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AIRCRAFT CIRCULARS

NATIONAL ADVISORY COMMITTEE FOR AERONAUTICS

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No. 176

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THE CAUDRON P.V. 200 TOURING AIRPLANE (FRENCH)

An All-Metal Amphibian Monoplane

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THE CAUDRON P.V. 200 TOURING AIRPLANE (FRENCH)\*

An All-Metal Amphibian Monoplane

The P.V. 200 touring amphibian is a two-place cantilever monoplane with folding wings and dual controls. It is equipped with a Renault 4 Pci 100 hp engine. (fig. 1).

The engine is placed above the wing in a special nacelle with straight sides. It is an air-cooled, four-cylinder Renault, driving a metal two-blade pusher propeller through a transmission shaft. The comfort of flying is increased by the elimination of the odors of oil and gasoline and also of much of the noise. The engine and propeller are protected from the spray and are perfectly accessible when the airplane is resting on land or water. The fire hazards are practically nil.

The airplane is all metal including the covering of the wing and empennages. The metal used is an aluminum alloy L2R. The principal fittings are of rustproof steel of high chromium content. This type of construction has the following advantages.

1. It supplies a superabundance of connections minimizing the deformations and insures great protection against accidental ruptures.

2. It is incomparably more rigid than conventional fabric-covered airplanes.

3. It can withstand the elements and, if necessary, do without a hangar.

The search for simplicity, necessary for reducing the cost, has been pushed very far. The general use of open

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\*L'Aeronautique, December, 1932, p. 379; L'Aeronautique, January, 1933, pp. 6-7; and information furnished by the manufacturers.

channels, such as angles and omegas, facilitates the riveting. As much use as possible is made of panels and very simple forms, so as to require a minimum of stamped parts. The nature of the assemblies permits the general use of compressed air for riveting.

The wing is divided into three parts:

- a) A central part of uniform section resting on the fuselage and supporting the engine-propeller group.
- b) Two lateral parts, of evolutive profile, with ailerons and easily removed.

The three parts are assembled by easily accessible ball joints. Each of the three parts consists of a leading edge, a central box and a trailing edge.

The horizontal empennage is of the elevated type, rectangular, and consists of two halves, one on each side of the vertical empennage. Each half comprises a fixed part, braced by an oblique strut, and a corresponding movable part. The angle of attack of the fixed part is adjustable on the ground. The horizontal empennage is constructed like the wing, i.e., with leading edge, central box and trailing edge forming the elevator. The elevator hinges have ball bearings. The construction of the vertical empennage is like that of the horizontal empennage, but without external bracing.

The fuselage consists of four longerons joined by angles. The part which supports the wing has a frame of large section in line with the principal wing spar. Two secondary frames are located in front of the leading edge and in line with the rear wing spar, constituting the principal structure of the fuselage.

Access to the cabin is obtained by opening the doors downward on the floats. A quick-acting device for opening the doors from the inside of the cabin facilitates evacuation by parachute. The part of the fuselage forward of the principal frame is comfortably fitted as a cabin with glass windows for two persons abreast and with dual controls.

A special device, operated by the pilot, makes it possible to lower the ailerons, so as to increase the wing

camber by displacing the axis of the control.

The engine nacelle consists of a box formed by vertical panels of thin L2R metal and of drawn angles. The nacelle is supported by a horizontal plate with an opening for holding the engine. A special device is provided for supporting the rear bearing of the propeller shaft. This device offers great resistance to torsion and flexure.

The engine cowling is made of thin L2R metal stiffened on the inside. The movable parts are assembled by pins and hinges. The engine is cooled by air. The power of the engine is transmitted to the propeller by a tubular steel shaft connected with the engine by an elastic coupling.

The fuel tanks are located in the central part of the wing on each side of the fuselage and can be quickly emptied in flight. The fuel is delivered by an automatic pump. The engine is hand-started by means of a crank. The engine controls are rigid.

The gear for alighting on the water consists of two floats in catamaran. They are made of metal, have shock-absorbing bottoms and a reserve buoyancy of 90 per cent for a total displacement of 930 liters (2,050 pounds). Their construction provides for the installation of landing wheels. Each float is divided into seven water-tight compartments, each compartment being provided with an inspection door on top.

The gear for alighting on the land consists of two independent wheels, each mounted on a fork hinged to a bulkhead of the float. This fork, with the obturator serves to close the bottom when the wheel is retracted. The obturator is operated by the fork and is automatically drawn inside in the landing position.

The wheel is connected with the oleo-pneumatic shock absorber by a movable fork, the opposite end of the shock absorber being attached to the runner on the endless screw. This runner is a nut with two triangular threads and is guided by two steel rings. The screw is operated by bevel gears mounted at the end of the connecting shaft. A central bevel gear receives the motion from another shaft which carries the control wheel. The control gear is multiplied in such a way as to permit a quick lowering of the wheels. The screw-nut assembly renders the device reversible.

The landing gear also includes a tail wheel provided with a balloon tire and mounted on a swivelling fork.

Characteristics of Caudron P.V.200 (P. de Vizcaya license)

Span	13.00 m	42.65 ft.
Length	8.07 "	26.48 "
Height on land	3.42 "	11.22 "
Height on water	2.56 "	8.40 "
Wing area	18.02 m <sup>2</sup>	193.97 sq.ft.
Aspect ratio	9.37	
Chord at root	1.80 m	5.91 ft.
Chord at tip	0.72 "	2.36 "
Area of one aileron	1.125 m <sup>2</sup>	12.11 sq.ft.
Span of horizontal empennage	4.15 m	13.62 ft.
Area of stabilizer	1.61 m <sup>2</sup>	17.33 sq.ft.
Area of elevator	1.19 m <sup>2</sup>	12.81 "
Height of vertical empennage	1.80 m	5.91 ft.
Area of fin	1.29 m <sup>2</sup>	13.89 sq.ft.
Area of rudder	0.60 m <sup>2</sup>	6.46 "
Renault engine 4 P.B. - rated power		95 hp
Renault engine 4 Pci		100 to 115 hp
Total weight of airplane	930 kg	2,050 lb.
Wing loading	51.5 kg/m <sup>2</sup>	10.55 lb./sq.ft.
Power loading	9.8 kg/hp	21.31 lb./hp

Weight, empty	650 kg	1,455.0 lb.
Fuel, 54 kg	62 "	136.5 "
Oil, 8 "		
Useful load	208 "	458.5 "

## Performances

Maximum speed	172 km/h	106.9 mi./hr.
Cruising speed	142 "	88.2 "
Minimum speed	80 "	49.7 "
Speed range	53.5 percent	
Practical ceiling	5,000 m	16,400 ft.
Cruising range	450 km	279.6 mi.

## Legends Giving Structural Descriptions

FIGURES 2 & 3 - Wing structure.- As shown in the figure at the left, the central box of the wing consists of two spars (with solid duralumin webs 0.5 mm (.0197 in.) thick in front and 0.4 mm (.0157 in.) thick in the rear with stiffeners inside and angles outside) and solid ribs of 0.4 mm sheet metal about 70 cm (27.56 in.) apart. The covering panels of 0.32 mm (.0126 in.) sheet metal, with omega stiffeners inside, are attached to the ribs (section A) by means of angles. By this box construction a wing weighing only 6.5 kg/m<sup>2</sup> (1.33 lb./sq.ft.) was obtained with an area of 18 m<sup>2</sup> (193.8 sq.ft.) and an aspect ratio of 9.5. The central box represents only 25 percent of the total weight  $P_{tot}$  of the wing, although, in conventional two-spar wings, it would represent about 40 percent of the  $P_{tot}$ . The customary auxiliary spar, to which the aileron is hinged, is eliminated, so that the structure is equivalent to a monospar wing. Lastly, the  $C_{mo}$  of the profile being only 2.7, the torsional rigidity is very high.

The accompanying diagrams (fig. 2) illustrate the new method of attaching the covering with flush rivets: in one operation for sheets 0.32 to 0.5 mm thick; in two opera-



tions for sheets 0.5 to 1 mm thick. I, hole having diameter of rivet; II, riveting tool in place; III, riveting (hammer not shown); IV, riveting finished. Figure 3 - I, hole having diameter of rivet; II, franking tool in place; III, franking; IV, riveting tool in place; V, riveting; VI, riveting finished.

FIGURES 4 & 5 - Retractable landing gear.- The wheels of the Caudron P.V. 200 (Pierre de Vizcaya license) can be retracted in flight into the floats. The retracting mechanism, which is supplemented by a closing device, is simple and interesting.

Retracting.- The wheel V operates, through rods and bevel gears P, the endless screw v. On v is mounted the nut e, to which is hinged the cap C of the shock-absorbing strut J. The latter ends in a fork f, which carries the axle E. Moreover f is supported by a second fork F, hinged to the float at A.

Closing.- To F is keyed an arm g, which is connected, by a rod t, with a second arm g' integral with the obturator O. The latter, which works inside the fork F, consists of a plate carried by two arms, only one of which is visible in the drawing at the left. O and g' pivot about the fixed point o. As F rises toward the float, g and g' descend; the flat part of O moves back toward the wheel and slips under the tire, somewhat like a shovel, simultaneously rising. The hole in the bottom of the float is closed at the end of the process of retraction.

FIGURES 6, 7 & 8 - Remote power installation and transmission.- The Caudron P.V. 200 was the only airplane exhibited at the Paris Salon which employed a remote drive for the propeller, just as the Bleriot 110 was the only airplane equipped with a retractable landing gear. Judging from the small number of solutions proposed these questions seem to interest very few engineers.

Remote propeller drive, in particular, is a practically unexplored realm for investigation. In fact, if the drives of the G 38 are excepted, no installations of this type have yet been made on a modern airplane. A Junker's patent, analyzed farther on, evokes the difficulties of the problem, namely, the torsional and flexural couples exerted on the bearings. Since the structures must resist deformation, their weight is increased in proportion to the length of the transmission shafts. Vibrations also complicate the problem.

In the Caudron P.V. 200 Mr. Riffard seems to have completely absorbed the vibrations by the extensive use of rubber, in the mounting of the engine on "silent blocks," the "flector" between the end of the crankshaft and the 1.24 m (4.07 ft.) driving shaft, and the rear bearing enclosed in a rubber ring. This seems to be a very sound principle, susceptible of application to larger engines.

Transmission.- 1, coupling flange on engine with three lugs 2 at  $120^{\circ}$ , on which are threaded the elements 3 of the elastic coupling; 5, coupling flange on transmission shaft 6, also with three lugs at  $120^{\circ}$  between the lugs 2; 4, the holes for two of the six coupling bolts; connecting tube for the "tecalemit" cleaner 8 serving the bearing 19; 9, ball race; 10, locknut of bearing; 11, thrust collar of bearing; 12, "ferrodo" disk between propeller 13 and propeller hub 18; 14, propeller puller; 15, locknut of propeller hub; 16, piano-wire spring of 5/10 gage; 17, threaded duralumin rod; 18, thrust collar of bearing 19; 20, rubber ring; 21, washers for protecting the ring while tightening the outer and inner locknuts 24 and 25; 22, cage for elastic ring, mounted on flange of rear bearing by bolts 23; 26, bearing lubricator; 27, rear part of propeller shaft, to which the hub 28 is keyed; 29, centering flange of rear cone.

Structure of nacelle.- The nacelle is a duralumin box composed of two principal parts C and C' mounted on the wing by means of four fittings F (fig. 8). The sheet-duralumin walls of the box are supported by a grid of strips l and stiffeners r. E is the inlet for the cooling air, which, after circulating around the engine, is directed by the partition b toward the two outlets S. R is the oil tank.

Mounting of engine group.- a, crankcase attachments, by "silent blocks," to the longerons L and L'; A, elastic coupling between crankshaft and transmission shaft; P, rear bearing.

Translation by Dwight M. Miner,  
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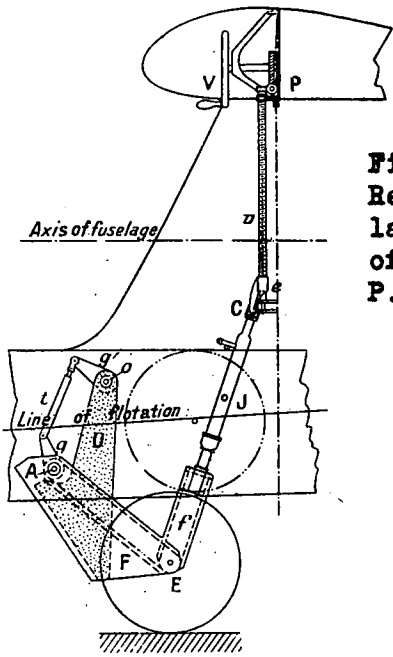


Figure 4.

Figures 4 and 5  
Retractable  
landing gear  
of the  
P.V. 200

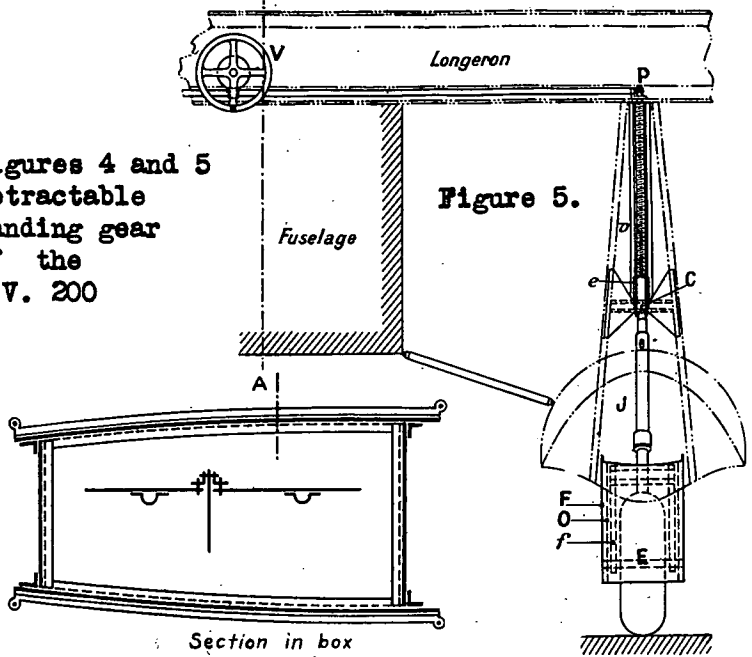


Figure 5.

Section in box  
taken at A

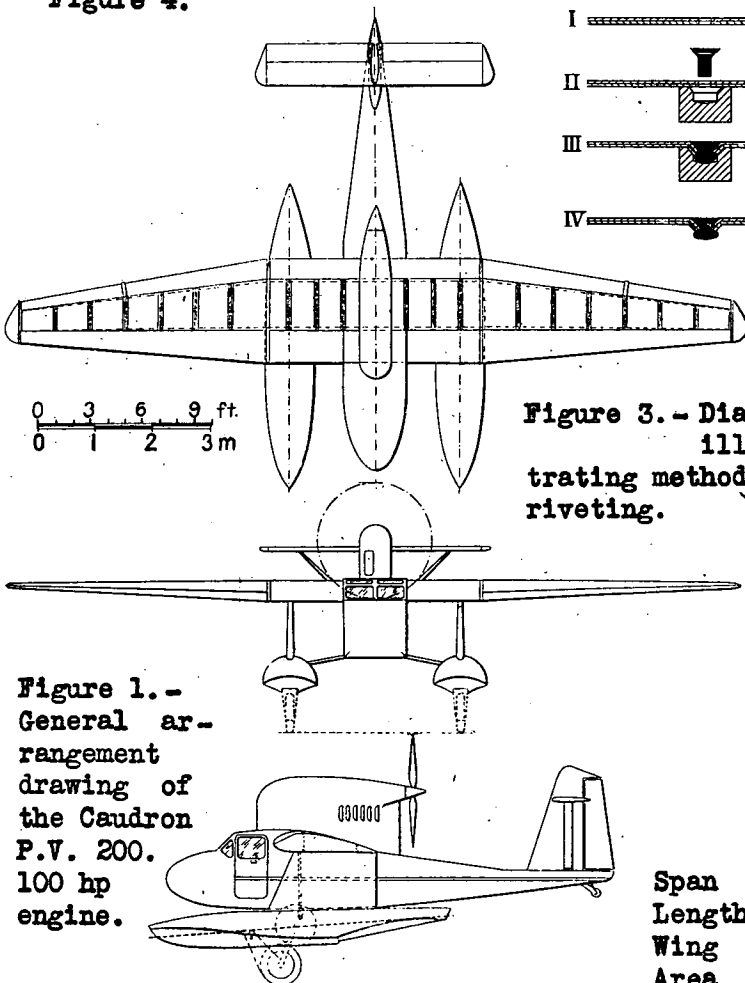


Figure 3.- Diagram  
illus-  
trating method of  
riveting.

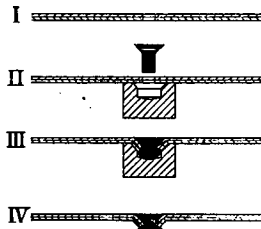


Figure 2.-  
Wing structure  
of the Caudron  
P.V. 200 with  
diagram illus-  
trating method  
of riveting.

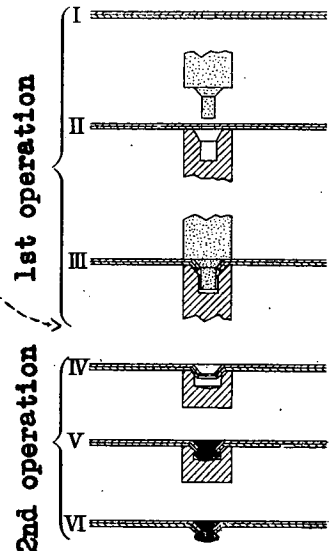


Figure 1.-  
General ar-  
rangement  
drawing of  
the Caudron  
P.V. 200.  
100 hp  
engine.

Span 13.00m (42.65 ft.)  
Length 8.07" (26.48 ")  
Wing  
Area 18.02m<sup>2</sup>(193.97sq.ft.)

Figure 7.-  
Power transmission  
of the P.V. 200

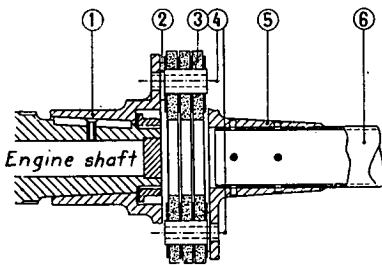
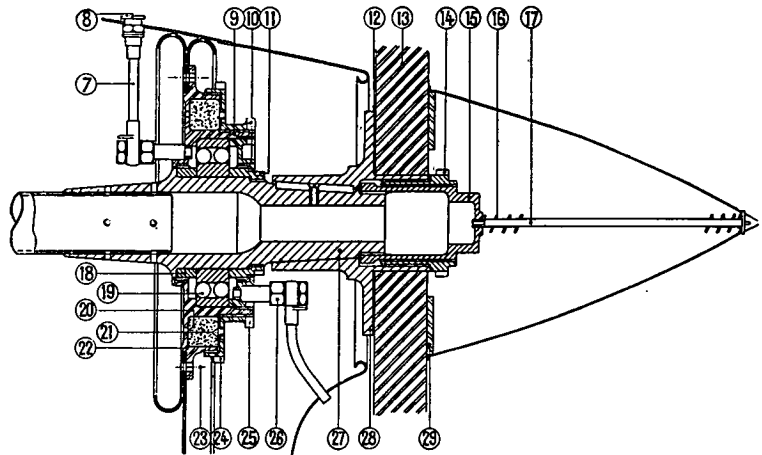


Figure 6.- Power transmission  
of the P.V. 200

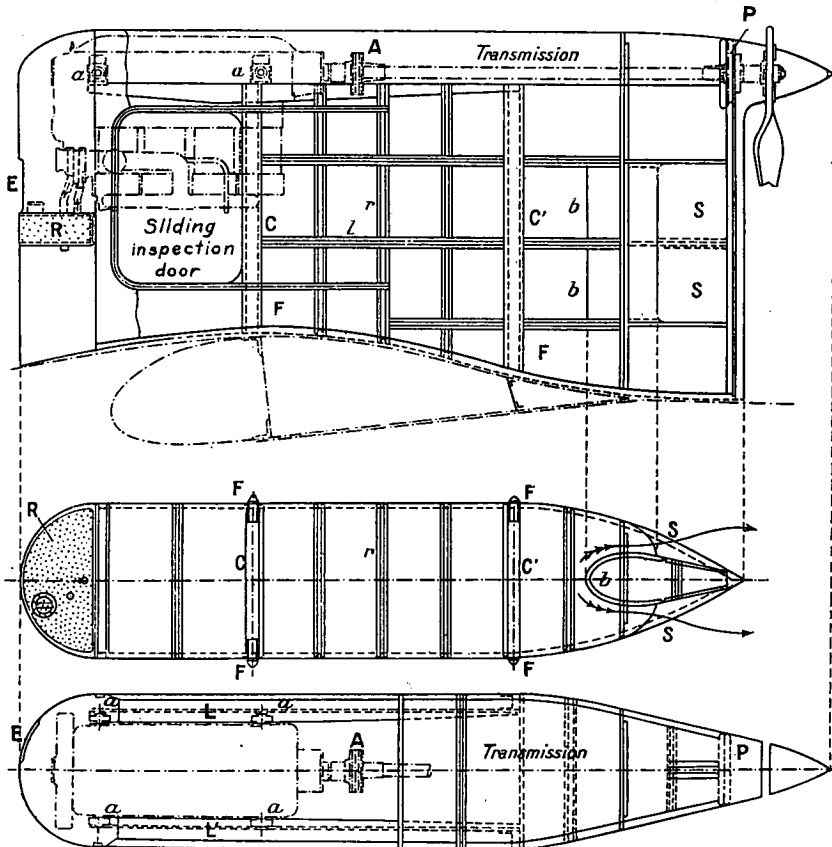


Figure 8.- Installation of power plant.