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No. 209

FAIREY "BATTLE" MEDIUM BOMBER AIRPLANE (BRITISH)

An All-Metal Low-Wing Cantilever Monoplane

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NATIONAL ADVISORY COMMITTEE FOR AERONAUTICS

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FAIREY "BATTLE" MEDIUM BOMBER AIRPLANE (BRITISH)*

An All-Metal Low-Wing Cantilever Monoplane

The Fairey "Battle" is the firm's first effort in stressed-skin construction. The design was based on the requirements which called for a two-seat medium bomber of high performance. The Fairey Company increased considerably the range called for in that specification. Also, there is plenty of room in the fuselage for a crew of three, if required. The Fairey "Battle" is a low-wing cantilever monoplane built entirely of metal (figs. 1, 2, 3, 4, 5, and 6). It has stressed skin on wings, fuselage, and tail. The retractable landing gear folds backward. The wheels when retracted still project enough to be of use in emergency landings.

The whole fuselage is built on a jig which acts as a core. When the fuselage is completely plated the core is collapsed and the fuselage is drawn off like a riding boot.

The wings are made in nine main pieces. First, there is the center section, onto which the fuselage is secured by riveting through flanges. Then, there are the right and left wings, made up of a middle portion between the two spars, across the chord of the wing, onto which the nosepiece and trailing edge are riveted. And, lastly, there are the tip pieces (figs. 7, 8, and 9). A great advantage of this method of construction is that, should any part be damaged, that section can be dismantled and replaced with a new one with the minimum of trouble.

The first process in the assembly of the fuselage on its core jig is the spacing out of the hoop frames, which have been stamped out on a large press. The frames are then connected by longitudinal Z-section stringers onto which the metal plating is riveted.

This stressed skin is laid in long longitudinal panels with the top side flanged around to add strength. The panels are overlapped downward and riveted through the stringers. When these processes have been completed the

*From The Aeroplane, June 16, and August 18, 1937.

jig is collapsed, the fuselage drawn off and assembled with the center section.

The center section and the wings are built on the two-spar principle. The spars are Warren girders at the root, running into a flanged beam with a single thickness of plate for the web. These spars are assembled with their ribs on a large vertical jig. Spanwise Z-section stringers are spaced along grooves cut in the rib surfaces. To these stringers and to the chordwise flanges of the ribs the metal stressed skin is riveted.

On the under surface of the wing one deep panel about 18 inches wide and running along the whole outer span is secured with Simmonds-Corsey lock nuts instead of rivets. The panels can then be easily detached for inspection of the interior of the wing structure. Onto the main portion of the wing is riveted the nosepiece and the trailing edge, already assembled on separate jigs. The nosepiece is the only portion of the airplane which is flush-riveted.

Large split trailing-edge flaps extend out to the ailerons, with a gap under the fuselage.

When the different portions of the wing have been assembled they are joined with the center section and riveted to the fuselage along a projecting flange built in on the fuselage jig. The whole structure then passes on to receive the tubular front portion forward of the leading edge and the engine mounting. These are bolted to massive channels running inside the fuselage structure.

At the same time the landing gear is fitted. This works on the Lockheed hydraulic principle and retracts backward into the wing, leaving about half the diameter of the wheels projecting.

The metal stabilizer and fin are attached, followed by the conical pointed tailpiece. When the Rolls-Royce Merlin has been lowered into its bearers the airplane begins to look complete.

The two 106-gallon gasoline tanks are carried in the center section of the fuselage, and the oil tank is mounted immediately above and behind the engine. The radiator, under the center section of the wing, is of the ducted type with controllable-flap cooling. The oil cooler is

built in with the radiator and takes up about one-sixth of the available area on the starboard side.

From the pilot's cockpit - immediately behind the fireproof bulkhead - there is an excellent view in almost every direction. It is about five feet in front of the rear gunner's cockpit, though the transparent hooding panelled in Perspex is carried the whole way between the two. Immediately behind the front cockpit there is a pyramid of struts built of high-tensile steel to withstand the whole weight of the airplane and protect the pilot should it turn over. The back cockpit is equally roomy. It is covered by an adaptable type of windshield which can be either lowered to give coupé comfort and form the perfect streamline to the fuselage or raised to protect the aft gunner.

Ailerons, elevator, and rudder, are all metal-framed and fabric-covered. The rudder and elevators have trimming tabs and one is also fitted to the port aileron. Just outboard of the retractable landing gear are the bomb compartments. These are entirely inside the wings. A De Havilland controllable-pitch propeller is fitted but no spinner has yet been made. The "Battle" can be looped and rolled. It seems to be almost as handy as the smaller biplane fighters.

SPECIFICATION

Type.- 2-to 3-seat medium bomber monoplane.

Wings.- Low-wing cantilever monoplane. Wing tapers in chord and in thickness. Two-spar construction. Spars are each girder-like at the root and run into a flanged beam toward the tip. Metal ribs pressed from plate have circular flanged lightening holes. Z-section stringers in grooves in ribs. Stressed-skin covering riveted to stringers and flanges on ribs. Inspection panel, secured by Simmonds stop nuts, runs spanwise along underside of wings. Flush-riveted nosepiece assembled on center portion of wing. Trailing-edge portion also attached as separate operation. Trailing-edge flaps extend from aileron to fuselage on each side.

Fuselage.- Oval section built up on core jigs. Hoop frames, stamped out in one process, assembled with longitudinal Z-section stringers riveted through to flanges on the hoops. Stringers and skin laid on in longitudinal

panels. From the pilot's cockpit forward is made up of tubular bolted and riveted portions.

Tail unit.- Cantilever monoplane tail and single fin have metal framework, metal-covered. Rudder and elevators metal-framed and fabric-covered.

Landing gear.- Retractable. Each unit folds up backward into the wing by working of Lockheed hydraulic jack. About half the diameter of the wheels is left projecting below the under surface of the wing.

Power plant.- One 1,035-hp. (take-off) Rolls-Royce Merlin 12-cylinder V liquid-cooled engine on welded steel tube mounting. Two 106-gallon fuel tanks in the center section of fuselage. Oil tanks in front of fireproof bulkhead. Ducted radiator just forward of center section of wings below the fuselage.

Accommodation.- Pilot's cockpit in line with the leading edge of the wing, with rear gunner's cockpit about 6 feet behind it. The whole enclosed in transparent Perspex hooding.

CHARACTERISTICS

Dimensions:

Length	42 ft. 1-3/4 in.
Height	15 ft. 6 in.
Span	54 ft.
Wing area	422 sq. ft.

Weights and loadings:

Structure	4,147 lb.
Power plant	2,500 lb.
Tare weight	6,647 lb.
Crew plus parachutes (2)	400 lb.
Fixed equipment	573 lb.

Weights and loadings (cont'd.):

Movable equipment	1,432 lb.
Fuel	1,632 lb.
Oil	108 lb.
Weight loaded	10,792 lb.
Wing loading	25.6 lb./sq.ft.
Power loading	10.4 lb./hp.

Performance:

Speed at ground level	210 m.p.h.
Speed at 10,000 ft.	240 m.p.h.
Speed at 15,000 ft.	257 m.p.h.
Speed at 20,000 ft.	250 m.p.h.
Climb to 5,000 ft.	4 min. 6 sec.
Climb to 10,000 ft.	8 min. 24 sec.
Climb to 15,000 ft.	13 min. 36 sec.
Climb to 20,000 ft.	21 min. 24 sec.
Service ceiling	25,000 ft.
Landing speed	60 m.p.h.
Range at 200 m.p.h. at 16,000 ft.	1,000 miles
Range at 257 m.p.h. at 16,000 ft.	640 miles

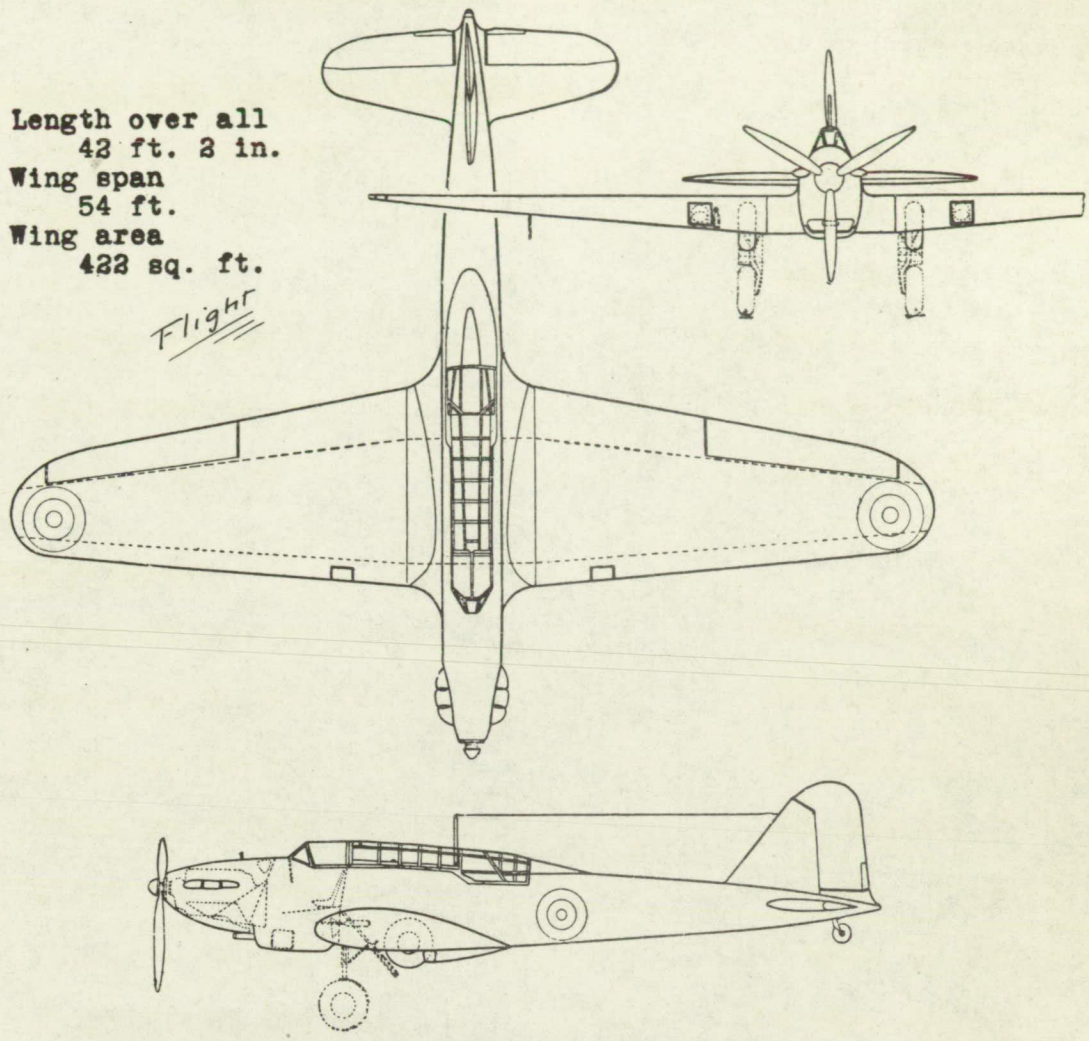


Figure 1.- General arrangement drawings of the Fairey "Battle" airplane.

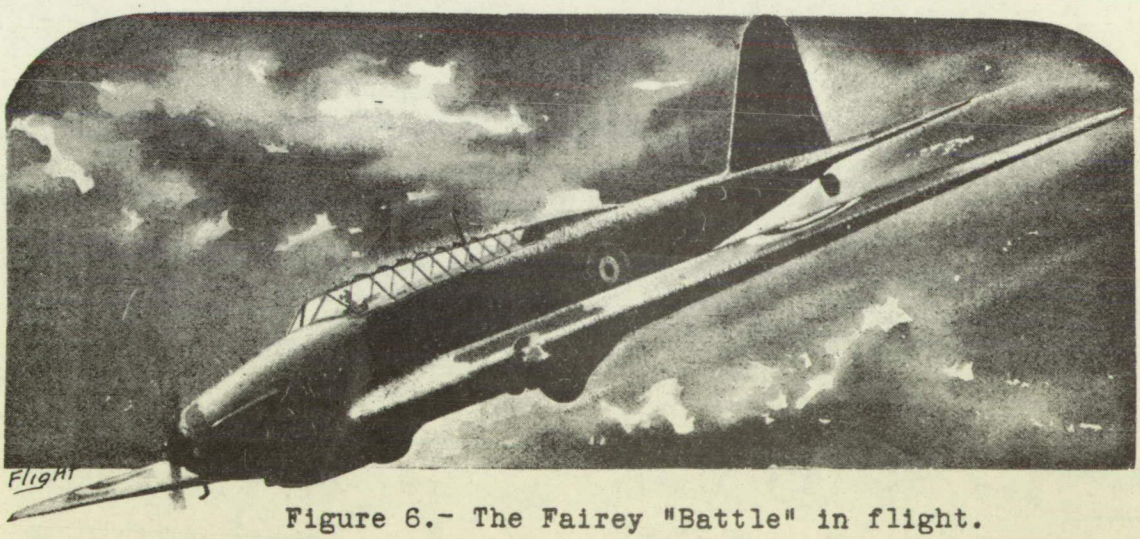
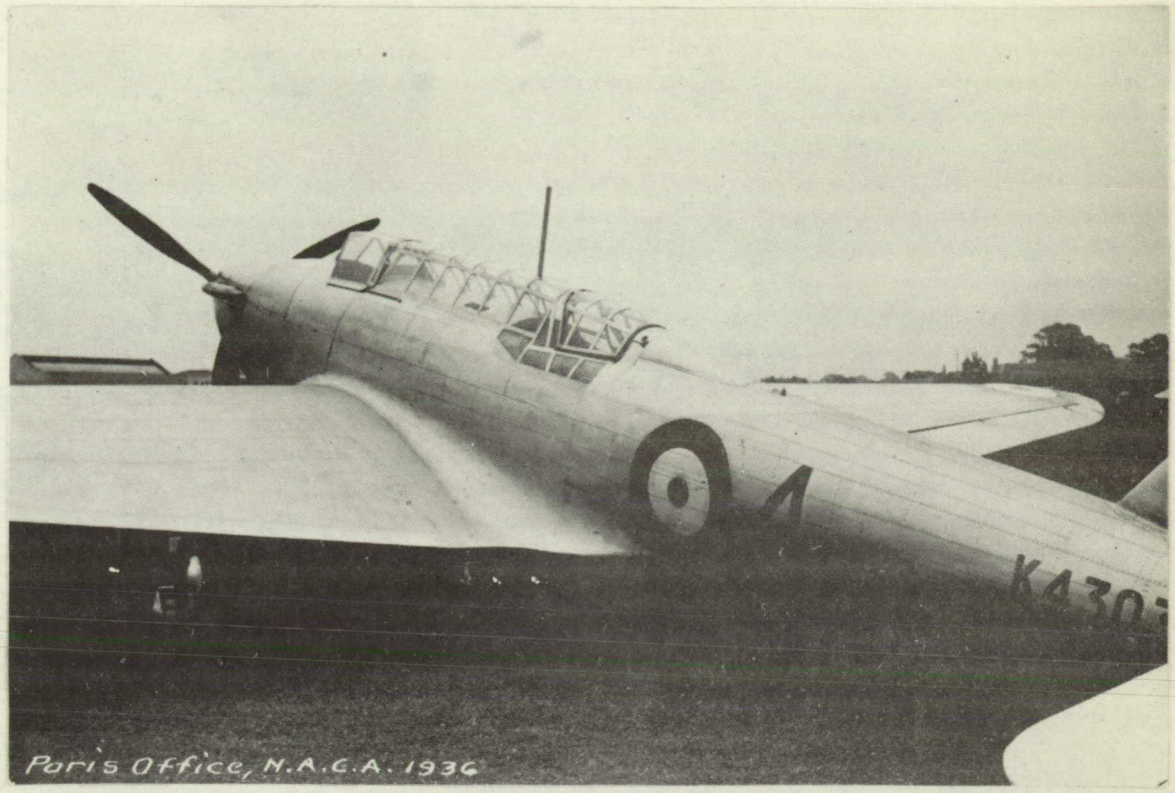
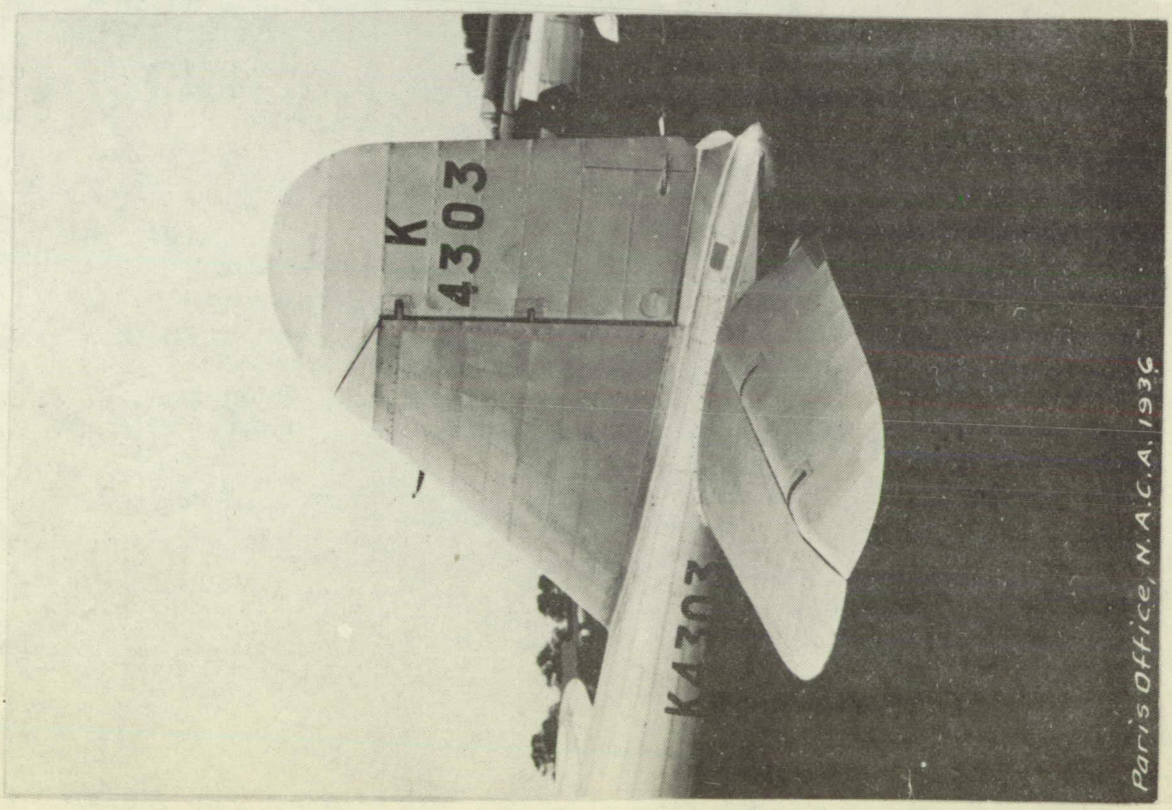
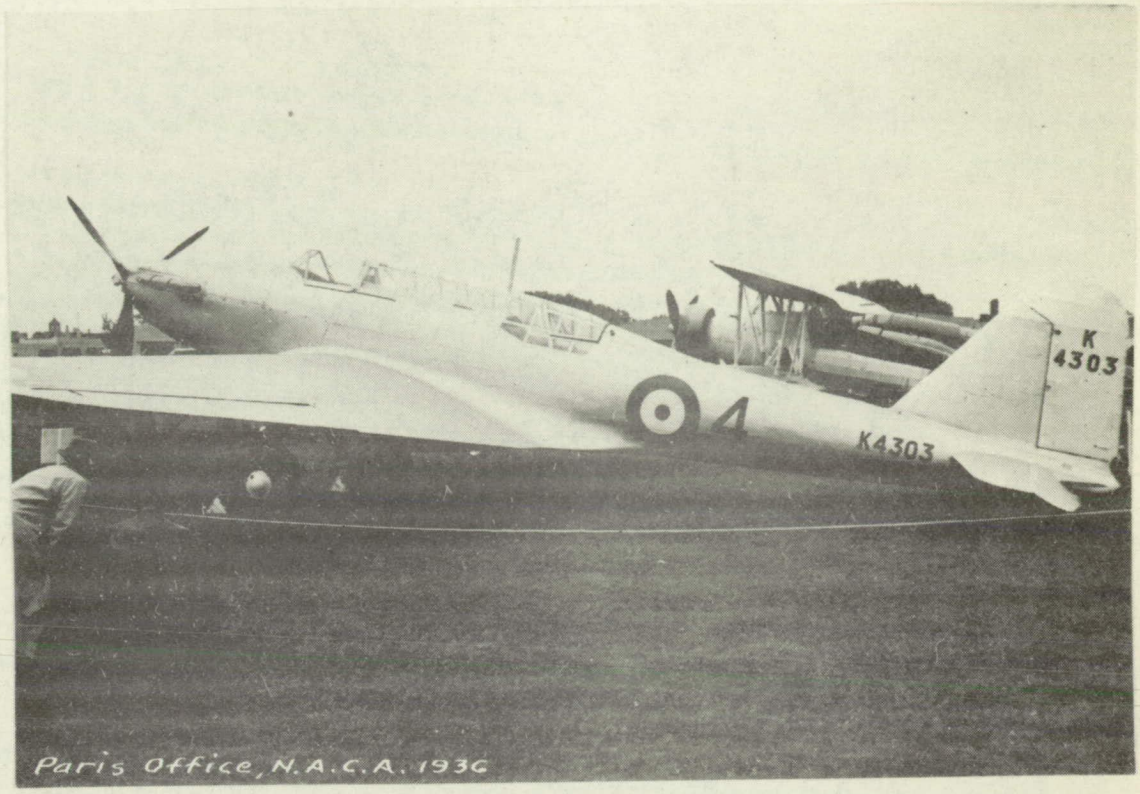


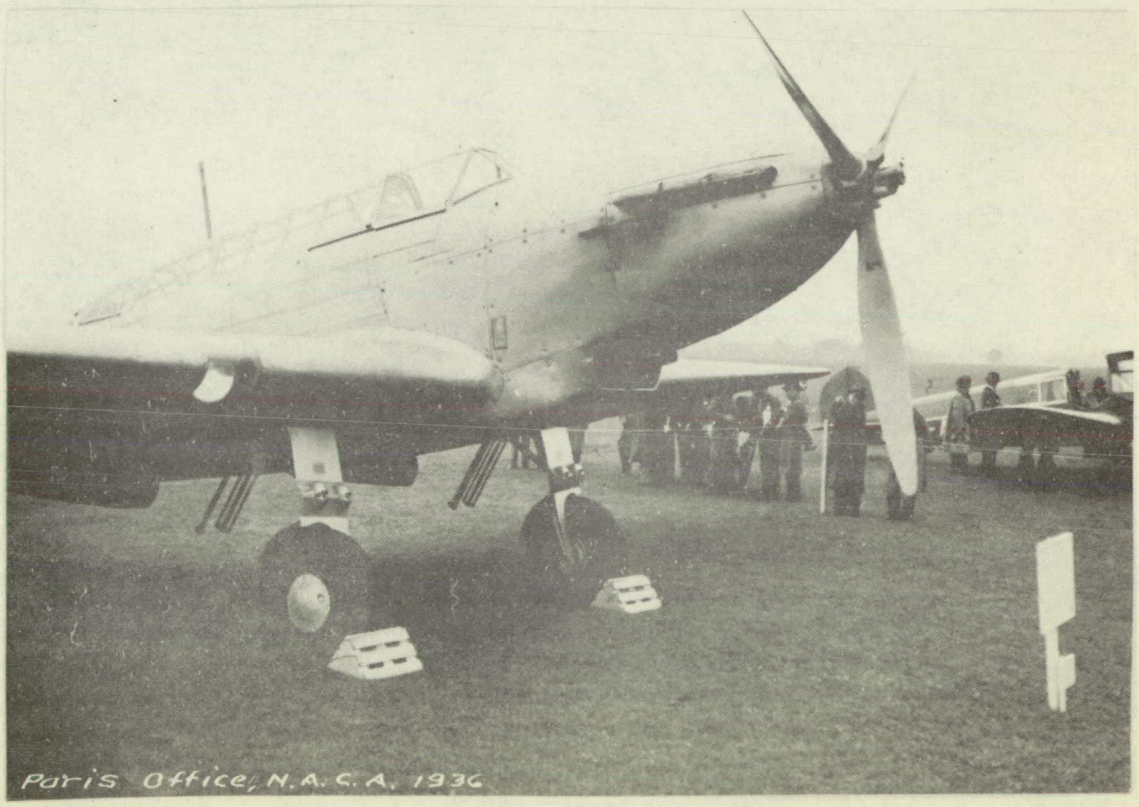
Figure 6.- The Fairey "Battle" in flight.





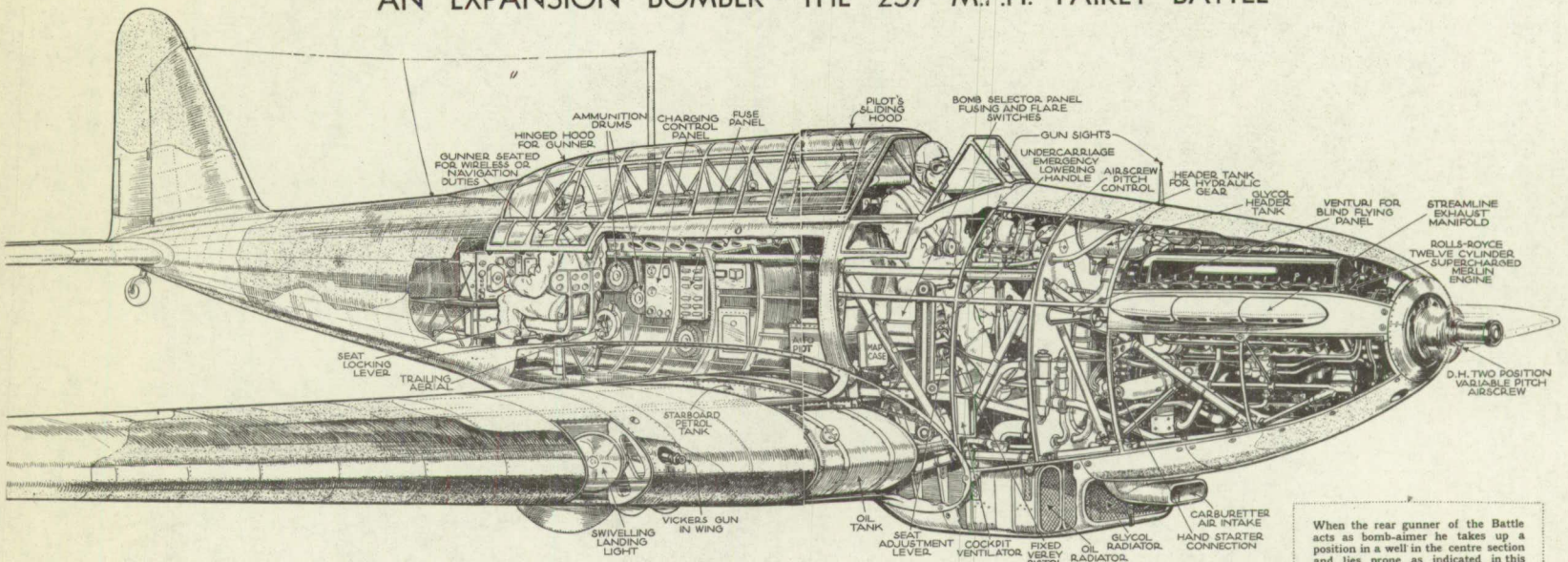
Figures 2,3.- Fairy Battle two-seat bomber (Rolls-Royce Merlin engine)



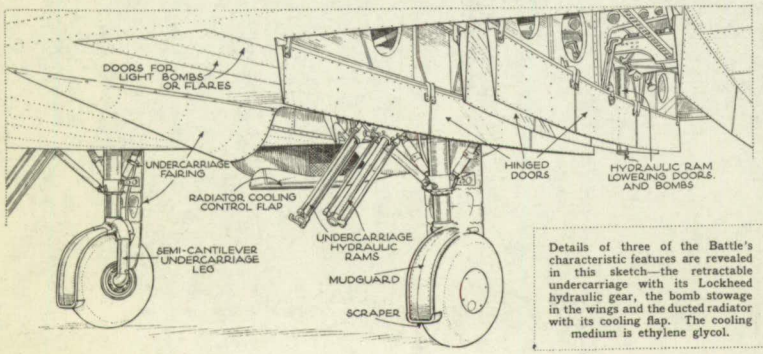


Figures 4,5.- Fairy Battle two-seat bomber (Rolls-Royce Merlin engine)

AN EXPANSION BOMBER—THE 257 M.P.H. FAIREY BATTLE



When the rear gunner of the Battle acts as bomb-aimer he takes up a position in a well in the centre section and lies prone as indicated in this sketch. When using his Lewis gun he is protected from the air stream by a hinged portion of the cockpit hooding. Note that a "crash pylon" is provided behind the pilot's head to give some protection in the event of the machine turning over on the ground.



Details of three of the Battle's characteristic features are revealed in this sketch—the retractable undercarriage with its Lockheed hydraulic gear, the bomb stowage in the wings and the ducted radiator with its cooling flap. The cooling medium is ethylene glycol.

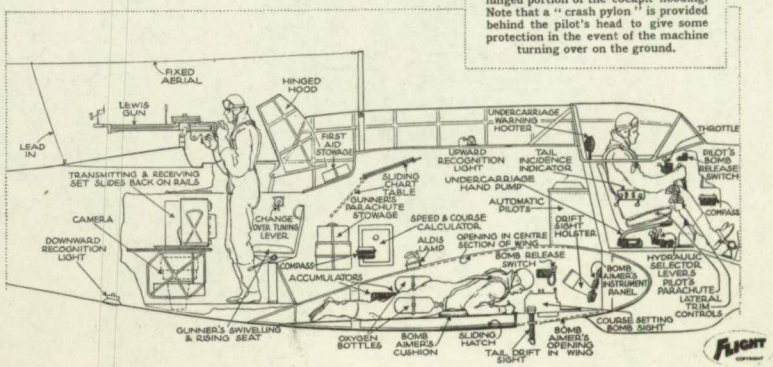


Figure 7.

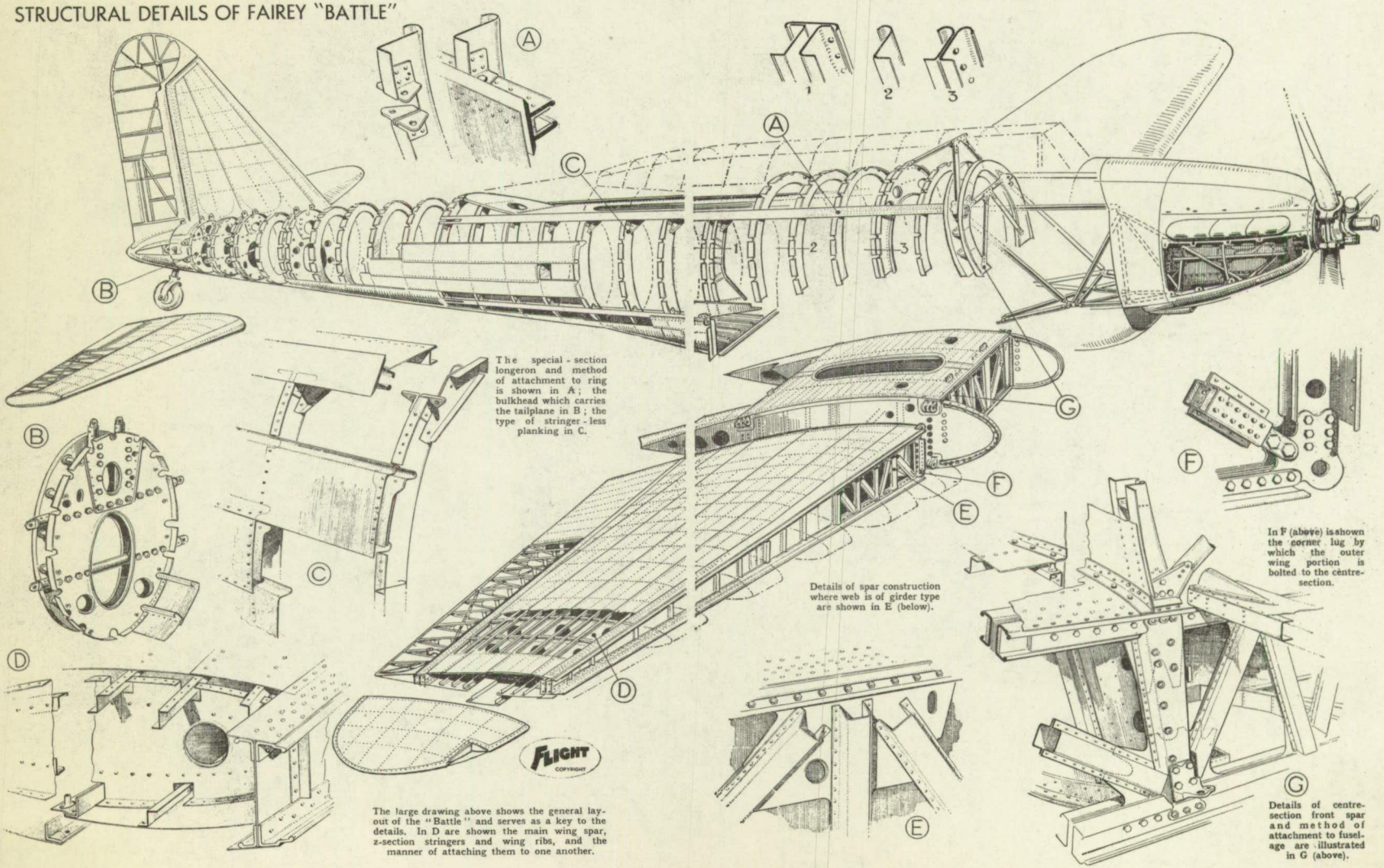

STRUCTURAL DETAILS OF FAIREY "BATTLE"
A
B
C
D
E
F
G
1
2
3
The special-section longeron and method of attachment to ring is shown in A; the bulkhead which carries the tailplane in B; the type of stringer-less planking in C.
Details of spar construction where web is of girder type are shown in E (below).
In F (above) is shown the corner lug by which the outer wing portion is bolted to the centre-section.
Details of centre-section front spar and method of attachment to fuselage are illustrated in G (above).
The large drawing above shows the general lay-out of the "Battle" and serves as a key to the details. In D are shown the main wing spar, z-section stringers and wing ribs, and the manner of attaching them to one another.
FLIGHT
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Figure 8.

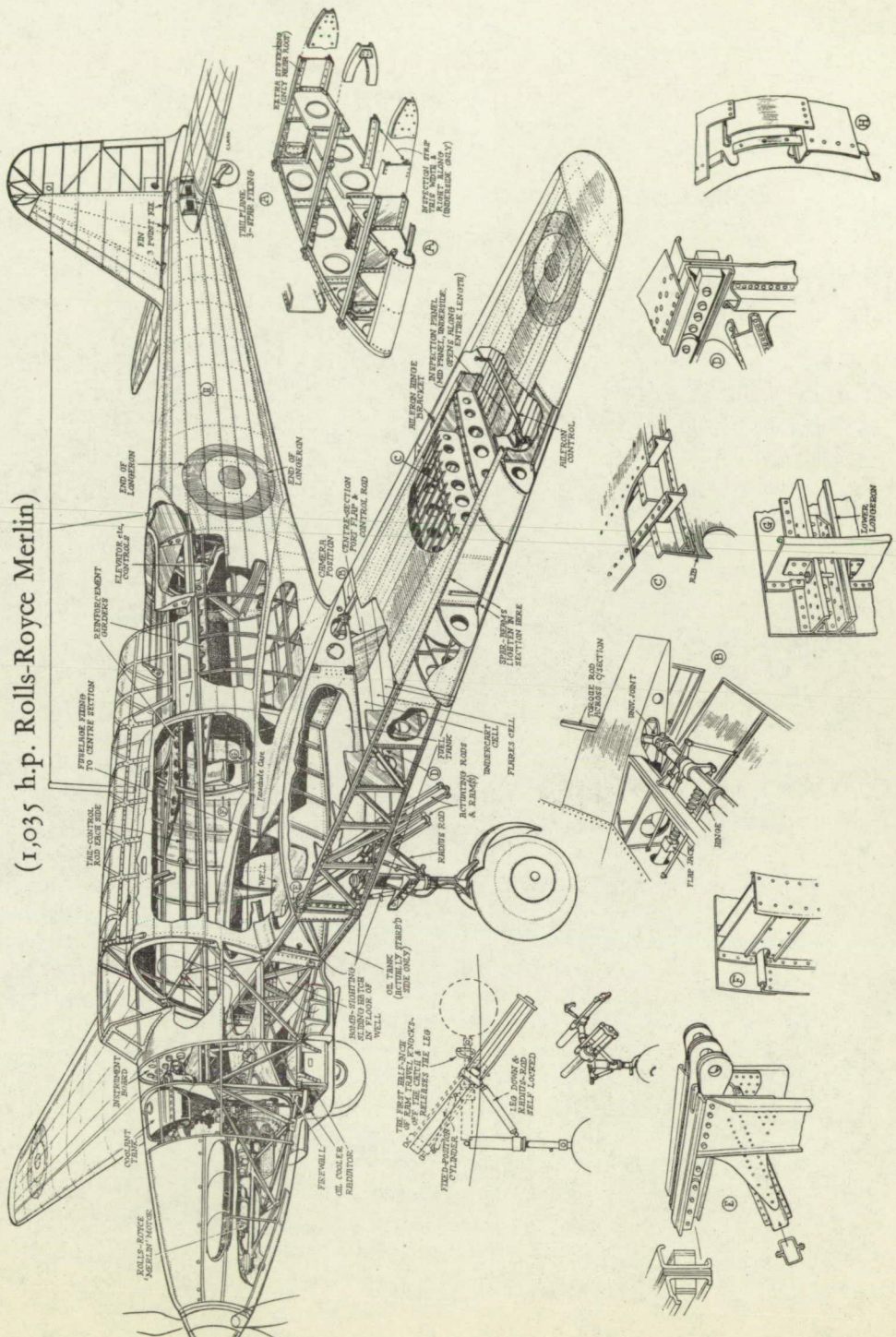
THE FAIREY BATTLE
(1,035 h.p. Rolls-Royce Merlin)
FIN
3 POINT FIX
END OF LONGERON
ELEVATOR etc. CONTROLS
FIREWALL
FUEL TANK
UNDERCARRIAGE CELL
FLAPS CELL
AILERON CONTROL
RUDDER
FLAP JACK
OIL TANK
OIL COOLER RADIATOR
ROLLS-ROYCE MERLIN ENGINE
INSTRUMENT BOARD
LOWER LONGERON

Figure 9.