DE HAVILLAND
CHIPMUNK
AIRCRAFT

PILOTS'
MANUAL

A.L.9

PILOTS' MANUAL

FOR THE

DE HAVILLAND CHIPMUNK

AIRCRAFT

This manual has been prepared in accordance with Chapter A6–2 of the British Civil Airworthiness Requirements and is issued with the approval of the Air Registration Board. Amendments to this publication invalidate the approval unless issued by the manufacturer by arrangement with the Air Registration Board.

October 1969

FOREWORD

This manual is applicable to Chipmunk Mks. 20, 21, 22 and 22A aircraft, Chipmunk Mks. 21, 22 and 22A aircraft being those which are covered by British Civil Airworthiness Requirements.

The manual has been compiled to give the pilot a working knowledge of the equipment under his control, together with airframe and engine data, and notes on handling the aircraft. For Chipmunk Mks. 21, 22 and 22A aircraft, it should be read in conjunction with the approved Flight Manual associated with the Certificate of Airworthiness for the particular aircraft. Should the information given in this manual conflict with that in the Flight Manual, the latter should be taken as the overriding authority.

For detailed descriptions and drawings of airframe structure, and installations, reference is directed to the Maintenance and Repair Manual (publication reference CMR.–1).

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AMENDMENTS

Alterations to the contents of this publication are circulated in the form of Amendment Lists (abbreviated "A.L."), each being identified by a number and issued in numerical sequence. In order that the amendment state of the publication can be readily ascertained, entries should be made against the appropriate No. below, immediately an A.L. is embodied. When pages are re-issued a marginal rule is normally inserted to indicate the location of alteration(s) of technical importance.

A.L. No.	Signature	Date	A.L. No.	Signature	Date
1 to 8	Amendments No. 1 to 8 inclusive incorporated		22		
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FOREWORD

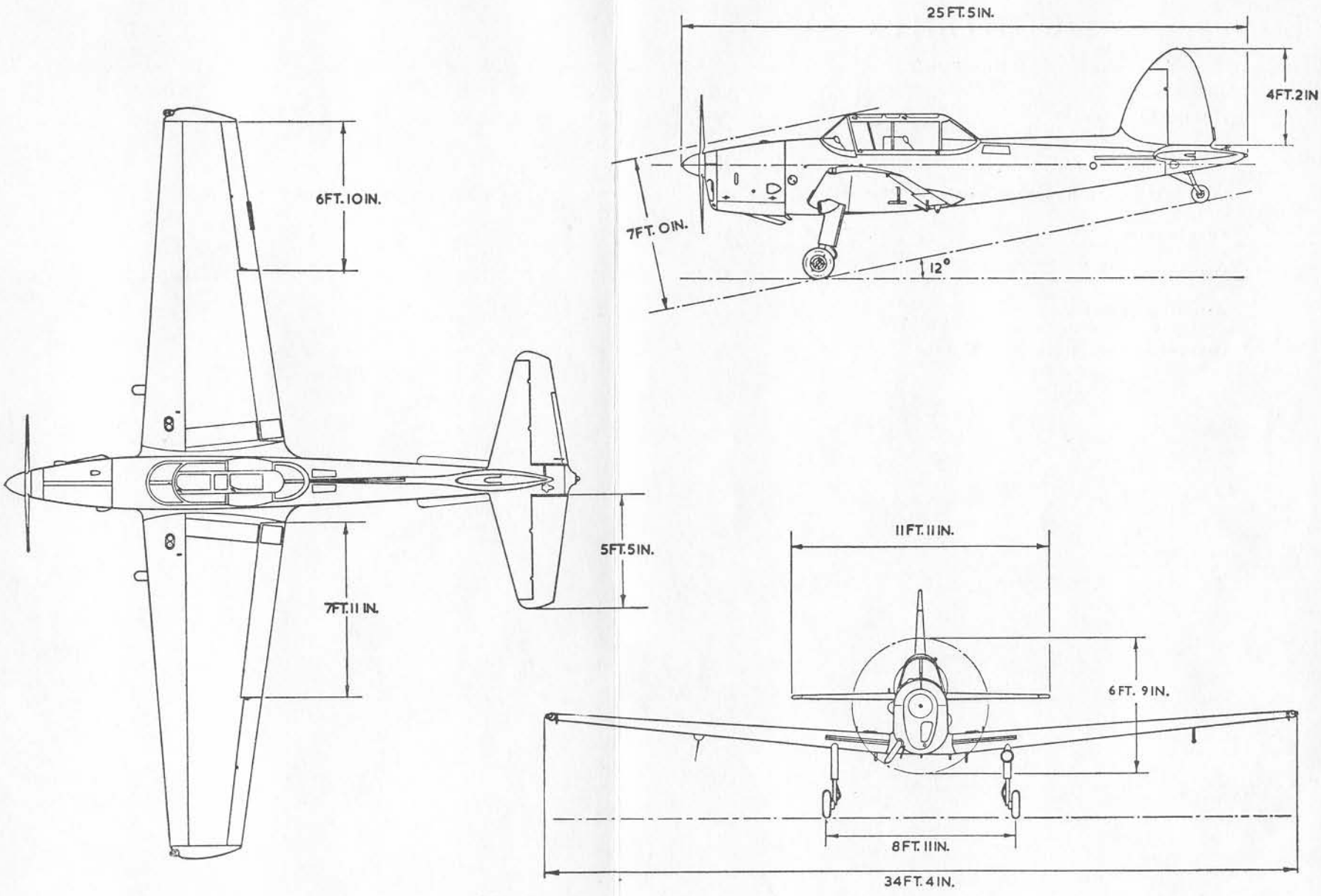

Fig. 1. GENERAL ARRANGEMENT (Mods H.104 and H.231 incorporated)

LEADING PARTICULARS

Principal dimensions

1.	Span	34 ft 4 in.
	Length, overall	25 ft 5 in.
	Height, over canopy (tail down)	7 ft 0 in.
	Ground angle	12° approximately
	Fuselage width (maximum)	2 ft 6 in.
	Fuselage height (including canopy)	4 ft 7 in.
	Wing	
	Chord at root	6 ft 7·3 in.
	Chord (mean)	5 ft 0·3 in.
	Incidence (chord line to fuselage datum at centre section)	2°
	Dihedral (on chord plane)	5°
	Tailplane	
	Span	11 ft 11 in.
	Incidence	$-1° \pm 15'$

Areas

2.	Gross wing area	172·5 sq. ft
	Ailerons (total)	13·9 sq. ft
	Flaps (total)	22·0 sq. ft
	Tailplane (without elevators)	17·0 sq. ft
	Elevators (total)	14·0 sq. ft
	Elevator trim tab	1·21 sq. ft
	Fin	5·9 sq. ft
	Rudder Pre-Mod. 104	6·8 sq. ft
	Post-Mod. 104	7·41 sq. ft

Control surface movements

3.	Ailerons	UP	21°
		DOWN	16°
	Flaps	UP	15° and 30° DOWN
	Elevators	UP	38°
		DOWN	15°
	Rudder (each way)		31°

Alighting gear

4. MAIN UNDERCARRIAGE

Type	Two cantilever legs with cantilever axles, secured to the wing
Track	8 ft 11 in.
Shock-absorber units	Rubber blocks in compression and for rebound
Wheels	Dunlop A.H.9389

Alighting gear
(continued)

Tyres	Dunlop 1A—TR.19, size 6·00–6½
Tubes	Dunlop 1A—3
Tyre pressure	38 lb./sq. in.
Brakes	Dunlop hydraulic A.H. 9220
TAIL WHEEL	
Type	Fully castering, non-retractable
Shock-absorber unit	Levered suspension with rubber blocks
Wheel	Dunlop A.H.O.5047 or A.H.9869
Tyre	Dunlop W.P.–R.11, size 3·00–3½
Tube	Dunlop W.P.2
Pressure	40 lb./sq. in.

Engine

5. Name .. .. Gipsy Major 8 (Chipmunk Mks. 20, 22 and 22A)
Gipsy Major 10, Mk. 2 (Chipmunk Mk. 21)

For the above engines:

Type	4 cylinder in-line inverted, air-cooled
Fuel: MINIMUM grade:	80 octane, containing not more than 5·5 mls. T.E.L./Imperial gallon
Oil	Normal conditions: D.Eng.R.D.2472 B/O (for variations refer to the Engine Maintenance Manual)

Propeller

6. Type .. .. Fairey-Reed, metal, fixed pitch
Part No. .. .. A66753/X1, or approved alternative
Diameter .. .. 6 ft 9 in.

Tank capacities

7. Fuel tanks (one flexible cell in each main plane):

	Chipmunk Mks. 20 and 22	*Chipmunk Mks. 21 and 22A*
Each	9·0 Imp. gallons	12·0 Imp. gallons
Total	18·0 Imp. gallons	24·0 Imp. gallons

Oil tank (on firewall):

Total capacity	2 gallons 4 pints
Air space	4 pints
Effective capacity	2 gallons

GENERAL DESCRIPTION

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GENERAL DESCRIPTION

Type

1. The D.H. Chipmunk is a two-seater low-wing cantilever monoplane. The Chipmunk Mk. 21 is powered by a de Havilland Gipsy Major 10 Mk. 2 engine of four cylinder in-line inverted and air-cooled arrangement. Virtually the same engine is used to power the Chipmunk Mks. 20, 22 and 22A, but it is generally known by its Service designation: Gipsy Major Mk. 8. In all cases the engine drives a two-blade, fixed-pitch, metal propeller.

2. The Chipmunk variants are similar in most respects. The main difference is in the capacity of the fuel tanks, which provide a total fuel load of 18 Imperial gallons for the Chipmunk Mks. 20 and 22, and 24 Imperial gallons for the Chipmunk Mks. 21 and 22A. All versions are fitted with complete dual control equipment.

Seating capacity

3. The two seats are arranged in tandem and enclosed by a fixed windscreen, incorporating a crash pylon and a single sliding canopy. A pilot, when flying solo, occupies the front cockpit. The aircraft must not be flown solo from the rear seat.

Fuselage

4. The fuselage is a metal, semi-monocoque structure and is built in two parts. The joint is located near the trailing edge of the wing. The portion of fuselage between the rear cockpit and fuselage joint forms the luggage locker.

Mainplanes

5. The mainplanes are of single-spar, metal construction and are secured to the fuselage at the spars and leading edges. A metal skin covers the "D"-shaped box beam leading edge: the remainder of the mainplane structure is fabric covered.

6. Slotted ailerons are fitted, and hand-operated slotted flaps extend from root fillets to the inboard ends of the ailerons. Both ailerons and flaps are fabric covered.

Empennage

7. A single fin and balanced rudder, mounted wholly above the fuselage, and a cantilever tailplane and balanced elevators form the empennage. The fin and tailplane are metal covered: the rudder and elevators are fabric covered.

Alighting gear

8. A conventional two-wheel cantilever non-retractable undercarriage is secured to the wing, and a fully castering tail wheel is provided. Hydraulic brakes are fitted to the main wheels and are operable by hand levers in the cockpits for normal use. Differential braking, via the rudder pedals, is available for ground manœuvring.

CONTROLS AND EQUIPMENT IN COCKPITS

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(continued)

ILLUSTRATIONS

CONTROLS AND EQUIPMENT IN COCKPITS

General

1. The cockpits are entered from walkways on port and starboard mainplane surfaces and flaps. Externally, the canopy is provided with two handles on the top surface which are connected to corresponding levers within the structure; twisting a handle unlocks the canopy and enables it to be manipulated rearwards.

2. The release mechanism is connected to a spring-loaded plunger which engages holes in the centre canopy rail to provide the following four alternative locked positions: fully closed; partially open; approximately half-open, giving access to the front cockpit; and fully open.

Seats

3. Parachute-type metal seats are built into the fuselage structure and are not adjustable. They are equipped with Z-type harness.

Controls and instruments

4. Dual controls and instrument panels are provided. The location of all controls and instruments is given pictorially on Figs. 1 and 2 respectively.

AIRFRAME CONTROLS

General

5. All pivots and pulleys are fitted with ball bearings and all controls are covered or protected to prevent jamming by any movements of the crew.

Control columns

6. The elevators and ailerons are operated by conventional control columns mounted within a keel structure forming a control box disposed centrally on the fuselage floor; the columns are not adjustable. The rear column is detachable, for solo or passenger flying, by removing two safety-pins and withdrawing two pins at the base, and disconnecting the radio cable.

Rudder bars

7. Rudder bars, of conventional form, are pivoted within the control box and the pedals are adjustable on the ground. Three alternative positions are provided for each pedal, the tube to which the pedal is secured being held on the rudder bar by a pin formed with a retaining spring clip.

Control locks

8. Control locking gear is available to special order. Clips are provided in the front cockpit for the attachment of the gear: it comprises a bar to lock the left-hand side of the rudder bar to the control box and a transverse unit which fits into spring clips on the fuselage sides and is connected to the top of the control column.

Trimming controls

9. A trimming tab, adjustable from the cockpit, is provided on the starboard elevator only. The rudder and starboard aileron are equipped with fixed tabs of the

metal plate type, the angle of which can be adjusted on the ground, by bending, to obtain the desired zero control-load flight condition.

10. The elevator tab is adjustable by a trimming wheel mounted on the left-hand support diaphragm of each seat, the movement being conveyed to the tab by cables. The control is labelled UP—NOSE—DOWN with associated arrows indicating natural sense rotation. The wheel itself has an engraved N denoting the neutral position and is, in addition, divided into numbered segments either side of neutral.

11. Trim setting is read off at a plate at the rear of the trim wheel casing. As a visual guide to the setting of the tab, the trim wheel is painted black at all positions forward of neutral and white aft of neutral. Thus, if the black portion of the wheel is set against the trim setting datum plate, the aircraft is trimmed NOSE UP: if the white portion is set at the datum plate the aircraft is trimmed NOSE DOWN.

Flap controls

12. The wing flaps are operated, through cables and against spring loading, by interconnected hand levers located on the right-hand side of the cockpits. Each lever is retained in the desired position by a pawl which is released, for forward movement only, by a hand-operated spring-loaded trigger. The trigger is protected by a guard to prevent accidental movement of the flaps.

13. The lever operates in the natural sense and has three positive positions, giving the following flap angles:

Fully forward	UP
Mid-position	15° FLAP
Fully back	30° FLAP

14. Since the flaps are clearly visible from either cockpit, no position indicator is fitted.

Brakes

15. The Dunlop hydraulic brakes fitted to the undercarriage are controlled for braking the aircraft in a straight line (rudder bar central) by interconnected levers mounted on the left-hand side of each cockpit. A slight backward movement of either brake lever effects the release of the pawls from the brake quadrants, so that the levers can be moved to the OFF position. A downward movement of the collar on either lever, when the latter is in the desired position, engages the corresponding pawl in the quadrant. A spring is fitted to the rear brake lever assembly to ensure that the brakes do not engage during inverted flying.

16. The brakes can be applied fully ON for parking, but it is undesirable to use them for this purpose for long periods because of the continuous pressure established thereby in the hydraulic system.

17. For manœuvring the aircraft on the ground, the brakes are operable, differentially, by the rudder bars. To obtain differential braking, set the hand-brake lever OFF and apply full rudder in either direction. Move the brake lever backwards until pressure is felt on the rudder pedal. This amount of brake will give adequate control in light winds, but in strong winds it may be necessary to use more brake.

18. The number of notches required to give differential braking can be counted by applying light pressure on the brake lever collar during the operation described. If differential braking is required for a crosswind landing the correct amount of brake can then be set in the air.

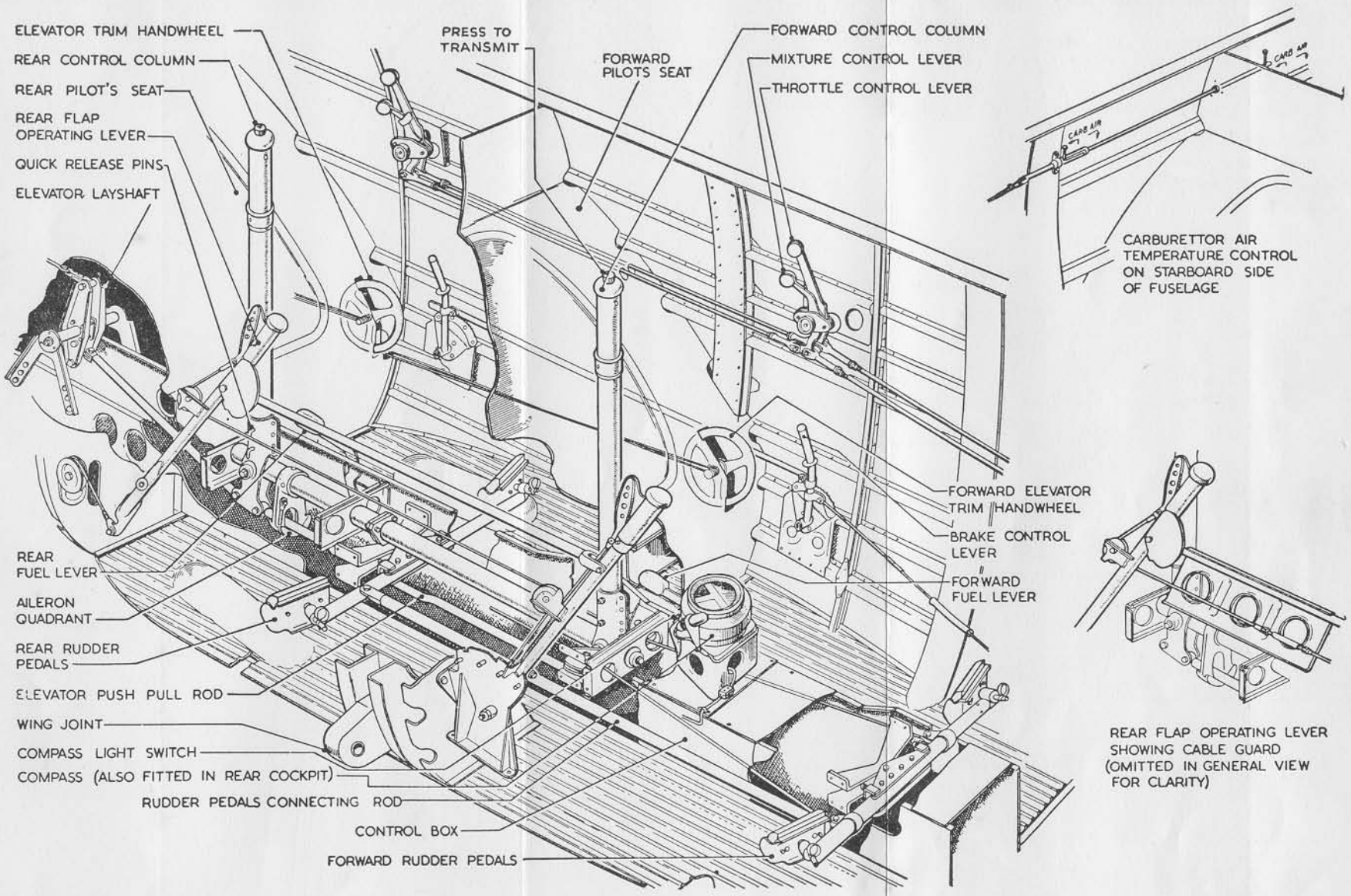

Fig. 1. CONTROLS IN COCKPIT

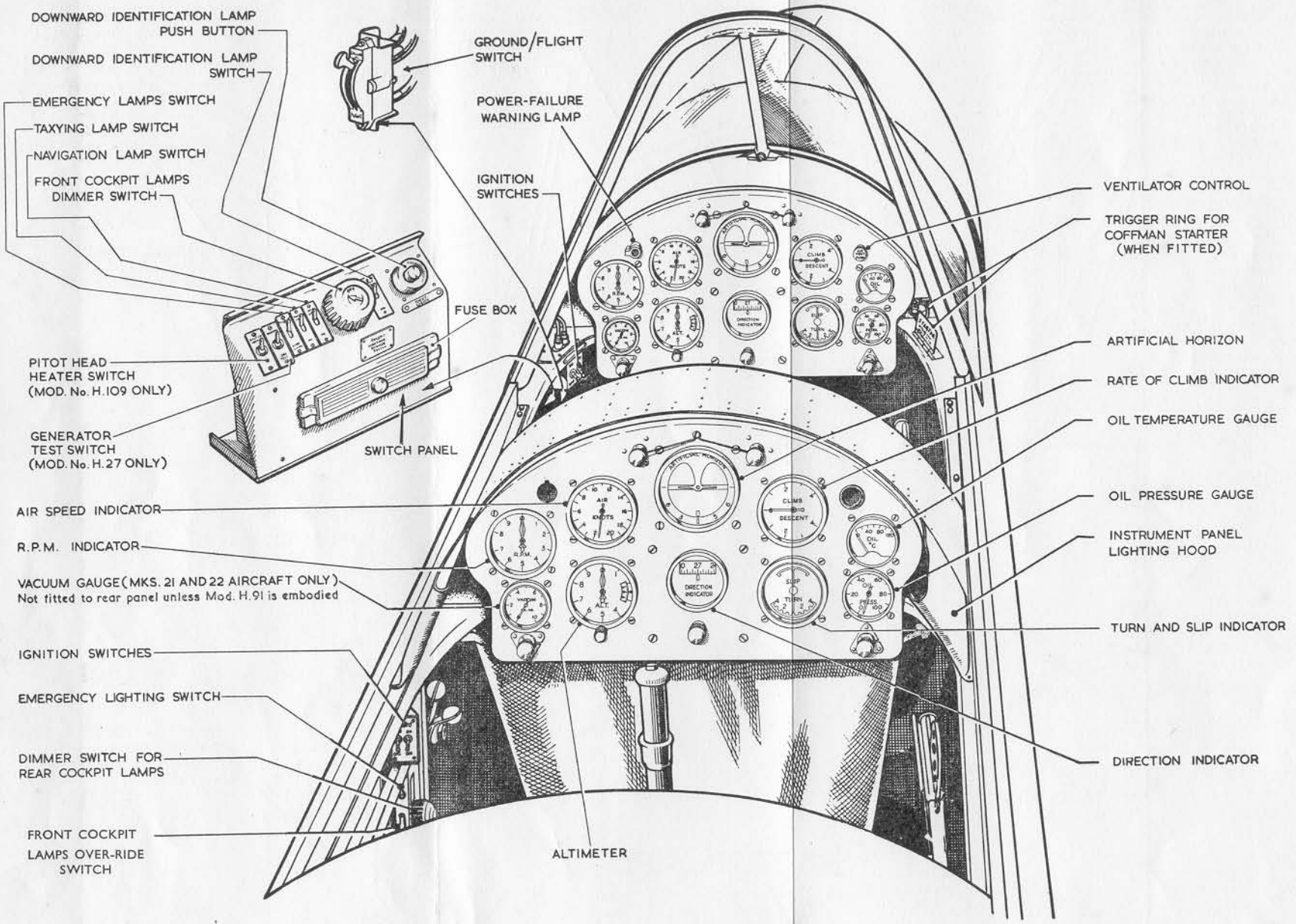

Fig. 2. INSTRUMENT PANELS

ENGINE CONTROLS AND SYSTEMS

General

19. The aircraft is not normally provided with a starter unit. A Coffman cartridge starter may be fitted, to special order, in which event the trigger ring for the cartridge starter is mounted on the starboard side of the front cockpit; the cartridge starter is a self-indexing, percussion-firing type, containing six charges, and when the trigger ring is pulled out to the full extent of its travel (approximately 9 inches) a cartridge is both indexed and fired. Alternatively, an electric starter can be fitted, in which case a starter button is located in the corresponding position, in each cockpit, with labels reading AIRCRAFT BATTERIES MUST *NOT* BE USED FOR STARTING EXCEPT IN EMERGENCY.

Throttle and mixture controls

20. Throttle and mixture levers are mounted on common quadrants and linked so that the throttle cannot be closed without moving the mixture control back to the rich position. A common friction nut is provided on each quadrant for both throttle and mixture control levers.

21. The mixture control should be fully rich for starting, ground-running, and take-off. At the required altitude, but not below 3,000 ft, adjust the throttle to obtain the recommended r.p.m., and move the mixture lever forward towards the weak position until the r.p.m. drop or rough running commences; it should then be moved back until the original r.p.m. and smooth running conditions are restored.

Carburettor air temperature control

22. By means of a controllable shutter, warmed air can be drawn through a flame trap, close to the engine, or cold air through the duct and the scoop on the starboard cowling.

23. A cable and pulley assembly is connected to a control for each occupant, with a locking gate in the front cockpit and a return spring on the assembly.

24. To select hot air, the control handle is moved rearwards and into the down position, against the spring tension; the movement is indicated by the words CARB. AIR with arrows labelled HOT and COLD.

25. Take-off and climb should normally be made in COLD but, should icing conditions be suspected, HOT air may be used. In the latter case it should be remembered that some loss of maximum power will be experienced. In cruising flight, HOT air should be used continuously unless the ambient air temperature exceeds 30°C.

Ignition switches

26. Dual sets of switches are provided, one pair of switches on the port wall in each cockpit. Both sets of switches must be ON before the engine will run. To earth the circuit either set may be moved to OFF. The magneto controlled by the starboard switches (marked No. 2) is an impulse starter. When starting by hand, the engine should be started on this magneto only, No. 1 magneto being switched on as soon as the engine fires.

FUEL SYSTEM:

General

27. Fuel is carried in two flexible tanks, mounted one in each mainplane and providing a capacity as quoted in LEADING PARTICULARS. The fuel is fed to the

engine from both tanks simultaneously, via a cock. Non-return valves prevent the contents of one tank being transferred to the other. The system is illustrated on Fig. 3.

Fuel tank venting

28. Each of the two fuel tanks is vented to atmosphere by means of a short vent pipe projecting vertically above the wing top surface and encased by a fairing. Air from a common vent inlet, located centrally beneath the fuselage, is directed to the interior of each vent pipe fairing, and thence to the tanks through the vertical pipes. A ball valve, located at the lower end of each vent pipe, ensures that there is no loss of fuel from the tanks during inverted flight, although a small quantity may enter the pipes when rolling into the inverted position, or during other similar manœuvres. A small hole in the side of each vent fairing ensures that syphoning action does not occur in the event of fuel entering the vent pipe as described above. IT IS MOST IMPORTANT that this hole is kept clear, since if it is blocked and syphoning occurs, fuel will be lost continuously through the common vent inlet, which is not visible from the cockpit. For this reason the hole must be inspected before flight, and aerobatics, or other manœuvres likely to cause spillage from the tanks, must not be carried out if ice formation is observed on the vent fairings, which may have caused the anti-syphon holes to become blocked. Stencilled instructions on the fairings, in the vicinity of the anti-syphon holes, read: KEEP HOLE CLEAR.

Fuel cock controls

29. The fuel cock, within the control box, is controlled by levers projecting through cover plates forward of, and to the left of, each control column. ON and OFF settings for the fuel cock are marked at the control lever quadrant, the ON position being fully forward. If one tank empties prior to the other, the latter will continue to supply the engine provided the cock is ON.

Fuel contents gauges

30. A gauge is mounted adjacent to the filler cap of each wing tank. The gauges are calibrated in white figures to indicate contents when the aircraft is in flying position and in red to show the contents in ground attitude; the former are visible from the front pilot's seat and there are no cockpit gauges. On some aircraft the zero calibration and the pointer are luminous, to enable them to be seen during night-flying.

Fuel pumps and priming

31. Two engine-driven fuel pumps are installed, and priming of the engine before starting is effected by a carburettor flooder-control and a hand-priming lever on the rear fuel pump. Use of the hand-priming lever, which may be reached and operated through an opening in the engine port side cowling panel, ensures that the pumps, the pipeline to the carburettor, and the carburettor float chamber are filled with fuel. The carburettor flooder-control, operated by a pull-wire through a second opening in the port side cowling panel, enables the carburettor to be flooded and thus provides the required rich mixture for starting; this is effected by operating the fuel pump priming lever whilst holding out the carburettor flooding device, with the fuel cock ON, until fuel flows from the induction manifold drain at the bottom of the firewall. If no resistance is felt when operating the priming lever, the propeller should be rotated to bring

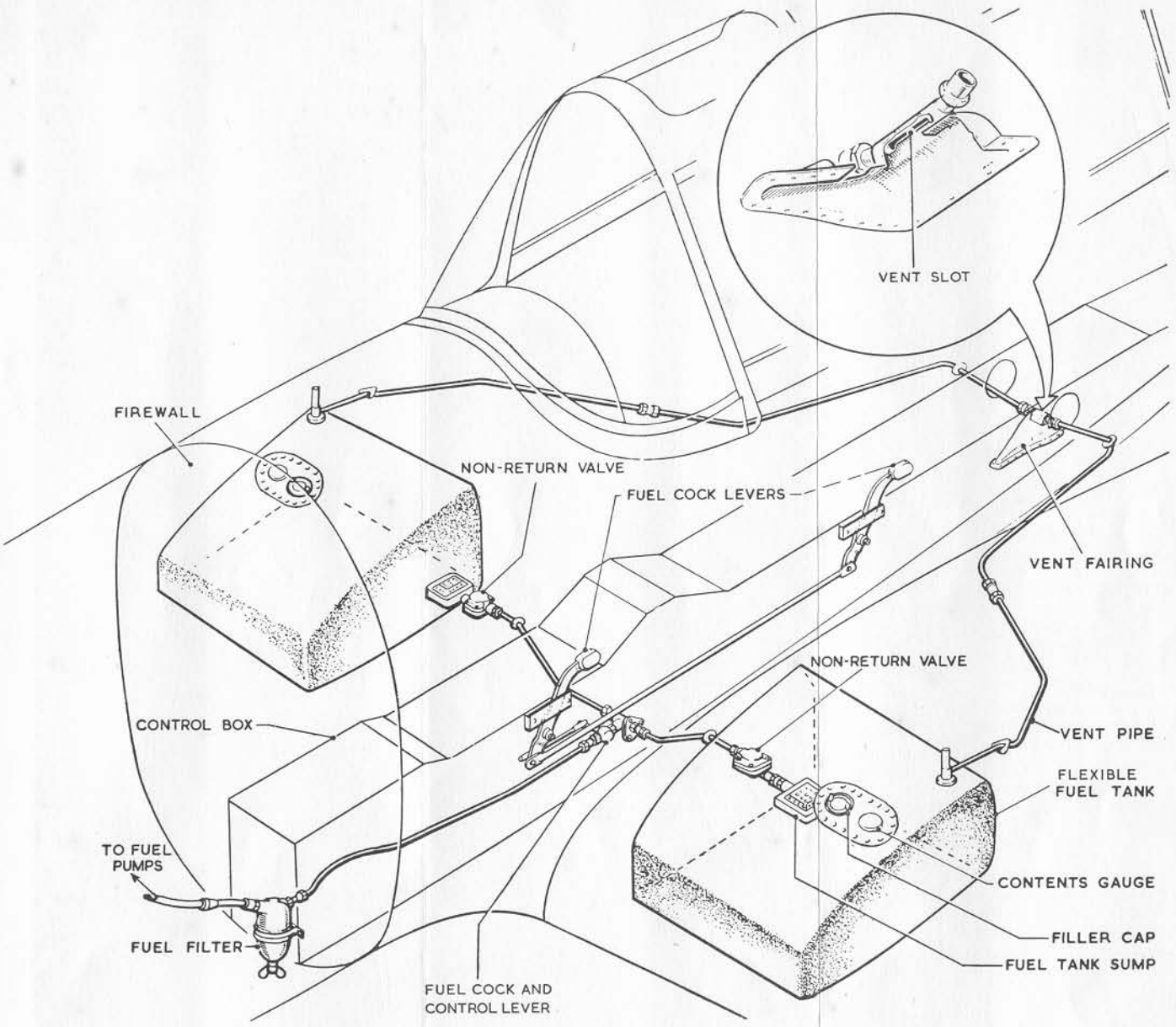

Fig. 3. FUEL SYSTEM

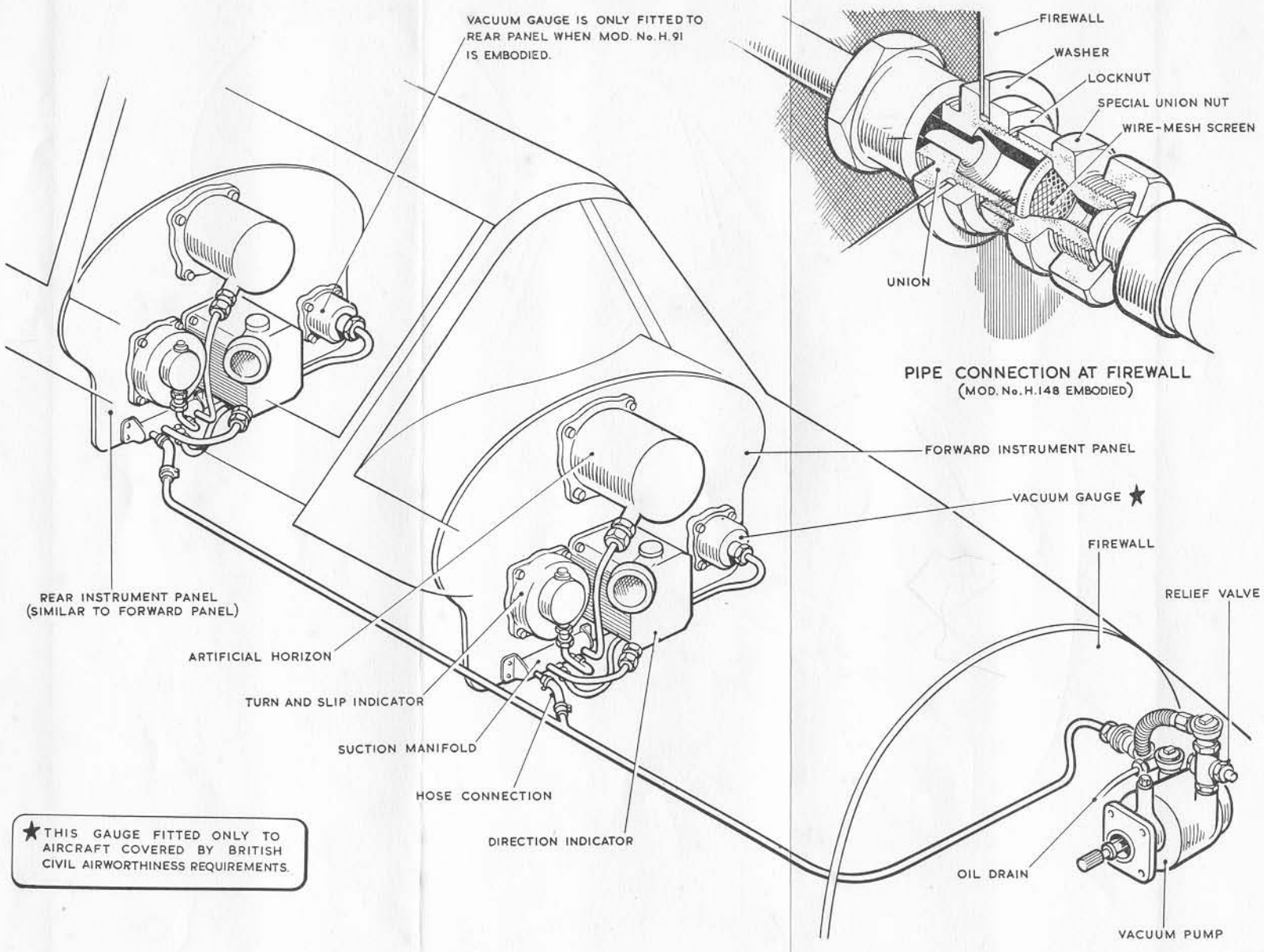

Fig. 4. VACUUM SYSTEM

the eccentric on the engine camshaft to a suitable position. Engine-starting should not be attempted until fuel has ceased draining.

NOTE: On some aircraft, where the induction manifold drain leads into a common drain (crankcase breather pipe) care must be taken, before priming, to ensure that the pipe outlet is not blocked by, for example, frozen or congealed oil.

OIL SYSTEM:

General

32. An oil tank of 2½ Imperial gallons capacity, of which ½ gallon is air space, is mounted on the forward face of the firewall. Oil level is checked by a dip-stick formed integrally with the filler cap which is under the starboard side engine cowling. The oil is cooled by air which is scooped in from the port cowling and passed through a cooler in the tank. Oil pressure and temperature gauges are mounted on the right-hand side of each instrument panel.

MAIN SERVICES

ELECTRICAL INSTALLATION:

General

33. A 24-volt installation is provided, with an engine-driven generator to charge the accumulators for operation of radio (if fitted), electric starter (if fitted), oil temperature gauges, lighting services, and pressure head heater (if connected). A Ground/Flight master switch is provided in the front cockpit and should be at FLIGHT before starting the engine, unless starting is to be effected from an external accumulator via the external supply socket on the port side of the nose fuselage. The switch must be left at GROUND when the aircraft is parked. If an electric starter is not fitted, the external supply socket is only used for testing the electrical circuits from an external accumulator.

34. A power-failure warning lamp is provided on the front cockpit instrument panel, and will illuminate when the main fuse blows, the accumulator cut-out fails to close or the generator is not giving an output. It should be noted that the lamp will not light if the Ground/Flight switch is in the GROUND position unless power is connected to the external supply socket.

35. The front cockpit lamps are controlled by an on-off master switch in the rear cockpit, with a dimmer switch in the front cockpit. The master switch must therefore be ON before solo night-flying. Emergency lighting is available from a small battery, the switch being on the switch panel on the port side of each cockpit, with a luminized dot at the OFF position.

VACUUM SYSTEM:

General

36. An engine-driven vacuum pump provides suction for operation of the artificial horizon, directional gyro, and turn and slip indicator gyro. The system is illustrated on Fig. 4. A vacuum gauge is fitted in the front cockpit instrument panel when Mod. No. H.219 is incorporated, or in both cockpit instrument panels when Mod. No. H.91 is embodied. The normal vacuum gauge reading is 4·5 to 5·0 in. Hg. at 2,100 r.p.m.

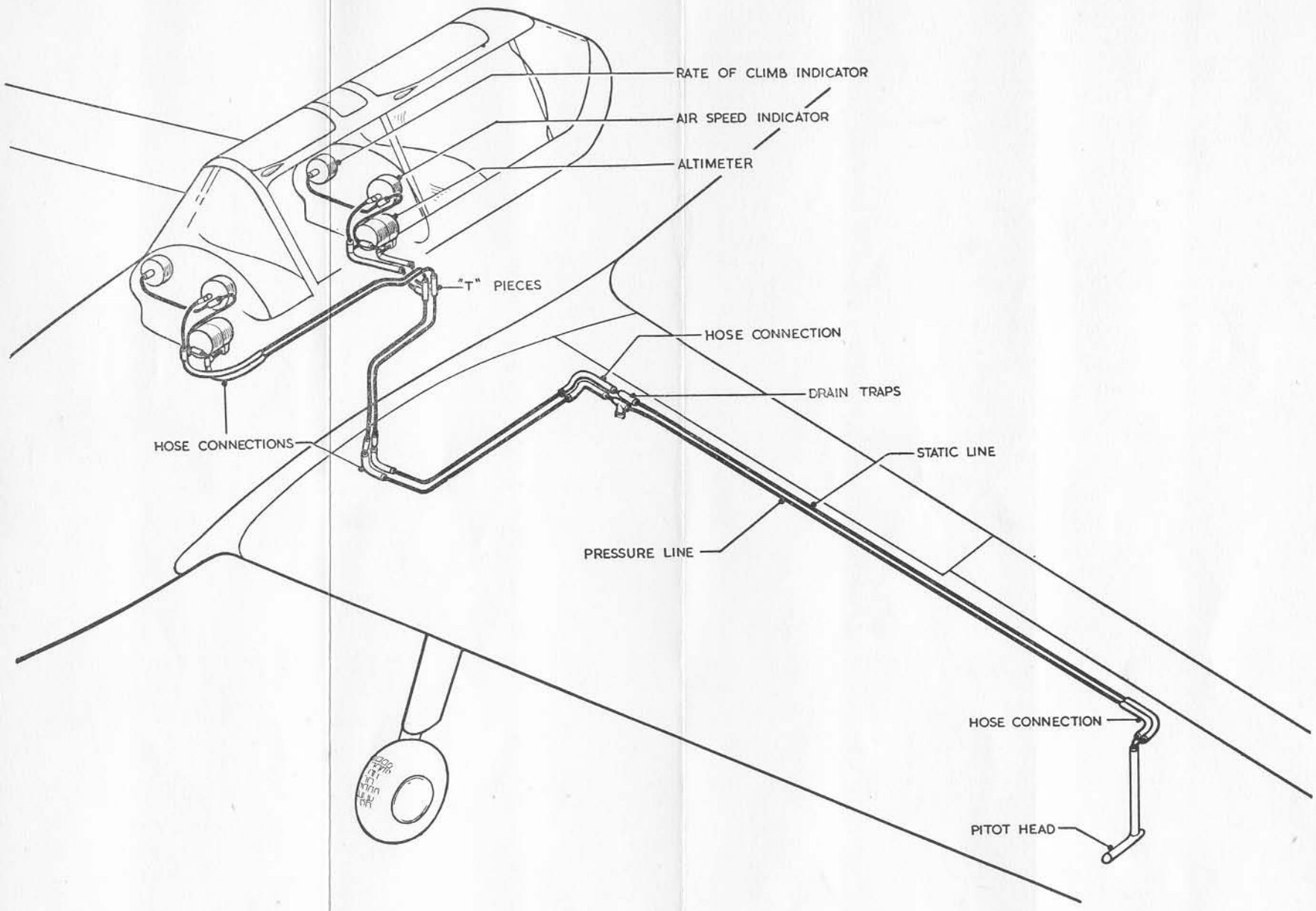

Fig. 5. PITOT/STATIC SYSTEM

PITOT/STATIC SYSTEM:

General

37. The dynamic and static pressures for the air speed indicator, and the static pressure for the vertical air speed indicator and altimeter, are obtained from a combined pitot/static pressure head mounted on the underside of the port wing. When Mod. No. H.109 is embodied, a pressure head heater is available. This is controlled by a switch at the aft end of the switch panel in the front cockpit. The pitot/static system is illustrated on Fig. 5.

BRAKES SYSTEM:

General

38. The main wheels are fitted with Dunlop hydraulic, single disc brake units, each operated by a separate master cylinder. The latter are supplied with fluid from a header tank, mounted on the forward face of the firewall on some Mk. 20 aircraft, and aft of the firewall on Mks. 21, 22, and 22A aircraft.

39. It will be seen from Fig. 6 that the interconnected brake levers are attached to a cable which extends around pulleys in the fuselage nose. Forward of the rudder bar, this cable is coupled to two cables which are directed around pulleys on the underside of the rudder bar and connected to levers on the master cylinders.

40. A pull on the single cable, by the lever in either cockpit, exerts an equal pull on the cylinder levers and transmits similar pressure to each brake. Application of left or right rudder results in movement of right- or left-hand cylinder lever respectively and pressure is transmitted to the appropriate brake to provide differential braking.

MISCELLANEOUS

Amber panels and blue goggles

41. Amber screens, for instrument flying practice, can be supplied to special order and are for use in the front cockpit only. They are stowed in a metal container outboard of the front flap control lever; the pocket is closed by a bungee loop. The screens comprise a centre panel which is hinged about the vertical centre-line and held against the front of the windscreen by two rotatable retaining catches, and two side screens, each secured by a single fastener. When assembling, secure the side screens first, so that the reinforced edges abut the crash pylon and are held by the catches at the base; then fit the centre screen which will hold the forward edges of the side panels in position. A sliding amber screen is fitted in channel section members on the interior of each front panel of the canopy. In use, the screens are slid forward from a mid-position and contact narrow amber strips permanently fitted at the front of the canopy. A pocket for goggles stowage, with zip-fastener closure, is mounted immediately below the clip for the bungee cord on the amber screen container. The goggles are fitted with a flexible ventilation tube which plugs into a socket on the starboard wall of the front cockpit.

Radio

42. A radio installation may be provided to special order, to give V.H.F. transmitting, receiving, and inter-communication service for radio telephony. Press-to-transmit switches are then provided on each control column and a muting switch is

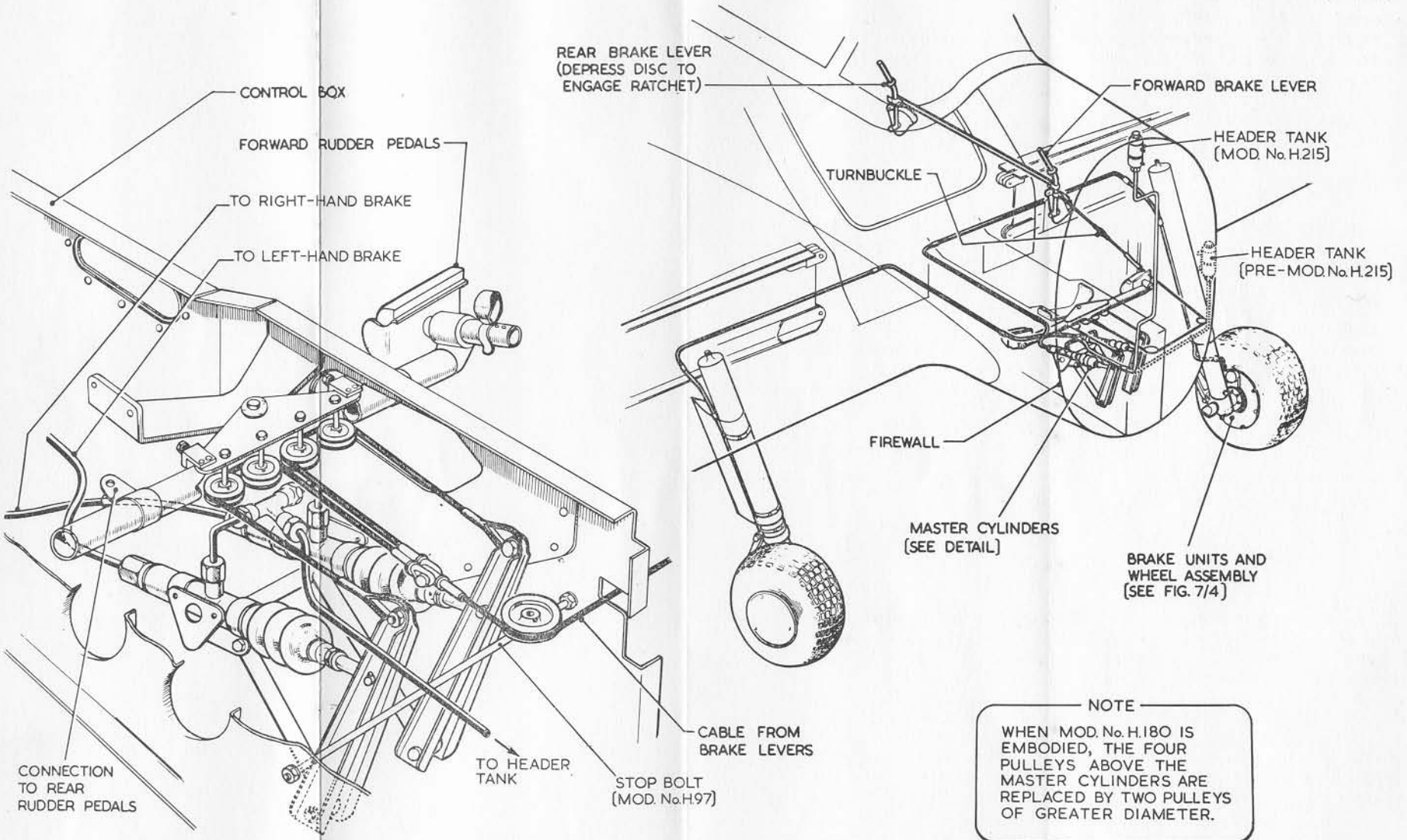

Fig. 6. BRAKES SYSTEM

incorporated on the master control panel in the rear cockpit. A change-over switch is provided in the rear cockpit to select control in either front or rear cockpit.

WARNING: *If the aircraft is to be flown solo, from the front cockpit, ensure that the muting switch is up (in the non-muting position) before take-off, and that the change-over switch is at FRONT.*

Cockpit ventilation

43. A duct is mounted in front of the windscreen to provide controllable ventilation for the cockpits. The control knob, on the front cockpit instrument panel, is labelled AIR VENT: PUSH.

Glider towing

44. When mods. H.121, H.167 and H.197 are embodied the aircraft may be used to tow gliders subject to the restrictions listed under LIMITATIONS.

45. The towing hook is in the fuselage just aft of the tail wheel and the pilot's release knob is on the left of the instrument panel just below the ingition switches. It is recommended that a 9 to 10 cwt. $\frac{3}{4}$ inch nylon rope, up to 210 feet in length, be used.

46. A cylinder head temperature gauge must be fitted if the aircraft is to be used for glider towing in ambient temperatures above I.S.A. $+15^{\circ}$C.

EMERGENCIES

CONTENTS

EMERGENCIES

Action in the event of fire

1. In the event of fire carry out the applicable drill, given below. Note that no engine fire extinguisher is fitted.

A. In the air:
(i) Warn crew member.
(ii) Close the throttle.
(iii) Turn fuel OFF and raise nose to reduce air speed and r.p.m.
(iv) Switch OFF ignition when engine cuts.
(v) If fire does not go out, abandon the aircraft (if parachutes are carried and sufficient height is available), otherwise make a forced landing. If the fire does go out, do not re-start the engine but make a forced landing immediately.

B. Fire in the front cockpit:
Use the hand-operated fire extinguisher, located on the quick-release bracket on the floor of the front cockpit.

C. On the ground:
(i) Close the throttle.
(ii) Ignition switches OFF.
(iii) Turn fuel cock OFF.
(iv) If necessary, release the brakes to allow the aircraft to be pushed away from burning fuel on the ground.

Opening the canopy during flight

2. The canopy is not jettisonable but, to enable it to be moved rapidly to the fully-open position in flight, the roof is fitted with a small door hinged at the rear. When the door is pivoted upwards, into the slipstream, it overcomes the suction of the canopy and facilitates normal opening. The door is held closed by a catch and is spring-loaded by two bungee cords, release being effected by pulling either of the knobs located one in each cockpit roof, on the starboard side. An indicated airspeed of at least 120 m.p.h. (104 knots) is desirable for this method of canopy opening.

Emergency exit and rescue

3. To enable the crew to get clear, or to be released, in the event of the canopy being jammed in a crash, two "break-out" panels are fitted on the port side of the canopy, one per cockpit. For release, an internal and an external lever are provided for each panel; all levers are painted red (or yellow and black). The outside levers are marked EMERGENCY and locked with a single strand of 22 s.w.g. copper wire. Inside the canopy, stencilled instructions near each lever read: TURN AND PUSH OUT FOR CRASH LANDING EXIT. Externally, the instructions read: LIFT, TURN AND PULL FOR EMERGENCY RESCUE.

First-aid outfit

4. A first-aid outfit is mounted in the port mainplane, near the root end, and clearly labelled. It is retained in position by a rip panel and a tag is provided to facilitate quick removal of the panel.

LIMITATIONS

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LIMITATIONS

Introduction

1. The following paragraphs detail limitations concerning air speed, airframe, weight, centre of gravity, power plant, etc., which must, at all times, be observed when operating this aircraft.

Air speed limitations

2. Maximum permissible diving speed:

Chipmunk Mk. 20	199 m.p.h. (173 knots) I.A.S.
Chipmunk Mks. 21, 22 and 22A ..	178 m.p.h. (155 knots) I.A.S.
Maximum speed for extending flaps	107 m.p.h. (93 knots) I.A.S.
Maximum speed for extending flaps beyond 15°	82 m.p.h. (71 knots) I.A.S.

The flap limiting speed also applies to flight with the flaps lowered.

Manœuvring speed: manœuvres involving an approach to the stall, or full application of aileron or rudder control, must not be undertaken when the air speed exceeds:

135 m.p.h. (117 knots) I.A.S.

NOTE: Although the aeroplane is strong enough for steady application of full rudder control at this speed, a violently checked manœuvre might overstress it. For example, any violent yaw must not be checked with sudden application of opposite rudder.

Airframe limitations

3. The maximum positive acceleration which the structure has been designed to withstand without permanent deformation at a weight of two thousand one hundred pounds (2,100 lb.) is 6·0 g. Intentional manœuvres must be confined to load factors well below this value.

Manœuvres

4. Stalls may be carried out. Aerobatic manœuvres are not permitted unless the aircraft is fitted with anti-spin strakes (mod. H.231). See LEADING PARTICULARS Figure 1. When anti-spin strakes are fitted aerobatic manœuvres are permitted and the aeroplane has been demonstrated to have safe handling characteristics in the following manœuvres:

(*a*) Tight turns
(*b*) Inside loops
(*c*) Slow rolls
(*d*) Stall turns
(*e*) Half inside loop and roll out
(*f*) Half roll and dive out
(*g*) Spins

In the case of the Chipmunk Mk 22 aerobatic manœuvres are not permitted when the weight of the aeroplane exceeds 2,100 lb.

Power plant limitations

5. Power plant limitations for the GIPSY MAJOR 8 and GIPSY MAJOR 10 Mk. 2 are tabulated overleaf.

POWER PLANT LIMITATIONS

Power conditions	*R.p.m.*	*Manifold pressure*	*Oil temperature* (°C.)	†*Cylinder temperature* (°C.)
Maximum take-off (5 min. limit)	2,550	Full throttle	100	255
Maximum continuous	2,400	—	85	250
Maximum weak mixture	2,300	26 in Hg	85	230
*Maximum overspeed (20 sec. limit)	2,675	—	—	—

*If either the r.p.m. or time limit are exceeded the engine and propeller must be removed for examination before the next flight.
†This aeroplane may not be fitted with a cylinder temperature gauge.

6. Maximum oil temperatures for various power conditions are given in the "Power limitation" table. The minimum oil temperature for opening up cold is 15°C.

7. The normal oil pressure, at 2,400 r.p.m., is 40 to 45 lb./sq. in. The minimum safe oil pressure in flight is 30 lb./sq. in.

8. The mixture control is only to be used to maintain the weakest mixture for maximum power conditions when the engine is operated within the maximum weak mixture power conditions, or to avoid rough running due to over richness in all other power conditions, and must not be used to cause a drop in engine speed.

Weight limitations

9. The maximum permissible take-off and landing weight is two thousand one hundred pounds (2,100 lb.) but a lower weight may be advised or enforced by operational performance considerations. In the case of the Chipmunk Mk 22, when used in a private capacity (ie. not for public transport or aerial work), the maximum permissible take-off and landing weight is two thousand two hundred pounds (2,200 lb.).

Centre of gravity limitations

10. The aircraft must always be so loaded that the centre of gravity lies as follows:
Chipmunk Mk. 20: between 6·48 in. forward and 0·26 in. aft of the C.G. datum.
Chipmunk Mks. 21, 22, and 22A: between 6·8 in. and 0·77 in. forward of the C.G. datum.

The C.G. datum point is defined under LOADING AND C.G. DATA

Glider towing

11. When the aeroplane is used for towing a glider:

(*a*) The following modifications or their approved equivalents shall be fitted to the aeroplane.

H121 Introduction of steel bracket at TP rear spar.
H167 Introduction of strengthened bracket at TP shock absorber.
H197 Introduction of glider towing gear.

(*b*) The aeroplane shall not be flown for public transport.
(*c*) One person only, the pilot, shall be carried in the aeroplane.
(*d*) Not more than one glider may be towed at any time, and the maximum weight of the glider shall not exceed 1,200 lb.
(*e*) The breaking strength of the towing cable shall not be greater than 10 cwt. This maximum figure of cable strength is dictated by the strength of the tug aircraft and has no reference to the strength of the glider.
(*f*) The towing cable must be attached to the towing aircraft by a quick release mechanism under the control of the pilot. When a glider is being towed a quick release mechanism must also be fitted at the end of the cable under the control of the pilot of the glider.
(*g*) The airspeeds for glider towing shall be such as to maintain the engine temperatures within the limits, but should not normally fall below 50 knots. Maximum speed is governed by the maximum towing speed of the glider.
(*h*) In ambient temperatures above I.S.A. + 15°C, a cylinder temperature gauge shall be fitted to the aeroplane.
(*j*) The maximum take-off weight is 2,100 lb.

Miscellaneous limitations

12. The minimum crew is one pilot.

The aeroplane must not be flown solo from the rear seat.

Smoking is not permitted.

The number of persons carried must not exceed the number of seats provided except that infants under 3 years of age, carried in the arms of passengers, may be left out of account for this purpose.

Flight in icing conditions is not permitted.

The aeroplane may be flown at night provided that modifications H.164 or H.220 and H.160 or their approved equivalents are installed and additional equipment required by the relevant legislation is fitted.

HANDLING NOTES

CONTENTS

HANDLING NOTES

Introduction

1. The following paragraphs give details of checks to be carried out before flight, in the air, and after landing, with notes upon the normal characteristics of the aeroplane on the ground and in the air. For handling under emergency conditions, refer to EMERGENCIES.

Pre-flight action and inspection

2. When approaching the aircraft check that its general position is suitable for engine starting—i.e., clear of other aircraft, buildings, etc. Ensure that ground fire extinguishers are immediately available.

3. Before starting the external check, ensure that:

Brakes	OFF.
Ignition switches	All OFF.
Flying controls	Locks removed and stowed.
Ground/Flight switch	GROUND.
Flaps	UP.
Canopy	Runners clear, panels clean. Break-out panels secure and jettison levers wire-locked in the vertical position.
Cockpits	No loose articles.

4. External check:

PORT WING	
Upper surface	Condition. Free of ice, snow, or hoar frost.
First-aid kit	Rip-panel secure. Pack in position.
Access panels	Secure.
Flap	Condition, particularly the under surface. Check position.
Aileron	Condition of upper and lower surfaces. Drain holes clear. Hinges and linkages secure. Full, free movement.
Wing tip	Condition. Navigation lamp secure, glass unbroken.
Pressure head	Cover removed, security.
Leading edge and lower surface	Condition. Panels secure, zip-fasteners wire-locked closed.
Fuel tank filler cap	Secure.
Fuel contents gauge	Tank contents.
Fuel vent	Condition. Vent hole clear.
PORT UNDERCARRIAGE:	
Fairing	Condition and security.
Taxy lamp	Condition.
Main leg	Condition and extension (approx. 7 inches).

External Check
(continued)

Brake lead	Condition, security, no fluid leaks.
Tyre	No cuts or creep. Pressure correct, valve free.
Chock	In position.
ENGINE:	
Port cowling	Security.
Propeller	Condition. Clear engine by pulling propeller through four blades.
Spinner	Condition, security.
Oil leaks	Check visually.
Exhaust pipe	Condition, security.
Starboard cowling	Security.
Oil filler cap (visible behind rear of cowling)	Security.
Cartridge starter exhaust	In line with vent in cowling.
STARBOARD UNDERCARRIAGE:	
	As for port undercarriage except for the taxying lamp.
STARBOARD WING:	
	As for port wing, omitting the pressure head, and addiing:
Identification lamp	Condition.
V.H.F. Aerial	Security.
Aileron trim tab	Undamaged.
STARBOARD FUSELAGE:	
Fuselage skin	Condition.
Inspection panels	Secure.
TAIL UNIT:	
Fin and tailplane	Condition of surfaces.
Elevators and rudder	Condition of surfaces, hinges, connection, and tabs. Check clearance of rudder above tail fairing. Drain holes clear.
Tail fairing	Secure. Tail lamp secure, glass unbroken.
Tail wheel	Extension of strut. Check tyre for creep, cuts, pressure, and valve free.
PORT FUSELAGE:	
Fuselage skin	Condition.
Inspection panels	Secure.

5. If the aircraft is to be flown solo, or from the front seat with a passenger, carry out the following checks in the rear cockpit:

Luggage locker	Contents secure, door shut.
Safety harness	Secure.
Rear cockpit lamp switches	All off.
Front cockpit lights over-ride switch	ON (down).

Ignition switches	ON.
Throttle friction nut	Loosened.
Direction indicator	Caged.
V.H.F. Change-over switch	Set to FRONT.
Muting switch	Off (up).
Control column	Removed if necessary.
Canopy	Set half-closed.

Cockpit checks prior to starting the engine

6. Having entered the aircraft, adjust the rudder pedals and switch the ground/flight switch to FLIGHT. Fasten the safety harness and check the flying controls for full, free, and correct movement. Check, from left to right, around the cockpit:

Pitot head heating switch (if fitted)	Off.
Generator test switch (if fitted)	NORMAL.
Emergency lights switch	Off (up).
Taxying lamp switch	OFF (up).
Navigation light switch	As required.
Cockpit lighting OFF-DIMMER switch	As required.
Downward identification light switch	Off (up).
Elevator trim wheel	Full, free, and correct movement. Set neutral when both cockpits occupied: slightly back for solo flying.
Brake lever	Freedom of movement. Set fully ON.
Mixture control	Fully rich.
Throttle	Friction nut loosened. Free movement of lever. Leave throttle closed.
Ignition switches	OFF.
Generator power failure warning light	On.
Direction indicator	Caged.
V.H.F. (if fitted)	OFF.
Carburettor air intake control	COLD.
Hand fire extinguisher	Securely stowed.
Flap lever	Operate and check flap position visually. Select flaps UP.
Fuel cock lever	Fuel ON.
Magnetic compass	Serviceability check. Lamp switch as required.

Starting the engine

7. When ready, indicate to the ground crewman that preparations for starting are complete by calling:

Brakes on.
Fuel on.
Switches off (accompanied by a clear "thumbs down" signal).
Throttle closed.

Note that only one set of ignition switches need be in the OFF position to earth the ignition circuit. The ground crewman should repeat the above and, if necessary,

operate the priming levers on the fuel pump while holding out the carburettor flooder-control until fuel flows from the overflow vent at the bottom of the engine.

8. If, due to the position of the fuel pump operating cam, there is insufficient leverage on the hand priming lever, alter the cam position by rotating the propeller through 180 degrees.

9. When fuel has ceased to drain from the overflow vent prime the cylinders by turning the propeller by hand through about four compressions. This should only be necessary on a cold engine; a hot engine should not require priming.

Starting by hand-swinging the propeller

10. On completion of priming, the ground crewman will grasp the propeller and call:

Ready for starting.
Contact (giving a clear "thumbs up" signal).

Set the throttle lever 0·5 in. forward of the fully closed position, switch ON the impulse magneto (No. 2) and call:

Contact (giving a clear "thumbs up" signal).

The ground crewman will swing the propeller cleanly through the compression stroke to start the engine. When the engine starts, switch on No. 1 magneto. If the engine fails to start, switch both ignition switches OFF and give a clear "thumbs down" signal. The ground crewman will then position the propeller for another starting swing. The starting sequence given in this paragraph is then recommenced.

Over-priming

11. If, after several attempts, the engine still fails to start, the cause is most probably due to over-priming. To remedy this, switch both ignition switches OFF, open the throttle wide, and turn the propeller backwards through at least six revolutions. The starting procedure should then be repeated, first attempting to start without priming. If the engine fails to start after two or three successive attempts, have the cause investigated.

Starting, using a Coffman starter

12. On completion of the preliminaries given in paras. 7 to 9, the ground crewman should move well clear to one side and call:

Ready for starting.
Contact (giving a clear "thumbs up" signal).

Set the throttle lever 0·5 in. forward of the fully closed position, switch ON both ignition switches and call:

Contact (giving a clear "thumbs up" signal).

Operate the cartridge starter by lowering the cartridge starter safety flap and pulling the control out to its full extent (about 9 inches). This will automatically index and fire a cartridge. Release the starter control ring immediately and return the safety flap to the "safe" position.

13. In the event of a cartridge failing to fire, do not index or fire a fresh cartridge for at least 30 seconds. During this time all personnel must keep clear of the engine and propeller. No attempt must be made to unload the breech until 3 minutes have elapsed after:

(i) a cartridge has been indexed but failed to fire, or
(ii) a cartridge has been fired but the engine has failed to start.

14. If the engine fails to start and over-priming is suspected, proceed as detailed in para. 11.

Starting, using an electric starter

15. On completion of the preliminaries given in paras. 7 to 9, the ground crewman should move well clear to one side and call:

Ready for starting.

Contact (giving a clear "thumbs up" signal).

Set the throttle lever 0·5 in. forward of the fully closed position, switch ON both ignition switches and call:

Contact (giving a clear "thumbs up" signal).

Press the starter button; the electric starter should not be operated continuously for more than 20 seconds and at least one minute must be allowed between each successive attempt to start.

Starting from ground power supplies

16. If using an electric starter in conjunction with an external electrical power supply, plug in the supply and set the ground/flight switch to GROUND. Proceed then as described in para. 15. As soon as the engine is running, move the ground/flight switch to FLIGHT and have the external power supply disconnected.

17. If the engine fails to start and over-priming is suspected, proceed as described in para. 11.

After starting

18. As soon as the engine is running, check that the oil pressure rises almost immediately to 30 to 40 lb./sq. in. If it does not, shut down the engine immediately and have the cause investigated. Set the throttle lever to give 1,000 to 1,200 r.p.m. for warming up.

19. Whilst allowing the engine oil to warm up carry out the following checks:

Generator failure warning light . .	Out.
V.H.F. radio	ON and checked.
Instruments	Serviceable. Set altimeter barometric scale.
Direction indicator	Synchronized with magnetic compass. Uncaged.
Ignition switches	Check each switch in turn for dead cut.

Engine testing

20. When the engine oil temperature reaches the minimum for opening up (15°C.) open the throttle steadily to full power. Check that the oil pressure is 40 to 45 lb./sq. in., and that the generator failure warning light is out. Switch off each ignition switch in turn; the resultant drop in r.p.m. should not exceed 120 r.p.m. or 5 per cent. Whilst making this check there should be no excessive vibration.

21. The full throttle r.p.m. on the ground will vary slightly according to the propeller fitted and atmospheric conditions. The minimum static r.p.m. before take-off is 2,000. The engine should not be held at full throttle for more than 30 seconds.

After completing the checks close the throttle steadily to the fully closed position and check the minimum idling r.p.m. (approx. 650). Open the throttle to 1,000 to 1,200 r.p.m.

Taxying

22. Close the throttle and request the removal of the chocks. When the chocks are clear, release the brakes, open the throttle sufficiently to allow the aircraft to move

forward then close the throttle and, with rudder bar central, check brakes operation by applying the brakes. Release the brakes and set differential braking as described under CONTROLS AND EQUIPMENT IN COCKPIT, paras. 17 and 18.

23. Whilst taxying check the operation of the artificial horizon, direction indicator, and turn and slip indicator. The maximum crosswind component in which the aircraft has been demonstrated to be safe for taxying is 30 knots. This wind speed relates to a height of 33 ft.

Before take-off

24. Immediately prior to take-off check:

T—Trim tab (elevator)	Set neutral when both cockpits are occupied, slightly back for solo flying.
Throttle friction nut	Tightened for take-off.
M—Mixture	Fully rich.
A—Air	Carb. air COLD or as required.
F—Fuel	ON. Contents sufficient for the flight.
Flaps	UP (15 deg. for shortest take-off run.
G—Gyro	Direction indicator synchronized with magnetic compass.
Gauges	Oil temperature and pressure normal for take-off.
H—Harness	Tight.
Pitot head heater	As required.
C—Canopy	Closed and locked.
B—Brakes	OFF.

Take-off

25. Align the aircraft with the intended take-off path and open the throttle firmly and smoothly to the fully forward position. Keep straight initially by coarse use of the rudder, and gentle use as speed increases. There is a slight tendency to swing starboard if the throttle is opened too quickly. The aircraft should be flown off at 52 m.p.h. (45 knots) I.A.S.

26. To achieve a short take-off, select half flap prior to take-off and maintain an I.A.S. of 63 m.p.h. (55 knots) until clear of obstacles. Raise the flaps at a safe height.

27. When taking-off cross wind, keep straight as described in para. 25, and if necessary use differential brake in addition. Hold the aircraft on the ground until 57 m.p.h. (50 knots) I.A.S. is reached then unstick with a positive movement. Release the brakes, if used, when airborne. The maximum crosswind component in which the aircraft has been demonstrated to be safe for take-off and landing is 10 knots. This wind speed is related to a height of 33 ft.

Climbing

28. Climb at full throttle at 80 m.p.h. (70 knots) I.A.S. This speed gives the maximum rate of climb, at sea level, and also provides the most comfortable attitude of the aircraft.

29. Normally the mixture control is left in the fully "rich" position, as a rich mixture is desirable to assist engine cooling. At altitudes above 3,000 ft, however, in

order to obtain increased economy and smoothness the mixture control should be moved carefully towards the "weak" position until a slight drop in r.p.m. is detected, and then returned towards "rich" to restore r.p.m. to the highest value. The mixture control is then set for all throttle settings at that altitude. It is important that the engine is not run for more than the briefest period in the condition where r.p.m. are reduced by use of the mixture control.

Flight handling

30. The aircraft is stable and easy to trim under all conditions of flight. During the operation of the flaps the following trim changes will be observed:

Flaps down	Slightly nose-down.
Flaps up	Slightly nose-up.

Changes of power and speed cause slight changes in directional trim.

Carburettor icing

31. Carburettor icing will be indicated by rough running and/or loss of engine power. If icing conditions are suspected, select the carburettor air control to HOT. If icing does not clear immediately after the selection of HOT air, manipulation of the throttle lever may assist.

Stalling

32. Prior to carrying out practice stalling, spinning, or aerobatics, check the following:

Brakes	OFF.
Mixture	Fully rich.
Carb. air	As required.
Elevator trim	Neutral.
Flaps	As required for stalling. UP for spinning or aerobatics.
Gyros	Caged.
Harness	Tight.
Canopy	Closed and locked.

No loose articles in the cockpit.

In addition, ensure that the aircraft is clear of built-up areas and other aircraft. Height must be sufficient to ensure compliance with Air Navigation Orders. For details of spinning and aerobatics, refer to the relevant paragraph.

33. The stalling speeds, engine off, are:

Flaps down	49 m.p.h. (43 knots) I.A.S.
Flaps up	54 m.p.h. (47 knots) I.A.S.

These figures relate to an all-up weight of 2,100 lb.

34. The stall with flaps up is gentle. The control column must be fully back in order to demonstrate the nose drop at the point of stall. With flaps fully down the stall is more positive. In both cases recovery is quite normal and slight wing drop may occur, but this can easily be checked.

35. When approaching a high speed stall in a steep turn, a slight buffeting occurs which provides ample warning.

Spinning

36. Before carrying out practice spins complete the checks given in para. 32.
NOTE: Refer to LIMITATIONS, para. 4, for the limitations associated with spinning.

37. The aeroplane is difficult to spin properly at almost all centre of gravity positions. Therefore it is usually necessary to apply aileron against the intended direction of spin, in addition to the normal pro-spin control movements. Entry with central aileron will probably cause the aeroplane to describe a semi-stalled spiral dive. This is often confused with a true spin.

38. The spiral dive: This in many ways is like a fast, steep spin, but the following points indicate that it is only a semi-stalled condition:

(i) On releasing the controls the aeroplane will recover by itself, or with some opposite rudder, in from one-quarter to one-half turn.
(ii) The airspeed will increase from 46 m.p.h. (40 knots) I.A.S. at the start to 92–103 m.p.h. (80–90 knots) I.A.S. after two turns with stick fully back and full rudder to maintain the manœuvre.
(iii) The controls retain the forces of normal manœuvres but there is some buffeting on the tail.
(iv) There is usually noticeable noise and rattle due to a combination of (ii) and (iii).

39. The spin:

(i) The aeroplane should be spun with full rudder and stick fully back: application of aileron against the direction of spin will assist in initiating the spin.
(ii) The attitude in the spin is steep initially, but after two or three turns the spin may become less steep with the nose 30 deg. to 50 deg. below the horizon—but appearing to be less.
(iii) When in the spin the airspeed remains steady between 35 and 58 m.p.h. (30 and 50 knots) I.A.S.
(iv) The rudder force is light as is also the stick force until moved forward of the mid-position when a relatively heavy push force is required for full forward stick movement. This may be accompanied by some buffeting.
(v) The aeroplane will recover from any spin if positive corrective action is taken:

Apply full opposite rudder with ailerons central and then, after a pause, move the control column firmly and progressively forward until rotation ceases. Centralize the rudder and ease out of the dive. From the initial stages of the spin, recovery takes from ½ to 1½ turns.

(vi) It is essential that full recovery action is maintained until spinning ceases and that the stick is pushed through the increase in stick force and stick buffeting. The rate of rotation will increase momentarily when anti-spin control movement is applied—this is to be taken as an indication that the correct control movements are being made.

40. Mishandling:

(i) If anti-spiral dive control is applied in a true spin, recovery will not occur.
(ii) Make a conscious effort to apply and maintain full anti-spin control movements in the correct sense.

(iii) In the event of the spin continuing, the normal emergency actions should be taken:

Apply aileron in the direction of the spin, maintaining full opposite rudder and full forward stick movement.

Diving

41. The mixture control must be moved to the fully "rich" position before commencing a dive. During the dive the throttle should be at least one-third open and care should be taken not to allow the maximum r.p.m. limitation to be exceeded. With larger throttle opening it will be necessary to throttle back as the maximum speed is approached in order to keep the r.p.m. within the permissible limit.

42. As speed increases, directional trim must be maintained by progressive application of right rudder.

Aerobatics

43. Before performing aerobatic manœuvres, carry out the checks detailed in para. 32. All aerobatic manœuvres may be carried out at the maximum all-up-weight of 2,100 lb. Take care not to exceed the airspeed limitations quoted under LIMITATIONS (para. 2).

44. It is recommended that the following aerobatic manœuvres are performed at the indicated airspeeds quoted:

Roll	130 m.p.h. (113 knots).
Loop	140 m.p.h. (122 knots).
Half roll off the top of a loop ..	150 m.p.h. (130 knots).

NOTE: The aircraft is not designed for sustained inverted flight.

Gliding

45. To obtain the optimum glide path the following speeds are recommended:

Flaps up	80 m.p.h. (70 knots).
Flaps extended	75 m.p.h. (65 knots).

Field approach

46. Prior to joining the circuit check that sufficient fuel remains for the landing and, if necessary, an overshoot. Unmute the V.H.F. and select the necessary V.H.F. frequency.

47. Prior to landing check:

Brakes	OFF or as required for a crosswind landing.
Mixture	Rich.
Air	Carb. air as required.
Flaps	As required.
Harness	Tight.
Canopy	Closed and locked.

Approach and landing

48. Half flap (15 deg.) provides the most suitable approach angle for normal elementary training. The recommended approach speed is 70 m.p.h. (60 knots) I.A.S. for all conditions.

49. Without the use of flap the approach is long and flat, whereas full flap (30 deg.) provides a fairly steep gliding angle and an excellent view of the runway.

50. For a short landing, approach with full flaps and under power at 63 m.p.h. (55 knots) I.A.S. aiming to cross the runway threshold at 57 m.p.h. (50 knots) I.A.S.

Overshoot

51. The aircraft will climb away easily with the flaps fully down. If the aircraft has been trimmed for the glide with full flap, then retrimming is necessary as soon as the throttle is opened fully. The flaps may be raised in two stages with very little loss in height.

After landing

52. When clear of the runway, or landing area, check:

Flaps	UP.
Brakes	Set for taxying.
Pitot head heater	OFF.

Stopping the engine

53. If the serviceability of the engine is in doubt carry out the engine tests detailed in para. 20. In any case, idle the engine at 800–900 r.p.m. for at least 30 seconds, during which time a dead cut check should be carried out.

54. Stop the engine by closing the throttle, switching off the ignition switches in either cockpit and, finally, when the propeller speed has dropped to approximately 300 r.p.m., opening the throttle fully. When the engine has stopped, close the throttle.

Before leaving the aircraft

55. Before leaving the aircraft after flight check:

Fuel cock	OFF.
Electrical services	All off.
Ground/flight switch	GROUND.
Direction indicator	Caged.
Internal control locks	In position if required.
Chocks	In position.
Brakes	OFF.
Pitot head cover	On.

Glider towing

55a. Take-off.

(i) Use half-flap for take-off. Take up slack and, on receiving the signal from the marshaller, open the throttle quickly to full power. Until experience is gained, it is recommended that the stick is held hard back until established on the take-off run. If the glider has a skid and no wheels, the aircraft accelerates quickly initially as the nylon rope stretches and then slows down again until the glider starts to move, after which the speed builds up fairly quickly. Considerable left rudder is required to maintain heading and slight use of brakes may be necessary.

(ii) The glider should not be allowed to rise more than 20 feet above the aircraft; if it is allowed to rise 30 feet during the take-off run, full aft stick is required to get the aircraft off the ground.

(iii) The recommended unstick speed is 45 knots. increasing to 50 knots for the climb-away.

55b. Climb: When climbing at 50 knots, approximately ⅓ left rudder is required. At this speed, with the flaps up, the aircraft is in a marked nose-up attitude and the forward view is noticeably restricted. The use of half flap improves the forward view and gives greater stability in turbulent conditions.

55c. Cruising.

(i) The minimum cruising speed is 50 knots; turns on tow should not exceed Rate 2, as the glider speed builds up rapidly at higher rates of turn.

(ii) The maximum cruising speed must be governed by the maximum towing speed of the glider, allowing for differences in pressure-error corrections.

55d. If, because of the limiting speed of the glider, the aircraft has to be flown below the recommended speed of 50 knots, this should be done only by an experienced tug pilot, subject to a minimum speed of 45 knots. Half flap must be used. The nose-up attitude is marked and considerable rudder is needed to prevent yawing. Elevator control is normally adequate but is dependent on the glider pilot maintaing his correct station. Engine cooling is reduced and oil temperatures must be monitored. Pre-stall buffet may occur, particularly in turbulent conditions.

AIRCRAFT PERFORMANCE DATA

General

56. The following performance figures apply at an all-up-weight of 2,100 lb., and in Standard Atmospheric conditions.

Take-off

57. Distance to 50 ft. in still air at sea level, flaps 15 deg. .. .. 450 yards.

Climb

58.

Rate of climb at sea level	840 ft/min.
Gradient of climb at sea level	12·6 per cent
Rate of climb at 5,000 ft	600 ft/min.
Gradient of climb at 5,000 ft	8·5 per cent
Time to climb to 5,000 ft	7·0 min.
Service ceiling (100 ft/min. rate of climb)	15,800 ft

The performance figures given above are based on a climbing speed of 71 m.p.h. (62 knots) I.A.S. This speed is equal to 1·20 times the power off stalling speed and results in the best gradient of climb.

Maximum level speed

59. At:

sea level	138 m.p.h. (120 knots) T.A.S.
5,000 ft	134 m.p.h. (116 knots) T.A.S.

Cruising speed

60. Using 2,100 r.p.m. at:

sea level	119 m.p.h. (103 knots) T.A.S.
5,000 ft	116 m.p.h. (101 knots) T.A.S.

Fuel consumption

61. At cruising speed, at:
sea level .. .. .. 7·4 gall./hr, 16·1 m.p.g. (statute), 13·9 m.p.g. (nautical).
5,000 ft .. .. 6·8 gall./hr, 17·1 m.p.g. (statute), 14·8 m.p.g. (nautical).

Range and endurance

62. In still air at cruising speed, including an allowance for take-off and climb:

Fuel carried:	18 *Imp. gall.*	24 *Imp. gall.*
Range at sea level (statute miles)	275	370
(nautical miles)	235	320
Range at 5,000 ft (statute miles)	280	380
(nautical miles)	240	330
Endurance at sea level	2·3 hr	3·1 hr
Endurance at 5,000 ft	2·3 hr	3·2 hr

Glide

63. Gradient of glide at 63 m.p.h. (55 knots) I.A.S. .. .. 9·5 per cent.

Landing

64. Distance from 50 ft in still air, at sea level, using wheel brakes .. .. 475 yds.

Position error

65. For corrections at 2,000 lb. refer to graph overleaf.

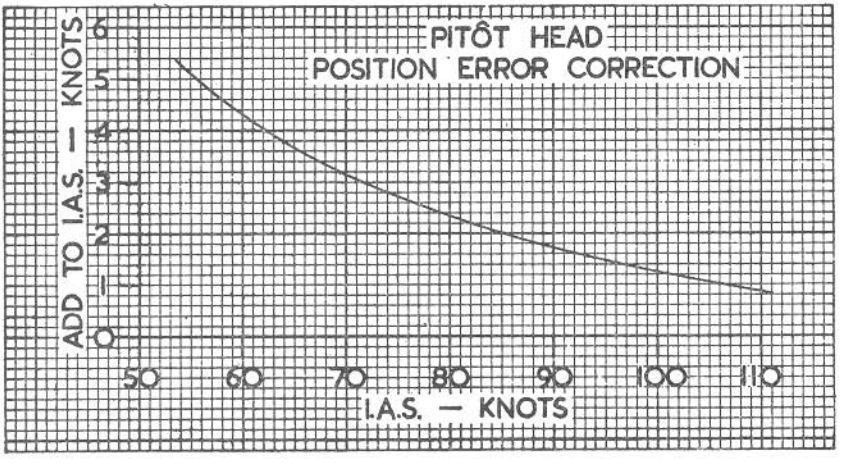
Glider towing

66. Take-off: Towing a glider of the maximum weight, the ground run (on grass) is approximately 300 yds and the take-off distance for the combination to reach 50 ft is approximately 660 yds in I.S.A. conditions, with flaps up, using the recommended unstick speed of 45 knots and climb-away speed of 50 knots. The distances are reduced to approximately 290 and 600 yds, using half flap and unstick and climb-away speeds of 40 and 45 knots respectively.

67. Climb: At the maximum glider weight, with full throttle, flaps up and a speed of 50 knots, the sea-level rate of climb is approximately 360 ft/min. and the service ceiling is approximately 7,700 ft. The use of half flap reduces the rate of climb slightly.

68. Cruise: The comfortable continuous cruising speed is 50 knots. At this speed, towing a glider of the maximum weight, the still air range in I.S.A. conditions is 150 nautical miles and the endurance is approximately 2½ hours.

PITOT HEAD POSITION ERROR



LOADING AND C.G. DATA

CONTENTS

ILLUSTRATIONS

LOADING AND C.G. DATA

Introduction

1. These notes deal with the effect of different loads upon the fore and aft positions of the centre of gravity (C.G.) of the Chipmunk Mks. 20, 21, 22, and 22A aircraft.

2. The weight and C.G. figures given in these notes do not apply to any individual aircraft, but are given only to illustrate the method of calculation. For a particular aircraft, reference should be made to the relevant data supplied with each aircraft.

3. The C.G. position is determined with the aircraft in the rigging position (fuselage datum line horizontal) and it is found by taking moments about a fixed point known as the "C.G. datum point".

Datum point

4. The position of the datum point is arbitrarily selected by the manufacturers and, on these aircraft, is marked on the port side of the fuselage, 36·0 inches aft of the forward levelling peg.

Positive and negative moments

5. The distance of each load from the datum point is known as its "moment arm". The loads are measured in pounds and the moment arm in inches. If a load is forward of the datum point, its moment arm is taken as negative and therefore the resultant moment is negative. Conversely, the moment arms and moments of loads aft of the datum are taken as positive.

Method of calculating the C.G. position

6. The C.G. position is determined from the following expression:

$$\frac{(\text{Empty weight} \times \text{empty moment arm}) + (\text{weight of loads} \times \text{respective moment arms})}{\text{Empty weight} + \text{total weight of loads}}$$

$$= \frac{\text{Empty moment} + \text{load moments}}{\text{Total weight}}$$

The C.G. range

7. Approved limits of travel of the C.G. are shown in the diagrams. The C.G. must always be kept within these limits, even when the fuel and oil are partially or wholly expended.

Typical load

8. The C.G. positions of all items of equipment to complete the typical load are given on the diagram on Fig. 1 (Chipmunk Mk. 20), Fig. 2 (Chipmunk Mk. 21), Fig. 3 (Chipmunk Mk. 22), and Fig. 4 (Chipmunk Mk. 22A).

Empty weight

9. This weight includes all fixed parts and equipment not shown in the derivation of tare weight given on the diagrams.

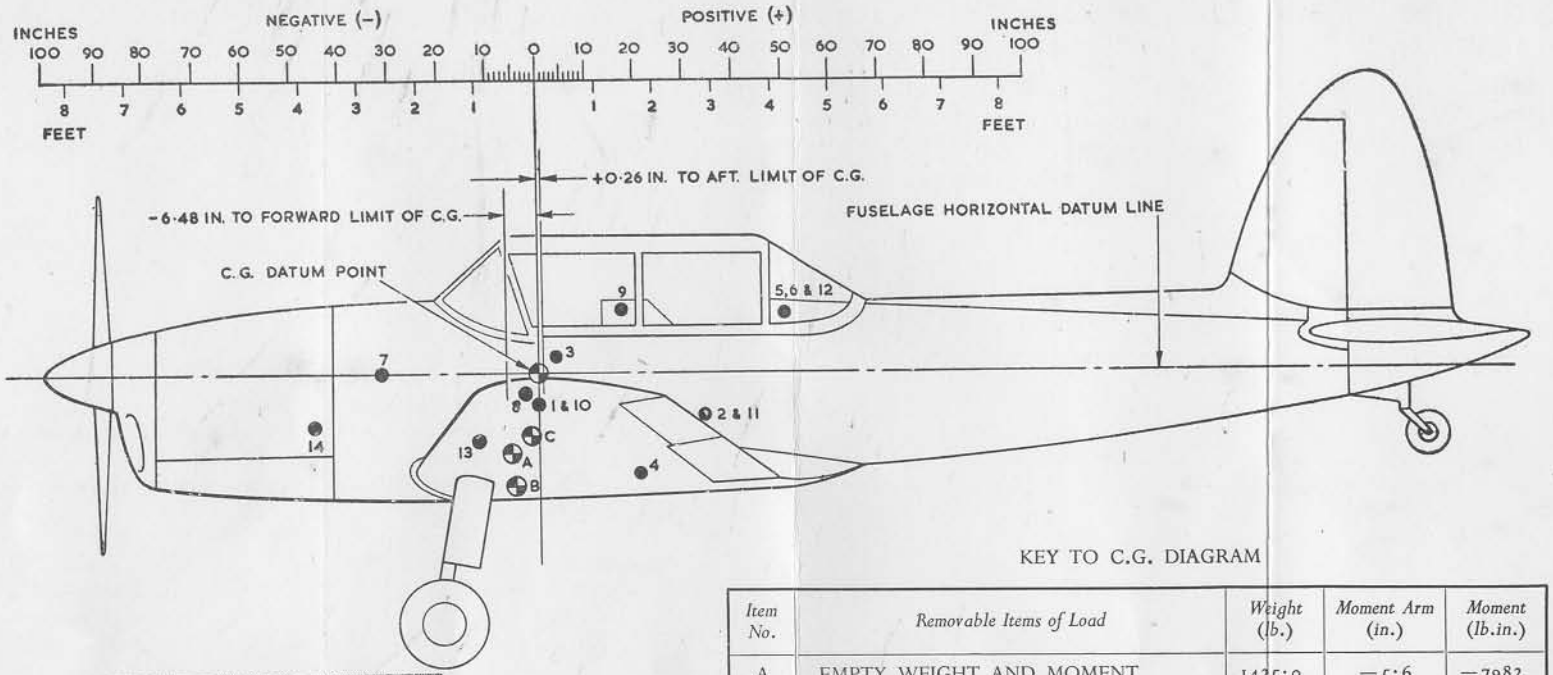
CHIPMUNK Mk. 20

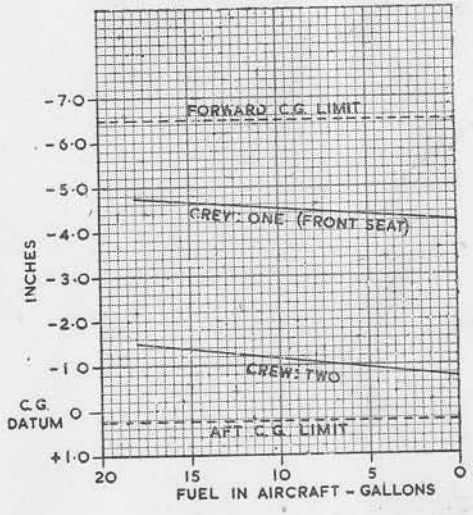
Weight and centre of gravity restrictions

10. Maximum all-up-weight for take-off, landing, and aerobatics 2,100 lb.
Maximum capacity of luggage locker .. .. 40 lb.
This weight must be evenly distributed within the locker.

Approved limits of C.G. travel:

FORWARD LIMIT .. .. 6·48 inches forward of C.G. datum
AFT LIMIT .. .. 0·26 inch aft of C.G. datum
These distances are measured parallel to the fuselage horizontal datum line.





KEY TO C.G. DIAGRAM

Item No.	*Removable Items of Load*	*Weight (lb.)*	*Moment Arm (in.)*	*Moment (lb.in.)*
A	EMPTY WEIGHT AND MOMENT	1425·0	–5·6	–7982
	General equipment:			
1	Front seat cushion	11·5	0·0	0
2	Rear seat cushion	11·5	33·6	386
3	Map cases	0·4	3·0	1
4	First-aid kit	1·0	20·0	20
5	Control locks (Stowed in luggage locker)	1·5	50·0	75
6	Tool roll (Stowed in luggage locker)	8·9	50·0	445
	Radio equipment:			
7	V.H.F. STR 9X	26·0	–31·8	–827
8	Control unit	0·6	–3·0	–2
9	Headsets	3·0	17·0	51
B	TARE WEIGHT AND MOMENT	1489·4	–5·3	–7833
10	Pilot in front cockpit	170·0	0·0	0
11	Pilot in rear cockpit	170·0	33·6	5712
12	Luggage locker; available distributed load	29·6	50·0	1480
	Fuel and oil:			
13	Fuel (at 7·2 lb./gall.) 18 gallons	130·0	–12·0	–1560
14	Oil (at 9·0 lb./gall.) 2 gallons	18·0	–45·6	–821
C	TOTAL WEIGHT AND MOMENT, WITH 2 CREW AND FULL FUEL AND OIL	2007·0	–1·5	–3022

Fig. 1. C.G. DIAGRAM (CHIPMUNK MK. 20)

CHIPMUNK Mk. 21

Weight and centre of gravity restrictions

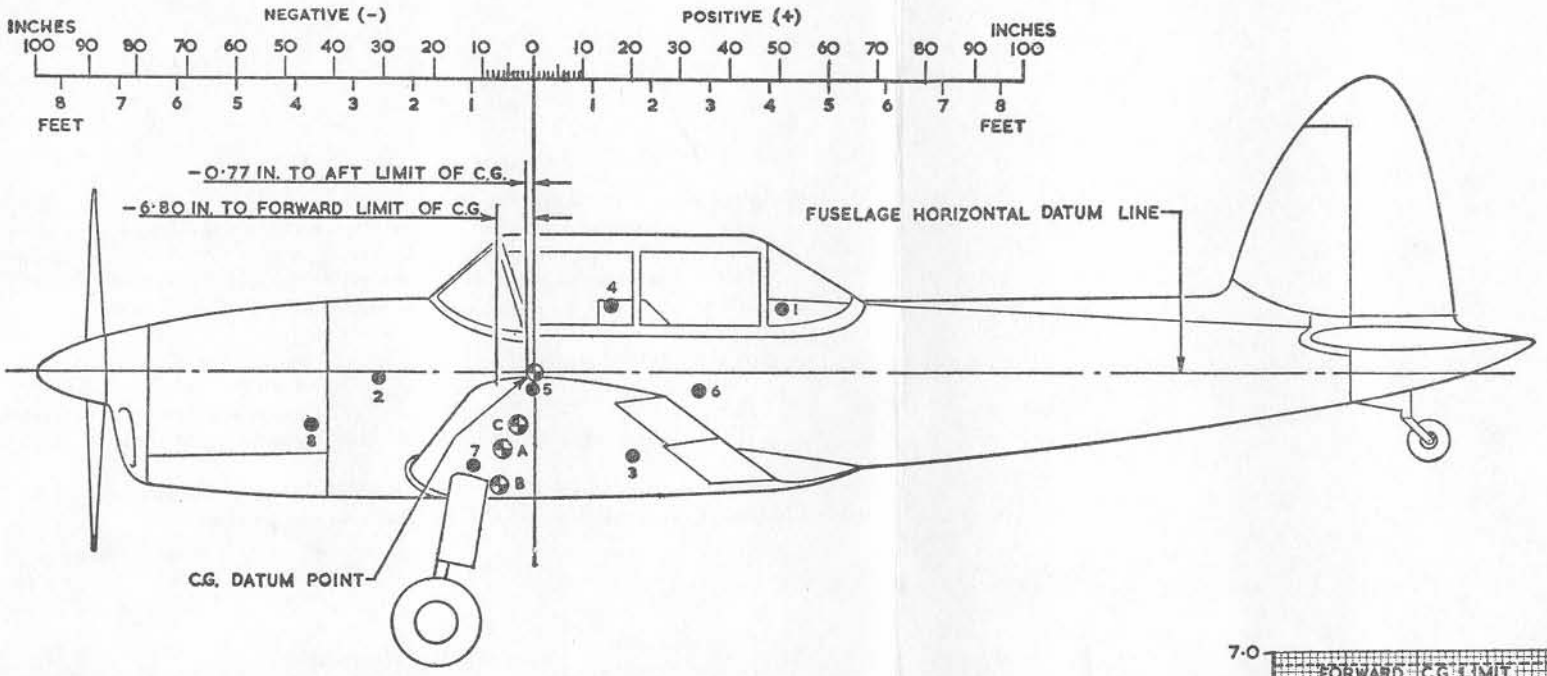
11. Maximum all-up-weight for take-off, landing, and aerobatics 2,100 lb.
Maximum capacity of luggage locker .. .. 40 lb.

On this aircraft it will normally be found that use of the locker is restricted by C.G. limitations.

Approved limits of C.G. travel:

FORWARD LIMIT .. .. 6·80 inches forward of C.G. datum
AFT LIMIT .. .. 0·77 inch forward of C.G. datum

These distances are measured parallel to the fuselage horizontal datum line.



KEY TO C.G. DIAGRAM

Item No.	*Removable Items of Load*	*Weight (lb.)*	*Moment Arm (in.)*	*Moment (lb.in.)*
A	EMPTY WEIGHT AND MOMENT	1430·0	–5·80	–8294
1	Control locks	1·5	50·0	75
2	V.H.F. STR 9X	26·0	–31·8	–827
3	First-aid pack	1·0	20·0	20
4	Headsets	3·0	17·0	51
B	TARE WEIGHT AND MOMENT	1461·5	–6·14	–8975
5	Pilot and parachute in front cockpit	200·0	0·0	0
6	Pilot and parachute in rear cockpit	200·0	33·6	6720
7	Fuel (at 7·2 lb./gall.) 24 gall.	173·0	–12·0	–2076
8	Oil (at 9·0 lb./gall.) 2 gall.	18·0	–45·6	–821
C	TOTAL WEIGHT AND MOMENT, WITH 2 CREW AND FULL FUEL AND OIL	2052·5	–2·51	–5152

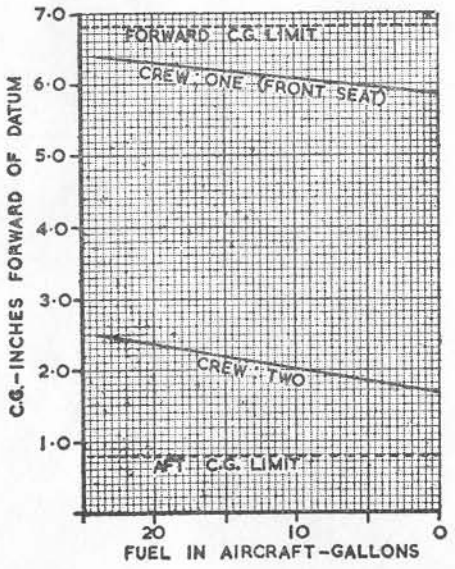


Fig. 2. C.G. DIAGRAM (CHIPMUNK MK. 21)

CHIPMUNK Mks. 22 AND 22A

Weight and centre of gravity restrictions

12. Maximum all-up-weight for take-off, landing, and aerobatics 2,100 lb.*
Maximum capacity of luggage locker .. .. 40 lb.

This weight must be evenly distributed within the locker. On these aircraft it will normally be found that use of the locker is restricted by C.G. limitations.

Approved limits of C.G. travel:

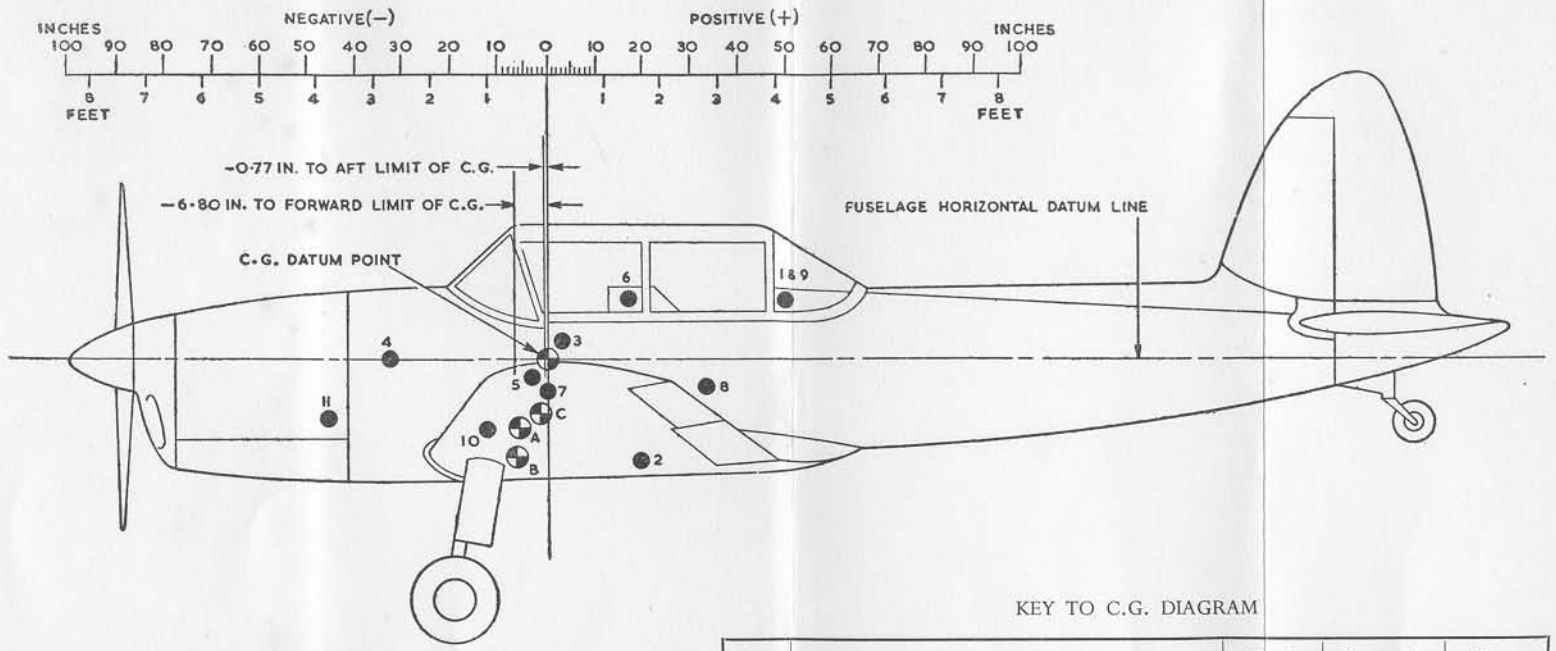
FORWARD LIMIT .. .. 6·80 inches forward of C.G. datum
AFT LIMIT .. .. 0·77 inch forward of C.G. datum

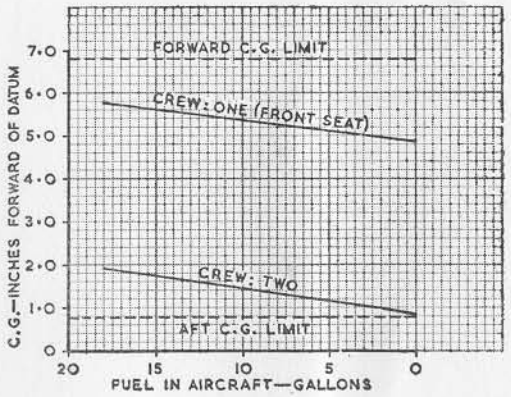
These distances are measured parallel to the fuselage horizontal datum line.

The following items of equipment may be also fitted to these aircraft, and are additional to those given in the C.G. diagrams on Figs 3 and 4:

Item	*Weight (lb.)*	*Moment Arm (in.)*	*Moment (lb./in.)*
Front seat cushion } carried in lieu of parachutes	11·5	0·0	0
Rear seat cushion } carried in lieu of parachutes	11·5	33·6	386
Tool roll (normally stowed in luggage locker) ..	8·9	50·0	445
Amber screens	2·0	—6·0	—12
Electric starter in lieu of Coffman starter (increase to aircraft Empty Weight)	5·3	—45·0	—239

*This weight may be increased to 2,200 lb. provided the aeroplane is not flown for public transport or aerial work.





KEY TO C.G. DIAGRAM

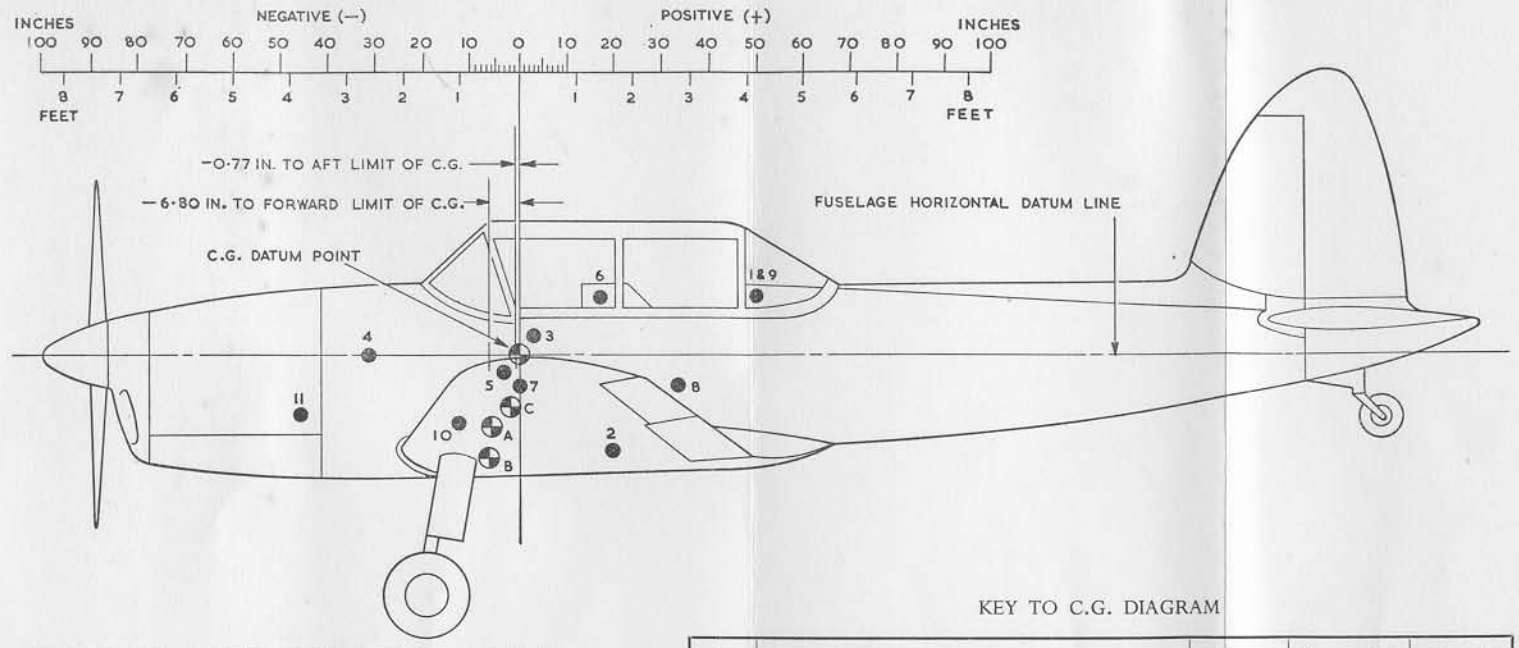
Item No.	*Removable Items of Load*	*Weight (lb.)*	*Moment Arm (in.)*	*Moment (lb.in.)*
A	EMPTY WEIGHT AND MOMENT	1428·0	—5·65	—8073
	General equipment:			
1	Control locks (stowed in luggage locker)	1·5	50·0	75
2	First-aid kit	1·0	20·0	20
3	Map cases	2·0	3·0	6
	Radio equipment:			
4	V.H.F. STR 9X	26·0	—31·8	—827
5	Control unit	0·6	—3·0	—2
6	Headsets	3·0	17·0	51
B	TARE WEIGHT AND MOMENT	1462·1	—5·98	—8750
7	Pilot and parachute in front cockpit	200·0	0·0	0
8	Pilot and parachute in rear cockpit	200·0	33·6	6720
9	Luggage locker, available distributed load for C.G. considerations	11·5	50·0	575
	Fuel and oil:			
10	Fuel (at 7·2 lb./gall.) 18 gallons	130·0	—12·0	—1560
11	Oil (at 9·0 lb./gall.) 2 gallons	18·0	—45·6	—821
C	TOTAL WEIGHT AND MOMENT WITH 2 CREW AND FULL FUEL AND OIL	2021·6	—1·90	—3836

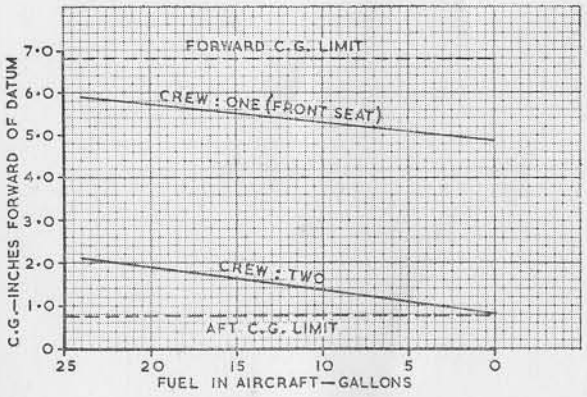
Fig. 3. C.G. DIAGRAM (CHIPMUNK MK. 22)

CHIPMUNK Mk. 22A

Weight and centre of gravity restrictions

For details, refer to para. 12.





KEY TO C.G. DIAGRAM

Item No.	*Removable Items of Load*	*Weight (lb.)*	*Moment Arm (in.)*	*Moment (lb.in.)*
A	EMPTY WEIGHT AND MOMENT	1434·0	–5·68	–8145
	General equipment:			
1	Control locks (stowed in luggage locker)	1·5	50·0	75
2	First-aid kit	1·0	20·0	20
3	Map cases	2·0	3·0	6
	Radio equipment:			
4	V.H.F. STR 9X	26·0	–31·8	–827
5	Control unit	0·6	–3·0	–2
6	Headsets	3·0	17·0	51
B	TARE WEIGHT AND MOMENT	1468·1	–6·01	–8822
7	Pilot and parachute in front cockpit	200·0	0·0	0
8	Pilot and parachute in rear cockpit	200·0	33·6	6720
9	Luggage locker, available distributed load for C.G. considerations	13·0	50·0	650
	Fuel and oil:			
10	Fuel (at 7·2 lb./gall.) 24 gallons	173·0	–12·0	–2076
11	Oil (at 9·0 lb./gall.) 2 gallons	18·0	–45·6	–821
C	TOTAL WEIGHT AND MOMENT WITH 2 CREW AND FULL FUEL AND OIL	2072·1	–2·10	–4349

Fig. 4. C.G. DIAGRAM (CHIPMUNK MK. 22A)

NOTES

NOTES