine mounted on wing.

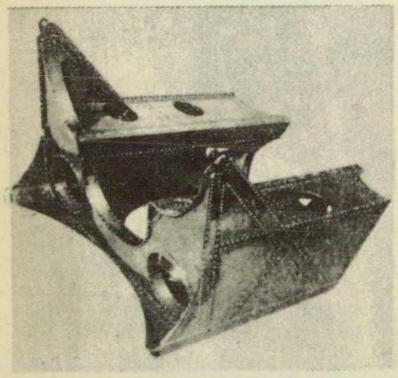


Fig.25 Rear view of bearer.

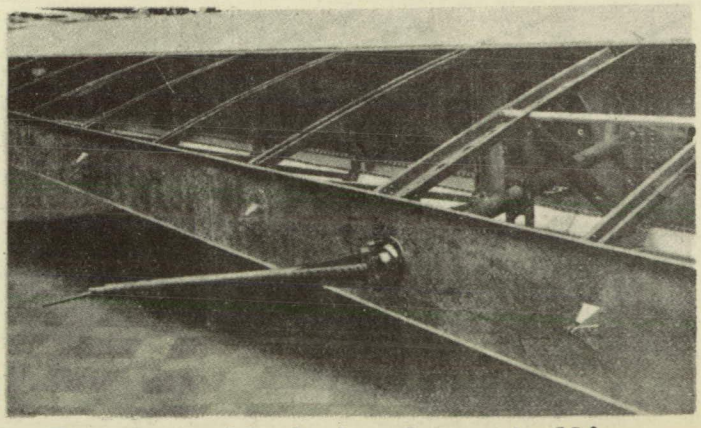


Fig.32 Inside device for controlling aileron balancing flap.

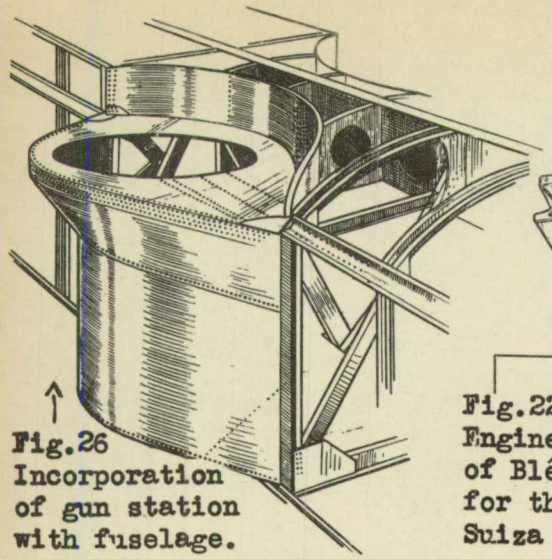


Fig.26 Incorporation of gun station with fuselage.

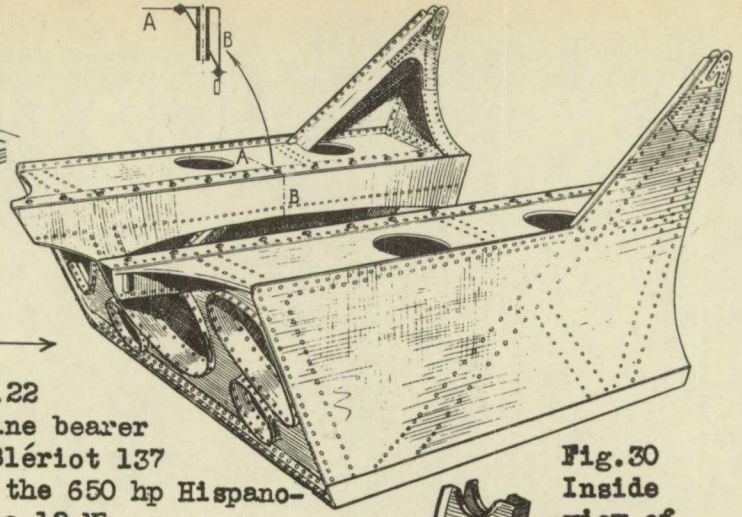


Fig.22 Engine bearer of Blériot 137 for the 650 hp Hispano-Suiza 12 Nb.

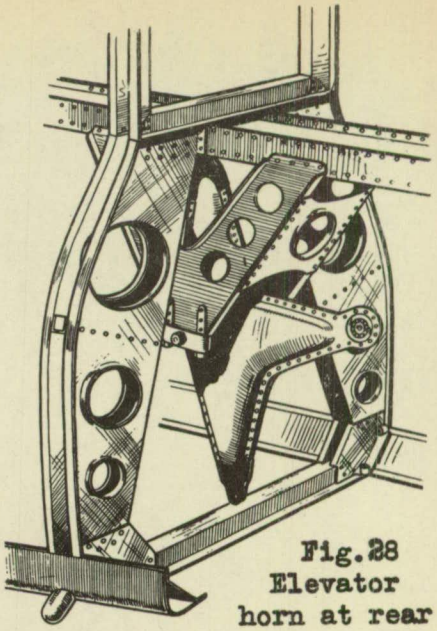
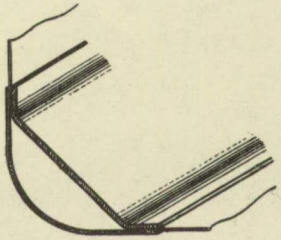


Fig.28 Elevator horn at rear of fuselage. On bottom of frame, a centering stud for the tail skid.

Fig.27 Section of longeron. Note bends of reinforcing strip at less than 90°.



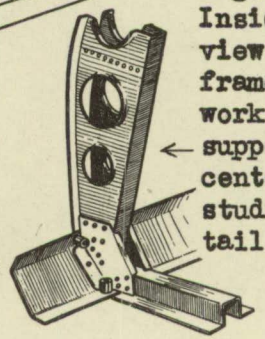
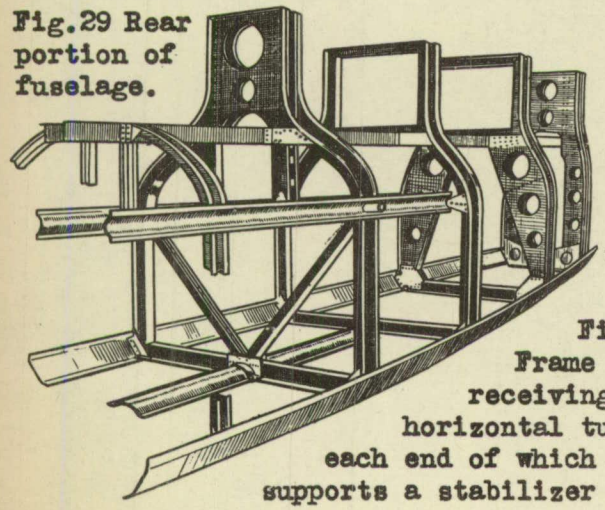


Fig.30 Inside view of framework supporting centering stud for tail skid.

Fig.29 Rear portion of fuselage.



Taken from L'Aéronautique

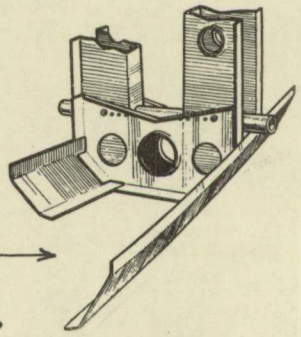
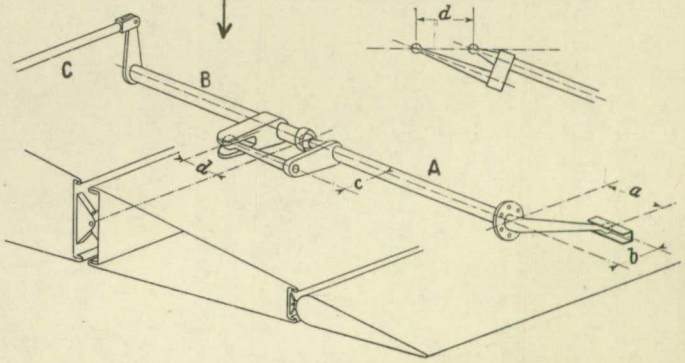


Fig.31 Frame for receiving a horizontal tube, each end of which supports a stabilizer strut.

Fig.33 Correcting and balancing device for trailing edge of control surfaces.



Figs.22,26,27,28,29,30,31,33