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AIRCRAFT CIRCULARS

NATIONAL ADVISORY COMMITTEE FOR AERONAUTICS

No. 155

THE DORNIER Do K COMMERCIAL AIRPLANE (GERMAN)

A High-Wing Cantilever Monoplane

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THE DORNIER Do K COMMERCIAL AIRPLANE (GERMAN)*

A High-Wing Cantilever Monoplane

By Edwin P. A. Heinze

Owing to the kindness of the makers, which we duly acknowledge, the writer has received interesting details of the Do K commercial airplane (figs. 1, 2, 3, 4), which give a good idea of constructional features.

It bears no resemblance to the old Dornier Merkur landplane, which had a single engine and could convey six, or at most eight, passengers besides the crew of two. The Do K has a streamline fuselage of oval section, with a cantilever type wing of entirely new form secured on top, and has ample cabin space for ten passengers. The idea of the designers was to create a fast passenger transport airplane incorporating a high degree of safety for flying over country offering few necessities of alighting in cases of emergency, such as in the Alps and on big deserts. For this reason high aerodynamical efficiency has to be secured, and the power plant had to be subdivided to as great an extent as was compatible with economical working. Four air-cooled Czechoslovakian Walter "Castor" engines of 240 hp output each were adopted and suspended in couples, one behind the other, beneath the wing right and left of the fuselage. The front engines have been provided with four-bladed wooden tractor propellers and the rear with two-bladed pusher propellers.

To secure low profile height (or wing thickness), which only amounts to 27½ inches, it was found advisable to employ three spars instead of the two usually adopted. In this Dr. Dornier has followed the practice that has already proved successful. The three spars consist each of a top and bottom rail of rolled duralumin of channel section. These rails are trussed by upright and diagonal channels riveted in place, the compression members of which are reduced in weight by a number of holes in the channel beds. The wing has a practically straight rear edge, to which the leading edge sweeps round, and it tapers in thickness toward the tips.

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*From Flight, October 9, and 30, 1931.

The spars are connected by fourteen main ribs, twelve auxiliary and a large number of forming ribs. The main ribs are constructed in a manner similar to the spars and, like the other ribs, of course, also are made of duralumin. They pass over the top and bottom surfaces of the spars, to which they are secured by short channel sections riveted on. The upright and diagonal bracings likewise consist of channels. The wing panels thus formed by the main ribs and spars are braced horizontally in two planes by crossed wires. The upper channels of the main ribs between the spars being straight, forming ribs of smaller and lighter duralumin channels are superimposed. The lower channels are slightly arched upwards between the spars.

A number of auxiliary spars are formed by relatively small diameter tubes of oval section passing through the joints on the main and auxiliary ribs where the upright and diagonal web channels meet. Over these tubes is slipped a number of small pressed plates. Joints are formed by three rivets placed equidistantly around the circumference, with a distance piece between, and they serve to hold the top and bottom channels of the light forming ribs, which have no web structure of any kind.

The leading edge of the wing is formed by shaped duralumin sheets, and the ailerons, which are constructed like the wing, are arranged in a cut-out in the trailing edge, of which their trailing edges form continuations to the tips. (Figs. 5 and 6.) These are rounded and merge into the tip curves of the main wing. The upper and lower surfaces of the ailerons, when in their normal position, are flush with the wing and leave no slot between them and the latter. They are pivoted, however, on their lower sides some distance from their front edge on a number of brackets fixed on the rear spar of the wing. These brackets, when the ailerons are flush with the wing, cannot be seen, as they lie within corresponding recesses or slots in the ailerons, which are not balanced. Both the wing and the ailerons are fabric-covered. The ailerons are operated by a rod coming out of the upper wing surface, and which is pivoted to a horn on top of the ailerons. Inside the wing (fig. 7) and also for the operation of the elevator, steel cables are employed in combination with the usual pulleys and bell cranks.

The wing is secured in the normal manner on the fuselage, which, with a length of 52 ft. 2 in., has a main

framework of steel tubes, around which is arranged a forming framework of duralumin hoops of channel section with flanges turned inwards. The hoops are joined by numerous stringers, also of channel section, which are secured to the hoops by one flange (fig. 8) while the other and outer flange is perforated for the attachment of the fabric covering. The steel tubes are flattened at the ends and slotted. Gusset plates are pressed into these slots, and screw bolts passing through the tubes and plates secure the joints. Only in some points of minor importance are rivets employed. In the cabin section of the fuselage the steel frame is braced with diagonal tubes. At the sides the outside forming frame comes close to the steel frame, but still the rather small windows in the outer frame are a few inches out from the steel frame, so when the cabin equipment is complete, they appear inside recesses from the interior. In front of and to the rear of the cabin the steel frame is braced by wire.

While the rear end of the fuselage tapers into a point flattened at the sides, the front end is formed by a large duralumin cap, which is hinged at the top, and, when open, gives access to a spacious luggage hold. Behind this follows the cockpit for the two pilots, whose seats are raised. This cabin is totally enclosed, and the roof superstructure of duralumin merges into the wing top. The roof sections over the pilot's seats slide in guides, and can be pushed back. Access to the cockpit is attained through the passenger cabin, to the rear of which is a lobby, with the entrance on the left and a lavatory on the right side, while behind this a further luggage or goods hold is to be found.

The tail, which is also fabric-covered, is situated on top of the fuselage, with the fin standing on the stabilizer, which is braced with wires both against the fin and the fuselage. The rudder extending down the rear edge of the fuselage, requires the elevator to be divided. The latter is balanced by the small typical Dornier compensating planes arranged a few inches above the stabilizer.

The engine nacelles are suspended each by two perpendicular faired struts from the wing. These two struts form a rectangular frame, of which the top beam is secured in a shallow recess in the lower wing surface, where two steel eyes are provided to attach it. A diagonal tension

rod braces the struts and takes the propeller pull. Two almost horizontal struts connect each engine nacelle with the fuselage. Also with these a diagonal tension rod is used. The engine control rods are located inside the fairing of the upright struts.

The landing wheels are mounted on the apex of two struts, each arranged to form a triangle with the fuselage, on which they are hinged. The spring legs are attached to the bottom of the engine nacelles and incorporate Rheinmetall-Faudi pneumatic shock absorbers. The wheels are furnished with long mud guards extending at the rear. For the tail support a skid is employed.

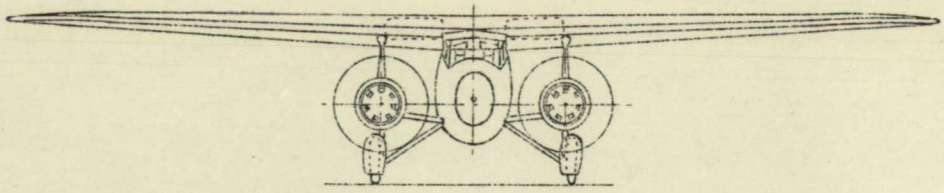
The Do K, when flying at 1000 m (3300 ft.) altitude, with two of the four engines stopped, the rate of climb was 1.31 ft./sec. (78 ft./min.) or a little less than the rate of climb corresponding to service ceiling. This figure was obtained with the airplane carrying a full load.

CHARACTERISTICS AND PERFORMANCE

Length	16.5 m	54 ft. 2 in.
Wing span	25.0 "	82 " 0 "
Height	4.2 "	13 " 9 "
Wing area	88 m^2	948 sq.ft.
Weight, bare	3,600 kg	7,925 lb.
Tare weight, fully equipped	4,000 "	8,800 "
Gross flying weight	6,000 "	13,200 "
Wing loading		14 lb./sq.ft.
Power loading		13.75 lb./hp

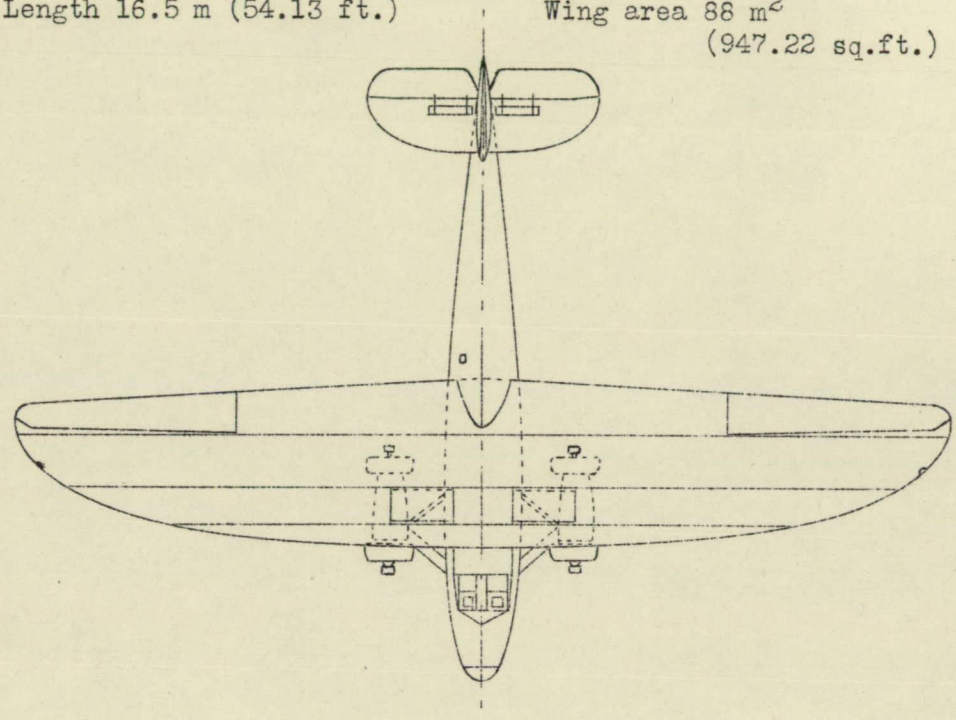
At a gross weight of 13,200 pounds, the following performances were attained during test flights:

Maximum speed	220 km/h	136.5 mi./hr.
Cruising speed	200 "	124.0 "
Ceiling	6,300 m	20,650 ft.
Ceiling (with one engine stopped)	3,800 "	12,500 "



Span 25 m (82.02 ft.)
Length 16.5 m (54.13 ft.)

Height 4.2 m (13.78 ft.)
Wing area 88 m^2
(947.22 sq.ft.)



Four 240 hp Walter "Castor"
engines.

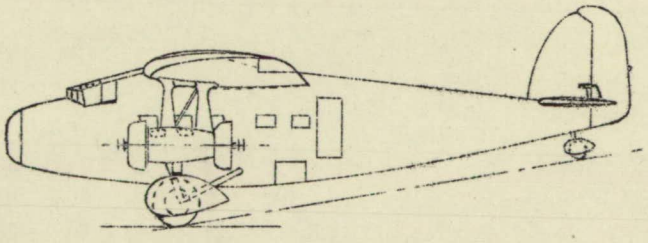
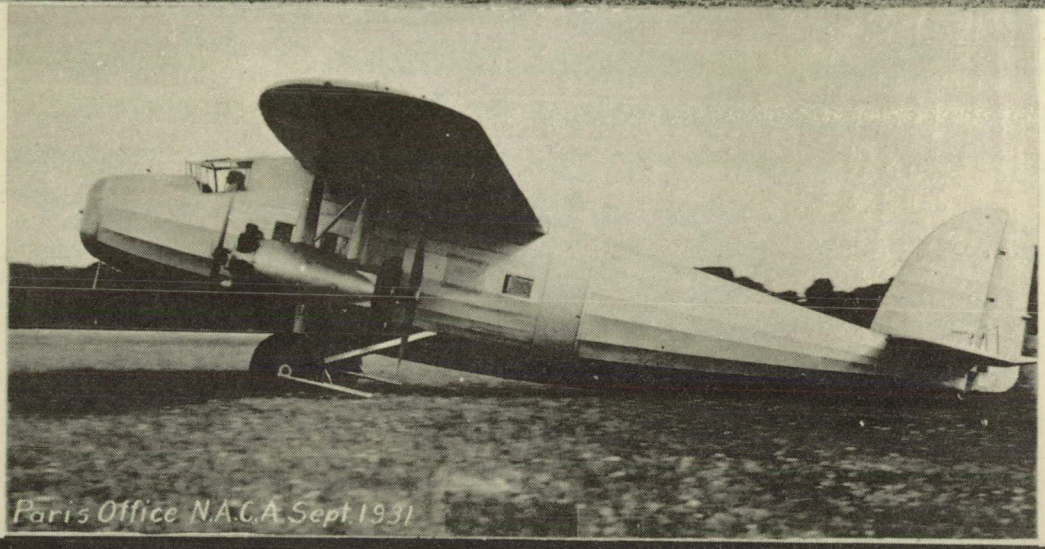
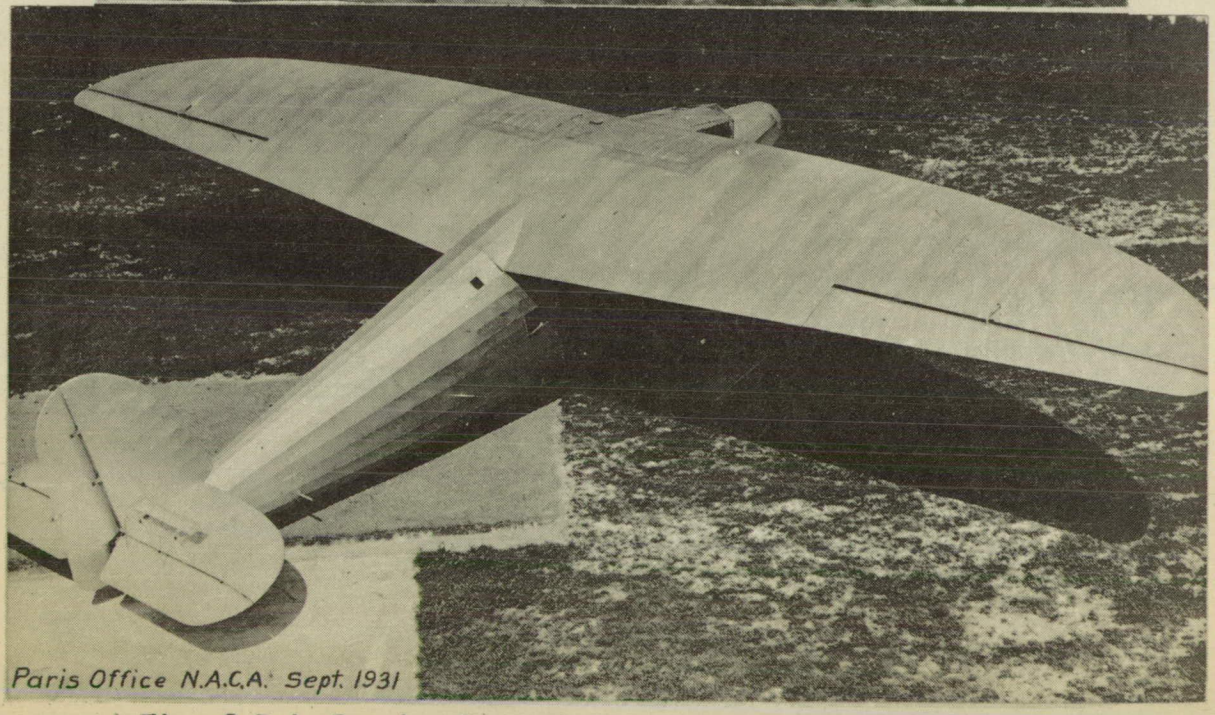


Fig.1 General arrangement drawings of the Do-K commercial airplane.





Figs.2,3,4 Dornier Do-K, 4-240 hp Walter "Castor" engines.

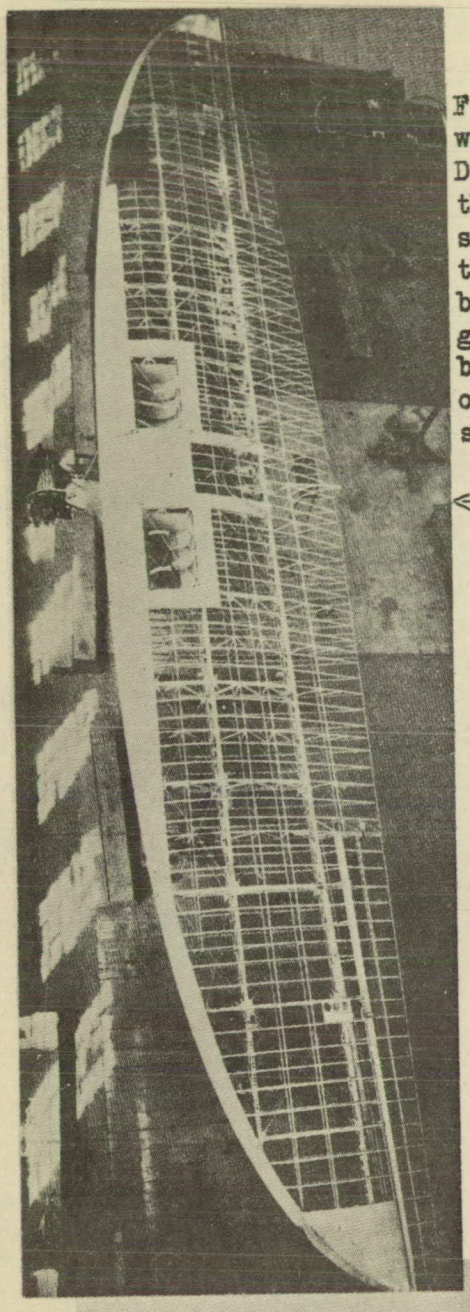


Fig.5 The wing of the Do-K is a three-spar structure, the spars being girders built up of channel sections.

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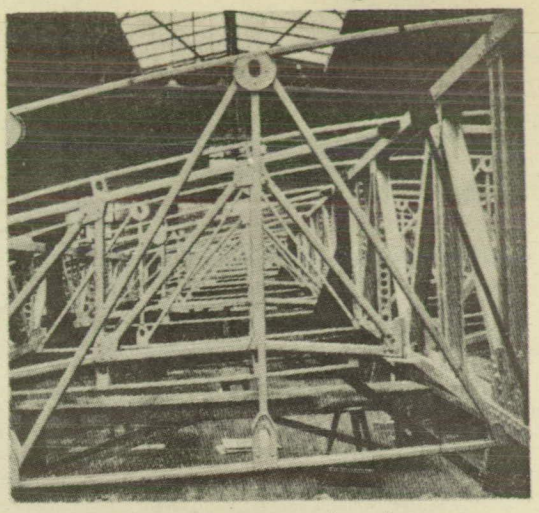

Fig.7 View showing interior structure of wing.

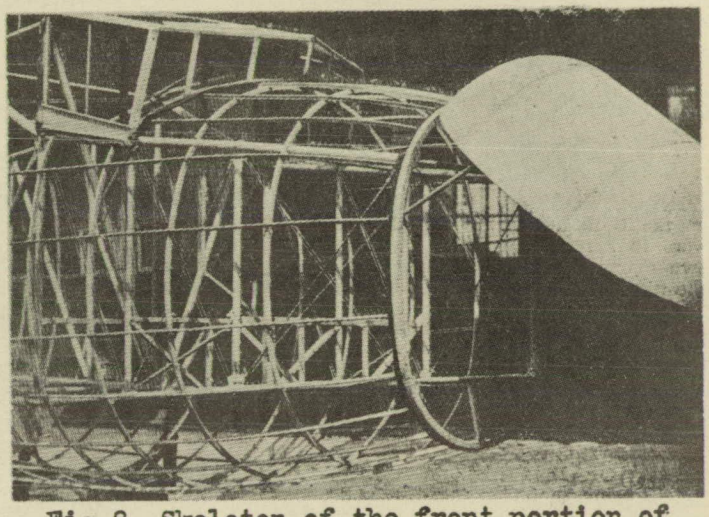

Fig.8 Skeleton of the front portion of the fuselage. The main fuselage structure is of steel tube.

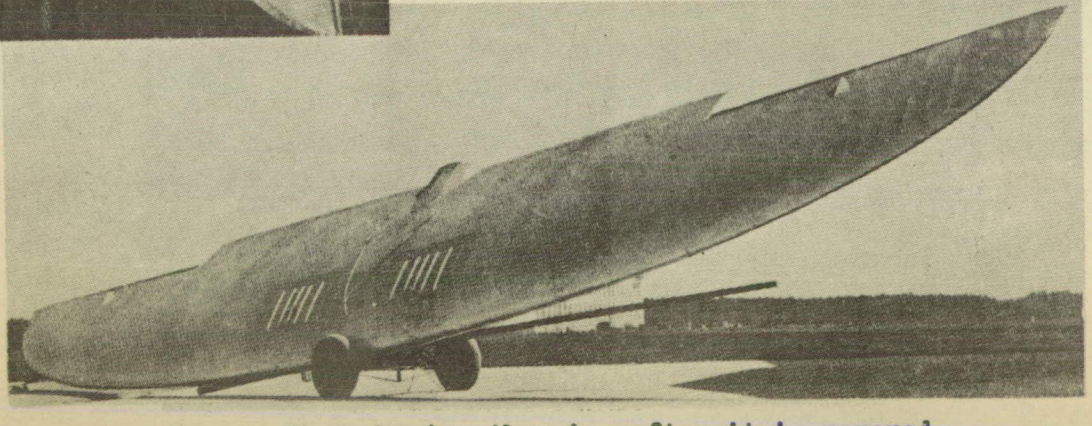

Fig.6 View showing the wing after it is covered.