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AIRCRAFT CIRCULARS

NATIONAL ADVISORY COMMITTEE FOR AERONAUTICS

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No. 150

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THE AVRO 627 "MAILPLANE" (ENGLISH)

A Single-Seat Biplane

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Washington  
August, 1931

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THE AVRO 627 "MAILPLANE" (ENGLISH)\*

A Single-Seat Biplane

A. V. Roe & Co., Ltd., of Manchester, have just produced one of the first aircraft specially designed in this country for carrying air mails. This is undoubtedly a step in the right direction, particularly as the Avro 627, as it is called, has been built with the specific purpose of catering for Canadian desires.

The construction throughout is of metal, and every precaution has been taken to make her safe, comfortable, and easy to fly in bad and exceptionally cold weather. As befits a modern production, the whole landing gear can easily be changed for skis or floats, and full night-flying equipment is, of course, fitted. The engine installation includes an electric inertia starter and an engine-driven electric generator. The mail compartment is built up in the manner of our fireproof bulkheads, with asbestos sheeting sandwiched between duralumin plates. A summary of the main conditions which the airplane has been designed to fulfill would be high cruising speed, some 600-mile range in still air, ease of maintenance, ease of transport of all replaceable components, and complete equipment for comfortable and regular operation of air-mail services under Canadian conditions. (Figs. 1, 2, and 3.)

F u s e l a g e

Following the now accepted Avro practice, the type 627 fuselage is of welded steel tubing. The main frame is divided into three sections, consisting of the engine mounting, which is of the straightforward tubular type, the middle section, which includes the mail compartment and the pilot's cockpit, and the rear section continuing from behind the pilot to the sternpost. As far aft as the pilot's

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\*From Flight, August 14, 1931, and The Aeroplane, August 12, 1931.

cockpit the fuselage is tubular strut-braced, while the rear section is wire-braced. (Figs. 4 and 5.) Directly behind the engine mounting is the section carrying the two fuel tanks, having a large rectangular one in the middle slung on steel straps (Figs. 4 and 6), with a shaped gravity tank above it. Aft of this is the mail compartment, which is completely lined with duralumin-asbestos-duralumin, and provides 40 cubic feet of clear space inside it. A folding lid of the same material opens toward the starboard side of the airplane, and provides a large-size entrance for loading. This half of the lid is further divided into halves, so as to incommode the loading operation as little as possible. (Figs. 7 and 8.)

Directly behind the mail compartment is the pilot's cockpit and, being situated thus far aft, the pilot should have an excellent view in all directions; moreover, his position should make him very safe and give him every chance of surviving in the event of a crash. No pains have been spared to make the pilot's job as comfortable as possible, so that long-distance flights should present no difficulty.

The seat is adjustable in the same manner as in the Avro Tutor, the operating lever being situated on the right-hand side (fig. 9), the handle part of this lever being, as are all the other handles and levers in the cockpit "Doverised," in order that the pilot should have no trouble through touching cold metal in very low temperatures.

The rudder bar is easily adjustable in flight by means of a small hand wheel mounted directly in line with the pivot, in the same manner as other Avro airplanes. (Fig. 10.) In the standard position, on the port side of the cockpit, is a wheel for adjusting the stabilizer; a refinement is an indicator for showing the stabilizer setting. All fuel system controls are situated on the right-hand side of the cockpit, enabling either or both tanks to be connected direct to the carburetor, and there is also a lever to a hand-worked Vickers pump for use in case the engine pump breaks down. Landing lights (fig. 11), which are fitted in the bottom wings, can be swung down to the landing position by means of another control, and another lever on the same side opens or closes louvers in the engine cowling to regulate the engine temperature. Cockpit heating is provided direct from the exhaust, with openings under either heel board, thus keeping the pilot's feet warm, as well as heating the cockpit (figs. 10 and 12). Special instruments include a Pioneer bank and turn indi-

cator, and a climb indicator, a button on the dashboard controlling the Eclipse electric inertia starter. Arrangements are also made for releasing the American type parachute flares for emergency landing. A receiver for the Western Electric radio beacon is situated on the floor behind the pilot's seat. Following the usual Avro practice, the side fairings of this part of the fuselage are built up of spruce and three-ply, in complete frames, which are easily detachable, thus readily exposing all control rods and wires, which are led outside the actual fuselage frame when desired, leaving the inside of the cockpit absolutely clean. The front cowling panels just abaft the engine are aluminum, well shaped to work in harmony with the engine cowling and keep the drag of this large-sized fuselage as low as possible. The engine cowling itself is of the Townend ring type, which contributes a great deal to the high performance. (Fig. 13.)

### Main Wings

The main wings and interplane struts are constructed of metal, the spars being of high tensile corrugated strip steel and the ribs, duralumin pressings. (Figs. 14 and 15.) The drag bracing is effected with built-up girder-type compression struts and cross bracing wires, the whole being covered with fabric. The ailerons, which are balanced on the Frise principle, are only fitted to the top wing, which is considerably larger in area than the bottom, and is placed low so that the pilot's eye is almost on a level with it, giving him a good view and presenting a minimum of obstruction to his vision. The bottom wing is also staggered with regard to the top, and thus gives the pilot an excellent forward and down view, besides increasing the efficiency of both wings. The airfoil section used is a special one designed to give a very nearly stationary center of pressure, and has already been tested out in full scale with excellent results.

The interplane struts, as already mentioned, are steel and of streamline cross-section tube, the cross bracing being the normal streamline wire type. (Fig. 16.) The designers have adhered to the biplane type of construction for this airplane, in view of the fact that they consider it necessary first to keep down the over-all dimensions of the aircraft and also to make transport of replacement parts as easy as possible. The lower wing in particular,

which is the one most likely to be damaged, is so small that it can be transported with great ease, and a new one fitted to the airplane with a minimum of trouble.

### The Tail Unit

All the tail surfaces are of welded steel tubular construction, covered with fabric, with both the rudder and elevators balanced aerodynamically, the elevators also being balanced statically, like the ailerons. Both these surfaces are mounted on ball bearings of large size, making operation both smooth and easy. (Fig. 17.) The rudder and fin are unbraced, but the stabilizer, which is provided with incidence adjustment of the usual Avro screw type worked from the pilot's cockpit, has two streamline tubular steel struts on each side. The front spar fittings also provide additional adjustment, which can be operated on the ground. The lower wings have hinged landing lights fitted to them, operated from the pilot's cockpit by wires, which allow them to be withdrawn up into the wing out of the air stream when not in use. (Fig. 11.) The elevators are operated by means of a push-and-pull rod, which has two universal joints in it to allow of free movement. In order to make dismantling the stabilizer a simple matter, this rod also has a ball coupling, with a neat type of locking ring which can very readily be disconnected. The ailerons and rudder are worked in a normal manner by cables.

### Landing Gear

The landing gear is straightforward and simple, with a cross axle, streamlined section tube radius rods, and compression legs, combining an oleo cylinder and rubber disks for shock absorbers. (Figs. 18 and 19.) The oleo cylinder provides a free travel of some 8 inches, thus giving exceptionally good shock-absorbing qualities. Dunlop disk wheels with Bendix brakes are fitted as standard, the brake torque being taken directly through the radius rod.

On left side of pilot is the brake lever which applies both brakes simultaneously when pulled back and may be rocked from side to side to apply brakes independently for steering on the ground. (Figs. 10 and 20.) The wheels themselves, and also the balloon-type tail wheel, are covered with beaten aluminum streamline fairings. (Fig. 21.)

Attachment points are provided so that either a twin-float or ski landing gear may easily be substituted for the standard landing gear. The tail wheel is of the free type, providing castor action, with small centralizing springs of shock-absorbing cord. (Figs. 22, 23, and 24.) The wheel is mounted in a welded sheet-steel fork, which is carried on a post sprung with small stiff springs, the main shock being taken by the balloon tire, which is a low-pressure Goodyear.

### The Power Installation

The engine mounting is a triangulated welded-up steel tube structure, terminating in a ring to which the engine is mounted in front, and four attachment points on the after end, which are bolted to machined steel fittings on the fuselage. (Fig. 25.) The oil tank is placed in front of the fireproof bulkhead, and lies inside the engine mounting. (Fig. 4.) A unique feature of the power plant is the fitting of an Eclipse Electric Inertia Starter, and the provision of direct drive for the electric generator. The starter may also be worked by hand, for which purpose a hand lever is provided. The engine is an Armstrong-Siddeley "Jaguar-Major" of 525 b.hp at 2000 r.p.m., fitted with a geared propeller running at 0.657 crankshaft speed. The engine is also fitted with a geared fan, maintaining ground level power up to 3000 feet.

Fuel tankage is provided for 100 gallons, there being 72 gallons in the main tank, which is situated directly behind the fireproof bulkhead, and 28 gallons in the gravity tank above it. Both tanks are built up of welded aluminum sheet of some 16 gauge, thus providing both lightness and strength. The main tank being slung in leather-covered steel straps, may be removed for repair through the bottom of the fuselage, when necessary. The gravity tank, sitting on bearers on the top of the fuselage, is constructed with the diagonal bracing struts of the top center section, passing through grooves each side of it. The gravity tank has a direct reading contents gauge, and fuel is passed to it from the main tank by the engine-driven pump, which is fitted as standard for emergency use. There is, however, also a hand-worked Vickers pump.

The oil tank which, as we have already mentioned, is in the engine mounting, is of cylindrical form, and also constructed of aluminum. Its capacity is 11 gallons. One

end of it has a special large-diameter drain cock, so that the contents may be emptied quickly and heated before use when operating the aircraft in very cold climates.

A three-way fuel cock gives feed from either main or gravity, or both tanks to carburetor. A combined fuel and oil cock turns off oil when gasoline is cut off. All engine controls and fuel controls are of positive push-pull rod type, passing through special glands in the fireproof bulkhead and all pipes are connected to special unions at the bulkhead. Removable cowling round engine mounting and removable side panels of fuselage give complete access to engine, accessories and controls.

A Vickers-Potts oil cooler is used with a by-pass, so that it may be cut out of the oil circuit when conditions are particularly cold. The exhaust manifold, placed behind the engine, is of streamline section, with a long tail pipe carried below the pilot's cockpit and, being in the form of a ring, is designed to work in conjunction with the Townend ring engine cowling. The tail pipe finishes right aft of the pilot's cockpit and, by means of a muff, supplies air through suitable ducts into the cockpit, the outlets being at the front end of each footboard. A control handle is fitted on the right-hand side of the cockpit for regulating the supply of warm air.

The modern arrangement of swivelling tail-wheel together with efficient wheel brakes certainly makes the aircraft nearly as handy on the ground as a motor car.

## Avro "Mailplane" Type 627

(Armstrong-Siddley "Jaguar Major" 525 hp at 2000 r.p.m.  
at 3000 ft. (914.4 m). Gear ratio 1.0:0.657)

## Performance with full load

(Within  $2\frac{1}{2}$  per cent in speed and 5 per cent in climb.)

Speed:

Maximum speed at sea level	170 m.p.h. (273.6 k.p.h.)
" " " 3000 ft. ( 914.4 m)	170 " (273.6 " )
" " " 5000 ft. (1524.0 m)	168 " (270.5 " )
" " " 10000 ft. (3048.0 m)	160 " (257.5 " )
" " " 15000 ft. (4572.0 m)	149 " (239.8 " )
Landing speed	66 " (106.2 " )
Cruising speed at 3000 ft. (914.4 m) at three- quarters normal power	147 " (236.6 " )
Duration at 147 m.p.h. (236.6 k.p.h.)	3.8 hr. 560 miles (901.2 km)
Cruising speed at 3000 ft. (914.4 m) at two-thirds normal power	140 m.p.h. (225.3 k.p.h.)
Duration at 140 m.p.h. (225.3 k.p.h.)	4.3 hr. 600 miles (965.6 km)

Climb:

Rate of climb at sea level	1200 ft./min. (6.1 m/s)
Time to 1000 ft. ( 304.8 m)	0.83 min.
" " 5000 " (1524.0 " )	4.30 "
" " 10000 " (3048.0 " )	10.50 "
" " 15000 " (4572.0 " )	23.00 "
Service ceiling	17500 ft. (5334.0 m)
Absolute ceiling	19000 " (5791.2 " )

Dimensions:

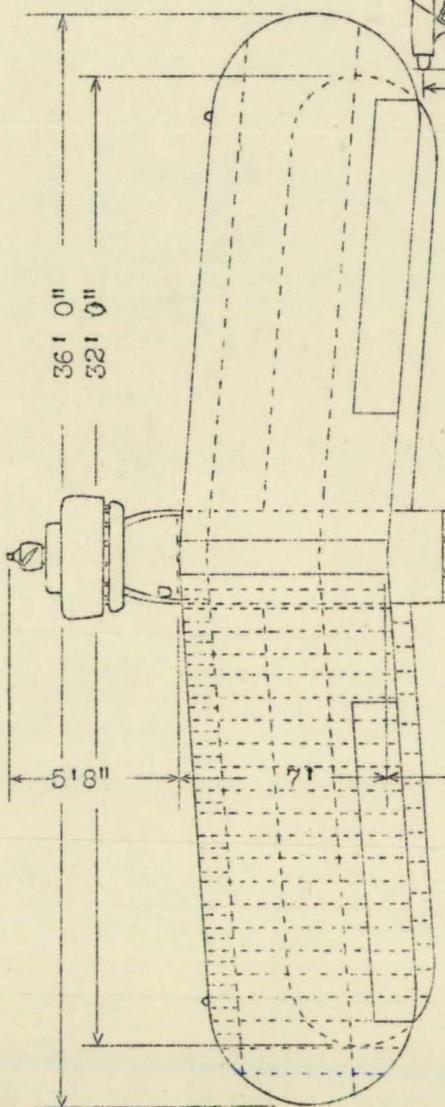
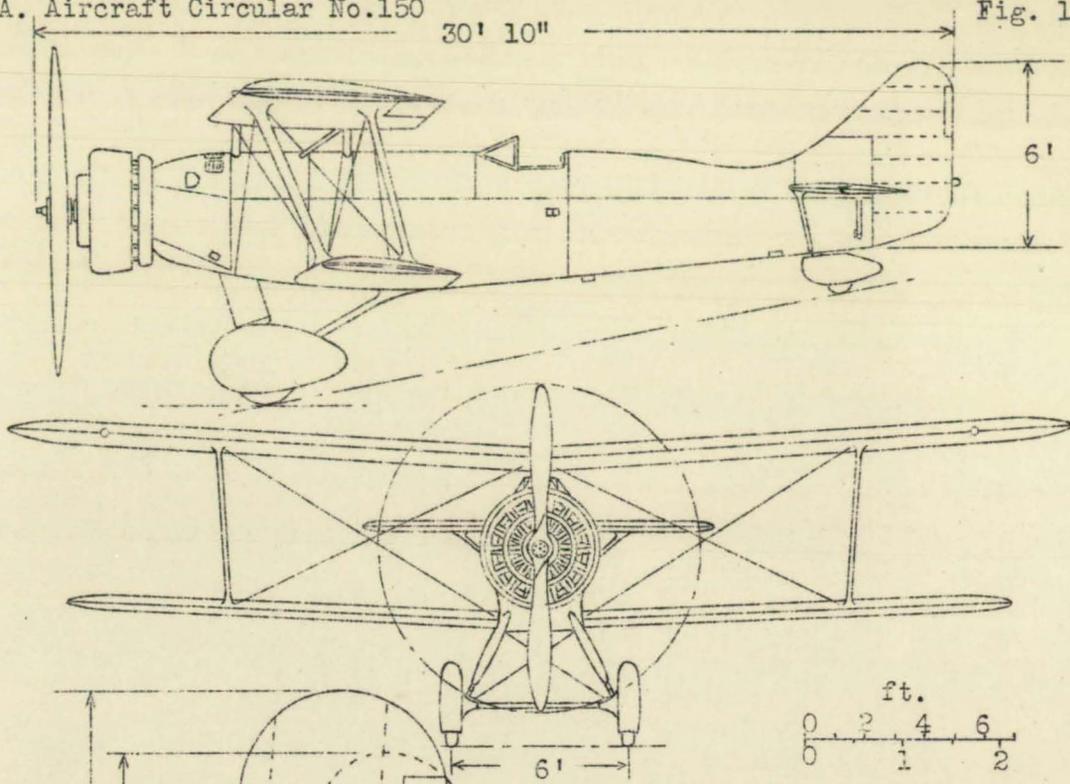
Span of top wings	36 ft. 0 in.	(11.0 m)
" " bottom wings	32 " 0 "	( 9.7 " )
" " horizontal tail surface	12 " 0 "	( 3.6 " )
Height over-all	10 " 6 "	( 3.2 " )
Length "	30 " 10 "	( 9.4 " )
Chord of top wing	7 " 0 "	( 2.1 " )
" " bottom wing	5 " 0 "	( 1.5 " )
Gap between wings	5 " 4 "	( 1.6 " )
Chord of horizontal tail surface	4 " 3 "	( 1.2 " )

Areas:

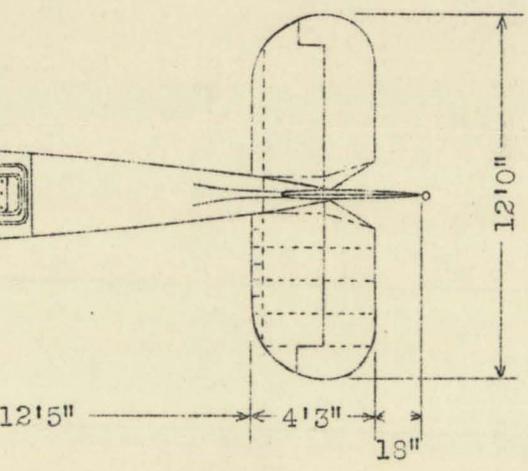
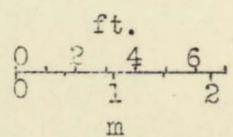
Main wings with ailerons	381.0 sq.ft.	(35.39 m <sup>2</sup> )
Ailerons only	32.0 " "	( 2.97 " )
Stabilizer	24.7 " "	( 2.39 " )
Elevators	16.8 " "	( 1.56 " )
Rudder	16.0 " "	( 1.48 " )
Fin	5.0 " "	( 0.46 " )

Weights:

Weight of aircraft, light	3,077 lb.	(1395.7 kg)
Electric starting gear	17 lb.	( 7.7 kg)
Engine-driven generator and drive	25 " "	(11.3 " )
Accumulator (starting, lighting and W/T)	39 " "	(17.7 " )
Navigation lights and wiring	6 " "	( 2.7 " )
Landing light gear and wiring	22 " "	(10.0 " )
Radio beacon receiver W/T	<u>32</u> " "	(14.5 " )
	141 lb.	(63.9 kg)
Tare weight of aircraft with all equipment	3,218 lb.	(1459.6 kg)
Pilot with parachute	190 lb.	( 86.2 kg)
Fuel (100 gal.) (454.6 liters)	765 " "	(347.0 " )
Oil (10.7 gal.) (48.6 liters)	<u>107</u> " "	( 48.5 " )
	1062 lb.	( 481.7 kg)
Maximum mail load	<u>870</u> " "	( 394.6 " )
Gross weight, fully loaded	5,150 " "	(2335.9 " )



Wings & ailerons,	381.0	sq.ft.
Ailerons alone,	32.0	"
Stabilizer,	24.7	"
Elevators,	16.8	"
Rudder,	16.0	"
Fin,	5.0	"



Armstrong-Siddeley 525 hp  
"Jaguar Major"  
engine.

Fig.1 General arrangement drawings of the Avro 627 mailplane.



Taken from "Aeroplans"

Fig.2 A three-quarter front view of the Avro 627 mail plane.

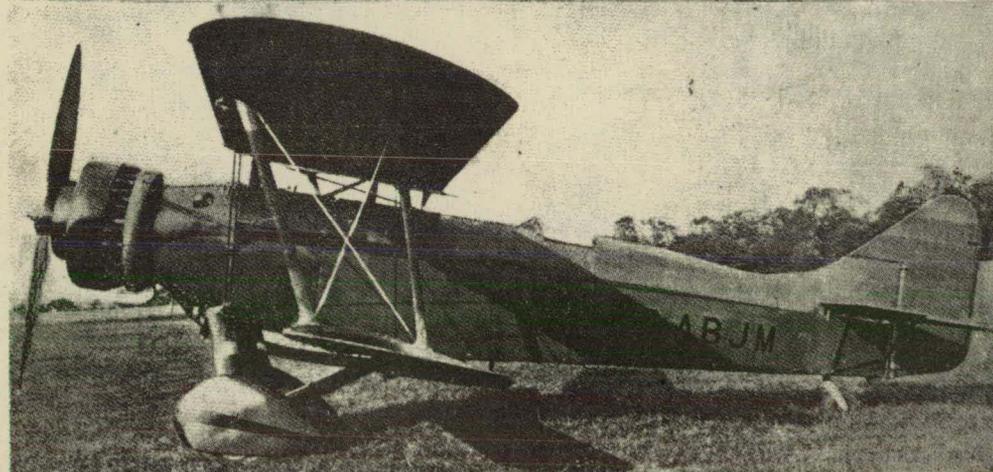


Fig.3 Side view showing robustness of the Avro mail plane and the exceptionally clean lines.

Figs.3,5,7  
Taken from "Flight"

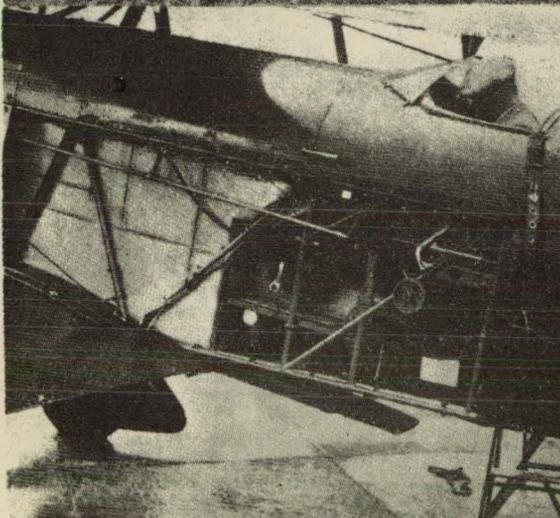


Fig.5 The side panels of the fuselage may be quickly and easily detached to expose all pipes and control rods for adjustment and maintenance.

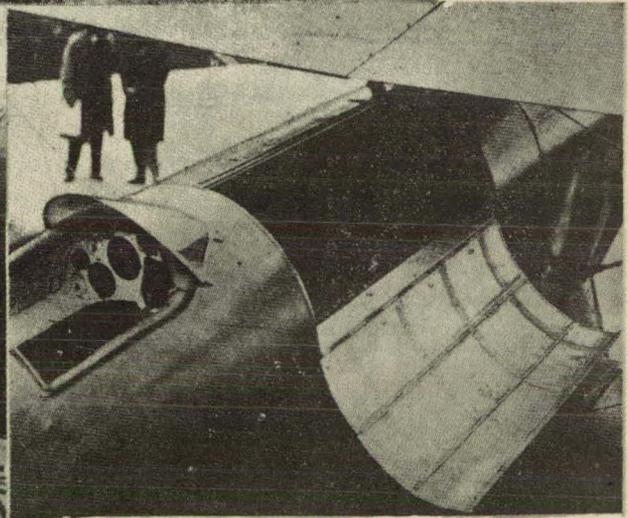
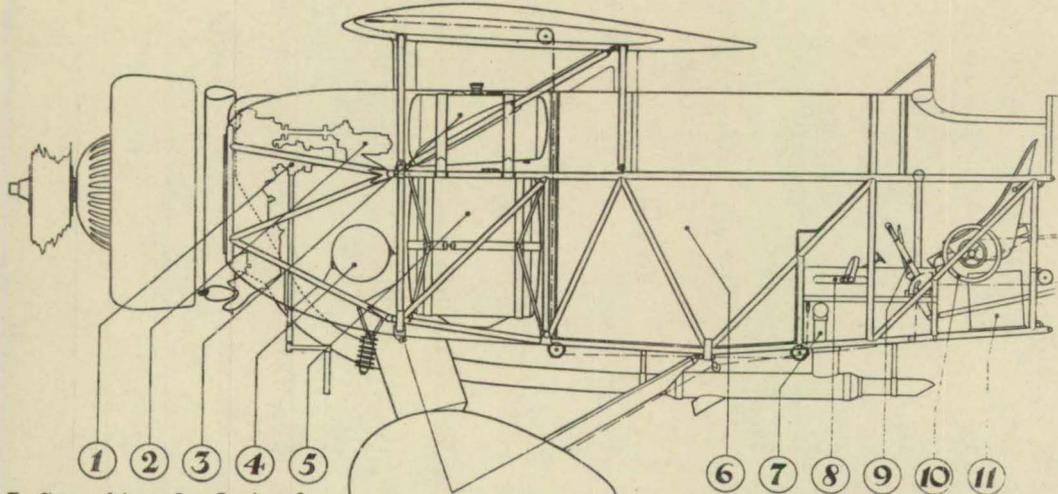


Fig.7 View showing the mail compartment with the lid open. This lid folds again twice and so does not impede loading up of the compartment.



3.Gravity fuel tank.  
4.Oil tank  
5.Main fuel tank.

Fig.4 Section of fuselage.  
1.Eclipse inertia starter.  
2.Inertia starter generator

- 6.Mail compartment.
- 7.Cockpit heater.
- 8.Adjustable rudder bar.
- 9.Brake lever.
- 10.Stabilizer adjustment wheel.
- 11.Battery box for lighting and wireless.

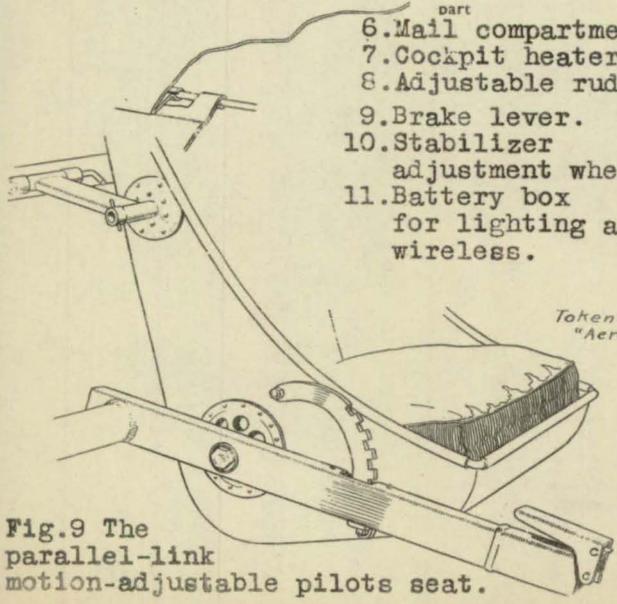


Fig.9 The parallel-link motion-adjustable pilots seat.

Taken from "Aeroplane"

Fig.6 Method of suspension of the main gasoline tank in the fuselage.

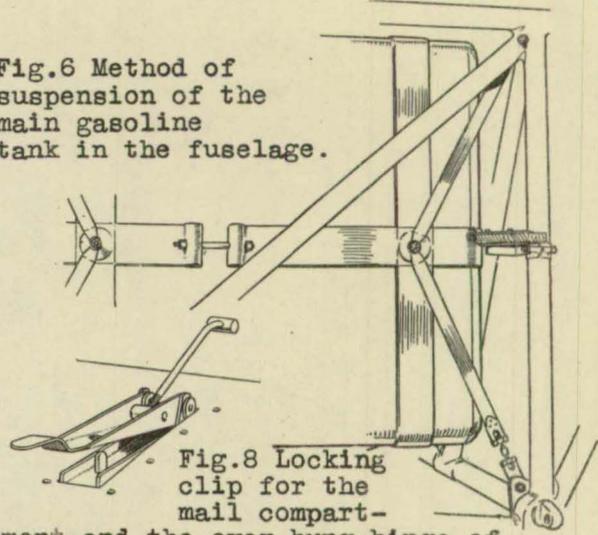


Fig.8 Locking clip for the mail compartment,

and the over-hung hinge of the cover which prevents rain and water from getting into the mail compartment.

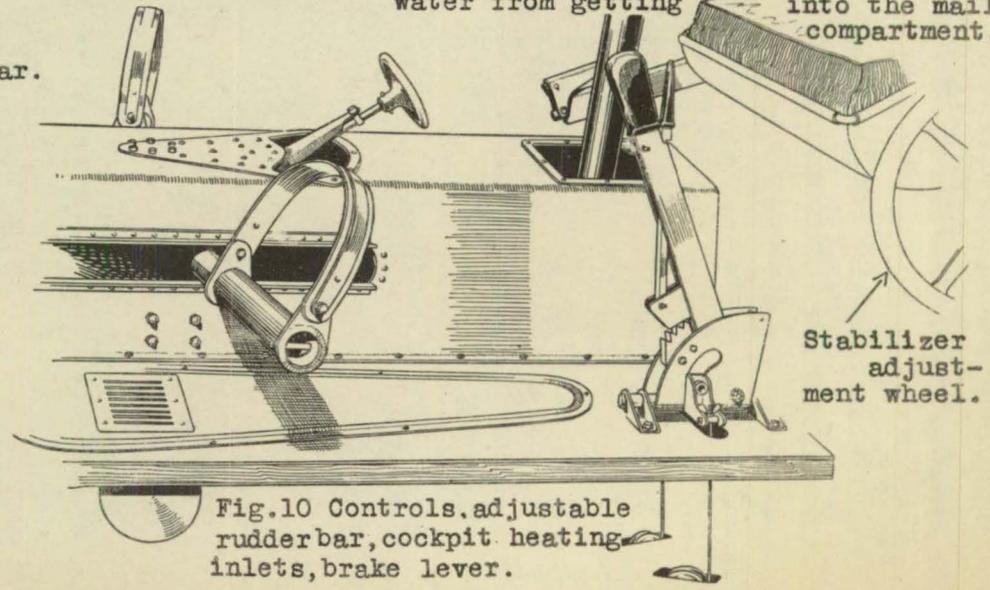
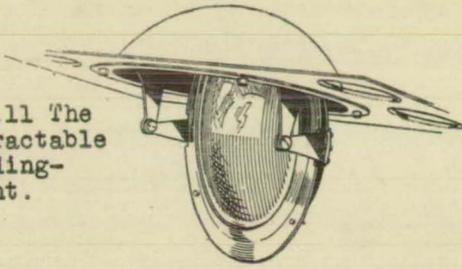


Fig.10 Controls, adjustable rudder bar, cockpit heating inlets, brake lever.

Stabilizer adjustment wheel.

Fig.11 The retractable landing-light.



Figs.16,17,21,22 Taken from "Flight".

Figs.11,12,19,20,24 Taken from "Aeroplane".

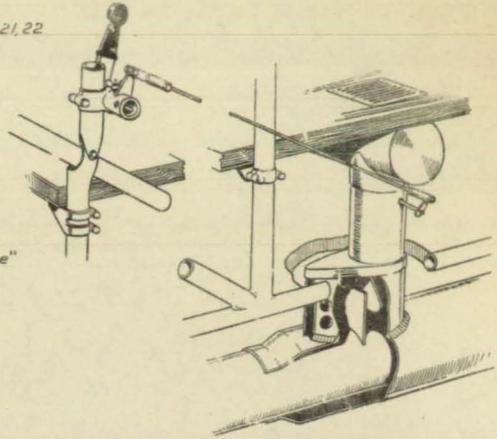
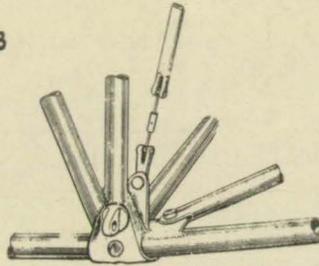
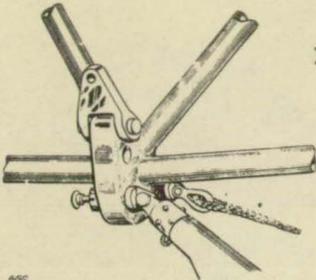


Fig.12 The cockpit-heating device which admits hot air collected off the exhaust pipe to the pilot's cockpit.

Fig.16



Front pair of flying wires. Front pair of the bottom wing of the Avro 627 airplane.

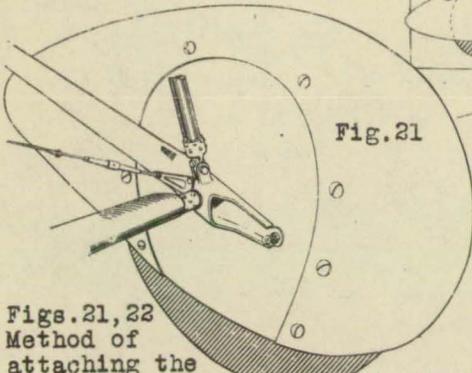


Fig.21

Figs.21,22 Method of attaching the streamline fairing over the landing wheels. Tail wheel and its spring. The hollow steel fork carrying the wheel (see small sketch) is shown cut through in order that the method of attaching the fairing to a transverse plate may be understood.

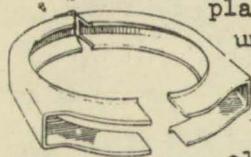


Fig.17 The aileron and elevator hinges are of the ball bearing type, and are not divided, the balls being put into the bearing at the coincidence of a groove in the center sleeve and a notch in the outer race.

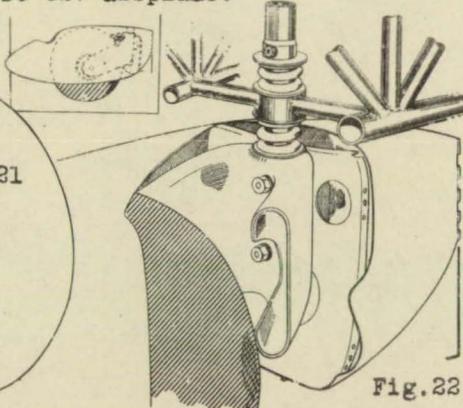
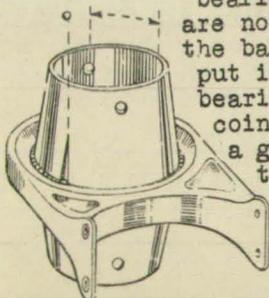


Fig.22

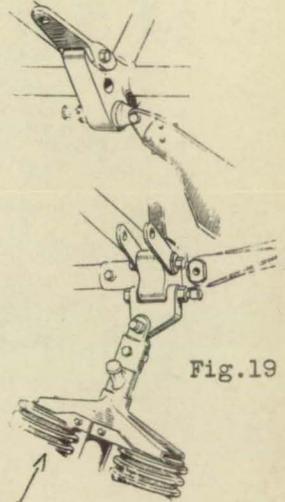


Fig.19

Figs.19 Details of the landing gear.

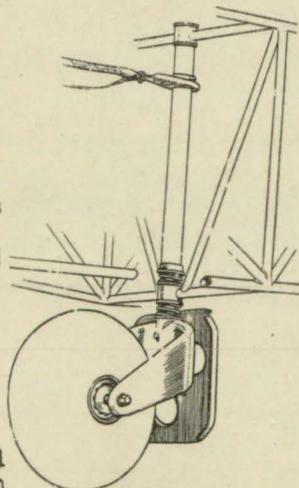
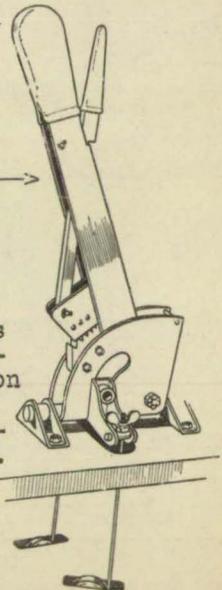
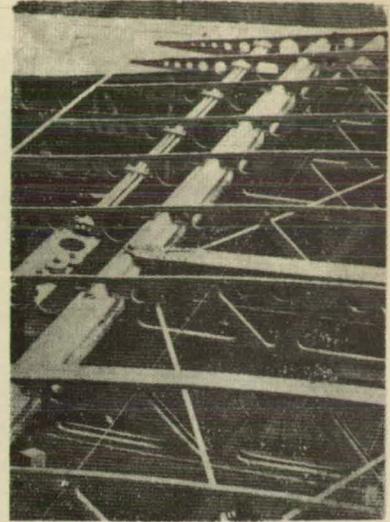
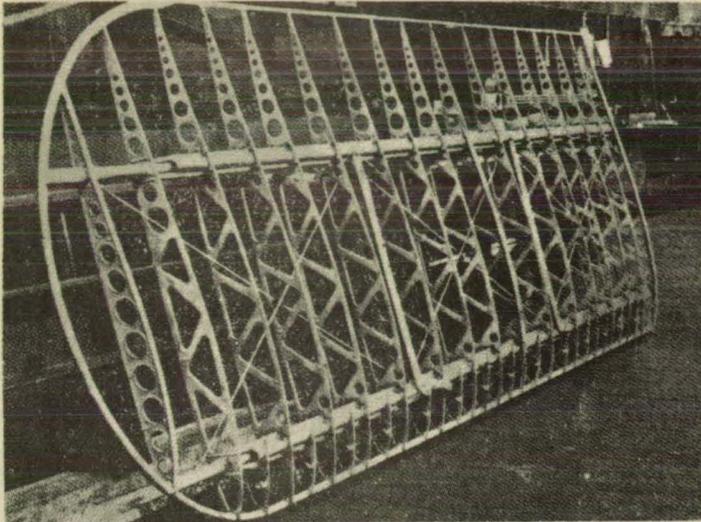


Fig.24 The castor-action tail-wheel without it's streamline casing.

Fig.20 The brake operating lever which gives both simultaneous or independent operation by fore-and aft or side-ways motion.





Figs.14,15 Wing details showing the strip steel spars and duralumin ribs of the Avro 627 airplane.



*Taken from "Flight"*

Fig.13 Attention has been paid to the reduction of drag in the use of a double form of a Townsend Ring and "spats" over the wheels.

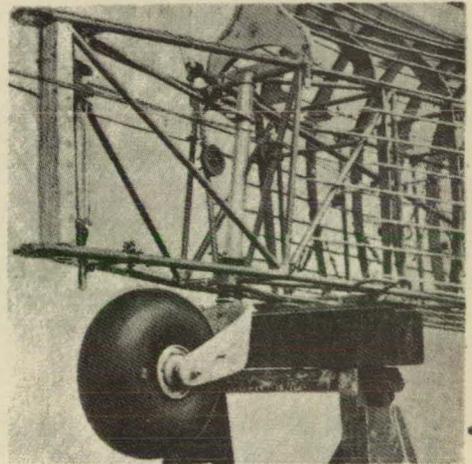


Fig.23 Tail wheel spring and stabilizer gear of the Avro 627.



Fig.18

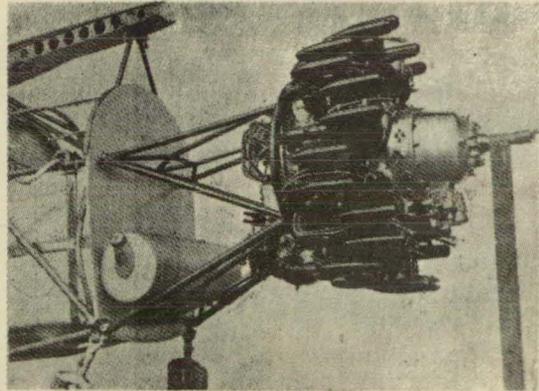


Fig.25

Landing gear and engine mounting of simplicity and efficiency in Avro 627.