AIRCRAFT CIRCULARS
NATIONAL ADVISORY COMMITTEE FOR AERONAUTICS

No. 112

THE "LATÉCOÈRE 28" COMMERCIAL AIRPLANE (FRENCH)

A Ten-Passenger High-Wing Monoplane

Washington
March, 1930

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THE "LATÉCOÈRE 28" COMMERCIAL AIRPLANE (FRENCH)

A Ten-Passenger High-Wing Monoplane.*

The "Latécoère 28" is a monoplane with a span of 19.25 m (63.15 ft.). The wing is rigidly attached to the fuselage by a set of oblique struts (Figs. 1, 2, and 3). It has a chord of 2.9 m (9.5 ft.), two ailerons and elliptical tips.

The two wing spars are rectangular light-metal tubes reinforced by riveted channel flanges and lightened by holes with crimped edges. The spars terminate in two slightly weaker tip sections designed to protect the main part of the structure by breaking in case of contact of the wing with the ground.

The wing profile is determined by the curvature of the ribs, which are triangularly braced spruce girders with birch plywood gussets. Reinforced box ribs insure the rigidity of the wing under the tension of the fabric, particularly at the points of attachment to the fuselage and at the ends of the ailerons. The end sections of the wing have a number of special ribs designed to maintain a correct profile of the elliptical tips.

The distance between the spars is maintained by tubular members of light metal. These distance members are braced by wires of high-resistance steel. The whole forms a triangulated

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*From a pamphlet issued by the Société Industrielle d'Aviation Latécoère.

girder for resisting the recoil of the wing.

The wing is covered with linen fabric. This fabric, covered with three coats of a dope recommended by the S.F.Aé., is attached to the ribs by thrumming, the knots of the thrumming being covered by glued strips of fabric.

The framework of the two ailerons is all metal. It consists of a round light-metal tube forming the main aileron spar. The ribs are riveted to this spar and braced by a secondary spar. Each aileron carries a light-metal horn. The aileron hinges have ball bearings.

The wing is attached to the fuselage by two bolts for each spar.

The tail consists of a vertical empennage and a horizontal empennage. The vertical empennage comprises a fin and a rudder balanced by an "aileronnet." The triangular fin has three tubular longerons of light metal supporting stamped light-metal ribs. The whole is covered with linen and doped according to regulations. The angle of the plane of the fin to the fuselage is fixed in mounting. It is supported at each end by a cross piece attached to the upper longerons of the fuselage. It is braced by four wires from the horizontal stabilizer. The semicircular rudder has a main tubular spar with an opening for the passage of the front elevator spar. This spar receives the riveted stamped sheet-metal ribs, which are themselves braced by a tubular secondary spar. The whole is of light metal and is covered with doped linen. A light-metal horn is riveted to the rudder spar. The rudder is attached to the rear spar of the fin by light-metal hinges. It is balanced at the rear by an "aileronnet" of autogenously welded steel tubing covered with fabric.

The horizontal empennage consists of a horizontal stabilizer and an elevator balanced by an "aileronnet." Its construction is similar to that of the vertical empennage. The whole structure is made of light-metal tubular members and stamped ribs. The covering is linen with the usual doping. The stabilizer is triangular. It receives the brace wires of the fin and is itself braced by wires to the rear girder of the fuselage. The elevator has two trapezoidal parts joined at their leading edge by the hinge spar. The "aileronnets" are constructed entirely of light metal.

The fuselage has a perfect streamlined shape. It comprises three sections: the bow, containing the power plant; the central section, containing the pilot, passenger and baggage rooms; the rear section, a simple girder supporting the tail. The structure of these three sections is different, the only common members being the longerons. These are light-metal tubes running the whole length of the fuselage and enabling it to withstand longitudinal bending stresses.

The framework of the bow constitutes the engine bed. This is a double tubular triangulated framework supporting a composite-girder cradle. The oblique plane formed by the two lower members of the support is braced by wires of high-resistance steel. The front part of the cradle receives the longerons which support the engine. The latter is also supported by the transverse frame of the fuselage which holds the girders. The propeller thrust is transmitted by two struts. To this framework are attached all the engine accessories: fire extinguisher, fuel and oil cocks, oil tank, oil filters, water radiator, pipes, controls, etc. The whole is covered with a removable aluminum hood.

The central section of the fuselage is an all-metal framework consisting of light-metal members attached to tubular longerons and supporting the light-metal covering. The pilot room is behind the engine. Underneath the former there is a baggage room. Next come the two main bulkheads, to which the wings and landing gear are attached. The fuel tank is between these bulkheads. Aft of these bulkheads is the passenger cabin, which is entirely free from all obstructions. Next comes the toilet room and lastly the baggage room. The doors and windows are reinforced by light-metal frames.

The rear section of the fuselage comprises four girders, two of them horizontal and two vertical. The flanges of these girders are the fuselage longerons. The uprights and cross pieces are light-metal tubes. Piano wires are used for bracing. This section carries the tail skid and tail surfaces. It is enclosed by a light wood cowling, which gives it a perfect streamlined shape. The whole is covered with fabric and doped like the wing.

The landing gear has two independent wheels mounted on axles jointed to the fuselage and supported by elastic struts. The recoil is absorbed by a strut in the plane of the axle. The axle is a tube of uniform strength, bent to give the spindle the proper direction for the normal repose of the airplane. The steel used is a particularly strong carbon steel, hardened and tempered after machining. The recoil is absorbed by a light-metal strut supported at one end by the bend of the axle and hinged at the other end to the fuselage. This strut absorbs the energy developed by the landing shocks. The elastic strut contains an interchangeable shock absorber with metal springs or compressed air. In either case the recoil of the shock absorber is damped, in order to prevent the airplane from bouncing.

The contact with the ground is damped by an elastic tail skid. It consists of a triangle hinged in front and held at the rear by sandows. Its lower edge carries an orientable shoe.

The system of controls comprises a rudder bar, a wheel for the ailerons and a control stick for the elevator. The rudder bar is a duralumin tube mounted on ball bearings and provided with toe clips.

The ailerons are actuated by a steering wheel. This imparts its motion to a drum on which a cable is wound. This cable transmits the force to two sectors on the upper part of the frame for attaching the wing. To these sectors are attached the tubular members which impart the motion to the aileron horns through bell cranks and universal joints. The hinges are ball bearing.

The wheel for operating the ailerons is attached to the top of the control stick. The latter is secured to the horizontal rod which actuates the sectors to which the elevator-control cables are attached, the opposite ends of these cables being attached directly to the elevator horns. All the joints have ball bearings.

In order to make it easier for the pilot, the aerodynamic thrusts are offset by hinged "aileronnets" at the trailing edge of the elevator and rudder. The angle of these "aileronnets" can be varied from the pilot room during flight by means of two wheels with handles situated between the pilots. When an "aileronnet" moves, an indicator shows the angle of incidence with respect to the elevator.

The fuel tank has a capacity of 735 liters (194 gallons). It is made of light-metal sheets stamped and riveted together. It can be dumped during flight by means of a special device controlled by a bowden cable. The oil tank has a capacity of 45 liters (11.9 gal.). It is placed under the engine with its bottom exposed to the air to form a radiator. It is also made of light metal.

The radiator is of the honeycomb type and is placed under the fuselage. It can also be dropped during flight at the will of the pilot. It is connected with the engine by flexible tubes.

The engine is a Hispano-Suiza 12 H b r with 12 cylinders arranged in V. Its nominal power is 480 hp at 2000 r.p.m. The propeller speed is reduced by a Farman 2 : 1 reduction gear. It is started by means of a Viet starter operated from the pilot room.

The pilot room is located behind the engine forward of the leading edge of the wing. It is well lighted through the windshield, and its ventilation is provided for by two sliding overhead doors. These doors can also be used for escape in case of danger. Access is afforded through two side doors. There are two pilot seats. The seat for the chief pilot is on the left, with the instrument board in front of it, including the electric light switches. The seat on the right is equipped for radio sending and receiving. A window behind this seat enables the crew to communicate with the passengers.

The cabin is lighted by ten windows which can be opened. It is entered from the rear. The walls are covered with washable fabric and the floor is carpeted. It has three ceiling lights for night flying. The equipment consists of eight chairs with pockets and ten baggage nets (Fig. 4) on the side walls above the heads of the passengers. The clock, altimeter and airspeed indicator are in full view of the passengers (Fig. 5).

The toilet room is at the entrance to the airplane, being converted into a vestibule on the ground.

There are two baggage rooms: one under the pilot room and one aft of the toilet room. This arrangement enables the trimming of the airplane for different loads. There are rings on the inside framework for securing the baggage.

Characteristics

Span	19.250	m	63.16	ft.
Length	13.645	"	44.77	"
Chord	2.9	"	9.51	"
Height	3.580	"	11.75	"
Wing area	48.60	m²	523.13	sq.ft.
Elevator area	3.60	"	38.75	"
Rudder "	1.65	"	17.76	"
Tractor propeller at fixed point	1620	r.p.m.		
Weight of airplane empty	2120	kg	4673.8	lb.
Total load carried	1920	"	4232.9	"
Capacity of fuel tank	735	liters	194	gal.
Capacity of oil tank	45	"	11.9	"
Track gauge	3.36	m	11.02	ft.
Tire dimensions	1000 × 225	mm	39.37 × 8.86	in.

Performances

With a full load of 4040 kg (8907 lb.)

Climb to	1000 m	(3281 ft.)	3 min.	45 sec.
" "	2000 "	(6562 ")	11 "	16 "
" "	3000 "	(9842 ")	18 "	12 "
" "	4000 "	(13123 ")	30 "	12 "
" "	5000 "	(16404 ")	48 "	52 "

Maximum horizontal speed:

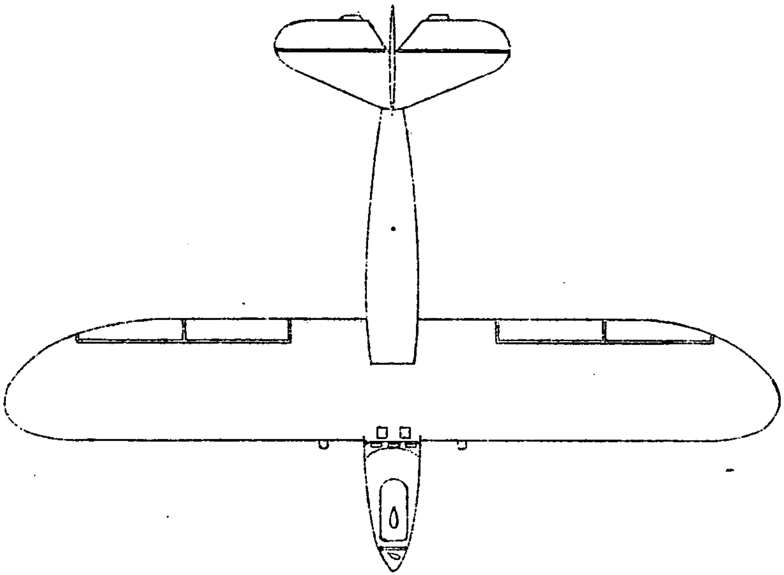
near ground	240 km/h	149.1 mi./hr.
at 1000 m	237 "	147.3 "
2000 "	232 "	144.2 "
3000 "	225 "	139.8 "
4000 "	215 "	133.6 "
5000 "	195 "	121.2 "

Static test showed a safety factor 5.6 at breaking point.

Empty wt. with water	2120 kg	4673.8 lb.
Cabin furnishings	170 "	374.8 "
Radio equipment	96 "	211.6 "
	2386 "	5260.2 "

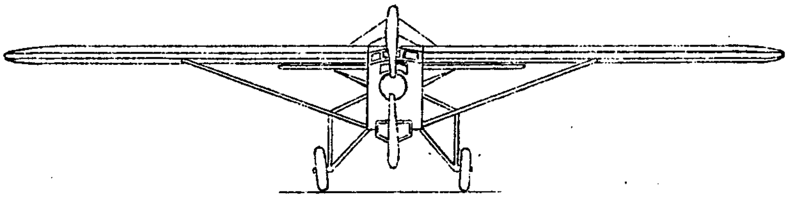
Weight of fuel	573	kg	1263.2	lb.
" " oil	57	"	125.7	"
" " crew (2)	176	"	388.0	"
Passengers and freight	848	"	1869.5	"
Useful load	1654	"	3646.4	"
Full load	4040	"	8906.6	"

Translation by Dwight M. Miner,
National Advisory Committee
for Aeronautics.



Span 19.25 m (63.16 ft.) Height 3.58 m (11.75 ft.)

Length 13.645 m (44.77 ft.) Wing area 48.60 m^2 (523.13 sq.ft.)



Hispano-Suiza 12 Hbr. 12 cyl.

480 hp. engine.

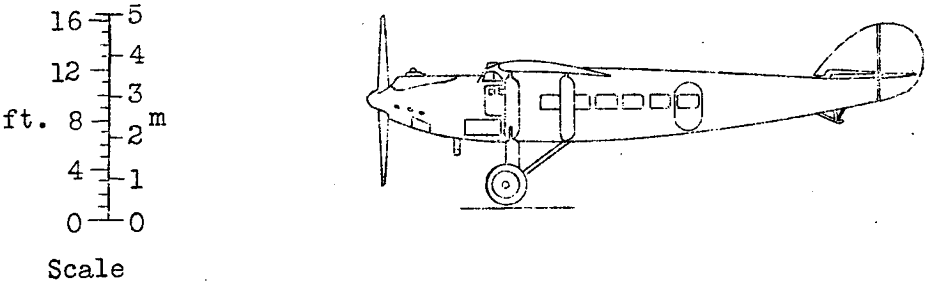


Fig.1 General arrangement drawings of the "Latécoère 28" commercial airplane.

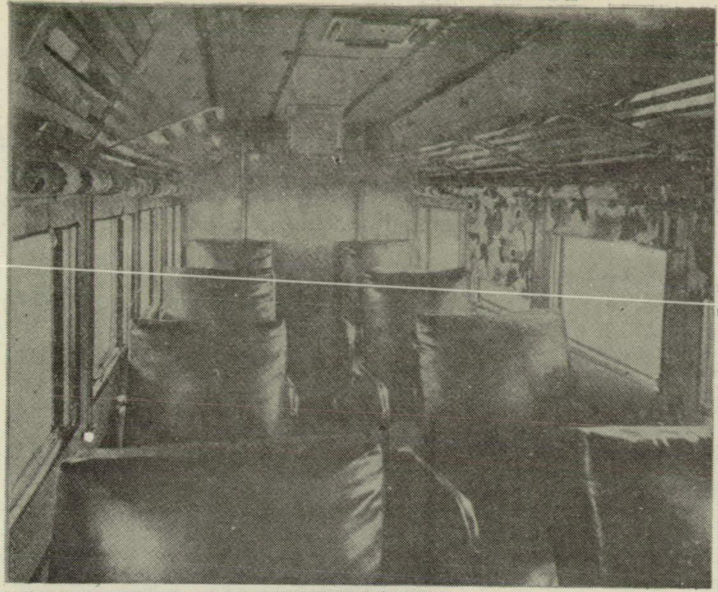


Fig.4

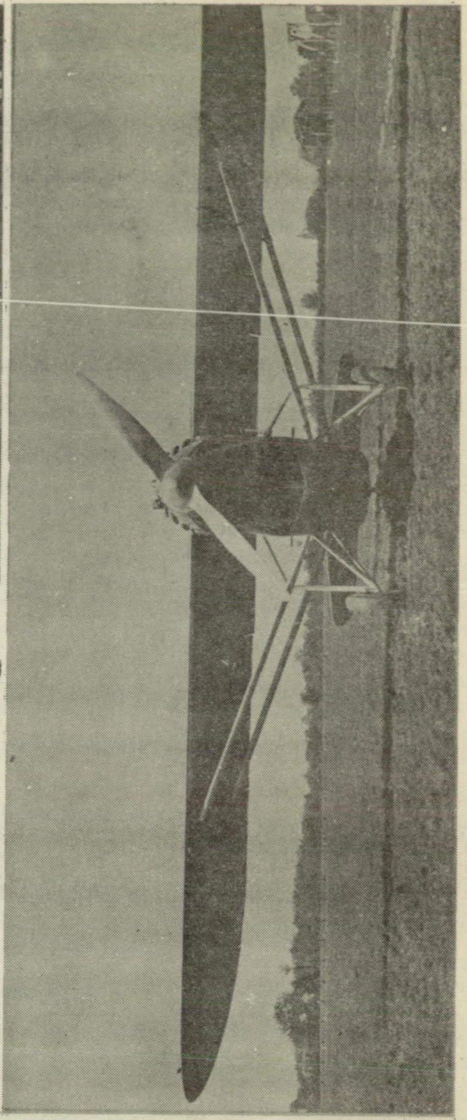


Fig.3

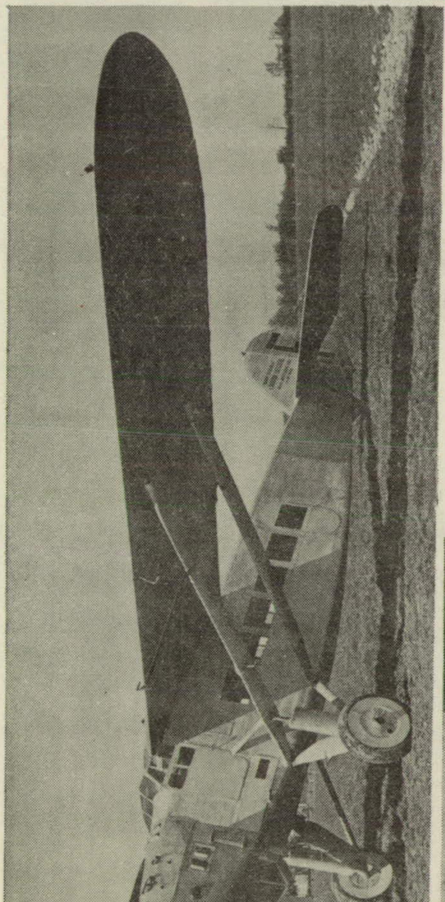


Fig.2

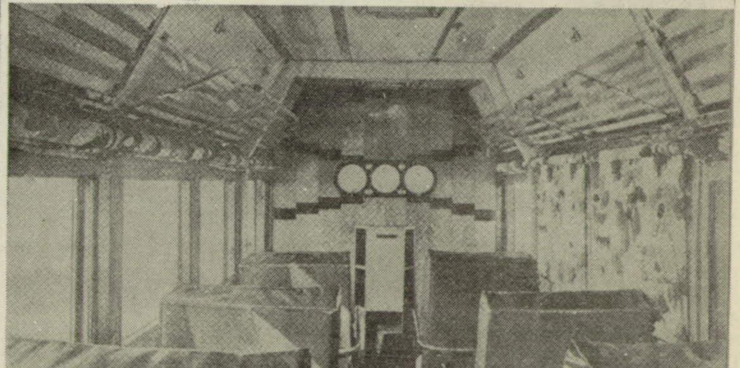


Fig.5

Views of the "Latecoere 28 " commercial airplane.

AIRCRAFT CIRCULARS

NATIONAL ADVISORY COMMITTEE FOR AERONAUTICS

No. 71

THE BOULTON AND PAUL "SIDESTRAND I" BOMBER AIRPLANE (BRITISH)

Washington
April, 1928

NATIONAL ADVISORY COMMITTEE FOR AERONAUTICS.

AIRCRAFT CIRCULAR NO. 71.

THE BOULTON AND PAUL "SIDESTRAND I" BOMBER AIRPLANE (BRITISH).*

Two Bristol "Jupiter VI" Engines.

In attempting to convey an adequate idea of the new Boulton and Paul twin-engined bomber which has recently gone into production for the Royal Air Force squadrons, two ways are open: One might concentrate on the merits of the airplane (and they are many) for the particular purpose for which it was designed, or one may approach the subject along more general lines, examining the airplane as an aircraft pure and simple, with but minor regard to its particular function as a military weapon. In the former case one would merely be describing an airplane which is a very excellent bomber, while by taking the alternative approach the merits of it as a piece of aeronautical engineering can be examined. On the whole, we believe that the majority of our readers are likely to be more interested in the general aerodynamic and structural features, and as there are certain restrictions which prevent a full discussion of the military equipment, the following notes will be devoted to the general design of the "Sidestrand," bearing in mind that the airplane has been designed as a three-seat day bomber, and that therefore certain specified loads had to be carried, loads consisting partly of equipment, partly of machine gun armament, and partly of bombs. What percentage of each is involved we are not in a

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*From "Flight," March 29, 1928.

position to state.

Aerodynamic Design

The readers who have followed his interesting series of articles on "Aircraft Performance" in "Flight's" monthly technical supplement "The Aircraft Engineer," will have obtained a fairly good idea of the general design policy of Mr. J. D. North, Boulton & Paul's Chief Engineer and Designer, and in examining the "Sidestrand" one looks for such features as Mr. North has advocated in his articles. Among these perhaps none was more prominent than the reduction of induced drag by having a high value of the ratio of $\frac{\text{span}^2}{\text{weight}}$, and a glance at the general arrangement drawings and some of the photographs (Figs. 1, 2, 3 and 4) will show that the "Sidestrand" has a very large span for its area or, as we used to say before modern airfoil theory became the fashion, high "aspect ratio." While Mr. North drew attention to the importance of large span, he also pointed out that for large airplanes it is difficult to obtain a high value of the $\frac{\text{span}^2}{\text{weight}}$ ratio because of the increased wing weight which quickly puts a limit to the span which it is economic to employ. In the "Sidestrand," therefore, one may take it that an endeavor has been made to get the best compromise between wing structure weight and aerodynamic efficiency, and it will be of interest to examine briefly how far the wing arrangement of the "Sidestrand" may be expected to have reduced that part of the wing drag which is due, as Mr. C. C. Walker put it, to "carrying a certain weight on a certain span at a certain speed."

The total loaded weight of the "Sidestrand" is 8850 lb. and the span is 72 ft. The value of $\frac{\text{span}^2}{W}$ is therefore 0.518 and the monoplane value of the ratio of lift to induced drag is, at 70 M.P.H., for instance, 20.31. As the gap/span ratio of the "Sidestrand" is about 0.14, this value is increased to 25.9 for the biplane arrangement used. Thus at 70 M.P.H. the induced drag is only 342 lb., which is remarkably low and corresponds to a thrust horsepower of 64 B.HP. only for overcoming induced drag at that speed. Since at this low speed (corresponding probably fairly well with the climbing speed of the airplane) the induced drag is a large percentage of the total wing drag, it is seen that the "high aspect ratio" wing arrangement does appear to have proved extrenely beneficent. The $\frac{\text{span}^2}{\text{weight}}$ value of 0.518 is quite high for an airplane of this weight, and in a number of airplanes this ratio only reaches a value of 0.3 or so. We believe that actually in the "Sidestrand" the extra wing weight which was the "price paid" for the higher value of $\frac{\text{span}^2}{W}$ amounted to some 200 lb., but at that it paid to carry the extra weight.

While on the subject of wing design, a few words concerning the method used by Mr. North and his staff in the choice of wing section may be of interest. The method was outlined by Mr. North in his series of articles to which reference has already been made, and consists in starting off with a consideration of the operational conditions to be met, and then, taking as a basis a good streamline shape, curving its center line to give the required aerodynamic characteristics, the original streamline section being chosen of such a thickness that it will accommodate spars of sufficient depth. Thus, in any Boulton and Paul airplanes, one is not likely to find any stereotyped wing section, although some of those in use may, more or less accidentally, have a fairly close resemblance to certain "accepted" sections. Incidentally, the original streamline shape taken as the basis is generated by the generalized Joukowsky theory.

The wing cellule having been carefully designed to meet the particular operational conditions of the type in question, great care is again taken in the design of fuselage and engine nacelles. In the case of the "Sidestrand," for instance, a start was made with a body of very good streamline shape, generated as in the case of the wing sections, a model of which was tested in the wind tunnel. The cockpits were then added one by one, the drag being measured after each such addition. If a certain cockpit shape or arrangement was found to add unduly to the drag, modifications were made until the figure had been reduced to what appeared to be the lowest practicable value. Take, for example, the prone gun position under the fuselage. Obviously this might easily increase the body drag to a very high figure, but by persistent experimentation the drag caused by this gun emplacement was ultimately reduced to a very low value, indeed.

The engine nacelles were the subject of similar research and the form finally chosen, which is well shown in several of our photographs, has given about as low a drag as it is possible to attain with engines placed outboard. The research included wind tunnel tests with model propellers running, and at large angles, it having been found that the "interference drag" is largely an induced drag and liable to be greater at large angles, thus affecting performance on climb, etc.

The landing gear design (Figs. 7 and 8), although perhaps more of a structural than an aerodynamic problem, also shows this striving for aerodynamic "cleanness," the landing gear of the "Sidestrand" being of remarkably low frontal area for an airplane of this size.

Altogether the Boulton and Paul "Sidestrand" is an airplane which well repays a close study, the results of the very great care taken in its aerodynamic design being reflected in the performance figures which will be found at the end of this report.

Structural Design

If the aerodynamic design of the "Sidestrand" is of more than usual interest, the same applies at least as much to the structural features. Although in what follows the reference is particularly to the "Sidestrand," most of the constructional details are now standard Boulton and Paul practice, and would apply fairly closely to any airplane built by that firm, since a process of standardization without cramping the freest possible development has been evolved by the firm during the last few years.

It will be known to most of our readers that Boulton and Paul were among the very first aircraft firms in England to take up all-metal, and more particularly all-steel, construction of aircraft, and a visit to the works at Norwich, very soon reveals the fact that a very high degree of perfection has been attained, not only in the design of metal members but also, and which is, perhaps, even more important because it is a good deal more difficult, in rapid and relatively cheap manufacturing processes. Concerning the latter, but little can be said in the present article, in which we must confine ourselves to the finished results rather than go into details concerning the manner in which these results were obtained.

Earlier forms of Boulton and Paul metal fuselage construction have been described and illustrated in "Flight" from time to time, but with the present form something like finality has been attained, since certain sizes have been standardized. The basis of the new form of fuselage construction is the locked-joint circular tube, which is a relatively recent product of the firm. This type of tube is made from strip, by a special process of rolling and drawing, and the accuracy obtained is really remarkable. Not only does the tube leave the draw bench "as straight as a die," but the locked-joint seam itself is perfectly uniform and straight, i.e., there is no twist in the tube. This is important because of the attachment of the fittings, for which it is desirable to know exactly where the seam is going to come, and that it will be in the same place at all fittings.

Having evolved an eminently satisfactory type of tube for longerons and struts, standardized in a certain number of sizes, the next step was to design a neat type of fitting for the attachment of struts to longerons. How the problem was ultimately solved is indicated in Figure 5. A tubular "pad" of magnesium alloy, fitting snugly over the tubular longeron, and with flat faces machined on the outside, gave the solution. Bolts pass through "pad" and longeron vertically and horizontally (being, of course, slightly staggered in relation to each other), the strut ends being attached to the bolt heads and the bracing wires to sheet steel links or wiring plates in the manner shown. The bolts themselves are of duralumin, and bushes are interposed between them and the walls of the longerons to increase the bearing area. The arrangement will be clear from Figure 5. By the employment of magnesium alloy "pads" and duralumin bolts, the weight of the fuselage fittings is kept down to a very low figure, while certainly the locked-joint tubes, of high-grade steel, are lighter than any drawn tube could be. The result is a structurally very economical construction. We regret that we have no figures relating to the bare structure weight of the "sidestrand" but knowing the amount of equipment carried, and the difference between tare weight and gross weight, it is fairly obvious that the aircraft structure must be a very low percentage.

If the fuselage structure is unusually interesting, the wing structure is no less so, although showing perhaps, a less noticeable departure from Boulton and Paul's previous forms of wing structure. We believe we are correct in stating that this firm was among the pioneers of rolled steel strip wing spar construction, at least in its efficient modern form using high-tensile steels. And it is certainly the first British firm to standardize a scheme of construction by which all conceivable manner and sizes of wings may be built from standardized parts.

Of the Boulton & Paul method of manufacturing steel spars, nothing need be said here. Suffice it to point out that manufacturing processes have been evolved which allow of both rapid and cheap production. What is of interest is the system of standardizing certain spar flanges, webs and fittings in a manner which gives a sufficient number of combinations to meet well-nigh every possible demand without having to go to the expense of making special rollers and dies. A few of the standardized combinations of webs and flanges are shown diagrammatically in Figure 6. It will be seen that, with three standard webs, and six standard flanges, 18 different spars are produced, giving quite a wide range. Add to this the fact that further variety may be added by a change of material, even to a change from steel to duralumin, and it will be obvious that the range immediately available is very wide.

Incidentally, the accuracy of production is within 0.01 in., thus ensuring complete interchangeability, which is even more important from the point of view of mass production than repairs. It might here be mentioned that all Boulton & Paul strip is formed in the soft state, and hardened and tempered after forming.

The rib design is very simple, and consists of channel flanges and tubular distance pieces forming the girder webs. This applies to the normal rib. At points where heavier stresses have to be withstood, modified forms are used, also of channel section, but with larger channels, and with channel section distance pieces. Several types are shown in Figure 6.

The attachment to the spars of internal drag struts and interplane struts is effected via bridge pieces in such a manner as to impose no crushing stresses on the thin-walled spars, the loads being taken either on the bridge pieces or on bolts passing through the distance tubes in the spars.

Without being a very detailed description of the construction of "Sidestrand," the above notes should give a general idea of the types of structure employed. In the absence of an explanation of the internal arrangement of the fuselage, which would necessitate a reference to equipment of a military nature, about which nothing may be said, we must confine ourselves to stating that the load of bombs forming the raison d'etre of the airplane is carried inside the fuselage instead of outside. In this way a great deal of air resistance must be saved, and doubtless this fact has contributed materially towards the good performance attained.

The Bristol "Jupiter VI" engines are mounted on the lower wing, the supporting structure being rather neatly triangulated in a manner to avoid torque reaction stresses being transmitted to the wing spars in the form of bending moments (Fig. 5). The engines are hung on swivelling mounts which greatly facilitate inspection. The gasoline tanks are situated in the fuselage, and number three in all, a front main, a rear main, and a service tank. The full tankage is 260 gallons, of which 35 gallons represent an overload to be used for long flights or some such special occasion, the normal capacity being 225 gallons, of which 65 gallons in the service tank, 90 gallons in the front main tank, and 70 gallons in the aft main tank.

The landing gear of the "Sidestrand" is of simple two-wheeled type, with oleo-pneumatic telescopic "legs" of somewhat unusual design. A long stroke is one of the features of this "leg," and it is quite remarkable to see the "Sidestrand" taxying at high speed across rough ground, the airplane itself remaining steady, while the "legs" are telescoping in and out, the wheels moving up and down with the uneven surface. In place of a sectional drawing of the actual "leg," which would have to be of a highly technical nature, we publish a diagrammatic representation which will serve to illustrate the general principle upon which the "leg" is designed (Fig. 8).

The lower portion of the "leg" is filled with air (pumped in at an initial pressure of 125 lb./sq.in.), and the upper part with oil, a floating diaphragm separating the air from the oil. A piston is attached to, and moves up and down with, the lower part of the leg. This piston has in its head a valve seat and a spring-loaded hollow-stem valve. This hollow or cylindrical stem is provided with ports, so that when the valve opens, the oil can pass through from one side of the piston to the other. In the valve head is a small leak hole. This, of course, permits oil to pass through under all conditions.

When the "leg" is subjected to a load, the air is compressed by the upward movement of the lower half. If the movement is a relatively gentle one, oil merely leaks through the small leak hole in the valve head. When a certain speed of travel is reached, however, the valve opens against the action of its spring, and the oil is then permitted to flow through the ports in the valve stem, from the space above the piston to the space below it. The size of leak hole and ports has been carefully proportioned so as to give, in conjunction with the compressed air and the pneumatic tire, a deflection diagram of the right shape. In taxying, the damping of the oil is such as to prevent any tendency to bouncing, and the airplane travels along on an even keel, although on rough ground the wheels may be seen to be moving up and down rapidly, following the irregularities of the ground. The small air vent pipe shown may possibly pass a small amount of oil during the travel of the "leg," but its chief function is to avoid the formation of an air lock while the "leg" is being filled with oil. The jack shown in the diagrams and in Figure 7 can be used for extending the "leg," or for tire changing, etc., as well as for relieving the "legs" of load when the airplane is standing in a shed for long periods.

Specifications

Length	40 ft. 8 in.
Span	72 " 0 "
Areas:	
Total wing areas	943.5 sq.ft.
Ailerons	142.0 "
Stabilizer	68.6 "
Elevators	50.7 "
Fins	11.0 "
Rudder	31.8 "

The main dimensions of the "Sidestrand I" are shown in Figure 1. The weight of the airplane light, is 5275 lb. (2400 kg), and the load carried is 3575 lb. (1625 kg), giving a total loaded weight of 8850 lb. (4025 kg).

Wing loading $\frac{8850}{944}$ = 9.37 lb./sq.ft. (45.9 kg/m^2)

Power " (on normal power of 450 B.HP. per engine)

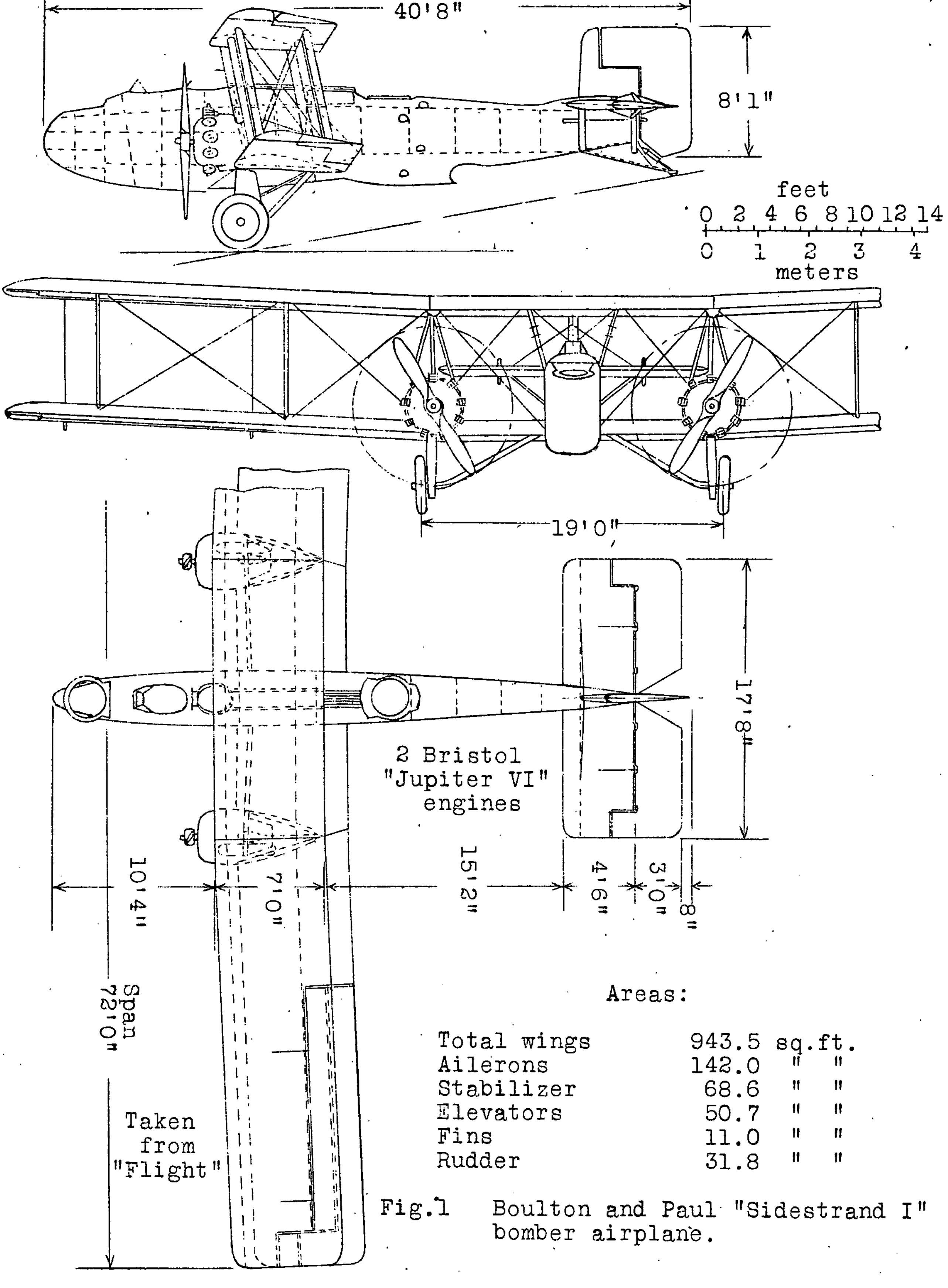
$\frac{8850}{900}$ = 9.84 lb./HP. (4.47 kg/HP)

"Wing Power" = 0.95 HP./sq.ft. (10.25 HP/m^2)

Performance

Speed at ground level, 125 M.P.H. (201 km/h).

Speed at 5000 ft. (1525 m), 130 M.P.H. (209 km/h).

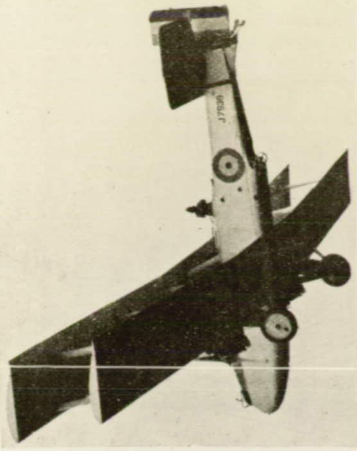


Taken from "Flight"

Areas:

Total wings	943.5	sq.ft.
Ailerons	142.0	" "
Stabilizer	68.6	" "
Elevators	50.7	" "
Fins	11.0	" "
Rudder	31.8	" "

Fig.1 Boulton and Paul "Sidestrand I" bomber airplane.



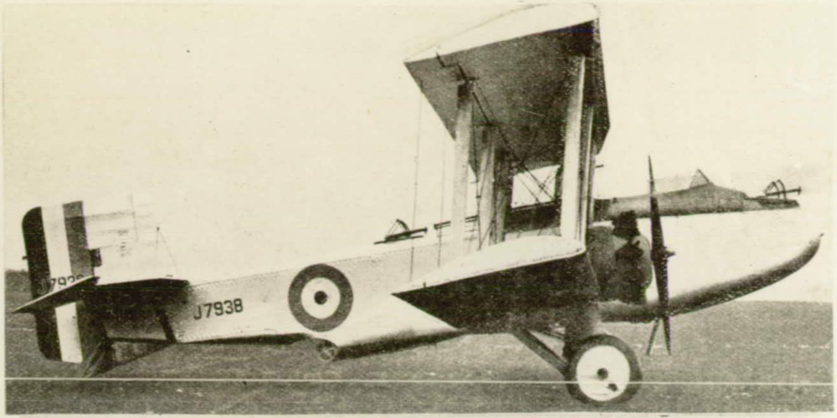


Fig.2 Side view of the Boulton & Paul "Sidestrand I". Note the three gun positions, and more particularly that for the aft gunner firing under the tail.

Fig.4 The "Sidestrand I" in flight showing the large span and clean lines.

"Flight" photographs

Fig.3 Three-quarter rear view of the "Sidestrand I". The careful streamlining of the engine nacelle is apparent.

Fig.5 Details of the "Sidestrand I". 1, engine mountings for the Bristol Jupiter designed to avoid receiving torque reaction loads as bending moments on the wing spars.

A typical fuselage joint is illustrated in 3. A disassembly of this structure is shown in 4. Note particularly the locked-joint tube longeron and the magnesium alloy pad with flat faces for the fittings.

A slightly different fuselage joint is shown in 2.

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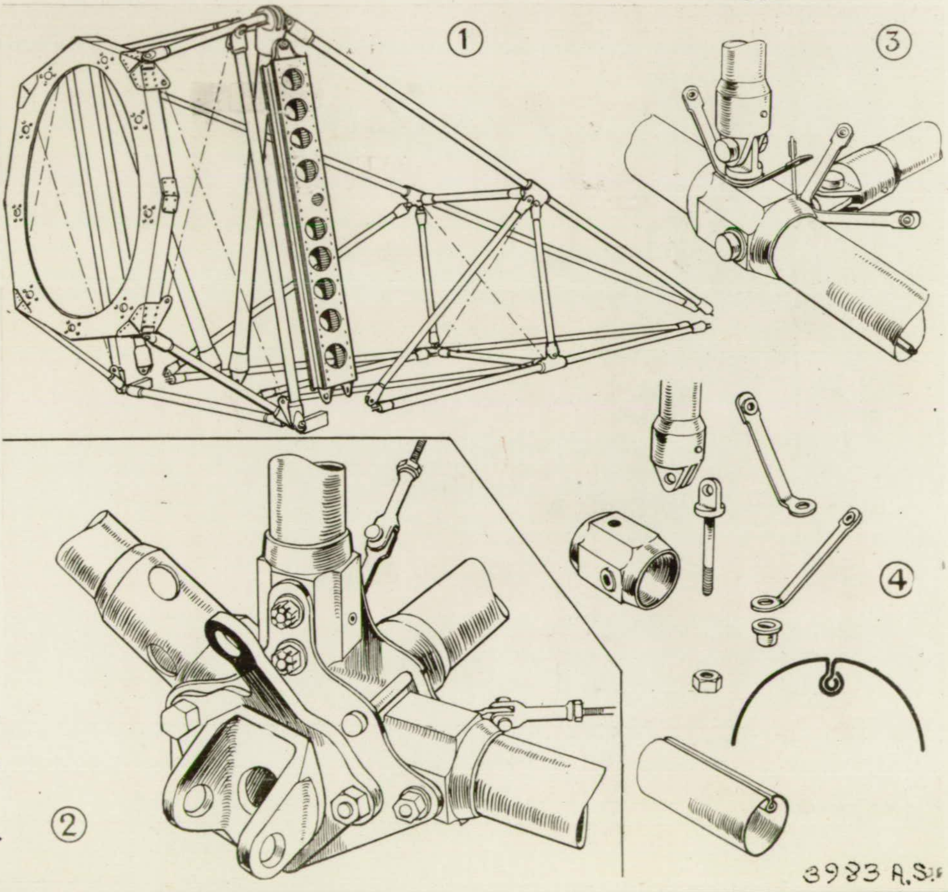

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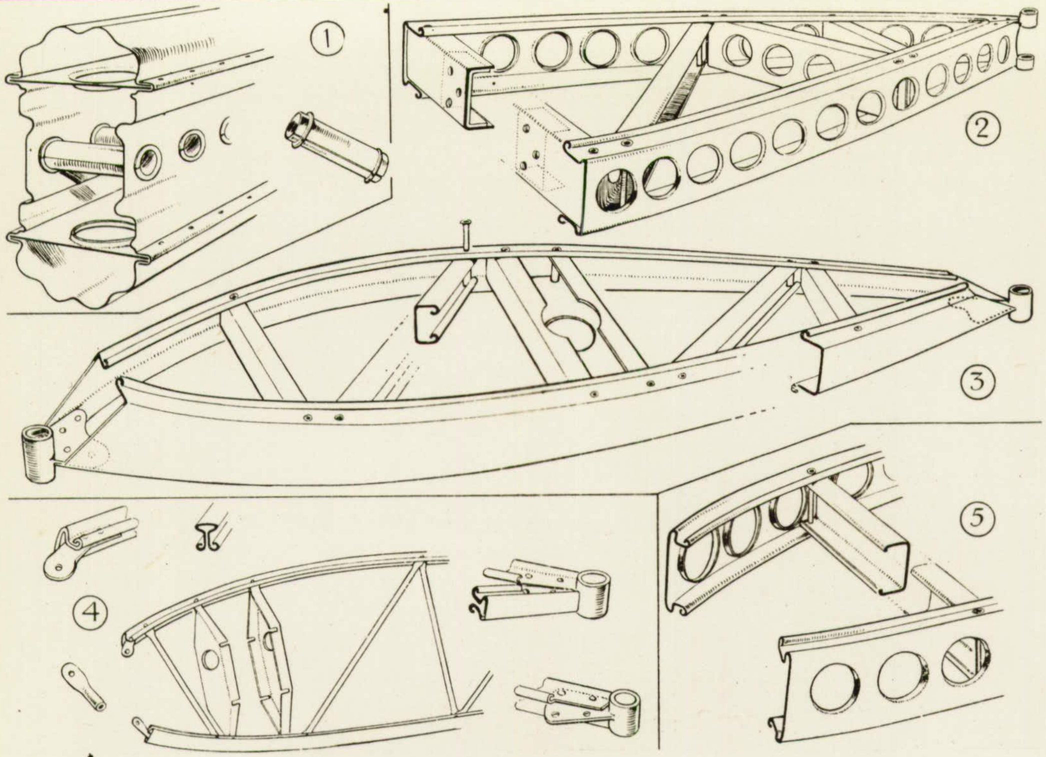

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Fig.6 Some of the constructional details of the wings of the "Sidestrand I" 1, is a spar section with inset showing the distance-tube bracing the web walls together. A standard wing rib is shown in 4. The attachment to the spars is by means of the notched plates shown, the notches fitting over the spar flanges along the lines of rivets. A somewhat stronger form of rib, used at points where concentrated loads occur, is illustrated in 2, while 3 shows a rudder rib. Further details are illustrated in sketch 5.

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Fig.7 One of the landing gear "legs" of the "Sidestrand I". The streamline fairing has been removed to show the arrangement.

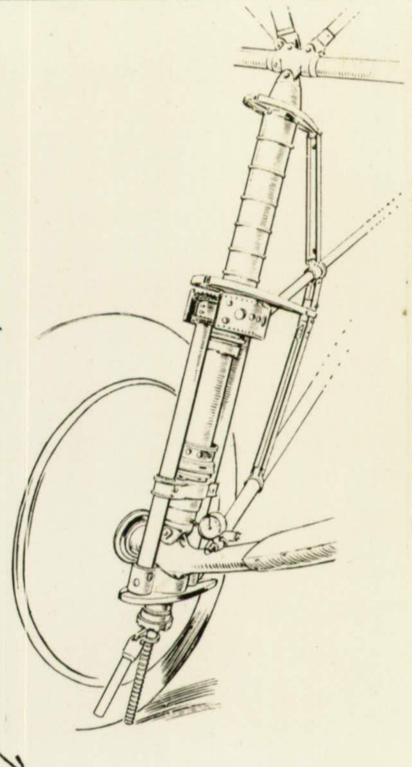

Fig.8 Diagrammatic representation of a landing gear "leg" of the Boulton and Paul "Sidestrand I". The valve has a leak hole in its head, and ports in the tubular stem.