

AIRCRAFT CIRCULARS  
NATIONAL ADVISORY COMMITTEE FOR AERONAUTICS

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No. 62

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THE SHORT "CALCUTTA"  
FIRST BRITISH ALL-METAL COMMERCIAL SEAPLANE

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THE SHORT "CALCUTTA"

First British All-Metal Commercial Seaplane.

Launched at Rochester on Monday, February 13, 1928, the Short "Calcutta" has been moored in the Medway off the Short Works for several days, owing to the gales which prevented bringing her up the slipway and into the works. While this meant a great deal of anxiety on the part of the staff, because of the possibility of the seaplane dragging her moorings, it also gave an opportunity of testing its seaworthiness qualities in an extremely strong wind. Let it be said at once that the "Calcutta" proved equal to the test. Rolling gently from side to side in the strong gusty wind, she rode as easily as a yacht, and in point of fact when one was aboard, as the writer had an opportunity of being for some two hours last week, one had very strongly the impression that one was aboard a yacht at anchor. In the cabin there was quiet, with but the slap-slap of the waves against the metal hull, but a visit "on deck" for the purpose of examining in some detail the mounting and cowling of the central engine very quickly brought home to one the force of the gale. So strong was this that it was necessary, in order to keep from getting blown in, to clutch hold of bracing wires, struts and anything else that offered a hand hold. The wind whistled in

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\*From "Flight," February 23, 1928.

wires and struts, the rain beat down unmercifully on the wing fabric and drummed on it and on the metal roof of the cabin. Yet the seaplane appeared perfectly at home and in her element. If she is as steady in the air she will be a wonderful craft, (Fig. 1).

The cabin of the Short "Calcutta" is a very roomy affair. There is about 6 ft. headroom, and the cabin is long and wide and gives an airy impression in spite of the fact that to get 16 seats arranged in the space available there is naturally no room wasted anywhere. Actually, the cabin has seating accommodation for 15 passengers, the sixteenth seat being for the steward who presides over a small galley and buffet just aft of the cabin (Fig. 5). In front there is a sliding door communicating with the wireless compartment, which in turn leads to the pilot's cockpit. Aft of the cabin, and on the starboard side, opposite the galley, is a very roomy lavatory with tip-up wash basin (Fig. 2). Aft of that again, and communicating with the cabin by a hinged door, is the luggage compartment, which is, as a matter of fact, the entire aft portion of the hull. And amazingly roomy it is with the total absence of any bracing members. Nowhere does one, perhaps, see to better advantage the special type of hull construction developed by the Shorts. One can walk right up in the extreme stern to the rudder post (not that it would be advisable to do so during flight, as it might upset the trim), and although the luggage to be carried will naturally be collected and secured

as close to the cabin as possible, it is obvious that, should the seaplane ever be used by a relatively few passengers for a protracted cruise, it would be extremely easy to fit up this aft portion of the hull with bunks, so that one could sleep comfortably on board. The fact that all gasoline is some 15 ft. or so away from the cabin roof makes it perfectly safe to smoke in the hull, and half a dozen people could live very comfortably on board for long periods.

The cabin chairs are built of duralumin tubes, and the extent to which it has been possible to reduce weight in this part of the equipment may be realized when we point out that the weight of a chair frame (without upholstery) is only 2 lb. (Fig. 3)! The chairs are arranged with a single row down the port side and a double row down the starboard side, the gangway between them being thus slightly off center (Figs. 3 & 5). The upholstery is in the form of air cushions, and another neat idea is that these cushions have been designed as life belts, being easily detached from the chairs and put on, a strap being provided for keeping them in place. Thus no extra weight of special life belts is incurred (Fig. 6).

Large glass port holes of oval shape give plenty of light in the cabin. Even with the seaplane moored, and thus with the lower wing fairly low over the water, the cabin is quite light (Fig. 6). In flight, the amount of light which comes through the windows is naturally even greater, and the fact that the port holes are below

the level of the lower wing gives the passengers an unobstructed view outward and downward.

The pilot's cockpit is very roomy, and as it is far forward in the hull, the view is particularly good. There are two seats, side by side, the port one being the pilot's, while the starboard seat has removable controls in front of it. Normally, the navigator will be in his wireless cabin, where a seat, table, map shelf, instrument lockers, etc., give comfort for working out a position as well as for sending and receiving messages. The seaplane is equipped with a Marconi AD.8 set, the range of the transmitting apparatus from the seaplane to a ground station being, under average conditions, 300-400 miles for C. W. telegraphy, 200-250 miles for telephony, and 240-280 miles for Tonic Train telegraphy. For use when the seaplane is on the sea, there is an emergency aerial on a telescopic mast attached to the upper wing. In addition to the normal radio equipment, the "Calcutta" carries Bellini-Tosi loops for purposes of direction-finding radio.

Two hatchways give access to the cabin and luggage compartment, respectively, the cabin hatchway being on the port side, forward of the wings, and forming, when open, steps by means of which the passengers can easily get into and out of the cabin (Fig. 7). The aft hatchway would also serve as an emergency exit in case, through any mishap, the forward one should be inaccessible.

For transporting the "Calcutta" on land, a special beach landing gear has been designed (Fig. 7), which incorporates two large aero wheels, the struts of which have quick-release attachments to the chine tubes and lower wing spar fittings. To prevent the tubes from sinking, they are provided with bladders, and the outside tubes have, in addition, a special form of quick-locking device so as to facilitate assembly while the seaplane is on the water. The two inner landing gear struts and the halves of the outer landing gear struts are permanently bolted to the wheel. The upper ends of the outer struts, however, are separate units, and when putting on the landing gear, the two pins of the inner struts are secured first. Then the short upper ends of the outer struts are secured to the spar fittings, and the whole is secured by the special joints in the outer struts.

#### Constructional Features

The Short "Calcutta" is an all-metal seaplane, the first commercial flying boat of this type to be built in Great Britain. The material used is mainly duralumin, which is employed for the entire hull, and for wing spars and ribs. Only a few stainless steel fittings are used, and a few steel struts. The wing covering is fabric.

The hull of the "Calcutta" is of the special Short patented type, in which, as will be familiar to our readers by now (Fig. 8) there are no longitudinal members running through the hull.

The frames are the main members, and the sheet plating is part of the stress-bearing structure, reinforced by V-section stringers, which, however, stop short at the transverse frames instead of being let into them.

The underwater body of the "Calcutta" is very nearly identical with that of the "Singapore" on which Sir Alan and Lady Gladys Cobham are now making a survey flight of Africa, but the shape above the water line is a good deal different, due chiefly to the fact that a large cabin for passengers had to be provided. Thus, instead of the pronounced sheer of the "Singapore," the "Calcutta" shows a nearly straight deck line from bow to stern.

The wing spars are of a type also specially developed by Short Brothers. Their general section will be seen in Figs. 4 and 8, and it will be noticed that they are laminated so as to proportion the strength to local loads. These spars are produced with remarkable ease and rapidity by very simple equipment, and have proved on test to develop practically the full strength of the material from which they are made.

The ailerons are balanced by the Bristol-Frise type of balance and are fitted to the top wing only. The tail has monoplane surfaces, i.e., a single rudder and a single tail plane. There is a large horn balance on the elevator, and also on the rudder, and the latter is operated by a small servo rudder mounted some distance aft of the main rudder. This type of control is becoming popular for large seaplanes, as it reduces the load on the foot

bar and enables a pilot to work with ease a rudder of even very large area. The principle of this type of rudder, which was, we believe, invented by the German engineer, Anton Flettner, also the inventor of the Flettner rotor is, of course, simple enough. The pilot operates the small servo rudder, which in turn actuates the large rudder.

### Engine Installation

The power plant of the Short "Calcutta" consists of three Bristol air-cooled "Jupiters," series IX, mounted side by side in the gap between the wings, and driving four-bladed propellers. Each engine is neatly streamlined in a nacelle, only the cylinder heads projecting. In Figure 7, the engines are shown with open exhausts, and a cowling over the front of the engines. Actually, they will be fitted with exhaust collectors, and the rings of these will be of the same shape as the present cowlings, so that the shape will be but little altered by this modification. Above each of the wing engine nacelles can be mounted a special crane or gantry, by means of which an engine can be lifted out/<sup>of</sup> or put into the seaplane without external assistance. So effective have these cranes proved that they are used even when the seaplane is in the shops, as affording the easiest means of installing the engines. The details are shown in Figure 7.

There is no gasoline in the hull of the "Calcutta," the two gasoline tanks being housed in the top wing, whence the fuel runs by direct gravity feed to the three engines, the piping being so

arranged that all or either engine can be supplied from either or both tanks. The oil is contained in tanks behind the engines, inside the nacelles, and the tanks communicate with external oil coolers. A "Bristol" engine starter is installed in the central engine nacelle, whence it is arranged to start all three engines. This same starter engine has also been arranged to drive a mechanically operated bilge pump as well as the general-purpose dynamo for lighting and radio when the main engines are not running.

#### Specification

The general arrangement drawings of the Short "Calcutta" are given in Figure 9. The main dimensions and areas are:

Span of upper wing	93 ft.	(28.35 m)
Span of lower wing	76 ft. 6 in.	(23.15 " )
Total wing area, including ailerons	1825 sq.ft.	(170 m <sup>2</sup> )
Length (over-all) including servo rudder	65 ft.	(19.81 m)
Wing chord	11 ft. 6 in.	(3.51 " )
Area of ailerons (total)	150 sq.ft.	(13.95 m <sup>2</sup> )
" " tail plane	112 "	(10.4 m <sup>2</sup> )
" " elevators	105 "	( 9.76 m <sup>2</sup> )
" " fin	56 "	( 5.2 m <sup>2</sup> )
" " main rudder	49 "	( 4.55 m <sup>2</sup> )
" " servo "	7.6 sq.ft.	( 0.706 m <sup>2</sup> )
Weight of seaplane, empty	12600 lb.	( 5730 kg)
" fully loaded	20200 "	( 9185 " )

Weight available for load	7,600 lb.	(3,455 kg)
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The available load may be composed as follows:

Crew of 3, with baggage, food and water	768 lb.	(319 kg)
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320 gal. gasoline & 30 gal. oil	2,730 lb.	(1,241 kg)
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Wireless, electrical equipment, instruments, fire extinguishers, cooking and marine equipment, account for a weight of	562 lb.	(255 kg)
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leaving a pay load of	3,540 lb.	(1,610 kg)
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which is equivalent to 15 passengers with baggage, food and water (at 236 lb. per head). The fuel and oil capacity given does not represent the maximum, as the tanks have been designed to hold 480 gallons of gasoline and 45 gallons of oil, so that by sacrificing a certain amount of pay load the range can be correspondingly increased. With the quantities mentioned, the range is  $5\frac{1}{2}$  hours, or 500 miles (805 km), and with full tanks and a smaller pay load the duration is 8.2 hours, and the range 740 miles (1,190 km). The wing loading is 11.05 lb./sq.ft. (54 kg/m<sup>2</sup>), and the power loading (at full power), 12.8 lb./HP. (5.83 kg/HP).

#### Performance

Although the official performance tests of the "Calcutta" have not yet been carried out, it may be of interest to give the estimated performances:

Top speed at sea level	120 M.P.H.	(193 km/h)
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Cruising speed	100 M.P.H.	(161 km/h)
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Landing speed	57.5 M.P.H.	( 93 km/h)
Rate of climb at ground level	800 ft./min.	(244 m/min)
Service ceiling	10,000 ft.	(3,050 m)

"Wing Power",  $\frac{1575}{1825} 0.863 \text{ HP./sq.ft.} = 9.26 \text{ HP/m}^2$ .

As the top speed is 193 km/h, the Everling "High-speed Figure" (metric) is 14, which is an extremely good value for a three-engined flying boat. The Everling "Distance Figure" at top speed is 4.2, which is also a high value for a seaplane of this type. As this refers to the top speed, it is not, of course, an optimum value, but as we have no information relating to the power at which the seaplane cruises most economically, it is not possible to give the maximum value of the "Distance Figure." That it is well above the average seems more than probable.



Fig. 1 The "Calcutta" in flight. It will not only fly on two engines but will also take off on two.

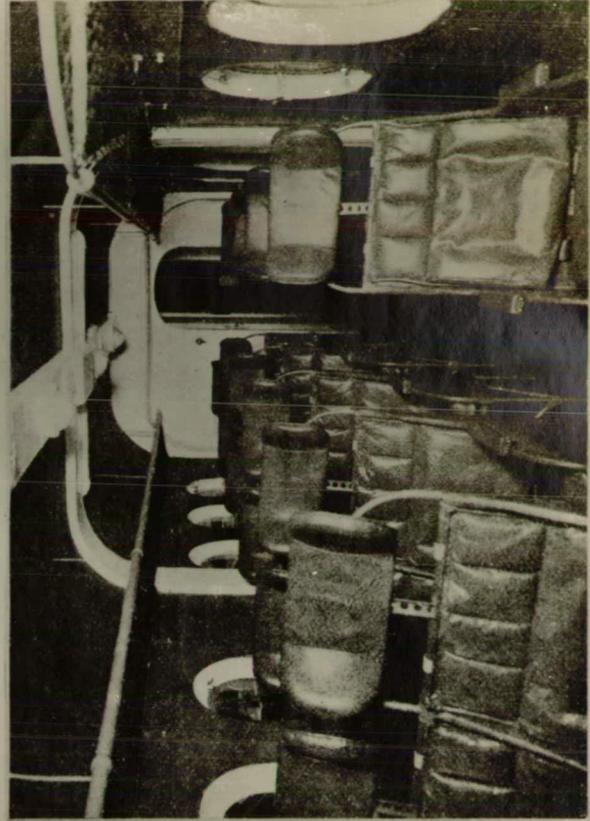
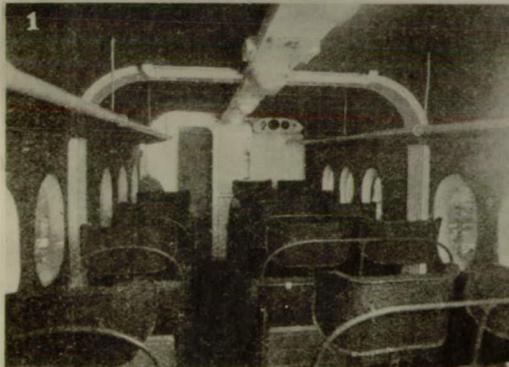


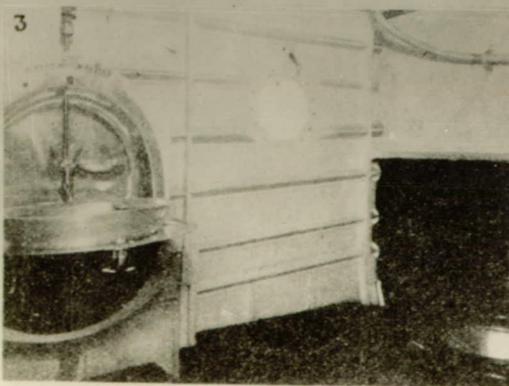
Fig. 2 View in the cabin looking aft.

"Flight" photographs

Fig. 3 View inside the cabin



the "Calcutta" looking forward. 2, the galley and buffet 3, the lavatory, with tip-up wash basin. 4, view in the luggage hold, looking aft.



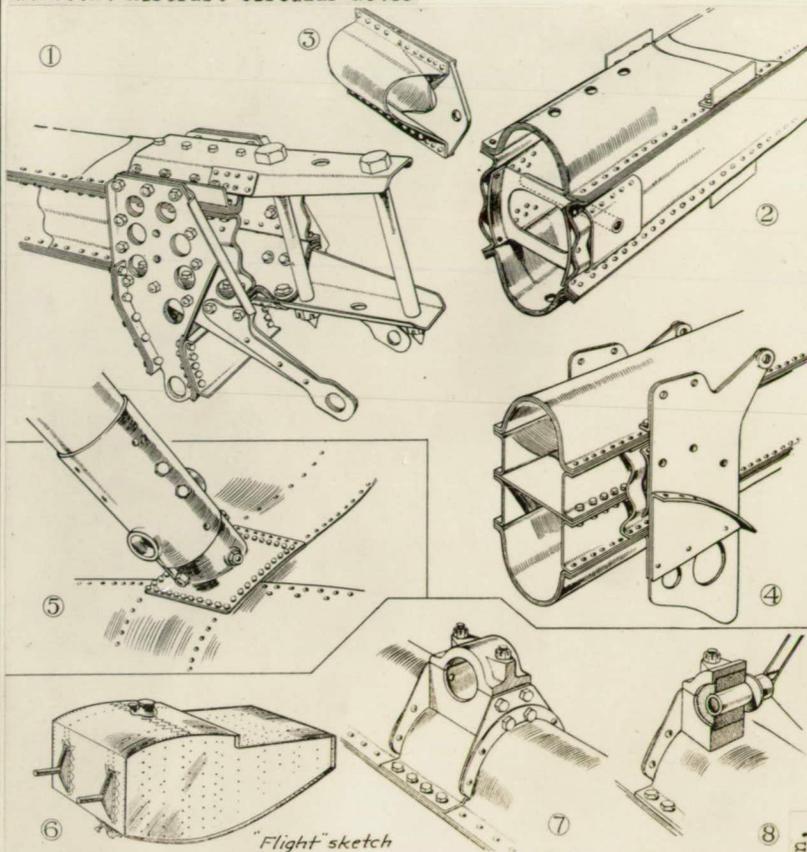


Fig. 4 Constructional details of the "Calcutta". A section of the rear spar of the top center section is shown in 1, with its steel fittings for strut and lift wires, etc. 2, shows a section of the top rear spar. Note the laminations which reinforce the spar at point of attachment of fittings. Built-up compression struts are used, the end of one being illustrated in 3. The spars of the lower center section differ slightly in construction, as shown in 4. The curved angle-section piece conforms to the cabin roof, through which this spar passes. The attachment of the raked struts which run from the lower wing at engine supports to chine, meet the latter as shown in 5. The two gasoline tanks are housed in the top wing, and are of the form shown in 6. Details of the tank supports, incorporating rubber buffers, are shown in 7 and 8.

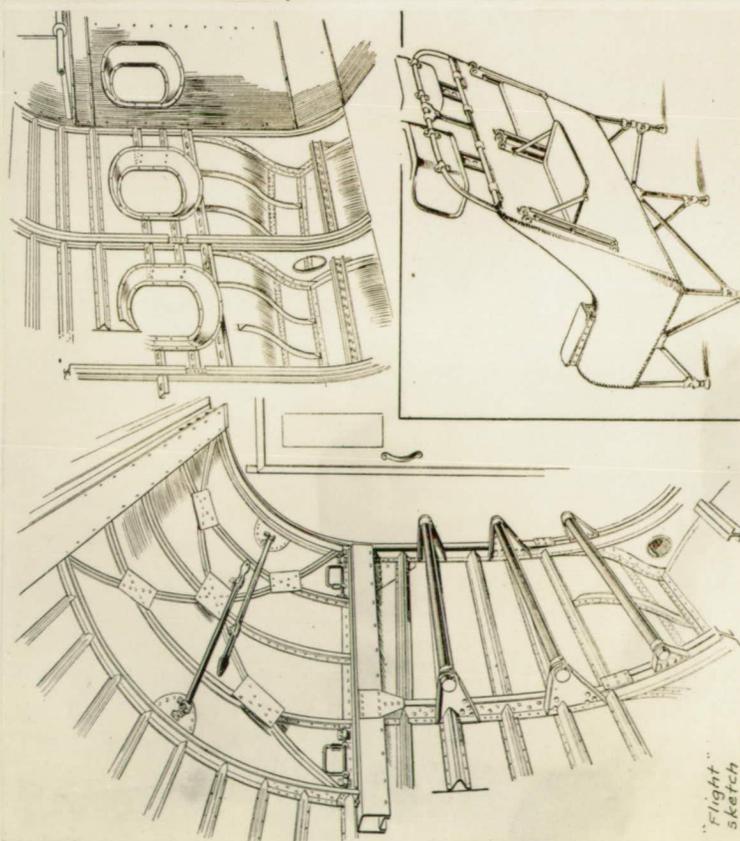


Fig. 5 On the left, a view inside the luggage compartment, showing the general construction, the special hatch which also serves as an emergency exit, and the tubular steps. When open, the hatch is held by tubes-folded into clips. On right is portion of cabin showing construction and finished covering. Below is double seat with neat folding tables provided for each passenger.

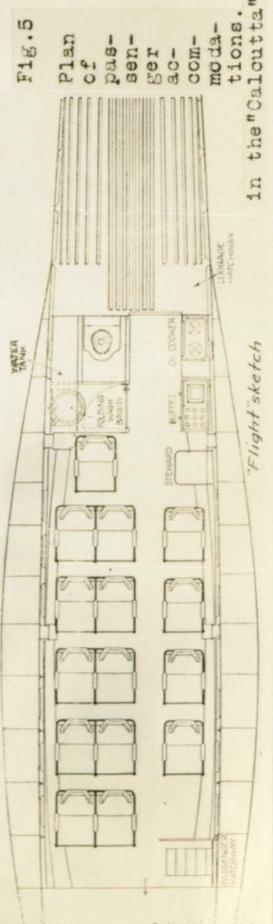
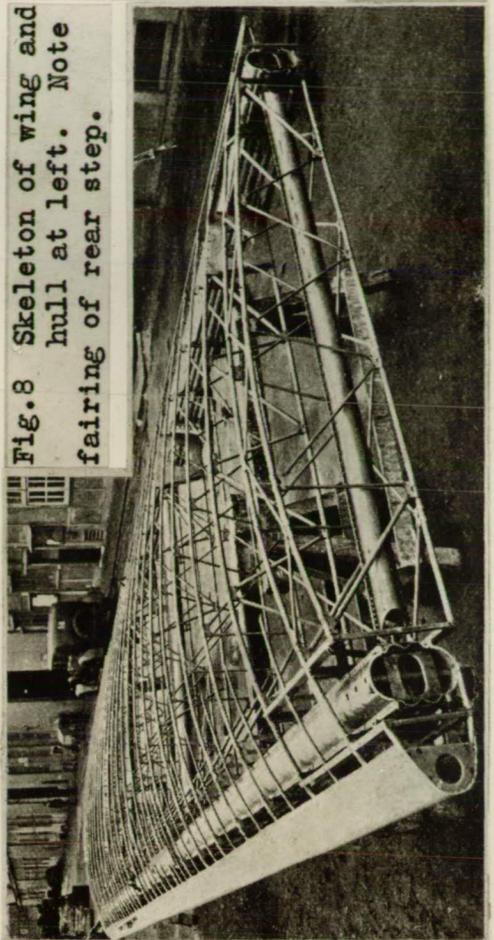
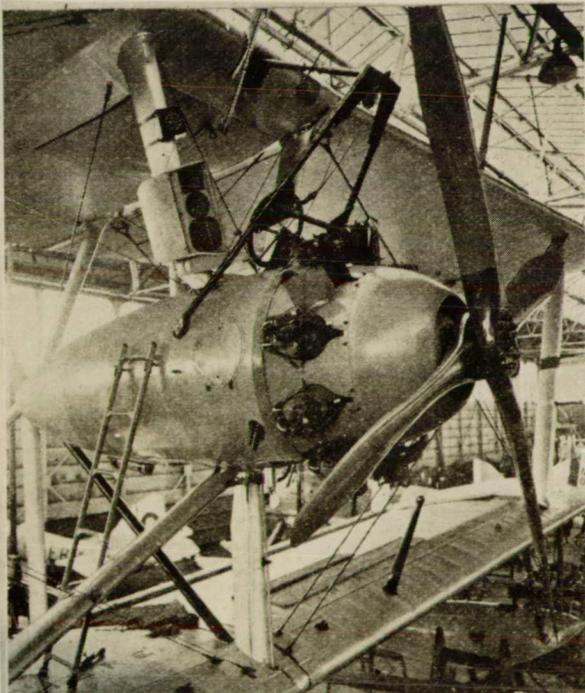




Fig.8 Skeleton of wing and hull at left. Note fairing of rear step.



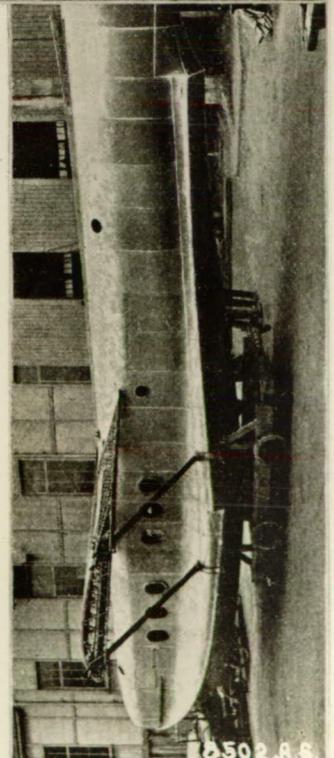
"Flight" photographs



"Flight" photographs

Fig.7 Beach-  
ing  
landing gear  
of "Calcutta"  
at top. The  
front hatch,  
which also  
forms steps  
can just be  
seen. At the  
bottom is  
shown, port  
wing engine.

Above the nacelle can be seen the crane, used for lifting the engines into and out of the seaplane. In the photograph, the engine has open exhaust. A collector ring, shaped like the cowling in the photograph, will be installed in later designs.



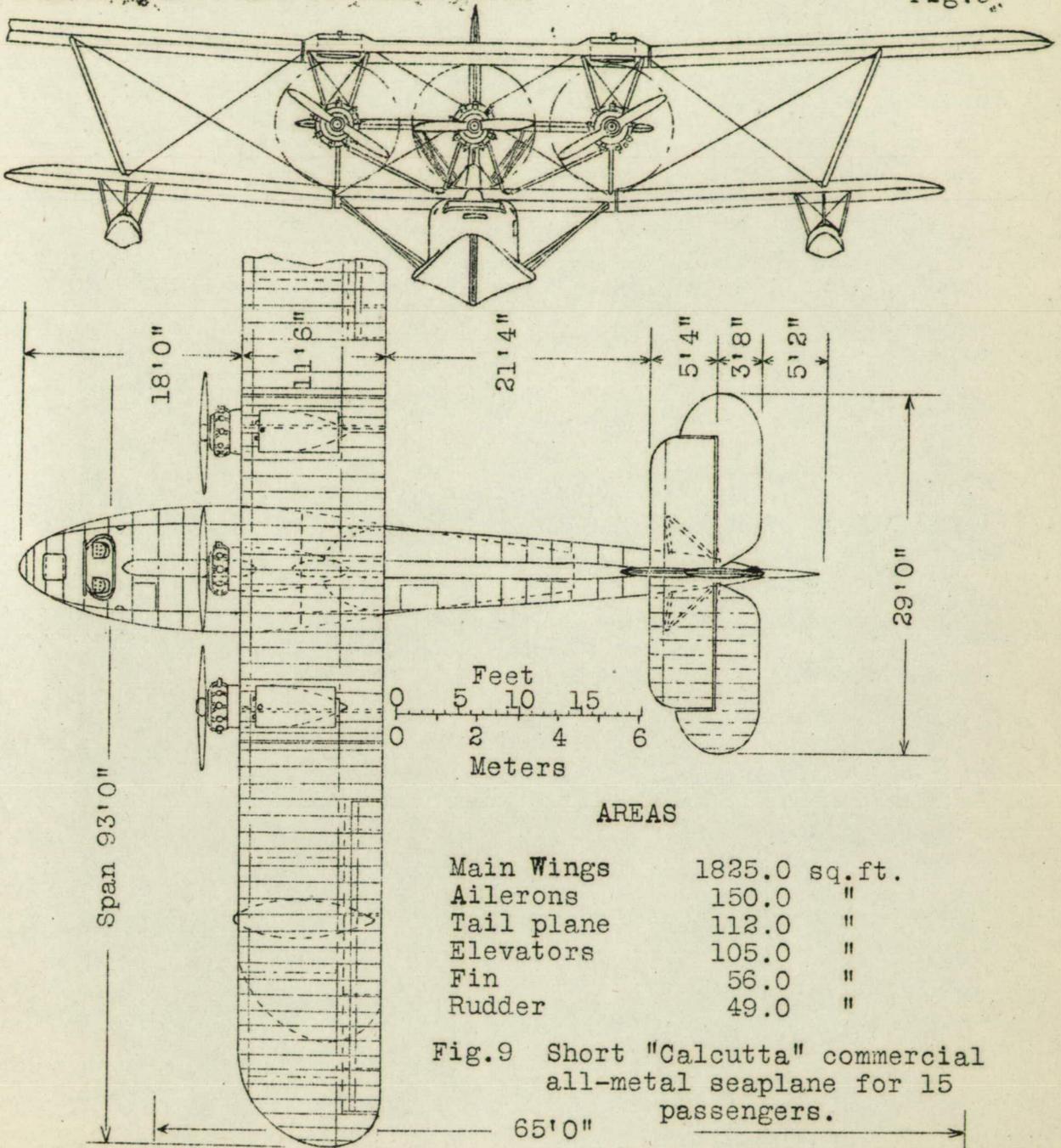
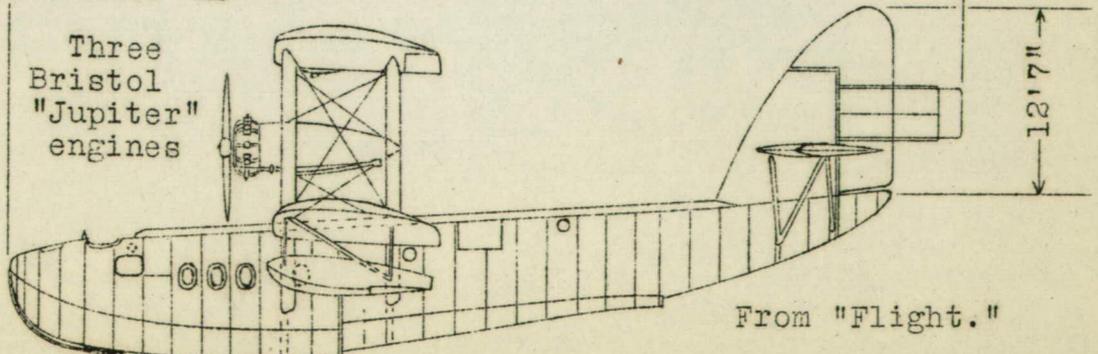


Fig.9 Short "Calcutta" commercial all-metal seaplane for 15 passengers.



From "Flight."