

"Sweet 16" by crews. Accepted by Pan Am on October 9, 1935, with one hour news flight over Maryland. Was flown to Pan Am base at North Beach, Long Island about October 16, 1935. There, it made a series of test flights to various places including at least one 2,400 mile flight to Puerto Rico and Kingston, Jamaica. Before delivery to Alameda, at 2:20 P.M., December 6, 1936, it logged 30,000 miles of test flying. Made first scheduled crossing, San Francisco to Manila and return, November 22 through December 6, 1935. Had wavy American Flags on bow and wings in 1938. Turned over to Navy in early 1942 as BuAer Number 48230 or 48231 but number not painted on. Overhauled and given war paint and straight American Flags on bow and wings in 1942. Retained Pan American Airways' name on side. Operated by Pan Am crews. Returned to Pan Am on October 13, 1943 and used on Miami, Leopoldville run. Crashed at Port of Spain, Trinidad in night landing, January 8, 1945, three weeks after its 10th birthday. In over eight years of Pacific use and one year of Atlantic use, plane flew 3,000,000 miles, averaged 10 hour/day during the war and 5 hour/day before the war. In one period of 7 years, 2 months it flew 15,769.31 hours, 2,400,000 miles, used 2,340,000

gallons of gas, 31,200 gallons of oil and 104 engines, carrying 370,000 pounds of express, 380,000 pounds of mail and 3,500 passengers at an operating cost of \$350/hour. During its life it had only one overhaul. Prior to crash it had one minor accident while refueling when a barge drifted into it causing minor damage. It was even the star of the movie, "China Clipper", which was notable as the first aviation movie ever completed without loss of life. A summary of its travels reads:

1935-1937	12 round trips, San Francisco to Manila
1938	12 round trips, San Francisco to Hong Kong
1939	12 round trips, San Francisco to Hong Kong 2 round trips, San Francisco to Manila 1 round trip, Manila to Hong Kong
1940	13 round trips, San Francisco to Hong Kong 1 round trip, San Francisco to Wake Island
1941	11 round trips, San Francisco to Hong Kong 2 round trips, San Francisco to Singapore 1 round trip, San Francisco to Honolulu
1942	88 round trips, San Francisco to Honolulu
1943-1945	15 round trips, San Francisco to Honolulu 1 trip, San Francisco to Miami Various trips, Miami to Leopoldville.

Beachey's Little Looper

By WILLIS L. NYE

There was only one of her breed ever built. She could be classed as the first biplane primarily constructed for looping the loop and other aerobatic maneuvers by the one and only, incomparable Lincoln Beachey. The Little Looper, as she was affectionately known, proved to have exceptional flight characteristics, high performance, good stability and precise controllability. Her configuration as a biplane was the product of the coordinated design ideas of Lincoln Beachey, Warren Eaton and Art Mix, the latter two being mechanics in the employ of the great pilot. The Little Looper could climb in excess of 1125 feet per minute, and at the time of her construction such a rate of climb was exceeded by only two known foreign airplanes. The first test flight by Lincoln Beachey was made in Chicago, Illinois, where she was built on May 19, 1914.

The Little Looper was constructed so the major assemblies could be assembled or disassembled quickly for the future barnstorming exhibitions around the countryside planned by Beachey's manager, William Pickens. Warren Eaton and Lincoln Beachey, at the time the plane was constructed, were experienced plane builders, in a field of technical science where engineering data was so limited. It may be superfluous to comment, but had Lincoln Beachey not cast aside this little biplane for the black monoplane, his death might have been averted. The Little Looper was a faithful performer and never failed her master.

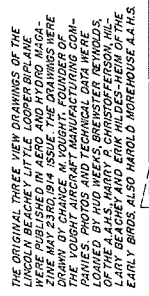
ENGINE INSTALLATION. The engine installed in the Little Looper was a Gnome, rotary, air-cooled engine, of the monosoupape type which was capable of developing approximately 84 hp. The engine was purchased from the manufacturer in a cash sale by Lincoln Beachey on a hurried trip to France in early 1914. The engine had seven cylinders and revolved about the engine crankshaft at a speed of 1350 RPM at full throttle when using automobile type gasoline. The fuel, prior to use, was meticulously strained through a silk handkerchief to remove any impurities. Engine weight was 205 pounds, including the single magneto ignition, spark plugs, oil pump and the fore and aft engine mounting plates. The engine lubricant was pure castor oil which was mixed with the gasoline.

The throttle for the engine was of the foot type and was mounted directly on the chassis. It controlled the engine timing, which in turn controlled the engine's RPM's.

The engine mount consisted of eight, high-strength steel tubes attached by bolts to a machined engine ring turned to fit the engine mounting plate. The front steel tubes were of larger diameter than the aft steel tubes which were also bolted to the aft engine crankshaft extension ring. A floating steel collar, mounted on annular-type ball bearing assemblies, was located between the revolving engine and the propeller. This floating steel collar was stayed by wire bracing which relieved the engine supports of a major portion of the static weight. By this method of suspension, the front steel tubes were relieved of the weight and existing torsional forces generated when the engine was in operation. Although flimsy by modern design principles, this type of engine mounting served the purpose well without failure.

ENGINE OIL AND FUEL SYSTEM. The engine fuel tank was of the composite type, containing the fuel and the engine lubricant and was mounted under the upper wing in the center section. It was stayed by cable bracing. The fuel tank was built of light gauge steel and had a fuel capacity sufficient for approximately 40 minutes of flight. The tank was compartmented to hold the necessary amount of castor lubricating oil. Each compartment was filled by means of separate fillers. The flow of fuel and engine lubricant was by gravity to the engine carburetor which admitted the fuel to the engine by means of a hollow crankshaft. The lubricating oil was injected in the same manner by means of a two-cylinder engine-driven pump with two distribution ports. Thus, the fuel and oil were mixed together when the engine was in operation. Oil consumption was high, being approximately a half gallon of lubricant for every gallon of fuel. Fuel consumption was close to 80 lbs/hr. Provision was made for the fuel and oil system to function in inverted flight.

WING CELLULE. The wing cellule was simply a rectangular space framework configuration. The wings were of constant chord throughout the span for the upper and lower surfaces. The biplane configuration was of the orthogonal type with neither stagger, decalage or sweepback.



Upper and lower wings were connected by semi-streamlined struts, all of which were braced by means of cables to comprise the wing truss. Each wing was comprised of three major assemblies--the outer wing panels, right and left, and the center section. The dimensions of each wing were identical. Steel fittings joined the assemblies together. The wing structure was covered on both surfaces with linen fabric which was doped to strengthen it and to make it impervious to the inroads of moisture. The wing ribs consisted of formed spruce strips. Each wing rib was attached at the leading edge with a wrapped metal fitting screwed to the leading edge spar. It was attached, likewise, to the aft spar and also at the trailing edge in this manner. Wing construction of this kind was typical of this era in plane construction. In short, the wing structural configuration resembled a scaled down version of the Curtiss Biplane wing. At each intersection of the wing rib and wing spar, small wooden blocks were glued and nailed in place to further strengthen the wing structural rigidity.

Interplane struts were semi-streamlined in cross section and made of straight-grained spruce. Struts were finished in natural wood finish, and steel fittings secured each end to the wing spar and cable fittings.

Total wing area was 147 square feet, not including a lifting type of horizontal tail surfaces. The wing loading was approximately 5.13 lbs per square foot, with horizontal tail surfaces supporting 20 lbs.

The airfoil for each wing was somewhat similar to the conventional Curtiss airfoil used on the early model Curtiss Biplanes. Maximum camber was 1.875" at 42% aft of the leading edge. The aerodynamic characteristics are not known but it is believed to be similar to the early Eiffel sections which it resembles.

Wing ribs were made of silver spruce strips laminated together in five horizontal pieces, glued together and steamed to shape over a wooden form. The wing ribs were secured by glued and nailed gusset blocks at the wing rib and wing spar joints. Strap-type light gauge brass fittings, nailed and glued, were used to secure the wing ribs to the front wing spar and the aft wing spar. Brass escutcheon pins were used for the nails.

The front wing spar was made of straight grain spruce and measured 1.625" x 1.25" in cross section. It was "D" shape in cross section, the rounded part of the spar comprising the entering edge of the wing airfoil. The aft wing spar was located at 80% of the wing chord. The wing spars were made up of five vertically laminated spruce strips, glued together under pressure. In the wing reference plane, the short length of each wing spar provided great structural strength. Wing attachment fittings were of high-strength steel. Stagger cables were used to maintain the orthogonal rigidity of the wing cellule. To react against the drag loads, single internal, structural bracing cables were attached by steel fittings to the structural ribs. The structural ribs were similar to the conventional wing ribs but somewhat wider and heavier. All structural components tended to maintain the security of the wing structure giving a high strength to weight ratio. The dimensions of the aft wing spar were 1.25" x 1.25" and it was constructed of five vertical spruce laminated members glued together.

The wing fittings, and the outrigger boom fittings were designed in such a manner that a rapid disassembly and reassembly was possible. Removal of a few cottered nuts made it possible to disassemble the Little Looper. All of the wing cellule bracing cables, i.e., the flying and the landing cables, remained attached to the fittings at the interplane struts. This was made possible by means of a disconnecting turnbuckle located midway between each fitting and safety wired.

The wing trailing edge was made of tapered spruce, formed as required, to which the wing ribs were attached by means of light gauge brass sheet fittings nailed and glued into position.

LANDING GEAR. The landing gear was of a rigid design and of the tricycle type. The main members of the

landing structure extending to the wing lower center section were the major structural members. They carried the front wheel at the apex, the pilot's seat and the control column, in addition to adding to the strength of the wing cellule. The single lower landing gear skid was made of ash and braced by a configuration of high strength steel tubes. The wire spoke-type wheels were shod with 4-inch, medium pressure, pneumatic rubber tires which absorbed the shock and impact of landing. The pilot was provided with a friction-type manually operated footbrake which was used to arrest the forward motion of the plane once the landing roll was started. The brake was spring-loaded in its action. The tires had inner tubes and were of the clincher type.

FLIGHT CONTROLS. The control column was a spoked wheel. Its rim was grooved to provide for the installation of a flexible copper tube to the point of the axis and inside this tube ran the rudder cable. Rotation of the wheel right or to the left actuated the rudder. Rudder cables ran from the bottom of the hollow steel control column tube back to the rudder by way of pulleys attached to the outriggers. The rudder control throw was approximately 20° right or left. A shoulder yoke was hinged to move sideways in either direction. Movement of the seat by the pilot with the hinged shoulder yoke actuated the aileron cables. The cable was crossed so that the ailerons operated alternately with respect to each other when the seat was moved sidewise right or left. Aileron control was sensitive at high speed. Ailerons and rudders were kept straight in high speed flight.

Fore and aft trim was maintained by movement of the control column by the pilot. Coordination of this kind of control configuration was somewhat different than the conventional Dep control used on modern planes. Incidentally, this kind of control was the only type with which Lincoln Beachey knew how to fly.

The single and flexible control cables were all provided with disconnect turnbuckles located throughout the control system for quick disconnecting.

TAIL SURFACES. These consisted of the horizontal stabilizer, split elevators and a balanced rudder. The structural configurations and construction were the same as that of the wing. The tail surfaces were supported by outriggers made of laminated spruce, wire trussed, and of square cross section. The fixed horizontal stabilizer could be adjusted on the ground to whatever angle of incidence was desired. The range of movement of the elevators was approximately 20 degrees down and 30 degrees up. The elevators were fabric covered with linen on two sides and were cable actuated by means of torque-type control horns attached to the leading edge as was the rudder. The elevators were interconnected and attached to the horizontal stabilizer by means of strap-type steel hinges. The rudder was attached in the same way and also operated by a torque-type control horn. The elevator area was 16.0 square feet, horizontal stabilizer area was 14.5 square feet and rudder area was 6.5 square feet.

WEIGHT AND PERFORMANCE. The gross weight of the Little Looper with Beachey in the pilot's seat was approximately 775 pounds. Thus the wing loading was low and the performance could be of a high order.

The plane was very controllable and yet not cranky, or excessively stable. On many occasions Lincoln Beachey flew this airplane with hands off the controls close to the ground. It could be placed in various abnormal flight attitudes, steep climbs and dives in addition to loops of all kinds, and yet be easily recovered to normal flight. Beachey always concluded each exhibition flight by staying in the air until the fuel tank was dry and then gliding down to a landing. It was one of the features of his daring exhibitions. The climb of the Little Looper was approximately 1125 feet per minute at sea level, and the high speed was approximately 85 mph at full throttle. These figures are estimated because the Little Looper was not provided with instruments of any kind.