AIRCRAFT CIRCULARS

NATIONAL ADVISORY COMMITTEE FOR AERONAUTICS

No. 188

THE AVIA 51 COMMERCIAL AIRPLANE (CZECHOSLOVAKIAN)

A Cantilever High-Wing Monoplane

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A Cantilever High-Wing Monoplane

In external appearance the Avia 51 is of fairly orthodox design, with the wing engines faired into the leading edge and the central engine mounted in the nose of a streamline fuselage. The somewhat "stilty" appearance caused by the long landing-gear legs is doubtless a result of the designer's desire to provide a good ground angle coupled with a long travel of the wheels (figs. 1, 2, and 3).

This airplane made its test flights some time ago, and came up to its designer's estimates in every respect. The value of the Everling "high-speed figure" is 20.9, which must be regarded as extremely good for a three-engine airplane, and shows that the minimum drag coefficient is low. Another very important factor in a commercial airplane is the maximum ratio of lift to drag. The maximum L/D of the Avia 51 is 10.2 or, expressed otherwise, the best gliding angle is 5 degrees 35 minutes. The wing loading is high (19.3 lb./sq.ft.), and as the maximum lift coefficient is about normal (0.75 in British "absolute" units), the landing speed is also high. The figure 62 m.p.h. is quoted by the firm, but for the wing loading and $k_{L_{max}}$ mentioned above, one would expect the minimum speed to be about 70-71 m.p.h. As no air brakes are fitted, and the gliding angle is very flat, this landing speed appears rather high in comparison with current British practice. Since, however, the Avia 51 is capable of maintaining flight with one engine stopped, forced landings should rarely occur, and the high landing speed may be tolerated.

In the construction of the Avia 51, nothing but metal and fabric has been used (with the exception of certain cabin decorations). Duralumin and high-tensile steel are the materials employed. Painting, lacquering, and cadmium plating are the precautions taken against corrosion.

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*From Flight, January 18, 1934, pp. 54-56.

The cantilever monoplane wing is of orthodox two-spar construction (fig. 4). The spars are built up of duralumin, with booms of D section and ties of channel section, forming an N girder. The D-section spar booms are, of course, built up of a U-section strip with a corrugated covering strip closing the open side of the U section (fig. 5). It is noted that the rounded side of the D is facing inward. One would have thought that the more logical way was to turn the rounded side outward so as to get the riveting a little away from the area of maximum stress. The reverse arrangement possibly makes the attachment of the channel-section ties easier, and the designer informs us that he has been able to get 45,000 pounds per square inch column stress out of his spar booms. The wing ribs (fig. 6), also of duralumin, are built up of bulb sections.

Ailerons of Frise type are used, the aileron spars being duralumin tubes. Fin, rudder, stabilizer, and elevator are of duralumin construction, and the hinges of the rudder and elevator are of the setback Handley Page type.

In the construction of the fuselage the so-called "mixed monocoque" system is used (fig. 7). The unsupported panel areas are very small, as there are six main longerons with intermediate stringers, while double-walled bulkheads are spaced fairly closely, and lighter formers are placed between them. The fuselage cross section is of oval shape, and the covering is duralumin sheet, riveted to longerons, stringers and double-walled bulkheads, but not to the intermediate formers.

A divided type of landing gear is used, with long telescopic legs running to the front wing spar. These telescopic legs are of the oleo-pneumatic type, and have a long stroke. The wheel track is wide, and wheel brakes are fitted. If desired, the Avia 51 can be fitted with floats.

The three Avia R-12 engines which form the power plant of the Avia 51 are 7-cylinder radial air-cooled, of a rated power of 200 b.hp. each (fig. 8). They are mounted on welded-steel-tube structures (fig. 9), easily detachable as complete units, and rubber bushes are interposed to absorb vibration. Engine starting is by compressed air, the central engine driving the compressor. Two-blade adjustable-pitch metal propellers are used. All three engines are enclosed in complete N.A.C.A. cowlings.

Gasoline is carried in two soldered brass tanks, each of 16½ gallons capacity. The tanks are mounted in the wing, between the spars. Fuel is supplied to the engines by engine-driven pumps. The oil tanks have a capacity of 5 gallons each, and adjustable oil coolers are combined with the tanks.

Seating accommodation is provided in the cabin for five passengers, the seats having deep cushions and headrests. Ventilation is by ducts from cowls in the wing roots, and adjustable ventilators are placed at each seat. Heating is by hot air from a muff around the exhaust pipe of the central engine. The cabin has a length of 10 feet, a height of 5 feet 1 inch, and a width of 4 feet 11 inches. The height is not sufficient to give room to stand upright, but in any case it is doubtful if there is room to walk about in such a small cabin. Behind the cabin is a lavatory, and there are three luggage and mail compartments, one forward, one in the cabin, and one behind the cabin.

A door in the front wall of the cabin communicates with the pilots' cockpit, which has two seats side by side. The chief pilot occupies the left seat, while the second pilot, who is also the radio operator, occupies the right seat. The windshield is of nonsplintering glass, and the side windows can be opened. View upward is afforded by the cockpit skylight, but to the back the view is cut off, and a mirror is so fitted that the pilot can see what is behind the airplane.

The usual instrument equipment is supplied with the standard airplane, but if night flying or blind flying is contemplated, special equipment can be supplied at extra cost. The usual navigation lighting equipment is always provided.

CHARACTERISTICS

Dimensions:

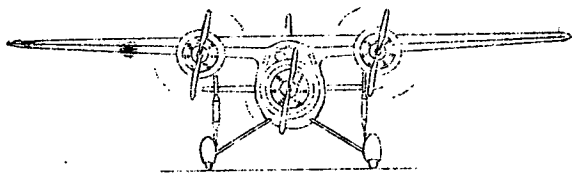
Length, over-all	35 ft. 3-1/4 in.
Height	11 " 5-3/4 "
Maximum width of fuselage	5 " 6 "
Wing span	49 " 6-1/2 "
Wing area	410 sq.ft.

Weights and loadings:

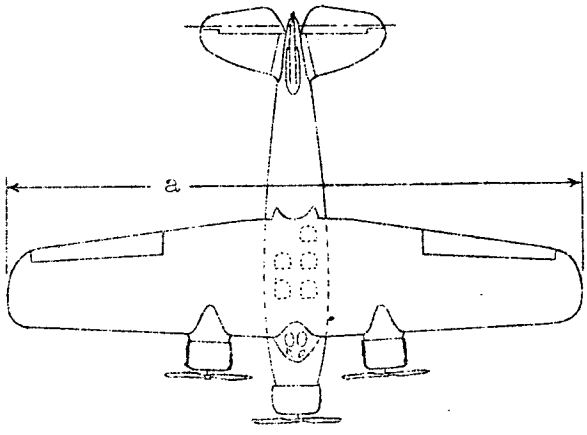
Tare weight, equipped		5,200 lb.
Disposable load		2,720 "
Crew	350 lb.	
5 passengers	880 "	
Luggage	165 "	
Mails	275 "	
Total pay load	1,670 "	
Gasoline	820 "	
Oil	110 "	
Special equipment	120 "	
Total weight, loaded		7,920 lb.
Ratio, gross wt./tare wt.		1.523
Power loading		13.2 lb./hp.
Wing loading		19.3 lb./sq.ft.

Performance:

Maximum speed	165 m.p.h.
Cruising speed	142 "
Landing speed	62 "
Initial climb	820 ft./min.
Service ceiling	14,000 ft.
Service ceiling with 2 engines	3,600 "
Take-off	780 "
Landing run (with brakes)	650 "
Range at cruising speed	500 miles



a, Span: 49 ft. 6 1/2 in.
b, Length: 35 " 3 1/4 "
c, Height: 11 " 5 3/4 "



Wing area: 410 sq. ft.

Three 200 hp engines.

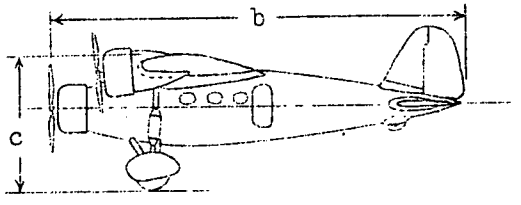


Figure 1.--Three-view general arrangement drawings of the Avia 51.

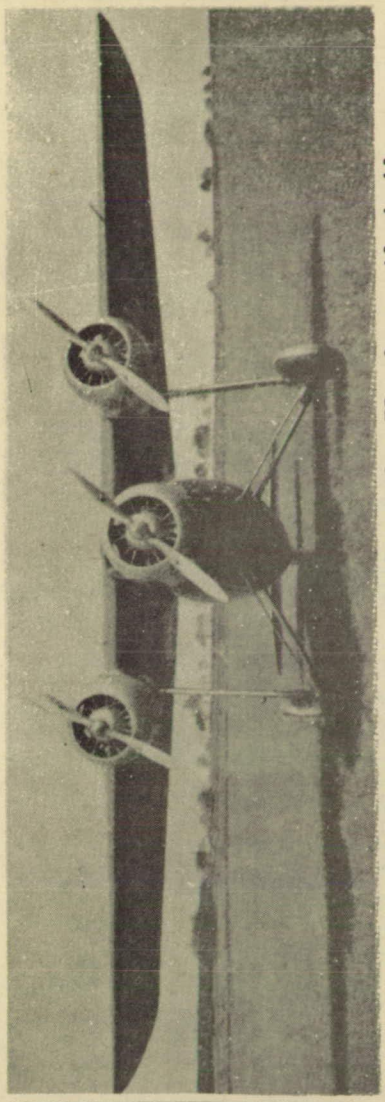


Figure 2.-The front view of the Avia 51 shows that there are no unnecessary excrescences. From "Flight"

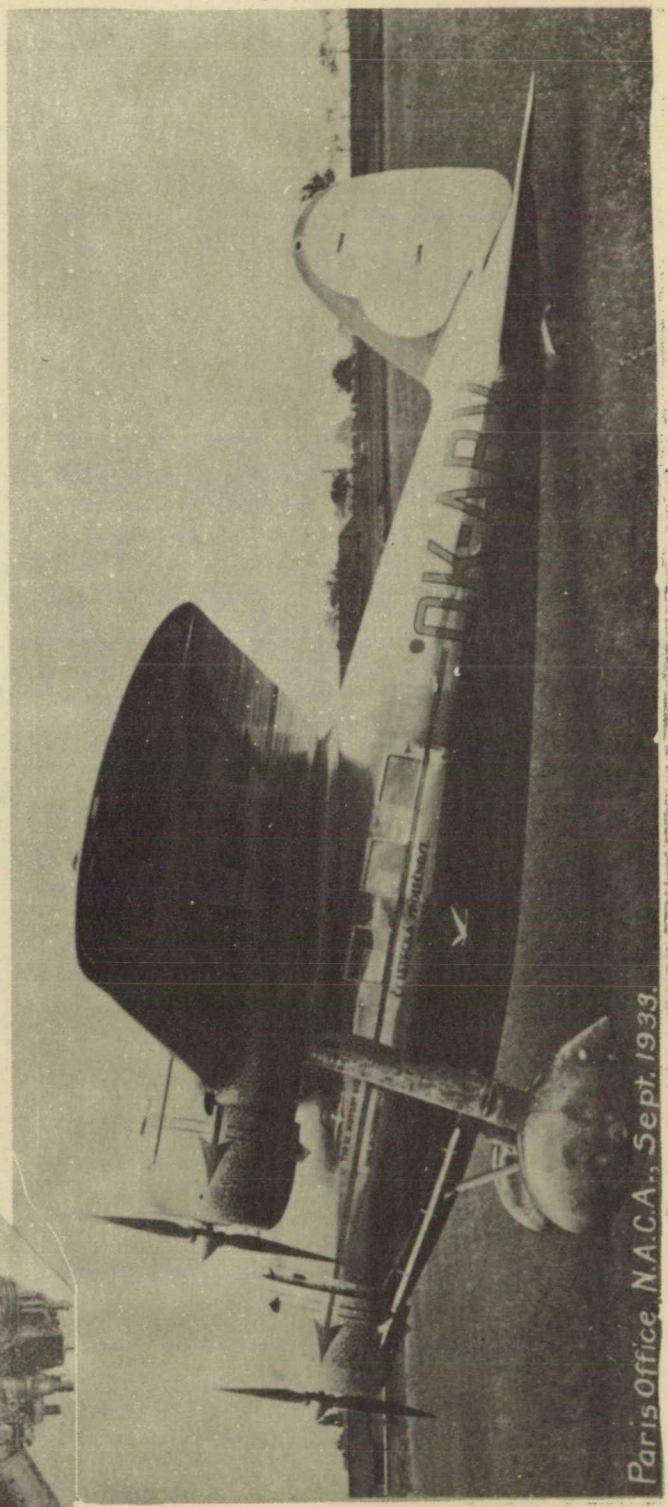


Figure 3.-The Avia 51 transport monoplane, with three 200 hp Avia R-12 engines.

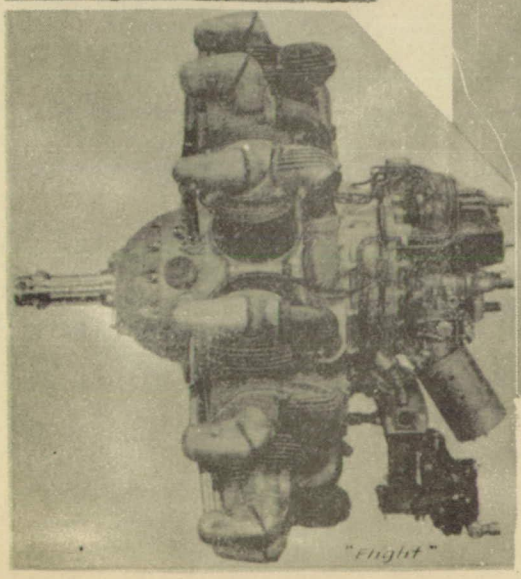


Figure 8.-The Avia R-12 engine is a 7 cyl. radial air-cooled, rated at 200 b.hp at 2,000 r.p.m. normal. It has a capacity of 735 cu.in. and weighs 466 lb. without propeller hub.

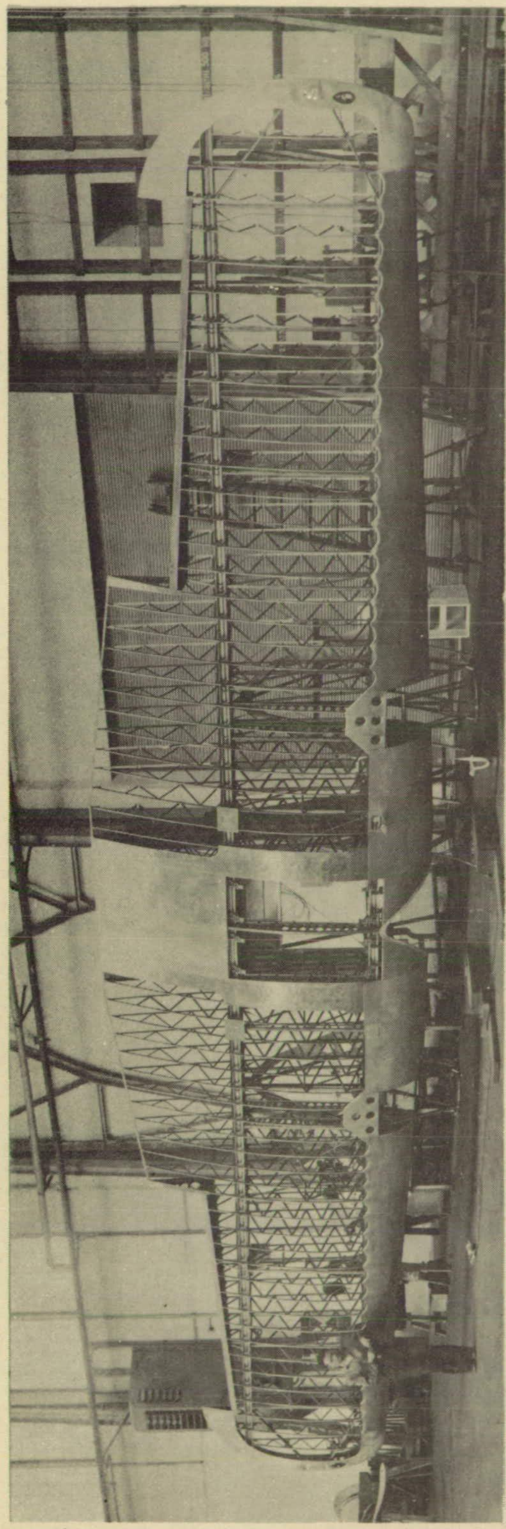


Figure 4.-The all-metal wing structure of the Avia 51. A sheet duralumin covering extends over the leading edge and back behind the front spar.

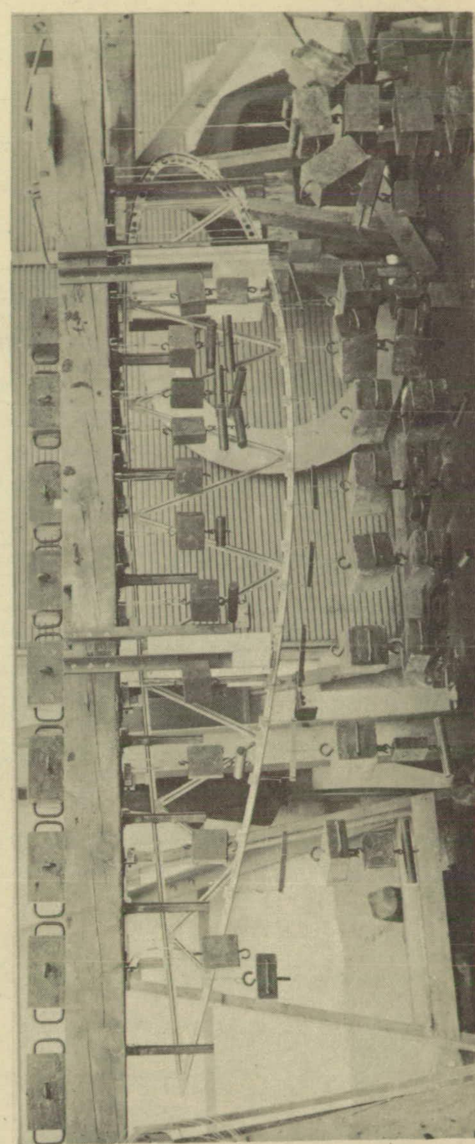


Figure 6.-Close-up view of wing rib, under static test.

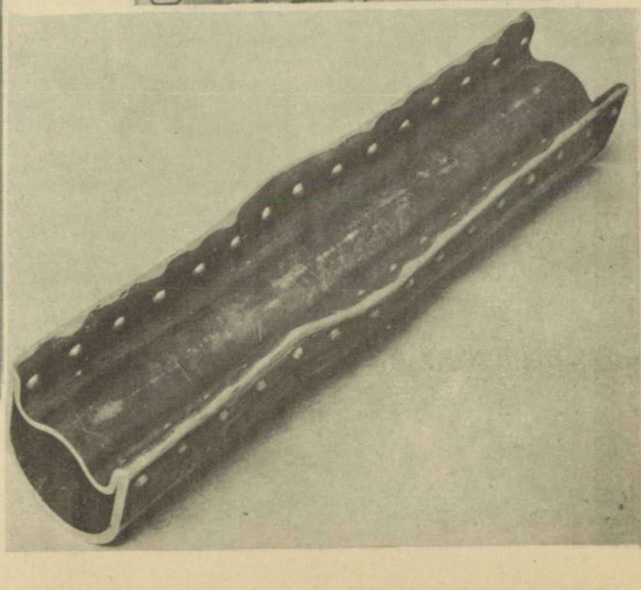


Figure 5.-Wing spar of the Avia 51 after a compression test.

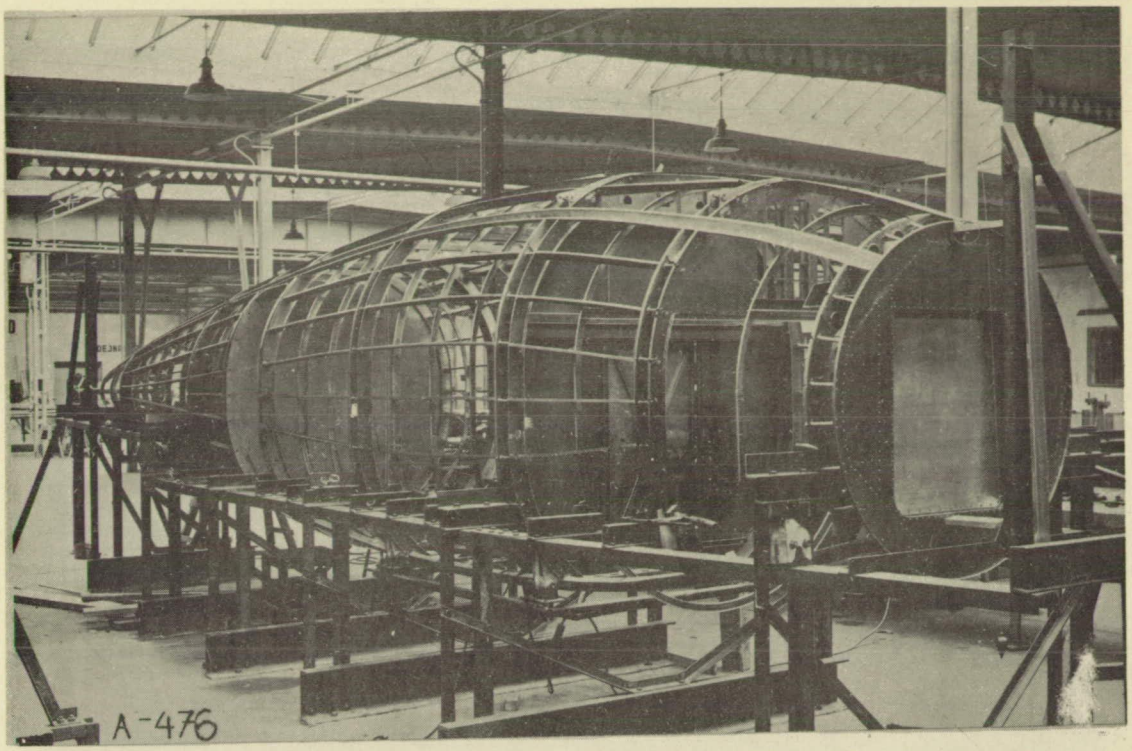


Figure 7.-Fuselage structure of the Avia 51 without covering

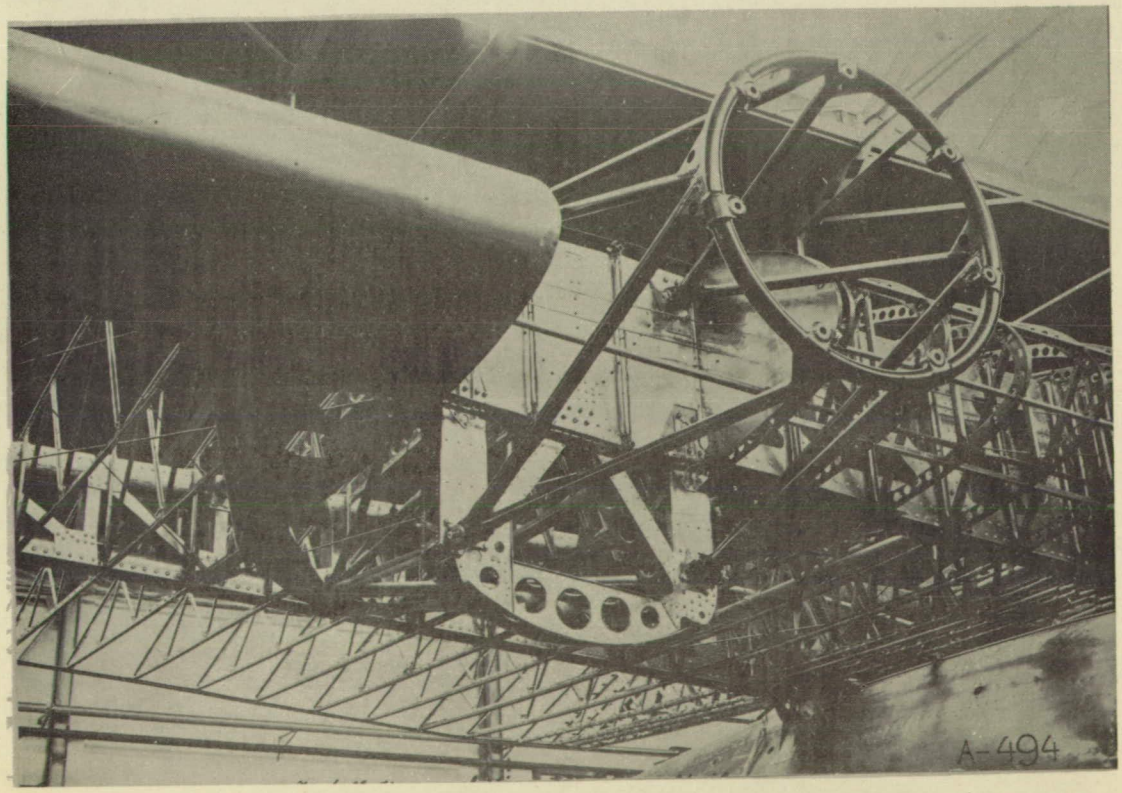


Figure 9.-Engine mount in leading edge of wing.