AIRCRAFT CIRCULARS

NATIONAL ADVISORY COMMITTEE FOR AERONAUTICS

No. 166

THE BREDA 32 COMMERCIAL AIRPLANE (ITALIAN)

A Three-Engine All-Metal Low-Wing Monoplane

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THE BREDA 32 COMMERCIAL AIRPLANE (ITALIAN)*

A Three-Engine All-Metal Low-Wing Monoplane

The Breda 32 exemplifies the most recent aerodynamic and constructive tendencies. Its low cantilever wings have a high aspect ratio and taper, both in plan and thickness, throughout their whole length. (Figs. 1, 2, 3.)

The wing, especially designed for obtaining the maximum aerodynamic efficiency, as well as the most perfect stability, is an exact reproduction, on a smaller scale, of the wing of a large three-engine airplane designed by Breda in 1930.

Lateral stability is insured by a pronounced dihedral angle, while prompt lateral control is obtained by ailerons occupying about half of the trailing edge, with hinge line so arranged as to effect a partial aerodynamic balance.

The streamlined nacelles of the two outboard engines are faired into the wing. (Fig. 4.) The propellers are placed well ahead of the leading edge of the wing, which helps to diminish the induced drag and makes for smooth working and minimum interference.

The axes of the outboard engines are slightly inclined to each other, thus increasing the effect of the fin and rudder and slightly offsetting the turning moment when one of the outboard engines is stopped.

The shape of the fuselage, with its clean and aerodynamically perfect lines, is the result of experiments at the time of the construction of the Breda CC 20. These experiments were supplemented by many severe wind-tunnel tests of the Breda 32.

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*From information furnished by the manufacturers, the Societá Italiana Ernesto Breda, Milan, Italy.

The cowling of the central engine, which encloses the exhaust manifold, and the shape of the windshield and of the top of the pilots' cockpit are such as to afford excellent penetration.

The landing gear consists of two wheels partially enclosed in fairings and placed under the outboard engines, where they produce very little interference with the wing.

The thin fixed tail surfaces are braced with streamline struts and wires. The rudder and elevator are balanced aerodynamically.

The search for aerodynamic cleanness compromised in no way the proper assembly of the structural elements, nor diminished the comfort of the various furnishings, which are installed in such a way as to fully satisfy the requirements of the airplane. The Breda 32 is of all-metal construction, both as to framework and covering.

The wing consists of a single spar with metal ribs and covering, these features being the subjects of numerous patents. The single spar, of square section, is placed in the thickest part of the wing and offers very great resistance to both torsional and bending stresses. (Figs. 5 and 6.) The ribs are composed of members stamped from light sheet duralumin and are attached to both sides of the spar. The covering is riveted to the rib flanges. It is likewise of duralumin and the requisite rigidity with respect to the two principal axes of inertia is insured by special short corrugations stamped in the metal. (Fig. 7.)

Static tests (for elasticity and strength) of the spar and other parts of the wing structure have shown the important contribution of the covering to the strength of the wing.

The fuselage structure consists of four tubular steel longerons and duralumin lattice frames to which the metal covering (like that of the wing) is riveted. The principal structural elements of the fuselage are similar to the wing spar, and the covering adds rigidity. The different parts of the fuselage and wing are connected by spherical joints and can be readily taken apart and transported by rail.

The fixed tail surfaces are braced by tubular steel struts and by high-resistance section-metal bars. The

framework of each tail surface consists of two spars of stamped duralumin components riveted to duralumin ribs with metal covering.

Each engine bearer (fig. 8) of welded steel tubing, is joined to the fuselage and to the wing spar by four steel bolts. The engines are mounted on the bearers by means of a set of bolts with the interposition of rubber sockets and buffers. The engine cowlings are mounted on the bearers and are entirely independent of the fuselage and wing.

The landing wheels are provided with compressed-air brakes, easily operated and with a differential action on the two wheels. The flexibility of the brakes and the ample distance between the wheels enable the airplane to make very short turns on the ground. The shock-absorbing strut attachment is shown in Figure 9. A tail wheel with a "balloon" tire is mounted on a swiveling fork with sandow shock absorbers.

All the cowls can be opened very easily with the aid of a few hooks. Ample ports are provided along the wing and under the fuselage for inspecting the controls, piping, etc.

The fuel tanks are placed in the wing in separate ventilated compartments beyond the outboard engines. The tanks in each half-wing are provided with a dump valve under the control of the pilot. Each fuel tank is provided with stopcocks and, for the group of tanks in each half-wing (namely, two larger and two smaller tanks, symmetrically arranged with respect to the wing spar), there is a collector pocket, provided with a "Televel" fuel gauge, from which the delivery pipes go to the different engines. The fuel system also includes two gravity tanks of sufficient capacity to insure flight even in case of injury to all the tanks or failure of the engine pumps. The system is provided with hand pumps. The brass tanks can be quickly removed through ports in the wing covering. They are provided with screw caps for filling. Moreover, they are connected with one another by large pipes which enable simultaneous filling with a single funnel. The fuel pipes are steel. The bent portions are of flexible tubing.

The oil systems of the different engines are independent of one another. The pipes are all flexible and the oil tanks are air-cooled. Each tank is provided with

a "Televel" oil gauge with an indicator dial in the pilots' cockpit.

Each of the air-cooled radial engines is provided with a device for regulating the cooling of the crankcase, thus making it possible to keep the temperature of the oil in the engines within the proper limits. The engine cowling perfectly fits the exhaust manifold, the shape of which was specially designed to obtain the best penetration. The metal propellers of all three engines each have two blades adjustable on the ground.

The passenger cabin (figs. 10 and 11) is 1.6 m (5.25 ft.) wide, 2.1 m (6.89 ft.) high, and 4.3 m (14.11 ft.) long. It is entered through a wide door. An emergency exit is also provided on request. The cabin is normally equipped with eight places, three chairs on each side and a sofa for two in the rear. Three central tip-up seats can also be installed, making it possible to carry as many as eleven persons in the cabin. This arrangement was adopted in order to afford passengers the maximum of convenience. The side seats are spaced so as to permit the adjustment of their backs for the greatest possible comfort. The cabin is lighted by a continuous row of windows along each side. The windows have large panes of triplex glass and can be easily opened. The cabin is heated by air entering around the exhaust manifold of the central engine. The walls and chairs are upholstered with elegant fabric edged with leather. The cushions and chair backs were stuffed with feathers and covered with fabric on one side and with leather on the other side. The floor is carpeted. Overhead baggage racks are attached to the walls.

The airplane has two spacious compartments (one forward and the other aft) for baggage and merchandise, each with a capacity of 200 kg (441 lb.).

The pilots' cockpit affords very complete forward and lateral visibility. (Fig. 12.) Both sides are provided with adjustable glass windows and windshields enabling the pilots to stick their heads out without being exposed to the relative wind. The pilots' cockpit has two comfortable leather-covered chairs for the pilots and two smaller chairs for the mechanic and radio operator. The floor is covered with linoleum, and the walls are upholstered with leather and fabric.

By night the pilots' cockpit is lighted by reflecting lamps, while the passenger cabin is provided with indirect lighting. The electric installation is adapted in all its details for night flying. The instruments have luminous figures and the airplane is provided with landing and navigation lights. The landing lights are generally concealed in the wings outside the propeller disks and, at the moment of landing, are operated from the pilots' cockpit by means of a lever. The position lights are provided with a switch, so as to make them available for signalling.

The electric energy for the various uses is furnished by a generator driven by the central engine. This generator supplies the current to the small Eclipse motors for starting the three engines and for the lighting and radio. A large storage battery insures the supply of current even in case of failure of the generator. The radio is provided with a fixed antenna and a movable one.

The navigation instruments comprise everything required for flight in bad weather and for blind piloting. These include, in addition to a complete set of instruments for the control of the engines, the following instruments:

Remote compass,

Pezzani compass,

Flight indicator,

Indicator of climb and descent,

Altimeter,

Electric clock,

Air-speed indicator,

Air-speed indicator with electrically heated Venturi tube,

Precision altimeter to 500 m (1,640 ft.)

Characteristics of Breda 32 Equipped with Three Pratt and Whitney "Wasp Junior" Engines

Length	16.75	m	54.95	ft.
Height	4.15	"	13.62	"
Span	26.60	"	87.27	"
Maximum chord	4.50	"	14.76	"
Minimum "	2.60	"	8.53	"
Wing area	85	m²	914.93	sq.ft.
Rated power (3 x 320)	960	hp	946.85	hp
Weight empty	3,800	kg	8,377.56	lb.
Crew	160	"	352.74	"
Radio	60	"	132.28	"
Fuel	1,050	"	2,314.85	"
Oil	75	"	165.35	"
Passengers and baggage	1,355	"	2,987.26	"
Useful load	2,700	"	5,952.47	"
Total "	6,500	"	14,330.00	"
Safety factor	5.5			

Official Performances

Maximum speed	235 km/h	146 mi./hr.
Minimum "	92 "	57.2 "
Cruising "	1,000 m (3,280 ft.)	210 km/h (130 mi./hr.)
Range at cruising speed	1,350 km	839 mi.
climbing time to	5,000 m (16,404 ft.)	52 min.
Practical ceiling	5,300 m (17,388 ft.)	

The range can be considerably increased, if so desired.

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

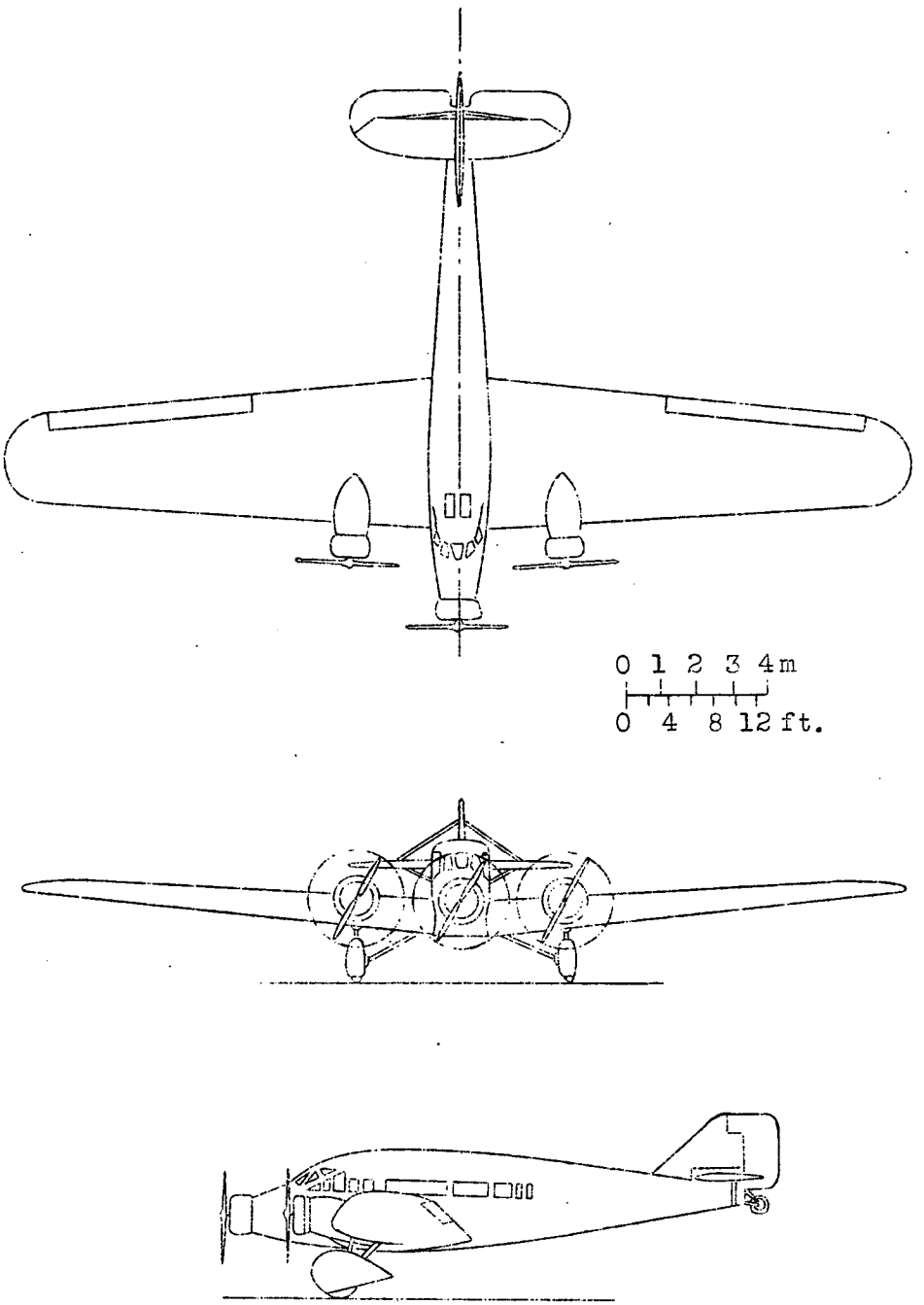

Fig.1 General arrangement drawings of the Breda 32 airplane.

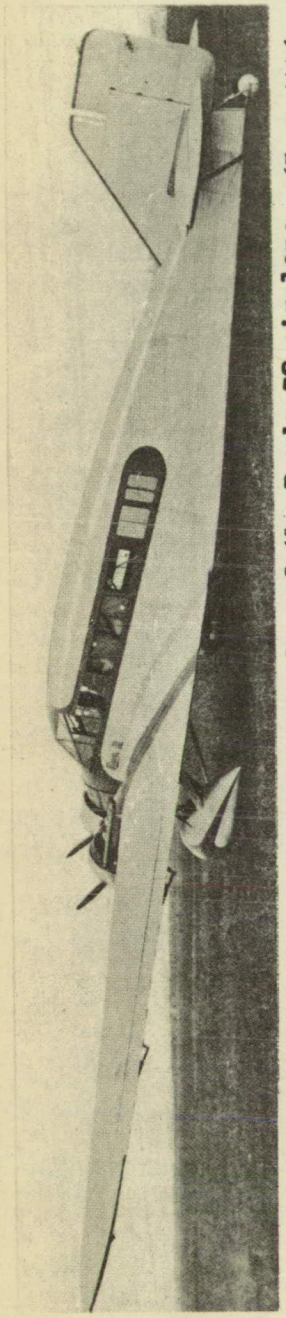

Fig.2 Three-quarter rear view of the Breda 32 airplane. (From L'Aéronautique)

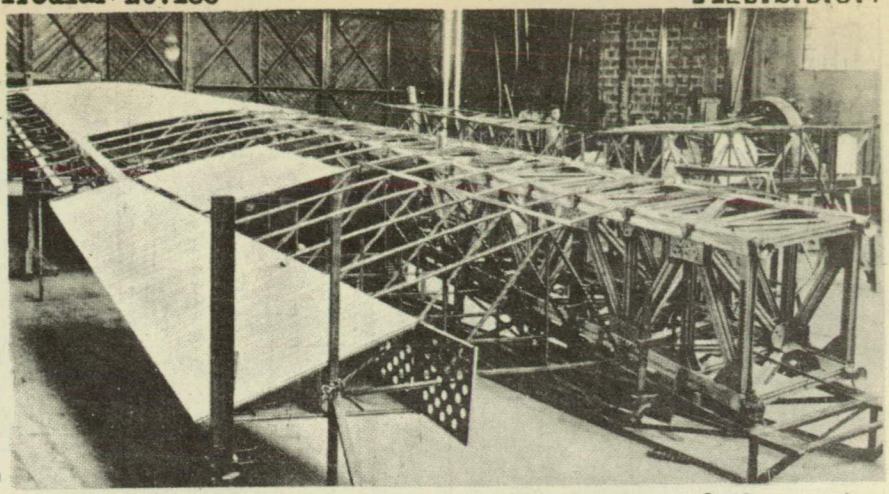

Fig.5 The Breda 32 wing. A general view of the port wing, showing single spar, ribs, skin, etc. The four pipe unions by which the wing is attached to the wing root are seen at the right-hand extremity of the photograph. (From L'Aéronautique)

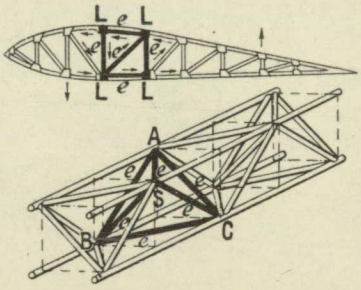

Fig.6 The spar is composed of four longitudinal members L, connected by uprights and cross pieces, with oblique members e, forming a system of pyramidal bracing.
(From L'Aéronautique)

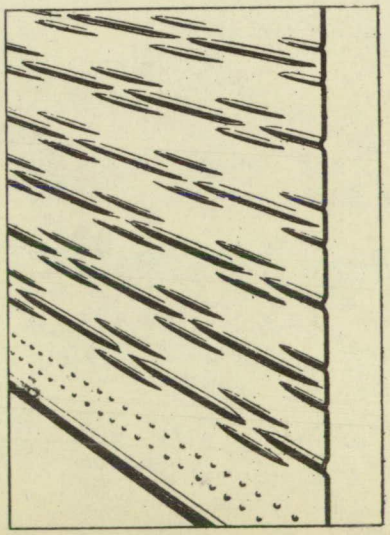

Fig.7 The covering is made sufficiently rigid by use of special short corrigations stamped in the metal. (From Flight)

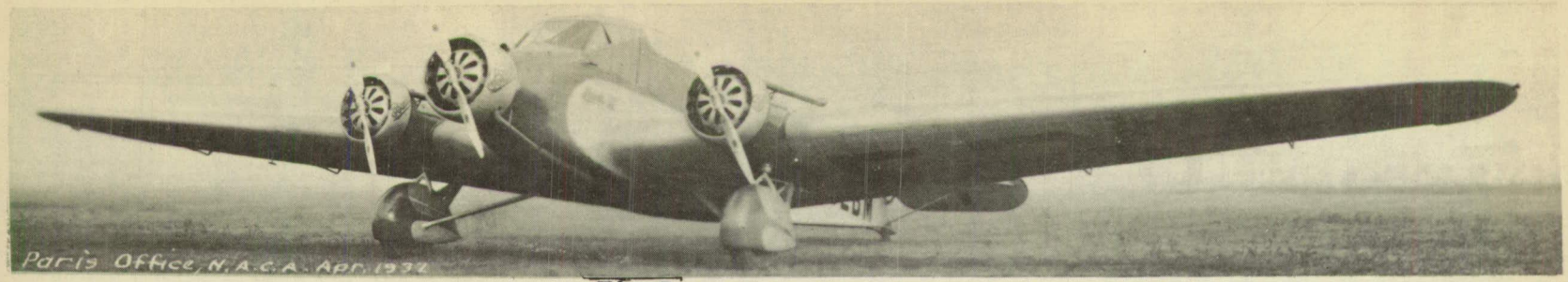

Fig.3

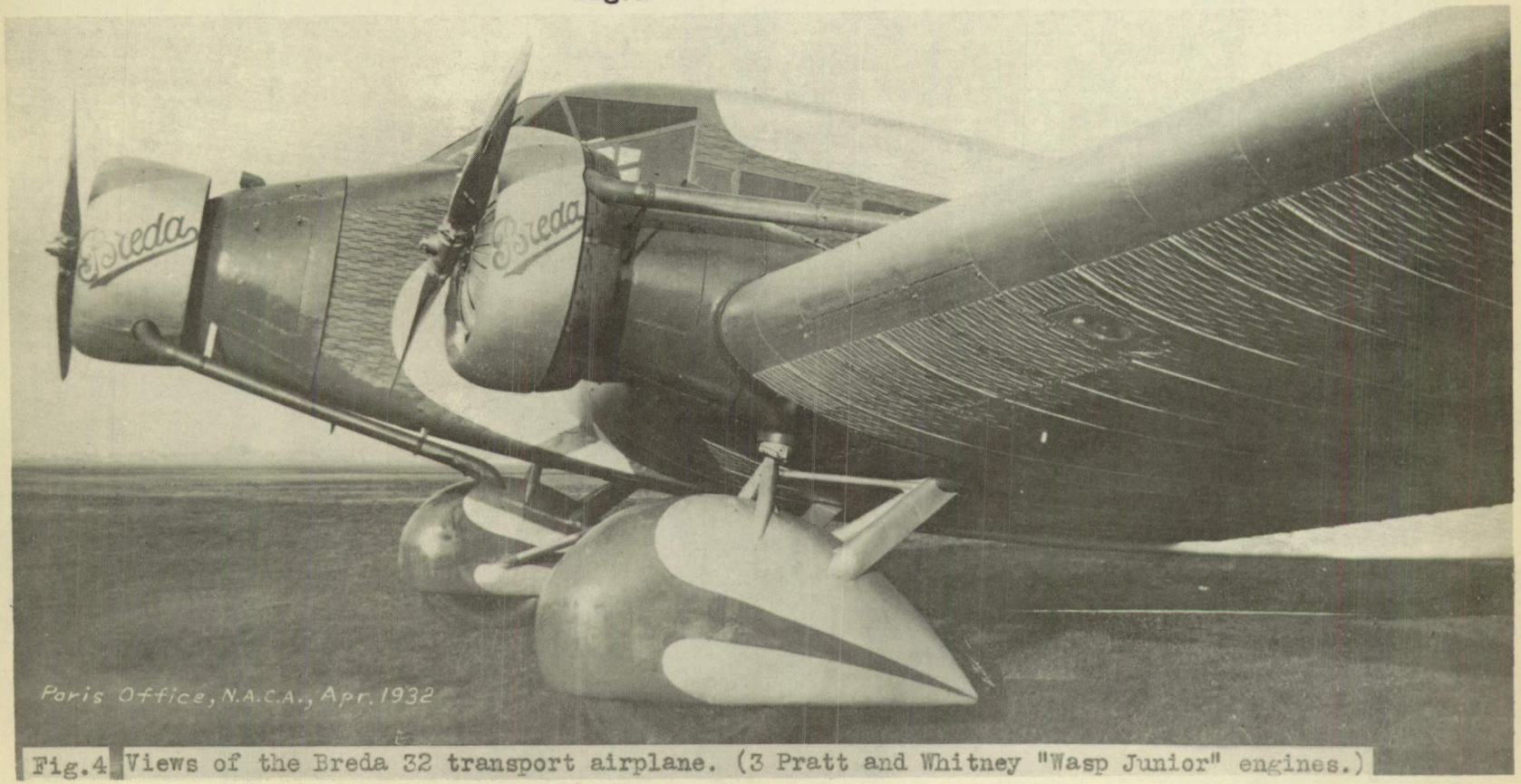

Fig.4 Views of the Breda 32 transport airplane. (3 Pratt and Whitney "Wasp Junior" engines.)

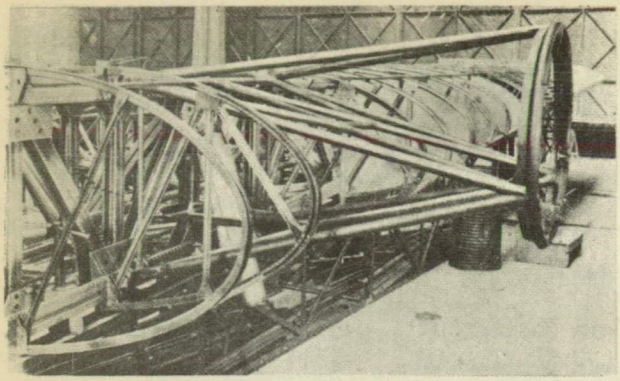

Fig.8 Attachment of outboard engine bearer to wing spar.
(From L'Aéronautique)

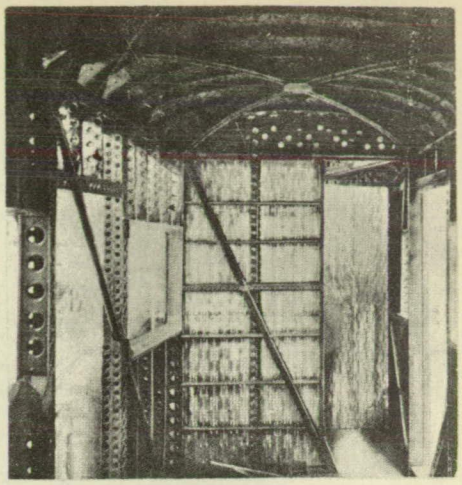

Fig.10 Interior of fuselage structure.
(From L'Aéronautique)

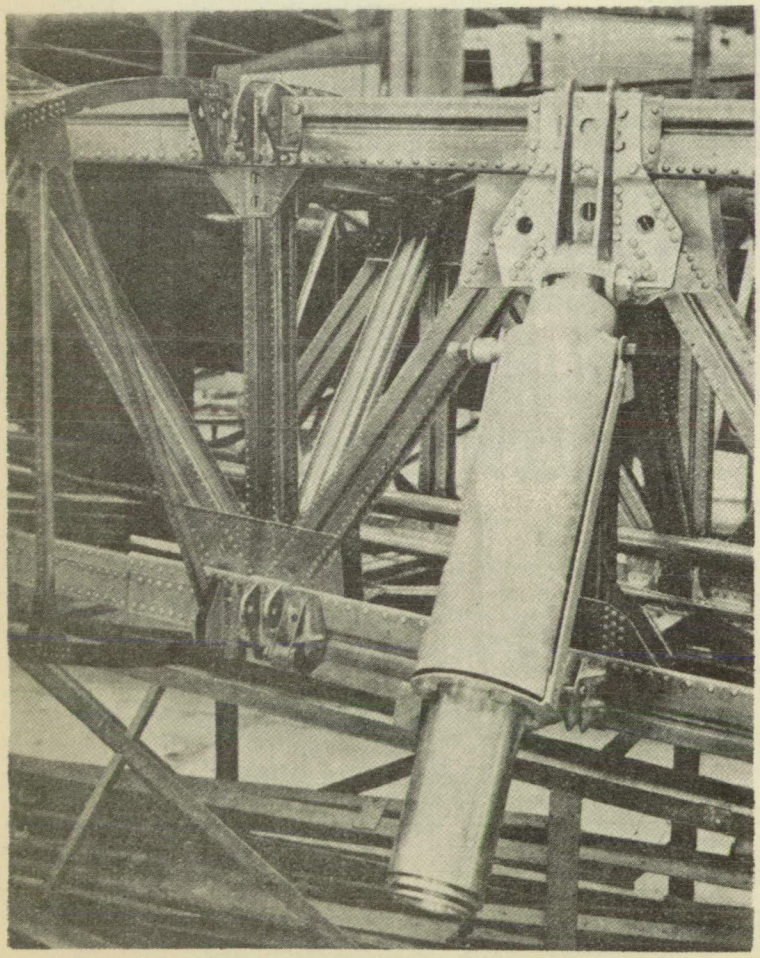

Fig.9 Details of wing and landing gear. This photograph gives a good idea of the construction of the single spar, which is a girder built up of box-section booms and struts. The telescopic leg of the landing gear is attached to the spar, and housed inside the wing. The other lugs seen are for the support of the engine bearer.
(From Flight)

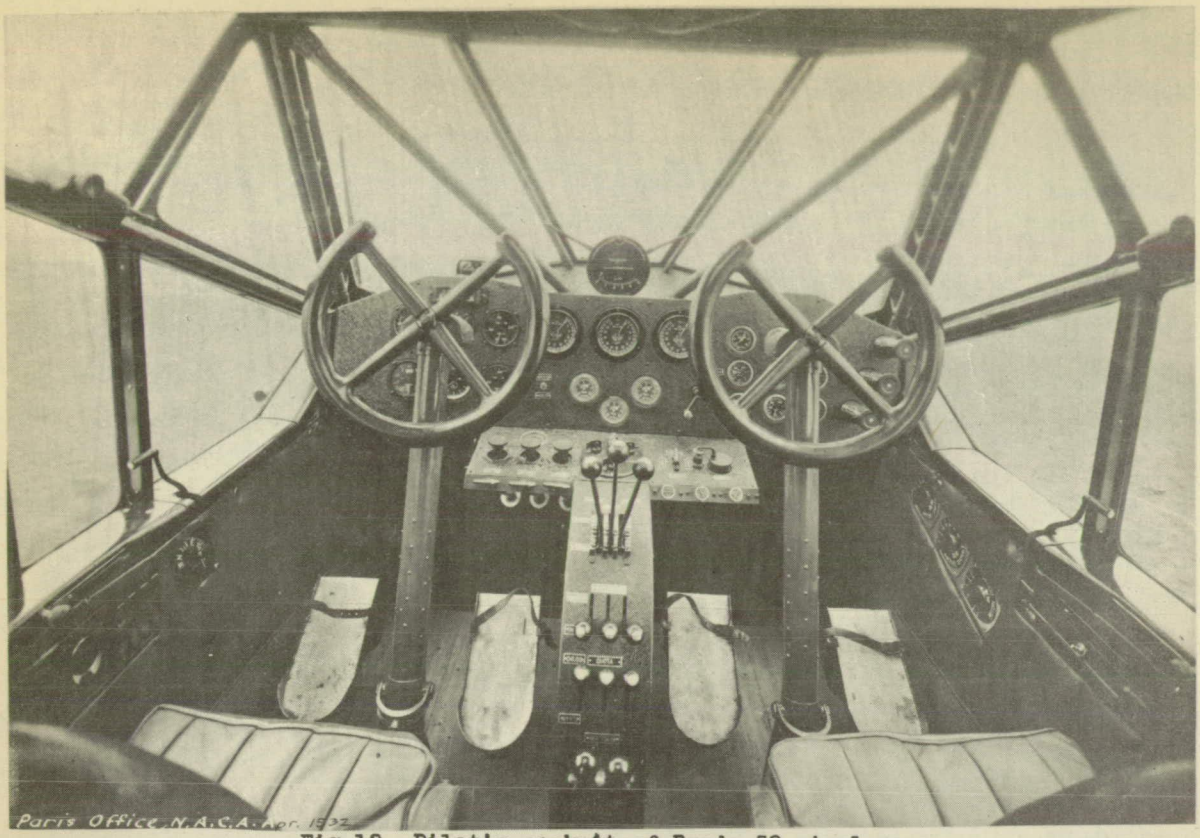

Fig.12 Pilot's cockpit of Breda 32 airplane.

Fig.11 Cabin of Breda 32 airplane.