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AIRCRAFT CIRCULARS

NATIONAL ADVISORY COMMITTEE FOR AERONAUTICS

No. 157

THE LOIRE 11 COLONIAL MILITARY AIRPLANE (FRENCH)*

A High-Wing Semicantilever All-Metal Monoplane

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A High-Wing Semicantilever All-Metal Monoplane

By P. Loyer

The "Ateliers et Chantiers de la Loire," whose aeronautic activity was originally limited to the construction of the Loire-Gourdon-Leseurre pursuit planes, has considerably extended the scope of its work during the last two years. Parallel with its naval construction, the company has begun, in its new and well-equipped shops, the construction of new airplane types.

The "Ateliers et Chantiers de la Loire" are equipped for metal construction. Their first two airplanes, the Loire 11 landplane and the Loire 50 seaplane, are very interesting to study, because they embody the technique thus far developed by the bureau of research.

The Loire 11 introduces a novel method of metal construction and original solutions of problems of detail. We will explain the principles in the text and leave the comments on the problems of detail to the legends.

PRINCIPLES OF CONSTRUCTION

Materials

Duralumin in its simplest forms of sheets, strips and open channels; the most limited use possible of special shapes (spar flanges, for example); few tubes; steel fittings, class 34; a certain number of cast-alpax parts (supports, rudder pedals, shims), preferably of like parts made in quantity; no autogenously welded parts.

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* L'Aéronautique, January, 1932, pp. 5-10.

WING

Warren-girder structure. - This comprises two L and L' (fig. 3, a and b) between which are arranged the ribs E placed zigzag at angles of 60°. These ribs have profiles corresponding to oblique sections of the wing and support the covering by means of strips l. The patent describing this construction** likewise covers its application in the case of wings with several spars (fig. 3, c). According to the inventor, the principal advantages of this structure are:

1. Compression bars or ribs E which brace the wing and occupy the whole height of the profile. They can not buckle, because they are connected by the strips l.

2. The cross bracing is light and produces a remarkable torsional rigidity. This structure is practically indeformable, even without the covering. The covering can be attached after the wing has been mounted, without fear of deformation during the process of riveting.

3. The ribs E (fig. 3, d) are joined together and to the spars by standard fittings F, or more exactly by gussets, the large number of which (12 per joint N) enables economical production. All the joints are alike.

No plate girders. - This type of girder, much used in bridge construction, has been eliminated from the wing. In these girders the flanges comprise several plates riveted together by means of straps. The lattice bars are attached to the flanges with the aid of gussets and angles. The bars working in tension consist of simple angles, while the bars working in compression are composed of U channels or multiple angles. The assemblage is made by numerous rivets. The working stresses are generally far below the elastic limit of the materials used, so as to allow for any possible deterioration of the rivets from vibration.

In the Loire 11 plain sheet metal, lightened by round triangular holes with crimped edges, was used wherever possible (spar webs and ribs). Thus the riveting was reduced to a minimum, since the web is only a perforated plate.

** French patent 685,793 (March 1, 1929), Société Anonyme des Ateliers et Chantiers de la Loire (A. Asselot's invention), "Mode de construction d'ailes d'appareils volants."

Lastly, the wing is composed of disconnectable parts, each semiwing having a leading edge and a trailing edge, attached by hinges.

BRIEF DESCRIPTION OF THE LOIRE 11

Wing

The wing has an elliptical shape with a slight dihedral; Clark YH section or profile, with slight displacements of the center of pressure; two conventional ailerons differentially controlled, and two auxiliary ailerons to facilitate landing on rough ground. Each half of the wing is attached to the fuselage at the top of the cabin. The wing has no ordinary ribs, and the covering is attached to strips or stringers.

Fuselage

The structure of the fuselage is based on the same principles as that of the wing. It consists of two vertical Warren girders braced by transverse frames riveted to gussets. The plain sheet-duralumin covering participates in the stresses. It is attached to the girders by means of longitudinal stringers.

The fuselage, the front end of which supports the engine bearer, is divided into two parts assembled by four ball-and-socket joints along the oblique planes P_1 and P_2 determined by two transverse members of the Warren girders.

The landing gear is of the divided-axle type, with Messier shock absorbers of 180 mm (7 in.). Each axle is carried by the two lower struts, whose junction forms a box. The airplane has wheel brakes and a tail skid with a Messier shock absorber.

The rather complex equipment is similar to that of colonial three-seaters, which has been repeatedly described, and is adapted to the following uses: messenger, observation, bombardment, ambulance.

The Loire 11 has a disconnectable dual control; a glass roof which can be opened in flight, permitting exit

by parachute. Behind the cockpit there is a cabin 3.25 m (10.66 ft.) long, 1.65 m (5.41 ft.) wide and 1.2 m (3.94 ft.) high. This cabin can hold a wounded man on a stretcher and an attendant seated at his head.

The equipment embraces everything required for night flying, including navigation and position lights, landing lights and Michelin flares. The armament comprises two machine guns on Scarff mounts above the cabin and a box of 30 hand grenades; 12 rockets for distress signals in case of breakdown. The airplane is also equipped with two-way radio, 100 km (62 miles) range, with emergency generator.

Power Plant

The original plan was to use a Salmson 9Nb of 250 hp engine. Due to an increase in the general equipment, necessitated by changes in design during its construction, the total weight was increased from 1720 kg (3792 lb.) to 1920 kg (4233 lb.), which made it necessary to install a more powerful engine, the 300 hp Lorraine "Algol".

The sheet-metal engine bearer, attached to the fuselage by four bolts, supports the oil tank forming a radiator, the 10 kg (22 lb.) fire extinguisher, all the oil pipes and the instrument board. The metal propeller is a Levasseur or Ratier. An N.A.C.A. engine cowling protects the delicate distribution mechanism from projections of sand.

CHARACTERISTICS

Span	16.50 m	54.13 ft.
Length	10.00 m	32.81 ft.
Height	3.25 m	10.66 ft.
Wing area	35 m^2	376.74 sq.ft.
Weight empty	1120 kg	2469.17 lb.
Total weight	1920 kg	4232.87 lb.

PERFORMANCES

(Announced with "Algol" engine)

Speed, with a total weight of 1750 kg (3858 lb.) and at 1800 r.p.m.,	201 km/h	124.9 mi./hr.
Range	600 km	373 miles

LEGENDS

FIGURE 1.-General arrangement drawings of the Loire 11 airplane.

FIGURE 2.-Metal structure of Loire 11. Note arrangement, in Warren girders, of wing ribs and sides of fuselage.

FIGURE 3.-Wing structure of Loire 11 in Warren girders.

FIGURE 4.-Fuselage elements. The bracings of the lateral Warren girders are represented by fine lines. The frames are dot-hatched. Letters indicate location of certain structural elements shown in detail in Figures 5-7.

FIGURES 5-7.-Details of elements A, B' and E in Figure 4. In Figure 5, note assembly by gussets. In Figure 7 a mooring ring is visible under the sternpost.

FIGURE 8.-Ball-and-socket joint (R in fig. 4) between front and rear parts of fuselage; L', lower rear longeron; M_1 and M_2, oblique struts of front part; M', oblique strut of rear part (This strut prevents disadjustment of rear part in disassembling.); P, reinforcing plate on longeron for attaching ball-and-socket joint.

FIGURE 9.-Joint B in Figure 4. In this longeron, consisting of a U channel with crimped edges, are placed blocks of stamped duralumin, which insure the union of the two parts of the box frame. The inner gusset, with crimped edges, is in one piece. The small outer gussets insure the perfect union of the longeron and front frame before covering.

FIGURE 10.-Passage of a stringer through a wing rib. The stringers are of equal strength vertically between two

successive points of passage.

FIGURE 11.-Typical assembly of two ribs with a wing spar (joint N, fig. 3, d). The spar L has two slotted flanges of the Wibault type and a web lightened by triangular or circular holes with crimped edges. The ribs E, set obliquely at 60° to one another and to the spar, have crimped edges, reinforced by angles to form the flanges, and webs lightened like the web of the spar. Four standard gussets of stamped duralumin are shown, all having an angle of 60° at the apex and connecting one of the ribs with the spar. The lower gusset is attached to the spar flange with the intermediation of a reinforcing angle. Between the ribs is shown a gusset with a lug forming a hinge for attaching the trailing (or leading) edge of the wing.

FIGURE 12.-Joint A' in Figure 4. The assembly is effected by a longitudinal gusset folded at right angles and a stamped transverse gusset.

FIGURE 13.-Dumping device. 1, attachment for wing strut and landing-gear strut; 2, transverse frame of fuselage; 3, support for pinions 4 and 5; 4, control pinion for separating fuel pipe; 5, control pinion for dumping; 6, shaft for supporting tank 8 by means of section 7, and resting at its ends in the sockets 10; 9, fuselage stringer; 11, roller cage. A pull on the dumping cable turns pinion 5. The latter rotates the socket 10, which makes a semiturn. The parallel-faced ends of shaft 6 come opposite the slots in the roller cages 11. The tank drops forward and is then released from the rear.

FIGURE 14.-Mechanism for disconnecting the fuel pipe. The drawings represent a vertical section and a horizontal section through S in Figure 13. Tightness is obtained by contact of collars 1 and 9, which are held against each other by the nut 4. When key 8 is pulled out, the two jaws of the clamping collar 2 open wide under the action of the flat spring 6. The collar 5 is then no longer held together and separates into four sectors, s_1- s_4 under the action of the round spring 7. The collars 1 and 9 are then released. The dumped tank carries collar 9 with it, while collar 1 remains on the airplane.

FIGURE 15.-Ball-and-socket joint connecting two parts of fuselage.

FIGURE 16.-Pin for attaching wing spar to longeron. 1, reinforcing box; 2, shock-absorbing angles; 3, pin; 4, shims; 5, fixed socket; 6, screw integral with socket 5 for attaching compression bar; 7, plates for attaching strut; box for longeron; 9, 10, web and flange of longeron. The wing strut is attached to the neutral axis of the longeron with the aid of the two plates 7 of high-tensile steel. The plates slide on the box 8, to which they are attached by the pin 3, which extends into box 1 and tightened by 6.

FIGURE 17.-Leading edge of wing.

FIGURE 18.-Aileron and trailing edge.

FIGURE 19.-Fuselage frame with chief pilot's seat.

FIGURE 20.-Portion of longeron near attachment of wing spar and aileron control.

FIGURE 21.-Tip of wing.

FIGURE 22.-Dual aileron and elevator control. B, locking lever. The bowden wire b ends at the clutch E of the elevator control. T, aileron control corresponding to tubes T of Figure 23. The rotation of the wheels is transmitted to the tubes T by chains and cog wheels.

FIGURE 23.-Differential aileron control. This renders it possible to lower simultaneously the auxiliary, as well as the conventional ailerons. When the pilot pulls the lever L toward himself and locks it on the notched quadrant S, he simultaneously pulls the tube V and engages the small rod b. This rod, the details of which are shown in Figure 24, moves the guide G in a system of three concentric tubes with helicoidal grooves. (For greater simplicity, this system is here represented in the form of a solid cylinder supported at its ends by the collar BB and the fitting F.) When G moves in the direction of the arrow, the horns integral with the rods A_g and a_d which activate the left and right ailerons respectively, turn through an angle α toward each other. This lowers by 15° the regular ailerons, which, at their lowest position, still retain a freedom of 10° for warping. D, clutches

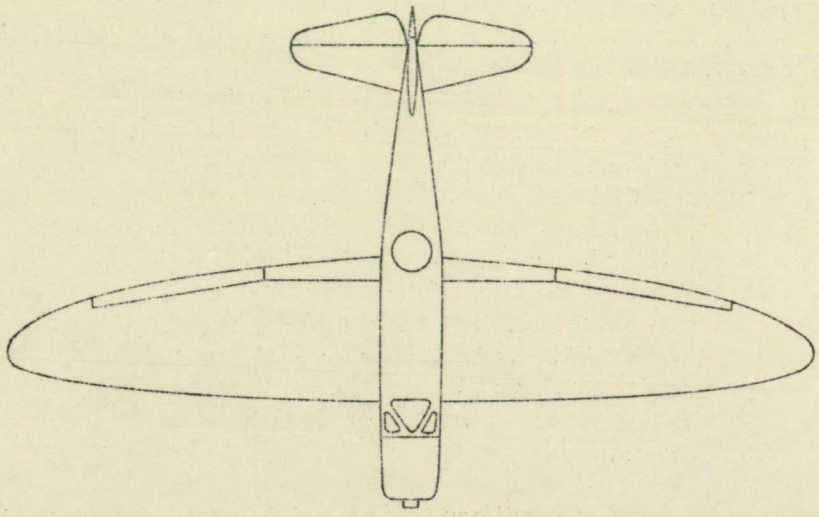
for tubes T; M, socket for control stick. Pulling V lowers the auxiliary ailerons.

FIGURE 24.-The letters BB, F, G, A_g, A_d and b designate the same parts as in Figure 23. 1, flange with ball bearings; 2, horn for control of right aileron; 3, horn for control of left aileron; 4, tube integral with horn 3 with right-hand helicoidal groove; 5, tube for control of warping, with axial groove in which moves the guide G; 6, tube integral with horn 2 with left-hand helicoidal groove; 7, sliding socket controlled by rod b. f_1 and f_2 represent respectively the directions of rotation of tubes 4 and 6, when b and socket 7 engage in the direction of the arrow.

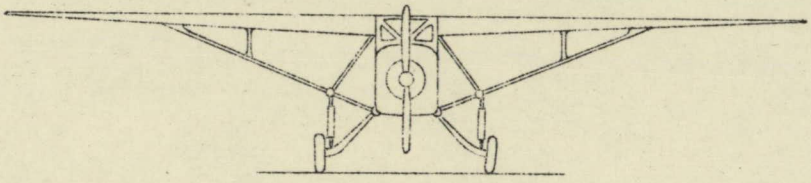
FIGURE 25.- Side view of the Loire 11 military airplane.

FIGURE 26.-Three-quarter front view of the Loire 11 showing semicantilever construction.

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



Span 16.50 m (54.13 ft.) Height 3.25 m (10.66 ft.)
Length 10.00 m (32.81 ft.) Wing area 35 m^2
(376.74 sq.ft.)



Feet
0 5 10
0 1 2 3
Meters

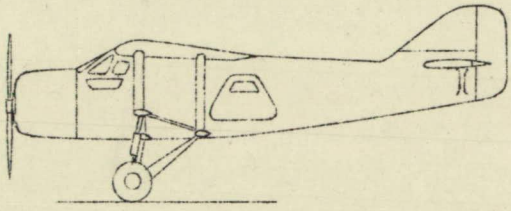


Fig.1 General arrangement drawings of the Loire 11 airplane.

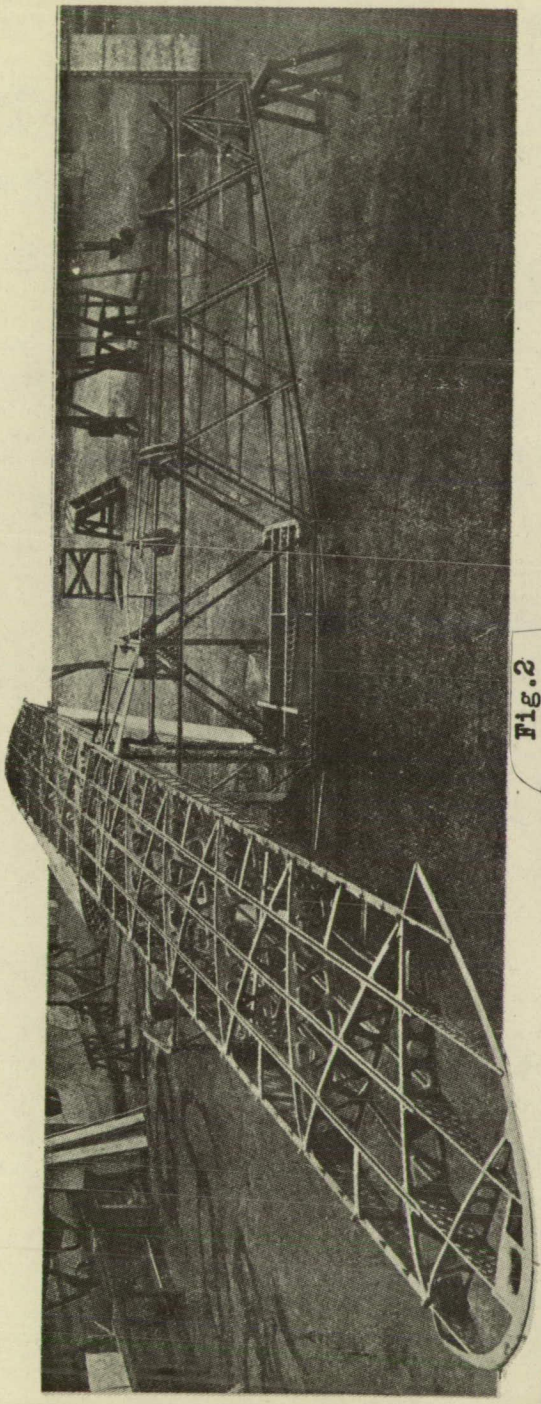


Fig.2

Taken from
"L'Aéronautique"
Jan. 1932

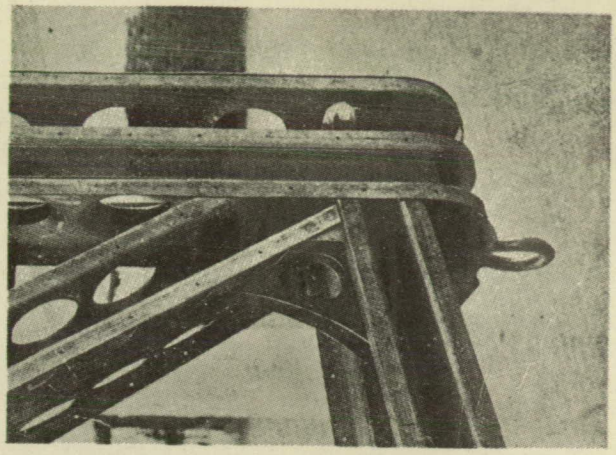


Fig.7

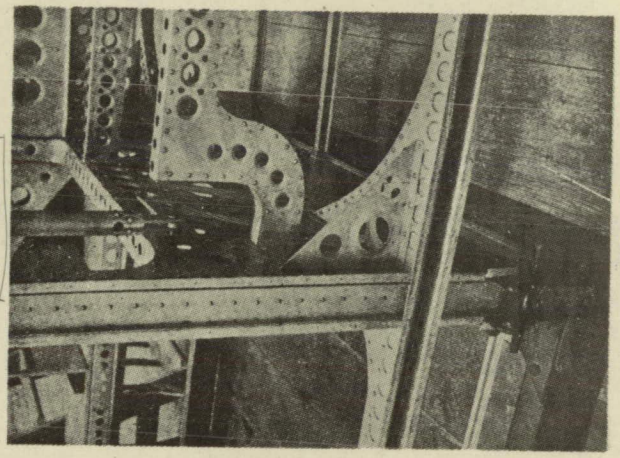


Fig.6

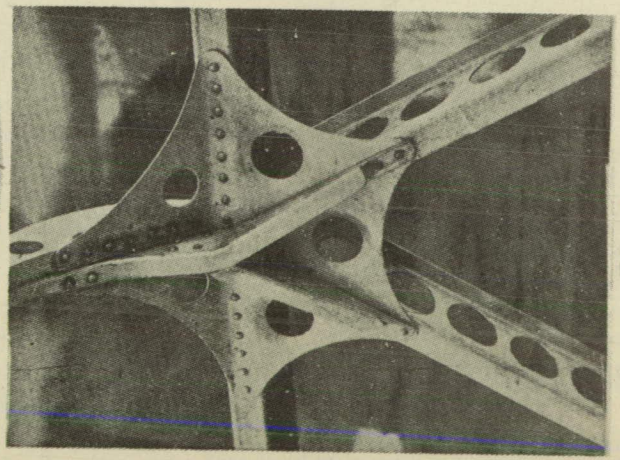


Fig.5

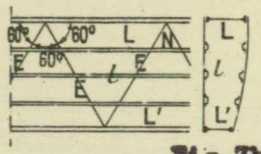


Fig.3a

Fig.3b

Fig.3c

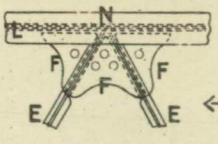


Fig.3d

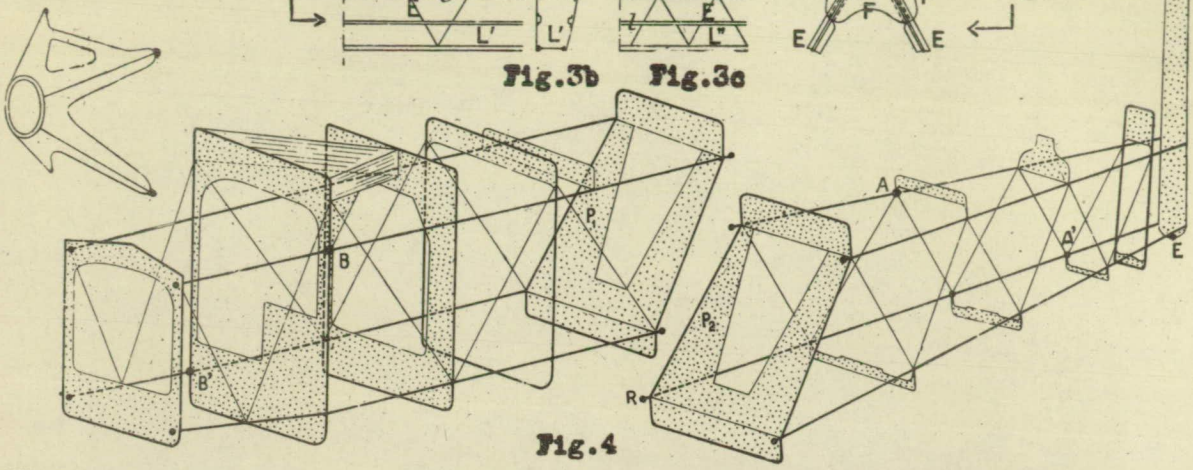


Fig.4

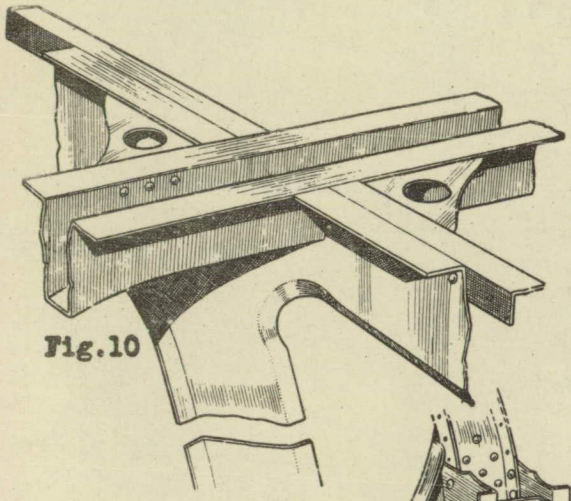


Fig.10

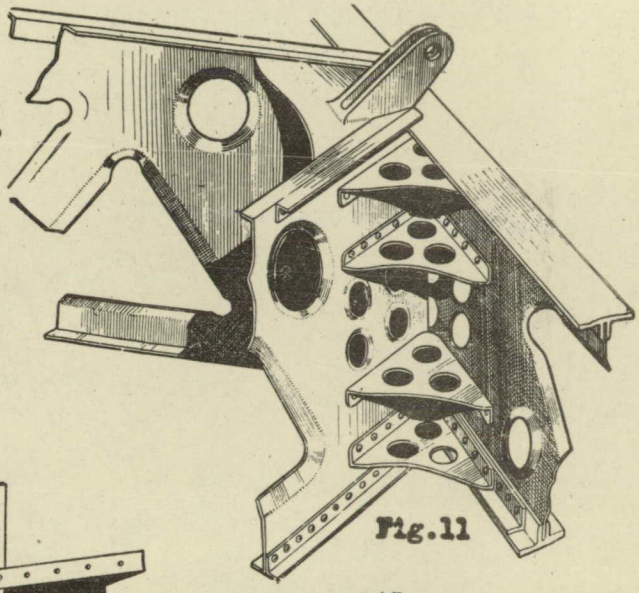


Fig.11

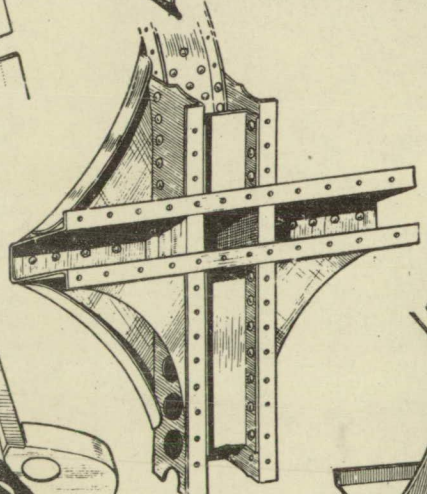


Fig.9

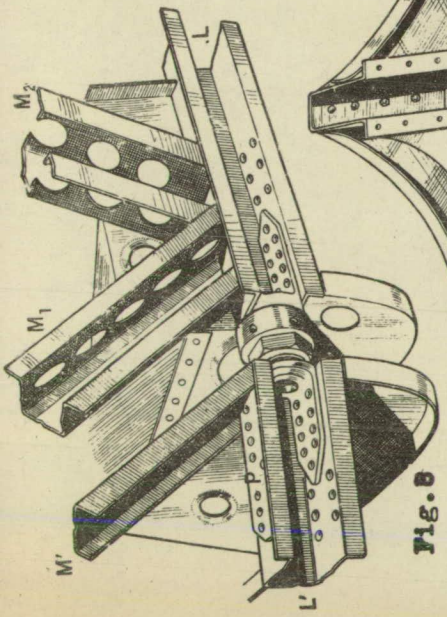


Fig.8

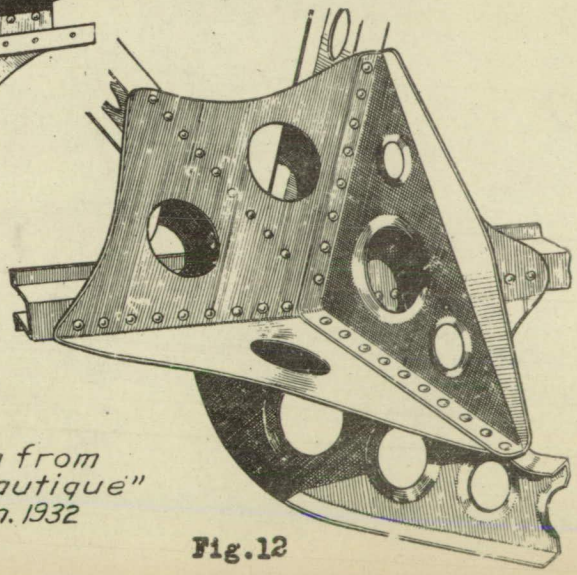


Fig.12

Taken from
"L'Aéronautique"
Jan. 1932

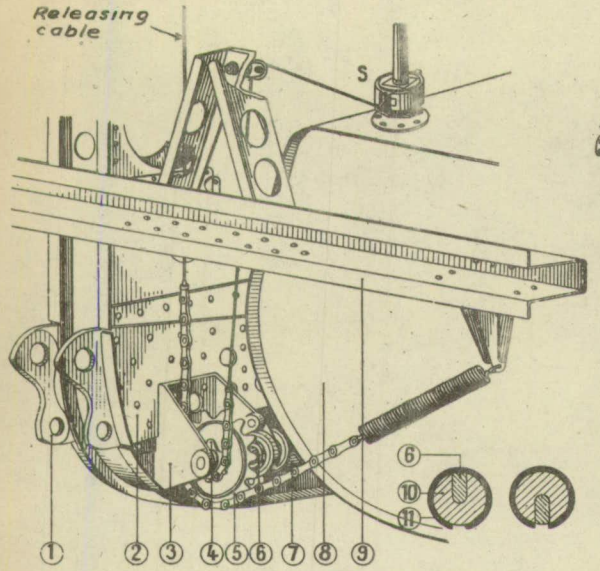


Fig.13

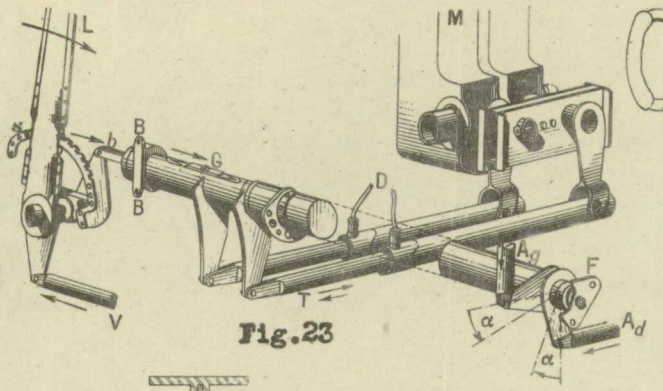


Fig.23

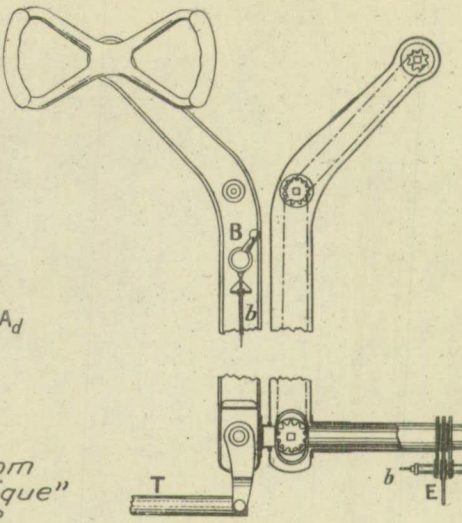


Fig.22

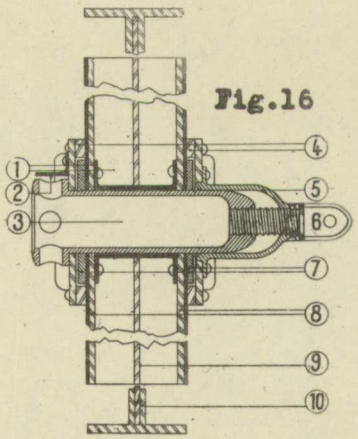


Fig.16

Taken from "L'Aéronautique" Jan. 1932

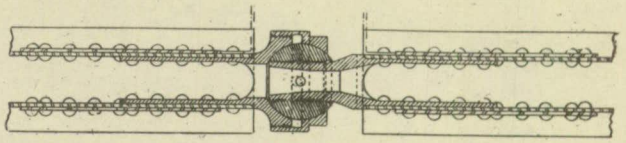


Fig.15

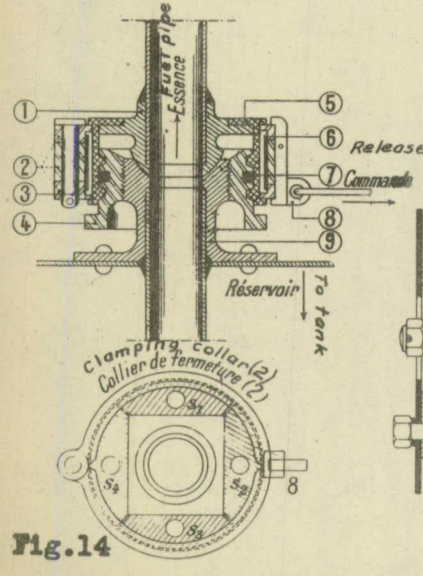


Fig.14

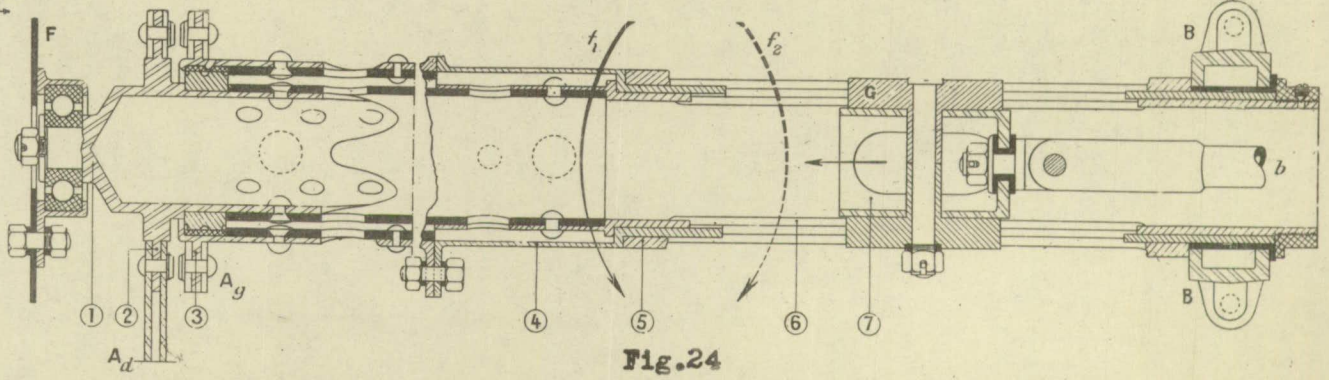


Fig.24

Figs.13,14,15,16,22,23,24

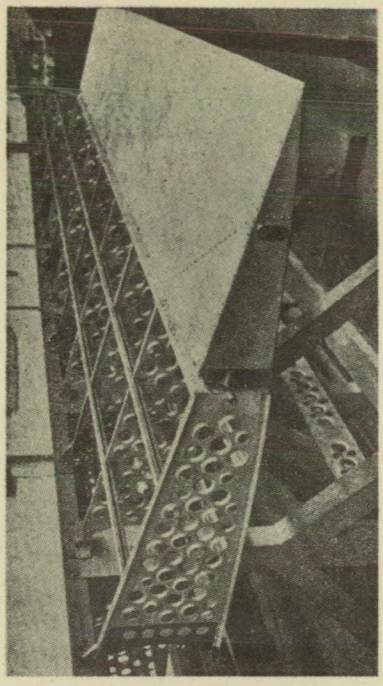


Fig.18

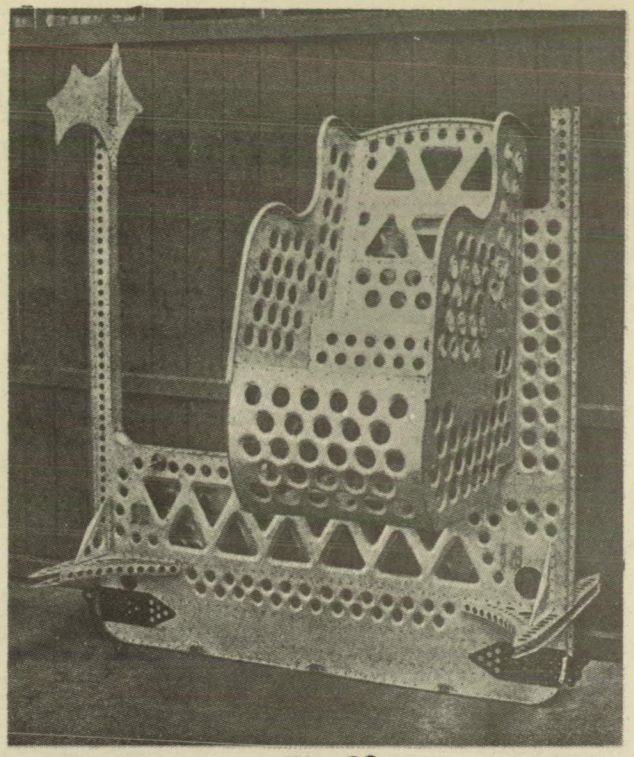


Fig.19

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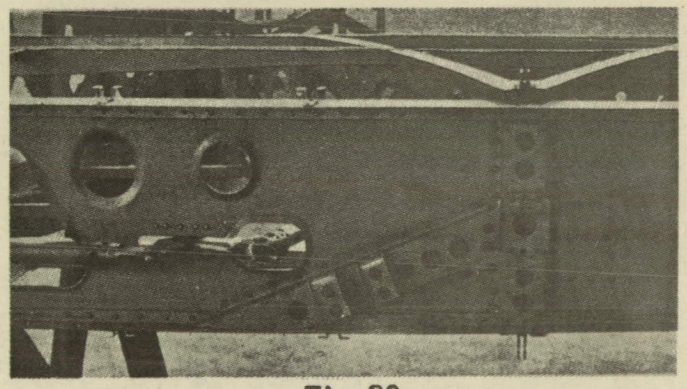

Fig.20

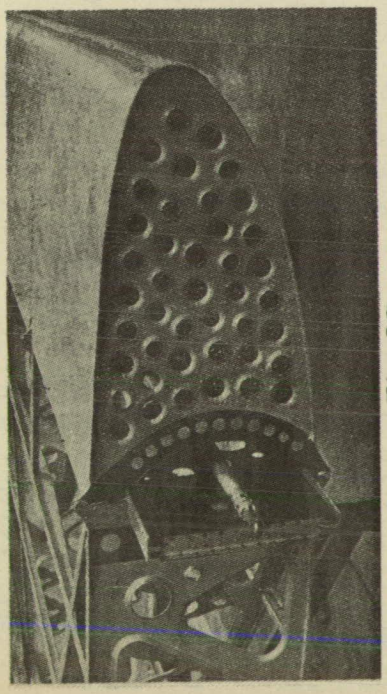

Fig.17

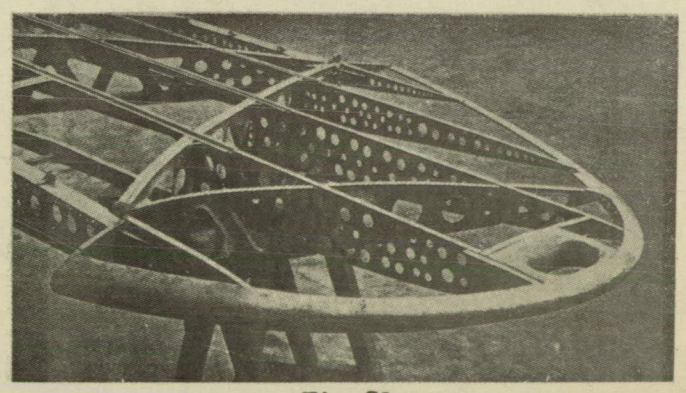

Fig.21

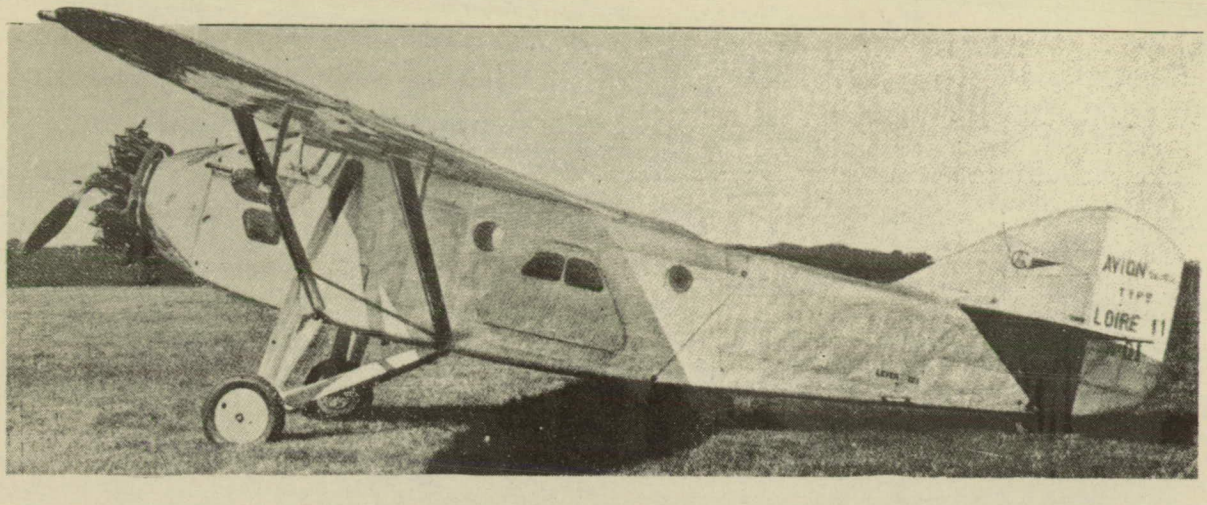

Fig.25 Side view of the Loire II military airplane.

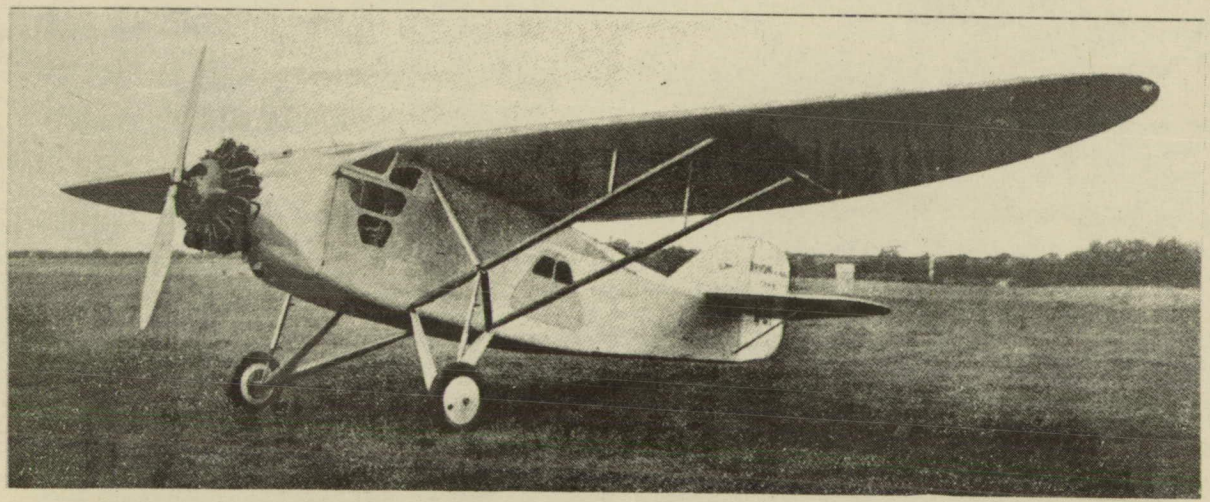

Fig.26 Three-quarter front view of the Loire II showing semi-cantilever construction.