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AIRCRAFT CIRCULARS
NATIONAL ADVISORY COMMITTEE FOR AERONAUTICS

No. 7

TWO "GLOSTER" AIRPLANES

The "Grouse II," - Two-Seat Training Airplane

The "Grebe II," - Single-Seat Fighter

From "Flight," November 19, 1925

Washington
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The "Grouse II" and the "Grebe II." *

Until recently it has been impossible to describe in detail one of the most successful airplanes produced by the Gloucestershire Aircraft Company, i.e., the "Grebe II" single-seat fighter. In order to demonstrate the remarkable quality of design and workmanship in this airplane, it was flown to a great altitude, from which point it was turned into a steep dive, and when attaining a speed of 240 M.P.H. was flattened out suddenly and then "zoomed," the pilot being ready, of course, to use the parachute.

Contrary to all expectations it was found after landing that no part of the structure had been broken and that the only adjustment necessary to restore the flying trim was the tightening up of the wires which had been stretched under the terrific loads imposed.

A very unique two-seat training airplane has been produced in the "Grouse II." This airplane is considered remarkably easy to fly and yet capable of all kinds of evolutions in the air.

Structurally and aerodynamically these airplanes are nearly identical, and a majority of the fittings, etc., are inter-

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changeable, particularly those of the fuselage, tail skid, and wings.

Constructional Features.

In many respects the construction of these airplanes is similar to that of the "Nighthawk."

The fuselage, except for minor changes, is still almost identical to that of the earlier designs. The longerons are of ash, the lower one being spliced in the region where the wing spars and landing gear struts are attached (Fig. 6). The fuselage struts are tapered towards their ends, and fit over the bolt heads of the fuselage fittings. The latter are of very simple form, and consist, generally speaking, of flat plates in the line of pull, very little bending being employed. The fuselage bracing is in the form of round tie-rods, threaded at the ends to fit the fork ends securing them to the steel clip fittings (Fig. 7). Over the main fuselage structure light formers and stringers provide a good streamline form above and below. The covering is of fabric.

The fuselage front terminates with a multi-plywood board attached to the four longerons by very simple sheet-steel fittings. To this board or wall the special "saucepan" engine bearer is bolted. At the stern the construction is somewhat unusual in that the stern post is not permanently built into the structure, but is an integral part of the top and bottom

fin assembly and is secured to the longerons by special fittings, as shown in Fig. 7 (1).

The fins, rudder and elevator are of normal wood construction, but the elevator attachment is somewhat different in that the elevator spars are not secured directly to the longerons, but to a cross-tube suspended in the diagonal bracing wires, Fig. 7 (1).

The trimming gear for the stabilizer is in the form of a worm, and is operated by a lever from the cockpit.

The landing gear is of the normal Vee type, but the shock absorbing medium in the "Grebe II" ^{consists} of rubber blocks working in compression, while the rebound is checked by an oil damper gear or dashpot.

The tail skid, which moves with the rudder so as to give good steering on the ground, is similarly sprung, Fig. 6 (6).

Cockpits

In the case of the cockpits a distinction must, of course, be made between the "Grouse" and the "Grebe," the former being a two-seater school airplane and the latter a single-seater fighter. In the "Grouse" the two cockpits are placed one just aft of the wings and the other partly under the top wing, which is cut away to facilitate access. Dual controls of normal stick type are provided, and the airplane can be piloted from either seat. In the "Grebe" there is but a single cockpit, but

this is of very ample proportion, and is not in the least cramped. The two machine guns which form the normal equipment of this type are housed inside the fuselage fairings, so that the pilot can change his ammunition drums and generally attend to his guns without having to put his hands over the side, where, at the high speeds, and great altitudes, they quickly become numbed with cold. The guns, it may be added, are very conveniently situated, and yet do not in the least interfere with the airplane controls. The usual interrupter gear is, of course, fitted so as to enable the guns to be fired through the propeller.

Fuel System

The fuel system of the "Gloster" airplanes is of the direct gravity feed type, the two gasoline tanks being situated in the top wing, and pipes leading from them down to a T-collector with non-return valves, Fig. 6 (5), which enables the pilot to take the fuel from either tank, or from both simultaneously if required. The two gasoline cocks are provided with extension handles, which can be reached from the cockpit, so that if the pilot believes himself to be in danger of crashing he can shut off the gasoline. The absence of gasoline pumps and the provision of two separate gasoline tanks should result in great reliability as regards the fuel system, and in the case of the "Grebe," which is a military airplane, a bullet hole in one

tank would not put the airplane out of action, as the pilot would merely switch on the other tank.

The Wings

It has already been stated that in chord and section the top and bottom wings of the Gloster airplanes are respectively unequal. The bottom wing section is a "thin" high-speed one, while the top wing is a deep high-lift section. The construction is normal, except that the wing spars, which are of I-section, are built up of several laminations. The ribs are normal N-girders of spruce, and the drag bracing is in the form of round section tie-rods. Where the tanks are housed in the top wing, the bracing is transferred from the center lines of the spars to the top, so as to clear the top of the tanks. The ailerons, which are operated by tie-rods and T-cranks inside the bottom wing, are not hinged directly to the rear spars, but to false spars forming an angle with the main spars. In the latest airplanes, the ailerons project beyond the trailing edge of the main wing. Only the bottom ailerons are operated direct from the cockpit, the movement being transmitted to the top ailerons by a single strut on each side, the attachment for which, as well as the T-crank, is shown in Fig. 7 (4).

The top wing of the Gloster airplanes does not have the usual center section, but the two halves are attached to a steel tube cabane rising from the top longerons of the fuselage. The

attachment is a very simple one and consists of two bolts, one for each spar. The details, as well as those of the spar root fittings, are shown in Fig. 6 (3). The lower spars are secured to short spar roots bolted underneath the bottom longerons of the fuselage, and in the case of the spar coinciding with the landing gear strut attachment short tubes running diagonally to the lower longerons brace the spar roots against the oblique loads imposed by the landing gear strut. Details of the arrangement are given in Fig. 6. The wing fittings are of simple straightforward type, and the work of dismantling and re-erecting of the wings takes but a very short time. The wing bracing is by swaged wires of usual type, and the arrangement of the bracing follows orthodox single-bay biplane practice.

Characteristics of the "Grouse II"

The main dimensions, areas, etc., of the "Grouse II" are shown in Figs. 1, 2 and 3. The engine fitted as standard is the Armstrong-Siddeley "Lynx" of 180 HP. at 1620 R.P.M. The gasoline tanks have a capacity of 20 gallons each, while the oil tank, situated in top fairing of fuselage near the engine, has a capacity of $3\frac{1}{2}$ gallons. With the amount of fuel stated, the duration is $3\frac{3}{4}$ hours at 10,000 ft.

The load factors of the "Grouse II" are as follows: Front wing truss, 7; rear wing truss, 5; working to a stress of 5,000 lb./sq.in. for spruce members. The fuselage factors are

5 on front and rear portions for landing loads, and the load factor of the landing gear is $4\frac{1}{2}$. The weight of the airplane fully loaded (with a weight of 360 lb. for pilot and passenger) is 2,120 lb., giving a wing loading of $\frac{2,120}{208} = 10.2$ lb./sq.ft., and the power loading is $\frac{2,120}{180} = 11.8$ lb./HP. With this loading, the performances of the Gloster "Grouse II" are:

Maximum speed,	118 M.P.H.
Landing speed,	52 "
Climb to 10,000 ft. in	17 minutes
Ceiling,	18,000 feet
Duration at 10,000 ft.,	3 $\frac{3}{4}$ hr.

Characteristics of the Gloster "Grebe II"

The Gloster "Grebe II" (Figs. 4 and 5) is a fast single-seater fighter designed for work at fairly great altitudes, having a high performance and being extremely sensitive to control, yet having a considerable degree of stability so that it can be flown "hands off." The engine is an Armstrong-Siddeley "Jaguar," rated at 385 HP., but developing a normal power of 396 B.HP. at 1700 R.P.M., which is the normal speed of the engine, and a maximum of 421 B.HP. at the maximum speed of 1870 R.P.M. The capacity of the two gasoline tanks, mounted in the top wings, is 26 gallons each, or a total of 52 gallons. The oil tank capacity is $5\frac{1}{2}$ gallons, and the duration with this quantity of fuel is $2\frac{3}{4}$ hours at 15,000 feet.

The total loaded weight of the "Grouse II" is 2,614 lb., made up as follows:

Engine,	820 lb.
Propeller,	50 "
Oil,	55 "
Gasoline,	390 "
Piping,	25 "
Total for power unit,	1340 "

The structure item weights are:

Wings,	350 lb.
Fuselage,	139 "
Gun mounts,	10 "
Fins,	7 "
Tail trimming gear,	10 "
Tail and elevators,	28 "
Tail skid,	9 "
Rudder,	4 "
Controls,	26 "
Cockpit,	16 "
Fairing,	69 "
Main gasoline tanks,	68 "
Undercarriage,	103 "
Oil tank,	11 "
Total structure weight,	850 "

The military load is 424 lb., composed as follows:

Pilot,	180 lb.
Electrical equipment,	30 "
Oxygen,	21 "
Instruments,	23 "
Guns, ammunition, sights, and C.C. gear,	170 "
Total	424 "
Total loaded weight,	2614 "
Wing loading,	$\frac{2614}{254} = 10.3$ lb./sq.ft.
Power loading,	$\frac{2614}{400} = 6.54$ lb./HP.

The performance figures of the Gloster "Grebe II" are as follows:

Maximum speed,	152 M.P.H.
Landing speed,	53 "
Speed at 10,000 ft.,	146 "
Climb to 20,000 ft. in	24 minutes
Absolute ceiling,	23000 ft.
Duration at 15,000 ft.,	2 3/4 hr.

The gasoline consumption is 27.5 gallons per hour and the oil consumption is 1.2 gallons per hour at full throttle. The load factors are the same as those quoted for the "Grouse II." In addition to the two Vickers machine guns and 1200 rounds of ammunition, the airplane has provision for carrying four 20-pound bombs.

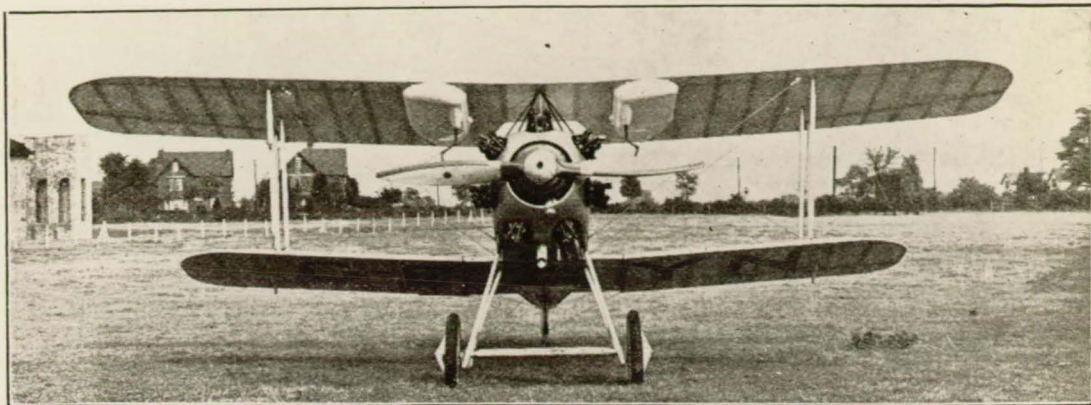


Fig.1 The Gloster "Grouse"II" front view

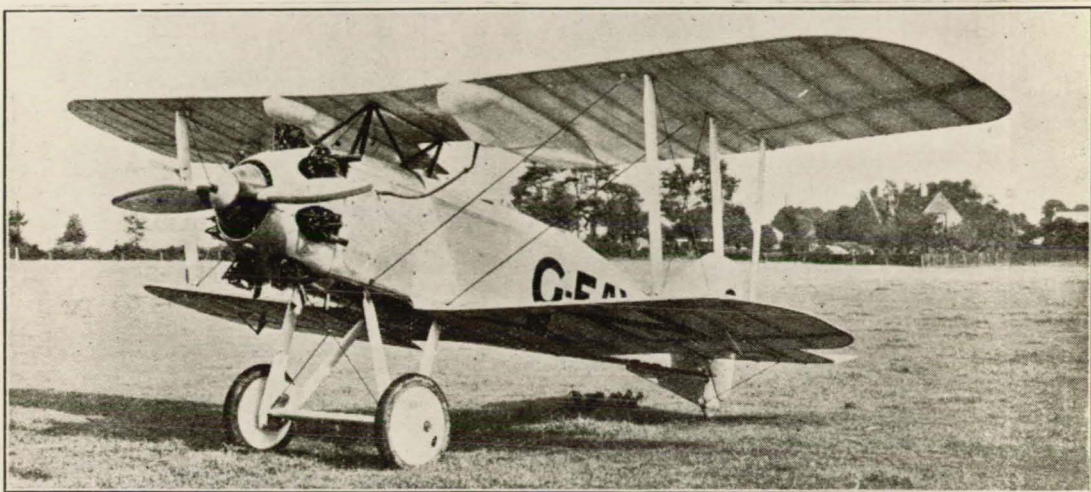


Fig.2 The "Grouse II" three-quarter view

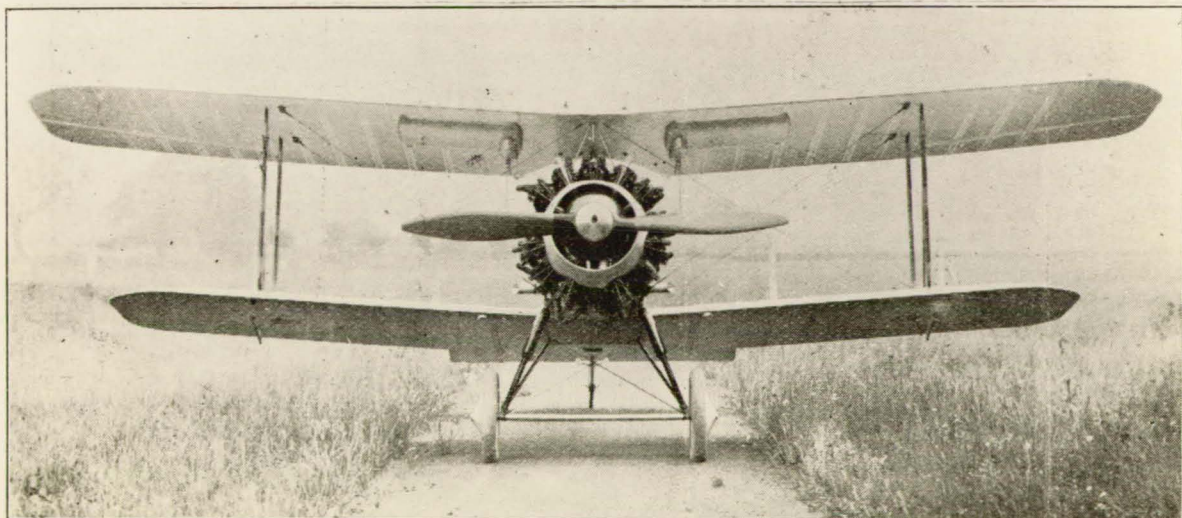
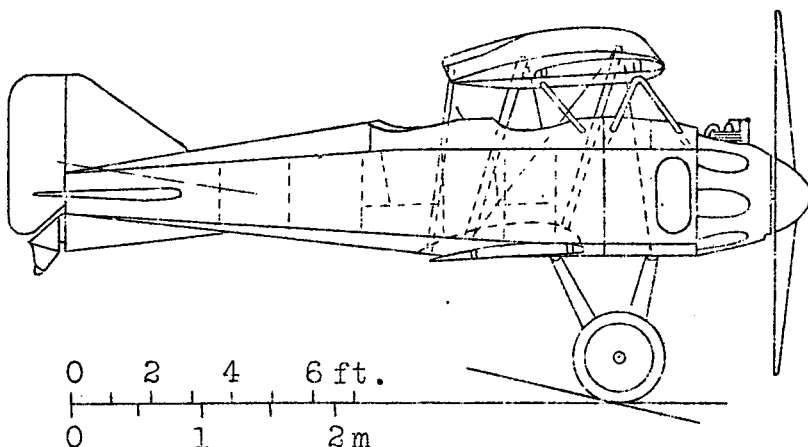
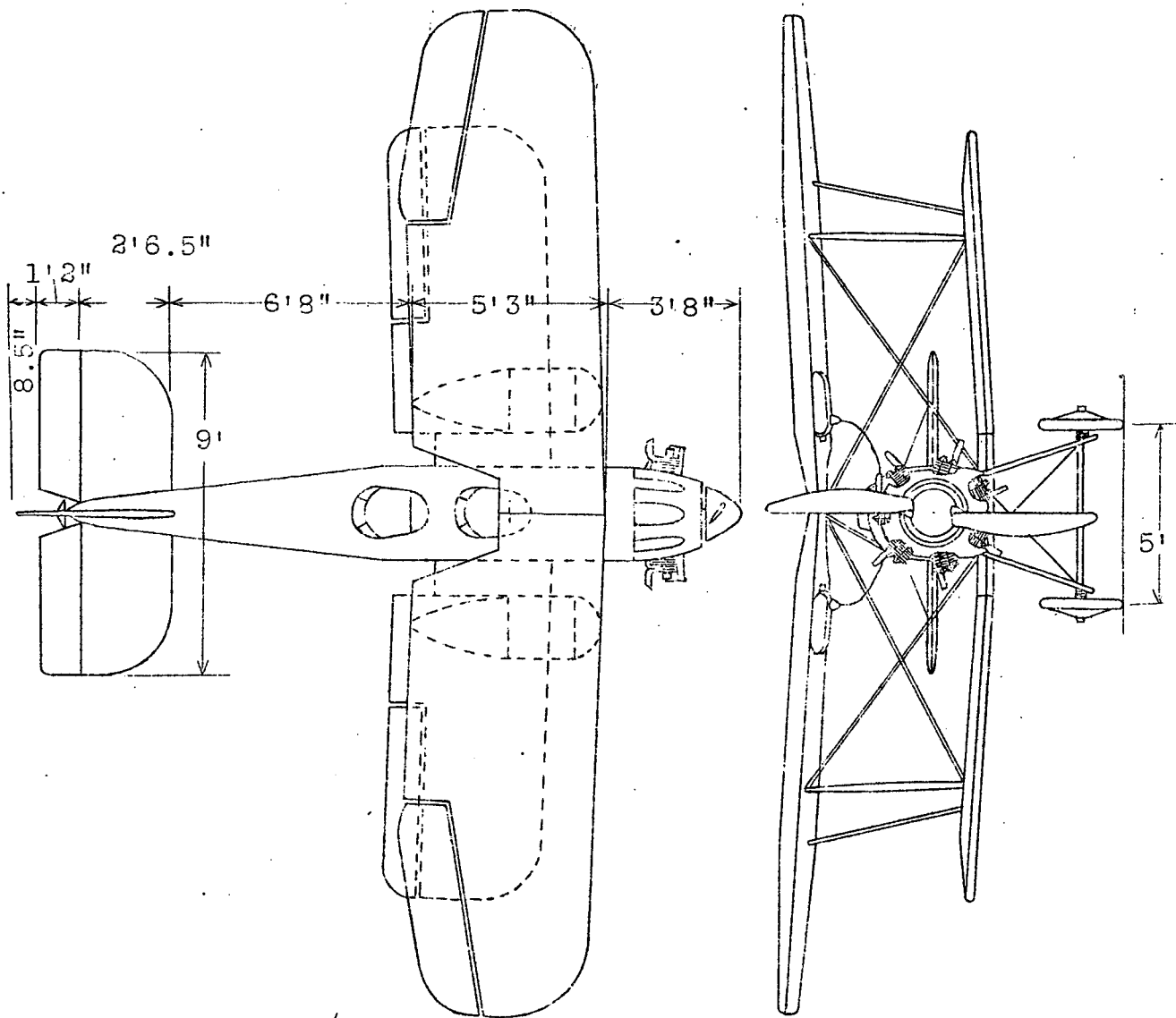


Fig.4 The Gloster "Grebe II" airplane



Areas:	
Wings	208.00 sq. ft.
Ailerons	28.00 " "
Stabilizer	18.20 " "
Elevator	9.80 " "
Fin	5.25 " "
Rudder	5.50 " "

Armstrong-Siddeley
 "Lynx" engine
 180 HP. at 1620 R.P.M.

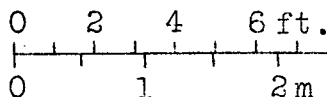


Fig. 3 Gloster "Grouse II" airplane.

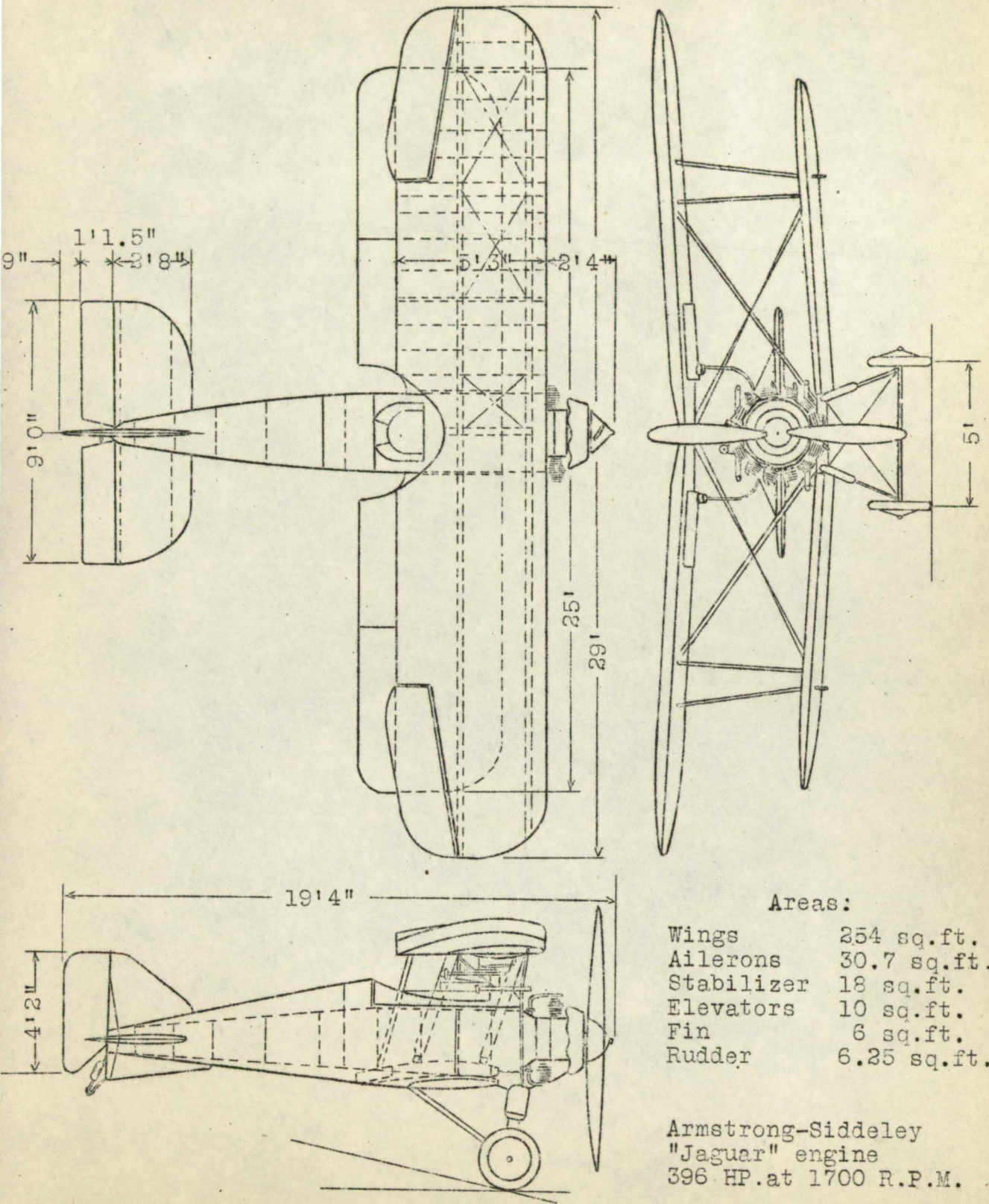


Fig.5 The Gloster "Grebe II" airplane.

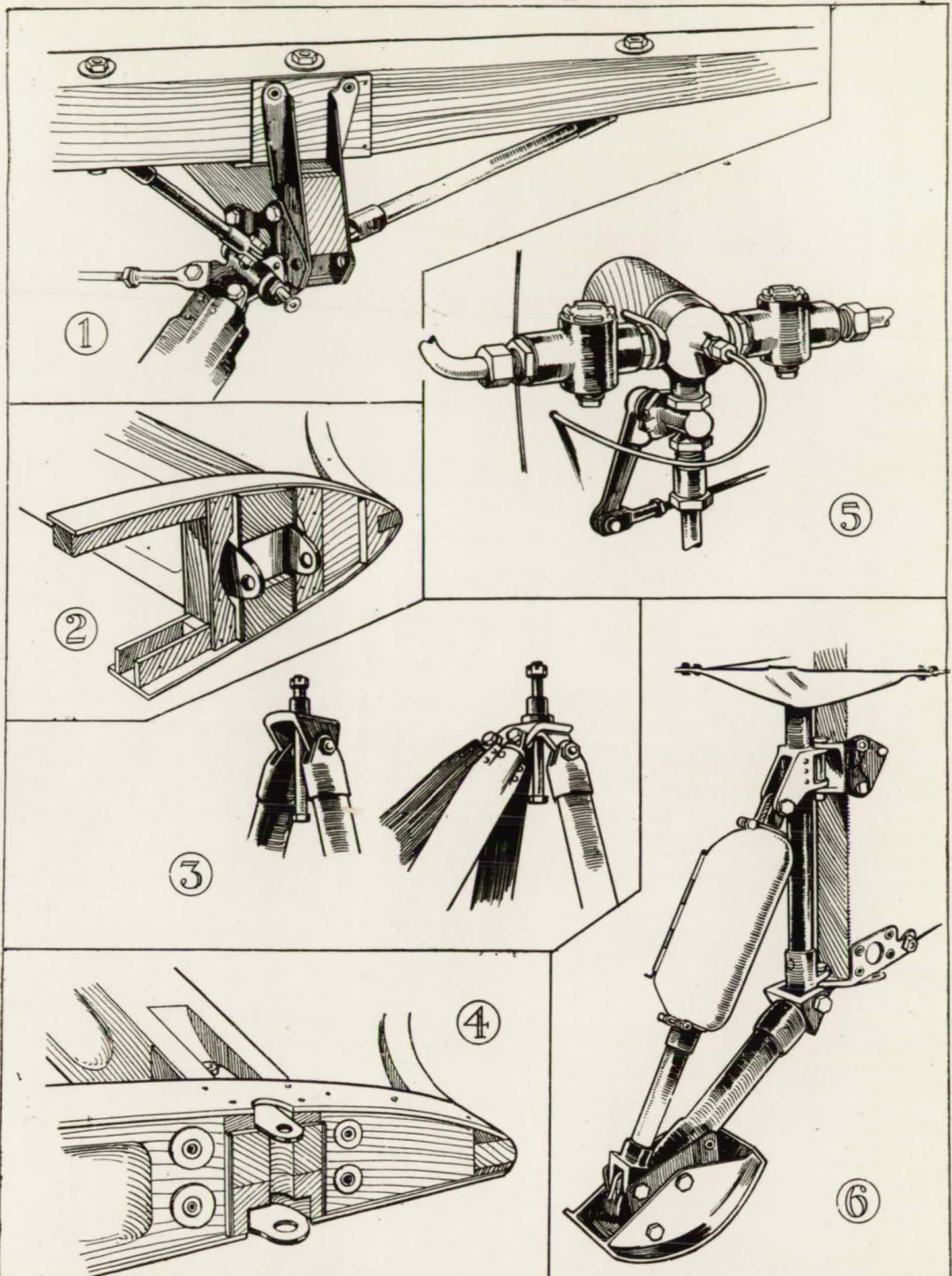


Fig.6 Constructional details; (1) attachment of lower wing spar, landing gear strut, etc., to lower longerons of fuselage. (2) spar root fitting on lower rear spar engaging with fitting in (1). (3) the two simple bolts on the cabane by which top wing halves are secured. (4) top spar root fittings which are locked by bolts shown in (3); note that the bottom lug is larger to accommodate the shoulder on the cabane. (5) the gasoline distributor, by means of which the gasoline is taken from either or both tanks simultaneously. (6) tail skid, sprung by rubber blocks in compression, and steering with the rudder; fairing removed to show detail.

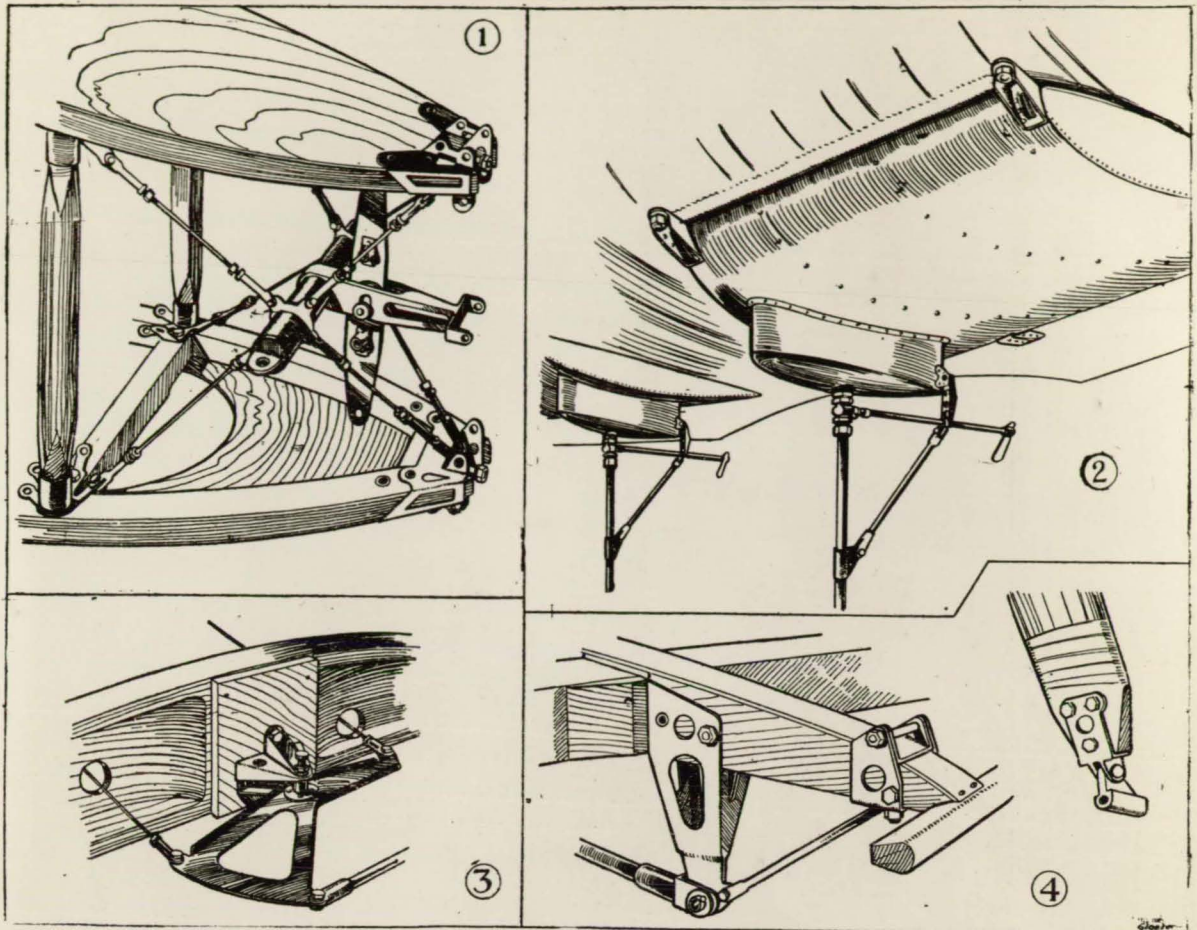


Fig.7 Constructional details; (1)stabilizer support and elevator crank as well as fittings for the stern post etc.,of the "Grebe". (2) gravity gasoline tanks mounted in the top wings, the cocks being within reach of the pilot. The ailerons of the lower wings are operated by a crank(3) which is mounted on a specially strengthened rib, and from which tie rods are run to the controls while a steel tube runs to the aileron crank(4). From the fitting on the crank a strut is run to the top-wing aileron.