Yesterday's Wings

The Flying Flea

Economy-minded Frenchman designs low-cost sportplane in early 1930s. His book triggers construction boom in Europe, but motorcycle-engine-powered homebuilt fails to catch on in the United States

by PETER M. BOWERS / AOPA 54408

The first "production" version of the Flying Flea, Model HM-14. This one, powered with a 30 h.p. Poinsard-Mengin four-cycle, two-cylinder engine, is the demonstrator that Henri Mignet brought to the United States. Note the overlap of the two wings.

E.M. Sommerich Collection

■■ One of the most unusual and controversial sportplanes of all time is the little French *Pou du Ciel.* This translates to "Sky Louse," but for English usage has been altered to the much more appealing "Flying Flea."

The first "Pou" to be given the name flew in September 1933. This was the result of evolution through several unconventional, ultra-light airplanes developed by Henri Mignet in his quest for a low-cost, easy-to-fly sportplane for the pure amateur. Mignet maintained that all the contemporary lightplanes were merely adaptations of basic military designs developed in World War I, were too complex and costly to build, and were downright dangerous to fly because of the coordination required to operate their three-axis controls. Mignet prided himself on being neither an engineer nor a trained pilot. He considered himself representative of hundreds who wanted to fly but couldn't afford it, and sought to develop a bare-minimum airplane for what today would be called an underprivileged minority group.

Once his "Pou" proved successful, Mignet wrote a book. "Le Sport de L'Air" explained his philosophy of flying and gave detailed instructions for building the HM-14 airplane. The original book and the English translation, "The Flying Flea," triggered a construction boom. The world of low-budget sport flyers had been waiting for just such a machine and such a man to lead them.

The "Pou" was tailored closely to the dream. Cost was low, thanks to construction from commercial grades of wood and the use of a motorcycle engine. The flying was greatly simplified, too. The "Pou" had only two axes of control—pitch and yaw. There were no ailerons for roll control. Lateral stability was built in, in the form of generous dihedral, and the low center of gravity (CG) was supposed to help through pendulum action. Because of its structural and aerodynamic simplicity, which bordered on crudity, it was no exaggeration to call the "Pou" an oversized and highly unorthodox model airplane.

While there had been many attempts since the end of World War I to produce an ultra-light single-seat sportplane, most of these followed the traditional layouts and proportions of the "big" planes. The fallacy of light weight achieved through small size soon became apparent. The littlest designs, which were merely standard models scaled down, were extremely tricky to fly. The lower Reynold's numbers at which these models were operated largely negated the measurably lighter wing loadings. Interference factors did not decrease with size. If anything, they increased to a larger percentage of the overall drag. The most successful designs in the motorcycle-power range were long-span types that were virtually powered gliders using relatively sophisticated structures.

Mignet's approach to the problem was unique. He achieved the desired small dimensions for economy and limited shop space, but obtained the generous wing area needed for flight with low power by using two wings in tandem instead of the conventional main wing and a small following tail surface.

The tandem arrangement was not new. It had been around since before the Wright Brothers. (Remember Langley?) However, few of those built, other than the French Pyret Glider of 1922, had been notably successful. Mignet's was the first powered tandem-wing design to demonstrate practical results and to achieve the distinction of continued production and the compliment of imitation.

The Mignet approach to longitudinal control was entirely new. Instead of having both wings fixed relative to each other, and a set of conventional elevators at the rear end of the whole combination, as had been used by other tandems, he fixed the rear wing and made the front one movable. There was a slight overlap of the two surfaces, and the forward one was well above the rear one, whereas previous tandems had both wings in line with each other. As pointed out by the designer, the "Pou" could almost be regarded as a tailless biplane with extremely heavy stagger.

The tilting of the forward wing, according to Mignet, did more than merely alter the angle of attack of that surface to provide control in pitch. The gap between the overlapping surfaces was in effect a variable-width slot. Changing the angle of attack of the front (upper) wing not only altered the setting of the slot, and thereby affected the velocity of the air flowing over the rear wing, but the redirected downwash of the forward wing altered the angle of attack of the rear wing. According to Mignet's calculations, this resulted in an almost stall-proof plane because the low pressure area above the lower (rear) wing in effect sucked in the air flowing over the forward wing when it was operating at high angles of attack, thereby delaying the stall considerably beyond the usual point.

As built to Mignet's original concepts, and with the powerplant originally selected, the "Pou" was a great success. It was an awkward-looking thing and had odd handling characteristics because of its two-axis control and movable forward wing. The original powerplant was a two-cylinder, two-cycle Aubier-Dunne motorcycle engine delivering 22 h.p. by European ratings. Mignet quickly recognized a major problem of motorcycle engines adapted to airplanes and propellers: the high crankshaft speed that greatly reduced propeller efficiency. He resolved this on his early models by using an auxiliary shaft for the propeller. This was mounted above the engine and was driven at less than crankshaft speed by a sprocket and chain. Later versions, using the two-cycle engines that Mignet preferred, were geared.

Since the wing pivot was ahead of the center of lift, the pilot always had to hold back-pressure on the stick. Mignet insisted that one should not have to fly by both pushing and pulling the stick. With no ailerons, turn was by rudder alone. There were no rudder pedals; left stick gave left rudder. This took a lot of getting used to for normal-control pilots, and also made tricky operations of crosswind taxiing, landings, and takeoffs. Normal taxiing was easy; two little wheels were fitted to the bottom of

SPECIFICATIONS AND PERFORMANCE

Mignet "Pou du Ciel" HM-14

Span (front)	19 ft. 6 in.
Span (rear)	13 ft. 1 in.
Length	11 ft. 10 in.
Height	5 ft. 6 in.
Wing area	119 sq. ft.
Powerplant	Aubier-Dunne two-cycle, 22 h.p.
Empty weight	220 lbs.
Gross weight	375 lbs. and up
High speed	62 m.p.h.
Cruise speed	50 m.p.h.
Landing speed	19 m.p.h. (claimed)
Climb	300 f.p.m.
Ceiling	5,700 ft.
Range	100–115 mi.

the rudder.

Mignet was not enough of an aerodynamicist to realize the terrific aerodynamic handicap inherent in his low-aspect-ratio wings. The induced drag of such wings increases greatly at low speeds and high angles of attack. The most notable low-speed planes, including gliders or sailplanes, all have aspect ratios that are extremely high by airplane standards. Some sailplanes go as high as 24:1, with 18 a good average. A Piper *Cherokee* has an aspect ratio of 6:1. The original "Pou," with little more than 4.5:1 for the front wing and 3.3:1 for the rear, also mushed through the air at a high angle of attack, to compound the drag problem.

However, for Mignet's purposes, this didn't matter. The object was to get a man into the air, and at low cost. The "Pou" flew. It had no direct competition, so comparative performance was not important.

However, there were other major aerodynamic shortcomings in the design that were more serious than excessive drag. One was center-of-pressure travel and lift-coefficient change, resulting from changing trim and angle-of-attack with changes in speed. With both surfaces lifting, the center of gravity had to be between the centers of pressure or lift (CP) of both wings instead of very nearly coinciding with the CP of the conventional airplane. Every student pilot is aware of the effect of the full-speed range on the trim of conventional designs, where the CP never gets more than a few inches away from the CG. On tandems, with both wings lifting, a shift of the center of pressure shortens the distance from the CP of one wing to the CG, while lengthening the other, and creates a severe disturbance of the longitudinal balance. This can be likened to two kids on opposite sides of a balanced teeter-totter moving in the same direction simultaneously. Mignet anticipated this problem, though, and deliberately reflexed the trailing edge of his original airfoil to reduce CP travel.

Fortunately for Mignet's early efforts, he was a poor man who could not afford an expensive engine. He got along with the lowest power that could get the "Pou" into the air. With the takeoff, climb, cruise, maximum, and landing speeds all very close together, center-of-pressure travel resulting from speed and trim changes did not become a problem.

Not until the "Pou" design caught on in a big way, and amateur and professional talent began to make improvements, did serious trouble appear. Notable examples were British versions with aircraft conversions of the British-built Model "A" Ford automobile engine or the standard 32 h.p. British "Cherub" four-cycle, air-cooled lightplane engine. These powerplants gave the "Pou" enough of a speed range for the longitudinal stability problems to become acute. After a rash of crashes, both the French and British Governments grounded the "Pou" in 1936. The United States did not ground the few in this country because amateur-built airplanes were illegal in most states at the time, so their problems were not getting official attention.

The "Pou" design was so unconventional that its problems could not be worked out satisfactorily on paper. The French Government decided to test one in the large wind tunnel at Chalais-Meudon (the first full-scale plane tested there). The British tunnel-tested one at Farnborough, and NACA tested one in the large Langley Field (Va.) tunnel. The findings were essentially the same—in high-speed conditions, the rearrangement of the lift vectors exerted a greater nose-down force than the "elevator" effect of the front wing could overcome.

As a result of these findings, the "Pou" was redesigned. Some essential changes were made, but the two-axis control feature was retained. The wings were moved farther apart longitudinally, the gap was increased, and a more stable airfoil was used. The CG was also moved forward. One fix for the existing HM-14 models was to make the rear wing movable or add elevators to it.

Improvement has continued to this day. The pre-World War II HM-18 model and those following resembled conventional airplanes in having a tripod landing gear. The 38 h.p. HM-18 licked the problems of the HM-14, but the design had a long fight to regain official favor. It has finally started coming on strong again in France and other countries that allow amateur building. A few have appeared in the United States, but since the majority of American amateurs prefer higher performance, the "Pou," or "Flying Flea," remains a rarity in U.S. skies. □

An American-built Flea powered by a 32 h.p British Bristol Cherub airplane engine. Pilot Myron Buswell taxied this one right up to his brother's gas station in Tulatin, Ore., circa 1939.

Myron Buswell photo

A modified Flying Flea, Model ME-2Y, built by Frank Easton of Salem, O., in 1945. Powered by a 40 h.p. Continental A40 engine and fitted with a cockpit canopy, this one features an elevator built into the trailing edge of the rear wing. Now in EAA Museum, Hales Corners, Wis.

Peter M. Bowers photo

A post-World War II Mignet HM-360 built in 1963 by Ralph Wefel of Canoga Park, Calif. Power is A40 Continental. Putting engine down into fuselage to improve pilot visibility made it necessary to use a conventional tripod landing gear to obtain propeller ground clearance. Compare with HM-14.

Peter M. Bowers photo

Several models of the Flying Flea have featured folding wings to simplify the storage problem. Note the thick "modern" airfoil on this HM-290 built by John Sayle of Vancouver, Canada. Power is an O-100 McCullough target drone engine.

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