SECTION 7

DESCRIPTION OF STRUCTURE

CHAPTER 1: FUSELAGE
CHAPTER 2: MAINPLANE
CHAPTER 3: TAIL UNIT
CHAPTER 4: FLYING CONTROLS
CHAPTER 5: LANDING GEAR

SECTION 7 — CHAPTER 1

FUSELAGE

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Fuselage

General

230. The fuselage is constructed of balsa wood sandwiched between ply skins, with four bulkheads interposed throughout its length (see Fig. 78). The fuselage is oval in section, tapering in plan and elevation from bulkhead No. 3 to nose. It is built in two halves and joined along the top and bottom centre lines. The forward face of No. 1 bulkhead is armour-plated and carries the nose wheel unit bracing structure. The cockpit, access to which is gained by a retractable footstep in the port side of the fuselage, is enclosed between bulkheads Nos. 1 and 2 by a canopy. Bulkheads Nos. 3 and 4 are reinforced by plate fittings and steel tubes for the wing attachment fittings. Bulkhead No. 4 also carries the engine mounting (see Fig. 48) and the Auxiliary Gear Box.

Detachable Nose Panel

231. A detachable nose panel is fitted, which gives access to the AN-N6 G.S.A.P. camera and also the Loop installation of the A.D.F.14—"Lear" Radio Compass.

Doors

232. Two removable gun bay doors covering the ventral bay provide access to the centre fuel tank and the 20 mm. guns (see para. 320, last item).

Canopy

233. The canopy is a "tear-drop" design, made of moulded Perspex with a light alloy frame. It is made to slide fore and aft by a winding handle on the right-hand side of the cockpit. The windscreen and side panels are of the Triplex dry air sandwich type.

Covering

234. The fuselage outer skin is covered with mercerised cotton fabric to Spec. D.T.D. 407 or F8 or mercerised linen fabric to Spec. D.T.D. 540.

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Mainplane

General

235. The mainplane is a cantilever structure tapering in plan and elevation. It comprises a channel-section main spar running the whole length of the wing, with a false spar at the trailing edge to which the dive brakes, flaps and aileron hinges are attached. The structure forward of the main spar is constructed as a unit and the whole assembly is riveted to the spar. The skins are aluminium alloy sheets riveted to the spar, ribs and stringers; the main stringers are located parallel to the front spar (see Figs. 79, 80, 81 and 82).

Provision is made to house one fuel tank at the inboard end of each wing, the two outboard fuel tanks are housed between ribs 5 and 9, and the leading edge tank between ribs 2 and 5. Access is obtained through three detachable doors in the underside of each wing. An undercarriage diaphragm, which is fabricated as a separate structure, is assembled to the wing outboard of the inboard wing tank bay. An air intake duct is located in each wing, protruding at the root end rib. Navigation lights are housed in the all metal wing tips, which are attached to the wing end rib by means of countersunk screws into anchor nuts. The retractable landing light is mounted in the port wing, and the G3F compass in the starboard wing.

The V.H.F. radio aerial is mounted in the port wing tip.

Attachment Points

236. (i) There are three wing-to-fuselage attachment points, one at the top and bottom of the front spar, and the other, which is a drag member, is bolted to a channel section member forward of the front spar (see Figs. 83 and 84).

(ii) The wing-to-boom attachment point is provided by an L-section forging riveted to the end of a stub boom which is built into the wing.

Spars

237. The main spar is a channel-section light-alloy pressing comprised of three lengths which are butt-jointed, strapped and riveted together at the web. Top and bottom light-alloy booms, diminishing in depth toward the wing tip, are riveted to the spar flange. At the spar root end the top and bottom booms are "stepped" to receive the shanks of the wing attachment fittings, which are shaped accordingly. The spars are further strengthened by numerous extrusions riveted to the web. The false spar at the rear is built in a similar manner indicated above, with the exception that the top and bottom booms are omitted.

Drag Member

238. The drag member is a light alloy pressing with a reinforcing channel attached to the top edge, into which a fitting is attached by four bolts through the member and a bolt through a fitting on rib No. 1A. A lug is attached to the channel fitting by four wire-locked bolts; the lug is received between two joint plates attached to bulkhead No. 3 (see Fig. 84).

Ribs

239. The ribs are light-alloy pressings with flanged edges and lightening holes. Details of the heavy and light ribs are given in Figs. 79, 80 and 81.

Ailerons

240. The ailerons are constructed of light alloy, with a single spar to which the main ribs and nose ribs are attached (see Fig. 85). The component is covered with alclad sheet. There are three hinge attachments to the mainplane rear false spar.

Flaps

241. The inner and outer flaps, interconnected by a torque tube, are all metal in construction, with reinforced ribs to which the hinge attachment fittings are located. (See Fig. 52.)

Dive Brakes

242. The dive brakes are of all-metal construction, with a single light alloy spar and pressed ribs. The two hinges are located on reinforced ribs, while the jack ram is attached to a casting, bolted to the skin. (See Fig. 53.)

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Tail Unit

General

243. The tail unit is built up on the end of twin booms. The fins, which are integral with the booms, support the interposed tail plane and the twin rudders. A servo trim-tab, operated from the cockpit, is provided on the elevator, but the trim-tabs located at the base of each rudder may only be adjusted when the aircraft is on the ground. Detachable fairings are fitted at the intersections of the fin and tail plane, and are attached with roundhead and countersunk screws. Rear end fairings, which are detachable, are fitted to the booms by countersunk screws. The tail lamp is fitted only in the port fairing. (Figs. 19 and 87.)

Tail Boom

244. Each tail boom is a metal oval-section structure, with ten light alloy diaphragms spaced along the length and reinforced with longitudinal stringers (see Fig. 86). The boom-to-wing joint diaphragm is an L-section forging, while the rear end diaphragm is riveted to a fitting on the spar of the fin. Access to flying control cables is provided by hand holes covered by screwed panels in either side of the boom.

Fin

245. The fin is constructed of a light alloy channel section spar, pressed ribs and L-shaped stringers riveted to the skin. The lower end of the spar is riveted to the tail boom attachment fitting on the rear diaphragm of the tail boom. The spar houses the top rudder hinge bracket, which is attached by four wire-locked bolts. The bracket for the pitot head is attached to the port fin by six countersunk screws. (See Fig. 87.)

Rudders

246. The two separate rudders are built up from a rudder post tube and a channel section spar, to which are attached light alloy flanged ribs, the whole being covered with a light alloy metal skin. An integral rudder balance weight is accommodated in the rudder horn, and a linked rudder balance weight is provided inside the boom rear end cone fairing. The top hinge is mounted on the rudder spar, and the bottom hinge is provided by a spigot at the end of the rudder post tube (see Fig. 87).

Tail Plane

247. The tail plane is constructed of front and rear light-alloy channel-section spars, with nose and main ribs and transverse stringers. The component is covered by alclad sheet riveted to spars, ribs, and stringers; the tail plane angle of incidence is not adjustable. Two hinges for attaching the elevator are located on the rear spar (see Fig. 87).

Elevator

248. The elevator comprises a single channel-section spar with light-alloy ribs and a built-in torque tube, the ends of which bear spigots for location in end hinges which are mounted in the fin shroud. Two hinge fittings are also positioned on the spar. Suitably reinforced ribs are employed to carry the external balance weights (see Fig. 87).

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Flying Controls

General

249. The flying control system is operated by chain and cable, with tie rods on the control column, chain on the elevator trim tab jack, and push rods and levers for rudder and elevator controls in the boom rear end. The elevator trim system is operated by Teleflex control from a cockpit hand wheel to a mid position on No. 1 wing rib, thence by cables to the trim tab jack. The control locking positions for rigging are shown in Fig. 10.

Control Column

250. The control column is a vertical tubular dural member, incorporating at its lowest end a traverse torque tube, to either end of which a double-ended lever is attached (see Figs. 88 and 89). The lower ends of the levers are located in fittings at floor level, permitting fore and aft movement about these points, thus providing the elevator control. An inertia weight projecting forward on the port side is attached to the outer torque tube on the control column. Aileron control is provided by a single column grip extension piece, hinged at the top of the column, accommodating a parking brake lever, and also gun, camera and RP/Bombs firing switches, the RP/Bombs switch being operative on Mk.31 aircraft only.

Aileron Controls

251. The aileron control is connected to a sprocket, which is in turn connected by tie rods and chains to an elliptical sprocket at the bottom of the column. The elliptical sprocket is integral with a quadrant to which the operating cable ends are bolted. Pulleys located either side of the cockpit carry the cables from the quadrant through the bulkheads to a pulley assembly positioned on the face of No. 1 wing rib (see Fig. 22). The top pulley of the assembly changes the direction of the cable and conducts it to an aileron differential wheel located on the rear face of the false spar. Two pulleys, located on the left and right-hand sides of the aft face of No. 4 bulkhead, carry the balance cable to the differential wheel through pulleys on the face of No. 1 wing rib. The position of the turnbuckles for adjustment is shown in Fig. 90.

Aileron Tabs

252. Servo trim tabs are fitted to both ailerons, and may only be adjusted on the ground to suit the flying characteristics of the particular aircraft. The tab trailing edge may be raised by adjusting the length of its connecting rod, or by altering the setting of the tab connecting link (see Sect. 4, Chap. 3, para. 90).

Elevator Controls

253. (i) The control column transverse torque tube (see para. 250) is connected, through levers and connecting rods, to quadrant pulleys located on the left and right-hand sides of the cockpit. Cables are bolted to the quadrants, and pass through the bulkheads to pulley assemblies positioned on the left and right-hand No. 1 wing ribs (see Fig. 22). Cable direction is then changed to the aft face of the false spars, which bear elliptical pulley assemblies positioned on the tail boom centre lines. The elliptical pulleys provide a lower gear ratio at small control angles and a progressively higher gearing at increasing control column movement. The cables are bolted to this assembly and are carried through fairleads to the lever assemblies in the boom rear ends, and the lever movement is transmitted to the elevator via lead-filled control rods, connected to a lever at each end of the elevator torque shaft (see Sect. 4, Chap. 3, para. 91).

(ii) A bungee cord is located on the light frame fitting at the starboard boom-to-wing joint, and stretches to the elevator control lever in the boom rear end. Its function is to assist control stability.

(iii) Cable adjustment points are shown in Fig. 91.

Elevator Tabs

254. A servo tab is fitted which is also under the pilot's control. The tab movement is provided by a hand wheel, actuating Teleflex controls to which cables are attached. Trim pulleys are positioned on No.

1 wing rib and on the false spar for changing direction for the cables to the port boom. The cables are carried by fairleads to pulleys in the rear end of the boom, then into the tail plane to a chain on the trim jack. A connecting rod transmits movement from the jack to the tab.

254A. With the elevator in the neutral position, the clearance between the top and bottom shrouds and the elevator should be .08" plus or minus .02", this may vary with the elevator in other positions down to .002" which is the minimum clearance allowed.

If necessary the rivets in the bottom shroud may be filed to ensure the minimum clearance of .002" with the elevator in the fully raised position.

Rudder Controls

255. The rudder controls consist of pendulum-type rudder pedals which are located on a layshaft forward of the control column. The pedals can be adjusted independently for reach by lifting them against the tension of a spring. The run of the cables (see Fig. 92) to the rudder control lever in the boom rear end is similar to that of the elevator cables (see para. 253).

Rudder Tabs

256. Trim tabs are fitted, but they are not servo operated. They may be adjusted on the ground to correct flying irregularities by unscrewing a wire-locked bolt that passes through an elongated hole in a bracket at the base of the tab, and turning the tab to the desired position.

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Landing Gear

General

257. The landing gear comprises a tricycle undercarriage, with two main undercarriage units (one under each wing) and a fully castoring nose wheel unit incorporating a self-centring mechanism.

The nose wheel unit retracts backwards and the main units retract outwards under hydraulic power, and are enclosed automatically by doors which are linked to the struts.

Main Wheel Unit (Airdraulic Strut)

258. (i) The airdraulic strut comprises a plunger tube which is free to move in a cylinder. At the lower end of the plunger tube is fitted a hollow axle which is bolted to the tube, and the tube is plugged with the air head, which includes an inflation valve. The upper end of the plunger tube is threaded to receive a piston which is locked by a grub screw. The piston wall is formed with a groove, and a hole is drilled through the piston into the groove, allowing a passage for the fluid to a space between the plunger tube and the cylinder tube. The piston head accommodates the flutter plate and a spring, and also has ten holes, six of which are covered and uncovered by the flutter plate, while four are outside the range of the plate. Inside the plunger tube and below the piston is a sealed floating separator which isolates the fluid and air (see Fig. 26).

(ii) The cylinder tube is a forging incorporating at its upper end four lugs to which another forging is bolted to receive the eyebolt of the lower link of the radius rod. Bosses are provided in the lower end of the tube for accommodation of the torque links, the lower ends of which are located on the axle fitting (see Fig. 26).

Nose Wheel Unit

259. (i) The construction and operation of the nose wheel shock absorber unit is similar to that of the main strut, with the exception of the spring-loaded self-centring cam located internally at the top of the unit.

(ii) The self-centring device, while allowing a castoring action during taxi-ing, also ensures that the wheel is in the correct position for retraction (see Fig. 29).

The Radius Rod Assembly

260. The radius rod unit (see Fig. 23) comprises an upper link which is free to rotate on a tube located in end bearings, and a lug for the jack attachment incorporated in the lock-plate assembly. The fork end of the upper link receives the lock link, at the top of which a stop bolt is located, and should coincide with the face of a similar bolt in the upper link. The lower end of the lock-plate is drilled to receive a roller which is free to move in the kidney-shaped slot of the lock link. The lock link incorporates an adjustable eyebolt for attachment to the strut (see Fig. 28).

Radius Rod Locking Mechanism

261. The down and up positions are held by a mechanical latch. The initial movement of the jack moves lock-plate against the action of the spring until the lock-plate is in line with the upper and lower links. With unit in the unlocked position, movement of the jack ram now causes the radius rod to hinge and retract the unit, when the spring snaps the lock-plate into the locked position (see Fig. 28).

Undercarriage DOWN Indicator Switch

262. Movement of the lock-plate assembly is imparted to the micro-switch through a spigot M, which is in contact with a leaf spring K (see Fig. 28). It will be noted that the micro-switch is in circuit at the lock down and locked up positions, and only changes over when the leg is unlocked; this attitude is indicated by red lights in the undercarriage indicator.

Undercarriage UP Indicator Switches

263. A micro-switch located above the retracting gear is brought into circuit by full retraction of the unit, which depresses an adjustable button impinging on the micro-switch leaf springs, and, at the same time, a micro-switch located on the undercarriage wheel door is brought into circuit, being actuated by a Teleflex controlled door lock plunger on the wheel well wall, thus extinguishing the red lights in the undercarriage indicator, which indicates that the undercarriage and wheel door are in the locked up position. A throttle lever micro-switch is in circuit with the up switches, and is brought into operation when the undercarriage is retracted and the throttle retarded. A red light appears on the left-hand instrument panel, warning the pilot that the undercarriage is in an unsafe position for landing.

Undercarriage Lever Lock

264. Inadvertent operation of the undercarriage is impossible while the weight of the aircraft is on the struts. To obtain these conditions, a lever lock and two micro-switches are used, one switch being operated by the port undercarriage torque links, the other by the undercarriage selector lever.

Due to the weight of the aircraft, the torque links assume an acute angle, leaving the micro-switch in the normal position, so breaking the circuit. The undercarriage selector lever is locked by a solenoid-operated plunger which is in the extended position when the coil is de-energised, thus preventing any use of lever. As soon as the weight is removed from the struts, the torque links open, depress the micro-switch and close the circuit, and when the undercarriage selector lever commences to move it operates a micro-switch on the engine control box, thus completing the circuit and energising the solenoid, which withdraws the plunger and allows the selector lever to complete its movement.

Landing Wheel Assembly (Main Wheels)

265. The wheels are Dunlop, Part No. AH.9139, with tyres and tubes as shown in the Leading Particulars, mounted on ball and roller bearings on a tubular steel axle.

Nose Wheel Assembly

266. The nose wheel, Dunlop Part No. A.H.O. 17219/IX, is mounted in a similar manner to the main wheels, but the axle tube is supported at either end in a fork-shaped forging which is pivotally mounted on the lower end of the shock-absorber unit. The axle and fittings are located by end caps which are connected by a tie rod (see Fig. 30).

Brakes

267. For pneumatic system employed for operating the brakes, see Sect. 9 and Figs. 35 and 98.