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AIRCRAFT CIRCULARS
NATIONAL ADVISORY COMMITTEE FOR AERONAUTICS

No. 61

LOCKHEED "VEGA" AIRPLANE
A Commercial Cabin Monoplane

FILE COPY

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Advisory Committee
for Aeronautics
Washington, D. C.

Washington
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NATIONAL ADVISORY COMMITTEE FOR AERONAUTICS.

AIRCRAFT CIRCULAR NO. 61.

LOCKHEED "VEGA" AIRPLANE.*

A Commercial Cabin Monoplane.

The Lockheed "Vega" airplane is a very clean-cut design, suitable for commercial purposes. While the methods of construction used are so far in advance of present-day general practice as to seem almost radical, no item in its design or fabrication departs from proven successful and advanced methods. A glance at the general arrangement shows a cleanliness of line and lack of parasite resistance seen only in the high speed and costly racing types. Because of this beauty of line that is absolutely essential in successful racing airplanes, the Lockheed "Vega" will carry the same pay load farther and faster with less fuel expenditure than any of the present-day types. A moment's thought will show that ten or fifteen miles an hour greater cruising speed or two or three hundred feet a minute greater climb at altitude will often make the difference between success or failure in the commercial application of aircraft to severe service conditions. Combined with clean lines, the Lockheed method of construction enables us to produce airplanes of the greatest possible strength and ruggedness for a given weight. (Figs. 1, 2, 3, and 4).

*Prepared by the Lockheed Aircraft Company.

CONFERENZA DEL 1954

LA RIFORMA DELLA LEGISLAZIONE

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Il primo problema che si pone è quello di stabilire se la riforma della legislazione è un problema di ordine costituzionale o di ordine amministrativo. La risposta è che si tratta di un problema di ordine costituzionale, in quanto la riforma della legislazione è un atto di natura costituzionale.

Il secondo problema che si pone è quello di stabilire se la riforma della legislazione è un problema di ordine politico o di ordine giuridico. La risposta è che si tratta di un problema di ordine politico, in quanto la riforma della legislazione è un atto di natura politica.

Il terzo problema che si pone è quello di stabilire se la riforma della legislazione è un problema di ordine economico o di ordine sociale. La risposta è che si tratta di un problema di ordine economico e sociale, in quanto la riforma della legislazione è un atto di natura economica e sociale.

Il quarto problema che si pone è quello di stabilire se la riforma della legislazione è un problema di ordine culturale o di ordine spirituale. La risposta è che si tratta di un problema di ordine culturale e spirituale, in quanto la riforma della legislazione è un atto di natura culturale e spirituale.

Il quinto problema che si pone è quello di stabilire se la riforma della legislazione è un problema di ordine internazionale o di ordine nazionale. La risposta è che si tratta di un problema di ordine internazionale e nazionale, in quanto la riforma della legislazione è un atto di natura internazionale e nazionale.

Methods of Construction

Fuselage.— Wherever perfect streamline and highest quality are required, monocoque plywood fuselages have always been used. This type of fuselage construction has been used for all successful modern racing airplanes (including Italy's successful contender in the 1926 Schneider Cup race, and the famous Curtiss racers of past years) as well as some of the most recent and successful military airplanes of Great Britain and France.

Monocoque plywood construction has not been used to a large extent for the manufacture of commercial aircraft because of its excessive cost. Another disadvantage has been the difficulty of obtaining a perfect product because of the laborious processes generally used in applying and gluing each strip of wood separately to the form over which the fuselage is usually built.

By a patented process, developed by Malcolm Loughead (inventor of the Lockheed Hydraulic Brake), Allan Loughead, John K. Northrop, and Anthony Stadlman, which is exclusively controlled by this company, one-half of the complete fuselage shell is assembled, and glued as a unit, under a pressure of 150 tons, so that an absolutely perfect, uniform, and homogeneous shell of plywood results. The materials used are vertical grain spruce and best quality casein glue, so that with proper protective coverings the strength and life of the plywood is practically unaffected by time.

MEMORANDUM

TO: THE BOARD OF DIRECTORS

RE: [Illegible text]

[Illegible text]

[Illegible text]

The completed fuselage shells are assembled to laminated spruce diaphragms or rings, which hold the shells rigidly in place, and make of the fuselage in effect a giant tube, tapered at both ends, which gives the greatest possible strength for a given weight (Figs. 5, 6, 7, and 8).

At points of concentrated loading, such as engine mount, wing and tail surface attachment, and landing gear attachment, heavier stiffening diaphragms are used, so that the bending and torsional loads are uniformly distributed throughout the shell. A short section of aluminum cowling around the engine in front and a small aluminum fairing in the rear complete the fuselage structure, which is perfectly streamlined, and requires no alignment, inspection, recovering, or further attention except for an occasional coat of varnish or lacquer. Minor repairs are simply made by cutting away the damaged section of shell and nailing and gluing in a new panel of plywood between the adjacent transverse diaphragms. In case of a serious crash, the tremendous strength and resiliency of the structure tend to minimize the damage done both to airplane and personnel. There are no struts, longerons or wires to cut or impale anything carried within the fuselage, and in the worst cases a complete new fuselage can be furnished at a cost below that at which other types can be rebuilt.

Wings.— The Lockheed "Vega" monoplane wing is of the full cantilever plywood covered type pioneered by Anthony H. G. Fokker, and successfully used by Mr. Fokker, as well as others, for a number of years. By the application of the utmost care in design, this wing has been built to compare favorably in weight to the conventional wood and fabric type, thus eliminating the one objection of excessive weight that has heretofore been raised. The spars are of spruce box type, with spruce caps and spruce plywood webs. The spars taper in depth and size in proportion to the load imposed throughout the wing, being about 18 inches deep in the center and 5 inches deep at the tips.

The ribs are of the latest type of girder construction giving the maximum possible strength to weight ratio. The whole wing is covered with 3/32 inch spruce plywood, which adds greatly to the general stiffness and rigidity of the structure, and does away with the necessity of periodical re-covering. Experienced operators know that loose fabric will interfere seriously with an airplane's performance as well as render its use dangerous. The wing of the Lockheed "Vega" with an occasional protective coat of varnish will remain equally efficient throughout the life of the airplane. The features of ruggedness and ease of repair that apply to the monocoque fuselage, are equally applicable to this plywood-covered wing and result in a minimum of attention, inspection and repair.

The wing is attached to the fuselage at 4 points by 16 standard 5/16 inch diameter tie rods, giving a factor of safety of over 30 at this point. The main wing fittings are provided with eyes for hoisting the wing or airplane when required.

Control Surfaces.— Control surfaces carry out the same type of construction as above outlined, being covered with plywood, and rigidly reinforced where necessary. The ailerons are attached to the wing throughout their full length at the upper edge by means of a continuous duralumin hinge. The aileron loads are in this manner distributed throughout the whole wing, and the gap between wing and aileron is completely closed, obviating any possible danger through jamming with snow and ice in cold weather. The movable tail surfaces are also carefully fitted to reduce the gap to a minimum and prevent jamming. Attachment of all surfaces is simple and their removal, when necessary, may be quickly accomplished. The stabilizer is adjustable, being actuated by two small diameter screws operating in trunnions at its leading edge. Special attention has been paid to the stabilizer attachment and actuating mechanism to insure absolute rigidity, and at places where wear might occur in service, due to the continuous pounding and vibration to which the tail is subjected, extra large bearing surfaces are provided. The stabilizer is a cantilever structure and is carried through the fuselage without a break in order to obtain all possible strength and stiffness.

Landing gear.- Airplane wheels 30 x 5 are provided as standard equipment and may be replaced when desired in wet weather by 32 x 6 tires. The wheels are mounted on a chrome-molybdenum alloy steel divided type axle, which is braced by two struts, one extending to the rear and one upward to the fuselage. Standard shock absorber cord is used as the shock absorbing medium, the rebound being taken by a special hydraulic type snubber. The shock cord is carried on duplicate bridges, housed within the shock absorbing strut, in such a manner that it is absolutely protected from weather and dirt, and failure or breakage of one of the two sets of cords in each strut will not cause failure of the strut or damage to the airplane. The use of rubber shock cord in combination with suitable snubber, gives the non-rebound advantages of the oleo gear, and has additional advantages in that it is simpler, not subject to troubles due to oil leakage, and provides a fully adequate spring system during taxiing as well as when landing. The tail skid also of heat-treated alloy steel tubing is exceptionally well braced. It is rubber sprung, and a hardened alloy steel shoe is attached, which is reversible to provide for further use after one end is worn out.

Lockheed hydraulic wheel brakes are provided, being built into the fairing of the wheels in such a manner that no additional head resistance results in their use. Steering action is provided by means of the rudder pedals which increase

the braking action on one side and proportionately decrease it on the other when operated while the brakes are engaged. Provision is also made for locking the brakes when starting or warming up the engine.

Power Plant.— The engine provided for standard installation is the Wright "Whirlwind" J-5 220 HP. Due to the comparatively light weight and lack of parasite resistance of the Lockheed "Vega" monoplane, it is possible to operate the "Whirlwind" at little over one-half its rated power output, and still maintain a cruising speed close to the maximum speed of most competing types. This advantage further lengthens the serviceable life of the engine and decreases the already remote chance of breakage or serious damage.

As previously stated, the nose of the airplane is completed by a section of aluminum cowling. The engine is partially housed within this cowling, being mounted on a steel framework, ahead of a carefully fitted fire shield. Carburetor drains and air intake are carried outside the cowling, which is readily removable for inspection or repair to the engine. No wooden members are used within the engine section.

Gasoline is carried in two 50-gallon tanks cradled between the wing spars just outside the fuselage. This excess built-in tankage provides an emergency cruising radius of over 1000 miles when occasion demands, and is ready for immediate use at any time. It should be noted that the normal wing loading of

about 11 pounds is a very reasonable loading for this type of airplane. For this reason, excess emergency loads may be carried without seriously reducing the performance. Normal gas capacity is 55 gallons, or fuel for about 550 miles.

The tanks are provided with a simple dump valve for emergency use. The fuel feed is by gravity, of the simplest possible type, without pumps or pressure system complications, and consists simply of a fuel line from each tank with a shut-off convenient to the pilot, connecting to a strainer located so that it may be drained while in flight and a single line from strainer to carburetor.

Numerous tests have proven that the fireproofing of aircraft consists, to a large extent, in the proper installation of power plant, tanks, and piping.

In the Lockheed "Vega" monoplane the engine is supported on a simple all-steel mount, in a fireproof compartment, carefully insulated from the rest of the airplane. With the fuel tanks protected from damage in the strongest part of the wing, outside the fuselage, it is practically impossible for gasoline to come in contact with any of the engine parts, even in the most serious crash.

General Arrangement

During the past two years, the high-wing monoplane type has come more and more to the front, until at the present time it is generally accepted as the standard arrangement for medium

size commercial airplanes. Due to the deep wing and well-streamlined fuselage of the "Vega," this general arrangement is doubly attractive, affording as it does, perfect vision, as well as very excellent protection for the pilot in case of a nose-over. The pilot's cockpit is well shielded and comfortable, and has a transparent cover which may be slid into place when desired, enclosing the pilot for additional warmth and protection in bad weather.

The large unobstructed cabin provides ample space for four passengers and baggage, or six passengers if desired, and the comfortably upholstered wicker seats may be quickly removed to provide cargo space, of which 100 cubic feet is available.

Complete performance data may be found by referring to the general arrangement drawings following. While the speed and climb of the Lockheed "Vega" may seem almost phenomenal, these figures are conservative.

Specifications and Performances

Effective area of wings	250 sq.ft.
Area of ailerons	25 "
Total area	275 "
Area of stabilizer	25.8 "
" " elevators	15.8 "
" " fin	7.7 "
" " rudder	9.5 "
Span	41.0 ft.
Mean chord	78.0 in.
Length	27.5 ft.
Weight, empty	1650.0 lb.
Pay load	700-1000 lb.
Live "	1250-1550 "
Gross weight	2900-3200 "
Airfoil, Clark "Y"	11.7 to 18.0% ordinates
Engine, Wright "Whirlwind" J-5C	
Maximum fuel capacity:	
Gas	100 gal.
Oil	10 "
Pounds per square foot	10.5 - 11.6
" " horsepower (at 225 HP.)	12.9 - 14.2
High speed	135 M.P.H.
Landing speed	50 "
Service ceiling (700 lb. pay load)	15900 ft.
Cargo space	100 cu.ft.

Cruising speed at 1500 R.P.M.	110 M.P.H.
Cruising range	1000 miles
Absolute ceiling (700 lb. pay load)	17800 ft.
Climb at sea level (700 lb. pay load)	925 ft./min.
" " 10000 ft. " " " "	405 "
Normal live load disposition:	
Pilot	180 lb.
Gas (55 gal.)	330 "
Oil (5½ gal.)	38 "
Pay load	700 "
Total	1248 "
Additional allowable load	300 "

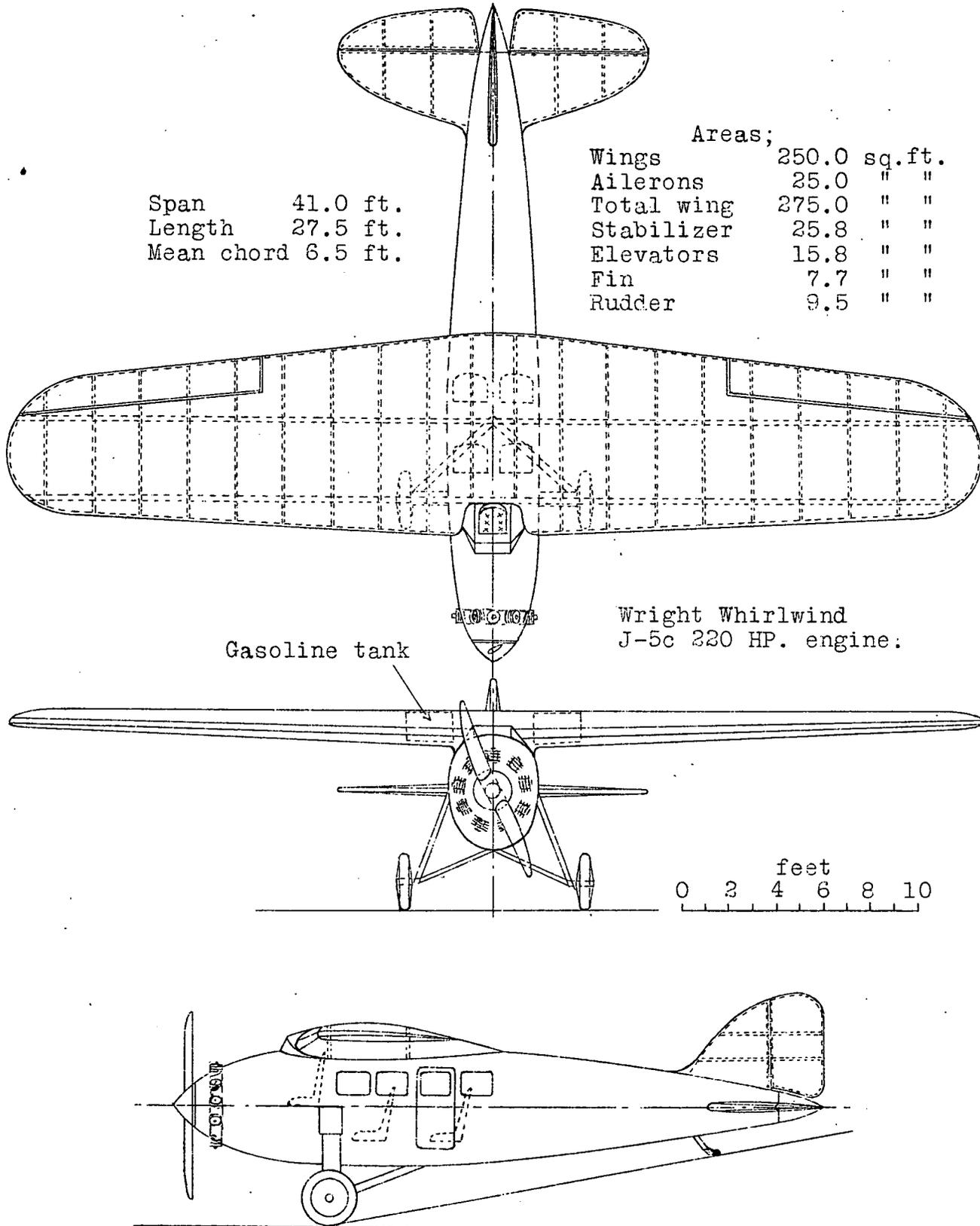


Fig.1 General arrangement drawing of the Lockheed "Vega" commercial airplane.

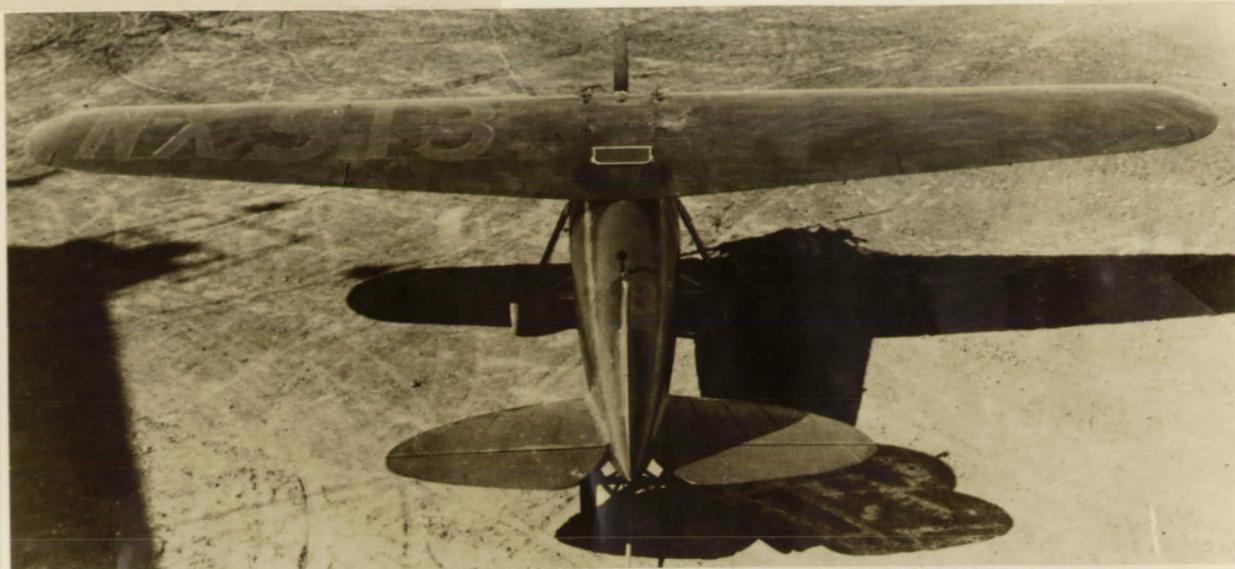


Fig.3



Fig.3

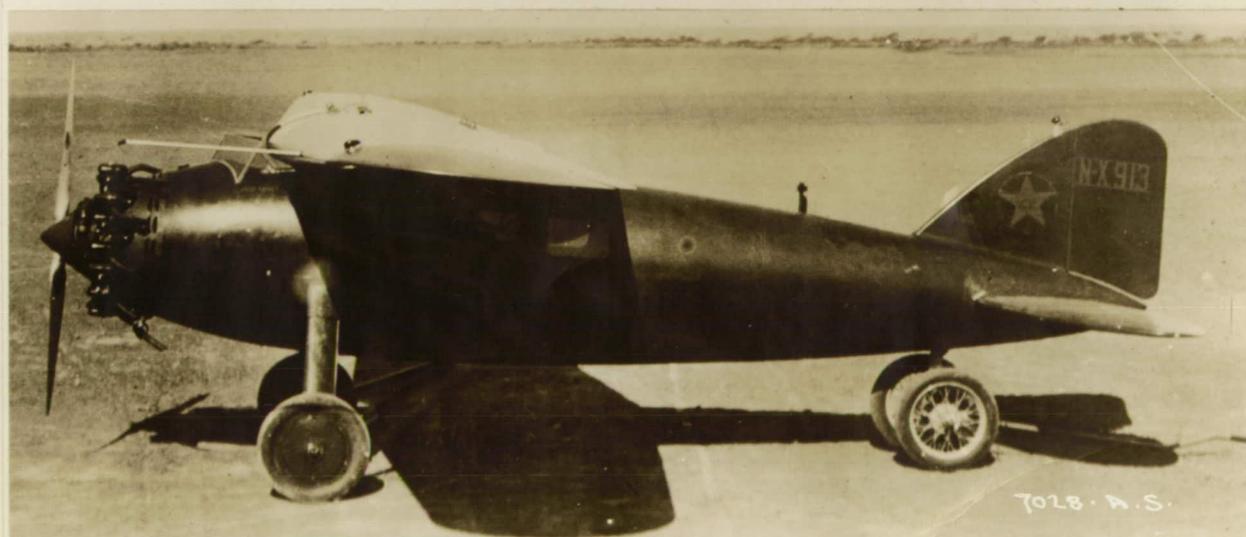


Fig.4

Lockheed "Vega" cabin airplane. Wright "Whirlwind" J-5 200 HP.engine.

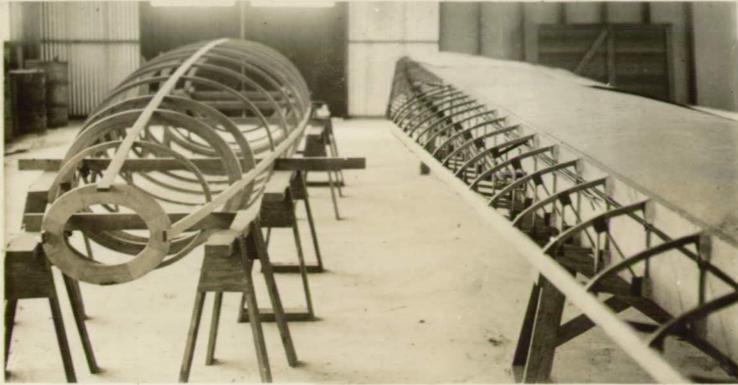


Fig.5

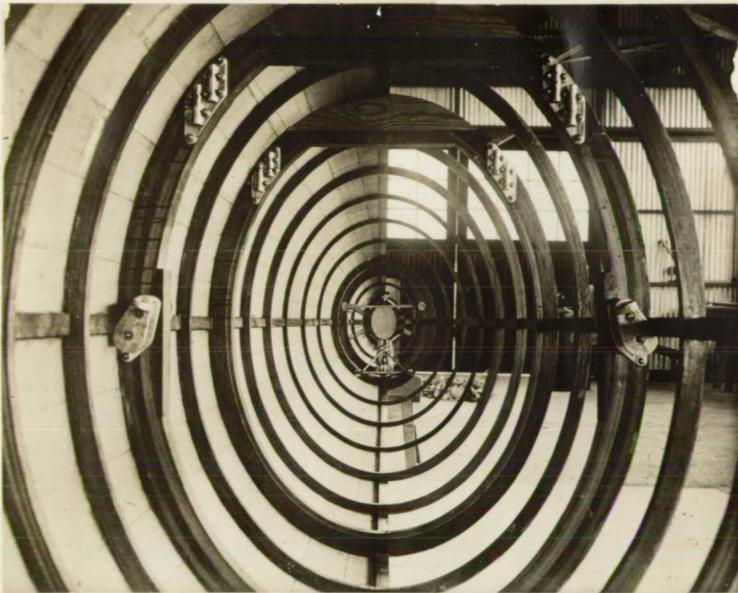


Fig.6

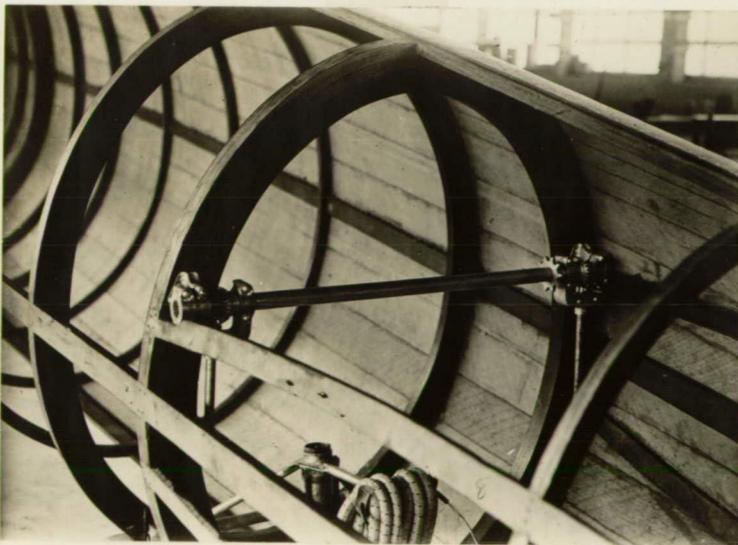


Fig.7



Fig.8

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Fuselage structure of the Lockheed "Vega" airplane.