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NATIONAL ADVISORY COMMITTEE FOR AERONAUTICS

No. 191

AVRO 642 COMMERCIAL AIRPLANE (BRITISH)

A High-Wing Cantilever Monoplane

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AVRO 642 COMMERCIAL AIRPLANE (BRITISH)*

A High-Wing Cantilever Monoplane

The Avro 642 is similar to the earlier Avro monoplanes. It is of mixed construction and is powered with 2 Armstrong Siddeley Jaguar 460 hp. engines.

Despite its size, the 642 is provided with excellent positive and comparatively light controls. A short trial showed that the 642 has not the characteristics of pronounced aileron drag, sluggish controls unharmonized as regards force required for operation, often to be found in large high-wing monoplanes, and it does not float when landing. Naturally, being a clean job, its run is fairly long and fast, and when the airplane is loaded the brakes may be used to shorten the run as desired. The take-off is good, and there is no difficulty at all in holding the airplane straight with one engine throttled back.

The table of performance figures, figures provided by the makers which are substantiated by official Air Ministry tests at Martlesham Heath, shows that the Everling high-speed figure is over 22. This is quite high for a twin-engine monoplane, and is a criterion of the cleanliness of design which has been achieved. (See figs. 1, 2, 3, and 4.)

From the passengers' point of view, the 642 is good. The chairs are comfortable, and the interior upholstery is excellent. A 16-seat layout was chosen. The windows are situated at the correct height for the passengers, so that they do not have to strain about when they wish to look out while seated. Naturally, with this number of passengers placed in two rows, there is not a superabundance of leg room, but the arrangement has a great advantage in that it gives every passenger a window seat. It is not provided, however, with windows that can be opened. Sliding windows can be fitted if required.

The fact that the cantilever wing, with its deep spars, is set right down on to the cabin means that the two spars

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*From Flight, April 5, 1934.

take up a good deal of head room (fig. 5), but in the 642 this has been utilized to house the battery for the lighting, and other electrical equipment.

The passenger cabin is easy to get into, as a large step has been designed which folds up into the door space when the door is closed and can be let down at once when required after landing. At the rear end of the cabin there is a well-fitted lavatory, and aft of that is the luggage compartment, while racks for light luggage run the full length, each side, of the cabin.

The pilots' cockpit is separated from the main passenger cabin by a bulkhead and door, so that all draft is excluded, and the passenger cabin may, in cold weather, be adequately heated by the heating system, consisting of a hot air supply from a jacketed exhaust pipe.

The pilots' cockpit is well arranged, with full dual flying controls, centrally placed engine and wheel brake control levers and, a point which is not very common, the tail trimming wheel is fitted to the side of the throttle-control-lever mounting, so that either pilot can get at it easily. The usual range of instruments was on the dashboard, but, as in all large aircraft, this is a matter which differs with each owner. The windows around the pilots' cockpit are adequate for forward and side view.

The wheels and wheel brakes are the latest Dunlop types and the latter make handling the 642* on the ground a simple matter. The central control lever, regulating the air pressure supplied to the brakes, is handily placed just below the throttle levers, and the pressure gage unit is on the dashboard in front of the left-hand seat, where the chief pilot normally sits.

Each "Jaguar" engine is fed from an individual fuel tank of welded aluminum - normal capacity 97 gallons (440 liters) - by dual engine-driven fuel pumps, through Petroflex tubing and the standard fuel filters. The tank cocks are controlled by levers situated on the cockpit roof above each pilot's seat. The engines are mounted on tubular welded steel mountings bolted to the front wing spars, with provision for carrying the torque loads back to the rear spars. Aluminum cowlings and Townend rings are used to

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*The Dunlop brakes were described in Flight for June 24, 1932, p. 579.

keep the drag of the installation low, and the model under review had four-blade wood propellers. The fuel tanks are mounted in the wing behind, and directly inboard of, each engine, and the oil tank is situated in front of it, forming a portion of the leading edge of the wing (fig. 6). A Kigass priming system is used and the engines are started by Siddeley hand-electric starters.

This article is concerned mainly with the 642 powered with two "Jaguar" engines, but it should be noted that the same type can, if desired, be fitted with four Siddeley "Lynx" engines of 215 hp. each. In this form the airplane will have top speed at sea level of 150 m.p.h. (241.4 km/h) and a cruising speed of 127 m.p.h. (204.4 km/h), while the passenger accommodation then becomes twelve, for a range of 400 miles (643.7 km). The table gives the maximum range of the "Jaguar" engined model for varying passenger loads when fitted with the standard fuel tanks, a lavatory and large baggage hold; it should be noted that the range can be increased by reducing the number of passengers and increasing the fuel tankage, at the rate of 60 miles cruising range per passenger.

Liberal instrument equipment is provided as standard and items like a turn and bank indicator, compass, clock, and all the usual flying and engine instruments are included in the specification.

Coming now to structural considerations, the 642 is similar to the earlier Avro monoplanes and qualities like economical maintenance and long life have, in particular, been retained.

The wing is basically like the Avro Ten, the boxed plywood and spruce spars being continuous from tip to tip. The ribs are also built up of plywood and spruce and, from the rear spar forward, the wing is completely plywood covered; moreover, this plywood has fabric glued over it as a final and lasting weather protection. Aft of the rear spar the wing is made in the form of a detachable section and is fabric covered; this is done so that transportation of the large wing may be thereby simplified (fig. 7).

The ailerons, of the Frise balanced type, are long and have a narrow chord. They are, like the wing, of spruce construction with a plywood leading edge and are fabric covered. Both the ailerons and the tail control surfaces are

operated through a tie-rod system which incorporates flexible cables running over pulleys where necessary, thus obviating the use of rubbing contacts on blocks of fiber.

All the tail-unit surfaces are of welded steel tube construction (figs. 8 and 9) with doped-fabric covering. The elevators have horn balances of the inset type while the rudder is balanced by means of a small auxiliary surface inset in the trailing edge, hinged to it and controlled by a lever fixed to the fin. The stabilizer is adjusted to trim the 642 through nonreversible screw gearing acting on the rear spar and operated by a wheel in the pilots' cockpit.

The fuselage is a single unit of welded steel tubes. In some cases the bracing is by diagonal tubes, in others, by steel wires. The tubes used are of specification, D.T.D. 89a, and are hermetically sealed, thus obviating any possibility of internal corrosion.

The floor of the cabin is particularly rigid and strong and replaces the diagonal bracing, in a horizontal plane of the bottom of the fuselage. Each section is built up of spruce and plywood and can carry a load of 100 lb./sq. ft. (488 kg/m^2). The walls of the cabin are lined with soundproof material and paneled with plywood. The outside of the cabin is fabric covered. The pilots' cockpit is a separate unit of wood construction bolted to the front of the fuselage.

Straightforward, simple, and robust, sums up the landing gear. Each side is a separate unit consisting of an axle hinged to the bottom longeron, a shock-absorbing strut carried up to wing which takes the landing loads through an oleo cylinder and the taxying loads through a system of spiral steel springs; a radius rod in tension, being led forward of the axle froms the rest of the unit. The Dunlop wheels carry high-pressure tires, and streamline fairing can be fitted over them if required.

CHARACTERISTICS

Dimensions:	ft.	in.	m
Span of wing	71	3	(21.72)
Height, over-all	11	6	(3.51)
Length, over-all	54	6	(16.61)
Wheel track	15	10.5	(4.85)
Engine centers	17	0	(5.18)
Mean chord	10	7.6	(3.24)
Aspect ratio	6.96 to 1		
Incidence	0°		
Dihedral	1.5°		

Areas:	sq. ft.	m^2
Main wing with ailerons	728.0	(67.63)
Ailerons, total	44.6	(4.14)
Stabilizer and elevators	87.5	(8.13)
Fin	14.1	(1.31)
Rudder	24.8	(2.30)

Weights:

	600 miles (965.61 km) range		350 miles (563.27 km) range	
	lb.	kg	lb.	kg
Tare weight	7,360	(3,338,44)	7,360	(3,338.44)
Radio equipment	90	(40.82)	90	(40.82)
Crew, two	340	(154.22)	340	(154.22)

Weights (continued):

600 miles (965.61 km) range	lb.	kg	350 miles (563.27 km) range	lb.	kg
Fuel, 194 gal. (881.91 liters)	1494	(677.67)	112 gal. (509.15 liters)	862	(391.00)
Oil, 14 gal. (63.64 liters)	136	(61.69)	8 gal. (36.37 liters)	78	(35.38)
Passengers, 12	1920	(870.89)	16	2560	(1161.19)
Baggage, etc.	450	(204.41)		500	(226.80)
Pay load	2370	(1075.01)		3060	(1387.99)
Gross weight	11,790	(5,347.64)		11,790	(5,347.64)
Maximum permissible weight				11,800	(5,352.37)

Loadings and ratios:

Wing loading	16.2 lb./sq.ft.	(79.09 kg/m^2)
Power loading	12.8 lb./hp.	(5.80 kg/hp)
Ratio of gross weight to tare weight	1.60 to 1	

Performance:	m.p.h.	km/h
Maximum speed at sea level	160	(257.49)
Maximum speed at 5,000 ft. (1,524 m)	154	(247.84)
Maximum speed at 10,000 ft. (3,048 m)	149	(239.79)
Stalling speed	64	(103.00)
Cruising speed, 1900 r.p.m. at 1000 ft. (304.8 m)	135	(217.26)

Performance (continued):	m.p.h.	km/h
Best climbing speed	94	(151.28)
Best gliding speed	85	(136.79)
Best gliding angle	1 in 9.3	
Everling high-speed figure	22.05	
Ratio of maximum speed to stalling speed	2.5 to 1	
Take-off run, wind 5 m.p.h.(22.35 m/sec)	300 yd.	(274.32 m)
Landing run, wind 5 m.p.h. (22.35 m/sec)	270 yd.	(246.89 m)
Service ceiling	15,500 ft.	(4724.4 m)
Rate of climb at sea level	970 ft./min.	4.93 m/sec)
Climb to 1000 ft. (304.8 m)	1.2 min.	
Climb to 5000 ft. (1524 m)	6.4 "	
Climb to 10,000 ft. (3048 m)	16.6 "	

Fuel consumption 43 gal./hr. (195.48 liters/hr) at 135 m.p.h. (217.26 km/h) at 1,900 r.p.m. at 325 hp. per engine.

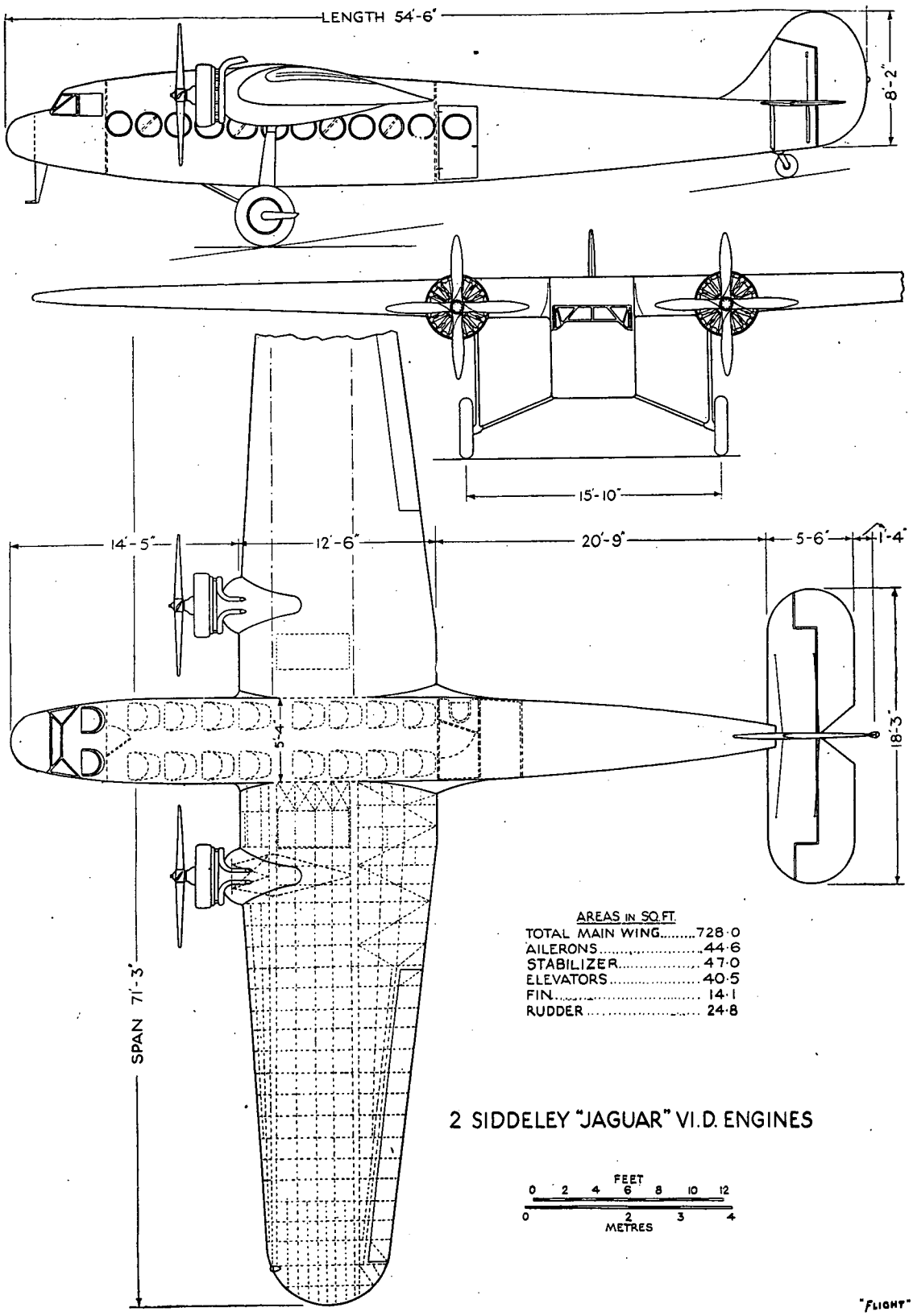


Figure 1.- General arrangement drawing of the Avro 642 airplane.

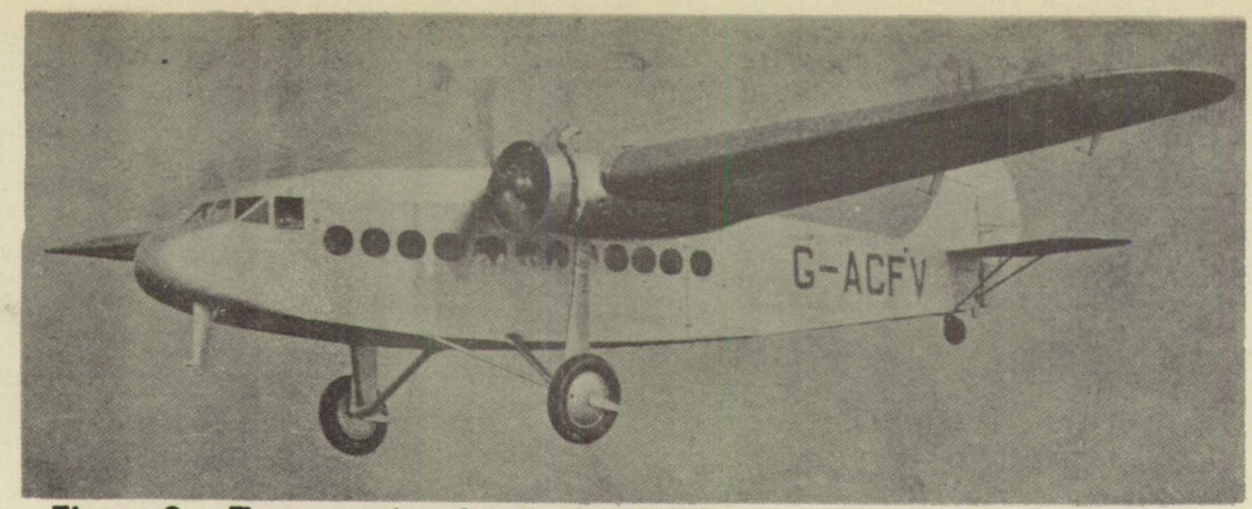


Figure 2.- Three-quarter front view of the new Avro monoplane in flight with two Siddeley Jaguar engines. "The Aeroplane"

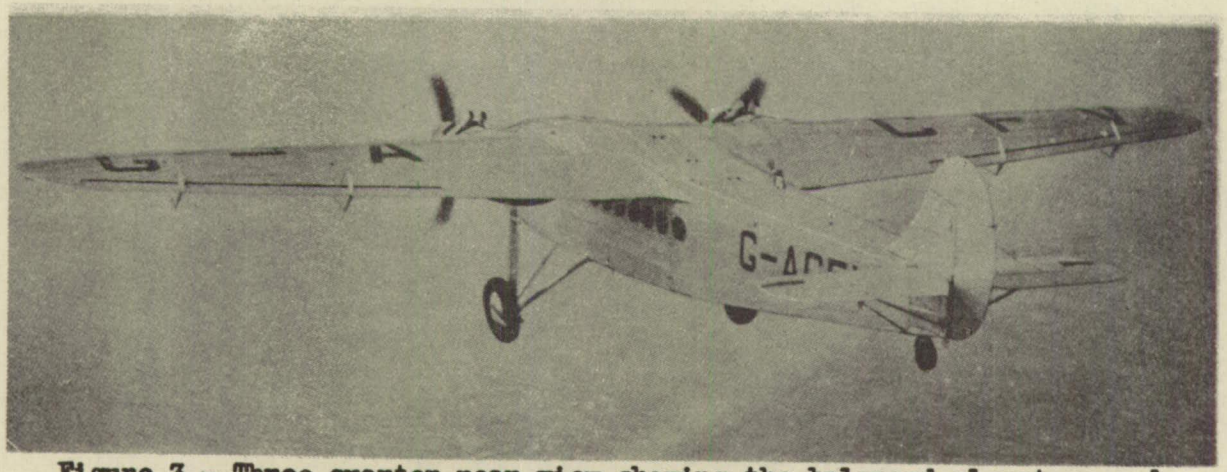


Figure 3.- Three-quarter rear view showing the balanced elevators and generator mounting on the top of the fuselage. "Flight"

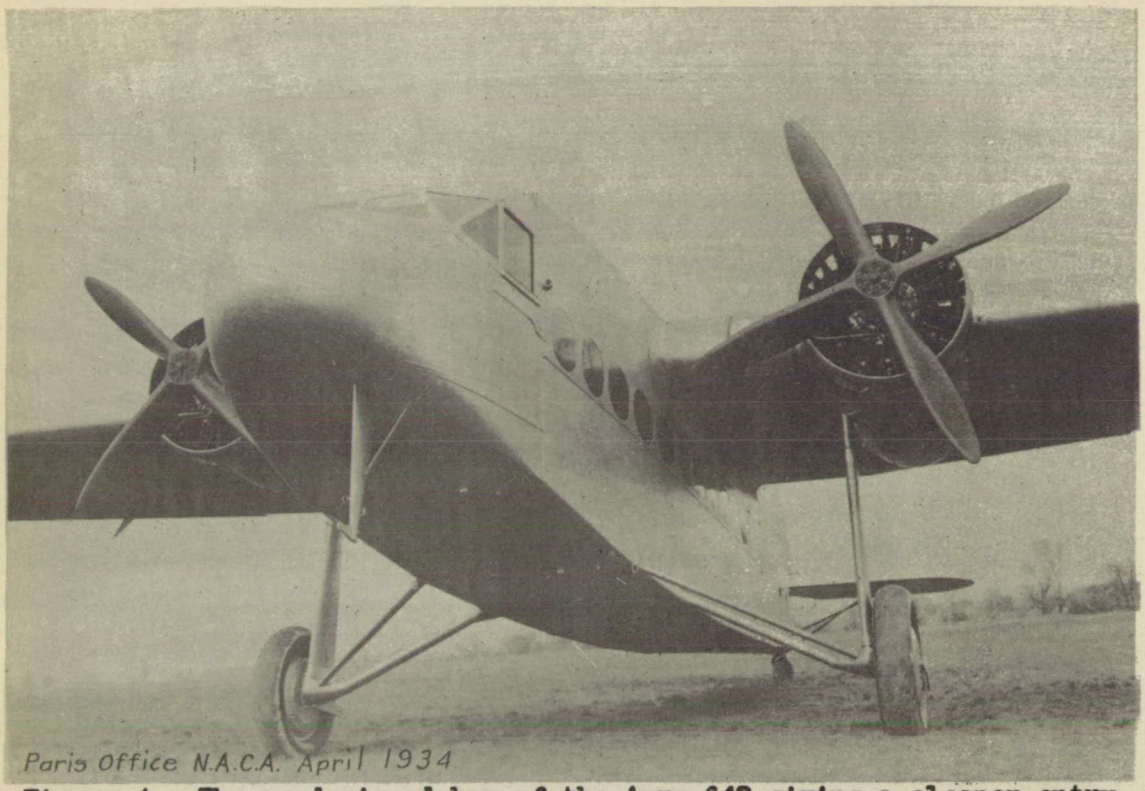


Figure 4.- The re-designed bow of the Avro 642 giving a cleaner entry and enhanced performance.

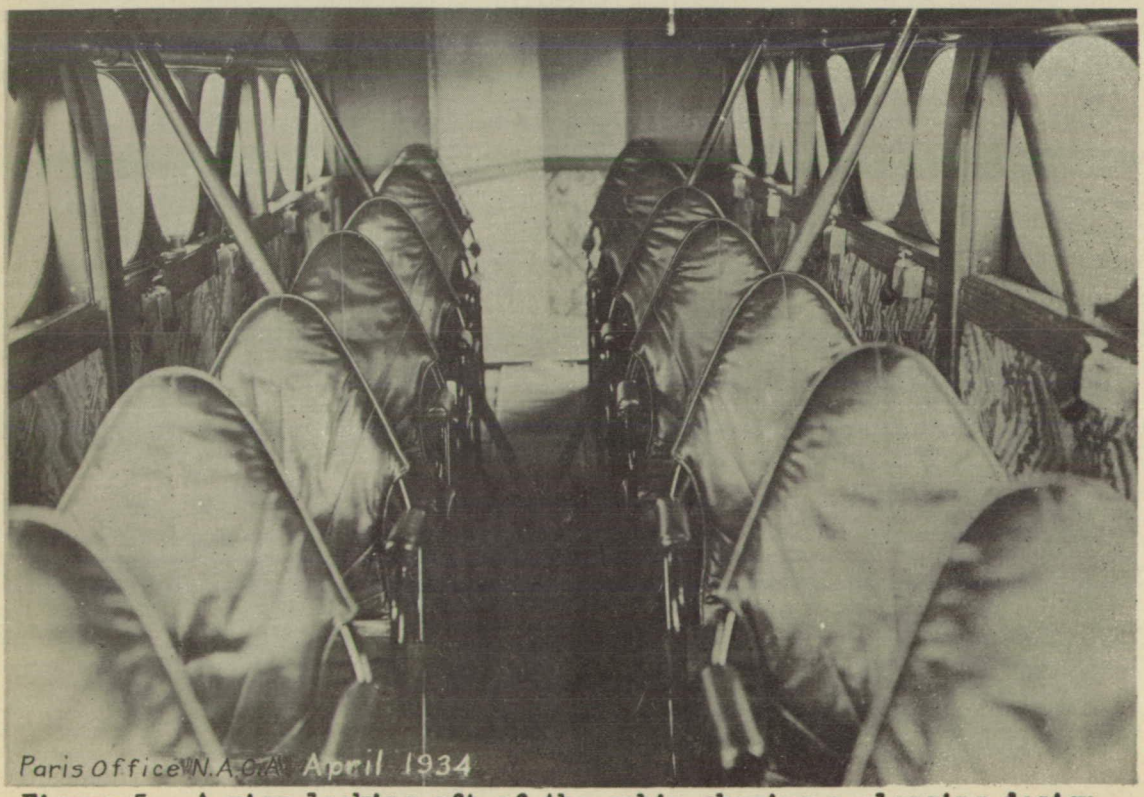
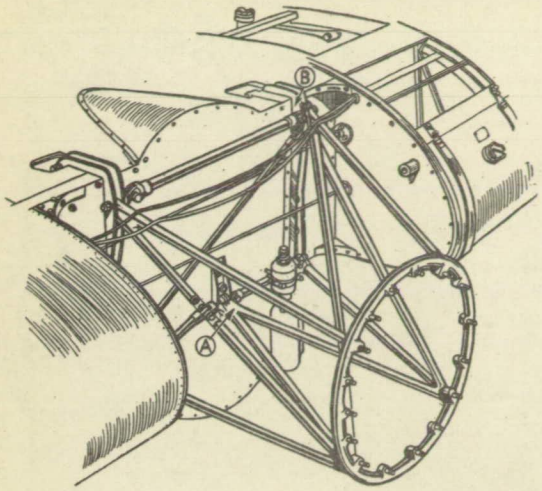


Figure 5.- A view looking aft of the cabin showing a pleasing design.



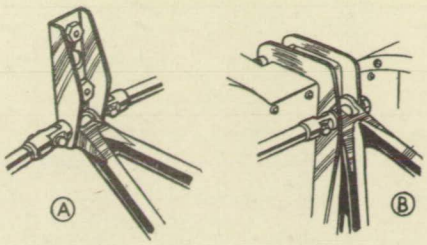


Figure 6.- Showing one of the engine mountings. "The Aeroplane"

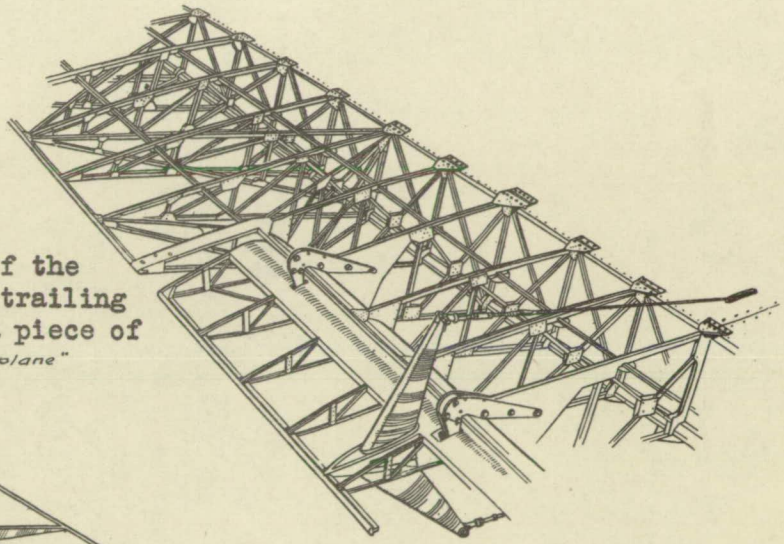


Figure 7.- A section of the detachable trailing edge of the wing and a piece of aileron. "The Aeroplane"

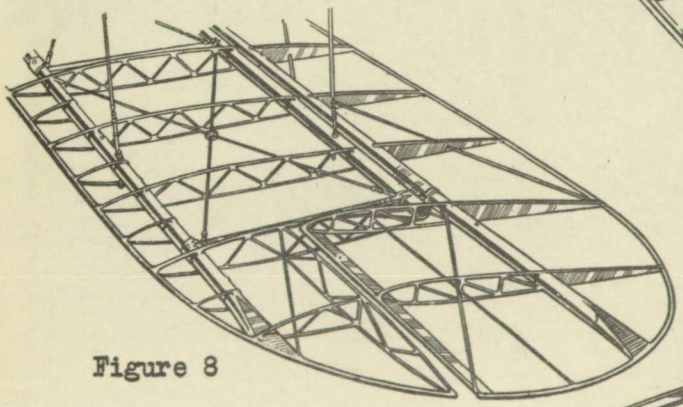


Figure 8

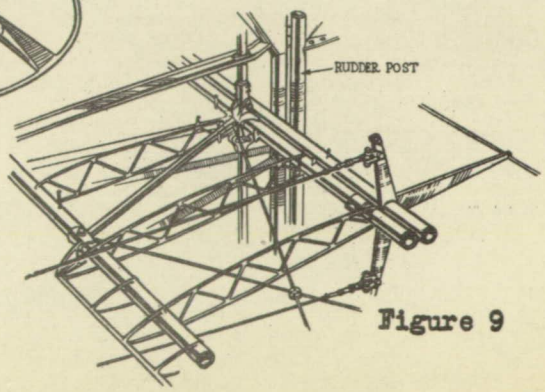


Figure 9

Figures 8,9.- Sketches of the stabilizer and elevator. "The Aeroplane"