AIRCRAFT CIRCULARS

NATIONAL ADVISORY COMMITTEE FOR AERONAUTICS

No. 95

THE WESTLAND IV COMMERCIAL MONOPLANE (BRITISH)

Three "Cirrus III" Engines

Washington
April, 1929

NATIONAL ADVISORY COMMITTEE FOR AERONAUTICS.

AIRCRAFT CIRCULAR NO. 95.

THE WESTLAND IV COMMERCIAL MONOPLANE (BRITISH)

Three "Cirrus III" Engines

General Design

The Westland IV is a high-wing monoplane with strut bracing, two outboard engines, a fairly large fuselage giving comfortable cabin accommodation, and a landing gear of very wide track to give good stability on the ground (Figures 1, 3, 4 and 5). Features of the design are the neat engine cowlings and the "clean" tapering nose of the fuselage. The three-engined type must necessarily have a higher drag than the single-engined, but in the Westland IV it would appear that very great care has been taken to reduce the extra drag as far as possible. The central engine is carefully mounted and cowled (Figure 6), and the lines of the nose of the fuselage merge into the wind-screen, cabin, and wing without very abrupt changes of direction. The outboard engines are neatly cowled, the inverted pyramid mountings lending themselves to the production of cowls of smooth outline and without sharp corners, and which trail off to a point at the rear (Figure 11).

The wing section used is that known as R.A.F. 34, which has an almost stationary center of pressure. The minimum profile drag coefficient is 0.0102 and occurs at a lift coefficient of about 0.1, both in "absolute" units. The maximum lift coeffi-

*From Flight, February 28, 1929.

cient is not high, about 1.02, at least according to model tests. There may, however, be a considerable scale effect, which may increase the maximum lift to 1.2. Based on model figures, and with a wing loading of 10 lb./sq.ft., which represents full load, the stalling speed of the Westland IV should be 62 M.P.H. It is likely, however, that the full-scale lift will reduce this somewhat, and the actual stalling speed is probably in the neighborhood of 55 M.P.H.

The total loaded weight of the airplane is 4,900 lb., and as the wing span is 57 ft. 6 in., the span loading, or $\frac{W}{span^2}$, is 1.485. Thus, at a take-off speed of 65 M.P.H., for instance, the horsepower required to overcome induced drag is only 37 T.HP. It would, therefore, seem that the wing arrangement chosen is a very efficient one. R.A.F. 34 section has a very good depth for spars, and its minimum profile drag is not much, if any, greater than that of R.A.F. 15. At a C_L of 0.92 the profile drag coefficient is 0.016, so that the profile drag at 65 M.P.H. would be about 85 lb., corresponding to a T.HP. of 15 or so, giving a total T.HP. required for wing drag of about 52. This figure does not include the drag of the wing-bracing struts, as it is a little difficult to decide how many feet of struts are properly wing struts and how many support the wing engines. At any rate, the wing drag at speeds slightly above stalling speed is very low, and the wing design must be regarded as an efficient one, apart from any practical advantages which the high-wing

monoplane may have.

Structural Features

The first airplane is of composite construction, with wooden wing spars and ribs, and wooden fuselage construction, but it may be assumed that if the type should prove popular, which appears likely, an all-metal version is a logical development, especially in view of the experience which the Westland Aircraft Works have gained with metal construction.

The fuselage consists of the usual four longerons, but metal construction practice is followed in so far as wire bracing is not used (Figure 9). Vertical and diagonal struts are arranged in the form of an "N" girder, the joint between them and the longerons being by fishplates. In the forward or cabin portion three-ply wood is used as an internal lining, and also provides the diagonal bracing. The covering is of fabric throughout.

The wing structure is of orthodox design, with two main spars of wood, and wooden ribs. The ailerons, which are of fairly large span, are hinged to a false spar some distance behind the rear main spar. The covering is fabric, but the leading edge of the wing is covered, under the fabric, with three-ply so as to maintain the airfoil form. It is noticeable that the wing covering fabric is exceptionally smooth and without sag between the ribs. Possibly the use of R.A.F. 34 section is partly responsible for this, as it has no concave curves.

The wing bracing is somewhat unusual, as has already been

hinted at. Strictly speaking, the wing is braced on each side by but two relatively short struts springing from the points at the bottom of the engine mountings. But the engines themselves are not, as is more generally done, suspended directly from the wing (Figures 2 and 10). Rather must they be regarded as being carried from the apexes of two prone triangles, the bases of which are in line with the fuselage sides. The inner ends of these two outriggers, as they may well be termed, are attached to lower longerons and wing center section, respectively, so that the weight of the outboard engines is carried mainly from the fuselage, and only secondarily by the outer wing struts. The arrangement is unusual, and one which we do not remember having come across elsewhere. Structurally, everything is triangulated, and each engine mounting is balanced, so to speak, upon a knife's edge, being steadied against torque reaction by a single strut running to the lower longeron, and crossing the upper main supporting strut on its way. With the cowling removed, the outboard engines are extremely accessible, and a small hinged platform is provided on each engine mounting, on which the engineer can stand when making adjustments, and which are also useful for filling the wing tanks by hand (Figure 11).

The central engine bed in the fuselage is shown in Figure 8. A view of the tail surfaces is given in Figure 7, showing bracing of stabilizer, tail skid and hood over rudder cables.

T h e C a b i n

The cabin of the Westland IV is very roomy and comfortable, and seating accommodation is provided for four passengers, of whom two face forward and two aft. In front and on the port side, is the pilot's seat, and to the right of him is another seat, which may be occupied by an engineer or, if desired, by another passenger. Windows in the sides of the cabin give an excellent view, while as regards the pilot the sloping wind screen affords a good view forward (Figure 6). Aft of the cabin is the usual lavatory, the door arrangement of which is such that the lavatory space is made use of when entering and leaving the airplane, but separated from the cabin when the airplane is in flight. In the lavatory roof is an emergency exit.

The cabin is entered through the aft door, and as the airplane is quite low on the ground, passengers can step straight into the cabin by the use of very simple steps. Behind the cabin is a very large luggage compartment, and under the pilot's cockpit is another and smaller compartment for suitcases, etc.

The gasoline tanks are housed in the wing, one of 48 gallons capacity on each side. From these two tanks the gasoline flows by gravity to a common point, and thence to the outboard engines by gravity, and to the central engine by gravity, assisted by a windmill-driven gasoline pump. In normal flying attitudes the "head" of gasoline is sufficient to give gravity feed to the central engine also, but during a steep climb the

pump is called upon to supplement gravity.

On the first airplane, the landing gear consists of two simple vees, one on each side, under the engine mountings, and springing is by rubber shock absorbers. The next airplane will, however, have oleo "legs," and wheel brakes. The wheel track is very wide and should give good stability on the ground.

During preliminary test flights one of the wing engines was stopped several times, and it was found that up to altitudes of about 5000 feet, the airplane could be flown, and even climbed slowly, on the other two engines. As the "Cirrus" is in itself an extremely reliable engine, an airplane with three of them and capable of flying on any two should be to all intents and purposes immune from forced landings.

The first of the Westland IV limousine monoplanes has a tare weight of 3,145 pounds, and as its present C. of A. total gross weight is 4,900 pounds, the ratio of gross to tare weight is 1.58 to 1. With full tanks the cruising range is estimated to be 570 miles. The gasoline (total capacity) would weigh approximately 700 pounds, so that, taking the weight of pilot at 160 pounds, and carrying no engineer, there would be available for pay load a capacity of about 395 pounds, which could be in the form of passengers or mails and goods. For shorter duration of flight, the pay load would, of course, be correspondingly increased. For instance, carrying 64 gallons of gasoline, which would give a range of about 380 miles, and one pilot, the pay load would be approximately 1,120 pounds.

Accurate performance figures have not yet been obtained, but the estimated cruising speed is about 95 M.P.H., and the estimated top speed 115 M.P.H. Assuming 90 B.HP. as maximum power for the "Cirrus III," the power loading becomes $\frac{4900}{270}$ = 18.15 lb./HP. The wing loading is 10 lb./sq.ft.

With passengers' seats removed, a certain amount would be saved on the tare weight, and in that case the airplane should be a very useful mail carrier, especially for the conveyance of night mails, where the reliability of the three-engined arrangement should make for safety. The stripped cabin and luggage compartments would then, between them, give an available cargo or mail space of 193 cu.ft. It would probably not be difficult, if desired, to arrange for a small extra supply of gasoline, when the airplane should be capable of the flight London-Berlin nonstop. We would suggest that an experimental night mail service between these two centers would be very well worth while.

For use in the dominions, the Westland IV should be an extremely serviceable type, and in this connection it might be pointed out that the airplane could be fitted with floats and used as a seaplane. Presumably, it would also be quite feasible to fit it with a ski landing gear for use in countries like Canada.

Dimensions

Length	37 ft. 6 in.
Span	57 " 6 "
Height	9 " 10 "
Areas:	
Total wing	490 sq.ft.
Ailerons	38 "
Stabilizer	36 "
Elevators	30 "
Fin	7 "
Rudder	22.5 "

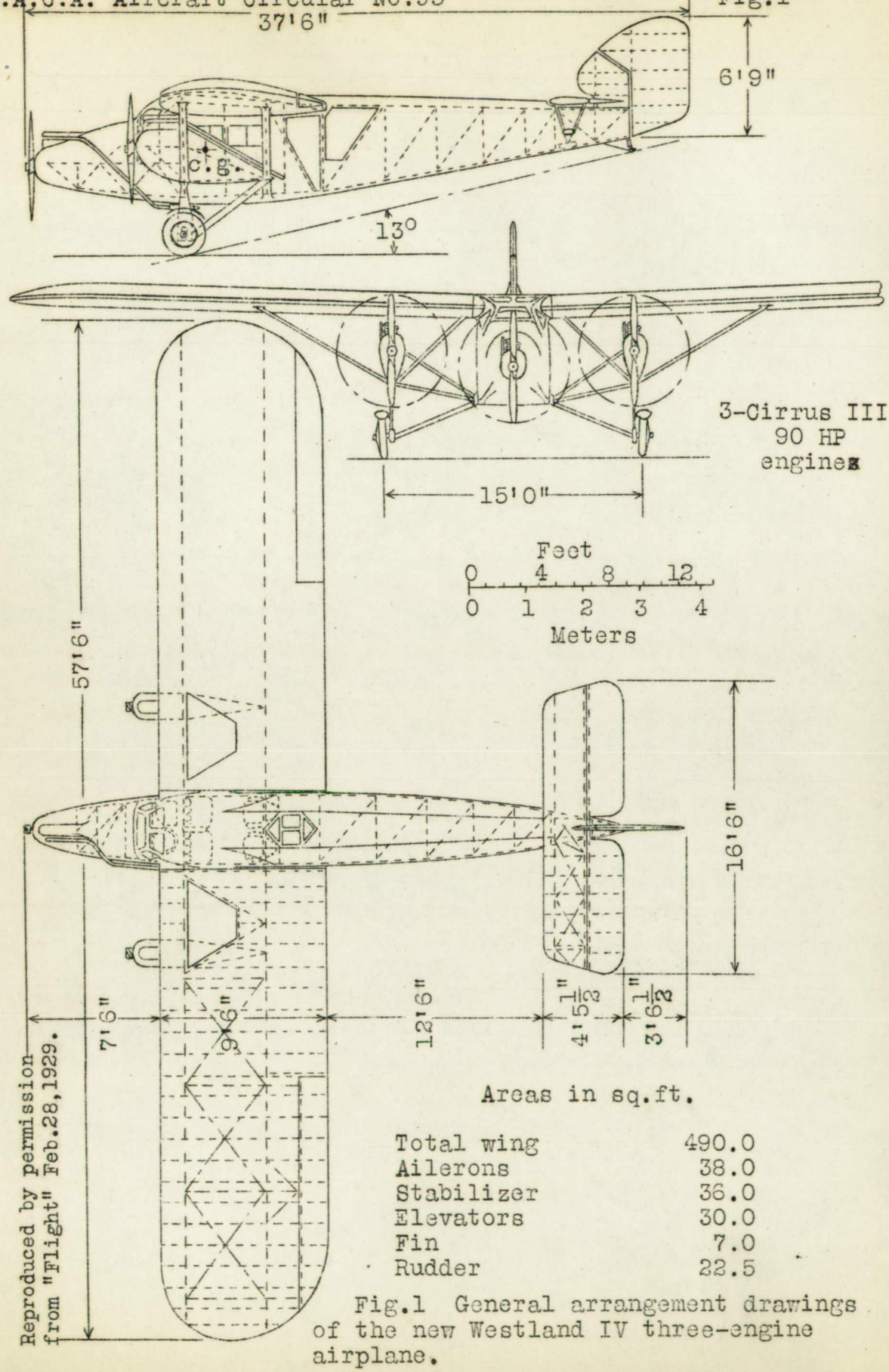
Characteristics

Power plant - three 90 HP. "Cirrus III" engines.

Weight empty	3145 lb.
Full load	4900 "
Pay "	895 "
Wing loading	10 lb./sq.ft.
Power "	18.15 lb./HP.
Power per unit area	.55 HP./sq.ft.

Performances (estimated)

Maximum speed	115 mi./hr.
Cruising "	95 "



Areas in sq.ft.

Total wing	490.0
Ailerons	38.0
Stabilizer	36.0
Elevators	30.0
Fin	7.0
Rudder	22.5

Fig.1 General arrangement drawings of the new Westland IV three-engine airplane.

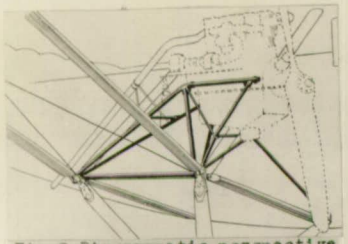
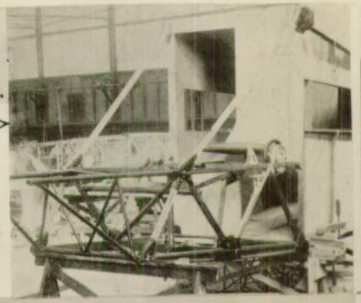


Fig.3 Diagrammatic perspective sketch, showing mounting of starboard wing engine.

Fig.8

Engine mounting in fuselage.



Figs. 2, 3, 4, 5, 6, 7 reproduced from "Flight" by permission. Fig. 8 from "The Aeroplane"

Figs. 3, 4 & 5 Views of the Westland IV commercial airplane.

Fig.6 Three-quarter front close-up of the Westland IV. Note streamline engine housing, wide track landing gear, and wind screen.

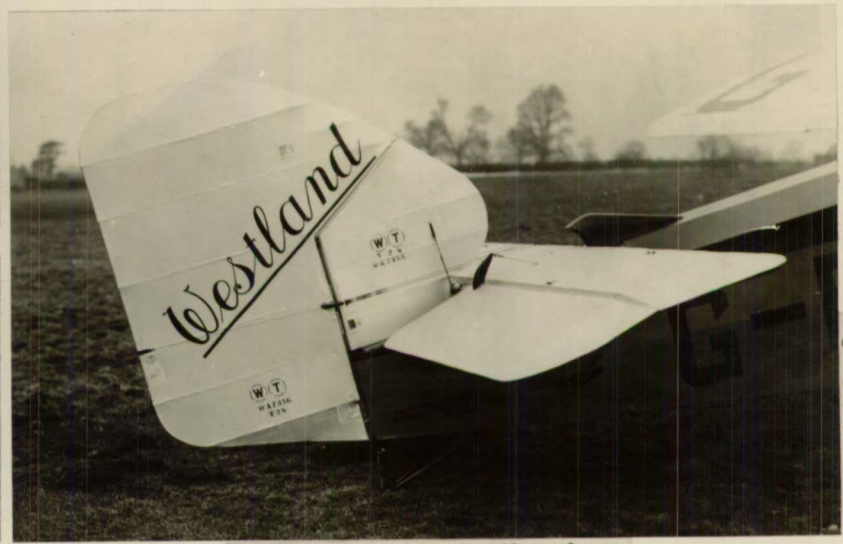


Fig.7 Close-up view of tail surfaces.

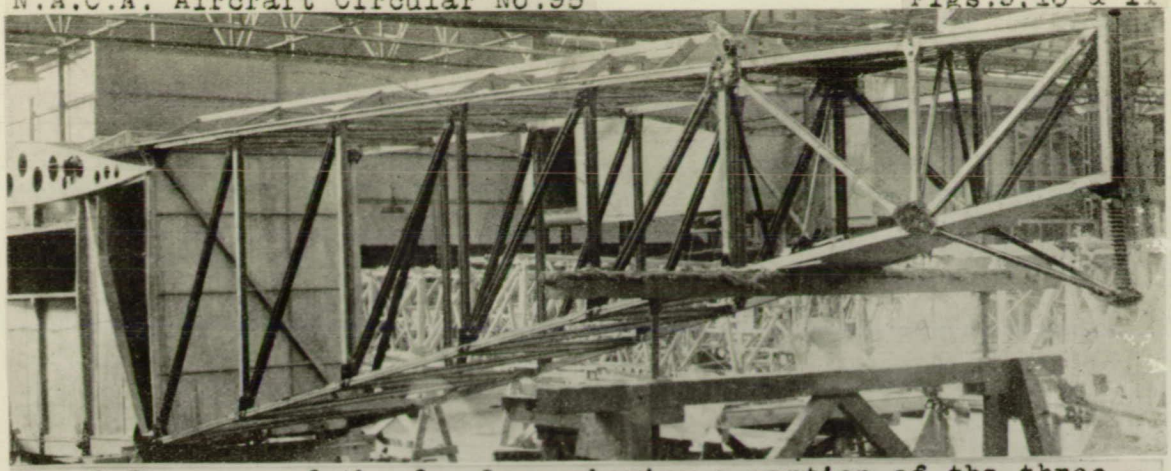


Fig.9 The rear of the fuselage, showing a portion of the three - ply box which forms the cabin of the Westland IV airplane.

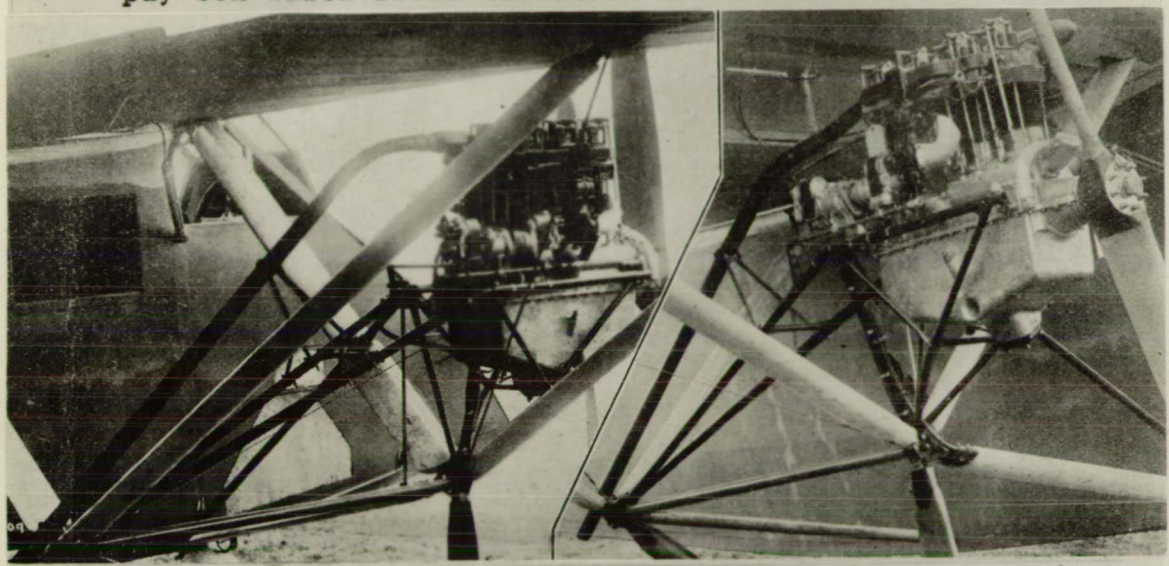


Fig.10 The mounting and bracing of the outboard Cirrus engines.

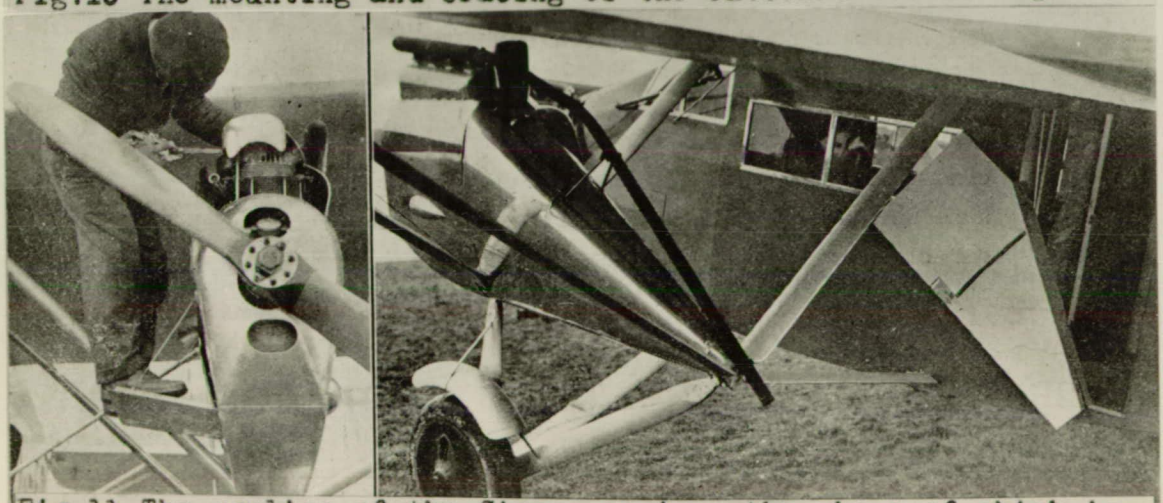


Fig.11 The cowling of the Cirrus engines, the shape of which is imposed by the tubular struts shown above. The stand for a mechanic on the flap of the cowling is ingenious. Taken from "The Aeroplane"