

AIRCRAFT CIRCULARS
NATIONAL ADVISORY COMMITTEE FOR AERONAUTICS

No. 88

FARMAN TWO-ENGINE COMMERCIAL BIPLANE F.180 (FRENCH)

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FARMAN TWO-ENGINE COMMERCIAL BIPLANE F.180 (FRENCH).*

This airplane was designed with the purpose of making improvements in commercial efficiency, safety and economy. The object sought was the realization of an airplane which, while having a very great efficiency in the load carried on existing lines, the average stage of which is about 500 km (311 miles), would also be capable of directly connecting distant commercial centers under such conditions of safety, comfort and efficiency that its advantages would be self-evident. It was therefore designed for use on stages of 500, 1000 and 1500 km (311, 621 and 932 miles) with corresponding pay loads of 2500, 2000 and 1500 kg (5512, 4409 and 3307 lb.). It is also equipped for both day and night flying. Such a program requires an extremely reliable airplane with a comfortable cabin and a great enough carrying capacity for the pay load to be sufficiently remunerative despite the great length of the stages flown.

Safety Research.- This resulted in the choice of two extremely reliable engines, which had already demonstrated their worth in commercial aviation, namely, the Farman 18 WE 500 HP., and especially in the method of mounting them, a method which is the fundamental characteristic of this airplane.

*From a mimeographed circular received from the Paris Office, N. A. C. A., August 3, 1928.

The two engines are arranged tandem in the longitudinal axis of the airplane (Figs. 1, 2 and 3). It therefore follows that the arrest of one engine only diminishes the power and the continued horizontal flight with the other engine is simply a question of the total weight. In fact, the continuation of normal flight with one engine completely stopped is possible with a total weight of 6750 kg (14,881 lb.), corresponding approximately to 2500 kg (5512 lb.) of useful load, including about 1000 kg (2205 lb.) of pay load.

Under these conditions and on a route suitably marked, the service of the airplane is guaranteed under any circumstances by day or night, since, having two engines with which troubles are extremely rare, the airplane can fly safely with one engine stopped. This security frees it largely from atmospheric conditions by enabling the pilot to make detours above clouds without constant anxiety as to where he would land in case of engine trouble. When the airplane is equipped for day flying under normal conditions, it can take an overload of about 1000 kg (2205 lb.), since the event of engine trouble no longer presents the same consequences and since, moreover, the remaining engine renders it possible to reach an emergency landing field without inconvenience. The safety of the airplane is further increased by a good lifting profile with a comparatively low wing loading of about 45 kg/m² (9.22 lb./sq.ft.).

Efficiency.— This is manifested chiefly in the weight carried, while maintaining a good cruising speed. It was for this purpose that the airplane was given the form of a biplane with a very large gap, which enabled the construction of a very light cell, 6.5 kg/m^2 , (1.33 lb./sq.ft.) and in which, nevertheless, the structural drag is relatively very small. The disposition adopted made it possible, as compared with a biplane cell of a two-engine airplane of similar dimensions, to eliminate three pairs of struts, one engine nacelle and a large part of the brace wires, while greatly reducing the losses from the interference of the two wings.

In designing the fuselage with the purpose of increasing the inside space available for the passenger cabin, while reducing the drag, a cylindrical form was adopted. This was covered with birch plywood, which offers very little frictional resistance. Thus a cabin was obtained, whose interior is absolutely free from any of the fuselage structure, very wide, 2.35 m (7.71 ft.) at the height of the seats, and 1.8 m (5.91 ft.) high. This width provides space for three wide chairs and an aisle. The strength of the fuselage is assured by a framework composed of longerons distributed over its circumference with double planking and transverse frames (Figs. 4, 5, 6 and 7).

The landing gear has two wheels $1250 \times 300 \text{ mm}$ ($49.2 \times 11.8 \text{ in.}$). Its height was made as small as possible, for the double

purpose of lowering the center of gravity and diminishing the drag. It has two principal struts, each consisting of two telescoping parts joined together by sandows arranged parallel in the direction of the wind. These struts support the axle and are braced by two small struts directed forward and hinged to the fuselage. This arrangement constitutes an extremely flexible and relatively light landing gear with very little drag.

Comfort.- This was sought in the location of the cabin, far from the engines, so as to lessen the noise and the vibrations. Its double wall affords a remarkable protection against cold, heat and noise. It constitutes a large room 8 m (26.25 ft.) long, 2.35 m (7.71 ft.) wide and 1.8 m (5.91 ft.) high. The lavatory is back of the cabin.

The cabin is equipped, according to the conditions of utilization, as follows:

For flights of 500 km (311 miles) with the normal day equipment of 20 chairs (possibly 25) in rows of three with a central aisle;

For flights of 1000 km (621 miles) with 17 chairs convertible into couches.

The middle row of seats can be replaced by a buffet bar.

For night use the equipment may consist of twelve couches.

The baggage is deposited in a special 5 m³ (177 cu.ft.) compartment in front of the cabin.

It was for the sake of economy that wood was chosen as the chief material, which, aside from its lower price has the great advantage of facilitating repairs, as shown by the current upkeep of wood airplanes on navigation lines, airplanes which are discarded only after complete destruction in an accident.

For the purpose of facilitating upkeep and adjustment, the cell was made in the form of a rectangular prism, with neither stagger nor decalage, the adjustment of this cell being very simple with no special instrument other than a string and a level. The fuselage is practically indeformable.

The engine mount consists of two girders forming a U to which the engine is secured by bolts. The installation and removal of an engine can be very easily effected with the aid of a derrick. The engine and its installation were planned with the greatest care, so as to facilitate the inspection, care and quick replacement of the various engine accessories.

Characteristics

Span	26 m	85.3 ft.
Length	18 "	59.1 "
Height	5.8 m	19.0 "
Wing area	172 m ²	1851.4 sq.ft.
Power	1000 HP. (2 Farman 500 HP. 12 WE)	
Empty weight, equipped	4500 kg	9921 lb.

Characteristics (Cont.)

Crew of two men	160 kg	353 lb.
Radio and miscellaneous	40 "	88.2 lb.

Performances

Maximum speed	190 km/h	118.1 mi./hr.
Cruising "	170 "	105.6 "
Ceiling with full load	4000 m	13,123.0 ft.

Length of flight,	500 km	(311 mi.)
	1000 "	(621 ")
	1500 "	(932 ")

Fuel required,	800 kg	(1764 lb.)
	1300 "	(2866 ")
	1800 "	(3968 ")

Pay load	2500 kg	(5512 lb.)
	2000 "	(4409 ")
	1500 "	(3307 ")

Full load	8000 kg	17,637 lb.
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Maximum load with one engine stopped	7000 kg	15,432 lb.
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Translation by Dwight M. Miner,
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for Aeronautics

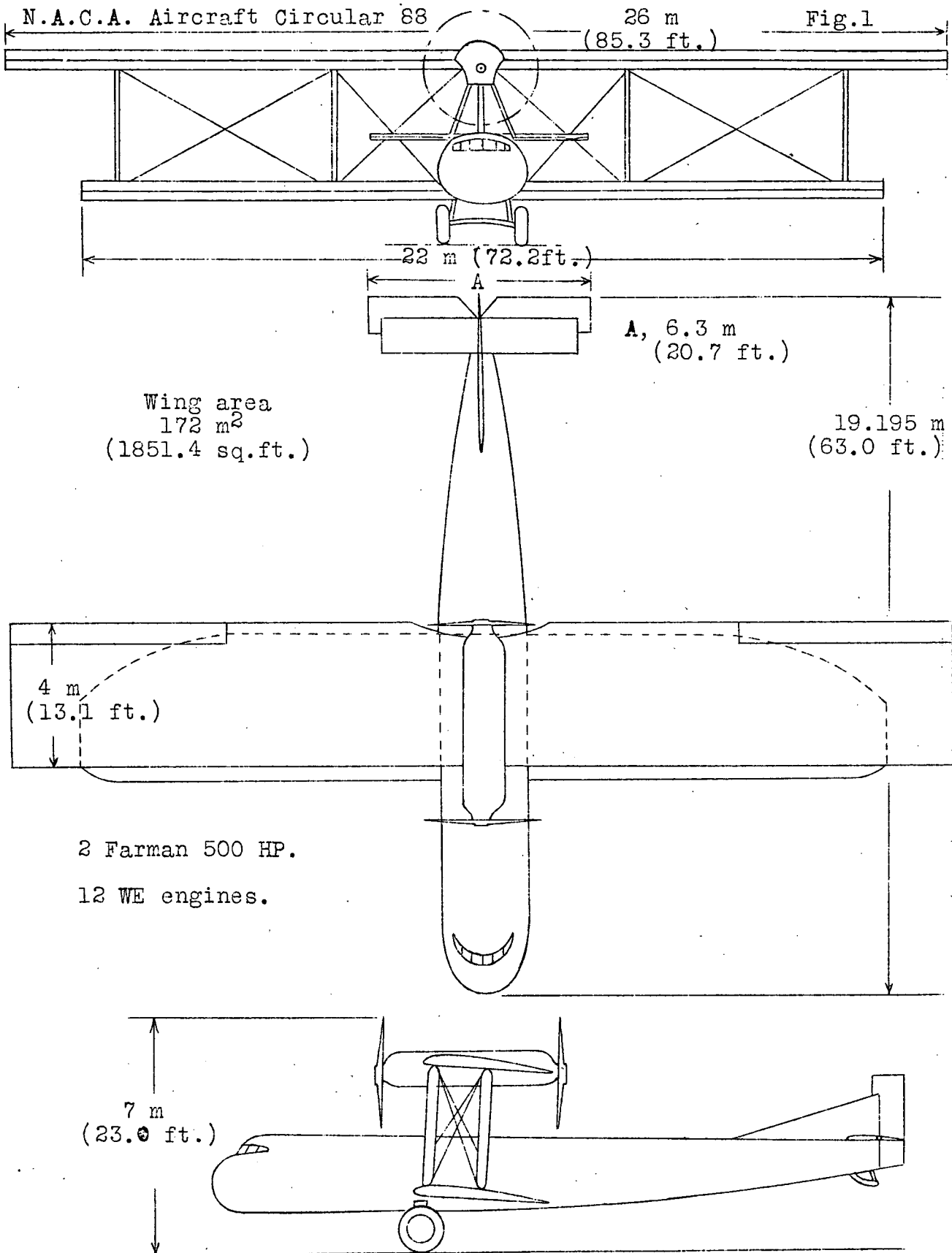


Fig.1 The Farman commercial airplane F-180.



FIG. 3

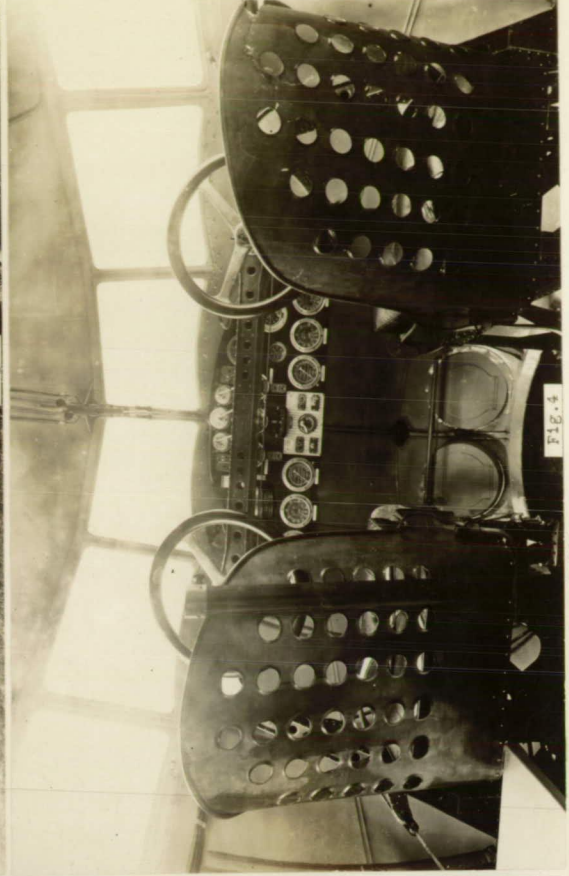


FIG. 4

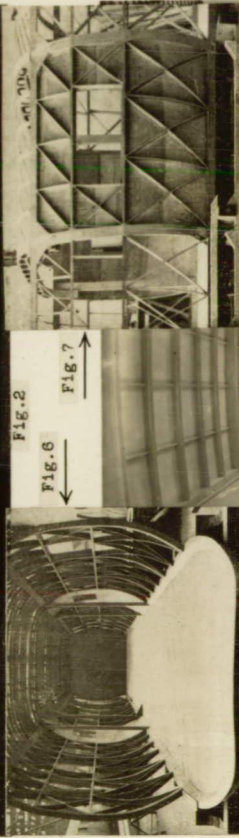


FIG. 2

FIG. 5

FIG. 6

FIG. 7



FIG. 6

Figs. 2, 3, 4, 5, 6, 7 Views of the Farman two-engine commercial airplane F. 18C