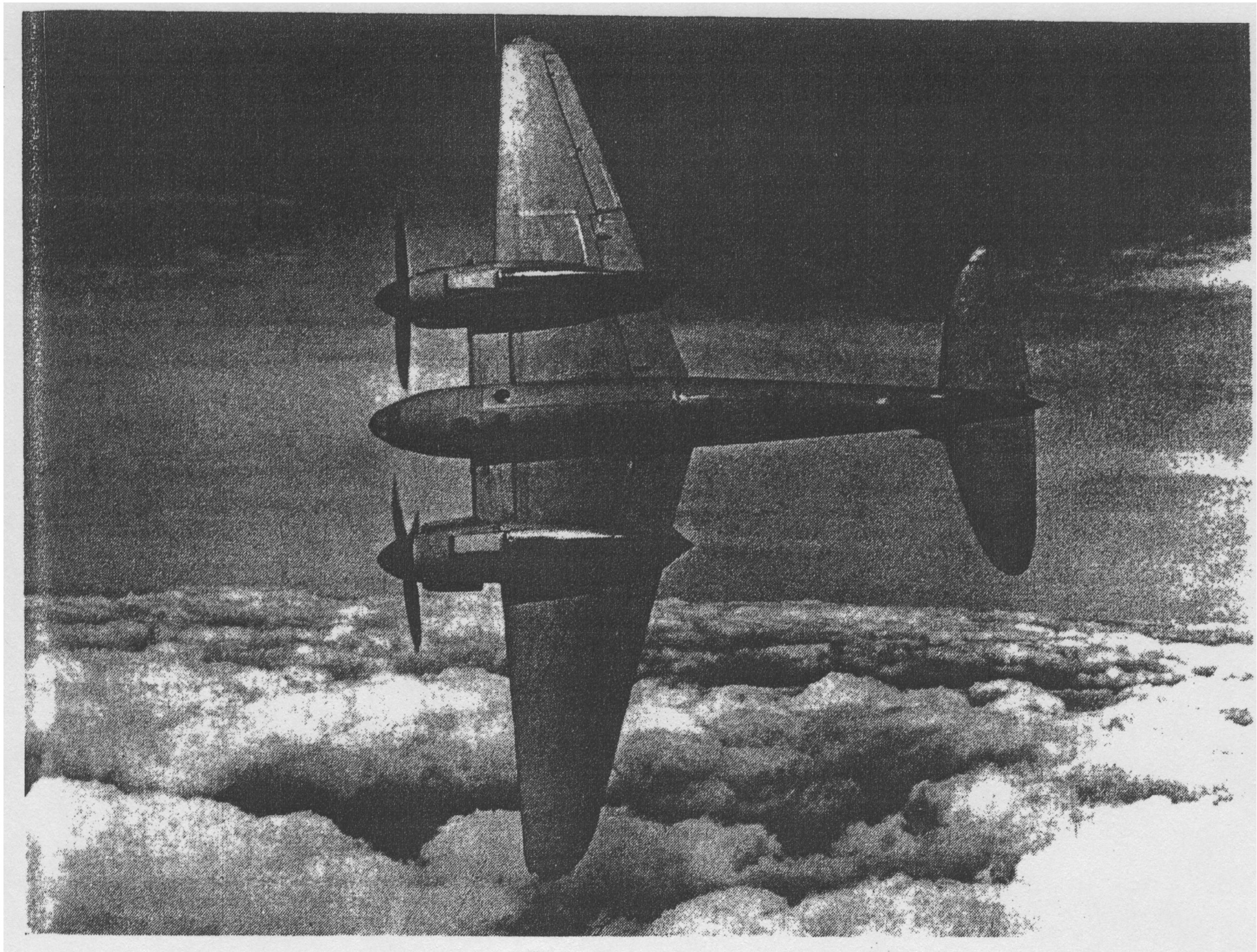
Editors note:

This Design Analysis article was originally published in the May and June, 1944 issues, Volume 43, numbers 5 and 6, of *Aviation* magazine, published by McGraw-Hill Publishing Company of New York, NY, USA. The production article is from the May, 1943 issue; the additional cutaway drawing is from the February, 1944 issue.

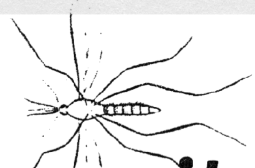
This reconstruction is derived from microfilm. The source is University Microfilms International, Publication No. 364 (*Aviation Week and Space Technology*), Reel No. 18 (January 1942 – December 1942) and Reel No. 20 (January 1944 – December 1944). The source was from tightly bound volumes, so that there is some distortion of the images, especially near the binding. It has not been practical to remove or compensate for all the distortions, so none of the illustrations in this reconstruction should be considered reliable sources as to fine details of shape, proportion or spatial relationship. The distortions are, in general, small, and should not detract from a general appreciation of arrangement and relationship.

The editor has attempted to represent the original layout of the article, but there are some exceptions. Limitations in the compositing tools cause a difference in the text flow relative to the illustrations, compared to the original, so that some changes have been made, to compensate partially for that effect, and the tabular data have been removed from the flow of text and brought together on a single page after the text, partly to make them more accessible, and partly to sidestep problems with page layout. Part I had two cut-away views; these have been moved as enlarged images to the end of the article, for easier reference.

This article was one in a series of design analyses published in *Aviation* during the war years, between May 1943 and November 1945. The subjects were the Bell P-39 *Airacobra*, Curtis C-46 *Commando*, Fleetwing BT-12, Douglas A-20 *Havoc*, Bristol *Beaufighter* (British), deHavilland *Mosquito* (British), North American P-51 *Mustang*, Lockheed P-38 *Lightning*, Focke-Wulf FW-190 (captured German), Boeing B-17 *Flying Fortress*, North American B-25 *Mitchell* (specifically, the B-25H and B-25J models), Mitsubishi “Zeke 32” *Hamp* (captured Japanese), Consolidated Vultee B-24 *Liberator*, Fairchild C-82 *Packet*, and Messerschmitt Me-262 (captured German), with one article dealing specifically with the Me-262's Jumo 004 jet engine. Some of the analyses were authored by senior members of the design teams at the original manufacturers, while others were written by staff editors of *Aviation* magazine.



DESIGN ANALYSIS NO. 6



DeHavilland "Mosquito"

PART I

By CHESTER S. RICKER, *Detroit Editor, "Aviation"*

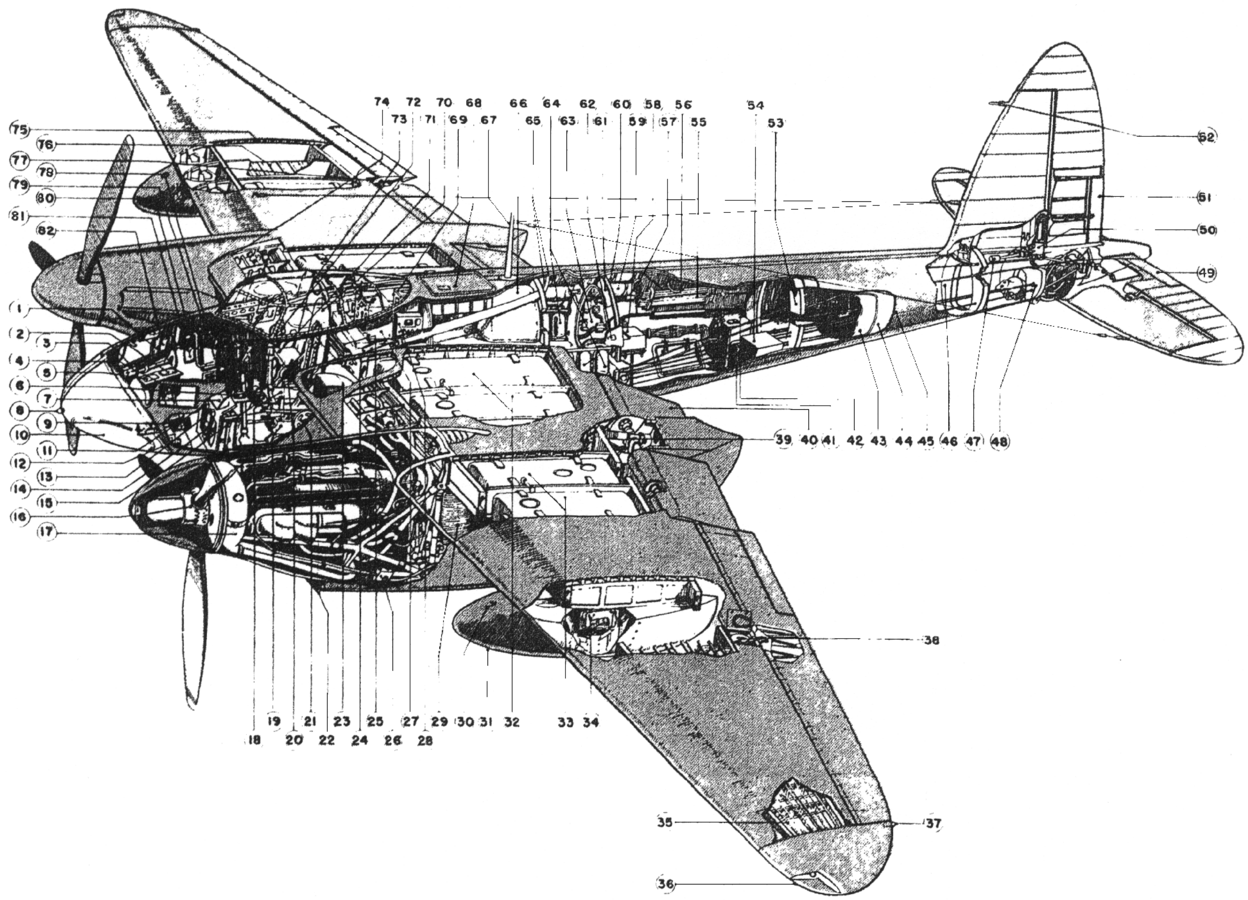
Continuing Aviation's comprehensive series, DeHavilland's famous all-wood fighter-bomber is torn down to design and construction fundamentals, revealing unusual thought and execution . . .First of a graphic two-part study.

ALTHOUGH the *Mosquito* performances make newspaper headlines almost every day, the background of unusual design which produced this airplane is not common knowledge. Neither are the details of its advanced all-wood construction, which is the culmination of 23 yr. of deHavilland experience with all-wood construction. It is of interest here to note that during this time all DH designs except one have been in wood.

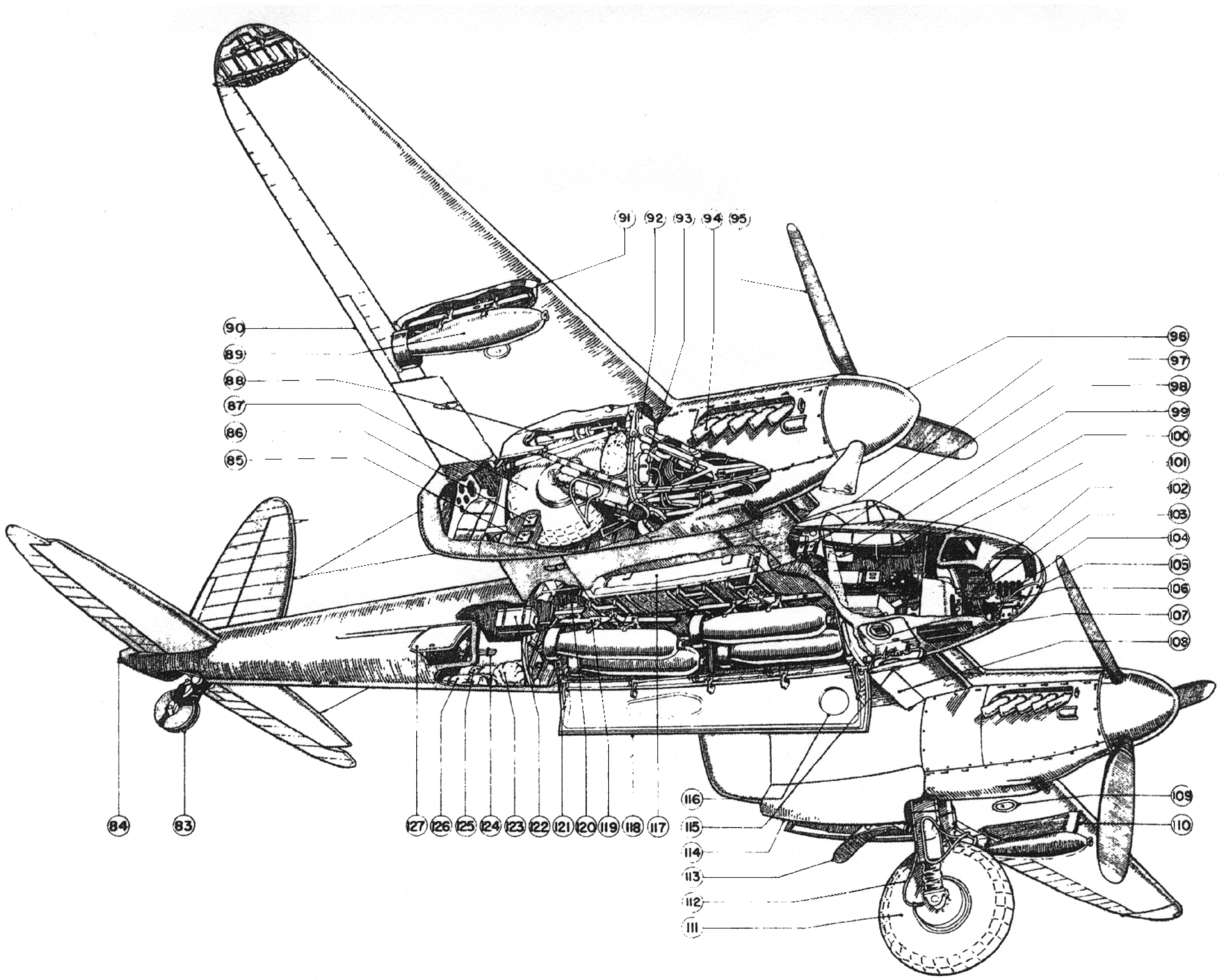
The ideas of Sir Geoffrey deHavilland and C.C. Walker, director and chief engineer, were presented to the British Air Ministry in Sept. 1939. Their aims were to create a wooden operational aircraft to increase air force strength without further strain on the metal industries, also to sacrifice armament for greater bomber speed.

The design was immediately begun, and in Dec. 1939 a layout was presented which has not yet been fundamentally changed — a twin-*Merlin*-engine two-man crew wooden bomber without armament, carrying a 3,000-lb. bomb load and having a 1,500-mi. range at fighter speed.

In spite of the fact that the company was rapidly expanding production of *Tiger Moths* and *Oxfords* for training purposes, once the *Mosquito* was proposed production was immediately started on the *Mosquito* prototype — the company's 98th design. Only 29



Upper and lower sectional views of Mosquito. References: (1) Fireman's axe; (2) bombardier's elbow pad; (3) intercom; (4) portable oxygen bottle; (5) bombardier's writing pad; (6) pilot's compass; (7) parachute stowage; (8) navigation headlight; (9) bombsight; (10) bombardier's window; (11) impact switch; (12) Plexiglas nose; (13) gravity switch; (14) fire extinguisher; (15) pilot's thigh rests; (16) Hydromatic propeller; (17) coolant header tank; (18) pilot's seat; (19) intercom; (20) engine controls; (21) elevator trim tab hand wheel; (22) carburetor air intake; (23) oil and coolant radiators; (24) pilot's harness; (25) throttle and propeller controls; (26) oil trap; (27) radio transmitter; (28) radio compass; (29) oil tank; (30) dump tank filler cap; (31) dump tank; (32) inboard fuel tanks; (33) outboard fuel tanks; (34) dump fuel tank release gear; (35) stringers; (36) navigation lamp; (37) identification lamp; (38) aileron control; (39) flap jack and crank; (40) flaps; (41) rear camera; (42) stowage for camera heating cables; (43) plywood inner skin; (44) balsa; (45) plywood outer skin; (46) bulkhead No. 6; (49) trim tab; (50) rudder linkage; (51) trim tab; (52) pitot head; (53) bulkhead No. 5; (54) camera mounting boxes; (55) spike pickets; (56) DF loop; (57) lamp; (58) radio; (59) compressed air container; (60) de-icing fluid tank; (61) bulkhead No. 4; (62) ground starter plug; (63) pneumatic hydraulic panel; (64) oxygen bottles; (65) hydraulic tank; (66) long range oil tank; (67) aerial mast; (68) dinghy stowage; (69) antenna loading unit; (70) pilot's armor; (71) observer's seat; (72) trailing aerial winch; (73) observer's armor; (74) oil and coolant radiators; (75) double top skin and stringers; (76) single under skin and stringers; (77) aileron tab control; (78) observer's demand oxygen regulator; (79) instrument panel; (80) camera temperature gage box; (81) camera leads stowage; (82) inspection lamp stowage; (83) tail wheel stowage; (84) navigation light; (85) stowage picketing eyes; (86) stowage, landing gear locking cap; (87) landing gear retracted; (88) landing gear jack; (89) 500-lb. bomb; (90) aileron trim tab; (91) universal bomb carrier; (92) firewall; (93) fire extinguisher; (94) stub exhaust; (95) propeller; (96) spinner; (97) cockpit canopy; (98) radio remote control boxes; (99) pilot's pouch; (100) pilot's demand oxygen regulator; (101) dimmer switches; (102) signal cartridges; (103) fire extinguisher; (104) thermos bottles; (105) glycol spray; (106) tail drift sight; (107) ladder stowage; (108) radiator flap; (109) landing light; (110) wing band fairing; (111) landing wheel; (112) brake hose; (113) mud guard; (114) landing gear doors.; (115) entrance door; (116) camera window; (117) center fuel tank; (118) bomb bay doors; (119) bomb carriers; (120) bomb winch; (121) bomb bay door lock; (122) ration container; (123) engine covers, sleeping bags, etc.; (124) locking controls, stowage; (125) signal strips; (126) emergency tool kit, and (127) rear entry door.



months after the design layout was completed, a full squadron bombed Cologne — on May 30, 1942.

Use of wood and employment of the wood working industries, it is felt, contributed largely to the speed with which the *Mosquito* was put into production. It is built in three types: Bomber, fighter and photo-reconnaissance.

The *Mosquito* now being constructed in North America by deHavilland Aircraft of Canada, Ltd. Launching of the Canadian version introduced many new engineering problems since all of the manufacturing equipment had to be purchased on this side of the Atlantic. This required a tremendous amount of re-engineering before attaining production. On this score, much credit is due W.D. Hunter, Canadian chief engineer; H. Povey, chief production engineer; F.H. Burrell, chief service liaison engineer, who came from the parent company in England; and W.J. Jakimiuk, chief Canadian design development engineer.

The power plant of the Canadian version consists of tow Rolls-Royce *Merlin* 31, 33, or 225 Packard-built engines, each rated at 1,260 bhp.

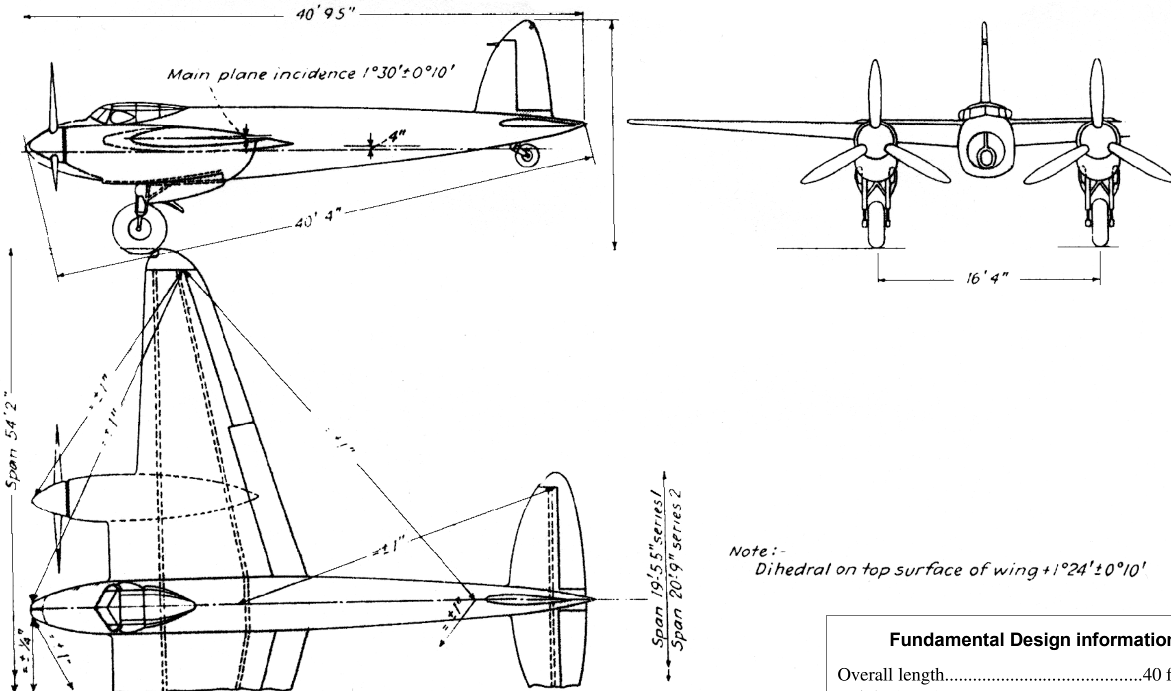
DeHavilland's long experience in building all-wood airplanes has been fully utilized. Chief feature of the design is the balsa-plywood sandwich principle used in constructing the fuselage and other structural wood parts. Prior to the war this fabrication was successfully applied to deHavilland *Albatross* four-engine transport.

Wood construction has many advantages, according to *Mosquito* designers. It materially reduced the time required to design and produce the prototype, compared with a metal ship. Wood design is also one of the quickest methods yet devised to produce a monocoque type unit, and by using split fuselage construction, the craft is one of the easiest in which to install equipment. It utilizes the skilled labor of wood-working trades, which were greatly curtailed by the war.

Structurally, the plane also has many advantages. Due to comparatively low skin stresses and light weight of the wood, it is possible to produce a fuselage that offers more resistance to buckling than a metal one of the same weight per square foot. The system of molding fuselages makes them remarkably free from "waviness." When finished, they are fabric covered.

The one-piece full cantilever wing is also of all-wood construction. It is formed on two full-length box-type wood spars. The top skin is made from two 0.25 in. plywood skins separated by Douglas fir stringers. Also of wood construction are the tailplane, fin, and flaps.

Engines and main landing wheels are mounted on the wings and completely streamlined by sheet metal



Fundamental Design information

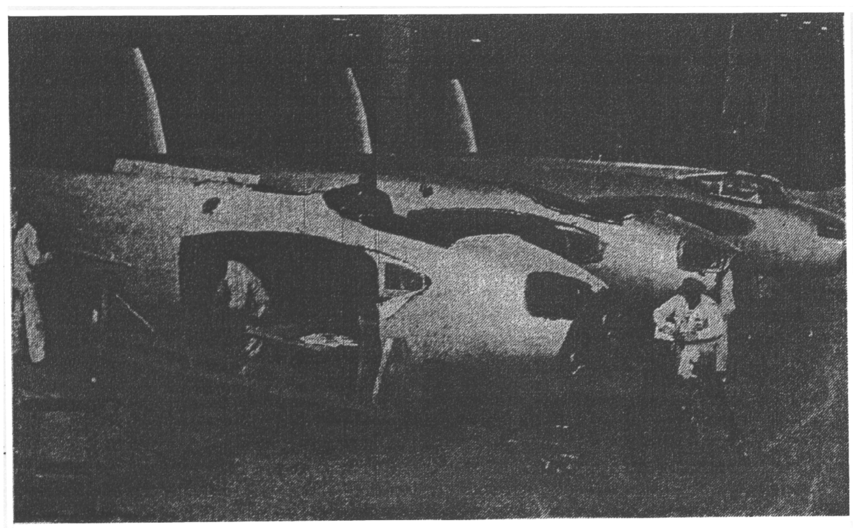
Overall length	40 ft. 9¼ in.
Height (max.) over fin and rudder	17 ft. 5 in.
Span	54 ft. 2 in.
Wing area (net)	440 sq.ft.
Taper ratio (root chord to tip chord)	3.2 to 1
Length root chord (25 in. from fuselage centerline)	12 ft. 3 in.
Length tip chord (300 in. from fuselage centerline)	3 ft 10 in.
Fuselage depth (max.)	5 ft. 5½ in.
Fuselage width (max.)	4 ft. 5 in.
Design gross weight, Canadian handbook	21,313 lb.

nacelles and folding landing gear doors. Inside the nacelles there is a metal bulkhead or firewall attached to the front wing spar. This is secured to the same brackets to which the tubular framework, which supports the engine in front and the main landing gear in the rear, is attached.

Engine coolant and oil radiators are mounted in the leading edge of the wing between the fuselage and each nacelle. Cooling air enters through a fixed opening in the leading edge and air flow is controlled by adjustable flaps on the underside of the wing. Provision is made to deflect a part of the radiator-heated air into the cockpit.

The landing gear is as unique as the rest of this all-wood plane. Here, rubber blocks are provided to cushion landing shocks. This rubber-block design is applied to both main landing and tail wheels.

How unusual the *Mosquito* design really is can better be judged by a careful analysis of the various unit which comprise the ship:

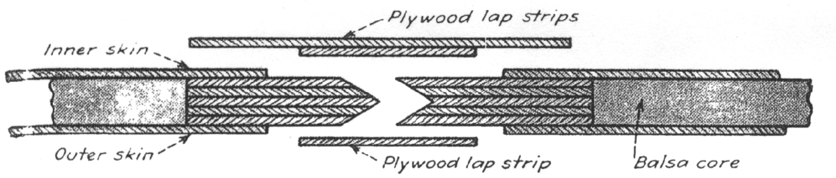


Fuselage as received from a subcontractor, with preparation for fitting windows, doors, and canopy before mounting wing.

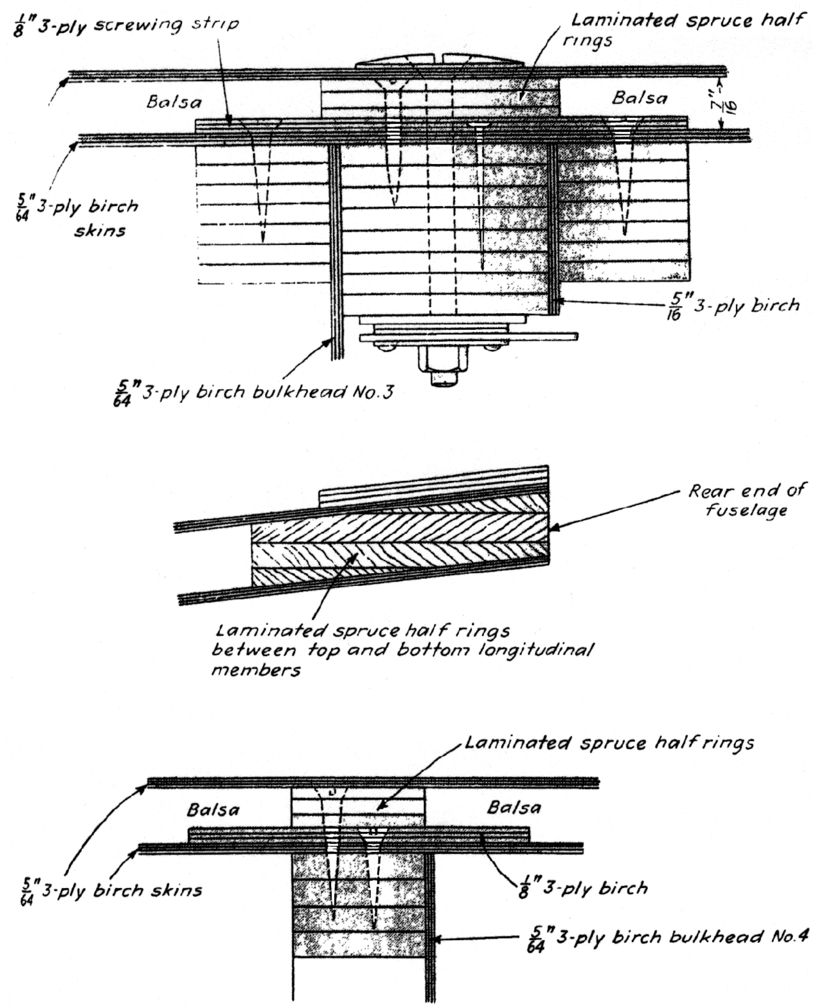
Design Features — Fuselage

The complete fuselage is made up as a balsa-plywood sandwich, the 0.437-in. balsa being compressed between two 0.062-in. 3-ply spruce or birch skins. Since balsa wood varies greatly in weight — from 5 to 30 lb. per cu. ft. — it must be carefully selected. Weight of that used in the *Mosquito* averages about 9 lb. per cu. ft. With a large volume used, this is an important item in the final weight of the ship.

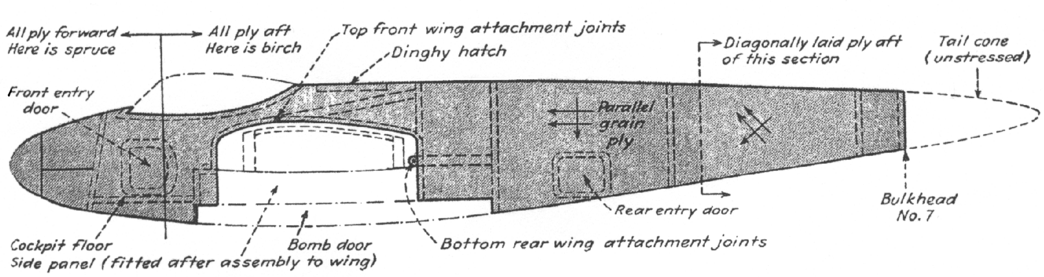
Kind of plywood and direction of grain is changed to suit stress conditions. in the section from mid-cockpit forward to bombardier's window, 3-ply spruce is used. Here the fuselage has a sharp compound curvature, requiring narrow strips, taper cut, with two plies lengthwise



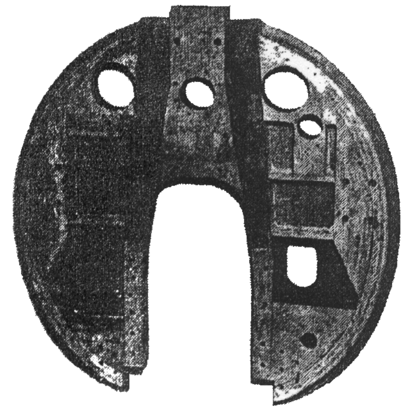
Details of skin joint where fuselage halves are mated. Plywood lap strips are glued and screwed into the shell members.



Methods of reinforcing monocoque walls at bulkheads.



Fuselage construction, showing general arrangement and location of bulkheads.



Detail of rear bulkhead No. 7, looking forward. Left half is shown with plywood facing removed to reveal material and structure.

as the first one applied.

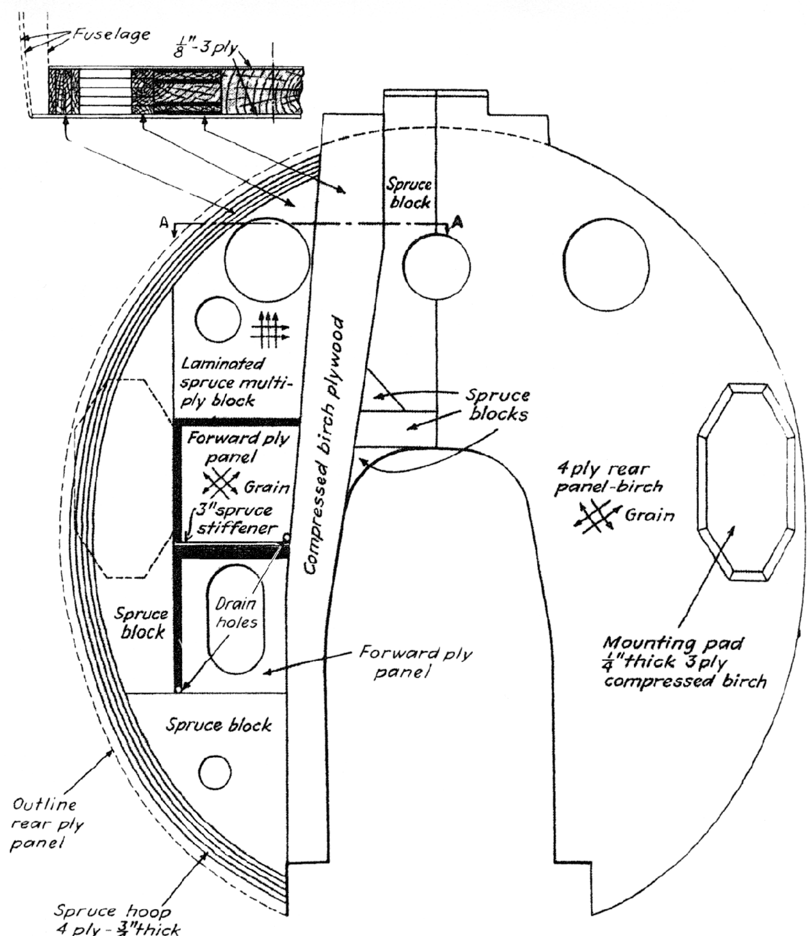
Union of the two halves does not depend entirely on bonding of these top and bottom edges. Of the seven bulkheads, six are made in halves and have a butt joint on the vertical centerline of the fuselage. The rear No. 7 bulkhead is made in one piece and inserted at the time the two fuselage halves are mated.

Wherever there is a bearing between parts that are bolted or fastened together, fabric reinforced Bakelite is used to prevent compression of the softer wood at these points. The Bakelite is faced with 0.50-in. birch veneer to assure a secure bond when glued to plywood members.

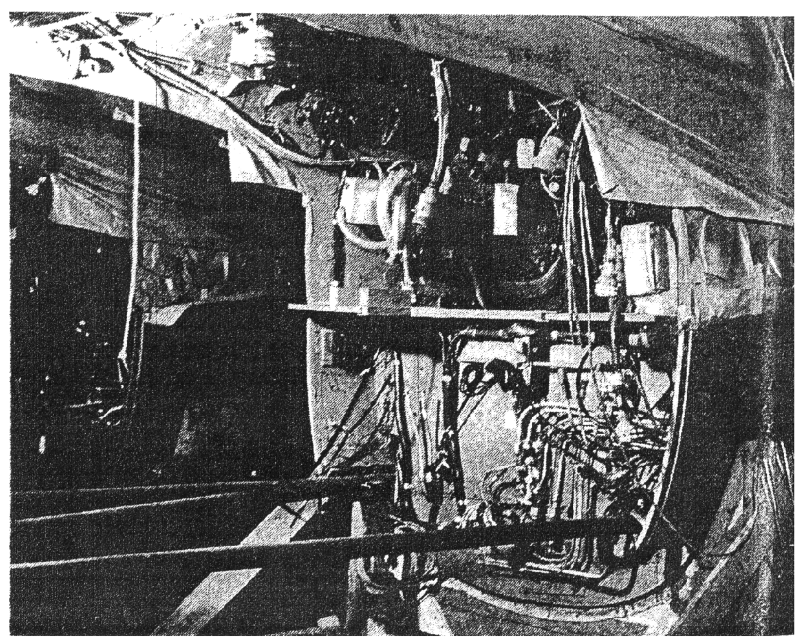
Ends of the fuselage are reinforced by laminated and formed half circles glued between the inner and outer skins. They are of the same thickness as the balsa core. All openings are reinforced around the edge by solid spruce, walnut, or laminated and formed members. In addition, two stringers are built into each half and extend from No. 3 bulkhead to No. 7. These are buried between the skins in the balsa core. Only external stiffening member is a long half-round piece on the left side of the fuselage rear above the rear entry door. The upper stringers tie int No. 3 bulkhead and run forward about 1 ft. to include the rear end of the wing pickup member.

Bulkheads

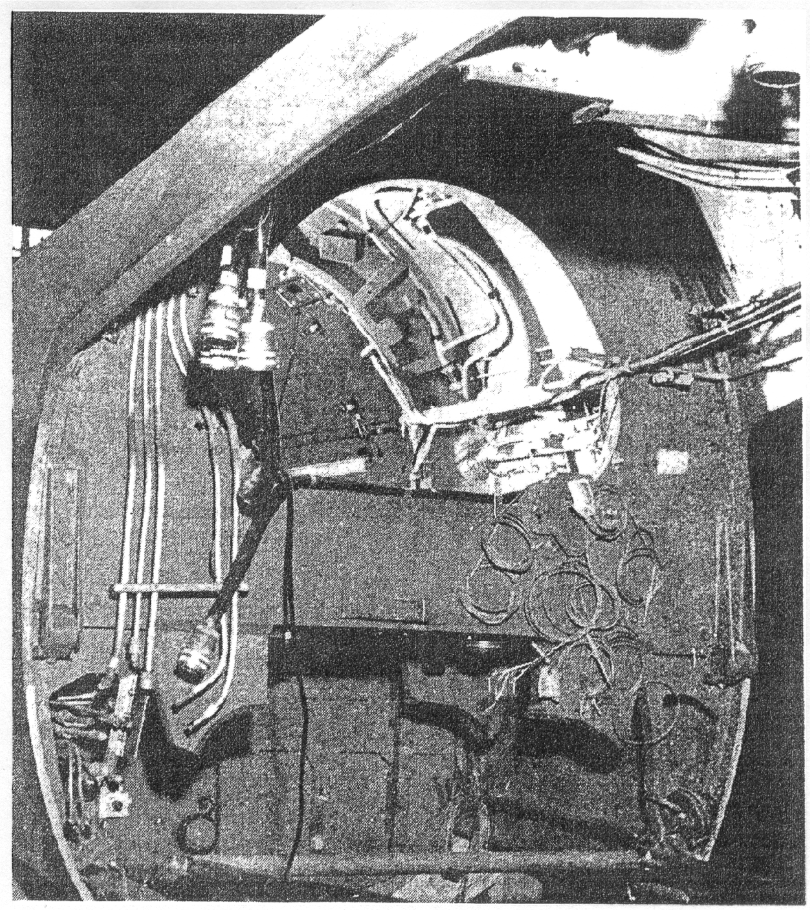
Method of assembling bulkheads is the same for all except No. 7. Intermediate bulkheads are all located in their proper stations in the fuselage



Rear Face of Rear Bulkhead
Looking Forward



Looking forward into nose section, showing cockpit, also No. 2 bulkhead fittings which are installed prior to mating with wing. Note tubular bracing which supports fuselage.


View aft of wing opening, showing bulkheads 3 and 4, fittings for picking up rear spar, and wing centering bracket. Note how all cables, tubes, and fittings end here for easy installation of wing; also temporary tubular braces are attached to bomb door hinge brackets.

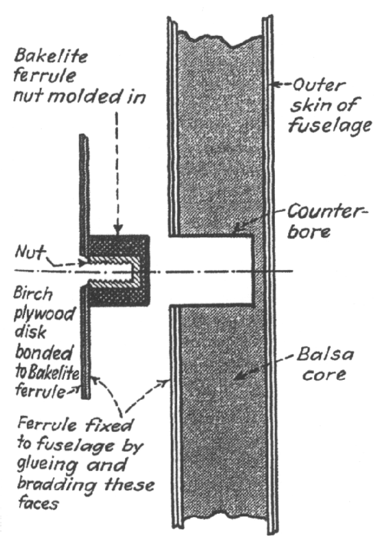
build-up mold, and the inner skin is stretched over them. Glue and screws are both used for attaching skin to bulkhead. There is a 0.12-in. 3-ply screw strip approximately double the width of the bulkhead thickness glued to the inker skin, through which are driven screws to secure bulkhead.

Next, formed laminated spruce semi-circular pieces of same width as the bulkhead are glued and screwed on top of the first strips and are also screwed directly into the bulkhead. Combined height of the two pieces, attached to the bulkhead but outside the inner skin, is equal to the balsa core. These bulkhead reinforcements are stopped off at the stringers.

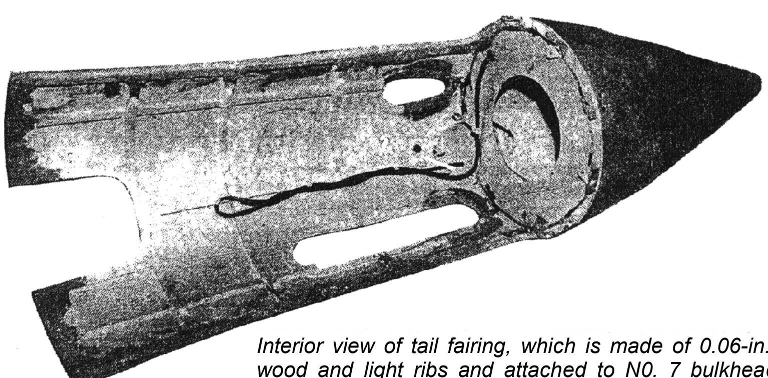
The front floor forward of bulkhead No. 2 reaches form side to side of the fuselage, and when joined with No. 2 bulkhead and instrument panel structure it greatly stiffens the front section Bulkhead No. 3 carries at its outer lower corners the heavy reinforcements to which the lower wing pickup brackets are bolted. These are attached not only to the bulkhead but also to the side of the fuselage and forward ends of the lowest stringers built into the aft section. These stringers are of larger section for about 40 in. aft of the bulkhead in order to distribute stresses over more of the fuselage at this point.

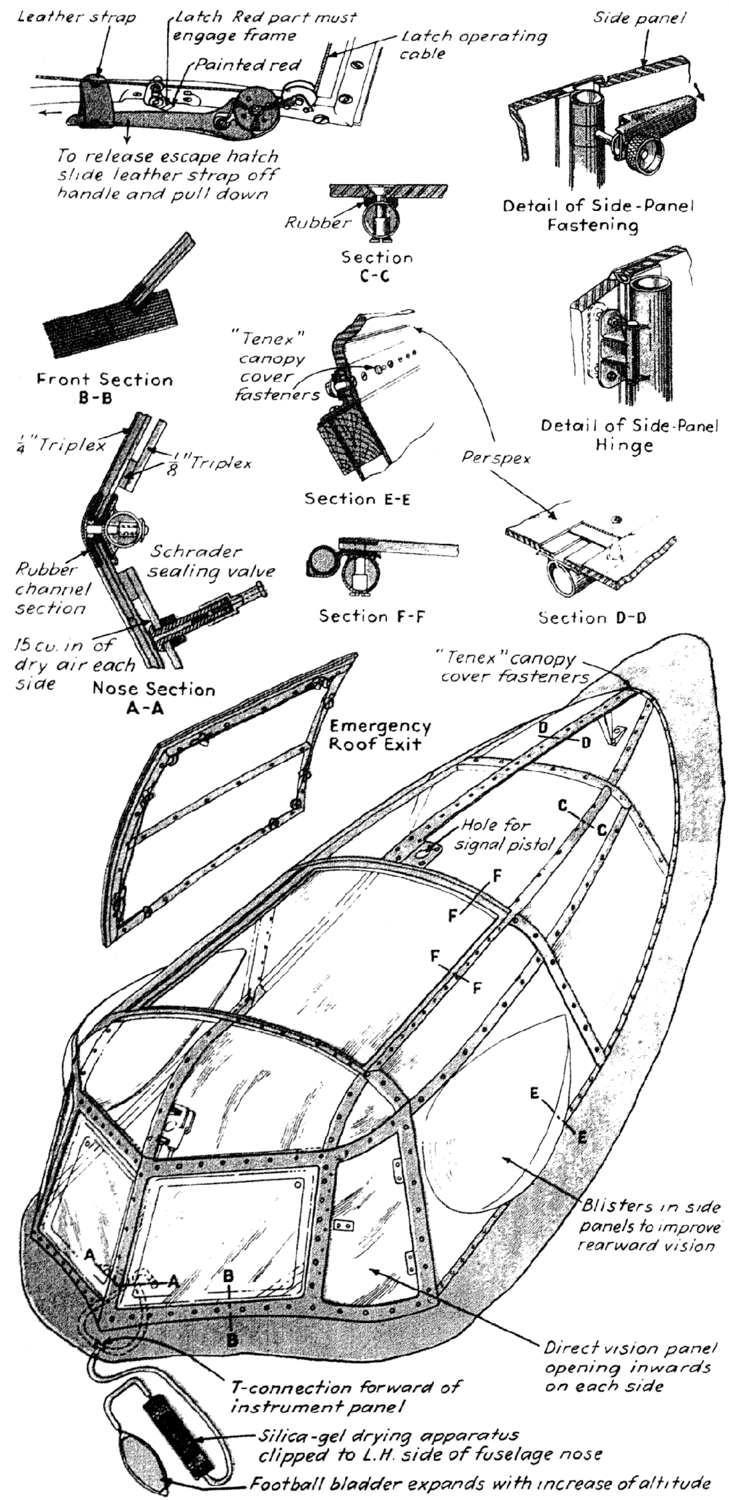
Probably the heaviest load of any member in the fuselage is carried by the rear bulkhead, for it supports the tailplane and tail wheel, also shares fin and rudder reactions with bulkhead No. 6. It is a composite structure built up of many types and forms of wood. Spruce blocks, either solid or laminated, are provided for certain parts. The outside *edge* is made from a 4-ply spruce half ring. The two members which run vertically on either side of the opening are compressed birch plywood. At top they support the rear bracket of the fin, while at the bottom they carry the tailwheel bracket and tailplane rear spar braces. the whole unit is tied together by 0.12-in 3-ply birch facings glued to each side.

The side panels which finally close the opening below the wing are held in place by a 2.0 x 0.12-in aluminum plate which covers the front end gap. This end plate is securely bolted. At the rear end,two 1.62 x 0.06-in

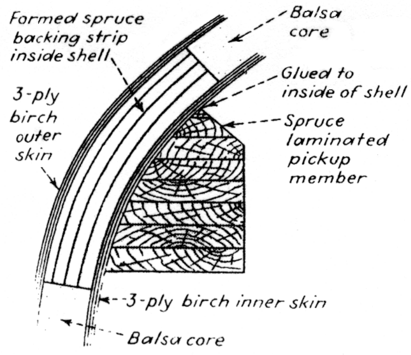


Unique method used in fastening accessory mounting units in wall of fuselage.


Interior view of tail fairing, which is made of 0.06-in. 3-ply wood and light ribs and attached to N0. 7 bulkhead with Dzus fasteners.



Construction of cockpit canopy showing use of air space in triple plate windshield, also method of evacuating air to prevent fogging in cold or high altitudes.

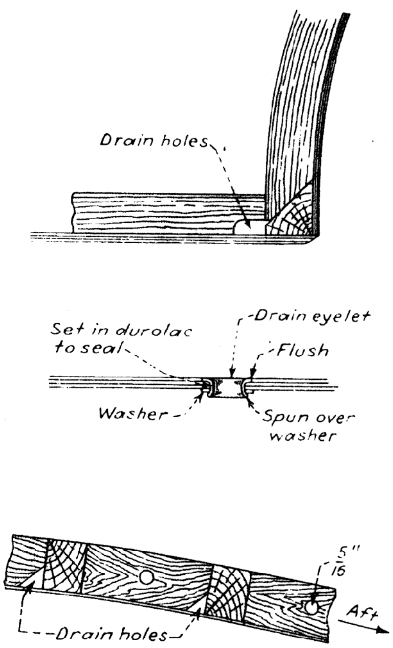


Section through fuselage shell where spruce wing pickup member is screwed and glued to it. This important part carries front wing attachment joint.

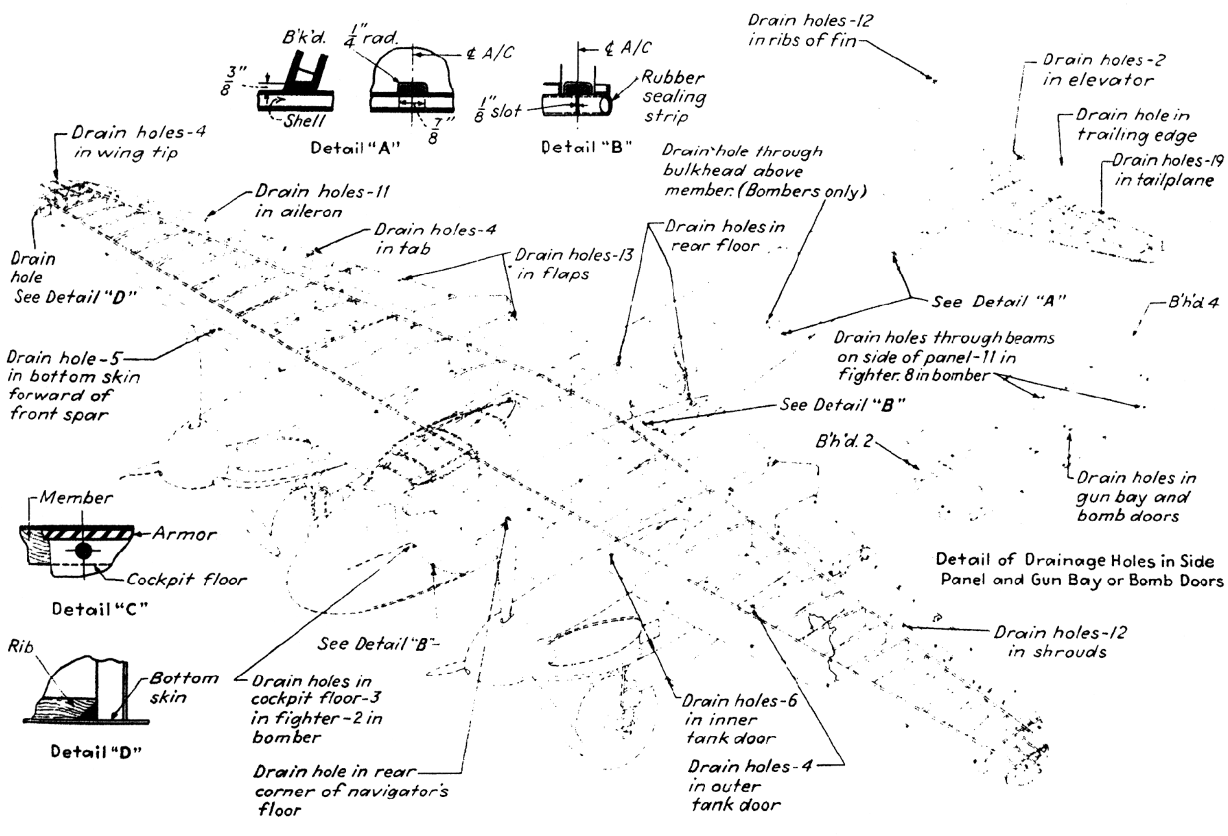
The triple-plate anti-fogging "V" windshield windows incorporate a unique system for exhausting the air space between them. Each is connected by a tube with a Schrader air valve. Air can be sucked out but its return is prevented by the valve. A small bladder attached to the outlet tube provides the exhaust system. It expands as the ship climbs, thus the air is sucked out of the hollow windshield. A tube of silica-gel is inserted in the suction line so as to remove moisture contained in the air within the windshields.

Wing pickup members are built up from 0.4-in. laminated spruce with the brain running lengthwise in all plies. The pickup member extends forward from bulkhead No. 3 to the point where it is bolted to the fitting that is mounted on top of the front main wing spar. The adjustable fitting which is bolted to the wing clevis bracket is secured to the wooden pickup member by top and bottom plates. The pickup at this point is also secured to the side of the fuselage by five through-bolts with a metal compression plate inside the fuselage as a bearing for the nuts.

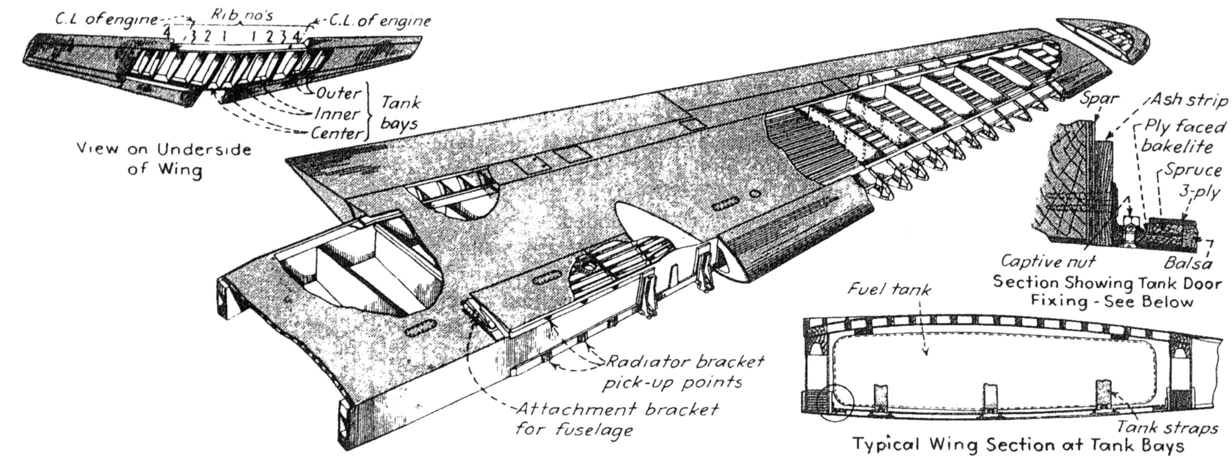
The wooden pickup member is care- fully fitted to the inside of the fuselage and then screwed and glued to the inside skin. A formed 4-ply spruce backing strip forms the core of



Types of drainage openings used.



Location of drain holes. (An all wood airplane, although protected by paint, must also be perfectly drained. Even parts not exposed may absorb moisture condensed within, so that every point of possible collection must be included.

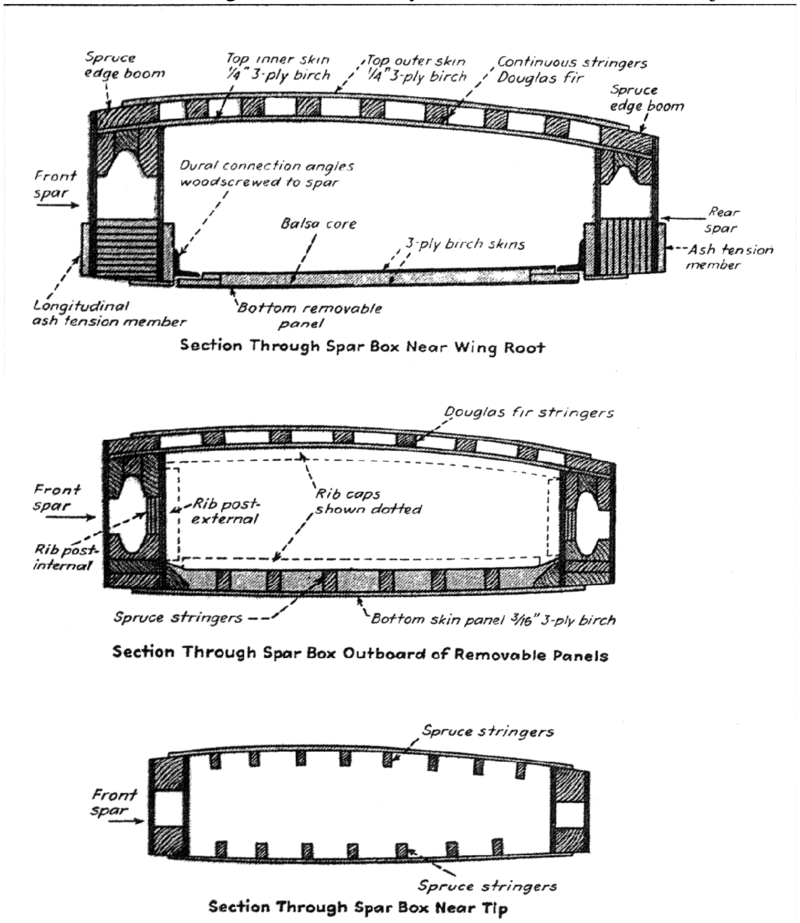


Airfoil Data

Root airfoil, Piercy Modified	Section RAF 34
Tip airfoil, Piercy Modified	Section RAF 34
Root chord (outboard of airplane centerline)	25 in.
Tip chord (outboard of airplane centerline	300 in.
Wing area (net)	440 sq.ft.
Angle of incidence	Plus 1½ deg.
Dihedral (measured on top face of front spar)	1 deg. 24 min. ± 10 min.
Sweepback at rib No. 4	2½ deg.
Aspect ratio	6.67
Aileron area (two ailerons)	34.4 sq.ft.
Aileron location (distance from fuselage side to centroid of aileron area)	196.2 in.
Aileron static balance, approx	6 percent mean
Trim tab chord (chord aft of aileron hinge line is 0.8 in.)	4.3 to 4.5
Trim tab span	41.37 in.
Trim tab area (each tab)	1.1 sq.ft. (total 2.2 sq.ft.)

the fuselage behind the pick-up member. This is glued and screwed in place before the outer 3-ply skin is applied.

A serrated block, tapped out for the adjustable pick-up fitting, is secured between top and bottom metal plates by through-bolts. Transverse grooves relieve the holding bolts of any shearing stresses in a fore and aft direction. The adjustment is ingenious. A sleeve is threaded inside and out with a hex nut on the end. The threads are of opposite hand to the sleeve acts like a turnbuckle. Check nuts are provided on both sleeve and bolt so the whole nut can be locked when adjustment is complete. The wing holding nut is slipped in place through a hole provided in the fuselage skin and secured by a castellated nut.



Three sectional views through spar box.

Drainage of a wooden ship is of vital importance. There are scupper holes provided between ribs and spars or similar members, throughout fuselage and wings. Holes with flush eyelets are provided at all drain points.

Bonding is another one of the vital features on a wood ship. Every metal bracket or metal part is connected to every other one by flexible metallic tape. This is usually glued to wood members before they are painted. Bonding is soldered to all permanent metal fittings to assure a perfect electrical connection

Main Wing

This is the main load carrying structure of the *Mosquito*. It carries the engines, landing gear, radiators, gas and oil tanks, and the bomb racks. It is guilt up as a single unit to which the wing tips, leading edges, and control surfaces are added. The all-wood fuselage is lowered on top of the center section, to which it is secured by four pick-up bolts and a centering bracket.

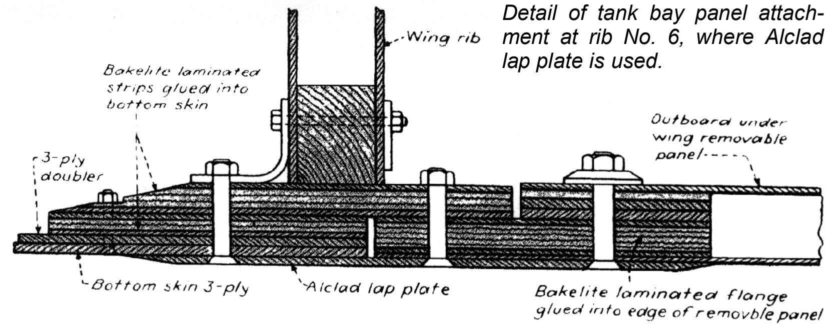
Briefly, the wing from tip to tip is built on two huge box spars with 0.25 plywood webs and laminated spruce flanges. Top of the wing is of double thickness reinforced by spanwise Douglas fir stringers sandwiched between two layers of 0.25-in. 5-ply birch. The leading edge, of formed plywood, is attached to the front spar. Bottom of the wing, composite in construction, provides openings through which the tanks may be introduced. These are closed by stressed skins bolted to the spars and to adjacent ribs.

From the outermost fuel tank to the tip, the plywood under-skin is permanently secured tot he wing and also reinforced by spanwise spruce stringers. The complete wing is blued, screwed and bolted together and when finished is fabric covered, doped, sanded, and painted until it is exceedingly smooth. The flaps and ailerons and their fairings are attached to the rear of the spar box.

The section of the wing spar box varies at different points along the wing span. Typical section between the center of the wing and rib No. 6 is shown in Fig. 6A. This part of the wing takes loads from the fuselage, fuel tanks, engines, and undercarriage. The top section is made of two plywood panels with stringers running lengthwise between the panels. The bottom section is composed of detachable panels made as plywood-balsa sandwiches.

The box spar section of the wing between ribs 6 to 12 is shown in Fig. 6. Top skin is of the same construction as between the center and rib No. 6; bottom skin is fixed and made of a single panel of plywood with longitudinal stringers. From the 13th rib to the wing tip there are only single plywood skins on top and bottom of the wing.

Each spar consists of two flanges of booms, top and bottom, jointed by two 0.25-in. 5-p;y birch webs on each side. These vary in height from about 16 in. at the root of the wing to about 5 in. at the wing tip end. In plan view, the spars also taper from root to tip. The front spar varies in width from 4.37 to



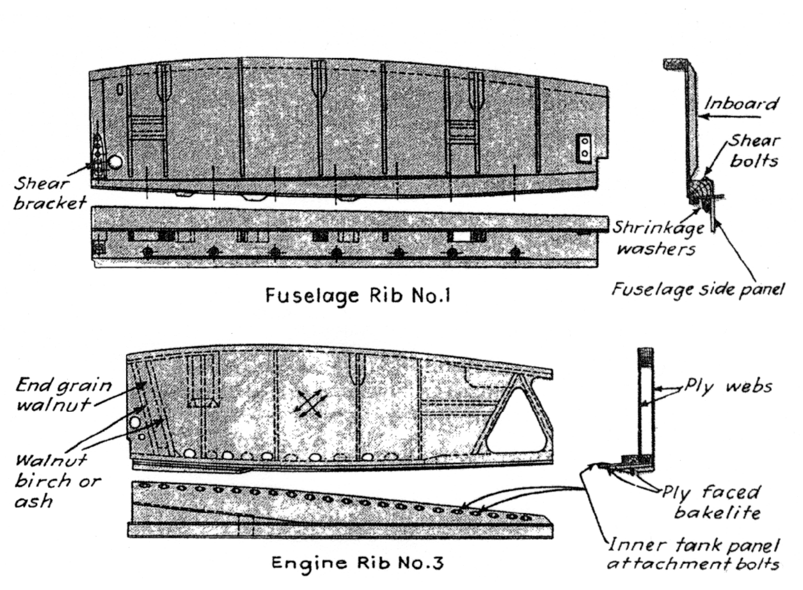
Detail of tank bay panel attachment at rib No. 6, where Alclad lap plate is used.

1.26 in. At the bottom edges of each spar in the load carrying section long 4-ply-ash tension strips are added for reinforcement. Top flanges of both front and rear main spars are made from three laminations of 1.5-in. thick spruce, scarfed and spliced together vertically in the thickest section. Flanges are approximately 4.37-in. wide and 3.62-in. deep. They are lightened between the points of rib attachment by spindled slots approximately 2.12-in. deep, with 3.62-in. openings, and with 25-deg. tapered sides.

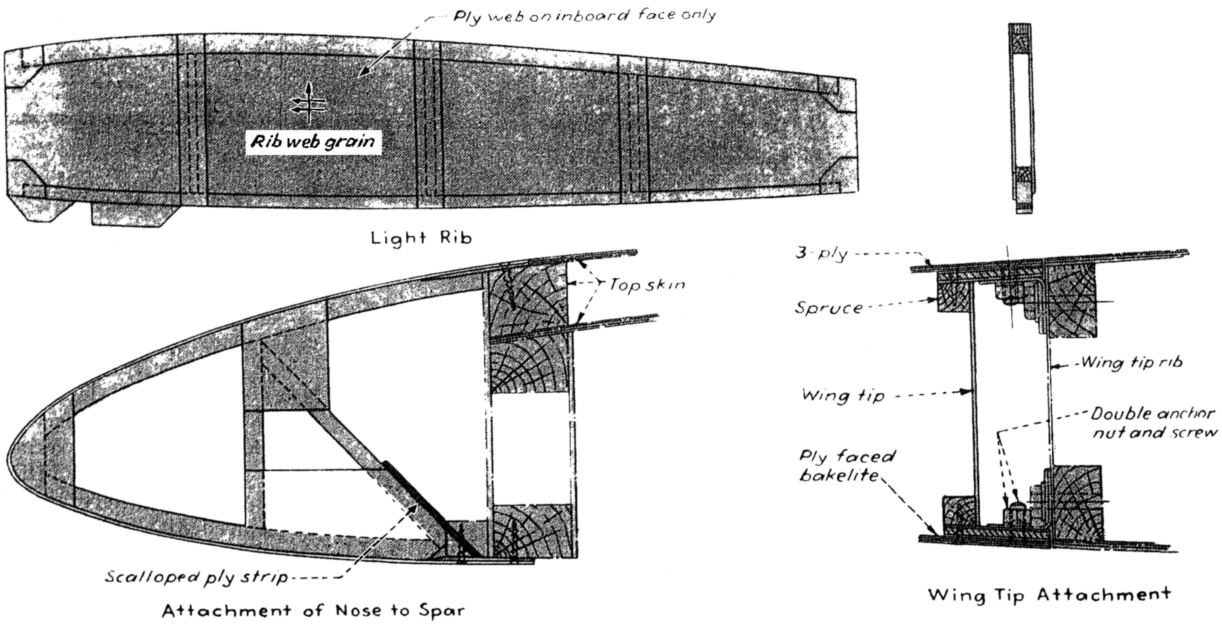
Lower flange of the front spar is made of 0.4-in. horizontal laminations. In the rear spar, the lower flange has vertical laminations in order to facilitate fabrication. The front spar is practically straight all the way across the wing. The rear spar, although parallel to the front one throughout the center section of the wing for about 5 ft., sweeps forward at an angle of about 10 deg. on either side of the mid-section and also upward at an angle of about 3 deg. The vertical laminations in the rear spar are more easily formed to these angles.

On the face of the front spar, hardwood or Bakelite backings are used to distribute pressure of the metal brackets that support the landing gear. On the inside of the rear spar, similar packings are provided where the landing gear brackets are attached. Space between the vertical 3-ply sides of the spar is filled in at each main rib, also wherever a bracket is applied. Additional vertical spacers are found at ribs 1, 3, 4, 6, 9, 14, and 16, and between 11 and 12. Where possible the upper flange is spindled out between them.

The lower front flange is built up in three sections, the major one at the center with horizontal 0.4-in. laminations that extend approximately to rib No. 6. Then three heavier laminations are used until the spar becomes a solid piece from rib 12 to



Wing details. Note heavy ribs.



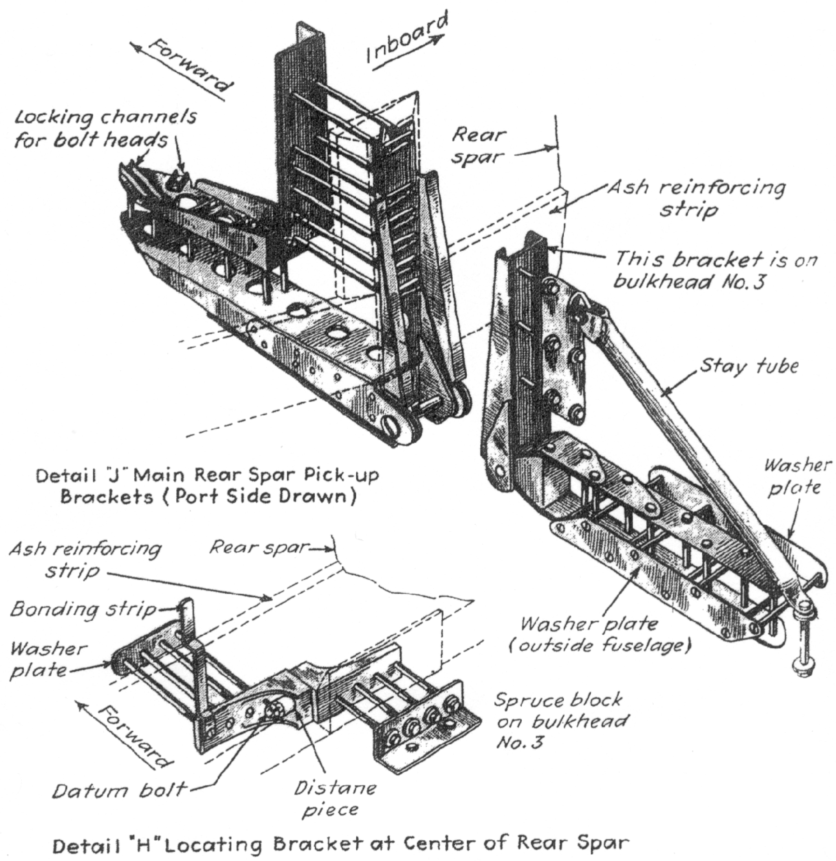
Light ribs and attachment of leading edge and wing tip.

the tip. Long scarfs of 1/15 ratio are used at the transition points. Provided at rib attachment points on the inside of the wing spars are 1-in. square vertical spruce blocks. These are screwed through the plywood to a similar block on the inside, at points where the screws do not enter either the top or bottom boom. The ribs are glued and screwed to these spruce blocks. The plywood web grain runs diagonally when the spar is in its horizontal position..

Double Skin on Wing

Top skin of the wing is made up of two ¼-in. 3-p;y birch skins separated by 1.3-in. maximum thickness Douglas fir stringers that extend spanwise from tip to tip. At each edge there is a wide spruce boom (between the two skins) that is superimposed over each spar, thus adding to their strength. In between the wide-edge boom fifteen narrow Douglas fir stringers are equally spaced. At the center section of the wing they are parallel to one another, but outboard of the fuselage, although equally spaced, all incline together at different angles. For reference purposes they are numbered from 1 to 15, No. 1 being the first aft of the front edge spar.

These stringers have to be bent at something less than 10 deg. between wing ribs 1 and 3. They are spliced in



Metal fittings which form lower rear connection between fuselage bulkhead No. 3 and lower rear edge of rear wing spar.

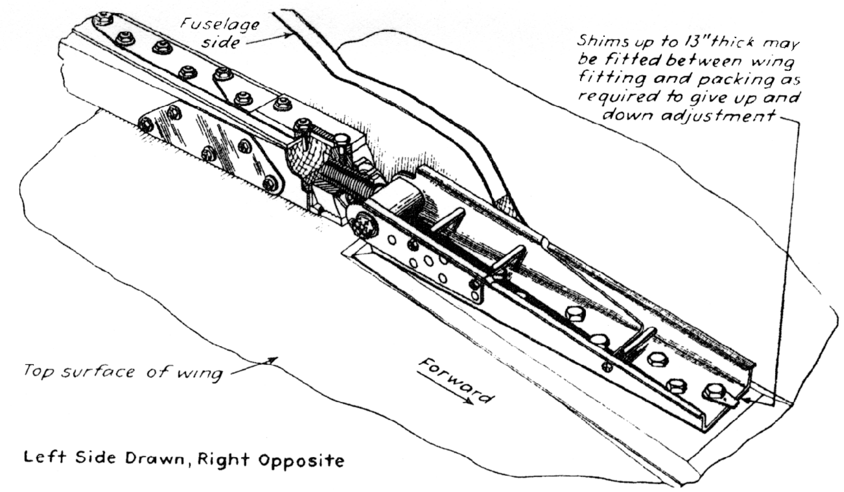
this section to facilitate making the bend, also increasing their effective width at this point where maximum strength is needed. Stringers 1 to 4 and 11 to 15 are 1.0-in. wide, while 5 through 10 are 1.6-in. wide. At the root of the wing they are spaced approximately 4.37 in., center to center. At rib 3 the spacing, due to wing taper, has been reduced to about 3.82 in. Outward of rib 6 all 15 stringers are the same width, 1.0 in. Incidentally, rib 6 forms the outboard wall of the most outboard fuel tank. Between ribs 8 and 9, stringers 7 and 13 terminate and stringers 4 and 10 end on rib 9, so that only 11 pass beyond this point. At rib 11 all stringers have been reduced to 1.0-in. thickness and 0.75-in. width. At this point the 1.0 x 0.5-in. stringers start, and spacing is about 2.30 in. Spruce is specified for the 0.75- and 0.5-in. stringers instead of Douglas fir. Between ribs 13 and 14, stringers 1, 6, and 12 terminate, while between ribs 14 and 15 stringers 3, 9, and 15 stop. This leaves 2, 5, 8, 11, and 14 to end on wing tip rib No. 16.

The stringers are separated by wood blocks over ribs 1, 3, 4, and 6 and the top skin is bolted through to the rib at these points. Elsewhere the top and bottom skins are screwed to the stringers after gluing. Screws are put in at intervals of 3 in., the upper and lower skin screws being offset 1.50 in. to distribute the load evenly and prevent interference. At ribs where there are through bolts, the wood screws are left out.

Double top skin ends between the 12th and 13th ribs. From this point outward there is only a single top skin. Near rib 8 the single top skin is spliced into the top dual skin with a full 3-in. scarf.

The single under skin, 0.187-in. thick, is made from 3-ply birch reinforced with spruce stringers. This skin extends from rib 6 to the wing tip and is glued and screwed permanently in place.

The bomb bay doors enclose the center section of the wing from port rib 1 to starboard rib 1. From rib 1 outward, both sides of the wing follow the same pattern so that description of one serves for both. The space between ribs 3 and 4 forms the wheel well. Between ribs 1 and 2, 2 and 3, 4 and 5, and 5 and 6, four fuel tanks are suspended from the ribs in each side of the main wing. The landing gear is enclosed by a metal fairing, hence this portion of the wing bottom surface does not have to be covered. The four fuel-tank access openings, however, must be closed.



Front attachment joint between wing and fuselage, showing metal bracket fastened to front rib of pickup member and bracket bolted to wing above front spar.

One cover panel serves to enclose the two fuel tank openings inboard of the wheel well; a similar one protects the two outboard tanks. These give a perfectly smooth bottom to the wing where they are attached, since flush screw heads are provided and the edges are faired into the wing.

Like the fuselage, the tank-bay covers are plywood and balsa sandwiches. The main constructional feature is use of laminated fabric reinforced Bakelite sheets having a 0.050-in. birch veneer facing for bolting strips. This permits gluing Bakelite to edges of the tank-bay panels and to bottom skin of the wing where the bolted joint is made. The Bakelite has a bearing stress value of 35,000 psi. and provides a non-crushable bearing for attachment screws. For further protection and strength, Alclad lap plates are provided, with three rows of counter-sunk bolt holes for the joint along the edge of rib 6. The nuts are held captive with metal covers riveted to structural rolled aluminum angles. These angles are fastened to the inside faces of front and rear spars by wood screws. The angles are made up in 1-ft. lengths and each carry four fastened nuts. Dividing these angles into sections allows for any expansion or contraction of the wood. The angles are mounted in the 3.0 x 0.5-in. ash tension members at the lower edge of each wing spar.

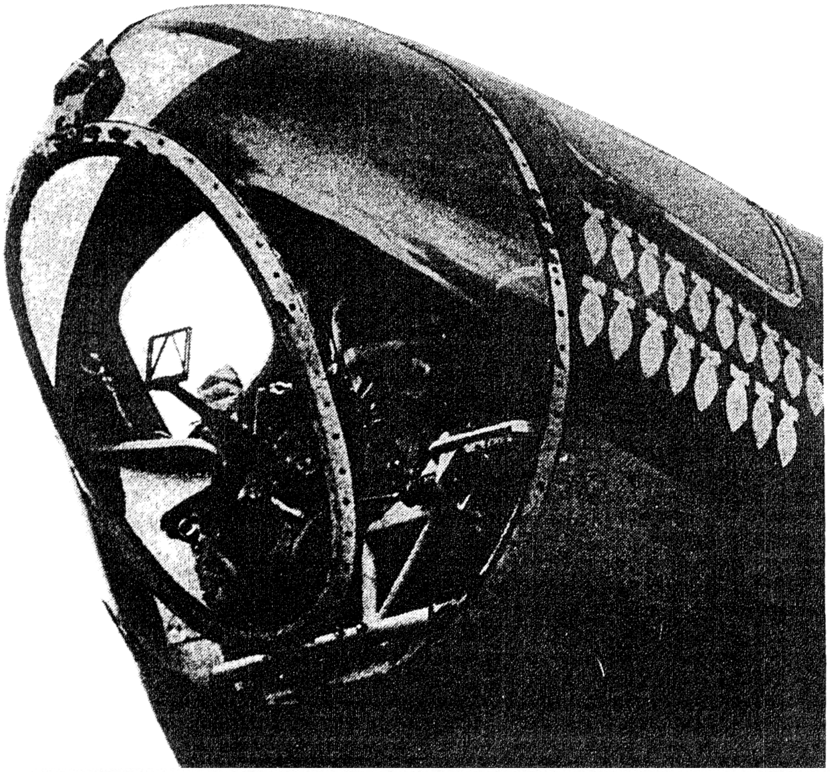
Attachment nuts along bottom edges of the ribs are riveted to wood ply-faced Bakelite flanges glued to the ribs. The intermediate rib between the fuel tanks also has a series of fastened nuts, so that the center of each panel is secured by bolts, with bottom of the rib accurately positioned. These Aerotight nuts are fastened either with wood screws, rivets, or bolts.

Wing Ribs

There are three types of wing ribs: No. 1 or fuselage rib, the double sided or box type ribs such as are used on each side of the wheel well, and the open faced or light ribs.

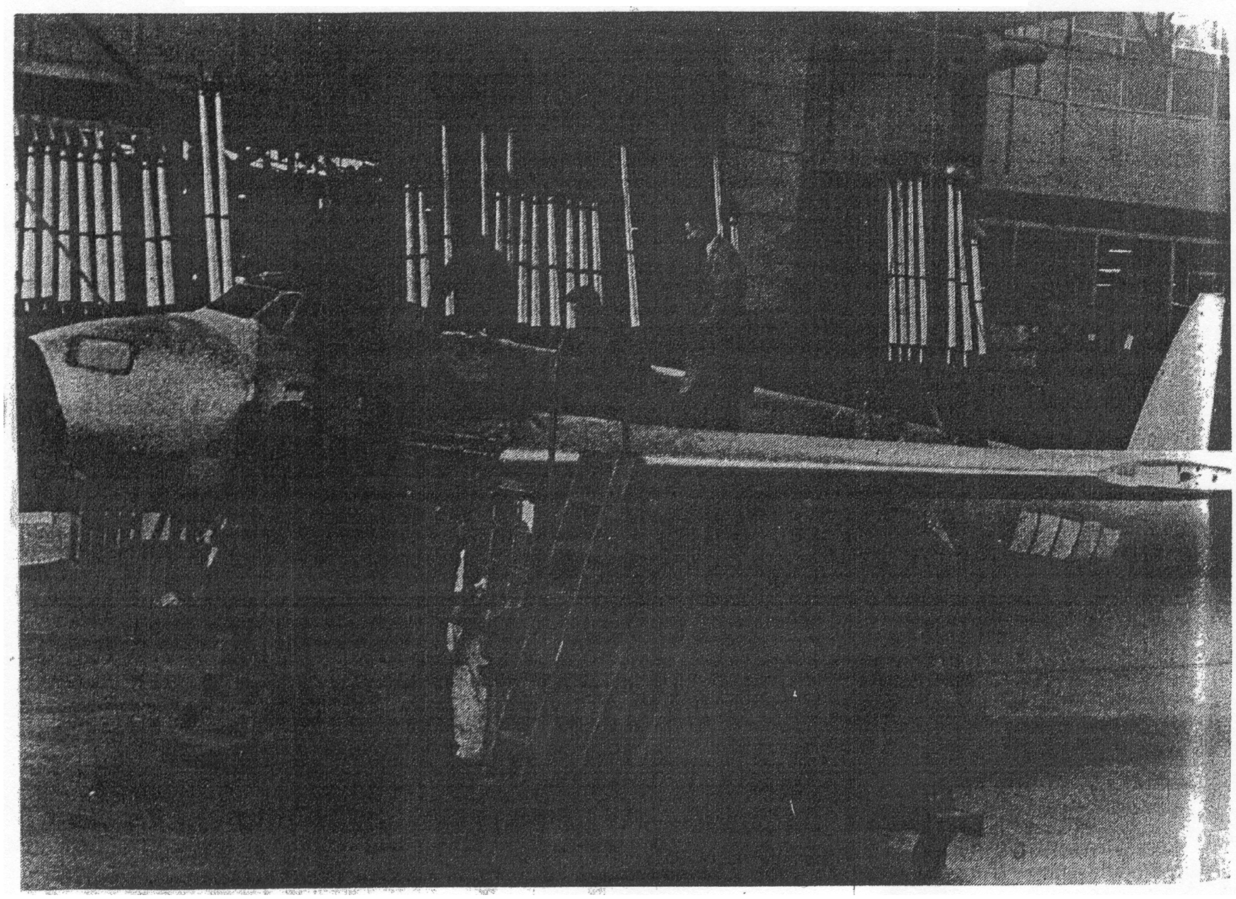
No. 1 ribs come just inside the fuselage contour and carry shear bolts which support the fuselage side panels below the wing. The web of these ribs is 3-ply birch 0.25-in. thick. They are reinforced with spruce flanges top and bottom, also by rectangular vertical stiffeners. The bottom flange carries a Bakelite reinforcement connection strip, to which the inboard edge of the inner fuel tank cover panel is bolted.

The box type ribs are made with two 0.187-in. 3-ply birch sides and have walnut, birch, ash, or spruce stiffeners, depending on their location and purpose. Engine rib No. 3 is typical. The stiffeners are all grade-A spruce, and except for the top one they are all solid. The top flange is made from 0.27-in. spruce laminations and is approximately 0.8-in. deep over its full length. The lower flange averages 1.3-in. deep. The solid spruce vertical



Plexiglas nose of “Mosquito” Bomber. Bombs painted on side show number of missions flown. (Chas. E. Brown photo)

Mounting of fuselage on wing. Truck jacks carry wing underneath, pickup pins are inserted on No. 3 bulkhead and rear wing spar, and fuselage is then lowered into place.



Single web ribs are made in two weights: Those for ribs 7, 8, 12, 13, and 15 have a 3-ply 0.0625-in. thick web; the others have 0.078-in. webs. All are made from 3-ply birch with the web located on the inboard face. The top and bottom flanges are solid spruce. The lower one varies in depth from 0.6 to 0.7 in. by 0.7-in. width. The top flanges vary from o.97 to a 0.65-in depth. the 0.4 x 0.7-in. vertical stiffeners are each reinforced by a 1.4 x 1/16-in. 3-ply piece glued and bradded to the exposed side. Triangular gussets, also of 3-ply birch, are provided at corners of the rib.

There are 16 ribs on each wing, not counting the double-sided box-type rib which is located at the center of the ship. The latter is used to help support the bomb racks. Ribs on each side of fuel tanks and wheel wells are box type. There are also two other box type ribs, Nos. 8 and 14. These are located at critical points, the first where aileron control reactions take place, the latter at the outboard aileron support.

Wing tips are bolted in place just like the tank bay doors, with flush screws that engage captured nuts on wing end rib No. 16. These nuts are held by an aluminum cuff bolted to the wing end rib. The wing tip has a spruce and laminated plywood rib that matches the wing and rib. Feature of this construction is provision of ply-faced Bakelite reinforcements all around the attaching point so that screws will not crush the tip or wing end at the joint when they are tightened up. The wing tip itself is constructed with a plywood outer skin glued and screwed to spruce formers and to a triple laminated spruce edge that gives the tip its proper contour.

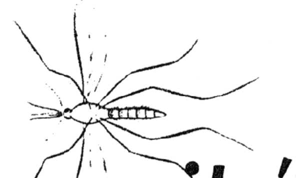
Leading Edge

The leading edge of the wing is made up in four sections. Tow of these, one right, the other left, extend outboard from engine nacelle to wing tip. They are slipped over the forward side of the front wing spars and screwed and glued in place. When assembled, they become a fixed portion of the wing unit. Each leading edge consists of a series of spruce nose ribs reinforced by 3-ply wood gussets and a longitudinal scalloped plywood strip set in at a 45-deg. angle. This structure is then covered with a pre-formed plywood skin that fairs into top and bottom skins of the wing.

Between engine and fuselage the second section of leading edge has been developed so as to form a housing for oil and liquid coolant radiators. It is constructed of 24ST Alclad sheet. The leading edge has a fixed opening that forms a duct through which air passes to the radiators. The rear bottom portion of each cooling unit has a two-position flap to control flow of air through the radiators.

Design Analysis of the deHavilland Mosquito *will be concluded in June* Aviation.

DESIGN ANALYSIS NO. 6



DeHavilland "Mosquito"

PART II

By CHESTER S. RICKER, *Aviation's Detroit Editor*

Concluding his outstanding study, the author thoroughly details the landing gear, hydraulic and pneumatic systems, and controls of this remarkable twin-engine bomber.

HAVING DISCUSSED the airframe in detail, we shall now take up the design of the movable parts, such as controls, landing gear and hydraulic and pneumatic pressure systems. First, the controls —

Flaps

Trailing edge flaps are located between the inboard end of the aileron and the fuselage. The flaps are in two sections connected by a torque tube with hinges at each end and in the middle. They are constructed with spruce ribs reinforced with plywood. Finished flaps are covered with a 3-ply skin having the dual grain running longitudinally. The operating jack is attached to the rear spar and moves the flaps by a direct connection at center to the flap operating arm. Control reactions are taken by the rear wing spar almost immediately behind rib 3., where greatest resistance to deflection can be obtained. A rubber tube seal at bottom of the flap prevents any air leakage through the hinge during flight.

Ailerons

The aileron is built upon 24ST Alclad spar of channel section. The ribs, except those for hinges, are all of skeleton form and made from 24ST Alclad. The entire assembly is covered with 0.012 24ST Alclad skin. The tab, also made from Alclad,is attached at inner end of the aileron by means of a piano hinge. Mass balances are provided in the leading edge of the aileron. It is supported by three hinges, the outer and inner ones of which are universal so that there can be no misalignment in assembly or in service. Tabs are differentially controlled, the port one being trimmed from the cockpit.

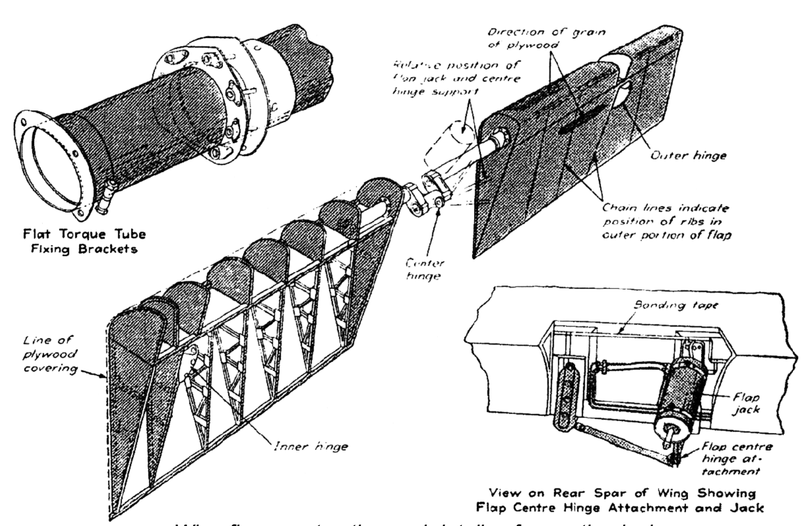
The empennage is quite conventional in general design, but the stabilizer and fin are of wood, while rudder, elevator and trim tabs are aluminum. This group also includes the tail fairings. No outside bracing is used, and all controls are easily reached after removing tail fairings, which are secured with Dzus locks.

Stabilizer

The stabilizer is one-piece all-wood cantilever construction of symmetrical airfoil section. It extends 110 in. each side of the centerline, is 16 in. wide at the tip and about 41 in. at the root. It is supported by two continuous wooden box type spars that run from tip to tip. Except for the center sections, these spars have spruce flanges top and bottom and 3-ply webs on each side. At center the spars are filled with laminated spruce at the point where the rear one carries the rigging brackets. There are ten spruce-and-plywood ribs on each side of the stabilizer between spars. A similar number of spruce-and-plywood formers are provided ahead of the front spar for the leading edge.

Small plywood brackets are provided on the back of the rear spar to support the skin where it overhangs. Each half of the stabilizer is covered with 0.16 in. 3-ply birch skins. The leading edge is made from a formed 3-ply spruce member into which the top and bottom skins are fastened and feathered off. Near the center on the forward side of the front spar there are three metal brackets which anchor the tailplane to No. 7, or rear bulkhead of the fuselage. Two brackets bolted to front of the rear spar are connected to the rear bulkhead by two diagonal tubes at each point. These tubes have adjustable clevises at the rear spar brackets so that incidence of the stabilizer can be adjusted when rigging the ship.

Construction of these stabilizer brackets is very interesting. Fittings



Wing flap construction and details of operating jack attached to the rear bulkhead to support the front spar have screwed-in bushings which may be adjusted about 1/16 in. in either direction. Thus it is easy to correct for slight variations in dimensions when assembling the stabilizer on the fuselage. To make an absolutely tight fit between fuselage bracket and front spar bracket which straddles it, a split bushing instead of a bolt is used. Each end of this bushing is bored out on a taper into which cones are inserted with a bolt so they can be drawn together to expand the split bushing. A castellated nut and cotter key secure the bolt when bushing is tight.

At top and bottom of the rear fuselage bulkhead there are brackets to which the rear spar diagonal braces are attached. One through-bolt holds both in place. At rear spar brackets, the bracing tubes are attached with clevises, which have screw and lock nut adjustments to permit adjusting incidence of the stabilizer. This adjustment varies through angularity, so it is necessary to connect the clevises to the bracket proper through links pivoted on a horizontal pin. Thus no bending strains are introduced either in the tubes or on the threaded portion of the clevises.

What does not show in the drawings but is an important part of the support, are the longitudinal laminated spruce reinforcements which transfer loads from the rear spar brace brackets on No. 7 rear bulkhead to the fuselage floor and to No. 6 bulkhead. Metal angles backing up the brackets are fastened to these reinforcing members, thus the stabilizer forces are absorbed by both No. 7 and No. 6 bulkheads, as well as the monocoque structure enclosing them.

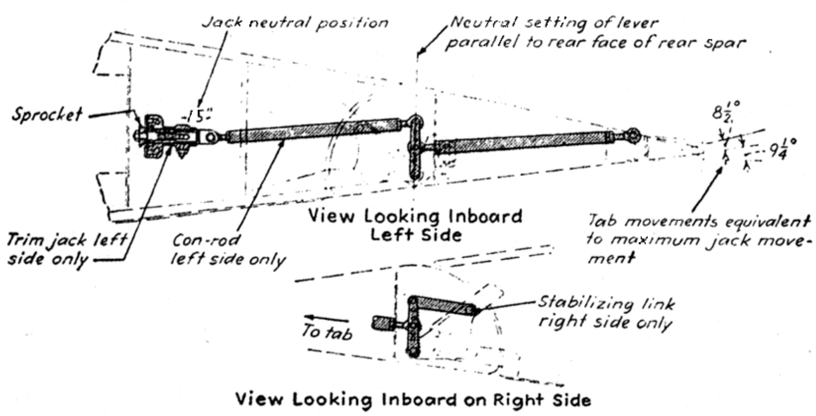
The stabilizer spars taper from center to tip, varying from about 1.25 in. maximum height at center to about 4 in. at the tip. In width they are also tapered from 2.25 in. at center to 1.25 in. at the tip. The rear spar is straight, but the front has a sweep back on each side of about 1 in. in 4. The spar booms are formed from six laminations of o.4 in. spruce and built up to selected long grain pieces. The front flanges are tied together with 0.16 in. 3-ply webs, the rear flanges by 0.12 in. 3-ply webs on each side. The inside of the spars is filled with 5-ply spruce blocks wherever a bracket is attached. The attachment points are armored on the outside with compressed 0.5-in. plywood. There are six of these points on the rear spar, two at the center, two at the ends, and two for the intermediate hinge brackets. At every rib point there are o.5 in. wide and 0.4 in. thick vertical spruce stiffeners to which the leading edge, intermediate ribs, and trailing edge ribs are glued and screwed.

The stabilizer tip rib and the rib at the inside edge of each section have solid 3-ply sides that act as a closure. All the other rib units are of one-sided plywood construction. There are also two heavy box section ribs 1 in. wide and about 7 in. high near the brackets which support the stabilizer and act as compression spacing members between front and rear spars. They are bolted through metal angle plates to both spars and brackets and bear against compressed plywood facing on spars.

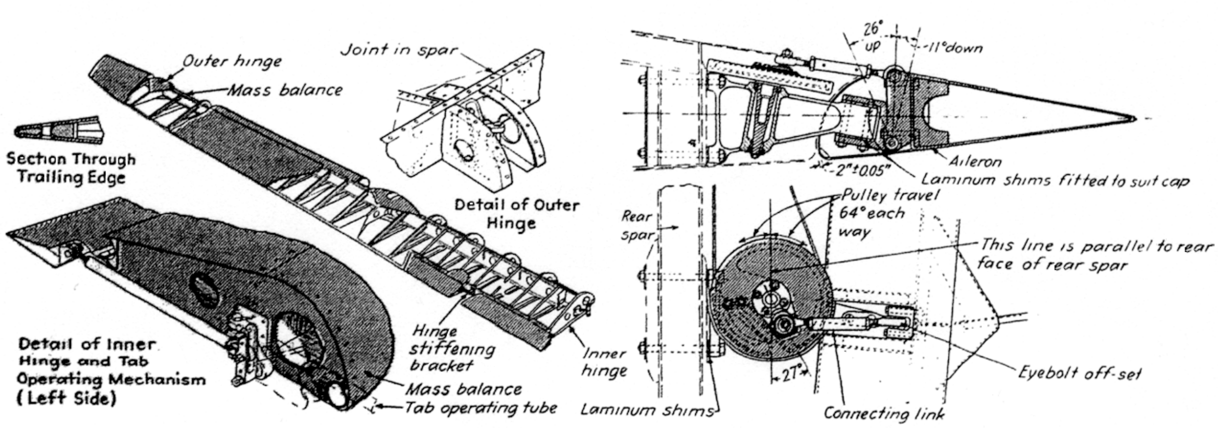
Elevators

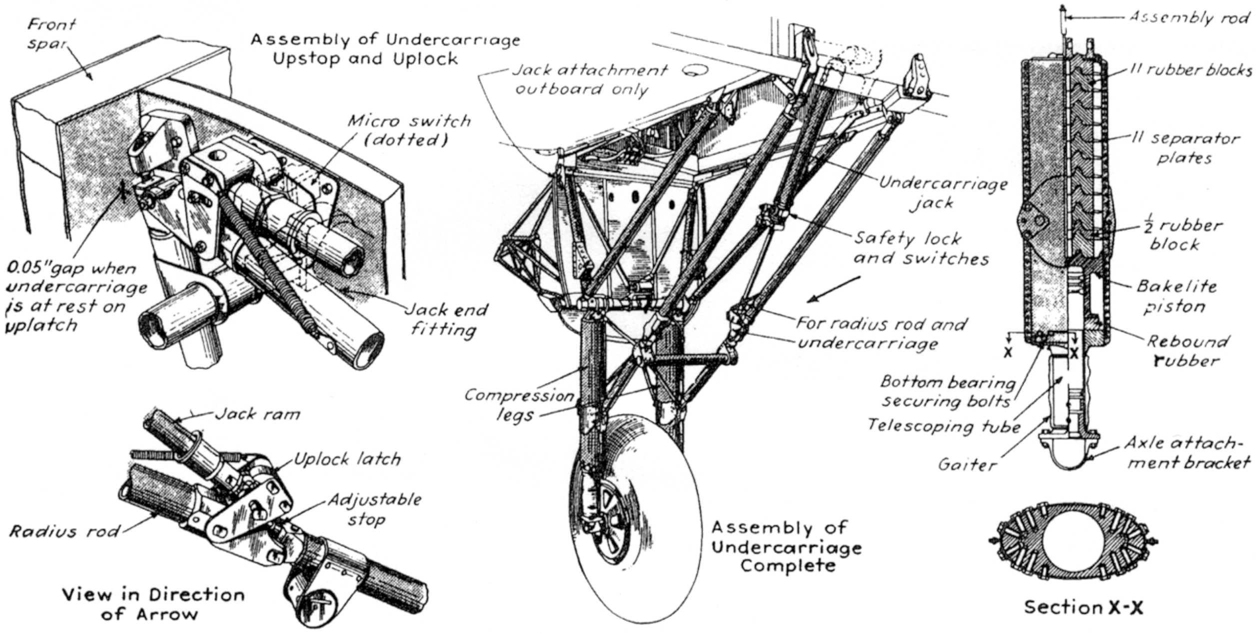
The elevator is hinged to stabilizer rear spar by a center locating and four hinge brackets. The latter are of the universal type having a link with cross bolts that give each one considerable lateral freedom s well as providing the axis about which the elevator turns. Two similar self-aligning hinges are used for the rudder and mounted on the rear fin spar.

Each elevator is formed on a single box type Alclad spar. Elevators are interchangeable. Tab operating



Aileron, showing method of construction with outer and inner universal hinges and center hinge on differential control bracket, also trim tab controls and method of operating.





Landing gear with details of lock, hydraulic hack, and compression strut. Micro switch is attached to side member of frame.

mechanism is under the elevator on the left side, and above the wing on the other, being covered with detachable fairing. Alclad ribs are used in each elevator. Three ribs support the horn and six carry the tab. Second and third ribs from the inner end are closer together and straddle the tab operating rod. This prevents deflection at this point, assures uniform action in tab control, and provides secure anchorage for the elevator torque tube. Elevators are bolted together at the center hinge fitting.

To the port elevator torque tube flange are bolted the elevator operating arms, to which the operating cables are attached. These pass over ball bearing sheaves on the aft side of stabilizer front spar and through rear bulkhead into fuselage. To the starboard elevator a static balance weight arm is bolted. Mass balance weights are also provided inside the aerodynamic horn balance at outboard end of each elevator. The elevator torque tube extends through the two inboard ribs of each elevator and is riveted to them.

Elevator tabs are located between the inboard end of each elevator and the 6th rib from center. An Alclad channel spar connects the rear ends of these ribs and has a piano type tab hinge along its lower flange. The port tab can be used for trimming and can be adjusted 8½ deg. up to 9¼ deg. down by the cockpit tab trim control. Adjustment is obtained by a screw trimming jack, located at elevator center bearing and bolted to back of the tailplane rear spar.

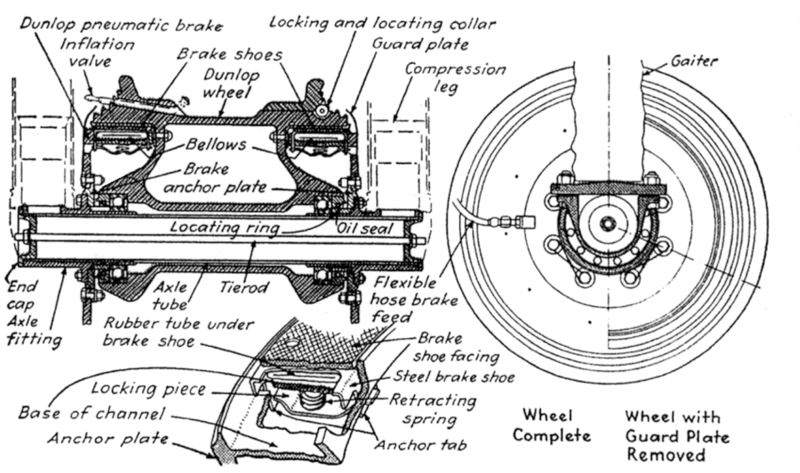
The trim control operates through a box-like member bolted to the left trim tab tube. A nut running on a vertical screw changes the tab position and is turned by a small chain sprocket at the top, which is controlled by a chain and two elevator trimming cables leading from the cockpit. Sprocket and cables are in a sheet aluminum housing to protect them from water or mud.

Elevator construction follows conventional practice. Forward edge

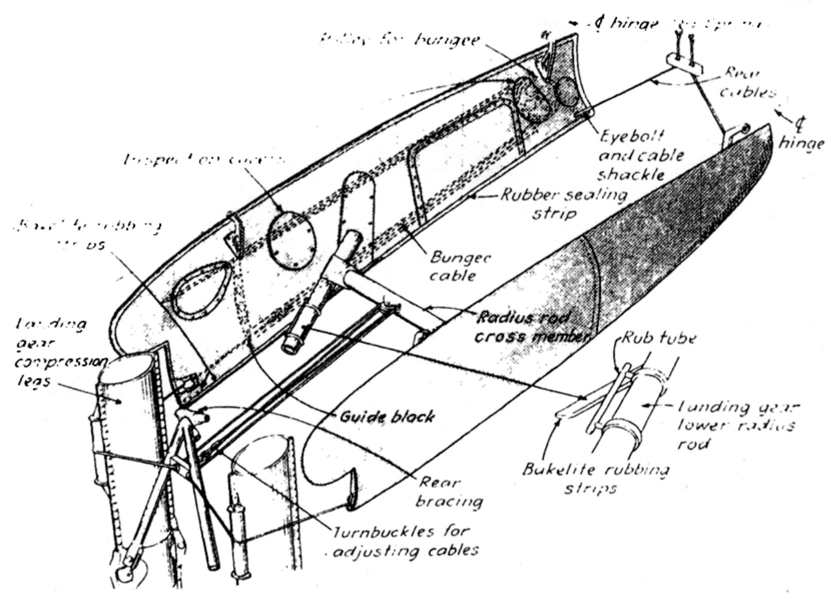
Landing Gear Data

Type — Two retractable single wheel units with two rubber shock absorber struts to a unit.

Wheel material (all wheels)	Magnesium
Wheel base	342.875 in.
Tread	196.0 in.
Main gear compression leg travel (total)	5.5 in.
Tail wheel	Swivel type, retractable
Main wheel dia.	16 in.
Tail wheel tire dia. (dual tread)	17.5 in.
Main wheel tire (Dunlop)	15.00 x 16 in.
Tail wheel tire	8.00 x 5 in.



Section through landing wheel showing arrangement of twin pneumatic brakes mounted on hollow axle. Brake anchor plates on each side of wheel inclose braking surfaces and transmit brake torque to axle and struts. Detail gives method of holding brakes in position.



Bungee in wheel doors provides force for closing them when gear is raised. Cable attached to radius rod cross member gives sufficient tension to bungee, while rollers on outside of compression legs moves cable outwards to cause doors to open. Bakelite rubbing strips on radius rods prevent wear on members.

has a 2.75 in. radius skin with a 5.12 x 0.75 in. channel main spar riveted inside, to which channel section ribs are attached. Aft inner corner of the elevator is braced by a diagonal tube. The ribs all have lightening holes and “Z” section stiffeners are used top and bottom on the skins between ribs. Trailing and elevator tip edges are formed with an oval aluminum tube to which skins are fitted and riveted. Brazier head rivets are used throughout. The under skin and trailing edge are fastened by 0.12 in. explosive rivets.

Tail Fin

The single fin is attached to top of the fuselage by four brackets and four bolts. These brackets are attached to the two rearmost fuselage bulkheads and project above the fuselage skin. A fairing covers bolts and brackets after fin is installed. As will be noted, the fin and rudder loads are well distributed over rear end of the monocoque structure.

Fin spars are of heavy laminated construction with 3-ply spruce webs. The rear spar is approximately 7 in. wide and 2.5 in. thick at the bottom, tapering to 0.87 in. at top. The front spar tapers from 2.12 to 1 in.. Front and back these spars have “H” shaped laminated steel brackets bolted to the bottom ends. The inner lamination runs about 13 in. up the spar. These metal bracket straddle the metal ones which strengthen the fuselage bulkhead extensions that project through top fuselage skin. Brackets on the bottom of the two fin spars are 21.5 in. apart on centers. To give lateral stiffness to the fin, bolt holes at rear bracket are spaced 2.87 in. each side of centerline. Two 0.75 in. bolts are used to hold the rear spar; two 0.62 in. to secure front spar of the fin. Leading edge of the fin is a 3-ply formed spruce member into which the skin is faired.

The three rudder hinge brackets are bolted to aft side of fin rear spar. Where brackets are bolted, Bakelite or compressed laminated wood is used as a bearing for both brackets and bolts.

Rudder

Rudder is a fabric covered metal structure , while the tab is all Alclad attached by a piano hinge on the right side to metal rear spar of the rudder, and extending upward from bottom edge of rudder to No. 4 rig. Tab is used to trim the rudder but also acts as a servo device. It furnishes the trim and servo deflections to the left, while a spring moves it to the right (this is fully explained under controls). Rudder is fastened to fin by three hinges along the rear spar. Bottom hinge of the rudder and center hinge of the elevator are arranged to take both radial and end loads. That is why all the other hinges can be universal jointed. Eleven hinges have ball bearings and are packed in non-freezing grease.

The rudder is built like the elevator with an Alclad box spar consisting of the semi-circular hinge portion with a channel spar riveted between the open ends. There are eleven metal ribs, three of which form the rudder horn and carry the mass balance weight. Five bottom ribs support rear spar and tab. Tab mechanism is between ribs 2 and 3, which are close together as on elevator. Rudder lower corner is braced by a diagonal tubular brace from rib 5 at the hinge spar to trailing edge. The trailing edge is a flattened aluminum tube riveted between trailing edge flanges of the ribs. The torque tube is bolted to ribs 1 and 2 of the rudder and carries tab operating tube inside it.

Landing Gear

Landing gear consists of two interchangeable units attached by tubular structures to the wing immediately behind the engines. Two brackets on front of forward wing spar serve as pick-up points for both engine mounting and undercarriage. These brackets are bolted to companion angles that tie the front spar and wing ribs 3 and 4 together. Landing gear supports extend downward behind firewall to a horizontal tube that serves as a hinge point for landing gear. This upper structure is braced laterally by diagonal tubes and longitudinally by heavy tubes which terminate in brackets on the rear portion of wing ribs 3 and 4, forming fixed portion of the support.

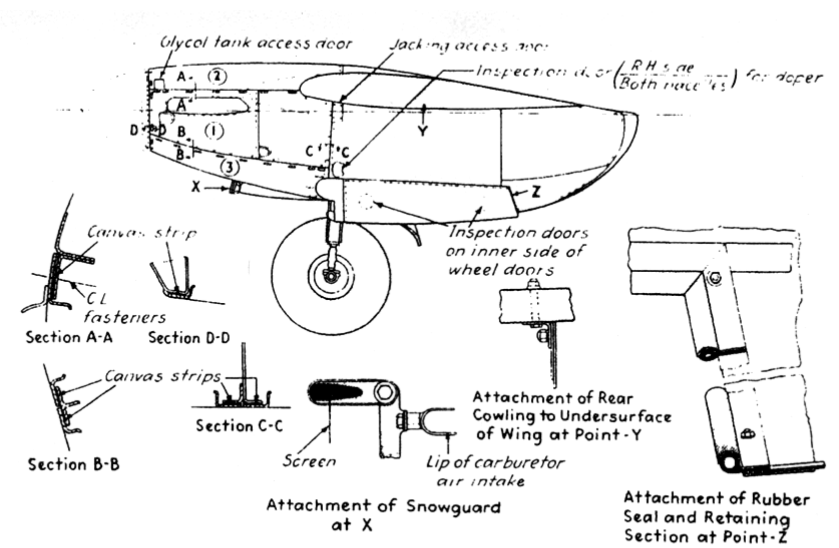
Movable parts of landing gear consist of oval steel-tube compression struts hinged on fixed horizontal tube. At bottom they are secured to the axle with forged steel “U” straps. Legs are cross-braced by tubular members diagonally arranged and are held in place by radius rods that are attached to rear of legs and to rear wing spar. A double acting hydraulic jack raises or lowers the gear.

Each landing gear unit is provided with doors that close automatically as the unit is retracted into the wheel bay. A latch mechanism on the right hand radius rod holds gear in up position. Down position is secured by a spring-loaded mechanical safety latch incorporated in the lower fitting on hydraulic jack cylinder. It engages in a collar on the jack ram and is released only by hydraulic pressure on the safety valve when raising undercarriage.

Bottom sections of the right and left-hand hinged radius rods are joined together at their upper ends by a large tube and forged fittings. Since the hydraulic jack in only attached to the right hand radius rod, the cross tube must carry load due to lifting the left hand radius rod.

A visual indicator in the cockpit shows when under carriage and tail wheel are locked in up or down position, and a warning horn will sound when landing gear is not locked down and throttles are more than three-quarters closed.

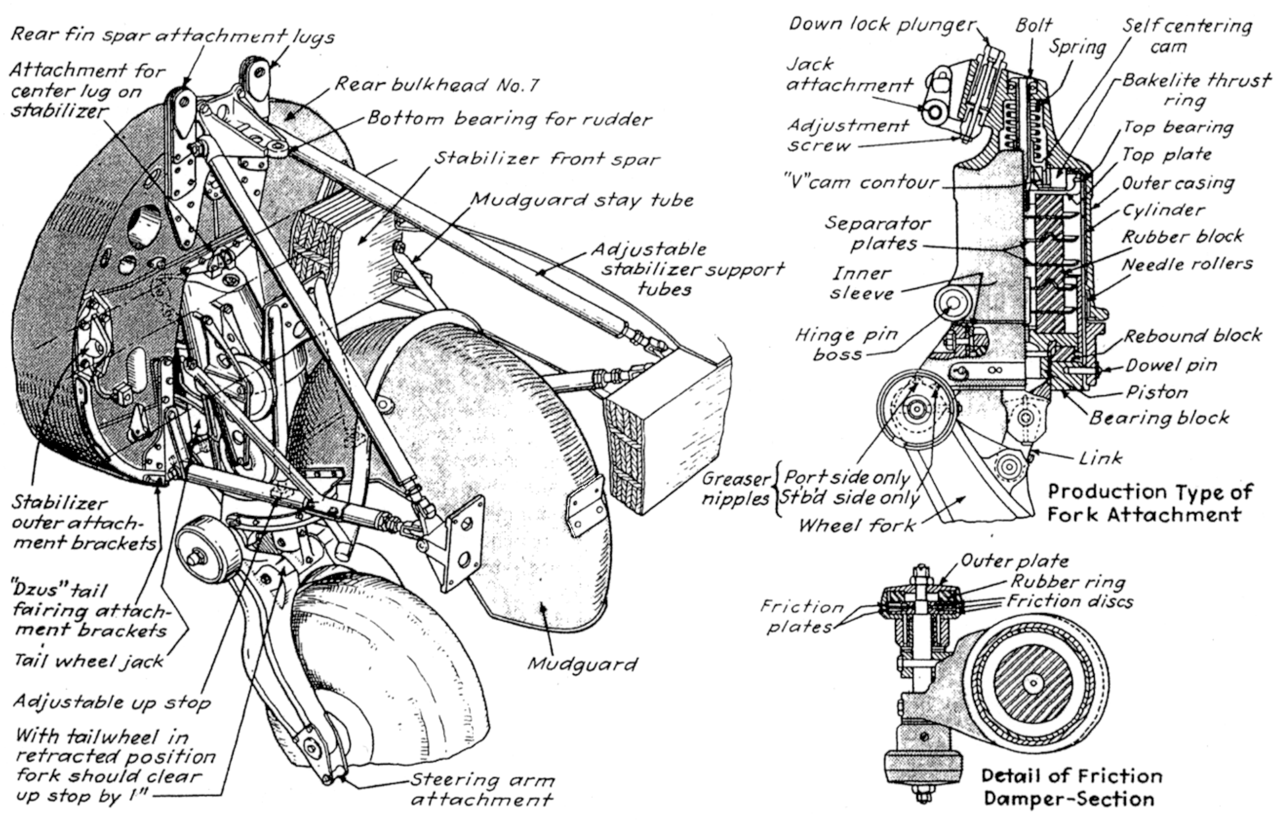
Two micro switches on the landing gear operate visual indicators: the up switch is just above the up latch bracket on right wing rib and operates when latch has engaged the uplock; the down switch is on the undercarriage jack cylinder. A Graviner gravity type is used. A second switch is introduced in the circuit so that the gravity switch can be rendered operative when the wheels are down and inoperative when they are up. This is necessary to prevent the fire extinguisher from functioning during aerobatics.



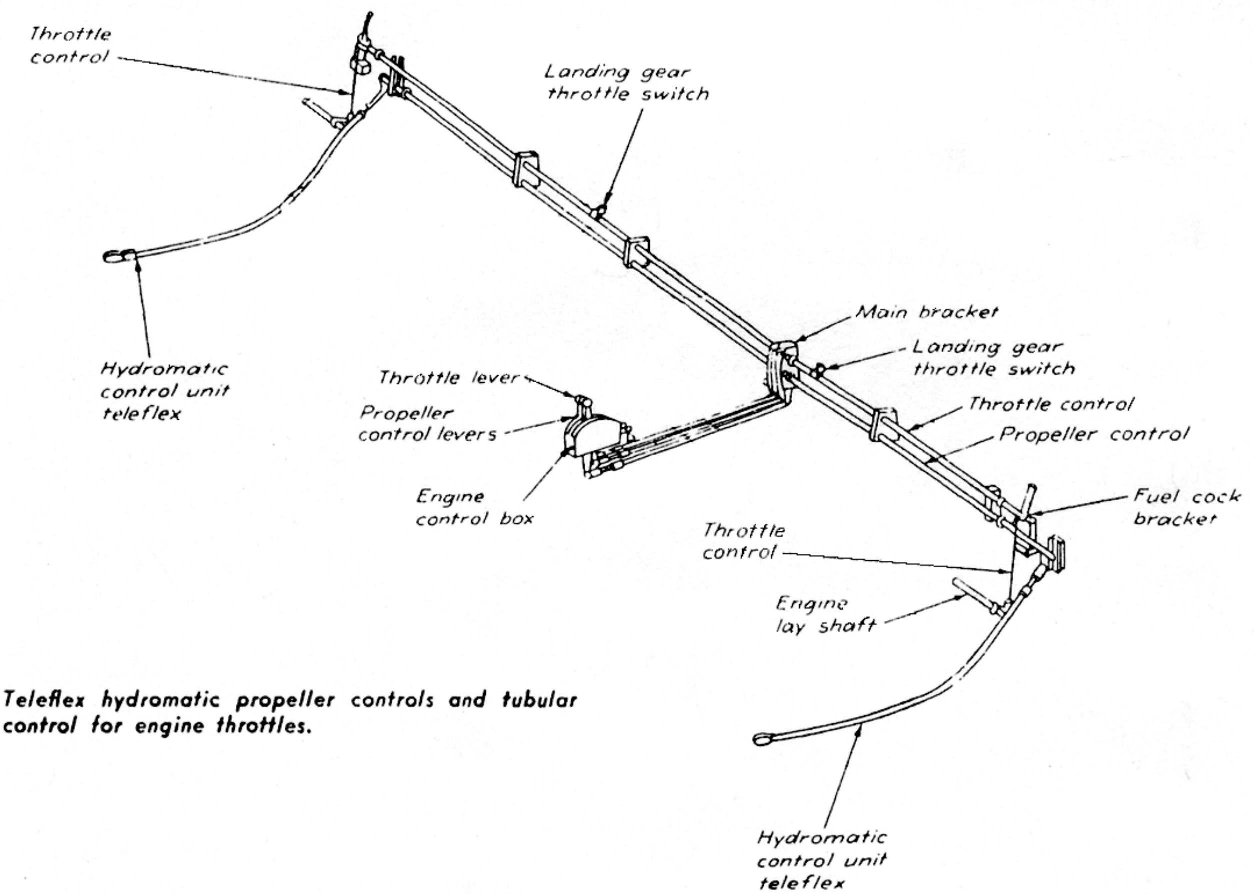
Engine cowling and nacelle in relation to wing section, showing methods of attaching.

Shock Absorber Strut

Two shock absorber struts are compression rubber type and re oval in



Dual-tread tire, friction dampeners, and centering cam make high speed landings possible with this tail wheel. Rubber shock absorber takes stresses from framework. Fin spar is supported by laminated steel lugs at top of bulkhead.



Teleflex hydromatic propeller controls and tubular control for engine throttles.

section, made from 8-ga. steel stampings. The upper head carries a bracket that is hinged tot he stationary landing gear frame. The lower or open end of the tube is closed by a fabric and Bakelite molded head which guides the tubular piston rod. An oval Bakelite piston slides up and down inside the tube.

Between head of strut tube and piston are nested eleven rubber compression blocks, separated by aluminum guide plates. The blocks are smaller in section than the tube to allow for expansion. There are eleven blocks of full thickness and one of half thickness all located above the piston and also one block beneath the piston to absorb rebound. Each block is molded with two conical projections on top and corresponding depressions in the bottom to keep blocks in alignment. The piston tube is attached to the Bakelite piston by scrivets and threaded rods. Where the piston rod passes through the Bakelite guide, the bore is lubricated with graphite. Bottom end of the piston tube carries a rectangular forged flange to which the wheel axle is attached by a forged steel U-shaped strap and four bolts.

Since there is no hydraulic or pneumatic mechanism in the strut to leak, it can be made without recourse to micro finishes. No adjustment is required in service beyond renewal of compression and rebound rubbers after considerable service. For small adjustments a full block of rubber can be substituted for the one of half thickness.

The tube is made from two stampings of 8-ga. steel that are held to very close limits. They are riveted together impairs to form a complete oval tube and do not require further finish inside after assembly.

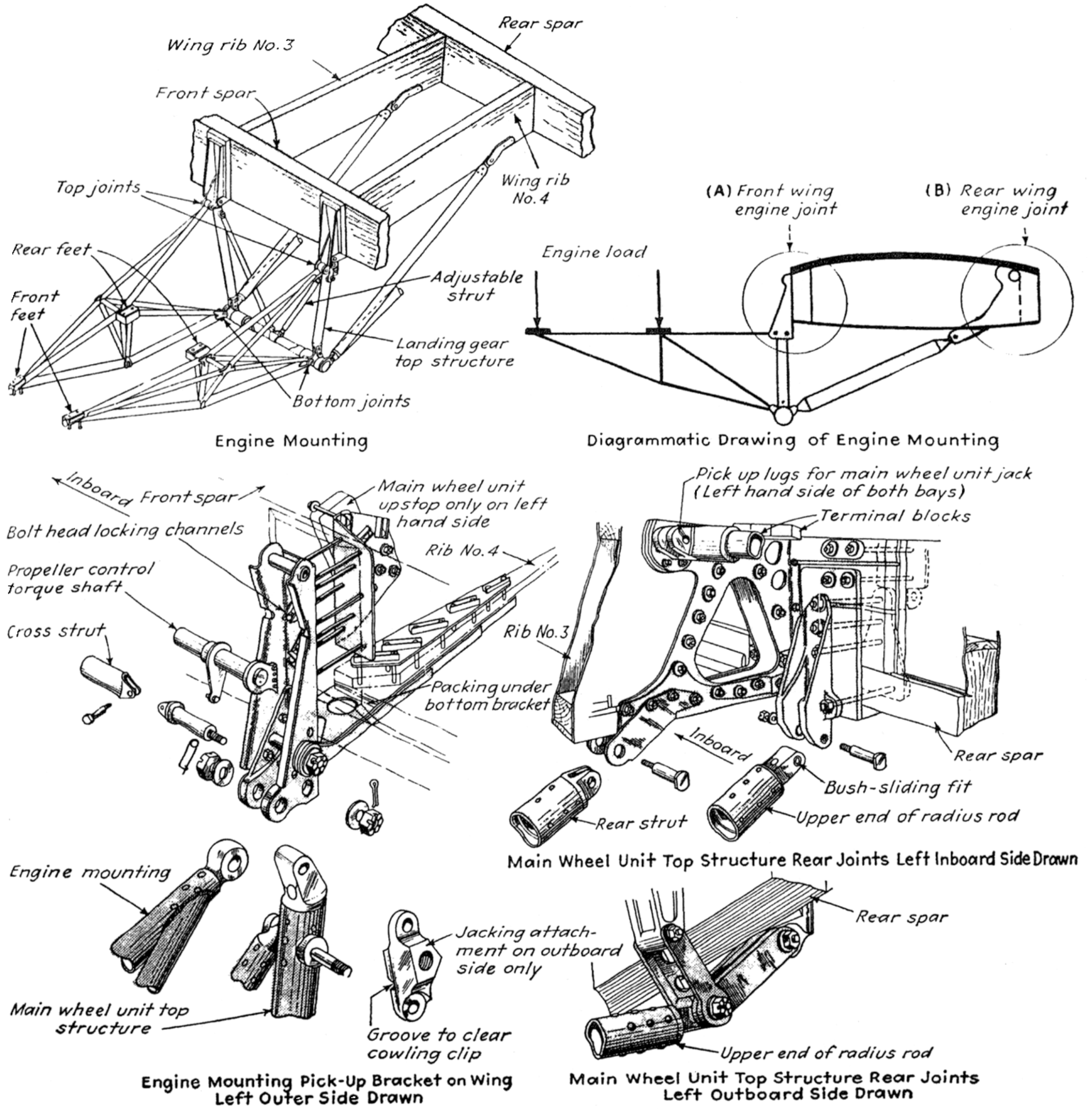
Exposed end of the piston rod is fully protected from the elements, dirt, and water by a boot attached to bottom head of tube and axle attachment forging.

Landing Wheels

The landing wheel is a magnesium casting of Dunlop design, made by Kelsey Wheel, and mounts a 15.00 x 16-in. tire with anti-skid tread. The tire is held on the wheel by a flanged locating collar secured by a locking ring. Wheel is mounted on two anti-friction bearings supported by tubular axle. End caps and a tie rod retainer seal ends of axle tube. Axle end fittings carry ball bearings, are flanged to attach the brake anchor plates. The hub of these fittings has a flat upper surface with a spigot to lock and pilot the shock absorbed strut bottom. Through this the braking torque is transferred to the shock absorber unit.

Brakes

There are two 13 x 3.25 in. internal expanding brakes in each wheel. They are pneumatically operated by a rubber tube located just under the six brake shoes in each brake assembly. The brake anchor plate has a channel shaped rim which extends inward beneath the braking surface of the wheel. This channel is 3.37 in. wide and 0.5 in. deep. It has 1.5 in. slots at 60 deg. intervals, which are located at each side of the channel and go clear

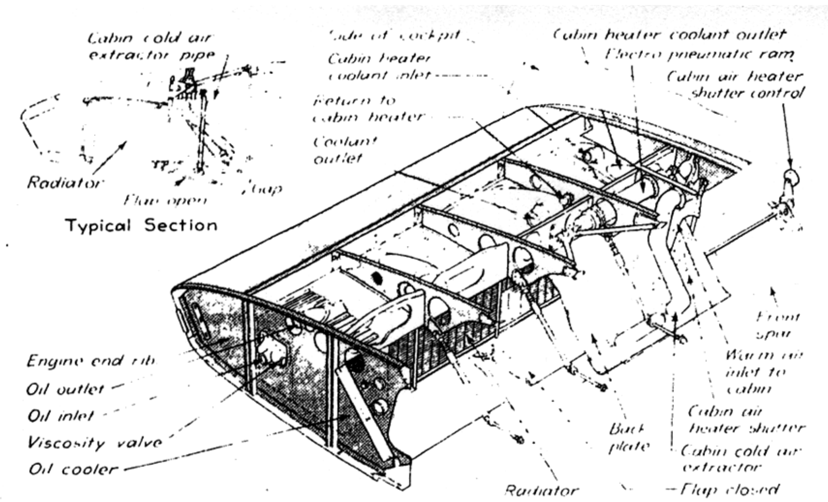


Engine and landing gear supports form a light, rigid frame, bolted through spars and ribs to spread load and stresses throughout the structure.

through to the inside. The rim of the channel is unbroken. These slots anchor the brake shoes. Each brake shoe is made from a 16-ga steel channel 3.25 in. wide and 0.37 in. deep. At center of each flange there is a slotted tongue 1 in. deep and 1.5 wide to fit in the slots of the brake anchor plate.

In assembly, the rubber tube is first laid in the anchor plate channel, then the six brake shoes are slipped in place. To hold them, a retainer yoke goes across between slots in lower ends of the brake shoe anchor tongues. A small coil spring is slipped in between yoke and underside of the anchor plate. This not only locks the brake shoe in place but draws it down tightly against the anchor plate channel and prevents it dragging when brake is released. The individual brake shoes have a 3.25 x o.25 in. brake lining riveted to their working face.

A regular tire tube angle stem is used to connect the air pressure line to the brake expanding tube. This is stationary, so after it passes through he brake anchor plate it can be connected directly to the earl pressure tubes fixed to the side of the compression leg. A flexible air pressure hose joins tubes and fitting on the anchor plate so as to allow for shock absorber action on the compression leg.



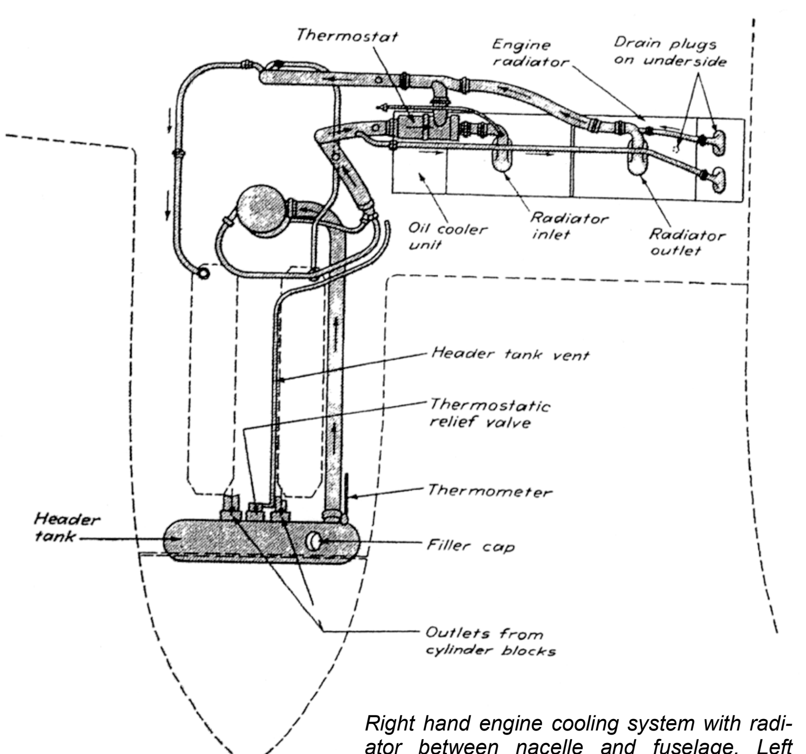
Cooling unit in three sections, seen from rear. Oil cooler at left; engine radiator on right; Cabin heater is heated by radiator coolant.

Since the magnesium wheel does not of itself make a good braking surface, cadmium plated steel inserts, 0.18-in. thick, are provided. They have a 1 in. lip on the inside that is secured to the magnesium wheel with 16 0.312 bolts.

Spring closed L-shaped oil seals are provided at each end of the axle to prevent any grease working out of the hub and being thrown on the brakes.

Wheel Doors

Wheel doors are contoured to enclose nacelle bottom from engine firewall back to rear spar. They are made from two sheet aluminum stampings riveted together along the edges, and there is a stiffening rib at the front hinge section. Each is supported by two invisible hinge brackets. The lower edges have a 0.5 in. rubber tube to provide a seal. Front and rear ends fit over canvas sealing pads riveted to nacelle panels.



Right hand engine cooling system with radiator between nacelle and fuselage. Left hand installation is similar.

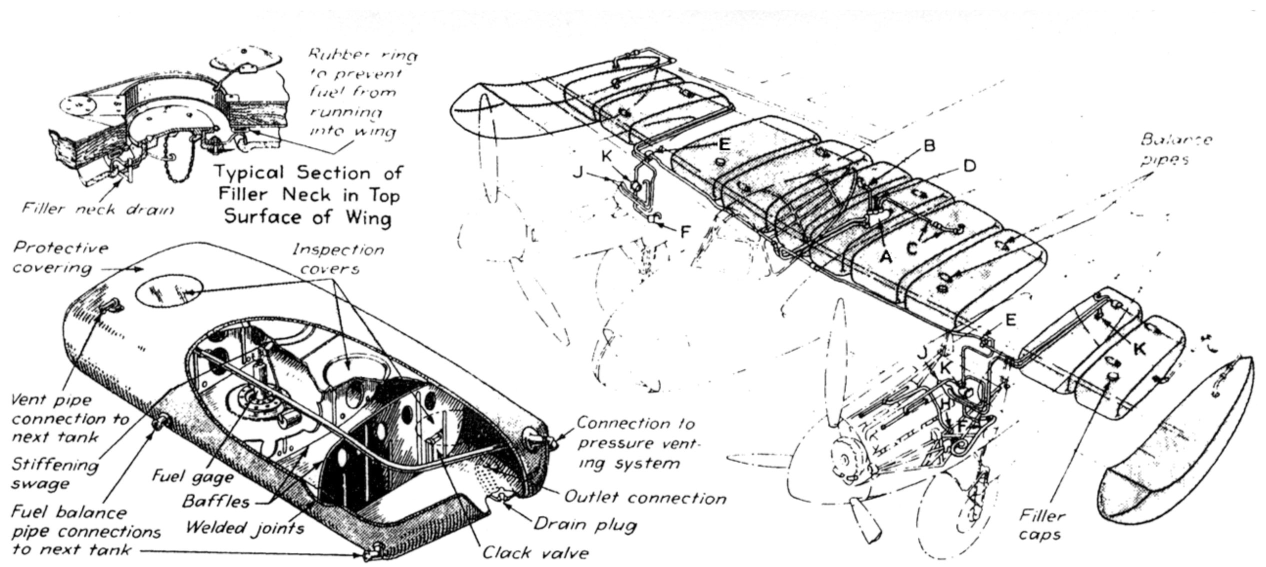
Operation of the doors is perhaps the most interesting feature of the assembly. The rear ends are drawn together by spring-loaded 0.18-in. flexible steel cables and are opened by tubular steel guards attached to the undercarriage legs as landing wheel is lowered. After legs clear ends of the doors, tubes attached to sides of lower radius rods catch Bakelite rubbing strips on bottom edge of doors and keep them apart.

To pull the doors together, 0.18-in. flexible steel cables are used. These are attached through turnbuckle adjustments to the cross piece between diagonal leg cross braces. They are then led back to a pair of pulleys on the radius rod cross member tube and forward again through bronze fairleads in the cross piece to which the ends are first attached. From the fairleads the cables pass over long Bakelite rollers attached to front of the compression legs and thence into front end of the wheel doors guided between a couple of plastic sheaves.

End of the cable is attached by eye splices to the end of a 3/8-in. “bungee,” which is led around a pulley at rear of each wheel door and back to the front end of that door. When doors are open, the “bungee” is stretched almost double its original length. This structure permits keeping the doors under tension at all times, whether open or closed.

The hydraulic system used for operating the landing gear contains two independent circuits — one the regular, the other an emergency system. Two hydraulic pumps are used, one on each engine. A hydraulic accumulator is provided in the aft part of the fuselage between bulkheads 3 and 4. Lines from engines to junction block in the cockpit, and from selector valve to undercarriage jacks, run along the front side of main wing front spar, where they are accessible when fairing over the radiator is removed.

The emergency undercarriage “down” line runs along aft side of main wing rear spar. Hence if the front lines are damaged it is still possible to lower the wheels. A hand pump can be used for this purpose if engine pumps are not working. Emergency selector valve just behind pilot's seat cuts in emergency line. This line does not



Fuel system consists of ten tanks plus end drop tanks, as shown. Insert gives detail of tank construction.

connect with the tail wheel, and the ship has to land without it being lowered; but the damage sustained would be minor compared with a “belly landing.”

Undercarriage and tail wheel selector lever is center in the hydraulic control box in cockpit. A safety catch must be released before the up position can be selected. Selector lever should return automatically to neutral when up or down operation is completed. If it should return prematurely, it is put down again by hand. This is possible in cold weather due to the greater viscosity of the hydraulic fluid.

Tail Wheel Assembly

The 8.00 x 5 in. rail wheel is on a retractable unit having a vertical trunnion . Like the undercarriage legs it has a rubber shock absorber. The wheel is mounted on a hinged fork attached to a caster swivel. Load is transmitted from hinged fork to rubber elements in swivel cylinder by link and piston rod. Shock absorbing elements are carried in a steel cylinder on needle bearings inside the shock absorber casing on the rear bulkhead. The jack ram is connected to the casing through a link which retracts the locking pin before it starts to raise the tail wheel.

A micro switch operated through a flat spring, which contacts the tail wheel casing when it is in the down position, closes the circuit to the indicator on instrument panel. No indication is provided when the wheel is up.

The shock absorbing unit has six rubber blocks for cushioning purposes and one between shock absorber piston and bearing block to take rebound.

The outer casing is a magnesium casting in which the shock absorber cylinder rotates. The cylinder is supported at the head end by a plain bearing and at the lower end by a needle roller bearing so there is no wear on the softer magnesium. The top plate or cylinder head bears against a Bakelite thrust ring when the shock absorber is in action. This top plate carries a V-shaped centering cam. Another cam that does not rotate is located in the head of the casing and spring pressed against the V-cam on the cylinder to center the tail wheel in flight. The cylinder is held in place by a hollow bolt through the center and supported by a ball thrust bearing.

The shock absorber piston is guided by a bearing block inserted at bottom end of the cylinder. The method of locking the fork attachment to it with dowel pins is interesting. These pins are held in place by a band with notched holes that slip into a groove under the head of each dowel pin.

Cylinder and inner sleeve are fastened to the fork attachment by countersunk bolts.

Adjustable friction disk vibration dampeners are applied to the hinge shaft of the fork attachment. A rubber compression ring is used to adjust their tension. Tail wheel assembly on the rear bulkhead is pivoted on two bearings located as far apart as possible and supported by a tube. This tube prevents their binding under severe twists. Laminum shim in the supporting bracket bushings permit axial adjustment of the tail wheel assembly so the socking pin will align with the locking ring in the rear bulkhead.

The combination of self-centering cam friction shock absorbers and dual-tread tail wheel provides an unusually safe and satisfactory tail wheel action during high speed landings, according to the designers.

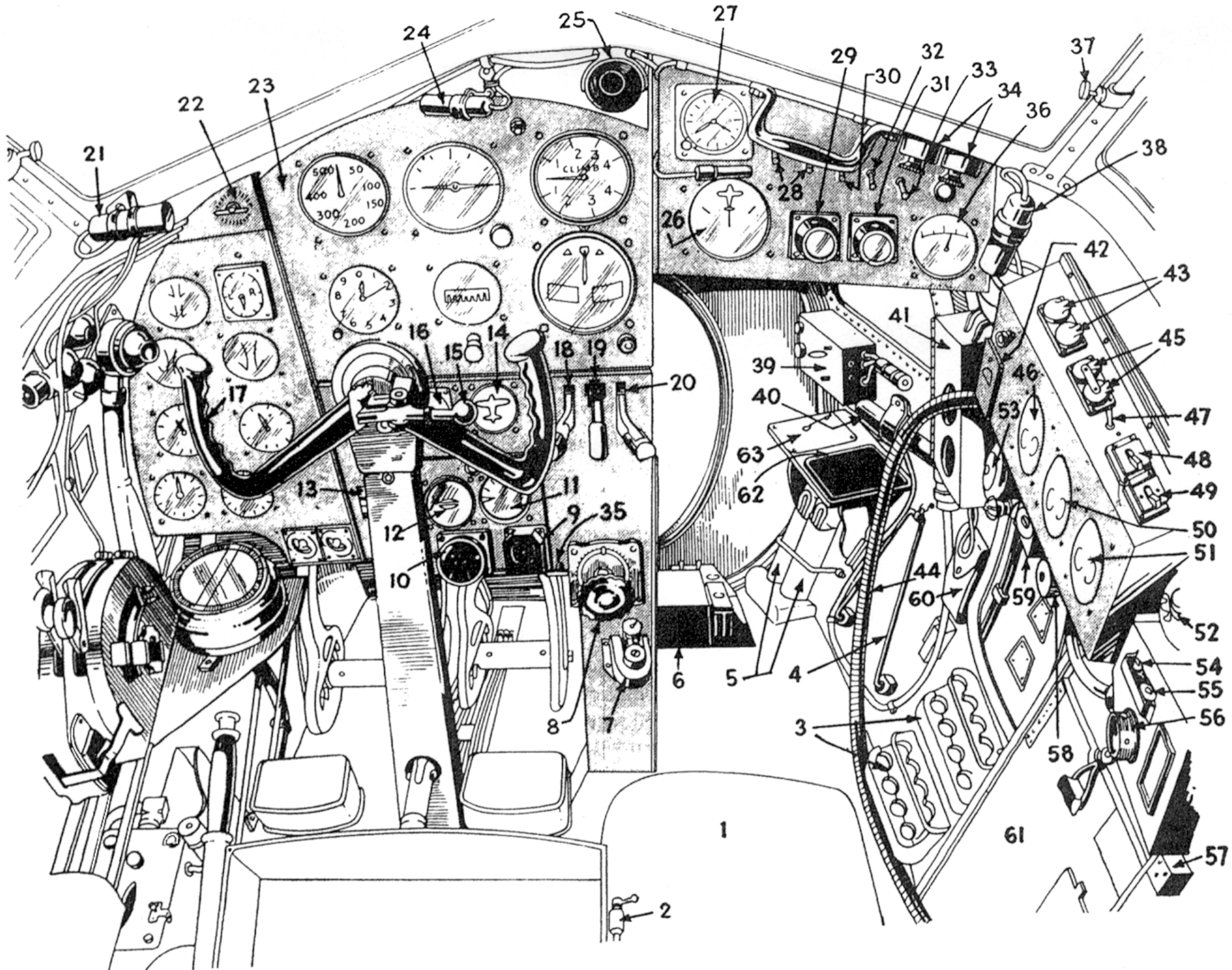
Engine Cowling

Engine cowling, nacelle, and wheel doors form a streamlined unit that is beautifully faired into the main wing when the ship is in flight. Dzus fasteners are used to hold the engine cowlings in place. All joints are made practically air tight, either with tubular rubber or canvas seals.

Engine Controls

Throttle and propellor controls are mechanically operated from the cockpit through levers and ball baring torque tubes attached by brackets to the front wing spar. Cams on throttle torque tubes operate undercarriage warning lamps and horn switches when the throttles are more than three-quarters closed.

Two-speed supercharger on each



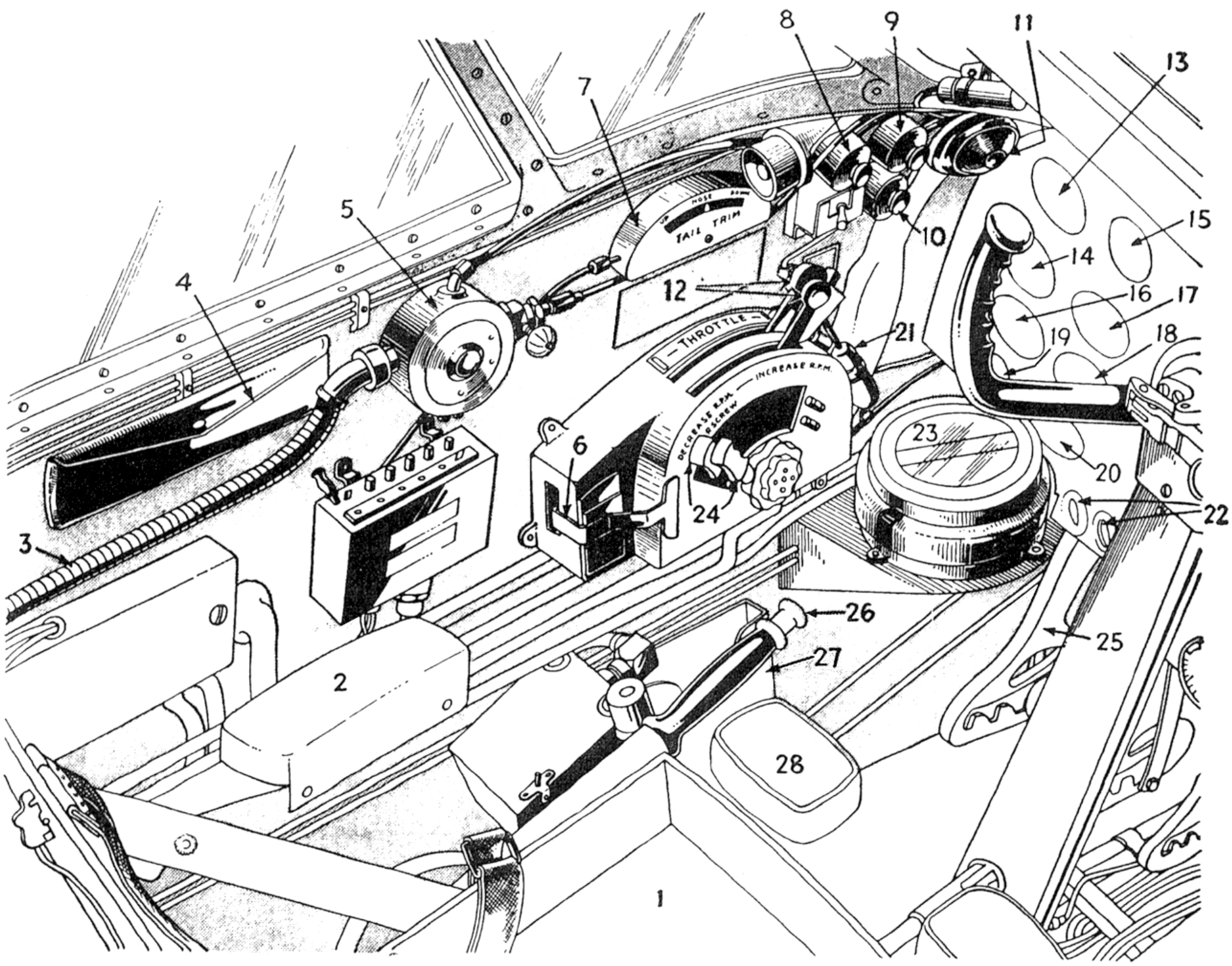
View of cockpit from pilot's seat, showing access door to nose.

1. Front entrance door.
2. Harness release lever
3. Very light cartridges.
4. Syko storage.
5. Portable oxygen bottles.
6. Bombsight base.
7. Deicing hand pump.
8. Aileron lateral trim control
9. Aileron trim indicator.
10. Brake pressure gage.
11. Oxygen contents gage.
12. Oxygen flow indicator.
13. Master switch.
14. Flap and undercarriage indicator
15. Brake lever.
16. Undercarriage position indicator.
17. Handwheel.
18. Bomb door control lever.
19. Undercarriage and tail wheel control.
20. Flap control lever.
21. Lamp.
22. Automatic boost cutout control.
23. Blind flying instrument panel.
24. Lamp.
25. Ventilator.
26. Visual indicator.
27. Time of flight clock.
28. Radiator flap switches.
29. Feathering control switch — left.
30. Navigation lamp switch.
31. Feathering control switch — right.
32. Fuel pump switch.
33. Pilot head switch.
34. Dimmer switches.
35. Bomb jettison switch.
36. Air temperature gage.
37. Direct vision panel knob.
38. Air observer's lamp.
39. Fuse box.
40. Fireman's axe.
41. Camera temperature indicator.
42. Voltmeter.
43. Fire extinguisher switches.
44. Navigator's oxygen tube.
45. Push switches.
46. Fuel contents gage, outer tank.
47. Switch.
48. Navigation head lamp switch.
49. Downward identification lamp switch.
50. Fuel contents gage, center tanks.
51. Fuel contents gage, inner tanks.
52. Downward identification lamp switch.
53. Oxygen demand regulator.
54. Booster pump switches.
55. Recognition light switch.
56. Watch holder.
57. Power socket.
58. Oxygen contents gage.
59. Oxygen flow indicator.
60. Camera stowage.
61. Navigator's hinged table.
62. Elbow rest.
63. Writing tablet.

machine is controlled by an electro-pneumatic ram. With cockpit switch set at *Auto* an aneroid operated switch will bring the supercharger into operation at 15,250 ft. altitude. If the switch is set at *Mod.* (moderate) only single-speed supercharging will be obtained at all altitudes. Flexible cables from cockpit to engines cut out “slow running” and “automatic boost” controls when required in emergencies. Additional electro-pneumatic air intake controls are provided for tropical operation.

Mounting

Two Packard-Rolls-Royce *Merlin* 31, 33 or 225 engines are used. They are mounted on four feet cast integral with the crank case. To support the engines in the plane, a tubular steel frame is provided. This consists of two units, one left and the other right, which are attached to brackets bolted to the front of the front spar. Ribs 3 and 4, immediately behind these brackets, give them the necessary torsional rigidity. The interesting feature of this structure is combination of engine mounting frames with fixed undercarriage tubular members. This makes an inverted bridge truss that not only supports the engine but strengthens the landing gear. The construction transmits the engine inertia loads directly to the undercarriage when landing instead of through the wing structure.



Left hand side of cockpit.

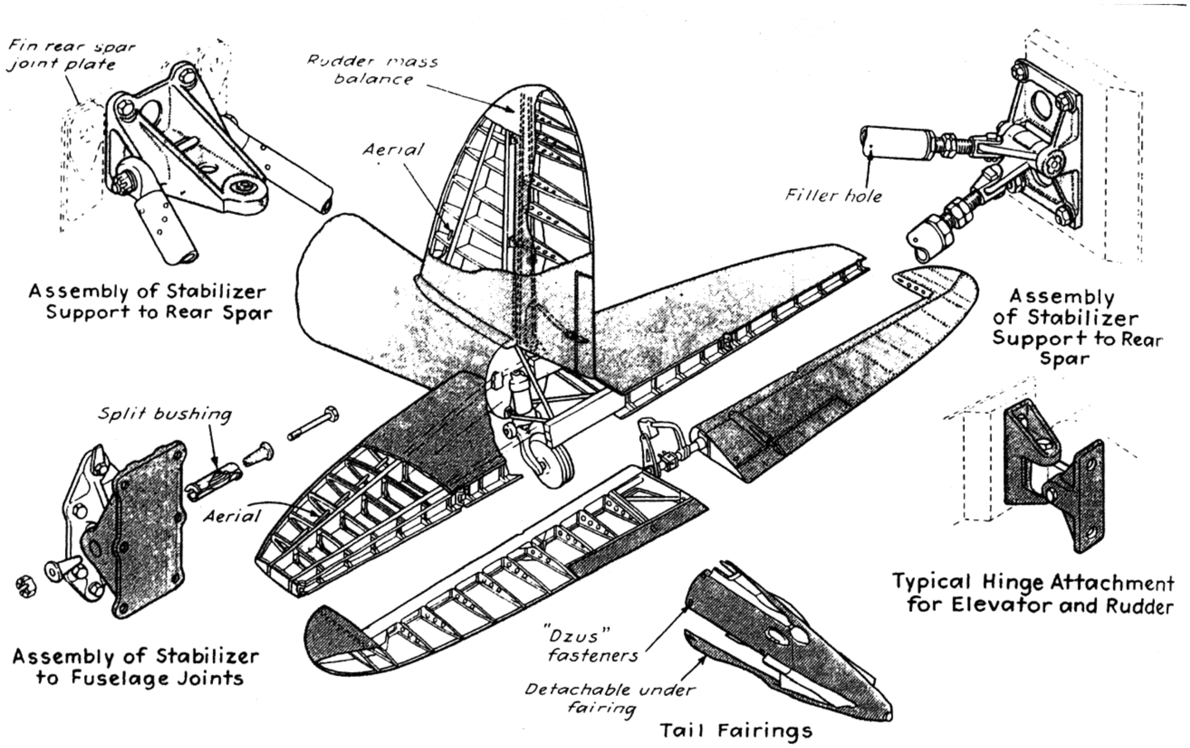
1. Pilot's seat.
2. Pilot's arm rest.
3. Pilot's oxygen tube.
4. Pilot's pouch.
5. Oxygen demand regulator.
6. Supercharger switch.
7. Elevator trim tab indicator.
8. Dimmer switch.
9. Dimmer switch.
10. Compass dimmer switch.
11. Ventilator.
12. Throttle controls.
13. Oil and fuel pressure gages.
14. Steering indicator
15. Radiator temperature gage.
16. Manifold pressure gage, left.
17. Oil temperature gage.
18. Manifold pressure gage, right.
19. Tachometer, left.
20. Tachometer, right.
21. Compass lamp.
22. Landing lamp switches.
23. Compass.
24. Propeller control lines.
25. Rudder pedals.
26. Pilot's seat adjusting lever.
27. Map case.
28. Pilot's thigh rests.

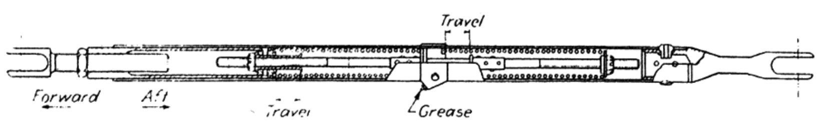
To take engine torque and provide lateral stability for the engine, transverse and diagonal bracing is incorporated in each mount. Construction of the spar attachment brackets for undercarriage and engine are of unusual interest. Ordinarily it is quite a difficult problem to make transition from metal to wood, but the problem is handled in a very direct and simple manner in this case. Even the flap jack and center hinge support are tied into this structure to get maximum bracing.

Sixteen gallons of water and ethylene glycol mixture are use in each engine, with provision of an expansion header tank just ahead of the cylinders. Filler opening for the cooling system is in header tank. A thermometer is provided to indicate engine temperature on the instrument panel. Thermostats and movable radiator air duct flaps control engine temperature. The flaps are controlled by the pilot. The automatic thermostat valves are designed so only jacket coolant is circulated up to 185 deg. F. This provides a quick warm-up. Above 221 deg. F. all coolant radiators. Each engine has its own cooling system for both coolant and lubricating oil. The connections are short and direct from engine to radiator core.

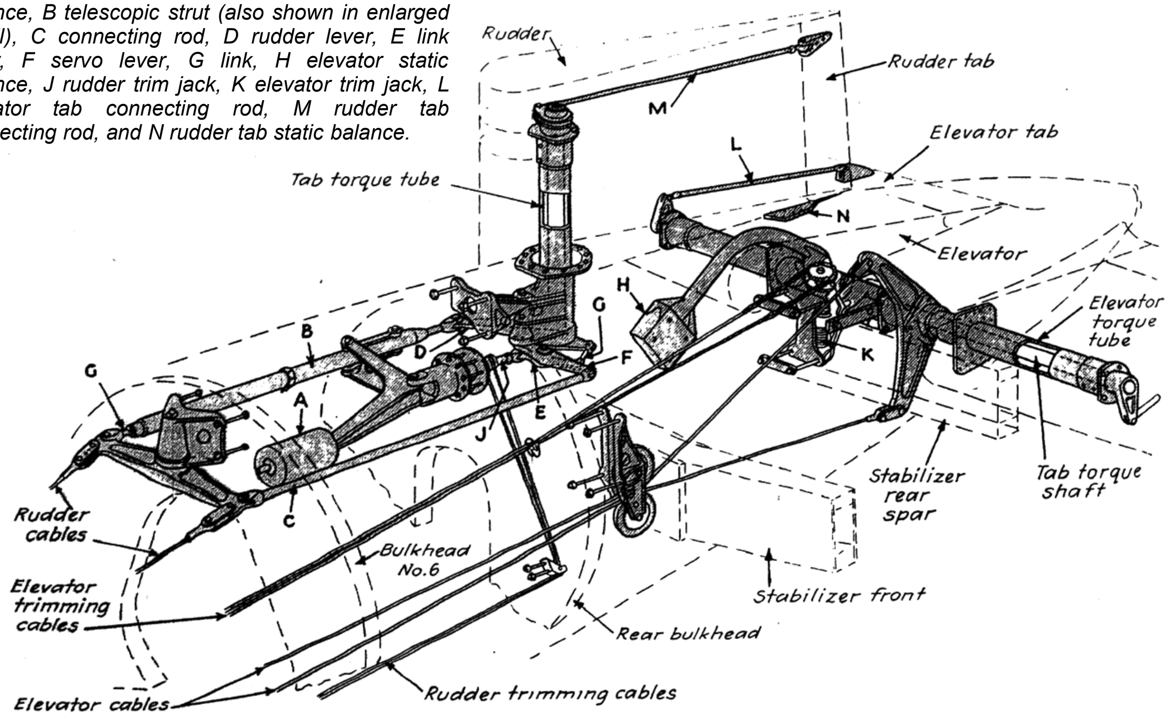
Radiator is located on front spar between fuselage and engine nacelle. The air duct forms leading edge at this point. Radiator unit cover forms the top of the wing, and the same is true of the bottom. The radiator cores are mounted in an aluminum frame structure that is bolted to the front of the main wing spar. The lower connections are tubular in form, provided with a screw adjustment for length. The top is attached to the wing spar by the five channel shaped ribs which go over the top of the radiator cores. These ribs have lightening holes through which the service pipes are threaded. Diagonal tubular braces at center steady the whole installation laterally. They also take reactions from the electro-pneumatic ram which operates the cooling flaps in the air outlet stream.

Air enters the radiator duct through a slot in the leading edge of the wing, but the flow is controlled by position of the outlet flap below and behind the





Empennage and controls, with details of fastenings and method of transmission. A is rudder static balance, B telescopic strut (also shown in enlarged detail), C connecting rod, D rudder lever, E link lever, F servo lever, G link, H elevator static balance, J rudder trim jack, K elevator trim jack, L elevator tab connecting rod, M rudder tab connecting rod, and N rudder tab static balance.



radiator cores. A back plate streamlines the air beneath the front spar when the flap is open. Flaps for each engine are separately controlled by switches at the pilot's hand. The electro-pneumatic rams are designed to close flaps when the temperature is below 230 deg. F. and open them when it reaches 239 deg. maximum.

The radiator core is divided into three sections. A small section with a special outlet passage is located next to the fuselage. There is a hand-operated flap in this passage controlled by the pilot. When flap is closed, all air passing through this section of the radiator goes into the cabin through an inlet tube inside of the fuselage. An air tube from cabin to airstream is also provided to exhaust the air.

At the engine side of the radiator there is a honeycomb type cellular core to cool oil in the same airstream but entirely separate from the engine cooling section. The engine cooling radiator core is of the fin and flat tube type.

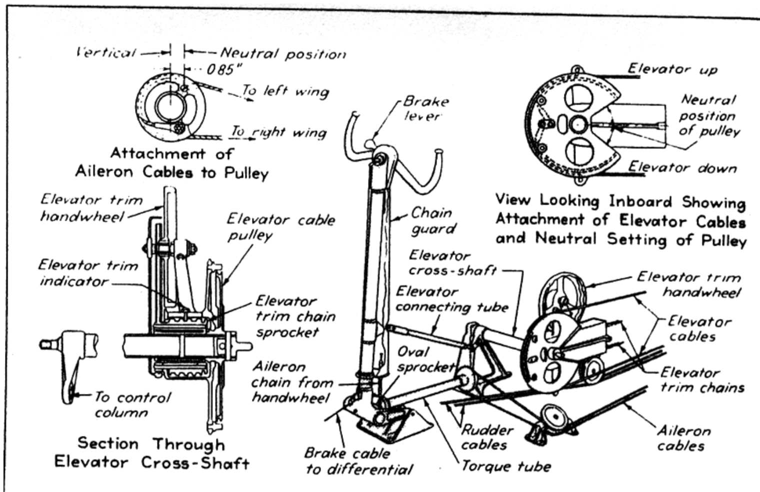
All oil and liquid couplings are made with the "Alvimo" design. The thermostatic relief valve mounted on the header tank controls pressure in the cooling system and suppresses boiling. It also admits air to the header when temperature falls, thus relieving the system of sub-atmospheric internal pressures. A relief valve opens up at two atmospheres pressure. The vent tube discharges just aft of exhaust stacks.

Fuel System

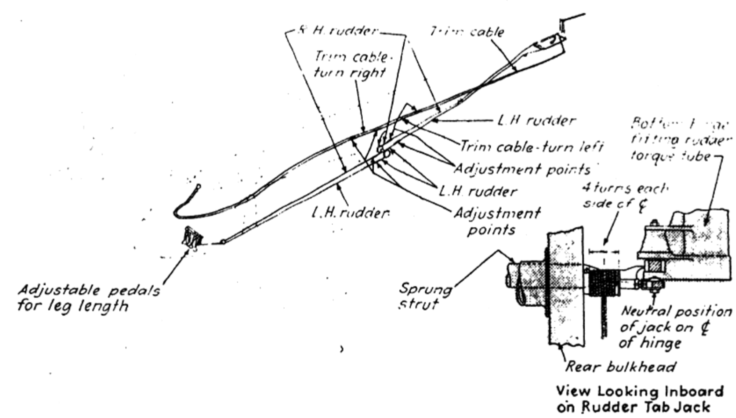
Fuel is carried in five pairs of aluminum alloy tanks protected by

Control Travel

Control column neutral position		5º aft of vertical
At centerline of control column,		
handwheel travel,	forward	12½º
	aft	12½º
	lateral	none
Elevator travel,		
above neutral		25º up
below neutral		25º down
Rudder travel.		
right or left		26º
Aileron travel,		
above neutral		26½º
below neutral		11½º
Tolerance on control surface travel		-1º, +2º
Elevator trim tab travel,		
up or down		7½º
Rudder trim tab travel,		
left or right		16º + 2½º
Left aileron trim tab travel,		
	up	8½º
	down	9½º
Flaps		45º down ± 2º (max.)

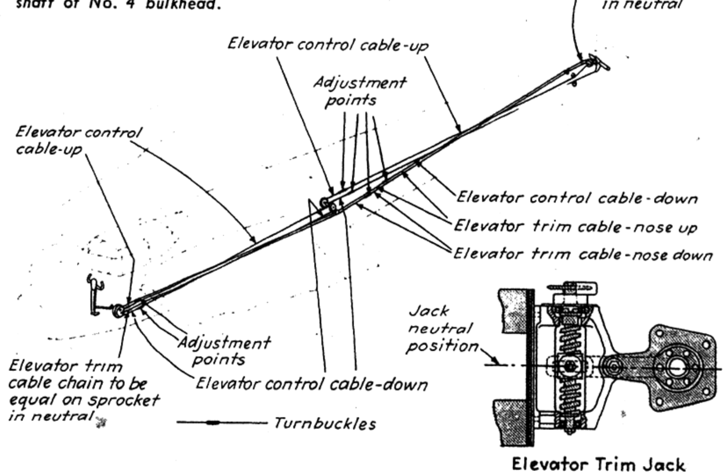


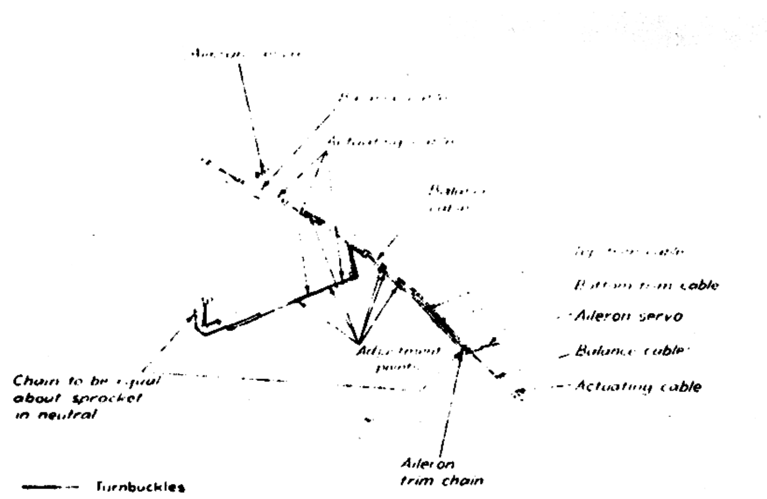
Details of elevator controls.



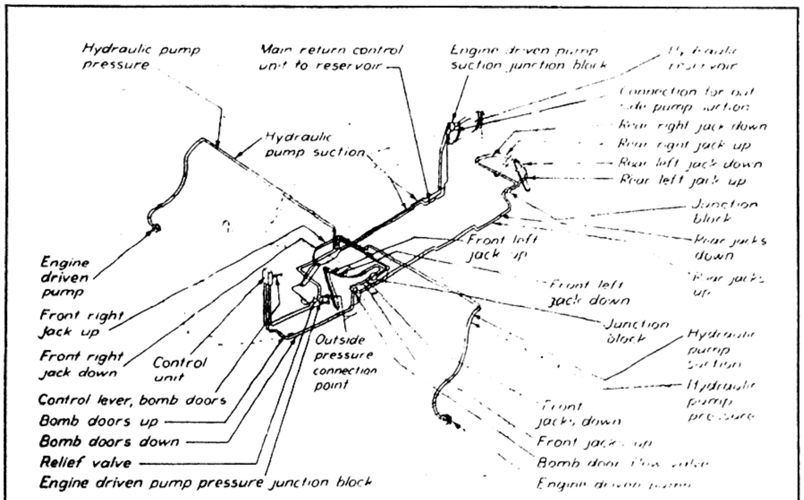
Rudder control cables with adjusting turnbuckles indicated.

Elevator controls with detail of trim jack. Trim cables run to jack, but others run to intermediate shaft of No. 4 bulkhead.

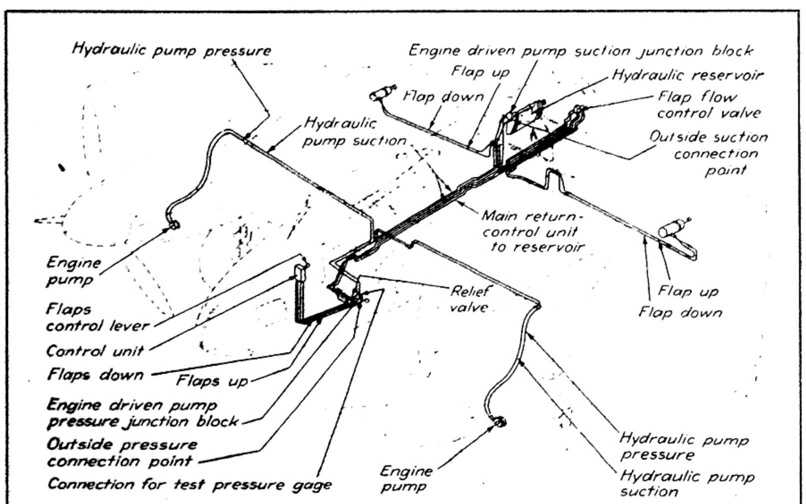




Aileron controls are operated by cables over ball-bearing pulleys. Right hand tab is adjustable in flight, but left hand one is only adjustable on ground.



Four hydraulic jacks—one at each door end —are used to operate bomb bay doors.



Hydraulic flap controls draw fluid from reservoir in center of fuselage. Lever control valve is in central instrument panel. Both reservoir and emergency hand pumps may be used for operating landing gear in emergencies.

self-sealing coverings. They are all housed within the main wing and have a total capacity of 674 U.S. gal. Electrically operated gages indicate contents of each pair of tanks. Filler openings are through top of wing or fuselage for all tanks. On the starboard side of the fuselage there is a fuel collection gallery casting that has disk-type non-return valves to prevent flow of fuel from one tank to another.

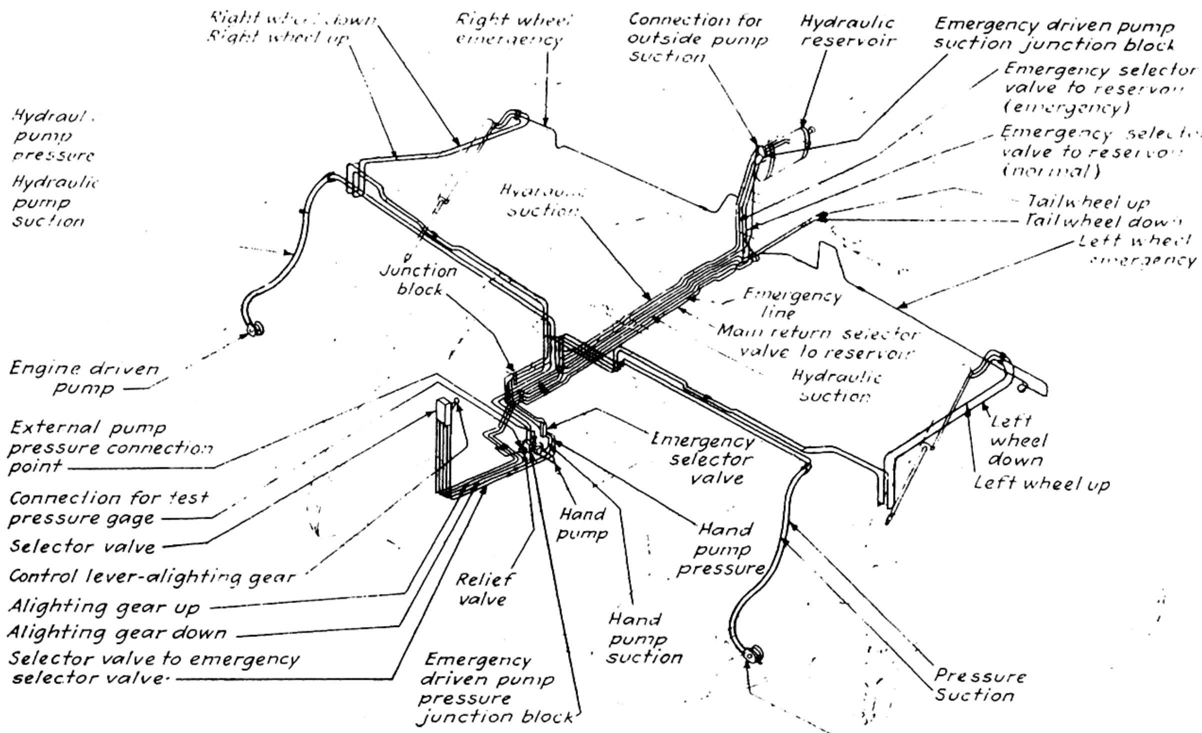
The outboard tanks feed direct to their respective engines, through the main control cocks and through the booster pumps, but they are not connected to the fuel gallery with the other tanks. The fuel gallery feeds both engines from the tanks connected to it. Each pair of tanks is provided with a drain cock and all delivery connections have a check valve so they can be disconnected without loss of fuel. Pressure is applied to tanks, but it can be cut off and the tank vented.

Aileron, elevator, and rudder controls are all operated through cables guided by molded pulleys mounted on sealed ball bearings. In several locations, adjustable tubular connecting rods are used. These are also pivoted on ball bearings.

The control column is a vertical tube hinged at the bottom and surmounted by an abbreviated wheel and a thumb lever for operating the brakes. There is no adjustment on the control column for height or position. The pedals, however, are adjustable for leg length and can be set at five different points about 1 in. apart.

Elevator Control

The control column is connected by an adjustable length tube to the elevator control layshaft beneath the pilot's seat. Cables connect the layshaft with a countershaft mounted on the aft-side of No. 4 bulkhead. These cables are attached to circular pulleys at both ends. The second elevator pulley on the countershaft is oval in shape so as to provide a low gear ratio at small control angles with a progressively higher gearing as the angles increase. Cables run from the oval pulley to levers on the elevator torque tube. Travel limit stops are



Landing gear hydraulic system draws fluid from general reservoir which is supplied by engine-driven pumps.

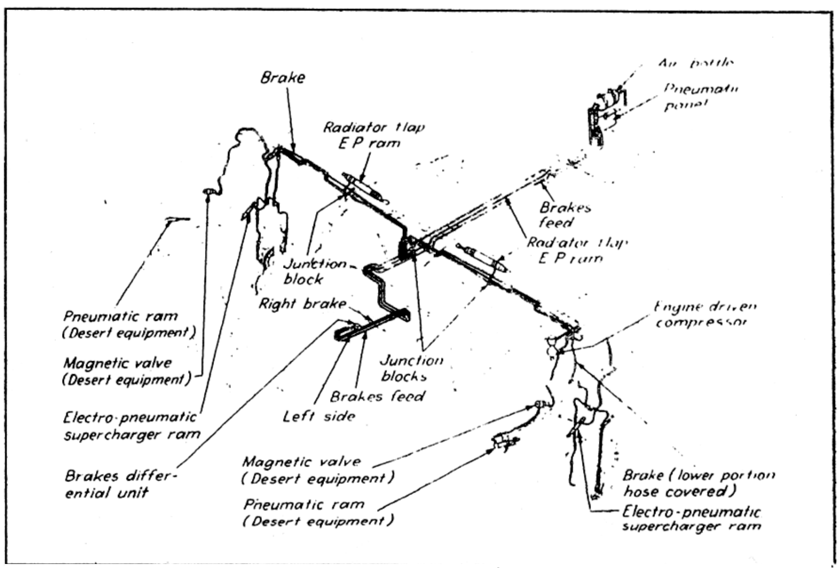
provided on the layshaft and also a trimming weight. This hangs down about 6 in. below the countershaft center when elevator controls are at neutral.

Elevator trim tabs are controlled by a hand-wheel at the left of the seat. A quill shaft, concentric with the elevator layshaft, is connected to the wheel shaft by chain and sprockets. On the outboard end of the quill shaft there is another sprocket. Motion of this sprocket is transferred to the two elevator trim tab cables by a short length of chain and to the elevator trim jack bolted to back of rear tailplane spar. Construction of this jack and its location and method of operation by chain and sprocket are illustrated. From rear bulkhead to jack, the cables, chain, and sprocket are enclosed in a sheet metal tube, the top side of which is removable.

Aileron Control

Motion of the aileron control is transmitted to the bottom end of the control column by chains and sprockets connected by rods. Top sprocket is circular, but the bottom one is oval to give a low gearing around neutral position increasing to maximum at full aileron. The oval pulley is connected to a pulley beneath the seat by a tubular torque shaft. To allow for movement of the control column, a universal joint is provided in the torque tube attachment casting. The pulley on the end of torque tube operates two aileron control cables, which pass down left side of fuselage to rear face of rear main spar and thence over ball bearing molded pulleys to the aileron differential pulley.

Both ailerons have geared balance tabs. The right aileron tab adjustment is fixed during flight (although adequate adjustment is provided when



Pneumatic controls operate brakes, air intake flaps, supercharger controls, and radiator flaps for regulating engine temperature. Compressed air is supplied by left-hand engine-driven compressor and is stored in bottles for emergency use.

trimming on the ground) but left trim tab can be positioned during flight. The control with its indicator is on lower right corner of instrument board. This operates with a sprocket and chain, connected to control cables taking same path as aileron control cables to left wing. On the wing a chain and sprocket connection is provided to operate a screw-and-nut type of trim jack.

Rudder Controls

Adjustable rudder pedals are hung from two parallel overhead shafts, the right pedal being suspended from the front one. Two arms on each side of the pedal pad are provided. Each shaft has an arm almost as long as the pedal that is connected to one of the two rudder cables. The latter pass along left side of fuselage to arms of the cable lever, pivoted on the forward side of No. 6 bulkhead. Bulkhead acts as a stop for rudder pedal movement.

Rudder trim tab is operated by a jack mounted on rear face of N0. 7 bulkhead, just below rudder. It is operated by small flexible cables wound on a small drum that forms the nut of the trim jack. At the cockpit and the rudder trim control a Teleflex control box is mounted on the center support of the “V” windshield where its crank control is easy to reach and the indicator showing rudder tab position easily read. The Teleflex cable runs from the control through No. 3 bulkhead. From this point to the tab control drum, flexible cables are run over molded ball bearing sheaves.

Rudder tabs not only serve as trimmers but also provide servo action for the rudder. To introduce the servo action a telescopic spring strut is fitted in the rudder control system.

Pneumatic brake control is operated by thumb lever attached to right hand spoke of aileron control wheel. It is provided with finger operated clip so it can be locked in *on* position. A flexible cable transmits brake lever motion to differential control box on floor just ahead of the rudder pedals. Thumb lever merely operates an air valve. The brake control box is also connected to the forward tor right brake pedal layshaft. A tubular rod joins the short levers provided at each end. This control divides the braking effort between the landing wheels depending on the position of the rudder pedals. To get even braking, it is only necessary to keep both rudder pedals at center position and control the amount of braking by thumb pressure.

Location of brake differential control valves is indicated in the diagram of the pneumatic system controls.

The pneumatic system controls brakes, radiator flaps, superchargers, and desert air control, and it has a small single cylinder aircooled compressor on the engine. An air bottle is provided in the after part of the fuselage. Pressure regulator valves, pressure maintaining valve, and oil filters provide adequate volume of clean air. Compressor cylinder is air-jacketed so that a high pressure head of air due to sip speed will be circulated all around it.

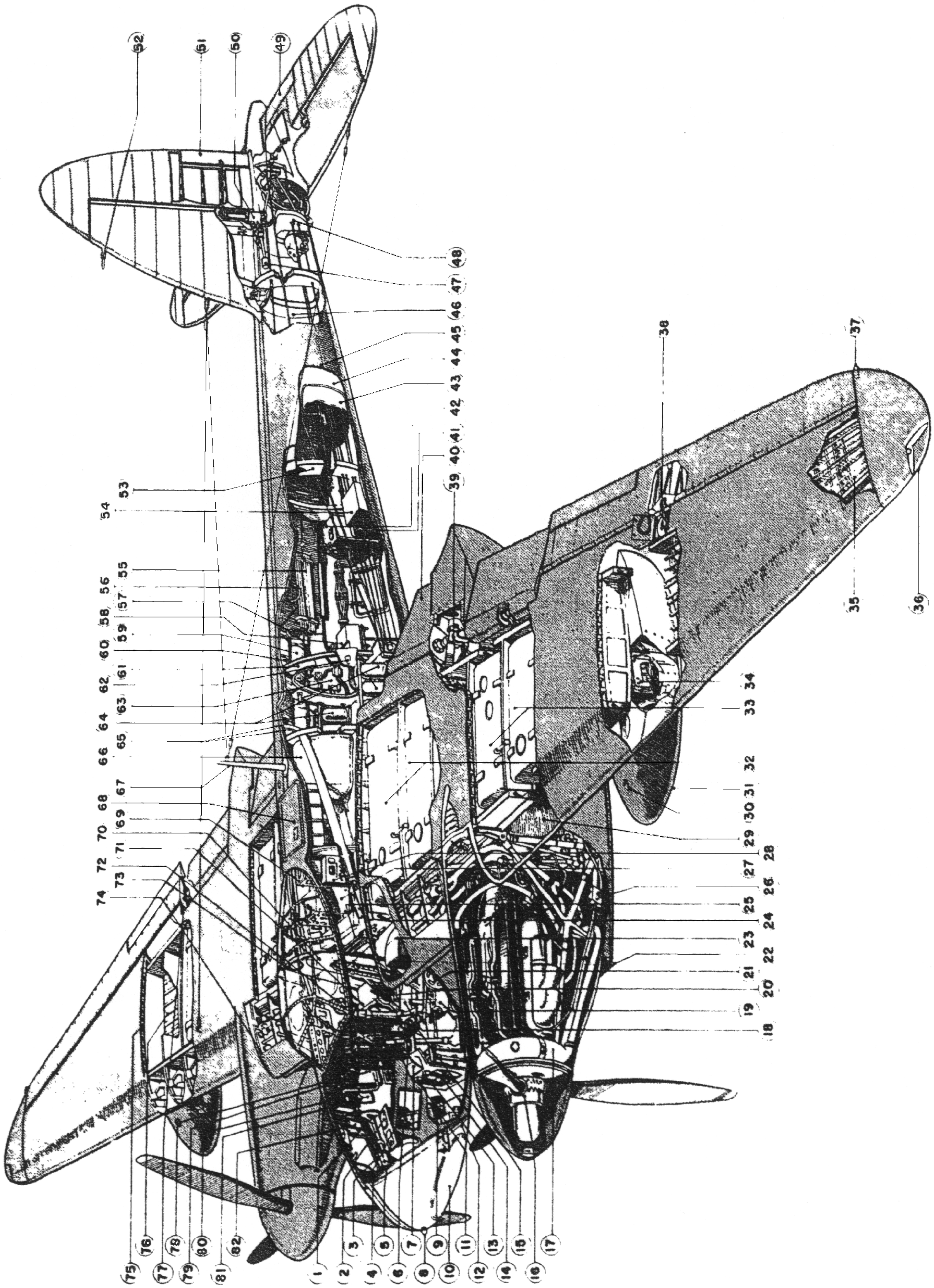
Oxygen System

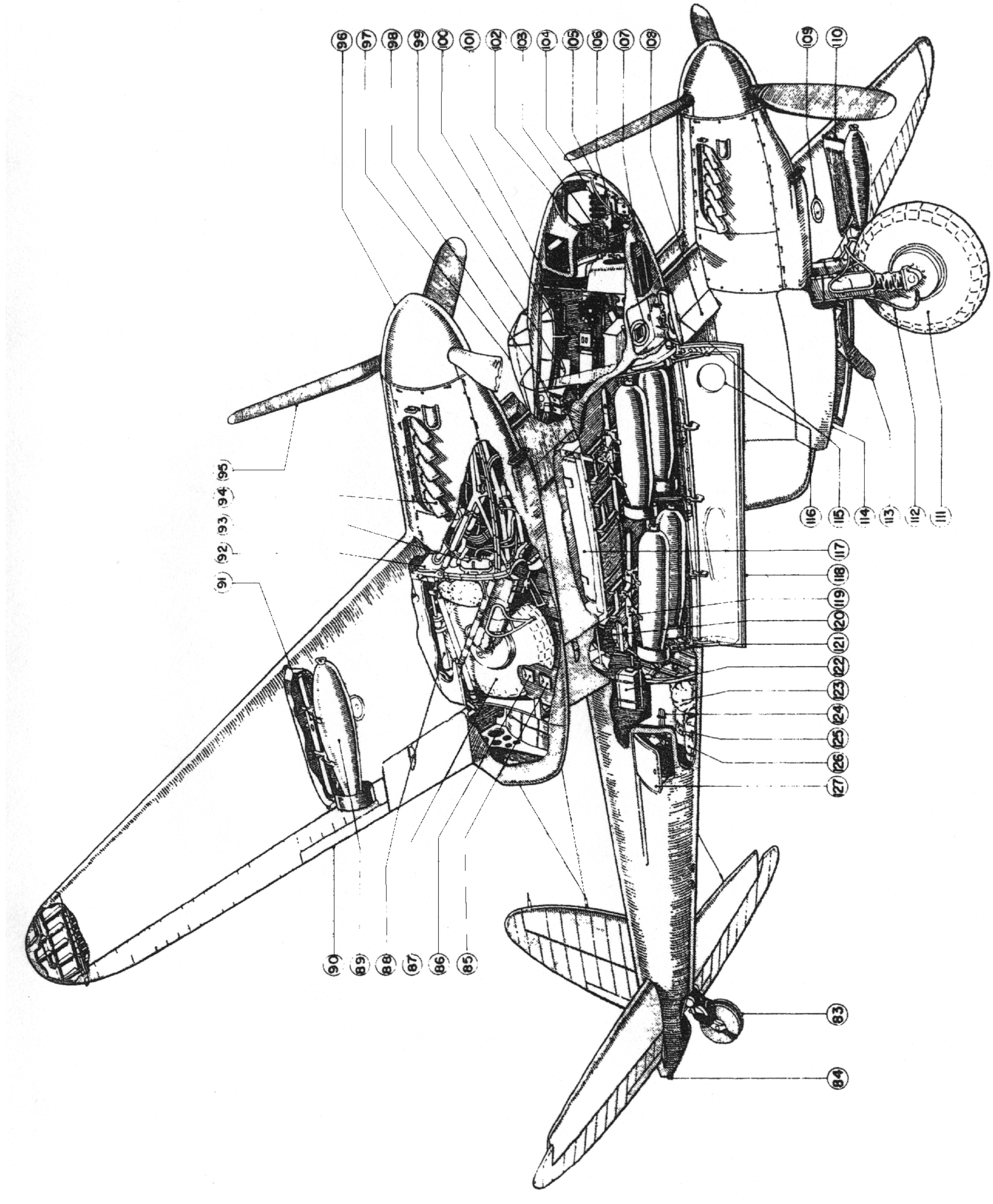
Since the *Mosquito* is used at high altitude as well as for strafing, a complete system of oxygen tanks is provided. Two different demand regulators and flow meters are provided — one for the pilot and another for the bombardier.

For flying or in cold weather, hot air from the left air heater is directed into the cockpit. Ordinarily, heat is not taken from the right heater where a duplicate installation is provided. However, for photographic work at high altitude it is necessary to keep the cameras warm, so ducts are provided to distribute heat from the right heater where needed. For long distance missions, an auxiliary oil tank is carried in the aft fuselage, and this also is kept warm by the same means. The regular oil tanks for each engine are located behind the firewalls of their respective engines in the landing wheel bays.

The *Mosquito* is now being built on North America by DeHavilland Aircraft of Canada, Ltd. Because shipping requirements made it necessary to purchase all equipment on this side of the Atlantic, many new engineering problems introduced themselves, resulting in a tremendous amount of re-engineering before production could be attained. Much credit is due W.D.Hunter, Canadian Chief Engineer, W.J. Jakimiuk, Chief Canadian design development engineer and F. H. Burrell, Chief service liaison engineer, who came from England especially for this project.

Acknowledgment:— This description of the deHavilland *Mosquito* was only made possible by the generous assistance and cooperation of the management and Engineering Departments of the deHavilland Aircraft of Canada, Ltd., and particularly Messrs. J.G. Glassco, controller; L.C.L. Murray, executive director; E.H. Staite, assistant controller; W.D. Hunter, chief engineer; W.J. Jakimiuk, chief design development engineer; F.H. Burrell, chief technical service engineer; D.G. Higgins, public relations; Robert B. McIntyre, chief production-liaison engineer; C. Don. Long, chief project engineer; and W.H. Jackson, development engineer; Joe Holliday, plant photographer; R.V. Corlett, methods engineer; W.K. Aykroyd, chief draughtsman; C.E. Cowtan, air publications section; H.R. Johns, service inspection; and John Greeniaus, Lorne Janis, and F. Willcox.

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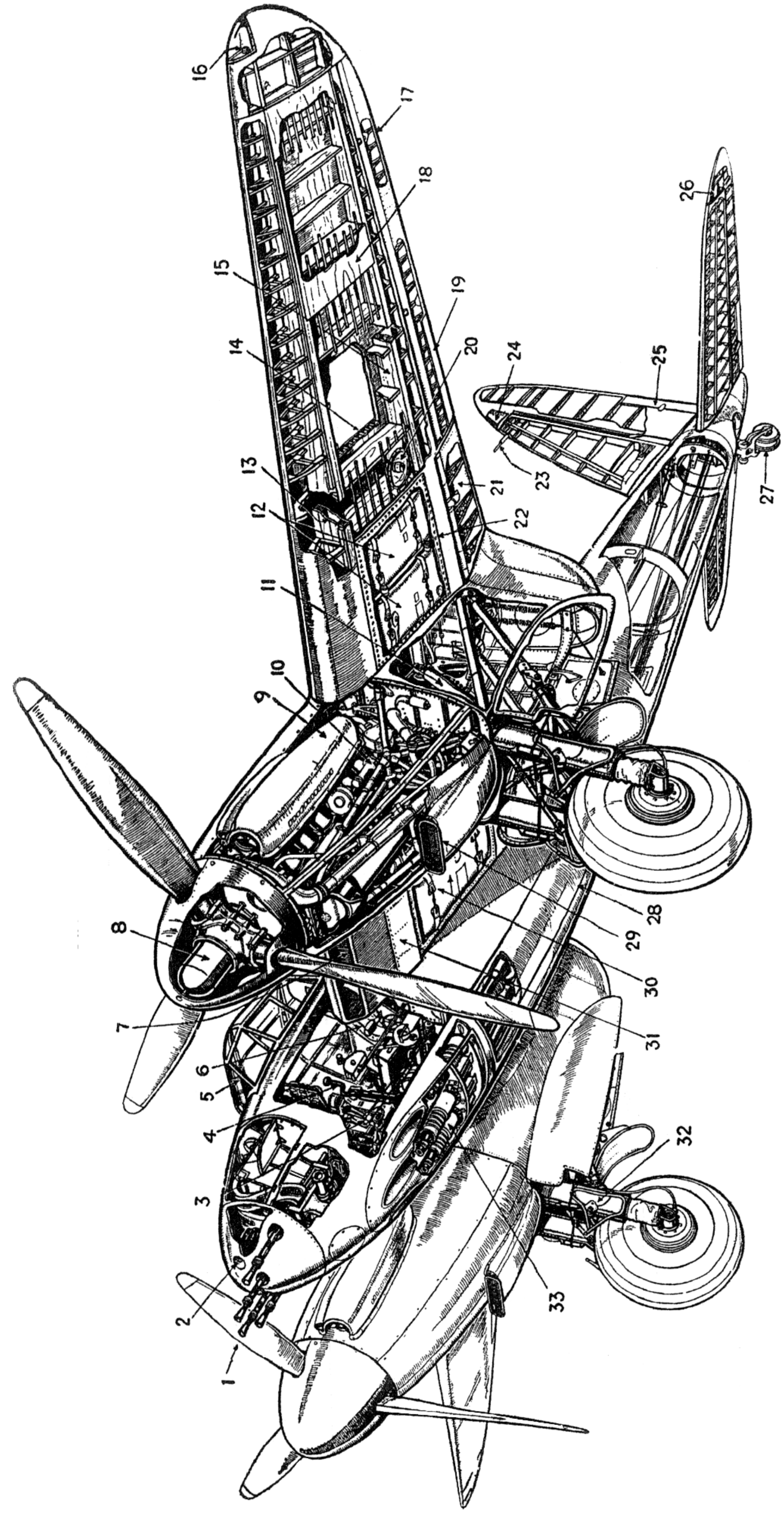
Upper and lower sectional view of Mosquito. References: (1) Fireman's axe; (2) bombardier's elbow pad; (3) inter-com.; (4) portable oxygen bottle; (5) bombardier's writing pad; (6) pilot's compass; (7) parachute stowage; (8) navigation headlight; (9) bombsight; (10) bombardier's window; (11) impact switch; (12) Plexiglas nose; (13) gravity switch; (14) fire extinguisher; (15) pilot's thigh rests; (16) Hydromatic propeller; (17) coolant header tank; (18) pilot's seat; (19) inter-com.; (20) engine controls; (21) elevator trim tab hand wheel; (22) carburetor air intake; (23) oil and coolant radiators; (24) pilot's harness; (25) throttle and propeller control; (26) oil trap; (27) radio transmitter; (28) radio compass; (29) oil tank; (30) dump tank filler cap; (31) dump tank; (32) inboard fuel tanks; (33) out board fuel tanks; (34) dump fuel tank release gear; (35) stringers; (36) navigation lamp; (37) identification lamp; (38) aileron control; (39) flap jack and crank; (40) flaps; (41) rear camera; (42) stowage for camera heating cables; (43) plywood inner skin; (44) balsa; (45) plywood outer skin; (46) bulkhead No.6; (47) rudder mass balance; (48) bulkhead No. 7; (49) trim tab; (50) rudder linkage; (51) trim tab; (52) pitot head; (53) bulkhead No. 5; (54) camera mounting boxes; (55) spike pickets; (56) DF loop; (57) lamp; (58) radio; (59) compressed air container; (60) de-icing fluid tank; (61) bulkhead No. 4; (62) ground starter plug; (63) pneumatic hydraulic panel; (64) oxygen bottles; (65) hydraulic tank; (66) long range oil tank; (67) aerial mast; (68) dinghy stowage; (69) antenna loading unit; (70) pilot's armor; (71) observer's seat; (72) trailing aerial winch; (73) observer's armor; (74) oil and coolant radiators; (75) double top skin and stringers; (76) single under skin and stringers; (77) aileron tab control; (78) observer's demand oxygen regulator; (79) instrument panel; (80) camera temperature gage box; (81) camera leads stowage; (82) inspection lamp stowage; (83) tail wheel stowage; (84) navigation light; (85) stowage picketing eyes; (86) stowage, landing gear locking cap; (87) landing gear retracted; (88) landing gear jack; (89) 500-lb. bomb; (90) aileron trim tab; (91) universal bomb carrier; (92) firewall; (93) fire extinguisher; (94) stub exhaust; (95) propeller; (96) spinner; (97) cockpit canopy; (98) radio remote control boxes; (99) pilot's pouch; (100) pilot's demand oxygen regulator; (101) dimmer switches; (102) signal cartridges; (103) fire extinguisher; (104) themos bottles; (105) glycol spray; (106) tail drift sight; (107) ladder stowage; (108) radiator flap; (109) landing light; (110) wing bond fairing; (111) landing wheel; (112) brake hose; (113) mud guard; (114) landing gear doors; (115) entrance door; (116) camera window; (117) center fuel tank; (118) bomb bay doors; (119) bomb carrriers; (120) bomb winch; (121) bomb day door jack; (122) ration container; (123) engine covers, sleeping bags, etc.; (124) locking controls, stowage; (125) signal strips; (126) emergency tool kit, and (127) rear entry door.

Cutaway drawing of de Havilland *Mosquito*, re-drawn from *Flight*, showing details listed below.

1—Four .303 machine guns
2—Camera
3—Rudder pedals
4—Control column
5—Bullet proof screen
6—Pilot's seat
7—Oil and glycol radiators
8—De Havilland hydromatic airscrews
9—Exhaust flame damper
10—Rolls-Royce *Merlin XX* 12 cyl. engines
11—Landing gear hydraulic jack
12—Outboard fuel tanks
13—Front main spar
14—Spaced double skin
15—Rear main spar
16—Navigation light
17—Aileron
18—Single plywood skin (lower)
19—Aileron trim tab
20—Landing light
21—Flap
22—Fuel tank cover
23—Pitot head
24—Rudder mass balance
25—Rudder trim tab
26—Elevator mass balance
27—Retractable tail wheel
28—Gun bay folding doors
29—Carburetor air intake with anti-ice guards
30—Inboard fuel tanks
31—Radiator shutter
32—Compression rubber landing gear leg
33—2 20-mm. cannon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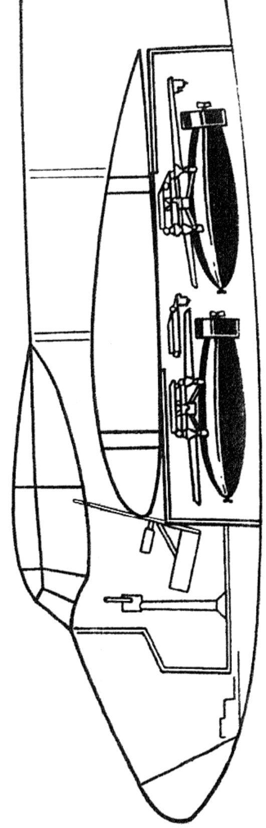
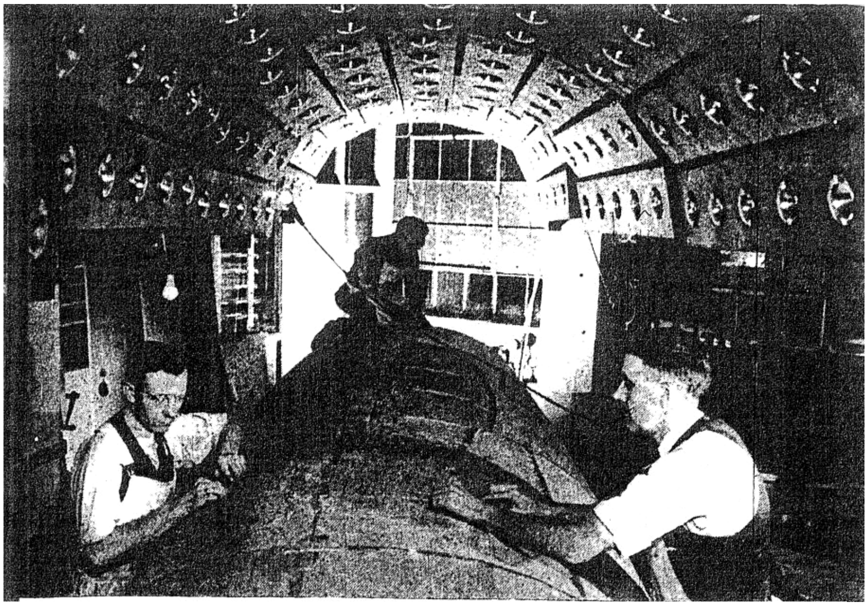




Initial step in building de Havilland *Mosquito* bomber is to build up lengthwise fuselage half. Plywood sheets arer bent over concrete form, held in place by tacks driven into wood strips set in the concrete. Sheets are bonded by special glue which is dried by battery of 250 infra-red lamps lowered over form. All photos by National Film Board.

"Mosquito" Design Facilitates Production

By JAMES MONTAGNES, *Aviation's* Canadian Correspondent

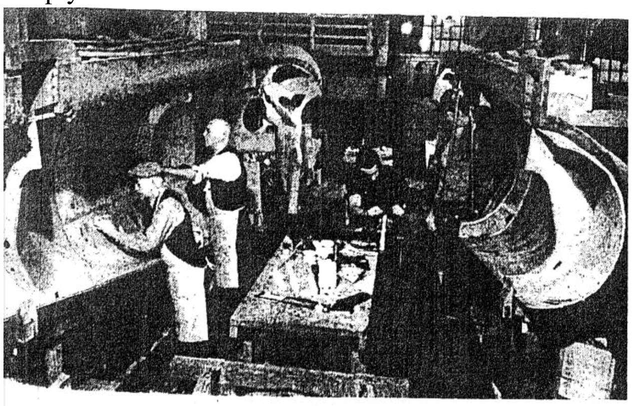
With plywood fuselage constructed in lengthwise halves, control and wiring installations are simplified. De Havilland Aircraft of Canada uses Packard-built engines in producing these formidable craft.

IN DESIGNING the now-famed *Mosquito* bomber, de Havilland engineers considered ease of production as well as aerodynamic efficiency, as is evidenced by the rate of production by de Havilland Aircraft of Canada alone.

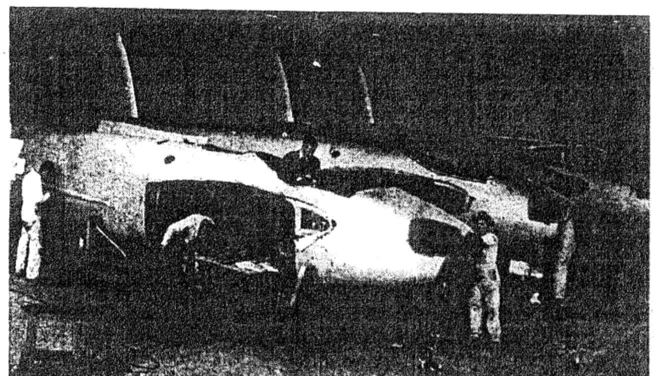
First step in creating the plane is construction of the fuselage in lengthwise halves, which are built up of plywood sheets laid over a concrete form. Shaping of the sheets is achieved by bending them into place on the form and holding them by means of tacks driven into wood strips set into the concrete. Using a special plastic bonding agent, the fuselage is built up to proper thickness, the bonding agent being dried by a battery of 250 infra-red lamps. One of the largest such batteries in Canada, the infra-red unit was designed especially for *Mosquito* production.

Other structural sections of the fuselage, such as the five main bulkheads, are built up from smaller pieces of wood, which are cut, bent, and bonded on molds before being bonded as an integral part of the fuselage of the Mosquito.

This work is done in one plant, the halves then being shipped to the company's main plant outside Toronto. Here the two halves are set up in fixtures and all possible wiring and control installations made. This system eliminates the necessity of employees working in cramped space, thus speeding production considerably. When the two halves of the fuselage have been fitted and bonded into one unit, the whole is



Fuselage halves, with bulkheads in place, receive interior finishing touches at de Havilland Aircraft of Canada. Note tongue and groove fitting for joining two components into one unit.



***Mosquito* fuselages near final assembly area.** All possible wiring and controls have been installed before the lengthwixe halves were bonded together, when complet fuselage is fabric covered.

fabric covered.

Moved then to the final assembly area, it receives the empennage and plywood wing, the latter with landing gear already attached.

The aircraft is then placed in jigs which keep it in flying position as it moves through the final assembly area where engines, nacelles, bomb racks and doors, instruments, self sealing fuel tanks, and other units are installed.

The plastic cockpit cover is put in place after the armor-backed pilot's and bombardier-radio operator's seats have been installed. The transparent plastic nose is put in place after the bombardier's instruments are all in and all controls for operating bomb racks and bomb doors have been tested.

Access to the plane is through a small hatch via a collapsible metal ladder. The bombardier's seat is to the pilot's right so that the bombardier can drop down and lie full length over the hatch opening with the upper part of his body in the nose of the plane where the bomb sight is located.

When the *Mosquito* was first put in production in Canada, some of the instruments were made in England. Now, however, these are being replaced with Canadian and American built units, some of which have required considerable modification in the original cockpit layout and wiring.

Canadian built *Mosquitos* are powered by Packard-built Rolls-Royce *Merlin 21* engines developing 1,250 hp.

Releasable specifications include the following: Span, 54 ft. 2 in.; Length, 40 ft. 9 in.; Height, 15 ft. 3 in.; High speed (approx), 400 mph.; Range (maximum), 2,000 mi.; Armament (reported), 4 20 mm. cannon and four .303 machine guns; Power, 2 Packard Rolls-Royce *Merlin* 21's.