AIRCRAFT CIRCULARS

NATIONAL ADVISORY COMMITTEE FOR AERONAUTICS

No. 202

THE LATÉCOÈRE 521 "LIEUTENANT DE VAISSEAU PARIS" COMMERCIAL FLYING BOAT (FRENCH)

A Two-Deck Six-Engine Semicantilever Sesquiplane

Washington
March 1936

NATIONAL ADVISORY COMMITTEE FOR AERONAUTICS

AIRCRAFT CIRCULAR NO. 202

THE LATÉCOÈRE 521 "LIEUTENANT DE VAISSEAU PARIS" COMMERCIAL FLYING BOAT (FRENCH)*

A Two-Deck Six-Engine Semicantilever Sesquiplane

The Latécoère 521, a flying boat of 37 tons and 5,300 horsepower, is the largest aircraft as yet built in France and has been christened "Lieutenant de vaisseau Paris", in memory of the French naval officer of that name, an exceptional pilot and holder of fifteen international records in 1930 and 1931.

The Latécoère 521 is a sesquiplane with a central hull and two stub wings like the Latécoère 300, known as the "Croix-du-Sud", and is fitted with six Hispano-Suiza type 12 Ybrs water-cooled 890-horsepower engines (figs. 1, 2, and 3). It is an all-metal design, and duralumin and vedal account for 10 tons of its total empty weight, which is 17 tons.

Wings.- The wing has a Latécoère semi-thick section, constant over the span, and rounded tips (figs. 4 and 5). It is in three sections: a center section and two fabric-covered outer sections, which are braced to the stub wings. The wing is of normal two-spar design with box spars and ribs of duralumin. The wing tips have spars in lattice form.

The box spars are formed by two webs in duralumin sheet, strengthened internally by U sections. The flanges are attached by angle irons. The ribs are in lattice form. The structure is internally braced by duralumin tie rods of square tubing and by diagonal bracing members of round, high-tensile steel tubing.

The ailerons are divided into three sections and are statically balanced, the levers being located at 30 percent of the chord from the leading edge. The central ailerons have spars in lattice form, and the outer ailerons have spars of round tubing. The ailerons are fabric-covered.

---

*From L'Aéronautique, No. 198, November 1935.

The wing is braced on either side by four inclined, faired Vee struts. Viewed from the front, they form a triangle, with the apex at the extremity of the stub wing. The fairings of the bracing struts consist of two shells of duralumin sheet, held internally by U sections and small flat plates.

The hull.- The hull or body is entirely of duralumin and vedal (figs. 6, 7, 8, and 9). It consists of a main deck and a superstructure making a second deck. The hull has a two-step bottom. Its cross section with the superstructure forms an inverted T, the superstructure having a much narrower beam than the hull. The construction is of the longitudinal type, skin stresses being transmitted to the transverse frames by the keels, which have a continuous I section. All parts below the water line are of open sections.

The hull is divided into seven watertight compartments. The over-all length of the hull is 29.63 m (97.21 ft.); the beam, 4.50 m (14.76 ft.); the height, 5.32 m (17.45 ft.); the maximum cross section, 14.80 m^2 (159.3 sq.ft.).

Accommodation (fig. 10)

For trans-Mediterranean service.- The marine gear position (T) is in the nose of the hull. Behind are the compartments (b) of the wireless operator and navigator. Next comes a salon (c) for 20 passengers; then six de luxe cabins (d), each having two berths and a washstand. In the rear is a large cabin (e) for 22 passengers; a companionway from the cabin gives access to the upper deck. Behind are a kitchen and bar (f), a lavatory (g), and a baggage hold.

In the upper deck, the commanding officer's position is in the nose, behind which and slightly raised above are the positions of the two pilots, who are seated side by side. Dual control is provided (fig. 11). Aft of the pilots' positions are those of three mechanics, from which access can be had to the six engines through the thickness of the wing. The remainder of the upper deck consists of a cabin for 18 passengers, followed by a kitchen, bar, lavatory, and baggage hold.

The flight range is 1,200 km (745.6 miles); the gross weight is 32 tons (70,548 pounds).

For trans-Atlantic service, a crew of 8 and 26 passengers will be carried. The crew is housed in the upper deck, but no passengers. The lower deck has accommodations for 6 passengers in the salon (c), for 12 in six cabins de luxe (d), and for 8 in four cabins (e).

The range is 5,000 km (3,107 miles); the gross weight is 37 tons (70,587 pounds), which may be raised to 40 tons.

The Latécoère 521 was originally intended for the trans-Mediterranean night service, and for that reason the hull was designed with a view of carrying a large number of berths.

The stub wings.- The stub wings are hinged to the bottom longerons of the hull and carry the fittings for the wing bracing struts. They have an airfoil section, with the leading edge slightly raised to assist in taking off (figs. 12, 13, and 14); each carries a sponson at its extremity to give added stability on the water and to take some of the shock in landing. The stub wings are built up with a number of stiffeners, transmitting stresses to the frames and hull spars. The type of construction is very resistant to local shocks, the ribs acting as keels and transmitting the stresses of the covering to the three spars. The stresses of the central spar are transmitted to the other two by the two main ribs.

The characteristics follow:

Span	14.70 m	(48.23 ft.)
Chord	4.72 m	(15.49 ft.)
Area	48 m^2	(516.7 sq.ft.)
Angle of setting	7^o 30'	
Dihedral	5^o	
Distance of plane of symmetry of ballonet from plane of symmetry of airplane	6.08 m	(19.95 ft.)

Each stub wing holds 11,000 liters (2,906 gallons) of fuel.

Each stub wing has three watertight compartments forming the fuel tanks: front, 3,950 liters (1,043.5 gallons); center, 3,900 liters (1,030.3 gallons); rear, 3,300 liters (871.8 gallons). The entire fuel load, including the two feed tanks in the wing (of 500 liters = 132.1 gallons capacity), is 23,300 liters (6,155 gallons).

The tail is of normal monoplane type of metal construction, with fabric covering. The rudder and elevators are statically balanced and are fitted with tabs. The front spar of the stabilizer is in lattice form and the rear spar forms a box; those of the rudder, fin, and elevators are of rectangular tubing. The stabilizer is wire-braced above and has N struts below.

The power plant.- Originally, the Latécoère 521 was to be fitted with 1,200-horsepower Hispano-Suiza engines, which were to have been developed from the 1,500-horsepower engines designed for the Schneider Cup Race. Four of them would have sufficed for a seaplane of 30 tons (66,139 pounds), but as these engines were not available at the time it was decided to use six 890-horsepower engines. The design changes, of course, caused a long delay of the work. The "Lieutenant de vaisseau Paris" is therefore fitted with six Hispano-Suiza type 12 Ybrs engines, with supercharger and reduction gear, developing 890 horsepower at 2,300 m (7,546 ft.). Four of the engines (tractors) are mounted in front of the leading edge and two (pushers) at the trailing edge of the center section of the wing. Access to the nacelles in flight is through a runway in the wing; on the ground, the engine-cowl panels serve as working platforms (figs. 15 and 16). The radiators are carried under the wing on the sides of the nacelles.

The oil tanks of 129 or 126 liters (34.1 or 33.3 gallons) each, are placed in the leading edge of the wing for the tractor engines and between the wing spars for the pusher engines. The oil coolers are mounted on top of the center section.

Fuel system.- The wing carries two feed tanks of 500 liters (132 gallons) capacity each, mounted on both sides of the hull. Two Rellumit air-driven pumps draw the fuel from the six tanks in the stub wings to the feed tanks. Pressure feed is maintained by automatically adjusting A.M. pumps, each of which fills one of the feed tanks.

In reality, each engine is separately fueled, but with the set of reversing switches, collectors, and cocks, any desired combination may be established.

Engine controls.- The installation of these controls involved a number of problems.

For the gas control, the pitot has a hinged lever which pivots around its hinge axis as well as around itself. The six gas levers are integral, three by three, by means of a kind of declutchable tip or finger, with two stirrups. (The levers of the three engines on the same side are linked to the same stirrup.) The first movement of the lever engages simultaneously, i.e., opens or closes to the same extent, the butterfly valves of all carburetors - there are 36 of them. The second motion actuates the stirrups differentially; that is, shifts them in opposite direction. It throttles the port nozzles and opens those on the starboard side or vice versa. Of course, each lever may may be operated independently.

This ingenious arrangement, developed by the Jacottet company, facilitates turning as well as maneuvering on the water. The principles of the differential control of outboard engines in a multi-engine airplane have been described by M. Tampier, in a previous article (L'Aéronautique, No. 176, January 1934.

The transmission cables housed in tubing were supplied by the Jacottet company. Laid end to end, the gas controls are 60 m (196.8 ft.) long. But in spite of this length and the many bends, the operation of these levers is very satisfactory.

Practically all other engine controls (air, fuel cocks, pump priming, etc.) were fitted with Jacottet transmissions.

Auxiliaries.- These include a Bristol starter aft of the second pitot tube and a separate fuel tank holding 10 liters (2.64 gallons), as well as a Potez 2 C set with 600 W generator in the forward station.

As a result of the acceptance tests, it was found that the flight weight could be raised to 40 tons (88,185 pounds) (instead of 37 tons (81,571 pounds) design weight). The top speed at 3,100 m (10,170 ft.) estimated at 245 km/h (152.2 mi./hr.) for a gross weight of 37 tons, reached 250 km/h (155.3 mi./hr.) for 40 tons gross weight. Take-offs have been made in 29 seconds with 32 tons (70,548 pounds); and in 43 seconds with a weight of 35 tons (77,162 pounds). The ceiling is 5,800 m (19,029 ft.). The aircraft can fly with two engines cut out and bank without losing height.

The Latécoère 521 was designed and built under the direction of Engineer Moine. The tests were made by the pilots Crespy and Gonord under the supervision of Captain Bonnet as representative of the Air Ministry.

A minute comparison of the Latécoère 521 with the Dornier Do.X would be quite interesting, but it would lead us too far afield.

The power necessary in the Do.X had to be divided into 12 groups, the engines available at the time scarcely exceeding 500 horsepower. Dr. Dornier's "flying ship" has always operated under this handicap. The wing structure, once it had been designed to furnish 24 supporting points to the struts carrying them in tandem, would have been difficult to adapt to the installation of a smaller - even though more powerful - number of groups.

Mounting the engine on top of the wings constituted another handicap. Fitted into the wing, with distant control, as in the recent Do.18, or in front of the leading edge, if the diameter is small enough (Twin Wasp in the Martin 130) is far preferable.

Lastly, in comparing the two, we must not lose sight of the fact that the Do.X took the air in 1929, and the Latécoère 521, in 1935.

In the Do.X the useful load represented 36 to 43 percent of the gross weight as against 50 percent in the Latécoère 521. The latter, which weighs 10 tons (22,046 pounds) less than the Do.X, carries - with a total of 5,300 horsepower instead of 7,500 horsepower - a weight of 9 tons (19,842 pounds) instead of 6 tons (13,228 pounds), for a distance of 1,200 km (745.6 miles), and at a speed of 220 km/h (136.7 mi./hr.) as against 170 km/h (105.6

mi./hr.). For a distance of 3,000 km (1,864 miles), it carries a weight of 3 to 4 tons (6,614 to 8,818 pounds), while the Do.X could scarcely carry enough fuel for such a flight.

These figures give an idea of the progress made within a span of five years, although the delays on the Latécoère 521 (five years) made it somewhat out of date by the time it was finished.

For example, the development of high-lift devices within the last three years, would probably influence the design of a new 37- to 40-ton airplane built now. Besides, the speed with which an airplane can be built now has also been accelerated. The Sikorsky S.42 took 1½ years, and the Martin 130, a little less than 2 years to build.

Translation by J. Vanier,
National Advisory Committee
For Aeronautics.

GENERAL CHARACTERISTICS

Dimensions:

Span	49.31 m	(161.8 ft.)
Length	31.62 m	(103.7 ft.)
Height	9.07 m	(29.8 ft.)
Draft (gross weight)	1.20 m	(3.94 ft.)
Height of propellers above water line	3.60 m and 3.90 m	(11.8 ft. and 12.8 ft.)
Sweepback	5° 20'	
Dihedral	5°	

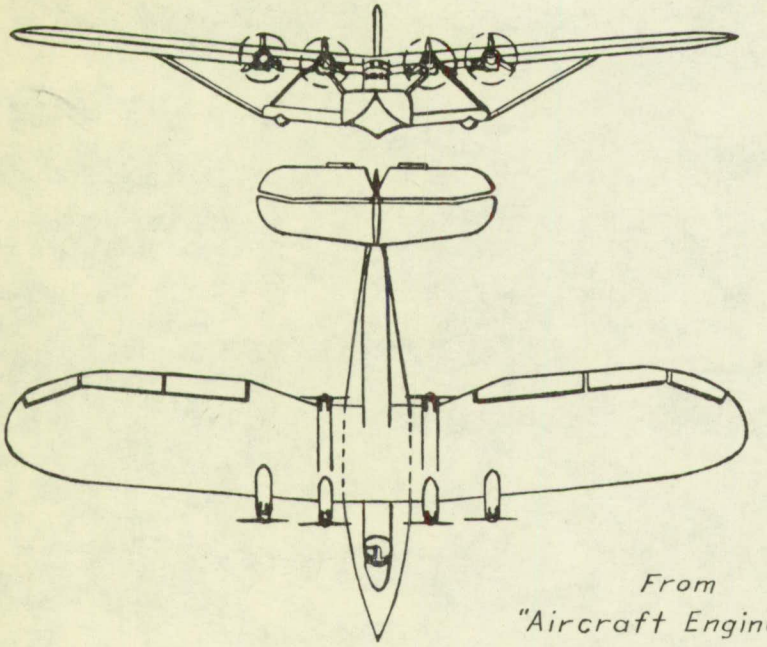
Areas:

Wing	330.0 m^2	(3552.0 sq.ft.)
Stabilizer	40.9 m^2	(440.2 sq.ft.)
Elevator	27.3 m^2	(293.8 sq.ft.)
Fin	10.5 m^2	(113.0 sq.ft.)
Rudder	8.47 m^2	(91.2 sq.ft.)

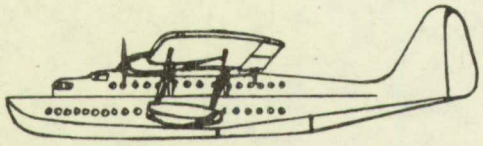
Load Schedule for Transatlantic Service

Tare weight:	18882 kg	(41628 lb.)
Airplane	12804 kg	(28228 lb.)
Engines empty	2710 kg	(5974 lb.)
Engine accessories	1885 kg	(4156 lb.)
Tanks	86 kg	(190 lb.)
Water and oil	528 kg	(1164 lb.)
Fixed equipment	869 kg	(1915.8 lb.)

Fuel	14500 kg	(31967.0 lb.)
General equipment (instruments, etc.)	66 kg	(145.5 lb.)
Special equipment	695 kg	(1532.2 lb.)
Crew	566 kg	(1247.8 lb.)
Passengers	2670 kg	(5886.3 lb.)
Tools and covers	30 kg	(66.1 lb.)
Gross weight	37409 kg	(82473.0 lb.)



From "Aircraft Engineering"



Span	49.31 m	161.8 ft.
Length	31.62 "	103.7 "
Height	9.07 "	29.8 "
Wing area	330 m^2	3552 sq.ft.

Figure 1.- General arrangement drawings of the Latécoère 521 "Lieutenant de Vaisseau Paris" seaplane.

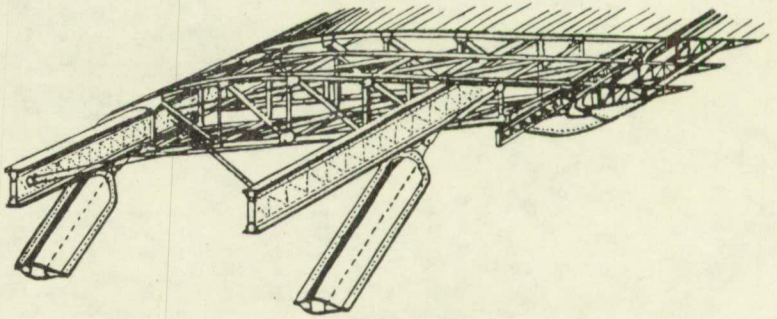


Figure 5.- Wing construction showing attachment of diagonal struts.

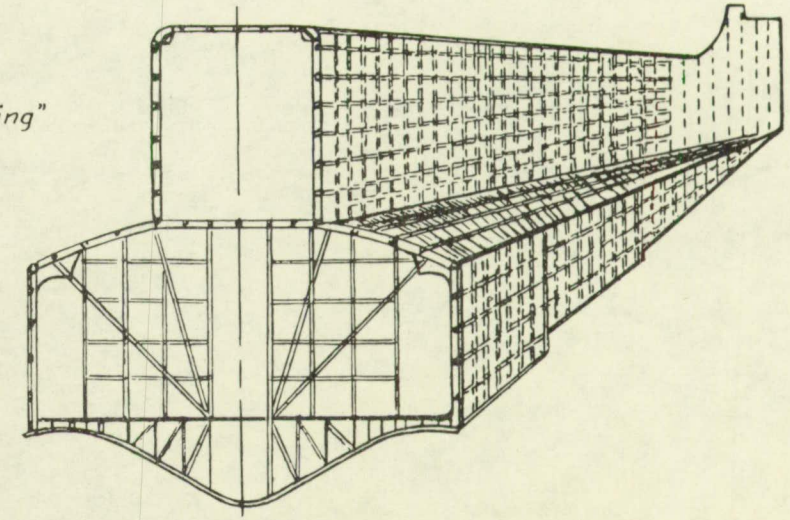


Figure 6.- Structural sketch of the Latécoère 521 hull.

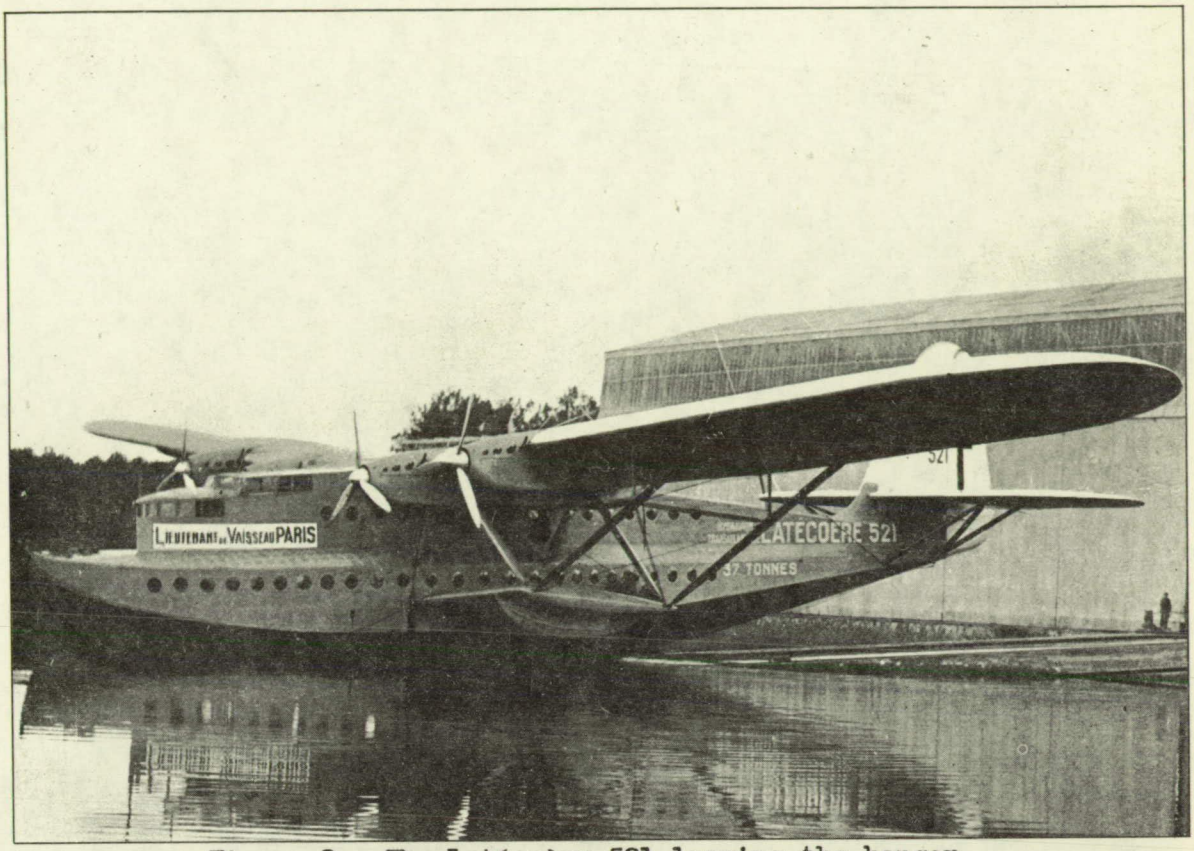


Figure 2.- The Latécoère 521 leaving the hanger.

From "Hispano Suiza" Bulletin

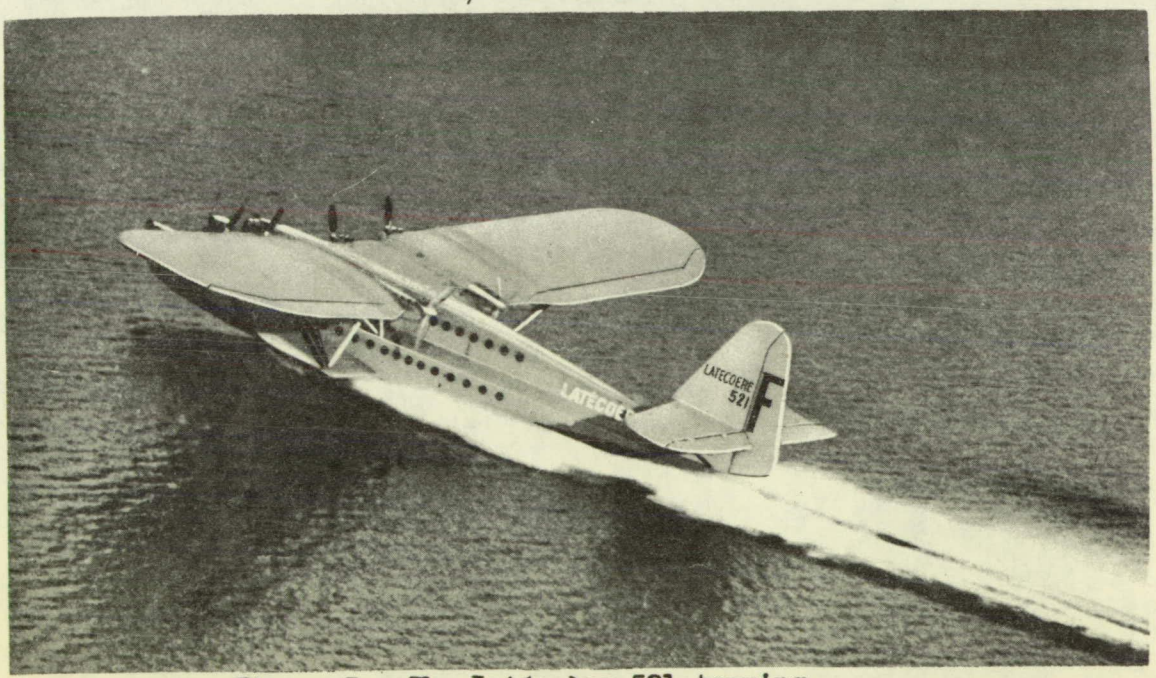
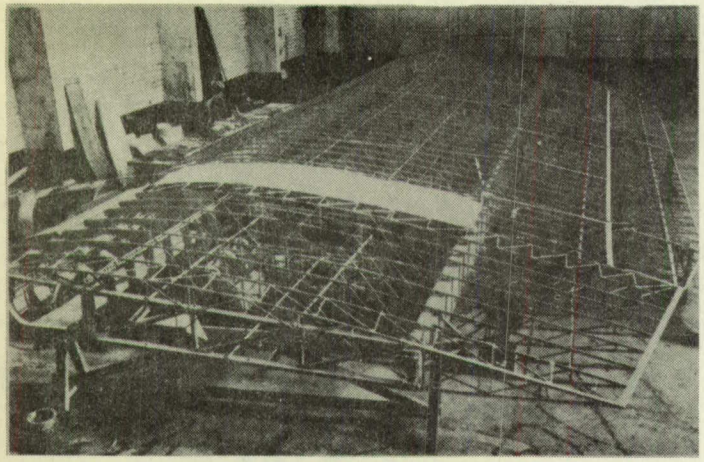
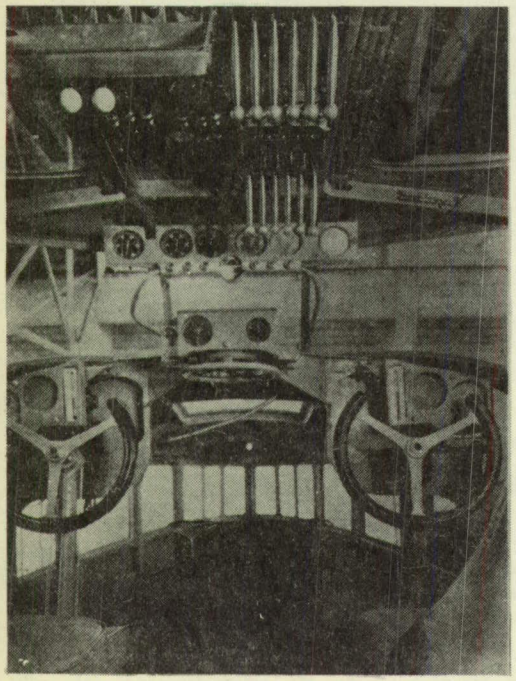


Figure 3.- The Latécoère 521 taxying.



Photographs from "L'Aéronautique"

Figure 4.- Photograph of construction of wing.



Structural parts of the Latécoère 521

Figure 11.- View of the Pilot's cockpit.

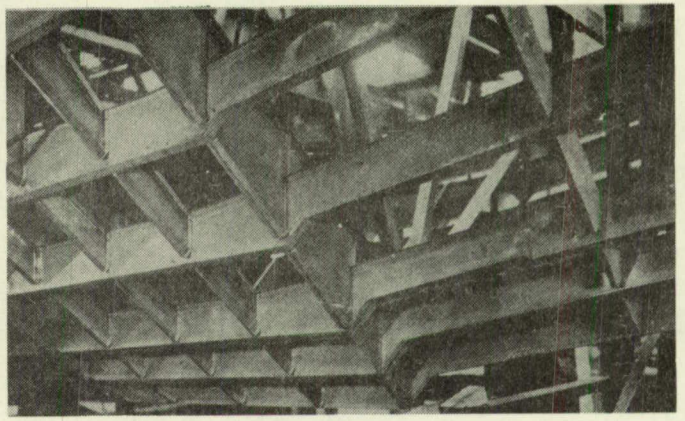


Figure 7.- Structural frame at step.

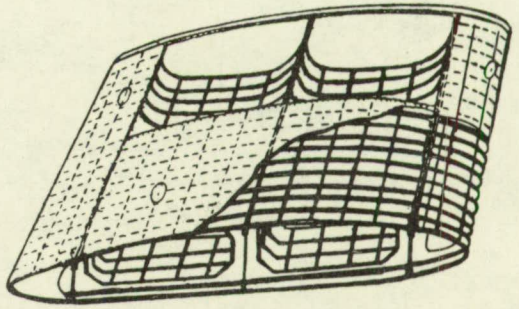


Figure 12.- Portion of stub plane structure.

From "Aircraft Engineering"

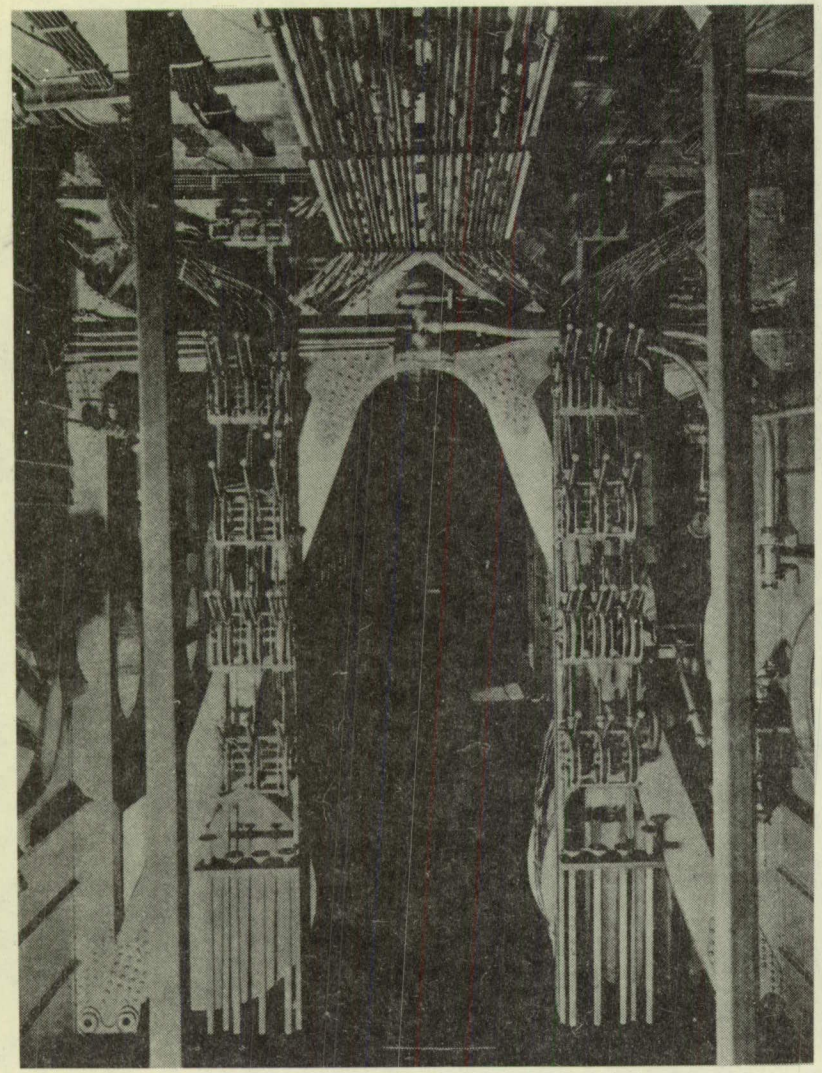


Figure 8.- View of Jacottet control system for fuel cocks, fire extinguishers etc.

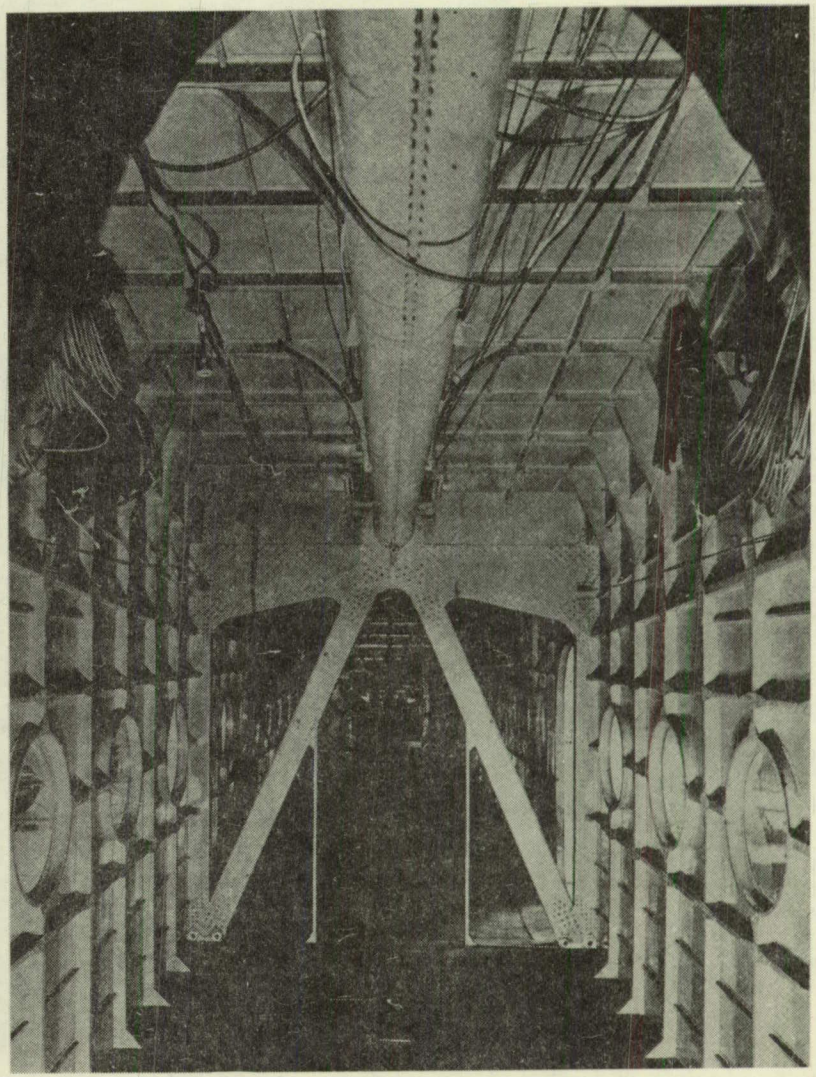
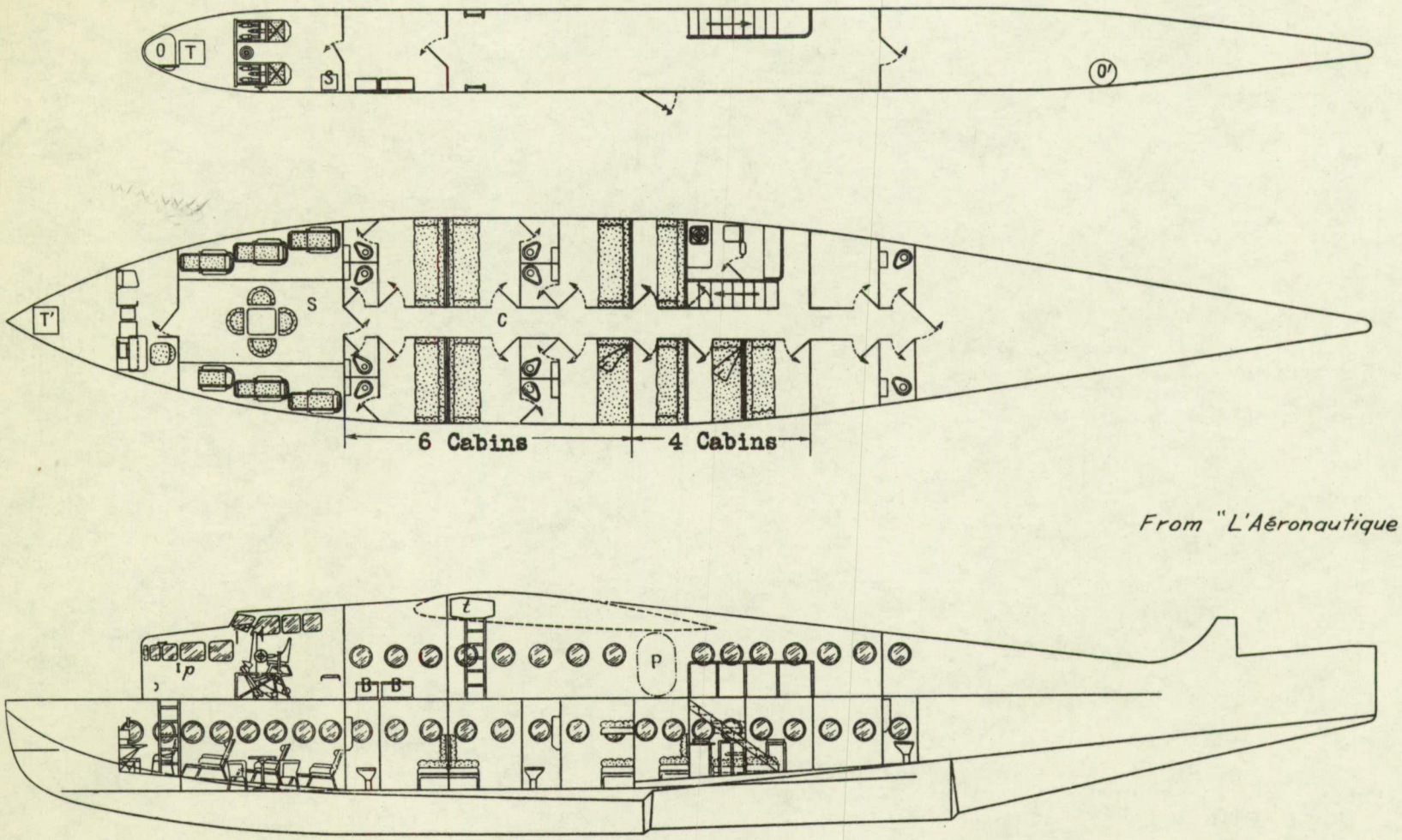


Figure 9.- Upper deck looking aft.
From "L'Aéronautique"



From "L'Aëronautique"

Figure 10.- Sectional elevation and plan sketches of the Latécoère 521 hull.

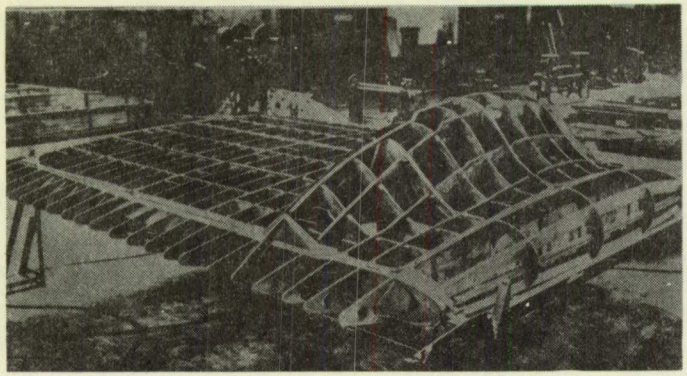


Figure 13.- Stub plane structure without covering.

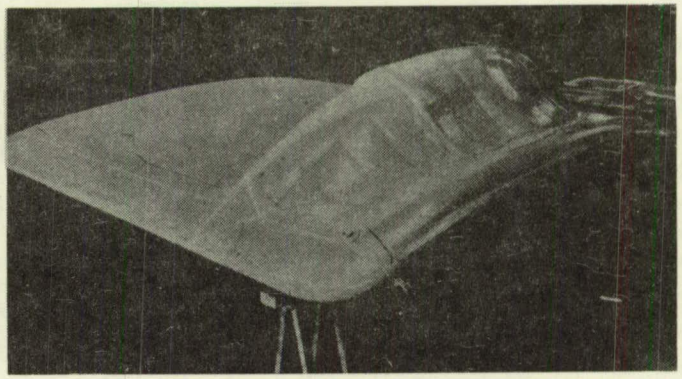


Figure 14.- Stub plane complete with covering.

From "L'Aéronautique"

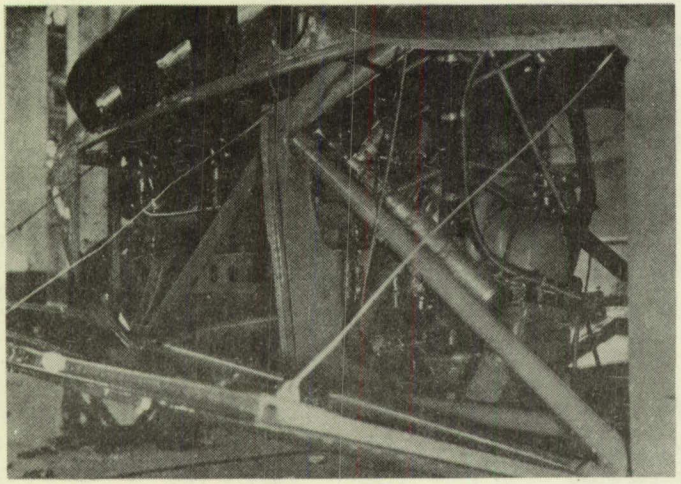


Figure 15.

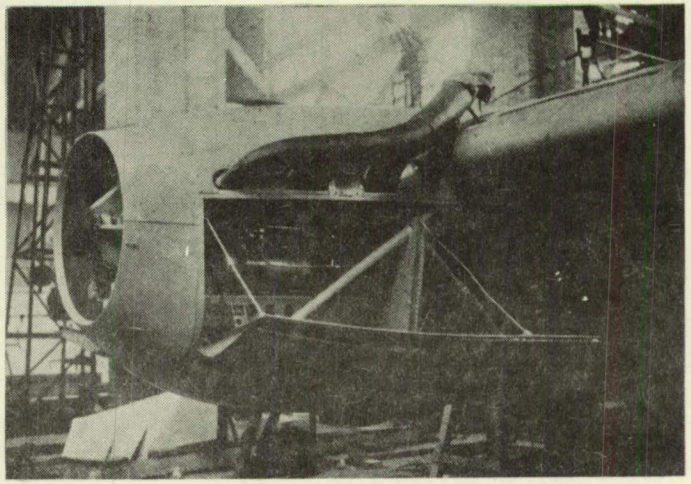


Figure 16.

Figures 15 and 16.- Views showing side panels of cowling lowered to serve as a working platform.