AIRCRAFT CIRCULARS

NATIONAL ADVISORY COMMITTEE FOR AERONAUTICS

No. 181

THE SHACKLETON-MURRAY SM-1 LIGHT AIRPLANE

A Two-Place High-Wing Monoplane

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THE SHACKLETON-MURRAY SM-1 LIGHT AIRPLANE*

A Two-Place High-Wing Monoplane

The light airplane SM-1, designed by the firm of W. S. Shackleton and Lee Murray, has now been flying for several weeks, first at Sherburn-in-Elmet, and more recently at Hanworth.

This airplane has been designed with the idea of what the ideal light airplane should be (figs. 1, 2, 3, and 4).

It is a high-wing monoplane with a 70 hp. Hirth engine which, tucked away in the wing above and behind the passenger, drives a pusher propeller. The primary reason for this is that the pilot sits in the nose, where he can see all around. A pusher propeller should also be more efficient and less noisy, as the propeller does not have to push the slipstream past the fuselage. And the engine fumes are not blown into the cockpits.

By using a parasol wing and a pusher propeller the fuselage comes close to the ground, and so stepping in and out is easy. This low position also makes for safety, because the airplane cannot nose over, even if it runs into a ditch. The low center of gravity makes the airplane stable on the ground, even in a high wind.

Because of the small clearance under the fuselage the swiveling tail wheel has been brought forward so that the fuselage shall not "bottom" on rough ground.

Besides giving unimpeded outlook, the designers intended the airplane to be easy to land, comfortable in the air, and safe in a forced landing. The combination of wheel brakes and tail wheel makes it easy to steer on the ground. In the air it is remarkably stable and controllable. It takes off readily and climbs well.

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*From The Aeroplane, May 17, 1933.

Cooling of the engine is assured by an extension of the back end of the cowling to the propeller, which thus draws a steady flow of air past the cylinders. Tests in the air with a thermocouple under the spark plugs of the middle cylinders have shown that the temperature at those points do not exceed 200° C. (392° F.).

Papier-maché is used for the wing tips, so that these sections can be readily replaced if damaged. Its use also saves the expense of special ribs, and the ends of the spars can be finished off square. All four spars are identical, as are all former ribs. The drag bracing wires are all the same length. The ailerons and trailing-edge boxes are interchangeable.

The airplane is not particularly fast but with the more powerful Pobjoy will probably put up the speed. It seems to be particularly suited for training schools and clubs, and it should be attractive to all those to whom unrestricted view, low landing speed, and ease of access and egress are more important than sheer speed.

SPECIFICATION

<u>Type</u>.- Two-seat light airplane.

<u>Wings</u>.- High-wing, rigidly braced, folding monoplane. Welded and pinned steel tube center section, incorporating engine mounting, carried above fuselage by streamline steel tube struts (figs. 4 and 5). Center section spars, round tubes, and fore-and-aft members, square tubes. Engine bearers, "8" section tubes, braced to rear spar by round tubes. Wing sections, wood with fabric covering, braced to bottom of the fuselage by streamline tube Vee struts, welded together at apexes. Incidence may be adjusted at tops of rear struts. Both spars and all girder-type former ribs identical. The standard rib weighs only 5 ounces, and has withstood a load of 450 pounds without failure. Shaped wing tips of moulded papier-maché attached to ends of spars. Between each former rib is a false rib extending to midway between spars to maintain contour of wing section.

Leading edge is covered with plywood (fig. 6). Whole trailing edge hinged - outer part to act as ailerons, inner part to act as flaps which fold up when wings fold. Interspar bracing by square steel tubes at wing-bracing points and at middle hinges of ailerons and flaps. Drag bracing by swaged rods, all of identical length, doubled from roots to bracing-strut attachments, and single to wing tips.

Differential interchangeable ailerons (fig. 8), each with three hinge points (fig. 9). Ailerons have D section leading edges which fit into concave rear faces of false spars.

Fuselage.- Spruce and plywood structure of rectangular section with decking forward built up to accommodate the tandem cockpits. Metal nose piece may be hinged to one side to give access to the controls and back of instrument board.

Tail unit.- Monoplane (fig. 10). One-piece stabilizer on top of lower fin built integral with fuselage. Small upper fin above stabilizer. Statically balanced rudder. Stabilizer braced to base of lower fin by inverted Vee struts, with the apexes of Vees attached to front spar. Stabilizer adjustment on rear spar.

Landing gear.- Divided. Each side unit a Dowty spring leg, anchored by top end to upper longeron of fuselage (fig. 7). Lower end hinged to lower longeron by steel tube axle and forwardly inclined radius rod. Dunlop low-pressure wheels and Bendix brakes. Dunlop solid rubber tail wheel which swivels through 360 degrees, mounted in third bulkhead from tail post. Tail wheel sprung by coil spring which beds up against top of fuselage and leaves tube free to rise and fall through fuselage (fig. 11). Rubber-in-compression rings take rebound of coil spring. Ash skid under nose of fuselage.

Power plant.- One 70 hp. Hirth H.M. 60 four-cylinder in-line inverted air-cooled engine on steel-tube mounting aft of center section driving pusher propeller. Main fuel tank between spars of center section, and oil tank above, streamlined aft over crankcase by metal cowling. Front of gasoline tank and underside of center section faired with plywood.

Accommodation.- Tandem open cockpits in front of wing, pilot's cockpit in nose, and passenger under leading edge (fig. 12). Low doors on the port side of the cockpits. Complete set of instruments in front cockpit (fig. 13). Parachute seats (fig. 14). Luggage locker behind aft cockpit.

Controls.- Dual. Control columns mounted on central torque tube within which runs interconnecting tube between columns (fig. 15). Cables through fuselage to lever and push rods through fin to elevator.

Cross lever at the end of torque tube connects by push rod with lever control on rear spar of center section. Thence continuous cable operates ailerons by short chains over differential sprockets, with short push rods connecting with levers on ailerons.

Rudder control is by hanging pedals (fig. 16). Cables from lower ends of pedals connect direct with small levers on rudder. An instrument board screw-tension device provides the necessary bias to the rudder control. Brakes are operated by toe pedals forming part of rudder-pedal assembly. Tail adjustment by screw jack and continuous cable. Hand grip on one cable is moved to give tail movement.

Dimensions:

Span	12.2 m	40 ft.
Width, folded	5.8 "	12 " 9 in.
Length, over-all	7.8 "	25 " 7 "
Length, folded	8.8 "	28 " 10 "
Wing area	19.5 m^2	210 sq.ft.

Weights:

Weight, empty	381 kg	840 lb.
Disposable load	277 "	610 "
Weight loaded (normal)	658 "	1,450 "

Weights (cont'd):

Wing loading	34.6 kg/m²	7.1 lb./sq.ft.
Power "	9.4 kg/hp	20.7 lb./hp.

Performance:

Maximum speed	145.6 km/h	90.5 mi./hr.
Cruising "	120.7 "	75 "
Landing "	56.3 "	35 "
Initial rate of climb	176.8 m/min	580 ft./min.
Service ceiling	4,270 m	14,000 ft.
Range at cruising speed ($3\frac{1}{2}$ hours)	400 km	250 miles
Take-off run	64 "	70 yards

Note.- The above performance figures were obtained with a propeller which was 50 r.p.m. down on the maximum r.p.m.

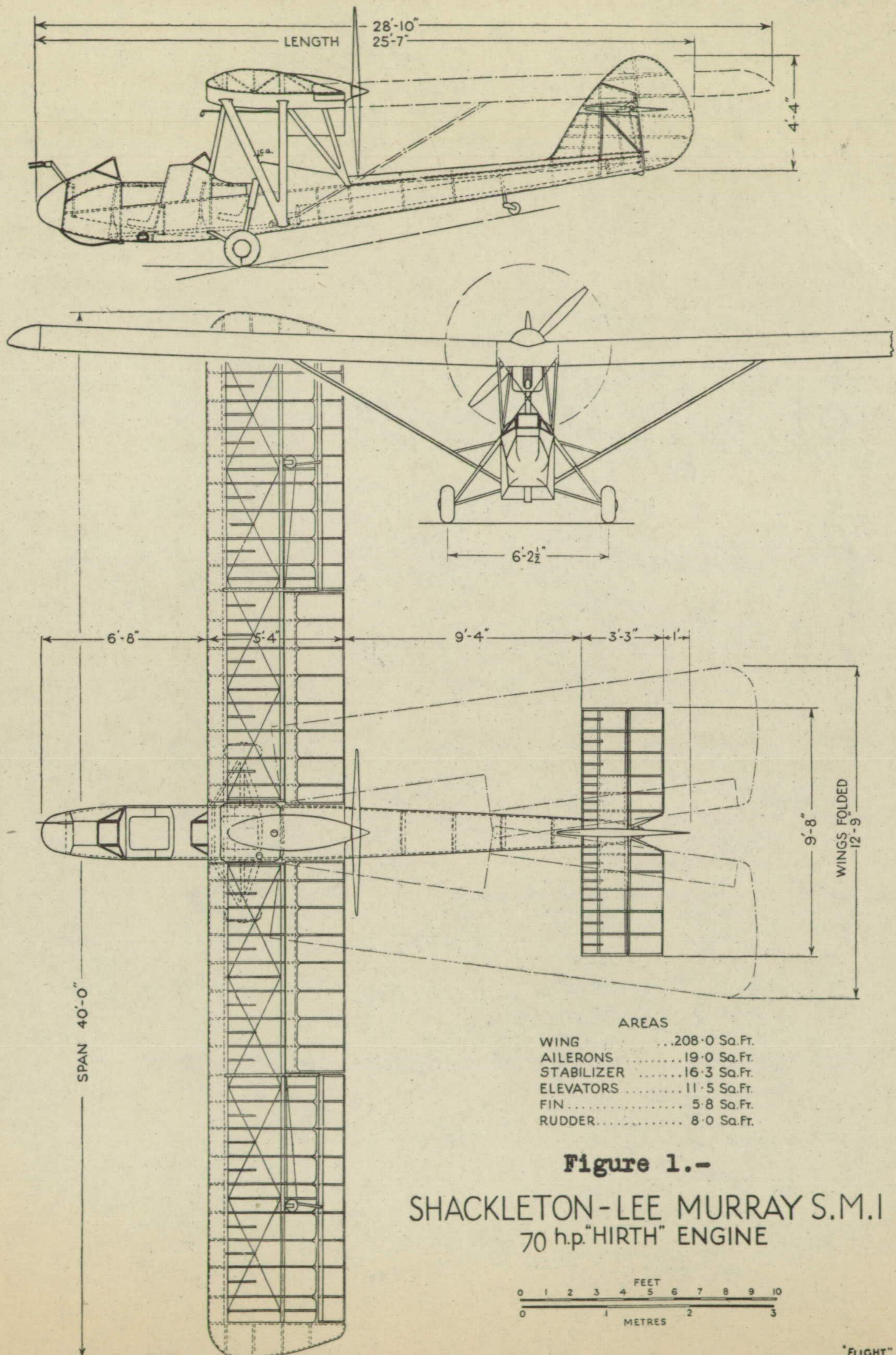


Figure 1.-

SHACKLETON-LEE MURRAY S.M.I
70 h.p. "HIRTH" ENGINE

Figures 2,3.-Three-quarter views of the S.M.1 airplane giving an idea of the excellent vision.

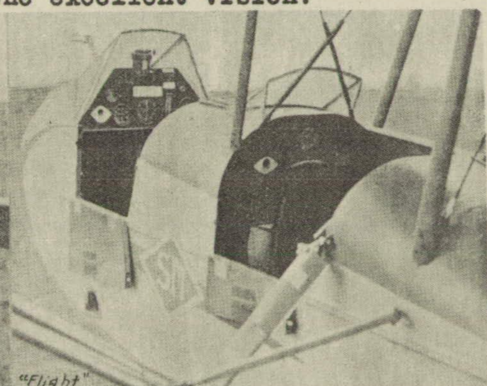
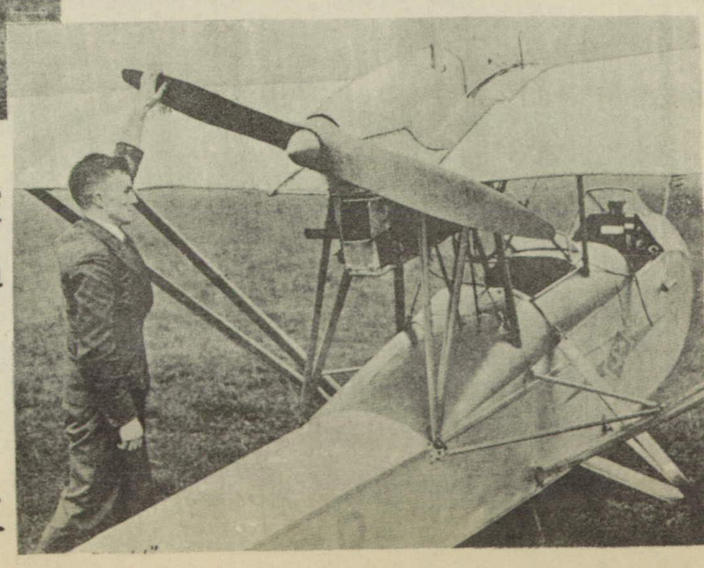


Figure 12.- Entering or leaving does not call for acrobatic ability in the S.M.1 airplane.

Figure 10.- The stabilizer of the S.M.1 is carried on two tripods, but one "leg" of each is a wire. The worm drive for trimming is housed in the fin.

Figure 4.- The propeller can be easily reached for swinging, and being behind the wing and doors there is little opportunity for passengers to walk into it. →



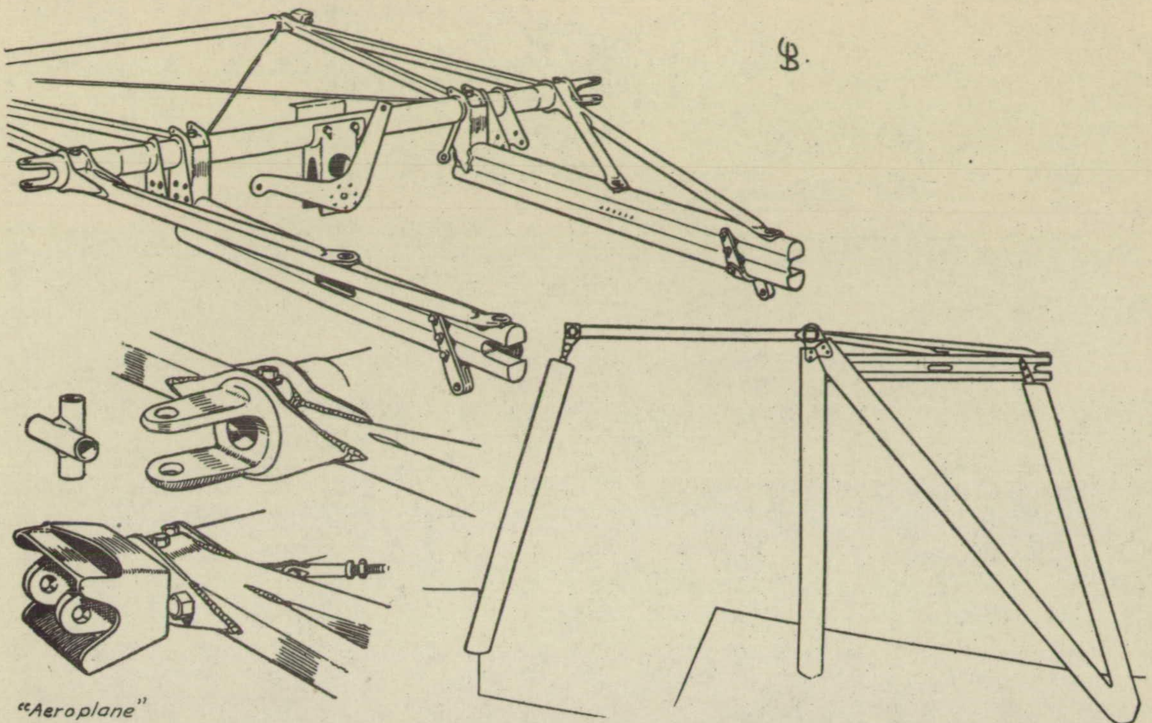


Figure 5.-At the top is the welded-steel tube center-section and engine bearer unit, which is carried above the fuselage on steel-tube struts, as shown diagrammatically below.The two small sketches on the left show the wing spar fittings on the center-section.

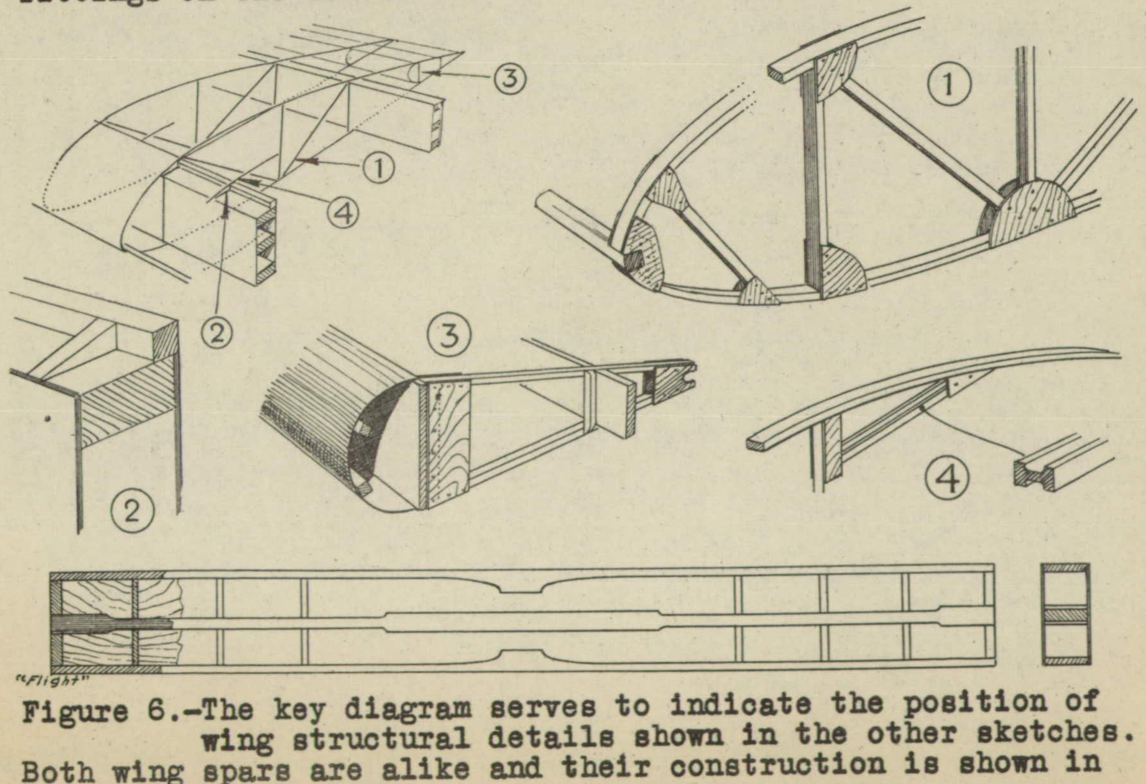


Figure 6.-The key diagram serves to indicate the position of wing structural details shown in the other sketches. Both wing spars are alike and their construction is shown in the lower sketch, which is not to scale.

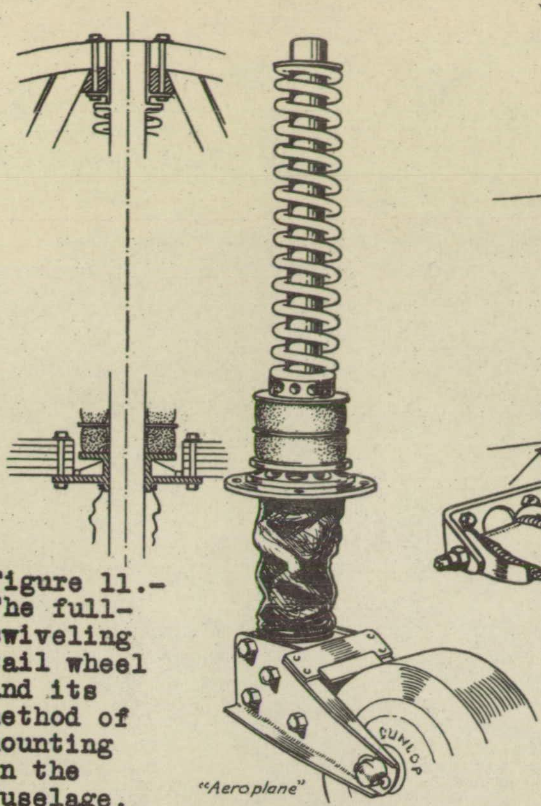


Figure 11.- The full-swiveling tail wheel and its method of mounting in the fuselage.

"Aeroplane"

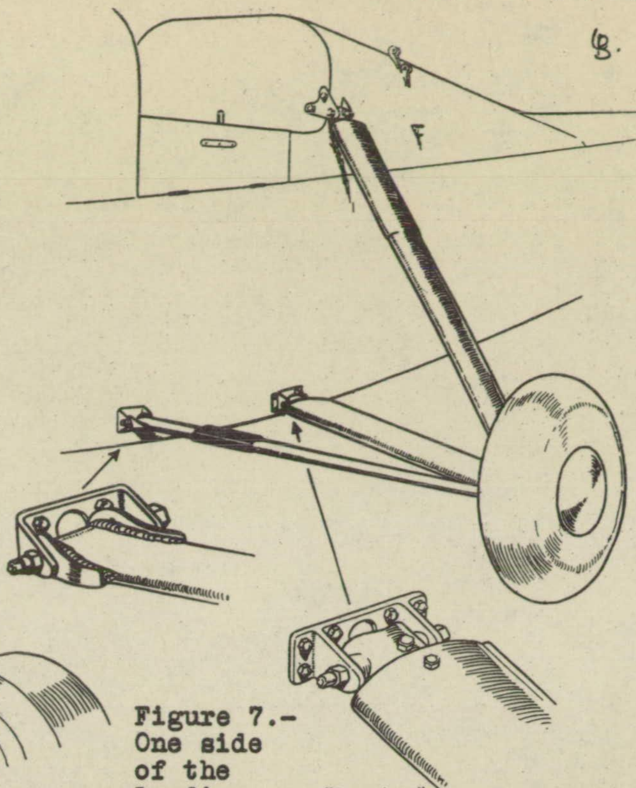


Figure 7.- One side of the landing gear.

"Aeroplane"

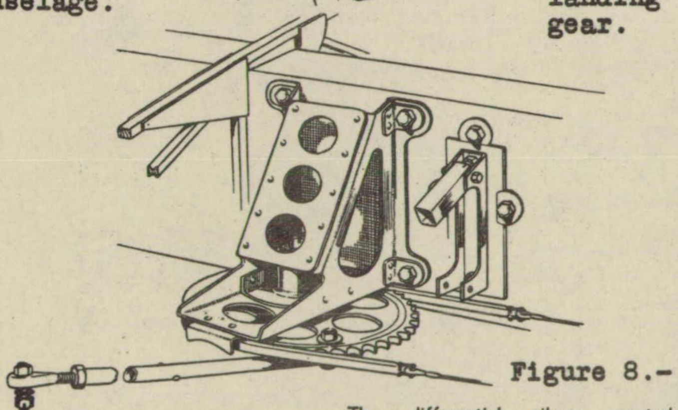


Figure 8.-

The differential aileron control bracket on the rear spar. The operating chain is shown conventionally.

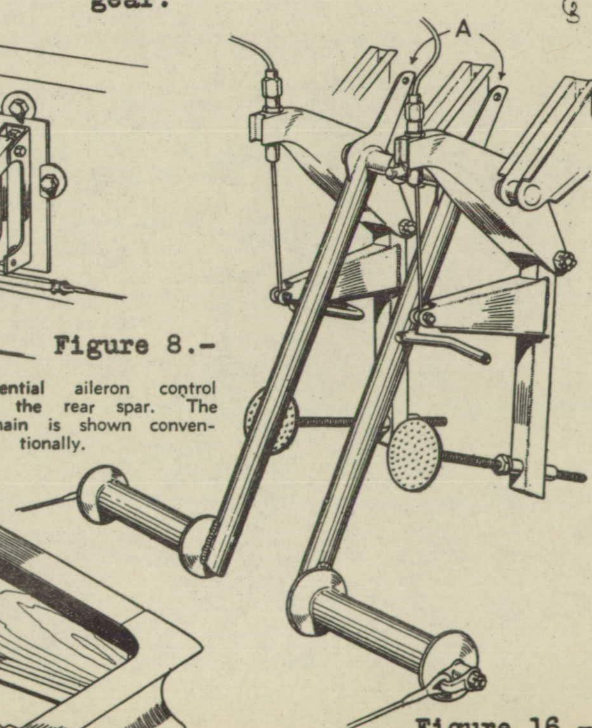


Figure 16.-

The rudder-pedals and brake levers in the front cockpit. The two eyelets (A) connect with two spring-loaded cables, one of which is anchored rigidly to the back of the dashboard and the other to a tension screw on the dashboard.

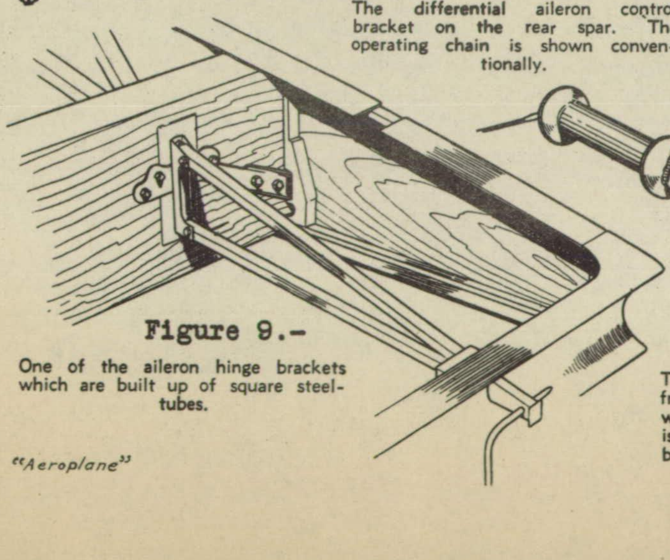


Figure 9.-

One of the aileron hinge brackets which are built up of square steel-tubes.

"Aeroplane"

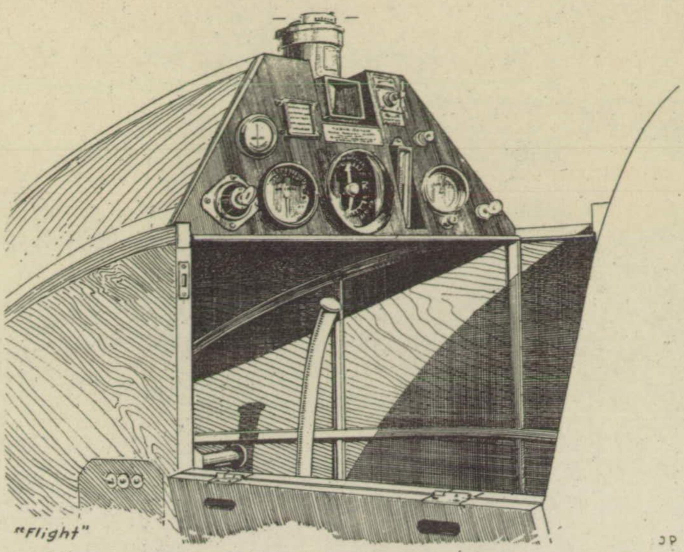


Figure 13.- The instrument board in the front cockpit of the S.M.1 airplane.

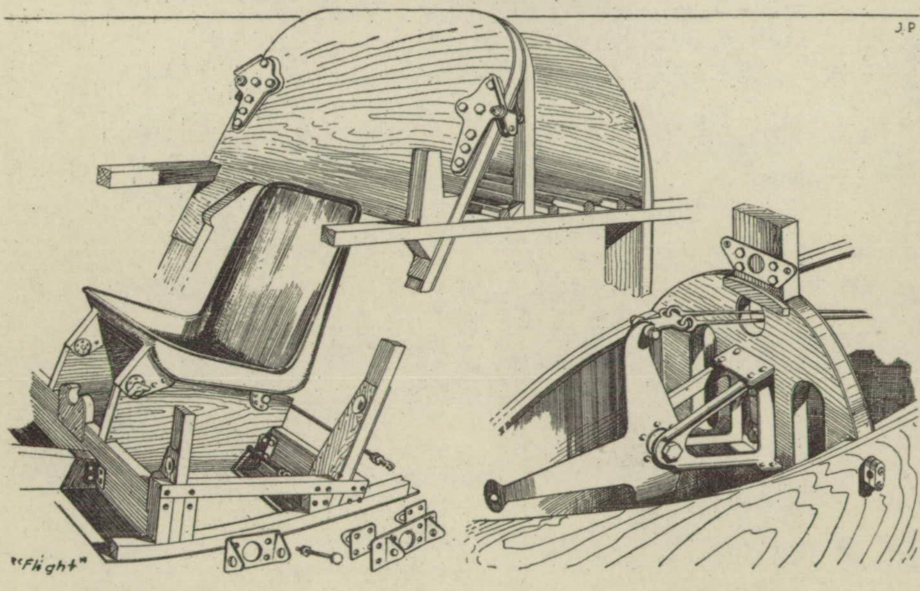


Figure 14.- The back seat is shown on the left, with sloping bulkhead and landing gear fittings. On the right is seen the elevator control in the stern, from which a vertical tube passes to the elevator crank.

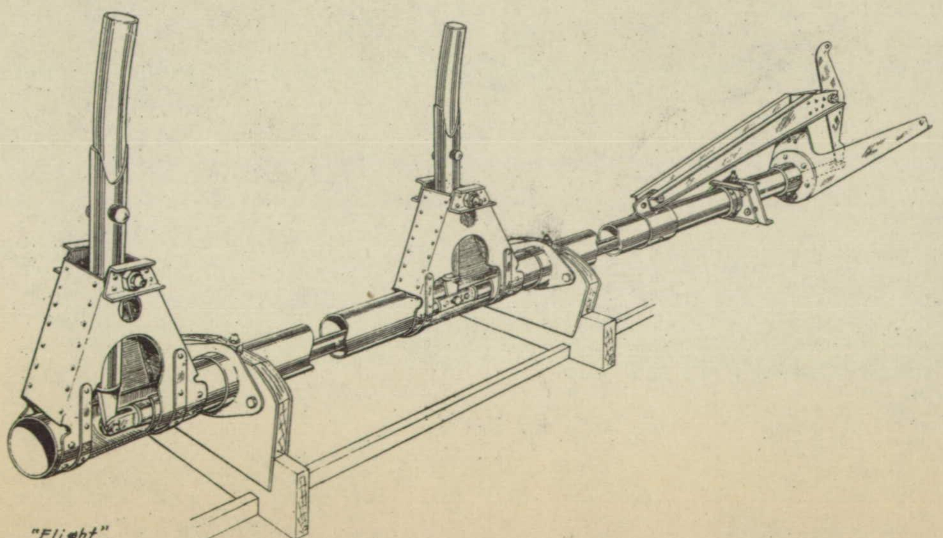


Figure 15.- The stick in either cockpit can be instantly removed and the airplane flown from the other.