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NATIONAL ADVISORY COMMITTEE FOR AERONAUTICS

No. 207

BAYNES BEE LIGHT AIRPLANE (BRITISH)

A Two-Seat High-Wing Monoplane

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BAYNES BEE LIGHT AIRPLANE (BRITISH)*

A Two-Seat High-Wing Monoplane

When a new type of private owner's airplane is produced which has pusher propellers driven by supercharged versions of the well-known Ford 10-horsepower water-cooled automobile engine, it starts off with certain advantages all its own.

The newcomer to this specification is the Baynes Bee, built to the designs of Mr. L. E. Baynes by Carden-Baynes Aircraft Ltd. It is a little high-wing monoplane which seats two side by side in an extremely roomy cabin, which is 42 inches wide.

The successful conversion of an automobile engine into an airplane engine may or may not mean cheaper maintenance, although it should. But it certainly should make for lower first cost. The majority of parts can be taken straight off the production line where the enormous flow of work justifies an outlay on tools and jigs not yet economic in the production of airplane engines per se.

An unusual feature of the Baynes Bee (figs. 1, 2, 3, and 4) which should appeal to the private owner is the method adopted of swinging the wing out of the way to reduce over-all width when garaging. The trouble, from the designer's point of view, with the usual scheme of breaking the main spars and making a hinged joint in the back spar is the very large extra weight of the necessary fittings. These have to take all the loads of the wings, which thus have to pass through a concentrated mass of material instead of being spread over the whole structure as happens in a wing where the spars and covering are continuous.

Mr. L. E. Baynes, designer of the Bee, solved the problem by mounting the wing on a turntable. The actual pivot is on the rear wall. Two pins lock the front wall of the spar (figs. 5 and 6) to suitable lugs. By pulling

*From The Aeroplane, March 17, 1937, and Flight, March 11, and March 18, 1937.

out the two pins, the wing can be swung around in the line of the fuselage. The width of the airplane is thus reduced to the span of the stabilizer, about nine feet. Against this must be offset the lengthening of the airplane by something like half the span of the wing.

To allow the trailing edge of the wing to pass over the top of the fuselage, the decking of the fuselage can be split along the top and the halves open outward and downward (figs. 7 and 8). In this way, most of the extra weight made necessary by the usual system of wing folding is saved because in any event three fittings are usually necessary for the attaching of the wing to the fuselage.

The thing which has really made the whole airplane possible, including the swinging of the wing, is the successful persuasion of the 10-horsepower Ford engine to run on its side. One says "Ford" but actually the engine which Carden-Baynes Aircraft Ltd. have persuaded to run on its side is the aeronautical conversion produced by their associated company, Carden Aero Engines Ltd. (fig. 9).

The engine is mounted by means of a steel plate, sandwiched between the crankcase, which is in one piece with the cylinder block, and the crankcase cover. This steel plate, flanged top and bottom, forms a very deep beam, which is attached to the top and bottom flanges of the spar. The front support is a triangle based on the spar and its apex is fastened to the cylinder head.

The pressure oil pump has not been moved. A scavenge pump has been added and put at the lowest point in the engine immediately beneath the side valves.

Spigoted into the end of the crankcase is an aluminum extension, one day to be elektron, to carry the extension shaft. It has four flanged webs, the top and bottom bolt onto the plate, sandwiched through the crankcase. The horizontal webs carry the two magnetos and a single common distributor.

The hollow extension shaft is an extremely massive piece of work some two inches in diameter with walls about $3/16$ inch thick (fig. 10). It is driven directly off the crankshaft through a splined coupling. The thrust bearing is at the propeller end of the extension. The extension shaft and mounting adds some 10 pounds to the weight of the engine.

Besides being persuaded to run on their sides, the Carden engines have been supplied with Centric superchargers. These vane-type blowers run at 1.1 times crankshaft speed and supply mixture to the cylinders at a pressure of 4-3/4 pounds per square inch above atmospheric. With their help the engine gives 40 horsepower at 3,500 revolutions per minute.

Pusher propellers have more to commend them to the private owner than theoretical efficiency. For instance, they can be put behind the trailing edge of the wing, so that in a small airplane the whirling blades are well out of the way of people getting in and out of a cabin in the nose, by doors in front of the leading edge. They should also make less noise.

Thus the airplane has the aerodynamic advantages conferred by the application of pusher propellers. Propellers do not have to push the slipstream past the engine which is driving them nor waste power battering their own slipstream against the leading edge as they chop up and down past it.

Moreover, with the converted Ford engines there is practically no increase of frontal area, and very little of wetted area. Wet, in this sense has nothing to do with water, nor any psychological significance. It is used to convey the idea that any increase of superficial area on airplanes must increase frictional drag, or skin friction, because the whole of an airplane is immersed in an enveloping fluid.

The radiator for the cooling system also lies on its side in the wing. The cooling water is circulated by an engine-driven pump (fig. 11).

The cruising consumption of fuel is about 2 gallons per hour.

In spite of these alterations, the engines are not expensive to produce and in production the cost of two is expected to be considerably less than the price of one 80-horsepower airplane engine. At the same time particular attention has been given to the design so that the structure will be as cheap as possible to build.

With this aim in view, the designer has evolved a

particularly simple and light form of structure. The main stress-carrying members of the wing, and of all the other flying surfaces, consist of a single plywood box with plywood walls and spruce longitudinals. Over this box light ribs are laid to give the wing or other surface the desired contours. Plywood is used to give the leading edge its shape, and the whole is covered with fabric. (See fig. 12.)

The cabin is particularly well laid out and the backs of the seats are arranged to take parachutes. Access to the luggage space is had by tilting the seat backs forward. The single control column issues from a box in the floor of the cabin in which all the controls run. The control column is branched at the top to either seat. Rudder control is by hanging stirrups. Those in front of the passenger can be quickly removed. The front end of the control box forms a convenient mounting for the compass.

The wheels of the landing gear project through slots in the bottom of the fuselage. Consequently, the bottom of the fuselage is close to the ground and as there is a large deep door on each side of the cabin, one can get in and out with rather less trouble than from a modern car of medium power.

So many good airplanes have failed to become successful because suitable engines did not exist at the time of their appearance, that we particularly hope the new Carden-Baynes engines will come up to expectations. Mr. Baynes has made such an important contribution to aeronautical progress by going for wing-enclosed engines and pusher propellers that there would be a major disaster if the Bee failed to come up to expectation because some minor bug had not been exorcised from the engine. There would be a tendency for people to attribute its lack of success to the design. On the other hand, people are beginning to become spray conscious and the Bee is so obviously not a spray maker that we may expect it to set the fashion which we have long been anxious to see.

CHARACTERISTICS

Dimensions:

Length	23 ft.
Height	4 ft. 9 in.
Span	29 ft. 10 in.
Width folded	9 ft.
Length folded	29 ft. 10 in.
Track	3 ft.

Areas:

Main wing with ailerons	141 sq. ft.
Ailerons	15 sq. ft.
Stabilizer	15 sq. ft.
Elevators	10 sq. ft.
Rudder	7 sq. ft.
Fin	5 sq. ft.

Weights:

Weight empty	880 lb.
Pilot and passenger	320 lb.
Luggage	50 lb.
Fuel (10 gallons)	75 lb.
Oil (1/2 gallon per engine)	10 lb.
Water	15 lb.
Disposable load	470 lb.
Weight loaded	1350 lb.

Loadings:

Wing loading	9.55 lb. per sq. ft.
Power loading	16.87 lb. per hp.
Span loading	1.51 lb. per sq. ft.

Performance (estimated)

Maximum speed	110 m.p.h.
Cruising speed	100 m.p.h.
Stalling speed	40 m.p.h.
Initial rate of climb	700 ft. per min.
Duration, with 210 lb. payload	3 hours

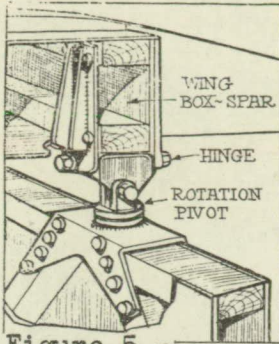


Figure 5.—**TURNING GEAR.**—Above, the central fixing on which the wing swings. Right, the locking pins on the front of the spar. The turn-table in which the wing runs is clearly *The Aeroplane*

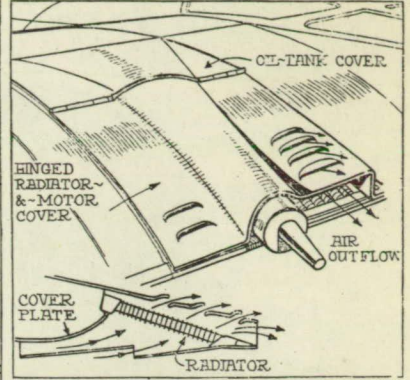
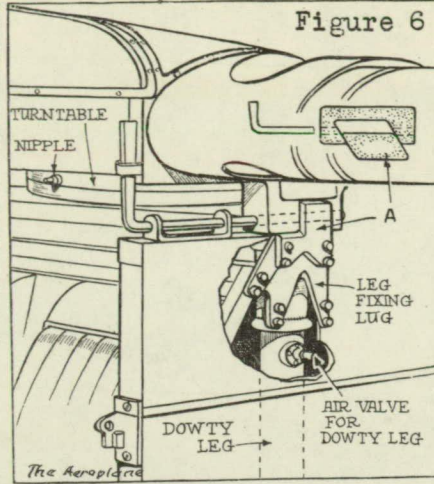


Figure 11.—*The Aeroplane*
CUTTING DOWN COOLING DRAG.—
The neat radiator installation of the Baynes Bee.

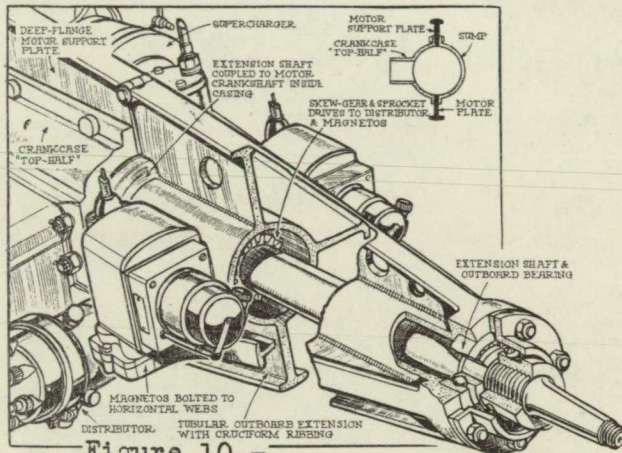


Figure 10.—**SHAFT-DRIVEN.**—How the hollow extension shaft is added to the Carden motor. The diagrammatic sketch in the top right corner shows how the support to the wing is sandwiched through the crankcase. *The Aeroplane*

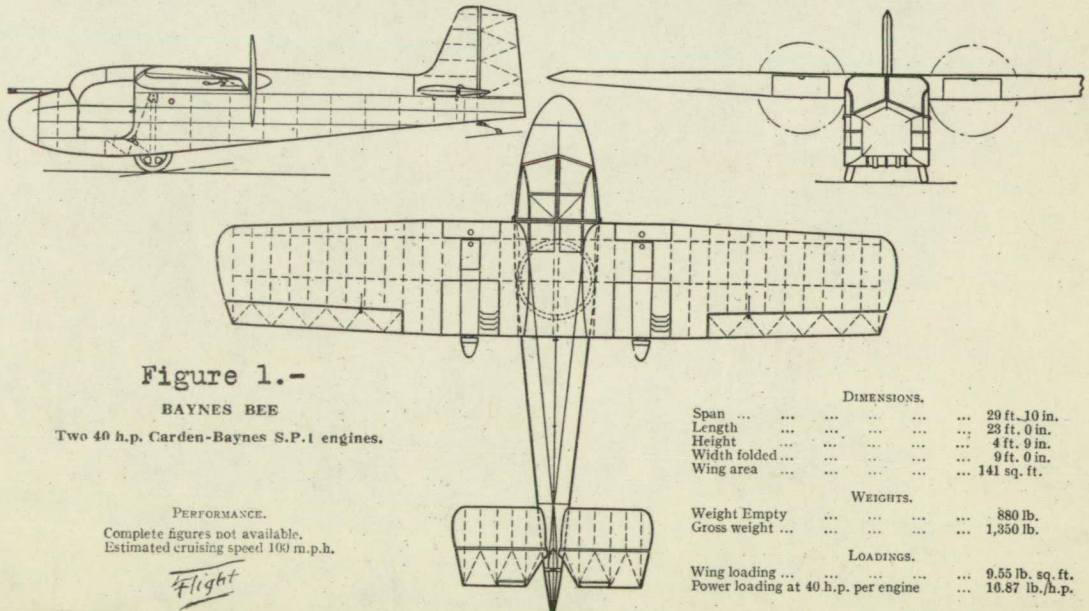


Figure 1.—

BAYNES BEE

Two 40 h.p. Carden-Baynes S.P.1 engines.

PERFORMANCE.
Complete figures not available.
Estimated cruising speed 100 m.p.h.

Flight

DIMENSIONS.	
Span	29 ft. 10 in.
Length	23 ft. 0 in.
Height	4 ft. 9 in.
Width folded	9 ft. 0 in.
Wing area	141 sq. ft.
WEIGHTS.	
Weight Empty	880 lb.
Gross weight	1,350 lb.
LOADINGS.	
Wing loading	9.55 lb. sq. ft.
Power loading at 40 h.p. per engine	10.87 lb./h.p.

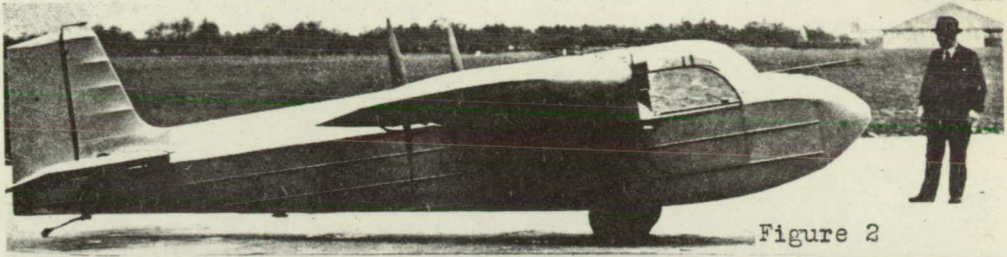


Figure 2

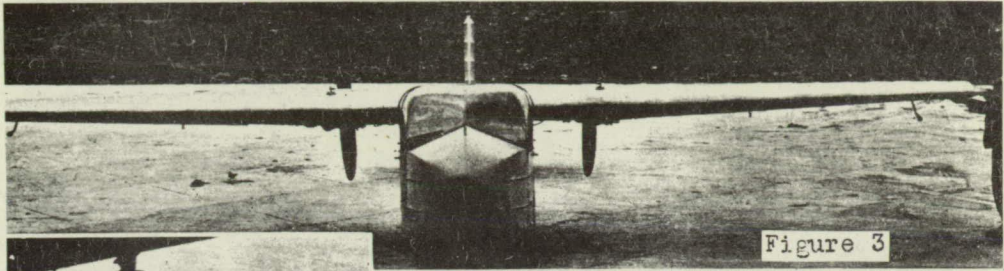


Figure 3

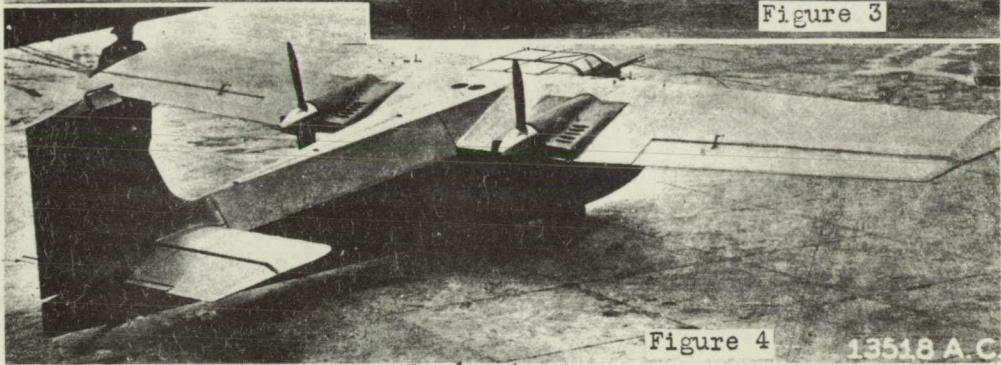


Figure 4

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"The Aeroplane"
SETTING A FASHION.—The Baynes Bee, which has two four-cylinder Carden-Baynes motors lying on their sides in the wing behind the main spar, and driving pusher propellers. The middle view above shows what can be done in the way of providing a clean leading edge.

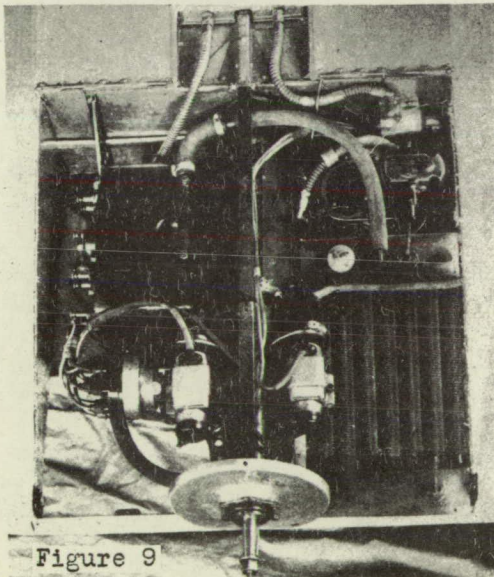


Figure 9

OUT OF THE WIND.—A plan view of one of the Carden-Baynes supercharged four-cylinder water-cooled motors. The cylinder block is lying on its side to the left. On the right are the Centric supercharger nearest to the spar, and between it and the trailing edge the sloping radiator. *The Aeroplane*

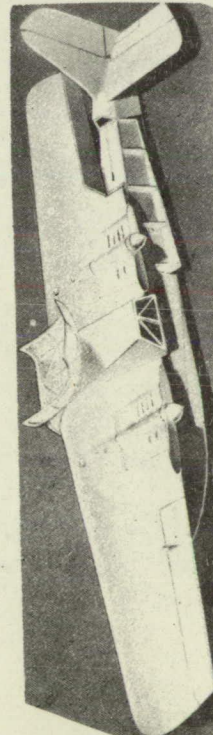


Figure 8.— Sketch illustrates the ingenious "turntable" wing-folding system of the Carden-Baynes Bee. *Flight*

Figure 12:- Gasoline is carried in leading edge tanks. The accessibility of the cabin is particularly commendable: the doors are large and the fuselage low.

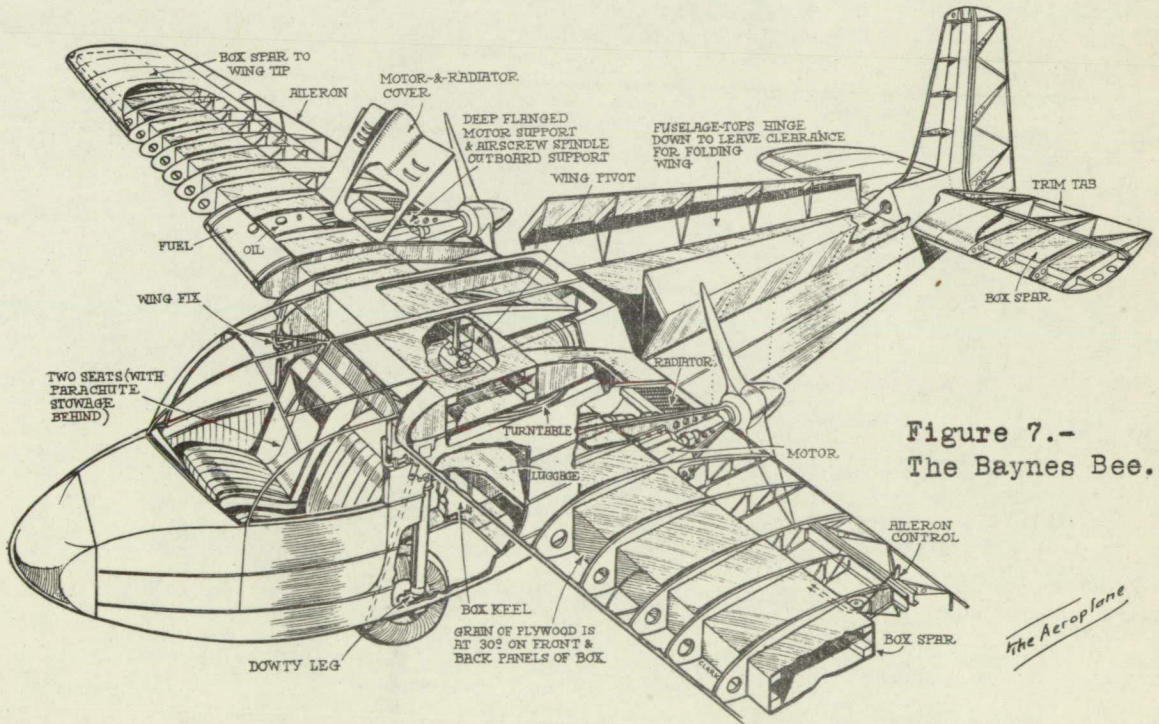
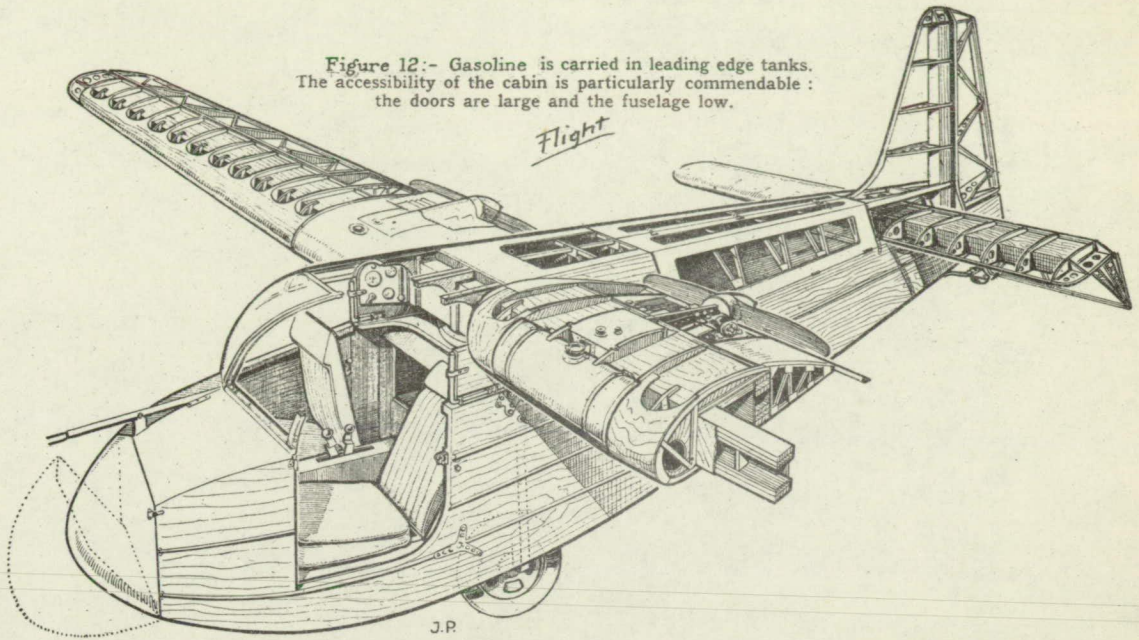


Figure 7.- The Baynes Bee.